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Interconnected ferro-periclase in the subducting slab at the top of lower mantle

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Major phase transformation occurs from ringwoodite to (Mg,Fe)SiO3 perovskite plus ferro-periclase when oceanic lithosphere sink into deep mantle across the 660 km discontinuity. After the transformation, material (rock) properties strongly depend on their two phase geometry, for example, grain-size, phase distribution, grain shape, lattice preferred orientation, and so on. The interconnection of ferro-periclase is a key factor on rheology and chemical heterogeneity because ferro-periclase is much weaker than (Mg,Fe)SiO3 perovskite and chemical diffusivity of ferro-periclase is higher than that of (Mg,Fe)SiO3 perovskite.

To investigate the interconnectivity of ferro-periclase after transformation from ringwoodite in the conditions of subducting slab, we carried out in-situ electrical conductivity measurement by means of high pressure experiment using a Kawai-type multianvil apparatus and 3D-textural observation on the recovered sample using FIB-SEM technique. The electrical conductivity of ferro-periclase is much higher than that of perovskite, suggesting that the conductivity of their aggregate is good indicator to estimate interconnectivity of ferro-periclase.

Our result suggested that the interconnected network of ferro-periclase was formed after phase transition from ringwoodite and remained for a while in the condition of cold subducting slab, leading that interconnected ferro-periclase plays important role on physicochemical properties of bulk rock. On the other hand, in the warm slab or regular mantle, ferro-periclase may be isolated in the aggregate. In this case, (Mg,Fe)SiO3 perovskite mainly controls the bulk properties.