RELATIONSHIPS OF DIONE'S SPECTRAL PROPERTIES TO GEOLOGICAL SURFACE UNITS. K. Stephan[1], R. Jaumann[1], R. Wagner[1], Th. Roatsch[1], R.N. Clark[2], D.P. Cruikshank[3], C.A. Hibbitts[4], G.B. Hansen[5], B.J. Buratti[6], G. Filacchione[7], T.B. McCord[5], K.H. Baines[6], P.D. Nicholson[8], R.M. Nelson[6] and R.H. Brown[9], [1] DLR, Inst. for Planet. Expl. Rutherfordstrasse 2, 12489 Berlin, Germany, [2] USGS, Mail Stop 964, Box 25046, Denver Federal Center, Denver CO, USA, [3] NASA Ames Research Center, Astrophysics Branch, Moffett Field, CA 94035-1000, USA, [4]Applied Physics Laboratory, Laurel, MD, USA, [5] Planetary Science Institute, 22 Fiddler's Rd., Winthrop WA 98862-0667, USA, [6] Jet propulsion Laboratory, Pasadena CA 91109, USA, [7] Istituto Fisica Spazio Interplanetario, CNR, Via Fosso del Cavaliere, Roma , Italy,[8] Cornell University, 418 Space Sci. Bldg, Ithaca, NY 14853, USA, [9] Dept. Pl. Sci and LPL, U. of AZ, Tucson AZ 85721-0092, USA (Katrin.Stephan@dlr.de).

Introduction: During orbit DI 016 (October 2005) Cassini's Visual and Infrared Imaging Spectrometer (VIMS) [1] acquired spatially resolved spectral data of the Saturnian satellite Dione with pixel ground resolutions up to 2 km. Additionally, the Imaging Science Subsystem (ISS) [2] observed the satellite synchronously to VIMS with pixel ground resolutions up to 15 m. These high resolution data cover Dione's surface from 20°N to 25°S and from 210 to 250°W (Fig. 1) that include Dione's major geologic units [3,4]. Therefore, we mapped the chemical and physical properties, across Dione's surface, using VIMS data, in detail and analyzed them with respect to geologic units defined in Cassini ISS images. Results regarding the varying abundance of water ice and rocky non-ice material in the surface material are presented here.

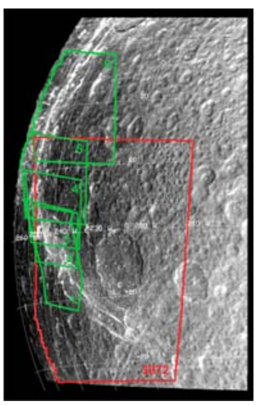


Figure 1: VIMS-hires observations acquired in Orbit DI016.

Processing of the VIMS data: VIMS data calibrated as described by [5,6] were used for this study. The method of [7] was applied to the VIMS data to improve the S/N ratio of the individual VIMS spectra. Chemical and physical properties were derived from band depths measurements [8] of individual absorptions identified in the VIMS spectra by [9] as well as a linear mixing model [10]. In order to study the relationships between the spectral characteristics of the surface material and geological processes we reprojected and mosaicked the resulting VIMS maps [11] and registered them to the simultaneously acquired ISS images [12].

Geological mapping: Mapping of geological units was done based on Cassini ISS images with respect to morphology. The following major units could be distinguished in the observed region (Fig. 2): 1. Densely cratered plains represent the oldest geological unit (4.1 b.y.) [4]. 2. These densely cratered plains are disrupted by younger regions e.g. the fractured plains [13]. Different geological subunits of the densely cratered plains could be distinguished (e.g. hummocky cratered plains). No fresh impact craters occur in the observed region. All impact craters exhibit a varying degree of degradation.

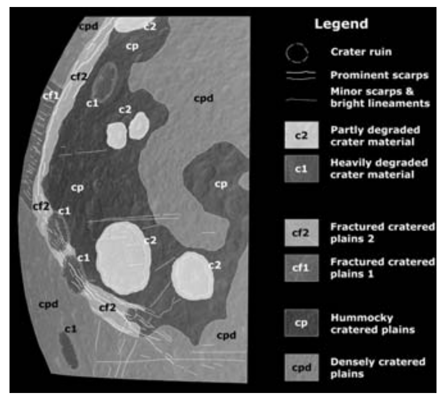
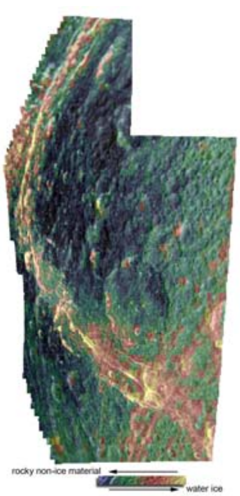


Figure 2: Geological map created based on Cassini ISS images.

Fractured plains: Regions that are dominated by linear tectonic features (Fig. 1) are clearly separated in the VIMS maps from darker cratered plains (Fig. 3). The latter show the highest influence of dark rocky material [7] whereas the linear features show pronounced water ice absorptions at 1.5, 2 and about 3 µm (Fig. 3). Water ice absorptions at 1.04 and 1.25 µm could not be measured due to saturation effects of the measured signal or are subdued due to another surface



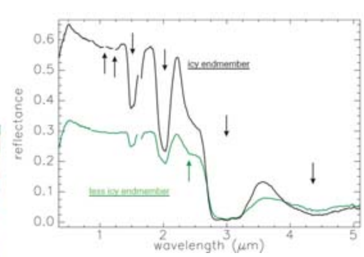


Figure 3: VIMS map illustrating the distribution of water ice (and dark rocky non-ice material) in the observed region (left) based on two endmember spectra (above).

compound e.g. the rocky non-ice material (Fig. 3).

Several different sets of linear tectonic features are covered by VIMS at high resolution. Despite there different orientation and location on Dione no spectral differences were measured. None of these features is characterized by pure water ice as an indicator for fresh material. Probably all tectonic features have been exposed to weathering including the deposition of dark rocky material. This corresponds to a relative high age of these tectonic features of about 3 b.y. in general compared to 4.1 b.y. of the densely cratered plains [4].

VIMS spectra of crater walls associated with impact craters close or within the fractured plains indicate similar amount of water ice like the tectonic features itself. However, this signature does not correspond to the heavily degraded morphology of most of these impact craters (Fig.2). Probably these crater walls have been reactivated due to the tectonic processes.

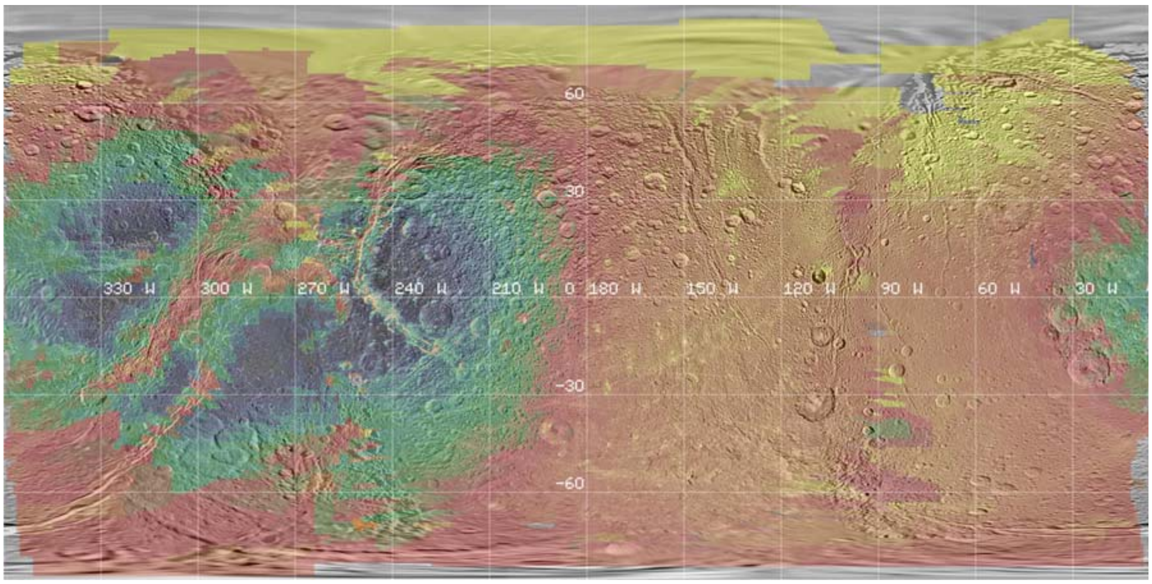


Figure 4: Global distribution of water ice (and rocky non-ice material), same color bar as in Fig. 3.

Densely cratered plains: Although distinct spatial variations with respect to the influence of the rocky non-ice material occur, these variations could not be correlated with the geological subunits (Fig. 2). The global context of the VIMS maps makes clear that the influence of the rocky non-ice material decreases toward the leading side of the satellite, esp. when looking at the equator (Fig. 4,5). Whereas water ice absorptions are most pronounced at ~ 135°W they weaken continuously toward 285°W. This corresponds to previous studies that favour an exogenic origin of the rocky non-ice material [9,13]. No distinct spectral variations were measured between the parts of densely cratered plains and the fractured plains located in the central leading hemisphere as well as the fractured plains in the trailing hemisphere. No distinct polar caps were observed (Fig. 4).

Impact craters: Observed impact craters lie either fully within the densely cratered plains but also at least partly within the fractured plains. These impact craters represent fully the properties of the terrain (substrate). No signatures characterize the impact craters alone.

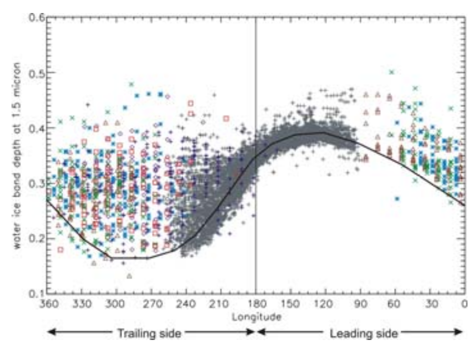


Figure 5: Global band depth variations at 1.5 µm as an indicator for variations in relative water ice abundance depending on latitude on Dione.

References: [1] Brown et al. 2004, *SSR*, 115, 111-168. [2] Porco et al. 2004, *SSR*, 115, 363-497. [3] Plescia, J. (1983), *Icarus*, 56, 255-277. [4] Wagner et al. LPSC XXXVII, abstract 1805. [5] Coradini et al. 2004, *PSS*, 52, 661-670. [6] McCord et al. 2004, *Icarus* 127, 104-126. [7] Stephan et al. 2007, *PSS*, in press. [8] Clark et al. 1983 [9] Clark et al. 2007, Icarus, in press. [10] Boardsman et al., 1993. [11] Jaumann et al. 2006, *PSS*, 54, 1146-1155. [12] Roatsch et al., 2006, *PSS*, 54. [13] Morrison & Cruikshank, 1974, *SSR*, 15, 641.