MARS SAMPLING STRATEGY AND AEOLIAN PROCESSES;

Ronald Greeley, Dept. of Geology, Arizona State University, Tempe, AZ 85287

It is critical that the geological context of planetary samples (both *in situ* analyses and return samples) be well known and documented. Apollo experience showed that this goal is often difficult to achieve even for a planet on which surficial processes are relatively restricted. On Mars, the variety of present and past surface processes is much greater than on the Moon and establishing the geological context of samples will be much more difficult. In addition to impact gardening, Mars has been modified by running water, periglacial activity, wind, and other processes, all of which have the potential for profoundly affecting the geological intregity of potential samples.

Aeolian, or wind, processes are ubiquitous on Mars. In the absence of liquid water on the surface, aeolian activity dominates the present surface as documented by frequent dust storms (both local and global), landforms such as dunes, and "variable features"--albedo patterns which change their size, shape, and position with time in response to the wind. Aeolian processes involve the erosion, transportation, and deposition of material by the wind and have the potential for:

- "sorting" some materials by size, density, and composition
- "homogenizing" some materials via dust storms
- altering rock compositions by the formation of desert "varnish"
- forming deposits which range in thickness from a few µm to tens of meters
- eroding rocks through abrasion and deflation

In some cases, these processes have a negative effect on sampling goals; in other cases they may help achieve sampling goals. In all cases, the potential effects of aeolian processes must be taken into account in developing sampling strategies.

Wind sorting. In some cases, wind is an effective agent for separating materials. Depending upon wind strength, fine material is deflated, transported by the wind, and redeposited in other areas. In the process, windblown materials become sorted by size and density. The surface which remains is also altered; large or high-density particles may remain as a lag deposit, contributing to the development of desert "pavement" surfaces.

Homogenization. The fine material carried into the atmosphere via dust clouds has the potential for becoming thoroughly mixed. Estimated to be less than a few microns in diameter, martian dust-cloud material is globally transported.

Thus, dust derived from diverse geological sources may become homogenized in the dust cloud and, as such, may reflect a type of planetary compositional average.

Desert varnish. In many desert regions on Earth, rocks are commonly coated with a veneer of dark material, termed desert varnish. Although its origin is somewhat controversial, one commonly accepted model involves windblown dust which adheres to surfaces and reacts with dew to form a layer which may be a centimeter or more thick. Compositional measurements obtained via remote sensing or through shallow surface sampling thus may represent only the varnish and may be markedly different from the "host" rock. Although desert dew or its equivalent is unlikely on Mars today, a type of martian varnish may form through other processes. For example, laboratory experiments simulating Mars show that under the high winds required to transport material in the low-density martian atmosphere, some particles impact rocks and adhere to the surfaces. Although the amount of water in the martian atmosphere is miniscule, over the long periods of exposure typical for martian surfaces, reactions may occur in which the adhering particles react with the host rock to develop a desert-like varnish.

Sedimentary deposits. Smooth plains deposits are found in many regions of Mars, including the layered terrain of the polar areas, mantling deposits found in some equatorial regions, as intercrater plains deposits, and as crater-filling units. Although the origin of some of these units is generally accepted as aeolian (e.g., the polar layered material), the sources and evolution of some of the smooth plains is highly controversial. For example, mantling material in the Memnonia region has been proposed to be widespread ignimbrite deposits. As such, they could be extremely important sampling sites. Alternatively, these materials could be deposits of windblown dust. Similarly, other smooth plains deposits on Mars have also been suggested as volcanic in origin, yet could also be aeolian.

Erosion and deflation. Erosion of the surface by the wind and deflation of weathered materials in some areas may enhance sampling efforts. Low-albedo surfaces, including those found in the "wake" zones of some craters, may represent eroded and deflated bedrock surfaces and could be high-priority sites for obtaining relatively fresh samples.

In summary, aeolian activity dominates the present surface of Mars and appears to have played an important role in the evolution of its surface. Recognizing the occurrence of windblown deposits and the potential for aeolian processes in modifying the surface must be taken into account in developing sampling strategies.