Mystery methane on Mars: The saga continues

May 15 2015, by Johnny Bontemps, Astrobiology Magazine

NASA’s Curiosity rover has detected methane on Mars. Could the gas be coming from the rover itself? Credit: NASA/JPL

Is the Red Planet giving off methane? The question has taunted scientists for nearly 50 years, ever since the Mariner 7 spacecraft detected a whiff of the gas near Mars' south pole. Researchers retracted the finding a

month later after realizing that the signal was in fact coming from carbon dioxide ice.

Then in 2003 and 2004, earthbound telescopes and orbiting spacecraft rekindled the mystery with reports of large methane clouds in Mars' atmosphere. Most of Earth's methane comes from living organisms, though a small fraction can form when rocks and hot water interact. A burp of methane on Mars would indicate that the planet might be more alive than previously thought—whether biologically or geologically. But the "plumes" mysteriously vanished a few years later, sparking intense debate over whether they might have been seasonal, or the results of flawed measurements.

NASA's Curiosity rover would resolve the matter, everyone hoped. The rover sampled Mars' atmosphere six times for methane between October 2012 and June 2013—and detected none. But the case for Martian methane remained far from settled. A few months later, Curiosity detected a sudden burst of the gas in four measurements over a period of two months.

Working hard to rule out potential anomalies and monitor the evolution of the burst over time, the Curiosity team waited an entire year before announcing the new results at a meeting of the American Geophysical Union in December 2014. A paper was published in the journal *Science* in January 2015. Whether microbes hid below the Martian surface or geology was at play, the Red Planet could well be alive in some way after all.

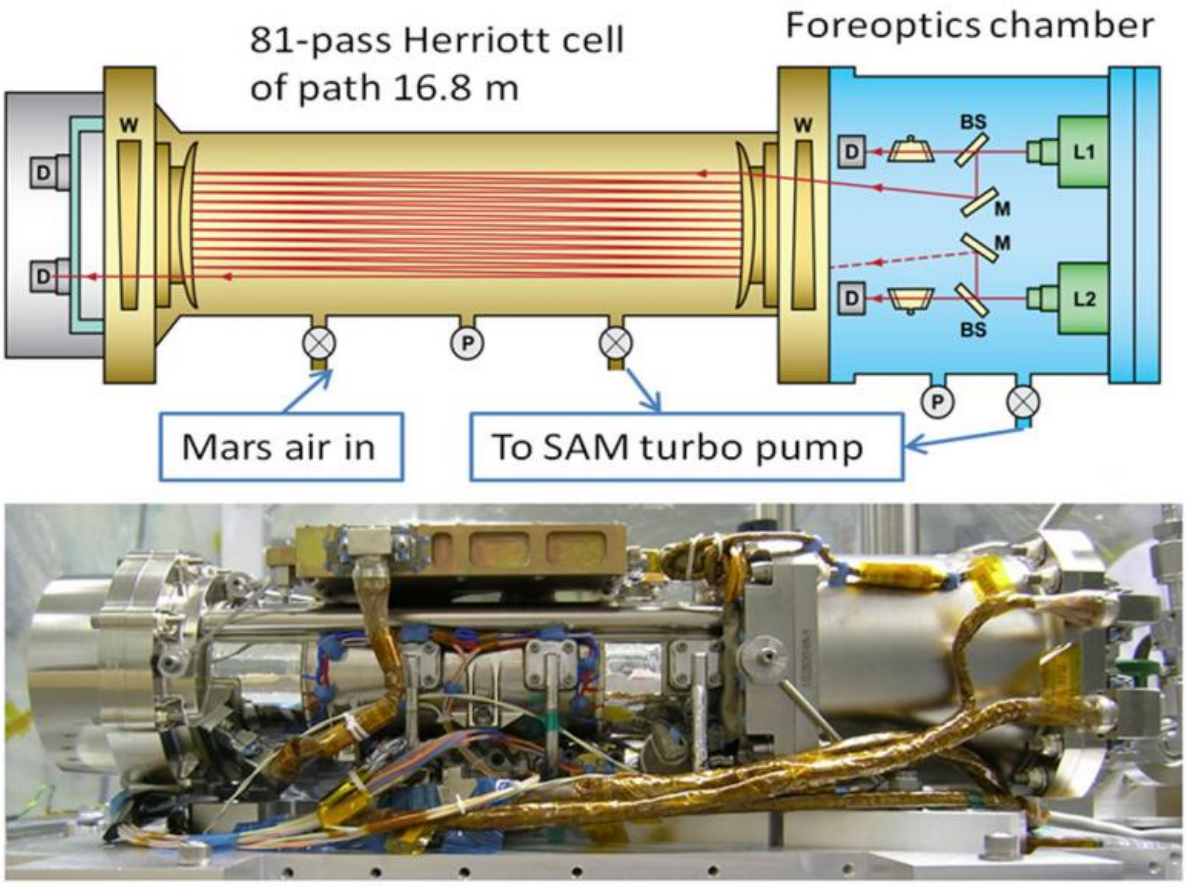
And yet, a researcher remains skeptical. Kevin Zahnle, a scientist at NASA Ames Researcher Center who was not involved with the discovery, voiced his concerns last month in a seminar hosted by the NASA Astrobiology Institute's Virtual Planetary Lab.

"I am convinced that they really are seeing methane," he said. "But I'm thinking that it has to be coming from the rover."

Methane From Earth

Zahnle, who was also critical of the 2003 and 2004 methane reports, said that it wouldn't take much from the rover to lead scientists astray. After all, the rover contains within a chamber some methane at a concentration 1,000 times higher than the puff supposedly found in Mars' atmosphere. That methane had come from Earth.

Upon landing in Gale Crater, the rover's tunable laser spectrometer gave off an unusually high reading for methane. The scientists on the team quickly realized that some terrestrial air had leaked into the instrument while the rover was sitting on the launch pad at Cape Canaveral. They pumped out most of that methane, keeping a small amount in the antechamber to the sample cell for calibration purposes.



The Tunable Laser Spectrometer on NASA's Curiosity Mars Rover. The foreoptics chamber contains a small amount of methane for calibration purpose. Credit: NASA/JPL

But Curiosity's team insists that this known source hasn't interfered with the discovery.

"We are continuously monitoring that methane amount and there hasn't been evidence of any leakage during the entire mission," says Chris Webster, a senior research scientist at NASA's Jet Propulsion Laboratory and lead author of the study. "And while it's true that the concentration of methane in that chamber is 1,000 times higher than in Mars's

atmosphere, the comparison is actually misleading."

"You have to look at the amount of methane, not the concentration," he explains. The concentration of methane on the rover may seem high, but the actual amount is very small because the chamber is very small. To produce the amount we detected in Mars's atmosphere, you'd need a gas bottle of pure methane leaking from the rover. And we simply don't have it."

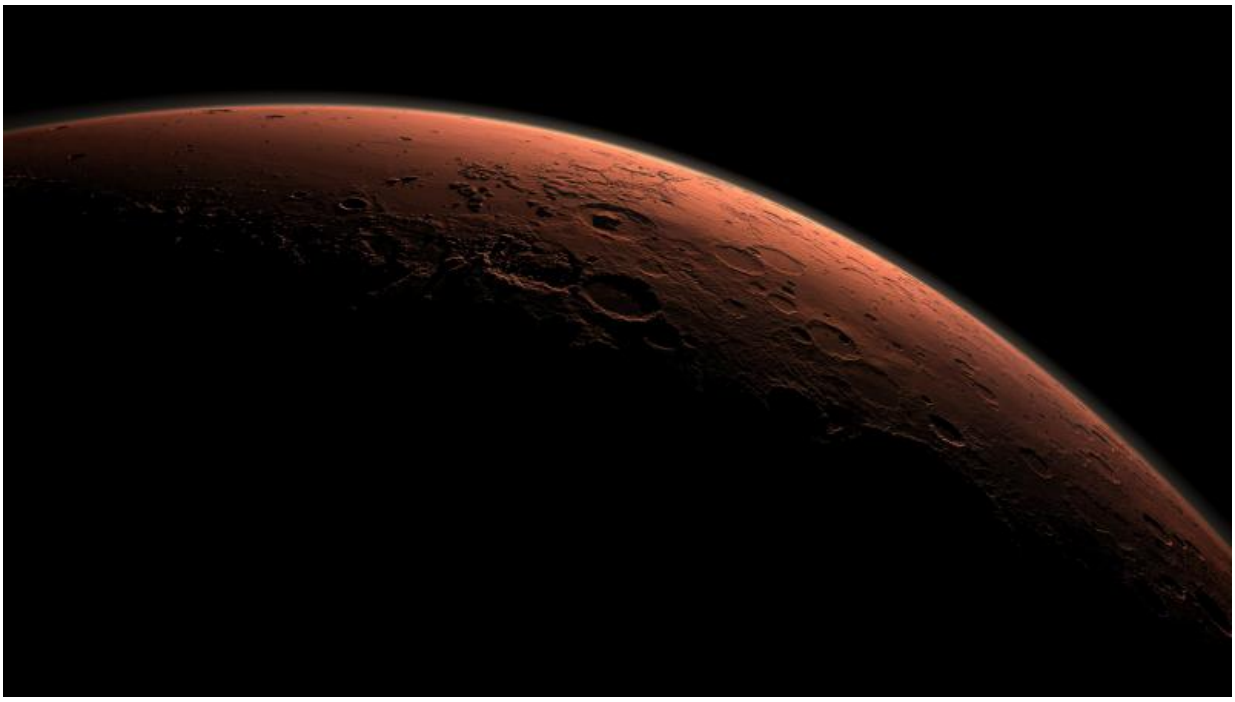
Unknown Sources?

Zahnle also contends that the terrestrial air could have infiltrated other areas on the rover.

"Ruling out the rover entirely as a cause is a hard thing to do," he says. "You'd have to know about every place where methane could be stored."

Chris McKay, a researcher at NASA Ames and co-author on the January paper, thinks that Zanhle's concerns are valid. "I think the possibility of a methane source aboard should still be considered until completely ruled out," he says.

But Paul Mahaffy, the principal investigator on the Sample Analysis at Mars (SAM) suite of instruments, doubts that the rover could be a possible source. "It seems unlikely that after more than a year on the surface of Mars a sudden source of methane from the spacecraft would appear, persist for 60 days and then disappear," he says. "Methane is a very volatile gas and any residual methane brought to Mars should be long gone."



Daybreak at Gale Crater. Credit: NASA/JPL

Webster agrees that an unknown source on the rover seems highly unlikely, but he says it's not impossible.

"There are a few areas that are sealed," he says. "They could, in theory, be a source if some methane had made its way into them and was then leaking out, but we've looked very hard for other sources and we haven't identified any."

What's Next?

Curiosity is gearing up for new measurements later this year around the holiday season, which is when the mysterious burst was detected in 2013, one Mars year ago. "If the methane comes back around that time, that will tell us that something seasonal is going on," Webster says. "That

would be a huge discovery, and would put to rest the questions about the rover being a potential source."

Meanwhile, McKay is exploring another possibility—namely, that a meteorite may have recently fallen within the vicinity of the rover. Carbonaceous meteorites contain a small amount of organic materials, which can give off a plume of methane when broken down by ultraviolet radiation.

"It's probabilistically unlikely, but those events do happen," McKay says. "If the rover had been in the town of Murchison when the meteorite fell in 1969, it would have detected a pulse of methane."

The Curiosity team has searched for fresh craters near the rover by looking at images taken from orbit. They haven't found any. However, McKay noted that, unlike stony-iron meteorites, carbonaceous meteorites don't leave craters. Instead, they typically break apart in the atmosphere and fall into a rain of small organic fragments. McKay is currently working with a meteorite expert to determine the size of a potential object that could have produce the methane spike detected by Curiosity.

The ExoMars Trace Gas Orbiter, a new mission led by the European Space Agency and planned for 2016, will also scan the Martian atmosphere for trace amounts of methane and other exotic gases. India's Mars mission currently in orbit may also soon report its methane findings. Both will survey an area much greater than covered by Curiosity, which will spend its lifetime in Gale Crater. Will they finally resolve the mystery behind Mars's capricious methane plumes? Time will tell.

* *Follow Johnny Bontemps on* Twitter

Source: Astrobio.net