上部マントル条件下での$MgSiO_3$の相図
Phase diagram of $MgSiO_3$ in the upper mantle

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As olivine, pyroxene and garnet are major minerals in the upper mantle, understanding the dynamics and evolution of the mantle requires knowledge of $MgSiO_3$, which is an end-member of pyroxene. Therefore, phase relations in $MgSiO_3$ have been repeatedly investigated by a number of author. We investigated the disputed issue of two phase boundaries (high-pressure clinoenstatite and wadsleyite + stishovite, ringwoodite + stishovite and akimotoite) in $MgSiO_3$, and suggest a revised phase diagram for $MgSiO_3$ based on the obtained data.

We performed the high-pressure experiments using a multi-anvil high-pressure system combined with a synchrotron radiation source made it possible to acquire precise data from samples under high-pressure and high-temperature conditions. Experimental details have been described elsewhere [1,2]. A synthetic gel was used to produce a reactive and homogeneous starting material. The chemical composition of the synthesized gel was $MgSiO_3$.

The reaction boundaries in $MgSiO_3$ were determined over the range of 1150–1450 K. The stability of each phase was determined by observing the powdered X-ray diffraction data and analyzing the recovered samples. The reaction boundary between high-pressure clinoenstatite and wadsleyite + stishovite was found to occur at P (GPa) = 16.1 + 0.0064 x (T-1250) (K). According to our new data, the stability field of wadsleyite and stishovite expands to a low temperature region. The reaction boundary between ringwoodite + stishovite and akimotoite was found to occur at P (GPa) =22.0 - 0.0012 x T (K) [3]. This indicated that the triple point of ringwoodite+stishovite-wadsleyite+stishovite-akimotoite estimated in our study was at ~20 GPa and ~1700 K. The revised phase boundaries reconcile inconsistencies recorded between previous studies regarding the phase relation in $MgSiO_3$

[1] S. Ono et al. (2011) Phys. Chem. Minerals, 38, 735-740.

[2] S. Ono et al. (2013) Phys. Chem. Minerals, 40, 811-816.

[3] S. Ono et al. (2017) Phys. Chem. Minerals, 44, 425-430.

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