Team identifies water-bearing minerals on asteroid Bennu

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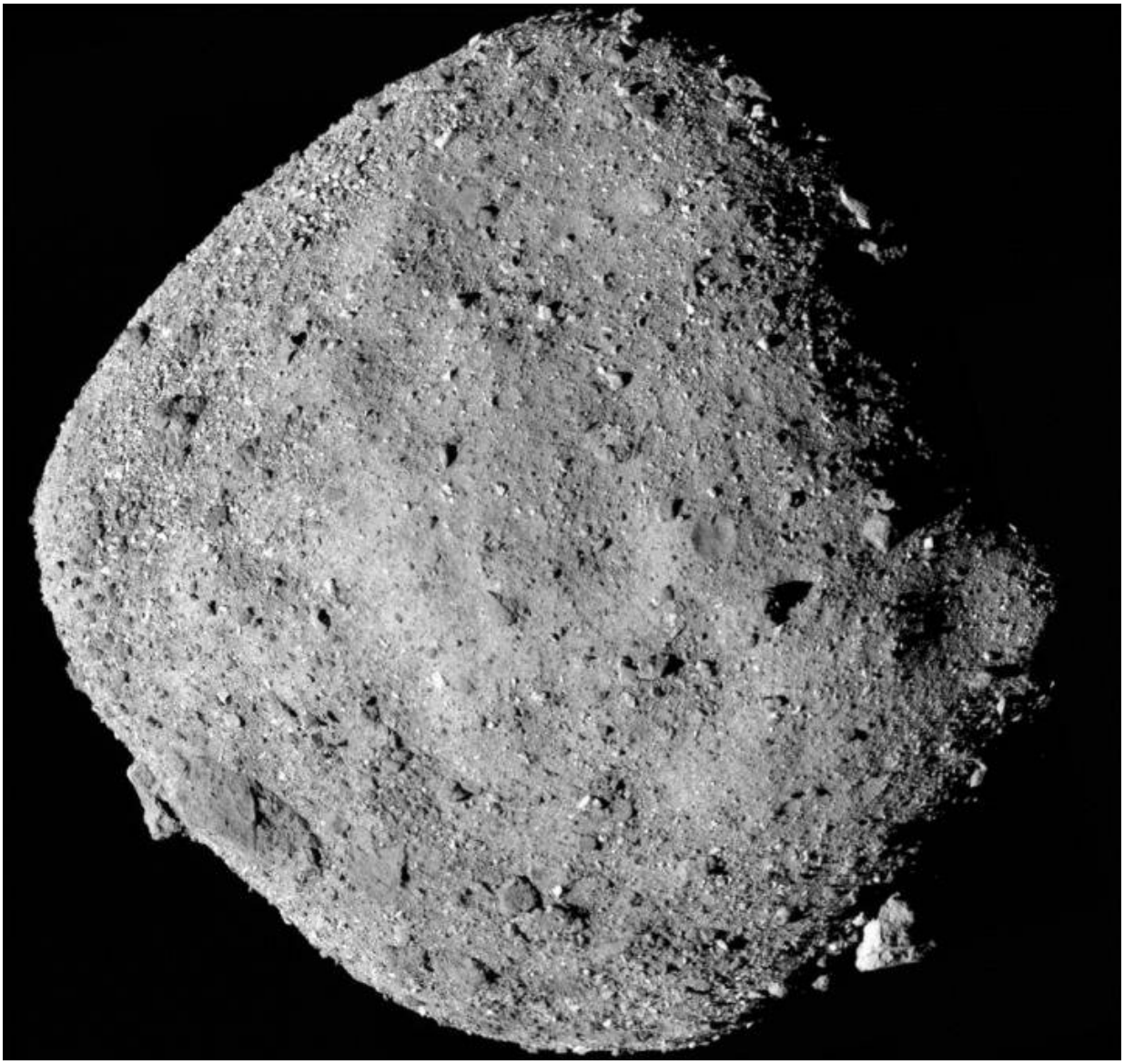

This mosaic image of the asteroid Bennu is composed of 12 PolyCam images

collected by the OSIRIS-REx spacecraft from 15 miles away. An SwRI-led team is looking at the spectral data from the surface to better understand the composition of the asteroid. Credit: NASA/GSFC/University of Arizona

A Southwest Research Institute-led team discovered evidence of abundant water-bearing minerals on the surface of the near-Earth asteroid (101955) Bennu. Using early spectral data from NASA's OSIRIS-REx spacecraft orbiting the asteroid, the team identified infrared properties similar to those in a type of meteorite called carbonaceous chondrites.

"Scientists are interested in the composition of Bennu because similar objects may have seeded the Earth with water and organic materials," said SwRI's Dr. Victoria Hamilton, a mission co-investigator and lead author of a paper outlining the discovery published March 19 in *Nature Astronomy*. "OSIRIS-REx data confirm previous ground-based observations pointing to aqueously altered, hydrated minerals on the surface of the asteroid."

Typical planetary models show that around 4.6 billion years ago, the solar system formed from the gravitational collapse of a giant nebular cloud. The Sun, planets and other objects such as asteroids and comets formed as materials within the collapsing cloud clumped together in a process known as accretion. Carbonaceous chondrites, which come from asteroids, show evidence for post-accretion interactions with water and/or ice that led to chemical reactions that produce hydrated minerals. Because these meteorites and their parent bodies formed close to the beginning of the solar system, they may provide clues to the distribution, abundance and movements of water in the solar disk at these times.

"During planetary formation, scientists believe that water was one of

many chemical components that accreted to form Earth; however, most scientists think additional water was delivered in part by comets and pieces of asteroids, including water-bearing carbonaceous meteorites," Hamilton said. "Many of these meteorites also contain prebiotic organic chemicals and amino acids, which are precursors to the origin of life. The details of water delivery to Earth as well as the larger issue of the different inventories of water ice in the early solar system affect how we view solar system formation."

Two types of carbonaceous chondrites called CI and CM chondrites contain several percent by weight of organic compounds and some also contain water in abundances of 10-15 percent and as much as 20 percent in rare cases. The presence of volatile organic chemicals and water indicates that they have not undergone substantial heating.

"Because asteroids with hydrated minerals are found throughout the main asteroid belt, significant ice must have been present in the disk during and shortly after the time of carbonaceous asteroid accretion," Hamilton said.

In summer of 2020, OSIRIS-REx will touch Bennu's surface to collect a sample the surface regolith for return to Earth. The spectral measurements used in this study will be confirmed by lab experiments when a sample of Bennu's surface materials arrives back at Earth in 2023.

The geological characteristics of Bennu's surface indicate that it is an old rubble pile of gravitationally bound, unconsolidated fragments, left over from an ancient collision in the asteroid belt. These and future, higher-resolution spectral observations from OSIRIS-REx will provide vital context for analyzing the returned sample to evaluate the aqueous alteration experienced by Bennu's parent body based on details of mineral distribution, abundance and composition.

More information: *Nature Astronomy* (2019). DOI: 10.1038/s41550-019-0722-2