

Compositional features of enriched Icelandic mantle components

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We have analysed a suite of primitive (MgO > 8 wt%) alkali basalts from off-axis locations in Iceland (Snaefell, Heimey, Snaefellnes) for elemental & isotopic (Sr-Nd-Pb-Hf-He-O) composition. Small degrees of melting beneath these off-axis volcanic zones produces alkali basalts that should preferentially sample enriched components in the underlying mantle. Each area has some unique compositional feature distinct from the other two areas. Lavas from Heimay and Snaefellnes have high $^{206}\text{Pb}/^{204}\text{Pb}$ (18.9-19.2) and straddle the NHRL for $^{208}\text{Pb}/^{204}\text{Pb}$ ($\Delta 8/4$ +5 to -5). Olivines from both areas have oxygen isotopes ($\delta^{18}\text{O}_{\text{ol}}$ +4.9-5.1‰) similar to normal mantle olivine values, which conflicts with the recent inference [1] that the enriched Icelandic components should have low $\delta^{18}\text{O}_{\text{ol}} < +4.6\%$. However, Heimey lavas have high $^3\text{He}/^4\text{He}_{\text{ol}}$ (13.1-14.5 R_A) relative to Snaefellnes samples (6.3-8.6 R_A), and double-spike Pb isotope data show a small but significant difference in $\Delta 7/4$ (-1 to -2 vs. -2 to -4) at a given $^{206}\text{Pb}/^{204}\text{Pb}$ value. This suggests minor spatial variations in the composition of the radiogenic Pb enriched component. In contrast, Snaefell lavas have less radiogenic Pb isotope compositions ($^{206}\text{Pb}/^{204}\text{Pb}$ 18.4-18.6) and low $^3\text{He}/^4\text{He}_{\text{ol}}$ (6.9-7.5 R_A). Two notable features of Snaefell lavas are their anomalously low $\delta^{18}\text{O}_{\text{ol}}$ values (+4.1-4.6‰) and their high $\Delta 7/4$ (-1 to +1). Positive $\Delta 7/4$ values are rare in Iceland, and in post-glacial lavas they are only found in the adjacent Öraefajökull centre and in a few samples from the Reykjanes Peninsula. This is consistent with a minor role for an EM1-type mantle component in Icelandic magmatism. The spatial distribution of the enriched mantle components is best assessed from double-spike Pb isotope data [2, 3]. Lavas from restricted geographic areas tend to show distinct linear arrays that indicate binary mixing between local mixtures of the regional end-member components: e.g. the high $^{206}\text{Pb}/^{204}\text{Pb}$ component for Reykjanes Peninsula tholeiitic lavas is similar to the low $^{206}\text{Pb}/^{204}\text{Pb}$ component in alkalic lavas from the adjacent Heimay area.

References

[1] Thirlwall et al. (2006) *GCA* **70**, 993-1019.

[2] Thirlwall et al. (2004) *GCA* **68**, 361-386.

[3] Peate et al. (2004) *GCA* **68**(11S), A569.