WAS THE RED PLANET ONCE BLUE? METEORITIC EVIDENCE FOR HISTORICAL BIOSIGNATURES

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Introduction: We have reached new degrees of certainty to suggest signatures of life beyond Mother Earth. Since the earliest days of space exploration, we have accumulated a large repository of evidence about the existence, motions, and evolution of celestial bodies. Yet, conjecture of whether there is life beyond us has perplexed and been subjected to heated debate by both scientist and sensationalist audiences.

Historical Mars Expeditions: In the 1970s, the Viking collected soil samples "spiked" with organic nutrients like amino acids. These samples showed measurements approximately akin to what we would expect were there to be life present on the surface of Mars. Over time though, the scientific majority argued that these were merely the result of chemically reactive components present in the soil that reacted with terrestrial contaminants of the Earth to produce organic by-products. [1]

However, discoveries from the Curiosity rover suggested otherwise. Using evolved gas analysis and chromatography-spectrometry techniques, the first conclusive proof of the presence of native organic matter on Mars was recorded. [2] Coupled with evidence the unit found for ancient lakes and water underneath the Martian regolith, the case for Martian life may be even stronger piecing this jigsaw together.

Meteoritic Evidence: One rich source of speculation and proof comes from chondritic meteorites like the infamous Allan Hills 77005 (ALH77005) and 84001 (ALH84001) Martian meteorites discovered in Antarctica in 1977 and 1984 respectively. Chondritic meteorites represent pearls of the primitive Solar System in contrast to the differentiated iron meteorites. For Mars, the planet is considered to have undergone extensive differentiation over the epochs.

The ALH77005 meteorite was the first meteorite identified to come from Mars and it contained bacterial signatures of life. [3] While arguments of contamination exist, optical microscopy and infrared technology along with isotope tests have revealed carbon and minerals containing biomaterial that is difficult to pinpoint origin, if not native. Scientists observed bacteria that survive by eating iron rust in the pockets of the meteorite and proposed the existence of microbes on Mars.

The ALH84001 meteorite has not only carbon, but also nitrogen-based molecules 4-billion-years-old [4]. As we know, nitrogen is another crucial element that is of utmost importance for life on Earth, making up both our biology and geology. So, regardless of whether the nitrogen came from other carbon-containing meteorites or it originally formed on Mars, the fact is that Mars had organic nitrogen before it became the inhabitable red planet it is now.

Recently, there has been another alignment of evidence that finishes the picture. While scientists have had both magnetic and isotope data to suggest connections between the primitive Solar System and differentiated bodies structurally similar to Earth-like planets, we now have meteoritic evidence to document the partial melting and onset of differentiation. The discovery and characterization of UH154-11 have revealed the magma-based activities of a carbonaceous asteroid on the interim of differentiating. [5]

Conclusion: Taken collectively, we can draw the asteroid differentiation from icy comets to iron meteorites to the Mars context of its differentiation from a blue planet to a red one. The clues point to a common narrative of a Martian history that was potentially a wet and life-sustaining environment.

References:

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