ASU Mars instrument gets new lease on life as NASA extends Mars Odyssey mission

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A six-minute rocket firing on Sept. 30 has put NASA's Mars Odyssey spacecraft on track for a new orbit around the Red Planet. The change, part of a two-year extension for the mission, will give an ASU-operated instrument carried on Odyssey greater sensitivity for mapping Martian minerals. The instrument is the Thermal Emission Imaging System (THEMIS), a multi-band heat-sensing camera operated by ASU's Mars Space Flight Facility.

"The orbital change lets THEMIS operate at its maximum potential," says Philip Christensen of ASU's School of Earth and Space Exploration, part of the College of Liberal Arts and Sciences. Christensen designed THEMIS and is the instrument's principal investigator. "In the months to come, we expect to see a steady increase in the camera's ability to detect and map minerals on the planet's surface."

Odyssey's orbit is synchronized with the Sun. For the five years before the Sept. 30 orbital maneuver, the local solar time on Mars was about 5 p.m. wherever the spacecraft was flying over as it made its dozen passes a day moving from north to south. Similarly, the local time was 5 a.m. under the spacecraft as it flew the south-to-north leg of each orbit.

Slow drift through time

The push from the Sept. 30 maneuver will gradually change that synchronization over the next year or so. Its effect is that the time of day

on the ground when Odyssey passes overhead is now getting earlier by about 20 seconds per day. A follow-up maneuver, probably in late 2009 when the overpass time is between 2:30 and 3:00 p.m., will end the drift toward earlier times of day.

The 5 p.m./a.m. orbit was a compromise between THEMIS and the three-instrument Gamma Ray Spectrometer suite. For THEMIS, the time of day was usable but not optimal, while one of the GRS instruments, the gamma-ray detector, needed a late-afternoon orbit to avoid overheating.

The Gamma Ray Spectrometer suite made dramatic discoveries of water ice near the surface throughout most of high-latitude Mars, and provided the impetus for NASA's Phoenix Mars Lander mission. The gamma ray detector has also mapped the global distribution of many elements, such as iron, silicon and potassium. This was a high science priority for the first and second extensions of the Odyssey mission.

A panel of planetary scientists assembled by NASA recommended this year that Odyssey make the orbit change to get the best science return from the mission in coming years. The change will require shutting down the GRS' gamma-ray detector, while leaving the suite's neutron spectrometer and high-energy neutron detector in operation.

For THEMIS, the shift to a mid-afternoon orbit will boost its science data return. THEMIS works better when day-night temperature contrasts are stronger, which is the natural outcome of orbital passes earlier in the day.

Looking away

In addition, Odyssey's science team plans to begin occasionally aiming THEMIS away from the straight-down pointing used throughout the mission so far. This will allow THEMIS to fill in some gaps in earlier

mapping. It will also permit the creation of some stereo, three-dimensional imaging.

When Odyssey began mapping Mars, the spacecraft had a 4 p.m. orbit. Then mission controllers deliberately let the orbit drift over the course of about a year to the 5 p.m. time so that the GRS instrument could operate.

Yet as Christensen explains, "Many of THEMIS' most significant scientific results have come from data collected during the first six months after we arrived at Mars in late 2001."

One important finding based on such early-mission THEMIS data was the recently announced discovery of chloride mineral deposits in the ancient southern highlands. These deposits — salt beds — are possible relics of a warmer and wetter epoch on Mars. Because salt beds are effective at preserving biological traces, scientists would like to examine these to determine what they can say about a Martian biosphere, past or present.

Says Christensen, "It'll be good to get back to an orbit where THEMIS works better."

Source: Arizona State University