https://ntrs.nasa.gov/search.jsp?R=20120009056 2019-08-30T20:29:30+00:00Z

"The Search for Life on Mars – Current Knowledge, Earth Analogues, and Principal Issues."

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For centuries, the planet Mars has been imagined as a possible abode for life. Serious searches for life's signatures began in the 19th century via ground-based visual astronomy that stimulated a vibrant fantasy literature but little lasting scientific knowledge. Modern scientific inquiry has emphasized the search for chemical signatures of life in the soil and rocks at the planet's surface, and via biomarker gases in the atmosphere. Today, investigations are based on high-resolution spectroscopy at Earth's largest telescopes along with planet orbiting and landed space missions. Methane has assumed central importance in these searches.

Living systems produce more than 90% of Earth's atmospheric methane; the balance is of geochemical origin. Abundant methane is not expected in an oxidizing atmosphere such as Mars', and its presence would imply recent release - whether biological or geochemical. For that reason, the quest for methane on Mars has been a continuing thread in the fabric of searches conducted since 1969. I will review aspects of the discovery and distribution of methane on Mars, and will mention ongoing extended searches for clues to its origin and destruction.

On Earth, hydrogen (generated via serpentinization or radiolysis of water) provides an important 'fuel' for carbonate-reducing and sulphate-reducing biota (CH_4 and H_2S producers, respectively). Several such communities are known to reside at depth in continental domains (e.g., Lidy Hot Springs, Idaho; Witwatersrand Basin, S. Africa). If similar conditions exist in favourable locations on Mars, organisms similar to these could likely prosper there. Geologic (abiotic) production will also be mentioned, especially abiotic methane production associated with low-temperature serpentinization (e.g., terrestrial ophiolites). It is vitally important to pursue evidence for geochemical and biological production with equal vigour and intellectual weight lest unwanted and unintended bias contaminate the results.

Finally, I will touch upon unresolved questions and issues posed by the methane detections.