Orbiter discovers a possibly once-habitable ancient Mars lake

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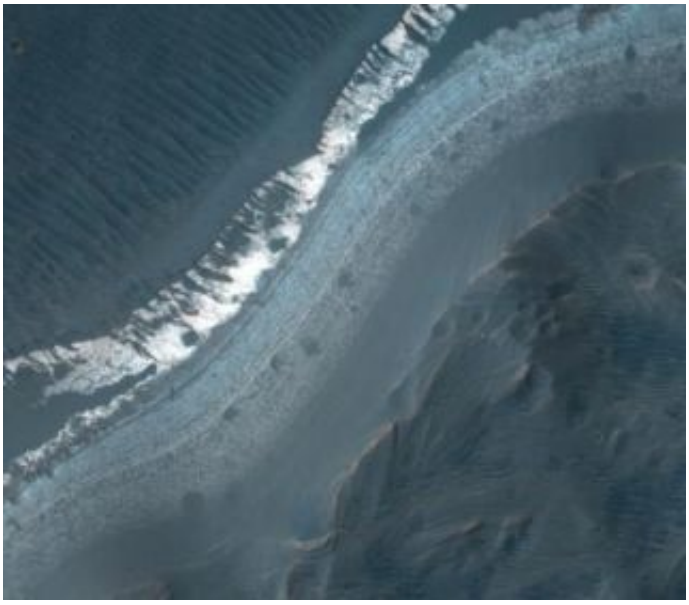

The HiRISE camera on the Mars Reconnaissance Orbiter took this image of the largest fan in Holden crater when the orbiter was flying about 162 miles over the surface in March 2007. Geologists discovered a complex geologic history for the site, including two wet episodes that may have been amenable to life. Credit: NASA/JPL/University of Arizona

Scientists studying images from The University of Arizona-led High Resolution Imaging Experiment camera on NASA's Mars Reconnaissance Orbiter have discovered never-before-seen impact "megabreccia" and a possibly once-habitable ancient lake on Mars at a place called Holden crater.

The megabreccia is topped by layers of fine sediments that formed in what apparently was a long-lived, calm lake that filled Holden crater on early Mars, HiRISE scientists say.

"Holden crater has some of the best-exposed lake deposits and ancient megabreccia known on Mars," said HiRISE's principal investigator, professor Alfred McEwen of the UA's Lunar and Planetary Laboratory. "Both contain minerals that formed in the presence of water and mark potentially habitable environments. This would be an excellent place to send a rover or sample-return mission to make major advances in understanding if Mars supported life."

Holden crater is an impact crater that formed within an older, multi-ringed impact basin called Holden basin. Before an impact created Holden crater, large channels crossed and deposited sediments in Holden basin.

Blocks as big as 50 meters across were blasted from Holden basin when Holden crater formed, then fell chaotically back to the surface and eventually formed "megabreccia," a conglomeration of large, broken boulders mixed with smaller particles. HiRISE images show megabreccia outcrops in Holden crater walls. This megabreccia may be some of the oldest deposits exposed on the surface of Mars.

At least 5 percent, by weight, of the fine sediments in the layer on top of the megabreccia consists of clay, according to another instrument on the Mars Reconnaissance Orbiter, the Compact Reconnaissance Imaging Spectrometer for Mars, or CRISM.

"The origin of the clays is uncertain, but clays in the probable lake sediments implies quiescent conditions that may preserve signatures of a past habitable environment," HiRISE co-investigator John Grant of the Smithsonian National Air and Space Museum said. "If we were looking

on Earth for an environment that preserves signatures related to habitability, this is one of the kinds of environments we would look at."

And even the clay-containing layers aren't all that's icing the cake. Topping the clay layers that formed in the placid Holden crater lake are layers of great boulder-filled debris unleashed later, when water breached Holden crater rim, creating a torrential flood that eroded the older lake sediments.

The clay-rich layers would have remained buried from view, except for that great piece of luck, the fact that Holden crater rim could no longer withstand the force of an estimated 4,000 cubic kilometers of water dammed behind it. The body of water would have been larger than Lake Huron.

"The volume of water that poured through during this flood must have been spectacular," Grant said. "It ripped up finely bedded materials, including blocks 70 meters or 80 meters across -- blocks nearly the size of football fields."

The first, prolonged watery episode at Holden crater that settled out the fine-grain sediments probably lasted at least thousands of years. By contrast, the second lake, formed when the crater rim was breached, may have lasted only hundreds of years, not long at all, Grant said.

The megabreccia excavated when Holden crater formed is the first found on Mars, Grant said. "When large craters form, they produce very large blocks of material. We see them on Earth. Popigai Crater in Russia is one example. But we'd never seen them on Mars, and we knew they ought to be there. Now we've seen them with HiRISE."

The observations suggest that the clays originally could have formed before the impact created Holden crater in the older Holden basin. Many

of the blocks in the megabreccia appear to erode more easily than the surrounding crater wall material. These blocks could be chunks of Holden basin sediments that predate the impact crater, Grant said. "These blocks could be derived from the earlier Holden basin that were excavated on impact, then later re-eroded, with the sediments settling to the bottom of the long-lived lake. It's intriguing to think the clays we see in Holden crater now might actually have been recycled."

Holden crater is one of six remaining landing site candidates for NASA's Mars Science Laboratory, a mission scheduled for launch next year.

So far, most evidence for sustained wet conditions on Mars is limited to the planet's earliest history, the HiRISE scientists say. While water certainly flowed over the planet later in its history, it may have flowed only in short-lived, or catastrophic events.

Grant is first author on a research paper about Holden crater, published in the journal *Geology* last week.

The Holden Crater image is on the HiRISE Website at http://hirise.lpl.arizona.edu/PSP_003077_1530

Source: University of Arizona