The role of ferro-periclase in the lower mantle

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Rheology of the lower mantle characterizes the dynamics of the earth's interior and it is often controlled by the textures of the constituting material which are (Mg,Fe)SiO3 perovskite and ferro-periclase aggregate. We conducted high-pressure experiments to synthesize the (Mg,Fe)SiO3 perovskite and ferro-periclase aggregates and measured two important textures of grain-size and dihedral angle. The grain growth rates of perovskite and (ferro-)periclase in two phase aggregates were influenced by the iron content and increased with factors of ˜1.5 in iron-rich system. This difference in grain growth rates indicates that the viscosity of aggregates of iron-rich system is only a few times greater than that of iron-poor system for likely diffusion creep in the lower mantle. In contrast, the change of the dihedral angle of perovskite - periclase - perovskite at triple grain junction with variation of iron content was not observed systematically, but the dihedral angle decreases from ˜110 to ˜105 degree with an increase of temperature from 1673 to 2273 K. The dihedral angle of 105-110 degree would imply the interconnected network spatially of ferro-periclase in the aggregates and the connectivity increases with temperature. As a result, at higher temperature, ferro-periclase plays more important role for understanding the rheology of the lower mantle because ferro-periclase is a few order of magnitude softer than (Mg,Fe)SiO3 perovskite.