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Magma sources of the Mull Lava Sequence, British Palaeogene Igneous Province, western Scotland.

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The Mull Lava Sequence (MLS) is part of the remnants of the early Palaeogene (62-58 Ma) volcanic products of the North Atlantic Igneous Province (NAIP). This stratigraphically well-constrained sequence begins with subalkaline basaltic lava flows, progressively becoming more evolved into trachytes, finally returning into more primitive compositions in their younger lavas [1]. The focus of this study is to characterise in more detail this temporal geochemical evolution and produce a preliminary integrated petrogenetic model combining geochemical and mineralogical evolution.

Whole-rock geochemical analyses has revealed that basaltic melts that partially supplied the MLS can be derived by partial melting of the depleted mantle. Using Harzburgite xenoliths compositions from the GEOROC database [2] as a starting melt, equilibrium partial melting was calculated using MELTS [3], fairly reproducing the basaltic products with ~11% degree of partial melting. Preliminary results from MELTS also indicate that the potential source region can be constrained to depths equivalent to pressures of 1 GPa. Equilibrium batch melting of whole rock trace elements has shown that assimilation of likely Lewisian gneiss is needed to account Sr, Ba, Rb, Nb and Zr enrichments. Mantle potential temperatures (◦C) and pressures of partial melting were estimated using the geothermobarometer from [4]. Preliminary results indicate potential mantle melting temperatures of 1202-1346 ◦C and pressures between 1.09 and 1.70 GPa, consistent with the MELTS calculations.

Stratigraphically ordered Rare Earth Element (REE) trends show a repeating pattern of depletion and enrichment over time throughout the sequence. Most notably is a section of flows at the top of the sequence with a clear transition from a depleted N-MORB basalt, progressively enriching (E-MORB) and returning to N-MORB. This, coupled with modelling of the intrinsic conditions, suggest cyclic fertile mantle-generated pulses mixing with the N-MORB basalt, with crustal assimilation of the lower crust when the magma is ascending or ponded.

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