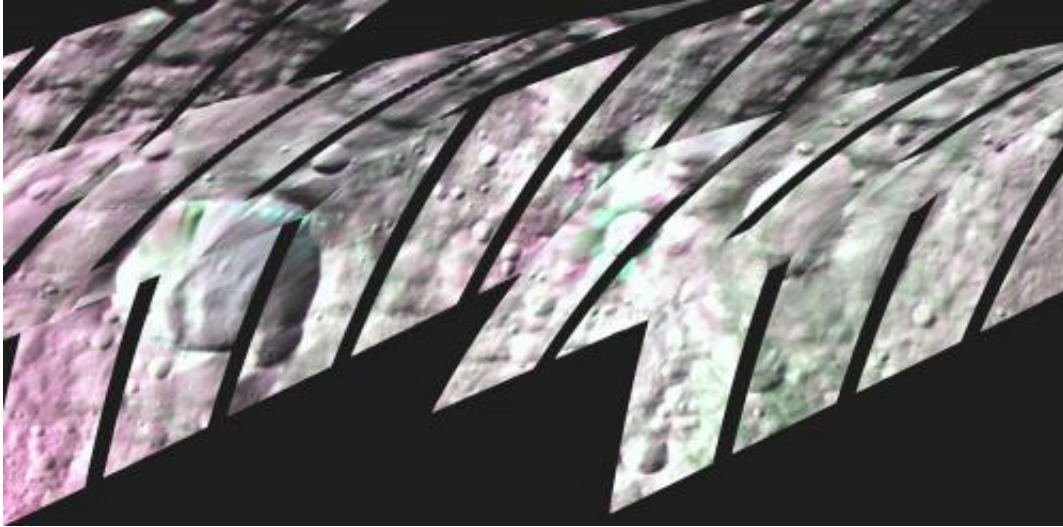


Asteroid Vesta's mysterious olivine

November 7 2013



This image shows infrared views of two craters at the giant asteroid Vesta that NASA's Dawn mission has found to sport the mineral olivine. These craters, Bellicia (left) and Arruntia (right), are in the northern hemisphere, where Dawn scientists didn't expect to find olivine. If Vesta's formation had followed the script for the formation of rocky planets like our own, heat from the interior would have created distinct, separated layers of rock (generally, a core, mantle and crust). In that story, the mineral olivine should concentrate in the mantle. However, Dawn's visible and infrared mapping spectrometer (VIR) did not find olivine at the huge craters in Vesta's southern hemisphere that exposed Vesta's mantle. Instead, scientists found signatures of olivine in the surface material in the northern hemisphere, at Bellicia and Arruntia craters. These images were taken between June 15 and July 25, 2012, from an altitude of 420 miles (680 kilometers). Scientists assigned red to the 1.25-micron range of the infrared radiation spectrum, green to the 1.93-micron range, and blue to the 1.64-micron range. Green areas show where Vesta's surface is rich in olivine. Credit: NASA/JPL-Caltech/UCLA/ASI/INAF

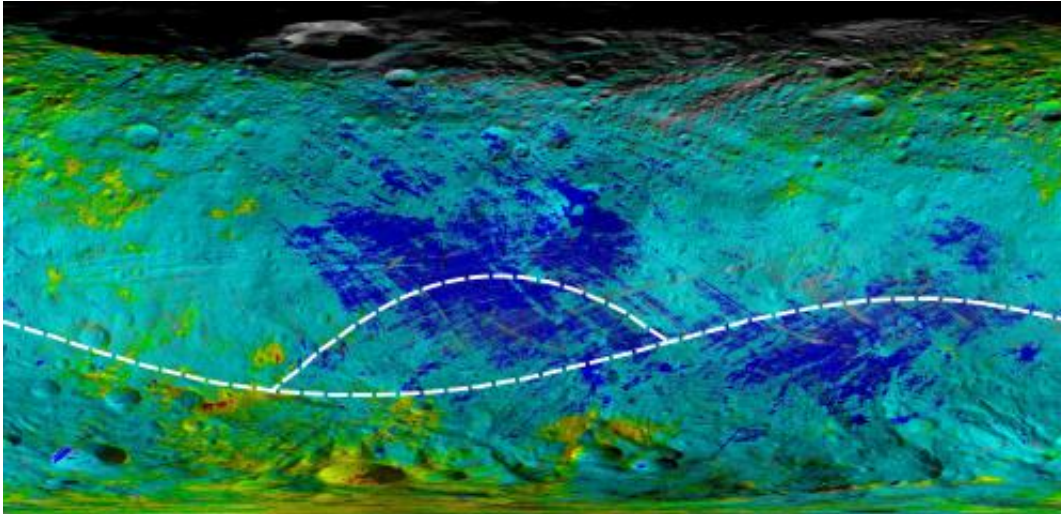
(Phys.org) —Just when scientists thought they had a tidy theory for how the giant asteroid Vesta formed, a new paper from NASA's Dawn mission suggests the history is more complicated.

If Vesta's formation had followed the script for the formation of rocky planets like our own, heat from the interior would have created distinct, separated layers of rock (generally, a core, mantle and crust). In that story, the mineral olivine should concentrate in the mantle.

However, as described in a paper in this week's issue of the journal *Nature*, that's not what Dawn's visible and infrared mapping spectrometer (VIR) instrument found. The observations of the huge craters in Vesta's southern hemisphere that exposed the lower crust and should have excavated the mantle did not find evidence of olivine there. Scientists instead found clear signatures of olivine in the surface material in the northern hemisphere.

"The lack of pure olivine in the deeply excavated basins in Vesta's southern hemisphere and its unexpected discovery in the [northern hemisphere](#) indicate a more complex evolutionary history than inferred from models of Vesta before Dawn arrived," said Maria Cristina De Sanctis, Dawn co-investigator and VIR leader at the National Institute for Astrophysics in Rome, Italy.

Perhaps Vesta only underwent partial melting, which would create pockets of olivine rather than a global layer. Perhaps the exposed mantle in Vesta's [southern hemisphere](#) was later covered by a layer of other material, which prevented Dawn from seeing the olivine below it.



This colorized map from NASA's Dawn mission shows the types of rocks and minerals distributed around the surface of the giant asteroid Vesta. In this color scheme, red shows diogenite, a type of mineral thought to be formed through magmatic processes deep in the crust. Green shows howardite, a type of surface rock that is made of broken bits of different materials that are excavated, ejected and mixed by meteor impacts. These types of rocks are the most abundant observed on Vesta's surface. Blue shows eucrite, a type of rock formed in the crust of Vesta that isn't as deep down as diogenite. For example, Vesta's equatorial region is replete with eucrites. Yellow areas show regions with diogenite and howardite. The yellow and red areas have large quantities of the magnesium-and silicate-rich mineral diogenite, especially in the southern hemisphere. Cyan areas show regions with eucrite and howardite. Many howardite, eucrite and diogenite meteorites have been found on Earth, and earlier work from Dawn confirmed theories that they came from Vesta. The location of two craters, Arruntia and Bellicia, are noted in the annotated version. At these craters, scientists unexpectedly found the mineral olivine. The outlines of the giant craters Rheasilvia and Veneneia are also noted. Scientists thought they'd find olivine in those locations but have not. The data for this map were obtained by Dawn's visible and infrared mapping spectrometer (VIR) during Dawn's orbital measurements of Vesta from 2011 to 2012. Credit: NASA/JPL-Caltech/UCLA/ASI/INAF

"These latest findings from Dawn stimulate us to test some different ideas about Vesta's origin," said Carol Raymond, Dawn's deputy principal investigator at NASA's Jet Propulsion Laboratory, Pasadena, Calif. "They also show us what additional information we can learn by going into orbit around places like Vesta to complement the bits that come to us as meteorites or observations from long distances."

Dawn is currently cruising toward its second destination, the dwarf planet Ceres, which is the biggest member of the [main asteroid belt](#) between Mars and Jupiter. It will arrive at Ceres in early 2015.

More information: Paper: [dx.doi.org/10.1038/nature12665](https://doi.org/10.1038/nature12665)

Provided by NASA

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