【Grant-in-Aid for Scientific Research(S)】
Science and Engineering (Mathematical and physical sciences)

Title of Project : Experimental study on physical properties of minerals at the lowermost mantle conditions by means of Kawai-type apparatus

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Research Area : Solid State Geophysics

Keyword : Kawai-type apparatus, D" layer

【Purpose and Background of the Research】

The D" layer is located above the mantle core boundary (CMB) and is expected to be the most active region in the earth. The present research project aims to reveal physical properties of constituting minerals within the D" layer by using the Kawai type multi-anvil apparatus (KMA).

Diamond Anvil cell (DAC) and KMA are two major experimental techniques in Solid State Geophysics targeting the Earth's deep interior. Although DAC can generate higher pressures than KMA, cell volume of KMA is 10^4 times larger than that of DAC.

This research project aims to generate the pressure and temperature at the core mantle boundary (136 Pa, ~4000 K) in KMA, and then conduct various physical property measurements, such as rheology, electric conductivity and thermal conductivity on unquenchable post perovskite phase discovered in laser heated DAC (Murakami et al., 2004).

【Research Methods】

Below is a photograph of the new 6 axis press installed at Okayama University in 2007. Each axis of 600 ton maximum load is precisely controlled by a hybrid system of hydraulic ram and servomotor. The horizontal white scale is 2 m.

The computer simulation technique, such as finite element method, has been rapidly improved in recent years. Utilizing the technical improvements in both hardware and software, we challenge simultaneous pressure and temperature generation to CMB, and physical properties measurements under the corresponding temperature and pressure condition. It is also noted that we have already succeeded to generate ~3800 K by using a boron doped semi conductor diamond heater in KMA.

【Expected Research Achievements and Scientific Significance】

The most important result expected in this project is to accumulate physical property data for post-perovskite phase at conditions corresponding to the D" layer.

Recently, features of the D" layer have been revealed utilizing seismological data such as Hi-net. Additionally, numerical simulations regarding our understanding of mantle convection, plume generation and slab subduction, have rapidly improved. Thus, conducting this experimental project will provide a link between observation and numerical simulations with quantifiable experimental data.

【Publications Relevant to the Project】

・ Ito et al., Pressure generation and investigation of the post-perovskite transformation in $MgGeO_3$ by squeezing the Kawai-cell equipped with sintered diamond anvils. Earth Planet. Sci. Lett., **293**, 84-89, 2010.

・ Yoneda et al., Heat capacity measurement under high pressure: A finite element method assessment, Phys. Earth Planet. Inter., **174**, 309-314, 2009.

【Term of Project】 FY2010-2014

【Budget Allocation】 155,200 Thousand Yen

【 Homepage Address and Other Contact Information】

http://www.misasa.okayama-u.ac.jp/~hacto/