

FUNGAL BORINGS IN NEOSELACHIAN TEETH FROM THE LOWER OXFORD CLAY OF PETERBOROUGH

by

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Summary

Neoselachian teeth from a lag deposit in the Lower Oxford Clay (Middle Jurassic, Callovian) of Peterborough, Cambridgeshire, frequently show heavy infestations of borings, probably of fungal origin. Borings are largely restricted to the enamel of the crown, and can be sufficiently intense as to cause substantial damage to the tooth crown. The borings are assigned to the new ichnospecies *Mycelites enameloides* sp. nov. It is likely that significant quantities of biogenically produced phosphate minerals may be recycled by this activity.

Key words. New species, *Mycelites enameloides*, fungal borings, trace fossil, neoselachian, Lower Oxford Clay, Callovian, Jurassic, England.

Introduction

Vertebrate remains are relatively abundant in the Lower Oxford Clay (Callovian, Middle Jurassic) of the Midlands basin. Commonly the remains of marine reptiles (Andrews, 1910, 1913) and fish (Woodward, 1897) occur, but terrestrial vertebrates such as dinosaurs (Woodward, 1905) and pterosaurs (Leeds, 1956) have also been reported. Martill (1985) recognised a spectrum of vertebrate preservational styles ranging from exceptionally well preserved specimens in which the entire skeleton is preserved in an articulated condition, to specimens which are represented by isolated or fragmentary and abraded bones. The preservational styles can be correlated with different lithologies and with slight changes in depositional environment.

Much of the Oxford Clay was deposited in well oxygenated water, which supported a rich benthos of molluscs, including bivalves, gastropods and scaphopods (Duff, 1975), but other benthic invertebrate groups are less well represented. In the Lower Oxford Clay neoselachians were abundant, feeding largely on the rich benthic invertebrate fauna (Thies, 1983). At frequent intervals background deposition of clay was punctuated by erosive events which mobilised much of the unconsolidated sediment, concentrating the contained fossils. This process resulted in the formation of thin accumulations of broken shells and shell beds, which often became suitable substrates for colonisation by gryphaeate oysters, especially in the basal parts of the sequence. The process was also responsible for concentrating micro-vertebrate remains, especially the highly resistant teeth of fishes. Particularly rich horizons occur at the top of the *Kosmoceras jason* zone (bed 13, Callomon 1968), and within the *Erymnoceras coronatum* zone (bed 18a, Callomon 1968) and is well exposed in most of the brick pits in the Peterborough and Whittlesley districts.

These and other shell beds were sampled for microvertebrate remains during the summers of 1983/4. Among the material isolated from the residues were abundant teeth of neoselachian elasmobranchs. It was noted that a substantial number of these teeth had been host to a species of boring organism probably of fungal or bacterial affinity.

All specimens referred to are deposited in the Department of Geology, University of Leicester, prefixed LEIUG.

Mercian Geologist, vol. 12, no. 1,
1989, pp. 1-4 plus one page
of plates.

Methods

The shell bed at the top of the *jason* zone can easily be bulk sampled as it occurs at a convenient height (approximately one metre) above the floor of the brick pits. It is also easy to recognise in the field as it weathers bright orange due to a high iron pyrite content. Several kilograms of each of the shell beds were collected from the Dogsthorpe Brick Pit, (TF 219019) and Beebys pit, Yaxley (TL 178932). Micro-vertebrate remains were extracted by wet sieving to a sieve diameter of 250 microns, and were further concentrated by repeated circular swashing in a 20 cm wide evaporating basin, the slightly heavier bone and pyritised material being repeatedly pipetted out. From this vertebrate-rich residue recognisable remains were isolated by hand picking from a gridded tray.

Stratigraphy

The horizons at which the neoselachian teeth were collected are accessible in most of the active brick pits in the Peterborough district. Rich horizons occur at the top of the *jason* Zone; where current scour and storm events have produced a lag deposit of broken shells, belemnites and abundant fragments of well-rounded, but compressed, drift wood (Fig. 1), and in the *coronatum* zone where shell beds are well developed. In the Peterborough district the *jason* zone is the lowest zone of the Lower Oxford Clay. It is dominated by thin shell beds, slightly silty clays at the base, bituminous paper shales and clays towards the top. The Zone is rarely more than 1.2 metres thick at Peterborough, but is thicker in more southerly parts of the Midlands basin. Fossils are abundant in this zone, and a diverse nekton includes numerous aragonitic and calcitic cephalopods, and vertebrates. The abundance of vertebrate remains is attributable to high productivity in the surface waters, indicated by organic carbon contents of up to 10% (Fisher 1983). Thies (1983) has demonstrated that neoselachian remains are abundant in other parts of the Lower Oxford Clay succession in Bedfordshire.

Material

Several hundred teeth were recovered from sieved residues, of which about ten percent were from neoselachians. The remainder were from hybodont sharks and primitive teleosts. A recent review of Jurassic neoselachians by Thies (1983) permitted identification of many, but not all of the elements recovered. Most of the neoselachian teeth were referable to *Palaeobrachylurus* sp. and *Palaeospinax* sp. Tooth nomenclature used here follows that of Duffin and Ward (1983).

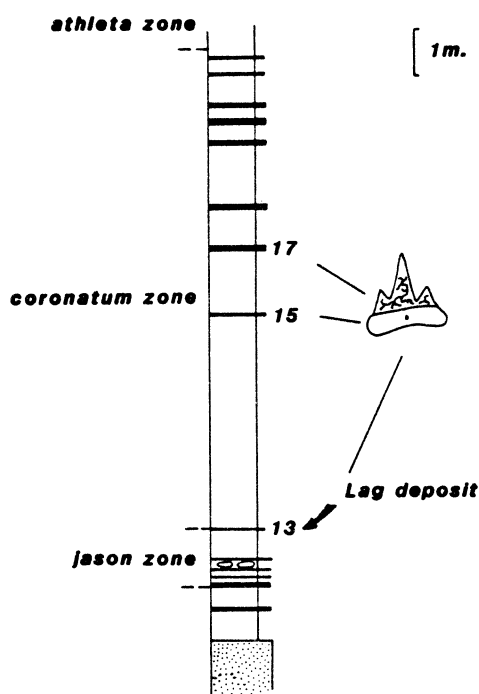


Fig. 1. Generalised stratigraphic log for the Lower Oxford Clay of the Peterborough district with the most productive neoselachian horizons indicated. Bed numbers after Callomon (1968).

Systematic palaeontology

Mycelites enameloides sp. nov.

Ichnogenus, *Mycelites* Roux 1887.

Ichnospecies, *M. enameloides* sp. nov.

Etymology, after its restriction to dental enamel substrates.

Holotype, Neoselachian tooth or dermal denticle, LEIUG 96251, with heavy infestation of borings on the crown.

Paratypes, LEIUG 96349, and LEIUG 96350. Both neoselachian teeth of *Palaeobrachaelurus* sp. with light infestations on the crown in the region of the crown/root junction.

Description

Elongate, endolithic meandering borings restricted to the surface enamel of fish teeth. Occasional bifurcations of the borings produce a ramifying network which can spread over much of the surface of the tooth crown (Plate 1c). All observed borings were empty, lacking the organism responsible for producing the boring. The borings are approximately 7 microns wide with sub-parallel margins. They are between 5 and 7 microns deep with U shaped cross sections. There appears to be slight closure of the margins suggesting a more O shaped cross section boring, that is open due to its proximity to the surface of the tooth enamel. The majority of borings are concentrated at the surface of the teeth, meandering over the surface. Smaller diameter borings approximately 2 microns across appear to penetrate deeper into the teeth.

Affinities

Gouget and Locquin (1979) described a number of borings in vertebrate teeth and scales from the Devonian of Brittany and Spitzbergen. The borings were of similar size to those found in the Lower Oxford Clay of Peterborough, but appear to be restricted to the boundary between the dentine and enamel, rather than the enamel itself. In some of Gouget and Locquin's material the organic remains of the boring organism are preserved, and consist of spores and filaments of fungal origin referred to *Mycobystrovia lepidophaga*, and also to coccoid bacteria.

The Lower Oxford Clay borings differ significantly from those from the Devonian teeth and scales described by Gouget and Loquin (1979), but show a number of similarities with material described by Bystrov (1956).

Borings in bones of ichthyosaurs were described by Bystrov (1956) and referred to *Mycelites ossifragus* Roux. These were found only in the internal parts of highly trabecular bone. Similar borings in similar situations were also found in the bones of *Scaporhynchus* sp., *Holonema* sp. and *Rhytina* sp. These borings closely resemble those from the Lower Oxford Clay differing only in their lack of specificity to enamel substrates, and in being deeply penetrative. The Oxford Clay borings can be assigned to the genus *Mycelites* because their morphology is remarkably similar to the specimens figured by Roux (1887). They are, however, considered to represent a new species because their distribution is restricted to the enamel layers of teeth, and they are open to the surface along most of their length (plate 1). Therefore this Lower Oxford Clay material is referred to here as *Mycelites enameloides* sp. nov.

Gouget and Loquin considered that *Mycobystrovia* was parasitic on the teeth and scales of Palaeozoic fishes. It is not possible to determine whether the Lower Oxford Clay boring organisms were parasitic on a living animal or were the result of post mortem infestation. The restriction of the borings to the exposed enamel may be indicative of parasitic infestation due to the vulnerability of exposed tissue, but it may simply reflect a high substrate specificity on detrital material.

The new borings frequently occur on the enamel portion of the crowns of multicuspidate neoselachian teeth. The borings appear to be more numerous on neoselachian teeth, but occasionally can be found on teleost teeth. No borings were observed on the teeth or denticles of hybodont sharks. Although the distribution of the borings appears to be concentrated toward the crown/root junction, borings frequently extend towards the cusp apex. As the borings do not contain the organism responsible for the production of the boring, they are referred to a new ichnospecies in accordance with the guidelines set out by Sarjeant and Kennedy (1973).

Implications

The role of boring organisms in recycling biogenically produced stable phosphate mineral phases is significant. Tooth enamel is composed of cryptocrystalline apatite, usually in the form of hydroxyapatite in living organism, (after death hydroxyl is frequently substituted by fluorine to give fluorapatite in marine environments) and is extremely resistant to physical and microbial breakdown. Fluorapatite is resistant to chemical erosion, and being relatively hard, it is also resistant to mechanical erosion. A great deal of phosphate converted to bone or enamel can be locked up in the sedimentary record for long periods and rendered unavailable for biological activity. It is, however, quite likely that fungi and bacteria with the ability to utilise apatitic phosphate may be responsible for recycling phosphate that might have been locked up in sediments, and converting it into organic macromolecules, where it is again available for use in the phosphate cycle.

Also of importance is the effect such activity has on biasing the fossil record. If such organisms can continue boring until the entire tooth is destroyed, the former presence of micro-vertebrate remains at certain horizons may no longer be recognisable. Substrate specificity of phosphatophagous organisms may also lead to preferential preservation of some mineralised vertebrate tissues and the destruction of others.

Acknowledgements

I would like to thank the London Brick Company Plc for permission to undertake research in their pits. I thank Alan Dawn for much assistance with collecting. Trevor Ford kindly read the manuscript. Tenure of a University of Leicester research scholarship is gratefully acknowledged, as is an Open University research grant.

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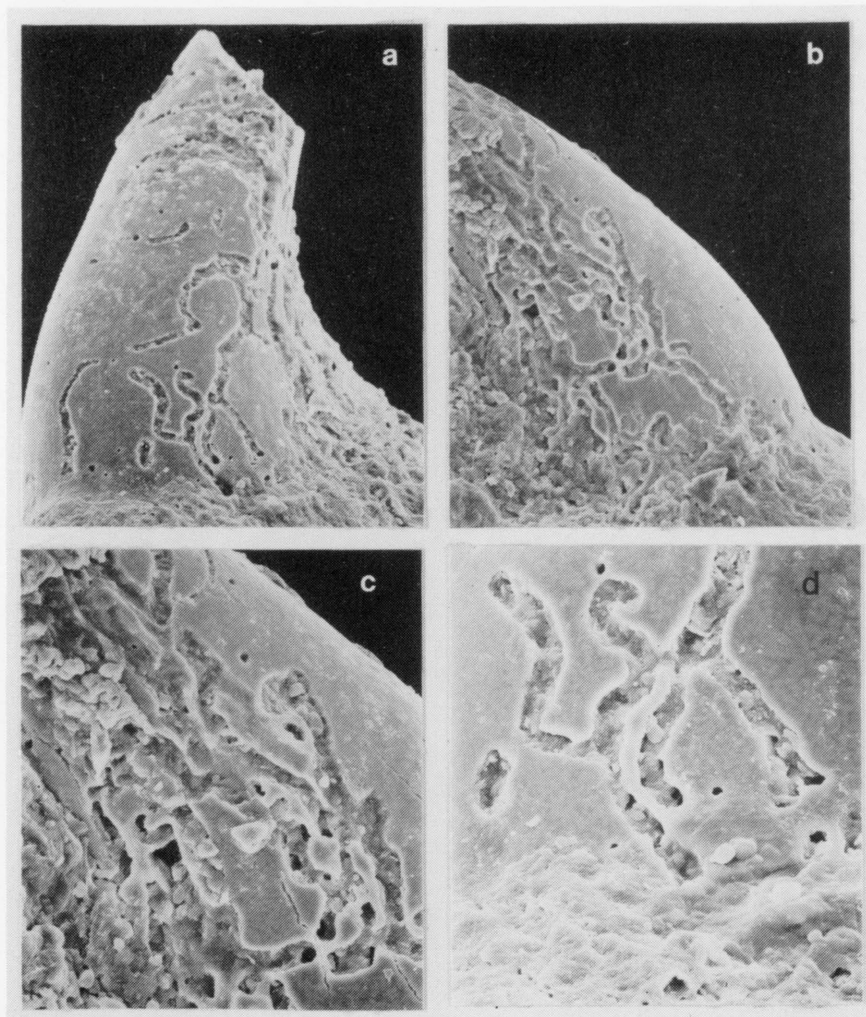


Plate 1. Holotype of *Mycelites enameloides* sp. nov. Lower Oxford Clay, Peterborough, England. *a.* meandering borings on dental cusp of neoselachian X 100. *b.* heavy infestation on enamel surface X 100. *c.* detail of heavy infestation demonstrating almost total destruction of enamel X 300. *d.* detail of meandering system of borings with termination of boring at crown/root junction X 300. All borings on same tooth LEIUG 96251.

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