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LOCH AIRIGHE BHEG

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OS Grid Reference: NC703025

Introduction

The Rogart igneous complex extends over about 115 km² in SE Sutherland (Figure8.2). It has been described by Read *et al*. (1925, 1926) and Soper (1963), and consists of a zoned quartz-monzodiorite–granodiorite–granite pluton, together with a peripheral zone of migmatization. The complex was emplaced into metasedimentary rocks of the Altnaharra Formation in the Morar Group of the Moine Supergroup after the main, presumed Caledonian, deformation. It is overlain by Devonian strata of Old Red Sandstone facies. It therefore belongs to the late Caledonian 'Newer Granites' and is a component of the Argyll and Northern Highlands Suite.

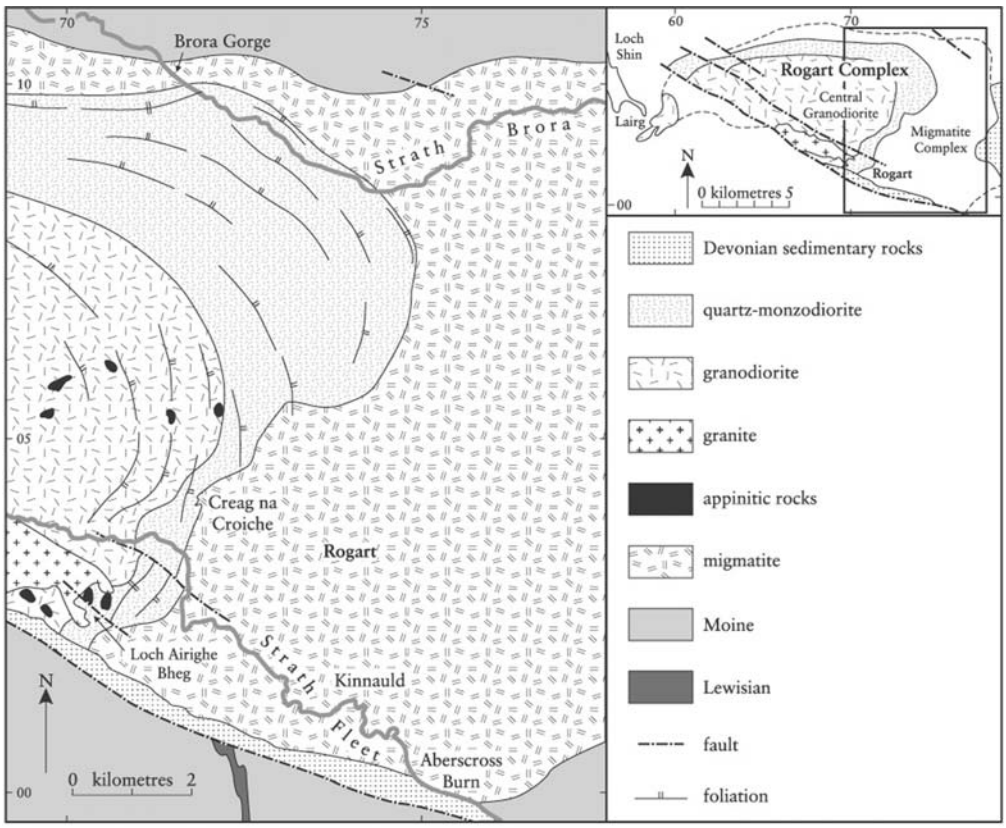

Figure 8.2: Map of the eastern part of the Rogart pluton, including the Loch Airighe Bheg GCR site. The inset shows the whole Rogart complex.

The scale of the migmatitic envelope of the Rogart complex is unique in British Caledonian granites, and three GCR sites have been chosen to illustrate its features, Creag na Croiche, Aberscross Burn–Kinnauld and Brora Gorge. These are to be described in the*Lewisian, Torridonian and Moine Rocks of Scotland* GCR volume. The Loch Airighe Bheg GCR site described here displays features of the intrusive part of the complex, the pluton, together with hybridized appinitic rocks that occur as xenoliths.

The Appinite Suite of alkalic ultramafic, intermediate and felsic intrusive rocks is intimately associated with late Caledonian plutons throughout the Scottish Highlands. The type area of the suite is described in this GCR volume (see theArdsheal Hill and Peninsula GCR site report). Appinitic intrusions are widely developed in the Moine rocks of the Northern Highlands where they form isolated bosses, often a hundred metres or so across. They were described byRead *et al*. (1925) as 'hybrids of Ach'uaine type', from a locality some 10 km SW of this GCR site (NH 624 952), where they range in composition from ultramafic olivine-pyroxene-amphibole-

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biotite rocks to granodiorite. Read interpreted the diversity of the suite as a result of hybridization of granitic magma with either ultrabasic magma or solid rock. More recent geochemical studies have invoked the contamination of mantle-derived, K-rich (shoshonitic) basic magmas (Fowler, 1988a; Fowler and Henney, 1996).

Description

The GCR site is located near the south-eastern margin of the Rogart pluton (Figure8.2). This intrusion consists of hornblende-biotite granodiorite that grades into a marginal quartz-monzodiorite and is cut by a body of granite; the quartz-monzodiorite and granite are exposed at the site, but not the granodiorite.

The quartz-monzodiorite crops out immediately east of the loch and at Dalmore Quarry 600 m to the NE (709 029). At the latter locality it is composed of plagioclase An_{23} (50%), quartz (18%), K-feldspar (12%), biotite (10%) and amphibole (8%), together with minor titanite, allanite, zircon and apatite. It is cut by aplitic microgranite, granite pegmatite and rare microgranodiorite veins (Figure 8.3). The quartz-monzodiorite has a foliation defined by the preferred orientation of biotite, amphibole and to some extent plagioclase. This foliation is subvertical and here strikes NE, roughly parallel to the contact of the outer facies with its migmatitic envelope. Surfaces parallel to the foliation show a weak linear fabric, defined mainly by the alignment of amphibole, which plunges gently north-eastwards.

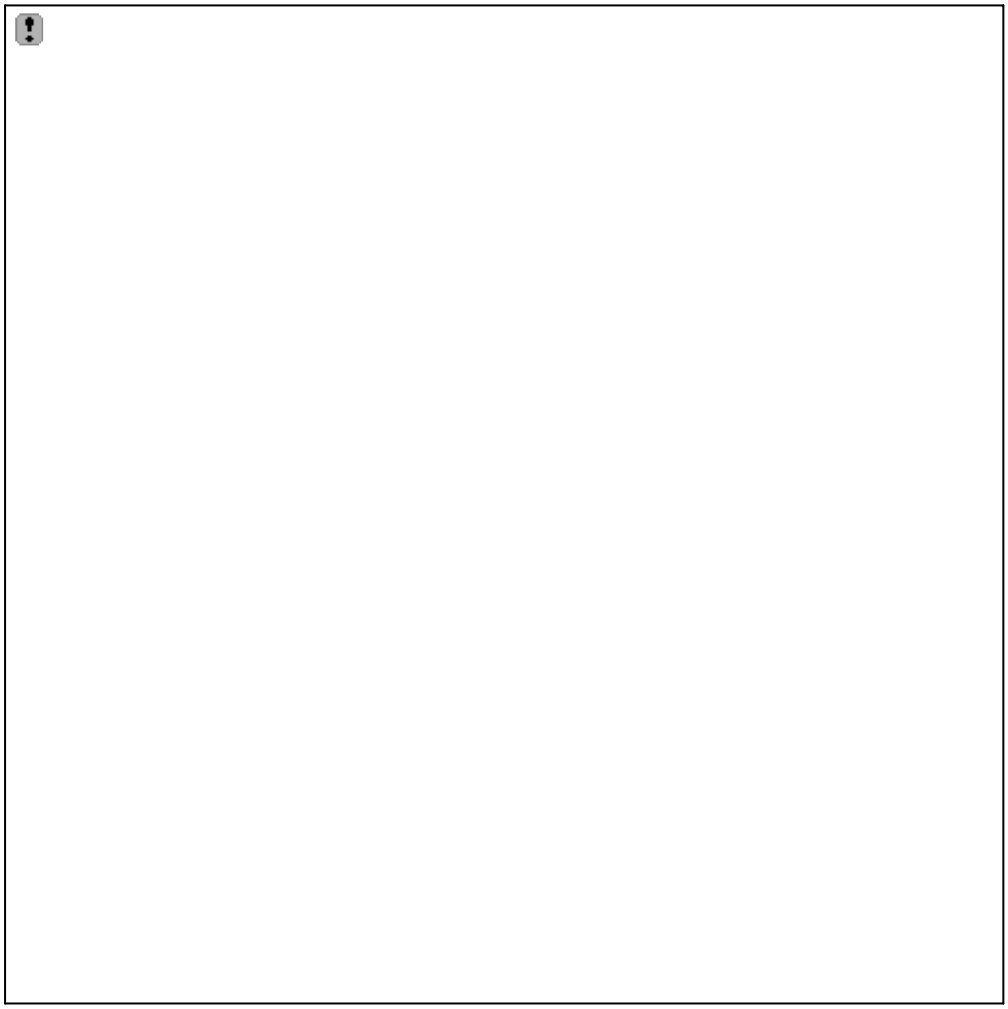

Figure 8.3: Poorly foliated outer quartz-monzodiorite of the Rogart pluton cut by veins of aplitic microgranite (NC 704 025). (Photo: Susan Hall.)

The later granite, exposed in the northern part of the GCR site, consists essentially of plagioclase An_{12} (50%), quartz (26%), K-feldspar (18%) and biotite (6%). It is unfoliated and although its contact with the quartz-monzodiorite is not exposed here, elsewhere there is a

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narrow gradation between the facies.

Crags immediately to the north and NW of the loch are composed of a wide variety of appinitic lithologies, ranging from ultramafic types composed of pyroxene, amphibole, biotite and minor feldspar to meladiorite and melanocratic syenogranite; the commonest type is made of amphibole and biotite with patches of pink K-feldspar. Angular to sub-rounded appinitic xenoliths are enclosed by the host quartz-monzodiorite, with biotite-rich selvages developed locally at the contact (Figure 8.4). Larger appinitic masses are veined by hornblende-rich quartz-monzodiorite and contain patches of hornblende-K-feldspar pegmatite.

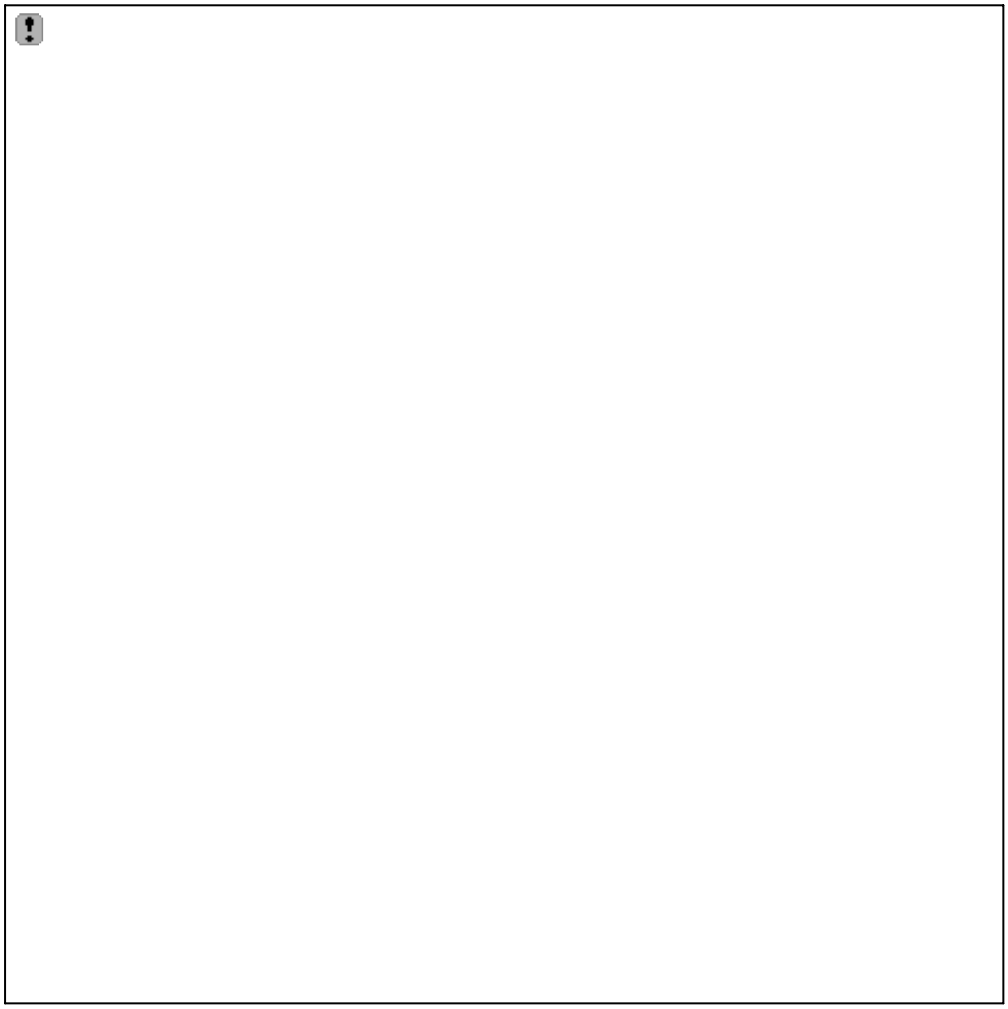

Figure 8.4: Xenoliths of appinitic rock in quartz-monzodiorite of the Rogart pluton (NC 703 026). Dark biotite-rich selvages are visible at the margin of the xenolith above the compass. (Photo: Susan Hall.)

Interpretation

In a structural study of the Rogart complex, Soper (1963) interpreted the foliation and sub-horizontal linear fabric in the outer quartz-monzodiorite as the result of ballooning during its final emplacement. Evidence that the pluton deformed and eventually punched through its own migmatite envelope is illustrated by the sites in the*Lewisian, Torridonian and Moine Rocks of Scotland* GCR volume.

Read (1961) classified the ‘Newer Granites' into ‘forceful' and ‘permitted'. The ‘forceful' intrusions were emplaced by shouldering aside the country rocks and were thought to be deeper and older than the ‘permitted' high-level, subvolcanic granites emplaced by brittle mechanisms: the Rogart pluton was cited as an example of the forceful type. While modern views on pluton emplacement emphasize tectonic controls on space creation (Hutton, 1988a), in the Highlands it is evident that concordant, foliated intrusions such as Rogart were emplaced

in a more ductile environment than nearby cross-cutting plutons such as Helmsdale (Figure 8.1). The K-Ar age of the Rogart complex is about 420 Ma (Brown *et al.*, 1968), similar to K-Ar ages generally obtained from the Moine rocks of the Northern Highlands, suggesting that the complex was emplaced during the waning stages of regional metamorphism and cooled together with the country rocks during late orogenic uplift and erosion. The K-Ar age of the Helmsdale pluton is about 400 Ma (Brown *et al.*, 1968), and so this intrusion is likely to have been emplaced after substantial erosion had taken place. Thus Read's view that the 'forceful' Highland granites were deeper and older than the 'permitted' types is essentially true.

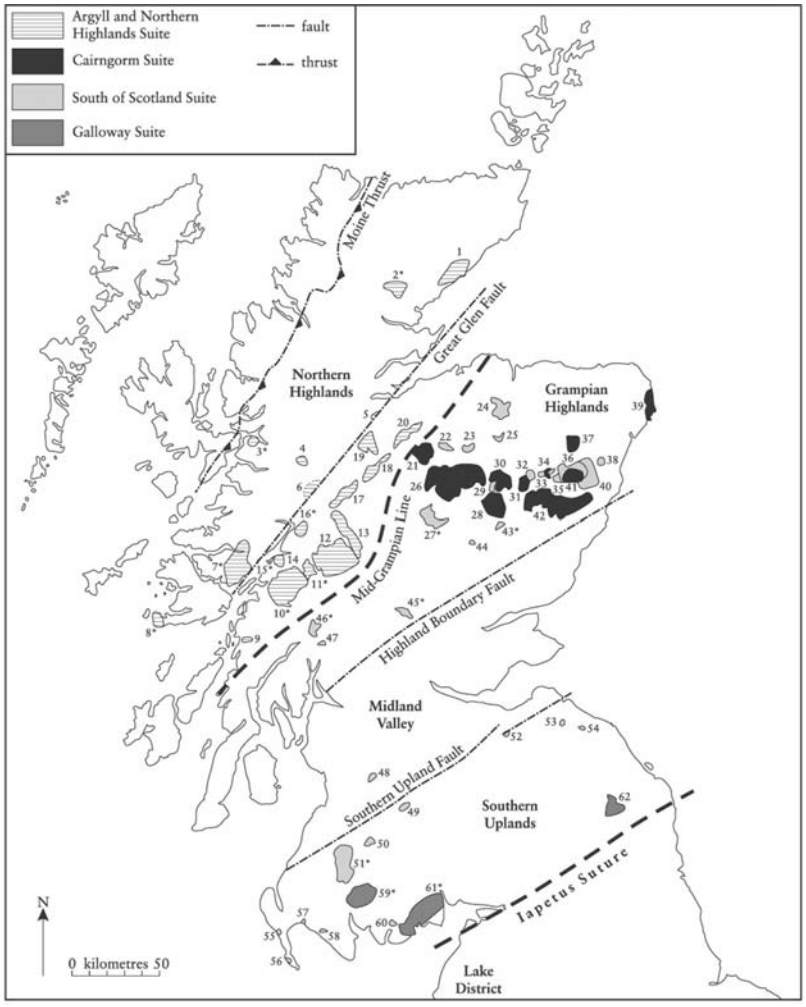

Figure 8.1: Late Caledonian granitic intrusions and plutonic suites of Scotland (starred numbers indicate those intrusions with GCR sites, named it italic type below): 1, Helmsdale; 2, Rogart (Loch Airighe Bheg); 3, Ratagain (Glen More); 4, Cluanie; 5, Abriachan; 6, Glen Garry; 7, Strontian (Loch Sunart); 8, Ross of Mull (Cnoc Mor to Rubh' Ardalanish and Knockvologan to Eilean a'Chlamain); 9, Kilmelford; 10, Etive (Bonawe to Cadderlie Burn and Cruachan Reservoir); 11, Glencoe fault intrusion (Stob Mhic Mhartuin and Loch Achtriochtan, Chapter 9); 12, Rannoch Moor; 13, Strath Ossian; 14, Ballachullish; 15, Duror of Appin (Ardsheal Hill and Peninsula and Kentallen); 16, Ben Nevis (Ben Nevis and Allt a'Mhuilinn, Chapter 9); 17, Corrieyairack; 18, Allt Crom; 19, Foyers; 20, Findhorn; 21, Monadhliath; 22, Boat of Garten; 23, Dorback; 24, Ben Rinnes; 25, Glen Livet; 26, Cairngorm; 27, Glen Tilt (Forest Lodge); 28, Lochnagar; 29, Craig Nardie; 30, Glen Gairn/Coilacreach; 31, Ballater; 32, Logie Coldstone; 33, Tomnaverie; 34, Cromar; 35, Torphins; 36, Balblair; 37, Bennachie; 38, Clinterty; 39, Peterhead; 40, Crathes/Gask; 41, Hill of Fare; 42, Mount Battock; 43, Glen Doll (Red Craig); 44, Glen Shee; 45, Comrie (Funtullich and Craig More); 46, Garabal Hill (Garabal Hill to Lochan Strath Dubh-uisge); 47, Arrochar; 48, Distinkhorn; 49, Spango; 50, Cairnsmore of Carsphairn; 51, Loch Doon (Loch Dee); 52, Broad Law; 53, Priestlaw; 54, Cockburns Law; 55, Cairngarroch Bay; 56, Portencorkrie; 57, Glenluce; 58, Mochrum Fell; 59, Fleet (Clatteringshaws Dam Quarry and Lea Larks); 60, Black Stockarton Moor; 61, Criffel (Lotus Quarries to Drungans Burn and Millour and Airdrie Hill); 62, Cheviot.

The 'Ach'uaine hybrids' are regarded as a component of the late Caledonian 'Newer Granite'

magmatism (Read *et al.*, 1925). Fowler (1988a) interpreted them as differentiates of relatively primitive, K-rich mantle-derived magma that crystallized under hydrous conditions with some crustal contamination. Fowler and Henney (1996), however, invoked the mixing of shoshonitic magma with contemporaneous syenitic magma. The appinitic masses at Loch na Airighe Bheg are xenoliths within the quartz-monzodiorite, not intrusions, so their emplacement pre-dates that of the Rogart pluton at the level now exposed. No modern petrogenetic investigation of these rocks has been undertaken, so it is uncertain to what extent their compositional diversity is a result of hybridization with the Rogart magma.

Conclusions

The Rogart complex is a member of the Argyll and Northern Highlands Suite of late Caledonian intrusions, emplaced into metasedimentary rocks of the Moine Supergroup. It consists of a quartz-monzodiorite–granodiorite– granite pluton flanked to the east and north by a concordant aureole and migmatite envelope. At the Loch Airighe Bheg GCR site several components of the pluton are exposed. The quartz-monzodiorite is foliated roughly parallel to its nearby contact with the migmatized envelope and also carries a weak sub-horizontal alignment of amphibole. This is thought to be due to ballooning of the quartz-monzodiorite–granodiorite magma during its emplacement. The later inner granite is unfoliated and apparently discordant.

The most interesting feature of the site is the presence of numerous appinitic xenoliths within the quartz-monzodiorite. These belong to a regional suite of mantle-derived, K-rich mafic intrusions known as the Ach'uaine hybrids. The xenoliths show a wide range of structural, textural and mineralogical relationships with the surrounding quartz-monzodiorite, which would repay further investigation to establish to what extent the compositional diversity of the appinitic rocks at this locality is a result of hybridization with the host quartz-monzodiorite.

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