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Global spectral properties of Rhea measured by VIMS

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1. Introduction

The icy Saturnian satellite Rhea is often regarded as twin to its neighboring satellite Dione especially with respect to its geological history [1,2] and its spectral surface properties [3]. Cassini VIMS detected the satellites surfaces in the wavelength range from 0.35 to 5.1µm and offers the first spatially resolved hyperspectral data of the Saturnian satellites [4], which allow a detailed comparison of the spatial distribution of the spectral properties of Rhea in comparison the results achieved for Dione [5,6]. Images acquired by Cassini ISS camera offer the opportunity to study any relationships between the spectral variations to geological and morphological surface features.

2. Major geological units

Voyager images showed that Rhea exhibits a similar distribution of geological units to that of its inner neighbor Dione [1,2] with densely cratered plains dominating Rhea's leading hemisphere with average cratering model ages of about 4.1 Gyr [8,9] or 3.6 Gyr [10] and bright, tectonic resurfaced regions characterizing the trailing hemisphere [8]. Abundant old large craters and multiring impact basins, though heavily degraded, were detected in a digital elevation model (DEM) derived by ISS data [8]. Rhea's most prominent ray crater Inktomi (12.5°S/112°W) with crater model ages of 280 Myr or 8 Myr [7,9,10] probably represents the youngest surface feature on Rhea.

3. Spectral variations

Although Rhea's surface is mainly composed of water ice [10] distinct spatial variations of its spectral properties could be derived (Fig. 1) that appear to be similar to the neighboring satellite Dione [2,3]. Fig. 1 shows the variations in band depth of the water ice absorption at 2 µm with relative deep absorptions indicating a higher amount of water ice and/or larger ice particles. As observed on Dione, clean ice deposits on the leading hemisphere extend from a geologically young impact crater named Inktomi. Its ejecta representing excavated material imply more or less clean ice in Rhea's crust. Similar to the ray crater Creusa on Dione [6] Inktomi exhibits the largest ice particles measured on this satellite's surface. Its extended ejecta dominate most parts of the leading hemisphere, which has a strong effect onto global hemispherical spectral differences (Fig. 1).

Instead, icy regions on the trailing side occur in the vicinity of the prominent tectonic graben systems. The remaining parts of this hemisphere are characterized by a concentration of non-ice material. Although, the variations are less pronounced than measured on Dione their spatial distribution nevertheless indicate a similar mechanism responsible for them i.e. magnetospheric particles that impact onto the trailing hemisphere. This is also supported by similar major spectral characteristics of the dark material on Rhea and Dione [5]. The lesser but still distinct degree of contamination is probably related to different positions of both satellites within Saturn's magnetosphere.

Distinct variations also occur in the measured ratios of the VIMS signal at 0.5 and 0.35µm (Fig. 1), which are surprisingly different from what can be seen in the band depth measurements. Although the dominance of the spectral signature of the dark rocky and/or organic material on the trailing hemisphere was expected in this wavelength range, the measured ratio shows an increase in the slope towards the center of both the trailing and the leading hemisphere and a minimal slope exactly at 0 and 180° W, the center of the hemispheres facing toward and away from Saturn as derived from Cassini ISS images by [13]. Although, the influence of the dark material on the slope from the visible to the ultraviolet spectral range can not be excluded, it does not account for the relatively high ratio on the leading hemisphere. Thus, global processes altering the surface material of both hemispheres due to magnetospheric and/or E ring particles in a similar way must be ongoing.

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References

[1] Smith et al. (1981), *Science*, *212*, 163-191; [2] Plescia (1983) *Icarus 56*, 255–277 ; [3] Clark R. N. et al. (1986), in *Saturn*, UofA Press, Tucson, Az., p. 437-491; [4] Brown, R.H. et al. (2005) *SSR*, *115*, 115–18; [5] Clark et al. (2008) *Icarus*, *193*, 372-386 ; [6] Stephan et al. (2009) *Icarus;* [7] Jaumann et al., 2006 PSS ; [8] Wagner et al. (2007) *LPSC XXXVIII* [9] Neukum [10] Zahnle [11] Wagner et al. (2006), *LPSC XXXVII*, 1805; [12] Stephan et al. (2008a), *LPSC XXXIX*, 1717; [13] Schenk et al. (2010), Icarus.

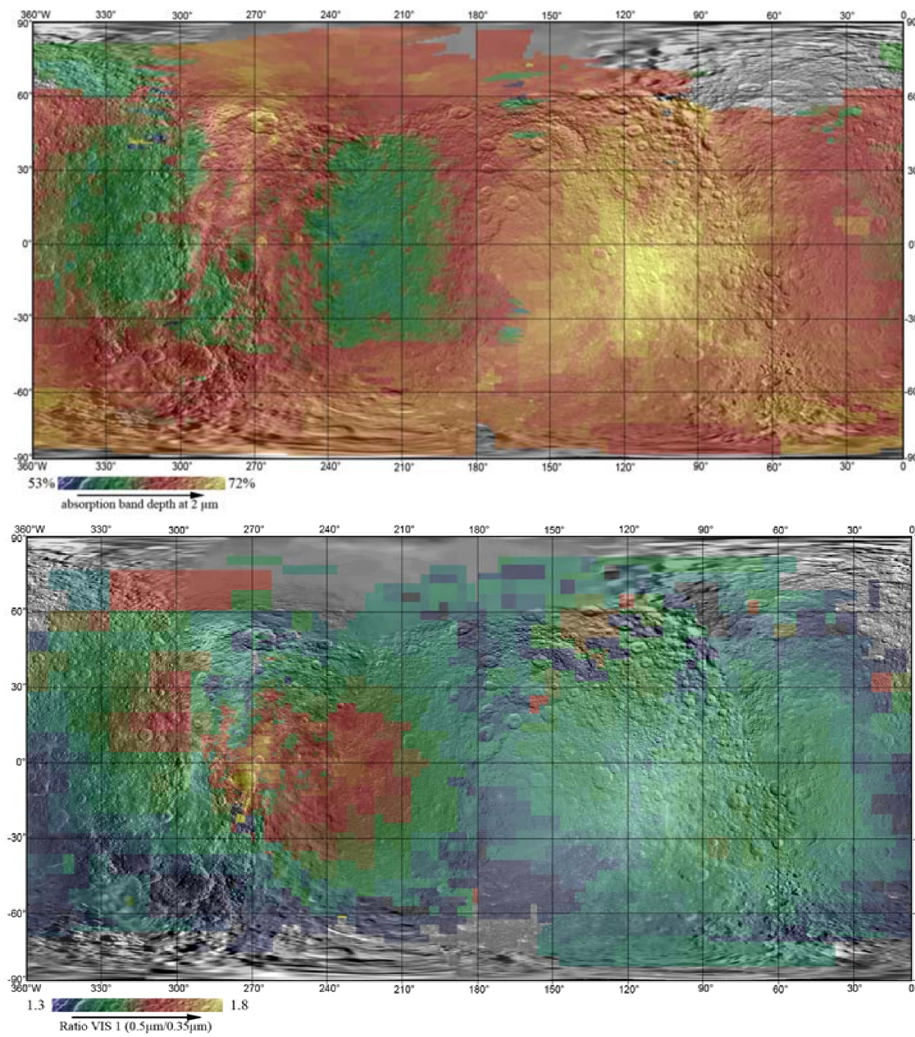

Fig. 1: Global VIMS maps of Rhea showing the variations in the ice absorption band depth at 2 µm (increasing depth as an indicator for an increasing spectral dominance of water ice) overlaid onto a Voyager/Cassini ISS basemap (top) and the variations in the spectral slope between 0.5 and 0.35µm (top).