Asteroid collision that spawned Vesta's asteroid family occurred more recently than thought

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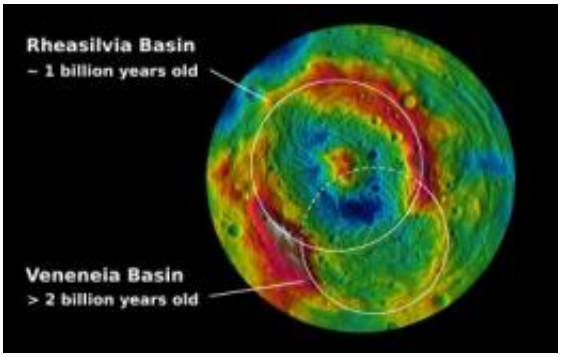
This image shows three slices of a class of meteorites that fell to Earth that NASA's Dawn mission has confirmed as originating from the giant asteroid Vesta. The meteorites, known as howardite, eucrite and diogenite meteorites, were viewed through a polarizing microscope, where different minerals appear in different colors. The texture of the rocks reveals that they crystallized at different rates. The image on the left comes from a meteorite named QUE 97053 (Antarctica), which is basaltic eucrite. The image in the middle comes from the Moore County (North Carolina) cumulate eucrite. The image on the right comes from a diogenite meteorite named GRA 98108 (Antarctica). Credit: University of Tennessee

A team of researchers led by a NASA Lunar Science Institute (NLSI) member based at Southwest Research Institute has discovered evidence that the giant impact crater Rheasilvia on Asteroid (4) Vesta was created in a collision that occurred only about 1 billion years ago, much more

recently than previously thought. This result is based on the analysis of high-resolution images obtained with the Dawn spacecraft, which entered orbit around Vesta in July 2011.

In addition to creating the crater, the impact is believed to have launched a large number of fragments into space, some of which later escaped the main belt and possibly hit the Earth.

Vesta, the second-most massive body in the main asteroid belt, is believed to have formed within the first few million years after the earliest solar system solids (~4.6 billion years ago). According to models, its early evolution occurred in an environment where collisions with other asteroids were much more frequent than they are today. It was thought that one such early collision on Vesta created a swarm of fragments, which we now call an asteroid family. Although Vesta and its family are located between Mars and Jupiter, smaller pieces of these asteroids can be found in meteorite collections on Earth, including most eucrite, howardite and diogenite meteorites.



This topographic map from NASA's Dawn mission shows the two large impact basins in the southern hemisphere of the giant asteroid Vesta. The map is color-coded by elevation, with red showing the higher areas and blue showing the lower areas. Rheasilvia, the largest impact basin on Vesta, is 310 miles (500 kilometers) in diameter. Scientists estimate that it formed 1 billion years ago by counting the number of smaller craters that have formed on top of it. The other

basin, Veneneia, is 250 miles (400 kilometers) across and lies partially beneath Rheasilvia. Scientists estimate that Veneneia is at least two billion years old. The topography was derived from images taken by Dawn's framing camera during Dawn's high-altitude mapping orbit, which averaged about 420 miles (680 kilometers) in altitude and took place from Sept. 30 to Nov. 2, 2011. The resolution during that orbit was about 200 feet (60 meters) per pixel. Credit: NASA/JPL-Caltech/UCLA/MPS/DLR/IDA/PSI

Several large craters on Vesta were first inferred by Hubble Space Telescope imaging. However, a photographic survey by the Dawn spacecraft revealed a collision-dominated history, as well as a strong north-south dichotomy in the asteroid's cratering record. Vesta's heavily cratered northern terrains retain much of their earliest history, but the southern hemisphere was reset by two major collisions in more recent times.

The Dawn survey revealed high-resolution details of these craters, allowing scientists to estimate their ages on the basis of the number of younger craters that have been superposed on the crater's floor since their formation.

Rheasilvia, the youngest of these impact structures, is about 505 kilometers (314 miles) across. The number of smaller craters found within Rheasilvia can be used like a clock to estimate its formation age. The best estimates suggest it is only about 1 billion years old. For reference, this is nearly 3 billion years after the barrage of comets and asteroids that produced the so-called Late Heavy Bombardment of the Moon (and Solar System). Before this time, the asteroid belt is believed to have been substantially larger than it is today.

The volume of material excavated by the impact that formed Rheasilvia is larger than the estimated volume of known asteroidal members of

Vesta's dynamical family, suggesting that most of the observed family was formed in this single event.

"An age of about 1 billion years for Rheasilvia is unexpectedly young. This result has important implications for our understanding of the evolution of the Vesta, its asteroid family and the inner main asteroid belt in general. We have just started exploring Vesta's secrets, and I'm sure other intriguing results will come along shortly," said NLSI team member Dr. Simone Marchi, lead author of "The Violent Collisional History of Asteroid (4) Vesta," published in the May 11 issue of the journal *Science*.

Provided by Southwest Research Institute