THE DISTRIBUTION OF TRANSVERSE AEOLIAN RIDGES ON MARS. D. C. Berman[1], M. R. Balme[1], M. C. Bourke[1], and J. R. Zimbelman[2], [1]Planetary Science Institute, 1700 E. Ft. Lowell Rd., Suite 106, Tucson, AZ, 85719, bermandc@psi.edu; [2] Center for Earth and Planetary Studies, National Air and Space Museum, Smithsonian Institution, PO Box 37012, MRC 315, Washington, DC 20013-7012.

Introduction: Mars is host to a wide range of aeolian forms such as dunes, ripples, dust devils, dust storms, yardangs, and ventifacts. Large dune fields characterized by low albedos and large duneform sizes have been observed and occur mainly around the north polar cap and in the southern mid-latitudes. However, another morphologically and dimensionally distinct population of aeolian bedforms have also been noted. These are generally brighter than the surrounding terrain, are about an order of magnitude smaller than the large, dark dunes (LDDs) and have simple forms. These bedforms have been designated 'Transverse Aeolian Ridges', or 'TARs' [1].

We have conducted a survey of all high-resolution (~1-11 m/pixel) Mars Orbiter Camera (MOC) images (~10,000 images) in a pole-to-pole swath between 0 and 45° E longitude to identify and classify TARs. This work extends the preliminary survey of [2], and was conducted on the opposite site of the planet. The aims are to determine TAR distributions, orientations, morphologies and morphometries, possible sediment sources, and superposition relationships with LDDs. Approximate percentage of areal coverage of TARs in each MOC image was recorded, as well as classification according to [3] and associations with other features such as LDDs and slope streaks.

Distributions and orientations: The geographic distribution of TARs is significantly non-random: in the northern hemisphere, TARs are most commonly found between 0 and 35° N, particularly in the Terra Meridiani region. 668 MOC images in the northern hemisphere contained at least 5% areal coverage of TARs (Fig. 1). In the southern hemisphere, TARs are found between 0 and 55° S. 1591 MOC images in the southern hemisphere had 5% or more areal coverage containing TARs (Fig. 2). TARs tend to be found on crater floors and in regions containing mesas and layered terrains; in short, anywhere where significant mass-wasting can occur. The geographical distribution of different classes of TARs is also non-random: there are a much higher proportion of TARs classified as 'barchan-like' in the Meridiani region than anywhere else in the study region.

Orientations of TARs (when not influenced by local topography) are consistent over large areas (cf. Fig. 3), suggesting that the wind regimes which control the formation of TARs are also consistent over wide areas.

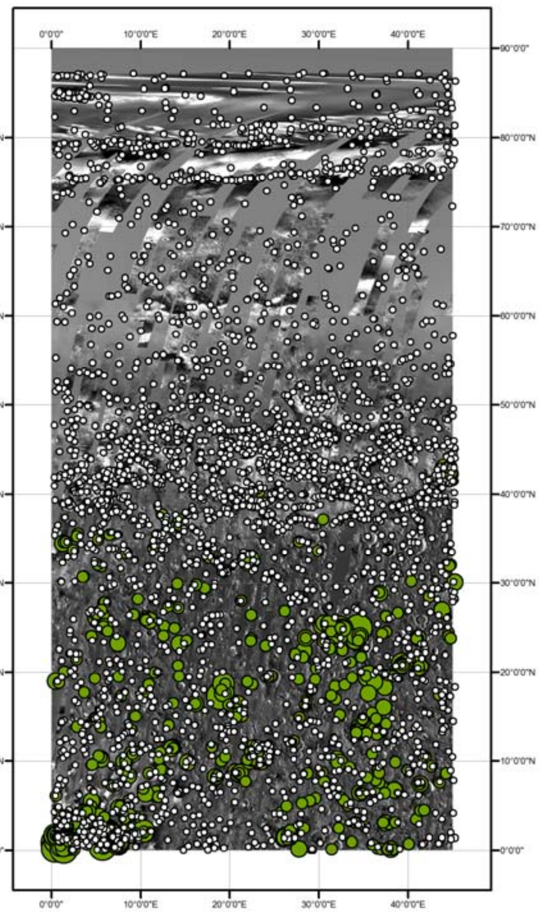

Figure 1. Percent areal coverage of TARs in MOC images for northern hemisphere. White dots represent MOC images with <5% TARs. Green dots show proportional percentages greater than 5%.

Sediment sources for TARs: The source of sediment for TARs is currently unknown. Although associations of slope streaks with TARs are common, it seems unlikely that enough sediment can be supplied to create all the TARs observed. Neither are there any obvious specific source regions, nor readily observable regional sediment pathways. Large numbers of TARs have been found in Terra Meridiani, a region containing large outcrops of layered material. This suggests that mass wasting and/or weathering combined with deflation of these layered outcrops is the source for TAR sediments.

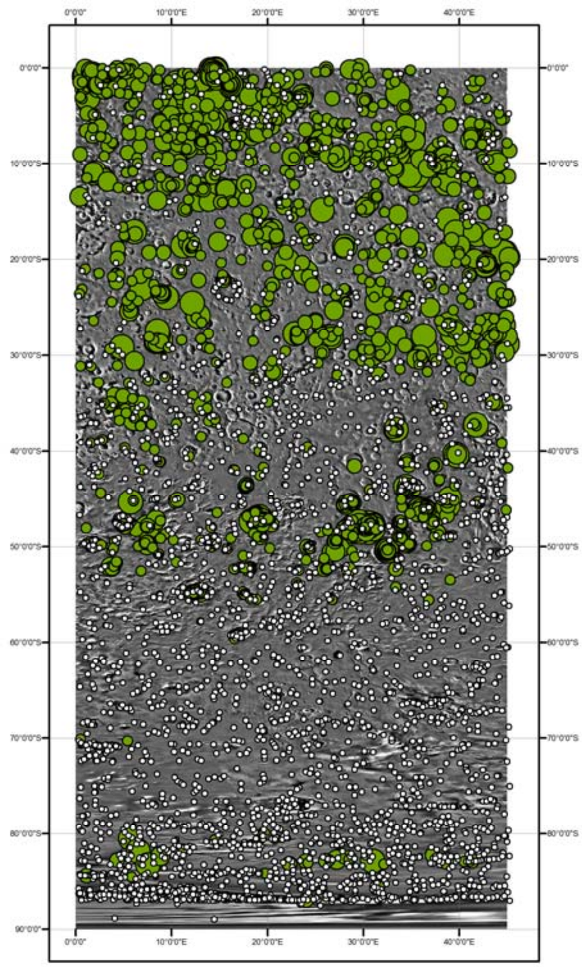

Figure 2. Percent areal coverage of TARs in MOC images for southern hemisphere.

Superposition relations with other geological features: In many locations TARs have orientations consistent with other aeolian landforms such as dust devils tracks and LDDs. However, these landforms evolved over very different time scales. Dust devil tracks form in minutes to hours and are 'reset' each year [4] but, by analogy with terrestrial duneforms, TARs and LDDs likley form in periods of 10-10^4 yr (LDDs, being larger, are likely to have formed more slowly than TARs). This suggests that the regional winds have been consistent over long periods. Interestingly though, LDDs in general superpose TARs, suggesting perhaps that TARs formed and then became immobile (perhaps becoming indurated?) before other aeolian features formed. This idea is reinforced by observations of impact craters in TARs [5].

Counter examples to these observations do exist, however, and some TARs have clearly formed after LDDs. This shows that the situation is more complicated than simply a linear progression from TAR activity to LDD activity in Mars' recent history.

Discussion: Transverse Aeolian Ridges (TARs) are widespread on Mars and are found at low to mid-latitudes in the northern and southern hemispheres. they are usually found in clusters on crater floors or associated with layered terrain. TAR sediments are likely derived from mass wasting and/or deflation of nearby steep slopes or layered terrains. Consistent wind regimes over large areas and associations with other features such as LDDs suggest that TARs are not transient features.

Future work: To explore whether specific TAR deposits have formed under present or past wind regimes we will compare TAR orientations with global and mesoscale models of the Mars recent climate and with orientations of wind streaks, LDDs and dust devil tracks. We will also perform systematic crater counts of the larger TAR 'seas' in these regions. In this way we hope to define qualitative TAR ages for several regions within the larger study area and hence to explore sediment sources for the youngest examples.

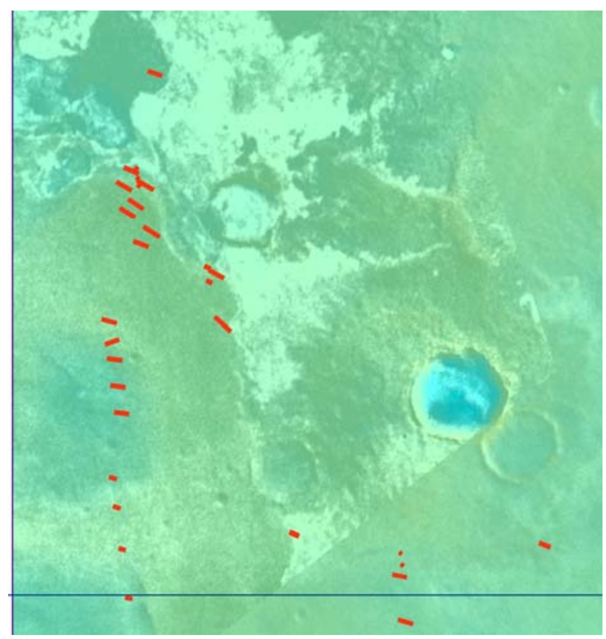

Figure 3. Red lines drawn normal to crestline orientations of TARs, which approximate direction of all constructive winds, in the Terra Meridiani region.

References: [1] Bourke, M.C. et al., LPSC XXXIII, Abstr. # 2090, 2003. [2] Wilson, S.A. and Zimbelman, J.R., J. Geophy. Res., 109 (E10), 2004. [3] Balme, M.R. et al., Geomorphology, accepted pending corrections, 2008. [4] Balme, M.R., et al., J. Geophys. Res., 108 (E8), 2003. [5] Reiss, D., S. et al., J. Geophy. Res., 109 (E06), 2004.