ICY SATURNIAN SATELLITE SURFACE COMPOSITIONS: MAPPING AND MODELING. J. B. Dalton[1]
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Introduction: The icy Saturnian satellites are slowly, if grudgingly, beginning to give up the secrets of their surface compositions. Ground-based observations, laboratory simulations, and new data from the Cassini VIMS instrument are being brought to bear on these remarkable worlds. By comparing spectral observations for each of these moons to the others, inferences may be drawn which help to reveal their varying formation histories. Compositions range from nearly pure water ice at Mimas and Tethys to dark, organic- and nitrile-laced compounds at Phoebe and Dione.

Ice-dominated Worlds: Spectral modeling of Tethys observations [1], for example, indicates a surface dominated by water ice with only small contributions by other materials such as carbon dioxide or amorphous carbon; yet, requires an unusual mixture of grain sizes ranging from less than ten microns to as much as 2.5 millimeters in diameter.

At the other extreme, Phoebe has been shown to exhibit much clearer evidence [2] for a host of compounds, including iron-bearing materials, carbon dioxide, nitriles, and organics.

Similar Spectral Features: Comparison of Cassini VIMS spectra of Phoebe, Dione, and Hyperion indicate many of the same spectral features. Water ice being chief among them, it is noticeable that the water ice features at 1.5 and 2.0 μm are reduced in the adarker terrain. These dark terrains reveal spectral signatures indicative of C-N bonds at 2.42 and 4.5 μm. Weak evidence of C-H is also apparent near 2.5 μm in the Dione spectrum. Comparison of features identified in the Phoebe spectrum with their weaker counterparts in the spectra of the other satellites permits constraints to be placed upon the formation and subsequent evolution of these satellites.

Mapping of these spectral features using automated feature extraction algorithms, cryogenic laboratory reflectance measurements, and standard Hapke reflectance models also allows insights into the nature and distribution of these materials and suggests ways in which the models might be improved.

These include more precise formulations of phase and scattering functions, as well as laboratory investigations of both pure compounds and mixtures.

References: [1] Emery J.P. et al.(2005) *A&A 435,* 335-362 [2] Clark, R.N. et al.(2005) *Nature 435,* 66-69

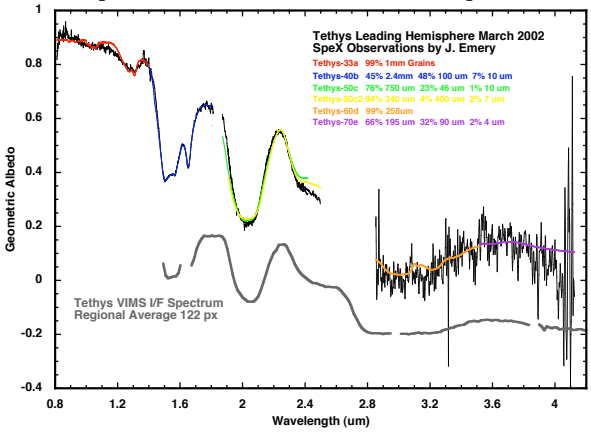

Figure 1. VIMS and SpeX spectra of Tethys. Modeling of Cassini VIMS and ground-based SpeX (J. Emery) spectra of Tethys reveals a primarily water ice composition.

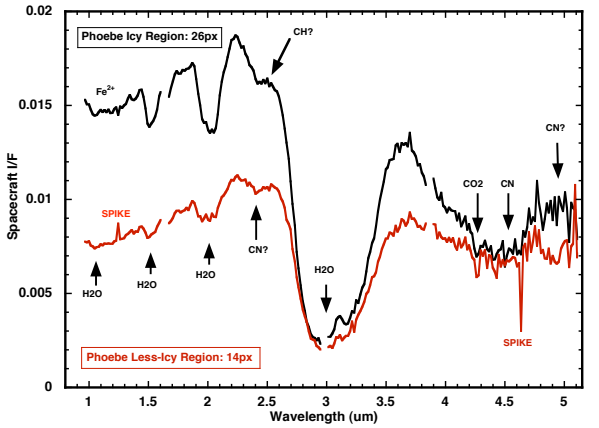

Figure 2. Cassini VIMS spectra of Phoebe. Icy and less-icy terrains evidence features of several compounds, which are enhanced in the darker terrains.

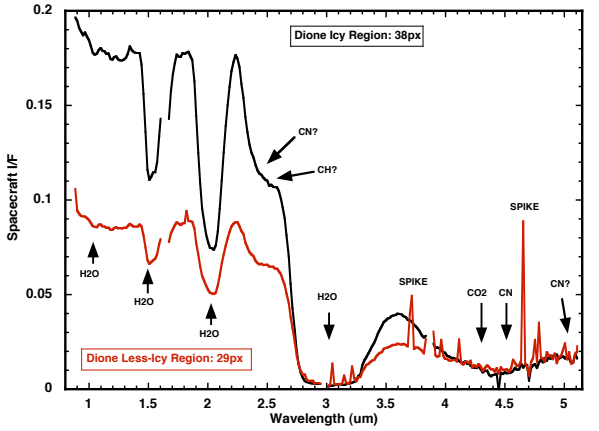

Figure 3. Cassini VIMS spectra of Dione. Several features identified on Phoebe also appear on Dione, although not as strongly.