PERSISTENT SURFACE CHANGES IN SOLIS LACUS, MARS. P. E. Geissler[1] (pgeissler@usgs.gov), and the HiRISE Team, [1]Center for Astrogeology, U.S. Geological Survey, Flagstaff, AZ 86001 USA.

Introduction: The classical low albedo feature known as Solis Lacus occupies the center of a vast high plain south of the Valles Marineris extending more than 30° in longitude and 20° in latitude. Ringed by mountains to the south and canyons to the north, the plateau sits at elevations from 2500 m to 4300 m above datum and includes Syria Planum, Sinai Planum, Thaumasia Planum and Solis Planum. Made up of Hesperian aged volcanic plains, the region has higher than average thermal inertia (240 to 340 MKS units) and inferred rock abundance (6% to 17%). Dozens of small shield volcanoes are found in Syria Planum, in the region's northwest [1].

Surface albedo changes in this region have been documented by ground-based observers since the 1920s, and the global dust storms of 1973 and 1988 were observed to start in Solis Lacus [2-5]. In addition to frequent dust cloud activity, Solis is the location of numerous dust-devil plume sightings [6, 7]. Significant surface changes were observed by the Viking spacecraft in 1977 [8] and during the interval between Viking and the arrival of Mars Global Surveyor (MGS) in 1999 [9]. Continuous orbital monitoring since then, at first by MGS and later by Mars Reconnaissance Orbiter (MRO), has shown that the Solis Lacus region undergoes continual change, with drastic alterations during dust-storm seasons punctuating more subtle changes at other times of the year [10] (Figure 1).

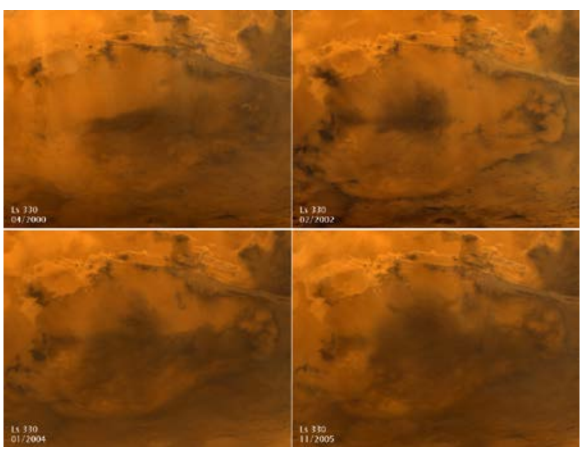

Figure 1. Solis Lacus observed by MGS MOC over 4 consecutive Mars years. (Top left) April 2000. (Top right) February 2002. (Lower left) January 2004. (Lower right) November 2005.

HiRISE Observations: To better understand the frantic pace of eolian alteration in Solis Lacus, we examined high resolution images for clues to the nature of the changeable surface. In general, these images show a region relatively free of dust, falling into the following categories:

Dust Free Surfaces: Surfaces scoured clean of dust, showing rocks and boulders and isolated transverse aeolian ridges (TARs, deflated sediments that are not presently active) are seen to the south in Solis Planum (e.g. PSP_006797_1545, ESP_017056_1475, ESP_018058_1555), to the north in Sinai Planum (PSP_008788_1655), and to the east in Thaumasia Planum (PSP_007693_1555).

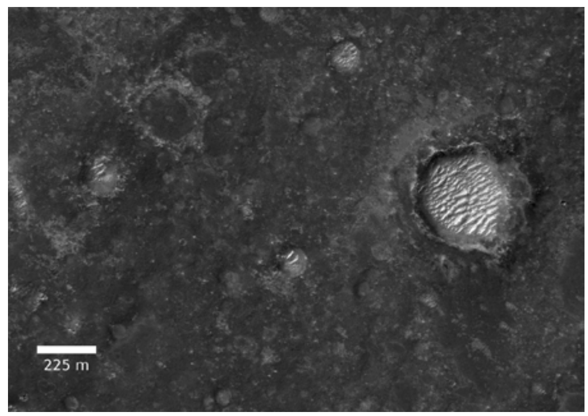

Figure 2. Remnant dust in Sinai (ESP_016357_1645).

Transient Dust Deposits: Surfaces with coatings of dust that are too thin to show topographic expression at HiRISE scales are suspected to be responsible for the short-term albedo changes, as dust is deposited or removed by the winds. Isolated patches of remnant dust can be seen in Sinai (ESP_016357_1645) (Figure 2), temporarily trapped by topographic obstacles but soon to blow away. In several areas with more extensive dust coatings, the dust is being actively vacuumed by dust devils that leave dark tracks, such as seen in Solis Planum (PSP_006125_1525) and Syria (PSP_007022_1655). Fresh dust deposits in the form of bright wind streaks are found in Syria Planum (PSP_008749_1660, CTX B01_010028_1634) (Figure 3), suggesting that dust is supplied to the region from the northwest.

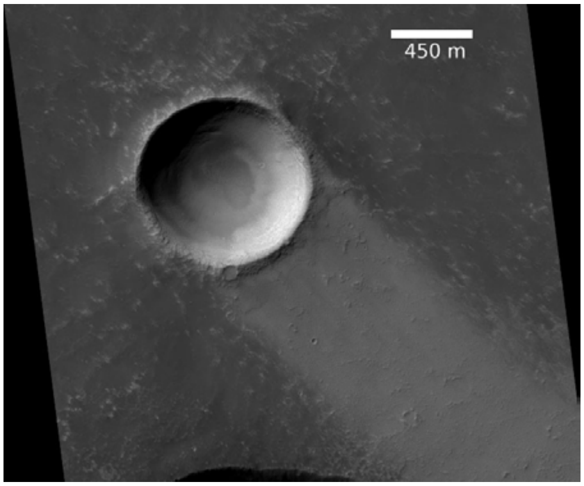

Figure 3. Bright streak in Syria (PSP_008749_1660).

Dust Accumulations: Stable dust deposits are seen at the northwestern margin of Solis Lacus, in discrete bright regions in Syria Planum up to 480 km across. These bright patches have abrupt albedo boundaries that have changed little between the Viking era and the present (Figure 4). The albedo boundaries do not appear to be topographically controlled (PSP_006152_1655, PSP_006521_1665) and their placement remains a mystery. Stranger still are the thick piles of dust downwind of the bright patches in images PSP_006152_1655, PSP_010028_1630, and ESP_014406_1670. Dust has accumulated in the lee of rocks and other obstacles, forming tapered deposits shaped by northwesterly winds (Figure 5). The deposits reach thicknesses of up to 70 cm, as estimated from shadow length measurements. The dust infills craters and other depressions, suggesting that these features are depositional rather than erosional.

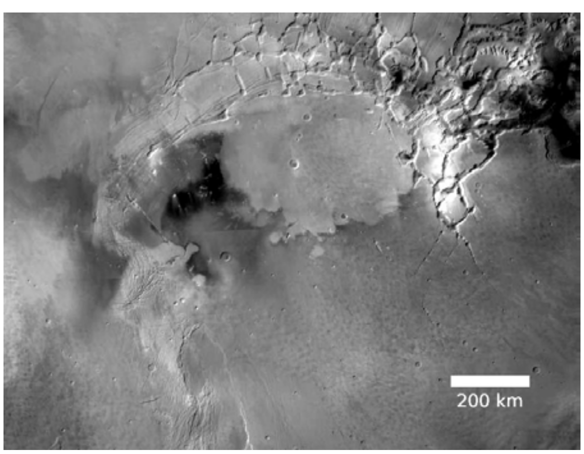

Figure 4. Stable dust patches in Syria Planum.

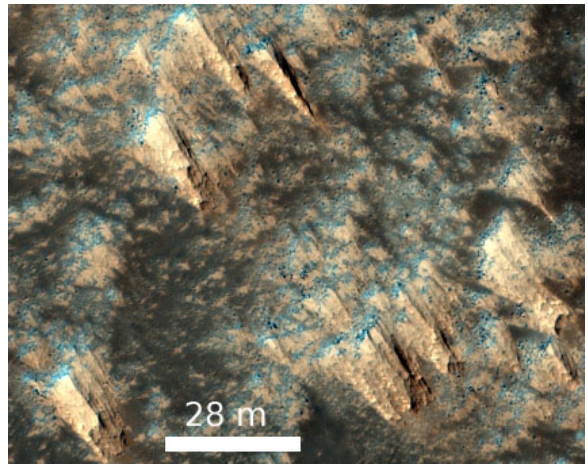

Figure 5. Dust deposits in Syria (PSP_010028_1630).

How long these features take to form is a puzzle to be solved by future HiRISE imaging.

Discussion: The HiRISE observations suggest that the rapid surface changes in Solis Lacus are caused by the deposition and erosion of thin coatings of bright dust. The dust appears to be supplied from the northwest, as suggested by both wind streaks and thick dust accumulations interpreted to be depositional. This is consistent with the results of Greeley et al. [12], who inferred surface sediment transport from the west based on global wind circulation models (although their model considered sand, not dust). The implication is that Martian dust deposits are mobile and are transported across the surface by horizontal winds.

References: [1] Baptista, A. R. *et al.* (2008) *JGR 113*, doi:10.1029/2007JE002945. [2] Anon. (2003) *Journ. Assoc. Lunar Planet. Observers, 45*, 38. [3] Dolfus, A. (1965) *Ann. Astrophys. 28*, 722-754. [4] Slipher, E. C. (1962) *A Photographic History of Mars, 1905-1961*, Lowell Obs. [5] Martin, L. J. (1976) *Icarus, 29*, 363. [6] Biener, K. K. *et al.* (2002) *LPSC 33*, #2004. [7] Fisher, J. *et al.* (2005) *JGR 110*, doi: 10.1029/2003JE002165. [8] Lee, S. W. (1986) *Symposium on Mars: Evolution of its Climate and Atmosphere*, LPI Contrib. 599, 57. [9] Geissler, P. E. (2005) *JGR 110*, doi:10.1029 /2004JE002345. [10] Geissler, P. E. *et al.* (2009) *AGU Fall Meeting 2009*, abstract #P21C-08. [11] Greeley, R., *et al.* (1993), *LPSC 24*, 563G.