High-resolution global thermal images of Ryugu acquired from the dawn side

*Yuri Shimaki[1], Hiroki Senshu[2], Naoya Sakatani[3], Tatsuaki Okada[1,4], Tetsuya Fukuhara[3], Satoshi Tanaka[1,5], Takehiko Arai[6], Hirohide Demura[7], Tomohiko Sekiguchi[8], Toru Kouyama[9], Jun Takita[10], Sunao Hasegawa[1]

1. Institute of Space and Astronautical Science, Japan Aerospace Exploration Agency, 2. Planetary Exploration Research Center, Chiba Institute of Technology, 3. Rikkyo University, 4. The University of Tokyo, 5. The Graduate University for Advanced Studies, SOKENDAI, 6. Ashikaga University, 7. The University of Aizu, 8. Hokkaido University of Education, 9. National Institute of Advanced Industrial Science and Technology (AIST), 10. Hokkaido Kitami Hokuto High School

The thermal infrared imager (TIR) on Hayabusa2 acquired high-resolution thermal images of Ryugu during the Mid-altitude observation on August 1, 2018. By comparing the temperature profiles of Ryugu and the results of a thermophysical model, we estimated the thermal inertia and surface roughness maps of Ryugu. The global average of the thermal inertia was calculated to be 225 J m^{-2} K^{-1} $s^{-0.5}$, with a surface roughness of 47° in the RMS slope [1]. However, we failed to determine the thermal inertia in the northern hemisphere due to temperature profiles' limitations. To assess the thermophysical properties of these areas, here we report other high-resolution thermal images of Ryugu acquired during Box-C observations in 2019, where the observational geometries were different from the Mid-altitude observation.

We used three high-resolution global observations with different sub-solar latitudes (L_s), solar phase angles (t_s), and heliocentric distances (r). They are the Mid-altitude on 2018-08-01 (L_s = -8.4°, t_s = -20°, r = 1.06 AU), the Box-C4 on 2019-07-25 (L_s = 4.6°, t_s = 37, r = 1.05 AU), and the Box-C5 observations on 2019-10-24 (L_s = -7.6°, t_s = 33°, r = 1.00 AU). The brightness temperature images were obtained using a calibration method described in [2]. We assumed an emissivity of 0.9. The brightness temperature images were projected onto a shape model of Ryugu using the SPICE kernels; thus, we obtained three temperature profiles for each polygon of the shape model.

We prepared temperature profiles expected for the three observations by TPM2 with various thermal inertia and surface roughness. Since the dawn-side observations yield temperature rise in the morning but are hard to determine temperature peak in the afternoon, we directly compared observed and calculated temperature profiles to estimate thermal inertia and surface roughness. Our analysis suggests that global thermal inertia of 200-300 J m^{-2} K^{-1} $s^{-0.5}$ and with a surface roughness of 40-47° in the RMS slope could satisfy observation results.

[1] Shimaki Y. et al. (2020) *Icarus* 348, 113835. [2] Okada T. et al. (2020) *Nature* 579, 518-522.

Keywords: Hayabusa2, Thermal Infrared Imager, Asteroid Ryugu

©2021. Japan Geoscience Union. All Right Reserved.