DISTRIBUTION OF NIRS3 SPECTRAL SLOPE FOR THE CHARACTERIZATION OF THE RYUGU SURFACE. A. Galiano[1], E. Palomba[1,2], M. D'Amore[3], A. Zinzi[2], F. Dirri[1], A. Longobardo[1], K. Kitazato[4], T. Iwata[5], M. Matsuoka[5], T. Hiroi[6], D. Takir[7], T. Nakamura[8], M. Abe[5], M. Ohtake[5], S. Matsuura[9], S. Watanabe[5,10], M. Yoshikawa[5], T. Saiki[5], S. Tanaka[5], T. Okada[5], Y. Yamamoto[5], Y. Takei[5], K. Shirai[5], N. Hirata[11], N. Hirata[4], K. Matsumoto[12], Y. Tsuda[5], [1]INAF-IAPS, Rome, Italy (anna.galiano@inaf.it), [2]SSDC-ASI, Rome, Italy, [3]German Aerospace Center, Institute of Planetary Research, Berlin, Germany, [4]University of Aizu, Aizu-Wakamatsu 965-8580, Fukushima, Japan, [5]Institute of Space and Astronautical Science (ISAS), Japan Aerospace Exploration Agency, Sagamihara, 252-5210, Japan, [6]Department of Earth, Environmental and Planetary Sciences, Brown University, Providence, RI 02912, USA, [7]Jacobs/NASA Johnson Space Center, USA, [8]Tohoku University, Miyagi, Japan, [9]Kwansei Gakuin University, Hyogo, Japan, [10]Nagoya University, Nagoya 464-8601, [11]Kobe University, Kobe 657-8501, Japan, [12]National Astronomical Observatory of Japan, Mitaka 181-8588, Japan.

Introduction: The Near-Earth Asteroid 162173 Ryugu (1999 JU3) was investigated by the JAXA Hayabusa2 mission from June 2018 to November 2019. Images acquired by ONC (Optical Navigation Camera) revealed a dark top-shaped asteroid, with an equatorial ridge [1]. The low bulk density (1.19±0.02 g/cm3), suggests that Ryugu is a rubble pile object likely formed from reaccumulation of fragments generated by a catastrophic disruption of its parent body [2]. The data acquired by NIRS3 (Near-Infrared Spectrometer) spectrometer revealed a dark surface with a positive spectral slope and the occurrence of a weak absorption band at 2.7 µm, related to the symmetric stretching of hydroxyl group (OH) in phyllosilicates [3]. In this work we investigated the variations in spectral slope across the surface of Ryugu, which could provide information about its physical/chemical properties.

Procedure: We analyzed the calibrated, thermally and photometrically corrected NIRS3 data acquired on the 10, 11 and 19 July 2018, from an altitude of 20 km (Home Position) and 13 km and with a spatial resolution of 40 m and 20 m, respectively. We calculated the mean value of the spectral slope in 1.9-2.5 µm range, corresponding to 0.163. Starting from the mean value of slope and moving in step of 1 standard deviation (0.022), we defined 9 "families of slope". All these families are characterized by a positive spectral slope, but we distinguished between the families with a spectral slope lower than the mean value (Low-Red-Slope families; i.e. LR1, LR2 and LR3) and families with a spectral slope higher than the mean value (High-Red-Sloped families; HR1, HR2, HR3, HR4, HR5, HR6). The mean values of some spectral parameters were estimated for each family, such as the reflectance factor at 1.9 µm, the spectral slope, the depth of band at 2.7 µm.

Spectral analysis of families: A dichotomy between northern and southern hemisphere emerges, since LR families are mainly located in the northern one and HR families are in the southern one. HR families are related to impact features, such as crater floor and crater wall. The HR6 family is, nonetheless, coincident with Ejiima Saxum, (30 °S; 105°E). LR families are localized in crater rims and on the equatorial buldge. A progressive spectral reddening, darkening and weakening/narrowing of OH band is observed moving from the LR families to the HR families. In fact, strong anti-correlations emerge between spectral slope and 2.7-µm band depth (***Figure 1***) and between spectral slope and 1.9 µm reflectance.

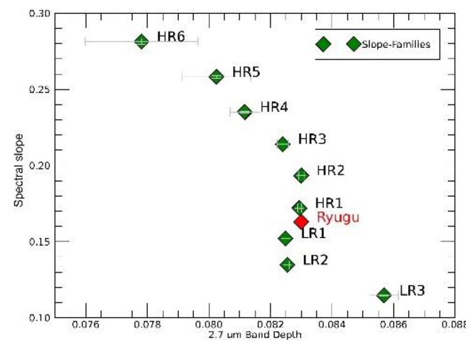

Figure 1: Scatterplot of spectral slope versus band depth at 2.7 µm for the families of slope (green diamonds) compared to mean Ryugu (red diamond).

We concluded that the spectral variability observed on Ryugu surface is the result of both thermal metamorphism experienced by the asteroid after the catastrophic disruption of its parent body and space weathering processes occurring on airless bodies as Ryugu (impact cratering and solar wind irradiation). The HR1, LR1, LR2 and LR3 families are, hence, the less altered regions on Ryugu surface, which underwent the minor alteration and OH devolatilization; the HR2, HR3, HR4, HR5 families are the most altered areas, which suffered the three processes occurred on Ryugu. The fine-sized regolith covering Ejima Saxum [1] is likely responsible of the strong reddening of the HR6 family.

References[1] Sugita, S. et al., 2019, Science 364, Issue 6437, 252-252, doi: 10.1126/science.aaw0422. [2] Watanabe, S. et al., 2019, Science 364, Issue 6437, 268-272, doi: 10.1126/science.aav8032. [3] Kitazato, K. et al., 2109, Science 364, Issue 6437, 272-275, doi: 10.1126/science.aav7432.