Latitudinal Survey of Periglacial Landforms and Gullies of Eastern Argyre and Poleward on Mars.

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Introduction: On Earth periglacial features consists of an arrange of landforms with ground ice affinities, which involves different formation processes. On Mars there are extensive areas of ground ice [1] which display a range of landforms similar to those on Earth. These landforms are important in understanding late climate evolution, subsurface processes and surface atmosphere interaction on Mars. In our study we focus on patterned ground, thermokarst and gullies. Patterned ground can be divided in to non-active (annual frozen) layer features like thermal contraction polygons and sublimation polygons, and active layer (freeze and thaw) features like sorted nets and circles, striated soils and stripes. Previous investigations have mainly looked at the global distribution and seasonal changes in patterned ground [2,3,4]. A recent study using high resolution HiRISE images hypothezise that active layer patterns of sorted circles occur on Mars which would have important implications for late climate evolution [5].

We are currently performing a detailed investigation of the Argyre area 325º - 335º E and 30º S – 90º S using all available MOC, HiRISE, HRSC, THEMIS and MOLA data. The area was chosen due to a wide diversity of periglacial landforms [6], a large difference in elevation, and for the past glacial and hydrologic history of the Argyre basin [7].

The focus of this ongoing work is to investigate the influence by changes in topography, ground conditions, geologic context and latitude on a local and regional level. One addressed question is of micro climate zonation and its implication for late climate evolution [8].

Data and method: The identification of periglacial landforms has been made from the study of 2713 high resolution MOC images. Only images showing clearly distinguishable features were used. The features were identified by the presence of networks of polygons or circles (local and extensive occurrence), stripes, dissected terrain and gullies. Further mapping and analysis will be conducted with HRSC and HiRISE datasets.

Discussion: Our preliminary mapping of periglacial landforms show strong latitudinal zonation between patterned ground and the dissected terrain which is to be expected on Mars (fig 2). A pronounced zonation of patterned ground can be seen along 80 S latitude. An ongoing detailed classification procedure will highlight the distribution of landform subclasses and which will be correlated to a local and regional conditions.

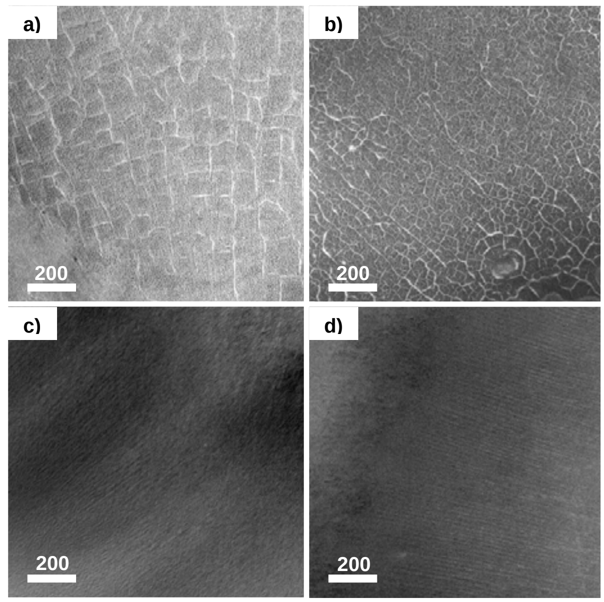

Figure 1 a-d. a) Orthogonal wedge polygons MOC M0701484. b) Random orthogonal polygons MOC M0805237. c) SW facing slope stripes MOC E0400726. d) East facing slope stripes E0501306.

Random orthogonal morphology. Polygons of this type occur as nets of cracks often displaying several hierarchies of polygon formation (fig 1b). They resemble terrestrial thermal contraction polygons even though the make-up of the wedge filling is still enigmatic.

Orthogonal morphology. Terrestrial orthogonal polygons mostly occur adjacent to bodies of water and are due to the thermal gradient in the ground affected by the water. On Mars they are mostly formed in intra crater environments (fig. 1a).

Non orthogonal morphology. Catalogued non orthogonal polygons is mainly the type of formation previously described as “basket ball terrain” [8]. They are generally small (<40 m) and are difficult to distinguish on MOC images but are now clearly resolved in HiRISE images. [9] describe these as sublimation polygons due to a striking resemblance to polygons found in Dry Valleys Antarctica.

Stripes and striated soils. On Earth freeze and thaw cycles on slopes may result in stripes of sorted ground

[10]. Stripes are usually divided into two kinds: (1) formed by elongation of convection cells, lateral squeezing of rocks or diapirs in the direction of the slope [11,12]. (2) Ice segregation like ice needles [10]. Similar landforms are observed on Mars and they are important in understanding patterned ground formation (fig 1 c-d).

Dissected mantle terrain. The dissected terrain is described as a formerly ice rich loess like material that undergo reworking due to sublimation of the interstitial ice leaving a broken up, bumpy texture [13]. This change is believed to be an obliquity driven process and the resulting landscape is comparable to terrestrial thermokarst terrain. Dissected terrain is important in understanding the Martian landscape evolution, being a sign of a climate driven process.

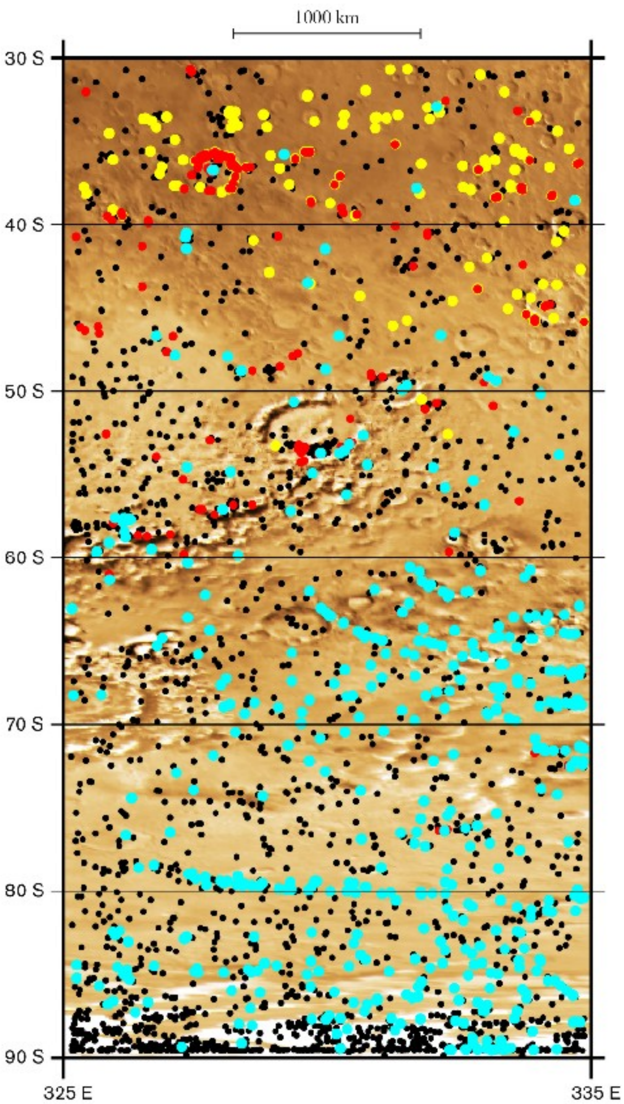

Figure 2) Distribution map showing patterned ground (blue), gullies (red), dissected terrain (yellow) and all MOC images (black).

Gullies. Gullies on Mars are recent landforms that indicate the erosion by a fluvial medium most likely water. Two end-member formation mechanisms have been proposed which involve at one end a snow melt hypothesis [14]. In one end a aquifer discharge fed erosion [15,16]. In either case these landforms have important implications for late climate evolution on Mars as well as being prime targets for future astrobiological investigations.

In synergizing our data we aim to add more insight to the periglacial environment and how it evolves on Mars.

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