PRESS RELEASE
Paris-Saclay, 12 January 2023

Samples from asteroid Ryugu provide valuable new insights into the early evolution of the solar system

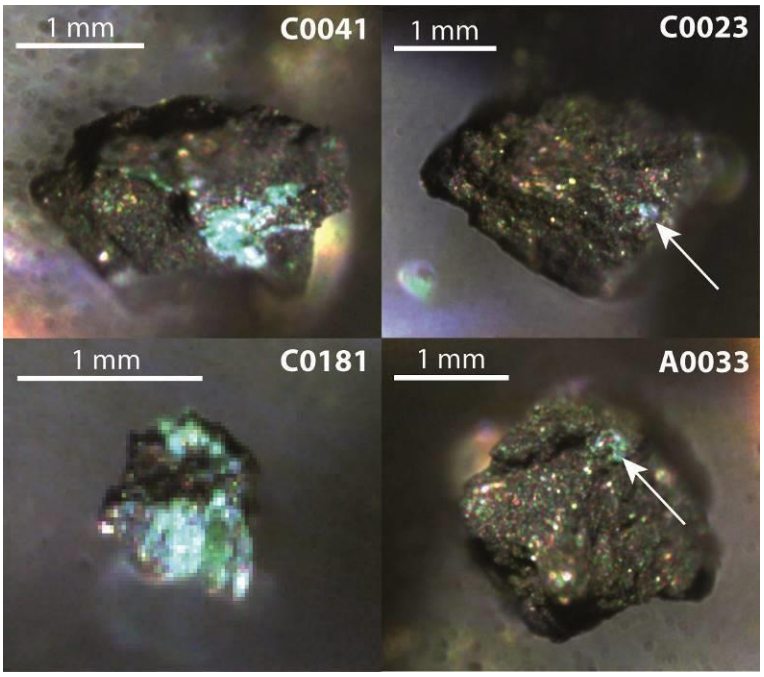
Samples from asteroid Ryugu are still revealing their secrets. New mineral characterisations have come to light thanks to the MicrOmega instrument, designed and developed at the Institut d'astrophysique spatiale (CNRS/Univ. Paris-Saclay). This work has just been published in *Nature Astronomy*.

At the end of 2020, Japan's Hayabusa2 mission brought samples from the carbonaceous asteroid Ryugu back to Earth. The samples have since been preserved from contamination and the Earth's atmosphere at ISAS near Tokyo. Within this laboratory, a French instrument, MicrOmega, analyses the samples.

MicrOmega is a hyperspectral microscope designed at the Institut d'astrophysique spatiale (CNRS/Univ. Paris-Saclay). It operates in the near-infrared range and can map minerals and organic molecules on the surface of samples at the scale of just a few tens of micrometers. MicrOmega is the only instrument that allows for all samples to be characterised as such, before they are removed from their protected environment.

After observing the surface of thousands of Ryugu grains, the instrument detected hundreds of carbonate inclusions, carbon-rich minerals ranging in size from a few dozen to a few hundred microns. The largest inclusions are Fe-Mg-rich (breunnerite), while a second population of smaller inclusions is Ca-Mg-rich (dolomite). These two types of disjointed inclusions show that carbonates were formed by two distinct processes, or during two different episodes, only a few million years after the start of the solar system's formation. At that time, CO_2 ice must have been present in the material that forms Ryugu today, and could have provided the carbon needed to form the carbonates. However, carbon-rich organic molecules, still present in Ryugu grains, may also have played a part.

Asteroid Ryugu belongs to a class of asteroids which are very common today in the main belt, but which include material formed much earlier in the younger days of the Solar System. The compositional properties of carbonates and their precursors, also found in CI-type chondrites, could thus constitute a generic property of the material formed beyond the main belt.



Four Ryugu grains with carbonate inclusions are visible in blue/green (colour composites of infrared images taken by MicrOmega). The arrows on the right point to the smallest dolomite inclusions.

Reference:

Constraints on Solar System early evolution by MicrOmega analysis of Ryugu carbonates
[1]Loizeau, D.; [1,2]Pilorget, C.; [1,3]Riu, L.; [1]Brunetto, R.; [1]Bibring, J.-P.; 4Nakato, A.; [1]Aléon-Toppani, A.; [3] [4,5]Hatakeda, K; [4]Yogata, K.; [1]Carter, J.; [1]Le Pivert-Jolivet, T.; [4]Yada, T.; [4,6]Okada, T.; [4,6]Usui, T.; [1]Langevin, [4] Y.; 1Lantz, C.; [1]Baklouti, D.; [4]Miyazaki, A.; [4]Nishimura, M.; [4]Nagashima, K.; [4,5]Kumagai, K.; [4,5]Hitomi, [5]Y.; [4,7]Abe, M.; [4]Saiki, T.; [4,7,8]Tanaka, S.; [4]Nakazawa, S.; [4,7]Tsuda, Y.; [9]Watanabe, S.

[1] Université Paris-Saclay, CNRS, Institut d'Astrophysique Spatiale, 91405 Orsay, France,
[2] Institut Universitaire de France,
[3] ESAC, ESA, Madrid, Spain,
[4] Institute of Space and Astronautical Science, Japan Aerospace Exploration Agency, Sagamihara 2525210, Japan,
[5] Marine Works Japan, Ltd., Yokosuka 237-9 0063, Japan,
[6] University of Tokyo, Bunkyo, Tokyo 113-0033, Japan, [7] The Graduate University for Advanced Studies (SOKENDAI), Hayama 240-0193, Japan,
[8] University of Tokyo, Kashiwa 277-8561, Japan,
[9] Nagoya University, Nagoya 464-8601, Japan.

DOI: 10.1038/s41550-022-01870-1.

Researcher contact details:
Damien Loizeau (CNRS), Institut d'astrophysique spatiale (CNRS/Univ. Paris-Saclay) – damien.loizeau@universite-paris-saclay.fr
Cédric Pilorget (Université Paris-Saclay), Institut d'astrophysique spatiale (CNRS/Univ. Paris-Saclay)/ OSUPS - cedric.pilorget@universite-paris-saclay.fr

Rosario Brunetto (CNRS), Institut d'astrophysique spatiale (CNRS/Univ. Paris-Saclay) / OSUPS - rosario.brunetto@universite-paris-saclay.fr
Jean-Pierre Bibring (Université Paris-Saclay), Institut d'astrophysique spatiale (CNRS/Univ. Paris-Saclay) / OSUPS - jean-pierre.bibring@universite-paris-saclay.fr

Press contacts:

The Press Team
service.presse@universite-paris-saclay.fr
+ 33 (0) 6 98 58 79 10

****

ABOUT UNIVERSITÉ PARIS-SACLAY

Université Paris-Saclay was born from the shared ambition of French universities, *grandes écoles* and national research organisations. As a leading university in Europe and the world, it covers the fields of science and engineering, life sciences and health, and humanities and social sciences. The university's science policy closely intertwines research and innovation, incorporating both basic and applied science to tackle major societal challenges. Université Paris-Saclay offers a varied range of undergraduate to doctorate level degrees, including programmes with its grandes écoles, all of which are focused on achieving student success and employability. The university prepares students for an ever-changing world where the ability to think critically, remain agile and renew one's skills are crucial. Université Paris-Saclay also offers a comprehensive range of lifelong learning courses. Located to the south of Paris, the university extends across a vast and rich local area. Its location strengthens both its international visibility and its close ties with its socio-economic partners (major companies, SMEs, start-ups, local authorities, charities).
www.universite-paris-saclay.fr/en

****

ABOUT CNRS

The French National Center for Scientific Research is one of the most recognised and renowned public research institutions in the world. For more than 80 years, it has continued to attract talent at the highest level and to nurture multi-disciplinary and interdisciplinary research projects at the national, European and international levels. Geared towards the public interest, it contributes to the scientific, economic, social and cultural progress of France. The CNRS is above all 33,000 women and men, more than 1,000 laboratories in partnership with universities and other higher education institutions bringing together more than 120,000 employees and 200 professions that advance knowledge by exploring the living world, matter, the Universe, and the functioning of human societies. The CNRS ensures that this mission is carried out in compliance with ethical rules and with a commitment to professional equality. The close relationship it establishes between its research missions and the transfer of acquired knowledge to the public makes it today a key player in innovation in France and around the world. Partnerships with companies are at the heart of its technology transfer policy, and the start-ups that have emerged from CNRS laboratories bear witness to the economic potential of its research. The CNRS provides also access to research findings and data, and this sharing of knowledge targets many audiences: scientific communities, the media, decision-makers, economic players and the general public.
www.cnrs.fr/en