Preparing for MSL - Experimental Eolian Erosion of Soft Sedimentary Rocks. T. V. Howald[1] and J. Schieber[2], [1,2]Department of Geological Sciences, Indiana University, 1001 E 10th Street, Bloomington, IN, 47405.

Introduction: Many of the surface rocks of Mars appear to be of sedimentary origin and may largely consist of altered volcanic materials mixed with evaporate salts [1]. These rocks are rather soft as indicated by MER RAT abrasion. On Earth such rocks are typically eroded by aqueous processes because of their solubility and low mechanical strength, even in areas that are quite arid and receive little rainfall. Even in climates where rainfall is absent, humidity alone can cause disaggregation of exposed rocks due to the hydration and dehydration of clay minerals and hydrated salts. Thus, especially for shales and evaporites, it is difficult on Earth to observe eolian erosion features in these types of sedimentary rocks. In contrast, the surface of Mars has seen little of any liquid water for several hundred million years, and much of the smaller scale erosional features observed by the MER rovers most likely resulted from eolian abrasion over long time periods. Previous experiments, utilizing commercial sandblasting equipment and medium-sized quartz sand, have shown that at high wind velocities and high particle density, erosional features such as fluting, pedestal formation, and dimpled surface textures are produced very quickly. Since then we have constructed an eolian abrasion device to explore long-term eolian abrasion of soft sediments with wind velocities and sediment types that are more likely to be encountered on the Martian surface.

Methodology: Two different eroding mediums were used; hematite and lava rock. The crushed grains of each were comparable in size to detrital surface grains on Mars (<62 microns for hematire dust, and ~100 microns for basaltic sand). We employed a constant wind speeds of ~32 km/hr. Mudstones, siltstones, sandstones, and evaporites were all anchored to the base of the chamber and each medium was then run for seven weeks or until noticeable erosional features arose. The observed features were captured with a digital camera at a resolution of as high as ~30 microns per pixel, a resolution comparable to the microscopic imager (MI) on the MER rovers.

Observations: Features observed as a result of hematite dust erosion of shales include erosional pinnacles, polished surfaces, enhanced lamina contrast, and rounding of corners and edges. In samples of gypsum and anhydrite, rounding of corners and edges and bumpy surfaces resulted. Up to three millimeters of rock were eroded over the 7 week duration. Shales were eroded more quickly and noticeably than evaporates. Features observed as a result of erosion by basaltic sand are comparable with those seen in the hematite dust experiment (Figures 1 and 2). The rate of erosion, however, was significantly lower. Also, erosion by hematite dust produced a much better surface polish and a higher degree of corner and edge rounding.

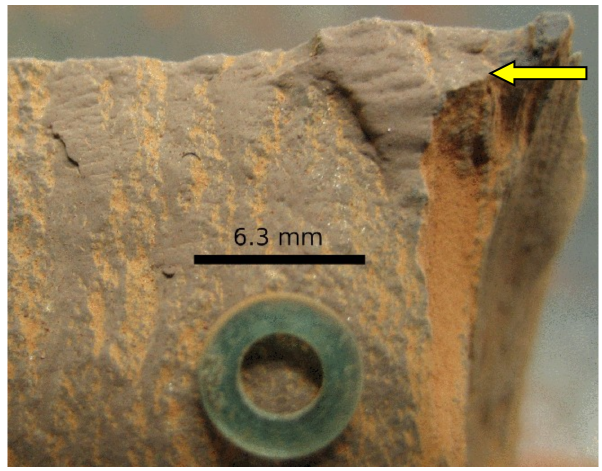

Figure 1: Mudstone exhibiting polished surfaces after seven weeks inside abraision chamber with lava rock as eroding medium.

Figure 2: Enhanced lamina contrast on a mudstone after seven weeks inside abraision chamber with lava rock as eroding medium.

Conclusions: Although these experiments are ongoing, our observations suggest that eolian erosion of Martian mudstones and evaporitic sediments occurs at such a high rate to allow for very substantial erosion within a matter of some million years. If large portions of the exposed rocks are indeed containing clays and evaporites [2], then a large portion of the presently existing surface topography may be explainable as the result of eolian erosion in conjunction with gravity driven slope processes. A comparison of eolian erosion features seen in our experiments with those seen in Martian surface rocks should help to differentiate mudstones and evaporites more readily from other more resistant sedimentary rock types. Our results will therefore assist in the future analysis of existing MER image data, as well as in the efficient conduct of the upcoming MSL mission.

References: [1] Results from the Microscopic Imagers on the Mars Exploration Rovers, Herkenhoff K. E. and The Athena Science Team (2005) AGU fall meeting, P11E-02. [2] Squyres S. W. and Knoll A. H. (2005) Earth and Planetary Science Letters, Vol. 240 Issue 1, pg 1-10, Sedimentary Geology at Meridiani Planum, Mars.