LIQUID INTERFACIAL AND MELT-WATER IN THE UPPER SUB-SURFACE OF MARS.

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Abstract: Conditions for the, at least temporary, presence of nano- to micrometer sized layers of liquid interfacial water and melt-water in the upper martian surface are described. Interfacial water can evolve there, as on Earth, in "sub-zero temperaturel" soils in course of "premelting of ice" and due to attractive van der Waals interactions at ice-mineral interfaces [1]. The physical background, related models and possible also macroscopic physical and possibly also biological consequences are described.

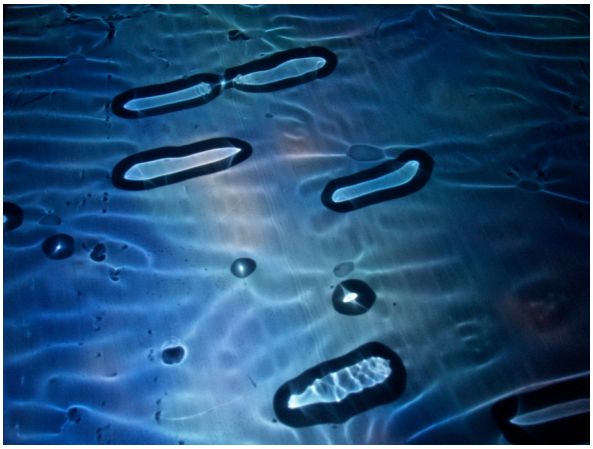
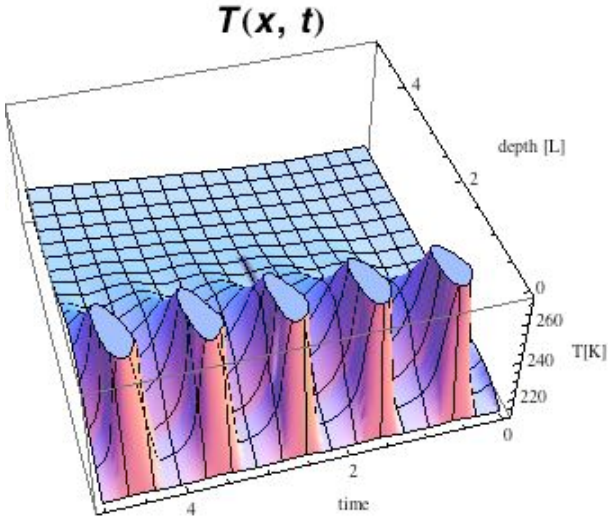


Image credit: Helmut Eigenmann
Illustration of liquid water-film covered particles in ice (no photo !).

Furthermore, as in cool regions on Earth, the solid-state greenhouse effect, can in course of diurnally and seasonally varying insolation (flow-in of solar energy [W m^{-2}]), give conditions in favor of temporary melting processes in upper sub-surface parts of snow/ice-packs on Mars at subzero sub-surface temperatures. The conditions for this possibly temporary melting are with different sub-surface energy absorption models quantitatively described for model parameters, which are typical for the thermo-physical conditions at snow/ice sites on the surface of present Mars. It is demonstrated by numerical modeling that conditions can result, which are in favor of a (possibly also repetitive) evolution towards cm- to dm-sized layers of liquid water in upper sub-surfaces of snow/ice-packs on Mars [2]. This liquid water can form in sufficient amounts to be relevant for macroscopic physical (rheology, erosion), chemical, and eventually also for biological processes. The conditions for the necessary preceding presence of snow/ice covered surfaces, and thus also for a temporary existence of liquid sub-surface water, are on present Mars "paradoxically" more favorable at sites in higher latitudes, since present deposits of snow/ice can mainly be found there. Possible rheologic and related erosion consequences of the appearance of liquid sub-surface water in martian snow/ice-packs are discussed in view of current observations of recent rheologic processes.
Seepages [3], gully-like rheologic phenomena, "white collars", e.g. are among the candidates to be modeled in trems of springtime sub-surface melting and related active processes on present Mars.



Example of a temperature field T(x,t), describing that the melting temperature (plateaus) can within a few sols be reached in the sub-surface of optically translucent ice at about 10 cm below the surface Depths are given in units of L = 11.4 cm. Time is given in sols. Heating can happen at a surface depth of and around 6.3 cm depth.

References:

[1] Möhlmann, D.T.F. (2009) *Cryobiology,* doi:10.1016/j.cryobiol.2009.01.004. [2] Möhlmann, D.T.F, (2009) *Icarus (submitted)* - Temporary liquid water in upper snow/ice sub-surfaces on Mars?. [3] Kereszturi, A. et al. (2009), Icarus, doi:10.1016/j.icarus.2009.01.014