PREBIOTIC CHEMICAL EVOLUTION ON AN EARLY MARS: ***CONSEQUENCES & ARTIFACTS OF "ORGANIC" WEATHER CYCLES IN THE NOACHIAN*** ***L. Lerman, Pteranodon Ventures (2601 S. Pavillion Center Dr. Suite 1140 Las Vegas, N.V. 89135 Bubbles@DNAi.com)***

Introduction: This is a first attempt to build a 'universal' theory of life's (potential) origin on a warmer, wetter younger Mars. The universalities of chemical physics provide intimate details of the hydrology and weather cycles of Mars' past; offering critical insight into whether life could have arisen on Mars in the first place through the process of chemical evolution. Requiring only liquid water and simple amphiphiles local 'organic weather cycles' inevitably form when the Rayleigh-Taylor instability in water is metastabilized by simple organic compounds. These lead to a complex set of mutually transforming phase transitions fundamental to Lerman's theory of chemical evolution [1–5] utilizing the organizing properties of the air-water interface and its microenvironments - bubbles, aerosols, and droplets (Figure 1). Early Martian weather cycles would thus provide functional support for an independent "origin" of Martian life through organic chemical self-organization.

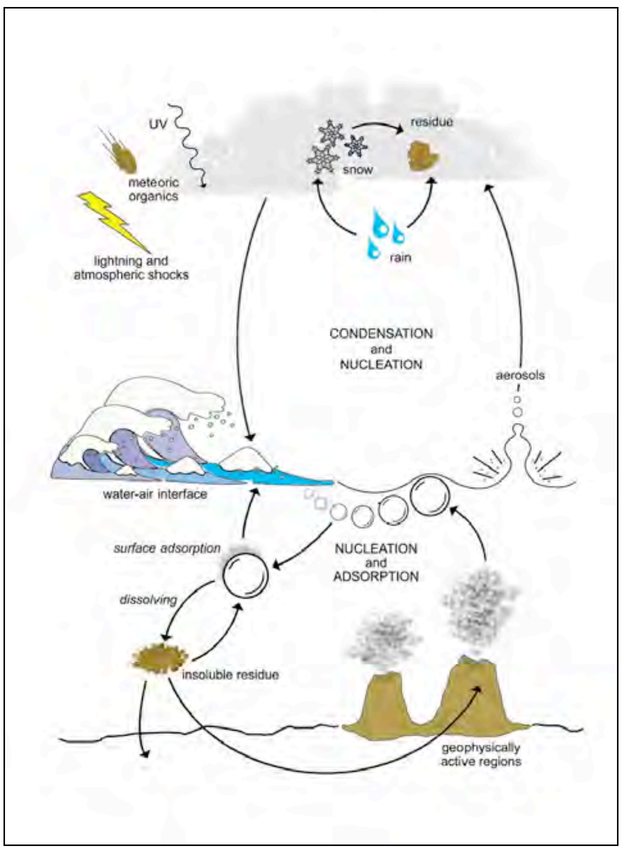

Figure 1: ***Early Archaean Hydrology Cycle — Was this also an Early Noachian Weather Cycle?***

A significant subset of these cycles (weather and the subsequent organic self-organization) is likely even if surface waters were only short-lived lakes and intermittent turbulent flows. Since the essential chemical physics occurs at the water's edge (an interface) it matters little if the water was three miles deep or three inches. One possible consequence is that Martian blueberries nucleated around organic matter, similar to their closest terrestrial analog, concretions. Also on Mars, artifacts of these prebiotic processes could mimic fossilized evidence of "life", providing abiotic origins for ALH8401-like "nanobacteria"; yet simultaneously preserving evidence of past conditions and processes capable of supporting the functional requirements of chemical evolution.

Motivation: It must be recognized that *the conditions suitable for life's habitability are not necessarily those needed for its origin.* This is the issue dealt with in this paper: *Could primordial organic molecules on an early Mars have come together to bring about the forms and functions of the earliest life forms?* We will strongly answer this question in the affirmative.

Methodology: Prebiotic chemical evolution presupposes successive generations of increasingly complex organic molecules combinatorially synthesized from previous generations. Just as the biochemistry of contemporary organisms can be viewed as a 'fossil' record of biogenesis, so the geochemical physics of the contemporary Earth and Mars is an indicator of the self-organizing dynamic processes underlying prebiotic chemistry. On the Earth, the key element appears to be the existence of an air-water interface at a variety of physical scales, coupled to the integrated stages of the had-to-have been hydrology cycles outlined in Figure 1. Also due to the universality of chemical physics, the geophysical and geochemical processes likely to have supported terrestrial chemical evolution are equally likely to have occurred on an earlier warmer wetter Mars and throughout any subsequent Martian hydrological episodes.

Remarkably, this complex supercycle is a process that requires *only* the disturbance of a water-air interface metastabilized by simple amphiphillic compounds (from carbonaceous chondrites, for example, or comets). The rest follows from the fundamentals of chemical physics, being relatively independent of specific chemistry. Specifically, bubble formation is a physico-chemical process due to the Rayleigh-Taylor instability its initiation requiring only the existence of an air-water interface disrupted by mechanical turbulent energy (from waves, meteorites, or geophysically active regions). Hence it is impossible to imagine something similar not being active in both the early Archaean and a wet Noachian. And because these processes are at the molecular level, and are independent of planetary-scale phenomena or specific details of local chemistry, they are expected to be primary ones for any terrestrial-like planet with water, organics, and heavy metals.

Do Martian Blueberries have Pits? Consequences & Artifacts of "Organic" Weather Cycles: One of the more intriguing ideas coming from this work is the possibility, even *likelihood*, that the Martian blueberries discovered by Spirit and Opportunity are nucleated around organic matter or otherwise mediated by organic rich fluids. From their initial discovery, Martian blueberries were linked to terrestrial concretions as their most likely analog; with the strong implication that they were similarly a result of Martian sedimentary processes. If Martian blueberries are concretion-like objects, then their ubiquity suggests highly efficient formation processes. On Earth, by far the most efficient of such processes (for ooids to larger concretions of many feet diameter) involve organic nucleation sites or organic coatings of mineral cores accompanied by intermittently agitated water. On Earth many of these organic nucleation sites are of biogenic origin. But organic is all that is actually "necessary". Lerman [6–8] suggested that this mechanism was also likely for Mars, due to organic complexes likely to have been made on Mars by the bubble-aerosol-droplet cycle described in this paper. The potentially crucial role of an abiotic organic component (as opposed to a biological) is highlighted when looking at the terrestrial hematite concretions considered closest to the Martian blueberries were first described by Chan and Beitler [9]. A close examination of their paper on the geological analogues between Martian blueberries and hematite concretions in Utah shows that a hydrocarbon-rich fluid component was the likely mediator for their concretions' formation due to groundwater flow through a permeable host rock coupled to a chemical reaction front.

Hence, it seems likely that the Martian blueberries offer not just evidence of sedimentary processes in a water-rich environment; but are likely transducers to the existence of a complex past 'organic' weather cycles which led to the creation of higher-order organics and their aggregates. And as discussed above, these same processes of molecular self-organization seem capable of supporting the essential functional requirements for a planetary-scale chemical evolution which can conceivably have led to the autonomous creation of Martian life.

Martian "Nanobacteria": Abiotic Artifacts of Early Martian Organic Weather Cycles? Another potentially natural consequence of the terrestrial bubble-aerosol (bubblesol) supercycle are objects which when dried appear fascinatingly akin to the so-named 'nanobacteria' of ALH 84001 [10–12]. These congruent properties include the basic morphology (spheres and sausages), gross chemistry (suites of organics along with metals), and size distributions (nanometers to microns). Whether of biological or bubblesol origin, these striking similarities are due to the universality of the chemical physics involved in the interactions of charge-polarized organic amphiphiles at an air-water interface, coupled to the ubiquity of such scalable macroscopic physical phenomena as the Rayleigh-Taylor instability. The basic morphology and size distributions come from surface tension effects which dominate structure at the micron level while the gross chemistry comes from the concentration effects of the air-water interface for organics, metal ions, and mineral dust. It is critical that these congruences be taken into account when designing and interpreting Mars missions looking for evidence of life in Martian paleosols, or when interpreting Martian meteoritic matter akin to the microscopic structures found in ALH84001.

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