Bothel Craggs Quarry, Cumbria

[NY 186 371]

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Introduction

Tholeiitic andesite in the Lower Carboniferous (Dinantian) Cockermouth Lavas is exposed in the small quarry on the west side of the A591 road, near Bothel Craggs, about 1.5 km SSE of the village of Bothel in Cumbria (Figure 3.5). The Bothel Craggs Quarry GCR site is at the eastern extent of the Cockermouth Lavas, the only exposed example of effusive volcanism localized along the southern hinge-zone margin of the Solway Basin.

The Cockermouth Lavas were first described by Eastwood (1928) and by Eastwood *et al.* (1968), and the Bothel Craggs Quarry GCR site is included within the British Geological Survey's 1:50 000 Sheet 23, Cockermouth (1997). Geochemical analysis of the lava from this quarry by Macdonald and Walker (1985) showed that it is a tholeiitic andesite, which has implications for the petrogenesis of the Cockermouth Lavas in the wider context of Early Carboniferous magmatism in Great Britain.

Description

The description of the Bothel Craggs Quarry GCR site is based on the published accounts by Eastwood (1928) and Eastwood *et al.* (1968), and on field maps in the archives of the British Geological Survey. Approximately 4 m of blue-black, sparsely amygdaloidal, fine-grained tholeiitic andesite are exposed in the quarry (Figure 3.6). Pseudo-columnar joints are very poorly developed and there are weak sub-horizontal joints and perhaps a faint sub-horizontal lamination. There is no evidence that more than one lava is present. Neither the top nor the base of the Cockermouth Lavas is exposed hereabouts. The andesite is similar to that described in the Gill Beck GCR site report, though mineralogical alteration is ubiquitous, with albitization, carbonation and sericitization of the plagioclase, and replacement of the clinopyroxene by aggregates of carbonate and 'serpentine' (Macdonald and Walker, 1985).

Interpretation

The rock from the Bothel Craggs Quarry was described as basalt on field maps by T. Eastwood. However, despite strong alteration, an intermediate composition was determined for this rock by Macdonald and Walker (1985), who classified it as tholeiitic andesite. They also recorded tholeiitic andesite in Gill Beck (see GCR site report), and possibly from Ullerance Gill [NY 170 351] as an altered xenolith in basalt lava. Their paper contained the first use of the term tholeiitic andesite for any British Carboniferous lava.

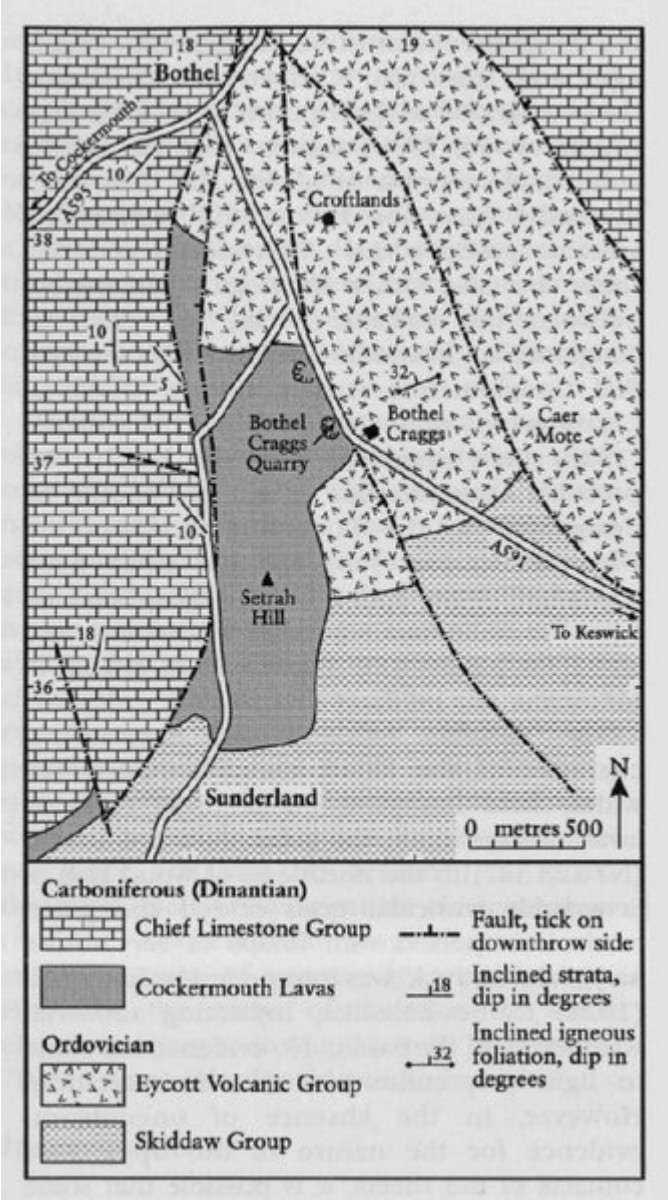
The magmatic evolution of the Cockermouth Lavas, as outlined in the Gill Beck GCR site report, probably involved low- to medium-pressure fractional crystallization. The presence of tholeiitic andesite within the Cockermouth Lavas further suggests that high-level magma chambers were established, at least locally, enabling crystal fractionation of the parental basaltic magma to take place.

The hypersthene-normative, transitional to alkaline Dinantian volcanic rocks of the Midland Valley of Scotland, to the north, include relatively common intermediate and silicic rocks (Macdonald, . 1975). In contrast, the tholeiitic lavas in Derbyshire to the south, in many respects compositionally similar to the Cockermouth Lavas, are entirely basaltic (Macdonald *et al.,* 1984). The Cockermouth Lavas are thus transitional in terms of their most evolved composition between the suites of the Midland Valley and Derbyshire.

Conclusions

Approximately 4 m of sparsely amygdaloidal, tholeiitic andesite are exposed in the Bothel Craggs Quarry GCR site. The andesite in the quarry is probably part of a single lava flow and occurs at the eastern extent of the outcrop of the Tournaisian Cockermouth Lavas. This was the first tholeiitic andesite to be recognized in a British Carboniferous lava succession and its presence suggests that high-level magma chambers were established, enabling some crystal fractionation of the basaltic parental magmas to take place. Its presence is also regionally significant among similar Dinantian rocks in Great Britain, because it shows that the Cockermouth Lavas reached a state of magmatic evolution between that seen in the Midland Valley of Scotland, where intermediate and felsic compositions are common, and that of Derbyshire, where only basic rocks occur.

References



(Figure 3.5) Map of the area around the Bothel Craggs Quarry GCR site. Based on British Geological Survey 1:50 000 Sheet 23, Cockermouth (1997).

(Figure 3.6) Bothel Craggs Quarry, excavated in fresh tholeiitic andesite of the Cockermouth Lavas; view south towards the western fells of the Lake District. (Photo: D. Stephenson.)