TUMULI VS PINGOS: A COMPARATIVE STUDY BETWEEN DAEDALIA PLANUM AND ELYSIUM PLANITIA FEATURES. **L. Giacomini**[1], S. Ferrari[1] and M. Massironi[1]
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Abstract: Tumuli and pingos are important distinctive features for inflated flows and unconsolidated water-rich periglacial terrains respectively. Therefore distinguishing these two classes is useful to understand the origin of the terrain where such features occur; this however could be complex since their morphologies are very similar. We focused our study on the dome-like forms detected on Daedalia Planum and Elysium Planitia regions taking into account a morphological analysis coupled with a density distribution study of mounds and age determinations of the surfaces where they were observed. Such comparative study revealed that Elysium Planitia features are more compatible with a pingo nature whereas the Daedalia Planum morphologies are more likely associable with tumuli. This would confirm the presence of inflated flows on Daedalia Planum lava field.

Introduction: The distinction between pingos and tumuli on Mars is an aspect still debated among the planetary geologists since has important implications about the nature of the hosting terrain. Tumuli are the most prominent fingerprints of inflated lava flows and form by the injection of hot lava which induces a local uplift and tensile stress in the colder but still visco-elastic crust [1]. Pingos can form in periglacial environments under various conditions, like on mudflows [2] or outflow channel deposits [3]. They are the result of a pressurized groundwater flow and the subsequent freezing that causes the ice core formation and the consequent ground up. It is evident that distinguishing these two types of features becomes crucial as they can be used as indicators of a specific environment. However this can be rather complex as their morphologies are rather similar, both appearing like domed morphologies, usually with clefts on their top.
In this work we analyzed and compared the mounds present on Daedalia Planum with the most discussed dome-like forms on Elysium Planitia, in order to shed more light on their respective origin. We choose a morphological approach, with attention also for the spatial distribution of the forms and dating of the surface.
Analysis of Daedalia Planum and Elysium Planitia features: Daedalia Planum is a plain located south west of the Arsia Mons where a huge number of lava flows were emplaced. The detection of lava flows more than 1500 km long raises some questions about the factors that contribute to their emplacement. MRO/HiRISE (High-Resolution Imaging Science Experiment) and MGS/MOC (Mars Orbiter Camera) images analysis suggested the presence of some inflated flows inside the lava field as showed several features that can be interpreted like inflation fingerprints. Among these are mounds showing both circular and elliptical map-shape with maximum length of about two hundred meters and interpreted to be tumuli (Fig.1a) [4]. However their morphologies appear different to those detected on the southern Elysium Planitia and interpreted as tumuli by Keszthelyi et al. [5]. Indeed, the latter are characterized by a circular shape, with a diameter range between 10-30 m, and show a smooth surface with medial and circumferential clefts (Fig.1b). However their origin is controversial since the geological units on Elysium Planitia are the result of both volcanic and fluvial processes [6;7], hence the mounds located in this region can be tumuli or pingos. This implies that in the first case the different morphologies between Daedalia Planum and Elysium Planitia mounds could be due to a different erosion degree, in the second case they are instead the expression of a different origin. To verify the first hypothesis, the ages of the Daedalia Planum and Elysium Planitia surfaces have to be compared. The dating of the Elysium surface gave an age of 33±6 Myr (Neukum Production Function[8]) whereas Daedalia Planum flows gave instead an age of 260±30Myr [4]. Such age difference between the two regions could justify the different morphologies between the mounds.

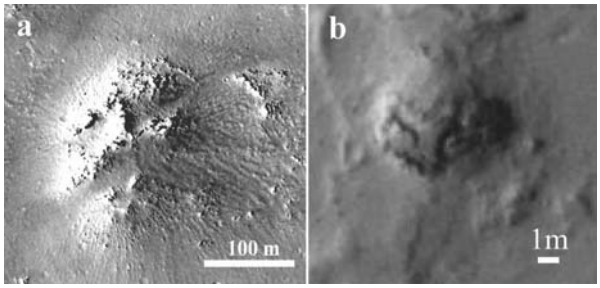

Fig.1: Tumuli vs Pingos. a) a candidate tumulus located on Daedalia Planum lava field b) mound located on Elysium Planitia which can be interpreted both like a tumulus and a pingo.

However some works [9; 10] documented the presence of pingo fields on periglacial terrains on Elysium Planitia, suggesting the possibility that the mounds considered by Keszthelyi et al. [5] could be pingos rather than tumuli. To verify this possibility a preliminary

density analysis of the Elysium and Daedalia mounds was performed. The density obtained is 38.5±1.8 mounds per km^2 (Poisson error). Such result is about 5 times greater that the Daedalia one which is attested at 6.9±0.4 per km^2, a density comparable with that of the terrestrial inflated lava flows detected in Argentina (6.1±0.3 per km^2) [4].

Conclusions: The comparison of age, morphological environment and distribution of Daedalia Planum and Elysium Planitia mounds attributed to inflation processes suggests their actual different nature on the two analyzed regions. In particular several signs of periglacial conditions in the surroundings of Elysium Planitia and the frequency of the Daedalia and Elysium Planitia mounds compared with that of tumuli in inflated flows of the Earth favor the hypothesis that Elysium Planitia is largely affected by pingos rather than tumuli. However for a better evaluation of these results further statistical data are needed both on Mars and Earth.

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