[EE] Evening Poster | S (Solid Earth Sciences) | S-IT Science of the Earth's Interior & Tectonophysics

[S-IT22]Interaction and Coevolution of the Core and Mantle in the Earth and Planets

convener:Tsuyoshi Iizuka(University of Tokyo), Hidetoshi Shibuya(Department of Earth and Environmental Sciences, Faculty of Advanced Science and Technology, Kumamoto University), Taku Tsuchiya(愛媛大学地球深部ダイナミクス研究センター, 共同), Kenji Ohta(Department of Earth and Planetary Sciences, Tokyo Institute of Technology)

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Recent observational and experimental investigations have significantly advanced our understanding of the structure and constituent materials of the deep Earth. Yet, even fundamental properties intimately linked with formation and evolution of the planet, such as details of the chemical heterogeneity in the mantle and light elements dissolved in the core, remained unclear. Seismological evidence has suggested a vigorous convection in the lower mantle, whereas geochemistry has suggested the presence of stable regions there that hold ancient chemical signatures. The amounts of radioactive isotopes that act as heat sources and drive dynamic behaviors of the deep Earth are also still largely unknown. We provide an opportunity to exchange the achievements and ideas, and encourage persons who try to elucidate these unsolved issues of the core-mantle evolution using various methods, including high-pressure and high-temperature experiments, high-precision geochemical and paleomagnetic analyses, high-resolution geophysical observations, geo-neutrino observations, and large-scale numerical simulations. Since this session is co-sponsored by geomagnetism, paleomagnetism and rock magnetism division of the SGEPSS, contributions in geomagnetism and geodynamo simulation are also encouraged.

[SIT22-P10]Thermal equations of state of $MgSiO_4H_2$ phase H up to 63 GPa determined by in situ X-ray diffraction measurement in a multianvil apparatus

*Masayuki Nishi[1,2], Jun Tsuchiya[1,2], Takeshi Arimoto[1], Sho Kakizawa[1], Takehiro Kunimoto[1], Yoshinori Tange[3], Yuji Higo[3], Tetsuo Irifune[1,2] (1.Geodynamics Research Center, Ehime University, 2.The Earth-Life Science Institute, Tokyo Institute of Technology, 3.Japan Synchrotron Radiation Research Institute)

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Hydrous minerals deliver a certain amount of water into the Earth’s interior via subduction of oceanic plates. Following to the theoretical prediction on the thermodynamic stability of $MgSiO_4H_2$ phase H at above 35 GPa in 2013 (Tsuchiya 2013), some experimental studies have succeeded to identify the formation of this phase under high pressure and temperature conditions (Nishi et al. 2014; Ohtani et al. 2014; Walter et al. 2015). Phase H is now considered to be the key hydrous phase responsible for the water cycle in the whole mantle as the highest-pressure form of DHMS. However, the qualities of in-situ X-ray diffraction (XRD) profiles of phase H obtained in earlier studies were sometimes not enough to satisfy the precise determination of its cell parameters because phase H easily dehydrates at temperatures where spectroradiometry can be applied in laser-heated diamond anvil cell (DAC) experiments. Therefore, XRD peaks of phase H have been used basically only for its phase identification within very limited temperature ranges. Nishi et al. (2014) succeeded to obtain the cell parameters of phase H from multiple independent XRD peaks by using multianvil apparatus, which can accurately control the temperature of the sample. However, the data in limited pressure ranges of the previous study (32-42 GPa) were not applicable to construct the equation of state (EOS) of $MgSiO_4H_2$ phase H.

Here, we have determined the thermal equations of state of phase H by using in situ X-ray diffraction measurements in conjunction with a multi-anvil apparatus through its stability field from 34 to 63 GPa up to 1300 K. We succeeded to expand the experimental conditions up to 63 GPa by state-of-the-art high-pressure technology using sinter diamond anvils and Al_2O_3 pressure medium, which achieved higher pressures by ~20 % compared to those using the conventional MgO pressure medium in the similar design of the cell assembly used in Nishi et al. 2014. The data analysis based on the Mie-Grüneisen-Debye model using the third-order Burch-Murnaghan equations at the reference pressure of 35 GPa yielded $V_{ref,}$ =49.61±0.01 (Å^3), K_{ref}=344.6±4.1 (GPa), K_{ref}’=3.05±0.32, *θ*$_{ref}$ =974±146 (K), *γ*$_{ref}$ =1.8±0.1, and q =1.79±0.55. The compressibility of phase H observed in this study is in good agreement with that derived by theoretical calculation in the pressure regions where hydrogen bond symmetrisation is predicted to occur.