

## HILLS ZEPHYRIA PLANUM - A SOURCE OF DEEP RESOURCES

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We propose area in the equatorial region Zephyria Planum to be considered as landing site for the mission. The site is located in "Sea Urchins" (fig.1,2) having landing point coordinates  $1^{\circ}22,3'S; 157^{\circ}8,5'E$

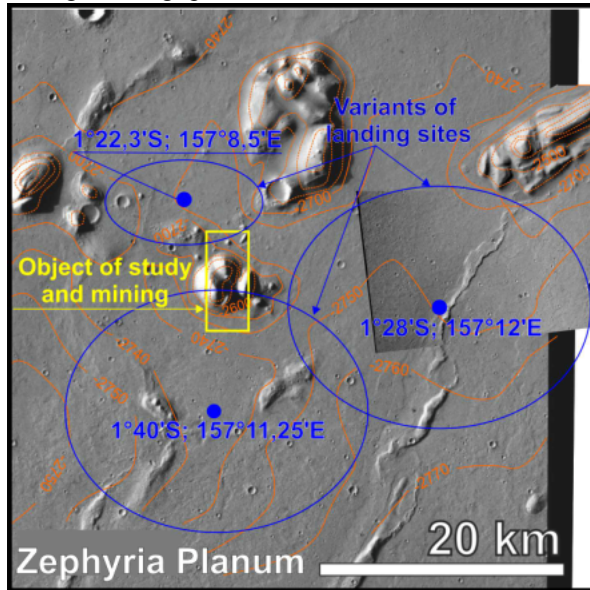


Figure 1. Location of intended landing, object of study and resource extraction in Zephyria Planum.

**Background of choice of the site.** The theoretical justification of the existence of large hydrolakkolits at low latitudes of Mars is based on existing notions of a subpermafrost hydrosphere [1] and is represented in the materials of conferences and publications [2-4]. Landing site for the scientific laboratory MSL2020 (Site 114) had been proposed by the author back in 2014. Extended version of the proposal was submitted in the beginning of 2015. There was no author's proposal presentation at the Second Landing Site Workshop because proposed area didn't meet technical constraints i.e. low thermal inertia, high albedo and planetary protection restrictions (cannot approach the water). What distinguishes current choice from others is that proposed site is focused on discovery of traces of modern and recent life in the substrate formed from subpermafrost waters.

**Study space.** Place of the first humanitarian mission is defined by the main purposes, which in the understanding of the author are to implement the landing on Mars and to test technology of survival. The biggest challenges for the perspective landing place are: to ensure safe landing and to address mission's survival concern, where easy access to the

verity of resources such as water, heat, metals, methane and other gases, building materials could be critical. Scientific goals of the first humanitarian mission will come mainly to the solving of technical tasks, except for the task of discovery traces of life. Proposed site for the first humanitarian mission takes into account the need to mitigate the adverse environmental conditions:

- location of the site is at the height of  $-2700$  m, which determines the significant thickness of the atmosphere and an opportunity for effective deceleration landing modules;
- location near the equator is favorable for reasons of ballistics;
- predominance of large lowland areas also creates favorable conditions for landing, movement and review;
- the equatorial position ( $1,5^{\circ}$  south latitude) defines the highest possible average temperature of the subsurface soil - about  $-40^{\circ}C$  and a long season with day time temperatures around zero;
- low thermal inertia ( $90 J m^{-2} s^{-0.5} K^{-1}$ ) and high albedo (0,3) of the surface in this area assume a loose cover of silt which can be used as a heat insulating material at building of hideouts;
- sand dunes is likely to contain a condensation (fresh) water, and the well-sorted dune granular substrate using a binder allows to produce blocks for building in automatic mode;
- hills on the plain Zephyria Planum typical, most likely are hydrolakkolits at geomorphological features and geological conditions, and show signs of recent activity [2,3]. This suggests existence of channels of brine in flow from interpermafrost or subpermafrost reservoirs to the surface of Mars, which increases the ability to attract water, mineral and thermal resource, sand expands the search capabilities of modern life to the deep reservoirs of liquid water. If injection nature of the hills on the plain Zephyria Planum confirmed they should become the main object of the scientific research and place to test the innovative technologies for resource excavation and data processing. Considering favorable climatic conditions and sand nature of the relief we can conclude that this site (and similar ones) can be very appealing for the first humanitarian mission. Summarizing above mentioned aspects we arrived at a decision that key factor in determining perspective landing site would be proving injection nature of the conical hills of Zephyria Planum.

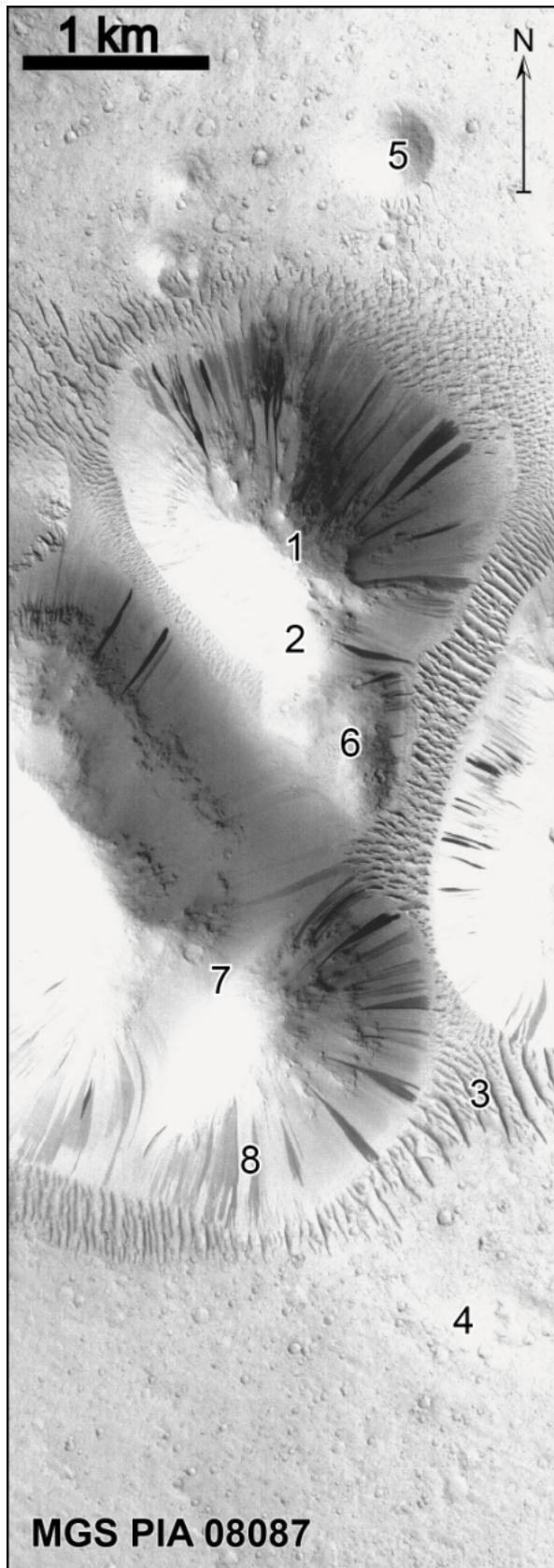


Figure 2. The object of study and resource extraction. Hills Sea Urchin. Numbers denote: a group of hills with convex caps (1) with jagged contours and gentle slopes (2). They are surrounded by dunes (3) on a flat plain (4). The height of hills above the plain is approximately 250-370 m. The indirect signs of hydrolakkolits are close grouping of large hills on the isometric site, the presence of small hills of the correct form in the upper part of the image (5), apparently having the same nature; the presence of clearly secondary form (6), presumably formed by the subsurface fluid flow from the top of the northern hill; the presence of a dense ring of dunes that resembles sand dunes of the terrestrial glaciers. The signs of the structures recent activity (modern subpermafrost water injection) include: the regular conical shaped hills; the correct form of the saddle (7) formed under the dominance of the active drift and accumulation of silt from the western larger hill; the large concentration of the slope streaks (8), having presumably aqueous nature and developing on the substrate of crystalline hydrates. The center of the image has the coordinates close to 1°28'S; 157°20'E

Reduced requirements for the magnitude of thermal inertia from  $100$  to  $90 \text{ J m}^{-2} \text{ s}^{-0.5} \text{ K}^{-1}$  and lifting the ban on contact with water bodies (planetary protection) will allow the MSL2020 to carry out this mission in conjunction with the future first humanitarian mission. The author believes that one of the physical analogues is Mount Sharp in the crater Gale, which, as the author suggests, has the injection nature [4]. Morphological characteristics of the mountain, elemental, lithological composition and traces of relatively large recent floods at its foot are not contrary to the model of participation of deep injections into the formations of the central massif of the crater Gale. Thus the area of research of laboratory of Curiosity to a certain extent can be considered as a valid test range for studying the large Martian hydrolakkolits.

Author is ready to offer his extensive expertise in the field of Earth's hydrosphere science if chosen to participate in special studies related to the testing of active hydrolakkolits, evaluation of landing sites of alleged humanitarian mission and the development of research programs of Martian hydrosphere.

**References:** 1.Clifford S. M., Lasue J., Heggy E., Boisson J., McGovern P., Max M.D. Depth of the Martian cryosphere: Revised estimates and implications for the existence and detection of subpermafrost groundwater. *Journal of Geophysical Research: Planets* (1991-2021)115 (E7) 2010. 2.Yakovlev V.V. Large basins of water on Mars/ European Mars Science and Exploration Conference: Mars Express & ExoMars. European Space Agency ESTEC, Noordwijk, 2007. 3.Yakovlev V. Conditions and mechanism of Mars big hydrolakkolits formation/ Fifth Mars Polar Science Conference (2011) 6026. 4.Yakovlev V.V. The nature of the central structure of the Martian crater Gale. Scientific publication UkrDGRIN#3.K2012-S.102-113.