Smallmouth Sands, Weymouth, Dorset

([SY 669 764] [SY 672 772])

Highlights

Smallmouth Sands has produced one of the most diverse assemblages of Kimmeridge Clay reptiles anywhere in the world. Its fauna of four species of turtles and three of pterosaurs is unique and, of its total fauna, six species are known only from this site.

Introduction

The Kimmeridge Clay south-west of Weymouth has yielded a large selection of marine and terres trial reptiles, including many type specimens. Most of the finds appear to have been made on Smallmouth Sands and possibly also in the railway cutting behind. Little in the way of large finds has been collected recently because the enclosure of Portland Harbour has reduced erosion, but the relevant beds could be re-excavated. In addition, specimens are occasionally found offshore from this site and in degraded Kimmeridge Clay beds west of the classic site.

The Kimmeridge Clay outcrop in the Weymouth district forms a tract along the northern shore of the Isle of Portland which is continued across the floor of Portland Harbour. It is best exposed between Sandsfoot Castle and Portland Ferry bridge at Small Mouth, where it forms a series of low sea cliffs. The earliest good account of these cliff exposures was provided by Waagen (1865). The Kimmeridge Clay south of Sandsfoot Castle includes the lowest beds in the *mutabilis* Zone, and shows good sections of the *cymodoce* and *baylei* Zones (Arkell, 1933, p. 454), the three lowest Kimmeridgian zones. The section between Sandsfoot Castle and Smallmouth bridge has been described by several authors (Damon, 1884, p. *77;* Blake and Hudleston, 1877, pp. 269–70; Salfeld, 1914, pp. 201–3; Arkell, 1933, pp. 385, 454; 1935, pp. 80–1; 1947c, pp. 56, 88; Birkelund *et al.,* 1978, p. 35; Cox and Gallois, 1981, pp. 4, 9), but most interest has focused on the Corallian.

Description

The section, based on Arkell (1933), Cox and Gallois (1981) and Cope (*in* Cope *et al.,* 1980b, p. 80) is:

	Thickness (m)
Lower Kimmeridgian	
mutabilis Zone	
Clays with nodules (?bed 13 (in part)-17 of Damon, 1884)	?20+
cymodoce Zone	
Black Head Siltstone	0.5
Shales with *D. delta* (bed 13 (in part) of Damon, 1884; bed 24 (in part) of Salfeld, 1914)	2.0+
Wyke Siltstone (bed 12 of Damon, 1884; bed 23 of Salfeld, 1914)	1.0
baylei Zone	
pale grey mudstones with thin, tabular clay ironstones at base (beds 8–11 of Damon, 1884; beds 21–22 of Salfeld, 1914)	?6+
dark grey mudstone with *D. delta* (? bed 7 of Damon, 1884; bed 20 of Salfeld, 1914; bed 13 of Arkell, 1933, 1947c)	3.0
Nanogyra nana Bed	

(bed 7 (in part) of Damon, 1884; bed 19 of Salfeld, 1914; bed 12 of Arkell, 1933, 1947c)	0.25
Rhactorhynchia inconstans Bed (bed 6 of Damon, 1884; bed 18 of Salfeld 1914; bed 11 of Arkell, 1933, 1947c)	0.7
Upper Oxfordian (Corallian)	
Westbury Iron Ore Beds (beds 1–5(?) of Damon, 1884; beds 13–17 of Salfeld, 1914; beds 8–10 of Arkell, 1933, 1947c)	

The beds dip south-west, and the clays with nodules of the *mutabilis* and higher ammonite zones are indicated largely by nodules washed ashore from the floor of Portland Harbour (Cope, *in* Cope *et al.,* 1980b, p. 80). Higher units of the Kimmeridge Clay occur in the harbour and on the north shore of the Isle of Portland.

The reptiles appear to have come from lower units of the Kimmeridge Clay and probably also from the top of the Corallian and from material washed out of Portland Harbour. Damon (1884, p. 77) noted that 'gigantic saurian remains have been found. Among others, *Gigantosaurus megalonyx,* Hulke in his bed 12. This was described as 'gritty clay… 3ft', and it is almost certainly equivalent to the Wyke Siltstone, thus *cymodoce* Zone. Damon (1884, p. 77 further noted 'saurian remains' below a 'layer of large flattened septaria', his bed 14, possibly equivalent to the main *Xenostephanus*-rich beds (Cox and Gallois, 1981, p. 5) at the base of the *mutabilis* Zone. Damon (1884, p. 77) also stated that his bed 16 (another horizon higher in the *mutabilis* Zone) also 'contains saurian bones'. BMNH R1798, a partial skull and mandible of *Kimmerosaurus langhami* (no detailed collection data available), most probably came from the cliff exposure between Sandsfoot Castle and the old Portland Ferry Bridge (Damon, 1884; Brown *et al.,* 1986, p. 226).

In his description of *Cetiosaurus humerocristatus,* 'a very large saurian limb-bone', Hulke (1874a, p. 16) noted that 'it was enveloped in large septarian masses, which stuck so closely to it that thin laminae of the surface of the bone were unavoidably detached in stripping the matrix from it'. The nodules probably indicate that the bone came from one of Damon's septarian beds of the *mutabilis* Zone, or from the harbour. Hulke (1874a, p. 16) noted further that 'the bone has been much fissured, and cemented together by spar; and some parts have been distorted by squeezing; but the general figure is well preserved'. The other fossil bones collected here have also been broken and disarticulated.

Other remains, including fragments of juvenile and mature turtles, including the type of *Pelobatochelys blakei,* were noted by the early authors as coming from the junction between the lowest Kimmeridge Clay and the highest Corallian (Oxfordian) horizons. These beds, the Westbury Iron Ore Beds, have formed the subject of many studies, and Blake (1875), for example, concluded that they were 'passage beds'. Other fossils (now lost) seem to have been collected from the uppermost Corallian beds at Sandsfoot itself (Blake and Hudleston, 1877). The ichthyosaur *Brachyptetygius extremus* appears to have come from the lowest Kimmeridgian zone or, more probably, from the same 'Passage Beds' (Delair, 1986, p. 133). The fossils from the uppermost Corallian Beds at Sandsfoot show close affinities with those from the immediately overlying Kimmeridgian zones (Arkell, 1935; Brookfield, 1978b; Delair, 1986).

Finds of bones have also been made in Portland Harbour. A jaw fragment of a megalosaurid dinosaur was dredged up in the 1980s (Powell, 1988), and associated ammonites indicated the *autissiodorensis* Zone (top of the Early Kimmeridgian).

The reptile remains from Smallmouth Sands most frequently consist of isolated limb bones, vertebrae or teeth, although partially articulated specimens have been found (e.g. the ichthyosaur paddle described by Boulenger (1904b) and Delair (1987), and several connected series of ichthyosaur vertebrae).

Fauna

Mansel-Pleydell (1888) and Delair (1958, 1959, 1960, 1986) have summarized the reptiles from 'Weymouth'. Some synonymizing can be done as a result of later work, but most of the material has not been studied recently. Most of the

Kimmeridge Clay specimens labelled 'Weymouth' may come from the Smallmouth Sands section, on the basis of Damon (1884, pp. 69, 77), outcrop distribution and labels on certain specimens. Repository numbers are given for type specimens, and an estimate of total numbers of each specimen of each species preserved in major collections is appended.

Testudines: Cryptodira: Thalassemyidae	Numbers
Acichelys (*Eurysternum*) sp.	4
Pelobatochelys blakei Seeley, 1875 Type specimens: BMNH 41235, 44177–8, R2	7
Pelobatochelys sp.	2
Tropidemys langi Ratimeyer, 1873	4
Testudines: Cryptodira: Plesiochelyidae	
Plesiochelys sp.	4
Archosauria: Crocodylia: Thalattosuchia	
Dakosaurus maximus (Plieninger, 1846)	4
Metriorhynchus sp.	3
Steneosaurus sp.	8
Archosauria: Pterosauria	
Rhamphorhynchus manselii (Owen, 1874) Type specimen: BMNH 41970	11
Rhamphorhynchus pleydelli (Owen, 1874) Type specimen: BMNH 42378	7
Rhamphorhynchus sp.	10
'Ornithocheirus sp.'	1
Pterodactylus suprajurensis Sauvage, 1873	1
Archosauria: Dinosauria: Saurischia: Theropoda: Megalosauridae	
megalosaurid	1
Archosauria: Dinosauria: Saurischia: Sauropoda	
Pelorosaurus bumerocristatus (Hulke, 1874) Type specimen: BMNH 44635	2
Archosauria: Dinosauria: Ornithischia: Ornithopoda	
'hypsilophodontid'	1
Archosauria: Dinosauria: Ornithischia: Stegosauria: Stegosauridae	
Dacentrurus armatus Owen, 1875	1
Sauropterygia: Plesiosauria: Elasmosauridae	
Colymbosaurus trochanterius (Owen, 1840) *Cimoliasaurus brevior* Lydekker, 1889 Type specimen: BMNH 41955	1
Sauropterygia: Plesiosauria: Cryptoclididie *Kimmerosaurus langhami* Brown, 1981	1
Sauropterygia: Plesiosauria: Pliosauridae	
Pliosaurus brachydetrus Owen, 1841	5
Pliosaurus sp.	7
Liopleurodon macromerus (Phillips, 1871)	2
Ichthyopterygia: Ichthyosauria	
Brachypterygius extremus (Boulenger, 1904) Type specimen: BMNH R3177	1
Macropterygius thyreospondylus (Owen, 1840)	4

Interpretation

The four genera of turtles from Weymouth are all cryptodires according to the classifications of Gaffney (1975b, 1976, 1979a) and M■ynarski (1976). The cryptodires, which retract their head in a vertical plane, are the commonest forms today. The cryptodires arose in the Early Jurassic of North America, but only became reasonably abundant in the Late Jurassic of Europe and North America. *Tropidemys, Acichelys (Eurysternum*) and *Pelobatochelys* are grouped together in the Thalassemyidae and *Plesiochelys* in the Plesiochelyidae, both of which families arose in the Late Jurassic, and are known elsewhere from Germany and Switzerland, as well as the Portlandian of the Isle of Portland (see below).

Acichelys is represented by several remains of carapace and limbs in the BMNH, but these have not been described. *Pelobatochelys blakei* Seeley (1875) was established on the basis of 'fragments of a chelonian carapace' which could include the remains of one or more animals. A restoration showed a broad low carapace about 0.5 m long. The genus was characterized by the broad vertebral scutes which were strongly fluted underneath and by a pointed midline ridge along the neural plates. It is known only from Dorset and from the Smallmouth section in particular.

The material was reviewed by Lydekker (1889b, pp. 152–5) and Delair (1958, pp. 54–5). *Plesiochelys is* represented by some carapace remains and limb bones. The specimens presently ascribed to this genus in the BMNH were initially named *Tropidemys langi* and 'generically undetermined specimens' (Lydekker, 1889b, pp. 156–8) and require restudy. *Tropidemys langi is* represented by isolated carapace elements which were tentatively identified as such by Lydekker (1889b, pp. 156–7). These turtles are all of significance as some of the earliest cryptodires known, but skulls are lacking, and much current taxonomic work depends on cranial characters.

The crocodile remains from Smallmouth consist largely of teeth, and these have been ascribed (Lydekker, 1889a, pp. 94, 100–1; 1890a, p. 233) to *Dakosaurus, Metriorhynchus, Steneosaurus* and *Teleosaurus,* genera well known from the Kimmeridgian. Some vertebrae, scutes and skull fragments of *Steneosaurus* and *Metriorhynchus* have also been collected. The teleosaurs *Steneosaurus* and *Teleosaurus* were medium-sized, long-snouted, marine, fish-eating crocodiles. They are distinguished on the characters of skull shape and tooth arrangement. The metriorhynchid *Dakosaurus* was much larger (up to 4 m body length) and had a relatively short snout. *Metriorhynchus* had a longer snout and was highly adapted for aquatic life; both fore and hind limbs were shortened and paddle-like.

Several remains of pterosaurs from Weymouth have been described. They consist generally of articular ends of limb bones and skull elements, all of which are readily identifiable as pterosaurian. Owen (1874a, pp. 8–11) described two new species, *Pterodactylus manseli* and *P. pleydelli* on the basis of a humerus (proximal end) and wing phalanx and humerus (distal end) and wing phalanx, respectively. Some carpal bones were called *' Pterodactylus* sp. incert.' Lydekker (1888a, pp. 40–1) enumerated these specimens, and others, in the BMNH collections. He noted that there were three species present, distinguished from each other by size, *P. pleydelli* having 'somewhat inferior dimensions' to *P. manseli,* and 'species c' considerably large size than either of the preceding forms'. Lydekker (1891, pp. 41–2) reinterpreted some of the bones he had earlier identified as metacarpals as pterosaur quadrates, and referred one of them to *Pterodactylus suprajurensis,* a species previously described from France. He also noted that *P. manseli* and *P. pleydelli* probably belonged to *Rhamphorhynchus.* Mansel-Pleydell (1888, p. 33) recorded that these specimens came from Kimmeridge, but Delair (1958, p. 70) confirmed Weymouth as the source. Wellnhofer (1978, p. 49) places the two Weymouth species in 'Pterodactylidae *incertae sedis',* but states that both were 'probably remains of rhamphorhynchids'. The lack of diagnostic skull, limb and vertebral .remains means that the Weymouth specimens cannot even be confidently assigned to one or other of the two suborders of Pterosauria.

Theropod dinosaurs are represented by a fragment of mcgalosaurid maxilla (Powell, 1988). The sauropod dinosaur *Pelorosaurus humerocristatus* was based on 'a very large saurian limb-bone adapted for progression upon land', a left humerus originally 1.5 m long (Hulke, 1874a). Lydekker (1888a, p. 152) also referred the dorsal portion of a right pubis from Weymouth to this species. Damon (1884, pp. 69, 77) mentioned specimens of *Gigantosaurus megalonyx* Seeley (1869) from the gritty clay bed (his bed 12) in the Kimmeridge Clay, and Delair (1959, p. 82) suggested that this could include the type humerus of *P. humerocristatus.*

Galton (1975, p. 745) described a dentary tooth from the Kimmeridge Clay of Weymouth (University of California Museum of Paleontology) as that of a hypsilophodontid. Later, he (1980b, p. 85) tentatively suggested that the locality assignment might be wrong because he had seen a strikingly similar tooth from the Late Cretaceous of Wyoming. A stegosaur vertebra (BMNH 15910) has been ascribed to *Dacentrurus armatus* (Galion, 1985b), a stegosaur well known from the Kimmeridge Clay elsewhere in England. This consists of the neural arch of a mid-caudal vertebra, and the short neural spine is a diagnostic character for the species.

The plesiosaur remains from Weymouth are generally isolated vertebrae and limb bones. Most have been ascribed to the cryptoclidid *Colymbosaurus trochanterius* (Owen, 1840), the best-known and most abundant Kimmeridgian plesiosauroid (Brown, 1981), which attained a maximum length of 6.6 m. Lydekker (1889a, p. 243) established the species *Cimoliasaurus brevtor* on the basis of six associated centra of immature middle cervical vertebrae from Weymouth; the relative length of the vertebrae was supposed to be diagnostic. Brown (1981, p. 322) noted this species as a *nomen dubium.* A third plesiosaur, represented by a fragmentary skull (BMNH R1798), consisting of an incomplete mandible, the squamosals, and fragments of the quadrates, jugals and postorbitals, was assigned to *Kimmerosaurus langhami* by Brown *et al.* (1986). The species had been named by Brown (1981) on the basis of a partial skull, from the Upper Kimmeridge Clay west of Freshwater Steps. Brown *et al.* (1986, p. 233) discuss the possibility that *Kimmerosaurus* might be synonymous with *Colymbosaurus,* which is the only other cryptoclidid known from the British Kimmeridgian, but the evidence for synonymy is ambivalent and both names are tentatively retained.

The pliosauroids are largely represented by vertebrae and teeth from Weymouth. These have been identified (Lydekker, 1889a, pp. 125, 128, 142, 147) as *Pliosaurus brachydeirus* and *Pliosaurus* sp., and some vertebrae as *Liopleurodon (Stretosaurus) macromerus.*

Ichthyosaurs are represented by abundant remains of vertebrae, limb bones, skull fragments and teeth that were ascribed to various species of *Ichthyosaurus'* by Lydekker (1889a, pp. 25, 27, 30, 35–40). The most complete specimen (BMNH 44637) consists of 40 vertebrae of a medium-sized individual (Lydekker, 1889a, p. 38). McGowan (1976, p. 670) regards *Macropterygius thyreospondylus* and *M. trigonus* as *taxa dubia* since they were based upon poor material. However, they may be definable (A. Kirton, pers. comm., 1981). Boulenger (1904b) named the new species *Ichthyosaurus extremus* on the basis of a right anterior paddle characterized by its great breadth and by the humerus contacting the wrist bone (the intermedium) directly, and Huene (1922, pp. 91, 97–8) assigned it to the new genus *Brachypterygius.* Boulenger (1904b) did not know its locality, but suggested, on H.B. Woodward's advice, that it came from the Lower Lias of Weston, Bath, while Andrews (1910, p. 54) proposed that it was of Kimmeridgian age. Delair (1960, pp. 68–9) pointed out the surprising fact that the label on the specimen clearly states its provenance as 'Kimmeridge Clay of Smalhnouth Sands'. Delair (1986, pp. 131–3) recognized that an isolated left forelimb in Woodspring Museum, Weston-super-Mare (WESTM 78/219) and the type specimen (BMNH R3177) in fact belonged to the same individual.

Comparison with other localities

Sites comparable to the Weymouth section, in having significant terrestrial faunas, include Swindon Brick and Tile Works (Lower Kimmeridge Clay) ([SU 142 838]; *Plesiochelys, Bothriospondylus, 'Megalosaurus*',*Dacentrurus armatus,* crocodiles, ichthyosaurs, plesiosaurs, pliosaurs); Chawley Brick Pit, Cumnor Hurst, near Oxford, Oxfordshire ([SP 475 043]; *Camptosaurus,* ichthyosaurs, plesiosaurs, pliosaurs); Ely, Cambridgeshire (probably one of several pits at [TL 555 808]; *Thalassemys, Pelorosaurus,* crocodiles, ichthyosaurs, plesiosaurs, pliosaurs); Wootton Bassett, Wiltshire ([SU 06 38]: *Dacentrurus armatus*) and Gillingham, Dorset ([ST 809 258]; *Dacentrurus armatus*).

Of the turtles, *Pelobatochelys* is known also from the Late Kimmeridgian of Encombe Bay (see below), but is restricted to Dorset. *Tropidemys* is known best from the Late Jurassic of Switzerland and Germany and *Eurysternum* from Bavaria and Switzerland (M■ynarski, 1976, p. 36). *Thalassemys,* a close relative, has been recorded from Devizes and Ely, as well as from localities in the Late Jurassic of Switzerland and Germany.

Various crocodiles are well represented at Kimmeridge Bay, Wootton Bassett, Swindon, Shotover Hill, Garsington, Cottenham and Ely. *Steneosaurus* and *Teleosaurus* are recorded from all stages of the Jurassic of Europe, *Dakosaurus*

from the Late Jurassic to Early Cretaceous of Europe, and *Metriorhynchus* from the Callovian–Kimmeridgian of England and France (Steel, 1973).

Pterosaurs are rare in the British Kimmeridgian. Specimens from Kimmeridge Bay have been identified as *'Rhamphorhynchus* sp.' and *Germanodactylus* sp., and one from Swindon as '*Ornithocheirus* sp.'. These, and other, Late Jurassic pterosaur genera are better known from sites in Germany, France, East Africa and Wyoming, but these overseas sites are younger.

The sauropod *Pelorosaurus* is known from the Kimmeridgian of Kimmeridge Bay (q.v.) and Cottenham, Stretham and Ely, Cambridgeshire. Various species have also been described from the Wealden of Sussex and the Isle of Wight, and from the Kimmeridgian of Boulogne-sur-Mer and Wimille (near Boulogne) (Steel, 1970, pp. 68, 70). *Dacentrurus* is better known from sites in the Kimmeridgian at Gillingham, Wootton Bassett and Swindon, but these are no longer accessible. A specimen from the Late Kimmeridgian of Le Havre, France was destroyed during World War 2 (Buffetaut *et al.,* 1991).

Most of the ichthyosaurs, plesiosaurs and pliosaurs from Weymouth are known from other British Kimmeridgian sites, so these will not be enumerated. The type of *K. langhami* and the only other referred material (BMNH R10042) is known only from Freshwater Steps [SY 924 773].

Conclusions

The Lower Kimmeridge Clay of the Smallmouth Sands section has yielded one of the most varied Kimmeridgian reptile faunas known. It is the best site for turtles (four species) and pterosaurs (three species). The material includes type specimens of one turtle, two pterosaurs, one sauropod, one ichthyosaur and one plesiosaur. *K. langhami* is only the second occurrence of a plesiosauroid from the British Kimmeridgian. One of the best sites in Europe for Kimmeridgian age terrestrial reptiles. The importance of this faunal richness and diversity combined with some potential for future finds give its considerable conservation value.

References