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Macromolecular organic matter in samples of the asteroid (162173) Ryugu

by Hikaru Yabuta et al.

Science, 379, eabn9057 (2023)

This article is paywalled:

https://www.science.org/doi/10.1126/science.abn9057

Hello researcher,

I am happy to share with you the next article for our nanoIR Journal Club series, Macromolecular organic matter in samples of the asteroid (162173) Ryugu.

Organic compounds in asteroids contain information about the early history of the solar system, and the potential delivery of organic material to Earth. In this study, **samples recently collected from the surface of the Ryugu asteroid were investigated** using a combination of advanced analytical methods, including photothermal AFM-IR on Bruker's **Dimension IconIR** platform**.**

IconIR offers AFM-IR measurements with the highest performance and enables researchers to clearly identify the macromolecular organic species and their distributions in these asteroid samples. Findings from this work help scientists better **understand the primordial materials formed during (or before) the early stages of the solar system** and **shed light on the origins of the building blocks of life on Earth**.

The results of the AFM-IR analysis showed that the Ryugu organic matter consists of:

- aromatic carbons
- aliphatic carbons
- ketones
- carboxyls

IR absorption images were collected at wavelengths corresponding to **carbonyl C=O (1720 cm^{-1}), aromatic C=C (1600 cm^{-1}), and Si-O (1020 cm^{-1}) modes**. The images showed that organic matter is abundant in the Ryugu grains, distributed as nanoglobule-like inclusions with sizes up to ~100 nm and as organic matter dispersed in the matrix. The abundances of carbonyl and C=C varied between the organic inclusions. AFM-IR spectra showed stronger carbonyl signal on the inclusions, and stronger phyllosilicate signal on the matrix.

The analysis of the functional group compositions and diversity provides evidence that the **organics were modified by aqueous alteration** on Ryugu's parent body, while the absence of graphite-like material indicates that the **organics were not subjected to heating events** on the parent body. The lack of sulfate IR absorption bands indicates that the Ryugu samples are pristine, as sulfate can be produced by oxidation of sulfides during terrestrial weathering of meteorites. Finally, some carbonaceous grains of the Ryugu samples showed extreme deuterium and nitrogen-15 enrichments or depletions, indicating an **origin in the interstellar medium before the formation of the solar system**.

I hope you find this article interesting, and please contact me if you need any assistance in nanoIR applications.

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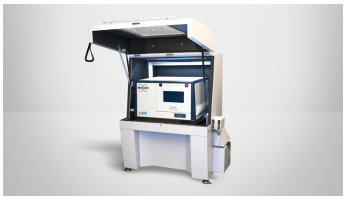

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