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If there is methane on Mars it has so far eluded detection by the Curiosity rover.

PLANETARY SCIENCE

Hopes linger for Mars methane

But negative signal from the Curiosity rover raises questions about planned European mission.

BY ERIC HAND

Last week's preliminary verdict from the Mars rover Curiosity on whether the planet's atmosphere contains methane ended weeks of anticipation. But the verdict — a qualified no — seems unlikely to end years of controversy.

Sporadic claims of Martian methane in the past decade have met with scepticism — and not just because the measurements are difficult to make. Methane at levels of tens of parts per billion could be a sign that microbes are at work on the planet, lending urgency to proposals to hunt for a subterranean Martian biosphere. The European Space Agency (ESA) has already taken steps in this direction, and is planning an orbiter that would map methane sources as a precursor to sending a rover to look for Martian life. Yet some scientists believe that this is premature, even quixotic, and could distract from the current agenda of NASA's rover, which is to look for signs that the planet was habitable at some time in its warmer and wetter past.

The Curiosity team couldn't quite lay the methane question to rest. In a 2 November announcement of the rover's first atmospheric results, the team said that, with 95% certainty, Martian methane does not exceed 5 parts per billion (p.p.b.), a level that could more readily be explained by non-biological geochemical reactions or by comet impacts delivering pulses of the gas from space. And the true value could be zero. "Bottom line is that we have no detection of methane so far," says Chris Webster, a Mars scientist at the Jet Propulsion Laboratory in Pasadena, California, and principal investigator for the Tunable Laser Spectrometer (TLS), the rover instrument with a crucial role in looking for the gas.

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Yet the upper limit offers wriggle room for scientists who have been trying to shore up their previous detections. The team performed only four tests with the TLS, which shines a laser into a small chamber filled with Martian air to look for methane's absorption spectrum. And some residual air from Earth trapped in the instrument had forced the team to change the planned experimental protocol, resulting in a surprisingly wide standard error.

Michael Mumma, of the Goddard Space Flight Center in Greenbelt, Maryland, says that the Curiosity results are consistent with his own observations using Earth-based telescopes. His team reported evidence of a plume of gas on Mars in 2003 with methane levels as high as 45 p.p.b. (M. J. Mumma *et al. Science* **323,** 1041–1045; 2009). Mumma's latest ground-based observations, from 2009–10, have found no methane, and have an upper limit of 6 p.p.b., similar to Curiosity's. One possibility, he says, is that Mars generates isolated bursts of methane, which then disperse.

Curiosity's result also doesn't faze researchers planning the ESA's Trace Gas Orbiter, which is due to launch in 2016. "I'm not worried right now," says Olivier Witasse, the mission's project scientist at the European Space Research and Technology Centre in Noordwijk, the Netherlands. "I think it's not the end of the story."

The ESA mission would add another chapter. In one mode, the orbiter will map the global distribution of gases, using light reflected from the Martian surface. But it will also stare at the rim of the planet, using the Sun as a backlight to map methane concentration as a function of altitude. Manish Patel at the Open University in Milton Keynes, UK, a member of one of the instrument teams, says that the orbiter should be able to detect concentrations as low as 14 parts per trillion — well below the 100 parts per trillion limit that the Curiosity team thinks it can achieve.

Patel hopes that such precision won't be needed, and that the next lot of Curiosity measurements will reveal methane at higher levels. That could bolster support from European politicians and keep the mission on track, he says.

Although Witasse also hopes for a positive methane result, he says that the ESA mission will still have value even if methane is absent. By looking at isotopic ratios of noble gases, the orbiter could help chart how the Martian atmosphere has steadily eroded over time. The craft could also map the seasonal movements of carbon dioxide and water vapour. And it could detect faint traces of sulphur compounds that might point to residual subterranean volcanic activity. "Even if there is no methane I will not be worried," he says. "There are other gases that are interesting." ■