INTERFACIAL WATER AS AN ISRU OBJECTIVE: A PROPOSED INVESTIGATION WITH INTERNAL REFLECTANCE SPECTROSCOPY. O. Igbinosun[1] and S. Wood [2] Department of Earth and Space Sciences Box 351310, University of Washington, Seattle WA 98195, [1]osaig@uw.edu, [2]sewood@ess.washington.edu

Introduction: Water on Mars is always of interest to the scientific community but an understanding of how local resources can be utilized for human space missions need also be addressed. ISRU (In-Situ Resource Utilization) can significantly reduce the mass of consumables needed for manned space missions, thus reducing the mass needed to disembark from Earth. Materials for life support (such as oxygen and water), rocket propellant, construction materials, and energy are just a few examples of potential resources.

There are three dominant reservoirs of water on Mars—polar regions, the atmosphere, and the subsurface. However, interfacial water, water that exists at interfaces (i.e. thin liquid films present at the interface between mineral grains and ice) could be a more useful site for extracting consumable water. Spectral data suggests that minerals, such as zeolites, are present on the surface of Mars. Zeolites exhibit a micro-porous structure, providing significant surface area for water adsorption. Conditions that would allow individual mineral grains to maximize water adsorption could potentially hold up to ~1.5 times their weight in water (e.g. a kg of soil yields 1.5 kg water).

Studies have shown that extracting atmospheric water vapor via molecular sieve adsorption at Mars conditions is feasible [1], but the volume of water acquired from the atmosphere would not be sufficient to support manned missions. This is due to the paucity of water available in the atmosphere of Mars (~10 precipitable microns [global annual average] [8]). WEH (water equivalent hydrogen) values equator-ward of the polar regions suggest significant amounts of water in the near surface. However, the availability of this water and its extractability is unknown.

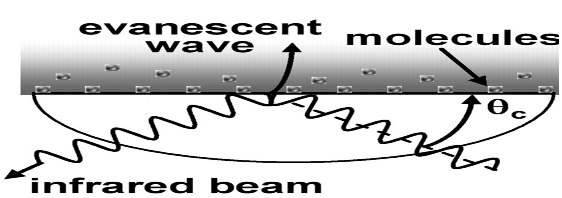

Fig.1

Methods: Internal reflection spectroscopy (IRS) exploits the evanescent field of internally reflected light (Fig. 1). As light is attenuated by a surrounding medium, an absorption spectrum of the medium can be obtained. Room temperature observations of water adsorption on silica surfaces utilizing IRS via a silicon crystal have been performed [2]. These experiments show that adsorbed water can be quantified at a range of relative humidities (Fig. 2). Modifying this technique to include fiber optic cables will allow us to determine how much adsorbed water exists during a diurnal temperature cycle on Mars. Premilinary results show a strong absorption via the evanescent field at 1935 nm (asymmetric stretch/bend) of water for a 15cm declad section at room temperature (Fig. 3).

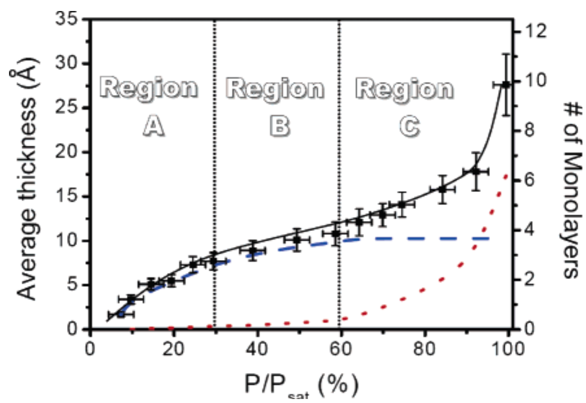

Fig. 2 [2]

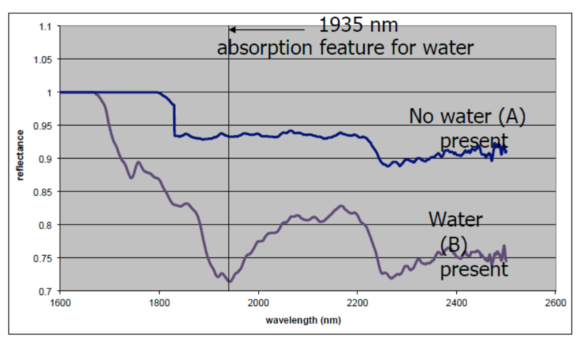

Fig. 3

Quantification of adsorbed water layer structure will be achieved by in situ observation of Mars soils at appropriate environmental conditions. Adsorption processes will be observed using fiber optical cables coupled to a spectrometer to observe changes in discreet O-H stretching/bending absorption bands (e.g. 3230, 3400, and 1630 wave numbers). Data collected from this experiment will be used to model adsorption water layer structure relative to water vapor partial pressure and temperature on diurnal time scales. The stability of these layers on temporal timescales can indicate how much water could be available for mining purposes.

References:

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