MODELING OF HYDROGEN ACCUMULATION AT THE LUNAR POLES. D. M. Hurley[1], R. C. Elphic[2], and R. R. Vondrak[3], [1]Johns Hopkins University Applied Physics Laboraroty (11100 Johns Hopkins Rd., Laurel, MD 20723), [2]NASA Ames Research Center, [3]NASA Goddard Space Flight Center.

Introduction: As evidence mounts establishing the presence of volatiles in permanently shadowed regions of the Moon [1-6], work continues to understand the distribution of those volatiles within the regolith. Are they homogeneous? If not, what is the lateral and depth distribution?

Modeling of space weathering processes on volatile deposits in permanently shadowed regions suggests that there is a time dependent spatial scale for which to expect coherence of a volatile deposit [7-10]. Comparing these predictions from modeling to limits placed on the distribution from the incoming data, one can place limits on the sources and timing of volatile emplacement in lunar permanently shadowed regions. We present modeling results and set benchmarks for the observations.

Space Weathering Model: The model follows the distribution of volatiles with depth in several vertical columns of material. The set of columns of material is separated by different lateral spacing. The volatiles in each column are tracked simultaneously as processes acting on the material modify the abundances.

The model is a Monte Carlo simulation that selects a distribution of impactors to bombard the area of simulation from the crater size-distribution function [11]. The impacts modify the material to a depth determined by the crater shape and the position of the crater center relative to the column. Impacts deposit ejecta in some areas and excavate material from other areas. This process alters the height of the surface, removes volatiles, and redistributes a reduced amount of volatiles. In between discrete impacts, the model computes the evolution in the top layers from steady processes. These include smaller impacts from micrometeoroids, exposure losses to UV and sublimation, diffusion, and delivery of new volatiles.

Performing many runs with different seeds to the random number generator, the output produces a range of final distributions. By averaging over the many runs, the model calculates the expectation values for the distribution of volatiles in a volume of lunar regolith as a function of time.

Interpretations: Starting with various assumptions of the initial distribution of volatiles, we follow the time evolution of pre-existing volatile deposits. Using many Monte Carlo runs, the expectation values for several parameters can be computed: e.g., retention rate, depth of deposit, correlation length. These parameters vary as a function of time, initial conditions, and assumptions about the delivery and loss in between larger impactors. We show the results for the evolution of an ice layer and for the steady accumulation of volatiles in permanent shadow. Using the expectation values, we place limits on how recently an ice layer could be emplaced and be detectable by remote sensing techniques, e.g., radar, neutron spectroscopy, and FUV reflectance.

After the LCROSS impact experiment into Cabeus, data now exist on the liberation of volatiles due to an impact into a permanently shadowed region [5, 12]. We discuss the implications these new results have on the modeling done here. Furthermore, these simulations reflect related processes in effect at the planet Mercury. The similarities to Mercury are discussed. Based on the retention rates calculated here, we also extrapolate to the influx of volatiles to the Moon.

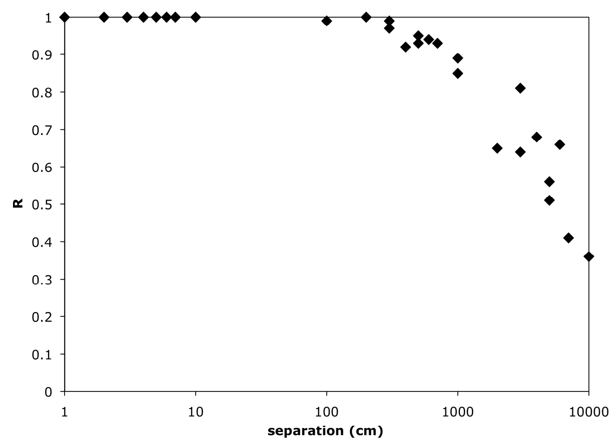

Figure 1. As a function of the lateral separtion of two columns of regolith, the correlation coefficient is shown for the amount of regolith cover emplaced in 100 Myr.

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