**ABSTRACT**

**Planets, Minerals and Life’s Origin**

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Four paradoxes stand astride any effort to understand how

life originated on Earth:

(a) The Tar Paradox. Organic molecules, given energy and

left to themselves, devolve into complex mixtures, “asphalts”

better suited for paving roads than supporting Darwinian

evolution. Any scenario for origins requires a way to allow

organic material to escape this devolution into a Darwinian

existence, where replication with imperfections, where the

imperfections are themselves heritable, allows natural

selection to avoid a tarry fate.

(b) The Water Paradox: Water is commonly believed to be

essential for life. So are biopolymers, like RNA, DNA, and

proteins. However, the biopolymers that we know find water

corrosive. Any scenario for origins must manage the apparent

need of life for a substance (water) this is inherently toxic to

life.

(c) The Single Biopolymer Paradox. Even if we can make

biopolymers prebioically, it is hard to imaging making two or

three (DNA, RNA, proteins) at the same time. At the same

time, genetics versus catalysis place different demands on the

behavior of a single biopolymer intended to support life.

Catalytic biopolymers should fold, for example, while genetic

biopolymers should not fold. Catalytic biopolymers should

contain many building blocks; genetic biopolymers should

contain few.

(d) The Probability Paradox. Some biopolymers, like

RNA, strike a reasonable compromise between the needs of

genetics and the needs of catalysis. However, emerging data

suggests that RNA is more likely to deliver catalytic power

that destroys RNA than catalytic power that makes RNA.

This talk will review experimental data that makes

suggestions about early planetary environments and

mineralogy that might avoid, mitigate, and possibly resolve

certain of these paradoxes. Key are the presence of minerals,

including borates and molybdates, that interact with organic

species that are intermediates between atmospheric carbon

dioxide and dinitrogen and RNA. Productive interaction

requires as well a subaerial environment having only

intermittent interaction with water. Recent data suggests that

such environments might even be found today on Mars.