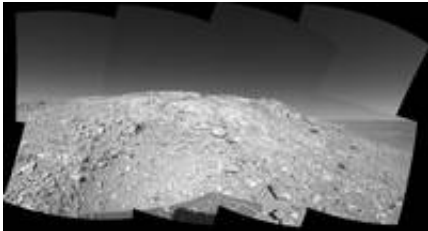


"Science" Special: How Mars rover Spirit's cameras detected variations in Martian soil

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The eyes aboard the Mars rover Spirit are delivering ground truth.

After more than six months of examining the photographic and spectral data from the rover, [Mars](#) mission scientists confirm that the albedo -- which is the percentage of sunlight reflected on the red planet's dusty surface -- indicates important variations in mineral and dust composition.

"Spirit landed in a medium brightness region of Gusev crater, and on this mission has crossed into brighter and darker areas travelling to Bonneville crater and beyond," says Jim Bell, associate professor of astronomy at [Cornell University](#) and the lead scientist on the high-resolution, color, stereo panoramic cameras, known as Pancams, carried by Spirit and its twin rover, Opportunity. Says Bell, "The albedo changes that we noticed with Pancam correlate with the changes seen from the Mars orbiters above. This is ground-truth information." (Bonneville was

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The albedo findings are detailed in a research paper, which, along with 10 other papers resulting from Spirit's journey across the Martian surface, are published this week in a special issue of the journal *Science* (Aug. 6, 2004). The issue, in which 120 authors -- including several from Cornell -- participate, features a 2-foot long, eight-fold poster of Pancam views of Spirit's landing site in Gusev crater.

The issue's most prominent author is Steve Squyres, Cornell professor of astronomy and leader of the science team on the twin-rover Mars mission. In his overview article, Squyres notes that in its first three months of exploration Spirit has failed to find "lacustrine" (lake-related) deposits. To date, "we have found no evidence for lacustrine sedimentations at the Spirit landing site," writes Squyres in his overview. However, since its landing, Spirit has traveled nearly 2 miles, or 3 kilometers, to a hilly region dubbed Columbia Hills, where the promise of finding water-related materials may be greater. "I think there's a potential for a lot more in the Columbia Hills," says Squyres.

On the way to the Columbia Hills Spirit used 13 different spectral filters on the Pancams, enabling mission scientists to obtain spectra of the ultraviolet to infrared properties of soils and rocks.

Bell and his colleagues use the panoramic cameras to identify rocks and soil regions for suitable analysis. "We looked to see how dusty or clean the rocks were," Bell notes. Using Pancam photographic filters in the visual spectrum and in the infrared, the scientists can ascertain whether a rock is worth examining. "We use this information about the shape, size and color properties of the rocks to find what kinds of iron-bearing minerals are present and to identify rock candidates for further investigation with the arm instruments," he says.

The image resolution from the mast-mounted Pancams provides a 20/20 view similar to what a person would experience on the Martian surface. This resolution is three times higher than that recorded by the cameras on the Mars Pathfinder mission in 1997 or the Viking landers in the mid-1970s. From 3 meters (10 feet) away, Pancam has a resolution of 1 millimeter per pixel.

As well as looking at the ground, Spirit's Pancams have spent time looking up. The scientists attempted to point their cameras at the sun daily and, early in the mission, found a relatively opaque atmosphere, related to a global dust storm in late 2003. By sol 85 (a sol, or Martian day, is equal to 24 hours, 39 minutes, 35 seconds on Earth) the dust had begun to clear, reducing the opacity of the Martian sky. This clearing of the Martian atmosphere at Gusev crater allowed researchers to observe the twilight development of water-ice cloud formation.

Last week Spirit passed the 200-sol mark and it was driving up Columbia Hills searching for bedrock that could provide evidence of having been formed in, or altered by, liquid water. Since sol 190, Spirit has been driving backwards on five wheels to preserve the sixth wheel's actuator, which is slowly degrading.

Bell's paper is titled "Pancam Multispectral Imaging Results from the Spirit Rover at Gusev Crater." Squyres' overview article is titled "The

Spirit Rover's Athena Science Investigation at Gusev Crater, Mars."

Source: Cornell

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