

Space weathering of bright boulders inferred from the spectral comparison between SCI crater and blue regions on Ryugu

*青木 美波¹、杉本 知穂¹、湯本 航生¹、高木 直史¹、巽 瑛理^{2,1}、諸田 智克¹、横田 康弘³、荒川 政彦⁴、杉田 精司¹

*Minami Aoki¹, Chiho Sugimoto¹, Koki Yumoto¹, Naofumi Takaki¹, ERI TATSUMI^{2,1}, Tomokatsu Morota¹, Yasuhiro Yokota³, Masahiko Arakawa⁴, Seiji Sugita¹

1. 東京大学大学院理学系研究科地球惑星科学専攻、2. カナリア天体物理研究所、3. JAXA/ISAS、4. 神戸大学

1. Department of Earth and Planetary Science, Graduate School of Science, The University of Tokyo, 2. Instituto de Astrofísica de Canarias, 3. JAXA/ISAS, 4. Kobe University

Boulders with reflectance ≥ 1.5 times the surrounding background have been discovered on Ryugu [1-4]. These are called bright boulders (BBs). Based on spectral features, they are classified into S-type and C-type BBs. The former is likely exogenous, and the latter is likely endogenous [2-4]. Detailed spectral analysis using principal component analysis have revealed that S-type boulders on Ryugu experienced different degrees of space weathering. However, the degrees and patterns of space weathering of C-type bright boulders on Ryugu have not been understood well yet. Because Hayabusa2 collected samples near the SCI crater, which excavated fresh materials from depth that is not intensively influenced by either space weathering or solar heating [5], optical navigation camera telescope (ONC-T) have captured many high-resolution images of fresh materials. Analysis of 13 BBs inside the SCI crater indicate that all these 13 turned to be C-type BBs [6]. In this study, we extend our analysis of C-type BBs inside the SCI crater to understand the nature of space weathering on these C-type materials.

First, we compared the spectra of C-type BBs inside and outside the SCI crater with those of the heated carbonaceous chondrites [7, 8] in v-x slope/ul-index space. Results showed that the distribution of BBs inside the SCI crater is generally consistent with that of BBs outside the SCI crater. Also found is that the spectral trend of C-type BBs in v-x slope/ul-index space is generally similar to the trend formed by heating experiments with carbonaceous chondrites (CCs). However, there is significant difference between C-type BB trend and that of heated CCs; some BBs inside the SCI crater have a high ul-index value that is not found in BBs outside the SCI crater. Thus, this spectral feature may be lost due to space weathering. Second, we further investigated whether the new spectral shape (e.g., excess ul-index) not seen in BBs outside the SCI crater is unique to BBs that have not undergone space weathering. Previous studies have found that Ryugu surface have both reddish and blueish regions [1]. Results of geologic analysis have shown that the reddish regions may have been exposed for a long time and experienced solar heating and/or solar wind irradiation [9]. Blueish regions are stratigraphically younger than reddish regions; they probably experienced some kind of resurfacing relatively recently [1, 9]. Thus, BBs in blue regions may be less affected by space weathering than those in reddish regions. Then, we have three different stages of solar heating and/or space weathering on Ryugu. Comparison of spectral properties of C-type BBs in these three different regions would give us important clue for understanding space weathering on C-type BBs. Preliminary analysis results suggest that C-type bright boulders on bluish regions, whose surface exposure ages are estimated to be ~ 0.3 to ~ 8 Myr [9], do not exhibit statistically significant excess ul-index. Thus, if the decrease in ul-index excess is caused by space weathering, then this mode of space weathering may occur at such short timescales. In the presentation, we will present the up-to-date results of our analyses of this comparison.

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