Humphrey Head, Cumbria

[SD 392 737]–[SD 391 747]

Introduction

Situated on the western side of the Kent Estuary, 8 km SSW of Grange-over-Sands, Humphrey Head [SD 393 740] offers one of the most important and fossiliferous sections of the Upper Urswick Limestone (Asbian, D_1) and the lower Gleaston Formation (Brigantian, D_2) in south Cumbria. Close to the base of the Gleaston Formation is an exceptional development of the 'Girvanella Nodular Bed', an oncoid horizon described by Garwood (1913, 1916) as the finest of its type in northern England. The sequence was deposited on a carbonate platform overlying the Lake District Block some 15 km from the NE–SW-trending platform margin bordering the Lancaster Fells Basin to the south-east (Horbury, 1989). The most informative accounts of the site geology are provided by Garwood (1913), Rose and Dunham (1977), Horbury (1987) and Johnson *et al.* (2001).

Description

Exposure at this site is largely confined to the coastal outcrops that extend down the east side of the Humphrey Head peninsula from the eastern end of Pigeon Cote Lane [SD 391 747] south to Humphrey Head Point [SD 392 732] and up the west side of the peninsula to the southern end of Holy Well Lane [SD 391 740]. Exposure then continues as an inland cliff along the east side of Holy Well Lane to the western end of Pigeon Cote Lane [SD 388 747].

The Upper Urswick Limestone and lower Gleaston Formation are best exposed on the eastern side of the peninsula where the succession dips moderately to the east at 25°. Here, in a strike-section along the shoreline, the junction between the two formations can be traced almost continuously for a distance of approximately 500 m, with the Urswick Limestone cropping out in small cliffs at the top of the beach and the Gleaston Formation in the lower foreshore area. Minor displacements of the boundary between the two formations are caused by a number of small NW–SE-trending faults. On the western side of Humphrey Head the eastern branch of the Humphrey Head Fault forms a prominent haematite-stained N–S- trending fault scarp in the Urswick Limestone. To the west of this fault, on its downthrow side, further exposures of the Gleaston Formation crop out on the shore near Holy Well.

The Urswick Limestone at this site comprises a varied sequence of pale, bioclastic and rubbly bedded limestones. A detailed log of the sequence is provided by Horbury (1987) who records a 26 m section, the lower part of which is dominated by grainy bioclastic limestones with disarticulated productoids, rolled solitary corals and some colonial corals, palaeokarsts and rhizocretions. In its upper part, disarticulated productoids and rolled solitary corals are less common and zones of intense bioturbation mottling (*Thalassinoides* burrows) and pressure solution give the limestone a distinctive rubbly or 'pseudobrecciated' texture. The upper part of the Urwick Limestone contains the distinctive Asbian (D_1) brachiopod *Davidsonina septosa,* and at its top, downward-penetrating rhizocretions associated with a prominent palaeokarst indicate a period of emergence. Another bed of *D. septosa* 15 m from the top of the sequence is the likely equivalent of the 'Cyrtina' septosa Band recorded by Garwood (1913) from beneath the Girvanella Nodular Bed at Humphrey Head. A sparse coral–brachiopod fauna recorded from the topmost 5.7 m of the Urswick Limestone by Rose and Dunham (1977) includes *Siphonodendron junceum, S. pauciradiale, S. martini, Lithostrotion portlocki,* '*Caninia*'*juddi* and *Linoprotonia hemisphaerica*; the latter concentrated in a 30 cm band, 2 m from the top of the sequence.

The overlying Gleaston Formation (11 m), in contrast to the Urswick Limestone, comprises darker, thinly bedded, argillaceous limestones that are locally very fossiliferous; and towards its base, the formation is said to contain mega-ripples (N. Riley, pers. comm., 2002). About 7 m above the base is the Girvanella Nodular Bed of Garwood (1913), a 90 cm-thick development containing abundant spherical, oval and kidney-shaped oncoids (Figure 4.13). Typically these microbial algal') structures are 2–3 cm in diameter and consist of irregular laminae containing *Girvanella* concentrically arranged around a brachiopod or coral fragment nucleus. Encrustations of tabuliporoid and fistuliporoid bryozoans occur sandwiched between the laminae of some oncoids. A rich fauna dominated by corals is associated with the Girvanella

Nodular Bed and the 60 cm interval immediately above it (which also contains '*Girvanella*'nodules) (Rose and Dunham, 1977). These include *Dibunophyllum bipartitum, Clisiophyllum keyserlingi, Axophyllum vaughani, Siphonodendron junceum, S. pauciradiale, S. martini, Diphyphyllum lateseptatum, Lithostrotion portlocki* and *Pugilis?,* many of which are common in the Brigantian (D_2) successions of northern England. Garwood (1913, 1916) also recorded an extensive D_2 fauna from these beds, including *Aulophyllum fungites* (now *A. pachyendothecum*)and reef-like masses of '*Lithostrotion*', *Actinocyathus* '*Lonsdaleia*' *floriformis* and *Palastraea regia*;the occurrence of *Siphonodendron* colonies in abundance immediately below the Girvanella Nodular Bed may indicate the position of Garwood's 'reef-like' coral development. An additional record of significance from the Girvanella Nodular Bed is the discovery of *Aphralysia carbonaria* first reported by Garwood (1914).

Other taxa from Gleaston Formation beds beneath the Girvanella Nodular Bed include *Productus hispidus* and the typical Brigantian (13_2) corals *Lonsdaleia duplicata* and *L. alstonensis,* while abundant *Saccaminopsis* is found above the Girvanella Nodular Bed, 35 cm from the top of the exposed sequence (Rose and Dunham, 1977). A 'Stick Bed' (*c.* 1 m) recorded by Rose and Dunham (1977) and containing 'worm burrows' 2 in above the base of the formation resembles some of the bioturbated beds near the top of the Urswick Limestone recorded by Hoibury (1987).

Interpretation

In establishing the zonal sequence for Lower Carboniferous rocks in north-west England, Garwood (1913) took the Girvanella Nodular Bed as a marker for the base of the Upper *Dibunophyllum* (D_2) Subzone, a subzone originally defined by Vaughan (1905) in south-west England (see Avon Gorge GCR site report, Chapter 9). However, the recognition of typical D2 (Brigantian) faunas below the Girvanella Nodular Bed at a number of sites in northern England, including this site (Miller and Turner, 1931; Hudson, 1938a; Burgess and Mitchell, 1976), enabled George *et al.* (1976) and Rose and Dunham (1977) to establish the D_1–D_2 sub-zone boundary (= Asbian–Brigantian stage boundary) slightly lower in the sequence at the junction between the Urswick Limestone and the Gleaston Formation. Rose and Dunham (1977) equated those beds of the Gleaston Formation below the Girvanella Nodular Bed at Humphrey Head with the Lower Hawes Limestone of the Askrigg Block, and those from the base of the Girvanella Nodular Bed to the top of the section with the Upper Hawes Limestone.

Horbury (1989) regarded the Urswick Limestone as the product of four tectonically generated shoaling-upward cycles that resulted from alternating phases of rapid and slow but steady subsidence, onto which were superimposed the effects of a smaller scale glacio-eustatically controlled cyclicity. Seen in this context, the lower beds of the Urswick Limestone at this site are considered as part of a high-energy, shallow-water carbonate sand-body (Fades 2 of Horbury, 1989) with a depositional relief of approximately 10 m that developed on the Lake District carbonate platform as it slowly subsided, while the upper beds of the Urswick Limestone are considered as a sub-fair-weather wave-base facies (Facies 1 of Horbury, 1989) that formed as the platform subsided more rapidly. Rhizocretions and palaeokarsts at different levels in the sequence were produced during glacio-eustatically controlled regressive episodes of platform emergence (Horbury, 1989).

In addition to the faunal changes noted above, the Asbian–Brigantian stage boundary is also characterized by a distinctive lithofacies change as the dominantly pale massive Urswick Limestone gives way to the highly variable, darker (muddier) and sometimes sandy facies of 'Yoredale' aspect in the Gleaston Formation (Mitchell, 1978). Although a detailed sedimentological appraisal of this formation has yet to be undertaken, the association of oncoids (the Girvanella Nodular Bed), rich coral faunas and argillaceous limestones suggests deposition in a shallow subtidal environment on a carbonate platform that was, most probably, subsiding quite rapidly. Furthermore, in comparing the Brigantian sequences of south Cumbria with those in other areas in Britain and in Derbyshire in particular, Adams *et al.* (1990) intimated that regional variations in thickness may be attributed to penecontemporaneous tectonic activity (including fault re-activation) that resulted in the dissection and collapse of the platform and the generation of 'intra-shelf basins'. Thus the Brigantian rocks at Humphrey Head may be regarded as the deposits of a sub-basin with a development history that was distinctly different to others on the platform.

Conclusions

This site provides an outstanding section of the Upper Urswick Limestone (late Asbian, D_1) and lower Gleaston Formation (early Brigantian, D_2), one of the finest stage boundary sections in south Cumbria, and arguably the most spectacular exposure of the Girvanella Nodular Bed in Britain. The sequence was deposited in a variety of dominantly shallow and subtidal marine environments on the Lake District carbonate platform as it subsided during the later part of Asbian and in early Brigantian times. The occurrence of rich fossil assemblages and a range of rock types, especially in the poorly understood Gleaston Formation, highlights the value of this site to future palaeontological and sedimentological research.

References

(Figure 4.13) Bedding-plane view of Garwood's (1913) Girvanella Nodular Bed near the base of the Gleaston Formation (Brigantian) at the Humphrey Head GCR site. (Photo: P.J. Cossey.)