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News

Mars rover finds conditions 'more conducive to life'

Carbonate-rock outcrop holds clues to red planet's history.

Richard A. Lovett

More than four years after they were gathered, hard-to-interpret data from the Mars rover Spirit have finally been cracked. They reveal carbonate minerals to be a major component of a rock formation known as Comanche in the Columbia Hills region of the Gusev Crater.

Rocks on Mars suggest water on the planet's surface was not too acidic to harbour life.

NASA & The Hubble Heritage Team (STScI/AURA)

"The discovery is significant," says Oded Aharonson, a planetary scientist at the California Institute of Technology in Pasadena who was not directly involved in the find, "because of the intimate connection between the formation of carbonates and persistent liquid water." That connection helps to solidify the view that Mars was once warm, wet and perhaps capable of supporting life.

One way for the planet to have been warm in its youth would have been greenhouse warming from a thick carbon dioxide atmosphere, but, if so, where did all the carbon dioxide go? "One possibility is that meteorites blew it out into space," says Richard Morris, a planetary scientist at NASA's Johnson Space Center in Houston, Texas, and lead author of the study[1]. "Another is that it got tied up interacting with water and precipitated out as carbonate minerals."

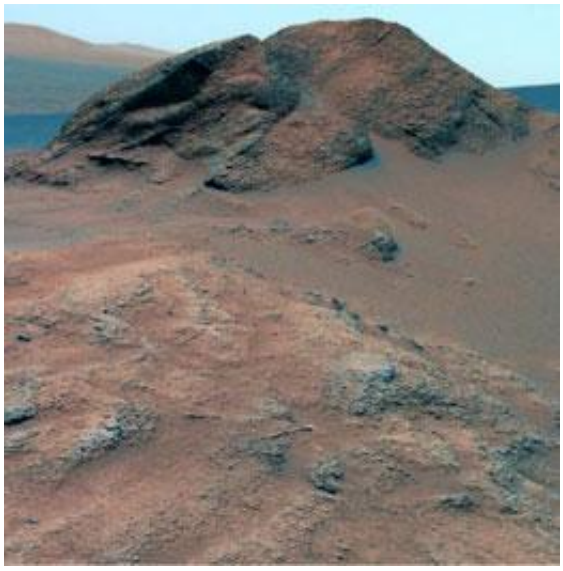
Because carbonate minerals dissolve easily in acid, their continued, unaltered existence also indicates that they not only formed in chemically neutral — rather than acidic — conditions, but that the conditions remained that way. That was not the case for other water-related rocks found on the far side of the planet by the rover Opportunity[2]. "That's certainly more conducive to life," says Morris, "but it doesn't prove one way or another that there was life."

Testing times

So why were Spirit's findings such a long time coming?

When Spirit visited the Comanche outcrop in late 2005, it was in a hurry to get to a safe winter haven. Scientists stopped it for long enough to examine the outcrop with three instruments: the rover's Mössbauer spectrometer, its alpha-particle X-ray spectrometer (APXS) and its miniature thermal-emission spectrometer (Mini-TES). All three produced data that was difficult to decipher.

"The Mössbauer data were our first clue that something was really different about this outcrop," Morris says. He notes, however, that at first, "we were unsure how to interpret it". It took a while for the team to figure out that the spectra were consistent with an iron-containing carbonate.



The Spirit rover found evidence of carbonate minerals at the Comanche outcrop on Mars. *NASA/JPL/Cornell*

The APXS data were even more difficult to interpret. That's because the APXS only directly identifies the presence of elements at least as heavy as sodium. After untangling the data, Morris says, the team realized that the readings meant that the outcrop was rich in light elements such as carbon and oxygen, both of which are prevalent in carbonates.

But the biggest problem was with the Mini-TES. A few months before the rover reached Comanche, a storm hit it, coating a crucial lens in dust. "It kind of put dust in its eye," Morris says. Only recently did the rover team figure out how to correct for that to make sense of the subsequent readings.

Once that was done, all three instruments pointed to a consistent result: Comanche contains a large amount of magnesium–iron carbonate.

The fact that all three instruments agree adds to the strength of the finding. "I think the authors make a compelling case," says Aharonson.

Orbital maps

The results augment a prior discovery by a spectrometer aboard NASA's Reconnaissance Orbiter of signs of carbonate deposits in a region called Nili Fossae[3]. Not only had these spectra shown the existence of carbonates, but details of their composition were similar to those found by Spirit. "The mineralogy is in pretty good agreement," Morris says.

But the space measurements didn't reveal how much carbonate was present. And limited prior direct measurements, from rocks blasted from the Martian surface that later fell to Earth as 'Martian meteorites', had shown only low levels: "about 2%, maximum", says Morris.

Comanche, on the other hand, is 16–34% carbonate by weight. Furthermore, the outcrop seems to be a remnant of a larger layer, now heavily eroded.

"This is the first step in the process of figuring out if there is enough carbonate on Mars to account for the atmosphere in times past," Morris says.

Other scientists agree. "The new results indicate that the carbonate formation was most probably widespread," says Victor Baker, a geologist and planetary scientist at the University of Arizona in Tucson.

References

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