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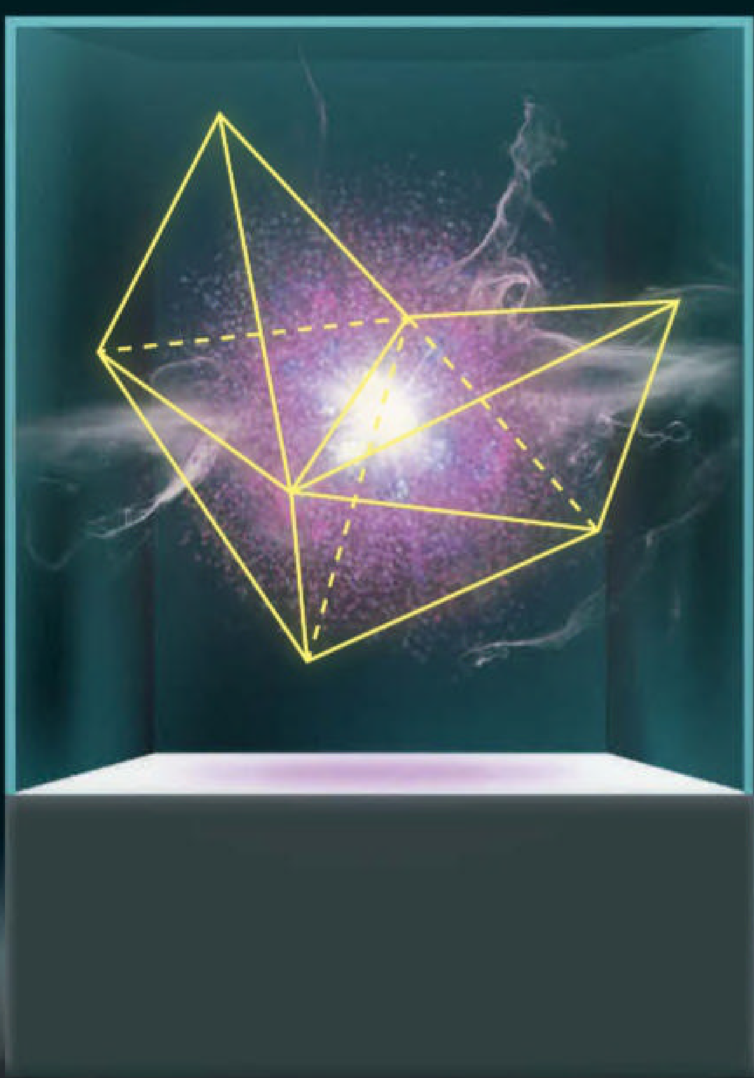

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Space

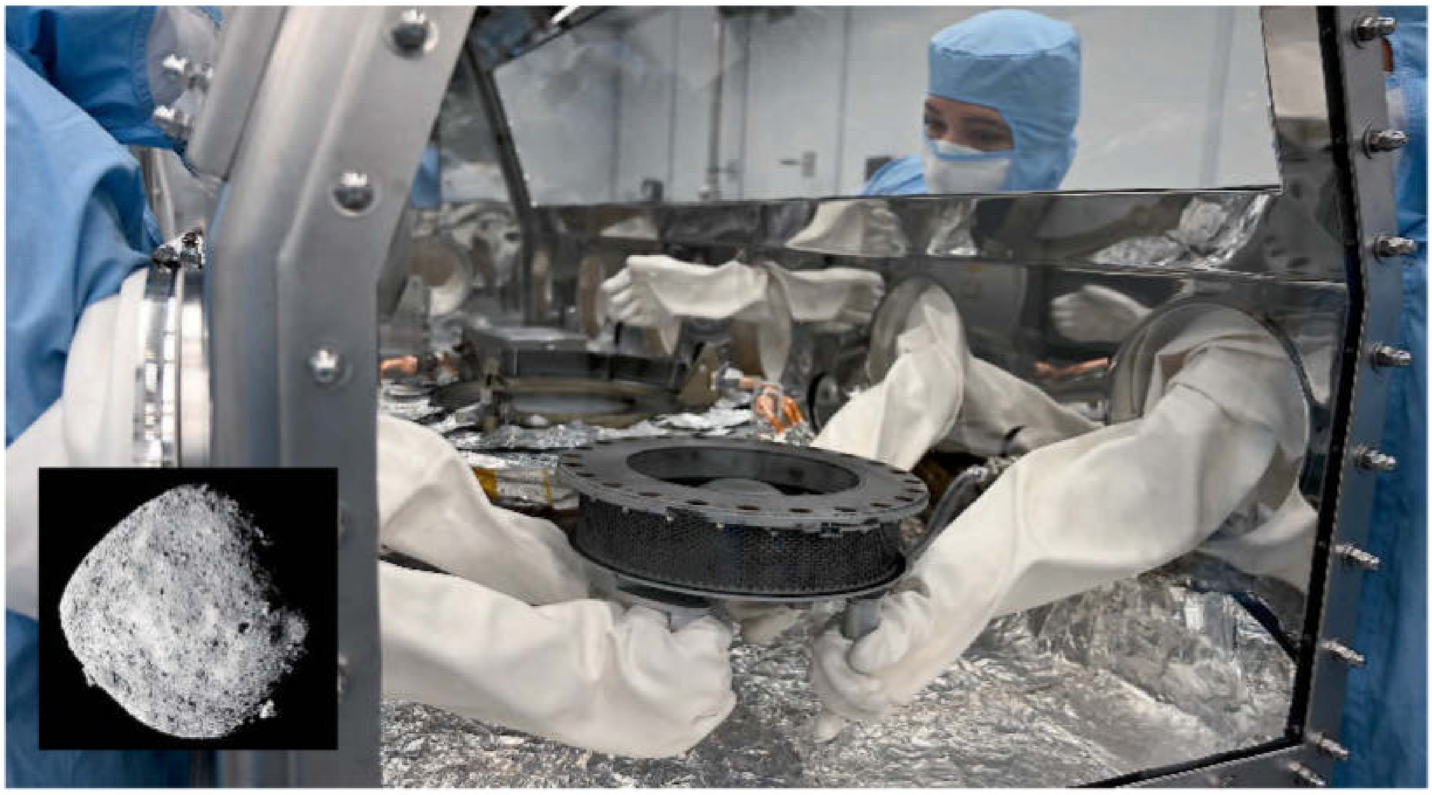
Bennu may be from an ocean world

A sample from the asteroid, brought back by NASA's OSIRIS-REx mission, hints it was once part of a small planet with conditions favourable for life to emerge, finds **Joshua Howgego**

AN ASTEROID sample brought back to Earth may once have been part of a small, ocean-covered world with conditions favourable for life to emerge. That's according to the team behind NASA's OSIRIS-REx mission, which returned a sample of the asteroid Bennu in September 2023.

"My working hypothesis is that this was an ancient ocean world," says Dante Lauretta at the University of Arizona, the mission's principal investigator. The sample also contains structures that could give clues about the origins of life, he adds.

After its launch in 2016, OSIRIS-REx travelled to Bennu, a dark-coloured and carbon-rich asteroid about the size of the Empire State Building that has an orbit similar to Earth's. It aimed to bring back 60 grams of material, but its haul weighs roughly twice that. That makes it the largest sample of an asteroid ever returned to Earth. The Japanese mission Hayabusa returned a few tiny grains from the asteroid Itokawa in 2010 and its successor, Hayabusa2, returned almost 6 grams from the asteroid Ryugu in 2020.



NASA/GODDARD/UNIVERSITY OF ARIZONA

Researchers processing samples from asteroid Bennu (pictured inset)

Exposed to water

Lauretta is basing his hypothesis on the analysis of the material carried out over the past few months, which hasn't yet been published. This includes X-ray diffraction, a technique that reveals the minerals in the sample. Most of the rock is made of clays, including minerals called serpentinites. On Earth, such substances form when rock from Earth's mantle is pushed upwards into the seabed and exposed to water. The reaction is exothermic, meaning it generates heat.

The team has also found that some of Bennu's dark rock is coated with a thin crust of brighter material. Lauretta says this is a calcium and magnesium-rich phosphate mineral that is very rare. "I had never seen it before," he says. However, the same material has been detected in the plumes of water that shoot out from the surface of Saturn's moon Enceladus. This world is assumed to have an ocean of liquid water beneath its icy crust and its seabed is considered to be one of the most plausible locations in the solar system for life to conceivably start.

If you put that all together, says Lauretta, it suggests that Bennu was once part of an ocean world in the early solar system, akin to Enceladus but probably only about half as big. That original world, known as a planetesimal, would have been destroyed in a collision, with the resulting rubble later coalescing into thousands of asteroids, one of which is Bennu.

"There are indeed similarities between the mineralogy of Bennu and what has been found on Enceladus," says Fabian Klenner at the University of Washington in Seattle. Lauretta's hypothesis is "incredibly exciting", he says.

Sara Russell at London's Natural History Museum is part of the team that has been analysing the Bennu sample. She says the asteroid is full of minerals that would have formed through the action of hot water. However, she says Bennu itself would have held its water in its internal pores. "I don't imagine blue waves of oceans covering the asteroid. I think the liquid would evaporate at the surface, unfortunately," she says.

"These could be exciting from an origin-of-life perspective. They're like protocells"

Lauretta has also found what he calls "nanoglobules" in the rock sample. These are tiny, bubble-like structures that can be thought of as like droplets of oil in water. "These could be exciting from an origin-of-life perspective. They're like protocells," he says.

These are evidence of compartmentalisation, says Lauretta. Living things today are highly compartmentalised, for example into cells. Because of this, the separation of groups of chemicals is thought to be a key step in the emergence of life. "If you can get that, that's where metabolism could maybe start to originate," says Lauretta.

He stresses that he isn't claiming any evidence for life, but "origins of life is a big area of study for these samples", he says.

Studying hydrothermal vents on Earth's seabeds is one way to work out how chemistry can transition into biology, but the picture here is complicated by there being all kinds of life present now. The sample from Bennu offers a preserved snapshot of the kinds of environment that we think can produce life, but without any contamination from life that emerged later. ■