TEXTURAL FEATURES PRODUCED BY AOELIAN EROSION OF MUDSTONES. T. V. Howald[1] and J. Schieber[2], [1] Geological Sciences, Indiana University, 1001 E 10th Street, Bloomington, IN 47405, thowald@indiana.edu, [2]Department of Geological Sciences, Indiana Univ, 1001 E 10th Str, Bloomington, IN 47405

Introduction: Nearly all mudstones on the surface of the earth show mainly erosional features due to water, even in climates where rainfalls are rare. Humidity in the air alone can cause exposed mudstones to crumble due to hydration and dehydration of clay minerals. Freeze and thaw action as well leads to ready disintegration of mudstones even in desert settings. In contrast, the surface of Mars has most likely been free of liquid water for several hundred million years, and much of the observed erosion is accomplished by eolian erosion. Looking at weathering of terrestrial basalts suggests that a substantial portion of the Martian sedimentary rock record may consist of mudstones, yet we know little about the textural features that may be produced when mudstones are solely eroded by eolian action. We have therefore conducted experiments in eolian erosion of mudstones and other lithologies by using a commercial sandblaster and quartz sand. In an ongoing experiment we also examine the eolian abrasion of mudstones with hematite dust over extended time periods.

Methodology: With the commercial sandblasting equipment, two different rock types of each group (shales, sandstones, and evaporites) were eroded to a depth of up to 10 mm, using quartz sand grains as an abrasive. Observed features were recorded with a digital camera at a resolution of as high as ~30 microns per pixel, a resolution comparable to the microscopic imager (MI) of the MER rovers. With the "wind tunnel" experiment several rock types are being eroded by blowing around hematite dust grains, which range in size from 10-63 microns. The wind speeds and abrasive concentrations, however, are substantially lower than achievable with commercial sandblasting equipment.

Observations: Features observed in eolian eroded mudstones include erosional fluting and pedestal concretions (Figure 1) that have direct analogs to pictures taken by the Opportunity rover. In general, eolian erosion of mudstones produces smooth flowing surface contours, scalloped surfaces, and enhances lamina contrast. A shallow light incident angle is very helpful for enhancing features of subtle relief for viewing and photography. Features observed in eolian eroded sandstones include etching out of fractures (Figure 2) and concretions on pedestals (Figure 3).

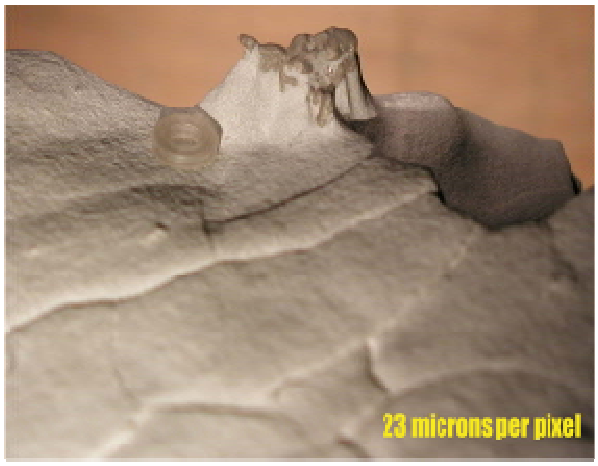

Figure 1: Sandblasted gray shale. Note dimpled surface, only minor "etching" of fractures, and the pyrite nodule on pedestal of shale. Washer for scale, 6.3 mm diameter.

Figure 2: Sandblasted quartz arenite. The rock was originally smooth with fractures. Note how fractures and cracks in the rock were deepened and accentuated. Washer for scale, 6.3 mm diameter.

Frosting of an abraded surface by the impact of windblown grains is a universal feature of eolian erosion and well known from the surface of quartz grains [1], hard rock surfaces, and glass bottles on beaches. In mudstones, we observed that the impact of sand grains leads to a dimpling of the surface at the grain size scale of the sandblasting medium. As a result, an eolian eroded mudstone surface may show close textural resemblance to the surface of a sandstone (Figure 4). At the hand-lens scale, however, and at a shallow incident angle, a dimpled mudstone surface can be differentiated from the bumpy surface of a sandstone. In the latter case shadows form next to projecting sand grains, whereas in case of a dimpled mudstone surface

the shadows are found in the interior of the dimples. Although to date there has been no definite report of Martian mudstones from the MER rovers, re-examination of MER MI images for above features may reveal likely mudstones among the many images taken so far.

Figure 3: Sandblasted quartz arenite with small iron oxide concretions. These were originally hidden in the rock, and were exposed and "pedestaled" by sandblasting. Washer for scale, 6.3 mm diameter.

Figure 4: Sandblasted surface of a carbonaceous mudstone. Note the dimpled surface that suggests initially a coarser, sandy, sediment. Washer for scale, 6.3 mm diameter.

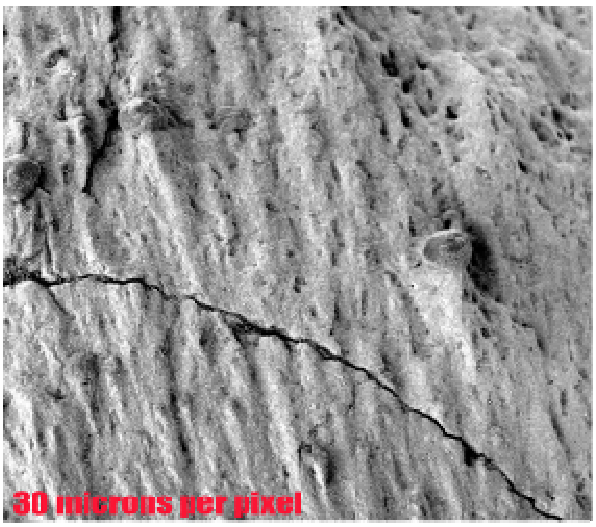

Figure 5: Possible mudstone on Mars, polished by abrasion with hematite-rich dust. Photo taken by the Microscopic Imager on the Opportunity rover. (Image NASA).

Conclusions: Eolian abrasion of mudstones produces features that relate to the movement of the abrasive medium above the surface, such as fluting and pedestal formation, and a dimpled surface texture that may (incorrectly) suggest a coarser lithology (sandstone). Similar features are also observed in the eolian abrasion of sandstones. Eolian erosion enhances pre-existing fractures in sandstones, but does not enhance comparable fractures in mudstones. The observed characteristics may be helpful for better visual differentiation of mudstones and sandstones in current and planned Mars rover missions.

In our ongoing experiment with long-term eolian abrasion by hematite dust, we expect to find that abraded mudstone surfaces become polished, rather than dimpled, and may bear close resemblance to some rocks seen by the MER rovers (Figure 5).

References: [1] Margolis, S.V. and Krinsley D.H. (1973) *Nature*, 245, 30-31.