
Lydney, Gloucestershire

[SO 652 015]–[SO 655 023]

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Introduction

This site is situated on the north-west bank of the River Severn in Gloucestershire and extends northwards from Lydney Harbour [SO 652 015] to a point mid-way between Fairtide Rock [SO 655 021] and Cliff Farm [SO 656 025] (Figure 5.47). It consists of laterally extensive cliff and foreshore sections in the uppermost part of the Raglan Mudstone Formation and the lowermost few metres of the St Maughans Formation. The Raglan Mudstone Formation is mostly of Pridoli (Silurian) age and the St Maughans Formation is Early Devonian (Lochkovian–Dittonian stage), with the Silurian-Devonian boundary thought to lie within the uppermost part of the Raglan Mudstone Formation. The locality has played a key role in establishing the extent of both fluvial and marine influences in the deposition of the Lower Old Red Sandstone, and includes a regionally important fish fauna, for which it is independently selected as a GCR site (Dineley and Metcalf, 1999). It is also one of only a few sites in the Anglo-Welsh Basin that has yielded modiolopsid bivalves at this stratigraphical level. In addition, the site contains several mature fossil soil carbonate (calcrete) profiles, including the regionally important Psammosteus Limestone (the Bishop's Frome Limestone of the Welsh Borderland and the Chapel Point Calcretes Member of Pembrokeshire).

Description

The section was initially documented by Welch and Trotter (1961), who described its geological context and identified the Psammosteus

Limestone. Subsequently, Allen (1964a) examined the locality in greater detail and recognized the palaeoenvironmental significance of a complex cyclothem, which contributed to the establishment of a fluvial, meandering stream model for the deposition of large parts of the Lower Old Red Sandstone. The limestones at the site were among those used to develop a model for soil carbonate (calcrete) formation in the Old Red Sandstone of the Anglo-Welsh Basin (Allen, 1974d).

Allen (1964a, 1971) placed the cyclothem he described, and thus a large part of the sequence at Lydney, in the St Maughans Formation. Later, however (Allen, 1974d, 1978b), he recognized that the cyclothem actually lies beneath the Psammosteus Limestone, which forms the topmost bed of the underlying Raglan Mudstone Formation. Confusion over the stratigraphical position of the cyclothem, and that of the associated fish faunas, has since been compounded by Dineley (1999e, fig. 3.19). He produced an erroneous composite section by combining two different versions (Allen, 1964a, fig. 5 and Allen, 1978b, fig. 34) of the same cyclothem, one of which he placed above the Psammosteus Limestone and the other beneath it.

The sequence is gently folded and cut by several NW-trending faults. Between two prominent faults ([SO 652 016]; [SO 655 023]), the first about 200 m north of the harbour wall, the topmost mudstones of the Raglan Mudstone Formation are downthrown to the level of the foreshore and can be examined in laterally continuous exposures over several hundred metres (Figure 5.47). The Psammosteus Limestone and a few metres of the overlying St Maughans Formation are well exposed above about halfway up the cliff face just to the north of Fairtide Rock.

The section in the Raglan Mudstone Formation is typical of the unit elsewhere in Wales and the Welsh Borderlands. It consists predominantly of thick, red, micaceous, calcretized mudstones and siltstones, interbedded with thin, very fine-grained sandstones. It is, however, notable at this site in containing bivalve molluscs, one of only a few occurrences known at this level (Barclay *et al.*, 1994). The bivalves (*Modiolopsis complanata* Sowerby var. *trimpleyensis* Reed) are preserved in abundance and in life position, most with their valves tightly closed, in two thin layers within a 5 m-thick interval of red, well-bedded, coarse siltstones on the foreshore not far beneath the Psammosteus Limestone (Allen,

1973a). Scattered fish debris and abundant sub-vertical burrows are also present. The bivalves were examined by Allen and a British Geological Survey party in 1980, but were not located during a visit to the site in 2000 and are now probably concealed beneath estuarine mud. Among the fish remains recovered from intraformational conglomerate layers, Dineley (1999e) lists the heterostracan *Tesseraspis tessellata* Wills and the unusual acanthodian *Sabrinacantbus arcuatus* Miles.

The cyclothem immediately below the Psammosteus Limestone consists of three facies arranged in a fining-upward sequence, and is best exposed on and around Fairtide Rock. The lowermost facies rests on a scoured surface of red silty mudstones with abundant calcrete nodules. It consists of finely interbedded pale green siltstones, some of which yield plant fragments, and white to green, fine- to coarse-grained lenticular sandstones. The sandstones have sharp bases, locally resting on erosion surfaces. They contain mudstone rip-up clasts, are cross-stratified, and have sharp, rippled or smooth tops. They are generally 5–25 cm thick and locally contain fish debris, *Pachytheca* and other carbonized plant fragments. These beds are sharply overlain by red, green and purple, micaceous, cross-bedded, fine- to medium-grained sandstones of the second facies. Most of the sets in this facies are planar, but some are contorted owing to extensive de-watering. This facies everywhere lies on a scoured surface, and locally, a 20 cm-thick intraformational conglomerate. The topmost facies comprises red, coarse-grained, micaceous siltstones interbedded with thin (less than 16 cm), red, mauve and white, ripple-bedded sandstones. The sandstones range from clayey and fine-grained to clean and medium-grained. Some of their tops are gradational, but all of their bases are sharp and some overlie surfaces with desiccation cracks. The top few metres of the cyclothem consist of red, clayey siltstones and sandy siltstones with abundant calcrete nodules, faint ripple-bedding and rare invertebrate burrows.

The cyclothem terminates at the base of a thin sandstone, 10.5 m beneath the base of the St Maughans Formation. Directional structures throughout the cyclothem consistently indicate palaeoflow from the north.

Above the cyclothem are 20 m of red mudstone containing six calcrete profiles, the first three of which are particularly mature. The first and third profiles comprise massive limestone beds, and the second profile (the Psammosteus Limestone) is especially thick (9 m). It shows a gradual upward increase in the size and density of calcrete nodules from small, sporadic nodules at the base to a persistent horizon of closely packed, crudely prismatic nodules at the top. The Psammosteus Limestone and several other calcrete profiles show superb examples of pseudo-anticlines and nodule fans (Figure 5.48). The most prominent forms have a regularly undulose top in which cusped or sharply rounded crests are separated by broadly rounded troughs on a scale of several metres. Within these 'folds', the calcrete nodules are arranged in fan-like arrays.

Interpretation

The locality provides an excellent section of the strata at the boundary between the Raglan Mudstone Formation (Downtonian) and the St Maughans Formation (Dittonian). The boundary corresponds to an important tectonically induced diastem, represented by basin shut-down and major pedogenic carbonate development, and which more-or-less coincides with a major faunal and facies change (Allen and Tarlo, 1963; Allen, 1985; Dineley, 1999e). The Raglan Mudstone Formation was deposited on extensive coastal mudflats traversed by sparse channels (Allen, 1985). The section at Lydney has played an important part in assessing the nature, extent and timing of marine influence on these mudflats, and the nature of the transition from the marine environments of late Silurian times to the terrestrial, continental environments of early Devonian times (Allen, 1985). It is one of a handful of occurrences in the Welsh Borderland that has yielded a low-diversity, brackish to marine bivalve mollusc fauna (Allen, 1973a; King, 1934) at this level. These faunas, which are now known to extend up into the lowermost part of the St Maughans Formation (Barclay *et al.*, 1994), record short-lived, but probably quite extensive, brackish-water incursions on to the coastal mudflats (Allen, 1973a).

Further evidence for marine influence in the deposition of the Raglan Mudstone Formation is afforded by the lowermost facies of the cyclothem at Lydney. It consists of rapid alternations of siltstone and lenticular sandstone, which, based on modern analogues, suggests deposition in a tidal river channel in which the freshwater was periodically backed up by advancing tides (Allen, 1964a). The overlying part of the cyclothem was probably deposited in a non-tidal, meandering river that migrated across, and incised into, the deposits of an earlier channel system, with the finer topmost beds representing overbank facies. This non-tidal part is typical of cyclothem elsewhere in the Lower Old Red Sandstone and

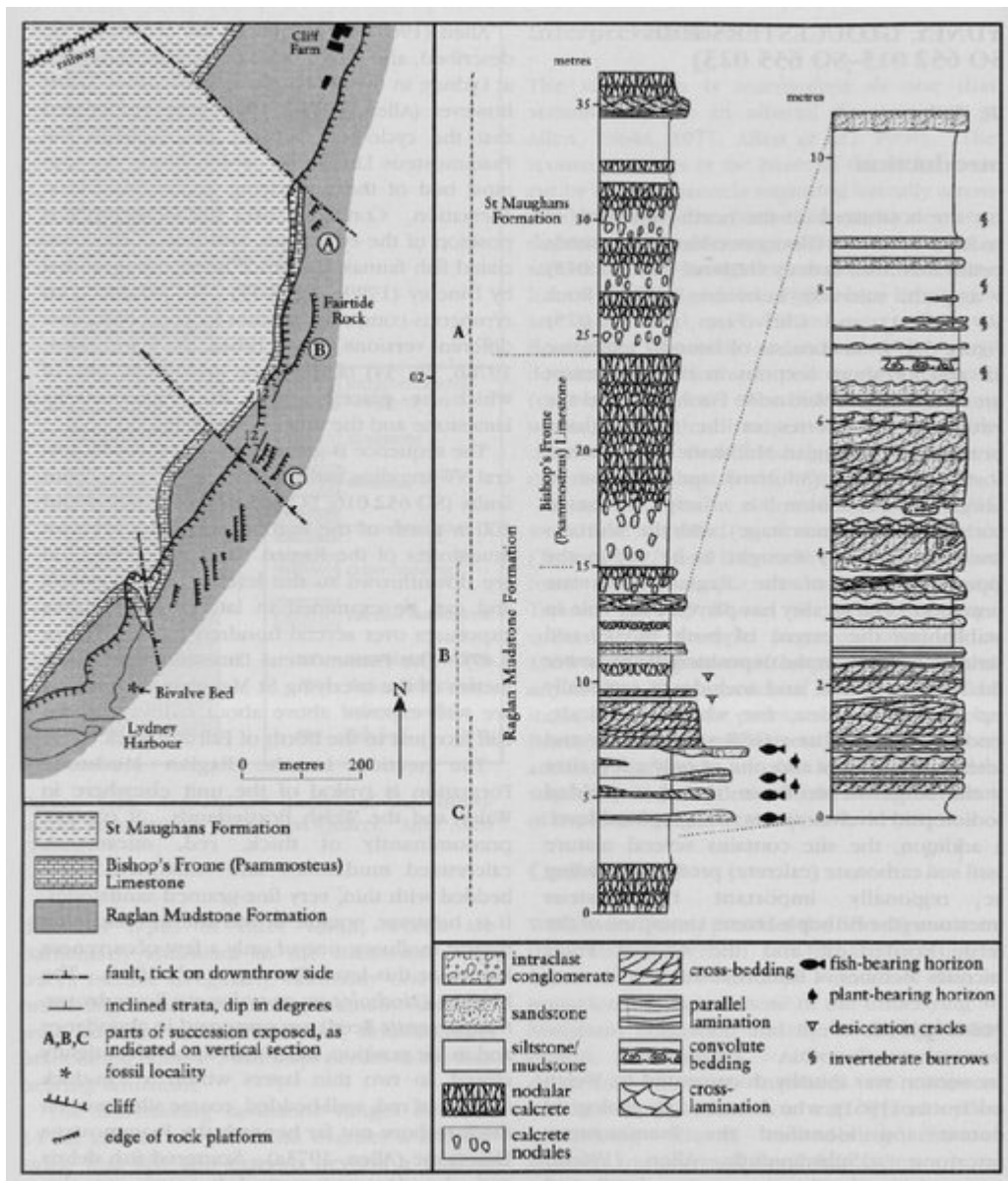
provides strong evidence for a fluvial origin of much of the sequence in the Anglo-Welsh Basin (Allen, 1964a).

The overlying calcrete profiles exhibit some of the best-developed pseudo-anticlines recorded from the Old Red Sandstone of Britain, comparable to those in Pembrokeshire. Lydney was one of five localities at which Allen (1974d) demonstrated a pedogenic origin for the limestones in the Old Red Sandstone of the Anglo-Welsh Basin. By comparison with modern examples, he concluded that they formed by replacive and displacive development of calcite in alluvial, floodplain muds. Pseudo-anticlines and related structures develop due to the swelling of the clay-rich sediment and the displacive growth of the calcite in response to seasonal wetting and drying (Allen, 1973b; 1974d, 1986). Allen (1974d, 1985) deduced that the climate in the Anglo-Welsh region during deposition of the Lower Old Red Sandstone was relatively warm (mean annual temperature of 16°–20°C), with low, seasonal rainfall averaging 100 mm to 500 mm per annum. He estimated that each calcrete profile records a period (and depositional break) of the general order of 10⁴ years. Marriott and Wright (2004) provide a more recent discussion of calcrete formation, which may have taken tens of thousands to millions of years. The Psammosteus Limestone at Lydney, as at other localities, is particularly mature and is notable for its considerable thickness. This, together with the incoming of thick sandstones above the limestone, suggests that it records a regional, tectonically controlled event that resulted in changes to the source and rate of sediment supply to the basin (Allen, 1985).

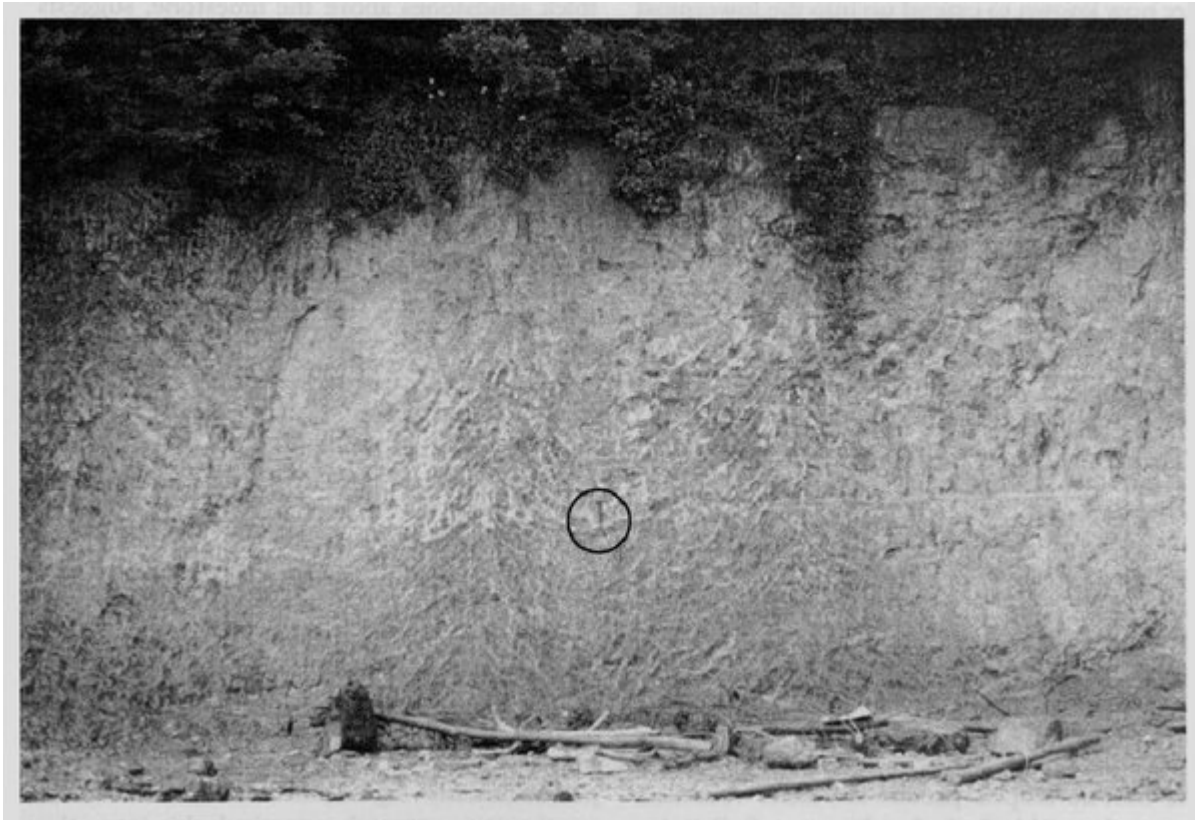
Conclusions

The riverside cliffs at Lydney provide one of the best and most accessible sections in the uppermost part of the Pridoli–Lower Devonian (Downtonian) Raglan Mudstone Formation. The beds comprise a basal complex sandstone body of intertidal origin, and pass up through fluvial sediments into a stacked series of calcrete profiles, including the regionally important Psammosteus Limestone. The site is important because of its role in helping to model the depositional environments of the Lower Old Red Sandstone, and in determining the degree of marine influence during the transition into the overlying, wholly terrestrial Old Red Sandstone facies. In addition, it has played a key role in understanding the genesis of fossil calcretes and their palaeoenvironmental and palaeoclimatic significance. It is a site of continuing research, particularly into the composition of its fish faunas.

[References](#)



(Figure 5.47) Geological sketch map of Lydney GCR site (inset) and composite vertical section of the strata exposed. Map after British Geological Survey 1:10 560 manuscript map SO 60SE (1973). Section based on Allen (1978b) and Dineley (1999e, fig. 3.19).



(Figure 5.48) Calcrete profile in the Psammosteus Limestone at Lydney showing pseudo-anticlinal structure. Hammer (circled) for scale. (Photo: P.R. Wilby.)