NASA Curation Preparation for Ryugu Sample Returned by JAXA's Hayabusa2 Mission

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The NASA OSIRIS-REx and JAXA Hayabusa2 missions to near-Earth asteroids Bennu and Ryugu share similar mission goals of understanding the origins of primitive, organic-rich asteroids. Under an agreement between JAXA and NASA, there is an on-going and productive collaboration between science teams of Hayabusa2 [1] and OSIRIS-REx missions [2]. Under this agreement, a portion of each of the returned sample masses will be exchanged between the agencies and the scientific results of their study will be shared. NASA's portion of the returned Hayabusa2 sample, consisting of 10% of the returned mass, will be jointly separated by NASA and JAXA. The sample will be legally and physically transferred to NASA's dedicated Hayabusa2 curation facility at Johnson Space Center (JSC) no later than one year after the return of the Hayabusa2 sample to Earth (December 2020). The JSC Hayabusa2 curation cleanroom facility design has now been completed. In the same manner, JAXA will receive 0.5% of the total returned OSIRIS-REx sample (minimum required sample to return 60 g, maximum sample return capacity of 2 kg) from the rest of the specimen [2]. No later than one year after the return of the OSIRIS-REx sample to Earth (September 2023), legal, physical, and permanent custody of this sample subset will be transferred to JAXA, and the sample subset will be brought to JAXA's Extraterrestrial Sample Curation Center (ESCuC) at Institute of Space and Astronautical Science, Sagamihara City Japan.

Both the Hayabusa2 sample to be sent to NASA and the OSIRIS-REx sample to be sent to JAXA will be unprocessed and representative of the returned bulk sample. "Unprocessed" means that the sample will be handled in a way that minimizes chemical and physical changes to the sample, including avoidance of harsh radiation and heating environments such as electron beams and Raman microscopy. The exchange samples will also be protected from organic and other forms of contamination to the greatest extent possible. "Representative" means that the separated sample has, as well as can be determined on the unprocessed sample, very similar characteristics to the bulk returned sample, including grain size, color, and other physical properties readily determined by optical observation.

The overarching objectives of NASA's Hayabusa2 curation are to preserve and protect the returned Ryugu subset samples to maximize the science return. Curation scientists at JSC together with ESCuC members and the OSIRIS-REx science team have been working to identify requirements on contamination and sample environmental controls. The Hayabusa2 curation requirements can be categorized into the following nine major responsibilities: 1) Contamination control, 2) Curation procedures for solid and gas samples from Ryugu surfaces, 3) Clean laboratory design and construction, 4). Sample characterization for catalog (non-destructive organic-nonorganic lithology identification in a glovebox), 5) Sample distribution, and 6) long term curation activity. Many of the aspects of NASA Hayabusa2 curation for the Ryugu samples are already well developed and have strong heritage at JSC. Examples of existing knowledge and application in this area include ppb level organic residue monitoring of the gaseous curation grade nitrogen, precision cleaning of ultrapure water circulating in the clean labs, particle count monitoring, and metal material control for terrestrial trace element contamination control (Apollo, Genesis samples), and sample handling of small particles (cosmic dust, Stardust cometary particles, Hayabusa1 asteroid samples), to mm-cm sized rocks (Antarctic meteorites). The Hayabusa2 sample storage and handling facility at JSC have been co-designed with the OSIRIS-REx sample curation clean facility to protect the samples from contamination, cross-contamination, temperature excursions, and moisture that could alter the sample. The construction of the facility will start in 2018 [3].

As with every new extraterrestrial collection, returned primitive Ryugu samples bring special new requirements for potentially organic rich samples. Hayabusa2 mission will attempt to collect three samples from the surface of the asteroid in order to return a minimum of 100 mg of material. Prior to its third touchdown, Hayabusa2 will release an impactor to the asteroid that will create a small crater, possibly exposing more pristine materials from beneath the surface from which sample collection may be attempted. Each of the three samples may have different characteristics and they should be properly handled to preserve them. Hayabusa2 Science Team will attempt to extract the gas sample before opening the pneumatically sealed sample container. JSC will develop the gas sample curation and handling technique under our advanced curation activity [4].

References: [1] Watanabe S. et al. (2017) Space Science Reviews, 208, 3-16. [2] Lauretta D.S. et al. (2017) Space Science Reviews, in press. [3] Righter et al. (2017) this volume. [4] McCubbin F.M et al. (2017) this volume.