Interfacial Water as an ISRU Objective: A proposed investigation with internal reflectance spectroscopy (IRS)

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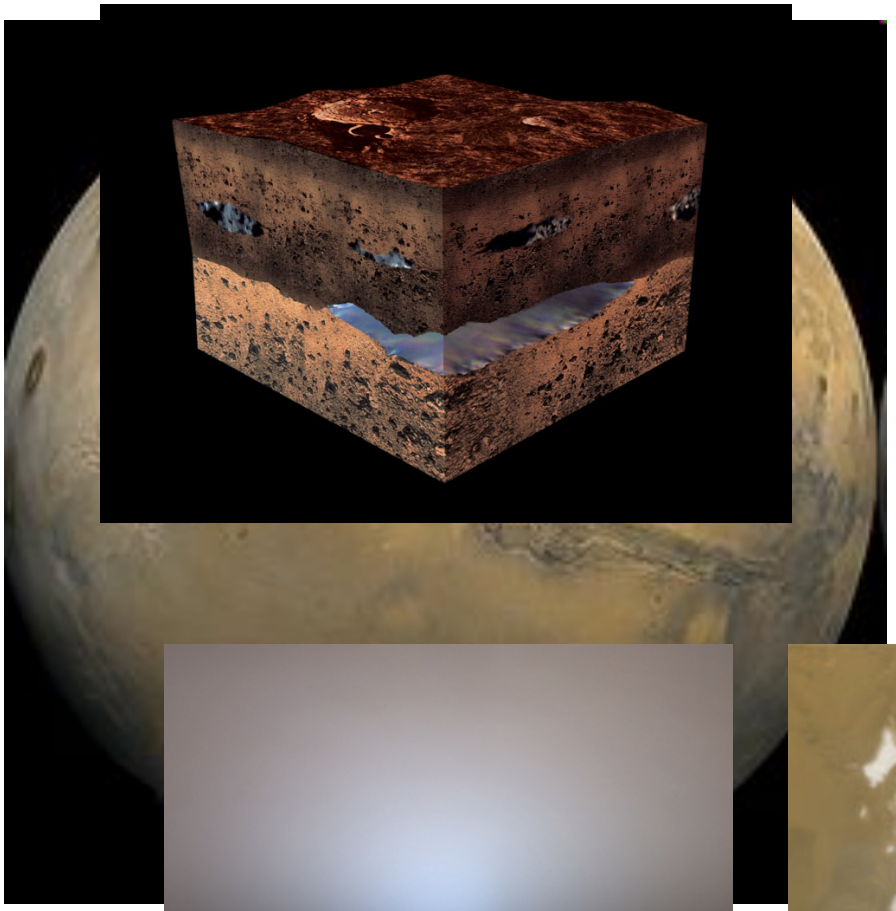
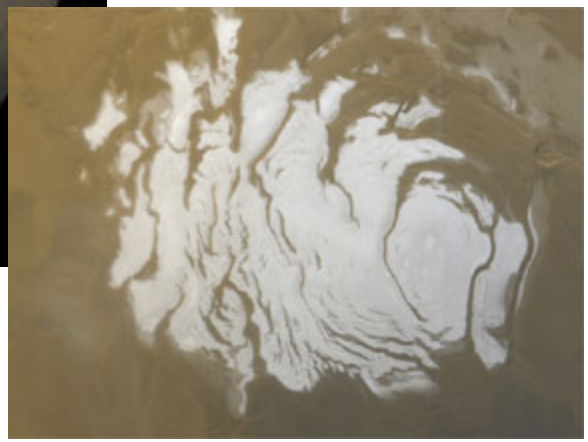
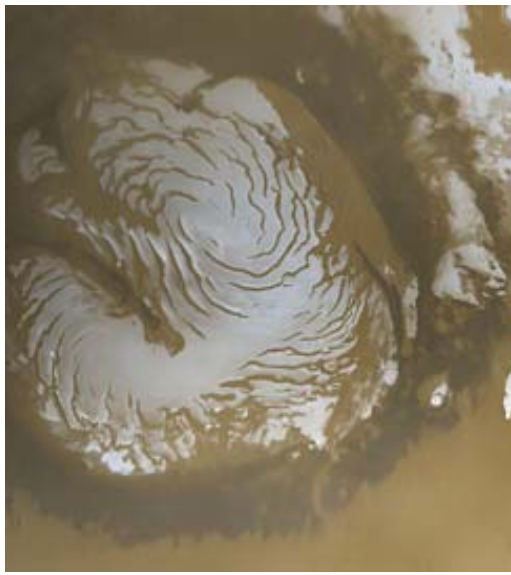
“Water, water, every where, nor any drop to drink”

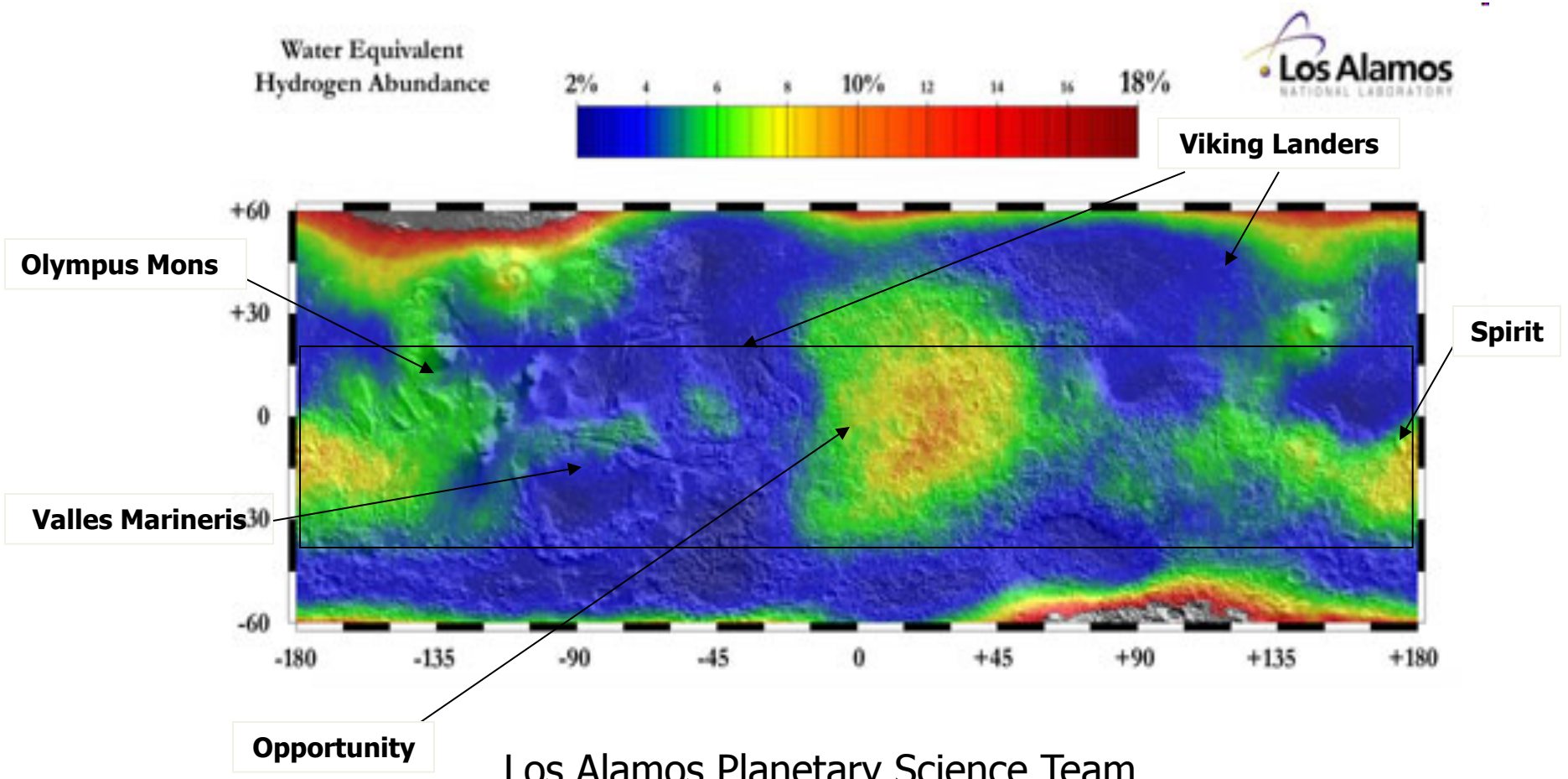


- Temperatures vary from 150K to 295K
- Water vapor column abundance ~10-100 pr **μm** (~10 pr **cm** on Earth!)
- Pressure is 600 Pascal





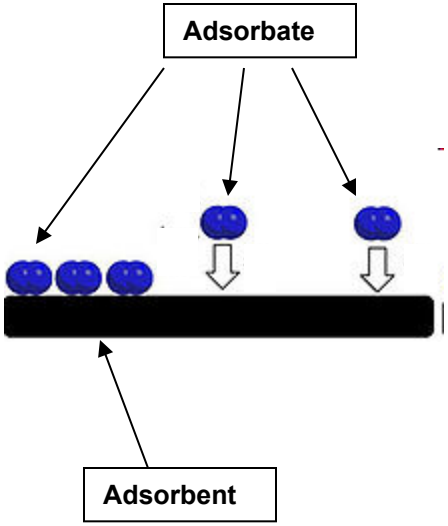
- Detection limited to <1 m below the surface.
- Hydrogen abundance = water



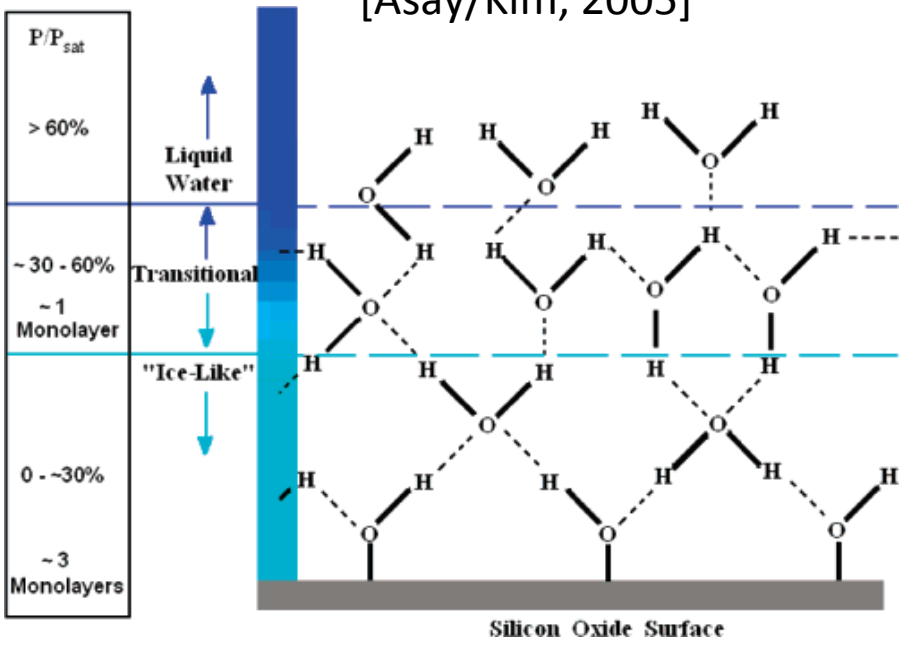
Los Alamos Planetary Science Team

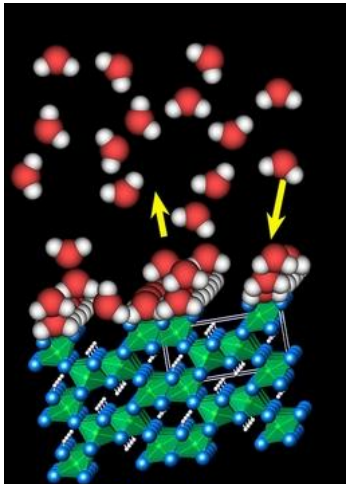
The adsorption of water by silicate minerals is a very common and ubiquitous process

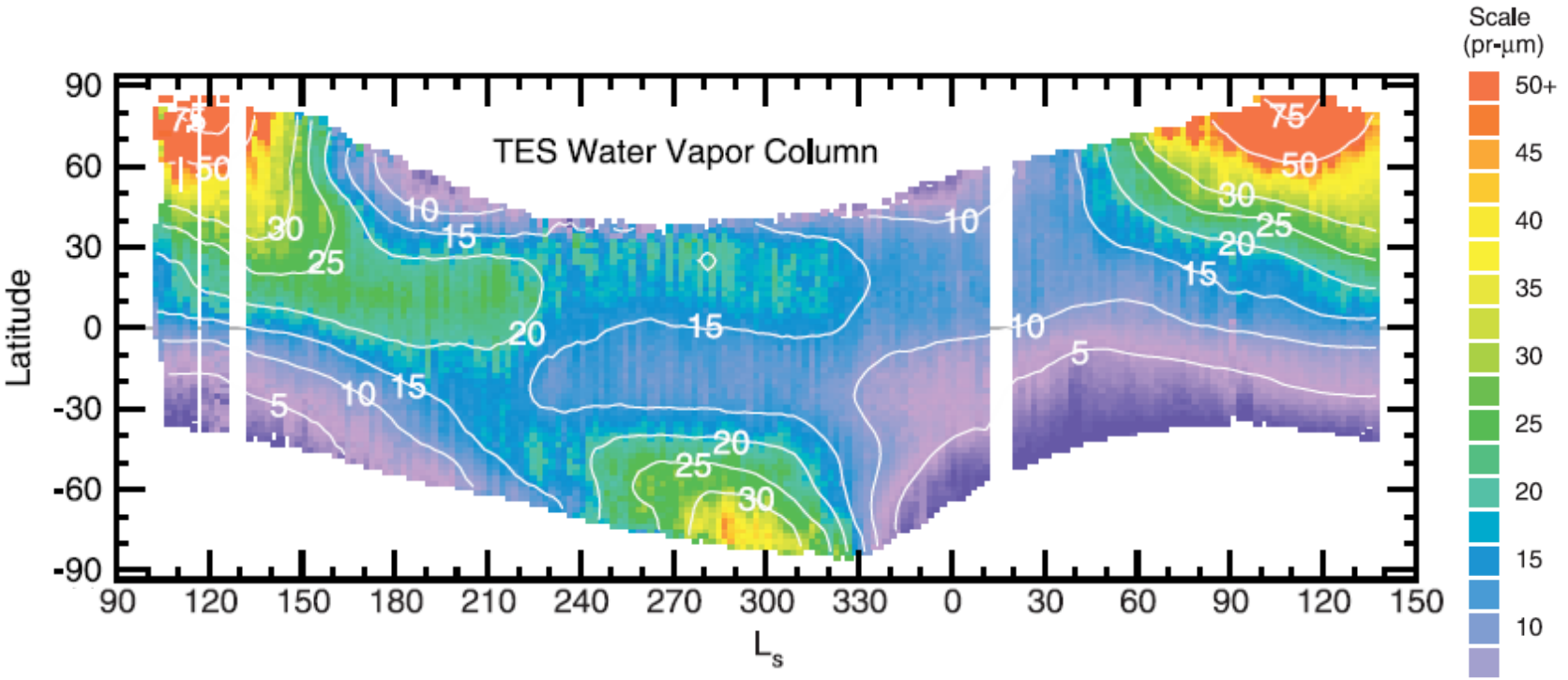
- Adhesion of atoms, ions, or molecules to a surface
- Occurs at a range of RH/T

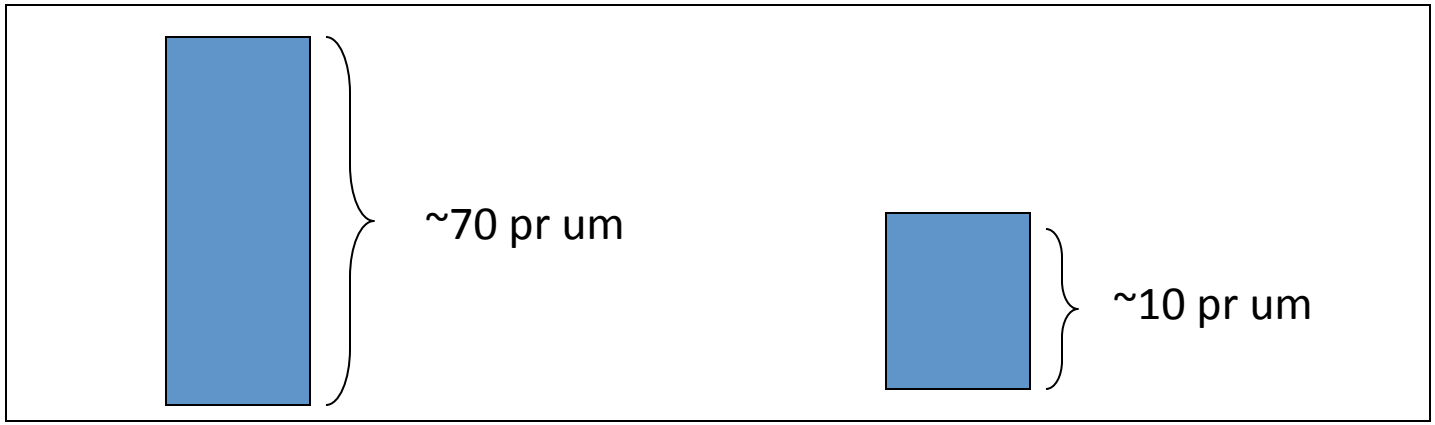


[Asay/Kim, 2005]









20-30 cm of soil*

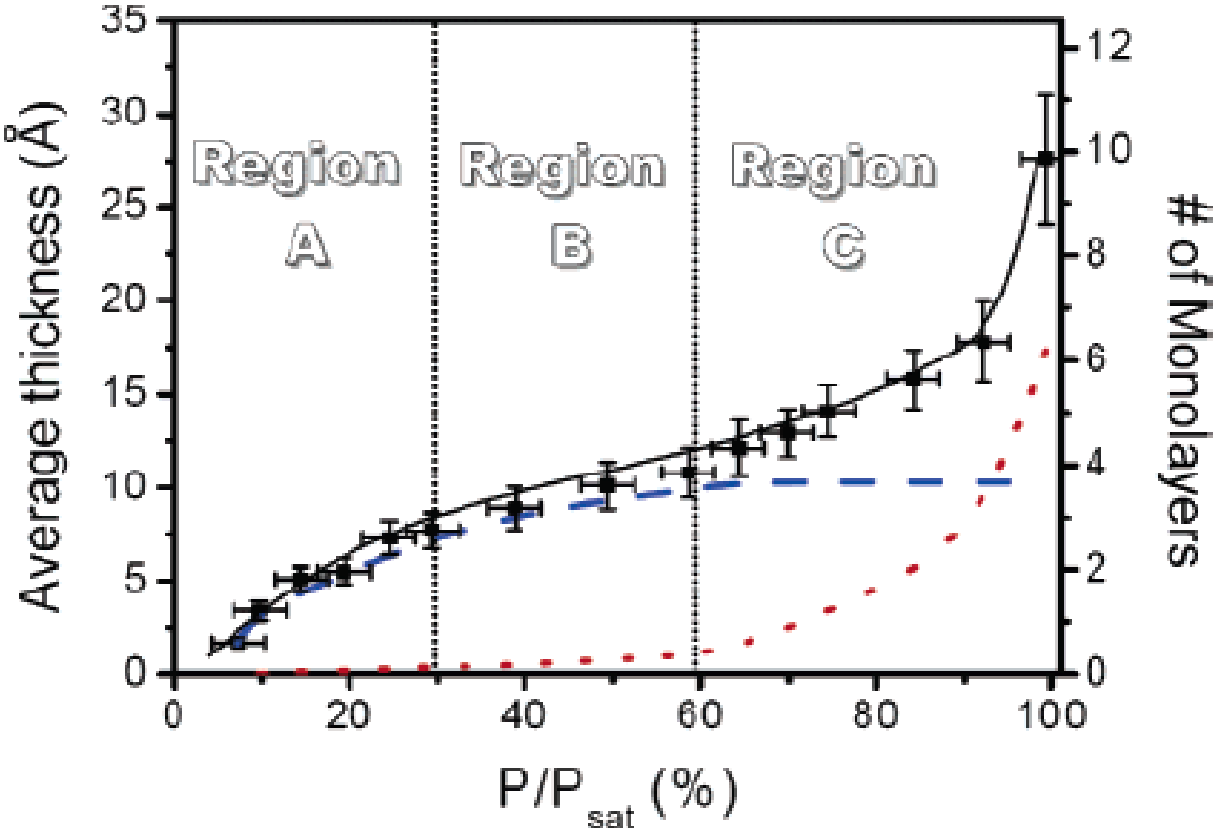
the atmosphere

*for small grains, d~1µm

[Smith, 2001]

- Adsorption layers
  - Relative humidity
  - Temperature

[Asay/Kim, 2005]



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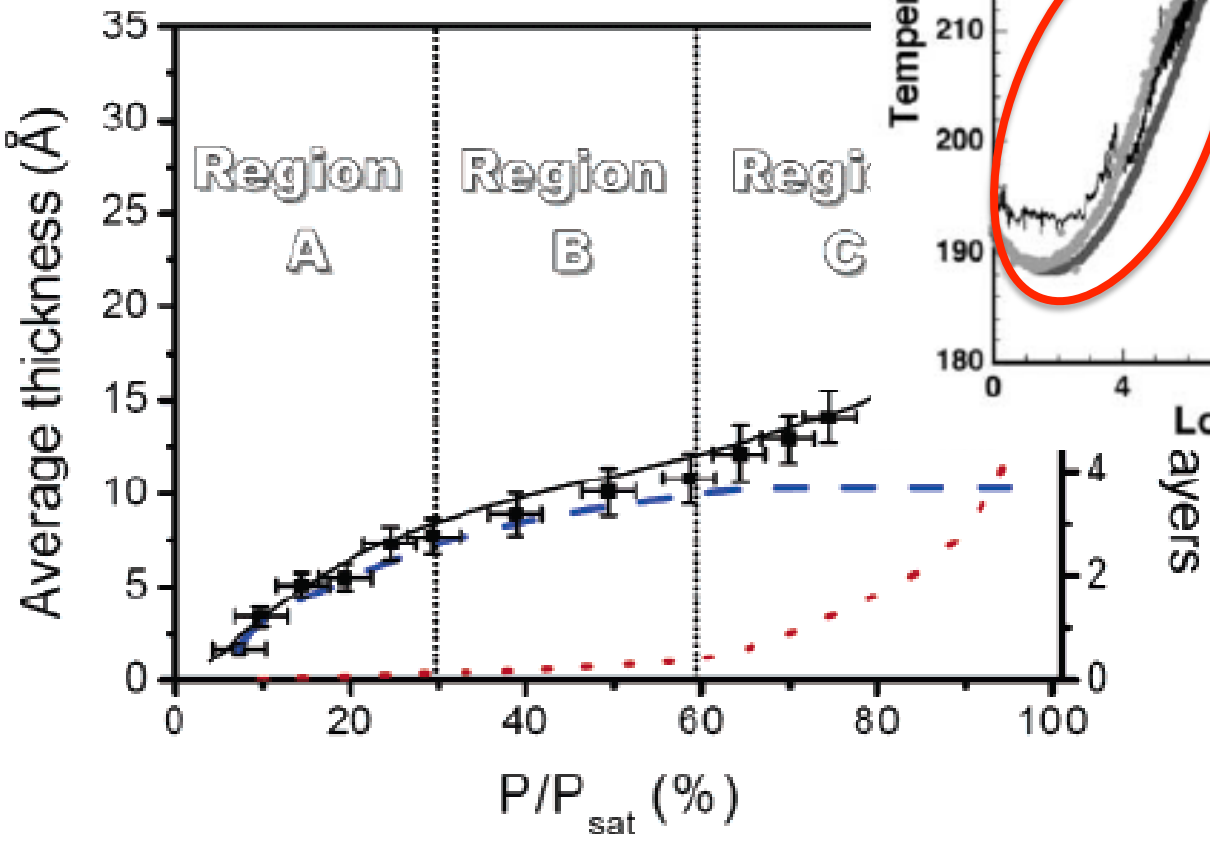
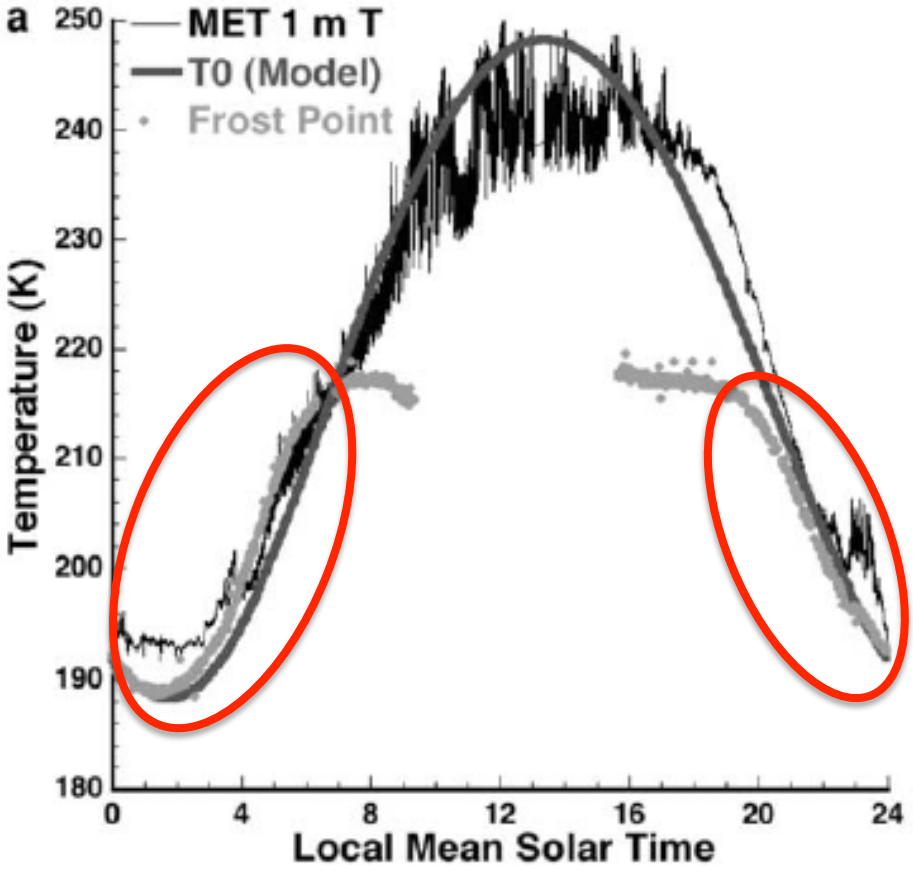
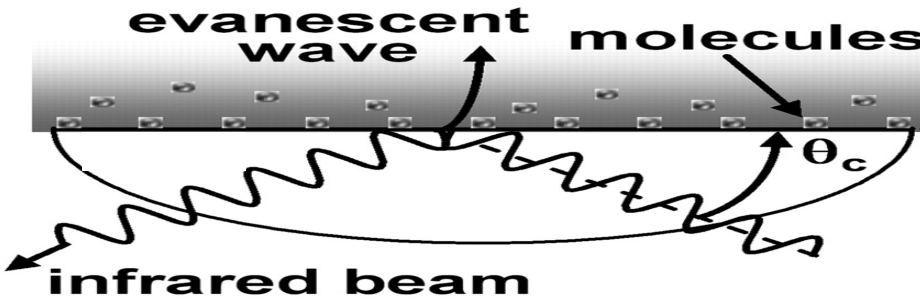
[Asay/Kim, 2005]

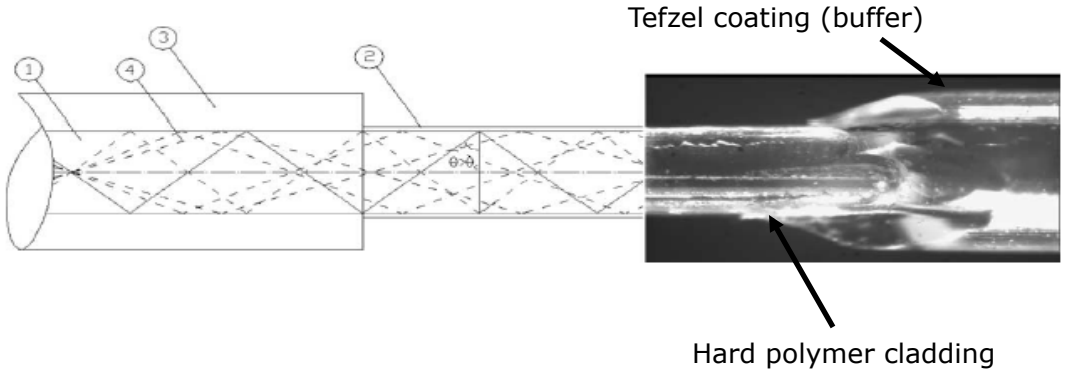




Internal Reflection Spectroscopy

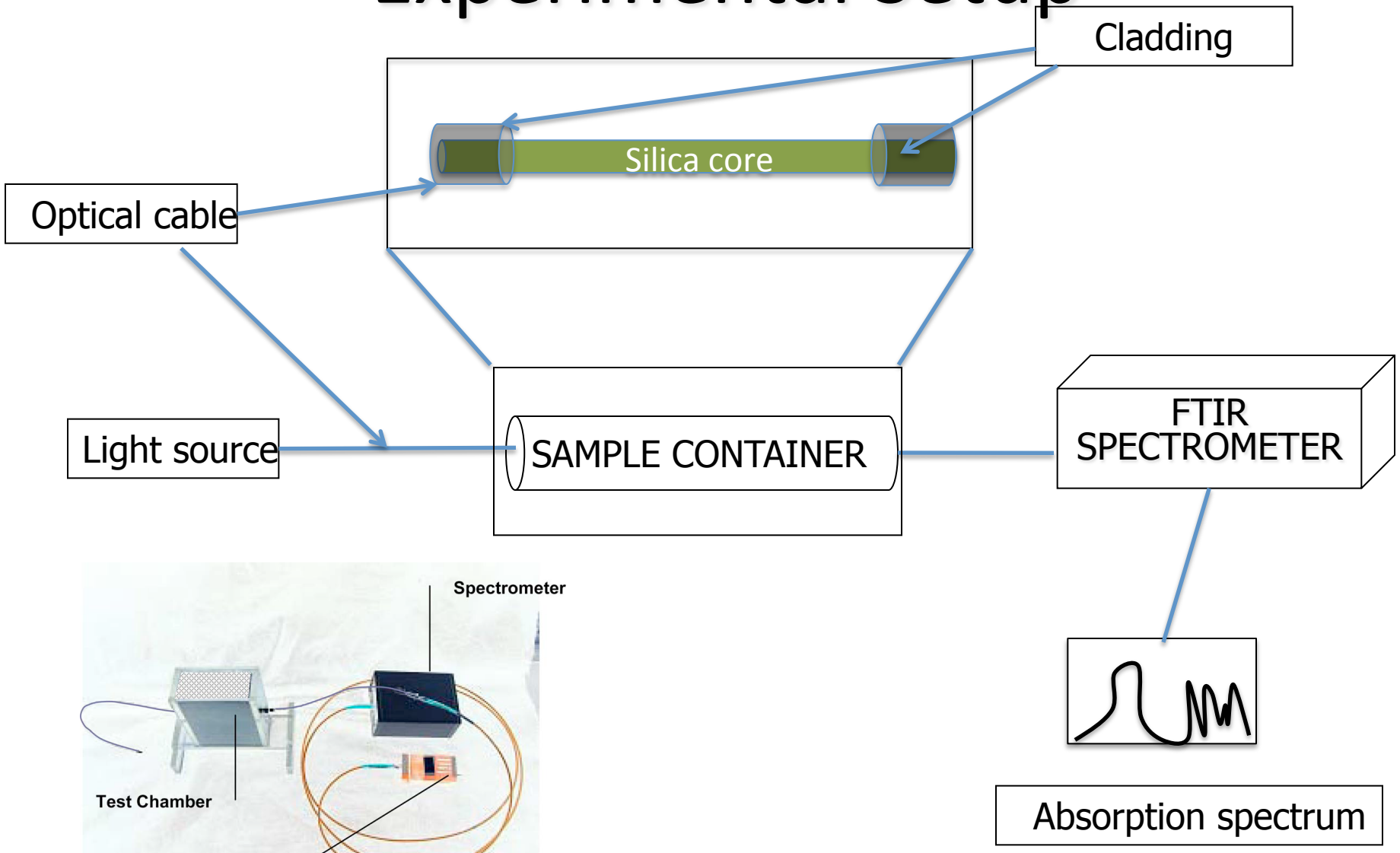
- IRS*
  - $\theta > \theta_c$
  - Spectra attenuated at absorbed λ
  - Absorbed λ characterizes surrounding medium
  - Able to "see" about a wavelength from interface



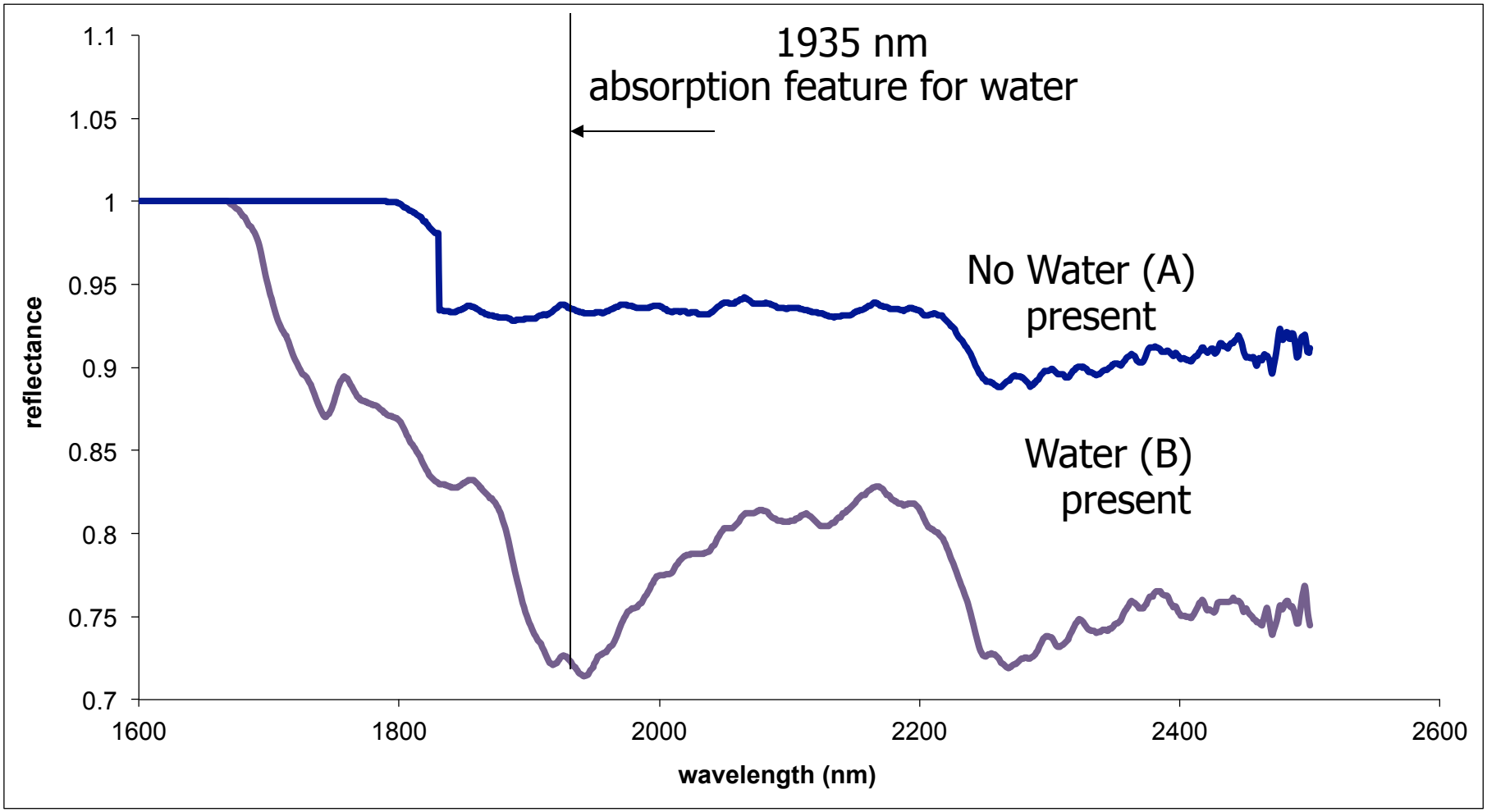


*Internal Reflection Spectroscopy

Experimental Setup

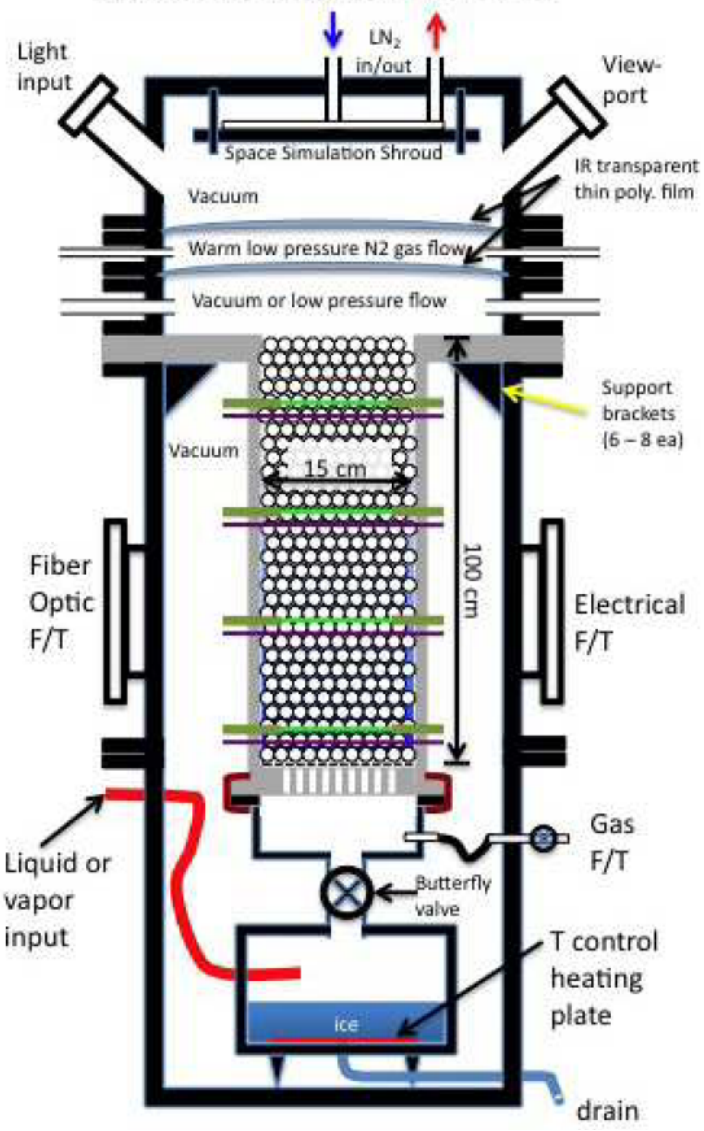


Technique: IRS



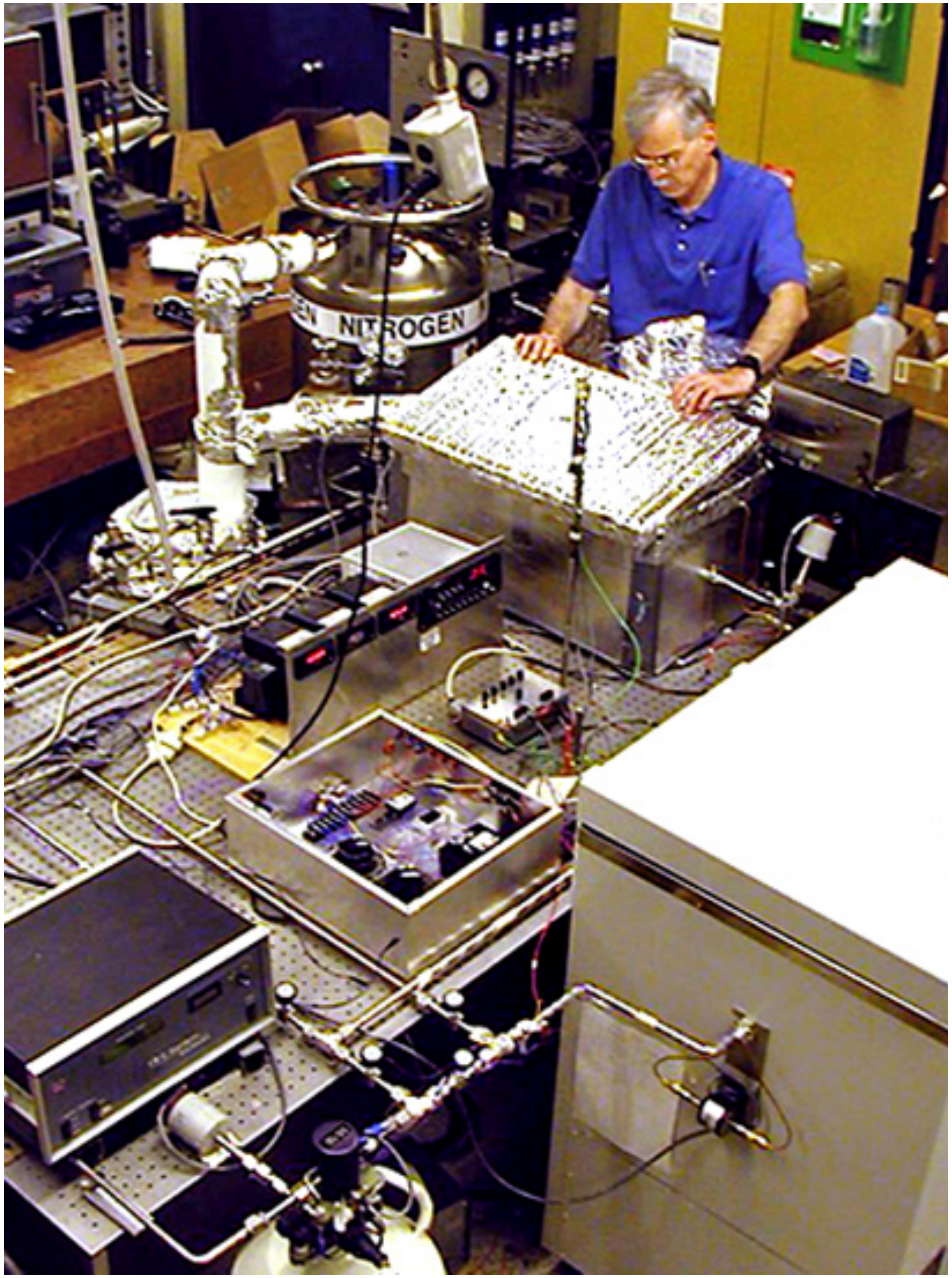
Icy-Regolith Simulation Chamber

- Controlled gradients of temperature and humidity
- Real-time, in-situ observations of quantities and fluxes of sub-surface water (adsorbate and ice)
- Applicable to Mars, Lunar poles, and Asteroids



[Image courtesy of S. Wood]

- Mars Atmospheric Simulation Facility
- University of Washington
- Department of Astronautics and Aeronautics
- PI: Dr. Adam Bruckner



Conclusion

- Quantify water present in near surface regolith
- Determine how adsorption process contribute to WEH signature
- This work can provide a useful tool to learn more about surface/sub-surface water on Mars and understand its kinetics

Acknowledgements

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Questions?