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Preliminary examination of Hayabusa asteroidal samples: Noble gases

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Samples of the asteroid 25143 Itokawa were successfully recovered by the Hayabusa spacecraft. Near-infrared spectroscopic observation by the Hayabusa indicated that the surface materials of the asteroid are similar to the LL5-6 chondrites [1]. Because this is the first chance to measure samples from a known asteroid, we have improved analytical techniques and mass spectrometry system available to noble gas analysis of small grains. Because the returned materials were free from terrestrial noble gas contamination, which is essentially different from meteorites and cosmic dust particles collected on the Earth, the Itokawa samples were treated under condition of nitrogen gas with low concentration of noble gases in the curation facility [2]. Accordingly, we can expect low contamination of terrestrial noble gases for the samples.

Surface materials of asteroids are exposed to solar gases, and the gases are implanted into surface layer of the materials. The asteroidal surface materials are also bombarded by galactic cosmic-rays, producing cosmogenic noble gases with characteristic isotopic compositions through nuclear reactions. Therefore, noble gases of the Itokawa samples would be a mixture of several different origins, e.g., trapped, radiogenic, cosmogenic, and solar gases. The cosmogenic and solar noble gases will provide us with information about the cosmic-ray irradiation, surface gardening, and surface erosion histories of small asteroids.

Detection limits for ^{3}He and ^{132}Xe with our mass spectrometers are ca. 1x10^{-15} and 1x10^{-16} cm^{3}STP, respectively, which correspond to the number of atoms in the order of 10^{4} and 10^{3}. Noble gas extraction system using a Nd-YAG laser performs extremely low blank levels (in cm^{3}STP), e.g., 7x10^{-12} (^{4}He), 1x10^{-13} (^{20}Ne), 5x10^{-12} (^{40}Ar), 2x10^{-16} (^{84}Kr), and $<$1x10^{-16} (^{132}Xe). The analytical techniques have been applied to a large number of micrometeorites from Antarctica to measure all noble gases (He, Ne, Ar, Kr, and Xe) extracted from single grains weighing ca. 1 micro-g or less each [3-8]. Measured amounts of noble gases extracted from single grains with carbonaceous chondritic character were (10-10000)x10^{-12} cm^{3}STP for ^{4}He and (1-10)x10^{-15} cm^{3}STP for ^{132}Xe. The results showed high concentrations of solar noble gases implanted in most micrometeorites, suggesting an importance of solar gas implantation for small grains in space. Histories of crystallization, accumulation of radiogenic noble gases, cosmic-ray irradiation, and solar gas implantation are expected to be variable among the grains as indicated by the single grain analysis of micrometeorites [3-7].

The Hayabusa samples have been analyzed for noble gases as a member of the university consortium team. We used our laser extraction system to extract noble gases from single grains, and measured noble gases on the modified-VG5400 (MS-III) at the Geochemical Research Center, University of Tokyo. The samples were heated stepwisely, two steps at low temperatures and at high temperature to melt. Results will be presented at the meeting.

References: [1] Abe et al. (2006) *Science*, 312, 1334-1338. [2] Okazaki et al. (2011) *LPSC*. [3] Osawa T. et al. (2000) *Antarctic Meteorite Research* 13, 322-341. [4] Osawa T. and Nagao K. (2002) *Antarctic Meteorite Research* 15, 165-177. [5] Osawa T. and Nagao K. (2002) *Meteoritics & Planetary Science* 37, 911-936. [6] Osawa T. et al. (2003) *Antarctic Meteorite Research* 16, 196-219. [7] Osawa T. et al. (2003) *Meteoritics & Planetary Science* 38, 1627-1640. [8] Bajo K. et al. (2010) *Earth, Planets and Space* (submitted).

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