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Nanoscale mineralogy and organics in Ryugu samples investigated with AFM-IR

PIERRE BECK[1], VAN THI HAI PHAN[2,3], ROLANDO REBOIS[4], TAKAAKI NOGUCHI[5] AND HAYABUSA 2 SAND TEAM[6]

[1]Institut de Planétologie et d'Astrophysique de Grenoble – Université Grenoble Alpes - CNRS
[2]IPAG
[3]IPAG, Univ. Grenoble Alpes
[4]Institut de Planétologie et d'Astrophysique de Grenoble
[5]Division of Earth and Planetary Sciences, Kyoto University
[6]International Team

Presenting Author: pierre.beck@univ-grenoble-alpes.fr

In late 2020, samples of Ryugu, a C-type asteroid, were returned to Earth by the Hayausa2 spacecraft, a mission led by the Japan Aerospace Exploration Agency (JAXA). Results from the initial analysis of Ryugu samples reveal that are made of materials similar to CI chondrites [1-3], and that the later were modified on Earth by interaction with the terrestrial atmosphere. Here, we will present an analysis of these samples in the framework of the sand team ([3]) where we focus on the nature and spatial distributions of organic compounds, using nanoscale photothermal IR spectroscopy (AFM-IR).

Two grains of Ryugu (C0105-03300401 and C0105-03800101), received from the Sand initial analysis team, were prepared by crushing 10 – 20 µm fragments between diamond windows. Before AFM-IR analysis, all samples were analyzed with micro-FTIR analysis to select region of interests. We use the setup presented in [4] that enables to acquire IR absorption properties in the 4-2.6 µm and 7-13 µm spectral range, with a sub-µm spatial resolution.

Both grains studied show the presence of a narrow absorption mode around 1000 cm-1 that can be interpreted by the presence of a smectite-like phyllosilicates. The 3-µm region shows the presence of a narrow peak around 2.71 µm that is attributed to -OH stretching in an Mg-rich phyllosilicate. By performing IR mapping at 1450 we searched for possible area enriched in NH4+. We observed a few grains (100 nm to a few µm) with increased absorption at this wavelength, but full AFM-IR spectra obtained revealed that they are carbonates rather than ammonium-bearing compounds. By mapping the grains at 1720 cm-1 (organic C=O), a circular area of increase absorption was observed. Full AFM-IR spectra confirmed that this area is largely enriched in organics, with an IR spectrum similar to spectra obtained on Ryugu IOM. We will discuss the possible origin of this organic globule at the conference.

Reference: [1] Yokoyama T. et al. 2023 *Science (379, 6634)*. [2] Nakamura T. et al. 2023 *Science (379, 6634)* [3] Noguchi T. et al., Nature Astronomy 2022 (*7, 170-181*) [4] Phan VTH. et al. 2022. *Meteorit Planet Sci*.