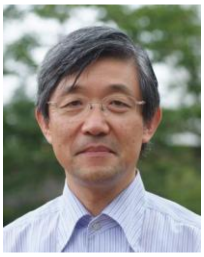


Title of Project : Ultrahigh-pressure Material Science of the Central regions of the Earth and Planet

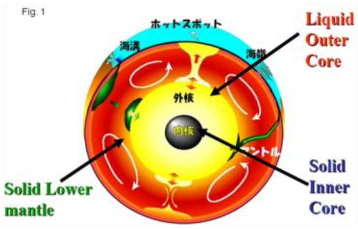
Eiji Ohtani
(Tohoku University, Graduate school of Science, Professor)

Research Area : High Pressure Earth Science

Keyword : Earth and Planetary Materials, Evolution of Earth, Core, Mineral Physics

【Purpose and Background of the Research】

The first objective is to generate pressure and temperature conditions that cover the center of the Earth.



The second objective is to clarify the nature of the various transitions occurring in the lower mantle and core. These transitions include spin crossovers and the post-perovskite transition in lower mantle minerals, and magnetic transitions in iron alloys at high pressures and temperatures.

The third objective is to clarify the sound velocities of the lower mantle and core materials. A unique mineralogical model has not yet been proposed for the central region of the Earth because of a lack of reliable data on the sound velocity of the deep Earth's interior.

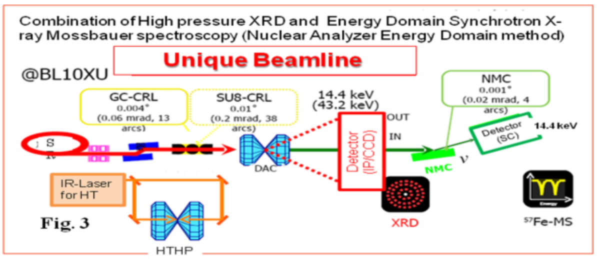
【Research Methods】

We will make simultaneous measurements of the compression and sound velocity of MgO and the B1 and B2 phases of NaCl to establish a primary pressure scale for core conditions.

We will also establish routine procedures for the generation of high temperatures exceeding 3000 K at core pressures, and we will perform in situ X-ray observations.

Diamond Anvil Cell

We will conduct X-ray Mossbauer spectroscopy using the nuclear analyzer energy domain method, together with the conventional X-ray powder diffraction method at high pressures and temperatures (Figure 3) to determine the valence states of the iron, the spin states of the iron in lower mantle silicates, and the magnetic properties of iron alloys in micro-samples under extreme conditions. We will also perform sound velocity measurements of the mantle and core forming minerals at high pressures and temperatures using inelastic X-ray scattering (IXS) spectroscopy and Brillouin scattering spectroscopy.



【Expected Research Achievements and Scientific Significance】

Previous mineralogical models of the Earth's deep interior have been limited to the density model because of a lack of reliable data on the seismic velocities of the materials in the lower mantle and core.

Our goal is to present an advanced model of the lower mantle and core that can explain both the seismic velocities and the density observed in seismology. We can break through the current limit in our understanding of the Earth's deep interior with the results of this project.

【Publications Relevant to the Project】

E. Ohtani, Melting relations and the equation of state of magmas at high pressure: application to geodynamics, Chemical Geology, Vol. 265, No. 3-4, 279-288, 2009.

E. Ohtani, D. Andrault, P. D. Asimow, L. Stixrude, Y.Wang, Editors, Advances in high-pressure mineral physics: From the deep mantle to the core, Physics of the Earth and Planetary Interiors, 174, Issues 1-4, 2009.

【Term of Project】 FY2010-2014

【Budget Allocation】 371, 100 Thousand Yen

【Homepage Address and Other Contact Information】

http://www.ganko.tohoku.ac.jp/bussei/newHP/busseiHP/tokusuiHP_22-26/index._e.html