Late Palaeogene and Neogene, Palaeogene volcanic districts of Scotland


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Introduction
North Arran Granite Pluton. P914151

Following the cessation of igneous activity in the early Eocene, the geological evolution of the area was dominated by uplift, weathering and erosion, with the accumulation of clastic debris offshore. Rapid erosion of the Highlands provided detritus which accumulated in the North Sea Basin in considerable thickness during Paleocene to early Eocene times. The major sediment influxes may have been pulsed, in response to the Palaeogene igneous activity and were not equalled later (e.g. Zeigler, 1981; White and Lovell, 1997). In contrast, the late Eocene to Neogene was a period of relatively limited uplift and erosion of the Highlands and western Scotland (Hall, 1991). Terrestrial sedimentary rocks of Oligocene age occur in restricted basins and have been proved in a borehole in the Little Minch, south-east of Harris and in the Canna Basin south-west of Skye where they are about 1000 m thick (Fyfe et al., 1993). Oligocene rocks also occur on the Blackstones Bank where they partly conceal the central complex. The sediments consist of carbonaceous mudstone with plant debris and lignite deposited in a floodplain or lacustrine environment of swamps and fens.

In common with several areas on the mainland, deep chemical weathering predating the Quaternary glaciations has affected the Inner Hebrides and Arran. Chemical weathering profiles, particularly of basic and ultrabasic rocks, occur on Rum where they are found both beneath glacial deposits and in pockets, up to 21 m deep, on bare rock surfaces (e.g. Ball, 1964). The age of the weathering is uncertain, but much of it may date from the Eocene to the Miocene, when chemical alteration would have been favoured by the prevailing warm, wet conditions. Extensive weathering did occur during the Pleistocene and continues to the present day, with physical rather than chemical processes causing disaggregation.

The present-day landscape has clearly developed over a considerable period of time, but the history of uplift and erosion is poorly understood. The distribution of the Cretaceous rocks (Chapter 3) and the sedimentary lithologies associated with the Eigg Lava Formation (Chapter 6) indicate that when igneous activity began at about 61 Ma, relief over the area was generally subdued. It has been recognised that there was rapid, deep subaerial erosion during the Paleocene (e.g. Hall, 1991). This erosion occurred as the central complexes grew and the lava fields developed; there is evidence that the Rum Central Complex was unroofed in less than 1.6 Ma (Hamilton et al., 1998; Chambers et al., 2005 see also chapters 5, 6 and 9). Evidence from the central complexes indicates that mountain
massifs formed by a combination of igneous intrusion and extrusion, faulting and folding. Major differential movements occurred in and around all of the central complexes, and evidence for this is particularly well preserved on Mull and Arran (P914146; P914151).

The Cuillin hills (about 970 m OD), certain of the Red Hills and the Kyleakin Hills of Skye (about 720 m OD) all show a similar altitude of the main summits and this is also apparent elsewhere. In the past, this similarity in the levels has been attributed to marine planation during a relative rise in sea level, most likely in the Neogene. This interpretation is almost certainly wrong because most uplift occurred during the Paleocene and sea level dropped during the Neogene. Tilted planation surfaces of subaerial origin have been recognised, for example on Skye outwith the Cuillin (at 500 to 700 m, 400 to 450 m, and 250 to 300 m OD) and a lower surface is identified at 80 to 120 m OD at many places in western Scotland, including Skye, Rum, Ardnamurchan and Mull (Le Coeur, 1988). These planation surfaces are now attributed to uplift that occurred in a number of stages, and it can be inferred that some tectonic tilting and deformation took place subsequent to the Paleogene igneous activity. Evidence for faulting of the lower planation surface during the Neogene is found in the offshore extension of the surface east of Lewis. This is thrown down to the east by about 150 m on the Minch Fault. Flexuring of the surface is seen at a number of places; for example, it is tilted towards the west on either side of the Sound of Raasay (Le Coeur, 1988).

References

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