REEVALUATING SURFACE COMPOSITION OF ASTEROID (4) VESTA BY COMPARING HED SPECTRAL DATA WITH DAWN FRAMING CAMERA (FC) OBSERVATIONS

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Introduction: Asteroid (4) Vesta was observed by the DAWN spacecraft in 2011 and 2012. While most of the scientific attention has now been shifted to the missions second target, (1) Ceres, this work tries to reevaluate findings regarding the distribution of differentiated HED (Howardite, Eucrite, Diogenites) lithologies on Vesta's surface, as well as their geological settings and implications for surface processes. Of special interest is for example the distribution of the deep-crustal Diogenites and the clarification why some craters show diogenitic signatures in their ejecta and others in the same region do not. Moreover, the formation mechanism for Vestas youngest large crater, Marcia, remains a mystery. Our analysis of its spectral dichotomy and its geological heterogeneity might shed more light on this matter. Most of the studies that identified the composition of the surface have been using VIR data as their basis (e.g., [1], [2]). In this work, FC Filter images of the visible and near infrared light are used in a new way to confirm and/or study previous results in more detail. Due to the higher spatial resolution of these images and with the help of additional highest resolution (LAMO) data, we try to gain more insight into Vestas geological evolution.

Methods: In this work, we combine useful FC Filter ratios (R750 nm/915 nm, R965 nm/830 nm, R965 nm/915 nm and R965 nm/750 nm) that illustrate differences in band depth as well as band center and thus, are able to spectrally separate HED lithologies, especially Eucrites and Diogenites (Fig. 1). In conjunction with subsequently created spectral and geological maps, the above mentioned topics shall be clarified in more detail.

Findings: Diogenitic spectral features are found clustered mostly in the Southern hemisphere, in our work most prominent at the scarp of Matronalia Rupes as well as in the ejecta field of geologically anomalous crater Antonia, consistent with previous studies (e.g., [3], [4], [5]). The northwestern area of crater Marcia stands out through a quite uniform spectral signature, consistent with a fine-grained, Mg-rich eucritic lithology. The rest of Marcias inner crater shows quite different spectral features, including low albedo features as reported also in previous studies (e.g., [6], [5]). This most likely reflects subsurface lithologic heterogeneities. A region of interest is also the western crater wall of Marcia, which shows dark lens-like outcrops a few hundred meters below the rim at the southern end, whereas at the northern end only bright, spectrally homogenous wall material is observed. This contributes to a formation theory that includes distinct events leading to the current appearance of Marcia.

Comments: Some of the HED samples analyzed in our work show specific petrologic characteristics which are introduced in this work as well. For example, several samples are outliers in our ratio plots and among the samples exhibiting delta ^{17}O anomalies, we find Eucrite A-881394 to be one of these outliers (Fig. 2). This implies that its parent body is indeed a different one than Vesta.

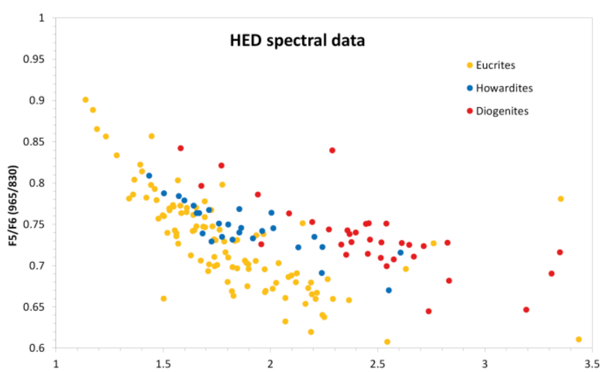

Fig. 1: separated HEDs using FC Filter wavelengths

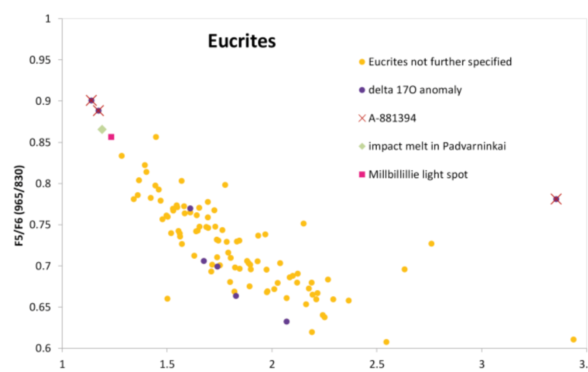

Fig. 2: Eucrites subdivided into their lithologic characteristics

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