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An in-depth study of Marcia Crater, Vesta

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After visiting the second most massive asteroid Vesta from July 2011 to September 2012, the Dawn spacecraft is now on its way to asteroid Ceres. Dawn observed Vesta with three instruments: the German Framing Camera (FC), the Italian Visible and InfraRed mapping spectrometer (VIR), and the American Gamma Ray and Neutron Detector (GRaND) [1]. Marcia crater (190°E, 10°N; 68 x 58 km) is the largest of three adjacent impact structures: Marcia (youngest), Calpurnia, and Minucia (oldest). It is the largest well-preserved post-Rheasilvia impact crater, shows a complex geology [2], is young [2], exhibits evidence for gully-like mass wasting [3], contains the largest location of pitted terrain [4], has smooth impact melt ponds [5], shows enhanced spectral pyroxene signatures on its inner walls [2], and has low abundances of OH and H in comparison to the surrounding low-albedo terrain [6, 7]. Geophysically, the broad region of Marcia and Calpurnia craters is characterized by a higher Bouguer gravity, indicating denser material [9]. Williams et al. [2] have produced a detailed geologic map of Marcia crater and the surrounding terrain. They identified several units within Marcia crater, including bright crater material, pitted terrain, and smooth material. Units outside Marcia, include undivided crater ejecta material, bright lobate material, dark lobate material, and dark crater ray material [2]. Because of its extensive ejecta and fresh appearance, the Marcia impact defines a major stratigraphic event, postdating the Rheasilvia impact [2]. However, the exact age of Marcia crater is still under debate. Compositionally, Marcia crater is characterized by higher iron abundances, which were interpreted as more basaltic-eucrite-rich materials suggesting that this region has not been blanketed by diogenitic materials from large impact events [10, 11]. Using FC data, [13] identified "gray material" associated with the ejecta blanket of Marcia crater. This material is characterized by a 0.75-mm reflectance of $\sim$15%, a shallow visible slope, and a weak R(0.75 μm)/R(0.92 μm) ratio [12], which is still high compared to immediately adjacent terrains. The most prominent thermal feature in Marcia is the pitted terrain on its floor [8]. Temperatures of the pitted floor of Marcia are significantly lower than in the surrounding terrains, when observed under similar solar illumination. Denevi et al. [4] argued that the morphology and geologic setting are consistent with rapid degassing of volatile-bearing materials following an impact, which would lead to an increased local density and/or a higher thermal conductivity [8].

References:

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