The 403th Geodynamics Seminar

Planetary interiors inferred from high pressure experiments on H_2O and MgO

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Abstract

H_2O is believed to be major components in the ice giant including Neptune and Uranus. Therefore, the equation of state (EOS) is critical for understanding the structure and evolution of the planets. We have obtained $P - \rho - T$ data for H_2O up to 260 GPa by using laser-driven shock compression technique. Our data agree with those of the quantum molecular dynamics (QMD) based EOS model (M. French *et al.*, 2009), indicating this model to be adopted as the standard for modeling the interior structures of the ice giants. While, the melting temperatures determined by our recent measurements are in disagreement with those of the QMD prediction (T. Kimura *et al.*, 2014). These results suggest that stably stratified layer is composed of not H_2O but C and N_2.

MgO is one of the most fundamental constituents of the terrestrial planets. Determination of melting behavior of MgO is important to understand the chemical differentiation and the origin of seismic-wave attenuation in the Earth. All the predictions by the theoretical calculations show that melting temperature of MgO remains the highest in all the mantle materials even at high pressure and temperature condition corresponding to core – mantle boundary (e.g., D. Alfe, 2005). On the other hand, the experiments show the MgO melting curve intersects with that of Mg-perovskite at ~50 GPa (A. Zerr and R. Boehler, 1994). Thus, making sense in the MgO melting behavior is a key to comprehensively understanding the melting relation in the lower mantle materials. Based on both static compression experiments and textural characterization of the recovered sample, we determined melting temperatures of MgO up to 35 GPa, suggesting that melting temperature of MgO is the highest in the mantle materials even up to core – mantle boundary conditions. The melting curve of ($Mg_{0.8}$, $Fe_{0.2}$)O inferred from both the MgO and FeO melting curves intersects with that of Mg-perovskite around 60 GPa, leading to a consensus on the melting relation between the experimental and theoretical studies.

詳細は当センターホームページ：http://www.ehime-u.ac.jp/~grc/をご覧ください
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