Geophysical Research Abstracts
Vol. 15, EGU2013-2885, 2013
EGU General Assembly 2013

The Geology of Vesta's Dark Material

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Deposits of dark material appear on Vesta's surface as low-albedo features in the visible wavelength range of the Dawn camera and spectrometer (1-4). This material is intermixed into the regolith and partially excavated by younger impacts exposed as blocks or layers out-cropping in crater walls, having been uncovered and broken by the impact process. Fans slumping down crater walls and dark deposits on crater floors are the result of gravity-driven mass wasting triggered by steep slopes and impact seismicity. The mixing of dark material with impact ejecta indicates that this material is processed together with the ejected material. Some small craters possess continuous dark ejecta similar to lunar dark-halo impact craters, indicating that the impact excavated the material from beneath a higher-albedo surface. Asymmetric distribution of dark material in impact craters and ejecta suggests non-continuous distribution in the local subsurface. Some positive-relief dark edifices appear to be impact-sculpted hills with dark material distributed over the hill slopes. Dark features are in some places arranged as linear outcrops along scarps or as dark streaks crossing a range of topographies. Dark features inside and outside of craters are in some places arranged as linear outcrops along scarps or dark streaks crossing different topographies. The composition of the dark material resembles that of the Vesta regolith (5). Dark material is distributed unevenly across Vesta's surface. Clustering occurs for all types of dark material exposure. On a local scale some craters expose or are associated with dark material, while others in the immediate vicinity are free of dark material. The wide variety of the surface exposures of dark material and their different geological correlations with surface features as well as their uneven distribution indicate a globally inhomogeneous distribution in the subsurface. However on a global scale the dark material seems to be correlated with the rim and ejecta of the older Veneneia south polar basin structure. The origin of the dark material is still debated and it is tentatively suggested that dark material could be either exogenic, from carbon-rich low velocity impactors, or endogenic, from freshly exposed mafic material or impact melt, created or exposed by impacts (1,3,4). The variety of geological settings of dark material suggests that more than one process is involved in their formation.
References: (1) Jaumann et al., 2012, LPSC 43, #1807; (2) Jaumann, et al., 2012, Science 336, 687-690; (3) McCord, et al., 2012, Nature 491, 83-86; (4) Reddy V., et al., Icarus 221, 544-559; Stephan, K., et al., PSS, submitted.
The support of the Dawn Instrument, Operations, and Science Teams is gratefully acknowledged. This work is supported by DLR, by NASA through the Dawn project and the Dawn at Vesta Participating Scientist program and by ASI.