

THE STRATIGRAPHY OF THE LONDON CLAY AND ASSOCIATED DEPOSITS

ABSTRACT

Previous work on the stratigraphy of the London Clay and associated beds is reviewed. A revised lithostratigraphical classification of these beds is proposed: the Thames Group is erected to include the strata between the top of the Woolwich and Reading Beds and the base of the Bracklesham Group. It includes the London Clay Formation and the Oldhaven Formation. Stratotype sections for the London Clay Formation are defined in the London area and at Whitecliff Bay, Isle of Wight. The beds formerly included in the London Clay Basement Bed are separated into several new Members, which are included in the Oldhaven Formation and the basal London Clay Formation. The Claygate Beds are redefined as the Claygate Member and are included in the London Clay Formation. The Lower Bagshot Sands of the London Basin are renamed the Virginia Water Formation.

Five major transgressive-regressive sedimentary cycles are recognised within the London Clay Formation. The base of each cycle is marked by a sedimentary discontinuity in the western London Basin and the Hampshire Basin, with a basal pebble-bed or glauconitic bed. The cycles are used to define five informal divisions (division A to division E), similar in status to the divisions of the Bracklesham group (CURRY *et al.* 1977). Four major groups of facies are recognised within the London Clay Formation (clays, silts and silty sands; fine to coarse sands; 'pebble-beds'; and laminated clays). Their characteristics and depositional environments are summarised.

The stratigraphy of the Oldhaven Formation and the London Clay Formation in the London Basin and Hampshire Basin is summarised, incorporating data from many new temporary exposures and borehole sections. Divisions A to E are traced throughout the London Basin, predominantly in clay facies in the east, but with sandy interbeds in the west. In the Hampshire Basin, divisions A to C are recognisable; interbedded sands, mainly at the top of the cycles, are here well developed, and thicken westwards and southwards. The beds previously referred to the 'Bagshot Sands' in the Hampshire Basin are shown to comprise sand bodies in the upper part of the London Clay Formation and the lower part of the Bracklesham Group.

Faunal and stratigraphical data suggest that the highest parts of the London Clay Formation (divisions D and E) are represented in the Hampshire Basin mainly by the lower part of the Wittering division (Bracklesham Group).

Maps of isopachytes and lithological facies are given for the Oldhaven Formation and parts of the London Clay Formation, and the palaeogeography is briefly discussed. The outcrops of the Hampshire and London basins were originally connected, and the facies-trends in the London Clay Formation are mostly unrelated to present-day structures, contrary to previous statements by BOSWELL and WOOLDRIDGE. There is no positive evidence for the existence of a 'Wealden Island' during the Early Eocene.

The stratigraphical significance of fossil groups including the microplankton, nannoplankton, diatoms, foraminiferids, molluscs, ostracods and fish is evaluated. A number of taxa have relatively short ranges and can be used for correlation. There is a close relationship between benthonic faunas and sedimentary facies.

The Early Eocene succession in the English Channel, northern France, Belgium, Holland, north Germany, Denmark and the North Sea is briefly described, incorporating new data from several areas, and comparison and correlation is made with the English succession. The correlation of these sequences with the zonal schemes based on nannoplankton, microplankton and planktonic foraminiferids is summarised.

The base of the *Wetzelilla astra* microplankton zone is accepted as the Paleocene/Eocene boundary in the North Sea Basin, following COSTA *et al.* This boundary lies very close to the division A1/division A2 boundary, in the lowest part of the London Clay Formation. The excessive number of stage names currently in use is regarded as unnecessary and only a single stage, the Ypresian, is recognised in the Early Eocene, following HARDENBOL & BERGGREN (1978).

1. INTRODUCTION

The London Clay forms part of the Early Tertiary (Palaeogene) succession in southern England. It comprises a sequence of marine silty clays, clayey and sandy silts, and subordinate sands, reaching a maximum thickness of over 150 m in south Essex. Favoured by its existence under and around London, the London Clay has received much attention from the earliest days of geology up to the present time, and is the subject of a body of literature dating back to the eighteenth century.

The London Clay outcrop (and subcrop) in southern England is confined to the London Basin and the Hampshire Basin. These are synclinal areas created by mid-Tertiary folding, isolated by subsequent denudation, and although misleadingly termed 'Basins', they are in reality remnants of a much larger depositional area.

The London Clay has an extensive outcrop in the London Basin (Text-fig. 1), due to its prevailing low dip, combined with the removal by erosion of much of the formerly overlying Tertiary succession. In the Hampshire Basin (Text-fig. 2), due to generally steeper dips the outcrop is a narrow strip, usually less than 3 km in width. In both basins the outcrop is partly covered by Pleistocene or Recent deposits - terrace or valley gravels, glacial deposits or brickearths.

Weathering has usually resulted in the leaching of the sediments near the ground surface. Clays may be relatively unaffected at depths of over 3 m, but in permeable silts and sands calcareous fossils may be destroyed down to depths of 10 m or more. Thus shallow exposures generally show only oxidised and decalcified sediments, unless below the water-table.

Coastal cliff and foreshore exposures exist in both basins, including the classic sections in the Isle of Sheppey (Kent), at Walton-on-Naze (Essex), Alum Bay and Whitecliff Bay (Isle of Wight) and Bognor Regis (West Sussex). Inland, useful natural exposures are almost non-existent.

The London Clay has in the past been extensively dug for brick, tile, and cement manufacture, but few clay quarries now remain, and today semipermanent exposures are rare. Temporary sections are a major source of information. In the past these have included railway cuttings and tunnels, dock excavations and water wells. In recent years motorway construction and other road building programmes have provided many useful exposures.

During the present study a large body of data has also been obtained from civil engineering boreholes, chiefly site investigations for road and buildings. These have enabled parts of the succession to be studied in many areas where exposures are absent. The Institute of Geological Sciences has recently drilled a number of cored boreholes into or through the London Clay in the London and Hampshire Basins, and some data from these are included in this study.

Basic difficulties confronting studies on the London Clay include the rarity of good sections, the relatively monotonous lithology, and the scarcity of macrofossils at many levels. These problems have been dealt with by use of borehole data, by sedimentological logging and close-interval sampling of all available sections, and by quantitative analysis of the microfauna and macrofauna recovered.

This paper presents a summary of some of the stratigraphical results of work on the London Clay carried out between 1965-1978; detailed lithostratigraphical and biostratigraphical results, and environmental interpretations, are not yet completed and will appear elsewhere.