LANDING SITE PROPOSALS FOR NEXT MARS LANDERS: POSSIBILITY TO EXPLORE ASTROBIOLOGY RELEVANT LOCATIONS IN THE SOUTHERN POLAR REGION OF MARS.
A. Horváth[1,4], Sz. Bérczi[2,4], A. Sik[3,4], Pócs, T.[5] Szathmáry E.[6]. [1]Research Centre for Astronomy and Earth Sciences, Hungarian Academy of Sciences, Konkoly Observatory, H-1121 Budapest, Konkoly Thege út 15-17. Hungary, (andrasf.horvath@gmail.com) [2]Eötvös University, Inst. of Physics, Cosmic Materials Sp. Research Gr. H-1117 Budapest, Pázmány P. s. 1/a. Hungary, [3] Eötvös University, Dept. Physical Geography, H-1117 Budapest, Pázmány P. s. 1/c. Hungary, [4]New Europe School for Theoretical Biology and Ecology, Budapest, Hungary, [5]Eszterházy Károly College, Dept. of Botany, H-3301 Eger Pf 43, Hungary, [6]Eötvös University, Dept. of Plant Taxonomy and Ecology, H-1117 Budapest, Pázmány 1/c. Hungary

Introduction: Eearlier the Hungarian Mars Astrobiology Group proposed the MSO-DDS hypothesis which supposed that living organisms may couse the darkening of frost cover at Polar Regions of Mars [1-3]. Regardless the possible hypothetic living organisms, these sites are still interesting because of the conditions annually favorably for the ephemeral occurrence of microscopic liquid water. Several exciting landing sites at Southern Polar Region frosted fields, like the Pityusa Patera, the Inca City, [4-6], and other craters in the subpolar belt are discussed below. The main goal is these sites are suitable for the ephemeral appearance of microscopic liquid water, and in theory even for hypothetically organisms too [7-9], 1-3 mm below the soil surface (tens of centimeters below the frost) are there existing or not.

Method: We analyzed MOC, HRSC, HiRISE images and the corresponding topographic data.

The proposed landing sites: The sections below show the basic parameters of the proposed landing sites (Fig.1.)

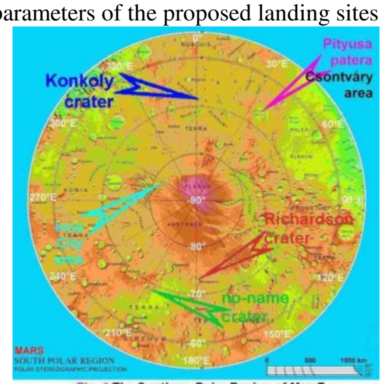

Fig. 1 The Southern Polar Region of Mars¶

Fig.1 The Southern Polar Region of Mars with proposed landing sites for MARS- missions

Pityusa Patera (Fig.1., 2.,3.,4.)

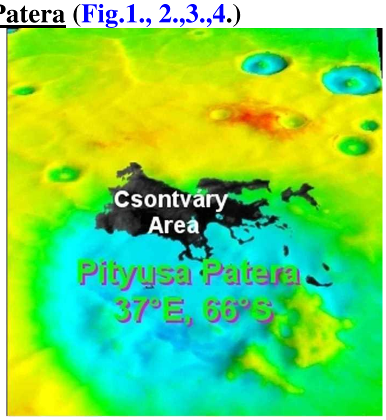

Fig.2. Dark Dune area of Pityusa Patera on MGS-MOLA image [3]

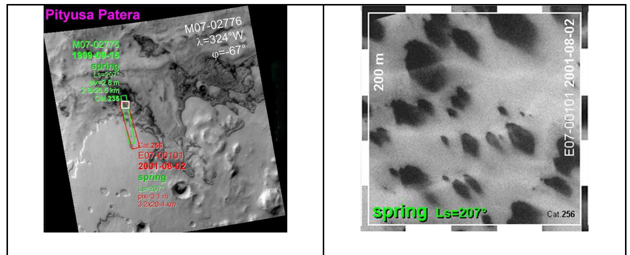

Fig.3,.4. Imagse of Pityusa Patera made by MGS [5] and DDSs [3]

Angustus Labyrinthus („Inca City"), Gánti ghost crater (Fig. 1., 5., 6.):

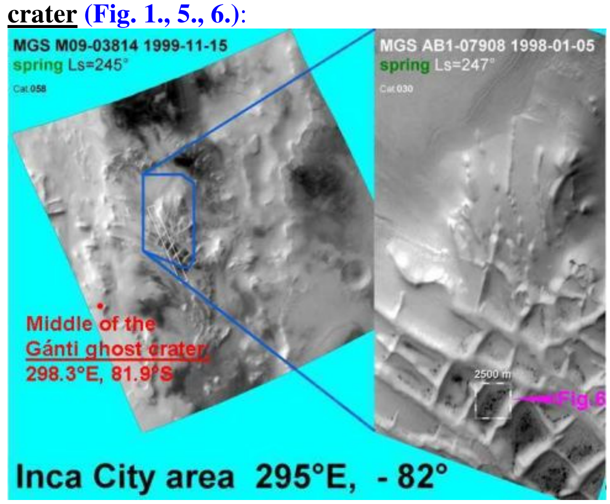

*Fig.5. Part of the Angustus Labyrinthus („Inca City"[3]), **Gánti ghost crater (middle: at 81.9 °S, 298.3 °E)***

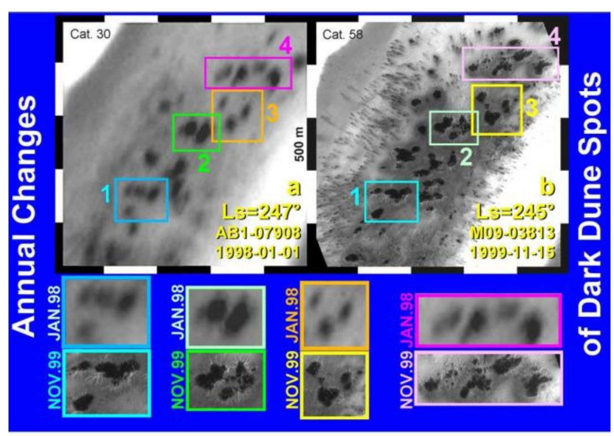

Fig.6. Annual change of DDS [3] on the „Inca City"

No-name crater (209 E, 69 S, diameter about 70 km, Fig.7., 8.)

*Fig.7.a No-name crater, Southern Polar Region [8. from Fig.3**a**]*

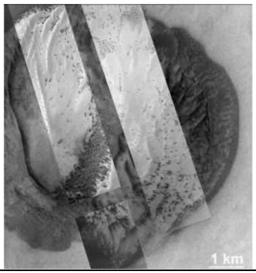

*Fig.7.b. Dark Dune region on No-name crater of 209°E, 69°S [8. from Fig.3 **d**.]*

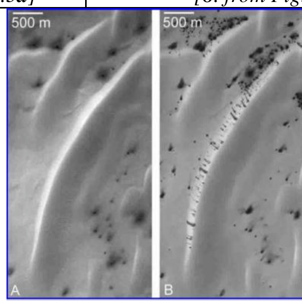

Fig.8. The appearance of an analyzed area (209°E, 69°S) at different dates. (On the B images from the DDS started seepages.). (A) and (B) show the same terrain in the same year with 90 Earth days' difference. Image (A) (R04-00399) was acquired in winter at Ls =165°, while (B) (R07-00376) was acquired in spring at Ls = 216°. The appearance of slope albedo structures on virgin, undisturbed frost cover (A) along the ridge of a dune is obvious, which is consistent with their development as seasonal phenomenon. [9]

<u>"Konkoly" crater</u> (1°E, -68°S, diameter about 70 km, [9]:

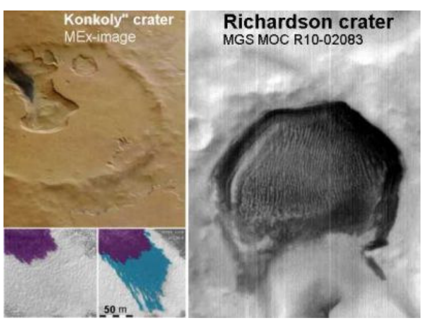

Fig.9.a.,b."Konkoly" and Richardson crater. The target region to show these MSO theoretically photosynthesizing units are on the Dark Dune Spots [9, top images by Mars Express; left below colored 2 HiRISE photos].Seepages depart from DDS (viole, blue)

<u>Richardson crater</u> (179°E, -72°S, diam. about 60 km, (bottom of the page)

Conclusion: These circumpolar locations are interesing because of ephemeral appearance of microscopic liquid water. Because under different climates the water could exist there substantially longer duration, these sites are useful to analyze, could any hypothetical Martian biota remained on the planet [3]. These landing sites may have the possibility to discover the Martian living organisms in the form of CryptoBiotic Crust formed by extremophile bacteria.

Acknowledgment: This work has been supported by the ESA ECS-project No. 98076.

References: [1] Horváth A., Gánti T., Gesztesi A., Bérczi Sz., Szathmáry E. (2001) Probable evidences of recent biological activity on Mars: appearance and growing of dark dune spots in the south polar region. 32nd *LPSC* #1543, Houston. [2] T. Gánti, Horváth A., Sz. Bérczi, A. Gesztesi, E. Szathmáry (2003a) Dark Dune Spots: Possible Biomarkers on Mars? *Origins of Life and Evolution of the Biosphere* **33**: pp. 515-557, Kluwer, Netherlands. [3] Szathmáry E., Gánti T., Pócs T., Horváth A., Kereszturi Á., Bérczi Sz., Sik A. (2007): Life in the Dark Dune Spots of Mars: a testable hypothesis, Chapter 13. in*: Planetary Systems and the Origins of Life*. R. Pudritz, P. Higgs, J. Stone, Eds. Cambridge Astrobiology, Cambridge University Press, pp. 241-262. [4] Horváth, A., Bérczi, Sz., Sik, A., Kereszturi, A. (2009) "Inca City" DDS Test Region in Mars: New Comparisons by MRO Data, *EPSC*, EPSC2009-0294**,** Berlin. [5] Horváth A., S. C. Manrubia, T. Gánti, Sz. Bérczi, A. Gesztesi, D. Fernández-Remolar, O. Prieto Ballesteros, E. Szathmáry (2003b) Proposal for Mars Express: detailed DDS-test in the "Inca City" and "Csontváry" areas, *EGS-AGU-EUG Joint Ass.*, Nice, EAE03-A-14142. [6] A. Horváth, T. Pócs, T. Gánti, Sz. Bérczi, E. Szathmáry (2004): On the possibility of crypto-biotic-crust on Mars based on northern and southern ringed polar dune spots. *35th LPSC*, #1914, LPI, Houston [7] Pócs, T.; Horvath, A.; Ganti, T.; Bérczi, Sz.; Kereszturi, A.; Sik, A.; Szathmary, E. (2007): Comparison of Surface Mineral Crusts and Cryptobiotic-Crusts: How Can They Help Life Support Mechanisms; Implications to Living Organisms on Mars. *38th LPSC*, #1144, LPI, Houston [8] Horváth A., Kereszturi Á., Bérczi Sz., Sik A., Pócs T., Gánti T., and Szathmáry E. (2009) Analysis of Dark Albedo Features on a Southern Polar Dune Field of Mars, *Astrobiology* **9**/1, pp. 90-103. [9] Vizi, P.G., Dulai, S., Marschall, M., Bérczi, Sz., Horváth, A., Hudoba, Gy., Pócs, T., 2013.: Possible Identification Method for Martian Surface Organisms by Using a New Strategy of Nano-Robots, *44th LPSC*, #2281. LPI, Houston. [10] **Bérczi** Sz,, Horváth A., Kereszturi A., Sik A. (**2010**) Microstructure on the Surface of Dark Dunes in the Polar Region of Mars, *41st Lunar and Planetary Sci. Conf.* **#1671**, Houston, , [11] Kereszturi A., Sik A., Horváth A., Reiss D., Jaumann R., Neukum G. (2007) *LPSC #1864.*

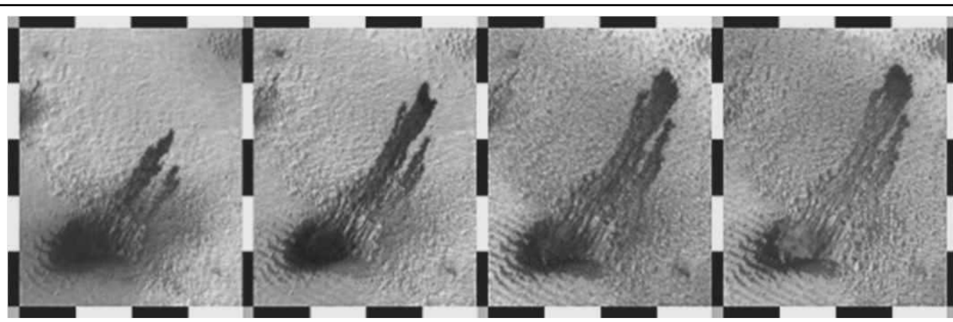

Fig.10. Southern hemisphere DDS-seepages extending on 80x100 m sized subsets of HiRISE images of the Richardson crater. Image numbers and Ls-values from left: PSP-003175, 210.6°; PSP-003386, 220.7°; PSP-003597, 230.9°; PSP-00374, 238.1° [11]. The slopes are tilted upward