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Effect of Fe^{3+} on the subsolidus and melting phase relations under lower mantle conditions

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Earth's lower mantle is mainly composed of $MgSiO_3$-rich bridgmanite and lesser amount of $(Mg,Fe^{2+})O$ ferropericlase. Bridgmanite can accommodate much greater concentrations of Fe^{3+} than other mantle minerals. Although Fe^{3+} affects both physical and chemical properties of bridgmanite, the high pressure phase relations are poorly known in the system including Fe^{3+}. We have conducted high-pressure and -temperature experiments using multi-anvil apparatus to study phase relations in the Fe^{3+}-bearing system under lower mantle conditions. We observed coexisting of $MgSiO_3$-rich bridgmanite, Fe^{3+}-rich oxide phase and SiO_2 in the recovered sample at temperatures below ~1900 K. Quenched partial melt was observed above ~ 2000 K, which is significantly lower than solidus temperature in Fe^{3+}-free bulk composition. This is likely due to a lower eutectic point between bridgmanite and Fe^{3+}-rich oxide phase, compared to bridgmanite and ferropericlase. The maximum solubility of iron in bridgmanite was significantly higher than that in reduced bulk compositions. Partial melt in Fe^{3+}-rich bulk composition was more iron-rich than coexisting bridgmanite, similarly to the Fe^{2+}-dominant system. Current results suggest that strong anomalies in mantle oxygen fugacity might alter subsolidus and melting phase relations of lower mantle dramatically.