

CORRESPONDENCE AND NOTES

Discussion of 'The Ordovician batholith of the English Lake District'
by R. J. Firman & M. K. Lee

SIRS – The paper by Firman & Lee (1986) on the Lake District batholith has attracted much attention, and discussions of it by Soper and Webb *et al.* (1987), have already been submitted to you. I would like to add one other point which I believe is relevant to the timing of the intrusion of the batholith during the Ordovician. This relates to the Borrowdale volcanic stratigraphy, its bearing on uplift associated with the intrusion and on the topographic form of the volcano.

Since the Borrowdale volcanic sequence totals more than 5 km it is tempting to think of the volcano or volcanoes as upstanding cones rather like many of our modern calc-alkali volcanoes. However, I believe that this was not so, certainly for some of the time, when the region was one of low relief with scattered eruptive centres. The Upper Tilberthwaite Tuff Formation is perhaps the best unit to consider in this respect. These tuffs are mostly volcanoclastic with a great variety of sedimentary structures which suggest a largely lacustrine origin. They were mapped in a reconnaissance fashion by Hartley (1925, 1932) (his 'bedded tuffs'); were named by Mitchell (1940) for the outcrops in the Coniston area, and are stratigraphically placed near the top of the volcanic pile. If the whole of the volcanics were erupted during the Caradoc Series as suggested by Soper (this discussion), the tuffs are likely to be of late Caradoc age. The outcrop is continuous south to north from the Broughton Moor quarries near Torver (SD 255 945), to the Langdales, Bowfell and Great Gable (NY 211 103), a total of 17 km. Recent mapping has shown the Seathwaite Fells tuff of Oliver (1961) to be the same formation. West of this line older formations are exposed but to the East they can be followed via Grasmere as far as the Kirkstone Pass (NY 402 080), a distance of 15 km, although part of the latter area has not been completely mapped. This covers the greater part of the Borrowdale volcanic outcrop which at this time would therefore appear to have had a low relief with mainly lacustrine conditions. Nor is it likely that the elevation was high since the known area of the volcanics does not extend far beyond the present outcrop. Beneath the Upper Tilberthwaite tuffs there are 3 km or more of variable volcanic rocks in the northwest and in the Ullswater region, which implies a great deal of subsidence and downwarping during the earlier part of the volcanic episode. It seems to

me therefore that any uplift caused by the intrusion of the Batholith would have to be post Tilberthwaite tuff, possibly synchronous with the acid volcanics which form the highest parts of the volcanic sequence. These observations in general could support suggestions of a late Caradoc emplacement of the batholith, and its likely relationship to the strong pre-Coniston limestone unconformity in the southwest, but they give no indication of an upper age limit.

References

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