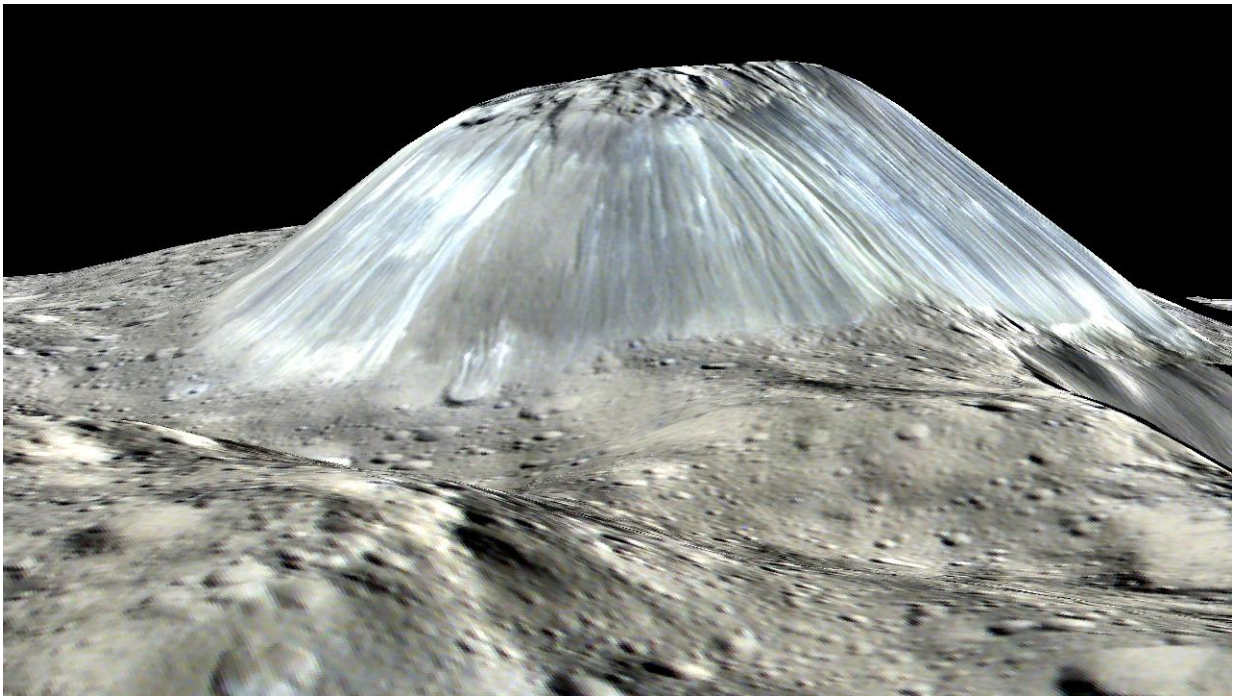


New research shows Ceres may have vanishing ice volcanoes

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Ahuna Mons seen in a simulated perspective view. The elevation has been exaggerated by a factor of two. The view was made using enhanced-color images from NASA's Dawn mission. Credit: NASA

A recently discovered solitary ice volcano on the dwarf planet Ceres may have some hidden older siblings, say scientists who have tested a likely way such mountains of icy rock - called cryovolcanoes - might disappear over millions of years.

NASA's Dawn spacecraft discovered Ceres's 4-kilometer (2.5-mile) tall Ahuna Mons cryovolcano in 2015. Other icy worlds in our solar system, like Pluto, Europa, Triton, Charon and Titan, may also have cryovolcanoes, but Ahuna Mons is conspicuously alone on Ceres. The dwarf planet, with an orbit between Mars and Jupiter, also lies far closer to the sun than other planetary bodies where cryovolcanoes have been found.

Now, scientists show there may have been cryovolcanoes other than Ahuna Mons on Ceres millions or billions of years ago, but these cryovolcanoes may have flattened out over time and become indistinguishable from the planet's surface. They report their findings in a new paper accepted for publication in *Geophysical Research Letters*, a journal of the American Geophysical Union.

"We think we have a very good case that there have been lots of cryovolcanoes on Ceres but they have deformed," said Michael Sori of the Lunar and Planetary Laboratory at the University of Arizona in Tucson, and lead author of the new paper.

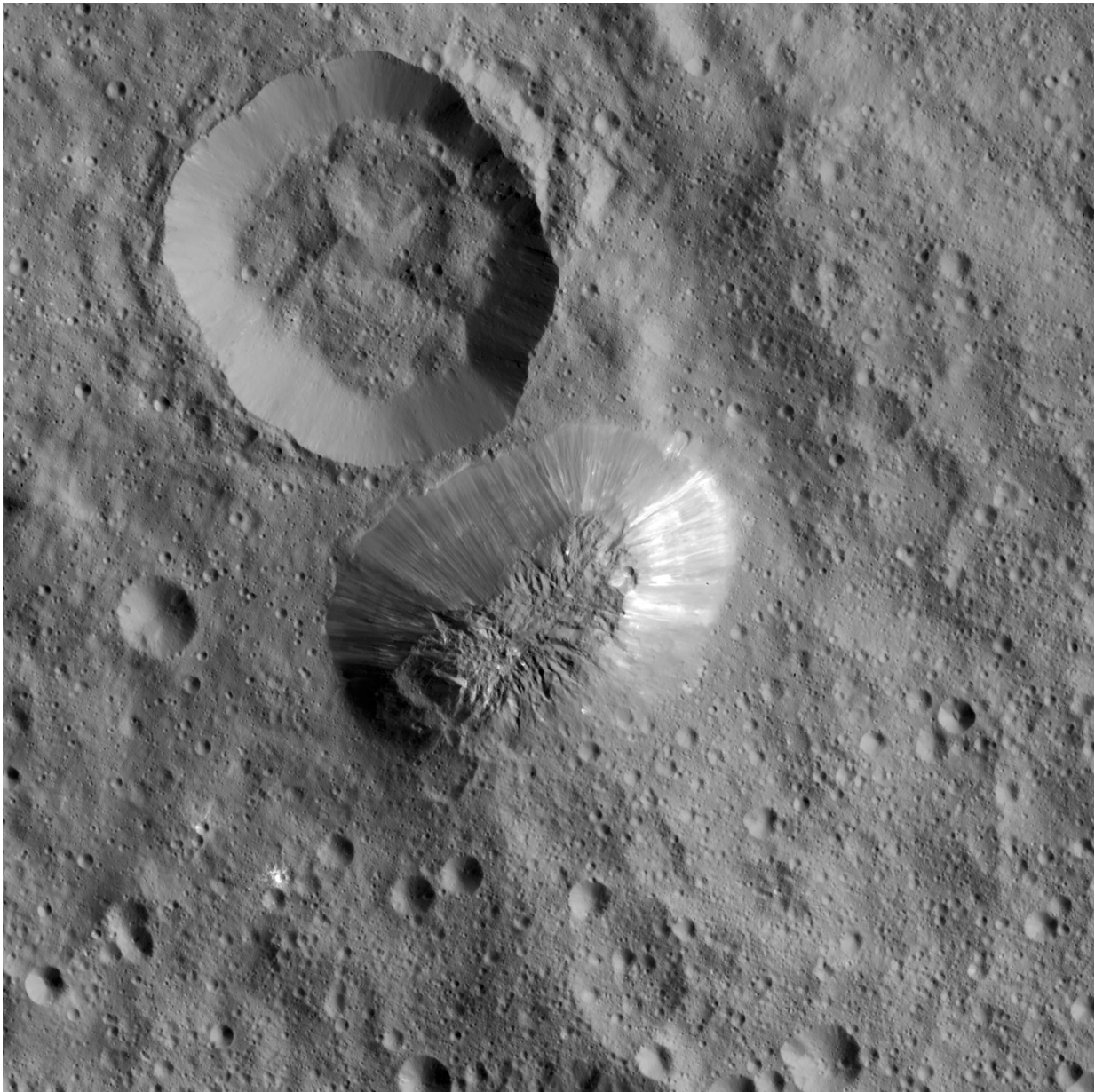
Ahuna Mons is a prominent feature on Ceres, rising to about half the height of Mount Everest. Its solitary existence has puzzled scientists since they spied it.

"Imagine if there was just one volcano on all of Earth," Sori said. "That would be puzzling."

Adding to the puzzle are the steep sides and well-defined features of Ahuna Mons - usually signs of geologic youth, Sori said. That leads to two possibilities: Ahuna Mons is just as it appears, inexplicably alone after forming relatively recently on an otherwise inactive world. Or, the cryovolcano is not alone or unusual, and there is some process on Ceres that has destroyed its predecessors and left the young Ahuna Mons as the

solitary cryovolcano on the dwarf planet, according to Sori.

Ceres has no atmosphere, so the processes that wear down volcanoes on Earth - wind, rain and ice - aren't possible on the dwarf planet. Sori and his colleagues hypothesized that another process, called viscous relaxation, could be at work.



Ceres's mysterious mountain Ahuna Mons is seen in this mosaic of images from NASA's Dawn spacecraft. Dawn took these images from 240 miles (385 kilometers) above the surface, in December 2015. The resolution of the image is 120 feet (35 meters) per pixel. Credit: NASA

Viscous relaxation is the idea that just about any solid will flow, given enough time. For example, a cold block of honey appears to be solid. But if given enough time, the block will flatten out until there is no sign left of the original block structure.

On Earth, viscous relaxation is what makes glaciers flow, Sori explained. The process doesn't affect volcanoes on Earth because they are made of rock, but Ceres's volcanoes contain ice - making viscous relaxation possible. On Ceres, viscous relaxation could be causing older cryovolcanoes to flatten out over millions of years so they are hard to discern. Ceres's location close to the sun could make the process more pronounced, Sori said.

To test the idea that viscous relaxation had caused cryovolcanoes to flatten out on Ceres, Sori and his colleagues created a model using the actual dimensions of Ahuna Mons to predict how fast the mountain might be flowing. They ran the model assuming different water contents of the material that makes up the mountain - ranging from 100 percent water ice to 40 percent water ice, Sori explained.

Ahuna Mons would need to be composed of more than 40 percent [water ice](#) to be affected by viscous relaxation, they found. At this composition, Sori estimates that Ahuna Mons should be flattening out at a rate of 10 to 50 meters (30 to 160 feet) per million years. That is enough to render cryovolcanoes unrecognizable in hundreds of millions to billions of years, suggesting there could have been other cryovolcanoes on Ceres,

according to the new study.

"Ahuna Mons is at most 200 million years old. It just hasn't had time to deform," Sori said.

The next step for Sori and his team will be to try and identify the flattened remnants of older cryovolcanoes on Ceres. The findings could help scientists better decipher the history of how the [dwarf planet](#) formed, he added.

The new study helps scientists expand their knowledge of what might be possible on planetary bodies in our solar system, said Kelsi Singer, a postdoctoral researcher who studies icy worlds at Southwest Research Institute in Boulder, Colorado, and was not involved with the new research.

"It would be fun to check some of the other features that are potentially older domes on Ceres to see if they fit in with the theory of how the shapes should viscously evolve over time," she said. "Because all of the putative cryovolcanic features on other worlds are different, I think this helps to expand our inventory of what is possible."

More information: The Vanishing Cryovolcanoes of Ceres, *Geophysical Research Letters*, [onlinelibrary.wiley.com/doi/10 ... 016GL072319/abstract](https://onlinelibrary.wiley.com/doi/10.1029/2016GL072319/abstract)

Provided by American Geophysical Union

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