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Baffin Island picrites contain normal terrestrial $^{142}Nd/^{144}Nd$: Implications for the source of high $^{3}He/^{4}He$ in deep Earth

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The short-lived ($t_{1/2}$ = 103 My) radiogenic isotope system ^{146}Sm-^{142}Nd has been used to infer early differentiation of the Earth. Compared to chondrites, most terrestrial rocks are enriched in ^{142}Nd by about 20 ppm. One explanation for this is that bulk Earth did not start off with a chondritic Sm/Nd. However, the magnitude of the enrichment requires bulk Earth Sm/Nd beyond the range observed in chondrites. An alternative explanation is that the Earth experienced differentiation during the lifetime of ^{146}Sm that isolated a complementary low Sm/Nd reservoir (the early enriched reservoir (EER)) which is able to balance the apparent ^{142}Nd excess. Thus, in a chondritic bulk Earth, non-chondritic $^{142}Nd/^{144}Nd$ signatures require that early enriched and early depleted reservoirs separated from the primitive undifferentiated mantle. The highest $^{3}He/^{4}He$ in basalts is conventionally interpreted as requiring the existence of a mantle reservoir that has been convectively isolated for over 3 billion years, and it has previously been proposed that the EER might be the source of elevated $^{3}He/^{4}He$ in the deep Earth. As there is uncertainty about the relative partition coefficients of U and He there is the possibility that high $^{3}He/^{4}He$ may also be hosted in the early depleted reservoir (EDR). Here we present $^{142}Nd/^{144}Nd$ for a suite of proto-Iceland plume picrites from Baffin Island that have the highest mantle $^{3}He/^{4}He$ (c. 50 R_a) yet measured. For all samples $^{142}Nd/^{144}Nd$ is identical, within analytical precision, to the terrestrial standard giving a mean $\epsilon^{142}Nd$ value of -0.03 $\pm$ 0.05 (n = 11). Thus, the high $^{3}He/^{4}He$ source has a super-chondritic $^{142}Nd/^{144}Nd$ signature which does not appear to be derived from primitive undifferentiated mantle. The data are consistent with the addition of primordial He into the Icelandic plume source which contains modern $^{142}Nd/^{144}Nd$ values.