The Wrekin Range

[SJ 617 074]–[SJ 647 103]

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Introduction

The Wrekin range is the type area for the late Precambrian Uriconian Group (Pauley, 1986, 1991), and has been included as a GCR site because it undoubtedly provides the best and most varied exposures of these rocks in England. The intrusive rocks, lavas and pyroclastic beds of the Wrekin (Pocock *et al.,* 1938; Hamblin and Coppack, 1995) form part of the so-called Eastern Uriconian (Callaway, 1886), extending in a series of isolated outcrops along the line of the Church Stretton Fault System. The site (Figure 5.3) covers an area of some 4 km^2 and includes the impressive ridge of ancient rocks that runs south-west from the Ercall, across the Wrekin to Primrose Hill. This area is of great historical importance, for it was here that the volcanic nature of these rocks was first demonstrated (Allport, 1877), and the term 'Uriconian' applied to them by Callaway (1886). It was here also that Callaway (1879) demonstrated the unconformable nature of the Uriconian and Cambrian strata, which flank the Wrekin to the east and south, as discussed in the introduction to this chapter.

Although most of this ridge is composed of Uriconian rocks, there is also a small but stratigraphically significant outcrop of Primrose Hill Gneiss, which has been interpreted as a rare inlier of Malvernian-type basement (see also, Chapter 4).

Description

The oldest Precambrian representatives at the Wrekin site are considered to be the metamorphic and intrusive rocks of Primrose Hill (renamed Little Hill on modern OS maps), a small feature separated from the main mass of the Wrekin by a depression containing the Primrose Hill Fault. The poorly exposed Primrose Hill Gneisses (Pocock *et al.,* 1938; Wright, 1969; Thorpe, 1974) comprise a range of rock types that include granitic and amphibolitic gneisses, altered tuffs, intrusive granite and pegmatite. The best exposures are near the summit of Little Hill ((Figure 5.3), Locality 1) and in the steep path to the south (Locality 2). They reveal a group of gneissose rocks consisting of dark grey hornblende-rich layers, which alternate with layers rich in the leucocratic minerals, quartz, plagioclase and alkali feldspar. Granite and granitic lithologies, which crop out at the summit and down the western slope, are albite-microcline-quartz rocks with accessory muscovite and chloritized biotite (Thorpe, 1974). In places they appear gneissose, thin sections suggesting that the fabric may result from streaking-out of original granitic or granophyric material. Specimens obtained by Pocock *et al.* (1938), from the summit, show this group of rocks to contain chloritic and garnetiferous concentrations, probably representing highly altered xenoliths. The uppermost group, which crops out on the northern and north-eastern slopes, is composed of acid igneous material, resembling intensely deformed crystal tuffs with a strong cataclastic texture (Pocock *et al.,* 1938). All the rocks on Little Hill have undergone a variable amount of solid state granulation and recrystallization, and are considerably veined by coarse pegmatitic material.

The main mass of the Wrekin is formed by a northerly dipping succession of up to 700 m of rhyolitic lavas and interbedded pyroclastic rocks. The lower part, which crops out on the steep south-western slopes of the hill, is well displayed in crags [SJ 6214 0760] and [SJ 6204 0756] on the forest path (Locality 3). It consists of at least 200 m of fine to coarse, variably welded, basic and subordinate acid crystal-lithic lapilli tuffs, in places with clasts of rhyolite up to 10 mm, interbedded with tuffaceous conglomerates (Pocock *et al.,* 1938). Higher in the sequence, about 80 m of rhyolitic crystal-lithic lapilli tuffs, with andesitic and dacitic fragments, vitric tuffs and devitrified purplish red rhyolites are exposed in crags [SJ 6233 0771] east of the summit path (Locality 4) and on the south-eastern slopes of the hill. The succeeding pyroclastic rocks comprise a thick (200 m) sequence of basic lithic lapilli tuffs, crystal-lithic tuffs and some vitric-crystal tuffs showing variable degrees of welding and alteration. There are thin horizons of largely devitrified flow-banded rhyolite, and beds of lithic lapilli tuff composed of large fragments of rhyolite in crags [SJ 6233 0790] south-west of the summit (Locality 5). On the south-eastern side of the Wrekin, the pyroclastic rocks and rhyolite are intruded by a series of

narrow veins of granitic material, composed of fine-grained irregular intergrowths of quartz and alkali feldspar locally with pronounced spherulitic structure (Pocock *et al.,* 1938).

The summit of the Wrekin is composed of rhyolitic rocks (the 'Summit Rhyolite' of Pocock *et al.,* 1938) overlying the pyroclastic succession. They form a series of flows with a few thin pyroclastic horizons, and are well exposed in the impressive crags of the Raven's Bowl [SJ 6283 0799], Bladder Stone [SJ 6275 0795] and Needle's Eye [SJ 6267 0795] 150 m south of the summit ((Figure 5.4); Locality 6), and elsewhere on the flanks of the hill. The rhyolites are generally massive, silicified, and largely denitrified quartz-alkali feldspar rocks with abundant spherulitic feldspar growths, minor chlorite intergrowths and a few albite phenocrysts. They are coloured pink, purplish red, brown and greenish grey, typically weathering brown and buff. A strongly developed pink to brown flow-banding foliation is present in many exposures and is particularly noticeable in small crags [SJ 6303 0832]; [SJ 6324 0853] along the footpath leading north from the summit (Locality 7). The bands dip generally northward, but are rarely planar, showing varying degrees of puckering, folding and brecciation.

At Hell Gate [SJ 6323 0853], about 270 m north-east of the track to the television transmitter, rhyolitic rocks with well-developed flow-banding are interbedded with strongly welded lithic lapilli tuffs containing 5 mm clasts of dacitic or andesitic rock (Locality 7). From this point northward along the track, pyroclastic material becomes increasingly coarser and more abundant, and the northern end of the Wrekin is composed of at least 400 m of mostly coarse-grained rhyolitic, andesitic and dacitic tuffs. The tuffs are intermittently exposed on the path (Locality 8) that leads from the entrance of the Country Park to the summit, via Wrekin Cottage [SJ 6371 0891]. They are generally unwelded crystal-lithic lapilli tuffs, containing fragments of andesitic, rhyolitic and dacitic rocks in varying proportions, older welded tuff and quartzite, together with broken quartz and plagioclase phenocrysts; lithic clasts may be locally up to 50 mm in diameter. At intervals there are beds of fine-grained vitric-crystal tuffs within the sequence, but these are generally subordinate to the coarse material. West of Wrekin Cottage, one of several N- to NE-trending dolerite dykes intruding the tuffs is exposed in the track leading to the summit near the flagpole marking the firing range [SJ 6330 0865] (Locality 9). East of Wrekin Cottage, quartzose sandstones of the Lower Cambrian Wrekin Quartzite are exposed intermittently on the footpath leading to the park entrance at Forest Glen (Locality 10). The unconformity with the underlying tuffs is not well exposed, but the quartzite locally contains pebbles of highly weathered igneous material.

On the north side of Forest Glen, which separates the Wrekin from Lawrence Hill and the Ercall, three of the previously mentioned NE-trending dolerite dykes are exposed in the disused Lawrence Hill Quarry [SJ 6390 0923]. The quarry is important, however, for its section through coarse-grained pyroclastic rocks and lavas that represent the upper part of the sequence exposed on the northern part of the Wrekin (Locality 11). The section reveals a group of coarse purple and green, andesitic and rhyolitic, lithic-lapilli tuffs, with some vitric and crystal tuffs, strongly welded and graded in places. In the quarry face there is a volcanic breccia horizon with blocks of rhyolite and quartz locally up to 0.3 m long (Pocock *et al.,* 1938; Toghill and Beale, 1994). In the upper part of the quarry, a sequence of vitric and lithic tuffs and lapilli tuffs includes vesicular olivine basalt considered to be a lava flow (Pocock *et al.,* 1938). At the top of the quarry is a rhyolite or dacite, which forms part of a thick sequence of flow-banded rhyolites that outcrop over much of the ground between Lawrence Hill and the Ercall.

The Ercall, lying north-east of Lawrence Hill, is largely composed of a granophyre pluton, which in thin section shows coarse micrographic intergrowths of quartz and feldspar enclosing rectangular plagioclase (albite-oligoclase) phenocrysts. Previous names given to the rock include 'granitoidite', 'eurite', 'aplite' and 'ercallite'. The Ercall Granophyre appears to have intruded the Uriconian rocks (cf. Bonney, 1879), although field evidence is now limited, and it has inevitably been compared with the intrusive granitic rocks of the Wrekin and Primrose Hill (Pocock *et al.,* 1938; cf. Thorpe, 1974). There are many exposures of the rock in disused and overgrown quarries [SJ 6455 1015] beside the road from Buckatree Hall to Wellington, but the principal ones are now in the disused Ercall Quarries [SJ 6435 0955], where the granophyre is overlain unconformably by the Wrekin Quartzite (Figure 5.5). The quarries expose a range of lithologies and relationships, described in detail by Wright *et al.* (1993) and Toghill and Beale (1994). In the main western quarry [SJ 6407 0952], flow-banded rhyolites and unwelded crystal-lithic tuffs (Dearnley, 1966) are intruded by, or possibly faulted against, a dolerite dyke that represents a continuation of one of those exposed in Lawrence Hill Quarry (Locality 12). The basal conglomerates of the Wrekin Quartzite, and the quartzite itself, overlie and are possibly faulted against the Uriconian rocks in the south-eastern corner of this quarry [SJ 6410 0945]; however, the unconformity is

exceptionally well displayed in the large northeastern quarry [SJ 6436 0962] (Locality 13). The irregular top of the Ercall Granophyre is variably weathered to a depth of 0.5 m, and the overlying conglomerates of the basal Wrekin Quartzite contain pebbles up to 0.1 m, mostly of Uriconian volcanics and, rarely, granophyre (Cope and Gibbons, 1987).

Interpretation

The Precambrian rocks of the Wrekin include the stratigraphically important but poorly understood Primrose Hill Gneisses. Locally these bear a strong resemblance to the Ercall Granophyre, and thus could be the recrystallized and tectonically reworked equivalents of Uriconian intrusive lithologies, although the textures of the metamorphic rocks are generally coarser (Hamblin and Coppack, 1995). It is noteworthy that Callaway (1886) described pebbles of schist and gneiss in nearby Uriconian sedimentary rocks that may be comparable to Primrose Hill metamorphic lithologies, but this has not been confirmed.

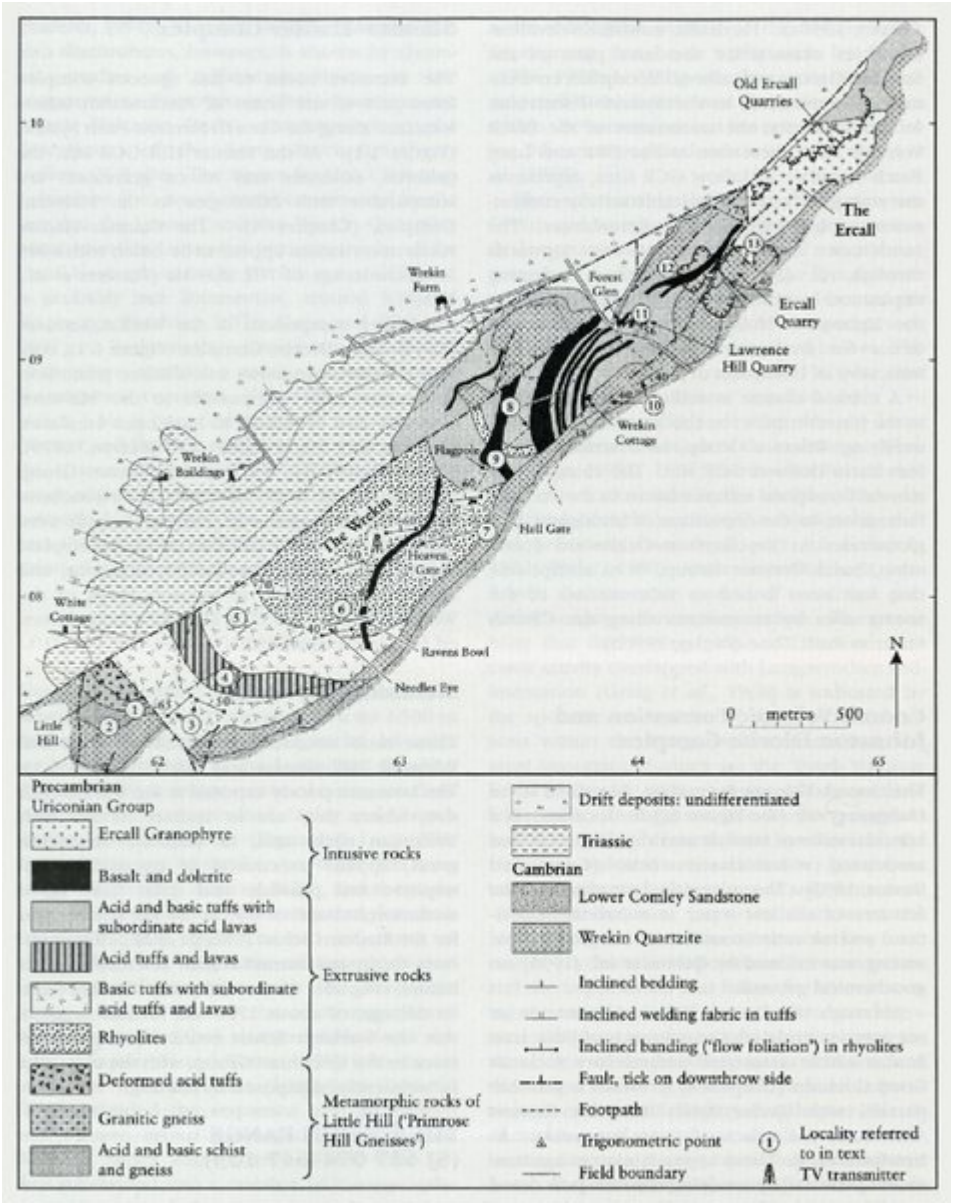
The geochemistry of the Uriconian Group (Pharaoh *et al.,* 1987b), summarized in the introduction to this chapter, suggests that this is a bimodal magmatic suite, which was generated in an ensialic marginal basin environment within a late Precambrian volcanic arc system (Figure 1.4). Radiometric studies further suggest that eruption occurred between 566 ± 2 and 560 Ma, the latter being the date of the Ercall Granophyre, which is considered to be the terminating episode of Uriconian magmatism. Most of the pyroclastic lithologies on the Wrekin are either acidic (rhyolitic and dacitic) or basic in composition, with subordinate intermediate rocks such as andesite; the lavas are largely potassic rhyolites. The volume and extent of pyroclastic material within this sequence is indicative of a highly explosive style of volcanism, whereas the occurrence of welded tuffs, and a general absence of pillowed basalts, suggests that the eruptions probably occurred sub-aerially. The abundance of coarsely fragmental lithologies, such as lithic-lapilli tuffs and local volcanic breccias, within the succession indicates proximity to volcanic centres, but no such source has yet been identified within the Uriconian Group.

The 560 Ma age of the Ercall Granophyre is also the maximum possible value for the age of the unconformable Cambrian strata. In order to more closely constrain the latter's age, however, Wright *et al.* (1993) have quoted a Rb-Sr age of 533 ± 13 Ma obtained by Patchett *et al.* (1980) on the granophyre. On the assumption that it reflects a resetting of isotope systems by a major post-Longmyndian tectonic episode, this lower value could be regarded as providing a rather younger, albeit rather imprecise, maximum age for the Cambrian marine transgression. It is in keeping with the late Tommotian age that has been proposed for the Lower Cambrian Wrekin Quartzite by Cope and Gibbons (1987).

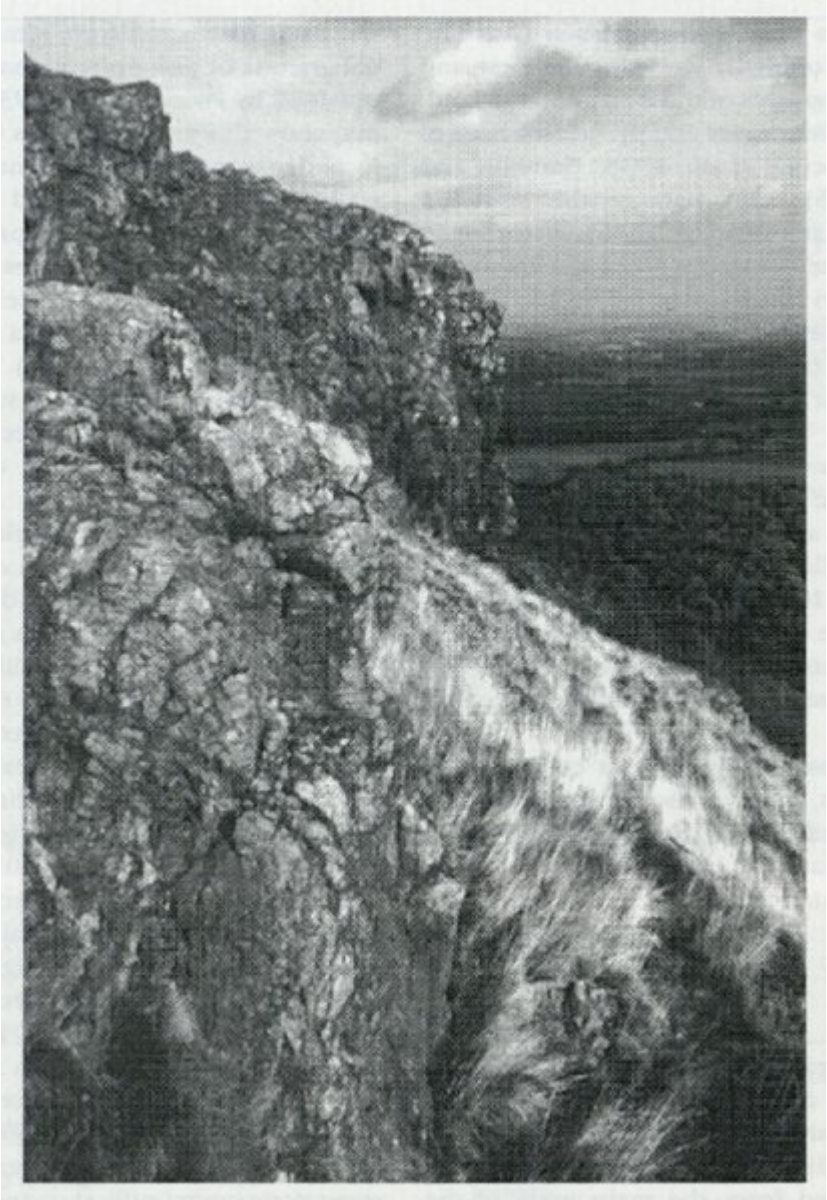
Conclusions

The Wrekin range includes excellent examples of a wide variety of pyroclastic lithologies, rhyolite and dacite lavas, subordinate basic intrusions and plutonic granite. The extrusive rocks belong to the late Precambrian Uriconian Group, which was erupted between 566 and 560 Ma, the latter date being that of a large intrusive body, the Ercall Granophyre, considered to be the final product of Uriconian magmatism. The numerous important sections of the extrusive rocks are critical to understanding the nature of late Precambrian volcanism, and the tectonic setting in which it occurred. Most of the lithologies are pyroclastic in origin and of rhyolitic composition, in keeping with the violent, explosive character of Uriconian volcanism. The Primrose Hill Gneisses are of enigmatic origin, but may testify to locally intense shearing of these rocks at a later stage in the tectonic evolution of this region. The Uriconian rocks are overlain unconformably by early Cambrian strata, which are thus no older than 560 Ma, and could be younger than about 533 Ma.

References

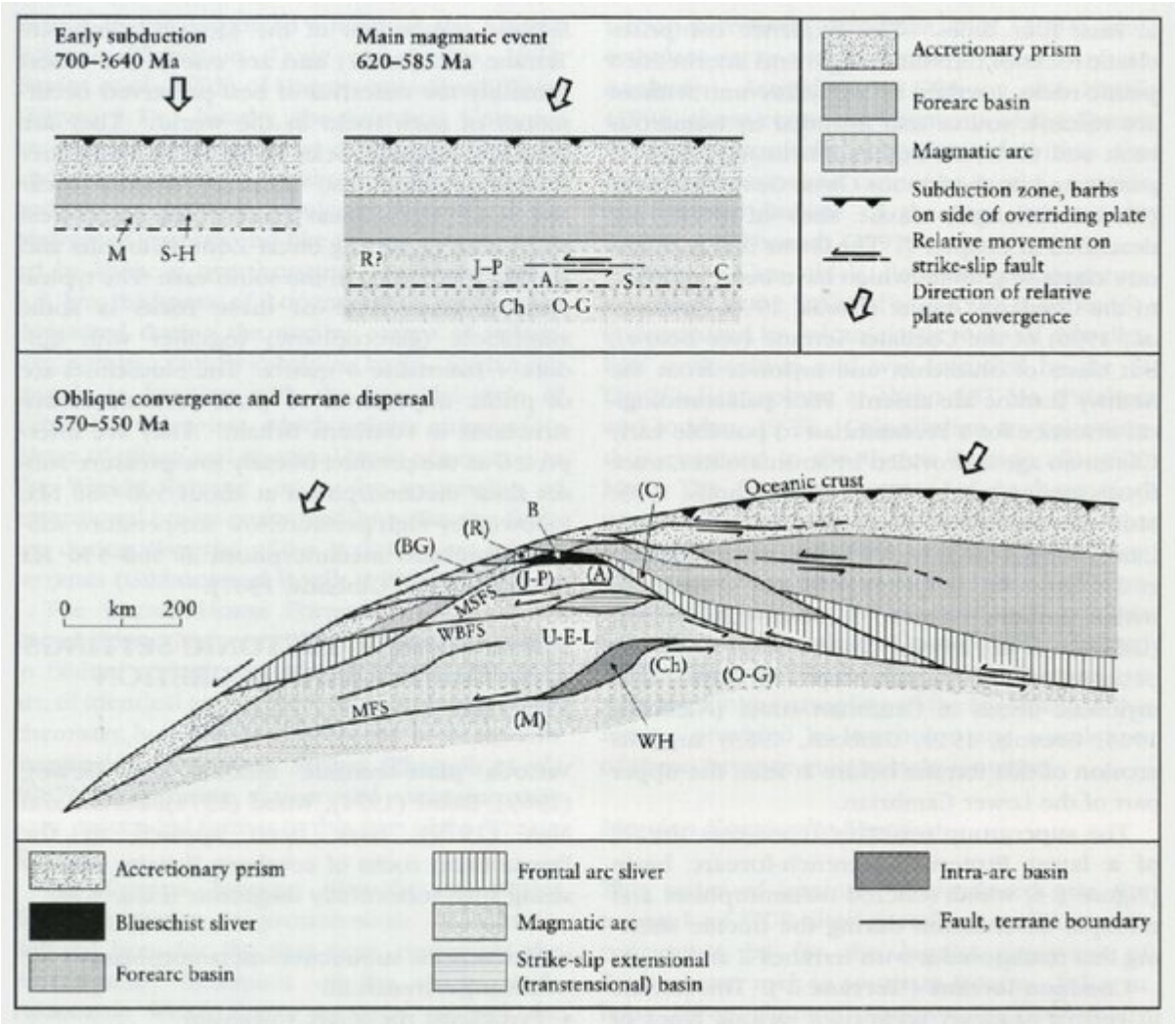


(Figure 5.3) Geological map of the Wrekin range.



(Figure 5.4) Crags in massive, silicified rhyolitic lavas of the Uriconian Group at Raven's Bowl, south-east side of The Wrekin. (Photo: D. Wilson.)

(Figure 5.5) Exposures in Ercall Quarry showing the Ercall Granophyre (left of picture) unconformably overlain by well-bedded Lower Cambrian Wrekin Quartzite. (Photo: D. Wilson.)



(Figure 1.4) Model for the late Precambrian evolution of the Avalonian subduction system: episodic Precambrian magmatism (top two cartoons) followed by the dispersal of terranes by transcurrent faulting along the plate margin as

convergence became increasingly oblique during the latest Precambrian (modified from Gibbons and Horik, 1996). Note that the presence of the Monian Composite Terrane within this system cannot be proved until Arenig time. A = Arfon Group; B = Anglesey blueschists; BG = Bwlch Gwyn Tuff and related strata (Anglesey); C = Coedana Complex; Ch = Charnian Supergroup; J-P = Johnston Plutonic Complex and Pebidian Supergroup; M = Malverns Complex; MFS = Malverns lineament or fault system; MSFS = Menai Strait fault system; O-G = volcanics in Orton and Glinton boreholes; R = Rosslare Complex; S = Sam Complex; S-H = Stanner-Hanter Complex; U-E-L = Uriconian Group, Ercall Granophyre, Longmyndian Supergroup; WBFS = Welsh Borderland fault system; WH = Warren House Formation. The same letters in brackets (lower cartoon) refer to the relative positions of those volcanic belts that were by then extinct.