SPECTRAL PROPERTIES OF THE SATURNIAN SATELLITE TETHYS AS DERIVED FROM CASSINI-VIMS DATA. K. Stephan[1], R. Jaumann[1,2], R. Wagner[1], R.N. Clark[3], D.P. Cruikshank[4], C. Dalle Ore[4], R.H. Brown[5], B. Giese[1], T. Roatsch[1], D. Matson[6], K. Baines[7], G. Filacchione[8], F. Capaccione[8], B.J. Buratti[6] and P.D. Nicholson[8], [1]DLR, Institute of Planetary Research, Berlin, Germany, [2]FU Berlin, Germany, [3]U.S.G.S., Denver, USA, [4]NASA Ames, Moffett Field, USA, [5]UoA, Tucson, USA, [6]JPL, Pasadena, USA, 7 SSEC, Madison, USA, [8]INAF-IASF, Rome, Italy, [8]Cornell Univ., Ithaca, USA. (Katrin.Stephan@dlr.de).

Introduction: Since 2004 the Cassini spacecraft performed numerous targeted and non-targeted flybys at the major Saturnian satellites. During these flybys the Visual and Infrared Mapping Spectrometer (VIMS) onboard the Cassini spacecraft [1] detects the spectral properties of the satellites' surfaces in the wavelength range from 0.35 to 5.1 µm with a spectral resolution that allows the mapping of the distribution of major surface compounds like H_2O ice as well as discovery/identification of minor and/or trace compounds like CO_2 as shown for several Saturnian satellites [2-6]. Mapping of these compounds revealed a distinct distribution of most of these surface compounds either related to geological surface features/processes or to weathering of the uppermost surface layer. In order to further our understanding of the Satutnian system we now performed an analysis of the spectral surface properties of Tethys in context of the surface geology as well as topography based on simultaneously acquired Cassini ISS images.

VIMS observations: Observations of Tethys' surface were performed during numerous targeted and non-targeted flybys with a closest approach of about 16,000 km during Cassini's orbit 47, which enabled an almost complete coverage of the satellite's surface. In general, pixel ground resolutions of the corresponding VIMS observations used in this study range only between 150 and 40 km, which only allow the spectral analysis of global variations. During the flyby in Cassini's orbit 47, however, pixel ground resolutions reach up to 2 km.

Spectral analysis: The spectral analysis follows the analyses previously done for Dione and Rhea as described in detail in [5,6]. The main focus lies on mapping the distribution of the major surface compounds H_2O including its physical properties as well as a surface darkening agent. Minor or trace compounds other than H_2O as detected on other Saturnian satellites [2-6] could not be identified in the VIMS spectra of Tethys. Although, these findings are consistent with previous analyses [7,8] at least radiolytic products due to intertaction with the space environment could be expected. The only indicator for the existence of radiolytic products in the surface ice layer so far is suspected to be the cause for changes in the spectral slope from the visible into the ultra-violet wavelength range [6].

Global spectral properties: The available VIMS data set enabled us to generate global maps of Tethys' surface displaying unique hemispherical spectral differences characteristics as well as regional maps covering geologically most interesting surface features like Tethys' prominent graben system Ithaca Chasma. Despite the spectral dominance of H_2O ice on Tethys' surface distinct spectral variations could be detected (Fig. 1), which are surprisingly very different from what was expected from the visible albedo derived from Voyager and Cassini camera data [9,10]. The abundance of H_2O ice is qualitatively expressed by the depth of the ice absorptions at 1.5 and 2µm and usually follows the visible surface albedo as seen on many other satellites. Thus, on Dione and Rhea [5,6], H_2O ice absorptions are weakest on the trailing hemisphere due to magnetospheric 'dust' impacting and darkening the surface. Although on Tethys', the weakest absorptions could be also measured on the trailing hemisphere, the detailed mapping shows a more complex pattern. Two relatively narrow N/S trending bands characterized by deep H_2O ice absorptions separate the Saturn-facing and the anti-Saturnian hemisphere. With respect to the discrepancy between the global trends in the band depth and the visible albedo, the observed variations are interpreted to be caused by particle sizes rather the abundance of H_2O. The oval shaped dark albedo unit observed by Cassini ISS in the equatorial region of Tethys' leading hemisphere [10,11], which could be related to magnetispheric 'dust' impacting the surface, may only be indicated in the VIMS data by slightly surpressed H_2O ice absorptions compared to their surrounding regions. In contrast, the variations in the spectral slope from the visible to the ultra-violet wavelength range i.e from 0.5 to 0.35µm again are similar to the variations observed by Cassini ISS [10] as well as observed on Rhea [6]. The spectral slope is steepest (i.e. the effect of an ultra-violet absorber other than H_2O ice is strongest) on the leading as well on the trailing hemisphere.

Regional spectral properties: It is interesting that the largest impact crater *Odysseus* (33°N/129°W) in included in one band of deeper H_2O absorptions described above, whereas the geologically older and fourth largest impact crater *Penelope* (11°S/249°W) is different from the other 'icy' band. Although, the uppermost surface layer in the vicinity of Odysseus is expected to be strongly affected by space weathering processes, deeper H_2O ice band depths might be taken as ghosts of the genuine spectral properties of this impact basin.

In contrast to the prominent graben systems on Dione and Rhea [5,6] with a relatively high H_2O ice abundance exposed on steep walls, no spectral properties could be exclusively associated with Tethys' extended graben system *Ithaca Chasma* [9] (Fig. 2). Although, a slight increase in depth of the H_2O ice absorptions could be observed in the vicinity of Ithaca Chasma, the graben system rather largely separates weaker H_2O absorptions in the neighboring the trailing hemisphere from deeper ones in the leading hemisphere including the graben system itself. Changes of the spectral slope toward the ultra-violet wavelength range appears to be more independent of the geological feature at least at the scale of the VIMS observations.

Local variations, i.e. local deepening of H_2O ice ab-sorptions, are mostly related to several probably *fresh impact craters* and to locations where topographic slope is high like crater walls. In constract to Dione and Rhea [5,6], however, only a few such fresh impact craters could be observed.

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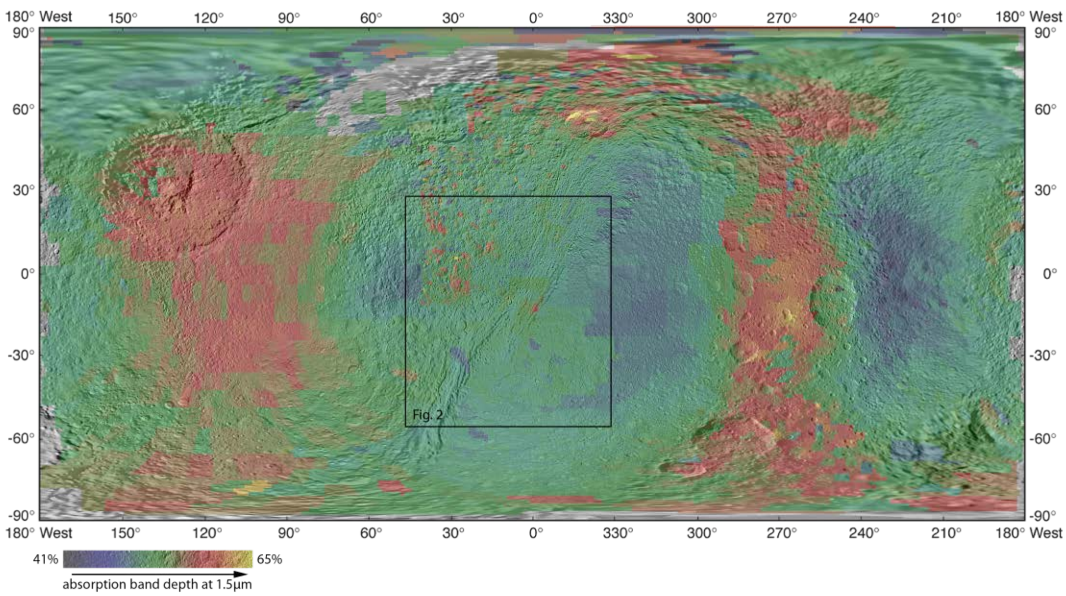

Fig. 1 Global map of Tethys' showing the spatial variations in the depth of the H_2O ice absorption at 1.5µm.

Fig. 2 Three-dimensional view of the spectral variations of Ithaca Chasma: Casini ISS mosaic (left), depth of the H_2O ice absorption at 1.5µm (center), and ratio of the VIMS channels centering at 0.5 and 0.35µm, respectively.