The nature of the lithospheric mantle underpinning the Fijian archipelago: insights from Koro Island mantle xenoliths

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The tectonic setting of the Fijian archipelago is poorly understood because of the complex regional interplay of subduction, intra-plate magmatism and even ridge magmatism. Insight to the relative roles of these processes could come from studying the lithospheric mantle underpinning the crust. Understanding the evolution and geological processes at mantle lithospheric depths is also essential for quantifying the Earth's thermal budget, melt differentiation, and subsequent growth of new islands and continents. This study reports the initial results from a superbly exposed suite of mantle xenoliths from Koro Island, Fiji – the first modern geochemical study of mantle rocks from this region. This study is focused on the geochemical and Os isotope systematics of the lithospheric mantle beneath Koro, as sampled by spinel peridotite xenoliths hosted in < 3.0 Ma alkali basalts.

Geochemical signatures of these mantle xenoliths, compared to residual mantle depletion indices (e.g. olivine Fo %, spinel Cr# and bulk Al_2O_3 wt.%) are slightly more fertile than most peridotites sampled from the sub-oceanic mantle, suggesting lower degrees of melting and/or re-fertilization. Rare Earth Element (REE) fractionation modelling of major peridotite phases (ol, cpx, opx), suggest the Fijian suite has experienced compositional changes related to post-entrainment, and support the later interpretation. HREE signatures along with spinel symplectite-breakdown textures, provide evidence of cpx phase equilibration in the garnet stability field, and are consistent with models supporting a transition to the spinel stability field during adiabatic decompression melting. Bulk-rock $^{187}Os/^{188}Os$ signatures exceed primitive upper mantle estimates as sampled by refractory abyssal and OIB-hosted peridotites. As such, there is no evidence of the ancient melting events evident in other suites of oceanic peridotites. The mildly radiogenic Os isotope compositions in the Koro peridotites also show no relationship with melt-depletion indices, making its use as a melt-depletion geochronometer ambiguous. The radiogenic Os, along with the complex REE systematics, however, provide important insights for re-fertilization and highly siderophile element recycling.