
Grieston Quarry

[NT 3135 3618]

Introduction

Grieston Quarry lies 1.6 km WSW of Innerleithen, Peeblesshire, within an area of upper Llandovery greywackes that were referred to the Gala Group by Lapworth (1870). It has been an important site for graptolites since the initial reports of Nicol (1848, 1850), with subsequent records of these fossils being included in the publications of Lapworth (1870, 1876a), Peach and Horne (1899) and Elles and Wood (1901–18). The graptolite fauna was reassessed, with new descriptions, by Toghill and Strachan (1970). There is also a distinctive trace fossil assemblage, which has been described by Benton and Trewin (1980).

The quarry is the type locality for *Monoclimacis griestoniensis* (Nicol, 1850), the index species of the Telychian *griestoniensis* Biozone, and for other graptolites including *Pristiograptus nudus* (Lapworth, 1880c), *Monograptus drepanoformis* Toghill and Strachan, 1970, and *Glyptograptus nebula* Toghill and Strachan, 1970. It is also the type locality for the trace fossil *Dictyodora tenuis* (M'Coy, 1851a).

Description

The exposure in the quarry consists of 43 m of shales and greywackes, dipping 60–65° to the north-west (Figure 3.69). They were described by Toghill and Strachan (1970) as fissile grey-green flaggy shales and fine- to medium-grained grey-green and blue-grey greywackes, the latter of which are up to 1 m thick and occasionally thicker (Figure 3.70). In the thinner greywacke beds, parallel lamination, cross-lamination and convolute lamination are apparent. Occasional nodular horizons occur. Nicol (1850) reported three graptolitic levels, two of which were 3.1 m apart in the lower part of the section; the third was some 21–24 m higher. Toghill and Strachan (1970), however, were able to find only two fossiliferous horizons *in situ*, at 0.9 m and 3.7 m above the base of the section, and equated the upper one of these with Nicol's lowest horizon. They also reported graptolitic debris in the quarry with a different lithology from the material from the quarry face, and suggested that these loose blocks may represent Nicol's middle or highest level. Trewin (1979) managed to find seven graptolite-bearing horizons, which he considered to include all those previously mentioned. He noted that the graptolites almost all occur in finely-laminated coarse silts or ripple-laminated fine sands, and concluded that they had been transported. He also found tool marks on the bases of sandy beds that had clearly been formed by graptolites during transport, as they show unmistakable impressions of thecae.

Graptolites recorded by Toghill and Strachan (1970) from 3.7 m above the base of the section include *Monograptus discus* (restricted to this horizon), *Monoclimacis griestoniensis* (only common at this horizon), *Monograptus priodon* and *Oktavites spiralis*. The micaceous greywackes found as loose blocks contain *Monograptus drepanoformis*, *Pristiograptus nudus*, *Glyptograptus nebula* (all restricted to this material), *M. priodon*, *O. spiralis*, and rare *M. griestoniensis*, among others. These faunas are indicative of the *griestoniensis* Biozone, of late Telychian age.

Tail spines of the phyllocarid *Ceratiocaris* also occur (Trewin, 1979; Benton and Trewin, 1980), and tool marks produced during the transport of these rigid, three-pronged structures were described by Trewin (1979). Benton and Trewin (1980) also documented the trace fossil assemblage, which is dominated by meandering burrows of *Dictyodora*, together with straight traces referred to *Caridolites* by Nicholson (1873). The ichnofauna is a typical deep-water mud association assignable to the *Nereites* ichnofacies.

Interpretation

The fine-grain size of most of the greywackes, the dominance of mud, and the sedimentary structures, indicate a distal environment on a turbidite fan (Trewin, 1979; Weir, 1992). The beds represent units Tcde of the Bouma (1962) sequence

(Figure 3.40), and were deposited by weak turbidity currents that are shown from measurements on tool marks and flutes to have come from a variety of directions (Trewin, 1979). Trewin (1979) also showed that some of the coarser beds (between 6 and 6.5 m above the base of the exposed section) contain original and replaced grains of volcanic origin, suggesting that they were derived from a petrographically distinct source from the rest of the strata. The ichnofauna and the evidence of current activity attest to deep but oxygenated bottom waters.

The graptolite fauna at Grieston Quarry is the youngest known in the area. The absence of *Monoclimacis crenulata* and *Monograptus marri* was taken by Toghill and Strachan (1970) to indicate that the highest part of the *griestoniensis* Biozone is not represented in the quarry. To the east and south-east, including the network site at Thornylee, graptolitic horizons within the Gala Group indicate the *crispus* and *turriculatus* biozones (Lapworth, 1870; Peach and Horne, 1899). The ground to the northwest of the quarry is occupied by unfossiliferous greywackes as far as the Ordovician–Silurian boundary, which is about 4 km away (Toghill and Strachan, 1970). There is no local representation of the highly graptolitic Birkhill Shale Formation seen, for example, in the Moffat area (e.g. Dob's Linn), and the onset of greywacke deposition in the Innerleithen area was evidently much earlier than in the Moffat tract of the Southern Uplands (see (Figure 1.6)).

The presence of relatively young Telychian rocks in the northern part of the Southern Uplands is an anomaly, and the implications remain a topic for future research. One possibility is that these strata were deposited in an isolated perched basin above the developing Southern Uplands complex (Weir, 1992).

Conclusions

This is a classic and important graptolite locality in the Southern Uplands, with a diverse fauna of local and international importance for biostratigraphy and correlation. It is the type locality for the biozonal graptolite species *Monoclimacis griestoniensis*. The quarry also provides a representative section in the Telychian greywackes of this part of the Southern Uplands; these are otherwise poorly exposed.

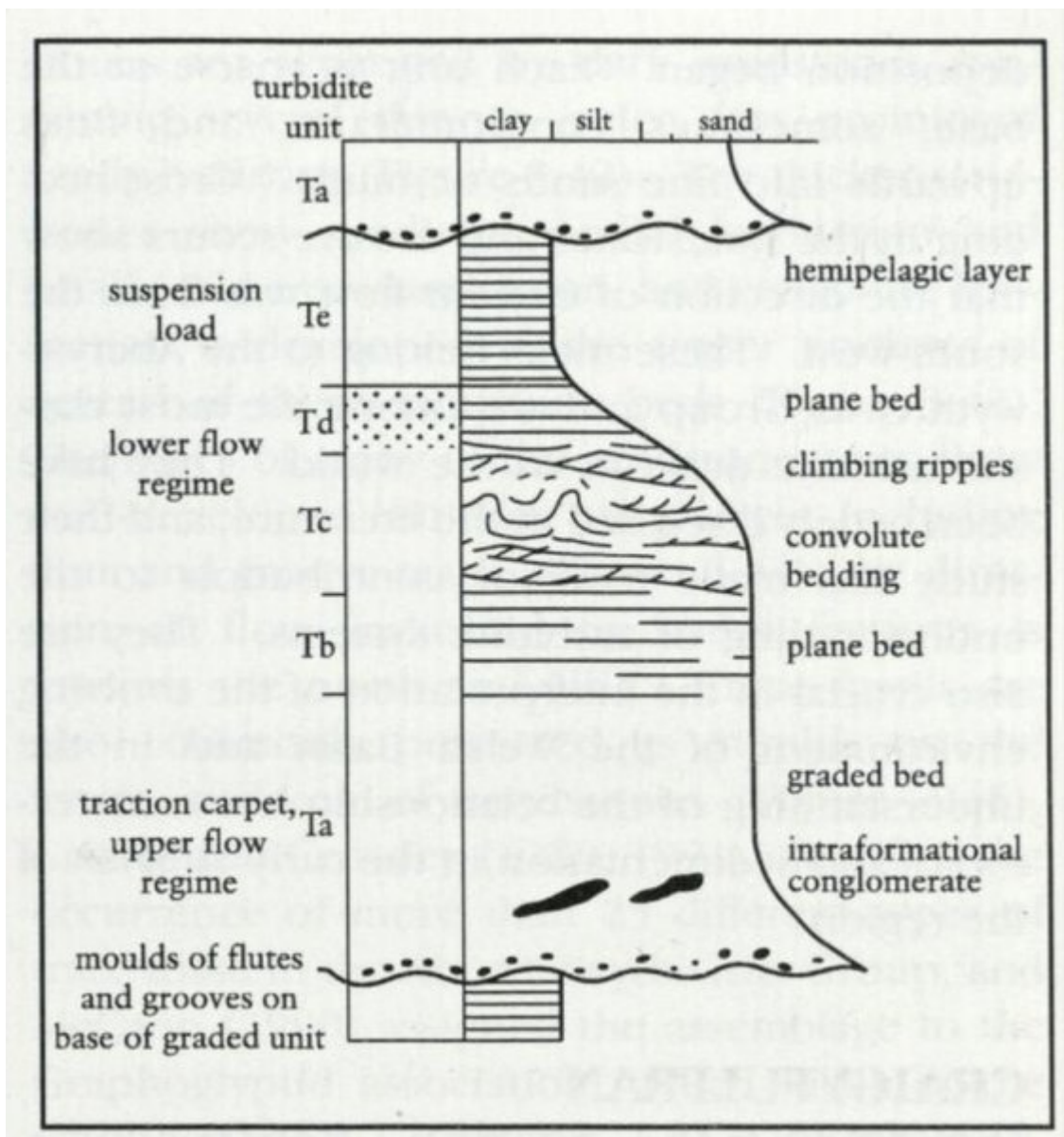
References



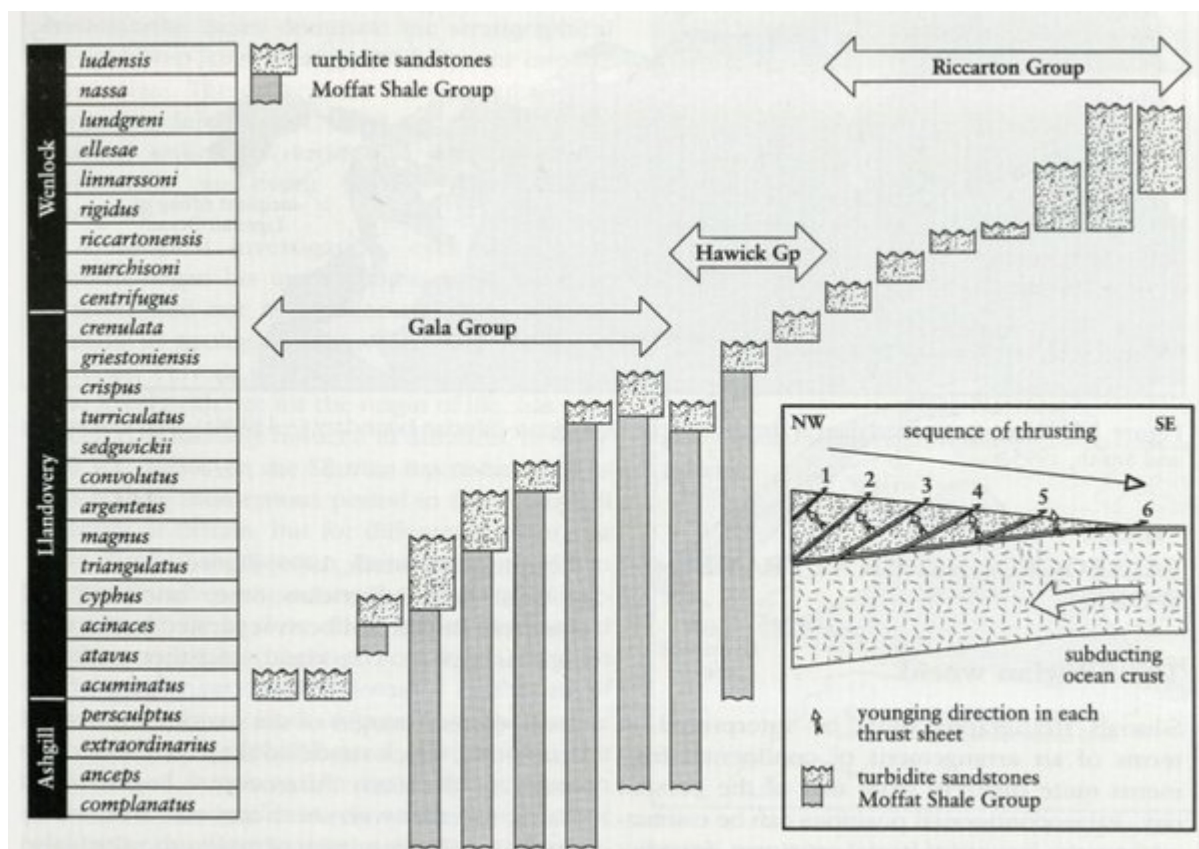
(Figure 3.69) The Gala Group in Grieston Quarry Innerleithen. (Photo: TS1455, reproduced by kind permission of the Director, British Geological Survey, © NERC.)



(Figure 3.70) Fissile thin greywackes and shales of the Gala Group, Grieston Quarry, Innerliethen. (Photo: TS1457, reproduced by kind permission of the Director, British Geological Survey, © NERC.)



(Figure 3.40) Idealized graphic log of the full Tabcde Bouma turbidite cycle (modified from Selley, 1978, after Bouma, 1962).



(Figure 1.6) The stratigraphical columns of successive tectonic slices across the south-west end of the Southern Uplands of Scotland (after Rushton et al., 1996). Inset shows the geometry of an accreting sedimentary prism.