COMPLEX ORGANICS IN TITAN LAKES: SPECTRAL DETECTION AND CHEMICAL BEHAVIOR.

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Introduction: Due to its complexity, heterogeneity and chemical singularity, Titan surface composition is particularly intriguing and still poorly identified and determined. In 2005-2006, Cassini ISS and RADAR (SAR) instruments discovered a large dark lake feature in the Titan south polar region (Ontario lacus) [1] and of a vast array of lake and sea like features in the north polar region [2]. Observations of the Titan's lakes and seas by Radar radiometry and VIMS have emerged to try to characterize the polar lakes and seas, however, their chemical composition is still undetermined. It is supposed that they should be composed of the Titan atmospheric precipitates, mainly hydrocarbons, such as ethane and methane. Thermodynamic equilibrium models predict liquid ethane and methane to be the most abundant constituents in Titan lakes [3, 4] and other organic species from atmospheric precipitation to be additional constituents such as complex organics including the refractory macromolecular material of Titan's aerosols (Titan tholins) [5]. While VIMS is still providing data on Titan surface, it is important to study how the deposits of the atmospheric organic aerosols may interact optically and chemically with the hydrocarbons lakes. Here we present the results of experiments examining the spectroscopic signatures of a liquid ethane, liquid methane and the mixture of both in contact with laboratory analogs of Titan's aerosols.

Laboratory Simulation of Titan's lakes: Experiments have been performed in the Titan simulation facility of the W.M Keck laboratory at the University of Arkansas [6]. An insulated cylindrical steel cryo-vacuum chamber accommodates out a Titan module that sits inside a main chamber. Titan module contains a temperature control box internally and externally lined with LN_2 cooling pipes allowing approaching temperatures relevant to Titan surface (90-94 K). Titan tholins synthesized at Keck lab were introduced inside a Petri dish into the sample collection pan sit inside the module. The pressure was maintained at 1.5 bar N_2 atmosphere throughout the experiments to simulate Titan atmospheric pressure at the surface. Once the required temperature and pressure were reached, the sample (ethane, methane) was introduced into the chamber and the module, through a condenser, using condenser input coils. The behavior of the sample was monitored via FTIR, in the near-infrared from 2.5 to 1.0 µm (4000-10000 cm^{-1}).

Results: Several spectra were acquired during the following experiments: tholins in liquid ethane, liquid methane, in the mixtures of liquid ethane/methane and liquid ethane/acetonitrile. Fig. 1 is an example of the series of spectra obtained during liquid ethane experiments.

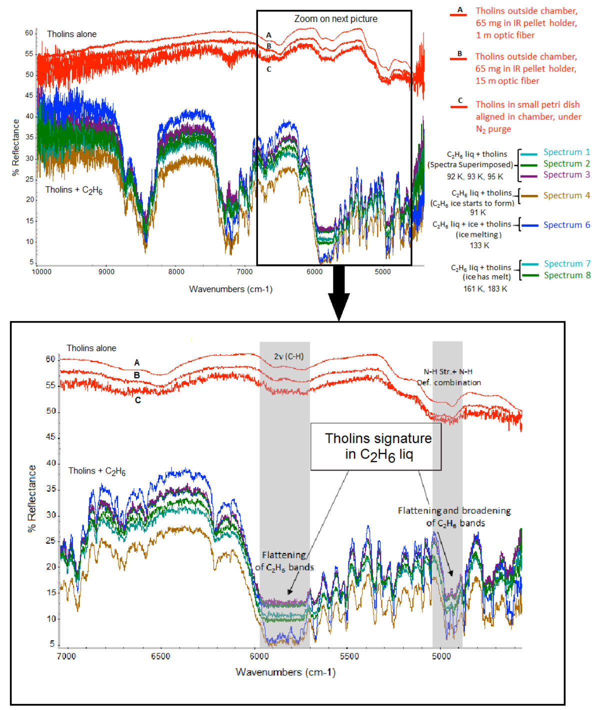

Fig. 1. Spectra of tholins/ethane mixtures between 91 K and 183 K.

The results for liquid ethane show modifications of the ethane bands at 1.7-1.75 µm and 2.0 µm (Fig. 1). Tholins can be detected in liquid ethane, essentially through flattening and broadening of specific bands. Results for liquid methane and other mixtures will be presented at the conference. Our experimental approach and its resulting data are relevant in regards to current VIMS observations of Titan's lakes and proposed future missions to Titan like the ESA's Titan Saturn System Mission.

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