RECENT DUNE CHANGES AT ENDEAVOUR CRATER, MERIDIANI PLANUM, MARS, FROM ORBITAL OBSERVATIONS. M. Chojnacki[1], D. M. Burr[1], and J. Moersch[1], [1]Planetary Geosciences Institute, Department of Earth and Planetary Sciences, 306 EPS Building, University of Tennessee, Knoxville, TN 37996 (chojan1@utk.edu).

Introduction: Despite a dynamic atmosphere and plentiful sediment supply, orbital detection of dune movement on Mars has been elusive. Meridiani Planum exhibits ample evidence in orbital images and ground-based observations by the Opportunity rover for aeolian activity with dunes, ripples and dark streaks. The next major campaign for Opportunity is the investigation of the ~20-km-diameter Endeavour crater, ~13 km to southeast of the rover's position in December, 2009. Here we present orbit-based evidence that aeolian bedforms in Endeavour crater have been active in the span of the past decade (Figure 1 and Table 1) and at a spatial scale which should be directly observable from the rim of the crater by the Opportunity rover. A companion abstract [1] describes the regional-scale geologic setting for Endeavour crater.

Background: Contemporary dune activity has been a long-sought goal of Martian aeolian remote sensing. Although a campaign was put forth to look for dune migration from the Viking to MGS eras [2], no detectable dune migration was observed in that 14 Martian year time span [2]. *Bourke et al* [3] used repeat MGS data (1999-2004) to show the disappearance of two, small (~1000 m^2) dome dunes, although no bedform migration was observed. This disappearance demonstrates that the threshold windspeed for entrainment was exceeded under current conditions in these polar locations.

Evidence for modern day aeolian activity at rover landing sites was found with the deposition and erosion of basaltic sand in a dark streak at Victoria Crater [4]. Additionally, inferred sand-sized grains were found on the 66 cm tall rover deck [5], giving perhaps the most conclusive proof for current day sand saltation. However, no associated bedform change has been detected from orbital observations.

Methods: For our investigation of aeolian

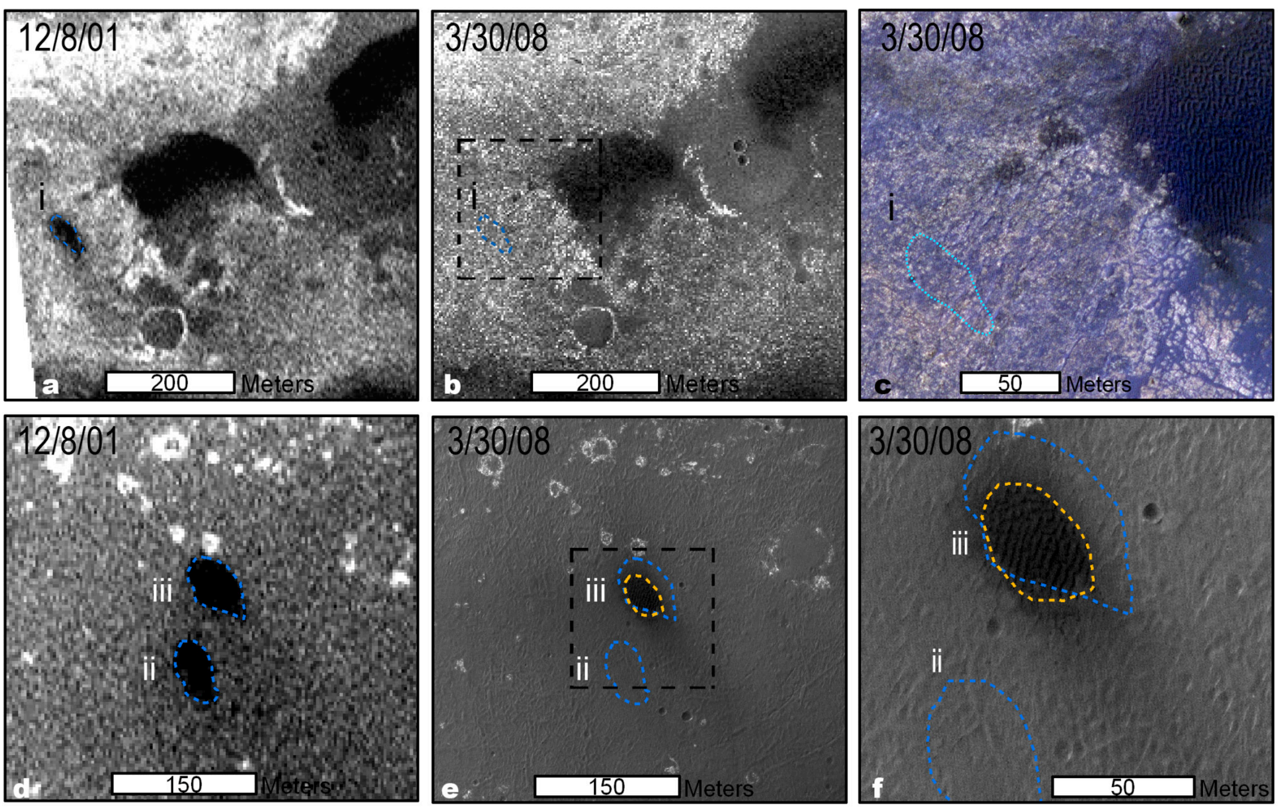

Figure 1. (a-c) Visible wavelength images showing the disappearance of bedform i and (d-f) disappearance of bedform ii and changes in bedform iii. See Table 1 for all image #s, resolutions and location. (a) MOC image and (b) a HiRISE image down-sampled to MOC resolution with approximately the same contrast enhancement of the scene. (c) A closer view in the color HiRISE image showing the texture of the eastern bedform is no longer visible where bedform i was previously located. (d) MOC shows bedform ii in 2001. (e) HiRISE shows the disappearance of bedform ii and the ~50% reduction in size of bedform iii in 2008. (e) Closer examination shows differences in surface texture from bedform ii to bedform iii and hints at a southward erosional direction. Blue polygons represent the extent of bedforms in 2001 and yellow the extent of bedforms in 2008. North is up in all images.

bedforms and change in Endeavor crater, we used narrow-angle images from the Mars Orbiter Camera (MOC) [6] to compare with data from the Context Camera (CTX) [7] and the High Resolution Imaging Science Experiment (HiRISE) [8]. The resolution for select images is listed in Table 1. Using the USGS ISIS [9], ArcGIS©, and ENVI© software suites, dune morphometric characteristics were measured with special effort to mitigate any differences in spacecraft cameras and illumination conditions.

Aeolian Activity: Endeavour crater has two main populations of dune bedforms and numerous transverse aeolian ridges. Well-formed barchans and transverse dunes are found in the western portions of crater, whereas less-developed, degraded bedforms populate the eastern half. The eastern dunes resemble transverse and small dome dunes, but appear to lack slipfaces and appear to have low relief.

Six bedforms appear in the 2001 and 2003 MOC images shown in Figure 1. However, in CTX and HiRISE images taken in 2008, two of the bedforms (i & ii) have disappeared entirely, while four others (iii-vi) have decreased in area. Bedforms iv-vi (not shown) are only covered in the lower resolution MOC+CTX pair of images, making area estimates more difficult than for bedforms i-iii, which are covered in the MOC+HIRSE pair of images. We suggest two possible explanations for the disappearance of these bedforms: (1) aeolian removal and/or deflation, or (2) dust deposition (with consequent increase of albedo) over the area such that these dark bedforms are no longer visible. We judge the second explanation to be less likely because the locations where the dark-toned features have disappeared now (as of 2008) lack the ripple-like texture seen in the dark-toned features that remain (see HiRISE images in Figure 1c and 1e). Although the MOC images from 2001 are of insufficient resolution to distinguish this texture, it is reasonable to assume that all the dark-toned features in this vicinity originally had the same rippled surface texture. If the reason the dark-toned features went away was simply because a mantle of bright dust had been deposited on top of them, the rippled texture would have been preserved, but it is not. Thus, we suggest, these three bedforms and another three (not shown) were eroded and/or removed in the 2.3-3.4 Mars years between the images.

The total amount of sediment removed is on the order of 10,000 m^2, or roughly the one sixth of the Victoria crater dune field. However, these time spans for change and the removal fluxes shown in Table 1 are lower limits, as no intermediate images are available. Sediment loss rates vary widely from dune to dune (Table 1), but are on the order of 500 m^2 per Mars year.

Morphometry	Image ID and DOA		Area Loss	Time Change[a]	Rate[b]
Bedform *i*	M1 12/8/2001	H1 3/30/2008		3.4	
Length (m)	58	na			
Width (m)	24	na			
Area (m^2)	1071	na	100%		315.0
Bedform *ii*	M1 12/8/2001	H1 3/30/2008		3.4	
Length (m)	63	na			
Width (m)	29	na			
Area (m^2)	1630	na	100%		479.4
Bedform *iii*	M1 12/8/2001	H1 3/30/2008		3.4	
Length (m)	71	47			
Width (m)	43	30			
Area (m^2)	2094	1159	45%		275.0
Bedform *iv*	M2 12/30/2003	C1 3/30/2008		2.3	
Length (m)	62	48			
Width (m)	39	34			
Area (m^2)	1929	1259	35%		291.3
Bedform *v*	M2 12/30/2003	C1 3/30/2008		2.3	
Length (m)	109	69			
Width (m)	45	50			
Area (m^2)	4322	2728	37%		693.0
Bedform *vi*	M2 12/30/2003	C1 3/30/2008		2.3	
Length (m)	131	88			
Width (m)	84	74			
Area (m^2)	8,666	5786	33%		1252.2

Table 1. A table listing the morphometric values before and after bedform removal or deflation. Image IDs resolution are the following: C1=P17_007849_1793_XN_00S005W at 5.37 m/pixel, H1=PSP_007849_1775 at 0.25 m/pixel, M1=E1101328 at 3.61 m/pixel and M2=R1203949 at 3.59 m/pixel. The approximate location of all bedforms discussed in Table 1 is 2.32° S, 354.81° E.

Discussion: The unambiguous deflation of Endeavour Crater dune sediment and associated estimated removal rates may suggest Martian bedform activity is more frequent than previously thought. This result confirms that local winds are sufficient to initiate entrainment possibly saltation, as observed elsewhere on Mars [3, 4, 5]. As in the case with the polar disappearing dunes [4], erosion, not translational migration of the bedforms, appears to be the process operating in Endeavour. One possible exception is that of bedform v (not shown) which appears to have been transported south by ~20 m, in addition to losing ~40% of its sediment. This result suggests these modest dunes are not in equilibrium with their environment, nor are they adequately stabilized due to induration.

References: [1] Chojnacki M. et al. (2010) LPSC, *this conference.* [2] Malin and Edgett (2001) *JGR,* 106, 23,429–23,570. [3] Bourke et al. (2008) Geomorphology, 94, 247–255. [4] Geissler et al. (2008) JGR, 113, E12S31. [5] Greeley et al. (2006) JGR, 111, E02S09. [6] Malin et al. (1992) *JGR,* 97, 7699–7718. [7] Malin et al. (2007) JGR, 112, E05S04. [8] McEwen, A. S. et al. (2007) JGR, 112, E05S02. [9] Gaddis et al. (1997) LPSC XXVIII, 387–388.