Thermal Analysis of Rolling Boulders on Asteroid Ryugu

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In addition to remote sensing and sample return from a C-type asteroid, Ryugu, the Hayabusa2 spacecraft also successfully conducted an artificial impact experiment on the asteroid using the Small Carry-on Impactor (SCI). This could be seen as an attempt to artificially change the asteroid's topography, and it provides knowledge that contributes to planetary defense. Furthermore, we confirmed the movement of boulders due to thruster firing during the descent operations of the Hayabusa2 spacecraft [1]. The surface alteration gives us a clue to its mechanical properties, the evolution of the reflectance spectra, the valuable knowledge for sampling, and the application to planetary defense activity. The OSIRIS-APEX mission also plans to fire its thrusters to expose the subsurface material of asteroid Apophis [2].
The optical navigation camera (ONC-T) and thermal infrared imager (TIR) of Hayabusa2 captured rolling boulders during the maneuvers to ascend from near the surface of the asteroid Ryugu. Based on the TIR images, we conducted a thermal analysis of the rolling boulders. Figure 1 shows an example of the brightness temperature change when a boulder flips. We can see the area with a lower temperature exposed in response to the boulder motion. This place will then be exposed and heated by the sunlight. We analyzed the temperature increase after the boulder moved and estimated the thermal properties, such as thermal inertia. We will compare the thermal properties in the above region with those of other areas and discuss the implications of the time scale over which surface materials move.

References

[1] Sakatani N. et al. (2024), Abstract #1719, 55th LPSC.
[2] DellaGiustina D. et al. (2023), The Planetary Science Journal, 4:198.

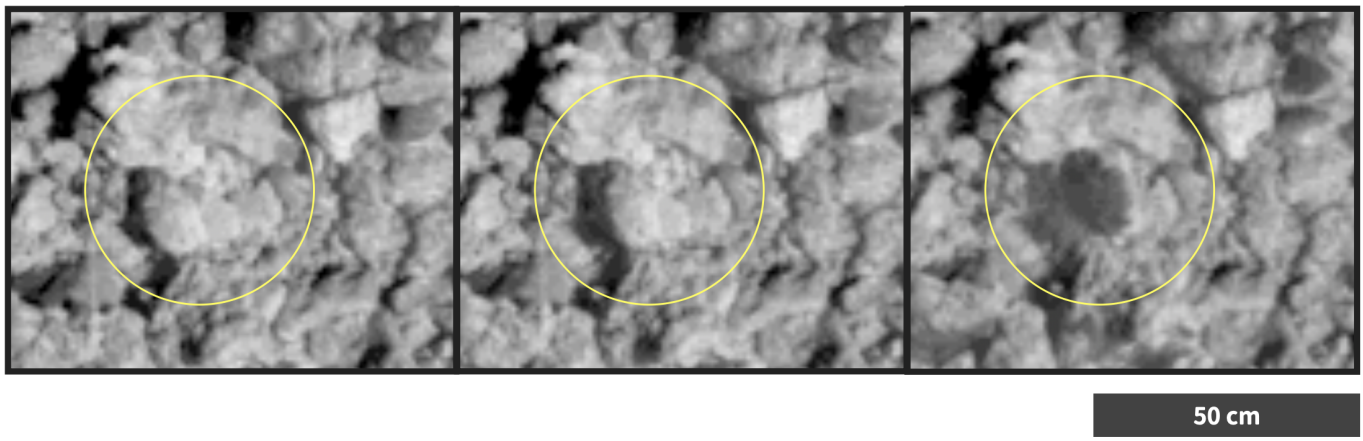

Figure 1. Brightness temperature change in TIRI images due to boulder flip.