**A BALANCED SLOPE STREAK POPULATION ON MARS: COMPARISON OF CTX AND VIKING IMAGES.** N. Schorghofer[1], K. M. Rottas[2], and J. R. Bergonio[2], [1]Institute for Astronomy, University of Hawaii, Honolulu, HI 96822, [2]Department of Geology and Geophysics, University of Hawaii, Honolulu, HI 96822.

**Introduction:** Slope streaks are down-slope mass movements on the surface of Mars that are among the few known examples of contemporary geologic activity on Mars [1,2]. They often exhibit a point-source morphology with a tail which widens downslope and are generally believed to be erosional features created by dust avalanches [1]. Dark streaks are young and form in sudden events while bright streaks are interpreted as aged dark streaks, brightening and fading with time as dust settles from the atmosphere or gradually moves downslope [3,4].

Slope streaks are seen in rare high-resolution images obtained by the Viking Orbiter Camera (VOC). Here, we study slope streak activity between images taken by the Context Camera (CTX) on board Mars Reconnaissance Orbiter in the years 2007−2010 and VOC images from 1977. Thus, observations of the study site are separated by at least three decades.

Earlier work [2,3] identified several disappeared streaks in MOC-VOC images, but the number of new streaks exceeded the number of disappeared streaks by an order of magnitude. A significant imbalance between the rates of formation and fading would imply that the number of streaks is increasing, and would be evidence for a disequilibrium in the dust cycle, perhaps on a centennial time scale [2].

**Viking/CTX Overlaps:** Seeking unambiguous instances of faded slope streaks, 41 Viking Orbiter images with a spatial resolution of finer than 60 m/pixel where slope streaks were known to occur [3] are surveyed. Twenty-eight of these Viking images are excluded from the final comparison as their resolutions were not high enough to allow for accurate comparison to CTX images. The 13 remaining VOC images, 441B01−441B13, cover an area in the Lycus Sulci region in the Olympus Mons aureole, 27.6˚N–28.0˚N 146.8˚W–147.6˚W. This site is studied in detail due to the very high resolution (8 m/pixel) of the Viking images and the abundance of dark slope streaks. While MOC images provided only partial coverage of this area, CTX images cover the available area entirely.

Figure 1 shows a map-projected mosaic of the Viking images. Green dots indicate persisting streaks, red faded (disappeared) streaks, blue new streaks, and yellow partially faded streaks. Streaks were compared between Viking images as well as with one or more of three CTX images covering the area. Only streaks that are completely gone in the corresponding CTX image were counted as having faded. If a streak remained it was counted as persisting, regardless of how much lighter it appeared in the CTX image than in the Viking image(s). These persisting streaks are marked with green dots. New slope streaks (blue) are readily identified, because they have high contrast. Partially faded streaks are those where part of the streaks have definitely disappeared and other parts have definitely persisted. They thus represent an intermediate case between persisting and faded streaks.

The appearance of dark streaks is known to be independent of illumination and viewing conditions. Individual streaks were revised multiple times in between each Viking and CTX images. Only those streaks that are unambiguous are included in the results.

The time difference between the Viking and CTX images ranges from 30 to 33 Earth years, or 16 to 18 Mars years. In areas where more than one CTX image is available, results are relative to the most recent of the three CTX images. Some streaks have persisted (25), but most have disappeared, and there are numerous new streaks. Comparison of the number of disappeared (70) with the number of new slope streaks (99) shows, for the first time, an approximate balance between streak formation and streak fading.

**Discussion:** *Quantitative estimate of lifetime and turnover time.* The average time span between the Viking and CTX images is 32 years. Based on the fact that some streaks (about one quarter) are persisting, but most streaks (about three quarters) have disappeared, the lifetime of streaks, defined as the time between formation and the time when the streak fades from visibility, is not much longer than 32 years.

It is sensible to define rates of formation and fading relative to the number of streaks in the study area. We calculate a formation rate of 2.5% per (Earth) year and a fading rate of 2.3% per year.

In a simplistic model, all streaks have a lifetime of $L$. Every year there is a probability of $1/L$ that one of the streaks disappears. Hence, $L$ can be estimated by $L=(25/70+1)\times 32=43$ years.

Realistically, there will be a spread in the lifetime of the streaks. A spread in lifetimes will lead to mean lifetimes smaller than would be estimated without a spread. We numerically created ensembles with a Gaussian distribution of lifetimes of given mean and spread and then determined the mean and maximum spread consistent with observational constraints. We find that the lowest plausible mean is 34 years.

Combining these two estimates, a likely value for the lifetime is four decades. This lifetime agrees with the inverse of the formation rate at the same location, 1/0.025=40 years. Thus, the turnover time of the slope streak population approximately equals the lifetime.

Planet-encircling dust storms have occurred in 1971 and 2001, and possibly also in 1979 and 1982 [5]. The 2001 global dust storm did not erase the streak population.

*Spatial patterns of fading and persistence.* Spatially coherent regions of persisting streaks are seen in Fig. 1; there are several islands of persistence.

On the smaller scale of individual streaks, we identified no common pattern for partially faded streaks. They fade from the head or the tail or from the outside toward the interior.

*Comparison with pervious studies.* Previous studies based on MOC images [2,3] did not have enough spatial coverage and time separation for a statistically reliable sample. Our survey increases the number of disappeared slope streaks that have been documented in Mars images from 5 to 70. Slope streaks fade faster than previously thought.

**Conclusions:** At the study site in Lycus Sulci, the number of disappeared streaks approximately equals the number of newly formed streaks. For the first time we see an approximate balance between faded and new streaks. The rate of formation and rate of fading are nearly equal, revealing that the number of slope streaks on the surface of Mars is approximately constant rather than increasing with time. This indicates the streak population is balanced.

The average lifetime of slope streaks, from time of formation until they disappear, and the turnover time of the slope streak population are estimated to be four decades.

Slope streaks fade gradually over time, with islands of persistence, and are not erased by planet-encircling dust storms.

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**References:** [1] Sullivan R. et al. (2001) *JGR, 106,* 23607–23633. [2] Aharonson O. et al. (2003) *JGR, 108,* 5138. [3] Schorghofer N. et al. (2007) *Icarus, 191,* 132–140. [4] Chuang F. et al. (2010) *Icarus, 205*, 154–164. [5] Cantor B. A. (2007) *Icarus, 186*, 60–96.

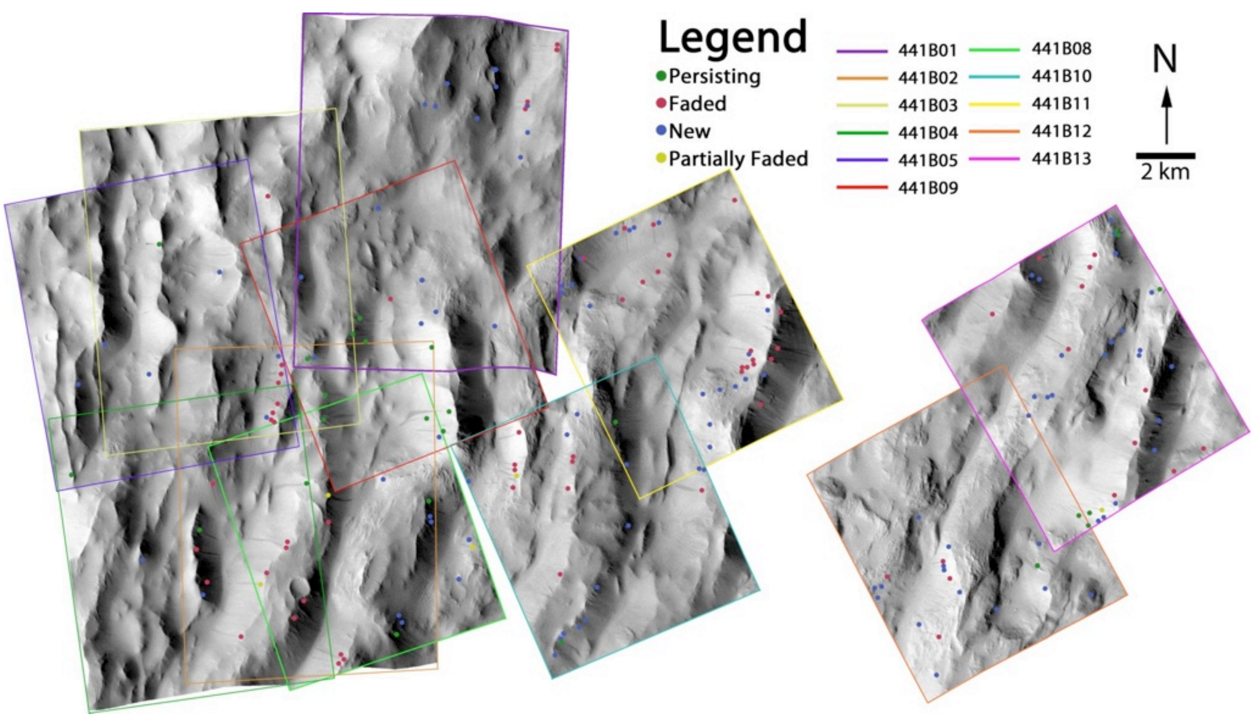


Figure 1: Map projected composite of Viking images in the Lycus Sulci region of Mars. Images 441B06 and 441B07 lie entirely within this area. Green, red, and blue dots indicate persisting, disappeared, and new slope streaks relative to CTX images, as described in the text. Illumination is from the upper left.