STRATIGRAPHY OF SPECIAL LAYERS – TRANSIENT ONES ON PERMEABLE ONES: EXAMPLES FROM EARTH AND MARS. Sz. Bérczi[1], A. Kereszturi[2], A. Horváth[3]; [1]Eötvös University, Dept. G. Physics, H-1117 Budapest, Pázmány P. s. 1/a. Hungary, [2]Eötvös University, Dept. Physical Geography, H-1117 Budapest, Pázmány P. s. 1/c. Hungary, [3]Budapest Planetárium, H-1476 Budapest Pf. 47, Hungary; . (berczisz ani@ludens.elte.hu)

Introduction: Although stratigraphy has been developed for strata of geological ages, its principles can be used for layers formed by short timescale events too. Aeolian transports and moreover, climatic seasons produce transient layers on the planetary surface with various time scale. We studied the stratigraphic behaviour of the dark dune material strata and the precipitated frost layers from the point of view of their interaction during defrosting. The dark layer was formed by winds and its surface pattern is dependent of its thickness. The frosted layer is interacting with the permanent (longer scale stable) but permeable lower dark dune layer. The transient frost cover may be a source of components to be invaded in the permanent layer. Contrary, evaporation may liberate some solid or liquid component residing in the soil. This way stratigraphy of the dark dune layer and its defrosting cover is a complex process.

The dark dune layers: Larger and smaller regions are covered with dark dune materials on Mars. They occure across the whole planetary surface but they get contact with the more transient frosted layers in the Polar Regions. Precipitation of frosts in autumn and winter [1], defrosting phenomenon in spring is observable well on dark layers because they give good background to appear when dark frosted regions lost their cover. There are excellent images made by the MGS MOC [2] and they were studied by our group. A selection of these images well demonstrates how the depth of the solid floor or the thickness of the dark dune layers determines the surface pattern of the dark units. Here we show 3 parts of the M07-02777 image.

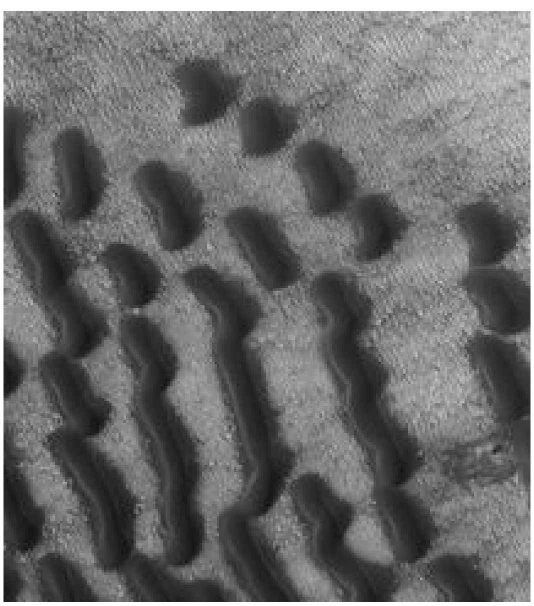

***Fig. 1.* At the edge of the dark dune layer it is fragmented into individual dune "biscuits".**

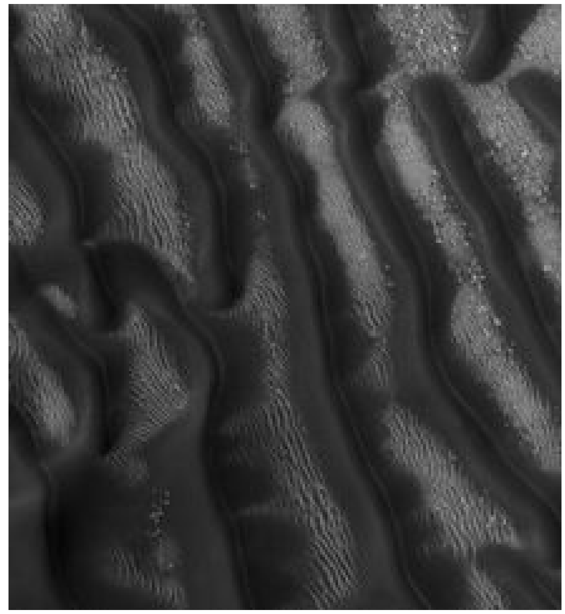

Fig. 2. In the thicker region dark dunes form interrupted dunefield, however, the floor of the crater can be seen between the dune ridges.

***Fig. 3.* In the thickest region (no lighter floor can be observed) cassette like surface pattern can be observed on the dark dune layer.**

So the sequence of the gradually thicker sections give the following patterns. At the edges the dark dune layer it is fragmented into individual dune "biscuits" (Fig. 1.). In the middle regions the dark dunes form interrupted dunefield, however, the floor of the crater can be seen between the dune edges (Fig. 2.). In the thickest region cassette like surface pattern can be observed on the dark dune layer (Fig. 3.). The overview of another more narrow unit shows all the sequence in one image (Fig. 4.).

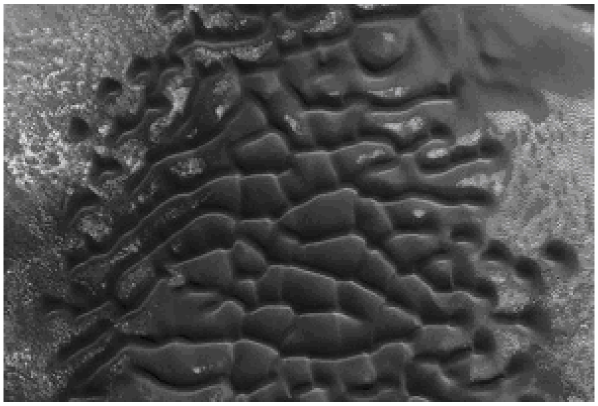

Fig. 4. An overview of an Inca City like region is visible on MOC M0702254 image.

Permeable dark dune soil: Permeable upper layers allow two ways of dissipation of the defrosting upper layer. In the defrosting process ices (clathrate) may partly migrating into the soil and may evaporate. Migration into the soil violates the positions according to Steno's stratigraphic principle in the local sequence. Not only frosted layers violates this principle in a short time scale because in a permeable layer there are possibilities of an opposite transport mechanism too. If soil contains brines in the pores and dries out, then some salts may crystallize from the vapourized brines and some part of the crystals may precipitate on the surface. Permeable layers on the surface violate this classical startigraphic principle.

Transport in the permeable layer: We suggest one possibility for gas phase transport in the permeable dark dune layer [3]. On Mars the surface atmospheric pressure varies annually around: 6.7-8.8 mbar (VL-1) and 7.5-9.7 mbar (VL-2); daily around 6.4-6.8 mbar (MPF). Because of the pressure changes subsurface gases expand and contract periodically inside pores that are in mechanical contact with the atmosphere. Generally inside sand dunes the porosity can be around 15-32 volume %, in uncemented case without substantial ice between grains. We suppose downward gas flow during increase of and upward flow during decrease of atmospheric pressure. For the computation of gas flow we used 1. ideal gas law, 2. constant temperature taken to be equal to the average surface, 3. characteristic pore diameter inside dunes of 10^{-4} m, 4. pressure gradient arise between top and bottom of sand dunes, 5. flow regime is viscous flow with Knudsen number=10^{-3}, 6. CO_2's viscosity of 0.0001 P, 7. upper mentioned pressure values. The results are visible in Table 1. for dune thickness of 100 m, porosity of 30 vol. %, GRD is for gas release depth, TGV for transported gas volume.

Table 1. Possibe parameters of supposed gas flow

Period of pressure decrease (Ls)	Pressure difference (bar) / expansion factor	Max. gas flow speed (m/s)	Max. GRD (m) / TGV below 1x1 m (m^3)
60°-160°	0.0015 / 1.14x	4.7×10^{-6}	12 / 4
280°-350°	0.001 / 1.1x	3.1×10^{-6}	9 / 3
Daily at 220°, 320°	0.0002 / 1.03x	6.3×10^{-7}	0.03 / 0.9

The critical part of the model is the free mechanical contact between interpore "dune gases" and the atmosphere through the top frost layer. Our model gives only possibility for transport in the permeable layer, and requires improvement in the future, above all regarding the structure of the top frost. The result of gas flow depends on local p/T condition and vapor content. We suggest this flow can take part in the volatile transport and produce surface markings only at locations of weakened or brocken off top frost. These location can be in connection with the formation of DDS's and the arms of spiders as gas travel paths. A highly hypothetic evolutionary scheme is visible in Fig. 5.

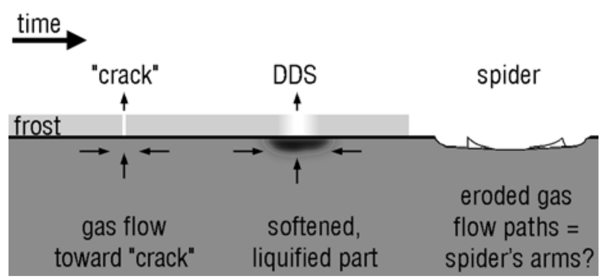

Fig. 5. Hypothetical evolutionary cheme of the contact between the transient (frosted) and the permeable (dark dune) layers.

Conclusion: In our transient and permeable (frost and dark dune) strata studies in the first approach model we gave a possible explanation for the seasonal changes in the contact surface between these two layers. However, there are models [4, 5, 6, 7] which suppose other components to explain the defrosting process on dark material dunes.

References: [1] Malin, M. C., Edgett, K. S., 2000, Frosting and defrosting of Martian polar dunes, *LPS* XXXI#1056. [2] http://www.msss.com/moc_gallery/. [3] A. Kereszturi (2003), „Breathing soils" of Mars as indicators of subsurface environment, Sixth International Conference on Mars, 3038, Pasadena. [4] 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. *LPS* XXXII#1543, Houston-CD. [5] Kieffer, H. H., 2003, Behavior of solid CO_2 on Mars: a real Zoo, 6th Int. Conf. on Mars, #3158. [6] Gánti, T., Horváth, A., Gesztesi, A., Bérczi, Sz., Szathmáry, E., 2003, DARK DUNE SPOTS: POSSIBLE BIOMARKERS ON MARS? *Origins of Life and Evolution of the Biosphere*, 33, 515-557. [7] http://www.martianspiders.com/, (2001), P. K. Ness, G. M. Orme, *J. Brit. Interplan. Soc.*, 55, 85 (2002).