

VESTA – COMPOSITIONAL FINGERPRINT OF SMALL FRESH IMPACT CRATERS. K. Stephan¹, R. Jaumann^{1,2}, M. C. De Sanctis³, F. Tosi³, E. Ammannito³, K. Krohn¹, F. Zambon³, S. Marchi⁴, O. Ruesch⁵, K.-D. Matz¹, T. Roatsch¹, F. Preusker¹, C.A. Raymond⁶ and C. T. Russell⁷, ¹Institute of Planetary Research, German Aerospace Center (DLR), Berlin, Germany (Katrin.Stephan@dlr.de), ²Freie Universität Berlin, ³INAF, Rome, Italy, NASA Lunar Science Institute, Boulder, CO, USA, ⁵Westfälische Wilhelms-Univ. Münster, Germany, ⁶Jet Propulsion Laboratory, California Institute of Technology, Pasadena, USA, ⁷UCLA, Institute of Geophysics, Los Angeles, USA

Introduction: In order to further understand the composition of the upper as well as lower parts of Vesta's crust, small impact crater (< 10km in diameter), which show distinct ejecta and represent unweathered surface areas, have been identified and their spectral properties investigated with respect to their geological and geomorphological context [1]. The study was performed based on data acquired by the Visual and Infrared Spectrometer (VIR) [2], which observed Vesta's surface between 0.25 and 5.1 μ m with a pixel ground resolution of ~60 m/pixel. The geological and geomorphological context is provided by images acquired by the Framing Camera (FC) with a pixel ground resolution up to 20 m/pixel [3].

Spectral properties: The ejecta blankets of small fresh craters appear bright or dark in the visible light with a sharp contrast to the surrounding region (Fig. 1).

pond, supporting an origin from carbon-rich impactors (Fig. 2).

Mostly, the crater itself is characterized by a similar albedo such as the ejecta. Only a few impact craters show bright ejecta and a dark crater floor (Fig. 1). Few of these impact craters could be identified to contain material that resembles diogenites, which are expected to exist in the deeper parts of Vesta's interior (Fig. 2+3). One of these impact craters is directly located at Matronalia Rupus (Fig. 1) allowing a direct view into the subsurface. This scarp is known to mark the rim of the Rheasilvia impact basin.

Intriguingly, both type of materials, i.e. the bright ejecta as well as the darker slumping material extending from the crater floor appear yellow in the ratio color composite classifying them as fresh (Fig. 1). Both materials also show a pronounced pyroxene signature.

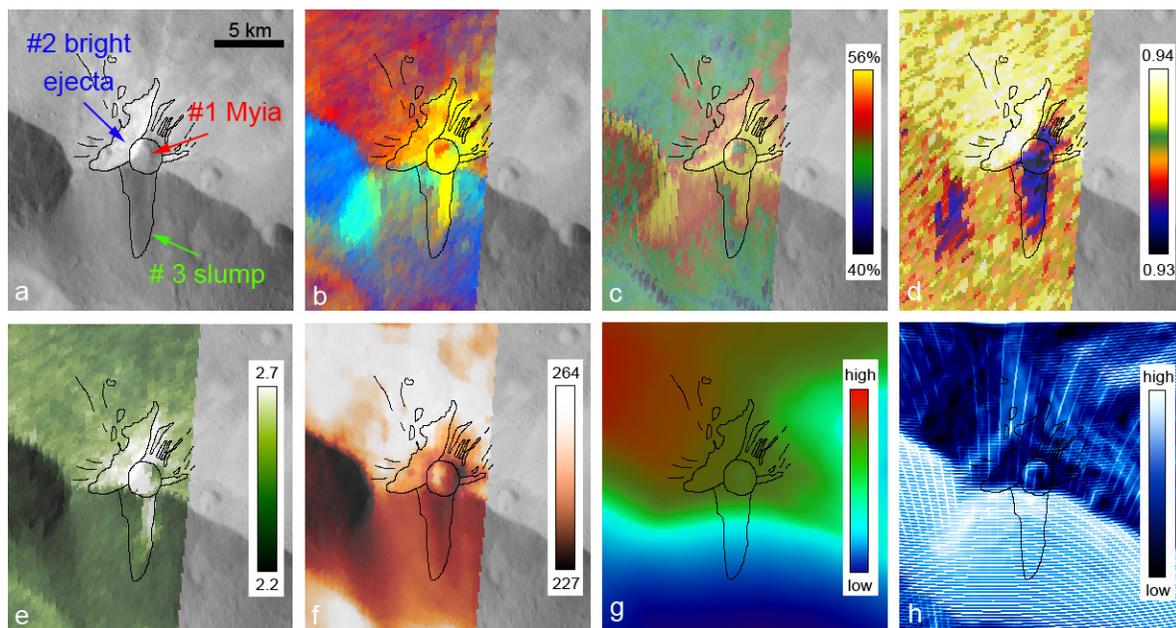


Figure 1

Bright ejecta are dominated by howardite-like material as expected for Vesta's crust and/or ejecta of the southern impact basin Rheasilvia, which cover most of Vesta's southern hemisphere (Fig. 3). Dark ejecta associated with dark impact craters do not show a different pyroxene composition than the bright ejecta but an additional strongly absorbing, spectrally neutral com-

(Fig. 2+3), which is contrary to the variations in the spectral properties elsewhere on Vesta's surface. Usually, bright material corresponds to a strong pyroxene signature with deep absorptions near 1 and 2 μ m, whereas this signature is suppressed, where the visible albedo is low. Finally, VIR spectra show a possible slight shift in the position of the 1 μ m-pyroxene absorp-

tion toward shorter wavelength. This points a diogenitic composition of the material in the crater and the slump (Fig. 3).

Geological implications: The spectral variations mirror the global trend with a more diogenitic composition in the Rheasilvia basin and an eucrite/howardite-like composition in the geologically older densely cratered equatorial region. This points to the interpretation that the bright ejecta might be related to the Rheasilvia basin whereas the darker material resembles excavated in-situ subsurface material. This interpretation is strengthened by the fact that the bright ejecta were formed only in the western part of the small impact crater in the direction of slightly higher elevation (Fig. 3) possibly representing an additional upper surface layer of former ejecta of Rheasilvia newly excavated.

References: [1] Stephan, K. et al. (2013) A compositional and geological view of fresh ejecta of small impact craters on asteroid 4 Vesta. submitted. [2] De Sanctis et al. (2011), The VIR Spectrometer, Space Science Reviews, 163, 329-369. [3] Sierks, H., et al. (2011), The Dawn Framing Camera, Space Science Reviews, 163, 263-327.

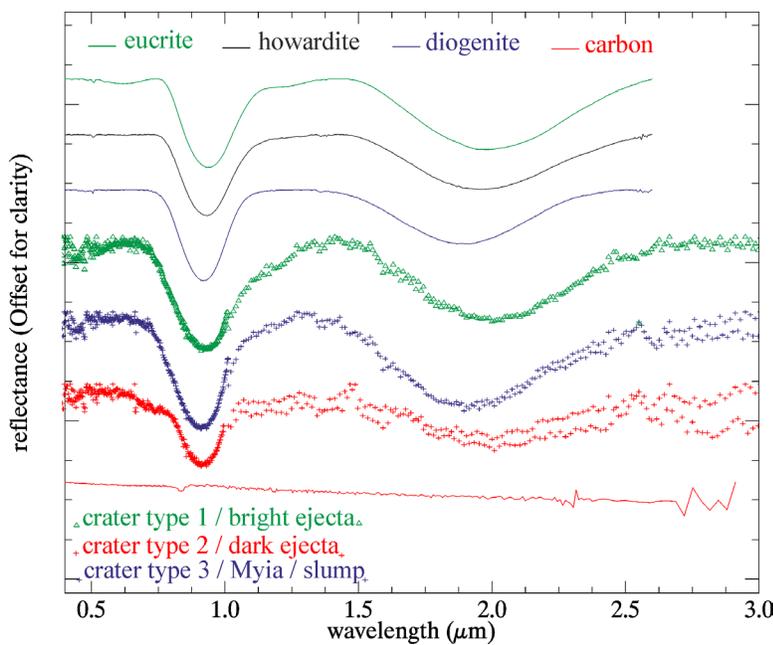


Figure 2

Figure captions:

Fig. 1: Spectral parameters near impact crater Myia: a) FC Clear filter images, b) color-ratio composite, c) BII band depth, d) BII position, e) VIS/UV ratio, f) local surface temperature [K], g) local topography, h) local topographic slope.

Fig. 2: VIR spectra of 1) bright, 2) dark and 3) diogenitic material in comparison to HED laboratory spectra and carbon as the darkening compound (RELAB spectral library); (lower left): comparison of the BI absorption band depth of the selected impact crater materials to the visual geometric albedo, and (lower right): BI and BII band center positions in comparison to the HED laboratory spectra (RELAB).

Fig. 3: Ratio spectrum enhancing the spectral characteristics of the bright ejecta compared to their “weathered” surroundings showing several small absorptions related to Fe²⁺ in comparison to laboratory spectra (USGS) of orthopyroxenes i.e. hypersthene of various grain sizes (a) 7, b) 23, c) 50, d) 180μm) and e) enstatite as well as clinopyroxenes f) hedenbergite, g) diopside and h) augite.

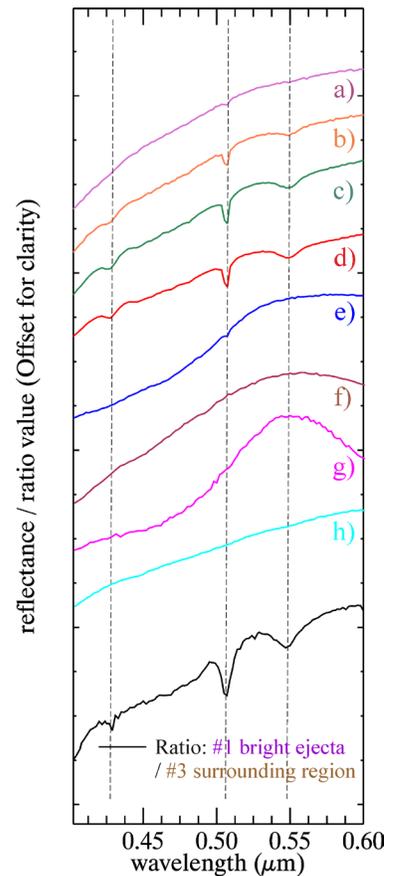


Figure 3