EPSC Abstracts
Vol. 7 EPSC2012-599 2012
European Planetary Science Congress 2012

Spectral analysis of bright materials on 4 Vesta

F. Zambon (1), F. Capaccioni (1), M. C. De Sanctis (1), E. Ammannito (1), J.-Y. 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), M. T. Capria (1), F. Carraro (1), S. Fonte (1), A. Frigeri (1), G. Magni (1) and the Dawn Team
(1) INAF-IAPS, Via del Fosso del Cavaliere 100, 00133 Rome, Italy (francesca.zambon@iaps.inaf.it), (2) Department of Astronomy, University of Maryland, MD, USA, (3) Astromaterials Research Office, NASA Johnson Space Center, TX, USA, (4) Department of Geological Sciences, Brown University, RI, USA, (5) Max-Planck-Institut für Sonnensystemforschung, Lindau, Germany, (6) Institut für Planetologie, Westfälische Wilhelms-Universität Münster, Germany, (7) Johns Hopkins University Applied Physics Laboratory, MD, USA, (8) Institute of Geophysics and Planetary Physics, Department of Earth and Space Sciences, UCLA, CA, USA, (9) Jet Propulsion Laboratory, California Institute of Technology, CA, USA.

Introduction

The Dawn spectrometer, VIR-MS (Visible and InfraRed Mapping Spectrometer), acquired data during Approach, Survey, High Altitude Mapping Orbit (HAMO) and Low Altitude Mapping Orbit (LAMO) covering a large part of Vesta's surface [1]. VIR provides data in two distinct channels: visible (0.25 - 1 μm) and infrared (0.95 - 5.02 μm), producing hyperspectral cubes of 432 bands for each channel [2]. The data obtained allow to investigate the mineralogical composition of the asteroid surface. Here we present a spectral analysis of the bright materials on Vesta.

Spectral analysis

Vesta presents a large distribution of bright material principally concentrated at mid-southern latitude between 0° and 60° S [3], with two gaps in the equatorial region, while the south pole appears free from bright deposits (see the map in [4]). The nature of these deposits is variegated. Bright materials on Vesta are classified in: Crater Wall/Scarp Material, Radial Material, Slope Material, Patchy Material, Spot Material and Diffuse Plains Material. The bright areas, often, present characteristics belonging to more than one category. For more details see [4]. Vesta is characterized by a basaltic surface and its spectra presents two strong absorption bands at 0.9μm and 1.9μm associated with the pyroxenes [5]. Band depths (BD) of the bright materials are deeper than the surroundings and this could indicate an higher abundance of pyroxenes. Band depth is also affected by grain size distribution and abundance of opaque materials [5] and to distinguish the contribute of each parameter is not easy. The grain size has an important effect on both reflectance and BD. Currently the Vesta's grain size is not well known and it will be subject of future studies. Bright deposits present an albedo higher than the Vestan average, i.e. about 0.38. For instance, crater walls and bright ejecta have an albedo level 40% higher, whereas bright spots are 20% brighter than the rest of the surface [3]. From the VIR-IR data, it is possible to get the thermal map of Vesta, these data reveal that bright areas have a lower thermal emission, corresponding to lower temperature [6]. Here we show two examples of bright deposits relative to the Tuccia and Oppia craters. Tuccia crater (lon 196° E, lat 40° S) (FIG. 1A) contains an evident Radial Material bright deposit. The VIR HAMO RGB image (R: 1.4 μm, G: 1.2 μm, B: 1,9 μm) of Tuccia highlights clearly that the ejecta of the crater have spectral characteristics different from the background (FIG. 1A). The Oppia crater (lon 310° E, lat 8° S) contains three types of bright deposits: Crater Wall Material (region B, C FIG. 2A), Radial Material (region A FIG. 2A) and Slope Material (region B, C FIG. 2A). In both the RGB images it is possible to notice that the bright areas have a yellow dominance (FIG. 1A, FIG. 2A). The band ratio relative to the band I ($0.93\mu m/0.75\mu m$) and band II ($1.9\mu m/1.4\mu m$) of the Tuccia (FIG. 1B-C) and Oppia (FIG. 2B-C) regions show a big difference between bright deposits and the average surface. The distribution of the bright materials in Tuccia presents more variations for the band ratio in FIG. 1B than that in FIG. 1C respect to the neighboring areas and as it is possible to notice from the FIG. 1E, BDI and BDII of the bright regions are deeper than the adjoining areas. Oppia instead, shows a similar distribution for both the band ratio. The thermal flux at 5μm confirms that the thermal emission of the bright deposits is lower than the other region as shown in FIG. 1D and FIG. 2D and it is interesting to notice that there is a clear correspondence between the bright deposits and the low thermal flux regions.

Summary and Conclusions

Vesta presents an heterogeneous distribution of bright materials principally concentrated at latitude between 0° and 60° S. Bright areas are characterized by deeper band depth, albedo higher up to 40% than the Vestan average and low thermal emission. Grain size, space weathering, impacts that have exposed fresh material etc., could influence the reflectance level and band depth. A more detailed analysis of the HAMO and LAMO high resolution data will improve the results about the nature and the spectral characteristics of the bright regions.

Acknowledgements

The authors acknowledge the support of the Dawn Science, Instrument and Operations Teams. This work was supported by the Italian Space Agency (ASI), ASI-INAF Contract.

References

[1] F. Capaccioni et al., Spectral Characterization of Bright Materials on Vesta, LPSC 2012

[2] Russel et al., Dawn: A journey in space and time, PSS, 2004.

[3] J.-Y. Li et al., Investigating the origin of bright materials on Vesta: synthesis, conclusions, and implications, LPSC 2012.

[4] D.W. Mittlefehldt et al., Types and distrubution of bright materials on 4 Vesta, LPSC 2012

[5] M. C. De Sanctis et al., Spectroscopic Characterization of Mineralogy and Its Diversity Across Vesta, Science, 336, 697 (2012).

[6] F. Tosi et al., Analysis of temperature maps of selected Dawn data over the surface of Vesta, LPSC 2012.

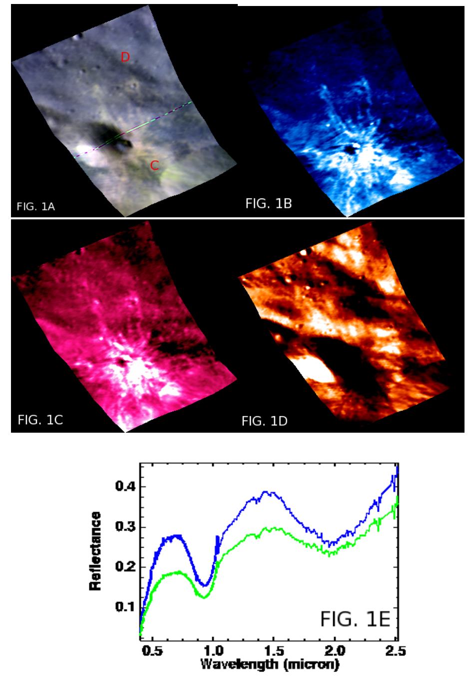

Figure 1: FIG. 1A: RGB (R: 1.4 μm, G: 1.2 μm, B: 1,9 μm) HAMO image of Tuccia crater in cylindrical projection (resolution: 180 m/pixel). FIG. 1B: Band ratio $0.93\mu m/0.75\mu m$ relative to Tuccia crater. FIG. 1C: Band ratio $1.9\mu m/1.4\mu m$ relative to Tuccia Crater. FIG. 1D: Maps of thermal flux at 5μm of the Tuccia crater. FIG. 1E: Blue spectrum: mean spectrum of a Bright Material region (BM) in the Tuccia areas (region C in FIG. 1A). Green spectrum: mean spectrum of the region D in FIG. 1A.

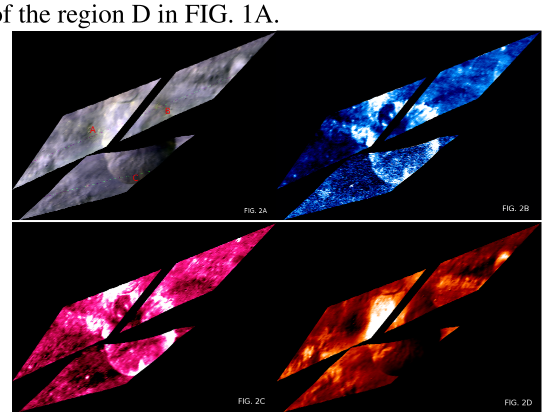

Figure 2: FIG 2A: RGB (R: 1.4 μm, G: 1.2 μm, B: 1,9 μm) HAMO mosaic of the Oppia crater in cylindrical projection (resolution: 180 m/pixel). FIG. 2B: Band ratio $0.93\mu m/0.75\mu m$ relative to Oppia crater. FIG. 2C: $1.9\mu m/1.4\mu m$ relative to Oppia Crater. FIG. 2D: Maps of thermal flux at 5μm of the Oppia region.