Lithophile-siderophile constraints on Hadean processes preserved in hotspot sources

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New Nd, Hf, and W isotopic data are reported for well-characterized basaltic rocks from the Mascarene Islands and the Deccan Traps, which comprise the modern and ancient endmembers of the Réunion hotspot. Réunion ocean island basalts (OIB) have modestly negative $\mu^{182}W$ and both positive and negative $\mu^{142}Nd$, similar to what is known of global OIB, that are difficult to reconcile with a single-stage Hadean differentiation process. Deccan continental flood basalts (CFB) display excesses in $\mu^{142}Nd$ and deficits in $\mu^{182}W$ that are occasionally resolved from their respective terrestrial standards. However, the He-Sr-Nd-Hf-Os isotopic signatures of the CFB reveal crustal assimilation signatures, suggesting that Indian cratonic rocks have $\mu^{142}Nd$ and $\mu^{182}W$ compositions that deviate from terrestrial standards.

The Nd, Hf, and W isotopic and highly siderophile element compositions of the Réunion hotspot basalts are compatible with a model that invokes both magma ocean processes and core-mantle mixing In the model, magma ocean products interact with the liquid outer core, and the resulting domain is later exposed to a small amount of Archean crustal material. Such a scenario produces a broad negative correlation between $\mu^{142}Nd$ and $\mu^{182}W$ compositions that would be distorted by later interaction with young, depleted materials. An analogous model for $\varepsilon^{143}Nd$ and $\varepsilon^{176}Hf$ reveals trends similar to the classical view of coupled oceanic crust and sediment recycling into hotspot mantle sources. Core-mantle interaction could potentially explain in principle an observed positively-trending relationship between $\mu^{182}W$ and Ru/Ir ratios among global OIB. We envisage multiple Hadean domains with distinct heritages in the deep mantle sources to hotspots that control the ancient geochemical component of many global OIB and CFB.