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Isotopic and chemical analysis of individual melt inclusions

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Minerals and mineral-hosted melt inclusions often reveal much larger isotopic variability than the bulk rock samples of eruptions/lavas (e.g. [1],[2]), but analyzing such small samples, of only several 10-100s µm cross section, is analytically challenging. Here we present a time-efficient protocol for Sr and Nd isotope ratio, and combined major-trace element, as well as halogen element concentration measurements of individual melt inclusions from olivine grains in primitive basaltic lavas.

Melt inclusions are homogenized in a vertical gas-mixing furnace and individual MI are recoverd by micro core drilling with customized core drill bits (Ø 250 µm) using a NewWave^{TM} MicroMill. The MI are subsequently analyzed by EPMA (major elements and halogens) and LA-ICP-MS (trace elements). The remainder of each MI and individual mineral grains are dissolved, and Sr and Nd are separated by low-blank miniaturized ion exchange chromatography. Isotope compositions are determined by MC-ICP-MS (APEX Omega desolvating system attached to a Thermo Scientific Neptune *Plus*).

Sr-Nd isotope ratios from a single lava from Gough island, show that both individual olivine grains and olivine-hosted MI from have more variable chemical and isotopic compositions than the host lava. In fact, the observed isotopic variation exceeds that of all analyzed lavas from Gough island. Therefore, investigation of olivine-hosted melt inclusions of individual lavas shows that there is a greater extent of chemical and isotopic diversity in the sub-volcanic magmatic system and the underlying mantle source than documented in the sampled lava flows.

[1] Anderson, et al., (2021) Geochemistry, Geophysics, Geosystems 22

[2] Stracke, et al. (2019), Nature Geoscience 12