THE PROPERTIES OF THE UPPER REGOLITH LAYER ON THE PHOBOS. C. A. Lorenz[1], [1]Vernadsky Institute of geochemistry and analytical chemistry RAS, 119991, Kosygin St. 19, Moscow, Russia; c-lorenz@yandex.ru

Introduction: Information about the regolith properties is quite important for construction of spacecrafts landing on the small bodies and for planning of the onboard scientific experiments. Preliminary suggestions about the properties of the Phobos upper regolith based on analysis of "Mars Express" (MEX) images are presented here.

Results: The crater of ~50 m in diameter exposed on a groove rim was found near the South Pole of the Phobos, on the outer slope of Grildrig crater (MEX image h5851_0000.nd2; max. res. 4 m/pix). The crater is associated with a trench that is propagated from the crater rim down to the groove bottom and further up over the opposite groove rim (Fig. 1). The trench has the same albedo as the crater deposits and most probably is a trace of crater-forming impactor. Besides the MEX image has many artifacts at high magnification, it is clear that the trench ~12 m wide near the crater rim became ~35 m wide on the groove bottom that could be due to a downsloping of the trench rims. It is not clear, is crater rim destroyed by rolling stone or not. However, visible trench width is ~30 m on a plain behind the opposite groove rim as well. It could indicate that the impactor probably was not rolled out from the crater but create a crater in the upper regolith layer, pushed off from the substitute solid layer, jumped over the crater rim and then rolled across the groove slope. Since the stone is not observed on the end of trench, it was launched over the surface again and finally landing somewhere further at slow velocity, probably without formation of the crater. The trench width allows to estimate the stone size. Assuming that minimal trench width corresponds to incomplete contact of the stone with a surface in the beginning of its trajectory, and maximal visible trench width corresponds to a distance between the trench rims after the modification and initial trench slopes angle is ~45°, an initial trench width could be estimated as 20 m and the stone diameter could be estimated as ~10 m (Fig 2). Thus, it could be suggested that a depth of the upper unconsolidated regolith layer on the groove slope is ≥5 m.

The trench geometry should mostly depend on size, mass and velocity of the moving stone, Phobos gravity and regolith strength. Assuming that the stone mostly lost its kinetic energy after formation of the crater, an approach used in the Lunokhod program for analysis of mechanical properties of lunar regolith [1] was applied for estimation of a load capacity of the regolith of Phobos. The load capacity of the upper regolith layer was estimated at minimal and maximal Phobos gravity if spherical stone is 10 m in diameter and its density is 1, 3 and 8 g/cm^3 (Fig. 3).

Discussion: Estimated values of load capacity of the Phobos regolith on the groove slope is similar to that of thin (1-2 cm) upper layer of lunar regolith (200-300 kg/m^2) and significantly less than the most typical values measured by Lunokhod 1, 2 (2000-3000 kg/m^2) [1]. The low strength of the regolith possibly is a result of low gravity that suppresses the regolith compacting. Relatively large estimated depth of the upper weak regolith layer on the Phobos groove slopes could be a result of regolith accumulation during large-scale moving across the regional slope. This suggestion is supported by evidences of regolith downslope movements on the groove slopes at the North Pole and at other regions of the Phobos [2, 3]. It could be concerned with probable old age of investigated area as well. Small craters of the Phobos with complex morphology indicate layered structure of the upper regolith with friable upper layer and more consolidated substitute layers [3]. Occurrence of meter-sized stones scattered on the Phobos terrains [2, 4] suggested that at places the upper layer of the soft regolith has small thickness and should be substituted by more consolidated material. Small fresh craters with remnants of low-velocity impactors exposed on the surface within and around the craters [2] show that on that areas the upper regolith is not thick enough to bury meter-sized stones. These facts indicate that a thickness of the upper regolith on the Phobos could be various in different regions in a wide range, probably from ≤0.5 to ≥5 m.

Conclusion: The object described above is a sample of the regolith excavation resulted from an interaction with a stone that was moved along the surface mostly under the action of Phobos gravitation. It allows to use the stone as an instrument for investigation of properties of the upper regolith layer on the slope of the groove. The obtained results indicate that the upper layer could be more friable than lunar regolith and to have a thickness about several meter. Some smooth Phobos terrains [4] could be covered by the same deep weak regolith. It could be a subject of attention for spacecraft landing, sensing and sampling units construction.

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References: [1] Cherkasov and Shvarev (1975) In *"Grunt Luny"*, Nauka Publishing, 49–52. [2] Shingareva T. and Kuzmin R. (2001) *Solar System Research*, 35, 431–443. [3] Basilevsky A. et al. (2014) *Planet. Space Sci.*, 102, 95–118. [4] Thomas P. et al. (2000) *J. Geophys. Res.*, 105, 15091–15106.

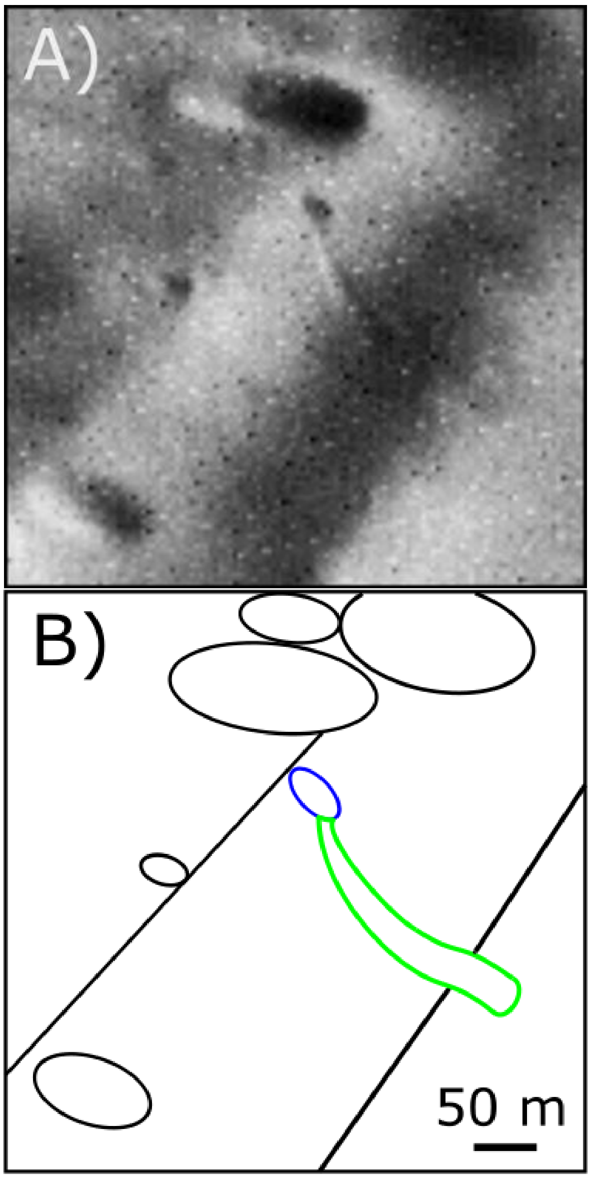

Fig. 1. a) A fragment of the MEX image h5851_0000.nd2; b) A scheme of the area covered by the Fig. 1a; the crater and trench are marked by blue and green colors.

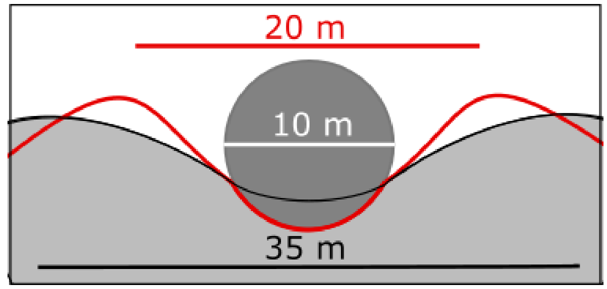

Fig. 2. Schematic cross-section of the trench; red line is a fresh trench, black line is a trench after modification of the trench rims. Numbers indicate the trench width and rolling stone diameter.

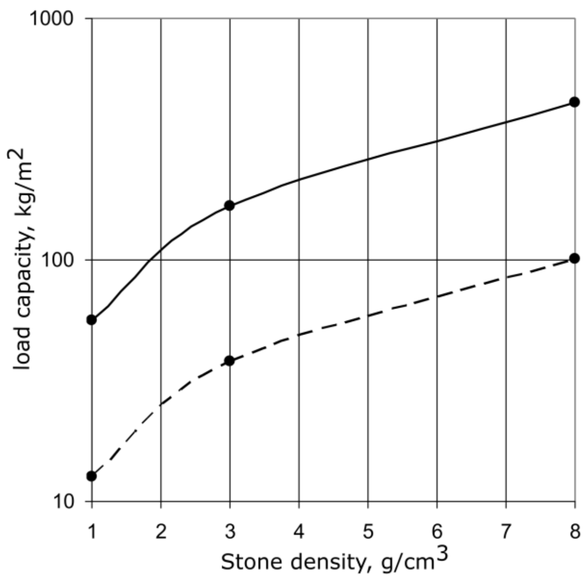

Fig. 3. The diagram showing calculated load capacity of the regolith depending on the density of the rolling stone (1 g/sm^3 – ice, 3 – stone; 8 – iron) at the lowest and highest values of Phobos gravitational acceleration (dash lines corresponds to 0.0019, solid line – 0.0084 m/s^2).