PRELIMINARY ORGANIC COMPOUND ANALYSIS OF PARTICLES RETURNED FROM ASTEROID 25143 ITOKAWA BY THE HAYABUSA MISSION. H. Naraoka[1], H. Mita[2], K. Hamase[3], M. Mita[4], H. Yabuta[5], K. Saito[6], K. Fukushima[6], F. Kitajima[1], S. A. Sandford[7], T. Nakamura[8], T. Noguchi[9], R. Okazaki[1], A. Tsuchiyama[5], T. Yada[10], K. Shirai[10], A. Fujimura[10], Y. Ishibashi[10], M. Abe[10], T. Okada[10], M. Ueno[10], T. Mukai[10]
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Introduction: Many kinds of organic molecules have been observed in the interstellar medium as well as primitive meteorites. In particular, various organic compounds including amino acids are reported from carbonaceous chondrites, which may have connections to emergence of life on the primitive Earth. By the Hayabusa mission, the existence of organic matter at the surface of Asteroid 25143 Itokawa can be examined without terrestrial contaminants. Ordinary chondrites, which seem to have an origin of S-type asteroid including Itokawa [1] [2], are generally depleted in not only volatile organic compounds but also carbonaceous materials due to their relatively high formation temperature. However, the existence of organic compounds is possible at the surface of Itokawa, because indigenous amino acids are found in lunar soils by Harada et al. [3] and Brinton and Bada [4] and interplanetary dust particles (IDPs) by Brinton et al. [5]. In addition, polycyclic aromatic hydrocarbons (PAHs) are reported in a Martian igneous meteorite [6] and IDPs [7]. In this study, we will perform a preliminary organic compound analysis on particles from asteroid Itokawa returned by the Hayabusa mission.

Sample and Methods: Several particles will be allocated for organic and carbonaceous material analyses on a diamond plate. After spectroscopic analyses by Kitajima et al. [8], the particles are rinsed with small amount of methanol/dichloromethane on the plate. The extract is hydrolyzed with HCl followed by separation into amino acid and other organic compound fractions. Amino acid analysis with enantiomeric separation is carried out using two-dimensional high performance liquid chromatography with high-sensitive fluorescence detectors (2D-HPLC/FD; sub femto mol in detection limit) [9]. The other organic fraction including PAHs is subjected to time of flight-secondary ion mass spectrometry (ToF-SIMS) analysis. The ToF-SIMS analysis is also applied directly to the carbonaceous materials in the particles.

Discussion: Detection of amino acids and PAHs is highly dependent on the concentrations of these compounds in particles as well as the sample amount available for the analyses. If the particles yield glycine, one of the abundant amino acids in extraterrestrial materials, as much as the concentration in carbonaceous chondrites (~10-500 fmol/μg) [10] [11], the 2D-HPLC/FD can reveal the amino acids distribution. If the particle contains glycine as the similar amount as lunar soils (~0.1 fmol/μg) [3] [4], the quantification competes against the detection limit. The ToF-SIMS analysis can identify various organic compounds including PAHs in a ppm level [12].

The compound distributions may clarify origins of organic compounds at the surface of Itokawa. If glycine is the most abundant as observed in lunar soils [3] [4] and cometary dusts [11], hydrogen cyanide (HCN) may contribute to the amino acid precursors. In the case of anhydrous minerals, the HCN may be implanted by solar wind. If α-aminoisobutyric acid (AIB) is abundant as observed in some CM chondrites, meteoritic source derived from aqueous altered parent body is considered after a Sterecker-type reaction with ketones. In such a case, the organic compounds survived upon impact.

The particle amount available for the preliminary organic analysis may be very limited. Further investigations are necessary on the second stage of analysis with much sample by direct extraction with hot water.

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