EXPERIMENTAL STUDY OF THE ANGLE OF REPOSE OF SURROGATE MARTIAN DUST.

L.E. Möller[1], M. Tuller[2], L. Baker[3], J. Marshall[4], P. Castiglione[2] and K. Kuhlman[5]; [1]Moscow Junior High School, Moscow, ID, 83843 lemoller@adelphia.net, [2]University of Idaho, Plant, Soil, and Entomological Sciences, Moscow, ID 83844-2339 mtuller@uidaho.edu paoloc@uidaho.edu, [3]University of Idaho, Geological Sciences, Moscow, ID 83844 lbaker@uidaho.edu, [4]SETI Institute, 2035 Landings Drive, Mountain View, CA 94043, jmarshall@seti.org, [5]NASA Jet Propulsion Laboratory, 4800 Oak Grove Drive, Pasadena, CA 91109 kkuhlman@jpl.nasa.gov

Introduction: Accumulation of wind-blown dust particles on solar cells and instruments will be a great challenge in the exploration of Mars, significantly reducing their lifetime, durability, and power output. For future Mars Lander missions it is crucial to gaininformation about the ideal angle at which solar panels can be positioned to minimize dust deposition and thus, maximize the power output and lifetime of the solar cells. The major determinant for the optimal panel angle is the angle of repose of the dust particles that is dependent on a variety of physical and chemical properties of the particles, the panel surface, and the environmental conditions on the Mars surface.

Previous work has shown that cylindrical and spherical surfaces can be used to determine the angle of repose, θ_r , of surrogate mineral dusts [1, 2]. These studies revealed reasonable agreement between the spherical surface method and conventional tilting table experiments and theoretical predictions reported by Albert, et al. [3]

The primary factors determining the angle of repose are: (a) the angularity, roughness, size, and surface charge of the dust particles; (b) the humidity, temperature, and chemical composition of the Martian atmosphere; and (c) the properties of the panel surface. While the effects of many of these factors are well understood qualitatively, quantitative analyses, especially under physical and chemical conditions prevailing on the Mars surface are lacking.

Materials and Methods: To gain a basic understanding of the physical and chemical processes that govern dust deposition and to get feedback for the design of an experiment suitable for one of the future Mars Lander missions we simulate atmospheric conditions expected on the Mars surface in a controlled chamber, and observe the angle of repose of Mars dust surrogates. Dust deposition and angle of repose were observed on different sized spheres. To cover a range of potential materials we will use spheres made of 7075 aluminum (10 mm, and 15 mm), alumina oxide ceramic (10 mm), and Teflon® (10 mm) and wafers of gallium arsenide, silicon.

The experiment was conducted in four phases. In phase one the experiment is setup within the chamber, and the observation system is focused and centered above the platform carrying the spheres (Fig.1). The chamber is sealed, desired temperature and humidity values are preset, and the gas mixture and vacuum are applied.

In phase two we wait for the system to equilibrate and apply surrogate Martian dust through siphon-feed ceramic nozzles (Fig.1). Arrays of common CPU fans are used to create turbulence within the chamber. After shutting down dust supply, fans, and gas stream, and waiting for the dust to settle a series of images is taken from the dust cones that developed on top of the spheres (Fig.2), and image analyses software is used to measure sphere diameter (d) and dust cone base (m).

With these measurements we are able to calculate the θ_r as demonstrated by Möller et al. [2] where $\sin(\theta_r) = m/d$.

We present a recently developed test module to simulate environmental conditions prevailing on the Mars surface and to measure the angle of repose of surrogate Martian dust on spherical surfaces. The planned measurements are an important step towards improved understanding of mechanisms and factors determining Martian dust deposition, and should provide improved design criteria for solar panels employed in future Lander missions.

References: [1] Möller, L. E. et al. (2001) *LPSC XXXII*, #1470 [2] Möller, L. E. et al. (2002) *LPSC XXXIII*, #2015 [3] Albert, R. et al. (1997) *Phys. Rev. E*, 56(6), R6271-R6274.

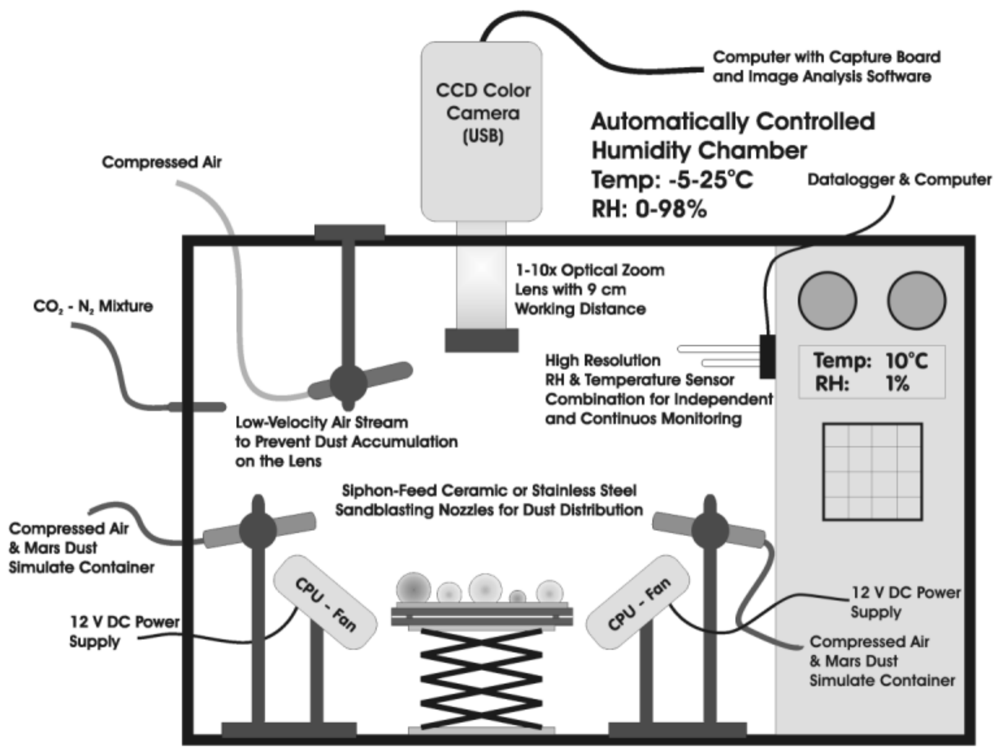

Figure 1: Conceptual sketch of the experimental setup

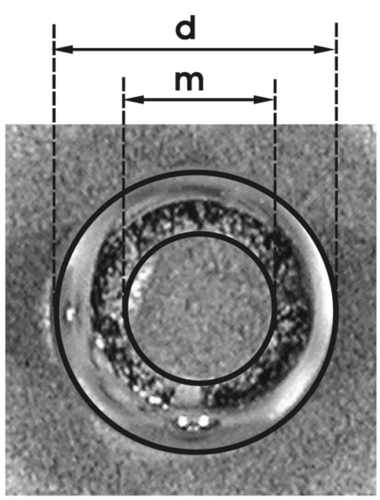

Figure 2: Digital image showing a sand cone deposited on top of an aluminum sphere