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Depletion of Titanium in the mantle of the Earth

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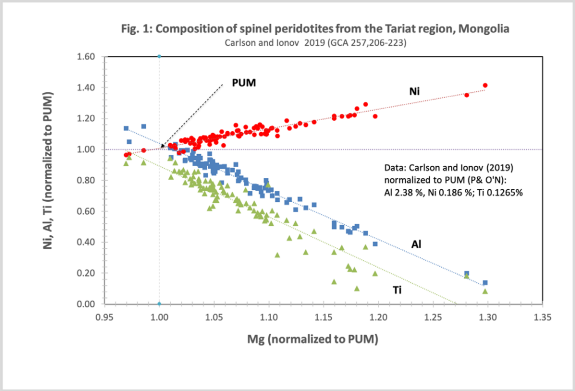

Many authors have used the chemical composition of peridotitic rocks from a variety of geological settings to estimate the composition of the upper mantle of the Earth, (PUM-primitive upper mantle). For various reasons this composition is often thought to represent the bulk Earth mantle after core formation and before the onset of mantle melting. The basis for these estimates are negative correlations of refractory elements such as Al and Ca with MgO and positive correlations with Ni and Co in peridotitic rocks (see [1] and references therein). One assumption in all Earth making models is that refractory lithophile elements occur in chondritic ratios in the mantle of Earth. A close inspection of recent data on mantle rocks (e.g., [2]) shows, however, that Al/Ti ratios in these rocks are generally above 20, compared to the chondritic ratio of about 18. This demonstrated in Fig. 1, where the PUM-normalized Ni, Al and Ti concentrations are plotted against the Mg-normalized concentrations of a suite of mantle xenoliths from the Tariat region in Siberia [2]. The Al and Ni correlations intersect at the PUM composition. If the Ti content of PUM is reduced by 12 %, the Ti correlation would coincide with the Al-correlation reflecting a chondritic Al/Ti ratio.

A closer inspection reveals that this signature is visible in many suites of mantle rocks, even considering the generally poor quality of Ti analyses in chondrites and mantle rocks. It thus appears that Ti is depleted in PUM by 10 to 15% relative to Al.

The depletion of Ti in the mantle of the Earth may reflect increasing siderophile tendencies of Ti at core formation conditions, similar to Cr [3]. About 400 ppm Ti in the core are required to explain the depletion of Ti in the mantle. Recently metal-silicate partition coefficients at high pressures and temperature were experimentally determined. Data reduction is in progress.

Lit.: [1] Palme H. and O'Neill H.St.C. (2014), in *Treatise on Geochemistry* (2nd ed., vol.3, 1-39. [2] Carlson R.W. and Ionov D.A. (2019) GCA 257, 206-223. [3] Siebert et al. (2013), Science 339, 6124.