SOUTHERN HEMISPHERE DUNES OF MARS: MORPHOLOGY TRENDS AND CLIMATE CHANGE.

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Introduction: A major focus of Mars science over the past few decades is the impact of recent climatic shifts on geological, polar, and atmospheric processes. Sand dunes and other aeolian features are unique in their contribution to understanding climate change because they are geological features formed by atmospheric forces. In particular, cold climate sand dunes are surface features that become more active under windy, nonicy conditions, but less active under non-windy and/or icy conditions. Thus they are extremely sensitive to changes in temperature, humidity, and atmospheric dynamics that drive climate change.

Here we present the continuing work of mapping, classification, and morphological analysis of 1196 (to date) martian dune fields located poleward of 50º S. Part of the study represents a southward extension of the Mars Global Digital Dune Database (MGD^3) [1], and it complements a similar study in the high northern latitudes [2].

Mapping: Dune fields between 50º - 60º S were obtained from the MGD^3. Dune fields poleward of 60º S were identified using the nearly complete spatial coverage of daytime Thermal Emission Imaging System (THEMIS) IR images (as part of the original MGD^3 study). Further work using THEMIS VIS, Mars Orbiter Camera (MOC) Narrow Angle (NA), and Mars Reconnaissance Orbiter (MRO) Context Camera (CTX) images has aided in refining dune field boundaries and identifying smaller dune fields than the THEMIS IR images can resolve.

Dune Field Classification: Southern high- and midlatitude dune fields have been classified into six types that are interpreted to relate to their present level of aeolian activity and state of degradation. Characteristics of each are listed below, progressing from the least to the most degraded.

Sharp: Typical of dune fields in the equatorial MGD^3, minimal degradation at THEMIS VIS scale, dune crests appear sharp.

Sharp/Aproned Intermediate: Part of dune field consistent with "sharp" category, part consistent with "aproned". Apron around dune field perimeter is not complete.

Aproned: Presence of a distinctive sharp-edged apron surrounding dune field, between dunes. Dune crests may be either sharp or slightly rounded.

Aproned/Degraded Intermediate: Apron surrounding dune field is apparent, possible signs of dune degradation, possible exposure of layered material beneath dune field.

Degraded: Clear degradation of dunes, possible exposure of layered material beneath dune field.

Sand Patch: Sandy area without dunes. Possible layering (some cases may be polar layered deposits). Unclear if dunes were ever present.

Dune Field Distribution: Figure 1 shows the distribution of dune fields by type (see Figure 2 for a legend). Dune fields are common, especially between 60º - 80º S. Histograms of dune fields by type are shown in Figure 2 with a bin of 1º latitude. The histograms indicates that there is considerable overlap in dune field type, but that there is a general progression in type (interpreted here to indicate an increase in degradation) towards the pole. For example, sharp dune fields dominate equatorward of 65º S and aproned dune fields dominate between 60º - 70º S.

Influence of local topography: Local topography appears to account for some (but not all) of the latitudinal overlap in dune type. In forty of sixty pairs of adjacent dune fields, the less degraded dune field is located at a higher elevation.

CROCUS Date: Equatorward of ~65º S, dune fields retain seasonal frost longer than the surrounding terrain [3] by 10º-40º L_s. It is possible that some thermal property of dune sand (or perhaps ice in the subsurface) allows dune slopes to act as a cold trap for frost.

Discussion and Future Work: The progression in dune degradation towards the south pole is likely indicative of climate change postdating dune field formation. Dune fields will accumulate in an environment in which the wind can blow above the saltation threshold stress and sand is both plentiful and available for transport (*e.g.*, not indurated) [4]. The increasingly inactive and eroded appearance of dunes towards the pole indicates that at these latitudes, erosion (and perhaps induration by ground ice) currently dominates over saltation.

Future work will include investigating higher resolution images for morphological patterns and wind orientations; comparison of morphology and location to sand mineralogy, and ground ice modeling of dune sand as a function of recent orbital variations.

References: [1] Hayward R. K. et al (2007) *JGR, 112,* E11007. [2] Tanaka K. L. and Hayward R. K. (2008) *Planet. Dunes Wkshp.* (this mtg.). [3] Titus T. N. (2005) *LPSC XXXVI,* Abst. #1993. [4] Kocurek G. and Lancaster N. (1999) *Sediment., 46,* 505-515.

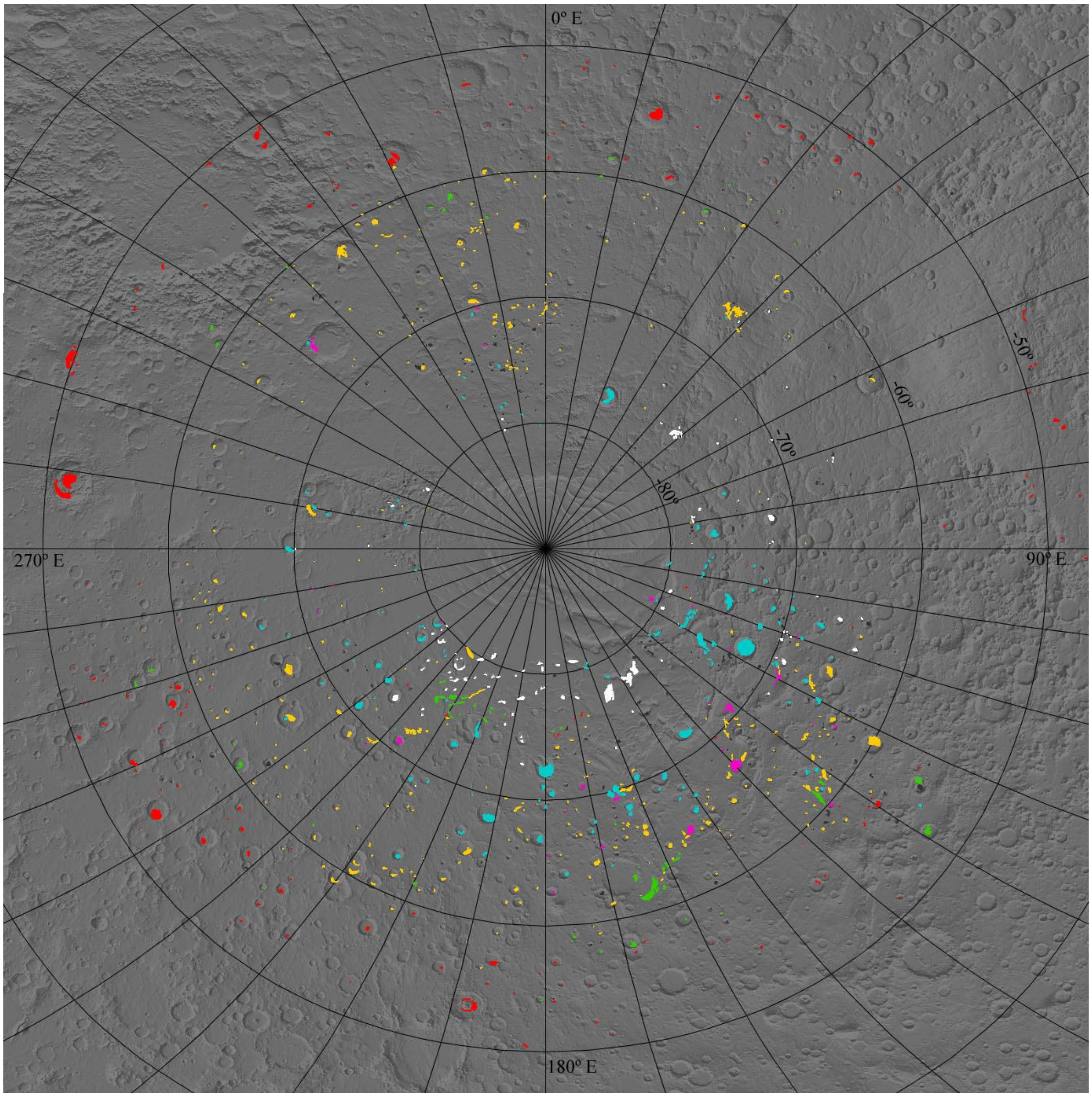

Figure 1. Distribution of dune fields by type poleward of 50° S (see legend in Fig. 2).

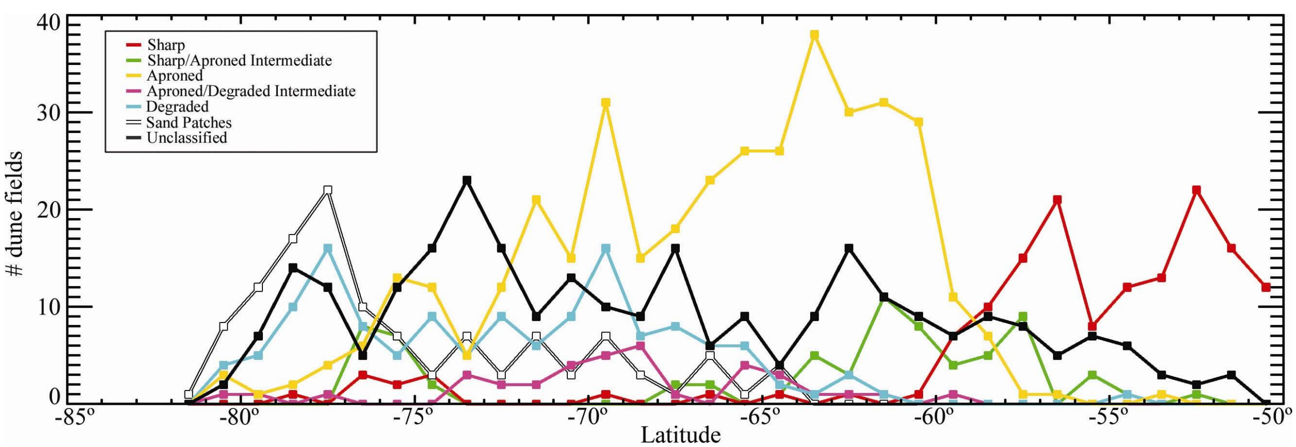

Figure 2. Histograms of dune fields per 1° latitude, shown by type. Note prevalence of sharp dune fields equatorward of 60° S and aproned dune fields between 60°-75° S.