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Methane Mystery On Mars

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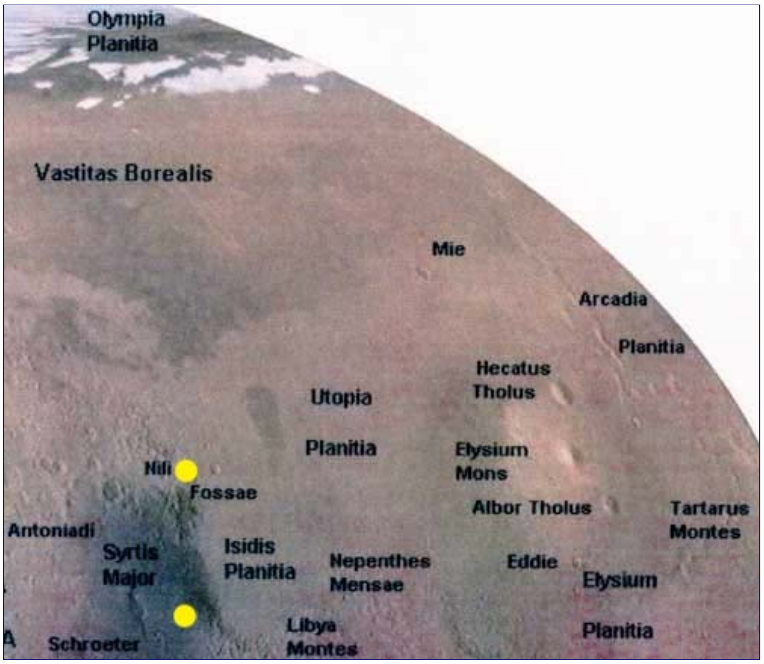
"We observed and mapped multiple plumes of methane on Mars, one of which released about 19,000 metric tons of methane."
- Geronimo Villanueva, Ph.D., NASA Goddard

Dark central area is region of Syrtis Major Planum, locations of Nili Fossae and Syrtis Major ancient volcano, both emission sites of methane gas plumes. Image by Hubble.



Yellow circles at Nili Fossae and southeast quadrant of Syrtis Major, ancient volcano, mark where NASA and the European Space Agency (ESA) have measured large quantities of methane emissions since 2003. The persistent size of methane quantities imply a continually replenishing source. Is it geological? Or biological? Map created by Alwyn Botha, www.the-planet-mars-com.

January 25, 2009 Greenbelt, Maryland - Methane on Mars was first detected in 1999 and 2001, and then has been measured in persistent quantities since 2003 over at least two "hot spots" in the Martian northern hemisphere shown on map above:

1) east of Arabia Terra in the Nili Fossae region;

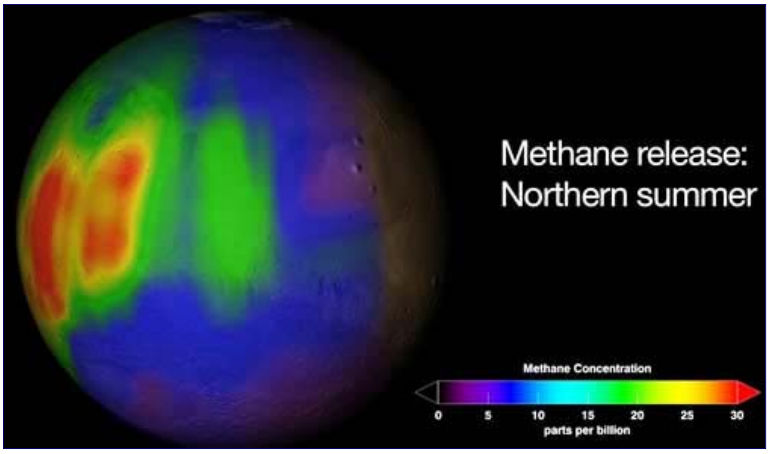
2) and in the southeastern quadrant of Syrtis Major, an ancient Martian volcano that is 745 miles across (1200 kilometer).

Syrtis Major Planum, is a low-relief volcanic shield probably composed of dark basalt.

Methane is not a stable molecule in the Martian atmosphere and would vanish over time unless replenished by a methane-producing source. The mystery is the source since on Earth methane is the main constituent of natural gas, four atoms of hydrogen bound to a carbon atom. Biological organisms release much of Earth's methane as they digest nutrients. However, other purely geological processes, such as oxidation of iron, also release methane as do active volcanoes. But since there are no known active volcanoes on Mars, does the persistent methane release mean there are methane-producing organisms? If living organisms, what are they? How old are they? How deep underground are they?

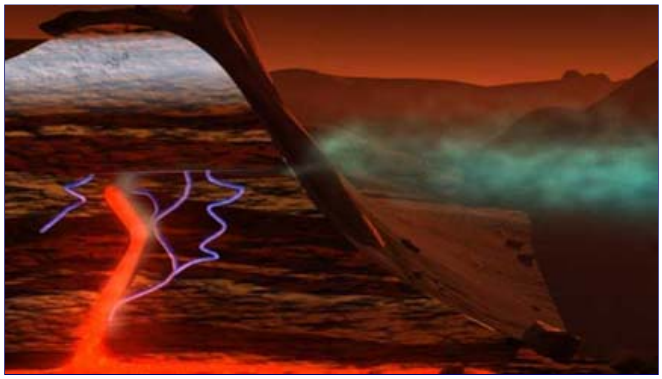
Over the past five years, the spectral signature of methane on Mars has been seen by the Infrared Telescope and W. M. Keck telescope, both at Mauna Kea, Hawaii; the Gemini South Observatory in Chile; and the Mars Express Planetary Fourier Spectrometer (FPS). In the January 15, 2009, electronic journal *Science Express*, lead author Michael Mumma, Ph.D., NASA Goddard Space Flight Center in Greenbelt, Maryland; and Geronimo Villaneuva, Ph.D., Catholic University of America in Washington, D. C. who works with NASA Goddard, reported “the first definitive detection of methane in the atmosphere of Mars that indicates the planet is still alive in either a biological or geological sense.”

NASA's January 19, 2009, press release quotes Dr. Michael Mumma: “Methane is quickly destroyed in the Martian atmosphere in a variety of ways, so our discovery of substantial plumes of methane in the northern hemisphere of Mars in 2003 indicates some ongoing process is releasing the gas. At northern Martian mid-summer, methane is released at a rate comparable to that of the massive hydrocarbon seep at Coal Oil Point in Santa Barbara, California.”



Red and yellow indicate substantial plumes of methane measured by NASA in the Nili Fossae and southeastern quadrant of Syrtis Major ancient volcano in Martian northern hemisphere. 2009 graphic image by NASA.

NASA's press release states that scientists don't yet know enough to say with certainty what the source of the Martian methane is, but provides an artist's concept of another hypothetical methane release beyond active volcanism and living organisms - “ice cages” of trapped ancient methane.



In this illustration, subsurface water, carbon dioxide and the Martian internal heat combine to release methane from a hypothetical underground “ice cage” of ancient trapped methane. 2009 image by Susan Twardy, NASA.

NASA also stated, “If microscopic Martian life is producing the methane, it likely resides far below the surface, where it's still warm enough for liquid water to exist. Liquid water, as well as energy sources and a supply of carbon, are necessary for all known forms of life.

NASA's Mumma: “On Earth, microorganisms thrive 2 to 3 kilometers (about 1.2 to 1.9 miles) beneath the Witwatersrand basin of South Africa, where natural radioactivity splits water molecules into molecular hydrogen (H2) and oxygen. The organisms use the hydrogen for energy. It might be possible for similar organisms to survive for billions of years below the permafrost layer on Mars, where water is liquid, radiation supplies energy, and carbon dioxide provides carbon. Gases, like methane, accumulated in such underground zones might be released into the atmosphere if pores or fissures open during the warm seasons, connecting the deep zones to the atmosphere at crater walls or canyons.”

Carl Pilcher, Ph.D., Director of NASA's Astrobiology Institute added: “Microbes that produced methane from hydrogen and carbon dioxide were one of the earliest forms of life on Earth. If life ever existed on Mars, it's reasonable to think that its metabolism might have involved making methane from Martian atmospheric carbon dioxide.”

> NASA January 19, 2009 Press Release: “The Goddard science team used spectrometer instruments attached to the telescopes to make the detection. Spectrometers spread light into its component colors, like a prism separates white light into a rainbow. The team looked for dark areas in specific places along the rainbow (light spectrum) where methane was absorbing sunlight reflected from the Martian surface. They found three such areas, called absorption lines, which together are a definitive signature of methane, according to the team. They were able to distinguish lines from Martian methane from the methane in Earth's atmosphere because the motion of the Red Planet shifted the position of the Martian lines, much as a speeding ambulance causes its siren to change pitch as it passes by.

‘We observed and mapped multiple plumes of methane on Mars, one of which released about 19,000 metric tons of methane,’ said Geronimo Villanueva, Ph.D. ‘The plumes were emitted during the warmer seasons -- spring and summer -- perhaps because the permafrost blocking cracks and fissures vaporized, allowing methane to seep into the Martian air. Curiously, some plumes had water vapor while others did not.’

It will take future missions, like NASA's Mars Science Laboratory, to discover the origin of the Martian methane. One way to tell if life is the source of the gas is by measuring isotope ratios. Isotopes are heavier versions of an element; for example, deuterium is a heavier version of hydrogen. In molecules that contain hydrogen, like water and methane, the rare deuterium occasionally replaces a hydrogen atom. Since life prefers to use the lighter isotopes, if the methane has less deuterium than the water released with it on Mars, it's a sign that life is producing the methane.”

More Information:

For further reports about the red planet Mars, please see **Earthfiles Archive.** Only a sample of previous reports are listed below.

• 08/05/2008 — Perchlorate Discovery by Phoenix Lander Does Not End Search for Life On Mars
• 07/16/2008 — Astronomical Data in July 2008 U. K. Crop Formations?
• 05/29/2008 — Phoenix Robotic Arm Preparing to Dig Into Martian Permafrost
• 12/08/2006 — NASA Wants Permanent Moon Base by 2024
• 12/16/2005 — MARSIS Radar Looking Below Surface of Mars
• 11/09/2005 — Dust Storm On Mars, Cosmic First Light and Black Hole At Our Galaxy's Center
• 08/24/2005 — Dust Devils and “Lemon Rinds” on Mars
• 06/23/2005 — Mars Express Orbiter Finally Turns On Deep Ground-Penetrating Radar
• 03/20/2005 — Astronaut John Young: “The Moon Can Save Earth's Civilization.”
• 03/04/2005 — Subterranean Life On Earth - and Mars?
• 02/26/2005 — Mars Spirit Rover Discovered Boundary Between Gusev Lava and Older, Water-Soaked Rocks in "Columbia Hills"
• 02/22/2005 — Frozen Sea Near Martian Equator Size of Lake Michigan
• 09/21/2004 — Part 2: Martian Water Ice and Organic Molecules - NASA Will Look for “Unique Signs of Life” on Mars
• 09/20/2004 — Part 1: Martian Water Vapor and Methane Overlap in Equatorial Regions
• 07/22/2004 — Is Physicist Vittorio Formisano's Mars Data Being Suppressed by ESA?
• 05/06/2004 — Formaldehyde, Ammonia and Benzene Molecules on Mars? Would Probably Mean Life.
• 04/02/2004 — Updates on Spirit and Opportunity Rovers
• 03/31/2004 — Methane on Mars - Biology? Volcanic?
• 03/11/2004 — Updated - Mars Spirit and Opportunity Sol 65 and Sol 46
• 03/08/2004 — Updates from NASA's Rovers and ESA's Mars Express
• 03/05/2004 — Part 3 - Mars: A Sulfate Salty Planet - Could It Have Sulfate-Loving Microbes?
• 03/03/2004 — Part 1 - Mars: Meridiani Planum Was Once “Drenched With Water and Habitable.”
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• 03/01/2004 — Opportunity Grinds Bedrock; Spirit Ready to Grind "Humphrey"
• 02/23/2004 — Is There Liquid Water on Martian Surface?
• 02/21/2004 — Update On Mars with Cornell Astronomer Steve Squyers, Principal Investigator on the Mars Rover Missions
• 02/18/2004 — Distorted Distance Perspective in Martian Rover Camera Images
• 02/14/2004 — Another Puzzle On the Martian Soil
• 02/11/2004 — Updated - Part 2: Opportunity Finds Martian Bedrock Has Lots of Sulfur and Small Spherical Rocks
• 02/10/2004 — Part 1 - Opportunity Investigating Bedrock and Spirit's Headed for Bonneville Crater
• 01/31/2004 — Opportunity Rolls Onto Martian Soil and Confirms Hematite
• 01/28/2004 — Mars - First Bedrock Seen Beyond Earth
• 01/25/2004 — Opportunity Lands on Mars - in “Muddy” Hematite?
• 01/24/2004 — Mars Express Sees Water Ice and Ancient River Channel
• 01/21/2004 — Spirit Rover's First Martian Soil Analysis Has Surprises
• 01/19/2004 — Martian Soil “Clumpy” - Electrostatic Binding of Dust?
• 01/15/2004 — Spirit Is Moving in the Martian Crater
• 12/07/2003 — “Smoking Gun” Evidence That Liquid Water Has Flowed on Mars?
• 08/26/2003 — Mars At Its Closest August 27, 2003, At 2:51 a.m. PDT / 5:51 a.m. EDT.
• 01/05/2003 — What Are the Grooves in the Martian South Pole?
• 06/01/2002 — Scientists Surprised by Abundance of Water On Mars
• 03/18/2001 — Can Earth Plants and Bacteria Grow On Mars?
• 12/24/2000 — Martian Bacteria?
• 06/26/2000 — 250 Photographs of Mars Show Signs of Water
• 12/02/1999 — Is There Water - And Life - On Mars?

Websites:

NASA: **http://www.nasa.gov/mission_pages/mars/news/marsmethane.html**

Map of Mars: **http://www.astro.virginia.edu/~mnc3z/images/astro121/map-of-mars.jpg**

USGS of Mars: **http://astrogeology.usgs.gov/Projects/MarsHemispheres/**

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