Preliminary results on the grain shape change of the mixture of (Mg,Fe)SiO3 perovskite and magnesiowüstite

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Earth's lower mantle is mainly composed of mixture of (Mg,Fe)SiO3 perovskite and magnesiowustite. Therefore, the nature of the mixture should controls the dynamics of the lower mantle. However, most of previous works have been focused on the physical and chemical properties of each phase. Here, we propose the importance of geometry of the (Mg,Fe)SiO3 perovskite and magnesiowustite mixture.

We carried out high-pressure experiments using a Kawai-type apparatus at 24 GPa and 1400-2000ºC. We used San Carlos olivine as a starting material, which transformed to (Mg,Fe)SiO3 perovskite and magnesiowustite at the present high pressure and high temperature conditions. After experiments, the recovered samples were examined by SEM, EDS and X-ray diffraction techniques. Especially, FE-SEM was used for more detailed microstructural observation.

The microsructural observation revealed that the magnesiowustite surrounded by perovskite annealed at 2000ºC showed the euhedral shape with straight grain boundaries. On the other hand, magnesiowüstite surrounded by perovskite annealed at lower than 1800ºC showed the convex grain boundary. This observation indicates that relative surface energies depend on the temperature and/or Mg/Fe ratio. The shape change may affect the connectivity of magnesiowustite in the mixture and hence affect the dynamics in the lower mantle.