

Stability of Post-Perovskite Phase in Analogue Materials to MgSiO₃

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Recent high-pressure experiments by Murakami et al. (2004) showed a novel phase transition from perovskite to a CaIrO₃-type post-perovskite phase (space group: Cmcm) in MgSiO₃ above 125 GPa and 2500 K. It is well known that a wide range of chemical compositions has perovskite structure at high pressures. In order to know the chemical variation that adopts CaIrO₃-type post-perovskite structure, we examined the phase transition of perovskite structure in germinates (MgGeO₃, MnGeO₃ and CdGeO₃) and titanates (MnTiO₃ and CdTiO₃) with increasing pressure at high temperature. Experiments were made at BL10XU of SPring-8 by a combination of laser-heated diamond-anvil cell (LHDAC) techniques and synchrotron X-ray diffraction measurements.

Results demonstrate that both MnGeO₃ and MgGeO₃ perovskites undergo phase transition to the CaIrO₃-type post-perovskite structure similarly to the MgSiO₃ perovskite. The transition pressures are 58 GPa and 63 GPa at 1600 K, respectively, that are much lower than that in MgSiO₃. The molar volumes of these post-perovskite phases are smaller by 1.5 % than those of perovskite at equivalent pressure. In contrast, structure of CdGeO₃ perovskite becomes less distorted from ideal cubic structure with increasing pressure, and perovskite phase is stable at least to 110 GPa at 2000 K. Post-perovskite phase transition is, therefore, unlikely to occur in CdGeO₃ with further compression. Perovskite phase is stable also in MnTiO₃ and CdTiO₃ up to 50 GPa at 1700 K and 70 GPa at 2500 K, respectively. However, the structural distortion of both MnTiO₃ and CdTiO₃ perovskite increases with pressure. This observation suggests that phase transition or decomposition may occur in both the compositions at higher pressures.