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## Brow Gill Beck

[NY 4982 0590]–[NY 4916 0540]

### Introduction

The small stream of Brow Gill runs into Stockdale Beck near Stockdale Farm, some 6 km north of Kendal. The sections exposed in the two streams extend for 800 m north-east of Stockdale and include the type locality for the Browgill Formation, the upper division of the Stockdale Group. The term 'Browgill Shales' was introduced for this unit by Marr and Nicholson (1888) to replace the earlier names of 'Pale Slates' (Aveline and Hughes, 1872) and 'Knock Beds' (Nicholson and Lapworth, 1875). Cocks *et al.* (1992) gave a thickness of 40 m for the Browgill Formation.

This locality provides an almost complete section through the entire Stockdale Group and into the overlying Brathay Formation. The Browgill Formation is particularly well exposed in Stockdale Beck, with complementary exposures available in Brow Gill Beck. The site has provided important graptolite faunas, especially from the *turriculatus* and *crispus* biozones, and is the type locality of the graptolite *Pseudoretiolites perlatus perlatus* (Nicholson, 1868).

### Description

A full description of the rocks in Brow Gill Beck and Stockdale Beck was provided by Marr and Nicholson (1888). The course of Brow Gill approximately parallels the strike of the beds, with the south-east (left) bank formed by steep cliffs. In the lower part of the cliffs the Skelgill Formation is exposed, with the upper part formed by the Browgill Formation; a representative section can be seen in a cleft in the cliff at [NY 4965 0580] at a point termed 'The Rake' by Marr and Nicholson (1888, fig. 2). Here, a strike fault occurs between the lower and middle parts of the Skelgill Formation, cutting out some of the beds. At the base of the section, the Ashgill Formation is succeeded by at least 1 m of pale shales yielding an *acuminatus* Biozone graptolite fauna, so there may be a non-sequence at the level of the *persculptus* Biozone (Rickards, 1978). At places in the stream, however, a weathered rottenstone 0.05 m thick occurs below the *acuminatus* Biozone and may be the lithological and stratigraphical equivalent of the Spengill Member (Rickards, 1988). Above this at The Rake, the Skelgill Formation is disturbed by the faulting, but Hutt (1974) recorded graptolitic black mudstone horizons representing the *magnus* and *convolutus* biozones. The paler, occasionally calcareous, layers yield a variety of trilobites and brachiopods, and can be matched with similar bands in the Skelghyll Beck section (Marr and Nicholson, 1888).

The highest beds of the Skelgill Formation at The Rake comprise 3 m of blue mudstones, from which fossils have not been recorded. These are succeeded by pale-green laminated shales of the lower Browgill Formation. Marr and Nicholson (1888) reported a band of black mudstone crowded with specimens of *Spirograptus turriculatus* 6.5 m above the base of the formation, and Hutt (1974) found three 50 mm black layers with graptolites indicating the *maximus* Sub-biozone of the *turriculatus* Biozone at a similar level. Some 6 m higher, graptolitic layers become more frequent, and contain a diverse fauna with *Monograptus crispus*, *Streptograptus exiguus* and *Retiolites geinitzianus* abundant. These are referable to the *crispus* Biozone. At the top of The Rake, 2 m of unfossiliferous pale calcareous shales mark the bottom of the upper part of the Browgill Formation (Marr and Nicholson, 1888).

A complete section through the Browgill Formation is available in Stockdale Beck, north of the farm (Figure 3.57). Here, most of the Skelgill Formation is cut out by a strike fault, and predominantly black beds with a *sedgwickii* Biozone fauna are juxtaposed with the Ashgill Formation. The lower Browgill Beds compare with those at The Rake, with the three *turriculatus* Biozone bands identifiable and at least 23 graptolitic bands of the *crispus* Biozone (Hutt, 1974; Rickards, 1989a). Above the last graptolitic band are about 6 m of pale, non-graptolitic mudstones, followed by a prominent red mudstone horizon containing abundant calcareous nodules. A conodont sample from the nodular material has yielded a small number of blackened fragments of *Dapsilodus* sp. and *Decoriconus* sp. (Wang and Aldridge, 1997). The uppermost 4 m of the Browgill Formation comprise pale unfossiliferous mudstones, with calcareous nodules or patches developed towards the base. These were termed the 'Grey Beds' by Rickards (1978) and have been assigned to the Far House

Member by Kneller *et al.* (1994). The junction with the flags of the overlying Brathay Formation approximately coincides with the Llandovery–Wenlock boundary, and is fairly sharp.

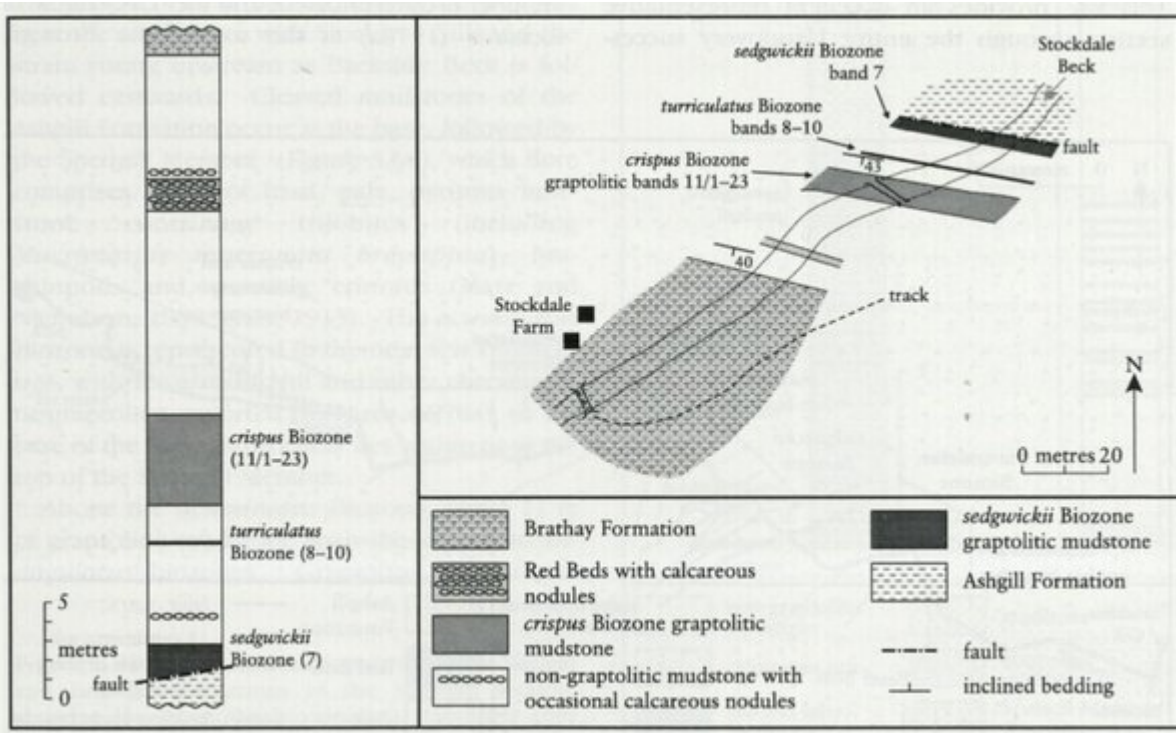
## Interpretation

Brow Gill Beck is situated in the eastern part of the Lake District, and lies to the east of a major north–south fault, the Brathay Fault, which appears to have separated a relatively shallow submarine block from a deeper depositional basin to the west during the early Llandovery (Hutt, 1974; Rickards, 1978; (Figure 3.52)). The whole Lake District area shows evidence of subsidence during the late Ordovician and Silurian (see Chapter 1). As in other sections, the Skelgill Formation displays an alternation of graptolitic black mudstones and paler, sometimes calcareous mudstones, reflecting periods of anoxic and oxic bottom conditions respectively. During deposition of the more calcareous levels the sea bed was able to support benthic faunas, with trilobites particularly characteristic. In the Browgill Formation, the graptolitic mudstones are still present, but are reduced in relative thickness within a sequence of pale, unfossiliferous mudstones, which have been interpreted to at least partially represent distal turbidites (Rickards, 1964, 1989a). With the lack of fossils, it is impossible to determine the completeness of this sedimentary sequence, and Rickards (1989a) suggested that there might be a non-sequence in the lower part of the formation. The red beds in the upper part of the Browgill Formation can be correlated lithologically with similar beds to the east, where they contain thin dark bands with a *crenulata* Biozone graptolite fauna (Rickards, 1973). The red mudstones are not, however, represented in the Lake District in sections to the west of Stockdale Beck. Ziegler and McKerrow (1975) interpreted the red beds as being possibly derived from erosion of a desert landscape, and Rickards (1978) considered that in the Lake District they accumulated in hollows on the sea floor.

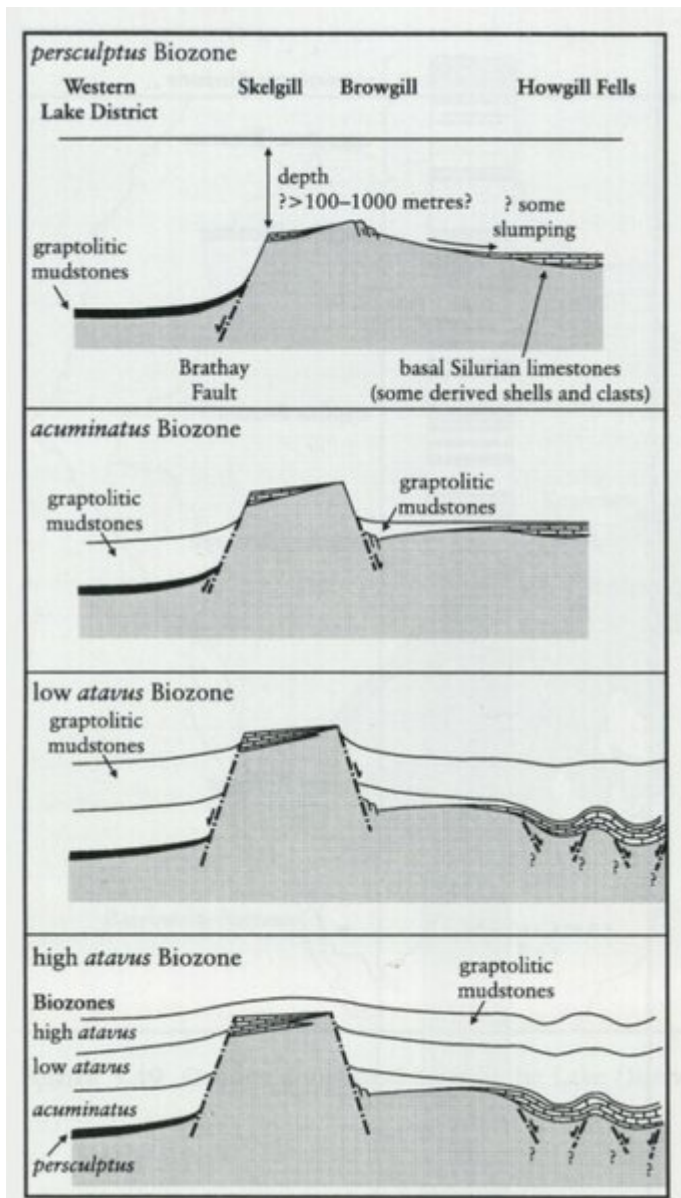
## Conclusions

This site provides an excellent representative section through the entire Llandovery succession in the eastern Lake District. It is the type locality for the Browgill Formation, and includes Stockdale Beck, after which the Stockdale Group is named. Graptolitic horizons occur in the Skelgill Formation and in the lower part of the Browgill Formation, and the locality is particularly important for the faunas of the Telychian *turriculatus* and *crispus* biozones. The upper part of the Browgill Formation includes the most westerly development of red mudstones in the Lake District area; these are interpreted as being deposited in hollows on the sea floor during periods of active erosion of a terrestrial desert landscape.

## [References](#)



(Figure 3.57) Stratigraphical log and geological plan of the Browgill Formation in Stockdale Beck, showing the main graptolitic horizons (after Hutt, 1974).



*(Figure 3.52) Reconstucted west-east sections across the Lake District, showing the development of the depositional environment during the early Llandovery (after Rickards, 1978).*