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Helium isotope evolution of the Iceland plume

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The high 3He/4He of intraplate basalts relative to mid-ocean ridge basalts is conventionally used in support of the existence of a deep mantle reservoir that has remained at least partially isolated from the mantle convection that has generated the depleted and enriched mantle domains sampled by MORB and OIB. The first basalts erupted by the Iceland plume at ∼62 Ma on Baffin Island and West Greenland have the highest 3He/4He so far recorded [1,2]. These basalts should, in the prevailing paradigm, be the best sample of unprocessed primordial mantle. However, the high 3He/4He basalts do not have a unique incompatible trace element-radiogenic isotope signature, values span approximately 70% of the range of E-MORB and N-MORB [2]. Ne and Ar isotopes in the high 3He/4He proto-Iceland plume picrites display a similarly large range that overlaps MORB-OIB compositions and show no sign of the primordial values expected from the He isotope compositions. This is consistent with the trace element-radiogenic isotope geochemistry that implies the deep mantle in the earliest Iceland plume was indistinguishable from the mantle except that it is strongly enriched in primordial He.
A compilation of the helium isotopic composition of basalts erupted by the Iceland plume (n > 300) demonstrates an essentially linear decrease of the maximum value from 50 Ra in proto-Iceland plume picrites erupted at 62 Ma, to 33 Ra at Iceland today. This cannot be generated by radiogenic ingrowth in the mantle source reservoir, nor is it due to a change melt fraction. It is most easily explained as a decrease in the flux of 3He-rich deep mantle material within the plume. This corresponds, to a first order, to a decrease in the plume temperature and flux, but is not (so far) evident in a demonstrable change in basalt chemistry. This is significantly different to the Hawaii plume [3]. Implications will be discussed.

References
[1] Stuart et al. (2003) High 3He/4He ratios in picritic basalts from Baffin Island and the role of a mixed reservoir in mantle plumes. Nature 424, 57-59.
[2] Starkey et al. (2009) Helium isotopes in early Iceland plume picrites: constraints on the composition of high 3He/4He mantle. Earth Planet. Sci. Lett. 277, 91-100
[3] Keller et al. (2004) Cretaceous-to-recent record of elevated 3He/4He along the Hawaiian-Emperor volcanic chain. Geochem. Geophys. Geosys. 5, Q12L05, doi:10.1029/2004GC000739