# NASA's first successful recovery of asteroid samples may reveal information about the origins of the universe

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The OSIRIS-REx capsule carrying samples from the asteroid Bennu lands in Utah on Sept. 24, 2023. Credit: NASA/Keegan Barber

The OSIRIS-REx mission is NASA's first mission to collect samples from an asteroid—in this case 101955 Bennu—and return to Earth.

OSIRIS-REx is an acronym for Origins, Spectral Interpretation, Resource Identification, and Security—Regolith Explorer. The sealed

capsule landed on Sept. 24 near Salt Lake City, Utah, a feat that was broadcast live by NASA.

My research investigates geologic samples in craters formed by meteorite collisions on Earth. These samples include materials that can be found on other planetary bodies like the moon, Mars and asteroids.

## Asteroid samples

Planning for the OSIRIS-REx mission dates back to the 2010s, but the vision of a mission to bring back samples of an asteroid goes back even further.

The importance of planetary sample return missions was already being recognized in the 1960s, during the Apollo era, with the collection of several suites of lunar rock samples by astronauts.

In 1986, comet Halley's close approach to Earth sparked an interest in the global scientific community to explore planetary objects like comets and asteroids. The European Space Agency's Rosetta mission to comet 67P/Churyumov–Gerasimenko, which also performed fly-bys of two asteroids on the journey, and the Japan Aerospace Exploration Agency's (JAXA) Hayabusa 1 and Hayabusa 2 missions to near-Earth asteroids (NEAs) are some of the important milestones that laid the foundation for exploratory missions to comets and asteroids.

Asteroid Bennu was chosen by NASA for the OSIRIS-REx mission after rigorous discussions that considered the scientific and engineering capabilities of the mission. Bennu is a near-Earth asteroid (NEA) that has been studied extensively by Earth-based telescopic observations in the last two decades, making it a strategic target for an exploratory mission.

Bennu is a carbonaceous asteroid—a class of asteroids that contain a high amount of carbon. It is also pristine, meaning that its material was created in the early stages of solar system formation and is preserved in an unaltered condition.

## Mission significance

The question of how life came to be on Earth has fascinated people for a long time. Understanding the origin and history of the Earth can shed light on how life on Earth began.

Earth has a very dynamic environment, from a thick atmosphere to a very active biosphere and a vast expanse of water oceans. Most material on Earth that was present when the Earth first formed has been significantly modified by dynamic processes like weathering and erosion by elements like water or wind, active plate tectonics, active volcanism, as well as human activities such as mining or excavation.

Asteroids, on the other hand, have very little to no modification since their formation, going back to the time of the formation of our solar system.

Pieces of asteroids, and other planetary bodies such as the moon or Mars, land on the Earth's surface, in the form of meteorites, almost every year. These meteorites are invaluable to our knowledge of the solar system, but most of these samples originate from unknown sources.

## Known sources

A planned robotic mission to bring a sample from an asteroid ensures that the source of the material is known and can help correlate the information gained from previous studies of unknown samples, as well

as remote observations of the asteroid to direct observations from collected samples.

Specifically, as asteroid Bennu is a carbonaceous asteroid, analyses of its samples can lead to a higher knowledge of pristine carbon in our solar system and improve our understanding of the role that asteroids may have played in the origin of life on Earth.

OSIRIS-REx was not the first global asteroid sample return mission. In 2010, the Japan Aerospace Exploration Agency completed the first asteroid sample return mission, Hayabusa 1, that brought back a sample weighing less than one gram from the asteroid Itokawa. More recently, in 2020, Hayabusa 2 returned from asteroid 162173 Ryugu with a 5.4g soil sample.

The Hayabusa 2 mission has already resulted in research revealing the nature of some of the oldest known materials in our solar system.

## A continued search

The OSIRIS-REx mission continues to explore space. The spacecraft has been rebranded as OSIRIS-APEX, and is currently on its way to the asteroid Apophis on a nearly six-year long journey to conduct a fly-by of the asteroid.

Innovations required for the exploration of space and planetary bodies have historically been shown to benefit life on Earth.

For example, satellite technology, a concept that we depend so heavily upon in our daily lives—from navigation systems as well as national security or monitoring of natural landforms and ecosystems—is a product of space exploration.

As we attempt to venture deeper into the outer space, we can expect to see more creative technological advancements that will eventually help solve problems on Earth.



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