

PUTATIVE ACTIVE BRINE FLOWS IN THE CERBERUS FOSSAE, MARS. K. D. Runyon¹, A. K. Davatzes¹, and V. C. Gulick², ¹Earth and Environmental Science, Temple University, Philadelphia, PA, USA (kirby.runyon@gmail.com, alix@temple.edu), ²NASA Ames/SETI Institute (Virginia.C.Gulick@nasa.gov).

Introduction: Transient albedo features morphologically identical to transient slope lineae (TSL) and recurring slope lineae (RSL) as discussed by [1,2,3] have been discovered in northern equatorial regions in single and repeat HiRISE images of the Cerberus Fossae (9.9°N, 157.9°E), Mars. Some show transience between repeat images whereas others do not. We interpret at least some slope lineae (SL) to be candidate TSL and possibly RSL.

Description: Slope lineae (SL) are low albedo features with anastomosing and/or digitate flow-like morphology down-slope and often originating at the base of outcrops. They are on the order of meters wide and tens or hundreds of meters long, sometimes appear to diverge around topographic obstacles, and have no topography visible in HiRISE stereo pairs. Features with identical morphology were discovered in the Martian mid-southern latitudes by [1] and were termed TSL because they changed in linear extent and albedo between repeat HiRISE imaging. Later [3], they were termed RSL due to a confirmed seasonal recurrence based on repeat HiRISE imaging of up to five times. RSL and SL share the following major characteristics which differentiate them from slope streaks: (1) lower albedos, (2) roughly an order of magnitude thinner, and (3) associated with rock outcrops [3]. It has been suggested that liquid brines with low eutectic temperatures (T_e) are responsible, though the lack of water absorption features in CRISM imaging challenges this hypothesis [3]. McEwen et al. [3] report that though candidate RSL have been found in northern equatorial regions, none have shown transience, much less recurrence. Here, we report on confirmed transience of some SL and no change of other SL between repeated HiRISE images.

Geologic Context: These putative brine flows are on the north (equator-facing) wall of the Cerberus Fossae (CF) at 10°N near the eastern edge of the head of Athabasca Valles (AV), a relatively young outflow channel. The Cerberus Fossae are degraded graben [4] which strike radially from Elysium Mons to the south-east for over 500 km and likely formed in response to dike injection at depth [5].

Results: Multi-seasonal repeat imaging from three locations reveal transient as well as non-transient SL on the Cerberus Fossae equator-facing walls. Furthermore, SLs' growth and emergence were not confined to late spring through early fall, as was the finding in [1,2,3]. We offer the following examples: (1) Identical SL (Table 1) which are present more than one Martian

year apart in time at two of the locations. (2) At one location, some of the SL faded and we observed no new SL formation. (3) There is at least one SL seen to substantially grow in length down slope between winter ($L_s = 310.5$) and early spring ($L_s = 6.5$) (Fig. 1). Finally, (4) there are SL at one location that are absent in northern summer ($L_s = 133.0$) and present in northern winter ($L_s = 329.2$) one-half Mars year apart (Fig. 2). However, these two images have substantially different look angles, and additional repeat imaging and/or generation of digital terrain models is needed.

Table 1. SL in the Cerberus Fossae. Repeat images are grouped together in the left column. NA = Northern Autumn, NW = Northern Winter, NSp = Northern Spring, NSu = Northern Summer. HiRISE observations begin with PSP_ or ESP_.

HiRISE Image (PSP or ESP)	Season (L_s)	Image Center Location	SL Description
003650_1900 004283_1900 022809_1900 022875_1900 024220_1900	233.6 NA 264.8 NA 307.5 NW 310.5 NW 6.5 NSp	10.0°N 157.8°E ~20 km WNW of AV's proximal eastern extent	Major SL appearance between 4283 (NA) and 22809 (NW) (>1 Mars year apart); growth on another between 22875 (NW) & 24220 (NSp). Elsewhere large-scale fading and persistence from 3650 (NA) to 24220 (NSp).
018985_1900 023297_1900	133.0 NSu 329.2 NW	9.9°N 157.9°E ~12 km WNW of AV's proximal eastern extent	Appearance of new SL between 18985 (NSu) & 23297 (NW).
016216_1900 024932_1900	36.2 NSp 29.7 NSp	9.9°N 158.3°E ~5 km ESE of AV's proximal eastern extent.	No change in SL between images. ~1 Mars year apart, same season.

Discussion & Conclusion: Seasonality does not have a strong effect on at least some transient SL in that SL activity takes place in northern winter and possibly summer or autumn. This aseasonality may be explained due to the near coincidence of Mars' perihelion and aphelion with the northern winter and summer

solstices, respectively, and the fact that this region is near the equator.

Given the general low albedo, anastomosing or digitate morphology, and transient nature of SL, we conclude that at least some SL are TSL and possibly RSL. Therefore, the possibility exists that the Cerberus Fossae are hydrogeologically active in the present epoch and could be habitable.

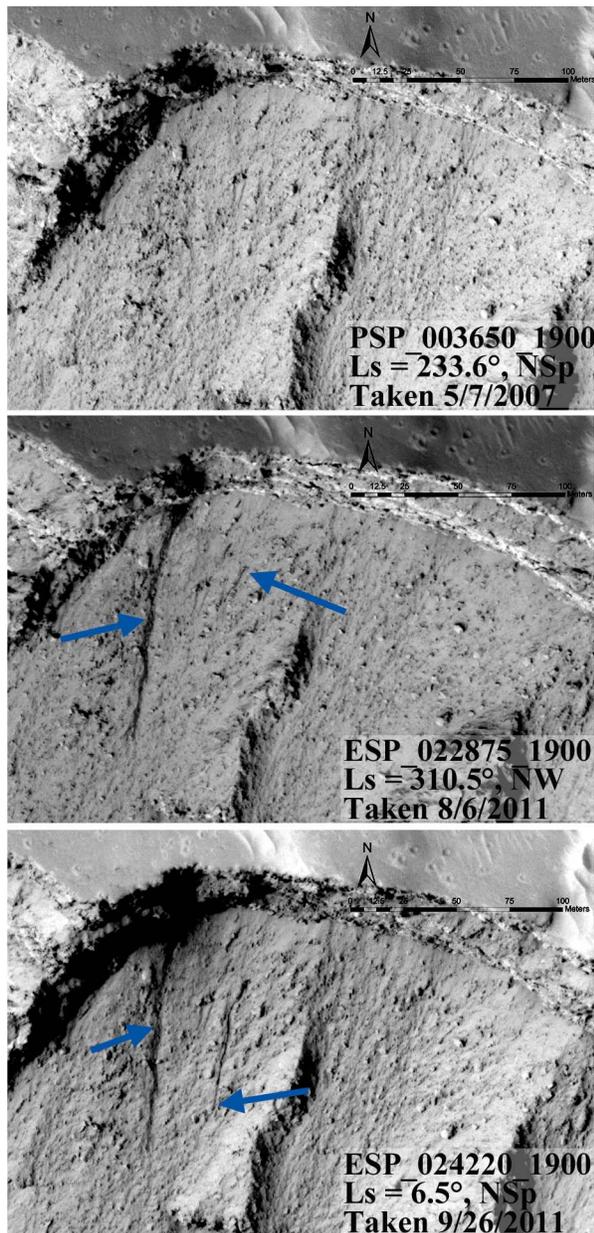


Figure 1. Emergence and growth of SL. Note that temporal separation of more than 1 Mars year between the top two frames. However, significant growth (~50 m) occurred between the bottom two frames (only ~1.7 months apart) during winter and early spring. Subframes from the indicated HiRISE images, all centered near 10.0°N, 157.8°E. Image credit: NASA/JPL/U of Arizona.

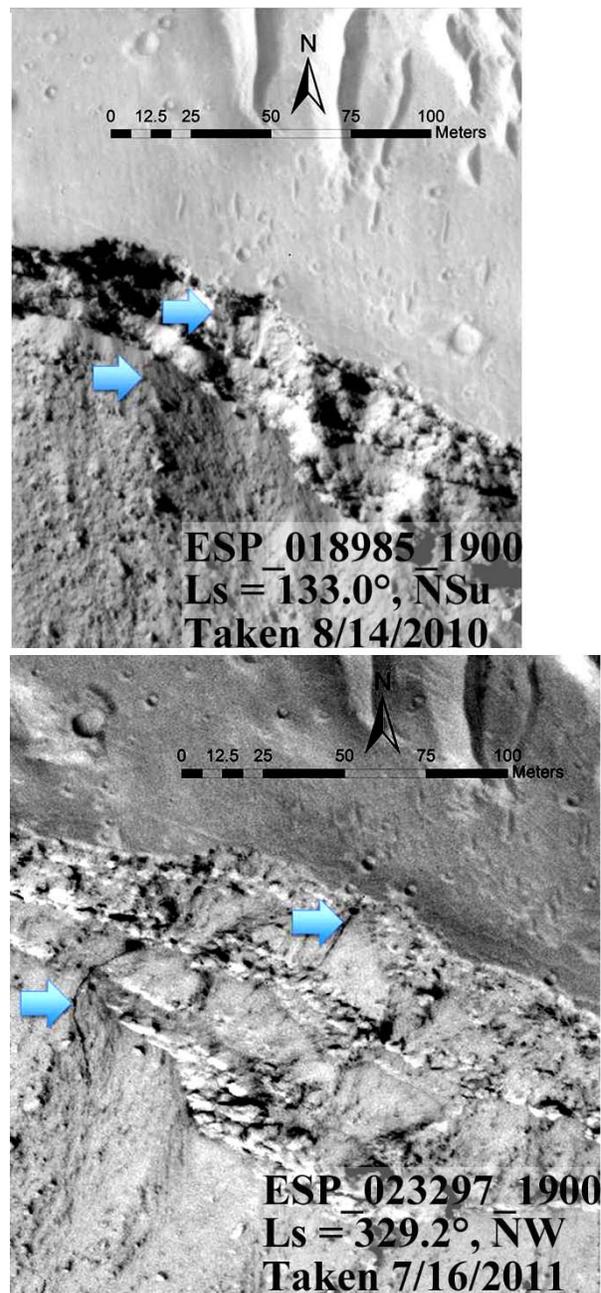


Figure 2. Emergence of at least two SL during a one-half Mars year between northern summer and winter. Subframes from the indicated HiRISE images, both centered near 10.0°N, 157.9°E. Image credit: NASA/JPL/U of Arizona.

References: [1] Ojha L. et al. (2011) *LPSC 42*, Abstract #2101. [2] McEwen A. et al. (2011) *LPSC 42*, Abstract #2314. [3] McEwen A. et al. (2011) *Science*, 33, 740-743. [4] Hall J. L., Solomon S.C., Head J. W. (1986) *JGR*, 91, 11,377-11,392. [5] Head J. W., Wilson L., Mitchell K. L., (2003) *GRL* 30, 11, 31-1 – 31-4.