# Lilleshall Hill

[SJ 729 156]

Potential GCR site

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## Introduction

Lilleshall Hill has been proposed as a GCR site because it represents the northernmost outcrop of the Uriconian Group, whose main development occurs 10 km to the south-west, at the Wrekin range GCR site. Callaway (1879), in commenting on the general appearance and structure of the predominantly acidic tuffites exposed here, noted their probable Precambrian age and equivalence to the Wrekin volcanic rocks. The sequence was described in considerably greater detail, and studied petrographically, by Whitehead *et al.* (1928), who suggested that it mainly consisted of 'albite rhyolites' along with tuffs, breccias and possible lava flows. The Lilleshall site (Figure 5.6) occupies an important tectonic position since it is bounded by major displacements (Figure 5.1) forming the northerly continuation of the Church Stretton Fault System (e.g. Pauley, 1991). Structures affecting the Precambrian rocks are therefore likely to reflect early movements along the Welsh Borderland Fault System (Woodcock and Gibbons, 1988), a major Precambrian terrane boundary that also defines the western limit of the Midlands Microcraton basement block (Smith, 1987).

## Description

The most accessible exposures are on the crags along the eastern margin of the hill, below and to the south of the Memorial. The stepped appearance of these crags resembles that produced by gently dipping bedding faces shown in this photograph correspond to the bases of beds (see below). The lower crags, at Locality 1 (Figure 5.6), consist of massive, pink to grey-weathering lithic-lapilli tuffs and breccias containing 20–30 per cent of angular to subangular, pale grey or pink glassy volcanic clasts averaging 5 mm across (maximum 30 mm), together with subordinate crystals of grey quartz. The matrix is grey to cream and coarse-grained, one thin section showing abundant devitrified glass shards and pumice lapilli. The tuff develops bedding, at 1–2 m scale, about 4 m above the base of the crags, where the lithic-lapilli tuff locally contains wispy inclusions and large rafts of fine-grained, cream to pink tuff. A highly distinctive, 2.2 m-thick bed, consists of white weathering, fine-grained tuff with a gently wavy lamination. This may be the lithology described as a vitric tuff by Whitehead *et al.* (1928); it is laterally impersistent, dying out immediately below the Memorial. In the higher part of the crag, the junction between this laminated tuff and a further bed of lithic-lapilli tuff shows complex intermixing textures. If these are sediment loading phenomena, their orientation would suggest that the lapilli tuff bed is also the youngest, and that therefore the sequence youngs westwards, in to the hill; this inferred younging occurs against the 85° easterly dip, implying a sequence that is slightly overturned. In thin section the overlying lithic-lapilli tuff has a matrix mainly composed of fractured quartz and alkali-feldspar crystals and devitrified glass shards. The lapilli are 2–5 mm fragments of glassy volcanic rock showing perlitic, spherulitic and plumose (feathery) devitrification textures; devitrified pumice lapilli occur in lesser abundance than these glassy volcanic clasts. An important feature of this tuff is that it fines upwards, in the inferred direction of younging, to a lithology containing diffusely-bounded layers of fine- to medium-grained tuff seen in pavement exposures at the crest of the crag.

Across the summit of the hill, at Locality 2, the sequence is mainly in unbedded, grey to pink tuffs, with a 'silty' surface texture, and with sporadic lithic-lapilli tuff layers up to several centimetres thick. Apart from the latter, these tuffs appear uniformly fine-grained, but polished rock slabs show that they are crammed with pale grey or cream, rounded to subangular lapilli between 2 and 8 mm in size. A thin section of similar rocks exposed at the Memorial shows that most of the shadowy fragments consist of devitrified pumice, interspersed with small quartz and alkali feldspar crystals, classifying the rock as a pumice lapilli tuff. This is the dominant type of lithology in other exposures and crags along the western parts of Lilleshall Hill.

The basic rocks exposed in a former quarry near the south-western extremity of the hill (Locality 3) are those described by Whitehead *et al.* (1928, pp. 10–11). In the south of the quarry they are dark green to grey, chloritic schists, overlying mylonitized siliceous tuffs within a major shear zone dipping 40° to the north.

Farther north, the quarry exposes fine- to medium-grained, dark grey, quartz microgabbro, possibly the unsheared equivalent of the chloritic schists. At the north-western end of Lilleshall Hill (Locality 4), a cutting into a former quarried slope revealed *c.* 2 m of dark green-grey, coarse-textured chlorite-rich foliated basic rock intercalated with very fine-grained, pale grey, siliceous tuffs in a sequence dipping 60° west.

Bedding at Lilleshall Hill was originally described as being inclined at about 40° to the NNW (Callaway, 1879), a view accepted by Whitehead *et al.* (1928). The structure is more complex than this (Figure 5.6), and the dips previously reported in the vicinity of the Memorial may have been measured on particularly prominent fracture surfaces, which were wrongly identified as bedding planes. The eastern margin of the hill coincides with a zone in which bedding dips at 85° to the SSE. The evidence discussed above, that these beds also young to the west, is tenuous, but if confirmed would indicate that the sequence is overturned. Coinciding with this eastern sub-vertical zone is a highly pervasive cleavage (Figure 5.6), visible at millimetre to sub-millimetre scale, dipping at about 70° to the north-west (strike 054°). Vitric tuffs affected by this cleavage show boudin-like structures on crags immediately below (to the east of) the Memorial, and at a further locality 15 m west of the trigonometric point. On the western slopes of the hill the beds dip westwards and it is assumed that they are the right way up; no cleavage structure was noted here.

The major shear zone, originally noted by Whitehead *et al.* (1928), exposed in the quarry to the south-west (Locality 3), is characterized by an intense, north-dipping mylonitic foliation within siliceous tuffs. The foliation consists of millimetre-size, discontinuous quartz ribbons; it is also present in adjacent basic rocks, defined by chlorite laths. No elongation lineation is developed in either lithology, however. In the siliceous tuffs the foliation locally shows asymmetric drag folds indicative of a (top-down-to-north) normal movement component of the shear zone.

## Interpretation

The Uriconian sequence at Lilleshall Hill includes a range of pyroclastic rocks suggestive of a highly explosive style of volcanism. The presence of alkali feldspar crystals in association with quartz suggests that the magmas were of rhyolitic composition. Based on tenuous way-up evidence, the *c.* 120 m-thick succession may be interpreted as part of a density-graded sequence characterized by a concentration of lithic material towards the base. The lithic-lapilli tuffs forming part of the lower *c.* 40 m of this sequence have matrixes rich in vitric constituents, but the lapilli size fraction contains abundant dense material (lithic clasts and crystals). In these compositional respects the tuffs are comparable to certain of the 'heavies' enriched layers produced by pyroclastic flow activity (e.g. Wilson and Walker, 1982), although the absence of large blocks could suggest they are of a distal facies. A type of normal grading is suggested in the upper lithic-lapilli tuff bed, which contains layers of medium-grained tuff towards the top; such diffuse layering and grading has been described from subaerial pyroclastic flows (Fisher and Heiken, 1982); however, there is no textural evidence for significant welding. The discontinuous nature of laminated vitric tuff intercalations is due to their erosion and incorporation into overlying lithic-lapilli tuff beds, further supporting a flowage origin for the latter. These finer-grained intercalations could be the remnants of intervening pyroclastic surge deposits (e.g. Walker, 1984), but may also be accumulations of fine ash falls during relatively quiescent periods. The associated soft sediment deformation structures are possibly caused by the loading of coarse-grained tuff into an underlying fine-grained tuff bed, and are indicative of deposition on a wet substrate. The pumice lapilli tuffs forming the upper *c.* 80 m of the Lilleshall Hill sequence show apparent uniformity of texture, and absence of bedding or grading, which could suggest deposition in the distal parts of pumice flows (e.g. Perrotta and Scarpati, 1994). In the upper part of the sequence, microgabbro intrusive sheets are present, but there is no evidence for basic extrusive activity.

Lilleshall Hill provides a structural 'window' into early deformation that took place along the northern Welsh Borderlands Fault System. A heterogeneous style of deformation is suggested by bedding attitudes that steepen to become sub-vertical, or locally overturned, in the east of the outcrop, with the cleavage also becoming more intensely developed in that direction. These structures suggest that compression of the sequence was localized along one of the major faults defining the eastern margin of the Precambrian inlier. This event could be as young as Acadian (Siluro–Devonian), but the deformation is also of a similar style to that affecting the Longmyndian and Uriconian rocks of the Church Stretton area (Pauley, 1991), and which has been dated to the latest Precambrian or early Cambrian (see the introduction to this chapter). Cleavage formation could therefore be related to one of the major late Precambrian terrane accretion events along the Welsh Borderlands Fault System (e.g. Gibbons and Horák, 1996). Further complexity is suggested by the discrete shear zone, trending across the southern part of the outcrop, which shows evidence for a phase of normal faulting.

## Conclusions

Lilleshall Hill contains many informative sections through about 120 m of massive to thickly bedded Uriconian acidic pyroclastic rocks. Most lithologies are probably pumice lapilli tuffs with rhyolitic compositions, suggesting an origin by highly explosive volcanic eruptions. The succession shows an upward diminution in the content of relatively dense constituents (volcanic rock fragments and crystals), as opposed to pumice, recalling a trend that is commonly seen in deposits formed by pyroclastic flows. This may only be part of the story, however, because the few horizons with sedimentary structures suggest that deposition occurred on a wet substrate. Basic rocks are restricted to minor developments of chloritic tuffs or microgabbro intrusions, locally converted to chlorite schists, in the upper (i.e. westernmost) part of the sequence. Following deposition, the succession was affected by unevenly-distributed deformation involving westwards tilting and the progressive steepening of beds, which became sub-vertical to locally overturned, and penetratively cleaved, on the eastern flank of the inlier. The age of this deformation is not known but is possibly Precambrian, related to compression along the Welsh Borderlands Fault System.

**References**

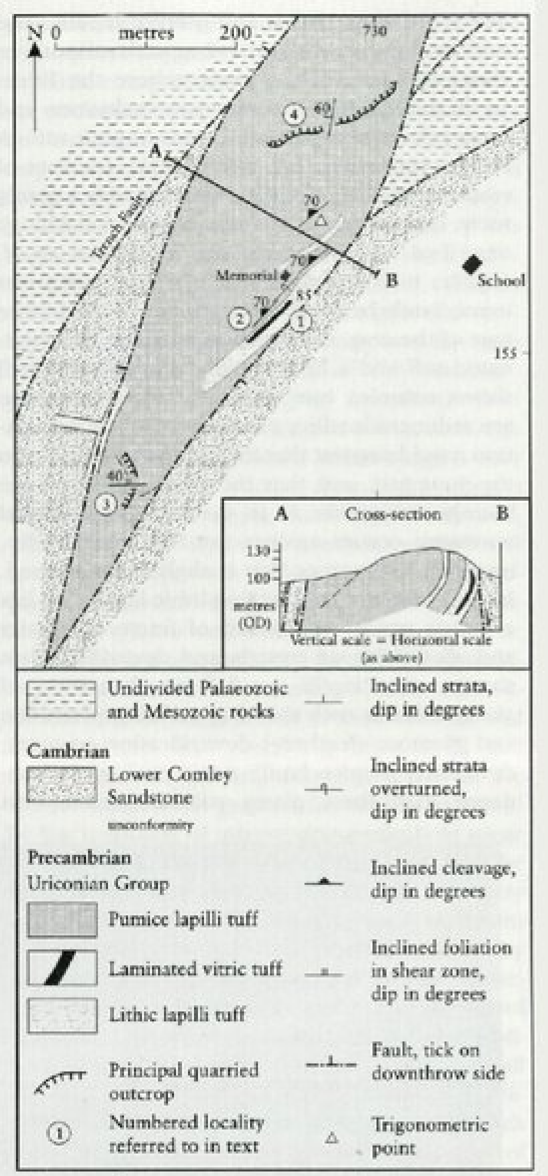
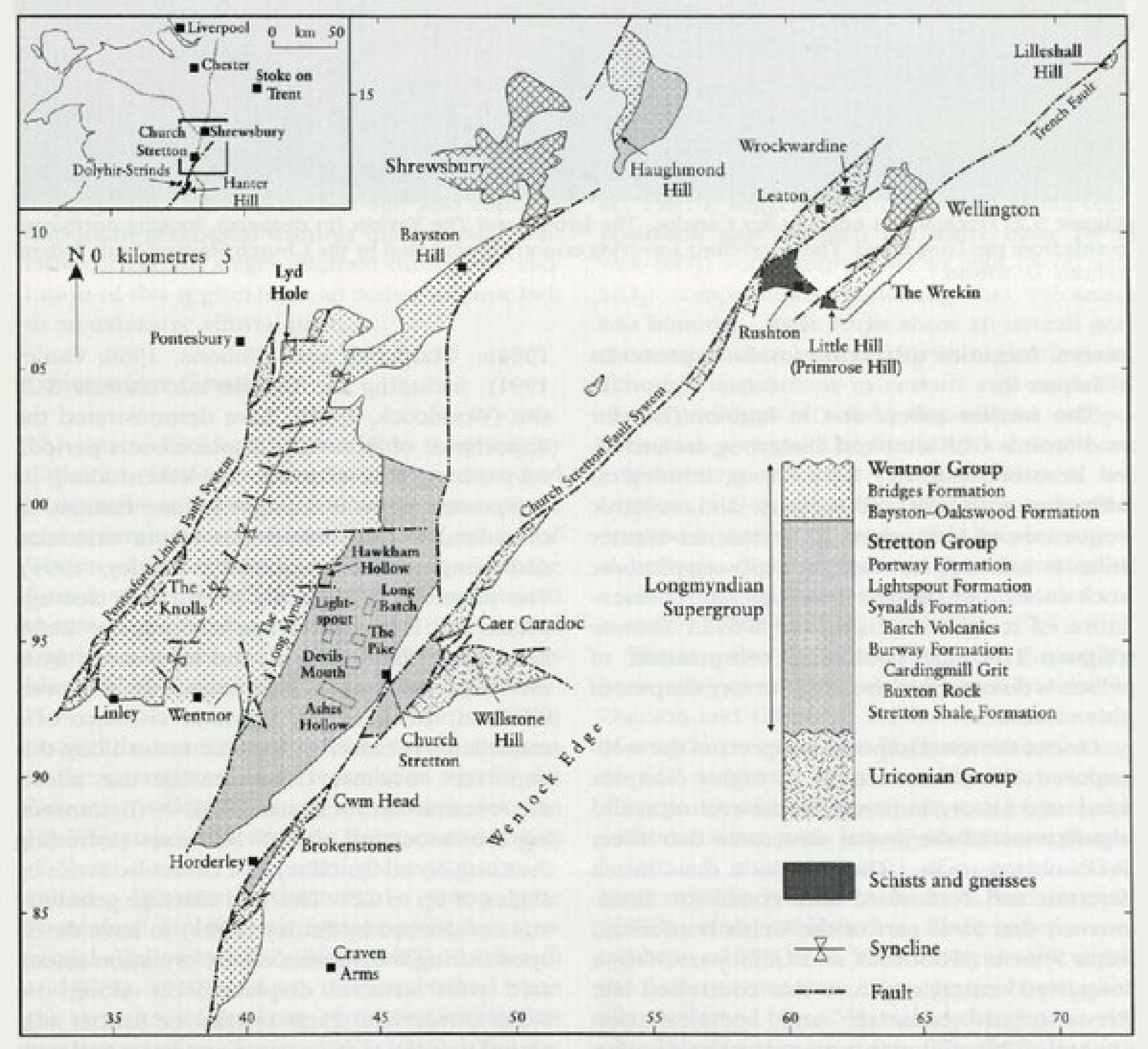



**Figure 5.6** Geological sketch map of Lilleshall Hill.

*(Figure 5.6) Geological sketch map of Lilleshall Hill, with cross section at lower right.*




*(Figure 5.1) Geological map of the Shropshire Precambrian outcrops (modified from Pauley, 1991), with the GCR sites indicated by bold lettering. The Radnor inliers (Dolyhir and Strinds quarries and Hanter Hill sites) are shown by the inset at top left. The location of the Llangynog site is given in (Figure 6.1).*