Prospect Quarry, Isle of Wight

[SZ 385 866]

Highlights

Prospect Quarry occurs entirely within the Bembridge Limestone and is the best locality for the study of calcretes within that unit. It is also the major Bembridge Limestone locality for fossil land snails.

Introduction

Prospect Quarry (Figure 5.34) is a small quarry in the Bembridge Limestone Formation, some 4.5 km east of Freshwater, Isle of Wight, at grid reference [SZ 385 866]. It is one of two remaining quarries of a number in the formation, including those referred to in White (1921, pp. 119–120). No Bembridge Limestone is visible at any of these other former quarry sites, except for Tapnell Farm Quarry [SZ 377 864] where part of the succession is still visible.

This quarry provides the best exposure in the Bembridge Limestone Formation of the pisolitic and laminated facies which are absent or poorly represented at other localities such as Gurnard Ledge (Thorness Bay) to the north and Whitecliff Bay to the east.

No mention of the quarry was made in White (1921) or earlier publications, since it was not opened until 1938 (Pain and Preece, 1968). Apart from the unpublished work of Edwards (1967), who briefly described the stratigraphy and lithologies present, the main interest in the quarry has reflected the molluscan fauna, in particular a diverse fauna of terrestrial gastropods (Pain and Preece, 1968; Jarzembowski, 1976; Preece, 1976). More recent research has centred on the sedimentology, following the recognition that the Bembridge Limestone here has been extensively calcretized (Armenteros *et al.,* 1992, 1997; Daley, 1999, pp. 60–61).

Description

The Bembridge Limestone is exposed in the western and northern part of the quarry in an approximately 40 m long face.

Lithological succession

The succession is up to 4 m in thickness but neither the top nor the bottom of the formation is exposed. The section appears to be in the lower part of the formation, stratigraphically below the muds found towards the middle of the formation at most other localities (Daley and Edwards, 1990). A variety of limestone lithologies are represented, including both well-indurated and soft, poorly lithified rocks (Figure 5.35).

Sedimentology and palaeopedology

Lithological relationships are complex and particularly appear to reflect pedogenic changes associated with calcrete development, whose recognition here has much wider palaeogeographical and palaeoclimatological significance. Certain thin horizons are characterized by irregular, crinkled and contorted laminations, some of which may represent calcified, pedogenic rootlet mats (Wright, 1989, fig. 12; Daley and Edwards, 1990). Some of the indurated limestones contain an ill-sorted mixture of peloidal and coated grains, including quite large pisoliths. Micrites, containing whole and fragmented shells, and intraclasts are also present. Small, soft pseudointraclasts represent remnants of primary lithologies. Contemporaneous breakage and solution added to the complexity. Hollows, veins and other spaces are sometimes filled with coarse sparry calcite or by various mixtures of intraclasts and coated grains. Such cavities are much larger than the 'pseudo-microkarst' features seen in the Bembridge Limestone Formation at Whitecliff Bay, but are probably analogous in origin. Recent work on Prospect Quarry by Armenteros *et al.* (1992, 1997) and Armenteros and Daley (1998) has involved both petrographic and stable isotope work which confirms that the succession here is predominantly of

pedogenic facies.

Macropalaeontology

Palaeontologically, the most important feature of the site is its terrestrial gastropod fauna. Pain and Preece (1968) described 12 terrestrial species from the quarry, whilst Preece (1976) listed a total of 25. Aquatic genera are also present, including pulmonates like *Galba* and *Planorbina,* but not in the profusion found, for example, at Whitecliff Bay. Calcareous ovoid-cylindrical trace fossils, once thought to be the eggs of land snails, may be chambers made by insects for pupation or by some unknown organism for hibernation or aestivation (Edwards *et al.,* 1998).

Interpretation and evaluation

Prospect Quarry is the largest of the two remaining inland quarries in the Bembridge Limestone. Although the sequence is incomplete, it exhibits a facies differing from those of Whitecliff Bay and Thorness Bay. Although the diagenetically complex lithologies present are comparable with some in the poorer exposures in Headon Hill and those formerly visible at Cliff End, they are only well exposed in Prospect Quarry.

Palaeogeographical context

Elsewhere in the local Palaeogene strata, the presence of rounded Upper Cretaceous flint pebbles is evidence that older rocks were being eroded during the Eocene. Contemporaneous weathering and soil formation at this site is further evidence of subaerial exposure. Although it has been speculated that the Chalk may have been exposed during the Eocene southwards of a line approximately corresponding to the Isle of Wight Monocline (Plint, 1983a, fig. 12), there is no isopachyte evidence for southward thinning of the Bembridge Limestone (Insole and Daley, 1985, text-fig. 23) to indicate a southerly basin margin. A southward transition to at least periodically subaerial conditions is, however, supported in Prospect Quarry by both palaeontological and lithological evidence.

Significance of the gastropod fauna

At all localities where the Bembridge Limestone is exposed, the presence of large numbers of air-breathing pulmonate gastropods, such as *Galba* in particular, provides evidence of the shallowness of the lake waters. Whilst Prospect Quarry is far less rich in such snails compared with Whitecliff Bay, it does have a considerable terrestrial gastropod fauna, presumably relatively locally derived, which is absent or poorly represented at the more northerly and easterly localities. Prospect Quarry, therefore, appears to reflect a lake margin (palustrine) environment, contrasting with the generally more open lake waters represented at such localities as Thorness and Whitecliff Bays.

Depositional environment

Since both *Galba* and *Planorbina* have little tolerance to even slightly saline waters, it must be assumed that the primary facies here are essentially freshwater in origin. There is, however, increasing evidence that the Bembridge Limestone 'lake' may have been less separate from more saline waters than had hitherto been thought. Part of this evidence comes from the investigations by Marshall *et al.* (1987, 1988) and Armenteros *et al.* (1992) of the distribution of the stable isotopes of C and O in the Bembridge Limestone of Prospect Quarry. Their distribution is complicated, reflecting both depositional, pedogenic and later diagenetic calcite formations, but some of the diagenetic fluids appear to have included a component of marine and/or brackish waters. This is compatible with the findings of Murray and Wright (1974) whose work on Palaeogene foraminifera revealed the presence of marine elements in the Bembridge Limestone, the recognition by Daley and Edwards (1990) that the presence of hydrobiids at certain horizons in the formation implies some degree of brackishness, and with the occurrence of microlenticular gypsum in the Gurnard section (Daley, 1989).

Pedogenesis

The existence of emergent conditions inferred from the nature of the gastropod fauna, is well supported by the particularly fine development of pedogenic facies which dominates the Prospect Quarry sections. Marshall *et al.* (1987,

1988) concluded that the site contained at least seven pedogenic profiles. They identified a number of pedogenic fabrics indicative of calcrete development, a conclusion confirmed by the later, more detailed work of Armenteros *et al.* (1992) and Armenteros *et al.* (1997). The latter authors considered that the few remnants of primary facies probably represented areas that were intermittently water-covered and marshy. Such areas were repeatedly subaerially exposed and subject to pedogenic modification (see Armenteros and Daley (1998) for a detailed description and interpretation). The superimposition of successive pedogenic phases has hindered interpretation and has led to the almost complete obliteration of the primary facies.

Palaeoclimatology

The recognition of calcrete at Prospect Quarry and the consequent inference of dry climatic conditions is compatible with the presence of the thick evaporites of the Gypse in the Paris Basin to the south, with which the Bembridge Limestone has been correlated (Curry *et al.,* 1978). It supports the idea that the former belief in the continuity of humid tropical to subtropical climatic conditions during the Palaeogene is unsustainable. However, recent work on the Bembridge Limestone of Headon Hill by Hooker *et al.* (1995) clearly indicates that there were phases of forest and woodland development and consequently wetter periods. Whilst these authors (p. 450) suggest that their samples are from higher in the succession, the likelihood of wetter phases at the time represented by the Prospect Quarry section may be inferred from the terrestrial gastropod fauna since, according to Preece (1980, p. 178), many land snails are shade-demanding and may indicate the proximity of forest. Consequently, with the lithological evidence for alternating deposition and pedogenic modification (including dissolution), it may reasonably be concluded that the succession represents an alternation of wetter and drier climatic phases.

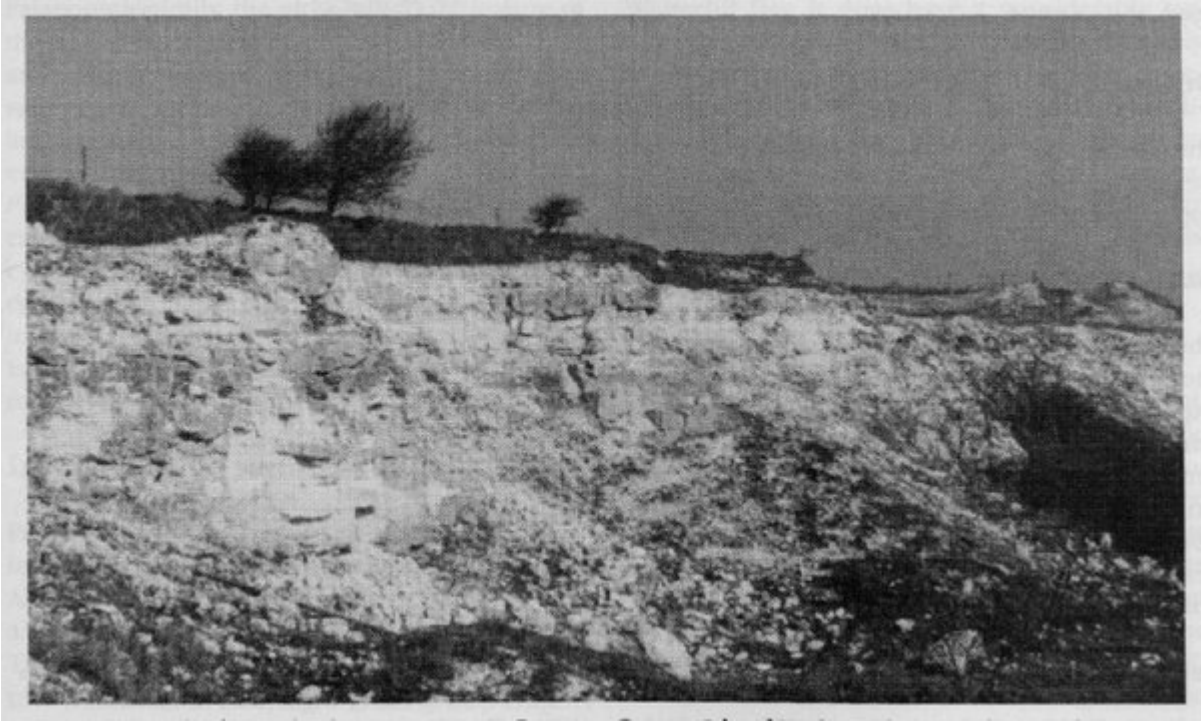
Conclusions

Although no complete succession of the Bembridge Limestone occurs at Prospect Quarry, the locality is palaeontologically and lithologically significantly different from other major localities where the formation is exposed.

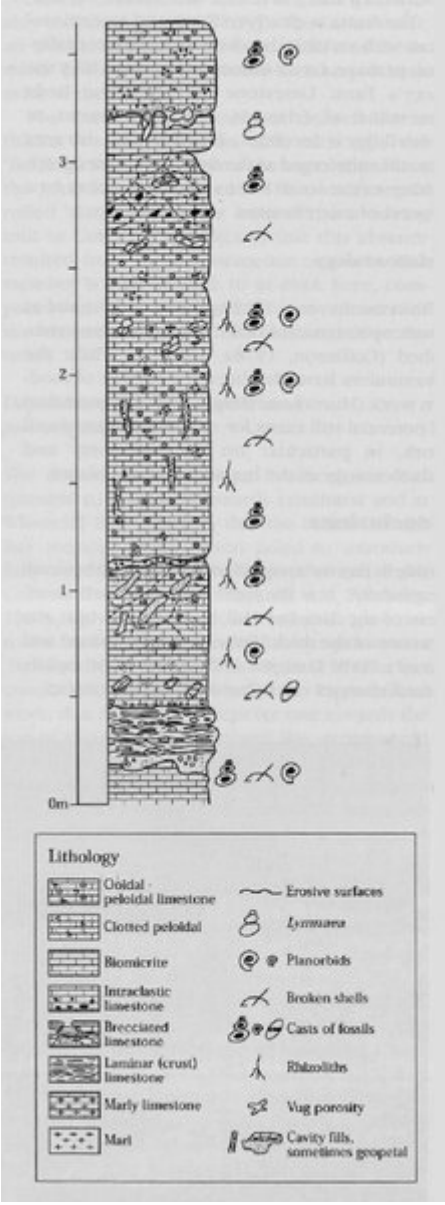
This site represents lake margin (palustrine) and emergent facies of the formation. Land gastropods are much more important here than at any other locality where the formation outcrops. Whilst the original carbonate sediments accumulated in freshwater, isotopic studies suggest the proximity of more saline waters which, together with evidence derived from other localities, calls into question to what extent the Bembridge Limestone 'lake' was separated from coeval brackish or more marine waters.

The recognition that repeated pedogenic modification led to the development of calcretes suggests that the climate was periodically dry whilst the common occurrence of land gastropods appears to indicate the existence of wetter conditions. It therefore seems likely that the succession represents an alternation of drier and wetter climatic phases.

References



(Figure 5.34) Bembridge Limestone in Prospect Quarry, Isle of Wight. (Photograph: B. Daley.)



(Figure 5.35) Bembridge Limestone succession in Prospect Quarry, Isle of Wight (after Armenteros et al., 1997).