RYUGU AS SEEN UP CLOSE BY THE MASCOT CAMERA. S. E. Schröder[0,1], R. Jaumann[1], N. Schmitz[1], K. Otto[1], K. Stephan[1], F. Preusker[1], S. Elgner[1], K.-D. Matz[1], T. Roatsch[1], R. Parekh[1], S. Mottola[1], K. Krohn[1], F. Trauthan[1], A. Koncz[1], H. Michaelis[1], W. Neumann[2,1], J.-B. Vincent[1], R. Wagner[1], S. Sugita[3], [0]stefanus.schroeder@dlr.de, [1]Deutsches Zentrum für Luft- und Raumfahrt (DLR), Rutherfordstraße 2, 12489 Berlin, Germany, [2]Institut für Planetologie, University of Münster, Wilhelm-Klemm-Str. 10, 48149 Münster, Germany, [3]University of Tokyo 7-3-1 Hongo, Bunkyo-ku, Tokyo 113-0033, Japan.

Introduction: The MASCOT lander was dropped by the JAXA Hayabusa2 spacecraft towards the surface of C-type asteroid Ryugu on October 3, 2018 [1]. It successfully settled on the surface and, after activating an internal mobility unit, 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 onboard array of LEDs in four colors.

Rock diversity: MasCam showed the Ryugu surface to be extremely rough, with rocks, pebbles, and boulders everywhere. Striking is the complete absence of fine regolith. Images acquired during the descent (Fig. 1) reveal two dominant rock types on the surface: (1) rocks with smooth, angular features and linear fractures, and (2) rocks with a very rough surface with cauliflower-like texture. This morphological diversity point to differences in erosional response to the diurnal thermal cycle and exposure to the space environment.

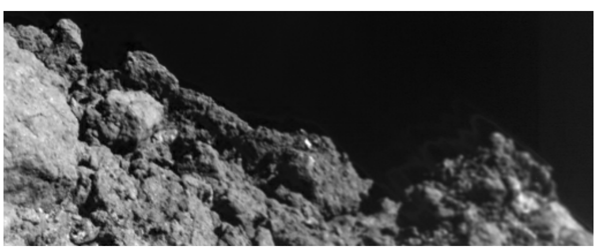

Figure 1: An image of the surface of Ryugu acquired by MasCam during the bouncing phase, showing an abundance of rocks. One such rock was seen up-close after settling.

Close-up view of a rock: After landing, MASCOT successfully re-oriented itself to achieve the optimum observation geometry for MasCam. A wealth of data was acquired, with the asteroid surface clearly visible at close range. Dominating MasCam's field-of-view is a small (~25 cm) rock, whose surface is resolved at an unprecedented spatial resolution of 0.25 mm per pixel. The day images reveal the rock to have a high surface roughness, and we recognize it as a type 2. Night images of this rock were acquired in four colors (blue, green, red, near-IR; 470/530/630/810 nm) using the onboard LEDs to assess any color variability. Thanks to the small phase angle of the LED observations, the presence of many small (mm-sized) bright inclusions set in a dark matrix is revealed. These inclusions cannot be identified in sunlit images, which demonstrates an unexpected additional benefit of bringing your own light source. As MasCam did not observe rocks of type 1 up-close, it is unknown if these too have inclusions. The inclusions exhibit a surprisingly large range of spectral variation in the visible wavelength range, with apparent colors ranging from blue, via yellow, to red. The presence of abundant multi-colored, chondrule-sized inclusions in this Ryugu rock unequivocally links C-type asteroids with carbonaceous chondrites. To further explore this link, we study the inclusion abundance and spatial distribution over the rock surface. In addition, we compare the MasCam spectrophotometric data to color observations by the Hayabusa2 ONC camera and resolved multispectral observations of carbonaceous chondrite slabs (e.g. [3]). As multispectral imaging data for the visible wavelength are rather scarce in the literature, additional laboratory observations of carbonaceous chondrites with a MasCam spare will help interpretation of the data.

References: [1] Ho, T.-M. et al. (2016), SSR, doi: 10.1007/s11214-016-0251-6, [2] Jaumann, R., et al. (2016), SSR, doi: 10.1007/s11214-016-0263-2. [3] Cloutis, E.A. et al. (2018) *Icarus 305*, 203.