Influence of high oxygen fugacity on melting temperature of wadsleyite

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About 60% of the upper part of the Earth's mantle transition zone is composed of wadsleyite, which is the high-pressure phase of olivine. It is known that water and ferric iron are supplied to the mantle transition zone by subduction of the oceanic plates. A recent study revealed that ferric iron lowers melting temperature of bridgmanite, the major mineral in the lower mantle, in the MgO-FeO-Fe_2O_3-SiO_2 system (Sinmyo et al., 2019). However, the effect of high oxygen fugacity on melting temperature of wadsleyite has not been studied so far. Therefore, in this study, we conducted experiments to clarify the effect of high oxygen fugacity on the melting temperature of $(Mg_{0.9},Fe_{0.1})_2SiO_4$ wadsleyite using a Kawai-type multi-anvil press. The experiments were performed twice at 13.5–16 GPa and 1500–1900 ℃ at oxygen fugacities buffered by Re-ReO_2 and Mo-MoO_2 oxygen fugacity buffers. As a result, quenched crystals were observed at high oxygen fugacity buffered by the Re-ReO_2 buffer in both experiments while no quenched crystals were observed at low oxygen fugacity buffered by the Mo-MoO_2 buffer. Wadsleyite with the $(Mg_{0.9},Fe_{0.1})_2SiO_4$ composition melts at about 2200 ℃ at low oxygen fugacity (Ohtani et al., 1998). Therefore, this result shows that the melting temperature of wadsleyite probably be lowered by at least about 700 ℃ due to the influence of high oxygen fugacity.

Keywords: wadsleyite, high oxygen fugacity, ferric iron, quenched crystals, melting

