Redesdale Ironstone Quarry, Northumberland

[NY 897 830]

Introduction

Located 6 km east of Bellingham, in the heart of the Northumberland Basin, the Redesdale Ironstone Quarry GCR site [NY 8965 8295] provides an outstanding section through the highly fossiliferous Redesdale Ironstone Shale and the overlying Redesdale Limestone, one of the finest mid-Asbian sections in northern England. The Redesdale Limestone is taken locally as the boundary between the Upper Border Group and overlying Lower Liddesdale Group, and its development marks the onset of Yoredale cyclicity in the North Tyne area. The site has an international reputation for the rich diversity and fine preservation of its fossils, and is of critical importance to the correlation of Asbian successions throughout the Northumberland Basin. Early descriptions of the Redesdale succession are provided by Lebour (1873) and Smith, S. (1910) who added a substantial amount of palaeontological detail. Further information on the Redesdale Limestone is provided by Frost (1969), while a comprehensive account of the Redesdale Ironstone Shale is given by Hemingway (1972). Specific locality details are best described by Frost and Holliday (1980).

Description

The site forms part of a complex of old workings which last saw active service during the 19th century when the Redesdale area was a thriving centre for the extraction of ironstone. Outcrops are confined to the eastern side of the site, with the best sections occurring towards the centre of the quarry face. A summary log of the succession is presented in (Figure 3.16).

The Redesdale Ironstone Shale consists of a 9 m-thick sequence of shale with scattered nodules of concretionary ironstone (siderite). The elongate nodules range in size up to 35 cm and weigh up to 23 kg. Laterally, some nodules coalesce to form irregular ironstone layers but the combined thickness of ironstone is less than 10% of the unit. Details of the petrography and petrogenesis of the ironstones are provided by Hemingway (1972). The unit is extremely fossiliferous and celebrated for the fine preservation of its faunas. Common elements of the fauna include brachiopods, bivalves, crinoids and bryozoans, but other groups, including possible algae, foraminifera, sponges, conularids, serpulids, gastropods, nautiloids, goniatites, ostracodes, trilobites, palaeoniscid and bradyodont fish are also represented. Well-preserved wood fragments in carbonaceous bands have also been reported, but corals, phyllocarids and echinoids are rare.

Although fossils occur throughout the unit, they are more commonly found concentrated in thin shell layers. Occasionally they are found in the ironstones. A distinctive ferruginous shelly limestone, typically less than 25 cm thick and known as the 'Shell Band', occurs towards the middle of the sequence. This band, originally used by miners to subdivide the ironstone beds into lower and upper units (Hemingway, 1972), was discarded during mining operations on account of its high lime content and consigned to the spoil tips where it can still be found today. Three other fossiliferous horizons, each no more than 5 cm thick, occur in the 50 cm of shale immediately overlying this band (Hemingway, 1972).

Lebour (1886a) and Smith, S. (1910) recorded close to 100 species from the Redesdale Ironstone Shale and the sequence is a well-known source of type, figured and cited material (Hind, 1896–1905; Lee, 1912; North, 1920; Jackson, 1926; Muir-Wood, 1928; Wright, 1950–1960; Wilson, 1959; Brand, 1972). Frost and Holliday (1980) described the typical bryozoan, brachiopod and bivalve fauna as including *Fenestella* spp., *Stenodiscus redesdalense, Composita ambigua, Leptagonia caledonica, Pugilis scoticus, Punctospirifer redesdalense, Actinopteria persulcata, Nuculopsis gibbosa, Phestia attenuata* and *Streblopteria? redesdalense.*

Details of the taphonomy of the Shell Band were considered by Hemingway (1972) who noted the delicate preservation of many shell structures. Although bioerosion and predation marks were observed on some shells, the majority showed no sign of any shell damage or abrasion. Many of the shells appeared to be complete and uncrushed while others

possessed delicate encrustations. In consideration of these features, Hemingway (1972) concluded that the assemblage was largely autochthonous and that the fauna represented a thriving mixed community that developed on and within a clay substrate in an open, well-oxygenated, low-energy environment.

Separating the Redesdale Ironstone Shale from the Redesdale Limestone is a 2.5 m-thick interbedded sequence of shale and sandstone (Figure 3.16) and (Figure 3.17) containing trace fossils (Lees, 1991). A prominent cross-stratified sandstone from this interval occurs towards the northern end of the site and indicates a palaeocurrent flow from the north.

The Redesdale Limestone comprises 3.2 m of interbedded limestone and mudstone (Frost and Holliday, 1980) with a prominent and partly dolomitic limestone at its base containing corals and brachiopods in abundance including *Siphonodendron junceum* and *Gigantoproductus.* The corals *Lithostrotion, Syringopora* and other species of *Siphonodendron* also occur at this level. Detailed faunal lists prepared by Frost (1969) for this unit included the typical D_1 corals *Palaeosmilia murchisoni, S. junceum, L. decipiens* and *Dibunophyllum* c.f. *bourtonense.* The same author also provided details of the microfaunas (foraminifera and ostracodes) recorded both from the Redesdale Limestone and from the overlying shales.

Interpretation

The Redesdale succession occupies a pivotal position at the centre of the Northumberland Basin and has therefore been crucial to the correlation of sequences between the Tweed Basin and Cheviot Block areas to the north and the Solway Basin to the west. However, because of dramatic lateral facies change, discontinuous exposure, structural complexities and poor biostratigraphical control, the correlation of the Redesdale succession with those in neighbouring areas has, over the years, proved to be problematical.

On the basis that it represented the lowest distinctive and mappable marine limestone with Lower *Dibunophyllum* (D_1) Zone faunas, the Redesdale Limestone was taken by early workers to mark the base of the Lower Liddesdale (Lower Limestone) Group in the North Tyne area and the lateral equivalent of the Dun Limestone to the north-east (Miller, 1887; Fowler, 1926, 1936) and the Naworth Limestone to the west (Miller, 1887; Smith, S., 1910; Trotter and Hollingworth, 1932; Frost, 1969). Its correlation to the northeast was questioned by Anderson (in Carruthers, 1929, 1930, 1931) and Fowler (1966) as it became clear that the onset of marine sedimentation at the base of the Lower Limestone Group began much later in north Northumberland than it did in the North Tyne area. The Dun Limestone was therefore considered to be at a higher stratigraphical level than that of the Redesdale Limestone. In supporting this view, and in recognition of the obvious diachronous nature of the boundary between the Scremerston Coal Group and the Lower Limestone Group, Frost (1969) questioned the validity of using these divisions as chronostratigraphical units, but argued for their retention as useful lithostratigraphical terms.

As a result of the discovery of D_1 faunas in the Piper's Cross Limestone and Plashetts Dun Limestone (Robinson in Weston *et al.*, 1955), respectively 300 m and 440 m below the level of the Redesdale Limestone in the North Tyne area, the suggested correlation of the Redesdale Limestone and Naworth Limestone has also been called into question (Fowler, 1966; Ramsbottom in discussion of Frost, 1969; Day, 1970). While accepting that this discovery and foraminiferal evidence from the Archerbeck Borehole (George *et al.*, 1976) required the lowering of the base of the D_1 Zone to include the whole of the Upper Border Group, Frost and Holliday (1980) equated the Piper's Cross Limestone with the Redesdale Limestone, and the Naworth Limestone with the Fourlaws Limestone, thus confirming the earlier held view of Frost (1969) that the Redesdale Limestone, if not the exact equivalent of the Naworth Limestone, was 'stratigraphically fairly close' to it (see (Figure 3.3)). Despite these correlation problems, the Redesdale succession is now widely accepted as being of Asbian (D_1) age. This is confirmed by the occurrence of the typical Asbian faunas referred to above and by the discovery of the B Zone goniatite *Beyrichoceratoides redesdalense* from the Redesdale Ironstone Shale (Delepine, 1940).

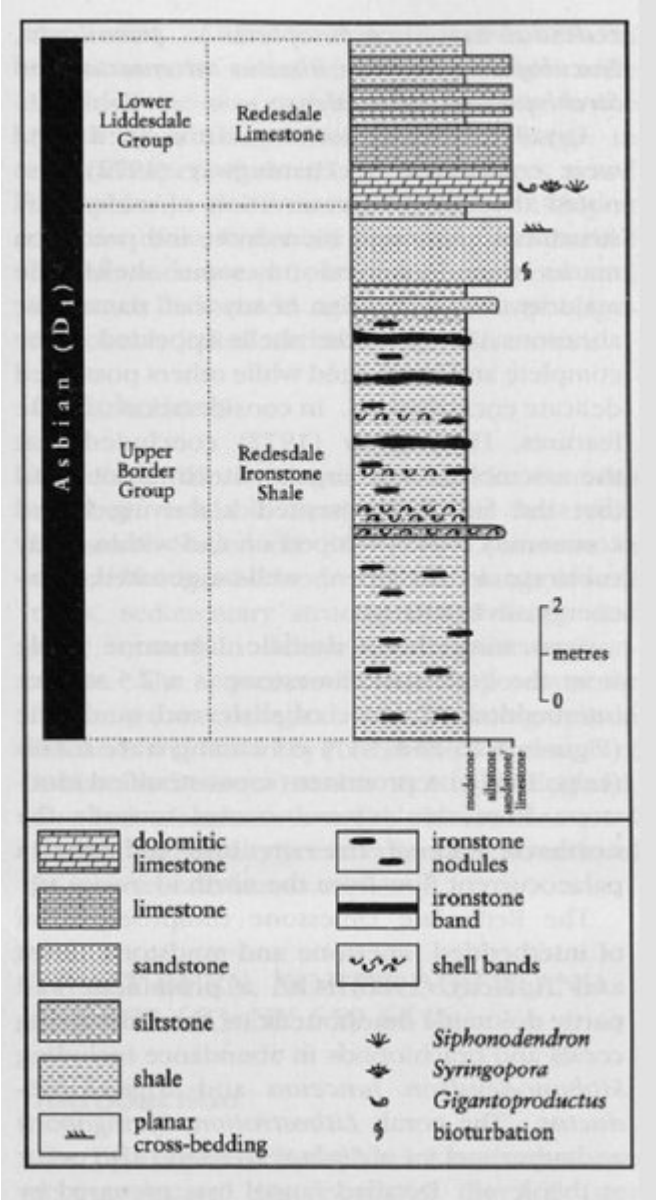
The succession at Redesdale provides spectacular evidence of the changing style of sedimentation that is typical of the transition from the higher parts of the Upper Border Group, dominated by coarsening-upward cycles of deltaic origin, into the Yoredale cycles of the Lower Liddesdale Group, where marine influences are more apparent. Although the lower part

of the Redesdale Ironstone Shale with its diverse fauna indicates deposition in a fairly shallow marine environment, its development was terminated in the upper part of the sequence by the influx of deltaic sand prograding from the north. The subsequent formation of the Redesdale Limestone marked the return of marine depositional conditions in the area, an event which on the wider scale heralded the onset of Yoredale cyclicity in the North Tyne area. The dramatic change in the character of ostracode assemblages noted by Robinson (in Frost and Holliday, 1980) at the base of the Redesdale Limestone and marked by the widespread loss of carbonaceous and ironstone associated microfaunal assemblages is probably linked to this transgressive event.

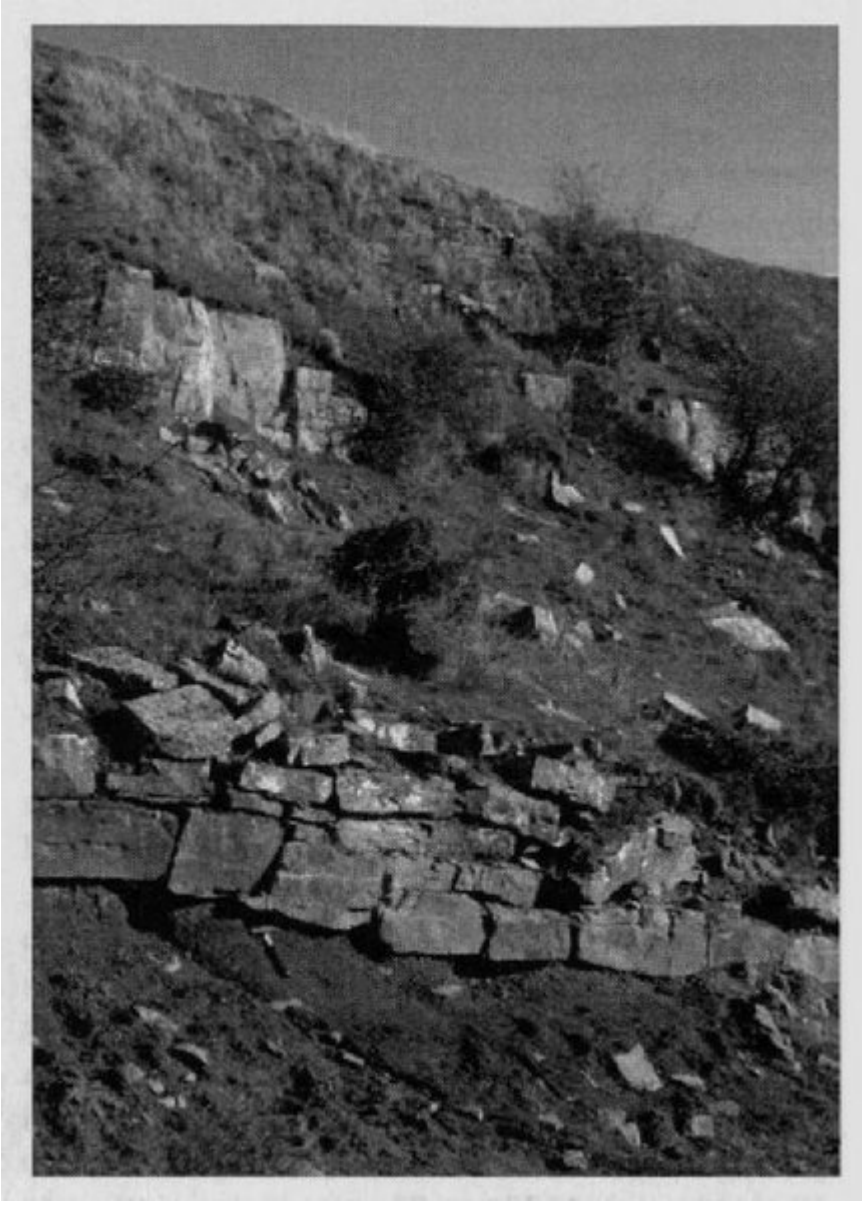
Conclusions

The Redesdale Ironstone Quarry site contains the best available section of the Redesdale Ironstone Shale and Redesdale Limestone in central Northumberland. It shows a range of rock types, sedimentary structures and fossils that were formed in deltaic and marine environments. The sequence offers great potential for future palaeoecological and biostratigraphical research and has a key role in the correlation of Asbian successions across northern England. The Redesdale Ironstone Shale is also renowned for the high-quality preservation and diversity of its invertebrate faunas.

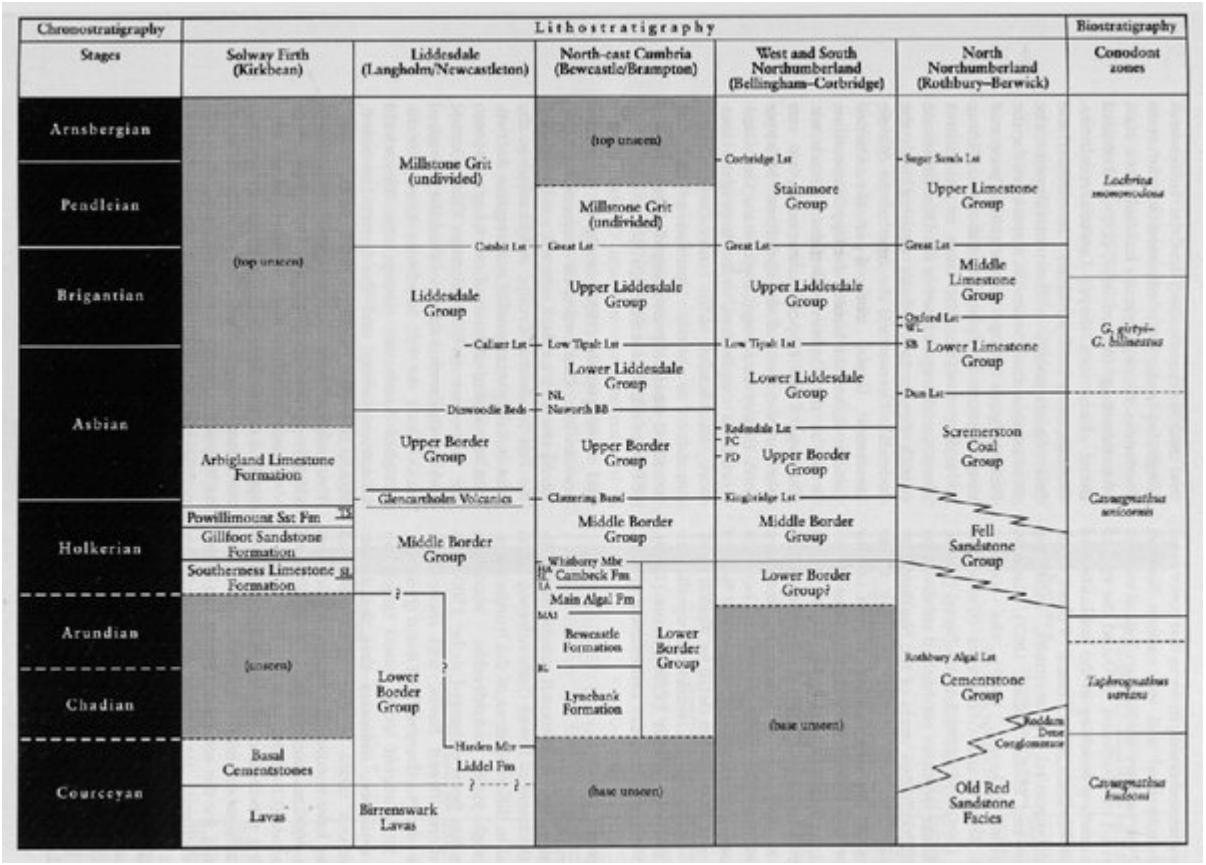
References



(Figure 3.16) Summary log of the succession at Redesdale Ironstone Quarry. Compilation based on information from Hemingway (1972) and Frost and Holliday (1980), and on information supplied by D. Frost (pers. comm., 1979). The lower part of this succession was poorly exposed at the time of writing.



(Figure 3.17) The upper part of the succession at Redesdale Ironstone Quarry showing the prominent development of sandstones between the top of the Redesdale Ironstone Shale (bottom) and the overlying Redesdale Limestone (top). (Photo: P.J. Cossey.)



(Figure 3.3) Simplified Lower Carboniferous stratigraphical chart of the Northumberland Trough. Compilation based on information from Lumsden et al. (1967), Day (1970), George et al. (1976), Ramsbottom et al. (1978), Frost and Holliday (1980), Armstrong and Purnell (1987), Smith and Holliday (1991), Purnell (1992), British Geological Survey (1993a), Turner et al. (1993), Chadwick et al. (1995), Johnson et al. (1995) and Maguire et al. (1996). Note that the implied correlations between the lithostratigraphy and both the biostratigraphy and the chronostratigraphy remains uncertain in many areas. SL — Syringothyris Limestone Member; TS — Thirlstane Sandstone Member; BL — Bogside Limestone Member; MAI — Main Algal 1 Member; LA — Lower Antiquatonia Member; HA — Hillend Algal Member; Naworth BB — Naworth Bryozoa Band; NL — Naworth Limestone; PD — Plashetts Dun Limestone; PC — Piper's Cross Limestone; SB — Spirifer Band; WL — Watchlaw Limestone; Lst — Limestone; SSt — Sandstone; Mbr — Member; Fm — Formation. Conodont zones from Armstrong and Purnell (1987) and Purnell (1989, 1992). Not to scale.