Methane pockets may narrow search for Mars life

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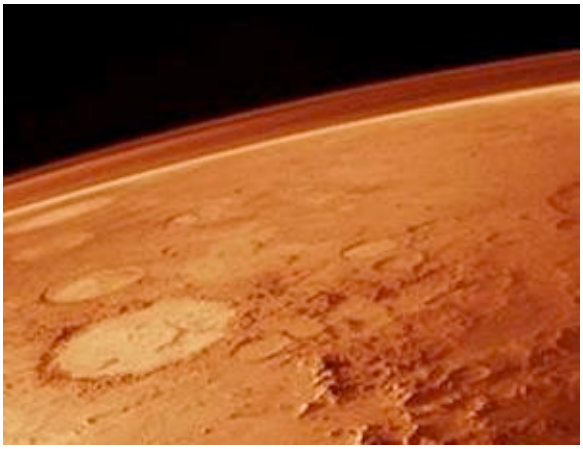
Methane gas in the Martian atmosphere is concentrated in three specific regions, according to the most sensitive measurements yet made. The discovery will likely stoke further debate on the source of the gas, which could be created through geological processes but might be tantalising evidence of life below the Martian surface.

Since methane was first discovered on Mars in 2003, three teams have found signatures of the gas using ground-based telescopes as well as Europe's Mars Express orbiter.

Some observations hinted that the gas was not distributed evenly across the planet, but the source of the methane remained unclear.



Methane may be produced by microbes below the Martian surface (Image: NASA)

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Now a team led by Michael Mumma of the Goddard Space Flight Center in Greenbelt, Maryland, has released high-resolution maps of Mars from 2003 that pinpoint three areas just north of the Martian equator that seem to be the source of the gas (see image).

The team used two telescopes in Hawaii - the Infrared Telescope Facility and Keck-2 - to measure the light emitted by the planet. By observing Mars through a long, narrow slit, the team built up a high-resolution map of methane as the planet rotated.

"We observed and mapped multiple plumes of methane on Mars, one of which released about 19,000 metric tonnes of methane," team member Geronimo Villanueva of the Catholic University of America in Washington, DC, said in a statement. "The plumes were emitted during the warmer seasons, spring and summer, perhaps because ice blocking cracks and fissures vaporised, allowing methane to seep into the Martian air."

Different geologies

One of the three regions is centred on a rift called Nili Fossae, which had until late last year been considered as a possible landing site for NASA's one-tonne rover, the Mars Science Laboratory, which is set to launch in 2011.

The two other hotspots, each some 1000 kilometres away, have different geologies. One centres on the southeastern region of the volcano Syrtis Major. The other is a flatter, cratered region called Terra Sabae.

"This is the very first evidence of local methane sources," Mumma told **New Scientist**.

Burst of gas?

Sushil Atreya, a member of the Mars Express team at the University of Michigan, is impressed with the results.

"The previous observations, particularly those from Mars Express, gave only a hint of broad areas of possibly large abundances of methane," he told **New Scientist**. "Moreover, the Mars Express results relied on a single strong spectral line of methane, whereas the current data identify at least two lines, which gives more confidence in the presence of methane on Mars."

But the story of how this methane was released remains unclear. The hotspots might have produced a single burst of methane in 2003, or the gas might seep out from them regularly.

Either way, the lifetime of methane in the atmosphere is unexpectedly short.

Seasonal heating

Sunlight breaks apart methane in some 350 years or so, but the team found evidence of a much faster destruction process. In 2006, methane levels in the Martian atmosphere were 50% lower during the local springtime than they were in the 2003 Martian summer.

If methane was somehow released by all three regions in a singular event, the observed reduction in methane levels would mean the lifetime of the gas is only four years long.

But the methane might be also produced each summer, released when the ground warms and expands to open pores containing methane deposits. If that were the case, the 2006 methane levels suggest that the gas lasts for less than a year.

Mysteriously destroyed

What could be destroying the methane on such short timescales? Harsh chemicals, such as hydrogen peroxide, could be the culprit, and researchers have previously suggested that the chemicals may be produced when wind-blown dust grains rub together.

But models already predict the right levels of peroxide in the atmosphere without the need for electrically charged dust, says James Lyons of the University of California, Los Angeles.

Finding pockets of peroxide that could destroy the methane will be "an important test", Lyons says. "If that is observed at some point in the future, it will make me a believer in the methane story."

Subsurface water

And what could be producing the methane itself? Pockets of methane might have been produced long ago by the interaction of water and volcanic rock below the Martian surface. But the gas might also be produced by microbes that thrive below the inhospitable Martian surface, where there may be liquid water (see *Mars special: a whiff of life*).

Such organisms might be similar to those seen kilometres below the surface of the Witwatersrand Basin in South Africa, where life has survived without the Sun for millions of years, the team says. There, radioactivity breaks apart water, and microbes use the resulting hydrogen to process carbon dioxide and make methane.

"Whatever the source, it indicates the presence of liquid water underground, and that there is some type of activity going on - biologic or geologic, and that is exciting," says Atreya.

Signature of life

But an ultimate determination of the source of the methane will have to wait. "We don't have the capability to identify what is at work here," Mumma told **New Scientist**.

The Mars Science Laboratory will be able to identify the levels of carbon isotopes in methane. Life on Earth prefers to process carbon-12, so finding methane on Mars with a high abundance of the isotope could indicate a biological origin.

The methane hotspot Nili Fossae was on the short list of possible landing sites for the rover. But the region may not be selected, as engineers worry the elevation is too high to allow the rover to complete its full landing sequence, says John Grant of the Smithsonian Institution and co-chair of the landing-site selection committee.

But an additional site could be added late this year or in early 2010, Grant says.

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