

A Chemical Analysis Protocol for Titan

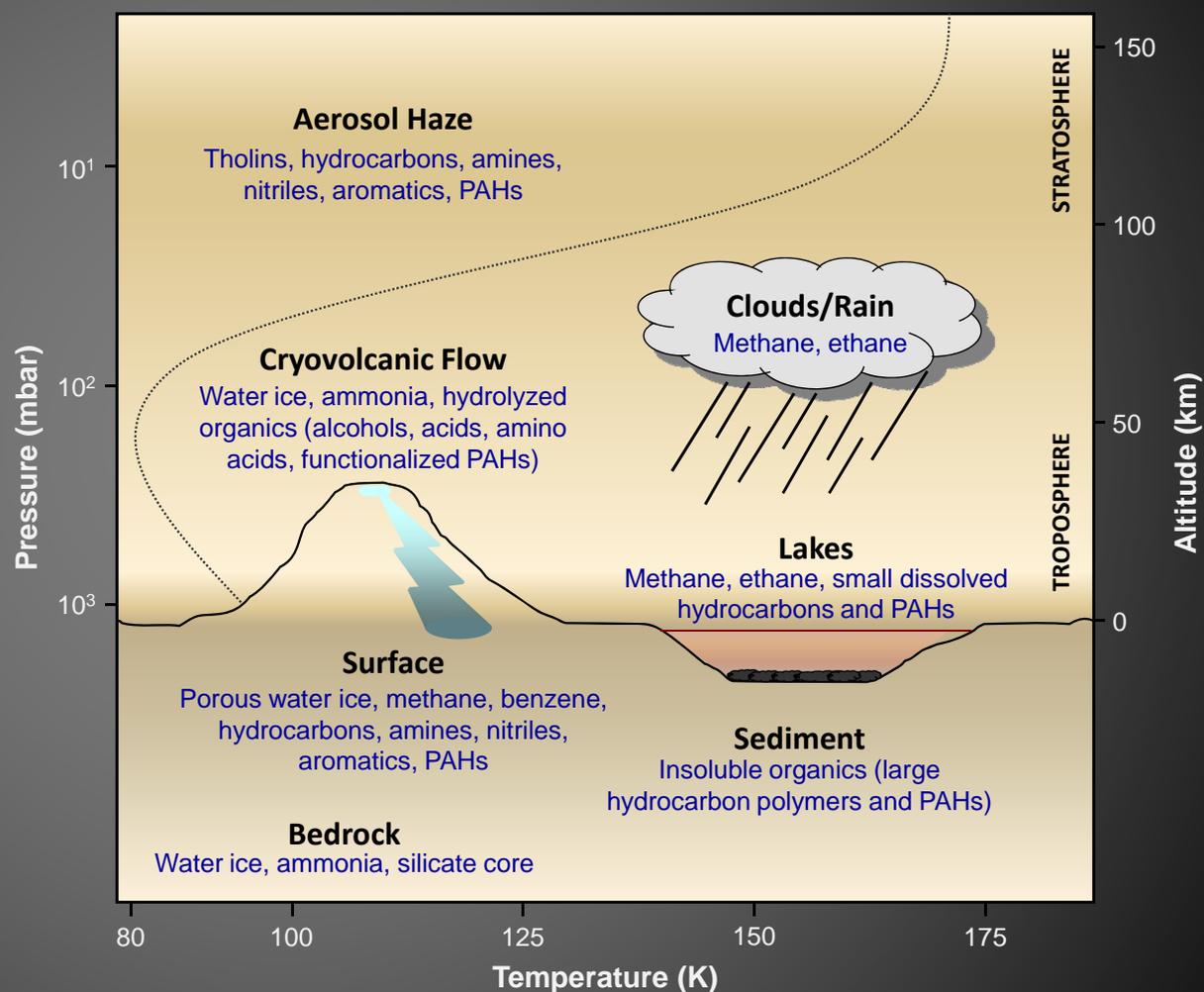
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NAI Icy Satellite Environment Focus Group

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Why Titan?

- Thick atmosphere
- Environment is rich in organics
- Analogue of prebiotic Earth
- Hydrological cycle



Objectives

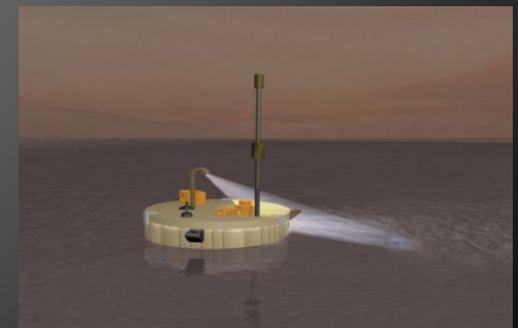
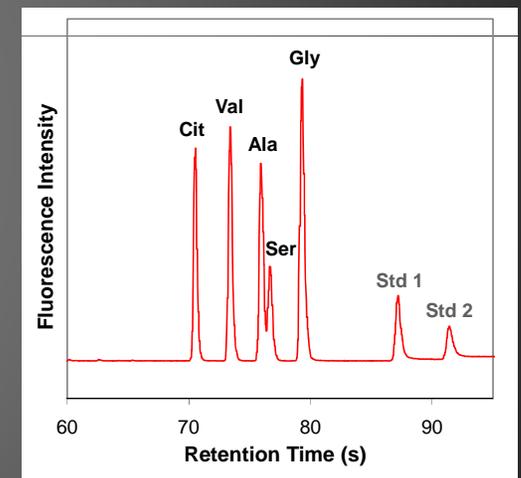
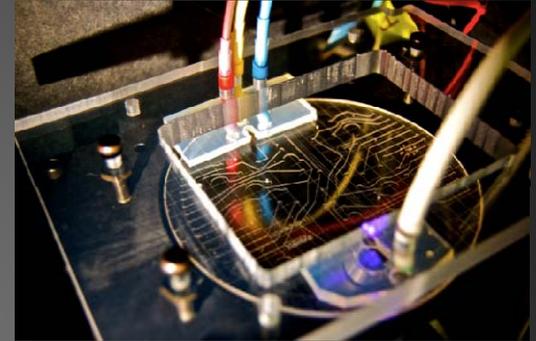
- Develop an *in situ* chemical protocol for the surface of Titan
 - Separate and identify organics
- Determine if H₂O plays a role in any surface chemistry
 - Presence of oxygen containing species?
 - Aldehydes, ketones, amino acids (chirality?)
- Design and package all components in a lab-on-a-chip (LOC) format
 - Low mass and power
 - Small sample volume required (20-25 μL)



Image from Huygens probe on
Titan surface
(<http://saturn.jpl.nasa.gov/photos/>)

Research Plan

- Separation using microfluidics
 - Microcapillary electrochromatography (μ CEC)
 - Low power and mass
 - Can be done at Titan surface conditions or in a 'warm box'
 - Separates both charged and neutral species
 - Chiral separation also possible
- Detection with fluorescence
 - Laser-induced fluorescence of labeled species (amino acids, aldehydes, ketones, carboxylic acids)
 - Fluorescence spectroscopy of intrinsically fluorescent species (PAHs)



A Chemical Analysis Protocol

Sample Acquisition



Separation



Characterization

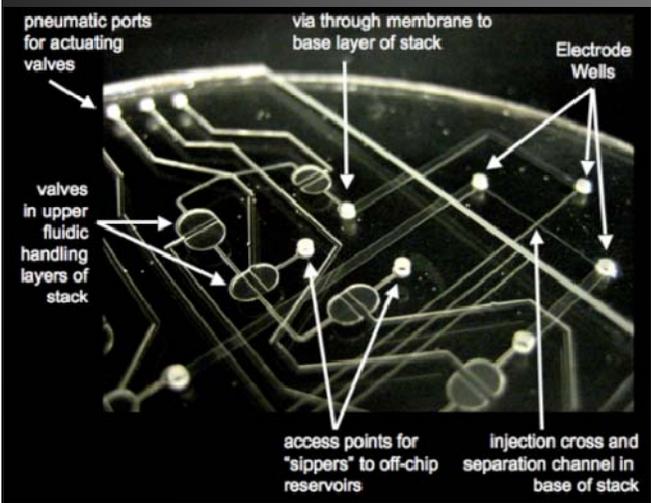
Microcapillary
Electrochromatography
(μ CEC)

Microcapillary
Electrophoresis
(μ CE)

Laser-Induced
Fluorescence

Fluorescence
Spectroscopy

Mass Spectrometry
(possibly)

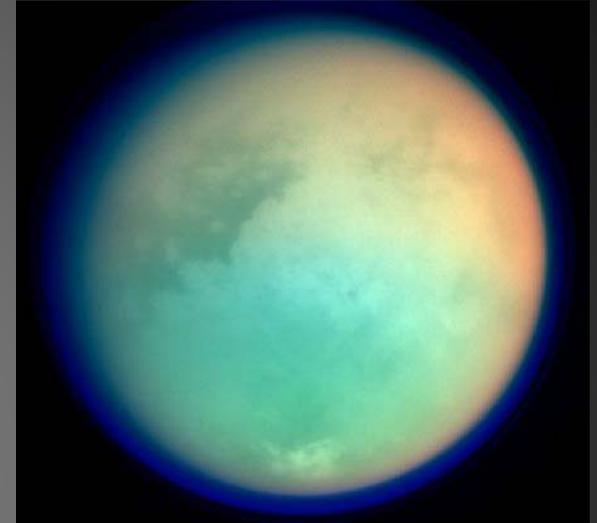


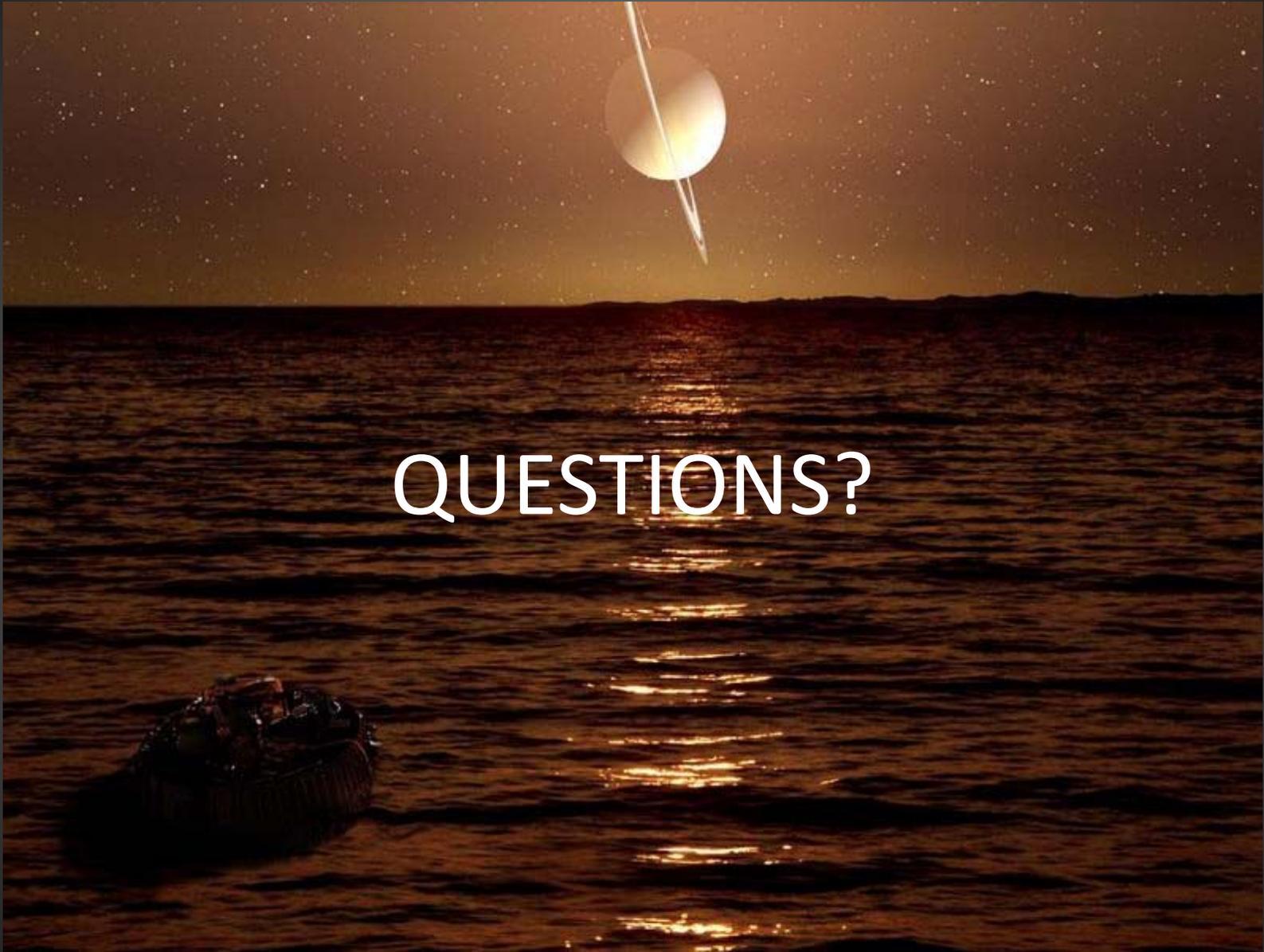
Approach:

- 1) Develop the Protocol and
- 2) Develop the Lab-on-a-Chip System to Perform It

Relevance

- Presence/distribution of organics
 - Evolution of atmosphere
 - Extent of geothermal activity
 - Effects of liquid water (hydrolysis, etc.)
- Generation of a planetary model of Titan
 - Atmosphere
 - Surface
 - Cryovolcanic flows
 - Hydrocarbon lakes
- Better our understanding of Earth and other worlds





QUESTIONS?