RYUGU'S PARENT-BODY PROCESSES ESTIMATED FROM HAYABUSA2 MULTI-BAND OPTICAL OBSERVATIONS

S. Sugita[1,7], R. Honda[2], T. Morota[3], S. Kameda[4], E. Tatsumi[1], C. Honda[5], Y. Yokota[6], M. Yamada[7], T. Kouyama[8], N. Sakatani[6], H. Suzuki[9], K. Yoshioka[1], Y. Cho[1], M. Matsuoka[6], K. Ogawa[10], D. Domingue[11], H. Miyamoto[1], O. S. Barnouin[12], P. Michel[13], C. M. Ernst[12], T. Hiroi[14], T. Nakamura[15], H. Sawada[6], M. Hayakawa[6], N. Hirata[5], N. Hirata[10], H. Kikuchi[1], R. Hemmi[1], T. Michikami[16], Eric Palmer[11], R. Gaskell[11], M. Hirabayashi[17], R. Jaumann[18], K. Otto[18], N. Schmitz[18], S. E. Schröder[18], G. Komatsu[19], S. Tanaka[6], K. Shirai[6], M. Yoshikawa[6], S. Watanabe[3], Y. Tsuda[6], [1]Univ. of Tokyo (Tokyo, Japan, sugita@eps.s.u-tokyo.ac.jp), [2]Kochi Univ., [3]Nagoya Univ., [4]Rikkyo Univ., [5]Univ. of Aizu, [6]JAXA/ISAS, [7]PERC CIT, [8]AIST, [9]Meiji Univ., [10]Kobe Univ., [11]Planetetary Science Institute, [12]APL, Johns Hopkins University, [13]Observatoire de la Cote d'Azur, [14]Brown Univ., [15]Tohoku Univ. [16]Kindai Univ. [17]Auburn Univ., [18]DLR, [19]Univ. d'Annunzio

Introduction: JAXA's Hayabusa2 spacecraft arrived at asteroid 162173 Ryugu on June 27, 2018 and conducted global observations (~2 m/pix) from 20 km of altitude first and subsequently conducted a number of high-resolution regional and local observations (down to ~1mm/pix) during low-altitude descents including touch-down operation for sampling on Feb. 22, 2019 [1,2]. In this study, we summarize optical imaging observation results obtained from these wide range of spatial resolutions, focusing on the constraints they provide on Ryugu's parent body.

Spectroscopic Properties: The global observations have revealed many important properties of Ryugu [3]. Ryugu's average spectrum is consistent with Cb type and does not exhibit a strong 0.7-μm absorption band. It has a very low 0.55-μm geometric albedo of 0.045 ± 0.002, among the lowest in the solar system. Its crater retention age for small craters (≥ 10m) is very young (< a few Myr), strongly suggesting a high surface rejuvenation rate.

Ryugu's Parent Body: 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 [4]. 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 (ν_6 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).

Boulders on Unconsolidated Surface: Furthermore, very high abundance (about twice Itokawa) of boulders is seen on Ryugu. Many lines of evidence for mass wasting observed on Ryugu's surface indicate that its surface is mechanically unconsolidated, allowing surface boulders to move easily. The morphologies (e.g., raised rims and wall slumping) of impact craters on Ryugu are consistent with low internal cohesion of materials, leading to production of large ejecta masses. These suggest that large mass of boulders and pebbles can be ejected from Ryugu to space over time.

Meteoritic Counterparts: 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 [5]. 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 [6] may be due to partial dehydration on Ryugu's parent body.

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