# Exposed rocks point to water on ancient Mars

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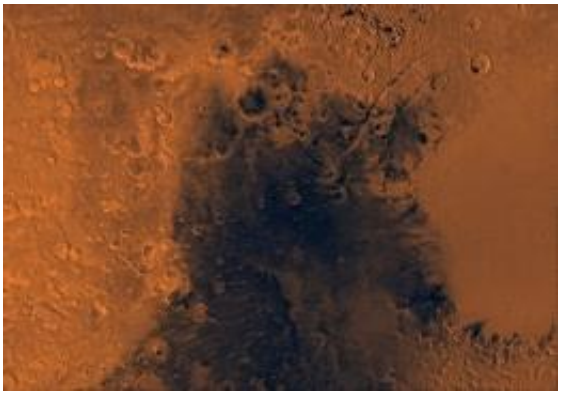


Mars digital-image mosaic merged with color of the MC-13 quadrangle, Syrtis Major region of Mars. The central part is dominated by dark dust and lava flows of the Syrtis Major Planitia region. The unique outcrop was located within the central peak of a crater to the southwest of Syrtis Major. Credit: NASA

A new discovery of hydrothermally altered carbonate-bearing rocks on Mars points toward habitable environments deep in the martian crust, a Planetary Science Institute researcher said.

A deposit of carbonate rocks that once existed 6 km (about 4 miles) below the surface of Mars was uplifted and exposed by an ancient meteor impact, said Joseph Michalski, research scientist with PSI. The carbonate minerals exist along with hydrated silicate minerals of a likely hydrothermal origin.

Using data returned from NASA's Mars Reconnaissance Orbiter (MRO) spacecraft, researchers have spotted this unique mineralogy within the central peak of a crater to the southwest of a giant martian volcanic province named Syrtis Major. With infrared spectra from the Compact Reconnaissance Imaging Spectrometer for Mars (CRISM), planetary geologists detected the hydrothermal minerals from their spectroscopic fingerprints.

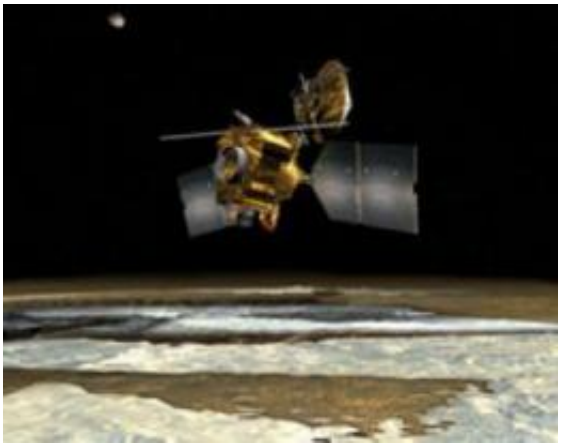
Visible images from the High Resolution Imaging Science Experiment (HiRISE) camera aboard MRO show that the carbonates and hydrated silicate minerals occur within deformed bedrock that was exhumed by an ancient meteor impact that poked through the volcanic upper crust of Mars.

"Carbonate rocks have long been a Holy Grail of Mars exploration for several reasons," Michalski said. "One reason is because carbonates form with the ocean and within lakes on Earth, so the same could be true for ancient Mars -- such deposits could indicate past seas that were once present on Mars. Another reason is because we suspect that the ancient martian atmosphere was probably denser and $CO_2$-rich, but today the atmosphere is quite thin so we infer that the $CO_2$ must have gone into carbonate rocks somewhere on Mars."

Michalski and co-author Paul B. Niles of NASA Johnson Space Center recently published the results in a paper titled "Deep crustal carbonate rocks exposed by meteor impact on Mars" in *Nature Geoscience*.

While this is not the first detection of carbonates on Mars, Michalski said, "This detection is significant because it shows other carbonates detected by previous workers, which were found in a fairly limited spatial extent, were not a localized phenomenon. Carbonates may have formed over a very large region of ancient Mars, but been covered up by volcanic flows later in the history of the planet. A very exciting history

of water on Mars may be simply covered up by younger lava!”



The research team used data from the HiRise instrument onboard NASA's Mars Reconnaissance Orbiter, Credit: NASA/JPL-Caltech

The discovery also has implications for the habitability of the martian crust.

“The presence of carbonates along with hydrothermal silicate minerals indicates that a hydrothermal system existed in the presence of $CO_2$ deep in the martian crust,” Michalski says. “Such an environment is chemically similar to the type of hydrothermal systems that exist within the ocean floor of Earth, which are capable of sustaining vast communities of organisms that have never seen the light of day.

“The cold, dry surface of Mars is a tough place to survive, even for microbes. If we can identify places where habitable environments once existed at depth, protected from the harsh surface environment, it is a big step forward for astrobiological exploration of the red planet.”