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Evaporites on Ice: Experimental Assessment of Evaporites Formation on Antarctica (and on Martian North Polar Residual Cap)

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Evaporites are highly water soluble minerals, formed as a result of the evaporation or freezing of bodies of water. They are common weathering minerals found on rocks (including meteorites) on Antarctic ice sheet [1,2,3,4]. The water necessary for the reaction is produced by melting of ice below the dark-colored meteorites which can heat up to a few degrees above 0 °C due to insolation heating during wind-free summer days [5,6].

The Martian North Polar Residual Cap is surrounded by a young [7] dune field that is rich in evaporitic mineral: gypsum [8]. Its existence implies that relatively recently in the Martian history (in late Amazonian, when surface conditions were comparable to the current ones) there was a significant amount of liquid water present on the Mars surface. One of the proposed solutions to this problem is that gypsum is formed by weathering on/in ice [9,10,11,12,13], similarly to the process occurring on the Antarctic ice sheet.

Recently, Losiak et al. 2015 showed that that during the warmest days of the Martian summer, solar irradiation may be sufficient to melt pure water ice located below a layer of dark dust particles lying on the steepest sections of the equator-facing slopes of the spiral troughs within Martian NPRC. Under the current irradiation conditions, melting is possible in very restricted areas of the NPRC and it lasts for up to couple of hours, but during the times of high irradiance at the north pole [15] this process could have been much more pronounced.

Liquid water can be metastable at the NPRC because the pressure during the summer season is ∼760-650 Pa [16] which is above the triple point of water. The rate of free-surface “clean” liquid water evaporation under average Martian conditions determined experimentally by [17] is comparable to the rate of melting determined by [21] (if there is no wind at the surface).

In the current study we attempt to determine experimentally how many melting-freezing cycles are required to form detectable (X-Ray Diffraction and SEM-EDS) amounts of evaporites on basaltic dust and slabs under simulated Antarctic conditions. In the future a similar experiment in simulated Martian conditions will be performed.

References:

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