REPORT

The Coire Uaigneich granophyre, Skye

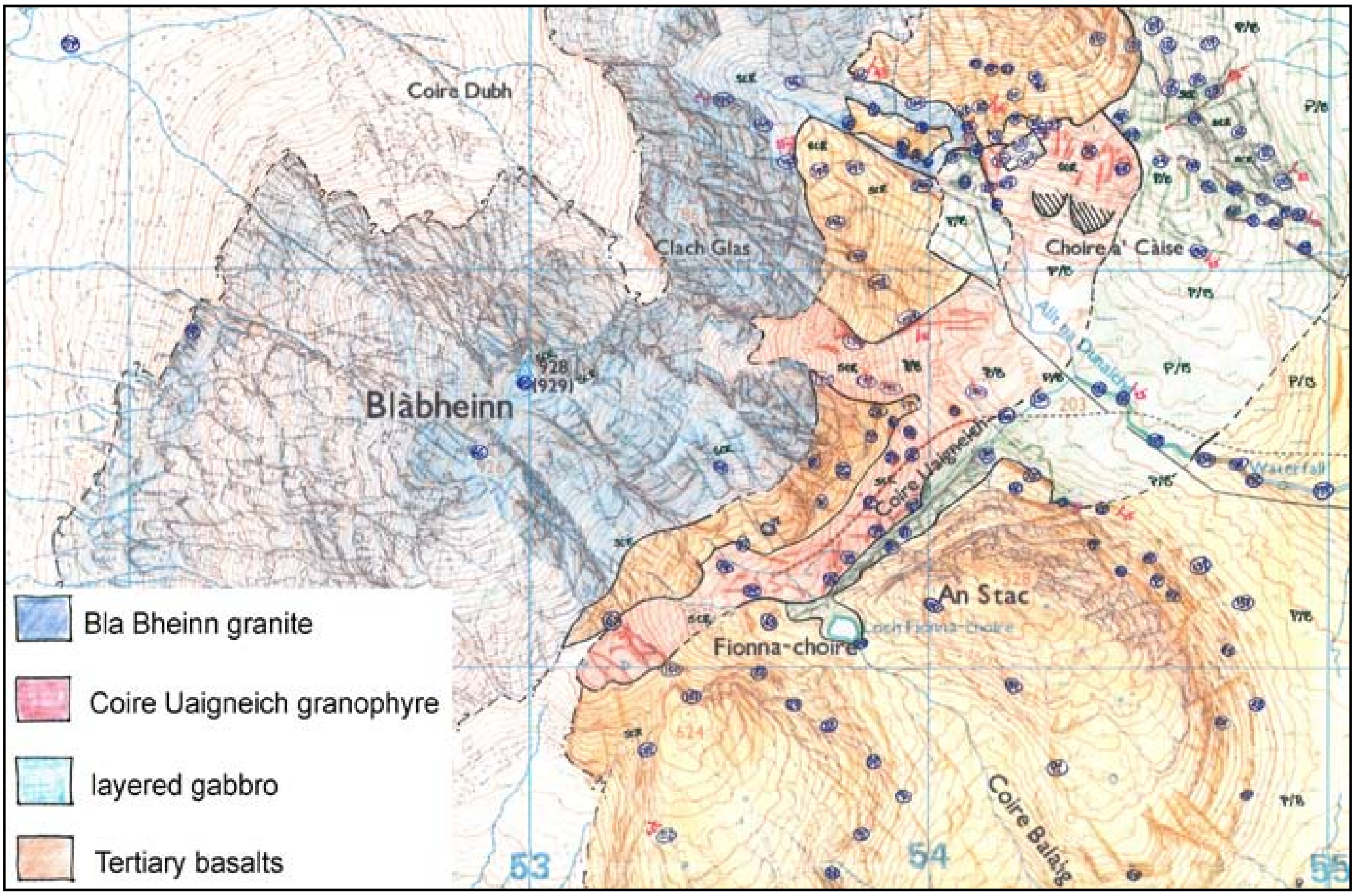
The origin of the Coire Uaigneich granophyre has been disputed since it was described by Alfred Harker (1911). Three theories of its origin have been proposed: fractional crystallization of mantle-derived basalt magmas, and partial melting of either the Lewisian Gneiss or the Torridonian Sandstone within the Precambrian basement. Data collected to compile a geological map and field relationships have confirmed the order of events at the site, and samples of the granophyre with inclusions were collected to help suggest its potential origin. Evidence from petrography, rock chemistry and electron microscope work excluded the possibility of fractional crystallization of mantle-derived basalt magmas, as abundant chlorite suggests a sedimentary origin. The two theories of partial melting both remained until a normative an-ab-or, $^{87}Sr/^{86}Sr$ ratios, $\delta^{18}O$ values and textural similarities all suggested that Torridonian sandstone was the likely source of the granophyre magma.

Outcrops show the lower Jurassic strata overlain by Palaeocene lavas. Both of these units are in contact with the gabbros of the Cuillin centre in the Coire Uaigneich. A ribbon-like intrusion of granite crops out in Coire Uaigneich, and shows a thinning of the granophyre in a vertical direction. Away from Blà Bheinn, Torridonian rocks crop out in Camasunary Bay, where the granophyre appears to have been emplaced along the unconformity between the Torridonian sandstone and Palaeogene lavas. The Torridonian beds underlie the Jurassic sequence, and Palaeogene lavas are in contact with the gabbro. Field relations at Camasunary Bay are consistent with the hypothesis of partial melting of Torridonian sandstone due to the emplacement of the Cuillin Gabbro to generate the CUG (Butler & Hutton, 1994). Basaltic and micro-gabbroic dykes extend NW-SE and basaltic sheet dykes lie W-E but were not mapped.

One model has the granophyre originating by the melting of Torridonian sandstone heated by the Cuillin gabbros during their emplacement (Fowler *et al*., 2004). Chilled contacts of the granophyre preclude any hypothesis of the generation of magma *in situ*, and the presence of quartz paramorphs after tridymite indicates that it could not have crystallised at a depth greater than 1 km (Wager *et al*., 1953; Brown & Phil, 1963). Torridonian sediments would have to be located at a shallow depth beneath the current outcrop of the granophyre; this is supported by the initial $^{87}Sr/^{86}Sr$ ratios and $\delta^{18}O$ values of samples from a traverse across the granophyre at Camasunary (Dicken *et al*., 1980). Torridonian rocks crop out near Camasunary Bay, and underlie the Jurassic sediments on the hills, both within a few kilometres of the granophyre outcrop. Heat output from the dense basic/ultrabasic magma body beneath much of southern Skye would have been sufficient to melt basement rocks (Bell, 1966). The very high-grade thermal metamorphism of the adjoining lavas, the occurrence of unusual calc-silicate hornfels in the altered Jurassic strata, and other rheomorphic phenomena, all provide unequivocal evidence that the Cuillin gabbros were a major heat source on emplacement.

Therefore, it is likely that when the gabbroic Cuillin Centre was intruded, it melted the Torridonian sediments, locally lying less than a kilometre beneath the surface, to produce a

Bla Bheinn, with its rugged topography in the Cuillin Hills of Scotland's Isle of Skye, as seen through the camera lens and by its complex geology as mapped in the field.



magma that then evolved into the Coire Uaigneich granophyre. From Tuttle and England's (1955) P-T curve we know that the minimum temperature for the melt was 930°C, though it is likely to have been much hotter. This is extremely hot for a granitic melt.

All samples of the Coire Uaigneich granophyre are severely depleted in ^{18}O compared to normal granitic rocks, as are the Torridonian samples (Dickin et al, 1980). Melting of Torridonian arkoses with $\delta^{18}O$ values similar to those near the granopyhre contact may have given rise to a magma low in ^{18}O (Forester & Taylor, 1977). Initial $^{87}Sr/^{86}r$ ratios are variable in the granophyre, but a typical value is 0.7320. Of the basement rocks, Lewisian gneiss has $^{87}Sr/^{86}Sr$ = 0.7174, and Torridonian Sandstone has $^{87}Sr/^{86}Sr$ = 0.74413. This suggests that Lewisian gneiss was not the source of the granophyre melt.

When the three rocks are placed on a normative an-ab-or plot, the Torridonian sandstone and the granophyre both plot within the granodiorite section, whereas the Lewisian gneiss sits in the granite section (Watkins et al., 2007). This provides further evidence of similarities between the granophyre and the Torridonian arkose, suggesting that the latter was derived from anatexis of the latter. And this took place as a result of heat output from the intrusion of the gabbroic Cuillin centre less than a kilometre beneath the surface.

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