

Mg-Fe partitioning between (Mg,Fe)SiO₃ perovskite and magnesiowustite

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(Mg,Fe)SiO₃ perovskite and magnesiowustite which are likely to be the most abundant mineral assemblage in the earth's lower mantle coexist with different Mg-Fe compositions. Mg-Fe partitioning relation is described by the parameter called Mg-Fe partition coefficient between perovskite and magnesiowustite, defined as $K = (X_{Fe}/X_{Mg})_{Pv} / (X_{Fe}/X_{Mg})_{Mw}$, where X is the mole fraction of Fe(Fe²⁺ and Fe³⁺) or Mg in perovskite and magnesiowustite. Previous studies indicated that K value depends on pressure, temperature, bulk Fe/Mg ratio, oxygen fugacity, and trivalent ion content. But the pressure dependence of K value derived from laser-heated diamond anvil cell experiments is still in controversy.

In this study, we reinvestigated Mg-Fe partitioning between coexisting (Mg,Fe)SiO₃ perovskite and magnesiowustite which were synthesized from San Carlos olivine [Fe# = 0.12] and Miyakejima olivine [Fe# = 0.20(2)] in double sided laser-heated diamond anvil cell at 23 to 53.6 GPa and 1500(100) to 2200(200)K. Pressures were measured by the ruby fluorescence method. Nd:YAG laser was used for heating and the temperatures were measured by the thermal radiation from the heated sample. The K values were calculated from the unit cell volume (V₀) - composition (X) relationship reported by Andrault(2001). The unit cell volumes of perovskite and magnesiowustite were measured by powder X-ray diffraction method (KEK-PF, Tsukuba, Japan). We also used electron probe microanalyser and analytical transmission electron microscope to examine the reliability of K values calculated from V₀-X relationship.

Experimental results on San Carlos olivine indicate that K increases with increasing pressure and this is consistent with previous reports. However, the K values for Miyakejima olivine were larger than those for San Carlos olivine and previous reports. The V₀-X relationship of magnesiowustite reported by Andrault(2001) was consistent with the present experimental results, but the V₀-X relationship of perovskite synthesized from Miyakejima olivine was inconsistent with relation reported by Andrault(2001). The difference in the content of minor elements or oxidization state of starting materials may affect the volume of perovskite, but still more detailed analysis is required for further investigation.