THE MARTIAN METHANE ENIGMA

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I. Abstract

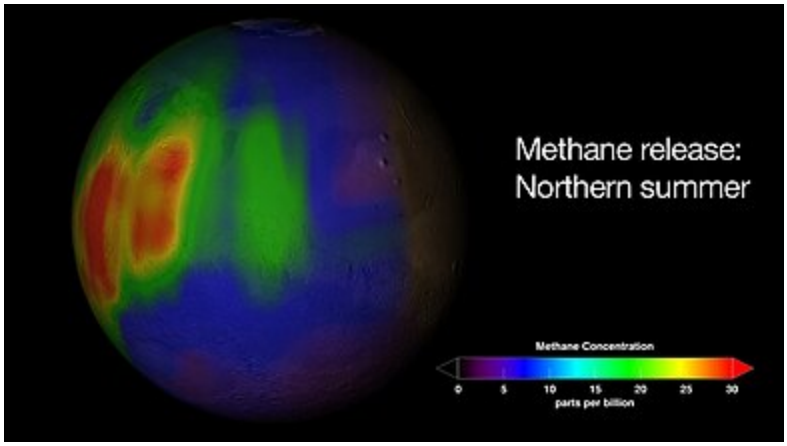
Scientists have widely debated the existence of methane on Mars. Methane (CH_4) is a hydrocarbon that is a primary component of natural gas. Methane is also a greenhouse gas (GHG), so its presence in the atmosphere affects the earth's temperature and climate system. Reports of methane detections at Mars have captivated scientists and non-scientists alike. On Earth, a significant amount of methane is produced by microbes that help most livestock digest plants. This digestion process ends with livestock exhaling or burping the gas into the air.

While there are no cattle, sheep, or goats on Mars, finding methane there is exciting because it may imply that microbes were, or are, living on the Red Planet. Methane could have nothing to do with microbes or any other biology, however; geological processes that involve the interaction of rocks, water, and heat can also produce it.

II. Introduction

On Earth, methane is produced mainly by life, and it has been proposed that, under certain conditions, methane detected in an exoplanetary spectrum may be considered a biosignature. Methane may be produced in hydrothermal vent systems by Serpentinization, which is the process of hydrothermal alteration that transforms Fe-Mg-silicates such as olivine, pyroxene, or amphiboles contained in ultramafic rocks into serpentine minerals. It's an important process in the Earth's crust and is also thought to play a role in how certain life forms might have first emerged on Earth.

The reported presence of methane in the atmosphere of Mars is of interest to many geologists and astrobiologists as it indicates the traces of microbial life or geochemical processes on Mars, which are the two main sources of the production of methane.



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III. Observational Evidence

NASA's Curiosity rover has found new evidence preserved in rocks on Mars that suggests the planet could have supported ancient life, as well as new evidence in the Martian atmosphere that relates to the search for current life on the Red Planet. This variation was detected by Curiosity's Sample Analysis at Mars (SAM) instrument suite. Water-rock chemistry might have generated the methane, but scientists cannot rule out the possibility of biological origins. "Our results support the idea that methane release on Mars might be characterised by small, transient geological events rather than a constantly replenishing global presence, but we also need to understand better how methane is removed from the atmosphere, and how to reconcile the Mars Express data with results from other missions," adds co-author Frank Daerden from the Royal Belgian Institute for Space Aeronomy in Brussels. Contrastingly, The newest probe to orbit Mars — the ExoMars Trace Gas Orbiter (TGO) — failed to find any methane in the Red Planet's atmosphere, according to a paper published today in the journal Nature.

IV. Possible Sources of Martian Methane

Biological sources of Methane are Methanogens are archaea bacteria that produce methane as a metabolic by-product. Examples of methane-producing genera are Methanobacterium, Methanosarcina, Methanococcus, and Methanospirillum.

Geological sources include Serpentinization, which is a hydration and metamorphic transformation of ferromagnesian minerals, such as olivine and pyroxene, in mafic and ultramafic rock to produce serpentinite. Another process is Clathrate Release, in which Methane clathrate is released as a gas into the surrounding water column or soils when ambient temperature increases. The clathrate gun hypothesis is a proposed explanation for the periods of rapid warming during the Quaternary. Even though no active volcanoes have been found, past volcanic processes might still be contributing methane.

V. The Mystery of Martian Methane Variability

Why do different instruments detect different methane levels? Certain chemical bonds have specific absorption band wavelengths making it possible to identify the gas by mid-IR absorption sensors. By this principle, methane gas can be detected by diode laser optical sensors at wavelengths of 2.3 and 3.26 μm, which are the strong absorption lines of methane. Seasonal changes, Interaction with Martian dust storms and UV breakdown of methane molecules in the atmosphere can be the possible explanations for the fluctuations in the methane levels.

VI. Future Research & Missions

The Perseverance rover is currently searching for signs of ancient microbial life, by drilling into Martian rock to collect samples of rock, soil, and atmosphere. The samples are stored in sealed tubes for future pick up, by a future mission that would ferry them back to Earth for detailed analysis. The rover is also testing technologies to help pave the way for future

human exploration of Mars. In 2028, ESA will launch its most ambitious exploration mission to search for past and present signs of life on Mars. Further, due to the advancements in technology, laboratory simulations and human exploration for direct testing might be possible in the near future.

VII. Conclusion

The Mystery of Martian Methane still continues to baffle the scientific minds. Is methane on Mars a strong biosignature or simply a geological phenomenon? The answer to this might be known soon. The future scientific discoveries might rule out the possibility of Extraterrestrial life on Mars, the red planet.

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