Partitioning of iron between perovskite/post-perovskite and magnesiowustite, and ferric iron in (Mg,Fe)SiO3 post-perovskite

Ryosuke Sinmyo[1]; Kei Hirose[1]; Daisuke Hamane[2]; Yusuke SETO[3]; Kiyoshi Fujino[4]; Nagayoshi SATA[5]; Yasuo Ohishi[6]

[1] Dept. Earth & Planet. Sci., Tokyo Tech.; [2] Earth and Planetary Sci., Hokkaido Univ; [3] Earth and Planetary Sci., Hokkaido Univ.; [4] Dept. of Natural History Sci., Hokkaido Univ.; [5] IFREE, JAMSTEC; [6] JASRI/SPring-8

The Earth's lower mantle primarily consists of (Mg,Fe)SiO_3 perovskite (Pv) and (Mg,Fe)O magnesiowustite (Mw). Recently, it is discovered that perovskite undergoes the phase transition to post-perovskite (PPv) under lowermost mantle condition. The iron partitioning between Pv/PPv and Mw is very important for geophysical modeling of the lower mantle. However, the P-T dependence of iron partitioning through the lower mantle conditions has been quite controversial [e.g., Guyot et al., 1988; Mao et al., 1997; Andrault, 2001]. Moreover, the valence state of iron in (Mg,Fe)SiO_3 PPv has not been measured, although total Fe partitioning between PPv and Mw was determined [Kobayashi et al., 2005]. Here we determined the iron partitioning between Pv/PPv and Mw from 30 to 126 GPa at about 2000 K, and ferric iron ratio (Fe^{3+}/total Fe) in (Mg,Fe)SiO_3 PPv. Synthetic gel with olivine composition (Mg# =89.9) were used as starting materials. Experiments were conducted in a laser-heated diamond-anvil cell (LHDAC). The in-situ X-ray diffraction measurements showed that Pv coexisted with Mw to 105 GPa and PPv was formed at 126 GPa and 2000 K. Recovered samples were analyzed by energy dispersive X-ray spectroscopy (EDS) and electron energy-loss spectroscopy (EELS), attached with transmission electron microscope (TEM). The results demonstrate that $K_D^{Mw/Pv}=(X_{Fe}/X_{Mg})^{Mw}/(X_{Fe}/X_{Mg})^{Pv}$ was approximately constant at 4 between 30 and 105 GPa. This value was lower than those obtained at about 1500 K by Kobayashi et al. [2005]. This difference is likely due to the effect of temperature. $K_D^{Mw/PPv}$ was found to be about 10, which is significantly higher than that of Kobayashi et al. [2005]. In addition, we observed low ferric iron ratio (Fe^{3+}/total Fe=0.13) in PPv. This indicates ferric iron may be negligible in our determination of $K_D^{Mw/PPv}$.