
Pooley Bridge, Cumbria

[NY 465 243]

Introduction

The Pooley Bridge GCR site comprises a shore section and road cutting at the northern end of Ullswater (Figure 4.5). It exposes the conglomerates of the lower part of the Mell Fell Conglomerate Formation, named after Great Mell Fell on the eastern side of the Lake District (Dakyns *et al.*, 1897; Green, 1918). The conglomerates were mentioned by early investigators, including Playfair, Otley, Sedgwick and Nicolson, all of whom referred them to the Old Red Sandstone. They form part of a 48 km-long outcrop of clastic strata on the eastern side of the Lake District from near Penrith to Ravonstonedale (Ward, 1876; Harker and Marr, 1891; Dakyns *et al.*, 1897; Oldham, 1900; Green, 1918). Originally referred to as 'Basement Beds' by Dakyns *et al.* (1897), the strata separate the Carboniferous Limestone from the underlying Lower Palaeozoic rocks. Recent studies of the Mell Fell Conglomerate Formation include those by Capewell (1954, 1955), Wadge (1978) and Kimber and Johnson (1984). The outlier has been re-mapped recently by the British Geological Survey as part of the revision of the Appleby 1:50 000 geological sheet 30 (England and Wales) (British Geological Survey, 2003; McCormac, 2001; Millward *et al.*, 2003). Hillier and Williams (in press) provide a summary and Soper and Woodcock (2003) discuss the regional tectonic setting of the Mell Fell Trough.

The age of the Mell Fell Conglomerate Formation is uncertain, but it is thought to be Late Devonian to Early Carboniferous in age. Soper and Woodcock (2003) assign it a post-Acadian (Givetian–Frasnian) age on tectonic considerations. The Pooley Bridge site is significant in interpreting the regional geology, being the best exposed example of Old Red Sandstone lithofacies in north-west England. The conglomerates accumulated in a fault-bounded trough, the Mell Fell Trough, which covers an area of about 20 km² north of Ullswater. The strata rest unconformably on rocks of the Ordovician Borrowdale Volcanic Group. They are overlain unconformably by conglomerates of the Marsett Formation, the basal part of the Ravenstonedale Group of Early Carboniferous age (British Geological Survey, 2003). The Mell Fell Conglomerate is correlated with identical cobble conglomerates in Heltondale Beck [NY 506 207], the Shap Wells Conglomerate Formation of the Shap Wells Trough (McCormac, 2001) and the 'Polygenetic Conglomerate' (Marr, 1899; Shotton, 1935). The last is confined to three outcrops in the Cross Fell Inlier (Burgess and Wadge, 1974) and one near Greystoke, west of Penrith (Arthurton and Wadge, 1981). Estimates of the thickness of the Mell Fell Conglomerate range from about 275 m (Dakyns *et al.*, 1897) to under 1000 m (McCormac, 2001) and 1500 m (Capewell, 1955).

Description

The Pooley Bridge GCR site consists of part of the foreshore of Ullswater and a cutting on the north side of the B5320 to about 500 m west of Pooley Bridge. The road cutting was overgrown at the time of writing, but a nearly continuous section occurs on the lake shore. The exposed beds belong to the Mell Fell Conglomerate Formation. On the basis of its field relationships with surrounding rocks, it is of post-Early Devonian age, and older than Early Carboniferous marine deposits. The Shap Wells Conglomerate and the Mell Fell Conglomerate formations are the only representatives in the Lake District of the Old Red Sandstone lithofacies, deposited in a continental desert setting subject to seasonal, tropical rain storms.

The Mell Fell Conglomerate Formation outlier was described in detail by Capewell (1955), who divided it into three units: (i) 'Lower Group and Basal Breccia' dominated by wacke sandstone clasts, (ii) 'Middle Group' characterized in the eastern part of the outcrop by minor acid intrusive and intermediate volcanic rocks and in the west by volcanic rocks and wacke sandstones and (iii) 'Upper Group' comprising volcanic rocks and wacke sandstones. The Pooley Bridge site provides an excellent section of the 'Lower Group'. Here, the strata consist of a very poorly sorted, dark red-brown, boulder- to cobble conglomerate (Figure 4.6) with irregular finer beds (Capewell, 1955). Rudimentary sub-horizontal to gently north-dipping bedding is seen in alignment of subangular to subrounded clasts. These range from about 0.1 m to 0.3 m in diameter, with some reaching 1.0 m. Oldham (1900) commented on the poor sorting and absence of

well-rounded pebbles. The clasts consist of about 95% wacke sandstone (Harker and Marr, 1891; Capewell, 1955) and sandstone. The presence of the Lower Ludlovian graptolite *Monograptus colonus* in the clasts shows that they were derived from the Windermere Supergroup. Minor constituents of the conglomerate are lavas and pyroclastic rocks of Borrowdale Volcanic Group affinity, fine-grained, apparently unfossiliferous limestone and vein-quartz. A calcite–hematite vein cuts a wacke cobble. The matrix of smaller pebbles and coarse sand is purple-red with a calcite or iron oxide cement. There is evidence that the conglomerates infill channels, and thin interbeds of fine-gravel are cross-bedded.

Interpretation

The sedimentary characteristics of the Mell Fell Conglomerate Formation suggest that it is of fluvial origin. The deposits were laid down in generally arid conditions, but with occasional violent storms generating very high levels of run-off. Capewell (1955) envisaged the formation as a bajada deposit (cf. Walker, 1967), laid down in coalescing, low-angle fans. These may have accumulated at the base of a fault scarp. Wadge (1978) noted that the dips in the formation converge to the north and east, supporting its interpretation as the product of several coalescing debris fans. Kimber and Johnson (1984) commented that the alternations of coarse, clast-supported conglomerates with thin, well-sorted pebbly sandstones in the west and north of the Mell Fell Trough was consistent with fluvial deposition in braided channels in a mid-fan environment. A north-eastwards change, from proximal conglomerates to distal, finer-pebble conglomerates and pebbly sandstones, and palaeocurrent directions indicate northeast-flowing drainage.

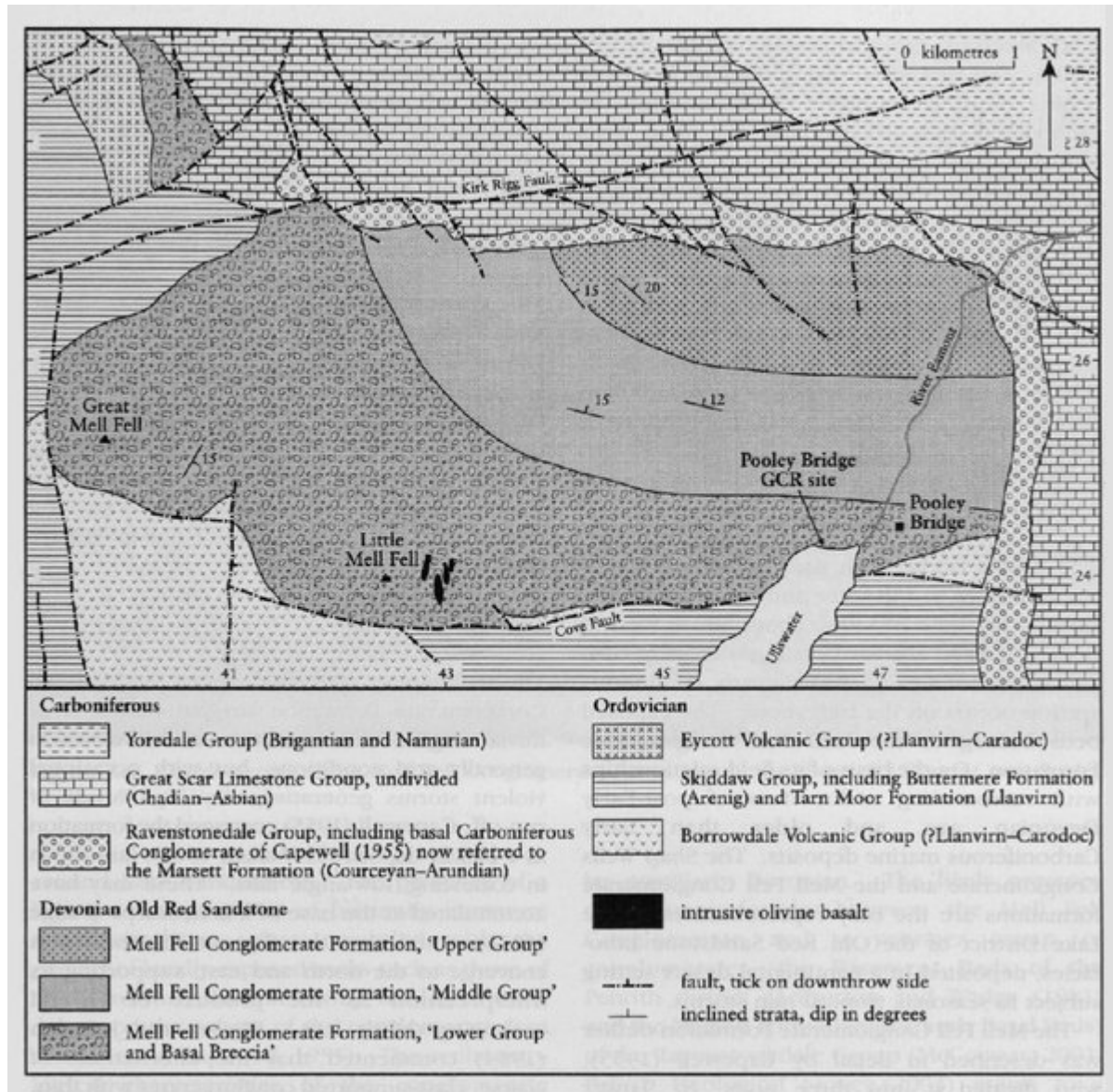
The clasts in Capewell's (1955) 'Lower Group' of the Mell Fell Conglomerate Formation at Pooley Bridge consist largely of sedimentary rocks of the Windermere Supergroup. They are predominantly siltstones, mudstones, and wacke sandstones of the Bannisdale Formation and Coniston Group. The nearest present outcrops of these rocks lie about 22 km to the south around Lake Windermere. The presence of a high percentage (95%) of texturally immature wacke sandstone clasts, coupled with the paucity of locally exposed rocks such as those of the Borrowdale Volcanic Group, has led to much debate on the source of the conglomerate (see discussion in Capewell, 1955). The sedimentological characteristics of the conglomerate indicate local provenance and deposition from rapid fluvial run-off from high hinterland, but the lithologies point to presently distant sources. Wadge (1978) considered that the lack of abrasion of the clasts suggested a source of Silurian and late Ordovician rocks much closer to Ullswater. McCormac (2001) noted that, although the conglomerate is texturally immature, the degree of rounding of the large clasts is unusual for such proximal deposits, and they may have been reworked from a desert regolith.

The age of the Mell Fell Conglomerate Formation has also been debated. The conglomerate contains cleaved Silurian (Ludlow) pebbles, and thus its deposition is considered to be post-Early Devonian. The likely presence of an unconformity between the Mell Fell Conglomerate and a younger group of conglomerates (the Basement Beds of the Penrith district (Arthurton and Wadge (1981) and the Marsett Formation (formerly Basal Beds) of the Ravonstonedale Group (McCormac, 2001; British Geological Survey, 2003) points to a period of uplift and erosion (Capewell, 1955). Thus Capewell (1955) favoured a pre-Late Devonian age for the Mell Fell Conglomerate, citing the evidence elsewhere in Britain for a conformable but diachronous boundary between the uppermost Old Red Sandstone and lowest Carboniferous beds. The Marsett Formation of Early Carboniferous age crops out to the north and east of Pooley Bridge. Although contact relationships are largely concealed, it is inferred that the junction with the Mell Fell Conglomerate is an unconformity, from a comparison of the regional dips of the two formations. The Marsett Formation is succeeded by strata which have yielded faunas of Chadian age (Dean, 2001). Thus the deposition of the Mell Fell Conglomerate Formation is constrained between the Early Devonian (post-cleavage) and the Chadian. Evidence further constraining its age to the Courceyan or older is provided by the intrusive basalts of Little Mell Fell (Figure 4.5) (Capewell, 1955; Millward, 2003). These rocks, intruded into the Mell Fell Conglomerate Formation, are chemically similar to the Cockermouth Lavas (MacDonald and Walker, 1985) and are considered to be the easternmost manifestation of this volcanism (Millward, 2003). The age of the Cockermouth Lavas is tightly constrained to the Courceyan, based on the presence of CM Zone spore assemblages in overlying sedimentary rocks in Gill Beck GCR site, 4.5 km north-east of Cockermouth.

Conclusions

The Pooley Bridge GCR site exposes the Mell Fell Conglomerate Formation and provides the best section of strata of Old Red Sandstone lithofacies in north-west England. It is correlated with the Shap Wells Conglomerate Formation and the Polygenetic Conglomerate of the Penrith district and Cross Fell Inlier and provides important palaeogeographical and sedimentological evidence for the uplift and erosion of the Lake District Massif. The strata comprise poorly bedded, boulder- to cobble-grade conglomerates with some lenticular sandstone beds. The precise timing of deposition of the Mell Fell Conglomerate is uncertain but a post-Early Devonian to Late Devonian age is most likely.

References



(Figure 4.5) Geological map of the Mell Fells-Ullswater area. After British Geological Survey 1:50 000 Sheet 30 (England and Wales), Appleby (2003).



*(Figure 4.6) Conglomerate of the Mell Fell Conglomerate Formation on the shore of Ullswater near Pooley Bridge.
(Photo: D. Stephenson.)*