VESTA TERRAINS SEEN BY THE DAWN FRAMING CAMERA COLOR FILTERS.

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Introduction: Vesta is the largest differentiated asteroid that is still mostly intact today and is considered to be a model for the initial stages of planetary differentiation. NASA's Dawn mission entered orbit around Vesta on July 16, 2011 for a yearlong global characterization. The Framing Camera (FC) [1] onboard the Dawn spacecraft has been mapping the asteroid in clear and seven narrow band filters (from 0.4 to 1.0 μm).

Our aim is to identify the color terrains and link them to geologic features observed using the data from the 7 color filters. Characterization of the terrains will be also carried out by comparing to near-infrared spectra of relevant meteorite samples. We will make use of spectral parameters such as color ratios and spectral slope to investigate the surface heterogeneity and compositional diversity.

Creation of maps: Color cubes and image mosaics of Vesta are processed with the Integrated Software for Imagers and Spectrometers (ISIS) [2] from USGS. This is used in combination with the kernels from NAIF to infer spacecraft position and observation conditions. Raw FC imagery is affected by multiple reflections between the color filters and the CCD. Thus, all frames have been corrected using a complex stray-light removal algorithm. The calibrated images are first photometrically corrected with Hapke photometric model based on Dawn approach data for defining photometric parameters. All the frames are then reprojected and orthorectified using a shape model derived from FC clear filter images. For each station, the 7 color frames are stacked together and coregistered. Finally, FC color cubes can be assembled together to create mosaics.

Analysis tools: We developed different methods in order to study the color data:

False-color composite maps and spectral parameter maps. FC color mosaics are used to create maps of spectral slope, ratios and F6 kink parameters. Those are displayed either using a single parameter in rainbow maps with appropriate color stretch, or combined to create false color composite mosaics such as the 'Clementine mission' color ratio map.

Plots of spectral parameters. We intend to also evaluate software tools such as "DawnKey" [3], an automated lithology identification software that allows us to classify spectrally distinct units by using a HED and non-HED spectral library [4]; and an Automated Spectral System Analyzer [5], a terrain mapping system based on pyroxene mineral chemistry, developed at MPS, to refine terrain analysis.

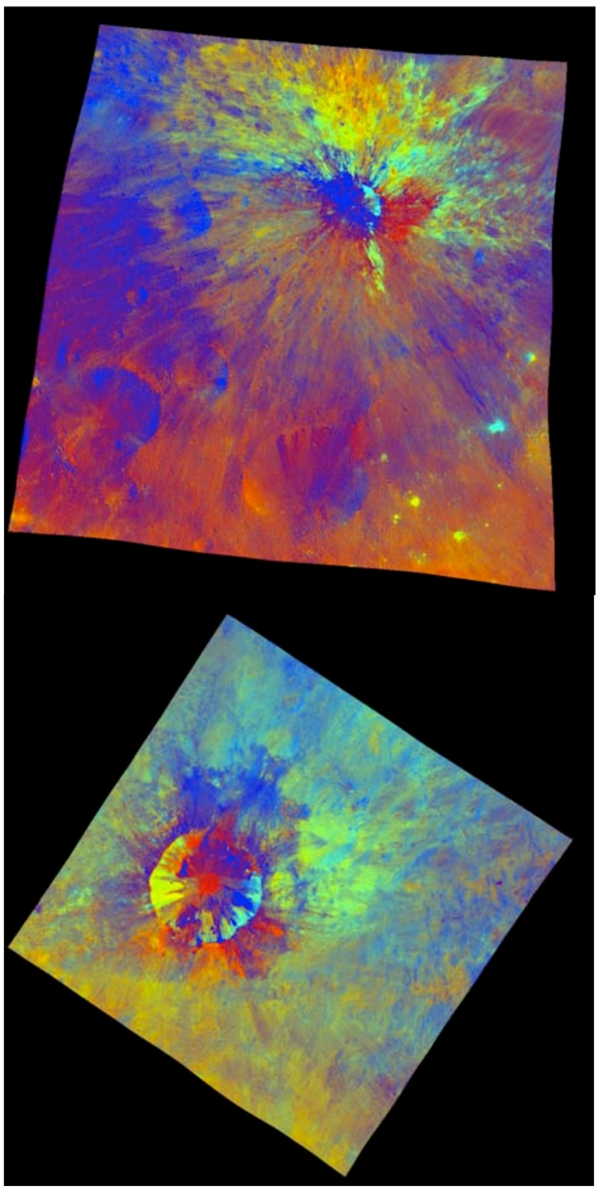
Discussion: Vesta exhibits global hemispherical scale dichotomy that is unlike any other asteroid we have observed in the asteroid belt. Large scale variations in albedo have been observed from ground-based telescopes [6] and Hubble Space Telescope [7]. Dawn FC observations during approach phase have confirmed this dichotomy. Nearly global mosaics at 487 m/pixel show that the eastern hemisphere has lower albedo than the western hemisphere and that the southern hemisphere has higher albedo than northern latitudes. A key explanation for this albedo variation seems to be the excavation of different lithologic units during the formation of Rheasilvia South Pole basin.

The depth of the 0.90-μm pyroxene band, represented by the ratio of the 0.75 and 0.92 μm, is deeper in the southern hemisphere than in the northern hemisphere. Global map of 0.75/0.92 μm band ratio shows deeper bands (red) in the Southern hemisphere. An extension of the deeper band ratio material up to northern mid-latitudes between 0° and 90° E could be interpreted as ejecta excavated from the Rheasilvia impact event.

Interesting correlation exists between the 0.75/0.92 μm band ratio and the 0.98/0.92 μm band ratio. The 0.98/0.92 μm band ratio helps to identify eucrite-like or diogenite-like terrains on Vesta. Eucrites have higher iron/calcium abundance in their pyroxene than diogenites. Due to this, the 0.90-μm pyroxene band of eucrites is shifted to longer wavelength compare to diogenites. Therefore, the reflectance value at 0.98 μm for diogenites will appear higher than for eucrites. Thus we can conclude that if the ratio of 0.98/0.92 μm is ≤1.0 the material is more eucrite-like and if this ratio is ≥ 1.0 then it is more diogenite-like.

The good correlation between the two ratio maps suggests that areas with deeper 0.90-μm pyroxene band are typically diogenite-like and shallower band areas are more eucrite-like. This correlation confirms earlier observation of deeper band ratio areas associated with the Rheasilvia basin, which could correspond to diogenitic material excavated from a deeper layer during the impact event.

Apart from global color variations, we have identified several color terrains that are associated with compositional units using the latest color data (60 m/pixel for HAMO and ~20 m/pixel for LAMO). We classified them as bright, dark, gray and orange/red materials (Fig. 1). Preliminary understanding of the nature and origin of these materials will be presented, especially concerning the orange/red terrains.



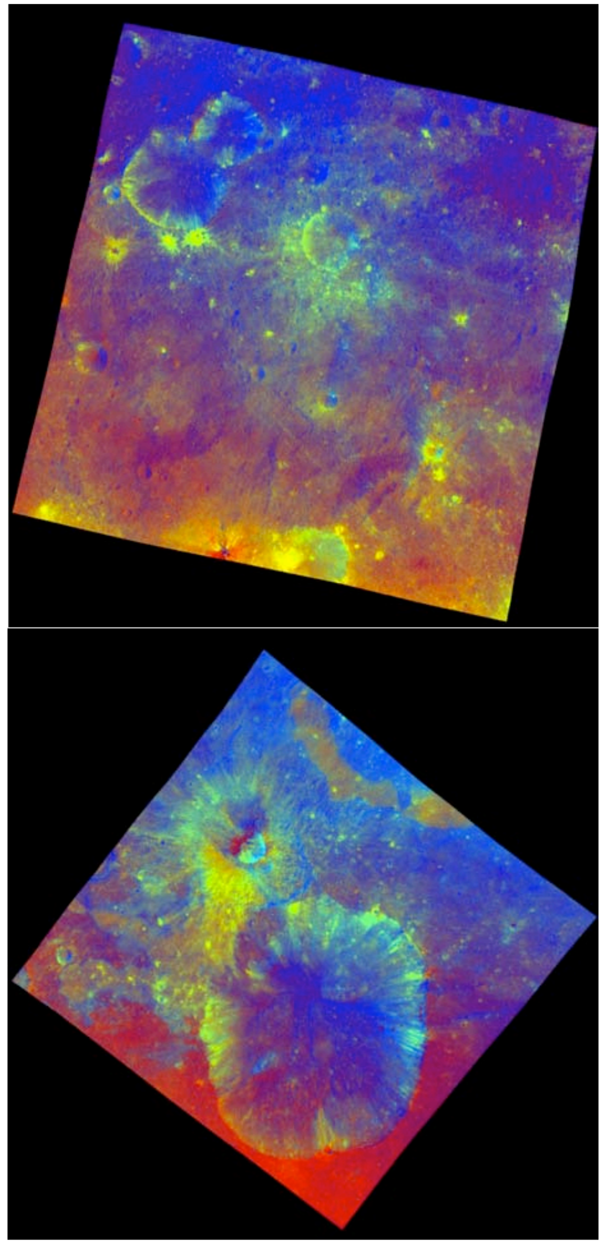


Fig.1. Examples of 'Clementine' color composite [Red (750/440 nm); Green (750/920 nm); Blue (440/750 nm)] for each of the different type of terrains identified in the FC color data: the first one shows bright terrain in the upper part of the crater, the second one dark terrain around crater rims, the third shows typical 'grey' terrains, and the last image exhibits the 30 km crater Oppia surrounded by orange units and red ejecta (all images at the same scale).

References: [1] Sierks et al., (2011) *Space Science Reviews* [2] Anderson, J. A., et al. (2004), LPS. XXXV, abstract 2039. [3] Le Corre et al., (2011) EPSC-DPS Abstract #758 [4] Le Corre et al. (2011) *Icarus* 216 [5] Reddy et al., (2011) EPSC-DPS Abstract #724 [6] Bobrovnikov (1929) *Lick Obs. Bull.* 14 [7] Thomas et al., (1997) *Science* 277.