RIPPLE MIGRATION AND SMALL MODIFICATIONS OF ACTIVE DARK DUNES IN NILI PATERA (MARS). S. Silvestro1, L. K. Fenton2, and D. A. Vaz3, 1International Research School of Planetary Sciences, Università d’Annunzio, Viale Pindaro 42, Pescara, Italy (simone@irsps.unich.it), 2SETI Institute, NASA Ames Research Center, CO, USA, 3Centre for Geophysics, University of Coimbra, Portugal.

Introduction: Are martian aeolian bedforms (ripples and dunes) capable of migration in present day atmospheric conditions? This is one of the major questions regarding the aeolian processes on the red planet. Although sparse evidence of dune activity [1, 2, 3] and ripple migration [4] have been recently detected on the surface of Mars, there is currently no evidence of widespread bedform migration.

Images from the High Resolution Imaging Science Experiment (HiRISE) recently revealed that, as it occurs on the Earth, smaller ripples are superposed on the slopes of martian dark sand dunes [5]. However, if the dark sand dunes are presently active, the migration of the ripples should be potentially detected using multitemporal hi-res images. Here we test such hypothesis analyzing two HiRISE images that provide multitemporal observations of a dark erg consisting of barchan and barchanoid dunes (Fig. 1) in Nili Patera. The latter dunes, with sharp brink and crests [6], are among the best candidate sites for the identification of bedform migration and overall dune activity.

Methods: Two overlapping HiRISE images (PSP_004339_1890 and PSP_005684_1890) were processed and co-registered with the CTX P04_002427_1888_XL_08N292W (Fig. 1) into a Geographic Information System (GIS) environment. The HiRISE have been acquired the 30 June and 13 October 2007 at Ls=267.5° (late autumn) and Ls= 330.0° (winter), respectively. A semiautomatic algorithm for ripple identification was used to extract ripple limbs and to search for changing ripple patterns [7,8,9] (Fig. 2).

Results: Three different kinds of dune modifications were detected in the study site: 1) Changes in the ripple pattern are visible at the ripple crest terminations in Fig. 3, based on the modification of the Y junction (by the process of defect migration [10,11,12]). Y junction are displaced westward in the observed examples (Figs. 3a, a1 and 3b, b1). Ripple crests are outlined in yellow and major modifications in blue. In Fig. 3c, c1 we highlighted the movement of the ripple (outlined in blue) toward the dune crest (in green). In Fig. 4 a, a1, we observed the displacement of the ripple crest with respect to the fractures on the substrate (outlined in white). Assuming that the displacement of the ripple crests would be less than one crest wavelength, we calculated a migration of ~2 m toward the WSW. This represents to date the higher value of bedform migration ever measured on Mars. 2) Changes in the shape of the dune edges are visible in Fig. 4a, a1 and 4b, b1. The edge of the dunes (outlined in green) changes significantly in the two HiRISE suggesting active sand saltation at this site. 3) Changes in the slip face structures (Fig. 5a, a1), we can observe that several new rectilinear streaks occurred on dune slip face (see Fig. 1 for location). We interpret these features as new grainflow events [13] suggesting consistent dune activity between late autumn and winter.

Discussion: The changes in the position of the Y junctions and in the edges of the study dunes (Figs. 3,
The ripple migration observed in this study is the first evidence of widespread bedform migration detected from orbital data and suggests that: 1) the surface of the dunes in the study area are not heavily cemented or crusted 2) high stress winds blow from the ENE between late autumn and winter. Other evidence of overall dune activity includes the modification of the dune edges and the occurrence of new grainflow scars over dune slip faces. Collectively, our results, indicate that sustained saltation occurred in the study area and that dark dunes in Nili Patera are active in present day atmospheric conditions. A global search for ripple movement over the Martian dark sand dunes will be performed in the future to better constrain the migration rate of the wind ripples and the geographical distribution of the active dark dunes on Mars.

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