EARTH & PLANETARY

"Tsubaki"- *Camellia*

Science

The success of the asteroid sample-return mission of JAXA, HAYABUSA mission, was one of the hottest scientific topics in 2011 and had a huge impact on the broad area of research. Japanese researchers have first analyzed samples from the asteroid Itokawa using a nondestructive analytic method based on synchrotron radiation at SPring-8. Tsuchiyama reported X-ray absorption imaging tomography results for samples of the S-type asteroid Itokawa, revealing that most of Itokawa rock samples were similar to the most common type of meteorite on Earth, the ordinary chondrites, in terms of mineral assemblage, abundances and texture. The researchers also discussed the regolith formation and evolution of Itokawa, on the basis of three-dimensional shape features of the particles.

Recent advances in synchrotron radiation instruments and techniques make it possible to understand the physical and chemical properties of deep Earth materials as well as extraterrestrial matter. Here, we introduce four topics as a result of important research on the high-pressure and high-temperature behavior of iron alloys and iron-bearing compounds. Yoshino performed an electrical conductivity measurement of ferropericlase (Mg,Fe)O with a low iron content, which would form the top of the lower mantle, using a large-volume press and accurately determined the generated pressures using the equation of state of gold, in order to investigate the electronic high-spin-to-low-spin transition pressure of iron in ferropericlase. As a result, he revealed that the low iron content in (Mg,Fe)O results in a marked decrease in spin transition pressure. Hirose's group has studied iron spin crossover in silicate glass by X-ray emission spectroscopy and reported that the change in the degree of Fe-Mg partitioning between solid silicate and melt at high pressures was caused by the spin transition. The density calculation of silicate melt indicates that silicate melt is present at the base of the mantle, producing a possibly ultralow-velocity zone above the core-mantle boundary.

The next two reports present the latest results regarding the core materials of Earth and a Jupiter satellite. Ozawa and coworkers have investigated the phase relation of FeO, a candidate of Earth's core materials, under the whole Earth's outer core conditions by *in situ* X-ray diffraction using a laser-heated diamond anvil cell. They discovered a B1-B2 structural phase transition at 230 GPa and 3850 K, and found the volume change relevant to the transition. The present experiments and numerical simulations suggest the presence of two-layered convection in the outer core, having a significant effect on the Earth's magnetic field. For modeling the internal structure of Ganymede, a Jupiter satellite, Shibazaki *et al.* determined the melting temperature at high pressures in the Fe–S–H system. The reaction of the FeS alloy with hydrogen was observed, and hydrogenation was found to cause the depression of the melting temperature of the FeS alloy. On the basis of the experimental results on the Fe–S–H system, they discussed Ganymede's core.

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