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Martian Magnetic Field

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Douglas Isbell
Headquarters, Washington, DC. Sept. 17, 1997
(Phone: 202/358-1753)

Diane Ainsworth
Jet Propulsion Laboratory, Pasadena, CA
(Phone: 818/354-5011)

Bill Steigerwald
Goddard Space Flight Center, Greenbelt, MD
(Phone: 301/286-7277)

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MARS GLOBAL SURVEYOR DETECTS MARTIAN MAGNETIC FIELD AS AEROBRAKING BEGINS

Scientists have confirmed the existence of a planet-wide magnetic field at Mars using an instrument on-board NASA's Mars Global Surveyor orbiter, as the spacecraft began to circle and study the planet from a highly elliptical orbit.

"Mars Global Surveyor has been in orbit for only a few days, yet it already has returned an important discovery about the Red Planet," said Vice President Al Gore. "This is another example of how NASA's commitment to faster, better, cheaper Mars exploration that began with Mars Pathfinder is going to help answer many fundamental questions about the history and environment of our neighboring planet, and the lessons it may hold for a better understanding of life on Earth."

The spacecraft's magnetometer, which began making measurements of Mars' magnetic field after its capture into orbit on Sept. 11, detected the magnetic field on Sept. 15. The existence of a planetary magnetic field has important implications for the geological history of Mars and for the possible development and continued existence of life on Mars.

"Preliminary evidence of a stronger than expected magnetic field of planetary origin was collected and is now under detailed study," said Dr. Mario H. Acuna, principal investigator for the magnetometer/electron reflectrometer instrument at NASA's Goddard Space Flight Center, Greenbelt, MD. "This was the first opportunity in the mission to collect close-in magnetic field data. Much more additional data will be collected in upcoming orbits during the aerobraking phase of the mission to further characterize the strength and geometry of the field. The current observations suggest a field with a polarity similar to that of Earth's and opposite that of Jupiter, with a maximum strength not exceeding 1/800ths of the magnetic field at the Earth's surface."

This result is the first conclusive evidence of a magnetic field at Mars. "More distant observations obtained previously by the Russian missions Mars 2,3 and 5 and Phobos 1 and 2 were inconclusive regarding the presence or absence of a magnetic field of internal origin," said Acuna.

The magnetic field has important implications for the evolution of Mars. Planets like Earth, Jupiter and Saturn generate their magnetic fields by means of a dynamo made up of moving molten metal at the core. This metal is a very good conductor of electricity, and the rotation of the planet creates electrical currents deep within the planet that give rise to the magnetic field. A molten interior suggests the existence of internal heat sources, which could give rise to volcanoes and a flowing crust responsible for moving continents over geologic time periods.

"A magnetic field shields a planet from fast-moving, electrically charged particles from the Sun which may affect its atmosphere, as well as from cosmic rays, which are an impediment to life," Acuna said. "If Mars had a more active dynamo in its past, as we suspect from the existence of ancient volcanoes there, then it may have had a thicker atmosphere and liquid water on its surface."

It is not known whether the current weaker field now results from a less active dynamo, or if the dynamo is now extinct and what the scientists are observing is really a remnant of an ancient magnetic field still detectable in the Martian crust.

"Whether this weak magnetic field implies that we are observing a fossil crustal magnetic field associated with a now extinct dynamo or merely a weak but active dynamo similar to that of Earth, Jupiter, Saturn, Uranus and Neptune remains to be seen," Acuna said.

Mars Global Surveyor's magnetometer discovered the outermost boundary of the Martian magnetic field -- known as the bow shock -- during the inbound leg of its second orbit around the planet, and again on the outbound leg.

The discovery came just before Mars Global Surveyor began its first aerobraking maneuver to lower and circularize its orbit around Mars, said Glenn Cunningham, Mars Global Surveyor project manager at NASA's Jet Propulsion Laboratory (JPL), Pasadena, CA.

"This first 'step down' into the upper atmosphere was performed in two stages," Cunningham said. "On Sept. 16, during the farthest point in the spacecraft's orbit, called the apoapsis, the spacecraft fired its main engine for 6.5 seconds, slowing Global Surveyor's velocity by 9.8 miles per hour (4.41 meters per second). This maneuver lowered the spacecraft's orbit from 163 miles (263 kilometers) to 93 miles (150 kilometers) above the surface of the planet.

At its closest approach to Mars this morning, known as the periapsis, the spacecraft dipped into the upper fringes of the Martian atmosphere for 27 seconds, allowing the drag on its solar panels to begin the long aerobraking process of circularizing its orbit."

Mars Global Surveyor will continue aerobraking through the Martian atmosphere for the next four months, until its orbit has been circularized and it is flying about 234 miles (378 kilometers) above the Martian surface. All systems and science instruments onboard the spacecraft continue to perform normally after six days in orbit around the red planet.

Additional information about the magnetic field discovery and the Mars Global Surveyor mission is available on the World Wide Web by accessing the JPL home page at:

http://www.jpl.nasa.gov

or at the Goddard Space Flight Center magnetometer site at:

http://mgs-mager.gsfc.nasa.gov

Meanwhile, NASA's Hubble Space Telescope (HST) has continued monitoring the atmospheric conditions on Mars to help planning for the Mars Global Surveyor aerobraking activity. The latest HST

Mars image, taken Sept. 12 with the Wide Field Planetary Camera 2
under the direction of Phil James of the University of Toledo and
Steve Lee of the University of Colorado, is available on the
Internet at the following URLs:

http://oposite.stsci.edu/pubinfo/PR/gif/mars0609.gif (GIF),
http://oposite.stsci.edu/pubinfo/PR/jpeg/mars0609.jpg (JPEG)

and via links in:

http://oposite.stsci.edu/pubinfo/PR/97/31.html

Mars Global Surveyor is the first mission in a sustained
program of robotic Mars exploration, known as the Mars Surveyor
Program. The mission is managed by the Jet Propulsion Laboratory
for NASA's Office of Space Science, Washington, DC. JPL's
industrial partner is Lockheed Martin Astronautics, Denver, CO,
which developed and operates the spacecraft. JPL is a division of
the California Institute of Technology, Pasadena, CA.

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