

Surface evolution of carbonaceous asteroid Ryugu revealed from touchdown operation of Hayabusa2

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The Hayabusa2 spacecraft touched down on the carbonaceous near-Earth asteroid 162173 Ryugu for the first time on 21 February 2019. In the process of the touchdown operation, Hayabusa2 the optical navigation camera (ONC) had taken extremely high-resolution images of Ryugu's surface and observed its response to the physical disturbances by the sampling projectile collision and thruster gas jets. Based on the touchdown and global observations, we report the nature of the stratigraphy of the surface materials as expressed in the color observations on Ryugu.

The ONC data show that Ryugu's surface has almost homogeneous reflectance and color at the macro scale, but there is the regional variation in the spectral slope (b-x slope). The bluer materials are distributed at the equatorial ridge and in the polar regions, while the redder materials are widely spread over the mid-latitude regions (Sugita et al. 2019). The latitudinal variation of spectral slope suggests that exposure of Ryugu's materials to space has led to their reddening by solar heating and/or space weathering. The ONC images obtained during the touchdown showed that a large amount of debris was produced by the impact of the projectile shot from the sampler system and the reaction control system (RCS) thrust immediately after the touchdown, and the entire field-of-view of ONC-W1 was darkened uniformly. Color changes of boulders observed during the touchdown suggest that the dark fine grains originate from the redder materials that covered the boulder surface. The stratigraphic relationship between the identified craters and the redder materials suggests that surface reddening occurred over a short period of time. These results suggest that Ryugu underwent an orbital excursion near the Sun.

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