

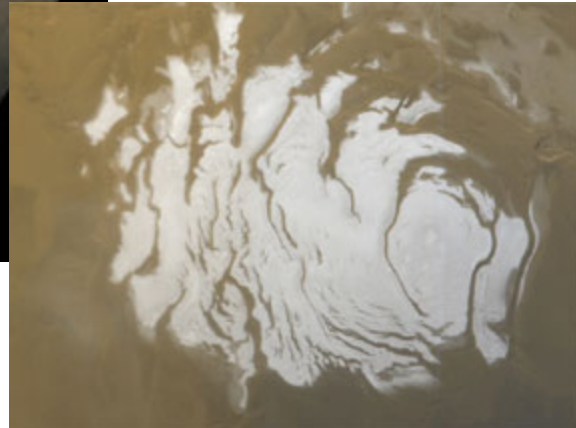
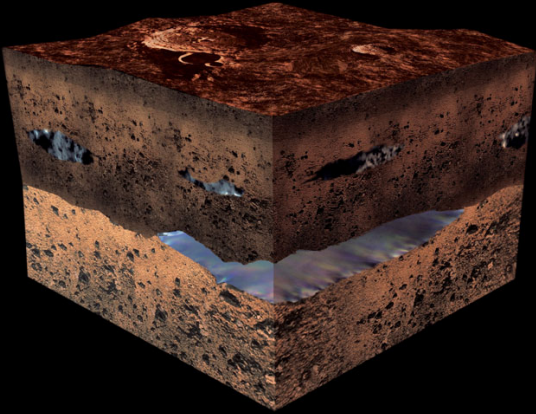
# Interfacial Water as an ISRU Objective: A proposed investigation with internal reflectance spectroscopy (IRS)

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*Third Joint Meeting of the Space Resources Roundtable and the Planetary  
& Terrestrial Mining Sciences Symposium*

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

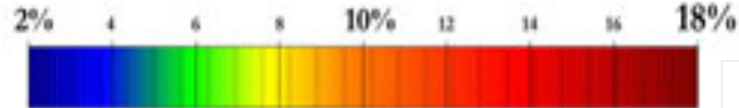
- Temperatures vary from 150K to 295K
- Water vapor column abundance  $\sim 10\text{-}100$  pr  $\mu\text{m}$  ( $\sim 10$  pr **cm** on Earth!)
- Pressure is 600 Pascal





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

Water Equivalent  
Hydrogen Abundance



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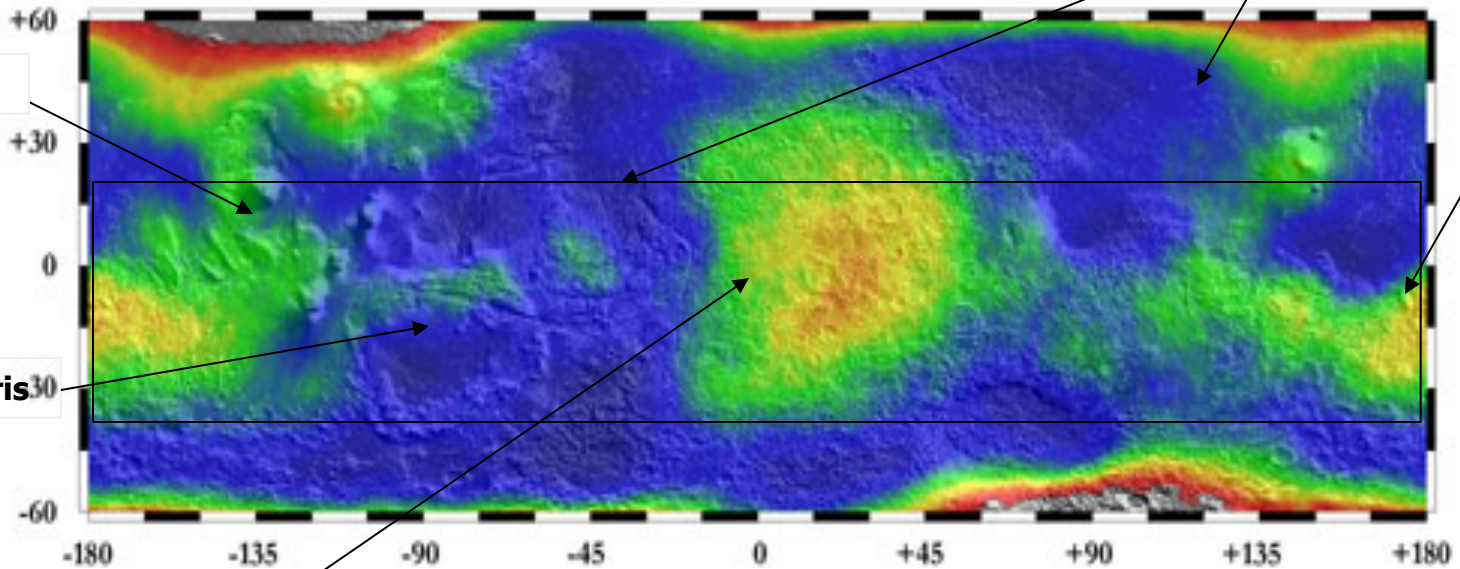
Viking Landers

Olympus Mons

Spirit

Valles Marineris

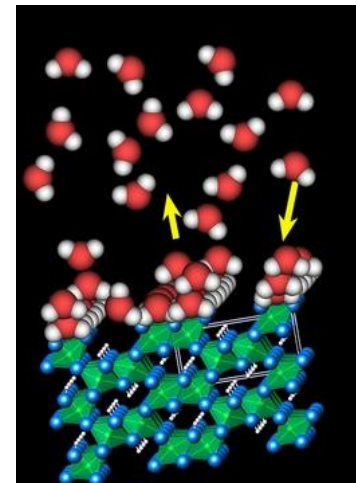
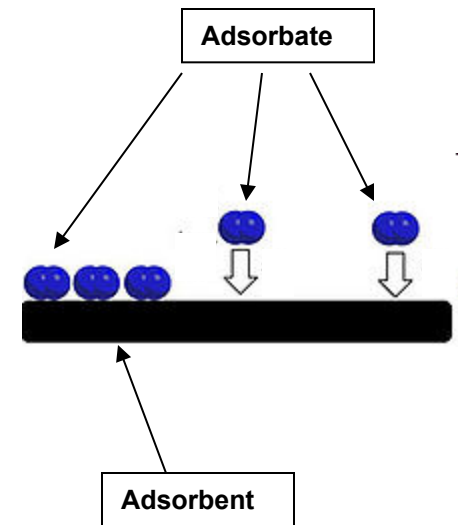
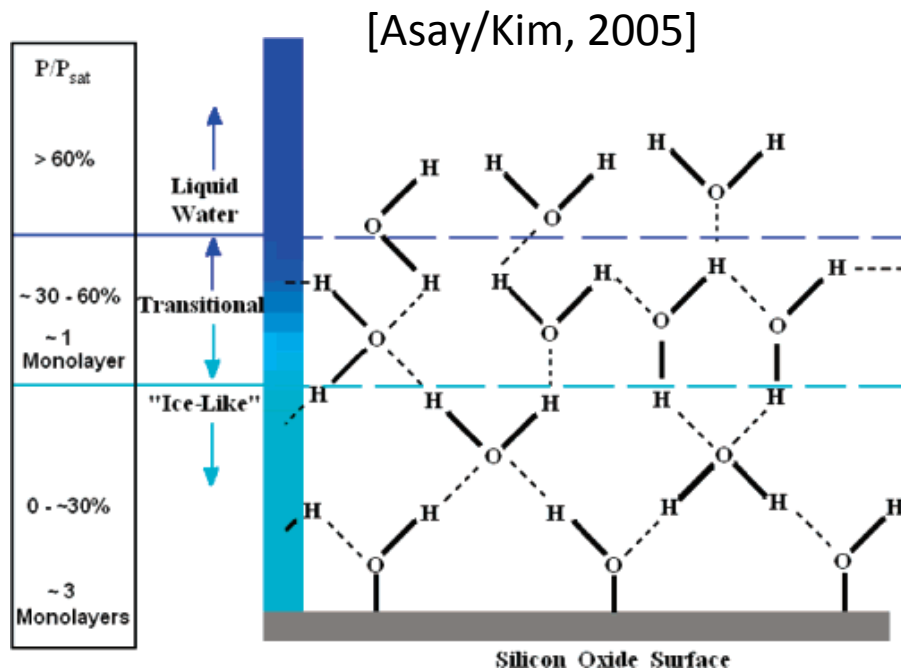
Opportunity

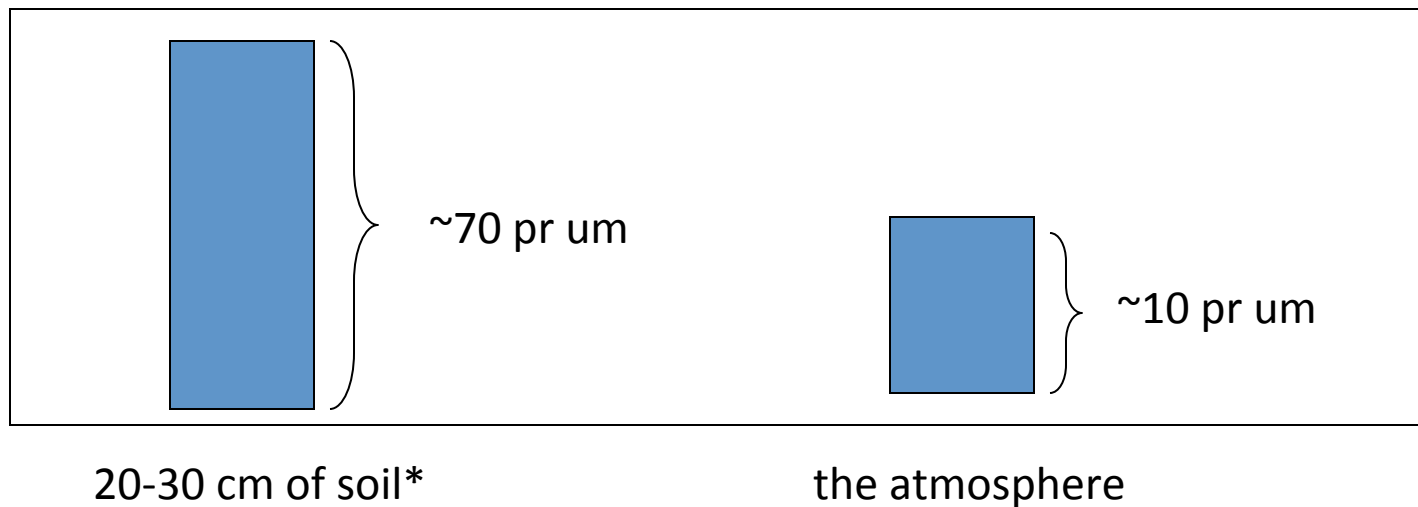
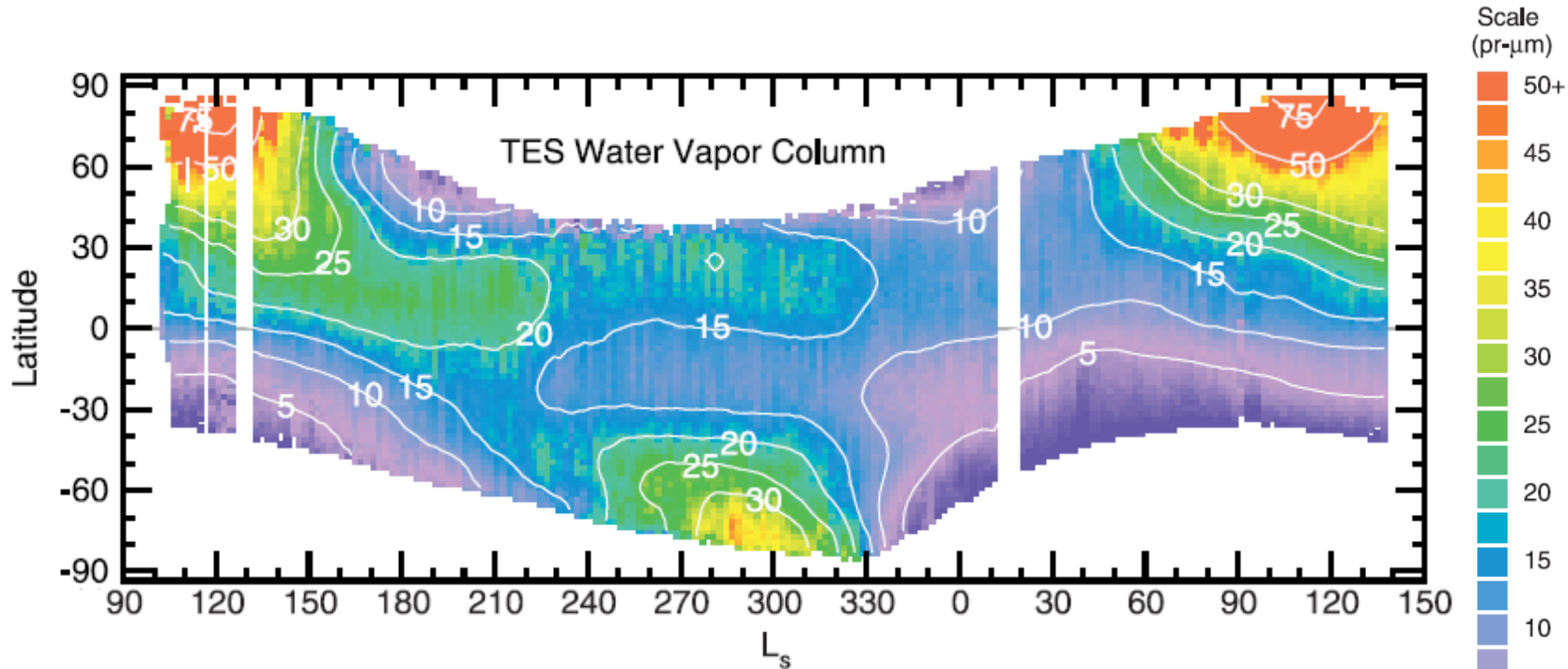


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# The adsorption of water by silicate minerals is a very common and ubiquitous process

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



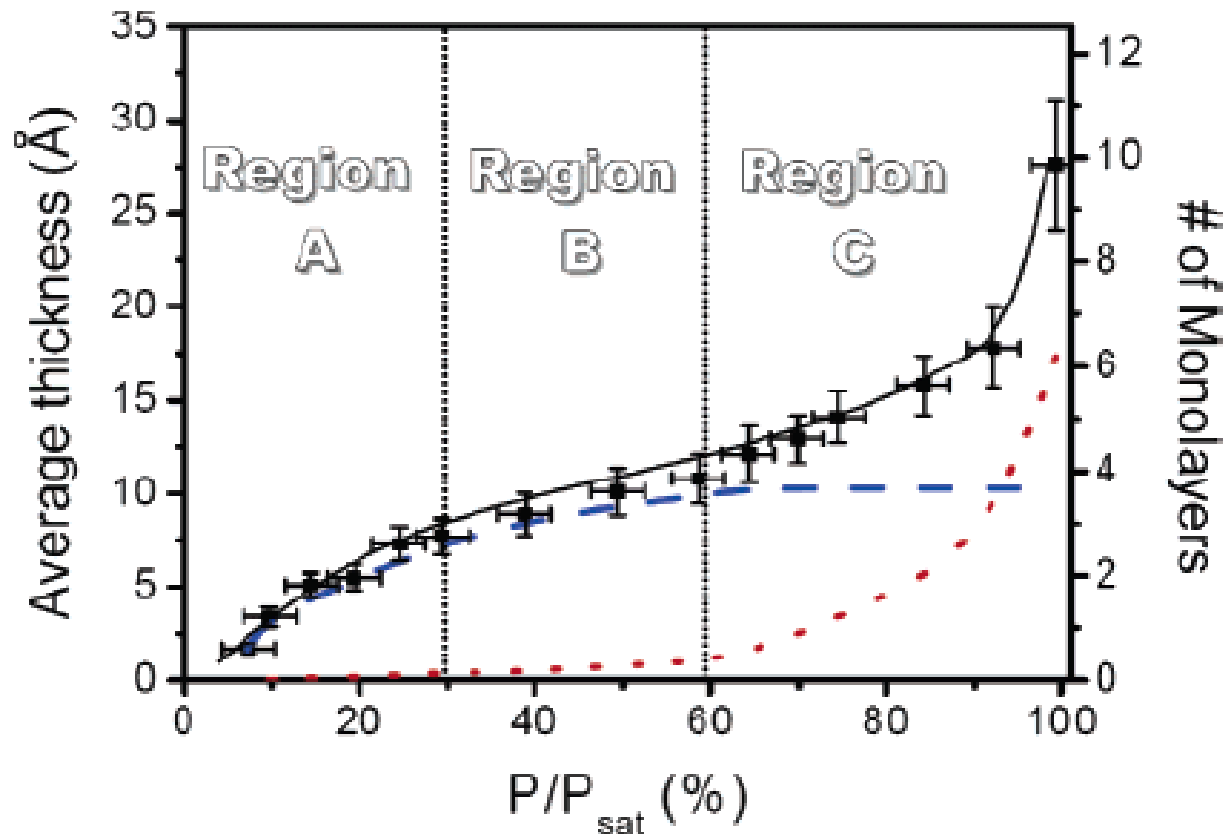


\*for small grains,  $d \sim 1 \mu\text{m}$

[Smith, 2001]

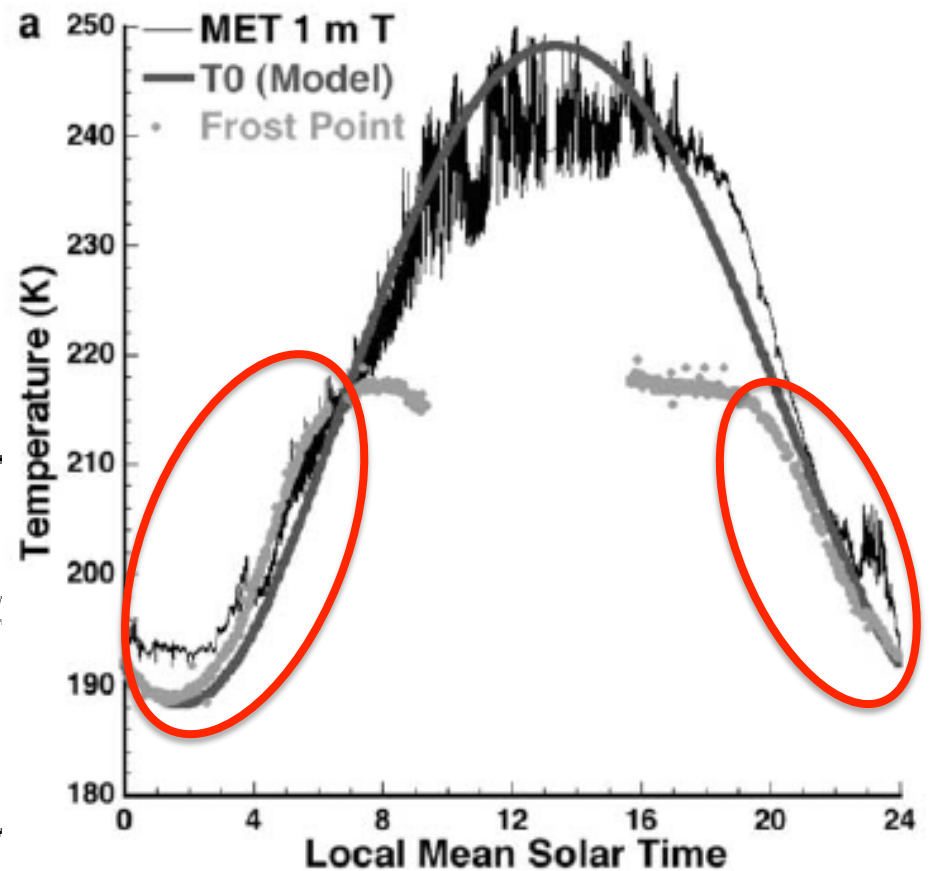
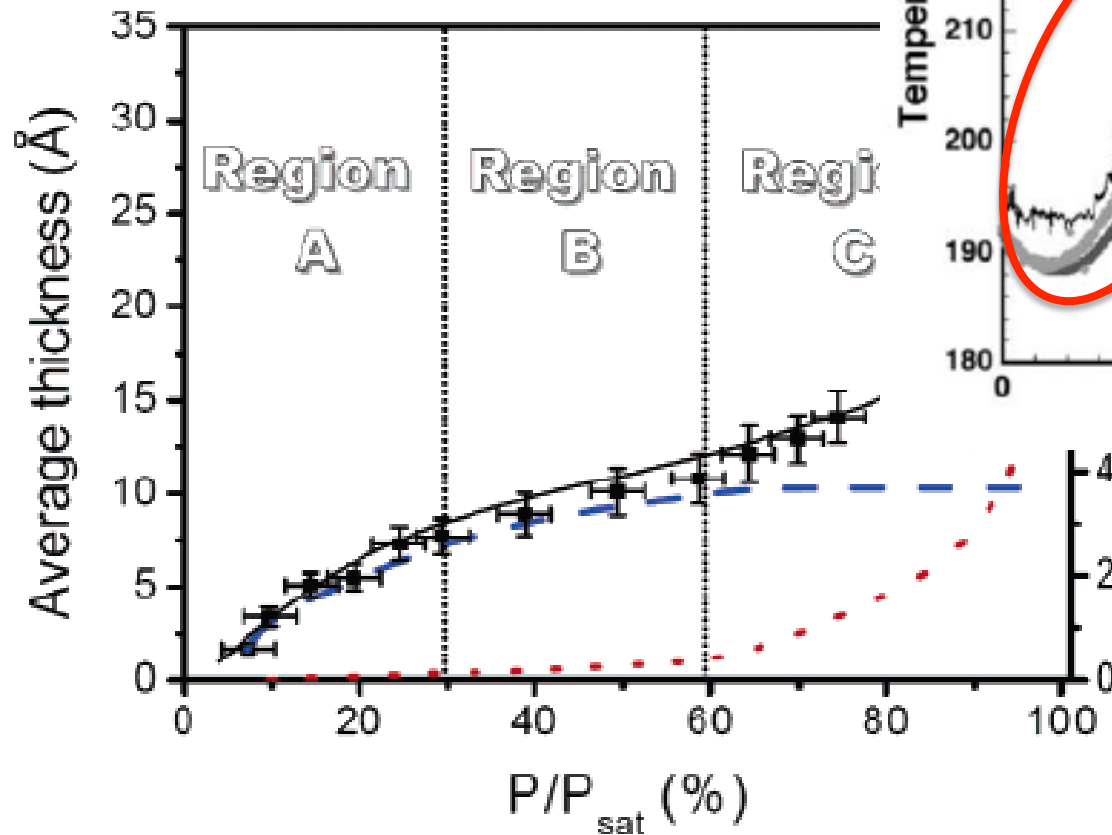
- Adsorption layers
  - Relative humidity
  - Temperature

[Asay/Kim, 2005]



- Adsorption layers
  - Relative humidity
  - Temperature

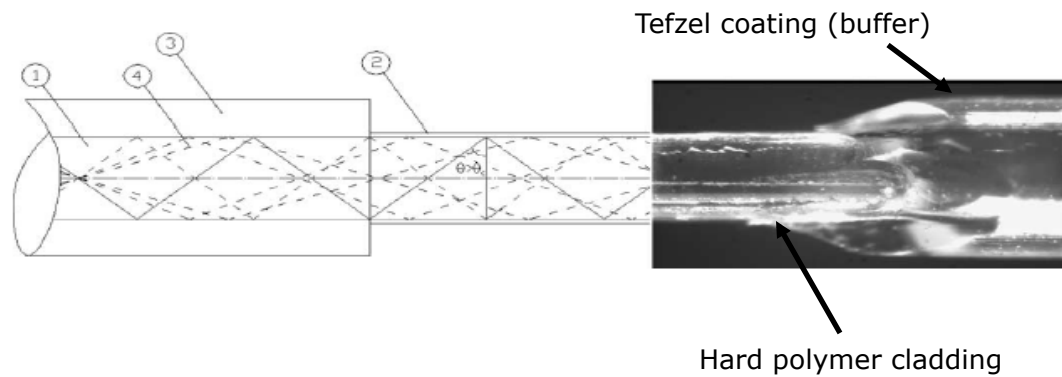
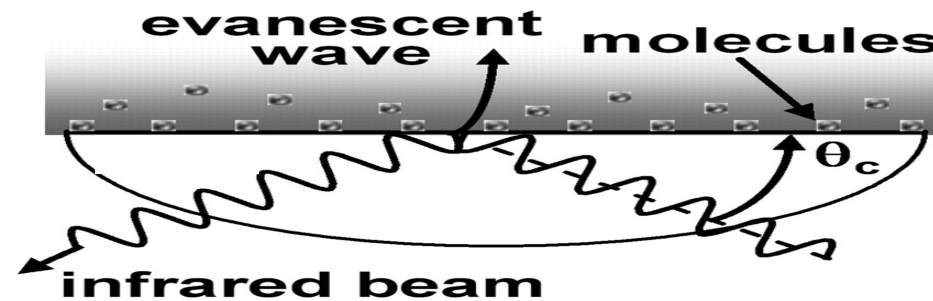
[Asay/Kim, 2005]





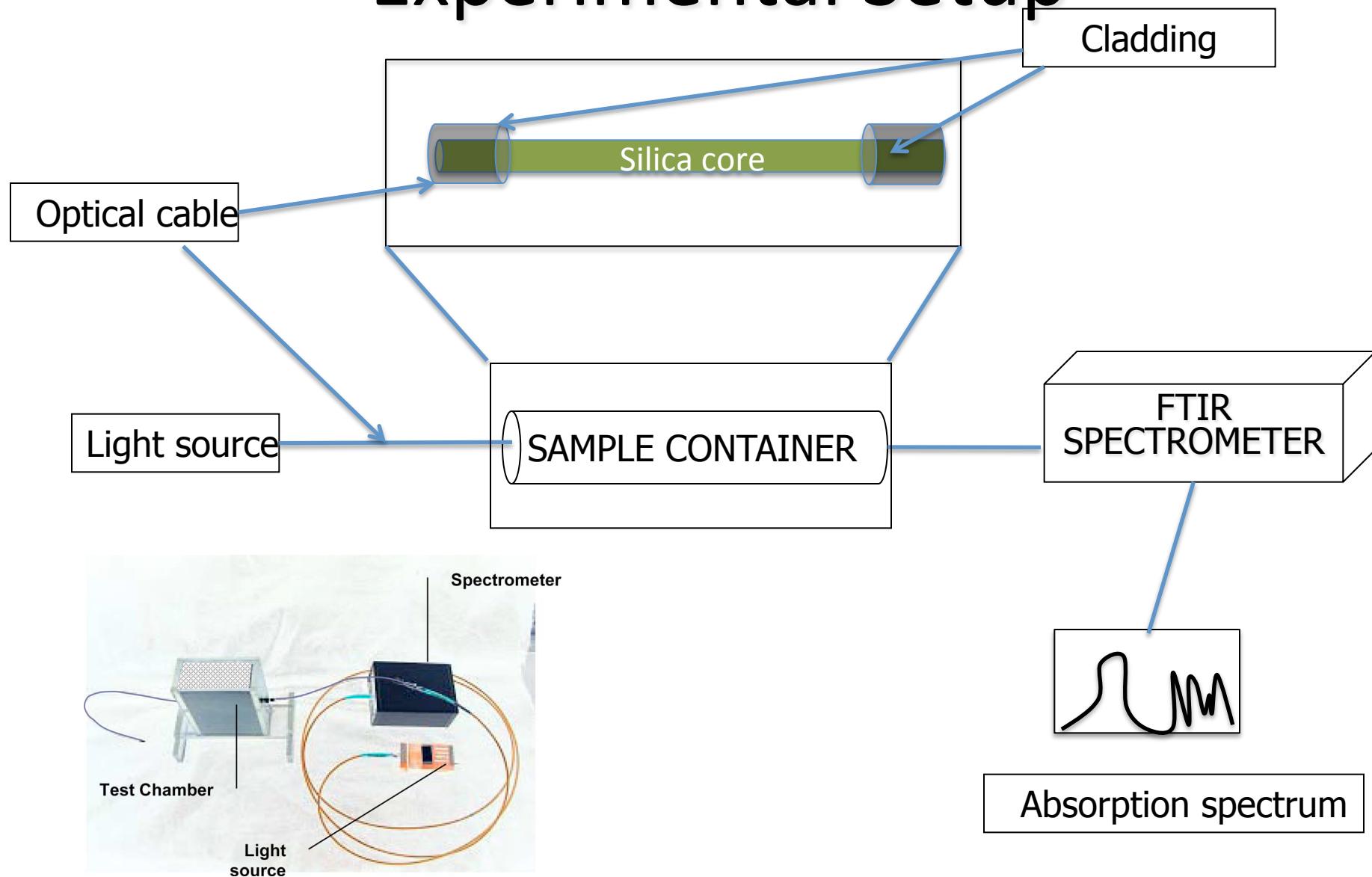
# Internal Reflection Spectroscopy

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

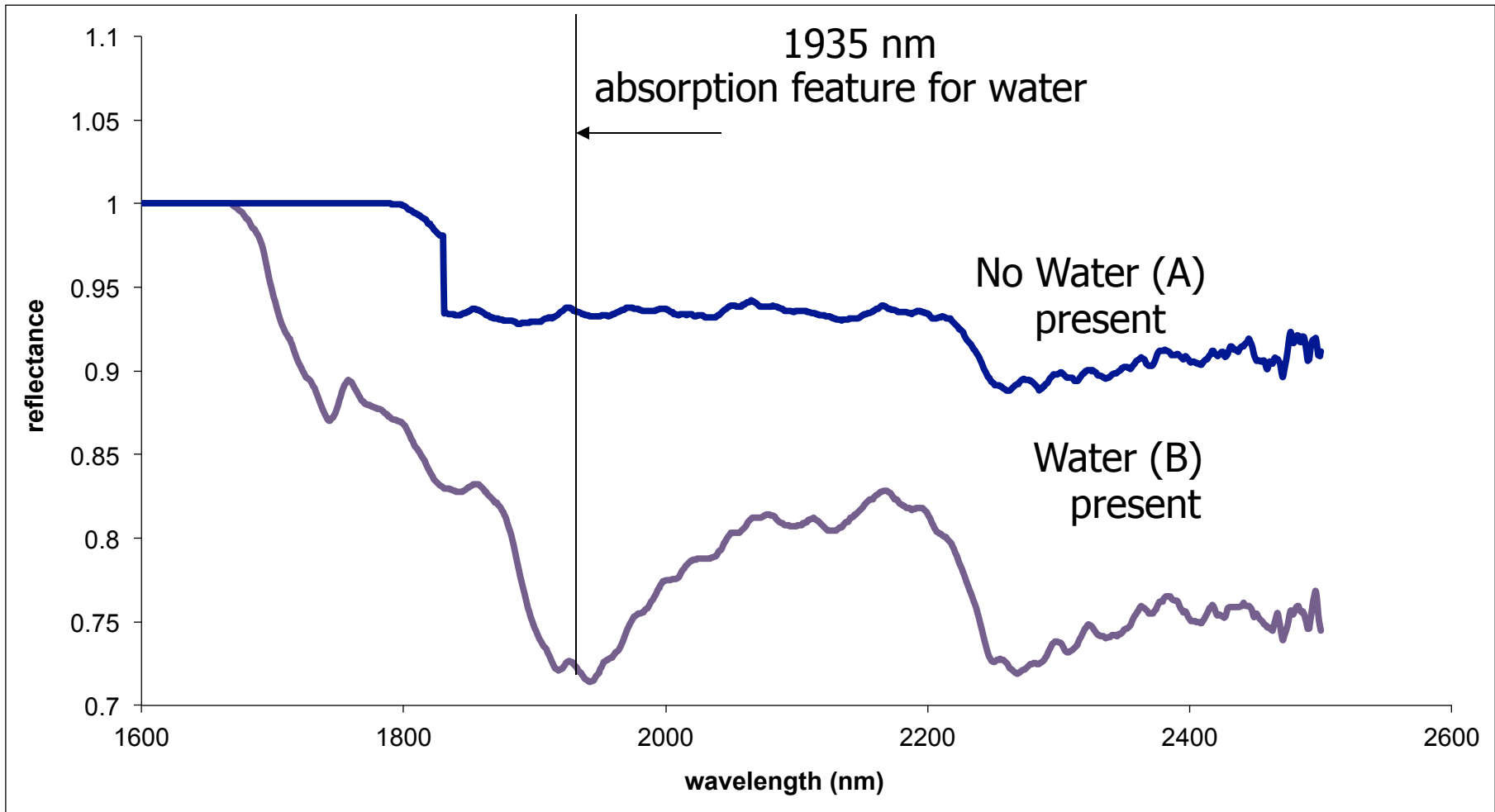




# Experimental Setup

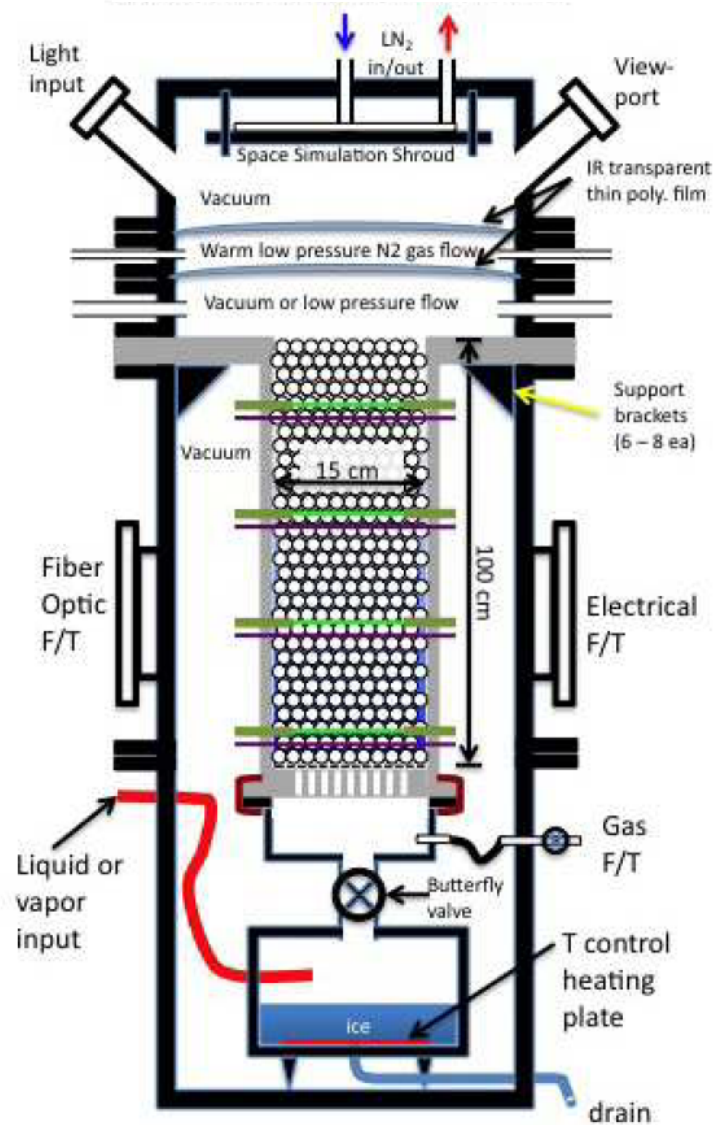


# Technique: IRS



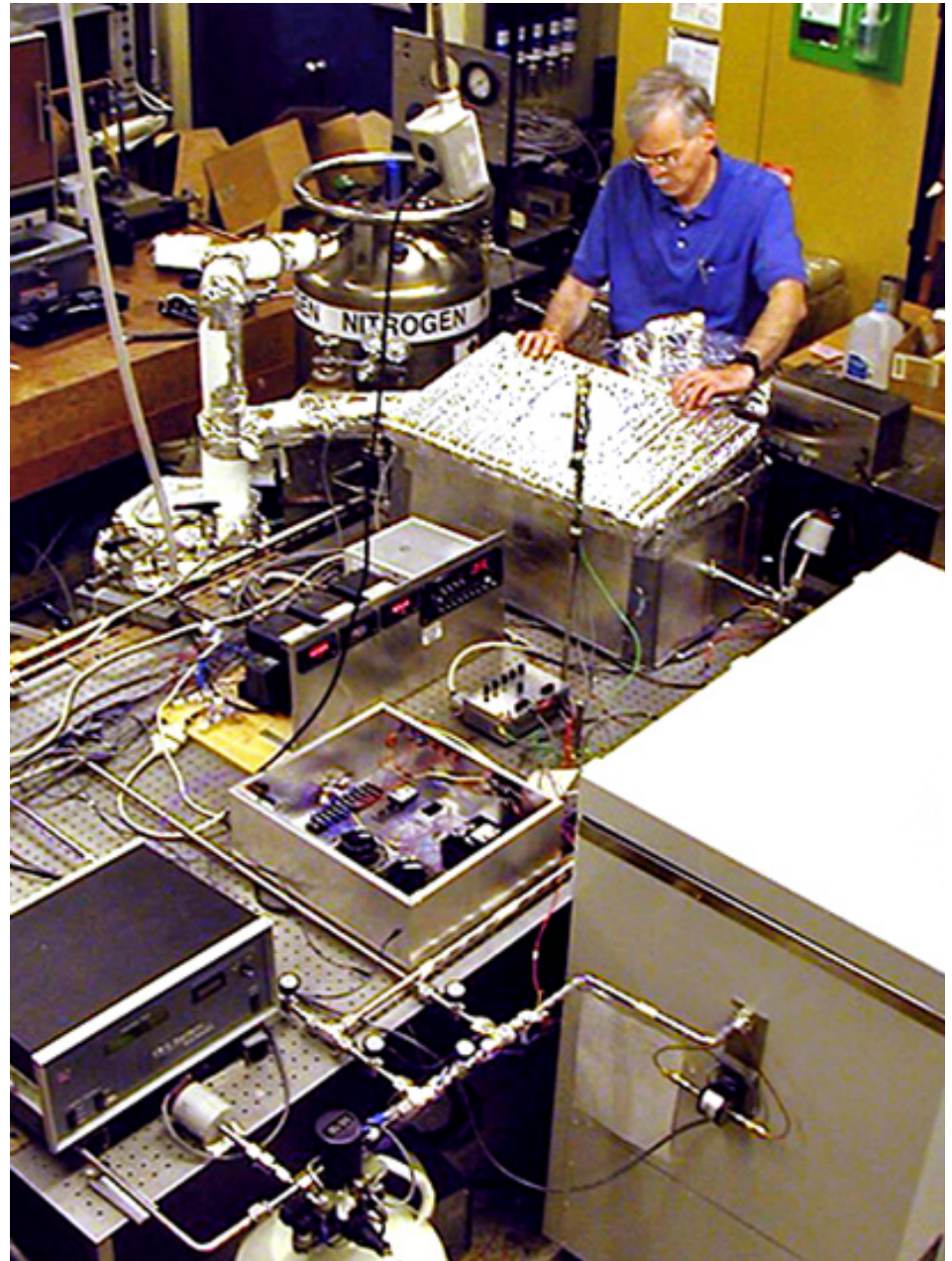
# Icy-Regolith Simulation Chamber

- 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

- Dr. Evan Abramson, University of Washington
- Dr. Adam Bruckner, University of Washington
- Graduate and Minority Achievement Program (GOMAP)
- National Science Foundation (NSF)



A detailed illustration of a Mars colony. In the foreground, two astronauts in white and blue spacesuits are crouching on the reddish-brown soil. The astronaut on the left is looking towards the camera, while the one on the right is looking down at something in their hands. In the background, there are several small, white, dome-shaped structures and a larger, more complex building. A bright, glowing light source, possibly the sun or a distant star, is visible on the horizon, casting a long, bright beam of light across the sky. The overall scene is set in a vast, arid, and rocky landscape with a hazy, orange-tinted sky.

Questions?