



Tertiary Igneous (TER-IGN)

Block Description

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Introduction

The GCR sites selected for this GCR Block represent a major episode of intrusive and extrusive igneous activity in north-west Britain that occurred during Palaeocene and early Eocene times (c. 63–52 Ma) that accompanied continental separation and lithospheric attenuation during the early stages of the opening of the North Atlantic Ocean.

For details of stratigraphy see **Palaeogene (PGN)** and **Neogene (NEO)**.

Tertiary Igneous rock distribution

In Great Britain, volcanism was most vigorous in the Inner Hebrides and adjoining north-west Scotland but also extended to southern Scotland, north-east England and the Outer Hebrides. Intrusions of similar age in North Wales and the English Midlands are probably outlying representatives of contemporaneous activity in north-east Ireland, additional activity in the Bristol Channel centred on Lundy. The region encompassing the activity is known as the British Tertiary Volcanic Province (BTVP) or the British Tertiary Igneous Province (BTIP).

The varied igneous rocks, together with associated sediments and metamorphic rocks have responded in different ways to the profound erosion of the last fifty million years. Gabbro and peridotite have given rise to the rugged mountain scenery of St Kilda, the Skye Cuillins and Rum. The considerable, but generally less-rugged, mountains of northern Arran and the Skye Red Hills are composed of granite, while the piles of flat-lying lavas form tabular, 'trap-featured' hills in northern Skye, rising sometimes to form high mountains, as at Ben More, Mull.

Tertiary Igneous activity and petrology

The igneous activity took many forms and involved a wide variety of magmas and rock types. The remains of large accumulations of dominantly basaltic lava flows cover extensive areas in Skye and Mull. Laterally extensive swarms of basaltic dykes are most intense near Skye, Rum, Mull, and Arran but extend to the Outer Hebrides, southern Scotland, Cleveland in north Yorkshire and parts of North Wales and central England. Central intrusive complexes consisting of granite, gabbro, peridotite and other rock types occur on a line from Skye to the Bristol Channel and at several places in the north-east Atlantic; these are the deeply-dissected roots of major volcanoes.

Volcanism in the BTVP extended over a period of about eleven million years, largely within the Palaeocene Epoch, apart from the later intrusions within the Eastern Red Hills Centre of Skye, the Sgurr of Eigg pitchstone, the Lundy granite complex and the youngest intrusion in the Mourne Mountains Western Centre, Ireland. The Palaeocene volcanism was preceded by Cretaceous igneous activity in the eastern Atlantic area and it is also possible that the submarine central complex at the Blackstones, south-west of Mull, is Cretaceous in age. Within the BTVP, the life span of individual central complexes was short, of the order of two or three million years (or even less) and the thick lava accumulations built up over even shorter periods.

Volcanic activity in a given area often started with the formation of small amounts of basaltic ash and other volcanoclastic accumulations. These were quickly followed by voluminous subaerial eruptions of basaltic lavas which covered the peneplaned surfaces of older sedimentary and metamorphic rocks ranging in age from the Precambrian to the Cretaceous. Occasionally, the lavas covered landscapes of considerable relief, filling valleys, burying hills and sometimes flowing into shallow lakes, where pillow lavas and hyaloclastites formed. Sedimentary horizons are not common in the lavas, but fluviatile conglomerates, sandstones and fine-grained plant-bearing horizons do occur and provide valuable stratigraphical and palaeogeographical information. The lavas were often subjected to intense weathering between flow extrusion, with the formation of bright red lateritic deposits. With increasing thickness of lavas, heated waters circulating through the flows altered the

basalts and deposited distinctive suites of zeolite minerals, for which Skye and Mull are particularly noted.

The lavas were principally fed from fissure eruptions similar to those of present day Iceland. The actual feeders are among the multitude of dykes forming the swarms which extend across the Province; dykes intrude virtually all intrusions and extrusions in the BTVP, so it is likely that lava effusion also occurred throughout the life span of the Province. However, the thick sequences of lavas now preserved in Mull, Skye, and the Small Isles built up between about 63 Ma and 60 Ma, early in the life of the BTVP. Occasionally, lavas must have been erupted as the central complexes developed; there is good evidence from several centres that silicic and intermediate lavas were closely associated with central complexes but there are few substantiated examples of basaltic lavas, with the exception of pillow lavas within the Mull centre. Not all the (predominantly basaltic) magma reached the surface to form flows, some froze in conduits as dykes and plugs and quite large amounts spread laterally through the Mesozoic sediments beneath the lavas to form the prominent dolerite sills of northern Skye and Arran.

The central complexes generally post-date the adjoining lavas, but they were intruded by later members of the dyke swarms. Within the complexes the magmatic sequences were rarely straightforward: in Mull early granite intrusions were followed by numerous basaltic, intermediate and acid cone-sheets, by gabbros and peridotites and by further granites; in Skye, the sequence was apparently simpler, the gabbros and peridotites of the Cuillins were cut by numerous basaltic cone-sheets and subsequently by granites of the Red Hills. Thus, the central complexes record varied intrusive sequences in which basaltic and granitic magmas have been intimately associated. Occasionally, it may be shown that contrasted magmas must have coexisted, forming, for example, the composite basalt–quartz–porphyry sheets and dykes of the Province and the complicated intrusion breccias found in Ardnamurchan, Skye and other central complexes.

Within the central complexes, individual centres of activity are defined by arcuate intrusions – cone-sheets, ring-dykes and stocks – which have a common focus. In most central complexes, and in particular Ardnamurchan, Skye and Mull, the intrusions of one centre may cut those of an earlier one, recording movements in the focus of magmatic activity with time. Ardnamurchan provides an exceptionally clear and often cited example of this phenomenon.

GCR site selection

The Tertiary igneous activity occurred in geographically well-defined areas which usually include a central volcano and surrounding lavas. These areas have been made the basis of the 'networks' for site selection.

- Isle of Skye
- Rum, Eigg, Muck, Canna–Sanday
- Ardnamurchan
- Isle of Mull
- Isle of Arran
- Rockall
- St Kilda
- Langbaugh Ridge and Cliff Ridge