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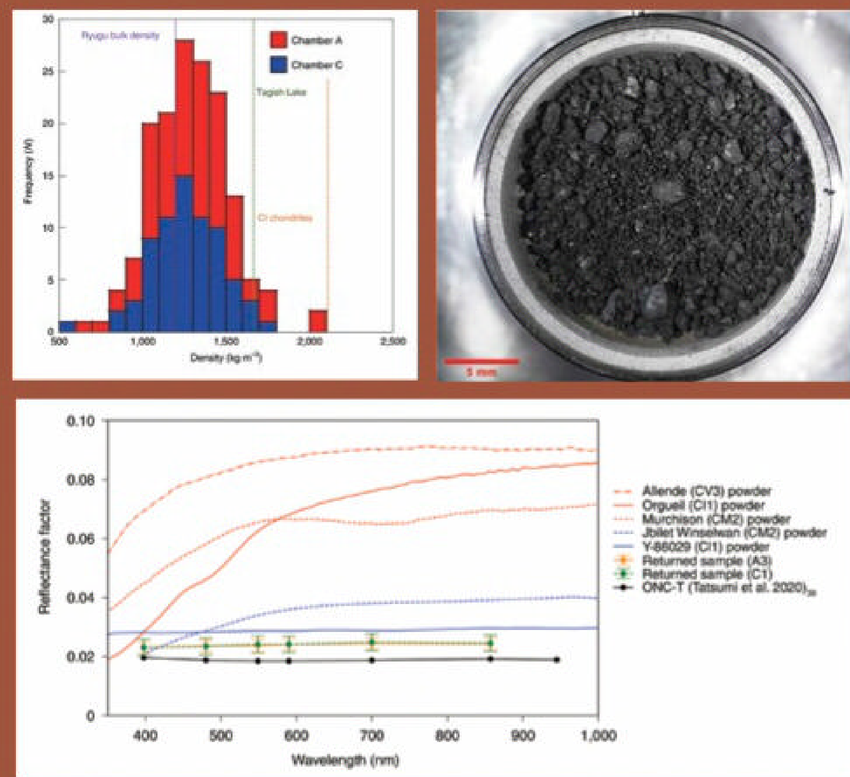
First results from Hayabusa's Ryugu asteroid sample



After a 5 billion km journey, Hayabusa's treasure hunt yields clues to the origin of Earth's water and organic material.

In December 2020, Japan's Hayabusa2 spacecraft dropped its treasure through the Earth's atmosphere and into the South Australian desert. This package held five grams of dust and rock from the primordial asteroid Ryugu (cover story, *Cosmos 88*).

Now, the results are in from the first preliminary analysis of this other-worldly material, and they show that we could soon discover whether asteroids like Ryugu brought water and organic materials to the ancient Earth.

Two studies – published in *Nature Astronomy* – delved into the physical properties and composition of Ryugu. Together, they confirm that it's a C-type asteroid – dark and rocky, rich in carbon and water. These types of asteroids are ancient, left over from the birth of our Solar System.

Scientists think that a type of meteorite known as carbonaceous chondrites, found on Earth, may have come from C-type asteroids. These meteorites look like they have been altered by fluids, which could fit with what we already know about C-type asteroids – formed in the far reaches of the asteroid belt, they contain ice that could have melted and helped produced clay minerals and carbonates (salts).

"One of the aims of the Hayabusa2 mission was to investigate the link between C-type asteroids and carbonaceous chondrites," explains planetary scientist Monica Grady. "This is important because carbonaceous chondrites are probably the sort of objects that brought water and organic compounds to Earth, enabling life to emerge here."

One study found that the sample was darker in colour than expected, reflecting just 2% of solar radiation, with a low density and a surprisingly high porosity.

The sample's density is also much lower than that of carbonaceous chondrites – perhaps because the meteorites that end up on Earth have to be hardy enough to survive a fiery plunge through the atmosphere.

"Ryugu may also contain more low-density material, such as organic molecules, than such meteorites," Grady adds. "This implies that the material from Ryugu has preserved a component of carbonaceous material that we have not been able to study before. This should allow us to learn more about the primordial building blocks of life."

The second study looked at the sample's composition, and found that it was rich in not only carbon but also hydrated minerals and clays, with a fine, uniform texture. This may suggest that Ryugu is the parent body of a type of meteorite called a CI chondrite – which give us a snapshot of what the Solar System was like when it formed.

According to Grady, together these papers "have shown us that the material from Ryugu is primitive and sufficiently different from known meteorites to make us think again about how representative meteorites are of asteroids. This might come to change some aspects of our view of early Solar System history."

Astronomers around the world are keen to learn more about these precious samples – and to compare them to a sample of the C-type asteroid Bennu, which will arrive back on Earth in 2023.

Hayabusa2's precious payload was retrieved from desert South Australia in December 2020. Now, first studies of the sample from the Ryugu asteroid confirm that it's an ancient C-type asteroid – a leftover from the Solar System's birth, formed about 4.5 billion years ago.

JAPAN AEROSPACE EXPLORATION AGENCY

RIGHT: NATURE ASTRONOMY