D5 Killerton Park and quarries

[SS 971 005]

Highlights

This is the best locality for the study of compositional variation within the lamprophyres of the post-Variscan volcanics; three distinct types of lamprophyres are clearly associated here.

Introduction

The lamprophyres of Killerton Park have been known for some time (Ussher, 1902), with petrographic details recorded by Tidmarsh (1932) and Knill (1969); the last placed them in the broad potassic group of the Exeter Volcanic 'Series'. A map showing the distribution of the various lamprophyric types in the area is shown in (Figure 6.8).

The site covers much of Killerton Park (National Trust) and Columbjohn Wood. The disused quarry [SS 980 001] at Budlake just outside the Park is also included, exposing a basaltic lava that belongs to the same volcanic province.

The few chemical analyses available (Cosgrove, 1972; Thorpe *et al.,* 1986; Leat *et al.,* 1987) exhibit the same high level of incompatible-element enrichment that is typical of the potassic group as a whole, as well as the characteristic subduction-related chemical signature (see Hannaborough Quarry above).

Description

Distribution of the lamprophyric lavas in Killerton Park (Figure 6.8) shows the close association of three main types: a biotite–apatite minette, an augite–biotite minette and a highly potassic minette or syenitic lamprophyre (Knill, 1969). The field relationships of the minettes are generally obscure, although Knill (1969) reports that the biotite–apatite-phyric variety occurs as xenoliths in the augite–biotite-phyric type. They are all assumed to be lavas fed by small fissures, but good evidence as to their mode of emplacement is lacking. In Columbjohn Wood, however, Permian red-bed sandstones were at one time seen to overlie the eroded surface of a lava flow (Knill, 1969).

One of the Killerton lavas has yielded a whole-rock K–Ar age of 291 Ma BP (Thorpe *et al.,* 1986; recalculated from Miller and Mohr, 1964) just below the Stephanian–Permian boundary and contemporaneous with the basaltic group of the Exeter Volcanic 'Series'.

One of the best exposures in the Killerton Park site is the quarry 100 m east of The Clump hillock and the surrounding area. This exposes approximately 20 m of a massive, fine-grained, blue-grey minette. Although generally considered to be a lava flow, it is poorly vesicular and does not show any internal flow features or flow boundaries. It is heavily jointed with a dominant subvertical set, the surfaces of which are reddened by hematite. There are small, apparently random differences in texture — in particular, grain-size changes from very fine-grained (almost glassy looking) to pitted and weathered coarser-grained areas. Small, brown biotite and rarer green, pyroxene phenocrysts can be seen in hand specimen, again irregularly distributed throughout the exposed body. The bulk of the lamprophyre is a biotite–pyroxene–phyric minette with a matrix of K-feldspar, biotite, titanomagnetite and apatite. Biotite may occur as both mega- and microphenocrysts which show different pleochroic schemes. A chemical analysis of a separated megacrystic biotite (Tidmarsh, 1932) shows it to be rich in Ti and Mg (with a chacteristically low FeO/MgO ratio of 0.67) distinct from the Dartmoor Granite high-Fe biotites. Much of the matrix may be composed of secondary minerals such as hematite, carbonate and clay.

Interpretation

This site shows representatives of the biotite-phyric minette, which is the typical lamprophyre type of south-west England, as well as the Exeter Volcanic 'Series'. A number of other minettes are present here in close proximity to each other, although their actual contact relationships are obscure. These volcanics are always assumed to be lavas (rather than high-level intrusives), although evidence for good flow features in the present outcrops is lacking.

The specific chemical features of the Killerton Park minettes are similar to other lamprophyres from south-west England, and the same general comments concerning their chemical petrogenesis apply (see Hannaborough Quarry).

Conclusions

The sections here show various lamprophyre lavas of the Exeter Volcanic 'Series' erupted around 290 million years ago. One of the sections here shows lava buried beneath red Permian sandstone, the latter having been deposited in the equatorial desert conditions of that time. Like the site at Hannaborough (as discussed above) the rocks here are characterized by very high incompatible-element contents, and are subject to debate over their origin and the nature of the source. Their unusual composition is considered generally to reflect a specific mantle composition, although crustal contamination is also a possibility. The site shows key sections in representatives of the biotite-phyric minette, which is a typical lamprophyre of south-west England.

References