WIDESPREAD PERIGLACIAL LANDFORMS IN THAUMASIA HIGHLAND, MARS.

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Introduction: Thaumasia region on Mars is characterized by a complex geological history, including various phases of fluvial, volcanic and tectonic activity [1]. Among the surface features visible on Thaumasia mountain range, a series of periglacial or glacial-looking landforms can be distinguished. We used HRSC nadir scenes, which are covering almost completely Thaumasia (Fig. 1), complemented by THEMIS and MOC NA data to investigate the glacier and rock glacier-like morphologies in the area. The occurrence of glaciers or rock glaciers on Mars has been investigated [e.g. 2] during last decades, mostly observing large-scale features [3]. Several glacial or periglacial features have been identified in recent years thanks to higher resolution data [e.g. 4,5].

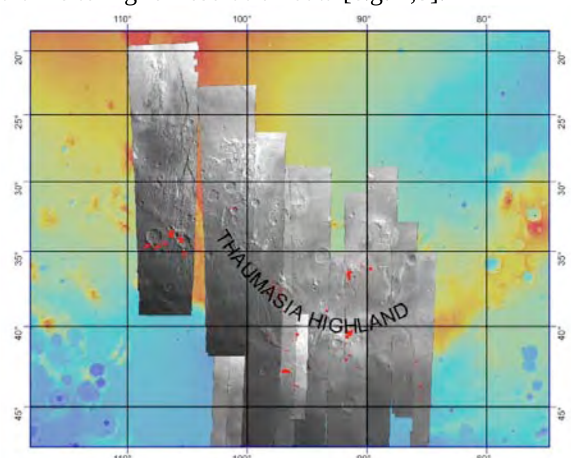

Fig. 1: HRSC nadir scenes covering Thaumasia Highland. Candidate periglacial features and landforms are indicated in red.

Description: Mapped morphologies include linear to curvilinear ridges, concentric at places, which strongly resemble terrestrial rock glaciers. Some of the flow features are originating from cirque-like landforms, and they are characterized by longitudinal linear and curvilinear (moraine-like) ridges and frontal arcuate ones (Fig. 2). Areas with protalus lobes (or valley side rock glaciers) [6] are also present, mostly facing southward (Fig. 3). Lineated or ridged crater fill, similar to hourglass shaped craters in [5], are also found in the region at various locations. These textured crater fills (Fig. 4) appear mostly characterized by transversal to concentric closely spaced ridges, rather than longitudinal, resembling piedmont rock glaciers [i.e. 6]. Moreover, small impact craters or crater-like structures, when present in the crater fill lineated deposits, appear at places slightly deformed and/or with uplifted portion in their center, suggesting possibly a pingo-like origin. Structures similar to more complex rock glaciers, including well-developed valley fills can be also observed (Fig. 5): they include lineated and ridged valleys, with apparent multiple lobes, locally forming piedmont-like rock glaciers as the valleys widen in their distal part. Features resembling fretted terrains also occur in several valleys or craters in Thaumasia. Moreover, smaller scale protalus ramparts are rather common in the area.

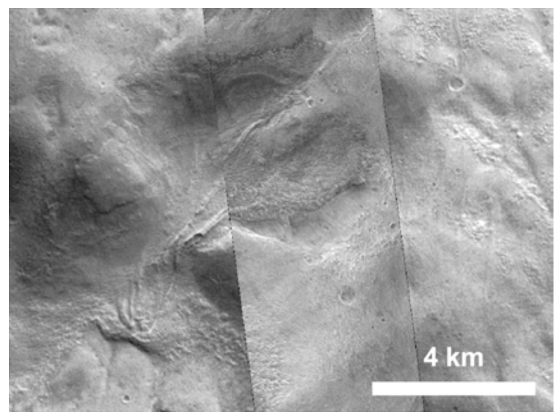

Fig. 2: Lobate rock glacier-like feature, emanating from a sub-circular source area (MOC NA e1003966 over HRSC nadir channel from orbit 279).

Discussion: Most of mapped landforms are located on Thaumasia Highland, with few occurring in the immediate surroundings. The latitude range at which these features are occurring is between about 35° and 45° S, while the exposition of rock glacier-bearing slopes or rock-glacier filled valleys are mostly south facing. This is consistent with previous observations on glacial/periglacial features at mid to low latitudes [5]. The occurrence of rock glaciers, fretted terrains, lineated crater fills etc. is mostly concentrated above 4000 m of height, where slopes are also higher (from a few degrees up to 15°-20° locally, such as on crater rims of fault scarps), therefore it is not clear if the possible ice-related flow features are linked to either height or slope, or a combination of both.

Most of the features occur in terrains mapped as Noachian [7]. Nevertheless, the absence of craters on most of the rock-glacier like features is pointing towards a young age of formation [5].

Modeling: If these are indeed glacier-like feature the question arise whether they are still ice-cored or just the relicts of extinct glacial activity. While ice in low latitudes is generally not stable at the surface over long periods a sublimation till can stabilize ice deposits over extended periods of time [8]. To assess the likelihood of finding ice rich deposits within the mapped features we have just started to use the Berlin Mars near Surface Thermal Model (BMST) [9]. We are considering scenarios in which a dirty snow mixture has been deposited during past climate cycles. While the snow will sublimate at the surface the water vapor can refreeze in deep layers forming an ice rich soil below a dry surface layer. The orientation of the slopes can benefit as south facing slopes receive less solar input.

Conclusions: We observed and started modeling glacial and periglacial like landforms in Thaumasia Highland. They include a variety of morphologies and there is some evidence that these features are geographically and/or topographically controlled. More pristine (and virtually craterless) rock-glacier like features are most abundant in the southeastern portion of the highland. High-resolution HRSC data are showing more and more widespread glacial/periglacial landforms on Mars [5].

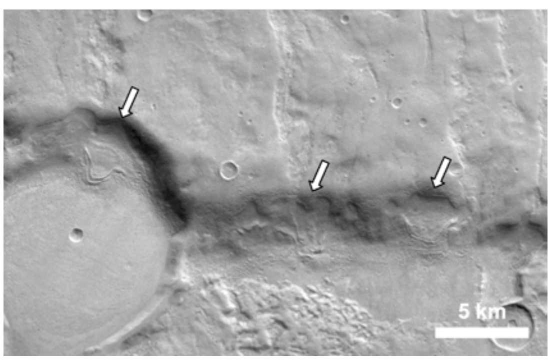

Fig. 3: Well developed protalus lobes, indicated by arrows (HRSC nadir band from orbit 292)

References: [1] Dohm J. M. and Tanaka K. L. (1999) *Planet Space Sci., 47*, 411–431. [2] Colaprete, A. and Jakosky, B. M. (1998) JGR, 103, E3, 5897-5909 [3] Kargel, J. S. and Strom, R. G. (1992) *Geology*, 20, 3-7. [4] Rossi, A. P. et al. (2000) *LPS XXXI*, Abstract #1587 [5] Head, J. W. et al. (2005) *Nature*, 434. [6] Whalley, W. B. and Azizi, F. (2003) *JGR*, 108, E4, doi:10.129/2002JE001864. [7] Dohm, J. et al. (2001) USGS Geologic Investigations Series I-2650. [8] Helbert, J. et al. (2005) *GRL*, 32, L17201, doi:10.1029/2005GL023712. [9] Helbert J. and Benkhoff, J. (2003) *JGR*, 108 (E12), 8087, doi:10.1029/2002JE002021.

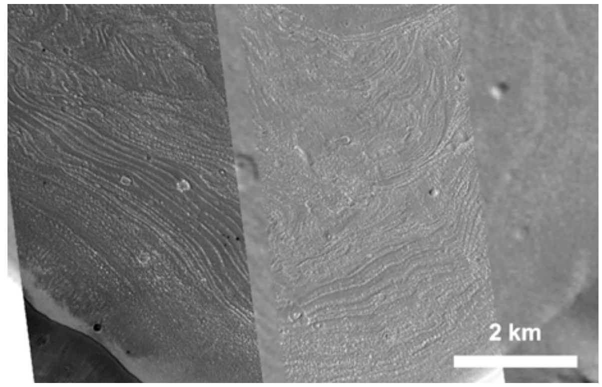

Fig. 4: Lineated crater fill (MOC NA e1200147 and e0501814 over HRSC nadir channel of orbit 508)

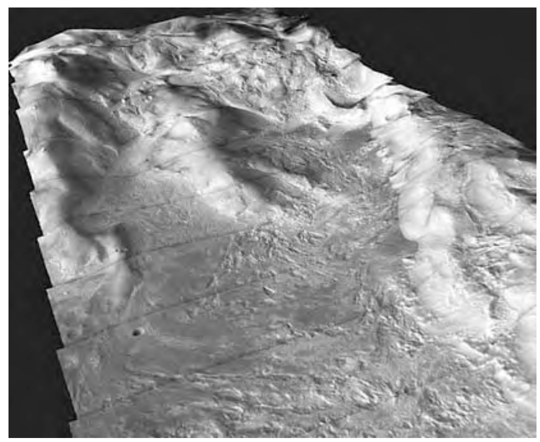

Fig. 5: Perspective view of a candidate (valley floor) rock glacier. Arcuate ridges are well visible in the mid-distal portion of the valleys. The scene is about 20 km wide (THEMIS VIS v14570002 draped on MOLA topography, 3x vertical exaggeration).

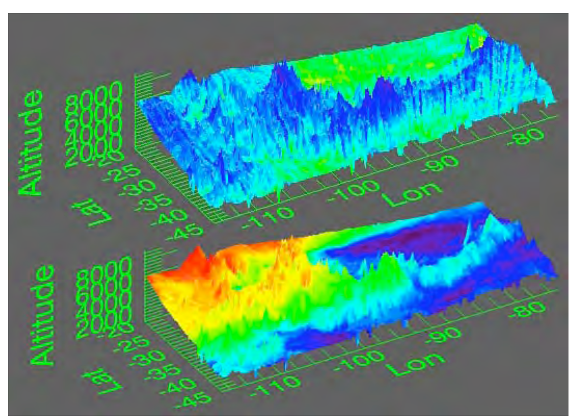

Fig. 6: Thermal inertia (above) and albedo (below) in Thaumasia. The location of periglacial features shows possibly some correlation with bright, low thermal inertia surfaces.