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六方晶鉄の圧力-温度-体積の状態方程式
P-V-T equation of state of hcp-Fe

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It is essential to realize high pressure and high temperature conditions in the laboratory by means of high pres-sure experiments to measure the physical properties of high pressure minerals for understanding the structure and dynamics in the earth's interior. In this study, we tried to expand the pressure range in a Kawai-type mul-tianvil apparatus equipped with sintered diamond anvil by optimization of assembly size and materials for cell assembly, and then measured P-V-T relationship of hcp-iron to discuss the dynamics of the inner core because. the hcp-iron is though to be dominant phase in the inner core based on recent diamond anvil experiments (Tateno et al., 2010).

We used synchrotron radiation facility, SPring-8, to conduct in situ X-ray observation at high pressure and temperature to determine P-V-T relation. Kawai-type cell assemblies were squeezed by high pressure press (SPEED-mk.II Madonna at BL04B1) using sintered diamond cubes with 14 mm edge length and 1.0 mm trun-cation edge length. Cr-doped MgO was used as pressure medium and TiB2+hBN was used as heating material. Preheated pyrophyllite was used as preformed gasket.

In the present study, pressure and temperature range were up to ~83 GPa and 1300K. In the experiments, X-ray diffraction data were collected at every 200 K step during cooling cycle with pressure interval of 5-10 GPa. Pressure was estimated from the volume of gold by using equation of state of gold proposed by Tsuchiya (2003).

We fitted our data to third-order Birch-Murnaghan equation of state and Mie-Gruneisen thermal equation of state. As a result, thermoelastic parameters of the isothermal bulk modulus, its pressure derivative, Debye temperature, Gruneisen parameter at ambient pressure and volume dependence of the Gruneisen parameter were determined to be 151.1 (4.8) GPa, 5.6 (0.2), 1110 (87) K, 2.92 (0.24) and 0.99 (0.42), respectively. In addition to present analysis, we need to re-analyze by taking into account the electric pressure term in equation of state.

Our thermoelastic data indicate that the density of the inner core is 4-5 % heavier than observations by seis-mology (e.g., PREM). This result is consistent with previous study (Dubrovinsky et al., 2000) and indicates the existence of light elements in the inner core.