“It is now more difficult to propose a sterile Mars than a live one”

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Some 35 recent scientific papers lend support to the possibility of life on Mars. Many also address the likelihood of transfer of microorganisms from one planet to another by meteoric impact. Extremophiles have been found that could survive. The author presents a model of Panspermia consistent with these findings, depicting each of the steps necessary to infect Mars with terrestrial organisms. Examination of the papers cited strengthens each link in the proposed chain of life bringing Mars within our biosphere. This evidence that terrestrial microorganisms could migrate to Mars and survive demonstrates the likelihood that life, from Earth or other sources, exists on Mars today. It is now more difficult to propose a sterile Mars than a live one.

Evidence refuting the traditionally cited key arguments against a biological interpretation of the 1976 Viking Labeled Release (LR) life detection experiment on Mars is given, including a first-time demonstration of liquid water under Martian conditions. Together with herein newly revealed evidence virtually precluding a highly oxidizing surface on Mars, these new findings add impetus to the increasing acceptance of microorganisms as the source of the Viking LR positive response. In response to requests from scientists showing new interest in the Viking LR results, NASA will soon launch and maintain a web site to host all of the LR data to permit new types of analyses.

As a possible means for settling the issue of extant life on Mars, a miniaturized LR experiment, modified to distinguish between chemical and biological reactions, is proposed for the next Mars lander. It is based on the widely accepted fact that chemical reactants do not distinguish between the stereoisomers of a given optically active amino acid or carbohydrate, while all known forms of life do. L- and D- isomers of $^{14}$C-labeled amino acids and carbohydrates would be separately added to duplicate samples of Martian soil. A preferential response to one isomer over the other would constitute unambiguous evidence for life. Preferences for L-amino acids and D-carbohydrates would indicate a similarity for Martian and terrestrial life forms, while the opposite set of preferences would indicate independent origins of the two biological systems.
Microorganisms in debris ejected by meteor impact on Earth survive shock and atmospheric heating, and are immediately freeze-dried by space environment. Organisms at UV- and ionizing radiation-protected depth survive. Some debris is captured by Mars’ gravity, heats and ablates entering atmosphere, but interior microorganisms survive. They survive impact that distributes them over wide area. Finding environment favorable, they establish habitat and invade Mars, as could organisms from other sources.
The Viking Labeled Release Life Detection Experiment

That Detected Life on Mars in 1976

Active Experiment

Identical Soil Samples

Control Experiment

Heat Sterilization 160°C for 3 hours, intended to kill bacteria but not to affect soil chemistry

LR Test

Active test is positive

Control test is negative

LR Test

Mars and Terrestrial LR Soil Tests Show Metabolism

Mars Results Not “Too Much, Too Soon,” Compared to Earth Results

Note: LR monitored continuously on Mars, terrestrial tests only where points indicate.
Theories Put Forth to Refute Mars LR Evidence for Life

Oxidant Theories
1. Hydrogen peroxide formed in atmosphere
2. Hydrogen peroxide formed on rocks
3. Hydrogen peroxide catalyzed by gamma iron
4. Hydrogen peroxide formed on titanium dioxide
5. Potassium dioxide in soil
6. Zinc dioxide in soil
7. Manganese dioxide in soil
8. Oxygen plasma
9. Superoxides in soil
10. Peroxynitrate in soil
11. Polymeric suboxides in soil
12. Iron VI production of oxygen radicals

Other Theories
13. No liquid water on surface of Mars
14. LR response was “Too much too soon”
15. No organics found in Mars soil
16. UV irradiation destroys organics and life
17. Ionizing radiation activates minerals to react with LR nutrient
18. Ionizing radiation on oxygen-rich minerals produces disjunctions
19. Carbon dioxide trapped in micropores of soil
20. Activated halides in soil
21. Mineral catalysis of LR medium
22. Mineral catalysis of formate
23. Heat of solution from nutrient wetting desiccated minerals
24. Iron III decarbonylation of lactate
25. Smectite clays
26. Palagonite clays
27. Limonite clay
28. Statistical improbability of independent origin of life

None has Adequately Explained or Reproduced the Mars LR Data

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SIPHERIX
Demonstration that Liquid Water Forms on the Surface of Mars Supports Life Possibility

Frost on Mars (remained for about 100 Martian days)

Mars in a Jar: Liquid Water from Frost on Rock

Courtesy of D. Gan and L. Kuznetz, U. Cal., Berkeley
Be Where the Oxides of Mars? Death of a Fable

BREAKING NEWS!

All Oxidant Theories Bite the Dust in the Viking Magnetic Properties Experiment

Reference test chart magnet image for VL-1 on sol 31.

Reference test chart magnet image for VL-2 on sol 42.

In newly examining the Viking data, the author found strong evidence, apparently long overlooked, against a highly oxidizing surface on Mars. Providing rationale for his magnetic properties experiment on Viking, Robert Hargraves said, “...if there is a lot of material adhering to the magnet, it would certainly say that whatever the surface processes are on Mars, they are not innately highly oxidizing.” After analyzing his Viking results, Hargraves reported, “...the loose Martian surface material contains 1 to 7% highly magnetic mineral.” The magnets picked up layers of 2 to 4 mm of material (see above) including “highly magnetic, unoxidized mineral grains.” This large amount of magnetic material precludes all oxidant theories.

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“Organic Matter in SNC Meteorites: Is it Time to Re-Evaluate the Viking Biology Data?”

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EXCERPTS

“The two Viking landers, which set down on Mars in 1976 have been the only craft to date to carry experiments designed for the direct search for microorganisms. The Labeled Release Experiment (LR) results with respect to life forms were positive based on criteria established before launch. However, largely in light of the failure of a fourth instrument, a mass spectrometer-gas chromatograph (GC-MS), to detect organic matter, the LR responses were later interpreted to have been produced by inorganic chemical oxidants presumed to exist in the Martian regolith.

More recently, evidence has begun to grow supporting the possibility that the Viking GC-MS would not have detected certain carboxylate salts that could have been present as metastable oxidation products of high molecular weight organic species. Additionally, despite the instrument’s high sensitivity, the possibility had remained that very low levels of organic matter, below the instrument’s detection limit, could have been present. Such low levels of organic matter would not be inconsistent with the presence of very low levels of microorganisms.

Since the strength of the GC-MS findings was considered enough to dismiss the biology packet, particularly the LR results, any subsequent evidence suggesting that organic molecules may in fact be present on the Martian surface necessitates a re-evaluation of the Viking LR data.

Given this perspective on organic material, a biological interpretation of the Viking LR results can no longer be ruled out.

Since the time of Viking, studies have been carried out with the objective of determining an oxidant, or combination of oxidants, that might exist on Mars and have produced the observed kinetics of the LR response. To date, no such agent has been found that produces all aspects of the LR results on Mars ... it is concluded that inorganic and biological explanations for the Viking LR data should now be considered equally plausible.”
A New Experiment Could Unambiguously Resolve the Life on Mars Issue

Chiral LR Experiment

Identical Soil Samples

Biologically Used Compounds

- L-Amino Acids and L-Sugars
  - L-Cysteine
  - D-Glucose

This test is Positive using Earth soils

LR Test

Mirror Image Compounds

- D-Amino Acids and L-Sugars
  - D-Cysteine
  - L-Glucose

This test is Negative using Earth soils

LR Test

A Chiral Preference Demonstrates Life

Chiral LR Probe

Length = 6 inches

Note: Pre-sterilized canister contains multiple probes that are ejected away from spacecraft after landing.
All Links in the Vital Chain Connecting Mars and Earth Are Now Established

1. Microorganisms are widely distributed on Earth.
2. Meteorites impacting Earth eject soil and rocks into space.
3. Microorganisms in the ejecta can survive the shock and temperature of impact.
4. Microorganisms in ejecta can survive heating through Earth’s atmosphere.
5. Microbes can survive the temperature and vacuum of the space environment.
6. Microorganisms can survive the ionizing radiation of space.
7. Mars-infecting ejectus can approach Mars and be captured in its gravity well.
8. Microbes can survive the temperature of entering the Martian atmosphere.
9. Microbes can survive the shock and temperature of impact on Mars.
10. Terrestrial microorganisms can grow under Martian conditions.
11. Microorganisms are capable of adapting to or evolving to spread over wide regions of Mars.
12. Earth and Mars were hospitable over epochs that would have permitted infection of Mars by Earth microorganisms—and from other sources.

Biology offers the only fit to the LR Mars data and is consistent with our new knowledge about Mars and Earth.

*It is time to accept the LR Results.*

*It is now more difficult to propose a sterile Mars than a live one.*

**Earth and Mars are part of the same biosphere.**

See <www.spherix.com/Mars>
Impetus For A Changing Mindset


GCMS could not have detected bacteria even if several million cells per gram were in Martian soil, D. Glavin et al., Earth and Planetary Sciences, 185, 1-5, 2001.


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Discoveries about life on Earth inspire Beagle 2, F. Westall et al., Planetary and Space Science, 48, 181-202, 2000, reported in sci.esa.int, 12/15/00.


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“Living organisms could emigrate through the solar system ... launch, space transit and re-entry are not too harsh” B. Weiss et al., *Science*, 290, 791-795, 10/27/00.

Microbes grow at South Pole (with access to liquid water similar to that on Mars), withstand extreme dryness and large doses of radiation, E. Carpenter et al., *Applied and Environmental Microbiol.*, 66, 10, 4514-4517, 10/00.


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Bacteria on rifle bullet survived impact of 100,000 g, yeast survived 70,000 g, thus could survive impact of planetary transfer, C-A Roten, *Founding Convention of the Mars Society*, U. Colorado, Boulder, CO, 8/16/98.


Possible Evolution of the Solar System’s Genome

- Bacteria evolve somewhere in the Milky Way
- Super Novas propel rock debris containing bacteria
- Bacteria freeze dry preserving them for journey in space
- Earth and Mars form and are instantly infected by space faring bacteria
- Man could evolve to 100,000 genes before the sun becomes a red giant

- Earth life has up to 30,000 genes (Man)
- Martian life may be stuck at 3,000 genes
- Algae and Yeast
- C. eligens (worm)