REPORT

Morley Quarry, Charnwood Forest

Precambrian and Triassic rocks are on view at Morley Quarry [SK 4765 1785] at the northern extremity of Charnwood Forest. The site is easily reached on foot from the Cricket Club car park along Morley Lane (Fig. 1), south of the A512 at Shepshed. The quarry represents a sizeable former working for building stone, and it constitutes a site that is both attractive and educational. In 1994, Charnwood Borough Council declared it a Local Nature Reserve and it has since been upgraded to a RIGS. Extensive remedial work has been carried out on the quarry faces, but although the rocks can be viewed in complete safety from the central part of the quarry, it is still advisable to wear a hard hat when examining them close up. The geological scene is set by colourful explanatory notice boards placed at intervals around the quarry. Further information about the site is provided in a leaflet that can be obtained from Charnwood Wildlife, Southfields Road, Loughborough LE11 2TN.

Precambrian rocks

The quarry exposes magnificent sections in late Precambrian rocks of the Ives Head Formation. This unit forms part of the Blackbrook Group, and its strata are of particular interest in being among the oldest outcropping representatives of the Charnian Supergroup. The eastern quarry face shows about 40 m of massive to thinly bedded lithologies variably composed of mudstones, siltstones and sandstones (Fig. 2). Although these beds are of obvious sedimentary aspect, thin sections show that they consist mainly of volcanic particles, some of which are of pyroclastic derivation; they are therefore described as *volcaniclastic*. Notable in the lower part of this succession are graded sandstone beds up to several metres thick. The basal parts of these sandstones are completely unbedded and very coarse-grained, with sporadic, pebble-sized clasts that include laminated volcaniclastic siltstone. Thin sections show that the coarse sand-size grains are mainly composed of euhedral or fragmented crystals of plagioclase and quartz, together with lithic grains of vesicular-textured dacite and tuff, the latter commonly preserving the outlines of volcanic glass shards. There is an upward transition into medium-grained sandstone, with diffuse parallel stratification, then to a thinly bedded top of parallel layers of volcaniclastic mudstone and siltstone.

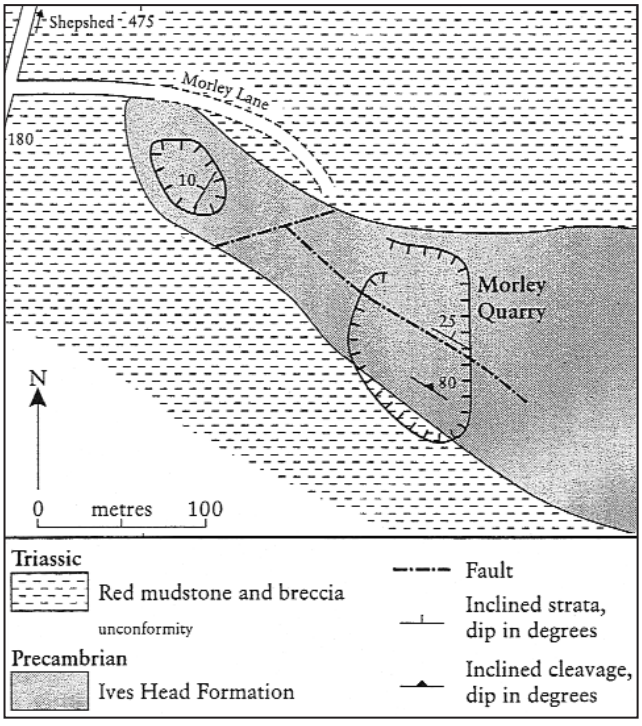

Figure 1. Geological sketch map of Morley Quarry.

These thick graded beds are interpreted as the deposits of turbidity currents, in which sand- to gravel-size grains were suspended by turbulence within plumes of sediment. This material flowed down the slopes of the active Charnian volcanic arc and accumulated in the surrounding seas (Moseley and Ford, 1989). Turbidites can be triggered by earthquakes, which commonly destabilise layers of unconsolidated sediments previously deposited along the basin margin, but they may also represent the distal, subaqueous continuations of pyroclastic flows erupted directly from volcanoes. There is little evidence to show the true origins of the Morley Quarry examples, however, since all of the textures and fabrics seen here are the result of depositional processes. Thus the structureless, coarse-grained facies, at the base of each graded sandstone bed, corresponds to a suspension-sedimentation stage of deposition, when grains were deposited directly from the suspended load of the turbidite without forming bedding structures. The incoming of finer-grained and better-stratified facies progressively higher up the bed, within the residual part of the turbidite flow, reflects more extensive sedimentary reworking. These upper beds represent the traction-sedimentation stage, when grains were accumulated from the bed-load of the turbidite (Lowe, 1982).

An added dimension to this site is provided by the findings of research drilling carried out in the quarry by the BGS as part of an investigation into the geothermal potential of Britain. The borehole section (Pharaoh and Evans, 1987), encountered a further 541 m (apparent thickness) of strata belonging to the Ives Head Formation and then entered a sequence consisting mainly of massive, grey, feldsparphyric dacite, interpreted as lava flows. This lower unit extends between 541 m and the base of the borehole at 835.5 m, and has been named the Morley Lane Volcanic Formation (Carney, 1994); it is not exposed in Charnwood.

The northeasterly Charnian dip, seen at the quarry, was imposed during the regional folding event that formed the main Charnian anticline. A

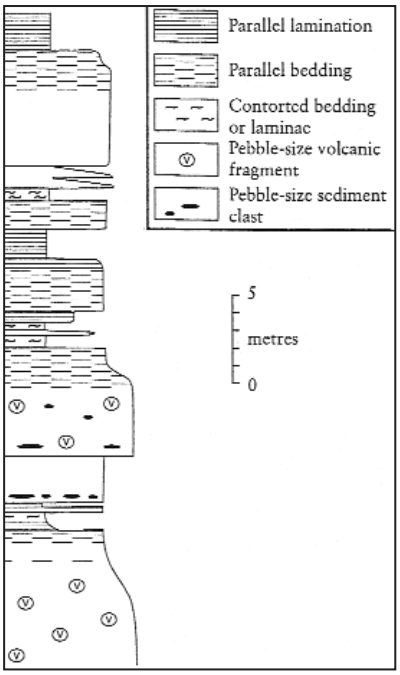

Figure 2. Lithological log of a measured section along the eastern face of Morley Quarry.

Figure 3. The upper southern face at Morley Quarry, showing the sharp unconformity between massive Precambrian rocks and poorly bedded Triassic breccia. The paler blocky deposit at the very top is the head.

highly penetrative cleavage fabric is visible as a faint foliation trending westnorthwest. The minerals defining these cleavage planes were crystallised at upper greenschist metamorphic grade, at the time of the folding, and radiometric determinations soon to be published will show that this deformation was not Precambrian, but was part of the Acadian (late Silurian to early Devonian) orogenic event. On the western quarry face, the cleavage, accentuated by weathering, shows broad crenulation and folding both within and adjacent to a westnorthwest fault (Fig. 1). This is clear evidence for a second, brittle (i.e. non-penetrative) phase of deformation; it possibly followed closely from the imposition of the cleavage, but could also be much younger, perhaps representing structures formed during Variscan (end-Carboniferous) earth movements.

Younger rocks and drift

Details of the early Triassic unconformity are magnificently displayed along the southern quarry face (Fig. 3). The Charnian rocks are unweathered beneath the unconformity, which shows sharp irregularities indicating that erosion had preferentially picked out subvertical joints in the Precambrian basement. The Triassic strata evidently accumulated within a shallow depression and are observed to progressively overstep the basement rocks in an eastwards direction, feathering out against the base of Morley Hill. This relationship shows that the hill existed in Triassic times, and therefore represents part of an exhumed palaeo-topography. The lowermost Triassic bed consists of 1 to 2 m of poorly sorted breccia made up of angular Charnian rock fragments within a red, silty sandstone matrix. The high matrix content suggests that these beds may be accumulations of finer-grained material, ultimately derived from arid weathering processes and possibly washed in by ephemeral sheetfloods or debris flows; there is a relatively small input from rockfalls, represented by the Charnian fragments.

Along the top of the quarry face, the Triassic rocks are overlain by 1-2 m of head, a Quaternary deposit that locally consists of abundant angular Charnian fragments in a pale brown, sandy or silty matrix. The head extends eastwards, up the slope and on to Morley Hill, overlying both the Triassic and Precambrian bedrock. On the hill itself , the angular blocks are closely packed, and the deposit resembles a scree that perhaps was formed by freeze-thaw activity in a cold Devensian climate, before the hill became fully covered by vegetation.

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John Carney
British Geological Survey

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