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The British-Irish Palaeocene Igneous Province revisited: influence of crustal composition on differentiation processes across five major crustal terranes

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The British-Irish Palaeocene Igneous Province (BPIP) is an ideal testing ground for the influence of crustal composition on ascending magmas as four major tectono-stratigraphic terranes are traversed on a transect from Skye and Rum in the North, to the Mourne Mtns, Carlingford and Slieve Gullion in the South. These crustal blocks are bounded by major crustal discontinuities, the Moine Thrust, the Highland Boundary Fault, the Southern Uplands Fault and the Iapetus Suture, and are isotopically extremely diverse, leading to the suggestion that ascending mantle-derived magmas may be variably contaminated depending on the terrane through which they have passed. This concept of crustal provincialism has been previously suggested for the BPIP (e.g. [1, 2]), but no comprehensive study or model has yet been presented. We have analysed a large suite of samples (more than 180) for Sr, Nd and Pb isotopes in a spectrum of mafic to felsic igneous rocks from the central complexes of Rum (Hebridean Terrane), Ardnamurchan, Mull (Northern Highland Terrane), Arran (Grampian and Midland Valley Terranes), Slieve Gullion and Carlingford (Southern Uplands Terrane). Together with previously published data and data from crustal lithologies exposed at the surface and present as xenoliths, our results suggest that the local crust has indeed been a significant influence on the majority of magma compositions at all of the 5 complexes. A major correlation between crustal terrane and the isotopic composition

of BPIP rocks exists (crustal provincialism), implying that ascending magmas are significantly, and characteristically, modified by the crust through which they travelled. The mantle Sr-isotope ratio (at 60Ma) for the region is suggested to be 0.7023–0.7032 [3, 4], however, our basaltic samples from throughout the province show a range of 0.7028 to 0.7111. Felsic rocks yield a range that shows even further elevation (0.7066 – 0.7226), while crustal compositions span a range of 0.7065 to 0.7379. We also find that the magnitude and detailed processes of contamination differ not only between centres, but also between (and within) individual sample suites from single centres. Our data imply that only very primitive, and generally rare, high MgO rocks are unequivocally suitable for the extraction of sensible information on primary magmatic sources. In turn, as previously suggested for individual centres (e.g. [5, 6, 7]), evolved mafic rocks frequently display lower crustal influences, while felsic rocks regularly record a more complex multi-stage evolution, reflecting the cumulative effects of successive contamination events in deep and upper crustal reservoirs.

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