Do Icelandic alkali basalts really have normal mantle $\delta^{18}O$?

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A low $\delta^{18}O$ mantle source has recently been proposed to generate at least some of the low $\delta^{18}O$ in Icelandic basalts [1]. Using laser flourination (LF) on olivine, normal mantle $\delta^{18}O$ (+5.2 ± 0.3‰, [2]) was only observed in highly incompatible element depleted lavas. However using conventional flourination, normal mantle values have also been reported for the only Icelandic alkaline lavas (Vestmannaejyar and Snaefellsnes, [3,4]). $\delta^{18}O_{WR}$ has been shown to decrease along the Southern Volcanic Zone towards the centre of Iceland [3], thought to reflect mixing between alkali basalts with normal mantle $\delta^{18}O$, produced at the tip in Vestmannaeyjar, and low $\delta^{18}O$ crustally contaminated tholeiites from the rift zone in central Iceland. Within Snaefellsnes, a decrease in $^{87}Sr/^{86}Sr$ and increase in $^{143}Nd/^{144}Nd$ towards the centre of Iceland has been reported [3,4], consistent with a contribution from an old enriched normal $\delta^{18}O$ source at the tip of the peninsula. This is not easily reconciled with the low $\delta^{18}O_{ol}$ (+4.2‰ [1]) in primitive Reykjanes Peninsula samples with equally low $^{143}Nd/^{144}Nd$.

Vestmannaejyar lavas yield normal mantle LF $\delta^{18}O_{ol}$ values (+5.0 ± 0.2‰, 2sd, N=13). Compared with low $\delta^{18}O$ Fe-Ti basalts on the nearby mainland, their alkaline character is only visible in elevated K and Na. Other incompatible elements are similar at constant MgO, resulting in high K/Nb ratios (~260 ≈ normal mantle). Low K/Nb in most basalts from Iceland cannot be a consequence of crustal contamination as K/Nb decreases northward along the Reykjanes Ridge. Low K/Nb probably reflects recycled ocean crust in the mantle source [5]. Vestmannaejyar lavas are thus not derived from normal Icelandic mantle, and their normal $\delta^{18}O_{ol}$ can not be used to support a contamination origin for low $\delta^{18}O$ elsewhere in Iceland.

Snaefellsnes lavas yield $\delta^{18}O_{ol}$ (+4.6 ± 0.13‰,2sd, N=9) in the west where the lavas were regarded to be uncontaminated mantle melts [3]. Despite being alkali basalts Snaefellsnes basalts have Sr-Nd signatures very similar to low $\delta^{18}O$ enriched Reykjanes tholeiites [1]. Like most Icelandic lavas, they have low K/Nb, indicating that they are derived by small degree partial melting of low $\delta^{18}O$ enriched Icelandic mantle.

References

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