Bryson, Kathryn; Chevrier, V.; Sears, D. W. (2007) An Experimental Study of the Behavior of Ice Under a Basalt Regolith and Implications for the Martian Diurnal Water Cycle, the Formation of Liquid, and the Presence of Ice at Low Latitudes on Mars. American Astronomical Society, DPS meeting #39, #17.07

Abstract

To understand the role played by a regolith layer on the stability of ice on Mars, we have studied sublimation of ice beneath various layers of fine-grained (< 63 µm, 63-125 µm, and 125-250 µm) basaltic regolith under simulated martian conditions. Diffusion through shallow depths, < 10 mm, was determined to be controlled by both the diffusivity of the regolith and diffusion through the atmosphere. For depths greater than 10 mm, the diffusion coefficients of water vapor through the < 63 µm, 63-125 µm, and 125-250 µm basaltic regoliths were determined to be 2.50 ± 0.84 x 10-4 m2s-1, 3.17 ± 1.27 x 10-4 m2s-1, and 5.02 ± 2.04 x 10-4 m2s-1, respectively, in agreement with theoretical values. These rather large diffusion coefficients suggest that diffusion of water through the regolith is rapid and diffusion is not a barrier to effective communication between atmospheric and condensed water. However, contrary to our initial expectations, our basalt samples have high adsorption constants. Thus despite high diffusion coefficients, adsorption by fine-grained basalt could explain the purported diurnal variations in atmospheric water content on Mars. Our data also indicate that thin, shallow ice deposits would last for more then 10 hours at temperature near 224 K. Temperatures during N. summer solstice remain above 224 K for longer than 10 hours, so that pure water and even saturated brine ices will dissipate before liquid can form. Lastly, our data indicate that for thicker ice layers, say 1 m, covered by 3 m of fine-grained basaltic regolith ice at 195 K would have survived since the last major obliquity change. For low latitudes of subsurface ice to last from a major obliquity change, the ice layer would have to either be thicker or deeper beneath the surface. This program was funded by the W.M. Keck Foundation.