NASA Facts

National Aeronautics and
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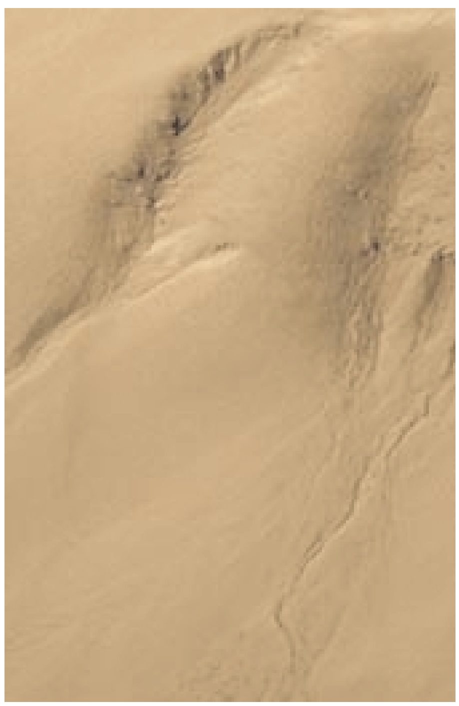
Mars Global Surveyor

NASA's Mars Global Surveyor, the first in a series of spacecraft destined to explore the red planet, began its primary mapping mission in March 1999.

Mars Global Surveyor is a global mapping mission, carrying a suite of science instruments designed to study the entire Martian surface, atmosphere and interior. Measurements are be collected from a low-altitude, nearly polar orbit 378 kilometers (234 miles) above the Martian surface over the course of one complete Martian year, the equivalent of nearly two Earth years.



Signs of water erosion and debris flow are seen in this high resolution view of gullies eroded into the wall of a meteor impact crater in Noachis Terra on Mars, taken by NASA's Mars Global Surveyor.

The mission is providing a new, global portrait of how Mars looks today. The new outlook is helping planetary scientists to better understand the history of Mars' evolution, and is providing clues about the planet's interior and surface evolution. With this information, we will have a better understanding of the history of all of the inner planets of the solar system, including our home planet, Earth.

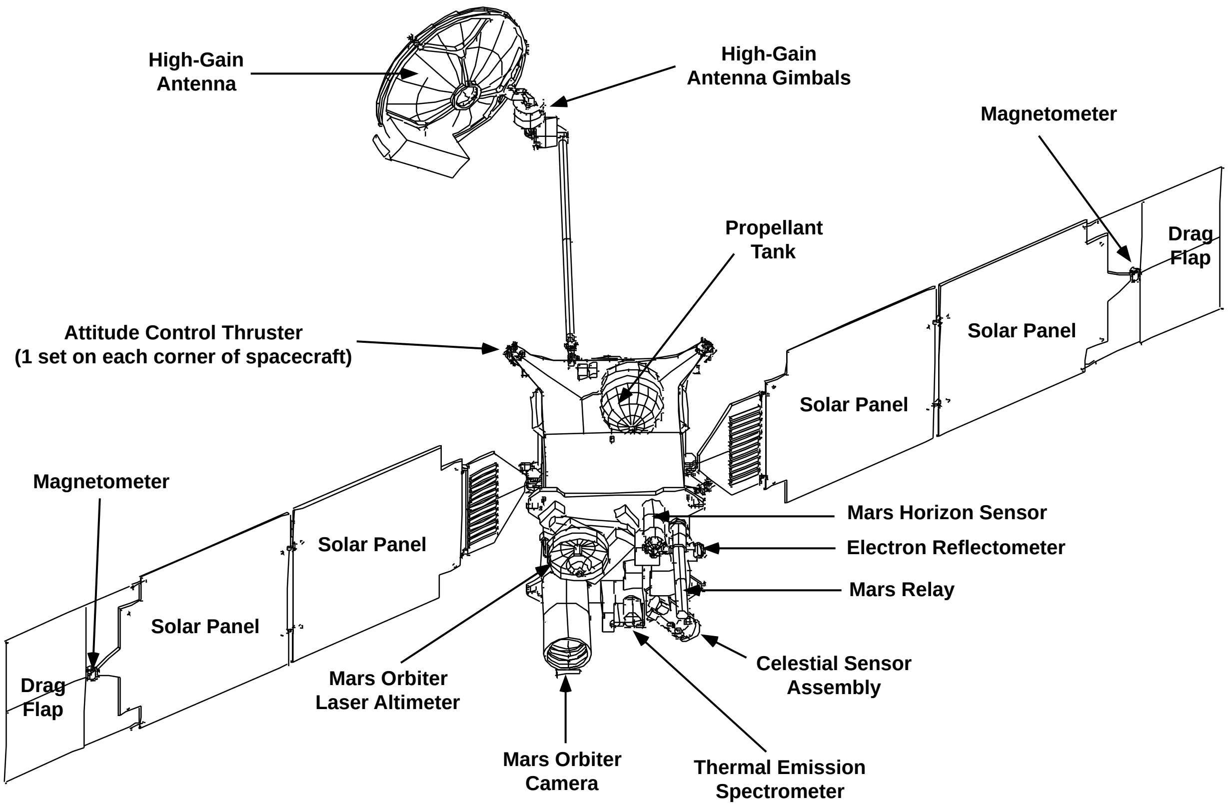
Mars Global Surveyor continues NASA's long exploration of the red planet, which began more than 30 years ago with the Mariner 4 spacecraft that produced the first pictures of the planet's cratered surface. Following the successful landing of the Mars Pathfinder lander and rover on July 4, 1997, Mars Global Surveyor was the first in a multi-year series of missions called the Mars Surveyor program that could lead to eventual human expeditions to the red planet.

Mission Overview

Mars Global Surveyor was launched at 12:00:49 p.m. Eastern Standard Time on November 7, 1996, atop a three-stage Delta II launch vehicle from launch pad 17A at Cape Canaveral Air Station, FL. The third-stage Star 48B solid rocket later propelled the spacecraft out of Earth orbit and on its way to Mars.

Once on course for the cruise to Mars, the spacecraft deployed its two solar panels to begin generating solar power. One of the solar panels did not fully deploy and is tilted about 20 degrees from its intended position. The low-gain antenna was used for initial spacecraft communications, until the spacecraft was far enough away from Earth in early January 1997 to begin using its 1.5-meter-diameter (5-foot) high-gain antenna.

Mars Global Surveyor's six science instruments — the thermal emission spectrometer, laser altimeter, magnetometer/electron reflectometer, ultra-stable oscillator, camera and radio relay system — were calibrated during the cruise to Mars. Three trajectory correction maneuvers were performed to fine-tune the spacecraft's flight path.



The start of the primary mapping mission was delayed by about a year due to a structural problem with the spacecraft's solar panel that required the flight team to take a more cautious approach to aerobraking to ensure that the weakened panel was not overstressed.

During the aerobraking technique, the spacecraft uses frictional drag as it skims through the planet's thin upper atmosphere to alter the shape of its orbit around the planet. First tested in the final days of the Magellan mission at Venus in 1994, the technique is an innovative way of changing the spacecraft's orbit while carrying less onboard fuel.

When Global Surveyor arrived at Mars in September 1997, it initially entered a looping, elliptical orbit around the planet that has been gradually circularized through aerobraking. Its winged solar panels — which feature a Kapton flap at the tip of each wing for added drag — supply most of the surface area that slowed the spacecraft by a total of more than 1,200 meters per second (about 2,700 miles per hour) during the entire aerobraking phase. Since the start of aerobraking, Surveyor's orbit around Mars has shrunk from an initial elliptical orbit of 45 hours to the now nearly circular orbit taking less than two hours to complete.

Science Highlights

Mars Global Surveyor is examining the entire planet — from the ionosphere, an envelope of charged particles surrounding Mars, down through the atmosphere to the surface and deep into Mars' interior. Scientists are gleaning valuable new information on daily and seasonal weather patterns, geological features and the migration of water vapor from hemisphere to hemisphere over a complete Martian year.

Among major science findings from the mission so far are:

q In what could turn out to be a landmark discovery in the history of Mars exploration, imaging scientists have seen gullies and debris flow features that suggest there may be current sources of liquid water, similar to an aquifer, at or near the surface of the planet. Features that appear to be gullies that were formed by flowing water have been identified, along with deposits of dirt and rocks transported by these flows. The scenes of the surface of Mars are reminiscent of features left behind after flash flood in the deserts of the southwestern United States, and scientists are trying to determine mechanisms that would account for such features on rainless Mars.

q The planet's magnetic field is not globally generated in the planet's core, but is localized in particular areas of the crust. Multiple magnetic anomalies were detected at various points on the planet's surface, indicating that magma solidified as it came up through the crust and cooled very early in Mars' evolution.

q Mars' very localized magnetic field also creates a new paradigm for the way in which it interacts with the solar wind, one not found with other planets. While Earth, Jupiter and other planets have large magnetospheres, and planets like Venus have strong ionospheres, Mars' small, localized magnetic fields are likely to produce a much more complicated interaction as these fields move with the planet's rotation.

q New temperature data and closeup images of the Martian moon Phobos show its surface is composed of powdery material at least 1 meter (3 feet) thick, caused by millions of years of meteoroid impacts. Measurements of the day and night sides of Phobos show extreme temperature variations on the sunlit and dark sides of the moon. Highs were measured by the spacecraft’s thermal emission spectrometer at -4 degrees Celsius (25 degrees Fahrenheit) and lows registered at -112 Celsius (-170 degrees Fahrenheit).

q New mineralogical and topographic evidence suggest that Mars had abundant water and thermal activity in its early history is emerging from data gleaned by NASA's Mars Global Surveyor spacecraft. Data from the thermal emission spectrometer indicate the first clear evidence of an ancient hydrothermal system. The finding implies that water was stable at or near the surface and that a thicker atmosphere existed in Mars' early history.

q Measurements by the thermal emission spectrometer also show an accumulation of the mineral hematite, well-crystallized grains of ferric (iron) oxide that typically originate from thermal activity and standing bodies of water. This deposit is localized near the Martian equator, in an area approximately 500 kilometers (300 miles) in diameter. (Fine-grained hematite, with tiny particles no larger than specks of dust, generally forms by the weathering of iron-bearing minerals during oxidation, or rusting, which can occur in an atmosphere at low temperatures.) The material has been previously detected on Mars in more dispersed concentrations and is widely thought to be an important component of the materials that give Mars its red color. The presence of a singular deposit of hematite was intriguing to scientists because it typically forms by crystal growth from hot, iron-rich fluids.

q Data from the spacecraft’s laser altimeter have given scientists their first 3-D views of Mars' north polar ice cap. Initial profiles show an often striking surface topology of canyons and spiral troughs in the water and carbon dioxide ice that can reach depths as great as 3,600 feet below the surface. Many of the larger and deeper troughs display a staircase structure, which may ultimately be correlated with seasonal layering of ice and dust observed by NASA's Viking mission orbiters in the late 1970s.

q Data from the altimeter have also shown that large areas of the ice cap are extremely smooth, with elevations that vary only a few feet over many miles. At 86.3 degrees north, the highest latitude yet sampled, the cap achieves an elevation of 2 to 2.5 kilometers (6,600 to 7,900 feet, or 1.25 to 1.5 mile) over the surrounding terrain. The laser measurements are accurate to approximately 30 centimeters (1 foot) in the vertical dimension.

Mars Global Surveyor is managed by the Jet Propulsion Laboratory, Pasadena, CA, for NASA's Office of Space Science, Washington, DC. JPL is a division of the California Institute of Technology.

At NASA Headquarters, Paul Hertz is Mars Global Surveyor program executive and Joseph Boyce is program scientist. At JPL, Tom Thorpe is acting project manager of Mars Global Surveyor. Dr. Arden Albee of Caltech is project scientist.

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