

"Slam Dunk" Sign of Ancient Water on Mars

Dec 8, 2011: NASA's Mars rover Opportunity has found bright veins of a mineral, apparently gypsum, deposited by water near the rim of Endeavour Crater. The discovery was presented yesterday at the American Geophysical Union's conference in San Francisco.

"This tells a slam-dunk story that water flowed through underground fractures in the rock," said Steve Squyres of Cornell University, Ithaca, N.Y., principal investigator for Opportunity. "This stuff is a fairly pure chemical deposit that formed in place right where we see it. It's the kind of thing that makes geologists jump out of their chairs."



This color view of a mineral vein called "Homestake" comes from Opportunity's panoramic camera. Opportunity examined it in November 2011 and found it to be rich in calcium and sulfur, possibly the calcium-sulfate mineral gypsum. [larger image]

The vein examined most closely by Opportunity is about the width of a human thumb (1 to 2 centimeters) and 40 to 50 centimeters long. Observations by the rover reveal this vein and others like it within an apron surrounding the rim of Endeavour Crater. Nothing like it was seen in the 33 kilometers of crater-pocked plains that Opportunity explored for 90 months before it reached Endeavour, nor in the higher ground of the crater's rim.²

Last month, researchers used the Microscopic Imager and Alpha Particle X-ray Spectrometer on the rover's arm and multiple filters of the Panoramic Camera on the rover's mast to examine the vein, which is informally named "Homestake." The spectrometer identified plentiful calcium and sulfur, in a ratio pointing to relatively pure calcium sulfate.



Calcium sulfate can exist in many forms varying by how much water is bound into the minerals' crystalline structure. The multi-filter data from the camera suggest gypsum, a hydrated calcium sulfate. On Earth, gypsum is used for making drywall and plaster of Paris.

Observations from orbit had detected gypsum on Mars previously. A dune field of windblown gypsum on far northern Mars resembles the glistening gypsum dunes in White Sands National Monument in New Mexico. The origin of that windblown gypsum is, however, uncertain.

"It is a mystery where gypsum sand on northern Mars comes from," said Opportunity science-team member Benton Clark of the Space Science Institute in Boulder, Colo. "At Homestake, however, we see the mineral right where it formed. It will be important to see if there are deposits like this in other areas of Mars."



A microscopic image of the "Homestake" mineral vein. [larger image]

The Homestake deposit, whether gypsum or another form of calcium sulfate, likely formed from water dissolving calcium out of volcanic rocks. The calcium combined with sulfur that was either leached from the rocks or introduced as volcanic gas, and it was deposited as calcium sulfate into an underground fracture that later became exposed at the surface.

The discovery of gypsum fits the emerging picture of an ancient wet environment. Throughout Opportunity's long traverse across Mars' Meridiani plain, the rover has driven over bedrock composed of magnesium, iron and calcium sulfate minerals that also indicate the presence of water billions of years ago. The highly concentrated calcium sulfate at Homestake could have been produced in conditions

more neutral than the harshly acidic conditions indicated by the other sulfate deposits observed by Opportunity.

"It could have formed in a different type of water environment, one more hospitable for a larger variety of living organisms," Clark said.

Opportunity has been exploring Mars for nearly 8 years, far exceeding than the rover's original 3-month mission, which began in 2004. Gypsum veins are just the latest example of an important discovery about wet environments on ancient Mars that may have been favorable for supporting microbial life. Opportunity's equally productive twin, Spirit, stopped communicating in 2010. Opportunity continues exploring, currently heading to a sun-facing slope on the northern end of the Endeavour rim fragment called "Cape York" to keep its solar panels at a favorable angle during the mission's fifth Martian winter.

For more information about the rovers, including NASA's newest rover Curiosity now en route to Mars, visit <http://www.nasa.gov/rovers> and <http://marsrovers.jpl.nasa.gov> .

Production Editor: Dr. Tony Phillips | Credit: Science@NASA

More Information

NASA Mars Rover Finds Mineral Vein Deposited by Water --more images and information related to this story

Mars Exploration Rovers -- home page

Footnotes:

(1) The fact that the gypsum is found where right it formed is significant. "That can't be said for other gypsum seen on Mars or for other water-related minerals Opportunity has found," notes Squyres. Other deposits of gypsum on Mars, for instance, are windblown dune formations where the mineral might have traveled far from its point of origin.

(2) Homestake and similar-looking veins appear in a zone where the sulfate-rich sedimentary bedrock of the plains meets older, volcanic bedrock exposed at the rim of Endeavour. That location may offer a clue about their origin. "We want to understand why these veins are in the apron but not out on the plains," said the mission's deputy principal investigator, Ray Arvidson, of Washington University in St. Louis. "The answer may be that rising groundwater coming from the ancient crust moved through material adjacent to Cape York and deposited gypsum, because this material would be relatively insoluble compared with either magnesium or iron sulfates."