Hawaiian peridotite xenoliths and the use of Ni in olivine as a petrogenetic indicator for basalt

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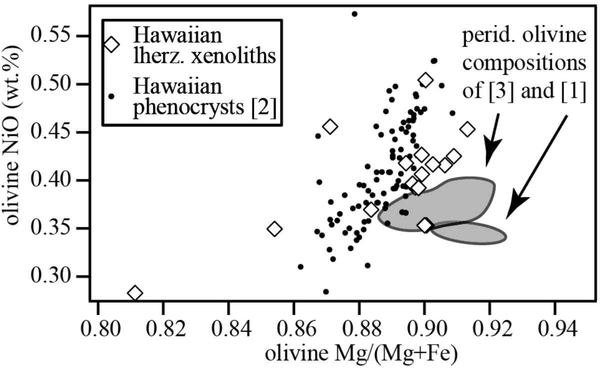
Olivine phenocrysts in Hawaiian basalts, as compared to those in MORB, are enriched in Ni at a given Mg# [1,2]. This enrichment may require that a large proportion of aggregated primary melt in the Hawaiian source is derived from pyroxenite rather than peridotite [1]; however, this conclusion assumes that Ni concentrations in mantle peridotites are relatively uniform (e.g., [3]). LA-ICP-MS analyses of first-row transition elements in minerals from 17 spinel lherzolite xenoliths from Ko'olau, Hawaii are used to investigate abundances of these elements in the sub-Hawaiian mantle.

Hawaiian xenolith olivines with Mg# >0.89 have 0.35-0.50 wt.% NiO (mean=0.41 wt.%), a range similar to olivine phenocrysts in Hawaiian basalts [2]. Following the temperature-dependent Ni-partitioning model of Matzen *et al.* [4], a partial melt of peridotite with olivine containing 0.41 wt.% NiO will precipitate phenocrysts with >0.47 wt.% NiO assuming a 100 °C decrease in temperature between source and magma chamber. If the Hawaiian basalt source is compositionally similar to these lherzolite xenoliths, then a pyroxenitic source component is not required to explain high-Ni olivine phenocrysts. The observed range of Ni concentrations for global peridotite olivines also calls into question the need to invoke core-mantle interaction [3] in the plume source of Ni-rich intraplate lavas.



[1] Sobolev *et al* (2005) *Nature* 434, 590-597 [2] Sobolev *et al* (2007) *Science* 316, 412-417 [3] Herzberg *et al* (2013) *Nature* 493, 393-397 [4] Matzen *et al* (2013) *J Pet* 54, 2521-2545