Geophysical Research Abstracts
Vol. 15, EGU2013-4053, 2013
EGU General Assembly 2013

Late Caledonian microdiorites and felsic porphyrites from Northern Scotland: implications for the petrogenesis of high Ba-Sr granites

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A suite of sharply cross-cutting microdiorite – felsic porphyrite dykes, emplaced into the southern part of the Northern Highlands Terrane, is thought to be coeval with the local Caledonian high Ba-Sr granites. On occasion they can be seen to pillow into, and mix with the granites (e.g. Strontian) in the manner of synplutonic dykes. In the least-deformed examples small-scale mixing and mingling textures are preserved between basic and acid variants, and the felsic porphyrites (rarely) have mafic marginal facies. Microdiorites also grade into rocks of the appinite suite. Thus, the compositional range of the suite is considerable, linking mafic magmas to more evolved compositions via many intermediate stages. These therefore offer a window into the processes of Caledonian magma evolution.

A selection of some 50 dykes has ben collected and analysed for major and trace elements, mostly from the environs of Strontian, but also as far north as Loch Quoich and west to Arisaig. They show a continuous chemical range from 47% to 74% SiO_2, 18% to <1% MgO, 0.5% to 6% Na2O and 1% to 5% K2O. The bulk composition of the homogenous microdiorites equates to high-Mg andesite of sanukite affinity. Petrogenetically-informative trace elements bear the hallmarks of a subduction-related source, with general enrichment in LILEs and relative depletion in HFSEs (in particular Nb-Ta). The chemistry of the felsic porphyrites is closely comparable with the local Strontian and Cluanie granites, and cumulus-enriched mafic microdiorites are chemically similar to local discrete appinites. Such data can therefore be used to test alternative petrogenetic hypotheses: that the high Ba-Sr granites evolved by crystal fractionation ($\pm$ crustal contamination) from mantle-derived appinitic parents, or that they are crustal melts associated with genetically unrelated but contemporaneous mafic magmas.