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Secular variability in the $^{142}Nd/^{144}Nd$ compositions of high-$^{3}He/^{4}He$ basalts from the Iceland hotspot

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Despite the theoretical relationship between initial plume head (large igneous province) and later plume tail (ocean island basalt, OIB) phases of hotspot volcanism, geochemical relationships have been challenging to identify. Within the long-lived (≥ 60 Ma) Iceland hotspot, one geochemical factor binding OIB-like picritic basalts from Baffin Island, Greenland, and Iceland is the presence of very high $^{3}He/^{4}He$ ratios (up to 50 R_A) among some samples. Such He isotopic signatures have been commonly interpreted to represent remnants of an undegassed, potentially ancient mantle reservoir in the deep mantle source of the Iceland hotspot. Notwithstanding, efforts to understand the origins of this reservoir have been complicated by variable ^{87}Sr-^{143}Nd-^{206}Pb isotopic compositions within the high-$^{3}He/^{4}He$ samples.

We present new $^{142,143}Nd$-^{176}Hf-^{182}W isotopic data to constrain the ancient origins of Iceland and West Greenland basalts with high $^{3}He/^{4}He$ ratios. West Greenland basalts display nearly constant $\mu^{142}Nd$ signatures (+3.7 ±1.5, 95% c.i., n = 5) that are resolved both from Iceland OIB (+0.4 ±1.2, n = 4; this study and [1]) and published Baffin Island picrites (-1.7 ±1.5, n = 11; data from [2]). The ^{142}Nd and ^{182}W signatures are not related to long-lived ^{143}Nd and ^{176}Hf signatures, nor to each other. Notwithstanding, age-corrected ^{143}Nd and ^{176}Hf signatures of West Greenland basalts strongly overlap with those of Iceland OIB. Among West Greenland basalts, variability of age-corrected ^{143}Nd and ^{176}Hf signatures by 2-4 epsilon units in spite of consistent, positive ^{142}Nd signatures implies that post-Hadean geological processes have been overlain onto a mantle reservoir with a Hadean history that is distinct from other parts of the Iceland hotspot track. The apparent independence of $^{3}He/^{4}He$ and $^{142}Nd/^{144}Nd$ signatures from other short- and long-lived radiogenic isotope systems reinforces the notion that deep mantle preserves multiple, distinct Hadean-aged domains. Accordingly, the similar $^{3}He/^{4}He$ maxima observed for different stages of Iceland hotspot volcanism may themselves derive from disparate primordial reservoirs.

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