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# Coire Uaigneich

## Highlights

The distinctive mineralogy of the Coire Uaigneich granophyre indicates that it crystallized under shallow, near-surface conditions and its bulk composition shows that it received a substantial contribution from the Torridonian sediments. It is the only sizeable granitic intrusion belonging to the Cuillin centre and it is older than the other Skye granites. Basalt lavas and calcareous country rocks adjoining the Cuillin gabbros have developed distinctive high-temperature mineralogies.

## Introduction

This site partly demonstrates the nature of the south-east margin of the Cuillin basic/ultrabasic centre and its effects upon the country rock and, as such, should be considered in conjunction with the Cuillin Hills site. The site contains Lower Jurassic sediments and overlying Palaeocene lavas which show the effects of thermal metamorphism and structural disturbance from the emplacement of the adjacent Cuillin layered eucrites (Figure 2.15). In addition, the site also encompasses the Coire Uaigneich Granophyre, the only granite associated with the Cuillin centre (Figure 2.16). This intrusion has been of significant petrological importance in the study of the origin and emplacement of the Skye granites.

The gabbros of the northern part of the Blaven Range belong to the Cuillin centre and were briefly considered in a study of granites and associated rocks in the eastern part of the Western Red Hills centre by Bell (1966). The effects of the Cuillin centre on the surrounding country rocks around Strathaird were the subject of a detailed investigation by Almond (1960, 1964). Wager *et al.* (1953) and Brown (1963) have studied the origins of the Coire Uaigneich Granophyre. The contentious issue of granite petrogenesis on Skye is discussed in detail by Gass and Thorpe (1976) in the Open University's case study on the Tertiary igneous rocks of Skye and these problems were further considered by Dickin and Exley (1981). The oldest rocks within the site are Jurassic sediments. These are overlain by Palaeocene basalt lavas and both were intruded successively by layered eucrites, the Coire Uaigneich Granophyre, basaltic cone-sheets and numerous NW-trending dykes.

## Description

The site comprises three principal units (in order of decreasing age):

1. The country rocks
2. Layered gabbros and other mafic intrusions of the Cullins
3. The Coire Uaigneich Granophyre

### i. The country rock

In Coire Uaigneich and along the course of Abhainn nan Leach to the south-west, Lower Jurassic strata overlain by Palaeocene lavas are in contact with the gabbros of the Cuillin centre. The emplacement of the latter has severely hornfelsed and faulted Jurassic shales, sandstones and thin limestones. Minor folding has also occurred immediately adjacent to the basic intrusion and a small anticlinal structure is present. Calc-silicate assemblages are developed in some of the dolomitic limestones and blocks of high-grade, thermally metamorphosed yellow, serpentinous marbles containing unusual calc-silicate minerals (for instance, spurrite and rankinite; Wyatt, 1952) are locally developed. Rheomorphism of the more leucocratic sediments has occurred along the contact; however, the most spectacular examples of this phenomenon are found 2 km to the south-west of the site at Camasunary [NG 512 192].

The Palaeocene alkali olivine basaltic lavas are also hornfelsed, and Almond (1960, 1964) has recognized three zones of alteration.

Inner Zone: Granular hornfelses consisting of plagioclase, clino- and ortho-pyroxene with or without olivine — formed by complete, or partial, recrystallization. Amygdaloidal structures commonly retained as aggregates or calcic plagioclase.

Middle Zone: Actinolite—albite—epidote—chlorite assemblages.

Outer Zone: Hydrothermal alterations only.

The lavas of the Coire Uaigneich site lie in zones a and b; the lava pile forming An Stac, though, lies totally within zone b.

## **ii. Cuillin layered gabbros**

Layered gabbros and eucritic gabbros of the Garbh Bheinn—Blaven (Figure 2.17) range dip towards the centre of the Cuillin intrusion. They form the high serrated ridge east of Strath na Creitheach and the Cuillin Hills. These rocks can be correlated to the layered gabbros and eucrites belonging to the Outer Layered Series of the Cuillin Hills centre (Bell, 1966) and, as such, are discussed within the Cuillin Hills site report below. Essentially, the gabbro is a layered, dark-coloured rock of variable grain size containing bytownite, clinopyroxene and opaque oxides with small amounts of olivine and orthopyroxene. In addition, the gabbros also contain lensoid inclusions of hornfels and ultrabasic rock which parallel the layered structures.

## **iii. Coire Uaigneich Granophyre**

The site has been chosen to include part of the only granitic intrusion associated with the Cuillin centre. The granophyre is exposed in Coire Uaigneich and on the col at Fionna-choire as part of a narrow, discontinuous, ribbon-like intrusion dipping steeply to the south-east at 70–80°. The granophyre is light weathering and contains fine- and coarse-grained facies bearing needles of hypersthene, together with quartz paramorphs after tridymite indicative of crystallization under low-pressure conditions (Wager *et al.*, 1953; Brown, 1963). Outside the limits of the site, on a wave-cut platform at Abhainn Camas Fhionnairigh [NG 509 187], the clean exposures of Coire Uaigneich Granophyre reveal partly digested xenoliths of sandstone.

The margins of the granophyre are chilled against Jurassic country rocks which have been deformed by the intrusion. Eucritic and basaltic xenoliths also occur along the margins of the granophyre showing that it is younger than the emplacement of the Cuillin centre. A close association with the Cuillin centre and a pre-Western Red Hills age are proved by the presence of numerous dykes and cone-sheets, related to the Cuillin centre, cutting the granophyre. In Coire Uaigneich, gabbro xenoliths are enclosed by the granophyre, but on the shore exposures there is a suggestion that the granophyre may have been remelted by the adjoining gabbros since acid net-veining is common.

## **Interpretation**

The very high-grade thermal metamorphism of the adjoining lavas, the presence of unusual calc-silicate hornfelses in the altered Jurassic strata and the occurrence of extensive net-veining and other rheomorphic phenomena close to the site at Camasunary, all provide unequivocal evidence that the Cuillin gabbros were a major heat source on emplacement. This view is compatible with *in situ* crystallization of mafic magmas during the formation of the layered rocks.

Both the Cuillin gabbros and the Coire Uaigneich Granophyre appear to have caused varying degrees of folding and faulting in the country rocks. In the case of the granophyre, the evidence for forcible emplacement contrasts strongly with the prevailing view that the majority of the Skye granites and granophyres were essentially passively emplaced by ring-dyke and block subsidence mechanisms. However, even a cursory examination of the existing maps suggests that this view may be an oversimplification, since disturbance of the sedimentary envelopes to the granites of both the Western Red Hills and the Eastern Red Hills centres may be verified at a number of localities (for example, on the north side of Glamaig, north-east of Mheall a' Mhaoil; on the south and west of Beinn na Caillich, west of Kilchrist). The emplacement of the Skye granites should provide a fruitful field for further research.

Much of the importance of the site lies in the fact that the Coire Uaigneich Granophyre has played a significant role in the understanding of the origin of the Skye granites. Attention was focused on this granite because of the occurrence of partly digested sandstone xenoliths (just outside the site), pointing to a possible origin from the anatexis of Torridonian basement rocks. Wager *et al.* (1953) studied the intrusion in detail, concluding that the granophyre represents partially melted Torridonian sandstone. This concept was supported by Brown (1963) on the evidence of experimental melting studies. Bell (1966) calculated that the heat output from the dense basic/ultrabasic magma body beneath much of southern Skye (see Cuillin Hills) would have been adequate to produce all of the granite magmas of Skye by melting of Lewisian/Torridonian basement rocks. Since these studies, ideas on the origin of the Skye granites have advanced significantly and a detailed discussion on the continuing controversy surrounding the origin of the Skye granites is contained in the Open University's igneous case study on Skye (Gass and Thorpe, 1976) and in Thompson (1982). More recently, in a detailed study on the Coire Uaigneich Granophyre, using trace-element and isotope data, Dickin and Exley (1981) suggested that the granophyre originated from the mixing of two contrasting magmas. These magmas were envisaged to be:

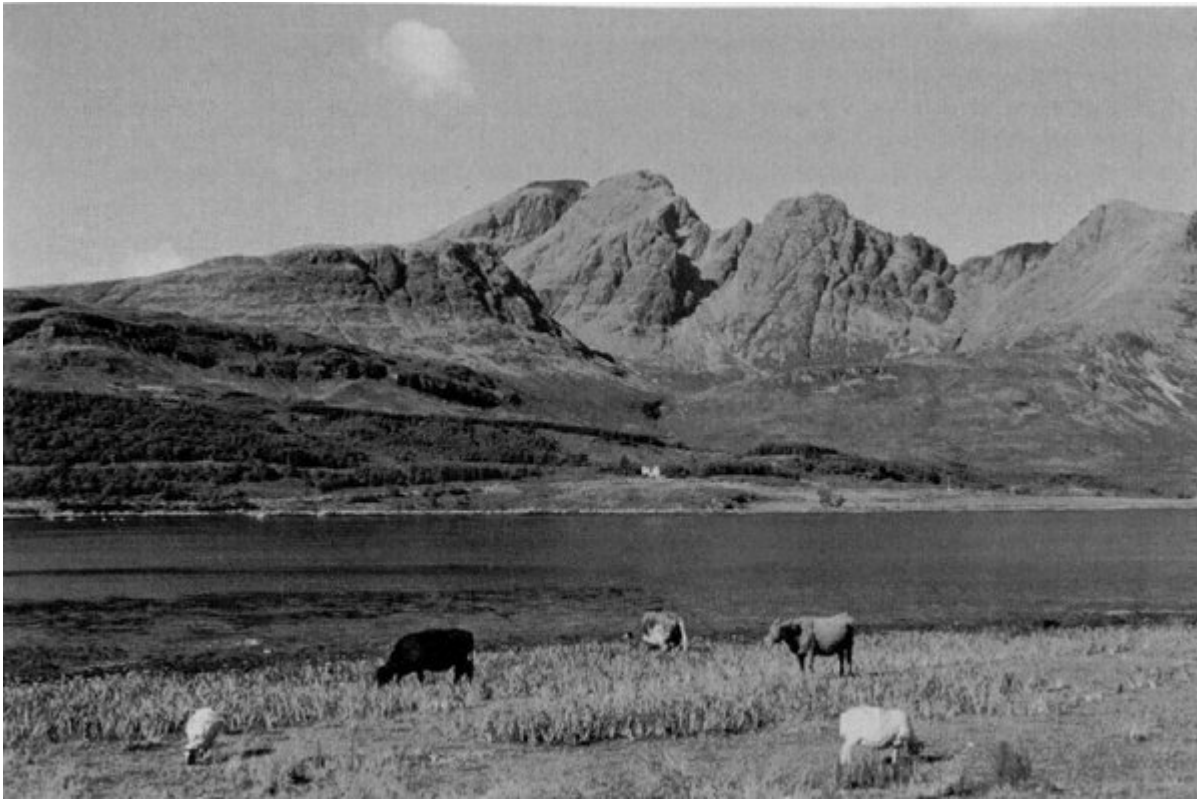
1. partially melted Torridonian sediments and
2. an acid differentiate of basic (Cuillin) magma, which mixed in the ratio 2:1.

The Coire Uaigneich Granophyre extends around the south-east side of the Cuillin layered mafic rocks and is obviously structurally related to the Cuillin centre. Since the majority of Skye granites are significantly younger than this centre, it is of some importance to determine its relative age as closely as possible. Probably the most conclusive evidence is provided by the cone-sheets which cut the granophyre and belong to the same suite which cuts the Cuillin layered gabbros, focusing on the Cuillin centre. None of these cone-sheets cuts the other Skye granites and rather, the reverse is true. Thus, the Coire Uaigneich Granophyre is significantly earlier than the Strath na Creitheach and Western Red Hills granites. There is also clear evidence that the granophyre postdates the Cuillin gabbros of the Blaven area (Figure 2.17) as xenoliths of the gabbro have been recorded in the granophyre. More importantly however, in Coire Uaigneich the granophyre lies well within the zone of high-grade thermal metamorphism developed in basalts around the gabbros but shows no sign of metamorphism itself. Had the acid intrusion pre-dated the gabbros it would have exhibited a thermal overprint and the fine-grained chilled contact, with its distinctive quartz paramorphs after tridymite, would in all probability have been obliterated. The presence of the quartz paramorphs after tridymite indicate a depth of cover of about 1 km (Brown, 1963). Nevertheless, exposures on the shore west of Abhainn Camas Fhionnairigh suggest that the xenolithic granophyre at this locality has been rheomorphically melted by the nearby gabbros, which may exhibit acid net-veining; thus, the unit mapped as Coire Uaigneich Granophyre may in fact be two separate acid bodies, one pre-gabbro, the other post-dating it.

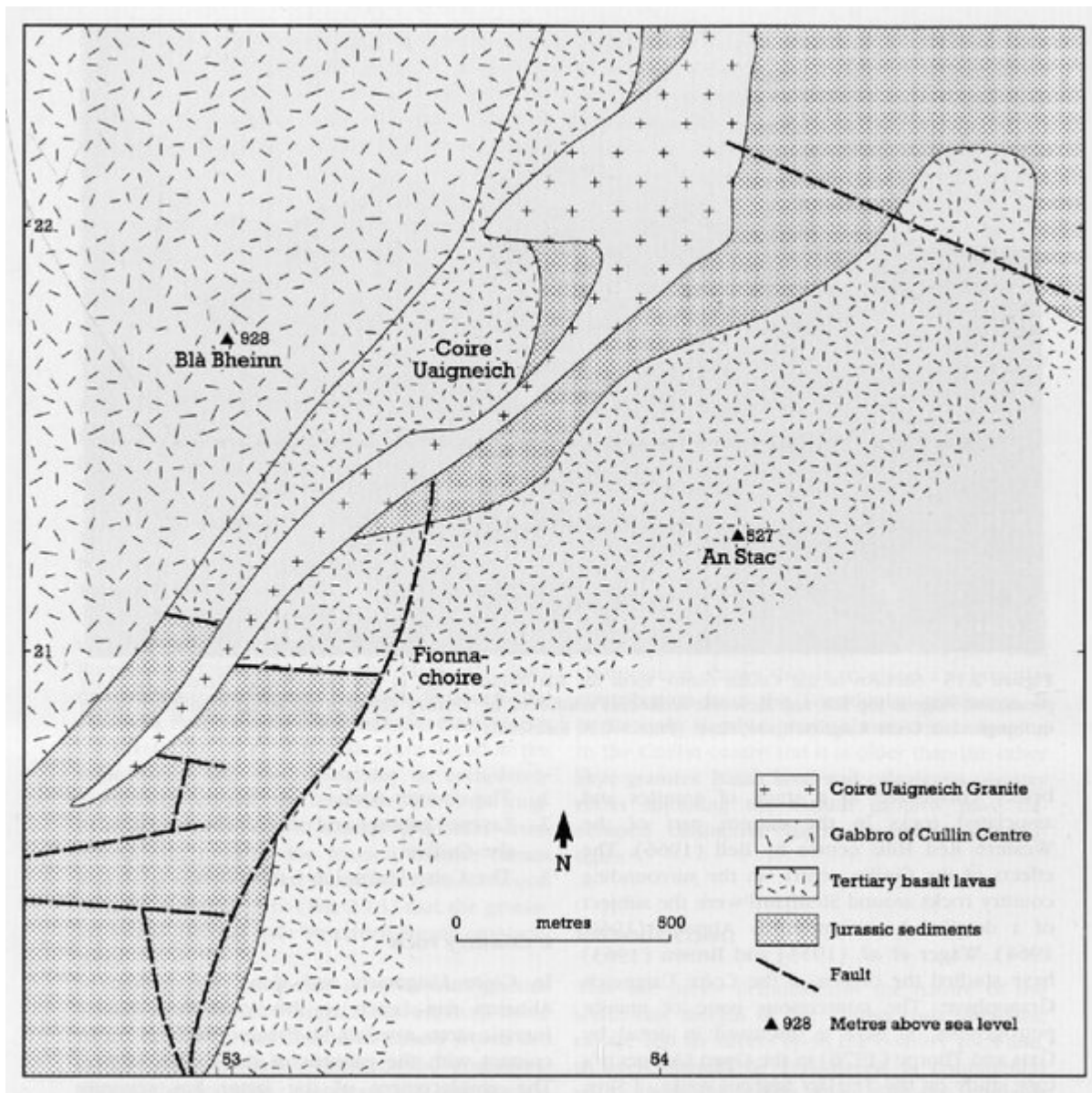
## Conclusions

There is abundant evidence in the site that the Cuillin gabbros were intruded at high temperatures. The Tertiary olivine basalt lavas have been altered to high-temperature olivine–pyroxene–plagioclase granulitic hornfelses adjacent to the contact and to rocks showing wholesale hydrous alteration at a greater distance from the contact. In the impure (sometimes dolomitic) Jurassic limestones there is alteration to high-grade calc-silicate mineral assemblages. The arcuate outcrop of the Coire Uaigneich Granophyre around the south-east of the Cuillin gabbros and intrusion of the granophyre by basic cone-sheets which focus on, and also cut, the Cuillin gabbros, shows that this granitic intrusion is structurally related to the Cuillin centre and of a significantly earlier date than the majority of the Skye/Tertiary granites. Geochemical studies show that it contains major components from melted Torridonian sandstones and from fractionated basaltic magma. The absence of any evidence of thermal overprint in the granophyre, which intrudes the severely thermally metamorphosed basalts, shows that it postdates the Cuillin gabbros. The presence of quartz paramorphs after tridymite provides mineralogical evidence that it was intruded at 1 km or less beneath the Tertiary land surface.

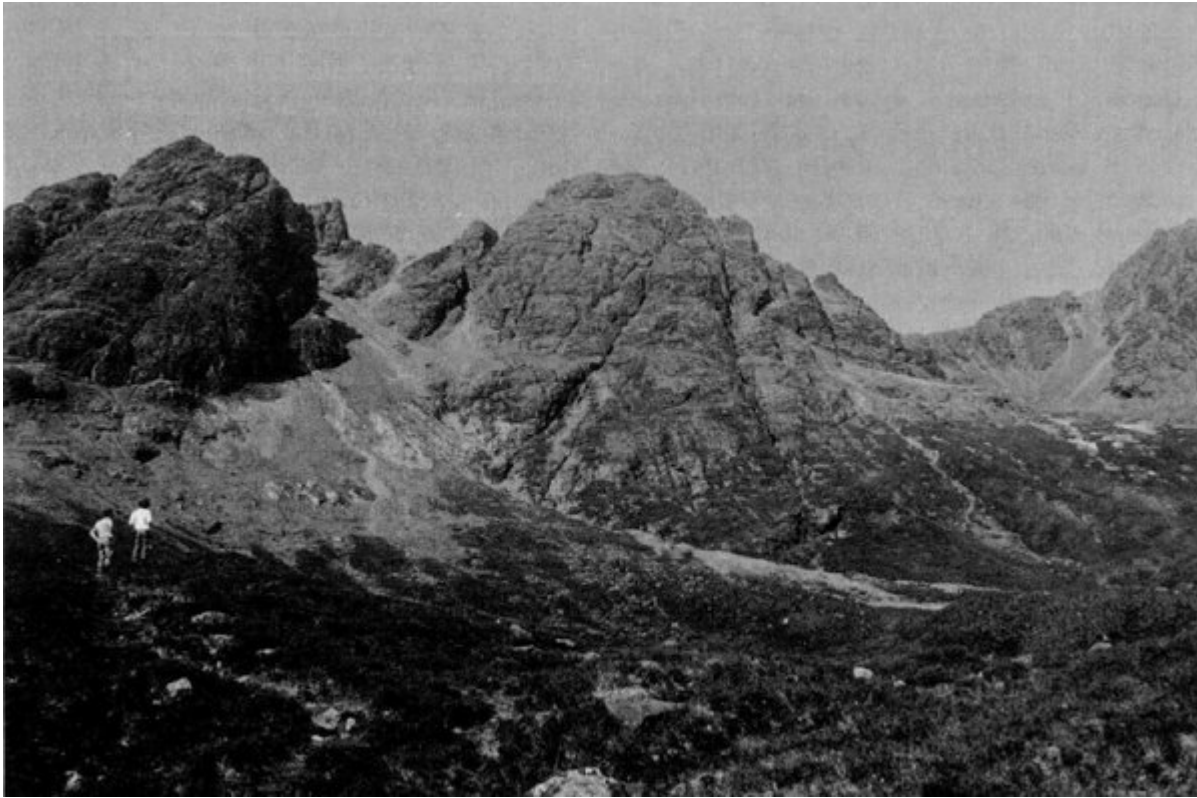
## References



*(Figure 2.15) Gabbros of the Cuillin centre form the Bla Bheinn ridge in the background, Tertiary lavas on prominent ridge in top left, and Mesozoic sediments reinforced by Tertiary sill(s) in left foreground. Loch Slapin in foreground. Coire Uaigneich site, Skye. (Photo: C.H. Emeleus.)*



(Figure 2.16) Geological map of the Coire Uaigneich site (after Gass and Thorpe, 1976, figure 6).



*(Figure 2.17) East face of Bla Bheinn formed by gabbros cut by later dykes (weathering to give notches) and cone-sheets (forming terraces on faces). Pale rocks at lower levels are the Coire Uaigneich Granite and Mesozoic sediments against the gabbros. Coire Uaigneich site, Skye. (Photo: A.P. McKirdy.)*