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Vesta: A Geological Overview

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Observations from the Dawn spacecraft [1] enable the derivation of the asteroid 4Vesta's shape, facilitate mapping of the surface geology, and provide the first evidence for interpreting Vesta's geological evolution. Science data were acquired during the approach to Vesta, a circular polar (Survey) orbit at an altitude of 2700 km providing $\sim$ 230 m/pix camera scale, and during a circular high-altitude mapping orbit (HAMO) at 700 km altitude with a camera scale of $\sim$ 65 m/pixel. Currently Dawn is orbiting Vesta in a low-altitude mapping orbit (LAMO) at 210 km altitude, yielding a global image coverage of $\sim$20 m/pixel at the time of EGU [2,3,4,5]. Geomorphology and distribution of surface features provide evidence for impact cratering, tectonic activity, and regolith and probable volcanic processes. Craters with dark rays, bright rays, and dark rim streaks have been observed, suggesting buried stratigraphy. The largest fresh craters retain a simple bowl-shaped morphology, with depth/diameter ratios roughly comparable to lunar values. The largest crater Rheasilvia, an $\sim$500 km diameter depression at the south pole, includes an incomplete inward facing cuspate scarp and a large central mound surrounded by unusual complex arcuate ridge and groove patterns, and overlies an older $\sim$400 km wide basin. A set of large equatorial troughs is related to these south polar structures. Vesta exhibits rugged topography ranging from -22 km to +19 km relative to a best fit ellipsoidal shape. Vesta's topography has a much greater range in elevation relative to its radius (15%) than do the Moon and Mars (1%) or the Earth (0.3%), but less than highly battered smaller asteroids like Lutetia (40%). This also identifies Vesta as a transitional body between asteroids and planets. The surface of Vesta exhibits very steep topographic slopes that are near the angle of repose. Impacts onto these steep surfaces, followed by slope failure, make resurfacing - due to impacts and their associated gravitational forces and seismic activity - an important geologic process on Vesta that significantly alters the morphology of geologic features and adds to the complexity of its geologic history. In general, Vesta's geology is more like the Moon and rocky planets than other asteroids.
References: [1] Russell and Raymond, 2011, Space Sci. Rev., 163, pp. 3-23, DOI 10.1007/s11214-011-9836-2; [2] Sierks, et al., 2011, Space Sci. Rev., 163, pp. 263-327, DOI 10.1007/s11214-011-9745-4; [3] De Sanctis et al., 2011, Space Sci. Rev. 163, pp. 329-369, DOI 10.1007/s11214-010-9668-5; [4] Prettyman et al., 2011, Space Sci Rev., 163, pp. 371-459, DOI 10.1007/s11214-011-9862-0; [5] Jaumann et al., 2011, AGU #U21-B02;

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