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Geophysical Observations of Vesta from Dawn

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During its yearlong stay at Vesta, Dawn collects data to determine its topography and gravity field, and derive its bulk density. Multiple techniques are being used to derive Vesta's topography from multi-angle image data obtained by the Framing Camera (FC), including stereophotogrammetry and stereophotoclinometry. To date, imaging data from the High-Altitude Mapping Orbit (HAMO) has been used to create a high-resolution digital topography model (DTM) at < 10-m height accuracy and 100-m horizontal spatial resolution. This DTM does not extend to high northern latitudes because of seasonal darkness at the beginning of Dawn's stay. Data to fill in the northern cap will be collected in a second HAMO when the Sun has moved north. Precision Doppler tracking data from the Low-Altitude Mapping Orbit (LAMO) has been used to determine a spherical harmonic representation of the gravity field to degree and order 18, yielding half-wavelength spatial resolution of less than 50 km. The topography and gravity data in combination define the relief of Vesta's surface relative to an equipotential and allow quantitative assessment of the morphology and crustal structure of the large south polar feature. Vesta's topography is complex at many scales. Within the $\sim$500-km diameter Rheasilvia impact basin, that is a probable source of the Howardite-Eucrite-Diogenite meteorites, there is a large central peak, surrounded by rough ridged topography. The basin has a disrupted rim scarp and is enclosed by a ring of deep troughs near the equator. The northern hemisphere is heavily cratered, shows evidence of relict large (> 100 km) impact basins, and contains more large troughs. The gravity and topography of Vesta appear correlated over large impact basins, and in regions of high topography associated with the central peak and ejecta from the Rheasilvia basin. Gravity anomalies are being investigated to determine Vesta's crustal thickness and its variations, as well as crust and mantle density, and density anomalies. The measured value for the gravitational moment J2 is not consistent with the expected value for a homogenous density body; rather it requires that mass be concentrated in Vesta's center. Models that can reproduce the measured J2 are consistent with an iron core of $\sim$110 km. Dawn has confirmed that Vesta is a differentiated body similar to the terrestrial planets, that has undergone complex geologic and geophysical processes. The authors acknowledge the support of the Dawn Science, Instrument and Operations Teams.