ACTIVE AEOLIAN PROCESSES ALONG CURIOSITY'S TRAVERSE IN GALE CRATER. S. Silvestro[1], D. A. Vaz[2,3], A. P. Rossi[4], J. Flahaut[5], L. K. Fenton[1,6], R. Ewing[7], and P. E. Geissler[8], [1]SETI Institute, Carl Sagan Center, 189 N. Bernardo Avenue, Mountain View, CA, USA (ssilvestro@seti.org), [2]Center for Geophysics, University of Coimbra, Portugal [3]CERENA, Instituto Superior Técnico, Lisboa, Portugal, [4]Jacobs University, Bremen, Germany, [5]Laboratoire de Géologie de Lyon, ENS Lyon, Villeurbanne, France, [6]NASA Ames Research Center, Mountain View, CA, USA, [7]University of Alabama, Department of Geological Sciences, Tuscaloosa, AL, USA, [8]US Geological Survey, Flagstaff, AZ, USA.

Introduction: Gale Crater is the landing site of the Mars Science Laboratory (MSL) mission to Mars (Fig. 1). This crater has been subject to a wide range of geological processes that gave rise to the dramatic variability of terrains observed from orbit [1]. Among these processes the action of the wind appears to have played a dominant role for much of the crater's history, as indicated by the abundance of aeolian features at this site [1,2,3]. In the NW portion of the crater floor, dark sand dunes are organized in a dune field crossing the landing ellipse from the NE to the SW (Fig. 1a). Recent observations of the migration of dark dunes and ripples throughout the Martian tropics have provided a wealth of new information on the sediment transport dynamics and wind regime at the surface of Mars [4,5,6,7] and similar analyses can provide precious indications about the current wind regime in the landing site. We analyzed two overlapping HiRISE images in the landing ellipse. These data, together with the morphology and orientations of the dark dunes and ripples, allow us to reconstruct the wind regime across the rover traverse, for the first time providing the opportunity to use ground measurements from the MSL Rover Environmental Monitoring Station (REMS) to test the accuracy of a wind regime derived from orbital data.

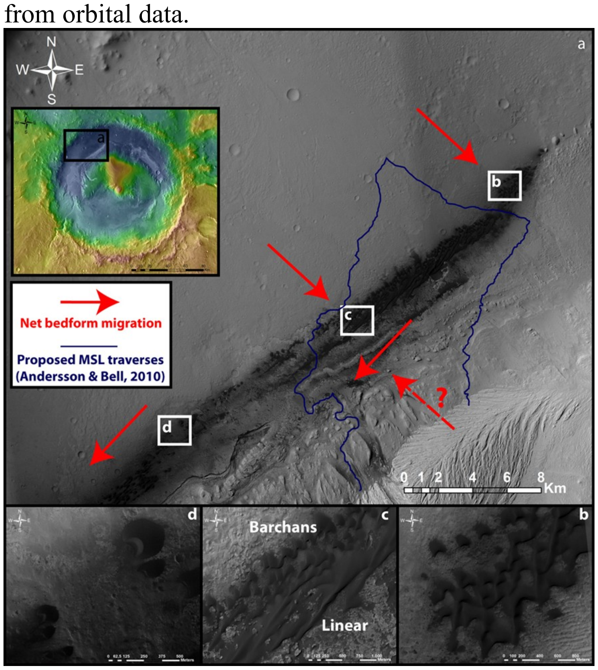


Fig. 1: Dune morphology in the study area

Methods: We performed our analysis over two orthorectified overlapping HiRISE images that were co-registered in ArcGIS using bedrock as reference. The two HiRISE images have been processed in ISIS and were acquired with minimal difference in lighting conditions in 2006 (T1) and 2008 (T2). CTX images have been used as context. The ripple pattern is mapped automatically using part of the methodology introduced by [8]. Ripple displacements were calculated along the whole ripple crest for 57 ripples over 5 dunes. CRISM data available over the area were processed as in [9] to derive mineralogical composition for the dunes.

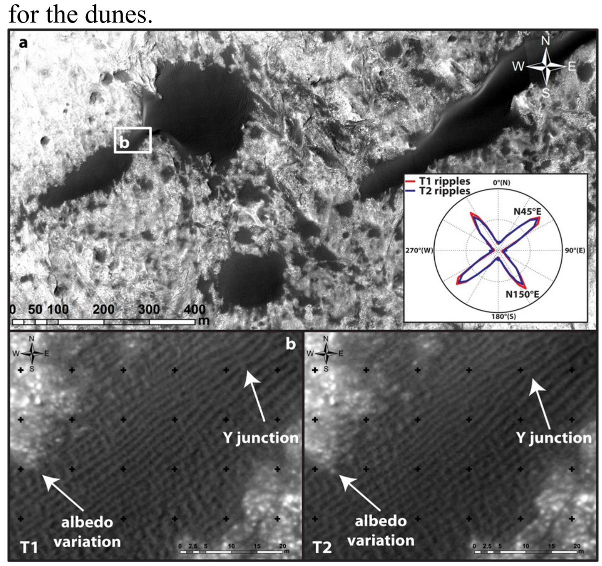


Fig. 2: ripple pattern and sand movement in the Site 1

Dune morphology and ripple pattern: The dark dunes in the MSL landing site consist of dark sand enriched in mafic minerals (olivine and high-calcium pyroxene) as seen with CRISM. Their morphology is quite complex as it changes moving toward the SW. Simple barchan dunes with SE facing slip faces are visible in the NE margin of the erg (Fig. 1b). In the central part of the erg, barchan dunes evolve to linear features close to the central mound (Fig. 1c). Further to the SW, the dune field is dominated by simple barchans with SW facing slip faces (Fig. 1d). A schematic representation of the net sand movement direction solely based on dune morphology is visible in Fig. 1a. However, because the wind regime is not strictly uni-directional, the dune morphology is not representative of individual wind directions [10].

Ripples rather than dunes give us more precise information about the wind regime in the study area and are analyzed in two different sites. *Site 1:* the ripples superposing three dunes (Fig. 2a) were mapped automatically and their orientations are plotted in the circular diagram shown in the inset. Two orthogonal patterns with modes at N45°E and N150°E are visible. The N150°E ripples migrated consistently and, while such a migration is not so evident for the N45°E pattern, it also displays significant changes (Fig. 2b). *Site 2:* at this site two classes of bedforms (dark and bright dunes-TARs) have accumulated in a canyon (Fig. 3a). The ripples (4-5 m in wavelength) consist of transverse ridges that are locally crossed by linear features (Fig. 3b). The bright bedforms (TARs) have a NW-SE trend and an average wavelength of ~17m (Fig. 3c). A steeper slope facing SW is visible (Profile AB). CRISM spectra indicate a weak hydration band suggesting that these features could be formed of the hydrated material eroded out from the layered mound outcropping nearby [11].

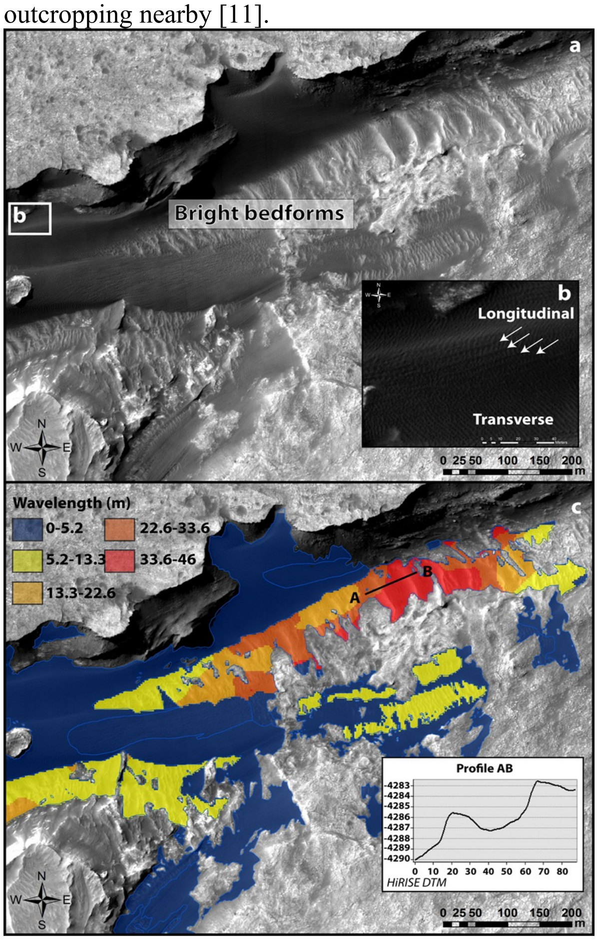
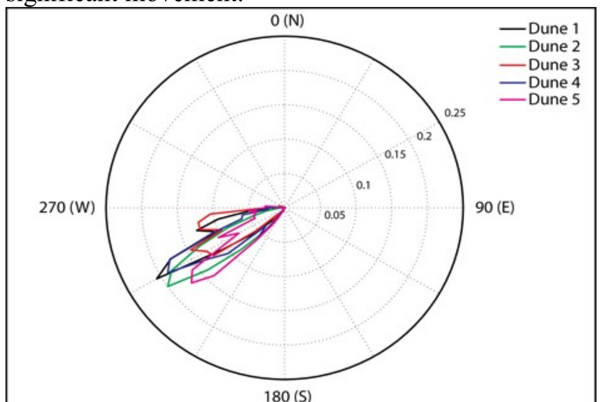


Fig. 3: Dark and bright dunes and ripples in the Site 2

Migration rate: the plot of Fig. 4 summarizes the computed minimum displacement [4] for 57 N150°E ripples measured over 5 dunes. The mean azimuths vary between 237°-248° indicating a displacement toward the SW forced by winds coming from the NE. Values of minimum displacement are all around 1–1.5 meters (0.5 – 0.75 m/Martian year), which are comparable to values of migrations in other tropical zones of Mars [4,12]. The N45°E ripple pattern is also changing suggesting a multi-directional wind regime. Conversely, the bright dunes in site 2 didn't display significant movement.



	Mean azimuth	Mean displacement	Circ.Var.	Circ.STD.
Dune 1	237.34°	1.64 m	0.02	11.45
Dune 2	245.65°	1.16 m	0.02	11.83
Dune 3	248.50°	0.97 m	0.03	14.16
Dune 4	242.06°	1.05 m	0.02	12.29
Dune 5	238.24°	1.07 m	0.04	15.82

Fig. 4: Computed ripple migration over 5 study dunes

Conclusion: We identified consistent ripple migration forced by strong winds from the NE in the MSL landing site. Because Curiosity will drive through th-ese dunes, it may eventually experience such winds. This will be an opportunity to measure the threshold friction velocity of sand saltation, a key factor for determining erosion rate and sand fluxes on Mars. The variability of the ripple pattern and dune morphology however, suggests a more complex wind regime. The morphology and orientations of the TARs also suggest formative NE flows near the central mound. Due to their enrichment in hydrated minerals these bedforms could be an interesting target for Curiosity.

Acknowledgements: we would like to thank D. Rubin for his useful advices. **References:** [1] Anderson R. B. and Bell J. F. (2010) *Mars, 5,* 76-128. [2] Hobbs S. W. et al. (2010) *Icar.,210,* 102-115. [3] Silvestro S. et al. (2010) *LPS XLI,* Abstract #1533, 1838. [4] Silvestro S. et al. (2010) *Geophys. Res. Lett., vol. 37,* L20203 doi:10.1029/2010GL044743, 2010. [5] Chojnacki M. et al. (2011), *JGR, 116*, E00F19, doi:10.1029/2010JE003675, 2011 [6] Silvestro S. et al. (2011) *Geophys. Res. Lett., vol. 38,* L20201, doi:10.1029/2011GL048955, 2011 [7] Bridges et al. (2012), *Geology, 40*, no.1. [8] Vaz D. A. (2011), *PSS, 59*, 1210-1221. [9] Murchie S. L. et al. (2009) *JGR, 114*, E00D07.[10] Rubin D. M. and Ikeda H. (1990), *Sedimentology, 37*, 673-684. [11] Milliken R. E. et al. (2010), *GRL, 37,* L04201. [12] Geissler P. E. et al. (2011) *LPS XLII,* 2537.