

〈講 演〉

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探査機「はやぶさ」による小惑星「イトカワ」の試料と
希ガス同位体質量分析技術

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Hayabusa Samples from Asteroid Itokawa and Noble Gas Mass Spectrometry

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Abstract

Hayabusa sample return mission successfully brought back numerous regolith grains from Itokawa asteroid in 2010. Itokawa had been classified as S-type asteroids on the basis of telescopic reflectance spectroscopy. The Hayabusa sample preliminary examination team measured about 60 small grains with various advanced analytical techniques and showed following epoch-making results: 1) Close affinities of the Hayabusa samples with LL-chondrites in elemental, mineral and oxygen isotope compositions gave a direct link with S-type asteroids, which had been thought to be parent asteroids of ordinary chondrites, the most popular meteorites falling on the Earth. 2) Regolith grains were produced by impacts of meteoroids occurring on the Itokawa's surface. The grains were ground in the regolith layer by shaking induced by the impacts, resulting in round edged grains. 3) Space weathered thin layers ranging 30–60 nm in thickness were observed at the grain surfaces. This is the first evidence of space weathering of asteroid's surface materials, which causes reddening and darkening of reflectance spectra. 4) High concentrations and isotopic ratios of He and Ne detected in the grains clearly indicate that the grains were exposed to solar wind irradiation on the uppermost surface of Itokawa. 5) Short cosmic ray exposure ages deduced for the grains indicate a short residence time of the grains in the regolith. This means that Itokawa is continuously shrinking by losing surface materials into space at a rate of ~ 1 m/My, and the lifetime of Itokawa will be less than 1000 My. Noble gas analytical method applied to the Hayabusa samples was briefly described as an appendix.

Key words: Hayabusa samples, asteroid Itokawa, sample return, solar wind, cosmic-rays.