ABOUT HILLL NATURE IN ELYSIUM PLANITIA ON MARS

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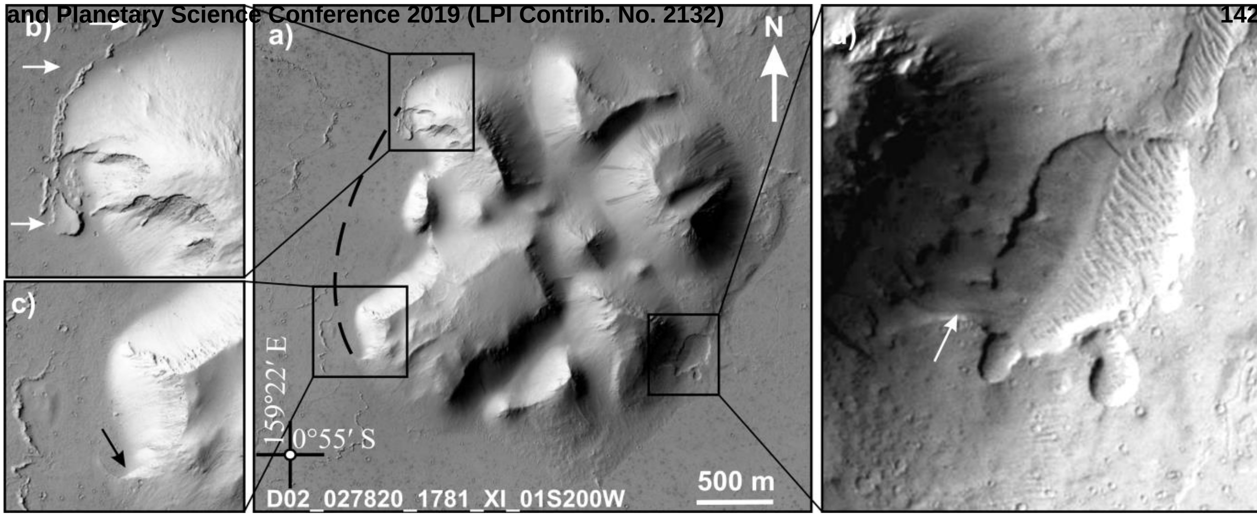
Introduction. The ice caps not covered with dust at the poles of Mars show that the ice growth occurs on them. It means that there are sources of water from where it is currently transported by means of the atmosphere. These water sources are outside the polar caps and must be inexhaustible and powerful enough for the ice is not covered with dust. Such a source can only be the global underground hydrosphere. In this case the most likely places for the upward movement of water are the low latitudes where the permafrost thickness is the smallest [1]. In this speculative planetary water exchange scheme there are not the observable sources of the water emission in the low latitudes. The author considers the hills nature in the near-equatorial region of Mars - Elysium Planitia that are likely formed by the injections from the underfrost water tanks [2].

Methods and materials used. The decoding of the objects on the Mars surface was carried out on the cosmic photographs in the visible and infrared wavelength ranges obtained with the HiRISE camera. The forms of structures on the surface, their age ratios were analyzed based on the calculation of the density of craters, the visual features of the surface substrate, and signs of the geological processes taking place.

Observation data. In the lowland region of Elysium Planitia, in the strong contrast to the surroundings, there are hills and their close groups that have a characteristic appearance – the convex conical, dome-shaped, and pyramidal forms against the flat surrounding surface. Their diameter reaches several kilometers and height - hundreds of meters (Fig. 1). The interest in the hills arose because of their shape and due to the fact that they have increased thermal inertia. It may be caused by the presence of the heat-intensive material - ice.

Such a typical structure is shown in Fig. 1a – a hill of complex shape strongly contrasting with the surrounding plain. The plain has a cover formed by a flat stream after the hardened substance probably basalt. The hill has an isometric shape in plan with deep linear depressions separating the remnants of the initially flattened surface. In fragment 1b it can be seen that in the northwestern section the cover of the plain overlaps the foot of the hill. Ib. the fragments resembling landslide bodies are also visible at the foot of the hill. In general the western contours of the hill have more steeply terraces than the others. In fragment 1c, one can see that the steep slope of the hill was less resistant to the effects of lava than the gentle one (indicated by the arrow). The oval contour of the entire structure on the west side has a defect (dotted line), possibly formed by the thermal effect of lava. The rest of the contours of the hills have the appearance of earthflows or scree. On the southeastern slope of the hill, a depression is observed with an area of several football fields with clear contours (Figure 1a) and hollows that could remain from the inflowing and outflowing fluid. As it can be seen in the figure the bottom of this depression has a different microrelief, the western part is smoothed and apparently is a part of a hill, and the eastern part is covered with ridges of dunes typical of the surrounding plain. On the outer and inner slopes, typical slope streaks are visible. They begin below the eroded parts of the slopes and end at the foot of scree. It can be seen that the density of the location of small impact craters on the plain is not less than on the upper areas of the hill that indicates their similar age. However, the highly eroded and accumulative parts of the slopes have the lower crater density that indicates their relatively young age.

Discussion. The exposure time of the surfaces of the positive structure and the adjacent plain allows us to attribute their appearance to a fairly narrow time interval but the hill was formed earlier. A lava flow that moved from the northwest to the base destroyed a large part of the hill. At the same time the debris trails turned out to be more resistant to the thermal effects of lava, and the middle part of the hill was destroyed with the formation of the steeper ledges and landslides. The depression on the eastern slope of the hill could occur as a result of the accumulation and freezing of water at the foot of the hill. The hollows of the drain indicate that the hill itself was the source of this fluid. The formation of a subsequently dried depression can be associated with a subsidence of the surface after the sublimation of ice. Totally the observed forms indicate a significant proportion of the volatiles in the hill material. At the same time there are more volatile substances in the middle parts of the hill than in the talus. The most likely volatile substance is water that is in the form of ice in the hill, and the hill



itself is a large hydrolaccolith formed by the injection of water from the permafrost closed reservoir. At the same time by the time the basaltic lava was formed the hydrolaccolith already had modern dimensions and was surrounded by the same screes less rich in water.The most likely sequence of geological events was the following. The heating of a remote subsoil site led to the melting of permafrost and groundwater flowed into the Elysium Planitia plains, filling dry permeable sediments over the permafrost existing here. The upper part of the new aquifer was frozen, and conditions for water extrusion to the surface were formed in a closed porous space. The formation of hydrolaccolith near the surface is not fundamentally different from the terrestrial analogs – pingo or bulguniah. The relatively large sizes of hydrolaccoliths on Mars are explained by relatively less gravity. The subsequent heating of the subsoil led to the smelting and outpouring of basaltic lava to the surface and partial destruction of hydrolaccoliths. The presence of internal depressions of the considered structure indicates its simultaneous heating from below. Thus, the observed structure of the hills in the considered area of Elysium Planitia was formed in two stages – low-temperature (permafrost injection) and high-temperature (partial melting and destruction).

Figure 1. A large partially destroyed hydrolaccolith among the young basalt coatings of Elysium Planitia:
a) general view with its estimated contour before the thermal effect of lava (the dotted line);
b) the edge of the lava flow that had a destructive effect on the western contour of the hydrolaccolith (the arrows indicate the direction of lava);
c) the result of the destructive effect of lava on the core of the hydrolaccolith (the arrow indicates the outlier, its material turned out to be thermally more stable);
d) traces of a supposed water body with an area of six football fields, allegedly formed as a result of ice melting from the body of a hydrolaccolith during thermal influence of lava flow (the arrow indicates the largest channel of water supply).

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