VIMS coverage of Saturn's icy satellite Rhea. Katrin Stephan[1], Ralf Jaumann[1,2,*], Roland Wagner[1], Roger Clark[3], Dale P. Cruikshank[4], C.A. Hibbitts[5], Thomas Roatsch[1], R. H. Brown[6], Bonnie J. Buratti[7], G. Filacchione[8], G.B. Hansen[9], T.B. McCord[10], Kevin H. Baines[7], Phil D. Nicholson[11].

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Introduction: Since July 2004 numerous flybys at satellite Rhea, the second largest satellite of Saturn with a diameter of 1528 km, were preformed. During these flybys the Visual and Infrared Mapping Spectrometer (VIMS) detected Rhea's surface in the wavelength range from 0.35 to 5.1µm and offers the first spatially resolved hyperspectral data [1].

VIMS observations were incorporated into a global ISS mosaic of Rhea illustrating the present VIMS coverage of this satellite. Although Rhea's surface is mainly composed of water ice distinct spatial variations of its spectral properties could be derived that appear to be similar to the neighboring satellite Dione [2,3].

VIMS observations: VIMS data acquired during 24 flybys (up to Cassini's 54th orbit in December 2007) that exhibit pixel ground resolutions of at least 100 km per pixel were incorporated into this study, map-projected and combined into VIMS mosaics according to [4]. Whereas most observations exhibit relatively low pixel ground resolutions of less than 50 km per pixel VIMS observations of Rhea's anti-Saturnian hemisphere acquired during one non-targeted flyby (Cassini orbit 49 on Aug. 30, 2007) reach pixel ground resolutions up to 1 km per pixel.

To avoid influences of the viewing geometries (i.e. phase angle) only results of band depth measurements of water ice absorptions were combined into the resulting map. Prelimininary results presented in Fig. 1 show the variations in band depth of the water ice absorption at 1.5µm indicating varying amount, sizes of the particles, and/or crystallinity of water ice.

In order to relate the spectral variations to geological and morphological surface features the derived VIMS maps were overlaid onto basemaps derived from Voyager ISS and Cassini ISS cameras at visible wavelengths.

Major geological surface units: Voyager images showed that Rhea exhibits a similar distribution of geological units like its inner neighbor Dione [5,6] with densely cratered plains dominating Rhea's leading hemisphere with average cratering model ages of about 4.1 Gyr [7,8] or 3.6 Gyr [9] and bright, filament-like wispy markings characterizing the trailing hemisphere verified as tectonic features by Cassini ISS data [7]. Abundant old large craters and multiring impact basins, though heavily degraded, were detected in a digital elevation model (DEM) derived by ISS data [7].

Spectral variations: The surface of Rhea is dominated by water ice [10]. Water ice absorptions are distinctly deeper than on Dione but still slightly weaker than on Enceladus. However, despite the high amount of water ice and the less strong band depth variations measured on Dione, spatial variations are clearly seen in the global band depth map in Fig. 1 that are quite similar to the one that could be measured across Dione's surface [2,3]. Water ice is concentrated on Rhea's leading hemisphere. The corresponding icy endmember spectrum shows all major absorptions at 1.04, 1.25, 1.5, 2 and 3µm (Fig. 2).

These ice deposits extend probably from the the only prominent geologically fresh ray crater, located at 12.5°S and 112°W (Fig 2) with crater model ages of 280 Myr or 8 Myr as derived by [7], using chronology models by [8] (lunar-like cratering rate, higher age) and [9] (constant cratering rate, lower age). No indications of polar caps or endogenic activity that could be related to any contribution to the E-ring material or impacting of E-ring particles preferably onto Rhea's leading hemisphere could be found.

Instead, less water ice was observed on Rhea's trailing hemisphere indicating similar processes i.e. impacting magnetospherical particles preferable onto the trailing hemisphere on Dione to responsible for this hemispherical effects on Rhea as well. This is also supported by similar major spectral characteristics of the dark material on Rhea and Dione (Fig. 2). However in contrast to Dione no absorption of CO_2 could be identified in the spectra of the darker regions on Rhea at this state of the analysis. As on Dione the dark region is crossed by icier tectonic linear features. Unfortunately the pixel ground resolution of the VIMS observation on the trailing hemisphere does not exceed

100 km per pixel and is like the resolution of the corresponding Voyager and Cassini imaging data far to low to derive explicit informations about the linear structures. On Dione, these region appear to be very young and tectonic processes may continue into recent times [11,12]. Both, observing Rhea's trailing hemisphere by VIMS as well as by the Cassini ISS cameras during Cassini's extended mission through the Saturnian system could complete our view of this satellite and could still reveal some ongoing activity.

Figure captions: Fig. 1: Global VIMS map showing the band depth variations of the water ice absorption at 1.5µm as an indicator for variations in amount, particle sizes and crystallinity of water ice across Rhea's surface overlaid onto an Voyager/Cassini ISS basemap. **Fig. 2:** Endmember spectra of Rhea representing the iciest and the less iciest spectra identified on Rhea. **Fig. 3:** High-resolution Cassini VIMS data overlaid onto simultaneously acquired Cassini ISS images showing the geologically fresh impact crater that appears to be the origin of the concentrated ice deposits on Rhea's leading hemisphere.

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

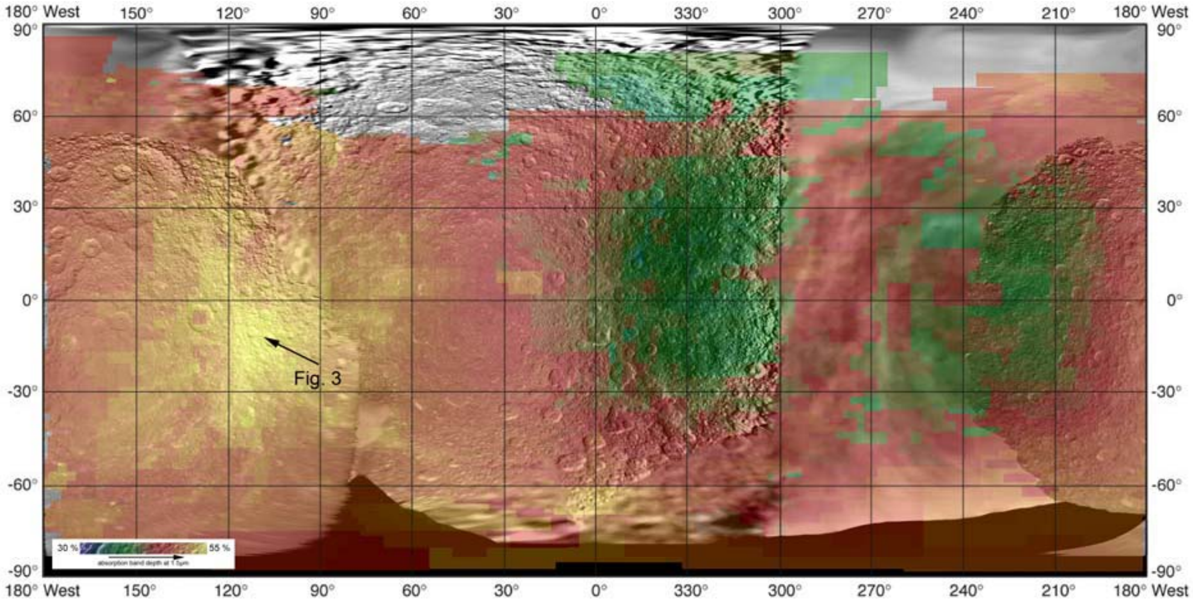

Fig. 1

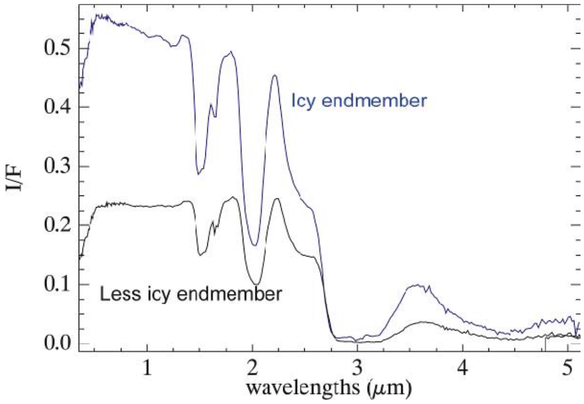

Fig. 2

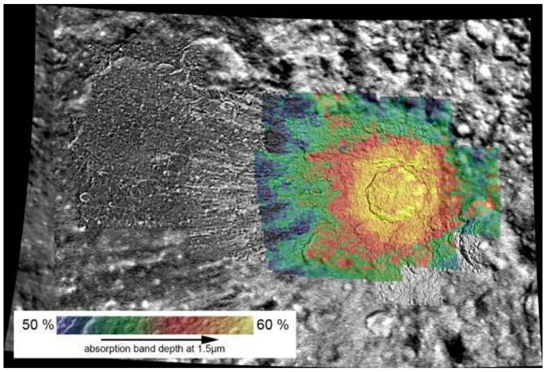

Fig.3