Camera on Curiosity's arm will magnify clues in rocks

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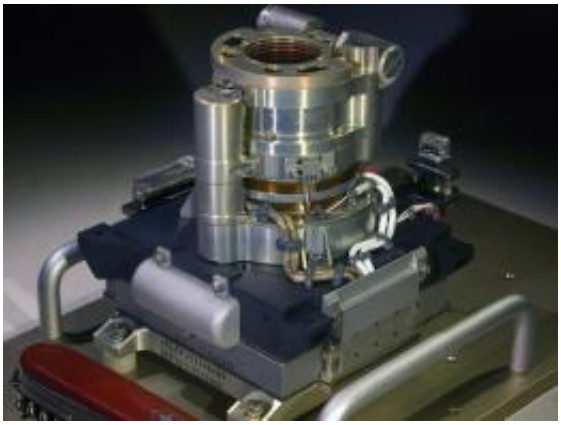

The Mars Hand Lens Imager (MAHLI) camera will fly on NASA's Mars Science Laboratory mission, launching in late 2011. Image credit: NASA/JPL-Caltech/Malin Space Science Systems

NASA's next Mars rover, Curiosity, will wield an arm-mounted magnifying camera similar to one on the Mars Rover Opportunity, which promptly demonstrated its importance for reading environmental history from rocks at its landing site in 2004.

Within a few weeks after the landing, that camera at the end of Opportunity's arm revealed details of small spheres embedded in the rocks, hollows where crystals had dissolved, and fine layering shaped like smiles. These details all provided information about the site's wet past.

The camera installed on the end of Curiosity's arm this month is the Mars Hand Lens Imager, or MAHLI. Its work will include the same type of close-up inspections accomplished by the comparable camera on Opportunity, but MAHLI has significantly greater capabilities: full-color photography, adjustable focus, lights, and even video. Also, it sits on a longer arm, one that can hold MAHLI up higher than the cameras on the rover's mast. MAHLI will use those capabilities as one of 10 science instruments to study the area of Mars where NASA's Mars Science Laboratory mission lands Curiosity in August 2012.

This close-up view of a stone found in San Diego was taken by a testing twin -- the "life test unit" -- of the Mars Hand Lens Imager (MAHLI) camera. Image credit: NASA/JPL-Caltech/Malin Space Science Systems

The Mars Hand Lens Imager takes its name from the magnifying tool that every field geologist carries. Ken Edgett of Malin Space Science Systems, San Diego, is the principal investigator for the instrument. He said, "When you're out in the field and you want to get a quick idea what minerals are in a rock, you pick up the rock in one hand and hold your hand lens in the other hand. You look through the lens at the colors, the crystals, the cleavage planes: features that help you diagnose what

minerals you see.

"If it's a sedimentary rock, such as the sandstone you see at Arches National Park in Utah, or shale -- which is basically petrified mud -- like in the Painted Desert in Arizona, you use the hand lens not just to see what minerals are in it but also the sizes and shapes of the grains in the rock. You also look at the fine-scale layering in the rock to get an idea of the sequence of events. Sedimentary rocks record past events and environments."

While other instruments on Curiosity will provide more information about what minerals are in rocks, the Mars Hand Lens Imager will play an important role in reading the environmental history recorded in sedimentary rocks. The mission's science team will use the instruments to assess whether the selected landing area has had environmental conditions favorable for life and for preserving evidence about whether life existed.

The team currently assembling and testing Curiosity and other parts of the Mars Science Laboratory spacecraft at NASA's Jet Propulsion Laboratory, Pasadena, Calif., is continuing tests of MAHLI this month, now that the camera is mounted beside other tools on the robotic arm. The spacecraft will launch from Florida between Nov. 25 and Dec. 18, 2011.

Edgett led the preparation in early 2004 of a proposal to include MAHLI in the Mars Science Laboratory's payload. During those same months, the camera on Opportunity's arm -- that mission's Microscopic Imager -- was demonstrating the potential value of a successor, and generating ideas for improvements. Opportunity's Microscopic Imager has a fixed focus. To get targets in focus, it always needs to be placed the same distance from the target, recording a view of an area 3 centimeters (1.2 inches) across. To view a larger area, the camera takes multiple images,

sometimes more than a dozen, each requiring a repositioning of Opportunity's arm.

"When I was writing the proposal, the Microscopic Imager took about 40 images for a mosaic of one rock," Edgett said. "That's where the idea came from to make the focus adjustable. With adjustable focus, the science team has more flexibility for trade-offs among the rover's resources, such as power, time, data storage and data downlink. For example, the camera could take one or two images from farther away to cover a larger area, then go in and sample selected parts in higher resolution from closer up."

MAHLI can focus on targets as close as about 21 millimeters (0.8 inch) and as distant as the horizon or farther. JPL's Ashwin Vasavada, deputy project scientist for the Mars Science Laboratory, said, "MAHLI is really a fully functional camera that happens to be on the end of the arm. The close-up capability is its specialty, but it will also be able to take images or videos from many viewpoints inaccessible to the cameras on the mast, such as up high, down low, under the rover and on the rover deck. Think of it like a hand-held camera with a macro lens, one that you could use for taking pictures of the Grand Canyon, of yourself, or of a bumblebee on a flower."

Edgett is looking forward to what the camera will reveal in rock textures. "Just like larger rocks in a river, grains of sand carried in a stream get rounded from bouncing around and colliding with each other," he said. "If you look at a sandstone with a hand lens and see rounded grains, that tells you they came from a distance. If they are more angular, they didn't come as far before they were deposited in the sediment that became the rock. Where an impact excavated a crater, particles of the material ejected from the crater would be very angular.

"When you're talking about ancient rocks as clues for assessing

habitability," he continued, "you're talking about the environments the sediments were deposited in -- whether a lake, a desert, an ice field. Also, what cemented the particles together to become rocks, and what changes have affected the rock after the sediments were deposited? All these things are relevant to whether an environment was favorable for life and also whether it was favorable for preserving the record of that life. Earth is a planet teeming with life, but most rocks have not preserved ancient organisms; Mars will be even more challenging than Earth in this sense."

Edgett says he is eager to see an additional image from this camera besides the details of rock textures. With the arm extended upwards, the camera can look down at the rover for a dramatic self-portrait on Mars. But as for the most important image the Mars Hand Lens Imager will take: "That will be something that surprises us, something we're not expecting."

Provided by JPL/NASA