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Laboratory spectra of N_2 and CH_4 mixtures: Applications to Observations of TNOs

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1. Introduction

CH_4-ice has multiple low temperature phases that have distinct spectra [1]. In the laboratory, infrared spectra CH4-ice diluted in N2 have absorptions that are different in shape, location, and strength compared to those of pure CH4-ice [2]. However, the full range of dilutions and changes with temperature have not been consistently explored for α-N2-ices. Although, β-N2 ices are common throughout the outer solar system, there are also surfaces where the temperatures are low enough for α-N2 to survive. Recent observations of Eris [3] demonstrate that the surfaces of TNOs may consists of a complex mixture of ices of different phases and dilutions.

2. Figures

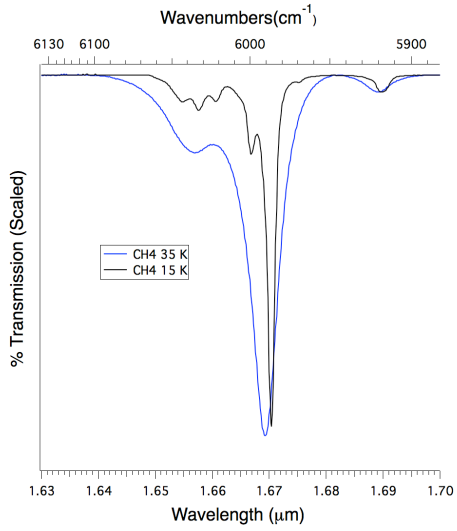

Figure 1. Transmission spectra of pure CH_4-ices at 15 and 35 K, demonstrating changes in the absorption near 1.67 μm. The individual spectra were scaled to similar strength for clarity.

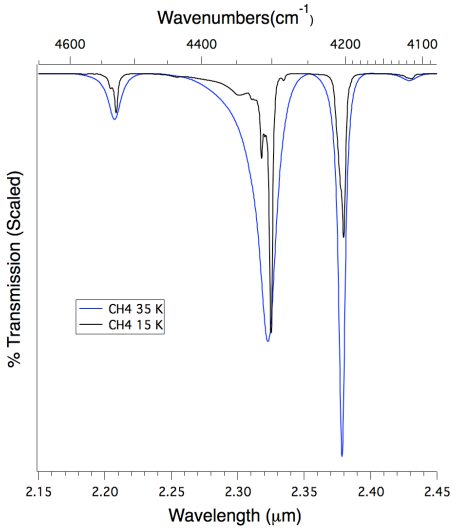

Figure 2. Transmission spectra of pure CH_4-ices at 15 and 35 K, depicting changes in the absorptions near 2.2, 2.32, and 2.38 μm. The individual spectra were scaled to similar strength for clarity.

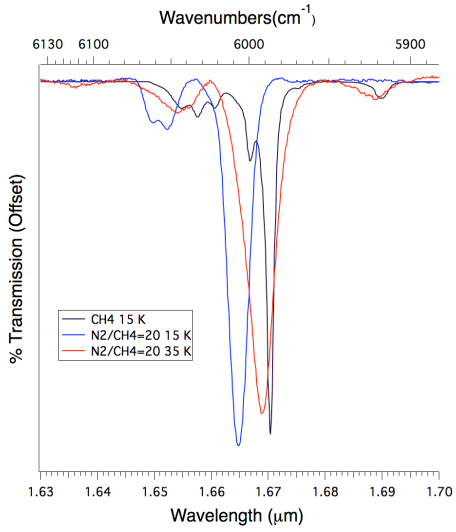

Figure3. Transmission spectra of pure CH_4-ices at 15 and a mixture of N_2/CH_4=20 at 15 and 35 K, depicting changes in the absorptions near 1.67 μm. The individual spectra were scaled to similar strength for clarity.

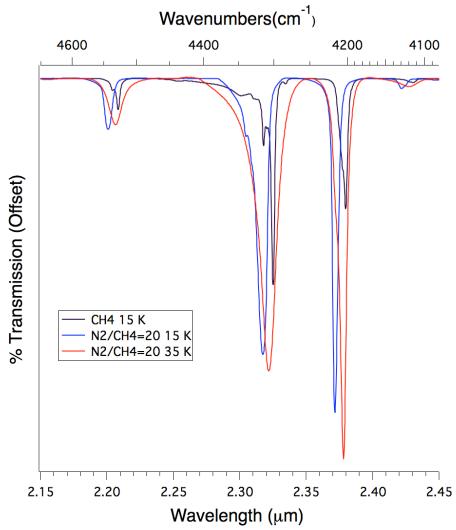

Figure 4. Transmission spectra of pure CH_4-ices at 15 and a mixture of N_2/CH_4=20 at 15 and 35 K, depicting changes in the absorptions near 2.2, 2.32, and 2.38 μm. The individual spectra were scaled to similar strength for clarity.

4. Summary and Conclusions

Figures 1 & 2 demonstrate shifts in absorptions in pure CH_4-ice. Note that all of the absorptions are shifted to shorter wavelength at higher temperature.

Figures 2 & 3 demonstrate the effect of diluting CH_4 in N_2-ice. There is a significant shift to shorter wavelength at 15 K, but that shift is lost at higher temperature.

We have demonstrated multiple changes in the location of CH_4 bands in both pure samples and dilutions in N_2. We will present results detailing the changes in absorption profile and location as a function of temperature and dilution for all wavelength ranges relevant to observations of TNOS.

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References

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2. Quirico, E. and B. Schmitt, *Near-Infrared spectroscopy of simple hydrocarbons and carbon oxides in solid N2 and as pure ices: Implications for Triton and Pluto.* Icarus, 1997. **127**: p. 354-378.
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