Olivine reveals distinct $\delta^{18}O$ domains in the Icelandic mantle

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Major and minor element chemistry of olivine is widely used as a proxy for lithological variations in the mantle source of oceanic basalts, including Iceland [1]. Olivine can therefore be useful for better understanding isotopic variations in elements susceptible to secondary modification. However, previous studies of $\delta^{18}O$ in Icelandic basalts have mostly involved batch mineral analyses, that cannot resolve intra-mineral variability resulting from shallow-level processes [2]. To avoid these, we couple major, minor and trace elements of high-Fo# (>80) olivine with *in-situ* $\delta^{18}O_{(Ol)}$ measurements to robustly constrain lithological and $\delta^{18}O$ variations in the Icelandic mantle plume. Our samples cover the neovolcanic zones and older Tertiary units, most of which previously have been analysed for $^{3}He/^{4}He$ ranging from 6.7 to 47.8 R_A [3].

The olivine crystals range in Fo# between 80 to 92 with limited intra-grain variability and display a variation in $\delta^{18}O_{(Ol)}$ of >3 ‰ across Iceland, with most values falling below those of typical upper mantle olivine (~5.1 ±0.2‰ [4]). This variability appears to be independent of Fo#, suggesting that it is largely primary. The trace element ratios of the olivines indicate a change in governing source lithology beneath Iceland with an olivine-poor mantle component being sampled to a greater extent in the South Iceland Volcanic Zone (SIVZ), which is a region of active rift propagation. Olivine crystals from the SIVZ are generally characterised by lower Mn/Fe and higher Ga/Sc relative to olivine from elsewhere in Iceland, while their $\delta^{18}O_{(Ol)}$ varies significantly (from +3.45 to +4.98 ‰). A lack of correlation between lithological proxies and $\delta^{18}O_{(Ol)}$, suggests that the low $\delta^{18}O$ is not constrained within one source lithology. Coupled $^{3}He/^{4}He$-$\delta^{18}O$ systematics in the Icelandic olivine crystals are best explained by mixing of three geochemical end-members, with one being a high $^{3}He/^{4}He$ and low $\delta^{18}O_{(Ol)}$ (~4‰) mantle component. This component is identified in olivine crystals found both in central and south Iceland and it is a likely candidate for the Icelandic plume.

[1] Sobolev *et al.*, (2007), *Science* **316**, 412-417; [2] Bindemann *et al.,* (2008), *GCA* **72**, 4397-4420; [3] Harðardóttir *et al.,* (2017), *Chemical Geology* **480,** 12-27; [4] Eiler, (2001), *Rev. Mineral. Geochem* **43** (1), 319-264