Fionchra

Highlights

The site is of particular importance since it contains the only example of lavas clearly postdating a central complex in the British Tertiary Volcanic Province. It also excellently demonstrates the interaction between the accumulation of lavas and the development of a contemporaneous fluviatile system.

Introduction

Four outliers of Tertiary volcanic rocks and associated fluviatile conglomerates and lacustrine sediments form the summits of Fionchra, West Minishal, Orval and Bloodstone Hill in north-west Rum (Figure 3.4) and (Figure 3.5). The site is unique within the Tertiary Igneous Province as it contains the only known occurrence of lavas which are demonstrably younger than the nearby central intrusive complex.

The lavas and associated sediments were first described by MacCulloch (1819). Judd (1874) correctly deduced their age relative to the plutonic rocks. However, Geikie (1897) and Harker (1908) both considered them to be relicts of a once extensive plateau embracing all the Small Isles subsequently intruded by the Rum Central Complex. Harker also frequently misinterpreted the massive flow interiors as intrusive sheets or sills (see site descriptions for northern Skye). Tomkeieff (1942) reinterpreted Harker's sills as trachyandesitic lava flows and, together with Bailey (1945), considered them to be of a pre-granophyre age.

Black (1952a) established beyond doubt that the lavas post-dated the Western Granophyre on Orval and had infilled a series of valleys carved into the granophyre and Torridonian country rocks. Through the work of Black and the more recent detailed studies of Dunham and Emeleus (1967), Emeleus and Forster (1979) and Emeleus (1985), the stratigraphy and petrology of these unique lavas are known in considerable detail.

Description

The lavas of the four outliers are essentially flat-lying or dipping gently to the west. They rest unconformably on Torridonian sediments and the Western Granophyre, overlapping the Main Ring Fault. The unconformity is irregular and the lavas appear to have filled an evolving river valley system. The most complete lava succession occurs on Fionchra where Black (1952b) estimated a total maximum thickness of over 500 m; however, not all members are represented here.

Emeleus (1985) remapped the Tertiary lavas of Rum and proposed a fourfold subdivision:

1. Lower Fionchra Formation. This is the oldest lava formation; it fills a river valley cut into Torridonian sediments and lined with Tertiary conglomerates. On the south side of West Minishal [NG 348 003], the lavas pass undisturbed across the Main Ring Fault to overlie the granophyre. The lavas are alkali-olivine basalts, typical of many Hebridean lavas, but less alkaline than those of Skye. Most contain phenocrysts of olivine and plagioclase. More fractionated, hawaiitic flows occur in the west of the Orval outlier where Black (1952a) demonstrated that they rest on an eroded surface of weathered granophyre. North of Minishal the lavas rest on thick fluviatile conglomerates which contain clasts derived from rocks now exposed in the Rum central complex (granophyre, porphyritic felsite, gabbro, explosion breccia, allivalite) and the country rocks (gneisses and Torridonian sandstones). There are also clasts of tholeiitic basalt, frequently vesicular, and dolerite. The basalts are compositionally unlike any now exposed on Rum or the adjoining islands.
2. Upper Fionchra Formation. This subdivision contains lavas termed 'mugearites' by earlier workers. Chemically, the lavas are tholeiitic and contain clinopyroxene and plagioclase phenocrysts; in modern terminology they are tholeiitic basaltic andesites. Some flows low in the Bloodstone Hill outlier and the lowest flows on Fionchra are strongly

feldspar-phyric and are superficially similar to some of the porphyritic upper members of the Skye composite flows (Harker, 1904; Kennedy, 1931b). The lavas rest on a slightly irregular surface of Torridonian arkose and Western Granite and are observed to overlap the Main Ring Fault at Bealach a'Bhraigh Bhig [NM 339 999]. On the western side of Bloodstone Hill [NG 317 006] and along the western and northern faces of Fionchra ([NG 332 009]–[NG 337 006]), a series of fluvial conglomerates, commonly containing porphyritic felsite and granophyre clasts, and silty beds separate the Upper Fionchra Formation from the underlying Lower Fionchra Formation lavas. These silty, lacustrine sediments contain plant remains such as leaf impressions. The sediments appear to fill a valley system partly excavated in the lavas of the Lower Fionchra Formation. The sediments frequently pass up into pillow breccias (for example, at [NG 3367 0070]) with the appearance of broken, angular or glassy lobate fragments of basalt in a finer basaltic breccia. Ponding of the lavas where they appear to have flowed into a small lake is indicated by the unusual thickness of the lowest flow and the occurrence of pillow breccias in its lower portions; the basal few metres of the flow are strongly columnar at Coire na Loigh [NG 332 009].

3. Guirdhil Formation. Rocks recognized by Ridley (1971, 1973) as icelandites comprise this formation. Their phenocryst assemblage consists of clinopyroxene, orthopyroxene, plagioclase and opaque oxide. The lavas of this formation occupy a twice-excavated, conglomerate-filled valley carved into the Upper Fionchra Formation and Torridonian sediments at Bloodstone Hill [NG 3165 0055]. At Bealach a'Bhraigh Bhig [NG 340 002], a small valley fill of icelandite lava rests directly on rubbly granophyre about 150 m north of the col, and lava overlying conglomerate adheres to the south side of Fionchra ([NG 335 005]; Emeleus and Forster, 1979).
4. Orval Formation. These lavas are olivine- and feldspar-phyric hawaiites and basaltic hawai-ites, petrographically similar to the lavas of the Lower Fionchra Formation. However, the Orval Formation lavas tend to be coarser-grained and contain biotite as overgrowths on opaque oxides and as discrete crystals. In addition, alkali-feldspar mantles strongly normal-zoned plagioclase phenocrysts. The flows are massive and the formation probably contains three or four flows, although these are not easily distinguished. High on Orval, just east of the summit, the formation cuts across strongly terraced flows belonging to the upper part of the Lower Fionchra Formation showing the younger age of the Orval Formation lavas. Elsewhere, the lavas of this formation lie directly on granophyre with no intervening conglomerate.

The chronological sequence of the formations is fairly clear; the oldest is the Lower Fionchra Formation which is overlain unconformably by both the Upper Fionchra Formation and the Orval Formation. The Upper Fionchra Formation is unconformably overlain by the Guirdhil Formation but there is no direct evidence for the relative ages of the Guirdhil and Orval Formations. However, the absence of clasts derived from the Orval Formation in the conglomerates associated with the Guirdhil Formation suggests that the Orval Formation is the younger.

No intrusions of compositions comparable with the lavas in the Fionchra site have been found on Rum, implying that the source(s) must have been outside the present area of the island. A possible source may have been offshore of eastern Canna, since coarse volcaniclastic rocks, probably of very local origin, are interbedded with the lavas of Compass Hill (East Canna and Sanday). However, this problem has not been fully resolved. These lavas are grouped with those of Canna and Sanday in the Canna Lava Formation, the individual 'formations' identified above are now termed 'members' (Emeleus, in preparation).

Interpretation

The Fionchra site contains an incomplete sequence of Palaeocene lavas which record the last major igneous event on Rum. The lavas and associated sediments are interpreted as having accumulated in a succession of hilly landscapes, filling valleys orientated parallel to the Main Ring Fault which was probably a zone of weakness exploited by weathering. River systems cut valleys into Tertiary granophyre and Torridonian rocks which occasionally became the sites of shallow lakes in which were deposited fine-grained sediments; the coarser conglomeratic sediments of the sequence probably had a fluviatile origin. Plant remains in the lacustrine sediments suggest a warm, temperate climate. Erosion occurred during periods of volcanic quiescence when the drainage system was reestablished. The Tertiary sediments are considered by Emeleus (1985) to result from the erosion of a terrane consisting of Palaeocene lavas and igneous intrusive rocks as well as Lewisian and Torridonian basement rocks.

The site provides unequivocal evidence for the post-Central Complex age of the lavas. This comes from:

1. the presence of clasts of gabbro, allivalite, peridotite, felsite, granophyre/microgranite, tuffisite and volcanic breccia in the interlava conglomerates (Figure 3.6);
2. the occurrence of lava flows resting on a weathered surface of granophyre; and
3. lavas overlapping the Main Ring Fault which separates granophyre and Torridonian sediments.

The Central Complex was clearly unroofed prior to accumulation of the lavas and it must have formed high ground which continued to undergo active subaerial erosion throughout the period of lava effusion.

The lavas and some of the sediments are comparable with those on Canna and Sanday (see below) to which they are related. Somewhat similar sediments also occur in south-west Skye (Allt Geodh a'Ghamhna). Taken together with these sites, Fionchra is a major link in a line of evidence which clearly indicates that the Rum central complex predated the central complex on Skye (for example, Meighan *et al.,* 1981; Dagley and Mussett, 1986).

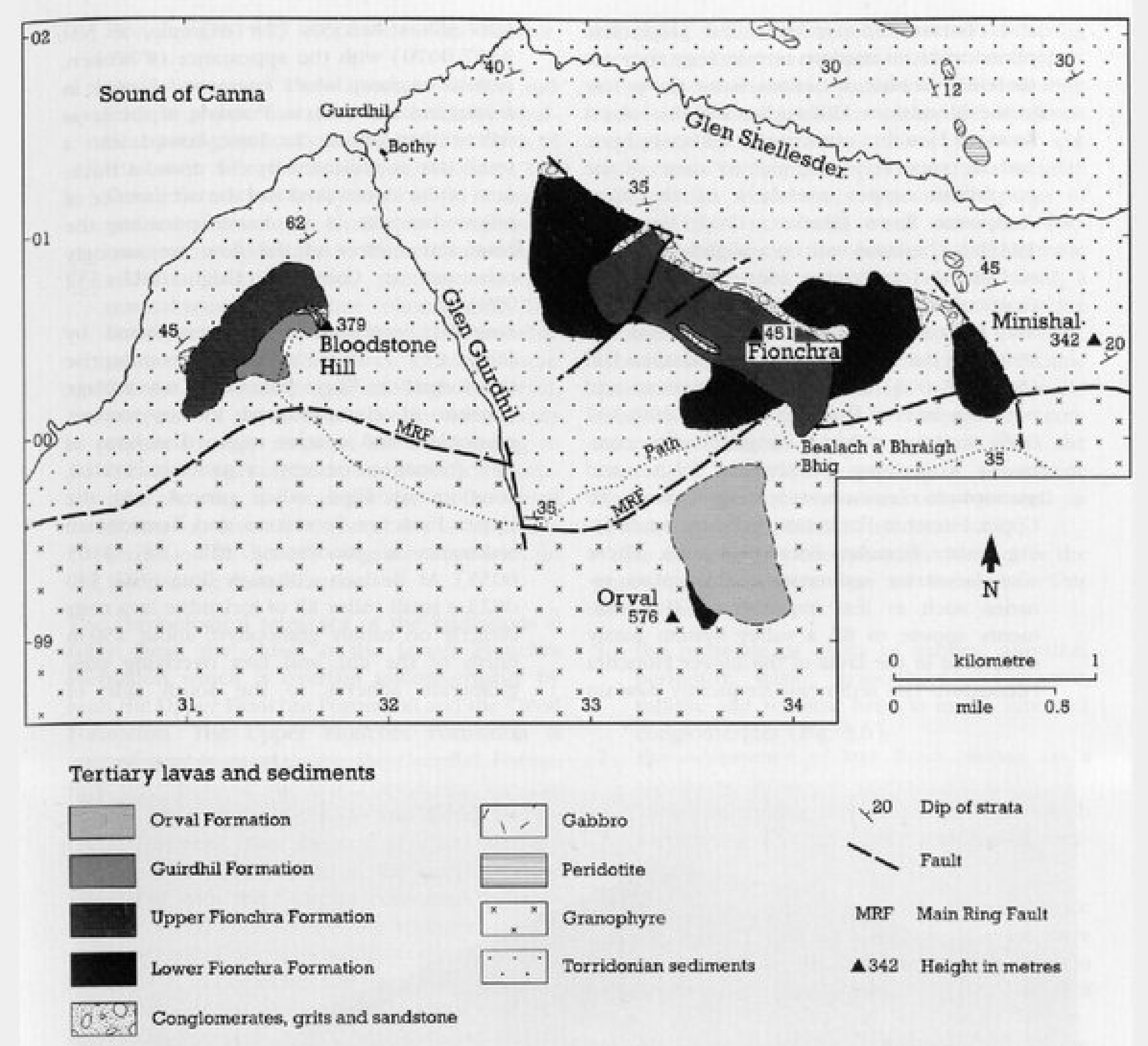
The Rum lavas varied considerably in composition with time. The Lower Fionchra Formation flows are alkali basalts but they were preceded by tholeiitic flows, now only represented by clasts in underlying conglomerates. The succeeding Upper Fionchra and Guirdhil Formations are tholeiitic and show progressively more evolved, or fractionated compositions up the sequence; however, the final flows of the Orval Formation, are fractionated alkali basalts and hawaiites. The Rum flows were probably derived from at least two source magmas, one alkali basaltic in character, the other tholeiitic. There are only limited age data available (about 58 Ma; Dagley and Mussett, 1986), but all flows sampled, to date, gave reversed magnetic polarities and it is likely that they were erupted in a short space of time (Mussett *et al.,* 1988, figure 2; see also Chapter 1, (Table 1.1)).

Conclusions

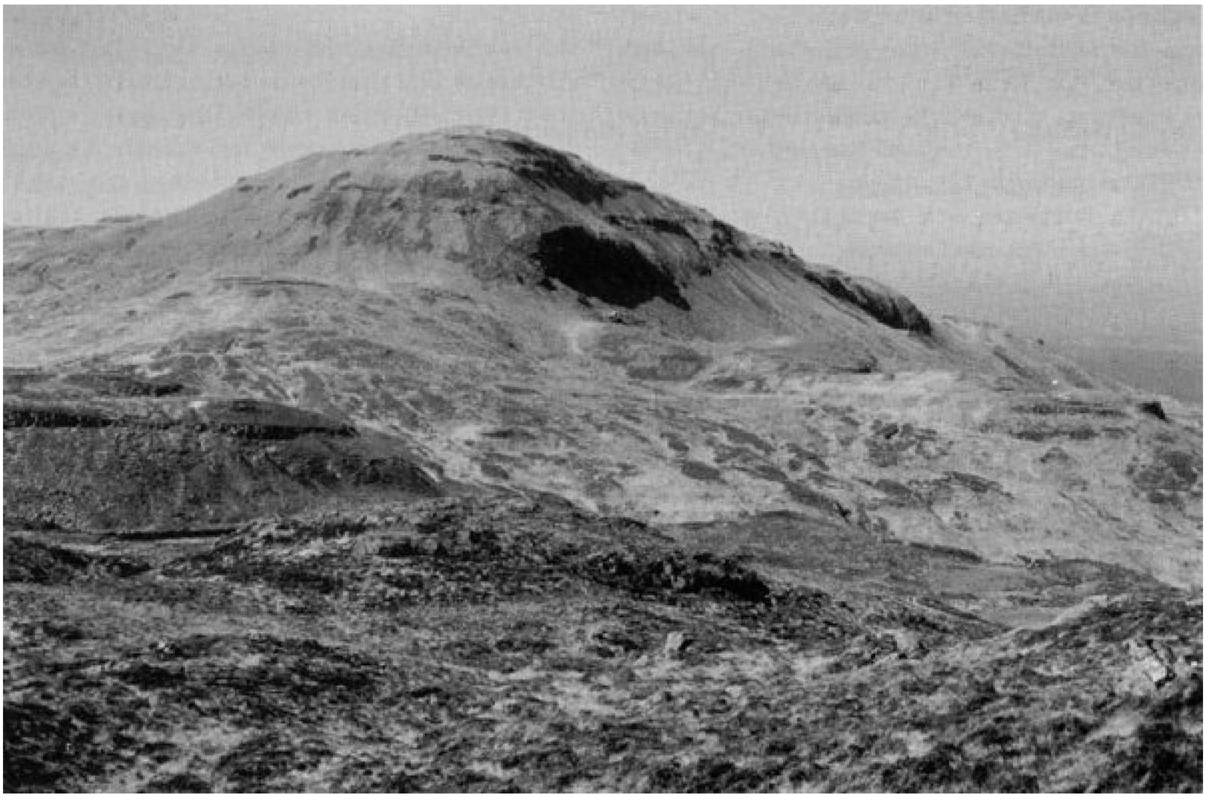
The final phase of igneous activity on Rum resulted in the accumulation of lavas and associated sediments now exposed only in the Fionchra site. The site provides an excellent opportunity to study the interaction between the emplacement of lava flows and a palaeofluvial system.

The Tertiary lavas of Rum were possibly erupted from a centre or centres north-west of Rum and these filled valleys in an incised topography. Four lava members are recognized, each separated by unconformable contacts, conglomerates and some fine-grained lacustrine sediments. Clast populations in the intra-flow conglomerates show that the lavas post-date the emplacement of the Central Complex which was unroofed by the time that the first lavas erupted. Preliminary geochemical investigations show the presence of lavas of both tholeiitic and alkaline affinities.

References

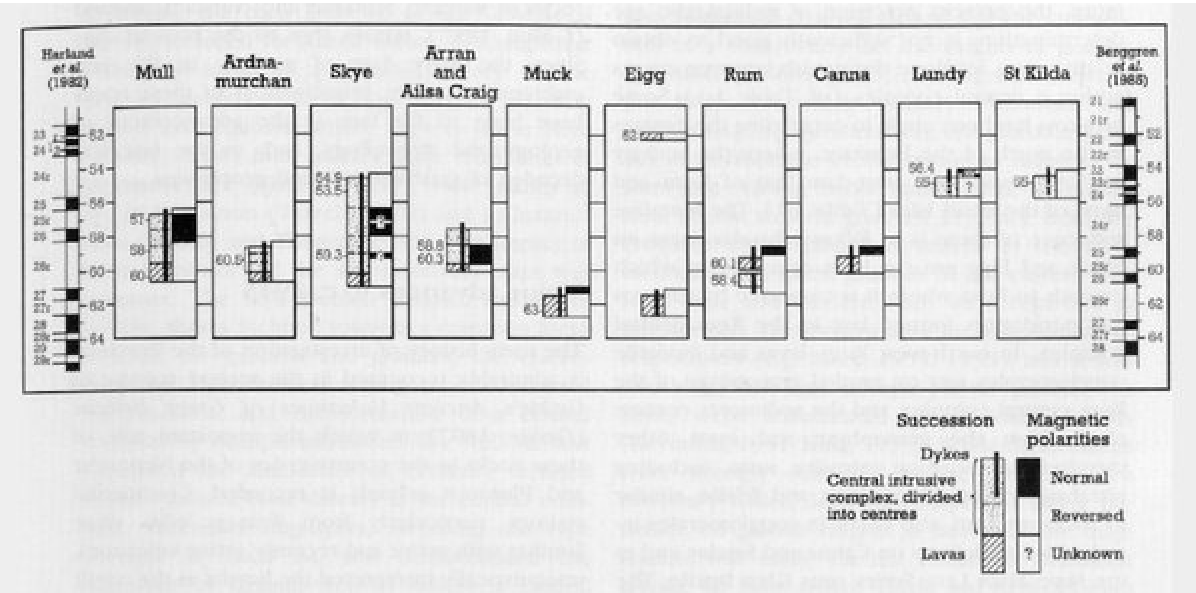


(Figure 3.4) Geological map of the Fionchra site, Rum (after Emeleus, 1980).



(Figure 3.5) Post-Central Complex basic lavas resting on an irregular surface of Torridonian sandstone. Fionchra site, Rum. (Photo: C.H. Emeleus.)

(Figure 3.6) Boulder conglomerate underlying flow-banded icelandite lava flow. The conglomerate contains granophyre, felsite and allivalite clasts derived from the weathering of the Rum Central Complex. South side of Fionchra. Fionchra site, Rum. (Photo: C.H. Emeleus.)



(Table 1.1) British Tertiary Volcanic Province: summary of the geological successions, radiometric ages and magnetic polarities (after Mussett et al., 1988, figure 2)