SCIENTIFIC IMPORTANCE OF RETURN SAMPLES FROM NEAR-EARTH C-TYPE ASTEROID 1999 JU3: SAMPLING METHOD/STRATEGY AND SAMPLE ANALYSES

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Following Hayabusa's successful return of the first asteroid samples to Earth, JAXA has a plan for another asteroid mission. Called Hayabusa-2, the mission will return surface samples of a near-Earth carbonaceous-type asteroid, 1999 JU3. Because asteroids are the evolved remnants of planetesimals that were the building blocks of planets, detailed on-site observation by a spacecraft and analyses of returned samples will provide direct evidence of planet formation and the dynam- ical evolution of the solar system. Moreover, carbonaceous-type asteroids are expected to preserve the most pristine materials in the solar system, an interacted mixture of minerals, ice, and organic matter that would have later evolved into the Earth, the oceans, and life, respectively. Space missions are the only way to obtain such pristine minerals, organics, and volatiles with a geologic context and without terrestrial contamination.

In order to understand the dynamical and chemical evolution of the solar system through its investigation and sampling of 1999 JU3, Hayabusa-2 has been given the following scientific objectives: (1) The thermal evolution from planetesimal to near-Earth asteroid, (2) The destruction and accumulation of a rubble-pile body: Planetesimal formation, (3) The diversification of organics through interactions with minerals and water on planetesimals, and (4) Material circulation in the early solar system: Chemical heterogeneity

The basic design of the spacecraft is the same as in the original Hayabusa, but many improvements will be made and new technology will be adopted. The on-board scientific instruments necessary for the fulfillment of the scientific objectives are a laser altimeter, a multiband camera, a near-infrared spectrometer, a thermal infrared imager, and a wide-angle camera. A small impactor will also be aboard for an asteroid-scale impact experi- ment, in which a crater several meters in diameter will be made. The concept and design of the Hayabusa-2 sampling device are also the same as in the original Hayabusa. In order to collect a sufficient amount of samples (at least 100 mg) compliant with both monolithic bedrock and regolith targets, a 5-g Ta projectile will be shot at 300 m/s and ejecta will be stored in a sample container. The sampler has three projectiles, and the sample container has three separate compartments for sampling at three different locations, one of which could be the artificial impact crater where subsurface materials in the ejecta would be sampled.

Hayabusa-2 will be launched in late 2014, arrive on 1999JU3 in mid- 2018, and fully investigate and sample the asteroid during its 18-month stay. The spacecraft will depart the asteroid in late 2019 and return to Earth with samples in December 2020.

In this talk, we describe a sampling system of the Hayabusa-2 spacecraft to obtain samples from multiple surface locations of the asteroid with their scientific importance. We would also like to discuss with the audience about the importance of return-samples from various bodies in 2020's.