PATTERN EVOLUTION IN TRANSVERSE AEOLIAN RIDGES (TARS) IN SCANDIA CAVI, MARS. L. K. Fenton[1], S. Silvestro[1,2], and G. Kocurek[3], [1]SETI Institute, Mountain View, CA, USA (lfenton@seti.org), [2]Istituto Nazionale di Astrofisica, Osservatorio di Capodimonte, Napoli, Italy, [3]Dept. Geological Sciences, U. Texas at Austin.

Introduction: TARs are a type of bedform nearly unique to Mars, with morphological characteristics similar to both dunes and ripples. Exhibiting a wide range of wavelengths (6-140 m) and heights (0.3-6.4 m), they are larger than most coarse-grained ripples on Earth [1-3]. However, TARs are also distinct from the characteristically broad, rippled, large dark dunes (LDDs) found on Mars. There is not yet a consensus on what type of bedform TARs are, with some suggesting they are similar to terrestrial coarse-grained ripples [e.g., 3-5]. An understanding of their timescales of formation may shed light on their relation to LDDs and the large (2-4 m) ripples that superpose LDDs.

In Scandia Cavi on Mars (76.6°N, 227.7°E), barchans (LDDs) actively migrate over an apparently immobile TAR field. The barchans disrupt the TAR pattern, leaving behind a "wake" of ripples that form between (and, we hypothesize, may interact with) TARs as they emerge from burial (**Fig. 1**). Where undisturbed by a barchan's passage, the TAR pattern is well-organized, with widely spaced crests. Where burial by a barchan has introduced new sediment to the system, the TAR/ripple pattern behind the barchan is disordered, growing more well-organized with distance upwind (and therefore, with time) from the dune's passage.

We present preliminary results on the progression of TAR pattern evolution in a TAR-filled wake.

Method: As bedforms grow and migrate, they interact and self-organize into fields with regular spacing [e.g., 6]. A common interaction type is defect repulsion, as bedform defects migrate downwind faster than bedforms, allowing the bedform crest spacing to grow [7]. The wakes show how the TAR pattern responds to the disruption of a passing dune. By measuring the progression of TAR spacing, length, and defect density with distance upwind along the wake (converted to time by measuring the disrupting dune's migration rate), we can reconstruct TAR pattern evolution over time. We selected one dune in the Scandia Cavi study area for a preliminary study.

Dune migration rates. To compute dune migration rates, overlapping images must be aligned, and parallax distortion must be removed. A DTM was produced using a HiRISE stereo image pair covering the study area (with HiRISE images ESP_044405_2570 and ESP_044722_2570) using the NASA Ames Stereo Pipeline [8]. Two non-stereo images (HiRISE images ESP_017426_2570 and ESP_062023_2570) were orthorectified to the DTM using the Co-registration of Optically Sensed Images and Correlation (COSI-Corr) tool [9], and aligned to the orthorectified stereo images using tie points within COSI-Corr.

Measurement of Pattern Evolution. Using ArcGIS® software by Esri, we mapped ten 50-m long segments of TAR crests, as well as an adjacent area of TARs relatively undisturbed by dunes (**Fig. 2**). For each segment, we calculated the wake segment area (A), total crestline length (L), number of defects (N), the defect density ($\rho = N/L$), and mean bedform spacing ($\lambda = A/L$).

Results:

Dune migration rates. The three sets of orthorectified images provide two time periods for which migration rates can be measured. Change in both the slip face brink and slip face toe of the study dune have been measured (**Table 1**), with the toe advancing more in the first period and the brink advancing more in the second period. The net migration rate of the dune is taken as the mean of the overall brink and toe migration

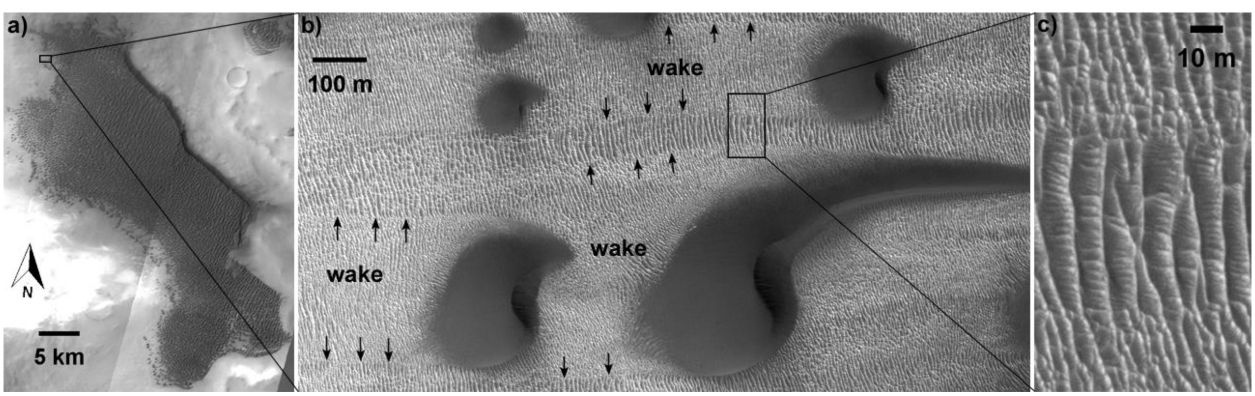

Figure 1. a) Dune field in Scandia Cavi, Mars in which b) barchans migrate over a TAR field, leaving wakes that disrupt the TARs (arrows point to wake borders; the study dune shown in Fig. 2 is at the top right). c) Disrupted TARs are closely spaced and disorganized (top/bottom); left alone they evolve into an organized, widely spaced pattern (middle).

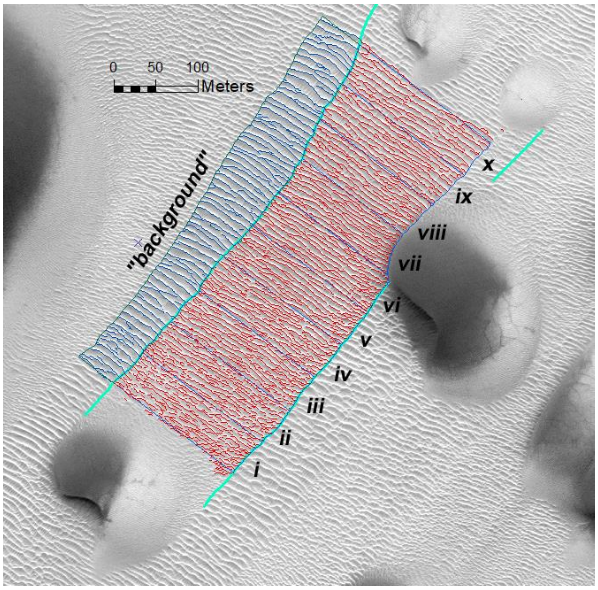

Figure 2. Mapped crestlines of the study dune's TAR wake, as well as a background area with a seemingly more mature pattern. The wake was divided into ten 50-m long segments, each representing a different time period since the dune's passage.

rates (0.2 m/yr). This is within the range, but on the slow side, of other measured Mars dune migration rates [10].

Pattern Evolution. The resulting trend in defect density and bedform spacing is shown in **Fig. 3**. The TARs exhibit a gradual loss in defects and a corresponding increase in mean spacing with distance/time from the dune's passage. This compares favorably with similar measurements made for different Earth dunes [11], although this is the first time-progression constructed for a single bedform field.

Table 1. Migration rate of study area barchan

HiRISE pair	**Δt**	**Brink rate**	**Toe rate**
Between each HiRISE pair:			
ESP_017425_2570 ESP_044722_2570	5.82 yr 3.08 MY	0.43 m/yr 0.82 m/MY	0.06 m/yr 0.11 m/MY
ESP_044722_2570 ESP_062023_2570	3.69 yr 1.97 MY	0.08 m/yr 0.16 m/MY	0.21 m/yr 0.38 m/MY
Total change:			
ESP_017425_2570 ESP_062023_2570	9.51 yr 5.05 MY	0.28 m/yr 0.53 m/MY	0.12 m/yr 0.22 m/MY
		Net migration rate: 0.2 m/yr	

Conclusions/Discussion: In Scandia Cavi, where LDDs actively migrate (albeit slowly for Mars), TARs require 3000-4000 years to readjust to the perturbation of a passing dune. This timescale is 5-7x longer than the 600 yr turnover time of the 120 m long dune, consistent the >0.5 km length of many TAR wakes.

This work raises the following hypotheses regarding the TAR and ripple evolution. We will discuss the evidence for and implications of each of these possibilities:

1. Ripples emerging from the dune into the wake evolve into TARs.
2. Ripples and TARs interact, such that sediment is transferred to TARs, thus providing a newly recognized TAR growth mechanism.
3. The ripples simply migrate out of the wake, or erode away, while the old TAR pattern is exhumed without pattern modification.

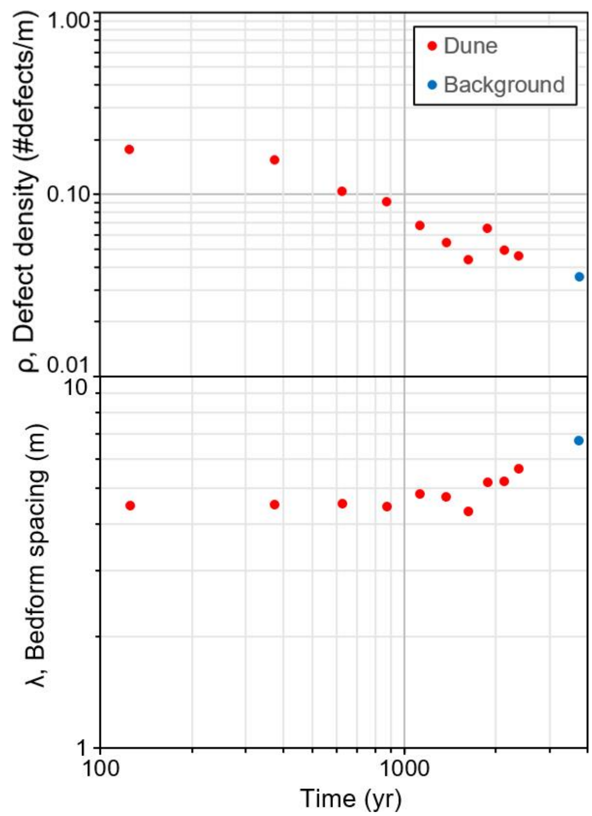

Figure 3. Temporal change in TAR defect density and bedform spacing in the TAR wake, showing that 3000-4000 years is needed to recover from the dune's disruption.

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