Early mantle heterogeneties in the Réunion hotspot source

BRADLEY J. PETERS[1], JAMES M.D. DAY[1], LAWRENCE A. TAYLOR[2]

[1]Geosciences Research Division, Scripps Institution of Oceanography, La Jolla, CA 92093-0208, USA; bpeters@ucsd.edu

[2]Department of Earth and Planetary Sciences, University of Tennessee, Knoxville, TN 37996-1410, USA

Ultramafic cumulate rocks incorporate relatively high abundances of compatible elements, including the highly siderophile elements (HSE). We utilize a suite of cumulate xenoliths from Piton de la Fournaise, La Réunion (Indian Ocean), to examine the mantle source composition of the Réunion hotspot using HSE abundances and Os isotopes. Dunite and wherlite xenoliths and associated lavas from the Piton de la Fournaise volcanic complex span a range of MgO contents (46 to 7 wt.%), yet exhibit remarkably homogenous $^{187}Os/^{188}Os$ (0.1324 ± 0.0014, 2σ), indistinguishable from measurements in previous studies [1,2]. Many of the xenoliths also have primitive upper-mantle (PUM) normalized HSE patterns with elevated Ru and Pd (Primitive upper mantle-normalized Ru/Ir and Pd/Pt of 0.8-6.3 and 0.5-32, respectively). These patterns are not the result of partial melting or differentiation, but rather require a primary magma with similar relative enrichments. Some highly olivine-phyric (>40 modal % olivine) Piton de la Fournaise lavas also preserve these relative Ru and Pd enrichments.

The estimate of HSE abundances in PUM indicates high Ru/Ir and Pd/Pt values relative to carbonaceous, ordinary and enstatite chondrite meteorite groups [1]. Thus, the existence of cumulate rocks with even more fractionated HSE patterns relative to PUM suggests that the Réunion hotspot samples a yet-unrecognized mantle source. These HSE patterns may arise from sampling of a mantle source that experienced limited late accretion (<0.2 percent by mass) compared with PUM (0.5-0.8 percent), possibly involving impactors that were distinct from present-day chondrites, or limited core-mantle interactions. Given the remarkably homogenous Os, Pb, and noble-gas isotopic signatures of Réunion, which plot near the convergence point of isotopic data for many hotspots, such a conclusion provides evidence for an early differentiated and subsequently isolated mantle domain that may be partially sampled by some ocean island basalts.

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