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Spatial Analysis of Correlation between Preliminary Geologic and Mineralogic Maps of Vesta

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1. Introduction

The Dawn mission to Vesta has greatly improved the quality and resolution of data available to explore the asteroid. Prior to the Dawn mission the best data available was the one from Hubble Space Telescope with a maximum resolution of 50 km per pixel. The *survey phase* of the mission has pushed spatial resolution up to about 100 meters per pixel by the Framing Camera on-board Dawn, and 700 meters per pixel for the VIR spectrometer, spanning the spectral range from the visible to infrared at $0.25 - 1\ \mu\mathrm{m}$ and $1 - 5\ \mu\mathrm{m}$. The frames of the FC and VIR have been processed and mosaicked. A preliminary Geologic map has been produced by mapping units and structures over the FC mosaic and the DTM derived from stereo processing of visible imagery[1]. Herein we will present first results of the quantitative correlation between the preliminary geologic and VIR-derived spectral parameters maps.

1.1. Mapping in the digital domain

Following the trend of the last 15 years [3] the Dawn mission team is using Geographic Information System tools for locating frames and for data exchange among the team. The use of GIS tools and data formats significantly improves our ability to create and interpret geologic maps, and also improves the interoperability of high level data products among the instruments' team. VIR data have been synthesized into a series of spectral indicators that give indications on the mineralogical composition and the physical state of the surface[2].

This way we imported into a GIS the preliminary geologic map and we projected the mosaics of spectral indicators in a common coordinate reference system.

1.2. Spatial Analysis of Mineralogic and Geologic maps in GIS

We have imported the preliminary Geologic Map of Vesta and the spectral indicators into GRASS GIS[4], a Free Open Source[5] Geographic Information System that survived more than 30 years of developments thanks to its flexibility and very robust software architecture.

Figure 1 shows VIR spectral indicator *Band Depth* for pyroxene band I, overlayed by geologic contacts extracted from the preliminary geologic map of Vesta. We projected data into a sinusoidal equal-area projection in order to analyze the *spectral content* of every mapped geologic unit, minimizing area distortions. In Figure 2 the boxplot shows the mean value of *Band Depth I* for the mapped units. It is evident that higher values of band depths correspond to units *bcrm* (bright crater ray material), *em* (ejecta material), *rcmt* (Rheasilvia cratered mount terrain), *rrgt* (Rehasilvia ridge-and-groove terrain). All these units are related to cratering processes and tectonic processes (*rrgt* unit). Lowest values of Band Depth I are typical of bright and dark lobate (units *blm* and *dlm*) and tholus materials (*tm* unit).

2. Discussion and future work

We have started to analyze quantitatively the correlation of spectral parameters and geologic units. The preliminary geologic map of Vesta and the spectral parameters maps are produced indipendently by completely different processes. Geologic units are made up of bodies of rock that are interpreted to have been formed by a particular process or set of related processes over a discrete interval of time, so the morphology and the topography are the primary sources for

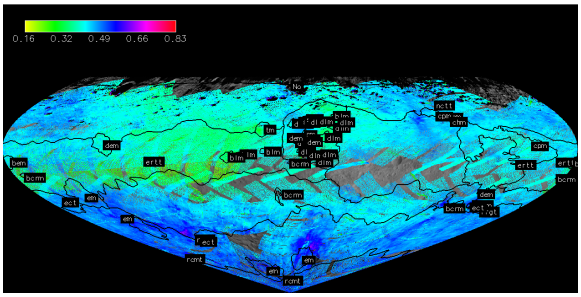

Figure 1: Sinusoidal projection (centered on 0°E,0°N) of global spectral parameter Band Depth I from VIR instrument, and geologic units (boundaries and labels) from the preliminary geologic map of Vesta.

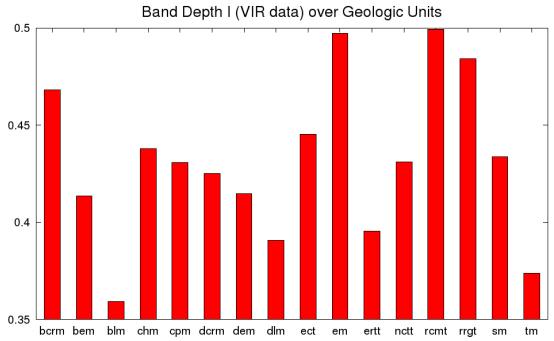

Figure 2: Box plot of mean values of Band Depth I for every mapped geologic unit.

the interpretative work for the crafting of a geologic map. Spectral parameters maps synthesize hyperspectral measurements using methods of data reduction, focusing on one particular aspect, as the change in composition or the physical state of the surface.

The use of spatial analysis tools available in Geographic Information Systems allows to study the correlation between these different, independently developed, maps. This generates a new series of observations that can be useful for interpreting the spectral evidences of Vesta and also to support the activity of geologic mappers.

We are extending our correlations, implementing up-to-date geologic and different spectral parameters maps, as soon as they are being produced.

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