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The meter-scale surface roughness of Bennu from the OSIRIS-REx mission

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Abstract

We calculate the surface roughness of Bennu from high-resolution shape models. In contrast to the results from previous studies of Eros and Itokawa, Bennu's surface roughness is spatially uniform. The surface roughness is dominated by boulders and reflects the lack of size sorting of boulders on Bennu's surface.

1. Introduction

The Origins, Spectral Interpretation, Resource Identification, and Security–Regolith Explorer (OSIRIS-REx) spacecraft arrived at (101955) Bennu in December 2018 [1]. The shape and topography of Bennu are derived from imaging and laser altimetry observations [2]. To understand the geologic history of Bennu and to compare its topography with that of other asteroids, we use topography derived from the geopotential to calculate the surface roughness of Bennu at horizontal scales of 1 to 40 m.

Surface roughness provides a quantitative metric that allows different regions on the same asteroid to be compared with each other, and permits comparisons with the surfaces of different asteroids at the same horizontal scale. Previous studies of Eros and Itokawa found that surface roughness is well correlated with features such as boulders and craters and gives insight into the geologic history of each body [e.g., 3, 4, 5].

2. Method

We used the global 81-cm-resolution shape model (SPC shape model with images up to 2 February 2019, mean error of 0.8 m) to generate north-south and east-west topographic profiles and calculated the surface roughness via the RMS (root-mean-square) deviation [6] using baselines (horizontal scales, L) of 1 to 40 m. Maps of the surface roughness were projected onto a ~3-m horizontal resolution shape model in the Small Body Mapping Tool.

3. Results

Bennu shows some spatial variations in surface roughness (Figure 1). Higher surface roughness values are found at and near the equator, in association with Bennu's equatorial ridge. The surface roughness at 10 and 20 m is correlated with the locations of the largest boulders. At baselines below 10 m, the surface roughness increases in regions of higher boulder density. There are no large-scale longitudinal surface roughness variations. On (25143) Itokawa, longitudinal variations in surface roughness are substantial and may contribute to the mismatch between observed and predicted YORP [5,7].

4. Discussion and Conclusion

The spatial relationship of surface roughness with boulders is consistent with past studies of the surface roughness of Itokawa [5], but Bennu lacks the size sorting of boulders found on Itokawa. The higher surface roughness at the equatorial ridge on Bennu is not seen on (162173) Ryugu at similar baselines [8] and appears to be concentrated in the center of some craters. The absence of large-scale spatial variations in surface roughness on Bennu could be related to Bennu's more uniform shape as compared to that of Itokawa.

Acknowledgements

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References

[1] Lauretta, D. S. et al.: The unexpected surface of asteroid (101955) Bennu, *Nature*, 568, 55-60, 2019. [2] Barnouin, O. S. et al.: add Shape of (101955) Bennu indicative of rubble pile with internal stiffness, *Nature Geoscience*, 12, 247-252, 2019. [3] Barnouin, O. S. et al.: Small-scale topography 25143 Itokawa, *Icarus*, 198, 108-124, 2008. [4] Susorney, H. C. M., and Barnouin O. S.: The Global Surface Roughness 433 Eros, *Icarus*, 314, 290-310, 2018. [5] Susorney, H. C. M. et al.: The Global Surface Roughness of 25143 Itokawa, *Icarus,* 325, 131-152, 2019. [6] Shepard et al.: The roughness of natural terrain: A planetary and remote sensing perspective, *J. Geophys. Res.* 106, 32777-32796, 2001. [7] Lowry S. C., et al.: The internal structure of 25143 Itokawa as revealed by detection of YORP spin-up, *A&A*, 562, A48, 2012. [8] Barnouin, O. S. et al.: The shape of Bennu, AGU Fall Meeting 2018, Abstract P33C-3835, 2018.

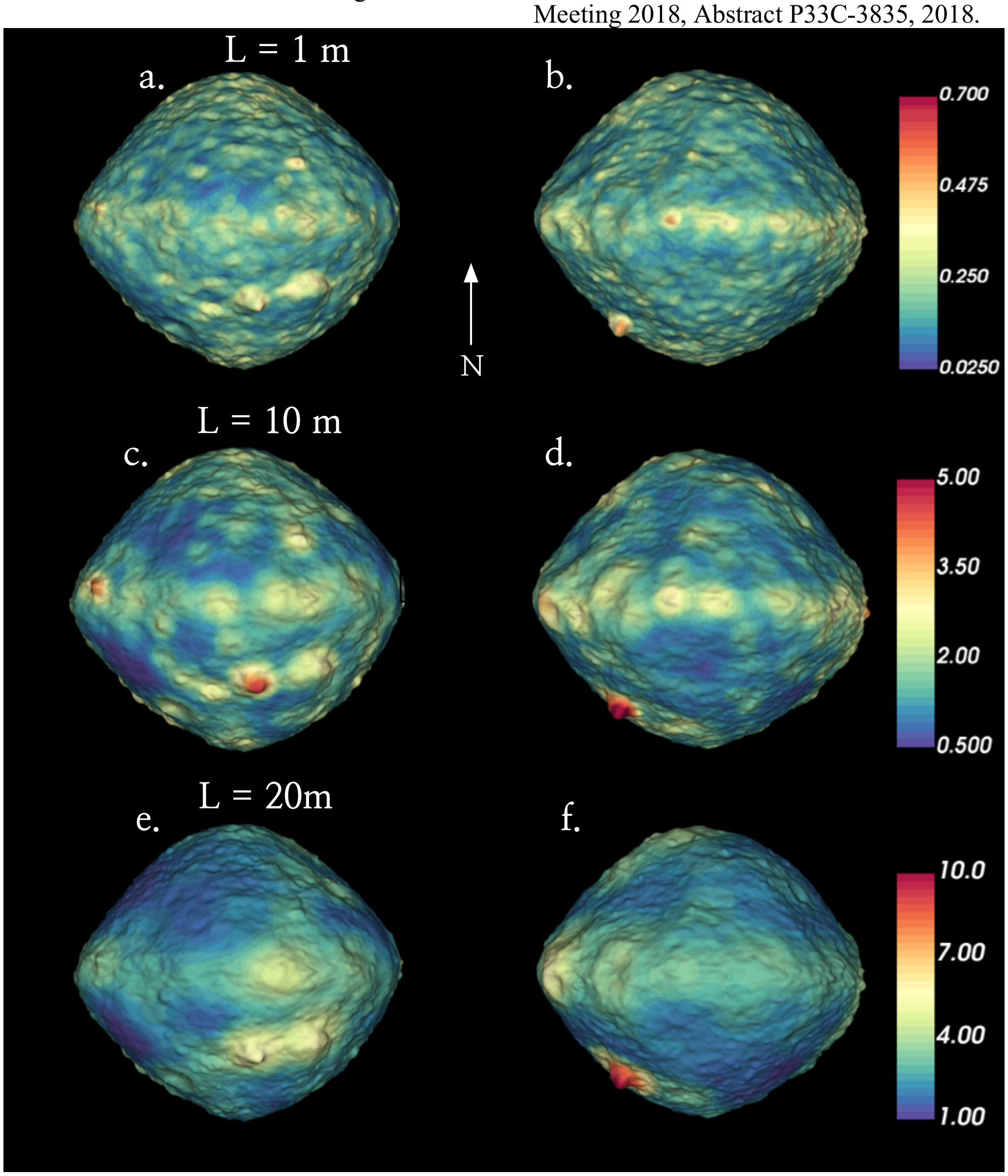

Figure 1. The surface roughness of Bennu for 1, 10, and 20 m horizontal scales. The color bar units are in meters.