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はやぶさ回収試料の初期分析２:酸素同位体分析、微量元素分析
Preliminary examination of Hayabusa asteroidal samples: oxygen isotope and trace elements analyses

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Introduction: Oxygen isotopic compositions of asteroidal materials returned from Itokawa by the Hayabusa mission are all depleted in O-16 relative to terrestrial materials and indicate that Itokawa, an S-type asteroid, is one of the source of the LL or L group to equilibrated ordinary chondrites (Yurimoto et al., 2011). As the second round measurements, we measured, using secondary ion mass spectrometry, oxygen isotopic compositions and trace elements of individual minerals in 5 grains including poorly equilibrated particles from petrologic observations returned from Itokawa by the Hayabusa mission.

Experiments: Each grain was mounted at the center of an epoxy disk and the surface was polished under the processes established for the preliminary examination. The samples were gold-coated to a thickness of 60 nm.

Oxygen isotope compositions and trace element have been investigated by the Hokudai isotope microscope system (Cameca ims-1270 and 6f SIMS). The detail analytical conditions of oxygen isotope analyses are shown in Yurimoto et al. (2011). Trace elements analyses were performed by 6f SIMS in Hokudai. A 23keV O- primary ions is focused to ˜15micron on the sample surface and secondary ions were collected with EM. The detail analytical conditions were shown in Yurimoto et al. (1989).

Results and Discussion: All oxygen isotopic compositions of the minerals from Itokawa plot on the upper side of terrestrial materials on an oxygen three-isotope diagram and are distributed parallel to the terrestrial mass fractionation line. This result is consistent with those of L or LL chondrites. Even if some particles show the fractionated delta values (olivine) relative to those of other particles, the isotopic relationship among olivine, orthopyroxene and plagioclase shows that the oxygen isotopes fractionated under equilibrium between coexisting phases. On the basis of the small variation of D17OSMOW, the poorly equilibrated grains may have caused by late thermal process (e.g., shock melting) from the equilibrated grains made by thermal metamorphism like other Itokawa equilibrated grains. We measured trace elements of mesostasis parts in less equilibrium particles. Incompatible trace elements are enriched in the mesostasis. REE patterns are less fractionated among LREEs and HREEs.

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