Q&A: Asteroid rocks may hold secrets to the origin of the solar system

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NASA’s OSIRIS-REx spacecraft released a container that subsequently landed in Utah containing samples from a carbon-rich asteroid in the solar system. The spacecraft then went on another mission to monitor a different asteroid. Credit: NASA

Early Sunday morning, NASA's OSIRIS-REx spacecraft released a

container that subsequently landed in Utah containing material from Bennu, a carbon-rich asteroid in the solar system.

The event ended a seven-year mission for the spacecraft, also known as the Origins, Spectral Interpretation, Resources Identification and Security-Regolith Explorer.

UVA Today checked in with Anne Verbiscer, a research professor in the University of Virginia's Department of Astronomy, to learn more about the mission and why it is important.

Verbiscer specializes in the structure and composition of surfaces in the outer solar system and has been a member of three different NASA spacecraft mission teams: Voyager, Cassini and New Horizons. She is currently a deputy project scientist on the New Horizons Kuiper Belt Extended Mission.

Q. What is important about the OSIRIS-REx mission?

For the United States, this is the first mission that has gone to an asteroid and returned samples from the surface after touching it. Japan has done this before—returned samples from a similar asteroid called Ryugu, very much like Bennu.

Getting samples from an asteroid provides real ground truth. We say that there's a connection between meteorites we find on Earth and asteroids. That helps us make connections between the compositions that you measure with the actual rock that you're holding in your hand and ground-based astronomy, where you look through a telescope at an asteroid and use a spectrometer and measure absorptions by different minerals and molecules on the surface to measure its surface composition.

And it's also a way to get below the surface. You can't do that with ground-based astronomy. You're just looking at the surface.

Q. What is in the samples?

Essentially, rock samples, but ranging widely in size. Some so small you would consider it dust, but also actual rock chunks, a few centimeters or so in size that you could hold in your hand—the whole range. And how much material was brought back? That's to be determined. The spacecraft did do a guess measurement of how much sample it got, but it wasn't very exact. It's likely to be in the range of 250 grams to as much as 600 grams, roughly 8 to 21 ounces.

Q. What is it that the scientists hope to learn from this material?

The connections that they want to make are to measure the actual composition of bodies that formed early in the solar system's history and haven't been modified all that much. Or you can tell how much modification there was. This will help us learn more about the origin of the solar system and how the asteroids were put together.

Q. How big is Bennu, and how old is it?

Bennu is about 1,600 feet in diameter, standing a bit taller than the Empire State Building. Bennu's age is commensurate with the age of the solar system, 4.5 billion years, and that's why it's of interest, because it formed so long ago. The oldest rocks on Earth are about 4 billion years old.

Q. How long will it take to analyze the Bennu

material?

The sample container was flown to NASA's Johnson Space Center in Houston, where the Astromaterials Curation Site is located. That's where all the moon rocks went after the Apollo missions and meteorites collected here on Earth are sent for analysis. They have the proper equipment and clean rooms there.

They're going to do that very carefully. There are several layers protecting both the samples from any kind of contamination we could give it and then back the other way to contamination from the samples for any humans. They're going to take the time to do the careful, thorough analysis.

Q. What do they hope to find in the samples?

The primary analysis will be composition, measuring what those rocks are made of and if there are any unique isotopes and minerals. We've been looking at this object and we've had close-up views of it from the spacecraft for years now, so we know generally what the surface is made of. But there are limits to remote sensing, without touching it and analyzing it. Now you have real samples that you can cut in half and see what they look like inside. You can't do that with just a telescope looking at an object in space. We slice meteorites open all the time and measure their elemental composition and crystal structures inside the object. They'll be cutting these rocks up.

Q. How big is the OSIRIS-REx explorer and what happens to it now?

OSIRIS-REx is 8 by 8 by 10 feet, a little bit bigger than a grand piano. The spacecraft itself came close to Earth on Sunday morning and

jettisoned a landing craft, and had to do that very carefully because you have to enter the Earth's atmosphere at just the right angle. If you come in too shallow, you'll just bounce off the atmosphere. If you come in too steep, you'll burn up. You have to get the angle just right.

The spacecraft itself, the OSIRIS-REx, has now got a new purpose. OSIRIS-APEX is the name of the new mission, and it's heading to another asteroid called Apophis. So it's got a whole new purpose in life, having an encounter with another asteroid. It won't be taking a sample because it only had one sample collector, but it will try to dislodge dust and tiny rocks on the surface of Apophis by firing the spacecraft's gas thrusters at it.

Q. What information is it supposed to send back about Apophis?

OSIRIS-APEX will go into orbit around Apophis in 2029, flying with the asteroid for 18 months, just after the asteroid's close fly-by past the Earth. Just like OSIRIS-REx did with Bennu, OSIRIS-APEX will take close-up pictures of Apophis and measure its surface composition using its on-board spectrometers.

Q. Are there other missions to study other asteroids?

This fall is quite a busy time for asteroid science at NASThe Psyche spacecraft is scheduled to launch around Oct. 12 from Kennedy Space Center, starting a six-year journey to the asteroid Psyche. Psyche is a unique asteroid because it is metal-rich. Originally, it was thought to be the remnant metal core of a larger asteroid, but I think now the consensus is that it's not a remnant core. There are silicates on the surface in addition to iron and nickel, but still the metal content is very high in this particular asteroid.

Another asteroid mission called Lucy, launched in 2021, will have its first close flyby on Nov. 1 when it will encounter the asteroid Dinkinesh. The Dinkinesh flyby will serve as a test for the upcoming flybys of Lucy's primary targets, six of the Trojan asteroids located in Jupiter's orbit. Lucy got its name from the hominid fossil called Lucy that was discovered in Ethiopia in 1974.

Provided by University of Virginia