Spectrophotometric behavior of Ryugu’s surface as inferred from the Hayabusa2/NIRS3 data

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We studied the photometric behavior of the main spectral parameters describing the Ryugu near-infrared spectrum as measured by the Hayabusa2/NIRS3 spectrometer with a focus on albedo at 1.9 um, the band depths at 2.7 um, band depth at 2.8 um, spectral slope between 1.2 and 1.9 um.

We applied the same empirical model used to examine the surfaces of other small bodies such as Vesta, Lutetia. Ceres, Churyumov-Gerasimenko (Longobardo et al., 2014, 2016, 2017, 2019). The model methodology involves removing the topographic influence by dividing the radiance factor by a disk function and deriving the phase function by means of a statistical analysis approach.

In the following we summarize the results.

Albedo. Due to the small phase angle coverage (15˚-40˚), we approximated the phase function as a straight line and compared its slope with the slope of the phase function of other asteroids retrieved in the infrared range. We found a similarity between Ceres and Ryugu and flatter phase functions for Eros and Vesta, confirming the well known anti-correlation between albedo and phase function steepness.

Band depths. Band depths are observed to decrease with increasing phase angle. This is a unique behavior that has not been observed on any other small body visited by a space mission. This behavior can be ascribed to Ryugu’s very dark surface (~2% of incident light is reflected from the surface, Sugita et al., 2019; Kitazato et al., 2019), in which the role of multiple scattering is negligible and the large absorption properties of the surface reduces the radiation reflected at larger phase angles.

Infrared slope. A small phase reddening is observed, very similar to that observed by the ONC camera in the visible range (Tastumi et al., 2020), suggesting a constant particle phase function between visible and near-infrared and/or microscopically smooth particles.

References:
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