Small scale polygonal patterns along the southern water ice margin on Mars.

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Introduction: From the high resolution images acquired by Mars Orbiter Camera an array of small scale polygon patterns have been detected which range in size and shape. They occur in a continuous meters-thick deposit [1] interpreted to be ice rich which is observed at latitudes above 60º at both hemispheres, but which has undergone degradation at lower latitudes and is absent in the equatorial regions (within ±30º) [2]. Also, the Mars Odyssey's Neutron spectrometer measurements of hydrogen emissions shows the presence of high water-ice abundance (>60% by volume) in the surface soils in the northern and southern latitudes above 60º [3]. The polygons interpreted to be forming in ice-rich terrain are thus strongly supported by indirect measurements of water-ice for those observed at latitudes higher than 60º S and for those at lower latitudes the morphology indicate a past when ice was stable to lower latitudes.

We have performed a comprehensive investigation of polygons along the latitudes of 30º S – 80º S on the southern hemisphere of Mars to highlight the change in morphology with latitude due to the presence or absence to subsurface water ice.

The hypothesis is that the surface morphology would reflect the proposed subsurface ice content, similar to periglacial landscapes on Earth, which is both theorised [4] and measured indirectly by Mars Odysseys Neutron spectrometer. The idea is also to differentiate the genesis of polygons and link them to different processes and time of formation. As an addition we includ cryocarst data which reflect the absence of near surface ice (m to tens of m). These previously unpublished results are the outcome of a master thesis project [5]. This work focus on the latitudinal distribution of polygons in relation to the cryocarst terrain.

Data and Methods: The identification of polygons has been made from the study of approximately 4000 high resolution MOC images that we obtained prior to January 2002. Only images showing clearly distinguishable polygons were used in this investigation. The features were identified by the presence of networks of polygons or circles to semi circles with dark or bright rims to the contrasting surface. The documented polygons were classed as orthogonal, random orthogonal and non-orthogonal [6]. We also used three size classes of less then 50 m, 50-200 m and 200-300 m.

Preliminary results and discussion: The southern water ice margin between 30º S to 80º S covers a wast area and contains many different geological locales. Craters of different sizes are abundant and the main geomorphic feature. The main temporal domains are of Noachian and Hesperian age. The elevation which is generally high is punctuated by the two impact basins of Argyre and Hellas.

Polygons have been known since the Viking era and they have been described by several authors [7,8]. Global distributions have been presented by [9, 10, 1] and more thorough analysis of morphology has been done by [11, 12].

The distribution of the catalogued polygons display a striking latitude dependence (fig 1) hence verifying previous work.

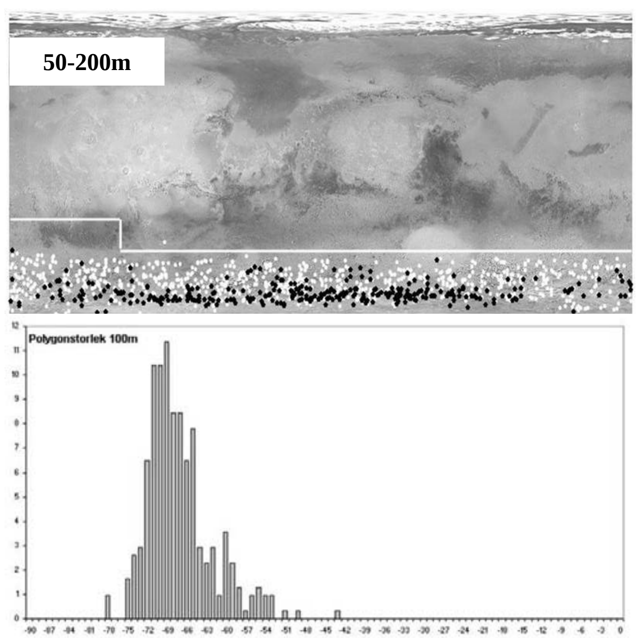

Figure 1. Above, map example with distribution of polygons of size 50-200 m. Below, note the peak concentration in latitude 70° S. Data in histograms is in 1° latitude bins from 0º S - 90º S.

The size classes as a function to morphology show a relationship that agree with what we could expect from terrestrial conditions (fig 2).

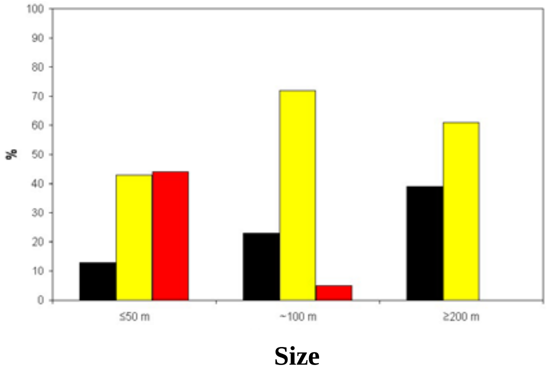

Figure 2. Polygon morphology as a function of size. Orthogonal-black, random orthogonal-yellow, non orthogonal-red

Random orthogonal morphology. Polygons of this type occur as nets of cracks often displaying several hierarchies of polygon formation (fig 1a). They resemble terrestrial thermal contraction polygons even though the character of the wedge filling is so far unknown.

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 intra crater landforms (fig. 1b-c).

Non orthogonal morphology. Catalogued non orthogonal polygons is mainly the type of formation previously described as "basket ball terrain" due to the likeness to the surface of a basket ball [11]. They are generally small and are difficult to distinguish on MOC images. [11] describe these as sublimation polygons due to a striking resemblance to polygons found in Dry Valleys Antarctica (fig. 1d).

Conclusion: What we discovered was that the polygons of medium size have a peak in occurrence in the 70 S latitude whereas the other classes show a more homogenous distribution. The peak correlate well with high emission of hydrogen as discovered by Mars Odyssey. Medium class polygons are for the most part made up by random orthogonal morphology whereas the small class is non orthogonal and large ones show an orthogonal morphology. This could point to formation during different climate conditions, an idea further developed by [12].

Work in progress: the Argyre area

We are currently performing a detailed investigation of the Argyre area 325º - 335º E and 30º S – 90º S using MOC, HRSC, THEMIS and MOLA data. The area was chosen due to a wide diversity of periglacial landforms [5] and it is also characterized by large variation in elevation due to the Argyre basin.

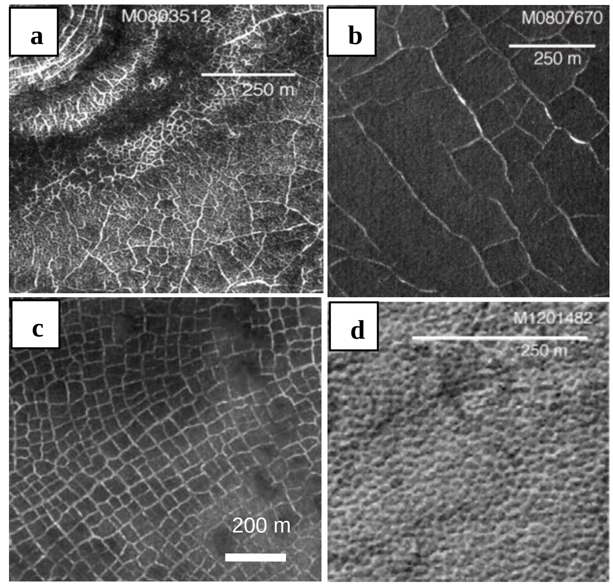

Figure 1 a-d. a) Random orthogonal polygons, note a change in network density presumable due to different soil condition. b-c) orthogonal polygons. d) non orthogonal polygons of "basket ball" type.

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