Chittenden, Julie; Chevrier, V.; Sears, D. W.; Roe, L. A.; Bryson, K.; Billingsly, L.; Hanley, J. (2006) Insights into Interactions of Water Ice with Regolith under Simulated Martian Conditions. American Astronomical Society, DPS meeting #38, #61.04

Abstract

In order to understand the diffusion process of water vapor through regolith, we have investigated the sublimation process of subsurface ice under varying depths of JSC Mars-1 soil simulant under martian conditions. Measurements were made at 0oC and 5.25 Torr in a CO2 atmosphere. We corrected for variations in temperature of the ice and the difference in gravity of Mars in relation to the Earth. Our results show that for depths up to 40 mm the process is mainly diffusion controlled and that for thicker regolith layers, desorption becomes the main process. After correction for the effect of desorption, we observed a decrease in sublimation rate from 0.625 ± 0.073 mm.h-1 at 5 mm of soil to 0.187 ± 0.093 mm.h-1 for 200 mm of soil. To characterize the diffusion process, we use the Farmer model (1976), which hypothesizes that the sublimation rate is equal to the diffusion coefficient divided by the soil depth. The derived diffusion coefficient from this data is 2.52 ± 0.55 mm2.h-1, or 7.0 ± 1.5 x 10-10 m2.s-1. Knowing the diffusion coefficient in the regolith, we can calculate the survival time, ?, of a layer of ice under a regolith layer which is given by t = liceL/D, where lice is the thickness of the ice layer. Using this equation, we find that a 10 cm-thick layer of ice buried under 1 m of regolith would last for more than 4 years at 0oC. Therefore, our study indicates that the transport of water through a regolith layer is a complex multi-faceted process that is readily quantified by laboratory investigations. This is especially important in interpreting previous theoretical models and in understanding in situ observations to be performed by martian landers such as Phoenix. The W.M. Keck Foundation funded this research.