**PREBIOTIC CHEMICAL EVOLUTION ON AN EARLY MARS: CONSEQUENCES & ARTIFACTS OF “ORGANIC” WEATHER CYCLES IN THE NOACHIAN**  
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**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 (from carbonaceous chondrites or comets) local ‘organic' weather cycles inevitably form when the Rayleigh-Taylor instability in water is metastabilized by simple organic compounds. The Rayleigh-Taylor instability itself requires only the existence of an air-water interface disrupted by turbulent mechanical energy from waves, meteorites, or geophysically active regions.

These lead to a complex set of mutually transforming phase transitions fundamental to Lerman's theory of chemical evolution [1–8] utilizing the organizing properties of the air-water interface and its microenvironments – bubbles, aerosols, and droplets. Early Martian weather cycles could have functionally supported an independent "origin" of Martian life through organic chemical self-organization.

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. Artifacts of these prebiotic processes might also mimic fossilized evidence of "life", providing abiotic origins for ALH8401-like "nanobacteria"; 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.

**Figure 1: Early Archaean Hydrology Cycle — Was this also a Noachian ‘Organic’ Weather Cycle?**