The 476th Geodynamics Seminar

High-pressure deformation experiments using rotational diamond anvil cell

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State-of-the-art static compression technology using diamond anvil cells enables the reproduction of high pressure (P) and high temperature (T) conditions in a laboratory that are equal to or higher than those found in the deep Earth's interior. However, investigation of the dynamical (rheological) properties of the deep-Earth materials remains a technical challenge, especially under high pressures of the lowermost mantle and the core. A rotational diamond anvil cell, which produces a torsional deformation like a rotational Drickamer apparatus, has the potential to achieve large-strain under ultra-high pressure conditions while attaining a steady-state deformation. We succeeded in extending the pressure range over that of the bottom of the mantle (135 GPa) with a help of hard nano-polycrystalline diamond anvils (Nomura et al., 2017 RSI). Quantitative investigation of the stress-strain relationship is important for understanding the rheological properties of deep Earth materials. The strain is successfully measured by X-ray laminography technique (Nomura and Uesugi, 2016 RSI), whereas we plan to use X-ray diffraction to determine the stress of the samples. The diamond anvils with deep grooves on the culet surface, made by Focused Ion Beam, successfully suppressed the slip between the diamond anvil and the sample, enabling us to conduct non-slip, strain-rate controlled deformation experiments (Azuma, Nomura et al., submitted). In this presentation, we will show the current status and future prospects on technical developments and potential applications to deep Earth sciences.

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