TRANSVERSE AEOLIAN RIDGES ON MARS. M. R. Balme[1], D. C. Berman[1], M. C. Bourke[1], S. Rafkin[2], and J. R. Zimbelman[3], [1]Planetary Science Institute, 1700 E. Ft. Lowell Rd., Suite 106, Tucson, AZ, 85719, mbalme@psi.edu; [2]SouthWest Research Institute, 1050 Walnut St, Suite 300 Boulder, CO 80302; [3]Center for Earth and Planetary Studies, National Air and Space Museum, Smithsonian Institution, PO Box 37012, MRC 315, Washington, DC 20013-7012.

Introduction: The martian surface hosts a range of aeolian bedforms; two types been observed from orbit: Large Dark Dunes (LDDs) and Transverse Aeolian Ridges (TARs [1]). Unlike LDDs, TARs are generally brighter than their surrounding terrain, are about an order of magnitude smaller and have simple ripple-like forms. LDDs occur mainly in circumpolar ergs and in intra-crater dune-fields, but the global distribution of TARs is not well constrained. The aim of this work is to explore when and how TARs formed and how they are related to LDDs.

Method: We have conducted a survey of ~10,000 high-resolution Mars Orbiter Camera narrow angle images (MOCNA) in a pole-to-pole swath between 0 and 45° E longitude to identify, classify, and map the distributions and orientations of TARs.

Distribution: The geographic distribution of TARs in the study swath is significantly non-random. TARs are more numerous in the southern hemisphere than the northern but are particularly common in the Terra Meridiani region (Figure 1). The lack of TARs in the northern lowlands and southern mid- to high-latitudes correlates with the lack of steep slopes in these regions. Locally, TARs are found on crater floors and in regions containing mesas and layered outcrops.

The Meridiani area is unique not only for the abundance of TARs, but also for their morphology: many have a distinctive barchan-like form, rarely seen in other locations. Where they are not topographically controlled, TAR orientations are regionally consistent, suggesting they are shaped by regional winds.

Association with LDDs: Although globally there is no spatial association of TARs with LDDs, throughout the southern mid-latitudes TARs most frequently occur close to large LDD fields in impact craters (figure 2). These TARs are almost always south or southwest of the LDDs and form within a few tens of kilometers of them. Interestingly, this spatial trend matches the climate model data [2] of wind directions, suggesting that TARs are found consistently upwind of LDDs. This suggests that in this region TARs and LDDs are genetically related. Moreover, our studies [3] have shown that, where they occur together and a superposition relation can be established, TARs are generally older than LDDs, consistent with the ~ 0-2 Ma impact crater retention ages for TARs [4] and the lack of even small impact craters seen on LDDs.

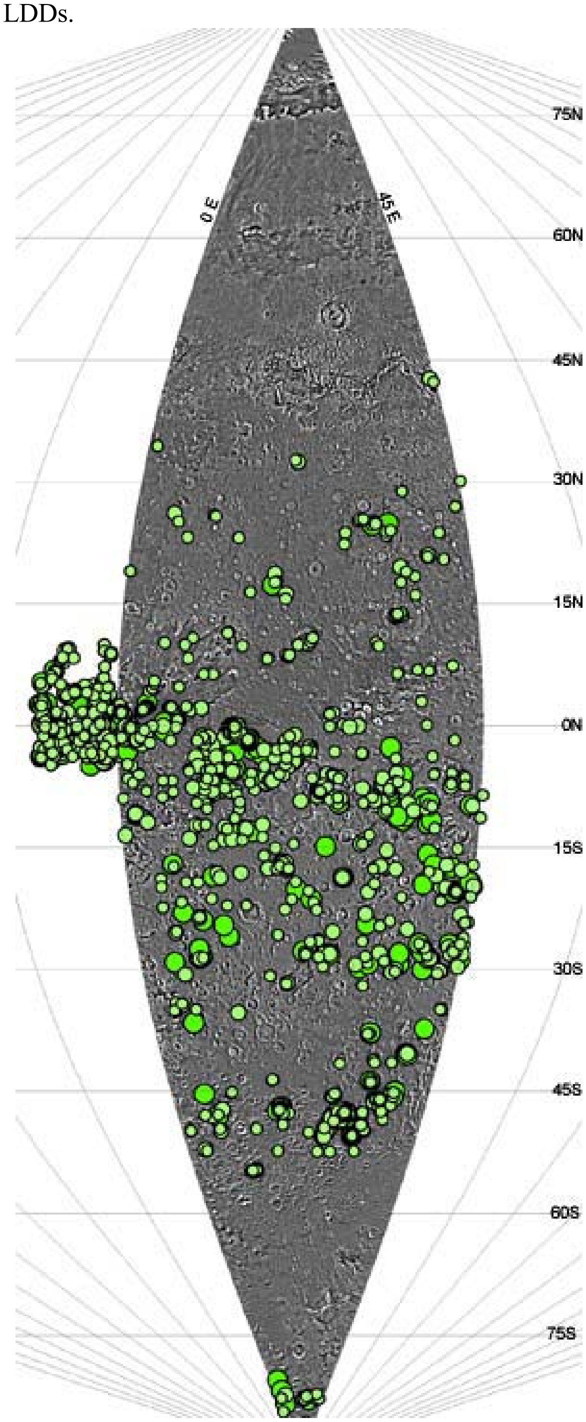

Figure 1. Location of MOC NA images that have >25% areal coverage of TARs. Largest circles repre-

sent >75% cover; smaller circles represent >25% or >50% cover. Background: USGS Viking MDIM 2.1.

Discussion: The spatial distribution of TARs seems closely linked to the presence of steep slopes and/or layered terrains. Thus the sediment source seems most consistent with formation from mass-wasting or denudation products. This suggests that sources are local and that TARs do not travel great distances. In Terra Meridiani the widespread outcrops of sedimentary terrains provide an abundant source of particulates, explaining why so many TARs are present here. The distinctive form of TARs in Meridiani suggests a control of their morphology by either the source lithlogy, or the rate of sediment supply. Given that we currently have only a poor understanding of local meterology, investigating this link with higher resolution climate models is a priority for our future studies

That TARs and LDDs are genetically related in the southern mid-latitudes provides new information on aeolian processes on Mars. If LDD materials here are indeed related to upwind TARs, this suggests that 1) They formed from the same source lithology, and 2) that TARs are a lag deposit from the least mobile part of the sediments and that LDDs form from the most mobile. This observation seems consistent with estimates of particle sizes equivalent to medium to coarse sand for LDDs [5] and with observations of TAR-like form in Meridiani that appear composed of finer grade material armored by a coarser lag [6].

References: [1] Bourke, M.C. *et al.*, LPSC XXXIII [CDROM], Abstr. # 2090, 2003. [2] Hayward, R.K. *et al.*, U.S. Geological Survey Open-File Report 2007-1158. http://pubs.usgs.gov/of/2007/1158/. [3] Balme, M.R. *et al.*, Geomorphology, accepted pending corrections, 2008. [4] Reiss, D., S. *et al.*, J. Geophy. Res., 109 (E06), 2004. [5] Fenton, L.K. *et al.*, J. Geophys. Res. 108 (E12), 5129, doi:10.1029/2002JE002015, 2003 [6] Sullivan, R. *et al.*, Nature, 436, 58-81, 2005

Figure 2. (below) Southern mid-latitude association of TARs with LDDs. Images with TARs are shown as green circles (as for figure 1 except images with <5% TARs are also shown as black dots) and mapped dune fields (from [2]) are shown in red. Climate model results for this region (also from [2]) are shown by blue lines that point in the direction of the winds. The modeled winds are broadly from the southwest, consistent with the spatial association of TARs and LDDs. Background: MOLA topography (warmer colors = higher elevations) draped over a MOC wide angle mosaic.