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Mineralogic Mapping of the Numisia region on Vesta from the Visible Infrared mapping spectrometer onboard NASA/Dawn

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1. Introduction

The NASA/Dawn mission [1] has collected data from the asteroid Vesta for a year, from summer 2011 to summer 2012.

During the phase of the mission around Vesta, The Visible and Infrared Mapping Spectrometer (VIR) acquired infrared and visible spectra from 0.2 to 5 microns, sampled in 864 channels with a spatial resolution reaching about 150 m/pixel.

The good coverage and the resolution of the data from VIR allows to explore the mineral diversity of the surface of the asteroid at a good detail. Following the quadrangle scheme used for the imagery Atlas of Vesta [2], the VIR and Dawn team is studying the mineralogy of the quadrangles within the same geospatial framework where geomorphologic and geologic mapping activities had led to important results.

In this work we analyze the mineralogic composition of this quadrangle using the data from VIR, integrated with dataset acquired from other experiments onboard the Dawn mission to Vesta.

2. The Numisia quadrangle

The area of Vesta extending from 22°S to 22°N and from 218° to 288°E takes its name from the impact crater Numisia. The 20 km of diameter crater has been named after Numisia Maximilla, one of the Virgin Vestales dedicated to the cult of the goddess of the earth, Vesta, since the beginning of the history of Rome, in 753 b.c. Beside Numisia, craters Fabia, Teia, Cornelia and Drusilia are present in the area. Teia Fabia and Cornelia show a very well defined ejecta ray system. Apart the craters, the main topographic feature in this area is Vestalia Terra, a considerable topographic high, about 10000 meters over the surrounding areas. Southwards, Vestalia Terra fades into the Rheasilvia basin. Recent geologic, spectroscopic and gravimetric studies involving Vestalia Terra [3, 4, 5] suggest that this area of Vesta was once magmatically active.

2.1. Mineralogic mapping of Numisia

Both the 7 Framing Camera band-pass filters and the 864 visible-infrared channels of VIR spectra show a large mineralogic diversity across the quadrangle.

In particular we make use of spectral parameters synthesizing characteristics of the whole spectra into a single value. Pyroxene-related spectral parameters allow to detect lower/crust or mantle material from upper crust material. The study of the correlation of pyroxenes' band centers around 1 and 2 microns, for example, allow to map the Howardite-Eucrite-Diogenite (HED) composition of the surface of Vesta within Numisia quadrangle (Figure 1).

The map shows that the mineralogic composition of the surface is mainly eucritic, as we would expect from upper crust material. However the main impact craters of the area, Fabia and Cornelia, excavated a less Fe-rich material from beneath, exposing it on the surface. Moreover a similar composition is also present over the steep sub-linear slope north of Vestalia Terra. The steep to very-steep slope north of Vestalia is very high for the accumulation of materials.

The crater sampling and the mineralogy along the slope north of the highlands in Numisia suggest that the mineralogic composition of Vestalia Terra is more howarditic than eucritic as we would expect from such elevated land.

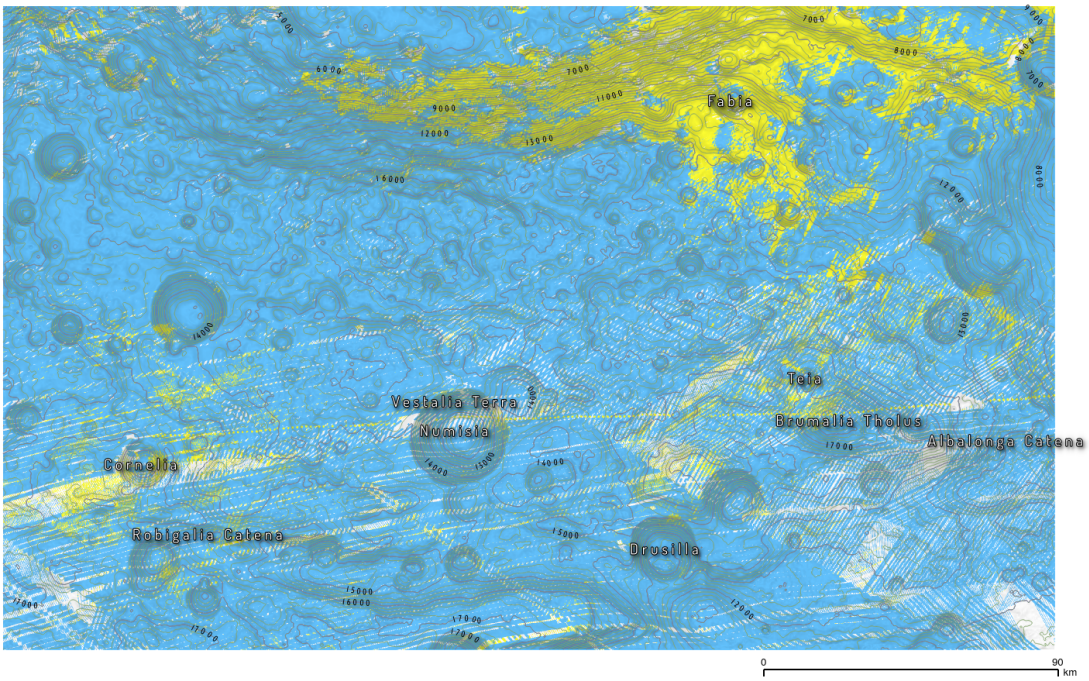

Figure 1: Lithologic map of Numisia, computed from the pyroxener-related spectral parameters. The area of the Numisia quadrangle of Vesta is mainly Fe-rich (ligth blue). However, mid-to-low Fe material is exposed at major craters' (yellow), and along the linearized slope, north of Vestalia Terra.

3. Summary

In the mineralogic mapping of Numisia we are combining mineralogic and morphologic observations in order to understand better the lithologic setting of the area.

Our first results suggest that the lithologic composition of the main feature of the Numisia quadrangle, Vestalia Terra, is compatible with lower-crust materials, in agreement with the idea that Vesta was once geologically active.

References

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