D3 Posbury Clump Quarry

[SX 815 978]

Highlights

This is the best section through trachybasalt lavas of the post-Variscan volcanics; autobrecciated lava tops and basal lava/soft-sediment contacts are both well seen.

Introduction

The site comprises the disused, elongate quarry on the hill about 0.4 km to the north-east of Posbury village. It is now heavily overgrown, although at the far end of the quarry and along the northern side a 15 m high face is partly accessible.

The Exeter Volcanic 'Series' was divided by Knill (1969) into a basaltic suite and a potassic suite. The latter mainly consisted of lamprophyres together with minor syenites and trachybasalts. This site is representative of the trachybasalts, although these rocks are not particularly K-rich compared with the other volcanics in the potassic suite. It was also demonstrated by Floyd (1983) that the trachybasalts around Crediton, including this site, were chemically related to the olivine basalts of Dunchideock and Silverton, analysed by Cosgrove (1972). The general field and chemical features of the basaltic suite described at Webberton Cross Quarry (discussed above) also apply here.

Description

Most of the quarry was developed in a massive, purplish-grey, variably vesicular trachybasalt lava flow. At the northern end of the quarry (by the stepway), can be seen a crude flow foliation, marked by steeply dipping trains of elongate vesicles. Their trend is not uniform across the quarry face, but varies in direction and degree of dip. Towards the quarry top, the massive lava is replaced by a reddened rubbly top to the flow. The junction is very irregular, dipping down into the massive lava, but crudely parallels the flow foliation. In detail, the junction between the rubbly flow top and massive lava is gradational and probably indicative of local autobrecciation, with cracks outlining incipient blocks in the massive portion of the flow. Spaces between the blocks in the rubble are now filled with coarse sparry calcite. At a lower level along the quarry wall, a further autobrecciated lava horizon is exposed, with the same gradational relationship. Many of the angular, purple-hearted lava blocks have highly vesicular, oxidized chilled rims and vesicle-poor centres.

Much of the rest of the quarry shows the lava flow closely associated and physically admixed with clastic sediments. This *mélange* is composed of highly vesicular, often flow-laminated, lava and baked red sandstone and siltstone. There appear to be two relationships exhibited by the lava and sediments. In the first, the lava forms angular blocks (varying from a few centimetres in width up to 1 m) mixed with smaller, red, baked sediment fragments. This suggests that the rubbly lava base flowed over a partly consolidated sediment surface, picking up fragments as it travelled forward. In other instances, the two main constituents do not form discrete blocks as such, and the lava appears rather to net vein the sediment, so that lava fingers and tubes intimately penetrate a sediment matrix. Contacts are often very irregular, cuspate, or in some cases diffuse and wispy rather than sharp. This suggests that the lava flowed over wet, unconsolidated sediments with basal lava lobes penetrating deep into an unstable sandy surface. A further feature of interest in this connection is the neptunean dyke at the northern end of the quarry. This is a vertical sediment dyke with very irregular margins, a width of *c.* 1 m at the base, and composed of structureless dolomitic sandstone. The actual mode of emplacement is not clear, although there are no sedimentary features which suggest that it was formed by the infilling of sand from the top.

Petrographically, most of the trachybasalt is highly altered, although it can be inferred from the fresher rock samples that the lava was olivine-and plagioclase-phyric, with a matrix of olivine, plagioclase, augite, K-feldspar and magnetite. Hematite, carbonate and clays are the common alteration products, with calcite, quartz and zeolites infilling the vesicles

(Krill, 1969). Quartz xenocrysts, presumably derived from the sandstones over which the lava flowed, are also present. A trachytic flow texture is sometimes discernible if the rock matrix is not too altered.

Interpretation

The trachybasalt of this site probably belongs to the mildly alkaline basaltic suite of the Exeter Volcanic 'Series' with which it has petrographic and chemical affinities. The regional significance of these post-orogenic basaltic volcanics and their particular chemical signature has been discussed previously in the description of the Webberton Cross Quarry.

Apart from representing an additional example of the Exeter Volcanic 'Series' basaltic suite, the geological interest in this site concerns the lava flow itself and its relationship with the associated red-bed sediments. Since the times of Ussher (1902), when the exposure was better and less degraded, it has been one of the few sites where there is reasonable evidence remaining to demonstrate that the Permian basalts were in fact lava flows and they had autobrecciated flow tops. The trachybasalt–sediment association also provides evidence for the nature of the land surface over which the lava was flowing. This was composed of a wet, partly consolidated sand into which the base of the flow ploughed to produce an intimate admixture. The highly vesicular nature of the basal portion of the lava suggests it was charged with volatiles that, together with steam generated from the sediments, fluidized and aided penetration of the sediments.

Conclusions

Posbury Clump Quarry shows graphic evidence for volcanic eruption on to the arid Permian landscape. Here basaltic lava, part of a suite of lavas called collectively the Exeter Volcanic 'Series', was erupted over newly deposited Permian sediments. Several features characteristic of lava flows may be seen to advantage at the site: evidence of the flow direction in the form of vesicle trains (former gas bubbles), aligned crystals in what is called a flow texture, rubbly broken tops to flows and an intricate relationship with the sediments below. This last feature takes the form of an intimate mixing between the lava and sediment, so that sharp contacts do not exist. This was produced by the effusion of the lava onto or partly into wet sediments. Apart from a mechanical mixing, water flashed to steam helped to fluidize the sediment and allow lava penetration through this medium. On the other hand, more rubbly mixture of lava blocks and sediment clasts resulted where consolidated sediments were ripped up from the surface as the lava flow moved across it. This is a key site for the study of the lavas which were formed after the Variscan Orogeny and for their relationship with Permian sedimentary rocks.

References