Solubility and Detectability of Acetonitrile in Titan Lakes

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INTRODUCTION

Lakes of Titan

- Cassini-Huygens mission confirmed existence of stable bodies of liquid
- Composition
  - mixture of CH_4 and C_2H_6
  - trace amounts of other hydrocarbons [1] such as CH_3CN (a potential precursor to the formation of amino acids [2])
- CH_4-based hydrological cycle [3]

Objectives

- To determine solubility of solid/liquid hydrocarbons
- Spectral detectability of CH_3CN in CH_4 and C_2H_6

METHODS

Benchtop Experiment

- Saturated C_6H_{14} with CH_3CN using a buret
- Used a closed container to minimize evaporation

Chamber Experiments

Andromeda Chamber: simulates Titan temperatures, pressures and atmosphere [4] at 94 K and1.5 bar.

- N_2 gas is saturated with CH_3CN (Fig. 1)
- Gas enters chamber and condenses
- CH_4 (experiment 1) or C_2H_6 (experiment 2) is flown over the condensed CH_3CN
- Solution is filtered to remove any solid particles.

Fig. 1: CH_3CN saturation apparatus

RESULTS

Benchtop Experiment

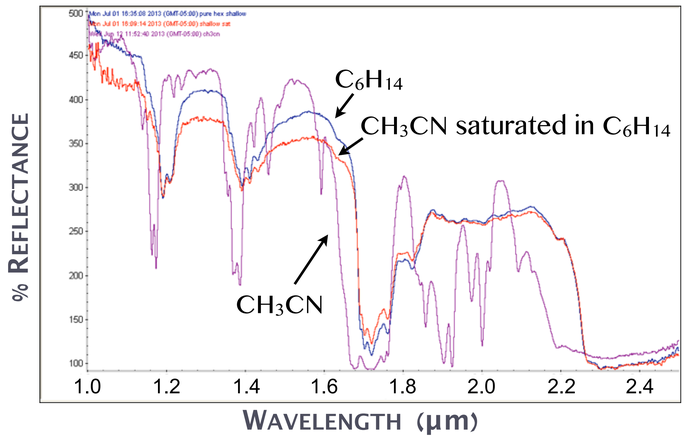

Fig. 2: C_6H_{14} saturated with CH_3CN

Chamber Experiments

Experiment 1

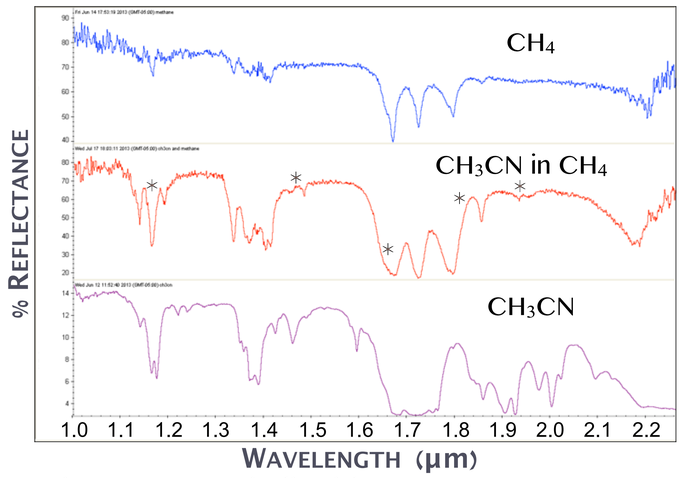

Fig. 3: CH_3CN in liquid CH_4. * represents CH_3CN features

Experiment 2

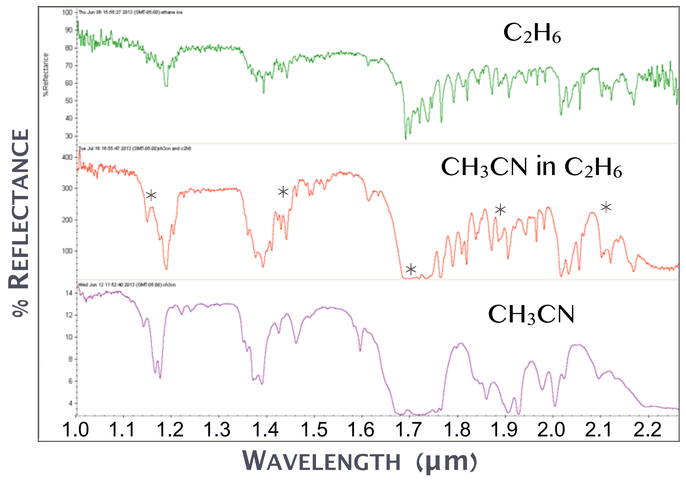

Fig. 4: CH_3CN in liquid C_2H_6. * represents CH_3CN features

DISCUSSION/ CONCLUSIONS

- Indeterminate CH_3CN features in C_6H_{14}
- Prominent CH_3CN features in both CH_4 and C_2H_6
- Solubility was determined by linear un-mixing with CH_3CN and CH_4/C_2H_6 [5].
  - CH_3CN mole fraction in CH_4: 2.1×10^{-2}
  - CH_3CN mole fraction in C_2H_6: 21.4×10^{-2}
- CH_3CN about 10 times more soluble in C_2H_6 than in CH_4

Applications to Titan

- Could indicate concentrations of CH_3CN in evaporite deposits near C_2H_6-rich lakes.
- Solubilities of hydrocarbons will further knowledge of evaporite compositions

FUTURE STUDIES

- Further analysis of CH_3CN-saturated CH_4 spectra as CH_4 evaporates
- Repeated experiments
- Test other hydrocarbons (e.g. C_6H_6, C_2H_2, C_4H_{10})

REFERENCES

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