MARTIAN SLOPE STREAKS FORM SPORADICALLY THROUGHOUT THE YEAR. Christina M. King[1], Norbert Schorghofer[2], and Kiri L. Wagstaff[3]. [1]Department of Physics and Astronomy, University of Hawaii, Honolulu, HI 96822 (cmking@hawaii.edu), [2]Institute for Astronomy, 2680 Woodlawn Drive, University of Hawaii, Honolulu, HI 96822 (norbert@hawaii.edu). [3]Jet Propulsion Laboratory, California Institute of Technology, 4800 Oak Grove Drive, Pasadena, CA 91109.

Introduction: Slope streaks are dark mass movements on Martian slopes, which occur only in areas of low thermal inertia and at low latitudes [1,2]. They first emerge as bold, elongated streaks, which can measure up to 2 km in length, and are seen to slowly fade with time [3]. Similar streaks have been observed in the Antarctic Dry Valleys [4], where the streaks have been attributed to the melting of seasonal frost.

Many models have been proposed to explain slope streak formation on Mars [2, 5-8]. One model suggests that like in Antarctica, slope streak formation could be triggered by melting seasonal frost. Other proposed models suggest that meteorite impacts, quakes, or dust devils play a role in slope streak formation on Mars. Previous work has had only very limited time constraints available for streak formation. The goal of our research is to establish better time constraints for streak formation, in order to determine which of these scenarios is most likely to cause slope streak formation.

Methods: Locations that have been imaged repeatedly are found with a semi-automatic algorithm specifically developed for this purpose.

The first step is to automatically identify overlapping image pairs. The cumulative index files of each camera contain the geographic coordinates of the image corners, which are inputs to this program. This part of the algorithm finds all pairwise overlaps among hundreds of thousands of images.

A group of images includes the same location if each member of the group has a pairwise overlap with every other member. The problem can be represented as a graph whose vertices are images and whose edges are overlapping pairs; an *n*-fold overlap appears as a completely connected part of this graph. In graph theory this is known as a “clique”. A C program from the Stony Brook Algorithm Repository was used to find the largest cliques. For example, all areas that have been imaged at least seven times by THEMIS-vis have been identified in this way.

Once the algorithm had identified potential sites, we then visually survey each location. We considered images from MOC, THEMIS, HRSC, HiRISE, and CTX. We studied a site if the image resolutions and seeing conditions were ideal enough to convincingly resolve slope streaks, if the site showed active streak formation, and if the time intervals between image capture dates were short enough to make conclusions about seasonality.

For each site, we compared each pair of overlapping images to look for convincingly new slope streaks. When a newly-formed streak was discovered, we linked it to a time interval by comparing the dates of the two overlapping images studied. The time interval between the latest image without the streak and the earliest image with the new streak constrains what time the streak had formed.

Results: We have so far completed survey of three sites. The first site is Nicholson Crater (0°N 196°E). Our survey of its central mound, north rim, and south rim made use of seven THEMIS, three CTX, one HiRISE, and two HRSC images. Figure 1 shows the study location.

In total, 17 new streaks or streak groups have been identified at this site, along with many hundreds of persisting streaks. Figure 2 shows the time constraints on new streak formation. There are at least six distinct time intervals with new streaks over three Mars years, and at least five distinct intervals over two Mars years.

When the same data is plotted as a function of season, one can see that there are at least three distinct time intervals during the Mars year when slope streaks form. Streaks form without any apparent seasonal preference. We also noted the orientation of the new slopes and see no systematic relation between slope orientation and time of formation.

Our observations at two other sites show the same qualitative behavior. At all three sites, streaks form throughout the year, with no seasonal dependence. Slope streak formation appears to be sporadic in time. Most of the newly-formed streaks we have observed emerged isolated. Generally, streak formation appears to be sporadic not only in time, but also in space.

Most of the new streaks we documented had emerged as a single streak, rather than in a group of streaks. However, on the Northern rim of Nicholson Crater, a cluster of at least seven new streaks formed on the same slope, and in the same interval of nine months. The overlap area of two images that cover this cluster is 1,600 km^2 and contains ~196 persisting streaks. The new streaks are all within a distance of less than 6.2 km of each other, a tiny stretch within the 1,600 km^2 large overlap area. This suggests that a localized event triggered this group of streaks to emerge. At the maximum resolution of the images after cluster formation (5 m/pixel), we could not discern any other surface changes in this area other than the new streaks.

Discussion: Various potential triggering mechanisms have been proposed [5-8]. Melting of seasonal frost, melting of subsurface ice, and aquifers would be seasonal. The lack of seasonality suggests that slope streak formation on Mars is not obviously related to temperature or melting of water. For meteorite impacts and quakes it would be expected that in any given area many streaks form at the same time. The data show no such spatial correlation. This argues against the possibility that streak formation is caused by meteorite impacts or quakes. Dust devils or the sudden collapse of a dust layer would be sporadic in time and space. These triggering mechanisms are consistent with our observational constraints.

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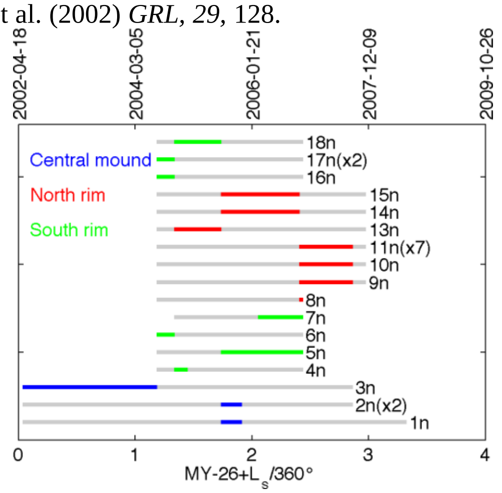

Figure 2. Time constraints for new streak formation at Nicholson Crater are shown as a function of time, beginning with the spring equinox of Mars Year 26. Colored horizontal bars represent intervals during which streak formation is known to have occurred. Grey horizontal intervals indicate the time span from the earliest to the latest available image. L_s=solar longitude, MY=Mars Year.

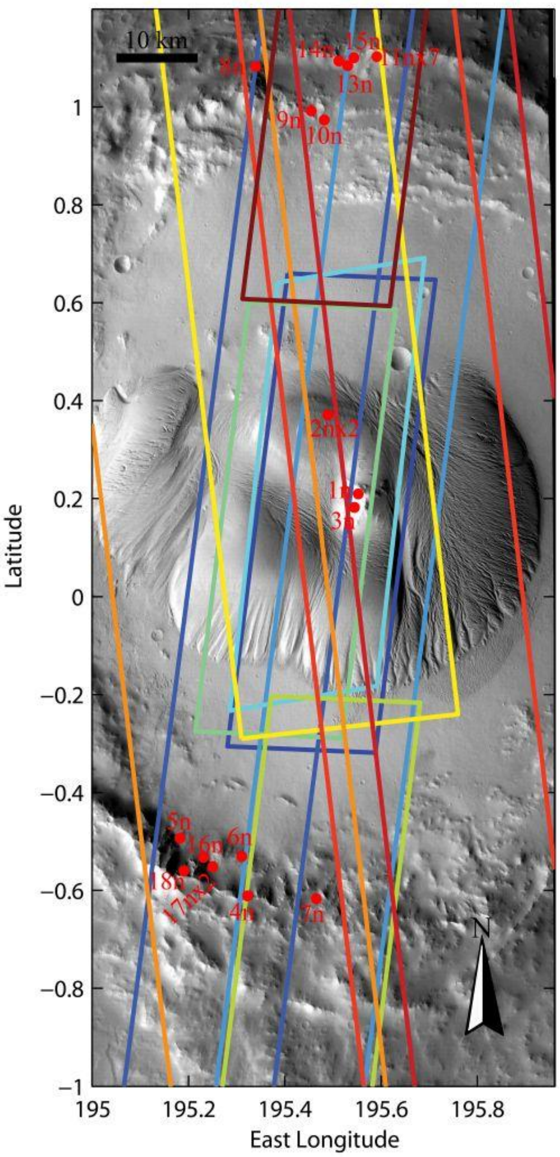

Figure 1 The Nicholson Crater study site with frames outlining overlapping images. Red dots mark the location of new slope streaks.

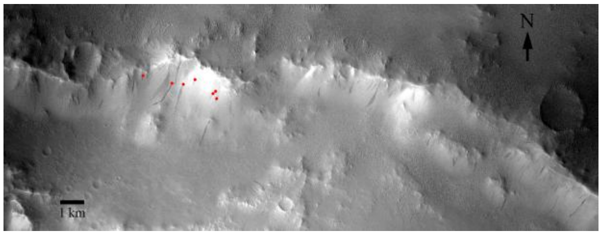

Figure 3 A portion of a CTX image shows a group of seven new streaks (marked by red dots), which appeared on the same slope within the same nine months. The vast area surrounding this group of streaks, far larger than shown in this figure, has only two additional new streaks (not visible here).