Decoupling among trace elements and Ni during melt percolation and melt-rock reaction in the mantle: An example from a dunite-harzburgite-lherzolite sequence from Trinity Ophiolite

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Trace elements were measured in clinopyroxene (cpx) across an ~20m long dunite-harzburgite-lherzolite-plagioclase lherzolite (DHL-PL) transect at the Trinity Ophiolite. Rare earth element (REE), high field strength element, and transition metal concentrations in dunite, harzburgite, and lherzolite are much lower than in lherzolite and plagioclase lherzolite. The transition from lower to higher concentrations occurs over a narrow interval 7.5-9.5m from the dunite-harzburgite contact. Pyroxene in the dunite, harzburgite, and lherzolite are in equilibrium with melts with REE patterns similar to depleted mid-ocean ridge basalt. Pyroxene in the lherzolite and plagioclase lherzolite are highly light rare earth element depleted but middle and heavy rare earth element enriched, similar to other plagioclase lherzolites. A gradient in NiO in olivine was previously observed at this transect by Morgan et al. (2008), who argued it originated by flow of dunite hosted melt into the surrounding peridotite. Unlike trace elements, NiO increases from lower to higher abundances ~3.5m from the dunite-harzburgite contact. The new data is consistent with the hypothesis of Morgan et al. (2008) and demonstrates decoupling between incompatible trace elements and Ni as melt flowed from dunite into host peridotite. Due to its high bulk partition coefficient and relatively fast diffusivity in peridotite Ni transport was chromatographically retarded. Incompatible trace elements, which are not fractionated from one another, likely experienced disequilibrium transport owing to their sluggish diffusivity in peridotite. They may increase from low to high concentrations at a former clinopyroxene saturation front. This locality demonstrates that in some cases tabular dunites are sources for melt impregnation and can play an important role in geochemical cycling.

Reference: