LABORATORY EXPERIMENTS OF MARTIAN CRYOGENIC PROCESSES. N. Zalewska[1,2], K. Kubiak-Siwińska[1,3], J. Małuj[1], Z. Woźniakowski[1], R. Borkowski[1]
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Introduction: The latest high-resolution images from the HiRISE camera and their thorough survey of the surface of Mars show that Mars has been undergoing climate change throughout its entire history [1]. On this basis it can be concluded that cryogenic processes in the arctic regions of Mars are taking place all the time, which is closely connected with the possible occurrence of life on this planet. Four experiments have been carried out in the Climats Chamber for the study of cryogenic processes on Mars. Parameters of the chamber were carefully matched to simulate Martian seasons. Climats Chamber (type R404A) parameters didn't allow for getting below 50 mbar pressure. Samples were placed in the 40x50x10 cm container for 12 hours in the temperature of +20°C and for another 12 hours in the temperature of -70°C. Whole cycle lasted 5 days. First experiment (Fig.1) consisted of placing a layer of water ice between layers of dry sand (0.3-0.6 mm). Second experiment (Fi.2) was putting water ice between layers of sand soaked with water, Third experiment (Fig.4) involved using frozen brine (150 grams of NaCl per liter). The last fourth experiment (Fig.6) involved using dry ice (CO_2) between quartz sand (1mm grains). Forms that appeared on the surface of samples resembled morphologically forms from arctic regions of Mars in microscale. Experiment result correlate with seasonal CO_2 and H_2O changes on northern and southern arctic regions of Mars [2]. In the first two experiments after the whole cycle collapsed oval-shaped structures appeared showing layer interruptions and cavities were formed under the surface (Fig 1,2). [3] Additionally in soaked sand sample sinuous surface cracks from thawing appeared (Fig.2). In the experiment with brine the surface showed no collapses as it was consolidated by crystallized salt but under the surface cavities formed (Fig.4). These struktures may correspond with the image from the HiRISE camera (Fig.5). In the last experiment after CO_2 sublimated the surface collapsed in such a way that characteristic polygonal structures formed but without breaking the surface layer (Fig.6). Distinct fine-grained structures that appeared may confirm Martian arctic phenomenon associated with the sublimation of CO_2 which forms characteristic silt dusty plumes (Fig.7), [4]. First two experiments can be correlated with cryogenic phenomena of H_2O on arctic regions of Mars (Fig.3),[5], [6]. Because of thawing and freezing of subsurface layer of ice characteristic collapsed forms are apparent such as observed by HiRISE telescope e.g.: PSP_004239_1060; ESP_017103_2255 ESP_014413_0930; ESP_013609_0980; PSP_004239_1060. These studies have been continued.

References: [1] Conway S. J. et al. (2012) *Icarus*, *220*, 174-193. [2]. Calvin W. M, et al. (2017) *Icarus*, *292*, 144-153. [3]. Soare R.J. et al. (2007) *Icarus 191*, 95–112. [4] Thomas N. et al. (2011) *Icarus 212*, 66–85. [5] Gaidos E. J. (2001) *Icarus 153*, 218–223. [6] Brougha S. et al. (2016) *Icarus 274*, 37–49.

Acknowledgment of the management of the Institute of Aviation for the opportunity to conduct the research in cryogenic chamber.

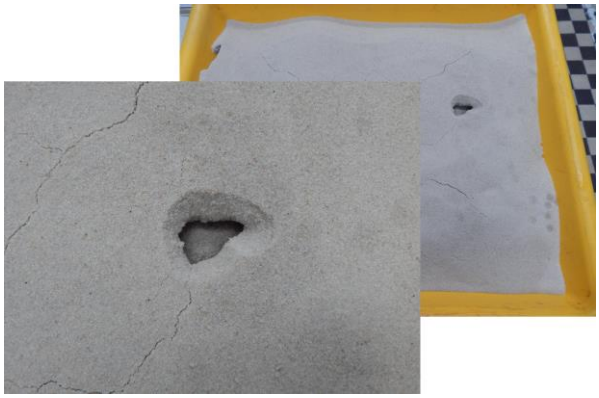

Fig1. Experiment no 1. Dry sand (0.3-0.6 mm) with ice layer H_2O underground (amount of water used to produce ice: 2.5 l. This Fig.1 refers to Fig.3

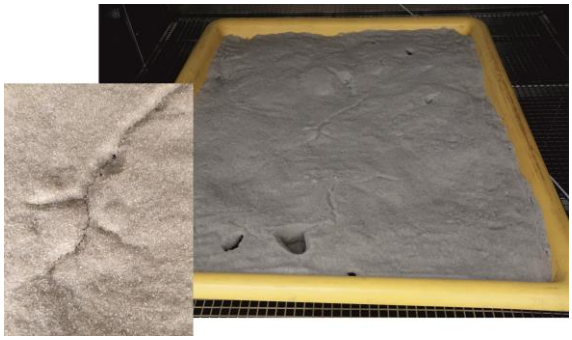

Fig.2. Experiment no 2. Wet sand with a layer of ice H_2O underground.(amount of water used to produce ice: 2.5 l). This Fig.2 refers to Fig.3.

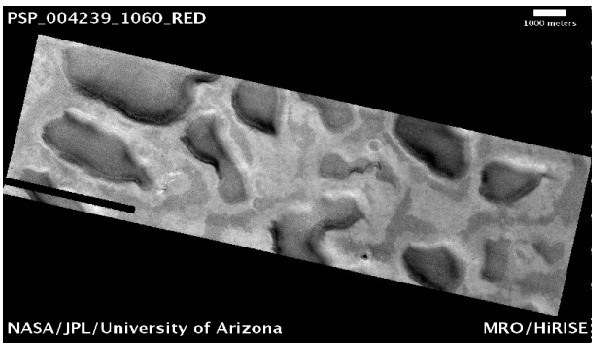

Fig.3 South Polar Region Lat: -73.9° Long: 293.3°E (PSP_004239_1060). This Fig.3 refers to Fig.1, 2.

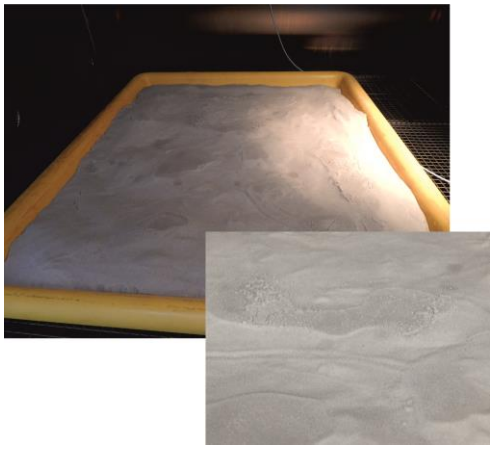

Fig.4. Experiment no 3. Dry sand (0.3-0.6 mm) with brine layer underground (150g NaCl/ l). (amount of brine used in the form of ice:4.5 l). This Fig.4 refers to Fig.5.

Fig.5. Pits along fractures in crater floor material (ESP_017103_2255) Lat: 45° Long: 57.4°E. This. Fig.5 refers to Fig.4.

Fig.6. Experiment no 4. Dry sand 1 mm with a dry carbon dioxide underground layer in granular form. Quantity of CO_2 granules used - 6 kg. This Fig.6 refers to Fig.7.

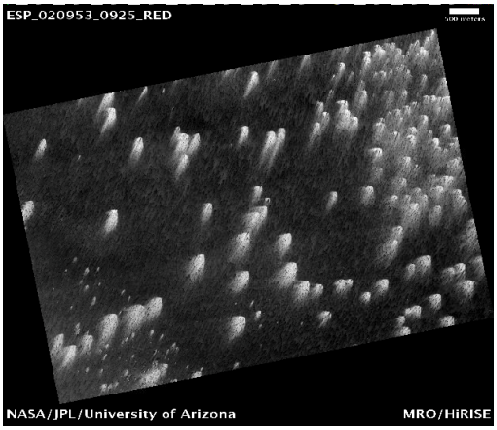

Fig.7. South polar region. Lat: -87.3° Long: 168.4°E (ESP_020953_0925). This Fig.7 refers to Fig.6.