



In-situ geochemical characterization of experimentally generated partial melts: modelling crustal contamination precisely

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Understanding partial melting of ancient gneiss terranes is crucial when considering crustal contamination in volcanic systems, as these rocks are unlikely to melt completely at magmatic temperatures (900-1200 °C) and crustal pressures (<500 MPa). Variations in the bulk composition of the protolith, magma temperature, pressure (depth) and the composition and abundance of any fluids present will produce a variety of partial melt compositions. This may range from partial melts enriched in incompatible elements to more complete melts, nearing the bulk chemistry of the parent gneiss.

We have used piston cylinder experiments to simulate partial melting in a suite of 10 gneisses from NW Scotland (Lewisian) and Eastern Greenland (Ammassalik, Liverpool Land) at magma chamber temperatures and pressures ($T = 975$ °C, $P = 200$ MPa). These gneisses form the basement to much of the North Atlantic Igneous Province, where crustal contamination is frequently identified. However, the actual compositions of the crustal partial melts are poorly constrained.

Partial melts were produced in all 10 experiments. The experimental charges were quenched so that partial melts were preserved as glass, making them suitable for in-situ microanalysis. Electron microprobe spot analyses of the glasses indicate they are compositionally heterogeneous and are significantly different to the whole rock geochemistry of the original parent gneisses. Typically the melts are trachy-dacitic to rhyolitic in composition. The samples were mapped using energy-dispersive x-ray spectroscopy (EDX), which deciphered the spatial variation in melt chemistry and revealed evidence of mixing and mingling processes. Individual melt domains were microdrilled for Sr and Pb isotope ratios.

Once completed, this novel petrological, experimental and in-situ geochemical approach will allow quantification of the processes of partial melting of gneiss in a volcanic context, providing accurate geochemical end-members for modelling crustal contamination processes with unprecedented precision.