NASA rover yet to find methane on Mars

Non-detection casts doubt on claims of hotspots.

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The question of methane on Mars isn't yet dead, but NASA's Curiosity rover has certainly made it look less likely.

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After three months on Mars, the Curiosity rover has released its first atmospheric results, including a non-detection of methane.

Curiosity scientists announced on 2 November that they had not detected methane with any confidence — although they left themselves wiggle room, saying that they are 95% confident that the level of methane lies between 0 and 5 parts per billion.

"Bottom line is that we have no detection of methane so far," says Chris Webster, a scientist at the Jet Propulsion Laboratory in Pasadena, California, and principal investigator for the Tunable Laser Spectrometer (TLS), the rover instrument central in seeking the gas. But "Mars may yet hold surprises for us".

On Earth, life is responsible for the vast majority of the planet's atmospheric methane, which exists at levels of about 1,700 parts per billion. If methane were detected on Mars, microbes could thus be invoked as its source, although trace amounts could also be produced through comet impacts or chemical reactions underground that involve rocks and hot water.

Various experiments in the past decade have claimed to detect Martian methane at levels as high as 30 parts per billion[1] and 45 parts per billion[2]. But more perplexing was the way in which some of the methane signals appeared as hotspots, or plumes, and then disappeared — implying both a sudden injection, as well as a process that would quickly destroy the methane, which would otherwise mix in the atmosphere and persist. Scepticism for these claims has abounded (See "Curiosity set to weigh in on Mars methane puzzle").

Although the Curiosity result would seem to cast doubt on those claims, one proponent, Michael Mumma, of the Goddard Space Flight Center in Greenbelt, Maryland, isn't yet backing down. The plume he detected back in 2003 was in a different part of the planet, he says, and could have dispersed by now at the rover's landing site. "Gale Crater is not an auspicious place to search for current releases," he says.

The TLS team will continue to take small gulps of Mars air in an effort to beat down the uncertainties. The instrument works by firing a laser into a small mirrored chamber; if methane is present, absorption lines should appear at key frequencies. The team has used the instrument four times, and on the first two occasions, a large methane signal — of 7 or 8 parts per billion — was present. The team quickly realized that it was due to contamination by residual Earth air in the device. The team has pumped out this residual air as best it can, and has devised a workaround — but it's a more complicated protocol that generates more systematic errors.

The TLS team has another trick that it plans to use to make any methane show up much more noticeably. By stripping the Mars air of carbon dioxide before illuminating it with the TLS laser, Webster says that the concentration of methane can be increased by a factor of 10 or more, making it stand out sharply. He says that the instrument should ultimately be able to detect methane at levels as low as 100 parts per trillion.

But at that sensitivity — which is not as good as was promised pre-launch — many natural processes could be responsible. Moreover, the TLS will no longer be able to distinguish between methane with different isotopes of carbon. The team had hoped to see the slightly different absorption lines associated with methane containing carbon-12 — the type that microbes tend to produce — and containing carbon-13, which tends to be non-biological in origin. Webster says that these differences would be noticeable only if methane existed at levels of several tens of parts per billion, which is now ruled out.

References

1. Formisano, V., Atreya, S., Encrenaz, T., Ignatiev, N. & Giuranna, M. *Science* **306**, 1758–1761 (2004).
2. Mumma, M. J. *et al*. *Science* **323**, 1041–1045 (2009).