WILL CURIOSITY CONFIRM THE 1976 EVIDENCE FOR LIFE ON MARS?

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Just seven months into its two-year mission, Curiosity has achieved its primary goal. It's chief scientist, John Grotzinger, said "Strong evidence for past habitability has been found." (quoted by Nola Taylor Redd, SPACE.com Contributor, March 18, 2013).

This author, however, contends the MSL has several experiments that might go beyond this limited goal and confirm the possibility that the 1976 Viking Labeled Release (LR) experiment discovered microbial life on Mars.

The LR was essentially one of the microbial analyses in the Standard Methods for the Examination of Water and Wastewater in use by public health departments worldwide. In the test selected, an aqueous solution of lactose is inoculated with the sample suspected of microbial contamination. The visual observation of bubbles is the evidence of living microorganisms that have consumed lactose. The LR adds several additional organic nutrients, all Miller-Urey products. These compounds are thought to have formed on early Earth. Some are believed to have participated in the genesis and evolution of life. Each is metabolized by a wide range of microbial species. Miller-Urey products are also likely to have formed on Mars.

To increase the sensitivity and rapidity of the method, against possible spacecraft or communication failure, the nutrients were uniformly tagged with ^{14}C. Any gas produced from any nutrient would be radioactive, permitting detection long before visible bubbles form. Thus, the LR is a Standard Method, merely augmenting the nutrients and substituting the form of read-out. But the LR goes one step further. It introduces the concept of controls against the possibility that some exotic chemical on Mars might trigger a false positive.

Viking 1 landed on Mars July 20, 1976. Viking 2 landed, 4,000 miles away, September 3. A total of four LR tests for life was made. All were positive. Duplicate samples of these were heated to temperatures to distinguish chemical from biological responses and then re-tested. A total of five control runs were made. All supported the positive results. The amplitudes and kinetics on Mars were virtually the same as produced by several soils in the thousands of tests on Earth – which tests had never produced a false result.

Nonetheless, the LR Mars results were largely discounted. The principal reason initially given was the failure of the Viking organic analysis instrument (GCMS) to find any organic matter. Two additional barriers to life were soon cited: the presumed presence of a highly oxidizing, organic-destroying, lethal substance in the Martian soil, and the presumed lack of liquid water.

Several publications have effectively impugned the results of the GCMS. Moreover, the Viking Pyrolytic Release (PR) experiment showed organic compounds forming and accumulating on Mars today. On Earth, this experiment had produced organic matter when its simulated sunlight

shone on its simulated Martian atmosphere, even under sterile conditions. To prevent such a false positive on Mars, an optical filter was inserted to remove the offending UV spectrum. Nonetheless, some organic compounds still appeared in the terrestrial PR tests. On Mars, the PR did produce positive results, but only in amounts corresponding to the sterile runs on Earth, high enough to demonstrate the formation of simple organics, but too little to allow a claim to life.

Curiosity has reported finding several organics, but not complex enough to support the claim to life. However, Curiosity has not yet reported on results from its liquid extraction method for detecting complex organics. Since the finding of such compounds by the Viking GCMS would have led to instant acceptance of the LR results in 1976, it might seem only logical that, should Curiosity find them now, the same conclusion should result.

The Mariner 9 IRIS experiment that orbited Mars in 1971, several subsequent Earth-based spectroscopic observations, and more recent results from soils analyzed by Pathfinder and Phoenix, have further demonstrated the absence of any strong oxidant dominating the Martian soil. Now Curiosity also confirms that the soil of Mars is not highly oxidizing: "The chemical analysis of the sample also revealed compounds in varying states of oxidation – for example both sulfate and sulfide. *This is significant because it demonstrates that the environment was not violently oxidizing* (emphasis added)."

At the Viking 2 landing site, as the sun rose, the correspondingly rising soil temperature paused at 273K for ten minutes: a "fingerprint" of ice absorbing the heat of fusion in becoming liquid water. Figure 1, Curiosity's thermal analysis of the 4th John Klein rock sample, shows water vapor evolving from the sample when heated to only a few degrees above 0 deg. C. This water vapor could have come only from liquid water. Hydrated minerals would not yield water vapor at those low temperatures. That the water vapor was not merely taken in as atmospheric vapor in the sampling process is shown by the fact that CO_2 which would have been taken in similarly, "did not appear until the sample was heated to approximately 90 deg. C."

Some experiments have applied known chemistry showing that a variety of oxidants can react with one or more LR nutrient to evolve gas. However, no chemical, including the recently proposed perchlorates, has duplicated the Viking LR control data. None of the proposers of abiotic explanations of the Mars LR results has addressed all of the control data, especially the one most difficult to explain – how the soil lost all activity after storage for two months in a dark box at the modest temperature of 10 deg. C, a temperature frequently reached on the Martian surface. This result more likely indicates death of organisms isolated from their environment, rather than the decay of any conceivable strong chemical oxidant.

Yet, these failures to duplicate the Viking LR results are not offered as the proof of the LR claim to life. No such "proof by elimination" is asserted. The claimed proof is the hard positive data of the Viking LR, replicated at two Martian sites, and confirmed by its range of controls. These data are supported by, or are consistent with, virtually every new finding about the habitability of Mars, and by the astonishing number of extremeophiles being found in the most Mars-like environments on Earth.

So, in summary, we have 1. Positive results from a test universally accepted on Earth; 2. Negative responses from a range of strong controls; 3. The absence of any scientifically sustainable experiment or theory to provide a non-biological explanation; 4. mounting evidence that many terrestrial organisms can live under Martian conditions: the confirmation of liquid water in the surface material.

Those still not accepting life on Mars may be convinced should Curiosity, as the author predicts, find complex organic matter in the Martian soil. Ultimately, science will prevail, and the paradigm will change, alas, once more deflating man's ego regarding his place in the universe.

FIG. 1. Proof of Current Liquid Water on Mars.

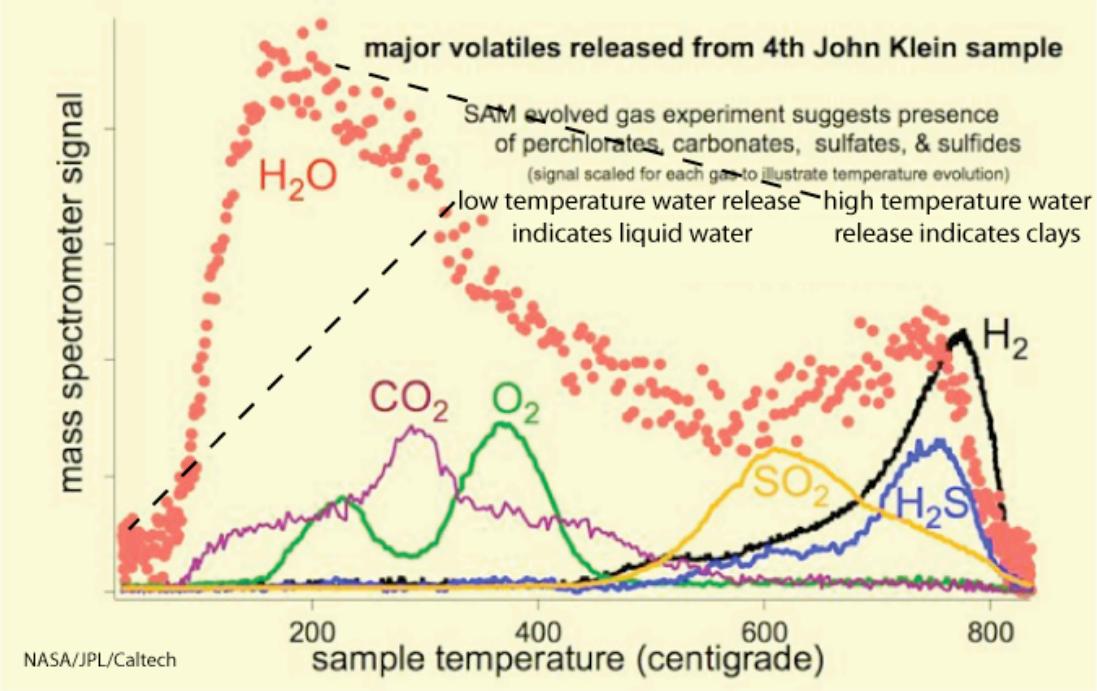

Figure 1. As the Sample Analysis at Mars (SAM) suite of instruments on NASA's Curiosity Mars rover heats a sample, gases are released (or "evolved") from the sample and can be identified using SAM's quadrupole mass spectrometer. This graphic shows the principal gases evolved from the fourth portion of powder delivered to SAM from the sample material collected when Curiosity first drilled into the "John Klein" target rock in the "Yellowknife Bay" area of Mars' Gale Crater. Image: NASA/JPL/Caltech.