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**AEOLIAN PROCESSES ON VENUS**; *R. Greeley, Department of Geology, Arizona State University, Tempe, Arizona 85287-1404*

This review assesses the potential aeolian regime on Venus as derived from spacecraft observations, laboratory simulations, and theoretical considerations. The two requirements for aeolian processes--a supply of small, loose particles and winds of sufficient strength to move them--appear to be met on Venus. Venera 9, 10, 13, and 14 images show particles considered to be sand-and-silt size on the surface (1-5). In addition, "dust spurts" (grains 5-50 μm in diameter) observed via lander images (6) and inferred from the Pioneer-Venus nephalometer experiments suggest that the particles are loose and subject to movement. Although data on near-surface winds are limited, measurements of 0.3 to 1.2 m/sec from the Venera lander and Pioneer-Venus probes (7) appear to be well within the range required for sand and dust entrainment.

The Venus Wind Tunnel (VWT) is an apparatus used to simulate the movement of particles on Venus (8); it operates with carbon dioxide gas at 35 bars pressure and 27°C (ambient laboratory temperature); this produces a *fluid density* (the critical factor in aeolian processes) that is equivalent to the nominal Venus case of 90 bars at 475°C. Experiments have been run to determine threshold (e.g., minimum wind speeds) for particle entrainment as a function of grain size: results show that in the dense venusian atmosphere particles are easily moved ($u_{*t}$ = 2.8 cm $s^{-1}$ for ~80 μm grains, the optimum size). However, experiments also reveal a mode of aeolian transport unusual on Earth (and presumably unusual on Mars), i.e., *rolling*, in which grains roll along the surface and are *not* impacted by saltating grains (9). The threshold wind speed ($u_*$) is about 20% *lower* than that for saltation, suggesting that aeolian processes could occur with greater frequency than otherwise expected on Venus.

Once set into motion, what is the potential for transport of surficial material and for erosion by windblown particles? Experiments show that the *flux* of grains is lower than predicted, primarily due to a "choking" effect that occurs in high-density grain flow. Nonetheless, the velocity of the grains in motion very quickly achieves 75-100% of the wind speed, in contrast to windblown particles on Earth and Mars (10). Evidently, the coupling of particles with the atmosphere is directly proportional to atmospheric density.

From analyses of Venera lander images, there was speculation on the existence of various aeolian bedforms such as ripples and dunes (3). The postulation of the existence of "microdunes" is supported by simulations that show the development of dunelike features 10-20 cm long by a few cm high (11). The existence of "slip faces", foreset beds, flow separation, and distinctive grain size distributions all are appropriate for dunes as opposed to ripples. However, experiments also show that microdunes and other bedforms developed under venusian conditions are highly dependent on wind speed, particle diameter, and atmospheric density. Consequently, the formation and preservation of small bedforms may be limited and ephemeral.

Aeolian activity involves the interaction of the 1) atmosphere, 2) lithosphere, and 3) loose particles. Thus, there is the potential for various physical and chemical weathering processes that can effect not only rates of erosion, but changes in the composition of all three components. The *Venus Simulator* is an apparatus used to simulate weathering under venusian conditions at full pressure (to 112 bars) and temperature (to 800 K). In one series of tests, the physical modifications of windblown particles and rock targets were assessed and it was shown that particles become abraded even when moved by gentle winds (12, 13). However, little abrasion occurs on the target; rather, the comminuted material from the particles readily adheres to the target faces. Thus, compositional "signatures" for target rocks may be more indicative of the windblown particles than of the "bedrock".

From these and other considerations, aeolian modifications of the venusian surface may be expected to occur as weathering, erosion, transportation, and deposition of surficial materials. Depending upon global and local wind regimes, there may be distinctive "sources" and "sinks" of windblown materials. Radar imaging, especially as potentially supplied via the Magellan mission, may enable the identification of such areas on Venus.

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THOUGHTS ON THE VENUSIAN SURFACE AND EARLY EARTH,

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The possibility that improved understanding of the tectonic style on Venus may have particular relevance to the Archean Earth, adds to the interest and excitement of the Magellan mission. The speaker - no expert on Venus - will present his views of this aspect based on limited reading and what he learns at this Tutorial.