LONGITUDINAL AEOLIAN DEPOSITIONAL FEATURES ON MARS? S. Silvestro[1], D. A. Vaz[2,3], C. Popa[1], F. Esposito[1], [1]INAF Osservatorio Astronomico di Capodimonte, Napoli, Italy (silvestro@na.astro.it), [2]CITEUC - Centre for Earth and Space Research of the University of Coimbra, Portugal, [3]CERENA, Lisboa, Portugal.

Introduction: Mars has abundant aeolian bedforms like dunes, ripples, megaripples and TARs [1]. While dunes can have different morphologies according to the complexity of the wind regime and sediment availability, wind ripples are generally considered to trend perpendicular to the sand transporting winds. Non-transverse aeolian ripples on Earth have only been obtained experimentally under the influence of bi-directional flows [2] and hypothesized to occur on the flank of sand dunes [3]. In this report we propose a couple of possible new interpretations for some ripple patterns/morphologies on Mars that might not be transverse to the resultant wind direction.

Methods: Aeolian bedform are studied on HiRISE data (0.25-0.50 m/pixel). We used HiRISE stereo pairs to build DTMs and to orthorectify the overlapping images. We built the DTMs using SocetSet [4] and the NASA Ames Stereo Pipeline [5]. Ripple migration is measured on overlapping orthorectified HiRISE images [4].

Sand ribbon pattern: In Fig. 1a we show a sand ribbon pattern at Dillon Beach, CA (USA) which consists of longitudinal stripes of coarse/fine grained ripples. Ribbon features or "sand streams" [6-9] represent a mode of self-organization that is still poorly understood, likely due to small scale rotatory flows caused by the change in the roughness at the flow/bed interface [6]. Grain size segregation seems to be the main responsible for the observed wavelength differences. In Figs. 2b and c we show a couple of potential martian analogues. The first one is located in Gale Crater ~7 km SW from the selected Aeolis Mons entry point (Fig. 2b) [10]. In this area ripples are migrating to the SW suggesting winds coming from the NE [13]. Together with the transverse ripples sculpting the slope of the dark dune of Fig. 1b, we also notice several longitudinal stripes of sand running NE-SW [10]. These features are morphologically different from ripples as they do not display clear defect terminations and junctions. In addition, by looking at the same overlapping images analyzed in [11], these rectilinear features do not seem to change over time. One possible explanation is that they are ribbon-like features which form parallel to the main wind direction. In Fig. 2c we show another potential ribbon pattern located in the ESA 2016 landing ellipse in Meridiani Planum [12]. In this area larger wavelength megaripples form an E-W trending pattern extending for tens of kilometers. The pattern shows a clear topographic expression highlighted in the 3D view of Fig. 2c. Remote sensing analysis and in situ investigations [12-14] clearly indicate formative winds blowing from the east, thus the potential ribbons trend parallel to the main flow.

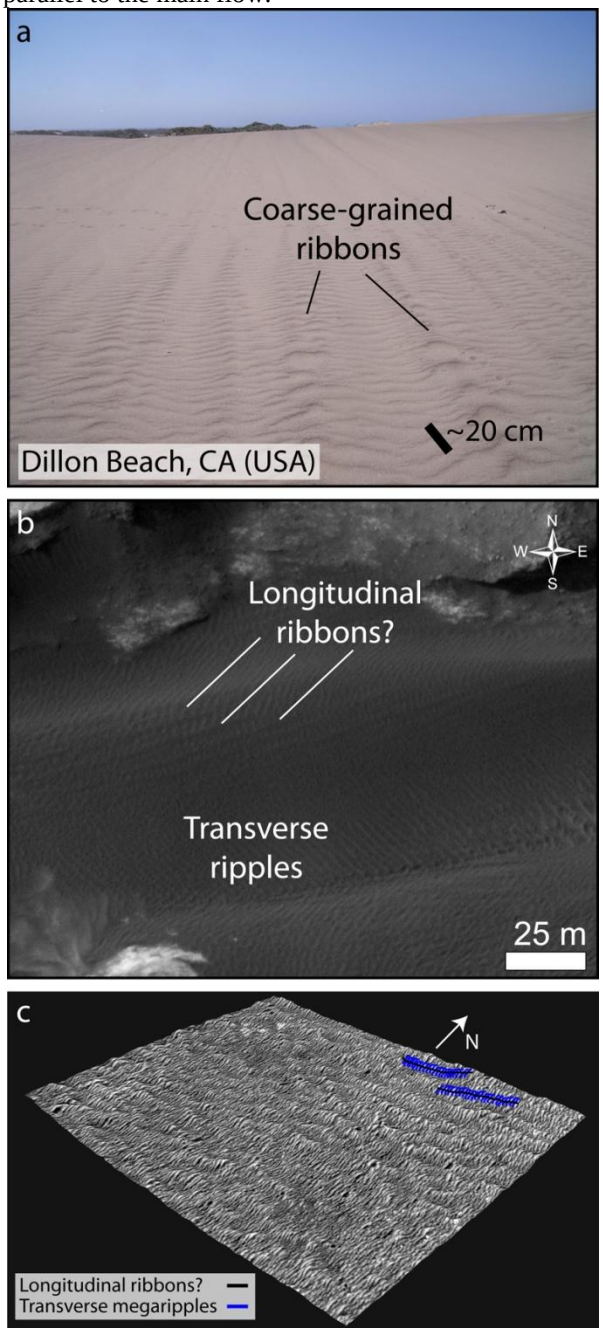

Fig. 1: Sand ribbon patterns **a)** Ribbons over the stoss side of a barchanoid dune, Dillon Beach, CA (USA) **b)** Potential longitudinal ribbon pattern in Gale Crater (Mars) **c)** 3D view of potential ribbons in Meridiani Planum (vertical exaggeration 10x).

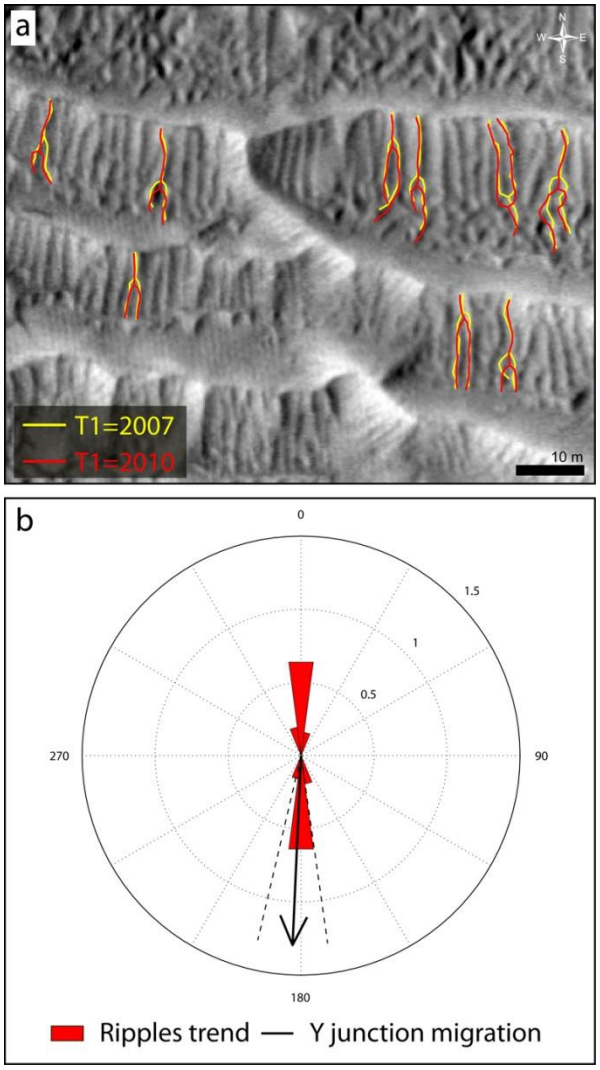

Fig. 2: Longitudinal ripples migration **a)** Mapped crestlines at T1 and T2. Note the longitudinal displacement of the Y junctions at T2 **b)** Rose diagram showing the ripple trend and the direction of the Y junctions migration.

Longitudinal ripples? Recent studies have demonstrated that bedform interactions are similar across scales (ripples, dunes) and environments (air, water) [15,16]. Of particular interest is the migration of the defect terminations (Y junctions) [17-19]. Computer models, laboratory experiments, and field observations have shown that Y junctions tend to migrate downwind when the flow is mostly uni-directional (or when two different flows approach at an acute angle) [17-22]. Conversely, when two flows approach at higher angles, longitudinal bedforms form, with junctures being displaced along the bedform crestlines [18,19] (see movie DR4 and DR6 in [21]). In Fig. 2 we show an example of potential longitudinal ripple migrations by comparing two overlapping HiRISE orthoimages acquired in 2007 and 2010. In this area active ripples trending N-S are located directly downwind of a set of 0.4-0.6 meters tall TARs (main wind deduced from dune migration and morphologies is from north to south). By looking at the overlapping T1 and T2 images we noticed that individual ripples are not migrating toward the East/West as expected. Instead, they seem to elongate downwind with the Y junction terminations being displaced towards the south at T2 (Figs. 2a and b). We hypothesize that flow convergence is probably occurring in this area, causing the ripples to evolve longitudinally. Such a convergence is likely triggered by the particular topographic setting in which ripples are evolving. Results from a preliminary mapping of potential longitudinal ripple migrations will be presented in support to this hypothesis.

Conclusion: In this report we show two examples of potential longitudinal depositional features on Mars. At the pattern scale we show sand ribbons which are formed by longitudinal rows of transverse ripples. If images resolution is not good enough to resolve individual ripples (Fig. 1b), these structures might be mistaken for transverse ripple patterns. At the ripple scale we show that some aeolian ripples might not be completely transverse to the resultant flow direction. The topographic setting in which sand ripples evolve needs to be considered when extracting wind information from images of planetary surfaces. Collectively, our observations suggest that the assumption of the transverse nature of ripples must be used with caution.

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