**Spectral Characterization of Bright Materials on Vesta.** F. Capaccioni[1], M.C. De Sanctis[1], E. Ammannito[1], Jian-Yang Li[2], A. Longobardo[1], D.W. Mittlefehldt[3], E. Palomba[1], C.M. Pieters[4], S.E. Schroeder[5], F. Tosi[1], H. Hiesinger[6], D.T. Blewett[7], C.T. Russell[8], C.A. Raymond[9].
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**Introduction:** The surface of Vesta, as observed by the camera and imaging spectrometer onboard the Dawn spacecraft, displays large surface diversity in terms of its geology and mineralogy (e.g., [1], [2]), with noticeably dark and bright areas on the surface ([3], [4]) often associated with various geological features and showing remarkably different forms. Here we report our initial attempt to spectrally characterize the areas that are distinctively brighter than their surroundings.

**Data:** During the Approach, Survey Orbit and the High Altitude Mapping Orbit (HAMO) ([5]), the Visible and InfraRed Mapping Spectrometer (VIR) acquired hyperspectral images of Vesta surface ( [2]), obtaining good coverage of the surface (> 65%). Data of high quality, from 0.25 to 5.1 µm, have been acquired for a total of about 8.5 million spectra in 864 spectral channels. The VIR pixel resolution ranges from about 1.3 km (Approach phase) to about 0.18-0.15 km (HAMO). A survey of the bright materials on Vesta is reported by [3]. Several types of bright materials are observed: walls/ ejecta of craters, bright spots, radial material, diffuse bright material, etc. The distribution of bright materials appear to be concentrated in mid-southern latitudes between 0º S and 60º S.

**Spectroscopic Analysis of Bright Materials:** The bright areas show distinct spectral behavior with respect to the surrounding areas by having larger reflectance in the VIS range (0.55 µm). Some very bright areas have a visible continuum much brighter (40%) than surrounding areas. Moreover, bright regions correspond to regions with lower thermal emission than surrounding regions in the same illumination conditions (fig. 1, 2)( [7]). Finally, the spectra of the bright areas generally show deeper and wider 1- µm and 2-µm pyroxenes bands (fig.2).

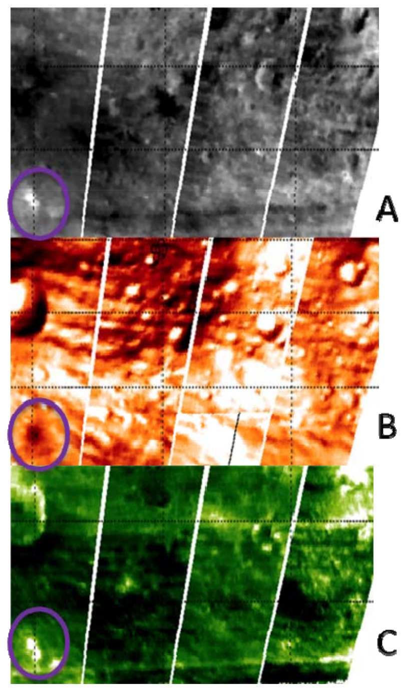


Figure.1: A: Mercator Maps of VIR reflectance at 0.55µm; B: Mercator Maps of VIR thermal flux at 5.0 µm; C: Mercator Maps of VIR 1 um pyroxene band depths. The encircled areas appears very bright at 0.55 µm and extremely dark in the thermal range, indicating that the bright appearance is not due to illumination conditions but to very high albedo. In panel C, the same bright area corresponds to very deep 1 µm pyroxene absorption band.

An interesting area with bright material is shown in Fig 3. The black and white image is taken at 1.2 µm. Bright materials are clearly seen and, according to the nomenclature given by [6], can be distinguished as: Type 1 – crater wall material, Type 2 – radial material, Type 4 – slope material.

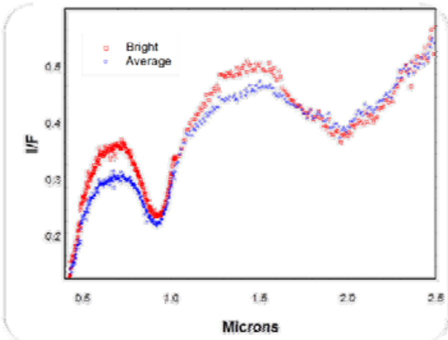


Figure 2. Typical spectra of two areas on Vesta surface. The bright area (red) shows deeper band depths with respect to the average (blue).

The RGB image, however, shows a more complex picture. Bright materials, areas A and B, are of type 1, 2 and 4 (according to the cited nomenclature) and are the spectra with the highest reflectance; they show also deeper absorption bands than the spectra of C and F areas. C and F area spectra show similar band depths although the reflectance level of the crater floor is lower. D and E areas (shown in purple in the RGB image) are characterized by reflectance at 1.2 µm similar to the surrounding, which is the reason why they are not distinct in the gray scale image, and with an absorption band deeper than the bright materials. But their major difference with respect to the other spectra is in the shift of the band center towards shorter wavelengths, which points to a different ortho/clino pyroxene ratio.

This last point indicates that the impact that generated the crater in Fig 3 has exposed preexisting materials of different composition, and also that bright materials are not necessarily different in composition from surrounding areas.

The depth of an absorption band is mainly determined by the abundance of the absorbing minerals, the grain size distribution of the regolith, and the presence of opaque minerals; and it is extremely difficult to discriminate among the various effects.

If we take into account only the grain size effects the reflectance decreases as the grain size increases while as the grain size is increased from a small value, the absorption band depth, will first increase, reach a maximum, and then decrease [8]. Moreover, the high reflectance of the materials on the surface of Vesta indicates that multiple scattering has a relevant role in determining the reflectance and the band depths. Deeper band depths could indicate a larger abundance of the absorbing materials. In this case, bright areas should be characterized by a higher abundance of pyroxene.

Another possibility is that the bright ejecta materials are associated with fresh, unweathered material excavated and deposited across more weathered background material. This would certainly increase the reflectance and possibly the band contrast. In this case we should have bright materials associated mainly with very fresh craters and this is not always the case.

The uneven distribution of bright materials on Vesta as shown by [6] suggests that they become exposed as a result of the excavation of subsurface layers located at shallow depth (tens of meters to several km). As to the nature of the bright materials all the processes described above, which can affect the reflectance and the band depth, can be responsible for their appearance; however, the reported observations indicate also that bright materials (A and B in figure 3) should not be compositionally different from surrounding areas (regions C and F).

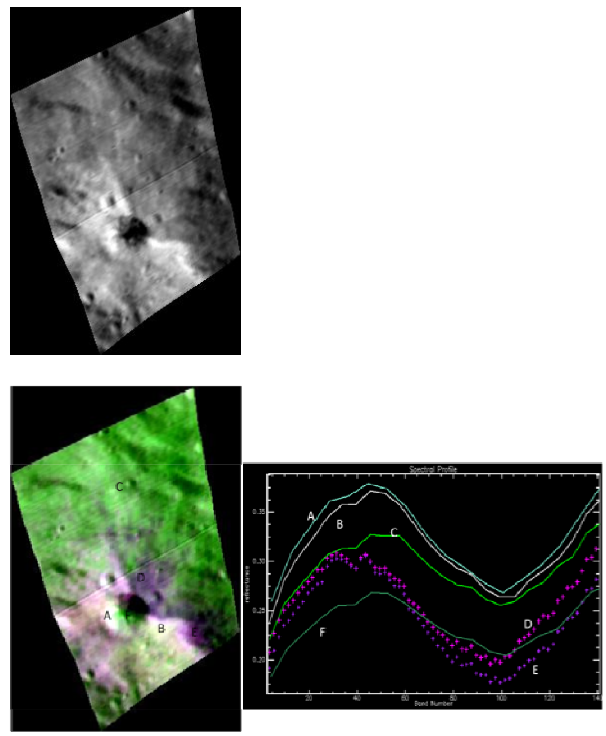


Figure 3: top: VIR gray scale image at 1200 nm of a bright feature located at 34.10°S, 317.64°. The bright sinuous structure as well as some locations on the crater walls and ejecta are clearly distinct from the surrounding. Bottom left VIR false colors images made combining 3 bands in the infrared: R: 1.4 µm, B:1.2 µm and G:1.9 µm.

**References:** [1] Jaumann et al. (2011) *AGU*. [2] De Sanctis et al., (2012) *LPSC XLIII*. [3] Li et al., (2012) *LPSC XLIII*. [4] McCord et al., (2012) *LPCS XLIII*. [5] Russell et al., (2012) *LPSC XLIII*. [6] Mittlefehldt et al. (2012) *LPSC XLIII*. [7] Tosi et al., (2012) *LPSC XLIII*. [8] Clark and Lucey (1984), *JGR,89, 6341-6348*.