EARTH & PLANETARY

Synchrotron-based research in the field of Earth and planetary sciences, including mineral physics, geology, geochemistry, and astronomy, is one of the rapidly growing sectors of science conducted at synchrotron sources. Its applications have led to major advances in the frontier of Earth and planetary sciences. Constant challenges to develop and upgrade instrumentations and techniques, on the basis of the high-flux and low-emittance X-ray beam, have allowed researchers to analyze various materials in a wide variety of environments, that is, high-pressure and high-temperature or micro- to nanosize. In this chapter, we would like to introduce five research highlights in the categories of Earth and planetary sciences.

In situ X-ray diffraction observation of materials under the high-pressure and high-temperature conditions corresponding to the center of the Earth (~360 GPa and ~6000 K) is definitely one of the goals in the high-pressure research program at SPring-8. The first paper is the most up-to-date work on the Earth's core materials. Kuwayama *et al*. conducted high-pressure/temperature experiments on iron and iron-nickel alloys using a laser-heated diamond anvil cell at up to 301 GPa and 2000 K, the Earth's core conditions that had never been experimentally generated before. His observations suggested that the hcp phase is stable even under the Earth's inner-core conditions. Murakami *et al*. report high-pressure Brillouin scattering spectroscopy on MgO in combination with the synchrotron X-ray diffraction method in the pressure range of the Earth's upper mantle to the lowermost mantle. Their results show that the shear velocity profile can reproduce the 1-D global seismic model of the lower mantle remarkably well using a model composed of ~92 vol% Mg-silicate perovskite phase and ~8 vol% MgO.

SCIENCE

Tange *et al*. developed the technique of high-pressure generation using a Kawai-type multi-anvil high-pressure apparatus, one of the large-volume presses, with sintered diamond anvils, and extended achievable high pressure of up to 80 GPa. By the new technique, they also determined the accurate phase relation and Fe-Mg partitioning in the system of MgO-FeO-SiO_2 in the middle part of the Earth's lower mantle. Kogiso *et al*. presented the microbeam X-ray fluorescence analysis of platinum-group elements in the natural peridotite that is dominant in the lower crust and abundant in the uppermost mantle. Measurements of the platinum-group element concentrations in microphases of the sample are challenging because of the extremely small amount analysis. The further development of the X-ray analytical technique will lead to the improvement of the accuracy of the analyzing system. Ogasaka *et al*. demonstrated the method for the calibration and development of new instruments for a hard X-ray telescope operated in space. Only hard X-ray synchrotron radiation allows us to conduct performance tests on the multilayer hard X-ray mirrors and to evaluate the performance as onboard equipment of a hard X-ray telescope.

Yasuo Ohishi

"Ookinkeigiku" - *Coreopsis or Tickseed*