





Mars

*Rover.*

"This is really a great moment for the mission," Grotzinger told a news conference here at the fall meeting of the American Geophysical Union.

The presence of methane is significant because the gas cannot exist for long. Calculations indicate that sunlight and chemical reactions in the Martian atmosphere would break up the molecules within a few hundred years, so any methane there now must have been created recently.

It could have been created by a geological process known as serpentinization, which requires both heat and liquid water. Or it could be a product of life in the form of microbes known as methanogens, which release methane as a waste product.

Even if the explanation for the methane turns out to be geological, the hydrothermal systems would still be prime locations to search for signs of life.

Scientists have always expected that some tiny amount of methane would be found on Mars. Cosmic dust falling on the planet contains organic compounds that are broken up by ultraviolet light from the sun, producing methane.

But the new findings, which are described in detail in a paper this week in the journal *Science*, are a 180-degree flip from a year ago, when mission scientists said that Curiosity had found no signs of methane, placing an upper limit of 1.3 parts per billion by volume.

Since then, the scientists refined their measurements, detecting a background level of 0.7 parts per billion. That is half of what was predicted, raising another mystery that somehow methane is also being destroyed.

But in November 2013, two months after the scientists reported the absence of methane on Mars, the rover measured methane levels 10 times as high.

"It was an 'oh my gosh' moment," said Christopher R Webster of Nasa's Jet Propulsion Laboratory, the lead author of the Science paper.

The methane levels stayed high through at least the end of January.



*Even if the explanation for the methane turns out to be geological, the hydrothermal systems would still be prime locations to search for signs of life. (Photo credit: Nasa)*

It subsequently fell, to less than 1 part per billion.

An earlier measurement in July had also been high, although it dropped by half a week later, and the

margin of error made it unclear what was going on. Curiosity made no methane measurements between July and November 2013.

Sushil K Atreya of the University of Michigan, a member of the science team, said it was possible that elevated methane levels lasted from July through January. "It could have been over six months," he said, "but we don't know that."

Given its quick appearance and quick disappearance, mission scientists suspect the newly discovered methane was a relatively small burst.

A decade ago, three teams of scientists reported that they had detected methane in the Martian atmosphere - two using observations from Earth, one using the European Space Agency's Mars Express orbiter.

All of the measurements were at the edge of the margin of error, and the methane appeared to disappear two years later. If true, that meant that not only was something creating methane on Mars, something else was quickly destroying it.

Many Mars scientists decided that a simpler solution to the methane mystery was that the measurements were mistaken, a conclusion bolstered by the absence reported by the Curiosity team last year.

Now, Grotzinger said, "It's back on the table."

Michael J Mumma of Nasa's Goddard Space Flight Center in Greenbelt, Maryland, who led one of the teams that reported much larger methane plumes in the Mars atmosphere in 2003 based on measurements from Earth - and has found no methane since 2005 - said the new data was "pleasant" after years of doubts from critics.

The new Curiosity measurements "confirmed this startling reality that methane is being released, sporadically, and it is being destroyed quickly," he said. "Both events are surprising."

As for the organic molecules, they showed up in a mudstone nicknamed Cumberland that Curiosity drilled in May 2013.

Within Curiosity is a miniature chemistry laboratory that detected significant amounts of the organic molecule chlorobenzene, in much higher concentrations than had been seen in other rocks it had examined.

Scientists spent months analyzing whether the organic compounds came from Cumberland or contamination Curiosity had brought from Earth.

"You don't want to be faked out," Grotzinger said.

The scientists are still unsure whether Cumberland contained chlorobenzene, which is not a naturally occurring compound on Earth, or if that was the end product of chemical reactions involving other

organic molecules in the rock as it was heated. But they convinced themselves that the organic carbon is Martian.

"In part, Curiosity was built to explore for organics," Grotzinger said, "and we found them."