Texture of (Mg,Fe)SiO3 perovskite and ferro-periclase aggregate: implications for rheology of 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 grater 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 105 to 110 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.