

# HFSE partitioning in pyroxenes and olivine: Parameterized models with implications to HFSE fractionation in the upper mantle

CHENGUANG SUN<sup>1</sup> AND YAN LIANG<sup>2</sup>

<sup>1</sup>Dept. of Geology and Geophysics, Woods Hole Oceanographic Institution, MA 02543, United States (csun@whoi.edu)

<sup>2</sup>Dept. of Earth, Environmental and Planetary Sciences, Brown University, Providence, RI 02912, United States

The high field strength elements (HFSE) Ti, Zr, Hf, Nb, and Ta) are relatively immobile and have been widely used to study the evolution of the mantle and crust. A key parameter to understanding HFSE fractionation in the mantle is their partition coefficients in mantle minerals. Based on the published experimental mineral-melt partitioning data and the lattice strain model [1], we developed new parameterized models for HFSE partitioning between clinopyroxene and basaltic melt and between olivine and basaltic melt. Similar to our recent models for REE partitioning in mantle minerals (olivine, clinopyroxene, low-Ca pyroxene, and garnet) and HFSE partitioning in low-Ca pyroxene [2-5], the two new models show that temperature and mineral composition are the dominant factors controlling HFSE partitioning between clinopyroxene and basaltic melt and between olivine and basaltic melt. Our olivine and clinopyroxene partitioning models also reproduce the measured olivine-clinopyroxene and orthopyroxene-clinopyroxene HFSE partition coefficients in well-equilibrated mantle peridotite xenoliths reported in the literature. This demonstrates the internal consistency of our parameterized lattice strain models for HFSE partitioning in olivine, clinopyroxene and low-Ca pyroxene. Using the new HFSE partitioning models, we assessed the fractionation of HFSE during adiabatic mantle melting and subsolidus re-equilibration in mantle peridotites. We found that (1) the variation of Zr/Hf in global primitive MORB is consistent with 2 – 15% melting of the depleted mantle, whereas the variation of Nb/Ta in MORB requires heterogeneity in the mantle source or perhaps disequilibrium mantle melting; (2) HFSE in clinopyroxene from residual mantle peridotites are less sensitive to temperature variation during subsolidus cooling and may better record magmatic processes.

[1] Blundy & Wood (1994) *Nature* **372**, 452-454. [2] Sun & Liang (2012) *CMP* **163**, 807-823. [3] Yao et al. (2012) *CMP* **164**, 261-280. [4] Sun & Liang (2013a) *GCA* **119**, 340-358. [5] Sun & Liang (2013b) *Chem. Geol.* **358**, 23-36.