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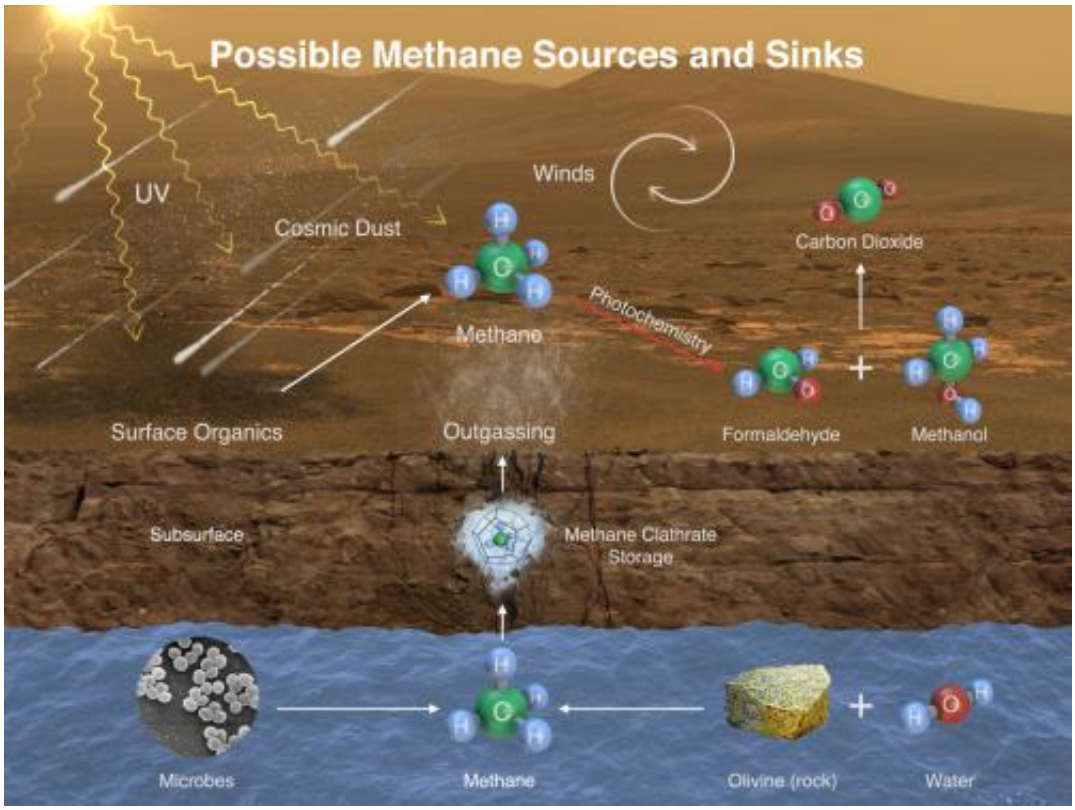
ty rover finds active, ancient organic chemistry on Mars

Dec 16, 2014 by Dwayne Brown



Enlarge

This image illustrates possible ways methane might be added to Mars' atmosphere (sources) and removed from the atmosphere (sinks). NASA's Curiosity Mars rover has detected fluctuations in methane concentration in the atmosphere, implying both …more

(Phys.org)—NASA's Mars Curiosity rover has measured a tenfold spike in methane, an organic chemical, in the atmosphere around it and detected other organic molecules in a rock-powder sample collected by the robotic laboratory's drill.

"This temporary increase in methane—sharply up and then back down—tells us there must be some relatively localized source," said Sushil Atreya of the University of Michigan, Ann Arbor, and Curiosity rover science team. "There are many possible sources, biological or non-biological, such as interaction of water and rock."

Researchers used Curiosity's onboard Sample Analysis at Mars (SAM) laboratory a dozen times in a 20-month period to sniff methane in the atmosphere. During two of those months, in late 2013 and early 2014, four measurements averaged seven parts per billion. Before and after that, readings averaged only one-tenth

that level.

Curiosity also detected different Martian organic chemicals in powder drilled from a rock dubbed Cumberland, the first definitive detection of organics in surface materials of Mars. These Martian organics could either have formed on Mars or been delivered to Mars by meteorites.

Organic molecules, which contain carbon and usually hydrogen, are chemical building blocks of life, although they can exist without the presence of life. Curiosity's findings from analyzing samples of atmosphere and rock powder do not reveal whether Mars has ever harbored living microbes, but the findings do shed light on a chemically active modern Mars and on favorable conditions for life on ancient Mars.

"We will keep working on the puzzles these findings present," said John Grotzinger, Curiosity project scientist of the California Institute of Technology in Pasadena (Caltech). "Can we learn more about the active chemistry causing such fluctuations in the amount of methane in the atmosphere? Can we choose rock targets where identifiable organics have been preserved?"

Researchers worked many months to determine whether any of the organic material detected in the Cumberland sample was truly Martian. Curiosity's SAM lab detected in several samples some organic carbon compounds that were, in fact, transported from Earth inside the rover. However, extensive testing and analysis yielded confidence in the detection of Martian organics.

Enlarge

NASA's Mars rover Curiosity drilled into this rock target, "Cumberland," during the 279th Martian day, or sol, of the rover's work on Mars (May 19, 2013) and collected a powdered sample of material from the rock's interior. Credit: NASA/JPL-Caltech/MSSS

Identifying which specific Martian organics are in the rock is complicated by the presence of perchlorate minerals in Martian rocks and soils. When heated inside SAM, the perchlorates alter the structures of the organic compounds, so the identities of the Martian organics in the rock remain uncertain.

"This first confirmation of organic carbon in a rock on Mars holds much promise," said Curiosity participating scientist Roger Summons of the Massachusetts Institute of Technology in Cambridge. "Organics are important because they can tell us about the chemical pathways by which they were formed and preserved. In turn, this is informative about Earth-Mars differences and whether or not particular environments represented by Gale Crater sedimentary rocks were more or less favorable for accumulation of organic materials. The challenge now is to find other rocks on Mount Sharp that might have different and more extensive inventories of organic compounds."

Researchers also reported that Curiosity's taste of Martian water, bound into lakebed minerals in the Cumberland rock more than three billion years ago, indicates the planet lost much of its water before that lakebed formed and continued to lose large amounts after.

SAM analyzed hydrogen isotopes from water molecules that had been locked inside a rock sample for billions of years and were freed when SAM heated it, yielding information about the history of Martian water. The ratio of a heavier hydrogen isotope, deuterium, to the most common hydrogen isotope can provide a signature for comparison across different stages of a planet's history.

"It's really interesting that our measurements from Curiosity of gases extracted from ancient rocks can tell us about loss of water from Mars," said Paul Mahaffy, SAM principal investigator of NASA's Goddard Space Flight Center in Greenbelt, Maryland, and lead author of a report published online this week by the journal *Science*.

The ratio of deuterium to hydrogen has changed because the lighter hydrogen escapes from the upper atmosphere of Mars much more readily than heavier deuterium. In order to go back in time and see how the deuterium-to-hydrogen ratio in Martian water changed over time, researchers can look at the ratio in water in the current atmosphere and water trapped in rocks at different times in the planet's history.

Daniel Glavin of NASA's Goddard Space Flight Center discusses the discovery of organic matter on Mars and other recent results from the MSL Curiosity rover. Credit: NASA Goddard

Martian meteorites found on Earth also provide some information, but this record has gaps. No known Martian meteorites are even close to the same age as the rock studied on Mars, which formed about 3.9 billion to 4.6 billion years ago, according to Curiosity's measurements.

The ratio that Curiosity found in the Cumberland sample is about one-half the ratio in water vapor in today's Martian atmosphere, suggesting much of the planet's water loss occurred since that rock formed. However, the measured ratio is about three times higher than the ratio in the original water supply of Mars, based on assumption that supply had a ratio similar to that measured in Earth's oceans. This suggests much of Mars' original water was lost before the rock formed.

Curiosity is one element of NASA's ongoing Mars research and preparation for a human mission to Mars in the 2030s. Caltech manages the Jet Propulsion Laboratory in Pasadena, California, and JPL manages Curiosity rover science investigations for NASA's Science Mission Directorate in Washington. The SAM investigation is led by Paul Mahaffy of Goddard. Two of SAM instruments key in these discoveries are the Quadrupole Mass Spectrometer, developed at Goddard, and the Tunable Laser Spectrometer, developed at JPL.

The results of the Curiosity rover investigation into methane detection and the Martian organics in an ancient rock were discussed at a news briefing Tuesday at the American Geophysical Union's convention in San Francisco. The methane results are described in a paper published online this week in the journal *Science* by NASA scientist Chris Webster of JPL, and co-authors.

A report on organics detection in the Cumberland rock by NASA scientist Caroline Freissenet, of Goddard, and co-authors, is pending publication.

Explore further: Curiosity rover makes first detection of organic matter on Mars

More information: Mars Methane Detection and Variability at Gale Crater, *Science Express*, www.sciencemag.org/content/ear… nce.1261713.abstract

The Imprint of Atmospheric Evolution in the D/H or Hesperian Clay Minerals on Mars, *Science Express*, www.sciencemag.org/content/ear… nce.1260291.abstract

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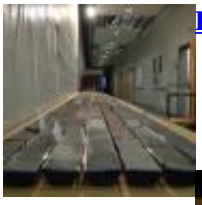

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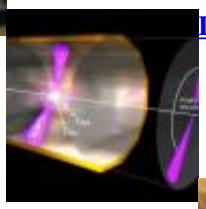

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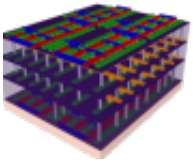

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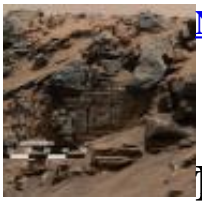

NASA image: Sedimentary signs of a Martian lakebed

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This scene, assembled from images acquired by the Mast Camera (Mastcam) on NASA's Curiosity Mars Rover shows a pattern typical of a lake-floor sedimentary deposit not far from where flowing water entered a lake. ...

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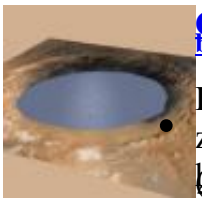

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Ever since hu[illegible] first looked up at the night sky and pondered whether we are alone in the universe. Dreams of life beyond Earth pervade literature, TV shows and drive Hollywood blockbusters but ...

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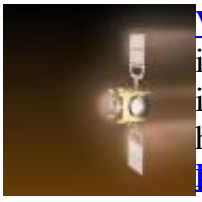
NASA's Ames Research Center in Moffett Field, California, will launch four life science experiments to the International Space Station aboard NASA's next commercial cargo resupply flight of the SpaceX Dragon.



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the question is ... Who farted?

As the days grow shorter and the temperatures drop in Europe, test your geography skills in the warmth of your home – while helping scientists to pinpoint light pollution.

Why did NASA scientists name a geologic feature on Mars "Aztec"?

SpaceX was founded by Elon Musk in 2002 with a dream of making commercial space exploration a reality. Since that time, Musk has seen his company become a major player in the aerospace industry, landing contracts f[illegible]

Last week, NASA's mission controllers for the Mars rover Curiosity spied a piece of rock outcropping with tiny holes, veins and fractures in the rocks. It's common practice for the science team to assign names t[illegible]

A stunning look at the cliffs of comet 67P/Churyumov-Gerasimenko

Curiosity rover finds clues to how water helped shape Martian landscape

baudrunner

Images from space don't get more dramatic than this. Image processing wizard Stuart Atkinson zoomed in on one of the most intriguing views yet of Comet 67P/Churyumov-Gerasimenko, highlighting the contrasts [illegible]

Report

Physorg.com observations by NASA's Curiosity Rover indicate Mars' Mount Sharp was built by sediments deposited in a large lake bed over tens of millions of years.

I like how the possibility of methane originating from life beneath the surface, in the form of the anaerobic methanogens, has not been ruled out. If that is the case, we might find hydrocarbon deposits beneath the surface, like oil. The digestion of ferrite substrata by these archaea yields oil as one the processes by which this valuable resource is sourced. The potential ramifications are enormous. Whether we are alone in

Image: Sunset over the Gulf of Mexico

From the International Space Station, Expedition 42 Flight Engineer Terry W. Virts took this photograph of the Gulf of Mexico and U.S. Gulf Coast at sunset and posted it to social media on Dec. 14, 2014.

A brief history of exo-Earths and the search for life elsewhere

7 hours ago

Report

foolspoo

Four life science experiments headed to ISS in the SpaceX-5 resupply launch

I like to remind myself of how difficult it is for the human mind to comprehend one billion. dollars/toads/humans/years. regardless of subject, the laymans' mind is not able to grasp the timescales which our universe operates. in just 10 million years, our planet may not be recognizable from a few thousand miles.

Venus Express goes gently into the night

it seems to me that these findings are incosequential, initially. as we continue to collect and interpret, we may very well learn that mars did indeed host life in its unfathomably long history. in its own right, these findings are remarkable!

Report

ESA's Venus Express has ended its eight-year mission after far exceeding its planned life. The spacecraft exhausted its propellant during a series of thruster burns to raise its orbit following the low-altitude

TopCat22

Bright lights: big cities at night

Report

Shootist

not rated yet 20 hours ago
It's ghouls I tell ya, religious ghouls. looking for a place to call their own.
Report

sselig

4 / 5 (4) 20 hours ago
The more suggestive the evidence becomes that mars might harbor life the more concerned we should be about contamination, particularly if we're serious about getting there ourselves someday. We ought to do everything possible to tease out its secrets before sneezing all over it. Is there a sample-return mission already funded and in the works? If not, there ought to be.
---s
Report

qitana

not rated yet 19 hours ago
I was thinking.. perhaps this instrument to measure the amount of methane could be malfunctioning too, but probably not, I do assume
Report

TheGhostofOtto1923

not rated yet 18 hours ago

> I like how the possibility of methane originating from life beneath the surface, in the form of the anaerobic methanogens, has not been ruled out. If that is the case, we might find hydrocarbon deposits beneath the surface, like oil. The digestion of ferrite substrata by these archaea yields oil as one the processes by which this valuable resource is sourced. The potential ramifications are enormous.

Hydrocarbons are found throughout the solar system which are not produced by organisms. We should expect to find them on mars as well. We should expect to discover that at least some of the hydrocarbons found here on earth are abiogenic in origin.
Report

Osiris1

not rated yet 11 hours ago
You future Mars explorers, take your bio hazard gear. The life you safe may be your OWN!! Listening to skeptics on the possibilities of native Martian life, however it got there can put you at risk, so protect yourself. Better to be safe than sorry.
Report

Z99

not rated yet 7 hours ago
Phys.org as usual relies on laymen's confusion about what "organic chemical" means. Carbon is the 4th most abundant element in the Universe. (after H, He, and O) It would be astounding if methane (composed of C and H; CH4) was not present on Mars. We've known for decades that the Gas Giants have megatons of 'organic chemicals', and yet why don't we hear chatter about whether we've discovered 'traces of life' there? Simple: this spin is about funding, not science. In fact the abstract cited says that the average methane detected is LESS than what we expected due simply to the reactions of meteoric debris on its surface. This drum-beat for Mars missions is similar to the Shuttle program. A lot of pseudo-science and misdirection, little science, and that only used selectively.
Report

Z99

1 / 5 (1) 6 hours ago
What I'd like to know is how deep would life have to be buried for it to be present under, say 1% or 0.01% of the surface? That is: we expect that life will emit telltale organics into the atmosphere (waste products). How deep and how geographically limited would we expect these active areas to be in order to be consistent with the (virtually zero) concentrations we're finding? Obviously, this question would rely on deserts on Earth for a baseline. My cynical guess is that we're not hearing answers to this type of question because it would threaten funding for future studies. IOW its not in the financial interest of either the space agencies or the space scientists to tell us.
Report

TheGhostofOtto1923

not rated yet 6 hours ago

> What I'd like to know is how deep would life have to be buried for it to be present under, say 1% or 0.01% of the surface? That is: we expect that life will emit telltale organics into the atmosphere (waste products). How deep and how geographically limited would we expect these active areas to be in order to be consistent with the (virtually zero) concentrations we're finding? Obviously, this question would rely on deserts on Earth for a baseline. My cynical guess is that we're not hearing answers to this type of question because it would threaten funding for future

> studies. IOW its not in the financial interest of either the space agencies or the space scientists to tell us.

That sounds like something basic and elementary that would have occurred to scientists, don't you think? Why don't you look around on the INTERNET and see what you can find?
Report

Professor Plum

-

not rated yet 3 hours ago
Me: TopCat22 did you fart?

Shootist: You have art?

sselig: I love playing darts.
Report

baudrunner

-

not rated yet 1 hour ago
@TheGhostofOtto1923 On the one hand, we had Carl Sagan describe Saturn's moon Titan as having the conditions of a pre-biotic Earth. On the other, we know now that over 90% of the methane found here was/is produced by archaea. Regardless of how the methane got in Mars, it is tempting to think that someday we might be prospecting for oil there.
Report

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