

Interdisciplinary Science of Hayabusa2 Mission

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Asteroid explorer *Hayabusa2* completed its proximity operation around C-type asteroid Ryugu and returned to Earth with surface sample. More than 5 g of the particles in the sample catchers were successfully retrieved and wait for analyses. We will review the interdisciplinary science of *Hayabusa2* mission based on the proximity observations through visible and thermal IR imaging, NIR spectrometer, LIDAR, and the Small Carry-on Impactor (SCI) experiment, which will give a strategy of the return sample analyses. The SCI experiment reveals crater-to-impactor size ratio on Ryugu is more than 60 [1], contrast to the lower value of 10 derived from the size-frequency distributions of the main-belt asteroids and craters on the asteroids already explored [2]. This will change the chronology of the material transport process from the main asteroid belt to the Earth region. Based on the SCI scaling law, the surface age of Ryugu is estimated to be ~16 Ma, which is much shorter than the estimated ages (100 Ma to 1 Ga) of the candidate source collisional families in the inner asteroidal belt. This suggests that Ryugu is a product of a higher generation of the parent body disruption [3] or global resurfacing due to YORP induced past rapid rotation [4]. Visible color variations on Ryugu suggest the reddening of surface material by solar heating and/or space weathering under a temporal excursion near the Sun [5]. These hypotheses based on remote-sensing observations and the SCI experiment will be confirmed through return sample analyses.

Another important issue is the reconstruction of the properties of the parent body. Proximity observations using NIRS3 reveals the presence of global OH bearing minerals on Ryugu [6], whereas the amount is relatively small compared with hydrated carbonaceous chondrites and Bennu [7]. Both partial dehydration and incipient aqueous alteration will produce the weak OH absorption [3], which will be distinguished by return sample analyses. High porosity of Ryugu could be ascribed to loss of water ice during or after the formation of the rubble pile, if its parent body was an icy asteroid [4]. Water-rock ratio of the parent planetesimal with ²⁶Al heating will determine the set of coexisting minerals, which will also be determined by return sample analyses. Size-frequency distribution of surface particles as well as aggregate's constituent particles are important for identifying what kind of dust grains planetesimals are consist of. We will discuss the vision of exploration-based reconstruction of planetesimals.

[1] Arakawa et al. (2020), *Science* **368**, 268; [2] Bottke et al. (2020), *Astron. J.* **160**, 14; [3] Sugita et al. (2019), *Science* **364**, eaaw0422, [4] Watanabe et al. *Science* **364**, 268; [5] Morota et al. (2020), *Science* **368**, 654; [6] Kitazato et al. (2019) *Science* **364**, 272; [7] Hamilton et al. (2019), *Nature Astron.* **3**, 332.

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