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Observations of south polar landforms, Mars: a case study in Angustus Labyrinthus.

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1. Introduction

Araneiform terrain (informally called "spiders"), usually characterized by central depressions and radially branched troughs carved into the substrate, is an enigmatic features of the Martian south polar area with no terrestrial analogies (Fig.1). They are thought to result from CO2 sublimation driven seasonal erosion [1-3].

The High Resolution Imaging Science Experiment (HiRISE) onboard NASA's Mars Reconnaissance Orbiter (MRO) spacecraft, together with the High Resolution Stereo Camera (HRSC) images onboard Mars Express, have repeatedly imaged Angustus Labyrinthus, informally known as the Inca City (-81ºN, 296ºE), which is characterized by rectilinear intersecting ridges and an active area for spring sublimation and jet activities and thus host a considerable concentration of spiders [2].

We mapped the spiders´ spatial distribution in the Inca City and classified them into four species according to their morphological features including two undescribed types. Our goal is to investigate the formation mechanisms and distribution characteristics of the spiders. We also evaluate whether the morphometry bears information about the homogeneity or heterogeneity of the surface material and supports gas-venting or other channel-erosion models.

2. Method

Inca City is characterized by rectilinear intersecting ridges (Fig.1). Its interior regions are active areas for spring sublimation and jet activities, and they host a considerable concentration of spiders [3]. We systematically scrutinized and mapped all spiders in the Inca City (Fig.1) using 100 HiRISE images.

HiRISE can return 25cm per pixel surface images with high signal to noise ratio [7,8]. HRSC provides a large and continuous coverage of the Martian surface with intermediate resolution 12.5m per pixel [9]. Both of them enable us to identify spiders including their troughs under low light conditions (Fig.1).

3. Result

We made a detailed mapping of the spider distribution and location in Inca city by investigating 100 HiRISE (Fig.1). In total we found 3618±34 spiders. Some of them are connected by troughs and it is not easy to determine whether this is a single spider.

Adding to the two types of spiders already described - fat and thin spiders [3], we identified two new types spiders which we termed 'elongated' and 'half' spiders (Fig.2).

Thin spiders usually with rough and large centres and thin and long troughs have much more complex and interlinked troughs net and irregular central depression shapes. They have large diversity in sizes and very distinctive characteristics making them easy to distinguish and identify (Fig.2b). Fat spiders have relatively larger centre depressions with wide and short troughs emanating radially from centre depressions (Fig.2a). Their troughs have very few branches and become narrow quickly increasing with distance from centre depressions (Fig.2a).

Half spiders only show one half of the typical spider features but the troughs nevertheless radiate from main depression (Fig.2d). They are found along the boundary with ridges or steep slopes and are relatively rare. Elongated spiders are characterized by linear central depressions and much thinner

branching troughs (Fig.2c). The troughs are short compared with the linear central depressions. A large fraction of the troughs emanates directly from the central depressions with branches or bifurcations (Fig.2c).

4. Future Work

We mapped the distributions of spiders in the Inca City and classified key morphometric features as well as subtler characteristics. Thus we intend to study the spatial growth trend of the spiders' troughs and to understand the implications for the surface properties and processes involved. We will focus on investigating how far and in which way spiders are controlled and affected by environmental parameters.

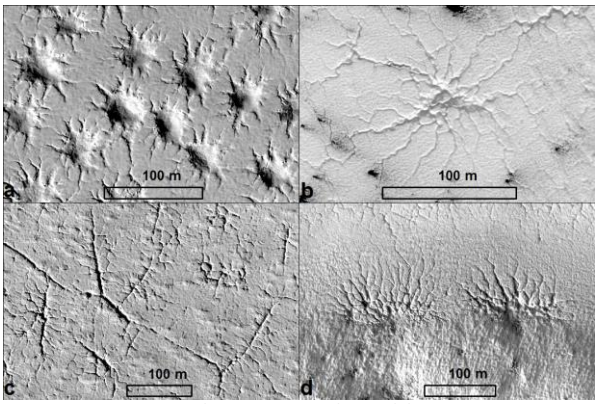

Figure 2. Four types of spiders. (a)A field of fat spiders, centered approximately at -81.62ºN, 296.395ºE. HiRISE image PSP_005993_0985 was acquired at Ls=342 with 50cm/pixel. (b) A field of thin spiders, centered approximately at -81.441ºN, 295.92ºE. HiRISE image PSP_003928_0815 was acquired at Ls=247 with 25cm/pixel. (c) A field of elongated spiders, centered approximately at -81.768ºN, 296.02ºE. HiRISE image PSP_006204_0985 was acquired at Ls=351 with 50cm/pixel. (d) A field of half spiders, centered approximately at -81.562ºN, 295.806ºE. HiRISE image PSP_006204_0985 was acquired at Ls=351, with 50cm/pixel.

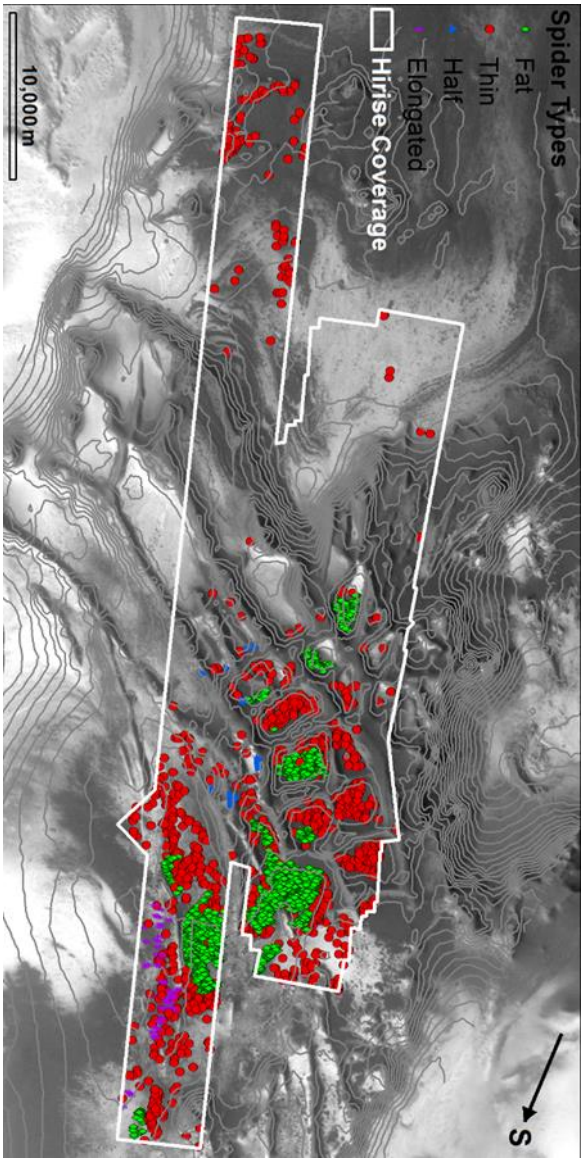

Figure 1. HiRISE coverage on Inca City superposed upon the spatial mapping of spiders and HRSC image and a contour map of 50m derived from the Mars Orbiter Laser Altimeter (MOLA). The white polygon indicates the area covered by HiRISE images.

References

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