The surface evolution of Ryugu (Noguchi et al. 2022)

Airless surfaces of small bodies gradually alter in composition, structure, and optical properties through a collective process referred to as space weathering. Solar wind irradiation and high-velocity micrometeoroid bombardment are the main causes of space weathering. Thus far, space weathering of carbonaceous bodies has been poorly understood. The Ryugu samples show surface modifications of the phyllosilicate-rich matrix in ~6% of the fine grains from the first touch-down site and ~7% from the second touch-down site. Several distinct surface modifications are observed in scanning electron microscope (SEM) and (scanning) transmission electron microscope (S)TEM analyses, including smooth layers, frothy layers, melt splashes, and their combinations (FIG. 3).

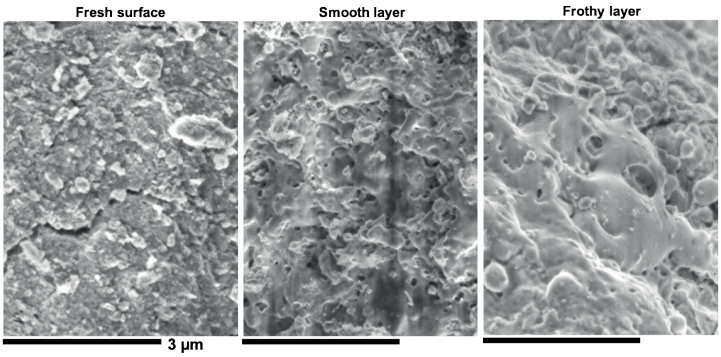

FIGURE 3 Secondary electron SEM images of the phyllosilicate surfaces of Ryugu grains. Scale bars indicate 3 µm. These images were obtained using field emission SEM at Kyoto University.

The smooth layers are continuous smooth sheets with completely amorphous structures. The iron is more reduced in the smooth layers than in the matrix. Ion irradiation experiments simulating solar wind exposure produced surface structures similar to those of the smooth layers. Solar wind irradiation therefore likely played a key role in forming the smooth layers. The frothy layers are composed of silicate glass containing abundant vesicles and submicroscopic iron sulfides. The internal structure suggests the melting of silicate and Fe–Ni sulfides and their immiscible separation, indicating that these structures formed by heating through micrometeorite bombardments. The depletion of structural –OH has been identified in both layers, suggesting that structural –OH in phyllosilicates is removed through dehydroxylation as space weathering proceeds. Approximately 40% of C-type asteroids do not show the 2.7-µm band features in their reflectance spectra; this is related to water absorption. Based on the analysis of the Ryugu samples, the absence of the 2.7-µm absorption band can be partly explained by surface dehydration resulting from space weathering, suggesting that asteroids showing apparently dry surfaces may have water-rich regions in their interiors.

REFERENCES

Nakamura T and 220 coauthors (2022) Formation and evolution of carbonaceous asteroid Ryugu: direct evidence from returned samples. Science 379: eabn8671, doi: http://doi.org/10.1126/science.abn867

Noguchi T and 138 coauthors (2022) A dehydrated space-weathered skin cloaking the hydrated interior of Ryugu. Nature Astronomy 7: 170-181, doi: 10.1038/s41550-022-01841-6

Sugita S and 119 coauthors (2019) The geomorphology, color, and thermal properties of Ryugu: implications for parent-body processes. Science 364: eaaw0422, doi: 10.1126/science.aaw0422

Watanabe S and 87 coauthors (2019) Hayabusa2 arrives at the carbonaceous asteroid 162173 Ryugu—a spinning top–shaped rubble pile. Science 364: 268-272, doi: 10.1126/science.aav8032

SEM Sociedad Española de Mineralogía

www.semineral.es

SEM 2023 ANNUAL MEETING IN MADRID

The 40th Annual Meeting of the Spanish Mineralogical Society (SEM) will be held in Madrid on June 16, 2023. It will be organized and coordinated by Nuria Sánchez Pastor and Rubén Piña García (Complutense University of Madrid).

The program for the SEM 2023 meeting includes the following.

- Two plenary lectures: "Mineral evolution: the perspective of time in mineralogy" by Dr. José María Fernández Barrenechea and "The power of crystals: origin and impact on our culture" by Juan Manuel García-Ruiz.
- A poster session. Presentations in the fields of clays, mineralogy, petrology, and geochemistry may be submitted. The main objective is to hold a high-quality scientific session that can become a platform for debate, the exchange of ideas, and the establishment of new scientific collaborations.
- General assembly of the Spanish Mineralogical Society.
- Closing dinner.

For updated information, visit https://sem2023madrid.com/.

EMU MEDAL

The Spanish Society of Mineralogy calls upon its members for nominations for the European Mineralogical Union (EMU) Research Excellence Medal 2023. This medal is presented to an early-career scientist who has made significant contributions to research in mineralogy and whose professional and societal activities contribute to strengthening scientific links in Europe. Early-career scientist nominees are expected to have completed their PhDs within 15 years (or equivalent once accounting for career breaks) of the closing date for nominations.

The deadline for applications is June 1, 2023. Please submit the nomination cover page and all other documents (which can be found at http://eurominunion.org/wp-content/uploads/2018/11/cover-page-EMU-award-interactive.pdf) to the Chair of the Medal Committee, Dr. István János Kovács (kovacs.istvan.janos@mfgi.hu).

The award ceremony will be held before the Medal talk given during an international meeting of relevance to Mineralogical Sciences selected according to the winner's expertise. EMU will provide partial support for the travel expenses. Additionally, the *European Journal of Mineralogy* (*EJM*) offers to the recipient/recipients of the medal the possibility to publish, as first author, one open-access article free of charge, which must be submitted no later than three years after the date of the announcement of the attribution of the Medal is made.