Ancient, highly depleted mantle constrained by Re-Os isotope and highly-siderophile element compositions of French Polynesian xenoliths

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Mantle xenoliths, which are fragmented mantle material trapped by ascending magma, can provide lithological and geochemical information of the inaccessible mantle. In order to better understand the lithological and geochemical characteristics of the mantle, we conducted extensive sampling of mantle xenoliths throughout French Polynesia archipelago: Tahiti, Moorea, and Rurutu islands. We collected a total of 42 mantle xenoliths: 1 lherzolite, 14 harzburgites, 22 dunites, 3 wehrlites, and 2 orthopyroxenites. Here, we present whole-rock rhenium-osmium isotope and highly-siderophile element (Os, Ir, Ru, Pt, Pd, and Re) compositions in addition to whole-rock major-element compositions. Osmium isotope ratio ($^{187}Os/^{188}Os$) of the mantle xenoliths ranges from 0.1172 to 0.1464, where the harzburgites show a statistical bimodal distribution with unradiogenic ($^{187}Os/^{188}Os < 0.125$) and radiogenic ($^{187}Os/^{188}Os > 0.125$) compositions. The harzburgites with unradiogenic $^{187}Os/^{188}Os$ are depleted with regards to whole-rock major-element compositions (< 1.22 wt% Al_2O_3), and chondrite-normalized patterns of highly-siderophile elements. Considering the lithological variation of the mantle xenoliths used herein, the mantle is considerably heterogeneous beneath French Polynesia archipelago. In particular, the contrasting isotopic compositions of the harzburgites suggest different mantle reservoirs with unradiogenic and radiogenic $^{187}Os/^{188}Os$ compositions. We propose a possibility that the harzburgites with unradiogenic $^{187}Os/^{188}Os$ are impinged mantle material beneath normal oceanic lithosphere due probably to ascending plumes.

Keywords: Harzburgite, Dunite, PGE, TIMS, ICP-MS, Whole-rock chemical composition

