Fe-Mg partitioning between post-perovskite and magnesiowustite

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$(Mg,Fe)SiO_3$ perovskite(Pv) and magnesiowustite(Mw) have been believed to be the most abundant mineral assemblage in the Earth's interior. Fe-Mg partitioning between these phases is important for understanding the physical and chemical properties of the Earth's lower mantle. In previous studies using laser-heated diamond anvil cells, Fe contents of the quenched phases were measured by either using the relationship between V_0 and Fe-concentration or by ATEM (analytical transmission electron microscopy). There is a disagreement in the pressure dependence of the partition coefficients determined using the two methods. Moreover, the pressure induced spin transition of iron in Mw and Pv has been expected to have a profound effect on the Fe-Mg partitioning behavior [1-2]. After the discovery of the Post-perovskite phase (PPv), the Fe-Mg partitioning behavior in the D" region has been reported to be different from that in lower mantle[3]. In this study, we reevaluated the pressure and temperature dependence of the Fe-Mg partition coefficients between Pv and Mw, and that of PPv and Mw, up to 130 GPa at 1600-2000 K in a simple Al-free system in order to avoid the complicated effect of trivalent cations. After laser-heateing in the diamond anvil cell, the samples were checked by in-situ X-ray diffraction at high pressures and ambient condition. Iron content in each phase was determined by both the lattice volume of the recovered sample and by ATEM. We observed a high FeO content in PPv coexisting with Mw [$K^{PPv/Mw} = (FeO/MgO)_{PPv} / (FeO/MgO)_{Mw} = 0.30$] compared to that in Pv [$K^{Pv/Mw} = (FeO/MgO)_{Pv} / (FeO/MgO)_{Mw} = 0.12$] observed from 23.0 to 95.4 GPa at around 1600 K. We also observed that $K^{Pv/Mw}$ keeps a constant value 0.12 up to the PPv phase boundary at around 1600 K and $K^{Pv/Mw}$ decreases with increasing pressure at around 2000 K. Our results also suggest possible generation of a metallic phase in the lower mantle. The assemblage of PPv and Mw is 1.5-1.7 % denser than the Pv bearing assemblage, which results in a gravitational stabilization of the lowermost mantle.

References

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[3] Murakami et al. (2005), *GRL* **32,** L03304, doi: 10.1029/2004GL021956