Cryogenic Titan Tholins

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Compositional interpretation of outer solar system surfaces reflectance spectra relies upon laboratory measurements; most of which are obtained with the sample of interest at ambient conditions. However, temperatures in the outer solar system are significantly cooler than ambient. The infrared spectra of silicates are a function of temperature [1-3]. The importance of assessing effects of temperature on compositional interpretations has been demonstrated [4-5].

Titan tholin is a solid residue created by energetic processing of H-, C-, and N-bearing gases that were mixed in abundances to simulate Titan's atmosphere [6]. The optical constants of Titan tholin have been used as a coloring agent in spectral models of outer solar system surfaces [e.g. 7]. We have undertaken a laboratory study to measure the reflectance spectra of Titan tholin from room temperature to ~100 K. Spectral measurements were obtained with sample temperatures of about 300, 280, 270, 250, 200, 150, & 100 K.

At low temperature the visual and near-infrared colors of Titan tholin become redder, i.e. the reflectance increases more at longer wavelengths than it does at shorter wavelengths. To quantify this change we evaluated color ratios, minimizing the effect of changes in albedo, and these ratios indicate ~5% reddening, at near-infrared wavelengths, upon cooling from 300 to 100 K. We estimated how this modest reddening effect may influence compositional interpretations by using the observed color change as a guide to adjust the Titan tholin optical constants [6]. We repeated the calculations of [7] that described the surface of the Centaur Pholus and then replaced the original Titan tholin optical constants with our altered values. Comparing the results leads us to conclude that the temperature effects on Titan tholins will have little influence on the compositional interpretation of the Pholus spectrum.

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