

## **An experimental study of chalcophile metal partitioning between silicate and sulphide liquids**

E.S. Kiseeva, B.J. Wood, and J Wade

Oxford University, Oxford, United Kingdom (kate.kiseeva@earth.ox.ac.uk)

Many elements exhibit chalcophile behavior as manifested by their concentration into sulphides at the expense of coexisting silicates. Experimental data on the exact partitioning of these elements between sulphides and silicates is sparse, however, which means that it is difficult to model processes involving sulphides such as core formation on the Earth and Mars, MORB and OIB magma generation and lower crust and upper mantle polymetallic ore genesis. Additionally, measurements of partition coefficients of chalcophile elements between silicate and sulphide liquids can provide insight into long-standing geochemical problems such as the so-called Pb paradox; the observation that the Pb isotope compositions of all sampled terrestrial reservoirs (continental crust, depleted (MORB) and enriched (OIB) mantle) are all more radiogenic than Earth's geochron, i.e. lie mainly to the right of the geochron (Hart and Gaetani, 2006; Hofmann, 2008). Simultaneously, the Ce/Pb ratio of MORB and OIB (around 25) is significantly higher than the "bulk silicate earth" (around 11) inferred from Earth's chondritic ratios of refractory elements. Since Ce/Pb and Nd/Pb ratios of MORB and OIB are remarkably similar and the distribution of chalcophile elements is controlled by the presence of sulphides, determination of Pb partition coefficients between mafic silicate and sulphide melts constrains the composition of the OIB and MORB source material.

In this study we performed a series of high-pressure experiments on a mixture of basalt and (Fe,Ni)S at 1.5 GPa and 1400°C. Most of the experiments were performed in carbon capsules and were olivine saturated. Experiments were doped with both Ce and a range of chalcophile and volatile elements, which were analysed using both EPMA and LA-ICPMS.

The data show that there is no correlation between D values for most of the analysed metals (Cu, Ga, In, Tl, Pb, Ag, Zn, Cr, V, Co, Sb, Ge, Cd) and Ni-content over the range of 0 - 7 wt% Ni in the sulphide liquid, consistent with the results reported by Brenan (2003) for olivine-sulphide liquid partitioning, that suggest no correlation between KD (Ni-Fe) for Ni and wt% Ni at low oxygen fugacity (around QFM-3).

On the other hand, we observed strong inter-correlations between D values of such elements as Pb (D = 36-65), In, Cd, Zn, Ag, Sb, Cu and Tl that appear to depend on variations of the sulphur/metal ratio of the sulphide liquid.

### **References**

- Brenan, J. M., 2003, Effects of fO<sub>2</sub>, fS<sub>2</sub>, temperature, and melt composition on Fe-Ni exchange between olivine and sulfide liquid: Implications for natural olivine-sulfide assemblages: *Geochimica Et Cosmochimica Acta*, v. 67, no. 14, p. 2663-2681.
- Hart, S. R., and Gaetani, G. A., 2006, Mantle Pb paradoxes: the sulfide solution: *Contributions to Mineralogy and Petrology*, v. 152, no. 3, p. 295-308.
- Hofmann, A. W., 2008, Chemical geodynamics: The enduring lead paradox: *Nature Geosci*, v. 1, no. 12, p. 812-813.