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(May 22-27 2011 at Makuhari, Chiba, Japan)

PPS022-P01 Room:Convention Hall Time:May 26 14:00-16:30

Eletrostatic micromanipulation system applied for the returned particles of the asteroid explorer Hayabusa

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The asteroid explorer Hayabusa successfully returned its reentry capsule back to the Woomera Prohibited Area on midnight of June 13th, 2010. Until the capsule was introduced into the planetary material sample curation facility in Sagamihara campus of JAXA, it experienced a series of processes to open the sample container and recover the returned particles in the sample catcher. The electrostatic micromanipulation system was playing a main role for the returned particle treatment during the processes.

The eletrostatic micromanipulation system was installed into the clean chamber 2 conditioned as highly purified N2 in the planetary material sample curation facility in January 2010, after around one year of development. It consists of a sample stage which is equipped with X, Y, Z and theta-Z axes macro- and micromotion and various types of stages, right and left probes stage which are equipped with X, Y, Z, theta-Y and theta-Z axes macro- and micromotion, and probe holders applicable for synthetic quartz glass needles involving Pt thin wire and an alpha-ray source holder for electrostatic neutralization. These stages is operated with gloves of the clean chamber 2 made of Viton, and the particle on the sample stage can be lifted up and released in the clean chamber filled with highly purified N2 with the quartz needle charged plus or minus voltage with a voltage controller outside the chamber, being observed with two optical microscopes equipped inside and outside the chamber.

The manipulation system was tested by simulated material(Ni olivine particles) from March to May, 2010, and the particle manipulation in the clean chamber was established before the Hayabusa capsule reentry.

The sample catcher is basically a small cylinder made of aluminum alloy coated by aluminum which is separated to three areas, that is a room A, a room B and a rotational cylinder. Because of the sequence of the sample catcher opening processes, the room A of the catcher was exposed, thus we firstly started particle manipulation from those found in the catcher room A. However, we mainly recovered aluminum flakes from there, and less translucent particles which would be possibly mineral grains, due to the difference of recognition easiness on its surface. Thus, we developed small spatulas made of Teflon which can be introduced into the sample chamber of the SEM. After the swipe of the spatula on the surface inside the room A, a lot of fine particles attached onto the edges of the spatula were observed with the optical microscopes. Then they were observed and analyzed with the SEM-EDX to be clarified that they contain $>$1500 silicate particles of $<$10 micron in size and that they are supposed to be originated from asteroid Itokawa because of their mineral compositions and combination including their relative abundances, as already informed by the press release of JAXA.

As a micromanipulation system for $<$10 micron particle was not established yet, we have to recover larger particles in easier handling condition. We prepared a synthetic quartz glass plate which fit to the opening of the catcher room A, and attached to the opening, turned upside down to let particles fall freely, turned back to the original position and recovered the plate to a synthetic quartz glass Petri dish. We recognized $>$1000 particles of $>$10 micron in size on it. Then we recovered the particles from the plate with the system, set the SEM holder, observed and analyze with the SEM-EDX. So far, around 50 of particles of $>$30 micron in size were recognized as silicate particles and supplied for the initial analyses.

The electrostatic micromanipulation system was utilized for a series of particle handling processes mentioned above, and it worked successfully with the least particle loss.

In this presentation, we plan to detail the configuration of the manipulation system, results of the test manipulation and up-to-date results of the Hayabusa returned particles manipulation.

Keywords: asteroid exploration, Hayabusa, Itokawa, curation, electrostatic control, micromanipulation

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MASCOT, a small lander on Hayabusa-2

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The small lander MASCOT (Mobile Asteroid Surface Scout) is being developed for HAYABUSA-2 under the international collaboration among DLR (Germany), CNES (France), and JAXA (Japan). It aims to investigate with high accuracy and spatial resolution the surface geomorphology, the minute structure, texture and composition of rocks, and the thermal and mechanical properties of C-class asteroid. Characteristics and status of the lander is briefly reported.

A 10kg-class lander is being considered with 3kg max. for science instruments. A wide angle multi-band imager WAC and a visible-infrared macro-imaging spectrometer will be equipped. Other candidates are laser induced breakdown spectrometer LIBS and small, light, high-performance instrument such as thermal probe or magnetometer. With these instruments, the lander will conduct its stand-alone surface science of geology and geophysics, obtain geologic context for sample return, and measure composition and mineralogy as groundtruth for remote sensing. The lander will strengthen and complete the science of HAYABUSA-2 complementary to remote sensing and analysis of returned samples.

Keywords: Hayabusa2, asteroid, surface exploration, lander, microscopy, elemental analysis

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Compositional variations of hydrothermal synthesized phyllosilicates -comparison with phyllosilicates in carbonaceous ch

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A variety of phyllosilicates exists in carbonaceous chondrites. These phyllosilicates may be formed by hydrous alteration of precursor materials including olivine and/or pyroxene. Many factors, such as temperature or oxidation-reduction condition, have an effect on occurrence of phyllosilicate mineral species and their compositions. An oxidation-reduction condition particularly has strong effect on iron partitioning in Fe metal, iron oxides and iron sulfides. Therefore, Fe content in phyllosilicates is a good indicator for the oxidation-reduction condition of the hydrous alteration.

Ozaki and Isobe (2009) carried out phyllosilicate synthesis experiments from olivine with solar abundance composition and enstatite or fayalite. Assemblage of the olivine and enstatite, or the olivine and fayalite were used to introduce initial variety of Mg/Fe compositions of phyllosilicate in the run products. Oxidation-reduction states were controlled by using ethanol solutions with different concentrations. Each starting material had been heated at various temperatures and durations.

In this study, run products made by Ozaki (2009MS) were observed with the scanning electron microscope (SEM) in detail. And the compositions of the synthesized phyllosilicates were analyzed with EDS. Finally, the compositions of synthesized phyllosilicates were compared with those in carbonaceous chondrites.

By SEM observations, phyllosilicates were found in run products of various experimental conditions. Phyllosilicates show diverse morphologies including fibrous, massive, and spongy. Compositions of the phyllosilicates in run products from the starting material with olivine and fayalite in short durations show Fe-rich phyllosilicates. Phyllosilicates produced with thick ethanol concentrations tend to homogenize compositions. And phyllosilicates synthesized at high temperature show Mg and Si-rich compositions. Long heating durations make compositions away from those of carbonaceous chondrites' phyllosilicates. Phyllosilicates in carbonaceous chondrites might be formed at temperature lower than 250 degrees C, and in short heating durations.

Keywords: Hydrous alteration, parent body, hydrous phillosilicate, hydrothermal experiment

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Methods to improve data quality when creating meteorite databases

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The purpose of our research is to obtain statistics of bulk analyses for meteorite groups/subgroups to help refine a more accurate understanding of near-earth asteroids (NEA). If laboratory and other database errors are not controlled then they can have a dramatic and adverse impact on how representative meteorites are, and whether they can be used to analyze NEA. Thus, we need to understand the various types of errors and eliminate them, correct for them, or modify any conclusions.

Many meteorites are already classified, so it makes sense to use previously published analyses. A number of authors have compiled lists to help subdivide and classify meteorites into groups/ subgroups based on chemistry and petrology [1-6]. Our database includes 26,661 bulk-analyses from 1195 meteorites, sourced from 112 journal articles published between 1953 and 2010.

To try to improve the quality of the analyses we preferentially used the most recent values on the assumption that they have lower laboratory precision errors. Analyses were tagged so they can be traced back to their source. Data was checked multiple times for errors. Precision errors of sourced analyses were analyzed. Some data were replaced where possible, especially where rounding errors > precision errors.

The results were then compared to other datasets to confirm: 1) that meteorite classifications are correct, 2) whether results differ from previously published works, and 3) whether any bias exists between Antarctic and non-Antarctic meteorites.

The results show that: 1) a close match exists between our database and other authors, 2) minimizing database errors helps to reduce dispersion, and 3) the majority of differences between Antarctic and non-Antarctic meteorites may be explained by: a) an insufficient number of samples, b) distributions with high skew or kurtosis (peakedness), and c) normal variability between samples.

We discuss ways to improve database quality by considering the following: 1) laboratory precision, 2) quality of analyses, 3) data entry and conversion errors, 4) over-rounding of analyses, and 5) potential misclassification of meteorites.

We conclude that the most efficient way to improve data quality is to replace older analyses with more recent ones. However, the assumption that the most recent analyses have lower precision does not always hold. Although laboratory precision has gradually improved over time, our results suggest it is also influenced by how well individuals follow standard laboratory procedures.

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Keywords: meteorites, chondrites, Near Earth Asteroids, NEA