Dawn spacecraft now in its lowest orbit around Vesta

22 December 2011

NASA's Dawn spacecraft has been in its lowest orbit around asteroid Vesta since mid-December 2011. During November the orbit was gradually lowered to an altitude of 210 kilometres above the asteroid's surface. The first images acquired by the German Framing Camera system at this altitude have now been transmitted to Earth and are being incorporated into maps and elevation models by researchers at the German Aerospace Center (Deutsches Zentrum für Luft- und Raumfahrt; DLR). They show portions of the landscape on the 500-kilometre-wide minor planet at a resolution that reveals surface details down to 20 – 25 metres across. The surface is mottled and irregularly formed, and littered with countless craters with a diameter of a few dozen metres.

"We have received around 10,000 images of Vesta from the two higher orbits since summer," explains Ralf Jaumann, who heads the Dawn science team at the DLR Institute of Planetary Research. “The images have revealed incredibly exciting things. At the same time, we have produced detailed, high-resolution maps of Vesta and assessed the precise shape and orientation of the asteroid. These new images are the icing on the cake in our exploration of Vesta, a kind of Christmas present at the end of a successful year for the whole international Dawn team!" By investigating Vesta – and the second mission target, dwarf planet Ceres, which Dawn will reach in 2015 – it is expected that fundamental discoveries about the earliest period of the Solar System will be made.

Improving the determination of Vesta's shape and topography

The Low-Altitude Mapping Orbit (LAMO) that has now been reached is due to be maintained for at least 10 weeks. There are two primary goals for the scientists during this period. Firstly, the US Gamma Ray and Neutron Detector (GRaND) is due to analyse the chemical composition of Vesta’s surface. Secondly, by analysing the radio signals travelling between Dawn and the NASA ground stations, tiny changes in the orbiter’s path that result from variations in the asteroid’s gravity field should be detected, enabling conclusions to be drawn about the mass, gravitational field and interior composition of the minor planet.

Even though capturing images is not the highest priority, with the mission now concentrating on the geochemistry and gravitational field experiments (for which the conditions in the HAMO – High-Altitude Mapping Orbit – were not ideal), important advances are still expected from the new images obtained with the Dawn camera system. Frank Preusker, planetary geodesist with the DLR Dawn team, explains why: "At the moment, we are using the stereo images from HAMO to compute a digital terrain model of Vesta that will have a horizontal resolution of 100 metres and a vertical precision of about 10 metres." However, in the LAMO phase, systematic, global coverage with stereo image data is not possible. "Nevertheless, we will try to use the significantly higher resolution of the LAMO images in combination with the HAMO images used thus far for stereo image analysis. We should be able to significantly improve our model of Vesta in a number of areas." From January 2012, the Italian Visual and Infrared Mapping Spectrometer (VIR) will acquire additional data on the mineralogy of Vesta.

Complex manoeuvre to lower the orbit

Lowering the orbit over the past weeks was one of the most difficult manoeuvres so far in the course of the mission, which was launched in September 2007. Thanks to the ion engines used on Dawn, it is much easier to achieve orbits of different altitudes around the mission targets, Vesta and Ceres. The precise shapes of the target bodies, their interior composition and the distribution of mass inside the bodies also play an important role. "As this is the first time that Vesta has been visited by a spacecraft, this data was not available with sufficient precision

before the arrival of the orbiter," explains Marc Rayman of NASA's Jet Propulsion Laboratory and chief engineer of Dawn. "So we first had to use the rough and then increasingly refined measurements from the early orbital phases to constantly improve our existing models of Vesta's complex gravitational field; we later adjusted our plans for the subsequent orbit accordingly."

Orbital planning was complicated even further by the fact that Vesta is slightly irregularly shaped, rather than being a spherical body – so it exercises a varying attractive force on the spacecraft. This means that Dawn's orbit cannot be perfectly circular; instead, it is slightly elliptical. "Lowering the orbit was the result of an ongoing process of adjusting the orbital parameters using the newer, more precise data we obtained from Vesta," says Rayman of this phase of the mission. "Originally, we wanted an orbit averaging 180 kilometres above the surface, but then we realised that Vesta was slightly 'heavier' than we anticipated, so we changed the plan to 200 kilometres; in the end we went for an orbit that was 210 kilometres above the asteroid for the LAMO."

The mission

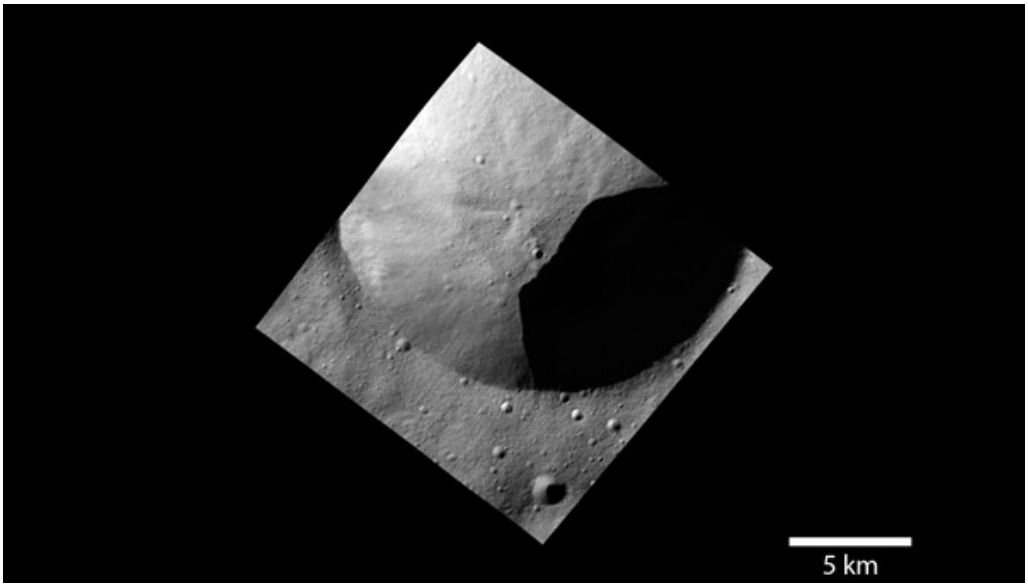
NASA's Jet Propulsion Laboratory (JPL), which is a division of the California Institute of Technology based in Pasadena, California, manages the Dawn mission to Vesta and Ceres for NASA's Science Mission Directorate in Washington DC. The University of California, Los Angeles, is responsible for overall Dawn mission science. The camera systems on the spacecraft have been developed and built under the leadership of the Max Planck Institute for Solar System Research, Katlenburg-Lindau, Germany, with significant contributions by the DLR Institute of Planetary Research, Berlin, and the Institute of Computer and Communication Network Engineering, Braunschweig. The Framing Camera project is funded by the Max Planck Society, DLR and NASA/JPL.

Contacts

Andreas Schütz
German Aerospace Center (DLR)
Corporate Communications, Spokesman
Tel.: +49 2203 601-2474
Fax: +49 2203 601-3249
andreas.schuetz@dlr.de

Prof.Dr. Ralf Jaumann
German Aerospace Center (DLR)
Institute of Planetary Research, Planetary Geology
Tel.: +49 30 67055-400
Fax: +49 30 67055-402
Ralf.Jaumann@dlr.de

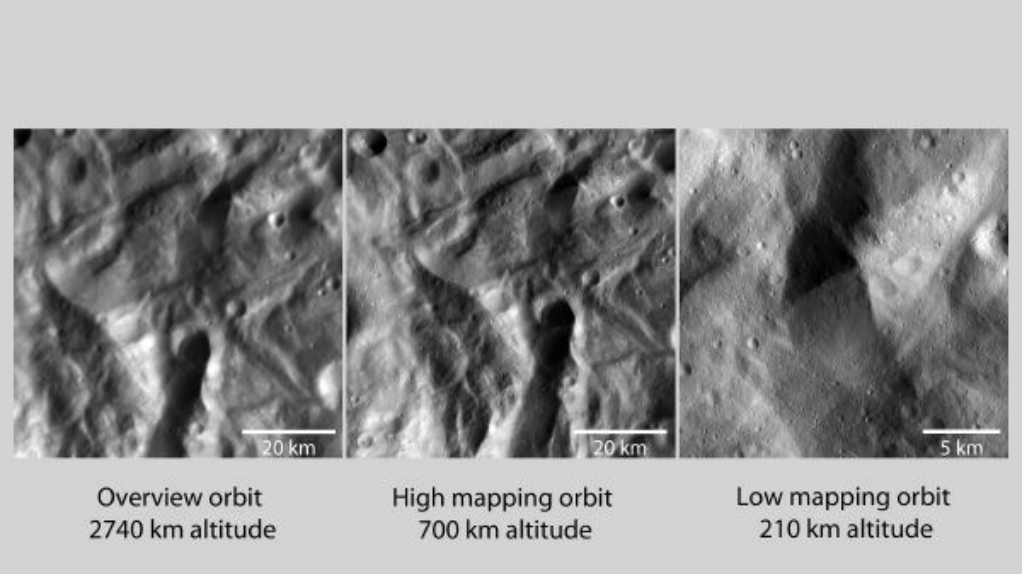
Crater in shadow



The image shows parts of the crater wall of a relatively fresh impact crater on the asteroid Vesta. The imaged area is located in the northern hemisphere, which has many such craters. It is one of the first images acquired by the German Framing Camera system on board NASA's Dawn spacecraft from the Low-Altitude Mapping Orbit (LAMO). The image data was acquired at 16.7 degrees north, 76.6 degrees east on 13 December 2011, from an altitude of 191 kilometres.

Credit: NASA/JPL-Caltech/UCLA/MPS/DLR/IDA.

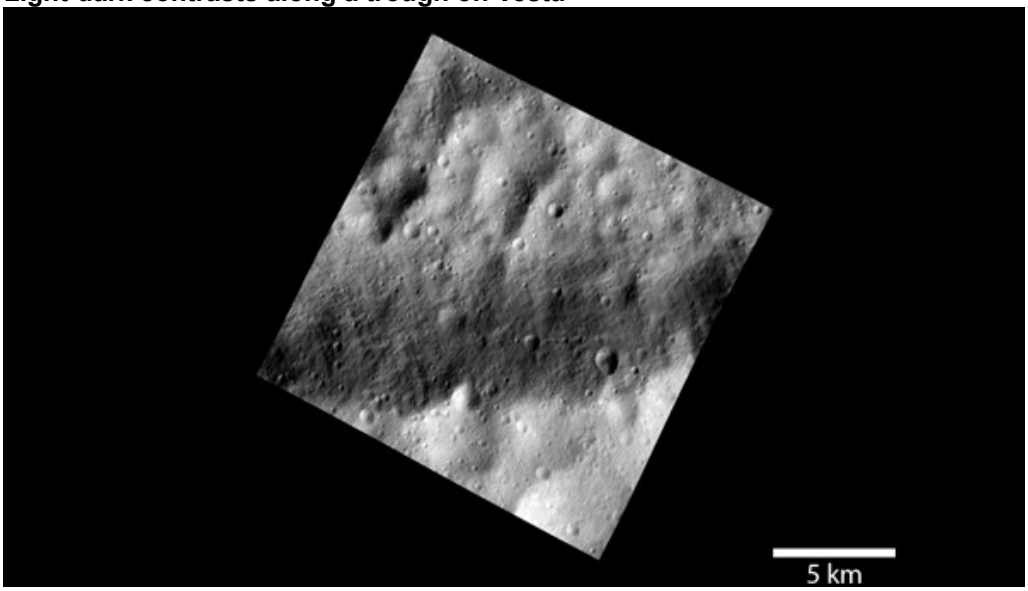
Close, closer, closest – the first images of Vesta obtained with the highest resolution



With the orbit lowered to an average height of 210 kilometres above the surface of the asteroid Vesta, the German Framing Camera system on board NASA's Dawn spacecraft is now able to acquire images with a resolution of approximately 20 by 20 metres per pixel. The left and centre images show the same area of the surface. The left image was acquired during the overview orbit in August 2011, from a distance of 2740 kilometres; it has a resolution of 260 metres per pixel. The centre image was acquired in September 2011 during the High-Altitude Mapping Orbit (HAMO), from an altitude of 700 kilometres, and reveals surface features down to 70 metres across. The right image was acquired on 13 December 2011 in the Low-Altitude Mapping Orbit (LAMO) from 199 kilometres above the surface, with a resolution of about 23 metres per pixel.

Credit: NASA/JPL-Caltech/UCLA/MPS/DLR/IDA.

Light-dark contrasts along a trough on Vesta



The image shows numerous covered craters along a trough near the equator on the asteroid Vesta. It is one of the first images acquired by the German Framing Camera system on board NASA's Dawn spacecraft from the Low-Altitude Mapping Orbit (LAMO), about 200 kilometres above the surface of the asteroid. The area shows signs of ejecta from a large impact basin named Rheasilvia (outside the image), which was formed by a collision with another asteroid near Vesta's South Pole. In addition, longitudinal terrain features of varying size and shape can be seen. The image data were acquired on 13 December 2011 from an altitude of 191 kilometres. The centre of the imaged area is located at 14.6 degrees south and 50.1 degrees east.

Credit: NASA/JPL-Caltech/UCLA/MPS/DLR/IDA.

Contact details for image and video enquiries as well as information regarding DLR's terms of use can be found on the DLR portal imprint.