WATTON CLIFF

OS Grid Reference: SY451908–SY453907

Highlights

The Upper Bathonian assemblage at Watton Cliff in Dorset represents mixed marine and freshwater influences, including abundant microshark elements and amphibian remains. Two species of the hybodont shark *Lissodus* have been described from material collected in recent years from Watton Cliff.

Introduction

The Forest Marble (Upper Bathonian) at Watton Cliff (also known as Ware or West Cliff), West Bay (Figure 12.20A; Clements, 1989b), contains channel deposits within a thick shelly horizon (Figure 12.20B), which have yielded abundant microvertebrate material including a reworked terrestrial component (Evans, 1992; Evans and Milner, 1994). The site was excavated in the late 1970s by a team from University College, London, as part of a project on Middle Jurassic tetrapod assemblages (Kermack, 1988; Evans, 1992). The fauna consists of selachians, including microshark remains, bony fish and amphibian material comparable to that from the Forest Marble at Kirtlington Cement Works (q.v.; Evans, 1992; Evans and Milner, 1994; D. Ward, pers. comm., 1993). The site has also yielded abundant small reptilian remains (Evans, 1992), along with much rarer tritylodont mammal-like reptile and mammalian teeth (Freeman, 1976; Ensom, 1977; Kermack *et al.*, 1987). The vertebrate-bearing channel-like deposits are rich in carbonaceous plant material and are thought to represent storm breaches through an offshore shell bank complex (Holloway, 1983).

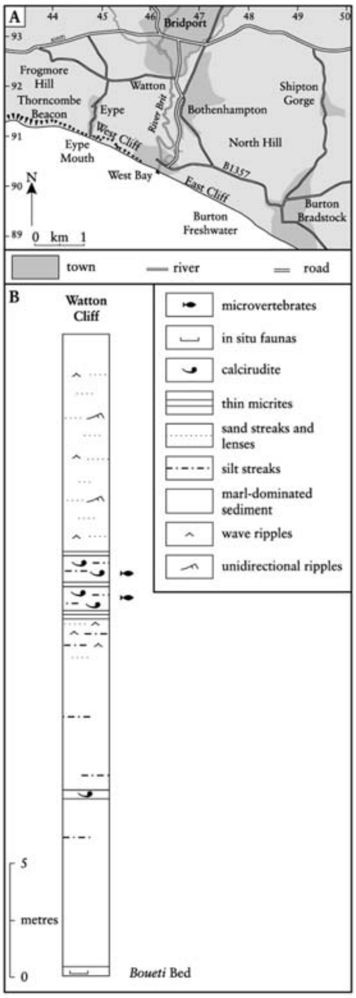

Figure 12.20: (A) Sketch map of the vicinity of the Watton Cliff (West Cliff) GCR site, Upper Bathonian of Dorset; (B) stratigraphical section through the Forest Marble (after Holloway, 1985). (C) View of Watton Cliff facing west (photo: S.J. Metcalf).

Description

The cliff section at Watton Cliff has been described by H.B. Woodward (*in* Strahan, 1898, p. 8) and by Torrens (1969a, pp. 37–8). The succession here is the most complete sequence of Forest Marble in west Dorset (Figure 12.20B) and additional information on the geology has been provided by Melville and Freshney (1982, pp. 26–7), House (1989, pp. 57–9) and Holloway (1985, p. 260). The section given here is based on the work of H.B. Woodward with modern terminology and measurements applied where appropriate.

		Thickness (m)
(Cornbrash)		
Forest Marble Formation		
10	Flaggy blue limestone, showing ripple marks, and clays or shales, with 'race'; the limestone preponderant	3.04
9	Clays with 'race', shaley limestone, thin shelly limestone and thin leaves of sandy limestone, ferruginous in places; the clay preponderant	6.10
8	(= 'calcirudite' of Holloway = ?*Digona* Bed of Torrens = 'Mammal Bed' of Freeman). False-bedded shelly limestones, sandy and oolitic in places,with irregular clay seams, many ochreous galls, lignite; and with the bivalves *Camptonectes*, *Plagiostoma*, *Praeexogyra* and fragments of the crinoid *Apiocrinus*	3.00–4.60
7	Grey clay (impersistent)	0–0.90
6	Hard, white or grey marl, with thin seams of bluish shelly limestone	0.15
5	Blue, flaggy, argillaceous limestones, and blue and yellow clays, with thin layers of calcareous grit	9.15
4	(= *Boueti* Bed). Hard, sandy marl stained reddish brown; brachiopods '*Rhynconella*'-bed, with *Chamlys vagans*, *Goniorhynchia boueti*, *Avonothyris langtonensis*, *Ornithella digona*, and crinoid (*Apiocrinus*) ossicles and serpulids	0.36
Fuller's Earth		
3	Bluish yellow marl, with impersistent band of hard white marl	2.74
2	Hard, fissile white marl	0.84
1	Grey marls	seen 25.00

The section of Forest Marble at Watton Cliff is considered to be complete as the overlying Cornbrash was formerly exposed on the cliff top (Cope *et al*., 1980b). The formation consists of three lithological units of roughly equal thicknesses (Arkell, 1947a). The lowest unit consists of a thick greeny brown marly clay interbedded with thin impersistent shelly limestones, silts and sandstone bands (Holloway, 1982). Similarly, the top horizon is dominated by laminated marly clays interbedded with very fine sandstones and silts. These two units are separated by 3–5 m of coarsely bioclastic limestone (bed 8 of Woodward's log), known as the 'calcirudite' bed (Holloway, 1982) and thought to be laterally equivalent to the brachiopod-rich bioclastic *Digona* Bed of the Weymouth region (Torrens, 1969a). At Watton Cliff a rich brachiopod-bearing, shell fragmental band, the *Boueti* Bed (bed 4 of Woodward's log; Melville and Freshney, 1982) provides a convenient base for the formation as it is laterally persistent and can be traced northwards into Somerset and the southern Mendips. This allows correlation with the succession in the southern Cotswolds (Arkell, 1947a; Cope *et al*., 1980b).

Microvertebrates were recovered from the thick calcirudite horizon (Figure 12.20B), known since as the 'Mammal Bed', in the middle of the section (bed 8) by bulk sampling (Freeman, 1976; Kermack *et al*., 1987; Kermack, 1988). This unit consists of individually impersistent sheets and lenses of planar or cross-bedded shell-fragmental and oolitic limestones, interbedded with thin marl drapes. The invertebrate macrofauna of the calcirudite units is largely made up of broken valves of *Praeexogyra hebridica* and whole large pectinids. Carbonized plant matter occurs as fine disseminated fragments and as large log material. The microvertebrate fauna has two well-defined components, the first consisting of well-preserved and clearly marine fish remains, and the second being comprised of a derived terrestrial tetrapod fauna. The tetrapod material is generally water worn, indicating considerable transport (Evans and Milner, 1994) into the high-energy offshore depostional environment.

The vertebrate remains at Watton Cliff were recovered by bulk sieving and acid preparation techniques upon the shelly limestones and marls known as the 'Mammal Bed' (Freeman, 1976; Kermack, 1988; Evans 1992; D. Ward, pers. comm., 1995). Some of the material is now housed in the UCL (Evans, 1992, and pers. comm., 1993) but most is in NHM collections (Duffin, 1985; F. Mussett, 1996, pers. comm.).

Chondrichthyes: Elasmobranchii: Euselachii: Hybodontoidea

Asteracanthus sp.

Hybodus spp.

Polyacrodus sp.

Lissodus wardi Duffin, 1985

L. pattersoni Duffin, 1985

Chondrichthyes: Elasmobranchii: Neoselachii: Batomorphii *Spathobatis* sp. Chondrichthyes: Elasmobranchii: Neoselachii: Squalomorphii

Protospinax sp.

Chondrichthyes: Elasmobranchii: Neoselachii: Galeomorphii *Heterodontus* sp.

orectolobid

?*Palaeocarcharias* sp.

Scyliorhinus spp.

Chondrichthyes: Holocephali: Chimaeriformes chimaerid

Osteichthyes: Actinopterygii: Neopterygii: Halecostomi

Lepidotes sp.

pycnodontid

Amphibia: Lissamphibia: Anura

Eodiscoglossus oxoniensis Evans, Milner and Mussett, 1990

Amphibia: Lissamphibia: Caudata

Marmorerpeton sp.

'Kirtlington Salamander A'

Amphibia: Lissamphibia: Albenerpetontidae

albanerpetontid indet.

Interpretation

Detailed biostratigraphical correlation of the Forest Marble sequence in west Dorset with the standard Upper Bathonian zonation is not easy as no diagnostic ammonites have been recorded in these beds. Correlation can, however, be demonstrated based upon the prevalence of the lithostratigraphical marker beds, the *Boueti* and *Digona* Beds, and their characteristic faunas, as ammonites occur in the east Dorset succession and have been recovered from the two brachiopod-rich units. Arkell (1959) figured a specimen of *Clydoniceras (Delecticeras)* cf. *ptychophorum* Neumayr from the base of the *Boueti* Bed at Langton Herring (SY 608822) and

Clydoniceras hollandi Buckman has been recovered from loose material beneath the outcrop of the *Digona* Bed at Herbury (SY 613807; Cope *et al.*, 1980b). The former specimen does not allow precise correlation, but similar forms have been recorded from a succession in north-west Germany interpreted as indicating the *aspidoides* Zone. If Torrens' (1969a, pp. 37–8) assertion that the microvertebrate-bearing calcirudites (bed 8) are the lateral equivalent of the *Digona* Bed is correct, then the appearance of the subzonal ammonite *Clydoniceras hollandi* within this unit suggests a precise age for the Watton Cliff assemblage.

The calcirudite bed is thought to represent an offshore bank of unstable shell detritus. Holloway (1982) considered the shell debris forming the calcirudite to be derived from the underlying Forest Marble and that the only organisms living in the subtidal shoals and channels were the boring bryozoans and encrusting organisms. The remains of the small tetrapods and the large pieces of wood were deposited within the cross-cutting channels during the waning stages of storms, and suggest a close proximity to land (?Cornubia).

The fish fauna recorded from Watton Cliff is largely made up of microshark material such as teeth and dermal denticles (Figure 12.21), associated with a small bony fish component of teeth and scales (D. Ward, pers. comm., 1995). The ubiquitous Jurassic hybodont genera are present in the assemblage and include *Hybodus*, *Polyacrodus*, *Asteracanthus* and *Lissodus*. There may be more than one species of *Hybodus*, but these have yet to be fully described (D. Ward, pers. comm., 1995). Two species of *Lissodus* have been described by Duffin (1985) from the Mammal Bed calcirudites. These are *L. pattersoni* and *L. wardi* (Figure 12.21) which are also present in the Kirtlington Mammal Bed (Duffin, 1985).

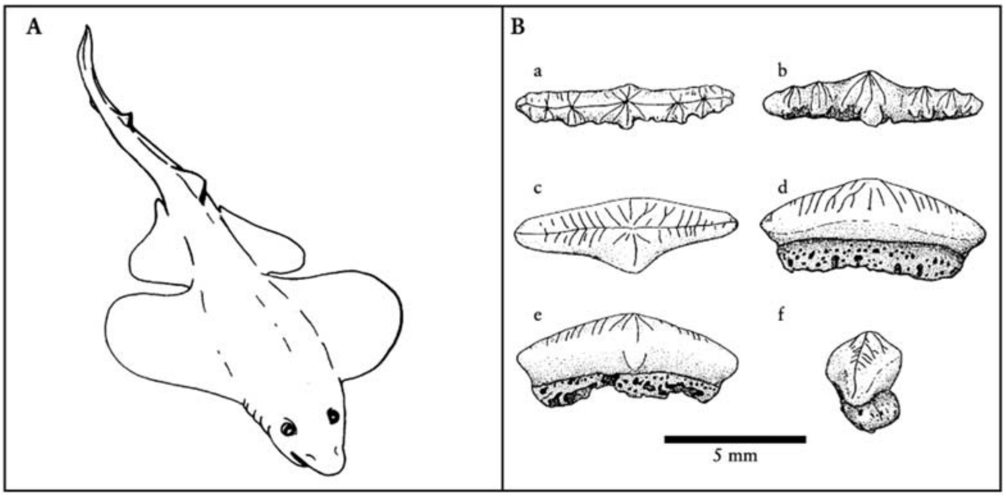

Figure 12.21: Elasmobranchs from the Bathonian: (A) Protospinax, × 0.1 restoration after Woodward 1919b. (B) Lissodus pattersoni Duffin (NHM P60706); a, occlusal view; b, labial view. L. wardi Duffin (holotype NHM P58701): c, occlusal view; d, lingual view; e, labial view; f, lateral view (from Duffin, 1985).

Neoselachians are also a common component of the microshark fauna. These include *Spathobatis* and the ?ancestral squalid shark *Protospinax* (Figure 12.21), both forms adapted to a specialized benthic mode of life as their crushing-type dentition indicates (Cappetta, 1987). *Protospinax* is a rather enigmatic genus known from an almost complete skeleton from the Lower Tithonian (Portlandian: Upper Jurassic) of Solnhöfen, Germany. Teeth referred to this genus have a high, wide oval crown with a crest which rises to a prominent cusp and a low, bilobed root (Figure 12.21; Cappetta, 1987). In several localities these have been assigned to the squalid shark *Squalogaleus* (e.g. Thies, 1983). Maisey (1976) considered that *Protospinax* was synonymous with the batoid genus *Belemnobatis*, but on review of the type specimens, Cappetta (1987) decided that *Protospinax* was valid and most probably was a primitive squalomorph.

Galeomorph sharks are well represented in the Forest Marble fauna of Watton Cliff. A species of the extant heterodontid genus *Heterodontus* (D. Ward, pers. comm., 1995) represents one of the earliest occurrences of the genus and of the Heterodontidae (Cappetta, 1987). Several species of *Heterodontus* have been recorded from the Upper Jurassic of southern Germany (Schweizer, 1961, 1964) and undifferentiated heterodontid teeth and denticles have been described from the Forest Marble of Cirencester, Gloucestershire (Young, 1984). Modern *Heterodontus* is a small benthonic

shark which lives in shallow, warm waters and possesses a differentiated clutching–grinding

dentition that has undergone little modification from the earliest occurrence of the family (Cappetta, 1987). An orectolobid shark (Order Orectolobiformes) is also present in the acid residues, but generic diagnosis is uncertain (D. Ward, pers. comm., 1995). Orectolobids are a common neoselachian component of many Bathonian faunas, and have been recovered from the Middle and Upper Bathonian of the Cotswolds (Young, 1984; S. Metcalf and C. Underwood, pers. comm.). *Palaeocarcharias* is a genus described from three partial specimens from the Lithographic Stone (Upper Kimmeridgian) of Eichstätt, Germany (de Beaumont, 1960). According to its dentition, *Palaeocarcharias* probably is related to the Lamniformes, and the presence of its teeth in the Watton Cliff assemblage is the earliest occurrence of the genus and possibly the order (Cappetta, 1987). Scyliorhinid teeth (Order Carcharhiniformes) have also been recognized in earlier Bathonian deposits at Huntsmans Quarry, Gloucestershire (S. Metcalf and C. Underwood, pers. comm.) and in Africa, and teeth of the scyliorhinid *Scyliorhinus* are recorded from the Forest Marble at Watton.

The amphibians from the Forest Marble at Watton Cliff have yet to be fully described (Evans, 1992; Evans and Milner, 1994), but the composition of the fauna seems to be typical of late Bathonian tetrapod assemblages (cf. Evans *et al*., 1988, 1990). The fauna includes all the major components of the Kirtlington Mammal Bed (see Kirtlington report) except for the undescribed caudate, 'Kirtlington Salamander B' (Evans, 1992). The affinities of these taxa are discussed in the site report for the Kirtlington Cement Works (q.v.).

Comparison with other localities

The microvertebrate assemblage from Watton Cliff is clearly similar to faunas from the Forest Marble and White Limestone successions of Oxfordshire and Gloucestershire. In particular the amphibian remains are directly comparable to those from Kirtlington (q.v.) and a detailed account of this and other late Bathonian freshwater faunas is given in the Kirtlington site report. The mid-Bathonian assemblages at Stonesfield (q.v.) and Huntsmans Quarry contain similar marine elements.

Conclusions

Watton Cliff presents the best exposure of the Forest Marble Formation (Upper Bathonian) in southern Britain and has been well dated. The 'Mammal Bed' fauna includes a unique mixed freshwater–marine assemblage of fishes and amphibians thus giving the site its conservation value. The cliff-top exposure is easily accessible and has great potential for future research collections to be made.

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