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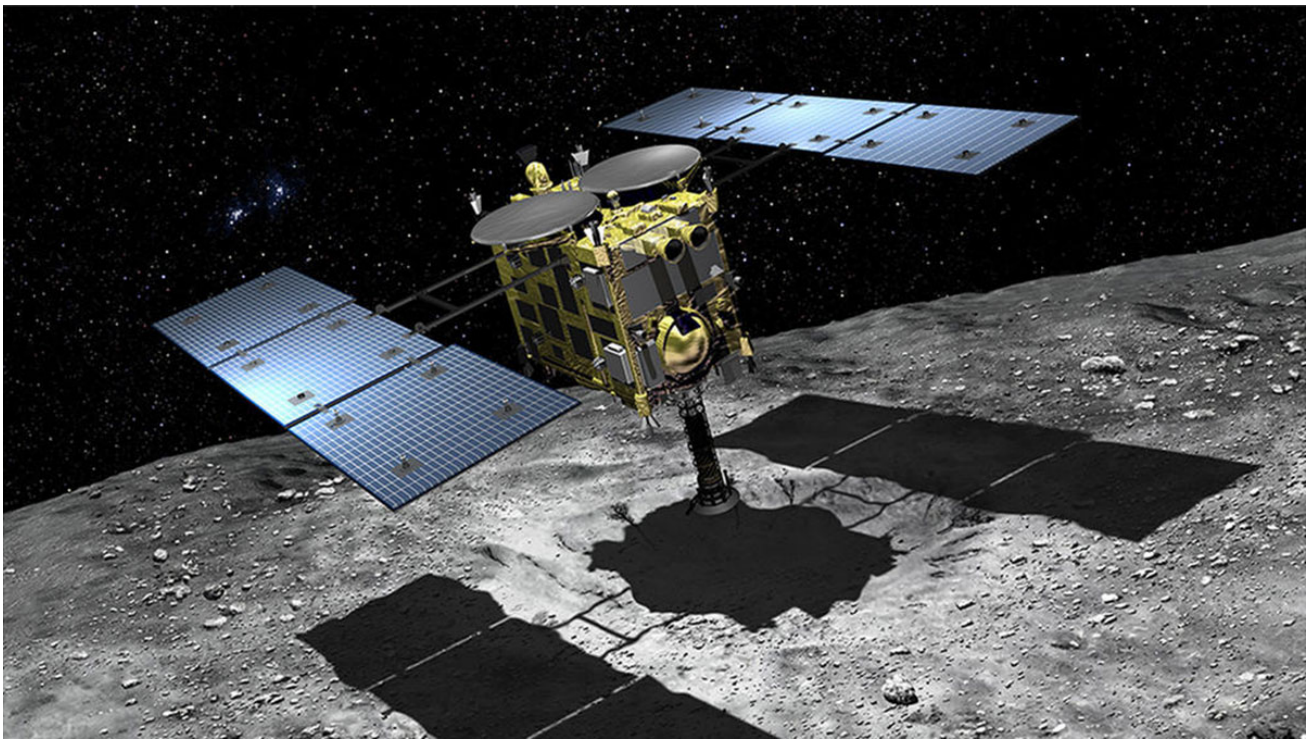
Asteroids may have been giant mudballs in the early solar system



Hayabusa 2 will collect samples from an asteroid
Akihiro Ikeshita/JAXA

By **Sam Wong**

Before there were asteroids, there were giant mudballs hurtling around the solar system.

The most common type of asteroid, called carbonaceous asteroids, may have delivered water and organic molecules to Earth, and could even be the precursors of rocky planets. They are thought to have formed from ice, dust and mineral grains called chondrules in the disc of dense gas and dust that birthed our solar system.

But not much is known about their history, and they have some unexplained characteristics. These rocks appear to have been altered at relatively low and uniform temperatures, so they must have had some way to lose heat from within. Some have proposed that water flowing inside the early asteroids cooled them down, but soluble elements don't appear to have been moved around, as would be expected if water had been present.

Modelling early asteroids as mud makes more sense, says Philip Bland at Curtin University in Perth, Australia, and his collaborator Bryan Travis at the Planetary Science Institute in Tucson, Arizona.

Muddy mixture

When the ice, dust and chondrules came together, they wouldn't have been compacted under pressure into rock straight away, says Bland. Instead, the ice would have been melted by decaying radioactive atoms present among the dust and gas, turning the mixture into a sludgy mud.

Their model shows that these mudball asteroids likely formed from dusty material left over after the sun's formation, and that convection would take place, allowing the interior to lose heat easily. Soluble and insoluble elements would be mixed together, preserving the primitive chemistry of the asteroid. "It turns out that that explains many more features of interest than if it's a rock," says Bland.

The mud would have turned to rock later on, perhaps aided by gravitational pressure once the asteroid got big enough, or by impacts with other objects.

"I think it's a very exciting idea," says Tom Davison at Imperial College London. "From the way they've presented it, it's almost inevitable that this would happen in at least some bodies."

Matching our meteorites

Sara Russell at the Natural History Museum in London says the mudball model aligns well with what is found in meteorites. "We see from our meteorite collection that chondrules within a single sample are the same size as each other," she says. That's difficult to explain without this model, she says.

Two space missions are currently en route to asteroids formed in the early universe that could be former mudballs: NASA's Osiris-Rex and Japan's Hayabusa 2 (depicted above). Both of these will map the asteroids in detail and return a sample to Earth, potentially allowing us to test this idea.

Understanding how asteroids formed will help us explain how organic chemistry evolved in the solar system, and could even help in the search for life elsewhere, says Bland. "It will help us make more sophisticated models of where we can look for habitable worlds around other stars," he says.

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