Essouk-Tadmekka

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Essouk-Tadmekka

An Early Islamic Trans-Saharan Market Town

Edited by

Sam Nixon

TUTA SUB AEGIDE PALLAS · 1683 ·

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Cover illustration: Looking down the Essouk valley, where the ruins of Essouk-Tadmekka are located.

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From Bughrat you go to Tiraqqa and from there across the desert plain to Tadmekka, which of all the towns in the world is the one that resembles Mecca the most. Its name means "the Mecca like". It is a large town amidst mountains and ravines and is better built than Ghana or Kawkaw. The inhabitants of Tadmekka are Muslim Berbers who veil themselves as the Berbers of the desert do ... Their dinars [coins] are called "bald" because they are of pure gold without any stamp.

The Book of Highways and of Kingdoms (*Kitab al-masalik wa-'l-mamalik*).

WRITTEN *CA* AD 1068, IN CORDOBA (SPAIN) BY ABU UBAYD BIN ABD AL-AZIZ AL-BAKRI

(LEVTZION & HOPKINS 2000: 85)

FIGURE 0.1 *Sign near Essouk-Tadmekka ruins produced by the Malian Ministry of Culture, reading* (*translated*) *'Essouk Tademekka. Berber Medieval City. Rock Art'* (*both French and Tifinagh are seen on the sign*).

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Preface

The archaeological fieldwork project around which this book is focused first developed in March 2004 in the Malian capital, Bamako, during a visit to discuss possible field projects for my PhD research. It was during discussions with Téréba Togola, head of the Direction Nationale de Patrimoine Culturel, that a concrete programme was established to work at the ruins of Tadmekka, the important early Islamic southern Saharan market town documented within early Arabic manuscripts. A brief reconnaissance visit to the Malian Sahara to visit Tadmekka's ruins, now called 'Essouk', laid the foundations for a more sustained investigation of the site, carried out between December 2004 and March 2005. The Essouk-Tadmekka research initially formed the basis of my broader PhD investigation into the nature of early Islamic West African towns associated with trans-Saharan commerce. While 10 years have now elapsed since the fieldwork, this period has seen extensive ongoing research involving a wide-ranging international team of specialists. This book brings together the results of this work with the aim of improving understanding of the history and position of this important town within the early trans-Saharan and Tuareg world.

Although never previously excavated, Essouk-Tadmekka had various archaeological lives before our 2004–2005 fieldwork. At the beginning of the twentieth century Georges de Gironcourt's work on the numerous Arabic inscriptions found within the cemeteries and cliffs around the site provided the first significant contribution to its archaeological recording. Raymond Mauny's 1948 organisation of invaluable aerial photographs of the ruins represented another hugely significant contribution. The most sustained work that has taken place though is that of Paulo de Moraes Farias. Since the 1980s, Moraes Farias systematically investigated the Arabic inscriptions at the site – including recovering what are the oldest known, internally-dated inscriptions in West Africa, dating to the early 11th century – as well as documenting some of its inscriptions in the indigenous Berber *Tifinagh* script. This huge contribution of new knowledge regarding the town is represented in his consummate 2003 work *Early Arabic Medieval Inscriptions from the Republic of Mali*. Of great importance to note also is an abandoned survey and excavation project at Essouk-Tadmekka that was planned from 1987 onwards, as part of a wider regional investigation. This was suspended in 1990 due to the tragic death in Mali of one of the project team, Suzanne Bernus, and then abandoned due to the Malian civil war. In the 1990s work was however carried out by Christian Dupuy on the extensive rock-art found in the cliffs around the ruins. Our research is therefore part of an extended archaeological story of Essouk-Tadmekka, and part of the aim of this volume is to try to also represent the findings of previous investigators.

I feel hugely fortunate to have been given the opportunity to bring together a group of researchers to investigate the remains of this once famous and important town. The northern Malian region where the ruins of Essouk-Tadmekka are located is today difficult of access for researchers, as it has been since 2006 following renewed insecurity in northern Mali. The ruins still sit on the 'tentative' UNESCO World Heritage list where they have been since 1999. Whether or not full UNESCO recognition is forthcoming, there can be no doubting the importance of the site and the great potential for future research. In addition to seeking to represent our knowledge of Essouk-Tadmekka as it stands today, hopefully this book will also serve as an inspiration and a guide for others to conduct this future work.

Sam Nixon
July 2017

Acknowledgements

This work is indebted to the Direction Nationale du Patrimoine Culturel, and particularly the late Téréba Togola for his encouragement to undertake this research. Likewise, great thanks are due to the Malian Institut des Sciences Humaines for authorising the fieldwork, and particularly to Kléna Sanogo who has been very supportive of the research. I would also like to highlight the role of Kevin MacDonald who has provided consistent and excellent guidance as a mentor since the beginning of the Essouk-Tadmekka project, and to whom I owe a great debt of gratitude. A consistent guide in this work also has been Paulo de Moraes Farias, a fountain of knowledge on Essouk-Tadmekka and Islam in the Sahara and West Africa, and an excellent scholarly example.

The Arts and Humanities Research Council (AHRC) provided funding for the PhD research within which the Tadmekka project was launched. The fieldwork itself was funded by the AHRC, UCL Graduate School, UCL Institute of Archaeology, and the University of London Central Research Fund. Specific analytical funding grants were provided for the following: AMS radiocarbon dating was supported by the joint Natural Environment Research Council (NERC)/AHRC Oxford Radiocarbon Dating Service (ORADS) initiative (ORADS project 2005/2/5); chemical and isotopic analysis of the copper alloys was funded by U.S. National Science Foundation grants DGE-0221494 and BCS-0852270 (David Killick/Thomas Fenn); chemical analysis of glass beads was funded by the U.S. National Science Foundation grant BCS-0209681 (Peter Robertshaw/Michael Glascock). UCL Qatar also generously contributed towards the publication costs. Institutions whose facilities were used for analysis are the following: Wolfson Archaeological Science Laboratories and Archaeological Conservation labs, UCL; UCL Institute of Archaeology Bone Room and archaeobotanical reference collections; Archaeological Materials Science Laboratories, UCL Qatar, Doha; Natural History Museum faunal collections, London; Department of the Middle East, The British Museum; Department of Coins and Medals, British Museum; Sotheby's Bond Street, London; English Heritage Centre for Archaeology, Fort Cumberland; Archaeological Science Laboratories, University of Bradford; Sainsbury Centre for Visual Arts Conservation lab, Norwich; Centre for Research and Restoration of the Museums of France, Paris; EHESS-CRH (Centre de Recherches Historiques), Paris; Institut de Recherche sur les Archéomatériaux, CNRS, Orleans; Faculté d'Architecture La Cambre, Université libre de Bruxelles; Ludwig Boltzmann Institute for Archaeological Prospection and Virtual Archaeology, Vienna; Field Museum of Natural History, Chicago; Department of Geosciences and Planetary Sciences Laboratories, University of Arizona. Other research institutions important to the research were: School of Oriental and African Studies, London; Centre d'études des mondes africains, Paris; IGN Photothèque Nationale, Paris; Cellule Imagerie Aérienne, Service Historique de la Défense, France; Sainsbury Research Unit, University of East Anglia.

Regarding the fieldwork itself, the first thanks should go to the people of the Kidal region, and particularly those in the Essouk locality who were consistently welcoming to the project. Great thanks are due to the Amenokal of the Ifoghas who authorised the work and to the Chef d'Essouk who, in addition to welcoming us, allowed us to use recently-built but unoccupied government buildings near Essouk-Tadmekka's ruins for the project. Huge thanks are obviously also due in particular to the fieldwork team who produced excellent work and with whom many entertaining times were had at the site. In addition to residents of Essouk, the fieldwork team also included the archaeologists Mamadou Cissé, Fané Yamoussa and Soumaila Coulibally, all of the Direction Nationale de Patrimoine Culturel, and their excellent work was much appreciated. Special thanks are due to Jean-Pierre Tita, the then Head of the Mission Culturelle Essouk. Jean-Pierre Tita was crucial to the functioning of the field season and without him things would certain have flowed less smoothly than they did. In Kidal, Jean-Pierre Tita's family also invited me to stay in their home on various occasions and made me feel very welcome. In Bamako, I was greatly aided by the staff of the Direction Nationale de Patrimoine Culturel and the Institut des Sciences Humaines, as well as by the Musée Nationale de Mali. During a subsequent three-month stay in Bamako conducting post-excavation analysis I was made to feel very welcome by the people of Kalaban Coura where I stayed. In particularly Mamadou Dembele and Rokia Sakara made this stay a hugely enjoyable one.

Following the fieldwork a range of people dedicated their research efforts and scientific and technical skills to the task of Essouk-Tadmekka, and much of the detailed findings of the project are due to their efforts. The following people in particular need to be acknowledged: Eleni Asderaki-Tzoumerkioti (conservation); Stefka Bargazova (conservation); Bruno Berteau (aerial photos); Stephanie Black (digital X-ray and conservation); Elizabeth Bloxom (stone aftefacts); Sandra Bond (textiles); Andy Boyce (illustration); Philip Connolly (archaeometallurgy sample prep.); Nafogo Coulibally (illustration); Ashley Coutu (ZooMS); Vesta Curtis (coins); Sophie Desrosiers (textiles); Christian Dupuy (petroglyphs); Laure Dussubieux (chemical analysis of vessel/bead glass and archaeometallurgy); Rachel Farmer (X-ray and conservation); Thomas Fenn (archaeometallurgy); Maria Filomena-Guerra (archaeometallurgy); Dorian Fuller (archaeobotany); Mike Glascock (glass bead chemistry); Voula Golfomitsou (conservation); Fiona Griffin (illustration); Simon Groom (petrography); Tom Higham (radiocarbon dating); Louise Iles (archaeometallurgy sample prep.); Derek Kennet (ceramics); Nadia Khalaf (satellite imagery); Regina Krahl (ceramics); Stuart Laidlaw (photography); James Lankton (vessel and bead glass chemistry); Kevin MacDonald (faunal analysis, ceramics, and petrography); Fabrice Melka (archival photography); Mary-Anne Murray (archaeobotany); Sonia O'Connor (bioarch.); Venetia Porter (ceramics); Thilo Rehren (archaeometallurgy); Peter Robertshaw (bead glass chemistry); Andi Sapey (photographic editing); Chris Sevara (aerial photographs and satellite imagery); Jane Sidell (shell); St John Simpson (vessel glass); Chris Stevens (archaeobotany); Benoit Suzanne (aerial photographs/illustration); Ken Thomas (shell); Julia Tubman (thin sections and conservation); Charlotte Veysey (illustration). Other people whose input was also greatly appreciated at various points of the research include Victor Brunfaut, Gregg Butensky, Elizabeth Fentress, Anne Haour, Jim Kelly, Marcos Martinón-Torres, Jean Polet, and Chris Scott. Thanks are also due to the helpful comments of the anonymous reviewer whose remarks greatly helped in rethinking certain sections of the book.

Naturally it is also necessary to acknowledge the work of researchers who have gone before us. In particular, it is important to acknowledge the work of Georges de Gironcourt, Raymond Mauny, the team of Patrice Cressier, Suzanne Bernus and Samuel Sidibe, and the work of Paulo de Moraes Farias. In particular it is necessary to acknowledge Raymond Mauny's work in undertaking aerial photography of Essouk-Tadmekka's ruins, and Paulo de Moraes Farias for providing me with copies of the aerial photos which he received from Mauny. Acknowledgement should also be made of the work of the researchers who excavated at the site of Tegdaoust in Mauritania in the 1960s, the publications of whom have provided a constant reference and inspiration for this project.

Certain figures and tables featured in this book have previously been published elsewhere and due acknowledgement is required of this. The publications these have featured in are as follows, with the specific figures listed in brackets: Cressier 1992 (Fig. 11.5); Lhote 1951 (Fig. 1.2); Moraes Farias 1990 (Fig. 5.3); Moraes Farias 2003 (Fig. 5.5); Nixon 2009 (Figs. 7.5, 7.15, 7.16, 7.21, 9.4); Nixon et al. 2011a (Fig. 21.5); Nixon et al. 2011b (Figs. 15.1, 15.2, 15.3, 15.4, 15.5, 15.6, 15.7; Tab. 15.1); Nixon 2013a (Figs. 7.3, 8.7); Pagnoni 2000 (Fig. 5.4); Porter 2012 (Fig. 3.4); Rehren & Nixon 2014 (Figs. 15.5, 15.6); Scott 2004 (Figs. 2.1, 2.2).

Great thanks are due to the team at Brill who I have worked with to bring this book to publication – in particular Franca de Kort, Pieter te Velde, and Joed Elich. Their careful and patient work on developing the finalised publication has been hugely appreciated.

It remains for me to thank the people who have supported me personally throughout this project. All the staff at UCL Institute of Archaeology where I began this research, who consistently support researchers, making it a friendly and supportive place to conduct research, as well as a vibrant and stimulating research institution. I am very grateful to my PhD comrades from that time who I worked together with in Research Room 322B, particularly Jago Cooper and Akira Matsuda. Crucially, huge thanks need to be given to the wonderful Africa Magna Verlag team and Sonja Magnavita in particular who has been hugely supportive in this publication project. My parents, Elaine and Michael, and my sister Hannah have been wonderfully supportive throughout and I would like to thank them very much. Also, I would like to acknowledge my grandfather Bob for his inspiration. Lastly, I want to thank my wife, Jennifer, always so enthusiastic and supportive and the greatest inspiration of all.

Sam Nixon
July 2017

FIGURE 0.2 *Some of the members of the fieldwork team at Essouk in 2005.*

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Notes on Contributors

Stephanie Black
(MSc 2012 & MA 2010, UCL) is an objects conservator with specializations in archaeological, ethnographic, and natural history collections. She was previously based at UCL Qatar in Doha, Qatar, where she conducted the digital X-ray imaging and treatment on small finds excavated from Essouk-Tadmekka. Stephanie is currently working as an assistant conservator for the Gallery Enhancement Project at the Oriental Institute, University of Chicago, USA.

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James Lankton
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Kevin C. MacDonald
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Paulo Fernando de Moraes Farias
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the interaction between the Islamic cultural heritage and other cultural heritages in West Africa.

Mary-Anne Murray
is an archaeobotanist/environmental archaeologist working in Qatar for the University of Copenhagen and University College London (UCL Qatar). She is also an Honorary Research Associate at the Institute of Archaeology, University College London, where she received her Ph.D. In Africa, she has worked extensively on ancient Egyptian plant remains from several sites, as well as those from Mali and Senegal. For many years she has also worked as an archaeologist and/or archaeobotanist in the Middle East, Europe, North and South America, and the Caribbean.

Sam Nixon
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Peter Robertshaw
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Jane Sidell
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Benoit Suzanne
(Masters, 2014, ULB, Architecture Faculty, La Cambre Horta, Brussels) is currently working as an independent architect, based in Belgium. He pursued his Masters thesis on Essouk-Tadmekka, conducting a transdisciplinary analysis of the architectural remains. Focused principally around a mapping of the town's surface archaeology, the aim of this study was to develop a critical approach to methodologies dedicated to urban and architectural analyses.

PART 1

Introduction

CHAPTER 1

Overview

Sam Nixon

Introducing the Essouk-Tadmekka Project

In the centuries following the Islamic conquest of North Africa in the 7th century AD trading connections across the Sahara escalated dramatically, leading to the development of a flourishing commercial system focused around commerce in West African gold, slaves, and ivory. This Saharan system, supported by large camel caravans and desert trading posts, was part of the wider developing commercial network of the early Islamic world, traders in West Africa being connected via a loose network of trade routes and commercial centres stretching as far as the Silk Road towns of eastern Asia. It was the wealth generated by this Islamic network of Saharan trade that led European powers to establish sea routes to West Africa, in order to gain direct access specifically to West African gold. In the 15th century Portuguese sailors mastered the shipping and navigational technology necessary to successfully sail along the treacherous Atlantic African coast, opening up the first sustained maritime links with West Africa. While the painful subsequent history of European connections with West Africa is well-known and intensively researched – Europeans finding not only gold but also slaves, going on to export millions of Africans to the Americas – the history of the Islamic trans-Saharan commerce which preceded European connections is a far less well-known story (for references see Chapter 2). Ultimately, this book is concerned with improving understanding of this earlier 'trans-Saharan' connection with West Africa, but approaching this through looking at the history of one town: Essouk-Tadmekka.

In *ca* AD 1068 the Andalusian Muslim geographer Al-Bakri wrote what is widely seen to be the most accurate and detailed early description of West Africa and the trans-Saharan trade, within the (Arabic) geographical text *The Book of Highways and Kingdoms*. Amongst the most striking descriptions featuring in Al-Bakri's text is that of Tadmekka:

"From Bughrat you go to Tiraqqa and from there across the desert plain to Tadmakka, which of all the towns in the world is the one that resembles Mecca the most. Its name means 'the Mecca like'. It is a large town amidst mountains and ravines and is better built than Ghana or Kawkaw [West African states]. The inhabitants of Tadmakka are Muslim Berbers who veil themselves as the Berbers of the desert do. They live on meat and milk as well as on a grain which the earth produces without being tilled. Sorghum and other grains are imported for them from the land of the Sudan. They wear clothes of cotton, nuli, and other robes dyed red. Their king wears a red turban, yellow shirt, and blue trousers. Their dinars [Islamic coinage unit] are called 'bald' because they are of pure gold without any stamp. Their women are of perfect beauty, unequalled among people of any other country, but adultery is allowed among them. They fall upon any merchant [disputing as to] which of them shall take him to her house". (see App. A)

Al-Bakri describes Tadmekka as one of the most important towns associated with the early Saharan trade, located at a crucial point on one of the principal camel-caravan routes to West Africa, positioned at the southern extremity of the harshest stretch of the Saharan crossing (see Chapter 2). Tadmekka appears as an impressive and wealthy market town, and while having a strong Muslim identity and a diverse community of traders it also clearly had a culture closely connected with that of the Berber peoples from the surrounding desert. It was also clearly positioned at the heart of a flourishing commercial network, channeling the various trade goods coming into West Africa and those being sent across the desert to other parts of the Islamic world and beyond. Importantly, Al-Bakri's description also identifies the meaning of Tadmekka's name, "the Mecca like", providing some form of comparison with the principal holy city of Islam, Mecca.

While Al-Bakri's description of Tadmekka is the best known, a range of other early Arabic geographical texts describe this place both before and afterwards, from the 10th to the 15th century AD (see Chapter 2 and App. A). These texts suggest Tadmekka was a key point within the early trans-Saharan world for at least 500 years, from the earliest Arabic descriptions of West Africa right up to the time when European ships first docked off the West African coast.

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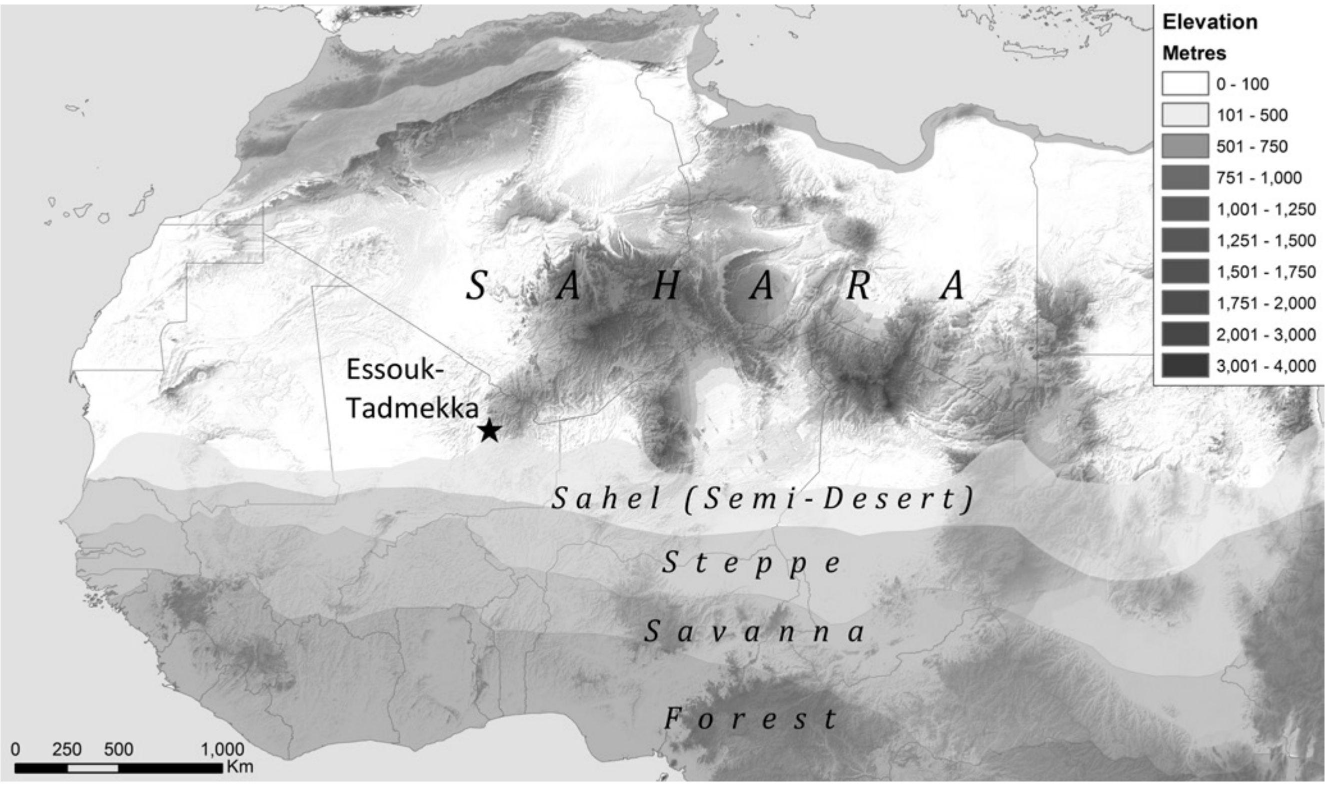

FIGURE 1.1 *Map of north-west Africa, showing the location of Essouk-Tadmekka at the southwest extension of the Saharan highlands – map shows both elevation data and the broad environmental zones of the Sahara and West Africa.*
GRAPHICS N. KHALAF – ELEVATION DATA COURTESY NASA/USGS

Although the name "Essouk" ('the market' in Arabic) goes unmentioned in Arabic historical records, ruins bearing this name located in the Adrar des Iforas desert region in the north of the Republic of Mali have long been seen as the location of Tadmekka (see Figs. 1.1, 1.2). The Adrar des Iforas is a sandstone massif more elevated than the rest of Mali, and environmentally more similar to the central Saharan highlands, it being mostly vast swathes of sandy terrain dotted with rocky outcrops, and with only occasional scrub or oases-like environments (Camps & Claudot-Hawad 1985; see Chapters 3 & 21 for further environmental details). Importantly the Adrar des Iforas region corresponds well with the geographical location of Tadmekka provided by the Early Arabic geographers, and the ruins of Essouk are the most prominent in the region. While not explicitly mentioning the name "Tadmekka", oral traditions of the region's Tuareg (Berber) inhabitants identify Essouk as of central importance within the region's history (see Chapter 2 for details on Tuareg history and peoples). Despite not providing a definitive connection between the ruins of Essouk and the Tadmekka of the Arabic sources, these traditions were nevertheless taken as further evidence these were one and the same place. In recent years this relationship was indeed finally confirmed by research on inscriptions at Essouk providing a direct connection with the name "Tadmekka" (Chp. 5).

The central area of the town ruins of Essouk-Tadmekka comprise approximately 50 hectares covered with remains of stone structures, including commercial and residential buildings, mosques, and livestock enclosures (Fig. 1.2). Surrounding this are extensive cemeteries that have yielded inscriptions in Arabic. Further Arabic inscriptions are found amongst the Essouk cliffs, including the earliest-known internally-dated writing in West Africa, dated to the early 11th century AD. Other inscriptions in Tifinagh (indigenous Berber script) are also found in these cliffs, as well as rock-art which includes depictions of animals and people.

Widely considered for many years as amongst the most important locations for researching trans-Saharan trade, as well as Tuareg history, a series of researchers have engaged in the study of these ruins (see Chapter 2 for further discussion), including most importantly the Arabic inscriptions found there. Prior to the work detailed here, however, Essouk-Tadmekka had never been excavated, largely due to reasons of political instability. In 2004,

FIGURE 1.2 *Aerial photograph looking across the Essouk-Tadmekka town ruins, taken in 1948* (*shot at an oblique angle from 600m altitude*). *The stone ruins of the town are found along a 1km stretch of the Essouk valley – such is the preservation, one can even trace precise dimensions of individual buildings.*
© SERVICE HISTORIQUE DE LA DÉFENSE, FRANCE

though, in the context of an improved political climate, it became possible to set up the excavation project which forms the focus of this book. The field project was set up within the context of a broader research study into the origins and development of early Islamic trans-Saharan trade (NIXON 2008). The aim was both to improve understanding of Essouk-Tadmekka as a place, but also to gain new insights into this wider historical process.

The fieldwork took place between 2004 and 2005. The first phase of work involved survey and recording of building remains and other materials found across the surface of the ruins, enabling an on-the-ground record that could be related to aerial photographs and satellite imagery of the ruins. Following this, excavations were undertaken, leading to the recording of the first excavated sequence for the site, and the recovery of a wide range of finds. It is believed that the extensive study of the fieldwork results provides the basis for a new account of the history of Essouk-Tadmekka, in turn enabling a series of insights into the wider commercial and cultural world of which it formed a part.

Monograph Outline

While various journal and magazine articles have been written on the results (KEYS 2005a, 2005b; NIXON 2009; NIXON 2010; NIXON *et al.* 2011a; NIXON *et al.* 2011b; NIXON 2013a; REHREN & NIXON 2014), this book is designed as the final summary statement on this research. The remainder of the text is arranged as described below.

Chapter 2 provides a fuller background to the project. Firstly, this situates the research within the wider study of trans-Saharan commerce. This is followed by an account of the early Arabic textual sources and oral traditions for Tadmekka. Next is a broad introduction to the site of Essouk-Tadmekka, including the research history of the site and its relationship to contemporary cultural heritage institutions and movements. Finally, the chapter provides a brief account of the project design and structure. Chapter 3 provides a brief account of the contemporary environment and human geography of the locality within the Adrar des Iforas highlands where Essouk-Tadmekka is situated. Chapter 4 provides an overview of Essouk-Tadmekka's ruins, principally its stone structural remains, but also rock art and other evidence in the vicinity. Chapter 5 provides a focused account of the site's Arabic and Tifinagh inscriptions. Chapters 6–10 provide an account of the excavations and the dated excavated sequence constructed from them, as well as a broader reflection on the overall site chronology. Chapter 11 focuses on the architectural evidence, looking at both the building remains across the site surface as well as the evidence recovered during excavations – this includes considering both building types and individually distinctive structures, as well as materials and methods of construction. Chapters 12–21 are a series of focused chapters looking at the various finds recovered during the excavations, both material culture objects and waste products, as well as dietary evidence including faunal and plant remains. As well as providing focused, specialist discussions of these finds, the analysis conducted in these chapters provides the basis for the broader synthesis and discussion chapters which follow.

Chapter 22 provides a summary of what we can now say about the archaeological sequence of Essouk-Tadmekka, synthesising the various results to provide an overview of the evidence recovered from the various occupations of the site. Chapter 23 then places the archaeological data alongside other forms of historical evidence to provide a new account of Essouk-Tadmekka's history. Chapter 24 then considers this evidence in terms of broader debates related to trans-Saharan commerce and culture.

CHAPTER 2

An Unexplored Market Town of the Early Trans-Saharan Trade

Sam Nixon

Researching Early Trade across the Sahara

Trans-Saharan Environments, Societies, and Resources

Connections between North Africa and sub-Saharan Africa have been facilitated for thousands of years by the Nile valley, linking Egypt with the societies in the region which is now Sudan. From the Western Desert of Egypt westwards, however, the true Sahara represents a vast stretch of desert with no large waterways, and has been in this hyper-arid state for at least 5000 years, when the last major wet phase ended (Fig. 1.1; Brooks *et al.* 2003; Cremaschi *et al.* 2006). The Sahara has though always been occupied, even during its most arid periods. This has been enabled by the existence of relatively fertile areas – including for instance the central Saharan highlands – and by the ability of nomadic pastoralists to adapt their lifestyle to the desert. Today the Sahara is principally populated by Berber groups, and extensive research indicates the lengthy Berber pre-historic occupation of the Sahara (Brett & Fentress 1996). The 'Libyans' neighbouring Ancient Egypt are perhaps the best known early Saharan Berber peoples (Brett & Fentress 1996: chp. 2), but the Sahara is dotted with the burial grounds and fleeting remains of nomadic pastoralists going back many thousands of years (*e.g.* Di Lernia & Manzi 2002). The Sahara also has a great time depth of permanent settlement and developed sedentary societies. The Garamantian (Berber) culture which existed from at least the early-/mid-first millennium BC to the mid-first millennium AD in the Fezzan zone (in the south of modern day Libya) is the most developed early example of these sedentary societies, archaeological evidence including numerous towns, irrigated agriculture, and developed craft working traditions (Mattingly 2013).

While then the spread of Islam throughout the Sahara from around the 7th–8th centuries AD provided new impulses for settlement and societal development (see more below), the Sahara already had a deep and complex history. It is important also to remember that the Sahara is not an empty zone in terms of resources. In areas it has rich reserves of copper, including in Akjoujt and Aïr (Herbert 1984: chp. 1). Importantly, it also has salt, a commodity which was in particular demand as a dietary supplement amongst many sub-Saharan societies where salt was in limited supply (Lovejoy 1986: chp. 1). The Sahara has also been an area of significant cultivation at points in its history, including of crops such as wheat, dates, and cotton (see refs in Chapter 21). Amongst its numerous other products and commodities historically are semi-precious stones, animal skins, and ostrich feathers (Mitchell 2005: chp. 5). The Sahara then has long had its own complex social and economic systems, and has never been simply an empty zone to be crossed.

Discussion of commerce across the Sahara has been consistently connected with the key resources of West African gold, slaves, and ivory, the same products that drove European maritime exploration of West Africa from the early modern era (Bovill 1958; Devisse 1988; Mitchell 2005: Chp 5; Lydon 2009: 71–79; Gronenborn 2011). Principally West Africa is associated with gold, it having had the richest gold mines known in the Old World before the discovery of South American gold (see refs in Chapter 15). This resource generated legends of gold richness right up to the modern era, including associated with the town of Timbuktu, a fabled location of gold wealth which spurred European exploration of the interior of West Africa (Gardner 1968).

While West Africa was long recognised as a resource rich location, it was seen within much early scholarship to have had relatively primitive indigenous social systems (see discussion in McIntosh 1999). Social complexity was seen to have been stimulated by external connections, principally contact with Islam. Increasingly, however, archaeology has begun to show the time depth of West African social complexity (McIntosh 1999). Evidence for urbanism and internal networks of commerce now clearly predate the arrival of Islam, including at such key sites as the town of Jenné-jeno in Mali (McIntosh 1995a). This in turn relates to a larger story of social complexity in pre-Islamic West Africa, including for example at such sites as those associated with the Tichitt Tradition which developed in Mauritania from *ca* 2000 BC (see MacDonald 1998 and references therein). While then West Africa has consistently been a zone of resource richness, for thousands of years it has also witnessed a range of complex societies with developed networks to

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control and supply these resources, and in turn to engage with Saharan societies and the wider networks they were connected to.

Debating Pre-Islamic Trans-Saharan Connections

Historic records of early Islamic era commerce across the Sahara with West Africa are plentiful, and archaeology provides extensive concrete evidence of this commerce (see below). A question that has vexed researchers for a long time however is whether connections were established across the Sahara with West Africa in the pre-Islamic era; and if so what was the nature of those connections. While certain scholars have considered the possibility of such a trade across the Sahara in the Carthaginian era there is no compelling evidence of this, and serious discussion of pre-Islamic connections with West Africa starts with the era of ancient Rome (Law 1967; Liverani 2000). The development of the Garamantian culture in the Fezzan Oases zone during the Roman era has in particular been linked to developing trans-Saharan contacts (Mattingly 2013: Chapter 20). It is clear that certain contacts were established between Roman North Africa and the Garamantes, both diplomatic contacts and exchange of goods, including Garamantian wheat from the Fezzan and Roman wine. The key debate though concerns whether the Garamantes were at the heart of a commercial system going both north and south, thereby effectively linked Rome and West Africa into a unified commercial network. Certainly the camel – the crucial Saharan pack animal (Figs. 2.1, 2.2) – was already present within the Saharan world to facilitate this (Shaw 1979). However, the Saharan crossing from the relatively fertile Garmantian region to West Africa was still up to 2–months journey across *ca* 1500 kms of difficult terrain.

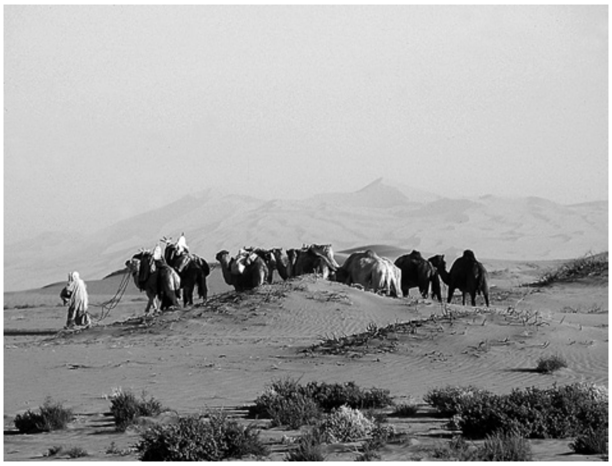

FIGURE 2.1 *Small nomad camel caravan near the Erg Tifernine, southern Algeria.*
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FIGURE 2.2 *A camel caravan ascends the Amogjar Pass in Mauritania.*
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There are certainly historical records from the Roman era indicating awareness of cross-Saharan routes to West Africa (Law 1967: 193). Also, while West African goods have not been conclusively demonstrated in North Africa in this era, an important argument has been put forward by Garrard (1982) for a commerce in West African gold. Garrard's argument, essentially a numismatic one based on the relative quantity of gold coinage minted in North Africa from the Roman through Islamic periods, as well as a consideration of coin weight systems, suggests an advent for the trans-Saharan gold trade as early as the 4th century AD. This is to date the most compelling evidence from North Africa in support of a trans-Saharan commerce, though arguments concerning trade in sub-Saharan slaves and wild animals have also been made (Fentress 2011). Turning to the concrete evidence from regions further south, Roman era goods from the tomb of Tin Hinan at Abalessa, southern Algeria, have long been seen as an indicator of pre-Islamic trans-Saharan connections (Camps 1974). More recently, compelling evidence has come from the site of Kissi in Burkina Faso, dated from *ca* 4th–7th century AD, in the form of significant imports from across the Sahara, including glass beads and copper (Magnavita 2009, 2013; Fenn *et al.* 2009).

Beyond looking for traces of trans-Saharan goods in West Africa, it is also useful to investigate the development of urban centres in the Western Sahel, at the southern fringes of the Sahara ('*Sahel*' meaning 'shore' in Arabic), a zone which would become crucial for the supply of sub-Saharan products. In the period *ca* 300–450 AD we start to see changes, including improved rainfall conditions (McIntosh 1998), and this period sees various permanent settlements founded in the southern areas of the Sahel, sites which would later grow into major urban centres, including Jenné-jeno (McIntosh 1995a) and Dia (Bedaux *et al.* 2005). Recent evidence for a significant early 1st millennium AD settlement at Tombouze in the northern Sahel (immediately next to Timbuktu) also needs to be considered (Park 2010). The development of these early permanent centres has long been interpreted as largely a result of inter-regional trade contacts rather than the external stimulus of trans-Saharan trade (*e.g.* McIntosh & McIntosh 1993). While this is so, the period in which these centres develop does show an interesting chronological parallel with the period identified by Garrard (1982) for the advent of the trans-Saharan gold trade. Certainly these Sahelian centres were linked into wider regional trade networks and these would almost certainly have reached further north into the southern Sahara. The key product consistently referred to in terms of such a developing exchange network between the Sahel and the southern Sahara is salt, a crucial dietary element, plentiful in the southern Sahara but significantly lacking further south. A trade involving Saharan salt exchanged for Sahelian grain and slaves is documented in later periods (Lovejoy 1986: 179–220) and this should be strongly considered back into the pre-Islamic era. It is likely such developing and intersecting regional pre-Islamic networks at both the Sahara's northern and southern edges provided increased potential for exchange of products, and this perhaps provides a compelling case for how other 'exotic' goods such as we see at Kissi and Abalessa may have moved across the Sahara.

The long held idea that Islamic trade sprang up overnight certainly now seems fanciful, and it is highly likely it developed on the back of earlier commercial networks of some form. We are though still a long way from being able to maintain that a highly developed pre-Islamic trans-Saharan trade existed. What is certain is that something new clearly happened in the early Islamic era. It is to this era that we can trace large scale camel caravans and a network of merchant centres across the Sahara to support them. It is to this world, and playing a crucial part within this story, that the focus of this book, Essouk-Tadmekka, belongs.

Early Islamic Trans-Saharan Trade

From Arabic geographical texts composed by Muslim scholars between the 9th and 15th centuries AD (Levtzion & Hopkins 2000: see index entries for various references below) the early Islamic cross-Saharan trade has long been familiar to Africanist historians (see *e.g.* Bovill 1958; Devisse 1988; Mitchell 2005: chp. 5). Amongst the detailed descriptions provided in these Arabic texts are accounts of the various trans-Saharan routes across the vast desert spaces, linking the areas which are now Morocco, Algeria, Tunisia and Libya with corresponding points southwards across the desert (Fig. 2.3). The texts also describe the various peoples of the Sahara, mainly Berber nomads who also controlled the cross-Saharan caravan routes, as well as the local traders and incoming merchants from throughout the Islamic world who settled in the trading towns along these routes. We also learn about the West African states involved in the trade (Fig. 2.3). Early focal points of the Islamic trade were Ghana and Gao, the earliest recorded West African trading polities, documented from the 9th century AD. Later, from the 13th century, we hear of the Empire of Mali, the supreme West African power whose name became associated with unrivalled wealth, as well as the equally important successor Songhay empire. Important movements in the Islamicisation of the Sahara and West Africa are also documented, including the rise of the Almoravids, an Islamic reform movement which developed from the 11th century. Amongst the most famous descriptions of the Islamic trade within these texts are accounts of the huge camel caravans, including fabled accounts of up to 12,000 camels in a single caravan (Levtzion & Hopkins 2000: 336–338). The texts also record the goods that moved on the caravans: the gold, slaves, and ivory from West Africa, and the North African products exchanged for these, such as copper, glass wares, and textiles. Through these texts therefore we are able to gain significant understanding of the extent and nature of the early Islamic trans-Saharan trade.

As an historical movement, the era of early Islamic cross-Saharan commerce (*ca* 7/8th–15/16th centuries AD) is profoundly important: it brought significant economic inputs to Central Islamic lands, most crucially gold and slaves, and these in turn supplied larger Eurasian networks. It also introduced Islam to West Africa (Devisse 1988; Savage 1992; Insoll 2003: chp. 5; Mitchell 2005: chp. 5). Not least, it established the first true connection between West Africa and the wider 'world system', such a vital precursor to European involvement in West Africa. Having developed direct contact with West Africa, Portuguese explorers searching for the source of West African gold soon became the suppliers of slaves for a burgeoning market in the new colonies of the Americas (Mitchell 2005: chp. 6). Ultimately, the combination of the discovery of South American gold and European coastal trade in West African gold, slaves, and ivory from the 15th century onwards diminished the importance of the trans-Saharan trade. Its decline was further compounded

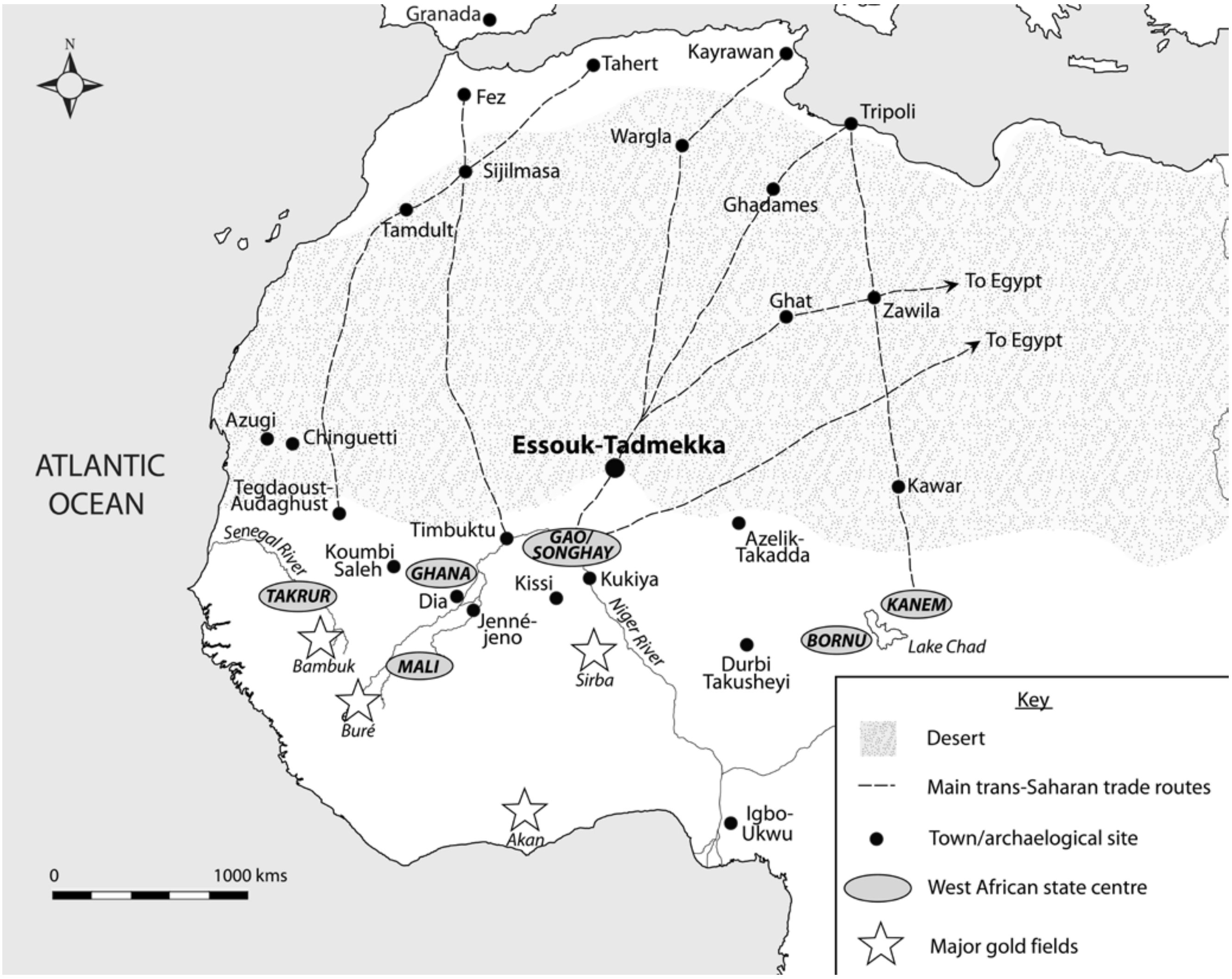

FIGURE 2.3 *Map showing early Islamic era Saharan and West African commercial networks and Essouk-Tadmekka's position within these.*

by the late 16th century Moroccan conquest of Timbuktu and the wider Songhay empire of which it then formed a part (Kaba 1981). The trans-Saharan camel caravan trade continued up to the 19th century, and indeed beyond (see *e.g.* Lydon 2009 chps. 2, 3), but it no longer occupied such a crucial and pivotal role on the world stage. While the early Islamic trans-Saharan trade has certainly been supplanted in our historical consciousness by European maritime exploration of West Africa and the Atlantic slave trade, one cannot stress highly enough the importance of the early Islamic trans-Saharan networks within African and global history; and consequently the need to improve understanding of them.

Understanding the growth of commerce across the Sahara in the early Islamic era is complex and no single explanation can suffice. In the very earliest period of Islam while the Caliphate had access to a range of alternative gold sources outside of West Africa (Shatzmiller 2013: 280–283), West Africa was identified from the earliest period of Islamic conquest in North Africa as clearly a very rich source of gold and soon as the richest known source of all (see *e.g.* Levtzion & Hopkins 2000). One certainly cannot stress highly enough the key role that the desire to gain access to this gold had in the growth of trans-Saharan commerce. While a process of demand and supply certainly led to the flow of gold across the desert, significant investment in trans-Saharan trade also appears to have been undertaken by Islamic powers to gain access to this gold, including by the Fatimids in the 10th century whom it is argued needed West African gold to finance their war chest and to pay for their Caliphal expansion (see *e.g.* Devisse 1988: 391–397). The increasing need for slaves in an expanding Islamic empire, however, also provided an important factor for the growth of trade across the Sahara, West Africa being identified as equally as attractive for slave trading as for trade in gold in the early centuries of Islam (SAVAGE 1992; AUSTEN 2010). Religion was also a very important factor – while there appears to have been very little growth of Christian communities in the Sahara before the rise of Islam, the strong bonds established by the spread of Islam and the growth of connected Muslim communities were integral to the development of the flourishing commercial network that would follow (INSOLL 2003: chp. 5). Overarching explanations of the causes behind the rise of Islamic trans-Saharan commerce lie beyond the realms of this volume, though useful research directions are developing in this area (MATTINGLY in prep.).

In terms of understanding *how* the early Islamic Saharan commercial network was supported, of crucial importance were the trading towns at the southern edge of the Sahara (Fig. 2.3; see INSOLL 2003: chp. 5; NIXON in prep for a review of this evidence). These centres were the principal locations where exchange took place between North African and West African merchants, and consequently where the most major trans-Saharan markets were. Located at the point where the Saharan Berber world met the Sudanic world, they were also where Islam first arrived in West Africa. Timbuktu is the most famous of these towns, first heard of in Arabic records in the 14th century (LEVTZION & HOPKINS 2000: 287), soon becoming known as a major centre of great wealth – the legends of this town went on to inspire European explorers up until the 19th century (even though its glory days had long ceased by that time). Arabic historical records though refer to a range of other trading towns, not only contemporary with Timbuktu but long before it is recorded, back to the 10th century. The most important early towns described at the southern Saharan fringe were Audaghust, Tadmekka and Kawar, and important merchant towns were also recorded in proximity to the capitals of the earliest recorded states of Ghana and Gao (Fig. 2.3). The Arabic sources provide a range of important details about these places, including their locations and their trading connections (LEVTZION & HOPKINS 2000: index). They also describe the communities there, as well as their history, providing an essential resource for understanding these early centres of trans-Saharan exchange. While a range of other commercial centres existed and developed throughout West Africa (including for instance Djenné and Dia) it is these towns at the southern edge of the Sahara where much of the crucial trans-Saharan exchange took place and around which discussions of trans-Saharan research in West Africa are principally focused.

Archaeology has contributed significantly to our understanding of these towns at the southern Saharan fringe. From the 1950s and 1960s there were investigations of Koumbi Saleh (a trading town associated with the polity of Ghana (BERTHIER 1997)), and of Tegdaoust, the site associated with the town of Audaghust documented in Arabic records (ROBERT *et al.* 1970; VANACKER 1979; DEVISSE 1983; POLET 1985; ROBERT-CHALEIX 1989). Important investigations have also taken place at the royal and merchant towns of Gao (INSOLL 1996, 2000; CISSÉ 2011; CISSÉ *et al.* 2013). Timbuktu has also seen some investigation, albeit only of its post-medieval layers and its surrounding settlements, rather than the medieval levels of the town itself (MCINTOSH & MCINTOSH 1986; INSOLL 2002; PARK 2010). From this archaeology we have gained greater insight into the southern Saharan edge towns, including their physical appearance, the lifestyle of their inhabitants, and the goods traded there. Also, studies of Arabic inscriptions at certain of these sites (Gao and Tadmekka) provide an alternative historical record, including shedding important light on local history, ethnicity and cultural practice (MORAES FARIAS 2003, 2011).

While both the Arabic historical sources and archaeology provide great insight into these market towns at the southern Saharan fringe, there is still much we need to learn about them and what they tell us about wider trade networks. The Arabic sources, while hugely insightful in certain areas, are very limited in other ways. For instance, the authors are often little inclined to provide commentary on the detail of cultural life in the towns. The Arabic records are also often seen to be highly inaccurate in certain periods, and entirely silent in others. Also, crucially, some of the most important towns have never been studied archaeologically. Consequently, we still have little idea of what these places looked like, how they functioned, who were their inhabitants, and what they traded. Indeed, we have little clear idea even of when they developed and when they declined. Amongst the locations never excavated are the important Kawar oases sites in Niger (LANGE & BERTHOUD 1977). A location that had also previously seen no excavation is another of the most important early southern Saharan towns, Essouk-Tadmekka, the focus of this book.

Tadmekka in Early Arabic Texts

The earliest documentary records of Tadmekka are those of the Arabic geographers, mainly from North Africa and the Middle East. The earliest authors compiled their texts from travellers' reports, never actually visiting West Africa themselves, but certain later authors (mainly post-13th century) did indeed cross the Sahara to provide first-hand accounts.

The first contemporary recording of "Tadmekka" in Arabic texts is in the 10th century AD when Ibn Hawqal describes it as a "territory" occupied by groups of mixed black/Berber heritage and ruled by two "kings" implied to be Muslim (App. A; see App. A for all early Arabic references to Tadmekka). While Ibn Hawqal's account contains no specific mention of a town nor trans-Saharan trade, slightly later documentary sources recounting earlier historical events feature passages recounting significant trade at Tadmekka in the tenth century. Certain texts written in later periods, seemingly borrowing from earlier (now lost) texts, also refer to even earlier periods at Tadmekka. The text of Ibn Hammad, writing in the early 13th century, contains a passage referring to a slave market at Tadmekka in the 9th century (App. A). Likewise, Yaqut, writing in the early 13th century but considered to be borrowing from the 10th century text of Al-Muhallabi, refers to the "Kingdom of Tadmak" and its capital "Zakram" (App. A) – LEWICKI (1981: 441–2) believed this latter name related to the Berber meaning of 'town' or 'built up locality'. These sources suggest Tadmekka was already a trade centre in the 10th century, and even possibly in the 9th century. From the combination of these early sources we gain a sense of Tadmekka as located at the southern fringes of the Sahara where camel caravans arrived and departed, a point at the southern extension of the Berber groups of the Sahara. The specific nature of its Islamic presence and the reference to a mixed race population, ruled by dual rulers, is however unclear. These early reports though clearly show the importance of traders from the Ibadi sect of Islam, a group who were of great importance in the establishment of early trade routes, particularly across the central Saharan routes (see App. A *'Ibadi extracts'*).

The first clear detailed record we have of Tadmekka as a town and a trans-Saharan trading centre is Al-Bakri's *ca* AD 1068 description (App. A). Al-Bakri's description is the most famous one known of Tadmekka, and is certainly a useful starting point for beginning to understand the town and the wider world it existed within. Al-Bakri is an author widely regarded as the first relatively reliable geographer of West Africa, and it is certainly this description which has formed the principal model for thinking about Tadmekka. One gains a sense from his description of a merchant centre within a wider desert nomadic landscape, a town whose citizens were either local Berbers who converted to Islam and adapted to an urban way of life, or incoming merchants from elsewhere in the Islamic world. Al-Bakri locates Tadmekka on trade routes linking the important Sudanic kingdoms of Ghana and Gao to the regions of contemporary Tunisia and Libya. He also describes its trade, including his enigmatic account of its gold coinage. Additionally, Al-Bakri's description crucially explains the meaning of the name "Tadmekka", it being explained as meaning "the Mecca like", clearly indicating the Muslim character of the town from an early period.

Al-Bakri's description, while important, only though represents Tadmekka at one point in time, while the Arabic records for the town cover the period from the 10th to the 15th century. Also it is quite possible it presents an inaccurate picture based on a meshing of various sources, or filling in of gaps in understanding with colourful detail. Most crucially, it is recognised that Al-Bakri copied some of his material from the works of the 10th century author Al-Waraq, whose works are now lost (LEWICKI 1969: 52–53; LEVTZION & HOPKINS 2000: 62–63). Importantly also, Al-Bakri's account appears to predate the rise of the Almoravids, one of the most important episodes in trans-Saharan history which occurred during the mid to late 11th century (see below).

In the 12th century, almost a century after Al-Bakri, Al-Zuhri reports that the people of Tadmekka "turned Muslim" (i.e. converted to orthodox Islam) in the late 11th century, following contact with the Almoravids (App. A). This Islamic reform movement from the Mauritanian region developed from a base of Islamic fundamentalism, reacting to the perceived laxity of Islamic practice in West Africa (HRBEK & DEVISSE 1988; MESSIER 2010). The Almoravids attacked certain Saharan centres, most notably Audaghust, and went on to conquer Morocco, as well as southern Spain. They also appear to have been involved in increased Islamicisation amongst the West African states, including Ghana and Gao, who were still only partially Muslim. Given that Al-Zuhri's description is somewhat vague, however, we are not sure what effect this movement had on Tadmekka.

It is difficult to gain any sense of the nature of 12th century Tadmekka from the sources, and the same is true for the 13th century, records of the town relating to these centuries being either extremely vague, likely erroneous, or simply a paraphrasing of Al-Bakri's earlier description (see App. A). Two 13th/early 14th century accounts – possibly plagiarisms of earlier texts – describe Tadmekka simply as a famous town (App. A).

In AD 1337–38 Al-ʿUmari describes Tadmekka as powerful, "independent" of Mali, and part of the territory of "white" Berber pastoralists, ruled by a Muslim Sultan – there is no explicit mention of a town or trade however (see App. A). By this time the Empire of Mali had assumed principal control of the trans-Saharan trade in West Africa following the demise of Ghana, and the whole social and commercial landscape had changed. New centres were strongly involved in trans-Saharan trade, including Timbuktu, but also Walata (Levtzion & Hopkins 2000: 284–286), and Takedda (Bernus & Cressier 1991). From Al-'Umari's description however it is unclear if Tadmekka is still an urban centre of trade, his description of powerful nomads (whose description strongly resembles the Tuareg) not providing any concrete details of a town.

Following Al-'Umari's description, a later 14th century description appears to provide more detail. In *ca* AD 1374–1393/4 Ibn Khaldoun's writing includes a description of "Takadda", located "in the country of the veil-wearers beyond Kawkaw" (App. A). Based upon the geography and content of this description, this is now widely seen to in fact refer to Tadmekka and not Takedda (Levtzion & Hopkins 2000: 425, n.72; Moraes Farias 2003: cxlv) – Ibn Khaldoun seemingly mixed up the names for Tadmekka and Takedda, a town much further to the east. Ibn Khaldoun's description again makes reference to a Sultan. It also importantly refers to a "capital". Further important details are provided, including the town's gift exchange with Wargla in southern Algeria, as well as identifying the town as a gathering point for pilgrims on the way to Mecca. Crucially also a reference is made to a caravan of 12,000 camels – even if this latter reference is apocryphal (though there is every possibility it is true), other content within the description suggests a continued and prosperous trans-Saharan role for the town. The description however also contains important passages related to the town being involved in conflict with the empire of Mali, Mali seemingly having "laid siege to it and invested it closely but then let it be". The overriding impression is of a town notionally subject to Mali, but in conflict with it concerning this status. Ibn Khaldoun's description is the last detailed Arabic account attributed to Tadmekka, there only being a vague reference in the early 15th century to a "city", again possibly simply a copying of earlier texts (see App. A). There exists no detailed account within the early Arabic texts of how and when occupation at Tadmekka ended. The internal Arabic sources produced in West Africa from the 16th century onwards also make no significant reference to Tadmekka (Moraes Farias 2003: cxliv).

The compilation of these historical sources referring to Tadmekka has provided a core set of material for various scholars to approach the town as a commercial centre (Mauny 1961: 117–118; Sidibé 1986; Moraes Farias 2003: cxxxiv–cxliv), as well as with which to consider the ethnic and cultural history of Tadmekka and its role in Tuareg history (Norris 1975). Beyond the Arabic texts though there are also a series of Tuareg oral traditions which continue the story of the town, but using the name "Essouk" not "Tadmekka".

"Essouk" within Tuareg Traditions

The Adrar des Ifoghas region within which Essouk is situated is predominantly occupied by Tuareg groups whose oral traditions clearly indicate the important role this locality occupied within Tuareg history. Historically, the Tuareg (called by themselves 'Tamashek') have been the principal group controlling camel caravans across the central Sahara, and through romantic depictions of them – principally dressed in blue robes and leading camel caravans – they are perhaps the most recognisable Saharan peoples. Inhabiting large areas of Libya, Niger, Mali and Algeria, the Tuareg number somewhere between 1.5–3 million. While many Tuareg today live in towns, the culture still has at its core a strong nomadic pastoral lifestyle and ideology (Nicolaisen & Nicolaisen 1997). Likewise, although the Tuareg have long been influenced by Islam and many Tuareg are Muslims, many Tuareg groups also have very weak ties with Islam. The roots of Tuareg culture are commonly traced back to Libya (Norris 1975, 2003; Hachid 2006), but the Tuareg long ago spread throughout the Sahara, much movement taking place in early medieval times with increased trans-Saharan activity. This region is identified as one of the key centres for the formation of the Tuareg identity, Norris (1975: 12) pointing out in particular that the key defining name associated with the 'noble' Tuareg, *Imashagen* (meaning 'the noble and the free'), has its earliest occurrence within Ibn Hawqal's 10th century description of Tadmekka (App. A).

The most obvious sign of a connection between the Tuareg and the site of Essouk in recent years has been the Essouk festival (Figs. 2.4, 2.5 and discussed further below). This is a celebration of the role of the site within the Tuareg past and a key element of this is celebrating the site as the urban centre of medieval Tadmekka. It should be stressed however that this connection between Essouk and "Tadmekka" is in fact largely based upon modern research not Tuareg oral traditions. While modern research points towards various evidence for this being the location of Tadmekka (see below), the oral traditions of Tuareg groups claiming ancestral connection with Essouk do not refer to "Tadmekka" at all, instead presenting the importance of the site in other terms.

The wider region surrounding Essouk is today occupied predominantly by nomadic Tuareg, the main group being

FIGURE 2.4 *Poster from the 'Festival Tuareg d'Essouk' (2004), a festival designed to celebrate Tuareg culture and the medieval era of Essouk-Tadmekka.*
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the Ifoghas, from whom the Adrar des Iforas ('the Adrar of the Ifoghas') takes its name (Camps & Claudot-Hawad 1985). It is however other Tuareg groups who are seen to have the closest connection with Essouk, the Ifoghas being considered relatively late arrivals in the region (Camps & Claudot-Hawad 1985; Moraes Farias 2003: cxxxiv–cxliv). The main group seen as historically connected with the site are the Kel Essouk, a group no longer significantly present in the area today, having migrated away principally to Niger (Norris 1975: 42–46; Bernus *et al.* 1999: 213–222; Moraes Farias 2003 cxxxiv). This group identify their origins as being the Islamic specialists (*Ineslemen*) within this region of the southern Sahara borderlands from the inception of Islam here, and Essouk is identified as the psychological centre of their world (Norris 1975 42–46; Moraes Farias 2003: cxxxiv–cxliv). Within their traditions there is no mention of the medieval commercial centre "Tadmekka", only a focus on Essouk as a holy centre of Islam, and indeed the origin point of Islam amongst the Tuareg of the southern Sahara; though certain Kel Essouk traditions do indeed attach a medieval origin to Essouk (Moraes Farias 2003 cxxxiv). One particularly prevalent tradition relates to Uqba, the Islamic conqueror of North Africa, and certain Kel Essouk have

FIGURE 2.5 *Tuareg camel riders during a performance at the Essouk festival, 2004.* © G. BUTENSKY

traced their origin to him (MORAES FARIAS 2003 cxxxvii). While there is no documented explanation of the origin of the Kel Essouk's name, it seems clear that they take their name from an historical market function of the site, Essouk meaning 'the market' in Arabic (and Kel meaning 'people' in Tamashek). The Kel Essouk are today still regarded as the highest Islamic scholars and holy men within the Tuareg world of the southern Sahara, and despite most having migrated from the Adrar they have kept their name association with their ancestral site.

The other group associated with the site of Essouk are the Tademakkat, whose name obviously relates to "Tadmekka" and the tribal names allotted to the rulers of this region within the earliest Arabic historical records. Traditions relate that this group lost its position of power within the Adrar region, seemingly around the 17th century, migrating away in the direction of Timbuktu (CAMPS & CLAUDOT-HAWAD 1985; MORAES FARIAS 2003 cxxxvii). Out of the conflict which developed at that time, a new confederacy rose up, known as the Oullemeden – it was into this confederacy that the Ifoghas came, in time gaining power in the region (CAMPS & CLAUDOT-HAWAD 1985). While having migrated away, Tademakkat oral traditions still relate back to the Adrar. Interestingly though the Tademakkat also use the name "Essouk" when discussing the ruins, not Tadmekka (MORAES FARIAS 2003: cxliii).

While then "Essouk" and "Tadmekka" have not been clearly linked in the oral traditions, the overwhelming scholarly consensus is still that they are associated (see Moraes Farias 2003 and Chapter 5 for further discussion). The rise and prominence of the name "Essouk" – and the associated disappearance of the name "Tadmekka" – is seen to be linked to the powerful ideological workings of the Kel Essouk and their identification of the town as "Essouk" in their own name; including potentially their need to define a name as distinct from the nomadic pastoral confederacy of the Tademakkat within whose territory the urban market town was located. When considering the nomadic pastoral Tademakkat's 'forgetting' of the name Tadmekka, one must also recognise the Tademakkat were principally invested in nomadic pastoralism and the Adrar as a whole, rather than the urban life of the town itself; unlike the Kel Essouk whose identification was with Islam and an urban lifestyle.

Aside from attempting to establish a connection between the names "Essouk" and "Tadmekka", gaining a sense of the decline of the town from the oral traditions is not straightforward. The succession of migrations and crises within this region over the past 500 or so years since the last Arabic references to the site, as well as innumerable other historical events, have inevitably led to significant reworkings of oral traditions. While providing important accounts to help understand the peopling of the region and the roles of these different groups (see

Moraes Farias 2003 and Norris 1975 for further discussion), the oral traditions have provided no solid basis for understanding the destruction and abandonment of the site itself. Proposed dates for the abandonment of Essouk-Tadmekka have ranged from the 15th century to the 18th century, and proposed causes have included conquest (by Songhay), as well as internal power struggles (Moraes Farias 2003: cxliii–cxliv). The Kel Essouk oral traditions clearly associate their migration away from Essouk with the decline of Islam in the region, though it is unclear exactly what era this refers to, and crucially might in fact be referring to a time when the site itself had already ceased to be occupied. Inevitably the oral traditions are even more problematic in relation to the foundation of the site and its earliest periods of occupation. In addition to the Kel Essouk origin stories associated with Uqba, non-Islamic indigenous Berber origin stories also provide additional accounts. Principally there is an association with Koceila, a semi-mythical Berber queen said to have fled from the northern Sahara following early Arab invasions in the 7th century AD, finally seeking refuge at Essouk (Camps & Claudot-Hawad 1985). Without research at the site to complement the oral traditions one cannot arrive at a sound idea concerning when the town was abandoned nor its earlier peopling.

Past Research at Essouk-Tadmekka's Ruins

At over 50 hectares in size, Essouk-Tadmekka stands as by far the largest known archaeological site in the Adrar des Iforas, corresponding with Tadmekka's regional historical importance. The nearest sites of an equivalent scale are found over 300 kilometres away, the medieval-era sites of Timbuktu, Gao, and Takedda (see Fig. 2.3 and references above). There are however other important medieval sites in the Adrar des Iforas, including Junhan (see Moraes Farias 2003: chp. 8), and the regional pre-Islamic archaeology has also seen some documentation, both in terms of settlement sites (Gaussen & Gaussen 1988) and the extensive rock art (see Chapter 4). Not only does the site stand as the supreme site in the region, importantly this is where Tadmekka should be located based upon locations provided within the Arabic geographies. Coupled with the Tuareg oral traditions relating the key medieval role of "Essouk" and its identification as the origin point of Islam in the region, this led early researchers to have great confidence in the connection between the "Tadmekka" of the Arabic histories and the archaeological site found within the Essouk valley.

By at least the 19th century explorers had recorded the presence of the ruins at Essouk on maps of the region, and had already started identifying them with medieval Tadmekka (see Blachère map of 1881 in Butler 2015: 118–19). Early 20th century French colonial missions subsequently provide summary accounts of the ruins (Gautier 1907; Cortier 1908). While already by this time there was some awareness of "Tadmekka" as an early settlement of some importance referred to by early Arabic geographers, this earliest scholarship on the ruins focused not on its Islamic medieval trade associations, but on the association between the site and the legend of the pre-Islamic Berber queen Koceila, mentioned above. Certainly this was linked to the desire to find early, potentially pre-Islamic, centres of 'indigenous' Berber culture. The scholar who pursued the most intensive study of the ruins during the early 20th century was De Gironcourt (1920), whose work on the Arabic inscriptions at the site established its importance as a centre of early Islam, and further supported its identification with Tadmekka (see Chapter 5). De Gironcourt also produced the first known detailed map of Essouk-Tadmekka (1920: 337).

The study of Essouk-Tadmekka received a major boost in 1948 when the archaeologist Raymond Mauny organised aerial photography of the ruins through the Escadrillon d'Outre Mere (EOM).[1] These aerial images helped researchers to properly visualise the ruins for the first time, showing not only the distribution of the stone structural remains within the landscape, but clearly showing for the first time the layout of the abandoned town, and even the forms of individual buildings, detectable across the entire site (see Fig. 1.2 and further illustrations in Chapters 3, 4, 11). These aerial photographs also provided the means to produce a new more accurate map of the site (Mauny 1961: 117–118). Mauny's published discussion of the site (1961) removed any lingering doubt over the identity of the ruins as those of Tadmekka (see however Lhote 1951 who, against all the evidence, argued this was not Tadmekka) and consolidated Essouk-Tadmekka's status as amongst the most important early cross-Saharan trading towns in West Africa (Mauny 1961: 117–118; see also Mauny 1952). Unfortunately, however, only a single aerial photograph of the ruins was ever published (in Lhote 1951 – see Fig. 1.2 in this volume). Mauny did also conduct very limited digging at Essouk-Tadmekka (in a single

1 Aerial photography archival details (from Moraes Farias 2003: pg. 221): Essouk 24-XI-1948: EOM 81, mission 84/1, n. 5001 to 5006, altitude 600m. IFAN: *Dossier* AP XV-6. Essouk 24-XII-1948: EOM 81, mission 84/2, n. 1 to 14, altitude 1,200m (1:10,000). IFAN: Dossier AP XV-6. Essouk: IGN, AOF 54–55, NE-31-XIV, n. 64, 65, 119, 120 (1:50,000).

FIGURE 2.6 *Page of Raymond Mauny's Essouk diary. © Centre d'études des mondes africains, Paris.*

afternoon – for location see Fig. 11.2), but his only published comment was to note excavation of unusual pottery, but without illustration or description (Mauny 1961: 117–118). Mauny's principal interest in Essouk-Tadmekka was that he considered it to be a likely place to find evidence of pre-Islamic trans-Saharan trade. This theory was due to the presence within the Essouk valley of rock art depictions of 'chariots', similar to those found spanning the Sahara

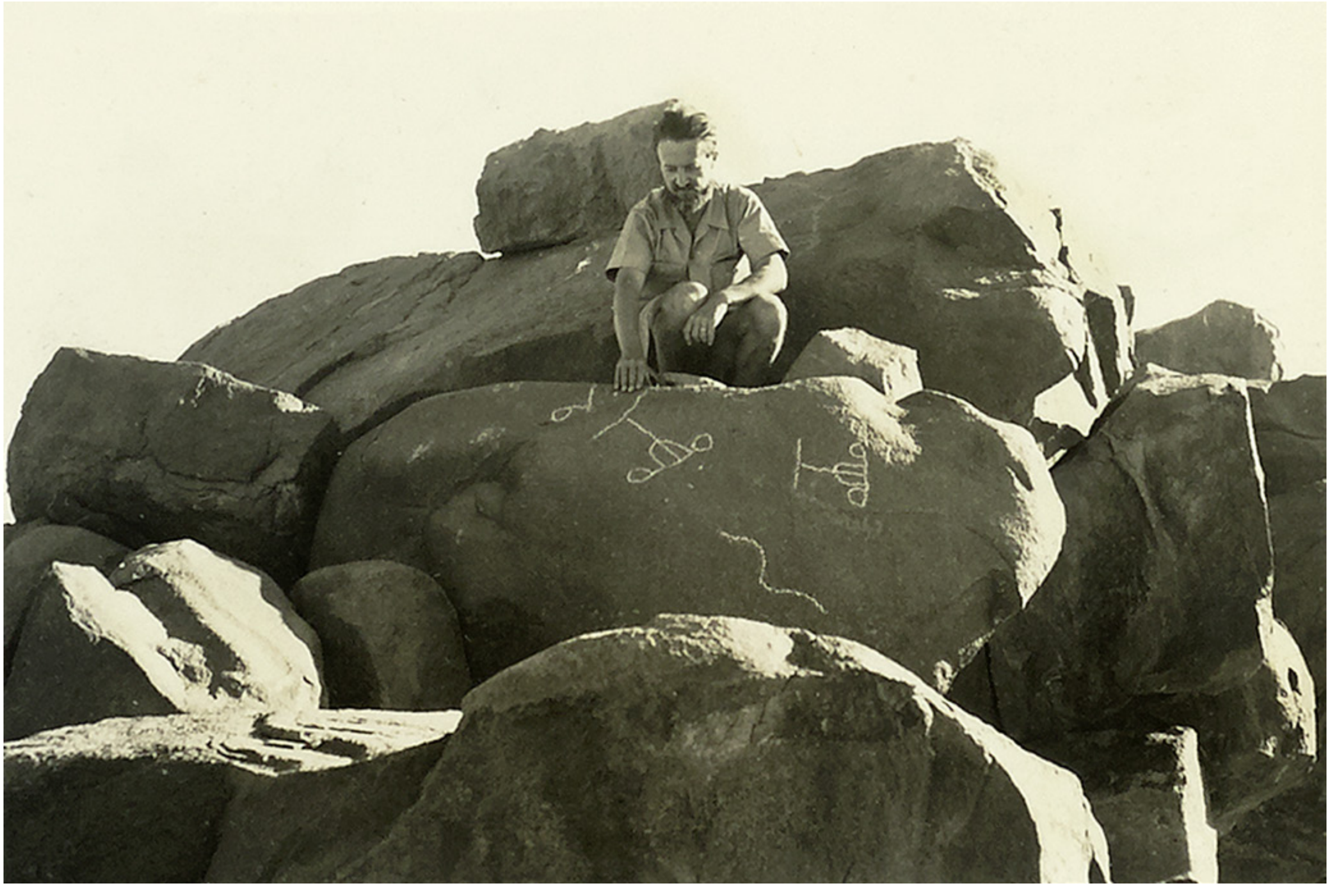

FIGURE 2.7 *Raymond Mauny at Essouk in 1952, shown inspecting rock-art depictions of 'chariots'.*

(see Fig. 2.7). These were considered to be depictions of chariots used by Saharan populations on a hypothesised early cross-Saharan route; seen to relate to a route vaguely described within the writings of the Ancient Greek geographer Herodotus (MAUNY 1978).

While Essouk-Tadmekka was of interest to early archaeologists, other sites in West Africa were seemingly of greater interest. Principally there was a great desire to find the capitals of the West African kingdoms described by early Arabic geographers. Accordingly, Mauny and others pursued investigations of the site of Koumbi Saleh (see BERTHIER 1997) – associated with Ghana – and Gao (see INSOLL 1996; 2000). The site of Tegdaoust, asssociated with the important trading centre of Audaghust, also saw explorations from the 1960s onwards (DEVISSE 1983).

The most important subsequent work undertaken at Essouk-Tadmekka was Paulo de Moraes Farias' research on the Arabic inscriptions (see Chapter 5), commenced in the 1970s. This consummate research did much to renew interest in the ruins, in particular due to the publication of inscriptions identified as the oldest internally-dated writing in West Africa, from the early 11th century. Crucially, Moraes Farias' work also recovered another inscription referring to "a market resembling Mecca", thereby finally enabling a solid correlation between the site and the historical "Tadmekka" described by Arabic authors. This research recovered extensive additional detailed information from the Arabic inscriptions, enabling a range of further insights into the history of Essouk-Tadmekka and its populations. Moraes Farias also researched some of the Tifinagh inscriptions at the site (see Chapter 5).

At the end of the 1980s a program of archaeological survey and excavation was proposed for Essouk-Tadmekka (CRESSIER 1988). Given that many other important sites related to discussions of trans-Saharan trade had by now seen significant work – including Koumbi Saleh, Gao, and Tegdaoust (Audgahust), as well as for instance Azelik-Takedda (BERNUS & CRESSIER 1991) – Essouk-Tadmekka represented an obvious challenge for archaeologists (INSOLL 2003: 215). While a reconnaissance visit was conducted by this team – involving some preliminary recordings of certain surface structures (see Chapter 11) – this program of research was terminated following the death of one of the project members. Any plans for recommencing it were made impossible by the deterioration of the political situation in Mali during the 1990s. There were no further attempts to develop a project, largely due to the increasingly difficult security situation. It is also necessary to mention brief amateur excavations undertaken by local Tuareg groups in 1987 (see below). The only other work which has taken place in recent years has been Dupuy's research on the extensive rock art at the site (1991, 1999; Chapter 4).

Site Protection and Cultural Heritage

The archaeological site of Essouk-Tadmekka has in recent years been integrated into educational and Cultural Heritage structures on both a national and local level. Under the auspices of the Direction Nationale de Patrimoine Culturel (DNPC), from 2002 the 'Mission Culturelle d'Essouk' served as the primary means of governmental Cultural Heritage efforts. Based in Kidal, the physical manifestation of the Mission at the site was limited to several signs, identifying its status as an archaeological site and highlighting its heritage assets (see Fig. 0.1). The main focus of the Mission was its educational and consciousness raising work in the local area, in particular to help conserve the archaeological site. A local organisation, the 'Association d'Essouk', also developed in recent years, with the explicit aim of promoting awareness of the historical importance of Essouk-Tadmekka, both amongst the regional Tuareg population and more widely. Perhaps the most important recent development was the annual 'Festival Tadamakat: Les Nuits Sahariennes d'Essouk', a cultural event focused around music, traditional performance, a programme of lectures, and a craft market (Figs. 2.4, 2.5). This started in the early 2000s and was organised by a range of local groups (including Taghrift Tinariwene), in collaboration with the Malian Ministry of Culture and Tourism (Sahara-Eliki 2008). Following the combination of the renewed Tuareg separatist movement and Islamicist movements in northern Mali, these various cultural heritage structures have ceased.

Since 1999 Essouk-Tadmekka has featured on UNESCO's 'tentative' list of potential World Heritage Sites. In 2012 it was also a focal point for a UNESCO associated initiative aimed at preventing destruction of archaeological sites during armed conflicts in northern Mali (MDLC/CRAterre 2012). Given the geographical positioning of the site, tourism is not common, though prior to the recent conflicts this was growing due to desert tours and music festivals.

Due to the local importance of the Essouk–Tadmekka site, in the 1980s there was in fact an attempt by local Tuareg groups to reoccupy it (Moraes Farias 2003: cxxxviii). Fascinatingly, as mentioned above, in 1987 this campaign involved unofficial excavations by local Tuareg groups (Idnan pastoralists) seeking archaeological confirmation of their ancestral ownership of Essouk-Tadmekka, and thereby their legitimate claim to reoccupy it (see Moraes Farias 2003: 148; Moraes Farias 2011). One building was constructed, but further construction was forbidden by the Malian heritage authorities, and the campaign collapsed. Instead, a new site for construction was designated 2kms to the south, a small settlement now existing there. The site of Essouk-Tadmekka itself today remains an active part of the pastoral landscape, and in particular the wells located at the centre of the site are frequented daily by shepherds bringing their flocks of animals. Essouk-Tadmekka has one permanent resident who cultivates some gardens at the site. While this contemporary activity is minimal, even this can be seen to have damaged the ruins over the past few years (see Chapter 11).

Project Design

Having researched Essouk-Tadmekka within the context of studies of Saharan trade and Tuareg history, and having seen the importance the site had, it was striking to see the total absence of published excavated evidence. Indeed, no single item of portable material culture from Essouk-Tadmekka had ever been published. Also, while the surface remains of the site were well-preserved, these were completely undated, it only being possible to make assumptions on their dating based upon dated inscriptions in the cemeteries (see Chapters 4, 5). There was also no sense of how deep the archaeological deposits at the site were. This distinct lack of a sustained archaeological study represented a huge scholarly gap.

In March 2004, when visiting Mali, the opportunity developed to conduct an archaeological project at Essouk-Tadmekka. Following discussions with the DNPC, it was established that such a project was possible, due to an improved political situation in northern Mali at that time. Such a project was also considered desirable for the Malian heritage authorities, seeking to promote and develop archaeological connections with the region. Accordingly, a preliminary visit was made to Essouk-Tadmekka to assess the feasibility of the proposed project. Following this visit, an accord was signed with the Malian Institut des Sciences Humaines to commence work later that year.

Among the questions to consider were those related to the early settlement of the town, as the earliest references to Tadmekka in the historical sources provide no clear insights into the creation of the town, nor its relationship to long distance trade networks in its earliest phase. Further fundamental questions posed themselves. What had Tadmekka looked like during the early Islamic era? Indeed, what exactly were we to make of Al-Bakri's suggestion that Tadmekka was seemingly amongst the best-built towns in West Africa? What was the balance in Tadmekka's population between Saharan, Sahelian and North African groups? What were the trade goods found in its markets? Was Al-Bakri's enigmatic reference to the unstamped gold dinar coinage of Tadmekka accurate historical reportage? When exactly did Essouk-Tadmekka cease to be inhabited? The questions were numerous.

Developing an archaeology of Essouk-Tadmekka was however more than simply a question of improving understanding of a single town. As indicated above, there has long been great interest in Essouk-Tadmekka in terms of its broader role in the development of trans-Saharan trade. Given Essouk-Tadmekka's importance within Tuareg history (Norris 1975), its investigation also had the potential to provide important new insights into the early history of this important Saharan group – this is particularly relevant given how little archaeological evidence there is related to the Tuareg (Bernus & Cressier 1991; *cf.* Hachid 2000; *cf.* Mattingly 2013). The aim of the project was then to find material evidence of the 'Tadmekka' of the historical sources to improve understanding of this important place, but also to insert it into these broader debates related to trans-Saharan trade and regional history.

While the project was conceived with focused scholarly goals in mind, there was also consideration of how the results might contribute to popular history and cultural heritage. In particular, there was recognition of the site's significance as a focus for local celebration of the Tuareg past. There was also awareness of its importance for Malian national heritage strategies, including the proposal to list it as a UNESCO World Heritage Site.

Between December 2004 and March 2005 the fieldwork took place, involving survey, surface collection, and excavations. This was undertaken together with archaeologists from the DNPC, and was supported locally by the Mission Culturelle Essouk. While only this single, long field season was undertaken, the study of the material and results recovered has continued since 2005, involving a wide range of specialists who have brought their expertise and enthusiasm to bear on the question of Essouk-Tadmekka (see Acknowledgements). Significant archival research has also taken place, as well as discussion with scholars who previously researched the site. The results of this process now provide the basis for a new cultural history of Essouk-Tadmekka and a consideration of its wider place within trans-Saharan history.

CHAPTER 3

The Essouk-Tadmekka Locality: Environment and Human Geography

Sam Nixon

Essouk-Tadmekka lies within the Adrar des Iforas (Figs. 1.1 & 3.1), a highland region characteried by broad stretches of sand and rock escarpments, with only a limited and patchy vegetation cover of acacia trees, scrub, and occasional localised water points (Fig. 3.2). Being just at the edge of the harsher area of the Sahara to the north, the region still today occupies a point as the southern reception point of trans-Saharan routes coming from Algeria and Libya, with the regional capital, Kidal, being the main hub for these. Other than Kidal, there are few other significant towns in the wider region and transport infrastructure is very limited. Essouk-Tadmekka itself is situated *ca* 45 kms to the northwest of Kidal (Fig. 3.1). There are no significant permanent settlements in this area, and with no paved roads motorised traffic is rare.

The defining local topographic feature is a series of sandstone ridges rising above the surrounding, rolling sandy plain. The ruins of Essouk-Tadmekka are located within and immediately around two lines of cliffs within this cluster, these two cliffs defining the Essouk valley (Figs. 3.3 & 3.4). This valley provides one of the best areas for wells in the Adrar des Iforas, offering a relatively high water table (author pers. comm.). This is partly related to the fact that a *wadi* (a seasonal stream) runs down the Essouk valley, channelling the limited rainfalls occurring in the summer and sporadically at other times. While vegetation is by no means bountiful within the Essouk valley, it represents an oasis of sorts within the local region, with in particular acacia trees being relatively abundant (Figs. 3.4 & 3.5). During periods of rainfall wild grasses and other plants also become more common in the valley and the surrounding area. The combination of its topography and its 'oasis-like' nature make the Essouk valley therefore one of the more obviously prominent spots within the region.

Given that the Essouk locality offers water and a certain amount of pasturage for animals, it provides an obvious location for nomadic Tuareg groups to use as a semi-permanent base, and a series of encampments are located close to Essouk-Tadmekka. This is though a relatively sparse population. These groups practice pastoralism with sheep and goat herds, ranging throughout the

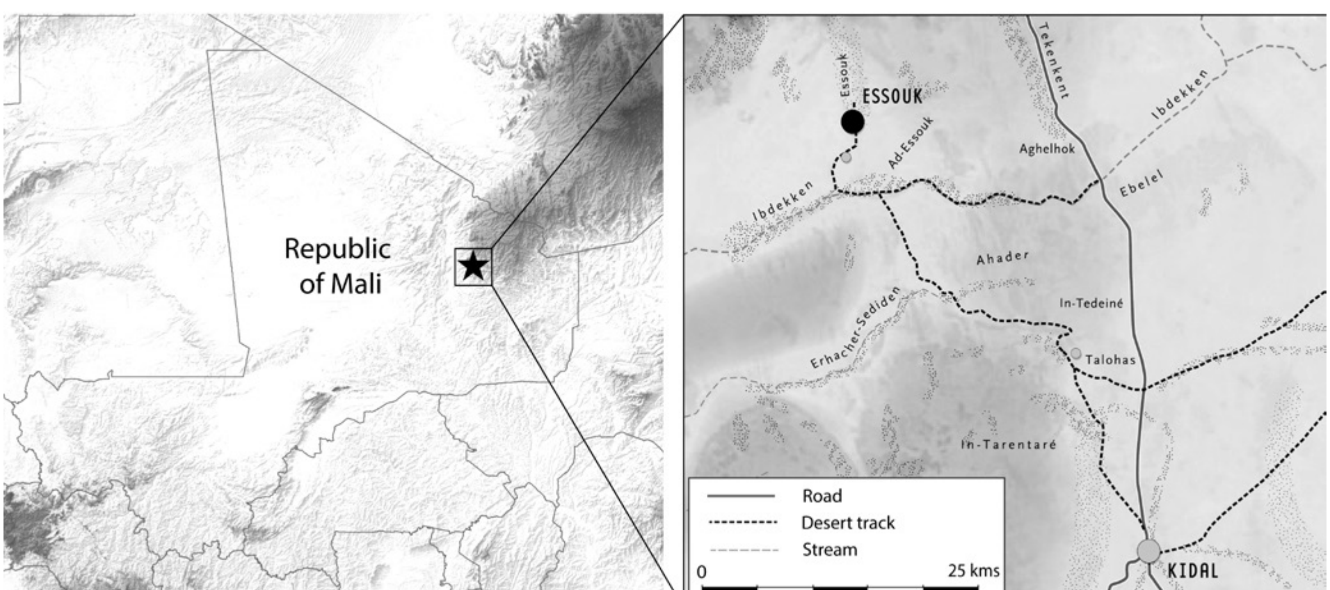

FIGURE 3.1 *Illustration showing both the location of Essouk-Tadmekka in the Adrar des Iforas highlands, in the north of the Republic of Mali, and its setting within the local geography.*
GRAPHICS: N. KHALAF, ELEVATION – DATA COURTESY OF NASA/USGS; LOCAL GEOGRAPHY BASED UPON ILLUSTRATION GENERATED BY CRATERRE

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FIGURE 3.2 *View of the desert environment close to Essouk-Tadmekka, showing the patchy vegetation cover of acacia trees and scrub, and the regional mountain range in the background.*

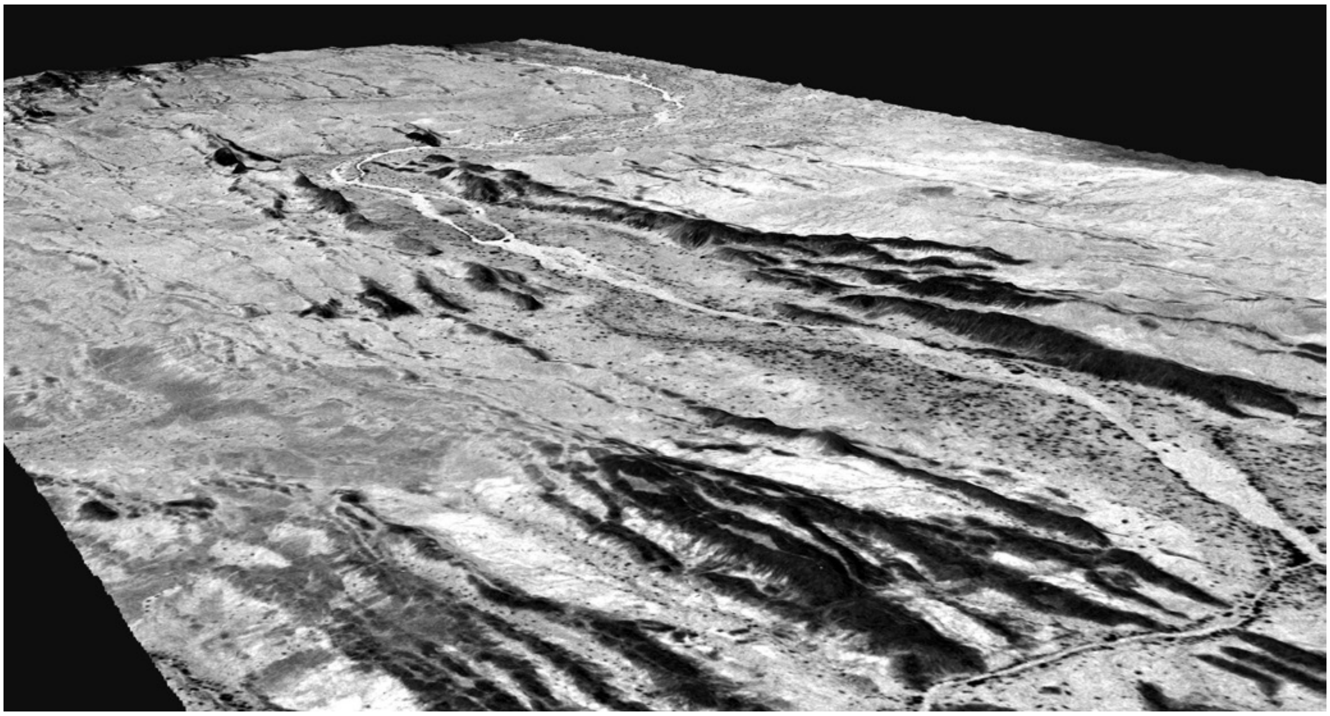

FIGURE 3.3 *3D view of the Essouk valley and surroundings, where the Essouk-Tadmekka ruins are located – note the wadi flowing through the two lines of cliffs, from the top to the bottom of the image.*
DEVELOPED BY CHRISTOPHER SEVARA FROM 2D EOM AERIAL PHOTOS PROVIDED BY PAULO DE MORAES FARIAS, RECEIVED FROM RAYMOND MAUNY; SEE FIG. 4.1 FOR EXACT DISTRIBUTION OF THE RUINS WITHIN THIS LANDSCAPE

FIGURE 3.4 *Looking down the Essouk valley, where the ruins of Tadmekka are located.*

FIGURE 3.5 *Within the Essouk valley; ca 1km to the south of the archaeological site.*

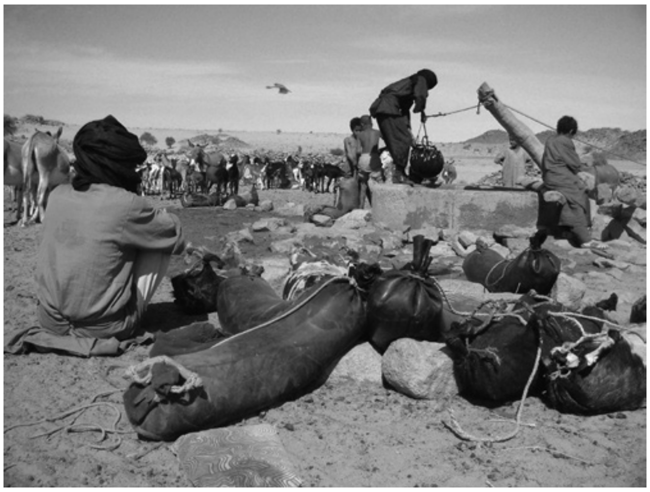

FIGURE 3.6 *Young boys filling water sacks (made from animal skins and rubber) at one of the wells located at the centre of the Essouk-Tadmekka ruins.*
© G. BUTENSKY

local region, but also beyond when local vegetation cover is too sparse. While camels are owned and used for journeys outside the local region, the common daily mode of transport are donkeys. The wells at the centre of the ruins are used daily, including for watering animals (Fig. 3.6).

In recent years a small settlement has developed *ca* two kilometres from the site, including a boarding school and two compounds for local government officials. This modern settlement was initially constructed on the archaeological site (see Chapter 2) but was forcibly moved by the cultural heritage ministry. This is being envisaged as developing into a sizable settlement, although the only private buildings at present are very small commercial premises.

PART 2

Site Overview and Surface Remains

CHAPTER 4

The Essouk-Tadmekka Ruins and Their Prospection

Sam Nixon

Introduction

The Essouk-Tadmekka ruins are mainly located within and amongst the two lines of cliffs forming the Essouk valley (see Figs. 4.1, 4.2, 4.3), and are distributed over a *ca* 1km stretch of the valley. Due to the lack of significant soil or sand deposition after the final abandonment of the site, it is possible to clearly trace the stone remains of the town, both using aerial imagery and when walking on the site.

The central settlement area of the town ruins is located within the cliffs, covering approximately 40–50 hectares of the valley floor (Figs. 4.2–4.5; grid reference n 18° 46.288, e 001° 11.136) – within this central area the ruins are located to both sides of the wadi which cuts through the cliffs, and on an island within the wadi. Surrounding this central settlement area are the remains of cemeteries (see Fig. 4.3), with tombstones featuring Arabic funerary inscriptions. These are mainly located outside and amongst the cliffs, though certain cemeteries are also within the valley itself. Beyond this central settlement area and the surrounding cemeteries, the evidence for structural remains is limited. This said, there is evidence of at least several important structures up to a kilometre from the town. Amongst the cliffs which define the Essouk valley there are also a range of carvings made into the rock. These include non-funerary Arabic inscriptions, Tifinagh inscriptions, and rock art, including depictions of animals and people.

The remainder of the chapter provides an overview of the prospection methodology and a summary account of the ruins. A more detailed account of the inscriptions is provided in Chapter 5, and likewise a more detailed examination of the surface architectural remains is provided in Chapter 11, together with a consideration of the excavated architectural evidence. Localisation of individual structures and points on the site discussed within this chapter is made by reference to Figure 11.2, a map of the central area of the ruins featured within Chapter 11 in the context of the focused discussion of the surface architectural remains. Close-up images of the mapping of the various zones of the central town ruins are also provided in Appendix B, together with detailed drawings of the cemeteries.

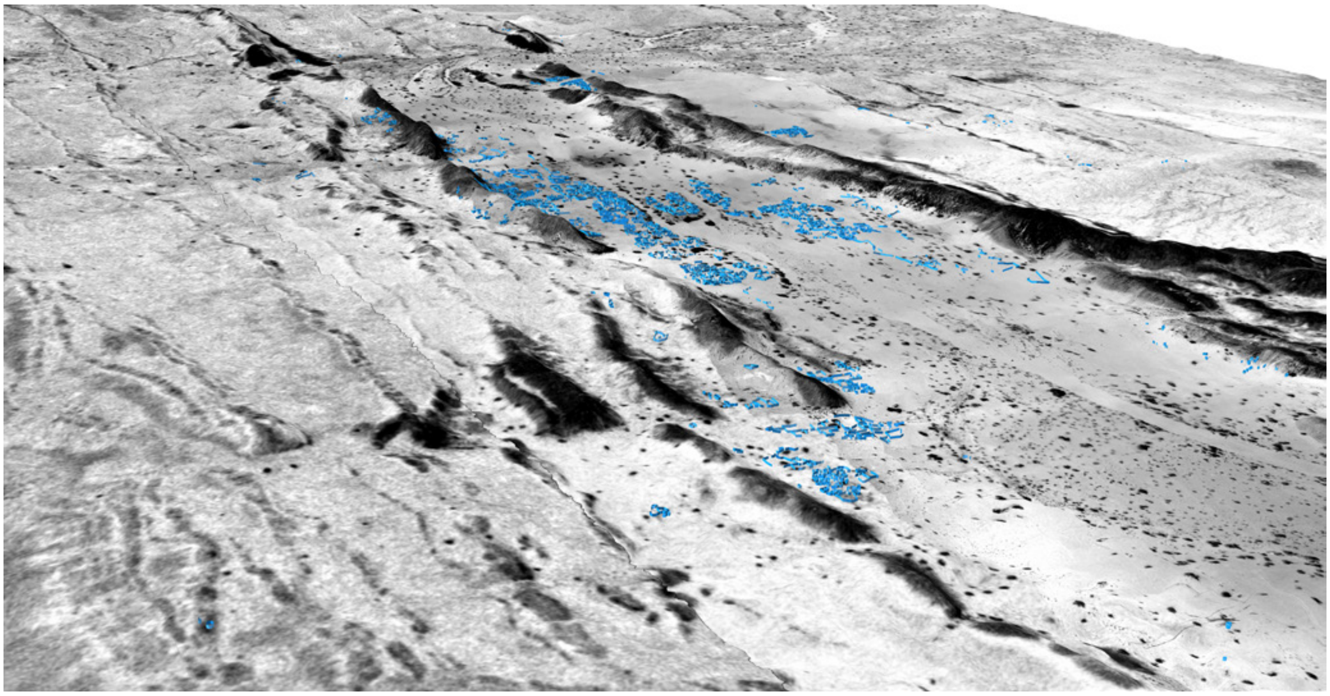

FIGURE 4.1 *3D image showing the distribution of the Essouk-Tadmekka ruins in relationship to the lines of cliffs which define the Essouk valley (view from the north-east; blue lines show stone structural remains; for scale see Fig. 4.2) – image developed by Christopher Sevara from 2D EOM stereopair aerial photos provided by Paulo de Moraes Farias, received from Raymond Mauny.*

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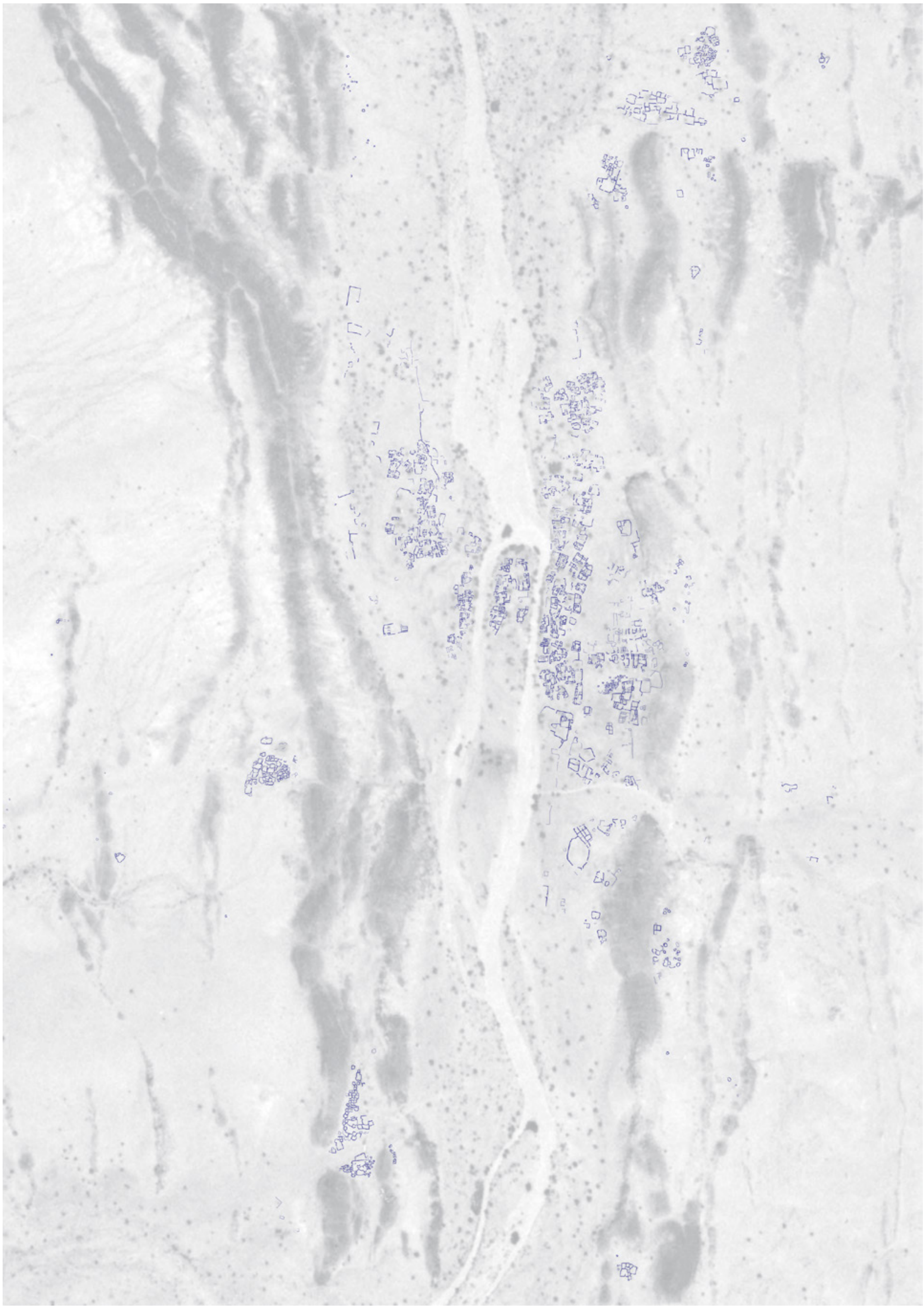

FIGURE 4.2 *Composite aerial photograph and satellite image (semi-transparent) of the Essouk-Tadmekka ruins with stone structural remains highlighted in blue (composite background image created by Chris Sevara from individual* EOM *aerial photos (1948) provided by Paulo de Moraes Farias, received from Raymond Mauny and GeoEye satellite imagery – satellite imagery is used for the areas outside the central area covered by the* EOM *images; drawing by Benoit Suzanne, based upon* EOM *aerial photos). Illustration covers an approximate area of 2 × 2.5 kms – compare with Figs. 4.3 and 11.2 for scale.*

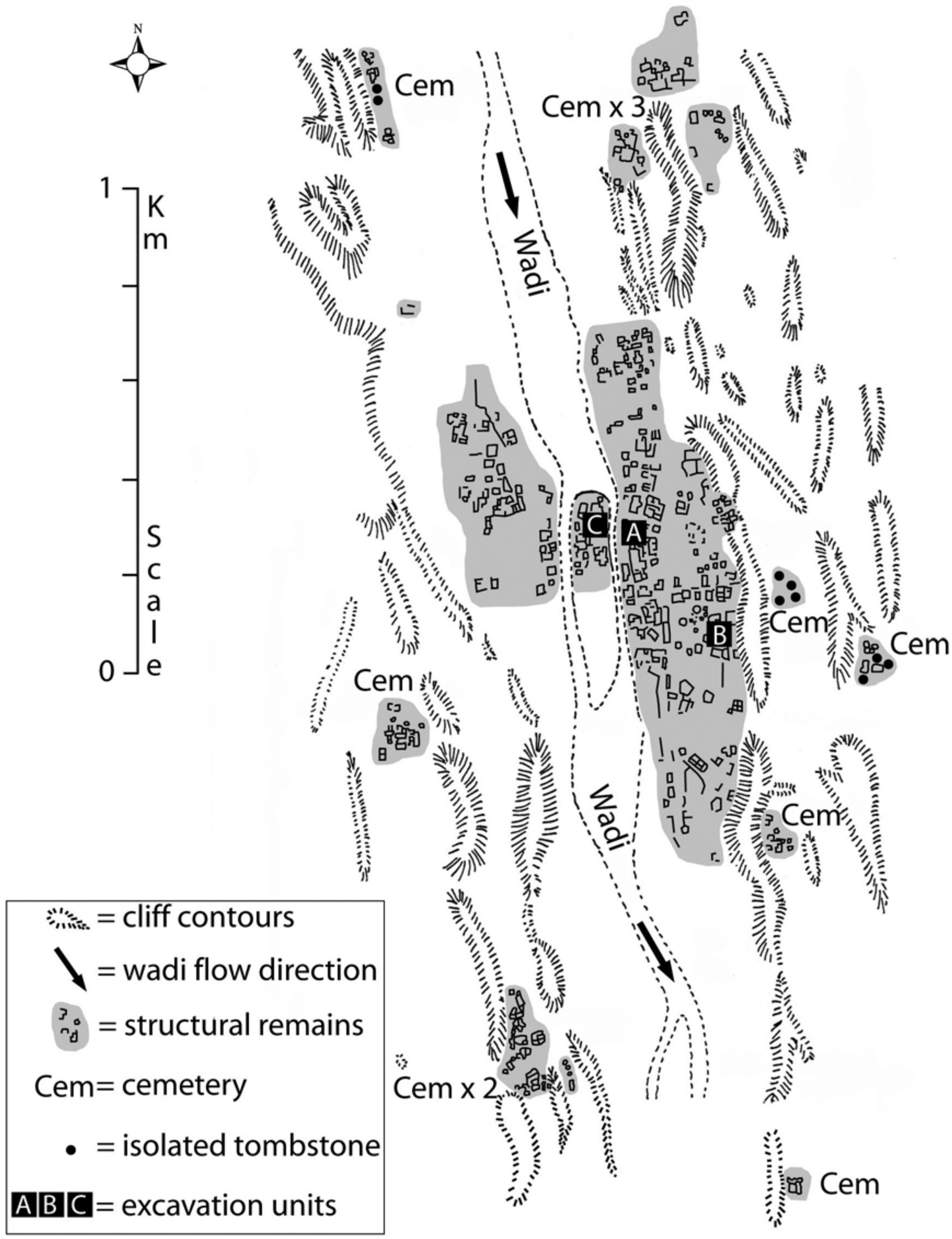

FIGURE 4.3 *Schematic map of the Essouk-Tadmekka ruins in relation to the surrounding cliffs and the wadi. Identified are the principal zones of the town ruins and surrounding cemeteries (based on* EOM *aerial photos and adapted from* MAUNY *1961 and* MORAES FARIAS *2003). See also Figure 11.2 and App. B for more detailed mapping of the central area of the ruins and cemeteries.*

FIGURE 4.4 *Aerial photograph of central area of the town ruins (created by Chris Sevara from individual* EOM *aerial photos (1948) provided by Paulo de Moraes Farias, received from Raymond Mauny). One can clearly trace the stone structural remains of the town, including streets and alleyways, and forms of individual buildings. Providing a sense of the scale of the ruins, one can make out acacia trees (irregular black spots seen lining the wadi and elsewhere); likewise, careful analysis of the southern portion of the image reveals groups of people and animals clustered around the wells (clusters of tiny dots in and around dark area below southern tip of the island). Compare with Fig. 4.2.*

FIGURE 4.5 *View across the town ruins within the cliff, looking from the western cliffs – the ruins can be seen running the whole length of the valley.*

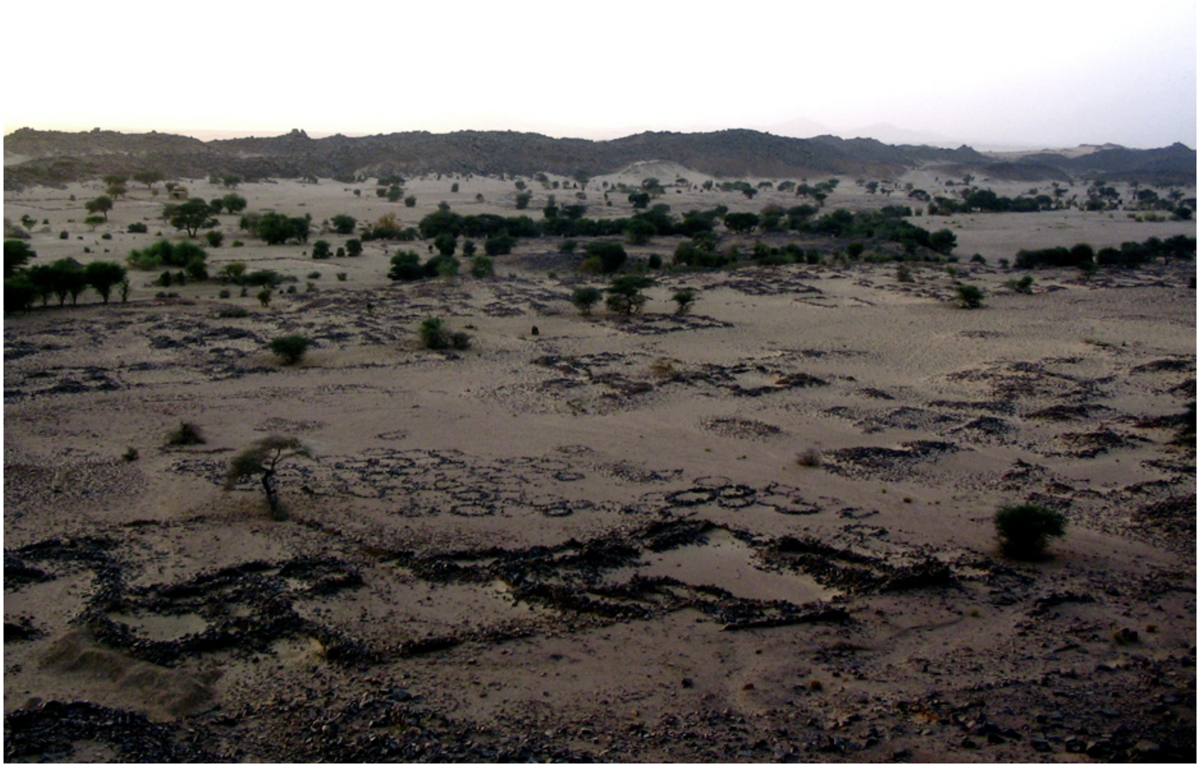

FIGURE 4.6 *View across the central area of the Essouk ruins looking from the eastern cliffs – a portion of the eastern ruins are seen in the foreground, the wadi and the island in the middle distance, and then the western ruins across to the far cliffs. One can easily make out the remains of stone walls across the entire area.*

Prospection Methodology

During December 2004 and January 2005 field walking was undertaken across the site, to record the nature of the surface structural remains, to undertake systematic surface collection of material culture, and to help determine excavation locations.

Given the systematic mapping of the surface remains from aerial photographs (see Fig. 4.2, Chapter 11 (Fig. 11.2), App. B), and the need to prioritise time for excavation, no detailed measured recording of the surface structures was undertaken on the ground. The ground survey of the structural remains instead consisted of written and photographic documentation to complement the mapping

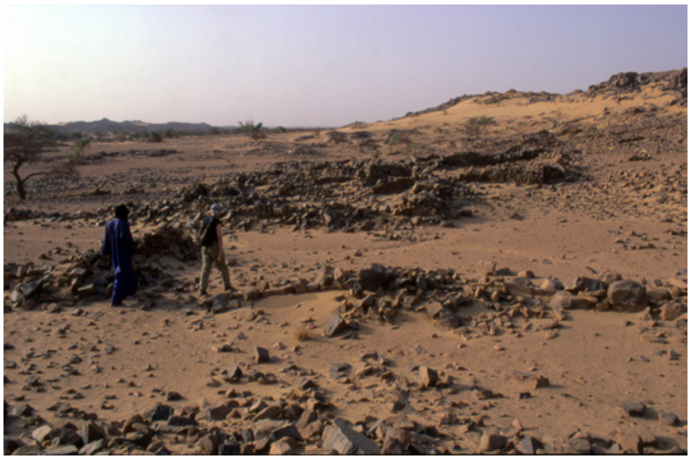

FIGURE 4.7 *Comparison between the experience of walking amongst the stone structural remains on the site surface (left: photo courtesy G. Pagnoni) and tracing the layout of the ruins in detail using aerial photography (right: EOM aerial photo provided by Paulo de Moraes Farias, received from Raymond Mauny) – image on right shows a ca 100m² area of ruins to the east of the wadi (irregular black spots are acacia trees), including the remains of the larger of two mosques seen on the site surface (see upper centre of image)).*

of the remains developed from the aerial photographs. No systematic survey of the surroundings of the site was undertaken, but structural remains observed beyond the central area were recorded when observed. As significant prior work had been done on the inscriptions and rock art at the site, no survey of these was carried out – this said, certain recordings of new inscriptions were made (see Chapter 5, App. C). Extensive systematic surface collection of material culture (principally ceramics – see below and Chapter 12) was undertaken to provide a record to compare against the excavated data – the individual methodology for this is explained further below.

The Central Settlement Area

The central settlement area of the town ruins, located within the valley, was the focal point of the survey (see Figs. 4.4–4.6), and it was here where excavations were to be focused. Both on the ground and from aerial imagery one can not only detect the broad distribution of the ruins but also clearly define the various quarters of the town (see *e.g.* Fig. 4.7). The level of preservation and visibility of surface remains allows one to trace individual roadways and alleyways, the dimensions of individual buildings, and even individual room spaces (see Fig. 4.8). The surface remains stand up to *ca* 1.5 metres high in places, but are more commonly found standing to a height of *ca* 50 cms. What was immediately established upon visiting the ruins is that they still correspond very closely with the EOM aerial photographs taken in 1948. This has subsequently been clarified in greater detail following the acquisition of high-definition satellite imagery (GeoEye).

When looking at the aerial imagery and the maps developed from them, it must be remembered that prior to subsurface investigation there was no clear sense of the extent to which various parts of the ruins were contemporaneous. Indeed, as is demonstrated in later chapters, various parts of the site were abandoned before the final abandonment of the site as a whole. A further relevant factor when considering the surface remains is that sand can cover relatively low walls, and therefore it is possible that fairly significant portions of the ruins may have no visible traces on the surface of the site (see below for further discussion).

The first statement that can be made about the town ruins is that they have no surrounding wall. While there is evidence of a long wall amongst the ruins to the west of the wadi (Fig. 11.2 point n° 6), this is seen as most likely a flood defence of some form to protect against wadi surges. The cliffs themselves however effectively provide a significant defence for the site. The ruins are though open to the north and south along the line of the wadi. Entrances also exist at gaps within the eastern cliffs, and various winding paths can be traced through the western cliffs (Fig. 4.1–4.3).

The ruins are broadly divided into three zones (see Figs. 4.2–4.4). The main area of ruins is seen to the east of the wadi. A substantial area of ruins is also seen to the wadi's west. Lastly, we see ruins on the island within the wadi. The wadi is most certainly not a later phenomenon cutting through the ruins as construction is clearly aligned to its edge, including steps at the north of the island (see

FIGURE 4.8 *Examples of stone structural remains across the site surface: a) remains of a building – the lines of stone are the remains of collapsed walls, while the empty areas within are the interiors of rooms and a courtyard; b) example of the remains of a wall standing to a height of* ca *1.5 metres, amongst the highest standing remains on the surface of the site; c) the 'monument of Koceila' (see text for discussion); d) the northern mosque.*

in Fig. 11.2 point n° 7), as well as other steps associated with the northern mosque (see below). Considered as a whole, the ruins are quite flat relative to the surrounding topography, although when one approaches from a distance one can make out the slight rise of the settlement mound. Importantly, when we look at the level of the ground to either side of the wadi however we see that at certain points the ground rises up to *ca* 5 metres above the wadi floor, particularly in the area between the island and the ruins to the east of the wadi (see Figure 7.1). There is also a slight slope upwards south to north along the ruins to the east of the wadi and the ruins in this area also slope up slightly towards the cliffs – this is though likely at least partly due to the natural topography.

In seeking a preliminary understanding of the nature of the surface structural remains, we can start by saying that the basic building block of the settlement is a rectilinear building form having an enclosure wall and a courtyard with rooms arranged around it (see Figs. 4.4, 4.7, 4.8a; Chapter 11 for more detailed examples). This is a model which is very common within the Islamic world, but also within Berber traditions more widely. From what we know about the history of Essouk-Tadmekka, and from parallels with historic era traditions, we would assume these to be domestic habitations or commercial buildings (see Chapter 11 for further discussion).

The various districts of the ruins are broadly similar, composed of clusters of buildings based on the rectilinear model with courtyards, and with streets and alleyways weaving around and through these (see Figs. 4.2, 4.4, 4.7). This said, certain areas of the ruins do stand out as distinctive. Firstly, the area of ruins in the central part of the site near to the eastern cliffs (see Fig. 4.4) is the only area where ruins are found standing to a considerable height, up to *ca* 1.5 metres in places (*e.g.* Fig. 4.8b). In addition to being noteworthy due to their preservation, many of the buildings in this area appear to have a slightly different character to the majority of structures seen on the site's surface, often being constructed of very large individual stones and often having very thick walls. It is in this area that the remains of a building named 'the monument of Koceila' are found (see Fig. 11.2 point n° 5, Fig. 4.8c; see also Chapter 11), though this is less grand than made out by early 20th century researchers (Gautier 1907: 27). Additionally, within this area there are what appear to be a cluster of circular tombs (see Fig. 11.2 no. 9, App. B), as well as the apparent presence of other individual tombs distributed nearby. Almost certainly these post-date the end of habitation in this part of the site (see Chapter 11 for further discussion). One further area of the ruins stands out, the area to the south-east (Fig. 4.4). This zone is particularly noteworthy for a series of large open spaces defined by low walls, not seen elsewhere. It is possible that these structures were for the corralling of animals.

Amongst the additional individual structures necessary to comment on at this stage, firstly there are two mosques, both located on the east side of the wadi. One mosque is found roughly parallel with the north tip of the island, abutting the wadi (see Fig. 11.2 point n° 1, 4.8d). This is *ca* 25 metres long, its remains being principally stone, but also having some preserved traces of mud construction (see Chapter 11). Attached to this is a courtyard with steps down to the wadi. The other mosque is found roughly parallel to the south edge of the island, *ca* 100 metres from the wadi (Fig. 11.2 point n° 2 and Chapter 11). This is a relatively small mosque, measuring *ca* 8.5 metres in length.

When considering the distribution of ruins seen on the surface of the site, one must remember that shifting sands mean low lying structural remains can periodically be covered over. A case in point of this is the remains of a 'mosque' (or possibly an open prayer area) recorded by both De Gironcourt and Mauny at the eastern entrance to the town but no longer visible (see Fig. 11.2 point n° 3 and Chapter 11 for further discussion). One further thing that needs to be recognised is that the central town ruins in stone were likely one element of a wider area of shifting nomadic encampments, semi-permanent mat and pole structures, and temporary markets; both within the immediate periphery and the wider valley, as well as beyond the cemeteries. Therefore, even the areas of the valley where we now only see sand likely also saw some form of occupation in the past, even if shifting and sporadic.

In terms of considering the integrity of the sub-surface deposits, certainly many areas of the upper layers of the site have seen significant disturbance over time. Mauny recorded people digging for artefacts, specifically glass beads (Mauny 1952; see Fig. 4.9). Also, the wells seen around the site today (mainly in the centre close to the wadi – see Fig. 3.6) should make us aware of the various wells which have been dug over the site's history and following its abandonment; a significant disturbance to deposits at points across the site (see also Chapter 9). Various recently dug holes were observed by the author, including in the site's south-eastern area.

Surrounding Cemeteries

There are six distinct cemeteries surrounding the central town ruins (see Fig. 4.2, 4.3, 4.10, 4.11 and App. B). All but one of these cemeteries lie either amongst the cliffs or outside the cliffs entirely (*e.g.* Fig. 4.10). The one cemetery

FIGURE 4.9 *Image taken by Raymond Mauny in 1952 showing digging in the corner of one of the ruined buildings, by people in search of glass beads.*
© CENTRE D'ÉTUDES DES MONDES AFRICAINS, PARIS

within the valley itself – the north-western cemetery – is however at a significant spatial remove from the settlement. These cemeteries are obviously Islamic, conveyed most clearly by the fact that all but one (the western cemetery) feature Arabic epigraphy on their tombstones (even the cemetery lacking Arabic inscriptions conforms to a standard Muslim pattern with simple individual headstones). The north-east cemeteries are the largest, with various cemeteries distributed over hundreds of metres (see Fig. 4.11a and App. B), but all the cemeteries are relatively extensive and feature multiple enclosures. We have already noted above a group of tombs found within the centre of the settlement itself (composed of small circular enclosures, but featuring no headstones), as well as what appear to be other tombs nearby. It seems highly unlikely these latter tombs were contemporary to the settlement however as this would represent a significant departure from orthodox Muslim practice for burying the dead in zones removed from settlement areas.

No detailed study was made of the cemeteries, but some broad summary comments are useful to place them within the wider context of the study. As can be seen from the plans of the cemeteries developed from the aerial imagery (see App. B), the three most major cemeteries, the north-east, south-west and west, all feature remains of enclosure walls (relatively low, *ca* 50cms) which define clusters of individual tombs from each other. While providing this definition, however, the majority of enclosures are spatially attached to other enclosures rather than existing as completely independent units. The cemeteries do have a certain broad formal similarity, but it is clear they are very different in their arrangement, there being great variability within the size of the individual compounds, and the nature of their clustering. It is possible that this relates to either different populations and tomb architecture traditions, or to the fact that they were constructed at different periods (see below). One particularly noteworthy feature is in the north-east cemetery, one of the enclosures there having a *mihrab* (see also Chapter 5 for discussion). All the cemeteries feature tombstones made of local stone (see Chapter 5 for further details). These are of a broadly rectangular form, but vary in size and shape, from relatively small simple stones of *ca* 40–50cms height (see *e.g.* Fig. 4.11b), to larger monumental forms up to a 1 metre in height (see Chapter 5 for other examples). As explained above, only the tombstones within the western cemetery lack epigraphy.

While the Arabic epigraphy found within the cemeteries is discussed in greater detail in Chapter 5, it is relevant to point out here that we have working chronologies for five of the cemeteries due to the presence of absolutely dated inscriptions on the tombstones (data taken from Moraes Farias 2003: chp. 7). It is to be remembered however that this does not provide a secure chronology for the earliest and latest use of these cemeteries as it is possible they were used both before and after these dates by people who did not 'date' their headstones. The date ranges we have for the cemeteries at present are as follows:

- North-east = AD 1033 AD–1251;
- North-west = AD 1212–1385/1387;
- East = AD 1037–1342;
- South-east = AD 1074–1275/76 or 1294/1295;
- South-west = AD 1017/1019–1168/1169;
- West = no dates available.

Like all Muslim groups around the world, those at Essouk-Tadmekka certainly attempted to bury their dead in alignment to Mecca (see Chapter 5 and discussion for further on the relationship of the Essouk-Tadmekka population to Mecca). It has been commented by Moraes Farias (see Chapter 5) however that a significant portion of the

FIGURE 4.10 *3D aerial image of the southwest cemeteries seen amongst the cliffs (see also western cemetery in the top left of the image).*
IMAGE DEVELOPED BY CHRISTOPHER SEVARA FROM EOM AERIAL PHOTOS PROVIDED BY PAULO DE MORAES FARIAS, RECEIVED FROM RAYMOND MAUNY

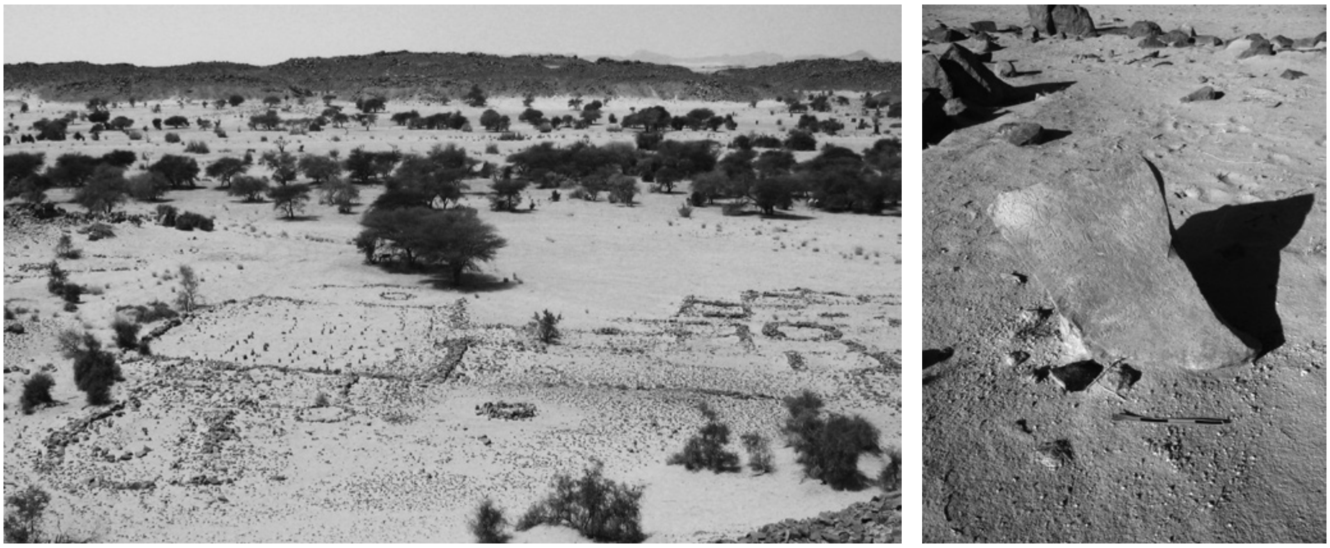

FIGURE 4.11 *a) one of the northeast cemeteries; b) an example of an Arabic inscribed tombstone found within the cemeteries.*

tombstones are most likely displaced, fallen over and replaced in position. It is unlikely therefore they provide an accurate record of alignment by themselves without knowing the position of the individual buried in the tomb. No attempt was made to study tombstone alignment.

Limited evidence for what appear to be pre-Islamic tombs are seen in the vicinity of the site, though no detailed study was made of these – certainly given the relatively intensive pre-historic occupation indicated by rock-art (see below) it is highly likely that pre-Islamic burial took place around the site.

Other Outlying Structures

No systematic survey of the surrounding landscape was made during the field-season, survey of outlying regions being restricted to study of aerial imagery and limited fieldwalking. Study of the EOM aerial imagery appeared to show that there were no major concentrations of exposed structural remains in the wider surrounding area. We did however record certain previously unidentified structures. The most important was found *ca* 500 metres to the north-west of the north-eastern cemetery (see Fig. 4.12). Due to the presence of a *mihrab* and the large size of the structure this was thought to be a *musalla*, an open prayer area (the *qibla* faces roughly due east). Relatively near to this building, within the middle of the valley, was a small mound with stone remains, not dissimilar to the remains of buildings at the site but also potentially a burial mound – no detailed attempt was made to study this and its function and period are unknown. Another structure was found slightly further north of these remains, high on the eastern cliffs of the valley, a small building constructed in a similar style to the buildings in the central area of the settlement. Due to its high position up on the cliff this was thought to be most likely a watchtower of some form. Subsequent survey of the aerial imagery did reveal certain other limited evidence for structural remains in the wider locality. One particular structure to highlight is a square-shaped building located 1km to the south of the main ruins, at the entrance to the valley. It is possible this also served some form of security function, or some kind of toll function for caravans heading to or returning from further south.

Certain other limited structural evidence can be observed on the satellite imagery but this imagery does not lead us to believe that a previously undetected significant area of stone built ruins lies beyond the central area of the site. We should however remain open to the idea that the surrounds of the site potentially feature significant archaeological remains, most likely of non-permanent

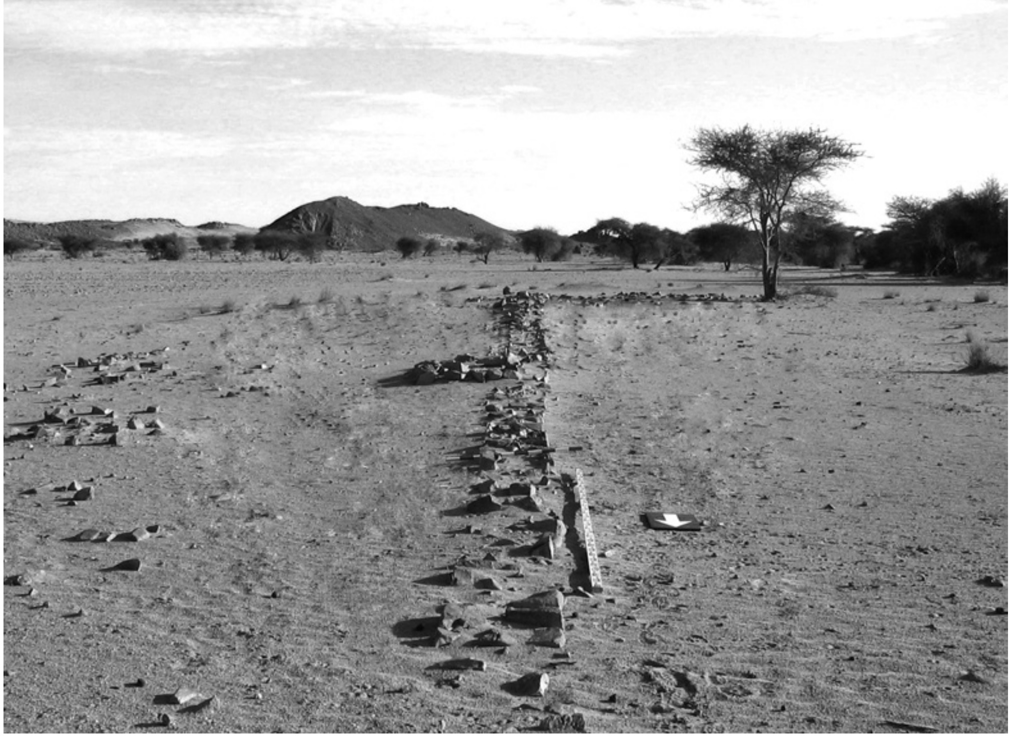

FIGURE 4.12 Musalla (*open Islamic prayer hall*) *located* ca *500 metres to the north of the main area of ruins – note the* mihrab *which can be seen at the mid-point of the length of wall, protruding to the left* (*the stones around this structure were cleared prior to photographing*).

occupation or sporadic gatherings. In particular, the common occurrence of holding markets outside of the city walls in the Islamic world should be considered (see Chapter 5 for further discussion), and likewise the use of the wider surrounding landscape for encampments of visiting trade caravans. Almost certainly systematic survey, including geophysical survey, would evidence archaeological remains in the wider vicinity around the site.

FIGURE 4.13 *Investigating inscriptions in the cliffs above the ruins.* PHOTO COURTESY JEAN PIERRE TITA.

Rock Carving in the Cliffs

The cliffs immediately around the site, as well as those in the wider vicinity, feature a range of rock carvings, including inscriptions in Arabic and Tifinagh, as well as rock art (Figs. 4.13 & 4.14). We have already looked at how the Arabic inscriptions provide broad date ranges for the cemeteries, but the earliest Arabic inscriptions are actually found in the cliffs – these are indeed the earliest known internally-dated writing in West Africa (dated to the early 11th century). In addition to their early dating, these represent a very important non-funerary epigraphic tradition. There are also important inscriptions in Tifinagh, indigenous Berber script. Chapter 5 provides a full summary of this important inscription evidence, considering the cliff inscriptions and the cemetery inscriptions as a whole.

Petroglyphs (or 'rock art') are widely dispersed throughout the Adrar des Iforas and the locality of Essouk features an important concentration of these. Petroglyphs are found both in the cliffs either side of the site and in the immediate locality. These depict wild and domesticated animals, people, items of material culture, and abstract designs (Fig. 4.14). Dupuy has provided a useful synthesis of the Adrar des Iforas petroglyphs, including the Essouk material (DUPUY 1991, 1998, 1999), and his work has amongst other things provided important broad chronological resolution to the petroglyph traditions.

Much of the Adrar des Iforas petroglyph traditions can clearly be seen to relate to time periods long predating the medieval era, due to the representation of certain wild animals clearly belonging to more humid earlier phases in this region, including the elephant and the rhino (DUPUY 1999: 71–76). DUPUY has also shown how depictions of people within the Adrar rock art can be related to early pre-historic occupation (1998). DUPUY has however also identified more recent phases in the Adrar petroglyphs traditions, including a phase seen to post-date the 5th century AD – this phase has been seen to relate to the movement of horse and camel rearing groups from the northern Sahara, hypothesised as groups ancestral to the Tuareg (DUPUY 1998: 44–50). In particular, the peoples depicted in this later tradition are never associated with cattle, nor with the hunting of wild animals. Instead they are associated with horses and camels, and often with writing in Tifinagh. One of the particular traits associated with the people depicted in this phase of the petroglyph traditions is that they are more obviously heavily clothed than the pastoralists depicted in the earlier petroglyph tradition. Also, this tradition commonly depicts women, unlike the earlier pastoral tradition which hardly ever does. Essouk possesses a good range of petroglyphs also related to this phase, including representations of the horse and the camel.

One petroglyph which has attracted particular attention at Essouk depicts two women, located *ca* 1km to the southwest of the town ruins (Fig. 4.14c). This is a relatively large (1 metre plus high) and detailed petroglyph, located in a small isolated rock outcrop. The depiction is quite naturalistic, showing two seated women, dressed in robes, with straight-cut hair styles. As far as is known this is quite a unique image within the Adrar des Iforas corpus. One is tempted to attribute this to the petroglyph tradition which Dupuy has associated with ancestral Tuareg traditions, on the basis of the obvious heavy clothing, and the depiction of women. This said it also has certain similarities with an image attributed by DUPUY to the earlier pastoral phase (1998: 33 fig. 2.2). Other petroglyphs to draw attention to at Essouk are the examples of 'chariots' (see Fig. 2.7), of the type which have been discussed since the early 20th century in relation to the hypothesised early 'chariot routes' across the Sahara (MAUNY 1978). While this whole thesis is now almost entirely discredited, it is important to document the presence of this petroglyph type at Essouk. An example of another petroglyph type recorded is shown in Figure 4.14d.

FIGURE 4.14 *Examples of rock art found in the cliffs of the Essouk locality: a) various animals, including a giraffe; b) long-horned cattle; c) two women; d) Abstract petroglyph, possibly representing 'sandals' (see text for discussion).*

This abstract or symbolic design (sometimes called an 'ovaloide') is a relatively widespread type of petroglyph known from Berber and Tuareg rock art of the Sahara and North Africa (Achrati 2003). This form is commonly seen to represent a sandal, and in turn is seen to have a wide range of symbolisms, including for instance in relation to hunting, the presence of water points, or sexuality (Achrati 2003: 480–483). Given the role of the foot within Muslim symbolism (Achrati 2003) one should also, however, not disconnect this form of rock art entirely from Essouk-Tadmekka's association with Islam and Islamic pilgrimage, and indeed there is at least one example from Essouk-Tadmekka where the motif appears to have been partly formed, or at least elaborated, using Arabic writing (Moraes Farias 2003: 150, plate 50).

Surface Material Culture and Collection

While the most striking evidence on the site's surface is the stone structural remains, other material culture is encountered across the surface, relating both to the waste products of the terminal phase of the site, as well as to material from earlier phases which has been brought to the surface through subsequent digging and erosion. Principally we find extensive evidence for broken pottery.

The majority of this is unglazed and largely unpainted or unslipped coarse ware (see Chapter 12). In addition, glazed or wheel-turned pottery fragments are also found. These latter types are of importance due to their association with trans-Saharan trade, there being no known traditions for the production of glazed or wheel turned ceramics in West Africa.

A systematic sampling collection of material was undertaken across the site. In the first instance this was done in order to help determine which areas to target for excavation. Also though, this was undertaken with a view to having material from various parts of the site which were not to be excavated, in order to be able to use this material to make certain judgements about the occupational history in those areas when compared with the material from the excavations. Principally this sampling was focused on the abundant pottery evidence, but finds of other material were also collected when identified. This surface collection was undertaken during December 2004 and January 2005 alongside the surface survey of architecture.

Pottery was collected across the majority of the site, although within certain areas of the ruins very little pottery was found, due it was assumed to coverage by windblown sand. There were also areas where pottery was found in significant quantities even though there were no structures. In particular, it is important to note the large quantities of pottery found in an area on top of the eastern cliffs, interpreted as some kind of temporary look-out post. Glazed/wheel-thrown pottery was principally recovered from the eastern area of the site where the ruins are found to their highest extent (five fragments: see Chapter 12). Portable material culture other than pottery was limited, but included limited finds of glass beads and metal items. The fact that excavations in historic times have been made to search for such artefacts indicates that examples of these on the site surface would be collected by people on a passing basis – one would then not expect to find abundant evidence of them during survey. One important find though was a stone figurine recovered from the south-east area of the site. In addition to this portable material culture, the only other material observed were grinding stones, occasionally observed *in situ* within certain buildings. No systematic notation was made of these, but it is necessary to relate their presence.

A fuller account of the pottery collected is detailed in Chapter 12. Other than the glazed ceramics and the stone figurine, the other limited surface finds are not recorded here as no significant benefit could be seen in light of the information already attained from the excavated evidence. Some explanation of how this surface collection informed excavation location is provided in Chapter 6, and in Chapter 10 some commentary is provided on how this informed the understanding of the chronology of the various areas of the ruins remaining unexcavated.

CHAPTER 5

Arabic and Tifinagh Inscriptions

Paulo Fernando de Moraes Farias

Introduction

Essouk's landscape is dotted with old writing, inscribed in the cliffs and cemeteries around the town. On the Essouk cliffs, there are graffiti in two different languages and scripts, Berber (in Tifinagh signs) and Arabic. Writing in Arabic (but not in Tifinagh) is also abundant on the funerary stelae in Essouk's cemeteries. Given the high visibility of these cemeteries within the landscape (especially those in the south-west and north-east), and the prominent position of certain Arabic cliff inscriptions (see below), Arabic writing in particular is immediately noticeable in the valley.

Together, the Arabic cliff and tomb inscriptions constitute an internally-dated textual resource as indispensable as the descriptions of Tadmekka by the early Arab geographers. Dating from the 11th–14th centuries AD, this body of textual sources covers a long period of the history of Essouk. Unlike manuscripts, these writings set in stone survive as originally engraved (except for natural erosion), without the mediation of copyists, who often commit errors. Also, as it was locally produced, it records cultural features not captured by the narratives compiled from outside by the Arab geographers – how local people appropriated ideas about time and the wider world made available by Muslim trans-Saharan trade, how they invested the geography of the Essouk valley with those ideas, and how inscriptions played a crucial role in this. It also hints at political arrangements at Essouk.

Tifinagh inscriptions in the Adrar region around Essouk (Drouin 2010), and generally in the Sahel and Sahara, have different purposes than the Arabic inscriptions. The Tifinagh engravings so far studied at Essouk follow this rule. They do not record dates nor mention political or religious matters. Rather, they are graffiti marking personal presence and conveying purely personal messages between the living and about the living. No Tifinagh-inscribed tombstone has been found at Essouk.[1] In fact, the Tifinagh and the Arabic inscriptions differ not only in language and script, but also in function. They belong to distinct domains of writing. Nevertheless, Tifinagh epigraphic usages left their mark on Essouk's Arabic inscriptions (see below and Moraes Farias 2003: cxxvii–cxxxiv, 85–87, 124–125).

It is fortunate that epigraphic sources exist for Essouk, as comparable archaeological sites further to the west like Koumbi Saleh and Tegdaoust are virtually deprived of inscriptions and have yielded no pre-modern epitaphs (Moraes Farias 2003: cxxii–cxxv). In West Africa, only Gao-Saney and Bentyia (further south in Mali) also feature extensive corpuses of early dated inscriptions, although only in Arabic (Moraes Farias 2003).

This text provides a summary account of Essouk's inscriptions, drawing principally on Moraes Farias 2003, which provides a detailed account of these, including the earlier work of De Gironcourt (1920). New inscriptions recovered in 2004–2005 are however featured in Appendix C, along with other previously unpublished inscriptions. It is also highly likely that some inscriptions still remain to be discovered, including those periodically covered by shifting sands; or even more deeply buried, as was the case with certain inscriptions excavated in the 1980s (Moraes Farias 2003: 148, 150).

Arabic Inscriptions

Of the six Essouk cemeteries (see Fig. 4.3, App. B), five contain Arabic inscriptions on the tombstones, with only the western cemetery not having inscriptions. The quantity of cemetery inscriptions so far evidenced is 77. The core content of these are dates recording year and century (to which explicit proclamations of allegiance to the Islamic calendar are added), names, Qur'ānic quotes and religious formulae (Moraes Farias 2003: cxiv, cxxxii–cxxxiv, clxxx–clxxxiii, 211–215).

Approximately 70% of the cemetery inscriptions feature a date (many of the undated ones are quotations of Qur'ānic passages). The date range of inscriptions we have from the various cemeteries is as follows: South-west cemetery = AD 1017/1019–1168/1169; North-east cemetery = AD 1033–1251; East cemetery = AD 1037–1342; South-east cemetery = AD 1074–1275/1276 or 1294/1295; North-west cemetery = AD 1212–1385/1387. Two other inscriptions from unspecified Essouk cemeteries are kept in Dakar, at the IFAN, and are both dated 1111 AD (n° 179a and 179b in

1 Very few tomb inscriptions in Tifinagh have ever been reported.

 | doi 10.1163/9789004348998_006

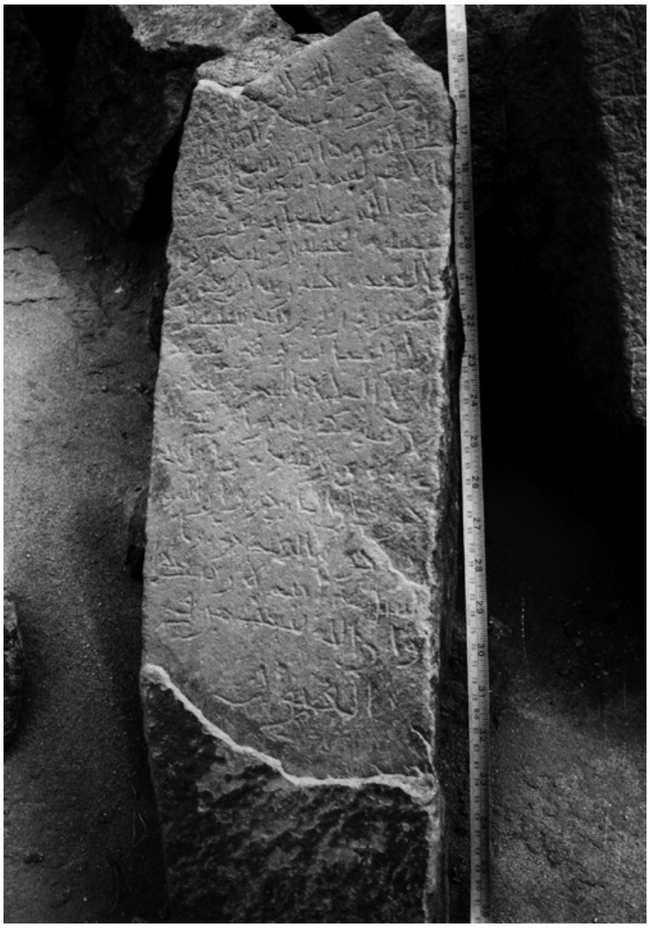

FIGURE 5.1 *Arabic inscribed tombstone in Essouk's north-eastern cemetery (corresponds to n° 154b.1 in* Moraes Farias *2003). It records the political title* al-Amīn.

FIGURE 5.2 *Arabic inscribed tombstone from Essouk's north-western cemetery (corresponds to n° 132a & 132b in* Moraes Farias *2003).*
PHOTO COURTESY JEAN-PIERRE TITA

Moraes Farias 2003). Therefore, as a whole, the date range for the cemeteries stretches from the early 11th century to the late 14th century.[2] The earliest known epitaph at Essouk (inscription n. 113 in Moraes Farias 2003: 100), is in the south-west necropolis and its date may be read as either 407 H / AD 1017 or 409 H / AD 1019 (the ambiguity of date resulting from the form of the Arabic script). Most of the cemetery inscriptions are carved on relatively simple stone slabs of a broadly rectangular form, of *ca* 40cm to 1m height (though greatly varying in shape and dimensions), and with inscriptions arranged in a series of horizontal lines (see *e.g.* Fig. 5.1 – more will be said later about this important inscription). In certain cases, different inscriptions are arranged on different faces of the same tombstone (see *e.g.* Fig. 5.2), or an inscription begins on one face and ends on another. Some tombs have two inscribed tombstones, one at the head and the other at the foot.

Fewer Arabic cliff inscriptions than cemetery inscriptions have been reported from Essouk, yet those already analysed form a hugely significant epigraphic corpus (Moraes Farias 2003: 86–99). 25 from the south-east area of the cliffs have been published, to which are now added, in Appendix C, 3 from the eastern cliffs overlooking the site, 1 found on a boulder at an unspecified cliff location, plus a cluster of about 10 intermingled inscriptions photographed at another unspecified cliff location. Other Arabic inscriptions, including apparently recent ones, exist in other areas of the cliffs around Essouk and even at a little remove from these, *ca* 2km to the south-west of the site.

Of the *ca.* 37 cliff inscriptions analysed, only 9 are dated. The phrasing of the date in the earliest but one of these

2 For comparison, the range of dates at the early epigraphic sites further south, along the Niger, is as follows. (Gao) Saney: AD 1042 to 1280/1299; Gao (Ancien): AD 1130 to 1364; Bentyia: AD 1182/1201 to 1489 (Moraes Farias 2003: xxxiii–xxxiv). These sites contain only tomb inscriptions. At Junhan, an Adrar site to the south-west of Essouk, there is a tomb inscription dated 498 H / AD 1104–1105 (Moraes Farias 2003: 151–152).

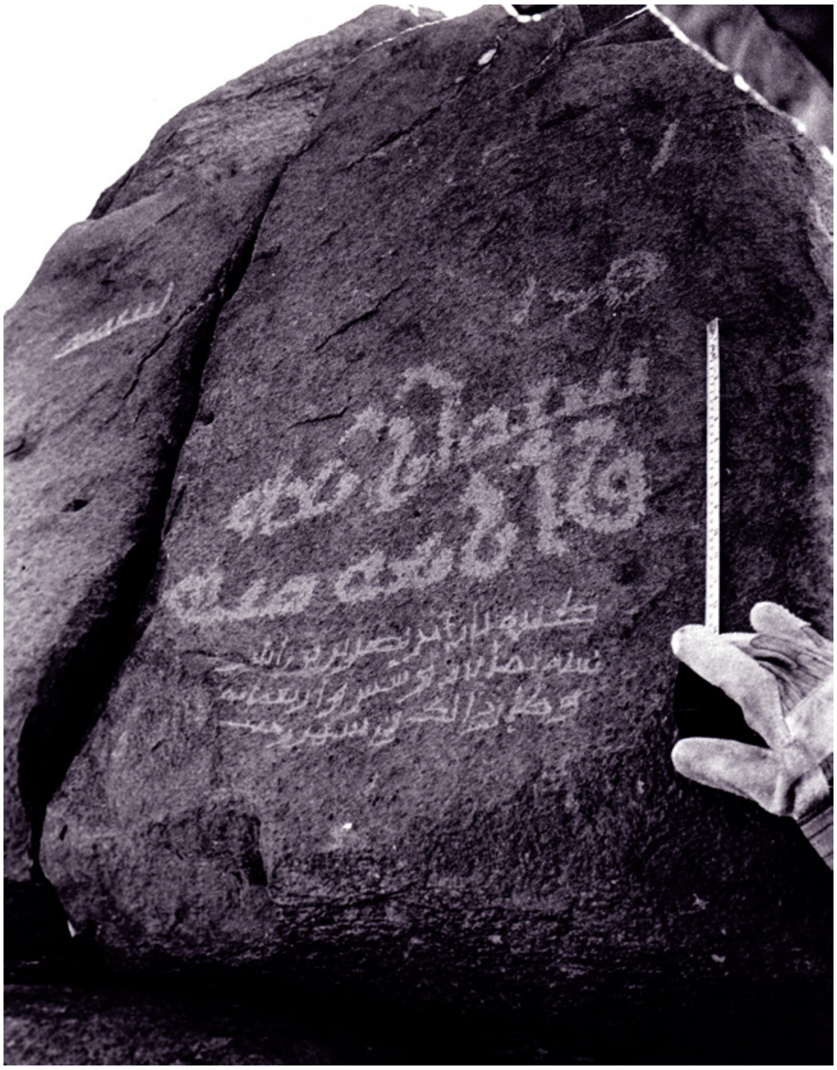

FIGURE 5.3 *Arabic inscription dated to AD 1013/14, the second oldest internally-dated text from West Africa known (corresponds to n° 106 in MORAES FARIAS 2003).*

(Fig. 5.3 – corresponding to n° 106 in MORAES FARIAS 2003) is however particularly significant (see below). The date range for these cliff inscriptions is AD 1010–1011 to 1216. Some of the Arabic cliff inscriptions, whether dated or not, are graffiti. However, three cliff inscriptions (n° 104, n° 105, and n° 106 in MORAES FARIAS 2003) probably fulfilled less casual functions. They are of larger dimensions and prominently displayed close to each other at the eastern entrance to the valley. They were carved in large ornamental Kufic letters, and contain statements proclaiming the computation of time according to the Islamic calendar, recommending a particular way to recite the Islamic profession of faith, and postulating the local market-town's identification with Mecca (see below).

At Essouk, all the Arabic inscriptions tend to be relatively shallow cut and would have been done with a metal pointed tool. Many of the cemetery inscriptions are engraved on tombstones made of microgranite with inclusions of biotite and chlorite, which abounds in the Essouk valley. Less durable tombstones were also fashioned from easier to work types of local stone.

Internal dates according to the Islamic calendar are a central feature of the Arabic inscriptions at Essouk, and one of their main ideological *raisons d'être*. An inscription from a cemetery and another from the cliffs are the clearest manifestations of this.

One of the inscriptions from the north-east cemetery (n° 157 in MORAES FARIAS 2003) reads not as a conventional epitaph, but rather as an abstract calendar entry. After religious formulae and a quotation from the Qur'ān, it simply announces "the New Moon [i.e. the beginning] of 557 of the [Islamic] Era", that is 01–01–557 H / 21–12–1161 AD. It dates no death, and names no name (MORAES FARIAS 2003: clxxxi–clxxxii, 134–135).

Another inscription, from the south-east cliffs (n° 106 in Moraes Farias 2003; see the three top lines in Fig. 5.3), which is the second oldest internally-dated text from West Africa published thus far,[3] simply states:

"This is
the year four
and four hundred."

It records the year and century (404 H = the period from AD 13–07–1013 to AD 02–07–1014) but nothing else – no month, no day, no season, no local event, no author's name, not even the invocation of the name of God that usually opens Muslim texts. As in inscription n. 157, the calendar is not used for dating anything. Moreover, inscription n° 106 subsumes religious affiliation under the calendar entry. The inscription's sole business is to affirm knowledge of the Islamic calendar abstracted from any local context, as a striking symbol of the town's participation in trans-local history, geography, and trade (Moraes Farias 2003: xliii, clxxxi, 89). In the Sahel, the practice of numbering the years and grouping them into centuries is, still, what distinguishes the Islamic calendar from locally-centred Berber-language calendars. These calendars do not reckon in centuries and simply name the years after significant local events (Moraes Farias 1990: 95–96).

Of the 60 Essouk inscriptions that preserve datelines, 35 (two in the cliffs and the others in the cemeteries) add to the date the expression "of the Era", or "of the Era of the Prophet", or similar expressions. Some of these expressions contain calculated redundancies – *e.g.* inscription n° 179b inserts "a year of his [the Prophet's] Era" after "of the Era". This rhetorical emphasis on the era is also abundantly present at Gao-Saney and Bentiya, but rarely found elsewhere. It occasionally occurs in North Africa, the Iberian Peninsula, and Iran (and a little more often in East Africa), and in other regions where the Islamic calendar also competed with other calendars (Moraes Farias 2003: clxxx–clxxxiii, 91, 136–137, 149–150). However, its massive use at Essouk, Gao-Saney, and Bentyia, distinguishes early West African Arabic epigraphy from its counterparts elsewhere. Significantly, the marble epitaphs imported from Almeria (Spain) to Gao-Saney simply state the dates of death, without mentioning the era, while other Gao-Saney epitaphs, which imitate the Almerian ones but were locally produced, all refer to "the Era" (Moraes Farias 2003: ccxxxvii, 3, 5–8, 12–16). It seems that in the Adrar, and the eastern Niger valley, Muslims chose the calendar as a primary means of underlining their identity, which was locally maintained in close alliance with non-Muslim cultures, but which was also necessarily tied to references beyond local computations of time (Moraes Farias 2003: cxvi–cxix).

The second main *raison d'être* of the Essouk inscriptions was to appropriate the geographical trans-locality made available by Islam. Muslim burials orientated towards Mecca, and grouped in cemeteries identified by Arabic epitaphs, embedded the notion of trans-locality in Essouk's landscape (Moraes Farias 2003: cxix–cxx). But cliff inscriptions n° 104 and n° 105 (see Figs. 5.4, 5.5), situated in the south-east cliffs alongside inscription n° 106 described above (close to 'Mauny mosque', see Fig. 11.2), are even clearer embodiments of that notion, as will now be detailed. On palaeographic grounds, we assume that n° 104 and n° 105 are approximately contemporary with dated inscription n° 106, and were therefore made in the early 11th century AD, at the very beginning of the engraving of Arabic texts in Essouk's landscape (Moraes Farias 2003: xxxvi, ccxxxi, 86–89). They may have been intended as proclamations of Essouk as a market town under the protection of religious authorities where it was safe to trade under *pax sacra*, to be read by those entering the valley from the east.

The first inscription, n° 105 (see Fig. 5.4, right side) states:

"There is no god but God. 40 [times] //
Muḥammad is His Messenger. 20 [times] //
And this was written by Aḥmad //
arrāw [i.e.: son of] Saʿīd."

Using the alphanumeric *abjad* system, in which letters of the Arabic alphabet represent numbers, the inscription instructs the viewer to recite 40 times the first part of the Muslim profession of faith (which is about God), and 20 times the second part (which is about the Prophet). Positioned at the eastern entrance to the valley, it was effectively advertising the Muslim nature of the town. The inscription also calls attention to the link between epigraphy and orality. Arabic inscriptions were not for silent reading, but to be read aloud, often as a group activity. This is true of early Islamic inscriptions in the Middle East, and of Islamic Andalusian epitaphs, as well indeed of Tifinagh and ancient Greek inscriptions (Moraes Farias 2003: clxxxv–clxxxvii; Aghali-Zakara & Drouin 2007: 9). There is historical and ethnographic evidence from the Sahel that the inordinate reiteration of the profession of faith has been used to induce a "dangerous" state of trance during ecstatic rituals. Most likely, inscription n° 105 was

3 For the oldest of all, dated 401 H / AD 1010–1011, see Appendix C.

FIGURE 5.4 *Arabic cliff inscriptions, one describing Essouk-Tadmekka in relation to Mecca, the other indicating how the Muslim profession of faith should be recited (corresponds to n° 104 & 105 in Moraes Farias 2003).*
PHOTO COURTESY G. PAGNONI

determining the "safe", praiseworthy number of repetitions. However, it is not inconceivable it was deliberately promoting ecstatic recitations (Moraes Farias 2003: xliii, cxlviii, cciv, 88–89).

Situated next to this inscription just described, inscription n° 104 (Fig. 5.4 on the left & Fig. 5.5) is crucial, relating as it does to the name of Tadmekka, and providing insights into the construction of identity and authority around this name. Mecca was the centre of the locals' imagined world-community. This notion must have been so important in early Essouk that the Berber name constructed for the town went a step further. It actually identified the town with Mecca: Tadmekka = "Ta + d + Măkkăt", i.e. "This very one, Mecca", or "Verily here, Mecca" (Moraes Farias 1999; Moraes Farias 2003: xxxvi, cxl–cxliii). Inscription n° 104 provides an even sharper formulation of this, expressing the aspiration to integrate local space into the Islamic world not as a remote exotic outpost, but as a mirror of Mecca, the focal point for all Muslims (Moraes Farias 1999; Moraes Farias 2003: cxxxiv–cxxxv, cxc–cxcii, 87–88). It states in its final lines:

".............. And there will remain to it [to Tadmekka's valley, or town] //
a market [*sūq*, the etymology of the place name "Essouk"] in conformity to Mecca. //
And the Book [the Qurʾān] will remain."

This inscription clinches the identification of Essouk with Tadmekka, even though it refrains from explicitly mentioning this latter place-name. The analysis of its grammar shows that the "it" referred to is a geographical entity: "the area", or "the town" (Moraes Farias 2003: cxci). The imagined link with distant Mecca portrayed in this prominently displayed epigraphic text will have made the inscription a focal point within the Essouk valley. It inscribed Essouk-Tadmekka on the world-crossing itineraries of Muslim traders and pilgrims, while claiming for it a role in the Sahel like that of Mecca in Arabia: at the same time a market and a religious centre (and a fountainhead of Islam). The inscription shows that the identification of Tadmekka with Mecca was a deliberate ideological construction, not simply a matter of perceived topographical

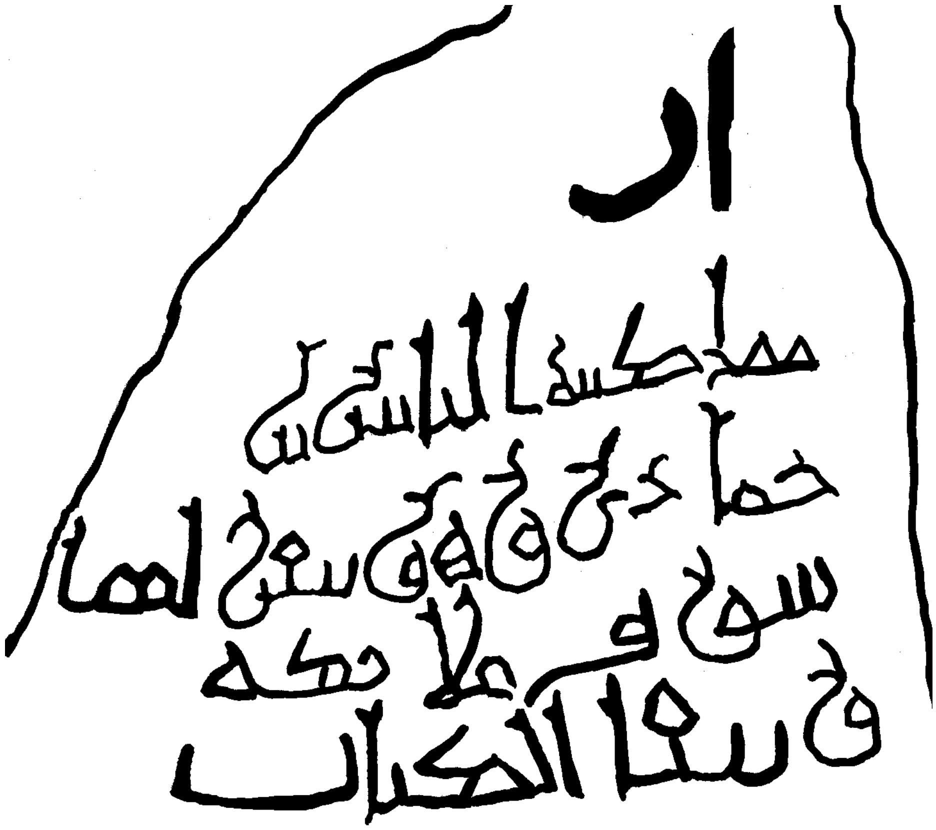

FIGURE 5.5 *Drawing of Arabic inscription in the Essouk cliffs describing Essouk-Tadmekka in relation to Mecca (corresponds to n° 104 in* Moraes Farias *2003; see also left side inscription in Fig. 5.4).*

similarities between the two cities as suggested by Al-Bakrī's text (App. A; Moraes Farias 2003: xxxvi, cxli–cxlii). The place name "Tadmekka" became widely known. It is for example recorded in the Tadrārt Akākūs in the form of a Tifinagh inscription (Biagetti *et al.* 2015: 16).

What is also important to note in relation to inscription n°104 is that the great *sūq* ("market", in Arabic) proudly proclaimed by it (Fig. 5.5), and which generated the toponym "Essouk", was an innovation in the region. At first, the settlement that eventually became Tadmekka was referred to by the Berber name *Aghrem* ("Town", "Built-up settlement"). Later the name *As-Sūq* ("The Market") was borrowed from Arabic, because there was no equivalent word in the local Berber. Even now, the rarely used Berber word *ewet* applies only to animal markets, and Berber-speakers in the region generally employ for "market" words borrowed from Songhay (*hebu*), Fulfulde (*luumu*), or Arabic. But no other place name derived from *sūq* occurs in the region, which underlines the uniqueness of Tadmekka as a market town (Moraes Farias 2003: cxlii–cxliii). Even in North Africa, Berber settlements either did not have markets or kept them at a distance, the exception to this being the Ibāḍīte town of Taghardayt / Ghārdāya in Algeria (Brett & Fentress 1996: 257–259). At Tadmekka, one may speculate, the market was largely kept outside the eastern entrance to the valley, hence the positioning there of inscriptions n° 104, n° 105, and n° 106.

The theme of ideological construction and religious authority raised by inscription n° 104 brings us to the question of who exercised political power at Essouk-Tadmekka at the time. The early geographer Ibn Ḥawqal (writing in AD 988: see App. A) stated that Tadmekka was governed by local *mulūk* ("kings", "princes", "rulers") belonging to a *banū* ("descent group", "tribe") called Banū Tānmāk, and that in his day the Banū Tānmāk had not one chief but two. He records Berber names for the two chiefs, and describes them not as warrior kings, but as men combining political skills and religious learning. Al-Bakrī (writing *ca.* AD 1067–1068) mentions only one "king" (*malik*), while Al-ʿUmarī, writing *ca* AD 1337–1338, describes Tadmekka no longer as a commercial city but as a zone of pastoralism ruled by a *sulṭān*[4] (see App. A). Ibn Ḥawqal's evidence

4 Al-ʿUmarī's evidence may reflect either the end, or just a temporary interruption, of Tadmekka's role as an important trans-Saharan trade centre (Moraes Farias 2003: cxlv, cxlvii–cclviii, ccxlv).

reminds us of the known historical tendency for south-Saharan trading towns to be governed by clerical groups. It also calls to mind the customs of the North-African Berber Muslims belonging to the Ibāḍīte denomination of Islam, who were probably the first Muslim group to establish trade connections with Essouk-Tadmekka. The Ibāḍīte had elected leaders, but these could be chosen always within the same descent group. The leaders had the title of *Imām* or, occasionally, *Malik* (king); and there is at least one known North-African case when two such leaders shared *mulk* (political power) (Moraes Farias 2003: cxl–cxli, cxlv–cxlvi).

No royal inscription has been found at Essouk, and the title of *malik* (king) is absent from the local Arabic epigraphy. Nevertheless, it records another appellation (*al-Amīn*, "Trustee", "Guardian"), not as a nickname or part of a personal name, but as a title with political connotations (Moraes Farias 2003: ccxvi, 130–133, 136). The title *Amīn* is reported from the history of the Maghreb and the Muslim Iberian lands, with meanings that include "market inspector", "tax collector", and "guild master". In the Berber-speaking Kabyle region of northern Algeria, it has been used with the sense of "village head" and "tribal chief". Power over a village could be divided between two officeholders, the *Amīn* ("Village Chief") and the *Wakīl* ("Treasurer", "Superintendent", "Trustee") (Direche-Slimane 2004: 39, 41).

At Essouk the title *al-Amīn* is recorded in the north-east cemetery, at a tomb made prominent by the presence of four inscriptions engraved on two tombstones, and by being situated within an enclosure which distinguishes itself from all others by featuring a *miḥrāb* (a prayer-orientating niche intended to point towards Mecca). The four inscriptions correspond to n° 154a.1, n° 154a.2, n° 154b.1 (Fig. 5.1), and n° 154.b2 in Moraes Farias 2003. All these inscriptions commemorate "Shama daughter of *al-Amīn* L.s.m.d. son of Mūrd.gh",[5] who died on 24–11–470 H / AD 08–06–1078. It is not possible to reconstitute the names of the *Amīn* and his father in full. As to the name "Shama", it is still current among the speakers of the Berber language Tamazight in central Morocco, and occurs elsewhere in the Maghreb. In a close-by enclosure also in the north-east cemetery, another inscription (n° 160 in Moraes Farias 2003) records the death in 639 H / AD 1242 of a man killed as a *shahīd* ("martyr"). He is given a title that may be read, given the eroded condition of the engraved writing and the particular characteristics of the inscription's lettering, either as *al-Amīr* ("the Emir") or as *al-Amīn*. "Al-Amīn" ("The Trustworthy One") was the Meccan *laqab* (honorific surname) of Prophet Muḥammad. This has inspired Islamic personal names such as "Muḥammad Lamīn" and "Aḥmad al-Amīn", which are common in West Africa. However, this is not the way the term is used in the Essouk inscriptions (Moraes Farias 2003: cc–cci, ccxvi, ccxviii–ccxix).

The study of Essouk's epigraphic rhetoric has up to now revealed only unspecific Islamic formulae shared by the three great branches of Islam then present in North Africa, namely the Sunnīte, the Ibāḍīte, and the Shīʿīte. The North-African Ibāḍīte may have been the first to develop trans-Saharan trade with Essouk-Tadmekka. Despite this, the absence of Ibāḍīte epitaphs in the area is not surprising, as this denomination of Islam eschews tomb inscriptions. However, the Ibāḍīte did produce other categories of inscriptions, not always including formulae characteristic of their branch of Islam. Specific Shīʿīte formulae are also absent from the Essouk tomb inscriptions and cliff inscriptions found thus far. Nevertheless, the available epigraphic evidence does not definitely exclude the presence of non-Sunnīte Muslims in Essouk-Tadmekka at the time the earliest inscriptions were engraved there and even later (Moraes Farias 2003: cxlvi–cxlvii, ccv–ccvii). It is not impossible that the western cemetery, which is anepigraphic, was an Ibāḍīte cemetery. The graphic analysis of Essouk's earliest cliff inscriptions points to influences from Tripoli, and from Qayrawān (Kairouan) –a city where a Sunnīte political reaction in the years AD 1016–1051 destroyed most inscriptions bearing specific Shīʿīte phraseology.

In addition to the content, the physical aspect of the writing in the inscriptions indeed offers us clues as to the long distance connections of Essouk. The letter shapes in the more elaborate Arabic cliff inscriptions at Essouk point to influences carried across the Sahara in the 10th to early 11th century AD, particularly from Qayrawān (Kairouan) and Ṭarābulus (Tripoli). This confirms the information of Al-Bakrī about Tadmekka's links to those two North-African cities (see App. A). A fuller discussion of this topic can be found in Moraes Farias (2003: ccxxxi–ccxxxv), but here we will highlight some central points.

Most of Essouk's published cliff inscriptions and, with one exception (tomb inscription n° 173 in Moraes Farias 2003), all known epitaphs at the site, are incised in a lettering style which may be classified as "Sahelian plain Kufic", also present at Gao-Saney and Bentyia. In this style, the letters tend to be angular and, in general, display no embellishments or diacritical marks (aiding pronunciation) (Fig. 5.1). By contrast, cemetery inscription n° 173, which contains no legible date, and a number of cliff inscriptions are incised in unpointed letters in what may be

5 The dots added to the letters represent missing short vowels.

called "Essouk ornamental Kufic". No similar letter types occur in the other West African early epigraphic sites, except at Saney in epitaphs imported from Andalusia and local imitations of these. However, as Gao-Saney had close relations with Essouk-Tadmekka, it is possible that the influence of Essouk ornamental Kufic interacted with Andalusian influence there (Moraes Farias 1990: 97; Moraes Farias 2003: ccxxxvii).

The Essouk ornamental Kufic style is prominently displayed at the site, but represented by only a minority of the inscriptions known so far, all of them probably dated from the first half of the 11th century AD. The best examples of the Essouk ornamental Kufic style are cliff inscriptions n° 104, n° 105, and n° 106, discussed above (Figs. 5.3, 5.4, 5.5). However, other Essouk cliff inscriptions (G.1 and G.2, and –in part – G.3, G. 11, and G.12) also display simplified features of the same style (Moraes Farias 2003: 95–96, 98).[6] These inscriptions are not internally dated, except for n° 106 (404 H / AD 1013–1014), and for two inscriptions in Appendix C, dated 401 H / AD 1010–1011 (the oldest dated text in Essouk and the whole of West Africa) and 435 H / AD 1043–1044. It is not known why Essouk's ornamental Kufic is virtually absent from the cemetery inscriptions (with the single known exception of inscription n° 173). Maybe this style came to be mostly reserved for large "public" inscriptions like n° 104, n° 105, and n° 106, discussed above (Fig. 5.3, 5.4, 5.5). Though the marble epitaphs imported to Gao-Saney from Spain almost certainly transited through Essouk, there is no evidence that either their lettering style or their phraseology influenced Essouk epigraphy (Moraes Farias 1990: 74). In any case, the earliest of those Andalusian tombstones is dated 494 H / AD 1100. It is 86 years more recent that Essouk ornamental-Kufic inscription n° 106, and 90 years more recent than the oldest Essouk inscription (shown in App. C).

Essouk ornamental Kufic is more elaborate than Sahelian plain Kufic, and its engraving probably demanded a higher level of skill. Conceivably, it marks a period when Essouk was a town sufficiently rich to attract from outside, or locally train, craftspeople able to carve elaborate ornamental letters. The large, wealthy cities of the Maghreb, Andalusia, and other Muslim countries, had professional workshops specialised in stone-cutting techniques appropriate to high lapidary art, which included Kufic inscriptions in relief. In West Africa however, it was the blacksmiths who engraved epitaphs as a secondary job (Moraes Farias 1990: 86, 91; Moraes Farias 2003: lvii, ccxxxvii). One should certainly also note that the practice of engraving Tifinagh and petroglyphs on rock surfaces has been historically widespread within Tuāreg societies. Reasonable levels of stone-engraving skill have been always better distributed across these societies than across others in West Africa. However, the incising of ornamental Kufic letters may have required apprenticeship.

Essouk-Tadmekka was not a colonial town ruled by expatriate traders, nor merely an outpost of North-African Muslim urban culture. Ibn Ḥawqal records two views about its ruling group. According to some, though the Banū Tānmāk and their kin had become "White", originally they were *Sūdān* ("Black people") from the Kawkaw (Gao) region. (Such changes of position in local schemata of classificatory "colour" did happen, when groups moved from one ecological zone to another and from agriculturalism to pastoralism or vice versa – see Moraes Farias 2003: cxiii–cxiv, cxl, ccviii–ccix). Others classified the Banū Tānmāk just as "Ṣanhāja" (the Arabic form of the Berber name "Iẓnaagen", applied at the time to various south-Saharan Berber groups). Though a Muslim town, Tadmekka was a place where North-African Muslims experienced cultural unfamiliarity, even cultural shock. The Andalusian Al-Bakrī, who had North-African informants, reported that the inhabitants of Tadmekka were Muslim Berbers, but added two notes of exoticism: the men veiled their faces like the desert Berbers, and the women's behaviour shocked North-African prudery[7] (Moraes Farias 2003: clxxx).

Internal evidence in Essouk`s Arabic epigraphy suggests this epigraphy was not simply the work of expatriates. Inscription n° 104 (Fig. 5.5) speaks for an independent southern-Berber authority established on the Sahara-Sahel border, and seeking legitimacy directly from Mecca. In inscription n° 154b.1 (Fig. 5.1), the *Amīn* and his relatives have Berber names, like the Banū Tānmāk chiefs recorded by Ibn Ḥawqal. In inscription n° 105 (Fig. 5.4), the names of the author and his father are Arabic-Islamic, but the genealogical particle linking them is not the Arabic *bin* ("son of"), but still its Berber equivalent *arrāw*. The feeling of "novelty" of the Islamic calendar portrayed by inscription n° 106 (Fig. 5.3) also must reflect a neo-convert ethos. Two undated inscriptions from the north-east cemetery explicitly commemorate a *Muslimānī* ("convert to Islam") (Moraes Farias 2003: cliii–cliv, ccv, ccxxxvi, 139–140, inscriptions n° 165a and 165b).

The evidence suggests that the bulk of Tadmekka's permanent population, and certainly its rulers, were

6 See also some of the inscriptions in Appendix C.

7 The North-African Ibn Baṭṭūṭa famously experienced similar outrage at the perceived misbehaviour of southern-Berber Muslim women in Walāta (Iwalaaten), in the 14th c. AD.

Muslims of south-Saharan and Sahelian background (Moraes Farias 2003: ccxvi–ccxx). However, epigraphy also shows the presence there of people of other origins. In the south-east cemetery, inscription n° 175 (AD 1165) names Abū Yūsuf al-Mūsāwī, possibly a south-Moroccan Shīʿīte; and, in the north-east cemetery, inscription n° 161 (AD 1245) commemorates a man with a Persian name (Moraes Farias 2003: ccv–ccvii, ccx, 137, 146). Surely, people from Gao and other "Lands of the Blacks" also frequented Tadmekka. It is however difficult to identify them in the epigraphic record, as Essouk's inscriptions rarely include *nisba* appellations displaying origin (Moraes Farias 2003: cc, ccv).

Tifinagh Inscriptions

Tifinagh inscriptions have been recorded at various Saharan and Sahelian sites, from the Tadrārt Akākūs in south-western Libya (Biagetti *et al.* 2012; Biagetti *et al.* 2015; EAP265/1) to the valleys of the Malian Adrar (Dupuy 1991; Drouin 2010; Drouin 2014) and Niger (Aghali-Zakara & Drouin 2007). In the southern Sahara and Sahel, Tifinagh inscriptions have attracted more research than Arabic inscriptions. Galand and his colleagues have much contributed to the study of Tifinagh epigraphy (see RILB). Other scholars have also investigated the subject (bibliographic references in Moraes Farias 2003: cxxvii–cxxxiv).

There are many Tifinagh inscriptions engraved amongst the Essouk cliffs (*e.g.* Fig. 5.6). Their exact number is still to be determined. There is yet no extensive analysis of the Essouk Tifinagh comparable to that of the sites of Adar-en-Bukar (in Mali, southeast of Menaka) and Iwelen (further south, in Niger) by Aghali-Zakara & Drouin (2007). However, Dupuy recorded Tifinagh inscriptions at Essouk and other Adrar valleys (see *e.g.* Dupuy 1991: I, 130-Fig, 70, 131, 135-Fig. 75, inscription ESS 1/1). He made his photographs available to Drouin, and she has begun to publish her analyses of this material, which so far cover three Essouk inscriptions (Drouin 2010; Drouin 2014: 12, 14). Her French translations of these Tifinagh read as follows:

"On te dit / Il te dit que Matta t'aime beaucoup" ["You are being told / He tells you that Matta loves you much"].

"Il te dit laisse les gens retourne à Djanet l'été" ["He tells you: leave these people, go back to Djanet [in southern Algeria] in Summer"].

"Kamelul te dit de retourner à Djanet" ["Kamelul tells you to return to Djanet"].

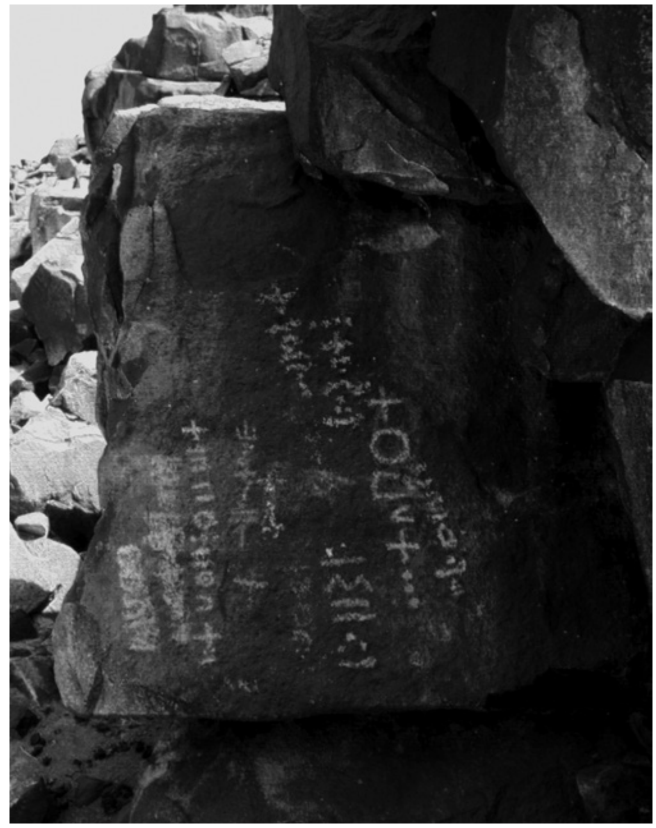

FIGURE 5.6 *Tifinagh inscription amongst the Essouk cliffs.* PHOTO COURTESY G. PAGNONI

We have published four other Tifinagh inscriptions from Essouk, T-I, T-II, T-III (all in Fig. 5.7), and T-IV (Moraes Farias 2003: 92–95, and plates 31, 33). They come from the south-eastern cliff area. Their decipherment is hampered by erosion, but above all by the presence of certain Tifinagh signs which, from the point of view of the present population of the Adrar, are either not readable (Aghali-Zakara & Drouin 2007: 3–4), or of uncertain reading:[8]

T-I: "[It is] me, Aridal, I am at .t.?.r. [a place-name no longer used]".
T-II: "[It is] me, [.................]".
T-III: "[It is] me, .k.[...] [the beginning of a now unreadable personal name, perhaps "Ekă[de]"]".
T-IV: "[It is] me, Esu [or: "Essahi[b]"] [.....] .t.?.r. [probably the same place-name as in T-I]".[9]

8 In the translations, the dots take the place of unknown short vowels, and the ? signs correspond to consonantal Tifinagh signs of which the phonological value is no longer known, or certain.

9 I thank Lionel Galand, Jeannine Drouin, Mohamed Aghali-Zakara, Hélène Claudot-Hawad, and Mahmoudan Hawad, for helpful discussions about inscriptions T-I, T-II, and T-IV.

Inscriptions of the same type as these seven are common at other sites (*cf.* Aghali-Zakara & Drouin 2007). The initial formula *Năk* ("[It is] me") is recurrent in both modern and ancient Tifinagh inscriptions (*e.g.* Dupuy 1991: 130, Fig. 70, IBD1/2; Drouin 2014: 12). Names like "Aridal" (literally "Hyena"), and "Esu" ("Bull") are well known Berber personal names, and so is the Arabic-derived "Essahib" (Moraes Farias 2003: ccxix).

Tifinagh alphabets vary across time and space. Inscriptions T-I, T-II, and T-IV include signs no longer in use in the Adrar, nor listed in any of the published regional alphabets of modern Tifinagh. Therefore, they are not recent inscriptions, but date from an earlier phase in the evolution of the Tifinagh alphabets.

It is estimated that the making of Tifinagh inscriptions in the Adrar began not later than the 5th century AD, earlier than the beginning of Islam and its calendar in Arabia in the 7th century AD (Dupuy 1991: I, 150–160). However, Tifinagh inscriptions eschew chronological references and allusions to historical context. Their age-patina tones do not provide reliable estimates of their dates either (Dupuy 1991: I, 15, footnote 1).

Tifinagh is a script that has a unique historical association with eroticism and playfulness, and with pastoralist work and leisure. Though hard, the work of pastoralists regularly left them with time on their hands for writing Tifinagh signs in sand and engraving them on rock. The core purposes of Tifinagh rock inscriptions were individual signature, informal private chatting, and courtship. They also provided tips about the terrain crossed by the herds. One of the alternative readings of a Tifinagh inscription at Adar-en-Bukar is "Hey! I saw watering places [when] I crossed [the valley of] Abalakha" (Aghali-Zakara & Drouin 2007: 94–95, inscription 90). Essouk-Tadmekka was not only a traders' town. Over the centuries, Berber-speaking pastoralists have frequented the permanent wells in the valley and engraved Tifinagh on its cliffs and boulders. They will have also frequented Essouk-Tadmekka's market (*sūq*). Additionally, kinship links must have helped to tie town life and nomadic life together.

Tifinagh-Arabic Relationships

The sample of seven Essouk Tifinagh inscriptions published so far (admittedly limited) suggests that Tifinagh writing and Arabic writing stand to each other in the Essouk-Tadmekka valley in the same way as they do elsewhere in the Sahel and the Sahara. The Arabic script carried to Essouk its association with religious scripture, law, political administration, and other public matters, but also with commercial correspondence and other utilitarian purposes. The script has been Islamic culture's collective signature. Its presence identifies private and public spaces as Muslim spaces, often as an element of architecture and decoration (as at Koumbi Saleh and Tegdaoust). Members of the Tuāreg "clerical" groups often affect disdain for the Tifinagh script, for its supposedly trivial, even impious associations. Yet, Tifinagh signs are used for teaching short Qur'ānic passages to children (Moraes Farias 2003: cxxxii–cxxxiii) and, while Tifinagh inscriptions mentioning Islam are rare, at least one of the Tifinagh inscriptions in the Tadrārt Akākūs consists of the *Basmala* Islamic formula "In the name of God, the Clement, the Merciful" (Biagetti *et al.* 2015: 16, fig. 1.4). Clearly, it is not religious affiliation that essentially distinguishes the Tifinagh script from the Arabic script. Rather, it is the distinctness of the writing genres traditionally assigned to each script that separates them.

FIGURE 5.7 *Arabic inscriptions (including one dated AD 1041), and Tifinagh inscriptions T-I, T-II, T-III, side by side in the south-east Essouk cliffs – note also the seal of Sulaymān/star of Solomon, an Islamic as well as a Jewish symbol (Moraes Farias 2003: ccxxxv–ccxxxvi, 91–95).*

To Muslim traders and religious-political leaders, Tifinagh engravings were a prompt to inscribe the Essouk landscape with their own Arabic signs, which carried a new way of computing time, a new system of geographical references, and Islam's scripture and profession of faith, as well as potentially new sources of political authority. Moreover, like the recording of dates, the making of tomb inscriptions was a "missing" dimension in Tifinagh engraving. This also prompted Muslims to appropriate the "vacant" writing genre for Arabic, and for the proclamation of the Muslim identity. It allowed them to make explicit a new conception of the relations between the living and the dead, in contrast with the local pre-Islamic notions of how living human beings related to the world of the *Kel-Esuf* ("spirits") (MORAES FARIAS 2003: cxiv). Significantly, the early production of Islamic Arabic epitaphs only happened in West Africa at Essouk and Junhan in the Adrar, and along the eastern arc of the Niger valley, precisely in areas where the Tifinagh script was also present. It is likely that this was not a mere coincidence, but the result of the creative tension between the two scripts. Koumbi Saleh and Tegdaoust had contacts with North African Muslims as strong as Essouk-Tadmekka's; nevertheless, their large cemeteries have yielded no Islamic epitaphs. The production of Islamic tomb inscriptions did not automatically follow the introduction of the Muslim faith. Throughout history, the engraving of epitaphs and the embellishment of tombs have been controversial issues in Islam (MORAES FARIAS 2003: cxxii–cxxviii, cxxxii–cxxxiv). The North-African Ibāḍīte, who may have been the first Muslim traders to reach Essouk, never engraved epitaphs.

Tifinagh epigraphic usages influenced the Arabic cliff inscriptions at Essouk. One example of this is inscription 104 (Fig. 5.5). It begins with the expression "This was written by Ilyās", in which the Arabic demonstrative *hādhā* ("this") performs a presentative function that is a calque of the Berber *a-wa* ("this") in the formula *a-wa-năk* ("this [is] me"), followed by the name of the engraver, which begins many Saharan and Sahelian Tifinagh inscriptions (MORAES FARIAS 2003: cxcv, ccxxxiv–ccxxxv, 86–87).

Conclusion

At Essouk, old Arabic and Tifinagh inscriptions existed side by side, and traded influences (grammatical features and proper names). However, textual analysis reveals that they embody different writing genres, hence occupy distinct niches in the cultural history of the area. In all probability, Essouk's Tifinagh inscriptions were engraved by Berber-speaking pastoralists who frequented the valley, whereas the Arabic inscriptions were made by people closely involved (at different social levels) in Essouk's life as Tadmekka, a market town devoted to long-distance trade. However, many –probably most – of the authors of the Arabic inscriptions seem to have been people of southern-Berber (or other south-Saharan / Sahelian) background, who added Arabic to their native language(s).

To an unusual extent, the ideology dominant in the market town highlighted trans-local conceptions of space and computations of time, which reflected Tadmekka's economic role, and which were formulated in the idiom of Islamic culture, the most trans-local idiom then available in the region. Only Essouk's Arabic epigraphic texts fully record this ideological enterprise. No other source does that. Essouk-Tadmekka was though a place where the ideas brought from across the Sahara were redirected according to local purposes. The Arabic inscriptions there do not simply reiterate rhetorical conventions imported without alteration from other Muslim countries. Rather, they appropriate those conventions and creatively adapt them to novel tasks. The aim, successfully achieved, was to establish the market town, under rulers of its own, as a centre of long-range trade and political authority under the aegis of Islam and Mecca, and independent of other powers, whether North African or Sahelian, and whether Muslim or not.

PART 3

Excavations and Architecture

CHAPTER 6

Excavation Programme and Methods

Sam Nixon

Introduction

Excavations were carried out between January and March 2005. The central objective was to attain an absolutely-dated archaeological sequence that as far as possible represented Essouk-Tadmekka's occupational history. Systematic excavations were pursued at three different locations (Fig. 6.1). Two units were excavated in the area of ruins to the east of the wadi (units Ek-A and Ek-B), and a third unit on the island (unit Ek-C).

Excavation Unit Placement

The main factors governing excavation locations were topography, surface structural remains, and the surface

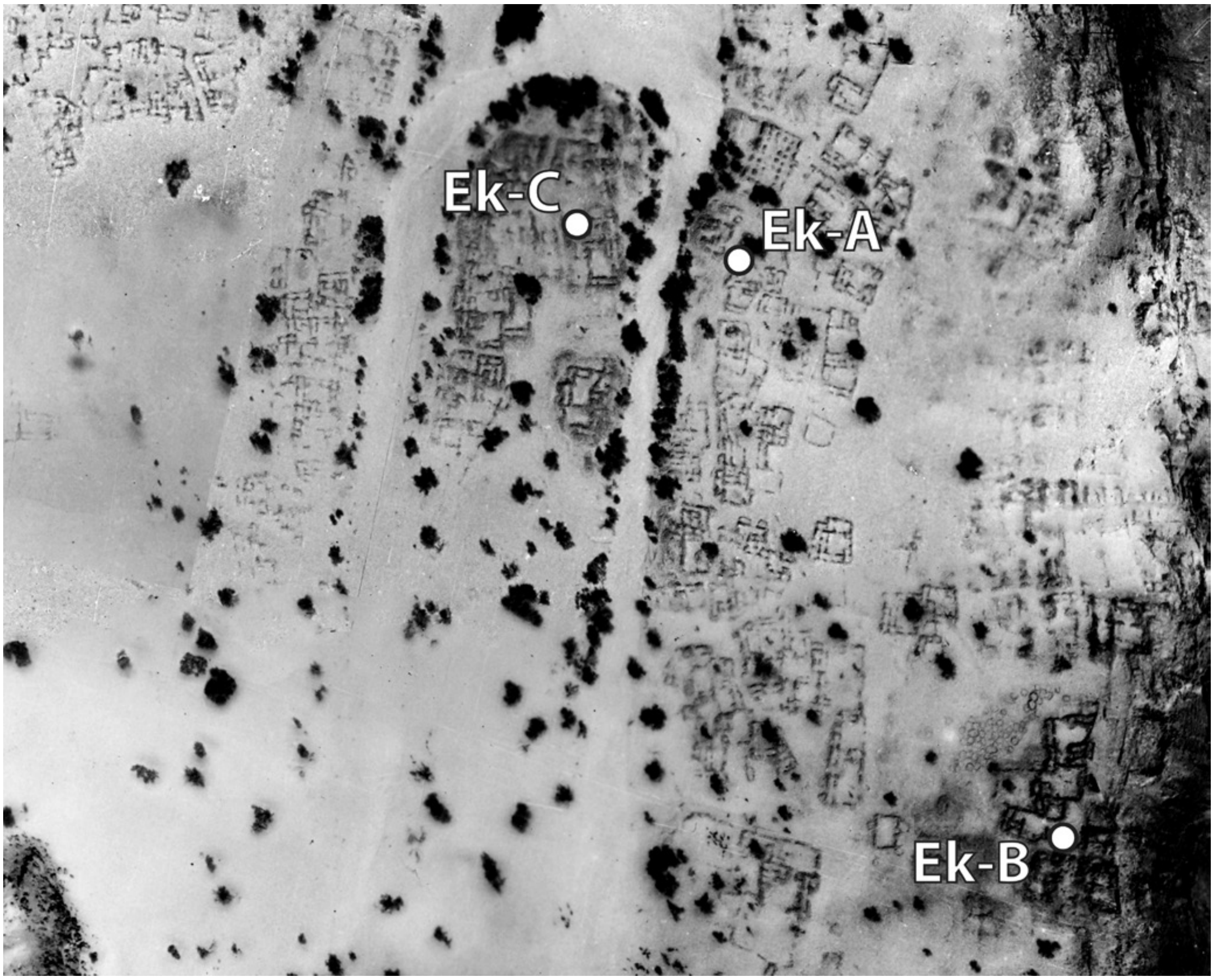

FIGURE 6.1 *Aerial photograph (EOM) provided by Paulo de Moraes Farias, received from Raymond Mauny, of central area of site showing excavation unit locations (compare with Fig. 4.2, 4.4 for overall site context).*

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presence of material culture, principally ceramics. As prior to the excavations no ceramic typology existed for the region, ceramics present on the site surface were however of limited use as a guide to the nature and date of sub-surface deposits. Additionally, large areas of the site did not feature any surface material culture at all, due to coverage by windblown sand.

Unit Ek-A was located amongst the ruins to the east of the wadi, at a point parallel to the northern tip of the island. Given this is at the mid-point (north-south) of the largest area of the ruins, it was considered a strong possibility that this had been an important area for a significant portion of the site's history. Additionally, the proximity to the wadi was seen as important, areas close to the wadi today being the location of the principal wells within the valley and therefore potentially attractive locations for past settlement. A very important reason for the placement of Ek-A though was that there appeared to be deep deposits at this point of the site, the ground here being significantly higher than the floor of the wadi, and this being seen as likely a result of accumulated settlement deposits (see Fig. 7.1). A final factor was the presence of the ruins of the largest mosque observed on the surface of the site, suggesting the importance of this area. It should be noted that there was practically no material culture seen on the surface here. On the balance of the evidence, however, it was believed this area offered good potential for recording an occupation sequence from important phases of the site's history. Specifically, the unit was located at the corner of the ruins of a building complex, set back slightly from the wadi, immediately to the south of the ruins of the mosque (see Chapter 7 for details). The unit measured 5 × 5 metres at its commencement.

Unit Ek-B was also located amongst the ruins to the east of the wadi, further south than Ek-A and close to the cliffs. Specifically, Ek-B was located in the area of the ruins with the highest standing wall remains at the site. The logic behind excavating here was two-fold. Firstly, five sherds of glazed pottery were found here (see Chapter 12), constituting the largest surface collection of material culture of trans-Saharan origin at the site. Given that a specific aim of the excavation was to record occupational deposits associated with trans-Saharan activity, this was seen to be important as it appeared to guarantee some deposits associated with this activity. Secondly, it was felt that the distinctive nature of the standing remains from this part of the site (see Chapters 4, 11) might indicate a functionally or culturally different zone, or perhaps a different period of occupation. Together, this made for a compelling case as a site of excavation. Unit Ek-B was located in relation to the remains of one of the larger building complexes in this area of the site (see Chapter 8 for details). This was also commenced as a 5 × 5 metre unit.

One further locality was excavated, unit Ek-C, on the island. This location was chosen following termination of excavations in unit Ek-B, and in view of the findings from the upper levels of unit Ek-A (see Chapters 7, 8). The main objective was to gain evidence from an area of the site in addition to the largest area of ruins to the east of the wadi. Accordingly, we assessed the potential of the other two major areas of ruins, the area to the west of the wadi, and the island. Considering the area to the west of the wadi, it could be seen that the majority of the ceramics on the surface were very similar to those found only in the upper levels of unit Ek-A (see Chapter 12 for further discussion). Additionally, having compared the elevation of this western zone with the level of the wadi floor, it did not obviously appear to have deep deposits. There was therefore no convincing evidence to suggest occupation there preceded a late phase of the site. In contrast, survey on the island had produced no pottery at all, making it difficult to estimate the likely nature of occupation by reference to the preliminary excavation results from the other two excavation units. Also, the elevation of this area relative to the wadi floor was higher than that to the west of the wadi, potentially indicating deeper deposits. As noted above, also, Mauny had recorded pottery with distinctive decorations during his brief digging on the island (1961: 118). While unfortunately he published no further details, this raised the possibility he had evidenced a ceramic type of a cultural group and/or period not already encountered in our other excavations. The island was also an obvious topographic feature of the site which could have led to its importance as an area of settlement, providing further argument for excavating here. Specifically, Ek-C was located in relation to the remains of a building complex in the north-east of the island (see Chapter 9). Given time limitations, this unit was only excavated over a 2 × 3 metre area.

All the excavation units were related to a central datum point set up in the eastern cliffs (using a dumpy level). A standard datum level symbol was carved into the rock to record this point (see Fig. 11.2 no. 11 for location). The elevation for this central datum point was then used to measure the relative elevations of the surface levels of each excavation unit, provided in Chapters 7, 8 & 9.

Methods

Stratigraphic Excavation and Recording

Stratigraphic excavation of all occupational deposits encountered was undertaken, rather than excavation by ar-

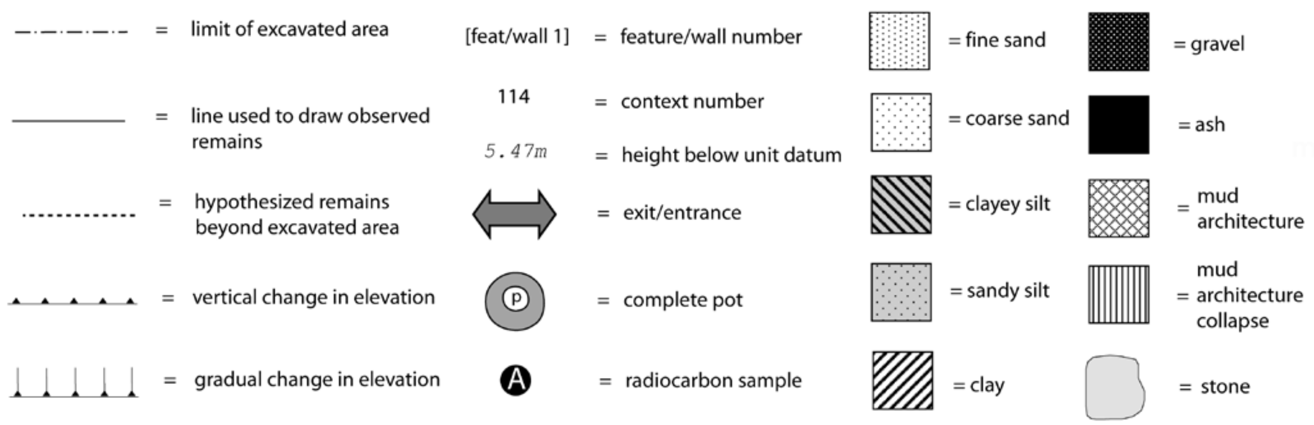

FIGURE 6.2 *Key for all plans and stratigraphic drawings in Chps. 7, 8, 9.*

bitrary levels. Following the removal of surface deposits, each individually distinct occupational deposit (defined by colour, consistency and soil type) was removed as a single context. Only very rarely were arbitrary levels excavated when natural stratigraphy was not discernable (indicated in the text).

The recording procedures practiced during the excavation involved full documentation of the nature of each individual context, including soil type, texture and colour (using the Munsell system). Additionally we recorded the character and extent of natural and cultural inclusions (*e.g.* stones/pottery). Individual descriptions of all excavation contexts are given in Appendix D. An accurate plan drawing was also made of each context. These procedures ensured that a highly detailed stratigraphic occupation sequence could be reconstructed for all excavation units.

As the majority of the walls were left *in situ* the analysis of architectural construction is based principally upon the recording of the exterior surfaces of walls. It is to be noted therefore that while the plan drawings presented within the following chapters provide an accurate representation of the position and dimensions of walls, illustration of their internal structure is purely schematic. Detailed profile drawings were however made of selected wall surfaces (see Chapter 11).

See Figure 6.2 for key to plans and stratigraphic drawings.

Artefact Recovery and Recording

All deposits were carefully sieved for artefacts (excluding wall removals). For each unit, consistent use of the same mesh size was practiced. In unit Ek-A a 1cm mesh was used as it was believed the unit would be deep and sieving with a 2mm far too slow. Units Ek-B and Ek-C were sieved with a 2mm sieve. In particular, for Ek-B a 2mm sieve was adopted to recover evidence of very small beads, this unit being located principally in order to recover evidence of trans-Saharan material culture, and glass beads being one of the main artefact types expected. When the unit proved to be relatively shallow, the 2mm mesh size was continued for all deposits. Following termination of excavations in Ek-B, a 2mm sieve was also used in Ek-C as this was a relatively small unit and deposits could easily be processed. All artefacts collected during sieving were bagged and labelled on site according to their individual contexts.

Specialist Recovery Procedures

In addition to the recovery of sieved artefacts, two types of excavated evidence were collected by hand. Firstly, we collected individual ceramic specimens seen to offer good potential for radiocarbon dating, ceramics containing organic materials (chaff) having been identified as one of the most suitable means of radiocarbon dating (see Chapter 10 for discussion). These samples were bagged and labelled individually. In addition, charcoal was also sampled as a back-up for radiocarbon dating – this was carefully wrapped in foil, bagged and labelled individually. Archaeobotanical sampling was also practiced systematically (largely from unit Ek-A – see Chapter 21).

Personnel

The excavations were directed by the author, assisted by Jean-Pierre Tita (then Head of the Mission Culturelle Essouk) and three members of the Malian Direction Nationale de Patrimoine Culturelle (Fané Yamoussa, archaeologist; Mamadou Cissé, archaeologist; and Soumaila Coulibally, trainee archaeologist). The fieldwork team also consisted of workmen recruited locally.

CHAPTER 7

Excavations in the Mosque Quarter (Unit Ek-A)

Sam Nixon

Introduction

Excavation unit Ek-A was located to the east of the wadi, close to the northern mosque (Fig. 7.1; grid reference: n 18° 46.278, e 001° 11.181). More precisely, the unit was located in relation to a structural complex south of the mosque, on the east side of the street running parallel to the wadi. This complex is based on the classic format of rooms arranged around a central courtyard, and is part of a larger irregular agglomeration of such structures. From the surface remains alone it is not possible to ascertain its function, but its form suggests it was likely some kind of private dwelling or commercial complex (see Chapter 11 for discussion). The unit was placed on the western side of this complex, containing within it a complete room space, as well as portions of the surrounding spaces and the street (Fig. 7.2). At the commencement of excavation the unit covered an area of 25 m² (5 × 5 metres). The surface level at the centre of the unit was 6.45 metres below the site datum.

Excavation of unit Ek-A recorded *ca* 6.5 metres of cultural deposits (Fig. 7.3). Based upon radiocarbon dating it is estimated the surface deposits date to the 14th/15th century, with the earliest evidence recorded most likely dating back to approximately the mid-first millennium AD (see Chapter 10 for discussion). As stated in the previous section, these deposits provide evidence of all the major periods of occupation so far recorded at Essouk-Tadmekka, making it the most significant unit in terms of developing an archaeological sequence. During the excavation we identified and recorded 14 archaeological horizons, defined as episodes of significant depositional or architectural change. While recording significant changes within the sequence, there was also however tremendous continuity. This is well illustrated by the fact that two of the walls of the room space evidenced on the surface of the site (the north and west walls) were rebuildings of walls from a previous building horizon; and these in turn were themselves rebuildings of earlier walls, part of a process of using previous walls as foundations for new walls which can be traced within the Ek-A deposits right back to the earliest walls at 5 metres below the surface. Rather than removing the various sections of these superimposed walls we left them in place (they defined the north and west side of the excavation unit as it descended: see Fig. 7.3) and therefore by the end of the excavation these appear as 5-metre high walls, even though they never at any point existed as such in a single occupation at the site. Another example of this continuity is the fact that over the first four building horizons all

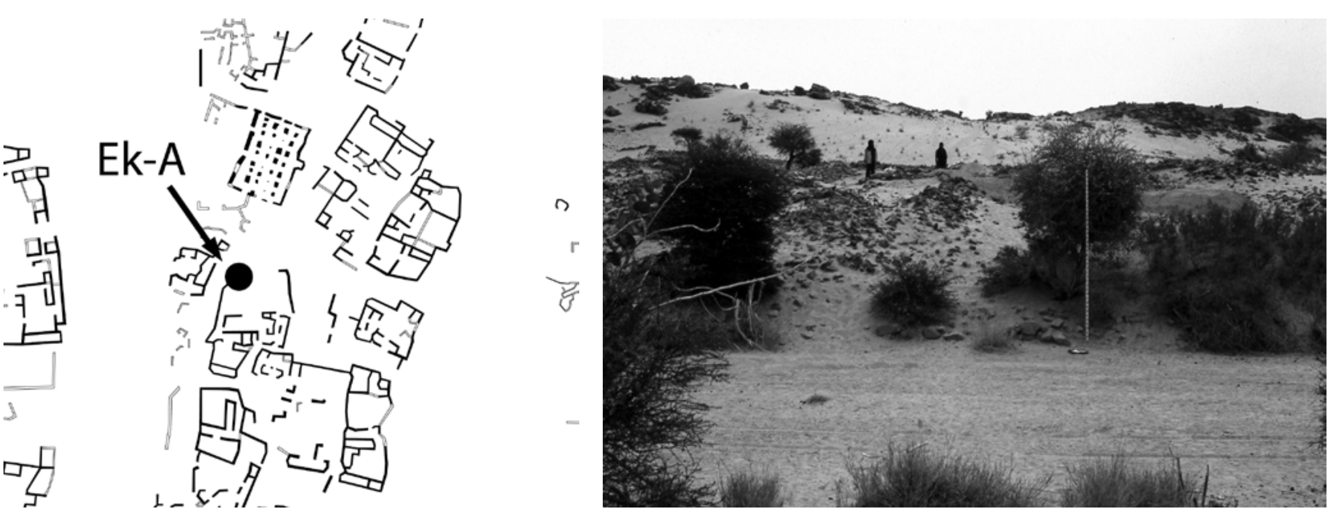

FIGURE 7.1 *Illustration of the location of unit Ek-A: a) map showing the surface structural remains around unit Ek-A (note pillared mosque to the north of the unit); b) view looking across the wadi from the island to unit Ek-A (where standing figures are located) – note the height of the Ek-A area above the wadi (ca 5 metres).*

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FIGURE 7.2 *Surface of unit Ek-A following the removal of loose sand – the loose rocks seen protruding through the surface represent the outer wall of the compound (long wall on right side) and the walls of a small rectangular room attached to this outer wall.*

four walls of the room excavated were rebuilt in the same position.

While this continuity is interesting, it does make explaining changes in construction more complex than if walls are constantly rebuilt in new positions. To overcome this complexity, a new wall number is allotted to any rebuilding significantly changing the spatial configuration (for example, the building of a wall containing a doorway on the foundations of an earlier wall which contained no doorway). In turn, when rebuilding of a wall has taken place which simply adds height to the previous wall, no new wall number is allotted.

Regarding archaeological preservation, this was extremely good with practically no post-depositional disturbance. The deposits themselves were characterised by horizontal floor surfaces 'layer-caked' one on another. As a result, when one looks at the section-drawing of the unit's stratigraphy (see end of Chapter), one can have the impression the unit was excavated in arbitrary levels, something which it is necessary to emphasise was *not* the case. As these floor surfaces were often very compact – indeed often made of heavily compacted clay – this would have prevented significant movement of artefacts between different archaeological horizons. Combined, the excellent preservation and the intact solid floors provide excellent conditions for a chronologically secure archaeological sequence.

FIGURE 7.3 *Looking down into excavation unit Ek-A from the surface – image shows digging at depth of ca 5 metres (Context 117) at the depth of the earliest walls revealed within the unit.*

In the following we present the results period by period, broken down into individual occupational horizons. The occupations are presented in reverse order to that in which they were dug, therefore commencing with the earliest and deepest occupations. Detailed results for individual contexts are provided in Appendix D.

Excavation Results by Individual Building Horizons

Period 1

Horizon 1

Horizon 1 commences with Context 123, the context therefore evidencing the earliest cultural activity from the excavation unit, and indeed from the site as a whole so far. Below Context 123, sterile deposits were recorded to a depth of 7.68 metres below the surface of the unit. This horizon was excavated over an area of 3 metres (North-South) by 2.5 metres (East-West). All contexts in this horizon – 123, 122 and 121 – were composed of a loose, medium-grained sand containing limited organic material. Due to the lack of clear, natural stratigraphic layers, the archaeological contexts within the horizon are defined from each other on an arbitrary basis. There was no evidence for architectural structures or any other features within this horizon.

Given the nature of the deposits, it appears this area of the site did not witness intensive cultural activity at the period this horizon relates to. No radiocarbon dates are available for this horizon.

Horizon 2

Horizon 2 (Fig. 7.4) is defined from Horizon 1 by evidence for what appears to be a shift to more intensive use of this area of the site. This evidence is represented firstly by remains of architecture, entirely absent from Horizon 1. This evidence consists of post-holes with a diameter of 7–12 cms and a depth of 5–10 cms. These post-holes are seen within all contexts in the horizon (see Fig. 7.4 for Context 117 post-holes). The post-holes contain stones, ceramic and bone, presumably to help secure the posts in the holes. We cannot precisely reconstruct this architecture, but the size and shallow depth of the post-holes suggests we are looking at evidence for either tent frames or mat and pole structures.

In addition to the architectural evidence, differences within the nature of the soil deposits between Horizons 1 and 2 also suggest distinct cultural change. Whereas in Horizon 1 we saw loose sand containing limited charcoal and other cultural materials, in Horizon 2 we see more compact silty deposits containing higher amounts of such material. Given this combined evidence, it is difficult to argue against there having been a shift to a more intensive use of this area during Horizon 2.

The difference between the Horizon 2 and Horizon 1 deposits aside, we also see a clear change *within* the deposits of Horizon 2. While Contexts 120, 119 and 118 all contain relatively high amounts of organic material, Context 117 contains far more organic material than any of the preceding contexts. Importantly, Context 117 immediately precedes the earliest evidence yet found for permanent

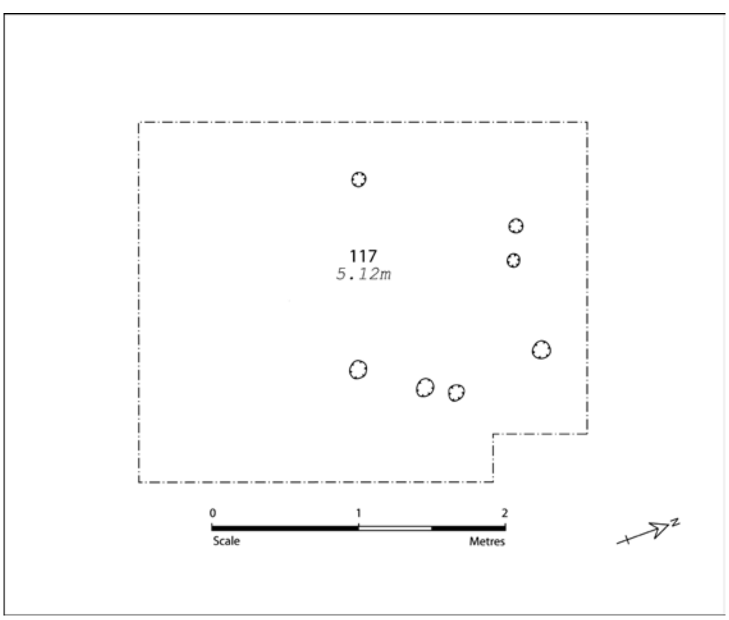

FIGURE 7.4 *Plan (a) and photograph (b) of unit Ek-A Horizon 2 Context 117 showing post-hole distribution.*

structures at the site (see below). This great increase in organic remains either suggests a surge in cultural activity prior to the establishment of permanent architecture in this zone of the site or that this area of the site was on the outskirts of an already developing permanent architectural occupation in the vicinity.

Period 2

Horizon 3

This horizon contains the earliest permanent architecture yet evidenced at Essouk-Tadmekka, a complete room space, within its four walls measuring 2.5m (east-west) by 3m (north-south) and having two ground-level exits (Fig. 7.5, 7.6). Within one corner of this space we also evidenced a substantial mud-built sub-structure [Feature 7], defined either as a large pillar or some form of staircase (see below). The walls defining this space [22 and 26] were built without a foundation trench. Three radiocarbon samples from the early levels of Horizon 3 have produced dates clustering around the 8th–10th century (see discussion below).

The materials used in the architecture are stone and mud construction. The east and south walls of the room [together defined as Wall 22] are constructed of solid, compacted mud, commonly referred to as *pisé* (this type of highly compacted mud construction at Essouk-Tadmekka is hereafter referred to as *pisé*), constructed upon a first course of stone (see Fig. 7.6). The room's west and north sides are constructed of worked stone coated with wet mud, this wet mud construction being commonly referred to in West African construction traditions as *banco* [Wall 26] (Fig. 7.7 – see Chapter 11 for illustration and further discussion of this technique).

As stated above, there appear to have been two ground-level exits from this room space: one to the east and one to the south can be clearly distinguished despite later rebuilding and in-filling (Figs. 7.5, 7.6). As mentioned above, a further feature of the room is the remains of a *pisé* structure [Feature 7] affixed to the north wall of the building (see Fig. 7.5 and Fig. 11.9). The size of this feature (*ca* 1.25m width), and its apparent rebuilding over the next five horizons suggests it was a major structural element. Initially it was thought this might be a load-bearing pillar, though if so this would be of a very substantial size. Suggestive signs of access having occurred *through* this structure though required consideration of another possibility, namely that it might be a staircase, in the manner of those still seen today within traditional Sahelian mud architecture constructions (*e.g.* MAAS & MOMMERSTEEG 1992: 72). While on its south side the rebuilt structure rises to a height of *ca* 2.5 metres, on its west side the remains only stand *ca* 60 cms high, giving the impression the low side of the structure might represent a stairway access point. The fact that the interior surface of this structure is cleanly finished indeed suggests the interior was designed to be visible and accessible. The presence at the 'access' point of stones in the form of a step (Fig. 7.5) provides suggestive evidence of access, as does what appears as an in-filled 'doorway' at the back of this structure, bearing evidence of various rebuildings, seemingly in *pisé*, and which could represent the periodic raising of a step. While the majority of the evidence for access through this structure comes from later horizons, its construction within Horizon 3 suggests at this point it might have provided access either to a flat roof or some other raised habitation area east of the excavated space.

The main architectural elements explained, we now look at the nature of the deposits. As indicated earlier, Context 116 was the first deposit associated with permanent architecture. This compact sandy-silt deposit was associated with the building phase of the walls, accumulating from their base. Onto this a compact, clayey-silt deposit was laid down [114] which one presumes provided a solid surface for occupation of the room space. It is on this surface that the *pisé* sub-structure [Feature 7] was built. Post-holes were recorded within Context 114 (Fig. 7.5), containing small supporting stones, bone and ceramics, as in Horizon 2. These post-holes were *ca* 5–10cms deep with a diameter of *ca* 10–14 cms. Being confined to the north-west of the room, their distribution does not obviously indicate a load-bearing function like those documented at other sites from this period (*e.g.* HORTON 1996, Chapter 11). It is possible therefore that the post-holes relate instead to internal sub-structures within the room space, perhaps with the function of keeping possessions and foodstuffs off the ground. Covering Context 114 is a layer of medium-grained sand [113b], presumably serving the function of a living surface (as one sees in modern Tuareg houses). Covering Context 113b is a compact clayey deposit [113a]. As with Context 114, this also features post-holes. While these are of a similar depth and diameter to those from Context 114 their distribution more obviously suggests some form of load-bearing function, particularly the presence of a group of post-holes within the centre of the room space. In the same way that Context 114 was covered with sand, Context 113a is followed by a thick layer of pure sand [111] – unlike Context 113b, however, this sand is very fine-grained, possibly sieved.

While a fuller discussion of the possible function of this room needs to consider the various excavated finds, it is important to make certain observations here. The

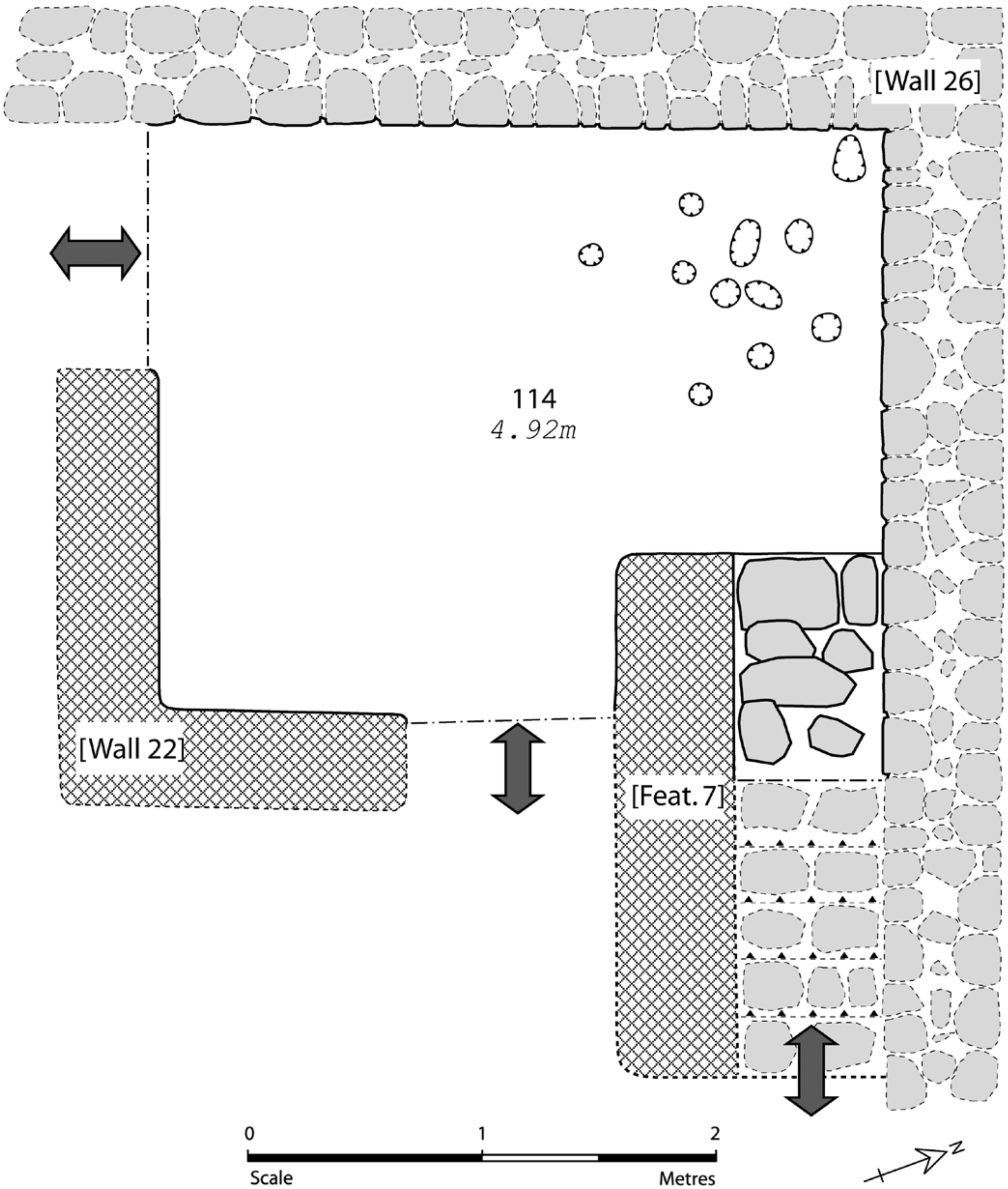

FIGURE 7.5 *Plan of Ek-A Horizon 3 (at Context 114) showing all contemporary walls and features.*

FIGURE 7.6 *View standing within room excavated as Horizon 3, looking towards the south wall and the infilled south exit (photograph taken at the base of the Horizon 3 deposits). The lower section of the exit is 'filled' with the accumulated deposits of living surfaces which went through this doorway (those of Horizons 3, 4 and 5); the upper section contains a stone infilling used to block off this exit in Horizon 6.*

FIGURE 7.7 *The base of the west wall constructed from Ek-A Horizon 3.*

presence of multiple exits suggests we are dealing with a space allowing movement to other parts of a larger architectural complex: this does not give the impression of being a one-room structure like the *magasin* buildings for storage of produce in the contemporary settlement near Essouk-Tadmekka. Due to the relatively small size of the room, it is believed to be an interior room rather than a courtyard. The architectural space as a whole also gives the impression of solid, skilful construction. The apparent mastery of load-bearing techniques, and the high-level of the architectural 'finish' shows the building resulted from a well-managed, skilled construction project.

Horizon 4

The dimensions of the room space recorded in Horizon 4 (Fig. 7.8) correspond very closely to that of the previous horizon as the majority of construction is either a rebuilding of previous structures [Wall 22 and Feature 7] or the creation of new structures on the foundations of the Horizon 3 structures [Walls 23 and 24 built on Wall 26 from Horizon 3]. Regardless of the desire to restructure space, new construction would most likely have been necessary as the rise in the floor surface brought about by Horizon 3 deposition would at some point have made the original Horizon 3 ceiling too low for habitation, a raising of the walls and roof therefore being the solution. One wall which is not located on top of a previous wall is Wall 25, a diagonal wall placed at the south-west corner of the room. The placement of this wall meant that the southern exit used in Horizon 3 was blocked off (the depositional evidence from behind this wall (sand) shows that the triangular section of space behind the wall now formed part of the space extending southwards of this room. While the room ceased to have a southern exit, there is evidence that the eastern exit created in Horizon 3 continued in use, namely the creation of a sand-filled step [Feature 8] (Fig. 7.9). The 'staircase' structure also appears to have continued in use, the evidence for this being the placement of new stones leading into Feature 7 (Fig. 7.8).

In addition to continued use of the eastern exits, building in this horizon [Walls 23 and 24] seems to have incorporated the construction of a western exit. When studying the arrangement of worked stones on the western side of the room space at the Horizon 4 level, the existence of a filled-in exit appeared to be detectable. Despite having been filled in during subsequent construction, it is possible to see this exit due to the presence of 'fault-lines' in the arrangement of the stones related to this process (see Fig. 7.7 and illustration in Chapter 11). The stones which have been used to fill this exit can be distinguished from the surrounding stones at this level by the fact that the lower section of them have been laid on a different plane to the rest of the wall, while the upper section contains stones of a colour and finish different to the rest of the construction at this level. These fillings seem to relate to Horizons 5 and 6 and are hence discussed later. Interestingly the newly constructed diagonal wall [25] was located in such a way that its surface within the room-space formed a continuous line with the left side of this hypothesised exit, though it is unclear why this was so.

The deposits in this horizon commence with Context 110, a compact, fairly pure layer of clayey-silt containing occasional large (*ca* 10cm) stones, presumably laid down to provide a solid covering for the sieved sand of the previous horizon: it is on this surface that the diagonal wall [25] is built. Laid on top of Context 110 is Context 109b, a layer of coarse sand, presumably representing a new living surface. This is in turn covered by a very compact, clay floor surface [109a] – the step [Feature 8] is built on this surface. In a departure from the depositional pattern so far, Context 109a is not followed by a layer of sand. Through Context 109a a cut is made [107b] which is filled with sand [107a] (Fig. 7.8): the presence of worked rectangular stones (red hued) loosely arranged on top of the sand fill suggests some kind of activity but unfortunately these stones were removed before they could be recorded. Interestingly nowhere in this horizon do we see the post-holes seen in the previous 2 horizons. Post-holes are not seen again until Horizon 9.

Regarding overall observations concerning the space and deposition, we see broad continuity in the spatial arrangement and construction materials. While we continue to see multiple exits, the articulation of this space with other surrounding spaces is now different, principally due to the closing of a southern exit and an opening of a western exit. The first usage of clay floors is noteworthy, perhaps relating to a different room function.

Horizon 5

The Horizon 5 space contains a rectangular room space defined by Walls 23, 24, 25 and 22 (Fig. 7.10) – the majority of any construction that took place was a rebuilding of previous structures. The only new structure within this horizon is a low *banco* structure containing a step [Feature 6] located in front of the eastern exit that seemingly continues in use. It also appears that access through the 'staircase' exit continues as we see new stones laid down leading into Feature 7 (Fig. 7.10); however, the fact that Feature 7 has not been significantly built up in this horizon and is nearly covered over now suggests this exit may now simply be at ground level. The western exit also appears to have continued in use – the evidence for this

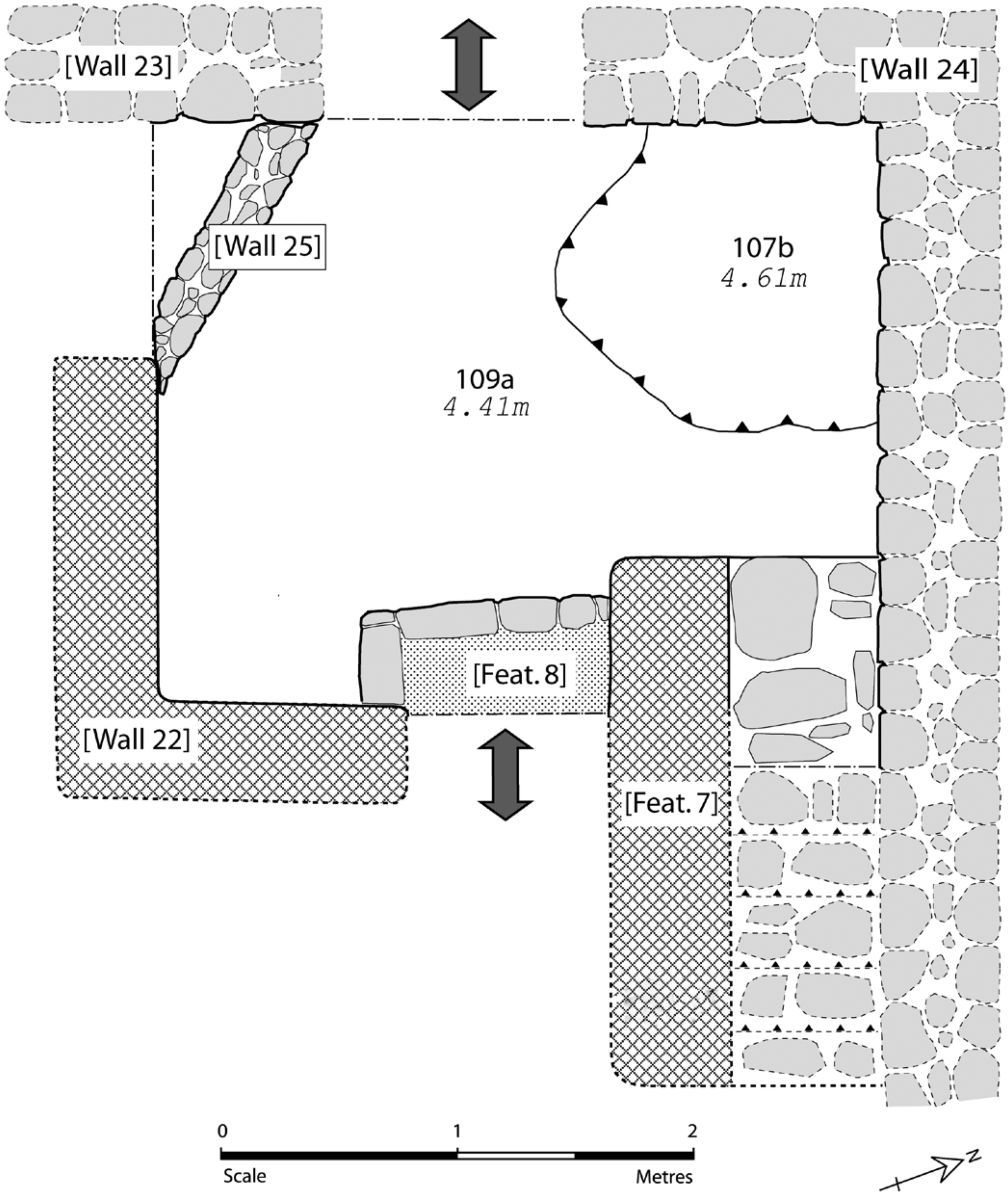

FIGURE 7.8 *Plan of Ek-A Horizon 4 (showing all contemporary walls and features).*

FIGURE 7.9 *Step (Feat. 8) created in front of eastern doorway in Horizon 4.*

is that the stones eventually used to block this exit in relate to two episodes of filling. The fact that the upper section has been filled in a construction style very different to any seen so far, and very similar to other construction seen in the next horizon, suggests this doorway was still open within Horizon 5 (partial filling presumably representing a building up of the level of the step within the doorway to match the rise in the floor surface caused by deposition).

The first deposit within this horizon is a compact layer of clay [106] covering up the mixed occupational surface of Contexts 109a and 107a from the previous horizon. Covering Context 106 (and Feature 8) is a thick layer of coarse-grained sand [103]. Upon this thick layer of sand the new low *banco* structure containing the step [Feature 6] is built and new paving stones are laid down leading into the 'staircase' passageway. Cut into Context 103 are two shallow, circular pits filled with a compact greenish clay [101b/a and 102b/a] (Fig. 7.10). The exact function of these is unclear.

Overall impressions of this horizon are that it demonstrates great spatial continuity with the previous horizon, the only possible significant change appearing to relate to the function of Feature 7, and whether or not this now relates to a different form of exit from the space. While a clay surface is utilised again, there appears to be a return to a use of a sand floor as a living surface. Also given the circular clay features, we again seem to be seeing a slight alteration in the use of space.

Horizon 6

The Horizon 6 room space is defined by a rebuilt Wall 22, and Walls 18 and 21 built on top of the previous horizon's structures (Fig. 7.11). Consequently, we again see a room space retaining the basic dimensions of the room originally created in Horizon 3. The first significant alteration to the room space brought about by new construction though is the levelling and covering of the diagonal wall used in the previous horizon [25]. This is accompanied by a filling in of the original south doorway from Horizon 3, which clearly takes place from this level. The very skilful working and laying of this stone is clearly distinguishable from previous construction, as is the stone type itself (a purple-tinged stone) (Fig. 7.6, Chapter 11). This further confirms that this space had been left open behind the small diagonal wall [25] present during the previous two horizons. Additionally, the western exit created in Horizon 4 and apparently continued in use in Horizon 5 now appears to have been completely blocked off during the building of Wall 18, the upper section of the hypothesised western exit fill containing well-worked, purple-tinged stone arranged on a clean plane with the rest of the wall (Fig. 7.7), as is seen in the fill of the southern doorway just described.

It appears therefore that for the first time the room space now only has exits through the east wall. Reuse of the exit in the centre of the east wall is evidenced by the building up of a stone step within the doorway. While there is no longer evidence for the rebuilding of the large *pisé* 'staircase' structure [Feature 7] within the room-space, the access that was taking place through this structure still seems to have been possible as the exit at the back of this does not appear to have been smoothly filled-in from the beginning of the horizon but rather seems to have been built up in stages (seemingly in *pisé*) suggesting the periodic raising of a step throughout the horizon. However, the lack of a major *pisé* structure *within* the room, coupled with clear evidence for a clay floor going through this exit at ground level in the next horizon (see below), suggests it is advisable to see this exit as merely a ground level passageway defined on one side by a *pisé* wall jutting out slightly into the room [Wall 21], rebuilt on the staircase structure below.

The occupational deposits laid down following the restructured of the room space commence with Context 97, a compact, clayey-silt deposit presumably designed to create a solid, flat surface for new occupation. Following Context 97 the occupational evidence from this horizon is limited to a thick layer of coarse-grained sand (this was removed separately as Contexts 96, 95 and 93 despite the lack of clear natural stratigraphic layers within this deposit). While sand build-up is often seen to represent abandonment, the sand we see here is not smooth, wind-blown sand (like that seen on the surface of the site). Also there

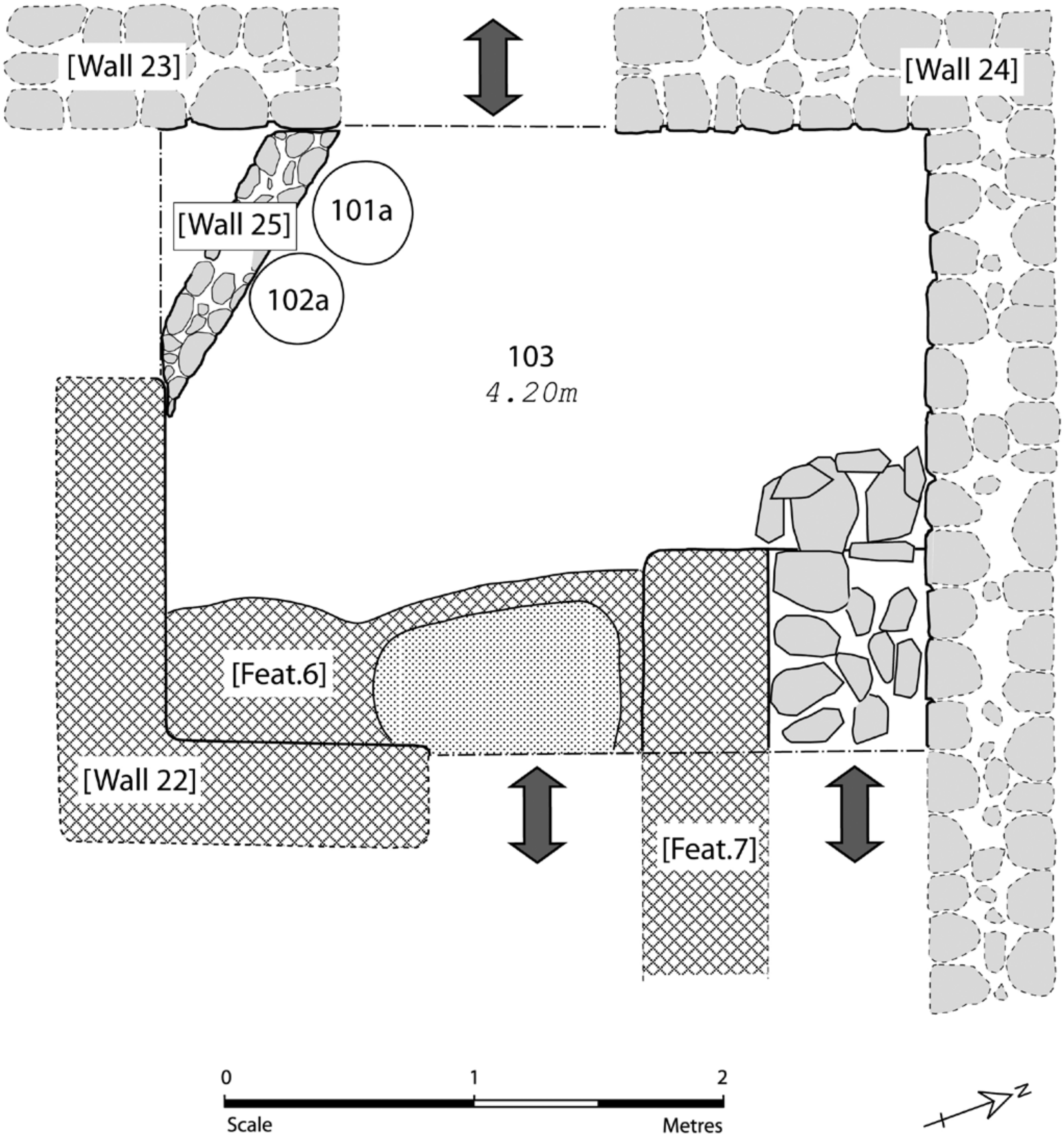

FIGURE 7.10 *Plan of Ek-A Horizon 5 (showing all contemporary walls and features).*

is evidence for occupation within this sand build-up including charcoal and other organic remains.

While the construction broadly shows significant continuity with previous horizons, this horizon is fairly different both due to the modifications of space – principally now only having exits through one wall – and in the deposition where we see no use of clay or sandy silt for the first time. Also there is an absence of any other features within the room.

Horizon 7

Continuing what has become a remarkable pattern of continuity, in Horizon 7 we again see a room retaining the dimensions of the original room created in Horizon 3 (Fig. 7.12). The north and the west walls of the room are defined by the rebuilding of Wall 18 while the south and the east walls see the creation of new walls [19 and 20] on top of previous walls. Other than the use of mud construction in the rebuilding of Wall 21 (associated with the

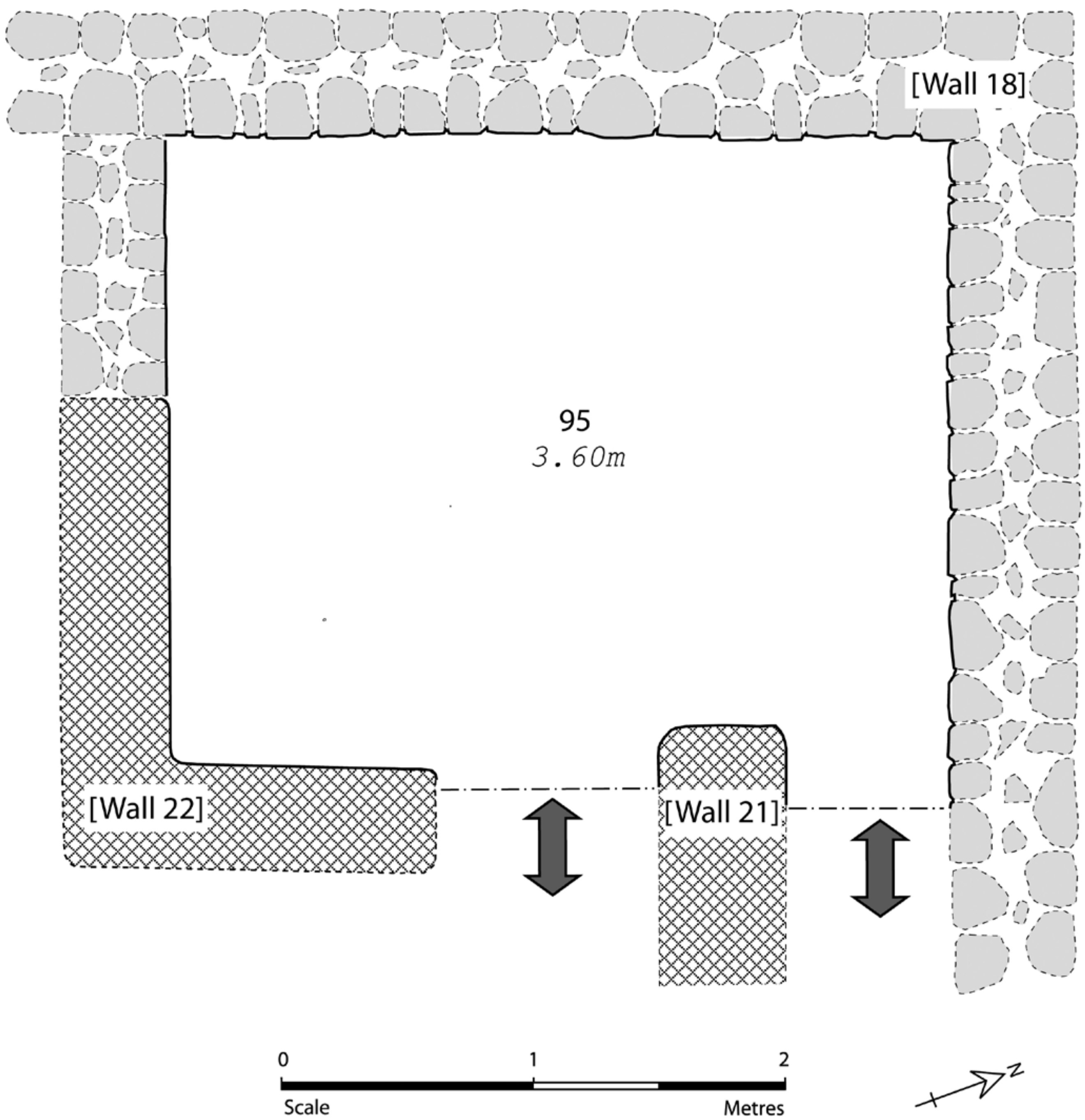

FIGURE 7.11 *Plan of Ek-A Horizon 6 (showing all contemporary walls).*

original 'staircase' structure) all rebuilding was done in stone coated with *banco*.

At the start of this horizon the exit in the centre of the east wall which had functioned since Horizon 3 was blocked off by the creation of Wall 20. However, this restructuring of the east wall incorporated a new exit further south on the east wall. Created in front of this new exit and Wall 20 is a low structure [Feature 5], partly constructed of mud-bricks (flat, potentially moulded: see Chapter 11 for discussion) and partly of *banco*. One section of this structure seemingly functioned as a step in front of the new eastern doorway, but it is unclear what function the remaining flat *banco*-covered surface would have had. The passageway between Wall 21 and Wall 18 appears to continue in use, a clay floor surface found within the interior of the room also continuing at ground level through this passageway at the beginning of this horizon (Fig. 7.13).

The first occupational deposit within this horizon is Context 92, a very compact, green-tinged clay surface which also continues into the passageway, as noted above.

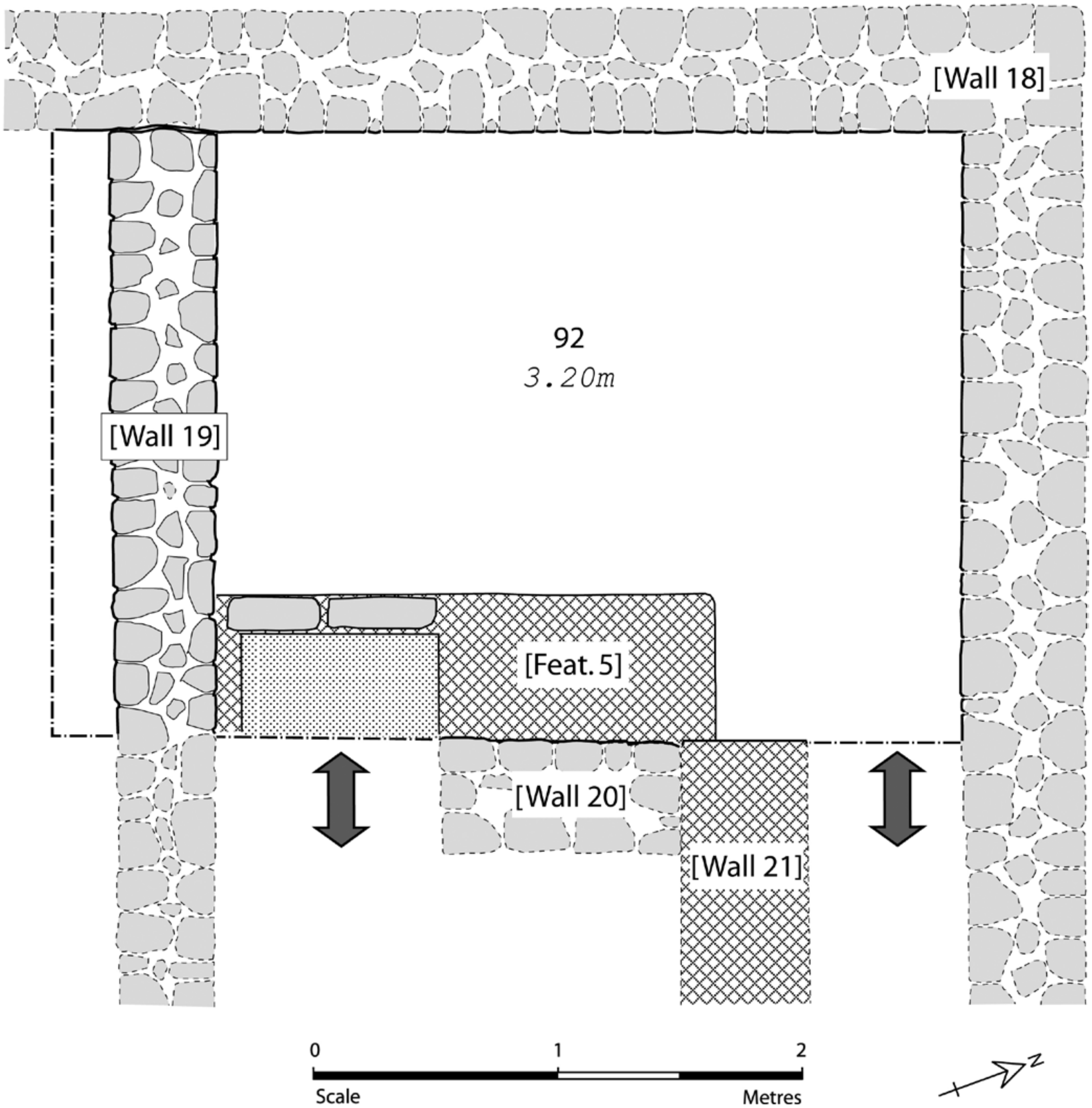

FIGURE 7.12 *Plan of Ek-A Horizon 7 (showing all contemporary walls and features).*

This appears to have been laid down to provide a solid surface for new occupation. The low mud-built structure seen on the east wall [Feature 5] is built on top of this. Covering the clay surface is a layer of coarse sand containing little cultural material [90], presumably a living surface, in the pattern we have so far observed.

As with the previous horizon, we seem to be dealing with a room space that has access points in only one wall. The minor shifts in the wall construction and the rearrangement of exits, as well as the reversion to a clay floor, and the presence of the mud built sub-structure within the room indicate a likely functional shift in the space.

Horizon 8

Within this horizon the dimensions of the rebuilt space of Horizon 7 are broadly retained (Fig. 7.14), though this is the last horizon in which we see the broad dimensions of the original Horizon 3 space retained. The significant change from the previous horizon is the blocking off of the 'passageway' between Walls 21 and 18 to allow for the

FIGURE 7.13 *Detail of the east wall section at the Horizon 7 level – in this image the clay floor which covers the interior of the Horizon 7 room space* [*92*] *can be seen continuing through an open, ground-level passageway which lies beyond the excavation area* (*dark strip at centre of image is clay floor continuing into passageway*).

creation of a large hearth area [89a/b] in the northern part of the room. This blocking off is carried out by filling the doorway with *pisé* and then adding a smoothed *banco* finish. The hearth is defined on the east side by the jutting-out end of the low mud-built structure [Feature 5] while on the western side of the room a small *banco* and stone structure [Feature 4], spatially defines the hearth area. The eastern exit created in the previous horizon is retained and the part of the low mud-built structure [Feature 5] which functioned as a step can be seen to have been built up to match the rise of the floor surface caused by the build-up of occupational deposits.

The first occupational deposit is Context 88b, a very compact, clay floor surface. This is covered by a layer of coarse-grained sand [88a]. Presumably this floor surface was used for a time before the hearth [89a/b] was created. The hearth appears to have been created by making a cut [89b] into the layers below and then placing some large stones at the bottom of this to use as a base. The majority of Context 89a consists of ashy deposits rich in organic material resulting from use of the hearth.

The most obvious alteration within this horizon is then the hearth, but this also alters the spatial layout of the space, leading to the blocking off of one of the room's access points. Accordingly this represents a fairly significant refurbishment of the space.

Period 3a

Horizon 9

Within this horizon for the first time we see a change in the dimensions of the excavated room space from that originally created in Horizon 3. While this horizon features west, east and north walls in the same position as those of the rooms in previous horizons, there is now no southern wall present within the excavated space (Fig. 7.15). The creation of Wall 17 – the only structure seen within the excavated space – sees construction taking place on top of three of the four walls of the previous room space. However, it seems this new construction only utilised previous walls as foundations rather than maintaining portions of them above the ground level as we seem to have seen previously. It is possible to discern that rebuilding has taken place from a basal level due to the discontinuity in the vertical plane of construction right round the three walls from the base of the Horizon 9 deposits, a discontinuity which would only likely occur if the walls were rebuilt from this level. Seemingly this represents the first time this building has been rebuilt from a basal level so far in the sequence, an equally large departure therefore from previous construction as the change in the dimensions of the room space. In addition to these departures in construction, we no longer see the use of mud-built construction, all three walls being made from uncoated worked stone – the wall [21] built on top of the original 'staircase' structure built in Horizon 3 is now levelled and not rebuilt. While the rebuilt northern wall contains no doorways, the west and the east walls both feature breaks which might relate to doorways, although the coverage of excavation does not allow us to clearly determine the southern extension of this structure. It is possible that this is actually a semi-enclosed space totally open on its southern side.

The first occupational deposit is a compact clayey-silt deposit [87b] seemingly laid down to level the occupation surface. Covering this is a layer of sand [87a], presumably a living surface. Following this is Context 86b, another compact clayey-silt 'bedding' deposit which has cut into it a pit [85b/a] of *ca* 50 cm diameter and *ca* 35 cms depth containing coarse-grained sand (in the northern portion of the room): possibly, this pit functioned to store valuables, being then sealed with the medium-grained sand living surface [86a] which covers it and Context 86b. Covering this sand surface is Context 84b, a compact clayey-silt layer dotted with post-holes (Fig. 7.15) and cut by a rectangular pit [82b/a] and a gulley or slot trench [83b/a] the latter containing a very ashy deposit. The arrangement of the posts and their association with Contexts 82b/a and 83b/a is very distinctive but has yet to be precisely interpreted. It is to be noted that this is the last horizon in which we see post-holes. Covering Context 84b is Context 84a, a layer of medium-grained sand. Slightly modifying the pattern of deposition, the next deposit is a sandy-silt layer [80b] containing a relatively high amount of organic material,

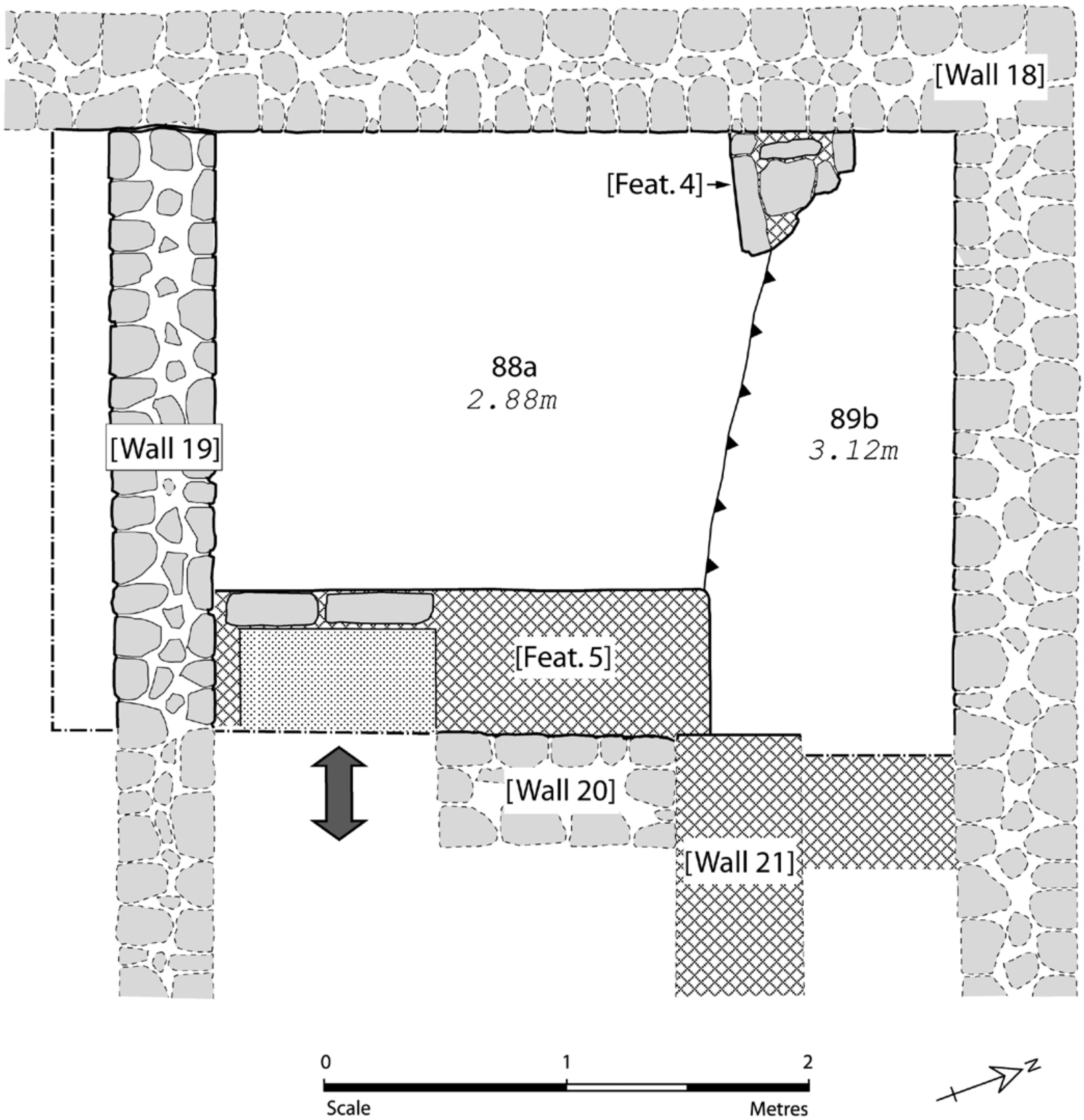

FIGURE 7.14 *Plan of Ek-A Horizon 8 (showing all contemporary walls and features).*

followed by a layer of medium-grained sand [80a]. No features are associated with these final two deposits.

This horizon therefore represents a significant departure in that we no longer see a complete room space within the parameters of the unit, and indeed there is also a lack of continuity in terms of the exits from the space. This said, deposition is very consistent with a 'layered caked' series of compact soil surfaces followed by sand.

Period 3b

Horizon 10

The walls built in the previous Horizon [17] are used as the foundation for the majority of the new construction in Horizon 10 (Fig. 7.16). However, the addition of Wall 16, built on an east-west axis across the centre of the excavation unit, leads to a major change in the arrangement of space. This east-west wall splits the space seen in

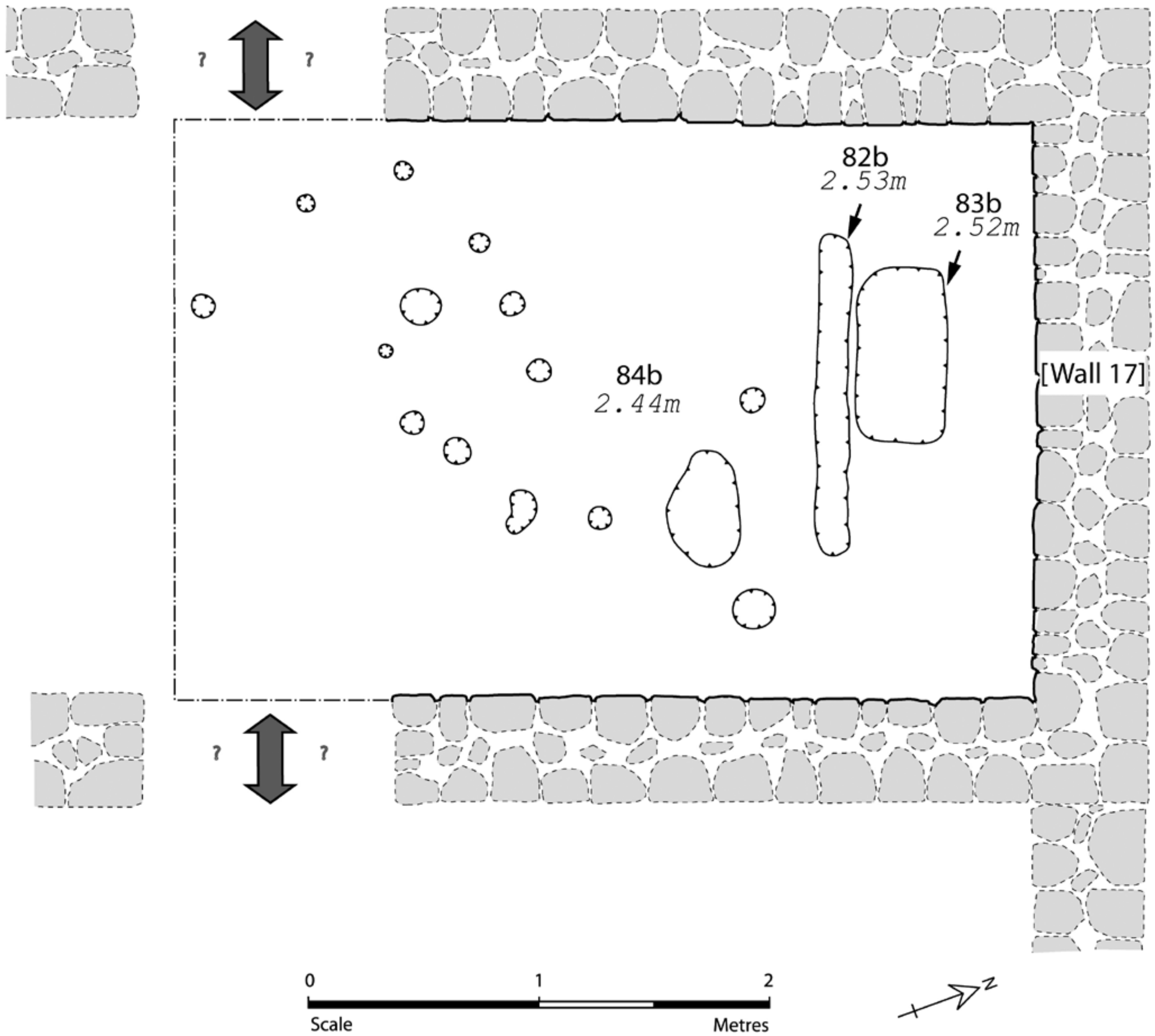

FIGURE 7.15 *Plan of Ek-A Horizon 9.*

the previous horizon to create a self-contained room space in the north of the excavated area while the remainder of the space contains a portion of an architectural space extending beyond the excavated area southwards. For the first time therefore we see substantial portions of two separate living spaces within the excavated space. The lack of a doorway in Wall 16 means that access between these spaces was not possible. The living space in the north of the unit seems therefore to have been approached through a doorway in the north wall incorporated into the building of Walls 12 and 15. The southern area has evidence of a doorway in the east wall and a break in the west wall which is either one side of a doorway or a larger opening in the wall.

While in the previous horizon for the first time we saw the absence of any mud architecture construction, this horizon again sees evidence of this, Wall 13 and the portion of Wall 14 forming the other side of the eastern doorway being constructed of *pisé* (the remainder of Wall 14 also has stone inset into it); the bottom range of the new east-west wall [16] is also a mud-built construction, but here we see the use of mud bricks (Fig. 7.17), only previously seen in relatively limited use in Feature 5 from Horizon 7. The rest of the construction is in worked stone. There is also evidence for the use of a plaster coating in this horizon on the eastern wall.

The first deposit is a mixture of clay and gravelly sand: this was removed as two separate contexts [72, 79] but represents one homogenous deposit. It is upon this layer that Wall 16 is constructed; while this wall is made of both mud bricks and stone it appears to represent one uni-

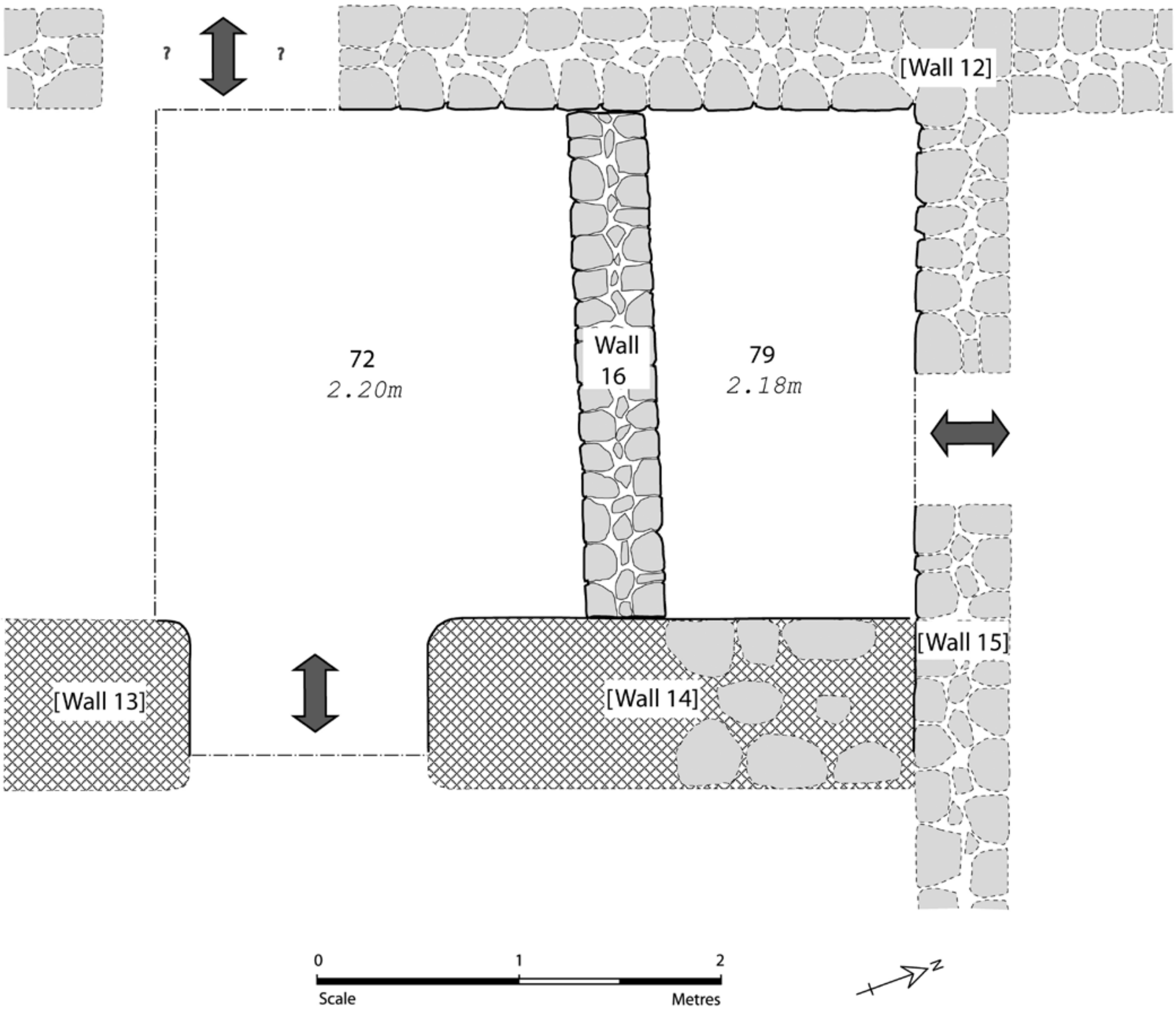

FIGURE 7.16 *Plan of Ek-A Horizon 10 (showing all contemporary walls).*

FIGURE 7.17 *Course of mud bricks forming the base of Wall 16.*

fied phase of construction. Following Wall 16's creation, the first deposit north of this wall is Context 78, an ashy, sandy-silt layer extremely rich in organic remains. Within this deposit is a hearth [78b] and also a lens of extremely well-preserved semolina (see Chapter 21 for further discussion). Overlaying Context 78 is a very similar ashy, sandy-silt deposit extremely rich in organic remains [77]: at the top of this deposit are the remains of a coiled-reed mat (see Chapter 18 for illustration), similar to those used amongst the Tuareg of the area today as a support for pots and other items. It seems this space would have been linked to another architectural space to its north rather than this being accessible from a street or other exterior space – while no excavations occurred to the north of this room in this horizon, excavation in the horizon above revealed a wall enclosing the area beyond this northern room space which appears to have already existed in Horizon 10. The only deposit laid down in the space south of Wall 16 following the clay bedding layer [72 and 74] is Context 71, a compact sandy silt containing little organic remains. The presence of multiple access points into and out of this southern space suggests this would have functioned as a thoroughfare in some way.

Horizon 11

In Horizon 11 though the majority of construction is rebuilding of previous structures, the major construction change that takes place creates an entirely different living space to that seen in Horizon 10. What takes place is a levelling of the east-west wall built in the previous horizon [Wall 16] to a height of *ca* 50 cms above the level of the inherited floor surface [71] in order to create a raised structure coated with red-ochre coloured *banco* [Feature 3] in the area north of this wall (see Figs. 7.18, 7.19); this

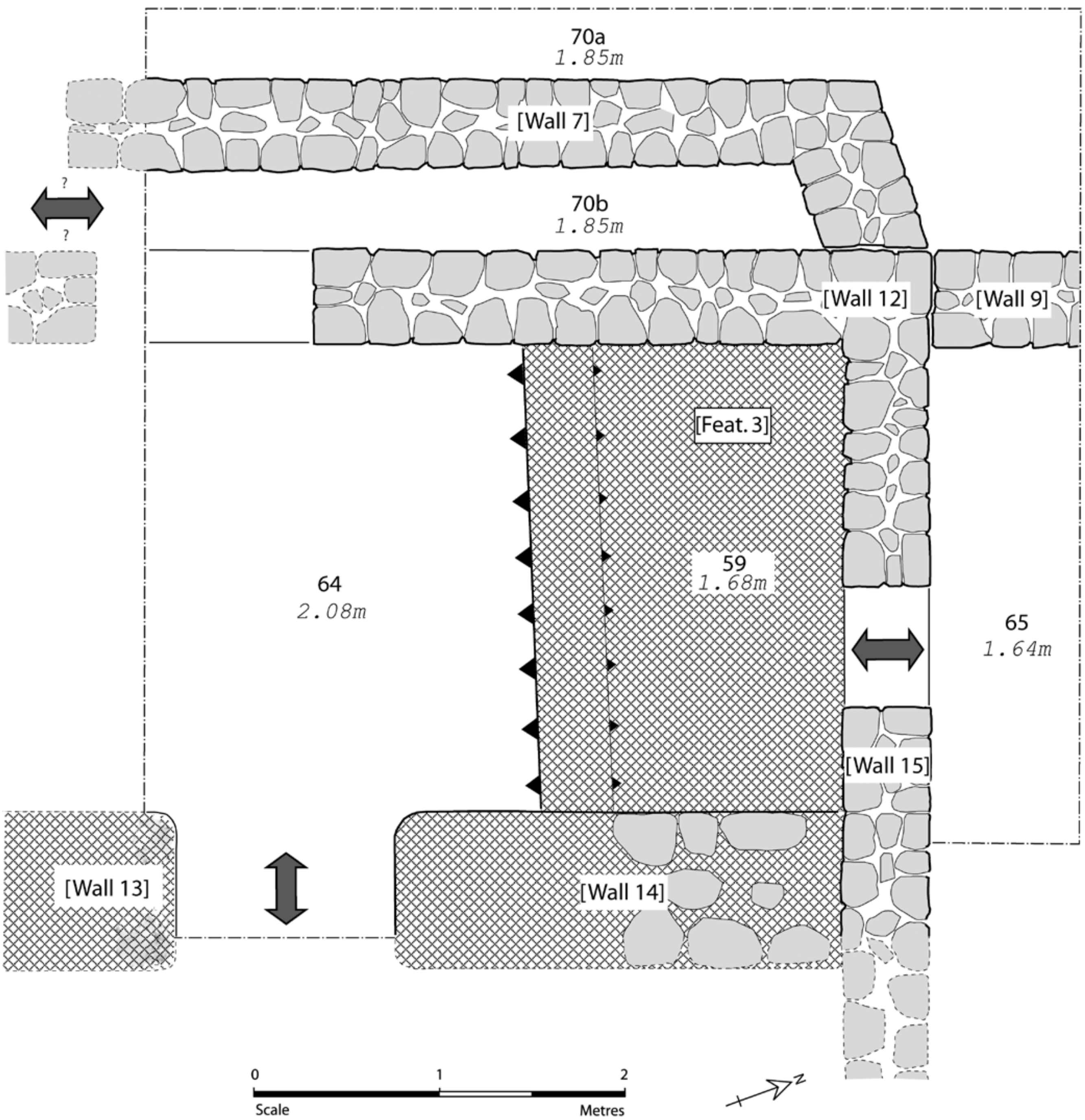

FIGURE 7.18 *Plan of Ek-A Horizon 11 (showing all contemporary walls and features).*

FIGURE 7.19 *Elevated view showing red-ochre coated,* banco *'seating-platform' within Ek-A Horizon 11.*

structure is interpreted as having been a seating platform (see Chapter 11 for further discussion). Having lowered the wall to a required height, the next stage of the construction process was the addition of a clayey-silt fill [75] to the area north of the wall to bring it up to the required height (this fill is distinguishable from the deposits preceding it as it contains little ash or organic material). To create the surface of the seating platform a very compact *banco* coating with a red-ochre colouring [59] is laid over this fill. This same red-ochre *banco* coating is also applied to the vertical face of the seating platform. The lower floor area of the rest of the room space is covered in a very compact clay layer [64]. Allowing access beyond the seating platform is a doorway which is a restructuring of that from the previous horizon. Due to the excavation of the area north of the room space in this horizon we see that the north side of Walls 12 and 15 were also coated in red-ochre *banco*. This area north of the room space was contained within the same compound as the central excavated room space, evidenced by the rebuilding of Wall 9 inherited from the previous horizon. Also, excavation to the west of the room space shows that during this horizon a wall [7] was tacked onto the exterior of Wall 12 (Fig. 7.20), seemingly either to obstruct the view from the exterior through the western break in the architectural space or to provide an area of storage in the gap created between Walls 12 and 9 (see Fig. 7.18 for hypothesised arrangement).

Exits from the southern area of the room space remain the same as in the previous horizon. The rest of the deposits in the horizon – in the central area [62, 57, 55, and 56], from the area in the north of the unit [Contexts 65 and 52], and the western area [Contexts 70, 68] – are a mixture of worked stone, loose clayey silt and mud 'wall melt' (i.e. the wall collapse of a mud-built wall). It is unclear whether the wall collapse these contexts signify relates to intentional destruction prior to new building or to other causes.

FIGURE 7.20 *Wall 7 created in Horizon 11.*

Period 4

Horizon 12

This horizon sees fairly significant restructuring of the architectural space following the major wall collapse seen in Horizon 11 (Fig. 7.21). The first major change is that the 'seating platform' [Feature 3] is completely covered over and not rebuilt. The majority of the excavation unit is again occupied by one architectural space on the same level. Three walls of this architectural space can be seen within the unit – a new wall, Wall 10 (not built on a previous wall as it occupies a slightly more westerly position than the preceding wall), defines the east side of the space, while the north and west walls of the space are formed by Wall 8, built on top of previous walls. Again we see the same 'break' in the west wall as in the previous horizon but the east wall and the north wall have no exits. The architectural space extends beyond the unit in a southern direction. The wall added onto the west wall in the previous horizon [Wall 7] continues in use, as does the wall extending the architectural space in a northern direction [Wall 9]. One other new wall is created, a mud wall (whether of *banco* or a more compact *pisé*-type construction is unclear) in the north of the unit [11] – the west face of this wall is coated with red-ochre coloured *banco*, as is the north face of the north wall [Wall 8]. A plan view of this layout shows that the excavated area now contains portions of three different living spaces in addition to the area to the west of Wall 8 (possibly an exterior area).

Only one deposit shows signs of occupation within this horizon, a thin layer of compact, sandy-silt containing occupational debris (Context 54, 45b, 58a, 58b and 47 – see Fig. 7.21 for context locations). No other significant features are found within the horizon. The termination of this horizon is marked by a thick layer of wall collapse containing worked stone, pure clayey-silt and mud 'wall melt'; this wall collapse has continuity right throughout the excavated area [43, 45a, 49 and 46 – locations given in context descriptions]. Buried by this wall collapse is a 'complete' crushed pot (Fig. 7.22). The organic temper of this pot has been radiocarbon dated and produced a date of 1316–1408 cal. AD [Oxa-16150; 579 +/– 30 BP].

Horizon 13

Following the large-scale collapse of Horizon 12, Horizon 13 sees significant rebuilding and a new arrangement of space (Figs. 7.23, 7.24). Architectural continuity is broadly maintained with the previous horizon, however, as the two most major walls [3 and 5] are built on previous walls, thereby retaining the basic positions of the north, west and east walls from the previous horizon (the section of Wall 3 which forms the east wall of the central architectural space is however created in a slightly more westerly position). The new arrangement of space is largely created by the addition of an east-west wall [6] with no structural precedent. Linking with Walls 3 and 5, this creates a roughly square room in the centre of the unit, accessible through its north wall; within this room we see a small, low, platform made of earth and worked stone [Feature 2] which seemingly functioned as a support for pots (see below). In the south of the unit we again see a fairly large portion of an architectural space extending southwards beyond the unit; this is accessible on its western side by a doorway between Wall 5 and Wall 4. Excavation on the east side of the unit again evidences a small portion of another architectural space. No construction was seen in the west and north-west areas of the unit and these are potentially exterior spaces.

Prior to construction of the east-west wall [6] a very compact clay deposit [39] was laid down on the remains of the previous horizon within the area defined by

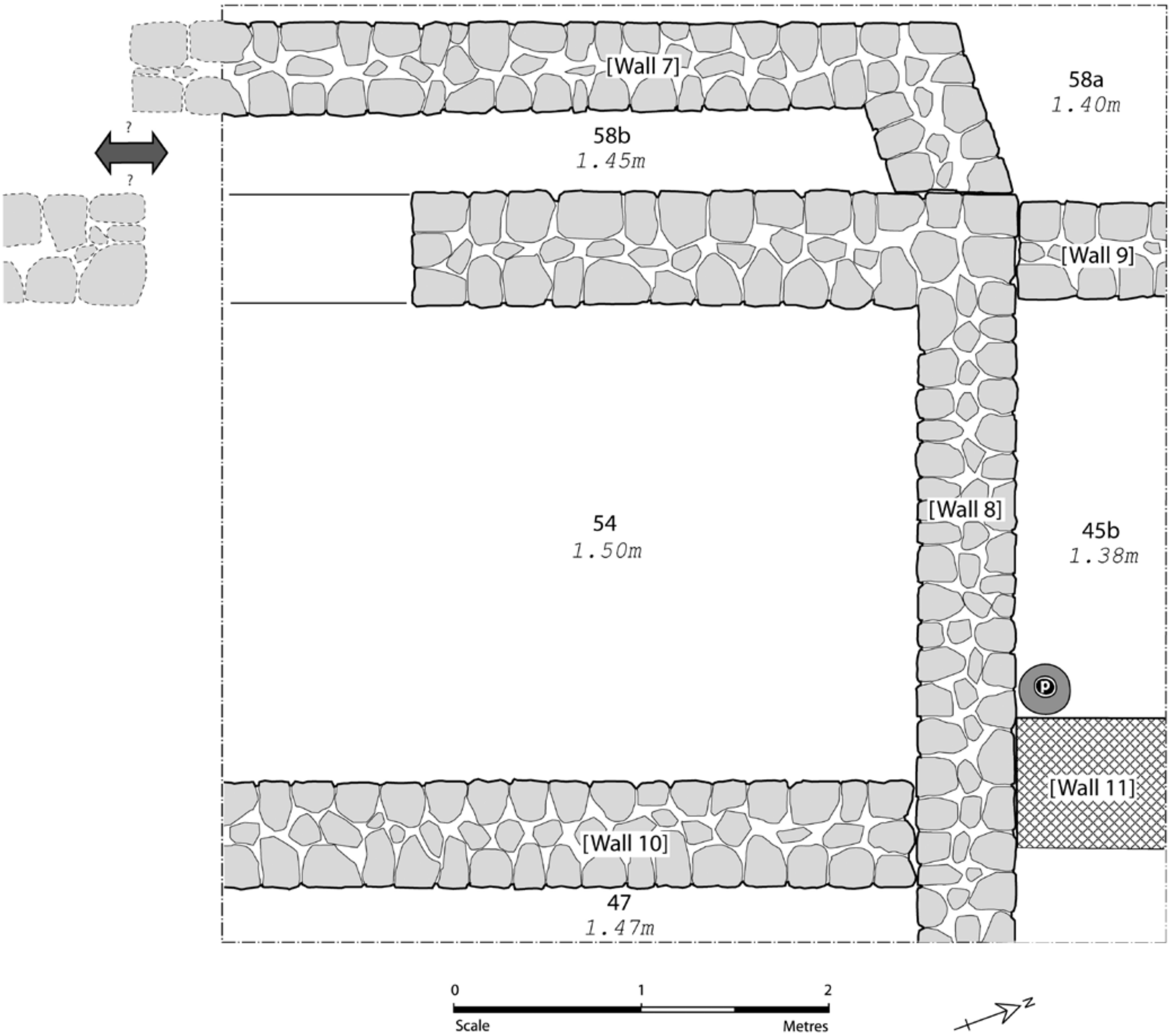

FIGURE 7.21 *Plan of Ek-A Horizon 12 (showing all contemporary walls).*

Walls 5, 6 and 3 (Feature 2 is also built on Context 39). The first deposit in the east of the unit [40b] is of a similar nature. Following construction of the east-west wall, we see a thick layer of sand [22] assumed to be the living surface of the room. Within the room we also see two complete pots (Fig. 7.24), one posed on the sand and one on the low platform. The next deposits in the spaces to the south [33] and the east [40a] of the room are of a similar character to those seen within the room. In the majority of the area to the west and the north of the unit the only deposit we see is a clayey silt containing patches of gravel [32]. Immediately outside the western doorway, large paving slabs appear to have functioned as an entrance step. Associated with these slabs was a small sheet of crumbly white plaster (no sample taken), seemingly fallen off from a wall surface.

FIGURE 7.22 *Crushed pot covered by the wall collapse marking the termination of Horizon 12.*

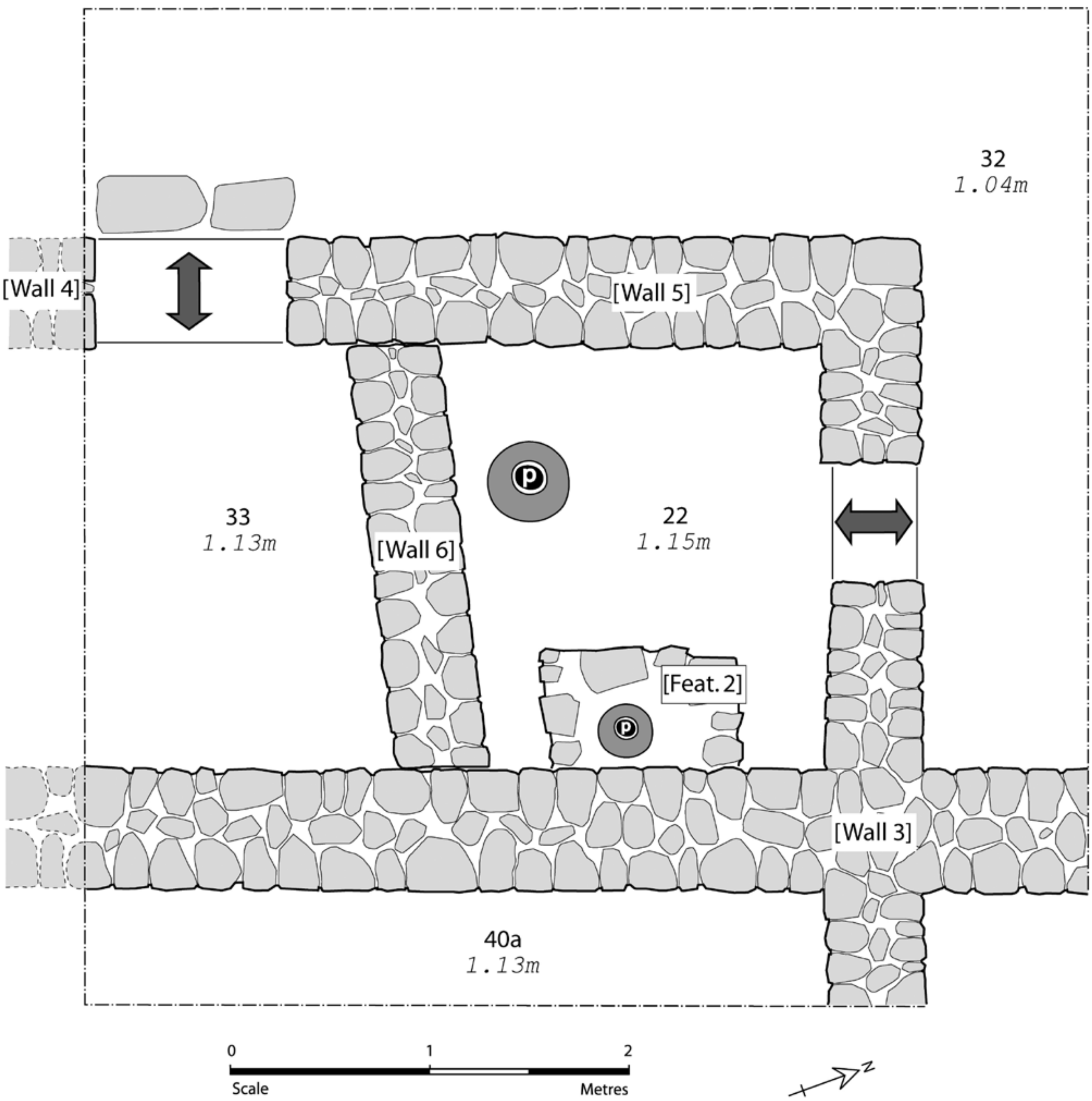

FIGURE 7.23 *Plan of Ek-A Horizon 13 (showing all contemporary walls and features).*

The termination of the horizon is marked by a thick layer of wall collapse throughout the unit [17, 16, 14, 30, 28, 31, 27, 38]. Significant amounts of pure charcoal within the first layer of this collapse [18] suggest the termination of this horizon was accompanied by burning, perhaps of a roof which collapsed.

Horizon 14

This is the terminal occupation horizon within the unit. The rebuilding following the previous horizon closely follows the architectural layout used in that horizon, with a complete room space continuing to occupy the central area (defined by Walls 1, 2 and 3) (Fig. 7.25). However, the east-west wall forming the new southern wall of the room [2] is built slightly further south than in the previous horizon. Also, the building of Wall 1 on the remains of previous walls includes a filling in of the western exit seen in the previous horizon, as well as a re-extension of the architectural space in the north-west of the unit. In addition to the rebuilding of Wall 3, the only other structure built within the horizon is Feature 1, a small *banco* structure featuring two *ca* 20cm deep circular depressions, in

FIGURE 7.24 *Horizon 13 room shown with intact pots (revealed by the removal of a thick-layer of wall collapse).*

the south-west of the room (Fig. 7.26). While these bear a certain resemblance to grain storage bins excavated at Tegdaoust (Devisse *et al* 1969) they are smaller than this and likely relate to some other still unexplained function.

Other than the central room, the unit contains portions of four other architectural spaces. The only break seen within the arrangement of walls is the doorway which provides access to the central room space through its north wall. As this is the terminal occupation, one can clearly trace the rest of the building complex that these excavated spaces relate to. One can see that the area excavated within this horizon is located on the west side of this larger building complex and this is situated on a street, a portion of which has been excavated in the west of the unit.

Within the central room the first deposit is a compact, gravelly sandy-silt surface rich in organic material [9] and deposits within the other architectural spaces are of a similar nature [8, 15 and 12]. The deposit in the west of the unit [20], the street area, has evidence for a pit [19b/a] having been dug into it. The termination of the horizon, and with it the occupation of this point of the site, is marked by a thick layer of wall collapse throughout the unit [3, 5, 4, 7, 13, 10, 1, 11 and 2], containing distinct burnt patches and ashy soil (Fig. 7.27), followed by a thin layer of wind-blown sand [Surface].

Stratigraphy and Periodisation

All the deposits within unit Ek-A have now been described. Figure 7.28 provides an illustration of these in stratigraphic position.

There is a need to divide the relatively numerous horizons encountered within the Ek-A sequence into broader divisions, or 'periods'. The primary aim in doing this is to allow us to analyse the sequence of deposits, structures and material culture at a sufficiently broad scale to help identify patterns of cultural change. Not only does this broader scale analysis allow us to consider longer term cultural change at Essouk-Tadmekka, it also allows us to compare the Essouk-Tadmekka sequence with similarly broad periodisation sequences established from other archaeological sites relevant to our analysis. We will however also investigate in more detail the variability between different horizons where this is relevant.

Figure 7.28 illustrates how the Ek-A sequence has been divided into four different periods. This periodisation

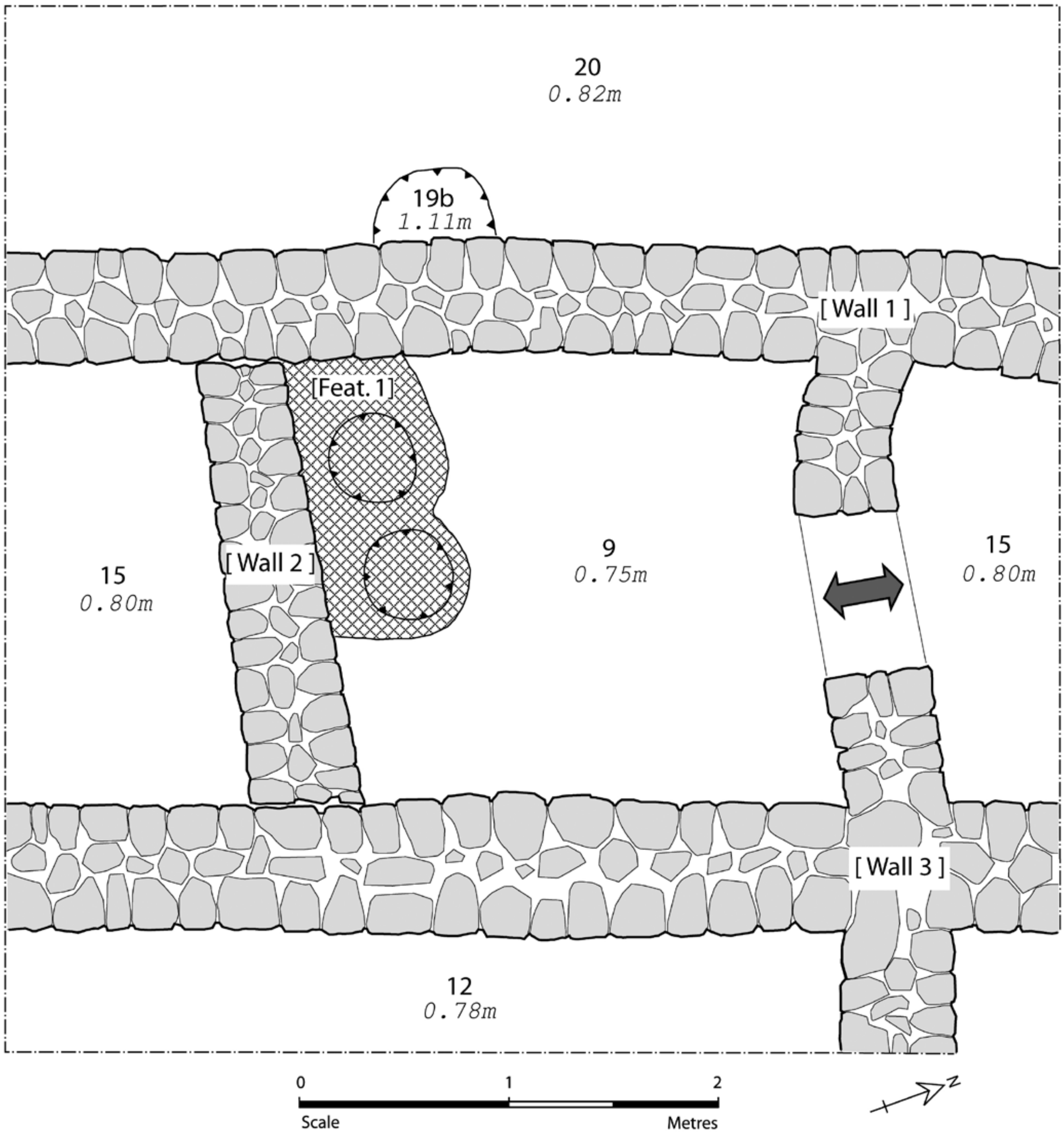

FIGURE 7.25 *Plan of Ek-A Horizon 14 (showing all contemporary walls and features).*

has been created on the basis of identifying significant changes in construction and significant changes within the nature of the occupational deposits. Accordingly, the first period, Period 1, was defined simply as the deposits prior to the first evidence of permanent architecture, corresponding to Horizons 1 and 2. Period 2 commences with the first evidence for permanent architecture and also includes all the horizons which maintain the basic dimensions of the original architectural space created in Horizon 3, therefore consisting of Horizons 3, 4, 5, 6, 7, 8. Aiding the selection of the Horizon 8/9 interface as a significant point at which to draw a division between periods is the fact that in addition to being the point at which the dimensions of architectural space see their first significant change, Horizon 9 also represents the first point at which we seem to see a complete rebuilding of structures

FIGURE 7.26 *Unidentified Feature 1 seen within the central room space of Horizon 14.*

FIGURE 7.27 *Southern area of the unit shown during the removal of Horizon 14 collapse deposits (dark area where arrow and scale are located is an area rich in charcoal and ash).*

from a basal level, something already pointed out in the Horizon 9 description.

Period 3 is composed of the deposits laid down in Horizons 9, 10 and 11. Deciding the point at which to draw the line between Period 3 and Period 4 (the Horizon 11/ Horizon 12 interface) was made principally according to the fact that the end of occupation of Horizon 11 seems to mark a point after which we see evidence for large-scale wall collapses, this being seen in each of the horizons which follow Horizon 11 whereas previously we had not seen this evidence. While Period 3 can be approached as a whole it was also seen to be advisable to make a sub-division of Period 3 into 'Period 3a' and 'Period 3b' as there was also a significant structural change which occurred between Horizons 9 and 10 and it was seen to be necessary to maintain the possibility of analysing the Horizon 9 and the Horizon 10/11 deposits separately. The remaining Horizons, 12, 13 and 14, are therefore grouped as the final period, Period 4. The Period 3/Period 4 distinction we have made appears to be a sensible one as we also see that in Period 4 we see a distinct decline in the quality of construction compared with what we had seen previously (though this is certainly more marked in Horizons 13 and 14 than in Horizon 12).

The sequence has been anchored to an absolute chronology by means of radiocarbon dating. A clear illustration of the chronology of the four periods is shown in Figure 7.28 and these are discussed further in Chapter 10. As there has been no previous attempt to construct a periodisation sequence for the site, and as this is based upon a limited excavated sample, it is obviously advisable to recognise that future excavation at the site might result in modification to this periodisation sequence.

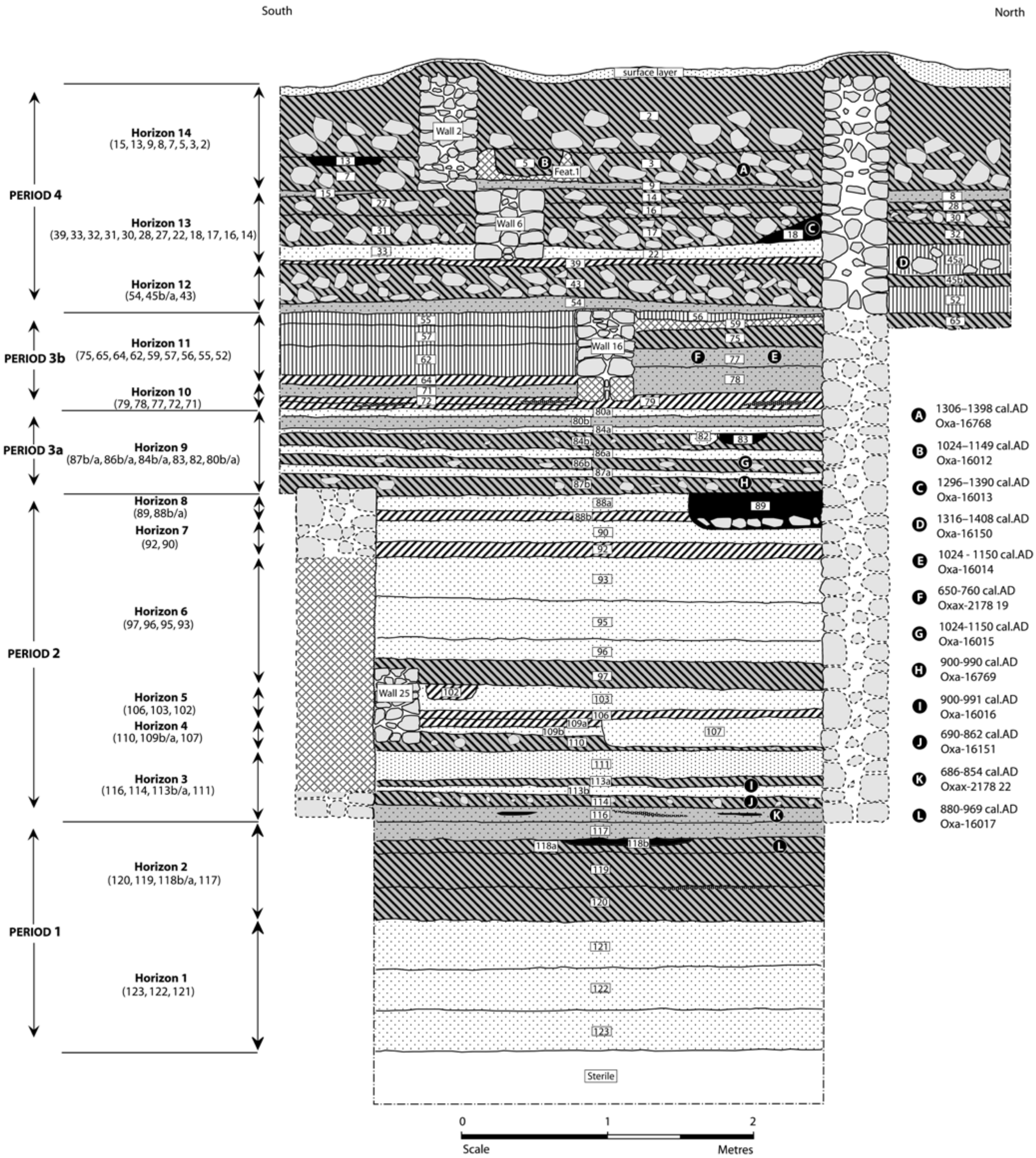

FIGURE 7.28 *Section drawing illustrating the individual deposits, horizons and periods excavated within unit Ek-A; based upon a north-south line through the centre of the excavation unit.*

CHAPTER 8

Excavations near the Eastern Cliffs (Unit Ek-B)

Sam Nixon

Overview

Excavation unit Ek-B was located amongst the eastern area of the ruins, further south than unit Ek-A and close to the cliffs (Fig. 8.1; grid reference: n 18° 46.145, e 001° 11.255). In this area of the site the standing remains of buildings are higher than anywhere else on the site, certain walls standing to 2 metres in places. In addition to the better preservation, the buildings in this area of the site also appear to be of a different nature to those encountered on the surface across the majority of the site, being generally composed of larger individual architectural spaces and with thicker walls containing larger individual stones (Chapter 11 for further discussion). The excavation unit itself was located across a wall which appeared to serve as the exterior (southern) wall of a courtyard associated with a large building complex (Fig. 8.2). At the commencement of excavation the unit covered an area of 25 m² (5 × 5 metres) and was oriented at 10°. The surface level of the unit was 5.40m below the site datum.

By comparison with unit Ek-A, this unit produced a fairly shallow stratigraphy, the deepest deposits being found at around 2 metres below the surface (note however that this does not imply that this whole zone of the site has a shallow stratigraphy: see further discussion below). Other than the wall on the surface included within the excavation unit, only one other wall and one other structural feature were evidenced during excavation. As will be shown later, the majority of the deposits appear to correspond to Period 2 of the occupation sequence defined from unit Ek-A.

The Ek-B Deposits

Horizon 1

The Horizon 1 deposits consist of *ca* 1.2m of cultural soils. Below these deposits sterile soil was encountered. The Horizon 1 deposits were only evidenced in the south-west corner of the excavation unit (Fig. 8.3), a heavily cemented sterile gravelly deposit being encountered in all other areas of the excavation unit. This localisation of the Horizon 1 deposits in the south-west corner results from the topography in this area of the site prior to the Horizon 1 occupation. Prior to Horizon 1, the area where the excavation unit is located was the site of a sharp drop in elevation as the land descended (east to west) from the hillside towards the wadi (similar sharp changes in elevation can

FIGURE 8.1 *Illustration of the location of unit Ek-B: a) map showing the surface structural remains around unit Ek-B (note small mosque in the bottom left section of image, as well as clusters of circular tombs); b) the eastern area of the site seen from the eastern cliffs, showing the location of unit Ek-B (indicated in white).*

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FIGURE 8.2 *Unit Ek-B seen on the surface – the unit was laid out across an exterior wall of a building compound.*

be seen in areas surrounding the site today where occupation has not taken place – these result from erosion due to water action during the seasonal inundations of the site). The Horizon 1 deposits have accumulated at the lower level of elevation up against the almost vertical wall of this sharp drop in elevation (Fig. 8.3), hence their being witnessed within the unit almost as if in a gully. By the end of the horizon, deposition has led to a levelling of the topography within this part of the site as the ground level of the area occupied during Horizon 1 has risen to the level of the sterile soil of the higher point of elevation and has begun to cover this.

The first deposit laid down within the horizon is Context 17, a loose, medium-grained sand containing fairly intensive evidence of cultural activity. This is followed by Contexts 16 and 15, both deposits being mixes of reddish gravel and greenish clay, but also containing evidence of fairly intensive cultural activity. Following these contexts, we see the deposition of a medium-grained sand mixed with a grey gravel – Contexts 12 and 11 – again evidencing fairly intensive cultural activity. What all these contexts appear to be showing is that within this horizon while the area was the location of fairly intensive cultural activity, deposition also appeared to be resulting from natural processes, most likely due to various types of sediments being washed off the steep incline of the hillside nearby.

There are no walls evidenced within this horizon and the only feature we see is what appears to be a latrine (Feature 1), evidenced in the excavation of a pit ringed by worked stones (Fig. 8.4) and containing soil seemingly rich in phosphorous (though this was not sampled for testing). This structure was created and used during the period of time represented by the last deposit within the horizon, Context 11. To create this structure a pit was cut [14b], then a circle of stones was laid around it. The pit was filled with an organic-rich clayey silt [14a and 13]. While we see no other evidence of architecture within this horizon, it is unwise to conclude this eastern area of the site was not a zone where structures were built at this period as we see such a small area of the Horizon 1 occupation within the excavation unit. Seeking to attach a date to the commencement of occupation seen within the unit, based upon a radiocarbon date from higher in the sequence it is most likely the Horizon 1 deposits date to either the ninth or tenth century AD (discussed further in Chapter 10).

Horizon 2

Horizon 2 consists of *ca* 70cms of deposits, excavated either side of the *ca* 90cm thick wall [Wall 1], recorded on the surface, and in relation to which the trench was laid out (Figs. 8.5, 8.6, 8.7). This wall was built at the start of this horizon. A second wall [Wall 2], *ca* 40 cm thick, abuts the northern side of Wall 1 and continues beyond the excavated space in a northern direction (Figs. 8.5); this was built shortly after Wall 1. The first deposit north of Wall 1 following its creation is Context 8, a loose, ashy deposit (the deposits both sides of Wall 2 were excavated as Context 8. The context above this [4] is of the same character. Both of these contexts contain large quantities of culturally associated organic material. These two contexts

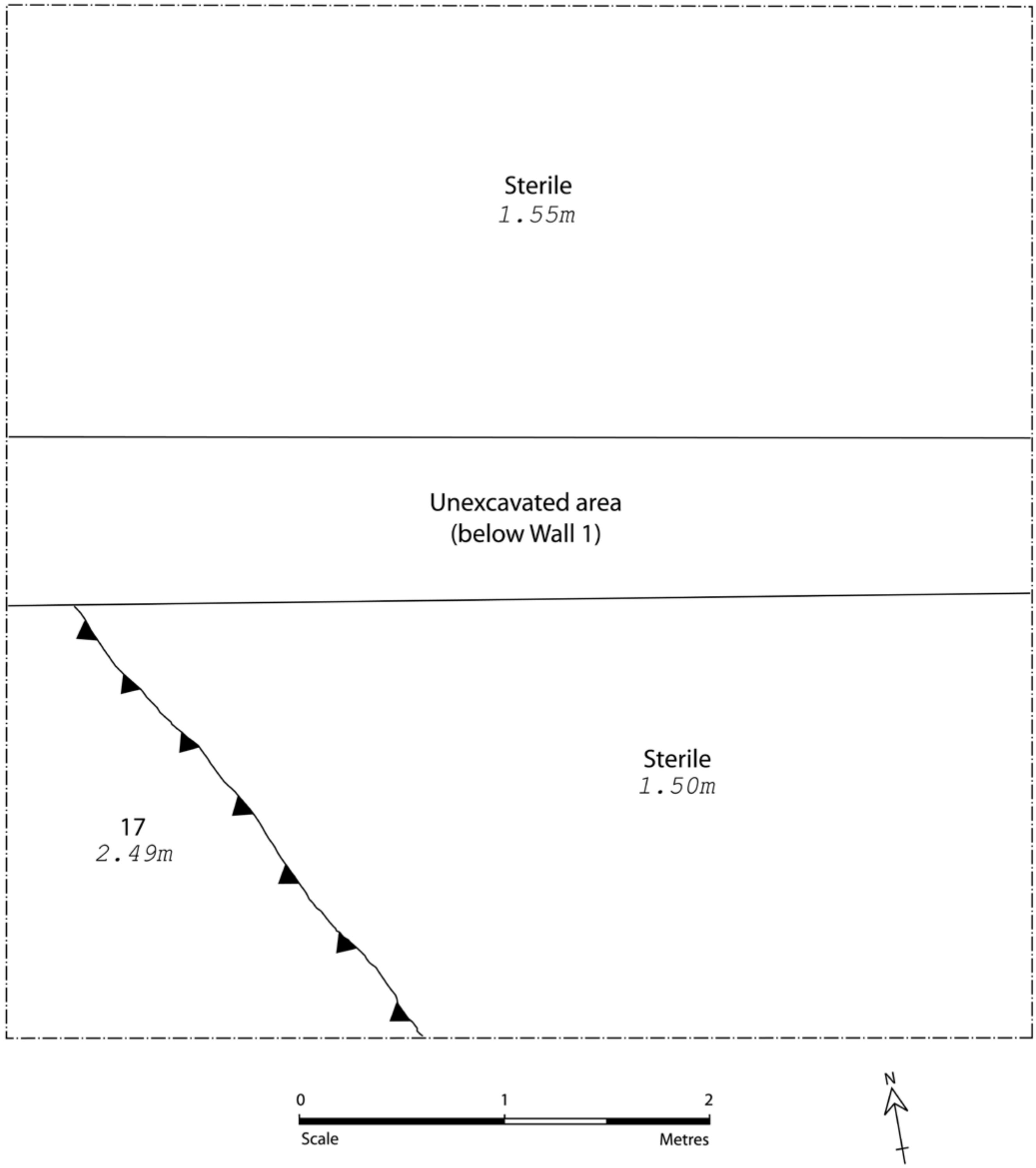

FIGURE 8.3 *Plan of unit Ek-B Horizon 1.*

appear to represent a continuity in the use of this space, either as an area of waste disposal or as a cooking area. The first deposit laid down within the horizon south of Wall 1 was Context 10, a loose, sandy deposit covering the whole southern area of the excavation unit. The deposit which overlays Context 10 and again covers the entire area south of the unit is Context 9, a loose sandy deposit containing areas of ash.

Regarding the spatial interpretation of the remains, it is assumed the area north of Wall 1 was an area internal to some form of architectural compound, while the area to the south was an external area of some form. This

FIGURE 8.4 *Feature 1 (assumed to be a latrine) – within the image the stones used to ring the pit of this structure can be seen.*

interpretation is made firstly on the basis of the presence of Wall 2 in the north area of the unit, a structure which defines an architectural space in conjunction with Wall 1. Secondly, the well-laid and carefully worked construction of the south face of Wall 1 – in contrast to the less well-constructed north face – suggests a surface designed to face the elements and designed for public display. This interpretation of the north and south areas as respectively internal and external would represent continuity in the use of space with the horizon above [3] where the surface archaeology clearly shows the area to the north of Wall 1 was an internal area while the area to the south was part of a passageway between the excavated building and another building.

Horizon 3

The excavated space is again broadly divided by Wall 1, which is reused and possibly built up in this horizon. The other wall which we had seen north of Wall 1 in the previous horizon [Wall 2] is covered over. No new walls or features are created within this horizon. To the north of Wall 1 the only occupational deposit in this horizon is Context 3, loose sand containing patches of ash and two hearths [3b and 3a]; one of these hearths [3a] is extremely large and appears to have been used over a long period of time, being quite a deep deposit (25cms deep). South of Wall 1 two contexts were excavated [2 and 6] but both are composed of a similar compact gravel containing patches of sand and ash. On the surface of this deposit there is evidence for a hearth [2a] and a pit [5b] was cut into this deposit.

The depositional evidence we see in this horizon appears to correlate well with the surface archaeology. The surface archaeology suggests the area to the north of Wall 1 is within a courtyard, while the area to the south is part of a passageway between this building and a neighbouring building. Certainly the gravel remains from the south of the unit fit well with the kind of surface one would expect to see in a passageway. Likewise, the large hearth in the north of the unit is the kind of evidence one would expect to see within a courtyard.

As it was seen to be of importance to determine the period at which occupation in this area of the site ceased, a radiocarbon date was gained from this horizon. This was taken from Context 2. This produced a date of 989–1022 cal. AD [Oxa-16152 1032 +/– 30].

All of the Ek-B horizons having now been presented, Figure 8.8 illustrates the Ek-B deposits in their stratigraphic position.

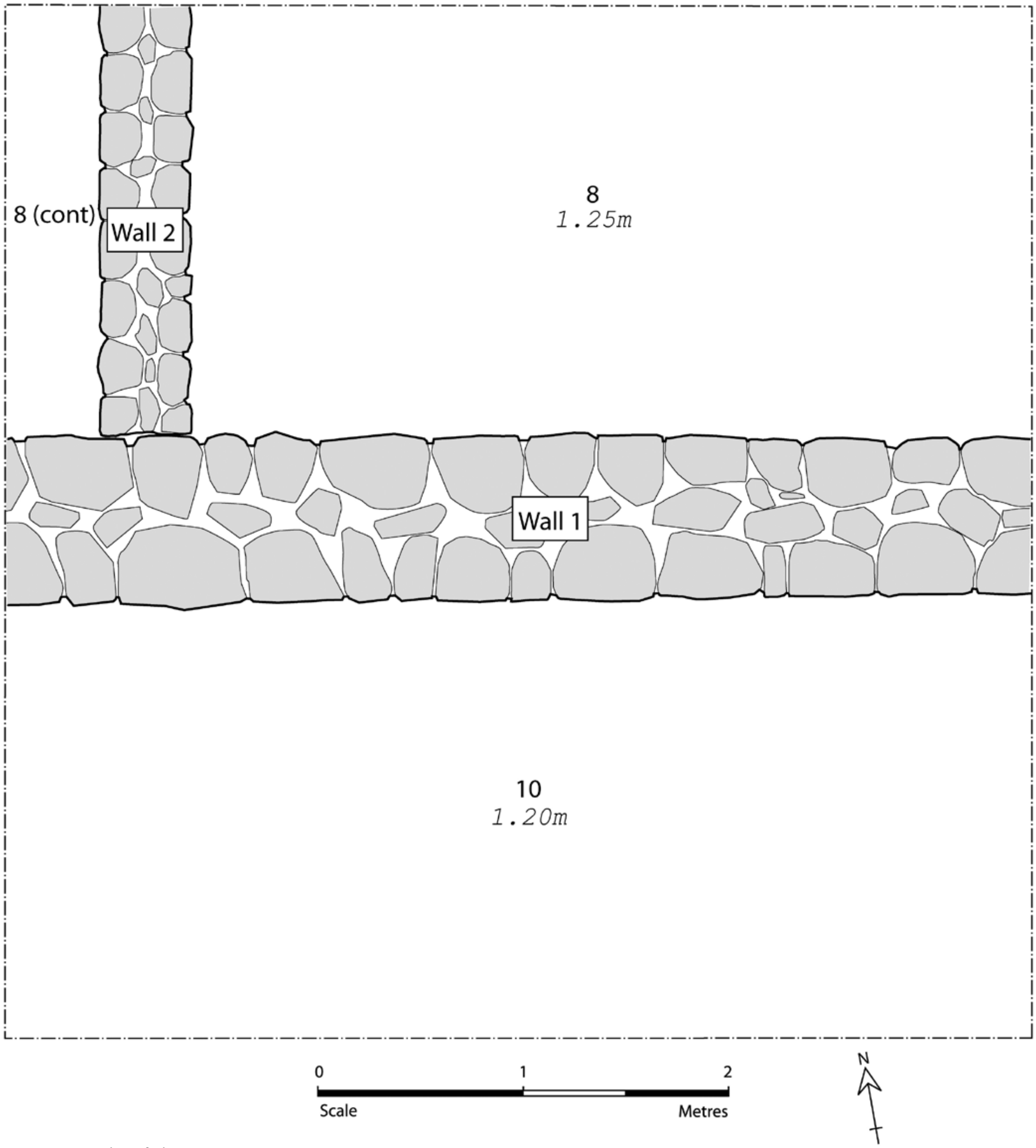

FIGURE 8.5 *Plan of Ek-B Horizon 2.*

FIGURE 8.6 *View of north area of the excavation showing the northern face of Wall 1 revealed to its base.*

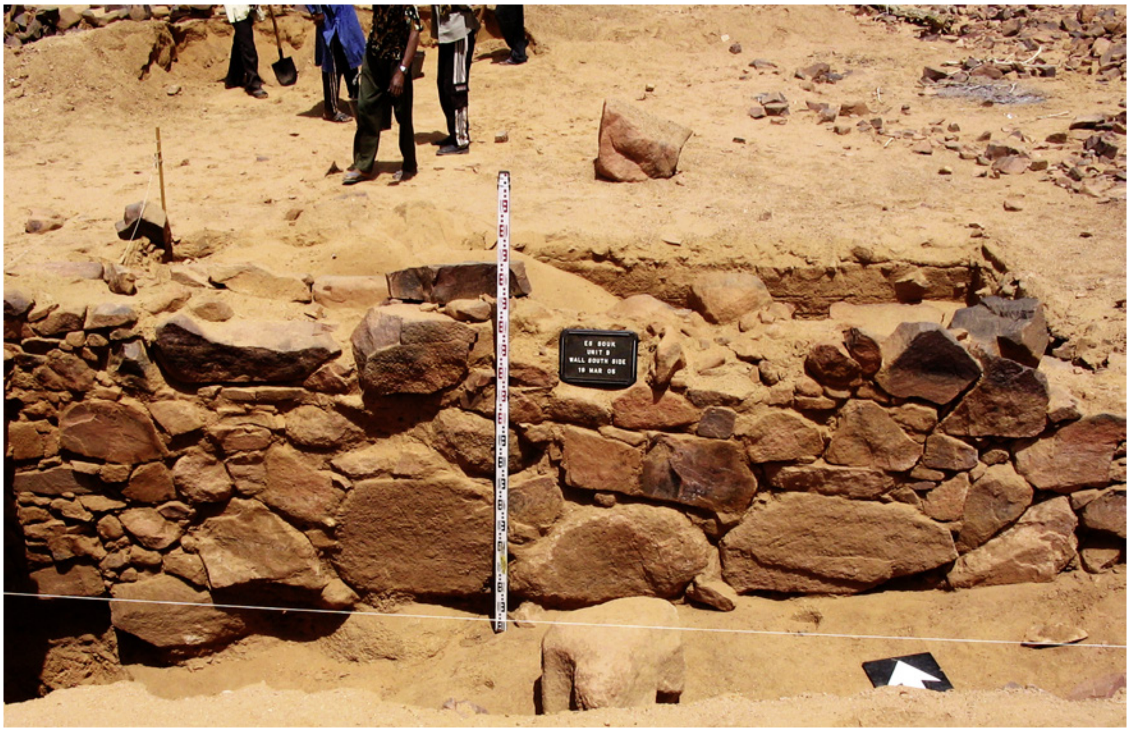

FIGURE 8.7 *South face of Wall 1, showing the large stones used in its construction and the skilful way in which they have been laid.*

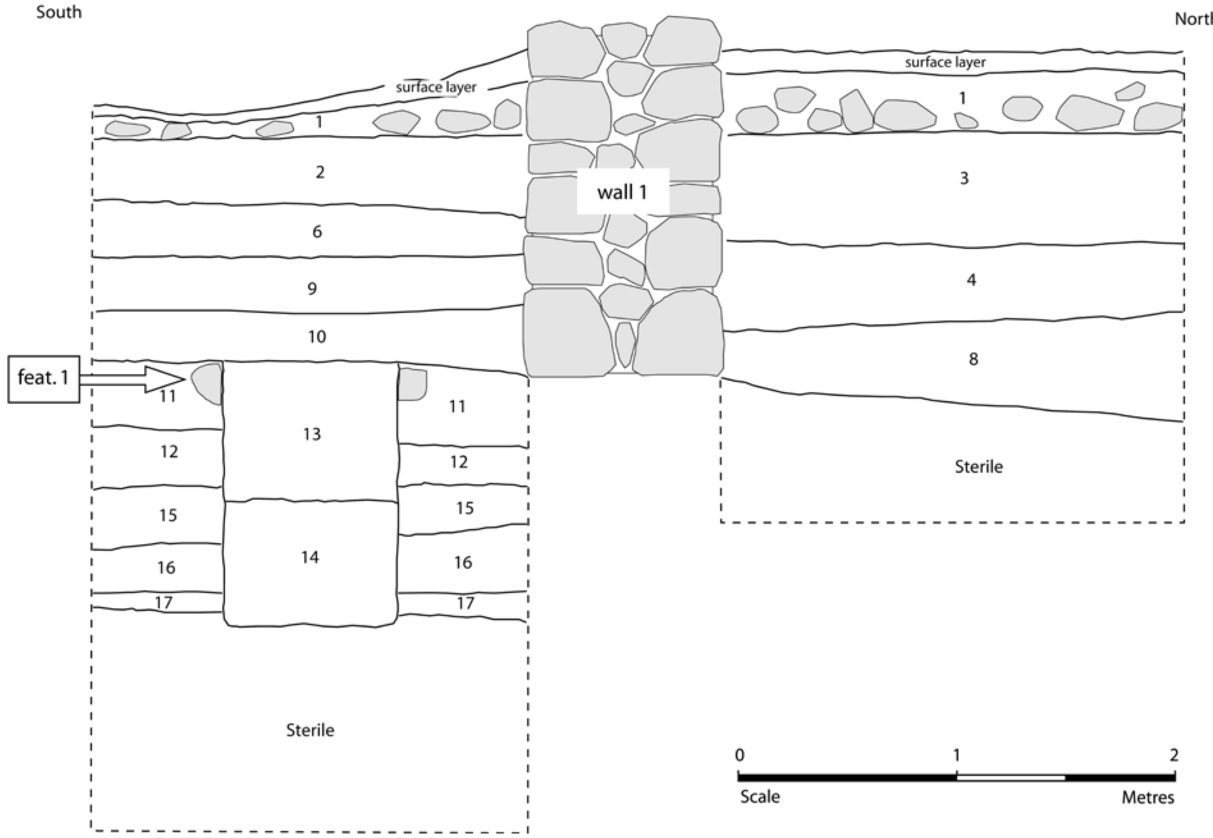

FIGURE 8.8 *Section drawing of the unit Ek-B deposits (on the west side of the unit).*

CHAPTER 9

Excavations on the Island (Unit Ek-C)

Sam Nixon

Overview

Unit Ek-C was located on the island in the middle of the wadi (Fig. 9.1; grid reference: n 18º 46.288, e 001º 11.136). The unit was located across an exterior wall of a building seen on the surface of the site, one side of the unit therefore being within the building, the other side being in the street running north-south along the centre of the island (Fig. 9.2). The unit covered an area of 6 m² (2 × 3 metres) and was oriented at 5º. The surface level of the unit was 7.95 metres below the site datum.

In retrospect, it was seen that the unit was not broad enough on the surface, the narrowing of the trench during excavation very soon resulting in too small an excavated

FIGURE 9.1 *Illustration of the location of unit Ek-C: a) map showing the surface structural remains around unit Ek-C, located at the north tip of the island; b) view of Ek-C excavations under way, looking from the eastern side of the wadi.*

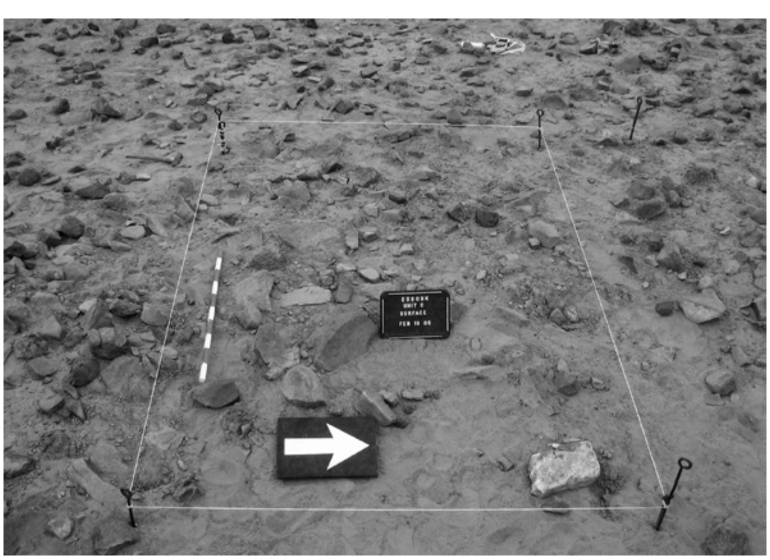

FIGURE 9.2 *Surface of Ek-C excavation area (the remains of a wall run across the centre of the unit but this was only barely visible prior to excavations).*

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area being available for analysis. This was compounded by the presence of a well which had been filled in, encountered just over a metre below the surface (see below). Despite this, excavation was continued, and indeed reached a depth of 10 metres. While investigating the depth of the well-fill was important and informative, there was little remaining room within the excavation unit to evidence the various levels of deposition in this part of the site which the well had cut through. Consequently, the archaeological stratigraphy is very problematic below 2 metres, and the deposits below this are not dealt with in detail. This said, the deposits excavated appear to show that cultural activity potentially occurs down to *ca* 7 metres depth. While it is to be noted that this depth is very similar to the depth of deposits that were encountered in unit Ek-A, it would be dangerous to conclude anything concrete concerning occupation on the island from this evidence. The problematic deposits below 2 metres were grouped into one and identified as 'Horizon 0'. The deposits from which analysis commences will be named 'Horizon 1', despite the fact that these definitely *do not* represent the earliest occupation on the island.

The Ek-C Deposits

Horizon 1

The first deposit within Horizon 1 is Context 13, a mixed deposit of a heavily compacted clay and a compact gravel. This deposit is covered by Context 11, a loose sandy-silt containing large quantities of ash. Into Context 11 a pit is cut [12b] which is then filled with a coarse-grained sand [12a], and this is surrounded by very high-quality, cut stones arranged in the soil immediately above this pit (Figs. 9.3, 9.4). The way in which they provide a neat, low surrounding wall [Feature. 1] to the pit immediately makes one think this is a grave. The depth of the part of the pit evidenced within the unit was *ca* 50 cms. Associated with Feature 1 on top of the pit were more stones which appear to have been similar standing stones but had fallen. The fact that Feature 1 and the pit are only partially present within the excavated area meant that any inhumation this may have contained would perhaps not have been evidenced by excavation. The final deposit within the horizon is Context 10, a layer of coarse-grained sand covering Feature 1 and Context 11. Also contained within the unit at this depth is the fill of the well which is not treated here as it represents the filling in of a cut from a later horizon (see below).

Horizon 2

The commencement of this horizon is marked by the construction of a wall [Wall 2] oriented on a north-south axis. This wall is only partially evidenced within the unit (Fig. 9.5) but from this it is clear that the part we see is a cleanly worked end of a wall of a width of 1 metre, suggesting that the excavation unit is cutting through a very large entranceway, the other side of which lies to the south of the unit. The large width of the wall certainly suggests a significant structure of some form. The deposit from

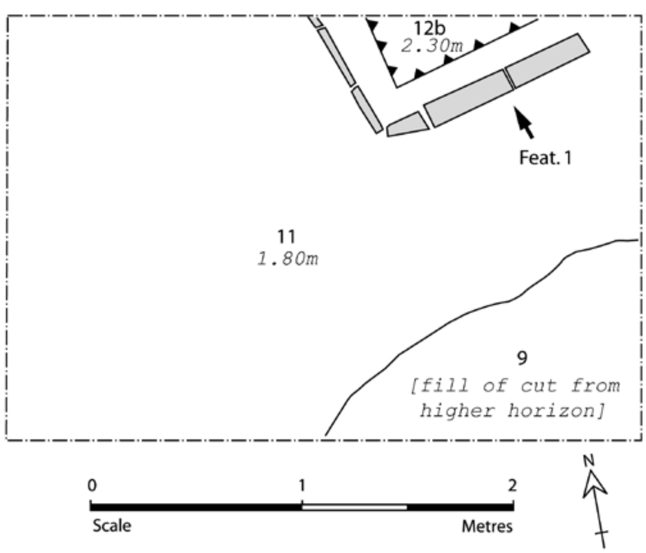

FIGURE 9.3 *Plan of Ek-C Horizon 1.*

FIGURE 9.4 *Feature 1, arrangement of well-worked stones, assumed to be the surrounding wall of a grave.*

the base of this wall was excavated as Context 7, a layer of coarse grained sand. Also seen within the unit was Context 9 (Fig. 9.6a), a deposit made up largely of worked stone but also containing clayey-silt, ash and sand; this context represents the uppermost level of the fill of a well (cut = Context 8) filled with stones and other debris during this horizon. This was explored down to 10 metres (Fig. 9.6b). It is not possible to say that the well was created in this horizon as it could have been created earlier and recut periodically as deposition raised the surface level surrounding it. The other contexts within the unit [6, 5 and 4] are evidence of wall collapse, surely a product of the collapse of Wall 2.

A radiocarbon date was obtained for Context 4, in order to try to date the upper levels of occupation on the island. A date of 1288–1386 cal.AD [Oxa-16770 – 650 bp +/– 27] was obtained.

FIGURE 9.5 *Wall 2 seen within the north face of the excavation unit.*

Horizon 3

The commencement of the horizon is marked by the construction of Wall 1, a wall running in a north-south direction through the centre of the unit (Figs. 9.7, 9.8) – this wall is seen on the surface of the site, Horizon 3 being the terminal horizon. Wall 1 is built immediately on top of the wall evidenced in the previous horizon [Wall 2]; while this is so, the new structure is in evidence right across the unit and therefore does not represent a rebuild of Wall 2 according to the exact same structural plan. It is to be noted that Wall 1 is slightly narrower than Wall 2 (*ca* 85 cms in width) – nevertheless this still represents a fairly wide wall. There are no other walls or features evidenced within the horizon. The deposits within the horizon [2 and 1] are for the most part wall collapse and there was little sign of a distinct occupation surface. The wall collapse within both contexts was composed of significant amounts of worked stone within a very ashy, sandy-silt deposit. This wall collapse represents the last deposit within the unit.

All of the Ek-C horizons having now been presented, a section drawing illustrates the stratigraphic position of the horizons within the unit (Fig. 9.8).

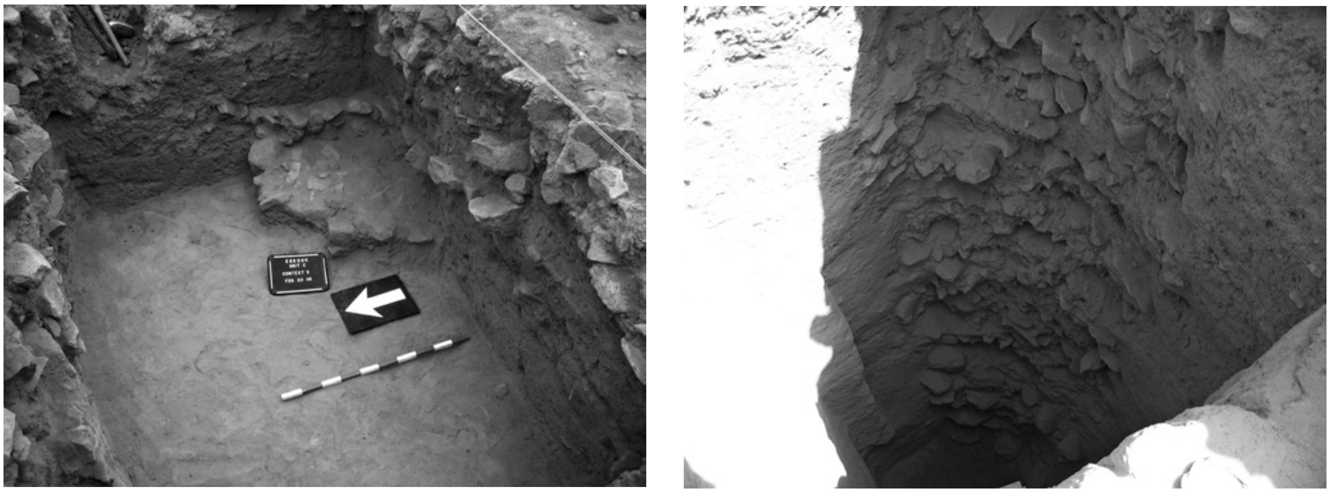

FIGURE 9.6 *Images illustrating the filling of the well with rocks which occurred in Horizon 2: a) shows uppermost fill of the well [9]; b) shows a* ca *5 metre deep cut through the well-fill deposits (the rock deposits in the corner of the trench going from top to bottom of the image).*

FIGURE 9.7
Wall 1 shown within the Horizon 3 deposits, the terminal horizon in this area of the site.

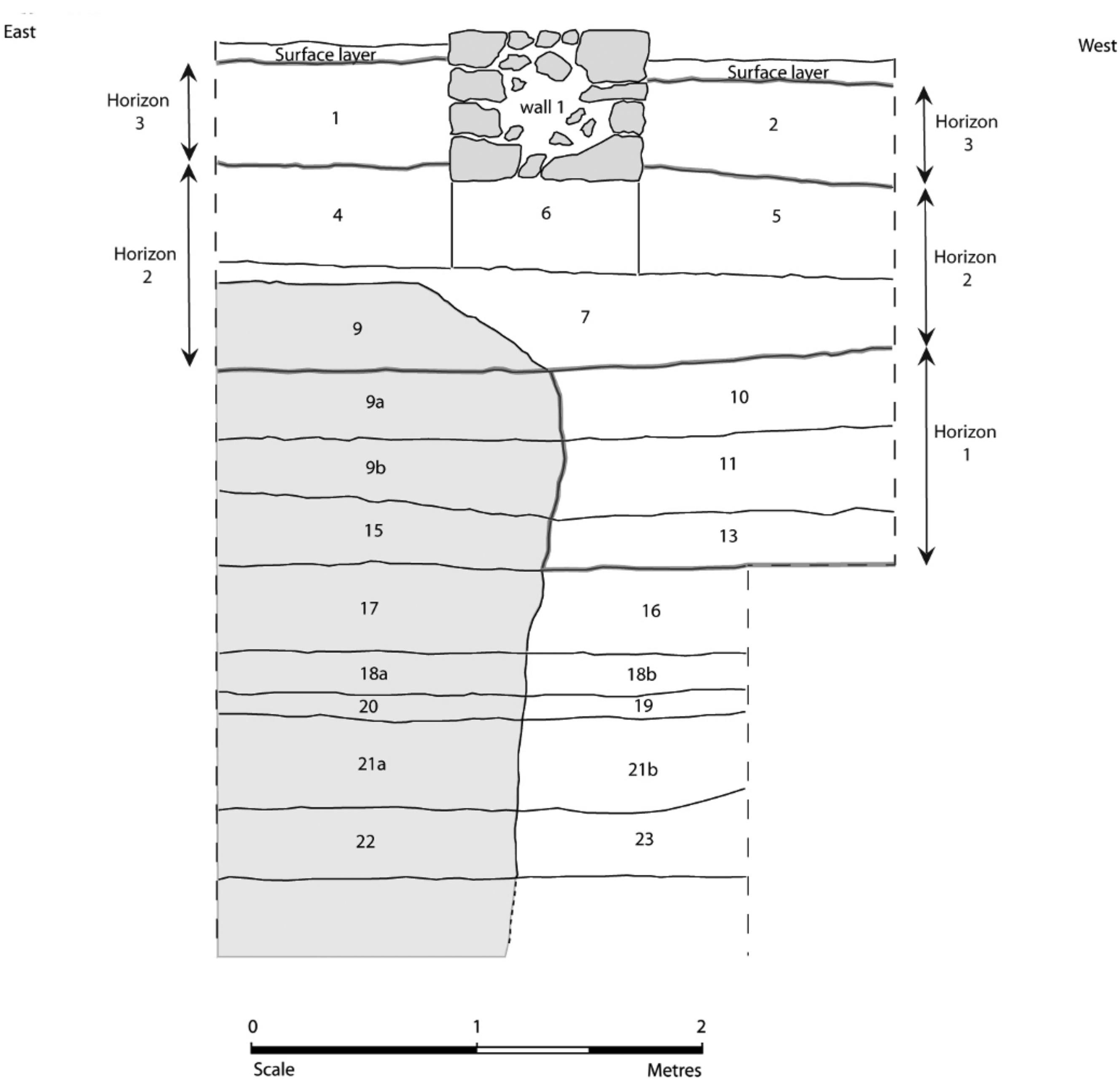

FIGURE 9.8 *Section drawing of the Ek-C occupation sequence showing the stratigraphic position of the three horizons excavated and the upper section of the well fill which occurred during Horizon 2.*

CHAPTER 10

Chronology

Sam Nixon

Radiocarbon Dating Methodology

In order to ground the excavated evidence chronologically, radiocarbon dating was essential, especially in light of the lack of a dated regional pottery sequence, and the limited potential for recovery of other absolutely-dated artefacts. The commencement of the radiocarbon dating program began before the fieldwork itself as it was necessary to develop a strategy for sample retrieval, selection, and storage. The first stage of this strategy involved deciding which types of material to sample for dating. As the area where the site is located is desert, and has been for a considerable period, it was decided not to use wood charcoal as a sample type due to the fact that in desert environments dead wood can remain in the environment for long periods without decaying. This is problematic as it raises the possibility that 'old wood' might be picked up, burnt and deposited in an archaeological context – thereby the radiocarbon date generated from the wood not accurately representing the date of the context in which it is buried. This is particularly problematic for generating dates for a site likely to be principally occupied in relatively 'recent' times (*i.e.* the medieval era).

In light of the above problem, it was decided to sample for short-lived organic materials. One form of evidence targeted was carbonised botanical remains, either charred seeds or other charred plant fragments. The other form of evidence sampled was preserved organic remains recovered from within the fabric of chaff-tempered ceramics, this fabric type confirmed as the dominant temper type in the ceramics at Essouk-Tadmekka during the preliminary survey of the site. This method of dating operates by extracting the burnt chaff from within the wall of the ceramic vessel and then dating this in the same way as other short-lived plant remains. With AMS dating it is possible to sample incredibly small amounts of organic matter, making this a viable technique. Far from being a technique which is just developing, AMS dating of ceramics has demonstrated itself to be a reliable dating method, and has previously been used in West African contexts (*e.g.* Bernus & Cressier 1991: 89–116). The combination of these two forms of dating was seen to offer the best potential for dating the Essouk-Tadmekka sequence.

During excavation suitable samples for dating purposes were taken from each context excavated, thereby allowing for a targeted dating strategy following reflection upon the initial results of the fieldwork. Botanical samples were taken where possible from primary contexts of deposition, such as hearths. In cases where this was not possible samples were taken from the carbonised plant remains recovered from flotation (see Chapter 21 for discussion). When selecting ceramic samples for dating there was an attempt to select samples whose deposition appeared to result from primary use, for example the near intact pot recorded in unit Ek-A Horizon 12 (used as sample Ox-A-16150; see Fig. 7.22). When such obviously good samples were not available we attempted to select pottery types with a temporally discrete position within the overall sequence, for instance the highly distinctive Cr-1 decorated wares found in the upper levels of unit Ek-A and Ek-C (see Chapter 12 for discussion). All ceramic samples selected were also inspected to ensure that they had sufficiently heavy inclusions of carbonised chaff. During the excavations the ceramic samples selected were bagged up separately in sealed bags and clearly labelled. Charcoal samples were also collected throughout as a back-up, and indeed when these charcoal samples were inspected they were also found to contain short-lived organics such as seeds.

In total 19 samples were processed and analysed in 2006 and 2007 by the Oxford Radiocarbon Laboratory. 13 of these samples were ceramic and 6 botanical remains.

Radiocarbon Results

The initial round of results from the 19 samples submitted produced nine dates considered by the lab to be reliable. Four further samples produced dates, but questions were raised by the lab regarding the accuracy of these. These problematic dates were all ceramic samples. Six samples failed to produce any dates at all. These were also all ceramic samples, and the failure to produce dates was seen to result from insufficient carbonised remains extracted from the sample. Following discussion with the lab, three samples were resubmitted, two of which were samples

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which had generated dates considered unreliable, and one new sample. The two samples whose dates had previously been questioned by the lab this time produced dates which were considered reliable – it is to be noted that this second set of dates are very similar to the first set of dates previously questioned by the lab. The other new sample also produced a date considered to be reliable.

The two rounds of dating therefore produced 16 dates, relating to 14 separate samples (the 2 retested samples each having 2 dates per sample). The full results of these are provided in Table 10.1. Of the 14 samples from which the dates are generated, 12 come from unit Ek-A – 6 are from carbonised seeds and 6 from potsherds. A calibration curve of these Ek-A dates is shown in Figure 10.1. Only 1 sample each from units Ek-B and Ek-C produced dates (further samples were submitted for these units but these were amongst the samples which failed to produce dates). The dates listed in Table 10.1 are all the dates generated by the lab, including all dates considered by the lab as potentially problematic. It is to be noted that two of the samples which generated dates considered to be potentially problematic were not reanalysed and therefore the only dates we have for these are the dates queried by the lab. All dates considered as potentially problematic by the lab are listed in Table 10.1 with an 'OxA-X' prefix. The stratigraphic positions of Ek-A radiocarbon samples are shown in the stratigraphic illustration for that unit (Fig. 7.28).

Regarding the samples which produced potentially problematic dates but which were not retested, one of these produced a very unusually early date relative to its fairly late position in the stratigraphic sequence (OxA-X-2178 19) – indeed this produced the earliest date from all the samples. Given that this was from a ceramic type with a very restricted distribution in the top half of the Ek-A sequence (CWSGI ware: see Chapter 12) it is clearly not intrusive from a much earlier context. Reconsideration of

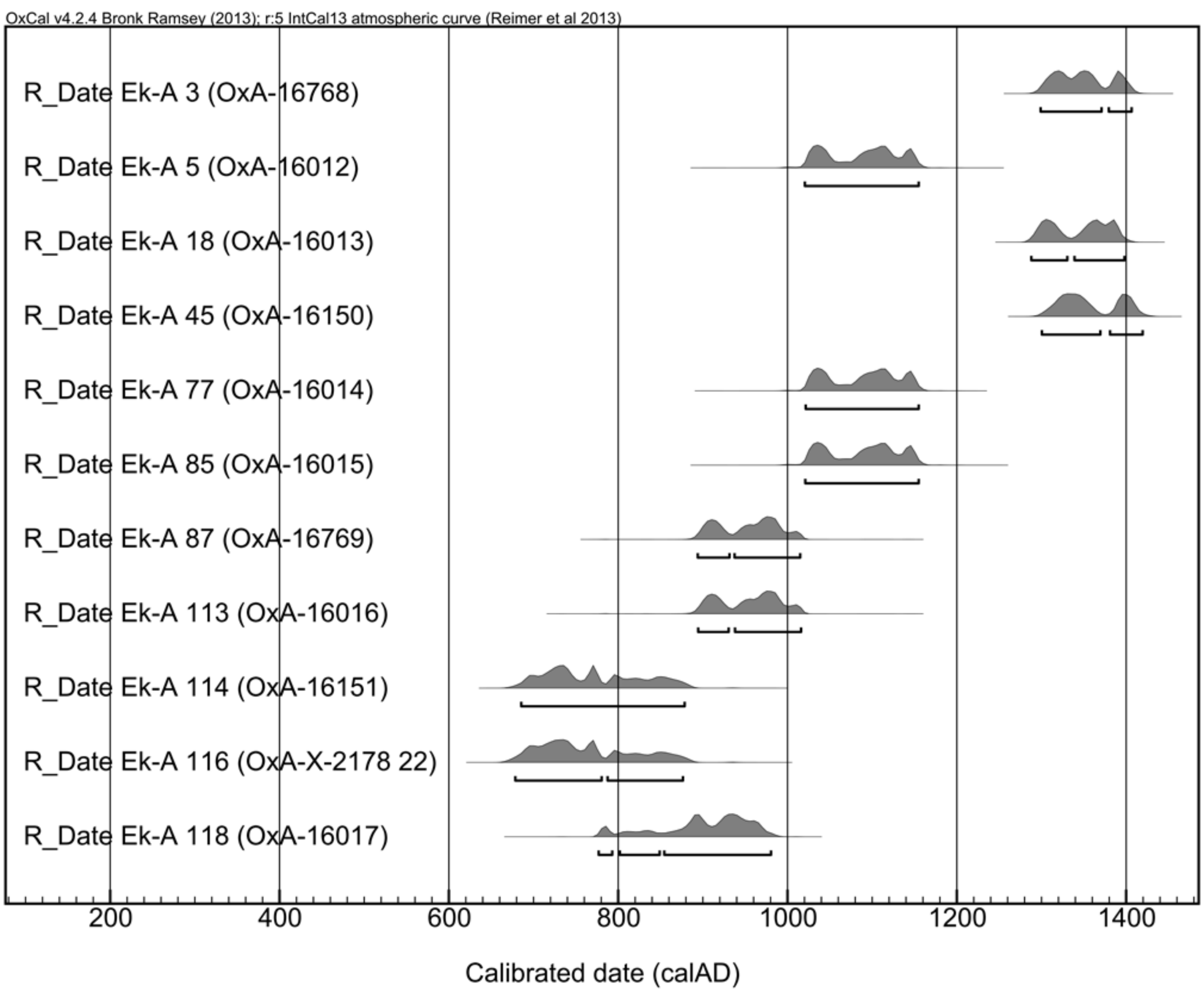

FIGURE 10.1 *Calibration curve of radiocarbon dates from unit Ek-A.*

TABLE 10.1 *Essouk-Tadmekka radiocarbon dates (*identifies OxA-X samples which were questioned for reliability by the lab – note however that two of these were retested with similar results). Calibration with OxCal v4.2 IntCal 13. For pottery codes see Chapter 12*

Lab No.	Context	Material (sherd/seed details in brackets)	Date BP	d13c	1 Sigma Calibration	2 Sigma Calibration
Ek-A						
OxA-16768	Ek-A 3	Pot temper (HB-1 handle; CR-1 decoration)	602 ± 26	−13.9	AD 1306–1398	AD 1298–1406
OxA-16012	Ek-A 5	Seed (*Triticum* sp.) from flotation	961 ± 28	−18.6	AD 1024–1149	AD 1020–1154
OxA-16013	Ek-A 18	Seed (*Ziziphus* sp.) from flotation	630 ± 27	−22.7	AD 1296–1390	AD 1288–1398
OxA-16150	Ek-A 45	Pot temper (whole pot; HR-1 handle)	579 ± 30	−13.2	AD 1316–1408	AD 1300–1419
OxA-16014	Ek-A 77	Seed (*Gossypium* sp.) from flotation	959 ± 27	−23.0	AD 1024–1150	AD 1021–1154
*OxA-X-2178–19	Ek-A 77	Pot temper (body sherd; CWSGI decoration)	1339 ± 36	−12.6	AD 650–760	AD 640–768
OxA-16015	Ek-A 85	Seed (*Acacia* sp.) from flotation	960 ± 28	−22.0	AD 1024–1150	AD 1020–1154
OxA-16769	Ek-A 87	Pot sherd temper (E44 rim; PFI-3 decoration)	1087 ± 27	−13.7	AD 900–990	AD 894–1014
*OxA-X-2178–20 (same sample as OxA-16769)	Ek-A 87	Same as above	1069 ± 35	−13.7	AD 902–1018	AD 894–1022
OxA-16016	Ek-A 113	Seed fragments from charcoal rich deposit	1086 ± 28	−23.0	AD 900–991	AD 894–1016
OxA-16151	Ek-A 114	Pot sherd temper (undecorated body sherd)	1238 ± 30	−13.6	AD 690–862	AD 685–878
*OxA-X-2178 22	Ek-A 116	Pot sherd temper (undecorated body sherd)	1245 ± 34	−14.7	AD 686–854	AD 678–876
OxA-16017	Ek-A 118	Seed fragments from hearth	1141 ± 28	−23.1	AD 880–969	AD 776–980
Ek-B						
OxA-16152	Ek-B 2	Pot sherd temper (E35 rim; PFI-3 decoration)	1032 ± 30	−13.3	AD 989–1022	AD 900–1040
Ek-C						
OxA-16770	Ek-C 4	Pot sherd temper (HR-9 handle; CR-1 decoration)	650 ± 27	−13.8	AD 1288–1386	AD 1280–1394
*OxA-X-2178–24 (same sample as OxA-16770)	Ek-C 4	Same as above	590 ± 35	−13.8	AD 1310–1405	AD 1296–1414

this sample suggested that it was likely affected by the inclusion of more ancient organic inclusions, namely sponge spicules, this ceramic type being subsequently identified as an import product with heavy sponge in it derived from fluvial deposits (see Chapter 12). The other sample whose date was queried by the lab but which was not resubmitted was questioned due to its d13C levels relative to the other pottery specimens (sample OxAx-2178 22). However, this in fact produced a date practically identical to a sample from an adjoining context. While not dismissing the lab concerns, this sample is still considered useful in the discussion of the excavated chronology.

Overall, the radiocarbon dating was successful and produced a good series of dates from which to date the excavation units and therein to also consider the dating of the site as a whole.

Dating the Excavations and Surface Remains

Other than the radiocarbon dates presented above there is very little other excavated material to help date the deposits (see however below). It was principally therefore through the radiocarbon dating that we dated the excavated sequence. Table 10.2 provides the proposed dates for the various excavated deposits. Not only does this include dates for the various periods defined in Ek-A, but also approximate dates for the various horizons encountered within the three units. This table is designed to be referred back to as a quick chronological reference point when reading the various material culture and ecofact chapters which follow. It is to be noted that certain of the dates provided here differ from dates provided in earlier publications on the excavations, the result of further reflection on the deposits and the radiocarbon results (including modifications resulting from updates of OxCal software). The dates provided here represent the final word on the excavated chronology.

TABLE 10.2 *Proposed chronology for period and horizon dates from Essouk-Tadmekka excavation units (estimated horizon dates take account of the potential ± error potential of the chronological estimates provided above; they are also approximations only for the purposes of more precise chronological discussion of data where this is necessary)*

Unit Ek-A	
Period 1: pre-ca AD 900 (+/–50yrs)	
Horizon 1	undated
Horizon 2	undated
Period 2: ca AD 900 (+/–50yrs)–AD 1150 (+/–50yrs)	
Horizon 3	9/10th century
Horizon 4	10th/11th century
Horizon 5	10/11th century
Horizon 6	11th century
Horizon 7	11/12th century
Horizon 8	11/12th century
Period 3a: ca AD 1150 (+/–50yrs)–AD 1225 (+/–50yrs)	
Horizon 9	12/13th century
Period 3b: ca AD 1225 (+/–50yrs)–AD 1300 (+/–25yrs)	
Horizon 10	12/13th century
Horizon 11	13/14th century
Period 4: ca AD 1300 (+/–25yrs)–AD 1400 (+/–25yrs)	
Horizon 12	13/14th century
Horizon 13	14th century
Horizon 14	14th century
Unit Ek-B	
Horizon 1	9/10th century
Horizons 2 & 3	10th/11th century
Unit Ek-C	
Horizon 1	13th century
Horizons 2 & 3	14th century

Unit Ek-A

In terms of providing a chronology for the Ek-A sequence, we start at the top by defining the proposed dates for Period 4. This is a solid place to commence discussion of the chronology of this unit as amongst the four samples dated from Period 4 three produced almost identical dates, thereby providing a very tight cluster. The fourth date is significantly different, almost certainly a result of the botanical sample it comes from being intrusive from an earlier period. Assessing this last sample, the context it comes from is not a clear primary context of deposition and in retrospect this was a poorly chosen sample. The other three samples are far more solid contextually. One of the three dates (OxA-16150) is from a crushed pot found *in situ*. Another of the dates (OxA-16768) is from a large potsherd of a pottery type with a very restricted presence in the stratigraphy (CR-1 decoration; HB-1 handle), being almost totally confined to Period 4. The final date of the three (OxA-16013), comes from a Ziziphus seed, found within the clearly *in situ* burnt deposit of Ek-A 18. The calibrated date range we have for these three samples is AD 1296–1408 at 1 Sigma. When we look in more detail we see that the samples from the first and the final horizons of the period are generated from pottery samples. While both of these pots could be newly made, they could also be slightly older (*e.g. ca* 10 years old), potentially leading to a slight stretching of this date range earlier and later. An additional factor is that the first context dated within the horizon, Ek-A 45, is a destruction deposit meaning that this is dating the end of this horizon rather than the beginning; therefore making it necessary to build in potential for a slightly earlier date again. Likewise, the potsherd sample from the final horizon comes from a wall collapse and was possibly once part of the construction materials of the walls which collapsed to form this deposit (gathered along with stone to form building materials) – it is possibly therefore slightly older than the final horizon, albeit not much older as its form and decoration are clearly related to Period 4 occupation. Given all these factors, a date of *ca* AD 1300 (+/– 25 years) for the beginning of Period 4 and a date of *ca* AD 1400 (+/– 25 years) for the end of the period is proposed.

We next discuss the deposits associated with the first evidence for permanent architecture within the unit, at the other end of the sequence, the deepest lying radiocarbon samples analysed. The reason for considering these next is that the dates in the middle of the sequence offer far less solid evidence for dating, with no clear clustering of dates nor clear dating of *in situ* material – we return to discuss these dates from the middle of the sequence only after first discussing the dates from lower down within the sequence.

Turning to the dating of the deepest deposits within Ek-A, we see that over a depth of *ca* 50cms of deposits, spanning contexts Ek-A 118 to 113, we have four dates. These dates relate to the contexts associated with the first evidence for permanent architecture in Ek-A. The sample from Context 118 comes from the deposits immediately before the creation of the first permanent architecture, from a hearth. The sample consists of seed fragments extracted from a larger sample taken in the field for radiocarbon dating. The sample from Context 116 likely relates to the construction phase of the building, or to its first use. The sample is an undecorated potsherd. The sample from Context 114 comes from the deposits seemingly associated with the first use of the building. Again, this is an undecorated potsherd. The sample from Context 113 comes from a deposit seemingly associated with a reuse phase of the building after its initial construction and first usage. The sample consists of seed fragments taken from a charcoal-rich area and extracted from a larger sample taken in the field for radiocarbon dating. For these 4 dates we have a 1 Sigma date range of AD 686–991. This therefore provides a roughly 300 year date span between the end of the 7th century and the end of the 10th century.

A *ca* 300 year date span is obviously a fairly wide date range for 50 cms of deposits and there is a need to attempt to narrow this down. When we look at the calibration curve of the dates (Fig. 10.1) we see however that there is not an obvious overlap which all the dates clearly fit into. While with the 2 Sigma date ranges one can present a reasonable sequence of dates spanning the second half of the ninth century, with the 1 Sigma range the dates do not present a clear overlap. When we look at the 1 Sigma dates the two middle dates of the sequence of four (*i.e.* from Contexts 114 and 116) are slightly earlier that the dates either side of them. Given that these two middle dates are generated from pots, one could propose that this might be a result of their having been in circulation for a period of time before being deposited in the ground. It is perhaps however more sensible to consider that these samples might not all be in primary contexts of deposition.

While it is common to argue that seeds, in being so small, can move downwards in deposits through post-depositional soil action, there doesn't seem much scope for using this as an explanation for the slight lack of correspondence between the dates from the samples associated with the earliest permanent architecture in Ek-A. The Ek-A sequence appears to have seen very little post-depositional disturbance, and in particular the solid floor surfaces used within the houses acts against bioturbation-induced vertical movement of materials. The seeds are also taken from contexts which appear to be *in situ*. When we consider the evidence, it appears far more sensible to suggest that the slightly earlier dates generated from the pottery samples might be a result of these samples having been displaced from an earlier context. This makes sense as the contexts the pottery samples come from (Contexts 116 and 114) are associated with the construction and first use of the house, when soil would be brought in from the immediate environs of the house, often dug from shallow pits, to provide foundational layers for occupation. It seems highly likely therefore that the potsherds are not in their primary contexts of deposition, relating instead to the depositional levels immediately before the construction of the house, dug up from next to the new building for construction materials.

When we focus on the two botanical dates (from Contexts 118 and 113) we see that they have a date range roughly across the late 9th century to late 10th century. The mid-point of the 1 Sigma date range for the sample from Context 118 is AD 925, while that for Context 113 is AD 945. Given this, one would say that the contexts in between these (Contexts 116 and 114), associated with the construction and first use of the building, most likely relate to the first half of the 10th century. This said, we cannot totally discount the dates generated from the pottery samples, seemingly related to the 'pre-architectural' levels immediately preceding the construction of this building. At the latest the deposits these potsherds relate to seems to be the first half of the 9th century, though the mid-point of their date ranges is the 8th century. Given this evidence, it seem sensible to consider the possibility the construction and first use of the building could span the second half of the 9th century – though this naturally asks us to allow for consideration of the 2 Sigma date ranges generated from the botanical samples.

In reality, we are not able to arrive at a clear precise date range for the deposits associated with the first evidence for permanent architecture in Ek-A. The most precise one can be is to propose a date sometime between the end of the 9th century and the first half of the 10th century. Accordingly, it seems sensible to attach a date of *ca* 900 +/– 50 years to the commencement of Period 2 and the first evidence of permanent architecture in Ek-A.

While the radiocarbon program generated a good range of dates with which to generate a chronology for both the top of the Ek-A sequence and the deposits associated with the earliest documented permanent architecture, the middle of the sequence is far more difficult to date. Aside from the sample which generated an obvious erroneous outlier, three dates were generated, a date of AD 1024–1150 (1 Sigma) from a seed sample (Context 77), a date of AD 1024–1150 (1 Sigma) from another seed sample (Context 85), and a date of AD 900–990 (1 Sigma) from a pottery sample (Context 87). Accordingly, the date range we have for these three samples is from the 10th to 12th centuries. The first thing one can say is that these dates do not present any inversions with the dates above and below them – accordingly, they broadly support the sequence as a whole. Also, these three dates do not present any chronological inversions relative to each other, and in isolation could be presented as representing a date range across the 10th–12th centuries.

When we look more closely at these dates however there are some obvious problems. One key issue is that the earliest of these three samples (from Context 87) produced practically the same uncalibrated date as the sample from Context 113, *ca* 2 metres below. It is just about feasible that with a *ca* AD 850 date for the start of Period 2 that a late 10th century date for the start of Period 3a could be correct. This though seems to be pushing the evidence very far. It seems far more likely that the sample from Context 87 has been reworked from earlier in the sequence, as we have argued for the pottery samples from the beginning of Period 2. Indeed, the botanical sample from a context immediately above Context 87 (Context 85) produced a date fitting far better in a sequence with the dates already presented from the top and the bottom of the stratigraphy. Another key issue is that the dating of the stratigraphically highest date of the three dates from the middle of the stratigraphy (Ek-A 77) is at the latest a mid 12th century date. This appears to allow very little room for any 13th century deposits before the start of Period 4 which we have dated to the 14th century – while one could suggest there was an abandonment in the 13th century there is no evidence for this. Short of questioning both the dates already proposed for Period 4 and those from the start of Period 2, it seems more advisable to question the stratigraphic integrity of some of the samples from the middle part of the sequence. Interpretation is moreover made more difficult by the fact that we only have three samples to represent the deposits between the earliest levels associated with permanent architecture and the Period 4 deposits.

A further factor when considering the middle of the sequence is the presence of the only imported sample of some solid dateable means, a sherd of Chinese Qingbai pottery found in Context 86, at the beginning of Period 3a. The proposed date range for this Qingbai pottery is *ca* 11th–13th centuries (see Chapter 12). If we take this

Qingbai sherd itself as a means of dating, its date range does actually fit nicely between the dates proposed for Period 4 above and the dates proposed for the start of Period 2, further confirming the proposed sequence. Also, this provides further support for the suggestion that a late 10th or 11th century date for these deposits seems unlikely, as this would make this amongst the very oldest known examples of Qingbai ware; something which seems very unlikely in this southern Saharan context, so distant from the ultimate source of this ceramic type and likely before it had become a major export ware.

In retrospect the samples from the middle of the sequence were not well chosen. The two ceramic samples selected do not relate to ceramic types which are clearly restricted in the sequence. Also, regarding the botanical sample, it is difficult to clearly argue that it comes from a primary context of deposition. It does appear likely that as with the stratigraphically earlier pottery samples, these samples have also undergone similar processes of displacement within the sequence, related to the use and rebuilding of the house. While the samples broadly support the sequence as a whole they do not allow us to provide a refined chronology for the middle part of the sequence. Given this, it has been necessary to propose dates for the middle part of the sequence largely on the basis of the dates we have developed for the top and the bottom of the sequence, calculating the likely dates according to the relative depth of the deposits (see Tab. 10.2).

Unit Ek-B

Only one radiocarbon date was gained from unit Ek-B, from Context 2, seemingly a midden context on the outside of the structure the excavations were planned around. This produced a date of AD 989–1022 (1 Sigma). This appears to be a relatively secure context as the deposits in this area are almost certainly purely a result of the deposition of waste products of daily life, rather than soils brought in from other areas of the site to create living surfaces like we have seen in the Ek-A sequence. When considering this date, importantly, it is also useful to consider the Ek-B pottery sequence in relation to that generated from unit Ek-A (see Chapter 12). We see that the key highly distinctive ceramics found in high quantities in Periods 3b and 4 in unit Ek-A are almost entirely absent in unit Ek-B. A date corresponding to the early period of unit Ek-A occupation therefore corresponds well. Given that we only have one date for the unit we cannot be overly precise in dating the deposits. Accordingly we have given the deposits associated with permanent architecture a date range of 10–11th centuries and the deposits before this an approximate date of 9th/10th centuries.

Unit Ek-C

Only one radiocarbon date was gained for unit Ek-C, from Context 4, in the upper levels of the unit. This produced a calibrated date of AD 1288–1386 (1 Sigma). Importantly this date was generated from a ceramic type with a very clear restriction in the excavated sequence, namely ceramics having a Cr-1 decoration type as well as a distinctive formal tradition of handles (see Chapter 12) – this ceramic type is almost entirely confined to the upper levels of both units Ek-C and Ek-A. Accordingly we are confident in the stratigraphic position of this sample. When we compare the date generated from the Ek-C sample with the dates from unit Ek-A this is indeed what we would expect based upon the now dated ceramic sequence seen in unit Ek-A. Given that we only have a single date to work with, it is difficult to be precise with the chronology. A broad date of the 14th century is accordingly provided for the final two horizons of unit Ek-C. For the horizon which precedes this we have provided an approximate date of *ca* 12th/13th century. Given the likely burial context of this earlier horizon, and the likelihood therefore for highly particular conditions for material culture deposition in this area, it is inadvisable to seek overly strict material culture parallels between this horizon and corresponding periods in the unit Ek-A sequence.

Other Areas of the Site

Thanks to the development of a dateable sequence for the three excavated units, we have been able to develop a dateable ceramic sequence for the site which can help us to consider the chronology of areas of the site which were unexcavated (see Chapter 12). As was made clear earlier, ceramics were collected across the site's surface. By comparing these ceramics collected across the site surface with distinctive ceramic types having a clear temporal restriction within the excavated sequence we can gain clues to the occupation history of areas of the site which were not excavated. While it is difficult to understand the chronology of many areas of the site from looking at the surface collected ceramics (see Chapter 12 for further discussion), one area for which the surface collected ceramics provide very useful data is the large area of remains to the west of the wadi. In this area the surface collected ceramics produced high quantities of ceramics strongly related to the ceramic types largely restricted to the final phases of both unit Ek-A and Ek-C. Accordingly it seems highly likely that the final occupation in the area to the west of the wadi either dates to the same period as the final periods in units Ek-A and Ek-C, or just possibly to a residual later population. It is difficult however to say anything too concrete about the earlier periods in that part of the site based upon the ceramics (see Chapter 12).

Accordingly we have good excavated dates from the area to the east of the wadi and the island, plus important chronological evidence provided by the surface collection from the area to the west of the wadi.

Suggestions for Future Work

The radiocarbon methodology adopted is believed to have generated a solid absolute chronology for the excavated deposits. When analysed together with the surface collected pottery from across the site this enables us to begin to discuss the growth and abandonment of the site as a whole. Future excavations though would undoubtedly refine Essouk-Tadmekka's chronology. Any future excavation would usefully focus on dating intact/*in situ* pots and short-lived organics from hearth contexts. The dating of silicified remains might also be a useful avenue to pursue, these types of remains being encountered within our excavations, including for instance the silicified basketry item recovered in unit Ek-A (see Chapter 18) or the rich botanical deposit of silicified remains in unit Ek-B (see Chapter 21). Potentially these sample types could also be supplemented by the dating of chaff in the mud-built constructions, including the *banco* coating of stone walls, thereby providing a solid date for these structures. Indeed, the noted occurrence of *banco* on some structures present on the surface of the site (Cressier 1988) means there might also be potential for some targeted dating of surface structures. Certainly with a very large budget for radiocarbon dating one could also systematically date charcoal as another strand of the dating program, selecting samples related to short-lived tree species; though the caution of 'old wood' would always need to be addressed.

CHAPTER 11

Architecture

Sam Nixon and Benoit Suzanne

"From Bughrat you go to Tiraqqa and from there across the desert plain to Tadmekka, which of all the towns in the world is the one that resembles Mecca the most.... It is a large town amidst mountains and ravines and is better built than Ghana or Kawkaw".

AL-BAKRI (LEVTZION & HOPKINS 2000: 85), *The Book of Highways and of Kingdoms*, ca *AD 1068*

Introduction

In describing Tadmekka as "better built than Ghana or Kawkaw" Al-Bakri's 11th century text seemingly identifies the town as a well-constructed urban locality (see App. A). Al-Bakri's favourable comparison of Tadmekka with urban centres of the sub-Saharan kingdoms also suggests a built environment more in keeping with the Islamic tradition to the north of the Sahara, the tradition that he and other Arabic authors were most familiar with. No other early Arabic documentary records provide insight into Tadmekka's architecture, with only Al-Bakri's additional statement that it was "a large town" giving some potential further sense of the town's built environment.

Essouk-Tadmekka's surface remains offer a great amount of potential information concerning the buildings abandoned across the site, data which at many sites can only be generated with very large exposure excavations. While on-site mapping of the structural remains at the site would represent a mammoth task, the EOM aerial photographs generated by Mauny in the 1940s (see Chapter 2 for details) provided a resource from which to develop very detailed plans of the ruins, even including detailed plans of individual buildings. As no previous attempt had been made to systematically record the structural remains on the site's surface, this was identified as a priority of the project. The excavations we conducted have now also provided some form of chronological resolution to the building remains on the surface of the site. While a definitive chronology of all the surface architecture is not available, our investigations show that much of the surface remains can be dated to approximately the 14th to 15th century (including the areas around units Ek-A and Ek-C, and likely the area to the west of the wadi); though our results also show that at least some of the building remains clearly predate this, the excavations (in Ek-B) having demonstrated certain areas of buildings to the east of the wadi date to the 10th/11th century. The excavations also provided a sample of what is clearly an excellently preserved architectural sequence, documented over 5–6 metres of deposits and relating to *ca* 500 years of occupation.

Together, the material evidence recorded allows us to start to build up a more detailed picture of the architectural traditions of the market town of Tadmekka. Here we provide a summary account of the work that has been done, including of the surface mapping methodology, as well as an overview and discussion of the evidence for building forms, construction materials, and construction techniques. The evidence has also already been the subject of a separate study (SUZANNE 2014).

Surface Mapping Methodology

The methodology for drawing the surface architectural remains firstly involved high-resolution scanning of the 1940s aerial photographs, then using these as the basis for generating a detailed mapping with vector graphics software (see also SUZANNE 2014). This was complemented by reference to contemporary satellite imagery (GeoEye). Drawing of the structural remains (carried out by the second author) involved distinguishing between walls which were very clearly indicated by the aerial imagery, and walls which were less clearly distinguishable; or indeed walls hypothesised to have existed but now covered by wind-blown sand (see Fig. 11.1). The reason for using the historic aerial photographs – as opposed to solely the satellite imagery – is that certain building remains have been destroyed in recent times through the reuse of their stones for contemporary construction, including surrounding walls for gardens (see SUZANNE 2014 for details on the state of destruction in 2013) – indeed, importantly, these new surrounding walls created at the site in very recent times can potentially be confused with the remains of historic structures.

While we produced a detailed mapping of all structural remains observed across the site, it is to be remembered

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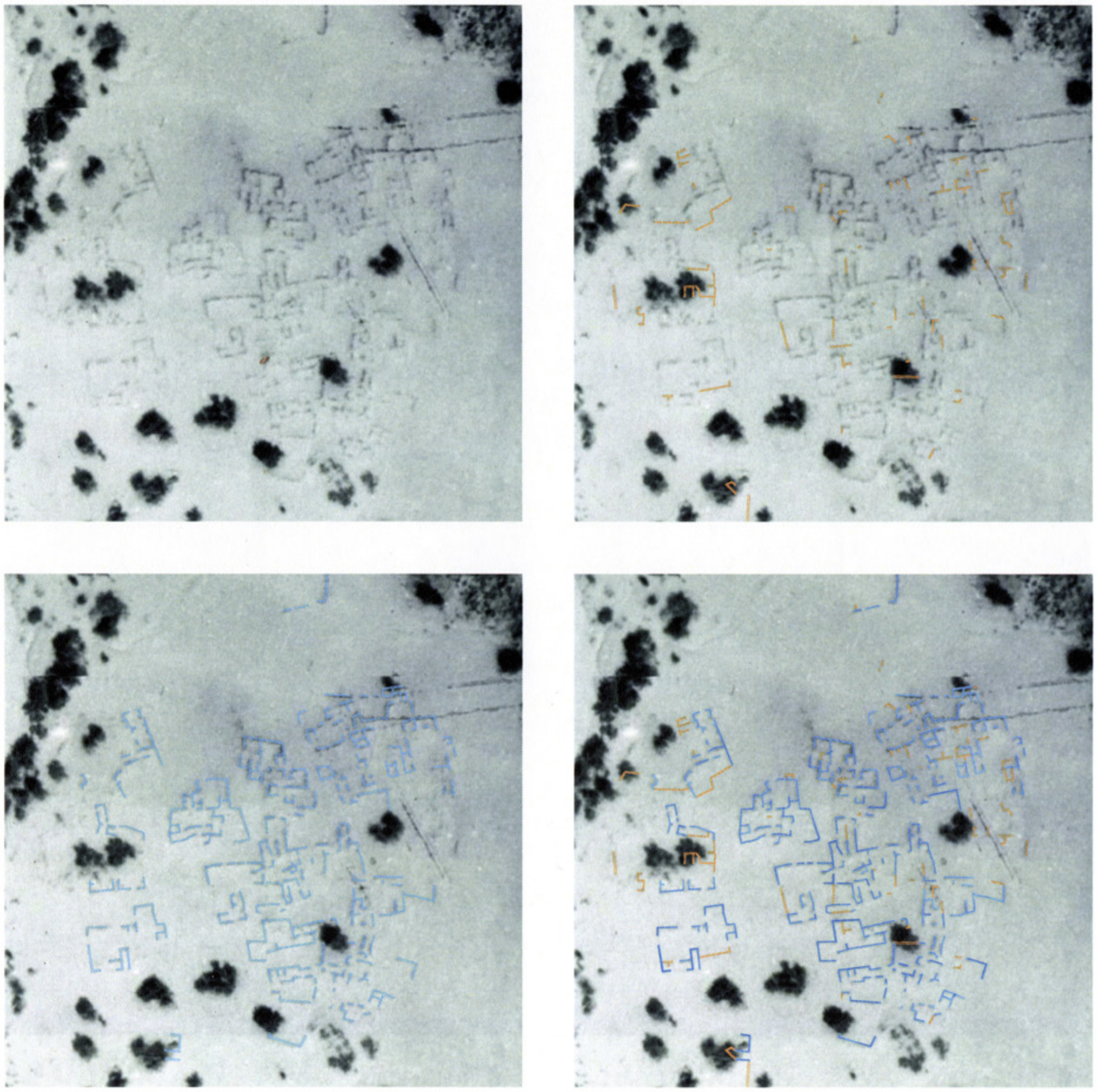

FIGURE 11.1 *Illustration of the methodology implemented in drawing the Essouk ruins from aerial photographs.* Top left, *unaltered close-up of aerial photo of portion of the ruins*; bottom left, *tracing of walls clearly visible on aerial photograph with blue lines*; top right, *tracing of walls faintly visible on aerial photograph with orange lines*; bottom right, *combination of tracing of clearly and faintly visible walls* (*developed by Benoit Suzanne from* EOM *aerial photos provided by Paulo de Moraes Farias, received from Raymond Mauny*).

that wind-blown sand easily covers the low wall remains and therefore this does not represent a definitive statement on the presence of building remains across the site. An overall representation of the structural remains across the central area of the site is provided in Figure 11.2. More detailed images of this central area are provided in Appendix B, together with drawings of the surrounding cemeteries. While no systematic ground-truthing was carried out in the drawing of the structural remains, observations made by the first author during the fieldwork are used to complement analysis and discussion.

Building Types and Forms

Prior to the earliest recorded evidence for permanent architecture, we have evidence for non-permanent architecture, immediately preceding the earliest building recorded in Ek-A. The three levels of post-hole remains almost certainly relate to either tents or mat and pole constructions. The early Arabic authors provide no commentary on this type of architecture at Essouk-Tadmekka, but they do report on this form of construction from the town of Audaghust at a similar period, describing the

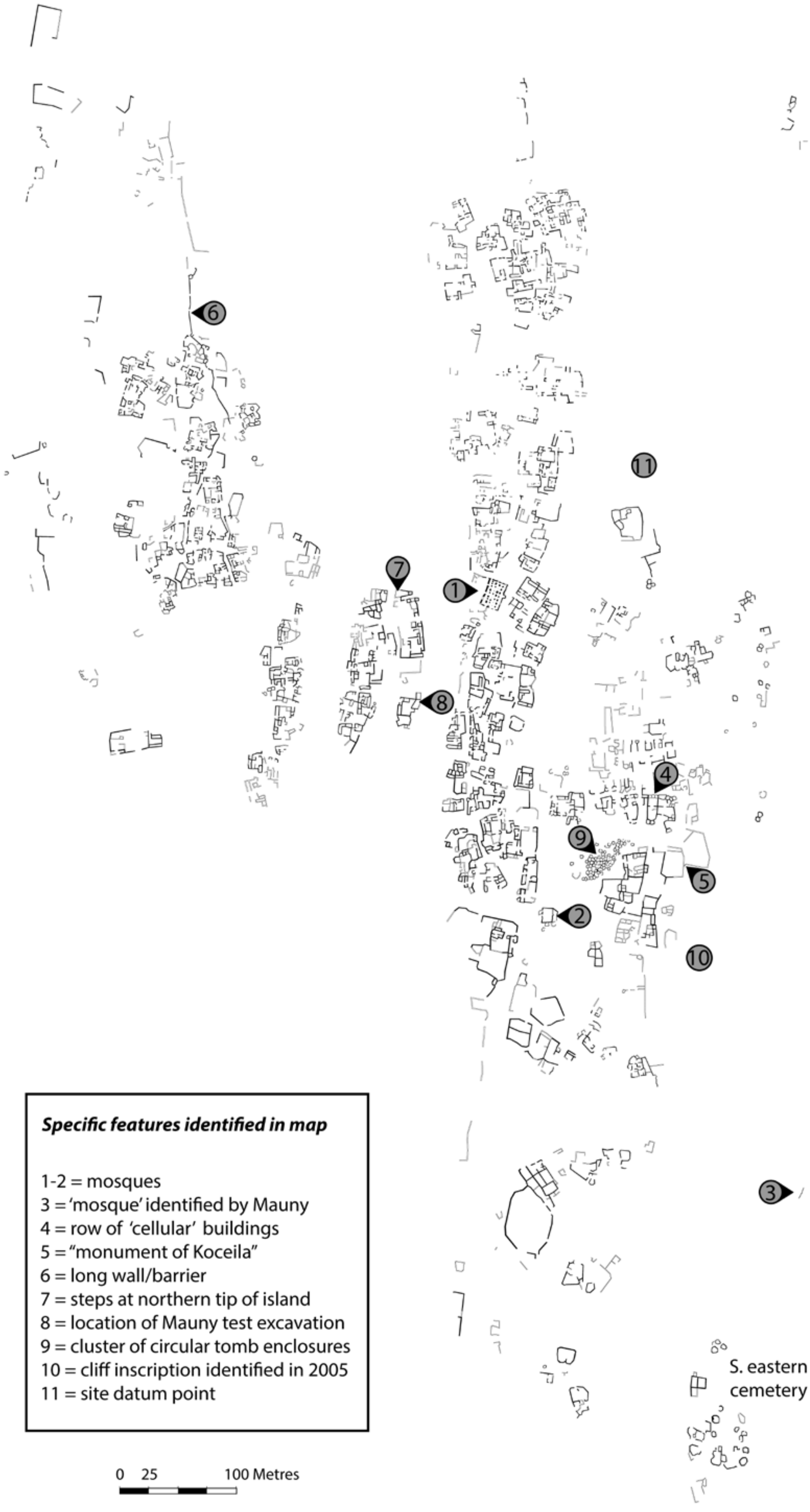

FIGURE 11.2
Map of the Essouk central town ruins developed from aerial photographs (developed by Benoit Suzanne from EOM *aerial photos provided by Paulo de Moraes Farias, received from Raymond Mauny) – see Appendix B for close-ups of this illustration as well as drawings of the surrounding cemeteries. (note the south-eastern cemetery which features at the bottom right of this illustration).*

inhabitants as living in huts made from organic materials (Levtzion & Hopkins 2000: 48; see Polet 1985: 233 for discussion of Tegdaoust evidence potentially relating to this). While the Ek-A sequence could be interpreted to show a clear transfer from non-permanent to permanent architecture, almost certainly this is not what happened at the site. Firstly, it seems likely that in the earliest phase of the site permanent and non-permanent dwellings would have co-existed side by side, as indeed we see today at the small developing settlement near Essouk-Tadmekka. Additionally, it is likely that this co-existence would have continued for the entire period of Essouk-Tadmekka's occupation, even if non-permanent architecture became more commonly found on the fringes of the permanent settlement. A useful parallel in this regard is provided by later historic records of Timbuktu, describing Tuareg slaves inhabiting encampments on the fringes of the town (Miner 1953). Additionally, as we discuss further below, at certain points tents would likely have been installed within the courtyards of buildings, or within other forms of permanent enclosures.

The vast majority of structural remains across the site relate to a rectilinear building tradition, with only curvilinear forms being occasionally identified, and these latter relating to distinct functional categories such as stock enclosures or tombs. A quick reference to the mapping developed from the aerial photographs (Fig. 11.2) shows that the vast majority of structures relate to a building type featuring an enclosure wall, with a regular arrangement of rectilinear rooms inside this, often arranged around one or more courtyards. Figure 11.3 provides two examples of buildings which relate to this broad type (recorded in the area of the site between Ek-A and Ek-B). While it is possible that courtyards were occasionally internal within these types of structures (*i.e.* covered), likely these were most often open to the elements. Although the use of *pisé*-type construction technique at the site (see below) does certainly indicate the potential for load-bearing roofs, all the evidence indicates the buildings encountered on the surface at Essouk-Tadmekka were single-storied. While the vast majority of remains across the site relate to this broadly defined building type with enclosure wall and courtyard, it is important to recognise that individual buildings consistently vary from each other in their individual arrangements, so much so that it is difficult to find exact replications of a standard construction formula across the site. It is also important to point out that the individual building units encountered at Essouk-Tadmekka are most often clustered together (see Fig. 11.2), a result of an organic and complex urban development which likely results mostly from new constructions being attached onto existing buildings.

This building type featuring an enclosure wall containing rooms arranged around a courtyard is a very common tradition in the Islamic world and would have been the prevalent type throughout North Africa during this period (Fentress 1987; Insoll 1999: chp. 3), as well as in the central and northern Sahara (Mattingly 2013: Chapter 12). In later periods this also became common further south in West Africa, associated with the increased connections with the Muslim world and the spread of Islam in West Africa (*e.g.* Prussin 1986; Bedaux *et al.* 2003). It is important to note however that this building form is also found within the Berber world more broadly, and the occurrence of building forms roughly approximating to this type back into pre-Islamic times in the central Sahara shows that this cannot be uncritically labelled as an Islamic tradition (see Mattingly 2013: Chapter 11). In the southern Sahara today this building type is widespread in such towns as Agadez in Niger and Chinguetti in Mauritania, as well indeed as in the nearest town to Essouk, Kidal (first author observation). Archaeologically, one finds a similar occurrence of these building types at various sites throughout the southern Saharan region, including Azelik-Takedda in Niger (Bernus & Cressier 1991) and Tegdaoust in Mauritania (Polet 1985). At Tegdaoust this building type is identified as one of the important markers of the arrival of North African trading communities (Polet 1985). Ethnographic and archaeological recording of this type of building most commonly identifies it with domestic habitation, and Figure 11.4 demonstrates how one of the buildings we recorded on the surface at Essouk-Tadmekka might have been arranged as a domestic space. One important thing to note concerning this building type is that in addition to the private internal rooms, the courtyard also provides a self-contained space to undertake a range of domestic activities removed from the public world of the town; something which is often discussed as one of the classic hallmarks of Islamic architecture (Insoll 1999: chapter 3). This differs greatly for instance from the small structures built today at the settlement near Essouk-Tadmekka which lack a courtyard and where consequently a greater amount of activities take place in the public areas outside the structure.

While undoubtedly a significant proportion of the remains seen across the surface at Essouk-Tadmekka do relate to domestic structures, one assumes such a town would have had a range of other building types, including commercial stockage buildings, *caravanserai*, places for commercial transactions (although accepting that

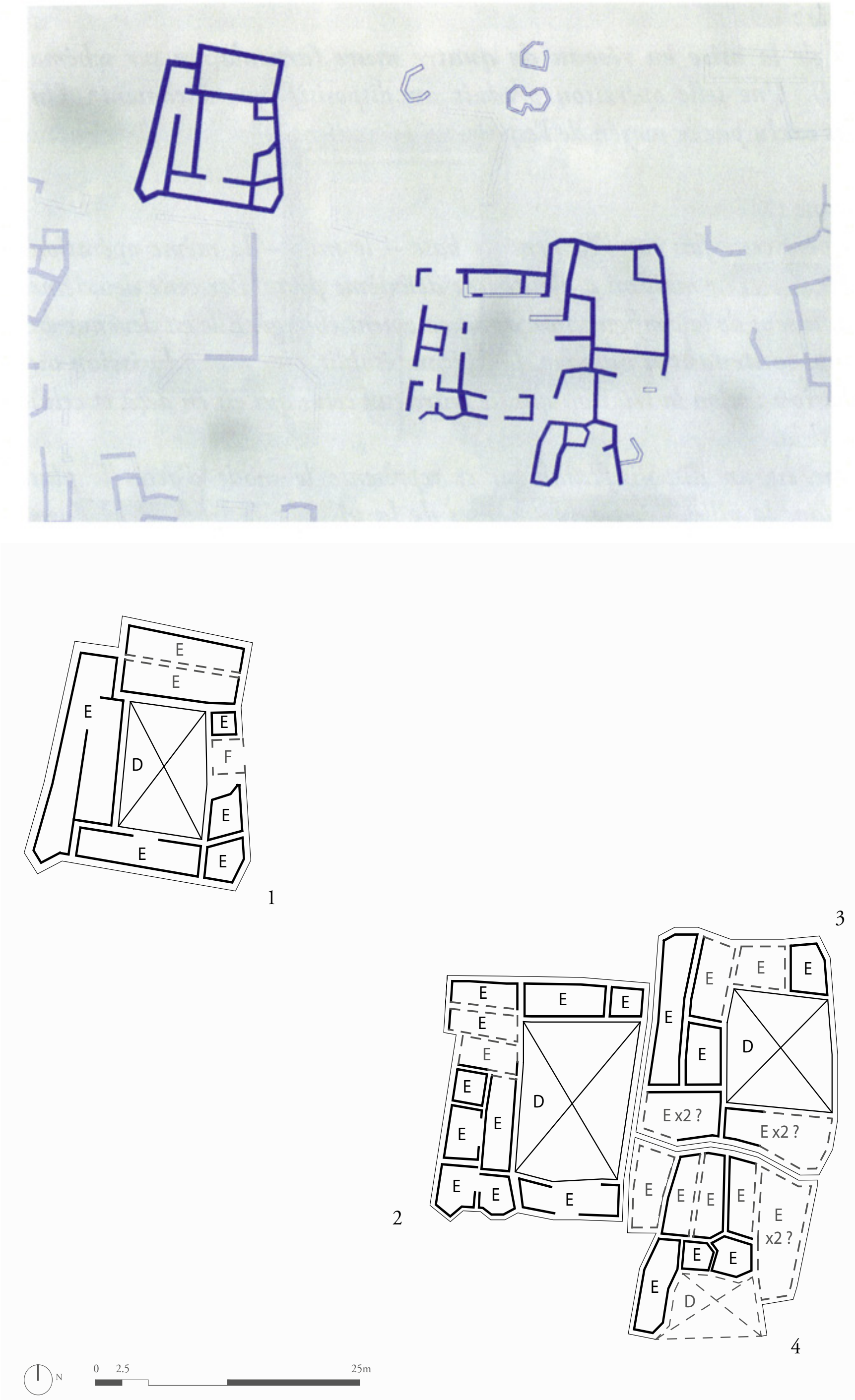

FIGURE 11.3
Illustration of examples of building units of a broad type commonly encountered amongst the ruins on the site's surface. Upper image shows tracing of two structural complexes drawn from a portion of the aerial photograph, lower image shows interpretation of the formal arrangement of these same structures, indicating interior rooms (E) and courtyards (D). Note the lower structural complex is composed of three distinct (but attached) built units (developed by Benoit Suzanne, drawn from EOM *aerial photograph provided by Paulo de Moraes Farias, received from Raymond Mauny). Compare with* Figure 11.4.

the main markets might have been outside the town), and workshops. One might also imagine the potential for various buildings connected to political authorities, including the possibility of 'palace' like structures. The common building type featuring rooms arranged around a courtyard, discussed above, could certainly have fulfilled many of these additional functions. There are also other forms of buildings we see amongst the ruins which likely relate to buildings having other non-domestic functions.

While we have not been able to undertake an extensive review to interpret the variety of additional building forms encountered across the site, there are certain forms we wish to highlight. One particular form to point out are large rectilinear enclosure walls having little internal division of space, found most obviously in the Ek-B area. These include the so-called 'monument of Koceila' discussed earlier (see Chapter 4 and Fig. 4.8c), as well as elements of the building complex partially excavated in unit

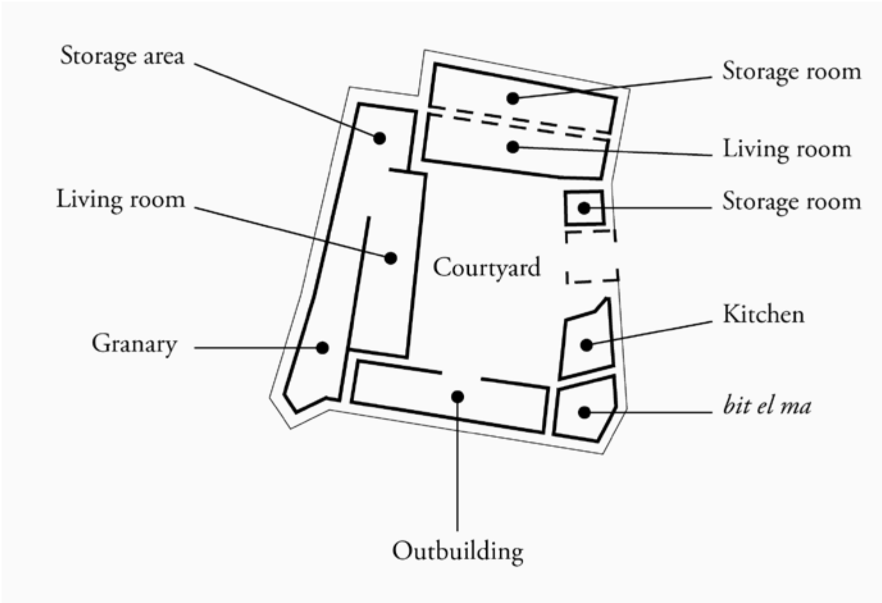

FIGURE 11.4
Interpretative illustration of the remains of a structural unit present on the surface of the Essouk ruins (*compare with* Fig. 11.3) (*developed by Benoit Suzanne from* EOM *aerial photos*).

Ek-B. There are a range of functions such structures could have had, including for instance as commercial warehouses (including housing slaves). At Tegdaoust relatively similar structures have also been associated with workshop areas, and specifically metallurgy (Polet 1985: 37–39) – relatively extensive metallurgical finds from the Ek-B area would certainly support this at Essouk-Tadmekka (see Chapter 16). Another building form to highlight is found most noticeably in a series of buildings just north of the Ek-B area (see Fig. 11.2 no. 4 & App. B Plan G *upper right area*) – these buildings are all arranged in a line, seemingly along a small passageway or street, and all have a number of small cell-like rooms at one end of the buildings. The particular arrangement of these buildings coupled with the regular presence of the small cell-like rooms gives the impression of a *souq*. Such interpretations certainly need to be grounded in further detailed research, but this does show how the mapping provides the potential for such detailed hypotheses with potential for concrete identification of building types.

One further thing that it is particularly important to stress when considering the forms of permanent architectural remains at Essouk-Tadmekka is how these would have functioned within a wider culture which was strongly nomadic. One thing in particular to highlight is how courtyards and the basic enclosure wall form discussed above both provided the potential to erect tents within them. One sees this practice today in Kidal, where important nomadic authorities come to spend a brief period in the town, placing their tent within a courtyard of a permanent building (observation by first author). This consideration of the interaction of nomadic groups with the urban world seems especially relevant when considering the surface remains as the majority of the building forms seen across the site relate to around the 14th century, a time when the Arabic historical records refer to Tadmekka as "capital of the veiled man's country", and clearly present it as part of a wider pastoral nomadic power base (see App. A).

Returning to the question of variability of building forms across the ruins, we also need to consider the question of chronology. How much did building form change over time at the site? As explained earlier, the building remains we see on the site surface do not all relate to the same period and therefore this provides us with some potential insight. While the majority of the remains on the surface seemingly relate to the 14th/15th century, the building complex partially excavated in unit Ek-B was dated to *ca* 10th/11th century. Surface collection of ceramics in the wider Ek-B area showed the wider zone in this area was abandoned at least before the 14th century. Accordingly this wider area provides a snapshot of earlier building forms. As was explained earlier, even prior to excavation the buildings in the Ek-B area were identified as different from those elsewhere at the site, partly due to the way they are constructed, but also partly due to their form. In particular this area is noticeable for the distinct presence of large enclosures with little internal division of space. As explained above, it is also in this part of the site that we identify other distinctive buildings, those which we have hypothesised as being a *souq*. It does certainly seem to be the case that the buildings we have demonstrated to date to an earlier period do not have clear correlates amongst the remains identified as dating to the 14th century. What we are currently unable to determine is how far these are representative of building forms as a whole in the earliest period of the site. This is a question briefly returned to further below once we have considered construction materials and methods.

The most easily identifiable building forms encountered at the site are the examples of religious architecture. Firstly, there are the two mosques recorded within the town ruins, one located to the east of the ruins very close to the site of excavation unit Ek-A, the other located not far from unit Ek-B. A *musalla* was also located to the north of the ruins. In addition, we discuss a possible mosque or *musalla* recorded by Mauny in the 1950s, located at the eastern entrance to the site.

The largest mosque observable amongst the town ruins, that located close to unit Ek-A, measures 23.5 × 15.5 metres (Fig. 4.8d, 11.5, and Fig. 11.2 no. 1 for location). The mosque has five aisles parallel to the *qibla*, identifiable by the remains of pillars. Study by CRESSIER (1992) indicated that it has no minaret or moveable minbar, this being standard within southern Saharan mosque traditions. The mosque also has an attached courtyard, located towards the wadi. The mosque has a *qibla* orientation of 110° (first author measurement recorded on site). Interestingly, this is very similar to the only cemetery enclosure at Essouk-Tadmekka that features a *mihrab*, located in the north-eastern cemetery (Fig. 4.11a, and App. B Plan N) – amongst the inscribed tombstones found within this cemetery enclosure are three that feature precise dates, indicating the enclosure was in use from at least AD 1078 (MORAES FARIAS 2003: 126). Cressier has commented that the form of the mosque suggests a rather poor construction (misaligned walls and varying thickness of walls); considering it therefore to possibly relate to a late period of the site (CRESSIER 1992: 82). He also comments however that the relatively large size of the mosque and the number of its aisles places it in a distinct category of significant mosques in the wider region, with only Agadez and Assode also having more than three aisles. Given the dating of the terminal horizon in the nearby excavation unit Ek-A, a 14th/15th century date seems the most sensible one to propose for this structure. CRESSIER (1992) has already highlighted the potential regional importance of this mosque in terms of influencing later mosque design in the wider region, and certainly we should consider this important religious building within the context of Tadmekka's acknowledged role as an origin point for Islamic movements in Niger in the late medieval and early modern era (NORRIS 1975; MORAES FARIAS 2003; CRESSIER 1992). The improved understanding we have of the likely date of this mosque now allows us to more clearly situate it within the developing regional typology of mosque design, suggesting indeed that it was a likely model for later mosques in Niger, including the important mosque of Agadez.

The other mosque located within the town ruins, to the east of the wadi not far from unit Ek-B, is far smaller, measuring 12 × 8.5 metres (Fig. 11.6, Fig. 11.2 for location). This is a very simple structure featuring no clear evidence for the division of the internal space; though CRESSIER (1988) proposes that the space was potentially originally divided in some way. As with the other mosque, there is no reason to think this had a minaret or minbar, and it appears not to have had a courtyard either. It has quite a different *qibla* orientation to the other mosque (and therefore also to the '*qibla* cemetery enclosure'), being orientated at 92° – this is however very similar to the *musalla* discussed below. Importantly, five inscriptions were found within this mosque during the clandestine excavations which were conducted within it in 1987 (see Chapter 2 for discussion), one of which dated to the early 12th century (MORAES FARIAS 2003: 148–150). It is though difficult to know their exact relationship to the mosque. While we do not have any concrete dates for this mosque, its relative proximity to the Ek-B area known to have been abandoned *ca* 11th century raises the question that this is an earlier structure, especially when we consider its different *qibla* orientation (this direction shifting over time with greater understanding of calculating the direction of Mecca). The above described inscriptions found within the structure could however problematise such an interpretation.

During survey to the north of the town ruins the remains of a structure identified as a *musalla* were recorded (see Fig. 4.12). It is not possible to trace the full extent of the original structure due to wind-blown sand coverage, but certain useful observations were able to be made (our subsequent checks showed this can be located on satellite imagery, though this is not illustrated within this volume). The structure was identified as a *musalla* rather than a mosque due to the fact that despite its large size (*ca* 30 metres in length; width not known) there is no evidence of internal pillars to support a roof, nor is there sufficient evidence of stone rubble covering the wall-stumps to indicate high walls that had collapsed. We are clearly dealing here with an open prayer area having only a low wall demarcating the prayer space, and the location outside the town lends extra weight to this interpretation. Potentially this structure was used either during festivals or for prayer associated with a temporary market; or indeed to enable large camel caravans to undertake communal prayer to bless a journey or give thanks for arrival at the town. We were able to clearly identify the *mihrab* and to record the *qibla* orientation, measured as due east (no more precision

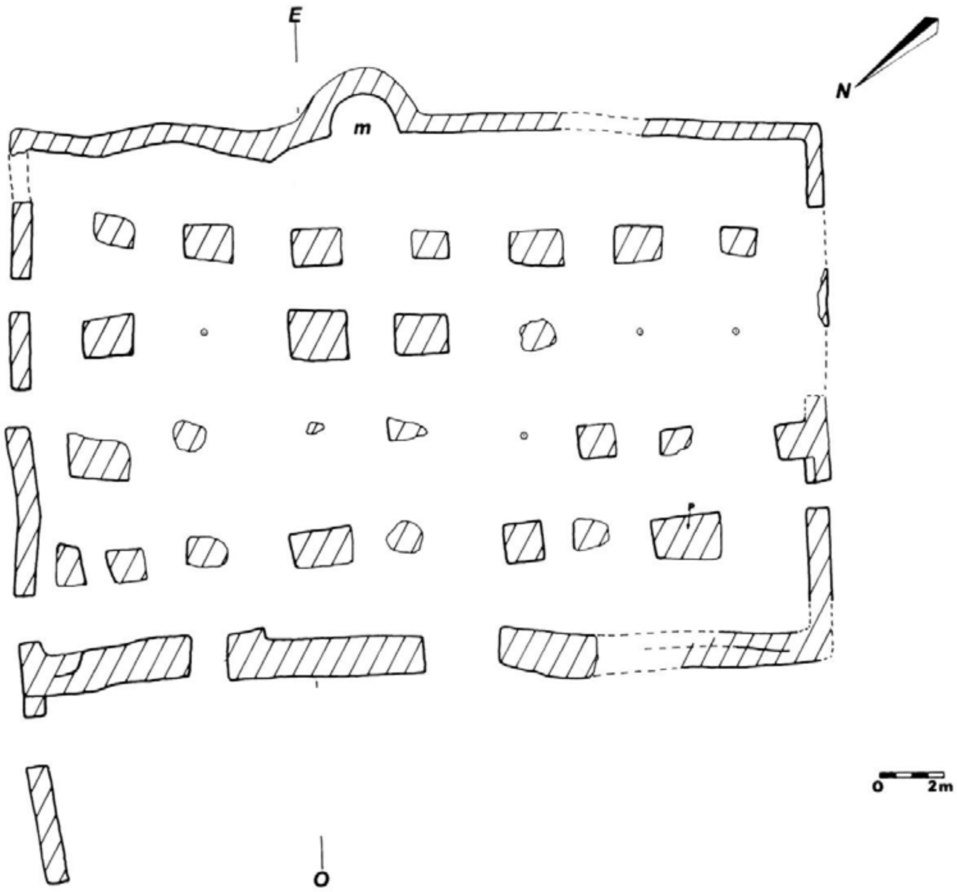

FIGURE 11.5
Drawing of the remains of northern mosque ('Friday mosque'), located on the site's surface close to unit Ek-A (illustration courtesy Patrice Cressier).

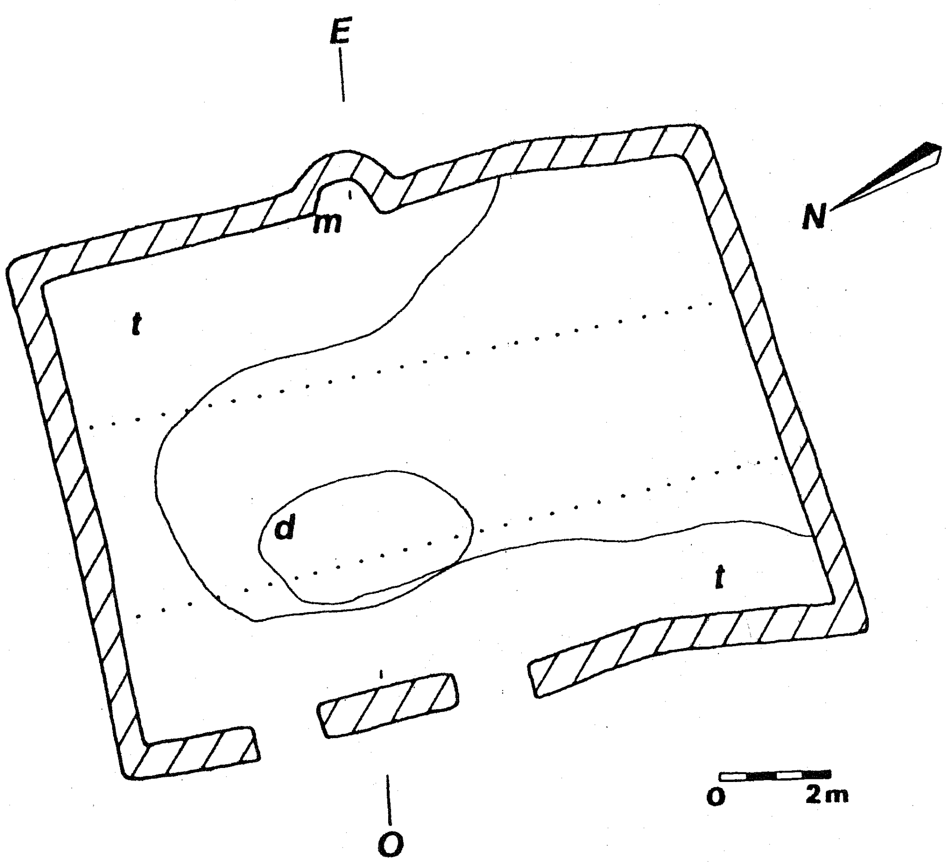

FIGURE 11.6
Drawing of the remains of the southern mosque, located on the site surface in the zone where unit Ek-B was situated (illustration courtesy Patrice Cressier).

was recorded). Interestingly this orientation accords very closely with the smaller (southern) mosque inside the town ruins, and differs from that of the larger mosque (and therefore also the '*qibla* cemetery enclosure'). Given the limited evidence available, it is however very difficult to provide a sensible date for this structure.

As noted above, Mauny (1961: 117–118) recorded the presence of what he described as a 'grande mosque', located at the eastern entrance to the town just outside the surrounding cliffs (see Fig. 11.2 for location). Today, however, the remains of this cannot be seen, certainly due to coverage by wind-blown sand. Mauny did not however provide a detailed recording of this structure. Cressier (1988) has suggested this could actually have been a *musalla* instead of a mosque, and until the recovery of further data we should reserve comment to simply noting that an additional prayer space existed at some point at the eastern entrance to the site. Certainly other mosques and other prayer spaces would have existed at various points during Essouk-Tadmekka's occupation, and certain of these are surely located within the earlier levels of the town, including earlier building levels of the two identifiable mosques.

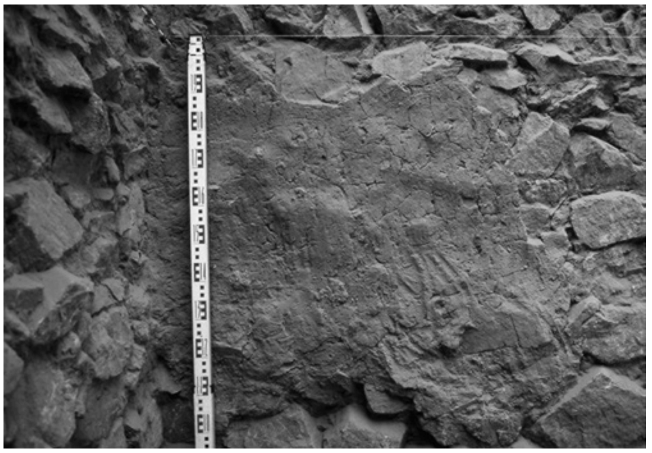

FIGURE 11.7 Banco *coating in the process of being removed from the lower levels of the walls in the north-west corner of Ek-A, revealing the stone wall behind.*

Materials and Construction Methods

From the surface remains and the excavated evidence it appears that the most commonly used material within the Essouk-Tadmekka architectural tradition was stone. The use of stone as a building material is easily explained by its abundance in the area and its being a relatively easily workable material. Stone is a commonly used construction material throughout the southern Saharan fringe area, both at archaeological sites such as Tegdaoust (Polet 1985), Azelik-Takedda (Bernus & Cressier 1991), and Koumbi Saleh (Berthier 1997), as well as within traditional structures still in use in Mauritania (Prussin 1986). The surface remains at the site appear almost entirely to relate to a dry-stone construction method of a relatively low quality, though in certain areas (particularly around Ek-B) we see evidence of higher quality construction. The excavation of the upper levels of units Ek-A and Ek-C revealed relatively poorly constructed dry-stone architecture with an earth fill, with the stone walls left bare. Excavation just below the surface in Ek-B however showed a far more solid, refined stone construction, albeit on the same broad model with an earth fill and the stone left bare. As excavation in unit Ek-A progressed to deeper levels we also saw far more evidence of more solid dry stone construction, as well as examples with very well-worked stone finishes (Fig. 11.8). The size of stones varies little throughout the Ek-A sequence however, and it is only in the buildings at the eastern edge of the site where we see larger stones used, including in the structure excavated in unit Ek-B. From the available evidence it appears that the thickness of dry-stone walls does not vary hugely over time.

The use of mud as a building material at Essouk-Tadmekka had previously been evidenced thanks to the detection of traces of mud-architecture within the surface remains of the northern mosque (see Cressier 1988; it should be clarified that a detailed systematic inspection of traces of mud remains has however not been undertaken). The excavations show a consistent use of mud construction materials throughout the sequence, but always in association with stone construction. Within West African building traditions, architects commonly work in either mud or stone, and it is uncommon to see these traditions mixed (Prussin 1986). The unusual combination of mud with stone therefore needs to be explained.

From the earliest building evidenced within Ek-A we see dry stone construction covered with "*banco*-plaster" (Fig. 11.7), and this is also combined with *pisé* (Figs. 11.8, 11.9). Given the method of excavation in the early levels of Ek-A (*i.e.* following the interior of the room space) we only have evidence from interior contexts – it is possible therefore that *banco* was also used on the exterior of early buildings; though the only early building exterior we see, from unit Ek-B, shows an untreated, bare stone exterior (assuming this has not eroded over time). While the coating of stone walls with mud plaster is obviously an

FIGURE 11.8
Well-dressed stone used to fill a doorway (southern) in Ek-A Horizon 6.

aesthetic treatment, the use of solid *pisé* walls in addition to these "*banco*-plastered" walls needs explaining. If we are to come up with a reason beyond the purely idiosyncratic, it is perhaps useful to think about the load-bearing properties of *pisé*, a material which is far easier to create a load-bearing structure with than is stone, especially in an arid environment when seasonal rain is not an issue. While there is no definitive evidence for this structure having had a roof which had to endure load-stress, the evidence for some form of staircase strongly suggests access to a roof (Fig. 11.9). The thermal properties of mud architecture in a desert environment are also potentially important. We continue to see the use of mud-plaster for much of the sequence, and at later points we also see the combination of uncoated dry stone with mud-construction, both in Period 3b and Period 4.

Mud-brick was only documented in two instances, though this might have been more commonly used elsewhere. Of particular importance to highlight is the highly distinctive use of red-ochre 'plaster', seen from Period 3b and the beginning of Period 4, including in the seating platform (Fig. 11.10). Red-ochre plaster is strongly associated with traditional architecture in certain southern Saharan areas, including Walata in Mauritania

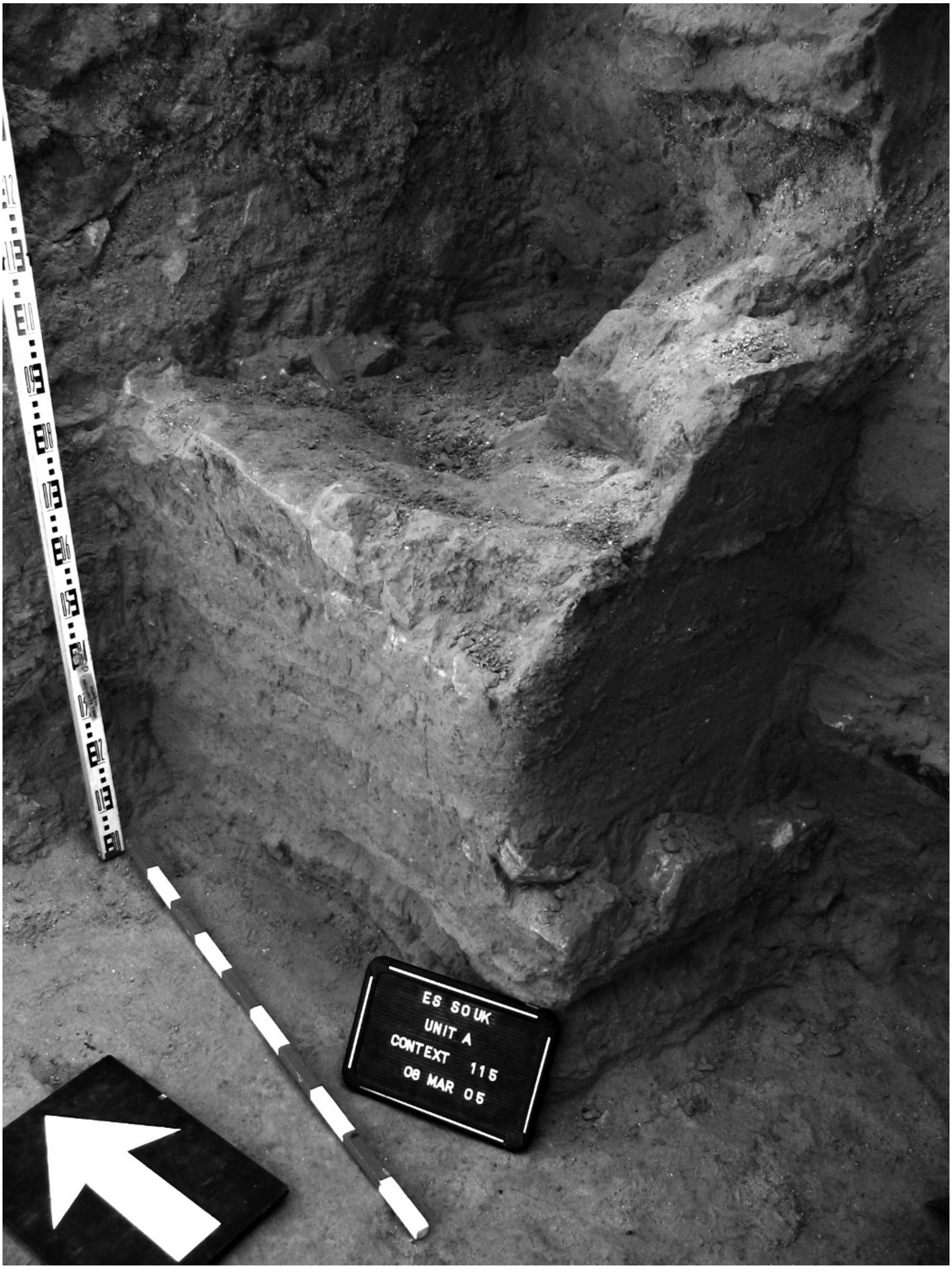

FIGURE 11.9 *Remains of* pisé *structure (Feature 7) built in Ek-A Horizon 3; potentially representing the remains of some form of staircase.*

FIGURE 11.10 *a. Ochre-coated seating-platform excavated in Ek-A Horizon 11, being put to use for afternoon tea (stones on right side are not* in situ *remains – placed to aid entering and exiting unit); b detail of the red/orange-ochre seen on the vertical face of the seating platform (right side).*

(Prussin 1986), but also further south, including for instance in Hausa areas (Prussin 1986). The excavations at Tegdaoust also recorded the use of red ochre *creppisage* (mud plaster) (Polet 1985: 239; Robert-Chaleix 1989: 182), and interestingly this was only encountered in the late phase occupations, like at Essouk-Tadmekka.

When seeking to understand the combination of stone and mud at Essouk-Tadmekka, we should also consider the better-documented archaeological example of Tegdaoust. At that site the excavators documented an early experimentation with mud architecture (brick), then a shift to mostly stone-built construction, although still combined with mud, in the form of bricks and *banco* coating (Polet 1985: 233–4). The interpretation offered by the excavators is that the initial use of mud-architecture was due to this having been the traditional practice of the first occupiers of the town, coming from North Africa. It is then proposed that the shift to an architecture based upon stone construction is due to the fact that the seasonal rain in the Tegdaoust environment led to rapid erosion of mud architecture, necessitating a change in building tradition. While Essouk-Tadmekka is not an identical scenario culturally or environmentally, a mixing of building traditions in adaptation to a new environment is possibly a useful explanation for the unusual combination of stone and mud seen at Essouk. Differences to highlight with Tegdaoust though are the much greater evidence for *pisé* at Essouk-Tadmekka and significantly less evidence for mud-brick. Interestingly, in the Essouk locality today mud architecture is used in construction, and soils for this appear relatively easily available.

In terms of other materials, almost certainly wood would have been used in roof construction, together with mud as a binding agent, although we have no clear indications of this. We do however have good evidence for flooring. Throughout the sequence there are sand floors, including a fine-sand example in Ek-A Horizon 3. We also see clay 'floors' in all periods, though it seems that these often formed a foundation for the sand covering which would have been the true living surface, as seen for instance in Kidal today (first author observation). Interestingly, we also seem to see potential evidence for wooden doors, although this is testified only by the presence of a large key in unit Ek-A Horizon 4 (see Chapter 17). The final thing to comment on is additional decorative treatments. We see evidence for white plaster, from Ek-A Period 3. We see no use of paint, however, though one should consider the potential for this, especially given that the *banco* coating at Tegdaoust was often painted (Polet 1985). While burnt brick technology was evidenced at Gao (Insoll 1996; Cissé *et al.* 2013), we recorded no evidence for this, but given the close-relationship between Tadmekka and Gao and the likely movement of ideas and goods through Essouk-Tadmekka to Gao one should consider the potential for detecting this in future. Another architectural technology to discuss is the highly distinctive decorative plaster work seen at the Ibadi site of Sedrata in Algeria (Van Berchem 1960). Given the supposed very strong early Ibadi influence at Essouk-Tadmekka one might perhaps expect to see an experimentation with such Ibadi styles, though perhaps the social and material technology for such a transfer did not exist.

Further Discussion

In exploring the architecture of Essouk-Tadmekka, one of the central concerns was to explore the foundational tradition of Essouk-Tadmekka architecture in the earliest phases of building activity at the site. The earliest building recorded in unit Ek-A, dating to *ca* AD 900, is seemingly a very well-built construction, both in terms of its solidity and in terms of its architectural finish – this includes the large *pisé* staircase/pillar feature and the sieved sand floors. We also gain a sense of the materials used, it being a sophisticated multi-media construction using both stone and mud. The area we excavated appears to relate to a larger, relatively developed multiple component space, and the *pisé* construction suggests this also had a load bearing roof. The buildings from the Ek-B area likely slightly post-date the earliest building recorded in Ek-A, but they do seem to indicate that untreated dry-stone architecture was also part of the early tradition. This building is also interesting in that its exterior face is very well constructed, presenting a well-worked stone finish to the outside. We are certainly not in a position to provide commentary on the wider architectural tradition during the earliest phases of the site, but the evidence we see does seem to indicate a highly developed and aesthetically constructed architecture was being built at the early site in a mix of materials. This evidence certainly does explain why by the time of Al-Bakri Tadmekka was being identified as one of the best-built towns in West Africa (see App. A).

Beyond commentary on the earliest building tradition at Essouk-Tadmekka, having peeled back the surface remains of the site we do indeed find evidence of solid construction and elaborate architectural forms in all periods. Following on from the earliest building recorded and its rebuilding throughout Ek-A Period 2, we see the evidence of the *banco* covered seating platform and its associated mud-built construction in Ek-A Period 3b; likewise, at the beginning of Period 4 we see the use of thick-red ochre plaster to finish the structures. Again, while it is difficult to gain a detailed sense of the wider architectural landscape in the various periods of the site, these various forms offer a very different perspective to the rough, dry-stone constructions seen on the site's surface, indicating a greater elaboration and quality of construction.

In addition to highlighting the quality of building over time, the fact that the terminal phase construction at the site appears to be of a markedly lesser quality to building seen in earlier periods raises the question that the terminal phase construction represents a significant departure from earlier building traditions. The excavation of the buildings in Ek-A Horizons 13 and 14 and in the terminal horizon of Ek-C show these buildings to have used fairly rudimentary dry stone architecture (Fig. 11.11). When we look at this evidence against the relatively extensive evidence for elaborate construction from earlier periods, there does certainly seem to be a case for arguing that there was a decline in building construction in the final occupations at the site. While we have to be a little cautious regarding this statement, it is interesting to observe that the highest quality constructions seen on the surface of the site date to the 10th/11th century. Likewise, most of the areas which we are suggesting relate to the terminal phase of the site are covered in the remains of fairly rudimentary dry-stone constructions.

Regardless of any hypothesised changes within the sequence – both in terms of architectural style and construction quality – one should not lose sight of the fact that there is a broad continuity over time. The 10th/11th century dated building from the unit Ek-B area and the

FIGURE 11.11 *North* (a) *and south* (b) *wall of room in Ek-A Horizon 14* (*floor level at Horizon 13 level*).

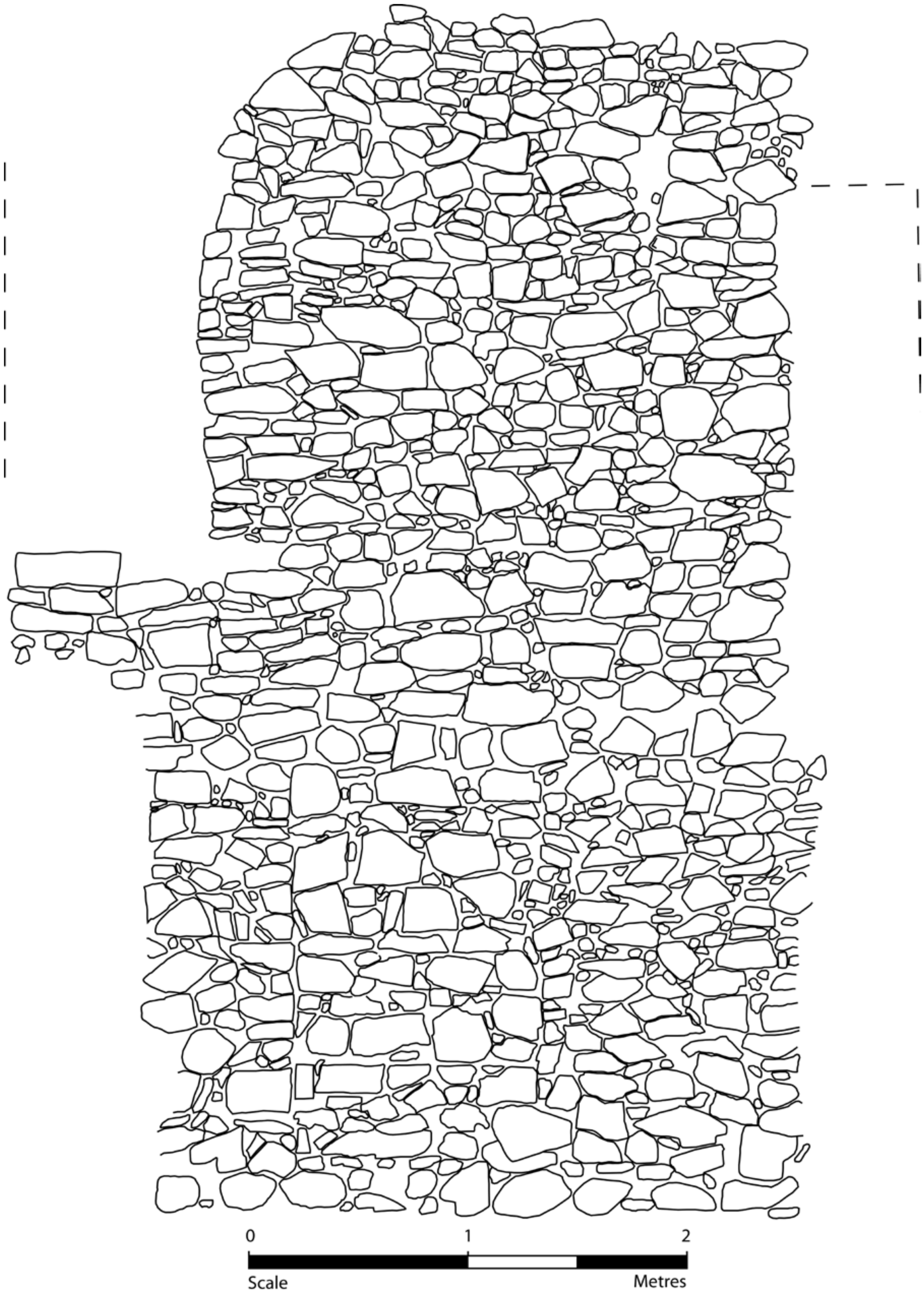

FIGURE 11.12 *Drawing of the superimposed walls which defined the west side of the series of rooms excavated in Ek-A over 14 building horizons, indicating the consistent use of walls from the previous horizons as foundations for rebuilding – while this appears as a 5-metre high wall, this obviously never existed in this form at any point in a single occupation at the site (compare with Fig. 7.3).*

early excavated evidence from unit Ek-A seem to indicate that early architectural forms were similarly constructed on a rectilinear model, using both dry-stone and mud construction, something which we see through all periods. The sequence in unit Ek-A also shows a remarkable continuity in the use of space, with the reuse of previous walls as foundations over the entire sequence (Fig. 11.12).

Conclusion

The surface architecture remains provide a wealth of data and thanks to the EOM aerial imagery we have now been able to map these in great detail. This has also been nicely supplemented by the excavated evidence. Not only does this combined data testify to the well-built town reported on by Al-Bakri, this now provides us with a broad sense of the building traditions of Essouk-Tadmekka, including their form, the materials used, and the construction techniques. There is clearly a great amount that could be done however. Further detailed comparative work on building forms using the map we have generated would be a useful start, to provide a more developed idea of dated types of Essouk-Tadmekka's religious, domestic and commercial structures. In terms of further work in the field, a more detailed on-site recording to ground-truth the map we have produced would be an important study. Focused research of the surroundings of the town would also prove useful. The initial finding of the *musalla* (see Fig. 4.12) with no systematic survey work shows the potential here and our study of the satellite imagery for the surroundings of the town clearly shows traces of various other structures (not detailed here). Further excavations could also be very strategically targeted. Importantly, our study has shown that the buildings on the surface date to different periods, including as early as the 10th/11th century – accordingly, it can be seen that undertaking broad exposure excavations of buildings from the early phase of the site is possible in certain areas without requiring the removal of the remains of subsequent periods. This said, an excellent study – though time-consuming – would be a broad exposure excavation looking at architectural change over different phases of the site. The building compound where we excavated in Ek-A would be ideal for this, with a linked sequence of 14 permanent building horizons over *ca* 500 years, preceded by evidence for non-permanent architecture.

PART 4

Finds

CHAPTER 12

Pottery

Sam Nixon and Kevin MacDonald

Introduction

The majority of the pottery recovered during the fieldwork was unglazed, earthenware of West African manufacture. While mainly locally produced, these unglazed, earthenwares also include various sub-sets seemingly imported from the banks of the Niger River, *ca* 300 kms distant. Additionally, the wider pottery assemblage contains a small sub-set of glazed wares and wheeled-turned wares (*ca* 0.15% of total pottery assemblage excavated). These arrived through trans-Saharan trade networks, and include some evidence for the import of pottery from outside the Maghreb.

As no pottery sequence previously existed for Essouk-Tadmekka, nor indeed from any medieval site in northern Mali – and as pottery is the most numerous finding from the site – an intensive program of analysis was undertaken. The aim was to provide a detailed characterisation of "Essouk pottery", and to construct a ceramic sequence which would enable insight into the changing nature of the assemblage over time, and thereby larger cultural patterns within and around the Essouk valley. In addition to classic typology building, some focused technical studies were also carried out.

Although our study focuses on the excavated pottery, a systematic collection of sherds found on the site's surface was also undertaken. By comparing this with the excavated pottery it was possible to begin to understand the nature of ceramics from unexcavated areas of the site, thereby providing some insight into the occupation history of these other parts of the site.

The majority of the tables quantifying the pottery study are located in Appendix E, to which reference is made throughout. Selected tables however are located within the body of the text. Certain additional illustrative materials are also featured in Appendix E, referred to throughout.

We commence our analysis with the small assemblage of imported glazed and wheel-thrown ceramics, before moving on to the hand-formed earthenware assemblage.

Glazed and Wheel-thrown Wares

Overview

30 fragments of glazed and wheel-turned pottery were collected during excavation, with a further 6 sherds recovered during the surface survey. Glazed and wheel-turned pottery is widely regarded never to have been produced in West Africa, and its relative rarity would seem to support this assumption. It is therefore treated as a separate analytical category. Prior to analysis of individual fragments, refitting was attempted – while refitting was not extensive we did achieve some results which allowed us to provide better reconstructions of the forms of certain vessels. Within this section a description is provided of the ceramic fragments, together with noteworthy comments provided by experts consulted. The description of the ceramics provided here will detail the following characteristics: form, decorative features, temper, fabric colour/texture, wall thickness, and any other noteworthy features. Illustration of the surface appearance and decoration of a select number of sherds is provided in Figures 12.1 & 12.2. Specimens from which it is possible to reconstruct significant elements of the original vessels are illustrated in Figures 12.3 & 12.4. Reference to these illustrations is provided within the specimen descriptions below.

Specimen Descriptions

The following is a sherd by sherd description of the glazed and wheel thrown pottery fragments prior to refitting work. Notes regarding refitting relationships of specimens are provided within the individual specimen descriptions.

1) Ek-A 54 (Horizon 12) – Fig. 12.1b, 12.4b. Vessel shoulder fragment; two lines of notched décor with single incised line between; unglazed; cream slipped exterior; light-brown, medium fine fabric (relatively high fired); sparse grog temper with occasional fine sand; wall thickness 0.4cm; most likely origin is Tunisia/eastern Algeria (Derek Kennet, pers. comm.).

2) Ek-A 55 (Horizon 11) – Fig. 12.1a, 12.4h. Modelled 'footed' base with shallow notch on foot of base; unglazed;

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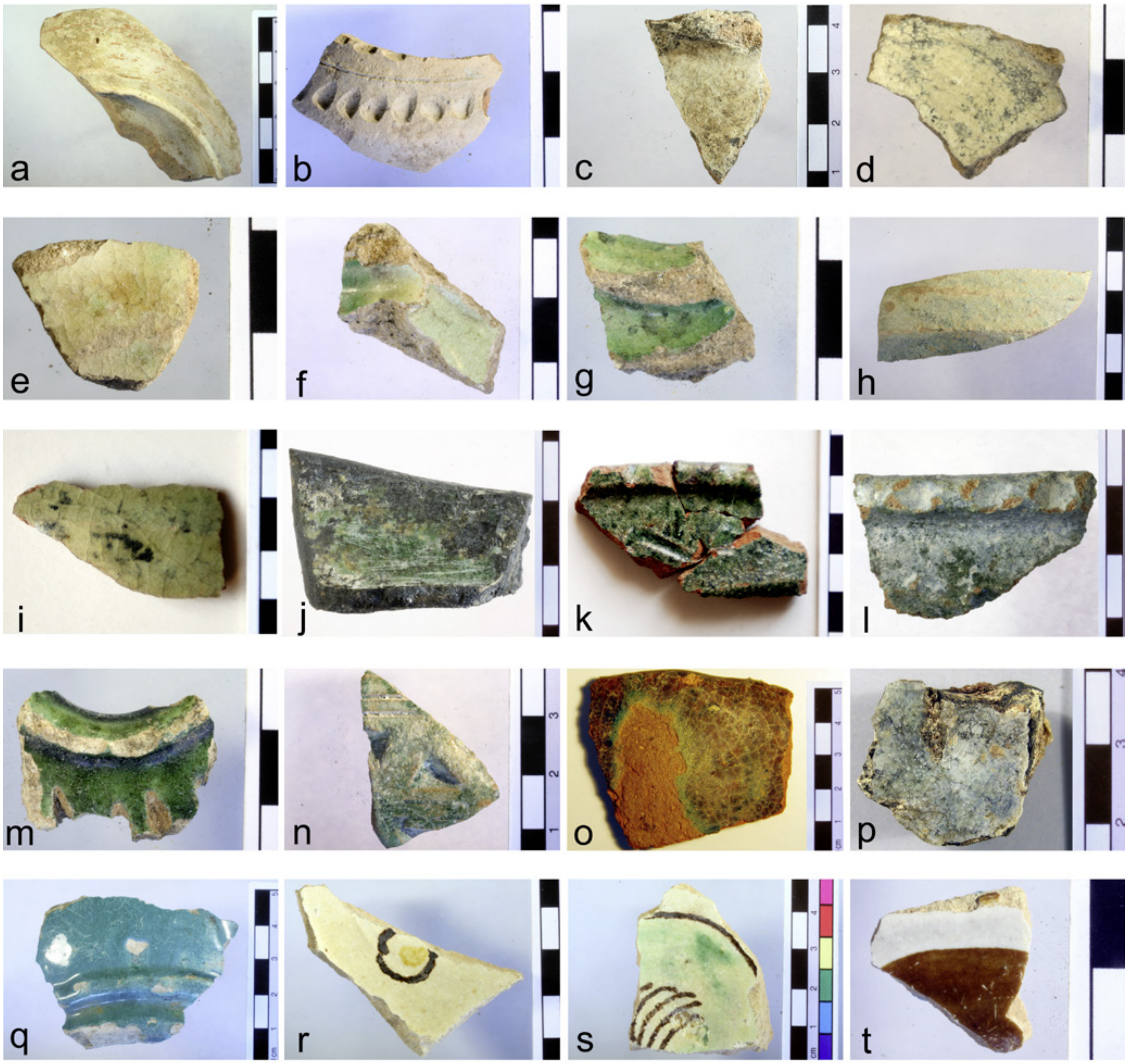

FIGURE 12.1 *Examples of glazed and wheel-turned pottery fragments from Essouk-Tadmekka (see text for individual details and compare with Fig. 12.4): a. Ek-A 55, b. Ek-A 54, c. Ek-A 62, d. Ek-B 8, e. Ek-B 8, f. Ek-B 8, g. Ek-B 8, h. Ek-S 108, i. Ek-A 79, j. Ek-A 87, k. Ek-B 4/Ek-B 8, l. Ek-B 4, m. Ek-B 8, n. Ek-B 10, o. Ek-S 109, p. Ek-C 11, q. Ek-B 4, r. Ek-B 4, s. Ek-B 4, t. Ek-C 11.*

cream slipped (exterior/interior); fine sand/mica temper with sparse grog; dark-orange, fine fabric (high fired); wheel thrown; 0.6cm max wall thickness/'rim' of base thickness 0.8cm; has close similarities to African Red Slip Ware (ARS) of the Late Roman tradition (D.Kennet, pers. comm.).

3) Ek-A 62 (Horizon 11) – Fig. 12.1c. Rim; cream glaze (exterior/interior); fine sand temper; light brown, medium coarse fabric; 1cm wall thickness.

4) Ek-A 79 (Horizon 10) – Fig. 12.1i. Shoulder of vessel; light green glaze (exterior/interior); fine sand temper; cream, medium fine fabric; 0.5cm wall thickness.

5) Ek-A 74 (Horizon 10). Modelled base fragment; dark-green glaze (interior/exterior); fine sand temper; dark orange, medium coarse fabric; 0.5cm wall thickness.

6) Ek-A 78 (Horizon 10) – Fig. 12.3. Near-complete oil lamp; mid-brown glaze (exterior/interior); no identifiable temper; light brown, fine fabric; geographical origin and production date undetermined (Venetia Porter, pers. comm.).

7) Ek-A 86 (Horizon 9) – Fig. 12.2, 12.4d. Rim of bowl; white crystalline glaze (interior/exterior); porcelain; cream, fine fabric; 0.2cm wall thickness; Chinese Qingbai

FIGURE 12.2 *Rim-sherd of Chinese Qingbai porcelain from Context Ek-A 86* (*scale in mm – see also Fig. 12.4.d for proposed reconstruction of vessel*).

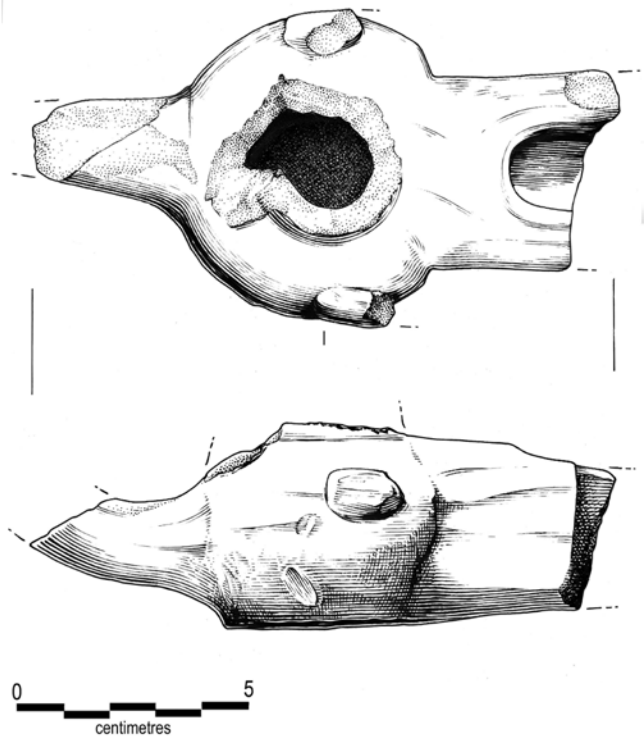

FIGURE 12.3 *Photograph* (left) *and drawing* (right) *of glazed oil lamp from context Ek-A 78.*

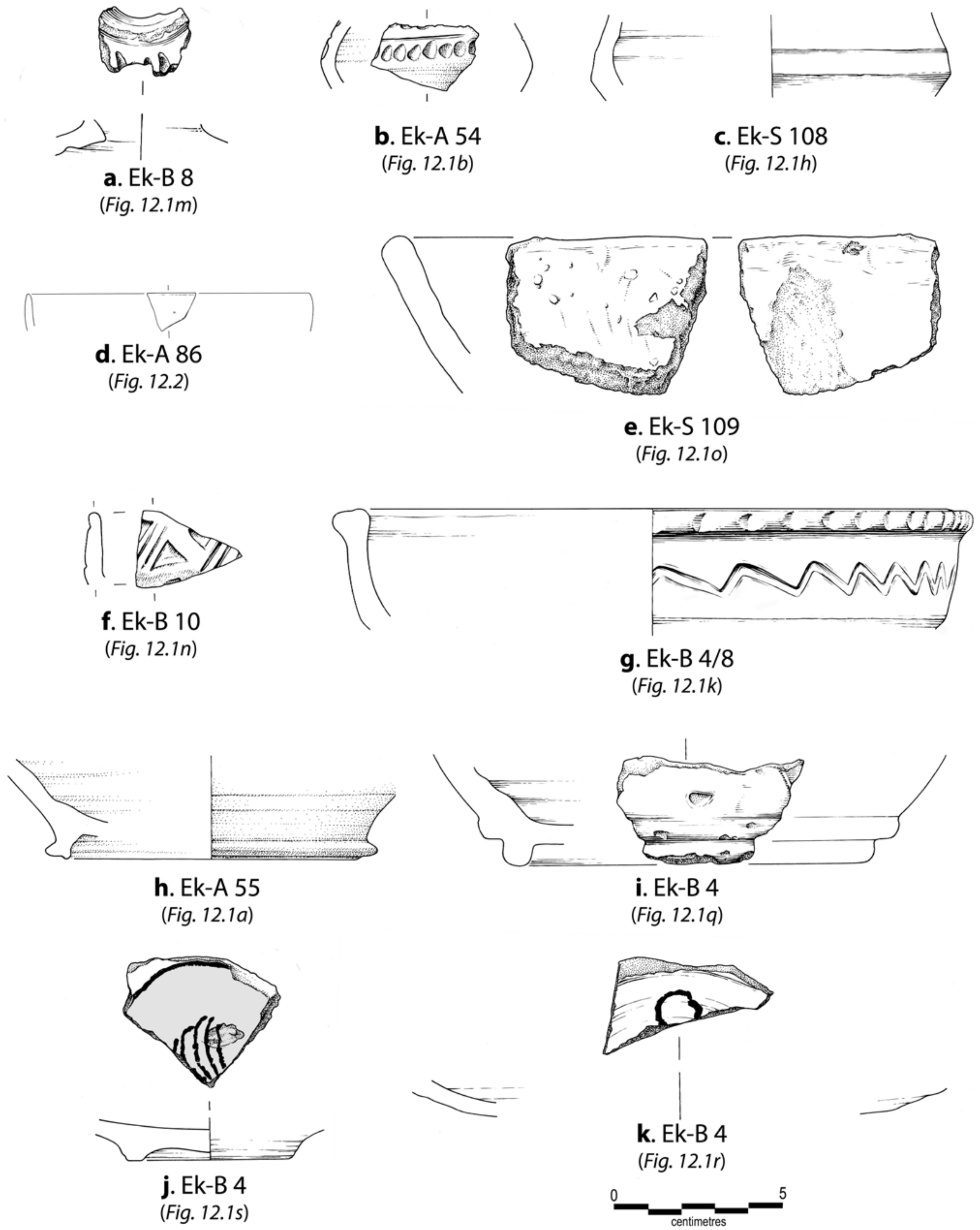

FIGURE 12.4 *Reconstruction drawings of selected glazed and wheel-thrown pottery from Essouk-Tadmekka based upon recovered fragments (for corresponding photographic illustrations see references to Figs. 12.1 and 12.2 below context numbers in illustration).*

ware (produced in eastern China), *ca* 11th–13th centuries (Regina Krahl, pers. comm.).

8) Ek-A 87 (Horizon 9) – Fig. 12.1j. Everted rim sherd; dark-green glaze (exterior/interior); temper and nature of fabric unavailable (specimen burnt); wall thickness 0.4cm/rim thickness 1.4cm.

9) Ek-A 87 (Horizon 9). Body sherd; mid green glaze (interior/exterior); fine sand temper; cream, medium fine fabric; 0.4cm wall thickness.

10) Ek-B 4 (Horizon 2) – Fig. 12.1q, 12.4i. Base with heavy channelling (refits with specimen no. 18); medium bluish-green tin glaze (interior/exterior); no identifiable temper; cream, fine fabric; 1.1cm wall thickness; possibly Fatimid era (Venetia Porter, pers. comm.).

11) Ek-B 4 (Horizon 2) – Fig. 12.1l. External thickened rim of bowl; dark green glaze (interior/exterior); notched decoration on lip and incised décor on upper exterior; fine sand temper; light brown, medium coarse fabric; 1.1cm rim thickness/0.5cm wall thickness; possible relationships with ceramics known from Pisa in the *ca* 11th century (D. Kennet, pers. comm.)

12) Ek-B 4 (Horizon 2) – Fig. 12.1k, Fig. 12.4g. External thickened rim of bowl (refits with specimens no. 15, 17, 21); dark green glaze (interior/exterior); notched decoration on lip; fine sand temper; medium orange, medium coarse fabric; 1.1cm rim thickness/0.6 wall thickness; possible relationships with ceramics known from Pisa in the *ca* 11th century (D. Kennet, pers. comm.)

13) Ek-B 4 (Horizon 2) – Fig. 12.1s, Fig. 12.4j. Modelled base fragment (base diameter 4cms); cream glaze with green wash and brown line decoration (interior); no identifiable temper; cream, fine fabric; 0.7cm wall thickness; possible Tunisian/Algerian origin, possible *ca* 11/12th centuries (D. Kennet, pers. comm.).

14) Ek-B 4 (Horizon 2). Body sherd; light green glaze (exterior/interior); fine sand temper; cream, medium fine fabric; 0.6cm wall thickness.

15) Ek-B 4 (Horizon 2) – Fig. 12.1k, Fig. 12.4g. External thickened rim of bowl (refits with specimens no. 12, 17, 21); dark green glaze (exterior/interior); notched décor on lip and incised décor on upper exterior; fine sand temper; medium orange, medium coarse fabric; 1.3cm rim thickness/0.7cm wall thickness; possible relationships with ceramics known from Pisa in the *ca* 11th century (D. Kennet, pers. comm.)

16) Ek-B 4 (Horizon 2) – Fig. 12.1r, Fig. 12.4k. Base sherd; yellow/cream glaze with brown and yellow décor (interior); no identifiable temper; cream, fine fabric; 0.4cm wall thickness.

17) Ek-B 4 (Horizon 2). Fig. 12.1k, Fig. 12.4g. Body sherd (refits with specimens no. 12, 15, 21); dark green glaze (exterior/interior); incised décor; fine sand temper; medium orange, medium coarse fabric; 0.6cm wall thickness; possible relationships with ceramics known from Pisa in the *ca* 11th century (D. Kennet, pers. comm.)

18) Ek-B 4 (Horizon 2) Fig. 12.1q, 12.4i. Fragment of base (see also no. 10 above which this refits with); medium bluish-green tin glaze (exterior/interior); no identifiable temper; cream, fine fabric; 0.6 cm wall thickness; possibly Fatimid era (Venetia Porter, pers. comm.).

19) Ek-B 8 (Horizon 2) – Fig. 12.1e. Body sherd; light greenish yellow glaze (exterior/interior); fine sand temper; cream, medium fine fabric; 0.6cm wall thickness.

20) Ek-B 8 (Horizon 2) – Fig. 12.1g. Broken rim of closed vessel; medium greenish-yellow glaze (exterior/interior); fine sand and occasional grog temper; cream, medium fine fabric; 0.6cm wall thickness.

21) Ek-B 8 (Horizon 2) – Fig. 12.1k, Fig. 12.4g. Vessel shoulder fragment (refits with specimens no. 12, 15, 17); dark green glaze (exterior/interior); fine sand temper; medium orange, medium coarse fabric; 0.8cm wall thickness; possible relationships with ceramics known from Pisa in the *ca* 11th century (D. Kennet, pers. comm.).

22) Ek-B 8 (Horizon 2) – Fig. 12.1f. Body sherd; light greenish-yellow glaze (exterior/interior); fine sand temper; cream, medium fine fabric; 0.6cm wall thickness.

23) Ek-B 8 (Horizon 2) Fig. 12.1d. Base fragment; cream glaze (exterior/interior); no identifiable temper; cream, medium fine fabric; 0.5cm wall thickness.

24) Ek-B 8 (Horizon 2) – Fig. 12.1m, Fig. 12.4a. Rim fragment of closed vessel; perforated decoration on upper-wall of vessel; dark green glaze (exterior/interior); fine sand temper; cream, medium coarse fabric; 0.6cm wall thickness.

25) Ek-B 9 (Horizon 2). Body sherd; exterior dark-green glaze (interior surface n.a.); fine sand temper; cream, medium coarse fabric; wall thickness n.a.

26) Ek-B 9 (Horizon 2). Body sherd; dark green glaze (exterior); fine sand temper; light orange, medium fine fabric; 0.4cm wall thickness.

27) Ek-B 10 (Horizon 2). Body sherd; exterior dark green glaze (interior surface n.a.); fine sand temper; cream, medium fine fabric; wall thickness n.a.

28) Ek-B 10 (Horizon 2) – Fig. 12.1n, Fig. 12.4f. Simple rim sherd; medium green glaze (exterior); incised décor on upper part of vessel (notched triangles and parallel lines); light orange, fine fabric; 0.5cm wall thickness.

29) Ek-C 11 (Horizon 1) – Fig. 12.1p. Body sherd; pale blue glaze (exterior/interior); fabric of sherd unidentifiable (sherd burnt); 1cm wall thickness.

30) Ek-C 11 (Horizon 1) – Fig. 12.1t. Body sherd, possibly associated with base; white and brown glaze interior/white glaze exterior ('lustreware', Venetia Porter, pers.

comm.); fine sand temper; cream, medium fine fabric; 0.5cm wall thickness;

31) Ek-S 61. Thickened rim sherd; dark-green glaze (exterior/interior); no identifiable temper; light orange, medium fine fabric; 0.6cm wall thickness/1.2cm rim thickness.

32) Ek-S 97. Base fragment; exterior dark green glaze, interior pale yellow glaze; fine sand temper; cream, medium fine fabric; 0.7cm wall thickness.

33) Ek-S 104. Body sherd; dark-green glaze (exterior/interior); fine sand temper; cream, medium fine fabric; 0.5cm wall thickness.

34) Ek-S 108 – Fig. 12.1h, Fig. 12.4c. Shoulder of jar (?); medium green glaze exterior; fine sand temper; light orange, medium fine fabric; 0.7cm wall thickness.

35) Ek-S 109 – Fig. 12.1o, Fig. 12.4e. Rim of bowl; dark brown/green glaze (exterior/interior) – coarse finish to glaze, especially interior; coarse sand and possible chaff temper; medium orange, coarse fabric; 0.9cm wall thickness.

36) Ek-S 110. Base fragment; medium green glaze (exterior/interior); no identifiable temper; cream, medium fine fabric; 0.8cm wall thickness.

Analytical Comments

The first thing to note about the glazed and wheel-turned specimens is their stratigraphic distribution. The majority of the excavated specimens (19 of 30) come from unit Ek-B, in contexts dated to the 10th and 11th centuries. In unit Ek-A none of this pottery was recorded before Horizon 9, and finds within the upper horizons of unit Ek-A are limited, as they are in unit Ek-C, seen to relate to a similar period. Broadly speaking we have a record of glazed or wheel thrown ceramics in contexts dated between the 10th and 13th centuries – while the strong focus of these wares in the 10th and 11th century deposits of Ek-B suggests a significant presence of these types of wares in that era, given the limited excavation sample we should not over-interpret the more limited finds from other periods as an indication that these wares were less common outside of 10th and 11th century contexts.

Given the relatively small assemblage and the small size of the fragments recovered, it is difficult to make very clear statements about the nature of this category of import pottery arriving at Essouk-Tadmekka. If one is to make a judgement upon the basis of the specimens recovered though, one would say that the assemblage does not include very many 'high end' items, strongly indicating the majority of ceramics coming across the Sahara to Essouk-Tadmekka were fairly common wares. This said, we do see certain higher end pieces, and in particular the Chinese Qingbai porcelain stands out (Figs. 12.2, 12.4d).

In terms of manufacturing provenance, in the absence of mineralogical studies, even with the aid of regional experts, our ability to 'trace' these ceramics and assign them to a particular geographical production area is limited; other that is than the Chinese item referred to above. While the most likely geographical origin for the majority of the glazed pottery recovered is from the Central Maghreb (Tunisia/Algeria), the limited number of highly diagnostic specimens combined with the relatively limited amount of good comparative assemblages from those regions means it is very difficult to substantiate this. Regardless, one can see that the well-stratified Essouk-Tadmekka assemblage provides a good data set for future comparative research into the Saharan long distance trade in Early Islamic glazed ceramics.

The quantity of notionally 'Maghrebian', wheel-turned and glazed, ceramics recovered from Saharan entrepôts has been variable. Berthier (1997: 47) notes only five such sherds from her excavations at Koumbi Saleh (Mauritania) – all from disturbed upper deposits. From Azelik-Takadda (Niger) Bernus & Cressier (1991: 116–7) report 20 wheel-turned and glazed sherds ranging in colour from green, blue and yellow to white. A mineralogical analysis of these sherds revealed three compositional groups: Egyptian (two samples), Tunisian (one sample) and Central Maghrebian (four samples). However, as most of these sherds were surface finds, they are of little chronological utility. Without doubt the best sampled and studied collection of such ceramics comes from Tegdaoust (Mauritania), where Vanacker (1979: 156–61) analysed an excavated assemblage of 121 specimens. His work, when combined with Robert-Chaleix's (1989) absolute chronology for the site, allows for some interesting chronological observations. First, imported glazed ceramics are most common in Vanacker's Occupation II (*ca* AD 850 – 1050), III (*ca* AD 1050–1200) and IV (*ca* AD 1200–1350) – they are entirely absent before AD 850. Vanacker found the colour of glaze to be temporally significant, with the earliest glazes being yellow (in Occupation II) and blue (in Occupations II and III). Green, white and transparent glazes were most common in Occupation IV. Decorated varieties, particularly with impressed rocker 'flames' and punctate triangles, were confined to Occupations II and III. Our findings from Essouk-Tadmekka are broadly in agreement with Vanacker's initial work. At Essouk-Tadmekka Blue and Yellow glazed sherds are mainly confined to earlier periods (*ca* AD 950–1000), while Green glazed sherds in particular are spread more evenly throughout the sequence. As at Tegdaoust, glazed sherds virtually disappear in the 14th century.

Further discussion of these glazed and wheel-turned wares is provided later in the chapter following the presentation of the unglazed, hand-formed wares.

Unglazed, Hand-Formed Pottery

Introduction

The most common type of material culture collected during the fieldwork is unglazed hand-formed pottery, undoubtedly mostly of local production. The main objective of this analysis is to assess the timing and nature of shifts in the Essouk-Tadmekka pottery assemblage, and to consider how these might correspond with larger socio-cultural changes connected to the people making and consuming the Essouk-Tadmekka pots. We contend that the validity of obtaining such information from the study of pottery is reinforced by the ethnoarchaeological understanding that formal and technical attributes of contemporary Sahelian West African pottery *can* show significant variation between cultural and/or linguistic groups (Gallay *et al.* 1996, 1998; Gosselain 1998). One must of course be very cautious about using the products of potters to represent historic bounded socio-cultural groups, especially as such pots can be produced exclusively by client groups or castes. Still, a careful use of the analytical data gained from the study of pots can allow insight into socio-cultural changes and long distance trade connections at Essouk-Tadmekka.

Methodology

As the 'medieval era' ceramics from this region have not been studied previously, to describe the ceramics it was necessary to develop a completely new attribute-based ceramic analytical framework. The methodology used to develop this typology broadly follows that which has been used and developed over a number of years at other West African sites from the past two millennia, including Jenné-jeno and Dia (*cf.* McIntosh 1995b; Schmidt *et al.* 2005; Arazi 2005; Macdonald 2011). The broad methodological approach guiding these studies is attribute-based, rather than typological, with the recording of all formal and material attributes of each individual sherd collected to build up a database which can then be used to conduct quantitative analysis; whether in terms of the distribution of individual attributes or their co-occurrence. Before this recording stage there are however a number of steps which have to be undertaken. The first step involves the definition of the attribute categories used to describe the ceramics. Examples of some of the descriptive categories used in this study include the following: decorative tool; fabric; firing technology; rim shape; and internal rim diameter. Having defined the descriptive categories for the attributes, the next step is to define individual types within each descriptive category (allotting codes to these types): for instance, one of the codes for the descriptive category 'fabric' is '41' which means a ceramic fabric which is chaff-tempered. Having assigned all the codes for all the descriptive categories, the recording process is ready to be carried out. This process includes entering all the descriptive codes for each individual sherd into a database set up for this purpose.

Once all the attribute codes are entered into the database it is then possible to use this to commence the analysis via the counting and sorting of attributes. Such an analysis both avoids the pitfalls of purely typological analyses – which play down important variation within types – and facilitates investigating vertical and horizontal patterning by attribute alone (*e.g.* rim form, fabric, décor).

The first stage of analysis (*single attribute analysis*) involves quantifying the assemblage from the isolated perspective of each of the attribute categories defined for the study. For each of the categories this will involve counting the numbers of occurrences within the assemblage of each of the attributes defined within the descriptive category across space and time. With this information it will then be possible to identify the dominant characteristics of the assemblage as a whole, as well as identifying significant time sensitive variability (*e.g.* the restriction of a particular decorative motif to a specific period within the occupation sequence). While this first level approach can be highly informative for focused studies of individual ceramic attributes, it obviously does not allow us to see potentially interesting correspondences between attributes. For this reason a second stage of analysis is conducted to establish these correspondences (*'combined attribute analysis'*). This second stage of analysis will focus on defining correspondences between elements such as form and décor. In the present study this second stage of analysis also includes investigation of the correspondences of ceramic fabric types with other attributes. The final stage of the analysis (*'forming attribute clusters'*) involves investigating in more detail the pots displaying the most significant decorative and form correspondences in stage 2 of the analysis, in order to identify statistically-based '*pottery types'* for Essouk-Tadmekka.

The first stage of the recording process took place at the site where the assemblage was divided into the following five groups:

1) Specimens with sufficient rim dimensions remaining to allow vessel form and diameter reconstruction (hereafter 'rim sherds');
2) Specimens having insufficient rim dimensions to enable vessel reconstruction but having handles or spouts ('modelled sherds');
3) Specimens having evident modelled bases ('base sherds');
4) Specimens having insufficient or no remaining rim, and no handles or spouts, but being decorated ('decorated body sherds');
5) Specimens having insufficient or no remaining rim, and no handles or spouts, and having no decoration ('non-decorated body sherds').

Following this division, the next step involved counting the undecorated body sherds by archaeological context and reburying these: no attempt was made to study the fabric or the firing technology of these body sherds as it was seen that this information could be gained from the other categories of the assemblage. The rest of the material was taken to Bamako to be stored for subsequent analysis. The recording was carried out in Bamako by the first author between October 2005 and January 2006.

The first category studied was 'decorated body sherds'. For these sherds the following attributes were recorded: décor motif; burnish; slip; firing core; temper. Explanation of these categories is provided below.

~ DÉCOR MOTIF – The decorative motifs featuring on the body sherds were recorded with the aid of a chart which lists the codes of all the types of decoration used on the ceramics from Essouk-Tadmekka (Fig. 12.5). This chart is based on a classificatory system long used by the second author with assemblages from the Middle Niger region of Mali (*e.g.* SCHMIDT *et al.* 2005; MACDONALD 2011) and benefits from collaborative work on the identification of impressed and rouletted cord motifs (Haour *et al.* 2010). It includes cord-related decorative motifs, painted motifs and plastic motifs. Illustration of a selection of these decorative motifs is provided in Figures 12.6 & 12.7. While the recording of decorative 'patterns' is noted and recorded where relevant, the main emphasis in the study of the décor is on the tools being used to produce the decoration. This is because recent African ethnoarchaeological work has shown that technical aspects (tools, forming techniques and fabrics) often tell us more about social boundaries than more readily transferred 'artistic' aspects (decorative pattern, for example) (*cf.* GOSSELAIN 1992, 1998; GALLAY *et al.* 1996).

~ BURNISH – Burnishing of vessels is a process which involves giving a polished surface to a vessel by rubbing or smoothing it before firing. Simply the presence or the absence of burnish was noted for all the body sherds.

~ SLIP – Slip is a liquid clay solution mixed with red ochre and applied to the surface of ceramic vessels after they have been formed to give them a smooth, red to red-brown surface. Again, simply the presence or absence of slip was noted for all the body sherds.

~ FIRING CORE – The firing core is the colouring of the interior of the ceramic wall. Different firing atmospheres produce different firing cores. The characteristics of the various firing cores evidenced at Essouk-Tadmekka are illustrated in Figure E.1 which also shows the codes that these firing core types were given during the recording process.

~ TEMPER – The temper of a ceramic vessel is the material which is added to the natural clay when the vessel is being formed to give it extra bonding strength and the capacity to withstand thermal shock. The temper types used in the production of the ceramics recorded at Essouk-Tadmekka are listed in Figure E.2 together with the codes used to represent these different types.

Following the study of the body sherds the next group of ceramics studied was the rim sherds. In addition to the recording of the attributes listed above for the decorated body sherds, the following additional attributes were recorded for the rim sherds: rim form; rim angle, maximum rim thickness; diameter of vessel; décor location.

~ RIM FORM AND ANGLE – In the West African Sahel rim forms are one of the attributes of ceramics which vary the most, with various ways of shaping, adding clay (thickening and joining), and bending. As with decorative tools, particular rim forms can be stable indicators of particular pottery traditions and therefore the careful recording of their various forms can potentially yield useful information related to cultural practice. The rim forms evidenced at Essouk-Tadmekka are divided into three broad categories: simple; thickened (with added clay at the rim, but no inflection); and everted (with an inflected/bent rim or an added inflected band of clay). Within these three categories a great range of variation was categorised and recorded. These rim types are illustrated in Figures E.3–E.7 together with the codes which represent them. Rims are further described with the attribute of 'rim angle,' essentially the angle of closure of the main body of the pot (*e.g.* an everted rimmed vessel will have a rim that 'flares' but the main body may well be tightly closed and jar-like – it is the latter which is measured by rim angle). The rim angles utilised are illustrated in Figure E.8, ranging from wide open (for example a shallow bowl or plate) to tightly closed (for example a jar with a tightly constricted opening).

Cord-Wrapped Decors (Peigne Fileté Souple et Peigne Fileté Rigide)
Impressed Cord-Wrapped Decors (Peigne Fileté Imprimé)
PFI-3 = Tightly Spaced (1.5mm or less between wraps), no stick marks
PFI-4 = Widely Spaced (more than 1.5mm between wraps), no stick marks
CWSGI = Cord-wrapped stick (1.5mm or less between wraps), faint stick marks
PFI-6 = Multiple cord-wrapped stick (Hurley 1979 nos. 262-270)
Cord-Wrapped Roulettes (Peigne Fileté Roulé)
PFR-1: Single Bead, Single Base, no stick marks (Hurley 1979 no. 271)

Cord Impressions and Roulettes [no base]
Cord Roulettes
CR-1 = Fine Knotted Cord Roulette (Hurley 1979 no. 165, nos. 182-198)
CR-2 = Double Braided Roulette [simple herringbone pattern] (Hurley 1979 no. 210, McIntosh 1995 Tw 1&2)
CR-4 = Accordian Pleat Roulette (McIntosh 1995 Tw 4&5); aka Folded Strip Roulette (Haour *et al*. 2010)
CR-5 = Knotted Strip Roulette (Soper 1985 Fig.5)
CR-6 = Twisted Cord Roulette (Hurley 1979 nos. 54-62; McIntosh 1995 Tw6)
CR-7 = Looped Cord [chevron roulette] (Hurley 1979 no. 172; McIntosh 1995 Tw12)
CR-9 = Multiple Element Twisted Cord Roulette (Hurley 1979 no. 87)
Cord Impressions
CI = Twisted cord impression insufficiently clear to show precise decorative pattern
CI-2 = Twisted cord mpressed in a Single Row/Channel
Other Cord
C = Cord décor of some form but too eroded to identify more precisely

Comb Decors
Dragged Comb (Peigne Entrainer)
PE-1 = Linear
PE-4 = Other geometric
Stabbed Comb
PI-1 = Linear

Stylus Decors
Channels
Ch = Single Channel
Mch = Multiple Channels (but slightly irregular, not made with a comb)
Simple Stylus-Incised Decors
SI-2 = Cross-hatched
SI-3 = Dashed lines
SI-4 = Geometric forms
SI-8 = Cross (Tuareg property sign?)
Punctate/impression with stylus
ST1 = Punctate, simple angular holes or depressions
ST2 = Punctate, simple circular holes or depressions
ST3 = Punctate, simple circular holes in geometric design
ST4 = Sideways impressions of the stylus.

Organic decors
Dragged Organics
Herb = Dragged straw or palm frond
Herb-geo = Dragged straw or palm frond to form patterns
Impressed Organics
OI = Fingernail Impressed [Ongle Imprimé]
OI-geo = Fingernail impressions arranged in geometric form
FI = Finger impression
Mat-formed
Natte = Grass mat impressed [fine sharp fibres in a diamond weave]
Dogon = Mat-formed impressions comparable to current Dogon techniques

Paint
Three letter Code describing:
Initial Code> P = paint, then dash (-)
Colour Code> R = rouge (red); B = Blanc (white); N = Noire (black)
Design Code> W = wash, C = Cross-hatch, L = Parallel Lines, T = Triangles, Do = dots
Example = P-RC is a red, painted cross-hatched design.

Applied Plastic
PA2 = Nubbins/Boutons – rounded
PA4 = Bands/Bandes - notched

Other
Perf = Single Drilled Hole (going through pot)
Mperf = Multiple Drilled holes (going through pot)
Erod = Eroded décor unable to be precisely defined.

FIGURE 12.5 *Pottery decoration codes used in the analysis of the unglazed, hand-formed pottery and their explanation. Certain of the décor types listed here are followed by references to the typologies of Hurley (1979), Soper (1985) and S.K. McIntosh (1995) for the purposes both of comparative reference and standardization; the numbers which follow the names of each of these authors when they appear after a reference indicate the code used in their typologies. This list is an improvement and modification of an attribute list used for Sahelian pottery analysis created by K.C. MacDonald and used by Projet Dia (Schmidt* et al. *2005).*

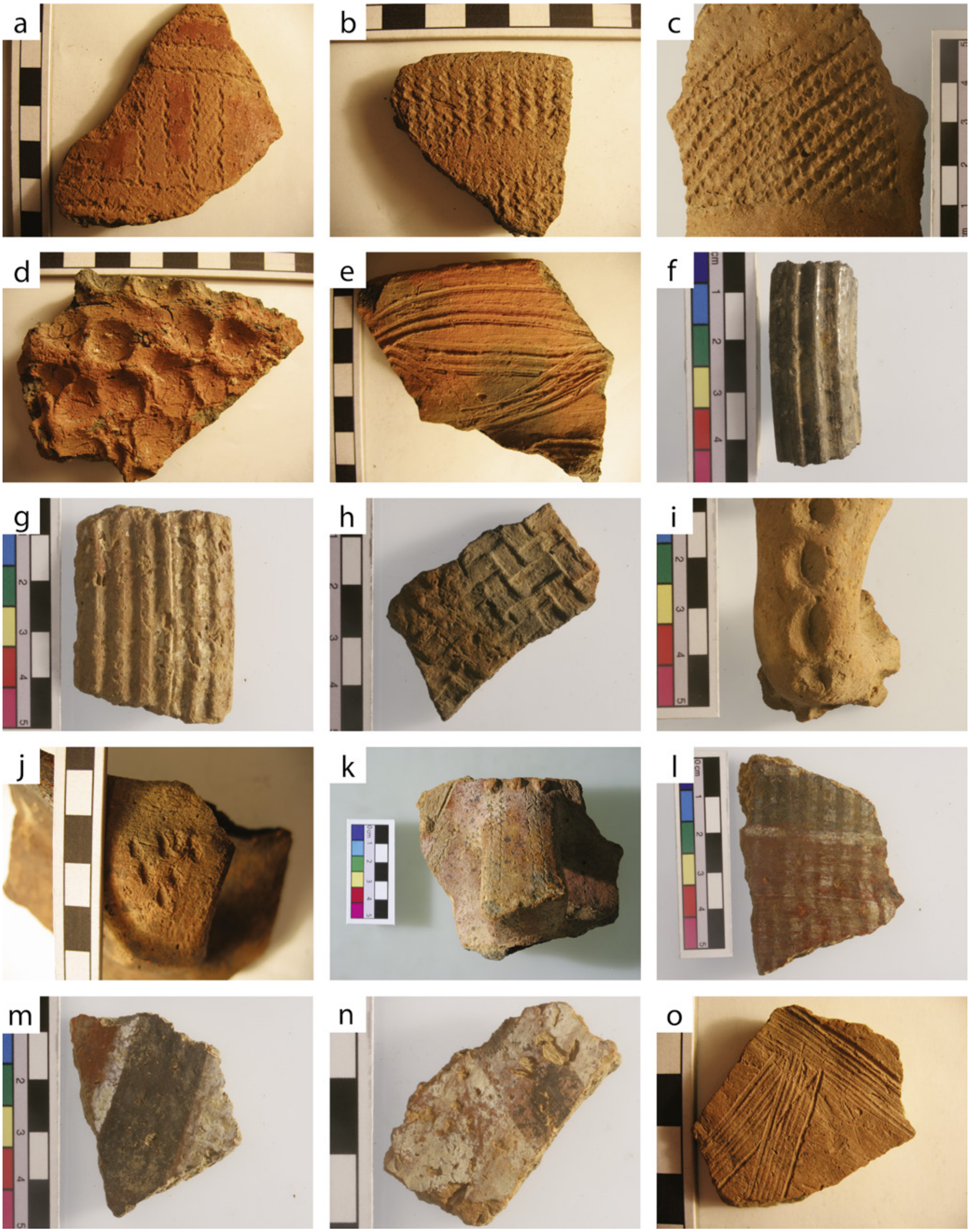

FIGURE 12.6 *Illustration of décor motifs recorded on Essouk-Tadmekka unglazed, hand-formed pottery (sheet 1): a. Cr-1 (Ek-A 2), b. Cr-4 (Ek-A 116), c. Cr-6 (Ek-B 9), d. Fi (Ek-C 11), e. Herb (Ek-A 45), f. Mch (Ek-B 9), g. Mch (Ek-B 14), h. Natte (Ek-B 8), i. Oi (Ek-A 2), j. Oi-Geo (Ek-A 45), k. Pa-2 (located at top of sherd – Ek-A 3), l. Paint (Ek-A 78), m. Paint (Ek-A 79), n. Paint (Ek-C 2), o. Pe-4 (Ek-A 2).*

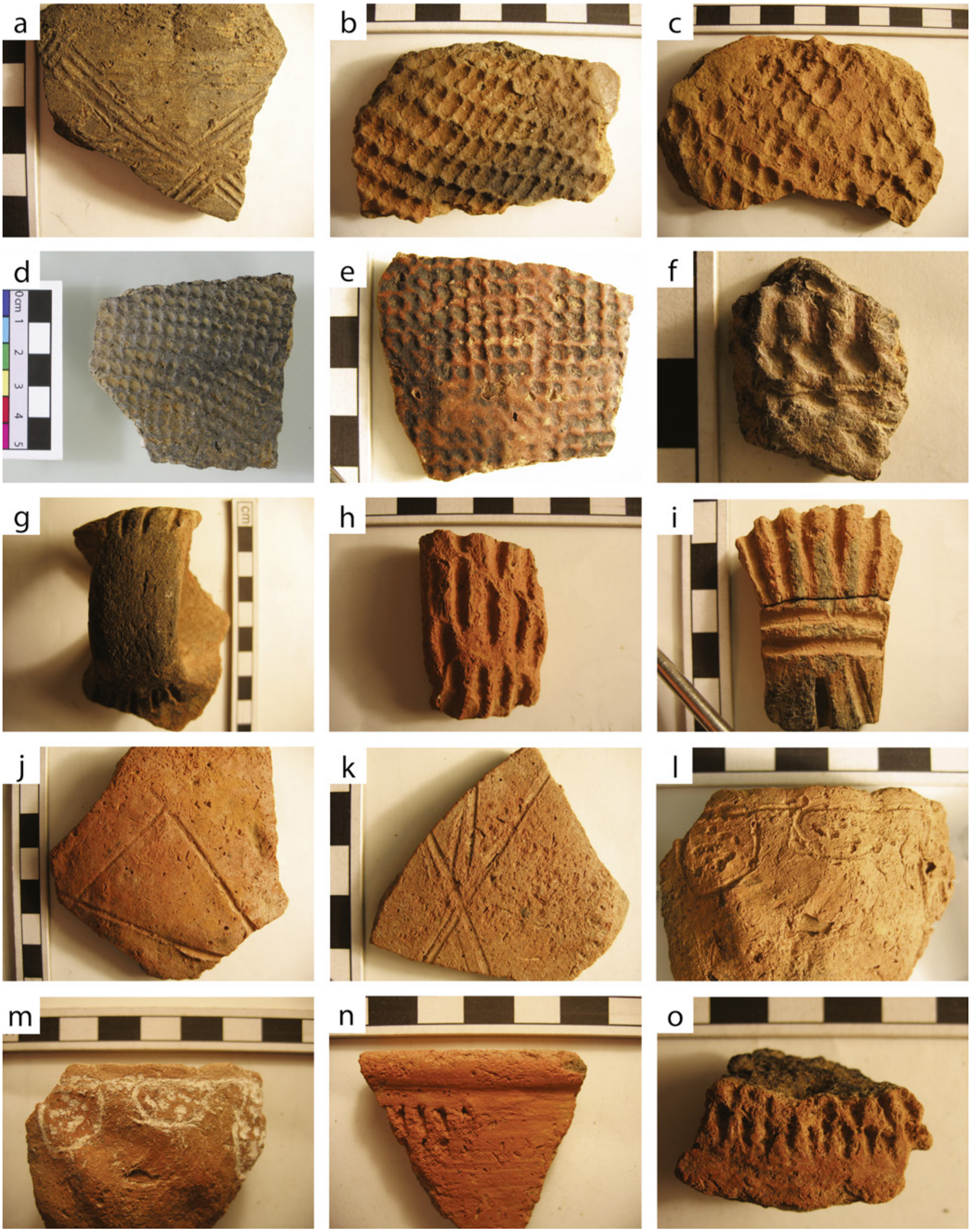

FIGURE 12.7 *Illustration of décor motifs recorded on Essouk-Tadmekka unglazed, hand-formed pottery (sheet 2) : a. Pe-4 (Ek-B 9), b. Pfi-3 (Ek-A 86), c. Pfi-3 (Ek-B 3), d. CWSGI (Ek-A 77), e. CWSGI (Ek-A 62), f. CWSGI (stick mark seen at top of sherd – Ek-A 84), g. Si-3 (located at top and base of handle – Ek-A 78), h. Si-3 (Ek-A 45), i. Si-4 (Ek-C 4), j. Si-4 (Ek-C 10), k. Si-4 (Ek-C 11), l. Si-4 (Ek-A 39), m. Si-4 (same sherd as seen 'l' with white powder applied to define design), n. St-1 (Ek-A 32), o. St-1 (Ek-A 113).*

~ Maximum rim thickness – The thickness of rims when recorded 'en mass' can often show interesting patterns within ceramic production. Within this analysis, the maximum thicknesses of the rims are recorded, that being the measurement of the thickest point of the rim seen in section.

~ Internal rim diameter – With certain pots which are intact or semi-intact we can measure the aperture of the pot opening (the internal rim diameter) with a ruler. Conversely, with very small rim fragments there is no way to determine the original internal rim diameter of the pot they formed a part of. In between these two cases, there are a large proportion of medium size rim sherds which enable us to determine their rim diameter by measuring this on a rim diameter chart, an illustration featuring a series of concentric circles corresponding to different rim diameters (not illustrated here). The accumulated rim diameter data enables us to gain a sense of the size ranges of pots used at Essouk-Tadmekka.

~ Handles, bases and other modelled forms (see Figs. E.9–12) – Following the study of the rim sherds the three remaining groups were studied: handles, bases, and other modelled forms. For these three groups the following attributes were noted where possible: form type; temper; firing core; décor motif; décor location. The explanations of the categories of temper, firing core and décor motif already given apply equally to these groups of the assemblage. The only extra information necessary for these groups relates to décor location.

~ Décor location – In addition to recording the décor motifs found on the rim sherds, the location of these motifs on the rim sherd is also noted. Figure E.13 illustrates the various location 'units' which are used to describe décor locations. Obviously, in addition to the rim itself a rim sherd can include a large part of a pot or an entire pot – therefore the location of the décor is able to be noted not simply on the rim but on all areas of the pot which are seen. There are two décor locations which apply to handles, the first being décor on the handle and the second being décor associated with the handle (*i.e.* the immediate area around the handle on the pot itself). For modelled bases, there is only one location code which relates to décor anywhere on the modelled base. The only 'other modelled form' to feature decoration was the trilobate pot rest (see below) and this is given one décor location code (the same as its form code: O2b).

Overview of the Excavated Assemblage

Before commencing more detailed analysis it is useful to establish a sense of the size of the assemblage and the character of the pottery sample within it. Table 12.1 shows the broad characteristics of the ceramics from the different periods of unit Ek-A.

The first thing to note in Table 12.1 is that pottery is relatively scarce in Period 1 (Horizons 1 and 2). In order to provide further definition as to when we start seeing significant amounts of pottery in the occupation sequence, the following additional figures are provided for the quantities of pottery specimens found in the first 3 *horizons* of Ek-A: Horizon 1 = 35 sherds; Horizon 2 = 103 sherds; Horizon 3 = 524 sherds. From these figures it can be clearly seen that pottery only starts to appear in large quantities with the beginning of permanent architecture in Horizon 3 – indeed, account should also be taken of the fact that less volume of deposits was excavated in Horizon 3 than in the two previous horizons.

In addition to providing certain information regarding the quantity of pottery found, Table 12.1 provides certain key indicators of the characteristics of the assemblage. Firstly, one can see that in all periods the assemblage is dominated by non-decorated pottery, the largest percentages of decorated vs. undecorated items reaching over the 15% mark only in Period 4. Within this overall tradition of limited decoration one can however see certain patterns – for instance, it is clear that there is more decorated pottery in Period 3b and Period 4 than in Periods 1, 2 and 3a. The second thing to note from Table 12.1 is that we can clearly see from the minimal amount of modelled bases recorded that on the whole the assemblage is of a round-bottomed tradition (never more than *ca* 7% of vessels if we compare numbers of rims against numbers of bases when bases are most numerous, in Period 3a). The last point to make regarding the assemblage in relation to Table 12.1 is that we can already note a significant time-sensitive variable within the assemblage, that being the presence of handles. While handles are obviously a major attribute of the Period 4 assemblage, in all other periods they are a limited presence.

The initial patterns observed in the decorative and formal attributes of the Ek-A excavated pottery are paralleled in units Ek-B and Ek-C, illustrated in Table 12.2. We again see that these assemblages are not highly decorated – the relatively large quantity of décor in Ek-B Horizons 2/3 should be noted, however. This is generally consistent with the chronological pattern of décor incidence from unit Ek-A. We see again that modelled bases are only minimally present. Likewise, the pattern for a low incidence of handles is consistent with the unit Ek-A assemblage relating to this period. One noteworthy pattern is the extremely large quantity of pottery observed from unit Ek-B Horizon 2/3: this indicates that excavation was taking

TABLE 12.1 *Broad overview of the unglazed, hand-formed pottery assemblage from unit Ek-A*

	Ek-A Period 1	**Ek-A Period 2**	**Ek-A Period 3a**	**Ek-A Period 3b**	**Ek-A Period 4**
Rim Sherds	6	57	44	110	164
Body Sherds	151	1367	1128	2158	3423
Handle Sherds	0	7	6	13	66
Sherds with modelled base	0	2	8	5	2
Feature Sherds (*e.g.* spouts)	0	2	2	10	2
All Sherds with no décor	137	1274	1080	1954	3089
All Sherds with décor	20 (12.7%)	159 (11.1%)	108 (9%)	342 (14.9%)	568 (15.5%)
Total items studied	**157**	**1433**	**1188**	**2296**	**3657**

TABLE 12.2 *Broad overview of the unglazed, hand-formed pottery assemblage from units Ek-B and Ek-C*

	Ek-B Hor. 1	**Ek-B Hor. 2/3**	**Ek-C Hor. 1**	**Ek-C Hor. 2/3**
Rim Sherds	39	416	51	79
Body Sherds	852	6844	760	1828
Handle Sherds	5	58	0	22
Sherds with modelled base	3	12	2	5
Feature Sherds (*e.g.* spouts)	3	11	0	1
All Sherds with no décor	806	5949	708	1770
All Sherds with décor	97 (10.7%)	1392 (19%)	105 (12.9%)	165 (8.5%)
Total items studied	**903**	**7341**	**813**	**1935**

place in an area previously used as some kind of '*dépotoir*'. Note that pottery from Horizon Ek-C '0' was discarded and not studied due to the problematic stratigraphy of these deposits noted earlier.

Analysis Phase 1: Individual Attributes

Having provided an initial broad view of the assemblage we now move to more detailed analysis, commencing with individual attributes in isolation. This analysis will be conducted in an order which broadly follows the stages by which pots are made. Firstly, we will look at the *material composition* (*temper*) of the pots, an attribute relating to the preparation of the clay by the potter. Following this, by looking at the *rim diameters* we will investigate the potter's decisions as to which size of pot to make. We then turn to the analysis of form, commencing with the decision of whether to provide a *modelled base* to the pot, following this by looking at the *rim type* the pot is to have, then considering the *rim thickness*. The next thing we investigate is the potter's decision as to whether the pot should have a *handle* or any *other modelled forms*. After form comes decoration. We look firstly at the choice of the *decoration* to be used, then at the choice of *décor location*. We then investigate possible final pre-firing treatments of the pot such as the addition of *slip* or the decision to *burnish* the pot. The final stage of the pot process and the final attribute to be studied is the firing technology as we look at the *firing core* of the pot.

Material Composition ('Temper')

From Tables E.1–E.2 (see App. E for all subsequent tables referred to in this chapter) we can see that the Essouk-Tadmekka assemblage is dominated by clays tempered only with 'chaff' (most likely cereal processing waste products) (code 41). While one can make a general statement that all deposits from all three units are dominated by chaff-tempered pottery (*ca* 96%) one can discern a pattern of significant variability in the presence of the next most frequently encountered temper type, namely chaff combined with 'grog' (crushed-up broken pottery) and with added coarse sand in small quantities (code 44). Pots tempered with this temper type are found in relatively high quantities (17% of all fabrics) in Ek-A Period 3b. The high incidence of this fabric type in Ek-A Period 3b and its low incidence from units Ek-B and Ek-C is broadly consistent with the stratigraphic relationship of the three units. The importance of these sherds featuring this type of temper is discussed further below (see sections on 'Technical Analysis' and 'CWSGI Ware'). All other temper types are found in negligible quantities and show no particular patterning.

Aperture Size (Rim Diameter)

Turning now to the aperture size of the pots, from Tables E.3–E.4 it can be seen that the rim diameters of Essouk-Tadmekka pots are as a whole fairly strongly concentrated in the 10–20 centimetre band. Likewise, a general statement can be made to the effect that pots are found in increasingly lesser quantities the larger the rim diameter category becomes beyond this 10–20 cm band. Sub-10 centimetre pots are by no means scarce in the assemblage. For instance pots of 6–8 centimetres are often found in excess of 50% of the total of the next diameter category up, the 10–12 centimetre category (Ek-A Period 1 excepted due to small sample size). The one most notable exception to these above broad statements relates to the Ek-A Period 4 pots where we clearly see that the rim diameter concentration in these pots is even more concentrated in the 10–16 centimetre category: if we compare these 10–16 centimetre measurements of the Ek-A Period 4 pots with rim diameters from Ek-B Horizon 2/3 for instance we can see that the *ca* 14th century pots of Ek-A Period 4 clearly have smaller diameters than the *ca* 10th/11th century pots of Ek-B Horizon 2/3; even though this size reduction is only of the scale of 4 centimetres. Given the low sample size of the pottery from other chronological units of the assemblage no further definite statements can be made about rim diameter change over time.

Modelled Bases

As was indicated earlier, modelled bases are very infrequently found in the Essouk-Tadmekka assemblage (Fig. E.10), clearly indicating that it is for the most part a round bottomed assemblage. Looking at Tables E.5 & E.6 we see that the modelled bases that are found are relatively equally distributed in time.

Rim Shapes

The decision as to what type of rim a pot should have is one of the most culturally and functionally contingent decisions in pot making, hence the variety of rim forms generally found is relatively large. While the task of defining a rim typology for a previously unstudied area is therefore a cumbersome task with the profusion of forms evidenced, this is also an important task as it provides a very useful body of new ceramic data.

The first broad division of the rims made is into three broad categories: simple rims – rims with no addition of clay to the rim tip and no bending of the upper part of the vessel (see Fig. E.3); thickened rims – rims with clay added to the tip to provide some form of modelled thickening but with no bending of the upper part of the vessel (see Fig. E.4); everted rims – vessels whose upper part is bent in some way (having a clear 'inflection' point), often related to the addition of a collar to a vessel (see Figs. E.5–E.7).

Looking broadly at the Ek-A assemblage we see that simple rims are consistently the most represented rim category, at around 40 to 60% of the total, thereby roughly equalling the combined totals of everted and thickened rims (Tab. E.7). Regarding the frequency distribution of the broad rim categories, we see everted rims becoming relatively more numerous over time. For instance in Periods 3 and 4 everted rims are more numerous than thickened rims while in Period 2 the inverse had been the case. This said, it should be noted that the quantity of rims in Period 2 is relatively small and therefore it is advisable to treat this pattern with caution.

Turning to the Ek-B and Ek-C assemblages we see a certain confirmation of the chronological patterns observed for unit Ek-A (see Tab. E.8). Looking first at the assemblage from unit Ek-B Horizon 2/3 we see that simple rims are again the most dominant rim category. In Ek-B Horizon 2/3 one can also see that everted rims are seen in greater proportion than thickened rims, a pattern that corresponds well chronologically with what was seen for unit Ek-A, Ek-B Horizon 2/3 being seen to relate to Ek-A Period 2. Regarding Ek-B Horizon 1, Ek-C Horizon 1 and Ek-C Horizon 2/3, we do see that these fit with the pattern of everted rims becoming more numerous over time, though again we should be cautious about these statistics given the small quantities of rims recorded.

Turning now to look at the three broad rim categories in more detail, let us first concentrate on simple rims (see Fig. E.3 for simple rim types). In the Ek-A assemblage (Tab. E.9) we can see that S4 rims are consistently dominant throughout the sequence, a pattern which is replicated when we look at Ek-B and Ek-C (Tab. E.10). This pattern is unsurprising as S4 is the most elementary simple rim form. Of the rim types which represent the remainder of the simple rims, S3 rims are the next most common in Ek-A and likewise in Ek-B and Ek-C. It should be noted that S3 rims are of an altogether different nature to S4 rims, requiring the gradual tapering of the clay as the pot wall is worked up to achieve a pointed finish, a more finessed production process. Of the remaining simple rims the most noteworthy distribution is that of S1 rims, these being seen in relatively large quantities later in the sequence (Period 3b and Period 4). While this flattened rim type is therefore reasonably time-sensitive it is however not a great carrier of cultural information by itself as it is another fairly 'universal' form.

Turning now to thickened rim types (Fig. E.4), we see that the majority are thickened on the external side only and are of a fairly basic design brought about by the simple addition of a small amount of clay to the rim tip. When we look to the frequency distribution table of thickened rims from unit Ek-A (Tab. E.11) we see that only small quantities of rims are found which are not of this broad type (T9 & T11). In units Ek-B and Ek-C we again see the dominance of this external thickened rim type (Tab. E.12), though Ek-B Horizons 2/3 was also where the majority of the other forms of thickened rims were recorded, a pattern which will be discussed further below.

T2, one of the most rudimentary of all the thickened rims seen, is the dominant thickened rim type in Ek-A Period 2 and also in Ek-B Horizon 2/3. In Period 4 a different thickened rim type was dominant, T7, one of the more angular of the external thickened rim types. Indeed, the T7 rim type appears to be a time-sensitive rim form, being concentrated in Period 4. Another time-sensitive rim-type to note is T6, present in relatively large quantities in Ek-B Horizons 2/3 though not in Ek-A Period 4. A final pattern to note regarding thickened rims is that the majority of more elaborate types were found in Ek-B Horizons 2/3: note in particular the relatively large quantity of rim T17. However, it is the diversity of thickened rim types being produced at that time which is of interest, in other words greater amounts of rims recorded producing greater amounts of types rather than larger quantities of a restricted range of rim forms.

Finally, we examine everted rims, the most diverse of the three rim categories. Let us first look at the broad categories of everted rims encountered at Essouk-Tadmekka. Our illustrations (Figs. E.5–E.7) show that a large proportion of the everted rims are quite basic eversions, the top part of the pot being bent outwards with little or no variation in the thickness of the pot wall above and below the inflection point (Fig. E.5). Within this broad type one can note a clear category of short to medium collared vessels on a closed vessel form (E28, E8, E3, E20, E39 & E2). A second broad category of rim seen is a short to medium collared vessel on a closed vessel with everted rim shapes which have some element of thickening above the inflection point and then taper towards a point (Fig. E.6: E24, E4, E63, E22, E29, E6, E44, E7 & E35); within this category we note in particular the rim types E6, E44, E7 and E35 which display very close formal affinities. The next category of rim type seen consists of only three rims: E37, E50, E21 (Fig. E.6), everted rims which have a closed or vertical collar on a closed vessel. The last broad type of everted rims contains those where inflection is accompanied by thickening above the inflection point but concentrated towards the rim tip. Within this last broad type we see two fairly clear divisions: firstly we see rims with a slight outward bending which lack a distinctive collar (E30, E13, E25, E70, E57 in Fig. E.7); secondly we see those which have a very distinctive collar, and one should particularly note the E52, E49, E19, E62 group of vertical collar vessels (Fig. E.7). In addition to these broad types outlined we also see bottles (E68 and E65) and a rim associated with a carinated form (E38).

We may now consider the relative frequency of everted rim types and their frequency distribution (Tabs. E.7, E.8, E.13, E.14). The first thing to remark is that everted rims are absent from Ek-A Period 1 but common in deposits post-dating this. Turning to look at the first broad category of everted rim, 'basic un-thickened eversions', we see that this category represents a relatively large proportion of the assemblage as a whole, unsurprising given that it is composed of fairly basic everted shapes. There appears to be little to remark in the way of chronological distribution, large quantities of these rims being seen throughout the sequence. The next broad category, 'tapered collar eversions', are well-represented within the assemblage. This category does not show significant frequency distribution between the different phases of the assemblage and nor does the sub-type 'E6-E44-E7-E35'. The highly distinctive type E35 does show a certain temporal distribution, this being found in relatively large quantities in Ek-B 2/3 and being restricted to Period 3 deposits in Ek-A (Tabs. E.13 & E.14) – tentatively therefore one can suggest that this is not a strong element within the Period 4 pottery tradition. The next group of everted rims, 'closed/vertical collar eversion with minimal thickening', is also well-represented in the assemblage. While as a whole this category cannot be restricted to a particular period, type E21 shows significant variation, being restricted to Ek-A Period 4 and in large quantities. The next broad type, 'thickened rim tip eversions', is again well represented and like the other broad categories it shows no particularly distinctive frequency distribution.

The remaining categories of everted rims, carinated rims (E38) and bottles (E68, E65) (Fig. E.7), are all relatively scarce. When considering the distribution of carinated rims however we also have to take into account the presence of 'shoulders' of carinated vessels found without a rim (Tab. E.19 & E.20). The fact that these 'shoulders' are concentrated in Period 3b fits with the distribution of carinated rims, these being present in Ek-A 3b but absent from the large quantities of specimens from Ek-A Period 4 and Ek-B 2/3. This combined evidence strongly suggests carinated rimmed vessels are a clear marker for Period Ek-A 3 occupation. Likewise, bottles are present in both Ek-B 2/3 and Ek-A 3a/b but absent from Ek-A Period 4.

Rim Thickness

As was stated earlier, how much clay is used in the production of a rim may be determinate of standard technical practice and therefore variability in rim thickness can occasionally show interesting patterns when analysed *en masse*. A look at Tables E.15 & E.16 however shows that the only pattern seen in the Essouk-Tadmekka vessels is one of great continuity over time. Rims with a 0.7/0.8cm thickness are fairly consistently recorded in the greatest quantities, with lesser quantities of rims recorded in relation to the amount of deviation from this 0.7/0.8cm standard. The broad range of rim thickness recorded as a whole is between 0.4 and 2cm.

Handles

The modelled formal attribute encountered most frequently on Essouk-Tadmekka pots are handles (see Fig. E.9, Tabs. E.17 & E.18). While absent from Period 1 deposits, handles are present from all other periods, but only become common in Period 4. One particular thing to note is the unusual presence of 'internal' handles (HR-4 & HR-7). While found in significantly smaller quantities than external handles, in Ek-B 2/3 they represent a significant proportion. Internal handles can thus be suggested to be a pre-Period 4 phenomenon. The function of these internal handled pots is difficult to ascertain.

Other Modelled Forms

In addition to the carinated forms we have already mentioned, there are three broad types of other pottery appendages or perforations (Fig. E.11 & E.12, Tabs. E.19 & E.20). Firstly we see spouts (V18), uncommon and only present in Ek-B Horizon 2/3 – yet given the small quantities of other modelled forms found these are not necessarily chronological markers for period Ek-B 2/3. Secondly, we see trilobate pot rests (V2) – designed for holding pots above another boiling pot or a fire – again these are not hugely common, though their restriction to deposits postdating Period 3a and their absence from the large quantities of pottery in Ek-B Horizons 2/3 should be noted. Thirdly, we see pottery forms with perforations (Fig. E.12). Of these we see couscousiere fragments (V3), varieties of pots likely for use in steaming grains or filtering liquids (V4, V5, V9 – note that type V9 is not recorded within Table E.20 as the only two examples recorded were from Ek-C Horizon '0'), and what appears to be fragments of a brazier (V11). These perforated forms are found throughout the sequence.

'Decoration'

The form of the vessel finished, all that remains are any final touches. The first potential element of this is decoration, including what type of decorative tool to use. We saw earlier in this chapter that pottery decoration is relatively rare at Essouk-Tadmekka. Despite this there is significant variability in the decoration seen, especially the tool types being used to create the décor. Therefore, while certain significant decorative 'patterns' are noted, for the most part this analysis is an analysis of the types of tools used. Let us concentrate on décor in unit Ek-A first as Ek-A shows the main chronological patterns of décor at Essouk-Tadmekka. Additional relevant information from Ek-B and Ek-C will be provided afterwards.

From looking at Table E.21, together with the décor code typology provided above and illustrations (Figs. 12.5–12.7), we see that the décor 'family' most common in Ek-A are 'cord-motif' decors. So it is with cordage that we begin our investigation. While cord-motifs are dominant throughout the sequence we can see that there is significant variation. Given the small amounts of pottery recovered from Period 1, the observation that PFI-3 décor [impressed cord-wrapped cord] is the most dominant type in that period provides little information other than telling us about the presence of that décor type at that period. Turning to Period 2, we see that PFI-3 remains far and away the most dominant cord-motif. The limited presence of CI-2 is likewise noted. The relatively large quantities of CR-4 (*cf.* folded-strip roulette, HAOUR *et al.* 2010) is relatively more significant, CR-4 being a very complex roulette type (see below for further discussion). Of particular note is CR-4's restriction to Period 2. Looking at the Ek-A Period 3a cord-decorated motifs, we see that PFI-3 décor dominates once again. Also to be noted in Period 3a is an impressed cord-wrapped stick décor type (CWSGI), a distinctly different décor type to the 'non-stick-based' (flexible) cord-wrapped decors of Period 2. Small amounts of CR-6 [twisted cord roulettes] are also noted but again not seen to be particularly significant as this is the most common and widespread cord roulette in West Africa during this period. In Period 3b the CWSGI décor described above is now clearly the most dominant type, virtually replacing PFI-3. The CWSGI décor we see is also all of a very specific impressed grid-design arrangement (see Fig. 12.10). In Period 4 we see another major cord-motif shift, CR-1, a knotted cord-décor, now being dominant.

Turning now to the non-cord décor types in unit Ek-A, we see from Table E.21 that there is no most obviously dominant 'motif family' after cord. Indeed, within the assemblage as a whole there are four other décor categories which are all found in relatively similar quantities: comb-decors; organic decors; painted decors; and stylus decors. Firstly let us look at comb-decors. Comb decors (PE-1 and PE-4) are relatively common in Period 2 and also in Period 4 but are a negligible presence in Period 3a and 3b; also to be noted is the fact that the geometric comb decors are mostly concentrated in Period 4. Moving to look at organic decors we see that decors created with the finger (FI) or the fingernail (OI) are concentrated in Period 4, although FI is present in small quantities in Period 2, 3a and 3b, and OI present in Period 3b. The other organic décor, dragged grass or straw, is restricted to Period 4. Painted decors are present in limited quantities in Period 2 and 3a but are more frequent in Period 3b and Period 4. Stylus decors are present in Periods 2, 3a and 3b but are mainly concentrated in Period 4. In addition to this second level of décor commonality, we do see other decors in Ek-A, but only in limited quantities. Firstly we see applied plastic nubbins present in Ek-A Period 4, but only in small quantities. Secondly we see perforations (PERF + M-PERF) concentrated in Period 4 but also present in Period 2. Thirdly we see one count of mat-formed décor in Period 4.

Looking now to units Ek-B and Ek-C (Tab. E.22) we see that broadly speaking the decorated motifs encountered in these two units accord with the patterns seen in unit Ek-A relative to the chronological relationships of the three units. The only slightly unexpected pattern is the relatively limited quantities of the knotted-cord roulette (CR-1) encountered in Ek-C Horizons 2/3, this either relating to a sampling artefact or some variability of occupation between units Ek-A and Ek-C in the latter stages of occupation at the site (see discussion below). The only other things to note in relation to these other two units are the décor types not encountered in unit Ek-A. These are as follows: CI; CR-2; CR-7; CR-9; PA-4; PBDO; PFI-6; PRC; 'Dogon'. These additional decors are all encountered in small quantities and the majority of them are encountered in Ek-B Horizons 2/3 where one would expect to see the 'static' or 'noise' of some additional décor types given the large amount of pottery recorded in Ek-B Horizon 2/3. The impressed matt décor (here termed 'Dogon'), although in small quantities, is of interest as it is usually part of a pounded-on matt formation technique, something known historically in Mali only from the Dogon and some Songhay groups (*cf.* MAYOR *et al.* 2005), and perhaps indicative either of traded pots or the presence of an enslaved potter from the south.

'Décor Location'

Tables E.23 & E.24 show that the majority of the pots were *not* decorated on the lip, collar, neck and upper areas, and that most decoration falls at or below the midpoint of the pot. The only temporal shift in this pattern is found in Ek-A Period 4 where we see more pots decorated on the collar, as well as decorated handles.

'Slip and Burnish'

Before certain of the Essouk-Tadmekka pots were fired they were given final treatments, either the addition of slip or the overall burnishing of the pot. Adding slip (usually a reddish fine clay-colourant-water solution) to the surface of a vessel after it has partially dried creates a smoother and less porous finish for the surface of the pot. Burnishing of a pot, done when it is almost dry, involves rubbing the surface with a smooth object (such as a river pebble) so that the pot will have a shiny, polished look once it is fired. Looking firstly at slip and burnish from Ek-A (Tab. E.25), we see that there appears to be a fairly clear pattern that in Periods 1, 2 and 3a burnishing is more common than slipping while in Periods 3b and 4 slipping becomes more common than burnishing. Burnishing is most common in Periods 3a and 3b (21–24% of all sherds), approximately twice as common as in Periods 2 and 4; the limited sample from Period 1 makes it difficult to pronounce with confidence on burnishing, but from the available evidence it does not appear to be common. Regarding slip, it is only negligibly present prior to Period 3, but within Period 3b it is extremely common (32% of all sherds). In Period 4 slip becomes less common (14%) but is still present. When we look to Table E.26 we can see that the pottery from units Ek-B and Ek-C fits very well with the slip and burnish patterns seen in Ek-A relative to the chronological relationship of the three units.

'Firing Technology'

The next thing to do with a pot is to fire it. Using RYE's (1981) firing core typology (see Fig. E.1) one can arrive at a complex array of firing atmosphere indicators which can be relatively difficult to interpret (Tabs. E.28 & E.29). However, if we collapse these into three interpretive groups and look at the data from Ek-A (see Tab. E.27), some interesting patterns begin to emerge. Firing Core Type 1 is essentially a 'clean' core, indicating that the firing atmosphere was an oxygen rich (oxidizing) one, either without organics or fired at too low a temperature to combust the organics. Cores 3–11 and 17 are varieties of 'sooty' cores, indicating either that organics were present (most likely given the *ca* 96% chaff tempering of the assemblage), or that pots were fired in an oxygen poor (reducing) atmosphere and then quickly dried in an oxidising atmosphere while the pots were still hot. Cores 12–14, 15 and 18 represent cores having a blackened exterior, interior, or both. Such cores usually result from a conscious manipulation of firing atmosphere (by keeping it oxygen poor) to produce black pots. This third 'oxygen reducing' group remains quantitatively consistent throughout the Ek-A sequence. However, there is an interesting co-variation in the first two groups during Period 3b. While this might indicate fuel economisation during that period (lower firing temperatures), more likely, given a similar fluctuation in temper types during Period 3b, it represents a lessening of quantities of chaff temper used, the possible cause for which could have multiple explanations.

Analysis Phase 2: Combined Attribute Analysis

Having analysed the pottery via individual attributes, we will now attempt to define significant patterns in the 'co-occurrence' of attributes in the Essouk-Tadmekka pottery – highlighting the most significant points of attribute correspondence within the assemblage. The principal aim of this analysis is to try to more precisely determine certain temporally diagnostic 'pot types' within the Essouk-Tadmekka sequence.

The first attribute correspondence we are going to investigate is between décor and form as both of these attributes displayed significant variability in Phase 1 of the analysis and they are perceived to be 'cultural information bearers'. While it was noted that the Essouk-Tadmekka assemblage as a whole does not feature a strong association of décor and form, the level of correspondence that was seen was still deemed to be worthy of further investigation. In addition we will also briefly investigate the correspondence of pottery fabric and decorative motif; this will in fact only involve looking at the one fabric type which showed a clear significant variability in the Phase 1 analysis, fabric type '44'.

Tables E.30–E.40 are referred to throughout this analysis. These provide a full breakdown of the attribute associations and their temporal variability.

'Décor Motif' >< 'Rim Form' Associations
(Tab. E.31–E.38)

To begin, we see that CR-4, the distinctive early décor motif found in association with the earliest permanent architectural occupation is only recorded in association with two 'S3' rims and not recorded with either thickened or everted rims. We also see that the CWSGI décor motif, a highly distinctive motif found in large quantities in Ek-A Period 3b, is associated with no rims at all: this strongly suggesting this motif is restricted to only the lower parts of vessels. However, some useful décor motif><rim form correspondences did occur. The first specific décor><rim form correspondence to note is that related to the rim form 'T6' a rim form found in relatively large quantities before Ek-A Period 4. When we look at the décor motif associations of this rim form we see that it shows nine counts of association with PFI-3 décor. Within the context of the relatively limited décor><rim form correspondences this is a fairly strong pattern. The next specific décor><rim form correspondence of note is that of rim form 'E35', temporally restricted to Ek-A Period 3 and Ek-B 2/3 deposits. When we look at the décor motif correspondences of this rim form we see that it shows a relatively frequent association with CR-6 décor (eight counts). The third significant specific décor><rim form correspondence to note is that related to the décor motif CR-1, a motif recorded in large quantities and almost exclusively in Ek-A Period 4. We can see that CR-1 has correspondences with the following rim forms: S1, S4, T7, T9, E21 and E15. While these rims all feature slightly different formal attributes which distinguish them from each other, they do have a broad commonality, all having either basic flattened or simple rim tips. Other than these observed correspondences there are no other highly significant patterns to be observed in the associations of décor motif and rim form.

'Décor Motif' >< 'Handle Form' Associations

We saw earlier that handles were concentrated in the most recent period of Essouk-Tadmekka's occupation, Ek-A Period 4. Looking at Tables E.39 & E.40 it can be seen that the décor motifs most commonly associated with handles in Ek-A Period 4 are CR-1 (eight counts) and OI/OI-Geo (eight counts); indeed only three other décor counts are found on handles in Period 4 (two painted motifs and one SI-3/SI-4 motif). When we look before Period 4 in unit Ek-A, the only connection that can be seen is that of four counts of SI-3/SI-4 décor associated with handles in Period 3b. When we look to the décor motif><handle associations in units Ek-B and Ek-C the only pattern providing information not already seen from unit Ek-A is in the Ek-B Horizon 2/3 deposits where we see that PFI-3 and CR-6 are the décor types most frequently associated with handles. One particular correspondence to note in the Ek-B Horizon 2/3 pots is the fact that the distinctive HR-4 handle is found commonly associated with PFI-3 décor (four counts of PFI-3 décor on the seven HR-4 handles recorded in Ek-B Horizon 2/3).

'Décor Motif' >< 'Fabric Type' Association

Only one décor motif><fabric type correspondence was adjudged significant, that pertaining to the high percent-

age of pots with a temper code of '44' (grog & chaff) in Period 3b. When we look at the data for Period 3b we see that 66% of the sherds having temper code '44' are associated with CWSGI décor (see Tab. E.30). While the remaining 41% of the sherds having a temper code '44' are associated with painted décor, this is in no small part due to the fact that paint is commonly applied on top of CWSGI décor (30% of the painted sherds associated with temper code 44 being CWSGI sherds) (see Fig. 12.10). This clearly implies a ware type of CWSGI +/– paint decorated sherds, all having the same rare temper type (*i.e.* featuring an addition of grog). The implications of this will be explored further below, together with a technical study of the CWSGI decorated body sherds.

Analysis Phase 3: Defining Pottery Types

The Phase 3 analysis seeks to build on the significant correspondences between specific rim forms and specific décor motifs defined in the Phase 2 analysis. The aim here is to define what additional attributes are most commonly associated, with a view to understanding more precisely what were the most recurrent attribute clusters or pottery 'types' are found at the site. Accordingly, in the tables below detailed descriptions are provided for pots which feature the T6 rim form and the E35 rim form, as well as the pot forms which relate to the CR-1 décor motif. Illustrations of some of these 'pot types' are also shown in Figure 12.8, 12.9. A brief discussion of each of these pot types follows.

'T6 Rimmed Pots'

The T6 rim form was found in deposits relating to Ek-A Periods 2–3b, and is noticeably absent from the Ek-A Period 4 assemblage, as well as the chronologically related deposits in Ek-C. The next phase of analysis showed this to have strong correspondence with the PFI-3 décor motif. Table E.41 shows the full attributes of pots featuring T6 rims (both with and without PFI-3 décor associated). We can see that 50% of T6 rims found featured PFI-3 décor and in all cases of the use of PFI-3 in association with rim T6 it is found on the lip of the vessel, though not purely restricted to the lip. We can see that only 5% of T6 pots have either slip or burnish. The T6 vessels have a rim thickness of 1.5–2.1cms and a diameter of 20–36cms. They are always open vessels. 17% of T6 pots have handles. Figure 12.8a shows an illustration of an open T6 rimmed vessel featuring PFI-3 décor on the lip.

'E35 Rimmed Pots'

Within the first phase of analysis, rim form E35 stood out as one of the more distinctive rim forms present in relatively large quantities. It was also noted that this had a certain temporal restriction within the sequence, like rim type T6 it being found in relatively significant quantities in deposits relating to Ek-A Periods 2–3b, but being absent from the Ek-A Period 4 assemblage, as well as the chronologically related deposits in Ek-C. Phase 2 analysis showed that E35 rims were often found in association with CR-6 décor. Table E.42 shows all the attributes of pots having E35 rims. It can be seen that 40% of E35 rim forms feature CR-6 décor and of these 88% feature this décor motif on the collar. As was evident from the attribute correspondence tables generated in the Phase 2 analysis, E35 rims are also found in association with certain other décor types and it can be seen from the above table that these other décor types are also mostly found on the collar of E35 vessels. E35 rims are all collared vessels (closed or tightly closed vessels, jars). While they feature a range of rim thickness between 0.8–2cms, 80% of the vessels have a rim thickness of 1–1.5cms. Likewise, while the vessels

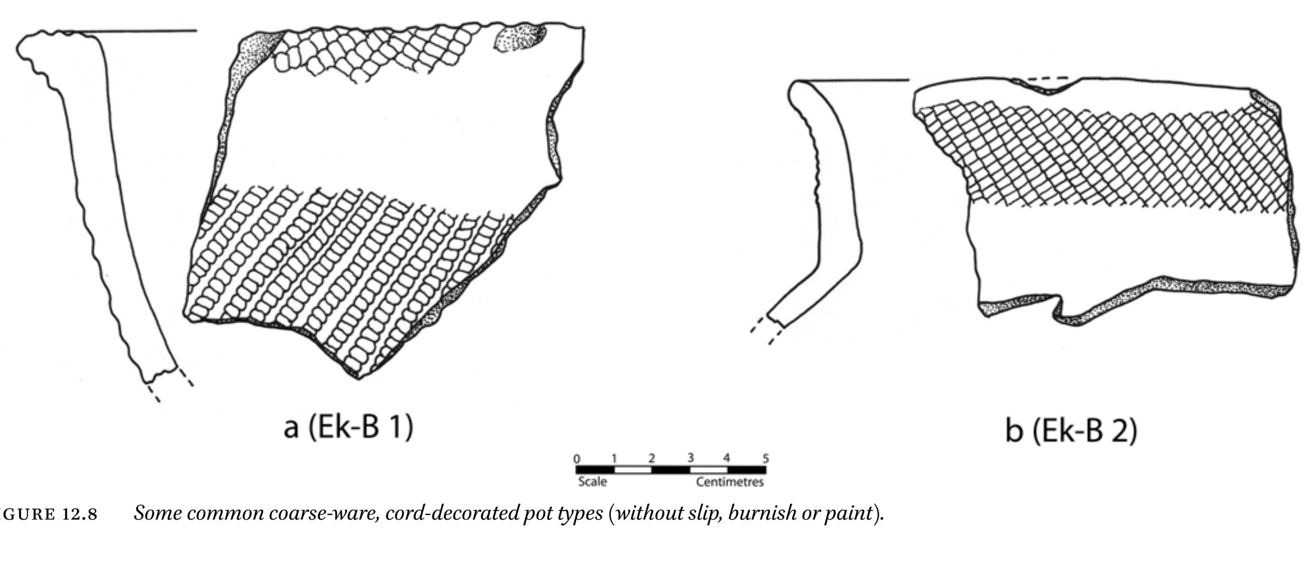

FIGURE 12.8 *Some common coarse-ware, cord-decorated pot types (without slip, burnish or paint).*

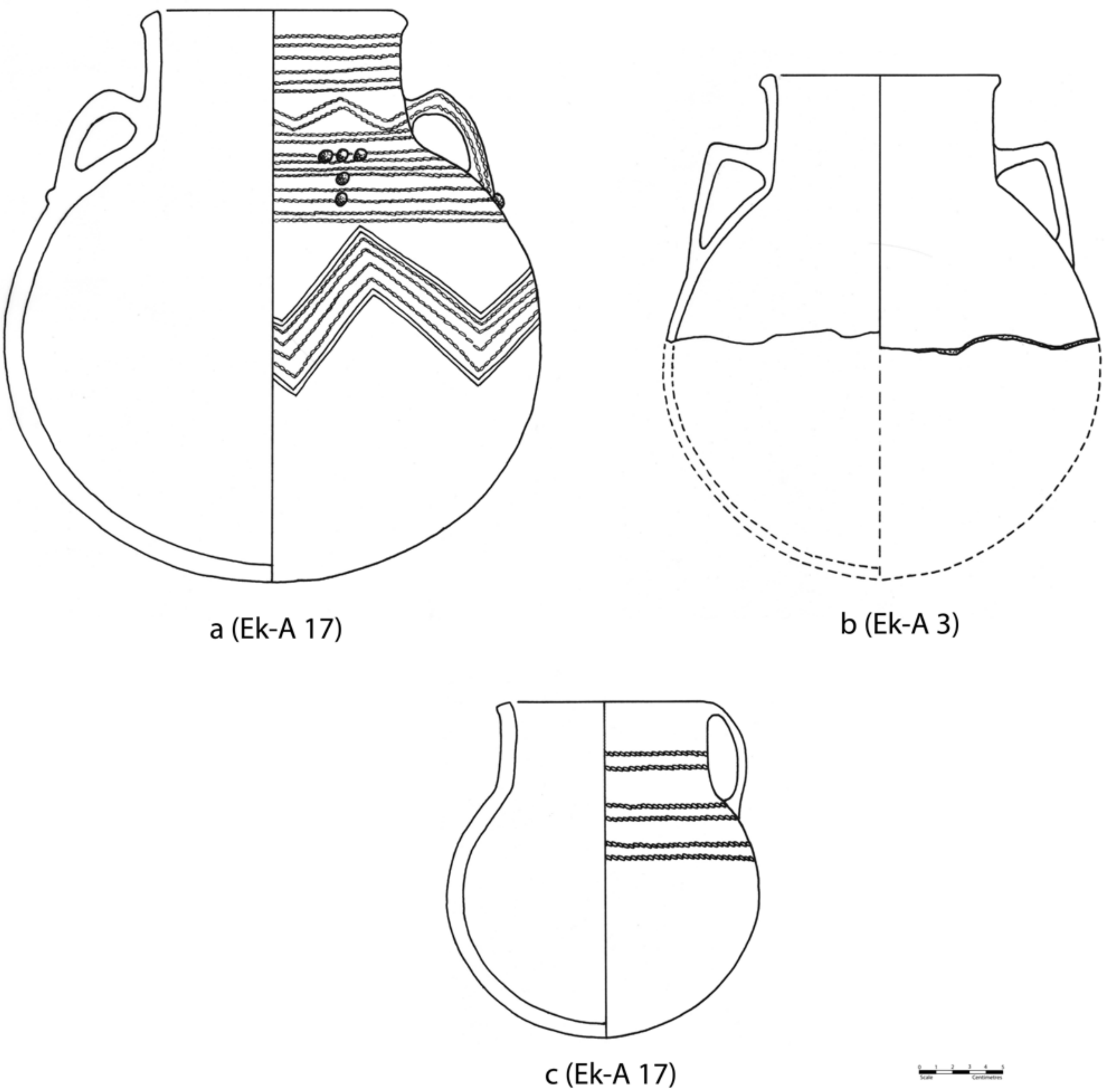

FIGURE 12.9 *Intact and near intact vessels from Ek-A Period 4.*

have a diameter range of 12–28cm, 80% of the vessels have a diameter range of 12–20cms. It can be seen that burnish is not infrequent on E35 vessels but slip is not frequent. An illustration of an E35 rimmed vessel featuring CR-6 on the collar is shown in Figure 12.8b.

'CR-1 Decorated Pots'

In the Phase 2 analysis it was noted that CR-1 décor (fine knotted cord roulette, see Figure 12.6a) was recorded in association with rim forms which could be seen to be part of a fairly similar category of vessels with square-tipped rims. These were largely restricted to Ek-A Period 4. We also saw in the Phase 2 analysis that CR-1 décor was not infrequently found in association with handles. The CR-1 décor type was thereby seen to demonstrate significant patterning in its co-occurrence with form attributes and it is therefore of interest to look further at the co-occurrences of CR-1 décor with forms. Table E.43 lists the full attributes of all the rim and handle forms featuring CR-1 décor. These vessels, which are all collared jars, have a rim thickness of 0.6–1.1cms and the majority (92%) have a diameter of 10–16cms. CR-1 decorated vessels always feature decoration on the superior part of the vessel, whether this is a collar or the upper part of a non-everted rim. Vessels

FIGURE 12.10 *Illustration of the CWSGI décor motif* (*top left Ek-A 2; top right Ek-C 29; bottom left Ek-A 84; bottom right Ek-A 62*).

featuring CR-1 on the pot wall also fairly commonly seem to have CR-1 decorated handles. We see also that PA-2 décor (rounded nubbins) is frequently associated with the CR-1 decorated pot body and the CR-1 decorated handle. The co-occurrence of CR-1 décor, square-tipped rims, CR-1 decorated handles, and PA-2 décor, shows that we are clearly dealing with a significant attribute cluster in the Period 4 assemblage. Figure 12.9 shows illustrations of two intact pots recovered featuring CR-1 decoration, one of which ('a') also features rounded nubbins. Also shown within this figure is another semi-intact pot which has the same form type as the pots most commonly featuring CR-1 décor, though this particular example is without decoration. Further examples of the CR-1 décor are also illustrated and discussed below.

Surface Finds

Prior to the excavations, a systematic collection of the pottery distributed on the site's surface was carried out. This was initially undertaken to decide upon the location of excavation units. Beyond this function, the surface collection was also undertaken to help understand the occupational history of areas of the site where excavations were not planned. By comparing the nature of the pottery collected on the site's surface with the pottery which had been excavated we hoped to be able to identify correspondences and differences which would indicate whether similar or different occupational histories occurred in those unexcavated areas. If ceramics were collected on the surface which had been identified by the excavations as relating to a specific period, this would indicate the presence of occupation related to that period. Likewise, if significant quantities of ceramics were found featuring attributes not recorded in the excavations, this would likely indicate periods of occupation of the site not evidenced by our excavations.

Collection took place at 20 survey units across the site, the locations of which are illustrated in Figure E.14. The selection of the areas of the site where ceramics were collected was defined entirely by the highly variable surface visibility of ceramics. While in certain areas of the site large amounts of ceramics were present, in certain other areas hardly a single sherd could be detected. This variability was due to the variable presence of wind-blown sand build-up across the surface of the site; the areas where no ceramics were detectable being covered with a layer of loose wind-blown sand. Accordingly survey zones were defined by the first author purely on the basis of places lacking sand coverage. When we look at the map of where pottery was collected, we see that no pottery was collected upon the island, nor along a large strip of the eastern bank of the wadi near where unit Ek-A was located: the simple reason for this is that no pottery could be found in these locations. At each of the locations where collection took place a 20x20 metre collection square was laid out (except in the case of Survey Unit 108 where a 40x20 square was laid out). For the purposes of limiting the amount of sherds to be processed, only rim sherds were collected, it being believed that these would also yield a representative view of decorative motifs for the purposes of the surface collection. Each survey zone was walked twice by a team of four people and all rim-sherds seen were collected, regardless of size. The rim sherds were recorded in exactly the same way that the excavated rim sherds were recorded. From Figure E.14 it can be seen that the 20 units can also be grouped into 5 different survey 'zones', allowing a broader interpretation of the various areas of the ruins. This zoning and results of the study of the survey pottery are shown in Tables E.45–E.50. Figure E.15 shows the rim types encountered in the survey which had not been encountered in the excavated assemblage. Discussion of the relationship between the surface finds and the typology based upon the excavated sequence is provided further below.

Technical Analysis

Introduction

During Phase 2 of the pottery analysis it was shown that the CWSGI (cord-wrapped stick grid impressed) decorated sherds found in large quantities in Ek-A Period 3b had a strong attribute correspondence with temper type '44' (grog and chaff), a temper not commonly found in other sherds from the site. Given that CWSGI décor was a unique décor motif coupled with an uncommon paste type, it was hypothesised that CWSGI wares might be imports to the site. Further investigation using plain light magnification revealed inclusions within the fabric of CWSGI wares which appeared to be absent in the rest of the Essouk-Tadmekka assemblage – these were preliminarily identified as Sorghum processing debris (chaff) and freshwater sponge (*Potamolepsis*) spicules (disarticulated siliceous skeleton of sponges), strong indicators of importation to the site from more southerly areas.

Sorghum chaff would only be found in areas where Sorghum grows and is processed for its seed, as shipping of Sorghum for export would include only the grain. Sorghum is a savanna-zone cultigen and, accordingly, it is clear that the use of Sorghum chaff temper would be restricted to the savanna zone. All authorities on the reconstruction of historical environments concur that during the Early Islamic period the nearest area of the savanna zone to Essouk-Tadmekka would have been the Niger Bend. Confirming the supposition that Sorghum was not cultivated at Essouk-Tadmekka at this time, Arabic historical sources mention Sorghum grain being imported to Tadmekka (LEVTZION & HOPKINS 2000: 85). No Sorghum chaff – nor indeed grain – was found in the macro botanical remains recovered from flotation (see Chapter 21 & NIXON *et al.* 2011a). If, therefore, the CWSGI pots found at Essouk-Tadmekka contained Sorghum chaff this would strongly suggest they were not produced in the Essouk area, originating instead in a Sorghum processing zone far from Essouk, such as the Niger Bend.

Sponge spicules compose the skeletal framework of sponges or, in this case freshwater sponges. BRISSAUD & HOUDAYER (1986) have argued that such sponges are characteristic of the paste of pottery from the Inland Niger Delta (IND). Further research by MCINTOSH & MACDONALD (1989) demonstrated that such spicules also feature as inclusions in pottery on the Niger outside of the Inland Delta, documenting them from 1st and 2nd Millennium AD pottery from at least as far eastwards as Timbuktu and Gourma Rharous. Such spicules were common in a random sample of 49 sherds from both the IND and the Niger

Bend quantified by McIntosh & Macdonald (1989) (spicules present in 37 or 76% of samples). Usually their presence was as a background natural clay inclusion (5% or less of fabric), however at least 4 of the sherds in the McIntosh & Macdonald study indicated an artificial concentration of sponge, possibly being used as deliberate temper (up to 17% of fabric). Subsequent work on LSA Kobadi Tradition sherds from the Méma region of the Middle Niger demonstrates that such artificial concentrations can rise as high as 25% (Macdonald 1994: 75–6). The low levels of sponge preliminarily identified in CWSGI ware suggest sponge had become included in the paste naturally rather than intentionally. Not only would identifying sponge back up the Sorghum evidence to strongly suggest the Essouk-Tadmekka pots were long distance imports from the south, it would also bring further precision to the origin of the pots, as the presence of sponge spicules would almost certainly prove their provenance from the banks or floodplain of the Niger River.

SEM and thin-section analyses were undertaken to confirm our hypotheses, with the aim of clearly verifying the presence of Sorghum chaff and sponge.

SEM

Our initial observation of the CWSGI wares showed voids in the surface of the fabric which appeared to have been created by the inclusion of Sorghum chaff which was then burnt out during firing of the pots (see Fig. 12.11). For the identification and verification of this Sorghum chaff we adopted the established method of identifying botanical material by making casts of the void spaces left by the burnt out botanical material, using silicon-based moulding material, then making identifications from the positive casts using SEM (*e.g.* Klee *et al.* 2004; Fuller

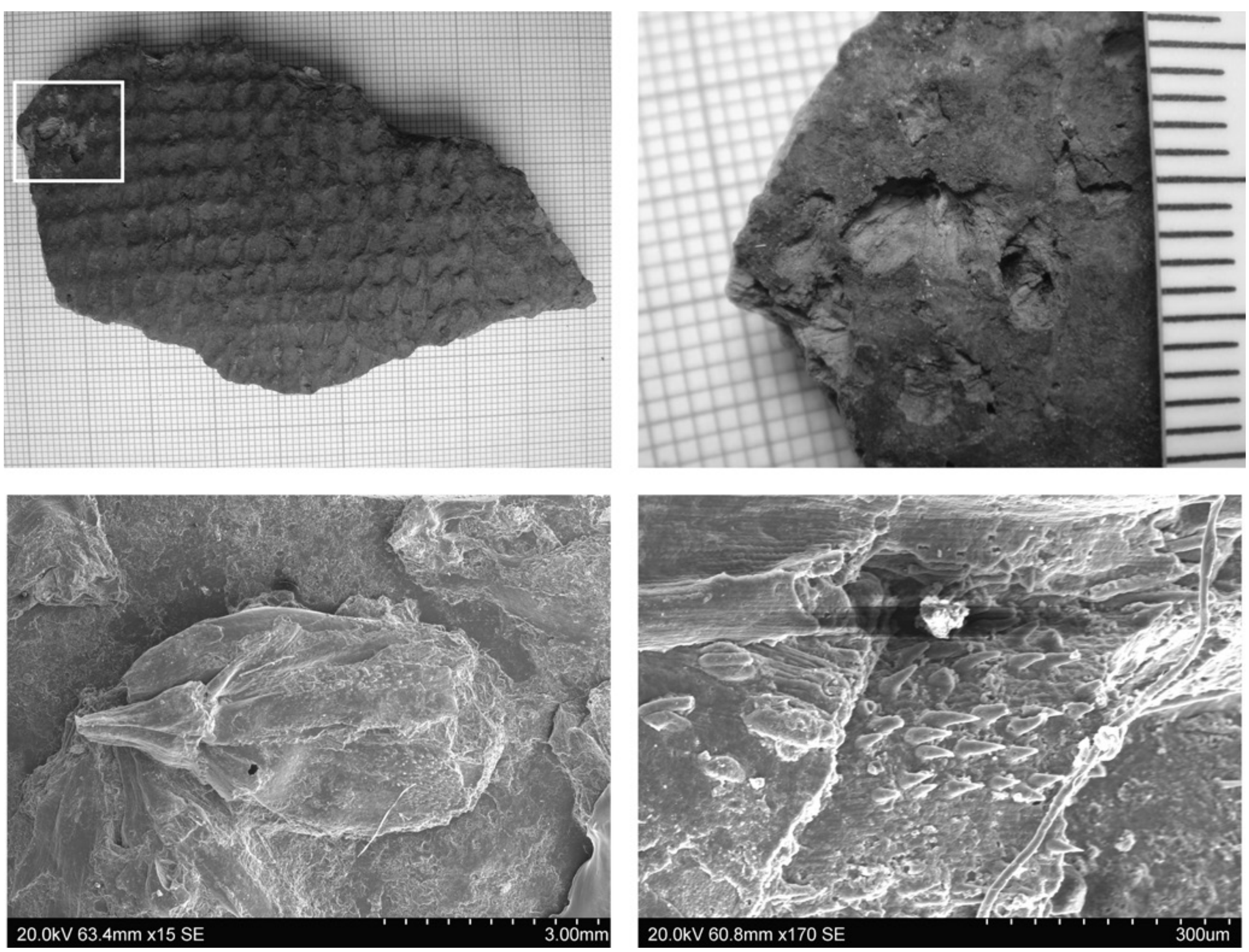

FIGURE 12.11 *Demonstration of the presence of Sorghum tempered pot sherds at Essouk: upper left) image of ceramic sherd from context Ek-A 75 used to create a cast of plant impression, with casting area highlighted in white; upper right) close-up of highlighted casting area; lower left) SEM image of cast of whole grain taken from casting area seen in upper images; lower right) close-up of the interior structure of grain cast seen in lower left image.*

et al. 2007). In line with these methods, casts were made from the CWSGI sherds using polyvinylsiloxane dental casting material, the casts then being mounted and sputter-coated with gold for SEM examination, following the methods of FULLER *et al.* (2007). The casts were examined with a Hitachi S-3400N SEM at UCL Institute of Archaeology.

Based upon preliminary examination, four sherds of CWSGI ware were chosen for SEM investigation, on the basis that they were the sherds most likely to yield positive identifications of Sorghum chaff. In addition to the four sherds featuring CWSGI decoration, a sherd featuring a rim type hypothesised to be associated with CWSGI ware (type E38: see Fig. E.7) was also chosen for analysis. The samples came from the following contexts: Ek-A 2; Ek-A 75; Ek-A 77 (rim sherd); Ek-A 84; Ek-C 6. The date range of the samples is *ca* AD 1200–1400. Casts were made of the five samples. Three sets of impressions were taken from each sherd to ensure good casts were achieved. Casts from the sherds from contexts EKA 75, 77 and 84 were chosen for SEM (date range of sherds *ca* AD 1200–1300), the other casts not having produced clear morphological details. To prepare the casts for SEM they were firstly cut to suitable size and secured to metallic SEM stubs with carbon cement. In addition to these ten casts, modern grains and chaff of different Sorghum varieties (race *bicolor* Sorghum and wild *S. arundinaceum*) were similarly mounted for examination.

The images produced by the SEM provided convincing evidence that the sherds from Ek-A 75, 77 and 84 contained Sorghum chaff, morphologically similar to modern *Sorghum bicolor* race *bicolor* (see Fig. 12.11). One key reason for making this taxonomic identification is the presence of *S. bicolor*'s distinctive stalk (pedicel), which would not be present in mature wild Sorghum spikelets that dehisced. Analysis of the microstructure of the cast and the modern grain revealed further similarities: firstly, the striations seen on the areas of the cast which relate to the fractured interior of the original plant material are very similar to those on the interior of the glume of *S. bicolor*; additionally, the small distinctive trichomes (hairs) seen on the interior of the glume of *S. bicolor* are also seen in the images of the casts. The combination of these factors confirms the positive identification of the plant impressions as Sorghum *bicolor* subsp *bicolor* chaff, probably of race *bicolor*. The SEM analysis therefore shows that the paste of CWSGI pots contain Sorghum processing waste. The analysis also showed that the paste of the rim sherd hypothesised to belong to CWSGI ware contained Sorghum chaff, strongly indicating an association.

Thin-section Analysis

To confirm that the preliminary identifications of sponge (*Potamolepis*) spicules were correct it was necessary to produce thin-sections of CWSGI ceramics. This would also allow comparable point counts of sponge to compare with results obtained by previous studies (see above). Five sherds of CWSGI pottery were selected for thin-sectioning, these being selected using plain-light microscopic analysis to offer the best chance of positively identifying sponge spicules. Two sherds were taken from Context Ek-A 2 and one sherd each was taken from Contexts Ek-A 62, Ek-A 84 and Ek-C 6 (date range of samples *ca* AD 1200–1400). The sherds from Ek-A 84 and Ek-C 6 were sherds also analysed in the SEM investigation of Sorghum chaff (detailed above). In addition to sherds of CWSGI pottery, thin-sections were also produced from three sherds of pottery selected from the remainder of the Essouk-Tadmekka assemblage (contexts Ek-A 75, Ek-A 87 and Ek-B 11 – date range *ca* AD 900–1300), these being produced to serve as 'control' samples that could allow us to investigate whether sponge spicules might also be found in the 'locally produced' Essouk-Tadmekka pottery. Control sherds were selected on the grounds of what seemed most likely to be local products, either due to their 'typological' commonality within the assemblage or for the fact that they were large utilitarian items for day-to-day domestic activity (*e.g.* a brazier, Ek-B 11: see Fig. E.12).

Thin-sections of all nine samples were cut and mounted on glass slides. The thin-section slides were then analysed using a petrographic microscope with mechanised point-counting stage. A grid of 200 points, covering the entire mounted specimen, was used for each quantification. The results of the petrographic analysis are presented in Table E.51.

The first thing that should be noted in Table E.51 is that the petrographic analysis evidenced sponge spicules (genus *Potamolepis*) in all five sherds of CWSGI ware. Conversely we can see that sponge was not evidenced in any of the three control samples. While the CWSGI samples and control samples can be differentiated further by comparing the counts of other elements of the paste (see for example igneous rock and FeO counts), these need not be discussed here other than to point out merely that they provide further evidence of the differences in the nature of the paste between the CWSGI sherds and the control sherds. To provide visual proof of the presence of sponge in CWSGI ware, micro-photographs from the thin-section slides were produced (see Fig. 12.12) – these photographs clearly evidence sponge, showing most crucially its distinctive hollow core. The thin-section analy-

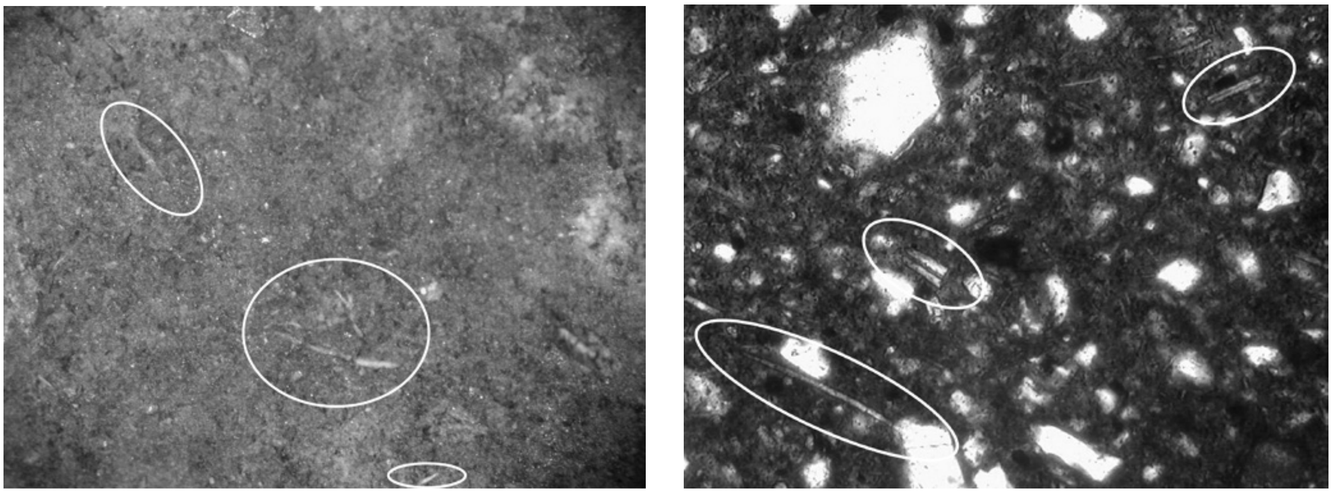

FIGURE 12.12 *Illustration of the presence of sponge (Potamolepis) spicules within the fabric of* CWSGI *decorated pot sherd.* Left*: close-up (plain light) view of surface of pot sherd showing sponge spicules (circled in white);* right*: microscopic image of thin-sectioned sherd illustrating the presence of sponge spicules (circled in white). Sponge spicules are approximately 150–300 micrometres in length.*

sis therefore confirms that CWSGI pots contain sponge spicules in low quantities, attributable to their natural occurrence in the clays utilised. It is satisfying to acknowledge a prescient assertion by previous researchers on this subject:

"Contrary to their [Brissaud & Houdayer] conclusion that *Potamolepis* spicules constitute a diagnostic characteristic of IND pottery, we have found spicules of what appear to be potamolepids from pottery well downriver of the IND, along the Niger Bend … Brissaud & Houdayer's hope for using this characteristic to 'deduce patterns of commercial and cultural exchange' (1986: 357) remains valid if we content ourselves with looking at the broad issue of movement of goods from the Niger river to points distant from it. Routine examination of sherds from early commercial centres in the southern Sahara, such as Koumbi Saleh and Essouk … might prove extremely informative" (Mcintosh & Macdonald 1989: 492).

Summary Comments

The technical analysis of SEM and thin-section undertaken on the CWSGI ceramic specimens demonstrates the presence within their fabric of both Sorghum processing debris and sponge spicules. This clearly shows that, as hypothesised, these are long distance imports to Essouk-Tadmekka, almost certainly coming from an area close to the Niger River, thereby adding an interesting element to the story of commerce at Essouk-Tadmekka.

Discussion

Broad Comments on the Essouk-Tadmekka Pottery Tradition

Regardless of the temporal fluctuations inherent in the Essouk-Tadmekka tradition, and excluding obviously imported wares, it is possible to make some observations about the assemblage as a whole, before going on to focus on a few diagnostic trends. Unfortunately, data for comparison with contemporary sites is highly uneven. Pottery studies undertaken thus far on the Saharan entrepôts have not tended to present their quantitative data in a way to make them easily comparable (see however Cissé *et al.* 2013 and van Doosselaere 2014 whose publication postdates the analysis presented here), and most have simply shown the temporal positioning of various rim form types, with some remarks on accompanying décor patterns (*e.g.* Vanacker 1979; Robert-Chaleix 1989). A few studies, notably Berthier (1997) and Cressier & Bernus (1991), have however photographically illustrated all of their décor types – even if the attribution of the tools that created them lacks sufficient precision. Meanwhile, major trading sites south of the Sahara, such as Jenné-jeno (Mcintosh 1995b) and Dia (Schmidt *et al.* 2005), have received analytical treatments methodologically comparable to our own study. The spatial evolutions of southern decorative traditions have also recently been traced in good detail by Mayor *et al.* (2005). So, with these caveats in mind concerning comparative data, we will now proceed.

The fabric of the Essouk-Tadmekka pottery is almost invariably low-fired (friable), employed in relatively thin wares, tempered with chaff and different admixtures of sand (*ca* 96% of all sherd fabrics). Such low firing might well be expected in the Sahara and its environs where fuel is at a premium. This sort of fabric is comparable to historic 'Berber' ceramic assemblages as we have been able to view from Mauritania. It is generally unlike those of the Inland Niger Delta and Niger Bend at sites such as Jenné-jeno, Dia and Gao which are generally thicker and more highly fired.

The frequency of decorated pottery at Essouk-Tadmekka, between 9 and 15% of all sherds over the entire occupation, stands in stark contrast to more southerly centres such as Jenné-jeno, Dia and Gao where decorated sherds are relatively common (at Dia-Shoma and Dia-Mara for example, 50 to 90% of rims were decorated, depending on occupation horizon: SCHMIDT *et al.* 2005: 230–1). However, based upon what the literature tells us about assemblages from Tegdaoust (VANACKER 1979; ROBERT-CHALEIX 1989), and the personal observations of one of us [KCM] while reviewing materials in Mauritania, the quantity of decoration at Tegdaoust is probably comparable to that of Essouk-Tadmekka. It is therefore tentatively argued, that in being relatively undecorated Essouk-Tadmekka more resembles other Sahelo-Saharan entrepôt assemblages, than those of the Middle Niger or Niger Bend.

Before moving on to decoration more broadly, it is worth noting that the practice of slipping pottery is relatively uncommon at Essouk-Tadmekka (11–24% of sherds from Ek-A Periods 2–4), and that painting is even more rare (0.4 to 3.7% of sherds from Ek-A Periods 2–4). At Koumbi Saleh, on the other hand, BERTHIER (1997: 67, 65) notes the very high frequency of slip and paint, remarking both that, "Á Koumbi Saleh, la majorité des ceramiques sont engobées [slipped]," and that "La céramique de Koumbi Saleh se caracterérise essentiellement par ses décors peints". Such practices are broadly in line with ceramics from the Middle Niger and the Niger Bend after *ca* AD 500, where at Jenné-jeno, for example, in Phase III [Sup] (*ca* AD 700–900) 50% of rims are painted, decreasing to *ca* 10% in Phase IV (AD 900–1400) (MCINTOSH 1995b). Thus, Essouk-Tadmekka seems to have been untouched by a fashion for painted ceramics which swept the Middle Niger and Koumbi Saleh during the time of Ghana/ Wagadu. Likewise, at Gao-Ancien the most common decorative class was that of red slip which occurs throughout the sequence, in quantities ranging from 38 to 41% of all sherds (INSOLL 2000). Painted sherds though less numerous, were markedly more common than at Essouk-Tadmekka, ranging from 6 to 9% (ibid.). Thus, in terms of painted and slipped décor, Essouk-Tadmekka also runs contra trends of the (proto-Songhay?) pottery traditions of the Niger Bend.

It is perhaps of interest that Essouk-Tadmekka's primary pottery décors are based around cord-wrapped cord impressions or roulettes, rather than cord roulettes or comb channelling (which are, of course, both present, though in lower numbers). This tendency to embrace cord-wrapped cord, in the first and second millennia AD, is virtually unknown in the Mande world of that time (*cf.* MAYOR *et al.* 2005). Rather, it is a motif that looks more to the world of the Niger Bend and the Gourma (potential sources for slaves which may have made a proportion of the pottery assemblages at Essouk-Tadmekka). Conversely, sparse decoration, with comb, stylus and cord-wrapped cord predominating is also known from the Proto-Berber (early first millennium AD) traditions of southern Mauritania (MACDONALD 2011). Overall, the assemblage from Essouk-Tadmekka, while largely associable contextually with the Berber world, also shows some distinct southern influences. Although we have not made a detailed comparison of rim forms here (a difficult task given the level of variability inherent in handmade West African pottery), the collared (everted) forms from Essouk-Tadmekka, and particularly vessels with handles show broad similarity with the pottery of Tegdaoust, Koumbi Saleh and Azelik-Takedda (see below).

Glazed and Wheel-thrown Pottery

While glazed and wheel-thrown pottery at Essouk-Tadmekka is far less common than unglazed, hand-thrown vessels, its relative frequency (*ca* 0.15% of total pottery assemblage) is higher than that found at other entrepôts such as Koumbi Saleh and Azelik-Takadda. Given the paucity of glazed ceramics in Sub-Saharan West Africa – in contrast to imported glass beads for instance, or even vessel glass – it is clear that glazed ceramics were not a common trans-Saharan trade commodity intended for the Sahara's southern shore. It is most likely they were high end trade goods, or indeed purchased by or on behalf of merchants to use within their own homes at Essouk-Tadmekka and at other trading centres.

The types of glazed vessels found appear to be mainly small bowls or plates. This form makes sense as they could be easily stacked, making it far less likely that they would get broken, and making it easy to carry many vessels in a relatively small amount of space. While they were likely high end trade goods from the perspective of the residents of Essouk-Tadmekka, they appear to have been mainly relatively common market products in a North African context. The stand-out exception to this is the sherd of Chinese Qingbai porcelain, a very high quality item that would have been considered valuable in North Africa already prior to its shipment across the desert, if only for its travel costs from Eastern China. In this context note should also be made of a possible Chinese sherd recovered during survey at Timbuktu (*cf.* INSOLL 1998a).

While it is extremely unlikely that any of the glazed ceramics were produced locally, certain of the glazed sherds recovered do raise this question (*e.g.* Fig. 12.1 o-p), these seemingly being of a very poor quality, making one question their status as trans-Saharan commodities and raising the idea of a limited, experimental local glazed ceramic industry. The fact that advanced metal working was present at Essouk-Tadmekka shows that the knowledge to produce high temperatures necessary for the production of glazed ceramics was present, and indeed the vitrification of crucible fragments shows that 'glazing' of some sort did actually take place in furnaces at Essouk-Tadmekka. While there was a demand for glazed ceramics, and also likely the skills to produce them locally, the environment at Essouk-Tadmekka was obviously not conducive to careless expenditure of wood sources, and therefore high firing activity is likely to have been restricted to more essential metallurgical activity.

CWSGI Ware

As was demonstrated above, SEM and plain light microscopic analysis clearly demonstrated that sherds decorated with CWSGI décor (see *e.g.* Fig. 12.10) had an origin further south in West Africa, and more precisely it was possible to show they were produced using Niger River basin clay. Before investigating the possible significance of large quantities of pots moving great distances from the Niger to Essouk-Tadmekka, principally during the period *ca* AD 1200–1300, let us first try to bring a little more precision to the zone from which these pots derived. To bring this greater precision we need to look at the distribution of cord-wrapped décor motifs within the various regions of the Niger River basin.

The first comparative pottery assemblage to consider is that of Gao, consistently identified as Tadmekka's trading partner during the medieval era. Building on prior work by INSOLL (2000) who identified cord-wrapped motifs in the medieval assemblage at Gao, more recent studies by CISSÉ (2011) and CISSÉ *et al.* (2013) have identified extensive evidence for cord-wrapped motifs at Gao, and provided illustrations which show a strong correspondence with CWSGI wares. This decoration is called 'sisal' in these studies and is identified as an extensive presence throughout the medieval deposits (see CISSÉ 2011 chp. 6, inc. Fig. 6.4; CISSÉ *et al.* 2013: pp. 19–24). Given this finding, this certainly provides a compelling case to make for the origin of the Essouk-Tadmekka pots. While this is so, Tadmekka did have other trading connections and it is useful to consider the wider landscape of cord-wrapped wares in the Sahel.

Looking at chronologically relevant documented pottery assemblages from west to east along the Niger, we start by looking at the Inland Niger Delta. What we see here is that at Jenné-jeno while cord-wrapped stick motifs were recorded in pre-5th century AD deposits (Phase I/II) they are scarce, and are not seen later than that (MCINTOSH 1995b). At Dia, cord-wrapped stick motifs make up 1% of the assemblage in the horizon 4 deposits (AD 1000–1600), suggesting the cord-wrapped décor technique was once again very uncommon. When we look at what would have been the northern limit of the Inland Niger Delta, the Méma, we see cord-wrapped motifs are present only in the early period (*ca* AD 400–900) (TOGOLA 1993). North of the Bandiagara escarpment at Tongo Maaré Diabal, a tell site excavated by one of the authors [KCM], we see that over the site's entire occupation (AD 500–1150) cord-wrapped roulettes are continually present and vary between 2–5% (on rim sherds) and 6–8% (on body sherds), as a percentage of total motifs present. Up into the Lakes region at the site of KNT2 we see that after *ca* 500 cal AD no cord-wrapped impressed or roulette motifs were found at the site – from contexts aggregated *ca* AD 200 to 500 cord-wrapped décor on rim sherds was noted at 3.4% (re-analysis of material present at the ISH, Bamako by MacDonald). While noting this statistical data in the Lakes region however we do see at El-Ouladji the presence of cord-wrapped motifs used to create a very similar decorative 'grid' pattern to that seen at Essouk-Tadmekka, though no good statistical data exists for pottery from this site (*cf.* DESPLANGES 1951; LEBEUF & PAQUES 1970). Cord-wrapped motifs are evident amongst the surface materials at Gourma Rharous (MCINTOSH & MCINTOSH 1986) though there is no good statistical data on quantities of cord-wrapped motifs from here. Likewise, we know from survey data that impressed cord-wrapped motifs were present at the great tell sites of Ansongo and Bentyia to the south-east of the Niger Bend, though we lack absolute dates and relative quantities (ARAZI 1999). Thus, Gao seems the most likely origin point of the CWSGI wares identified at Essouk-Tadmekka with only limited potential for them having originated in other areas. This proposed linkage is considerably reinforced not only by its historically documented links with Tadmekka and its relative proximity to Essouk-Tadmekka, but also given the recording of large quantities of very similar pots at Gao.

Having then dealt with the question of the origin of the CWSGI wares, let us then investigate the significance of our findings in terms of trade and exchange networks. Firstly, we need to bear in mind that the minimum distance these pots were traded is *ca* 250kms. The first thing this shipment of substantial quantities of these pots to Essouk-Tadmekka shows is that there was clearly an important exchange system operating between Essouk-Tadmekka and the Niger bend at that time. The next question is: what kind of exchange is this evidence of? Are we seeing a purely 'local' exchange system detached from the operation of a trans-Saharan trade network? Reflecting on this, it does seem unlikely that a 'local' trade system would exchange pottery over *ca* 250km distances divorced from an exchange network involving more commercially significant elements of exchange. It seems most likely that the pots we are seeing arriving at Essouk-Tadmekka are part of the 'add on' trade of commodities that would also have flowed along the trans-Saharan routes with the large caravans of camels and/or donkeys constantly moving back and forth. We do therefore appear to be seeing in the movement of these pots a register of intense Trans-Saharan trade activity at this time (*ca* AD 1200–1300), involving trade networks linking Essouk-Tadmekka to the Niger bend.

The pots then indicate a flourishing trade on the Essouk-Niger Bend route, but why were these pots moving? Being quite bulky commodities and fairly fragile, pots are not the most obvious export product for trading into the Sahara. Despite their very large quantities for an import, relative to the whole assemblage they still only account for *ca* 4% of the total potsherds recorded during their period of use (based upon in Ek-A Period 3b, 99 sherds of a total 2296). Accordingly, pots were clearly in plentiful supply locally without these imports. In addition to representing a new type of product not available locally, it is also important to recognise that the limited fuel resources available locally restricted the ability to produce relatively high-fired and more sturdy pots such as the CWSGI wares. Almost certainly the CWSGI pots were being imported not solely for themselves but also for what they contained. Unfortunately the studies of these pots at Gao have not revealed any particular functions for them which could provide us with additional insights (Cissé 2011; Cissé *et al.* 2013). Such pottery would certainly have provided another means of moving porous substances and we should consider they might have contained products such as shea butter oil, or for example honey, frequently consumed amongst the Berber groups of the North Sahel in the Early Islamic period according to textual sources (see refs. in Levtzion & Hopkins 2000: 473). Almost certainly the CWSGI wares contained commodities shipped to Essouk-Tadmekka, but once they arrived the pots themselves would also have been greatly valued in an area with relatively poor quality local pottery. Understanding why these pots began to be imported in such large quantities in Ek-A Period 3b is also an important question. Certainly they are not purely a reflection of increased opportunities for trade as we have seen that significant trade was taking place before this. Due to the suddenness of their increase one might suggest either some form of new entrepreneurial activity from the south or newly perceived commodity needs (culinary or otherwise) locally. The drop-off in these pots in Period 4 would likewise indicate a distinct shift in trade patterns, and most likely an end in the demand for these pots and their hypothesised contents.

CR-4 Wares

One of the most curious aspects of the Essouk-Tadmekka pottery assemblage are a small group of pots decorated with the CR-4 motif (see *e.g.* Fig. 12.13) – otherwise known as 'folded strip roulette' or 'accordion pleat roulette' – found in the *ca* 9th/10th century Ek-A Horizon 3 deposits. This décor motif is known to be a characteristic décor type of the Mande world, whose centre within this period was broadly focused on the Inland Niger Delta and adjoining regions to the west (Mayor *et al.* 2005). It is also encountered in other sub-Saharan regions in the 1st and 2nd millennium, including for instance in the Dendi region of northern Benin (see Haour *et al.* 2016). There are, though, no known Saharan pottery traditions using this motif. At Essouk-Tadmekka, we only encounter CR-4 decorated sherds within Ek-A Horizon 3. A significant proportion of these CR-4 decorated sherds also feature burnish (57%), a feature which is negligible within the Ek-A Horizon 3 pottery assemblage as a whole (3%, or 18 counts from 524 sherds). The paste of the majority of the CR-4 pots is also very different to that of other pots found within Horizon 3. Not only does this distinctive CR-4 pottery not relate well to the wider Essouk-Tadmekka pottery tradition, it is also interesting to note that these pots suddenly appear in Ek-A Horizon 3 when they had not been seen before; a finding strongly suggesting lack of continuity with previous pottery traditions in the region. Our findings strongly suggest therefore that Cr-4 pots at Essouk-Tadmekka are either imported, or produced by potters coming from sub-Saharan districts.

Let us then consider further the possible links the CR-4 ceramics indicate. Firstly, there is the possibility that these pots are imported, either brought by groups moving from the Mande cultural zone to Essouk-Tadmekka, or brought as trade items in themselves, or containing trade items. While plain light microscopy did not show any obvious signs that the clay used to produce these pots came

FIGURE 12.13 *Pot-rim featuring décor motif Cr-4 (Ek-A 116).*

from sub-Saharan region – as was seen for the CWSGI decorated sherds (see above) – there is still the possibility they are imported pots. Indicating the potential of this hypothesis is the fact that the CR-4 pots have a clay of a different consistency to other pots from Ek-A Horizon 3; though one cannot rule out that this might simply result from different local clay sources, manipulation and /or firing processes.

While then there is no compelling evidence that these are imported pots, we must keep this hypothesis open. The second possibility is that these pots were made *in situ* at Essouk-Tadmekka by groups newly moved to the region from sub-Saharan districts. These groups could either have come for purposes of trade or they could have been brought in as slaves – something we must seriously consider given the long tradition of sub-Saharan slaves in the Berber world, and given the clear references to imports of slaves to North Africa from the earliest Arabic documentation. When one reflects upon the very restricted stratigraphic distribution of the CR-4 pots, one is also tempted to tentatively advance a more complex hypothesis for the cultural processes these pots represent. Potentially we are dealing here with the movement of certain cultural groups to Essouk-Tadmekka who then cease to practice pottery traditions related to their original homeland – evidence, therefore, perhaps of second generation integration of these cultural groups into the local culture. What one can certainly say with confidence is that if these pots were produced locally they were not made in accordance with the more commonly occurring pottery tradition recorded before, during and after their *ca* 9th/10th century occurrence at the site.

Other 'sub-Saharan' Pottery Types

A small quantity of other pots seen within the assemblage closely resemble pottery excavated at Gao (INSOLL 2000; CISSÉ 2011; CISSÉ *et al.* 2013). These pots include bottle forms (E68, E65: App. E Fig. 7; Fig. 12.14), as well as some rim and body sherds bearing a distinctive heavy slipping and red, black and white paint (Fig. 12.14). Given the occurrence of the significant amount of CWSGI ware moving north it is not surprising that there also seem to be other wares appearing from the Niger Bend. While these other types of pots are most commonly found in the Ek-A Period 3b deposits alongside CWSGI ware, they are also found in earlier periods, including in unit Ek-B.

FIGURE 12.14 *Photograph of painted pottery showing close affinities with wares excavated at sites on the Niger River Bend. Upper left – Ek-A 78; upper right – Ek-A 80; bottom left – Ek-A78; bottom centre – Ek-A 77; bottom right (upper) – Ek-A 79; bottom right (lower) – Ek-C 29.*

The Period 4 Assemblage

As recounted earlier in this book (Chapter 2), during Mauny's 1952 brief excavation on the island at Essouk-Tadmekka he found pottery which he described as unusual, though not providing further description or illustration (MAUNY 1961: 117–118). The pottery we excavated on the island which features the highly striking formal designs and knotted cord roulette (CR-1) decoration is almost certainly what he also found (Figs. 12.6a, 12.9). We have now shown that these pots were part of a wider tradition which represents a distinct departure from earlier pottery traditions. Up to Period 4 there appears to be a fairly continuous process of development within the core pottery tradition, but with Period 4 we see fairly radical and widespread changes in form and decoration.

Firstly, we see a significant increase in the presence of handles in Period 4. Not only do we see that the quantities of handles increase, we also see that the handles recorded are of a distinctly different type to those encountered before. Additionally, some of the most common rim types encountered in Period 4 had not been seen previously (*e.g.* E21), or only negligibly (*e.g.* T7). Further, we also see that certain of the rim types which were a significance presence before Period 4 are no longer seen (*e.g.* E35, T6). We also see very significant changes in décor motifs. We put aside the significant decrease in CWSGI decorated pots, as these are known to have been an import and therefore do not tell us about local pottery traditions (though this significant decrease is itself a sign of changing activity at the site). The decorative change we note firstly is fine knotted cord roulette (CR-1): 95 counts of this were recorded in Ek-A Period 4 but not one single instance of this decoration is recorded in the unit before Period 4. There are also other key décor changes. Firstly there is a significant reduction in what has been until that point the most common distinctive décor type, cord-wrapped impression (PFI-3). Finger impression (FI), minimal previously, is now seen in large quantities; dragged grass (Herb), absent before, becomes a significant presence; comb décor is also again seen in significant quantities for the first time since Period 2. The combined changes in form and décor indicate a clear shift in the potting traditions at the site.

Comparative study of other arid-zone West African pottery assemblages does provide some strong parallels with certain distinctive elements of the Period 4 assemblage, most importantly with the distinctive knotted-cord roulette (CR-1) decoration, as well as some of the distinctive handle forms. Firstly, two pots recorded in the Azawagh region of Niger are almost identical in form to the Hr-1 and Hb-1/Hb-4 handled pots found at Essouk-Tadmekka (see BERNUS *et al.* 1999: 75). Interestingly, the Azawagh pot form most similar to those of the Essouk-Tadmekka CR-1 decorated pots does not appear to feature CR-1 décor. These Azawagh pots were though found in surface contexts and not associated with a site of permanent habitation (they were found on a dune) – therefore no definite idea of their chronological relationship to the Essouk-Tadmekka pots can be gained. Further parallels were though found in the Azelik-Takedda region of Niger, further east of the Azawagh. CR-1 décor was evidenced at Azelik-Takedda (BERNUS & CRESSIER 1991: 84–85 & chps. 5–6) and there are also certain formal similarities in that assemblage, most importantly Hr-1 handles (BERNUS & CRESSIER 1991: chps. 5 & 6). Amongst the material from Azelik-Takedda there are though no exact parallels combining both the CR-1 décor and the distinctive pot forms recorded in association at Essouk-Tadmekka. Regarding the chronological relationship between the Azelik-Takedda and the Essouk-Tadmekka material, the evidence collected seems to suggest a relatively similar chronology for the material that has been recorded. The lack of significant excavated evidence from Azelik-Takedda however means that earlier examples of this tradition could be found there.

Considering the Period 4 assemblage more widely, on the basis of the central decorative motif, CR-1, and the angular handles, we can say that there is no parallel for this pottery tradition in the medieval Sub-Saharan world. We are, it seems, dealing with a Berber pottery tradition. Other than the assemblages commented on above from Niger, no other correspondences were found with material in the Sahel, and due to the almost complete lack of pottery studies relating to this period in the desert to the north there was no basis for comparison with those regions. The link already established between the Essouk-Tadmekka Period 4 pots and those from the Azawagh and Azelik-Takedda regions is however an important one. The shared pottery tradition does indicate the cultural groups in these two regions were part of a strongly linked network in the late medieval period. It seems inescapable that this is a pottery tradition associated with the various Tuareg groups who begin to emerge more clearly in the Arabic historical sources at this time, both at Essouk-Tadmekka and Takedda. What still remains unclear is the origins of this tradition. The only documented parallels are from the Niger region, but we do not know the time depth of the tradition there. Indeed, given the oral traditions of migration from Essouk-Tadmekka to the Niger regions, one would tend to hypothesise that the pottery tradition moves from Essouk-Tadmekka to the Niger region rather than the other way – it is to exactly these areas in Niger that the Kel-Essouk oral traditions indicate the Essouk-Tadmekka population migrated following the abandonment of the

Essouk region and it is possible that this is a material signature of this movement.

While we do not know where this tradition comes from, the analysis does seem to be showing that a new Berber pottery tradition 'arrives' at Essouk-Tadmekka in Period 4, likely associated with a new element in the emerging Tuareg world. This is then the dominant pottery tradition at the site until its abandonment. Crucially, the excavations show that this potting tradition is intrusive at Essouk-Tadmekka at a time when we also see clear changes within the architectural tradition at the site. As is discussed later on (Chps. 22, 23), this shift in the pottery traditions appears to also be part of a wider change in cultural activity at the site and also corresponds with changes that can be detected within the early Arabic descriptions of the site.

One final comment to make in discussion of this Period 4 tradition relates to certain cross-overs observed within the tradition. Firstly, while the Hr-1 handles are not commonly associated with CR-1 décor, this does occasionally occur, indicating the need for caution when identifying types within the tradition. Likewise, in Figure 12.15 we see an interesting 'impersonation' of a CR-1 décor motif using a different décor tool (a comb). It is obviously very difficult to get at the significance of these minor variations within the tradition, but it is important to clarify their existence in order not to over-characterise this pottery 'type'.

Relationships between Excavated and Surface Collected Material

The clearest pattern in the data when comparing the surface-collected ceramics with the excavated sequence relates to the comparison of the surface ceramics with those from Period 4 (the upper levels of unit Ek-A and Ek-C). The pots from these terminal occupation levels on the island and around Ek-A feature highly diagnostic and temporally restricted attributes (as just discussed). Accordingly, tracking the patterning of Period 4 pots across the site surface should provide us with a fairly clear picture of the zones of the site where the terminal phase also related to Period 4 (or later) occupation.

Let us begin by looking at the presence across the different survey zones of the most highly diagnostic Period 4 décor, CR-1. What we see is that CR-1 is strongly present to the west of the wadi in Zone 5, but it does not feature in Zones 1, 2 and 3, and is only recorded twice in Zone 4 (see Tab. E.50). When we look at other décor motifs which were highly concentrated in Period 4, such as OI and PE-1, they are likewise present in relatively large quantities in Zone 5 but are far less prevalent elsewhere. Further indicating the pattern of Zone 5's distinction from other areas is its lack of PFI-3 décor, present in significant quantities elsewhere. While it had been the most common motif in previous periods, it should be remembered that PFI-3 décor dropped off significantly in Period 4. When we look at rim type E21, also a Period 4 diagnostic, we see it too is strongly present in Zone 5, but far less common from other areas of the site. No other temporally restricted attributes are available from Period 4 with which to compare the surface collected pottery, but from what we have already seen it is clear that Period 4 pots are almost entirely absent from Zones 1, 2 and 3. They are a reasonably significant presence in Zone 4, but their distribution is focused in Zone 5 west of the wadi. Zone 5 was clearly an area of intense Period 4 occupation, or even potentially a post-Period 4 occupation using a very similar ceramic tradition. Zone 4 appears to have had some Period 4 or post-Period 4 occupation but does not appear to have been as intensively occupied as Zone 5.

Comparing the surface ceramics with pre-Period 4 excavated pots is less easy. Let us turn firstly to the question of Period 3b pots. Unfortunately CWSGI décor – the décor motif which is recorded in large quantities from Period 3b onwards and which was the only clear temporally restricted attribute related to Period 3b – was not recorded on any rim sherds from the excavation (seemingly being a décor motif restricted to the lower parts of pots). The study of the surface-collected rims is therefore going to tell us nothing significant about the presence or absence of Period 3b occupation. The next comparison we have to make is that related to another attribute which was temporally restricted to the pre-Period 4 assemblage, rim form E35. What we observe initially in E35 distribution is that it is not present in Zone 5. In all other zones E35 is present but not in large quantities that would allow us to pronounce on the presence of a 'significant' pre-Period 4 occupation in those zones. Diagnostic ceramics from earlier periods, such as the Period 2 diagnostic rim form T6, were relatively rare. Rim form T6 was only recorded once, from survey Zone 2. We suggest therefore that this shows a relative lack of disturbance at the site, with earlier diagnostics being rarely encountered in upper deposits.

The only other information that it is necessary to discuss relates to the recording of attributes in the surface assemblage that were not recorded in the excavated assemblage. Firstly we should note that no décor motifs were recorded in the surface assemblage that were not also present in the excavated assemblage. Given the limited decoration of rim sherds within the Essouk-Tadmekka assemblage, however, this is perhaps not entirely surprising. What we can say with confidence with the material we did collect

FIGURE 12.15 *Illustration of the 'impersonation' of Cr-1 design forms using a dragged comb.* Left: *Cr-1 decorated sherd (Ek-A 16);* right*: Pe-4 decorated sherd (Ek-A 14).*

is that the rim forms recorded during excavation provide a fairly representative account of the rim forms present on the surface of the site, as only 21 counts of rim forms were recorded on the surface of the site which had not been already recorded in the excavated assemblage (see Fig. E.15). Given the vagaries of making interpretations from surface ceramics it is obviously however not possible to extend this to mean that there are definitely no significant occupations of the site that were not evidenced by the excavations.

From the study of the surface ceramics we have provided a fairly clear indication of the presence and absence of Period 4 occupation in the survey zones investigated. We established that amongst the areas not excavated Period 4 occupation appears to have been largely concentrated to the west of the wadi in Zone 5, with some form of occupation in Zone 4. Given that we have excavated data from the two broad areas where no surface ceramics were collected – the island and the area around unit Ek-A – we can combine the surface and excavated data to build up quite a clear idea of the abandonment of the site. This terminal period occupation would appear to have been to the west of the wadi, on the island, around the Ek-A area and possibly in Zone 4. It seems apparent that Period 4 occupation in Zones 1, 2 and 3 was negligible. When we tried to establish a sense of the extent of occupation in the pre-Period 4 era we encountered problems, partly brought about by methodological limitations (failure to collect decorated body sherds) and partly brought about by the fact that Essouk-Tadmekka is obviously a relatively undisturbed site where pottery from deeper deposits is not consistently found on the surface of the site. However, the occurrence of Period 3 diagnostics in Zones 1–3 would indicate that those areas were occupied up until a retraction which occurred either sometime in Period 3 or at its interface with Period 4.

CHAPTER 13

Glass Vessels

Sam Nixon, James Lankton and Laure Dussubieux

Introduction

During the excavations 172 glass fragments were recorded, almost exclusively relating to glass vessels. Study of these fragments involved both consultation with a vessel glass expert (St John Simpson, British Museum), as well as chemical analysis. The chemical analysis was part of a wider chemical analysis program, including also glass beads (Chapter 14), and glass within two crucibles related to gold processing (see Chapters 14 & 15). Conservation was also undertaken on the fragments to attempt to refit more complete portions of glass artefacts, though only limited refitting was achieved. Within this chapter a brief description of the glass and its analysis will be provided, including a commentary on noteworthy characteristics of the assemblage and a summary account of the chemical analysis findings. This is followed by a broader discussion of the evidence. A summary of the chemical analysis results is presented in Appendix H, and a fuller presentation and discussion of this chemical analysis is also the subject of a forthcoming article (LANKTON *et al.* in prep). Tables detailing the nature of the assemblage and its distribution within the sequence are provided in Appendix F and referred to throughout. Illustration of selected glass types and forms are provided in Figures 13.1–13.4.

Materials and Methods

The methodology used in the description of the glass was very simple. In addition to quantifying the samples, four characteristics were recorded: form; thickness; colour; and weathering. For the analysis of thickness (*i.e.* the thickness of the body or 'wall' of the vessel), a measurement with callipers was taken. The recording procedures for the descriptive analysis of glass colour and weathering were developed with reference to the work of BRILL (1999), who provides standardised and widely recognised guidelines for recording early glass. While broadly following Brill's model, the Essouk analysis made certain modifications. Firstly, Brill's colour types were simplified, it being felt that this classification draws distinctions between colours that the glass-maker could not control. The terms we have used to describe colours in the analysis are mostly self-explanatory. Colours which are not thought to represent the original glass colour due to their having undergone significant weathering are only identified where relevant. Secondly, Brill's weathering categories were reduced from six to three as we could not reliably discriminate between Brill's categories without both microscopic and destructive analysis – this was felt to be unnecessary for the very limited analytical benefits this would bring. The following weathering categories are used in the analysis: 'none' – no significant visible modification to the original glass surface; 'slight' – weathering products (a film or iridescent layer) covering the glass surface but seemingly going no deeper; 'heavy' – weathering that has led to deterioration of the glass below the surface.

Refitting and conservation of the glass was undertaken by Stefka Bargazova at the SCVA, University of East Anglia. LA-ICP-MS chemical analysis of 97 samples was carried out by Laure Dussubieux at the Field Museum of Natural History in Chicago. All quantitative and chemical analysis of the assemblage detailed here was undertaken prior to the attempt to refit and conserve the glass fragments.

Results

Quantity, Distribution, Size, and Refitting

Glass fragments were recorded in all excavation units, with unit Ek-A producing 91 fragments, unit Ek-B 65 fragments, and unit Ek-C 16 fragments (Table F.1). The clearest stratigraphic patterning is seen in Ek-A, there being a high concentration of glass fragments in Horizons 8 and 9 (61 of the total 91 fragments). Further inspection shows that the Ek-A vessel glass concentration is even more localised to three adjoining contexts, Contexts 89, 88 and 87, dating to *ca* 11th–12th centuries. In unit Ek-B, glass is most common in Horizon 2, with 43 of the total 65 fragments being found in these deposits, dated *ca* 10th–11th centuries. In unit Ek-C, glass is found principally in Horizon 1 (12 of total 16 fragments), dated *ca* 13th century. In summary, therefore, we see glass in contexts dated from *ca* 9/10–14th century AD, with the concentration of recorded fragments in *ca* 10–12th centuries dated contexts. When we compare this distribution pattern with that of the glass beads presented in the following chapter, we see that it is practically identical.

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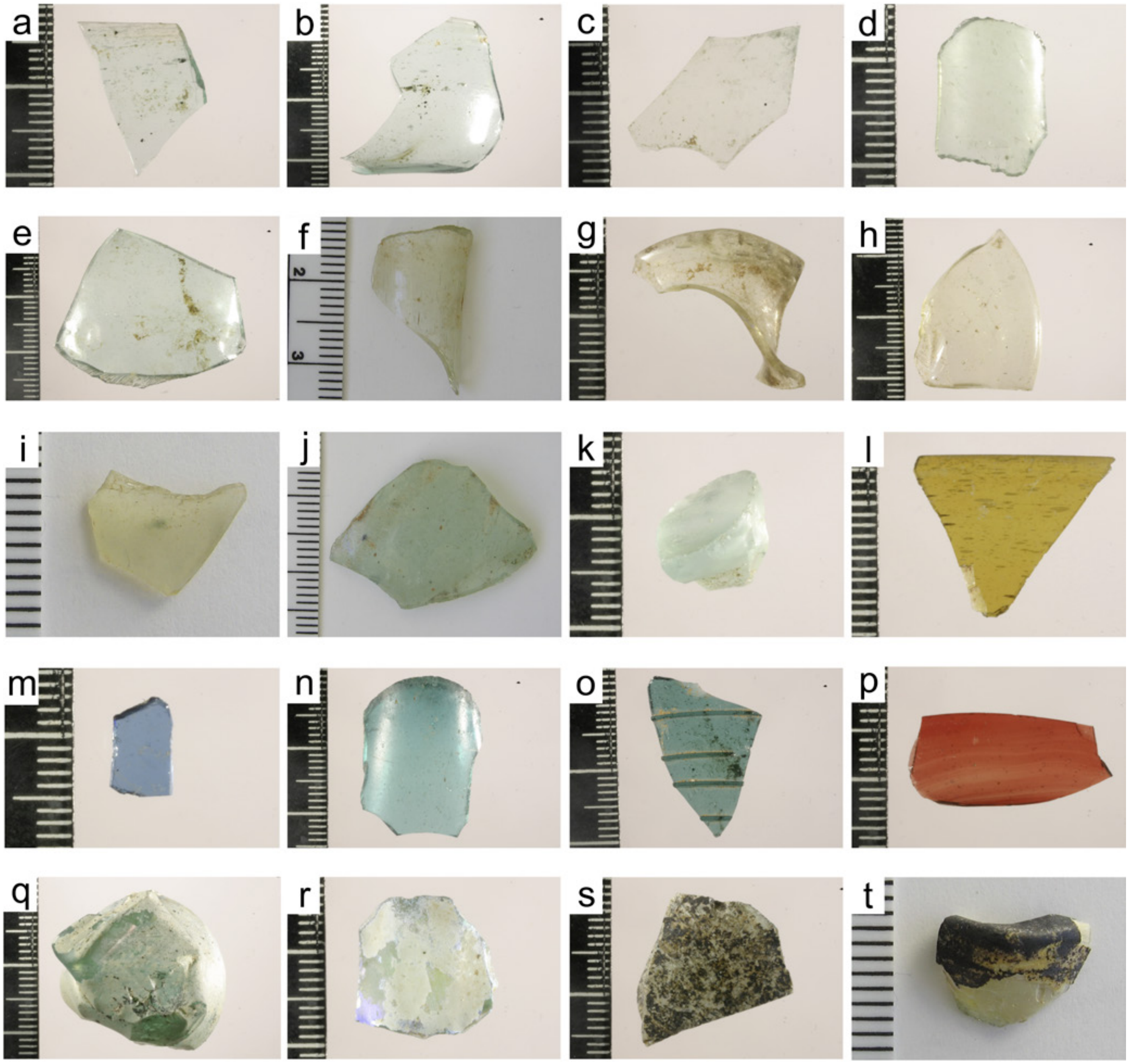

FIGURE 13.1 *Examples of glass fragments recorded at Essouk:* a–k, *colourless and near-colourless glass (a. Ek-A 87, b. Ek-A 87, c. Ek-A 87, d. Ek-A 114, e. Ek-A 87, f. Ek-A 87, g. Ek-A 43, h. Ek-A 43, i. Ek-A 103, j. Ek-A 80, k. Ek-A 87);* l–p, *coloured glass (l. Ek-A 54, m. Ek-A 14, n. Ek-A 77, o. Ek-A 87, p. Ek-A Wall 7);* q–t, *glass with heavy surface corrosion products (q. Ek-A 109, r. Ek-A 86, s. Ek-A 93, t. Ek-A 109).*

While within this analysis no detailed tabulation of the size of the glass sherds is provided, it is to be noted that no whole or near complete glass vessels were found and very few large fragments. All fragments were smaller than 16cm^2 in surface area and the majority were smaller than 4cm^2. Refitting did result in some reconstruction, though mainly piecing together of small fragments. Only one significant refit was achieved, piecing together four fragments to reconstitute a relatively significant portion of a glass vessel (see Fig. 13.2a; Fig. 13.1b shows largest fragment prior to gluing). All refits were undertaken after the quantification of the individual fragments represented in the tables presented in Appendix F.

Form

It can be seen from Table F.1 that the majority of the fragments relate to vessels, based upon an assessment of their curvature and overall form. Table F.2 shows that the vast majority of the glass samples have wall thicknesses of less than 2.5 millimetres, with the greatest quantities measuring within the 0.5–1.5mm bracket. Accordingly, it is clear that the majority of the glass samples have very

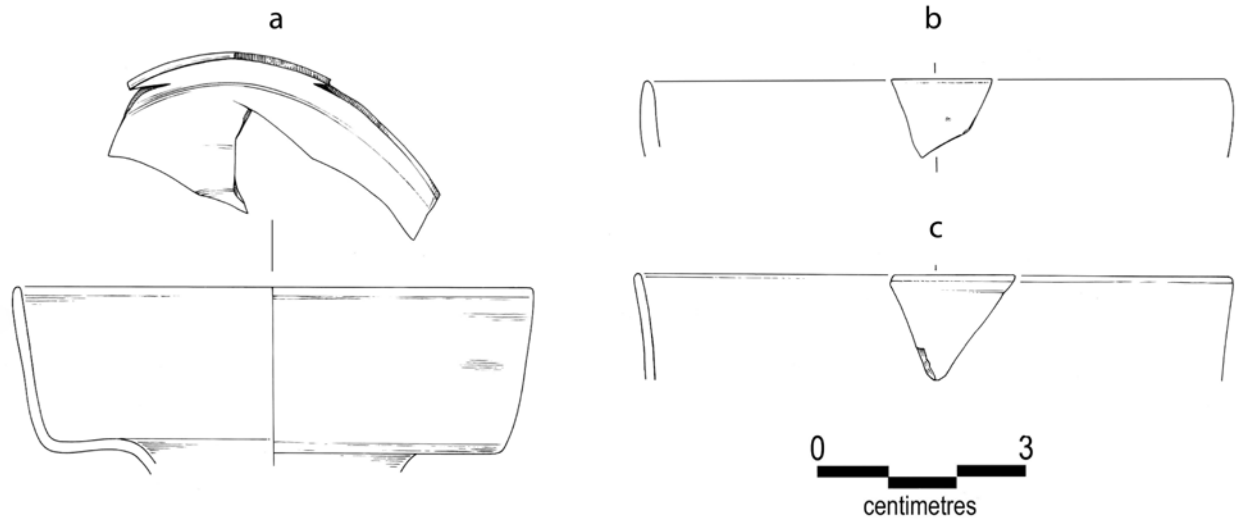

FIGURE 13.2 *Reconstruction drawings of selected glass bowl/dish fragments:* a. *Ek-A 87/89 (4 fragments refitted: 3 frags. = Ek-A 87; 1 frag = Ek-A 89; colour 'aqua' – see Fig. 13.1b for photo);* b. *Ek-A 86 (colour 'aqua');* c. *Ek-A 54 (colour 'Medium brown/green' – see Fig. 13.1l).*

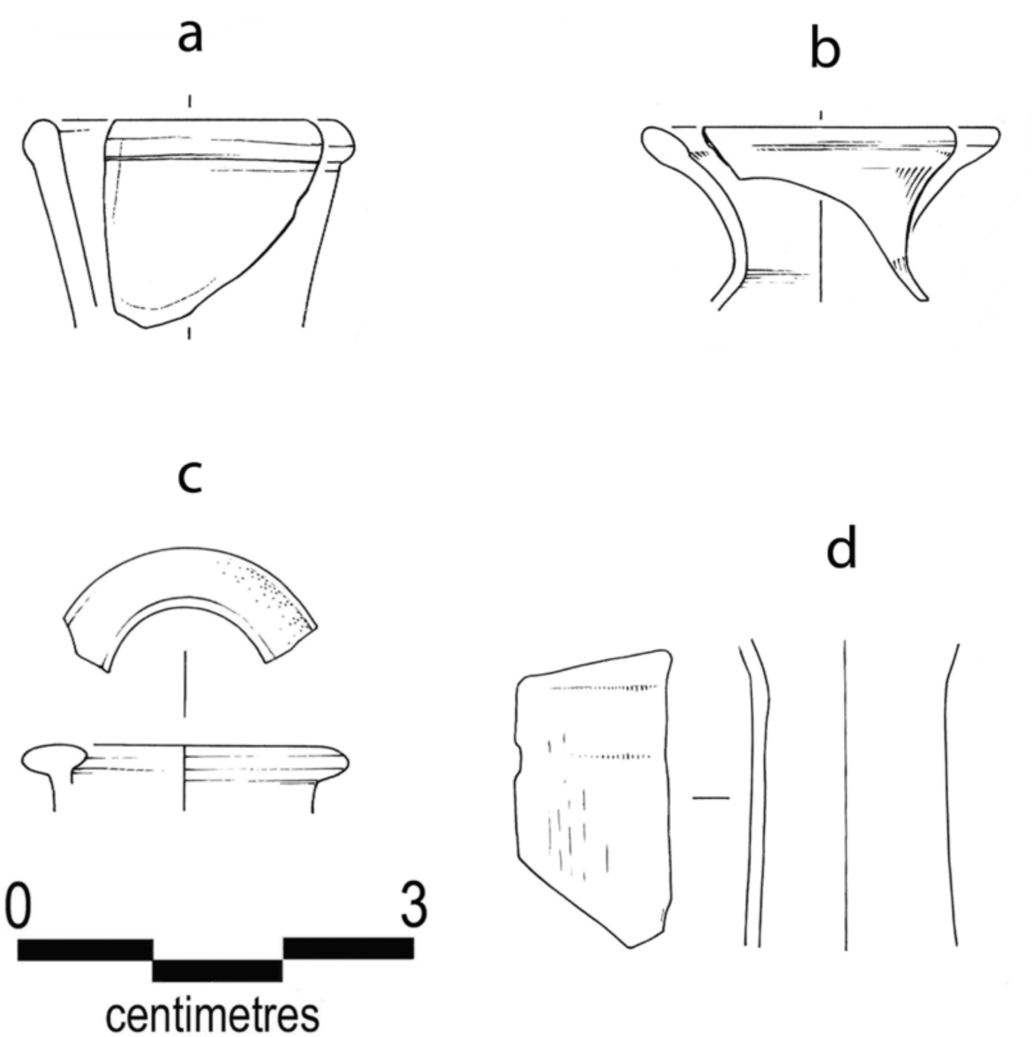

FIGURE 13.3 *Reconstruction drawings of selected glass bottle fragments:* a. *Ek-A Feat. 4 (colour 'clear');* b. *Ek-A 43 (colour 'pale yellow' – see Fig. 13.1g);* c. *Ek-B 10 (colour 'pale-green');* d. *Ek-A 87 (colour 'clear' – see Fig. 13.1f).*

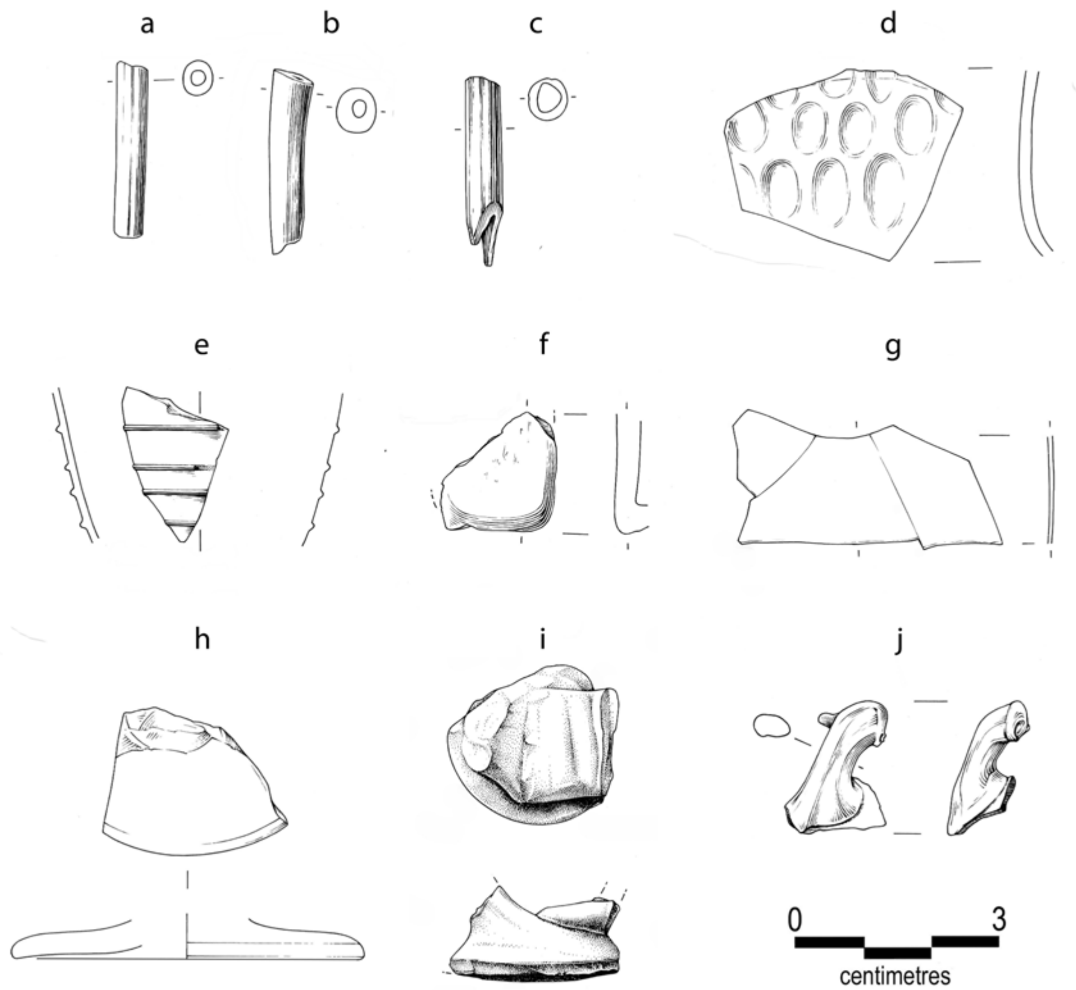

FIGURE 13.4 *Drawings of other distinctive forms within the Essouk assemblage (see text for discussion of form types):* a. *Ek-A 43 (colour 'pale green');* b. *Ek-A 84 (colour 'pale green');* c. *Ek-B 4 (colour 'aqua');* d. *Ek-A 87 (colour 'aqua' – see Fig. 13.1e);* e. *Ek-A 87 (colour 'dark blue/green' – see Fig. 13.10);* f. *Ek-A 87 (colour 'medium green');* g. *Ek-A 87/88 (3 fragments refitted: 2 frags. = Ek-A 87; 1 frag. = Ek-A 88) (colour 'pale green');* h. *Ek-A 43 (colour 'pale yellow' – see Fig. 13.1h);* i. *Ek-A 109 (colour medium-green (orig.?) – see Fig. 13.1q));* j. *Ek-B 12 (colour 'pale green').*

thin wall thicknesses. Due to the small size of the fragments it was difficult to gain a sense of the original forms of glass vessels. Nevertheless, we have been able to reconstruct vessel form from a number of fragments, showing in particular the presence of small glass bowls (Fig. 13.2). While narrow-necked vessels or bottles do not appear to be common, several of such vessels were also evidenced, of which we were able to understand partial forms (Fig. 13.3). A variety of other forms were recorded (Figs. 13.4), including a mosque lamp handle (Fig. 13.4j), window glass (Fig. 13.4g – see also Fig. 13.1c,), and goblet bases (Fig. 13.4h – same fragment shown in Fig. 13.1h). One distinctive subset is a group of tube fragments made of relatively transparent pale green/yellow glass (Fig. 13.4a–c). Initially these were considered to be 'bead wasters' – cast off lengths of the tube of glass used during a drawn bead making process – but given that the glass did not resemble bead glass and at least one had a very large perforation relative to the glass thickness this is seen to be unlikely. One strong possibility is that they relate to so called 'Alembic' vessels, used in medicinal processes, examples of which were found at early Islamic Nishapur (Kröger 1995: 186).

Colour

While discussing 'colour' here, we should state that much of this glass would often be described as 'clear' or 'colourless' by the non-specialist, the colours allotted often being very pale.

Looking at Table F.3 we see that no polychrome glasses were recorded (see also Fig. 13.1). The glass is dominated by very pale green, yellow, and aqua tones. The fact that greens and yellows are very strongly represented shows that a lot of the glass is 'untreated' in terms of its colour; yellow and green being the natural colours which tend to be produced if colour modifiers are not added. Of the remainder of colours seen, only blue registers as a significant minority presence. Completely colourless glass is present but not in large quantities. While present in small quantities, the mere presence of decolorised glass is interesting as this is a trait which suggests a very high quality glass (St John Simpson, pers. comm.). An even more outstanding presence within the assemblage is the single fragment of ruby red glass (Fig. 13.1p), a colour almost never seen in this era of glass production, an extremely rare item (St John Simpson, pers. comm.). It is also important to stress that the vast majority of glass recorded was transparent. Little worthwhile comment can be made concerning colour change over time.

Weathering

Table F.4 shows that the great majority of the glass is not heavily weathered, and indeed the majority of the specimens feature no weathering at all. Certain of the earlier samples, particularly from unit Ek-A, are however heavily weathered. While this could be a result of the earlier deposits tending to chemically weather the glass more for some reason, we should also consider the fact that very early Islamic glass is generally seen to weather more than the glass produced in later periods (St John Simpson, pers. comm.).

Surface Decoration

Surface decoration was relatively limited. The following list (by horizon) details the specimens featuring surface decoration:

Ek-A Horizon 9
1 × (specimen with) 'hot worked' finish
1 × mould-blown with surface dimples (Fig. 13.1e, Fig. 13.4d)
1 × horizontal trails (Fig. 13.10, Fig. 13.4e)

Ek-A Horizon 12
1 × fire-polishing

Ek-B Horizon 2
3 × wheel abrasion decor
1 × cut polished prismatic finishing

Ek-B Horizon 3
1 × wheel abrasion decor

Ek-C Horizon 1
1 × mould blown

EKC Horizon 2
1 × cut polished prismatic finishing

Chemical Analysis

97 specimens were analysed by Laure Dussubieux at the Field Museum, Chicago, USA, using the technique of laser ablation-inductively coupled plasma-mass spectrometry (LA-ICP-MS). LA-ICP-MS provides quantitative determinations of up to 60 different elements, while requiring little sample preparation and making a laser mark on the glass that is invisible to the naked eye. For a more detailed account of this technique as used at the Field Museum, see DUSSUBIEUX *et al.* 2009. A summary of the results is given in Appendix H, with a brief discussion here. A full report will follow (LANKTON *et al.* in prep.). For the purposes of the chemical analysis the samples were divided into two broad categories, 'early' and 'late': 'early' is defined as up to and including the 12th century, but not those samples attributed to 12th/13th century levels; 'late' represents all glass from deposits dated after the 12th century (including those given a '12th/13th century' designation).

Figure H.1a shows a plot of magnesia (MgO) by potassia (K_2O) for the Essouk vessel samples. All but one of the vessel samples have MgO values greater than 1.5 wt%, with K_2O ranging from 1.1 to 3.9 wt%. These values are typical for soda-lime-silica glass produced by melting the ashes of high-sodium desert or coastal plants with silica (SiO_2) from relatively pure sand or ground quartz pebbles. Such plant-ash soda lime glass predominated from the Late Bronze Age until *ca* 800 BC, when it was replaced in Egypt and western Asia by glass produced using mineral soda, natron or trona, almost exclusively from lakes near Wadi Natrun in Egypt. Between the late 8th and 10th century CE plant-ash glass again became the norm in western Asia and Egypt with wood-ash glass more common in Western Europe. All during these periods plant-ash glass production continued in the territory east of the Euphrates River. Our plant-ash glass from Essouk is typical for the Early Islamic glass produced in the Levant, Egypt and North Africa. The one exception is a fragment of aqua-colored cut glass, Ek-A 87 (n.57) (Fig. 13.1k), with both MgO and K2O less than 1.5 wt%, dated *ca* 12th century. This composition implies a mineral source, such as natron, for the soda flux, and is common until the 9th/10th century in Egypt and the Levant. The 12th century date is late for glass vessels made with natron, but might be explained by movement of the fragment from a lower level, or if the vessel were an heirloom already 100 years old, or even the recycling of Roman glass in a 12th century workshop. In addition, there are seven late samples with higher MgO values. These are all vessels from Ek-A and Ek-C, dating to the 13th–14th centuries, and includes the ruby-red fragment mentioned above.

Figure H.1b also shows a plot of alumina (Al_2O_3) by lime (CaO or calcium oxide). Here, we see a main group of early and late vessels tightly clustered with CaO between 8.5 and 12 wt%, and Al_2O_3 from 1.3 to 2.4 wt%. These values are typical for both 9th to 10th century natron glass and Early Islamic plant-ash glasses. In addition, there are a number of plant-ash glass samples with lower lime and higher alumina, with some points seemingly in-between. These lower-lime glasses include two window fragments and vessel rim and tube fragments, with dates ranging from the 10th to the 12/13th centuries. Also unusual are four vessels with very high alumina, greater than 4 wt%, and moderate lime. Three of these are late, all with high titania (TiO_2). In the compositional summaries in Appendix H, we refer to these glasses as v-Na-Ca-Al, indicating only that the alumina values are unusually high, not necessarily that the vessels have a different archaeological meaning.

One important question for the Essouk glass assemblage is where did it come from? Almost all of the vessel samples were too small to be linked to identifiable vessel types, thus precluding source identification based on vessel typology. However, chemical analysis may be helpful here. If we compare the compositions of the Essouk samples with those from possible source areas, we may have an indication of where the vessels were produced, although likely widespread exchange of both finished vessels and even raw glass makes firm linkage to production areas much more difficult, particularly since we have very few well documented sites where raw glass was produced during the 10th to 14th century. One point evident from the MgO by K_2O and Al_2O_3 by CaO plots is that there appears to be little difference between the early and late vessel samples, other than the high-Al_2O_3 samples that we identified. Some of these samples were also higher in magnesia, raising the question of a different production zone.

We compared the Essouk vessel samples to those from possible source areas thought to be important in glass production during the Early Islamic period. These include Iran and Iraq during the Abbasid Caliphate, the Levantine coast, always a major glassmaking centre, and North Africa, where the production of glass vessels flourished under the Fatimids. The comparison results (not shown) indicate that for major oxides such as K2O, MgO, CaO and Al2O3 there is considerable overlap among all three comparison groups and the large cluster of early and late Essouk vessels. For those late Essouk glasses with higher MgO and Al2O3, both the Levantine and Egyptian groups also include samples in this area.

Trace elements, introduced into the glass melt as contaminants of the raw materials, may offer a better guide to the underlying geology of the production area, and have been useful in sourcing a number of glasses, most notably the Late Bronze Age glass produced in Egypt and Mesopotamia (Shortland et al 2007). Our trace element comparisons (not shown) show some promise but are not definitive. In general, by plotting boron or chromium by titanium, much of the overlap with the three production zones disappears. Both the Iran/Iraq and Levantine samples are now clearly distinct, being much higher in boron and chromium than the other groups, indicating that these areas are an unlikely source for the Essouk vessels. The Egyptian samples, mainly from Fustat, are the most similar to Essouk glass, with considerable, but not complete, overlap. However, if we take the analysis one step further and and create principal components (PCA) diagrams (not shown) using a variety of major and trace elements, there is almost no overlap between the Essouk vessels, including those with high alumina and magnesia, and the Egyptian samples in our database. There are a number of reasons why this may be true, including particularly that the dates for our Essouk vessels may not correspond well to the dates for the Egyptian glasses, said to be 9th to 13th centuries for most but not precisely dated. It is also possible that we are dealing with glass source areas that are yet to be documented archaeologically and/or chemically.

Discussion

No intact glass vessels were recovered, and even our reconstruction program did not produce anything approximating to a 'whole' vessel (see however Fig. 13.2a). Given the fragile nature of glass this is perhaps not surprising. Finds of intact or near intact vessels from West Africa are very rare. During excavations at Tegdaoust five near complete (reconstructed) glass vessels were recovered from *ca* 9th /10th century deposits (Vanacker 1979: 163–66; Devisse 1983: 515–522). More recently a partially reconstructable vessel was also found at Tongo Maaré Diabal in Mali (N. Gestrich pers. comm.). Insoll (1998b: 80) has also reported that whole items were recovered from illicit excavations at Gao (see also Cissé *et al* 2013). When one considers that *only* five near intact glass vessels were found in the very extensive excavations at Tegdaoust this indicates the rarity of intact or near intact glass vessel finds. Given the use of broken glass in gold processing at Essouk (Chapter 15), and given the possible evidence for glass bead industries in West Africa drawing on broken glass (see Chapter 14 for discussion), one must consider that broken glass could have been traded as a commodity in itself within West Africa. However, it seems extremely unlikely that broken glass would be shipped across the Sahara on camel caravans given the potential for trading other more valuable goods, including whole glass vessels. In contrast to the various Arabic historical references to glass beads (see Chapter 14), there are no known specific Arabic records to trade in glass vessels.

The Essouk evidence seems to indicate that amongst the glass objects arriving at the site a large proportion were such items as glass bowls or dishes, obviously high status items for serving and display (Fig. 13.2). Bottles are also a distinct subset (Fig. 13.3) – albeit perhaps less numerous – these likely travelling with some form of liquid contents (such as ink, perfume, or medicines). Amongst the various other fragments are items identified as goblet bases, and one mosque lamp handle. Fragments tentatively identified as 'window glass' (both plain and pale blue glass) were also recorded, on the basis of the glass being entirely flat. Such 'window glass' has also been reported from Gao (Insoll 1998b: 85; Insoll 2000: 22–23), and it seems not unreasonable to think that small individual panes of glass were set into important buildings in the Sahel – one should certainly clarify though that we are not suggesting the trans-Saharan shipment of larger sections of window glass. There are also a number of rarer items, most notably the single ruby-red glass fragment. For many of the fragments found we cannot with certainty identify the objects they once formed a part of, as for instance with the fragments of glass tubes discussed above (Fig. 13.4a–c). One additional observation that certainly can be made is that the variability of the fragment forms suggests there was reasonable variety in the glass arriving at the site. At the same time, it has also been commented that the assemblage is dominated by mass-produced blown glass of fairly good quality (St-John Simpson, pers. comm.).

Considering the evidence more widely, one must first note that glass vessels are far less common in West Africa than fragments of glass beads. This said, at sites on the southern Saharan fringe glass vessel finds are not uncommon. At the trading site of Tegdaoust for instance, *ca* 200 fragments were found during Vanacker's excavation of a quarter of the town (1979). Likewise, glass finds from Gao, Essouk's most immediate trading partner further south, are relatively numerous, with *ca* 250 fragments recorded by Insoll (1998b) and *ca* 170 by Cissé (2011: 215–227). When we look for evidence from sites further south, however, this is almost entirely absent; unlike the very widely distributed glass bead evidence (see Chapter 14). This said, the find of a glass vessel from Tongo Maaré Diabal in Mali (see above) does indicate some movement of glass vessels beyond the southern Saharan trading towns.

Considering the Essouk and Gao data side by side provides a useful means of comparing the movement of glass along a single trade route. Insoll's work (1998b) indicated the presence of a range of glass not seen at Essouk, including polychrome and marvered wares, although the nature of the bulk of the non-descript material is unclear. Interestingly, Insoll noted from his research a concentration in the period *ca* 10th–12th centuries AD, appearing to offer a good overlap with the concentration of glass at Essouk. Cissé states that 70% of the glass recovered during his excavations was green glass (2011: 216), seeming to indicate that like Essouk the bulk of glass present relates to relatively more common wares. This said, Essouk's glass is particularly defined by clear or very pale green/yellow glass which is also very thin – from the available images, the Gao glass does not appear entirely similar (Insoll 1998b; Cissé 2011: 224). Given this evidence, it is a distinct possibility that certain glass types were preferentially reserved for use at Tadmekka while other types were more commonly traded onwards to Gao. On this note also, Cissé notes "several dozen" bottle fragments (2013: 14), a significantly larger quantity than was found at Essouk. For the Tegdaoust evidence (Vanacker 1979) it is more difficult to understand the specific nature of the glass, but broadly speaking these again seem to parallel the evidence from Essouk and Gao in being mainly monochrome wares with some distinct subsets of surface modelled and moulded wares. As at Essouk, seemingly there were no polychrome or marvered wares found at Tegdaoust.

When considering the contexts in which we see high quantities of glass vessel fragments it is important to also discuss the evidence recovered for gold processing crucibles which we have shown to contain crushed glass, used within the processing of gold (see Chapter 15). While the crushed glass found within the crucibles we recorded appears to be bead glass, there is also a strong possibility that crushed vessel glass was used in gold processing. Importantly, in Ek-A the high concentration of glass fragments is found in contexts at the Horizon 8/9 transition, within which we find the gold-processing crucibles; likewise, bead glass shows the same high concentration in these contexts (see Chapter 14). We do also see glass vessel fragments in relatively large quantities in portions of the Ek-B and Ek-C stratigraphies – it is unclear though if these also relate to some form of workshop context, or whether they are simply debris relating to the trade and usage of glass vessels. What it is certainly important to recognise when considering the glass vessel fragments – as with the glass bead fragments – is that glass, even when broken, had a potential sell-on value, to be used for secondary processing. Certainly at later periods in West African history, broken glass was used quite intensively in the powder glass bead industry (Francis 1993). We should strongly consider therefore that in addition to being reused at Essouk, and possibly other southern Saharan towns, broken glass might have been collected and sold on for shipment further south for secondary processing industries in other zones of West Africa. At the very least, the overlapping evidence for the use of glass in gold processing (see Chapter 15) should make us carefully consider patterns and discreet concentrations of vessel glass fragments at West African sites.

CHAPTER 14

Beads

James Lankton, Sam Nixon, Peter Robertshaw and Laure Dussubieux

Introduction

Of the large quantity of beads recovered during the excavation, the majority were glass, with a total of 385 glass bead specimens. Details of the distribution and nature of the glass beads are provided in Appendix G. In addition to typological classification, chemical and technical analyses were performed. The chemical analysis program was part of a wider study of the glass remains at the site, including also the vessel glass (Chapter 13), and glass within two crucibles related to gold processing (see below & Chapter 15). The glass bead chemical analysis is summarised below and a summary of the data is presented in Appendix H – a fuller presentation and discussion of this program is also the subject of a forthcoming article (LANKTON *et al.* in prep). A small assemblage of other beads was also found, made from a variety of materials, including stone and shell. Certain artefacts identified as coral also appear to have functioned as beads. In this chapter we discuss the relationship between the beads and trans-Saharan trade processes, as well as considering the West African manufacture of glass beads.

Glass Beads

Methodology

As with the glass vessels, the recording procedures for the descriptive analysis of the beads were developed with reference to the work of BRILL (1999). Brill provides standardised and widely recognised guidelines for recording the form, size, perforation size, colour, weathering, and opacity of beads. While broadly following Brill's model, the Essouk analysis made two modifications: firstly, Brill's colour types were simplified, it being felt that this classification draws distinctions between colours that the bead-maker could not control; secondly, Brill's weathering categories were reduced from 6 to 3 as we could not reliably discriminate between Brill's categories without both microscopic and destructive analysis and, for the very limited analytical benefits this would bring, this was felt to be unnecessary. In addition to Brill's categories, two other categories were added, 'manufacture' and 'regularity'. Although not included in Brill's analysis, the study of manufacture is recognised by various scholars to be an important attribute of beads to record (*e.g.* GLOVER *et al.* 2003). The second category added, 'regularity' of form, was developed to distinguish between beads whose form was fairly accurately represented by the standard illustrations of bead-form provided (Fig. 14.1) and those whose form was so irregular as to be insufficiently represented by these illustrations. While 'regularity' of form is a somewhat subjective judgement, it was felt necessary to make some attempt to record this aspect of the assemblage. Representative examples of glass beads recorded as 'irregular' are illustrated in Figure 14.2a–d.

To aid comprehension of the terms used in the analysis, the following explanations are provided:

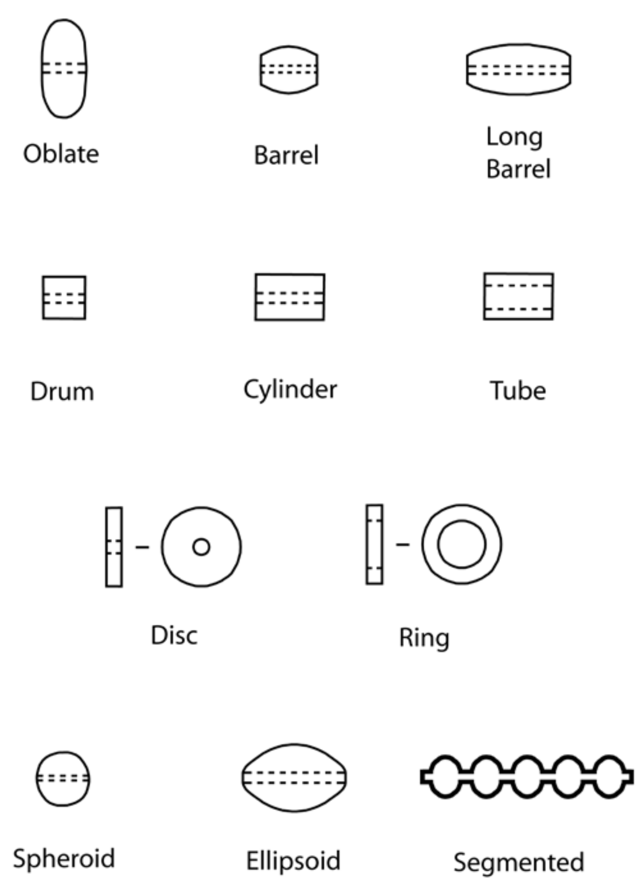

FIGURE 14.1 *Glass bead forms recorded at Essouk.*

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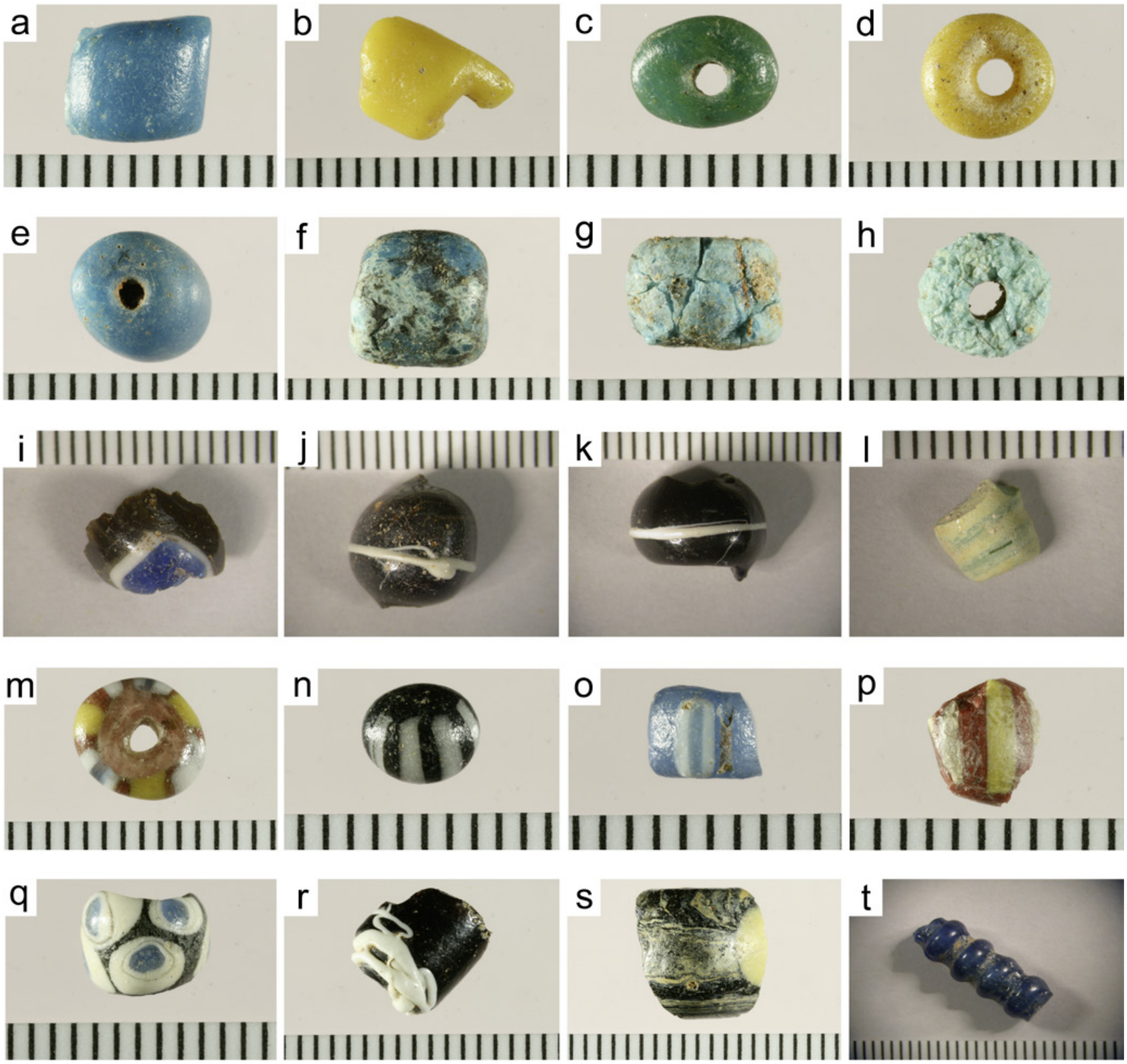

FIGURE 14.2 *Images illustrating various aspects of the Essouk glass bead assemblage:* a–d, *examples of 'irregular' bead forms* (*a. Ek-A 87, b. Ek-B 8, c. Ek-B 11, d. Ek-C 11*); e–h, *beads showing the various stages of weathering of the dominant mid-blue bead type seen at Essouk* (*e. Ek-A 89, f. Ek-A 87, g. Ek-A 88, h. Ek-A 87 – from left 'unweathered' to right 'very heavily weathered'*); i–s, *multi-coloured beads excavated at Essouk* (*i. Ek-A 74, j. Ek-A 87, k. Ek-A 87, l. Ek-A 87, m. Ek-B 4, n. Ek-B 10, o. Ek-B 10, p. Ek-B 11, q. Ek-B 11, r. Ek-B 13, s. Ek-B 16*); t, *segmented bead* (*Ek-A 103*); *see also dichroic bead,* Fig. 14.3.

Form. For illustration of the majority of the form types referred to see Figure 14.1. Form types referred to but not illustrated are as follows: 'Frag.': a fragment of a bead which is insufficient to reconstruct the form of the bead.

Regularity. 'Regular' and 'irregular' are the only terms used in this category. 'Regular' approximates to levels achievable by modern craft techniques rather than to highly regular machine-made objects. Figure 14.2a-d provides representative illustrations of beads recorded as 'irregular'.

Size (*diameter of beads*, perpendicular to perforation). 'Seed': equal to or less than 2.5mm; 'small': 3–5.5mm; 'medium': 6–9.5mm; 'large': 10–15mm.

Perforation diameter. The majority of terms are self-explanatory size categories. 'Fused' describes beads which have no perforation due to manufacturing error.

Manufacture. 'Drawn': a mass-produced bead cut from a tube of glass, then usually reheated to soften the cut ends; 'wound': an individually crafted bead created by winding glass around a rod; 'segmented': a bead that was originally part of a tube of glass which has been 'pinched' during production so that it appears to be composed of a series of individual beads joined together (Fig. 14.1, Fig. 14.2t); stratified 'eye bead': a bead, usually wound, decorated by applying roughly circular elements of glass to create a pattern on the bead surface resembling multiple eyes (see Fig. 14.2q).

Colour. The terms used to describe colours are mostly self-explanatory. When the original glass colour has changed due to it having undergone significant weathering we have highlighted this. Many of the glasses are various shades of blue. Where possible we will indicate 'greenish blue', usually coloured by copper, and 'purplish blue', usually coloured by cobalt.

Property under light. 'Opaq.': opaque; 'transl.': translucent; 'trans.': transparent; 'mixed': composed of different glasses having varying degrees of opacity; 'orig.?': original level of opacity cannot be discerned; 'dichroic': a glass whose colour differs in reflected and transmitted light.

Weathering. 'None': no significant visible modification to the original glass surface; 'slight': weathering products (a film or iridescent layer) covering the glass surface but seemingly going no deeper; 'heavy': weathering that has led to deterioration of the glass below the surface.

Descriptive analysis of the glass beads is structured around two phases of quantitative analysis. In Phase 1 we analysed the beads according to each of the categories listed above. Tables G.1–G.9 represent these various analyses of the glass beads. Phase 2 analysis was carried out to investigate correspondences between different attributes of the beads, to more clearly characterise the types of glass beads found at Essouk. The results of this second phase of analysis are shown in Tables G.10–G.14.

Quantity and Distribution

Of the 385 glass bead specimens recorded at Essouk, 230 were sufficiently complete to allow us to reconstruct their original form, while the remaining 155 specimens were small fragments from which the original form of the bead was unintelligible. For convenience, all these specimens will henceforth be referred to as 'beads'. Table G.1 shows the glass beads found within all three excavation units. We concentrate first on those from unit Ek-A, which produced 193 beads. No glass beads were present within Ek-A until Horizon 4. While glass beads are present in Horizons 4 to 7, they are found in small quantities, only 17 beads being recovered from these four horizons. A large increase in glass beads is seen in Horizon 8, the last horizon of Period 2, with 44 beads recorded. In Horizon 9 the quantity shows a further marked increase, with 63 beads recorded. In Horizon 10 there is a distinct drop off, with 16 beads recorded, and while a slight rise is noted in Horizon 11, there is then a consistent decline in numbers through Horizons 12, 13 and 14. By Horizon 14 a negligible quantity of glass beads are recorded. Looking at the Ek-A glass bead sequence as a whole, the most striking pattern is the peak seen in Horizons 8 and 9. Further inspection shows this peak in unit Ek-A can be narrowed down further, to Contexts 89, 88 and 87 – it is to be noted that this is the identical pattern as was observed with the glass vessels in unit Ek-A. What we see then in unit Ek-A is the presence of glass beads within contexts dateable to *ca* 10–14th centuries AD, with a concentration of evidence in deposits dated *ca* 11th–12th century.

Turning now to glass beads from the other units, in unit Ek-B we can see that while there is a moderate quantity in Horizon 1 (26 beads), in Horizon 2 we see far larger quantities (102 beads). While the difference in quantities between these two horizons is great, we should however bear in mind that far fewer deposits were excavated in Horizon 1 than in Horizon 2. While in Horizon 3 we see approximately the same amount of deposits excavated as in Horizon 2, we see far fewer beads. The Ek-B evidence therefore shows a significant presence of beads in contexts dated *ca* 10th–11th centuries AD. Regarding the distribution of beads seen in unit Ek-C, we see significant quantities in Horizon 1 (27 beads) but less in Horizon 2, and then no glass beads in Horizon 3. We therefore see a significant presence of glass beads in contexts dated *ca* 13th century AD, but limited evidence thereafter.

In summary, within the Essouk-Tadmekka excavations we see evidence for a significant presence of glass beads in contexts dated between the 10–13th centuries, with *ca* 14th century AD contexts producing significantly less evidence. While comparisons between the three units are useful in showing broad relative patterns, comparison of the absolute quantities of glass beads recovered between the three units should be made with caution, as whereas a 1cm sieve was used in unit Ek-A, a 2mm sieve was used in units Ek-B and Ek-C. While sub-1cm beads were recovered from unit Ek-A it is possible therefore that significantly more beads would have been recovered with a 2mm mesh size.

Form

Viewing the assemblage as a whole (see Tab. G.1), it can be clearly seen that the collection of beads whose original form can be deduced ('whole beads') is dominated by beads which are minor variations on a basic form, seemingly resulting from cutting a tube of glass into various lengths (see also 'manufacture' below). These forms are as follows: barrel; cylinder; disc; drum; long-barrel; oblate; ring; tube. These simple bead forms account for 96% of the total bead forms recorded. Amongst these similar forms, the barrel bead is the most common, accounting for 40% of the total bead forms recorded. Drum, oblate and cylinder beads are the other most notable forms, accounting together for 49% of the bead forms. The remaining small number of beads relate to the ellipsoid, spheroid and segmented forms, generally associated with more labour-intensive forms of production (see 'manufacture' below). Looking at the distribution of forms chronologically, there is no significant patterning to note. A large number of glass bead fragments whose original form we cannot establish were also found. None of these fragments appear to be evidence of local bead production, and are most likely the result of beads broken in use or arriving at Essouk-Tadmekka in a broken state (discussed further below).

From Tables G.2–G.3 it can be seen that irregular beads are more common than regular beads. From Table G.4 it can be seen that the whole beads recorded were dominated by small and medium beads (87%). 'Seed' beads are found in relatively low quantities (see however comments on mesh size above). Large beads are a negligible presence. There is no significant patterning to notice in the Ek-A sequence in terms of bead size. The Ek-B assemblage shows a much larger proportion of 'small' beads than does Ek-A or Ek-C. While this pattern is likely caused at least in part by the fact that a 2mm sieve was used in Ek-B – as opposed to the 1cm sieve used in Ek-A – it is possible that the relatively restricted time period of Ek-B is a factor, with potentially more small beads circulating at that time. Given the dominance of small and medium size beads, it is no surprise that we see small perforation sizes, 67% having a 1mm or less perforation and the vast majority of the remaining beads having either 1.5 or 2mm perforations (Table G.5).

Manufacture

Based upon our data, the 'drawn' bead manufacturing technique is dominant (Table G.6). This process is a 'bulk' manufacturing technique, producing large numbers of beads rapidly by cutting small sections of a long tube of glass in a repetitive workshop process. The 'wound' beads found in very small quantities at Essouk are more labour intensive. The negligible presence of segmented beads is an interesting pattern to be noted and is commented on below. There is no significant chronological patterning related to manufacture. An important subset of highly fragmentary beads were initially hypothesised to have been produced by the 'powder glass' technique (see Fig. 14.2e–h & 14.4), but following technical analysis (see below) these were found to be simply highly corroded drawn beads.

Colour

Looking at the colours of the glass beads, the first thing to note is that for 26% of the beads it was difficult to determine the original colour because of corrosion (Tab. G.7). Of the remaining beads, the dominant colour is blue (35%), and medium, slightly greenish, blue in particular. Something to bear in mind when noting the dominance of blue beads is that this colour is one of the easiest to achieve for a glass bead maker, requiring little manipulation of the raw materials used (KÜÇÜKERMAN 1988: 81). The next most common colour is green (21%), with medium and dark green dominating. Of a similar quantity is yellow (21%), with medium and dark yellow most prominent. The other colours registering a significant percentage are black, greenish blue, and multi-coloured. Looking at the beads which do not appear to have retained their original colour, we can see that greenish blue is by far the most common (47%). Almost certainly all of these weathered greenish blue beads were originally a medium blue colour, demonstrated by the fact that a number of medium blue beads feature patches of greenish blue weathering – this is illustrated in Figure 14.2e–h.

In terms of the distribution of colour over time, we can see that there are clear chronological patterns. Looking firstly at unit Ek-A, prior to the marked increase in bead glass from Horizon 8 it is difficult to say much of significance about colour due to the small quantity of the evidence. While yellow is the most common colour before Horizon 8, it is to be noted that the majority of the yellow beads come from the same context (in Horizon 7) and likely they come from the same bead string. With the Horizon 8 increase in glass beads it can be clearly seen that blue, and in particular medium blue, is far and away the most common colour, there being a negligible presence of other colours. Looking in a bit more detail, we can see that 58% of all blue bead glass in unit Ek-A is concentrated in Contexts 89, 88 and 87. While green – the second most common colour in the assemblage – is negligible in Horizon 8, in Horizon 9 it is a notable presence, and from Horizon 10 onwards when blue glass is no longer seen in great quantities it is the most common colour. The only other significant pattern to note regarding colour in unit

Ek-A is the fact that the weathered greenish blue beads show a concentration corresponding to that of blue beads, further confirming these were once blue beads.

Turning to the distribution of colours in unit Ek-B, we see that in Horizon 1 the most common colour is yellow followed by green, multi-coloured, and bluish green. In Horizon 2 we can see that yellow is again the most common colour, followed by blue, previously not seen, and green. The Horizon 2 glass beads have a greater diversity of colours than Horizon 1 glass beads, though we should be cautious in seeing this as representative of a shift as the greater variability in Horizon 2 could simply be a result of the greater numbers of beads recorded in this horizon. In Horizon 3 yellow beads are hardly present in comparison to their former common occurrence; green beads are now the most significant presence, though they are by no means dominant. In unit Ek-C, while the small quantity of bead-glass makes it difficult to determine colour patterns it is at least possible to note the consistency with the other units in the presence of the three most common colours, blue, yellow and green.

Comparing the colours of glass beads between the units, the most striking thing to note is that the blue beads dominating in unit Ek-A are a far less significant presence in units Ek-B and Ek-C. This might indicate a slight chronological difference in glass bead colour, with 11–12th century contexts seemingly better represented in Ek-A than Ek-B or Ek-C. At the same time, this is possibly also a local sampling phenomenon.

Property Under Light

From Table G.8 it can be seen that the vast majority of glass beads recorded are made from opaque glass. While opaque beads were dominant, translucent beads were also recorded in not insignificant quantities, along with a smaller collection of transparent beads. Beads having other properties were rare, but of particular note is the presence of a dichroic bead (*i.e.* one whose colour changes according to reflected or transmitted light) (Fig. 14.3).

Weathering

From Table G.9 it can be seen that a significant proportion of the glass beads show signs of weathering (53%), with 33% exhibiting heavy weathering. Looking at the Ek-A sequence, one notes a strong concentration of heavily weathered beads in Horizon 8. While the quantities of beads found before Horizon 8 are too small to make a sound judgement, it does seem as though the beads found from Horizon 9 onwards are less heavily weathered, with unweathered beads well represented. Broadly speaking, units Ek-B and Ek-C accord with the findings of unit Ek-A relative to their chronological relationship. We should however note the large quantities of unweathered beads recorded in Ek-B Horizon 2 – it is possible this pattern is linked to the recovery of smaller beads from that unit, this size of beads seemingly exhibiting less weathering.

'Colour'><'Weathering' Correspondences

Tables G.10 & G.11 show the correspondences that were recorded between selected colours and weathering for the beads from units Ek-A and Ek-B. This analysis concentrates on the three most common colours within the assemblage, blue, green, and yellow. Blue beads are reasonably evenly distributed over the three weathering categories. Green beads are rarely heavily weathered and are fairly evenly distributed between the categories of 'slight weathering' and 'no weathering'. The majority of yellow beads exhibit no weathering, with only a relatively small number exhibiting 'slight weathering' and none exhibiting 'heavy weathering'. For other beads whose original colours could be determined, none exhibited heavy weathering and only rarely exhibit slight weathering. Of the colours which are not believed to be the original bead colour we see that inevitably these are almost wholly concentrated in the heavy weathering category, weathering having been already defined as the principal reason for these beads having lost their original colour. As noted above, technical analysis was carried out on the blue weathered beads Fig. 14.2e–h & 14.4), in particular in order to investigate whether they were produced using the 'powder glass' technique (see below).

Multi-variable Correspondences of Blue, Green and Yellow Beads

Recognising the importance of blue, green and yellow beads, we attempted to bring greater definition to the 'types' of beads of these colours (Tables G.12–G.14). We have already seen that the overwhelming majority of beads relate to a basic form resulting from cutting a tube of glass into various lengths: barrel; cylinder; disc; drum; long-barrel; oblate; ring; and tube. The majority of the blue, green and yellow beads correspond to this broad category. Aware of this fact, the first stage in defining the bead types related to blue, yellow and green beads was therefore to simply select for study forms which were numerically dominant within the broad form category referred to above. The forms selected for study were: barrel; cylinder; drum; long barrel; and oblate. Accordingly, this analysis starts with an assemblage of blue, green and yellow beads having either a barrel, cylinder, drum, long-barrel or ob-

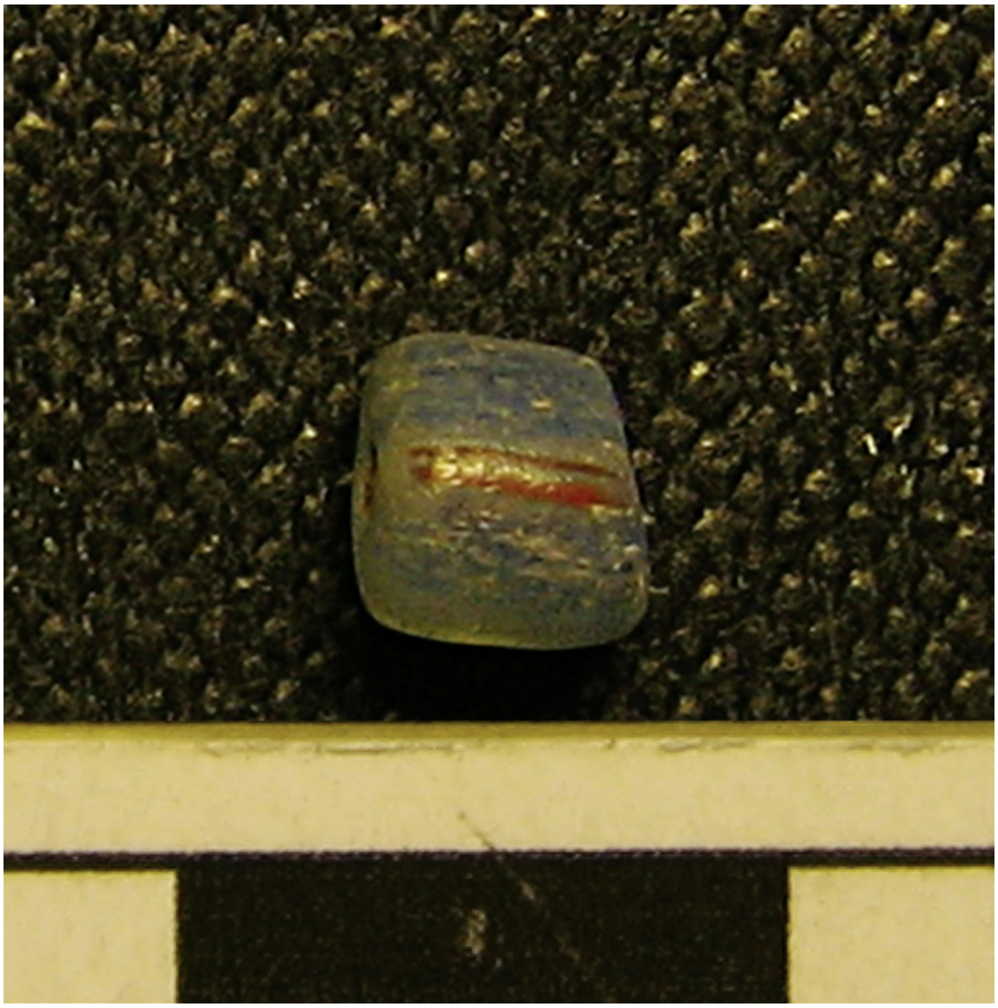

FIGURE 14.3 *Dichroic bead excavated at Essouk (Ek-A 45).*

late form. The object of this analysis is to bring greater definition to the nature of these beads by looking also at the results of the other analyses. Accordingly, we also looked at these beads according to the variables of 'weathering' and 'property under light', variables which also showed the most significant variation in the Phase 1 analysis.

Tables G.12–G.14 provide a clearer sense of the most common bead types at Essouk based upon this analysis of the main group of beads of blue, green and yellow glass. Looking firstly at blue beads we can see that opaque medium blue beads are the most common type, and in particular opaque medium blue beads exhibiting heavy weathering. Looking at green beads, we see that opaque medium and dark green beads are the most common type, with unweathered beads particularly well-represented. Looking at yellow beads, we see that unweathered opaque medium and dark yellow beads are the most common types.

Chemical and Technical Analysis

A focused program of chemical analysis was undertaken on the glass beads. This was developed with a view to providing a representative chemical dataset for trans-Saharan glass beads in West Africa, many previous studies of trans-Saharan commerce having been conducted before the era of intensive chemical analysis of artefactual material. Some preliminary thoughts are presented here, with a full discussion to follow (Lankton *et al.* in prep.). We studied a total of 64 beads by LA-ICP-MS (laser ablation-inductively coupled plasma-mass spectrometry), 17% of the excavation total, and several by SEM-EDS (scanning electron microscopy with energy-dispersive spectrometry) and EPMA (electron probe microanalysis) as well. LA-ICP-MS analyses were performed by Laure Dussubieux at the Field Museum of Natural History in Chicago, USA, using the methodology described in Chapter 13. All SEM-EDS and EPMA studies were conducted in the Wolfson

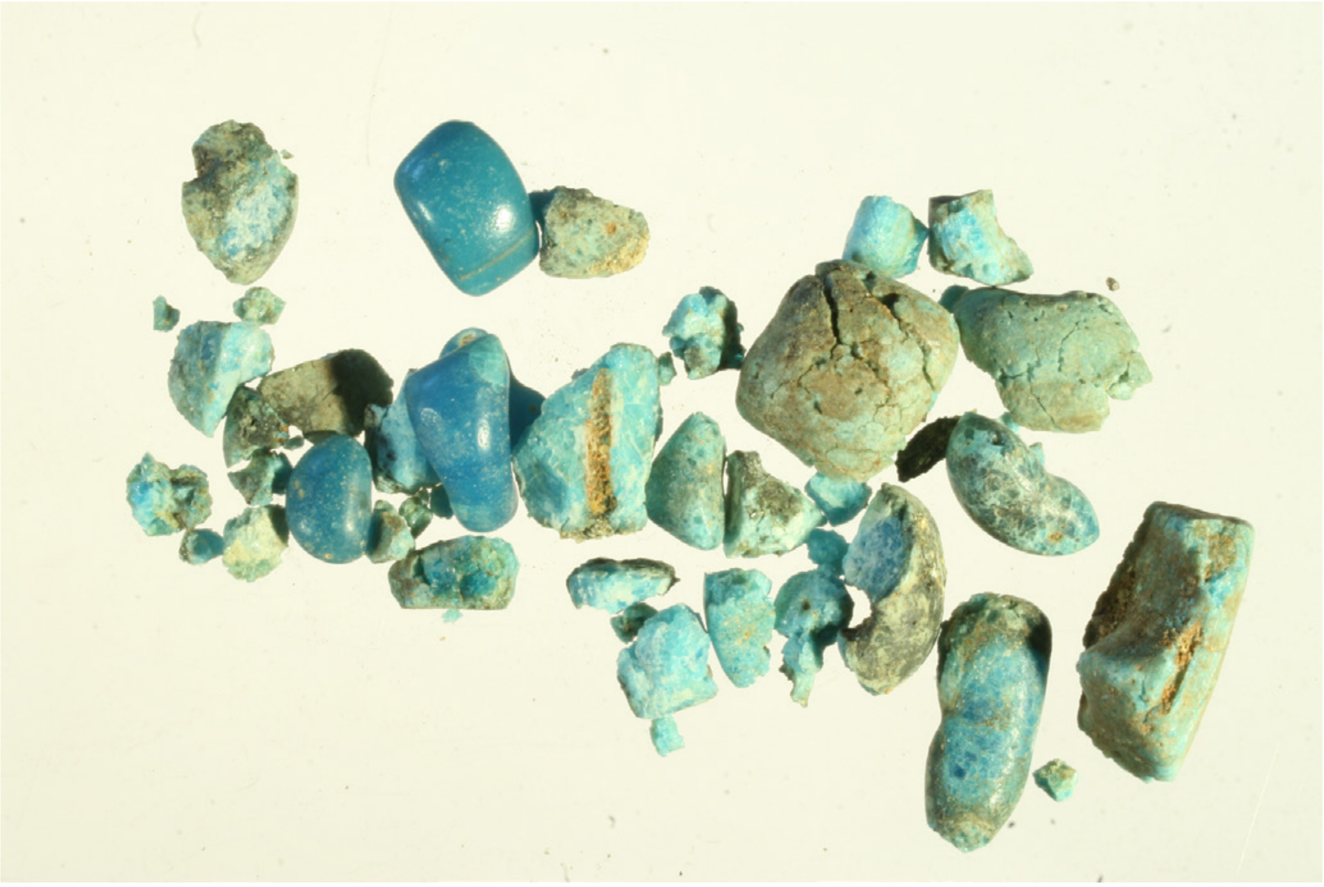

FIGURE 14.4 *A collection of the heavily weathered greenish blue beads and bead fragments found in significant quantities at Essouk.*

Archaeological Science Laboratories at UCL Institute of Archaeology, using a Hitachi SEM and a Caneca electron microprobe. The SEM studies were by James Lankton and Sam Nixon, while Kevin Reeves and Philip Connolly operated the microprobe. LA-ICP-MS and image-based technology analysis (SEM-EDS and EPMA) was also undertaken on a crucible containing glass, detailed in Chapter 15 but of relevance to the discussion here. For the purposes of the chemical analysis the samples were divided into two broad categories, 'early' and 'late': 'early' is defined as up to and including the 12th century, but not those samples attributed to 12th/13th century levels; 'late' represents all beads from deposits dated after the 12th century (including those given a '12th/13th century' designation).

Of the 64 beads analysed, 11 (17%) were too heavily weathered to provide reliable compositional data, having suffered significant loss of soda, potash and magnesia. Most of these beads were from the early period. The chemical compositions of the remainder, 25 beads from the early period and 27 from the late period, are shown in Figure H.2a, in a plot of magnesia (MgO) by potassia (K2O). On the same graph we have included 8 analyses of glass from a crucible identified as used in the refining of gold (Chapter 15). Many of the beads have a composition typical for Early Islamic glass: plant-ash soda lime glass or v-Na-Ca, where 'v' represents the vegetal source of flux, 'Na' that soda (Na_2O) is the main alkali present, and 'Ca' that lime (CaO) predominates over alumina (Al_2O_3) – with magnesia greater than 1.5 wt%, and, in most cases, potassia ranging between 1.5 and 4 wt%; although sometimes a bit lower or higher, as in our data. However, there are a significant number of beads, from both early and late levels, with lower magnesia suggesting a possible mineral soda source; all but one of the crucible glass samples are also low in magnesia. Turning to Figure H.2b, where the same beads and crucible glasses are plotted for alumina by lime, we see a main group of samples with lime between 4.5 and 9 wt% and alumina less than 4 wt%, typical for Islamic Period glass beads. In addition, there are samples with lower lime or much higher alumina; many of these are the same beads with low MgO values in Figure H.2a. When both major and trace elements are considered, these outlier beads fall into several different compositional groups.

Summaries of the full chemical compositions for both the majority group of more typical plant-ash soda lime glass (v-Na-Ca) beads, as well as for the exceptional groups identified on the two plots are given in Appendix H (Tab. 1). These include three beads, two from the early period and one from the late period, containing mainly lead and silica, referred to as lead-silica glass, or PbSi. The compositions of these three beads are similar although not identical, with lead contents from 66 to 76 wt% and low values for soda, potassia, magnesia, lime and alumina. From the early period, there are two white glasses with low MgO that are too high in potassia and low in lime to be traditional natron glasses, although a relatively low phosphate (P_2O_5) supports the use of a mineral-based flux. Both of these samples were white trails on black beads (Fig. 14.2j–k), where the black glass is conventional plant-ash glass, demonstrating the availability of both types of glass where these beads were made. Four beads from the late period, three of them black, are much higher in alumina but otherwise similar to the main group of plant-ash soda lime glass that makes up almost all of the vessels and the bulk of the beads. For convenience, we can call this compositional group v-Na-Ca-Al, indicating the high alumina levels. Also from the early period there are four beads with low-MgO compositions but high phosphate levels, indicating the use of a plant ash flux. Such lower MgO levels may occur if the plant ashes are treated before being added to the glass mixture, and that seems the most likely case here. Appendix H also includes the compositions of the HLHA and m-Na-Al 2 beads discussed below. Finally, we present the average composition of the generally heavily corroded bluish-green beads for which we were able to analyse relatively unweathered glass (Tab. H.1 'HC B-G beads'). These 14 beads, all but 2 from the early period, form a typological rather than chemical group, since the compositions are similar to those of the main early and late groups of plant-ash soda-lime glass (v-Na-Ca).

The crucible glass samples are lower in magnesia and lime, and higher in alumina, than the plant-ash glass beads. These changes are most likely the result of interaction between the glass and the clay crucibles, as the glass loses alkali and lime to the clay and gains alumina and a number of trace elements that have higher levels in the clay than in the original glass. The high copper oxide (CuO) values for the crucible glass samples (summarised in Table H.1), indicate that the glass was originally greenish blue, similar to the color of the most common heavily weathered beads from the site, and different from the glass vessels. On this evidence, it would appear that glass beads, rather than vessel fragments, were used in the gold-refining crucibles we see.

In the previous chapter we asked where the glass vessels found at Essouk may have originated, and this question is no less important for the glass beads. We can first consider whether the glass used to make beads was the same as the glass used for glass vessels. Based on plots of MgO by K_2O and Al_2O_3 by CaO, we see that the vessel and bead glasses are quite similar, although the beads tend to be lower in lime than the main group of vessels, so that we cannot conclude, *a priori*, that the beads and vessels came from the same sources. However, using the comparison groups of beads from Iran/Iraq and Fustat dated to roughly the same period as Essouk, vessel glass from the Levant, and beads from al-Basra, Morocco, we reach conclusions similar to those for the origins of the Essouk vessels. Again, there is considerable overlap among all of the groups when major elements alone are considered, although one possible clue to the origin of the high-alumina black beads is the presence of two beads with a similar composition, one of them black, from al-Basra. In terms of trace elements, boron oxide (B_2O3) was very useful to distinguish Levantine glass from that of Egypt and Essouk, but we do not have boron levels for most of the Essouk beads. Chromium oxide (Cr_2O_3) was distributed in a similar way to boron, but when we plot chromium oxide by titania for the Essouk beads and the possible source areas (not shown), there is still overlap, with the possible exception of some of the early and late higher-magnesia Essouk beads, including the stratified eye bead (Fig. 14.2i); these samples are more similar to some of the plant-ash glass beads from al-Basra. Preliminary multivariate statistics with PCA and cluster analysis bear this out, although the association with al-Basra is strong for only a few of the beads, and there are also samples from Fustat in the same compositional zone.

On a more positive note, there are three Essouk beads for which we do have a good idea of the source areas. One of these beads (Fig. 14.3) is very high in both lime and alumina but low in magnesia (high lime, high alumina glass or HLHA), similar to that produced in southern Nigeria at sites like Ile-Ife (Lankton *et al.* 2006; Babalola *et al.* 2017). Similar beads have been found at many West African sites, including Gao. The other two beads are both high in alumina but low in magnesia and lime, with very high uranium and low cesium content. Such m-Na-Al 2 (Dussubieux *et al.* 2010) glass beads have been found in East Africa as well, and were most likely produced on the west coast of India and shipped from ports like Chaul, beginning in the 9th or 10th century. Finding this glass at Essouk is quite exceptional.

Even if we have no clear indication of the sources of most of the Essouk beads, it may still be useful to explore where the beads might have gone after Essouk. Using the same graphs for major and trace elements, as well as the multivariate statistical techniques of principal components and cluster analysis, we compared the Essouk beads to those from Gao (11 samples, CISSÉ *et al.* 2013: 27–29), Kissi (48 samples, ROBERTSHAW *et al.* 2009 and LANKTON & GRATUZE unpublished) and Igbo-Ukwu (45 samples, all v-Na-Ca, LANKTON & GRATUZE unpublished). The strongest trend of the results of these comparisons is that beads from each site are much more similar to each other than they are to beads from the other sites. There is some overlap, particularly for the high-MgO, high-Cr_2O_3 Essouk beads with some of the Kissi beads, but, so far, no definite patterns of association between sites that would provide strong confirmation for the direct exchange links going south from Essouk reported in the Arabic historical records. We will continue to pursue this study, and hope to report more positive results.

Perhaps the most striking result from the glass bead chemical analyses is the much greater compositional variety compared to that of the vessels. While this may be the result of wider source areas, it may also speak to the different technological processes in bead and vessel workshops. Blown glass vessels were produced in large numbers using repetitive *châines operatoires* that required glass with tightly constrained physical properties. Much of the raw glass probably came from relatively few primary glass workshops, and the glass may not have been mixed more than necessary in order to maintain the desired optical properties of transparency and light coloration. Bead workshops operated on very different principles. The imported or locally produced raw glass was almost invariably mixed with colorants, opacifiers and recycled cullet, sometimes in small batches depending on the workshop organisation, resulting in much greater compositional variety. In addition, the technological requirements for glass to be drawn into tubes were more forgiving, and even stiff glasses with very high lime or alumina, unsuitable for blowing, could be made into beads.

To summarise the results of the compositional studies, we would say that all of the beads are consistent with an outside origin, with no evidence to support local production of the beads or of the raw glass. The Essouk glass beads were most likely not from the Levant or east of the Euphrates, with Fustat or some other Egyptian or North African source being more likely. Some of the later beads are a bit closer to beads from al-Basra, although the association is not strong. Al-Basra, where almost half of the beads analysed had a lead-silica composition, appears again as a possible source for the three lead-silica beads found at Essouk, although at least one similar bead has been found at Fustat. As mentioned above, two of the late period beads were made in India, and one most likely produced in south-eastern Nigeria. It is not difficult to imagine how a Nigerian bead may have come to Essouk, but for the Indian beads, there are no obvious links, and this will be a topic for future research.

In parallel to the compositional studies, we undertook technical analysis on a number of the glass beads hypothesised as potentially produced using the powder glass technique, commonly known in historic period West Africa; a technique involving melting crushed glass in a ceramic mould to produce beads (FRANCIS 1993). The majority of beads placed in this potential category were blue beads which commonly exhibited heavy weathering, also discussed above (Fig. 14.2e–h & 14.4). It was hypothesised that the cracking of the beads might relate to weaknesses in the structure of the glass caused by an incomplete fusion of glass fragments in a powder glass bead making process. A number of samples were mounted in resin blocks and polished for inspection using light microscopy and SEM (Fig. 14.5). This analysis showed that these beads were produced by the drawing technique, since the flow marks in the glass crossed over cracks within the bead; therefore indicating these were not products of powder glass bead making. No evidence was found in any of the samples to testify to the presence of a powder glass bead industry.

Stone Beads

Five complete stone beads and one stone-bead fragment were found during the excavations (see Fig. 14.6 & Fig. 14.7). These artefacts are as follows:

Ek-A Horizon 9
Ek-A 86. Agate (cornelian) bead fragment (Figs. 14.6a, 14.7d); biconical; red/orange; semi-transparent Length/Width/Thickness = n.a, 0.9cm, 0.8cm; perforation = 1.5mm (made from two sides, near-straight).

Ek-A Horizon 13
Ek-A Wall 3. Whole sandstone bead (Fig. 14.7g); disc; cream; L/W = 0.5cm, 1.7cm; perf. = 0.6mm

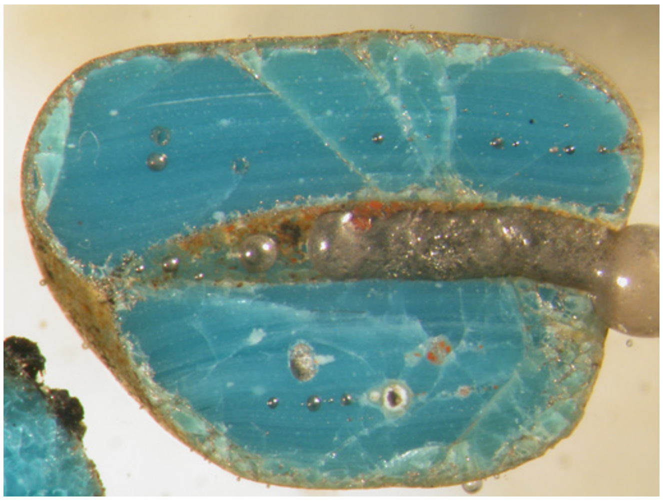

FIGURE 14.5
Corroded blue glass bead, sectioned and embedded in resin block, illustrating the production of this bead type using the drawing technique (distinctive 'flow' lines indicative of drawn beads can be observed, crossing over fractures which are caused by corrosion).

Ek-B Horizon 1
Ek-B 11. Whole bead, possibly jasper or bauxite (Figs. 14.6d, 14.7h); barrel; red-brown; L/W = 0.5cm, 0.8cm; perf. = one side 2.5mm, other side 1.5mm (straight).

Ek-B Horizon 2
Ek-B 10. Stone bead; relatively fine-grained stone with minimal sand or quartz grains; reddish/cream; L/W = 0.3cm, 0.4cm; perf. = 1.0mm.

Ek-C Horizon 2
Ek-C 6. Whole agate (cornelian) bead (Fig. 14.6b, 14.7e); irregular, near-rectangular form (possible re-working of an earlier form); red/orange; semi-transparent; L/W/T = 1.1cm, 0.7cm, 0.5cm; perf. = 1.5mm (made from both sides, not straight).

Ek-C 6. Whole agate bead (Fig. 14.6c, 14.7f); long-barrel; white/colourless; colourless part semi-transparent; L/W = 0.9cm, 0.6cm; perf. = 2mm (straight).

Other Beads

Six other beads were recorded, all produced from various forms of marine fossil or shell.
Ek-A Horizon 10
Ek-A 77. Shell bead (Fig. 14.6g); near-square; white; L/W/T = 0.3cm, 0.3cm, 0.1cm; perf. =1.5mm. [*not* ostrich eggshell, J. Sidell]

Ek-A Horizon 11
Ek-A 64. Shell bead [identified by S O'Connor] (Fig. 14.6e, 14.7c); irregular ellipsoid; white; L/W/T = 2cm, 0.9cm, 0.8cm; perf. = 1.5mm; heavily leached.

Ek-A Horizon 13
Ek-A Wall 3. Shell bead [identified by S O'Connor] (Fig. 14.6f, 14.7b); disc (section of a shell/fossil shell); white; L/W/T = 1cm, 1cm, 0.3cm; perf. = 1.5mm.

Ek-C Horizon 2
Ek-C 9. Shell bead [identified by S O'Connor] (Fig. 14.6h, 14.7a); surface features banded striations of the original fossil/shell surface; ellipsoid; white; L/W = 0.9cm, 0.6cm; perf. = 1.5mm.

Ek-C Horizon 3
Ek-C 2 – Coral [identified by S O'Connor]; (Fig. 14.8) half of ring (broken); cream; L/W = 0.6cm, 1.6cm; perf. = 7mm.

Survey Zone 5
Ek-S 126 – Coral [identified by S O'Connor] (Fig. 14.8); slightly irregular ring; light brown; L/W = 1cm, 2.2cm; perf. = 11mm.

Discussion

In AD 1154 Al Idrisi refers to "strings of glass [beads]" as a key commodity being shipped across the Sahara (Levtzion & Hopkins 2000: 108). There is also a range of other Arabic references testifying to the importance of glass beads as a trade commodity (*e.g.* Levtzion &

Hopkins 2000: 107, 128, 169, 177, 179, 287). Arabic references to the trade in semi-precious stones and agate (see above and Chapter 18) would also appear to be referring to the importation of beads of other materials into West Africa. No Arabic descriptions are however provided of any local bead making industries. Beads are a common occurrence at West African sites of the medieval era (see *e.g.* Shaw 1970; Vanacker 1984; Berthier 1997; Roy 2000; Magnavita 2003; Cissé *et al.* 2013), but it is important to also point out that glass beads and agate beads predating the Islamic era have been discovered, both at Kissi (Magnavita 2003) and Tombouze (Park 2010: 1081). The 100,000 plus glass beads found in *ca.* 9th–10th century burials at Igbo-Ukwu in southern Nigeria though provide the most spectacular testament to the scale and importance of the medieval trans-Saharan glass bead trade (Shaw 1970: 225–239).

The recovery at Essouk of a relatively large quantity of glass beads together with a sub-set of other beads is an expected pattern for such a town situated on the medieval trans-Saharan routes. In addition to the formal description of these beads, the extensive chemical analysis program conducted provides an important data set to further refine our understanding of the nature of the glass bead types arriving in West Africa through comparison with other sites for which chemical data exists, such as Gao and Kissi (see Lankton *et al.* in prep.). Together the formal description and chemical results provide important data for reconstructing the nature of the early glass bead shipments across the Sahara, as well as for understanding the other types of imported and locally produced beads occurring within medieval West Africa.

The first thing to tackle in relation to the glass beads is the discussion of local production, particularly for the most common type found at the site, fragmentary and corroded blue beads. Local production of primary glass is now demonstrated for medieval era contexts in West Africa, in southern Nigeria (Lankton *et al.* 2006; Babalola *et al.* 2017), and certain distinctive bead types have also been identified as produced in medieval West Africa, including dichroic beads made from hlha glass, one of which was found at Essouk (Fig. 14.3). In addition to this primary production of glass beads there is also documentation of secondary processing of glass in West Africa, crushing old glass artefacts to make 'powdered' glass beads (Francis 1993), although clear documentation of this industry is known only from early modern contexts. Investigations have been made of possible secondary glass processing at West African trans-Saharan trading centres, but so far definitive evidence has not been recovered (*e.g.* Vanacker 1984; Cissé *et al.* 2013). Specifically, hypotheses have been made for a medieval powder glass bead industry at the site of Tegdaoust, based upon the presence of ceramic moulds with certain formal similarities to historic era powder glass bead moulds (Vanacker 1984). However, given that very similar moulds from our own excavations at Essouk are demonstrated to be gold-coin moulds (Chapter 15), without conclusive technical analysis this evidence should be approached very cautiously. Evidence also from Tegdaoust for significant quantities of segmented beads – proposed as associated with secondary production – should however be kept in mind (Vanacker 1984). More recently a range of fused and 'wasted' beads from the site of Gao have also been used to argue for some form of local production industry (Cissé *et al.* 2013). Fused and wasted beads were also recovered from Essouk but these are not uncommonly found in bulk shipments, and we do not take this by itself to indicate a local industry. While

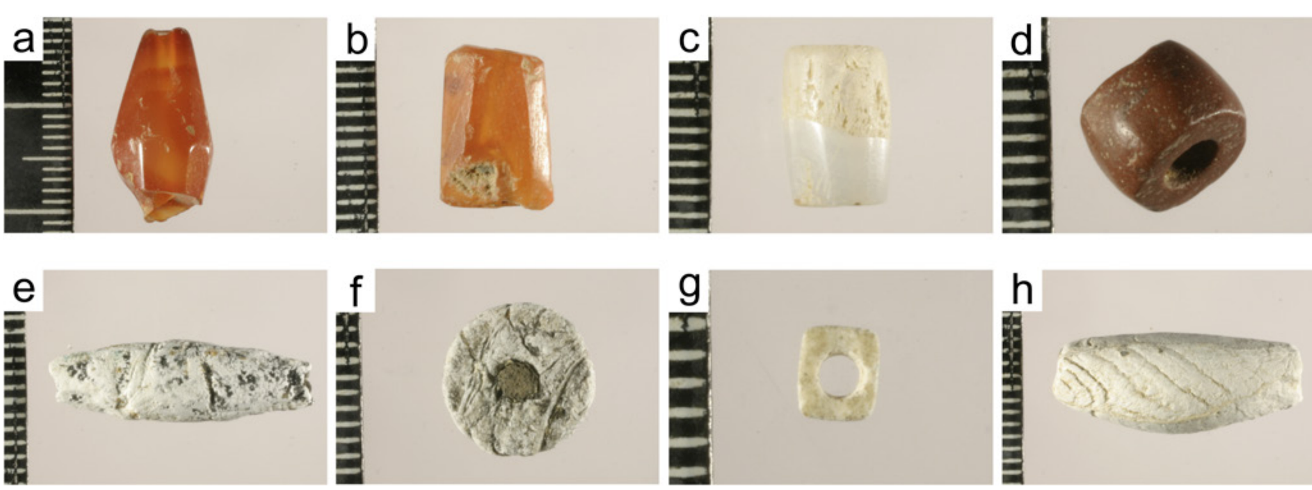

FIGURE 14.6 *Photographs of agate, jasper/bauxite and shell beads excavated at Essouk:.* a–c, *agate* (*Ek-A 86, Ekc-6, Ek-C 6*)*;* d, *jasper/bauxite* (*Ek-B 11*)*;* e-h, *shell* (*Ek-A 64, Ek-A Wall 3, Ek-A 77, Ek-C 9*).

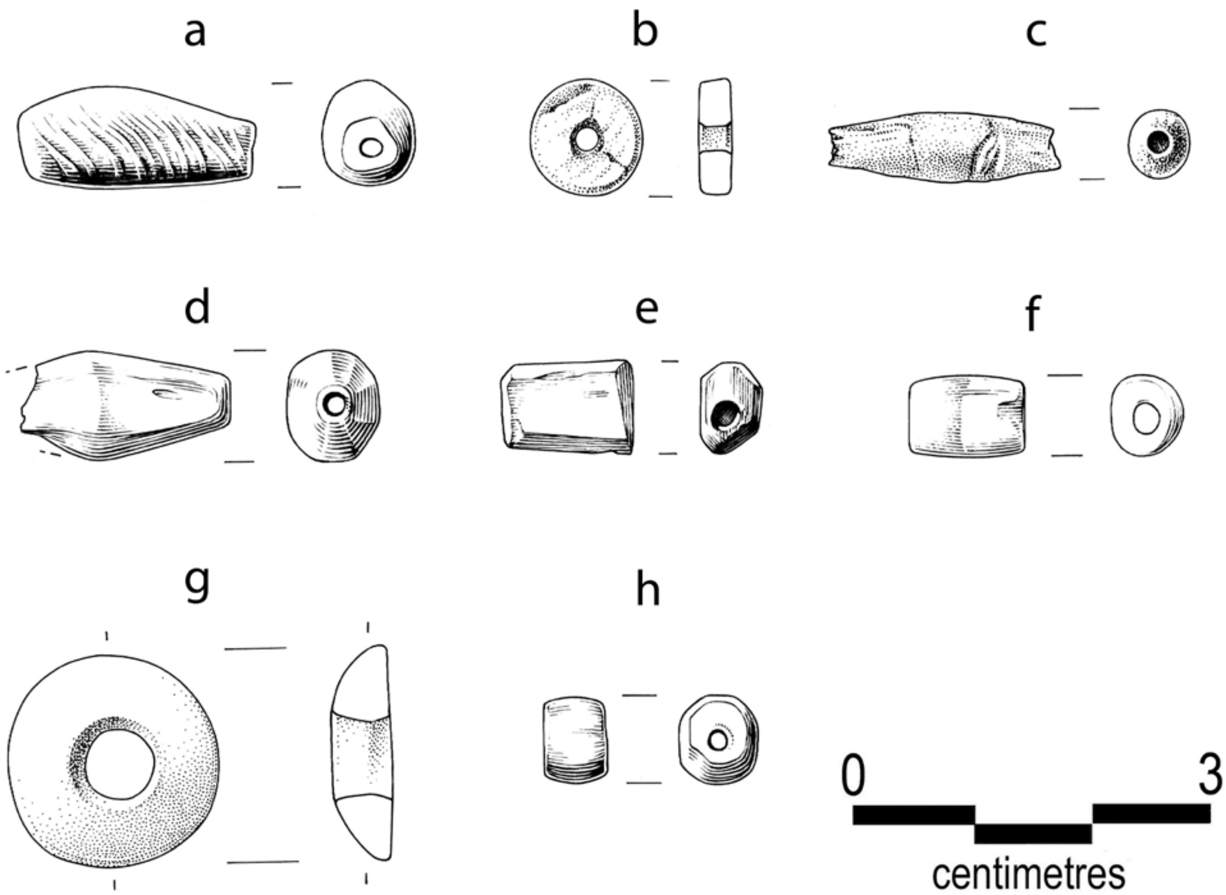

FIGURE 14.7 *Drawings of various beads excavated at Essouk made from materials other than glass:* a–c, *shell* (*a.Ek-C 9, b.Ek-A Wall 3, c.Ek-A 64*)*;* d–f, *agate* (*Ek-A 86, Ek-C 6, Ek-C 6*)*;* g, *sandstone* (*Ek-A Wall 3*)*;* h, *jasper/bauxite* (*Ek-B 11*)*;* i, *stone* (*Ek-B 10*).

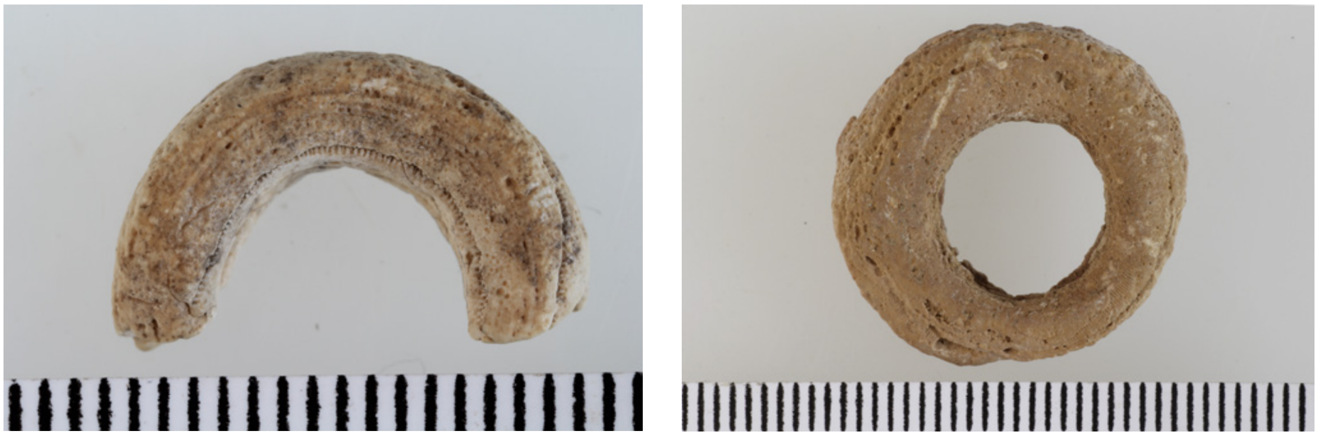

FIGURE 14.8 *Artefacts identified as made of coral, likely functioning as beads* (*left, Ek-C 2; right, Ek-S 126*).

not discounting the Tegdaoust and Gao evidence entirely, more concrete proof is needed to demonstrate the existence of glass bead production in the towns at the southern Sahara fringes.

The evidence from Essouk which initially seemed to suggest a possible local production of beads was the abundant blue beads found, many of which were fragmentary and corroded. Our investigation of these however clearly showed that these were drawn beads of common Islamic glass recipes and there is no reason to think they were locally produced. Indeed, when we look at the Arabic records it is interesting to note the specific reference of the geographer Yaqut to "blue beads" as one of the commodities traded to the Sudan (Levtzion & Hopkins 2000: 169). While Yaqut wrote in *ca* 1229 he was thought to have been quoting the work of the earlier geographer Al-Muhallabi writing *ca* 990. It seems that the craftworkers producing these blue beads were either not aware of or did not care about standard procedures for annealing the beads to prevent flaws in the glass that would lead to later cracking and accelerated weathering. It is hypothesised that such a situation would be more likely away from the traditional glassworking centres like Fustat and the Levantine coast, where production methods had been perfected over the centuries. Hence a Maghrebian origin for these blue beads is possible, and indeed Yaqut's quotation is made in the context of descriptions of merchants from Morocco suggesting this as a hypothetical origin point for these beads.

The Essouk glass beads are then almost entirely trans-Saharan shipments, with the majority likely produced in North Africa or the Middle East. We have also shown however that there are certain beads which have most likely come from as far away as India, and the interesting find of a dichroic bead shows that glass beads produced in Nigeria also made their way up to the southern Sahara.

While there is no evidence for local production of glass beads at Essouk, there is evidence for the working of glass. Crucibles found at the site used for the processing of gold show that crushed bead glass was used within this industry (Chapter 15). Both blue and green glass is evidenced within the two crucibles found, clearly identified as standard Islamic glass. What is also important to note is that these crucibles, one from Context 87 and one immediately above in Context 86, were in very strong association with the Ek-A contexts richest in glass beads (and vessels) (see also Chapter 15 for further discussion). Given this evidence it can clearly be seen that we need to start thinking about the beads recovered at Essouk not solely as evidence of waylaid trade goods lost in transit or lost or discarded jewellery. In particular, if we interpret the crucible finds as evidence for a workshop this would help explain the presence of the very fragmentary and weathered glass beads and fragments, as well as fused and malformed beads – it is possible that fused and malformed beads would be selected for crushing and use in industrial processes rather than well-formed beads.

Comparing the Essouk glass beads with those from other sites in West Africa, we firstly see that the most common form category, seemingly resulting from cutting a tube of glass into various lengths, is also the most common type encountered at the other key entrepôt sites excavated, Tegdaoust, Koumbi-Saleh, and Gao (Vanacker 1984; Berthier 1997: 91–94; Roy 2000: 102; Cissé *et al.* 2013). While no detailed study of manufacturing techniques was made at these sites it is most likely that, as at Essouk, this broad form type relates to a drawn glass industry, the mass-production bead making process. Likewise, the dominance at Essouk of the size categories of small and medium beads shows great similarity with these other entrepôt assemblages. Other similarities that can be seen with the assemblages from Tegdaoust, Koumbi-Saleh, and Gao are the strong presence of the colours blue, green and yellow (see above references). It is useful to note in particular that the most common bead colour at Essouk, blue, is also a strong presence at Gao, something which makes sense given that Essouk had close trade connections with Gao (Cisse *et al.* 2011, 2013). Blue beads are also common amongst the vast quantities of beads from Igbo-Ukwu, hypothesised to be connected to the same trade route as Essouk and Gao (Shaw 1970: Plates VII & VIII; Insoll & Shaw 1997; though note the comments made above regarding correspondences of glass chemistry results between these three sites). Looking further afield, it is instructive to point out that blue beads are not however common at Tegdaoust (Vanacker 1984), an intriguing difference given that this site is seen as the most directly comparable type of site to Essouk on the far western trans-Saharan route. Another significant pattern to observe when comparing the Essouk and Tegdaoust assemblages is that while at Essouk we found only one segmented bead (Fig. 14.2t), at Tegdaoust 23% of the glass beads were segmented (Vanacker 1984: 34–35). While then we see that the beads from the West African entrepôt sites share broad commonalities we see interesting detailed patterns of commonality and difference that can form the foundation for more nuanced understanding of the glass exchange networks of medieval West Africa.

The quantity of stone beads found at Essouk is miniscule compared with the quantity of beads made of glass.

This is entirely consistent with the pattern seen at the other major Early Islamic Trans-Saharan trading sites in West Africa (Berthier 1997: 90; Vanacker 1984; Roy 2000: 98–126; Cissé *et al.* 2013). As with the small stone-bead assemblages evidenced at these other major Early Islamic sites – and indeed at a range of other sites, including pre-Islamic contexts (see *e.g.* Magnavita 2003; Park 2010) – agate beads are evidenced at Essouk. The importance of the presence at Essouk of small quantities of beads made from agate – and in particular the red/orange agate, cornelian – is that it lends further material to the debate over whether or not agate artefacts found in West Africa have a local or an exotic (Egyptian or Indian) source (Insoll *et al.* 2004). Importantly, the source for a hypothesised 'local agate industry' is the Adrar des Iforas, where Essouk is located (Gaussen & Gaussen 1988: 247). The documentary historical evidence for Early Islamic agate mining in the Saharan regions between Essouk and Tunisia does indeed seem convincing (Levtzion and Hopkins 2000: 86, 151). The relatively limited recovery of agate beads from Essouk is however not compelling evidence for such an industry at the site; though certainly this does not preclude Essouk being involved in an agate trade with production taking place closer to the source. One should also note the presence of two unworked agate stones at Essouk and the Arabic historical records of agate and semi-precious stone shipment to West Africa (see Chapter 18). The jasper or bauxite bead recorded in the assemblage should be viewed within the context of the presence of stone debitage at Essouk (see below), suggesting that the bead might be a local product. Amongst the other artefacts which likely functioned as beads are those made of coral. Coral does feature in the Arabic sources on trans-Saharan trade (Levtzion & Hopkins 2000: 130) and is occasionally referred to as an important trans-Saharan trade commodity (Insoll 1996: 62–63; Mitchell 2005: 154). We found no other concrete identifications of coral from West African sites, though a near-identical artefact to the Essouk coral artefacts was found at Tegdaoust (Vanacker 1979: 154). The small quantities of these other beads recovered mean that little in the way of significant comment can be made on their distribution within the site sequence.

CHAPTER 15

Gold Processing Remains

Sam Nixon and Thilo Rehren

"The inhabitants of Tadmakka are Muslim Berbers who veil themselves as the Berbers of the desert do.... Their dinars are called 'bald' because they are of pure gold without any stamp".

WRITTEN *CA* AD 1068, IN CORDOBA (SPAIN) BY ABU UBAYD BIN ABD AL-AZIZ AL-BAKRI (LEVTZION & HOPKINS 2000: 85) *The Book of Highways and of Kingdoms* (*Kitab al-masalik wa-'l-mamalik*)

Introduction

References to gold trade at Tadmekka are found within the early Arabic historical sources relating to the 10th and 11th centuries. Most famously in the 11th century Al-Bakri describes Tadmekka's 'bald' dinars of pure gold (see above and App. A). Oral historical sources of the Ibadi relating to the 10th and 11th centuries also describe treasure houses at Tadmekka and clearly describe significant gold export across the Sahara (see below and 'Ibadi extracts' in App. A). While without concrete evidence these descriptions could be presented simply as reportage of exoticising folk tales of a gold trading town across the Sahara, the excavations now provide concrete evidence to place alongside these histories.

During the excavations at Essouk-Tadmekka evidence of gold-coin moulds and crucible fragments used for processing gold were recovered in Period 2 and Period 3 contexts, dated to *ca* 10–12th centuries AD. The recovery of this evidence and its technical and chemical study enables us to improve understanding of the town's gold working technology and trade, including most crucially providing concrete evidence supporting Al-Bakri's description of gold coinage at Tadmekka in the 11th century. Beyond Essouk-Tadmekka, this evidence is a crucial addition to the very limited data set for medieval West African gold trade, providing insights into the sources of gold, its processing, and its exchange. Indeed, given the very limited dataset for the archaeometallurgy of gold globally, this evidence has potential utility beyond research of West Africa and the trans-Saharan trade. Focused publications have already been produced on this evidence, considering both its significance for understanding the development of money in West Africa (NIXON *et al.* 2011b), as well as its significance for understanding early processing of panned gold (REHREN & NIXON 2014). A publication including this evidence within a wider summary of the trans-Saharan gold trade has also been prepared (NIXON in press). Here we provide a summary account of the evidence and a discussion of what it tells us about gold working at Essouk-Tadmekka, and the broader processes of trans-Saharan gold trade.

The Excavated Material

Three fragmentary ceramic objects identified as coin moulds (Figs. 15.1, 15.2, 15.3, 15.4) were excavated within the room space of unit Ek-A Horizon 6. The moulds were found at different levels of the *ca* 700mm of coarse sand excavated in this room [Contexts 96, 95, and 93], seemingly representing multiple floors. Amongst the other remains found in the room, we note the present of other metalworking remains (Chapter 16), and glass beads (Chapter 14).

The artefacts feature cup-shaped depressions whose form suggests they were moulds. The cups are roughly circular, with curved interiors, *ca* 20mm rim diameters, and c. 10mm deep. They were formed as impressions in the clay. All fragments feature surface vitrification. They are fairly porous and low fired, with chaff and sand temper, matching Tadmekka's domestic pottery. Two fragments clearly originally formed parts of plate-like objects, one roughly circular, one rectilinear. The circular mould was likely *ca* 180mm in diameter, featuring about 30 cups.

Similar artefacts to the Essouk-Tadmekka coin moulds have previously been found in West Africa, during excavations 40 years ago at Tegdaoust (VANACKER 1979: 1984). These were though identified as moulds for glass beads on the basis of twentieth century ethnographic examples. There was though no proper technical justification for this conclusion, and no associated glass waste or clearly identified locally made glass beads were recovered. It was indeed admitted by the excavators that there are certain formal differences between these artefacts and the ethnographically documented bead moulds (FRANCIS 1993; Chapter 14). These moulds are unfortunately not available for us to reassess, but this interpretation is certainly not appropriate for the Essouk-Tadmekka moulds.

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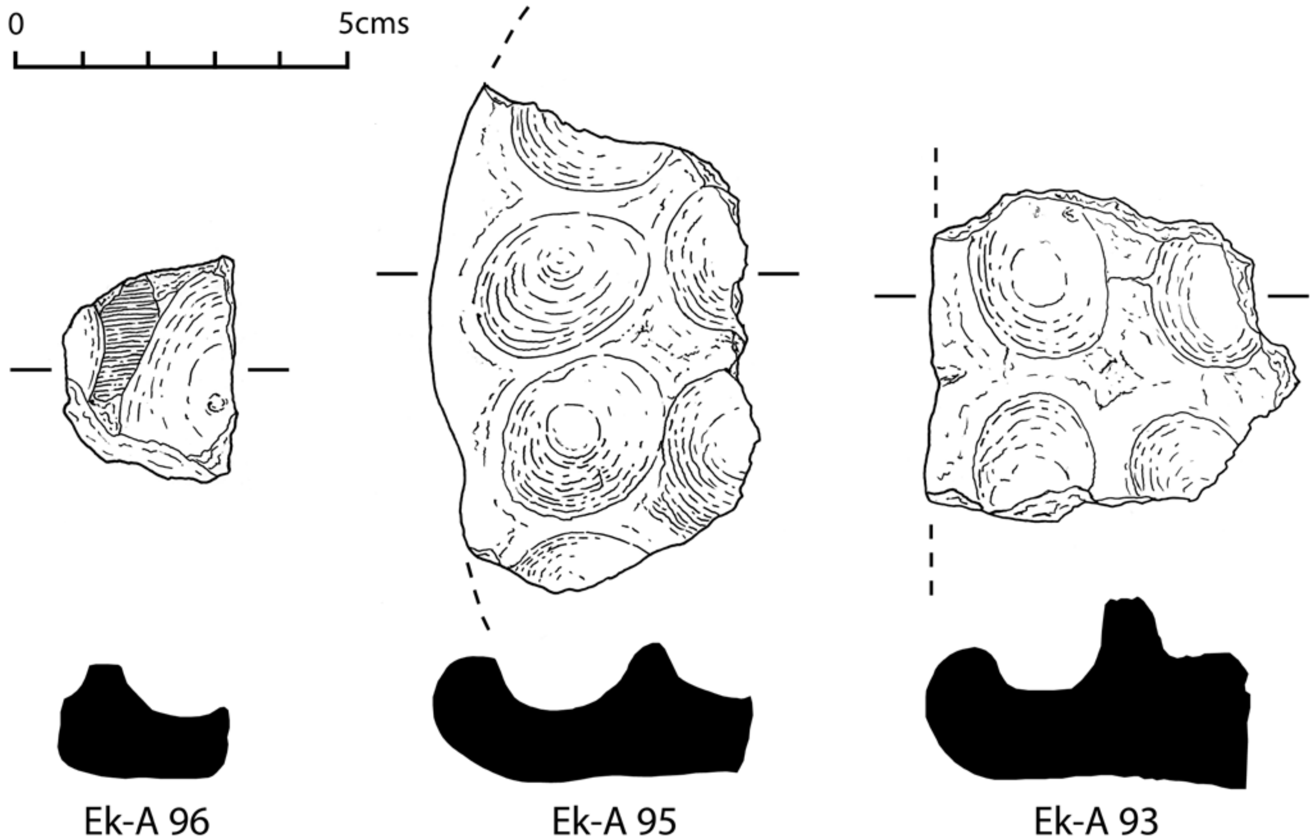

FIGURE 15.1 *The Tadmekka coin mould fragments seen in plan (upper) and section (lower) – stratigraphically earliest from left (illustration: Fiona Griffin). Original edges are seen on the left side of Ek-A 95 and 93.*

Particularly, the mould cups are far too large to correspond with the well-documented small size of medieval West African glass beads, and glass-working leaves much more heavily vitrified residues. Having carefully analysed the Essouk-Tadmekka glass beads, including detailed technical study (see Chapter 14), we found that none of these showed signs of being powder glass beads, nor were any beads identified which could have been produced in moulds such as these.

When considering the Essouk-Tadmekka evidence, the striking similarity was noted with coin mould traditions best known from European Iron Age contexts (Tournaire *et al.* 1982; Gebhard *et al.* 1995; Heinrichs & Rehren 1996; Robbins & Bayley 1997); particularly in view of the historical references to a coinage at the site. In such coin moulds, metal dust and nuggets were heated in the mould cups, forming irregular discs that were then struck to produce coins (see below for further discussion). Similar coin moulds are documented from Hellenistic Cyprus (Nicolaou 1990), Aksumite Ethiopia (Wilding 1989), and early Islamic Pakistan (Khan 1990). Examination of the Essouk-Tadmekka moulds' surfaces and firing characteristics showed very strong resemblances to known coin moulds. Crucially, through chemical analysis we identified three prills of gold within the cups of a mould (Fig. 15.3). The in-depth technical analysis subsequently conducted (see below) served to demonstrate further similarity with known coin moulds. The formal, technical and chemical evidence are sufficient to identify these artefacts as gold-coin moulds, corresponding therefore with Al-Bakri's contemporary description of Tadmekka's gold coinage.

From the same contexts as the coin moulds were two crucibles which possibly relate to gold metallurgy but show no base or noble metal inclusions; these are not treated further here (see Chapter 16). Two fragments of gold-working crucibles were, however, found in slightly younger deposits within the same unit, in Ek-A Contexts 87 and 86 (Figs. 15.5, 15.6). These deposits are two building horizons above that containing the coin moulds. Again this is a room of indefinite function, but contains further evidence of metal working (copper, iron working, and crucible steel – see Chapter 16), and large quantities of glass and glass beads.

The crucible fragments are both very small (*ca* 2 cm^3) and accordingly only vaguely identifiable as crucibles by their shape. The two crucible fragments were very

FIGURE 15.2 *Upper surface and profile view of coin mould Ek-A 95.*

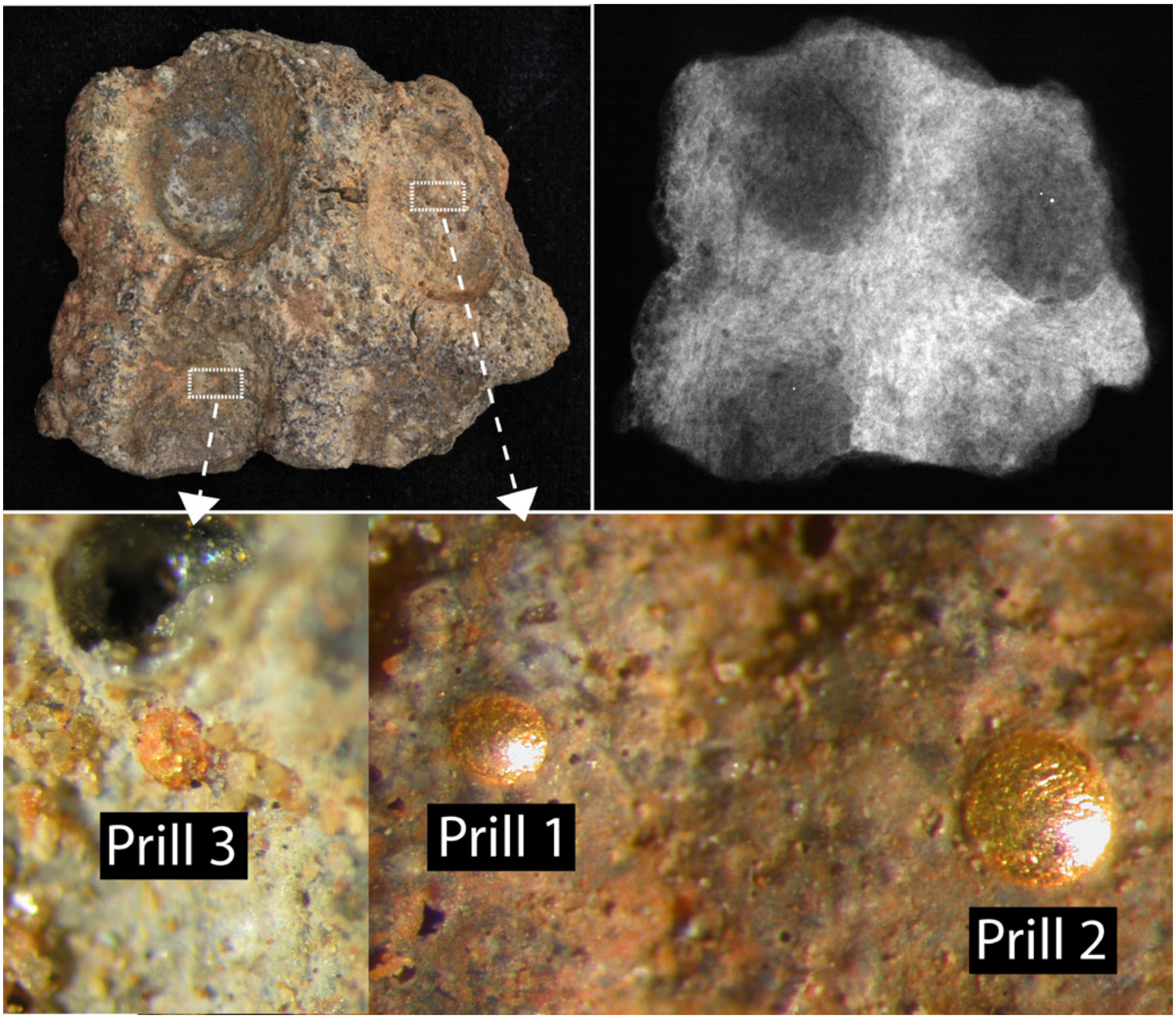

FIGURE 15.3 *Optical and X-ray views of coin mould Ek-A 93 showing affixed/embedded gold prills.*
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inconspicuous, and only identified following very close inspection of all potential metallurgical debris, and following identification of the coin moulds. The fabric differs from the moulds in that it is very light-coloured, sandy and dominated by badly-sorted quartz grains (Fig. 15.6), probably added as temper. Attached to the concave surfaces of the samples are relatively large agglomerates of glassy transparent slag, one appearing light blue (86A) and the other pale green (87E). Preliminary microscopic inspection of sections of the samples showed that embedded in the glassy slag are microscopic gold prills, as well as numerous grains of minerals such as quartz, but also magnetite, xenotime and other heavy minerals. On the basis of the nature of the slag, its inclusions and the gold prills, these samples were tentatively identified as crucible fragments for processing raw gold. No such types of crucibles for gold processing are known archaeologically, providing further incentive for in-depth technical and chemical analysis.

Gold-coin Mould Analysis

Polished sections were prepared from the moulds for optical microscopy and SEM-EDS analyses, following standard procedures established at the UCL Institute of Archaeology. Macroscopic inspection had identified three gold prills trapped in the surface of one of the mould fragments (Fig. 15.3). Based on this, we aimed to locate further metal inclusions, and to better understand the technical ceramic; however, no further gold prills were identified

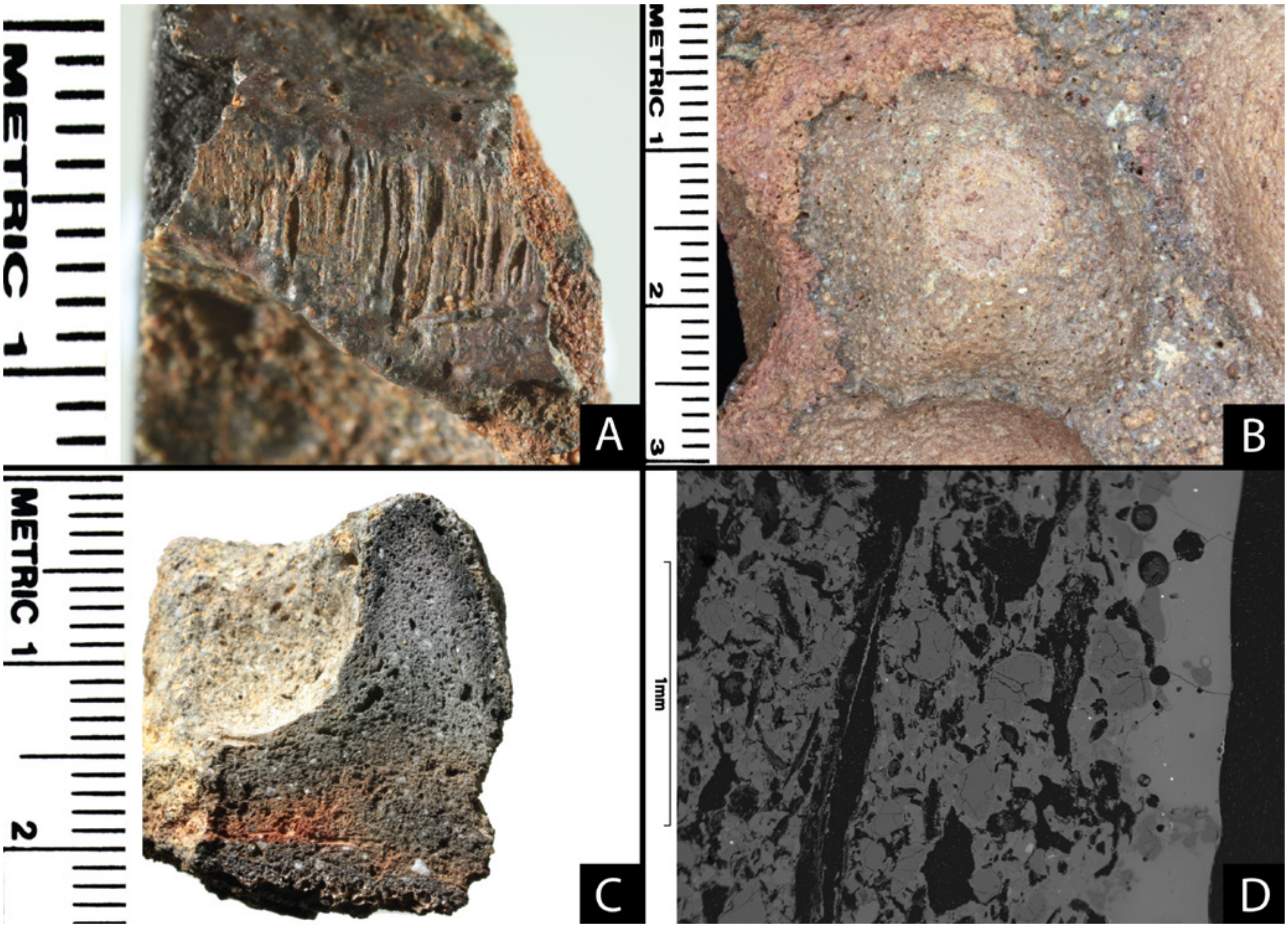

FIGURE 15.4 *Technical analysis of moulds:* a) *charcoal impression on mould ridge (Ek-A 96);* b) *circular vitrification patterning in cup base (Ek-A 95);* c) *sectioned fragment (Ek-A 93);* d) *SEM image of vitrified surface (right side) and underlying ceramic (Ek-A 96).*

in the sections. The gold prills identified on the surface of coin mould Ek-A 93 were analysed using Proton-Induced X-ray Emission (PIXE), at the AGLAE accelerator of the Centre for Research and Restoration of the Museums of France (C2RMF) in Paris (by Maria Filomena Guerra), to gain a more detailed chemical signature than could be obtained through SEM. While LA-ICP-MS analysis would have generated a still more detailed chemistry, this is a destructive process and it was felt that given the rarity of these specimens any destructive analysis should await specific chemical research questions not able to be answered by the available PIXE analysis; and indeed also await improvement of trace element analysis of gold.

Coin Mould Ek-A 96

The intact surface (upper) features vitrification, about 50–100μm thick and incorporating quartz grains from the ceramic. Extensive shattered quartz within the ceramic (Fig. 15.4D) suggests high, relatively even, firing temperature. The vitrified layer is chemically similar to the ceramic, except for increased lime and potash. No lead, copper or other base or noble metal was found (detection limit *ca* 0.2 wt%). Vitrification formed through fuel ash, rich in lime and potash, fluxing the ceramic, rather than through reaction with metal oxides as crucible slag. Minute iron phosphide prills observed within the vitrified layer likely formed from reaction between fuel-ash phosphate and iron oxide in the ceramic. The fragment features an impression of charcoal used during firing (Fig. 15.4A).

Coin Mould Ek-A 95

This sample appears less highly fired than sample Ek-A 96, and few shattered quartz grains were seen. Vitrification is seen on all surfaces but is patchy due to erosion. No vitrification was seen in section. The base of one cup however features a circular patterning in the vitrification (Figs. 15.2, 15.4B), almost certainly the 'ghost' of a molten coin disc. No metal inclusions were identified optically.

TABLE 15.1 *PIXE analysis of EKA-93 gold prills*

	Au%	Ag%	Cu%	Zn ppm	Pb ppm	Pd ppm	Sn ppm	Sb ppm
Inclusion 1	98.8	0.9	0.2	667	72	23	162	26
	98.7	0.8	0.3	1323	238	15	254	25
Inclusion 2	98.1	1.8	0.1	212	171	–	63	16
	98.3	1.4	0.1	484	229	21	490	19

Coin Mould Ek-A 93

All surfaces are vitrified but the cross section shows vitrification is very thin. Clear evidence of localised 'bloating' (Fig. 15.3) suggests the mould was exposed to significant heat, above the ceramic's thermal stability threshold. Shattered quartz is restricted to immediately underneath the bloated ceramic, pointing to somewhat uneven heating. We again see a circular vitrification pattern in one of the cups. No metal inclusions were identified in section. The two larger gold prills identified on the sample's surface were analysed using a 3 MeV proton beam of 30μm diameter, using the PIXE setup explained elsewhere (GUERRA & CALLIGARO 2004; GUERRA 2004). Both prills analysed were found to be very high-purity gold (98 wt%: Tab. 15.1), silver being the main impurity at around 1 to 2 wt%, and copper found at about one tenth of that quantity. The small size of the prills permitted only two discrete spots to be placed on each of the two larger prills. Due to the small size of the prills, trace element readings may have been influenced by the surrounding ceramic, and are therefore to be treated with caution. This said, it is interesting to note relatively high contents of zinc, lead and tin, well above usual background levels in ceramic materials, and therefore reliably attributable to the analysed metal.

Gold Crucible Analysis

The analysis of the crucible fragments followed the same protocol as adopted for the coin moulds, combining optical microscopy of polished sections with SEM imaging and EDS analysis of selected phases. This was carried out at the Archaeological Material Science Laboratories at UCL Qatar.

The fabric of both crucible fragments is very rich in mineral inclusions, mostly angular to well-rounded but badly-sorted quartz, with comparatively little matrix material. The transition from this fabric to the glassy slag is relatively sharp, but there is enough penetration of glass into the fabric to indicate that the process was not very quick. The glass near the interface between the crucible fabric and the slag contains numerous minute gold particles, often intimately intergrown with other heavy mineral inclusions (Fig. 15.7). Further away from the ceramic the glassy slag contains still numerous grains of minerals such as quartz, magnetite, zircon and several other heavy minerals (Fig. 15.8), but far less gold. Notably, the range of minerals in the glassy slag is very different from the minerals seen as inclusions in the crucible fabric; it is therefore highly unlikely that the minerals in the slag originate from the crucible fabric. Instead, it is assumed that they were part of the charge of the crucible, together with the gold-bearing grains near the bottom of the crucibles.

The prills have from 93 to 98 wt% gold, the balance being mostly silver and between one quarter and one half of one percent of copper, and occasionally iron (Tab. 15.2). The difference in composition between different particles within the same sample is striking. It indicates that these are indeed residual individual gold particles, and not prills separated from a single larger pool of liquid gold, as the latter would be far more homogenous.

The glass of the slag contains a large number of minerals, mostly quartz and feldspar, but also heavier minerals such as ilmenite, magnetite, zircon and others. Most of these are clearly residual mineral grains in various stages of reaction with the surrounding glass; the magnetite in particular appears to have interacted quite strongly with the surrounding glass. In addition, there are also numerous areas rich in newly-formed crystals, predominantly calcium-rich silicates related to the pyroxene family. It is difficult to say whether these are completely re-crystallised original diopside grains, or whether they crystallised from the glass due to local chemical heterogeneities. Despite the numerous inclusions, the glassy slag itself is clear and shows the same light-blue to pale-green colours already seen in the un-mounted specimens. Its composition is unlike any slag or vitrified ceramic seen in other metallurgical crucibles (REHREN 2003). Its most prominent feature is the high soda content, of around 13 wt%. This, and the rather low concentration of iron oxide (2 to 3 wt%) sets it apart from any typical metallurgical slag, or vitrified crucible ceramic. Instead, the

FIGURE 15.5 *Upper surface and profile of crucible fragment Ek-A 87E, prior to sectioning for analysis.*

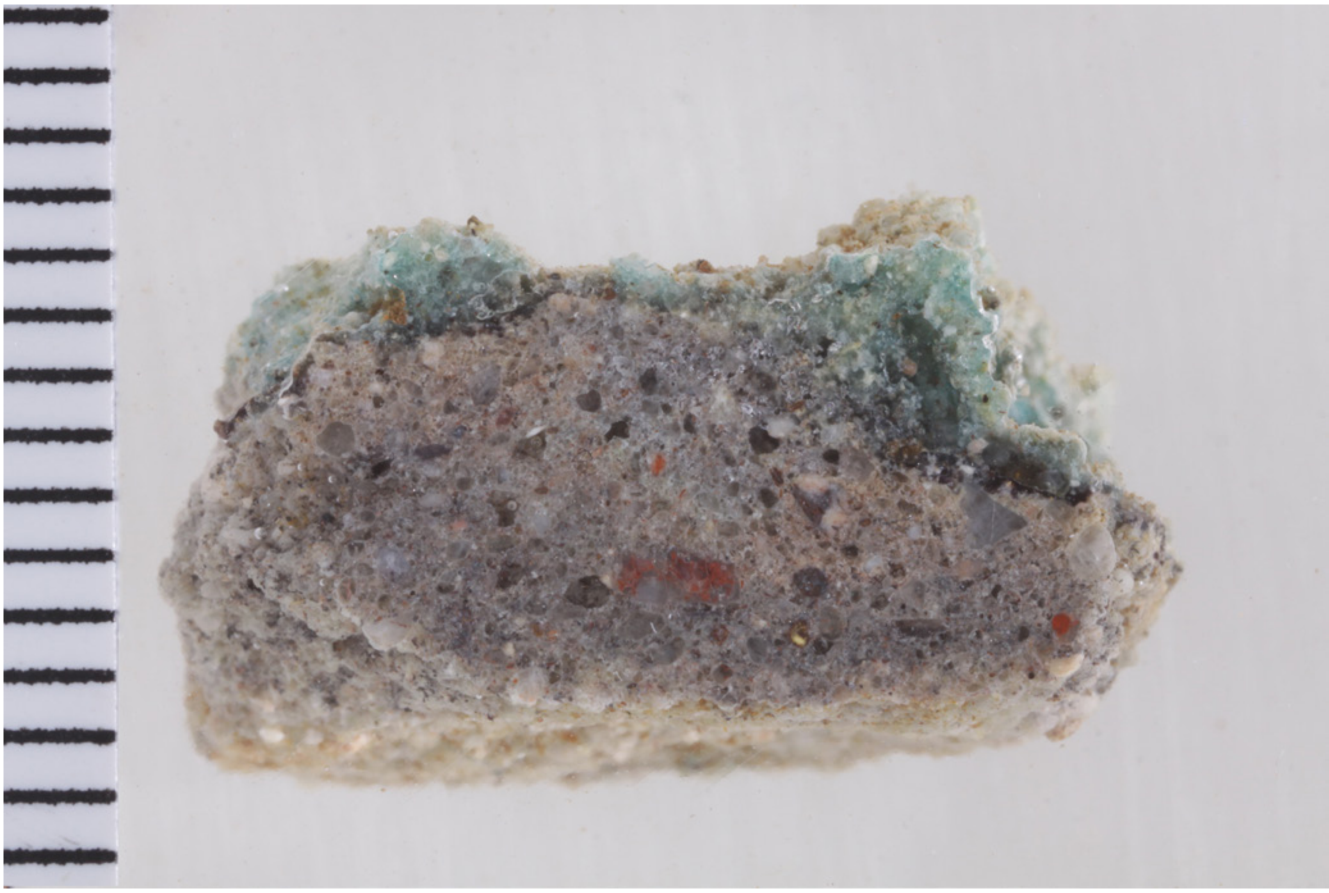

FIGURE 15.6 *Mounted and polished crucible fragment Ek-A 86A. Note the pale sandy fabric and the light blue colour of the glass-based crucible slag. Scale in mm.*

TABLE 15.2 *SEM-EDS analyses of individual gold particles within the two crucible fragments in weight % (for Ek-A 86A 2 sites of interest were analysed multiple times; for Ek-A 87E 5 sites of interest were analysed) (n.f. = not found). The data reported here is in good agreement with that obtained using a different instrument reported earlier in* NIXON et al. *2011: 1363*

Ek-A 86A						
	1a	*1b*	*1c*	*2a*	*2b*	*2c*
Au%	93.1	93.1	92.8	95.7	98.3	98.0
Ag%	6.4	6.3	6.3	4.2	1.5	1.3
Cu%	0.2	0.2	0.6	0.1	0.2	0.2
Fe%	0.3	0.3	0.4	n.f.	n.f.	0.5
Ek-A 87E						
	1	*2*	*3*	*4*	*5*	
Au%	97.9	97.8	96.8	98.2	98.0	
Ag%	1.8	1.9	2.9	1.2	1.5	
Cu%	0.3	0.2	0.2	0.2	n.f.	
Fe%	0.0	0.1	0.1	0.3	0.5	

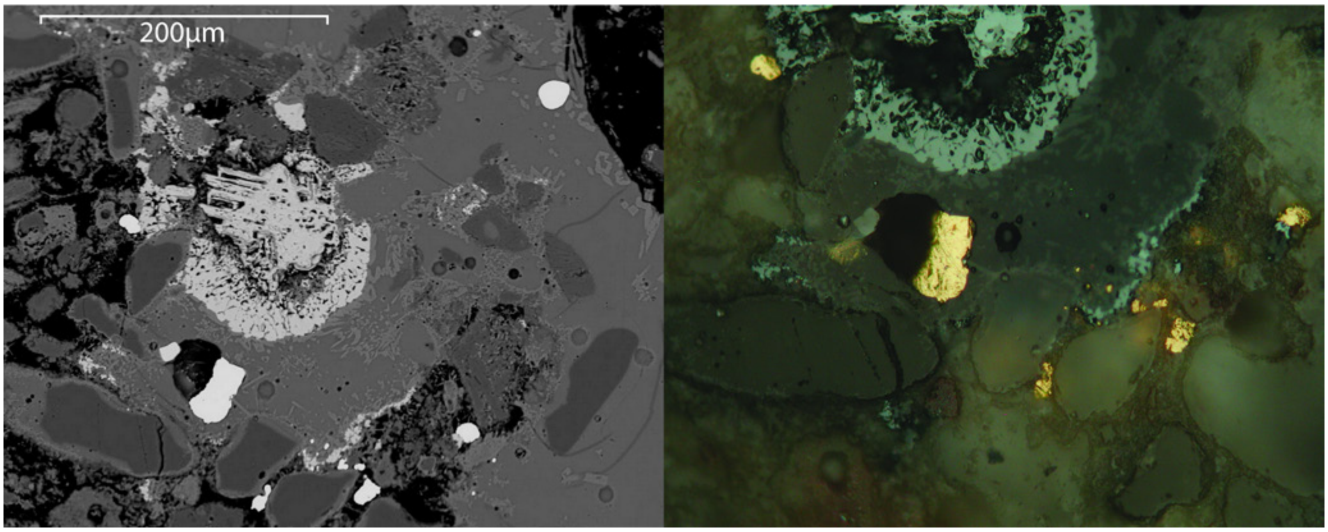

FIGURE 15.7 *SEM (left) and optical (right) images of gold prills and heavy minerals within the crucible Ek-A 86A – optical image focuses on gold prills identified in lower portion of SEM image.*

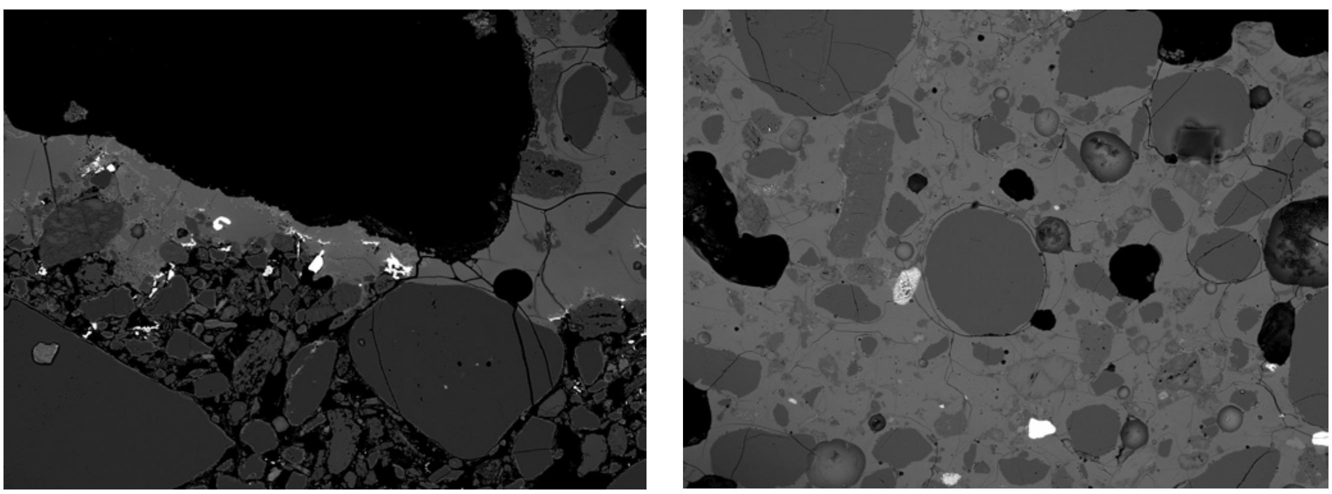

FIGURE 15.8 *BSE images of the crucible fragments:* a) *crucible fragment Ek-A 87E, showing the transition between crucible fabric (bottom) and glassy slag (centre, light grey), and note the gold particles in the centre (bright) – image width = 1.7mm;* b) *crucible fragment Ek-A 86A, mineral grains embedded in the glassy slag – image width = 2.5mm.*

melt composition resembles typical soda-based glass, with a low lime and relatively high alumina content (Tab. 15.3).

Discussion

Gold Working Technology at Essouk-Tadmekka

On a global scale, archaeological evidence for early medieval gold workshops is generally very rare, not least due to the almost complete recycling of gold waste and gold-contaminated debris. What evidence there is seems to fall into two distinct groups, but with considerable overlap between them due to the common use of certain techniques and tools (Eluère 1993). One group concerns jewellery production, often including casting debris or mould remains, or snippets of metal and semi-finished artefacts. The other group is linked to coin production or assaying, and includes finds such as cupels, dies or coin moulds. Given the relatively limited historical sources for medieval gold workshop practice, such as Theophilus Presbyter (Hawthorne & Smith 1963; Dodwell 1971) in medieval Europe, or the Islamic sources (Dunlop 1957; Ehrenkreutz 1953), any new gold archaeometallurgy is extremely valuable.

The gold from Essouk-Tadmekka is unusual for its very high natural fineness, regularly exceeding 950/1000 (see further discussion below). When considering the high purity of this gold, one could imagine that it had been refined through parting, a process known at least since the sixth century BC when the first known gold coinage emerged in

TABLE 15.3 *SEM-EDS data on the glassy slag coating the inside of the two crucible fragments and comparison of this with a glass group from Thailand (m-Na-Al 3) (n.f. = not found). The quality of the EDS data was tested by analysing Corning glasses A, B and D under the same conditions and using the same instrument as the crucible samples. See* Rehren & Nixon 2014 *Tab. 1 for the correspondence of measured values and published values, showing the generally very good agreement between the two even at concentrations as low as 0.5 wt%*

	87E	87E	87E	87E	86A	86A	Average	m-Na-Al 3 Dussubieux et al. 2010
	Site 2	*Site 7*	*Site 8*	*Site 10*	*Site 12*	*Site 13*		
Na_2O	13.6	12.2	12.7	12.0	14.6	13.7	***13.1***	14.6
MgO	1.8	1.4	1.3	1.4	1.7	0.9	***1.4***	1.3
Al_2O_3	3.2	5.5	6.1	6.7	5.7	6.3	***5.6***	7.1
SiO_2	65.6	68.8	67.4	67.5	64.1	63.9	***66.2***	66.8
SO_3	0.3	0.4	0.3	0.5	0.3	0.2	***0.3***	n.f
Cl	0.6	0.7	0.7	0.7	0.7	0.7	***0.7***	n.f
K_2O	2.3	2.9	2.6	3.0	2.1	2.0	***2.5***	3.3
CaO	3.0	2.5	2.4	3.4	2.4	3.0	***2.8***	2.9
TiO_2	0.3	0.6	0.7	0.5	0.3	0.3	***0.5***	0.3
MnO	1.8	0.5	0.4	0.3	1.9	3.3	***1.4***	0.1
FeO	1.4	3.0	3.2	2.9	2.3	2.0	***2.5***	2.0
CuO	5.1	1.6	1.6	1.2	2.3	1.9	***2.3***	0.5
ZnO	1.1	n.f	0.6	n.f	1.6	1.5	***1.2***	0.0

Lydia (Turkey) (Ramage & Craddock 2000). However, the fact that the high-purity gold in the crucibles appears to be primary gold, as indicated by its association with other heavy minerals in the glassy slag, together with the similarly low but still significant levels of silver present in the gold seen in the coin moulds, and the absence of any characteristic refining waste such as copper- or silver-rich slags or ceramics, argue against the Essouk-Tadmekka goldsmiths having used parting to attain this high purity. While access to highly pure gold meant no need for refining, this high purity gold was often found and traded in a dust form recovered from rivers, and was accordingly polluted with other minerals recovered with it from the river gravels. One of the crucial challenges within the gold trading network was separating the gold from the heavy minerals to be able to trade and work pure unpolluted gold. The crucible evidence provides a fascinating insight into the role of Essouk-Tadmekka's workshops in this process.

The Essouk-Tadmekka crucible fragments are archaeologically unique in their slag composition. Unlike the coin moulds, which have only a very faint layer of superficial vitrification of their ceramic, the crucibles have a thick layer of soda glass slag, and contain not only pure gold prills, but a raft of heavy minerals and quartz grains. There is no basis for thinking that primary glass production or secondary glass working is involved here; the nature of the mineral inclusions is inconsistent with anything we know about glass making, or the melting of existing glass for bead production. The nature of the glass-derived slag, its range of mineral inclusions and the gold prills identify these samples as fragments of crucibles used for the processing of raw gold. This processing seemingly aimed to separate panned gold particles from mineral contamination contained in the concentrate, by melting the gold and floating the mineral particles off in a light slag melt. This interpretation is based on the compositional range of the individual gold particles found in the crucible, indicating that they were not left behind from a single homogenous melt but represent discrete particles; also, the range and quantity of minerals floating in the glassy slag is consistent with a panned gold concentrate. To achieve this separation, the metalworker chose glass as the flux, creating a melt bath to facilitate the agglomeration of the gold particles into a single larger pool of gold. Despite the obvious interaction between mineral grains and glass melt, most of the minerals would simply remain suspended in the molten slag, while the much heavier and more liquid gold would settle at the bottom of the crucible beneath the glass melt. Upon cooling, a brittle and light-coloured transparent slag would easily reveal and release any gold trapped in it.

Little can be said about the original nature of the crucibles themselves, apart from the observation that they are made from a very sand-rich fabric and a light-firing clay. This sets them apart from the domestic pottery, but also from the coin moulds, and indicates a conscious choice in raw material selection. Technologically this makes sense for two reasons. During the melting process, estimated to require around 1050 to 1100 °C to ensure melting of the gold and sufficiently low viscosity of the glass melt to facilitate separation of the lighter minerals from the heavier metal, such a fabric will not melt and bloat as much as less sandy and more ferruginous material. Therefore, fewer gold prills would end up trapped in the sticky surface of the molten crucible ceramic. When the crucibles had reached the end of their useful life they would be crushed to retrieve any gold prills that did end up in their fabric; a friable quartz-rich fabric would be much easier to crush sufficiently fine to liberate even small prills from the matrix, ensuring a better recovery of this gold. This practice would also explain why the two fragments are so small, and why not more of this material has been found during the excavations. When considering the glass that has been used in the crucibles during this process, it was likely of the common variety found at the site, the 'soda glass' composition of the glass being contaminated by reaction with the ceramic fabric and the heavy mineral content of the panned gold (see Rehren & Nixon 2014 for further discussion). Almost certainly this glass material would have been reused multiple times for gold processing rather than simply thrown away after one firing; in a context where the glass supply is from across the Sahara and therefore not inexhaustible.

To our knowledge no such flux-driven crucible process for separating gold from a heavy mineral concentrate has to date been identified archaeologically anywhere in the world. This is though common practice today amongst amateur gold panners who want to avoid working with toxic mercury to collect their gold and prefer using borax as flux. Also, there exists a description of a similar separation of gold using crushed bottle glass, from a 19th-century Australian gold prospector: "*Rough gold smelting on the mine is effected with a flux of borax, carbonate of soda, or, as I have often done, with some powdered white glass.*" (Johnson 1904: 141). The absence of any prior archaeological evidence for such a flux-driven crucible process makes it obviously interesting beyond the local level of Essouk-Tadmekka. Use of water based technologies for processing gold go back to ancient times (*e.g.* Phillipson 2006). By the time of the Essouk-Tadmekka evidence, mercury is widely known within the Islamic world not only for amalgam gilding but also for the separation of heavy minerals from gold (Brooks 2012; Al Hassan & Hill 1986: 247; Blanchard 2006; Ehrenkreutz 1953). This latter process has continued in West Africa into modern times. No archaeological crucible remains have been found to suggest processes used other than these. What the Essouk-Tadmekka evidence clearly shows is the existence of a gold processing technology which either preceded the use of mercury in West Africa, or was some kind of complementary industry. The origin of this technology is currently unknown, and it is possible that it developed at least partly due to West Africa's remoteness from the main Islamic mercury sources in Spain and Central Asia, especially in such a frontier context of the early gold trade as we see at Essouk-Tadmekka, where glass cullet would have been more easily available than mercury. Now that we are aware of what the waste from this technology looks like archaeologically, we may hope to find further evidence of this in different geographical and temporal contexts.

Once produced in the crucibles, the gold reguli would then be ready to be worked or traded for their metal content. The moulds show that the Essouk-Tadmekka gold workers were converting at least some of this pure gold in a second, economically more sophisticated step, producing a regular coinage, and the excavated fragments enable a good tentative reconstruction of the technology of gold coin production at Essouk-Tadmekka.

So far, few direct technical parallels for the coin mould finds from Essouk-Tadmekka have been published. Gebhard *et al.* (1995; and literature therein) discuss the melting of gold within Late Iron Age European coin moulds closely resembling the Essouk-Tadmekka artefacts, and their technical evidence from Celtic Manching is virtually identical. The absence of any base-metal remains such as copper, zinc or lead from the Essouk-Tadmekka moulds rules out a copper alloy being processed. Similarly, the absence of glass-indicating oxides such as soda or potash excludes glass production, the interpretation suggested for similar finds from Tegdaoust discussed above. Only pure gold working would leave no chemical traces except superficial fuel-ash vitrification and occasional gold prills, as documented here. The presence of circular marks in the base of certain mould cups also strongly points to the production of coin flans. The technical and chemical analysis of these finds therefore both complements and supports the formal interpretation of the moulds, providing together very strong evidence that these were used to produce gold coins.

The metal composition suggests unpolluted gold was placed in the mould cups to be melted – this would be weighed in dust or nugget form to ensure correct weight for each coin flan. In view of the technical evidence of a generally reducing atmosphere and the charcoal impressions on the vitrified surface of mould Ek-A 96 it appears the moulds were then fired from above under charcoal cover. The firing temperature would have been around 1050 to 1100 °C degrees and for a sufficiently long period to melt the gold. From the curved shape of the base of the moulds and the naturally curved surface of the liquid metal an irregular 'lentil' shaped flan would have been produced (see *e.g.* RAMAGE & CRADDOCK 2000). As suggested above, the circular mould would have produced around 30 flans in a firing. Customarily these would then be worked into a coin form during the die striking stage; however, we argue, based on the historical evidence, that in this case the flans were left as-cast, producing 'bald' coins (see below). We cannot determine whether the moulds were designed for a single or multiple use, but it seems likely that any mould no longer to be used would be crushed for extraction of remaining gold prills, and it is probably only due to good luck that the fragments we see escaped this final step, probably due to their near-invisible gold traces.

The coin mould technology used to make the Essouk-Tadmekka coinage is commonly associated with the ancient north or central European world, and its recovery in a medieval sub-Saharan African context would not be expected. Treatises on medieval coin technology from the Islamic world mainly talk of coins being cut from ingots or sheet metal (EHRENKREUTZ 1953; RAMAGE & CRADDOCK 2000); however, there has been little archaeological evidence to confirm or contradict this. There is actually one instance of an apparently similar coin technology to that presented here from an Islamic archaeological context, that of al-Mansurah in Pakistan (KHAN 1990). Combined with this evidence the finds from Essouk-Tadmekka provide us with a sense that this technology might actually have been fairly widespread in the early Islamic era. Most particularly, we should strongly reconsider the interpretation of the so-called 'bead moulds' from Tegdaoust mentioned above, especially given that this was a gold trading town and references exist in the Arabic records to 'dinars' being exchanged there (LEVTZION & HOPKINS 2000: 45–9, 81). Other possible examples of this technology in sub-Saharan Africa are seen from Aksumite Ethiopia (WILDING 1989), and other similar West African finds remain functionally uninterpreted (GRIAULE & LEBEUF 1948: 54). Given the prior presence of this technology in the ancient world and earlier medieval contexts elsewhere, one is tempted to suggest that its presence at Essouk-Tadmekka can be explained by a process of diffusion, perhaps through trans-Saharan routes. We must not though rule out the possibility that a similar form for a common purpose developed independently in West Africa.

From the recovery of the excavated coin moulds and crucibles alone we cannot say we have excavated an *in situ* gold-working workshop at Essouk-Tadmekka. Certainly none of the structures allow us to say this. However, the recovery of gold working remains from different building horizons in Ek-A does lend weight to the idea that for several generations this area of the site was a gold working zone. Likewise, recovery of other metal working remains such as crucibles for steel production and iron and copper slag provides further basis for arguing that this structure was situated in a small but relatively versatile and sophisticated metal working quarter. Of particular interest is the fact that from within the contexts where we find the crucible fragments we also see numerous fragments of glass and glass beads. This intensity of glass remains is not seen elsewhere within the stratigraphy, and could potentially indicate the processing of both metal and glass in the same workshop or area (*cf.* REHREN *et al.* 1998 for a Late Bronze Age example of such an association and CREW & REHREN 2002 for an Iron Age Irish example). However, we have shown above that Essouk-Tadmekka goldsmiths were processing gold using crushed glass as a flux, rather than working glass as a material in its own right. This does make us think that this is a metallurgical workshop floor or associated structure (note that the Horizon 9 architectural space where the crucible fragments are found extends beyond the excavation area). While we see no gold remains from units Ek-B and Ek-C we should not take this to mean no gold processing occurred there, as not only were the excavations conducted fairly limited but gold remains are not commonly recovered archaeologically. Regardless of whether this is evidence of an *in situ* gold workshop, we are now clearly aware that there existed a sophisticated gold metallurgical industry processing high-quality gold at Essouk-Tadmekka, supporting the historical sources, as well as significantly expanding the level of detailed knowledge about this.

Tadmekka's Gold Coinage

Al-Bakri's description of Tadmekka's coinage is the most precise and spectacular reference to a gold trade at Tadmekka. Given that there has been no concrete evidence of this or any other pre-colonial West African coinages, it is perhaps not surprising that it has been treated with caution as possibly being a historical fiction. We have now shown though that this coinage was real. On reflection, the decision to produce gold coins at this flourishing early medieval trading town is unsurprising. It was fairly easy to process highly pure West African gold, and trans-Saharan merchants would prefer clean, processed gold in a standardised, exchangeable form. Also, other goods were exchanged here, including slaves and ivory, and efficient gold exchange would facilitate this. Ingots would obviously be useful for large transactions, such as those found at Tegdaoust (Devisse 1988). However, for such a valuable commodity smaller exchangeable units would be required. As Islamic merchants familiar with coinage were operating at Essouk-Tadmekka, and as Essouk-Tadmekka traded with North African coin-based economies, smaller units were produced in coin form. Tadmekka's coins likely corresponded to Islamic weight and size standards. Al-Bakri's reference to them as "dinars" supports this, as does the presence at contemporary Tegdaoust of Islamic standard weights (Launois & Devisse 1983; see also Chapter 18 for a possible Essouk-Tadmekka gold weight, 13.7grams). The moulds would initially produce irregular blanks (*e.g.* Ramage & Craddock 2000). However, these could be easily hammered into a dinar form to meet the expectations of Islamic traders.

Al-Bakri described the Tadmekka gold coins as pure and we have now been able to demonstrate this gold coinage utilised gold up to a percentage of 98 wt%, making it therefore an extremely pure gold coinage (see below for further discussion of gold purity). Al-Bakri also states Tadmekka's coins were "bald", *i.e.* blank. We have to assume this is accurate, or that they featured only very superficial identification marks. Objects considered 'coin blanks' north of the Sahara were seemingly then in this trading town a fully-functioning money. A comparable example are blank 'coins' from medieval Turkey having very superficial identification marks (Hinrichs 1997), in some cases single indented dots or lines of dots, in others small marks or symbols covering only *ca* 10% of the coin surface. These would be largely obliterated when struck with a die. Stamping coins in the early centuries of Islam was the prerogative of the Caliphs. An inscribed Tadmekka coinage would certainly have projected Tadmekka's power, and indeed would have communicated the ruler's guarantee of the coinage purity, but it is unlikely its Islamic authorities wanted to make this overtly political gesture (Tadmekka's 10th-century rulers are named as Fusahr bin Alfara and Inaw bin Sabanzak – Levtzion & Hopkins 2000: 51). A potential additional factor keeping coinage blank is that high-quality blank coins had huge commercial value: they could simply be stamped with no reworking by the buyer to produce high-quality coinage. While intriguing to reflect on the possibility of the 'king' of Tadmekka described by Al-Bakri stamping coins in his name, these coins were seemingly not a political tool but simply a trading mechanism. Whether there was an actual mint at Essouk-Tadmekka, in the sense of a controlling body which regulated coin weight and purity, it is not possible to say.

That Tadmekka's coinage featured in Al-Bakri's world geography suggests it was fairly significant – a very small-scale industry is unlikely to have been heard of across the Saharan routes and in Spain where Al-Bakri lived, let alone considered worthy of mention. Understanding how much Essouk-Tadmekka gold was converted to coins is currently impossible. However, even a small percentage would have been significant as substantial quantities of gold moved through Essouk-Tadmekka. A tantalising insight is perhaps provided by a report that a single Tadmekka merchant annually sent across the Sahara 16 bags containing 500 dinars each (8000 in total, *ca* 34kg of gold) (Levtzion & Hopkins 2000: 90). Its development makes logical sense for a flourishing gold market on a key Saharan route.

The Essouk-Tadmekka gold's high purity is consistent with supergene gold. Such deposits form when primary gold, typically containing 5–35 wt% silver, naturally dissolves under specific climatic conditions and over geological time-spans and is re-precipitated in soils and sediments in a highly pure form (Guerra & Rehren 2009, and references therein). Such deposits are accessible through panning or surface mining, which would be consistent with the evidence from the crucibles. This high purity also fits with analyses of modern West African nuggets (>97%: Gondonneau *et al.* 2001). The exact geological origin of the Essouk-Tadmekka gold cannot currently be pinpointed, as we do not have reliable data that can be associated with the medieval gold fields. Importantly though the gold we recovered is far purer than any previously discovered, with previous findings for medieval West African gold being around 92–94% (Messier 1974; Roux & Guerra 2000). The trace element characteristics of this are also different from any gold previously considered. The non-destructive analysis we conducted did not test for certain diagnostic trace elements, but the Essouk-Tadmekka trace contents differ from Almoravid coins, Gao's bead, and many West African gold nuggets, while equivalent trace contents were found in Audaghust gold wire and a modern nugget from Ivory Coast (Roux & Guerra 2000; Gondonneau *et al.* 2001). It is therefore not unreasonable to hypothesise that such gold deposits existed within the reach of Gao's trading network, providing the necessary raw material for Essouk-Tadmekka's mint.

Beyond being able to verify the existence of Tadmekka's coinage and the nature of the gold it was gaining, the evidence is importantly the clearest sign of the flourishing nature of the gold trade at Essouk-Tadmekka and on the route which it formed the central point of. The far western route running from Morocco through Mauritania to the Empire of Ghana is widely seen to have been the most significant early gold trade route (DEVISSE 1988: 397), and this is associated with the Fatimids in the 10th century who are seen to have attained from it sufficient gold for their quest for power in North Africa. There are indeed a series of references to a flourishing gold trade on this route from the 10th century, and this is seen to have been focused around the centre of Audaghust in Mauritania (LEVTZION & HOPKINS 2000). Archaeological excavations at the ruins of Audaghust in the 1960s recovered evidence of this gold trade, in the form of ingots and gold wire, as well as gold-weights, balances and Fatimid coins (DEVISSE 1983). This material evidence has done much to further promote the importance of the western route and the town of Audaghust within the account of the early trade. Certainly people have also long been aware of the Arabic historical descriptions referring to gold trade on the route running from Tunisia to the Niger Bend and focused around Tadmekka; principally Al-Bakri's description of Tadmekka's coinage, but also the oral traditions recorded in the 11th and 12th centuries referring to flourishing gold treasure houses at Tadmekka. Many authors have seemingly seen these as unreliable accounts however as they are seldom discussed. The fact also that no gold coinage has ever been recovered associated with the Ibadi city states in North Africa, whose traders were the principal trans-Saharan connection with Tadmekka, has led to caution in believing the historical sources of a flourishing gold trade on this route (see below for further discussion). The recovery of the Essouk-Tadmekka evidence now clearly shows the importance of this route for the early gold trade, providing concrete evidence of the gold traders documented on this route by the Ibadi at least back to the 10th century AD.

Conclusion

The coin mould evidence presented here confirms the existence of the Tadmekka 'unstamped' gold coinage mentioned in historical sources by Al-Bakri, but previously treated with some scepticism. Additionally, we documented the existence of a parallel process, involving the separation of panned gold from heavy mineral impurities. The finds show that Tadmekka gold exchange employed formally manufactured and regulated pieces, rather than simply gold dust, and that it was home to a sophisticated gold working industry. The evidence also shows that the coinage and any unprocessed reguli at Tadmekka attained extremely high purities (> at least 98%). Tadmekka's high purity gold and gold coinage were obviously key components of the early gold trading networks, and Essouk-Tadmekka was clearly amongst the most important of the gold trading towns in the earliest era of the trade.

The recovery of the evidence from Essouk-Tadmekka not only elevates the importance of this centre but also asks us to reassess the importance of the Tunisia-Niger Bend route Essouk-Tadmekka was positioned upon, a route less commonly discussed than the far western route from Morocco to Mauritania. Likewise, the evidence asks us to reconsider the importance of Gao as an early gold trading power, as well as potential little discussed mines to its south, most notably Sirba. The finds are also an important addition to the limited dataset for gold archaeometallurgy, including documenting the first evidence of a crucible flux-driven separation of gold from its impurities. The coin moulds also expand our understanding of early coinage technologies, as the Essouk-Tadmekka technical tradition is not commonly associated with the Islamic world, but rather with the ancient world and Europe.

CHAPTER 16

Crucible-steel Making and Other Metalworking Remains

Thilo Rehren and Sam Nixon

Introduction

In addition to the gold working remains reviewed in the previous chapter, the excavations recovered a range of other metalworking remains. These relate mainly to bloomery iron metallurgy, but also include waste products of crucible-steel making, copper-working, and a piece of lead. The evidence also features some crucible fragments which it is not possible to confidently relate to any particular metal, but which could potentially relate to gold-working (see Chapter 15). In terms of the nature of the evidence as a whole, this consists of both the apparatus used to produce the metals (furnace wall fragments and crucibles), slag remaining from the metal ore, and occasional specimens of waste metal. The remains presented here are treated separately from the finished metal objects which are detailed in the next chapter, as the material we are dealing with here is clearly evidence of local metal working, whereas the evidence in the next chapter consists of remains which could either have been produced locally, or been traded to the site in a finished state.

Alongside simple visual assessment of the remains, this material was subjected to an intensive program of technical and chemical analysis, including optical microscopy and SEM-EDS analysis. Approximately half the samples recovered were included in this program. This analysis was fundamental to the study, as it provided additional insight into certain specimens which prior to analysis it was only possible to make very generalising statements about – indeed, the analysis was often essential for basic identification of the metal type and production processes the remains relate to. This included most crucially the identification of the interesting sub-set of crucible-steel working remains from amongst a group of artefacts which on first inspection might have been identified simply as relating to bloomery iron metallurgy. In addition to the analysis detailed here, the copper processing remains were also sampled as part of a wider program of Lead Isotope Analysis (see App. K).

The metal working remains provide us with important information about metallurgy at the site which can be gained in no other way, as Tadmekka's historical records provide no insight into this aspect of life, beyond the limited references to gold working previously discussed. The information provided by the archaeometallurgical study includes insights into the movement of raw materials to the site and the types of metallurgy practiced there, as well as a sense of the level of expertise present in metal working communities. Beyond a narrow concern with metallurgy, more broadly the evidence provides some of the clearest insights into the scale of craft and industrial production in the town, the craft specialist communities present there, and the technical knowledge and social processes related to these. Indeed, the remains of waste products of metallurgy actually provide the clearest evidence amongst the excavated remains for sustained industry taking place in the urban centre of Essouk-Tadmekka itself, as opposed to production which might have taken place in encampments around the town or in the immediate region. As will be demonstrated later, the evidence also provides some important insights of wider concern for the understanding of metallurgy within the trans-Saharan system, and even to consideration of the wider medieval world of metallurgy.

Materials and Methods

74 specimens of metal working remains were found during the excavation (see Tab. 16.1, App. I). These were mainly relatively small fragments, for the most part measuring only a few centimetres in size. Principally the material was slag, with technical ceramic – in the sense of MARTINÓN-TORRES & REHREN (2014) – the second-most frequent category of finds. Much of the slag was covered by significant concretions of brown-rusty corrosion products and entrapped soil material, and preliminary inspection of the material indicated that the majority of material related to iron metallurgy, while the presence of green corrosion on some finds made it clear that there was some evidence also of copper metallurgy. Prior to more intensive analysis it was not possible to be more specific regarding the nature of local metal working, nor to clearly identify any other metallurgy than iron and copper. However, the preliminary visual analysis did seem to indicate some presence of remains relating to other metals, including gold (see Chapter 15), thereby seeming to offer further insights into a broader metallurgy complex at Essouk-Tadmekka.

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TABLE 16.1 *Summary account of stratigraphic distribution of archaeometallurgy samples from Essouk-Tadmekka (other than definitely identified gold metallurgy reported on in Chapter 15)*

	Ek-A Hor. 1	Ek-A Hor. 2	Ek-A Hor. 3	Ek-A Hor. 4	Ek-A Hor. 5	Ek-A Hor. 6	Ek-A Hor. 7	Ek-A Hor. 8	Ek-A Hor. 9	Ek-A Hor. 10	Ek-A Hor. 11	Ek-A Hor. 12	Ek-A Hor. 13	Ek-A Hor. 14	Ek-A Total	Ek-B Hor. 1	Ek-B Hor. 2	Ek-B Hor. 3	Ek-B Total	Ek-C Hor. 0	Ek-C Hor. 1	Ek-C Total
Iron metallurgy (definite smelting/ likely or possible smelting)	–	1 (–/1)	1 (–/1)	–	1 (–/1)	10 (2/3)	–	–	1	–	–	1	–	1		3 (2/1)	4 (0/4)	–		14 (1/–)	3 (1/–)	
Crucible-steel metallurgy	–	–	–	–	–	–	–	–	3	–	–	–	–			–	1	1		2	–	
Copper working (smelting)	–	–	–	–	–	–	–	–	1 (1)	–	–	–	–	1 (?)		4 (?)	–	–		–	–	
Other high temperature material	–	–	1	–	–	4	1	–	1	–	1	–	–	2		1	1	–		9	–	–
Total	0	1	2	0	1	14	1	0	6	0	1	1	0	4	31	8	6	1	15	25	3	28

The evidence was recovered from all three excavation units and spans the entire period of occupation associated with permanent architecture (see Tab. 16.1). In the deepest unit, Ek-A, the evidence is most plentiful from Horizons 6–10, with deposits before and after being relatively light in metallurgical remains; therefore, yielding remains principally from *ca* 10–12/13th centuries AD. Unit Ek-B yielded a healthy quantity of evidence, dated *ca* AD 950–1050. Ek-C displays a good range of material, some securely dated to Horizon 1, *ca* 13th century, but the majority of the relatively numerous finds come from mixed deposits (Horizon 0) and can only be given the very broad chronological definition of 'pre-c.13th century AD'. None of the contexts the material was found within demonstrated clear signs of being related to an *in situ* metal workshop. It certainly does appear that the majority of the evidence came from living surfaces, rather than for instance pits or fills. While it is not possible to categorically say we are dealing with primary contexts of deposition, this seems highly likely.

Despite the relatively small scale of evidence we have from Essouk-Tadmekka and the lack of *in situ* production facilities, it was clear that the evidence recovered could provide a crucial means of gaining insight into metallurgical activity at the site. A detailed program of analysis was therefore developed, both to gain more precise identifications of the material in general, and to further explore potentially interesting individual items.

The analyses took place over an extended period of time, first at the Wolfson Archaeological Sciences Laboratories at the UCL Institute of Archaeology, and then at the Archaeological Materials Science Laboratories at UCL Qatar. All material recovered was subjected to a basic visual assessment and, where possible, identification. During this process, each sample was individually assessed using a small but strong magnet and a binocular microscope to ascertain whether it should be subjected to more elaborate analysis. In certain cases this involved exploratory sectioning of the sample to inspect its interior, hidden underneath thick surface concretions. A portable XRF instrument was also used for several samples whose metallurgical nature could not be immediately established. Samples selected for more in-depth analysis were then sectioned, mounted in resin, and polished in preparation for optical and electron microscopy and analysis. For reasons outside our control, the process of assessment, sampling and analysis involved multiple stages conducted over an extended period; the material eventually being checked through and sampled three times. This was done in order to ensure that interesting material had not been missed, and especially as the first and second phases of analysis showed unexpected and exceptional results requiring a revisiting of potentially previously overlooked important material.

The prepared samples were all subjected to optical microscopy using reflected light in order to determine or confirm the metal the sample related to, and to provide a detailed account of the production process the remains resulted from. Following this, certain samples were then taken for a further phase of analysis using Scanning Electron Microscopy – Energy Dispersive Spectrometry (SEM-EDS), either in cases when the sample could not be properly identified using optical microscopy alone, or when the sample was deemed sufficiently interesting or exceptional to warrant more in depth analysis; or simply where higher magnification SEM images were needed. Assessment and sampling of the material for Lead Isotope Analysis was undertaken following the first phase of sampling for the analysis detailed in this chapter; the results of this are reported in the next chapter and Appendix K.

Results

Full details of the analysis undertaken on each sample and the observed results are contained in Appendix I, sorted according to their broad metallurgical types, roughly approximating to the division and discussion of the results in this chapter. Of the 74 fragments identified as potentially metallurgical, 31 are from Ek-A, 14 from Ek-B and 29 from Ek-C. Iron-related metallurgy dominates across the entire assemblage, both as small slag droplets, as possible furnace wall fragments of an iron smelting furnace, as fragments of crucible steel-making crucibles, and as fragments of so-called 'crown' material (that is, mixtures of bloomery iron and slag that would have formed at the periphery of the bloom during iron smelting). A few fragments are most likely copper-related, typically slag pieces with inclusions of copper metal and copper sulphide prills. Only six or seven fragments fall into this category, that is less than ten percent of the entire assemblage; however, four of these are from Ek-B, where they constitute more than a quarter of all metallurgical finds in that unit. By comparison, only two or three were recovered from Ek-A and none from Ek-C, despite both these units having around 30 metallurgical finds each.

Below is a summary of the results, by four broad materials groups: bloomery smelting, crucible steel making, copper metallurgy, and unidentified material.

Bloomery Metallurgy

More than half of the material (39 finds out of 74) is thought to relate to the smelting of iron in the bloomery process, that is reducing iron oxide ore with charcoal to a bloom, a lump of predominantly soft iron with various amounts of carbon or phosphorus alloyed into the metal, and mechanical inclusions of slag trapped between the metal parts. The bloom forms as a solid but porous lump of metal during the smelting; while the slag is liquid and drains from the bloom, as water from a sponge. Much as a sponge cannot be completely dried simply by squeezing, some slag remains in the bloom even after the bloom has been hammered into shape during smithing.

The material presented here related to this process is varied (see Fig. 16.1). There are several small slag droplets such as often form when smelting slag runs into a bed of charcoal and slowly cools there, as indicated by relatively large and well-formed crystals of fayalite (Fe_2SiO_4) and dendrites of wüstite ('FeO'). Other slag fragments are clearly from tap slag, characterised by a rapid cooling outside the furnace, as indicated by the needle-like shape of the fayalite in these samples, and the occurrence of 'tap lines' of magnetite separating individual slag runs (Fig. 16.2). These fayalite needles and tap lines only form when the liquid slag comes in contact with air when it flows out of the furnace. Other fragments appear to be furnace wall fragments, consisting of coarse ceramic with adhering bloomery slag, often relatively highly oxidised, showing magnetite (Fe_3O_4) as well as, or even instead of, wüstite. These could have formed through the ingression of ambient air through cracks in the furnace wall, or when the furnace was opened to remove the bloom. Alternatively, such magnetite-rich slag could also indicate copper smelting, but no inclusions of copper metal or sulphide was found in those pieces, which makes it unlikely that they are related to copper metallurgy. A few fragments seem to represent 'crown' material, that is mixtures rich in metallic iron and slag (*e.g.* Ek-B 11B, Fig. 16.3). Such material forms near the bloom in transition to the furnace slag, but is too low in quality to merit further working and is often discarded by the blacksmith when cleaning the bloom prior to smithing.

It is remarkable that no clear indication for smithing was found among the finds, with just a few fragments that could be either from smelting or from smithing. The diagnostic smithing hearth bottoms or plano-convex bottoms that typically indicate the near-by presence of a smithy are conspicuously absent from the assemblage. Even though the majority of slag fragments appear to represent primary smelting slag, there is no firm evidence for iron smelting having occurred close to where the samples are found

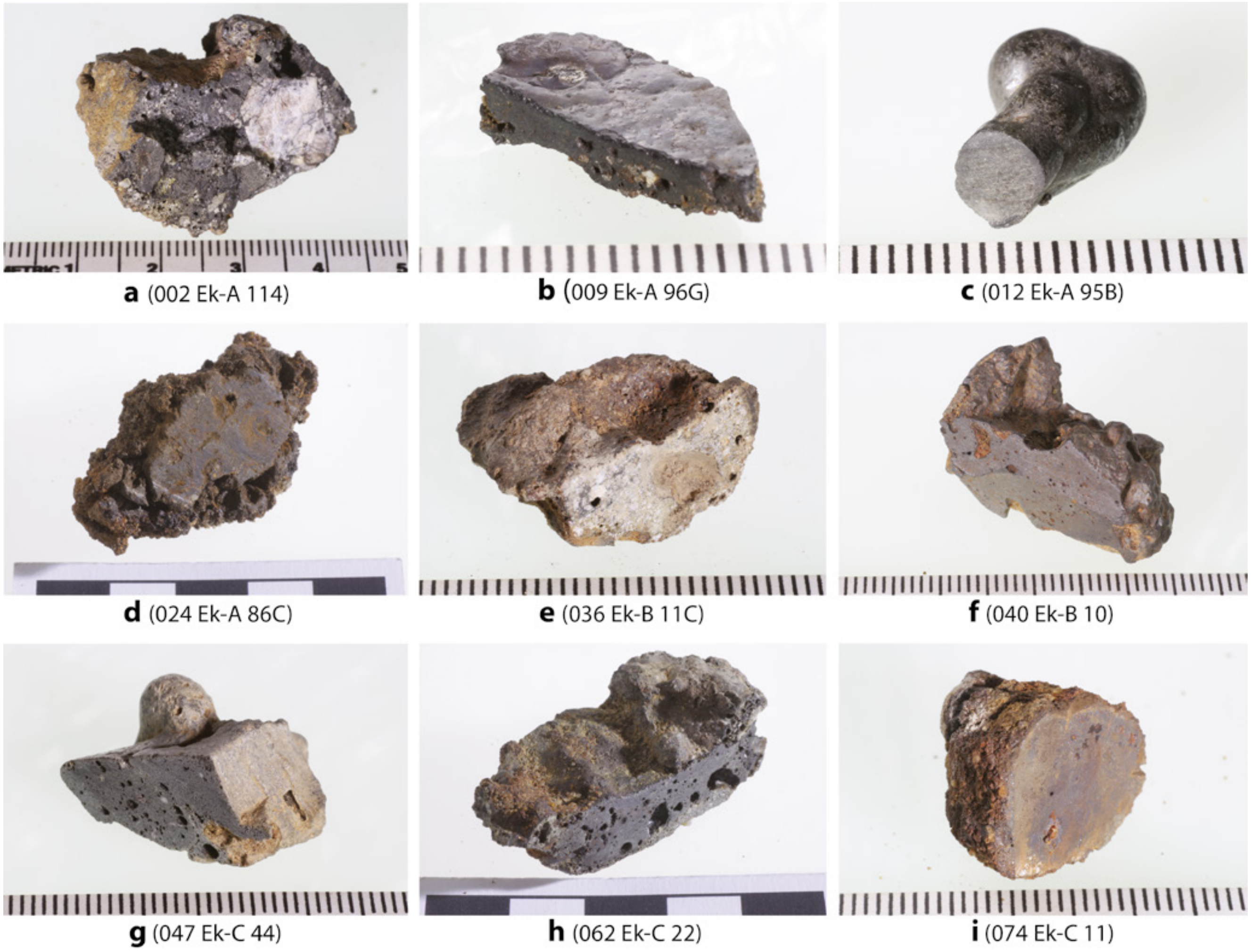


FIGURE 16.1 *Examples of iron bloomery remains from Essouk – all specimens are shown following sectioning to investigate their internal characteristics (both sample and context number are provided here; see App. I for descriptions of examples shown here).*

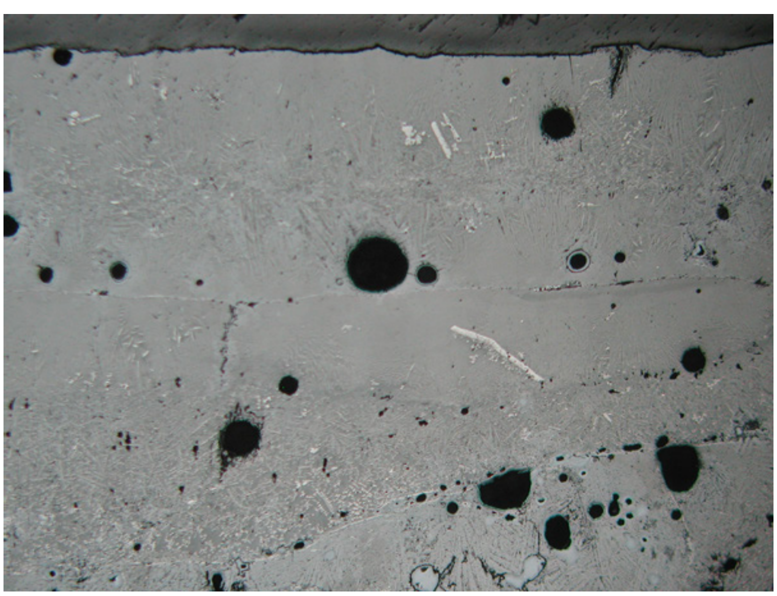


FIGURE 16.2 *Microphoto illustrating tap slag consisting of multiple thin flows of slag overlaying each other. The needle-like crystals (light grey) and the high amount of glassy matrix indicate rapid cooling of the slag, as is typical of tap slag. Sample Ek-A 96G (009) at 50× magnification, optical microscopy image. Width of view* ca *3 mm.*

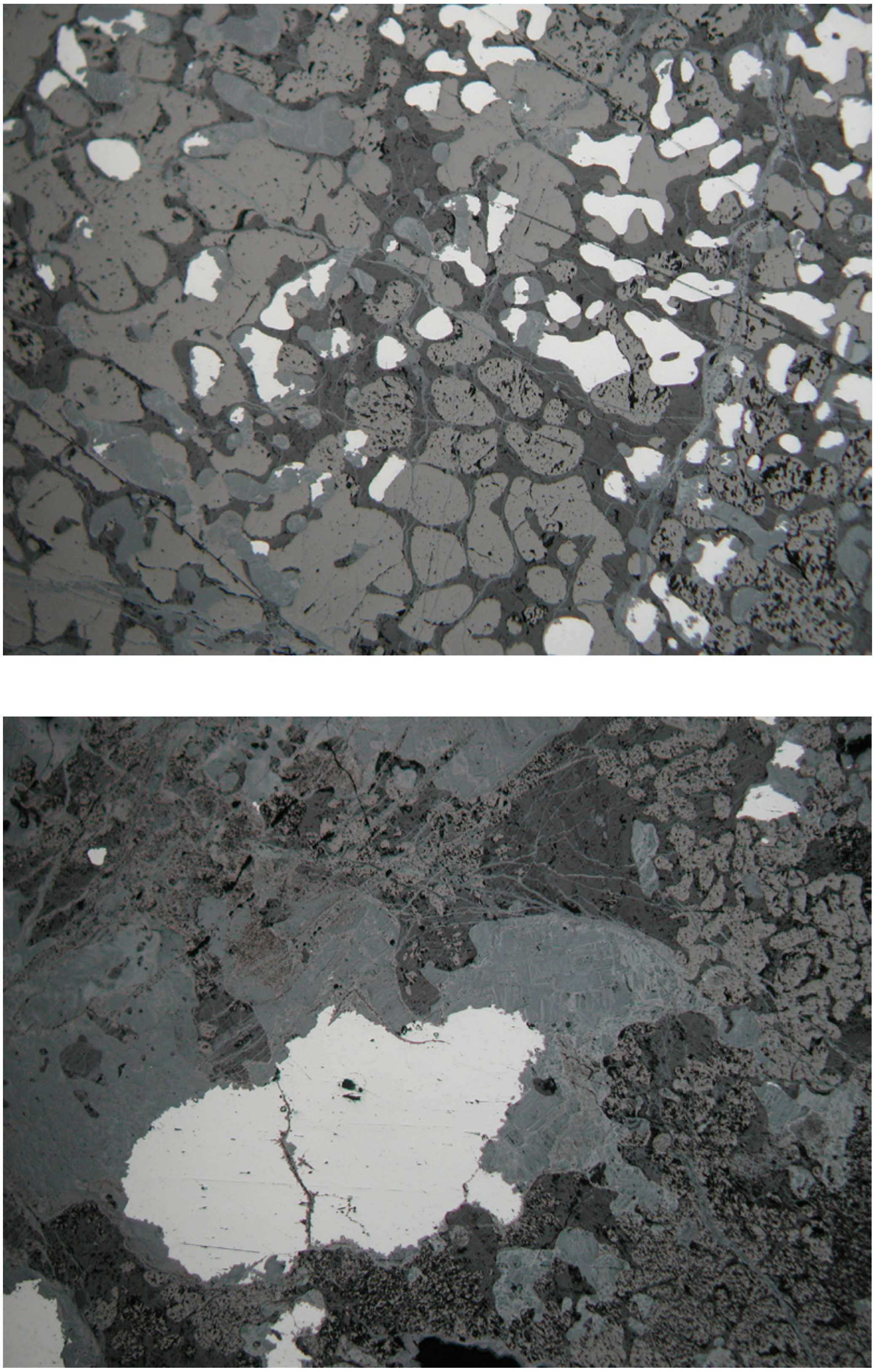


FIGURE 16.3 *Microphotos of bloomery slag from Essouk.* a) *A fragment of bloomery slag rich in wüstite (mid-grey rounded phase) transforming into iron metal (white). Sample Ek-B 11B (005) at 100x magnification; width of view* ca *1.5 mm;* b) *Part of a larger fragment of iron metal (white) in slag; the metal is partly corroded (mid-grey material surrounding the metal). Sample Ek-B 11B (005) at 50× magnification, width of view* ca *3 mm.*

(such as a furnace). One argument against this is that the overall quantities involved are so small; all the iron slag taken together weights less than a few hundred grams, while iron smelting evidence is typically measured in tens and hundreds of kilograms if it occurs in settlement contexts, and up to many thousand tons of slag elsewhere. The question of the function of the localities where the remains are found, and what their presence in the excavation units signifies, therefore remains an open one.

Crucible Steel Making

Ten of the 74 fragments can be related to crucible steel manufacture (see *e.g.* Fig. 16.4), a result entirely unexpected in this context. Crucible steel forms as a liquid iron-carbon alloy under extremely reducing conditions maintained within crucibles, and provides a much better metal than normal bloomery iron. Crucible steel is both harder than bloomery iron, due to its increased carbon content, and typically cleaner and more homogenous than bloomery iron, due to its formation as a liquid within the crucible which results in a complete separation of the slag from the metal. Throughout the Middle Ages and the early Modern Period, crucible steel production was restricted to Central and South Asia; only with the Industrial Revolution would this technology become known in Europe. The earliest well-documented evidence for crucible steel production is from 9th to 11th century AD Turkmenistan and Uzbekistan (Feuerbach *et al.* 1997, 2003; Rehren & Papakhristu 2000), even though it is thought to be a Persian technology (Allan & Gilmour 2000, and references therein). Current work by R. Alipour in central Iran is providing the first archaeological evidence for this process there, dating probably to the 11th century AD (Alipour & Rehren 2014). Vast quantities of crucible steel were also produced at numerous sites in India and Sri Lanka, mostly during the early modern period and until the early 20th century (Wayman & Juleff 1999). The technological and cultural connection between crucible steel production in Central Asia and South Asia is at present unknown (Rehren & Papachristou 2003), but several common features are noteworthy. Firstly, the conditions within the crucible are highly reducing,

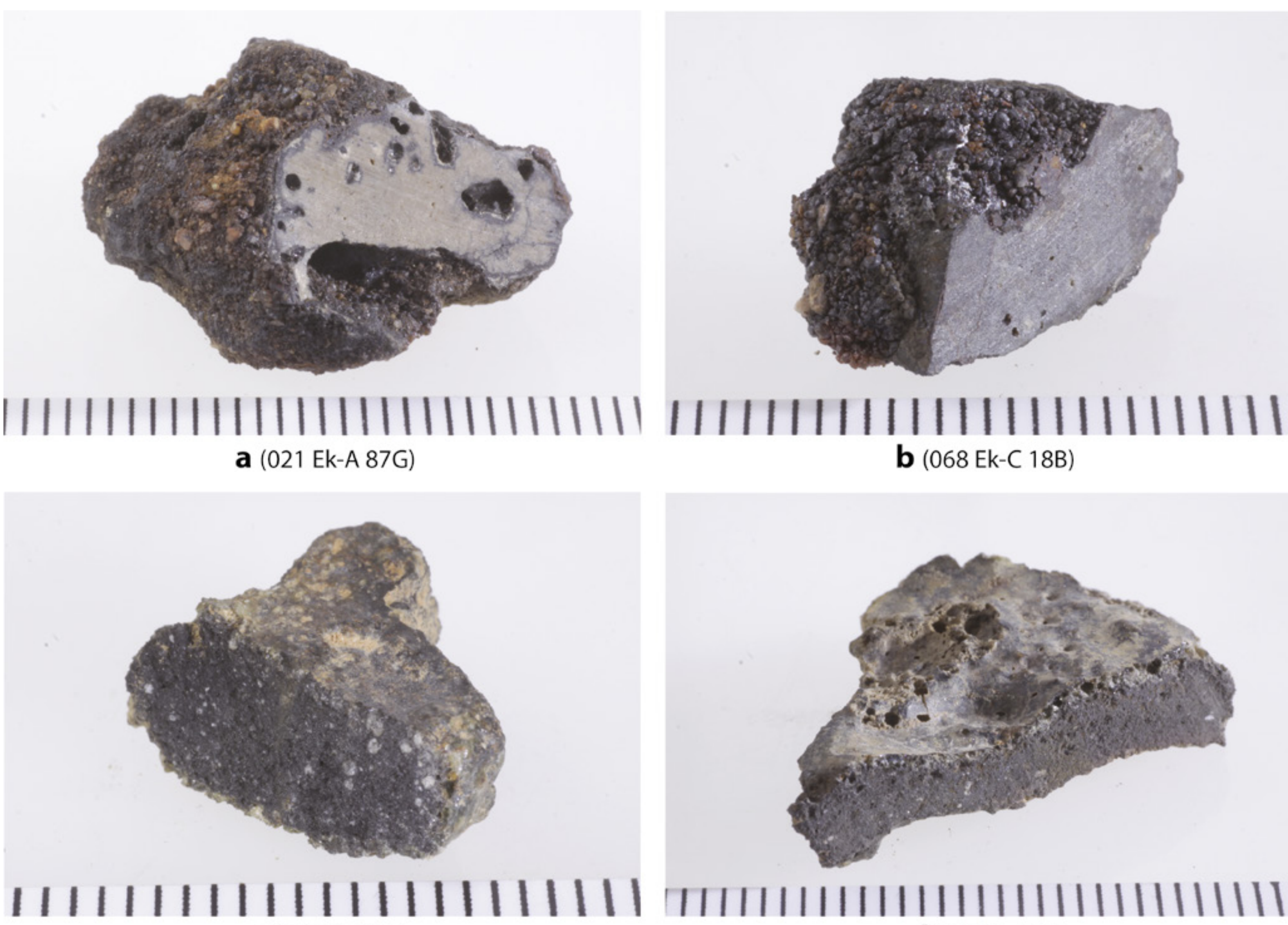


FIGURE 16.4 *Essouk crucible steel slag* (a, b) *and crucible fragments* (c, d) – *all specimens are shown following sectioning* (*both sample and context number are provided here; see App. I for descriptions of examples shown here*).

resulting in the diffusion of elemental carbon into the metal, lowering its melting point and finally forming a liquid alloy; these strongly reducing conditions also prevail in the furnace wall, due to its porosity and the migration of carbon monoxide from the crucible's interior into the ceramic. Secondly, the crucibles are covered on the outside with a dense fuel ash glaze, while the inside often contains prills of the high-carbon alloy in various stages of corrosion. Finally, all known crucible steel crucibles are closed vessels to maintain the strongly reducing conditions within the crucibles.

No evidence for crucible steel production has been published so far from Africa, although the technology is thought to have reached Muslim Spain as early as the 10th century AD (Karlsson 2000; Dinnetz 2001), which would imply that it was then also known, at least in theory, in the Maghreb. In contrast, an intriguing process involving cast iron smelting and then decarburising the brittle product in open crucibles is known ethnographically from the Mafa in the border region of northern Cameroon and Nigeria (David *et al.* 1989). Here, iron smelting is split into two steps, beginning with a down-draft furnace smelt producing a heterogeneous mix of bloomery iron, steel and cast iron. Loose high-carbon fragments of cast iron and steel are then collected from the ashes and transferred into shallow open crucibles for re-melting under oxidising conditions, resulting in a more fused but still heterogeneous mass of steely iron which is then forged into implements. Interestingly, the cast iron, occurring in mm-sized prills includes both grey and white cast iron, even in a single piece (David *et al.* 1989: 195, Fig 10).

The evidence for crucible steel production at Essouk-Tadmekka consists of several crucible fragments that share diagnostic criteria for this process, such as extremely reducing conditions throughout their fabric, resulting in the reduction of the iron oxide from the clay to iron metal prills scattered throughout the ceramic matrix, a very high operating temperature as indicated by the thorough vitrification of the ceramic matrix, and the formation of an outer fuel-ash glaze. The small size of the fragments and their very high degree of vitrification and distortion make their identification difficult and a reconstruction of the original shape and size impossible. So far, three likely crucible fragments have been identified: Ek-B 3, Ek-B 8, and Ek-C 18B (see *e.g.* Figs. 16.4, 16.5). The microscopic investigation reveals the formation of the outer fuel ash glaze and the high degree of porosity, much of which appears to be caused by burnt-out organic temper (Fig. 16.5).

The strongest evidence though are several heavily corroded fragments of formerly liquid high-carbon steel, and small prills trapped in the slag adhering to the inside of the crucible fragments. These include finds Ek-A 87F, Ek-A 87G (possibly), Ek-A 87H, Ek-B 3, Ek-B 8, and Ek-C 18B. Find Ek-C 18C is an isolated fragment of slag with a relatively large high-carbon prill (Fig. 16.6). Find Ek-A 87H is an almost completely corroded piece of crucible steel which preserves small areas of metal in the corrosion products, including large plates of cementite in a pearlite matrix (Fig. 16.7) as well as flakes of graphite, recognisable by their strong optical activity under crossed polarisers (Fig. 16.8).

The metal finds range in composition from grey and white cast iron to pearlite, often all in the same sample, and resemble in their heterogeneity the product of the primary smelting of the Mafa in northern Cameroon. However, the evidence from the crucible fragments indicates that these vessels were operated under much more strongly reducing conditions than those used by the Mafa to decarburise the cast iron of their first smelt. Also, the initial smelting there is reported to have used a very high ratio of fuel to ore, in the order of 4.5:1 (David *et al.* 1989: 195). Such a fuel-hungry process is not likely to have been conducted within the city of Essouk-Tadmekka where neither the ore nor the fuel would have been readily available, while ready bloomery iron could have been imported instead. Thus, on the basis of the limited evidence available so far and the balance of probability, we conclude that the high-carbon metal remains and the associated crucible fragments are more likely related to crucible steel making than to the Mafa iron smelting process.

Crucible steel ingots are a commodity easily traded, and historical records from later periods show that Indian crucible steel ingots were exported by European traders by their shipload (Craddock 2013: 21–2); a trade in such ingots, typically weighing between several hundred grams and a few kilograms each, can also be assumed to have occurred within the early Islamic world. However, the clean separation of the metal from the crucibles (Wayman & Juleff 1999; Craddock 2013) makes it very unlikely that the actual crucibles, or fragments of these, would have travelled with the ingots. Thus, the nature of the material found at Essouk-Tadmekka very strongly suggests that the crucible steel was being made locally, and not imported as a finished alloy. Six fragments come from unit Ek-A, and two each from the other two units, indicating that the activity was relatively wide-spread across the excavated area.

Copper Metallurgy

A few fragments were identified as related to copper metallurgy, either by the presence of green corrosion on their surface, or the presence of copper metal and sulphide

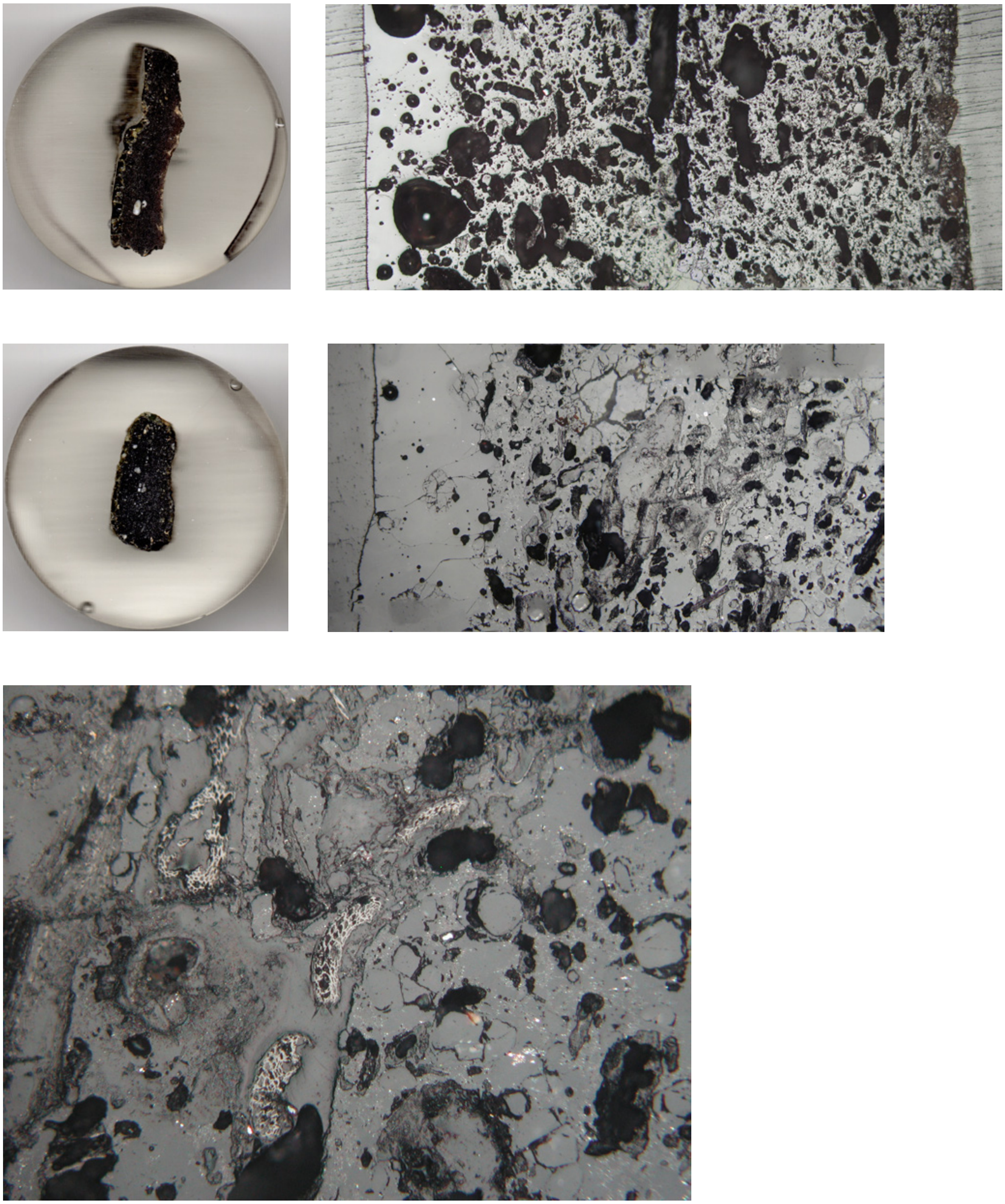


FIGURE 16.5 *a) Mounted sample Ek-B 3 (046), a fragment of a crucible steel crucible. Diameter of resin block is 3 cm. b) Optical microscope image of sample Ek-B 3 (046), showing the fuel ash glaze to the left and the porous ceramic body. Merged from two images taken at 50× magnification – width of cross section* ca *5 mm. c) Mounted sample of Ek-B 8 (045), a fragment of a crucible steel crucible. Diameter of resin block is 3 cm. d) Optical microscope image of sample Ek-B 8 (045), showing the fuel ash glaze to the left and the porous ceramic body in the centre. Merged from two images taken at 100x magnification – width of view* ca *2.5 mm. e) Close-up of Fig. 16.5d, showing remains of organic temper in sample* EKB *8 (045) rim. Taken at 200× magnification – width of image* ca *0.8 mm.*

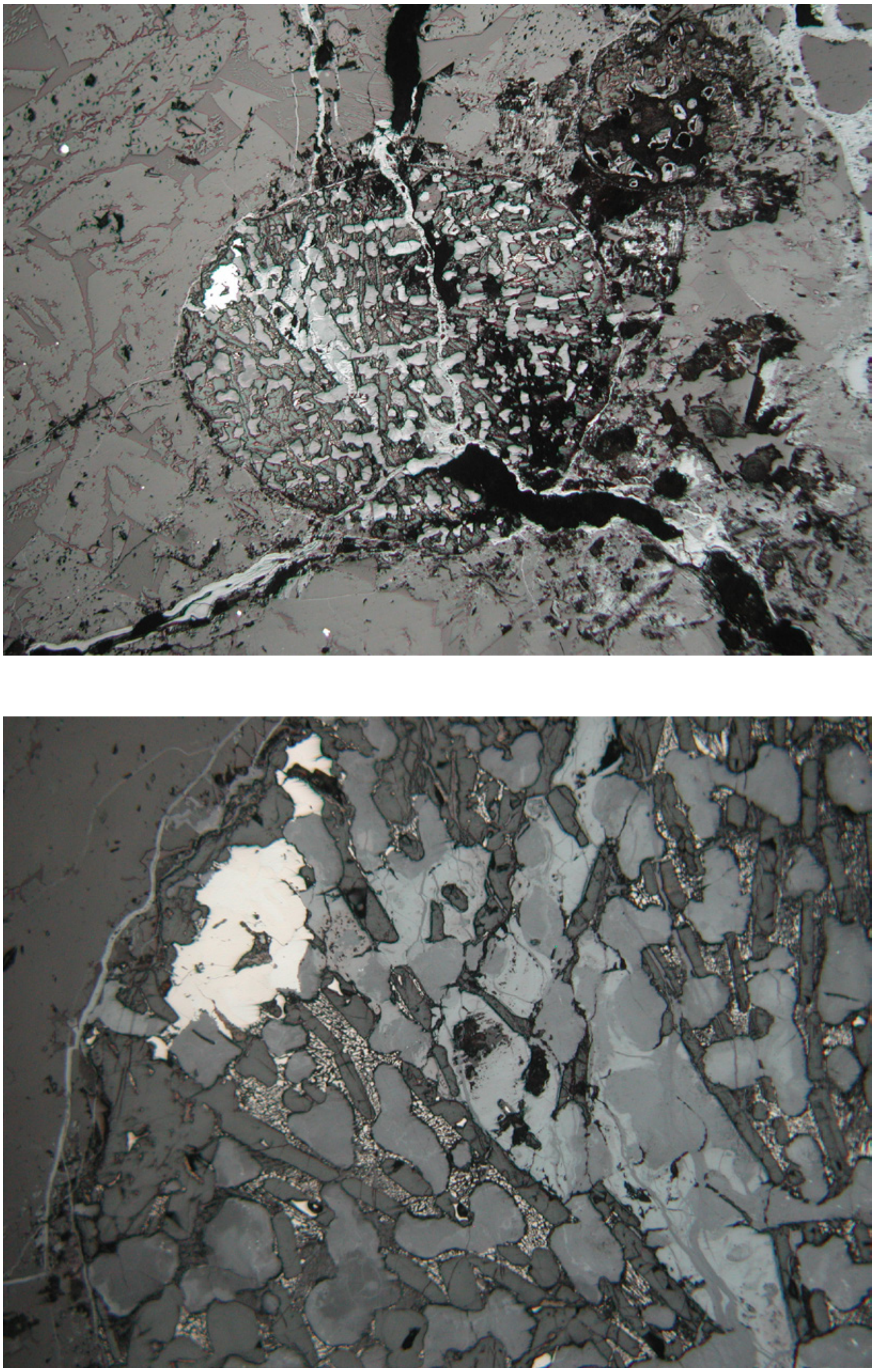


FIGURE 16.6 *a) Optical micrograph of a mostly corroded high-carbon prill within sample Ek-C 18C (069) at 50× magnification – width of image ca 3 mm. b) Close-up of Fig. 16.6a, sample Ek-C 18C (069), showing the remaining metal (white) and the texture of what was probably grey cast iron (different grey shades). Taken at 200× magnification – width of image ca 0.8 mm.*

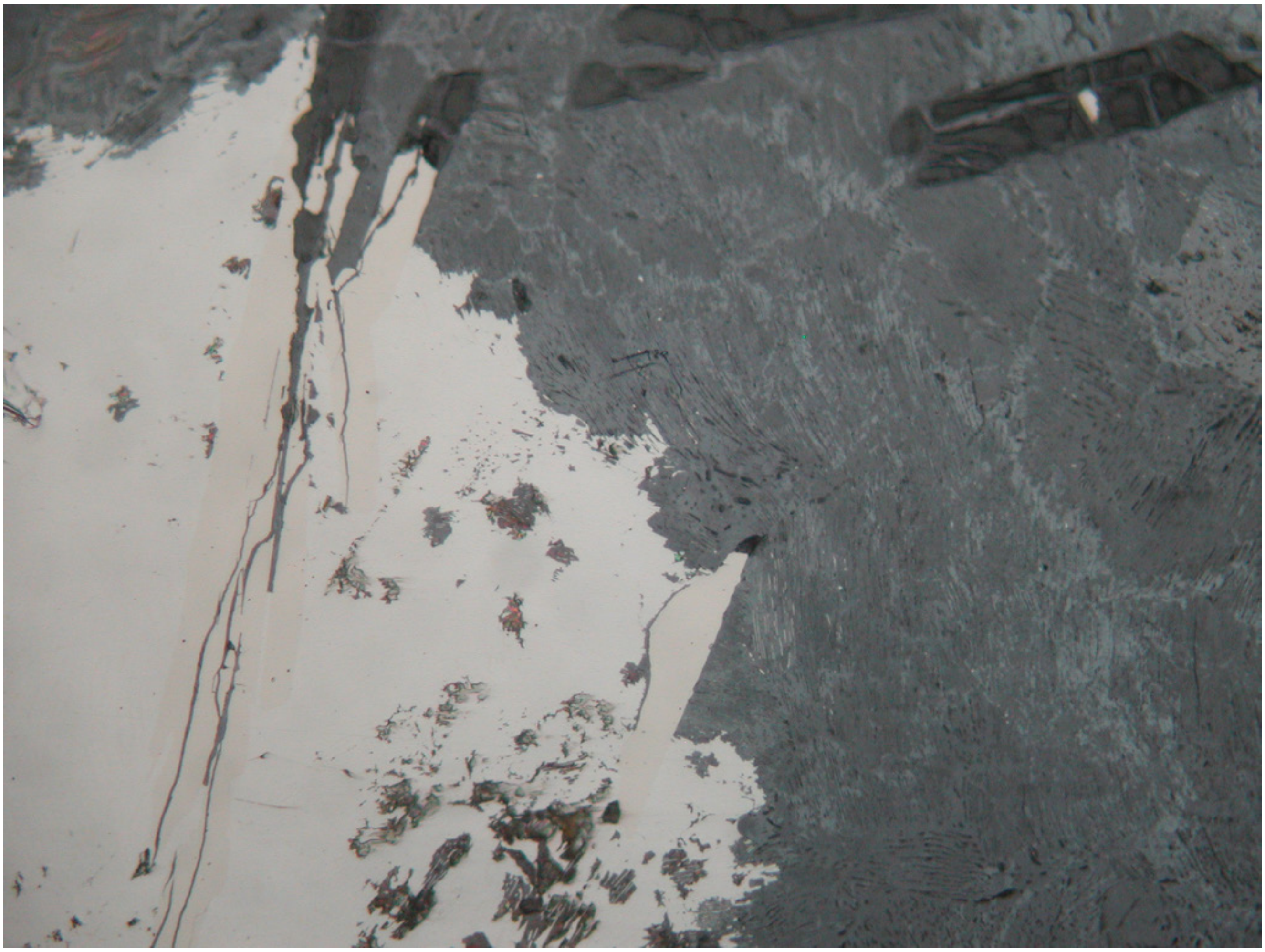


FIGURE 16.7 *Optical micrograph of a partly corroded high-carbon prill in sample Ek-A 87H (022), showing plates of cementite (Fe_3C, white as metal and dark grey where corroded,* e.g. *top and top right) embedded in iron (also white, and mid-grey where corroded). Taken at 500x magnification – width of image* ca *0.4 mm.*

prills in a fayalitic slag (see *e.g.* Fig. 16.9). Several of these were submitted for lead isotope analysis to test whether they can be linked to any of the copper-based artefacts found on site (see Chapter 17, App. K). The present material was insufficient to justify a more detailed technological study beyond the basic identification of copper smelting slag. Of note is that the sulphur content indicates the smelting of a sulphidic copper ore, while the generally low iron oxide content indicates that the ore was very rich. The generally low amount of copper trapped in the slag indicates that the smelting operation was conducted to a high standard. An example is slag Ek-A 86B, a fragment of tap slag with a clear flow pattern and very smooth and dense appearance. The polished block confirms this impression of a well-executed process using a high-grade sulphidic copper ore (Fig. 16.10).

The texture of the slag is dominated by long thin needles of silicate crystals in a mostly glassy matrix, and numerous prills of copper sulphide and copper metal, often combined in a single prill (Fig. 16.11). The analysed sample is notably free of magnetite; however, other copper slags do react to the magnet indicating that this absence is not a common feature of the copper slags from Essouk-Tadmekka. The shape of the silicate crystals indicates a rapid cooling of the melt, consistent with tapping from the furnace, while the presence of copper-copper sulphide prills and associated gas bubbles is strong evidence that the slag formed during the smelting of copper metal from a sulphidic ore, and not during re-melting of copper for casting. However, it is a single piece and no further conclusions can be drawn from it. Even so, the presence of copper smelting slag here is in remarkable contrast to the typical prevalence of copper (alloy) working slag in most medieval urban contexts, which have often much higher copper contents and are rich in alloying elements such as zinc or tin and lead.

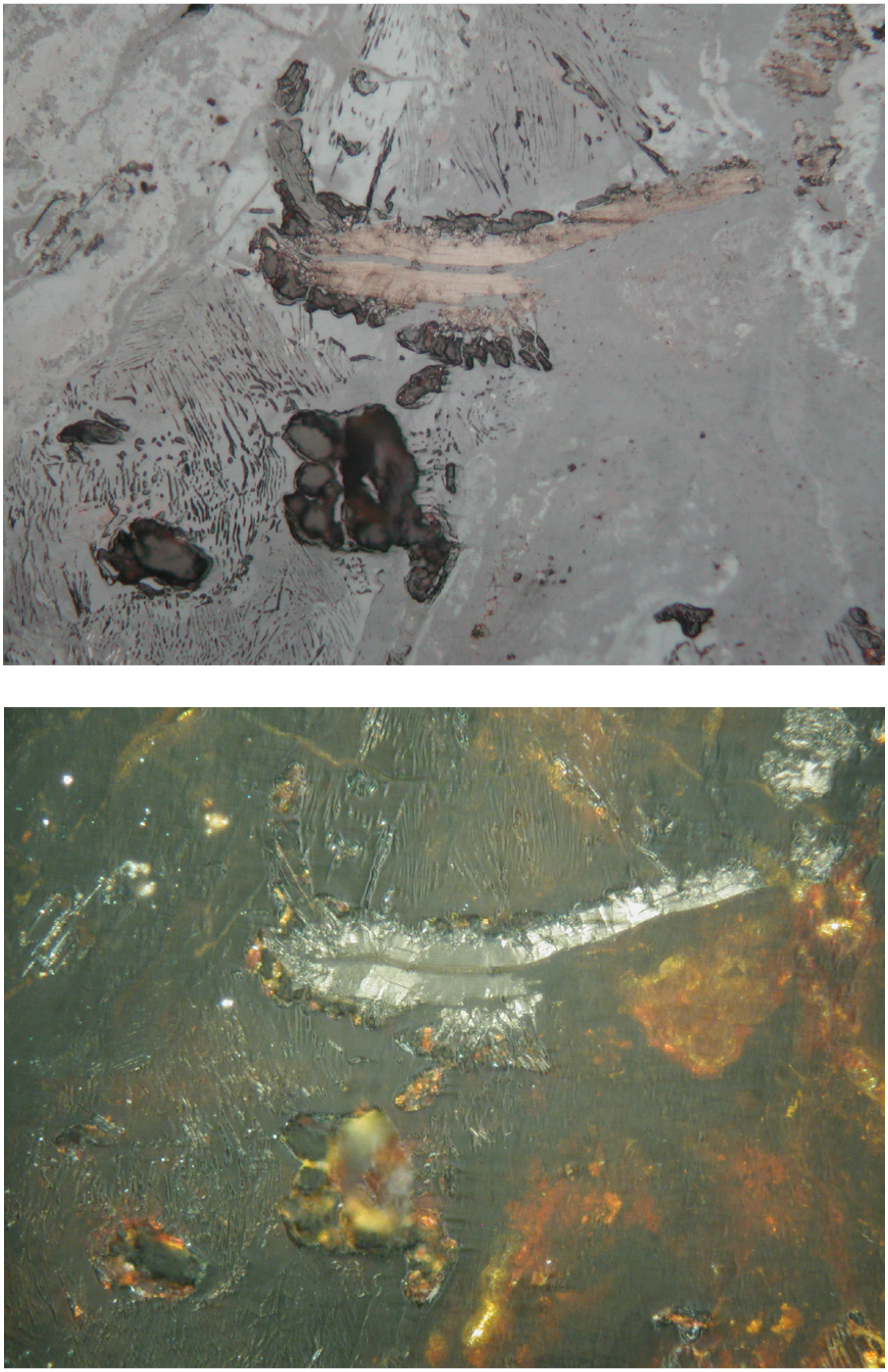


FIGURE 16.8 *a) Optical micrograph showing a flake of graphite (upper centre) in sample Ek-A 87H (022). Taken at 500× magnification; dark grey are slag inclusions, mid grey is corroded metal, partly showing pearlite ghost structures (lower left sector). b) The same view under crossed polarisers, showing the characteristic appearance of graphite in different light grey shades.*

FIGURE 16.9 *Essouk copper slag (only 'a' has been sectioned) (both sample and context number are provided here; see App. I for descriptions of examples shown here).*

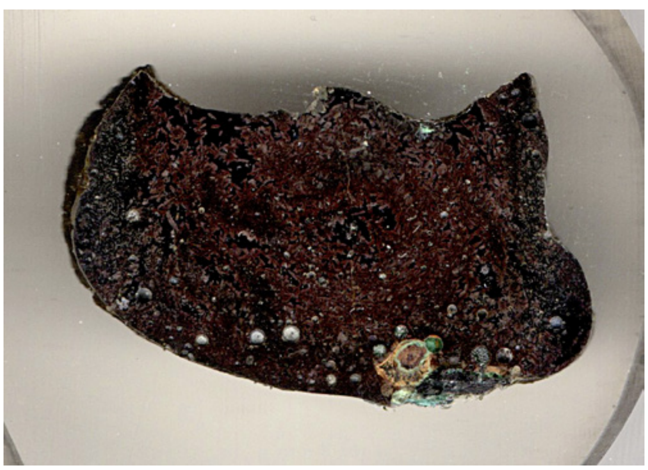


FIGURE 16.10 *Polished block of copper slag sample Ek-A 86B (023). The orientation of the sample (upper or lower surface) is uncertain, but it does show a tap flow pattern. Width of cut sample is* ca *2 cm.*

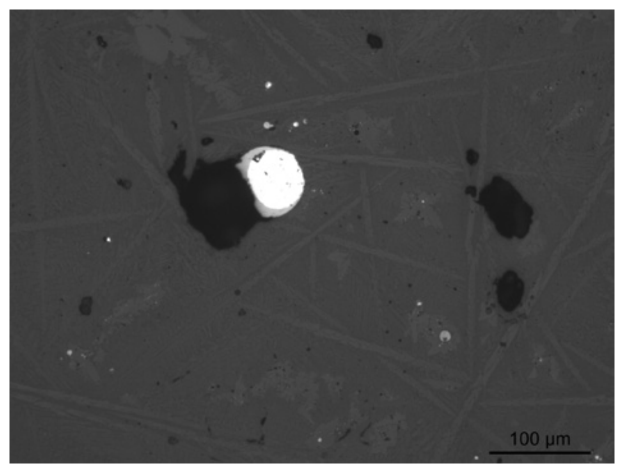


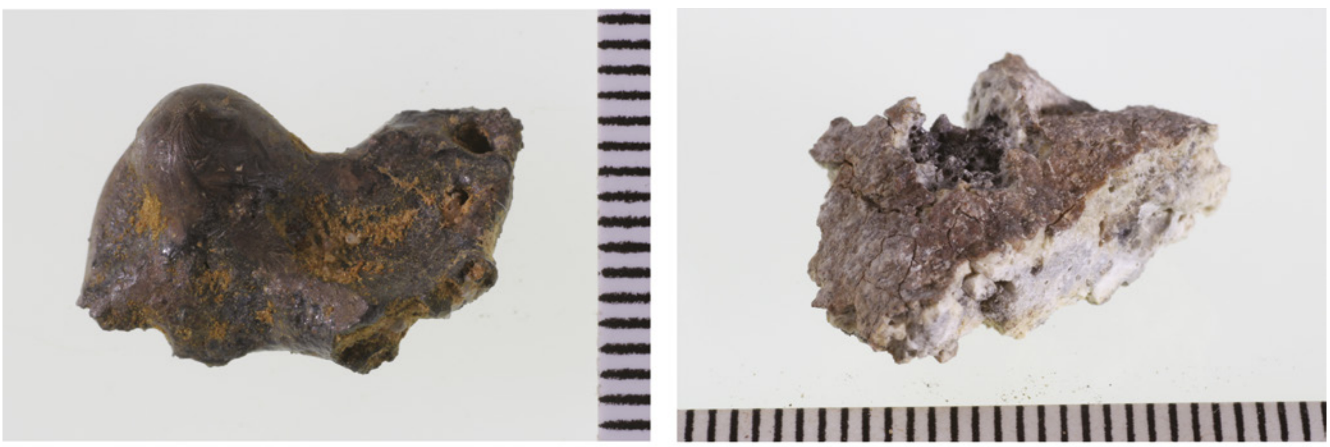
FIGURE 16.11 *Optical micrograph of sample Ek-A 86B (023) showing a combined copper metal – copper sulphide prill with an associated gas bubble, embedded in glassy slag (dark grey) with needle-like silicate crystals (mid grey). The combination of copper sulphide (mid grey), copper metal (bright) and associated gas bubbles (black) is indicative of the ongoing chemical reaction whereby copper sulphide is oxidised to copper metal and sulphur dioxide (forming the gas bubbles).*

Other High-temperature Material

Nearly a quarter of the entire metallurgical assemblage (18 samples out of 74) were identified as being related to some sort of high-temperature process, without attribution to a more specific technology (see *e.g.* Figs. 16.12, 16.13). This category includes superficially vitrified material such as technical ceramic or stones, but also material that resembles fuel ash slag, formed in a firing chamber or furnace pit from the reaction of fuel ash with some of the soil or ceramic, and other unidentified material. Such finds are common among most metallurgical workshops, but also form in pottery kilns, glass workshops, or even domestic hearths or destructive fires. Among this category is also a single piece of lead metal and a small flat lump tentatively identified as bitumen; both could have been brought to the site for any number of uses in domestic craft production, and do not indicate any specific activity. While this material looked generally unpromising for analysis, it was among this category that one of the gold refining crucibles (see Chapter 15) was discovered, following careful and repeated inspection based on the results of the earlier rounds of study.

a (013 Ek-A 93A) **b** (014 Ek-A 93B) **c** (019 Ek-A 89A)

FIGURE 16.12 *Various unidentified crucible fragments (both sample and context number are provided here; see App. I for descriptions of examples shown here).*



a (001 Ek-A 118) **b** (003 Ek-A 113)

FIGURE 16.13 *Highly vitrified furnace wall material/hearth lining fragments (both sample and context number are provided here; see App. I for descriptions of examples shown here).*

Discussion

The excavations at Essouk-Tadmekka have yielded tantalising evidence for highly specialised and unexpected metallurgical activities. The evidence for gold processing and coin making has been discussed in detail in the previous chapter; of similar outstanding significance is the evidence for the local production of crucible steel in Essouk-Tadmekka. Much of the evidence comes from layers dated to around AD 950 to 1050, which is contemporary to the heyday of early Islamic crucible steel production in Central Asia and the currently emerging first evidence for this technology in central Iran, the suspected centre of Persian crucible steel making. Several questions arise also with regard to the fragments of bloomery smelting slag and crown material, which dominates the metallurgical assemblage from Essouk-Tadmekka.

Bloomery iron smelting is a very established and widely used process, dominating iron production in Africa, Europe and much of Western and Central Asia since the inception of iron metallurgy in the Late Bronze Age, and until the beginning of the Industrial Revolution in Europe and the Colonial period in Africa. Evidence for bloomery smelting at this time, in the heart of northern Africa, is in itself not surprising. However, bloomery smelting is a very fuel-intensive metallurgy, and typically concentrated in areas that have both rich iron ore deposits and sufficient wood resources. As a result, much of it took place in areas away from settlements, where fire wood would be used preferentially for cooking and heating. The landscape surrounding Essouk-Tadmekka does not lend itself to sustain a significant bloomery industry, and it is unlikely that this would have been very different when Essouk-Tadmekka was a thriving trading centre. The presence of bloomery slag and related material, therefore, needs to be discussed and if possible explained.

Discussion of the Essouk-Tadmekka archaeometallurgical material is usefully approached by reference being made to the technologically closest parallel, even though it is geographically situated at the opposite end of the

Islamic world: the site of Akhsiket in eastern Uzbekistan. Akhsiket shares several fundamental similarities with Essouk-Tadmekka, in that it also formed a node on a continent-wide trade route, in this case the Silk Road. It flourished during the early Islamic period, with little if any activity following the wide-spread destructions of the 1220s that changed the course of Central Asian history. Excavations in Akhsiket by the Institute of Archaeology of the Uzbek (formerly Soviet) Academy of Sciences over several decades have opened numerous trenches across the city. In all of them, small fragments of crucible steel crucibles and various types of iron slag form part of the background 'noise' among the archaeological finds. Significant quantities of crucible steel production waste were only found in a few relatively limited areas along and just outside the city fortifications (Rehren & Papakhristu 2000), and only recognised as such in the late 1980s. A reconstruction of its crucible steel industry (Rehren & Papakhristu 2000) postulates that it used freshly-smelted bloomery iron from the mountainous hinterland as feed stock for the process. The raw blooms would have been brought to the city where they underwent a final cleaning to remove unwanted slag and other waste material before being broken up and placed in the crucibles; this explains the presence of small but consistent quantities of bloomery slag and crown material within the city, even though the actual bloomery smelting took place elsewhere. A similar picture is emerging from the ongoing research at the early Islamic crucible steel site of Chahak in central Iran (Alipour & Rehren 2014). It is possible that in both cases the crucible process was conducted in the city and not next to the bloomery sites in the mountains due to the high value and strategic nature of the product; the crucible steel ingots were the direct starting material to produce Damascene swords and other high-end tools and bladed instruments, and as such much more valuable and probably better controlled than ordinary bloomery iron.

Projecting this scenario to the evidence from Essouk-Tadmekka would indicate that the Islamic elite that ruled Tadmekka either brought with them the know-how of crucible steel production, whether from Persia or any other production area in Asia, or gained this knowledge from traders. The feed stock for the process would be bloomery iron imported from sub-Saharan Africa, as indicated by the presence of small pieces of bloomery slag and crown material that would have formed part of the raw bloomery iron. It is less likely that the crucible process used circulating iron metal from tools etc. as its starting material, since this would not result in the presence of bloomery slag and crown material scattered across the site. The bloomery iron would then have been placed in purpose-built crucibles together with some organic material and mineral fluxes, in keeping with the recipes recorded in early Islamic manuscripts, and fired for extended periods of time to very high temperatures. This could have been achieved using low-quality fuel not suitable for charcoal production, such as agricultural waste or brushwood, which burns fast and hot enough to provide the very high temperatures necessary for the process. The resulting crucible steel ingots would then have been worked locally to produce knives, daggers or similar artefacts of outstanding sharpness, value and prestige. It is impossible to say at this point whether these would have been worked and surface-etched to develop and reveal the typical Damascene pattern of crucible steel known from later swords and daggers (Feuerbach 2005). Similarly, it is impossible to estimate the scale of production; it may well have been a small-scale industry suited to satisfy the immediate needs of the local Islamic elite rather than reaching the large-scale surplus production documented for both Central Asia and India.

A similar pattern of small-scale production also emerges for the evidence for crucible steel metallurgy in Merv, Turkmenistan, another major Silk Road city (Feuerbach *et al.* 1997, 2003; Simpson 2001), where a more limited production is documented compared to Akhsiket. Merv is situated at an inland delta of a seasonal river in a predominantly arid environment; demand for fire wood would have been high in this city compared to the limited supply. However, as in Akhsiket there is a scatter of small fragments of crucible steel crucibles and iron slag evident across the site, mixed with indications for copper metallurgy and glass working, confirming that sufficient fuel was available to sustain these crafts within the city, rather than relocating them to more wooded areas elsewhere and trading the final produce into the city centre. We therefore begin to recognise a pattern for early Islamic urban metallurgy, with a significant presence of multiple high-temperature crafts within the confines of the city even if the environment offered only limited fuel resources. The choice of crafts and industries to be located within the city was most likely controlled by factors such as commercial value and strategic importance of the relevant material, with both gold and crucible steel featuring high on the list, followed by glass and glazed pottery production, and smithing of everyday objects. The specific location of each craft within the city would have been controlled by a mixture of central planning and organic development and is beyond the scope of this discussion; however, it seems clear that the taphonomic processes affecting the distribution of the evidence across the city's area are similar for all sites mentioned, and resulted in this background noise of metallurgical waste material which bears so much information value in principle about the activities happening in the city, even if no specific workshop sites have yet been identified.

As at Essouk-Tadmekka, copper slag also contributes to the 'noise' among the excavation units in Akhsiket and Merv; but no centre of activity for copper technology has yet been found in either of the sites, making it very difficult at this stage of our research to offer a meaningful interpretation of this material. It seems interesting though to note that unit Ek-B, which had the lowest total number of metallurgical debris (14 finds of 74) had by far the most finds related to copper metallurgy; this could indicate that copper workshops were relatively near to this unit.

Conclusion

The excavations at Essouk-Tadmekka have shown, despite their very limited extent, that Tadmekka was home to a range of high-value and very specialised craft operations, including the gold working documented in the previous chapter, and the evidence of crucible steel production using fresh bloomery iron presented here. In addition, there is evidence for copper metallurgy of some sort on site (as well as glass-working within the context of gold refining). It is also reasonable to assume smithing of iron implements for domestic and every-day use and repair. This is in line with evidence from other early Islamic centres, and suggests that highly specialised crafts were brought to the site as part of Islamisation and confirm Tadmekka's function as a major trading point. Any discussion of scale of production, or organisation of it within the cityscape, has to wait until much more extensive excavations have taken place; the depth of the archaeological layers indicates that simple surface survey will not provide the necessary spatial and chronological resolution to substitute for excavation.

The study does, however, again underline the utility of careful study of even small finds, and the richness of information that can be retrieved through careful archaeometric investigation of not obviously appealing finds.

CHAPTER 17

Coins and Other Metal Artefacts

Sam Nixon

Overview

Over 200 metal artefacts were recorded during the excavations at Essouk-Tadmekka, with roughly half made of iron and half of copper-alloys (see Tab. 17.1). An important subset of the evidence is a small group of coins, five of which are silver. These are of particular interest not only due to the fact that there have been very few coin finds in West Africa, but also due to the evidence presented earlier for the existence of a gold coin production industry at Essouk-Tadmekka. Note should also be made that one metal item has already been presented in Chapter 16 (a fragment of lead, possibly related to a working context).

The study of the metals has been hugely enhanced by a program of conservation and technical and chemical analysis. Many of the finds when recovered were covered in thick concretion layers and totally unidentifiable, but careful conservation work allowed us to better understand the nature of distinct subsets of the assemblage, as well as to identify individually important items. This work included a focused program on the coins (see App. J). Programs of technical and chemical analysis on the finds (see App. K) have also provided us with important insights into the metals trade and metalwork products at the site. This includes the important copper-alloy trade, a major discussion topic in early West African commerce and art history. In the following we provide a summary of the results, together with photographic and drawn illustrations of distinct artefact types and individually important items.

Coins

Six coins were recorded in all during the excavations (see Fig. 17.1–17.2). Five of these are silver, found in contexts Ek-A 55, Ek-A 70, Ek-A 72, Ek-A 75, and Ek-A 79. The remaining coin is a copper-alloy, from context Ek-A 40. When excavated, these artefacts were all covered in varying levels of corrosion layers (see *e.g.* Fig. 17.2) and at this stage the main basis for identifying them as coins was their shape and their lack of a perforation. From the nature of the corrosion layers, however, one could see that some were almost certainly made of silver. Given the very rare recovery of coin finds in West Africa (see below) it was seen as essential to attempt to learn as much as possible about them, and accordingly a dedicated program was undertaken involving XRF, digital X-ray and conservation (see App. J).

XRF provided confirmation of the metals of the coins, five being silver and one a copper-alloy. Prior to this work, one of the silver coins (Ek-A 75 – see Fig. 17.1 middle) had already been sectioned (unfortunately prior to conservation) and chemical and technical analysis of this item provides us with a detailed insight into its nature (see App. K). In particular, it is important to highlight that the Lead Isotope Analysis of this silver indicated a very close match with Moroccan silver ores. The digital X-ray work revealed inscriptions on four of the silver coins (Ek-A 70, Ek-A 72, Ek-A 75, and Ek-A 79), though given that they were very small (most being *ca* 1cm in diameter) and/or thin this did not provide an entirely clear picture of preserved features of the coins under the corrosion layer. A cleaning program was undertaken, focusing in particular on three of the silver coins seeming to offer the best potential for revealing their inscriptions, those from Ek-A 70, Ek-A 75, and Ek-A 79. The copper alloy coin did not produce any clear inscriptions upon cleaning, while the two remaining silver coins remain to be fully cleaned. While it was not possible to fully clean the three coins upon which we revealed the inscriptions (only one side of each coin presented in Fig. 17.1 was cleaned), the cleaning that was done did show that all three coins were clearly Islamic issues, with Arabic letters being clearly visible (Fig. 17.1). No clear words or phrases could be read however, and given the lack of full and distinct inscriptions one cannot determine the dynasty or mint location of these coins. While this is so, the inscriptions revealed are seen to offer sufficient potential for identification with known coinages, based upon overall patterning and appearance. This said, comparison with the British Museum coin collections and reference literature (ALBUM 1999 – in prep.), as well as consultation with experts (V. Curtis pers. comm.), did not produce any clear identifications. The publication here of the coins in their current state of conservation hopefully provides sufficient information for future studies to identify them. Given the very small size of the coins and their heavy corrosion layers,

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TABLE 17.1 *Essouk-Tadmekka metal artefacts shown by unit horizon (*note: this does not feature coins nor finds from Ek-C Horizon '0' – see however text for 'kohl applicator' from Ek-C Horizon '0')* (table continues on opposite page)

	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	B1	B2	B3	C1	C2	C3	Total
Iron																					***116***
Sword/dagger blade tip	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	1
Arrow/spear-head (barb 3–5cm) (*e.g. Fig. 17.3*)	–	–	–	–	–	–	–	–	2	–	1	–	–	–	–	–	–	–	–	–	3
Very small arrow-head (barb 1cm)	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	1
Large cotter pin (*Fig. 17.5b*)	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	1
Large chain section link (?) (*Fig. 17.5a*)	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	1
Large nail head/boss (?) (*Fig. 17.5c*)	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	1
'Tweezers' (*Fig. 17.5d*)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	1
Sub-rectangular sheet metal object, 2 piercings (*Fig 17.7a–b*)	–	–	–	–	–	–	–	–	–	–	1	–	1	–	–	–	–	–	–	–	2
Perforated sheet metal frag. & attached link (*Fig.17.7c*)	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	1
Pierced sheet metal frag.	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	1
Hammered/sheet fragments (< 3 cm^2)	–	–	–	–	–	–	–	–	–	1	4	1	–	1	–	2	2	1	1		13
Hammered/sheet metal length (*ca* 1cm × 3–6 cm)	–	–	–	–	–	–	–	–	2	1	–	–	1	–	–	1	1	–	–	–	6
Straight length (< 0.5 diam, < 5cm long)	–	–	–	–	5	2	–	–	–	–	–	–	1	–	–	–	–	–	–	–	8
Straight length (*ca* 0.5–1cm diam., < 10cm long)	–	–	1	1	–	1	–	1	5	3	5	2	2	3	–	4	1	2	1	–	32
Straight length (*ca* 0.5–1cm diam) with bent end (< 5cm long)	–	–	1	–	–	1	–	–	1	2	1	–	–	–	–	1	–	–	1	–	8
Straight length, 1cm diam., 17cm long; end bent	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	1
Small (<2cm^3) curved section/chain link	–	–	–	–	–	–	–	–	–	–	1	–	1	1	1	1	1	–	–	–	6
Indet. small (< ca 2cm^3) frag./frag. cluster	–	–	–	1	1	–	1	1	5	–	1	3	3	–	1	5	3	2	2	–	29
Copper alloy																					***91***
'Loop handle' (*Fig. 17.10 left*)	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	1

	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	B1	B2	B3	C1	C2	C3	Total
Curved ingot section (*Fig. 17.10 right*)	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1
Ingot frag. (?) sub-rectangular (4x1x0.3cm) [art. n^0. 208]	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	1
Ingot frag. (?) wedge shaped (1.5x1.5cm) [art. n^0. 217]	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	1
Small rectangular perforated strip (*e.g. Fig. 17.7e* – *additional example from unknown context not listed)	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	1
Small sub-rectangular perforated strip (*e.g. Fig. 17.7f*)	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	1
Small, thin, perforated fitting with shape based on conjoined circles design (*e.g. Fig. 17.7d*)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	3	1	–	–	–	5
Metal disc with central perforation (*Fig. 17.9*)	–	–	–	1	–	–	–	–	–	–	1	–	–	–	1	2	–	–	–	–	5
Bent metal disc with central perforation	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	1	–	–	–	2
Small sheet frag. (<3cm^2)	–	–	–	–	–	–	–	–	5	–	2	–	1	1	–	5	1	–	2	–	17
Small (<1cm^3) cotter pin	–	–	–	–	–	–	–	–	–	–	3	2	–	–	–	–	–	–	–	–	5
Pin/small nail (<1cm)	–	–	–	–	–	–	–	–	–	–	1	1	–	–	–	–	–	–	–	–	2
Wire frag.	–	–	1	–	1	–	–	1	1	–	1	–	–	1	–	2	1	–	–	–	9
Wire/ring frag.	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	1	–	–	–	2
Small coiled decorative frag.	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	1
Indet. frag. (<1cm^3)	–	–	–	–	1	2		1	6	2	4	6	2	–	3	7	2	–	1	–	36
Copper alloy/iron mix																					***3***
Copper sheet metal frag. with iron link	–	–	–	–	–	–	–	–	2	–	–	–	–	–	–	–	–	–	–	–	2
2 × small rectangular perforated strips held with iron links (*Fig. 17.7g*)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	1

FIGURE 17.1 *Silver coins following conservation. Upper, Ek-A 70; middle, Ek-A 75; lower, Ek-A 79.*

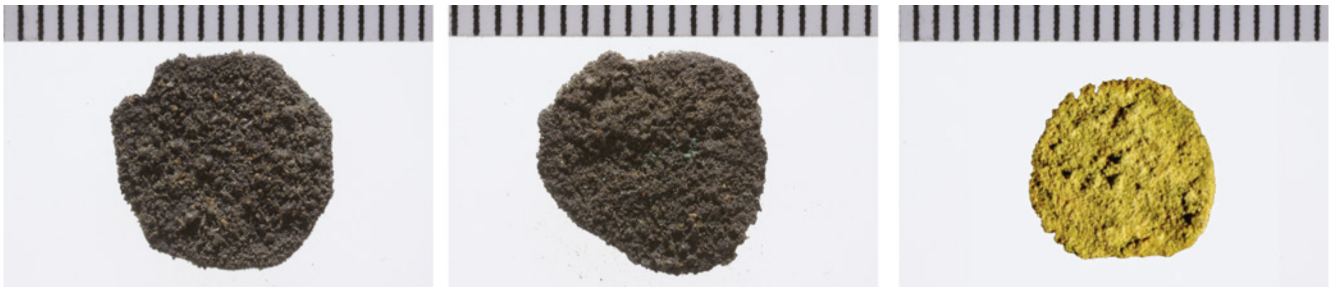

FIGURE 17.2 *Uncleaned coins: Left, Ek-A 72 (silver); middle: Ek-A 55 (silver); right, Ek-A 40 (copper alloy).*

combined with the partial cleaning and or/sectioning, it was felt that providing the weights of the coins was not helpful, and indeed potentially deceptive.

While we are not in a position to make detailed statements regarding the nature of the coin finds, it is important to note that they are highly varied, all six seemingly being of a different form and the three inscriptions revealed all being completely different. Also, it is important to note that they come from more than one discreet context, therefore appearing not to be a single localised 'hoard'. It is however important to note that all the silver coins were found in Ek-A Period 3b.

The evidence for circulation of any form of coinage in West Africa before the modern era is minimal. We have already discussed the gold coinage which circulated at Essouk-Tadmekka, as well as other possible locally produced West African gold coinage (Chapter 15). Looking at other evidence, six Almoravid gold coins were found at a site in Mauritania, close to Tegdaoust (Colin *et al.* 1983: 427–444). Additionally, from Tegdaoust a possible 'bronze' Islamic coin was recorded, listed amongst the glass weight evidence (Launois & devisse 1983: 403). A 10th century gold *dinar* has also been found at Gao (Latruffe 1953). A small collection of what appears to be a copper-alloy coinage was also identified at Azelik-Takedda, though this was neither cleaned nor illustrated (Bernus & Cressier 1991). A few further random finds of coins have also been made, including a pre-Islamic coin and a pre-colonial European coin (see Mauny 1949, 1958; Boudie *et al.* 1967). No Islamic silver coins have previously been found in West Africa, and no inscribed Islamic coins other than the above mentioned evidence from Mauritania and Gao. In light of the evidence for silver coins now recovered from Essouk-Tadmekka, it is interesting to note in particular the almost total absence of coins from the comparable site of Tegdaoust in Mauritania, a site which was not only extensively excavated but at which a fairly significant amount of glass coin weights were found (Launois & Devisse 1983: 399–419).

Regarding historical records of coinage circulation in West Africa, other than the references to Tadmekka's gold coinage and other limited references to gold coinage discussed in Chapter 15, there are only two other known documentary records referring to the circulation of coinage in West Africa, both references to silver coins. The first relates to 14th-century Kanem, near Lake Chad (Levtzion & Hopkins 2000: 260): "… they use cowries, beads, copper in round pieces, and coined silver as currency, but all valued in terms of that cloth [referring to cloth exchange discussed previously]". It is not clear from this description whether the coinage referred to here is locally produced or imported. Far clearer is a 15th-century reference, describing the presence in Egypt of silver coinage from 'Bilad al-Takrur', a generic name for West Africa (Bacharach 1967: 111, 224). Importantly this 15th-century reference is made in the context of an edict specifying that these 'Takrur' coins were illegal in Mamluk Egypt, and were to be brought to the mint to be melted down. Not only is this a very precise and realistic description, the fact that these coins were to be melted down possibly provides an explanation for their archaeological absence in North Africa. The non-specific name 'Takrur' though means the West African state or region referred to here is unclear. Given the 14th century description of a silver coinage from Kanem, and given the likely connections of Kanem and Egypt across the trans-Saharan routes, we should certainly consider this Egyptian record might also be referring to Kanemi silver coinage, albeit one century later.

While coinage as a money form was undoubtedly limited in West Africa, clearly there was some level at which coins interfaced with other currency forms. The silver coins we have recovered from Essouk-Tadmekka now add to this emerging picture, in the same way as the gold coin mould evidence discussed earlier. The Essouk-Tadmekka evidence for silver coinage is likely a sign of a coinage interacting with local monetary forms, in a similar way to what is being described at Kanem in the 14th century

Arabic sources. While West African silver sources are unknown, imported silver (whether in coin form or raw silver to be minted) would potentially have been very attractive, in particular as it was clearly distinguishable from the locally available precious metal, gold, and therefore a highly controllable currency form. The only other finding of silver previously from West Africa is a silver chain recovered at Tegdaoust (Devisse 1988: 405). Given the lack of previous evidence for locally minted coinages in West Africa, one would assume that the coins recovered at Essouk-Tadmekka are imports, and this would indeed be the best working hypothesis. At the same time, until clear identification is made, one must not dismiss out of hand the possibility they were produced in West Africa. Certainly, the 15th century record of a silver 'Takrur' coinage means it is highly likely archaeological evidence of indigenous West African silver coinage will be recovered in future.

Iron

Iron artefacts or fragments of them are found in all three units and throughout the sequence and there does not appear to be any particularly distinctive patterning in their distribution. While iron artefacts are not present in Ek-A Period 1, given the limited area excavated one should not overinterpret this absence. There is only a very minimal combination of iron with copper in the same artefact but it is useful to note the examples we did recover where they are used in combination (see Tab. 17.1). As we saw in the previous chapter, there is relatively extensive evidence for iron working at the site, and it is likely that a significant proportion of iron artefacts would be produced locally. We must also recognise though that iron artefacts were likely traded to the town, in view of the early Arabic references to iron tools being included in trans-Saharan shipments from North Africa (*e.g.* Levtzion & Hopkins 2000: 128).

The vast majority of iron artefacts recovered were indeterminate or unidentifiable corroded fragments. Likely the majority of these relate to corroded sections of artefacts such as nails or arrows, as well as other basic utilitarian items for construction and industry in the town, or indeed items of ornamentation. In addition to this large body of corroded fragments, amongst the finds there are also some clearly identifiable items. In addition to being important in themselves these identifiable items provide us with a sense of what the large body of corroded fragments might relate to.

The first category of identifiable artefacts relates to hunting and/or warfare. We see evidence of arrow or spearheads (Fig. 17.3) and a dagger or sword blade point (Fig. 17.4). The arrows are fairly common forms, seemingly with single barbs, and were likely attached to some kind of wooden shaft. Their level of preservation is not good enough to say much more about them. It does seem likely that many of the straight, thin sections of iron which make up a significant quantity of the unidentifiable fragments relate to broken arrow-head shafts. Dagger or sword blade fragments are far rarer finds and accordingly we X-rayed the example we found as well as attempting to conserve it. We also analysed the blade cross-section to see its construction and specifically to determine if it was made of steel, this being a major concern of research on such items (see Nicolle 1999), and in view of the reference to the use of steel swords (*hind*) in medieval West Africa, for example in the 11th century descriptions of the Almoravid army (Levtzion & Hopkins 2000: 164–65). The analysis showed that in fact this blade appeared to be produced from common bloomery iron (App. K), though undoubtedly the crucible steel industry presented in Chapter 16 would have been linked to production of similar items. X-ray and conservation detected no decorative surface or formal treatment of the blade.

Amongst the identifiable items we also recovered artefacts related to construction or industry. No clearly identifiable nails were found, though certain items appeared as such, including one which is possibly a large nail or boss head (Fig. 17.5c) – given the heavy level of corrosion failure to detect intact nails is perhaps not surprising. One of the larger items recorded is almost certainly a cotter pin (Fig. 17.5b), likely used for holding some large element of a larger wood or metal construction in place. This was found together with another large item, what appears to be some form of chain link (Fig. 17.5a). A *ca* 17cm long length of iron was another large item recovered (see Tab. 17.1), though its function could not be identified. The most interesting item telling us about the use of iron in the domestic environment was a large key, almost certainly a door key (Fig. 17.6), only identifiable after X-ray and significant conservation work. This conforms to a classic model of early Islamic doorkeys. The key was found deep within the Ek-A deposits of Period 2 (Horizon 4), likely dating to the 10th century. There is no known tradition of key making or the use of locks in the Sahel zone at that period, though a key and a lock was found at Koumbi Saleh from a later medieval context (Berthier 1997). In addition to giving us a glimpse into Essouk-Tadmekka's early urban fabric, this seems to be telling us that there is something sufficiently valuable to be locked up. This would appear to provide confirmation of the trans-Saharan role of Essouk-Tadmekka at this early period, likely relating to the locking up of either North African commodities, gold, or slaves.

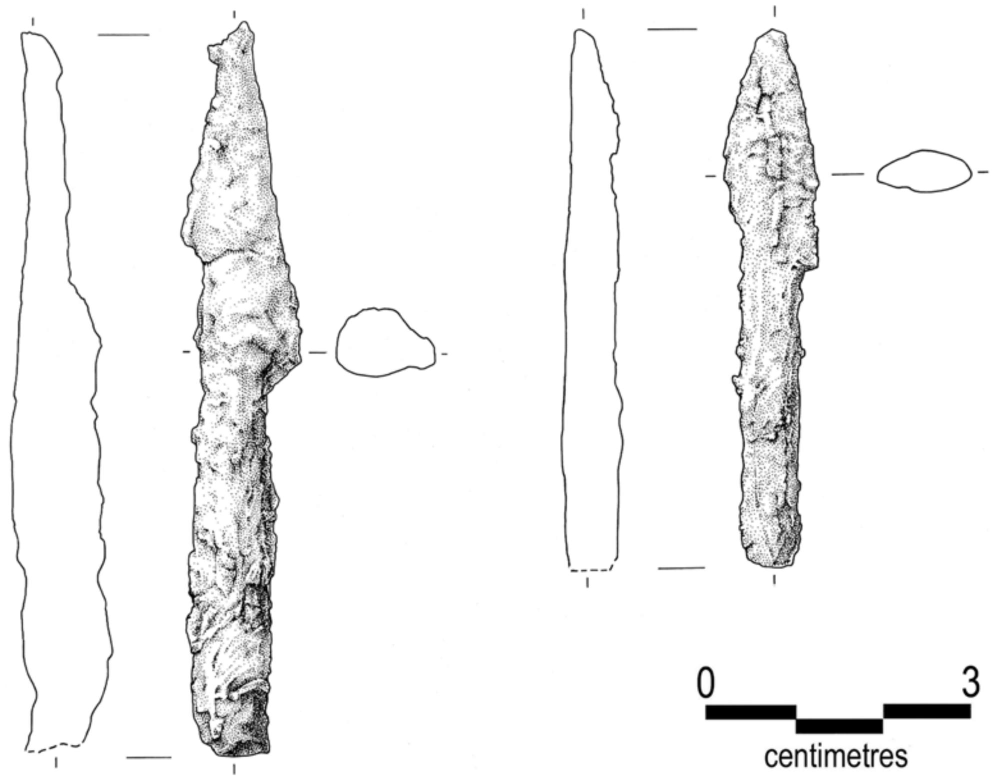

FIGURE 17.3 *Iron arrow/spearheads (both from context Ek-A 84).*

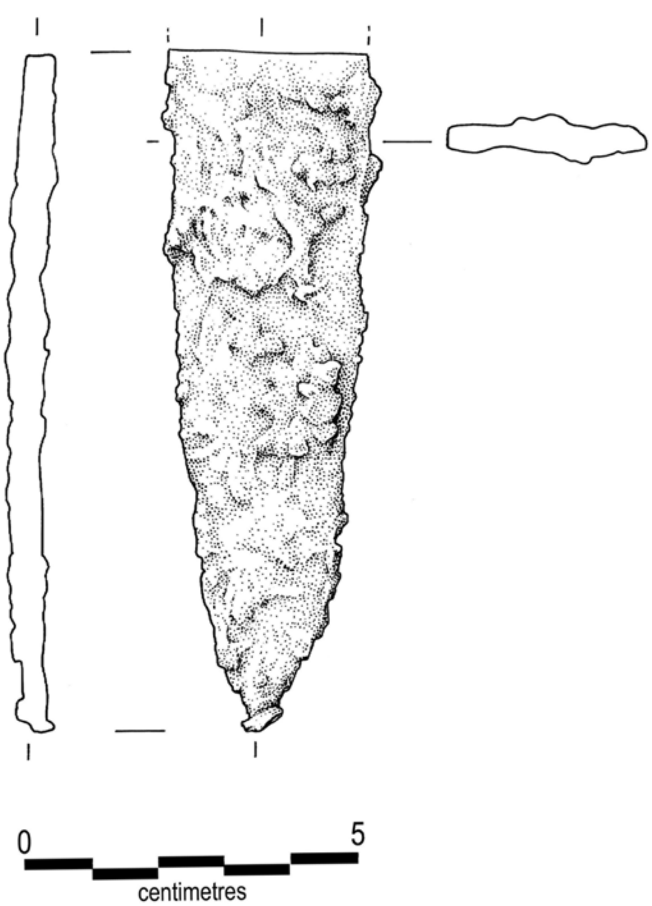

FIGURE 17.4
Iron sword/dagger tip (Ek-C 7) – see Figure K.5 *for image of cross-section of blade.*

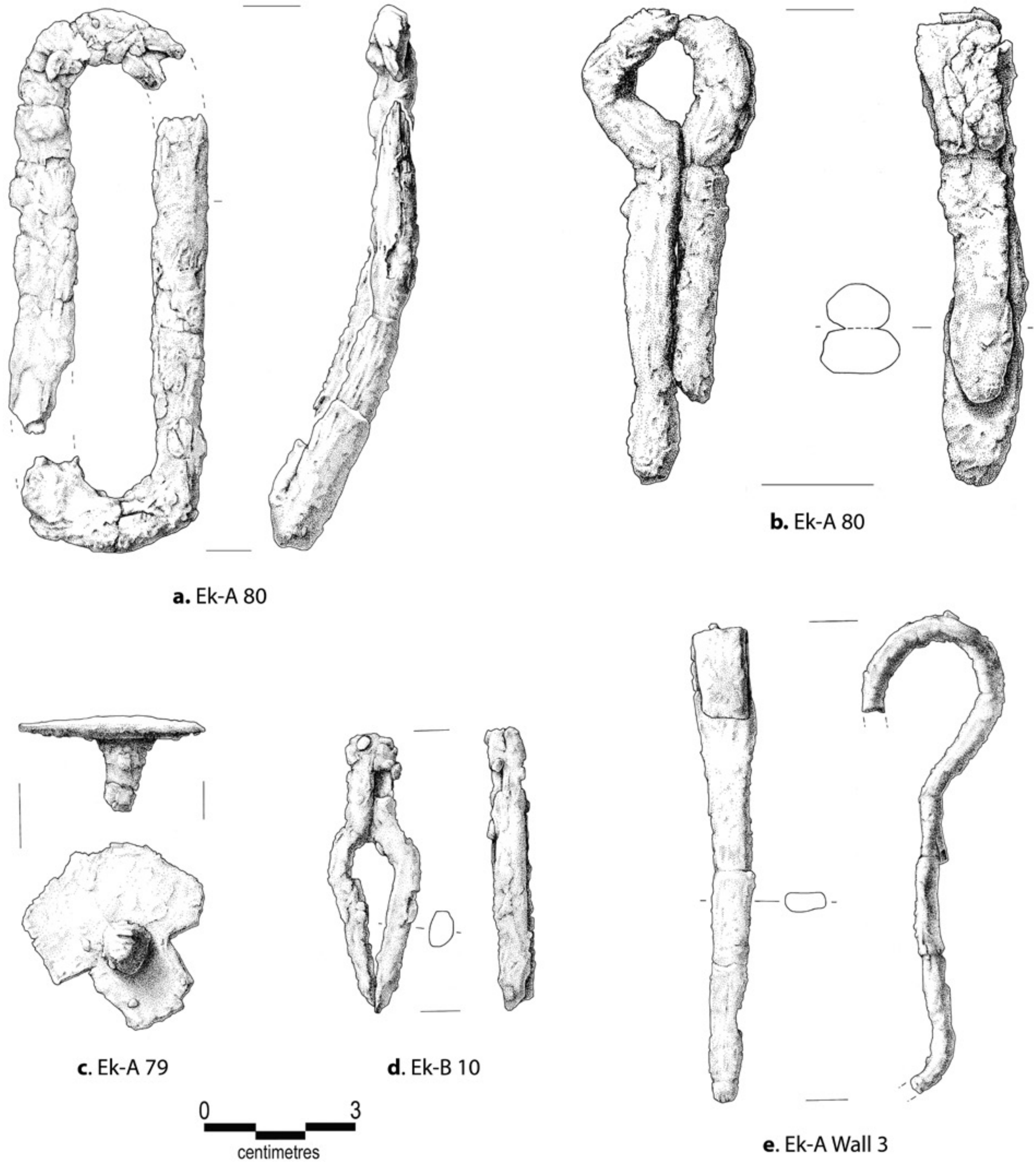

FIGURE 17.5 *Selection of excavated iron artefacts: a, unidentified (found in association with b); b, cotter pin (found in association with a); c, large nailhead/boss (?); d, tweezers (?); e, unidentified.*

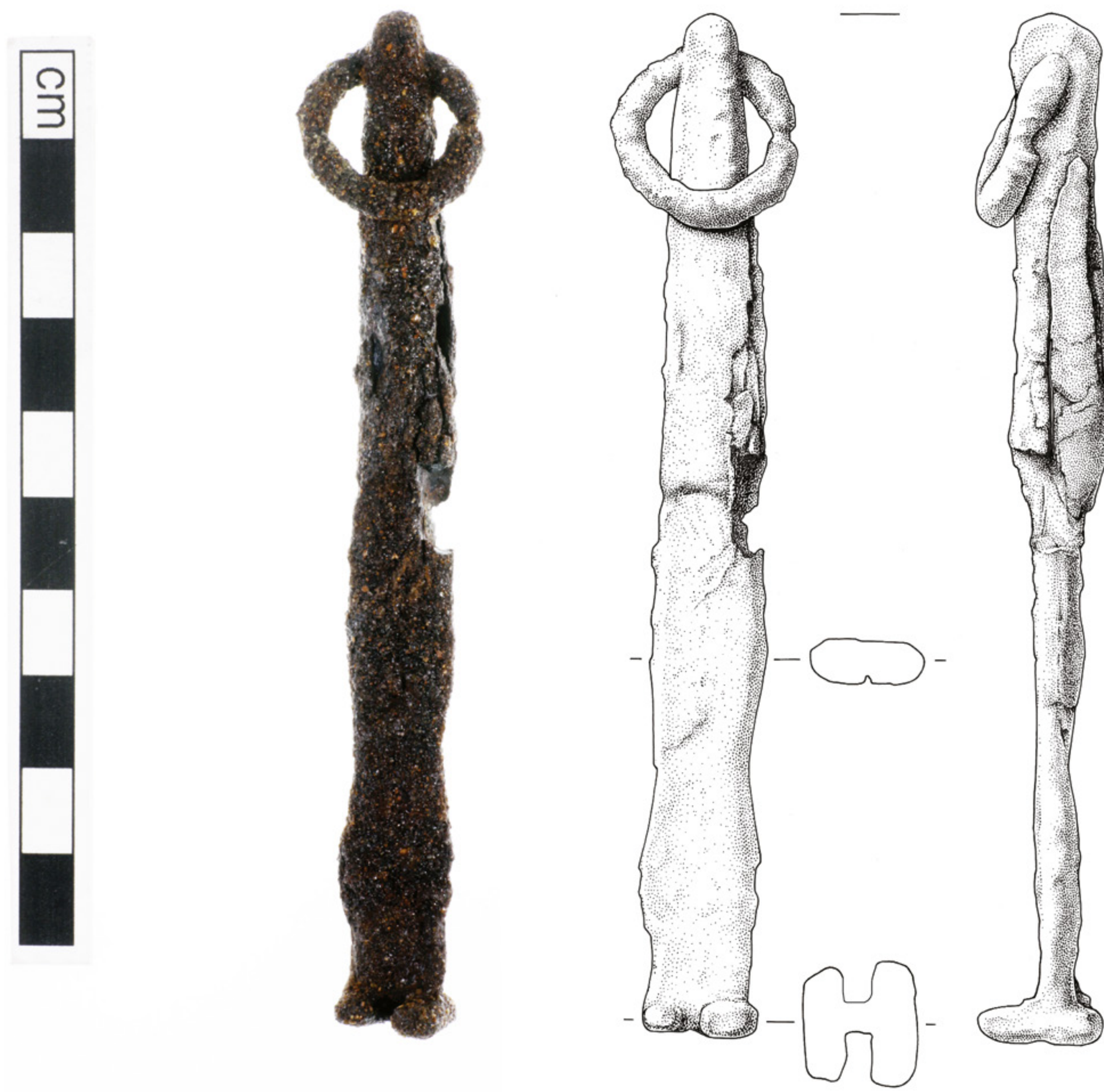

FIGURE 17.6 *Photograph and drawing of iron key on ring (Ek-A 110). While not detectable to the naked eye, from X-ray images one can discern a series of 3–4 parallel raised decorative bands running around the shaft of the key just below the hole into which the key-ring fits (contained within the area defined by the ring as illustrated here).*

Amongst the other preserved iron objects we have a small body of sheet metal items, perforated at both ends. These appear to relate to some form of decorative use, and the evidence seems to suggest these were affixed to other objects or to a larger surface using iron fittings (see Fig. 17.7). Again, the relatively large amount of sheet metal amongst the unidentifiable corroded fragments likely relate to items such as these. One should also note a similar object category in copper sheet (see below). The final complete iron artefact to note is what appear to be a pair of tweezers (Fig. 17.5).

Copper Alloys

Given the relative values of copper alloys and iron, individual copper alloy finds are unsurprisingly far smaller than iron. This said, copper alloys are found throughout the sequence and in terms of quantities of individual artefacts they nearly match iron. As with iron, the majority of finds are fragmentary corroded specimens that we are not able to determine what objects they originally related to or what function they had. As with the iron assemblage though, we have some nicely preserved individual items

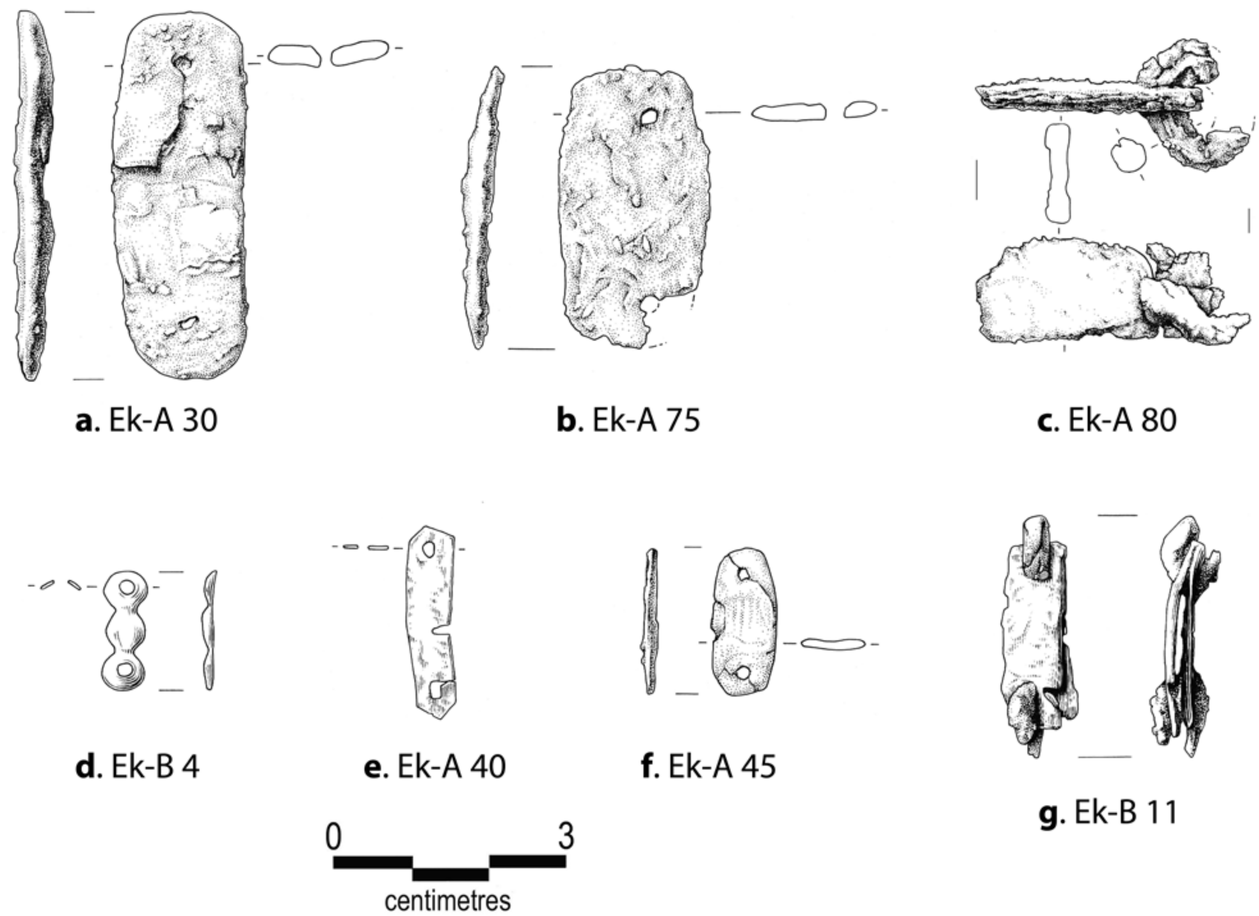

FIGURE 17.7 *Perforated sheet metal artefacts, including examples where iron loops are threaded through perforations to attach and link the sheet metal artefacts:* a–b, *iron artefacts each featuring two perforations;* c, *iron perforated artefact threaded with iron loop to attach it;* d-f, *copper alloy perforated artefacts;* g, *two perforated copper alloy strips held together by iron loops at each end.*

providing us with a sense of the copper alloy artefacts at the site and providing a context for interpreting the more fragmentary corroded specimens.

Of the finds which are sufficiently intact to interpret their function, the majority appear to relate to decorative items. A distinct category of artefact are small strips with perforations at both ends (Fig. 17.7). These consist of rectangular or sub-rectangular strips (this category also includes a bowed sub-rectangular strip with a slight point at each end), and a more developed type based on a design of conjoined circles (Fig. 17.7d: this has a variety of shapes within the overall design form, having either two conjoined circles with a perforation in each, three circles conjoined in a row with only the central one lacking a perforation, and four circles conjoined in a row with the central two lacking perforations). Thanks to the recovery of examples which are linked together with metal (iron) loops (Fig. 17.7g), we are able to understand how these small copper strips and shaped fittings might have functioned. When linked with metal loops, they might have formed part of chains or other composite forms, which could have been affixed to such things as dress items and leathers, or armour. It is also possible that they were sewn onto leather, or nailed onto wood. Another category of copper-alloy finds are very small partially hollow items with a domed boss, seemingly designed to function as a decorative ornament (Fig. 17.8). These artefacts appear to have a point protruding from the rear of the boss which enables it to be attached to a surface in combination with a corresponding fitting at the rear, in the manner of a modern lapel pin (termed 'domed boss pin fixtures'). Examination of a well-preserved example shows what appears to be a layer of leather preserved by the corrosion which formed on this artefact, suggesting these were originally fitted to leather. The prevalence of copper-alloy fixtures and fittings within Tuareg artefacts documented in more recent times (Nicolaisen & Nicolaisen 1997) provides a useful parallel for thinking about these

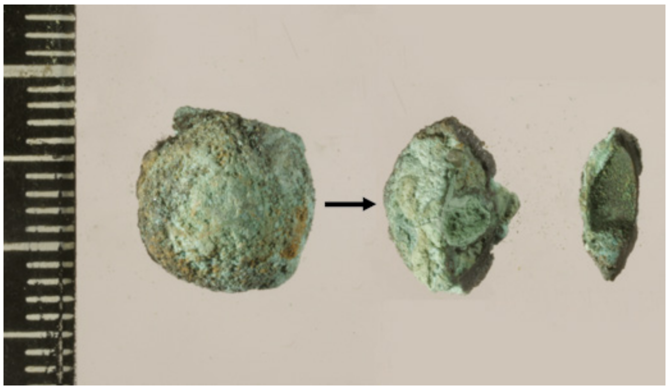

FIGURE 17.8
Illustration of a copper alloy fixture type, termed 'domed boss pin fixture': the example illustrated here (from Context Ek-43) shown before (left) and after (right) sectioning illustrates the hollow interior of these fixtures – these were likely previously affixed to leather (as shown by one example preserving what appears to be a layer of leather within the corrosion products covering the artefact).

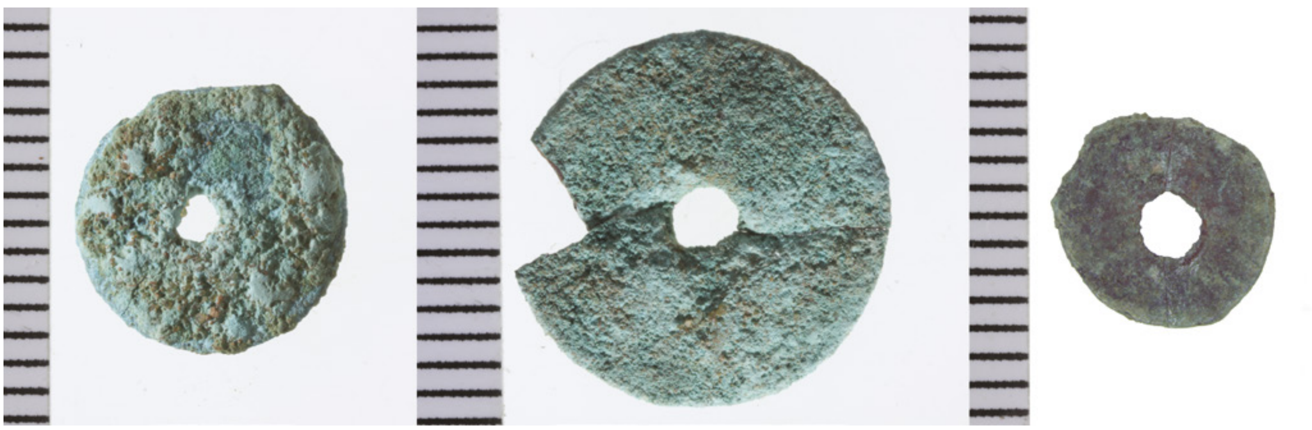

FIGURE 17.9 *Pierced copper alloy discs (left and centre, as excavated; right, cleaned/conserved:* left*, Ek-B-11;* middle*, Ek-B 9;* right*, Ek-B 9.*

small copper fittings; including their use in such functions as decorating wooden bowls, camel trappings, and decorative leather work. Copper alloy fixtures are still used today in the Essouk-Tadmekka area, the author having witnessed for instance small brass strips hammered into wooden objects which have split in order to strengthen them.

One category of item which is very well-preserved but unclear as to its precise function are a series of circular discs with perforations (Fig. 17.9). Again, it is possible that these were fixed to leather or wood, being either pinned on, or strung in some way. While this is so, given the trade function and the multiple forms of copper alloy currencies that circulated in medieval West Africa, there is also a possibility these were a form of currency, with the central hole allowing them to be strung for transport and safekeeping. Without examples which show remains of some form of fixing for any of these, we are not able to determine between these possibilities. It is certainly possible also that they functioned in both ways, as a currency item which was also then subsequently used in a decorative function. We also have various lengths and fragments of copper wire, and these could also have functioned as a standard unit of exchange.

A significant portion of the indeterminate fragmentary copper remains likely relate to variations of the artefact types described above, small thin items, using only relatively small amounts of highly valuable copper-alloy. Most of these remains have almost entirely corroded due to their thinness and we see very little of the original preserved copper-alloy metal remaining. While this is so, we also recovered a number of more substantial copper-alloy artefacts. Amongst these we see what appears to be a section of a ring-shaped copper ingot (Fig. 17.10 right). In addition to its size (external diam. = 5cm; internal diam. = 3.5cm), making it unlikely to be a bracelet, the presence of parallel hatched lines on its surface is compelling evidence for suggesting its function as an ingot. Three distinct areas of parallel marks are noted on the surface, one area featuring four clear parallel hatched lines (see Fig. 17.10 right) and the other two areas both having less obvious (but clearly present) notches (four notches in each area). Interestingly, a copper ingot/bar featuring very similar hatch marks was recorded at the site of Annissamane

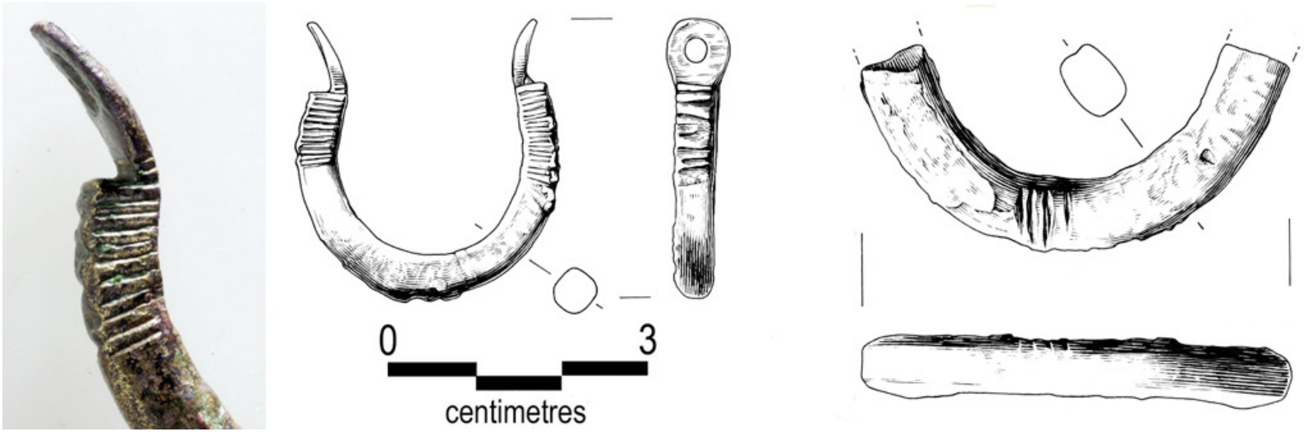

FIGURE 17.10 *Copper-alloy artefacts:* left, *drawing of 'loop handle' featuring hatched decoration* (*Ek-A 75*) *together with photographic close-up of hatching on upper-left side section;* right, *drawing of ingot/small bracelet fragment, featuring hatch marks* (*Ek-A 103*).

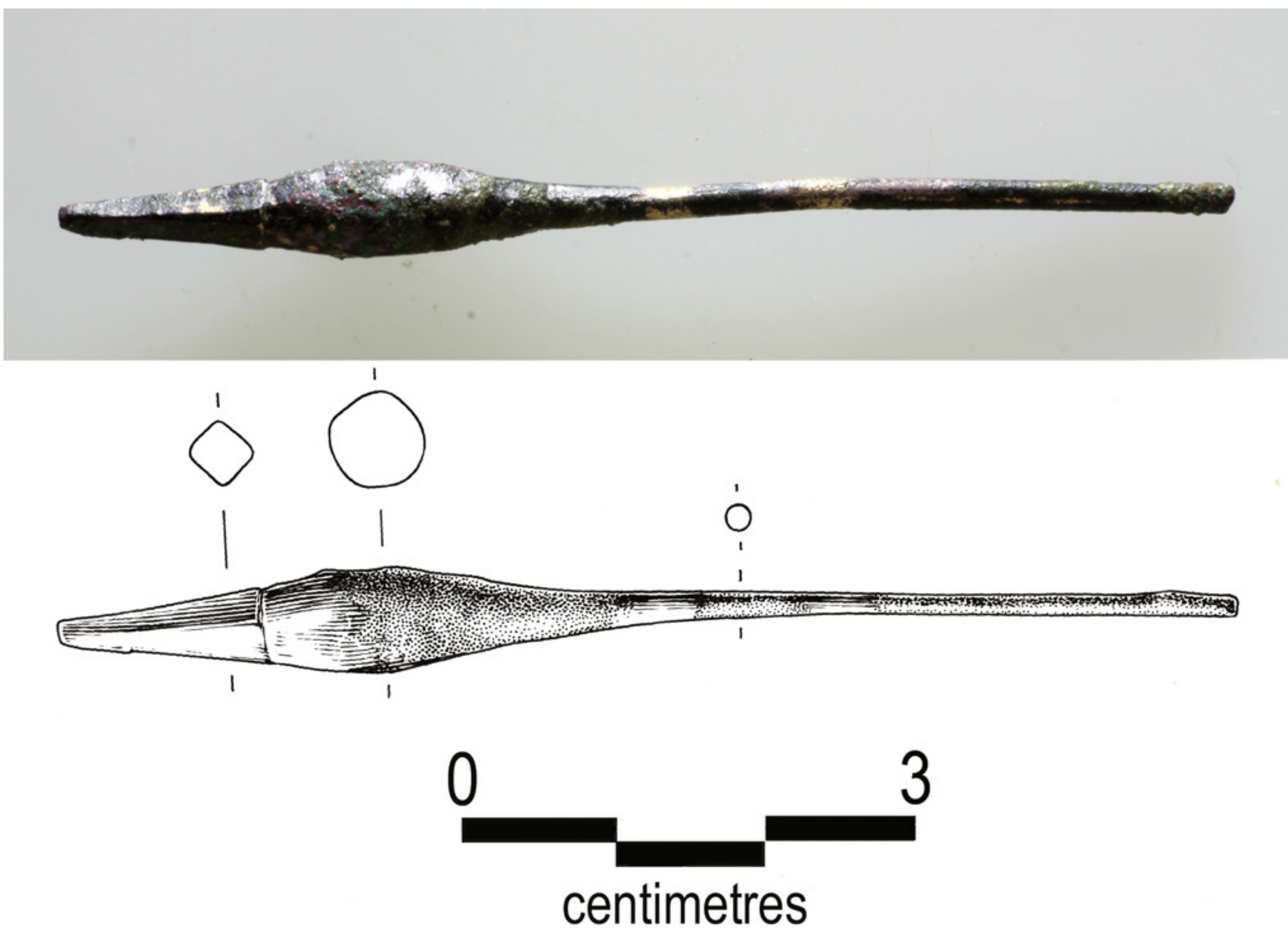

FIGURE 17.11 *Copper-alloy kohl applicator* (*Unit Ek-C, exact context unknown; bright areas in photo where copper-alloy core is showing through corrosion layer result from scratching during excavation*).

(Niger) (Brouin 1950: 91), and was interpreted as a money form. In addition to this artefact, two other specimens featuring well-preserved copper-alloy metal are also interpreted as possible ingot forms (see Table 17.1) – neither of these was cleaned however and therefore we cannot tell if they also feature any surface features. Other examples are a horse-shoe shaped item featuring holes at the two tips of the 'horse-shoe' (Fig. 17.10 left). Again, interestingly, we see hatching used here, but this is far more extensive and seems decorative. While this could conceivably be some form of ingot, far more likely is that it is a handle to be affixed to some kind of leather or wood item, perhaps a box. The final item to comment on is what is almost certainly an item used to apply make-up, known as a 'kohl applicator' (Fig. 17.11).

There is only a very minimal combination of copper with iron in the same artefact but it is useful to note the examples we did recover where they are used in combination (see Tab. 17.1).

Given the importance of the copper-alloy trade, the results of the program of chemical and technical analysis (App. K) have great potential for throwing light on wider questions of trans-Saharan metals trade, including how this related to the usage of copper-alloys within artistic traditions further south in West Africa. The key pattern shown by the chemical and technical analysis is that it clearly confirms the significant trans-Saharan import of copper-alloys to Essouk-Tadmekka, as well as identifying apparent changes over time. Importantly, this study also provides important new data for the relatively under-researched technical study of early brasses. An overview of this program of analysis is presented in Appendix K, but more extensive discussion together with a full presentation of the results will be presented in a forthcoming paper (Fenn *et al.* in prep.). While finished copper objects themselves were certainly traded to Essouk-Tadmekka, the town did also have some level of copper working, as is demonstrated by the copper slag seen in Chapter 16. The objects we have recovered here then start to provide a sense of both the imported copper-alloy import trade to Essouk-Tadmekka, as well as the ways in which this trade fed into developing local artistic traditions.

CHAPTER 18

Miscellaneous Material Culture

Sam Nixon

Introduction

Other than the artefacts and waste materials reviewed so far, a range of other material culture was found and this is treated within this chapter. This consists of the following evidence: cowrie shells; textiles and matting; ochre and stone artefacts; and ceramic objects. These various categories of evidence were carefully classified and analysed, and the textiles subjected to a detailed program of technical analysis.

Cowrie Shells

Materials and Methods

Excavated marine shells at Essouk-Tadmekka were identified as being of the *Cypraea* genus, commonly known as 'cowrie shells'. Nine specimens were recovered during the excavations (Tab. 18.1) and were identified in consultation with Ken Thomas using comparative collections at the Institute of Archaeology. The shells of the Indo-Pacific marine mollusc *Cypraea* are well-documented within the trans-Saharan trade and West Africa more widely, both as an important form of currency, and as an item of bodily adornment (for various historical references see Levtzion & Hopkins 2000: index pg. 481). Archaeologically, these have been identified both within the context of a trade shipment (*e.g.* Monod 1969) and as items of bodily adornment recovered within burial contexts (Togola 1993: 34; Magnavita 2009: 94). The species most commonly associated with the trade of cowrie shells is *Cypraea moneta*, known as 'the money cowrie'.

Results

Four of the cowrie shells from Essouk-Tadmekka were identified as *Cypraea moneta* (Tab. 18.1, Fig. 18.1). This determination was made on the basis of bumps at the extremities of these specimens, seen to be a distinctive marker of *Cypraea moneta*. The remaining five specimens were too eroded to determine species and were therefore identified simply as *Cypraea sp.*

The shells range between 1.1 and 1.7 centimetres in length. Analysis of the two specimens sufficiently intact to make a judgment concerning their original form showed that their backs had been cut off (Fig. 18.1), enabling them to be strung or attached as items of bodily adornment. No other signs of working were observed. Eight cowries were found in unit Ek-A, the other specimen coming from Ek-C Horizon '0'. All the specimens from unit Ek-A come from Period 3 deposits and are found within all horizons in Period 3, with the majority from Horizon 9. According to the hypothesised Ek-A chronology, the cowrie shells recovered fall within a date range of *ca* 11/12th–13/14th centuries AD.

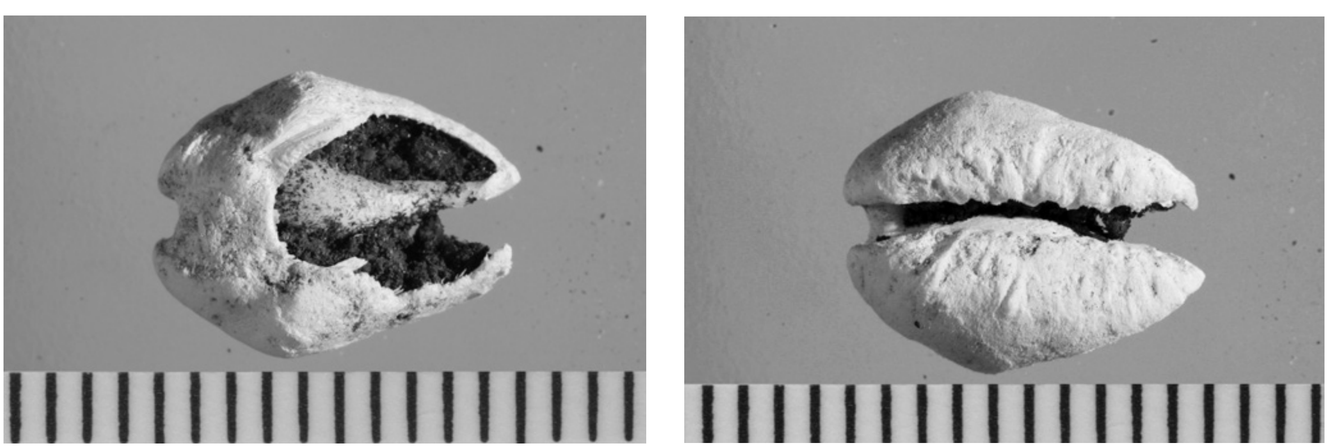

FIGURE 18.1 *Example of* Cypraea moneta *cowrie shell from Essouk (Ek-A 87) showing back with cut hole (left) and underside (right).*

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TABLE 18.1 *Distribution, taxonomy and measurements of cowrie shells from Essouk*

Unit	Context	Horizon	Taxa	Max. length (cm)	Max. width (cm)
Ek-A	57	11	*Cypraea sp.*	1.5	n.a
Ek-A	71	10	*Cypraea sp.*	1.7	n.a
Ek-A	71	10	*Cypraea moneta*	n.a	n.a
Ek-A	84	9	*Cypraea moneta*	1.1	n.a
Ek-A	84	9	*Cypraea moneta*	1.4	n.a
Ek-A	87	9	*Cypraea sp.*	1.4	n.a
Ek-A	87	9	*Cypraea sp.*	n.a	n.a
Ek-A	87	9	*Cypraea moneta*	1.1	0.9
Ek-C	16	0	*Cypraea sp.*	n.a	n.a

Discussion

The finding of cowrie shells at Essouk-Tadmekka is not surprising. Arabic historical sources indicate trans-Saharan caravans imported great quantities of these shells to West Africa, to serve both as a currency and as items of personal display (see above). This trade is spectacularly evidenced by the archaeological find of an abandoned 12th/13th century caravan at Ma'aden Ijafen in Mauritania, with thousands of cowrie shells being recorded (Monod 1969). Earlier finds than those from Essouk-Tadmekka have also been recovered, including from the site of Kissi in Burkina Faso (Magnavita 2009: 94). It does seem likely therefore that even before their first recording at Essouk-Tadmekka, cowries were likely moving through the site, their absence from earlier deposits therefore likely simply being due to questions of archaeological sampling and recovery. Other than the abovementioned Ma'aden Ijafen finds, finds of cowrie shells have most commonly been recovered from cache contexts (Macdonald *et al.* 2011: 61) or burial contexts (*e.g.* Togola 1993: 34; Magnavita 2009: 94).

The Arabic sources describe cowrie shells as a low value money form, and one which seems to have functioned in West Africa primarily as a currency for everyday exchange. It is difficult to know exactly how cowries would have functioned at Essouk-Tadmekka alongside the exchange of commodities such as gold, cloth, copper, and silver, but their relatively limited occurrence within unit Ek-A, and their absence from unit Ek-B, suggests they are not a consistent background presence throughout the stratigraphy. This is to be contrasted for example with glass beads which are far more consistently recorded (Chapter 14). Likely the majority of cowrie shells shipped through Essouk-Tadmekka were exchanged there in bulk before being shipped on, and one can postulate them only having a limited currency function within this Muslim market town. The fact that the specimens able to be confidently attributed to species are *moneta* is what would be expected, given this species is that most commonly associated with a trade function (it being known as 'the money cowrie'). While the removal of the backs of the cowries might mean they were used for ornamentation at Essouk-Tadmekka, it is also highly likely they were shipped across the Sahara in this form and our finds might simply represent incidental loss during trade.

Textiles and Matting

Materials and Methods

During the excavation of Ek-A Horizon 10 (Context 76) the remains of a silicified reed mat were recovered (Fig. 18.2). This very fragmentary artefact was not able to be removed without it completely fragmenting – the best that could be done was to carefully trowel off the soil covering it in order to record it *in situ*. It was possible to see that this matt was formed using the common technique of coiling a length of plant fibres to create a thin circular matt. Based upon the observable intact remains, this appeared to measure *ca* 30cms in diameter. No further analysis of this artefact was conducted. In addition to this artefact, it is important to note the impressions of a matt on a fragment of pottery (see Fig. 12.6h). While we cannot be certain this pot was not traded to the site from elsewhere (see discussion Chapter 12) it is useful to highlight this when considering other possible mat forms present at the site.

Two small fragments of textile were also recorded. A light-yellow, fine-textured textile with a red-embroidered edge, found in Ek-A Horizon 13 (Context 32) (Fig.18.3a), and a light-red, matted-textured specimen featuring a stitched mesh overlying the main body of the textile,

FIGURE 18.2 *Silicified remains of coiled reed mat (Context Ek-A 76).*

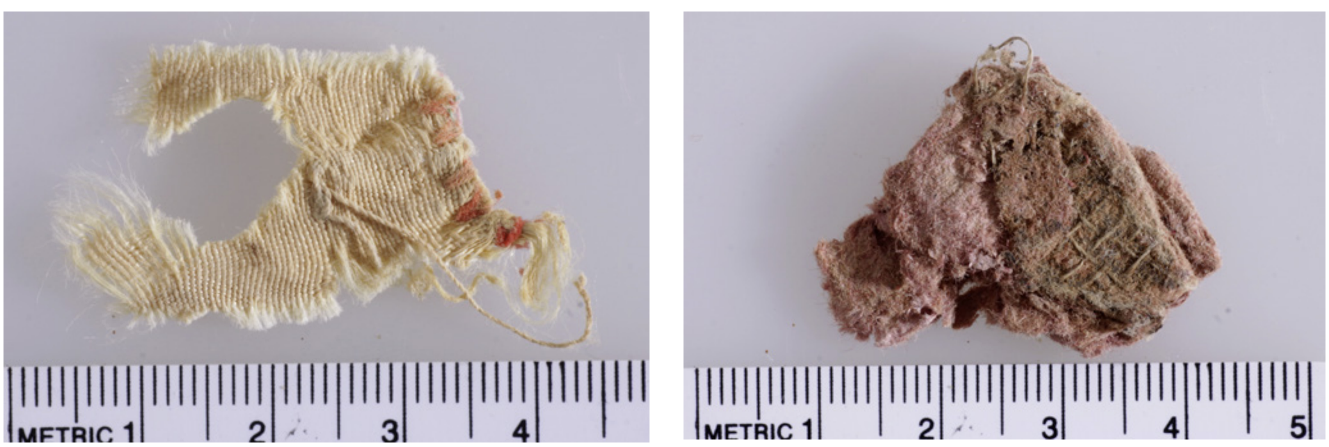

FIGURE 18.3 *Textile specimens excavated at Essouk: left, silk fragment (exterior face), Ek-A 32; right, textile fragment (unidentified basal material) with silk stitch, Ek-B 6.*

found in Ek-B Horizon 3 (Context 6) (Fig. 18.3b). Due to the rarity of textile finds in West Africa (see below) an analytical programme was developed for these specimens, as detailed below.

Textile Analysis Results

Two phases of analysis were carried out on the textile fragments. A first phase was undertaken by Sandra Bond of the Institute of Archaeology (participated in by the author) to identify the materials used within the textiles. A second phase of analysis was subsequently developed once the textile fragments were both demonstrated to feature silk, the aim here being to provide a more detailed study of raw materials used (including the dyes) as well as the weave structure. While this latter phase of analysis is ongoing, a summary is presented in Appendix L, with the full results the subject of a forthcoming article (Desrosiers *et al.* forthcoming). Here we detail the results of the first phase of analysis and provide a brief summary of the provisional results of the second phase of analysis.

The first phase of analysis involved two processes. Firstly, small fibres of the textiles were burnt to allow a

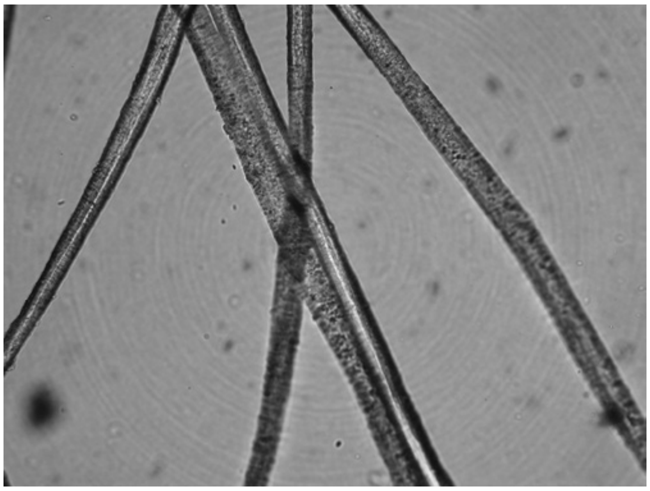
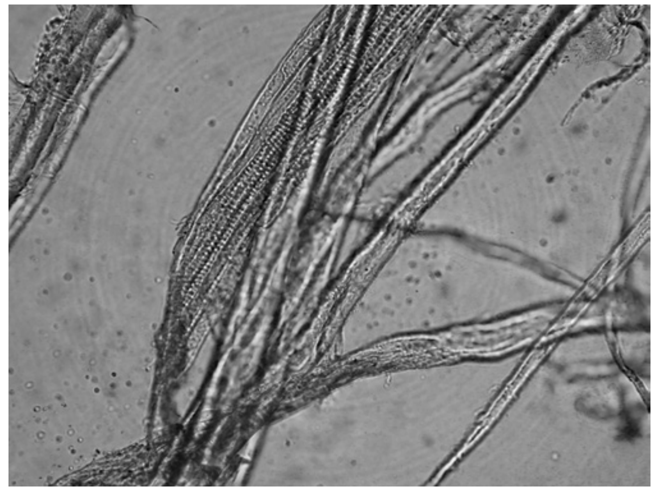

FIGURE 18.4 *Images showing microscopic structures of fibres from textile fragments shown in Fig. 18.3 (microscopic images taken at scale 200 mag): left, silk fibres from textile body of specimen from Ek-A 32; right, fibres from body of textile specimen from Ek-B 6.*

'smell test' to be undertaken on the odour this produced, it being recognised that the various materials commonly used to create textiles produce characteristic odours when burnt. Principally, the aim of this 'smell test' was to determine whether the odours produced were characteristic of burning animal material (an odour similar to burning human hair) or burning plant material (an odour similar to burning paper). This would thereby allow us to assign the textiles to either the animal-derived family of textiles (*e.g.* silk/felt) or the plant-derived family (*e.g.* cotton/linen). The second process involved the cutting and mounting of individual fibres on slides for microscopic analysis (Fig. 18.4); the materials commonly used to produce textiles having discernibly different physical characteristics at a microscopic level.

The first of the specimens to be analysed was the yellow fragment from Ek-A Horizon 13 (Context 32) (Fig. 18.3). On initial inspection the lustre of the material suggested it was silk. Seemingly confirming this, the burning of the sample produced an odour indicating it was composed of animal-derived material. The microscopic analysis of the surface of the sample showed it was composed of 'single central cores', something either associated with animal or synthetic materials (Fig. 18.4). The analysis of this central core showed it did not have scales and was therefore not animal hair. The cross-sectioning of the sample did not produce very successful results, seemingly due to degradation of the sample. Despite the inability to attain very clear cross-section images, it appeared that the sample had a double-cell, triangular shaped cross-section. The combination of these factors led to the conclusion that the material was indeed silk, having the following properties: a lustre to the surface of the textile; a burnt odour indicating animal material; a smooth, scaleless central core; a double-cell, triangular cross section. No analysis was conducted of the thread used to embroider the edge of the textile.

The second of the samples to be analysed was the red fragment found in Ek-B Horizon 3 (Context 6) Fig. 18.3. Due to the differences between the materials of the main body and the mesh of stitching, samples of both of these materials were analysed. Burning of the main body of the material produced an odour strongly suggesting plant material. Burning of the thread did not produce a clear indication of either animal or plant material. Viewed under the microscope, the main body of the textile was seen to be composed of individual fibres flat in section, strongly indicating plant material (Fig. 18.4). Given that we could demonstrate the presence of these flat sectioned fibres without the aid of cross-sectioning, cross-sectioning was not done. While the initial working assumption was that this was cotton, the peculiar appearance of the material under low magnification and the characteristics of its microscopic structure problematised this hypothesis, but no clear alternative identification of the material could be achieved. The microscopic analysis of the thread used in the stitched mesh showed that its fibres had a very similar composition to the fibres identified as silk from textile fragment Ek-A 32, namely a smooth, scaleless central core and a double-cell, triangular cross-section (again it was not possible to get a clear cross-section image). Accordingly it was concluded that the mesh of stitching on this specimen was also almost certainly silk.

Subsequent work (see App. L) has confirmed that the body of the yellow textile fragment (Fig. 18.3) is indeed made of silk. The analysis of the weave structure has also provided a more precise identification, it being possible to identify it as a Damas, a silk which has a sheen on the outer side and a matt finish on the interior. This has in fact been more precisely identified as a 'Damas 5', and it is concluded that this is from Asia, most likely China. Analysis of the thread used to embroider the border of this yellow textile fragment is ongoing, though it is hypothesised to be wool. The analysis of the light red textile (Fig. 18.3) has so far not arrived at a definite conclusion regarding the main body of the textile, though the stitching has indeed been confirmed to be of silk. Appendix L contains detailed information concerning the silk fibres and weaves and also a discussion of the wider specialist research context, only some elements of which are drawn on in the discussion below.

Discussion

The finding of textile fragments from sites in the Western Sahel is very rare, as despite the generally dry conditions seasonal inundations occur and the consequent wet-dry fluctuation within soils means that organic material such as textiles do not survive well archaeologically. Textiles are however recorded at certain other sites (see MAGNAVITA 2008 for review of evidence and App. L), including Kissi in Burkina Faso which has produced some very early finds, dating back to at least the first century AD (MAGNAVITA 2008). Textiles are clearly noted from the beginning of the trade as of huge importance within trans-Saharan commerce, and were arguably along with copper amongst the most important items shipped from North Africa throughout the early Islamic era (LEVTZION & HOPKINS 2000: see index entries pg. 479–480). In stating this, we should note in particular the association between the spread of Islam, and the importance of textiles, linked to the need to cover the body within Islam. The archaeobotanical evidence of cotton from sites in West Africa from the *ca* 8th century AD onwards (see Chapter 21) and the presence of spindle whorls from West Africa also dating to this period (see below for the excavated spindle whorls from Essouk-Tadmekka), indicates local production of woven textiles from at least the beginning of the Islamic era in West Africa, as well as their import. There is no reason however for thinking that silk was ever produced in West Africa.

When we look to the Arabic historical records of Tadmekka, one reference clearly stands out in terms of the discussion here, namely Al-Bakri's 11th century description of Tadmekka's inhabitants: "They wear clothes of cotton, *nuli*, and other robes dyed red. Their king wears a red turban, yellow shirt, and blue trousers" (LEVTZION & HOPKINS 2000: 85). In particular Al-Bakri's reference to "robes dyed red" suggests the importance of this colour of textiles, though one should be cautious about basing anything too concrete on this account. The reference to *nuli* is seemingly unique in the Arabic descriptions of West Africa (LEVTZION & HOPKINS 2000: see index entries pg. 479–480), though it is unclear what exactly this material was.

In terms of the textile trade as a whole, a description from Al-Zuhri in the 12th century provides an important reference point (LEVTZION & HOPKINS 2000: 97): "Silk and objects of gauze and linen are imported into their country [speaking of Gao] and from al-Andalus are imported saffron and cloth from Murcia and turbans and Susa cloth from Ifriqiya". This clearly shows the range of textiles imported to West Africa, and also provides some ideas for thinking about possible origins of imported textiles. Additionally, this description is important not only for the reference to silk, but also for its reference to "gauze" – this is one of the fabric types being considered within the ongoing analysis of the light-red fragment excavated at Essouk-Tadmekka (see App. L). Within the Arabic texts, further references to silk are particularly associated with descriptions of the courts of powerful rulers, such as those of Ghana and Mali (LEVTZION & HOPKINS 2000: 147; 335).

While obviously only a single item, the silk fragment from Essouk-Tadmekka does at least provide confirmation of trans-Saharan trade in silks, as until now our evidence for medieval silk imports to West Africa has been solely the Arabic textual sources. Of additional importance is the fact that this fragment has an Asian origin, another example of the trade in goods from beyond the Maghreb. Whether this was part of a luxury goods shipment moving through Essouk-Tadmekka or an item worn by a wealthy local individual we cannot know. Its recovery within a 14th century context is though important evidence for thinking about very high-end luxury goods trade and possible elite individuals at this period of the site when historical texts are fairly uninformative in this sense. One additional thing which should be noted is that the identification of the yellow silk fragment as a 'Damas 5' makes it a very rare specimen on a world scale (App. L). Given that the oldest known example of a 'Damas 5' is an AD 1320 fragment from China, the Essouk-Tadmekka fragment is amongst the oldest examples of this silk type known.

While we found no examples of cotton textiles at Essouk-Tadmekka, we do see cotton seeds (Chapter 21) and spindle whorls (see below). There is a good chance therefore that cotton textiles were produced locally. Likewise, wool could also have been produced. The embroidered thread on the yellow silk fragment from Essouk-Tadmekka is likely wool and this could have been produced and dyed locally, then stitched into the silk.

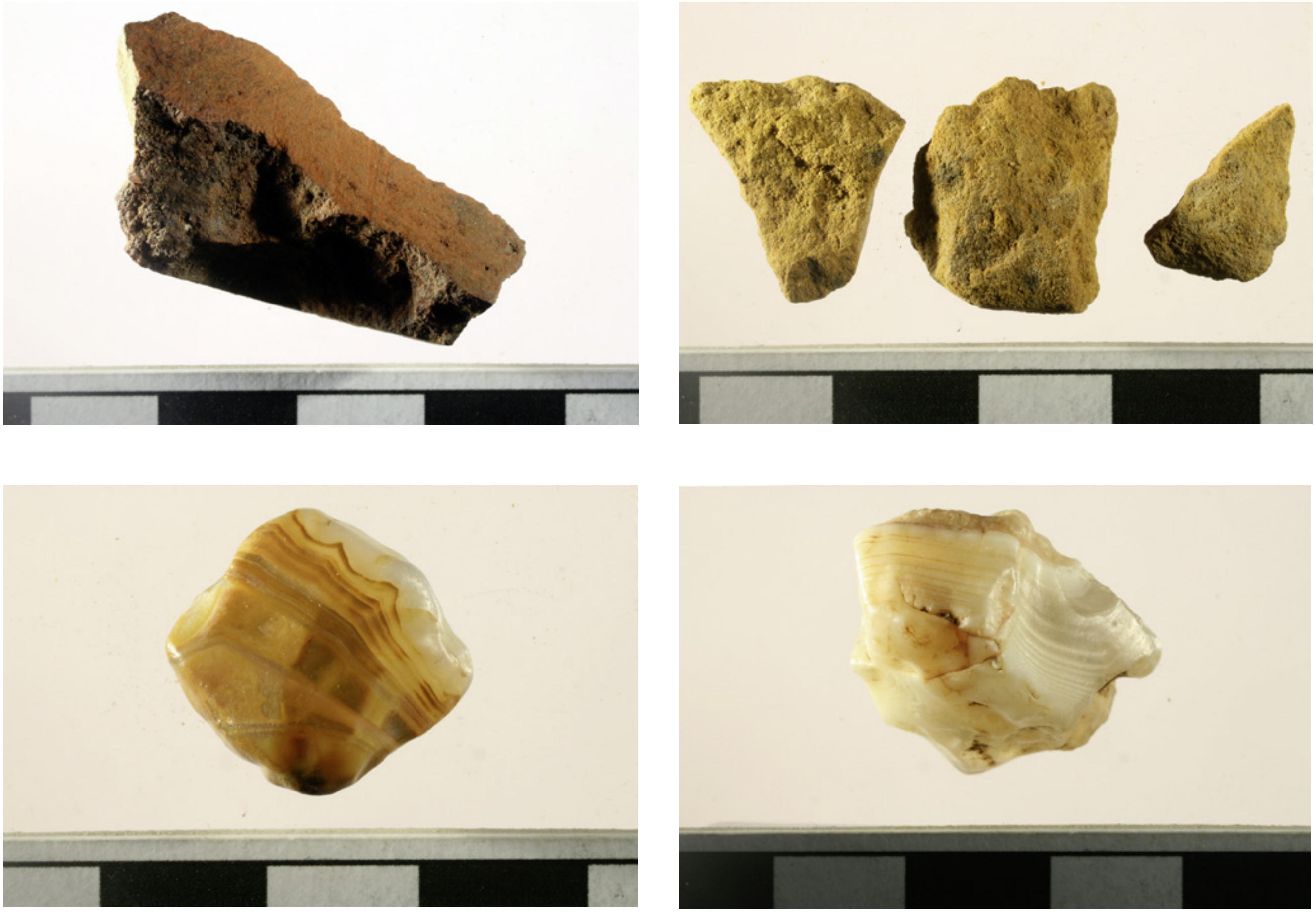

FIGURE 18.5 *Examples of ochre and agate artefacts from Essouk:* top – *red and yellow ochre (left, Ek-A 11 – see worked, planed surface; right, Ek-A 11);* bottom – *unworked agates (left, Ek-A 114; right, Ek-A 70).*

Ochre and Stone Artefacts

Ochre

Both red and yellow ochres were identified at Essouk-Tadmekka (*e.g.* Fig. 18.5), restricted to Ek-A Period 4 deposits. The following artefacts were excavated (3-dimensional measurements for each artefact are listed at the end of the descriptions in centimetres):

Ek-A Horizon 13
Ek-A-30 – unworked red ochre; 1.8, 1.4, 1.4.
Ek-A-17 – worked red ochre; 1.7, 1, 0.4.
Ek-A-14 – unworked red ochre; 2.2, 1.5, 1.3.
Ek-A-14 – worked red ochre; 1.7, 1.3, 0.7.
Ek-A-14 – unworked red ochre; 1.8, 1, 0.8.

Ek-A Horizon 14
Ek-A-11 – worked red ochre; 3.3, 1.7, 1.
Ek-A-11 – worked red ochre; 1.3, 1, 0.9.
Ek-A-11 – worked red ochre; 1.8, 0.7, 0.6
Ek-A-11 – unworked jarosite; 1.6, 1.2, 0.4
Ek-A-11 – unworked jarosite; 1.6, 1.4, 0.5
Ek-A-11 – unworked jarosite; 1.7, 0.8, 0.4
Ek-A-11 – unworked jarosite; 1.5, 0.8, 0.2
Ek-A-8 – unworked red ochre; 1.5, 0.9, 0.8.
Ek-A-7 – worked red ochre; 2.6, 1.9, 1.7.
Ek-A-7 – unworked red ochre; 1.9, 1.1, 0.9.

Within West Africa red ochre and yellow ochre have been recorded in ethnographic contexts as make-up (Insoll 2000: 32–33), decorative architectural pigment (Berthier 1997: 95), pottery colorants (Ibid.), and for staining leather (Ibid.). Amongst the West African sites where colorants have also been excavated are Gao (Insoll 2000: 132–134), Koumbi Saleh (Berthier 1997: 95) and Tombouze (Park 2010: 1080). That the colorants excavated at Essouk-Tadmekka are not 'naturally' occurring in the deposits is clearly shown by the fact that many of them have worked, planed surfaces (*e.g.* Fig. 18.5). It is most likely that these colorants therefore relate to uses such as those documented ethnographically in the western Sahel. Our excavation of red-ochre decorated architecture (see Chapters 7, 11) makes this the most likely explanation for these artefacts. A clear pattern can be seen in the distribution of ochre in our excavations, as while fairly large quantities of these are found in the last two horizons of the sequence, they are not present before this. While this is so, the presence of red-ochre decorated architecture from a previous horizon clearly shows that ochre was present and used previously

Flint Tools and Flint Working Debris

The following flint artefacts were recorded at Essouk-Tadmekka (3-dimensional measurements for each artefact are listed at the end of the descriptions in centimetres):

Ek-A Horizon 4

Ek-A 110 – transverse and denticulate; broken; fine chert/silex; brown; working of the flint seen only on edges of the object; 2.6, 2.4, 0.3.

Ek-A Horizon 6

Ek-A 95 – flint debitage; yellow; 2.2, 1.4, 0.7.
Ek-A 93 – Flint debitage (core?); brown interior, white surface with purple areas; 3.6, 2.7, 1.4.
Ek-A 93 – Flint debitage; brown; 1.7, 0.9, 0.4.
Ek-A 93 – Flint debitage; yellow; 1.5, 0.6, 0.5.

Ek-A Horizon 8

Ek-A-Feat. 4 – Flint scraper; brown; 5.6, 4.1, 1.2.

Ek-A Horizon 9

Ek-A 87 – Broken bladelet; retouched; chert; yellow; 2.5, 1.0, 0.5

Ek-A Horizon 11

Ek-A 70 – Unworked flint; brown; 3.3, 2.5, 0.9.

Ek-A Horizon 13

Ek-A 30 – Flint debitage; brown; 1.8, 1.4, 0.5.

Flint artefacts from Essouk-Tadmekka are a limited but consistent presence within the excavated stratigraphy. For the majority of the flint remains it is difficult to ascertain the exact tool or function the remains relate to. However, two artefacts (Ek-A 110, Ek-A 87) do appear to be stone tools ('arrowheads'). As this technology is commonly seen to relate to a far earlier epoch than the Early Islamic era, one would tend to associate these with a process of curation rather than having been manufactured by Essouk-Tadmekka's Early Islamic populations. This said, one must not rule out this possibility. The scraper evidenced seems far more likely the kind of tool that would have been produced through the flint-working we see consistent but small scale evidence for.

Semi-precious Stone

In addition to the semi-precious stone used to make the majority of the stone beads found at Essouk-Tadmekka (Chapter 14), the excavations also recorded an assemblage of unworked semi-precious stones and semi-precious stone-working waste products. These artefacts are as follows (3-dimensional measurements for each artefact are listed at the end of the descriptions in centimetres):

Ek-A Horizon 3

Ek-A 114 – Unworked Agate (see Fig. 18.5); mid-brown, yellow, white and colourless; semi-transparent; L/W/T = 1.6, 1.5, 0.7.

Ek-A Horizon 4

Ek-A 109 – Jasper/bauxite debitage (core?); red; L/W/T = 3.8, 2.8, 1.1.

EKA Horizon 6

Ek-A 95 – High-density silica (possibly jasper/bauxite) with signs of working; yellow and red; L/W/T = 3.8, 2.9, 0.6.

Ek-A Horizon 8

Ek-A Feat.4 – Semi-transparent, mid-purple stone showing possible signs of working (Fig. 18.6). Likely identification is as a garnet (H. Zelley pers. comm.). L/W/T = 1.1, 0.6, 0.4. (0.4grams).

Ek-A Horizon 11

Ek-A 70 – Unworked Agate (Fig. 18.5), white and colorless; semi-transparent; L/W/T = 2.3, 2.0, 1.6.

Ek-A Horizon 13

Ek-A 14 – Jasper/bauxite debitage; red; L/W/T = 1.1, 1.0, 0.1.

Turning first to the jasper/bauxite working debris, it should be noted that the working artefacts found are not of the same stone-type as the jasper/bauxite bead recorded (Chapter 14) and are also from different stratigraphic contexts. From the evidence recovered, it cannot be seen what was being produced with the jasper/bauxite we see being worked. It should also be noted that while labelled here as a semi-precious stone, jasper and bauxite are fairly widely occurring and we must be cautious about attaching too much status to it as a 'luxury' object. The presence of agate in a 'raw', unfinished state is more intriguing given the debates concerning whether or not agate objects seen in West Africa have a local or an exotic source

FIGURE 18.6 *Garnet from context Ek-A 91 (scale mm).*

(see Chapter 14). One very important source to point to in this context is the reference of Al-Bakri to what appears to be an agate mine in the central Sahara, to the north of Tadmekka (Levtzion & Hopkins 2000: 86). In this description Al-Bakri also points out the very high prices the best agates fetched amongst the people of Ghana. The garnet (Fig. 18.6) would appear to have been a rarer semi-precious stone in the Early Islamic period than agate, as unlike the fairly widespread finds of agate, the only other definite garnet identified from a West African site is from Tegdaoust (Devisse 1988: 421; *cf.* Delarozière 1994: 45–53). On the basis of good geological authorities there is no known source of garnet in West Africa (Carite 1989). This therefore does appear to have been a long-distance trade item and undoubtedly a valuable object.

While we saw that the evidence for beads made from semi-precious stones does not start until Ek-A Period 3, we can see that semi-precious stones were curated at Essouk-Tadmekka from the earliest occupations associated with permanent architecture. Working and curation of semi-precious stones was also present in later occupations when the semi-precious stone beads are seen. Given the small quantities of artefacts it is not possible, however, to make any further statements regarding chronological patterning of semi-precious stone working.

Regarding semi-precious stone working at the other entrepôt sites in the Western Sahel, there is evidence from Gao for "agate" flakes associated with a 'strike a light' function (Insoll 2000: 131–132). At Koumbi Saleh a small number of chalcedony fragments were found (Berthier 1997: 90), and at Tegdaoust numerous fragments of chalcedony (Devisse 1988: 421). Thus, in general, raw semi-precious stones are relatively rare at Western Sahelian entrepôt sites.

Other Stone Artefacts

Three stone artefacts were found which fit into none of the categories so far described. The first is a bracelet or arm-ring made from a grey granite, found in context Ek-B 12 (Fig. 18.7). The second is a base fragment of a bowl made from a cream sandstone with a pink tinge (minimal silicification), found in Ek-A Wall 3 (Fig. 18.7) – it is unclear what the precise function of this bowl was, though it could have been for instance part of a pestle and mortar. The third item found, a statuette (Fig. 18.8) – stone type undetermined – was found in a survey context in an area of the site not excavated (Ek-S 97). The statuette clearly represents a person, though of indeterminate gender. While all the limbs of the statuette are missing, one can see that it originally had a head which was attached separately,

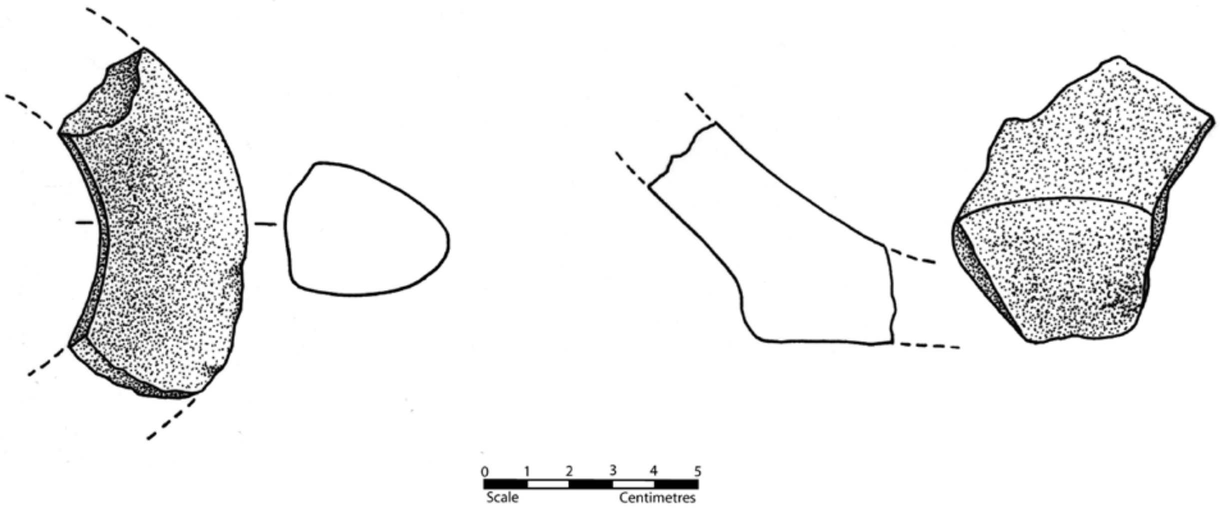

FIGURE 18.7 *Left, stone bracelet/arm-ring from Ek-B 12; right, base of stone bowl from (Ek-A Wall 3).*

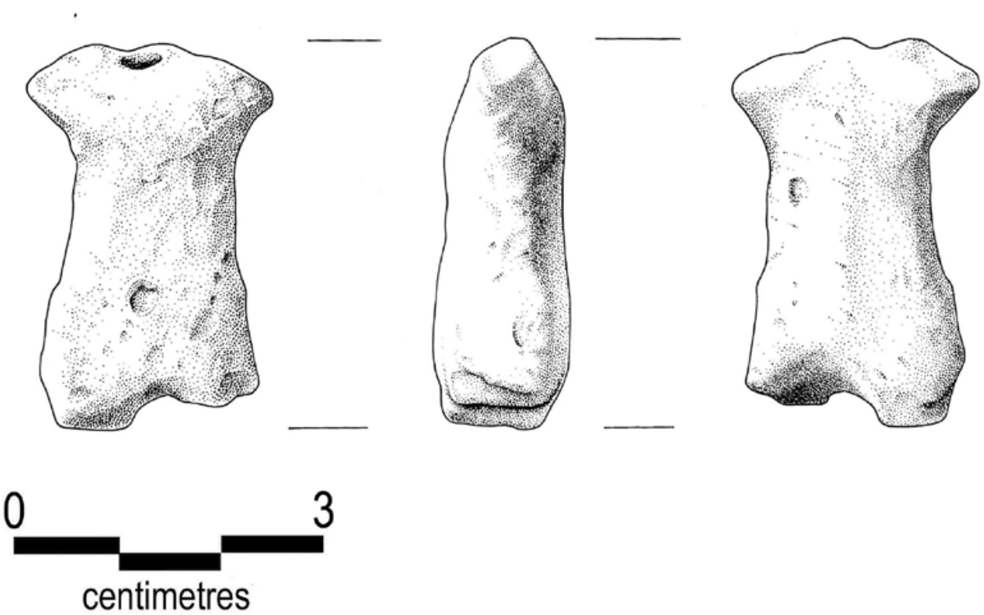

FIGURE 18 *Stone statuette (survey zone Ek-S 97).*

TABLE 18.2 *Frequency distribution of ceramic objects from unit Ek-A and Ek-B Horizons 2 & 3 (V7 also found in Ek-S 69)*

Form type	Ek-A Period 1	Ek-A Period 2	Ek-A Period 3a	Ek-A Period 3b	Ek-A Period 4	Ek-B Horizon 2 & 3
V01					1	
V06					1	
V07				1		
V08 (spindle whorl)				1	1	
V10 (spoon)			1			1
V12b						1
V13						1

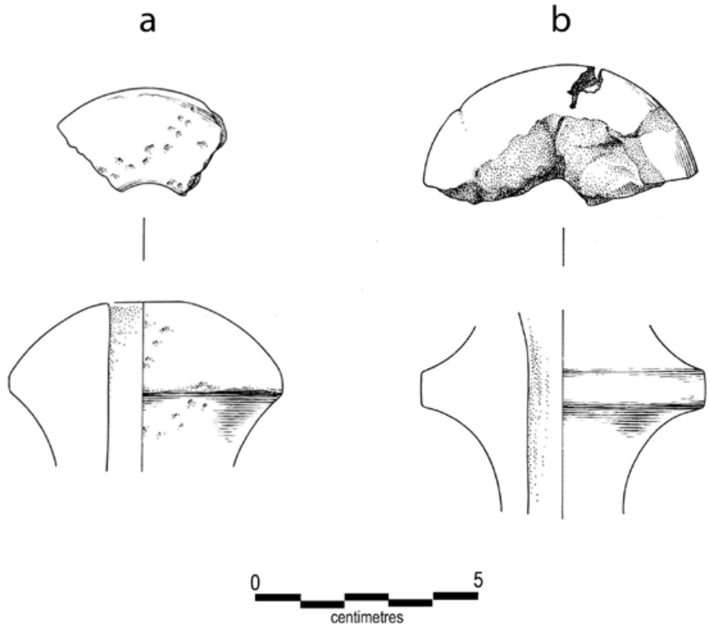

FIGURE 18.9 *Spindle whorl fragments (object type V8 – a. Ek-A 43; b. Ek-A 77).*

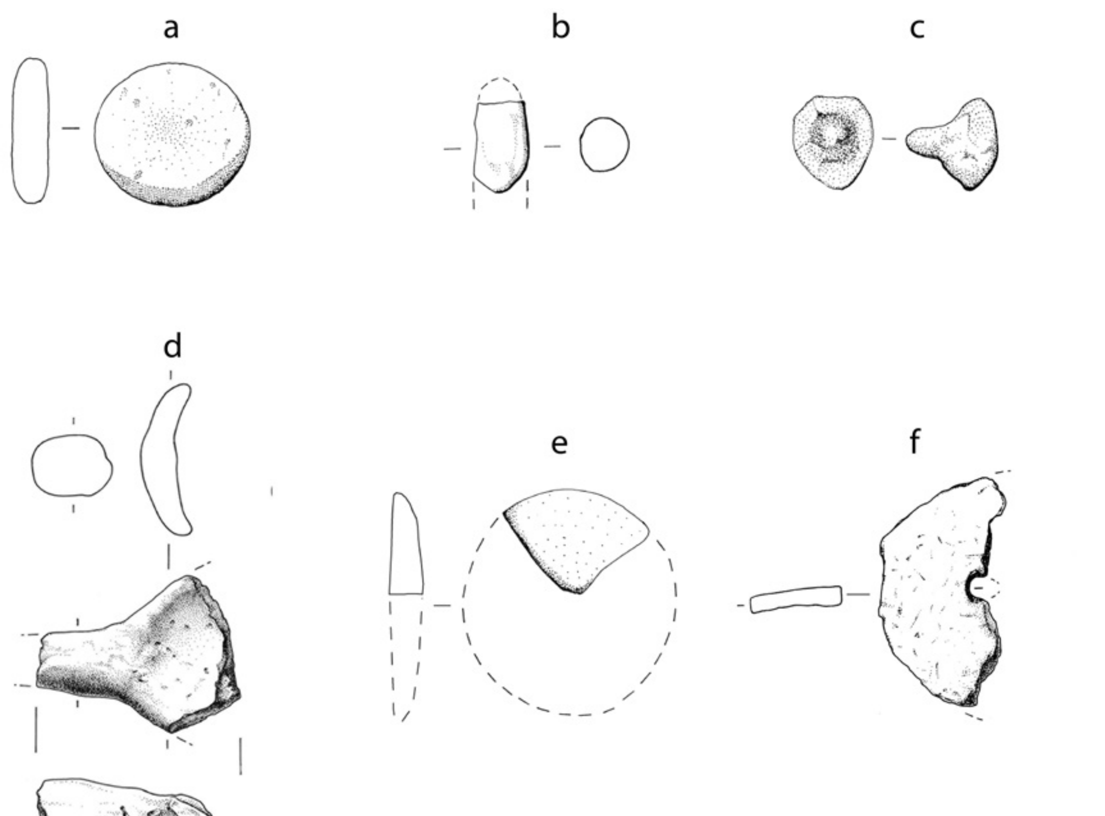

FIGURE 18.10 *Other ceramic object types from Essouk (see text for discussion of possible functions). a. V7 type (Ek-A 78); b. V12b type (Ek-B 10); c. V1 type (Ek-A 14); d. V10 type (Ek-A 80); e. V13 type (Ek-B 6); f. V6 type (Ek-A 14).*

a fairly deep hole being bored vertically into its neck to insert this. The intriguing thing about this statuette at Essouk-Tadmekka is obviously the fact that its representational nature is not in accord with widespread interpretations of Islamic orthodoxy forbidding the representation of the human form. Given the fact that the object was not found in a dateable context it is however impossible to determine whether it is related to pre-Islamic or Islamic era occupation of Essouk-Tadmekka.

Ceramic Objects

As well as pottery, other artefacts produced from fired clay are also found at Essouk-Tadmekka (Tab. 18.2; Figs. 18.9, 18.10), though this category of evidence is miniscule in comparison with the quantities of pottery collected.

The first category of objects to direct attention to are a small collection of spindle whorls, two artefacts clearly identifiable as such being excavated from Ek-A Periods 3 and 4 (Fig. 18.9, V8). The spindle whorls are extremely important in testifying to the existence of a local craft industry of spinning fibres, possibly indicating a local textile industry (see also above). One of the spindle whorls is slipped and burnished (Fig. 18.9b) and very similar to those excavated at sites further south, such as Gao (see Insoll 2000) – there is obviously indeed a possibility that these were imports to Essouk-Tadmekka.

The second point of discussion relates to the finding of two pottery disks (*e.g.* Fig. 18.10, V7). Artefacts such as these have been considered as weights for measuring gold dust (*e.g.* Mcintosh 1995a: 217). In view of the lack of other identifiable gold weights at Essouk-Tadmekka, such as the glass weights found at Tegdaoust, this is certainly a good possible explanation. It is noted that the weight of the neatest disk-shaped object is 13.6 grams (Fig. 18.10a), corresponding well with the Islamic weight standard for gold weights (Garrard 1982). Other possible interpretations for these objects put forward in a context much further south in West Africa are as 'gourd-stoppers', to protect materials stored within gourds (Insoll *et al.* 2013)

Other than these two types of objects, the only other clearly identifiable artefact is a ceramic spoon (Fig. 18.10d, V10). XRF analysis conducted on this artefact found no archaeometallurgical or other industrial traces, and therefore it does seem likely that this had some domestic function.

CHAPTER 19

Eggshell

Jane Sidell

Introduction

48 eggshell specimens were recovered in the excavations (see Tab. 19.1, Figs. 19.1, 19.2). All were relatively small fragments, and all but one were of a substantial thickness, clearly associated with the large eggs of a flightless bird, which in this geographical context can only be ostrich. The remaining sample was from an eggshell with a far thinner wall. In order to improve understanding of the samples, detailed scientific analysis was undertaken. The main aim was to provide species confirmation of the ostrich eggshell assemblage, and to identify whether the shells were from hatched or unhatched eggs. It was also seen to be important to provide a careful assessment of the condition of these specimens, this ranging from excellent preservation through to heavily deteriorated.

Materials, Methods, and Results

The eggshell specimens are found throughout the deposits post-dating Period 1, providing a broad date range from *ca* 9th/10th century AD to ca 1400 AD. Looking at their distribution, one might be tempted to assert that they are more common in the final period of the site, as 26 of the 48 samples post-date *ca* AD 1300. The presence of multiple

FIGURE 19.1 *A selection of the ostrich eggshell fragments excavated at Essouk.*

 | DOI 10.1163/9789004348998_020

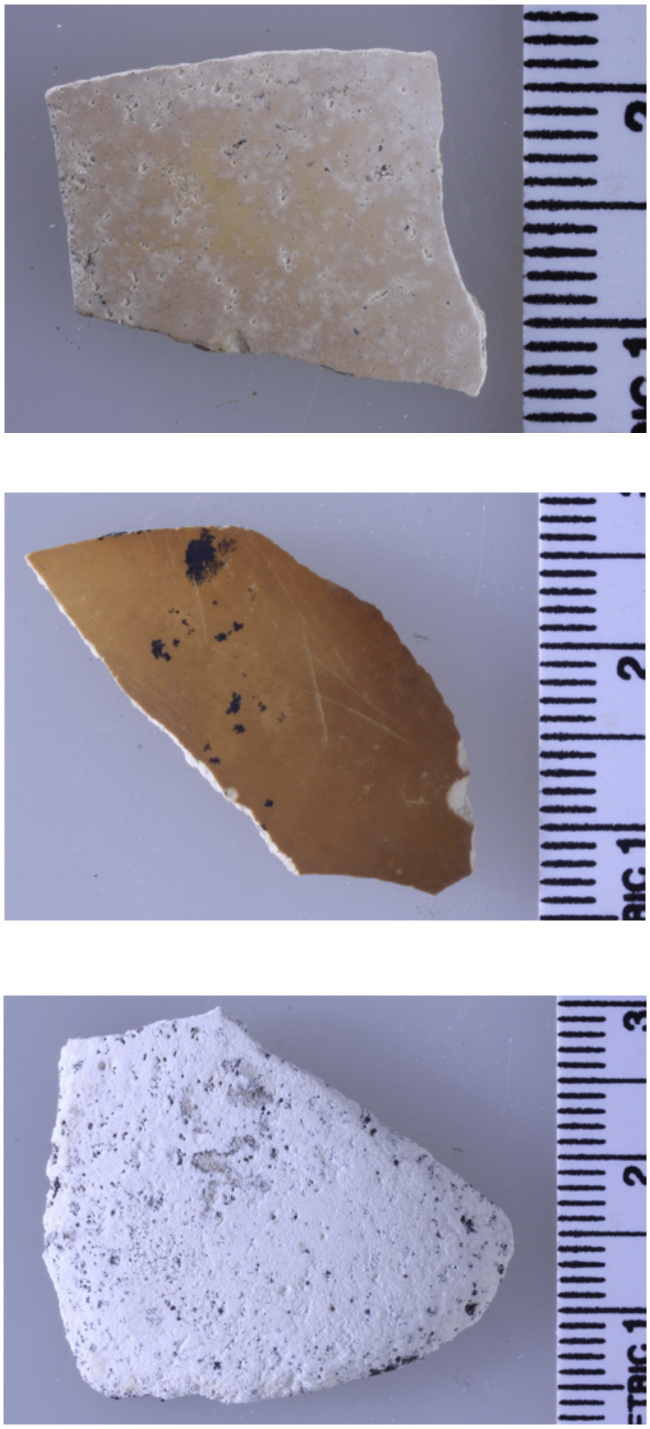

FIGURE 19.2 *a) image of well-preserved ostrich eggshell fragment (Ek-A 38); b) ostrich eggshell fragment with orange-brown colouring (note also scratches on surface) (Ek-C 2); c) image of heavily degraded ostrich eggshell (EKA-Wall 3).*

samples from earlier periods however should make us strongly consider that this is simply a result of sampling bias. The evidence thus far therefore suggests the common occurrence of eggshell in the post *ca* AD 1300 deposits, and that it is also at least relatively common in earlier deposits. There is no fixed relationship between the occurrence of eggshell and certain context types, though it should be noted that a significant amount of the material does come from sandy deposits, often identified as living floors.

None of the eggshell fragments surpass *ca* 3cm^2 in size. The fact that all the fragments are relatively small is unsurprising as eggshell tends to fragment quite extensively. Once it gets to a relatively small size – relative to the overall size of the egg and thickness of shell – however, it doesn't tend to fragment much more, unless conditions are very acidic. The samples are all of an irregular shape. They exhibit no particularly obvious signs of tool marks or breakage associated with working, and the edges exhibit no signs of polishing or smoothing. Some scratches are seen however (see *e.g.* Fig. 19.2b), and the samples featuring scratching which were not subjected to ultrasound (see below) show that dirt is found within the scratches, and therefore not a result of damage during excavation. The scratches appear generally quite superficial and relatively random, though on certain samples they have some regularity (parallel lines), and one (Ek-B 4) has slightly deeper parallel abrasions on its interior. As commented above, preservation is variable, the material ranging from the exceptionally preserved to the highly eroded. Samples which are very well-preserved closely resemble what fragments of modern ostrich eggshell look like (including the milky white colour). In some cases even the colour of the shell is retained on the external surface. The eroded specimens are quite friable and often show bleaching to a bright white colour. The presence of black spots (*e.g.* Fig. 19.2c), possibly mould, is surprising, but may account, in part, for the poor preservation seen in some of the samples.

Although generally in a clean state following initial washing in the field, ultrasound was used for further cleaning of the samples. This was conducted on all samples except for those from Ek-C Horizon '0'. The samples which saw this additional cleaning were placed in a water-filled beaker within a water-filled ultrasonic tank and subjected to short periods of ultrasound. This process gently lifts dirt adhering to the individual pieces of shell without damaging them. Following cleaning, the shells were air-dried. All samples were scanned using a low-powered stereo microscope at magnifications of between 10 and 40 times. This was done in order to pick out superficial differences and ascribe types, based on gross morphology such as thickness and relative size of mammillae. Examination of pore clusters on the external surfaces were made where possible. Pore clustering is a characteristic shown by eggs of large flightless birds and is a characteristic used to support identification of ostrich eggshell (see SIDELL 1993). Shell thickness was measured using vernier calipers.

Identification of the well-preserved fragments was relatively simple and did not require SEM work. The poorly

TABLE 19.1 *Ostrich eggshell excavated at Essouk-Tadmekka* (table continues overleaf)

Context (sample)	No. Fragments	Comments	Thickness (mm)	Hatched (H)/ Unhatched (U)	Definite Ostrich ID
Unit Ek-A					
Ek-A 1 (A)	2	Eroded; cream; good pore clusters	1.8	?	✓
Ek-A 1 (B)	2	Eroded; cream; good pore clusters	1.7	U	✓
Ek-A 10 (A)	1	Well-preserved, orange (outer colour) with black specks.	2.1	U	✓
Ek-A 10 (B)	1	Well-preserved; buff (outer colour); good pore clusters	1.9	?	✓
Ek-A 10 (C)	1	Eroded; cream	1.8	?	–
Ek-A 18	1	Well preserved, cream, partly blackened.	2.2	H	✓
Ek-A Wall 3	3	Eroded (chalky texture); white (with black specks); mould (?) present	1.4	?	–
Ek-A 38	1	Well-preserved; cream; good pore clusters	1.7	?	✓
Ek-A 45	6	Eroded; white (with black specks); mould (?) present	1.4	?	–
Ek-A 78	1	Eroded; white	1.4	U	–
Ek-A 85 (A)	2	Eroded (chalky texture); white (with black specks); mould (?) present	1.1	?	–
Ek-A 85 (B)	2	Eroded; white (with black specks); mould (?) present	1.4	?	–
Ek-A 93	1	Eroded (chalky texture); white with black specks; pores very clear.	1.5	U	✓
Ek-A 95	1	Eroded; white	1.6	U	–
Ek-A 97	1	Eroded (chalky texture); white	1.6	U	–
Unit Ek-B					
Ek-B 3 (A)	1	Very well-preserved; cream	1.8	?	✓
Ek-B 3 (B)	1	Well-preserved; cream	1.9	?	✓
Ek-B 4	1	Well preserved; cream; relatively deep parallel abrasions on interior	2.0	U	✓
Unit Ek-C					
Ek-C 2	1	Well preserved; brown/orange; external scratches (with black specks)	1.8	U	✓
Ek-C 7 (A)	1	Eroded; white	1.7	?	–
Ek-C 7 (B)	1	Eroded (chalky texture); white	1.8	?	✓
Ek-C7 (C)	1	Eroded (chalky texture); white	1.6	?	–
Ek-C 7 (D)	1	Eroded (chalky texture); white	1.6	?	–
Ek-C 7 (E)	2	Eroded; cream; mould (?) present	1.6	U	–
Ek-C 9	1	Eroded (chalky texture); white (with black specks); pores very clear	1.9	U	✓
Ek-C 9A (A)	1	Eroded (chalky); white (with black specks); pores clear; mineral deposits internally	1.9	U	✓
Ek-C 9A (B)	1	Well-preserved; cream; external scratches (containing dirt so not from excavation)	1.9	H	✓
Ek-C 9C	1	Very well-preserved (still with outer layer including extensive crazing); cream	1.8	U	✓
Ek-C 15	1	Eroded (chalky texture); white	1.7	U	✓
Ek-C 16	1	Very-well preserved (outer surface still preserved, although not with the crazed effect of 9C); cream; scratched (seemingly in antiquity – quite regular)	2.1	U	✓
Ek-C 18	1	Eroded (chalky texture); white; mineral deposits internally	1.6	?	✓

TABLE 19.1 *Ostrich eggshell excavated at Essouk-Tadmekka* (cont.)

Context (sample)	No. Fragments	Comments	Thickness (mm)	Hatched (H)/ Unhatched (U)	Definite Ostrich ID
Ek-C 22	1	Very well-preserved (outer surface still preserved – not crazed effect); cream	1.9	U	✓
Ek-C 26	1	Eroded (chalky texture); white	1.4	U	✓
Ek-C 27	1	Very-well preserved (outer surface still preserved – not crazed effect); cream	1.7	U	✓
Ek-C 34	1	Eroded; white	1.6	U	✓

preserved fragments are in such a bad state however that it is highly unlikely SEM examination would add anything. SEM work was therefore confined to illustrating examples of the hatched and unhatched ostrich eggshell samples. Two samples only were prepared for SEM. This was carried out at English Heritage's Fort Cumberland laboratory using an FEI Inspect F scanning electron microscope. The SEM samples were not coated. A more in-depth account of the methodology followed here may be found in SIDELL (1993), including discussion of the identification of hatched and unhatched eggshell.

Summary details of the stereo microscope analysis are presented in Table 19.1. As initially surmised, with the exception of one sample (Ek-C 11), the assemblage is almost certainly entirely ostrich eggshell. This is based not only upon general appearance, but on the expected thickness of the shell, and the expected pattern of pore clustering on the exterior of the shell (SIDELL 1993). In some cases, firm identification is not possible because morphology has been eroded; in these cases however the broad correspondence of the specimens to the large number of well-preserved specimens that can be firmly identified is sufficient evidence to also identify these as ostrich eggshell. The results therefore demonstrate that ostrich eggshell is present within the sequence from *ca* 9th/10th century AD to *ca* 1400 AD. Very little of this shell has come from hatched eggs, based on characteristics of the internal surface (SIMONS 1971). In particular this is shown by whether individual cells in the shell wall are fractured or not, hatching creating pits in these cells. SEM analysis produced good clear images illustrating examples of both the hatched and unhatched ostrich eggshell excavated (Fig. 19.3).

The single specimen that is not ostrich (from Ek-C 11) was unfortunately not able to be precisely identified. It is 0.25mm thick and is very well preserved, and was able to be identified as unhatched. We can certainly say that it is too thin to be chicken or guinea fowl (note though that this family of birds was present at Essouk-Tadmekka at certain periods: see Chapter 20). It likely therefore relates to a local wild bird.

Discussion

Other than the single unidentified eggshell specimen, the eggshell at Essouk-Tadmekka is, as surmised, indeed all ostrich eggshell. Within the Adrar des Iforas region ostriches are present within the rock art, including examples from Essouk (Chapter 4). While it is unclear from what time these depictions date, early Arabic sources do refer to the presence of ostriches in the West African Sahel during the early Islamic era (*e.g.* LEVTZION & HOPKINS 2000: 226, 264). From the 16th century a cross-Saharan trade in ostrich feathers is documented, and by the 19th century these occasionally formed half of the value of caravans from West Africa (LYDON 2009: 141–143). The deserts of the Adrar des Iforas would have been as likely a source as any for such products, and indeed the confirmation of the presence of ostriches in the area clearly allow us to consider this. The only possible evidence for ostrich within the faunal remains is a piece of worked bone from a large bird, but this has not been identified to species (Chapter 20).

Ostrich eggshell is most commonly known and discussed from Saharan and West African sites in the form of ostrich eggshell beads, and these have been evidenced from other medieval trans-Saharan trading sites, such as Tegdaoust (VANACKER 1979: 153–154) and Takedda (BERNUS & CRESSIER 1991: 128), as well as at pre-Islamic sites, such as Garamantian sites in the Libyan Fezzan (MATTINGLY 2013: 457–458). Unworked ostrich eggshell fragments have also been found together with this ostrich eggshell bead evidence, and naturally the unworked egg-

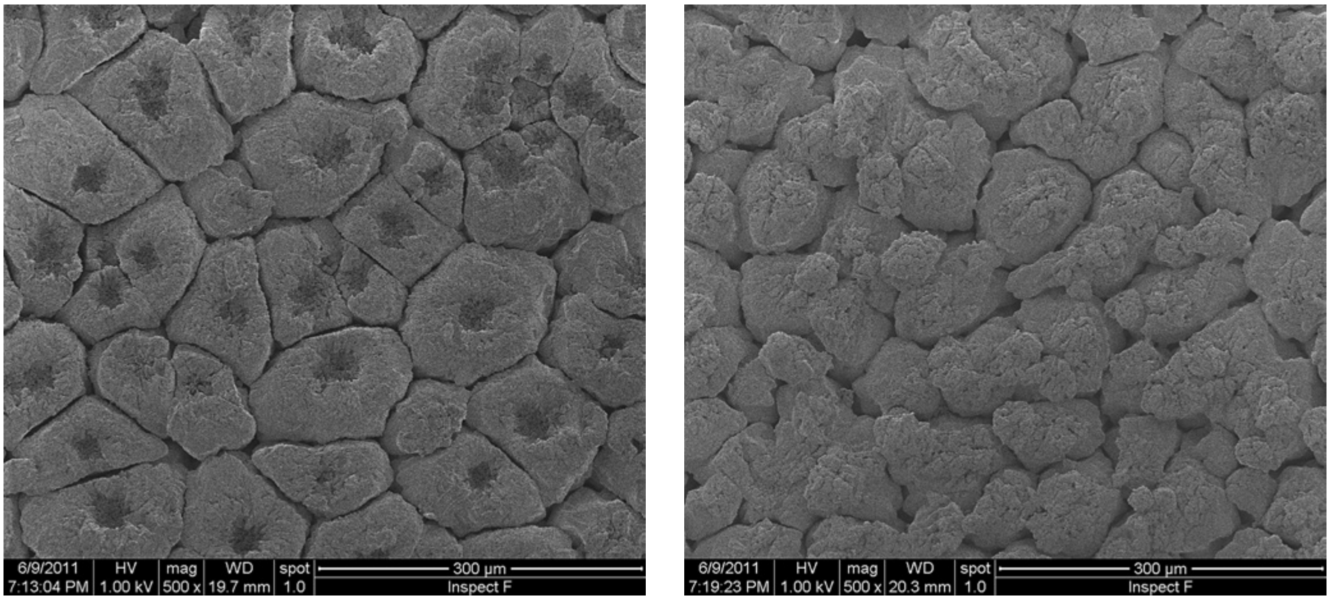

FIGURE 19.3 *a*) *SEM image of interior of a hatched ostrich eggshell fragment (Shell 1, context EKA 18) at 500× magnification. That the eggshell is hatched can be determined by the pits in the individual cells which make up the shell wall, this being caused by fracturing associated with hatching; b*) *SEM image of interior of an unhatched ostrich eggshell fragment (Shell 2, context EKA 10) at 500× magnification. In this image we can clearly see that the individual cells in the shell wall are not fractured, a clear sign the egg is unhatched.*

shell is seen as a waste product of the bead making industry. Unworked ostrich eggshell fragments are also however found at sites where no beads have been found, such as at the medieval Sahelian site of In Teduq in Niger (Bernus *et al.* 1999: 324), or the Bronze Age Egyptian site of Bates Island (Conwell 1987). In the absence of artefacts made from eggshell, the nature of this evidence has not been clearly explained, though at In Teduq this evidence was presented as part of the natural environment. Certainly it is possible that eggshell is deposited at sites by nesting birds, including during periods of abandonment, and in certain cases it is even possible eggshell deposited in the vicinity of sites could arrive in occupation layers through inclusion in sands or soils collected for furnishing building floors during construction or refurbishment. However, given the historically attested importance of the ostrich egg as a source of protein within the Tuareg world and the traditional utilisation of eggshell for various purposes in West Africa and the Sahara (see below), there is a need to carefully consider this commonly occurring material at sites such as Essouk-Tadmekka.

Considering firstly the material appearance of the Essouk-Tadmekka samples, the most noteworthy thing to be commented on is their condition. Some of the samples are in remarkably poor condition. One would tend to associate this either with something which has lain exposed and weathered before being covered, or with specimens buried in ground which has seen alternating conditions of wet and dry. It should be noted however that the relative condition of the samples is not related to depth below ground, and indeed some of the best preserved samples come from the upper levels of the site where wet and dry fluctuation is most common. Also, we see that some of the most eroded samples come from similar contexts to the best-preserved samples, and there appears to be no stratigraphic patterning to preservation. Some of the samples are also in remarkably good condition. The presence of colour surviving on several fragments is particularly interesting as the colouring of fresh eggs is an organic compound and only survives in exceptional conditions, for instance where anoxia prevails. Further investigation is needed to establish why colour has survived and whether it is in fact artificial. Interestingly, discoloration of ostrich eggshell has been demonstrated to be consistently associated with fire (Texier *et al.* 2010: 6183), suggesting a possible explanation for the several Essouk-Tadmekka fragments with grey and orange coloring. We cannot however rule out this colouring having been caused by a particular use of eggshell at medieval Tadmekka (see below). The abrasion of the samples likely relates to slight movement in the ground following deposition.

One could make a slightly tenuous argument to suggest that the arrival of the eggshell at Essouk-Tadmekka has nothing to do with the inhabitants, but this seems unsustainable. It seems extremely unlikely that wild ostrich nests would be consistently found within the inhabited valley of such a flourishing settlement during the period of its habitation, as wild birds would tend to live far removed from settlements. Ostrich farms are known from later periods linked to the feather trade (Lydon 2009: 141–143), and could also have been bred for meat, but even such a scenario would not explain the presence of the eggs in house interiors. One could hypothesis that the common finding of the eggshell in sand deposits within the houses could be caused by the use of sand from the wadi which might contain eggshell washed in during seasonal inundation, though this seems a weak argument.

The most obvious explanation for such a high percentage of eggshell in occupation contexts in houses is that in the relatively marginal environment of medieval Essouk-Tadmekka the large ostrich eggs were an attractive source of protein for the town's inhabitants. Ethnographic accounts of Tuareg groups from Niger testify to the great importance of ostrich eggs as a source of protein (Giazzi *et al.* 2006), and they are also documented from the Algerian Haggar Tuareg (Briggs 1960: 140); though it should be noted that in the Haggar example these eggs are only consumed by the *haratin*, black groups in domestic servitude. The fact that the eggshell positively identified as unhatched at Essouk-Tadmekka (18 samples) far outweighs that identified as hatched (2 samples) does strongly support the idea that they relate to consumption of eggs. If the eggs were indeed consumed, the way in which they were prepared (*e.g.* boiling or cooking in fire) might offer an explanation of the difference in the condition of the shell.

While then one can make a strong case for the ostrich eggshell making its way onto the site for its value as a food-source, there is also the possibility that the eggshell itself was of value. There is however no clear, obvious evidence from the eggshell that we have found of items which indicate an artefactual usage, neither flakes of working debris or fragments clearly part of a larger worked artefact. The surface wear is interesting in being shown to be pre-excavation, but again is not able to be demonstrated as a clear sign of artefactual use. The preservation and degradation can be hypothesised as relating to certain functions (see below) but do not offer clear proof of this. While then we cannot prove that the evidence we see relates to artefactual use of eggshell, a brief consideration of this possibility on the basis of evidence from other sites and historical sources is useful.

Near-intact ostrich eggshells are known to have been used in antiquity for a range of ornamental and functional purposes (Conwell 1987; Green 2006). Likewise, from the Islamic world near intact ostrich eggshells have commonly been used as mosque decorations (Insoll 1999: 42–43), but also as pilgrimage relics, drinking containers, and burial items, and gain a particular importance due to references to their use by the Prophet Mohammed (Green 2006). Even if near-intact ostrich eggshell was not desired locally for these purposes they were a valuable item elsewhere in the Islamic world and it has been proposed that these could have been one of the additional objects which made their way north on trans-Saharan caravans with gold, slaves and ivory (Green 2006: 54). All this said, we have no evidence to indicate curation of near intact eggs nor perforations related to this process; but it would be surprising if no such function at all existed locally for unhatched eggshell, as these objects have a functional importance and symbolism which has crossed over many cultural zones.

The most commonly known historic use for fragmented ostrich eggshell is for making beads, and despite not finding any ostrich eggshell beads we should not rule out a connection with such an industry. Occurrences of ostrich eggshell beads at West African sites are not abundant and are often restricted to certain types of contexts, for instance burials. The case of ostrich eggshell distribution at Tegdaoust is an interesting case in point (Vanacker 1979: 153–154). Here unworked eggshell was widespread, but beads tended to be more commonly recovered in certain functional contexts (in particular a building believed to have a commercial function). We should consider therefore that ostrich eggshell beads might be found in types of contexts so far unexcavated.

In discussing a possible function for ostrich eggshell in the Saharan world, perhaps the most important historical reference comes from a 13th century account of the Saharan regions around Audaghust (Levtzion & Hopkins 2000: 173). This reference refers to the use of ostrich eggshell in the preparation of the hides of the *lamt*, a gazelle-like animal, prior to their use for the fabrication of shields from this skin. It is asserted that the *lamt* skins were soaked in milk and ostrich eggshell to tan them, prior to their use in making the *lamt* shields – one of these references states that this process took one whole year (Levtzion & Hopkins 2000: 180). While it would not be sensible to draw too direct a parallel between such a reference and the Essouk-Tadmekka evidence, this does present a specific alternative hypothesis for ostrich eggshell use at Essouk-Tadmekka; and in particular for explaining the noteworthy degradation of certain specimens.

As stated above, the single eggshell sample which was not ostrich eggshell has not been possible to precisely identify. Certainly it does not seem to be a chicken or guinea fowl egg, and likely relates to a wild bird. It is possible this could be identified further with protein analysis (STEWART *et al.* 2013).

Conclusion

The study has clearly identified that all but one of the 48 fragments are ostrich eggshell. This is important firstly in confirming the presence of ostrich populations around Essouk-Tadmekka during the early Islamic period. Additionally, the study shows that the vast majority of the specimens relate to unhatched eggs. The most likely scenario for this is obviously the consumption of ostrich eggs by Essouk-Tadmekka's inhabitants, utilising a high protein source in their immediate environment. Parallel archaeological evidence from sites such as Takedda and Tegdaoust, as well as historical records, clearly show that eggshell was put to various uses throughout the West African Sahel/Sahara borderlands, including for bead making. Near complete eggshells were also seemingly a trans-Saharan trade item. Based upon the current evidence from Essouk-Tadmekka, though, there is no clear basis for attesting eggshell use for any function. The occurrence at certain other sites of significant quantities of unworked eggshell alongside only limited evidence for artefactual use, however, shows that artefactual use can be of limited visibility archaeologically, and we should not discount this evidence turning up at Essouk-Tadmekka in future.

CHAPTER 20

Faunal Remains

Kevin C. MacDonald

General Observations

The Essouk-Tadmekka assemblage is, regardless of excavated context, a highly comminuted one. This is seemingly due to a combination of pre- and post-depositional processes. Pre-depositional processes include the intensive and ubiquitous fragmentation of bones (even including first phalanges), probably for marrow extraction and eventual incorporation into stews or sauces. Post-depositional processes include some form of chemical weathering or leaching in the soil, rendering the bones particularly powdery and friable. Nonetheless, universal sieving of deposits and careful bone recovery makes this a representative assemblage;[1] something evidenced, for example, by the high frequency of Small Medium bovid carpals.

Across Essouk-Tadmekka's time periods, sheep and goat are the most frequent taxa, followed by domestic cattle (Tabs. M.1–M.2).[2] Specimens classed as Small Medium, Large Medium and Large Bovid most likely relate to livestock (sheep/goat and different sizes of cattle), but any remains so determined were too fragmentary to be taken to taxon reliably. In total, bovids represent 93.6% of all identifiable specimens from Ek-A (n=499 of 533). Other taxa (including other mammals, birds, reptiles and fish) are therefore relatively rare, attesting to a narrow dietary breadth in terms of meat protein undoubtedly linked to the desertic situation of the site.

Bone remains are scarce from Essouk-Tadmekka's first occupational period and do not allow a reliable assessment of the site's earliest economy, except to say that cattle are known to be present from the first occupation. In subsequent periods, we are in the presence of an 'urbanised' pastoral subsistence economy, with sheep/goat and – to a lesser extent – cattle dominating.

The state and size of the assemblage precludes the construction of age profiles for livestock or detailed butchery studies, yet some observations can be made regarding charring. It is interesting to note that no charred elements survive from Ek-A Periods 1 and 2, but that charring is relatively frequent (up to 16.8%) in Periods 3b through 4 (Tab. M.3). While one might be tempted to postulate a shift in cooking practice at the site from boiling to roasting from Period 3b onwards, this seems more likely to be a purely local sampling phenomenon as charring is relatively common in the earlier dated Ek-B samples.

Results by Taxa

Pastoral Economy: Cattle, Sheep and Goats

Cattle (*Bos* sp.[3]) occur throughout the sequence at Essouk-Tadmekka and, as one might expect from Saharan pastoral nomads there appears to be a tendency to consume sheep and goat, but conserve cattle – even mature males – as capital or insurance (*cf.* AMANOR 1995). Conversely, in my experience, Sahelian non-pastoralists, who consume purchased cattle, tend to consume more equal proportions of small and large livestock. As can be seen in Table 20.1, the livestock remains from Essouk-Tadmekka show a propensity towards consumption of small livestock, e.g. unit Ek-A Periods 2 and 3a/b showing a 7:1 sheep/goat to cattle ratio, and Ek-A Period 4 a 5:2 ratio. This pattern remains, even if small/medium bovid numbers are added to sheep/goat and large and large medium bovid counts are added to cattle. So, at Essouk – despite being a town – overall proportions still lean towards a more arid 'nomadic pastoral' pattern, especially if we compare numbers with samples from similar periods at the contemporary Sahelian urban sites of Dia and Jenné-jeno (MACDONALD 1995; MANNING & MACDONALD 2005) or the Saharan entrepôt of Tegdaoust (BOUCHUD 1983) (Tab. 20.1).

1 Note however that the Ek-C faunal remains represent a sample of the total sieve-collected while those from Ek-A and Ek-B are a 100 per cent sample.

2 Identifications were made by Kevin MacDonald using the collections of the Institute of Archaeology Bone Room as well as the private collections of MacDonald and Louise Martin. The identifications of some specimens were confirmed using the collections of the Natural History Museum (London).

3 I refrain from stating the species of Bos, given ongoing debate concerning the possibility of domestic animals descended from the native cattle of Africa (*Bos africanus*) as opposed to those of western Eurasia (*Bos taurus*). Additionally there is the likelihood during the time of Essouk-Tadmekka for the presence of genetic admixture of humped cattle (*Bos indicus*).

 | DOI 10.1163/9789004348998_021

TABLE 20.1 *Comparative livestock proportions between Essouk and other West African urban sites*

Site	Date Range	Sheep/Goat NISP	Cattle NISP	Approximate Proportion
Essouk (Ek-A)	Periods 2 and 3a/b *ca* AD 900–1300	155	23	7:1
Essouk (Ek-A)	Period 4 *ca* AD 1300–1400	80	34	5:2
Tegdaoust (1960/1965)	Niv. supérieur *ca* AD 1100–1300	52	55	1:1
Dia Mara (1999–2003)	Horizon IV *ca* AD 1000–1600	40	94	3:7
Jenné-jeno (1981 excav.)	Phase IV *ca* AD 850–1400	33	47	3:5

Of course urban sites are typically net consumers rather than producers of livestock which would have been culled from herds circulating around their hinterland; so to what may these different proportions be due? While it is tempting to attribute this difference to different biomass environments – the Inland Niger Delta versus the Sahara – all sites would have been to some degree dependent for meat on non-resident transhumant herders from which both cattle and sheep/goat would have been available (at a differing price, of course). Interestingly, the sample from Tegdaoust, a similarly desertic site, shows cattle and sheep/goat remains virtually equal in quantity. Does this mean that the inhabitants of Tegdaoust could afford more beef than those at Essouk-Tadmekka or were other factors in play? The fact that residents of Essouk-Tadmekka were themselves ancestrally (even psychologically?) pastoralists, although urbanised, may have contributed to this pattern. The tendency to view cattle as animals to be conserved for their value, both economically and as herd propagators in a marginal climate, is a habit which is hard to break.

Although mortality profiles are not available, such data as exists does seem to indicate a pattern supporting the foregoing discussion (Tab. M.4). Immature sheep and goat (and Small Medium bovids) are far more common in the sample than are immature cattle (or large / large medium bovids).

It should be noted that both Goat (*Capra hircus*) and Sheep (*Ovis aries*), which were differentiated using Boessneck's criteria (BOESSNECK 1969), are present in roughly equal numbers throughout the sequence. This indicates that throughout the occupation of the site more arid-land efficient goats were kept in balance with sheep, which may have been preferred for culinary reasons. This may relate to the 'elite' nature of Essouk-Tadmekka and its urban consumption patterns. We should also consider relating this evidence to the important observation of Briggs (BRIGGS 1960: 19) on the recent historic existence of a significant trans-Saharan trade in hairy sheep, purchased in the western Sudan or Air, and then transported through the Adrar-n-Ifoghas region – where Essouk is situated – finally making their way to the oases of the Tidikelt in central Algeria, as well as occasionally also further north to Wargla. It is therefore possible that the Essouk-Tadmekka sheep are not of local origin, and that some 'elite' consumption of this trans-Saharan commodity may have been taking place.

In terms of breed, or breed size, we are in a better position to comment with sheep and goat than with cattle (see Tab. 20.2, Tab. M.5). For cattle only two specimens are really useful and the results are rather equivocal. An intact astragalus (Gll=72mm) from Ek-B Horizon 2 is from a very large animal, in the range of large modern *indicine* humped breeds. A 1st Phalanx (Glpe 59.2) from Ek-C Horizon 3 is of an average size, falling in the middle of cattle size ranges established from contemporary Sahelian sites such as Jenné-jeno, Dia, Cubalel and Siouré and presumably reflecting medium-sized humpless shorthorn cattle such as modern Ndama breeds (MACDONALD 1995; MACDONALD & MACDONALD 2000; MANNING & MACDONALD 2005).

Sheep and goat, with better sample size, may be reasonably viewed against measurements from a range of other sites (MACDONALD & MACDONALD 2000) (Tab. 20.2).

Although this is useful new data, the results are fairly predictable: desertic herds from Essouk-Tadmekka and Gao Saney are somewhat larger than herds which existed in

TABLE 20.2 *Comparative Sheep/Goat measurements between Essouk and other contemporary West African sites*

Site	Period AD	Astragalus Gll			2nd Phal. Glpe		
		High	*Low*	*Median*	*High*	*Low*	*Median*
Essouk	*ca* 950–1400	33.9	27.0	30.9 (n=8)	27.9	23.7	25.3 (n=6)
Gao-Saney	*ca* 900–1200	34.7	34.0	34.2 (n=4)	na	na	26.6 (n=1)
Akumbu	*ca* 600–1400	27.3	26.8	27.1 (n=2)	27.2	21.1	25.3 (n=3)
Cubalel	*ca* 600–950	32.1	26.6	28.2 (n=7)	23.9	20.5	21.4 (n=9)

well-watered savanna conditions at Akumbu (in the Méma, at that time part of the Inland Niger Delta) and Cubalel (from the Middle Senegal River Valley). This phenomenon goes along with the well documented gradual size reduction of domestic stock in areas with strong *Tse tse* vectors – a product of natural selection (see MACDONALD 1995; MACDONALD & MACDONALD 2000).

Other Domestic Animals: Equids, Camel, Dog and Fowl

Equids

A few equid remains are scattered through the deposits of Ek-B and Ek-C. The sample is too small to show any reliable temporal patterns, but it is interesting to note that donkey (*Equus asinus*) is present by around *ca* AD 950 (a distal tibia from Ek-B horizon 1) while horse (*Equus caballus*) is not confirmed until *ca* AD 1200–1300 (a proximal metatarsal from Ek-C Horizon 1). While these finds are not unexpected, horses being well documented south of the Sahara by this period and some time before (*cf.* MACDONALD & MACDONALD 2000), they do indicate that the donkey was functioning as a beast of burden at Essouk-Tadmekka from the site's outset. Indeed they may have formed an essential part of the caravans journeying up from the Niger during the time of Essouk-Tadmekka; though they are less likely to have continued in the more difficult run to the north. It is interesting to note that Equids were entirely absent from the much larger excavated sample of Tegdaoust, even though camel remains were relatively common there (BOUCHUD 1983). It may be that the western caravans made more exclusive use of camels as beasts of burden. Horse and Donkey were separated on the basis of size alone and while measurements are not available from these fragmentary specimens the horse appears to have been of normal size and the donkeys particularly small. A proximal horse metatarsal from Ek-C Horizon 1 deposits was charred after breakage (possibly chopped) and therefore may indicate the consumption of Equids – even animals so prestigious as a horse – after their working lives were done.

Camel

Only two bones of *Camelus dromedarius* were recovered during the Essouk-Tadmekka excavations: a proximal calcaneus from Ek-B Horizon 3 and a navicular from Ek-A Horizon 13 (see Fig. 20.1). The dating of these remains from *ca* 950–1350 means that the first confirmed presence of camel at the site is slightly later than that of the donkey, although this is probably merely due to sample size, and it should be noted that camel remains are rare recoveries even from Saharan entrepôts (at Tegdaoust, from a much larger sample, only 11 identifiable camel bones were recovered, BOUCHUD 1983). Instead, most of their bones probably litter the wayside of the former great caravan routes.

Dog

Canis familaris (Domestic Dog) remains have been recovered from Ek-A in Periods 2 through 4 and become particularly common in Period 4 (*ca* AD 1300–1400). They have been differentiated from jackals (*Canis adustus* and *Canis aureus*) on the basis of size. The breed involved at Essouk-Tadmekka is also larger than the African pariah dogs. For example, the greatest length (GL) of an astragalus recovered from Ek-A Horizon 13 (Fig. 20.2) is 26.4mm as compared to four available specimens of contemporary African pariah dogs (ranging from 23.5 to 24.5mm), and a calcaneus from the same horizon measures 44.0 versus the pariah sample's range of 36.6 to 41.4mm. Such measurements are closer to the size one would expect from

FIGURE 20.1 *a&b) Two views of a* Camelus dromedarius *navicular from Ek-A Con. 38.*

FIGURE 20.2 Canis cf. familiaris *astragalus, anterior view, from Ek-A Con. 40.*

African greyhound breeds, types known historically more from North Africa and Egypt (*cf.* Epstein 1971, vol.1; Blench 2000). Pariah dogs, on the other hand, occur from Egypt across the Sahel and extend in range southwards into Central Africa.

Some of the canid remains from Essouk-Tadmekka (both from Ek-A Period 4 contexts) are charred (a phalanx and a metacarpal, see Fig. 20.3, Tab. M.3). This may be the result of roasting, or may represent a chance association with fire, but it is interesting that these bones are occurring in the same depositional contexts as roasted ovicaprines. There is indeed a long and well-documented history of dog-eating in the Sahara. A lively debate about historical cynophagie (dog eating) amongst Berbers occurred in the *Bulletin Liaison Saharienne* during the 1950s (Canard 1953; Bureau 1954; Chalumeau 1954). Briggs (1960: 24–25) wrote tellingly concerning Berber peoples and cynophagie:

“Dogs other than sloughis are eaten occasionally in the northern and central Sahara, and more rarely in the south, but this practice seems always to have some ritual significance, either purely magical or magico-medicinal. In a few cases its adepts have claimed that they ate dog meat only because they liked the taste, but the reports make it clear nevertheless that what they were really up to was

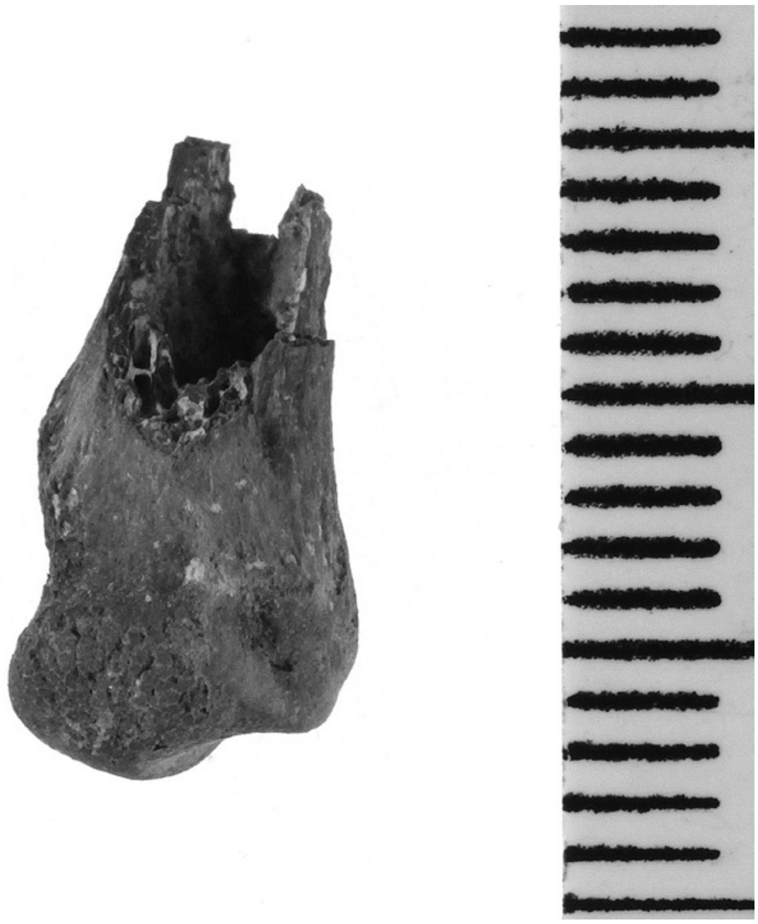

FIGURE 20.3 *Charred and broken* Canis cf. familiaris *metacarpal from Ek-A Con. 9.*

making a demonstration in ritual defiance of traditional dietary taboos …"

That such a practice was also prevalent in more ancient times, we have the word of Al-Bakrī (*ca* AD 1068) who saw the Ibadi as keepers (and consumers) of dogs: "The inhabitants of Sijilmasa fatten dogs and eat them, as do the people of the towns of Qafsa and Qastiliya" (LEVTZION & HOPKINS 2000: 65). Thus, there is every reason to believe that at the very least the Canid remains from Ek-A Period 4 contexts were subsistence remains, and have interesting implications regarding identity and ideology at Essouk-Tadmekka, *ca* 14th century. Further, it is important to note the particularly strict attitude towards dogs adopted by the Almoravids, who during their 11th century rise to power were reported (by Al-Bakri) to have slaughtered all dogs at Ibadi towns they conquered, something which appears to have been associated, at least in part, with the practice of cynophagie amongst the Ibadi, and the perception of this as poor Muslim conduct (MORAES FARIAS 1967: 809–810, 854).

Terrestrial Fowl

A few remains attributable to domestic fowl (Chicken or Guineafowl) were identified from the site. The fact that the remains are so scarce would suggest these were a delicacy rather than a major meat source. Yet there is another more likely explanation: Briggs (BRIGGS 1960) noted in recent historic times that the Tuareg consumed neither chickens nor their eggs, and that their slaves ate eggs, kept chickens, but did not consume the bird.

In one instance, Ek-B Horizon 3, chicken (*Gallus gallus*) was able to be identified on the basis of size with a distal tibiotarsus which was too small for guineafowl and too large for any francolin species (*cf.* MACDONALD 1992). This would place the domestic chicken at Essouk-Tadmekka at least by the 11th century, if not earlier. Bouchud claims the presence of chicken at Tegdaoust from the 9th century (1983: 356). Ironically they are attested much earlier south of the Sahara: at Jenné-jeno as early as the mid-first millennium AD (MACDONALD 1992) and at Kirikongo in Burkina Faso from the early first millennium AD (DUEPPEN 2011). Obviously there are still many gaps to be filled in tracking the appearance and dispersion of Domestic fowl in arid West Africa.

Wild Animals

Antelopes

One would expect a number of wild bovid taxa to be present at Essouk-Tadmekka, particularly the Dorcas gazelle, the Addax and the Barbary Sheep which were present in the region during the colonial era and to a more limited extent are still present today. However, only the Dorcas Gazelle (*Gazella dorcas*) was positively identified (tarsals and a 2nd phalanx from Ek-B Horizons 2 and 3, *ca* AD 950–1050). It is possible that some Addax and Barbary Sheep may be included in unidentified Large Medium Bovid material (which would otherwise be small cattle), but it is less likely that the petite Dorcas Gazelle would be confused with sheep/goat in the Small Medium category. Regardless, there appears to be little evidence at Essouk-Tadmekka for anything but the occasional hunting of Saharan game.

Wild Carnivores

Remains of the Striped Hyaena (*Hyaena hyaena*) were found in two contexts, a carpal from Ek-A Horizon 12, and three metacarpals from one individual in Ek-A Horizon 13. Striped hyaenas can frequently be found around Sahelian and Saharans settlements where they are known to prey on sheep and goat, and scavenge food refuse and even poorly buried cadavers. The remains of hyaenas recovered here likely come from individuals hunted as a preventative measure against stock raids.

The ulna of a polecat-sized small carnivore was recovered from the abandonment deposits of Ek-A and may be an intrusive specimen (from a burrow death).

Rodents

Undetermined Rodent remains (mandibles) were recovered from the abandonment deposits in Ek-A and probably represent burrow deaths.

Birds

Wild bird remains are rare at Essouk-Tadmekka. A single scapula of a large heron, attributed on size and morphology to the Grey Heron (*Ardea cinerea*) was recovered from Ek-A Horizon 13. The Grey Heron only traverses the Sahara as a Palaearctic migrant. During such migrations certain birds inevitably drop out from exhaustion and are predated upon. The author has been presented with i.d. rings from storks, herons and other European migrant birds by hunters while travelling in the Malian and Mauritanian Sahel and Sahara.

Monitor Lizard

The savanna monitor lizard (*Varanus exanthematicus*) was identified on the basis of a humerus and a vertebra from Ek-A Horizon 13. This large and robust lizard species, which can sometimes exceed one metre in length, commonly lives in arid rocky areas throughout Africa. The author has witnessed it hunted opportunistically for its meat and skin all across the Sahel, particularly by children.

Fish

Although distant from any water body containing fish, there is some evidence that dried fish may have occasionally been imported into Essouk-Tadmekka. A pelvic girdle fragment from a perch (Tilapia or Nile Perch) was recovered from Ek-A Horizon 13, and an anal pterygophore from a Nile Perch (*Lates niloticus*) reconstructable to a *ca* 70cm length was recovered from a mixed context in Ek-C (Context 30; not counted in the tables below) (Fig. 20.4). Taken together these may indicate a limited commerce in dried/ smoked fish to the site (particularly 'prestige' varieties such as the Nile Perch).

Conclusions

The faunal remains of Essouk-Tadmekka provide a tantalising glimpse of the animal economy of a medieval Saharan trading entrepôt. The assemblage stands in strong contrast to those of the Middle Niger urban sites of Jenné-jeno and Dia, and even the Niger Bend trading centre of Gao which all relied in great part on aquatic subsistence resources – large and diverse fish assemblages supplemented by reptiles and waterfowl. In contrast Essouk-Tadmekka's animal protein resources were primarily pastoral including, by inference, milk products. Such also appears to have been the case at the Mauritanian trading town of Tegdaoust (Bouchud 1983), which conversely consumed more cattle in comparison to sheep and goat than Essouk-Tadmekka.

Inevitably there are also certain specific attributes of the assemblage which undoubtedly relate to Essouk-Tadmekka's situation as a Saharan trading station within the Tuareg world, including the presence within the assemblage of equids, camel and dogs. The latter are particularly remarkable for their more numerous presence in Period 4, including charred remains indicative of consumption, fitting with historically attested cynophagie by some Berber groups.

Equid and camel remains from Essouk-Tadmekka, although scarce, are valuable indicators of the beasts of

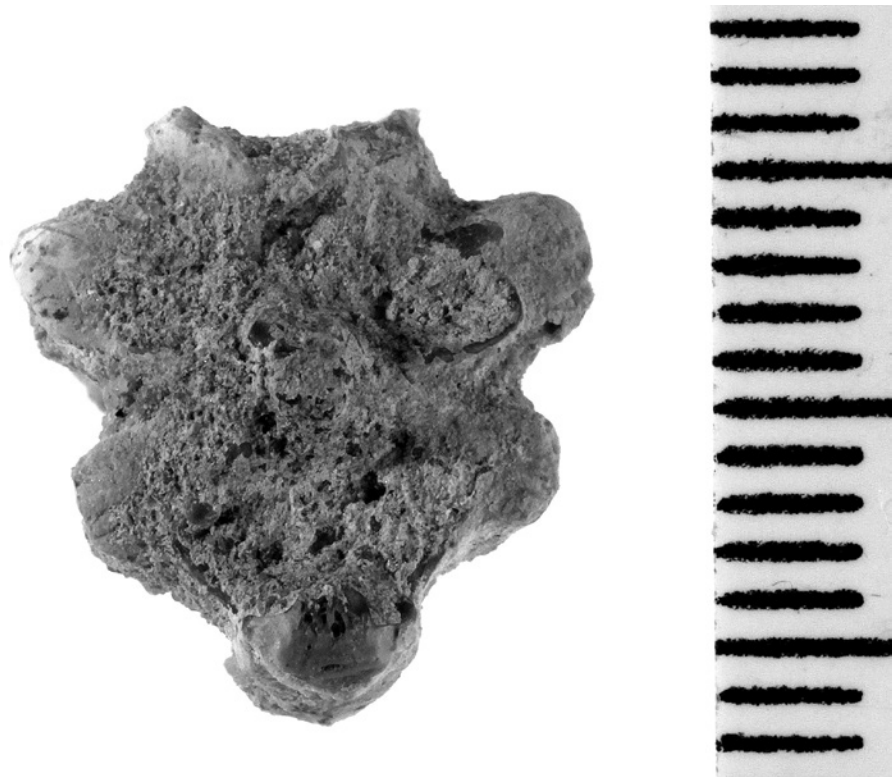

FIGURE 20.4 *Proximal articular end of* Lates niloticus *anal pterygophore from Ek-C Con. 30.*

burden which played a crucial role in the victualing and transportation of trade items for the town. Again, there is a contrast here with Tegdaoust, with Essouk-Tadmekka having sound evidence for the presence of donkey from its earliest layers, whereas only camels are known from the fauna of Tegdaoust. This may be indicative of the comparatively gentle nature of the first leg of the caravan route from the Niger Bend to Essouk-Tadmekka – with the Tilemsi palaeo-watercourse providing more water points and scrub vegetation than the more desertic route from the Middle Niger into central Mauritania and Tegdaoust.

The relative rarity of terrestrial fowl and imported fish at the site, as noted above, may simply be down to the 'luxury status' of these items. However, as noted above regarding domestic fowl, Briggs is suggestive of a different, cultural, reading of their relative absence: "The Haratin of the Ahaggar keep chickens too although only the eggs are eaten as a rule, but the Tuareg themselves eat neither eggs nor fowl, nor fish" (Briggs 1960: 140). While the author has not been personally aware of any such taboos in his interactions with the Tuareg over the years, Briggs' may be tapping into older practices, now dropped, which impacted on the faunal assemblage of Essouk-Tadmekka.

Finally, the Essouk-Tadmekka assemblage, when viewed over time is remarkably stable, with the notable exception of Period 4. Here we may tentatively observe two trends: an increase in cattle remains versus sheep/goat, and a greater diversity of more unorthodox resources (dog, lizard, fish and even a heron). This may be merely a circumstantial sampling phenomenon, but it may also be indicative of new or more diverse inhabitants at the site, with different dietary priorities and food taboos than its earlier populations.

CHAPTER 21

Plant Remains

Dorian Fuller, Mary-Anne Murray and Sam Nixon

Introduction

References in the Arabic histories to plant usage at Tadmekka do exist but are limited. Firstly, in AD 967–968 Ibn Hawqal describes people living beyond the southern territory of the Maghreb Kingdoms, including those of the Fazzan (southwest Libya) and Tadmekka, as "unacquainted with cereals (*ta'am*) and hav[ing] never seen wheat or barley or any other kind of grain" (see App. A). A century later Al-Bakri (writing *ca* AD 1068) stated that Tadmekka's inhabitants lived "on meat and milk as well as on a grain which the earth produces without being tilled" (see App. A); also supposedly 'Sorghum and other grains were imported for them from the land of the Sudan [the savannah zone]'. Lastly, in the 14th century (AD 1337–38) Al-'Umari describes Tadmekka's inhabitants as "liv[ing], as desert dwellers do, on meat and milk; grain [being] scarce with them" (see App. A); while they were described as "short of food" they supposedly inhabited "mountains which produce many fruits".

Archaeobotanical data enables us to shed greater light on the historical references to plant usage at Tadmekka, as well as providing insight into traditions not referred to by these sources. A range of important taxa were evidenced, including pearl millet, date, balanos ('desert date'), cotton, and linseed, as well as a host of other fruits, legumes, and wild plants. Perhaps the most striking finding is what is currently the earliest and largest archaeobotanical data set for wheat in West Africa. The archaeobotany also appears to identify potential change in plant use over time, seeming to suggest a shift to increased presence of fruit and legumes and more limited presence of cereals towards the end of the site's occupation. Reference can also be made to a previous publication on these results, NIXON *et al.* 2011a, which in particular contains more extensive discussion and referencing of individual taxa, though certain updates to the results and their illustration are featured here.

Materials and Methods

50 archaeobotanical sediment samples of 5 litres were collected during excavations and floated in the field using washover bucket flotation into a finely meshed cloth obtained in Mali (of approximately 300 μm). The limited size of the samples taken was due to the difficult field conditions, principally limited water availability for flotation. Various context types were sampled, including hearths, pit fills, occupation floors and ash deposits (Tab. 21.1). A concentration of silicified grass husks from what was probably a threshing context was also hand collected during excavation (see below). Visible wood charcoal samples were hand-collected from nearly all contexts excavated primarily for purposes of radiocarbon dating, but were also investigated for seeds and other smaller plant remains they might contain (study of the wood charcoal itself has not been conducted). The majority of the archaeobotanical samples collected were from the long sequence of unit Ek-A, but two samples were also taken from unit Ek-B. Of the samples within Ek-A, half come from Period 4, a result not only of the fact that more soil was excavated from this period, but probably also the greater presence of ashy deposits.

The macro-remains were identified using comparative collections (both modern and ancient) housed at the Institute of Archaeology, University College London. These contain a good range of African samples and in cases where limited African comparative samples exist (*e.g. Brachiaria* and *Echinochloa*) there is good representation of these genera from Asia. A selection of specimens were mounted and gold-coated for conventional SEM imaging, while additional samples were subjected to ESEM imaging. In addition to macro-remains, plant impressions within ceramics (of Sorghum processing waste) were also analysed, though as these relate to imported ceramics, and not therefore to plant processing at Essouk-Tadmekka, they are treated elsewhere (see Chapter 12).

Results

While some samples evidenced high quantities of plant remains, the Essouk-Tadmekka sample as a whole is characterised by relatively low density of specimens (6 items/l on average) with 1,539 plant items recovered in total and many sediment samples containing only wood charcoal (22/50). However, the assemblage features a wide diversity

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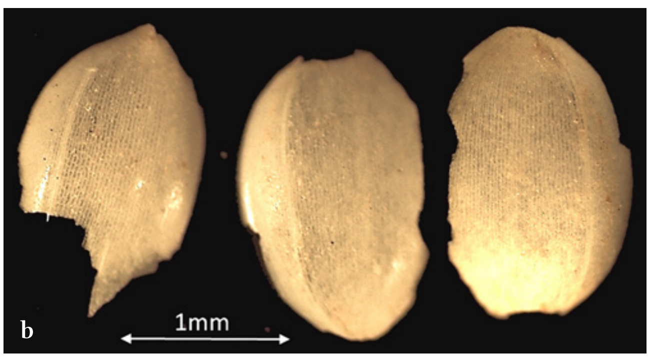
TABLE 21.1 *Archaeological contexts of flotation samples processed at Essouk*

	Period 1	Period 2	Period 3a	Period 3b	Period 4
Wall collapse (stone/ earth)					3, 4, 5, 16, 17, 30, 45, 43
Floor					22
Ashy gravel	119				
Ash deposit		6		62	13, 18
Pit			85, 83		19
Clay floor					39
Coiled reed mat and surround				76	
Loose rich mid brown sandy silt deposit				77, 78	
Compact mid brown clay deposit				79	
Hearth	118	89, 4 (Ek-B)			29
Loose sand		103			
Compact clayey silt		113			

FIGURE 21.1 *Plain light views of carbonised remains. Left to right:* Gossypium *sp. seed with charred lint (Ek-A 77);* Triticum durum/aestivum *grain, ventral view (Ek-A 62);* Triticum durum/aestivum *grain, oblique dorsal view (Ek-A 5).*

of remains, including cereals, legumes (Fabaceae), fruits, oil/fibre plants and wild/weed taxa. Only 28 contexts produced plant remains other than wood charcoal. Most materials were preserved by charring (see *e.g.* Fig. 21.1), although silicified grass husks, desiccated fibrous fruit, a leaf and inflorescence fragment, and several desiccated wild/weed items were also preserved. In addition to the flotation samples, a separate concentration of silicified grass husks was a noteworthy exception to the general rule of low density of plant remains in the archaeology. A *ca* 100 ml sample from a deposit observed to be rich in silicified remains was taken (from Ek-B Context 6) and *ca* 75% (estimated) of the sample volume was seen to be composed of highly fragmentary silicified grass husk, together with sand and fine wood charcoal (Fig. 21.2). Because of the highly fragmentary state of preservation, no systematic attempt was made to quantify this sample. However, inspection of the sample showed that it was clearly dominated by smooth husk fragments of *Panicum* cf. *laetum* with only a minor admixture of *Brachiaria* cf. *lata* (the latter probably less than 5%). Both of these are found in relatively complete forms in the other samples. In addition, a lens of what was believed to be semolina (coarse flour) was evidenced (within Ek-A Horizon 10, Context 78), though unfortunately no sample of this was taken.

Most plant remains were probably charred, and therefore preserved, when waste products from the processing of crops were used as fuel. The remains recovered are generally well-preserved, being heavily carbonised. A small number of carbonised dung pellets and dung fragments of caprines were also recovered. When broken, these pellets rarely contained seed remains and the seeds they did contain were not from the main taxa identified from the archaeobotanical samples. We have not tried to quantify these dung remains other than noting their presence or absence.



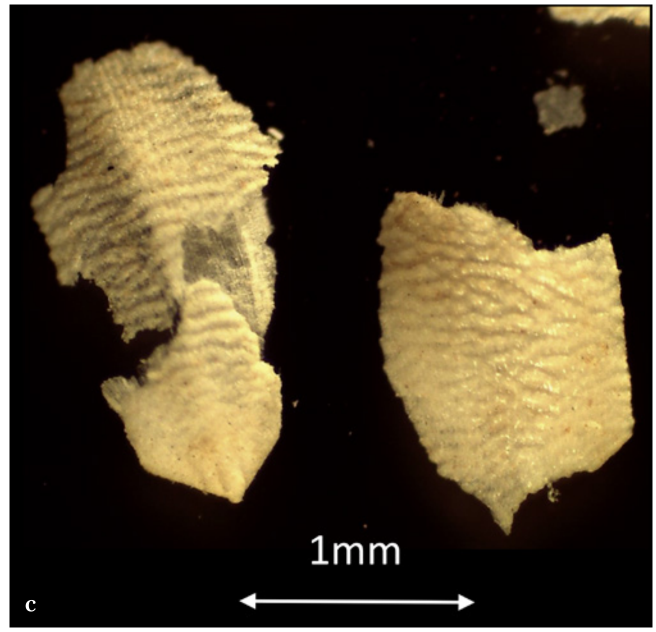


FIGURE 21.2
Views of silicified grass husk-rich sample from Ek-B 6: **a)** *close-up view of a portion of the sample;* **b)** *examples of remains of* Panicum *cf.* laetum, *by far the dominant taxa within the sample);* **c)** *example of* Brachiaria *cf.* lata *found within the sample.*

Full details of species counts of all specimens are provided in Appendix N. Unless otherwise stated, a specimen indicated in this appendix refers to the seed/grain of the plant. Also, unless a specimen is noted as desiccated (desicc.) or silicified (silic.), it is carbonised. Figures 21.1, 21.2, 21.3, and 21.4 provide photographic, SEM, and ESEM images of selected plant remains excavated. Table 21.2 provides basic counts of important taxa identified, their relative frequency and ubiquity, and presence/absence by period. Figure 21.5 provides a more detailed illustration of relative frequency and ubiquity, comparing remains from Period 4 with the combined remains from all other periods. Table 21.3 compares the presence/absence of a selection of taxa at Essouk-Tadmekka with evidence from other relevant sites. Taxa identification follows the nomenclature of *The Useful Plants of West Tropical Africa* (Burkill 1985–2000). For species not included in Burkill, the nomenclature is that of Ozenda (1991).

Cereals

The only identified cereal in the earliest deposits (Period 1) is pearl millet (*Pennisetum glaucum*), the most important dry savannah to Sahel cultivar (Fig. 21.3n). Pearl millet is seen again in Period 2 and 3a but is not recorded in the large numbers found in Periods 3b and 4. This species is inferred to have been domesticated in the third millennium BC in the far western Sahel, perhaps in Mauritania and/or northeast Mali (Kahlheber & Neumann 2007 Manning & Fuller 2014). The grains of *Pennisetum* recovered at Essouk-Tadmekka fall within the size range of cultivated pearl millet (*P. glaucum*); no millet chaff was recorded at Essouk-Tadmekka. In addition to being a staple cereal, the species is used as animal fodder, for beer and for medicine (Burkill 1994: 313–317).

The Essouk-Tadmekka assemblage contains two seeds of *Digitaria* sp. (Fig. 21.3d–e), found in Period 3b, most closely resembling fonio (*D. exilis*), one of the two cultivated *Digitaria* species used as cereals in West Africa. *Digitaria* is seen to have its centre of origin further south in the savannah belt, mostly in regions with ~1,500 mm rainfall (Portères 1976), in contrast to *Pennisetum glaucum* which is seen to have its origin in the more northerly Sahel and grows comfortably with only *ca* 200 mm of rainfall. Elsewhere, south of the Sahel, cf. *D. exilis* and *P. glaucum* are reported to co-occur at Cubalel by AD 500 (Murray *et al.* 2007) and at Jenné-Jeno sometime after

TABLE 21.2 *Taxa counts, relative frequency (percentage of all counted seeds) and ubiquity (percentage of samples in which species is present), and presence/absence by period of important plant taxa of Essouk. See App. N for full taxa counts*

	Taxa counts	Frequency	Ubiquity	Period 4	Period 3b	Period 3a	Period 2	Period 1
Cereals	**141**	**9.2%**	**60.7%**	X	X	X	X	X
Brachiaria/Setaria	17	1.1%	25%	X	X	X	X	
Digitaria	2	0.1%	3.6%		X			
Echinochloa	64	4.1%	35.7%	X	X	X	X	
Panicum	17	1.1%	21.4%	X	X	X	X	
Pennisetum	5	0.3%	10.7%			X	X	X
Triticum	16	1.0%	28.6%	X	X	X	X	
Legumes	**387**	**25.2%**	**42.9%**	X	X	X		X
Acacia	8	0.5%	17.9%	X		X		X
Small legumes	376	24.4%	25%	X	X			X
Fruits	**58**	**3.8%**	**39.3%**	X	X			
Balanites	3	0.2%	10.7%	X				
Citrullus	1	0.1%	3.6%	X				
Hyphaene	3	0.2%	3.6%	X				
Phoenix	3	0.2%	7.1%	X				
Ziziphus	47	3.0%	14.3%	X				
Oil/fibre	**4**	**0.3%**	**10.7%**	X	X			
Gossypium	3	0.2%	7.1%		X			
Linum	1	0.1%	3.6%	X				
Wild/weed	**108**	**7.0%**	**46.4%**	X	X	X	X	X
Cyperus	31	2.0%	14.3%	X				X
Chenopodium	19	1.2%	14.3%	X	X	X		
Tribulus sp. seed	21	1.4%	14.3%	X	X			X
Tribulus sp. pod	13	0.8%	14.3%	X	X			
Other	**841**	**54.7%**	**82.1%**	X	X	X	X	X

AD 800 (McIntosh 1995c). In this region, the genus *Digitaria* contains generally good fodder plants (Burkill 1994: 222–231) and other wild species are collected for food (Harlan 1989). It is also used for beer and medicine (Burkill 1994: 222–231).

Although not recorded in Period 1, *Echinochloa* sp. is present in all other periods and is the single most common grass recorded at Essouk-Tadmekka (Fig. 21.3f–j) – following a high in Period 3a/b it is less common in Period 4. *Echinochloa* is associated with pools, wet places and water edge habitats (Hutchinson & Dalziel 1927–1936), and certain species are also gathered in the Sahel – along water courses – under the general term 'kreb' (Burkill 1994: 86; *cf.* Harlan 1989: 86). Ozenda reports *E. colona* to be found occasionally in the southern Sahara (Ozenda 1991: 158), and we expect this to have been focused on locally wet zones (*e.g.* escarpment seepages, semi-sheltered hill slopes). *Echinochloa* has been found in the late Islamic levels at Jenné-jeno (McIntosh 1995c). The sample of husk fragments of *Echinochloa* (with some minor admixture of Brachiaria) from Ek-B 6 (see Fig. 21.2) attests to the dehusking of this taxon, presumably for human consumption.

Plant remains of the *Brachiaria/Setaria* group were identified from Periods 2–4 (Fig. 21.3a–c). Analysis of the husk remains allows more specific identification, suggesting gathering of a *Brachiaria* species. The wideness and flatness of the spikelet suggest *Brachiaria* rather than *Setaria*, seemingly confirmed by examination of the lemma and palea rugose patterns. The lemma rugae pattern and form of the acuminate lemma apex both are a

TABLE 21.3 *Presence/absence of selected taxa at Essouk and other relevant sites* (FULLER 2000; MCINTOSH 1995; M. MURRAY et al. 2007; S. MURRAY 2004; PELLING 2005, 2008 – ** free-threshing wheat not found but Emmer wheat* (Triticum dicoccum) *found; ** Sorghum not found in macro remains but found in the temper of pottery at the site*)

Site	Cubalel (Senegal)	Jarma (Libya)	Dia-Shoma	Dia-Shoma	Jenné-Jeno	Dia-Shoma	Jarma (Libya)	Essouk	Jenné-Jeno	Jenné-Jeno	Dia-Shoma	Dia-Mara	Gao	Jenné-Jeno	Dia-Shoma
Taxa / Period	Iron Age	Iron Age	Iron Age	Late Iron Age	Late Iron Age	Early Islamic/ LIA	Pre Islamic	Early Islamic	Early Islamic	Mid Islamic	Islamic	Islamic	Islamic	Late Islamic	Post Medieval
Oryza sp.	X		X	X	X	X			X	X	X	X	X	X	X
Pennisetum glaucum	X	X	X	X	X	X	X	**X**	X	X	X	X	X	X	
Pennisetum sp. wild			X	X							X	X			X
Sorghum bicolor		X			X	X	X	**	X	X	X	X		X	
Triticum aestivum/durum		*					X	**X**			X	X			
Brachiaria sp.	X	X			X		X	**X**		X	X	X		X	X
Digitaria sp.	X						X	**X**	X		X	X		X	
Echinochloa sp.	X							**X**						X	
Panicum laetum (incl. cf.)								**X**		X		X		X	
Panicum turgidum (incl. cf.)							X				X	X			
other *Paniceae*/*Panicum* sp.	X		X			X	X	**X**			X	X			
Paspalum sp.	X		X	X	X	X					X	X			
Setaria sp. (incl. cf.)	X						X					X			
Citrullus lanatus (incl. cf.)							X	**X**					X	X	
Gossypium sp.		X				X	X	**X**			X	X	X		X
Linum usitatissimum							X	**X**							
Balanites aegyptiaca								**X**					X		
Phoenix dactylifera		X					X	**X**					X		
Hyphaene thebaica			X	X		X		**X**			X	X	X		X
Ziziphus sp.	X		X	X		X	X	**X**			X	X	X		

better match for *B. lata* than for *B. deflexa* or *B. ramosa* in the limited reference material examined. While *B. deflexa*, black fonio, is known in a domesticated form (HARLAN 1992), wild populations of all three *Brachiaria* spp. are reported to be collected as wild food in West Africa (HARLAN 1989; BURKILL 1994: 191–194). Of these species, *B. lata* has the more northerly Sahelian distribution where it is widely gathered. Most often today it is found in disturbed and agricultural soils, so it is not restricted to water edge habitats to the degree that *Echinochloa* is, but to locally richer soils which might have included wadi margins, seepages and areas around the settlement. *Brachiaria* remains referred to as *B. ramosa* (potentially difficult to distinguish from *B. deflexa*) were in abundance at Jenné-jeno (MCINTOSH 1995c), but it is unclear if these were cultivated or gathered black fonio.

Panicum remains are found in consistently low quantities at Essouk-Tadmekka in Periods 2–4 (Fig. 21.3k–m). Essouk-Tadmekka specimens, which are fairly broad, are comparable to, but not definitively, *P. laetum*. *P. laetum* in particular is an important wild resource in the region, especially as a food during times of scarcity and in areas of marginal subsistence (BURKILL 1994). *P. laetum* is also present in the Islamic levels at Jenné-jeno (MCINTOSH

Details of individual taxa follow.

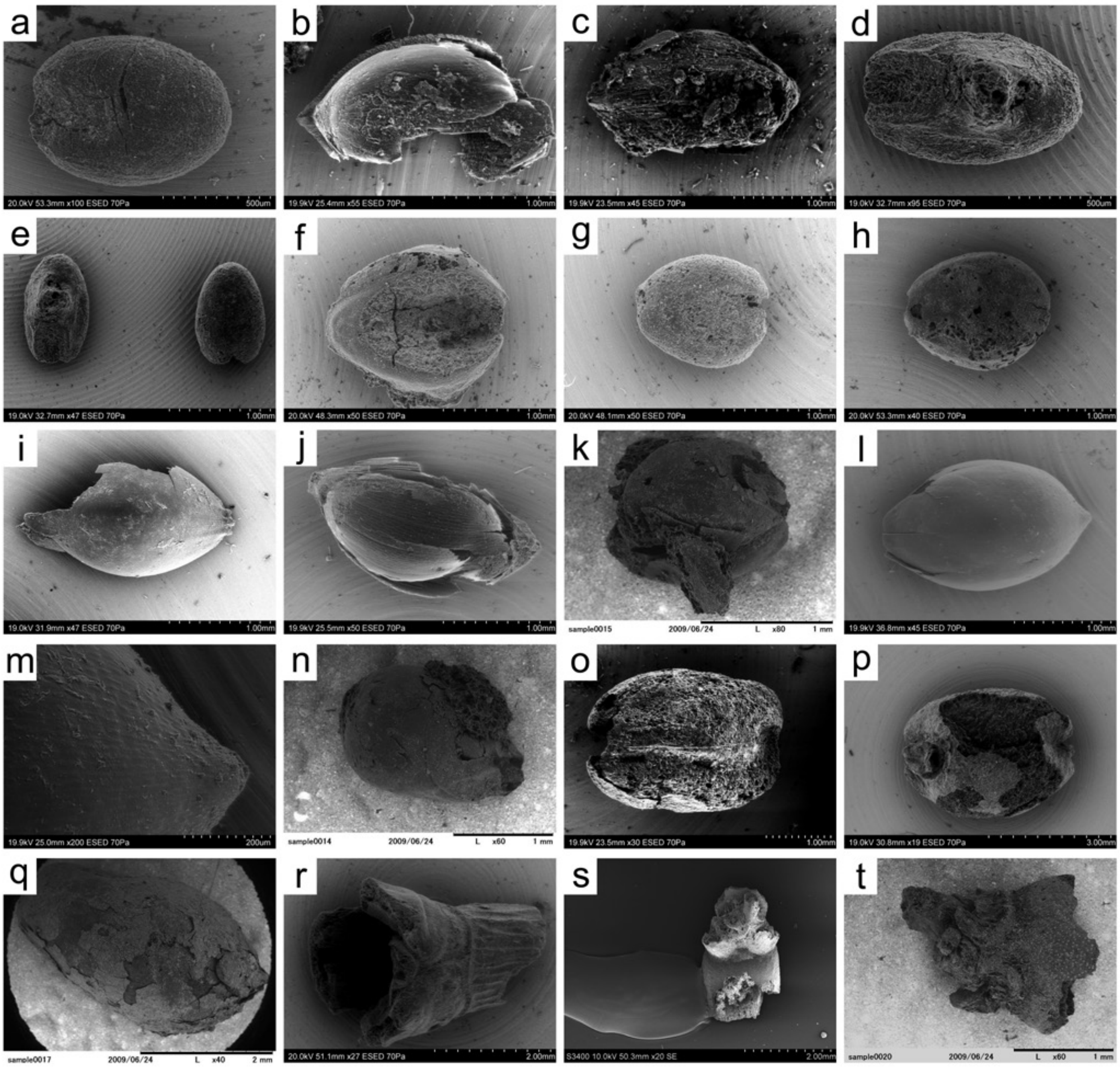


FIGURE 21.3 *SEM and ESEM images of selected Essouk cereal remains:* **a)** Brachiaria/Setaria *sp. grain* (*Ek-A 77*)*;* **b)** Brachiaria *cf.* lata *lemma, interior* (*Ek-A 5*)*;* **c)** Brachiaria *cf.* lata *palea* (*Ek-A 6*)*;* **d–e)** Digitaria *sp. grains* (*Ek-A 79*)*;* **f–h)** Echinochloa *sp. grains* (*Ek-A 79, 79, 77*)*;* **i)** Echinochloa *sp. lemma* (*Ek-B 6*)*;* **j)** Echinochloa *sp. palea* (*Ek-A 85*)*;* **k)** Panicum *sp. grain viewed obliquely from ventral and lateral views* (*Ek-A 62*)*;* **l–m)** Panicum *sp. lemma and lemma apex detail* (*Ek-A 85*)*;* **n)** Pennisetum glaucum *grain* (*Ek-B 4*)*;* **o)** Triticum durum/aestivum *grain, ventral view* (*Ek-A 45*)*;* **p–q)** Triticum durum/aestivum *grains, dorsal views* (*Ek-A 77, 62*)*;* **r)** Triticum durum *basal rachis* (*Ek-A 77*)*;* **s)** Triticum durum *rachis* (*Ek-A 77*)*;* **t)** Triticum aestivum *rachis* (*Ek-A 83*)*.*

1995c) and Dia (Murray 2004). *P. laetum* occurs on locally wet soils in the Sahel zone and is reported to be gathered by Tuareg groups (Burkill 1994). We expect it to have been found occasionally in the wettest micro-environments around Essouk-Tadmekka.

Wheat, both grains and rachis remains, is found at Essouk-Tadmekka from Period 2–4 (Figs. 21.1, 21.3o–t). For a cultivar not normally encountered in West Africa the quantities of remains recorded are significant. Also a lens of what was believed to be semolina was found in Period 3b, although unfortunately no images or sample was taken. When well preserved, grains appear to be identifiable as free-threshing (*Triticum durum/aestivum s. l.*). A free-threshing wheat grain was AMS dated to cal

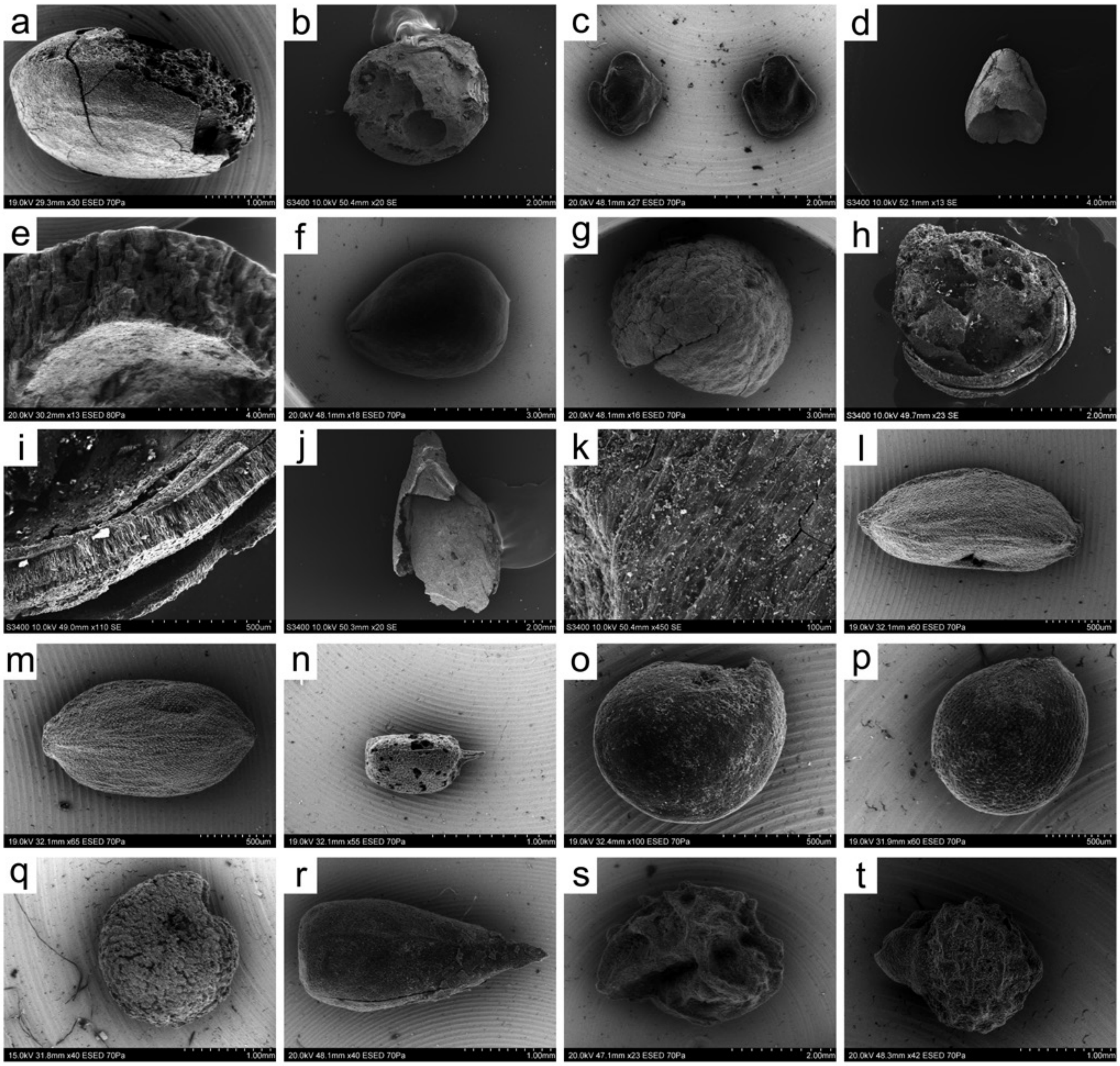


FIGURE 21.4 *SEM and ESEM images of selected Essouk legumes, fruits, oil/fibre, wild and other plant remains:* **a)** *cf.* Acacia *sp. frag.* (*Ek-A 29*)*;* **b)** *cf. Fabacae type A seed* (*Ek-A 3*)*;* **c)** *cf.* Crotalaria *sp. seed* (*Ek-A 13*)*;* **d)** Citrullus lanatus *seed tip* (*base*) (*Ek-A 18*)*;* **e)** Hyphaene thebaica *seed fragment of hard endosperm* (*Ek-A 16*)*;* **f–g)** Ziziphus *sp. seed and endocarp* (*Ek-A 3*)*;* **h–i)** Gossypium *sp. seed fragment in cross-section and detail of seed coat cross-section* (*Ek-A 76*)*;* **j–k)** Linum usitatissimum *seed tip* (*base*) *and detail of interior surface of testa – visible are testa fibre cells,* (*Ek-A 18*)*;* **l–n)** Cyperus *sp. nutlets* (*Ek-A 29*)*;* **o)** Chenopodium *sp. seed* (*Ek-A 79*)*;* **p)** Portulacaceae *cf.* Talinum *sp.* (*Ek-A 4*)*;* **q)** Portulacaceae /Caryophyllaceae (*Ek-A 4*)*;* **r–s)** Tribulus *sp. seed and pod* (*Ek-A 79*)*;* **t)** Hackelochloa granularis *spikelet* (*Ek-A 89*).

AD 1024–1149 (see Chapter 10 for all AMS dates quoted herein) but wheat is also found in lower contexts dated back to *ca* AD 900. Identifiable rachises were few, but both *T. durum* and *T. aestivum* rachises were clearly identified. These wheats are not traditionally West African cultivars, but were established in prehistory in the Mediterranean. A shift to durum wheat in North Africa is associated with the Islamic period based upon data from Setif in Algeria (PALMER 1991). There is minimal ethnographic evidence for traditions of cultivating wheat south of the Sahara (BURKILL 1994: 372), but there do exist early Islamic historical references to wheat cultivation in the Sahel (see LEWICKI 1974: 22–26; MURRAY 2007 and below). Free-threshing wheat has previously been seen from Islamic period Dia (MURRAY 2007).

Sorghum was recovered but only as temper in a pottery type found in large quantities, mainly in Period 3b (see Chapter 12).

Legumes

Small legumes were found in great quantity in Period 4 and were also present in Periods 1 and 3b. These present a good match for *Crotalaria* seeds, although we are not aware of diagnostic criteria for assigning these with certainty to that genus. It is possible these were weeds from cereal fields, though numerous taxa in this family provide ideal graze for animals (Burkill 1995). Several native small legumes are important amongst Tuareg pastoralists for their use as pasturage, for instance *Trigonella anguina* and *Crotalaria saharae* (Benchelah *et al.* 2000: 168, 175). While it is possible that certain of the legume remains came from dung fuel that has broken down, this seems an inadequate explanation as recovered carbonised dung pellets rarely contained seed remains. It is therefore possible that groups at Essouk-Tadmekka were gathering and eating wild, small-seeded legumes, but also possible they gathered the plants for fodder but removed the potentially toxic mature seeds. *Crotalaria saharae* favours wadi beds in the Sahara (Benchelah *et al.* 2000), and is endemic across the western Sahara (Ozenda 1991).

Cf. *Acacia* (Fig. 21.4a) is present in Periods 1, 3a and 4 but not in great quantities. An *Acacia* specimen from Period 3a was AMS dated to cal AD 1024–1150. *Acacia* trees are typical of the Sahel and open dry savannah and there are numerous *Acacia* species in Mali, and across the Sahara (Ozenda 1991). Acacia trees are used in various ways, such as for animal fodder, building material, fuel, tanning leather, rope making (tree fibres), and medicine (Burkill 1995: 177–203).

Fruits

Fruit is a very common component of the Period 4 assemblage but only 1 specimen of fruit is seen prior to Period 4. The remains consist primarily of fragmented seeds and endocarps of *Ziziphus* (Fig. 21.4f–g). A *Ziziphus* specimen from Period 4 was AMS dated to cal AD 1296–1390. *Ziziphus* fruits are edible fresh, dried, or ground into flour that makes long lasting bread, cakes and beverages (Cissé 1991; von Maydell 1986). The genus is also used as a living hedge for cattle enclosures and is important for shade (Burkill 1997). *Ziziphus* is widely reported from other sites in the region (Tab. 21.3).

Other fruits present include small numbers of watermelon (*Citrullus lanatus*), date (*Phoenix dactylifera*) and balanos (*Balanites aegyptiaca*), all found only in Period 4 (Fig. 21.4d; see Nixon *et al.* 2011a for images of date and balanos). Watermelon is a native of tropical and subtropical Africa, and may have been formerly distributed in the Early/Mid Holocene Sahara (Wasylikowa & van der Veen 2004). Nevertheless, it appears to have been reintroduced as a cultivar in the Iron Age (*cf.* Pelling 2005). As in many parts of Africa today, watermelon may have been cultivated primarily for its oil producing seed and cooked rind, rather than its juicy flesh, since this was likely to have been bitter and unpalatable prior to the development of improved varieties. Watson (1983) however suggests improved juicy-fruited varieties may have spread widely in the early Islamic period. As noted by Harlan (1992: 64), watermelon and pearl millet are cultivars associated with the driest margins of agriculture in the Sahel and the fringes of the Kalahari. As for the date palm (*Phoenix dactylifera*), virtually all parts of the tree are utilised. The nutritious date fruits have considerable food value and are widely consumed in the region today. *Phoenix dactylifera* had already reached the Sahel in earlier times of Islamic trans-Saharan trade, finds at Marandet in Niger, for example, have been dated to the 7th to 9th century AD (Magnavita *et al.* 2007). All parts of balanos (*Balanites aegyptiaca*), the "desert date", are useful, for crafts, firewood, charcoal and penning cattle, for its edible leaves, but especially for its oil bearing seed. The tree also produces useful resin and strong fibre and has many medicinal qualities (Burkill 1985: 242–246). Balanos is indigenous in the Sahel. The only other identifiable fruit found was *Hyphaene thebaica*, three fragments of which were found in Period 4 (Fig. 21.4e) (*cf.* Hillman *et al.* 1989). The *Hyphaene* mesocarp is sweet and aromatic, and may be pounded into a meal, while the hard white endocarp is used as vegetable ivory (Burkill 1997: 371–373).

Oil and Fibre Plants

Important oil and fibre plants are present at Essouk-Tadmekka although in limited quantity, consisting of three cotton specimens from Period 3b (Figs. 21.1, 21.4h–i), one of which was AMS dated to cal AD 1024–1150, and a linseed specimen from Period 4 (Fig. 21.4j–k). The cotton seeds and seed fragments need not indicate local cultivation or cotton ginning (seed removal) on site. Instead it can be suggested that raw cotton was imported to the site for spinning, but that the imperfections of ginning meant that some seed waste material remained in the cotton. The later processing of cotton is testified to by the presence of spindle whorls (in Periods 3b and 4). Cotton cultivation at Essouk-Tadmekka is certainly possible, but water requirements make large scale cultivation unlikely. It is worth noting that cotton is known from several Saharan oases by Late Roman times, such as the Libyan Fezzan, supplied by foggara irrigation (Pelling 2005). Despite attempts with SEM to identify distinguishing features of seed coat cross-section among *Gossypium* spp., we were unable to satisfactorily determine species (*cf.* Fig. 21.4h–i). While *G. herbaceum* is regarded as truly wild in sub- Saharan Africa (further South) (Wendel 1995), *G. arboreum* is generally regarded as a domesticate from Pakistan (ZOHARY & HOPF 2000: 134). Corresponding with historical evidence (KRIGER 2005), cotton is commonly found on West African sites of early Islamic date onwards (Tab. 21.3).

Linseed/Flax (*Linum usitatissimum*) is present at Essouk-Tadmekka, although only a single specimen was recovered (it is recognisable from the curved seed base and the morphology of fibre cells on the interior of the seed coat – see anatomical comparisons in VAUGHAN 1970: 142; BOESEWINKEL 1984: 446). It is an interesting find as, thus far, it appears to be absent from other West African sites, although it is known from the central Sahara at Jarma (Tab. 21.3). It is an important species due to its usefulness as fibre (flax) and its edible oilseed (linseed). Like wheat, it is normally a winter grown crop. As we found no reports of traditional cultivation in sub-Saharan West Africa (*cf.* BURKILL 1994) we must at this point infer it to have been imported from the north. As this is a solitary and fragmentary specimen, and the first of its kind from the region, further evidence should be sought before concluding that this species was of importance in Islamic West Africa.

Additional Wild/Weed Taxa

Identifiable wild/weed taxa consistently occur throughout the sequence in low numbers. The presence of sedges (*Cyperus* sp. – Fig. 21.4l–n) suggests wet localities near the site, although many *Cyperus* spp. can grow without standing water. It seems probable these seeds might have been gathered while gathering millet grasses. *Chenopodium* seeds (Fig. 21.4o), found throughout, could be weeds collected with crops or other millet grasses, but may have been processed as food in their own right. *C. murale* in particular is reported to be consumed in parts of the Sahara and distributed in the Sahel, being found especially in disturbed ground (BENCHELAH *et al.* 2000: 155; BURKILL 1985: 367). The Portulacaceae type is seen in Period 4 in relatively high quantities. *Tribulus* sp. also appears to be present in reasonably frequent occurrence in Periods 3b and 4 (Fig. 21.4r–s). In the Sahelian/Saharan border regions *Tribulus* sp. is recorded as an important taxon, both as an animal browse (BENCHELAH *et al.* 2000: 225–226; OZENDA 1991: 320–322; BURKILL 2000) and occasionally as flour for human consumption (BENCHELAH *et al.* 2000: 225–226). *Hackelochloa granularis* (the only *Hackelochloa* species known from West Africa), identified based on visual comparison with a number of accurate drawings (GARDNER 1952: 306–308; SOERJANI *et al.* 1987: 430–431), is known as a weed of cultivation and makes good fodder for horses, although probably not for other animals (BURKILL 1994: 257–258; HUTCHINSON & DALZIEL 1927–36: 505–506). It is short-lived and therefore never abundant in the landscape. It is reported mainly amongst crops in the Soudanian/savanna zone and would be expected to be scarce in the Sahel, but might occur in gardens there. Other wild/weed taxa present have so far only been identified to probable family.

Discussion

Defining Broad Chronological Patterns

During the earliest period of Essouk-Tadmekka's occupation (Period 1), the cultivar pearl millet was identified, as well as small legumes and certain wild taxa. With the first clear evidence for permanent settlement and (significant) trans-Saharan trade (beginning of Period 2/*ca* AD 900) we see continued evidence for pearl millet, but also wheat. The remainder of Period 2 through Period 3b (*ca* AD 900–1300) sees continued wheat evidence, wild taxa and legumes, and also strong evidence for the wild millet-grasses, *Echinochloa, Brachiaria* and *Panicum*. In Period 3b we also note cotton as a new presence and the absence of pearl millet.

The archaeobotany from Period 4 (*ca* AD 1300 to 1400) provides far more evidence. While there is some continuity with the earlier evidence, certain changes do seem to be apparent (see Fig. 21.5), although we must be cautious in interpreting these patterns in light of the fact that this is not an extensive sampling of the site. Firstly we see markedly reduced cereal presence with many samples containing no cereals. We also seem to see a different emphasis on the wild grasses collected with *Brachiaria* and *Panicum* being more common than the previously ubiquitous *Echinochloa,* and wheat notably less present. Small legumes are far more common, in particular *Crotalaria*-type. Fruit is ubiquitous, with *Ziziphus* seen in the largest quantities and the first recordings of date, balanos, watermelon, and *Hyphaene*. Cotton is not present and linseed is seen for the first time. Amongst the wild/weed taxa *Tribulus* is seen in significantly reduced quantities and *Cyperus*, not seen since Period 1, is a noteworthy presence. The latter, which correlates with the shift towards *Panicum* and *Brachiaria* over *Echinochloa*, could suggest a shift in the nature of moist microenvironments, perhaps towards lower water tables; if one assumes that *Echinochloa* prefers more water than these other species. This remains speculative until reliable species level identification and autoecological data are available.

Cultivation and Gathering

Essouk-Tadmekka's contemporary environment is extremely arid and offers poor soils for cultivation. Even allowing for the existence of a slightly wetter environment in early medieval times, it seems likely there was limited opportunity for cultivation without irrigation, probably by wells. The archaeology at Essouk-Tadmekka has so far not demonstrated any evidence for irrigation. Historical sources do not mention local cultivation and moreover refer specifically to "gathering of grain which grows without being tilled" (see above). All this said, a complete absence of cultivation at such a large settlement seems unlikely.

The evidence for pearl millet, a highly drought tolerant crop, is in line with the long tradition of its cultivation in the Sahel. Also, while it is likely some or even most of the wheat recorded was shipped across the Sahara – grain imports being a necessity for such marginal settlements as Essouk-Tadmekka – the presence of rachises (indicating threshing) raises the possibility that wheat was cultivated locally with irrigation. Given the comparative historical evidence from early Islamic Tegdaoust in Mauritania (Lewicki 1974: 22–26) and the obvious local demand for wheat at Essouk-Tadmekka, it does seem highly likely that some form of experimentation with irrigated wheat was attempted. Cotton was also possibly a limited local cultivar. While we certainly do see evidence of crop-processing waste (rachises, ginned seed fragments) we must be aware of the possibility that crop-processing waste could have been unintentionally included amongst imported processed crops – we are at present unclear to what extent this would have occurred.

The Period 4 fruit evidence also possibly indicates cultivation, including date palm and watermelon, and the shade of dates would have provided a context for small fields and gardens of cereals and vegetables. A similar format is seen in contemporary irrigated cultivation of tomato plants at Essouk-Tadmekka, and occasional date palms. While there were probably no flowing fields of cultivated crops in Essouk-Tadmekka's surroundings, we infer a patch scale cultivation in and around the town.

The evidence provides greater insight into the nature of wild gathering at Tadmekka, vaguely referred to by the historical sources. The evidence does suggest the Essouk-Tadmekka population used taxa which were not cultivated and begins to provide us with an idea of the types of cereals being gathered. These include *Echinochloa, Brachiaria* and *Panicum* which, while just possibly semi-cultivated or tended, were most likely to have been simply wild-gathered. These grasses would have been patchily available in wetter microenvironments, where either ground water seepage occurred or where light summer rains accumulated. Slightly wetter climatic conditions that were probably prevailing at the time (Grove 1993: 39–42; Brooks 1998)

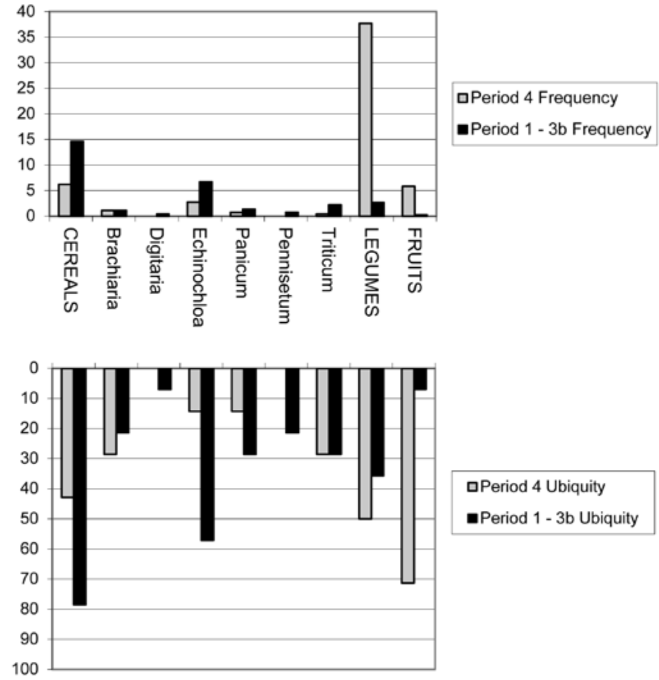


FIGURE 21.5 *Illustration comparing relative frequency and ubiquity of plant taxa of Essouk. Frequency indicates the percentage of all counted seeds in Ek-A Period 4 versus the combined remains from other Ek-A periods. Ubiquity indicates the percentage of all samples of the period(s) in which the taxon is present.*

would have been likely to have made these more common than is the case at present. *Echinochloa,* which is the most common wild grass through the first three periods, seems the most probable contender for being Al-Bakri's "grain which grows without being tilled" (see above).

While it is possible to suggest these grasses result from other processes than human consumption, on balance this seems unlikely, especially in view of the sample (from Ek-B 6) rich in silicified grass husks which is almost certainly the remains of dehusking of these grasses for human consumption. An argument suggesting the small Panicoid grasses could be weeds of pearl millet cultivation seems unlikely as pearl millet is taller than most other grasses and is typically harvested by cutting spikes, therefore meaning shorter weeds growing amongst it do not tend to be accidentally harvested when it is collected. The small grasses are not typical weeds of wheat cultivation as Panicoids are normally summer flowering and wheat is normally winter-grown. Also, they do not show any strong pattern of co-occurrence with wheat. As these wild genera are well-known ethnographically recorded sources of food on several continents, their occurrence with the apparent absence of other taxa of savanna grasses points towards deliberate selection of useful food grain species. It cannot of course be ruled out that these were for fodder as seems likely to have been the case with the small legumes and several of the other wild grasses.

What is particularly important to note is the difference between the evidence of gathering and cultivation between Period 4 and other periods (see Fig. 21.5). Interestingly the Period 4 archaeobotanical record corresponds with the 14th century historical evidence referring to grain shortage and fruit richness (see App. A '*Al-'Umari*'). This picture does seem to be borne out by the archaeology for the 14th century, but the earlier evidence does seem to show that this was not in line with earlier periods. This seems unlikely to relate to environmental conditions and changing availability, but rather to do with the peoples of Essouk-Tadmekka and their cultural traditions of food. Interestingly a 'Saharan plant package' is evident later at Gao and Jenné-jeno associated with the Songhay dynasty, of Saharan Berber descent (Fuller 2000; McIntosh 1995c). We take this 'Saharan plant package' to include the fruits *Phoenix dactylifera, Balanites aegypitaca* and *Citrullus lanatus*. *Hyphaene*, although available in West Africa may also be considered to have become more widely used. The extent to which the availability of *Gossypium* sp. may also be connected deserves further consideration as well.

Wheat

The assemblage of wheat from Essouk-Tadmekka is highly significant in being the largest archaeologically recovered from West Africa (*cf.* S. Murray 2007). While historical and archaeobotanical evidence clearly show that wheat was of limited importance in past West African dietary traditions (Lewicki 1974: 22–26; S. Murray 2007), there are historical references to the presence of wheat at some southern Saharan/Sahelian towns in West Africa (*e.g.* Takedda and Audaghust) as a luxury commodity, mainly for traders and elites (Levtzion & Hopkins 2000: 120, 127, 197, 301) – these historical sources refer both to the local production of wheat as well as to its importation from North Africa. The lack of archaeobotany at the towns where wheat is described historically has never enabled clear identification of this phenomenon at the southern Saharan centres, although evidence from the middle Niger Delta (S. Murray 2007) did suggest the veracity of this picture.

Unlike the southern Saharan centres referred to above, there are no Arabic sources describing wheat at Tadmekka, and indeed certain historical sources explicitly state that wheat was not at Tadmekka (see App. A '*Ibn Hawqal*'). The wheat evidence is therefore significant new data reflecting transfer of cereal food practice from North Africa to Essouk-Tadmekka. For discussion of the formation of Islamic identity in the Sahel this evidence is also important, as the early Arabic writers clearly identify wheat as an important element of civilised Islamic dietary regimes (Levtzion & Hopkins 2000: 46). At the various places where it is described historically it is described as a luxury product, for traders and elites, and likely this was the case at Essouk-Tadmekka. While it is difficult to gauge the importance of wheat at Essouk-Tadmekka, it should be noted that it is the second most ubiquitous cereal recovered at the site, and the taxa counts of 16 from a fairly limited sampling are relatively high. As explained above, the extent of local cultivation of wheat at Essouk-Tadmekka, versus its importation, is unclear. It is quite possible that the rachises recovered were simply included in sacks of imported wheat. However, as discussed above, it seems likely some form of experimentation with irrigated wheat was attempted at Essouk-Tadmekka (if grown locally, presumably over winter, wheat must have been watered).

A further point to make is that from our limited sample we found evidence for both *Triticum durum* and *Triticum aestivum* species of free-threshing wheat, from the rachis data. The field record of possible semolina is also of interest. Couscousiere vessel fragments, recorded from Periods 2–4 and first recorded in the same context as the earliest recording of wheat (see Chapter 12), might have been used for wheat preparation, although it is possible they were used for preparing small-grained millets.

'Sorghum and Other Grains from the Land of the Sudan'

The historical records refer to the import of sorghum and other grains from further south in West Africa (see above and *App. A 'Al-Bakri'*). This does seem a very likely scenario for this relatively marginal settlement to provision itself, as zones of cereal production in the south were relatively nearby and trade caravans came from there. However it was striking that in the flotation samples, neither sorghum nor any other obvious crops from the south were found. Sorghum was only evident from seed impressions in pottery imported from the south (see *Chapter 12*). While it is possible that the archaeology is indicating that grain import from the south was less extensive than suggested by the historical records, the archaeobotanical absence of a range of grains from the south does not mean that they were not at Essouk-Tadmekka. One must strongly consider that southern grain imports were arriving at Tadmekka 'clean', requiring no processing, and unlikely therefore to be preserved. Also, grain imports would be valued, reducing the likelihood of their loss and consequent archaeobotanical recovery. Indeed, it is also possible that sorghum and other 'grains' from the Sudan were imported in a processed flour form, similar to that which is seen in Ek-A Horizon 10. It is obviously possible also that future investigations might show that imported southern grains are archaeologically recoverable in a different area of the site.

Conclusions

The archaeobotanical finds from Essouk-Tadmekka both precede historical evidence for plant usage at this important Sahelian trans-Saharan trading site and move beyond the inaccuracies and limitations of early Arabic documentation of plant usage there. The data provide new insights into Tadmekka's gathering traditions, providing clear identifications of significant gathered taxa (including *Echinochloa, Brachiaria* and *Panicum*) only ever imprecisely described in historical documents. It also provides insights into possible cultivation at Essouk-Tadmekka, including pearl millet, wheat and various fruits. Additionally, we observe that imported crops from the south said to be present were not evidenced archaeologically. A key element of the assemblage is the earliest and largest archaeological assemblage of wheat from West Africa, a species important within Muslim dietary practice but until now perceived to have been practically absent from the West African Muslim diet in the medieval period. A range of other taxa important within the history of the region were also identified, including date, balanos, cotton, watermelon, and the earliest recorded linseed in West Africa. As well as providing broad insight into some of the plants used at the early Tuareg merchant centre of Tadmekka, we also identified potential changes over time in the plant use regime that were not recorded historically, most crucially a key shift in plant usage at the site *ca* AD 1300 possibly related to the arrival of new Saharan populations.

PART 5

Synthesis and Discussion

CHAPTER 22

Excavated Sequence

Sam Nixon

Introduction

Over the previous chapters we have now presented a wide range of excavated evidence, including soil deposits, architectural remains, material culture, and subsistence evidence, each presented and discussed as a distinct category of evidence. Prior to embarking on a broader discussion of Essouk-Tadmekka's history, this chapter provides a synthetic overview of the evidence over the various periods of the site's occupation. Not only does this provide a useful broad recap, it also seeks to highlight correspondences and differences between the various forms of excavated evidence over time, as well as how the evidence differs according to the various zones of the site excavated. This summary is structured around the evidence from the deep sequence of unit Ek-A, with the evidence from the other two units presented together with the Ek-A period evidence these deposits are seen to relate to. This presentation is also aided by Table 22.1 which provides a summary of the stratigraphy, chronology and phasing, and Table 22.2, which provides a summary of the excavated material culture and ecofacts. While we do need to recognise this represents a sampling of the archaeological sequence at the site, it is believed this provides a good representation of the preserved sub-surface remains at Essouk-Tadmekka.

Overview of Excavated Results by Period

Period 1

While at the commencement of the period we see no evidence testifying to settlement at the site, in the second half of this period (Horizon 2) we see evidence for various levels of non-permanent architectural remains, in the form of post-holes, relating certainly to either tents or mat-and-pole structures (see Fig. 7.4).

The main material culture recovered in this period is pottery, principally an almost invariably chaff-tempered ware that shows little decoration and no evidence for being wheel-thrown. Cord-wrapped cord is the most common decoration. This pottery is almost certainly a local ware and has strong affinities with Berber ceramic traditions. A single sherd of grog-tempered pottery with a distinctively different fabric (from Context 118) recalls ceramic traditions associated with areas further south, potentially indicating extra-regional contacts.

The only other item of note is an iron slag specimen (again from Context 118), most likely a smelting residue. Subsistence data are limited, but include cattle (*Bos* sp.), evidence of Pearl millet (*Pennisetum glaucum*), most likely cultivated, and for the gathering of wild plants. Overall, finds are significantly more common in Horizon 2 than in Horizon 1, consistent with the depositional evidence for intensifying use of this part of the site.

While it is possible occupation also took place in the Ek-B area at this time, the particular spot we excavated did not produce evidence of this. Likewise, our excavations on the island (Ek-C) were not able to arrive at a clear picture of the early occupation levels there and we are not able to say whether or not there was a corresponding Period 1 presence on the island.

Period 2

The beginning of this period is marked by the first recorded evidence at the site for permanent architecture, in the form of a well-built structure combining both dry-stone construction coated with mud plaster and *pisé* (Fig. 7.5, 7.6) – this includes what appears to be either a large mud-built pillar or a staircase structure (Fig. 11.9). The various reconstructions of this building throughout the period shows the continued combination of stone and mud architecture, as well as continued evidence for a series of floor surfaces, including sand and clay floors. Later additions within the period also include the use of very well-worked stone (Fig. 11.8), as well as mud-brick used towards the end of the period.

The beginning of this period sees a significant increase in the quantity of material recovered, indicating that the earliest recorded permanent architecture was also associated with 'occupational intensification'. The earliest recorded evidence for trans-Saharan and other long-distance connections is also seen from the beginning of this period. Firstly we see a fragment of Islamic glass. We also see two grains of wheat (*Triticum sp.*) – while it is unclear if wheat was imported or grown locally, there is no pre-Islamic recording of wheat in West Africa, strongly

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TABLE 22.1 *Summary of Essouk-Tadmekka stratigraphy, chronology and phasing*

Unit Ek-A	Unit Ek-B	Unit Ek-C
Period 1: Horizons 1–2 *pre ca 9th/10th century* – Pre-permanent architectural occupation including 1 metre of relatively rich deposits with semi-permanent structural evidence in form of post-holes (Horizon 2)	(sterile soil)	(no clear evidence)
Period 2: Horizons 3–8 *ca 9/10th century–11th/12th century* – First permanent architecture (complete room space of structural complex in dry-stone with banco coating and *pisé*) – Subsequent rebuildings (Horizons 4–8) broadly continuous in construction and deposition (alternating silt/clay and sand deposits)	**Horizon 1** *ca 9th/10th century* – Relatively intensive depositional evidence but limited structural remains (a latrine pit) **Horizons 2–3** *ca 10th/11th century* – Construction and use of dry-stone walled structure – Terminated by wall-collapse (*likely no occupation*)	(no clear evidence)
Period 3a: Horizon 9 *ca 12th/13th century* – Rebuilding of structure (dry-stone with banco coating) from base with significant spatial continuity with Period 2 building – excavated room space however now extends beyond unit – Broadly continuous reconditioning of living space in continuity with Period 2 deposition	(likely no occupation)	(no clear evidence)
Period 3b: Horizons 10–11 *ca 12th/13th–13th/14th century* – Reuse of Period 3a walls for construction (dry-stone/*pisé*) but new constructions radically change use of space – Horizon 11 features seating platform with red ochre coating – Deposition ends with wall collapse	(no occupation)	**Horizon 1** *ca 13th century* – Presumed graveyard – Possible presence of well
Period 4: Horizons 12–14 *ca 13th/14th–14th century* – Clear departure in construction spatially and materially – Horizon 12 features banco and red ochre coating – Horizons 13–14 dry stone construction of a low quality – All horizons feature thick destruction deposits – Terminal wall collapse ends occupation.	(no occupation)	**Horizons 2–3** *ca 14th century* – 2 building horizons of dry-stone architecture, the first seemingly built atop a grave – A well is filled in during Horizon 2 but it is unclear if used at beginning of horizon – Wall collapse ends occupation

TABLE 22.2 *Summary of excavated Essouk-Tadmekka material culture and subsistence evidence (see individual chapters for details on sampling, particularly in relation to the faunal remains and archaeobotany)*

	Ek-A Per. 1	Ek-A Per. 2	Ek-A Per. 3a	Ek-A Per. 3b	Ek-A Per. 4	Ek-B Hor. 1	Ek-B Hor. 2/3	Ek-C Hor. 1	Ek-C Hor. 2/3	Total	Nature of evidence
Unglazed, hand-formed pottery	157	1433	1188	2296	3657	903	7341	813	1935	19,723	Mainly 'Berber' tradition ware; also some Niger River zone imports
Glazed/ wheel thrown pottery	–	–	3	5	1	–	19	2	–	30	Mainly monochrome common wares; includes a Chinese Qingbai porcelain fragment
Glass beads	–	61	64	39	32	26	131	27	9	389	Majority monochrome drawn beads (blue most common); also some polychrome and some wound beads; 1 dichroic bead
Other beads	–	–	1	2	2	1	1	–	4	11	Stone (mainly agate), fossil/shell, coral
Vessel glass	–	37	36	9	6	8	56	12	4	168	Mainly good quality blown glass (includes bottle and bowl fragments)
Textiles	–	–	–	–	1	–	1	–	–	2	1 silk fragment from Asia; 1 other textile fragment featuring silk stitch
Cowrie shells	–	–	5	3	–	–	–	–	–	8	Includes 4 *Cypraea moneta* ('money cowrie')
Gold working remains (coin mould/ crucible)		3/0	0/2							5	Fragments of ceramic coin moulds and crucible fragments featuring gold droplets
Other metal working debris	1	18	6	1	5	8	7	3	–	49	Mainly iron working (likely smelting), but also evidence of crucible steel working and copper smelting
Coins (silver/ copper-alloy)	–	–	–	5/0	0/1	–	–	–	–	6	5 silver coins and 1 copper-alloy coin (conservation incomplete, but 3 of the silver coins have been demonstrated to feature Arabic inscriptions)

TABLE 22.2 *Summary of excavated Essouk-Tadmekka material culture and subsistence evidence* (cont.)

	Ek-A Per. 1	Ek-A Per. 2	Ek-A Per. 3a	Ek-A Per. 3b	Ek-A Per. 4	Ek-B Hor. 1	Ek-B Hor. 2/3	Ek-C Hor. 1	Ek-C Hor. 2/3	Total	Nature of evidence
Other metal objects (iron/copper/ iron & copper mix)	–	17/9/–	19/13/2	23/17/–	20/18/–	2/5/1	23/26/–	6/–/–	6/3/–	210	Iron includes a dagger or sword blade, arrow heads, and a key; copper-alloys include various small decorative attachments, and several presumed ingot fragments
Unworked semi-precious stone and debris	–	4	–	1	1	–	–	–	–	6	Agate, jasper/bauxite, and a garnet
Other stone artefacts/ colorants	–	6	1	1	17	1	–	–	–	26	Flint tools/debris, a stone bowl, and bracelet; colorants are red and yellow ochre
Other ceramic artefacts	–	–	1	2	3	–	3	–	–	9	Various: including spindle whorls and a presumed gold weight
Faunal remains (NISP)	2	113	53	163	202	21	108	16	45	723	Bovids dominant, especially sheep/goat; also equid and various wild taxa
Eggshell	–	3	4	1	18	–	3	–	7	36	Mainly ostrich
Archaeo-botany	42	38	36	356	982	–	85	–	–	1539	Cereals, legumes, fruit, wild/weed and oil/fibre plants.

suggesting an association with incoming trans-Saharan merchants. From the same levels, we see a small (no. =14) assemblage of potsherds decorated using a folded-strip roulette tool (*e.g.* Fig. 12.13), suggesting long-distance trade or cultural connections with the Middle Niger/Niger Bend area to the south. In addition to indicating the time-depth of these links with regions further south, the fact that these ceramics are first encountered in association with the earliest documented evidence of permanent architecture does suggest this link is associated with the early stages of the establishment of a permanent trading centre at Essouk. Further evidence for extra-regional trade are found associated with this earliest evidenced architecture, including an unworked agate stone (Fig. 18.5), and a copper-alloy of likely trans-Saharan provenance.

Evidence of trans-Saharan and other long-distance trade occurs throughout the remainder of the period including: 1) Islamic vessel glass and glass beads – this is mostly from Horizon 8, with glass beads mainly monochrome (and principally blue), and vessel glass mainly good quality blown glass (it should be noted that the association of beads and glass with gold processing using crushed glass in the following horizon perhaps also explains the rich finds of glass and beads here); 2) copper, including an ingot fragment (Fig. 17.10); 3) a garnet stone (Fig. 18.6); and 4) fragments of gold coin moulds (three) containing microscopic traces of gold droplets (Fig. 15.1–15.3). These final items, the coin moulds, are from Horizon 6 and dated by association to *ca* AD 10th/11th centuries are the earliest evidence of gold trade at Essouk-Tadmekka.

Fitting with this various evidence for trade is an iron key from Horizon 4 (Fig. 17.6), suggesting the locking up of valuable goods; one of a range of iron artefacts found. Period 2's pottery continues to be dominated by the broad Berber tradition described previously. Decoration is dominated by cord (~70 per cent) and particularly cord-wrapped cord impression (~ 40 per cent). An important minority decoration is dragged comb (~13 per cent). One distinctive vessel type has an internal handle. Grog-tempered wares (~ 5 per cent of total pottery) are the only sign of possible sub-Saharan connections other than the folded strip roulette ware noted above. Other evidence of local craft production takes the form of iron-working (again, most likely smelting), copper-working and the gold coin production evidenced by the mould fragments. Limited evidence for working of jasper/bauxite and flint was also recovered.

Faunal remains indicate that sheep/goat (*Ovis/Capra*) were preferentially consumed over cattle during this period (in a ratio of 4:1) and that either chicken (*Gallus gallus*) or guinea fowl (*Numida meleagris*) were also present. Additionally three canid bones (probably dog) were recovered and ostrich eggshell is also present. Archaeobotanical evidence is again limited; in addition to the wheat this consists mainly of the wild-gathered cereals *Brachiaria, Echinochloa and Panicum*. Ostrich eggshell is also seen.

Data from Ek-B Horizon 1, most likely contemporary with the early part of Ek-A Period 2, broadly fits the above described pattern. Trade goods include glass and glass beads; copper is also present, including examples with a trans-Saharan origin. Similar evidence is seen for pottery and iron-working and a jasper/bauxite bead relates well to the Ek-A jasper/bauxite débitage. An item not seen in Ek-A is a stone bracelet fragment (Fig. 18.7). Faunal remains show a similar emphasis on sheep/goat consumption, but also include the first evidence for donkey (*Equus asinus*) at Essouk-Tadmekka. While we do not see permanent architectural evidence in Ek-B Horizon 1, there is every chance that we were excavating just on the edge of a zone featuring permanent architecture, and certainly the finds indicate this was a thriving part of the site.

While the Ek-B evidence for permanent architecture does not appear to date back as early as the evidence from unit Ek-A, we do see evidence in Horizons 2 and 3, dated to ca 10th/11th century, in the form of well-constructed dry stone architecture (Fig. 8.6, 8.7) – note, however, the lack of any evidence for associated mud-architecture. While occupation of Ek-B does not continue for the entire length of time covered by unit Ek-A Period 2, this structure does appear to see two phases of building. Amongst the pottery which has a broad commonality with the Ek-A evidence, we also see the fairly distinctive internal handle type. Large quantities of vessel glass, glass beads, glazed ceramics and copper were found associated with this building (these are mostly concentrated in Horizon 2, with glazed ceramics, for instance, being only found there). Minute amounts of cord-wrapped stick impressed pottery (CWSGI ware), demonstrated to come from the River Niger, were also recovered (*e.g.* Fig. 12.10). Other trade-related items not evident in Ek-A include a cotton textile with silk stitch (Fig. 18.3). We also see evidence for crucible steel working from these deposits (see Chapter 16). Faunal remains provide the earliest evidence at the site for camel (*Camelus dromedarius*: Fig. 20.1) and the only definite identifications at the site of chicken and gazelle (*Gazella dorcas*). Seven *couscousière* fragments were found, possibly linked to wheat consumption. Also, a small but rich deposit of plant processing remains was found, relating to locally gathered grasses (Fig. 21.2). Ostrich eggshell is also seen. Again, we are not able to say if there was occupation on the island related to this period.

Period 3a

Unit Ek-A sees continuity in permanent architecture, though with certain distinct changes. In particular, there appears to be rebuilding of the structure from the base (Fig. 7.15). We also now only see limited evidence for mud-built construction within this period. The overall quantity of material recovered remains high, but subtle changes are apparent, mainly in the form of additional forms of evidence not seen previously in Ek-A. Evidence of trans-Saharan and other long-distance connections again includes large quantities of glass beads and vessel glass (similar in nature to the previous period), both heavily concentrated in the very first context of Horizon 9 (Context 87), thereby directly following on from the high levels of these finds from the final context of the previous period. Gold working is again evidenced in the form of two crucible fragments from the beginning of the period (Fig. 15.5–15.6). Importantly, these contain traces of melted crushed glass and we have argued that the associated glass vessel and bead fragments relate to a workshop context where they were being used for gold processing (see Chapter 15). Glazed ceramics are seen in Ek-A for the first time, including a Qingbai Chinese porcelain sherd of Song Dynasty date (AD 960–1279) from Context 86 (Fig. 12.2). We also see the first recorded evidence from the site for cowrie (*Cypraea* sp.) shells (see *e.g.* Fig. 18.1). Towards the end of Period 3a we see several sherds of cord-wrapped stick impressed pottery (CWSGI ware), one of the import wares from the Niger River region. Copper is also present, as is an agate bead (Fig. 14.6a).

Locally manufactured pottery continues broadly in the tradition already described. However, in this period comb decoration is little used (~ 2 per cent) and twisted cord-roulettes are recorded for the first time. Internal handles are again present in very small quantities. Iron working remains (likely smelting) are again found, and we now also see evidence for smelting of copper. We now also see evidence for crucible steel working, only previously seen in Ek-B. The faunal remains indicate a similar pattern of bovid consumption to that of Period 2 and again putative dog is present (one specimen). Cereals (especially *Echinochloa*) again dominate the archaeobotanical samples and importantly wheat is again evidenced. Ostrich eggshell is again present.

There is seemingly no occupation in Ek-B in this period, and indeed this is the case through to the end of the site's occupation. Again, the data from Ek-C is unclear but it is a strong possibility that occupation took place on the island at least by this period.

Period 3b

While broad continuity is evident from Ek-A Period 3a to Period 3b, certain clear departures are observable. Architectural construction in this period sees a continuity in terms of materials – a combination of stone and mud architecture, with *pisé* also significant; and mud-brick is again seen – but we see two building horizons significantly altering the arrangement of space seen within the unit. The most dramatic architectural change comes in the second half of the period with the building of a seating platform, and this also features the first evidence we see for red ochre coating within the unit (Fig. 7.19).

Ceramics remain dominated by relatively plain chaff-tempered wares, though we see a significant reduction in use of cord-wrapped cord impression on the local pottery. There is also a radical increase in the cord-wrapped stick impressed pottery (CWSGI ware) from the Niger River. We also see an increase in what appear to be other examples of imports from the Niger River region, featuring slip and paint and strongly resembling pottery from Gao (Fig. 12.14). Items of trans-Saharan origin are persistent though nowhere encountered in vast quantities. These include glass beads, vessel glass, and glazed ceramics, including a near intact oil lamp (Fig. 12.3). Cowries are also seen again. Five of the six coins excavated at Essouk-Tadmekka (all corroded) were recovered from these deposits, all of silver and three of which have been demonstrated to feature Arabic inscriptions (Fig. 17.1). Other evidence of long-distance connections with the south appear to be seen in the form of cotton seeds (*Gossypium* sp.) (*e.g.* Fig. 21.1), seen for the first time and likely suggesting long-distance movement of unprocessed cotton. A ceramic disc hypothesised to be a gold weight and corresponding to known Islamic standards (weight 13.6 g) was also recovered (Fig. 18.10a).

Despite the relatively large amounts of iron and copper objects found, there is only one specimen potentially indicating metal working during this period, a piece of lead. A spindle whorl (Fig. 18.9) documents textile production and the remains of a circular coiled-reed mat were also found (Fig. 18.2). Faunal remains consist entirely of domestic bovids, with sheep/goat overwhelmingly outnumbering cattle (in a ratio of 12:1). Higher numbers of bones with char marks may signal a change in cooking practices during this period. As in the previous 2 periods, ostrich eggshell is recorded. Cereals are the most common archaeobotanical specimens recovered with *Echinochloa* again the majority, but wheat is also of obvious importance (eight specimens recovered and a lens of semolina powder).

The first clear evidence available from unit Ek-C (Horizon 1) appears to relate to this period (though it should be remembered that occupation in the Ek-C area likely predates this (see Chapter 9 for discussion). The evidence suggests that there was a grave in the Ek-C area at this period (see Fig. 9.4), though we did not find an inhumation. The material culture evidence broadly fits the Ek-A Period 3b pattern. Finds include glass beads, vessel glass, glazed ceramics, copper and iron – CWSGI ware is a notable absence however. Faunal remains include the only definite horse (*Equus caballus*) bone yet found at the site.

Period 4

While we see continued evidence for dry stone architecture within all horizons in Ek-A Period 4, only in the first horizon do we see evidence for the use of mud construction and mud-plaster (although *banco* is used for a small sub-structure in Horizon 14). In the first horizon not only do we see evidence for the use of mud architectural wall units we also see evidence for thick red-ochre coloured mud plaster on certain walls. What is particularly noticeable within this period are the thick wall-collapse layers featuring large stones from the collapsed walls. These wall collapses are a feature of all horizons, and in the first two horizons these cover complete crushed pots and *in situ* intact pots.

This period sees the most radical departure in material culture and ecofactual evidence within the sequence. Evidence for trans-Saharan goods occurs, but no longer in large quantities. Glass beads, vessel glass and a single glazed ceramic sherd are present, but only two glass beads occur in the final horizon, one of these being dichroic (Fig. 14.3). Copper, including one coin, and CWSGI ware are both present, but again in reduced quantities. A piece of silk textile was however found (Fig. 18.3).

Very significant changes are evident in the ceramics. Knotted cord roulette (Cr-1), previously not seen in Ek-A and only negligible in Ek-B, is now present in substantial quantities (~ 16 per cent of all decoration). This décor type is also consistently associated with a distinctive decoration pattern having no precedent in the Essouk-Tadmekka pottery tradition (see *e.g.* Fig. 12.9, 12.15a). The previously dominant cord-wrapped cord impression drops hugely (~ 2 per cent). Dragged comb décors (~ 6 per cent), finger impression (~ 10 per cent) and dragged grass décor (~ four per cent) also occur in elevated quantities, and painting increases. Handles are also more common, occurring on 2 per cent of vessels compared to 0.5 per cent previously, and certain distinctive handle types present were not recorded previously (*e.g.* Fig. 12.9). Metalworking is clearly in evidence once again and includes iron smelting. Other craft activities involve the working of jasper/bauxite and flint, limited textile production (inferred from a single spindle whorl) and new evidence for the use of haematite and jarosite as colorants, present in relatively large quantities (Fig. 18.5). A stone bowl was also recorded (Fig. 18.7).

While sheep/goat were still preferred, there is a massive increase in the consumption of cattle at the site (a ratio of only 2:1 in favour of sheep/goat). Another dramatic change is the significant minority assemblage of canid (probably dog) bones (no. = 14), some of which are charred, probable evidence of *canofagi* (dog eating) (Fig. 20.2, 20.3). Wild animals – including hyaena (*Hyaena hyaena*), monitor lizard (*Varanus exanthematicus*), fish (*Pisces* sp. Indet) and grey heron (*Ardea cf. cinerea*) – are also far more common, and there is a distinct rise in the frequency of ostrich eggshell (eighteen fragments compared to a total of eight in all previous Ek-A deposits) (Fig. 19.1). Very clear changes are evident in the archaeobotanical samples: while cereals, including *Echinochloa, Brachiaria, Panicum*, are again relatively strongly represented (wheat is also again present), fruits and wild-gathered plants are far more common than previously. Noteworthy individual taxa are the first recorded date (*Phoenix*), watermelon (*Citrullus*), Balanos (*Balanites*) and *Hyphaene* (*thebaica*), these specimens all being the earliest recorded evidence of these taxa from West Africa. A single specimen of linseed (*Linum* sp.) from this period is a first from a West African site. From these archaeobotanical changes we infer here the arrival of a 'Saharan (plant) package' at the site, not seen previously.

Within Ek-C in this period we see the construction of a dry-stone wall, only separated from the grave recorded in the previous horizon by very thin deposits. The horizon also sees another dry-stone wall overlying this one, related to the building on the site surface.

Finds from Ek-C for this period correspond well with those from Ek-A. Exotic goods include vessel glass, glass beads and copper, though none of these occur in Ek-C's terminal horizon. Two agate beads were also found (Fig. 14.6b–c), as was a coral bead (Fig. 14.8). A dagger or sword blade point was also seen (Fig. 17.4). Ceramics are broadly similar and include the distinctive knotted cord roulette (Cr-1), as with Ek-A not seen previously in Ek-C. The fauna also shows a similar pattern in the ratio of sheep/goat versus cattle. Another donkey bone specimen was also recorded. Ostrich eggshell, not seen previously in Ek-C, is found in significant quantities.

CHAPTER 23

A New Cultural History of Essouk-Tadmekka

Sam Nixon

Pre-*ca* AD 900

While rock art shows some form of cultural activity in the Essouk locality before the earliest documentary records of Tadmekka by Ibn Hawqal in AD 967/68 (see App. A), it has not previously been possible to gain detailed ideas of the early occupational history of the site. The excavations reported here now indicate relatively intensive occupation of Essouk-Tadmekka before the time of Ibn Hawqal, suggesting the site's importance as a likely way-point for the very earliest Islamic trans-Saharan trade. While as yet we have no material proof of a trans-Saharan commerce before the first documented evidence for permanent architecture, dated *ca* 9th/10th century, the evidence for an intensifying occupation of the site in the 1 metre of deposits below the earliest documented walls is certainly intriguing. Indeed, it is difficult to propose compelling reasons for settlement in this very marginal Saharan fringe environment other than linkage to developing long distance trade networks. While one should be very cautious in the use of oral histories recounted by the Arabic geographers, we should certainly not entirely discount the Ibadi reference to the existence of a slave market at Tadmekka in the 9th century (see App. A *'Ibadi extracts'*).

ca AD 900

The excavations suggest that evidence for trans-Saharan and other long-distance connections – glass, copper, semi-precious stones, sub-Saharan pottery, and wheat, as well as elaborate permanent architecture – most likely date back to at least *ca* AD 900. Already by this point the permanent settlement was seemingly the location of a culturally and ethnically mixed community. The combination of Berber ceramics, Middle Niger/Niger Bend pottery, and suggestive evidence for North African cultural practices (*e.g.* wheat consumption) suggests the presence, or at least cultural influence, of all three populations involved in the trans-Saharan trade: Saharan, North African, and sub-Saharan. The unusual mixing of mud-built and dry-stone construction in the earliest documented architecture also supports this conclusion. While not wishing to construct precise ideas of the cultural composition of the population associated with this early settlement, it is intriguing to note that in Ibn Hawqal's 10th century description Tadmekka is singled out as a location with a racially mixed population, its citizens having both black and Berber ancestry. Moraes Farias (2003: sect. 3.4) has previously discussed Ibn Hawqal's description, seeing it as almost certainly indicating a long prior tradition of cultural mixing in the region. Certainly, such a cosmopolitan community is unsurprising within the early stages of this important trade centre, located as it was at a point between two environmentally and ethnically different zones.

10th Century

By the time of Ibn Hawqal's report in AD 967/68, the Essouk-Tadmekka settlement appears to have extended at least from the area of unit Ek-A to that of Ek-B, seemingly indicating a significant residential population. The building complex partially excavated in unit Ek-B, as well as the surrounding buildings, appear to give us a sense of the nature of the physical structure of the town at this time, these buildings being abandoned sometime either in the late 10th or 11th century. Their form clearly suggests a developed construction, in the rectilinear tradition so often associated in West Africa with the arrival of influences from north of the Sahara. The consistent stratigraphic presence of artefactual evidence for trans-Saharan and other long-distance connections – including glass vessels, glass beads, and copper, as well as a semi-precious stone and a door-key (indicating locking up of property) – establishes this was a highly developed commercial settlement. The gold coin mould evidence we recovered from the early period is perhaps the most compelling evidence of a highly developed trade, not only demonstrating access to highly pure gold, but also an economy supporting the conversion of this into a money form. This various evidence gives substance to the often neglected Ibadi historical records referring to trade and settlement at Essouk-Tadmekka in the 10th century, including their references

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to a flourishing gold trade (see App. A). Likewise, the early evidence recovered also provides more substance to the similarly neglected 10th century record of Yaqut, describing a permanent settlement ('Aghrem') within the locality of Tadmekka (App. A).

By the mid-10th century report of Ibn Hawqal it is clear there was a strong Muslim presence at the site – if not before – Ibn Hawqal describing Islamic rulers at Tadmekka (App. A). His intriguing description of dual Muslim rulers has in fact been considered as possibly referring to an Ibadi practice (Moraes Farias 2003: sect. 3.4). While there is an absence of Islamic gravestones dateable to the 10th century, Moraes Farias (2003: sect. 3.4) has discussed how this might simply be a result of the fact that the early Muslim traders at Essouk-Tadmekka appear to have been mainly Ibadi, a group with no tradition of inscriptions. Indeed, the fact that the western cemetery at Essouk-Tadmekka is totally devoid of inscriptions has led to a suggestion this might be an early Ibadi cemetery, most likely dateable to the 10th century (Moraes Farias 2003: sect. 3.4). Almost certainly there would have been a mosque in the tenth century settlement – whether the small mosque found in the south of the site (Fig. 11.6) dates from this time is difficult to say, but given its relative proximity to the area of Ek-B where we find abandoned buildings on the surface dating to the 10th/11th century this is a distinct possibility. When we consider the tenth century picture at Essouk-Tadmekka, we must also not forget that Al-Bakri's later text is seen to have borrowed significantly from the lost text of Al-Waraq, written in the 10th century (see Levtzion & Hopkins 2000: 62–63). We cannot determine which elements of Al-Bakri's description of Tadmekka were copied from Al-Waraq's 10th century text, but it does seem likely that the flourishing settlement described by Al-Bakri was already established in a similar form in the 10th century.

11th Century

It is at the start of the 11th century that we first see evidence at Essouk-Tadmekka for dated Arabic writing (Chapter 5). The working assumption is that these dated inscriptions are the first Arabic inscriptions of any form from the site – indeed, they are the earliest dated writing from anywhere in West Africa, and quite likely the first record of experimentation with Arabic in West Africa. Not only do these inscriptions confirm with great force the presence of a strong Muslim population at Essouk-Tadmekka, they were also an essential part of the process of claiming the landscape as a Muslim environment (see further discussion Chapter 5). Not only was Arabic writing a visually striking sign of a Muslim presence, the content of the inscriptions was also clearly designed to mark this as a Muslim place. Located at the main eastern entrance to the site, the inscription identifying the site as "a market town in conformity to Mecca" is the clearest representation of this practice (see Fig. 5.4). Alongside this, we see an inscription directing the reader to recite the Muslim profession of faith, another overt expression of the fact that this is a locality where Muslim practices should be followed. The dated inscriptions from the cemeteries show additionally that by the early 11th century at least three Muslim cemeteries were in use in the surrounds of the town, encircling the town and serving as a geographical boundary of the Muslim urban centre. As Moraes Farias has shown (Chapter 5), the fact that the Islamic calendar was such a central feature of the inscriptions clearly shows how the Essouk-Tadmekka population were highly conscious of the Muslim world beyond the southern Sahara, wishing to connect to it and link their cultural practice to a wider world of Islam.

The various spatially separated cemeteries ringing the town seem to indicate the presence of a diverse Muslim population with different quarters and clan affiliations, from at least the early 11th century. The letter shapes in the more elaborate Arabic cliff inscriptions at Essouk point to influences carried across the Sahara in the 10th to early 11th century AD, particularly from Qayrawān (Kairouan) and Ṭarābulus (Tripoli), suggesting that amongst the population there was a strong element with connections to these areas (see Chapter 5). Undoubtedly though, the inscriptions indicate that the Muslim population were predominantly local Berber Sahelian groups. The development of this new Arabic inscribed tradition in the early 11th century does appear to indicate some form of shift in the Muslim population of the town at this time, potentially a register of new ideas or influences and new contacts; potentially linked to the loosening of the dominance of Ibadi Islam in the town. It is intriguing to contrast Ibn Hawqal's AD 967/68 description of a culturally mixed Sahelian group with a dual kingship, with Al-Bakri's AD 1068 description of a Muslim Berber population ruled over by a single "king" (App. A). It is possible that some form of shift in the office of power occurred during this period, though the Arabic inscriptions at the site certainly do not inform us about any such change.

The excavations indicate that the 11th century saw continued construction of permanent architecture, in a solid and developed style. While we only have clearly dateable concrete evidence from the Ek-A area related to this time (it is possible the Ek-B area extended into the 11th century, though also possible this terminated in the 10th century), it seems very likely that significant areas of the site were occupied, especially in view of the multiple cemeteries that we see dated to this time. As well as evidence of gold processing, glass beads, vessel glass, and copper, new evidence of trade goods is seen, including glazed ceramics and cowrie shells. Local craft industries were also present, both high quality copper-working, and at least by this time crucible steel working. Clearly the town was not just an important shipment area, but home to a flourishing industrial life. We appear to be seeing here the archaeological evidence of the "*suq*" (market) so confidently and proudly expressed by the inscription at the eastern entrance to the site. We must not ignore the fact however that we do see certain buildings abandoned at least by this time in the Ek-B area – it is though difficult to make sense of this given that it is from around this time that we are seeing some of the richest evidence of trade remains, including indeed in these very same abandoned buildings. This abandonment could though relate to a number of factors and without further evidence should not be seen as a sign of a town in decline.

Al-Bakri's mid-11th century description of Tadmekka (App. A) appears then to date to a point in the life of the town when it was a significant site of trans-Saharan commerce, built on a prior period of escalating trade connections dating back to at least the 9th/10th century. Al-Bakri's highlighting of Tadmekka's gold coinage and our recovery of evidence of this coinage is perhaps the clearest example of the way in which this trading centre had flourished and the extent to which its economy was organised for trade. Al-Bakri's reference to the town's well-built status also gains a material signature at the site, the excavation of the central town ruins clearly showing the presence of an elaborate and developed building tradition. For Muslims such as Al-Bakri, the location of this urban core within a landscape encircled by Muslim cemeteries would also have meant it was a clear, recognisable model of a Muslim town. Tadmekka was clearly by this point a confident and dynamic centre of Islam in the region, following on from its early Ibadi community to become home to a diverse Muslim population. It had also clearly established its own local Muslim identity, so confidently expressed in the inscriptions found around the site from the early 11th century onwards. Al-Bakri's description of Tadmekka as being "of all the towns in the world [is] the one that resembles Mecca the most", with its name meaning "the Mecca-like", picks up on the way in which the town had come to incorporate into its identity the identification with the most holy city of Islam – the inscription drawing the parallel between the market town and Mecca concretely demonstrates how this mental connection with Mecca was part of the local identity and not merely a projection of outsiders such as Al-Bakri. The archaeological record should now dispel any unwillingness to take Al-Bakri's words at face value. Early Essouk-Tadmekka was a wealthy, well-constructed town, with a diverse merchant and Muslim population, with significant and important markets, supporting a trans-Saharan commerce linked to a trade in gold, and facilitated by the production and circulation of a gold coinage standard – for outsiders and the town's citizens it was clearly this status which led the author of the inscription in the eastern cliffs to proclaim that "there shall remain a market in conformity to Mecca".

12th/13th Centuries

The defining moment of the mid- to late-11th century in the southern Sahara and the Sahel is seen to be the rise of the Almoravids, the militant Islamicist group who seek to eradicate lax Muslim behaviour throughout these regions, as well as further propagating the cause of Islam further south in West Africa. Developing in Mauritania, but going on to rule in Morocco, their reported actions included destruction of the trading centre of Audaghust, as well as the widespread persecution of Ibadi Muslims (Moraes Farias 1967). Interestingly, Al-Bakri's AD 1068 report on Tadmekka makes no reference to this group, even though later texts suggest some involvement between the town and the Almoravids. Al-Zuhri's 12th century text (App. A) refers to Tadmekka having "turned Muslim" in the time of the Almoravids, a reference likely indicating a shift to Maliki Islam and the decline of Ibadi influence. Interestingly, the Arabic inscriptions at the site do not reveal any clear shifts which could be linked to such a change. When we look at the excavated remains it is likewise difficult to identify clear evidence of change which could clearly be linked to Almoravid action or influence – the abandonment of the Ek-B area could potentially be interpreted as a sign of Almoravid action, though the dates are insufficiently precise to allow us to do this and such a conclusion would be unwise. One thing which might be important is the lack of further Arabic descriptions of the Tadmekka gold coinage, such an important feature of Al-Bakri's description. Given the clear importance to the Almoravids of controlling the gold trade and the importance of their own minted coinage (Messier 1974), it is possible they actively attempted to curtail the importance of the gold coinage of Tadmekka. Certainly the Almoravids do appear to have had wide reaching connections across the Sahara (Moraes Farias 1967; Messier 2010) – but we should also remember that Tadmekka was part of a different geographical zone, and one should not assume the Almoravids had an endless reach across the Sahara. We are clearly still a long way from being able to define Tadmekka's relationship with the Almoravids and certainly we cannot construct anything too solid on Al-Zuhri's vague reference to Almoravid influence at Tadmekka.

In terms of the Arabic documentary historical sources, the 12th and 13th centuries at Tadmekka could be described as "lost years". As explained earlier, the historical records provide little clear picture of Tadmekka between the report of Al-Bakri and the 14th century. The only record which appears to provide fresh information on the town is a late 13th century reference to Tadmekka owing "obedience to Kanim" (App. A '*Ibn Sa'id*'). Moraes Farias' analysis of the inscriptions has shown continuity through this period (Chapter 5) – the prominent inscription overlooking the site dating to the early 13th century provides a good measure of this continuity, both in terms of its proclamation of allegiance to Islam, and its apparent continued reference to a Sahelian Berber population (App. C). The inscriptions however do not provide us with a huge amount of content regarding the political or economic environment of the town.

The archaeological evidence we now have contributes important new information to improve understanding of this vague 12th and 13th century period in Essouk-Tadmekka's history. The deposits from unit Ek-A indicate continuous activity right through this period. In the Ek-B area though there is no rebuilding, and indeed this area is a zone of ruins from the post-11th century period onwards. While the Ek-C deposits proved problematic, we did at least evidence what appear to be 13th century deposits, and there is every likelihood 12th century deposits are below. While it is difficult to get a sense of the scale of the settlement in this period, the excavated evidence shows continued trade activity. We see trade in gold, we see glass vessels and beads – albeit in lesser numbers – and we also see other important evidence, such as the porcelain from China and the first evidence for coins, made from silver. We also see evidence for large amounts of the impressed cord-wrapped stick pottery (CWSGI), as well as other Gao wares. Combined this evidence provides every sense of a continued interregional trade function. The increased evidence of imported pots from the Niger River region is quite a noticeable change, and we also see other changes. The most noticeable of these is in the architecture, with red ochre now used, and associated with a distinctive seating platform. We also see certain dietary changes, indicated by the faunal remains. While interpreting this evidence we must remember however that the majority of the evidence we have to work with here comes from just one point of the site. Looking at this evidence in light of the reference to Kanim however, one is tempted to see in the increased influx of pots from the south some kind of closer relationship with sub-Saharan areas. Given that "Kanim" is a significant distance away from Tadmekka, this reference to Tadmekka's subservience to a sub-Saharan power does though need to be treated cautiously. While then we have clearly showed the continued trade function of the town, and certain clear signs of cultural continuity, the political position of Tadmekka at this time remains somewhat of a mystery.

14th Century

During the 14th century, despite the Ek-B area remaining abandoned, the archaeology indicates continued permanent settlement on a large scale, not only in the Ek-A and Ek-C areas, but also in an extensive area west of the wadi (according to survey data). Though difficult to ascertain, settlement may even have been more expansive than in the previous period. The very good architectural data from the surface of the site (Fig. 11.2) also enables us to clearly visualise the town fabric at this time; clearly it was a complex web of settlement, and very much looking like a well-developed urban centre following a broadly Islamic model. The archaeological data reported here establish that Essouk-Tadmekka continued as a significant permanent settlement during the 14th century – this is a conclusion that it was not possible to make from the historical sources alone which make no reference to a permanent settlement at Essouk-Tadmekka at this time. The persistence of trade goods – if not in huge numbers, but including such items as silk – and Essouk-Tadmekka's very existence in such an ecologically marginal area, both suggest a continuing participation in trans-Saharan trade networks. While we see continuity in some senses, the archaeological data does though identify distinct changes: not only is there a distinct break in the stratigraphy around this time, we also see significant changes in building styles, as well as in material culture, with in particular significant changes in the ceramic traditions. We also see a shift in diet, including *canofagi* (eating of dogs), greatly frowned on within Islam. The evidence from this period does seem a strong indicator of the arrival at the site of new populations. When we look to the historical evidence in light of this, a clearer picture does seem to emerge.

Turning to the 14th century historical evidence we see Al-'Umari's description of the Tadmekka population as "white" Berber pastoralists (App. A). Al-'Umari's description does appear to be a departure from previous descriptions, in particular with his stress on the word "white" when Tadmekka has earlier clearly been associated with an ethnically mixed Sahelian population. Crucially, Al-'Umari's description does not appear to be describing Muslim town dwellers, but rather people of the desert, resembling the historic Tuareg populations. This description has previously been difficult to interpret, but in light of the excavated evidence indicating a clear departure in material culture and dietary practice – most likely seen to relate to new Saharan Berber populations – one is now tempted to suggest that the populations reported on by Al-'Umari are new arrivals at the site, coming from elsewhere within the Saharan Berber world. While we should be very cautious in tying in other historical data, there are certain traditions which relate the movement to the site of groups from elsewhere in the Sahara in this period, including from Morocco (*e.g.* Richer 1924). While highlighting the existence of such sources, we are however still not in a position to clearly identify the origins of the 'new' populations at the site.

In addition to seeming to indicate the arrival of new groups at Essouk-Tadmekka, perhaps around the beginning of the 14th century, the combined evidence we have certainly also seems to indicate that the 14th century was a time of great turbulence for Essouk-Tadmekka. It is of great interest that we find heavy destruction deposits at this time, with the buried layers featuring material culture seeming to indicate sudden abandonment (*i.e.* intact or whole crushed pots). This is of interest as Arabic references indicate a struggle between Tadmekka and the Empire of Mali in the 14th century, with the Empire of Mali seemingly having "laid siege" to the town. The archaeology does provide a striking parallel with the historical data. Whether this hypothesised clash with the Empire of Mali developed as a result of the arrival of new Berber populations at the site around this time is certainly an important question to consider – the existence of such a clash between Mali and Tadmekka does at least seem to be an increasingly real episode.

The purported clash between Tadmekka and Mali is part of a larger story of clashes between Berber nomads and the Sudanese states (Levtzion 1994). While clashes did occur, some form of synergy between the Sudanic kingdoms and the desert towns was essential to the functioning of the system. Without this, insecurity would reign along the trade routes, and this would lead to lack of confidence amongst traders to ply those routes. One has the sense that already by the time of Al-'Umari in the first half of the 14th century Tadmekka was not a place that traders could have confidence in – the reference to "grain being scarce with them" suggests a locality experiencing hardship (see App. A). The Arabic records also provide no confidence in Tadmekka as a thriving Muslim locality. Traders lacking confidence in the ability of a town to offer solid trading potential or a stable Muslim environment would certainly look elsewhere. Importantly at this time, Mali was promoting other trading centres, such as Timbuktu and Walata, nearer to its political centre. Other centres were also rising to the east, including Takedda. Already therefore in the early 14th century it would appear that Tadmekka's position as a trading centre was under threat.

The end of evidence for dated inscriptions at Tadmekka around the mid-14th century has previously raised the question that the town was possibly abandoned at this time (Moraes Farias 2003: sect 3.2). It is quite possible that the inscriptions do indeed mark the end of the town – the excavated chronology could just about support such a scenario. When we consider the evidence, though, it is perhaps important to consider that the decline of inscriptions might actually mark a decline in Islam preceding the abandonment of the town. For a place where dated Arabic inscriptions have assumed such significance since the early 11th century, their absence is a clear signal of a shift, and the end of a particular Islamic identity. Importantly, oral traditions referring to the decline of the town refer to the decline of Islam as precipitating the departure of many of the important groups within the urban population, including the clerical groups so essential to its functioning and its wider status (Norris 1975). Within these traditions, the cause of this decline appears to be incoming populations less inclined to the observance of Islam. While the ultimate collapse of such a town might commonly be explained by such factors as diminishing water sources, or environmental over-exploitation, or indeed competing trade centres, we should consider the decline of Islam as providing a potentially compelling explanation. The status of Essouk-Tadmekka as a trade centre was intertwined with its status as a Muslim centre – and often this status was potentially considered as of greater importance than trade. The decline of Islam would almost certainly spell the ruin of the town as traders would follow clerics in a migration away to other more stable locations.

For 500 years Tadmekka had been continuously occupied in the marginal environment of the southern Sahara, at the borderland between the Berber and Sudanic worlds. During this time it had been supported thanks to a delicate balance between nomad and urban dweller, Muslim and animist, and between Berber and Sudanic populations. This balance was then lost, whether exacerbated by larger patterns of trade, or internal dispute and conquest. In this marginal desert environment, this would more often than not lead to rapid decline as the whole basis for maintaining a town in a marginal ecological environment collapsed. It is possible this occurred around the time of the last dated inscriptions – the mid-14th century – but also possibly slightly later, towards the end of the 14th century, with even a slim chance of a vestigial occupation having persisted west of the wadi slightly later. What seems certain though is that when the Arabic records of the mid-15th century refer to a famous town amidst mountains and ravines, they are now simply referring to a memory or copying older texts – Essouk-Tadmekka was by that point abandoned, to remain as ruins until the present day.

Post-14th Century

After its abandonment the Essouk locality would certainly have continued as an important part of the nomadic landscape, and as today it would have been visited daily by nomadic groups to use its wells, some of the best in the region. Its ruins were likewise probably also soon a focus for relic hunters like in recent times, looking for glass beads and other potential treasures. While abandoned and in ruins, the town's legacy lived on elsewhere though. This is mainly due to the Kel Essouk, who went on to become the most important Islamic specialists through large parts of the southern Saharan and Sahelian territories, their name retaining the association with their origin point, and this in turn leading to the continued memory of the town. The Essouk locality became identified as a 'paradise lost' for the Kel Essouk (Norris 1975). As well as being part of the historical imagination, the Essouk locality itself did also became an important place of pilgrimage, and the presence of town ruins and its cemeteries were one of the factors leading to this becoming an important focal point for mystical Sufi movements in the region. The Arabic inscriptions more than anything provided a reminder of its past importance to Islam, even though a clear sense of their content and exact origins became lost over time (see Moraes Farias 2003: sect. 3.2). The strong sense of historical identification has never ceased up to the present day. The Essouk-Tadmekkat festival in recent years is only the most recent development in a 600 year process of remembering and revisiting this location to celebrate its past importance.

CHAPTER 24

Debating Trans-Saharan Commerce and Culture

Sam Nixon

The Rise of Islamic Trans-Saharan Commerce

"… Sijilmasa was not the sole conduit for the spread of Islam to the Sudan. Early North African caravan routes traversed the Sahara from Qayrawan (through Ghadamis), and from Libya (through Zawila) and thence to Egypt. Of these we know much less, other than that they existed and generally lost importance as Sijilmasa gained in stature over time".

MILLER 2001

While there is broad consensus that trans-Saharan commerce escalated in the early centuries of Islam (see Chapter 2), understanding exactly when and on which routes across the Sahara this occurred is not a simple process. Within discussion of the growth of trans-Saharan trade in the early Islamic era, the western route running from Sijilmasa to the kingdom of Ghana (see Fig. 2.3) has long been the most prominent (see *e.g.* DEVISSE 1988, MILLER 2001; MESSIER & MILLER 2015). This route, running through the trading town of Audaghust, is first documented within Arabic geographical texts from the 9th century (*e.g.* LEVTZION & HOPKINS 2000: 22), with the first description of significant trade recorded in the 10th century (LEVTZION & HOPKINS 2000: 45–6). The excavation of the trade centres of Sijilmasa (MESSIER & MILLER 2015) and the site of Audaghust (Tegdaoust: DEVISSE 1988) has provided physical evidence to support the Arabic geographical descriptions, with the evidence from Audaghust/Tegdaoust supporting a 9th–10th century escalation of trade. Alongside this route there are two other principal early routes documented within early Arabic geographical texts, but for which we have lacked physical evidence. Firstly, there is a route running from Libya down through the Kawar Oases to Kanem-Bornu, documented from the 9th century (LEVTZION & HOPKINS 2000: 22), often associated with a trade in slaves. Secondly there is the route from Wargla to Tadmekka, connecting on to Gao and Ghana. While the crucial Kawar oases sites still await investigation to help us provide commentary on the route from Libya to Kanem-Bornu (*cf.* LANGE & BERTHOUD 1977), we are now in a much better position to reconstruct the early route through Tadmekka and to better place this within the early landscape of Islamic trans-Saharan trade.

The reconstruction of the Wargla-Tadmekka route involves three key localities: Wargla, the northern entrepôt, Tadmekka, the corresponding southern Saharan fringe entrepôt, and Gao, the key sub-Saharan trading partner of Tadmekka (see Fig. 2.3). Arabic historical references appear to indicate developing trade at Wargla at least by the 9th century, if not earlier (VAN BERCHEM 1960). We also hear of Gao by the 9th century (LEVTZION & HOPKINS 2000: 21), seemingly a clear indicator of this route – importantly within this early description Gao is also described as the most powerful sub-Saharan kingdom at that time. The principal historical source used in the discussion of Tadmekka has been Al-Bakri's account of Tadmekka in the mid-11th century (App. A). As explained above, however, if we look at the pre-11th century evidence there is in fact clear indicators of an earlier commerce at this locality. Firstly, one needs to recognise that Al-Bakri's text is itself based upon an earlier 10th century text, that of Al Waraq, now lost (LEVTZION & HOPKINS 2000: 62–3). Also, when we look at the sources we see that while the Ibadi traders who were the main groups on the Tadmekka route did not record their histories at the time, oral traditions recorded in the 11th and 12th century do record a flourishing trade in the 10th century, as well as indicating an earlier trade into the 9th century (see App. A *'Ibadi extracts'* and LEVTZION & HOPKINS 2000: 88–91). There is also the record of Yaqut referring to a settlement in the Essouk-Tadmekka locality in the 10th century (App. A), and Ibn Hawqal refers to Muslim groups at Tadmekka in the 10th century (App. A). While this is a compelling picture of early activity on this route, the lack of archaeology has made it difficult to fully substantiate this activity.

Wargla has never been excavated (*cf.* VAN BERCHEM 1960). Gao has seen significant work (Insoll 1996, 2000; CISSÉ *et al.* 2013), but despite the important evidence recorded, there is still little clarity on Gao's earliest phase; particularly given that there were other possible motors for settlement there than trans-Saharan trade. Tadmekka indeed really provides the register of this route as the development and maintenance of a permanent centre in this environmentally fringe environment appears to be directly connected with trans-Saharan commerce. Our work at Essouk-Tadmekka now records a significant permanent settlement at least back to *ca* AD 900. This is

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complemented by evidence of trans-Saharan connections, including glass, wheat and brass, as well as a key and a semi-precious stone. In the horizons above we also find evidence of the gold trade, indicating highly developed trade linked to a monetised Islamic system. Before the earliest evidence of permanent architecture we also have evidence of a settlement with non-permanent architecture, going back at least into the 9th century.

The Essouk-Tadmekka evidence then would appear to provide the material evidence to support the somewhat diffuse collection of early Arabic geographical references to a pre-11th century town and trade on this route, including the 10th century record of a settlement by Yaqut, and the early trading settlement also indicated in later Ibadi oral traditions; as well as the 10th century town likely described in the lost book of Al-Waraq which is only now dimly discernable through the later copying of it by Al-Bakri. The settlement with non-permanent architectural evidence we recorded at Essouk-Tadmekka, dated back to at least the 9th century, would likewise appear to correspond very well with the indication of a 9th century slave market at Tadmekka reported in later Ibadi traditions, and with the first recording of Gao within the Arabic historical documents, Tadmekka's historical trading partner. Tadmekka as a town might not have been fully born by that point, but it seems most likely that it was in the 9th century that trade intensified, providing the immediate context for the development of a permanent town at the site. While one must be cautious in seeing the excavated Essouk-Tadmekka evidence as completely representative of activity at the site, on the basis of the results we have it does then seem that the archaeology provides the basis to support the until-now somewhat vague historical sources indicating the growth of flourishing trade on the Wargla-Tadmekka route in the 9th–10th centuries.

While the growth of developed trade along the western route from Sijilmasa through Tegdaoust to Ghana in the 9th–10th centuries has long been established, it is now clearly established that a parallel phenomenon was occurring along the Wargla-Tadmekka route. Beyond simply documenting this route through time and space, it is of wider interest for its insights into the cultures and social processes of trans-Saharan trade. While the western route was seemingly strongly linked with the growth of Fatimid trade – and was seemingly sponsored by the Fatimids (Devisse 1988) – the Wargla-Tadmekka route was very closely linked to the Ibadi, in fact seemingly to the exclusion of Fatimid linked traders (Savage 1992). The Ibadi sect lived outside the mainstream culture of North African Islam (Savage 1992), but were seemingly highly connected to the Saharan world. Indeed, historical sources suggest that Ibadi trading groups were significantly composed of Saharan Berbers (Hachid 2006). One has the sense of great cultural mixing, and the alliances thus forged would have given merchants secure access to the desert and thus to the possibility of trade across it. When one looks at the early historical records of Tadmekka, one has a sense of such a culturally embedded group of traders (see Ibn Hawqal in App. A). This provides a very different idea to the notion that traders were principally intrepid North African expatriates forging new routes through an unknown and hazardous wilderness, inhabited by hostile Berbers making it unpropitious to trade (Devisse 1988: 389). Trade on the Wargla-Tadmekka route would appear to have been facilitated by cultural mixing and in the control of indigenous Saharan groups, something which provides an important balance to the model of the trade network which has been suggested for the western route.

In addition to documenting this route and highlighting the social processes it seems to indicate, the piecing together of the fragmentary documentary historical sources for this route contains wider lessons for an understanding of the data related to the recording of early trans-Saharan routes. Firstly, this brings home the fact that we are dealing with an incomplete documentary resource. Aside from the fact that the earliest phases of the trade were likely completely undocumented, this process shows how we have lost important texts which did at one time exist. The lost book of Al-Waraq, no doubt a fountain of information, is obviously a significant absence in reconstructing 10th century trade routes, in particular across the Wargla-Tadmekka route. What we have also seen is that certain of the important early trading groups did not have strong documentary traditions. The Ibadi in particular seem to have been a group whose activities went largely unrecorded at the time. This brings us to another point, namely the linkage of the documentary tradition and political power. The classic case of this is seen to be Ibn Hawqal who is seen to have significant links to the Fatimids (Levtzion 1968). Given these links, there is a strong sense that Ibn Hawqal was reluctant to highlight the importance of the Ibadi route further to the east, in direct competition with the Fatimid route. These various factors then highlight how the 9th/10th century trade on the Wargla-Tadmekka route is only dimly present in the historical record, and we therefore rely on archaeology to effectively bring this back to life.

The reconstruction of this early Ibadi route is part of a wider process of documenting the fragmentary evidence for the earliest Islamic trade routes across the Sahara. Earlier archaeology on the Sijilmasa-Tegdaoust-Ghana route provided the basis for confirming historical records of 9th–10th century trade on that route. We have now shown a similar phenomenon on the Wargla-Tadmekka-Gao route. Almost certainly a similar process will in future be documented on the Kawar Oases route. On the current evidence, it does seem that the 9th–10th centuries saw the true forging of stable and sustained trans-Saharan networks, following on from the undoubted earlier presence of pre-Islamic trade routes. The creation of permanent trading centres in places like Tegdaoust and Essouk-Tadmekka provided the basis for established trade partnerships and secure locations of trade, as well as offering environments conducive to long trading ventures. While perhaps the most important chapter in the whole trans-Saharan process, in many ways this is a relatively unknown story, overshadowed by the emphasis on the rise of trade in the post-Almoravid era (11th century onwards) reported on by celebrated commenters such as Al-Idrisi, as well as the later era of Mali's trading ascendancy and the growth of Timbuktu (14th century). Certainly the Almoravids escalated trade further, and the era of Mali saw new heights reached, but the flourishing era of trans-Saharan trade was seemingly first established in the 9th/10th centuries, right across the trans-Saharan system.

West African Islamic Culture

"… And there will remain to it [to Tadmekka's valley, or town]

a market [*sūq*, the etymology of the place name "Essouk"] in conformity to Mecca.

And the Book [the Qur'ān] will remain."

ARABIC INSCRIPTION WITHIN THE CLIFFS AT ESSOUK-TADMEKKA, CA 11TH CENTURY *AD* – SEE CHAPTER 5

Crucial to the growth of Islamic trans-Saharan commerce is the growth of Islamic religion and culture below the Sahara. Essouk-Tadmekka is clearly identified as one of the first localities of Islam in West Africa, and is still identified into the modern era as an origin point of Islam in the region (Norris 1975). In many of the early Arabic descriptions of West Africa Essouk-Tadmekka also appears as part of the *dar al Islam* (Levtzion & Hopkins 2000), a region where Muslim traders would have found a relatively familiar world; just on the edge of the world of the sub-Saharan kingdoms to the south where denser settlement of non-Muslim groups would have been found and where animism prevailed. Given its status as one of the most important early centres of Islam in West Africa, Essouk-Tadmekka is central to wider discussion of how the Muslim faith and Muslim culture were first defined in this wider region.

Central to the development of Islam at Essouk-Tadmekka was the definition of a physical space of Islam within the surrounding nomadic non-Muslim territory. The cliffs lining the Essouk valley provided for a very clear demarcation of the urban landscape from the surrounding desert, and consequently this formed the basis for the definition of a geography of Islam in this locality (Figs. 4.1, 4.2. 4.3). The most obvious way in which the Muslim locality was defined from the surrounding desert was in the creation of Muslim cemeteries in and around the cliffs flanking the developing urban centre (see Fig. 4.2. 4.3 and App. B). From at least the 11th century the graves within these cemeteries featured Arabic inscriptions (see Chapter 5), providing additional symbolism to this new type of construction within the landscape. In addition to their use within the cemeteries, Arabic inscriptions were also used within the cliffs around the town (Chapter 5). The most obviously symbolic placement of these inscriptions is at what was clearly an important entrance point to the town, through the eastern cliffs, where we see two particularly important inscriptions (Fig. 5.4, 5.5). The first of these directs the reader to recite the Muslim profession of faith, signalling to visitors that they are about to enter a Muslim space, and encouraging Islamic prayer. An even more explicit affirmation of the Muslim identity of the town is the inscription which proclaims the identity of the town as a Muslim market town, stating its "conformity to Mecca" and avowing the law of Islam through reference to the Koran. These inscriptions appear to date from the early 11th century, and it would appear to be from this date that the landscape is confidently proclaimed as Muslim. Close to this inscription cluster are the remains of a prayer area (mosque or *musalla*), seemingly occupying a similarly symbolic position at the entrance to the town (Fig. 11.2 no. 3). To the north of the town is another Muslim structure, a *musalla* (Fig. 4.12). The dating of these structures is unclear, as is the exact extent of religious architecture in the periphery of the site, but it is clear that this too formed part of the definition of the Muslim town space at some point in its history.

The definition of the Muslim space at Essouk-Tadmekka was made in reference to strong existing local traditions of rock art and inscriptions (see Chapter 4 & 5), and in particular this explains the strong Arabic inscription tradition at Tadmekka. The Essouk-Tadmekka landscape had long been a place frequented by pastoralists before Islam, and these groups had themselves marked the landscape with images of animals and people. The use of the Tifinagh script to write messages and record passage within the landscape was another tradition which had left its mark in the Essouk valley. The use of Arabic inscriptions therefore distinctly marked the landscape as a new space, appropriated for Islam. The linkage between the use of Arabic inscriptions and pre-Islamic inscription traditions is brought into contrast by the fact that the tradition of Arabic inscription that is so strong at Essouk-Tadmekka is almost entirely absent from the landscape of the comparable southern-Saharan trading town on the western Saharan route, Tegdaoust. We do however see the use of inscriptions within the Songhay world to the south of Essouk-Tadmekka, at Gao and Kukiya (Moraes Farias 2003).

The most explicit and strongest definition of the Islamic identity of Essouk-Tadmekka was its name. Al-Bakri's 11th century description of Tadmekka explains how it is seen to 'resemble Mecca', but then goes on to explain that its name means literally 'resemblance to Mecca' (App. A). While other localities were described as resembling Mecca, including Audaghust in Mauritania (Levtzion & Hopkins 2000: 46), Tadmekka is the only place where this comparison forms the basis for the name of the locality itself. This meaning of the town name meant that its identification as a place of Islam was projected throughout the trade network, and its identity was therefore consistently reinforced through the use of this name. While the explanation of Tadmekka's name in Al-Bakri's text is extremely important, equally important is the inscription at the site proclaiming the parallel between the town and Mecca, referred to above. What is crucial about this inscription is that it shows how the identification with Mecca was not purely an idea created by outsiders, such as geographers and travellers, but was clearly part of the local identity – this is perhaps the strongest expression of the desire to link this outpost into the Muslim mental world geography. In complement to the name Tadmekka was the name Essouk, meaning market in Arabic: the combined name 'Essouk-Tadmekka' – literally 'a market of the place resembling Mecca' – provided a powerful message of a Muslim space.

The Arabic inscriptions at Essouk-Tadmekka reveal other ways in which the ideology of Islam was adopted and inculcated. Most importantly, Moraes Farias (Chapter 5) has demonstrated in particular how the inscriptions reveal a great stress on the use of the Muslim calendar, the listing of dates according to the Muslim calendar in fact often being the main focus of the inscription. This clearly shows one of the ways the inhabitants of the town began to link themselves into the cycles of the wider Muslim world and its history. Not only do the inscriptions reveal this practice, the existence of these dated inscriptions within the landscape would also have helped to reinforce the Muslim calendar on a day-to-day basis.

The religious geography and conceptual definition of a Muslim space at Essouk-Tadmekka is part of a wider adoption and definition of Islamic culture at Essouk-Tadmekka. Firstly, the physical environment of the town was defined by a recognisable Islamic architectural tradition (see Chapter 11). Naturally, trade also brought a whole range of material culture from North Africa – certain of these products would have been designed not for shipment onwards, but to provide local traders with a material culture of Islam. This includes glazed ceramics and glasswares. We also see a crucial dietary introduction, wheat, a cereal that is clearly associated with Muslim lifeways, as revealed by Ibn Hawqal's association between wheat and civilised practice (Levtzion & Hopkins 2000: 46). We also see some other transfers, including experimentation with coinage production (Chapter 15).

Crucially, Essouk-Tadmekka was clearly from the beginning a place where a learned and scholarly Muslim community resided, as expressed in Ibn Hawqal's text (App. A). Given Essouk-Tadmekka's Islamic status it also became a natural place for the Hajj to Mecca, as shown in the Arabic historical references (Levtzion & Hopkins 2000: 338). Hajj was a crucial element of the adoption of Islam, and many expatriate traders as well as new converts went on Hajj with the trade caravans. Tadmekka offered not only a learned community to support Hajji, it also offered the sacred landscape of Islam we have described above. In addition to its function as a stopping place for the Hajj journey, Essouk-Tadmekka likely also became a regional pilgrimage centre, in the same way that Timbuktu would become in later periods (see Nixon 2013b).

While Essouk-Tadmekka was a major focal point for early Islam in West Africa, importantly it was the Ibadi sect of Islam who became the early dominant Muslim group here (App. A *'Ibadi extracts'*). From an early period Ibadi Islam was in conflict with mainstream Islam, based upon both theology and cultural practice (Gaiser 2010). Muslim leaders and clerics at Essouk-Tadmekka were therefore converting people to a particular branch of Islam, one which was not practiced within the majority of the Muslim world. The Islamic fundamentalist Almoravid movement started in the 11th century on the basis of a recognition of the malpractice of Islam in the Sahara and West Africa – notionally this movement was fuelled by knowledge of the wider Muslim world gained during Hajj (Moraes Farias 1967). The Ibadi and their cultural practices were one of the specific targets of the Almoravids, with the consumption of dogs being a particular focus (Moraes Farias 1967: 809–810, 854). While we do not have a clear account of the social practices of early Tadmekka, it is useful to note that Al-Bakri's description of Tadmekka includes a passage describing the women of Tadmekka, and placing particular emphasis on their liberal sexual practices (App. A). In the 12th century

Al-Zuhri reported that Tadmekka had come in contact with the Almoravids during the period of their ascendancy, and to have 'turned Muslim', in other words converted to orthodox Islam (App. A). Interestingly the Arabic inscriptions at Essouk-Tadmekka provide little sense of a shift in Muslim practice during the era of Almoravid ascendancy, but it does seem almost certain that changes in Muslim practice took place.

As the centuries developed, Islam came to be consolidated further south in West Africa, in the lands of the sub-Saharan kingdoms (see INSOLL 2003). While many groups remained non-Muslim, there came to exist a wider network of Muslim centres and communities. It is interesting to note that in its later period the archaeology at Essouk-Tadmekka reveals a change in occupation at the site, broadly timed with the end of the dated Arabic inscriptions (see Chapter 22). Crucially the archaeological remains associated with this later period change in occupation at the site contains evidence of dog consumption (Chapter 20), as noted above specifically focused on by the Almoravids as an abhorrent and non-Muslim practice. Oral traditions refer to the idea of a 'paradise lost' at Essouk-Tadmekka in its later history, with Muslim clerics and other true followers of Islam moving away from this locality (NORRIS 1975). It is unclear if these traditions refer to the era in which Essouk-Tadmekka was abandoned or to a later period of anti-Islamic sentiment in the region. In reflecting on this evidence, it is important to consider the idea that the decline of trade at Essouk-Tadmekka was potentially a result of the decline of Islam there. Even after this period of decline, however, the site became part of a mystical landscape of Sufi Islam (NORRIS 1975), and certainly the presence of the ruined landscape of Essouk-Tadmekka and its Arabic inscriptions would have been a crucial stimulation to Sufi practice. Today still Essouk-Tadmekka holds status within regional Islamic thought, their being a continued connection and identification with it as a cradle of Islam within the region.

The Trans-Saharan World of the Tuareg

"… amidst this sweeping portrait of the Tuaregs, their true name, the name they use themselves, the Imashaghen or Imohagh – 'the noble and the free' – does not appear. If it does, at this period it is to be found in one locality, the Tuareg capital in the Middle Ages, Tadamakkat".

NORRIS 1975: 12

Essouk-Tadmekka and the region around it was crucial as an early centre of the Tuareg, the cultural group most synonymous with trans-Saharan trade. In a discussion of the formation of Tuareg identity, NORRIS (1975: 12) points out that the key defining name associated with the 'noble' Tuareg, *Imashagen* (meaning 'the noble and the free'), has its earliest occurrence within Ibn Hawqal's 10th century description of Tadmekka. "Essouk", the market town of Tadmekka, is also of fundamental importance within the development of Tuareg culture, this being the origin point for the Kel Essouk, one of the most important groups amongst the *Ineslemen*, the Islamic social category within the Tuareg world which assumed a crucial role in providing services of law and counsel, negotiation and dispute resolution (NORRIS 1975; MORAES FARIAS 2003: sect. 3.2). Throughout the early Islamic era the nomadic groups ancestral to the Tuareg absorbed elements of Islam, and their culture also became more entwined with the trade process and the urban centres of trade. Indeed, in many ways, this process created what we know as "the Tuareg", a cultural group which developed out of this particular dynamic between a pastoral nomadic existence and an urban-centred commercial network. Essouk-Tadmekka was the main place within the early Tuareg world where this dynamic and tension was played out, between the nomad and the urban dweller, the animist and the Muslim – it is this which makes Essouk-Tadmekka so fundamental for approaching understanding of early Tuareg culture.

The phrase used by NORRIS (1975) to describe Tadmekka, "Tuareg capital of the middle ages", appears as somewhat anachronistic: a settled urban centre of a nomadic people is something difficult to visualise. This phrase however provides a nice approximation of the nature and formation process of the early urban settlement which became Essouk-Tadmekka, a settlement which formed from within the heart of a nomadic culture. Yaqut's use of the term 'Aghrem' to describe the 10th century settlement within the Tadmekka territory appears to show that the urban form within this southern Saharan region was a new concept, the Berber word 'Aghrem' most likely being translated as 'settled place' (App. A). Similarly, Al-Bakri's reference to the population of Tadmekka as being "Muslim Berbers who veil themselves as the Berbers of the desert do" refers to a people who are part of the desert and part of the town (App. A). Al-Bakri also explains that "they live on meat and milk as well as on a grain which the earth produces without being tilled", and when we look to the archaeology we see a clear reflection of this pastoral and gathering diet. We have also suggested that the physical arrangement of the town likely allowed for significant semi-permanent settlement, or transitory settlement, including the possibility of tents being set up within compounds and courtyards throughout the town.

What we are seeing here is therefore perhaps the prime example of the formation of what one could call "Tuareg urbanism" – Tadmekka was even within its most developed urban format likely a place which was partly of the desert and linked to the desert.

It has been well-discussed how Essouk was the birthplace of the Kel Essouk, a key element of the *Ineslemen*, or Islamic specialists. The early historical record of Ibn Hawqal provides the first insights into the development of this group at Essouk, as in addition to discussing "the noble and the free" Ibn Hawqal also discussed the Muslim authorities of the town (App. A). These are essentially the forebears of the Kel Essouk. While it is difficult to gain a sense of the relationship between these early Muslim authorities and the urban site, almost certainly their authority was solely over the urban space and its population, the surrounding area being the domain of nomadic non-Muslim Berber groups. We are given very little further insight into specific Muslim authorities and the Kel Essouk through the Arabic documentary sources. However, the epigraphy at Essouk provides clear insight into how the early groups of the Kel Essouk defined the landscape of the Essouk locality, in the process effectively making it the central place of Tuareg Islam. The concept of a town "resembling Mecca" was certainly part of the wider process of the Islamic authorities actively establishing this location as a central Muslim place – effectively a 'Mecca replacement'. The landscape of cliff inscriptions and cemeteries created a powerful physical manifestation of this origin point of Tuareg Islam, the dated Arabic inscriptions in particular clearly establishing the ancestry of Islam here for all to see. With the abandonment of Essouk-Tadmekka, the Kel Essouk moved throughout the region, and with their illustrious Muslim ancestry they become the most respected and powerful of the Islamic specialists through the wider region, settling in various locations, but consistently retaining their name linking them back to the ancestral Tuareg Islamic site. Given their status, the Muslim traditions of Essouk-Tadmekka inevitably went on to have an influence throughout the Tuareg world. The recording of the remains at Essouk-Tadmekka provides an essential record of the early material world of the Kel Essouk, including their mosques, *musalla*, cemeteries, and inscriptions – Essouk-Tadmekka is an unparalleled religious landscape of early Tuareg Islam.

For the majority of Essouk-Tadmekka's occupation we appear to be dealing with a locality dominated by the urbanised Muslim strata of the Tuareg world, as we have laid out above, preoccupied with an urban lifestyle and their relationship to the wider Muslim world. In the final phase of Essouk-Tadmekka we appear to see a different picture however. As explained in the previous chapter, it would appear that around the 14th century Essouk-Tadmekka sees a shift, with the arrival of new Berber populations at the site, although it is difficult to determine their exact identity. The 14th century also sees Tadmekka seemingly become embroiled in a conflict with the Empire of Mali. While it is difficult to clearly define the historical process which took place here, this is potentially a very important episode. In later centuries, the Tuareg have a very well-documented relationship with the urban centres on the Niger River, including particularly Timbuktu and Gao (Levtzion 1994). This relationship involved attempts to control these commercial centres, and in the process these were often occupied by the Tuareg. Increasingly therefore there was an attempt by nomadic power groups to assume a position of power in the urban world. While we are still a long way from understanding the late phase of occupation at Essouk-Tadmekka, the conflict with the Empire of Mali that seems to have occurred does appear to somewhat presage later clashes between Berber nomads and the Sudanese states. The historically documented 14th century clash between the Empire of Mali and Essouk-Tadmekka is potentially an important early episode within the longer term story of Tuareg conflict and power in the southern Saharan fringes.

The Gold Trade

"… the richest gold mine on earth is that of Ghana in the land of the Maghrib. Deserts and fear of the Sudan of the Maghrib bar the way to it. When anyone arrives there he loads his camels heavily because the veins, eyes, strips, sandals and tongues of gold are numerous there and it is cut up and carried away".

AL-HAMDANI, AD 942–945 (LEVTZION & HOPKINS 2000: 29)

Central to the whole trans-Saharan trade process was the commerce in gold. As South American gold enchanted the early modern world, West African gold enchanted the medieval world before it, as the abundant, high-quality gold found there led it to become the world's major gold supplier until Columbus' era (Messier 1974; Devisse 1988; Spufford 1988; Gondonneau & Guerra 1999; Levtzion & Hopkins 2000). The West African regions where traders obtained gold took on huge significance in people's minds, leading to fantastic and mythical tales of splendour and riches (*e.g.* Levtzion 1968; Benjaminsen & Berge 2004). The early Arabic geographers' descriptions of the gold trade are themselves coloured by this myth making (see various references in Levtzion & Hopkins

2000), and they also reveal the difficulty of attaining precise information concerning the operation of the gold trade; certainly at least in part due to the great secrecy involved in the commerce. Certain important studies have been made of the gold trade, based upon both a synthetic treatment of Arabic records (Garrard 1980: chapter 1; Devisse 1988), as well as analysis of the coins presumed to have been produced from this gold (Messier 1974). The lack of significant archaeological evidence of gold within the trans-Saharan system has however been a major impediment to improving understanding of the gold trade, and consequently the finds from Essouk-Tadmekka provide very important new data.

During the medieval period in West Africa there would have existed a range of gold processing workshops, both at the capitals of the gold trading states, such as Ghana and Mali, as well as at other trading centres such as Audaghust and Timbuktu. This much we know from the frequent references of the Arabic authors to the circulation of *dhahab* (Levtzion & Hopkins 2000: index (474)), worked gold, and the reference to the use of gold jewellery and regalia amongst West African elites (*e.g.* Levtzion & Hopkins 2000: 80). There have been some spectacular archaeological finds of finished gold objects (*e.g.* Gronenborn 2011), as well as some important finds of ingots and wire from the site of Tegdaoust (see Devisse 1988 for review of this latter evidence, incl. Plates 14.3, 14.4). More recent finds of small fragments of gold from the site of Gao also show the continued potential to find further evidence (Cissé *et al.* 2013: 14). In previous research in West Africa, however, only one crucible fragment has previously been recovered that was identified as definitely related to gold working, from the site of Tegdaoust (Robert-Chaleix 1989 – this was not subjected to a detailed analysis however; *cf.* Vanacker 1979: 105–6).

The workshop remains recovered from Essouk-Tadmekka provide the basis for certain wider reflections. Firstly, their relationship to the gold coinage reported on by Al-Bakri challenges a long-held belief concerning the lack of conversion of gold into something equating to a fixed currency, it previously having been stated that: "The Arab sources attest that gold existed in wrought form in West Africa; but apparently those in power south of the Sahara, whether Muslim or not, never, even after 1050, turned this gold into coins." (Devisse 1988: 386–387). We have now shown that such a coined form of gold did exist, resulting from the particular trading circumstances pertaining at Essouk-Tadmekka in the early era of the trade. While Essouk-Tadmekka's gold coinage is the first precolonial West African coinage of any metal demonstrated to have existed, there is suggestive evidence from the Arabic geographers' descriptions that this coinage did not exist in a vacuum – these further references to West African produced gold coinages should now be more seriously considered. There are references to the circulation of 'dinars' at the town of Audaghust (Levtzion & Hopkins 2000: 45–9, 81, 90), and in light of the Essouk-Tadmekka evidence certain of the archaeological finds from this trading town might now usefully be reassessed as possible coin moulds (*cf.* Vanacker 1984). There is also historical evidence referring to dinars at other important locations which hosted large groups of Islamic traders, and engaged in continual exchange with coin-based economies across the Sahara, including Timbuktu (Brown 1896: 825), and Djenné (Brown 1896: 822). While traditional West African monetary systems largely dominated throughout West Africa, it does not seem too surprising that in more than one case the presence of abundant gold and Islamicising influence led to production of coinage. Intriguing evidence for *silver* coinage from Kanem and 'Takrur' should also be noted, as should the silver coins recovered during the excavations at Essouk-Tadmekka (discussed in Chapter 17 and below).

The Essouk-Tadmekka gold evidence also provides some basis for rethinking early gold suppliers and gold sources. When considering the early suppliers of gold, we have tended to think of the Empire of Ghana, on the far west of the trans-Saharan system. In the very earliest period of the Arabic records however the state which is singled out as the most important in West Africa is Gao (Levtzion & Hopkins 2000: 21), but we have tended to think of Gao more as a source of slaves or ivory. As Tadmekka is commonly considered to have supplied Gao with North African trade goods, the recovery of significant gold at Essouk-Tadmekka asks us now to at least consider that this gold was supplied by Gao from a mine within its vicinity. Bambuk and Buré (Fig. 2.3) in the west, associated with Ghana and then Mali, are the most commonly discussed goldfields (Devisse 1988), yet recent discussions have raised attention to the existence of other gold fields, most notably Sirba, roughly south of Gao (Devisse 1993; Vernet 1996: 325; Magnavita 2009). The gold we have evidenced is also important for its very high purity, indicating Tadmekka's access to a very valuable resource. Medieval geographies describe sourcing of high-quality gold from soils and streams in West Africa (Levtzion & Hopkins 2000), and these sources are fairly widespread even today. It is quite possible the Essouk-Tadmekka gold relates to such sources, and we should consider that there might have been a fairly wide range of smaller gold sources exploited early on in the trade – even if these possibly became depleted relatively rapidly through intensive exploitation.

We have already discussed how the Essouk-Tadmekka evidence as a whole highlights the importance of the trade route it sat upon, linking Wargla in the north with the sub-Saharan kingdoms, and it is now also clear that gold was clearly part of the importance of this route, not simply slaves and ivory. When highlighting the importance of this trade route within the gold trade, it is important to discuss a dynasty we have never found gold dinars for: the Ibadi. Importantly the route from Tadmekka ran directly to Wargla, the main trade centre of the Ibadi in North Africa (Fig. 2.3), and it is the Ibadi who are consistently linked to the early gold trade on this route within Arabic historical sources (see App. A *'Ibadi extracts'*). The Essouk-Tadmekka evidence now shows that the Ibadi had access to a highly pure gold and that they were shipping this across the Sahara in large quantities. While we have consistently lacked evidence of an Ibadi coinage, in actual fact the Tadmekka coinage was likely as much an Ibadi creation as anything else. We have not thought previously however that an Ibadi coinage might have been produced south of the desert rather than in the political centre of Wargla in the north, nor have we considered that they were producing a blank coinage. The Essouk-Tadmekka evidence therefore serves not only to bring the Ibadi back into the picture but it also asks us to think differently about the whole early Ibadi gold trading network, bringing some veracity to often neglected sources such as the unknown 12th century Ibadi author recounting a tale of a Tadmekka merchant some 100 years earlier: *'I saw there marked bags which I can only liken to puppies piled one on another, as full of gold. On each bag was written: "This is God's property. Praise be to God the Lord of the Worlds"'* (see App. A *'Ibadi extracts'*).

The evidence demonstrating Essouk-Tadmekka's access to extremely high purity gold (98% purity being evidenced in three separate artefacts) is also of great importance for reconsidering the known coinages of dynasties in North Africa. Amongst the gold coinages of the North African dynasties that traded with Tadmekka – such as the Aghlabids and the Fatimids – we find many coins of very high (98–99%) purity (Ehrenkreutz 1992; Gondonneau & Guerra 1999). It has often been assumed that this high purity is entirely a result of refining in the mint (*e.g.* Ehrenkreutz 1992), the gold purity evidence recovered previously in West Africa never providing any reason to doubt this. Given our analytical results (>98% purity), it is likely much of this high purity coinage was actually made directly from high quality supergene gold arriving from Essouk-Tadmekka, rather than from gold artificially refined in the mint. It is likely also that highly pure blank Tadmekka coins became a trans-Saharan trade item in their own right, struck on arrival into inscribed coinage in North African mints with little or no reworking. We have seldom considered that a portion of the coin flans used to produce some of the most important and commonly discussed early Islamic coinages in North Africa could have been produced below the Sahara.

While the evidence clearly shows Tadmekka's importance in the early gold trade, as the crucial focal point of the Tunisia to Niger Bend route, there is no evidence for gold trade on this route which can clearly be dated to later than the 11th century. There is definitely an argument to make that with the development of the Almoravids in the 11th century significant changes occurred in the trade networks. The Ibadi seemingly lost their position of power during this new era, and alliances changed in West Africa too, Gao and Ghana appearing to establish links with the Almoravids (Hrbek & Devisse 1988; Messier 2010). There is also the possibility that certain gold sources which were prominent early on ceased to be so productive. All these changes could have added up to a reduced importance for Essouk-Tadmekka within the gold trade. In particular, there is a distinct possibility that the Almoravids brought an end to Tadmekka's coinage as they tried to reduce the importance of competitor coinages to their own. While certainly the lack of historical references to post-11th century gold trade at Tadmekka makes it difficult to argue strongly for a continuation of Essouk-Tadmekka's early flourishing gold trade into later periods, we should also not over-interpret the silences in the historical sources. We do have limited evidence for later silver and base-metal coinage at Essouk-Tadmekka (Chapter 17), but it is not clear if any of these are locally produced. Certainly this at least suggests a continued coinage function within the economy. Essouk-Tadmekka continued and the evidence suggests that significant trade of some form continued. Perhaps it relied solely on slaves and ivory, but we should hold out the strong likelihood that an undocumented significant gold trade continued to move through the site.

Trans-Saharan Commodities and Technologies

"They are opulent wealthy merchants who go into the land of the Sudan with numbers of camels bearing immense sums in red and coloured copper and garments and woollen cloth and turbans and waist-wrappers and different kinds of beads of glass and mother-of-pearl and precious stones and various kinds of spices and perfumes and tools of worked iron. There is not one of them who despatches his slaves and men but has in his caravan 170 or 180 camels, each one loaded".

AL-IDRISI AD 1154, DESCRIBING THE MERCHANTS OF AGHMAT, MOROCCO (LEVTZION & HOPKINS 2000: 128)

In excavating Essouk-Tadmekka one of the priorities was to recover evidence of the material culture which moved along the trade routes alongside gold. Not only did the recovery of these goods provide confirmation of the trading status of the town, they also provided insights into the wider processes of trans-Saharan commodity movement. The early Arabic records provide us with a range of descriptions concerning the commodities traded across the Sahara (Levtzion & Hopkins 2000), but while these descriptions are in some ways detailed, at the same time they offer only a hint of the nature of the goods traded and the ways in which this changed over time and space. Accordingly, archaeology provides the means to complement the Arabic geographical descriptions with hard evidence. In addition to providing insights into the goods which moved, the Essouk-Tadmekka evidence demonstrates the potential of excavated materials to provide us with insights into developing technological knowledge within the trans-Saharan system, this knowledge itself often being a result of trans-Saharan exchange. Together these findings provide crucial understanding of material culture consumption and production in the trans-Saharan network, and of the wider developing artistic and technological history of the regions connected by this network.

The Essouk-Tadmekka excavations firstly provided the basis for augmenting our understanding of the range of goods moving from North to West Africa. Amongst the goods we recorded were vessel glass, glass beads, glazed ceramics, cowrie shells, textiles, silver, and copper alloys. There was also evidence of other potential northern imports, including coral, wheat, semi-precious stone, crucible steel, and horses. Inevitably this does not provide a full account of the goods which moved – both the limited excavation sample and the vagaries of preservation mean we are only seeing a small sample of the types of products which moved through the site. In addition to augmenting our understanding of the types of products traded, the recording of the Essouk-Tadmekka corpus of materials provides us with a new point on the map where we can look at the changing process of import and consumption, comparing this with the record from other trans-Saharan sites. While we have already provided a detailed discussion of the various artefact categories recovered within individual chapters – and while a more extensive synthetic treatment lies beyond the scope of this book – there are certain finds which deserve to be highlighted.

While most of the trans-Saharan imports recovered appear to have come from North Africa or the wider Mediterranean world, it is important to highlight the evidence of goods which have come from further afield. Cowrie shells (Chapter 18) have long been a recognised import with an origin from networks beyond North Africa, coming from the Indian Ocean. Other than these, the archaeological recovery of artefacts with a more distant origin is rare. The two standout finds we recorded in this category were the porcelain from China (Chapter 12), and silk (Chapter 18), either from China or Central Asia. Other evidence recorded includes the copper alloys, potentially including specimens whose metal has an ultimate origin in European mines (App. K). Also, the crucible steel assemblage we recovered might possibly include remains of ingots with a Central Asian origin, though most likely the remains recovered all relate to on-site production of crucible steel (see below). These forms of evidence allow us to chart the wider resource networks which brought goods to West Africa. In addition, what is important about this category of evidence is that it shows us that trans-Saharan commodities included goods which already had a high value prior to their shipment from North Africa, in this case a result of the investment expended on importing these goods from Asia or Europe.

In addition to indicating trans-Saharan links to trade networks beyond North Africa, the textile finds represent a hugely important category of evidence. Textiles are consistently referred to within Arabic sources as a very important trans-Saharan trade import (see refs. in Chapter 18 and App. L), both in terms of their proportion within trade caravans, and in terms of the value of these as a commodity. Their importance is additionally indicated by the fact that they are described in some West African contexts as a unit of currency (Levtzion & Hopkins 2000: 260). The archaeological recovery of textile evidence in West Africa is very rare (see App. L), but what the Essouk-Tadmekka evidence shows is that even very small finds can significantly improve our understanding of this trade. The archaeological recovery of silk is unprecedented at a trans-Saharan site and confirms the movement of this textile type reported within early Arabic sources (see App. L). Our recovery of two items featuring silk also raises the prospect that this was quite an important import type into West Africa. One of the textile fragments is also principally composed of a material that is as yet unidentified, but which might relate to a fabric type described within early Arabic sources but not clearly understood, namely 'gauze' (Chapter 18 and App. L). In addition to supplementing our understanding of the types of textiles traded, this material evidence of the textile trade also provides an important reminder of how our discussion of the commodities traded tends to be skewed towards goods which are far more easily recovered archaeologically due to their durability, including vessel glass, beads, and glazed ceramics. While recovery of textile fragments is rare, the work of MAGNAVITA *et al.* (2002: 38) at Kissi shows the potential there is for finding traces of textiles within metal corrosion layers – as only tiny fragments are needed to identify textile type, this offers a potentially hugely productive avenue for augmenting our understanding of this essential trans-Saharan commodity.

A truly standout finding was the recovery of silver coins (Chapter 17). While only six were recovered during the excavations, almost certainly this is a small representation of a wider occurrence at the site. While we are currently unsure if these silver coins were imported to Essouk-Tadmekka as finished coins or produced from imported raw silver, it is important to stress that there are no silver sources in West Africa. Silver therefore truly represents an exotic precious metal in a West African context. While silver coins are reported within the Arabic sources in the 14th century at Kanim (LEVTZION & HOPKINS 2000: 260), and in the 15th century there are records of silver coins from 'Takrur' in Egypt (BACHARACH 1967: 111, 224), no examples of silver coins have previously been found in West Africa. Silver has however been found previously in the form of a silver chain at Tegdaoust (DEVISSE 1988: 405). In view of the finding of the silver coins at Essouk-Tadmekka, it does now also seem likely that the Arabic historical records of these at Kanim are also reporting on a reality, as well as the 15th century 'Takrur' silver coins described in Egypt. The import of silver to West Africa to serve as a money form adds a further important dimension to the history of medieval West African money. How important silver was is currently unclear, but certainly this should open our eyes to the existence of a potentially important sub-field within the story of early metals circulation in West Africa. Likewise, it would be interesting to see whether there is a continuum between the medieval use of silver and the use of silver documented in West Africa in historic times, including amongst the Tuareg.

In terms of trade goods moving from West to North Africa, we have already discussed above the evidence for gold. Beyond this, we also tried to identify other material culture moving northwards along the trade routes. While slaves and ivory are commonly identified as the core products shipped northwards across the desert alongside gold, evidence of these is rarely detected archaeologically. We also know from historical sources that a range of other products moved alongside these core products. It is unfortunate for archaeology however that a lot of the other goods which were transported were organic materials which do not preserve well, such as skins and feathers, or amber and civet cats (see *e.g.* Leo Africanus' 16th century description referred to in LYDON 2009: 88–89). Nevertheless, at Essouk-Tadmekka one form of material culture which had moved from further south in West Africa was able to be identified, namely pottery, of which we recovered large quantities (Chapter 12). It is perhaps surprising to us that bulky, fragile West African pottery was moving along the Sahara routes – given however that we accept the arrival of pottery from North Africa, on reflection this should not be so surprising. This evidence not only alerts us to the movement of a trans-Saharan commodity we have little reflected on – West African pottery – but also potentially signals the contents the pots contained. We have also discussed other possible goods that moved to the site from further south. For instance, we have hypothesised that bloomery iron was imported from further south in West Africa to be converted into crucible steel at Essouk-Tadmekka (Chapter 16). Likewise, the evidence we see for cotton very likely relates to raw cotton, imported to the site for weaving (see Chapter 21). While we are documenting here the movement of commodities which were consumed at Essouk-Tadmekka rather than goods which went further across the Sahara, this in itself is important – this is showing us how products moved along stages of the trans-Saharan routes, not necessarily the entire trans-Saharan journey, as well as demonstrating how the trans-Saharan routes were also serving local economies. Indeed, this dynamic is also seen in the far more important trade in salt, traded against gold at the southern Saharan centres, and then shipped south to sub-Saharan districts such as Gao (see *e.g.* LOVEJOY 1986: chp. 1). While the salt trade is something which is extremely unlikely to be documented archaeologically, the documentation of the other goods which were traded in a similar way represents a very important diversification of our ideas of how the trans-Saharan routes operated.

In addition to the movement of finished objects and raw materials, the Essouk-Tadmekka evidence also provided insight into a range of technological knowledge. One crucial area we provided insight into was gold processing technology (Chapter 15). Firstly, we evidenced the presence of a very distinctive gold coin production technology, in the form of ceramic coin moulds. The fact that these relate very closely to a known coin production technology previously recorded within Europe and Asia, including from earlier periods, does suggest that this technology was imported into the trans-Saharan network. While this is a useful working hypothesis, we should also keep open the possibility that this technology was locally invented, particularly given that this is a technology form which is relatively basic and could simply be a logical form of technology for the conversion of gold into coin blanks. Alongside this we saw the far more unusual technology of crucible extraction of gold impurities, using a glass flux. This technology is totally without archaeological precedent anywhere in the world. While this technology could have been more commonly occurring that archaeological evidence has so far demonstrated – and therefore potentially also have moved to West Africa along the trans-Saharan routes – this does distinctly appear as a locally invented technology, using imported knowledge of glass fluxes, but adapting this to a local need and using locally available materials.

The recording of the use of glass to process gold raises another question concerning the development of glass working in West Africa. Early evidence for primary glass production in West Africa is now well-established, from early 2nd millennium AD contexts in Nigeria (Lankton *et al.* 2006). What is important about the Essouk-Tadmekka evidence is that it relates to another glass industry of which we know very little regarding its origins: powder-glass bead production. While the crushing of glass and its reworking is certainly a relatively simple technological step to take – and therefore likely developed locally in many different contexts – the association at Essouk-Tadmekka between a specific technology of gold working and the use of crushed glass raises a distinct question concerning the origins of the powder-glass bead industry in West Africa. The reason for this is that the moulds documented historically in the production of powder-glass beads (Francis 1993) have an almost identical form to the moulds used to produce the gold coins at Essouk-Tadmekka. Without the cross-over between glass and gold processing observed at Tadmekka the similar form of these moulds already raises a strong hypothesis regarding the influence of one technology on the other – but the evidence for crushing and reheating of glass alongside this mould technology raises a very strong hypothesis indeed that powder-glass bead industries were influenced by gold working technologies. Interestingly, it is also important to observe that the Essouk-Tadmekka glass-processing evidence relates to exactly the same period as the early evidence of primary glass production from Nigeria.

Another hugely important technology evidenced was that of crucible steel making (Chapter 16). Crucible steel production is most closely associated with Central Asia, this having long been the earliest recognised centre of this technology, from around the 10th–11th centuries AD. The evidence for crucible steel technology from Essouk-Tadmekka from a very similar period now also establishes another early centre of this technology. While we cannot be certain that there is a link between these Central Asian and West African centres of this technology, the fact that we see the evidence of this very complex process at these two locations an almost identical period suggests a process of technological diffusion between these places. Given the well-recognised high level production of crucible steel in Central Asia, the assumption would be that this technology travelled to Essouk-Tadmekka from there, with either a merchant or an itinerant craftsman. Again, however, this assumption should not remain totally unchallenged. The occurrence of this technology in the southern Sahara at this period is hugely important, particularly as steel provided a new technology of warfare in the form of steel swords, related most particularly to the Almoravid army (Levtzion & Hopkins 2000: 164–65). We now know that the technology for the production of these swords was available locally.

Conclusion

Essouk-Tadmekka has long been known as an important place within early trans-Saharan networks, principally through the records of early Arabic geographers, including most importantly Al-Bakri's record of the town and its flourishing trade in the 11th century. While never previously excavated, Essouk-Tadmekka's ruins have long intrigued researchers, not only due to the extensive remains of stone structures across the site, but also the numerous Arabic inscriptions found in its cemeteries and surrounding cliffs. The results of the first archaeological investigation of these ruins presented here have now added a new dimension to our knowledge of this important locality, helping to reconstruct the material world and history of the flourishing town recorded by Al-Bakri and other authors, as well as contributing to our understanding of the wider trans-Saharan world it formed a part of.

The evidence recovered from Essouk-Tadmekka clearly shows why it was described by Al-Bakri as one of the best-built towns in West Africa, and noted by other authors for centuries as an important place within the trans-Saharan landscape. The most alluring aspect of Tadmekka within the historical records is undoubtedly the description of its pure gold coinage, and the excavated evidence now for the first time provides material proof of this coinage. Al-Bakri's description of Tadmekka's gold coinage would have made Essouk-Tadmekka hugely attractive as a place of trade, as indeed would the coins themselves traded across the Saharan routes. The excavations also show the rich evidence of traded products from North Africa and beyond that these pure gold coins – as well as other sub-Saharan products – were exchanged against: glazed ceramics, glass vessels, silver coins, brass, and textiles were some of the goods which once circulated in its markets that we find traces of at the site. The surface studies and excavations also recorded the various forms of the urban structure of the town which developed over a period of around 500 years to cater to this trade – an urban landscape including mosques, commercial premises, workshops, and caravanserai. Insights are also provided into other aspects of the lives of the inhabitants of the town, including local craft traditions, and diet, as well as the industries which formed part of this flourishing urban centre, including of gold, steel, copper and glass.

Crucially, also, we gain a sense of the place of Islam at Essouk-Tadmekka, something which the town came to be associated with as much as trade. The translation of Tadmekka's name as "resemblance to Mecca" is perhaps the most direct example of a desire to project and convert the early West African landscape into an Islamic world. Al-Bakri's description of Tadmekka as "resembling Mecca" provides some sense of how this naming related to the physical environment of Essouk-Tadmekka, and thanks to the recording of an inscription at the site proclaiming how "a market will remain in conformity to Mecca" we are also able to understand more clearly how this concept was truly a fundamental part of the developing local Muslim identity. This inscription was part of a wider religious geography of Islam at Essouk-Tadmekka, including various other inscriptions and Muslim cemeteries, and religious buildings. The town would then clearly have offered a relatively familiar environment for traders making their way across the harsh Saharan camel caravan routes, both as an urban centre and as a place of Islam.

Through the powerful combination of functioning as both trade entrepôt and Islamic centre, Essouk-Tadmekka would have become a crucial element in the mental map of West Africa in the early phase of this region's integration into the medieval world trade network. In time more famous icons of the trans-Saharan trade would develop, including the legendary town of Timbuktu, and the gold-rich Malian emperor Mansa Musa (depicted in the AD 1375 Catalan Atlas holding a nugget of gold) – but in the early era of the trade, Tadmekka would have been a crucial part of the trans-Saharan vision for merchants and rulers in North Africa, along with the other major early towns of Audaghust and Kawar. Beyond its importance in terms of North African perceptions, Essouk-Tadmekka also obviously occupied a crucial role within the regional landscape of the southern Sahara, certainly as an urban and economic focal point, but perhaps more importantly as an Islamic centre, this latter importance continuing to resonate into the contemporary era.

As we have shown, the reconstruction of life in this important southern Saharan early Islamic town provides the platform from which to approach broader issues within trans-Saharan debates, including contributing to our understanding of the formation of the earliest Islamic trade routes across the Sahara, showing how the town was a central place for the negotiation of Islamic religion and culture in West Africa, as well also as showing the central importance of Tadmekka within the early world of the Tuareg. We also showed how the evidence from Essouk-Tadmekka provided new insights into the movement of trans-Saharan commodities, most crucially gold, but also the trade in other commodities from north and south, such as textiles, silver, and West African pottery. Additionally, the evidence

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provided many insights into the development of technologies of great importance within West African history, including gold working and crucible steel technology. As we consider the wider landscape of archaeological investigation of the trans-Saharan towns – including at places such as Tegdaoust, Gao, Koumbi Saleh, and Sijilmasa – we can see the great further potential these places have for recreating this crucial phase in African and global medieval history. The potential for future exploration at other points of the trans-Saharan map is also huge, with such major sites as Timbuktu, Kawar, Walata, Chinguetti, and Wargla almost entirely un-investigated.

When the opportunity comes for further work at Essouk-Tadmekka there is huge potential both for survey and excavation. Survey around the site would inevitably show up further remains, likely including market locations. Excavation in the various zones of the site remaining unexplored would allow the refining of the sequence, including that relating to the earliest occupation of the town. Wider investigation within and around the valley would also provide the potential for the identification and investigation of pre-Islamic archaeological remains. An obvious and important next stage would be the excavation of complete building complexes, including those buildings on the surface which our study has shown to date to an early period of the site's occupation. Naturally, excavation at depth represents a challenge – but at the same time the wealth of excellently preserved remains over at least six metres of deposits should be seen as a great opportunity for further work. Further focus on the gold workshop remains detected would be vital, as well as further recovery and investigation of other crucial artefact assemblages, including the silver coins and crucible steel remains. The excellent preservation conditions certainly show the potential to turn up a vast amount of finds, both of imported materials and local products, all with their stories to tell about trade and life within the Essouk-Tadmekka valley.

One certainly cannot ignore the current political and cultural climate in northern Mali and the Saharan Muslim world more widely. While this threatens the site and future work there, the cultural heritage dialogues and events that have developed around the site in recent years show this town and its remains continue to occupy a crucial role within the mental landscape of this area of the Sahara. Essouk-Tadmekka is associated not only with medieval era trade, but also with mystical Islam, as well as Tuareg myth and legend – these multiple roles and histories can provide the basis for inspirational stories to challenge and stimulate action within the modern world.

Appendices

APPENDIX A

Early Arabic Documentary Records of Tadmekka

Sam Nixon

Ibn Hawqal

***Written* ca *AD 967–968* (*Levtzion & Hopkins 2000: 46, 51, 52*)**

That which is beyond him [the ruler of the Maghrib] and situated more deeply in the deserts of Sijilmasa and Awdaghust and the territories of Lamta and Tadmakka towards the south and the territories of Fazzan contains water-points around which are tribes of unheeded Berbers who are unacquainted with cereals (*ta'am*) and have never seen wheat or barley or any other kind of grain. They are for the most part in a state of wretchedness and their dress is a piece of cloth worn sash-wise. Their staple diet is milk and flesh. I shall mention this and describe it again after I have finished mentioning the distance exhaustively, if God wills.

These are the tribes of the pure Sanhaja [list precedes this statement]. As for the Banu Tanamak, the kings of Tadmakka, and the tribes related to them, it is said that they were originally Sudan whose skin and complexion became white because they live close to the North and far from the land of Kawkaw, and that they descend on their mother's side from the progeny of Ham. They are: Handaza, Makita, Kilmata, Inkiriyaghan, Karka, Ilalaghmutan, Katutawa, Sakara, Balaghlagha, Indiman, Hakata, Inkakalan, Istafan, Imakdaran, Ikufan, Inmaziran, Imazwaghan, Kiltamuti, Kilmakzan, Kilfaruk, Fadala, Kilsanadat, Kil Dafar, Banu Bazar, Ifkaran.

Some say, however, that they actually belong to the Sanhaja. Those who attach the Banu Tanamak to the descendants of Ham base themselves on the theory of al-Kindi that the whites, when they breed for seven generations in the land of the Sudan, take on their external appearance and black colour. Also the Sudan, when they procreate in the country of the whites for seven generations, assume their appearance, their white colour and the purity of their complexion. Descent, however, may not be discussed with this kind of argument. Those who deny this origin of the Banu Tanamak affirm that the Banu Tamakizt belong to them.

The supreme kings of Tadmakka in our time are Fusahr b. Alfara and Inaw b. Sabanzak. They are the rulers, who combine leadership with learning, jurisprudence, and political skill, as well as some knowledge of biographies and they are versed in traditions and history. They are Banu Tanamak.

Al-Bakri

***Written AD 1068* (*Levtzion & Hopkins 2000: 84–87*)**

Then you go from there six stages along the Nile to the town of Tiraqqa. In the market of that town the people of Ghana and Tadmakka assemble.

From Tiraqqa the Nile turns towards the south into the land of the Sudan, and you go along it for about three stages, and then enter the country of the Saghmara, who are a Berber tribe living in the province of Tadmakka.On the opposite bank is the town of Kawkaw, which belongs to the Sudan. A description of this town and the neighbouring ones will be given in another place, if God wills.

From Ghana to Tadmakka is the distance of 50 days' journey on the high road (*jadda*).

From Bughrat you go to Tiraqqa and from there across the desert plain to Tadmakka, which of all the towns in the world is the one that resembles Mecca the most. Its name means "the Mecca-like". It is a large town amidst mountains and ravines and is better built than Ghana or Kawkaw. The inhabitants of Tadmakka are Muslim Berbers who veil themselves as the Berbers of the desert do. They live on meat and milk as well as on a grain which the earth produces without being tilled. Sorghum and other grains are imported for them from the land of the Sudan. They wear clothes of cotton, nuli, and other robes dyed red. Their king wears a red turban, yellow shirt, and blue trousers. Their dinars are called "bald" because they are of pure gold without any stamp. Their women are of perfect beauty, unequalled among people of any other country, but adultery is allowed among them. They fall upon any merchant [disputing as to] which of them shall take him to her house.

If you want to go from Tadmakka to Qayrawan you go through the desert for 50 days to Wargalan. (…) From Tadmakka to Ghadamis is 40 stages over the desert, water being found every two or three days in *ahsa*.

Another road from Tadmakka to Ghadamis: you go from Tadmakka for six days over the country inhabited by the Saghmara and then through the waterless waste for four days before attaining water, and then through another waterless region also for four days.

Between Tadmakka and the town of Kawkaw is a distance of nine stages. (…) The people of the region of Kawkaw trade with

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salt which serves as their currency. This salt is obtained from an underground mine at Tutak, in Berber country, and transported to Tadmakka and thence to Kawkaw. Between Tadmakka and Tutak is a distance of six stages.

Ibadi Extracts

Written 11th–12th centuries AD but referring to events which took place in the 10th–11th centuries (*Levtzion & Hopkins 2000: 89–91*)

Abu 'l-Rabi' Sulayman b. 'Umar related that Abu Salih [al-Yajrani] drove some camels of his from the Qibla [south] to sell them in Warjalan. A man of Warjalan bought one of them and asked the price. He replied: "The price of your camel at Tadmakkat." So Abu Salih got ready to travel with him to Tadmakkat and took a camel to ride. Another man asked him: "Carry for me on your camel a load of cloth." Abu Salih agreed and said to him: "How much shall I sell your load for?" He replied: "For so much." The shaykh [Abu Salih] arrived at Tadmakkat and bargained over the load. The price he could get fell a little (about ¾ of a *qirat*) short of the price prescribed by the man so he did not sell it but returned to Warjalan with it. We never heard of a load brought back from Tadmakkat to Warjalan except this one. Praise be to God the Lord of the Worlds.

Three *shaykhs*, Abu 'Amr ['Uthman b. Khalifa al-Sufi], Abu Nuh [Salih b. Ibrahim b. Yusuf al-Mazati] and Abu 'l-Rabi [Sulayman b. 'Abd al-Salam al-Wisyani] (may God have mercy upon them), recount that a man of the B.Wisyan named Tamli was mean (*muqill*) in his early years. (…) He belonged to the people of the Qusur. (…) He began to travel to Tadmakkat where he attained great wealth … He began to send from Tadmakkat every year sixteen bags, each bag containing 500 dinars. These bags were of cowhide and on each of them was written "This is God's property." He used to send them to Abu Imran Musa b. Sudrinm the father of Harun al-Hami al-Wisyani (may God have mercy on him) for him to distribute among his dependants (*ahl wilayatihi*) [in the Jarid] until Abu 'Imran wrote saying: "God's property is much but your dependants are no longer in need" [or "your dependants are few"]. So Tamli wrote to him: "Give of it to such of the *ahl al-da'wa* as you know to be free of major sin".

I took this account from the *shaykh* Abu Khazar without questioning anybody about it.

The *shaykhs* said that Abu Nuh Sa'id b. Yakhlaf (but Abu Nuh [Salih] said that it was his father Yakhlaf b. Tamaskwit al-Maduni) travelled to Tadmakkat until he arrived at Tamli's house. Tamli admitted him into his treasure houses saying: "If you take God's property (meaning the *zakah*) I will make you and your descendants rich." The shaykh [Abu Nuh] replied: "No." So Tamli said: "You have never known me to be generous" and gave him a dinar. The *shaykh* returned. He used to recount of his treasure houses: "I saw there marked bags which I can only liken to puppies piled one on another, as full of gold. On each bag was written: "This is God's property. Praise be to God the Lord of the Worlds"".

Abu 'Amr ['Uthman] recounted in the authority of the *shaykh* Yakhlaftan b. Ayyub al-Nafusi al-Masannani that the *shaykh* Abu Nuh the Lesser was known to have 40 horses. He had a thoroughbred horse on which he made the Pilgrimage and on which he travelled to Tadmakkat. It was worth 150 dinars.

[Incidental to events in J.Nafusa in the fifth/eleventh century is mention of] a man who at that time was at Tadmakkat.

Al-Zuhri

Written ca *AD 1150* (*Levtzion & Hopkins 2000: 98–99*)

Near to Ghana at a distance of fifteen days' travelling there are two towns, of which one is called NSLA and the second Tadimakka [*sic*]. Between these two towns is a distance of nine days' travelling. The people of these two towns turned Muslim seven years after the people of Ghana turned Muslim. There had been much warfare between them. The people of Ghana sought the help of the Almoravids. The people of Tadimakka make raids on the land of the Barbara, a tribe of Janawa. The Barbara, in their own opinion, are the most noble and aristocratic of men. This is because the *amir* of Ghana is related to them and used to be one of them. Every *amir* in the land of Janawa acknowledges their nobility except the Muslims, since the highest nobility belongs to those who believe in God and His Prophet and the Last Day.

The people of Barbara are pagans, so the people of Sila and Tadimakka make raids on them and seize any whom they can find. They live in the middle of the desert, neither to the east nor to the west.

About twenty *farsakhs* to the east of Ghana is the town of Zafun. This is the nearest of the desert towns to Waraqlan and Sijilmasa. Between these two towns the Almoravids live. These people accepted Islam when the people of Waraqlan did so in the time of Hisham b. 'Abd al-Malik [105/724–125/743]. But [then] they adopted a school which took them outside the Holy Law. They returned to orthodox Islam when the people of Ghana, Tadimakka and Zafun adopted Islam. They are attached to the town of Ghana because it is their capital and the seat of their kingdom.

Kitab al-Istibsar

Written ca *AD 1135* (*Levtzion & Hopkins 2000: 138, 149, 150, 151*)

From Ghadamis one sets off for Tadmakka and other cities of the land of the Sudan.

If you travel from Ghana towards the east you will travel through much country inhabited by Sudan and among nomadic Berber tribes who are Muslims. You will travel many stages up the Nil to the town of Tiraqqa, which is a big town, having populous markets where many nations gather from divers lands such as the land of Ghana and Tadmakka and others.

Near to Tiraqqa towards the west is the city of Tadmakka. It is a large city between mountains and ravines and of all towns is the one that resembles Mecca (may God ennoble it!) the most. The meaning of *tad* with them is "appearance" (*hay'a*): the appearance of Mecca. Its people are Muslim Berbers who wander about as the Berbers of the desert do. They live on meat and milk and have no wheat or barley. They have a grain which the earth produces without being tilled and resembles sorghum. They wear clothes of dyed cotton. The king wears coloured clothes; his turban may be red, his shirt yellow and his trousers blue, and the like. Their dinars are called "bald" because they are of pure gold without any stamp. Their women are of perfect beauty, unequalled among people of any other country, but adultery is allowed among them. They meet the merchants who come to their country and quarrel over any handsome man among them as to which shall take him to her house.

Between the city of Tadmakka and Ghana is about 50 stages. Between them there are cities and habitations of the Sudan and the Berbers.

Then from Bughrat to Tiraqqa aforementioned, then to Tadmakka.

If you want the road from Tadmakka to al-Qayrawan you go towards the north and travel through the desert for about 50 days to the town of Wargalan on the edge of the desert neighbouring Ifriqiya.

From Tadmakka there are nine days to the city of Kawkaw.

Ibn Hammad

Written AD 1220 but text refers to late 9th century (*Levtzion & Hopkins 2000: 154*)

Kidad, father of Abu Yazid, lived in Taqyus in the land of Qastiliya. He used to travel to and from the land of the Sudan with the merchants. In Tadmakkat he bought a slave girl called Sabika who became pregnant by him and gave birth to Abu Yazid. He was lame and had a birth mark on his tongue. His father Kidad took him to a diviner (*'arraf*) in the town of Kawkaw. His father showed him to the diviner, who said: "He will become important, and will become a king." Kidad then returned to Taqyus, where he died. [Abu Yazid grew up in Tuzar.]

Yaqut

Written AD 1224 but likely borrowing from the text of Al-Muhallabi (d. *AD 990*) (*Wustenfeld 1866–873: 938*)

[Yaqut refers to the] Kingdom of Tadmak [and its capital] Zakram.

Ibn Sa'id

Written between AD 1269 and 1287 (*Levtzion & Hopkins 2000: 193*)

At the west end of the Luniya mountains, among hills and valleys, is the town of Tadmakka, which is well known to travellers and mentioned in books. Its inhabitants are Muslim Berbers who travel much to trade to the land of the Sudan and owe obedience to the Kanim. The town is situated to the south of the range and to the north of the line of the Second Clime in longitude 44 and some minutes.

Al-Dimashqi

Writing between AD 1256 and 1327 (*Levtzion & Hopkins 2000: 210*)

Also in this desert is Tadamakka, which means "like Mecca". It is so-called from its lying between mountains. Its people live as those whom we have mentioned previously. They all wear the *litham* [face veil], and nothing appears of them except the eyes, but the women have their faces uncovered. A strange thing about the men is that they are unrecognizable when they remove the *litham*.

Also in this desert region is Warqalan, which is at a distance of 50 stages from Tadamakka.

Al-'Umari

Writing ca *AD 1337–8* (*Levtzion & Hopkins 2000: 274*)

In the land of the Sudan there are also three independent white Muslim kings who are Berbers; the sultan of Ahir (Aïr), the sultan of DMWShH, and the sultan of Tadmakka. The three are Muslim kings in the south of the west, between Morocco (the kingdom of the sultan Abu 'l-Hasan), and the country of Mali and its neighbours. Each of them is an independent sovereign; no one of them rules another, but the greatest is the king of Ahir. They are Berbers and dress more or less like the Moroccans in the *durra'a* (except that it is narrower) and turban with chinband. Having no horses, they ride camels. Neither the Marinid sultan nor the ruler of Mali has any authority over them. They live, as desert dwellers do, on meat and milk; grain is scarce with them.

Shaykh Sa'id al-Dukkali told me that he passed through their country on one of his journeys but did not remain long among them as they were short of food.

Zawawi told me that these Berbers possess inhabited mountains which produce many fruits. What is under the control of these three is about half what the king of Mali possesses, or a little more. The latter enjoys a greater income because of his proximity to the land of the infidels, for the place where the gold sprouts is there and he can coerce them. His income is great for this reason and because of the abundance of goods which are sold in his country and what he gains from forays into the land of the infidels. The land of the former, on the contrary, is sterile and they have no opportunity to earn. They make their living principally from their animals.

Ibn Khaldoun

Writing ca *AD 1374–1393/4* (*Levtzion & Hopkins 2000: 336, 338*)

**While Ibn Khaldoun here describes "Takadda" it is now widely accepted that he has confused the cities of Takadda and Tadmekka and is in fact here describing Tadmekka* (*see Levtzion & Hopkins 2000: 425 n.72, n.78*)

[Quoting Abu 'Abd Allah, qadi of Sijilmasa who had settled in West Africa]: "Mari Jata holds the sultan [of Mali] in seclusion and has taken his power exclusively into his own hands. (…) He has subdued the eastern provinces of their country and passed beyond the frontiers of Kawkaw. When he first assumed authority he sent against Takadda (which is in the country of the veil-wearers beyond Kawkaw) detachments which laid siege to it and invested it closely but then let it be. That is their situation at present." (…) "This Takadda is 70 stages from the town of Wargala towards the south-west. Its chief, who is of the wearers of the veil, is known as sultan. The route of the pilgrims of the Sudan passes through his territory. He exchanges gifts and maintains diplomatic relations with the emirs of the Zab and Wargala".

At a distance of twenty stages slightly to the west of south of this city [*i.e.* Wargala] is Takadda, the capital of the veiled men's country and rendezvous for pilgrims of the Sudan. It was founded by veiled men of Sanhaja, who are its inhabitants at the present day. Its ruler is an emir of one of their leading houses and they call him sultan. There are diplomatic relations and exchanges of gifts between him and the emir of the Zab.

In the year 1353, in the days of sultan Abu Inan [of Morocco], I went to Biskara on royal business and there encountered the ambassador of the ruler of Takadda at the residence of Yusuf al-Muzani emir of Biskara. He told me about the prosperous state of this city and the continual passage of wayfarers and said: "This year there passed through our city on the way to Mali a caravan of merchants from the east containing 12,000 camels". Another [informant] has told me that this is a yearly event. This country is subject to the sultan of Mali of the Sudan as is the case at present with the rest of the desert regions known as [the land of] the Mulaththamun.

Al-Maqrizi

Writing ca *AD 1400–1442* (*Levtzion & Hopkins 2000: 354*)

West of the mountains the land of the veiled Berbers extends for 40 stages along the banks of the Nil to the city of Tadmakka. From there to Kawkaw is ten stages and from Kawkaw to Ghana is twenty stages and beyond that is the Ocean.

APPENDIX B

Plans of Essouk-Tadmekka Town Ruins and Cemeteries

Benoit Suzanne

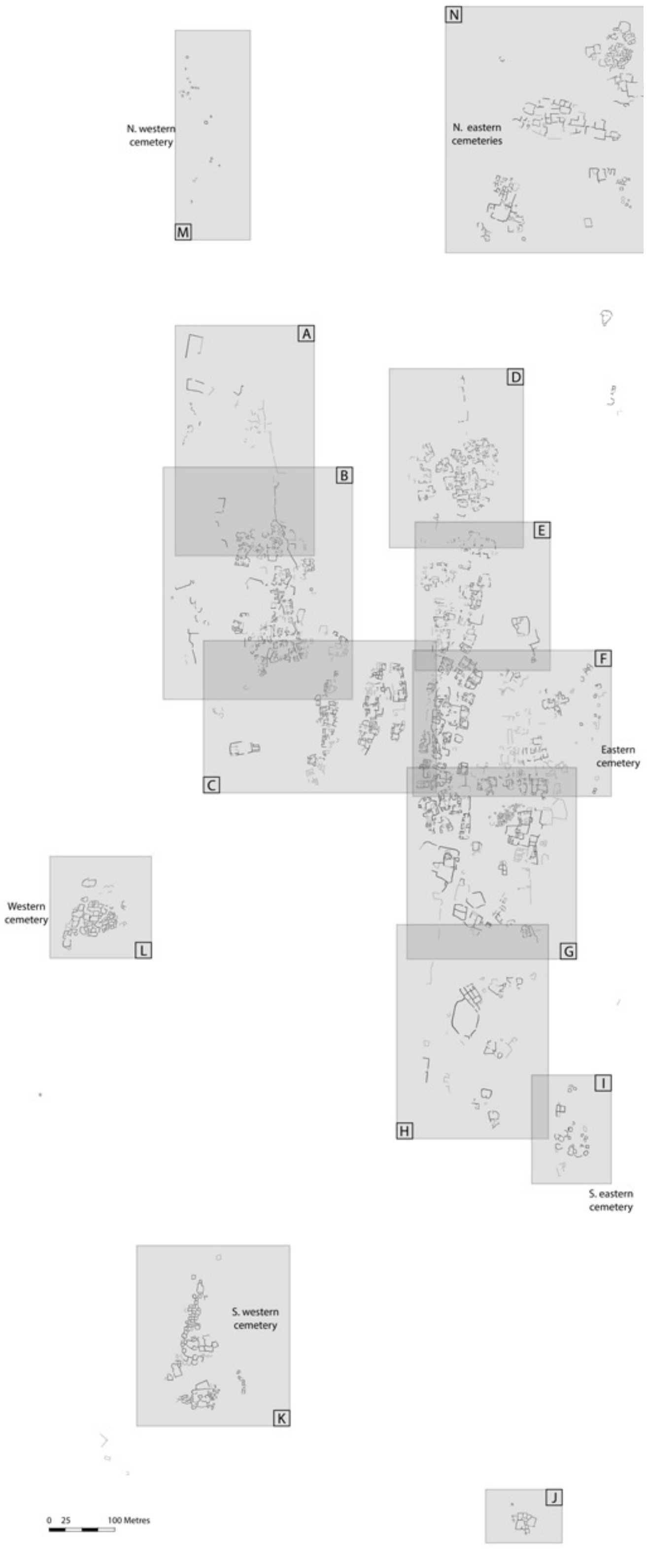

FIGURE B.1
Guide illustration showing location of individual plan sheets (see Plans A–N below) providing detailed illustration of the mapping of different sectors of the Essouk-Tadmekka town ruins and surrounding cemeteries. These plans are developed from EOM *aerial photographs provided by Paulo de Moraes Farias, received from Raymond Mauny (compare also with Figures 4.2, 4.3, 4.4 & 11.2).*

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FIGURE B.2 *Plan A. Plan of selected area of Essouk-Tadmekka town ruins: west of the wadi (northern section).*

FIGURE B.3 *Plan B. Plan of selected area of Essouk-Tadmekka town ruins: west of the wadi (central section).*

FIGURE B.4 *Plan C. Plan of selected area of Essouk-Tadmekka town ruin, showing the island, as well as a portion of the ruins on the west of the wadi (southern section), and a small portion of the ruins on the east of the wadi.*

FIGURE B.5
Plan D. Plan of selected area of Essouk-Tadmekka town ruins: east of the wadi (far northern section).

FIGURE B.6 *Plan E. Plan of selected area of Essouk-Tadmekka town ruins: east of the wadi* (*zone to north of the 'Friday mosque'*).

FIGURE B.7 *Plan F. Plan of selected area of Essouk-Tadmekka town ruins: east of the wadi (central zone – see 'Friday mosque' in top left corner) and eastern cemetery (right side of illustration)..*

FIGURE B.8 *Plan G. Plan of selected area of Essouk-Tadmekka town ruins: east of the wadi (zone surrounding 'southern mosque').*

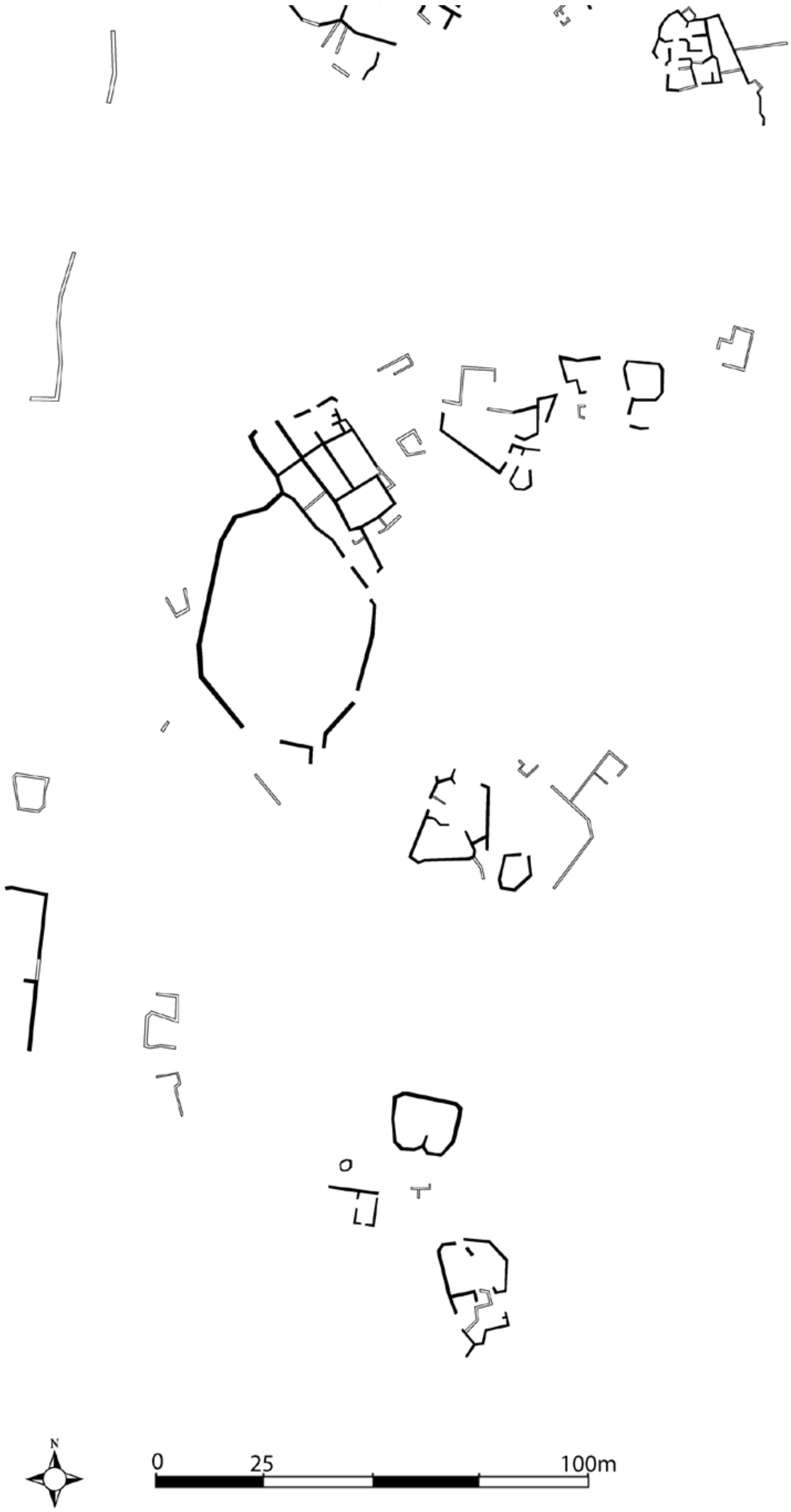

FIGURE B.9 *Plan H. Plan of selected area of Essouk-Tadmekka town ruins: east of the wadi (far southern section).*

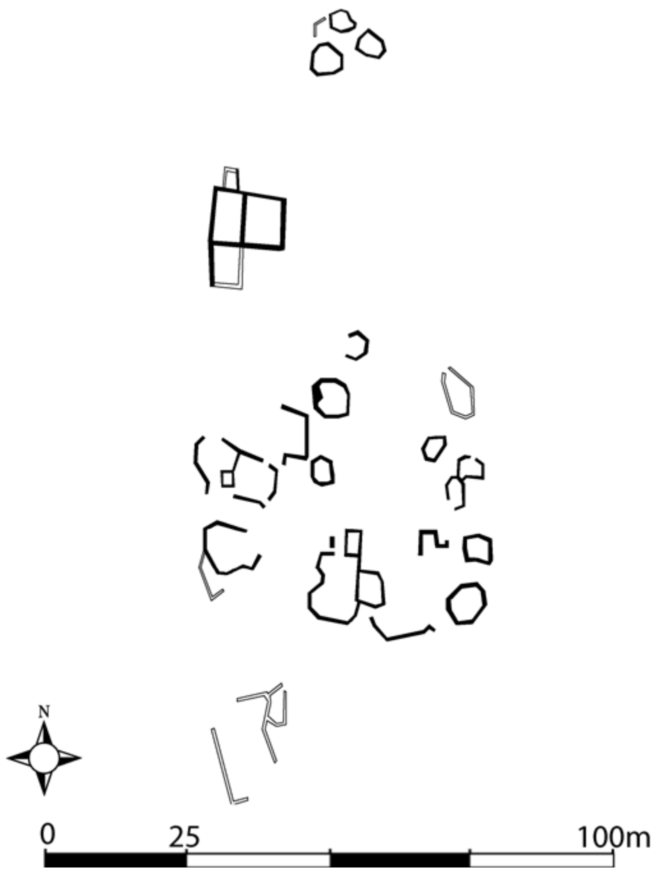

FIGURE B.10
Plan I. Plan of south-eastern cemeteries (northern zone).

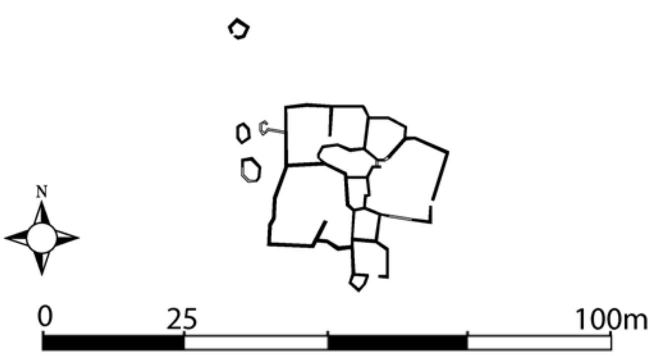

FIGURE B.11
Plan J. Plan of south-eastern cemeteries (southern zone).

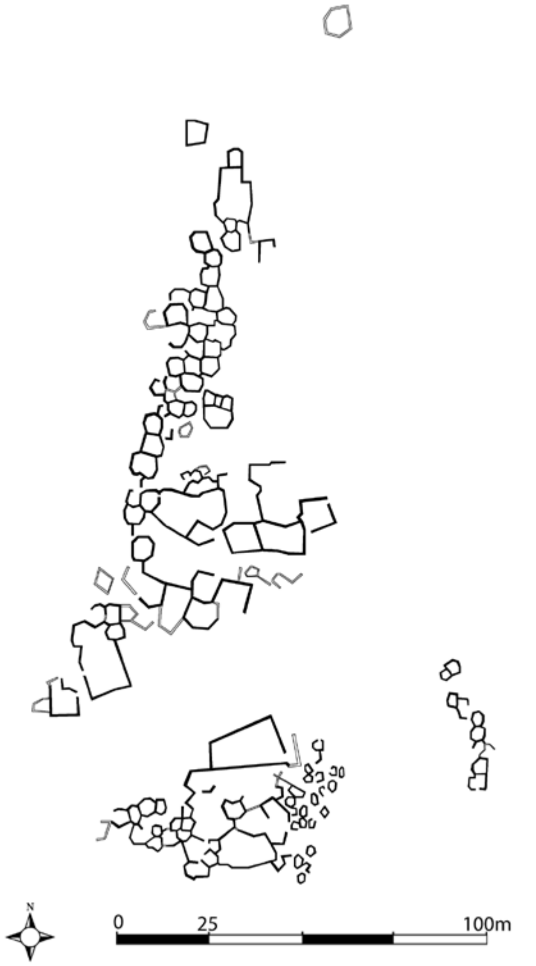

FIGURE B.12 *Plan K. Plan of south-western cemeteries.*

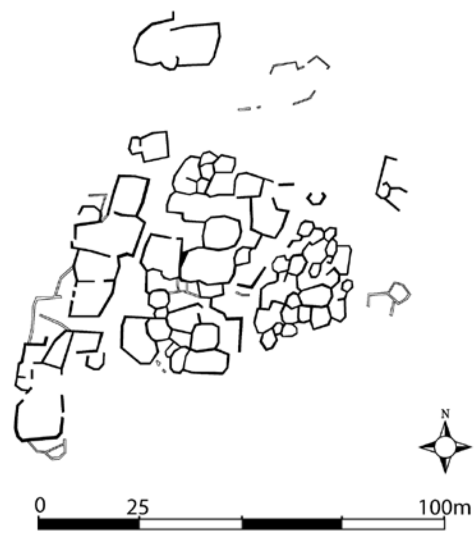

FIGURE B.13 *Plan L. Plan of western cemeteries.*

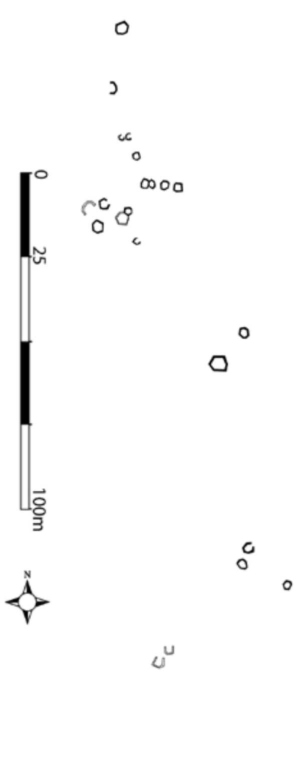

FIGURE B.14
Plan M. Plan of north-western cemeteries.

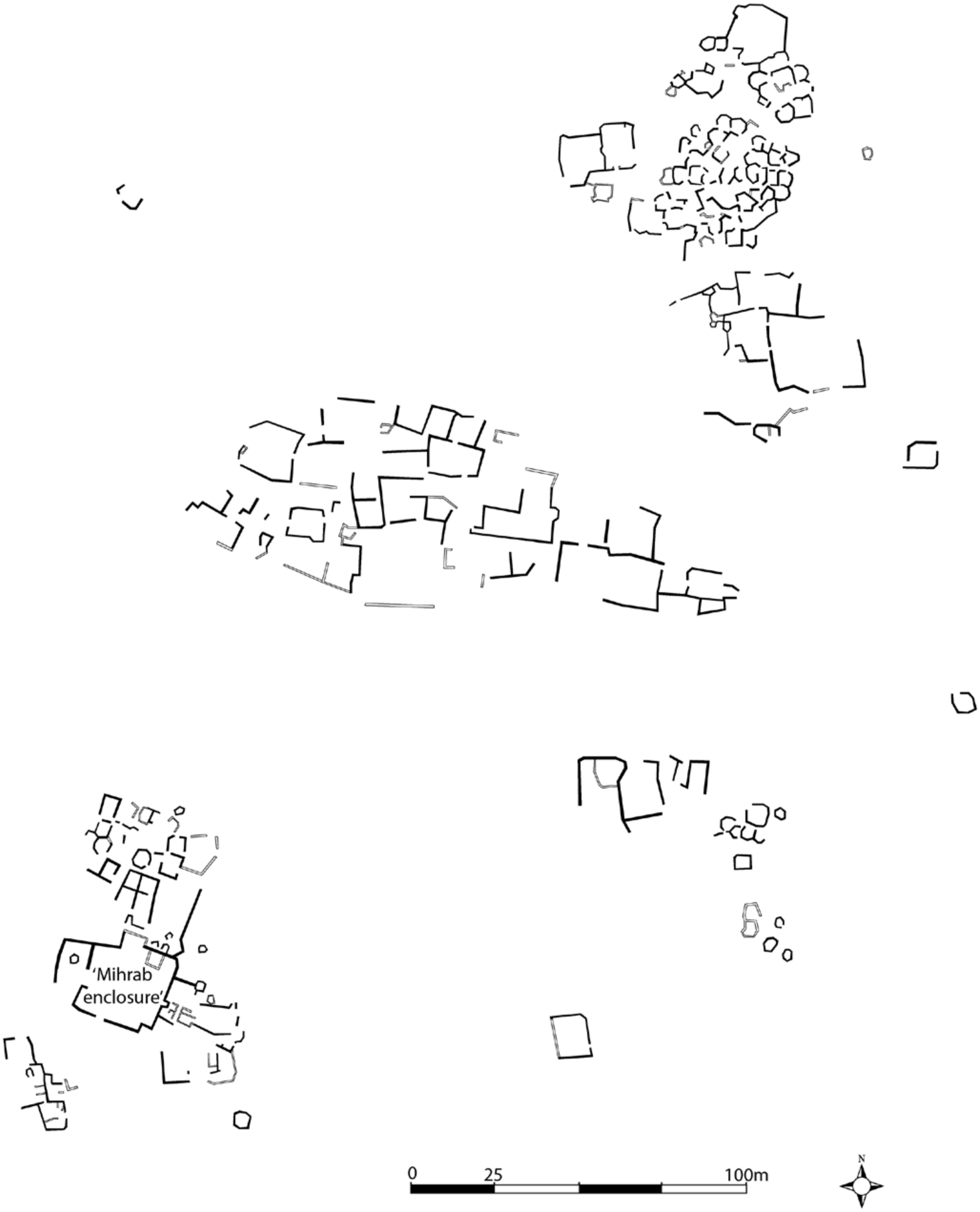

FIGURE B.15 *Plan N. Plan of north-eastern cemeteries.*

Essouk Arabic Non-Funerary Inscriptions, New (Previously Unpublished) Series

Paulo Fernando de Moraes Farias

We publish here some non-funerary Arabic inscriptions from the Essouk valley, which were photographically recorded after the publication of our book on West African early Arabic epigraphy (Moraes Farias 2003). We will call them "Essouk Arabic Non-Funerary Inscriptions, new series", and number them consecutively from nº 1. The expression "new series" will be abbreviated as "n.s."

Section 1. Inscriptions Photographed by Alain Brégy at an Unspecified Cliff Location[1]

This is a cluster of early inscriptions in Essouk ornamental Kufic lettering style, except for Essouk, n.s., nº 3, which is in Sahelian plain Kufic (see Chapter 5). They were engraved over the years very close to one another on three adjoining rock faces (Fig. C.1, Fig. C.2). There is no indication of scale in the photos. The lines of writing are so tightly clustered that it is at first difficult to distinguish one inscription from another. A degree of rock erosion compounds the difficulty. The cluster includes approximately 10 inscriptions, but some of them are vestigial, and others are too eroded to be read. However, four long inscriptions are readable, three of which contain early dates: 401 H / AD 1011 (Essouk, n.s., nº 1), 435 H / AD 1043–1044 (Essouk, n.s., nº 2), and 438 H / AD 1046–1047 (Essouk, n.s., nº 3). The first of these inscriptions is now the oldest internally dated piece of writing ever reported from West Africa.

The inscriptions are unpointed, and of considerable palaeographic interest, in particular because of the occurrence of open shapes of the letter *ʿayn* (inscriptions nº 1 and nº 2), and elaborate shapes of the letter *dāl* (which becomes very similar to the letter *kāf*), and of the letter *hāʾ* in "Allāh". To place the lettering style, vocabulary, spelling, and grammar of these inscriptions (and the others in this appendix) in the context of early Sahelian epigraphy see Moraes Farias 2003 (clxxxix, cci, cciii, ccxxvi, ccxxix–ccxxxv).

1 Alain Brégy organised some years ago the website KIDAL-INFO, bringing together information about Tuāreg history and culture. During a visit to the Essouk valley in January 2004, he photographed the inscription cluster reproduced here (Fig. C.1, Fig. C.2). He kindly made the photos available to me (attached to an e-mail dated 15 September 2004).

It should also be noted that at least two other rocks nearby also appear to feature inscriptions, observable in the background of Figure C.1 shown here (see small portions of rocks in top right and middle right). No other images of these other apparent inscriptions are available but almost certainly these other inscriptions have not been previously recorded.

Inscription Essouk, n.s., nº 1 (*Fig. C.2*)

(the five lines below the top three lines on the bottom-left rock face, and occupying approximately the central and left thirds of it).

Transcription:

وَكَتَبَهُ مُحَمَّدِين ابْنُ الْحَسَنِ
وَ هُوَ يَشْهَدُ أَنْ لاَ إِلَهَ
إِلاَّ اللهُ وَ أَنَّ مُحَمَّدًا عَبْدُهُ وَ رَسُولُهُ
كُتِبَ يَوْمَ الْخَمِيسِ فِي رَجَبٍ
سَنَةَ ارْبَعِ مِائَةٍ وَ وَأَحِدٍ

Translation:
"Muḥammadīn son of [or: descendant of] Al-Ḥasan wrote this,
and he professes that there is no god
but God, and that Muḥammad is His servant and His messenger.
This was written on [a] Thursday in [the month of] Rajab,
in the year 400 and 1".
[07-401 H / the period from 08 February to 09 March 1011 AD]

(*The three lines above this inscription, and the six below it, contain some vestigial inscriptions, which began with the introductory form "It was written by" followed by names. They are not readable).

Inscription Essouk, n.s., nº 2 (*Fig. C.2*)

(the ten lines occupying approximately the right third of the bottom-left rock face).

Transcription:

وَكَتَبَ مُحَمَّدُ
بْنُ عَبْدِ اللهِ

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بْنِ [.........]
وَهُوَ يَشْهَدُ
[...........] إِلاَّ
اللّٰهُ [...] مُحَمَّدًا
رَسُولُهُ كُتِبَ
الْجُمُعَةَ فِي
سَنَةِ خَمْسَةٍ وَثَلاَثِينَ
وَ ارْبَعِ مِائَةٍ

Translation:
"[This was] written by Muḥammad
son of ʿAbd Allāh
son of [...........],
and he professes that
[.................] but
God [..........] Muḥammad is
His messenger. This was written
On [a] Friday in
The year 5 and 30
and 4 hundred".
[435 H / 16 August 1043 AD to 28 July 1044 AD]

***Inscription Essouk, n.s., nº 3, in Sahelian plain Kufic* (*Fig. C.1*)**
(the four lines of small letters at the top of the uppermost of the three rock faces).

Transcription:

وَكَتَبَ أَبُو بَكْرِين
ابْنُ [....] بْنِ سَعْدُون
فِي سَنَةِ ثَمَانِيَةٍ وَثَلاَثِينَ وَ
ارْبَعَةِ مِائَةٍ

Translation:
"This was written by Abū Bakrīn
son of [.....] son of Saʿdūn,
in the year 8 and 30 and
4 hundred".
[438 H / 08 July 1046 AD to 27 June 1047 AD]

(*Words now blurred by erosion were engraved after the last word of this inscription by two different hands).

***Inscription Essouk, n.s., nº 4, undated* (*Fig. C.1*)**
(the three lines of large Essouk ornamental Kufic letters below inscription Essouk, n.s., nº 3).

Transcription:

وَكَتَبَهُ عَبْدُاللّٰهِ ابْنِ
زَارْمِنَ [؟] وَهُوَ يَشْهَدُ
أَنْ لاَ إِلَهَ إِلاَّ اللّٰهُ

Translation:
"This was written by ʿAbd Allāh son of [or descendant of]
Zārmin [?], and he professes
That there is no god but God".

(*The second part of the Muslim profession of faith is added in smaller letters after the end of the inscription. There are also six blurred lines in small letters at the bottom of the top rock face, which cannot be read from the photograph).

The bottom-right rock face displays only a few surviving words of two different inscriptions.

Section 2. Inscriptions Photographed by Sam Nixon in the Eastern Cliffs Overlooking the Essouk Town Ruins, in 2004–2005

During the fieldwork a cluster of three inscriptions (Essouk, n.s., nº 5, nº 6, nº 7) were recorded mid-way up the cliffs on the east side of the site, on a large boulder (Fig. C.3, Fig. C.4; and see Fig. 11.2 for location). No scale features in the photograph but it is believed that the inscription cluster is approximately 50cms in height.

***Inscription Essouk, n.s., nº 5* (*Fig. C.3, Fig. C.4*)**
(the five lines on the left of the image)

Transcription:

مَنْ قَالَ
لآ إِلآهَ إِلاّ اللّٰهُ
مُحَمَّدٌ رَسُولُ اللّٰهِ
مُخْلِصًا مِنْ قَلْبِهِ
دَجَلَ الْجَنَّةَ

Translation:
"Whoever says:
'[There is] no god except God,

[and] Muḥammad is the Messenger of God',
sincerely from their [literally: his] heart,
shall enter the Garden [Paradise]".

***Inscription Essouk, n.s., nº 6* (*Fig. C.3, Fig. C.4*)**
(the three lines at the top right of the image)

Transcription:

وَكَتَبَهُ بجَالُ
اِبْنُ ابَابَكْرٍ [ابَابَكْرَ ؟] رَحِمَهُ
اللّٰهُ يَوْمَ الثَلَثَةِ

Translation:
"This was written by Bajāl
son of Abābakrin [or: Abābakar ?], may mercy be granted him by God, on [a] Tuesday".

***Inscription Essouk, n.s., nº 7* (*Fig. C.3, Fig. C.4*)**
(the four lines at the bottom right of the image)

Transcription:

وَكَتَبَ إِبْرَاهِيمُ
بْنُ بُوبَكْرٍ [بُوبَكَرَ ؟] رَحِمَهُ
اللّٰهُ فِي عَامِ اِثْنَا عَشَرَ وَ سِتَّةِ
وَ[؟]مِائَةٍ مِنَ التَّأْرِيخِ

Translation:
"This was written by Ibrāhīm
son of Būbakrin [or: Būbakar ?], may mercy be granted him by God, in the year 12 and six
and [sic] hundred of the [Islamic] Era".
[612 H / the period from AD 02 May 1215 to AD 19 April 1216]

Commentary on Inscriptions Essouk, n.s., nº 5, nº 6, and nº 7

The inscriptions are in the Sahelian plain Kufic style (see Chapter 5), and nº 5 and nº 6 display diacritical points and are likely to be engraved by the same hand. In nº 6 and nº 7, the names of the fathers of the engravers are different spellings of dialectal forms of the Arabic name "Abū Bakr". Hence, it is possible the two engravers were brothers.

Section 3. Inscription Photographed by Sam Nixon in 2004–2005 at an Unspecified Location Within the Essouk Complex

***Inscription Essouk, n.s., nº 8* (*Fig. C.5*)**

Tentative transcription:

بِسْمِ اللّٰهِ الرَّحِمٰنِ الرَّحِيمِ
لآ إِلَهَ إِلاّ لّهُ [؟] للّٰهُ [؟] مُحَمَّدٌ رَسُولُ اللّٰهِ
هَا فِي فتعل [إِفْتِعَالِ ؟] الإِنْسَانِ شِلَّةً [...]
الْمَيْنَ زَنَّ قَالَ [ا...............]
بْنُ [؟] اقلَ [اقيل ؟ افيل ؟ اقمل ؟] كَابَى بْنِ بَابَ رَحِمَهُ
اللّٰهُ [؟] تلاى [تَعَالَى ؟] بَرَكَتَهُ كُتِبَ
[.............] ...ين [؟] [.......]

Tentative translation:
"In the name of God, the Merciful, the Compassionate.
There is no god but [G]od, [G]od [sic], Muḥammad is the messenger of God.
Behold! In the activity of humankind as a whole [.....]
the lie. [Thus] thinks [?] [and] says [........]
son of [?] A.q.l.[2] [Aqīl / Uqīl / Iqīl ?] Kābā son of Bāba, may mercy be granted him by
God the Most High, [and] His blessing. This was written [?]
in [? } [..]".

Commentary on Inscription Essouk, n.s., nº 8

Of its seven lines in pointed Sahelian plain Kufic, the first two are recognisable formulae (though mistakes have been made in the engraving of the first half of the second line). The reading of the rest of the inscription is made difficult by the condition of the inscribed surface, apparent spelling mistakes, and certain peculiarities of the carving (one of them is that when the letters *tā'* and *yā'* are in medial position, their stem is engraved not as a vertical line, but as a small triangle). Possibly, an inattentive engraver misread the text given him to copy.

The inscription appears to allude to Qur'ānic passages such as Q. 17:11, Q. 53:24, Q. 82:6, etc … On line 5, "Kābā son of Bāba" could be a name from the *Bilād al-Sūdān* (the "Countries of the Blacks"). The word that precedes it is deprived of diacritical points and may be read in different ways. It could be a title.

2 The dots represent unidentified / absent short vowels.

Bibliographic Reference

P.F. de Moraes Farias, 2003, *Arabic Medieval Inscriptions from the Republic of Mali: Epigraphy, Chronicles, and Songhay-Tuāreg History* (Oxford and New York: published for The British Academy by Oxford University Press).

FIGURE C.1 *Cluster of inscriptions photographed at an unspecified cliff location, including at the top inscriptions Essouk, n.s., nº 3 (438 H / AD 1046–1047) and nº 4.*
PHOTO COURTESY ALAIN BRÉGY

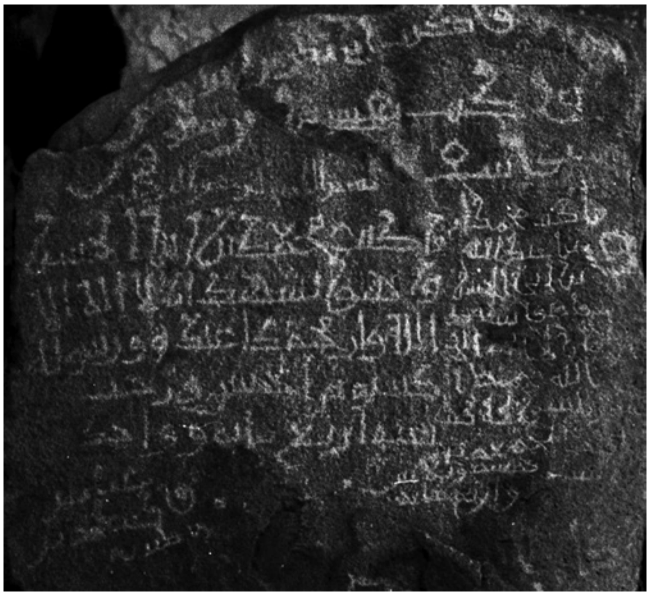

FIGURE C.2 *Closer view of the lower-left engraved rock face seen in Fig.C.1 including inscriptions Essouk, n.s., nº 1 (AD 1011) and nº 2 (AD 1043–1044).*
PHOTO COURTESY ALAIN BRÉGY

FIGURE C.3 *Inscriptions Essouk, n.s., nº 5, nº 6, and nº 7 (AD 1215–1216), located in the eastern cliffs overlooking the town ruins.*

FIGURE C.4 *Closer view of inscriptions Essouk, n.s., nº 5, nº 6, and nº 7 shown in Fig. C.3, showing the diacritical points in the first two of them.*

FIGURE C.5 *Undated inscription Essouk, n.s., n. 8.*

APPENDIX D

Context Descriptions for Excavation Units

Sam Nixon

Unit Ek-A

Horizon 1

123 Loose, light orange, medium-grained sand containing limited organic material; 667–640 cms

122 Loose, light yellow, medium-grained sand containing limited organic material; 640–611 cms

121 Loose, light yellow, medium-grained sand containing limited organic material; 611–578 cms

Horizon 2

120 Compact, light-brown, clayey-silt containing areas of gravel – post-holes recorded; 578–556 cms

119 Compact, light-brown, clayey-silt – post-holes recorded; 556–532 cms

118 Compact, light-brown, clayey-silt – post-holes recorded; 532–523 cms

118b Area of loose ash – remains of a hearth located within Context 118; 527–523 cms

117 Compact, mid-brown, sandy-silt containing large amounts of organic material – post-holes recorded; 523–512 cms

Horizon 3

116 Compact, dark-brown, sandy-silt with areas of ash and gravel; 512–500 cms

114 Compact, mid-brown, clayey-silt layer containing stones (*ca* 5cm size) – post-holes recorded; 500–492 cms

113b Loose, light-yellowish, medium-grained sand layer; 492–486 cms

113a Compact, mid-brown, clayey-silt layer – post-holes recorded; 486–482 cms

111 Loose, white, fine-grained sand layer; 482–463 cms

Horizon 4

110 Compact, mid-brown clayey-silt layer containing occasional large (*ca* 10cm) stones; 463–452 cms

109b Loose, light brown, coarse-grained sand layer; 452–446 cms

109a Very compact, mid-brown clay floor; 446–441 cms

107b/a Cut [107b] filled with loose, light brown, coarse-grained sand [107a] with worked stones arranged on top; 461–441 cms

Horizon 5

106 Very compact, mid-brown clay floor; 441–436 cms

103 Loose, light-brown, coarse-grained sand layer; 436–420 cms

102b/a Shallow pit [cut=102b] filled with compact greenish clay [102a]; 428–418 cms

101b/a Shallow pit [cut=101b] filled with compact, greenish clay [101a]; 430–420 cms

Horizon 6

97 Compact, mid-brown, clayey-silt layer; 420–401 cms

96 Loose, light-brown, coarse-grained sand; 401–386 cms

95 Loose, light-brown, coarse-grained sand; 386–360 cms

93 Loose, light-brown, coarse-grained sand including a lens of charcoal; 360–330 cms

Horizon 7

92 Very compact, green-tinged clay floor surface; 330–320 cms

90 Loose, light-brown, coarse-grained sand layer; 320–306 cms

Horizon 8

88b Very compact, mid-brown, clay floor; 306–300 cms

88a Loose, light-brown, coarse-grained sand layer; 300–288 cms

89b/a Cut [89b] filled with ash rich deposit [89a] containing large quantities of organic material; at base fill contains large stones (*ca* 10/15 cms). Presumed to be a hearth; 312–286 cms

Horizon 9

87b Compact, mid-brown clayey-silt layer containing occasional large (*ca* 10cms) stones; 288–276 cms

87a Loose, light brown, medium-grained sand layer; 276–270 cms

86b Compact, mid-brown clayey-silt layer containing occasional large (*ca* 10 cms) stones; 270–262 cms

85b/a Pit [cut = 85b] containing loose, light-brown, coarse-grained sand [85a]; 299–262 cms

86a Loose, light-brown, medium-grained sand layer; 262–256 cms

 | DOI 10.1163/9789004348998_030

84b	Compact, mid-brown clayey-silt layer containing occasional stones (*ca* 5 cm size) – layer dotted with postholes; 256–244 cms
83b/a	Rectangular pit [cut=83b] containing ashy deposit [83a]; 252–244 cms
82ba	Gulley/slot-trench [cut=82b] containing loose, light-brown, medium-grained sand [82a]; 253–244 cms
84a	Loose, light-brown, medium-grained sand layer; 244–240 cms
80b	Loose, mid-brown sandy-silt containing relatively large amounts of organic material; 240–233 cms
80a	Loose, light-brown, medium-grained sand layer; 233–228 cms

Horizon 10

79	Very compact, mid-brown clay containing patches of gravel; 228–218 cms
72	Very compact, mid-brown clay containing patches of gravel; 225–220 cms
71	Compact, mid-brown sandy-silt; 220–214cms
78	Loose, mid-brown sandy-silt rich in organic material; 218–200 cms
78b	Hearth within Context 78
77	Loose, mid-brown sandy-silt rich in organic material; 200–188 cms
76	Remains of coiled-reed mat found at the top of Context 77

Horizon 11

75	Compact, mid-brown clayey-silt; 188–174 cms
59	Very compact, red ochre-coloured *banco* layer; 174–168 cms
64	Very compact mid-brown clay floor; 214–208 cms
65	Loose, mid-brown clayey-silt; 175–164 cms
70a	Loose, mid-brown clayey-silt; 190–185 cms
70b	Loose, mid-brown clayey-silt; 192–185 cms
62	*Banco* wall melt – also contains some worked stone; 208–185 cms
57	*Banco* wall melt – also contains some worked stone; 185–172 cms
55	*Banco* wall melt – also contains areas of burnt clay and loose sand; 172–163 cms
56	*Banco* wall melt; 169–162 cms
52	*Banco* wall melt containing chunks of red ochre; 164–146 cms
68	Pure, loose, mid-brown clayey-silt containing large quantities of worked stone – wall collapse; 185–163 cms

Horizon 12

54	Compact, mid-brown sandy-silt containing large amounts of occupational debris; 162–150 cms
45b	Fairly pure, loose, mid-brown clayey-silt – crushed pot sitting on the top of this context; 146–138 cms
58b	Loose, dark-brown clayey-silt; 163–145 cms
58a	Loose, dark-brown clayey-silt containing patches of gravel; 160–140 cms
47	Loose, mid-brown sandy-silt containing patches of gravel; 160–147 cms
43	Loose, mid-brown clayey-silt containing numerous worked stones and some patches of banco wall melt – wall collapse (central area of unit); 150–130 cms
45a	Banco wall melt containing occasional worked stone and patches of loose, mid-brown clayey-silt (deposit covers the crushed pot) – wall collapse (north area of unit); 138–116 cms
49	Loose, mid-brown clayey-silt containing numerous worked stones – wall collapse (west side of unit); 145–118 cms
46	Loose, mid-brown clayey-silt containing numerous worked stones – wall collapse (east side of unit); 147–125 cms

Horizon 13

40b	Very compact, mid-brown clay floor containing patches of gravel; 132–122 cms
39	Very compact, mid-brown clay floor; 130–125 cms
22	Loose, light-brown, coarse-grained sand; 125–115 cms
33	Loose, light-brown, coarse-grained sand; 125–113 cms
40a	Loose, light-brown, coarse-grained sand; 122–113 cms
32	Loose, mid-brown clayey-silt containing patches of gravel; 117–104 cms
18	Area of ash and charcoal – seemingly the result of a burning event related to collapse of structures; 115–100 cms
17	Loose, fairly pure, mid-brown clayey-silt and worked stone – wall collapse in central room area; 115–100 cms
16	Description same as *17* – wall collapse in central room area; 100–88 cms
14	Description same as *17* – wall collapse in central room area; 88–80 cms
30	Description same as *17* – wall collapse in north and west areas of unit; 104–96 cms
28	Description same as *17* – wall collapse in north and west areas of unit; 96–88 cms
29	Hearth in upper level of Context 28
31	Description same as *17* – wall collapse in southern architectural space; 113–96 cms

27 Description same as *17* – wall collapse in southern architectural space; 96–84 cms
38 Description same as *17* – wall collapse in eastern architectural space; 113–85 cms

Horizon 14

9 Compact, gravelly, mid-brown sandy-silt surface rich in organic material – living floor; 80–75 cms
8 Loose, gravelly, mid-brown sandy-silt surface containing areas of sand and ash – occupation surface of northern architectural space; 88–80 cms
15 Loose ashy lens covering a more compact gravelly, sandy-silt surface – occupation surface of southern architectural space; 84–80 cms
12 Compact, gravelly, mid-brown clayey-silt with areas of ash – occupation surface of eastern architectural space; 85–78 cms
20 Loose, mid-brown, clayey silt – occupation surface of western space (street); 88–82 cms
19b/a Pit cut [19b] into Context 20; fill [19a] dark brown clayey-silt rich in organic material; 111–82 cms
3 Worked stone, sand and pure clayey-silt – wall collapse (central room space); 75–54 cms
5 Interior space of Feature 1 – containing similar evidence of wall collapse seen in Context 3; 70–52 cms
4 Interior space of Feature 1 – containing similar evidence of wall collapse seen in Context 3; 72–52 cms
7 Worked stone, sand and pure clayey silt, also containing areas of sand and ash (Context 13) – wall collapse (southern architectural space); 80–58 cms
13 Loose medium-grained sand and ash; 64–58 cms
10 Worked stone, sand and pure clayey-silt – wall collapse (western area of unit); 82–65 cms
1 Worked stone, sand and pure clayey-silt – wall collapse (western area of unit); 65–40 cms
11 Worked stone, sand and pure clayey-silt – wall collapse (eastern architectural space); 78–45 cms
2 General overburden/wall collapse debris covering entire unit (worked stone, sand and clayey silt with few artefacts); 75–10 cms
Surface Wind-blown sand; 10–0 cms

Unit Ek-B

Horizon 1

17 Loose, light yellow, medium grained sand; 260–249 cms
16 A fairly compact, greenish clayey deposit containing areas of reddish gravel; 249–220 cms
15 A fairly compact, greenish clayey deposit containing areas of reddish gravel; 220–202 cms
12 Loose, light brown, medium-grained sand containing areas of grey gravel; 202–175 cms
11 Loose, light-brown, medium-grained sand containing areas of grey gravel; 175–145 cms
14b Pit cut into Context 11 – assumed to have been cut to function as a latrine; 265–145 cms
14a Loose, yellowy-brown, clayey-silt rich in culturally associated organic material – appears to contain remains of excrement; 265–210 cms
13 Loose, yellowy-brown, clayey-silt rich in culturally associated organic material; 210–145 cms

Horizon 2

10 Loose, light-brown, medium-grained sand; 150–120 cms
9 Loose, light-brown medium-grained sand containing large areas of ash; 120–95 cms
8 Loose, ashy, sandy-silt rich in culturally associated organic material – appears to be some form of rubbish disposal area or cooking area; 155–125 cms
4 Loose, ashy, sandy-silt (contains hearth area located between Wall 2 and the west wall of the excavation unit); 125–90 cms

Horizon 3

6 Compact, light-grey gravel containing areas of ash and loose sand – passageway surface; 95–72 cms
3 Loose, light-brown, medium-grained sand, containing patches of ash and two hearths (Contexts 3b and 3a); 90–38 cms
3b Hearth found within Context 3; 70–62 cms
3a Hearth found within Context 3; 90–65 cms
2 Compact, light-grey gravel, containing areas of ash, loose sand and a hearth (see *2a*) – passageway surface; 72–42 cms
2a Hearth found within Context 2; 50–42 cms
5b/5a Pit [5b] cut into Context 2 – filled with organic rich loose clayey silt [5a]; 115–42 cms
1 Worked stone, pure clayey-silt, and sand – wall collapse and overburden covering entire unit; 42–12 cms
1a Surface covering of wind-blown sand; 12–0 cms

Unit Ek-C

Horizon 1

13 Mixed layer of heavily compacted clayey deposit and compact gravelly deposit; 235–212 cms

11	Loose sandy silt deposit containing large quantities of ash; 212–180 cms
12b/a	Pit cut [12b] with coarse-grained sand fill [12a] – associated with Feature 1; 230–180 cms
10	Loose coarse-grained sand layer containing areas of ash; 180–135 cms

***Horizon** 2*

7	Layer of coarse-grained sand containing areas of ash and yellowy clay; 135–105 cms
8	Cut of well; 10 metres-150cms (*excavation stopped before bottom)
9	Worked stone, clayey-silt and sand – uppermost layer of fill of well; 150–110 cms
6	Mixed deposit of clayey-silt, worked stone and loose, coarse-grained sand – wall collapse; 105–65 cms
5	Mixed deposit of clayey-silt, worked stone and loose, coarse-grained sand – wall collapse; 105–65 cms
4	Mixed deposit of clayey-silt, worked stone and loose, coarse-grained sand (the deposit also contains a lot of very well preserved wood) – wall collapse; 105–60 cms

***Horizon** 3*

2	Ashy, sandy silt deposit containing significant amounts of worked stone – wall collapse; 65–22 cms
1	Ashy, sandy-silt deposit containing significant amounts of worked stone – wall collapse; 60–12 cms
Surface	Windblown sand; 22/12–0 cms

Pottery Analysis Tables and Additional Illustrative Materials

Sam Nixon & Kevin MacDonald

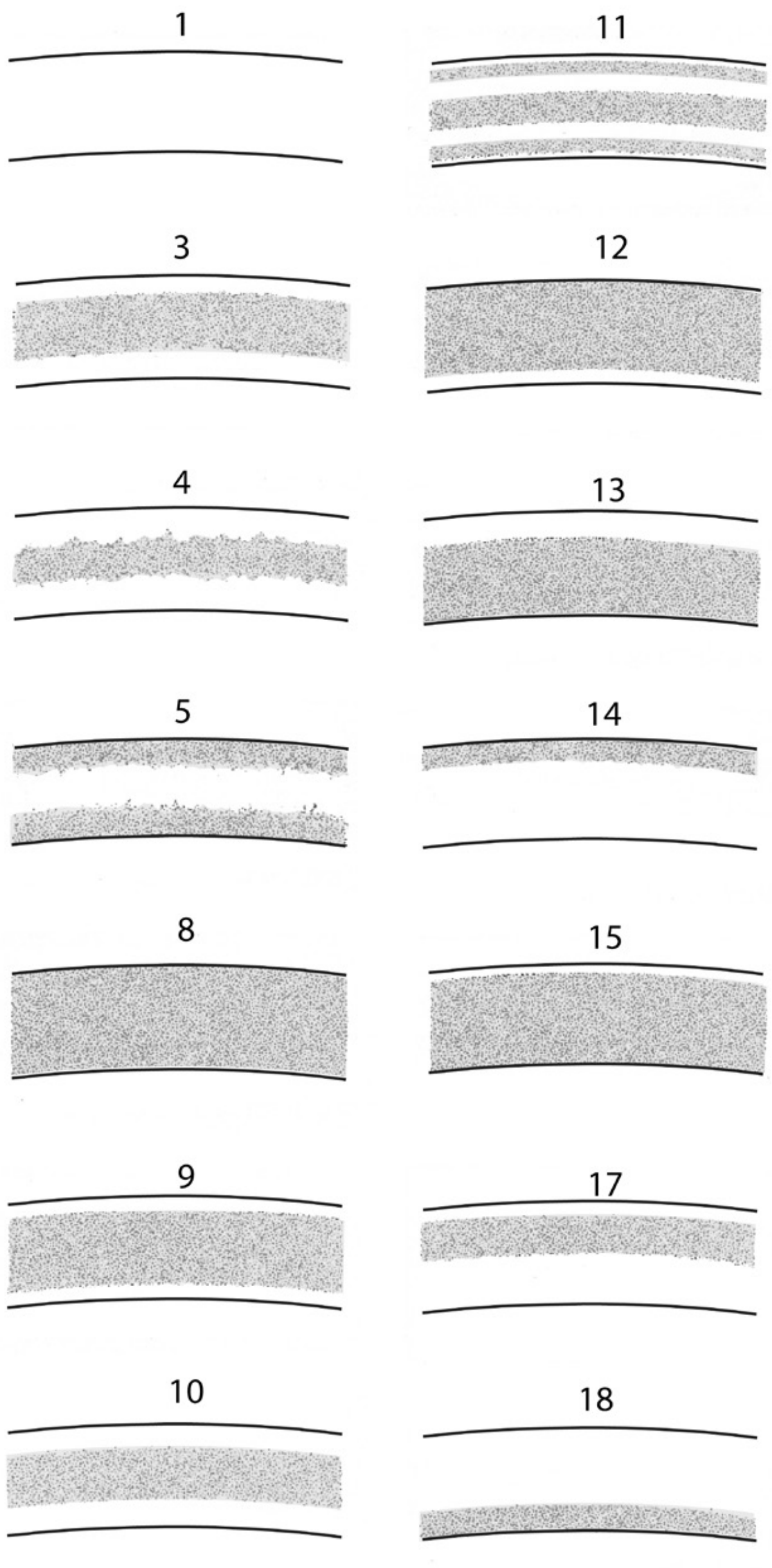

FIGURE E.1
Pottery firing core types (stylized pottery wall cross-sections showing variations in the appearance of firing cores; drawing after RYE *1981).*

 | DOI 10.1163/9789004348998_031

Material composition (temper) coding key
21 = coarse sand (potentially some occasional grog)
23 = fine sand (potentially some occasional grog)
31 = grog (other inclusions rare)
32 = grog + coarse sand abundant
41 = chaff (other inclusions rare)
42 = chaff + grog + coarse sand abundant
44 = chaff + grog + coarse sand in small quantities
45 = chaff + coarse sand (no grog)

FIGURE E.2 *Essouk-Tadmekka pottery temper types.*

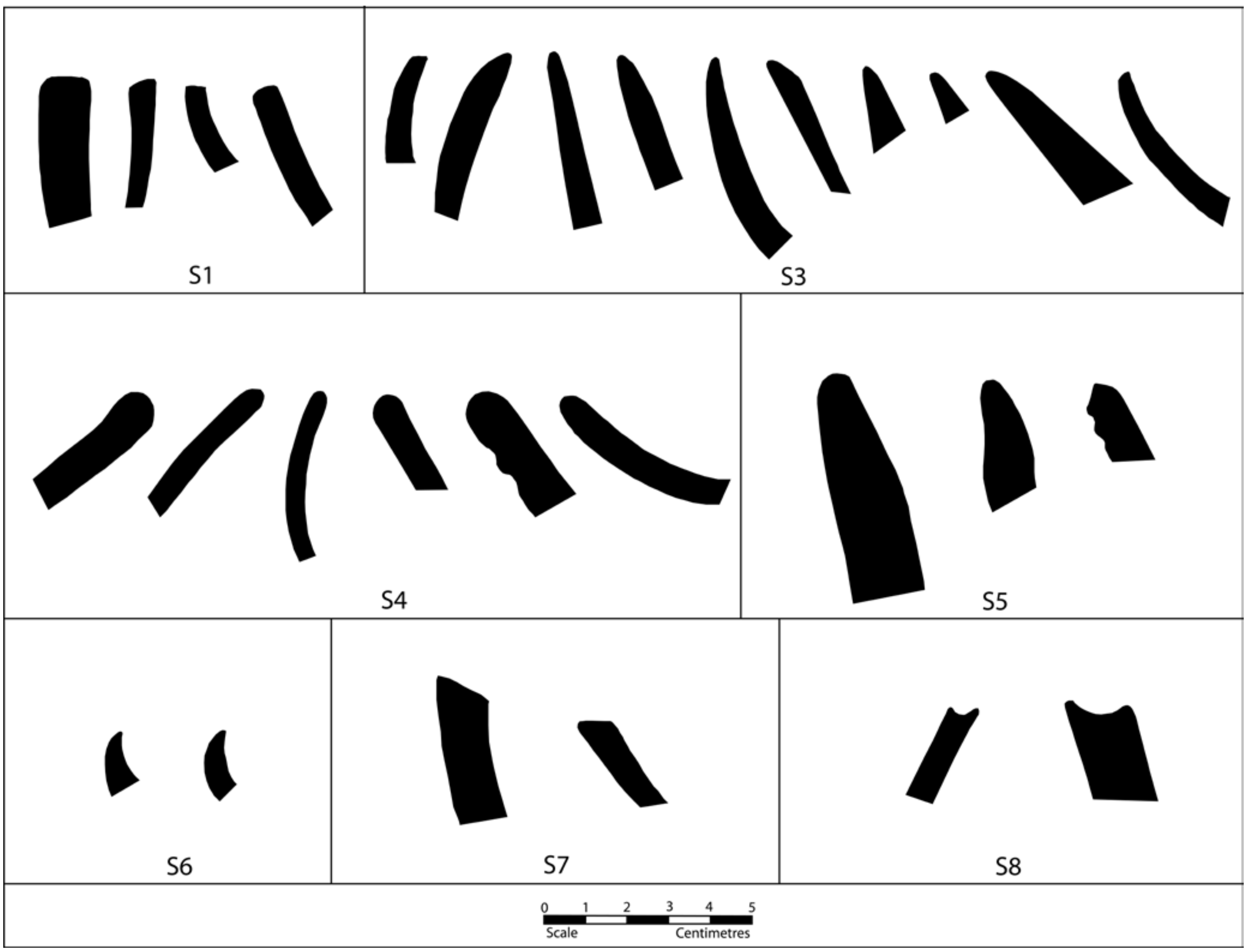

FIGURE E.3 *Essouk-Tadmekka excavated simple rim forms (illustrations show rim profiles of left side of pot).*

FIGURE E.4 *Essouk-Tadmekka excavated thickened rim forms (illustrations show rim profiles of left side of pot).*

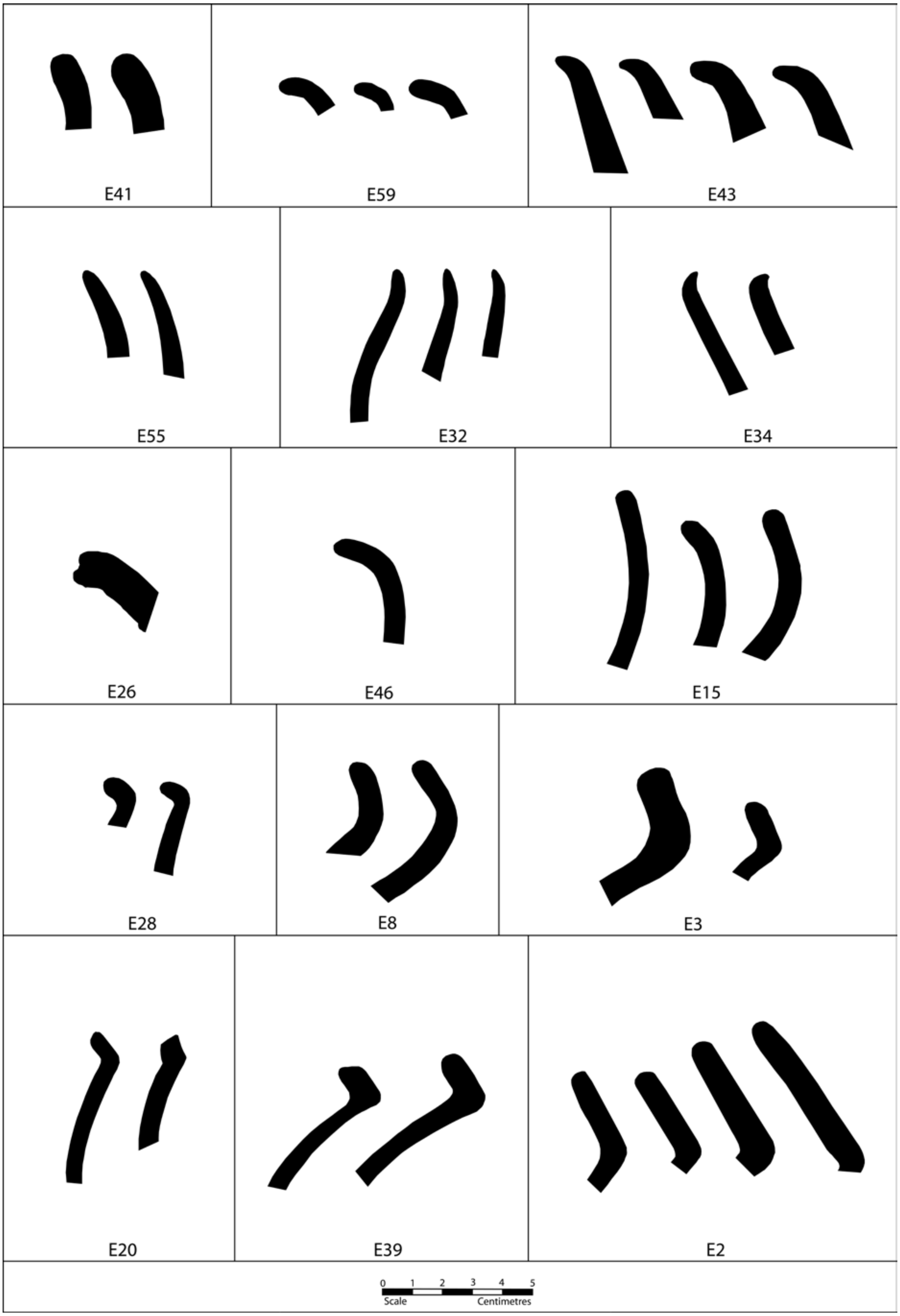

FIGURE E.5 *Essouk-Tadmekka excavated everted rim forms (1) (illustrations show rim profiles of left side of pot).*

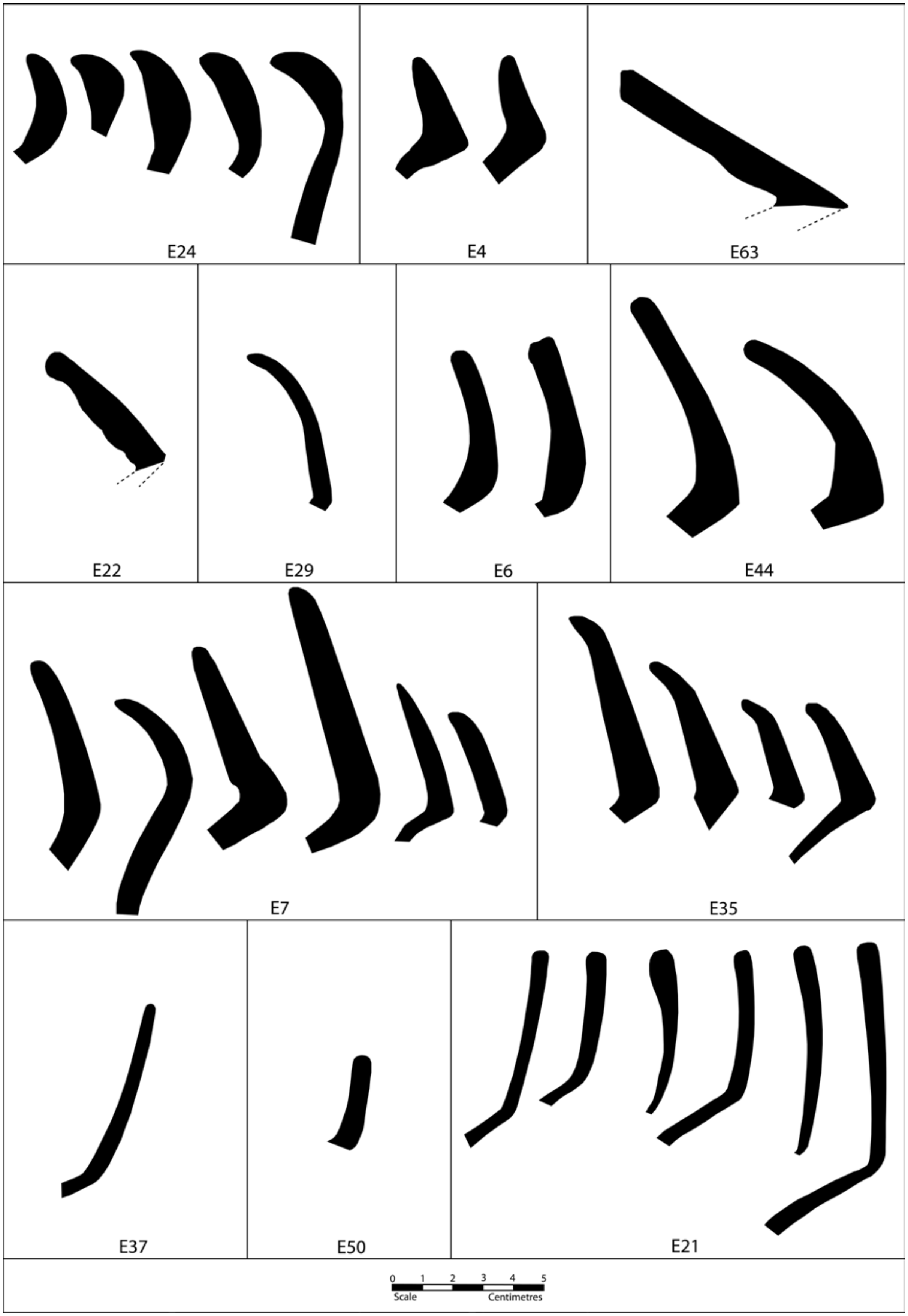

FIGURE E.6 *Essouk-Tadmekka excavated everted rim forms* (2) (*illustrations show rim profiles of left side of pot*).

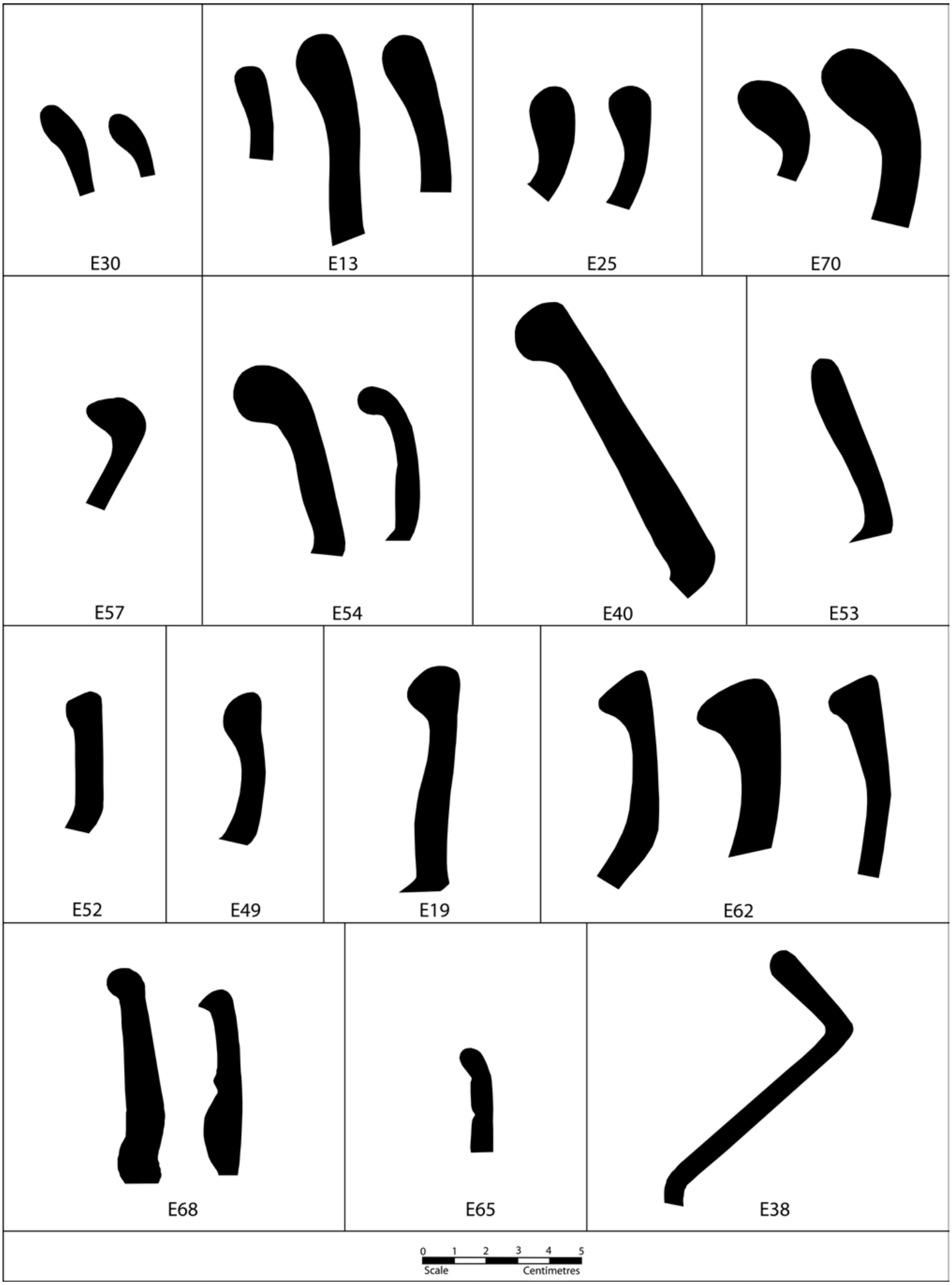

FIGURE E.7 *Essouk-Tadmekka excavated everted rim forms (3) (illustrations show rim profiles of left side of pot).*

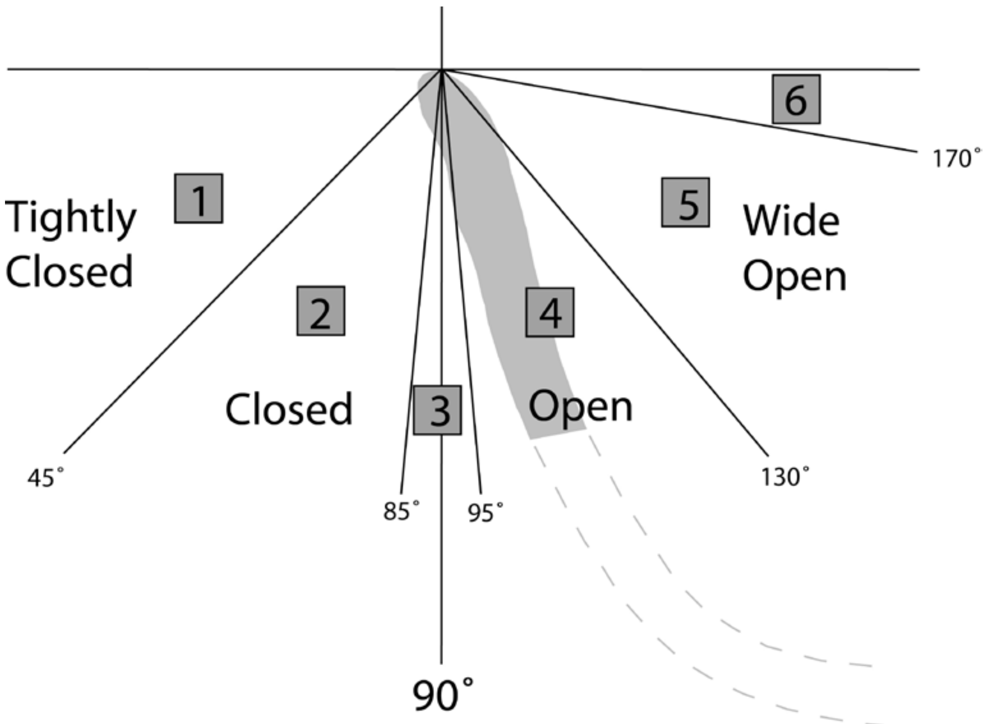

FIGURE E.8 *Illustration of pot angle codes.*

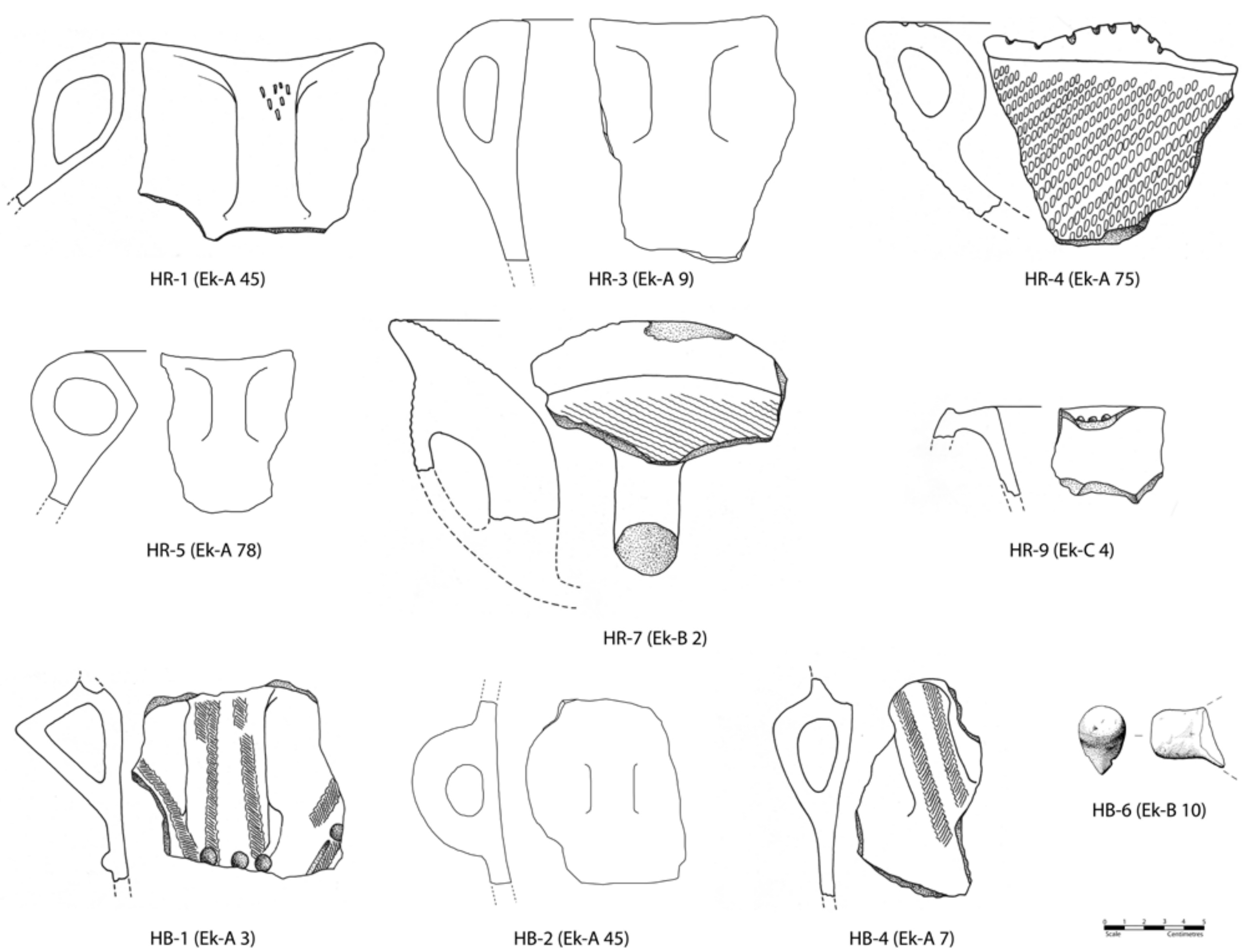

FIGURE E.9 *Essouk-Tadmekka excavated pot handle forms.*

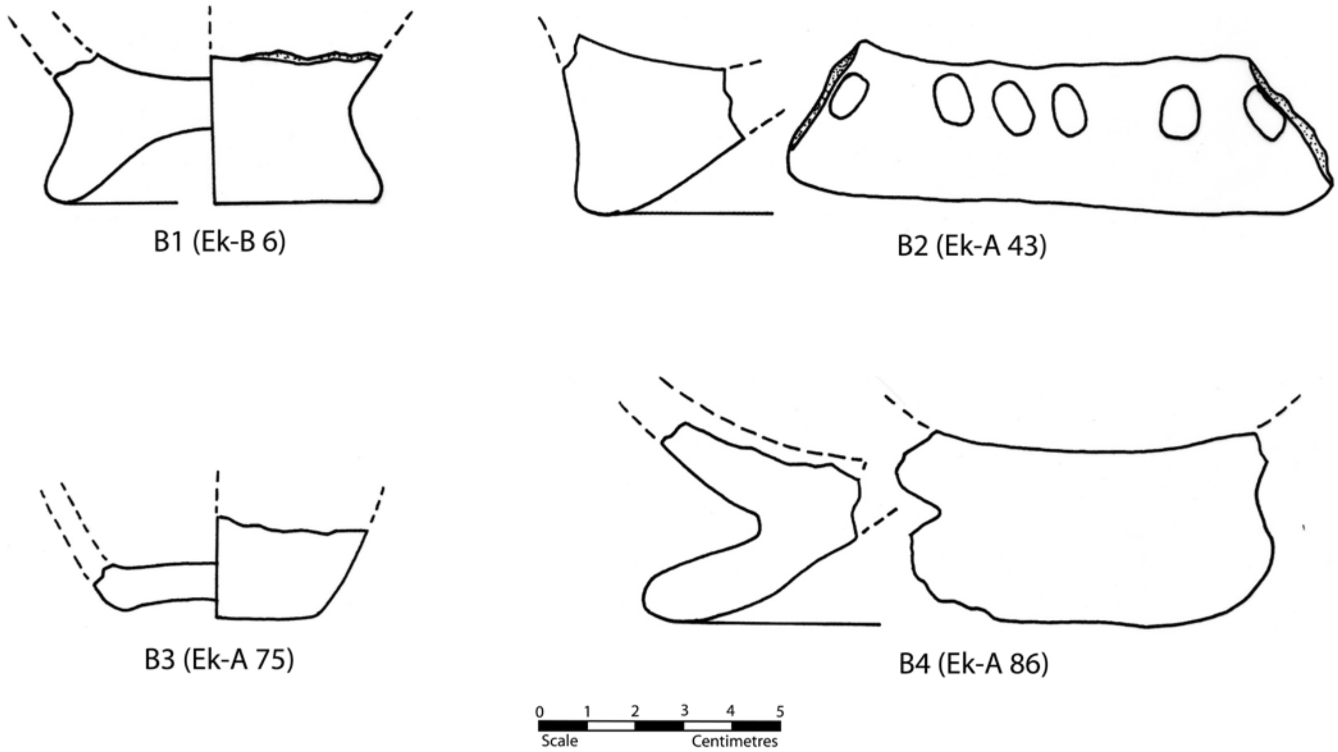

FIGURE E.10 *Essouk-Tadmekka excavated pottery modelled base forms.*

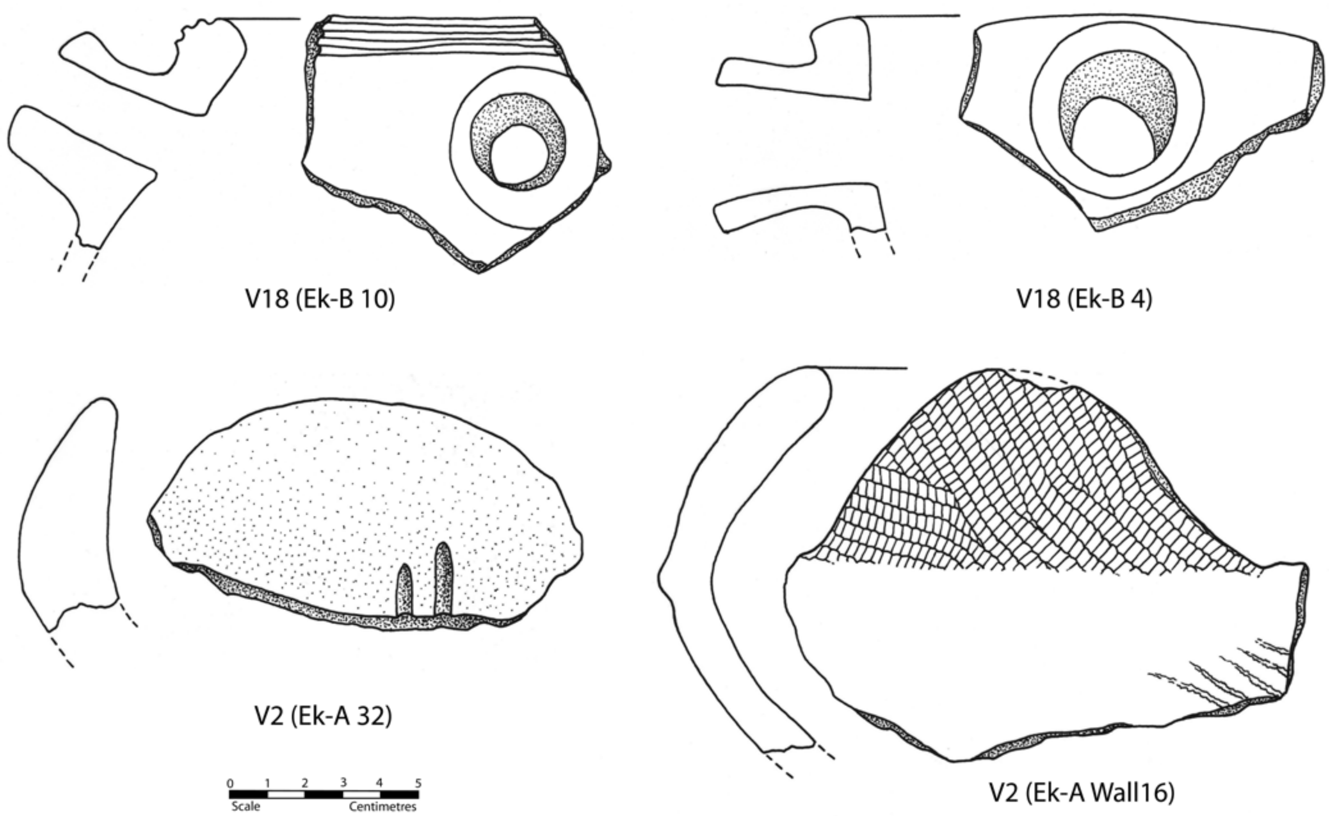

FIGURE E.11 *Essouk-Tadmekka excavated spouts and trilobate pot rest forms.*

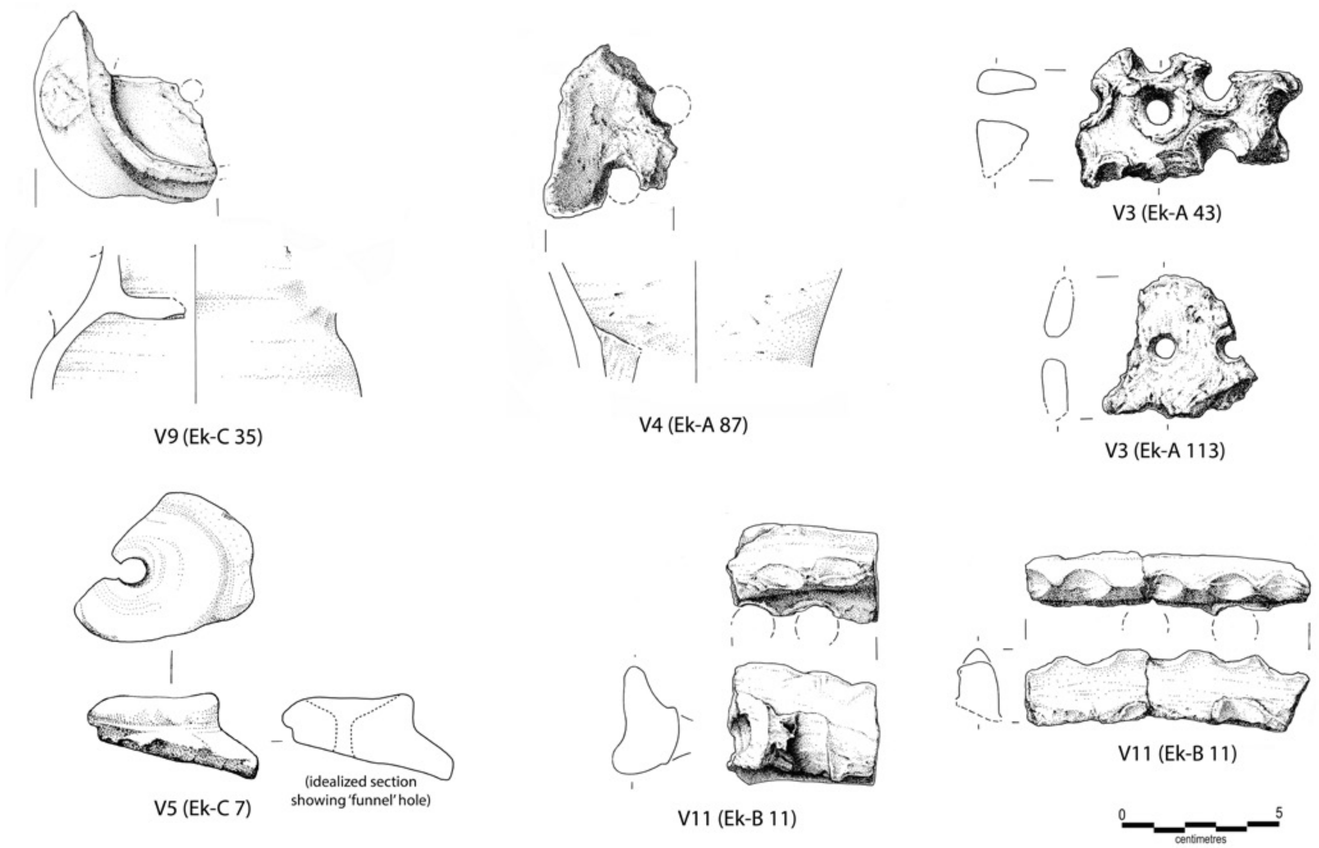

FIGURE E.12 *Essouk-Tadmekka excavated perforated forms (*note type V9 is not recorded within* Tables *E. 19–20 as it is only found in Ek-C Horizon 0).*

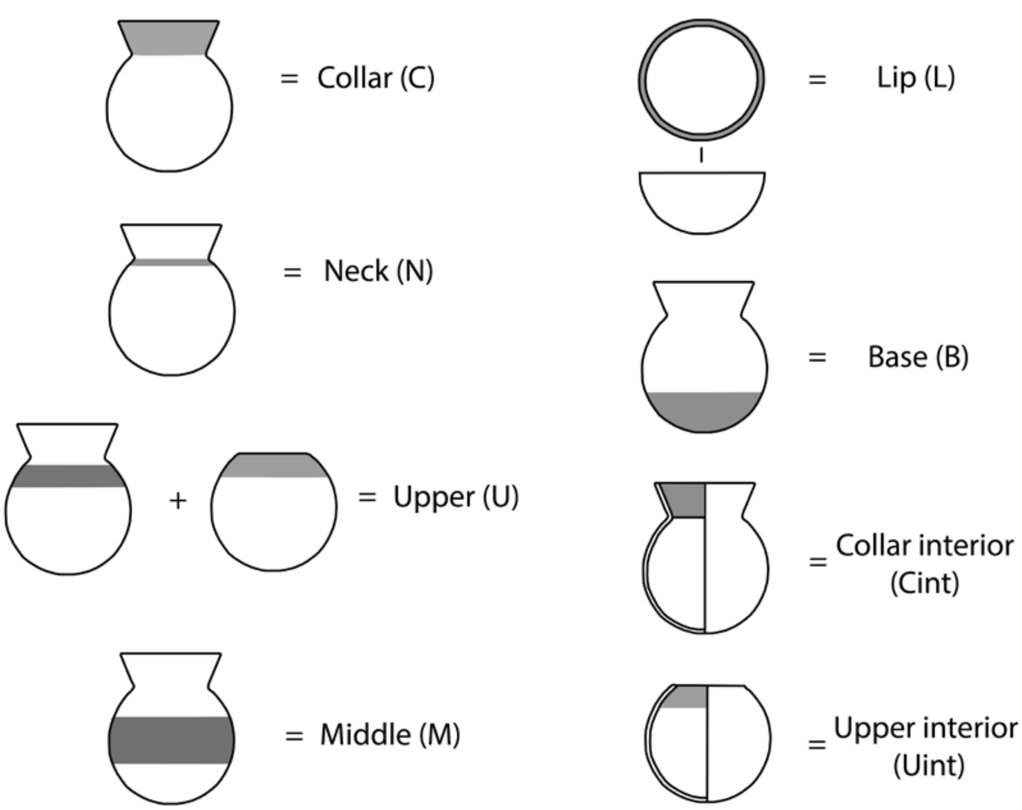

FIGURE E.13 *Illustration of décor location zones used in the pottery analysis.*

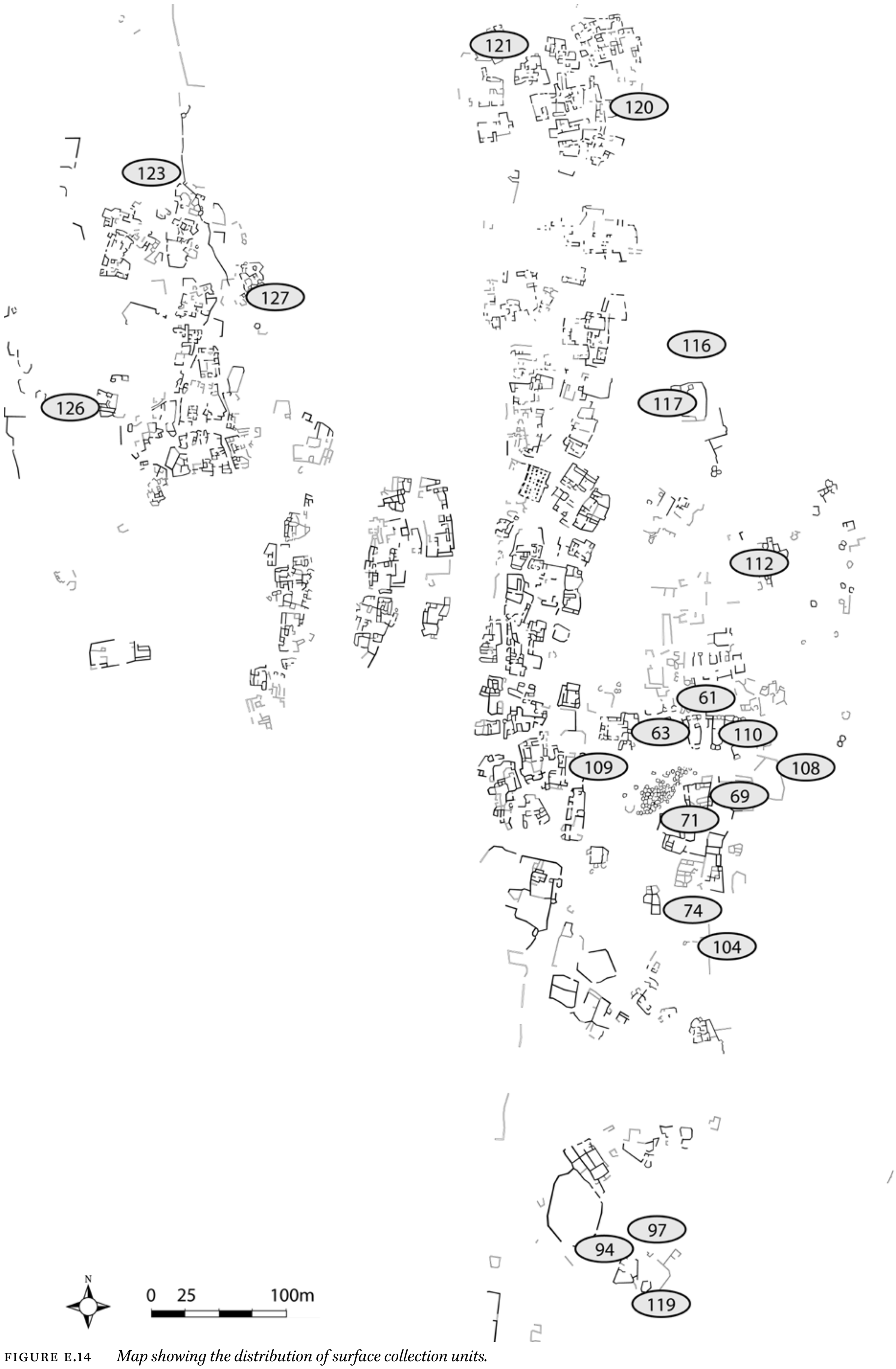

FIGURE E.14 *Map showing the distribution of surface collection units.*

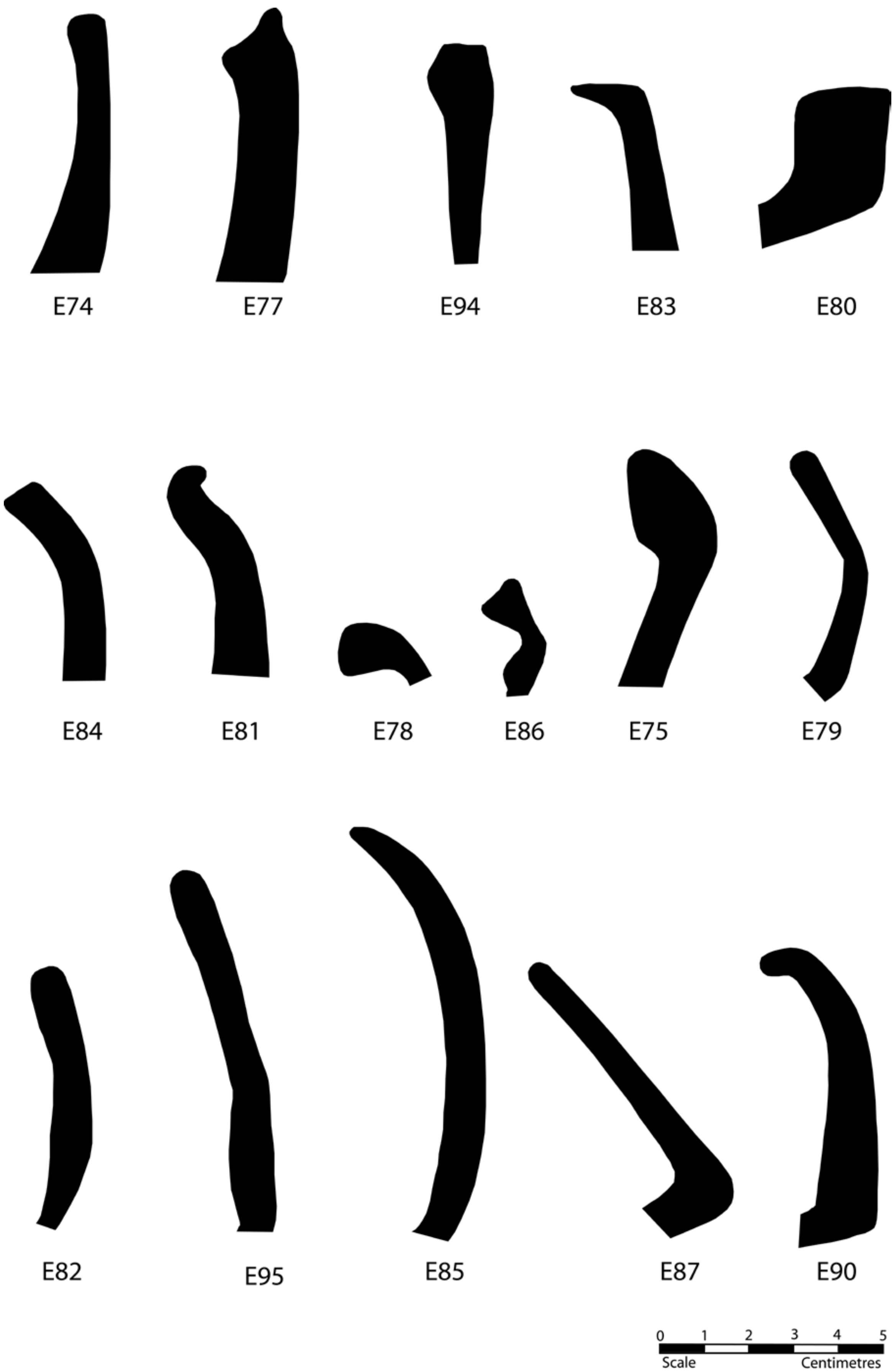

FIGURE E.15 *Illustration of pot rim forms recorded during surface collection but not present in the excavated assemblage (illustrations show rim profiles of left side of pot).*

TABLE E.1 *Frequency distribution of temper types from unit Ek-A pots*

Temper type	Ek-A Period 1	Ek-A Period 2	Ek-A Period 3a	Ek-A Period 3b	Ek-A Period 4
21				4	6
23		3	1	9	9
31	1	1	1	4	5
32				1	
41	24 (96%)	222 (92%)	172 (92%)	401 (76%)	748 (92%)
42		1			
43				1	
44		12 (5%)	10 (5%)	87 (17%)	23 (3%)
45		2	4	18	23
Total	**25**	**241**	**188**	**525**	**814**

TABLE E.2 *Frequency distribution of temper types from unit Ek-B and Ek-C pots*

Temper type	Ek-B Horizon 1	Ek-B Horizon 2/3	Ek-C Horizon 1	Ek-C Horizon 2/3
21		1	2	
23	1	3	1	
31	5	31	7	
32				
41	142 (91%)	1715 (92%)	148 (90%)	250 (96%)
42				
43				
44	6 (4%)	90 (5%)	2 (1%)	6 (2%)
45	2	35	4	4
Total	**156**	**1875**	**164**	**260**

TABLE E.3 *Frequency distribution of rim diameters from unit Ek-A pots*

Diameter	Ek-A Period 1	Ek-A Period 2	Ek-A Period 3a	Ek-A Period 3b	Ek-A Period 4
6–8	1	8	4	16	16
10–12	1	14	5	23	46
14–16	1	11	17	28	53
18–20	3	11	7	17	19
22–24		3	3	8	12
26–28		6	4	7	6
30–32		1	2	5	3
34–36		1	1	2	3
38–40					1
42–44		1	1	3	1
46–48		1		1	1
50–52					2
54–56					1
Total	**6**	**57**	**44**	**110**	**164**

TABLE E.4 *Frequency distribution of rim diameters from unit Ek-B and Ek-C pots*

Diameter	Ek-B Horizon 1	Ek-B Horizon 2/3	Ek-C Horizon 1	Ek-C Horizon 2/3
6–8	2	48	7	6
10–12	8	84	12	25
14–16	9	93	5	20
18–20	6	83	13	17
22–24	6	35	8	3
26–28	3	33	4	3
30–32	4	21	2	2
34–36	1	12		
38–40		4		1
42–44		2		1
46–48				
50–52		1		1
54–56				
Total	**39**	**416**	**51**	**79**

TABLE E.5 *Frequency distribution of modelled base types for unit Ek-A pots*

Base type	Ek-A Period 1	Ek-A Period 2	Ek-A Period 3a	Ek-A Period 3b	Ek-A Period 4
B1			2	1	1
B2			1	0	1
B3				3	
B4			1	0	
Bsect		2	4	1	
Total modelled bases	0	2	8	5	2

TABLE E.6 *Frequency distribution of modelled base types for unit Ek-B/Ek-C pots*

Base type	Ek-B Horizon 1	Ek-B Horizon 2/3	Ek-C Horizon 1	Ek-C Horizon 2/3
B1		5	2	
B2	2	2		1
B3				
B4		2		
Bsect	1	3		4
Total modelled bases	3	12	2	5

TABLE E.7 *Division of Ek-A rim forms into simple, everted and thickened rim form categories*

Rim category	Ek-A Period 1	Ek-A Period 2	Ek-A Period 3a	Ek-A Period 3b	Ek-A Period 4
Simple	3 (50)	31 (54.4)	17 (38.7)	66 (60.0)	77 (50)
Thickened	3 (50)	19 (33.3)	14 (31.8)	12 (11.0)	37 (22.6)
Everted	0 (0)	7 (12.3)	13 (30.5)	32 (29.0)	50 (30.5)
Total rims	**6 (100%)**	**57 (100%)**	**44 (100%)**	**110 (100%)**	**164 (100%)**

TABLE E.8 *Division of Ek-B and Ek-C rim forms into simple, everted and thickened rim form categories*

Rim category	Ek-B Horizon 1	Ek-B Horizon 2/3	Ek-C Horizon 1	Ek-C Horizon 2/3
Simple	14 (35.9)	178 (42.8)	16 (31.4)	20 (25.3)
Thickened	16 (41)	108 (26)	15 (29.4)	13 (16.5)
Everted	9 (23.1)	130 (31.3)	20 (39.2)	46 (58.2)
Total rims	**39 (100%)**	**416 (100%)**	**51 (100%)**	**79 (100%)**

TABLE E.9 *Frequency distribution of simple rims for unit Ek-A pots*

Rim type	Ek-A Period 1	Ek-A Period 2	Ek-A Period 3a	Ek-A Period 3b	Ek-A Period 4
S1			1	9	15
S3	1	8	3	16	18
S4	2	21	10	34	31
S5			3	7	9
S6					3
S7					1
S8		2			
Simple rims totals and % of overall rims per period	**3 (50%)**	**31 (54%)**	**17 (39%)**	**66 (60%)**	**77 (47%)**

TABLE E.10 *Frequency distribution of simple rims for unit Ek-B and Ek-C pots*

Rim type	Ek-B Horizon 1	Ek-B Horizons 2/3	Ek-C Horizon 1	Ek-C Horizons 2/3
S1	2	12	2	2
S3	1	52	6	7
S4	9	101	8	9
S5	2	13		1
S6				
S7				1
S8				
Simple rims totals and % of overall rims per period	**14 (36%)**	**178 (43%)**	**16 (31%)**	**20 (25%)**

TABLE E.11 *Frequency distribution of thickened rims for unit Ek-A pots*

Rim type	Ek-A Period 1	Ek-A Period 2	Ek-A Period 3a	Ek-A Period 3b	Ek-A Period 4
T01	1	1	3	2	2
T02	2	11	5	1	4
T05			3	2	5
T06		2	3		
T07				1	18
T09		1		2	4
T10		2		4	2
T11		1			
T12		1			1
T13					1
T14					
T15					
T17					
T18					
T19					
T20					
T21					
T23					
T24					
T25					
T26					
T27					
Thickened rims totals and % of overall rims per period	3 (50%)	19 (33%)	14 (32%)	12 (11%)	37 (23%)

TABLE E.12 *Frequency distribution of thickened rims for unit Ek-B and Ek-C pots*

Rim type	Ek-B Horizon 1	Ek-B Horizon 2/3	Ek-C Horizon 1	Ek-C Horizon 2/3
T01	1	10		1
T02	8	32	5	5
T05	3	23	5	3
T06		11	2	
T07		2		
T09	1	2	1	1
T10	1	10	1	1
T11		1		
T12				
T13		1		
T14		1		
T15		1		
T17		5		
T18		2		
T19		3		
T20		1		

Rim type	Ek-B Horizon 1	Ek-B Horizon 2/3	Ek-C Horizon 1	Ek-C Horizon 2/3
T21		1		
T23		1		
T24		1		
T25	2			1
T26				1
T27			1	
Thickened rims totals and % of overall rims per period	16 (41%)	108 (26%)	15 (29%)	13 (17%)

TABLE E.13 *Frequency distribution of everted rims for unit Ek-A pots*

Rim type	Ek-A Period 1	Ek-A Period 2	Ek-A Period 3a	Ek-A Period 3b	Ek-A Period 4
E02					2
E03					1
E04				1	1
E06				1	2
E07			1	5	7
E08					1
E13		1		3	
E15		1		1	1
E19					1
E20					
E21					22
E22					1
E24					5
E25				1	2
E26					1
E28					1
E29				1	
E30				1	1
E32					1
E34				1	
E35				9	
E37				1	
E38				3	
E39				1	
E40				1	
E41		2	5	1	
E43			4		
E44			2		
E46		1			
E49		1			
E50		1			
E52					
E53					
E54					

TABLE E.13 *Frequency distribution of everted rims for unit Ek-A pots* (cont.)

Rim type	Ek-A Period 1	Ek-A Period 2	Ek-A Period 3a	Ek-A Period 3b	Ek-A Period 4
E55					
E57					
E59					
E62					
E63					
E65					
E68			1	1	
E70					
Everted rims totals and % of overall rims per period	**0 (0%)**	**7 (12%)**	**13 (31%)**	**32 (29%)**	**50 (31%)**

TABLE E.14 *Frequency distribution of everted rims for unit Ek-B and Ek-C pots*

Rim type	Ek-B Horizon 1	Ek-B Horizon 2/3	Ek-C Horizon 1	Ek-C Horizon 2/3
E02		2		2
E03	1	1		
E04				
E06		3		1
E07		13	2	3
E08		1		1
E13		4		1
E15		2		5
E19				
E20	1	3		
E21				
E22				
E24		4		1
E25		2		1
E26				
E28		2	1	
E29				
E30		1		
E32	1	2	1	
E34		1		
E35		10	1	
E37				
E38				
E39				4
E40				
E41	1	29	8	11
E43	3	22	5	10
E44		2		
E46		1		
E49				
E50				
E52		1		

Rim type	Ek-B Horizon 1	Ek-B Horizon 2/3	Ek-C Horizon 1	Ek-C Horizon 2/3
E53		1		
E54		3		
E55	1	6	1	3
E57		1		
E59	1	7	1	2
E62		4		
E63		1		
E65		1		
E68				
E70				1
Everted rims totals and % of overall rims per period	**9 (23%)**	**130 (31%)**	**20 (39%)**	**46 (58%)**

TABLE E.15 *Frequency distribution of rim thickness for unit Ek-A pots*

Rim thickness in cm	Ek-A Period 1	Ek-A Period 2	Ek-A Period 3a	Ek-A Period 3b	Ek-A Period 4
0.4			1	2	1
0.5		1		6	10
0.6		8	5	14	11
0.7	1	6	6	17	27
0.8		12	6	15	28
0.9	1	4	5	12	18
1	1	5	6	13	18
1.1		3	3	8	19
1.2		5	2	6	10
1.3	1	4		3	5
1.4	2	3		2	1
1.5		1	1	2	5
1.6		1	1	2	1
1.7			1	3	2
1.8		2	2		3
1.9			3		1
2			1	2	2
2.1		1			
2.2					
2.3			1		
2.4				1	
2.5					
2.6					
2.7				2	1
2.8					1
2.9					
3.1					
3.2		1			
Total rims	**6**	**57**	**44**	**110**	**164**

TABLE E.16 *Frequency distribution of rim thickness for unit Ek-B and Ek-C pots*

Rim thickness in cm	Ek-B Horizon 1	Ek-B Horizon 2/3	Ek-C Horizon 1	Ek-C Horizon 2/3
0.4		4	1	2
0.5	2	32	1	4
0.6	3	36	6	6
0.7	5	64	12	9
0.8	4	63	10	9
0.9	5	45	4	12
1	8	33	2	14
1.1	1	21	2	5
1.2		17	3	4
1.3	4	19	1	3
1.4	1	12	1	3
1.5	3	18	2	1
1.6		12		2
1.7	1	16		2
1.8	1	8	5	1
1.9		4	1	
2		2		1
2.1		4		
2.2		1		
2.3		1		
2.4				
2.5	1	1		
2.6				1
2.7				
2.8				
2.9		2		
3.1		1		
3.2				
Total rims	39	416	51	79

TABLE E.17 *Frequency distribution of handle types for unit Ek-A pots*

Handle type	Ek-A Period 1	Ek-A Period 2	Ek-A Period 3a	Ek-A Period 3b	Ek-A Period 4
HB1					4
HB2					2
HB4					2
HB6					
HBext		2		2	14
HBint					1
HR1					7
HR3					3
HR4		2	1	1	
HR5				2	3

Handle type	Ek-A Period 1	Ek-A Period 2	Ek-A Period 3a	Ek-A Period 3b	Ek-A Period 4
HR7					
HR9					
HRext		1	1	1	11
HRint					
Hsect		2	4	7	19
Total	**0**	**7**	**6**	**13**	**66**

TABLE E.18 *Frequency distribution of handle types for unit Ek-B and Ek-C pots*

Handle type	Ek-B Horizon 1	Ek-B Horizon 2/3	Ek-C Horizon 1	Ek-C Horizon 2/3
HB1				
HB2				
HB4				
HB6		1		
HBext		8		5
HBint		3		
HR1				1
HR3				
HR4		7		
HR5		2		
HR7		1		
HR9				1
HRext	2	7		3
HRint		3		
Hsect	3	26		12
Total	**5**	**58**	**0**	**22**

TABLE E.19 *Frequency distribution of other modelled forms for unit Ek-A pots*

Form type	Ek-A Period 1	Ek-A Period 2	Ek-A Period 3a	Ek-A Period 3b	Ek-A Period 4
Carinated part			1	6	
V02				1	1
V03		1		3	1
V04		1	1		
V05					
V11					
V18					
Total	**0**	**2**	**2**	**10**	**2**

TABLE E.20 *Frequency distribution of other modelled forms for unit Ek-B and Ek-C pots*

Form type	Ek-B Horizon 1	Ek-B Horizon 2/3	Ek-C Horizon 1	Ek-C Horizon 2/3
Carinated part				
V02				1
V03	1	7		
V04				
V05				1
V11	2			
V18		4		
Total	3	11	0	1

TABLE E.21 *Frequency distribution of décor types for unit Ek-A pots*

Decor type	Ek-A Period 1	Ek-A Period 2	Ek-A Period 3a	Ek-A Period 3b	Ek-A Period 4
C	2	34	30	53	22
Ch	1	5	3	5	7
CI					
CI-2		3	3	13	25
CR-1					95
CR-2					
CR-4		14			
CR-5					1
CR-6			6	17	38
CR-7					
CR-9					
Erod	10	11	13	25	125
FI		1	9	7	62
Herb					17
Herb-geo					5
Mch	2	5	2	5	26
M-Perf		1			2
Natte					1
OI				2	10
OI-Geo					1
PA-2					3
PA-4					
PBC				9	
PBDO					
PBL			1	23	3
PBT				1	
PBW				18	15
PE-1		14	3	2	26
PE-4		1		1	13
Perf		1			10
PFI-3	4	68	33	51	16
PFI-4		1	1	1	7

Decor type	Ek-A Period 1	Ek-A Period 2	Ek-A Period 3a	Ek-A Period 3b	Ek-A Period 4
CWSGI			4	99	22
PFI-6					
PFR-1				2	
PI-1					1
PNL				8	1
PNW				1	
PRC					
PRL				1	1
PRW		6	4	33	28
SI-2					
SI-3			1	4	8
SI-4		1	1	2	5
SI-8					1
ST-1		2			2
ST-2				2	1
ST-3					1
ST-4	1			1	
Dogon					
Total	**20**	**168**	**114**	**386**	**601**

TABLE E.22 *Frequency distribution of décor types for unit Ek-B and Ek-C pots*

Decor type	Ek-B Horizon 1	Ek-B Horizon 2/3	Ek-C Horizon 1	Ek-C Horizon 2/3
C	37	485	30	32
Ch		25	5	5
CI		14		
CI-2	6	137	13	8
CR-1		17		5
CR-2	1	3		1
CR-4				
CR-5				
CR-6	1	100	10	7
CR-7		4		
CR-9		1		
Erod	2	2	1	6
FI		41	6	8
Herb		1		1
Herb-Geo				
Mch	4	32	1	6
M-Perf				
Natte	1	10		1
OI		7		3
OI-Geo				
PA-2	1	1		1
PA-4	1			

TABLE E.22 *Frequency distribution of décor types for unit Ek-B and Ek-C pots* (cont.)

Decor type	Ek-B Horizon 1	Ek-B Horizon 2/3	Ek-C Horizon 1	Ek-C Horizon 2/3
PBC				1
PBDO		1		
PBL	1	1		
PBT				
PBW		2		4
PE-1	3	31	3	20
PE-4	3	7		7
Perf		4	2	1
PFI-3	31	439	28	22
PFI-4		8	3	
CWSGI		7		15
PFI-6		4		
PFR-1	1			
PI-1		3		
PNL		2		1
PNW		1		
PRC				1
PRL				
PRW	1	29	3	14
SI-2				
SI-3	2	1		4
SI-4		3	4	1
Si-8				
ST-1	2	3		1
ST-2		3		
ST-3				
ST-4		2	2	
Dogon		2		3
Total	**98**	**1433**	**111**	**179**

TABLE E.23 *Frequency distribution of décor locations for unit Ek-A pots*

Locations décor recorded	Ek-A Period 1	Ek-A Period 2	Ek-A Period 3a	Ek-A Period 3b	Ek-A Period 4
Collar			3	6	24
Lip	1	2	3	5	8
Neck					
Upper		3	3	10	11
Middle				1	2
Base				1	
Collar interior				1	
Upper interior				2	
Handle		1		4	21
Handle associ.					9

Locations décor recorded	Ek-A Period 1	Ek-A Period 2	Ek-A Period 3a	Ek-A Period 3b	Ek-A Period 4
O2b				1	
Modelled base					
Body sherd	19	165	105	373	563

TABLE E.24 *Frequency distribution of décor locations for unit Ek-B and Ek-C pots*

Locations décor recorded	Ek-B Horizon 1	Ek-B Horizon 2/3	Ek-C Horizon 1	Ek-C Horizon 2/3
Collar		18	2	1
Lip	5	24	4	4
Neck		1		
Upper	6	37	5	10
Middle		13	1	
Base		1		
Collar interior				1
Upper interior	1	5	1	1
Handle		8		3
Handle associ.				6
O2b				
Modelled base		1		1
Body sherd	89	1353	101	161

TABLE E.25 *Frequency distribution of slip and burnish for unit Ek-A pots*

	Ek-A Period 1	Ek-A Period 2	Ek-A Period 3a	Ek-A Period 3b	Ek-A Period 4
Slip	–	6 (3%)	13 (7%)	167 (32%)	111 (14%)
Burnish	1 (4%)	36 (15%)	40 (21%)	125 (24%)	90 (11%)
Total sherds studied	25	241	188	525	814

TABLE E.26 *Frequency distribution of slip and burnish for unit Ek-B and Ek-C pots*

	Ek-B Horizon 1	Ek-B Horizon 2/3	Ek-C Horizon 1	Ek-C Horizon 2/3
Slip	7 (5%)	82 (5%)	7 (4%)	17 (7%)
Burnish	27 (17%)	204 (11%)	26 (16%)	11 (4%)
Total sherds studied	156	1875	164	260

TABLE E.27 *Frequency distribution table of broad firing core categories recorded in unit Ek-A*

Firing core type	Ek-A Period 1	Ek-A Period 2	Ek-A Period 3a	Ek-A Period 3b	Ek-A Period 4
1		9 (4%)	14 (8%)	91 (17%)	37 (5%)
3–11, 17	16 (64%)	143 (59%)	107 (57%)	251 (48%)	431 (53%)
12–14, 15,18	9 (36%)	89 (37%)	67 (35%)	183 (35%)	346 (32%)
Total	**25**	**241**	**188**	**525**	**814**

TABLE E.28 *Frequency distribution of Rye firing core types for unit Ek-A pots*

Firing core type	Ek-A Period 1	Ek-A Period 2	Ek-A Period 3a	Ek-A Period 3b	Ek-A Period 4
1		9	14	91	37
3	10	35	18	51	127
4		18	9	19	62
5					1
8	2	33	18	79	119
9	4	50	53	87	111
10		7	9	10	11
11				1	
12		1	1	2	5
13		21	9	40	30
14				4	
15	8	67	56	125	310
17					
18	1		1	16	1
Total	**25**	**241**	**188**	**525**	**814**

TABLE E.29 *Frequency distribution of Rye firing core types for unit Ek-B and Ek-C pots*

Firing core type	Ek-B Horizon 1	Ek-B Horizon 2/3	Ek-C Horizon 1	Ek-C Horizon 2/ 3
1	8	73	8	9
3	16	286	29	38
4	13	121	7	9
5		1		
8	21	177	11	20
9	30	482	36	91
10	11	82	3	5
11				
12	1	10		1
13	8	112	6	8
14	1	2	1	
15	45	493	58	77
17		22	1	
18	2	14	4	2
Total	**156**	**1875**	**164**	**260**

TABLE E.30 *Décor motif associations with temper code '44' sherds in Ek-A Period 3b*

Cord = 3
Painted = 36
PFI-3 = 3
CWSGI = 57
Channel = 1
Total sherds with temper code 44 in Ek-A Period 3b = 87

TABLE E.31 *Frequency distribution table of décor motif and simple rim correspondences on unit Ek-A pots*

Rim type	S1	S3	S4	S5	S6	S7	S8
CI-2 (Ek-A Per.2)							
CI-2 (Ek-A Per.3a)							
CI-2 (Ek-A Per.3b)							
CI-2 (Ek-A Per.4)							
CR-1 (Ek-A Per.2)							
CR-1 (Ek-A Per.3a)							
CR-1 (Ek-A Per.3b)							
CR-1 (Ek-A Per.4)	1		1				
CR-4 (Ek-A Per.2)		2					
CR-4 (Ek-A Per.3a)							
CR-4 (Ek-A Per.3b)							
CR-4 (Ek-A Per.4)							
CR-6 (Ek-A Per.2)							
CR-6 (Ek-A Per.3a)							
CR-6 (Ek-A Per.3b)	1						
CR-6 (Ek-A Per.4)	1						
FI (Ek-A Per.2)							
FI (Ek-A Per.3a)							
FI (Ek-A Per.3b)							
FI (Ek-A Per.4)							
Herb/H.g (Ek-A Per.2)							
Herb/H.g (Ek-A Per.3a)							
Herb/H.g (Ek-A Per.3b)							
Herb/H.g (Ek-A Per.4)	1	1					
Mch (Ek-A Per.2)							
Mch (Ek-A Per.3a)							
Mch (Ek-A Per.3b)				1			
Mch (Ek-A Per.4)			1				
Natte (Ek-A Per.2)							
Natte (Ek-A Per.3a)							
Natte (Ek-A Per.3b)							
Natte (Ek-A Per.4)							
OI-Geo/OI (Ek-A Per.2)							
OI-Geo/OI (Ek-A Per.3a)							

TABLE E.31 *Frequency distribution table of décor motif and simple rim correspondences on unit Ek-A pots* (cont.)

Rim type	S1	S3	S4	S5	S6	S7	S8
OI-Geo/OI (Ek-A Per.3b)							
OI-Geo/OI (Ek-A Per.4)	2						
Painted (Ek-A Per.2)							
Painted (Ek-A Per.3a)							
Painted (Ek-A Per.3b)							
Painted (Ek-A Per.4)			1				
PE-1/PE-4 (Ek-A Per.2)							
PE-1/PE-4 (Ek-A Per.3a)							
PE-1/PE-4 (Ek-A Per.3b)							
PE-1/PE-4 (Ek-A Per.4)							
PFI-3 (Ek-A Per.2)							
PFI-3 (Ek-A Per.3a)							
PFI-3 (Ek-A Per.3b)			1				
PFI-3 (Ek-A Per.4)							
CWSGI (Ek-A Per.2)							
CWSGI (Ek-A Per.3a)							
CWSGI (Ek-A Per.3b)							
CWSGI (Ek-A Per.4)							
SI-3/SI-4 (Ek-A Per.2)							
SI-3/SI-4 (Ek-A Per.3a)							
SI-3/SI-4 (Ek-A Per.3b)	2						
SI-3/SI-4 (Ek-A Per.4)	1	1		1			

TABLE E.32 *Frequency distribution table of décor motif and simple rim correspondences on Ek-B and Ek-C pots*

Rim type	S1	S3	S4	S5	S6	S7	S8
CI-2 (Ek-B Hor.1)							
CI-2 (Ek-B Hor.2/3)			1				
CI-2 (Ek-C Hor.1)							
CI-2 (Ek-C Hor.2/3)							
CR-1 (Ek-B Hor.1)							
CR-1 (Ek-B hor.2/3)							
CR-1 (Ek-C Hor.1)							
CR-1 (Ek-C Hor.2/3)			1				
CR-4 (Ek-B Hor.1)							
CR-4 (Ek-B Hor.2/3)							
CR-4 (Ek-C Hor.1)							
CR-4 (Ek-C Hor.2/3)							
CR-6 (Ek-B Hor.1)							
CR-6 (Ek-B Hor.2/3)							
CR-6 (Ek-C Hor.1)							
CR-6 (Ek-C Hor.2/3)							

Rim type	S1	S3	S4	S5	S6	S7	S8
FI (Ek-B Hor.1)							
FI (Ek-B Hor.2/3)							
FI (Ek-C Hor.1)							
FI (Ek-C Hor.2/3)							
Herb/H.g (Ek-B Hor.1)							
Herb/H.g (Ek-B Hor.2/3)							
Herb/H.g (Ek-C Hor.1)							
Herb/H.g (Ek-C Hor.2/3)							
Mch (EkB Hor.1)		1	1				
Mch (Ek-B Hor.2/3)			3	1			
Mch (Ek-C Hor.1)							
Mch (Ek-C Hor.2/3)			1				
Natte (Ek-B Hor.1)							
Natte (Ek-B Hor.2/3)							
Natte (Ek-C Hor.1)							
Natte (Ek-C Hor.2/3)							
Oi-Geo/OI (Ek-B Hor.1)							
Oi-Geo/OI (Ek-B Hor.2/3)							
Oi-Geo/OI (Ek-C Hor.1)							
Oi-Geo/OI (Ek-C Hor.2/3)							
Painted (Ek-B Hor.1)			1				
Painted (Ek-B Hor.2/3)			2				
Painted (Ek-C Hor.1)							
Painted (Ek-C Hor.2/3)							
PE-1/PE-4 (Ek-B Hor.1)							
PE-1/PE-4 (Ek-B Hor.2/3)	2		2				
PE-1/PE-4 (Ek-C Hor.1)							
PE-1/PE-4 (Ek-C Hor.2/3)							
PFi-3 (Ek-B Hor.1)							
PFI-3 (Ek-B Hor.2/3)	1		2				
PFi-3 (Ek-C Hor.1)			2				
PFI-3 (Ek-C Hor.2/3)		1					
CWSGI (Ek-B Hor.1)							
CWSGI (Ek-B Hor.2/3)							
CWSGI (Ek-C Hor.1)							
CWSGI (Ek-C Hor.2/3)							
SI-3/SI-4 (Ek-B Hor.1)				1			
SI-3/SI-4 (Ek-B Hor.2/3)							
SI-3/SI-4 (Ek-C Hor.1)		1					
SI-3/SI-4 (Ek-C Hor.2/3)			1				

TABLE E.33 *Frequency distribution table of décor motif and thickened rim correspondences on Ek-A pots*

Rim type	T1	T2	T5	T6	T7	T9	T10	T11	T12	T13	T14	T15	T17	T18	T19	T20	T21	T23	T24	T25	T26	T27
CI-2 (Ek-A Per.2)	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CI-2 (Ek-A Per.3a)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CI-2 (Ek-A Per.3b)	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CI-2 (Ek-A Per.4)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CR-1 (Ek-A Per.2)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CR-1 (Ek-A Per.3a)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CR-1 (Ek-A Per.3b)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CR-1 (Ek-A Per.4)	–	–	–	–	4	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CR-4 (Ek-A Per.2)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CR-4 (Ek-A Per.3a)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CR-4 (Ek-A Per.3b)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CR-4 (Ek-A Per.4)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CR-6 (Ek-A Per.2)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CR-6 (Ek-A Per.3a)	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CR-6 (Ek-A Per.3b)	–	1	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CR-6 (Ek-A Per.4)	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
FI (Ek-A Per.2)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
FI (Ek-A Per.3a)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
FI (Ek-A Per.3b)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
FI (Ek-A Per.4)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Herb/H.g (Ek-A Per.2)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
H/H.g (Ek-A Per.3a)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
H/H.g (Ek-A Per.3b)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Herb/H.g (Ek-A Per.4)	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Mch (Ek-A Per.2)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Mch (Ek-A Per.3a)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Mch (Ek-A Per.3b)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Mch (Ek-A Per.4)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Natte (Ek-A Per.2)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Natte (Ek-A Per.3a)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Natte (Ek-A Per.3b)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Natte (Ek-A Per.4)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
OI-Geo/OI (Ek-A Per.2)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
OI-Geo/OI (Ek-A Per.3a)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
OI-Geo/OI (Ek-A Per.3b)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
OI-Geo/OI (Ek-A Per.4)	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Painted (Ek-A Per.2)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Painted (Ek-A Per.3a)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Painted (Ek-A Per.3b)	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Painted (Ek-A Per.4)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
PE-1/4 (Ek-A Per.2)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
PE-1/4 (Ek-A Per.3a)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
PE-1/4 (Ek-A Per.3b)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–

Rim type	T1	T2	T5	T6	T7	T9	T10	T11	T12	T13	T14	T15	T17	T18	T19	T20	T21	T23	T24	T25	T26	T27
PE-1/4 (Ek-A Per.4)	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
PFI-3 (Ek-A Per.2)	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
PFI-3 (Ek-A Per.3a)	–	1	–	2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
PFI-3 (Ek-A Per.3b)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
PFI-3 (Ek-A Per.4)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CWSGI (Ek-A Per.2)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CWSGI (Ek-A Per.3a)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CWSGI (Ek-A Per.3b)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CWSGI (Ek-A Per.4)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
SI-3/4 (Ek-A Per.2)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
SI-3/4 (Ek-A Per.3a)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
SI-3/4 (Ek-A Per.3b)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
SI-3/4 (Ek-A Per.4)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–

TABLE E.34 *Frequency distribution table of décor motif and thickened rim correspondences on Ek-B and Ek-C pots*

Rim type	T1	T2	T5	T6	T7	T9	T10	T11	T12	T13	T14	T15	T17	T18	T19	T20	T21	T23	T24	T25	T26	T27
CI-2 (Ek-B Hor. 1)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CI-2 (Ek-B Hor. 2/3)	–	1	2	–	–	–	–	–	–	–	–	–	2	–	–	–	–	–	–	–	–	–
CI-2 (Ek-C Hor. 1)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CI-2 (Ek-C Hor. 2/3)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CR-1 (Ek-B Hor. 1)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CR-1 (Ek-B Hor. 2/3)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CR-1 (Ek-C Hor. 1)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CR-1 (Ek-C Hor. 2/3)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CR-4 (Ek-B Hor. 1)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CR-4 (Ek-B Hor. 2/3)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CR-4 (Ek-C Hor. 1)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CR-4 (Ek-C Hor. 2/3)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CR-6 (Ek-B Hor, 1)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CR-6 (Ek-B Hor. 2/3)	2	–	2	1	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CR-6 (Ek-C Hor. 1)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CR-6 (Ek-C Hor. 2/3)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
FI (Ek-B Hor. 1)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
FI (Ek-B Hor. 2/3)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
FI (Ek-C Hor. 1)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
FI (Ek-C Hor. 2/3)	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
H/H.g (Ek-B Hor. 1)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
H/H.g (Ek-B Hor. 2/3)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
H/H.g (Ek-C Hor. 1)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
H/H.g (Ek-C Hor. 2/3)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Mch (Ek-B Hor. 1)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Mch (Ek-B Hor. 2/3)	1	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–
Mch (Ek-C Hor. 1)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–

TABLE E.34 *Frequency distribution table of décor motif and thickened rim correspondences on Ek-B and Ek-C pots* (cont.)

Rim type	T1	T2	T5	T6	T7	T9	T10	T11	T12	T13	T14	T15	T17	T18	T19	T20	T21	T23	T24	T25	T26	T27
Mch (Ek-C Hor. 2/3)	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Natte (Ek-B Hor. 1)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Natte (Ek-B Hor. 2/3)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Natte (Ek-C Hor. 1)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Natte (Ek-C Hor. 2/3)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
OI-geo/OI (Ek-B Hor. 1)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
OI-Geo/OI (Ek-B Hor. 2/3)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
OI-Geo/OI (Ek-C Hor. 1)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
OI-Geo/OI (Ek-C Hor. 2/3)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Painted (Ek-B Hor. 1)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Painted (Ek-B Hor. 2/3)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Painted (Ek-C Hor. 1)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Painted (Ek-C Hor. 2/3)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
PE-1/4 (Ek-B Hor. 1)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
PE-1/4 (Ek-B Hor. 2/3)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
PE-1/4 (Ek-C Hor. 1)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
PE-1/4 (Ek-C Hor. 2/3)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
PFI-3 (Ek-B Hor. 1)	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–
PFI-3 (Ek-B Hor. 2/3)	–	3	3	6	–	1	–	–	–	–	–	–	2	–	–	–	–	–	–	–	–	–
PFi-3 (Ek-C Hor. 1)	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
PFI-3 (Ek-C Hor. 2/3)	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CWSGI (Ek-B Hor. 1)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CWSGI (Ek-B Hor. 2/3)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CWSGI (Ek-C Hor. 1)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CWSGI (Ek-C Hor. 2/3)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
SI-3/4 (Ek-B Hor. 1)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
SI-3/4 (Ek-B Hor. 2/3)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
SI-3/4 (Ek-C Hor. 1)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
SI-3/4 (Ek-C Hor. 2/3)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–

TABLE E.35 *Frequency distribution table of décor motif and everted rim correspondences on Ek-A pots* (*first table*)

Rim type	E2	E3	E4	E6	E7	E8	E13	E15	E19	E20	E21	E22	E24	E25	E26	E28	E29	E30	E32	E34	E35
CI-2 (Ek-A Per.2)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CI-2 (Ek-A Per.3a)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CI-2 (Ek-A Per.3b)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CI-2 (Ek-A Per.4)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CR-1 (Ek-A Per.2)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CR-1 (Ek-A Per.3a)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–

Rim type	E2	E3	E4	E6	E7	E8	E13	E15	E19	E20	E21	E22	E24	E25	E26	E28	E29	E30	E32	E34	E35
CR-1 (Ek-A Per.3b)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CR-1 (Ek-A Per.4)	–	–	–	–	–	–	–	–	–	–	4	–	–	–	–	–	–	–	–	–	–
CR-4 (Ek-A Per.2)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CR-4 (Ek-A Per.3a)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CR-4 (Ek-A Per.3b)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CR-4 (Ek-A Per.4)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CR-6 (Ek-A Per.2)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CR-6 (Ek-A Per.3a)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CR-6 (Ek-A Per.3b)	–	–	1	1	2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	3
CR-6 (Ek-A Per.4)	–	–	–	–	1	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–
FI (Ek-A Per.2)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
FI (Ek-A Per.3a)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
FI (Ek-A Per.3b)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
FI (Ek-A Per.4)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Herb/H.g (Ek-A Per.2)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Herb/H.g (Ek-A Per.3a)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Herb/H.g (Ek-A Per.3b)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Herb/H.g (Ek-A Per.4)	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–
Mch (Ek-A Per.2)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Mch (Ek-A Per.3a)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Mch (Ek-A Per.3b)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Mch (Ek-A Per.4)	1	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–
Natte (Ek-A Per.2)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Natte (Ek-A Per.3a)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Natte (Ek-A Per.3b)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Natte (Ek-A Per.4)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
OI-Geo/OI (Ek-A Per.2)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
OI-Geo/OI (Ek-A Per.3a)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
OI-Geo/OI (Ek-A Per.3b)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
OI-Geo/OI (Ek-A Per.4)	–	–	–	–	–	–	–	–	–	–	1	–	1	1	–	–	–	–	–	–	–
Painted (Ek-A Per.2)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Painted (Ek-A Per.3a)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Painted (Ek-A Per.3b)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Painted (Ek-A Per.4)	1	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–
PE-1/4 (Ek-A Per.2)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
PE-1/4 (Ek-A Per.3a)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
PE-1/4 (Ek-A Per.3b)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
PE-1/4 (Ek-A Per.4)	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–
PFI-3 (Ek-A Per.2)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
PFI-3 (Ek-A Per.3a)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
PFI-3 (Ek-A Per.3b)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
PFI-3 (Ek-A Per.4)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CWSGI (Ek-A Per.2)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CWSGI (Ek-A Per.3a)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–

TABLE E.35 *Frequency distribution table of décor motif and everted rim correspondences on Ek-A pots* (*first table*) (cont.)

Rim type	E2	E3	E4	E6	E7	E8	E13	E15	E19	E20	E21	E22	E24	E25	E26	E28	E29	E30	E32	E34	E35
CWSGI (Ek-A Per.3b)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CWSGI (Ek-A Per.4)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
SI-3/4 (Ek-A Per.2)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
SI-3/4 (Ek-A Per.3a)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
SI-3/4 (Ek-A Per.3b)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
SI-3/4 (Ek-A Per.4)	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–

TABLE E.36 *Frequency distribution table of décor motif and everted rim correspondences on Ek-A pots* (*second table*)

Rim type	E37	E38	E39	E40	E41	E43	E44	E46	E49	E50	E52	E53	E54	E55	E57	E59	E62	E63	E65	E68	E70
CI-2 (Ek-A Per.2)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CI-2 (Ek-A Per.3a)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CI-2 (Ek-A Per.3b)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CI-2 (Ek-A Per.4)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CR-1 (Ek-A Per.2)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CR-1 (Ek-A Per.3a)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CR-1 (Ek-A Per.3b)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CR-1 (Ek-A Per.4)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CR-4 (Ek-A Per.2)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CR-4 (Ek-A Per.3a)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CR-4 (Ek-A Per.3b)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CR-4 (Ek-A Per.4)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CR-6 (Ek-A Per.2)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CR-6 (Ek-A Per.3a)	–	–	–	–	–	2	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CR-6 (Ek-A Per.3b)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–
CR-6 (Ek-A Per.4)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
FI (Ek-A Per.2)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
FI (Ek-A Per.3a)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
FI (Ek-A Per.3b)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
FI (Ek-A Per.4)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Herb/H.g (Ek-A Per.2)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Herb/H.g (Ek-A Per.3a)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Herb/H.g (Ek-A Per.3b)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Herb/H.g (Ek-A Per.4)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Mch (Ek-A Per.2)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Mch (Ek-A Per.3a)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Mch (Ek-A Per.3b)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–
Mch (Ek-A Per.4)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Natte (Ek-A Per.2)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Natte (Ek-A Per.3a)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Natte (Ek-A Per.3b)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Natte (Ek-A Per.4)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–

Rim type	E37	E38	E39	E40	E41	E43	E44	E46	E49	E50	E52	E53	E54	E55	E57	E59	E62	E63	E65	E68	E70
OI-Geo/OI (Ek-A Per.2)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
OI-Geo/OI (Ek-A Per.3a)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
OI-Geo/OI (Ek-A Per.3b)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
OI-Geo/OI (Ek-A Per.4)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Painted (Ek-A Per.2)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Painted (Ek-A Per.3a)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–
Painted (Ek-A Per.3b)	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–
Painted (Ek-A Per.4)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
PE-1/4 (Ek-A Per.2)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
PE-1/4 (Ek-A Per.3a)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
PE-1/4 (Ek-A Per.3b)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
PE-1/4 (Ek-A Per.4)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
PFI-3 (Ek-A Per.2)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
PFI-3 (Ek-A Per.3a)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–
PFI-3 (Ek-A Per.3b)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
PFi-3 (Ek-A Per.4)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CWSGI (Ek-A Per.2)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CWSGI (Ek-A Per.3a)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CWSGI (Ek-A Per.3b)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CWSGI (Ek-A Per.4)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
SI-3/4 (Ek-A Per.2)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
SI-3/4 (Ek-A Per.3a)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
SI-3/4 (Ek-A Per.3b)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
SI-3/4 (Ek-A Per.4)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–

TABLE E.37 *Frequency distribution table of décor motif and everted rim correspondences on Ek-B and Ek-C pots (first table)*

Rim type	E2	E3	E4	E6	E7	E8	E13	E15	E19	E20	E21	E22	E24	E25	E26	E28	E29	E30	E32	E34	E35
CI-2 (Ek-B Hor. 1)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CI-2 (Ek-B Hor. 2/3)	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1
CI-2 (Ek-C Hor. 1)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CI-2 (Ek-C Hor. 2/3)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CR-1 (Ek-B Hor. 1)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CR-1 (Ek-B Hor. 2/3)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CR-1 (Ek-C Hor. 1)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CR-1 (Ek-C Hor. 2/3)	–	–	–	–	–	–	–	2	–	–	–	–	–	–	–	–	–	–	–	–	–
CR-4 (Ek-B Hor. 1)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CR-4 (Ek-B Hor. 2/3)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CR-4 (Ek-C Hor. 1)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CR-4 (Ek-C Hor. 2/3)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–

TABLE E.37 *Frequency distribution table of décor motif and everted rim correspondences on Ek-B and Ek-C pots (first table)* (cont)

Rim type	E2	E3	E4	E6	E7	E8	E13	E15	E19	E20	E21	E22	E24	E25	E26	E28	E29	E30	E32	E34	E35
CR-6 (Ek-B Hor. 1)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CR-6 (Ek-B Hor. 2/3)	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	5
CR-6 (Ek-C Hor. 1)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CR-6 (Ek-C Hor. 2/3)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
FI (Ek-B Hor. 1)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
FI (Ek-B Hor. 2/3)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
FI (Ek-C Hor. 1)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
FI (Ek-C. Hor. 2/3)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Herb/H.g (Ek-B Hor. 1)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Herb/H.g (Ek-B Hor. 2/3)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Herb/H.g (Ek-C Hor. 1)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Herb/H.g (Ek-C Hor. 2/3)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Mch (Ek-B Hor. 1)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Mch (Ek-B Hor. 2/3)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Mch (Ek-C Hor. 1)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Mch (Ek-C Hor. 2/3)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Natte (Ek-B Hor. 1)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Natte (Ek-B Hor. 2/3)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Natte (Ek-C Hor. 1)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Natte (Ek-C Hor. 2/3)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
OI-Geo/OI (Ek-B Hor. 1)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
OI-Geo/OI (Ek-B Hor. 2/3)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
OI-Geo/OI (Ek-C Hor. 1)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
OI-Geo/OI (Ek-C Hor. 2/3)	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Painted (Ek-B Hor. 1)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Painted (Ek-B Hor. 2/3)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Painted (Ek-C Hor. 1)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Painted (Ek-C Hor. 2/3)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
PE-1/4 (Ek-B Hor. 1)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
PE-1/4 (Ek-B Hor. 2/3)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
PE-1/4 (Ek-C Hor. 1)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
PE-1/4 (Ek-C Hor. 2/3)	2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
PFI-3 (Ek-B Hor. 1)	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
PFI-3 (Ek-B Hor. 2/3)	–	–	–	1	3	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1

Rim type	E2	E3	E4	E6	E7	E8	E13	E15	E19	E20	E21	E22	E24	E25	E26	E28	E29	E30	E32	E34	E35
PFI-3 (Ek-C Hor. 1)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1
PFI-3 (Ek-C Hor. 2/3)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CWSGI (Ek-B Hor. 1)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CWSGI (Ek-B Hor. 2/3)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CWSGI (Ek-C Hor. 1)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CWSGI (Ek-C Hor. 2/3)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
SI-3/4 (Ek-B Hor. 1)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
SI-3/4 (Ek-B Hor. 2/3)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
SI-3/4 (Ek-C Hor. 1)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
SI-3/4 (Ek-C Hor. 2/3)	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–

TABLE E.38 *Frequency distribution table of décor motif and everted rim correspondences on Ek-B and Ek-C pots (second table)*

Rim type	E37	E38	E39	E40	E41	E43	E44	E46	E49	E50	E52	E53	E54	E55	E57	E59	E62	E63	E65	E68	E70
CI-2 (Ek-B Hor. 1)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CI-2 (Ek-B Hor. 2/3)	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CI-2 (Ek-C Hor. 1)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CI-2 (Ek-C Hor. 2/3)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CR-1 (Ek-B Hor. 1)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CR-1 (Ek-B Hor. 2/3)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CR-1 (Ek-C Hor. 1)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CR-1 (Ek-C Hor. 2/3)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CR-4 (Ek-B Hor. 1)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CR-4 (Ek-B Hor. 2/3)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CR-4 (Ek-C Hor. 1)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CR-4 (Ek-C Hor. 2/3)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CR-6 (Ek-B Hor. 1)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CR-6 (Ek-B Hor. 2/3)	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CR-6 (Ek-C Hor. 1)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CR-6 (Ek-C Hor. 2/3)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
FI (Ek-B Hor. 1)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
FI (Ek-B Hor. 2/3)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
FI (Ek-C Hor. 1)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
FI (Ek-C Hor. 2/3)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Herb/H.g (Ek-B Hor. 1)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Herb/H.g (Ek-B Hor. 2/3)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Herb/H.g (Ek-C Hor. 1)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Herb/H.g (Ek-C Hor. 2/3)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–

TABLE E.38 *Frequency distribution table of décor motif and everted rim correspondences on Ek-B and Ek-C pots (second table)* (cont.)

Rim type	**E37**	**E38**	**E39**	**E40**	**E41**	**E43**	**E44**	**E46**	**E49**	**E50**	**E52**	**E53**	**E54**	**E55**	**E57**	**E59**	**E62**	**E63**	**E65**	**E68**	**E70**
Mch (Ek-B Hor. 1)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Mch (Ek-B Hor. 2/3)	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–
Mch (Ek-C Hor. 1)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Mch (Ek-C Hor. 2/3)	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Natte (Ek-B Hor. 1)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Natte (Ek-B Hor. 2/3)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Natte (Ek-C Hor. 1)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Natte (Ek-C Hor. 2/3)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
OI-Geo/OI (Ek-B Hor. 1)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
OI-Geo/OI (Ek-B Hor. 2/3)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
OI-Geo/OI (Ek-C Hor. 1)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
OI-Geo/OI (Ek-C Hor. 2/3)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Painted (Ek-B Hor. 1)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Painted (Ek-B Hor. 2/3)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Painted (Ek-C Hor. 1)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Painted (Ek-C Hor. 2/3)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
PE-1/4 (Ek-B Hor. 1)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
PE-1/4 (Ek-B Hor. 2/3)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
PE-1/4 (Ek-C Hor. 1)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
PE-1/4 (Ek-C Hor. 2/3)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
PFI-3 (Ek-B Hor. 1)	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
PFI-3 (Ek-B Hor. 2/3)	–	–	–	–	–	2	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–
PFI-3 (Ek-C Hor. 1)	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–
PFI-3 (Ek-C Hor. 2/3)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CWSGI (Ek-B Hor. 1)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CWSGI (Ek-B Hor. 2/3)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CWSGI (Ek-C Hor. 1)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CWSGI (Ek-C Hor. 2/3)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
SI-3/4 (Ek-B Hor. 1)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
SI-3/4 (Ek-B Hor. 2/3)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
SI-3/4 (Ek-C Hor. 1)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
SI-3/4 (Ek-C Hor. 2/3)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–

TABLE E.39 *Frequency distribution table of décor motif and handle form correspondences on Ek-A pots*

Rim type	HB1	HB2	HB4	HB6	HBext	HBint	HR1	HR3	HR4	HR5	HR7	HR9	HRext	HRint	Hsect
CI-2 (Ek-A Per.2)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CI-2 (Ek-A Per.3a)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CI-2 (Ek-A Per.3b)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CI-2 (Ek-A Per.4)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CR-1 (Ek-A Per.2)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CR-1 (Ek-A Per.3a)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CR-1 (Ek-A Per.3b)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CR-1 (Ek-A Per.4)	2	–	2	–	1	–	1	1	–	–	–	–	–	–	1
CR-4 (Ek-A Per.2)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CR-4 (Ek-A Per.3a)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CR-4 (Ek-A Per.3b)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CR-4 (Ek-A Per.4)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CR-6 (Ek-A Per.2)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CR-6 (Ek-A Per.3a)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CR-6 (Ek-A Per.3b)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CR-6 (Ek-A Per.4)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
FI (Ek-A Per.2)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
FI (Ek-A Per.3a)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
FI (Ek-A Per.3b)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
FI (Ek-A Per.4)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Herb/H.g (Ek-A Per.2)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Herb/H.g (Ek-A Per.3a)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Herb/H.g (Ek-A Per.3b)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Herb/H.g (Ek-A Per.4)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Mch (Ek-A Per.2)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Mch (Ek-A Per.3a)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Mch (Ek-A Per.3b)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Mch (Ek-A Per.4)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Natte (Ek-A Per.2)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Natte (Ek-A Per.3a)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Natte (Ek-A Per.3b)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Natte (Ek-A Per.4)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
OI-Geo/OI (Ek-A Per.2)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
OI-Geo/OI (Ek-A Per.3a)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
OI-Geo/OI (Ek-A Per.3b)	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–
OI-Geo/OI (Ek-A Per.4)	–	1	–	–	2	–	1	–	–	2	–	–	2	–	–
Painted (Ek-A Per.2)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Painted (Ek-A Per.3a)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Painted (Ek-A Per.3b)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Painted (Ek-A Per.4)	1	–	1	–	–	–	–	–	–	–	–	–	–	–	–

TABLE E.39 *Frequency distribution table of décor motif and handle form correspondences on Ek-A pots* (cont.)

Rim type	HB1	HB2	HB4	HB6	HBext	HBint	HR1	HR3	HR4	HR5	HR7	HR9	HRext	HRint	Hsect
PE-1/PE-4 (Ek-A Per.2)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
PE-1/PE-4 (Ek-A Per.3a)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
PE-1/PE-4 (Ek-A Per.3b)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
PE-1/PE-4 (Ek-A Per.4)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
PFI-3 (Ek-A Per.2)	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–
PFI-3 (Ek-A Per.3a)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
PFI-3 (Ek-A Per.3b)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
PFI-3 (Ek-A Per.4)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CWSGI (Ek-A Per.2)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CWSGI (Ek-A Per.3a)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CWSGI (Ek-A Per.3b)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CWSGI (Ek-A Per.4)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
SI-3/SI-4 (Ek-A Per.2)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
SI-3/SI-4 (Ek-A Per.3a)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
SI-3/SI-4 (Ek-A Per.3b)	–	–	–	–	–	–	–	–	1	1	–	–	–	–	2
SI-3/SI-4 (Ek-A Per.4)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1

TABLE E.40 *Frequency distribution table of décor motif and handle form correspondences on Ek-B and Ek-C pots*

Rim type	HB1	HB2	HB4	HB6	HBex	HBint	HR1	HR3	HR4	HR5	HR7	HR9	HRext	HRint	Hsect
CI-2 (Ek-B Hor.1)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CI-2 (Ek-B Hor.2/3)	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–
CI-2 (Ek-C Hor.1)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CI-2 (Ek-C Hor.2/3)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CR-1 (Ek-B Hor.1)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CR-1 (Ek-B Hor.2/3)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CR-1 (Ek-C Hor.1)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CR-1 (Ek-C Hor.2/3)	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–
CR-4 (Ek-B Hor.1)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CR-4 (Ek-B Hor.2/3)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CR-4 (Ek-C Hor.1)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CR-4 (Ek-C Hor.2/3)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CR-6 (Ek-B Hor.1)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CR-6 (Ek-B Hor.2/3)	–	–	–	–	–	–	–	–	–	–	1	–	–	–	3
CR-6 (Ek-C Hor.1)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CR-6 (Ek-C Hor.2/3)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
FI (Ek-B Hor.1)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
FI (Ek-B Hor.2/3)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–

Rim type	HB1	HB2	HB4	HB6	HBex	HBint	HR1	HR3	HR4	HR5	HR7	HR9	HRext	HRint	Hsect
FI (Ek-C Hor.1)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
FI (Ek-C Hor.2/3)	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–
Herb/H.g (Ek-B Hor.1)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Herb/H.g (Ek-B Hor.2/3)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Herb/H.g (Ek-C Hor.1)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Herb/H.g (Ek-C Hor.2/3)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Mch (Ek-B Hor.1)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Mch (Ek-B Hor.2/3)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Mch (Ek-C Hor.1)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Mch (Ek-C Hor.2/3)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Natte (Ek-B Hor.1)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Natte (Ek-B Hor.2/3)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Natte (Ek-C Hor.1)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Natte (Ek-C Hor.2/3)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
OI-Geo/OI (Ek-B Hor.1)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
OI-Geo/OI (Ek-B Hor.2/3)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
OI-Geo/OI (Ek-C Hor.1)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
OI-Geo/OI (Ek-C Hor.2/3)	–	–	–	–	2	–	–	–	–	–	–	–	–	–	2
Painted (Ek-B Hor.1)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Painted (Ek-B Hor.2/3)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Painted (Ek-C Hor.1)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Painted (Ek-C Hor.2/3)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
PE-1/PE-4 (Ek-B Hor.1)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
PE-1/PE-4 (Ek-B Hor.2/3)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
PE-1/PE-4 (Ek-C Hor.1)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
PE-1/PE-4 (Ek-C Hor.2/3)	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–
PFI-3 (Ek-B Hor.1)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1
PFI-3 (Ek-B Hor.2/3)	–	–	–	–	–	1	–	–	4	–	–	–	–	1	3
PFI-3 (Ek-C Hor.1)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
PFI-3 (Ek-C Hor.2/3)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CWSGI (Ek-B Hor.1)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CWSGI (Ek-B Hor.2/3)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CWSGI (Ek-C Hor.1)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–

TABLE E.40 *Frequency distribution table of décor motif and handle form correspondences on Ek-B and Ek-C pots* (cont.)

Rim type	HB1	HB2	HB4	HB6	HBex	HBint	HR1	HR3	HR4	HR5	HR7	HR9	HRext	HRint	Hsect
CWSGI (Ek-C Hor.2/3)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
SI-3/SI-4 (Ek-B Hor.1)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
SI-3/SI-4 (Ek-B Hor.2/3)	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–
SI-3/SI-4 (Ek-C Hor.1)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
SI-3/SI-4 (Ek-C Hor.2/3)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–

TABLE E.41 *Descriptive table of all T6 rims excavated at Essouk*

Horizon	Rim	Max-thick.	Diam.	Temper	Firing	Slip	Burn.	Handle	Motif	Motif Loc.
Ek-A Hor. 8	T6	1.8	28	45	4					
Ek-A Hor. 8	T6	1.8	36	42	12					
Ek-A Hor. 9	T6	1.9	22	41	12				PFI-3	L
Ek-A Hor. 9	T6	1.8	26	41	9					
Ek-A Hor. 9	T6	1.9	26	41	15				PFI-3	L
Ek-B Hor. 2	T6	1.5	34	41	3				PFI-3	L+U
Ek-B Hor. 2	T6	1.8	28	41	9				PFI-3	L+U+M
Ek-B Hor. 2	T6	2.1	30	41	9				PFI-3	L
Ek-B Hor. 2	T6	1.7	26	41	3			HB5		
Ek-B Hor. 3	T6	1.7	28	41	9				CR-6	L
Ek-B Hor. 3	T6	1.8	20	41	3					
Ek-B Hor. 3	T6	1.5	20	41	9		X			
Ek-B Hor. 3	T6	1.6	28	41	9					
Ek-B Hor. 3	T6	1.8	32	41	10			HRext	PFI-3	L+U
Ek-B Hor. 3	T6	1.9	36	41	9				PFI-3	L+M
Ek-B Hor. 3	T6	2	32	41	3			HRint	PFI-3	L+U+M+B
Ek-C Hor. 1	T6	1.8	24	41	3					
Ek-C Hor. 1	T6	1.9	20	41	15				PFI-3	L

TABLE E.42 *Descriptive table of all E35 rims excavated at Essouk*

Horizon	Rim	Max-thick.	Diam.	Temper	Firing	Slip	Burn.	Handle	Motif 1	Loc 1
Ek-A Hor. 10	E35	0.8	18	41	13				cr6	C
Ek-A Hor. 10	E35	1	18	41	8				st2	U
Ek-A Hor. 10	E35	1.2	18	41	15			hr5	cr6	U
Ek-A Hor. 11	E35	1	12	41	3					
Ek-A Hor. 11	E35	1.1	12	41	9					
Ek-A Hor. 11	E35	1.2	20	41	8					

Horizon	Rim	Max-thick.	Diam.	Temper	Firing	Slip	Burn.	Handle	Motif 1	Loc 1
Ek-A Hor. 11	E35	1.3	18	41	8					
Ek-A Hor. 11	E35	1.5	26	41	8					
Ek-A Hor. 11	E35	2	18	41	9				CR-6	C
Ek-B Hor. 2	E35	1.2	20	41	9		X		CR-6	C
Ek-B Hor. 2	E35	1.3	18	41	9		X		CR-6	C
Ek-B Hor. 2	E35	1.5	14	41	13	X	X			
Ek-B Hor. 2	E35	1.5	28	41	9	X			PFI-3	C
Ek-B Hor. 2	E35	1.7	14	41	3	X	X			
Ek-B Hor. 3	E35	1.8	10	41	3				CR-6	C
Ek-B Hor. 3	E35	1.1	14	41	9				CR-6	C
Ek-B Hor. 3	E35	1.3	24	41	3		X			
Ek-B Hor. 3	E35	1.4	16	41	3				CI-2	C
Ek-B Hor. 3	E35	1.5	14	41	9		X		CR-6	C
Ek-C Hor. 1	E35	1	20	41	9		X		PFI-3	C

TABLE E.43 *Descriptive table of all excavated pot forms associated with décor motif Cr-1*

Horizon	Rim	Max-thick.	Diam.	Temper	Firing	Slip	Burn.	Handle	Motif 1	Loc. 1	Motif 2	Loc. 2	Motif 3	Loc. 3
Ek-A 13	E21	0.8	12	41	15		X		CR-1	C				
Ek-A 13	E21	1.1	10	41	15			HR1	CR-1	C+M+H	PA-2	H+A		
Ek-A 13	E21	1.1	16	41	15	X	X	HB4	CR-1	C+U+M+H	PA-2	U+H+A		
Ek-A 13	E21	0.8	12	41	15			HR3	CR-1	C+U				
Ek-A 13	S1	0.8	10	41	3				CR-1	C				
Ek-A 13	T9	0.8	28	41	3	X			CR-1	C				
Ek-A 14	T7	0.8	14	41	9	X			CR-1	C				
Ek-A 14	S4	0.6	10	41	9				CR-1	C+U				
Ek-A 14			0	41	9			HBext	CR-1	H	PA-2	A		
Ek-A 14			0	41	4	X		Hsect	CR-1	H				
Ek-A 14			0	41	15			HB4	CR-1	H+A	PRW	H+A		
Ek-A 14			0	41	3	X		HB1	CR-1	H				
Ek-A 14			0	41	15			HB1	CR-1	H	PRW	H	PA-2	A
Ek-A 14	T7	1	14	41	15	X			CR-1	C				
Ek-A 14	T7	0.8	16	41	3	X			CR-1	C				
Ek-A 14	T7	0.8	16	41	3	X			CR-1	C				
Ek-C 2	S4	0.6	12	41	9				CR-1	U				
Ek-C 2	E15	0.7	12	41	9			HR9	CR-1	U+H	PA-2	H		

TABLE E.44 *Descriptive table of all CR-4 decorated sherds excavated*

Context	Horizon	Rim	Angle	Max. thick	Diam.	Temper	Firing	Burn.	Slip	Handle	Motif 1	Loc. 1	Motif 2	Loc. 2
Ek-A 114	3	–	–	–	–	44	8	–	–	–	CR-4	–	–	–
Ek-A 114	3	–	–	–	–	31	1	–	–	–	CR-4	–	–	–
Ek-A 114	3	–	–	–	–	44	4	x	x	–	CR-4	–	–	–
Ek-A 116	3	S3	5	1.2	20	41	3	x	–	–	CR-4	U	–	–
Ek-A 116	3	S3	5	1.1	18	41	4		–		CR-4	U	–	–
Ek-A 116	3	–	–	–	–	44	8	x	–	–	CR-4	–	–	–
Ek-A 116	3	–	–	–	–	44	8	x	–	–	CR-4	–	–	–
Ek-A 116	3	–	–	–	–	41	4	x	–	–	CR-4	–	–	–
Ek-A 116	3	–	–	–	–	41	3		–	–	CR-4	–	–	–
Ek-A 116	3	–	–	–	–	44	4	x	–	–	CR-4	–	–	–
Ek-A 116	3	–	–	–	–	44	1		–	–	CR-4	–	PRW	–
Ek-A 116	3	–	–	–	–	41	8	x	–	–	CR-4	–	–	–
Ek-A 116	3	–	–	–	–	44	1	x	–		CR-4	–	–	–
Ek-A 116	3	–	–	–	–	44	8		–	–	CR-4	–	PRW	–

TABLE E.45 *Frequency distribution table for simple rims recorded during the surface collection according to surface collection zones*

	S1	S3	S4	S5	S6	S7	S8
Zone 1							
119	1	1	3	1			
94	6	8	9				
97	2	2	6				
Zone 2							
104	1	4	7	1			
74	1	1	2	1			
71	3		2				
69	1	3	20			1	
108	2	4	22			1	
109	2	1	11	2			
63	4	4	2	2			
110	2	3	3				
61			2				
Zone 3							
112	5	3	10				
117	2		4	1			
116	1	2	2				
Zone 4							
120	1	3	14	4		1	
121	22	1	11	2		1	
Zone 5							
123	13		7				
126	13	2	9				
127	19	5	4				

TABLE E.46 *Frequency distribution table of thickened rims recorded during the surface collection according to surface collection zones*

	T1	T2	T5	T6	T7	T9	T10	T11	T12	T13	T14	T15	T17	T18	T19	T20	T21	T23	T24	T25	T26	T27
Zone 1																						
119	3	4	1	–	–	2	–	–	1	–	–	–	–	–	–	1	–	–	–	7	–	–
94	4	8	1	1	–	2	–	1	2	–	1	–	–	–	–	–	–	–	–	–	–	–
97	2	4	11	3	–	1	–	–	1	–	–	–	1	–	–	–	–	–	–	4	–	–
Zone 2																						
104	10	5	2	–	1	2	1	–	2	1	–	–	–	–	–	1	–	–	–	6	–	–
74	4	1	4	–	–		1	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–
71	2	6	2	–	–	2	1	–	1	–	–	–	1	–	–	–	–	–	–	–	–	–
69	10	15		–	1	3	1	–	3	2	1		1	–	–	–	–	–	–	2	–	–
108	15	12	2	–	–	2	1	–	1	–	–	1	2	–	–	–	–	–	–	2	–	–
109	8	8	4	1	–	–	2	–	–	–	2	–	–	–	–	1	–	–	–	2	–	–
63	11	10	5	–	–	4	1	2	–	1	–	–	–	–	1	–	–	–	–	5	–	–
110	5	3		–	–	1	–	1	–	–	–	–	–	–	–	–	–	–	–		–	–
61	1	3	1	–	–	1	–		–	–	–	–	–	–	–	–	–	–	–	1	–	–
Zone 3																						
112	4	4	7	–	–	2	–	1	1	1	–	–	1	–	–	1	–	–	–	–	–	–
117	1	1	1	–	–	2	–	–	3	1	–	–	1	–	–	1	–	–	–	1	–	–
116	6	2	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Zone 4																						
120	3	6	7	1	1	–	2	–	2	–	–	1	–	–	1	–	–	–	–	4	–	–
121	1	8	1	–	3	–	1	–	–	–	–	–	–	2	–	–	–	–	–	–	–	–
Zone 5																						
123	–	1	1	–	2	–	2	–	–	–	–	–	–	–	–	–	–	–	–	2	–	–
126	1	2	1	–	5	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
127	–	5	1	–	16	1	2	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–

TABLE E.47 *Frequency distribution table of everted rims recorded during the surface collection according to surface collection zones (no.1)*

	E2	E3	E4	E6	E7	E8	E13	E15	E19	E20	E21	E22	E24	E25	E26	E28	E29	E30	E32	E34	E35
Zone 1																					
119	–	–	–	1	2	–	–	–	–	–	–	–	1	2	–	1	–	–	–	–	2
94	–	–	–	1	12	–	–	2	–	–	1	–	–	2	–	–	1	–	–	–	1
97	–	–	–	1	3	–	–	1	–	–	–	–	–	–	–	3	–	1	1	–	3
Zone 2																					
104	–	–	–	1	12	2	1	1	–	–	1	–	–	–	–	3	–	–	1	–	2
74	–	1	1	1	3	1	–	–	1	–	–	–	–	1	–	2	–	–	–	–	3
71	–	–	–	2	5	1	–	–	–	1	–	–	–	3	–	–	–	–	–	–	3
69	–	–	1	4	12	–	–	2	–	1	–	–	–	1	–	2	–	–	1	–	–
108	6	1	–	5	6	1	–	3	–	–	4	–	–	4	–	3	–	–	4	–	1
109	1	–	–	1	7	–	1	–	–	–	–	–	–	1	–	–	–	–	–	–	–
63	–	–	–	–	1	–	1	1	–	1	1	–	–	–	–	2	–	–	–	–	1
110	–	–	1	–	9	1	–	1	–	–	1	–	–	–	–	2	–	–	–	–	1
61	–	–	–	1	–	–	–	1	–	–	–	–	–	–	–	1	–	–	–	–	–

TABLE E.47 *Frequency distribution table of everted rims recorded during the surface collection according to surface collection zones (no.1)* (cont.)

	E2	E3	E4	E6	E7	E8	E13	E15	E19	E20	E21	E22	E24	E25	E26	E28	E29	E30	E32	E34	E35
Zone 3																					
112	–	–	–	–	2	–	–	1	–	–	1	–	–	–	–	2	–	1	4	–	–
117	–	–	–	–	5	–	–	–	–	–	2	–	–	–	–	–	–	–	–	–	
116	–	–	–	1	3	–	–	–	–	1	–	–	–	1	–	–	–	1	–	–	2
Zone 4																					
120	–	–	–	–	5	–	1	2	–	–	3	–	–	1	–	1	–	2	1	–	2
121	–	–	–	–	–	–	–	8	–	–	6	–	1	–	–	–	–	–	–	–	–
Zone 5																					
123	–	–	–	1	–	–	–	–	–	–	38	–	1	1	–	–	–	–	–	–	–
126	–	–	–	2	1	2	–	3	–	–	19	–	1	2	–	1	–	–	–	–	–
127	–	–	–	–	1	2	–	2	–	–	50	–	–	1	–	–	–	–	–	–	–

TABLE E.48 *Frequency distribution table of everted rims recorded during the surface collection according to surface collection zones (no.2)*

	E37	E38	E39	E40	E41	E43	E44	E46	E49	E50	E52	E53	E54	E55	E57	E59	E62	E63	E65	E68	E70
Zone 1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
119	–	–	–	–	3	3	–	–	–	–	–	–	–	4	–	–	–	–	–	–	2
94	–	–	–	–	2	2	–	–	1	–	–	–	2	3	–	1	–	–	–	–	
97	–	–	–	–	1	2	3	1	–	–	–	1	–	2	–	–	–	–	–	–	1
Zone 2																					
104	–	–	–	–	3	5	–	–	1	1	–	1	–	8	–	1	–	–	–	–	3
74	–	–	1	–	3	1	–	–	1	–	–	–	–	2	–	1	1	–	–	–	
71	–	–	1	–	1	1	2	–	–	–	–	–	1	3	–	–	–	–	–	–	1
69	–	–	–	–	7	3	–	1	1	–	–	–	–	2	–	–	3	–	–	–	1
108	–	–	–	–	9	3	1	–	2	–	–	–	–	5	–	–	1	–	–	–	–
109	–	–	–	–	3	7	–	–	–	–	–	–	–	4	–	1	–	–	–	–	1
63	–	–	–	–	7	3	–	–	2	–	–	–	–	2	–	2	–	–	–	–	1
110	–	–	–	–	–	–	–	–	–	1	–	–	–		–	–	–	–	–	–	–
61	–	–	–	–	4	–	–	–	–	–	–	–	–	2	–	–	–	–	–	–	–
Zone 3																					
112	–	–	–	–	12	4	–	–	1	–	–	–	–	3	–	1	–	–	–	–	–
117	–	–	–	–	2	5	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–
116	–	–	–	–	2	2	–	–	–	1	–	1	–	1	–	1	–	–	–	–	–
Zone 4																					
120	–	–	–	–	9	3	1	–	–	–	–	–	–	5	–	–	–	–	–	–	–
121	–	–	–	–	5	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	1
Zone 5																					
123	–	–	–	–	1	1	–	–	–	–	–	–	–	3	–	–	–	–	–	–	–
126	–	–	–	–	6		–	–	–	–	–	–	–	–	–	–	–	–	–	–	1
127	–	–	–	–	3	2	–	–	–	–	–	–	–	2	–	–	1	–	–	–	–

TABLE E.49 *Frequency distribution table of everted rims recorded during the surface collection according to surface collection zones (no.3)*

	E74	E75	E77	E78	E79	E80	E81	E82	E83	E84	E85	E86	E87	E90	E94	E95
Zone 1																
119	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
94	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
97	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–
Zone 2																
104	–	–	1	1	2	–	–	–	1	1	–	–	–	–	–	–
74	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–
71	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
69	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
108	–	–	–	–	–	–	–	2	–	–	–	–	–	1	1	1
109	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
63	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
110	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–
61	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Zone 3																
112	–	–	–	1	–	–	1	–	–	–	–	–	–	–	–	–
117	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–
116	–	–	–	–	–	–	–	–	–	–	1	1	1	–	–	–
Zone 4																
120	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
121	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Zone 5																
123	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
126	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
127	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–

TABLE E.50 *Frequency distribution table of décor motifs recorded (on rims) during the surface collection according to surface collection zones*

	C	Ch	CI-2	CR-1	CR-6	FI	Mch	OI	PA-2	PBW	PE-1	PE-4	Perf	PFI-3	PRW	SI-3	SI-4	ST-1	ST-2	ST-4
Zone 1																				
119	6	–	–	–	–	–	–	–	–	–	–	–	–	7	–	1	–	–	1	1
94	7	–	–	–	–	1	–	–	–	–	–	–	–	5	1	–	2	–	–	–
97	1	–	1	–	–	–	–	–	–	–	–	–	–	13	–	1	–	–	–	–
Zone 2																				
104	3	–	–	–	–	–	1	–	–	–	–	–	–	17	–	–	–	–	–	–
74	–	–	1	–	–	–	1	–	–	–	–	–	–	6	–	–	–	–	–	–
71	–	–	–	–	–	–	–	–	–	–	–	–	–	6	–	1	–	1	–	–
69	10	1	–	–	–	–	–	–	–	–	–	1	1	7	–	1	–	1	1	1
108	5	–	–	–	–	–	–	–	–	–	–	–	–	12	–	1	–	–	2	–
109	–	–	3	–	–	–	–	–	–	1	2	–	–	7	1	–	1	–	1	–
63	4	–	–	–	1	–	1	–	–	–	–	–	–	7	–	–	–	–	–	–
110	4	–	–	–	1	–	–	–	–	–	1	–	–	4	–	1	–	–	–	–
61	2	–	–	–	–	–	–	–	–	–	–	–	–	2	–	–	–	1	–	–

TABLE E.50 *Frequency distribution table of décor motifs recorded (on rims) during the surface collection according to surface collection* (cont.)

	C	Ch	CI-2	CR-1	CR-6	FI	Mch	OI	PA-2	PBW	PE-1	PE-4	Perf	PFI-3	PRW	SI-3	SI-4	ST-1	ST-2	ST-4
Zone 3																				
112	1	2	2	–	–	–	3	–	–	–	–	–	–	3	2	1	–	–	–	–
117	4		1	–	–	–	1	–	–	–	–	–	–	9	–	–	–	–	–	–
116	4	1	1	–	–	–	2	–	–	–	–	–	–	3	–	1	–	1	–	–
Zone 4																				
120	2	–	–	1	2	–	–	3	–	–	1	1	–	4	–	–	–	–	–	1
121	–	–	–	1	–	1	–	4	–	–	3	–	1	1	–	–	–	–	–	–
Zone 5																				
123	–	–	–	11	–	2	–	3	1	–	5	1	2	–	1	–	–	–	–	–
126	–	–	–	14	–	–	–	6	–	–	3	1	–	–	2	–	–	–	2	–
127	–	2	–	26	–	–	–	9	–	–	16	4	1	–	1	–	–	1	3	2

TABLE E.51 *Results of thin section analysis of CWSGI sherds (Samples 1,2,3,4,6) and other control sherds (Samples 7, 8, 9) (Percentage of inclusions based upon 200 count samples)*

Sample >	**1**	**2**	**3**	**4**	**6**	**7**	**8**	**9**
Context >	**Ek-A 62**	**Ek-C 6**	**Ek-A 2**	**Ek-A 84**	**Ek-A 2**	**Ek-A 87**	**Ek-B 11**	**Ek-A 75**
Paste Matrix	52.0	41.5	55.5	68.5	48.0	70.0	41.0	50.0
Quartz- Argillaceous	19.5	11.5	16.5	7.5	14.0	17.0	17.0	29.0
FeO Inclusions	9.5	21.5	6.5	6.5	7.0		1.5	3.0
Organic Voids	10.0	16.5	6.5	10.0	7.0	3.5	26.0	2.5
Sponge Spicules	4.0	2.5	1.5	5.0	3.0			
Other Mineral Inclusions -								
Quartz- Rounded Sand	2.0	1.0	3.5		12.0	5.5	8.5	3.5
Plagioclase	3.0	2.0	1.0	1.0	1.0	1.5	1.5	2.5
Microcline		0.5				0.5	1.0	1.5
Biotite		0.5	1.0	1.5	0.5	0.5	1.5	5.0
Hornblende			0.5				0.5	
Staurolite							1.0	2.0
Igneous Rock (cf. Rhyolite)						1.5		1.0
Igneous Rock (cf. Basalt)							0.5	
Grog-								
Grog Paste Matrix		1.5	6.5		5.5			
Quartz in Grog- Argillaceous		0.5	0.5		0.5			
Quartz in Grog- Rounded Sand					0.5			
FeO Inclusions in Grog		0.5						
Sponge Spicules in Grog			0.5		1.0			

APPENDIX F

Glass Vessels Tables

Sam Nixon & James Lankton

TABLE F.1 *Frequency distribution table showing forms of all vessel glass specimens excavated at Essouk*

	Ek-A Hor. 1	Ek-A Hor. 2	Ek-A Hor. 3	Ek-A Hor. 4	Ek-A Hor. 5	Ek-A Hor. 6	Ek-A Hor. 7	Ek-A Hor. 8	Ek-A Hor. 9	Ek-A Hor. 10	Ek-A Hor. 11	Ek-A Hor. 12	Ek-A Hor. 13	Ek-A Hor. 14	Ek-B Hor. 1	Ek-B Hor. 2	Ek-B Hor. 3	Ek-C Hor. 1	Ek-C Hor. 2	Ek-C Hor. 3
General vessel body fragment	–	–	–	–	1	7	1	17	20	2	5	–	3	–	5	31	13	12	3	–
Bottle body fragment	–	–	1	–	–	–	–	–	4	1	–	–	–	–	–	1	–	–	–	–
General vessel rim	–	–	–	–	–	1	–	2	2	–	–	1	–	–	–	1	–	–	–	–
Bottle rim	–	–	–	1	–	–	–	1	1	–	–	1	–	–	–	1	–	–	–	–
General vessel modelled base	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–
Bottle modelled base	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–
Cut glass chunk	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–
Goblet base	–	–	–	–	–	–	–	–	1	–	–	1	–	–	–	–	–	–	–	–
Handle join	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Mosque lamp handle	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–
Tube fragment	–	–	–	–	–	–	–	–	1	–	–	2	–	–	1	3	–	–	–	–
Window glass (?)	–	–	–	–	–	–	–	3	5	1	–	–	–	–	1	5	1	–	–	–
Dish fragment	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–
Pendant/vessel leg (?)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	1	–
Total	–	–	1	2	1	8	1	24	37	4	5	5	3	–	8	43	14	12	4	–

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TABLE F.2 *Frequency distribution table showing thickness (in mm) of all (measureable) vessel glass excavated at Essouk*

	Ek-A Hor. 1	Ek-A Hor. 2	Ek-A Hor. 3	Ek-A Hor. 4	Ek-A Hor. 5	Ek-A Hor. 6	Ek-A Hor. 7	Ek-A Hor. 8	Ek-A Hor. 9	Ek-A Hor. 10	Ek-A Hor. 11	Ek-A Hor. 12	Ek-A Hor. 13	Ek-A Hor. 14	Ek-B Hor. 1	Ek-B Hor. 2	Ek-B Hor. 3	Ek-C Hor. 1	Ek-C Hor. 2	Ek-C Hor. 3
0.3–0.4	–	–	–	–	–	2	–	2	1	–	–	–	1	–	–	–	1	–	–	–
0.5–0.6	–	–	–	–	–	–	–	3	4	1	–	–	–	–	1	5	–	1	–	–
0.7–0.8	–	–	–	–	–	–	–	2	7	1	2	–	–	–	–	2	4	2	–	–
0.9–1.0	–	–	–	1	1	–	–	3	2	–	–	1	–	–	–	4	1	2	–	–
1.1–1.2	–	–	1	–	–	1	–	5	9	–	2	–	–	–	2	7	1	–	1	
1.3–1.4	–	–	–	–	–	–	1	5	5	–	–	–	1	–	–	5	–	2	–	–
1.5–1.6	–	–	–	–	–	–	–	1	1	–	–	1	–	–	1	5	1	1	–	–
1.7–1.8	–	–	–	–	–	2	–	1	–	1	–	–	–	–	2	1	2	1	–	–
1.9–2.0	–	–	–	–	–	–	–	–	1	–	–	–	–	–	1	3	1	1	–	–
2.1–2.4	–	–	–	–	–	1	–	1	2	–	–	–	–	–	–	1	1	2	1	–
2.5–2.8	–	–	–	–	–	1	–	1	–	–	–	–	–	–	–	4	–	–	1	–
2.9–3.2	–	–	–	–	–	–	–		–	1	1	–	–	–	–	–	1	–	–	–
3.3–3.6	–	–	–	–	–	–	–	–	2	–	–	1	–	–	–	2	1	–	–	–
3.7–4.0	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	1	–
4.1–4.4	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–
4.5–4.8	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
4.9–5.2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
5.3–5.6	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
5.7–6.0	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
6.1–6.4	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–

TABLE F.3 *Frequency distribution table showing colours of all vessel glass excavated at Essouk ('orig.?' = original colour uncertain)*

	Ek-A Hor. 1	Ek-A Hor. 2	Ek-A Hor. 3	Ek-A Hor. 4	Ek-A Hor. 5	Ek-A Hor. 6	Ek-A Hor. 7	Ek-A Hor. 8	Ek-A Hor. 9	Ek-A Hor. 10	Ek-A Hor. 11	Ek-A Hor. 12	Ek-A Hor. 13	Ek-A Hor. 14	Ek-B Hor. 1	Ek-B Hor. 2	Ek-B Hor. 3	Ek-C Hor. 1	Ek-C Hor. 2	Ek-C Hor. 3
Aqua	–	–	–	–	–	2	1	4	14	2	–	–	–	–	–	6	–	–	–	–
Clear	–	–	–	–	–	–	–	2	3	1	–	–	–	–	–	5	3	–	1	–
Decolorized	–	–	–	–	–	–	–	–	–	–	–	–	1	–	2	1	–	2	–	–
Dark-blue	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	1	–	–	–	–
Dark-blue/green	–	–	–	–	–	–	–	–	1	–	–	–	–	–	1	1	–	–	–	–
Light-blue	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	5	–	–	–	–
Light-blue/green	–	–	–	–	–	–	–	–	–	–	2	–	–	–	–	–	–	–	–	–
Light-pink brown	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	3	–	–	–	–
Light-yellow/green	–	–	–	–	–	–	–	3	–	–	–	–	–	–	–	–	–	–	–	–
Medium-blue/green	–	–	–	–	–	–	–	1	1	1	–	–	–	–	–	–	–	–	–	–
Medium-brown/green	–	–	–	–	–	–	–	1	–	–	–	1	–	–	–	–	–	–	–	–
Medium-green	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–
Pale-green	–	–	1	–	–	–	–	6	10	–	1	2	–	–	3	8	1	2	–	–
Pale-yellow	–	–	–	–	1	1	–	2	4	–	1	2	–	–	1	12	5	–	2	–
Ruby-red	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–
Aqua (orig.?)	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	1	–	–	–
Clear (orig.?)	–	–	–	–	–	–	–	1	2	–	–	–	–	–	–	–	2	5	1	
Dark-green (orig.?)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–		1	–	–
Light-green (orig.?)	–	–	–	1	–	2	–	–	–	–	–	–	–	–	–	1	2	1	–	–
Medium-green (orig.?)	–	–	–	1	–	2	–	–	1	–	–	–	–	–	–	–	–	1	–	–
Medium-yellow (orig.?)	–	–	–	–	–	1	–	3	–	–	–	–	–	–	–	–	–	–	–	–
Pale-blue (orig.?)	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–

TABLE F.4 *Frequency distribution table showing weathering of all vessel glass excavated at Essouk*

	Ek-A Hor. 1	Ek-A Hor. 2	Ek-A Hor. 3	Ek-A Hor. 4	Ek-A Hor. 5	Ek-A Hor. 6	Ek-A Hor. 7	Ek-A Hor. 8	Ek-A Hor. 9	Ek-A Hor. 10	Ek-A Hor. 11	Ek-A Hor .12	Ek-A Hor. 13	Ek-A Hor. 14	Ek-B Hor. 1	Ek-B Hor. 2	Ek-B Hor. 3	Ek-C Hor. 1	Ek-C Hor. 2	Ek-C Hor. 3
No weathering			1		1	1	1	9	25	4	4	5	2		8	40	8	3	2	
Slight weathering						2		11	8		1					3	5	6	1	
Heavy weathering				2		5		4	3				1				1	3	1	

APPENDIX G

Glass Bead Tables

Sam Nixon & James Lankton

TABLE G.1 *Frequency distribution table showing quantities and forms of glass beads throughout the three excavated units (including per horizon)*

	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	Ek-A total	B1	B2	B3	Ek-B total	C1	C2	C3	Ek-C total	Total
Barrel				1			1	10	15	3	5	6	1		*(42)*	5	24	9	*(38)*	10	2		*(12)*	92
Cylinder						1	1	2	3	2	4	1	1		*(15)*	4	10	3	*(17)*				*(0)*	32
Disc								2	2		1		1		*(6)*		1	1	*(2)*		1		*(1)*	9
Drum				1	1	1	4	1	6	2	3	1	3		*(23)*	1	14	2	*(17)*	6	1		*(7)*	47
Ellipsoid									1						*(1)*				*(0)*				*(0)*	1
Long barrel										1	1		1		*(3)*			1	*(1)*				*(0)*	4
Oblate				2				1	6	1		1			*(11)*	5	14	2	*(21)*	2			*(2)*	34
Ring															*(0)*			1	*(1)*				*(0)*	1
Segmented					1										*(1)*		2		*(2)*	1			*(1)*	4
Spheroid							1		2		1				*(4)*				*(0)*				*(0)*	4
Tube															*(0)*		1		*(1)*	1			*(1)*	2
Total whole beads	–	–	–	***4***	***2***	***2***	***7***	***16***	***35***	***9***	***15***	***9***	***7***	–	***(106)***	***15***	***66***	***19***	***(100)***	***20***	***4***	–	***(24)***	***230***
Fragments				***2***				***28***	***28***	***7***	***8***	***7***	***5***	***2***	***(87)***	***11***	***36***	***9***	***(56)***	***7***	***5***		***(12)***	***155***
Total bead-glass specimens	**0**	**0**	**0**	**6**	**2**	**2**	**7**	**44**	**63**	**16**	**23**	**16**	**12**	**2**	***(193)***	**26**	**102**	**28**	***(156)***	**27**	**9**	**0**	***(36)***	**385**

TABLE G.2 *Frequency distribution table showing regularity of glass bead forms per unit Ek-A horizon*

	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14
Regular				1	2	1	2	4	13	3	1	3	2	
Irregular				3		1	5	12	22	6	14	6	5	
Total	**0**	**0**	**0**	**4**	**2**	**2**	**7**	**16**	**35**	**9**	**15**	**9**	**7**	**0**

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TABLE G.3 *Frequency distribution table showing regularity of glass bead forms per horizon in units Ek-B & Ek-C*

	B1	B2	B3	C1	C2	C3
Regular	4	30	8	6	2	
Irregular	11	36	11	14	2	
Total	**15**	**66**	**19**	**20**	**4**	**0**

TABLE G.4 *Frequency distribution table showing sizes of excavated glass beads*

	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	Ek-A total	B1	B2	B3	Ek-B total	C1	C2	C3	Ek-C total	Total
Seed									1	1	4		2		*(8)*	2	5	3	*(10)*	4	1		*(5)*	23
Small				3		1	3	4	14	6	5	6	3		*(45)*	9	49	13	*(71)*	9	3		*(12)*	128
Med				1	2	1	4	12	17	2	4	2	2		*(47)*	4	11	3	*(18)*	7			*(7)*	72
Large									3		2	1			*(6)*		1		*(1)*				*(0)*	7
Total	**0**	**0**	**0**	**4**	**2**	**2**	**7**	**16**	**35**	**9**	**15**	**9**	**7**	**0**	***(106)***	**15**	**66**	**19**	***(100)***	**20**	**4**	**0**	***(24)***	**230**

TABLE G.5 *Frequency distribution table showing perforation sizes of excavated glass beads*

	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	Ek-A total	B1	B2	B3	Ek-B total	C1	C2	C3	Ek-C total	Total
<1mm						1		2	1	3	5	3	1		*(16)*	3	23	6	*(32)*	5	3		*(8)*	56
1mm				3			2	1	21	4	7	2	4		*(44)*	6	29	8	*(43)*	10	1		*(11)*	98
1.5mm				1	1		3	9	8	1	1	1			*(25)*	5	7	3	*(15)*				*(0)*	40
2mm						1	1	4	4		1		1		*(12)*		7	1	*(8)*	4			*(4)*	24
2.5mm					1										*(1)*				*(0)*				*(0)*	1
3mm											1				*(1)*	1			*(1)*				*(0)*	2
4mm							1		1	1		3			*(6)*				*(0)*				*(0)*	6
fused													1		*(1)*			1	*(1)*	1			*(1)*	3
Total	**0**	**0**	**0**	**4**	**2**	**2**	**7**	**16**	**35**	**9**	**15**	**9**	**7**	**0**	***(106)***	**15**	**66**	**19**	***(100)***	**20**	**4**		***(24)***	**230**

TABLE G.6 *Frequency distribution table showing manufacturing techniques used to make the excavated glass beads*

	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	Ek-A total	B1	B2	B3	Ek-B total	C1	C2	C3	Ek-C total	Total
Drawn				1	1	1	6	9	16	2	5	6	5		*(52)*	9	44	6	*(59)*	6	2		*(8)*	119
Wound							1		3	1		3	1		*(9)*	2	1		*(3)*	1			*(1)*	13
Segmented					1										*(1)*		3		*(3)*	1			*(1)*	5
Eyebead										1					*(1)*	1			*(1)*				*(0)*	2
Total identified	**0**	**0**	**0**	**1**	**2**	**1**	**7**	**9**	**19**	**4**	**5**	**9**	**6**	**0**	***(63)***	**12**	**48**	**6**	***(66)***	**8**	**2**	**0**	***(10)***	**139**

TABLE G.7 *Frequency distribution table showing colours of excavated glass beads*

	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	Ek-A total	B1	B2	B3	Ek-B total	C1	C2	C3	Ek-C total	Total
Black	–	–	–	–	–	–	–	–	1	3	–	3	–	–	(7)	1	7	3	(11)	2		–	(2)	20
Light blue	–	–	–	–	–	–	–	2	1	2	–	–	1	–	(6)	–	2		(2)	–	–	–	(0)	8
Medium blue	–	–	–	–	–	–	–	27	31	–	4	–	1	–	(63)	–	11	3	(14)	1		–	(1)	78
Dark blue	–	–	–	1	1	–	–	–	1	–	–	1	2	–	(6)	–	4		(4)	2	1	–	(3)	13
Clear	–	–	–	–	–	–	–	–		–	–	–	–	–	(0)	–	2		(2)	–	–	–	(0)	2
Cream	–	–	–	–	–	–	–	–	2	–	–	–	–	–	(2)	–	2	1	(3)	–	–	–	(0)	5
Light green	–	–	–	–	–	–	–	–	–	–	–	–	–	–	(0)	1	2	2	(5)	–	–	–	(0)	5
Medium green	–	–	–	1	–	–	–	1	4	2	2	–	3	–	(13)	1	6	1	(8)	5	1	–	(6)	27
Dark green	–	–	–	–	–	–	–	–	2	1	6	3	3	2	(17)	2	5	2	(9)	1	1	–	(2)	28
Medium purple	–	–	–	–	–	–	–	–	–	–	–	–	–	–	(0)	–	1	1	(2)	–	–	–	(0)	2
Medium greenish blue	–	–	–	1	–	–	–	–	–	–	1	2	1	–	(5)	2	1	1	(4)	1	2	–	(3)	12
Dark greenish blue	–	–	–	–	–	–	–	–	–	–	–	–	1	–	(1)	1	–	–	(1)	–	–	–	(0)	2
Light yellow	–	–	–	–	–	–	–	–	–	–	–	1	–	–	(1)	–	1	–	(1)	–	–	–	(0)	2
Medium yellow	–	–	–	–	–	–	1	1	2	1	3		–	–	(8)	5	16		(21)	1	–	–	(1)	30
Dark yellow	–	–	–	–	–	1	5	–	2	–	1		–	–	(9)	2	12	1	(15)	3	–	–	(3)	27
White	–	–	–	–	–	–	–	1	3	–	–	1	–	–	(5)	–	1	–	(1)	2	–	–	(2)	8
Brick red	–	–	–	–	–	–	–	–	–	1	–		–	–	(1)	–	–	–	(0)	–	–	–	(0)	1
Multi colour	–	–	–	–	–	–	–	–	3	1	–	1	–	–	(5)	4	4	–	(8)	–	–	–	(0)	13
Light greenish blue (orig.?)	–	–	–	1		1		4	4	1	–	1	–	–	(12)	1	1	1	(3)	–	1	–	(1)	16
Medium greenish blue (orig.?)	–	–	–	–	–	–	–	2	5	2	1	1	–	–	(11)	2	10	1	(13)	6	1	–	(7)	31
Dark greenish blue (orig.?)	–	–	–	–	–	–	–	–	–	–	–	1	–	–	(1)	–	–	–	(0)	–	–	–	(0)	1
Black (orig.?)	–	–	–	–	–	–	–	–	–	1	–	–	–	–	(1)	–	2	2	(4)	–	–	–	(0)	5
Light blue (orig.?)	–	–	–	–	–	–	–	1	1	–	–	–	–	–	(2)	1	1	–	(2)	–	1	–	(1)	5
Light brown (orig.?)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	(0)	–	–	1	(1)	–	–	–	(0)	1
Medium brown (orig.?)	–	–	–	–	–	–	–	–	–	–	2	–	–	–	(2)	2	6	2	(10)	1	–	–	(1)	13
Dark brown (orig.?)	–	–	–	–	–	–	–	–	–	–	2	–	–	–	(2)	–	1	–	(1)	–	–	–	(0)	3
Cream (orig.?)	–	–	–	–	1	–	1	4	–	–	–	1	–	–	(7)	–	1	3	(4)	1	1	–	(2)	13
Light green (orig.?)	–	–	–	2	–	–	–	1	1	–	–	–	–	–	(4)	–	2	1	(3)	–	–	–	(0)	7
Medium green (orig.?)	–	–	–	–	–	–	–	–	–	–	1	–	–	–	(1)	1	1	1	(3)	–	–	–	(0)	4
Silver (orig.?)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	(0)	–	–	1	(1	–	–	–	(0)	1
Light yellow (orig.?)	–	–	–	–	–	–	–	–	–	1	–	–	–	–	(1)	–	–	–	(0)	–	–	–	(0)	1
Medium yellow (orig.?)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	(0)	–	–	–	(0)	1	–	–	(1)	1
Total	**0**	**0**	**0**	**6**	**2**	**2**	**7**	**44**	**63**	**16**	**23**	**16**	**12**	**2**	**(193)**	**26**	**102**	**28**	**(156)**	**27**	**9**	**0**	**(36)**	**385**

TABLE G.8 *Frequency distribution table showing 'property under light' of excavated glass beads*

	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	Ek-A total	B1	B2	B3	Ek-B total	C1	C2	C3	Ek-C total	Total
Opaque				2		1	6	32	48	10	9	10	10	2	*(130)*	16	52	13	*(81)*	17	4		*(21)*	232
Transl.				1	1				3		7	1	1		*(14)*	2	17	1	*(20)*		1		*(1)*	35
Transp.									1	1	1		1		*(4)*		6	1	*(7)*	1			*(1)*	12
Dichroic												1			*(1)*				*(0)*				*(0)*	1
Mixed															*(0)*	1	2		*(3)*				*(0)*	3
?				3	1	1	1	12	11	5	6	4			*(44)*	7	25	13	*(45)*	9	4		*(13)*	102
Total	**0**	**0**	**0**	**6**	**2**	**2**	**7**	**44**	**63**	**16**	**23**	**16**	**12**	**2**	***(193)***	**26**	**102**	**28**	***(156)***	**27**	**9**	**0**	***(36)***	**385**

TABLE G.9 *Frequency distribution table showing degrees of weathering of excavated glass beads*

	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	Ek-A total	B1	B2	B3	Ek-B total	C1	C2	C3	Ek-C total	Total
Heavy				3				22	25	6	4	2			*(62)*	7	31	14	*(52)*	9	5		*(14)*	128
Slight				2	1	1	1	12	11	2	7	8	4	2	*(51)*	1	14	5	*(20)*	5	1		(6)	77
None				1	1	1	6	10	27	8	12	6	8		*(80)*	18	57	9	*(84)*	13	3		*(16)*	180
Total				**6**	**2**	**2**	**7**	**44**	**63**	**16**	**23**	**16**	**12**	**2**	***(193)***	**26**	**102**	**28**	***(156)***	**27**	**9**	**0**	***(36)***	**385**

TABLE G.10 *Frequency distribution table showing correspondences between original bead colours and degrees of weathering*

		Black	Light blue	Medium blue	Dark blue	Clear	Cream	Light green	Medium green	Dark green	Medium purple	Medium greenish blue	Dark greenish blue	Light yellow	Mid yellow	Dark yellow	Brick red	Multi colour	White
Ek-A Period 2 >	*Heavy*	–	1	12	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Ek-A Period 3a >	*Heavy*	–	–	13	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–
Ek-A Period 3b >	*Heavy*	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Ek-A Period 4 >	*Heavy*	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Ek-B Horizon 1 >	*Heavy*	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Ek-B Horizon 2/3 >	*Heavy*	–	–	8	–	–	–	1	3	–	–	–	–	–	–	–	–	–	–
Ek-A Period 2 >	*Slight*	–	1	7	1	–	–	–	1	–	–	1	–	–	–		–	–	
Ek-A Period 3a >	*Slight*	–	1	6	1	–	–	–	1	–	–	–	–	–	–	1	–	–	1
Ek-A Period 3b >	*Slight*	–	–	2	–	–	–	–	1	4	–	–	–	–	–	–	–	–	–
Ek-A Period 4 >	*Slight*	1	–	1	2	–	–	–	2	4	–	–	–	1	–	–	–	–	1
Ek-B Horizon 1 >	*Slight*	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–
Ek-B Horizon 2/3 >	*Slight*	–	–	1	1	1		1	1	2	1	–	–	–	3	3	–	–	–
Ek-A Period 2 >	*None*	–	–	8	1	–	–	–	1	–	–	–	–	–	2	6	–	–	1
Ek-A Period 3a >	*None*	1	–	12	–		2		2	2	–	–	–	–	2	1		3	2
Ek-A Period 3b >	*None*	3	1	2	–	–	–	–	3	3	–	1	–	–	4	1	1	1	–
Ek-A Period 4 >	*None*	2	1	–	1	–	–	–	1	4	–	3	1	–	–	–	–	1	–
Ek-B Horizon 1 >	*None*	1	–	–	–	–	–	1	1	1	–	2	1	–	5	2	–	4	–
Ek-B Horizon 2/3 >	*None*	10	2	5	3	1	3	2	3	5	1	2	–	1	13	10	–	4	1

TABLE G.11 *Frequency distribution table showing correspondences between bead colours not thought to be original and degrees of weathering*

		Light greenish blue (orig.?)	Medium greenish blue (orig.?)	Dark greenish blue (orig.?)	Black (orig.?)	Light blue (orig.?)	Light brown (orig.?)	Medium brown (orig.?)	Dark brown (orig.?)	Cream (orig.?)	Light green (orig.?)	Medium green (orig.?)	Silver (orig.?)	Light yellow (orig.?)	Medium yellow (orig.?)
Ek-A Period 2 >	*Heavy*	5	2	–	–	1	–	–	–	1	3	–	–	–	–
Ek-A Period 3a >	*Heavy*	4	5	–	–	1	–	–	–	–	1	–	–	–	–
Ek-A Period 3b >	*Heavy*	1	3	–	1	–	–	1	1	–	–	1	–	1	–
Ek-A Period 4 >	*Heavy*	1	1	–	–	–	–	–	–	–	–	–	–	–	–
Ek-B Horizon 1 >	*Heavy*	1	2	–	–	1		2	–	–	–	–	–	–	–
Ek-B Horizon 2/3 >	*Heavy*	2	11	–	2	1	1	8	1	2	2	2	1	–	–
Ek-A Period 2 >	*Slight*	1	–	–	–	–	–	–	–	5	–	–	–	–	–
Ek-A Period 3a >	*Slight*	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Ek-A Period 3b >	*Slight*	–	–	–	–	–	–	1	–	–	–	–	–	–	–
Ek-A Period 4 >	*Slight*	–	–	1	–	–	–	–	–	1	–	–	–	–	–
Ek-B Horizon 1 >	*Slight*	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Ek-B Horizon 2/3 >	*Slight*	–	–	–	2	–	–	–	–	2	1	–	–	–	–
Ek-A Period 2 >	*None*	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Ek-A Period 3a >	*None*	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Ek-A Period 3b >	*None*	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Ek-A Period 4 >	*None*	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Ek-B Horizon 1 >	*None*	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Ek-B Horizon 2/3 >	*None*	–	–	–	–	–	–	–	–	–	–	–	–	–	–

TABLE G.12 *Frequency distribution table showing correspondences between weathering and 'property under light' for varying shades of blue beads of the most common excavated form types (see Chp. 14)*

		Trans. Light blue	**Trans. Medium blue**	**Trans. Dark blue**	**Transl. Light blue**	**Transl. Medium blue**	**Transl. Dark blue**	**Opaque Light blue**	**Opaque Medium blue**	**Opaque Dark blue**
Ek-A Period 2 >	*Heavy*								6	
Ek-A Period 3a >	*Heavy*								6	
Ek-A Period 3b >	*Heavy*									
Ek-A Period 4 >	*Heavy*									
Ek-B Horizon 1 >	*Heavy*									
Ek-B Horizon 2/3 >	*Heavy*								3	
Ek-A Period 2 >	*Slight*						1	1	1	
Ek-A Period 3a >	*Slight*				1				3	1
Ek-A Period 3b >	*Slight*					1				
Ek-A Period 4 >	*Slight*						1			
Ek-B Horizon 1 >	*Slight*									
Ek-B Horizon 2/3 >	*Slight*						1			
Ek-A Period 2 >	*None*								3	
Ek-A Period 3a >	*None*								4	
Ek-A Period 3b >	*None*	1				1			1	
Ek-A Period 4 >	*None*	1								1
Ek-B Horizon 1 >	*None*									
Ek-B Horizon 2/3 >	*None*			3	1	4		1	1	

TABLE G.13 *Frequency distribution table showing correspondences between weathering and 'property under light' for varying shades of green beads of the most common excavated form types* (*see Chp. 14*)

		Trans. Light green	**Trans. Medium green**	**Trans. Dark green**	**Transl. Light green**	**Transl. Medium green**	**Transl. Dark green**	**Opaque Light green**	**Opaque Medium green**	**Opaque Dark green**
Ek-A Period 2	*Heavy*									
Ek-A Period 3a	*Heavy*								1	
Ek-A Period 3b	*Heavy*									
Ek-A Period 4	*Heavy*									
Ek-B Horizon 1	*Heavy*									
Ek-B Horizon 2/3	*Heavy*				1				2	
Ek-A Period 2	*Slight*								1	
Ek-A Period 3a	*Slight*								1	
Ek-A Period 3b	*Slight*						1			2
Ek-A Period 4	*Slight*								1	
Ek-B Horizon 1	*Slight*									
Ek-B Horizon 2/3	*Slight*	1							1	2
Ek-A Period 2	*None*								1	
Ek-A Period 3a	*None*			1			1		1	
Ek-A Period 3b	*None*			1					1	
Ek-A Period 4	*None*		1							3
Ek-B Horizon 1	*None*						1	1		
Ek-B Horizon 2/3	*None*		1		3	1			1	3

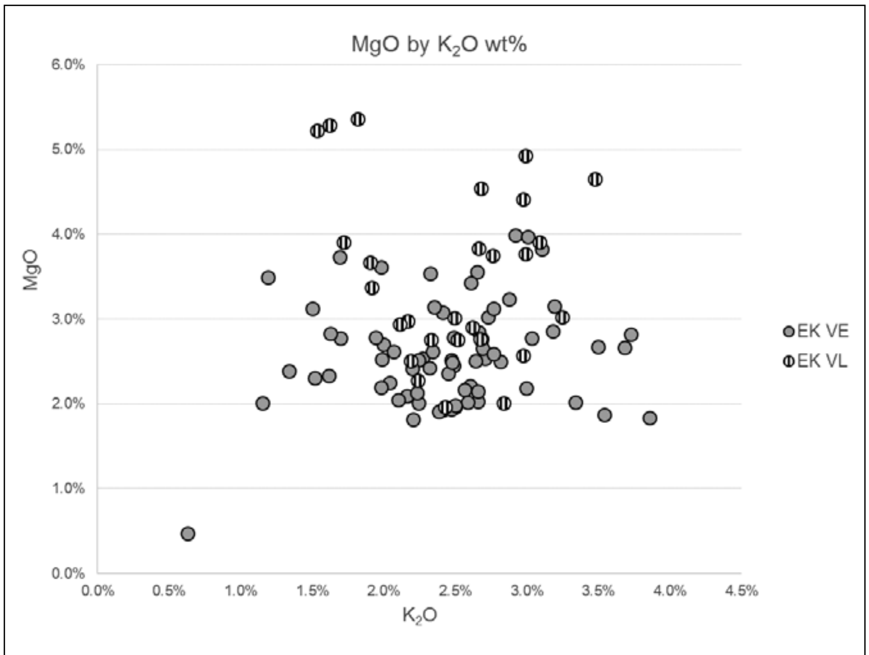
TABLE G.14 *Frequency distribution table showing correspondences between weathering and 'property under light' for varying shades of yellow beads of the most common excavated form types* (*see Chp. 14*)

		Trans. Light yellow	**Trans. Medium yellow**	**Trans. Dark yellow**	**Transl. Light yellow**	**Transl. Medium yellow**	**Transl. Dark yellow**	**Opaque Light yellow**	**Opaque Medium yellow**	**Opaque Dark yellow**
Ek-A Period 2	*Heavy*									
Ek-A Period 3a	*Heavy*									
Ek-A Period 3b	*Heavy*									
Ek-A Period 4	*Heavy*									
Ek-B Horizon 1	*Heavy*									
Ek-B Horizon 2/3	*Heavy*									
Ek-A Period 2	*Slight*									
Ek-A Period 3a	*Slight*									1
Ek-A Period 3b	*Slight*									
Ek-A Period 4	*Slight*									
Ek-B Horizon 1	*Slight*									
Ek-B Horizon 2/3	*Slight*						1			1
Ek-A Period 2	*None*								1	6
Ek-A Period 3a	*None*								1	1
Ek-A Period 3b	*None*					2			1	1
Ek-A Period 4	*None*									
Ek-B Horizon 1	*None*								4	
Ek-B Horizon 2/3	*None*	1				3			6	7

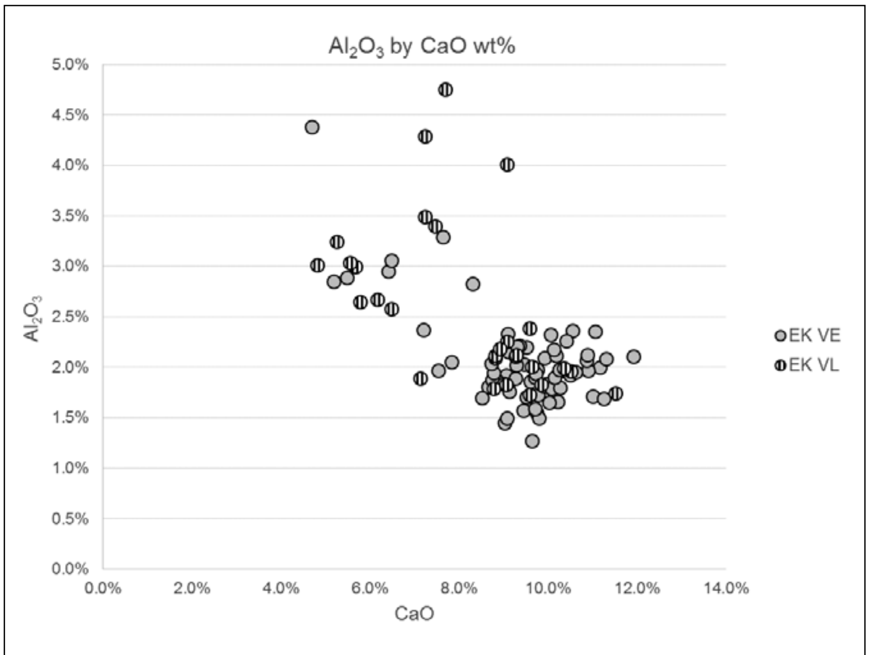
APPENDIX H

Vessel and Bead Glass Chemical Compositional Analysis

James Lankton, Peter Robertshaw, Laure Dussubieux & Sam Nixon

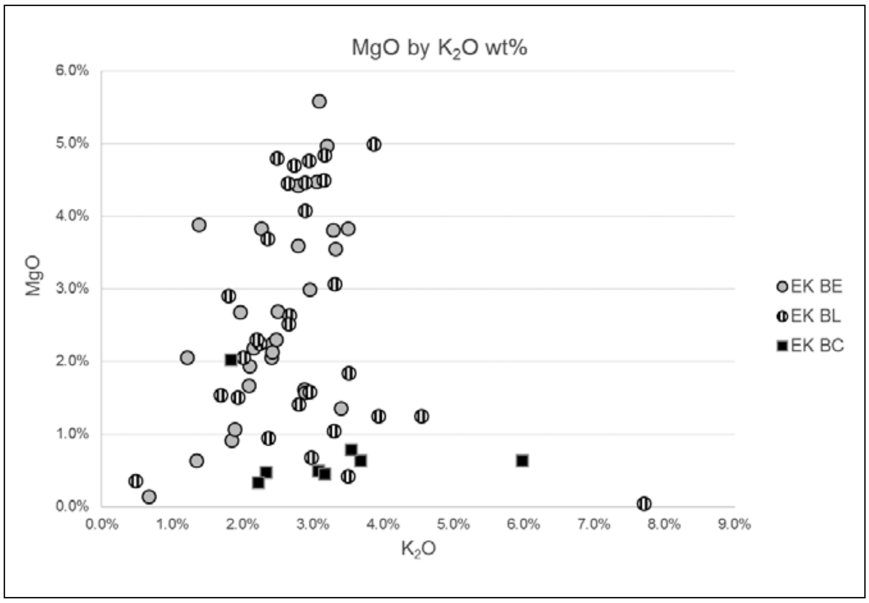


a



b

FIGURE H.1 *Graphs (a, b) illustrating the chemistry of Essouk-Tadmekka glass vessels (see Chapter 13 for details).*



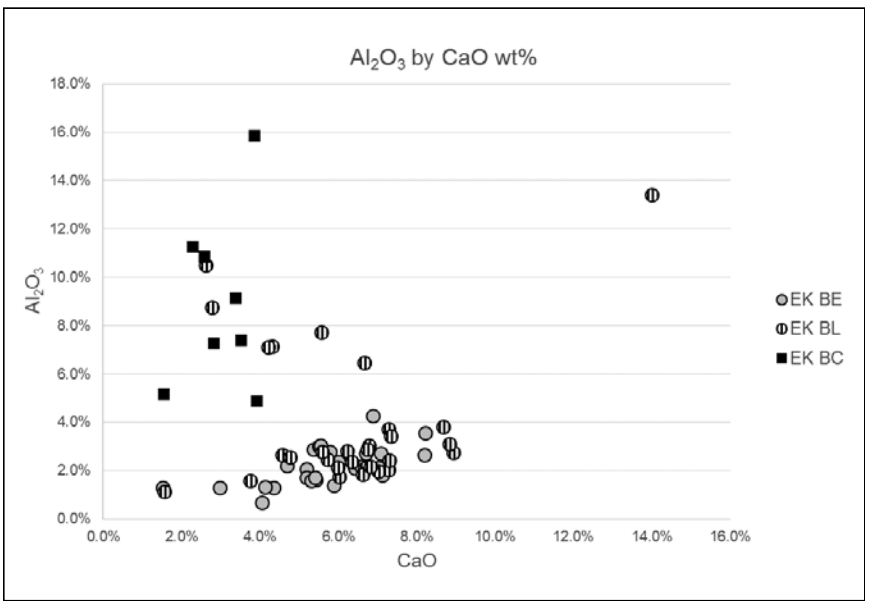


FIGURE H.2 *Graphs (a, b) illustrating the chemistry of Essouk-Tadmekka glass beads (see Chapter 14 for details).*

TABLE H.1 *Chemical compositions of the most important glass categories found at Essouk. Values in ppm (parts per million) unless otherwise indicated (%). Relative deviation (standard deviation as percent of mean) included as an index of variability. Major elements (*) reported as reduced compositions (Brill 1999, Vol. 2:9).*

Group	**Vessel**	**Vessels (EK VE)**		**Vessels (EK VL)**		**Vessels**		**Beads (EK BE)**		**Beads (EK BL)**		**Beads**
Date	**12c**	**9/10 to 12c.**		**12/13 to 14c.**		**12/13 to 13/14c.**		**10/11 to 12c.**		**12/13–14c**		**12 to 13/14c.**
Comp. type	**m-Na-Ca**	**v-Na-Ca**		**v-Na-Ca**		**v-Na-Ca-Al**		**v-Na-Ca**		**v-Na-Ca**		**Pb-Si**
number	**1**	**69**	***Rel.Dev.***	**24**	***Rel.Dev.***	**3**	***Rel.Dev.***	**11**	***Rel.Dev.***	**12**	***Rel.Dev.***	**3**
SiO2*	71.93%	68.66%	*2%*	67.90%	*3%*	62.78%	*4%*	67.62%	*5%*	69.15%	*5%*	24.54%
Na2O*	15.50%	13.94%	*9%*	14.81%	*16%*	16.63%	*8%*	15.06%	*19%*	14.47%	*13%*	1.90%
K2O*	0.63%	2.46%	*23%*	2.50%	*19%*	2.34%	*42%*	2.78%	*24%*	2.74%	*18%*	0.23%
MgO*	0.48%	2.62%	*21%*	3.38%	*28%*	4.64%	*16%*	3.80%	*31%*	3.41%	*40%*	0.11%
CaO*	8.31%	9.40%	*15%*	8.14%	*23%*	8.00%	*12%*	6.62%	*15%*	6.60%	*19%*	0.56%
Al2O3*	2.83%	2.04%	*23%*	2.38%	*24%*	4.35%	*9%*	2.89%	*21%*	2.66%	*24%*	0.34%
Li2O								23	*77%*	23	*49%*	3
B2O3	444	105	*31%*	120	*33%*	199	*20%*					
P2O5	0.12%	0.43%	*43%*	0.39%	*40%*	0.84%	*65%*	0.27%	*94%*	0.26%	*62%*	0.15%
Cl		242	*482%*	43	*158%*							
TiO2	485	630	*27%*	638	*38%*	1614	*26%*	515	*19%*	618	*35%*	178
V2O5	21	17	*70%*	15	*22%*	18	*14%*	15	*35%*	14	*30%*	3
Cr2O3	12	16	*64%*	19	*57%*	23	*10%*	24	*66%*	24	*62%*	1
MnO	0.45%	1.24%	*61%*	0.95%	*61%*	0.17%	*55%*	1.17%	*105%*	0.82%	*104%*	0.03%
Fe2O3	0.34%	0.85%	*34%*	0.87%	*38%*	1.23%	*22%*	0.93%	*62%*	0.84%	*49%*	0.09%
CoO	3	27	*293%*	41	*305%*	6	*4%*	53	*284%*	80	*346%*	1
NiO	5	15	*145%*	17	*144%*	17	*18%*	31	*99%*	21	*68%*	10
CuO	0.03%	0.20%	*255%*	0.18%	*198%*	0.19%	*169%*	0.42%	*141%*	0.43%	*100%*	0.65%
ZnO	19	146	*203%*	135	*275%*	78	*9%*	353	*168%*	510	*140%*	280
As2O3	21	14	*190%*	8	*133%*	5	*155%*	173	*93%*	116	*126%*	106
Rb2O	10	12	*25%*	14	*28%*	17	*28%*	16	*46%*	19	*45%*	3
SrO	512	477	*29%*	445	*24%*	287	*20%*	430	*26%*	445	*27%*	45
Y2O3	9	7	*14%*	6	*18%*	12	*8%*	5	*17%*	5	*20%*	1
ZrO2	60	93	*39%*	83	*50%*	222	*40%*	58	*26%*	72	*50%*	27
Nb2O3	1.7	3.0	*24%*	3.0	*32%*	6.5	*9%*	2.4	*27%*	2.9	*36%*	0.8
Ag	0.2	1.4	*227%*	0.8	*121%*	1.1	*148%*	2.4				
In	0.0	0.1	*339%*	0.1	*308%*	0.0	*23%*	4.5	*205%*	0.9	*146%*	0.7
SnO2	13	111	*215%*	45	*151%*	47	*156%*	1.5%	*104%*	1.3%	*116%*	7028
Sb2O3	22	11	*262%*	3	*183%*	4	*99%*	28	*125%*	13	*134%*	15
Cs2O	0.1	0.2	*41%*	0.2	*27%*	0.4	*24%*	0.3	*42%*	0.4	*45%*	0.1
BaO	240	241	*41%*	243	*39%*	148	*39%*	245	*51%*	220	*49%*	30
La2O3	8.5	7.7	*18%*	7.5	*24%*	15.2	*13%*	6.0	*21%*	6.3	*30%*	2.6
CeO2	17	15	*18%*	15	*26%*	31	*13%*	12	*24%*	13	*31%*	6
PrO2	2.2	1.9	*18%*	1.9	*23%*	3.7	*13%*	1.4	*18%*	1.5	*29%*	0.6
Nd2O3	8.3	7.4	*19%*	7.0	*21%*	13.4	*12%*	5.1	*17%*	5.4	*28%*	2.2
Sm2O3	1.5	1.5	*16%*	1.4	*21%*	2.6	*9%*	1.0	*15%*	1.1	*25%*	0.4

	Beads		Beads		Beads		Bead	Beads		HC B-G beads		Crucible glass	
	12c		12/13 to 14c.		12/13–14c		13/14c.	13/14c		mostly 10/11 to 12c		12/13c	
	mNC white		v-Na-Ca-Al		low-Mg vNC		HLHA	mNA 2		vNC		vNC/ceramic	
Rel.Dev.	2	*Rel.Dev.*	4	*Rel.Dev.*	4	*Rel.Dev.*	1	2	*Rel.Dev.*	14	*Rel.Dev.*	8	*Rel.Dev.*
22%	75.09%	*1%*	59.66%	*33%*	69.19%	*2%*	62.54%	64.51%	*1%*	72.13%	*5%*	72.40%	6%
63%	14.98%	*3%*	17.20%	*9%*	15.71%	*6%*	1.89%	17.67%	*4%*	14.52%	*20%*	9.69%	22%
55%	1.86%	*2%*	2.69%	*31%*	3.64%	*21%*	7.70%	3.23%	*11%*	2.41%	*22%*	3.23%	40%
66%	0.99%	*11%*	2.96%	*46%*	1.24%	*12%*	0.05%	0.55%	*33%*	2.42%	*30%*	0.73%	74%
43%	4.24%	*3%*	5.19%	*23%*	6.69%	*8%*	14.00%	2.69%	*4%*	5.92%	*20%*	2.98%	28%
12%	1.30%	*2%*	7.12%	*7%*	2.43%	*18%*	13.42%	9.63%	*13%*	1.89%	*29%*	8.99%	40%
46%	22	*10%*	11	*13%*	30	*31%*		14	*47%*	33	*72%*	71	15%
										105	*13%*	29	28%
127%	0.20%	*30%*	0.46%	*21%*	0.47%	*34%*	0.12%	0.10%	*19%*	0.45%	*26%*	0.30%	44%
										11750	*7%*	4400	23%
16%	379	*10%*	3074	*41%*	820	*21%*	159	2797	*42%*	753	*13%*	2243	66%
60%	6	*9%*	47	*42%*	17	*34%*	7	84	*21%*	10	*15%*	49	23%
120%	5	*10%*	42	*29%*	8	*121%*	4	11	*44%*	9	*45%*	25	78%
80%	0.19%	*0%*	0.24%	*109%*	0.50%	*79%*	0.16%	0.06%	*48%*	0.09%	*77%*	0.38%	233%
31%	1.11%	*19%*	5.1%	*65%*	1.04%	*38%*	0.41%	1.66%	*6%*	0.66%	*18%*	1.90%	29%
43%	5	*18%*	23	*51%*	6	*45%*	71	6	*0%*	2	*50%*	7	26%
10%	12	*16%*	29	*26%*	13	*31%*	31	12	*2%*	11	*18%*	11	22%
16%	0.08%	*37%*	0.34%	*184%*	1.29%	*67%*	88.08	0.30%	*138%*	1.85%	*25%*	1.32%	38%
149%	45	*26%*	86	*41%*	394	*101%*	16	5	*43%*	101	*58%*	3591	52%
70%	236	*27%*	20	*63%*	48	*62%*	5	15	*18%*	52	*90%*	4	27%
37%	7	*18%*	18	*62%*	27	*26%*	330	93	*11%*	10	*59%*	42	55%
4%	156	*2%*	398	*5%*	455	*18%*	295	270	*26%*	390	*46%*	495	49%
4%	3	*8%*	12	*29%*	5	*7%*	2	17	*39%*	4	*14%*	9	27%
23%	45	*15%*	93	*18%*	75	*23%*	16	386	*71%*	69	*18%*	40	39%
18%	2.3	*11%*	10.3	*27%*	4.0	*19%*	1.5	11.6	*78%*	3.1	*20%*	6.1	41%
										2.9	*100%*	466.5	25%
43%			0.7	*180%*	0.2	*97%*				10.8	*100%*	0.3	32%
110%	1.4%	*8%*	4711	*196%*	6547	*73%*	5	2773	*129%*	4352	*56%*	65	29%
63%	13	*19%*	34	*194%*	14	*115%*	0	11	*104%*	8	*180%*	1	28%
47%	0.2	*34%*	0.2	*42%*	0.6	*48%*	6.5	0.9	*15%*	0.1	*101%*	0.3	24%
52%	79	*15%*	404	*47%*	155	*13%*	141	542	*27%*	105	*34%*	493	36%
9%	5.0	*9%*	13.4	*28%*	8.1	*14%*	3.6	21.1	*74%*	7.2	*11%*	23.1	36%
12%	11	*10%*	28	*30%*	18	*29%*	11	60	*84%*	15	*11%*	40	27%
9%	1.2	*9%*	3.3	*28%*	2.0	*28%*	0.7	5.1	*74%*	1.6	*12%*	4.2	33%
7%	4.1	*3%*	12.5	*30%*	6.8	*14%*	2.5	18.3	*65%*	6.0	*13%*	16.2	33%
10%	0.8	*4%*	2.6	*31%*	1.3	*11%*	0.4	3.8	*60%*	1.1	*15%*	2.9	32%

TABLE H.1 *Chemical compositions of the most important glass categories found at Essouk. Values in ppm (parts per million)* (cont.)

Group	Vessel	Vessels (EK VE)		Vessels (EK VL)		Vessels		Beads (EK BE)		Beads (EK BL)		Beads
Date	**12c**	**9/10 to 12c.**		**12/13 to 14c.**		**12/13 to 13/14c.**		**10/11 to 12c.**		**12/13–14c**		**12 to 13/14c.**
Comp. type	**m-Na-Ca**	**v-Na-Ca**		**v-Na-Ca**		**v-Na-Ca-Al**		**v-Na-Ca**		**v-Na-Ca**		**Pb-Si**
number	**1**	**69**	***Rel.Dev.***	**24**	***Rel.Dev.***	**3**	***Rel.Dev.***	**11**	***Rel.Dev.***	**12**	***Rel.Dev.***	**3**
Eu2O3	0.4	0.3	*20%*	0.3	*17%*	0.5	*16%*	0.2	*18%*	0.3	*21%*	0.1
Gd2O3	1.4	1.3	*19%*	1.3	*19%*	2.2	*12%*	0.9	*17%*	0.9	*22%*	0.3
Tb2O3	0.2	0.2	*21%*	0.2	*19%*	0.3	*9%*	0.1	*17%*	0.2	*21%*	0.1
Dy2O3	1.3	1.2	*19%*	1.1	*19%*	2.1	*8%*	0.9	*17%*	0.9	*19%*	0.3
Ho2O3	0.3	0.2	*21%*	0.2	*18%*	0.4	*6%*	0.2	*16%*	0.2	*18%*	0.1
Er2O3	0.8	0.6	*15%*	0.6	*18%*	1.2	*3%*	0.5	*15%*	0.5	*17%*	0.2
Tm2O3	0.1	0.1	*21%*	0.1	*20%*	0.2	*8%*	0.1	*17%*	0.1	*17%*	0.0
Yb2O3	0.8	0.7	*30%*	0.6	*20%*	1.2	*10%*	0.5	*15%*	0.5	*18%*	0.2
Lu2O3	0.1	0.1	*34%*	0.1	*22%*	0.2	*5%*	0.1	*16%*	0.1	*18%*	0.0
HfO2	1.5	2.6	*42%*	2.3	*48%*	5.9	*34%*	1.7	*24%*	2.1	*48%*	1.0
WO	0.0	0.5	*121%*	0.5	*114%*	0.2	*4%*	5.0	*142%*	2.1	*95%*	0.2
Au	0.2	0.4	*181%*	0.3	*241%*	0.1	*106%*					
PbO	0.01%	0.47%	*195%*	0.27%	*178%*	0.07%	*64%*	16.66%	*90%*	12.45%	*133%*	71.20%
Bi	0.1	0.2	*274%*	0.1	*87%*	0.3	*98%*					
ThO2	2.2	1.7	*29%*	1.8	*38%*	5.0	*16%*	1.6	*22%*	1.7	*25%*	0.7
UO2	4.8	0.9	*43%*	0.9	*51%*	1.2	*25%*	0.8	*34%*	1.0	*53%*	0.3

	Beads		Beads		Beads		Bead	Beads		HC B-G beads		Crucible glass	
	12c		12/13 to 14c.		12/13–14c		13/14c.	13/14c		mostly 10/11 to 12c		12/13c	
	mNC white		v-Na-Ca-Al		low-Mg vNC		HLHA	mNA 2		vNC		vNC/ceramic	
Rel.Dev.	**2**	***Rel.Dev.***	**4**	***Rel.Dev.***	**4**	***Rel.Dev.***	**1**	**2**	***Rel.Dev.***	**14**	***Rel.Dev.***	**8**	***Rel.Dev.***
11%	0.2	*8%*	0.7	*25%*	0.3	*19%*	0.1	0.8	*41%*	0.2	*19%*	0.7	28%
12%	0.8	*14%*	2.4	*30%*	1.1	*14%*	0.4	3.2	*46%*	0.9	*15%*	2.2	31%
21%	0.1	*18%*	0.4	*26%*	0.2	*17%*	0.1	0.5	*53%*	0.1	*16%*	0.3	30%
19%	0.5	*10%*	2.2	*29%*	0.9	*11%*	0.4	3.1	*43%*	0.8	*12%*	1.9	27%
23%	0.1	*14%*	0.5	*25%*	0.2	*10%*	0.1	0.7	*48%*	0.2	*15%*	0.4	28%
13%	0.3	*6%*	1.2	*27%*	0.5	*3%*	0.2	1.8	*41%*	0.4	*13%*	1.0	28%
20%	0.1	*23%*	0.2	*25%*	0.1	*16%*	0.0	0.3	*46%*	0.1	*13%*	0.1	27%
48%	0.3	*5%*	1.2	*23%*	0.5	*9%*	0.2	1.9	*35%*	0.5	*11%*	1.0	27%
6%	0.1	*8%*	0.2	*20%*	0.1	*9%*	0.0	0.3	*45%*	0.1	*38%*	0.1	27%
31%	1.4	*15%*	2.7	*15%*	2.1	*23%*	0.5	11.3	*69%*	1.8	*17%*	1.3	39%
36%	1.6	*22%*	2.5	*67%*	1.9	*105%*	0.0	2.6	*42%*	0.3	*53%*	0.0	
										0.1	*42%*	57.7	55%
7%	27.91%	*29%*	0.27%	*157%*	3.42%	*65%*	0.03%	2.12%	*141%*	1.36%	*96%*	0.06%	26%
										2.7	*100%*	3.3	40%
11%	1.3	*8%*	3.2	*25%*	2.2	*9%*	0.4	16.5	*12%*	1.8	*13%*	2.7	20%
10%	0.4	*8%*	1.0	*33%*	0.8	*26%*	0.8	35.1	*23%*	0.7	*16%*	1.3	28%

APPENDIX I

Archaeometallurgical Waste

Thilo Rehren

Iron metallurgy (definite and probable identifications)

001 Ek-A 118 (*see* Fig. 16.13)

- Optical microscopy conducted
- *Polished block analysis:* Sample contains numerous pieces of iron slag. Sample also contains material which looks like sandstone/quartzite/rock/granite. It is possible that this material could be furnace building material, for example a furnace wall fragment. Areas of iron slag are stuck onto the material hypothesized as furnace building material. Evidence also of skeletal magnetite which indicates a somewhat more oxidising stage than one would expect for iron smelting, but which is often seen near furnace walls.
- *Summary comments*: The sample appears to relate to furnace wall material with bits of iron slag attached, most likely smelting slag, though this identification of smelting is not definite.

002 Ek-A 114 (*see* Fig. 16.1)

- Optical microscopy conducted
- *Polished block analysis:* Iron slag with feathery fayalite. First and 2nd generation wüstite. Stuck onto rock of what appears to be most likely a furnace wall fragment. Abundant magnetite crystals. Incorporated sand grains. Mostly glassy matrix.
- *Summary comments*: The sample appears to relate to furnace wall material with bits of iron slag attached, most likely smelting slag, though this identification of smelting is not definite.

004 Ek-A 103

- Optical microscopy conducted
- *Polished block analysis*: Iron slag. Rich in wüstite in a fayalitic matrix. Fayalite crystals small and elongated. Silica rich rim with recrystallised silica inclusions (sandstone?).
- *Summary comments*: Potentially smelting slag, but could also be smithing.

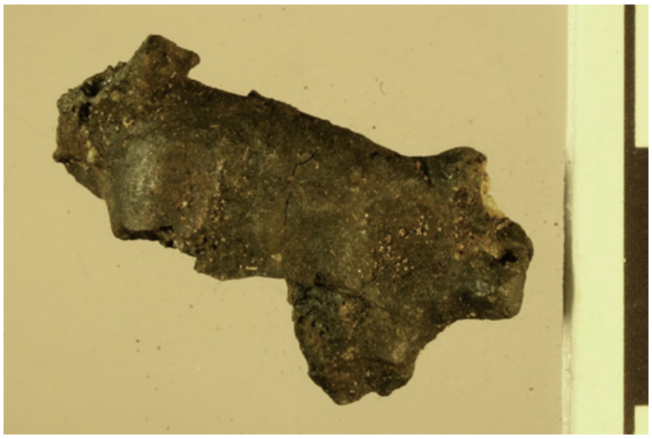


FIGURE I.1 *Archaeometallurgy sample 004 Ek-A 103.*

005 Ek-A 96

- Optical microscopy conducted
- *Polished block analysis*: Lots of slag with interesting inclusions. Blocky fayalite and skeletal fayalite in a glassy matrix. Magnetite dendrites 2nd generation. Wüstite aggregates/dendrites. Not homogenous but consists of different phases (multi-phased) – maybe an oxidation feature. Nothing in terms of sulphides or metals which would indicate copper smelting. Sand consisting of quartz. Wüstite in the process of being oxidised to magnetite; possibly this is a tap slag (*i.e.* flown out of a furnace) which would explain the oxidation. Slightly unusual is the sand included but this can occur in dry environments such as Essouk, when the fluid slag flows over dry sand.
- *Summary comments*: This looks to be iron smelting rather than smithing, though this conclusion is not indisputable.

FIGURE I.2 *Archaeometallurgy sample 005 Ek-A 96.*

 | DOI 10.1163/9789004348998_035

006 Ek-A 96

- Optical microscopy conducted
- *Polished block analysis*: Skeletal fayalite in a glassy matrix. Incorporated sand grains. 'Tap lines' (where one flow of slag flowing out of the furnace creates a contact zone with the previous flow). Wüstite/magnetite dendrites; 1st generation – 20% by vol (quite high). Locally iscorite developing; normally indicates non-ferrous metallurgy but with a tap slag can also get this with the oxygen coming in during tapping. No sulphides or metal indicating copper.
- *Summary comments*: Iron tap slag which looks to be more like smelting than smithing. This conclusion is based upon the flow texture and the amount and nature of iron oxide, shape and nature of fayalite. Again, slightly unusual is the sand included, though again it is noted that one can get this in dry environments such as Essouk.

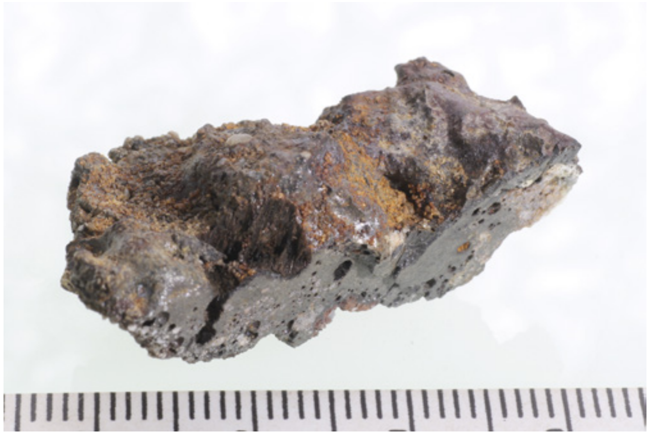


FIGURE I.3 *Archaeometallurgy sample 006 Ek-A 96.*

007 Ek-A 96

- Optical microscopy conducted
- *Polished block analysis*: Metallic iron in form of wüstite; mostly corroded. Fayalite slag matrix.
- *Summary comments*: "Crown material". Lump of crown material from bloomery smelting.

FIGURE I.4 *Archaeometallurgy sample 007 Ek-A 96.*

009 Ek-A 96 (*see* Fig. 16.1)

- Optical microscopy conducted
- *Polished block analysis*: Layers upon layers of very thin running slag. Tap slag with a spinifex texture. Spinifex in the centre with lower and upper surfaces smooth texture – a typical feature of tap slag. Skin oxidation layer on the top, forming magnetite in contact with air. Slightly puzzling are possible hammerscale fragments, but these could come from superficial burning of the iron tools used to rake out the slag.
- *Summary comments*: Straightforward bloomery smelting tap slag.

010 Ek-A 96

- Optical microscopy conducted
- *Polished block analysis*: Ceramic matrix; cracked quartz grains. Some areas rich in fayalite.
- *Summary comments*: Iron metallurgy. Smelting related. Looks like piece of furnace wall contaminated with smelting slag (fragment of charcoal attached – see image).

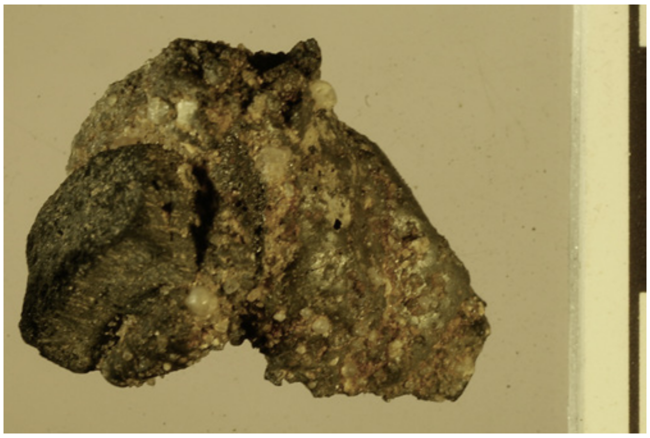


FIGURE I.5 *Archaeometallurgy sample 010 Ek-A 96.*

011 Ek-A 96

- Optical microscopy conducted
- *Polished block analysis*: A lot of magnetite in a slaggy matrix and numerous embedded quartz grains. Large cluster of dense wüstite. Looks like a piece of furnace wall or similar. Magnetite crystals are probably formed from iron oxide content of ceramics rather than a contamination of slag. Lump of wüstite shows that the fragment formed not too far away from a furnace. Could indicate some mechanical operation of iron smelting or iron smithing.
- *Summary comments*: Probably furnace wall fragment, related to iron smelting.

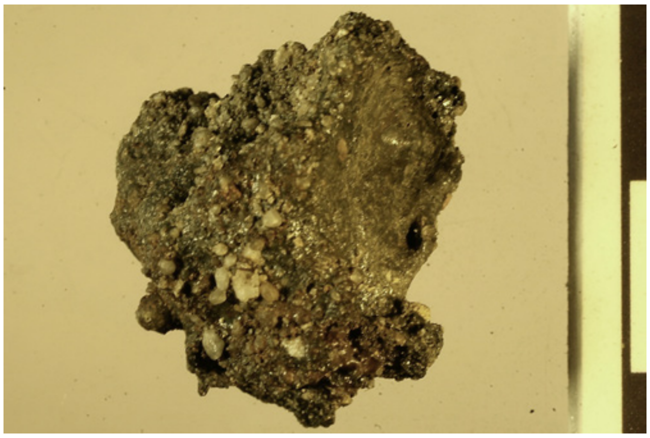


FIGURE I.6 *Archaeometallurgy sample 011 Ek-A 96.*

012 Ek-A 95

- *Summary comments*: Metallurgical slag, probably iron.

FIGURE I.7 *Archaeometallurgy sample 012 Ek-A 95.*

015 Ek-A 93

- *Summary comments*: Iron slag droplet.

016 Ek-A 93

- *Summary comments*: Iron slag droplet

018 Ek-A 93

- *Summary comments*: Iron slag droplet

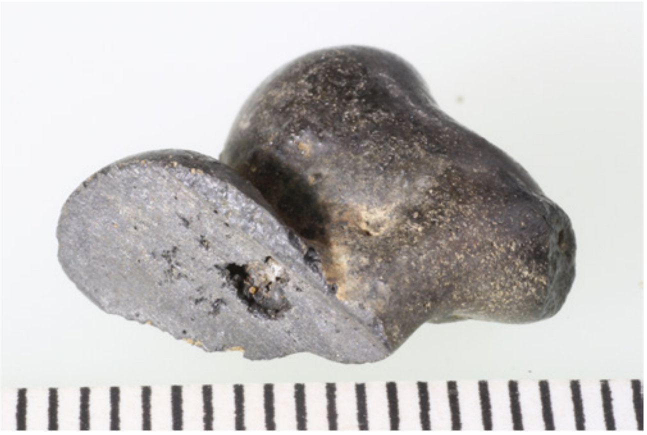


FIGURE I.8 *Archaeometallurgy sample 018 Ek-A 93.*

***024 Ek-A 86* (*see* Fig. 16.1)**

- Optical microscopy conducted
- *Polished block analysis*: Pieces of fayalitic slag with wüstite and rounded pieces of metallic iron (corroding). Enough iron present to label as "crown" material. Badly corroded. Significant amounts of dendritic wüstite to exclude high carbon metal production.
- *Summary comments*: Clearly iron metallurgy, probably "crown" material or a bad piece of bloom.

027 Ek-A 43

- *Summary comments*: Iron slag

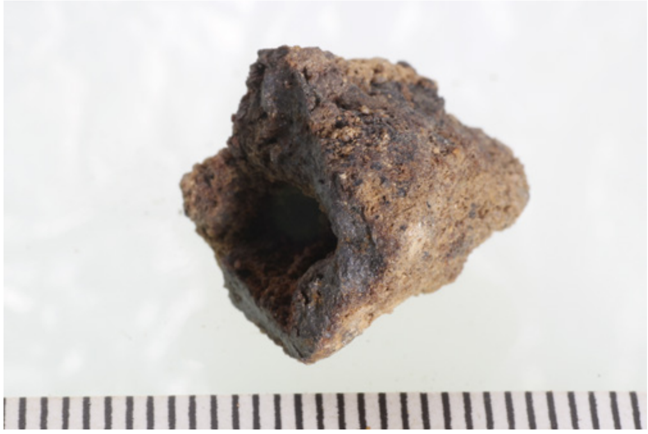


FIGURE I.9 *Archaeometallurgy sample 027 Ek-A 43.*

028 Ek-A 20

- Optical microscopy conducted
- *Polished block analysis:* Much whiter in polished section than most of the other slag samples due to the high wüstite content. Reasonably quick cooling; fayalite partly skeletal. 60/70% wüstite; 30% fayalite; 10% glass. Very homogenous throughout; no particular flow features.
- *Summary comments*: Iron slag. Could be either smelting or smithing – unlike previous samples discussed above where they appear to be most likely smelting, this is difficult to say here confidently; fragment is too small.

FIGURE I.10 *Archaeometallurgy sample 028 Ek-A 20.*

034 Ek-B 11

- Optical microscopy conducted
- *Polished block analysis*: Blocky fayalite in a glassy matrix. Opposite surface (possibly lower surface) feathery fayalite/spinifex, typical of tap slag flowing onto a cold surface. Cluster of metallic iron. 1st generation dendritic wüstite. Some multi-phased wüstite aggregates. Incorporated sand grains.
- *Summary comments*: Very likely an iron smelting slag with some residual free iron oxide (wüstite), and typical tapping features.

035 Ek-B 11

- Optical microscopy conducted
- *Polished block analysis*: High amount of wüstite, partly replaced by metallic iron, which in turn is replaced by rust. Areas of massive metallic iron half corroded and adhering soil consolidated by rust. Smelting slag very close to the bloom.
- *Summary comments*: Small chunk of bloomery smelting slag. "Crown material".

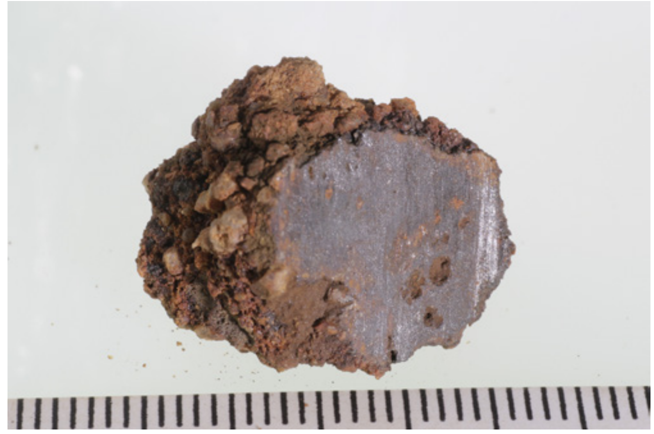


FIGURE I.11 *Archaeometallurgy sample 035 Ek-B 11.*

***036 Ek-B 11* (*see* Fig. 16.1)**

- Optical microscopy conducted
- *Polished block analysis*: Quartz grains embedded in vitrified ceramic matrix; droplets of iron metal, possibly some iron slag.
- *Summary comments*: Probably furnace wall fragment, related to iron smelting.

***040 Ek-B 10* (*see* Fig. 16.1)**

- Optical microscopy conducted
- *Polished block analysis*: Iron slag with blocky fayalite. Numerous wüstite dendrites. Minute metallic iron particles.
- *Summary comments*: Iron slag, most likely smelting.

041 Ek-B 10

- *Summary comments*: Small chunks of iron slag.

042 Ek-B 9

- Optical microscopy conducted
- *Polished block analysis*: Heavily corroded iron slag. Blocky fayalite. First generation wüstite dendrites. Glassy matrix. Considerable corrosion (general feature). Some of the fayalite beginning to oxidise. No copper or sulphides. Metallic iron preserved even though the fayalite is corroding.
- *Summary comments*: Iron slag (looks similar to Sample 043, Sample 044, Sample 041), most likely smelting.

043 Ek-B 9

- *Summary comments*: Small chunk of iron slag. Possibly same piece as Sample 042.

***047 Ek-C 44* (*see* Fig. 16.1)**

- *Summary comments*: Iron smelting slag.

048 Ek-C 35

- *Summary comments*: Iron slag, probably smelting.

049 Ek-C 34
- *Summary comments*: Iron slag

050 Ek-C 34
- *Summary comments*: Mixture of slag and furnace hearth material – probably iron smelting.

051 Ek-C 32
- *Summary comments*: Probably piece of iron metal or iron slag.

052 Ek-C 31
- *Summary comments*: Iron slag

053 Ek-C 30
- *Summary comments*: Slag, probably iron smelting.

054 Ek-C 30
- *Summary comments*: Iron slag.

056 Ek-C 30
- *Summary comments*: Iron slag

057 Ek-C 30
- *Summary comments*: Iron slag

060 Ek-C 26
- Optical microscopy conducted
- *Polished block analysis*: Piece of "crown" material, heavily corroded. Metallic iron replacing wüstite (no wüstite left) and most metallic iron now replaced by rust. Blocky to skeletal fayalite. Ferritic bloomery smelting.
- Summary comments: Piece of iron slag or bloom with fuel (charcoal) impressions.

061 Ek-C 26
- *Summary comments*: Iron slag with fuel impressions

***062 Ek-C 22* (*see* Fig. 16.1)**
- *Summary comments*: Iron slag.

063 Ek-C 22
- *Summary comments*: Iron slag.

064 Ek-C 20
- *Summary comments*: Iron/fuel ash slag, possibly from smithing context.

065 Ek-C 20
- *Summary comments*: Iron slag; similar to Sample 064.

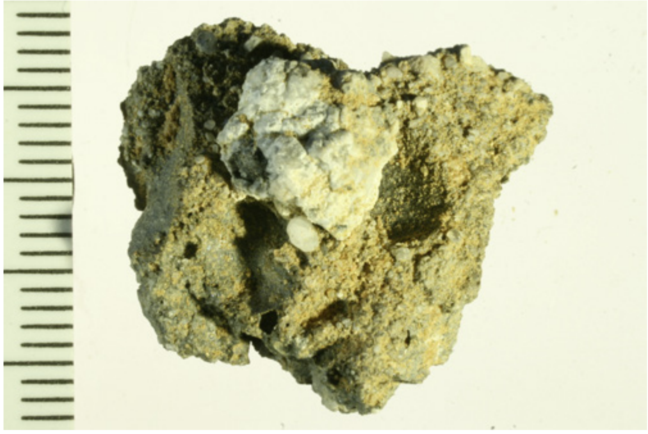


FIGURE I.12 *Archaeometallurgy sample 065 Ek-C 20.*

071 Ek-C 9
- *Summary comments*: Piece of iron slag.

072 Ek-C 13
- *Summary comments*: Iron slag/furnace wall.

073 Ek-C 11
- *Summary comments*: Iron slag?

***074 Ek-C 11* (*see* Fig. 16.1)**
- Optical microscopy conducted
- *Polished block analysis*: Piece of corroded metal; typical "crown"/bad bloom piece. Heavily corroded.
- *Summary comments:* Iron slag/bloom fragment from bloomery smelting.

Crucible Steel Making

020 Ek-A 87
- Optical microscopy conducted
- *Polished block analysis*: Heavily corroded metal structure with a glassy slag rim partly preserved. Possibly cast iron structure in some areas. Graphite flakes with blocky cementite, no working traces visible. Originally piece of hypereutectic steel with residual pearlite.
- *Summary comments*: Probably piece of crucible steel ready to be processed or fallen off main ingot.

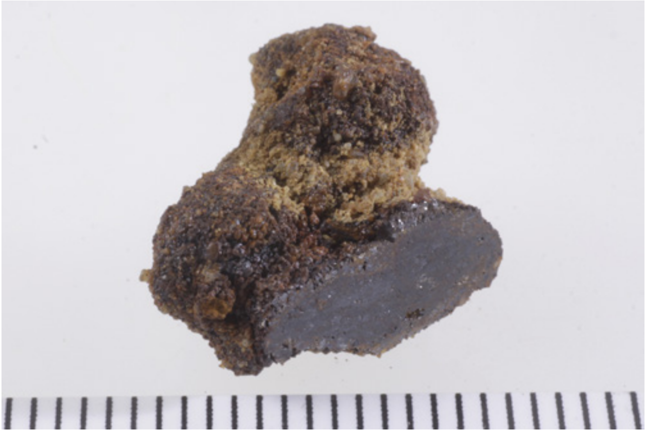


FIGURE I.13 *Archaeometallurgy sample 020 Ek-A 87.*

021 *Ek-A 87* (*see* Fig. 16.4)
- Optical microscopy conducted
- *Polished block analysis*: Frequent crystals/prills of iron. Unusual slag: rapidly cooled, long thin skeletal silicate crystals in microcrystalline ex-glassy matrix. Attached fully corroded lump of hyper-eutectic steel. Blocky cementite and ghost pearlite surrounding. Similar to piece of cast iron or pure hyper-eutectic steel with cluster of graphite flakes.
- *Summary comments*: Crucible steel/slag. Similar to crucible steel from Uzbekistan.

022 Ek-A 87
- Optical microscopy conducted
- *Polished block analysis*: Heavily corroded piece of high-carbon steel with a rim of rust-consolidated sand. Primary cementite, hyper-eutectic. Fully pearlite with primary cementite laths and on grain boundaries. Enough graphite present to be really significant.
- *Summary comments*: Fragment of crucible steel.

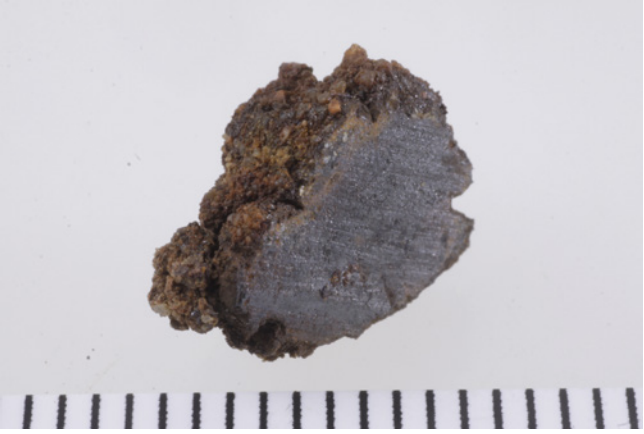


FIGURE I.14 *Archaeometallurgy sample 022 Ek-A 87.*

045 *Ek-B 8* (*see* Fig. 16.4)
- Optical microscopy conducted
- *Polished block analysis*: Highly vitrified ceramic with strong fuel-ash layer on one side. Tiny white metal prills throughout the matrix, probably iron. Organic temper mostly burnt out, with some cellular structures/phytoliths preserved.
- *Summary comments*: Crucible steel, crucible fragment.

046 *Ek-B 3* (*see* Fig. 16.4)
- Optical microscopy conducted
- *Polished block analysis*: Ceramic body, fuel ash vitrification on one surface. Metallic iron dust throughout the fabric. Few small metal droplets (high carbon steel prills), consistent with crucible steel. Strongly reducing conditions throughout. Fair amount of organic temper.
- *Summary comments*: Crucible steel, crucible fragment. Similar to Sample 045.

068 *Ek-C 18* (*see* Fig. 16.4)
- Optical microscopy conducted
- *Polished block analysis*: Fayalitic iron slag. Rich in cast iron prills.
- *Summary comments*: This piece of slag could reasonably be linked to the pieces of cast iron/crucible steel.

069 Ek-C 18
- Optical microscopy conducted
- *Polished block analysis*: Sand grain corrosion layer surrounding slag.
- *Summary comments*: Cast iron slag/liquid steel slag.

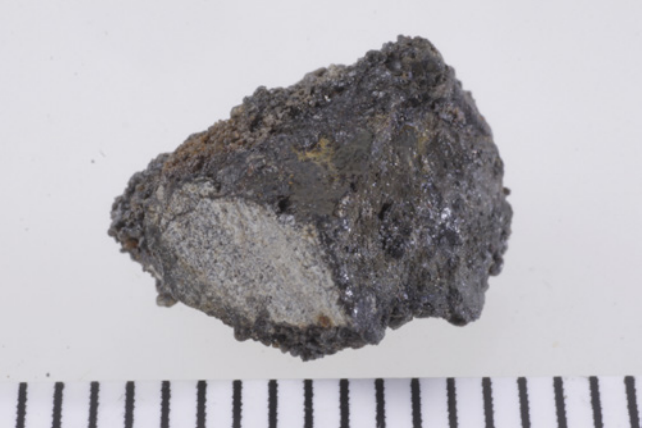


FIGURE I.15 *Archaeometallurgy sample 069 Ek-C 18.*

Copper Metallurgy (Definite and Probable Identifications)

023 Ek-A 86 (*see* Fig. 16.9)

- Optical microscopy conducted
- *Polished block analysis*: Homogenous piece of slag with little porosity (gas bubbles). Numerous prills of chalcocite, some with metallic copper cores ('fried egg' texture). Skeletal needle-like fayalite (?) in a predominant glassy matrix. Euhedral star-like aggregates of silicate crystals in interstitial glass areas, often studded with tiny copper prills and spinel micro-crystals.
- *Summary comments*: Piece of tap slag. High-quality copper smelting slag, iron-poor.

037 Ek-B 11 (*see* Fig. 16.9)

- *Summary comments*: Probably a droplet of copper slag.

038 Ek-B 11

- *Summary comments*: Probably a droplet of copper slag.

FIGURE I.16 *Archaeometallurgy sample 038 Ek-B 11.*

Unidentified Slag/Hearth/Crucible/Fuel Ash

003 Ek-A 113 (*see* Fig. 16.13)

- Optical microscopy conducted
- *Polished block analysis*: Stone with heavily vitrified surface. No clear metallurgical remains.
- *Summary comments*: Possibly a hearth lining or furnace wall building material.

008 Ek-A 96

- Optical microscopy conducted
- *Polished block analysis*: Ceramic matrix, some vitrification on one side.
- *Summary comments*: Superficially vitrified ceramic. Could be a piece of hearth, furnace, crucible.

013 Ek-A 93 (*see* Fig. 16.12)

- Optical microscopy conducted
- *Polished block analysis*: Ceramic matrix with high fired (cracked) quartz grains. Heavily vitrified on one side. Intense vitrified areas developing out of the ceramic, probably from fuel ash acting as a flux. No metal apart from the iron oxide occurring in the ceramic.
- *Summary comments*: Crucible fragment – similar to or possibly related to Sample 014 (in parts equally vitrified) but less reduced fabric. No definite conclusion. It is to be noted that the object which this sample was taken from appeared to contain a piece of copper in it; this however most likely results from the random inclusion of this within this object which was probably created in a metal working environment where this could easily happen.

014 Ek-A 93 (*see* Fig. 16.12)

- Optical microscopy conducted
- *Polished block analysis*: An odd sample. Pretty heavily vitrified. Two vitrified surfaces: outer side with thick fuel ash vitrification, well-developed with quartz grains in, a clear boundary between vitrified layer and ceramic, no metal present in this part; inner side with thinner vitrification, v.rich in iron oxide, magnetite spinel, iron not coming out of the ceramic but from the charge of the vessel. Flakes, possibly hammer scale particles. Deeper in the body of the ceramic, white prills/droplets – iron reduced by whatever organic temper. Ceramic fabric very heavily reduced throughout thickness. Wall thickness: 3–4mm.
- *Summary comments*: Crucible fragment. Related to hypereutectic steel? Similar to or possibly related to Sample 013 (in parts equally vitrified) but less reduced fabric. No definite conclusion.

019 Ek-A 89 (*see* Fig. 16.12)

- Optical microscopy conducted
- *Polished block analysis*: Fayalite and white metal droplets throughout the ceramic, most likely iron, possibly iron reduced out of the ceramic. High amount of iron oxide coming from the inner surface diluting as it penetrates the ceramic body. Possibly from a crack running through the fragment from inside to outside – seeping slag.
- *Summary comments*: Ceramic, very thick vitrified one side and much thinner the other side. Looks like iron metallurgy related; possibly a crucible fragment (?) or smithing hearth fragment. Clearly heated from outside with a lot of fuel ash. In view of the crucible steel slag maybe related to crucible steel making, as the strongly reducing conditions

indicated by iron particles are not needed for gold or copper working.

029 Ek-A 17
- *Summary comments*: unidentified slag

030 Ek-A 16
- Optical microscopy conducted
- *Polished block comments*: A piece of ceramic surrounded by an odd layer incorporating sand grains. Pure iron hydroxide rust.
- *Summary comments*: A porous material possibly absorbing on its surface iron hydroxide percolating through the deposits (similar to desert varnish, but here enhanced through iron-rich workshop environment).

031 Ek-A 1
- *Summary comments*: Molten ceramic, possibly bloated furnace wall.

FIGURE I.17 *Archaeometallurgy sample 031 Ek-A 1.*

032 Ek-B 12
- *Summary comments*: Possibly furnace wall fragment.

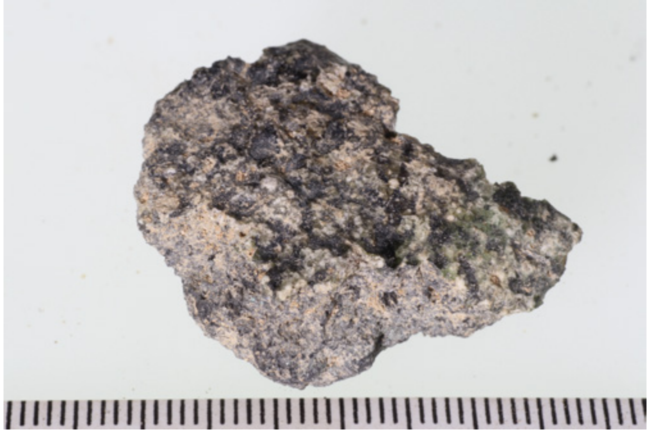


FIGURE I.18 *Archaeometallurgy sample 032 Ek-B 12.*

033 Ek-B 11
- *Summary comments*: Unidentified slag.

039 Ek-B 11
- *Summary comments*: Slag sample – metallurgy unidentified.

044 Ek-B 9
- *Summary comments*: Piece of slag with attached piece of charcoal.

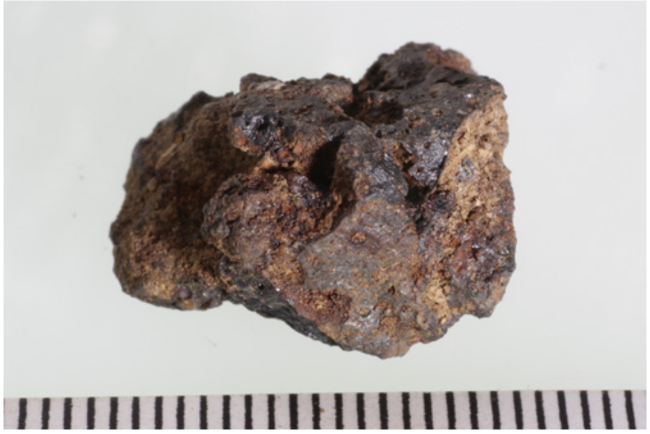


FIGURE I.19 *Archaeometallurgy sample 044 Ek-B 9.*

055 Ek-C 30
- *Summary comments*: Unclear.

058 Ek-C 28
- *Summary comments*: Fuel ash/hearth material

059 Ek-C 28
- *Summary comments*: Fuel ash/hearth material

066 Ek-C 19
- *Summary comments*: Bloated quartz-rich ceramic material.

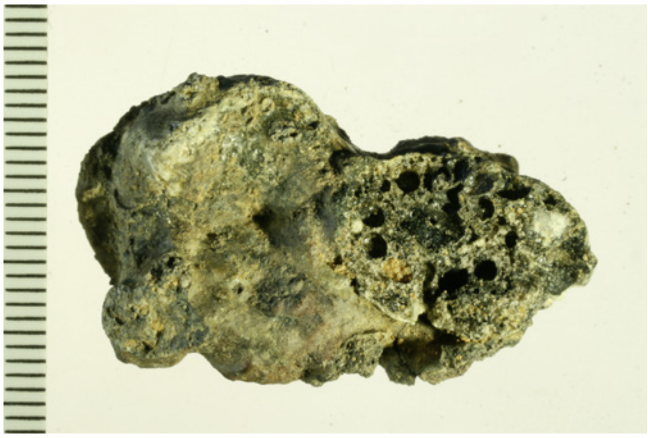


FIGURE I.20 *Archaeometallurgy sample 066 Ek-C 19.*

067 Ek-C 18

- *Summary comments*: Bloated ceramic material; some adhering rust.

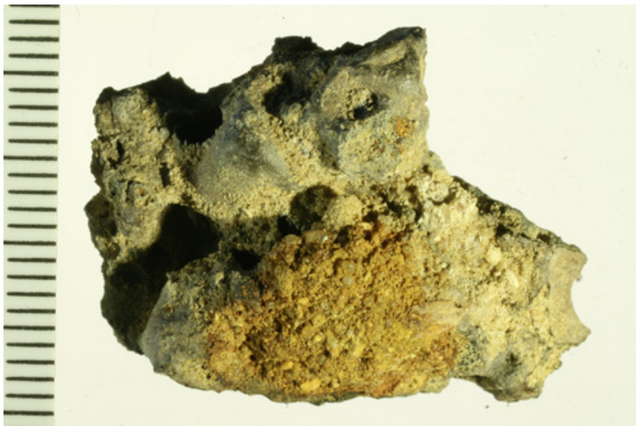


FIGURE I.21 *Archaeometallurgy sample 067 Ek-C 18.*

070 Ek-C 16

- *Summary comments*: Droplet of slag.

Other Remains

017 Ek-A 93

- *Summary comments*: Appears to be hardened earth but potentially with small pieces of metallurgy in it.

025 Ek-A 71

- Optical microscopy and pXRF analysis conducted.
- *Analysis results*: Inconclusive; pXRF analysis yields excessively high amount of light elements.
- *Summary comments*: Asphalt or bitumen with some sand inclusions and ample porosity.

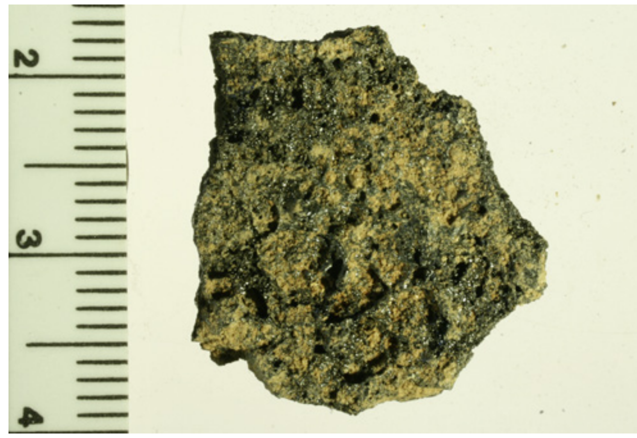


FIGURE I.22 *Archaeometallurgy sample 025 Ek-A 71.*

026 Ek-A 55

- pXRF analysis conducted
- *pXRF analysis results*: Lead as main element, arsenic 2660ppm (questionable due to line overlap between lead and arsenic; result could be due to the dominant lead content), copper 3500 ppm (pXRF).
- *Summary comments*: Piece of lead.

FIGURE I.23 *Archaeometallurgy sample 026 Ek-A 55.*

APPENDIX J

Digital X-ray Imaging and Conservation Treatment of Silver Coins and Related Finds

Stephanie Black

1. Introduction

The following is a report on the use of digital X-ray imaging and conservation to assess and investigate the set of presumed silver coins and other potentially related metal finds excavated at Essouk-Tadmekka. The work was undertaken at University College London's campus in Qatar (UCL Qatar). The imaging process ran from July 2013 to November 2014 and the conservation treatment from May to November 2014. Initial 'pre-treatment' X-ray imaging revealed that some of the metal finds contained inscriptions, but clearer images proved challenging to obtain due to interference from dense corrosion layers, the size of the finds (on average 10mm in diameter and 1–2mm in depth), and developing knowledge in using the X-ray imaging equipment. During the treatment process, additional X-ray imaging displayed clearer images due to the removal of heavier corrosion layers. Experimentation with different parameter settings and filtering helped to overcome recurring image quality issues. A final treatment, under the guidance of Dr. Stavroula Golfomitsou, revealed inscriptions on three of the finds identified as silver coins. Discussion of the coins and the other finds presented here as historic artefacts is provided in Chapter 17 of this volume.

2. Methodology

The methodology for imaging and conserving the metal finds is outlined below, starting with the equipment used and concluding with the conservation treatment. For the Essouk-Tadmekka finds, digital X-ray imaging was utilized in three ways:

- To help determine if any of the finds featured inscriptions obscured by heavy layers of corrosion;
- To assess the condition of the metal finds prior to conservation treatment;
- To see if treatment had removed enough corrosion products obscuring the inscriptions.

Each section describes the process that developed while highlighting some of the issues encountered. Some of the results of the X-ray imaging process will be discussed in the context of developing the methodology.

Condition Assessment and X-ray Fluorescence (XRF) Analysis

Prior to X-ray imaging, a quick visual assessment determined that the finds were stable enough for handling and radiography. A more in-depth condition assessment (Tab. J.1) was conducted by Eleni Asderaki once it was determined that the finds would undergo treatment. The condition assessment revealed that each of the finds was heavily corroded and that any inscriptions present could not be ascertained through simple visual examination. This made the use of X-ray imaging necessary for determining which finds featured inscriptions.

In May 2014, Ek-A 55, Ek-A 70, Ek-A 75 (2), Ek-B 9, and Ek-B 9 (2) were analysed by Eleni Asderaki using a bench-top Fisherscope X-ray XUV 733 XRF to help identify the composition and corrosion layers on some of the metal finds (Tab. J.2). The analysis, combined with the condition assessment, showed that Ek-A 55 and 70 were silver alloy coins covered with a thick layer of silver bromide. Ek-A 72, and Ek-A 79 were also assessed as silver alloy coins due to similar corrosion products, and Ek-A 75 had already been demonstrated as silver by a separate chemical analysis (see Chapter 17). Ek-A 40, Ek-A 75 (2), Ek-B 9, and Ek-B 9 (2) were determined to be copper alloys, while Ek-C 11 proved to be an iron alloy based on visual examination. Additionally, this analysis helped to explain some of the issues encountered during the initial X-ray imaging stages, as the bromine corrosion products were likely interfering with X-ray penetration.

Digital X-ray Imaging

The equipment used for X-ray imaging was a DXC 3000 Digital X-ray Cabinet manufactured by NTB XRAY GmbH, based in Germany. The DXC 3000 is an industrial X-ray unit with a manipulator that moves an object table across an iX-Pect SEZ X-ray camera (scanner) to create a two-dimensional (2-D) line by line image. The parameters for the initial X-ray images were set based on the suspected material composition, density, and thickness of the metal finds. These three factors are used when setting parameters on a conventional radiography cabinet using film (Middleton & Lang 2005). Like conventional cabinets, the DXC 3000 had both kV (kilovoltage – energy) and mA (milliamperes – intensity) parameters that are set using an X-ray Controller interface. However, unlike conventional cabinets, DXC 3000 has separate iX-Pect EZ Camera software with the following parameters:

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- Integration time – how long each scan line of the object will be exposed;
- Double Grey-level/Line averaging to reduce quantum noise from X-ray radiation;
- Pixelbinning.

These are the main parameters that determine the length of exposure to the X-ray beam/scan time and the resolution of the images produced.

Metal objects often require higher kV and mA levels to have the X-ray beam penetrate through to the image capturing apparatus and accurate methods for gauging these levels are discussed further in LANG & MIDDLETON 2005. Ek-A 40, Ek-A 55, Ek-A 70, Ek-A 72, Ek-A 75, Ek-A 75 (2), Ek-A 79, Ek-B 9, and Ek-B 9 (2) were imaged together based on size, while Ek-C 11 was scanned separately due to its greater thickness and different metallic composition. The integration time was set to a default of 10 milliseconds (ms) per scan line and pixelbinning at 1 (highest resolution setting). The digital images produced were inverted (dark/dense areas on a light background) from what is traditionally seen on X-ray films (white/dense areas on a dark background).

The first image (Fig. J.1), while dark, displayed a great deal of information that prompted further imaging for Ek-A 55, Ek-A 70, Ek-A 72, Ek-A 75, and Ek-A 79. From this point on, imaging was focused on these five artefacts and Ek-A 40, Ek-A 75 (2), Ek-B 9, Ek-B 9 (2), and Ek-C 11 were set aside for conservation treatment.

Experimentation began with the parameters and imaging software to improve the image quality, specifically on Ek-A 72, as this displayed the most discernible inscriptions. The kV and mA levels were increased and the X-ray camera recalibrated to run at higher integration times of 200, 400, and 800ms. Attempts to run the X-ray at 800ms were unsuccessful, while scans taken at 400ms had noticeable striation lines, likely due to inaccurate calibration.

As the image processing progressed, experimentation with higher integration times and image manipulation did produce improved images (Fig. J.2). Figure J.2 shows the gradual adjustments made using a multiscale filter, which included detail contrast enhancement, smoothing and sharpening, and latitude reduction. However, the image quality was still being impacted by the size of the finds and corrosion layers. While the images looked clearer in the original format, they became pixelated once expanded. Additionally, by May 2014 experimenting with the parameter settings had reached the limitation of the kV and mA levels at 120kV, 4.1mA, and 200ms. This, combined with developing knowledge in using the DXC 3000 and its imaging software, continued to limit the image quality of the X-rays.

The metal finds underwent conservation treatment in May 2014, which successfully revealed an inscription on Ek-A 70, but was not successful in revealing inscriptions on the remaining silver coins. The treatment did however diminish the overlaying corrosion layers, which made the inscriptions on Ek-A 75 and Ek-A 79 discernible for the first time during X-ray imaging (June 2014). Upon a recommendation from a colleague, a final round of X-ray imaging was conducted using a sheet of copper AnalaR of 0.1mm thickness in-between the X-ray beam (placed in front of the collimator) and the remaining three coins on the scanning bed. A metal sheet such as copper will readily absorb the less energetic, longer wavelengths that are less penetrating "so that the proportion of shorter wavelength X-rays in the emerging beam increases and effectively the beam is harder and more penetrating" (MIDDLETON & LANG 2005: 14). In order to compensate for a loss in beam intensity through the copper filter, the cabinet was recalibrated at an integration time of 400ms. This created much clearer images, the results of which are discussed further below.

Conservation Treatment

Each of the metal finds received conservation treatment to remove potentially active corrosion and to stabilise them for handling and transport. Treatment was conducted under a Leica A60 stereomicroscope to monitor treatment progress.

Mechanical Cleaning

EkA-40, Ek-A 75 (2), Ek-B 9, Ek-B 9 (2), and Ek-C 11 were each mechanically cleaned using a Marathon micro-motor to remove active corrosion. Ek-C 11 required further mechanical cleaning using air abrasion. Ek-C 11 was then placed in a 1% w/v solution of sodium hydroxide dissolved in deionised water (DI) for one week to remove iron chlorides, and thoroughly rinsed with DI. Ek-A 40, Ek-B 75 (2), and Ek-B 9 were placed in a 3% w/v Benzotriazole (BTA) solution in ethanol, a corrosion inhibitor, for 30 minutes. Once Ek-A 40, Ek-A 75 (2), Ek-B 9, Ek-B 9 (2), and Ek-C 11 were dry, each was coated with two applications of 7% and one application of 10% weight/volume solutions of Paraloid B44 (methyl methacrylate and ethyl acrylate copolymer) in toluene plus fumed silica and left under fume hood extraction. Ek-B 9 and Ek-B 9 (2) were re-adhered with a 10% w/v solution of Paraloid B48N (methyl methacrylate and butyl acrylate copolymer) in acetone (propanone).

Ek-A 70 was deemed stable enough for mechanical cleaning using a soft brush, ethanol, and bamboo skewer. It did not receive further treatment once the corrosion products were removed.

Chemical Cleaning

Ek-A 55, Ek-A 72, Ek-A 75, and Ek-A 79 were deemed too fragile for mechanical cleaning, which might have damaged the coins. For the initial chemical treatment, a cotton wool poultice wetted with a 5% w/v solution of ammonium thiosulphate in DI was applied to the surface of Ek-A 55, Ek-A 72, Ek-A 75, and Ek-A

79 for one hour to test its removal of the overlaying corrosion layers. The coins were then submerged in the same solution, twice for 30 minutes, and for another 30 minutes in a 1% w/v solution of ammonium thiosulphate in DI. The coins were lightly brushed with a soft brush while submerged and rinsed three times in DI after each session. Ek-A 55, Ek-A 72, Ek-A 75, and Ek-A 79 were dried in an oven at 60°C for five days, removed and allowed to cool, and then brushed with ethanol.

After the final X-ray imaging, Ek-A 72, Ek-A 75, and Ek-A 79 underwent further chemical treatment using a cotton wool poultice wetted with a 5% volume/volume solution of formic acid in DI applied to the surface of the coins for two minutes at a time. This was to remove the remaining corrosion products obscuring the inscriptions using a weak acid. The application of the acid solution was controlled using the cotton poultices and continuous monitoring. After each application, the coins were immersed in DI. This alternating process was repeated several times for each coin. The coins were then rinsed for 30 minutes in DI, which was changed every five minutes, and dried for 15 minutes in a 1:1 v/v solution of acetone and ethanol, followed by another 15 minutes of drying in acetone. The coins were immersed in 3% w/v solution of BTA in ethanol for 15 minutes, removed and allowed to dissipate, placed in an oven at 60°C for 30 minutes, removed and cooled in a sealed container of silica gel, and then coated twice with a ~7% w/v solution of Paraloid B44 in acetone.

After treatment photo-documentation was undertaken for each find using a Leica M165 C Digital stereomicroscope under high magnification at different angles of the inscriptions and treatment reports were produced for each of the finds.

3. X-ray Imaging and Conservation Treatment Results

X-ray Imaging

The first image produced (Figure J.1) showed that five of the finds, Ek-A 55, Ek-A 70, Ek-A 72, Ek-A 75, and Ek-A 79, had darker/denser metal compositions than that of Ek-A 40, Ek-A 75 (2), Ek-B 9, and Ek-B 9 (2). Silver is a heavier element than iron and copper and would generate darker/denser looking X-ray images at the same parameter settings. While Ek-A 40, Ek-A 75 (2), Ek-B 9, Ek-B 9 (2), and Ek-C 11 did not show any signs of inscriptions, X-ray imaging did show a crack through the middle of Ek-B 9 and that there was no metal core left in Ek-C 11. This information was vital when determining a course of treatment, as structural issues may not be readily visible to the unaided eye.

Experimentation with different parameters and digital filters did improve initial images, but it was not until after the coins underwent treatment and the corrosion layers decreased, that clearer images of the inscriptions were discernible on Ek-A 72, Ek-A 75, and Ek-A 79. After treatment X-ray imaging showed that Ek-A 55 did not appear to feature any inscriptions. Ek-A 72, Ek-A 75, and Ek-A 79 were scanned again, at levels between 75–90kV, 4–4.5mA, an integration time of 200ms, and with Double Greylevel. By raising the integration time to 200ms and increasing exposure time, clearer images were achieved, but pixilation and image size were still issues. The inscriptions were still slightly blurry and lost definition as the image was expanded.

The addition of the copper filter greatly improved the images as did increasing the integration time to 400ms (Fig. J.3). These improvements are most noted in Ek-A 75 and Ek-A 79, which were thicker and had heavier corrosion layers than Ek-A 72. There are still size limitations, but the striation lines and noise were greatly reduced, creating clearer images. The main issue that persisted was the overlapping of each side of the coins' inscriptions inherent in the production of 2-D X-ray images. While the copper filter did produce some added depth, it was not possible to tell which inscriptions belonged to which side until the corrosion layers were removed during treatment.

Conservation Treatment

The overall conservation treatment of the metal finds successfully revealed inscriptions, stabilised the finds, and prepared the finds for future handling and transportation. The mechanical cleaning using the Marathon micro-motors removed most of the overlaying corrosion from Ek-A 40, Ek-A 75 (2), Ek-B 9, and Ek-B 9 (2) and revealed the inscriptions on Ek-A 70. However, air abrasion proved more successful than the micro-motors at removing corrosion from Ek-C 11.

The ammonium thiosulphate solution removed enough of the corrosion layers from the silver coins for improved X-ray imaging, but was not successful at revealing the inscriptions. The formic acid treatment was successful at revealing inscriptions on Ek-A 72 and Ek-A 79. While the appearance of Ek-A 75 was improved, not all of the corrosion could be removed due to potential loss of the inscriptions and to time constraints.

The most successful treatment was Ek-A 79, which clearly shows the inscriptions revealed during X-ray imaging (Figure J.4). After treatment, each of the finds were treated to inhibit further corrosion and coated to enable them to be handled by specialists researching the inscriptions.

4. Conclusions

In the case of the Essouk-Tadmekka silver coins and metal finds, digital X-ray imaging played an important part in a series of interrelated methodologies. The X-ray imaging process, condition assessment and XRF analysis, and the conservation treatment interplayed with each other to inform, progress, and lead to revealing the inscriptions. While some issues are highlighted in this report, digital X-ray imaging allowed for a quick assessment of the metal finds that conventional radiography cannot provide. Scan previewing decreased the guesswork in setting X-ray parameters, and the digital images produced avoided the time required to process and develop X-ray film. This in turn allowed for the experimentation needed to improve the image quality of the inscribed coins. It is hoped that in the future digital X-ray imaging will become a regular and more affordable assessment tool in archaeology and conservation.

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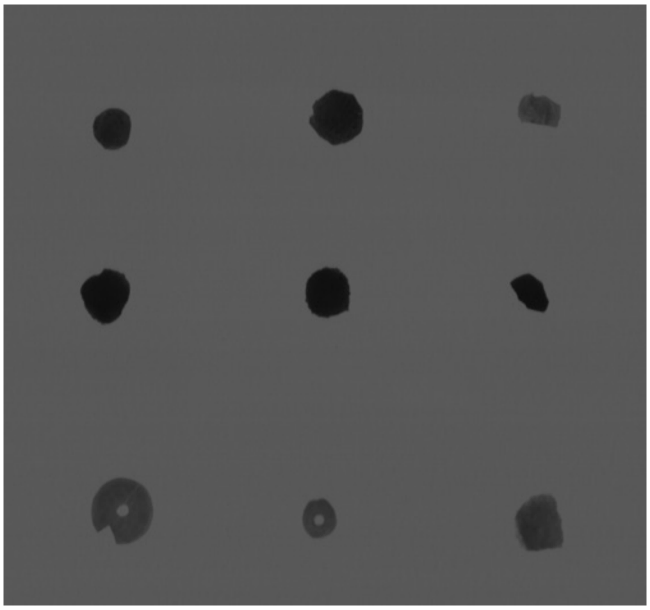

FIGURE J.1 *Initial image produced by Digital X-ray of the silver coins and copper alloys at 85kV, 2.5mA, and 10ms (top, left to right: Ek-A 70, Ek-A 72, Ek-A 40; middle, left to right: Ek-A 55, Ek-A 79, Ek-A 75; bottom, left to right: Ek-B 9 (2), Ek-B 9, Ek-A 75 (2)).*

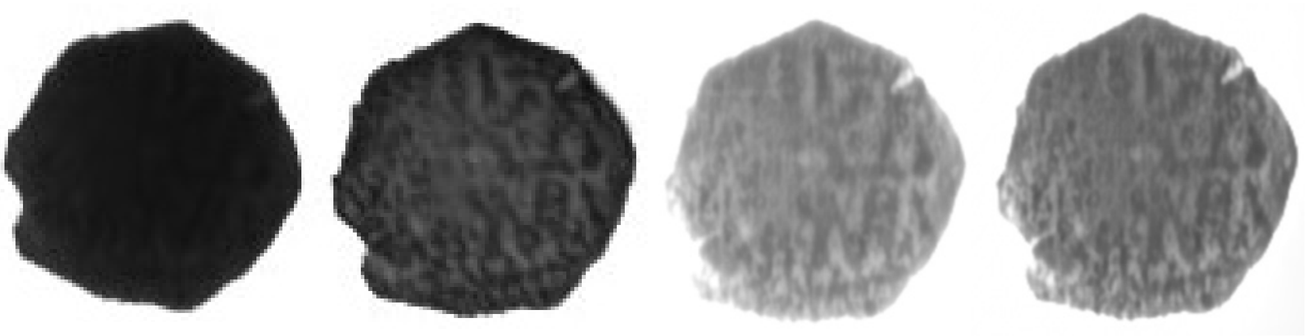

FIGURE J.2 *Silver coin Ek-A 72 shown during various stages of Digital X-ray image processing (without copper filter), July 2013–May 2014 (left to right): a) 85kV, 2.5mA, and 10ms; b) 85kV, 2.5mA, 10ms; c) 90kV, 4mA, 200ms; d) 120kV, 4.1mA, 200ms.*

FIGURE J.3 *Digital X-ray images of silver coins using the copper filter – left to right: coins Ek-A 72, Ek-A 75, and Ek-A 79.*

FIGURE J.4 *Conservation of silver coin Ek-A 79, showing (left to right) before, during, and final conservation stages.*

TABLE J.1 *Essouk-Tadmekka conservation finds condition assessment (summary)*

Context/Object no.	Description	Condition	Dimensions
Ek-A 40	Metal disc section/ sheet metal	The object is very thin and heavily corroded. The copper corrosion products make any existing decoration invisible. Five small pieces appear to have detached from the object. Copper oxides, copper chlorides, as well as copper carbonates are present.	~9–10mm widest diameter
Ek-A 55	Coin	The coin is covered with heavy corrosion products both of silver bromine and copper chloride salts mixed with soil. The heavy corrosion products make any existing decoration/inscription invisible.	10mm diameter
Ek-A 70	Coin	The coin is very thin and covered with layer of silver bromine. The silver bromine corrosion products make any existing decoration/inscription invisible.	8mm diameter
Ek-A 72	Coin	The coin is very thin and covered with a thick layer of silver bromine and copper corrosion products mixed with soil. The heavy corrosion products make any existing decoration/inscription invisible.	11mm diameter
Ek-A 75	Coin	The coin is covered with a very thick layer of silver bromine, copper corrosion products, and soil. The heavy corrosion products make any existing decoration/inscription invisible. The corrosion products are twice the original thickness of the object itself.	~8mm at widest diameter
Ek-A 75 (2)	Metal disc/sheet metal	The object is heavily corroded with soil encrustations mixed with iron corrosion products (possibly coming from an iron objects found nearby). Bronze disease exists extensively all over the surface giving it a cratered appearance.	10 × 10mm
Ek-A 79	Coin	The coin is very thin and covered with a thick layer of silver bromine and copper corrosion products mixed with soil. The heavy corrosion products make any existing decoration/inscription invisible.	10mm diameter

TABLE J.1 *Essouk-Tadmekka conservation finds condition assessment (summary)* (cont.)

Context/Object no.	Description	Condition	Dimensions
Ek-B 9	Disc with hole in	The object is heavily corroded with copper corrosion products. Soil encrustations are mixed in the corrosion products, obstructing visual examination of the original surface. Copper oxides, copper chlorides, copper carbonates, as well as pitting bronze disease, are obvious. The object may have a break down the middle section.	7mm diameter
Ek-B 9 (2)	Disc with hole in	The object is heavily corroded with copper corrosion products, obscuring visual observation of the original surface. Copper oxides, copper chlorides, as well as pitting bronze disease, are obvious. The object is broken in two pieces.	12mm diameter
Ek-C 11	Corroded sheet metal cluster?	The object is heavily corroded. Iron oxides are mixed with soil encrustations. It seems that no metal core is preserved.	40 × 20mm

TABLE J.2 *Summary of XRF analysis on selected silver coins and copper alloys*

Context/Object no.	Sample Site	Measurement Parameters	Results
Ek-A 55	Exposed surface	50kV for 300s	Silver-copper alloy containing lead and gold impurities
	Corrosion layer	50kV for 300s	Silver bromide in corrosion layer
Ek-A 70	Exposed surface	50kV for 300s	Silver alloy containing nickel and gold impurities
	Corrosion layer	50kV for 300s	Silver bromide in corrosion layer
Ek-A 75 (2)	Exposed surface	50kV for 300s	Copper-lead alloy with calcium, iron, and potassium linked to corrosion and soil contamination
	Corrosion layer	20kV for 500s	Chlorine linked to copper chloride salts
Ek-B 9	Exposed surface	50kV for 300s	Copper alloy
Ek-B 9 (2)	Exposed surface	50kV for 300s	Copper-lead-zinc alloy

APPENDIX K

Preliminary Chemical and Technical Analyses of Essouk Metal Artefacts

Thomas R. Fenn, Thilo Rehren and Laure Dussubieux

Introduction

A total of 66 metal and metallurgical artefacts, recovered from archaeological excavations at the site of Essouk-Tadmekka (Mali), underwent physical examination, while a smaller subsample was subjected to archaeometallurgical analyses. A detailed presentation of the results and conclusions, including data tables, will be provided in a forthcoming publication (Fenn *et al.* forthcoming). Presented here is a summary of preliminary observations and interpretations.

The objective of the bulk chemical analysis was to characterize a sample of the metals at the site to identify patterns of compositional variation and similarity. Another subsample of Essouk metal objects, including some of the objects analysed for bulk elemental composition, was subjected to lead isotope analysis (LIA) to examine potential provenance and the movement of metals into the site of Essouk through time and space.

Sampling and analytical methods

In total, 25 metal objects from Essouk-Tadmekka were analysed. Three main analytical techniques were utilized during research to collect bulk chemical and lead isotope abundance ratio data. Chemical composition of fifteen samples was determined both by Thomas Fenn with electron probe microanalysis (EPMA) at the Department of Planetary Sciences, The University of Arizona, Tucson, Arizona, and by Laure Dussubieux, using laser ablation (LA) inductively coupled plasma mass spectrometry (ICP-MS) at The Field Museum, Chicago, Illinois. A few specimens were examined at UCL Qatar, Doha, Qatar using scanning electron microscopy (SEM) with energy dispersive spectrometry (EDS). Only 11 samples retained enough uncorroded metal to yield meaningful quantitative chemical analysis results (10 copper-based objects and 1 silver coin; all data tables to be published in Fenn *et al.* forthcoming). 19 non-ferrous metal objects from Essouk were sampled for lead isotope analyses (LIA) (Thomas Fenn, using multi-collector (MC) ICP-MS at the Department of Geosciences, The University of Arizona, Tucson, Arizona), including 10 which had previously been analysed for composition.

Some samples were studied by optical microscopy, both to understand their texture and corrosion status, and to help interpret the chemical analysis results. For microstructural analysis, a small portion of the object was mounted in epoxy and polished using standard metallographic methods. Compositional analysis was conducted on the same epoxy-mounted polished samples with both EPMA and LA-ICP-MS. Details of the EMPA, LA-ICP-MS, and LIA methods are reported in Fenn *et al.* 2006, Fenn & Killick 2016, Dussubieux 2007, and Fenn *et al.* 2009 respectively. A more detailed version of specific analytical methods employed on the Essouk-Tadmekka samples will be provided in Fenn *et al.* forthcoming.

Elemental Analysis: Results and Discussion

The composition of the copper-based metal artefacts from Essouk-Tadmekka was analysed to determine whether they were brass (copper-zinc alloy) or bronze (copper-tin alloy) or another alloy that could suggest a trans-Saharan source. Alternatively, if the artefacts were made of pure or arsenical copper, we could explore local or regional sub-Saharan sources.

14 copper-based metal objects were subjected to compositional analyses consisting of four samples with no preserved metal remaining and 10 objects retaining enough metal to allow for accurate, representative bulk compositional analysis (see below for corresponding metallography and reference to illustrations of objects). A silver-based coin, exhibiting significant corrosion, was also analysed. The 10 specimens exhibit the typical broad range of compositions seen in copper-based artefacts in Islamic sub-Saharan West Africa (see Fig. K.1). These include unalloyed copper (Ek-A-091–214) where all elements other than copper are at trace levels, leaded copper (Ek-B-08–215) where the lead content is at levels suggesting intentional addition, brass (copper-zinc alloy) where the zinc content is greater than *ca* 10 wt% but lead, tin and/or arsenic may be present in concentrations ranging from *ca* 6.0–0.5 wt% (Ek-A-040–216, Ek-A-071–217, Ek-A-075–218, Ek-A-087–208, Ek-B-06–209 & Ek-B-10–219), and "mixed"-alloy copper which includes lead, tin, zinc and arsenic in varying minor amounts ranging from *ca* 0.5 wt% to as much as *ca* 5 wt% (Ek-A-103–191 & Ek-A-055–195). Two corroded specimens also had compositional data collected on corrosion products and appear to have previously been arsenical copper (Ek-A-054–213; arsenic >1 wt%) and bronze (Ek-A-116–193; tin >2 wt%, but also with >0.6% Zn). The silver coin (*ca* 96% silver by weight) included minor amounts of copper, zinc and lead

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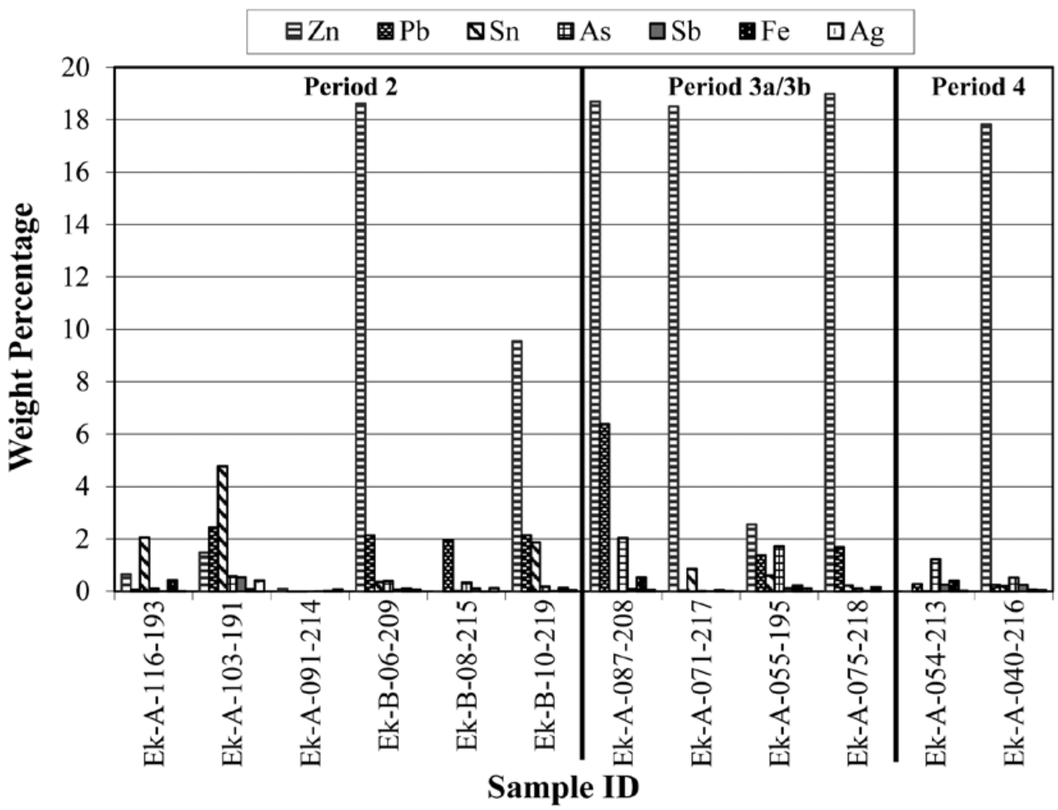

FIGURE K.1 *Elemental composition comparison of Essouk copper-based objects through time. Note: Ek-A-116–193 & Ek-A-54–213 are completely corroded and so compositions reflect corrosion products only.*

(between *ca* 1.6 and 0.8 wt%), and about one third of one percent of gold.

A few general observations can be made from a comparison of alloying and other important associated elements through time for the Essouk copper-based objects (Fig. K.1). Mixed low-tin bronze and unalloyed copper prevail in objects from Period 2 contexts in Ek-A; zinc occurs in some of these early objects, but tin is found at greater concentrations (>2 wt%). Interestingly, medium- to high-zinc brass is more common from Period 2 contexts in Ek-B. With a few exceptions, brass also is the prevalent metal from Period 3 and 4 contexts in Ek-A, commonly containing more than 15 wt% zinc. With one possible exception (Ek-A-040–216), none of these brass metals appear to be "pure" brasses, in that they are not just a pure copper and zinc alloy. In fact, most copper alloys analysed from Essouk tend to have a "major" alloying metal, but often contain a range of minor alloying or related elements. In some cases, a secondary alloying element – creating something of a ternary (or even quaternary) alloy – is present in significant concentrations. In a few objects tin or zinc are the major alloying metals, but lead also is present in significant concentrations. Arsenic does appear in moderate concentrations (>0.5 wt%) in several objects, but is not an exclusive "alloying" element, nor does it appear to be chronologically specific to earlier dated objects, as one might suspect. In fact, the highest concentrations of arsenic (>1.0 wt%) occur in the later periods at Essouk, after Period 2. In several of those cases, the elevated arsenic co-occurs with elevated antimony, silver and nickel, suggesting the possible presence of some fahlore (fahlerz) in copper ores used for production of some of the later copper-based metals. Also of note is that the only analysed object apparently manufactured from pure "unalloyed" copper (Ek-A-091-214) predates Period 3a.

Metallography

The text below provides some observations made during optical microscopy (OM), where appropriate relating them to the chemical and isotopic analytical results. Some selected images are provided to illustrate the points made. The copper-based metalwork consists mostly of small pieces of dress accessories or jewellery. Most were cast into their final form with some evidence for working and annealing; a few were heavily hammered into sheet metal. None of this is unusual for an assemblage of this kind.

Ek-A-040–216

Small copper-based jewellery/decorative fragment, possibly for tying onto leather. The LA-ICP-MS spots are placed in the sound metal (Fig. K.2 Left, in centre), identifying the alloy as brass with

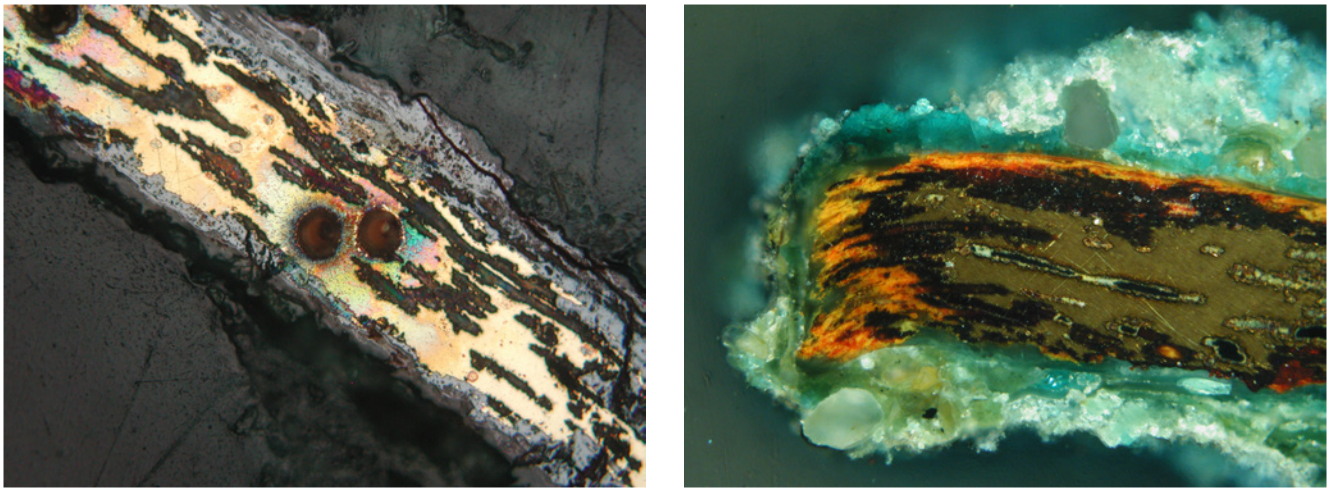

FIGURE K.2 *Ek-A-40–216. Left:* OM *image showing the hammered metal sheet with elongation borne out in the corrosion* (*dark areas in bright metal*)*, and two of the* LA-ICP-MS *craters* (*centre*)*. Width of image* ca *1 mm. Right:* OM *image using crossed polarizers, highlighting the corrosion* (*orange to white-bluish colours*)*, and deformation at the edge of the sample, probably from a chisel used to cut the sheet metal into shape. Width of image* ca *1 mm.*

ca 18 wt% zinc, half a percent arsenic and a quarter of a percent each of lead and antimony. The corrosion affects about 1/3 of the total metal, revealing a deformation pattern consistent with hammering an originally thicker sheet. It appears to have been cut with a chisel or similar as seen in the deformation at the edge (Fig. K.2 Right).

Ek-A-054–213

Small, thick unidentifiable fragment of copper-based metal, fully corroded to copper oxide throughout, with tiny spots of surviving metal. Structure appears as if it was as-cast. Areas of intact metal far too small to analyse, and the obtained chemical data therefore is probably not representative of the original alloy composition. Elements preserved in the corrosion products hint at the original composition being arsenical copper. However, some elements can be affected (*i.e.*, depleted/enriched) during the corrosion process. In particular, zinc is likely to be lost during corrosion, while tin/tin oxide would stay in the corrosion product. The lead and antimony levels are similar to those in Ek-A-40–216, but at this point nothing else can be concluded about the original alloy composition.

Ek-A-055–195

Small fragment of wire or jewellery, heavily deformed during working and subsequently annealed. Heavy corrosion is penetrating from the outside and on cracks. It is likely that the analytical results are affected by the corrosion, as the LA-ICP-MS crater would have included corroded material. This is consistent with the low zinc concentration found, possibly reflecting only the remaining amount of this element not yet leached from the alloy rather than the original alloy composition. Lead, tin and arsenic, as a group, are present in somewhat elevated levels, ranging from 0.5–1.5 wt%.

Ek-A-071–217

Small but thick, unidentifiable irregular sectioned fragment of copper alloy. Solid metal below thin corrosion layer, annealed and heavily worked with high amount of inter-granular corrosion. The LA-ICP-MS analysis shows this to be brass with around 18 wt% zinc and just under one percent tin.

Ek-A-075md-207

Silver coin fragment (see Fig. 17.1 middle, this volume). Hammered, elongated artefact, heavily annealed and badly corroded. Even densest part of metal shot through with inter-granular corrosion. Analysed by LA-ICP-MS in heavily corroded residual metal, so that the results have to be interpreted cautiously. The chemical composition is interesting, in particular the zinc content which is not normally found at such levels in silver unless the silver is debased with brass. The gold content as determined by SEM-EDS is in the order of one third of one percent, similar to some Sasanian and early Islamic silver coins that have gold content in the order of half of one percent to one percent (*e.g.* Ben Abdelouahed *et al.* 2010; Sodaei *et al.* 2013).

Ek-A-075–218

Horseshoe-shaped copper object, possibly a small functional item (see Fig. 17.10 left, this volume). It has an as-cast structure, partly annealed; only slight deformation visible. The dendritic structure is still visible, with inter-granular corrosion as well as intra-granular slip-lines. Some re-deposited copper seen within the artefact (discrete particles as with Ek-A-116–193). EPMA shows this to be brass with *ca* 18% zinc, and a minor amount of added lead (*ca* 1.6 wt%).

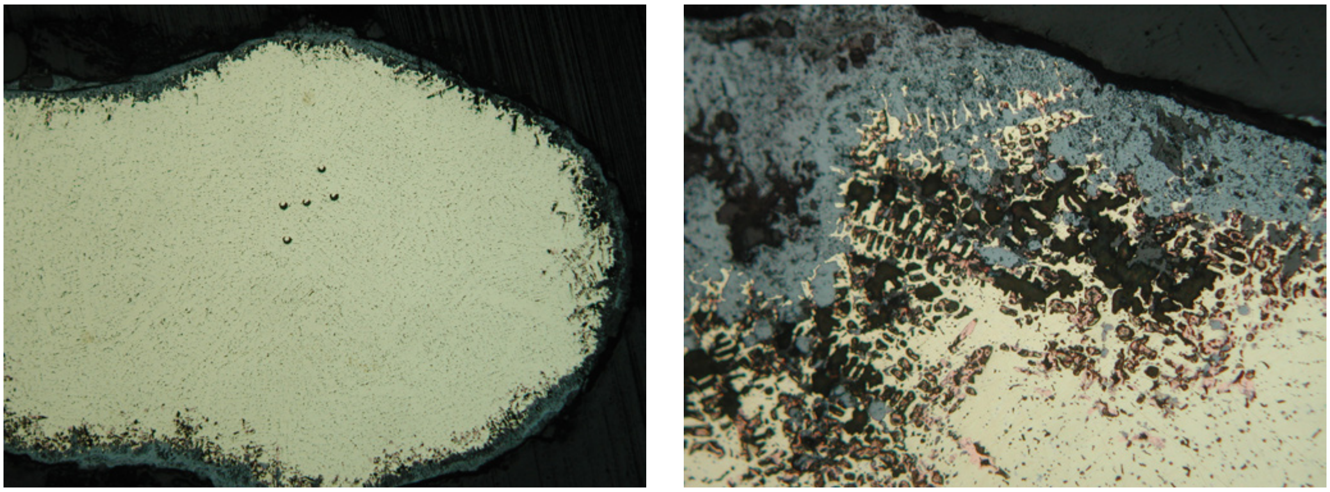

FIGURE K.3 *Ek-A-87–208. Left: Overview of mounted sample, showing the relatively thin corrosion (grey, surrounding the metal core) and the five* LA-ICP-MS *craters in the centre of the object. Width of image* ca *4 mm. Right: Detail of the corrosion layer, showing the dendritic as-cast texture of the metal. Width of image* ca *1 mm.*

Ek-A-087–208

Mostly intact jewellery item/decorative fragment, possibly for tying onto leather (possibly larger thicker version of Ek-A-040–216). As-cast structure preserved (Fig. K.3 Left), not annealed. Dendritic structure clearly visible and brought out by corrosion; where corroded it is partly refilled with re-deposited pure copper (Fig. K.3 Right). LA-ICP-MS data on sound metal shows this to be brass with *ca* 18% zinc and a high lead content of more than 6 wt%, in addition to *ca* 2 wt% arsenic and half a percent iron.

Ek-A-080–210

Small, thick unidentifiable fragment of copper-based metal. Completely corroded and no compositional data available. Faint indication of an as-cast structure.

Ek-A-091–214

Straight thin copper wire fragment with heavy corrosion layer. Core preserved what looks like a pure copper metal core which reveals little about its structure. It is probably as-cast, with no traces of working. Slightly oxidized, with copper/copper oxide eutectic in places and superficial corrosion. LA-ICP-MS data on sound metal confirms the essentially pure copper composition; the highest impurity concentrations were found for zinc (930 ppm) and silver (720 ppm).

Ek-A-097–192

Mostly soil concreted together by corrosion products surrounding what may have been a blob of metal. Clearly copper-based, and would have been hammered to some extent. No compositional information available.

Ek-A-103–191

Section of ring ingot (Fig. 17.10 right, this volume). As-cast structure with little evidence of being worked. Dendritic crystal growth, brought out through limited surface corrosion. EPMA analysis shows this to be a complex alloy, with nearly 5 wt% tin, *ca* 2.5 wt% lead, 1.5 wt% zinc, and half a percent each of arsenic, antimony and silver.

Ek-A-116–193

Small copper wire fragment which is completely corroded with some deformation visible in elongated sulphide inclusions, but overall very difficult to interpret the sample. Some tiny discrete metallic particles are preserved in the corrosion, potentially bismuth (based on the analysis and optical appearance). The LA-ICP-MS data is most likely influenced by the complete corrosion of the metal; zinc in particular may have been there originally and become lost through corrosion; the reported data is therefore unlikely to reflect the original alloy composition.

Ek-B-06–209

Thin curved copper-based wire/earring section fragment. Ordinary good brass, annealed but not much deformed. Light corrosion, mostly on the surface (Fig. K.4). The EPMA data shows this to be a brass with *ca* 18 wt% zinc, about 2 wt% lead and minor amounts of arsenic and tin, on the order of a third of a percent each.

Ek-B-08–215

Small fragment of metal completely used up in polished block. Leaded copper with a well-developed as-cast structure and lead on grain boundaries. No indication of any mechanical working/

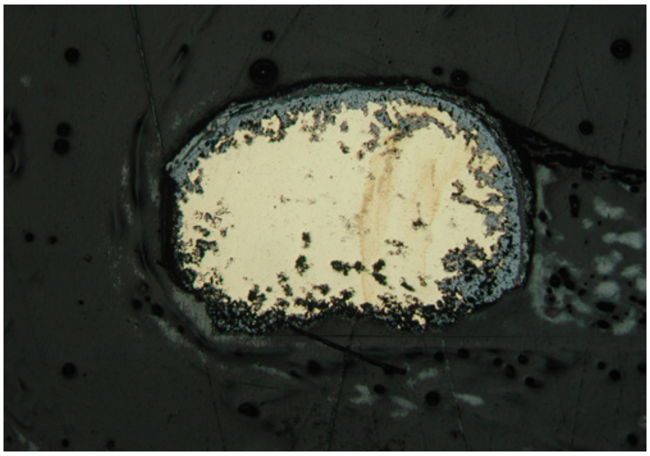

FIGURE K.4 *Ek-B-06-209. OM image of mounted sample, showing the corrosion layer (grey) surrounding the sound metal core. Width of artefact* ca *2 mm.*

FIGURE K.5 *Ek-C-07-1. Section of dagger/sword blade fragment from Essouk-Tadmekka.*

deformation. EPMA data indicate around 2 wt% lead, one third of one percent arsenic, and minor amounts of antimony and silver.

Ek-B-10–219

Small, thick unidentifiable fragment of copper-based metal with an as-cast structure and sound metal preserved inside and heavy corrosion outside. Dendritic structure with some intergranular corrosion attacking preferentially the alpha phase. LA-ICP-MS analysis shows this to be a low-zinc brass (just under 10 wt% zinc) with about 2 wt% each lead and tin, and minor amounts of arsenic and iron.

Ek-C-07–1

Sword blade fragment (Fig. 17.4 this volume) – A single iron artefact was analysed in addition to the finds of iron and steel-related metallurgical waste described elsewhere in this volume (Chapter 16, App. I). The possible identification of a local crucible steel industry, even if small-scale, prompted the investigation of this fragment. It was cut across the blade and mounted in resin for metallographic analysis.

Unfortunately, there was no metal left in the cross section; only the outline of the original artefact was still visible in the completely corroded material (Fig. K.5). In a few areas very faint indication for a low carbon content in the original metal survived, in the form of some residual cementite flecks in an area which might have been pearlite. There is no indication of any kind that would suggest that the metal could have been originally crucible steel; and while the surviving evidence makes it very difficult to make any positive statement about the possible original metal quality, the impression is that it was a soft bloomery iron blade.

Lead Isotope and Chemical Analysis: Results and Discussion

In this preliminary report we use the scatter graph plotting the ratios of $^{207}Pb/^{206}Pb$ on the X-axis against $^{208}Pb/^{206}Pb$ on the Y-axis to compare the analysed metal from Essouk with relevant published data. To simplify this preliminary presentation of these data, ore from only two potential source areas are plotted here for comparison, Tunisia and Morocco.

An initial examination of the LIA results from Essouk reveals that the data form several visually apparent patterns (Fig. K.6). First, the Essouk data form two general linear trends with the majority of the analyses (14) forming two relatively closely-spaced clusters separated by a gap just below 0.85 on the X-axis, while the remaining analyses (5) plot away from the main cluster trends and in a scattered array towards lower $^{208}Pb/^{206}Pb$ ratios. The main two cluster trends comprise several different metal types (relatively pure copper, mixed-alloy copper, brass and the silver coin). The spread particularly of the brass analyses, a metal to present knowledge not manufactured in sub-Saharan West Africa at this time (see for example CRADDOCK & PICTON 1986, HERBERT 1984:97), indicates that non-ferrous metals imported to Essouk likely were produced in multiple source regions.

Several patterns are apparent if the Essouk objects are examined by time periods provided by their excavation contexts. First, the three earliest objects in the LIA dataset from Ek-A, dating from Period 2, all plot in different regions of the graphs; one is an "outlier" located in the scattered array of data points, while two plot by themselves at opposite ends of the two main cluster trends. Likewise, the nine objects from Period two contexts in Ek-B plot in five different regions of the graph, and none

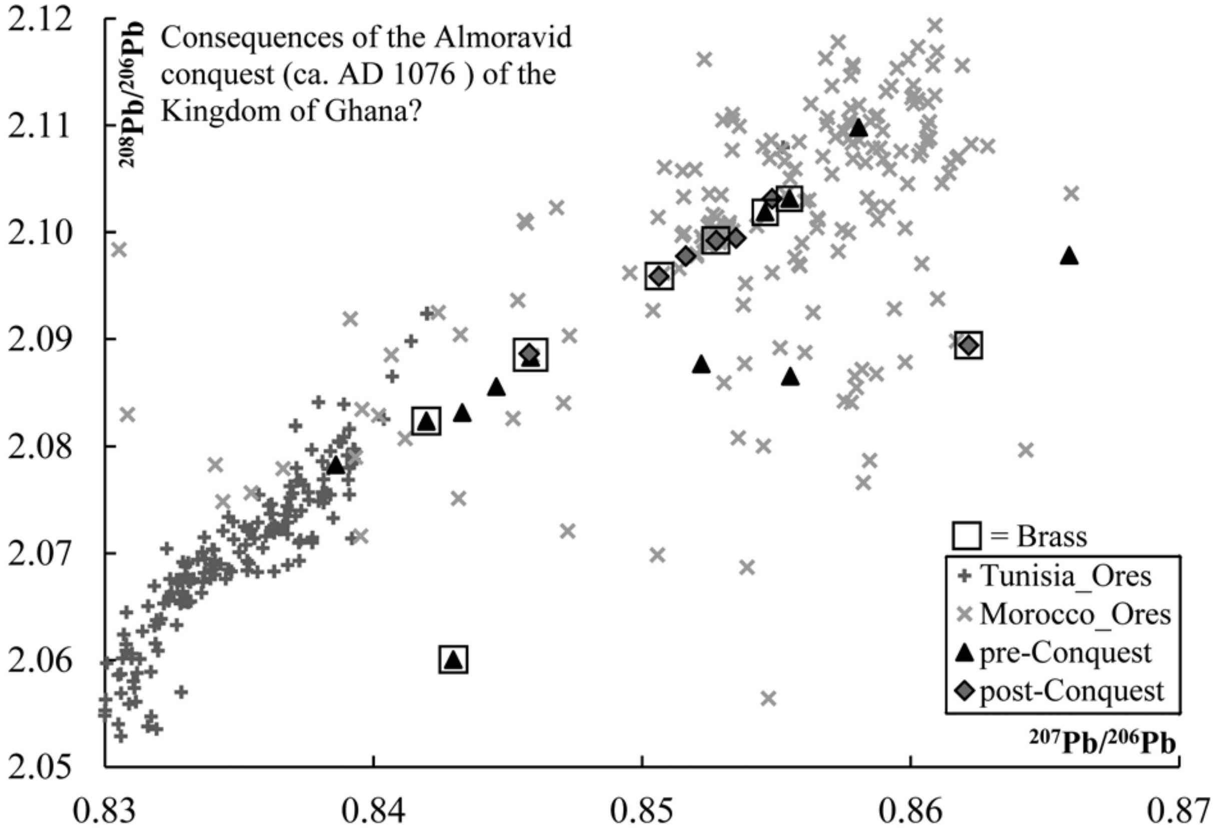

FIGURE K.6 *Lead isotopic ratio comparisons of analyzed objects from Essouk, Mali, by occurrence before and after the Almoravid conquest* (ca *1076 AD*) *of the Kingdom of Ghana, based upon the excavation chronology. Essouk analyses are plotted against isotopic data for copper/lead ores from Tunisia and Morocco. Note: some objects in this plot are identified as brass only from visual examination of a cut section.*

overlap with the three early objects from Ek-A; six in two groups of the two main cluster trends, and three as "outliers". Of all samples, only one object is consistent with ores from Tunisia. Interestingly this is the earliest object (Ek-A-103–191) analysed from Essouk, dating from Period 2. This suggests that metal reaching Essouk early in its occupation history originated from multiple source regions. Objects from Period 3a and early Period 3b (12th/13th centuries) show a broadly similar pattern with objects plotting on both major trend clusters and as an "outlier" in the scattered array. While the scatter of objects from this time period also suggests multiple source regions supplied metal to Essouk the majority of those objects fall into the two main cluster trends indicating that some source regions may have established more dominant roles in the metal supply by this time. The later Essouk metal objects in the dataset (13th/14th and 14th centuries), however, plot in a much more restricted spread suggesting the possibility that only a few source regions supplied metal to Essouk at this time. In fact, all four of these analysed artefacts, including the silver coin, dating from later Period 3b and Period 4, may have been supplied by a common source region matching Moroccan ore data.

When considering the shift of metal supply through time it is important to consider broader social events which have economic impacts on the trade and movement of materials. One such event was the invasion of the West African Kingdom of Ghana by North African Almoravids and/or their allies, recorded in historic descriptions as occurring at about AD 1076. The Kingdom of Ghana at that time was a region of loosely allied populations primarily centred around the capital city of Koumbi Saleh, which has been linked with an archaeological site in southeastern Mauritania. This event could have significantly disrupted the trans-Saharan trade routes connecting North and West Africa, and resulted in effectively limiting external metal supply for Essouk. The impact of the Almoravid control could have been to divert materials from the western trans-Saharan trade routes further east as caravans cross the Saharan Desert from the North, in effect displacing or supplanting the central and eastern caravans, or at least potentially reducing their penetration into the central Sahel. Prior to AD 1100 metal reaching Essouk came from a variety of source regions, but after AD 1100 the source regions were dramatically restricted. While the sample size for the later objects is relatively small, the spread of the ratios for metals post-dating AD 1100 is significantly limited, representing only a few source regions, source regions also represented in the earlier periods.

Brass appeared as the dominant copper alloy in the late first millennium AD across northern Europe and the Middle East, and the trade in brass ingots is well documented both from the Sahara (Monod 1969; Garenne-marot & Mille 2007) and the Viking world (Bayley *et al* 2014, and literature therein). A main source for late first millennium AD brass was the region of what is now western Germany, which may have contributed to the northern trade in brass as dominated by the Vikings and later the Hanse. There is also indication for contemporary brass making in Iran (I. Keesmann pers. comm.), which may have fed into the Islamic metal industry; however, very little detail is currently known about this. Intriguingly, the Saxon brass ingots from London share similarities in their composition, texture and lead isotope signatures with ingots found in Mauritania (Bayley *et al* 2014:126), which could potentially indicate a material link between the two geographically quite distinct brass-using regions. This, however, is not as surprising as it may seem, considering the massive and well-known occurrence of early Islamic *dirhams* from Central Asia in Viking contexts.

All this considered, it is noteworthy that the composition of the five Essouk brasses with around 18 wt% zinc is sufficiently below the zinc content of the Saxon / Mauritanian ingots (of around 19 to 25 wt% zinc) to argue that they could have been made from such metal; a single re-melting for casting of brass would reduce its zinc content by an estimated one-tenth of its original value (Caley 1964; Dungworth 1996). However, neither the elevated lead and tin contents in the Essouk brass nor the lead isotope ratios support any link between the two alloy groups. In conclusion, it is reasonable to consider the brass for the five objects with a relatively constant level of around 18 wt% zinc to have been made into artefacts in Essouk, using fresh metal imported from the North via the caravan trade, as brass ingots similar to those documented archaeologically.

The three mixed alloy samples appear to be resulting from indiscriminate recycling. The chemical composition data may suggest a general shift of imported metals from bronze (or tin-rich copper alloys) to brass in the 10th/11th centuries, although most of the brasses also contain concentrations of tin, lead and/or arsenic above trace levels. The only definitively bronze object (*ca* 5 wt% tin) in the Essouk assemblage analysed for lead isotopes (Ek-A-103–191) also happens to be one of the earliest metal objects and the only analysed object from the site made with metal likely originating from Tunisian ores. Previous compositional work led Craddock to conclude that "[c]learly the change from bronze to brass was well advanced by the seventh century [in the Mediterranean], and was probably complete by the time that the first distinctive Islamic metalwork was produced" (Craddock 1979:76). This statement makes the occurrence of the Essouk bronze curious, since at this time, 9th/10th centuries, brass should have been the predominant metal in North Africa. In fact this object, a fragment of a ring ingot (see metallography above), could have been simply collected from an ancient context in North Africa and sent south of the Sahara as a complete object. Furthermore, the lead isotope ratios for this object plot with many lead and bronze objects from Roman and Punic Carthage, many of which likely were produced with metals derived from Tunisian ores (see Fenn *et al*. 2009:131, Tables 4 & 5). Therefore, it seems plausible that this bronze object either represents an older artefact transported across the Sahara as is, or an object produced from recycled Byzantine or even Roman or Punic metal.

The two 'technically pure' copper artefacts are basically pure coppers, with one also having apparently added lead. They are chronologically similar in date, both potentially predating the Almoravid conquest, and the lack of major alloying metal (*e.g.* tin or zinc) leaves open the possibility that these could represent locally produced copper metal. Unfortunately only one of these, the pure copper (Ek-A-091–214), was available for lead isotope analysis. Interestingly, the LIA ratios for this sample do not plot with any of the other Essouk metals, and while there is peripheral similarity to a few Moroccan ores, the match is not really apparent. Therefore, this could be a West African metal, and could have originated from one of the nearby metal production sites, such as Marandet (Niger). Alternatively, unalloyed copper also could have been transported across the Sahara, from an as yet to be determined source region.

Conclusions

The range of metal compositions identified in the Essouk assemblage is similar to other sites in sub-Saharan West Africa from the Islamic era. The main alloying metals used with copper would be tin for bronze, during the earliest period, and zinc for brass afterwards. Keeping this in mind, the ten Essouk copper-based samples for which there are data from sound metal can be broadly sorted into three types. Half of these are of brass with around 18 wt% zinc (Ek-A-040–216, 071–217, 075–218, 087–208 and Ek-B-06–209), while three appear to be mixed alloys with around 10 wt% zinc (Ek-B-10–219), 5 wt% tin (Ek-A-103–191), and 2.5 wt% zinc (Ek-A-055–195), respectively, as main alloying components, in addition to a few percent of lead, zinc and/or arsenic. The remaining two are best described as 'technically pure' copper (Ek-A-091–214, pure copper; and Ek-B-08–215, leaded copper) with very low levels of impurities.

It may be tempting to see the five brasses as a group of finds all made from relatively fresh cementation brass, as indicated by their relatively consistent zinc concentration of around 18 wt%.

However, they originate from contexts spread over about 400 years, there is variability in other elements in their compositions, and the lead isotope ratios spread relatively widely. What is perhaps more remarkable about these five brasses is that despite all these other differences, including potential source regions, they all have about 18 wt% zinc, suggesting a remarkable continuity of zinc composition in brasses crossing the Sahara to Essouk. The isotopic analyses demonstrate that two of the five brasses fall into the larger LIA group with higher ratios matching the broad range of Moroccan ores, while two fall into the smaller group with slightly lower ratios, still overlapping Moroccan ores but approaching the field of Tunisian ores, and the last is an outlier but again still overlapping Moroccan ores. However, the origins of these brasses are not necessarily restricted to North Africa; instead, they could come from almost anywhere in the Islamic world, and beyond.

Regarding the general lead isotope results and questions of provenance and trade, the Essouk analyses on objects dating from before the Almoravid invasion show a relatively wide range of ratios. While one of the earliest appears to come from Tunisia, and others are consistent with ores from Morocco, a number of other source areas also seem represented, although the majority of metals tend to cluster and appear to originate from only a few main source regions. One of those clusters is consistent with ores from Morocco, while the other cluster falls about halfway between the two main clusters of ore analyses from Tunisia and Morocco, suggesting these may have resulted from mixing of metals from those two regions. After the Almoravid invasion, post-11th century AD, there seems to be a clear shift in metal supply with the majority appearing to originate from Moroccan ores. Thus, the political landscape of the trans-Saharan trade networks may have significantly influenced the supply of metal (and presumably other materials) to Essouk during this later period at the site.

The preliminary results of these analyses suggest that Essouk was firmly entrenched within a complex of socio-economic networks linking Essouk with other regions of sub-Saharan Africa as well as to multiple regions of North Africa and beyond. Additional analyses and the more comprehensive publication of these preliminary results will shed further light on the role of Essouk in these networks, as well as provide insight into trans-Saharan contacts during the Islamic era.

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APPENDIX L

Note sur le damas et sur le « voile » de soie d'Essouk-Tadmekka

Sophie Desrosiers

Il faut des conditions de conservation particulières pour trouver des textiles lors de fouilles archéologiques. Les matières organiques avec lesquelles ils sont généralement fabriqués résistent mal au passage du temps sauf lorsque certains équilibres sont conservés dans la longue durée – absence de lumière, sécheresse ou forte humidité constante, température stable, non développement de bactéries.

C'est pourquoi les régions désertiques sont favorisées – par exemple les déserts d'Egypte, de la côte du Pérou, ou du Taklamakan (région autonome ouïghoure du Xinjiang, Chine) – ainsi que les grottes sèches comme la Grotte des Guerriers (*Cave of the Warriors*) utilisée au 4e millénaire avant notre ère dans le désert de Judée, ou celles de Bandiagara occupée dès le 11e siècle de notre ère au Mali; mais aussi les tourbières et sépultures fermées, les sites lacustres et subaquatiques, les conditions de froid extrême, etc[1]. D'autres formes de conservation indirectes sont les empreintes dans l'argile ou les textiles minéralisés par leur contact avec des métaux oxydables comme ceux trouvés dans des sépultures de l'Âge du Fer à Kissi (Burkina Faso) ou du 9e–11e siècle à Igbo-Ukwu au Nigéria[2]. Enfin deux dernières preuves au moins de l'existence des textiles sont, d'une part, leur représentation avec d'autres matériaux plus facilement conservés comme le métal[3] et, d'autre part, leur absence mise en évidence par des objets nécessitant un lien ou un fil, comme les perles[4].

Ces dernières décennies, la multiplication des découvertes de textiles lors de fouilles archéologiques a été un facteur entrainant dans la mesure où les archéologues sont devenus plus attentifs à la présence éventuelle de tels matériaux et plus sensibles à leur potentiel informatif. L'essor que connaît actuellement l'archéologie des textiles dans plusieurs régions du monde, y compris en Afrique de l'Ouest est un signe encourageant. La découverte de deux fragments sur le site d'Essouk-Tadmekka épouse cette tendance, et on peut espérer que la poursuite des fouilles permette de découvrir dans le futur d'autres exemples aussi exceptionnels.

Les deux fragments ont été tissés avec des fils de soie[5]. Il s'agit d'un damas de soie de couleur crème pour l'un (Ek-A 13, trouvé dans une contexte daté vers 1300–1400) et d'un fragment de « voile » de soie adhérant à une sorte de feutre rose dans lequel entre du coton pour l'autre (Ek-B Horizon 3, trouvé dans une contexte daté du 10e–11e siècle)[6]. Sont ici présentés les éléments disponibles pour chacun, et quelques comparaisons permettant de les situer dans le contexte plus général des productions de soieries au Moyen Âge (le détail des analyses se trouve en annexe ainsi qu'un glossaire expliquant les termes techniques). Ces résultats sont partiels car les colorants employés pour les deux fragments, les fibres non analysées en 2008, ainsi que la nature d'une matière noire visible sur le second fragment sont en cours d'identification (Desrosiers *et al.* en prep.).

Le damas est un fragment de soierie avec un décor obtenu par le contraste entre la face brillante et la face mate d'une armure, ici un satin de 5 (Figs. L.1, L.2, L.3; Chp. 18, Fig. 18.3a). Malgré ses dimensions réduites il est possible de voir que la plus grande partie de l'endroit du tissu est effectivement brillante et qu'une petite portion de celui-ci, plus mate, est repérable en haut à gauche. Sur l'envers on observe la situation inverse. Une telle soierie, dite « façonnée » du fait de la création d'un dessin en même temps que l'étoffe, fait partie des soieries complexes nécessitant un métier à tisser et des savoir-faire particuliers. D'après les spécialistes, un tel type d'étoffe a été tissé d'abord en Chine à partir de la dynastie Yuan (1271–1368) et l'exemple

1 Par exemple : Schick 1998; Bolland 1991; Bedaux 1993.

2 Shaw 1970; Magnavita *et al.* 2002 et Magnavita 2008; voir Mayor 2011 pour des empreintes de vanneries sur des céramiques.

3 Les représentations de textiles sont assez courantes dans la métallurgie africaine. L'un des meilleurs exemples est probablement le « pot dans un filet » d'Igbo-Ukwu au Nigéria, du 9e siècle (Shaw 1970, vol. 2: pl. 196–197; Devisse *et al.* 1990, n° 157); de nombreux bracelets et autres objets de métal montrent la diversité des textiles qui ont existé. Ils sont généralement admirés pour la perfection des techniques de mise en forme du métal plutôt que pour les textiles qu'ils représentent, voir par exemple Coulibaly & Chieze 1993: 339, fig. 3.

4 Des fils parfois présents à l'intérieur des perles donnent une information importante sur les matériaux employés à cet usage et sur leur fabrication. A Kissi, une lanière de cuir remplissait cette fonction selon Magnavita *et al.* (2002: 38). D'autres exemples beaucoup plus anciens se trouvent dans Hardy 2007.

5 Pour des raisons imprévues qui ont fait que les résultats des identifications de fibres n'ont pas pu m'être communiquées avant la remise du texte, j'ai conservé les identifications faites par Sandra Bond et Sam Nixon (Nixon 2008: 319–320). J'ai ajouté un point d'interrogation après les hypothèses faites suite à l'examen des tissus à la binoculaire – identifications qui devront être confirmées dans un article à venir).

6 Nixon 2008, 2009, 2010, 2013.

 | doi 10.1163/9789004348998_038

le plus ancien qui soit connu provient d'une tombe de 1320[7]. Compte tenu de la stratigraphie d'Essouk-Tadmekka, il est possible qu'Ek-A 13 soit contemporain, sinon plus ancien que ce fragment[8]. Il serait alors parmi les plus anciens, sinon le plus ancien, vestige de damas satin de 5 chinois retrouvé jusqu'ici (cette position est bien sûre très vulnérable car elle peut changer en fonction de nouvelles découvertes ou de nouvelles études de textiles archéologiques en Chine). La présence de fils de chaîne sans torsion devrait être l'indice d'une fabrication ancienne au sein de la chronologie de la dynastie Yuan dans la mesure où elle est caractéristique des autres soieries monochromes façonnées qui étaient tissées depuis plusieurs millénaires en Chine, et que ce seraient les tisserands Yuan qui auraient les premiers expérimenté des fils de chaîne tordus afin d'obtenir des damas satin de 5 plus serrés et teints avant tissage. Mais les ateliers de tissage de soieries façonnées étant nombreux en Chine, ils n'ont pas forcément tous réagi à la nouvelle mode en même temps. Il est donc difficile pour le moment de se fonder sur cette étoffe pour infléchir la chronologie d'Essouk-Tadmekka[9]. Comme les exemples les plus anciens tissés hors de Chine – au Moyen-Orient au 14e siècle, ou en Italie dans la seconde moitié du siècle – se caractérisent aussi par des fils de chaîne tordus, l'hypothèse que cette soierie ait été fabriquée en Chine est un fait bien plus solide que la période pendant laquelle elle a pu être tissée[10]. Il faudrait une étude spécifique de ce type d'étoffe pour avoir des repères chronologiques plus fermes. Pour le moment, on peut dire que ce fragment est une pièce importante non seulement pour l'histoire des échanges entre l'Afrique de l'Ouest et l'Orient au Moyen Âge, mais aussi pour l'histoire des damas.

La mince bande brodée en bordure en haut du fragment avec des fils rouge, rose et vert pâle, peut-être en laine (Fig. L.3), n'apporte pour le moment aucun élément supplémentaire à l'enquête étant donné que je n'ai pas trouvé de pièces de comparaisons proches et qu'il est difficile de savoir où cet ajout a pu être fait. Peut-être l'identification des fibres et des colorants apportera-t-elle quelques précisions[11].

Le fragment de « voile » de soie a été nommé ainsi à cause de la torsion forte de ses fils de chaîne et de trame et de sa qualité très légère due à des fils très fins et peu serrés (Fig. L.4; Chp. 18, Fig. 18.3b). De par la forte torsion des fils il appartient à la catégorie des crêpes qui étaient tissés en Chine depuis la dynastie Shang (1600–1046 avant notre ère). Ce tissu très fragile doit certainement sa conservation au feutre végétal d'une couleur rose plus ou moins soutenue dans lequel il était incrusté et où il se trouvait protégé par un repli, mais peut-être également à la matière noire qui adhère encore partiellement à ses fils[12]. L'identification de cette matière permettra peut-être de comprendre sa provenance car ce type d'étoffe était assez répandu tant en Europe qu'au Moyen Orient et en Chine au Moyen Âge.

Des étoffes médiévales comparables pour leur légèreté ont été conservées en Europe. Certaines sont considérées comme ayant servi de voile de tête, mais d'autres utilisations sont possibles. Une partie d'entre elles doivent leur conservation à leur statut de reliques, d'autres ont été trouvées lors de fouilles urbaines, par exemple à Dublin et à Londres[13]. Une relique conservée dans le couvent d'Assise, avec un décor très simple, est attribuée à l'Egypte fatimide (969–1171) tandis que deux autres sont supposées avoir été tissées en Andalousie entre le 11e et le 13e siècle[14]. Pour ce qui est de la Chine, un manteau de bonze de la dynastie Tang (618–907) conservé dans un temple au Japon fournit une comparaison chronologiquement proche[15].

7 Zhao Feng 2012: 344–346; Kuhn 2012b: 521 (voir *anhua duan*).

8 Il faut aussi tenir compte que la chronologie d'Essouk-Tadmekka est encore partiellement définie, et qu'un mouvement au sein de la stratigraphie n'est pas à écarter totalement.

9 Voir par exemple Sylwan 1949: 103–114 (les damas de la dynastie Han décrits dans ces pages ne comportaient pas de satin; leurs fils sont toujours sans torsion). Voir Desrosiers sous presse: chaînes A et D; Zhao Feng 2012: 345.

10 C'est ce qui apparaît aussi dans les damas tissés au Moyen Orient au 14e siècle puis dans ceux qui seront tissés en Italie du nord (voir par exemple Flury-Lemberg 1988: 222–229 et 481 (n° 45), 328–331 et 471 (n°25), 440–441 et 470 (n° 22); Crowfoot *et al.* 1992: 124–126; Desrosiers 2004: 335–336, n° 180 et 434–439: n° 254–257).

11 Le seul indice d'une broderie en bordure d'un tissu que j'ai pu jusqu'ici repérer se trouve sur un bonnet en toile de coton trouvé dans la grotte C des falaises de Bandiagara, environ 11e–12e siècle (Bolland 1991: 136–137, et dessin 36).

12 On sait que certaines étoffes légères de soie à armure taffetas produites en Chine étaient imprégnées de laque noire pour les rendre rigides comme le montrent des exemples de la dynastie Han (206 avant n.è.–220 après n.è.). Voir par exemple Li Wenying 2012: 142, fig. 3.29; Nunome 1992: 97.

13 Heckett 1987, 2003; Pritchard 1988; Crowfoot *et al.* 1992: 93–96. Les exemples de Dublin proviennent de contextes de la fin du 10e et du 11e siècle tandis que ceux de Londres sont trop tardifs puisque du 14e siècle. Mais ils montrent l'usage de ce type d'étoffe dans la longue durée.

14 Il s'agit du voile dit de la Vierge conservé dans un reliquaire dans le couvent d'Assise, d'un autre voile conservé à Assise dans le reliquaire dit de saint André daté de 1288, et celui du Pape Clément II retrouvé dans sa sépulture à Bamberg (Flury-Lemberg 1988: 318–321, 492, 494, n° 77, 81; Müller-Christensen 1960: 54, 74–75). D'autres exemples conservés dans les trésors d'églises suisses seraient à étudier plus attentivement dans le futur (Schmedding 1978).

15 Nunome 1992: 109.

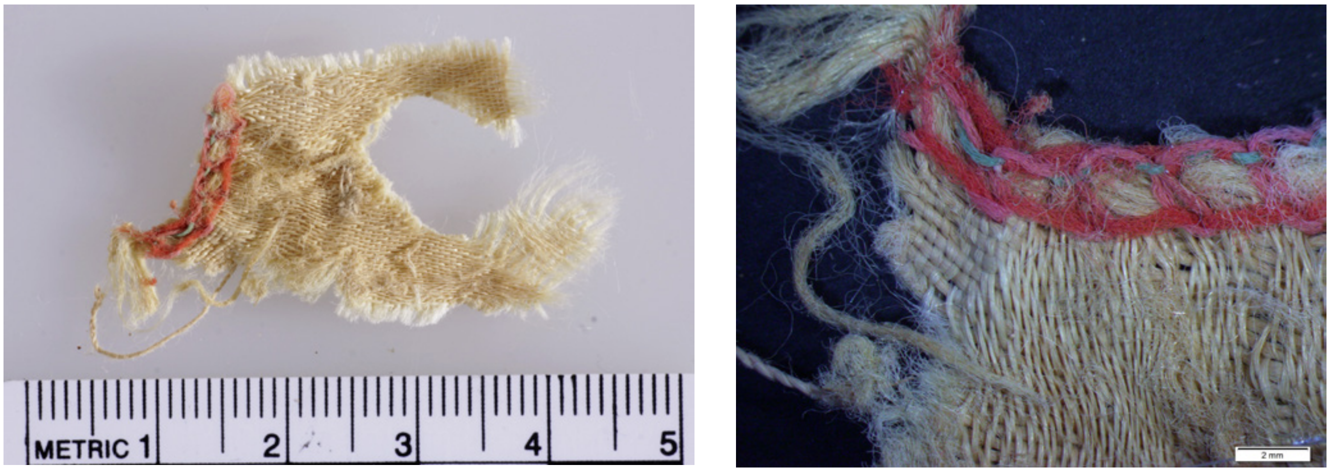

FIGURE L.1 *Face endroit du damas de soie crème avec bordure brodée (a) et détail de sa partie supérieure (b) montrant la face chaîne du satin du fond avec zone en satin trame du dessin en haut à droite.*
A: © S. NIXON; B: © S. DESROSIERS

FIGURE L.2 *Face envers du damas de soie crème avec bordure brodée (a) et détail de sa partie supérieure (b) montrant la face trame du satin du fond avec zone en satin chaîne du dessin en haut à gauche.*
A: © S. NIXON; B: © S. DESROSIERS

Si elles sont légères et ont des fils de torsion 'z' dans les deux directions, ces étoffes ont pour la plupart des fils de densité supérieure à 30 fils au centimètre, soit beaucoup plus que l'exemple d'Essouk-Tadmekka.

En français, dans le langage courant, le terme de « gaze » qui désigne une « Étoffe légère et transparente, de coton ou de soie » pourrait fort bien être employé pour ce fragment[16]. C'est d'ailleurs peut-être la signification du mot "gauze" traduisant le terme employé par Al-Zuhri au 12^{e} siècle à propos des étoffes importées en Afrique de l'Ouest : "*Silk and objects of gauze and linen are imported into their country and from al-Andalus are imported saffron and cloth from Murcia and turbans and Susa cloth from Ifriqiya*"[17]. Ainsi, les deux fragments de soierie et de « voile » ou « gaze » de soie trouvés à Essouk-Tadmekka pourraient être les témoins d'échanges beaucoup plus réguliers que ce que leur nombre et leur taille très réduits laissent au premier abord supposer. Quant à leurs origines, probablement chinoise pour

16 http://www.larousse.fr/dictionnaires/francais/gaze/36360. Je n'ai pas employé ce terme ici car du point de vue des techniques de tissage il représente un tissu très spécifique avec des fils de chaîne qui croisent et décroisent avec leurs voisins.

17 LEVTZION & HOPKINS 2000: 97.

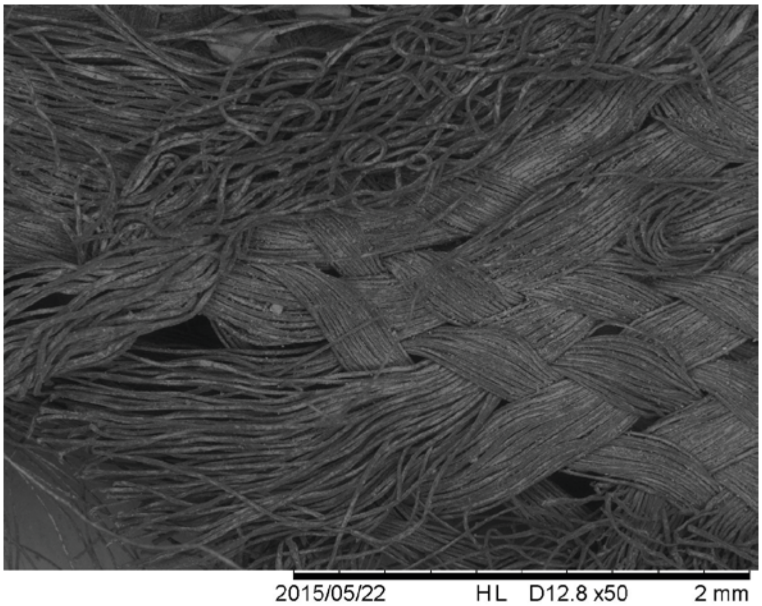

FIGURE L.3
Photo MEB *du damas brodé: en bas à droite les fils de soie sans torsion avec des brins fins et rectilignes du satin trame; en haut à gauche les fibres un peu plus grosses et plus ondulées de la broderie.*
© CH. MOULHERAT

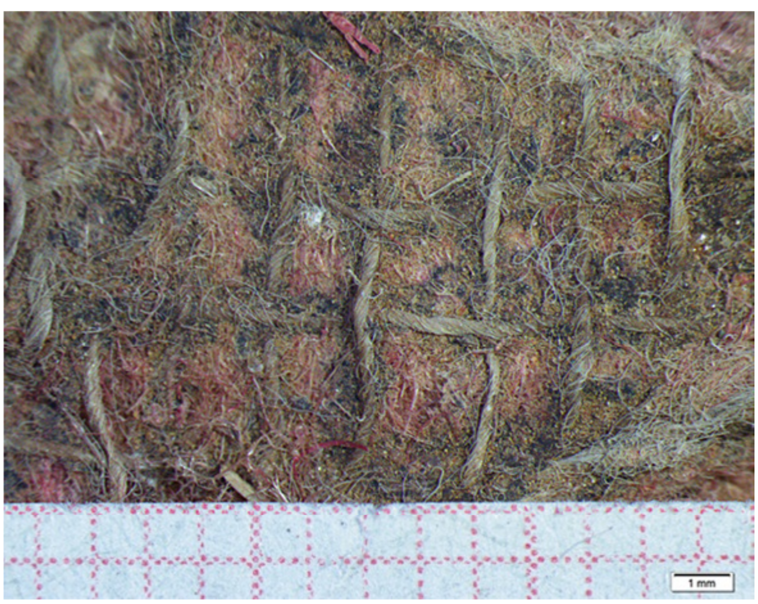

FIGURE L.4
Détail du fragment de « voile » de soie (*imprégné d'une matière noire*) *et adhérant à un « feutre végétal » rose trouvé a Essouk.*
© S. DESROSIERS

le damas, et beaucoup moins précise face à une multitude de possibles pour le « voile », elles ne laissent rien paraître pour le moment des trajets que ces étoffes ont pu suivre pour arriver à leur destination.

DESCRIPTIONS DES FRAGMENTS (comme cela a été précisé dans la note 5, j'ai conservé les identifications faites par Sandra Bond et Sam Nixon (NIXON 2008: 319–320) et j'ai ajouté un point d'interrogation après les hypothèses faites suite à l'examen des tissus à la binoculaire).

Damas de soie crème avec bordure brodée

***Damas de soie* (*Fig. L.1, Fig. L.2*)**
Dimensions (*chaîne verticale*): hauteur 3,8 cm, largeur 2,2 cm
Appellation technique: Damas satin de 5, fond satin chaîne décochement de 2, dessin satin trame décochement de 3.
Chaîne: soie grège au tissage, sans torsion, fils fins; découpure 3 fils; densité 80 fils au cm.
Trame: soie grège au tissage, fils beaucoup plus gros, sans torsion; découpure 1 coup; densité 23 coups de trame au cm.
L'étoffe a probablement été décreusée après tissage.
Fil de couture formant plusieurs points au centre du fragment: Fil de soie (?) crème, retors Z de deux bouts de torsion 's', diamètre 0,28 mm

***Bordure brodée* (*Fig. L.1–Fig. L.3*)**
Dimensions: 0,3 cm de hauteur x 1,6 cm de largeur
Elle a été réalisée avec 3 fils de couleurs différentes de façon à maintenir les six dernières trames de l'étoffe.
Fils rose et vert pâle: laine (?) sans torsion appréciable, colorants à déterminer (fibres de diamètre supérieur aux brins de soie).
Fil rouge: laine (?) sans torsion appréciable, colorant à déterminer (fibres de diamètre supérieur aux brins de soie et de qualité différente des précédentes)

« Voile » de soie imprégné d'une matière noire et adhérant à un « feutre végétal » rose (Fig. L.4)

Dimensions de l'ensemble: 2,9 × 2,7 cm

« Feutre végétal » rose
Dimensions des deux fragments séparés: 2,9 × 2,6 et 2 × 2,5 cm
Appellation technique: feutre végétal résultant peut-être d'une écorce battue comme le tapa, teint en rose.
Matière première et colorant: à déterminer

« Voile » de soie
Dimensions: 2,3 × 1,3 cm
Appellation technique: armure taffetas
Chaîne et trame (12 fils dans une direction et 6 fils dans l'autre) : soie crème, torsion 'z' forte, diamètre 0,2–0,4 mm, densité: 6 fils par cm dans les deux directions
Matière noire: à déterminer

Glossaire (la plupart des définitions reprennent avec quelques modifications celles du vocabulaire du CIETA, 1973)

Armure	système d'entrelacement des fils de chaîne et de trame d'un tissu.
Chaîne	ensemble des fils longitudinaux d'un tissu qui étaient tendus dans la longueur du métier à tisser.
Damas satin de 5	Tissu façonné dont le fond et le dessin sont constitués par la face chaîne et la face trame d'une même armure, ici un satin de 5.
Découpure	groupe de fils de chaîne ou de trame constituant l'unité de déplacement du décor et donc les contours des effets de dessin dans un tissu façonné.
Décochement	rythme régulier de déplacement des liages d'un coup de trame au suivant.
Décreusage	opération consistant à dépouiller un fil ou un tissu de soie de son grès.
Face chaîne	face sur laquelle dominent les fils de chaîne.
Face trame	face sur laquelle dominent les fils de trame.
Façonné	tissu décoré de dessins plus ou moins complexes obtenus par les croisements des fils de chaîne et de trame et dont l'exécution nécessite l'emploi de procédés spéciaux de fabrication mécaniques ou manuels.
Grège	fil de soie sans torsion résultant du dévidage simultané de plusieurs cocons et donc composé d'un certain nombre de baves de vers à soie juxtaposées et soudées par le grès.
Grès	ensemble de matières diverses entrant pour 25% environ dans la composition de la bave du vers à soie. Il permet de souder les deux brins qui composent la bave et de constituer la charpente du cocon en fixant les baves les unes aux autres (pour comprendre son importance dans la transformation de la soie, voir Desrosiers sous presse)

Satin — armure ayant une surface unie et plane, formée par des flottés dont les liages sont répartis de manière à être dissimulés par les flottés qui les entourent

Taffetas — armure dans laquelle les fils de chaîne pairs et impairs alternent à chaque coup au-dessus et en-dessous de la trame. Synonyme de toile. Terme employé pour les tissus faits de fils continus comme la soie.

Trame — fils disposés transversalement par rapport aux fils de chaîne d'un tissu.

Voile — type de tissu léger, souvent en soie mais pas seulement, tissé avec des fils très tordus et une armure taffetas. Il appartient à la catégorie des étoffes tissées en grès et éventuellement décreusées et teintes après tissage (voir DESROSIERS sous presse).

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APPENDIX M

Faunal Remains Tables

Kevin MacDonald

TABLE M.1 *Ek-A NISP* [*Number of Individual Specimens Present*]

Taxa	Ek-A Period 1 (Hor. 1/2)	Ek-A Period 2 (Hor. 3/4/5/6/7/8)	Ek-A Period 3a (Hor. 9)	Ek-A Period 3b (Hor. 10/11)	Ek-A Period 4 (Hor. 12/13/14)
Gazella dorcas (*Dorcas gazelle*)					
Ovis/Capra (sheep or goat)		44 (18/2/4/10/2/8)	24	75 (60/15)	75 (10/40/25)
Ovis aries (sheep)		1 (1/–/–/–/–/–)		6 (2/4)	2 (–/2/–)
Capra hircus (goat)		3 (–/1/–/–/–/2)	2		3 (–/2/1)
Bos sp. (domestic cattle)	2 (–/2)	10 (4/–/1/4/1/–)	6	7 (5/2)	34 (5/24/5)
Small-medium bovid		40 (16/–/7/8/1/8)	16	67 (54/13)	46 (23/18/5)
Large-medium bovid		7 (3/–/–/–/–/4)		2 (1/1)	4 (1/2/1)
Large bovid		4 (–/–/3/1/–/–)	4	6 (5/1)	9 (1/4/4)
Equus asinus (donkey)					
Equus cf. caballus (horse)					
Camelus dromedarius (dromedary camel)					1 (–/1/–)
Canis cf. familiaris (dog)		3 (–/–/–/–/–/3)	1		17 (2/11/4)
Indet. small carnivore					1 (–/–/1)
Hyaena hyaena (striped hyaena)					4 (1/–/3)
Gallus/Numidinae (chicken or guineafowl)		1 (1/–/–/–/–/–)			
Gallus gallus (chicken)					
Ardea cf. cinerea (Grey Heron)					1 (–/1/–)
Rodentia (rodent)					2 (–/–/2)

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TABLE M.1 *Ek-A NISP* [*Number of Individual Specimens Present*] (cont.)

Taxa	Ek-A Period 1 (Hor. 1/2)	Ek-A Period 2 (Hor. 3/4/5/6/7/8)	Ek-A Period 3a (Hor. 9)	Ek-A Period 3b (Hor. 10/11)	Ek-A Period 4 (Hor. 12/13/14)
Varanus exanthematicus (monitor lizard)					2 (–/2/–)
Pisces gen. et. sp. indet. (indet. fish)					1 (–/1/–)
Total	2	113	53	163	202

TABLE M.2 *Ek-B and Ek-C NISP*

Taxa	Ek-B Hor. 1	Ek-B Hors. 2&3	Ek-C Hor. 1	Ek-C Hors. 2&3
Gazella dorcas (Dorcas gazelle)		3		
Ovis/Capra (sheep or goat)	17	70	14	24
Ovis aries (sheep)		5		
Capra hircus (goat)		1		
Bos sp. (domestic cattle)	3	26	1	19
Small-medium bovid		1		1
Large-medium bovid				
Large bovid				
Equus asinus (donkey)	1			1
Equus cf. caballus (horse)			1	
Camelus dromedarius (dromedary camel)		1		
Canis cf. familiaris (dog)				
indet. Small carnivore				
Hyaena hyaena (striped hyaena)				
Gallus/Numidinae (chicken or guineafowl)				
Gallus gallus (chicken)		1		
Ardea cf. cinerea (Grey Heron)				
Rodentia (rodent)				
Varanus exanthematicus (monitor lizard)				
Pisces gen. et. sp. Indet. (indet. fish)				
Total	21	108	16	45

TABLE M.3 *Charring on elements of the Principal Taxa*

Taxa	Ek-A Period 1	Ek-A Period 2	Ek-A Period 3	Ek-A Period 4	Ek-B Hor. 1	Ek-B Hor. 2/3	Ek-C Hor. 1	Ek-C Hor. 2/3
Ovis/Capra	0/0	0/48	18/107	7/80	3/17	7/76	2/14	0/24
	–	**0%**	**16.8%**	**8.8%**	**17.6%**	**9.2%**	**14.3%**	**0%**
Bos	0/2	0/10	0/13	1/34	1/3	2/26	0/1	4/19
	0%	**0%**	**0%**	**2.9%**	**33.3%**	**7.7%**	**0%**	**21%**
	0/0	0/3	0/1	2/17	0/0	0/0	0/0	0/0
Canis	–	**0%**	**0%**	**11.8%**	–	–	–	–

TABLE M.4 *Numbers of Deciduous Dentition and Unfused elements versus Adult Dentition and Fused Elements in Cattle, Sheep and Goats*

Taxa	Ek-A Period 1	Ek-A Period 2	Ek-A Period 3	Ek-A Period 4
Ovis/Capra	0/0	5/48	9/107	10/80
	–	**10.4%**	**8.4%**	**12.5%**
Bos	1/2	0/10	0/13	0/34
	50%	**0%**	**0%**	**0%**
Small-medium bovids	0/0	1/40	3/83	2 /46
	–	**2.5%**	**3.6%**	**4.3%**
Large-medium bovids	0/0	0/7	0/2	0/4
	–	**0%**	**0%**	**0%**
	0/0	0/4	0/10	2/9
Large bovids	–	**0%**	**0%**	**22.2%**

TABLE M.5 *Measurable Bone Specimens (utilizing* VON DEN DRIESCH *1976)*

Taxa	Unit	Horizon	Est.date AD	Element	Measure 1	Measure 2	Measure 3	Measure 4	Measure 5
Bos	A	13	*ca* 14th century	1st Phalanx	Bp = 26.6				
Bos	A	13	*ca* 14th century	1st Phalanx	Bd = 28.8				
Bos	B	02	*ca* 10th–11th century	Astragalus	Gll = 72	GLm = 64	GB = 45		
Bos	C	03	*ca* 14th century	1st Phalanx	Glpe = 59.2				
Canis cf. familiaris	A	13	*ca* 14th century	Astragalus	GL = 26.4				
Canis cf. familiaris	A	13	*ca* 14th century	Calcaneus	GL = 44.0	Bp = 18.5			
Capra hircus	A	13	*ca* 14th century	2nd Phalanx	GL = 28.1	Glpe = 26.5	Bp = 11.4		
Capra hircus	A	13	*ca* 14th century	2nd Phalanx	GL = 24.4				
Capra hircus	A	14	*ca* 14th century	2nd Phalanx	GL = 24.5	Glpe = 23.7	Bp = 11.6		
Ovis/Capra	A	03	*ca* 9th/10th century	Astragalus	Glm = 28.6	Dm = 15.5			
Ovis/Capra	A	08	*ca* 11/12th century	Astragalus	Glm = 32.9	Bd = 21.3			
Ovis/Capra	A	09	*ca* 12/13th century	2nd Phalanx	Glpe = c.26	Bp = 13.3			

TABLE M.5 *Measurable Bone Specimens* (*utilizing* VON DEN DRIESCH *1976*) (cont.)

Taxa	Unit	Horizon	Est.date AD	Element	Measure 1	Measure 2	Measure 3	Measure 4	Measure 5
Ovis/Capra	A	09	*ca* 12/13th century	Astragalus	Gll = 32.5	Bd = c.20			
Ovis/Capra	A	09	*ca* 12/13th century	Astragalus	Gll = 31.2	Dl = 15.4			
Ovis/Capra	A	09	*ca* 12/13th century	Astragalus	Gll = 33.2	Bd = c.21			
Ovis/Capra	A	10	*ca* 12/13th century	Astragalus	Gll = 27.2	Glm = 26.5	Bp = 18.2		
Ovis/Capra	A	10	*ca* 12/13th century	Astragalus	Gll = 27.0	Glm = 24.8	Bd = 17.7	Dl = 14.0	Dm = 14.4
Ovis/Capra	A	11	*ca* 13/14th century	Astragalus	Gll = 30.5	GLm = 29.2	Dm = 15.8		
Ovis/Capra	A	13	*ca* 14th century	2nd Phalanx	Glpe = 24.0	Bp = 13.3			
Ovis/Capra	A	14	*ca* 14th century	1st Phalanx	Bp = 12.7				
Ovis/Capra	A	14	*ca* 14th century	1st Phalanx	Bp = 12.6				
Ovis/Capra	B	01	*ca* Pre-10th century	Tibia	BD = 26.9				
Ovis/Capra	B	01	*ca* Pre-10th century	Tibia	BD = 28.2				
Ovis/Capra	B	02	*ca* 10th/11th century	Astragalus	Glm = 33.3				
Ovis/Capra	B	02	*ca* 10th/11th century	Radius	Bp = c.29				
Ovis/Capra	B	02	*ca* 10th/11th century	Tibia distal	GB = 29.0				
Ovis/Capra	B	03	*ca* 10th/11th century	Astragalus	Gll = 33.9	Glm = na	Bd = c.23.0		
Ovis/Capra	B	03	*ca* 10th/11th century	Astragalus	Gll = 27.4				
Ovis/Capra	C	02	*ca* 14th century	2nd Phalanx	Glpe = 24.7				
Ovis/Capra	C	03	*ca* 14th century	2nd Phalanx	GL = 30.1	Glpe = 27.9			

Species Counts of Plant Remains

Dorian Fuller, Mary-Anne Murray and Sam Nixon

Period	Period 4													
Horizon	**A14**					**A13**							**A12**	
Taxa / **Sample**	**3**	**4 (a)**	**5**	**13**	**19**	**16**	**17**	**18**	**22**	**29**	**30**	**39**	**43**	**45**
Cereals	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Brachiaria/Setaria sp. grain	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Brachiaria cf. *lata* lemma (silic.)	–	–	1	–	–	–	–	–	–	–	–	–	–	1
Brachiaria cf. *lata* lemma frag.	–	–	–	–	–	–	–	–	–	1	–	–	–	
Brachiaria sp. palea (silic.)	–	–	–	–	–	–	–	–	–	–	–	–	–	2
Brachiaria cf. *lata* palea (silic.)	–	–	1	–	–	–	–	–	–	–	–	–	–	–
Brachiaria cf. *lata* spikelet (silic.)	–	–	–	–	–	–	–	–	–	–	–	–	–	–
cf. *Brachiaria* sp. grain	–	–	–	–	–	–	–	–	–	4	–	–	–	–
cf. *Brachiaria* sp. grain frag.	–	–	–	1	–	–	–	–	–	–	–	–	–	–
Digitaria sp. grain	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Echinochloa sp. grain	–	–	–	–	–	–	–	–	–	23	–	–	–	–
Echinochloa sp. lemma (silic.)	–	–	–	–	–	–	–	–	–	–	–	1	–	–
cf. Echinochloa sp. grain	–	–	–	–	–	–	–	–	–	–	–	–	–	–
cf. Echinochloa sp. grain frag.	–	–	–	–	–	–	–	–	–	–	–	–	–	–
cf. Echinochloa sp. lemma (silic.)	–	–	–	–	–	–	–	–	–	–	–	–	–	–
cf. *Echinochloa* sp. palea (silic.)	–	–	–	–	–	–	–	–	–	–	–	3	–	–
Panicum sp. grain	–	–	–	2	–	–	–	–	–	4	–	–	–	–
Panicum sp. glume (silic.)	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Panicum sp. spikelet (silic.)	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Panicum sp. lemma	–	–	–	–	–	–	–	–	–	–	–	–	–	–
cf. *Panicum* sp. grain	–	–	–	–	–	–	–	–	–	4	–	–	–	–
Indet. small Panicoideae	–	–	–	–	–	–	–	–	–	9	–	–	–	–
Indet. small immature Panicoideae	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Indet. Poaceae rachis	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Pennisetum glaucum grain	–	–	–	–	–	–	–	–	–	–	–	–	–	–
cf. *Pennisetum glaucum* grain	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Triticum sp. grain	–	–	–	–	–	–	–	–	–	1	–	–	–	–
Triticum sp. grain frag.	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Triticum sp. (free threshing) grain	–	–	1		–	–	1	–	–	–	–	–	–	1
Triticum sp. (free threshing) grain frag.	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Triticum durum basal rachis	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Triticum aestivum rachis	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Legumes	–	–	–	–	–	–	–	–	–	–	–	–	–	–
cf. *Acacia* sp.frag.	–	1	–	–	–	–	–	–	–	2	–	–	–	–
cf. *Crotalaria* sp. seed	–	–	–	238	–	–	1	–	–	111	–	–	–	3
cf. Fabacae type A seed	1	–	1	–	–	–	–	–	–	–	–	–	–	–

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Period 3b					Period 3a		Period 2					Period 1		Taxa Totals
A11	A10				A9		B6	B4	A8	A5	A3	A2		
62	76	77	78	79	83	85	6	4 (b)	89	103	113	118	119	
–	–	–	–	–	–	–	–	–	–	–	–	–	–	141
–	–	1	–	–	–	–	–	–	–	–	–	–	–	1
–	–	–	–	–	–	–	*	–	2	–	–	–	–	4
–	–	–	–	–	–	–		–	–	–	–	–	–	1
–	–	–	–	–	–	–	*	–	–	–	–	–	–	2
–	–	–	–	–	–	–	*	–	2	–	–	–	–	3
–	–	–	–	–	–	–	*	–	1	–	–	–	–	1
–	–	–	–	–	–	–	–	–	–	–	–	–	–	4
–	–	–	–	–	–	–	–	–	–	–	–	–	–	1
–	–	–	–	2	–	–	–	–	–	–	–	–	–	2
1	–	5	–	4	–	–	–	–	–	–	–	–	–	33
–	–	–	–	–	1	–	4/*	–	1	–	–	–	–	7
–	1	–	–	–	–	–	–	–	–	–	–	–	–	1
–	–	–	–	6	–	–	–	–	–	–	–	–	–	6
–	1	–	–	–	–	2	*	–	–	–	–	–	–	3
–	1	–	–	–	2	2	6/*	–	–	–	–	–	–	14
4	–	–	–	–	–	–	–	–	–	–	–	–	–	10
–	–	–	–	–	1	–	–	–	–	–	–	–	–	1
–	–	–	–	–	–	–	–	–	1	–	–	–	–	1
–	–	–	–	–	–	1	–	–	–	–	–	–	–	1
–	–	–	–	–	–	–	–	–	–	–	–	–	–	4
–	–	4	–	–	–	–	–	–	–	–	–	–	–	13
–	–	6	–	–	–	–	–	–	–	–	–	–	–	6
–	–	–	–	–	–	–	–	–	1	–	–	–	–	1
–	–	–	–	–	–	–	–	1	–	–	–	–	–	1
–	–	–	–	–	–	–	–	–	–	–	3	1	–	4
–	–	–	–	–	–	–	–	–	–	–	–	–	–	1
–	–	–	–	–	–	–	–	–	–	–	3		–	3
4	–	1	–	–	–	–	–	–	–	–	–	–	–	8
1	–		–	–	–	–	–	–	–	–	–	–	–	1
	–	2	–	–	–	–	–	–	–	–	–	–	–	2
–	–	–	–	–	1	–	–	–	–	–	–	–	–	1
–	–	–	–	–	–	–	–	–	–	–	–	–	–	387
–	–	–	–	–	–	1	–	3	–	–	–	1	–	8
–	2	–	–	2	–		–	–	–	–	–	5	–	362
–	–	–	–	–	–	–	–	–	–	–	–	–	–	2

(cont.)

Period	Period 4													
Horizon	**A14**					**A13**							**A12**	
Taxa / **Sample**	**3**	**4 (a)**	**5**	**13**	**19**	**16**	**17**	**18**	**22**	**29**	**30**	**39**	**43**	**45**
Small legume type B (globose-cuboid)	–	–	–	13	–	–	–	–	–	–	–	–	–	–
Small legume pod cf. *Astragalus*	–	–	–	–	–	–	–	–	–	1	–	–	–	–
Medium legume	–	–	–	1	–	–	–	–	–	–	–	–	–	–
Fruits	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Balanites aegyptiaca endocarp (desicc.)	–	–	–	–	–	–	–	–	–	–	1	–	–	–
cf. *Balanites* sp. endocarp frag.	–	1	–	–	–	–	–	–	–	1	–	–	–	–
Citrullus lanatus seed frag.	–	–	–	–	–	–	–	1	–	–	–	–	–	–
Hyphaene thebaica endocarp frag.	–	–	–	–	–	3	–	–	–	–	–	–	–	–
Phoenix dactylifera (date) seed	–	–	–	–	–	–	–	–	–	–	–	–	1	–
Phoenix dactylifera (date) seed frag.	–	–	–	–	–	–	–	–	–	–	–	1	1	–
Ziziphus sp. seed	3	–	–	–	–	–	–	–	–	–	–	–	–	–
Ziziphus sp. endocarp (desicc.)	–	–	1	–	–	–	–	–	–	–	–	–	–	–
Ziziphus sp. endocarp frag.	5	–	1	9	–	–	–	6	–	–	–	–	–	–
Ziziphus sp. endocarp frag. (desicc.)	1	–	15	3	–	–	–	–	–	–	–	–	–	–
cf. *Ziziphus* sp. seed	–	–	1	1	–	–	–	–	–	–	–	–	–	–
cf. *Ziziphus* sp. endocarp frag.	–	–	1	–	–	–	–	–	–	–	–	–	–	–
cf. nut-meat frag.	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Oil/fibre plants	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Gossypium sp. seed	–	–	–	–	–	–	–	–	–	–	–	–	–	–
cf. *Gossypium* sp. seed frag.	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Linum usitatissimum	–	–	–	–	–	–	–	1	–	–	–	–	–	–
Wild/Weed taxa	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Apiaceae type	–	–	–	1	–	–	–	–	–	4	–	–	–	–
cf. Caryophyllaceae type	–	–	–	–	–	–	–	–	–		–	–	–	–
Chenopodiaceae: *Chenopodium sp.*	–	–	–	3	–	–	–	–	–	10	–	–	–	–
cf. Chenopodiaceae type	–	–	–	–	–	–	–	–	2	–	–	–	–	–
Cyperaceae: *Cyperus* sp. nutlets	–	–	–	2	–	–	–	–	–	22	–	–	–	–
Cyperaceae: cf. *Scleria* sp. nutlet frag.	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Lamiaceae: *Ajuga* sp. type A (desicc.)	–	1	–	–	–	–	–	–	–	–	–	–	–	–
Malvaceae: cf. *Malva* sp. frag.	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Poaceae: *Hackelochloa granularis* spikelet (silicified)	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Portulacaceae: cf. *Portulaca* sp.	–	3	–	–	–	–	2	–	1	–	–	–	–	3
Portulacaceae: cf. *Talinum* sp.	–	1	–	–	–	–	–	–	–	–	–	–	–	–
Portulacaceae/Caryophyllaceae type (desicc.)	–	1	1	–	–	–	–	–	–	–	–	–	–	–
Zygophyllaceae: *Tribulus* sp. seed	–	–	–	–	–	–	–	–	–	3	–	–	–	–
Zygophyllaceae: *Tribulus* sp. pod	–	–	–	1	–	–	–	–	–	–	–	–	–	–
Zygophyllaceae: *Tribulus* sp. pod frag.	–	–	–	2	–	–	–	–	–	2	–	–	–	1
Other	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Indet bract/chaff	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Indet. endocarp frag.	2	–	–	2	–	–	–	–	–	–	–	–	–	–
Indet. frag.	–	1	1	10	24	–	91	–	1	261	–	3	–	2

Period 3b					Period 3a		Period 2					Period 1		Taxa Totals
A11	A10				A9		B6	B4	A8	A5	A3	A2		
62	76	77	78	79	83	85	6	4 (b)	89	103	113	118	119	
–	–	–	–	–	–	–	–	–	–	–	–	–	–	13
–	–	–	–	–	–	–	–	–	–	–	–	–	–	1
–	–	–	–	–	–	–	–	–	–	–	–	–	–	1
–	–	–	–	–	–	–	–	–	–	–	–	–	–	58
–	–	–	–	–	–	–	–	–	–	–	–	–	–	1
–	–	–	–	–	–	–	–	–	–	–	–	–	–	2
–	–	–	–	–	–	–	–	–	–	–	–	–	–	1
–	–	–	–	–	–	–	–	–	–	–	–	–	–	3
–	–	–	–	–	–	–	–	–	–	–	–	–	–	1
–	–	–	–	–	–	–	–	–	–	–	–	–	–	2
–	–	–	–	–	–	–	–	–	–	–	–	–	–	3
–	–	–	–	–	–	–	–	–	–	–	–	–	–	1
–	–	–	–	–	–	–	–	–	–	–	–	–	–	21
–	–	–	–	–	–	–	–	–	–	–	–	–	–	19
–	–	–	–	–	–	–	–	–	–	–	–	–	–	2
–	–	–	–	–	–	–	–	–	–	–	–	–	–	1
–	–	–	–	1	–	–	–	–	–	–	–	–	–	1
–	–	–	–	–	–	–	–	–	–	–	–	–	–	4
–	1	1	–	–	–	–	–	–	–	–	–	–	–	2
–	–	1	–	–	–	–	–	–	–	–	–	–	–	1
–	–	–	–	–	–	–	–	–	–	–	–	–	–	1
–	–	–	–	–	–	–	–	–	–	–	–	–	–	108
–	–	–	–	–	–	–	–	–	–	–	–	–	–	5
–	–	1	–	–	–	–	–	–	–	–	–	–	–	1
–	–	–	–	3	–	–	3	–	–	–	–	–	–	19
–	–	–	–	–	–	–	–	–	–	–	–	–	–	2
–	–	–	–	–	–	–	–	–	–	–	–	5	2	31
–	–	–	–	–	–	–	–	–	1	–	–	–	–	1
–	–	–	–	–	–	–	–	–	–	–	–	–	–	1
–	–	–	–	1	–	–	–	–	–	–	–	–	–	1
–	–	–	–	–	–	–	–	–	1	–	–	–	–	1
–	–	–	–	–	–	–	–	–	–	–	–	–	–	9
–	–	–	–	–	–	–	–	–	–	–	–	–	–	1
–	–	–	–	–	–	–	–	–	–	–	–	–	–	2
		6		11	–	–	–	–	–	–	–	1	–	21
–	–	–	–	2	–	–	–	–	–	–	–	–	–	3
–	–	–	–	5	–	–	–	–	–	–	–	–	–	10
–	–	–	–	–	–	–	–	–	–	–	–	–	–	841
1	–	–	–	–	–	–	–	–	–	–	–	–	–	1
–	–	–	–	–	–	–	–	–	–	–	–	–	–	4
21	–	31	5	179	24	1	8	58	11	–	8	20	1	761

(cont.)

Period	Period 4													
Horizon	**A14**					**A13**						**A12**		
Taxa / **Sample**	**3**	**4 (a)**	**5**	**13**	**19**	**16**	**17**	**18**	**22**	**29**	**30**	**39**	**43**	**45**
Indet. seed	2			5	–	–	–	–	–	5	–	–	–	–
Indet. seed coat (thick, large seed)	–	–	–	–	–	–	3	–	–	–	–	–	–	–
indet. seed frag.	–	–	–	–	–	–	–	–	2	–	–	–	–	–
Poaceae: Culm Node	–	–	–	–	–	–	–	–	–	1	–	–	–	–
Poaceae: Indet. small grasses	–	–	–	–	–	–	2	–	–	–	–	–	–	–
Poaceae: Indet. small grass frag.	–	–	–	–	–	–	1	–	–	–	–	–	–	–
Small husk frag. (silic.)	–	–	–	–	–	–	–	–	–	–	–	3	–	–
Spine	–	–	–	–	–	–	–	–	–	2	–	–	–	–
Animal dung	X	–	X	X	X	–	X	–	–	X	–	–	–	–
Sample total	**14**	**9**	**25**	**294**	**24**	**3**	**101**	**8**	**6**	**471**	**1**	**11**	**2**	**13**
Period total							982							
Sampling program total														

(* indicates taxa observed in the bulk silicified sample from Ek-B 6 which was not fully studied and quantified)

Period 3b					Period 3a		Period 2					Period 1		Taxa Totals
A11	A10				A9		B6	B4	A8	A5	A3	A2		
62	76	77	78	79	83	85	6	4 (b)	89	103	113	118	119	
–	5	–	–	–	–	–	–	–	–	–	3	–	3	23
–	–	–	–	–	–	–	–	–	–	–		–	–	3
–	–	1	–	–	–	–	–	–	–	–	–	–	–	3
6	1	–	–	–	–	–	1	1	–	–	–	–	–	10
–	–	–	–	–	–	–	–	–	–	–	–	–	–	2
3	–	–	–	–	–	–	–	–	–	–	–	3	–	7
–	–	–	–	–	–	–	–	–	–	–	–	–	–	3
–	1	1	1	19	–	–	–	–	–	–	–	–	–	24
–	X	X			X	–	–	–	X	X	–	–	–	
41	13	61	6	235	29	7	22	63	21	0	17	36	6	1539
		356			36				123			42		1539
1538														

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