NASA's Twin Mars Rovers Continue Exploration

February 15 2005

NASA's Spirit rover found a new class of water-affected rock, while its twin, Opportunity, finished inspecting its own heat shield and set a new martian driving record. The rovers successfully completed their three-month primary missions in April 2004 and are working on extended exploration missions.

"This is probably the most interesting and important rock Spirit has examined," said Dr. Steve Squyres of Cornell University, Ithaca, N.Y., principal investigator for the rovers. The rock, dubbed "Peace," is an exposure of bedrock in the Columbia Hills. The rock is in the Gusev Crater, where Spirit landed 13 months ago. "This may be what the bones of this mountain are really made of; it gives us even more compelling evidence for water playing a major role for altering the rocks here," Squyres added.

Peace contains more sulfate salt than any other rock Spirit has examined. Dr. Ralf Gellert, of Max-Planck-Institut fur Chemie, Mainz, Germany, said, "Usually when we have seen high levels of sulfur in rocks at Gusev, it has been at the very surface. The unusual thing about this rock is that deep inside; the sulfur is still very high. The sulfur enrichment at the surface is correlated with the amount of magnesium, which points to magnesium sulfate."

Observations by Spirit show the rock contains significant amounts of the minerals olivine, pyroxene and magnetite, all of which are common in some types of volcanic rock. The rock's texture appears to be sand-size

grains coated with a material loosely binding the rock together. Spirit's rock abrasion tool dug about 1 centimeter (0.4 inch) deep in two hours.

"It looks as if you took volcanic rocks that were ground into little grains, and then formed a layered rock with them cemented together by a substantial quantity of magnesium-sulfate salt," Squyres said. "Where did the salt come from? We have two working hypotheses we want to check by examining more rocks. It could come from liquid water with magnesium sulfate salt dissolved in it, percolating through the rock, then evaporating and leaving the salt behind. Or it could come from weathering by dilute sulfuric acid reacting with magnesium-rich minerals that were already in the rock. Either case involves water," he said.

Opportunity used its microscopic imager last week to examine a cross section of the heat shield that protected the spacecraft as it slammed into Mars' atmosphere. This is the first time experts have been able to examine a heat shield after it entered another planet's atmosphere. Engineers expect the findings to aid design for future missions.

"We've identified each broken piece of the heat shield. We know there's a lot of data there, but we still need to analyze it," said Ethiraj Venkatapathy of NASA's Ames Research Center, Moffett Field, Calif.

Christine Szalai, a spacecraft engineer at NASA's Jet Propulsion Laboratory (JPL), Pasadena, Calif., said, "We are examining the images to determine the depth of charring in the heat shield material. In the initial look, we didn't see any surprises. We will be working for the next few months to analyze the performance of the heat shield," Szalai said.

Since leaving the heat shield, Opportunity has been traveling south to explore new sites. The rover set a single-day martian driving record, covering 154.65 meters (507.4 feet) on Jan. 28. Two days later, it drove

even farther, 156.55 meters (513.6 feet). The first 90 meters (295 feet) of each drive was performed in blind-drive mode, following a route planners created from stereo images from the rover and maps created from orbital imagery. The rest was autonomous driving, with the rover choosing its own route to avoid any hazards it perceived in stereo images taken along the way.

"The terrain we're crossing is so flat we can see a long way ahead," said JPL rover planner Frank Hartman, who teamed with Jeff Biesiadecki to plot the drive. "Opportunity has paused for some trenching, but in a few days we'll put the pedal to the metal again."

Source: NASA (Guy Webster, Jet Propulsion Laboratory, Pasadena)