SMALL SCALE FEATURES REVEAL AEOLIAN INACTIVITY POLEWARD OF 60º S IN HIRISE IMAGES OF SOUTHERN HEMISPHERE DUNE FIELDS ON MARS. L. K. Fenton, Carl Sagan Center, NASA Ames Research Center, MS 245-3, Moffett Field, CA 94035-1000, lfenton@carlsagancenter.org.

Introduction: Latitudinal trends in the martian sedimentary record of Mars are often regarded as markers of climate change [*e.g.*, 1-5]. Southern hemisphere dune fields also display latitudinal changes in morphology at scales greater than ~30 m (visible to MOC, CTX, and THEMIS images) [6], possibly caused by changes in the volume of subsurface ice that is thought to stabilize high latitude dunes on Mars [7]. This investigation of HiRISE images reveals small scale (2-30 m) features on southern hemisphere high-latitude dunes that are different from those observed at lower resolution and that appear to be unique to aeolian sand. The spatial distribution of these features varies with latitude and level of aeolian activity.

HiRISE Images: A total of 46 high quality HiRISE images covers 46 dune fields within the study area (defined as dune-covered surfaces poleward of 44º S). These images are limited to those that are nonicy, nondusty, and noncloudy, with noise limited such that surface features are easily identified. They were obtained during the primary science phase, ranging from orbits 3325 through 6891 (encompassing southern summer: L_s = 217.7º – 17.8º, Earth dates 4/12/07 – 1/15/08, and Mars years 28 – 29).

Morphological Features: A number of morphological features are common to several dune fields in the study area. Some are consistent with aeolian activity; other features indicate that other processes erode the dunes, either competing with or dominating over aeolian activity.

Dune brinks: sharp / degraded. The brink of a slip face is typically sharp when grainflow is recent (Fig. 1) and rounded otherwise (Fig. 4). However, alcoves created by mass wasting of a slip face can also sharpen a brink (Fig. 3). In the study area sharp dune brinks, regardless of how they formed, are only present on dunes equatorward of 54.6º S.

Potential grainflow. Grainflow, avalanching caused by slip face oversteepening, is one of the easiest features to identify in images that likely indicates recent aeolian activity. Such features are only apparent in 6 of the 46 HiRISE images, all of which are located equatorward of 54.6º S (Fig. 1).

Mass wasting and gullies. Gullies and other mass wasting features (Figs. 2 and 3) are caused by processes still hotly debated by the community [8]. They seem to be coeval with aeolian activity, and they are present in HiRISE images equatorward of 58.2º S.

Ripples: sharp / degraded. Ripples and/or TARs (transverse aeolian ridges) are common to dune fields on Mars. Poleward of 60.4º S, all but one HiRISE image show ripples or TARs that appear degraded (Figs. 4 and 6). Equatorward of this point, only 3 out of 13 HiRISE images have degraded ripples and TARs (Fig. 3). Ten of the 46 HiRISE images contain no ripples at all, all of which are located poleward of 63º S.

Apron mounds. Aprons extend around most dune fields poleward of 60º S [6]. Between 60.4º S and 73.8º S, 16 out of 25 HiRISE images have aprons containing 10-30 m wide mounds (Fig. 5). The mounds tend to occur only in the proximity of boulders, and some appear to have boulders at their centers. The mounds, and perhaps the aprons, may indicate a process that has dominated over aeolian processes where they occur.

~1 m pits. Small pits are visible in all but two HiRISE images poleward of 60.4º S (Fig. 5), but they occur in just 4 of 13 images equatorward of this point (Fig. 3). However they form, the pits have overwritten prior aeolian activity.

Polygons: on aprons / dunes. Patterned ground is common at high southern latitudes. Polygons are visible off the edges of dune fields in every HiRISE image poleward of 60.4º S (Fig. 5), and none at all equatorward of this point. Four dune fields even have polygons that extend into the dune sand itself (Fig. 6), although it is not clear whether polygons have formed in consolidated sand or the sand is thin enough to reveal polygons in the underlying surface.

Discussion: Each of the above features varies with latitude, with a significant shift occurring at ~60º S, a latitude corresponding with a shift in water-equivalent hydrogen content [9]. Equatorward of this latitude, features may be indicative of recent aeolian activity or processes that compete with aeolian activity. Poleward of this latitude, these features appear to dominate aeolian surfaces. This provides further evidence that high latitude dunes may be inactive and indurated (possibly by water ice) in the present climate.

References: [1] Squyres S. W. and Carr M. H. (1986) *Science, 231*, 249-252. [2] Christensen P. R. (2003) *Nature, 422*, 45-48. [3] Mangold, N. (2005) *Icarus, 174*, 336-359. [4] Kreslavsky M. A. and Head J. W. (2003) *GRL, 30*(15), 1815. [5] Mustard J. F. et al. (2001) *Nature, 412*, 411-414. [6] Fenton L. K. and Hayward R. K. (2008) *Planet. Dunes Wkshp*, Abst. #7030. [7] Bourke M. C. (2005) *LPSC XXXVI*, Abst. #2373. [8] www.lpi.usra.edu/meetings/gullies2008/. [9] Feldman et al. (2004) *JGR, 109*, E09006.

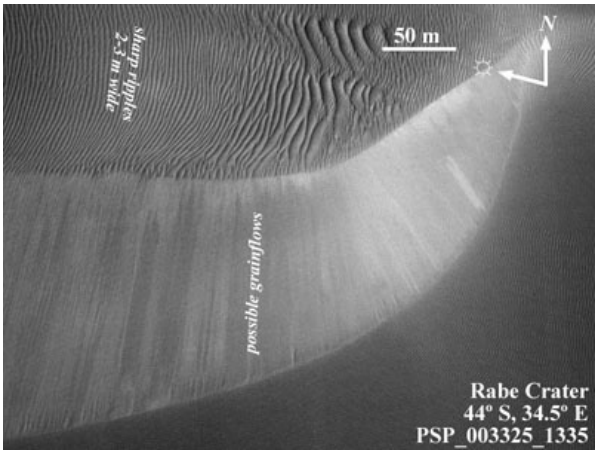

Figure 1. Examples of features consistent with recent aeolian activity: a sharp dune brink, potential grain-flows, and sharp ripples/TARs.

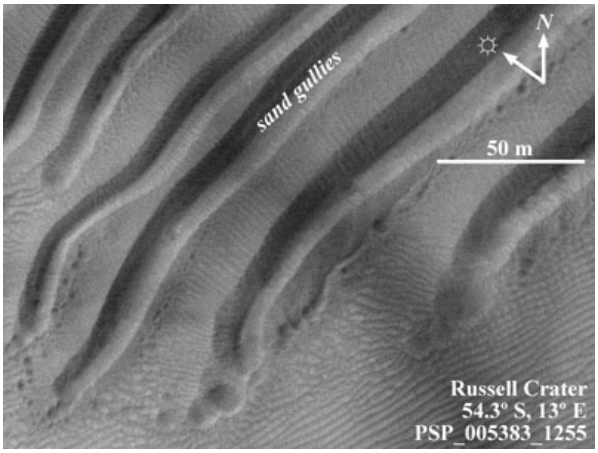

Figure 2. Details of gullies on a dune slope, influencing ripple orientations. Gullying in this dune field competes with aeolian activity.

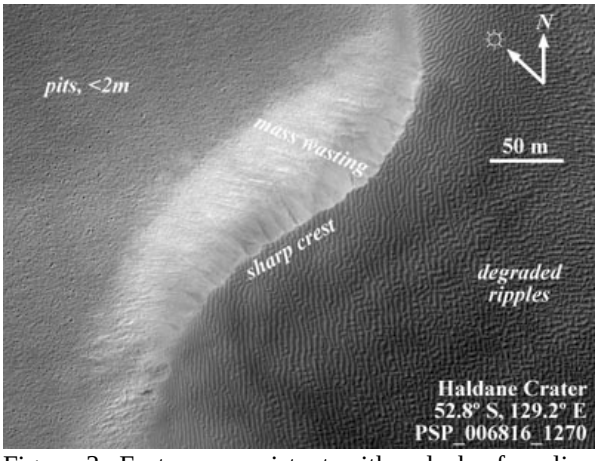

Figure 3. Features consistent with a lack of aeolian activity: small pits, mass wasting on a dune slip face, and degraded ripples.

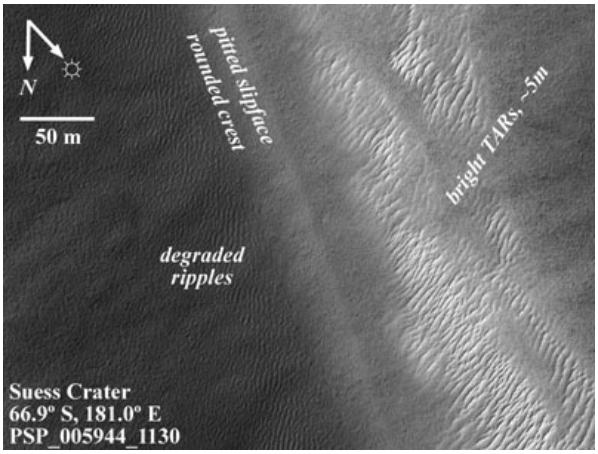

Figure 4. Features consistent with a lack of aeolian activity: degraded ripples, a pitted slip face, and a rounded dune brink.

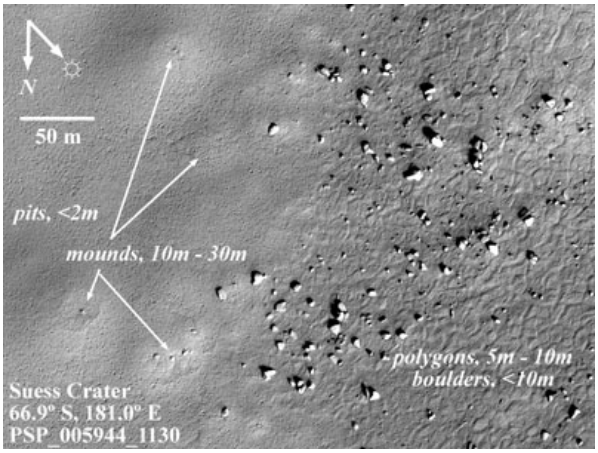

Figure 5. Features consistent with a lack of aeolian activity: the edge of a sand sheet with small pits and mounds associated with boulders. Polygons are present nearby but are not visible on the sand.

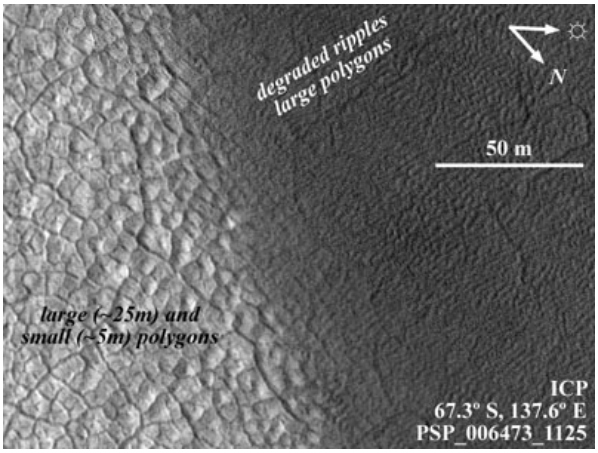

Figure 6. Features consistent with a lack of aeolian activity: the edge of a sand sheet with degraded ripples and polygons.