EARLY HiRISE OBSERVATIONS OF SLOPE STREAKS AND AVALANCHE SCARS. F.C. Chuang[1], A.S. McEwen[2], V.C. Gulick[3], and The HiRISE Team. [1]Planetary Science Institute, 1700 E. Fort Lowell Rd., Suite 106, Tucson, AZ 85719 (e-mail: chuang@psi.edu); [2]Lunar and Planetary Lab, University of Arizona, Tucson, AZ 85721; [3]NASA Ames Research Center and SETI Institute, Moffett Field, CA 94035.

Introduction: Approximately 15 images from the High Resolution Imaging Science Experiment (HiRISE) instrument [1] early in the Primary Science Phase were targeted at mass wasting features. These images have spatial resolutions of 25-50 cm/pxl, allowing for more detailed analyses of features than could be seen at Mars Orbiter Camera (MOC) scales. Multi-spectral false-color images of the red, blue-green, and infra-red channels of some targets were also produced for analyses. Here we present early observations of Martian slope streaks and avalanche scars, including detection of any changes or newly formed streaks since they were last imaged by MOC.

Background: Slope streaks are features prevalent throughout the mid-latitudes (30ºS to 40ºN) of Mars, often concentrated in volcanic regions and/or low thermal inertia [2-7]. Streaks are typically dark and are observed along the slopes of impact craters, buttes, knobs, escarpments, ridges, and troughs. Although rare, light slope streaks have been observed on dark surfaces [8]. Streaks generally start at a point source and then widen along its path downslope, often traveling over, and sometimes around various obstacles. Slope streaks are believed to not have relief, to not disturb the pre-existing surface, and only leave a dark trail along its path where the underlying topography can still be seen. Most streaks are single, but may also split into two separate streaks, potentially forming braided patterns. Dark streaks generally have uniform tone over their entire length and are thought to fade over time by mantling of bright airfall dust. Slope streaks were first observed in Viking Orbiter images and several models were proposed for their formation including debris weathering, stains from wet flows, and disturbance of dark mantles [2-4]. More recent studies using MOC images have proposed models involving dry mass-wasting of dust, briny liquid flows, dry granular flow, and mixed water-dust flows [9-13]. Repeat MOC images of slope streaks from a few months to more than a year have shown that new streaks are forming under current day conditions [8].

Another type of mass wasting feature in the mid-latitudes, thought to be unrelated to slope streaks, are meters-deep triangular-faceted scars left behind from avalanched slope materials [14]. The recognition of these features is highly dependent upon viewing geometries and local lighting conditions. Avalanche scars are sometimes observed in areas where slope streaks have formed.

Figure 1. (A) Slope streaks in a portion of HiRISE image PSP_001656_2175 in RGB false color at 50 cm/pxl. (B) Trough wall with a rippled trail (arrows) that appears crisper than the surrounding muted dusty surface.

HiRISE Observations: HiRISE has imaged three regions on Mars where slope streaks were observed in MOC images (3.5-5.2 m/pxl): Acheron Fossae (37.3N, 229.2E), Mangala Valles (5.4S, 213.7E), and Terra Sabaea (7.4N, 47.0E).

Acheron Fossae (PSP_001656_2175; MOC S13-01131). This image of a trough wall has over 100 dark slope streaks with different lengths, morphologies, and tones. Lengths of individual streaks are 2-3 m to less than 1 km (uncorrected for slope) and their widths at their widest portion are ≤1-30 m. The shape of the streaks vary, but all start from a point source and widen a short distance below the point. Streaks ending on the trough floor have narrow finger-like terminations and do not travel significantly beyond the break in slope. The majority of streaks travel along a rela-

tively straight path and over obstacles such as boulders, knobs, and small bumps or depressions on the trough floor. Few streaks have any branching pattern and its not clear if each branch is part of the same streak or different streaks formed at different times. The initiation sites of streaks generally fall within a narrow range of elevations near the top of the trough wall. Up to three generations of streaks are observed along the path of a single dark streak in color images. In cases where streaks overlap, the darkest, most recently formed streak lies within the area of an older lighter-toned streak, indicating successive streak formation from the same point. In many slope locales that appear muted with no dark streaks, numerous crisp-looking trails with an irregular surface of meter-sized ripples are observed (fig. 1). These trails provide compelling evidence that a layer of dust has been removed. No new streaks have formed in the one year between the MOC (~11/05) and HiRISE (12/06) images.

Mangala Valles (PSP_001472_1745; MOC R17-00464, M07-04393). This image along a portion of the highland escarpment has numerous dark slope streaks with different lengths and morphologies. Lengths of individual streaks are 35 m-1.35 km (uncorrected for slope) and their widths at their widest portion are ~3-275 m. All of the streaks start from a point source and widen a short distance below the point. The streaks generally travel along a straight path and over a surface of small fluted-like ridges shaped by eolian activity along a NW-SE orientation. Although most streaks are not affected by the irregular surface, some portions of a streak are confined to areas between two ridges. Many of the streaks have widened and branched, developing small fingers at their termini. Nearly all of the streaks begin at the top of the slope, however, no distinct cliff-forming layers are apparent. Dark streaks overlapping or completely overprinting older streaks are not observed and nearly all have the same tone. One new small streak has formed in the 2.5 years between the MOC (5/04) and HiRISE (11/06) images.

In a variety of slope locales, particularly shadowed regions, numerous triangular faceted avalanche scars are present (fig. 2). The high-standing remnant surfaces on either side of the lower scarred surface are clearly visible. Within the scar floor and on the higher-standing surfaces, bands of small fluted ridges can be traced across both surfaces indicating that the avalanched material must have been quite thin in order to preserve the features. Shadow height measurements along some high surface edges are ~1 m. Some scar initiation points start at a local positive relief feature, but many others do not. Dark material, presumably from slope streak activity, is present within the lower floor of some avalanche scars. This same relation is seen in other HiRISE images and suggests that slope streaks and avalanche scars may be the same phenomenon, but detection of the topography varies with image resolution, dust thickness, and illumination angle.

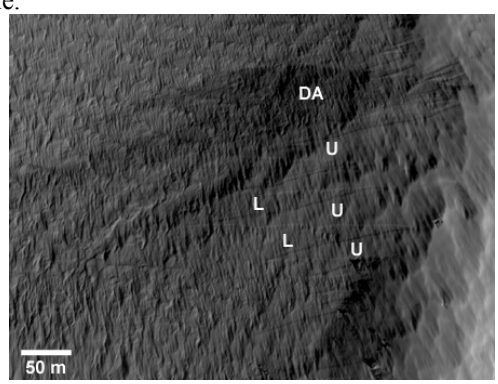

Figure 2. Portion of HiRISE image PSP_001472_1745 with upper (U) and lower (L) avalanche scar surfaces and a dark avalanche (DA) floor, presumably modified by slope streak activity.

Terra Sabaea (PSP_001808_1875; MOC M04-00072). This image along the interior wall of a 31 km diameter impact crater has several dark slope streaks with lengths of 20-480 m (uncorrected for slope) and widths at their widest portion between ~8 and 100 m. All of the streaks start from a point source and widen a short distance below the point. The streaks generally travel along a straight path and over a surface with small pits, boulders, and knobs. A few streaks have widened and branched, developing small fingers at their termini. All of the streaks begin at the top of the wall, just below the crater rim. All but one streak have their initiation point at the base of large rock outcrops with boulders. No new streaks have formed in the 7+ years between the MOC (8/99) and HiRISE (12/06) images. In a variety of slope locales, numerous triangular faceted avalanche scars are visible. The scarred surface has small ripples, knobs, or pits and nearly all of the scars can be traced to a point below a local resistant rock ledge or ridge.

Acknowledgments: Image credits: NASA/JPL/UA/LPL.

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