THE DISTRIBUTION OF GLACIO-FLUVIAL LANDFORMS IN THE SOUTHERN MID-LATITUDE REGION OF MARS.
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Introduction: The mid-latitude regions of Mars, poleward of roughly ±25°, are muted by a thick, ice-rich mantle [e.g., 1-2]. There is growing recognition of a suite of young (<3.5 Ga) intriguing landforms that may either be unique, or more prominent in the mid latitudes, including fresh shallow valleys, "pollywog" craters, decrescent scarps, and craters hosting glacio-fluvial landforms and gullies. We aim to assess the distribution of these landforms in the southern mid-latitudes, from ~25°S to 60°S, with the goal of understanding any relationships between these landforms in addition to their association with the mid-latitude mantling deposit.

Background: *Fresh shallow valleys* (FSVs) form sparse networks that appear relatively well-preserved at the ~6 m per pixel resolution of Context Camera (CTX) images, and they are most recognizable where they incise into the mid-latitude mantle [3-5] (**Fig. 1**).

Recently identified "*pollywog"* craters are small (generally <5 km in diameter), morphologically fresh craters with at least one channelized exit breach that formed when water in the crater overspilled its rim [4-6] (**Fig. 1**).

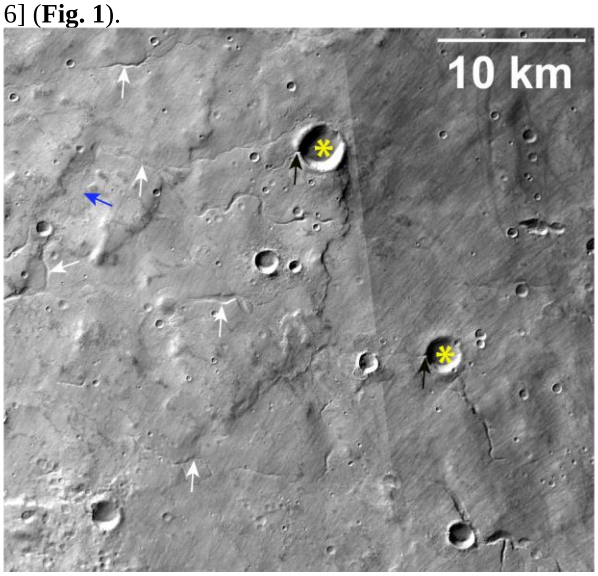

Figure 1. FSVs occur as generally narrow and sinuous valleys (type 1, white arrows) or wider valleys with near parallel borders and flat floors (type 2, blue arrow). Examples of pollywog craters (yellow asterisk) with associated exit channels (black arrows). Centered near 41°S, 162.7°E, CTX P14_006696_1369 and P14_005984_1370 (~5 m /pixel).

Decrescent scarps are rounded, arcuate scarps that bound topographically raised surfaces [7] (**Fig. 2**). Decrescent scarps are found in the Electris region and are morphologically similar to the fretted terrain along the dichotomy boundary in the northern hemisphere, and such scarps may be backwasted by episodic ice accumulation at the base of the scarp [7].

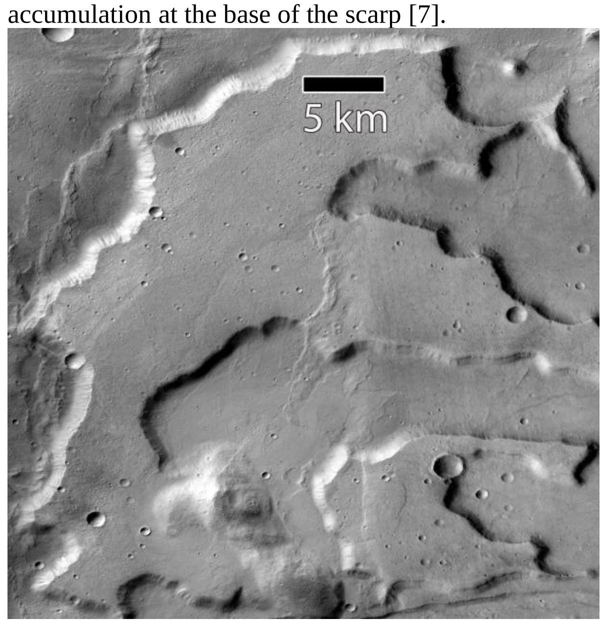

Figure 2. Example of decrescent scarps near 177.0°E, 36.6°S.

Craters with gullies, for the purposes of this study, are those with landforms that are morphologically consistent with flow, and exhibit a chute channel and apron [e.g., 8]. This survey did not include "spur and gully" type landforms that are characterized by steep slopes bordering a steep talus slope and lack of a chute channel (these gullies by contrast form via weathering and mass wasting. *Craters with glacio-fluvial* landforms host clear glacial features and fluvial overprinting, such as FSV-like channels on the surfaces of the glaciers within the crater interior.

Methods: Through a systematic survey of CTX images in ArcGIS, we mapped FSVs and pollywog craters [5] in addition to decrescent scarps, craters with gullies, and craters with glacio-fluvial landforms in the southern latitudes between ~25°S to 60°S. For linear features mapped in ArcMap (FSVs, decrescent scarps), the polylines were exported as vertices, and the *frequency* of these landforms with respect to latitude represents the number of vertices per 1 degree latitude.

Results: The distribution of FSVs (**Fig. 3**), pollywog craters (**Fig. 4**), decrescent scarps (**Fig. 5**), and craters with glacio-fluvial and gullies (**Fig. 6**) in the southern mid-latitude region of Mars are strongly banded with respect to latitude. FSVs between 30°S and 54°S, with highest peaks in frequency around 34°S and between ~41°S and 45°S (**Fig. 3**). "Firm" identification of pollywog craters are located between 25°S and 50°S, with the highest frequency ~40°S [5] (**Fig. 4**). Similarly, decrescent scarps occur between ~30°S and 52°S with the majority forming around 40°S.

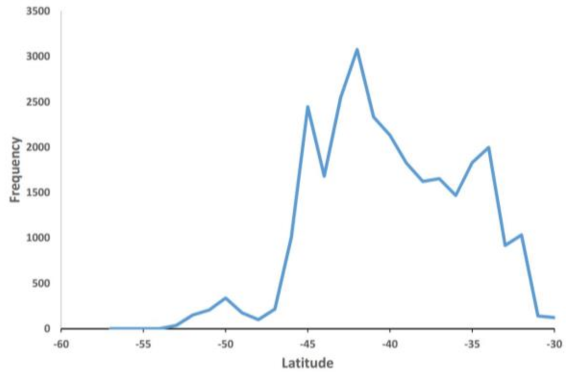

Figure 3. Distribution of FSVs (see **Fig. 1** for context) with respect to latitude in the southern mid-latitude region.

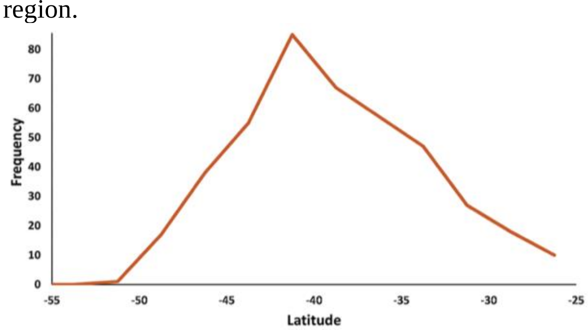

Figure 4. Distribution of pollywog craters (see **Fig. 1** for context) with respect to latitude in the southern mid-latitude region.

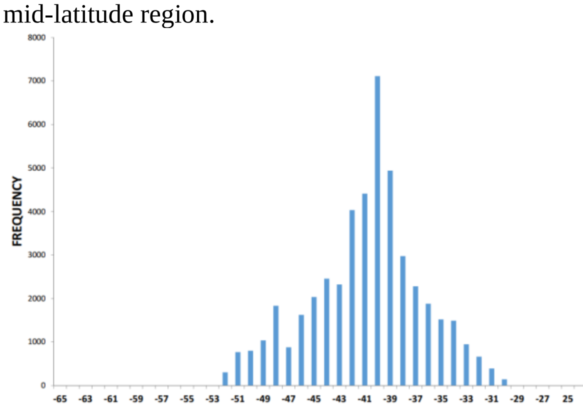

Figure 5. Distribution of decrescent scarps (see **Fig. 2** for context) with respect to latitude in the southern mid-latitude region.

Craters hosting gullies are more abundant than craters that have been modified by glacio-fluvial processes, yet both most frequently occur around 40°S (**Fig. 6**).

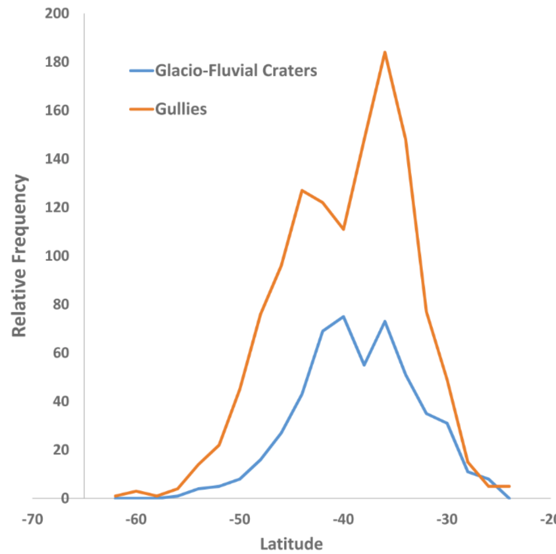

Figure 6. Distribution of glacio-fluvial craters (blue) and craters with gullies (orange) with respect to latitude in the southern mid-latitude region.

Discussion: This suite of landforms can provide insight into the late climate conditions on Mars in which they formed. The distribution and frequency of FSVs, pollywog craters, decrescent scarps, and craters with glacio-fluvial landforms exhibit the same latitudinal trend around 40°S, suggesting they are unique mid-latitude landforms. Even if the gullies in craters are not related to glacio-fluvial processes, it is interesting to note their correlation with these other features. Furthermore, this suite of landforms are unique in distribution to craters hosting alluvial fans and deltas in the southern hemisphere, which most commonly occur between 10°S and 30°S [9]. Investigation of these glacio-fluvial landforms in the northern mid-latitude regions for comparison is in progress.

References: [1] Soderblom, L. A., T. J. Kreidler, H. Masursky (1973), JGR, doi:10.1029/JB078i020p04117. [2] Kreslavsky, M. A., J. W. Head (2000), JGR, 105, 26695–26711 [3] Hobley et al. (2014), JGR, DOI:10.1002/2013JE004396 [4] Wilson et al., (2016), JGR, https://doi.org/10.1002/2016JE005052. [5] Wilson et al. (2021), AGU abstract P15E-2141. [6] Warren et al. (2021), https://doi.org/10.1016/j.epsl.2020.116671. [7] Howard, A.D, Moore, J.M., 2021, LPSC 52, Abstract 1150. [8] Conway, S.J., et al. (2019), Martian Gullies and their Earth Analogs, 467. Geol. Soc. of London [9] Wilson et al., (2021), JGR, https://doi.org/10.1029/2020GL091653.