MARTIAN BEDFORMS CHANGES AND TEXTURES AS SEEN BY HIRISE

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Introduction

HiRISE has been observing Mars in its primary science orbit since November, 2006, during which the full range of seasons in both hemispheres has been documented over 1.5 Martian years. Over 14,000 images have been acquired, showing a wealth of detail and diversity that have provided fundamental data for numerous investigations. Almost all HiRISE images show dunes, ripples, and transverse aeolian ridges (TARs), with over 500 specifically targeted to observe aeolian features. Here we provide a summary of HiRISE studies of bedforms, focusing on evidence or lack thereof for changes and surface textures. Some of this work, in particular the studies of change detection, is a summary of investigations by other researchers, with this abstract intended as a venue for discussion.

Major Themes

Change Detection

Many HiRISE observations have been taken one Mars year or more apart to look for changes in dune and ripple positions. A recent study found that the 2nd order ripples on dunes in Nili Patera moved 2 m in 2.5 months [1]. This represents apparently very rapid movement and is a surprising finding. On Earth, 2nd and 3rd order ripples can form on time scales as short as a day, so the findings that the Nili Patera ripples are moving on such rapid time scales, as opposed to the overall dunes, is consistent. Such movement also agrees with current sand migration in the Columbia Hills, as evidenced by the trend of ventifact abrasion features that are aligned with 2nd order ripples [2].

Evidence for deflation or abrasion of sand (as opposed to migration) is more common. For example, bedforms in Endeavour Crater in Terra Meridiani have been documented to disappear and shrink over a period of 7 years as seen by MOC and then HiRISE [3]. Similarly, MOC data has documented the shrinkage and disappearance of ice-cored dome dunes in the North Polar Erg [4], indicating an active saltation-induced process of sand transport and probably abrasion of ice-cemented sand, perhaps assisted by sublimation of interstitial ice, or a combination of the two. HiRISE images of the same area show no changes over a period of slightly more than 3 years [5]. Combined studies by MER and HiRISE indicate that basaltic sand is currently being blown out of Victoria Crater by northern summer winds, forming the prominent windstreaks projecting north of the crater [5]. Similarly, many HiRISE images show changes in sand-dust patterns , but whether sand or dust is moving cannot be ascertained.

Besides the Nili Patera case, there is no definitive evidence for a change in the position of dune or ripple crests that would indicate migration by the wind. This is consistent with past studies, albeit with lower resolution instruments, that also failed to document any changes [6-8]. It therefore seems that Mars is largely static, but with notable exceptions. A combination of high wind shear, loosely bound particles, and perhaps low particle size are favorable for saltation.

Reticulate Textures: Part Two

A reticulated texture down to scales of a few meters is common in many low thermal inertia regions and has been interpreted as intersecting ripple sets in a thick dust aggregate mantle [9]. Supporting a dust aggregate origin, a “fresh” crater with dark, radial ejecta, shows thick reticulated material in its interior in a recent HiRISE image (ESP_015962_1695). This crater, located south of Noctis Labynthus in a low thermal inertia area, may be filled with dust aggregates that have accumulated and become trapped. A more enigmatic example is seen in a recent HiRISE image of barchanoid dunes on Arsia Mons (originally identified by MOC) that show a texture confined to the stoss slopes (ESP_016068_1720). If the reticulate texture is redistributed mantle material, the mantle must have been stripped off the non-dune areas. Alternatively, this could represent some sort of sculpted abrasion texture on cemented dunes. More work is needed to assess the full range and characteristics of this texture outside of the Tharsis region that was initially studied.

Note: Figures were removed from this abstract due to file size limitations. They will be presented at the conference.

References [1] Silvestro, S. et al. (2010). *Lunar Planet. Sci. XLI*, 1820. [2] Thomson, B.H. et al. (2008), *J. Geophys. Res., 113*, E08010, doi:10.1029/2007JE003018. [3] Chojnacki et al. (2010), *Lunar Planet. Sci. XLI*, 2326. [4] Bourke, M.C. et al. (2008), *Geomorphology,* 94, 247–255. [5] Bourke, M.C. et al. (2009), *Lunar Planet. Sci. XL*, 1748. [5] Geissler, P.E. et al. (2008), *J. Geophys. Res.*, *113*, E12S31, doi:10.1029/2008JE003102. [6] Edgett, K.S. and M.C. Malin (2000), *J. Geophys. Res., 105*, 1623-1650. [7] Zimbelman, J.R. (2000), *Geophy. Res. Lett., 27*, 106901972. [8] Malin, M.C. and K.S. Edgett (2001), *J. Geophys. Res., 112*. 23,429-23,570. [9] Bridges, N.T. et al. (2010), *Icarus*, doi:10.1016/j.icarus.2009.05.017