

The stability of bridgmanite at hydrous conditions

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Bridgmanite, a member of enstatite polymorphs $(\text{Mg,Fe})\text{SiO}_3$, has long been recognized as the most abundant mineral in the lower mantle. It forms through the breakdown of $(\text{Mg,Fe})_2\text{SiO}_4$ into periclase $((\text{Mg,Fe})\text{O})$ and $(\text{Mg,Fe})\text{SiO}_3$. It was thought to be stable from at the depth of 660 km to the top of D'' layer, which is a region near the core mantle boundary in the mantle. The importance of bridgmanite has attracted much attention in the last few decades. Many studies have been conducted to examine the phase relation in the $\text{MgSiO}_3\text{-H}_2\text{O}$ system and the stability of bridgmanite at different chemical and physical conditions. Further research on the structural stability and properties of bridgmanite will promote our understanding of the composition and structure of the lower mantle.

In this study, high-pressure and high-temperature experiments were carried out on enstatite (MgSiO_3) with 5-10 wt% water in a multi-anvil apparatus. The sample was compressed to 25 GPa and heated to 1300-1500 °C for up to 48 hours. In addition to crystals of bridgmanite, other phases are present in the experimental products. Raman spectroscopy shows strong peaks of bridgmanite, stishovite and super-hydrous phase B. Back-scattered electron (BSE) images and energy-dispersive spectroscopy (EDS) analyses clearly identified the presence of bridgmanite, stishovite phase and a liquid phase. Results from our experiment suggest that water would influence the stability of bridgmanite and the phase relation of MgSiO_3 system. Superhydrous phase B and stishovite may emerge at hydrous mantle conditions. This result may contribute to our understanding of the mantle's components and interpreting some seismic velocity data in the mantle.