TRANSVERSE AEOLIAN RIDGES AS SEEN IN HIRISE IMAGES. K. M. Shockey[1] and J. R. Zimbelman[1], [1]CEPS/NASM MRC 315, Smithsonian Institution, Washington, D.C., 20013-7012; Shockeyk@si.edu.

Introduction: Recent HIRISE images have allowed us to see surface features on Mars that have not been seen previously at the meter scale, with the highest resolution yet seen from orbit [1], though topographic data outside of HiRISE stereo pairs have yet to reach a comparable resolution. Photoclinometry is a tool that can allow us to derive a topographic profile for certain areas of selected portions of HiRISE images. HiRISE images have significantly influenced the study of transverse aeolian ridges (TARs) [2,3,4], which have been previously interpreted to be either dunes or ripples[5].

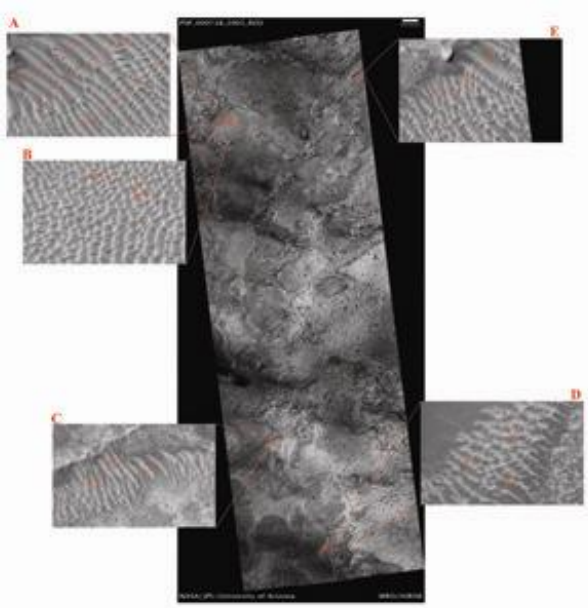

Figure 1: This HiRISE image (PSP-009718-2005) shows various types of TARs as classified by Balme et al. (2008) [4]. In this image, all the TARs would be under the classification of "influenced", which means that they are being affected by a topographic feature, in this case several breaks in slope. All the subsections, with the exception of C, would be under the classification of "networked", which refers to cross-cutting TARs. The subsection C would be under the classification of "forked", which appear to be a mix of linear and networked geomorphology**.**

Background: In our study, photoclinometry was used as a tool to extrapolate topographic profiles from HIRISE images. Before photoclinometry could be used, several assumptions needed to be made about the areas of interest [3]; 1) the albedo of the materials is constant along the entire line, and 2) the photometric properties of the surface materials are considered to be Lambertian, where reflected brightness is solely dependent upon the solar incidence angle to the surface. We also keep profiles relatively short (< 10s of meters) as a way to minimize errors due to possible albedo changes over larger distances.

Several classification systems have been used to describe TARs [2,3,5]. We use the classification system described by Balme (2008) [4] as the primary way to characterize the TARs examined in our study.

To date, we have used seven HIRISE images to create profiles in order to characterize TAR morphology. From these images we have extrapolated 49 individual profiles. Using these profiles, we quantified the width, height, and symmetry of each individual feature, and described the curvature of the TAR crest.

Methods: Figure 1 shows examples of multiple subsections taken of one HiRISE image to create multiple topographic profiles. The lines were consistently drawn from North and/or West to the South and/or East.

Width is measured from the basal break in slope from trough to trough across the TAR. The width would be measured from point A to point E horizontally, as seen in Figure 2. Height is measured from the crest to the midpoint (point C to halfway between A and E), in both the vertical and horizontal direction, between the troughs. This eliminates the need to remove effects of slope from the profile.

We quantified the symmetry by taking the same midpoint between the troughs, as used to measure height, and determined if the crest was directly over this point vertically. If the crest was directly over the midpoint, then the symmetry was assigned a value of zero. If the crest was not over the midpoint, then the horizontal distance between the crest and the midpoint was measured. If this result was negative, then the TAR was classified as left-leaning, with a positive result being classified as right-leaning, though this leaning direction is still somewhat subjective. The absolute value of the symmetry distance was divided by the width to give a scaled ratio. This ratio was used as a means to determine the amount of asymmetry for a TAR. The larger the ratio, the greater the asymmetry. Note that this symmetry analysis does not quantify things like breaks in slope along the sides of a feature.

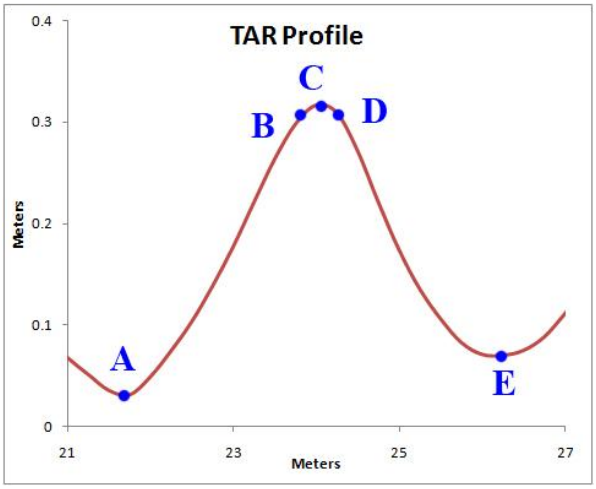

Figure 2: The above red line (left side of the image is pointing North) shows a profile for a TAR from HIRISE image PSP-009604-1725, centered at 7.4°S, 314.8°E. The five points in blue (A-E) indicate the locations on the profile used to determine the characteristics listed in Fig. 3.

$$Width = E_x - A_x$$

$$Height = C_y - (\frac{B_y - A_y}{2} + A_y)$$

$$symmetry = \frac{abs|C_x - \left(A_x + \frac{1}{2}width\right)|}{width}$$

$$crest\ curvature = \frac{Radius\ of\ Circle_{BCD}}{width}$$

Figure 3: The above equations relate to the points shown on Fig. 2.

To quantify the curvature of the crest of the TAR, three points are needed. The first point was at the crest (Fig. 2, point C). The other two points were to either side of the crest (Fig. 2, B and D), located where crest curvature merged with relatively straight flanks. Each of the two side points was equidistant from the crest. These three points were used to calculate a circle whose radius was then divided by the width of the TAR, which we call the curvature ratio (Fig. 3). The smaller the number, the sharper the crest.

Results: From the 49 profiles that have currently been assessed, we have compiled a summary of their morphologic characteristics. The average width for the TARs is 18.8 m, with a high of 44.75 m and a low of 2.25 m. The average height was determined to be 2.55 m, with a high of 9.68 m and a low of 0.27 m. For the curvatures ratio, an average of 17.7 was calculated. The high curvature ratio was 526.9 and the low was 0.09. A ratio for the symetry yielded an average of 2.2, a high of 2.7 and a low of 0 (perfectly symmetric).

Discussion: These small numbers for our results indicate that we are profiling TARs that were previously too small to characterize geomorpholigically like we are now doing. When compared to profiles of aeolian bedforms measured in the field [7], we hope that the measured Martian profiles will be able to constrain the probable origin of diverse TARs on Mars.

Conclusions: Through the use of HiRISE imagery, we have been able to expand on the work done by Wilson and Zimbelman (2004) [6]. Comparing our geomorphologic results to theirs, it is found that the average wavelength in our study is approximately half of what was obtained previously. This is an indicator that using HiRISE instead of MOC allows us to see features that are much smaller than previously imaged. We were able to further study the shape of the individual TARs and their given characteristics by use of photoclinometry. This gives us the highest resolution topography available.

Expanding on their geomorphologic studies and adding the classification system determined by Balme et al. (2008) [4], we are able to better understand the processes that form these TARs such as the surficial wind directions and how active they are.

Future work will include studying more HiRISE images to have a more comprehensive coverage of the Martian surface. We will also include studies of whether these features are considered to be active or not, as well as how degraded they may be. Pairing our work with these other studies will allow us to asses and understand these features better.

References: [1] McEwen et al. (2007) JGR [2] Shockey K. M. and J. R. Zimbelman (2010) *LPSC XXXXI*, Abstract #1423. [3] Zimbelman J. R. (2009) *Geomorph.*, in press. [4] Balme M. et al. (2008) *Geomorph*, *101*, 703-720. [5] Shockey K. M. and Zimbelman J. R. (2008) *LPSC XXXIX*, Abstract #1686. [6] Wilson S. A. and Zimbelman J. R. (2004) *JGR 109*, E10003. [7] Zimbelman J. R. et al. (this volume).
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