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Color variations on Ceres derived by Dawn/VIR: Implications for the surface composition

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Introduction

Ceres, the second target of the Dawn mission [1], with a diameter of ~952 km, is the largest object in the main asteroid belt [2], and classified as a dwarf planet. More than two years after departure from Vesta, Dawn finally arrived to Ceres. During the approach phase, the spacecraft acquired data with unprecedented spatial resolution. Previous work based on Hubble Space Telescope (HST) data, highlight regions with different albedo variation in the UV-VIS range [3] (Fig. 1). The Visible and InfraRed (VIR) mapping spectrometer onboard Dawn covers the overall wavelength range between 0.25 and 5.1 μm [4]. VIR will enable the first comprehensive compositional mapping of Ceres, focusing on the possible presence of water ice, salts, organics and volatiles, and surface thermal properties [5].

Dataset analysis

Here we present the first map of Ceres obtained from VIR data acquired during the Rotation Characterization 2 (RC2) observation phase in February 2015 (Fig. 2). The spatial resolution is ~11 km/pixel, better than the Hubble Space Telescope (HST). The map has been obtained by mosaicking seven VIR cubes, filtered for incidence angle $0°<i<50°$ and phase angle $0°<p<50°$. The map represents spectral ratios scaled to 0.64 μm indicating regions of different colors across Ceres. Red regions have a higher value of 0.9/0.64, or a weaker or absent absorption at 0.9 μm than do the green and blue regions. Blue regions have higher value of 0.44/0.64 or a weaker UV absorption than red or green regions.

First results from VIR

The RGB image in Fig.1 obtained from HST observations of Ceres shows regions with different spectral properties in the UV-VIS range based on three wavelengths (223 nm (blue), 335 nm (green) and 535 nm (red)), which correspond to different albedo variation [3]. The numbers in Fig.1 indicate regions of interest observed by HST with different colors relative to Ceres' average. At large scale two macro-regions have been identified, (between 0° and 120° in longitude and between 120° and 300° in longitude), as well as smaller dark and bright areas. In the VIR map in Fig. 2, we observe the same dichotomy and a similar but not identical distribution of the dark and bright regions. The bright spot #1 and #5 appear on both the maps. The two spots seem to have different thermal characteristics [5], which could indicate different physical properties, and therefore their different nature. In particular spot #5 is located in a region (a stripe with a range of longitude between 215° and 250°), which is considered potentially active by [6]. The Framing Camera color filter mosaics obtained from RC2 reveal darker regions corresponding to the longitude range between 120° and 300°, which appear magenta in VIR map [4], and may consist of carbonaceous chondritic material [7].

During the RC3 and Survey, VIR will acquire data with a spatial resolution of 3.4 km/px and 1.1 km/px,

respectively. New maps will be produced with the high resolution data. Moreover thermal analysis [6] combined with a detailed spectral analysis will reveal more on the composition and physical characteristics of Ceres' surface.

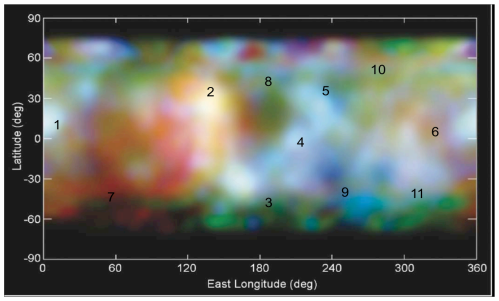

Fig. 1: RGB Hubble albedo deviation map obtained by Li et al. 2006 [3]. R: 0.555 µm, G: 0.33 µm B: 0.22 µm. The numbers indicate the regions of interest identified.

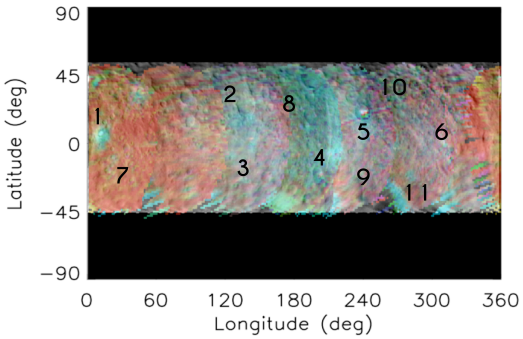

Fig 2: RGB maps of Ceres derived by RC2 VIR data overlapped to the corresponding Framing Camera map. R: 0.9 µm/0.64 µm, G: 0.55 µm/0.64 µm, B: 0.44 µm/0.64 µm. The numbers indicate the region identified in the Hubble map.

Acknowledgements

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References

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