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Smooth pond-like deposits on asteroid 4 Vesta: First results from the Dawn mission.

H. Hiesinger (1), O. Ruesch (1), R. Jaumann (2), A. Nathues (3), C. A. Raymond (4), and C. T. Russell (5)

(1) Westfälische Wilhelms-Universität, Institut f. Planetologie, Münster, Germany (hiesinger@uni-muenster.de), (2) DLR-Inst. für Planetenforschung, 12489 Berlin, Germany, (3) Max-Planck Institut für Sonnensystemforschung, 37191 Katlenburg-Lindau, Germany, (4) Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA 91109, USA, (5) Univ. of California Los Angeles, Inst. of Geophysics, Earth, and Space Sci-ences, Los Angeles, CA 90095, USA

The Dawn spacecraft arrived at Vesta on July 16, 2011 to study the asteroid with a Framing Camera (FC), a Visible & Infrared Spectrometer (VIR), and a Gamma Ray and Neutron Detector (GRaND) [1]. Dawn provides the first high-resolution data from its survey orbit, high-altitude mapping orbit (HAMO), and low-altitude mapping orbit (LAMO). FC data revealed smooth pond-like deposits of ambiguous origin, similar to deposits on other asteroids, including Eros and Itokawa [2,3]. Several scenarios for the origin of these deposits can be tested with Dawn data, including volcanism, impact sedimentation, impact melt deposition, dust levitation and transport, seismic shaking, or landslides. We measured 83 small ($\sim$7 km2 average size) smooth deposits distributed across the surface of Vesta. Most ponds on Vesta occur on the floors of impact craters and in irregular depressions. We did not observe inflow of material into the depressions. Most of these deposits have well-defined geological contacts, indicating that they are younger than the surrounding terrain. However, lunar impact melt pools that formed contemporaneously with surrounding ejecta blankets show similar stratigraphic relationships. Sometimes the albedo of these ponds is lower than the surrounding terrain, in other cases the ponds are indistinguishable from the adjacent terrain. The ponds preferentially occur in a band between -10 and 30 degrees latitude with fewer ponds north of $\sim$30 degrees and even fewer ponds in the southern hemisphere, i.e. the Rheasilvia region. The largest cluster of ponds occurs in the vicinity of the Marcia impact crater, which is part of the so-called snowman craters. Similar, but smaller (<230 m diameter) smooth ponds were also reported from the surface of asteroid Eros [2]. Robinson et al. [2] found that most smooth ponds on Eros occur in equatorial regions and concluded that the most likely process for their formation is electrostatic levitation and redistribution of the finest regolith components (<100 μm). Sierks et al. [4] argued that along the terminator, particularly strong electric fields can develop between the sun-lit and shaded areas, e.g., within craters, resulting in particle motion from sun-lit to dark regions. Dust levitation and transport was also discussed for asteroid 25143 Itokawa [3].

[1] Russell et al., (2007), Earth Moon Planets, 101; [2] Robinson et al., (2002), Met. Planet. Sci., 37; [3] Yano et al., (2006), Science, 312; [4] Sierks et al., (2011), Space Sci. Rev., doi:10.1007/s11214-011-9745-4.

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