DAWN-VIR AT VESTA AND CERES: A NEW LOOK IN THE VISIBLE THROUGH GLOBAL MAPS OF SPECTRAL PARAMETERS. B. Rousseau[1], M. C. De Sanctis[1], A. Raponi[1], M. Ciarniello[1], E. Ammannito[2], A. Frigeri[1], F. G. Carrozzo[1], P. Scarica[1], F. Tosi[1], M. Ferrari[1], S. De Angelis[1], C. A Raymond[3], C. T. Russell[4]. [1]IAPS-INAF, Via Fosso del Cavaliere, 100, 00133 Rome, Italy (batiste.rousseau@inaf.it), [2]ASI, Via del Politecnico, 00133, Rome Italy, [3]Jet Propulsion Laboratory, California Institute of Technology, Pasadena, USA, [4]Earth Planetary and Space Sciences, University of California Los Angeles, Los Angeles, CA, USA

Introduction: The Dawn mission has orbited the large asteroid Vesta from July 2011 to September 2012 and the dwarf planet Ceres from March 2015 to October 2018, with the aim to map their surface mineralogy. On board the spacecraft, the Visible and InfraRed mapping spectrometer (VIR) [1] collected an important amount of data in the visible (0.25-1.07µm) and in the infrared (1.02-5.09µm).

The spectral study of Vesta and Ceres, the two largest planetary bodies in the main asteroid belt, is key to understand their formation, their evolution path and thus to provide insight on the early Solar System.

These two bodies are very different. Vesta, 530 km in diameter, is a basaltic asteroid and exhibits a widespread spectral signature of pyroxene at about 0.9 µm and 2 µm [2, 3]. Regional variations indicate some lithologic heterogeneities, mainly linked to the Rheasilvia impact basin [4] which is very likely the source of the Howardites-Eucrites-Diogenites (HED) clan of meteorites, of which Vesta is the parent body [2, 5].

Ceres, 950 km in diameter, is considered as an ancient ocean world due to its size, a low global density and its composition [6]. Contrary to Vesta, Ceres' surface is very dark, homogeneous and exhibits a flat spectrum in the visible with widespread signatures of Mg-,NH_4-phyllosilicates and Mg-,Ca-carbonates in the infrared [7, 8]. Na-carbonates, salts, water ice and organics matter have also been detected on some localized spots.

The VIR spectrometer achieved a nearly global coverage of Vesta and Ceres. Thanks to the recent correction of VIR visible data [9,10, see also Rousseau et al., this conference], here we report the outlines of the investigation of this spectral range through global maps of various spectral parameters [11, 12] and we highlight the similarities and the differences between Ceres and Vesta.

Data: We used data calibrated in units of radiance factor (*I/F*), artifact-removed [13], corrected for the detector temperature effect [9, 10] and photometrically corrected [14, 15]. Global maps of Ceres and Vesta have been produced by merging various mission phases at different resolutions (ranging from 350 m/px to 3500 m/px and from 160 m/px to 700 m/px, respectively), giving an almost entire coverage of the surfaces and a good redundancy.

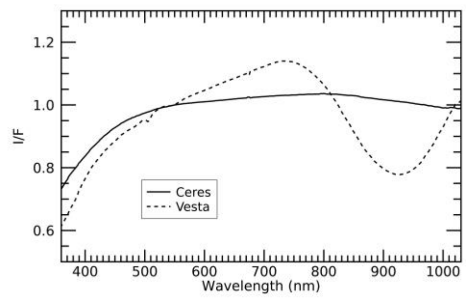

Figure 1- Mean VIR-VIS spectra of Ceres and Vesta (normalized at 550nm).

Results: Vesta and Ceres have a different spectral behavior in the visible, as shown in Fig. 1. Vesta is mainly characterized by the absorption band of the pyroxene around 0.9 µm, and a marked positive slope between 350 nm and 730 nm. In the same range, the averaged spectrum of Ceres varies from a slightly positive to negative slope towards the infrared. No absorption bands are observed. The two bodies are characterized by a steep slope in the UV-VIS range, below ~450nm.

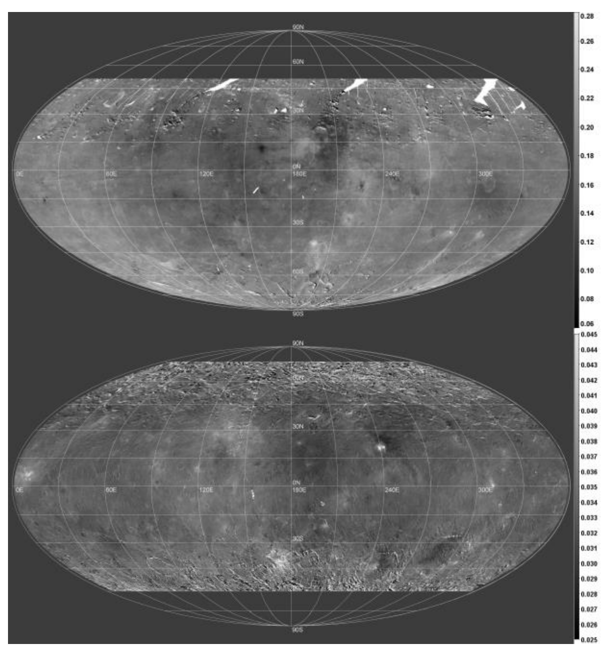

Figure 2 - Maps of the radiance factor at 550nm of Vesta (top) and Ceres (bottom).

To characterize the variations of the spectral behavior of Vesta and Ceres several parameters have been defined and will be discussed here: the I/F at 550 nm (Fig. 2), several RGB color composites as well as spectral slopes in the intervals ~380-465 nm and ~465-800 nm (Fig. 3).

Looking at Fig. 2, Vesta' surface is relatively bright and displays an important variability in terms of I/F at 550 nm (0.06-0.28). Heterogeneities are observed at large scale, with a global hemispherical dichotomy, but also at a local scale, in particular correlated with impacts that are sometimes associated with exogenous dark material [16] or have excavated brighter material compared to the surface. Ceres I/F spans a more limited range of albedo (0.025-0.045) and is much darker than Vesta. Variations are generally more often localized and associated with impacts craters and/or with endogenous-origin features like the Occator' bright spots.

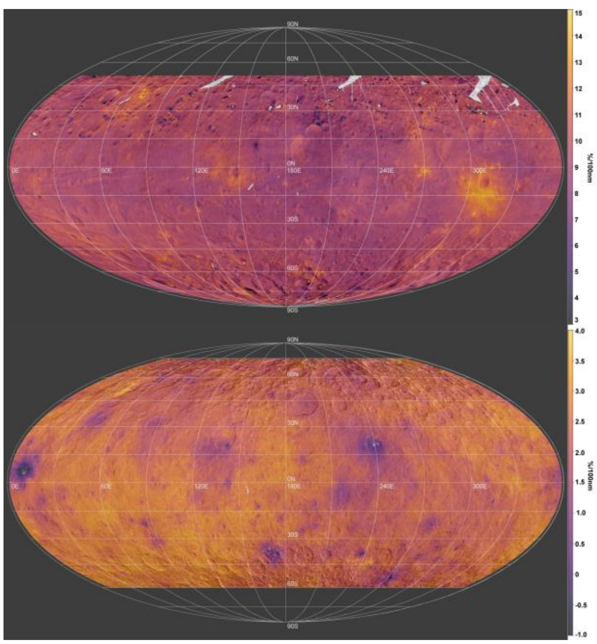

Figure 3 - Maps of the spectral slope in the intervals 465-730nm for Vesta (top) and 480-800nm for Ceres (bottom).

The use of RGB color composites (not illustrated here) and spectral slopes in the visible range is a powerful and complementary approach in mapping the surface mineralogy. In Fig. 3, the mid-range spectral slope behaves differently at the surface of the two bodies. In the Ceres case, the youngest craters and their ejecta exhibit a bluer slope – than the average surface – due to a transformation of the excavated material in composition or size [17] or in structure (likely due to the water-ice content in the subsurface) [18]. The opposite regime is observed for Vesta, in that an increase of the slope is observed for three to four main crater ejecta that reveal a different composition – referred as the 'orange' material, likely linked to an impact melt [19] – while the rest of the surface does not show substantial variations in terms of spectral slope.

Conclusion: The correction of the visible data set of the VIR mapping spectrometer [9, 10] has permitted the study of the surface through global maps of various spectral parameters [11, 12], which are also delivered to the community. This improves the data set and completes the previous investigations done by the Framing Camera and by VIR in the infrared (see special issues [20, 21]).

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