Vesta mineralogy after Dawn

M. De Sanctis[1], E. Ammannito[1], F. Capaccioni[1], M. Capria[1], J. Combe[2], R. Jaumann[3], T. McCord[2], L. McFadden[4], H. McSween[5], D. Mittlefehldt[6], C. Pieters[7], O. Ruesch[8], C. Raymond[9], and C. Russell[1]

[1]INAF, IAPS, Roma, Italy
[2]Bear Fight Institute,WA, USA
[3]DLR, Berlin, Germany
[4]NASA, GSFC MD, USA
[5]Univ.of Tennessee, TN, USA
[6]NASA JSC, TX, USA
[7]Brown University, RI,USA
[8]Institut für Planetologie, Münster, Germany
[9]JPL, Pasadena, CA, USA, 10 IGPP, UCLA, CA, USA

VIR aboard Dawn is the primary instrument for mapping the surface mineralogy of Vesta [1]. Vesta's spectrum has absorption features at 0.9 and 1.9 microns, indicative of Fe-bearing pyroxenes, similar to the spectra of HED meteorites, leading to the hypothesis that Vesta is the parent body of the HED clan [2,3]. The data from VIR [4–6] mapped the mineral distribution on Vesta, providing new insight into Vesta's formation and evolution. VIR discloses the mineralogical variation of Vesta's crustal stratigraphy on local and global scales. Ejecta from large craters have distinct spectral behaviors, and materials exposed in the craters show distinct spectra on floors and rims. Most of the VIR spectra are consistent with a surface covered by a howardite-like regolith containing varying proportions of eucrite and diogenite [5,6] (Fig.), with a significant gardening of surface. The mineralogy is imprinted by the huge impact that formed the Rheasilvia basin. Orthopyroxene-rich materials are present in the deepest parts of the basin and within its walls (Figure). Large eucrite-rich regions occur at equatorial/mid latitudes, suggesting remnants of Vesta's old crust. Diogenitic lithology is also exposed in a broad region extending from Rheasilvia to the Northern region. Olivine distribution is another key that can help in distinguishing between competing hypotheses about the Vesta evolution (Figure). A relatively large amount of olivine has been discovered in the northern hemisphere, far from the deeply excavated southern basins [7], and very small and localized enrichments of olivine have been recently suggested [8]. The global albedo map of Vesta [9] reveals the presence of different types of terrains: bright material (BM) and dark material (DM) [10–12]. Dark materials are distributed unevenly, and their spectra often present an OH signature at 2.8 microns. The origin of Vestan OH provides new insight into the delivery of hydrous materials in the main belt, offering new scenarios on the delivery of hydrous minerals in the inner solar system. The Vesta mineralogy is surprisingly rich in signs of its past history: the Dawn observations of Vesta are a key to understanding the evolution of the solar system.

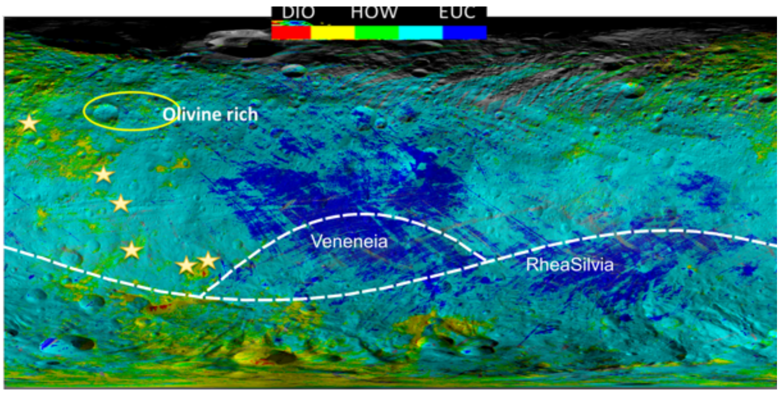

Figure: Lithological map of Vesta's surface: the color R stands for diogenite, G for howardite, B for eucrite, Y for diogenite-howardite, and C for eucrite-howardite (adapted from [1,8]).

References: [1] De Sanctis et al., (2011) SSR, 163. [2] McCord et al., (1970), Science 168, 1445–1447. [3] Binzel, R.P., et al., (1997) Icarus, 128, 95–103. [4] De Sanctis et al., 2012, Science, 336, 697–700. [5] De Sanctis et al., (2013), MAPS, doi:10.111/maps12138. [6] Ammannito et al., (2013), MAPS, doi: 10.111/maps12192. [7] Ammannito et al., Nature, doi: 10.1038/nature12665. [8] Ruesh et al al., JGR, submitted. [9] Schroder, S. et al., 2013, PSS. [10] Pieters et al. (2012)Nature,doi:10.1038/nature11534. [11] De Sanctis et al., (2012), ApJLett, doi: 10.1088/2041-8205/758/2/L36. [12] McCord et al., (2012), Nature, doi:10.1038/nature11561.