MEGA-RIPPLE AND CANDIDATE TRANSVERSE AEOLIAN RIDGE MIGRATION ON MARS – A CONTINUUM OF MARTIAN BEDFORMS. M. Chojnacki[1] S. Silvestro[2,3], and D. A. Vaz[4]. [1]Planetary Science Institute, Tucson, AZ (mchojnacki@psi.edu); [2]INAF Osservatorio di Capodimonte, Napoli, Italy; [3]SETI Institute, Mountain View, CA. [4]Centre for Earth and Space Research of the University of Coimbra, Coimbra, Portugal.

Introduction and Motivation: Many aeolian bedforms on Mars are enigmatic as compared to classical terrestrial bedforms. For example, the origin of moderate-scale (10-100 m spacing and 1-14 m tall), light-toned Transverse Aeolian Ridges (TARs) has been long debated (*1–3*), as similar terrestrial features are rare (*4*). Similarly, smaller (1-5 m spacing and ~40 cm tall) dark-toned ripples (DTRs) generally do not form on Earth, implying an unique martian process is involved (*5, 6*). Whereas the consensus view has been that TARs are dormant or inactive under current the climatic (based on superposed craters, lack of orbital detections, etc.), orbital and surface observations show DTRs are migrating on Mars today (e.g., *5, 7*). The size range in between these commonly cited bedform populations (5-20 m spacing, ~1-5 m tall) have been largely unexplored and generally assumed to be inactive like TARs (**Fig. 1**) (*8*). We term these intermediate-scale bedforms as “mega-ripples“ based on their greater dimensions and brighter crests than DTRs, where we infer the latter is due to a coarser grain size component (*9*).

Here we describe the morphology and evolution of aeolian bedforms bridging these seemingly different two groups. In particular, this abstract intends to provide an update on mega-ripple activity and their implications for planetary aeolian science.

Data Sets and Methods: We assessed aeolian activity using images acquired by the High Resolution Imaging Science Experiment (HiRISE) camera (0.25–1 m/pix) (*10*). For image orthorectification and dune topography, Digital Terrain Models (DTMs) (at 1 m post spacing) were constructed from HiRISE stereo pairs. Dune front advancements were recorded manually whereas mega-ripple migrations was quantified using COSI-Corr software (*11*) with megaripple fluxes derived using the method of (12). Dune migration vectors were converted to flux vectors by multiplying the migration rates to the dune heights derived from DTMs – see the method of (*13*) for details.

Results: Prior HiRISE surveys of dunes have shown variable ripple and dune activity across Mars (*14, 15*), but recently certain locations have been found with migrating ‘mega-ripples’, with spacing of ~8-18 m and heights of 0.8-2 m (**Fig. 1-2**) (*16*). Initially presented at the *Fifth International Planetary Dunes Workshop* (*17*), large, relatively bright mega-ripples were found migrating atop Nili Fossae dunes and in continuity with DTRs (**Fig. 1**; Animation DR1). Although dominantly transverse in morphology and motion, crescentic, oblique and star-like members can also occur that can migrate obliquely and longitudinally.

Migrating mega-ripples exist in a variety of regions and latitudes (North Polar erg, Hellespontus, Syrtis Major) but all detections to date are part of previously identified high sand flux dune field systems (defined here as 12 $m^3 m^{-1} yr^{-1}$) (*16*). For example, highly mobile dunes in Chasma Boreale show swiftly migrating mega-

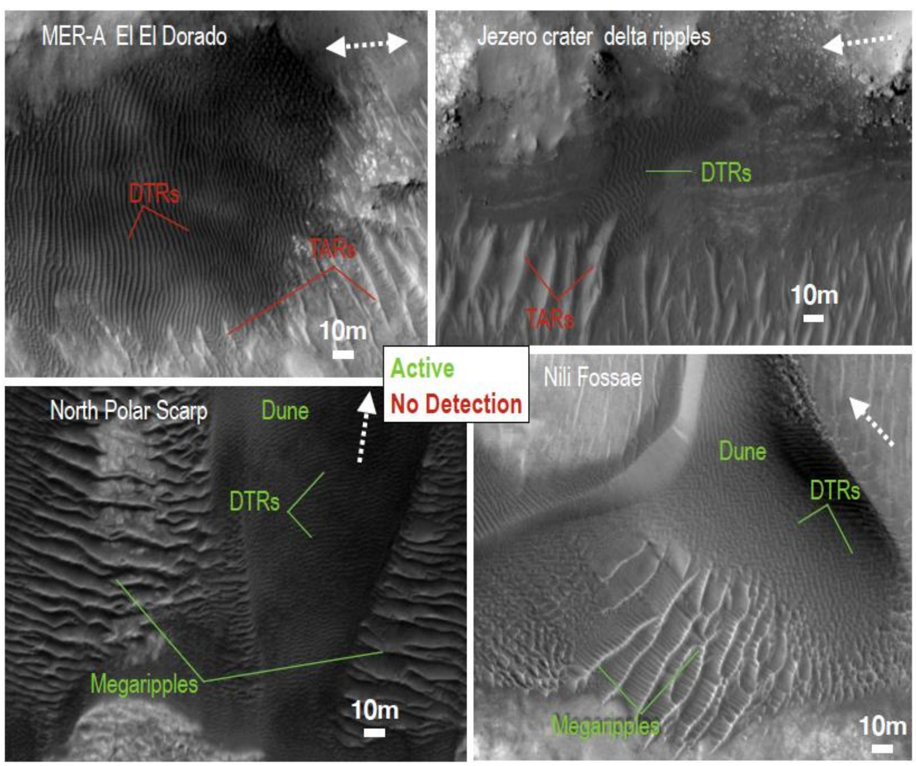

Fig. 1. Four bedform sites with or without detected migration, as viewed in HiRISE at that same scale. Known or suspected wind directions (arrows) are shown. See [*8, 15]* for image details and context.

ripple fields in upwind areas, where ripple heights are 1-2 m (**Fig. 1-2**; Animation DR8). This high level of activity is despite the limited sediment state as these areas are under meter-thick seasonal CO_2 frost and ice for over half the martian year (*16*, *18*).

These prior mega-ripple examples, while larger than previously documented active DTRs, were not recognized by the authors as "typical" TARs. However, new analysis of areas in McLaughlin crater showed mega-ripple (~15-20 m spacings) changes in 5 Mars year-baseline orthoimages (*11*). These bright-toned bedforms located stratigraphically below the dunes or in isolated patches are what would be normally referred to as small TARs (**Fig. 3**). Similar to Nili Fossae, these bedforms display fluxes that are two to three orders of magnitudes lower than the overlaying dune fluxes on average (*18*).

Discussion: Mega-ripples are found in continuity with DTRs and with similar dynamics and orientations, which implies both formed by similar aeolian processes (saltation and creep). This may suggest that these decameter-scale ripples exist on a continuum of Martian bedforms with small DTRs, as inferred by morphology (*19*). However, newly detected active bedforms cross over into the lower end of parameters previously described for TARs. TARs have been widely considered to be remnant landforms from a prior climate and obliquity, a scenario supported by the local superposition of craters and fractures in several areas of Mars (*3*, *8*). Indeed, isolated TAR fields in low wind areas may have become inactive following global changes, but since then were stabilized by induration and coarse grain armoring. New detections using increasingly longer temporal baselines afforded by the length of the HiRISE/MRO mission may support the notion of TAR/mega-ripple mobility in higher sand flux regions of Mars where bedform stabilization has yet to take hold.

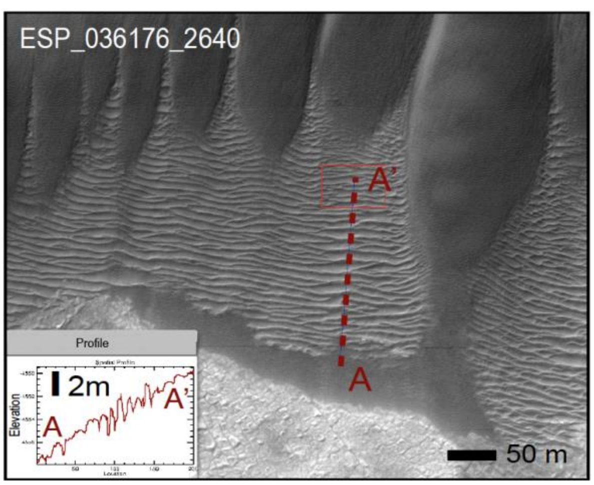

Fig. 2. Example of north polar erg active mega-ripples where bedform heights of 1-2 m are measurable in HiRISE DTMs (1 m/post).

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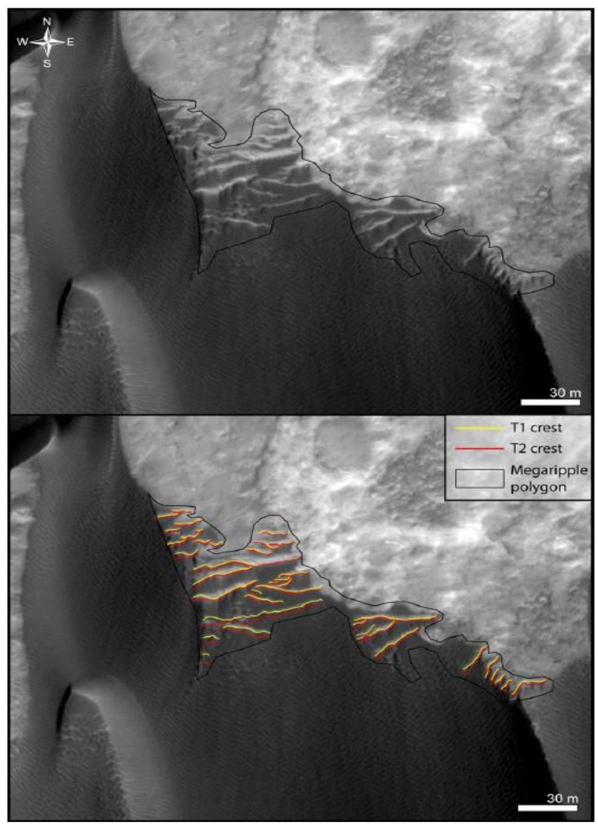

Figure 3. (top) Locations of some of the known migrating mega-ripples or small TARs in McLaughlin crater. (bottom) Bedform crestlines traced in the T1 and T2 images over 5 Mars years.