Element partitioning between post-perovskite and ferropericlase and implication to the lowermost mantle structure

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The lowermost 200 km of the mantle called D" region is a thermal and chemical boundary layer between the silicate mantle and outer core. (Mg, Fe)SiO_3 perovskite which is the most abundant mineral in the lower mantle transformed to post-perovskite phase at pressure and temperature conditions of D" layer [Murakami et al., 2004]. Thus, it is considered that (Mg, Fe)SiO_3 post-perovskite phase and (Mg, Fe)O ferropericlase are important minerals mainly constituting D" layer. The Fe-Mg partition coefficient between post-perovskite and ferropericlase is important to understand the chemical and physical properties of this region. In this study, high pressure and high temperature experiments up to 140 GPa and 2000 K were performed using a laser heated diamond anvil cell (LHDAC). Powdered San Carlos olivine ($Mg_{0.88}$, $Fe_{0.12}$)SiO_3 in simple Al-free system was used as a starting material in order to avoid complicated effects of trivalent cations. Pressures were determined by both the ruby fluorescence method [Mao et al., 1978] and the Raman shift of the first-order Raman spectra of diamond anvil [Akahama and Kawamura, 2004]. Temperatures were measured by spectroradiometric method. The recovered samples were analyzed using the technique of combination FIB and ATEM (JEOL JEM-3000F (FEG TEM-STEM))

The result shows that post-perovskite phase exhibits very small iron content, Fe# = 0.01 at 140 GPa. Therefore, the partition coefficient was K = 0.03, which indicates iron prefer ferropericlase phase rather than post-perovskite phase, which is consistent with the prediction from ab initio calculation [Iitaka et al., 2004], and the high-spin/low-spin transition arguments of ferropericlase [Badro et al., 2003]. Iron-rich ferropericlase (magnesiowustite) may play an essential role at the lowermost mantle.