Geophysical Research Abstracts
Vol. 21, EGU2019-11770-1, 2019
EGU General Assembly 2019

The properties of Ryugu's parent body revealed by Hayabusa2's optical imaging observations

Seiji Sugita (1,13), Rie Honda (2), Tomokatsu Morota (3), Shingo Kameda (4), Eri Tatsumi (1), Chikatoshi Honda (5), Yasuhiro Yokota (6), Toru Kouyama (7), Naoya Sakatani (6), Manabu Yamada (13), Hidehiko Suzuki (8), Kazuo Yoshioka (1), Yuichiro Cho (1), Moe Matsuoka (6), Kazunori Ogawa (9), Deborah Domingue (10), Hideaki Miyamoto (1), Olivier Barnouin (11), Patrick Michel (12), Carolyn Ernst (11), and the Hayabusa2 Project Team

(1) Univ. of Tokyo, Tokyo, Japan (sugita@eps.s.u-tokyo.ac.jp), (2) Kochi Univ., Kochi, Japan, (3) Nagoya Univ., Nagoya, Japan, (4) Rikkyo Univ., Tokyo, Japan, (5) Univ. of Aizu, Aizu-Wakamatsu, Japan, (6) ISAS, JAXA, Sagamihara, Japan, (7) AIST, Tsukuba, Japan, (13) PERC, Chiba Inst. of Technology, Narashino, Japan, (8) Meiji Univ., Ikuta, Japan, (9) Kobe Univ., Kobe, Japan, (10) Planetary Science Inst., Tucson, USA, (11) Applied Physics Laboratory, Johns Hopkins Univ., Laurel, USA, (12) Laboratoire Lagrange, Observatoire de la Coˆte d'Azur, Nice, France

After the arrival at asteroid Ryugu on June 28, 2018, JAXA's Hayabusa2 mission started global observations from 20 km and subsequently conducted many low-altitude descents with high-resolution regional/local observations [1]. In this study, we summarize optical imaging observation results focusing on the constraints they provide on Ryugu's parent body.

The global observations have revealed many important properties of Ryugu [2]. 1) Ryugu's average spectrum is Cb type. 2) It does not exhibit a strong 0.7-μm absorption band. 3) It has a very low 0.55-μm geometric albedo (4.5 $\pm$ 0.2) %, among the lowest in the solar system. 4) Its crater retention age for small craters ($\geq$ 10m) is very young (< a few Myr), strongly suggesting a high surface rejuvenation rate.

The observed spectral characteristics of Ryugu is consistent with the dynamically most probable source asteroid families for Ryugu: Eulalia and Polana families in the inner main belt [3]. This agreement between the prediction from dynamic calculations and spectral observations suggests that one of the two asteroids is likely Ryugu's parent body. These families are among the most widely dispersed C-complex families in the inner main belt, allowing to deliver family members at very high flux rate to the resonance zones (nue6 and 3:1) at both inner and outer boundaries of the inner main belt, which are the dominant source of near-Earth objects (NEO's).

Furthermore, 5) very high abundance (about twice Itokawa) of boulders are seen on Ryugu. 6) Many lines of evidence for mass wasting observed on Ryugu's surface indicates that its surface is mechanically unconsolidated, allowing surface boulders to move easily. 7) The morphologies of impact craters on Ryugu are consistent with gravity-regime formation, in which impact events produce large ejecta masses. These suggest that large mass of boulders and pebbles can be ejected from Ryugu to space over time.

Thus, a large number of macroscopic objects of Ryugu-like materials may enter Earth's atmosphere, implying that there should be counterparts in our meteorite collection. One of such candidates is moderately dehydrated carbonaceous chondrites, which exhibit very low albedo and flat spectra. They are also found with high abundance in Antarctica, which has sampled the long-term average flux of infalling meteorites on Earth [4]. Another is interplanetary dust particles (IDPs), which also exhibit low albedos and account for large influx of extraterrestrial material to Earth. Although a decisive conclusion may not be obtained before the analysis of Ryugu samples returned to Earth, currently available observational evidence, such as high boulder abundance on Ryugu, favors that its composition may be similar to moderately dehydrated carbonaceous chondrites. This would further suggest that Ryugu's relatively low abundance of hydrated minerals [5] may be due to partial dehydration on Ryugu's parent body.

References: [1] Watanabe et al. (2019) submitted to Science. [2] Sugita et al. (2019) submitted to Science. [3] Bottke et al. (2015) Icarus 247, 191–217 (2015) [4] Tonui et al. (2014) Geochim. Cosmochim. Acta 126, 284–306. [5] Kitazato et al. (2019) submitted to Science.