Whitberry Burn, Cumbria

[NY 523 740]–[NY 519 741]

Introduction

Located approximately 4 km west of Bewcastle, the Whitberry Burn GCR site [NY 5226 7404]–[NY 5194 7408], provides an outstanding section that extends from the upper part of the Main Algal Formation through the Cambeck Formation and into the lower strata of the overlying Middle Border Group (all within the Holkerian Stage). The site provides the most complete section through the Cambeck Formation, the uppermost formation of the Lower Border Group. It also provides important sections of the Barron's Pike Sandstone Member, Syringothyris Limestone Member, Hillend Algal Member, and Whitberry Member (type locality). These horizons have featured in local and regional correlations of the Lower Border Group and in the application of chronostratigraphical stages to the Bewcastle sequence (Garwood, 1931; Lumsden, 1967a; Day, 1970; Ramsbottom, 1973; George *et al.,* 1976).

Description

The Whitberry Burn succession (see (Figure 3.14)) lies on the western limb of the Bewcastle Anticline and dips steeply to the WNW (Day, 1970). The oldest bed exposed within the site is the Main Algal 12 Member, which crops out at the eastern boundary. Above this, exposure of the upper part of the Main Algal Formation and the lower part of the Cambeck Formation is poor, with approximately 40 m of section unexposed, including the lower third of the Barron's Pike Sandstone Member. The remaining 165 m of the Cambeck Formation and 131 m of the Middle Border Group comprise alternations of limestone, sandstone and shaly siltstone (Day, 1970). Limestones are mostly wackestones and packstones with brachiopods, crinoids, fossil fragments and ostracodes in variable proportions. Some of the limestones yield faunas dominated by bivalves (Day, 1970). The Upper Antiquatonia Member is lithologically similar to the underlying Lower Antiquatonia Member (see Birky Cleugh GCR site report, this chapter), being composed of alternations of shaly siltstones and limestones, the latter mostly wackestones and packstones dominated by brachiopod and crinoid remains. Individual limestone units within the member are up to 4 m thick. A few algal horizons are also known within the Cambeck Formation at this locality. The Hillend Algal Member, for example, is a 1.5 m-thick wackestone with oncoids of up to 5 cm in diameter, calcareous algae, ostracodes and finely comminuted skeletal debris. Other limestone units Include the Syringothyris Limestone Member, a skeletal packstone similar to others in the formation except for the presence of common whole *Syringothyris exoleta* and *Schucbertella ambigua,* and the Whitberry Member, 3.5 m of calcareous shale characterized by abundant *Rugosochonetes cumbriensis,* defining the base of the Middle Border Group. The rest of the sequence is composed of shaly siltstones (some calcareous with a marine fauna, some containing plant fragments), and medium-grained sandstones. Coarsening-upward and fining-upward sandstone units occur, some micaceous, and there is evidence of ripples, cross-stratification and rootlets. The sandstones generally range in thickness up to 4 m, except for a thick interval (*c.* 35 m) at the western limit of the site, and the Barron's Pike Sandstone Member, the incomplete exposure of which reaches approximately 15 m. The petrography of the several sandstone units in Whitberry Burn, including the Barron's Pike Sandstone Member, is considered in detail by Harrison (in Day, 1970).

Interpretation

The section in Whitberry Burn has played a significant role in establishing correlations within the Northumberland Trough, especially in attempts to establish the relationship between the sequences in the Bewcastle area and the Fell Sandstone Group to the east. Garwood (1931), for example, suggested that 'the sandstone which crops out above the Chonetes cumbriensis Band in Whitberry Burn [i.e. above the Whitberry Member] may represent the Fell Sandstone', and correlated the Hillend Algal Member with algal horizons In the Kershopefoot, Coomsden Burn (Redesdale), Kielder and Rothbury areas. Lumsden *et al.* (1967) correlated the Syringo-thyris Limestone Member with the Harden Member in the Newcastleton area. Ramsbottom (1973) took the Hillend Algal Member as the top of his Major Cyde 2 regression. Following this, George *et al.* (1976) correlated the Cambeck Formation with the Southerness Limestone Formation to the

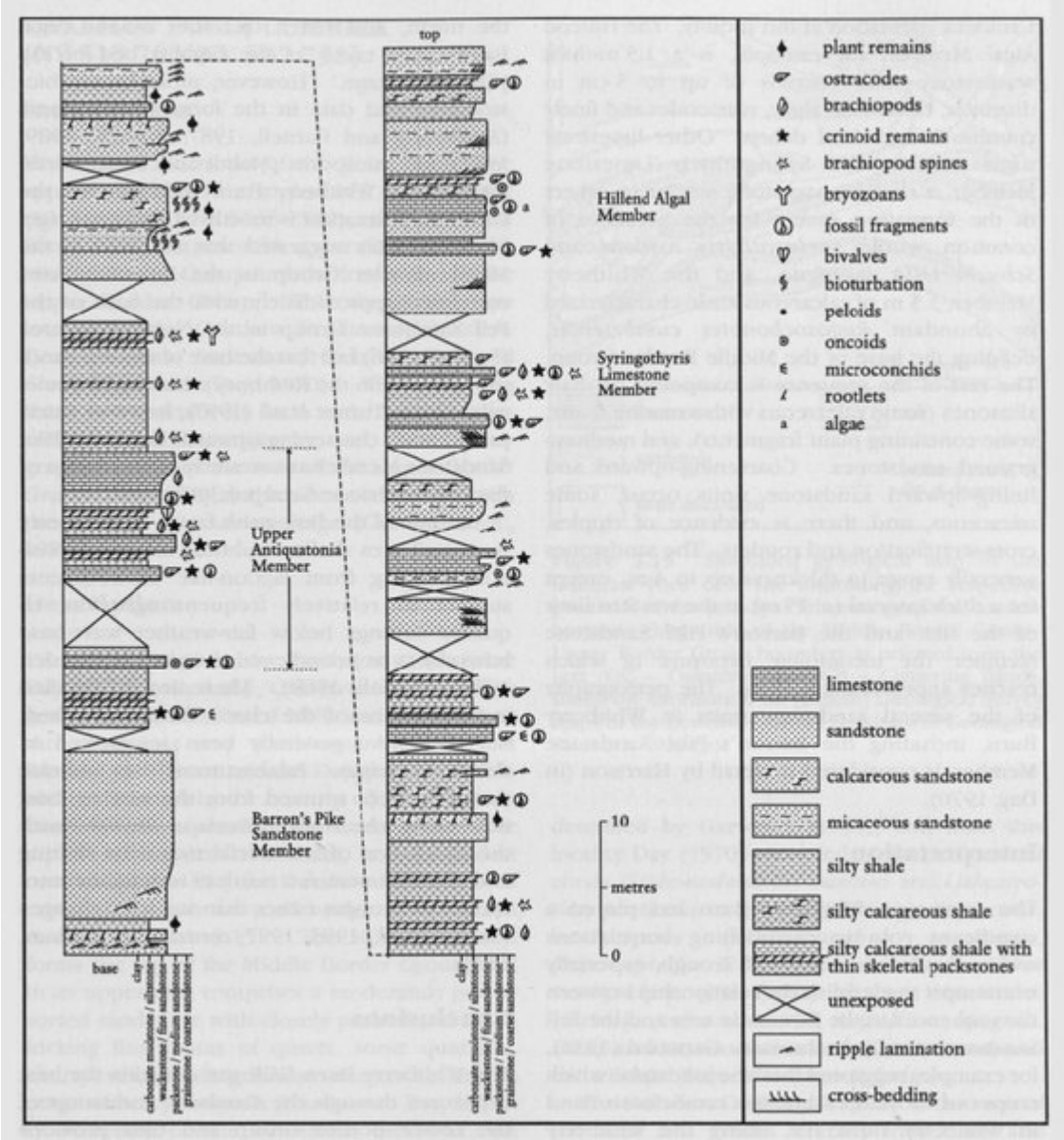
west (see Kirkbean GCR site report, this chapter) and the Harden Member to the north, and stated that the 'Hillend Algal Band … is taken as the highest bed of the [Chadian] stage.' However, more recent biostratigraphical data in the form of conodonts (Armstrong and Purnell, 1987; Purnell, 1989, 1992) and miospores (Mandi and Butterworth, 1994) from Whitberry Burn indicate that the Cambeck Formation is mostly of Holkerian age. Purnell (1989) suggested that the base of the Middle Border Group in the Bewcastle area correlated approximately with the base of the Fell Sandstone Group in the North Tyne area (Fowler, 1966) but that the base of the Fell Sandstone Group in the Rothbury area may be somewhat older. Turner *et al.* (1997), however, interpreted the coarsening-upward Barron's Pike Sandstone Member as a westerly progradation of the Fell Sandstone Group delta system.

Analysis of the limestone facies in Whitberry Burn indicates shallow subtidal marine deposition, ranging from lagoon-like environments subject to relatively frequent agitation, to quieter settings below fair-weather wave-base but subject to periodic storm agitation (Leeder, 1975b; Purnell, 1989). There are no detailed interpretations of the clastic facies published, but they have generally been interpreted as deltaic in origin. Palaeocurrent data indicate that they were sourced from the east by axial flow along the Northumberland Trough, with the alternation of facies reflecting delta shifting and abandonment as a result of tectonic or auto-cyclic mechanisms rather than sea-level changes (Turner *et al,* 1993, 1997; *contra* Ramsbottom, 1973).

Conclusions

The Whitberry Burn GCR site contains the best exposures through the Cambeck Formation of the Lower Border Group and thus provides important data for lithostratigraphical and biostratigraphical correlation, and for the interpretation of the palaeogeography, depositional environments and evolution of the Northumberland Trough during the Holkerian Age. As the type section of the Whitberry Member, the base of the Middle Border Group is defined in the Whitberry Burn sequence. Furthermore, several other marker horizons crop out that have been of critical importance in the development of lithostratigraphical schemes and sedimentological models within the Northumberland Trough.

References



(Figure 3.14) Sedimentary log of the Cambeck Formation (Lower Border Group) at Whitberry Burn extending from the Barron's Pike Sandstone Member to the Hillend Algal Member.