Becquerel Crater deposit on Mars, a case of namakier diapirism? C. Popa[1,2,3], F. Esposito[1], L. Colangeli[1], [1]Capodimonte Astronomic Observatory, Naples, Italy (Salita Moiariello 16, 80131, Napoli), author's email: ciprian.popa@na.astro.it, [2]IRSPS (Pescara, Italy), [3]Department of Geology, Univ. "Al. I. Cuza" Iasi, Romania

Introduction: Becquerel crater (figure 1) is an ~ 170 km diameter, situated in western Arabia Terra and is centered 20°N and 352°E, with a depth of ~ - 3.6 km below MOLA datum, situated in a region dominated by Hesperian ridged plains material [1]. Its most distinguishable feature is the light-toned layered deposit on the southern part of its floor. Several impact craters along the dichotomy boundary contain similar deposits [2], to which a variety of interpretations for their emplacement have been proposed, generally assigning a common depositional origin. Among many ideas, the most cited one seem to place them as possible lacustrine deposits.

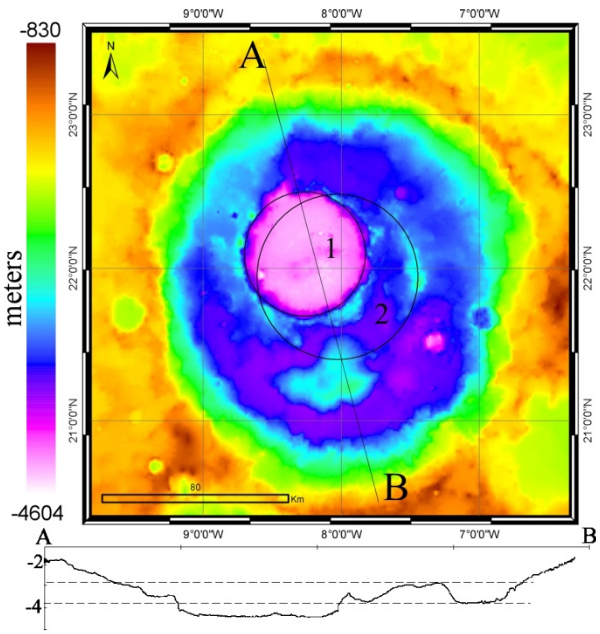

__Figure 1__ MOLA topography of Becquerel crater shows the traces of a second eroded crater (2) that controls the northern advancement of the namakier. This has been overcome either by a vertical growth, up to a threshold that overcome the rim, either by a breech through the rim.

Morphology and topography: The Becquerel deposit appears as geologically young one (crater counting), having an amoeba like shape with at least four distinguishable lobes (figure 2). The lobes diverge asymmetrically (E-W) from a central depression, constituted by a tectonically collapsed mélange. It raises about 800 meters from the floor of the main crater, with a 52x32 (N-S x E-W) km as its maxim spread. Each lobe recalls the plastic flow of a namakier under a brittle carapace [3]. The deposit N-S asymmetry is possibly controlled by the topography, constituted by the rim of the second internal crater (figure 1), giving it a younger relative age. The central depression resembles at large scale the mélange chimneys described in [3] with its biggest example representing an ~ 200m tall erosion remnant. At small scale, the deposit is layered with layers exposed in a stair-step like fashion, recalling Gale and Nicholson similar deposits. This layering is most obvious in the north eastern part of the deposit, and at the interface of the lobes. The southern lobes are yardangs like eroded following a general N-S pattern, though radial trend that follows the topography can be identified in the SE part, suggesting a gravity induced type of erosion.

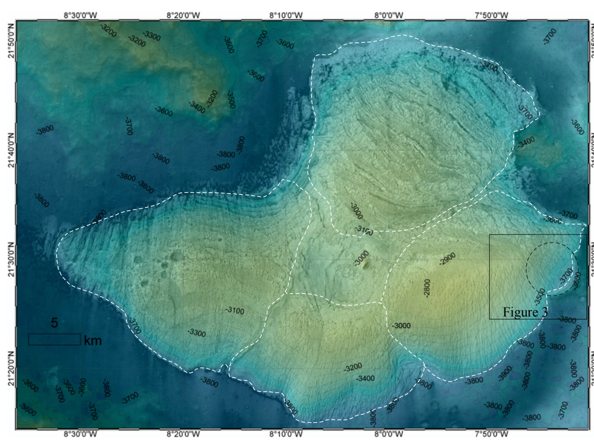

__Figure 2__ Detail of the tetralobate deposit in Becquerel crater. HRSC orbit 3231 image superimposed on a HRSC stereo derived color coded DEM. The four lobes are disposed radial from the center which is topographically lower, probably tectonically collapsed probably due to the depletion in source material and the passive falling stage of diapirism [6].

Evidence for movement: The best case for a namakier, combined with mineralogy, is the evidence of its movement. Similar salt glaciers on earth [4] have been reported to have a plastic flow heavily dependent on the water content (rainy seasons), whilst the dry periods when deform like elastic solids. Two images separated 30 years in time (figure 3) where studied for evidence of movement. There is no traceable evidence for movement during this period, calling as expected for an extreme dryness, but there is a clear proof that this occurred during the past geologic time. A small ~

5 km crater in the south eastern part of the deposit has been engulfed by the material that could have flown plastically in the SE direction with an unknown rate. This puts the limit of the deposit at least 4.5 km further to the NW at the moment of impact, if the flow was radial. This fact excludes the emplacement in a horizontal way of the sediments, pleading against the lacustrine or any other flat lying type of deposition.

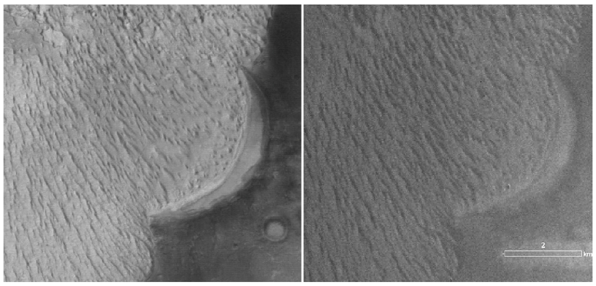

Figure 3 *(left) HRSC orbit 3231 image taken in 2006 and a 30 years old Viking image (F407B95) of the same area (right). There is no detectable advancement during the last 30 years separating the measurements (the position of the area is indicated in figure 2). We keep as indirect evidence for movement the infilling of the underneath crater.*

Mineralogy: The OMEGA C channel data covering the area fails to identify any characteristic absorption for water derived minerals. Although there are local and/or singular spectra that present small 2 µm that might account for water crystalline inclusions in halite, this may also account for atmospheric residual from CO_2 main atmospheric feature using "Mons Olympus" top-bottom ratio as atmospheric remove reduction of the data, hence not a proof for its existence.

Discussion: Cratering is by far one of the most intensive morphologic activities that occurred and occurs on Martian surface that has considerably contributed to the shaping of its crust. This is in fact a very efficient thinning process that can bring a possible non piercing situation of diapirism to step over the threshold imposed by the limit from which a salt, or any other fluidized material under fluidizing conditions, can start its upraise when the overburden has less than the empiric 1/3 of the weight of the overburden load [5]. This can also relate the size of the crater to the presence of the deposit. In a right stratigraphic sequence (figure 4 A) an impactor can trigger the requirements that such a process needs, and can lead to the sequence depicted in figure 4 (B, C, D). The presumed stratigraphic stack equilibrium is disturbed by the meteorite impactor that create the condition ideal for upraise of the material from a source layer. The final present stage is depicted in figure 5.

Conclusion: Although many issues must be solved yet, we keep this working hypothesis as the best fit for the observed data. The evidences so far are quite strong toward concluding favorably to namakier sedimentary glacier (possibly salt). This would in turn generate a more complex stratigraphic sequence for the area, or at least one major resurfacing event, with a hidden, possible evaporitic, basin under the Hesperian age material, that covers the western part of Arabia Terra. This could possibly be the layer source for other similar deposits in craters with same mechanisms of formation (e.g. Trouvelot). This also could be a time marker (the advancing limit) for the transition from a relatively water rich environment to the today's dry Mars.

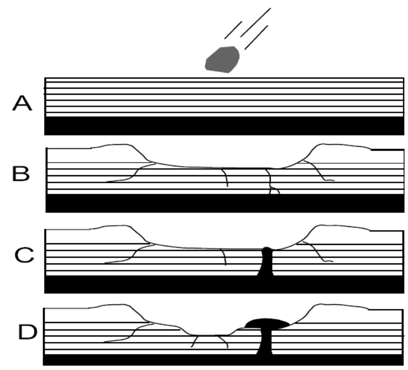

Figure 4 *Proposed reconstruction the evolution of the area, in terms of event succession. The figure is for the concept depiction. The vertical scale is by no means representative for this particular process.*

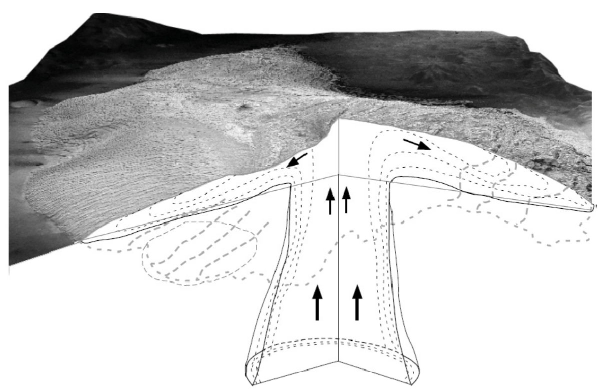

Figure 5 *A likely internal structure of the Becquerel deposit.*

References: [1] Greeley R. and Guest J. (1987), USGS map I-1802B. [2] Malin, M.C. and Edgett K.S. (2000). Science 290, 1927-1937. [3] Talbot (1998) Geological Society London Special Publications 143, 315-334. [4] Talbot (1980) Science, 208, 395-397 [5] Vendeville B.C. and Jackson M.P. (1992), Marine and Petroleum Geology, 9, 331-353. [6] Vendeville B.C. and Jackson M.P. (1992), Marine and Petroleum Geology, 9, 354-371.