THE GEODYNAMICS SEMINAR №593

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Venue: Meeting Room #486
Science Research Bldg. 1, 4th floor.
Ehime Univ.

Keywords:
1. Double-stage diamond anvil cell (ds-DAC)
2. Toroidal-type diamond anvil cell (t-DAC)

High pressure generation over 4 megabar III

Deep interior of planets is in high pressure condition. The highest pressure is at center of the planet. In the case of the Earth, the center pressure reaches 364 GPa. It is 'very high' pressure but not highest when we consider larger planets such as outer planets (gas giants, ice giants) and exoplanets (e.g., Super-Earths). In the 'extreme' pressure condition, a lot of interesting phenomena are predicted by theoretical studies. However, it is quite difficult to generate pressure above 400 GPa using the static compression technique. Thus, the technical development of high pressure and temperature generation is desired to confirm the phenomena occurred in the deep interior of large planets. Double-stage diamond anvil cell (ds-DAC) and toroidal-type diamond anvil cell (t-DAC) are new alternative techniques to break through the limit of conventional DAC technique. Our group has also developed the micro-paired type (Sakai et al., 2018) and the conical support type ds-DAC (Sakai et al. 2020) based on the elaborate processing technology using focused ion beam (FIB) system, in which it succeeded to generate about 450 GPa. We continue further development for both ds-DAC and t-DAC, and recently we are trying to test the new technique ds-t-DAC and t-DAC with semi-ball-like convex tip. On the other hand, how to determine the pressure is a fundamental problem so called 'pressure scale issue'. According to our results of simultaneous compression of several metals using t-DAC up to 450 GPa, the primary pressure scales recently proposed based on ramp compression studies are not necessarily consistent each other. Moreover, the high temperature generation is another challenge to investigate the planetary deep interior. The combination of t-DAC and laser heating technique has been tested and succeeded to detect the phase change of mantle mineral at 330 GPa and 2000 K. Further development of this technique at higher pressure might enable us to deeply understand the Super-Earth mantle mineralogy.