Earth & Planetary

"Tyuurippu" - *Tulip*

It is not an exaggeration to say that expansion of high-pressure generation conditions, which can be achieved by advances in high-pressure generation techniques using diamond-anvil cell (DAC) and large volume press (LVP) apparatuses, is the engine for development in Earth and planetary sciences. In 2010, advances in a combination technique of a diamond-anvil cell and laser heating successfully simulated high-pressure and high-temperature conditions corresponding to the center of the Earth (6400 km beneath the surface). These innovative techniques allows *in situ* X-ray diffraction studies of pure iron at such extreme conditions, enhancing the understanding of the state and evolution of the Earth's core and providing new knowledge about the Earth's deep interior. Here, two highlights by a brilliant X-ray source and the DAC technique will be first presented.

Ozawa *et al.* performed *in situ* X-ray diffraction experiments of iron sulfide at pressures and temperatures characteristic of the Earth's core and found that Fe_3S decomposes into Fe and FeS. They have suggested that sulfur may be an unlikely major light element in the Earth's core. Moreover, to learn about how iron behaves under extreme conditions like those at the Earth's core, Ohtani *et al.* determined the density and the vibrational properties of compressed pure iron by X-ray diffraction and inelastic X-ray scattering. Comparing their new data to seismic observations of the core, they discussed the composition of the Earth's core and showed the importance of information about both the density and the sound velocity in constraining the composition of the Earth's core.

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Although the pressure range attainable by the LVP apparatus is limited compared to that by the DAC, many unique studies have been carried out due to the larger sample space in LVP. Kawamoto *et al.* observed separation of a supercritical fluid with the composition of water-rich slab-derived components using an *in situ* X-ray radiographic method in LVP, and determined the second critical endpoint of two magmatic-hydrothermal systems. They showed that the existence of the critical endpoints plays a particularly important role on how various types of magma are generated in the subduction zones. Sakamaki *et al.* investigated the density, viscosity, and structure of molten basalt under high-pressure and high-temperature conditions in subduction zones. They concluded that ascending basaltic magma would have accumulated extensively in the pressure and temperature conditions corresponding to the boundary between the lithosphere and the asthenosphere due to the difference in melt mobilities.

Finally, new results of high-pressure generation over 100 GPa using LVP will be reported. Using X-ray source and a Kawai-type multi-anvil high-pressure apparatus with large sintered diamond anvils, Yamazaki *et al.* probed silicon dioxide (SiO_2) at extreme pressures and temperatures up to 109 GPa and 900 K, and observed the structural phase transition of stishovite, a high-pressure phase of SiO_2, to the $CaCl_2$-type phase. This technical evolution contributes to the understanding of the whole Earth's mantle and plays major roles in the advancement of high-pressure research.

Yasuo Ohishi