Upnor

[TQ 757 712]

Highlights

Upnor sand pit in Kent exhibits an unrivalled section through much of the Lower London Tertiaries and Thames Group, and vertebrate remains are found throughout the sequence. The quarry faces are clean, and individual fossiliferous beds can be sampled by bulk processing.

Introduction

The sand pit at Upnor, just north of Chatham, is one of few localities where a continuous section exists through the pre-London Clay 'Lower London Tertiaries' to the base of the London Clay (Figure 14.6)A.

Microvertebrate remains are recorded throughout the section and Upnor is the only inland site to have yielded fish from the Oldhaven Beds of the Blackheath and Oldhaven Formation. These beds are overlain by the 'Swanscombe Member' of the basal London Clay from which an undescribed fish fauna has been recovered in recent years (D. Ward, pers. comm., 1995).

The stratigraphical significance of the Upnor section was recognized early in the 19th century and has been described by many authors; more recently, parts of the sequence have been described by Dines *et al.* (1954), Stinton (1965a, 1965c), Hester (1965), Kennedy and Sellwood (1970) and Ellison (1983). The site is an SSSI for Tertiary stratigraphy, as it contains a complete sequence of the Woolwich Beds considered by Ellison (1983) to be the best extant exposure of these strata; see also Daley *in* Daley and Balson (1999). The fish fauna has been recorded by White (1931), Stinton (1965c), and Ward (1978a). Recent finds were communicated by S. Austen (pers. comm., 1995).

Description

Altogether, the continuous sequence through the upper part of the Thanet Formation to the basal beds of the London Clay Formation exposed in Upnor sandpit is some 25–30 m thick (Daley *in* Daley and Balson, 1999). Published sections for the Upnor succession include those by Dines *et al.* (1954), Stinton (1965a) and Kennedy and Sellwood (1970). The following (in descending order) is a composite made from the latter two accounts:

	Thickness (m)
London Clay Formation	
23. Grey clay, unfossiliferous, compact and poorly bedded becoming sandy downwards	seen up to 2.0
22. Reddish-grey sandy clay, poorly bedded, with some glauconite; bioturbated?	1.0
21. Sands and clays. Alternate layers of sand and clay with scattered, small (up to 2 cm) rounded black flint pebbles. Sands are ripple-drift bedded with clay-draped surfaces. Base of unit erosional with small (15 cm) scours and burrows (1.5 mm) 1.1	
Oldhaven and Blackheath Formation, Oldhaven Beds	
20. Fine, buff, cross-bedded sands, unfossiliferous	0.9
19. Impersistant line of cream-coloured septarian nodules	0–0.6
18. Sands and clays. Lenticles of ripple-drift bedded sands and lignitic micaceous clays with *Glycymeris*	1.0

17. Fine, buff, cross-bedded sands, ripple-drift bedded in top 10 cm. Small channels with coarser debris and small black flints at the base	0.5
16. Shell Bed. Fine, buff sand packed with broken mollusc shells and flint pebbles. Erosion surface at base, probably a channel fill	0.4
15. Shell Bed. Fine, yellow orcheous sand with numerous black pebbles and mollusc debris, including *Corbicula, Glycymeris* and *Nemocardium.* Lenses	0.4–1.3
Woolwich and Reading Formation, Woolwich Beds	
14. Low-angle cross-bedded yellow sands with lines of imbricated corbiculids, oysters etc. *Ophiomorpha* burrows occur in top 1.2 m; more shelly in basal 0.3 m, shark's teeth and teleost fragments occur.	
Erosional surface at base	
13. Grey sands and clays, with ripple-drift bedded and cross-bedded units. Burrowed by *Ophiomorpha,* profuse *Corbicula* and scattered fish remains occur	0.5–1.51.0
12. Massive, mottled, grey-yellow sands, iron-stained, burrowed	1.7
11. Sands with oysters and moulds of aragonitic bivalves. Poorly bedded, with wisps of clay	1.1
Woolwich and Reading Formation, Woolwich Shell Beds	
10. Low-angle cross-bedded, striped black, grey, green and pink sandy clays with abundant crushed and fragmentary *Corbicula,* a few fish remains and seams of lignite	1.5
10a. Line of carbonaceous ironstone nodules	0.1
9. Grey streaky sandy clay with sandy seams	0.6
8. Laminated black and brown sandy clays with gypsum and rare corbiculids	0.4
7. Carbonaceous iron-stained sandstone	0.3
6. White to buff sands with low-angle cross-bedding. Burrowed by large *Ophiomorpha*	0.6
5. Sandy ironstone	0.2
4. Hard, massive, purple sandstones with scattered small flint pebbles. Burrowed, and passing down into purple and yellow, cross- and ripple drift- bedded sands.	at base 2.1
Erosion surface	
Woolwich and Reading Formation, Woolwich Bottom Bed	
3. Grey and yellow, impersistently glauconitic sands with lenticles of gravel. Bed consists of low-angle cross-bedded units 0.3–0.6 m thick. Upper part of the unit ripple-drift bedded and burrowed, top surface ripple-marked with thin clay drapes. Some trough cross-bedding; clay breccias occur. *Ophiomorpha* occurs throughout	8.0
2. Basal conglomerate of small black flint pebbles, with scattered fish teeth	0–0.3
Thanet Formation	
1. Unfossiliferous whitish-grey and yellow sands, intensely burrowed seen to floor of pit	6.0

Although only the upper part of the Thanet Formation is exposed in Upnor sand pit, the locality is situated where this unit reaches its maximum thickness (Hester, 1965), and basal strata are exposed nearby (Weir and Catt, 1969). The Thanet Beds at Upnor have not yielded fish material. A complete sequence through the Woolwich Beds of the Woolwich and Reading Formation occurs in the pit, and three out of the six lithofacies described by Ellison (1983) are present there (Daley *in* Daley and Balson, 1999). Fish remains are found throughout the sequence, but are particularly common in the shelly units, such as Bed 14 in the above section (of Kennedy and Sellwood, 1970; roughly equivalent to bed 4 of Stinton (1965a)), although this might in part be due to collection bias in these beds. The overlying Oldhaven Formation is unconformable upon the Woolwich Formation, and a basal shell bed, packed full of *Corbicula, Glycymeris* and *Nemocardium,* occurs. The Oldhaven Formation has yielded abundant microvertebrate remains, but precise stratigraphical details have not been provided, although it is likely that much of the material was recovered by bulk sampling the channel-like shell beds (Beds 15 and 16 on the log, after Kennedy and Sellwood, 1970; equivalent to bed 2 of Stinton, 1965a). The Oldhaven Formation is relatively thin in this locality, and the basal beds of the London Clay are seen only a few metres above with a clearly erosive contact between the two units (Daley *in* Daley and Balson, 1999).

Fauna

The faunas described below from the Woolwich Formation and Oldhavcn Beds, have been taken from White (1931), Stinton (1965b) and Ward (1978a, 1980).

Woolwich Formation

Osteichthyes: Actinopterygii: Neopterygii: Ginglymodi

Lepisosteus sp.

Osteichthyes: Actinopterygii: Teleostei: Euteleostei

indeterminate bones, teeth, scales, vertebrae and otoliths

Oldhaven Beds

Chondrichthyes: Elasmobranchii: Neoselachii: Squatinomorphii

Squatina prima (Winkler, 1874)

Chondrichthyes: Elasmobranchii: Neoselachii: Galeomorphii

Palaeohypotodus rutoti (Winkler, 1874)

Synodontaspis hopei Agassiz, 1843

S. teretidens White, 1931

S. macrota Agassiz, 1843

S. striata Winkler, 1874

Chondrichthyes: Elasmobranchii: Neoselachii: Batomorphii

Hypolophodus ('*Hypolophus*')*sylvestris* (White, 1931)

Chondrichthyes: Holocephali: Chimaeriformes

Amylodon (*Chimaera*) *eoceanica* (Woodward and White, 1930)

Osteichthyes: Actinopterygii: Neopterygii: Ginglymodi

Lepisosteus sp.

Osteichthyes: Actinopterygii: Teleostei: Euteleostei

Ardiodus marriotti White, 1931

Diophyodus sp.

Indeterminate bones, teeth, scales, vertebrae and otoliths

Interpretation

The Thanet Formation shallow-marine glauconitic sands give way at Upnor to the much more regressive facies of the Woolwich and Oldhaven Beds. The Woolwich Beds display marked facies changes across the extensive outcrop, and at Upnor the great development of sands is thought to represent a barrier sand complex (Ellison, 1985). These pass westwards into muds and sands of a back-barrier lagoon in the London region. The fauna of the Woolwich Beds at Upnor is of low diversity and suggests that salinities were less than fully marine. For example, the common trace fossil *Ophiomorpha,* cited as representing fully marine conditions by Kennedy and Sellwood (1970), is also found in brackish and freshwater environments (Stewart, 1978). In mid Woolwich Formation times there was a significant regression, and a ferruginous sand facies developed upon the emergent barrier sands (Ellison, 1983).

At the top of the unit there is a significant unconformity, reflecting another period of emergence and erosion, following tectonic uplift in the eastern parts of the London Basin (Daley *in* Daley and Balson, 1999).

The overlying Oldhaven Beds are unusually fossiliferous at Upnor. This is because in most inland sections these beds have been decalcified (Ward, 1978a). The Oldhaven Formation was considered to have been deposited in a shallow marine environment by early authors (e.g. Monkton, 1904), but is now thought to be a nearshore facies of the initial London Clay transgression. The mixed fauna, including brackish-water molluscs, at Upnor hints at an inshore palaeoenvironment.

The list of Osteichthyes is relatively small, but includes the gar *Lepisosteus* and teleosts. Chondrichthyes are represented by both galeomorphs and batomorphs in appreciable numbers. This suggests that a wide variety of prey was available — small vertebrates and nektonic invertebrates — but as a large number of taxa are based on otoliths, further palaeobiological discussion is handicapped.

Comparison with other localities

A similar microshark fauna to that in the Woolwich Beds at Upnor has been found in the contemporaneous or slightly younger Suffolk Pebble Beds at Ferry Cliff, Suffolk [TM 278 486], and Harwich Harbour, Essex ([TM 26 32]; Hooker and Ward, 1980; D. Ward, pers. comm., 1995). The Suffolk Pebble Bed at Ferry Cliff has also yielded the only British Palaeocene amphibian material (Milner, 1986). Few indeterminate bones have been recovered, but they include an anterior caudal vertebra of the salamander *Koalliella* sp. This genus is recorded from the Upper Palaeocene of Germany (Herre, 1950) and France (Estes *et al.,* 1967).

As early as 1889, Whitaker alluded to the abundant yet low diversity of the Thanet Formation and overlying Woolwich Beds fauna at Upnor, compared with other localities in the London Basin such as Herne Bay (q.v.) and Pegwell Bay, Kent (q.v.), which subsequent authors (e.g. Monkton, 1904) suggested was related to differing depositional facies. However, the overlying Blackheath and Oldhaven Formation is richly fossiliferous at Upnor, yielding an abundant microvertebrate fauna. Elsewhere in Kent, the Oldhaven Beds have been decalcified, but components of the Upnor fish fauna are also found at Shelford quarry, Kent ([TR 160 600]; Ward, 1972) and in the contemporary Blackheath Pebble Beds from western parts of the London Basin (see Abbey Wood report).

Conclusion

Upnor sand pit derives conservation value from the rich fossil fish assemblage within the Oldhaven Formation, including two type specimens of teleost fishes. The facies within the sand pit display an almost continuous sequence through the Lower London Tertiaries, and fish remains have been recovered from several horizons in the Woolwich Formation.

References

Figure 14.6A

Figure 14.6B

(Figure 14.6)A Upnor sand pit, the eastern face exposing the upper part of the Oldhaven Formation (Photo: S.J. Metcalf.).B Exploratory trench in the Blackheath and Oldhaven Formation in Abbey Wood, Blackheath, (Photo: S.J. Metcalf, 1994).