The Surface Roughness of (162173) Ryugu based on the Topography from HAYABUSA2 Laser Altimeter (LIDAR)

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Introduction: The Japanese asteroid explorer Hayabusa2 spacecraft explored the near-Earth asteroid (162173) Ryugu between June 2018 and November 2019. During this period, the laser altimeter (LIght Detection And Ranging, LIDAR) onboard Hayabusa2 collected over 7 million measurements of the spacecraft range to the asteroid surface [8]. The surface roughness and global surface roughness maps for Ryugu were carried out using the LIDAR topography data. The surface roughness which is defined as RMS deviation over different horizontal scales enables to give a new insight into an origin and geologic processes of a small body. The roughness is also related to the self-affine nature of planetary surfaces through a value called the Hurst exponent, H (0 In this study, we investigated the correlations between the surface roughness and the geological features on Ryugu compared with those on Itokawa and Eros. Comparing Hurst exponent of Ryugu with other bodies, the surface evolution of rubble-pile small bodies will be discussed.

Results and Discussion: Deviograms provide a quantitative way to compare the surfaces of different bodies to one another [2-7]. The deviogram of Ryugu appears to have shallower slopes over all baselines than Eros and Moon. On the other hand, comparing the deviogram with Itokawa, it looks like a straight line that increases with increasing baseline. The Hurst exponent of Ryugu is 0.69 at L=8~60m (0.74, L=8~30m). The deviograms of Eros and Moon showed self-affine (straight-line in the deviogram) nature [4], and have a similar Hurst exponent (0.97, L=4~200m) compared to Mercury [3]. On the other hand, the Hurst exponent of Itokawa is 0.51 (L=8~32m). According to [4], Higher Hurst exponent (~1) might be indicative of the surfaces dominated by impact cratering. Several craters on Ryugu have topographically distinctive raised rims while those on Itokawa do not. Unlike Eros (which is believed to be a Fractured Monolith), Ryugu is thought to have a rubble-pile structure [9]. Therefore, due to lack of the ability to support large-scale topography, it is assumed that the Hurst exponent of Ryugu is higher than Itokawa but lower than Eros, Moon and Mercury. It is indicated that the Hurst exponent of Ryugu showed well-correlation to the surfaces topography which is dominated by impact cratering [3-5]. The surface roughness change by a collision will be examined by using the SCI (Small Carry-on Impactor) event.

Acknowledgement: This research have been summarized by Mr. Yosuke Masuda (Nihon University) as his master thesis. This work was carried out by the joint usage / research program at the Research Center for Space Informatics, University of Aizu.

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Keywords: Asteroids, Ryugu, Roughness, Craters, Boulders

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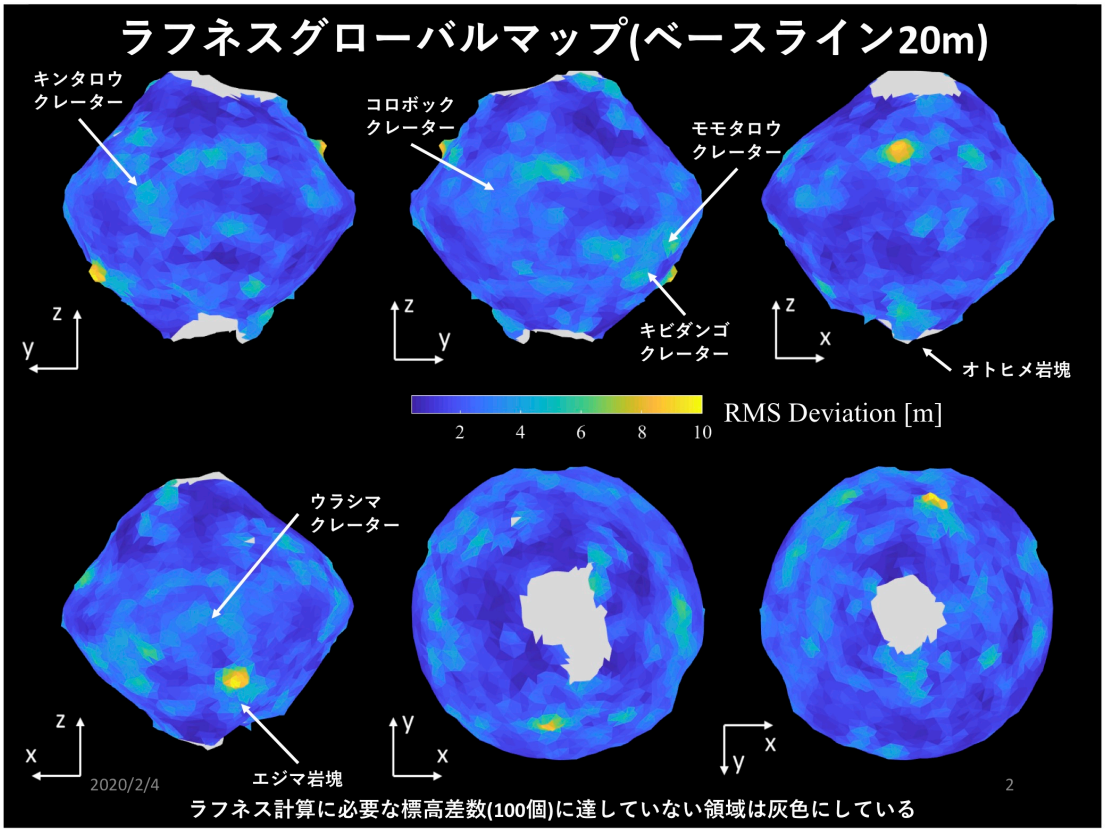

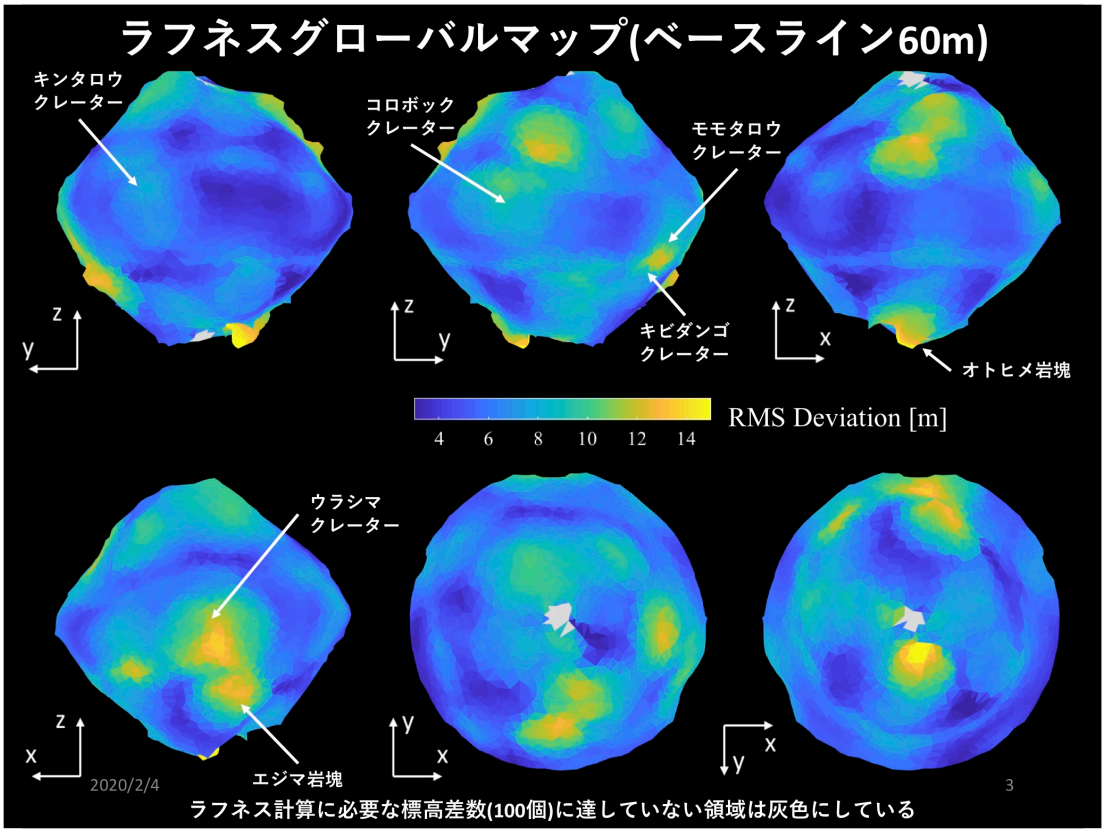

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