Element partitioning at ultra-high pressure: new insights on bulk lower-mantle geochemistry

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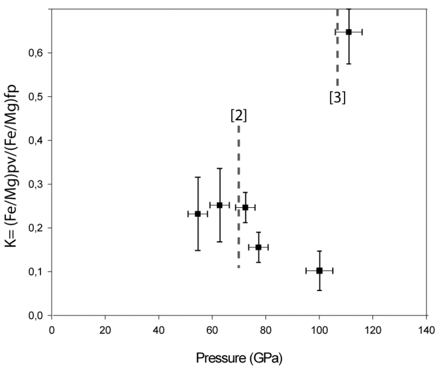
Magnesian perovskite (Mg,Fe)SiO_3 (Mg-*pv*) and ferropericlase (Mg,Fe)O (*fp*) are the dominant phases in the lower mantle. Their physical and chemical properties determine the dynamics of the deep Earth. It is thus of prime importance to constrain element-partitioning at high pressure for improving the geochemical models of the Earth. We investigated iron and trace element partitioning between Mg-*pv* and *fp* synthetised under lower mantle conditions (up to 115 GPa and 2800 K) in a laser heated diamond anvil cell. Recovered samples were thinned to electron transparency by focussed ion beam (FIB) and investigated by analytical transmission electron microscopy (ATEM). Iron concentrations in both phases were obtained from EDX measurements. Our results are the first to show that recently reported transitions in the lower mantle [1,2] directly affect the evolution of Fe/Mg partitioning between both phases (see figure). Mg-*pv* is increasingly iron-depleted above 70-80 GPa possibly due to the high spin-low spin transition of iron in *fp*. The *pv* to *post-pv* transition is accompanied by a strong iron enrichment of the silicate phase. Iron concentrations determined by ATEM and NanoSIMS are in good agreement. Transition trace-element (Ni, Mn) concentrations (determined with the NanoSIMS) show similar trends. The combination of laser-heated diamond anvil cell synthesis, FIB, ATEM and NanoSIMS analysis promises to be an effective tool for probing petrological and geochemical processes in the lower mantle.



Fe/Mg exchange coefficient between Mg-perovskite and ferropericlase

References

[1] Badro J. et al (2003) *Science* **300,** 789-791.
[2] Murakami M. et al. (2004) *Science* **304,** 855-858.