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Isotopic evolution of a large igneous centre; insights from the Isle of Rum, Scotland.

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The Isle of Rum lies within the British-Irish Palaeocene Igneous Province, which formed ($\sim$60.5Ma) within a zone of crustal stretching and thinning prior to the opening of the North Atlantic. Rum is located on Archean Lewisian gneissic basement unconformably overlain by a thick succession of Proterozoic sandstones of the Torridon Super Group. The Palaeocene igneous activity has traditionally been divided into two separate phases [1], an early voluminous felsic phase (stage 1) followed by the intrusion of large masses of picritic magma (stage 2). The majority of activity is bound within an elliptical ring fault (the Main Ring Fault) approximately 12km across.

Rock formed during the earliest igneous activity is preserved as very large and discrete coarse gabbro blocks within felsic intrusions of stage 1. The blocks have Pb isotopic signatures that are similar to the proposed North Atlantic end member [2], but show evidence for 10 - 15% crustal incorporation ($^{87}Sr/^{86}Sr$ 0.7099). An early stage of doming and deformation, that uplifted basement rocks within the ring fault by up to 1.5km, is probably associated with intrusion of these gabbros and the ascent of felsic magmas. Substantial dome erosion followed, which exposed the uplifted basement. Caldera collapse on the ring fault occurred contemporaneously with the eruption and intrusion of large volumes of dacitic to rhyolitic magmas ($^{87}Sr/^{86}Sr$ 0. 7111 – 0.7146), now preserved only in close proximity to the Main Ring Fault. These felsic magmas show considerable crustal incorporation (30 - 80%). Associated lobate basaltic inclusions show a range of magma-crust interactions from virtually uncontaminated

mantle-like magmas ($^{87}Sr/^{86}Sr$ 0.7029), to ones which have assimilated amphibolite-facies gneiss, to a third, previously unreported group that assimilated granulite-facies gneiss. Renewed uplift on the Main Ring Fault is recorded by complex faulting and a return to dominantly basaltic magmatism, marked by a series of cone sheets, picritic plugs ($^{87}Sr/^{86}Sr$ 0.7028) and radial dykes ($^{87}Sr/^{86}Sr$ 0.7045), with uncontaminated mantle-like values. The peak of magmatism was reached with the shallow emplacement (0.7 - 2km) of the ultrabasic layered intrusions ($^{87}Sr/^{86}Sr$ 0.7047), which cut the earlier felsic, caldera-infill products. The whole succession of igneous events occurred within $<$800,000 years. This short time points to a fundamental, temporal and spatial link between the felsic and ultrabasic magma systems that have previously been considered as separate episodes.

[1] Emeleus, 1997, Memoir of the BGS, Sheet 60, Scotland. [2] Ellam and Stuart, 2000, Journal of Petrology, Vol 41.