MARS MISSIONS: NOW AND BEYOND

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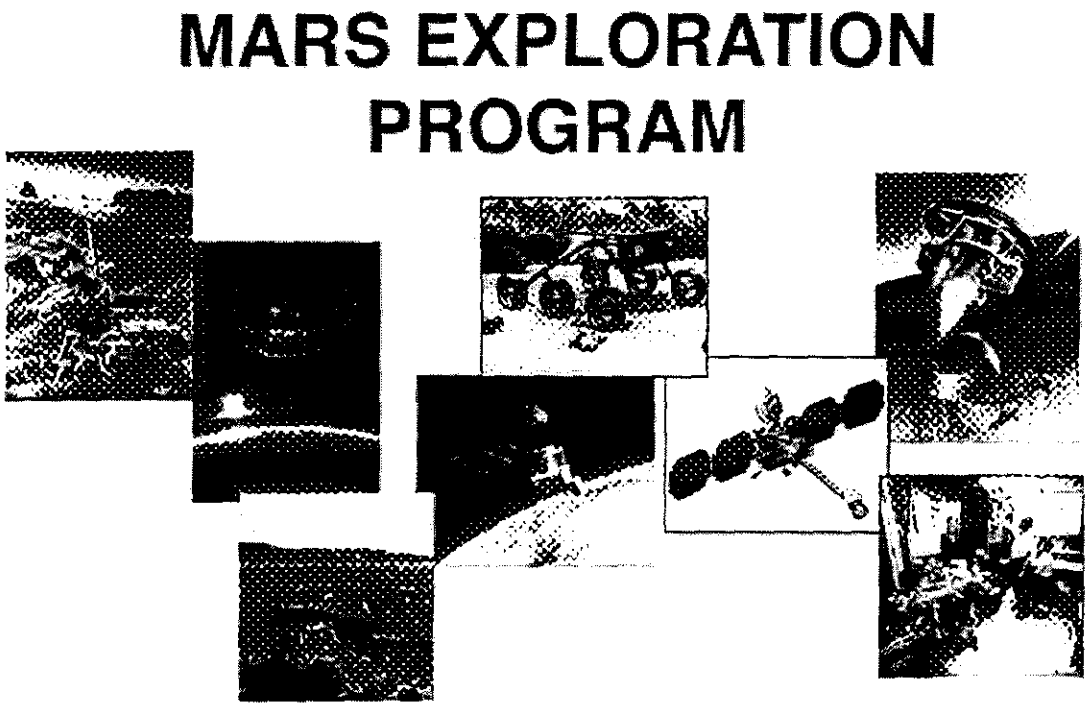
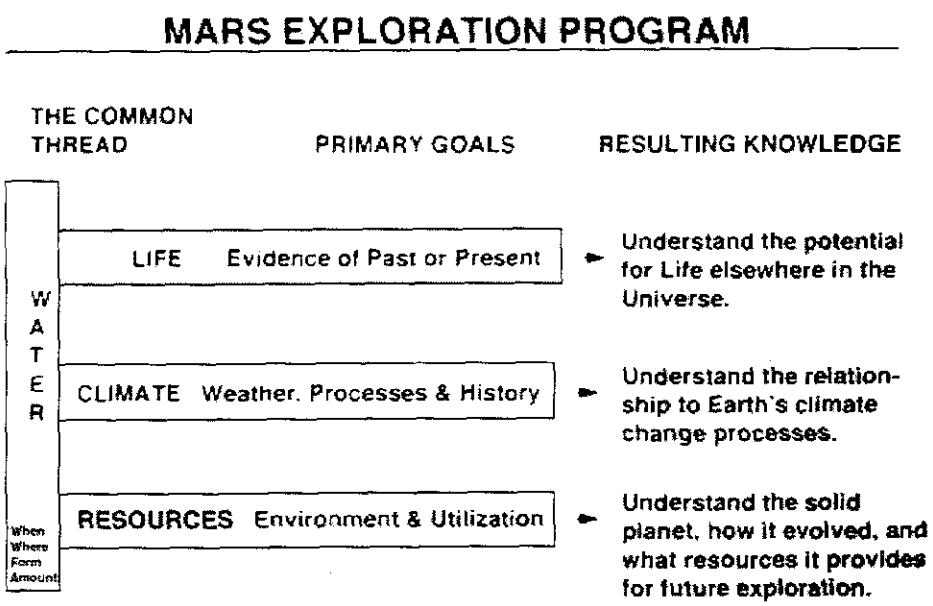
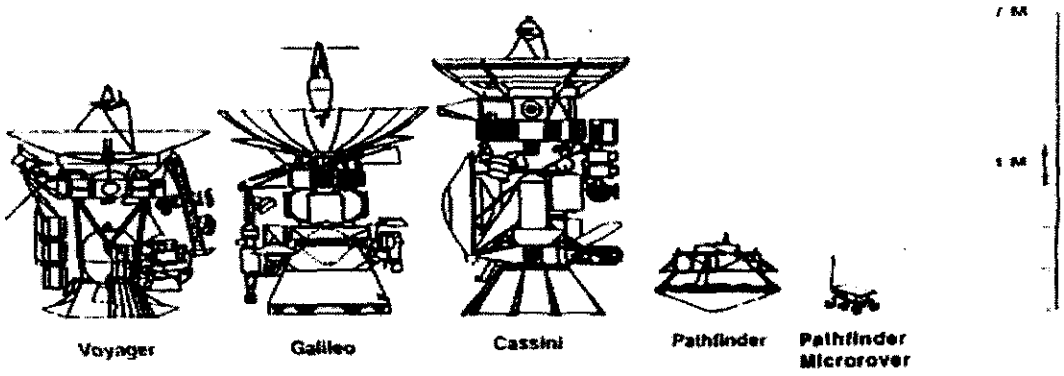


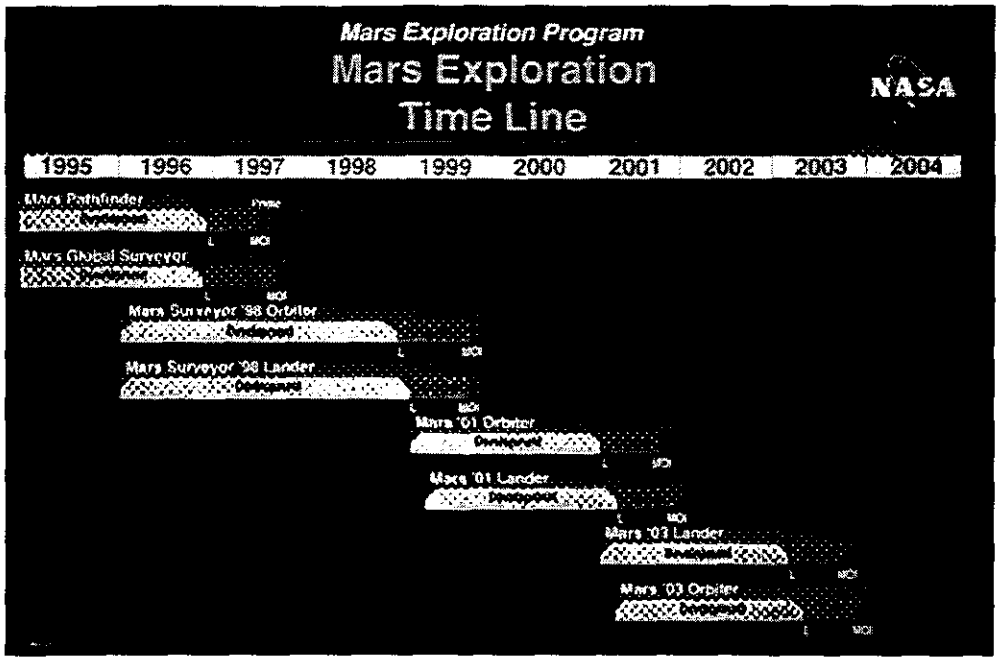
We have entered a new, exciting era of Mars exploration with the fabulous landing of Pathfinder on Mars last July 4th, and the subsequent captivating operations of the Sojourner Rover it deployed. The Mars Global Surveyor (MGS) entered Mars orbit in September and has been executing a series of aerobraking phases to achieve its 300-km circular mapping orbit next spring when it begins a very detailed mapping of the entire Mars surface over a full martian year. This December and in January 1999, we launch the Mars '98 Orbiter and Lander, respectively. The Lander is to land in the polar region at 70°S latitude. Basically, every Mars opportunity we will launch a pair of missions. In 2001 and in 2003, we plan to launch Orbiters and Landers with Rovers to acquire and cache carefully selected Mars samples. Then in 2005 the first Mars Sample Return Mission (MSR) is to be launched to return one of the caches to Earth in 2008. Ultimately, scientists in laboratories world-wide will analyze the samples and bounty of other data being returned from Mars on a continual basis.



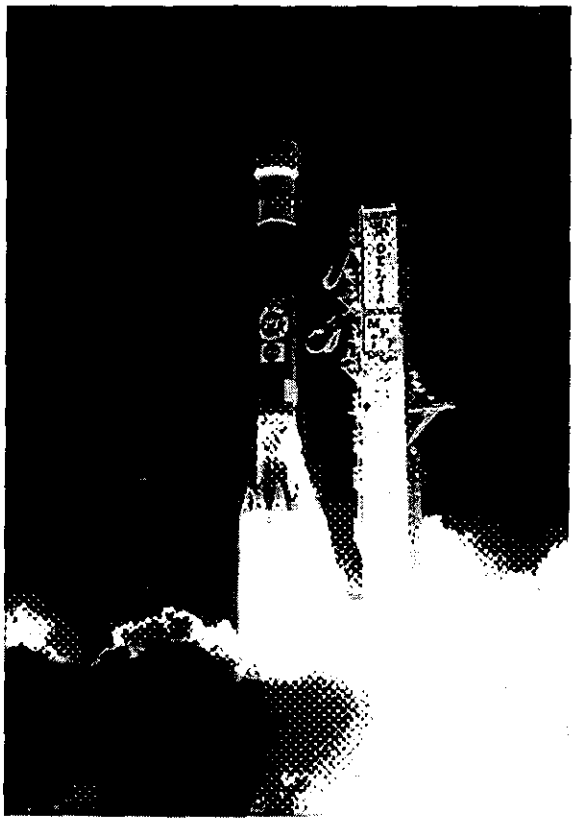
The common thread for Mars exploration is water. It is the key to our understanding of the possibility of extra-terrestrial life, Mars climate, and resources.



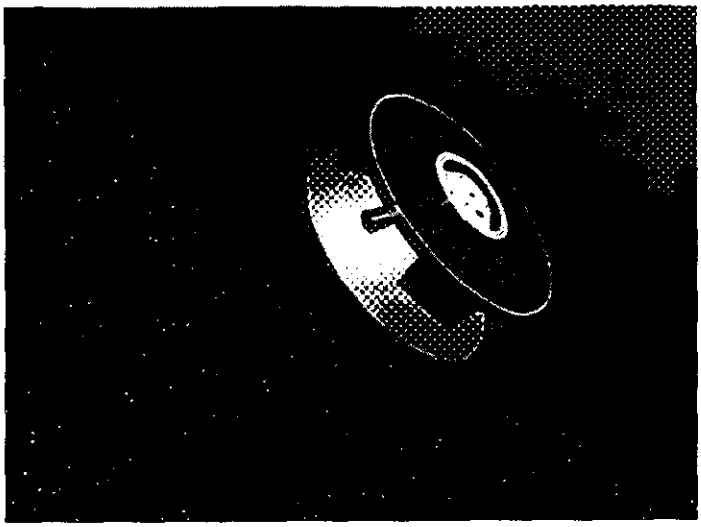
The reduction in the size of NASA/JPL planetary spacecrafts is dramatically illustrated.



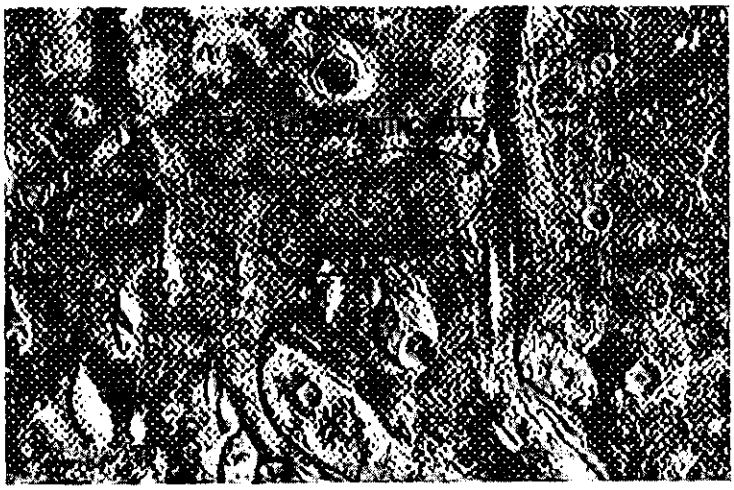
The very ambitious robotic Mars Exploration Program is illustrated showing the two launches — one orbiter and one lander — every opportunity. The development period, interplanetary cruise and mars operations periods are shown for each mission. And this chart shows the Program BEFORE the "Mars rock" resulted in the addition of the near term Mars sample return missions.



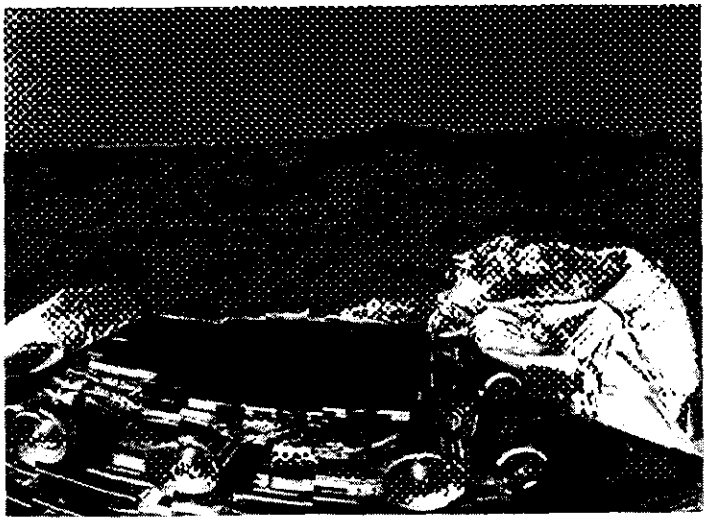
The launch of Mars Pathfinder on the Delta rocket.



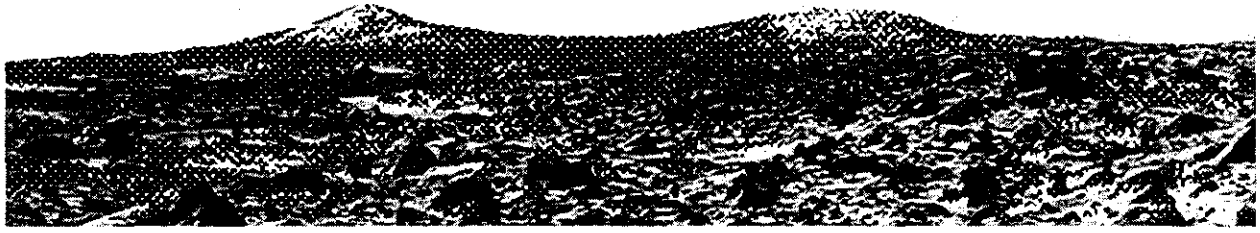
An artist's rendering of the Mars Pathfinder in interplanetary cruise to Mars. The cruise stage with its annular solar panel array is shown carrying the aeroshell with its precious cargo.



The pathfinder three-σ landing accuracy ellipse is shown on the Ares Valles Landing Site. Pathfinder landed one-σ (~25 km) to the left of the center of the ellipse.



The now famous first color image of the Sojourner Rover on its Pathfinder deployment petal. The obstructing airbag on the back ramp is clearly seen. The petal was subsequently raised and the airbag further retracted out of the way by ground command to allow Sojourner to drive down that ramp, which it did perfectly.

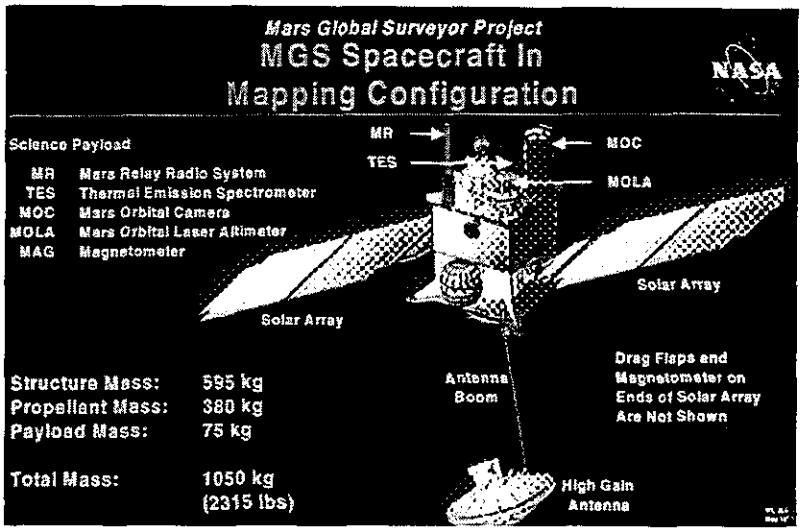


A view from the Lander's camera. A great flood of water washed over this region long ago, passing from left to right across this portion of the landscape. The Twin Peaks on the horizon are just about one kilometer away.

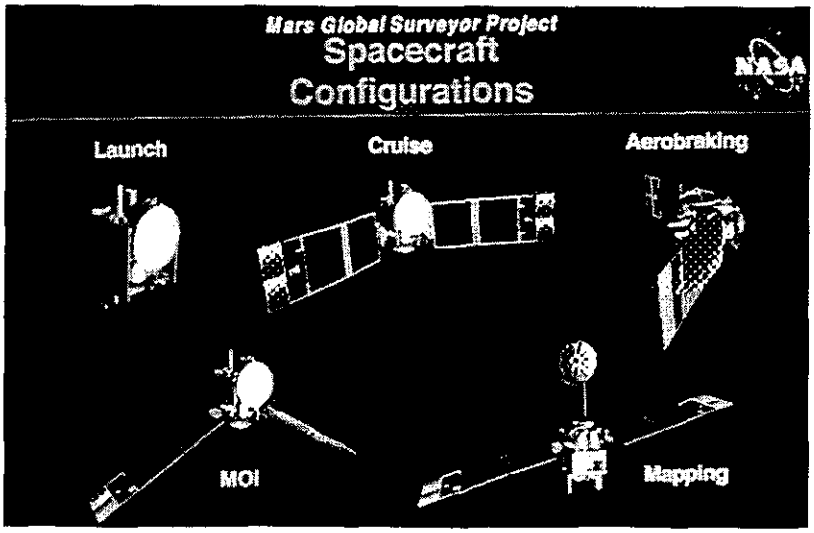
This view from the Lander camera shows the tracks of Sojourner over to the large rock called Yogi, about one meter tall. Sojourner has placed its Alpha Proton X-ray Spectrometer instrument against the rock to determine its elemental composition.

A view from Sojourner's camera looking back at the Pathfinder Lander.

A view from Sojourner showing the shadows of its hazard avoidance detectors.

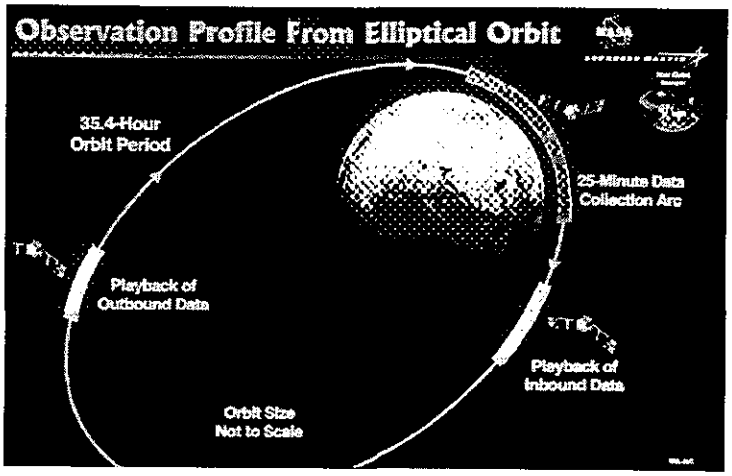


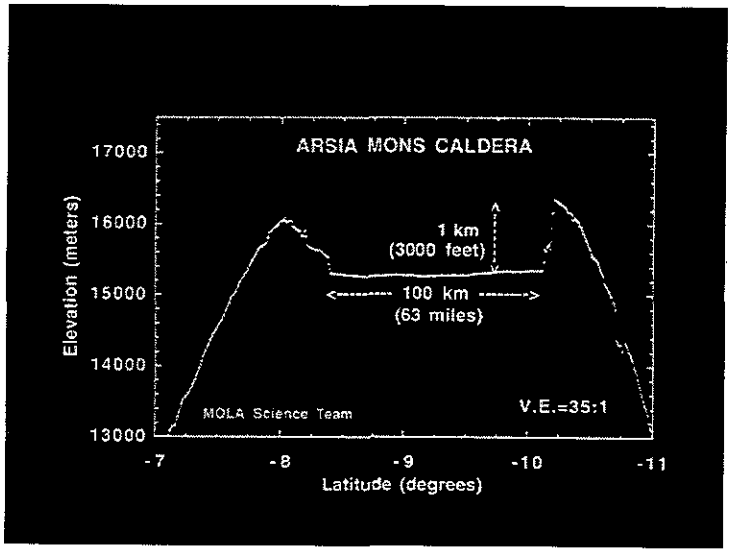
This cartoon illustrates the Mars Global Surveyor Spacecraft in Mapping Configuration. The body-fixed instruments are nadir pointed while the solar arrays and high gain antenna are articulated to track the Sun and the Earth, respectively.



Here MGS is shown in all its different mission configurations.

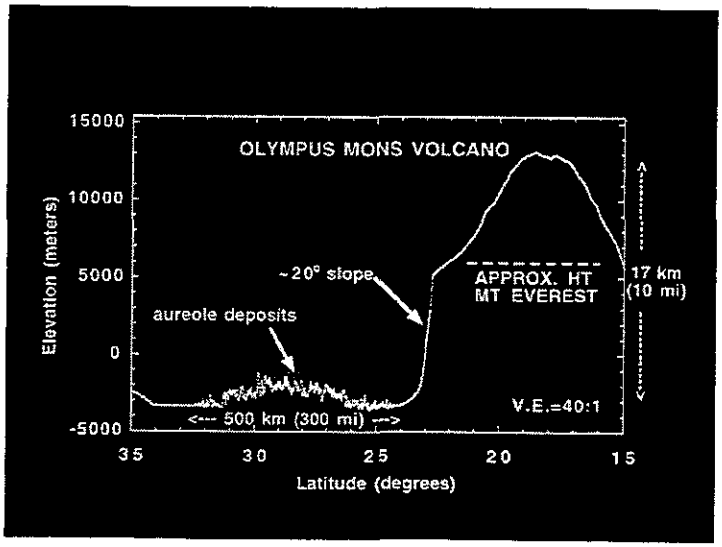
As MGS proceeds through its aerobraking phases it will be in a highly elliptical orbit for many months allowing the record and playback strategy illustrated here.



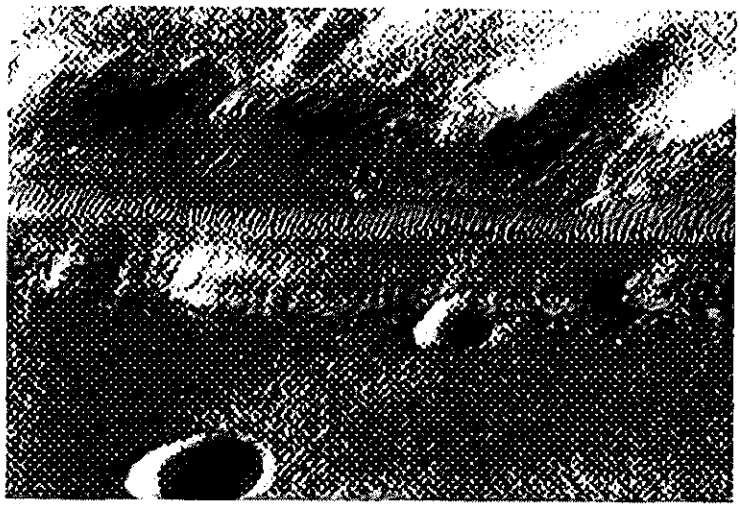


The MGS Mars Orbital Laser Altimeter (MOLA) measured this dramatic elevation profile of the Arsia Mons Caldera.

The MOLA measured the profile of Olympus Mons Volcano, which is more than twice the height of Earth's Mt. Everest.



An MGS color image looking down on Olympus Mons.



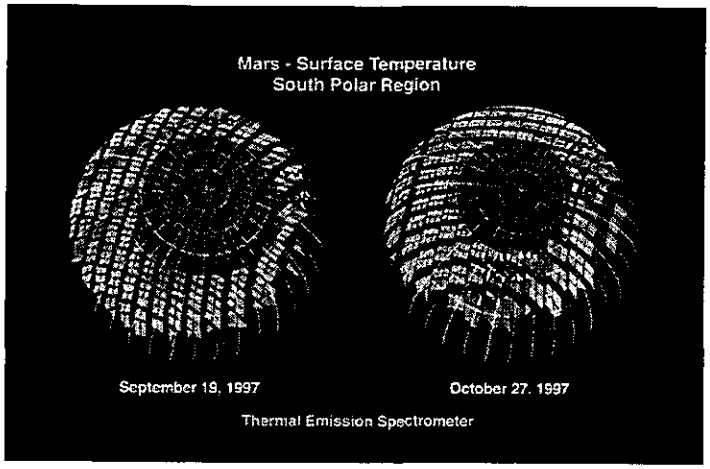
This view from MGS shows a Mars landscape looking like beach sand with craters.

These images from MGS show several views of a cliff face with quite remarkable features.

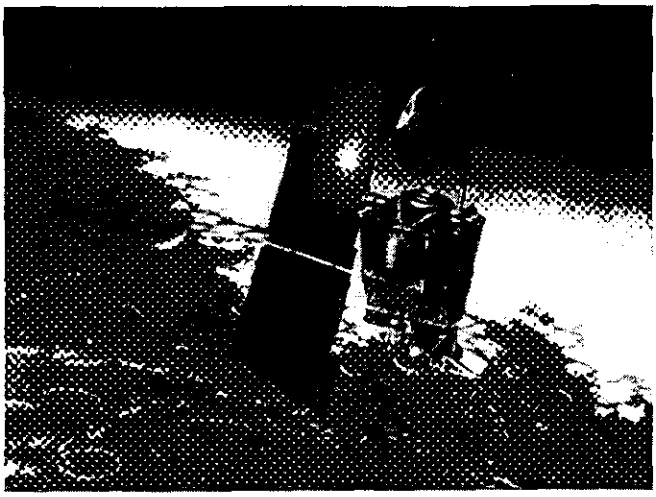
This is the highest resolution view of the cliff.

One of the most important images from MGS to date showing a river canyon with great stratification in the banks and clear evidence the river changed its path over time in the top part of the image.

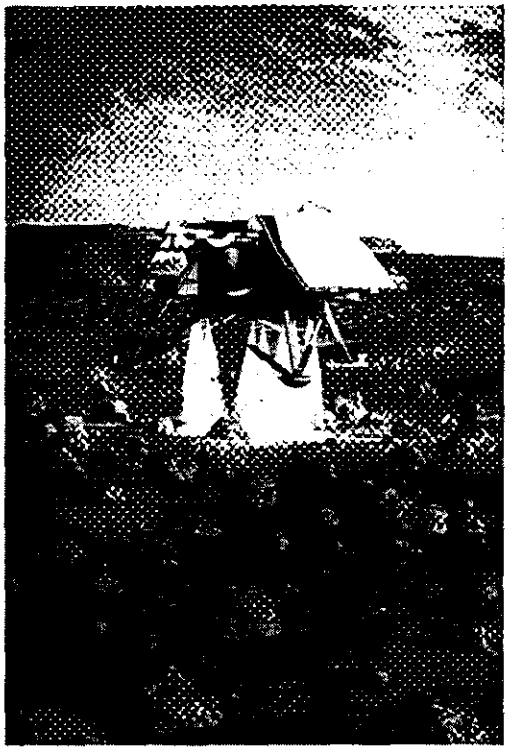
A riverbed seen by MGS.



Thermal imagery from the MGS Thermal Emission Spectrometer (TES) showing the receeding of the Mars South Polar Cap last fall.

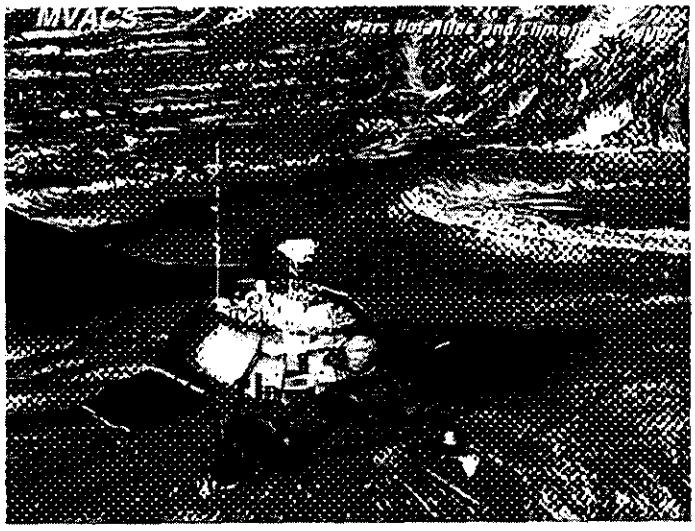


An artist's rendering of the Mars '98 Orbiter at Mars. The Orbiter is about the size of a household refrigerator.



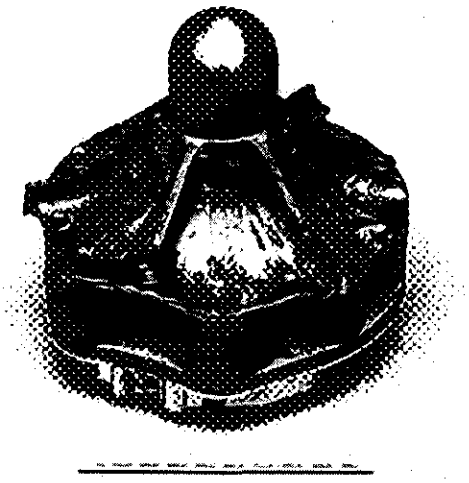
A rendering of the Mars '98 Polar Lander just before touchdown on Mars. The Lander is about the size of a household clothes dryer.

Mars Global Surveyor image of the planned Mars '98 Polar Lander landing area near 70°S latitude. The image on the left is raw and on the right is the image after processing to bring out details and contrast. The scientists and engineers may be rethinking about landing in this area based on the terrain seen here.



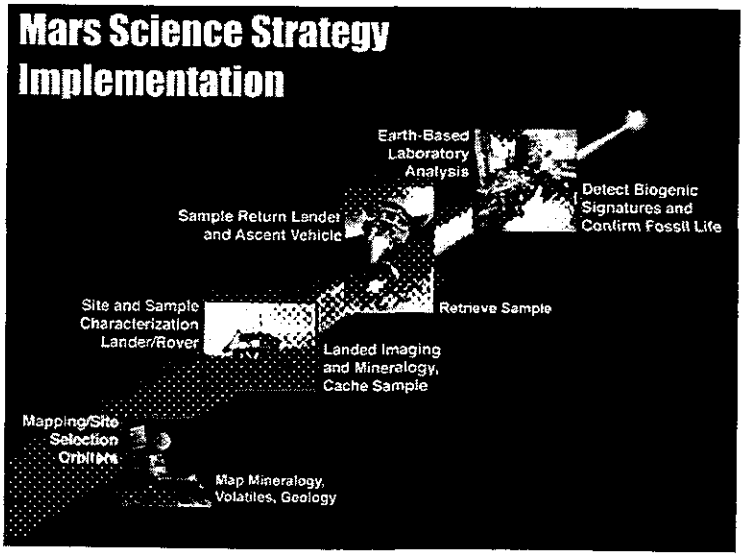
A rendering of the Mars '98 Polar Lander operating on the surface of Mars with its sampling arm, camera, antenna, weather mast, and solar panels deployed.

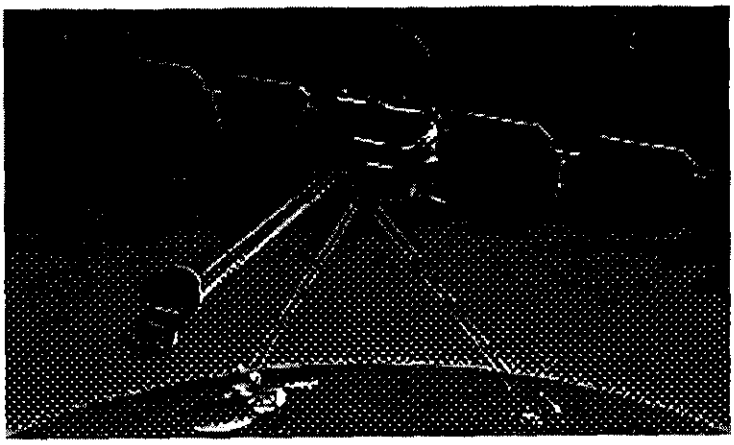
A photograph of a Deep-Space-2 Penetrator test article. Two of these penetrators are planned to fly aboard the Mars '98 Lander Cruise stage and be released shortly before entry to follow unbraked ballistic trajectories to impact the surface with high speed for substantial penetration below the surface.



The famous Allan Hills meteorite from Antarctica that scientists declared in August 1996 suggests evidence of ancient martian life. This declaration caused tremendous excitement and resulted in the NASA decision to advance the schedule for the first robotic sample return from Mars. We are now planning to launch the mission in 2005 and have the first sample back to Earth in 2008.

Here is our new Roadmap showing the science mission activities leading to landing site selection, sample selection, the first Mars Ascent Vehicle leaving the surface with the samples that the Rover acquired, and ultimately, the extensive Earth laboratory-based analysis of the returned samples.





An artist's rendering of the Mars '01 mission at Mars showing the '01 Oribiter relay links communicating to both sample acquisition Rover and the Lander that delivered the Rover and is operating an extensive HEDS payload to help characterize the martian environment for Human exploration and testing *in situ* production of Oxidizer propellant that the Human missions will use to launch from the surface of Mars for the trip back to Earth. Note the large solar panels on the Lander to support the HEDS experiments.

A rendering of the '05 Mars Sample Return Ascent Vehicle just after the first stage has been jettisioned and its second stage has ignited to complete the powered flight to the Mars parking orbit. The Earth return Orbiter will rendezvous and dock with the Ascent Vehicle and the sample cache will be transfered to the return vehicle, which will subsequently use its rocket engine to inject into the interplanetary Earth return trajectory. The Lander that delivered the Ascent Vehicle and served as its launch pad and the Rover that fetched the sample cache are seen on the surface below.

And here we have Ms. Sojourner Truth, the great, great granddaughter of the namesake of the NASA/JPL Rover that landed on Mars, July, 4, 1997, inspecting that very Rover on the surface of Mars, hopefully in the second decade of the next century.