# METHODS FOR THE ANALYSIS OF ORGANIC CHEMISTRY ON TITAN

Thesis by

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# Abstract

Tholins are brownish, sticky residues formed by the energetic processing of mixtures of gases abundant in the cosmos, such as $CH_4$, $N_2$, and $H_2O$, either with ultraviolet light or electrical discharge. This thesis describes investigations of the tholins produced by the processing of mixtures of $N_2$ and $CH_4$, as a model of photochemical processes occurring in the atmosphere of Titan. These compounds are mixed with liquid water during impacts or cryovolcanism, in melt pools which eventually freeze. The melt pools are interesting sites for astrobiological research, containing a wealth of organic material interacting over long time periods in a liquid water solvent. Studies of the near infrared reflectance spectrum and the fluorescent properties of the tholins are presented, yielding information on the composition of the tholins and a means of finding organic deposits on the surface of Titan. Tholin decomposition on heating is extensively investigated, partly to ascertain the utility of pyrolysis as a technique for tholin characterization. Tholins are found to undergo significant chemical change at temperatures as low as 100 °C, releasing large quantities of ammonia, while at higher temperatures, cyclizing and aromatizing reactions occur. Pyrolysis is thus not a good technique for the characterization of tholins. The development of two instruments for tholin characterization are also discussed: a gas chromatograph with an ultraviolet absorption detector, for functional group analysis of the tholins, and sensors designed for the determination of enantiomeric excess.

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