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Novel analytical/transportation system of extraterrestrial materials: Are we ready for Hayabusa 2 returned sample?

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The Hayabusa 2 is the exploration mission to the C-type asteroid 1999JU3. The spacecraft will arrive at the asteroid in 2018, and a minimum 1g of the piece of asteroid will be returned 2 years later (e.g., Tachibana et al., 2014). During the remote sensing investigation for 1.5 years at the asteroid, sample collection from the asteroid surface will perform for three different locations. The sample will be consisted of a mixture of anhydrous/hydrous minerals and organic materials. It is a key material providing critical evidence of evolution of the Solar System including planetesimals, and nature and origin of organic materials and life.

The Hayabusa 2 returned sample might be sensitive to terrestrial contamination during curation, transportation, preparation and analysis. Several reports mentioned that the Hayabusa sample contained carbon-rich particles, inorganic particles, metals and organic materials as terrestrial contaminants (e.g., Uesugi et al., 2014; Ito et al., 2014; Yabuta et al., 2014; Yada et al., 2014). Therefore, it requires to avoid contaminations to the Hayabusa 2 sample from any environmental conditions, to identify possible contaminants if any, and to prepare the proper curation and analytical flow/system in a few years. Uesugi et al. (2014) reported an optimized sample-handling system including transportation between institutes and the sequence of the analytical flow through the examination of Hayabusa category 3 organic materials and meteoritic samples as analogues of Hayabusa 2 returned sample.

JAXA Extraterrestrial Sample Curation Center is taking a lead to work on above problems of unexposed sample transportation, a coordinated analytical system including micro-Raman spectroscopy, FT-IR, XANES, ToF-SIMS, focused ion beam (FIB), transmission electron microscopy/scanning transmission electron microscopy (TEM/STEM) and NanoSIMS. This coordinated analysis is essential to acquire maximum information including abundances of major/trace elements and isotopes, characterization of organics, and petrographic textures from nanometer- to micrometer-scale samples. This technique has been applied to carbonaceous materials by Stardust cometary dust return mission (e.g., Sandford et al. 2006; Matrajt et al. 2008), and can be used for samples obtained by future missions such as Hayabusa 2 and Osiris-REX.

In this talk we will discuss about detailed analytical and comprehensive system for small samples, and future developments of curation, transportation and analysis under air-isolated and/or cryo condition.

Keywords: Hayabusa 2, Extraterrestrial organics, Micro analysis