Highly siderophile elements in Hawaiian xenoliths: Implications for the origin of low 187Os/188Os signatures in oceanic mantle

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Mantle xenoliths in ocean islands basalts (OIB) are generally regarded as fragments of shallow oceanic lithosphere accidentally brought by deeply-derived magmas en-route to the surface, and are genetically unrelated to the hot spot magmas which embed them and their mantle sources. However, it has been proposed that peridotite xenoliths from Salt Lake Crater in Oahu Island (Hawaii) and a high-temperature group of peridotite xenoliths in Malaita, Solomon Islands (Ontong Java Plateau) may represent the pieces of subcreted plume material which cause the primary volcanic activity on their regions (Bizimis et al., 2009 EPSL; Ishikawa et al., 2011 EPSL). This idea is largely based on characteristic contrast of the frequency distribution of whole-rock $^{187}Os/^{188}Os$ compositions between these xenolithic peridotites and Pacific uppermost mantle deduced from abyssal peridotites and mantle tectonites in ophiolites.
In this study, we investigated whole-rock abundances of highly siderophile elements (HSE: Os, Ir, Ru, Pt, Pd and Re) together with other major-trace lithophile elements in peridotites from Salt Lake Crater in Oahu Island (Hawaii) with the aim of examining whether peridotite xenoliths having low $^{187}Os/^{188}Os$ compositions ($^{187}Os/^{188}Os < 0.120$) represent (1) ancient depleted mantle domain produced by shallow melting, subsequently recycled back into deep mantle by subduction processes, or (2) lowermost mantle domain associated with ancient Re-depletion, possibly due to chemical interaction with metallic outer core and/or segregation of metallic materials. Our results demonstrate that refertilisation and melt-rock interaction are predominant mechanisms creating the observed major-trace element variations in Salt Lake Crater peridotites. By contrast, their HSE patterns are characterised by strong depletions in the Re, Pd and Pt relative to Ir-group platinum group elements (IPGE: Os, Ir, Ru), suggesting that refertilisation processes involving silicate melts can have little overall effect on the HSE compositions. This support the idea that their Os isotope records are strongly influenced by past melt depletion processes, and such ancient depleted materials are commonly embedded in deeply-derived mantle plumes.

Keywords: Highly siderophile elements, Os isotopes, mantle xenoliths, peridotite, Hawaii

