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Ryugu as seen close up by MASCOT

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Abstract

In October 2018, MASCOT landed on the surface of Ryugu to start a campaign of in-situ measurements. Its brief mission was successful, with the onboard camera revealing the surface of this C-type asteroid in unprecedented detail. The presence of abundant mm-sized, multi-colored inclusions in one rock suggests a link between Ryugu and carbonaceous chondrites.

1. Introduction

MASCOT landed on the surface of near-Earth asteroid Ryugu on October 3, 2018 [1]. After activating an internal mobility unit, it achieved the desired orientation for an in-situ observational campaign. The onboard camera (MasCam) [2] imaged the surface during the descent and over the course of two asteroid nights and days according to a robust observational plan. During the night, illumination was provided by an array of LEDs, allowing imaging the surface in four colors (blue, green, red, near-IR; 470/530/630/810 nm).

2. Descent imaging

MasCam images acquired during the descent show the Ryugu surface to be extremely rough, with rocks, pebbles, boulders, and without deposits of fine regolith. We distinguish two dominant rock types on the surface: rocks with smooth, angular features and linear fractures (type 1), and rocks with a very rough surface with cauliflower-like texture (type 2). The same rock types were observed by the ONC camera onboard Hayabusa2 [3]. ONC images acquired during the descent allowed the MASCOT trajectory to be reconstructed.

3. After landing

A wealth of data was acquired after MASCOT had settled. The surface of a small (∼25 cm) rock in front of the lander was resolved at an unprecedented spatial resolution of 0.25 mm per pixel. The day images reveal the rock to have a high surface roughness, suggesting it is of type 2. Night images of the rock were acquired using the onboard LEDs and reveal the rock in a reddish shade of gray (Fig. 1). The small phase angle of these observations allows us to distinguish many small (mm-sized) bright inclusions set in a dark matrix. These inclusions cannot be identified in sunlit images, with their much larger phase angle, which demonstrates the benefit of bringing your own light source. The inclusions exhibit a large range of color variation, ranging from blue, via yellow, to red. The presence of abundant multi-colored, chondrule-

Figure 1: A rock on Ryugu (∼25 cm across) seen close-up in natural color at night. Bright inclusions are visible, set in a dark matrix. The green band at the bottom on the frame is an artifact.

sized inclusions suggests a link between Ryugu and carbonaceous chondrites.

We mapped the spatial distribution and spectral variation of the inclusions over the rock surface. Their abundance excludes CI1 meteorites as an analogue for Ryugu, as this class has virtually no inclusions. This is consistent with the notion that Ryugu was only moderately hydrated in the past [3]. To more accurately match the Ryugu rock to a specific class of carbonaceous chondrite we plan to image a variety of such meteorites with a MasCam spare. We hope to present the results of this effort at the meeting.

Acknowledgements

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References

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