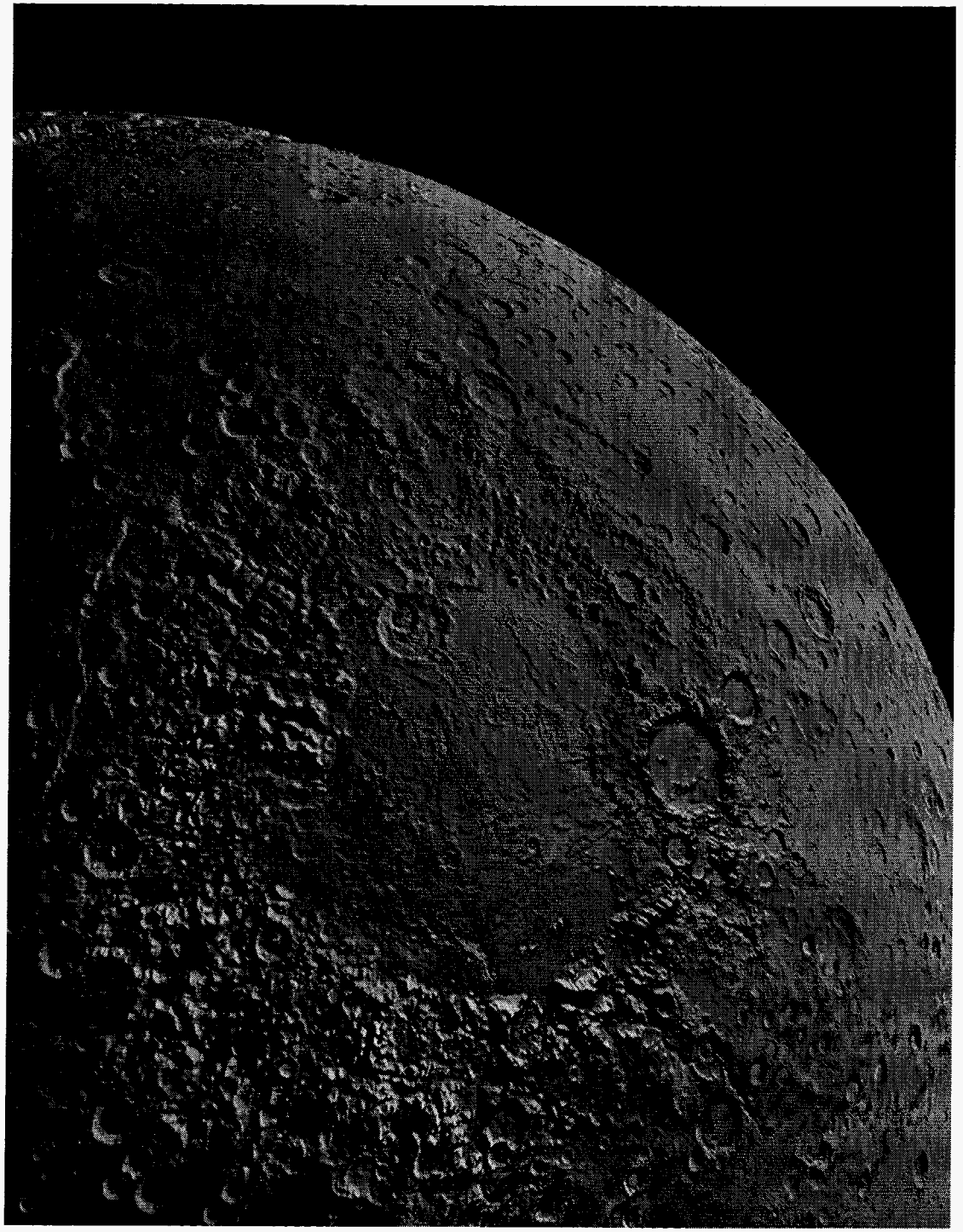


Mars Exploration Rovers

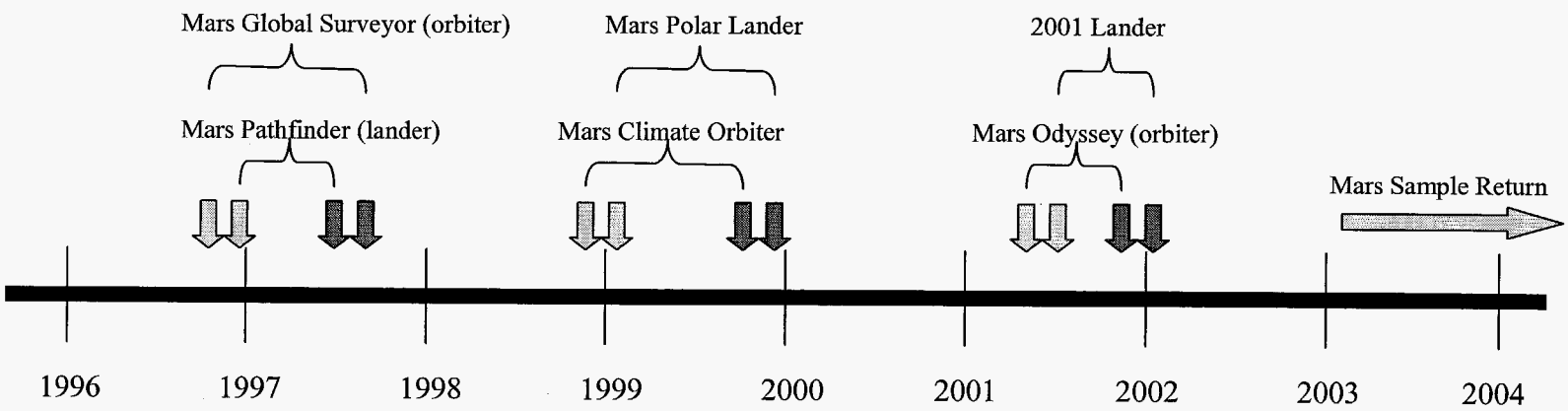
Miguel San Martin

Jet Propulsion Laboratory
NASA
California Institute of Technology

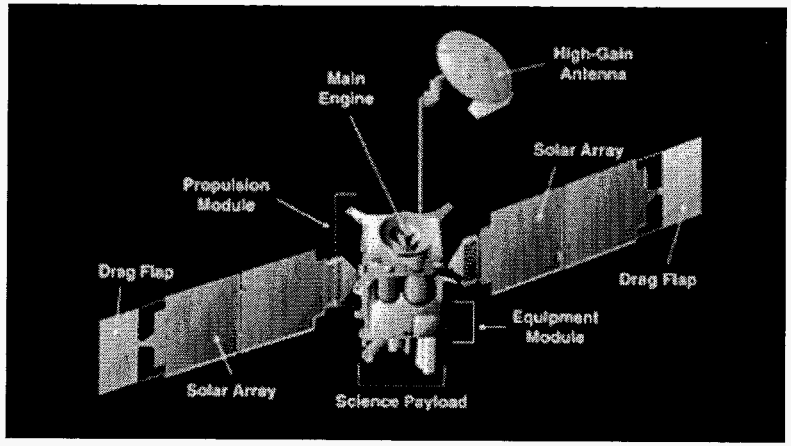
Project Genesis

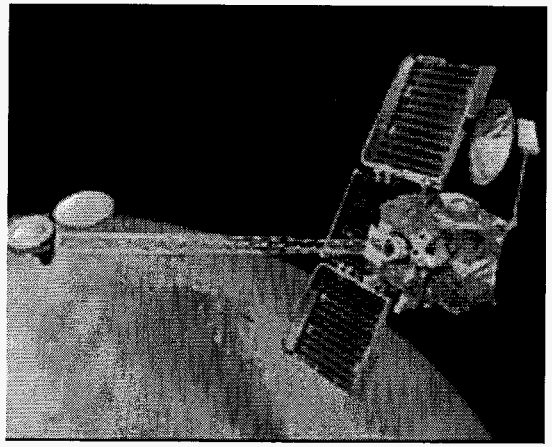
Project Genesis

- **Original Mars Exploration Plan**

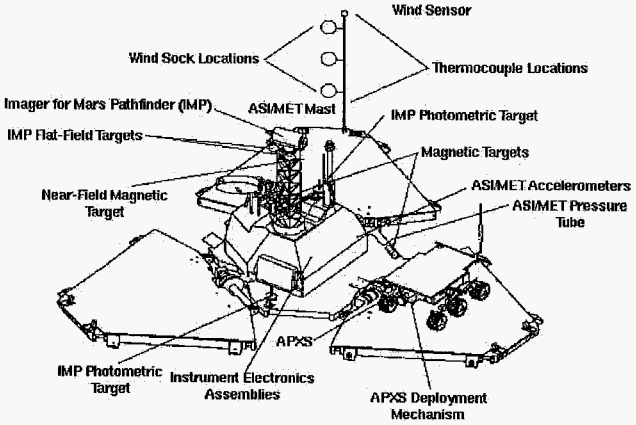


Mars Global Surveyor

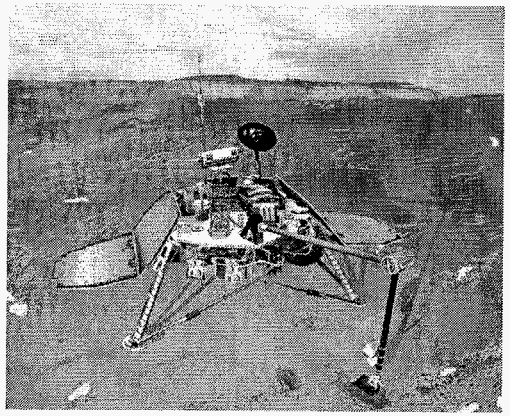




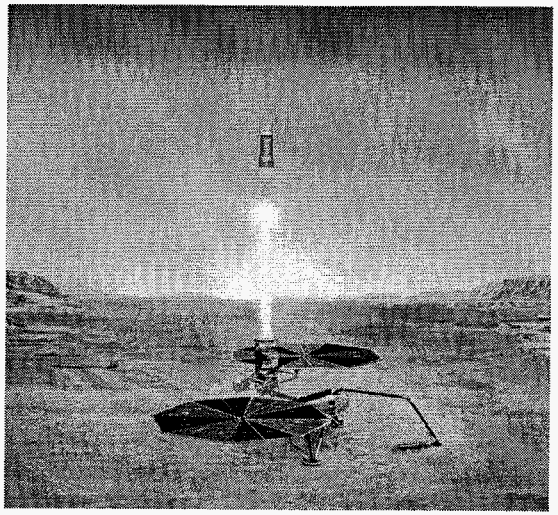
Mars Pathfinder



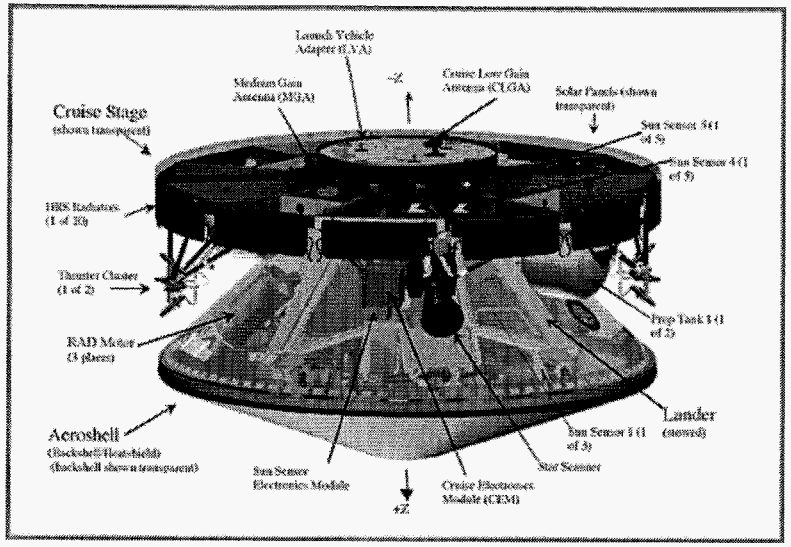
Mars Polar Lander

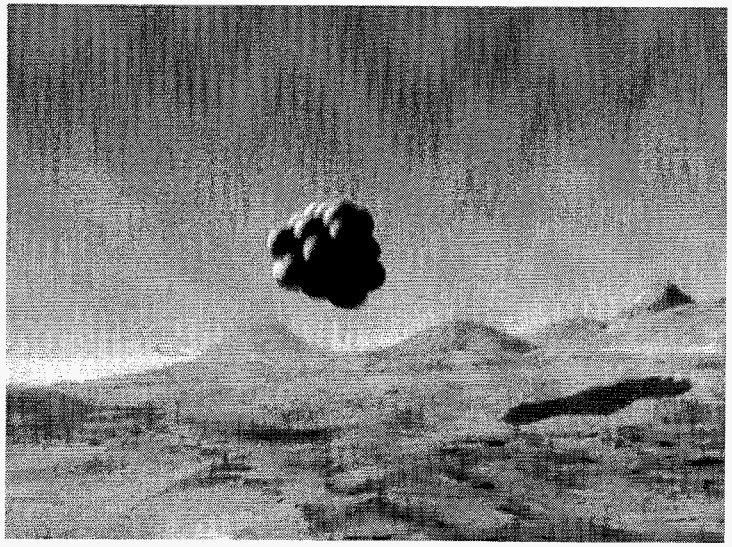


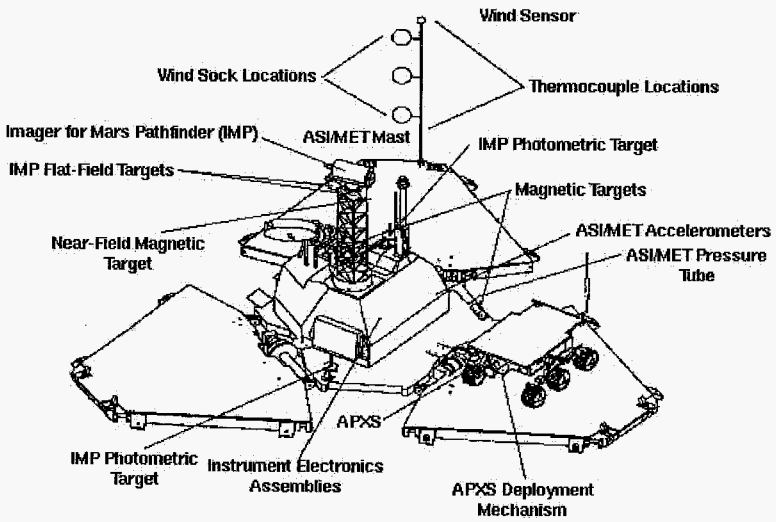
Mars Sample Return



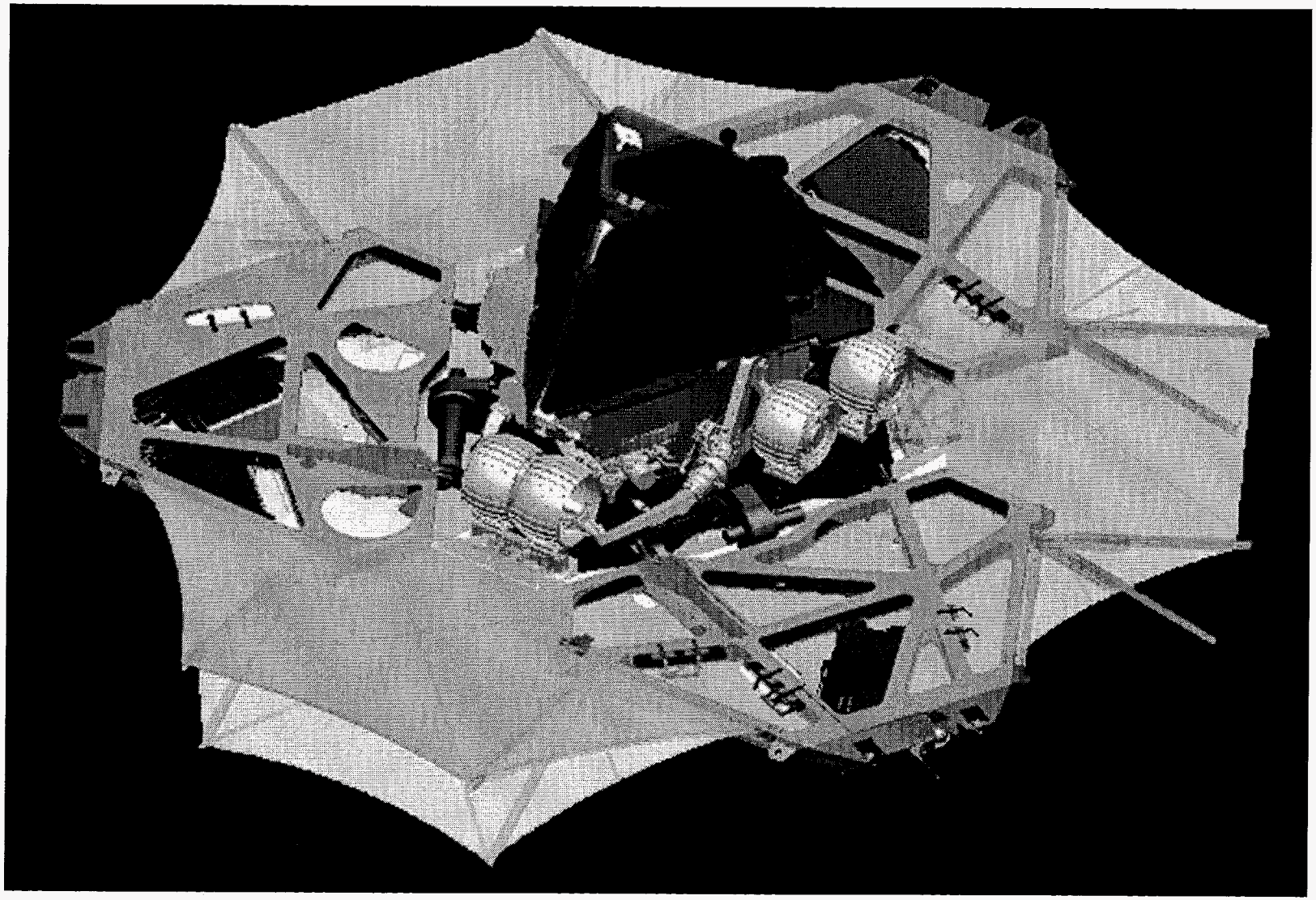
Mars Pathfinder



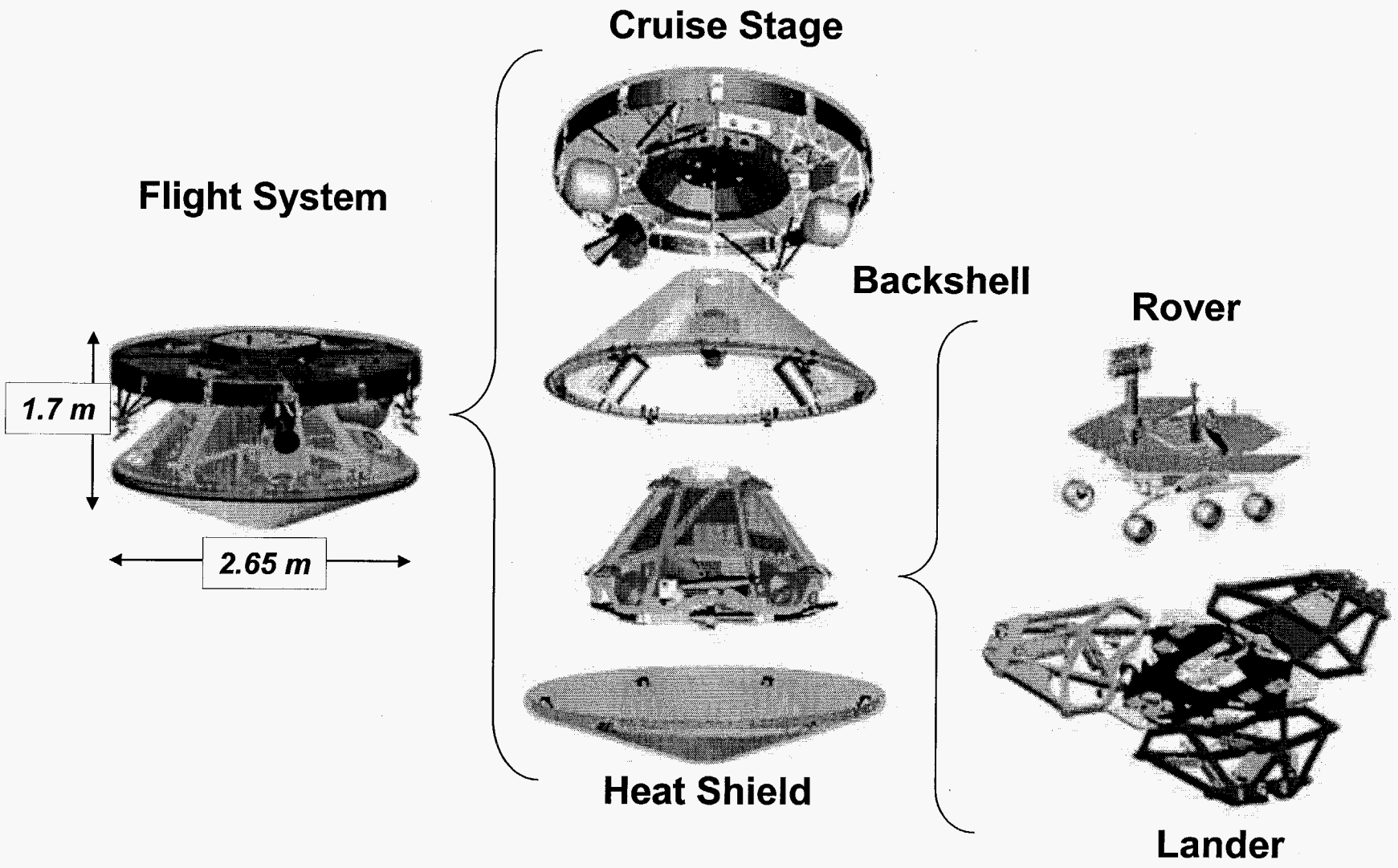




Mars Exploration Rover

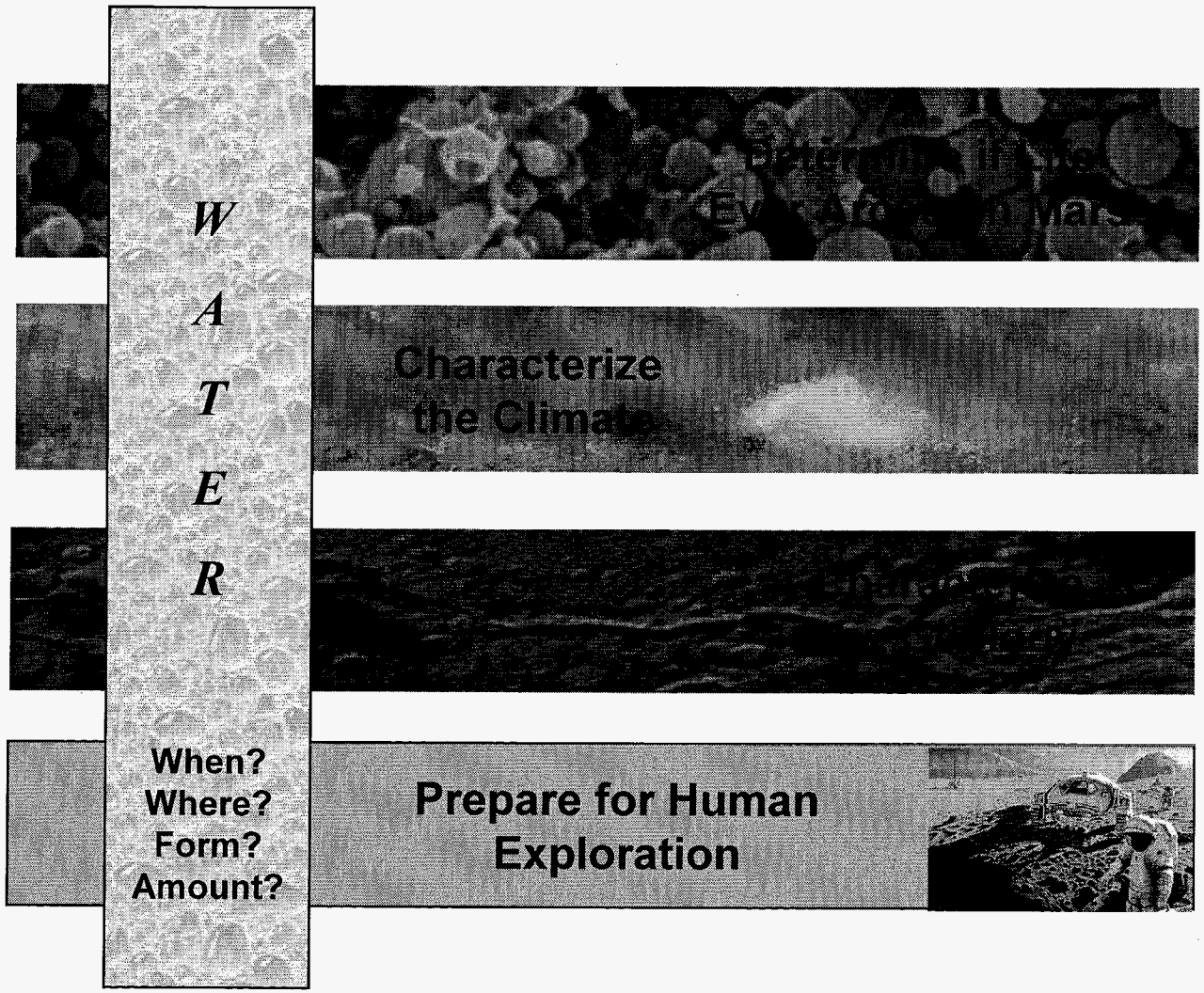


Mars Exploration Rover



Scientific Objectives

MARS SCIENCE STRATEGY: Follow the Water!



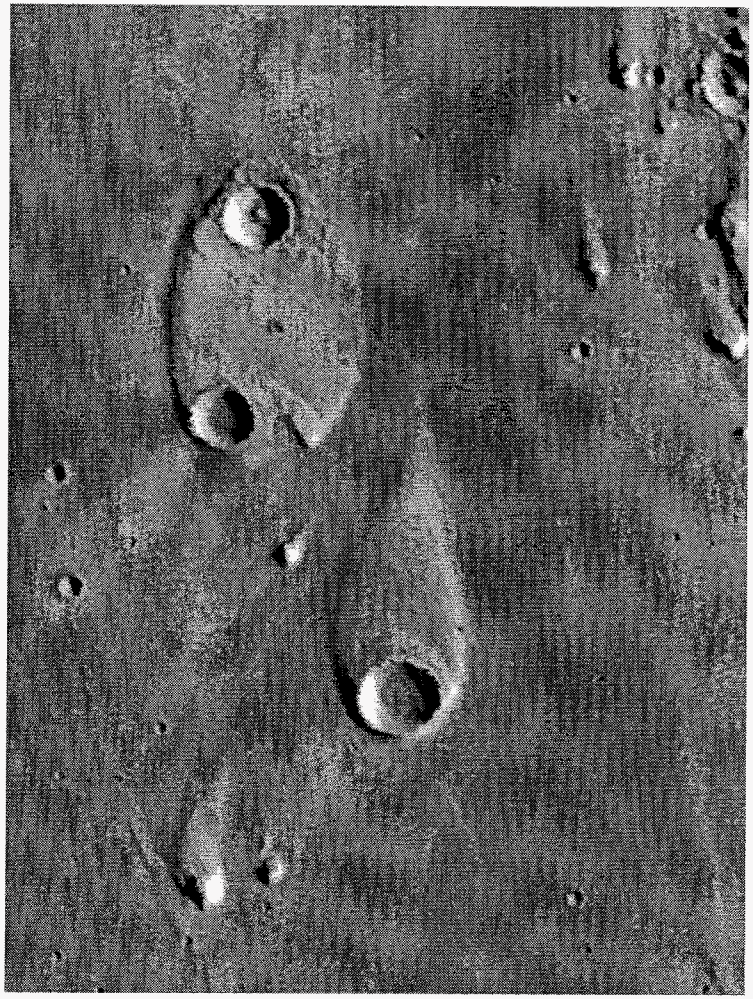
LIFE

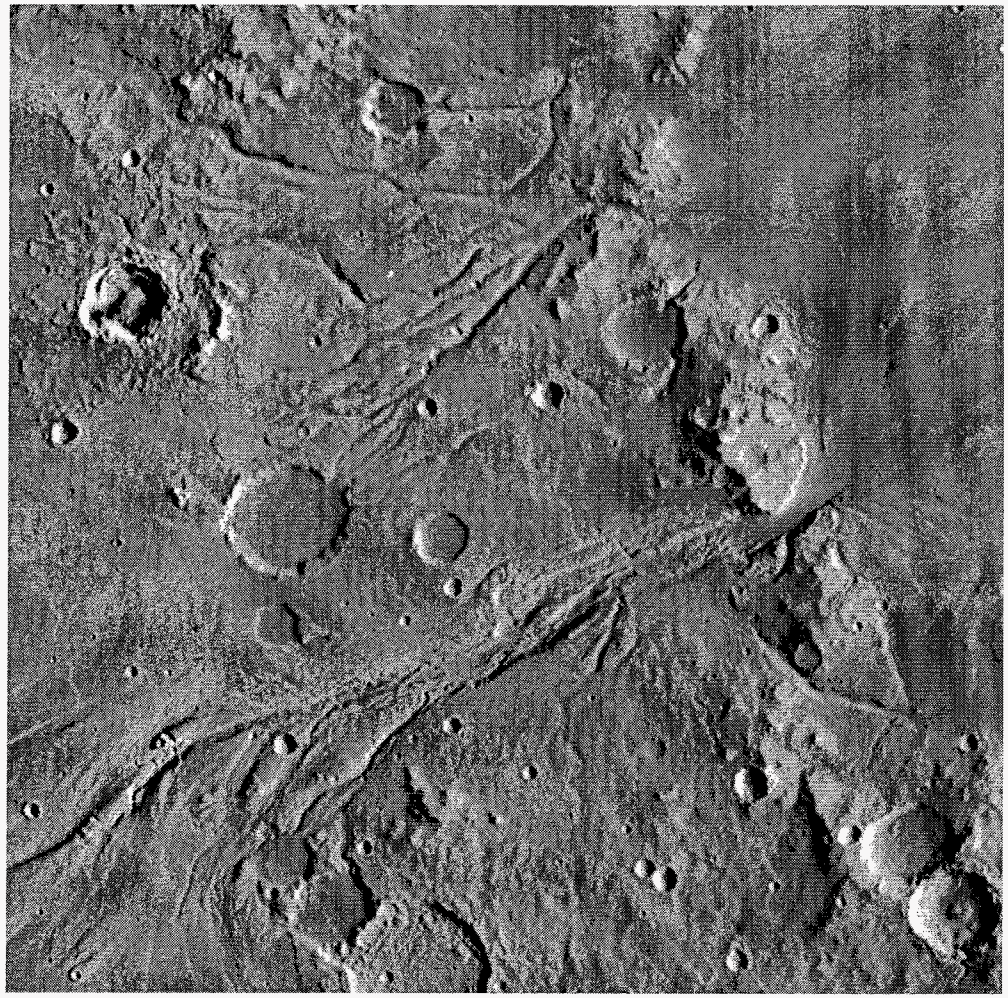
CLIMATE

GEOLOGY

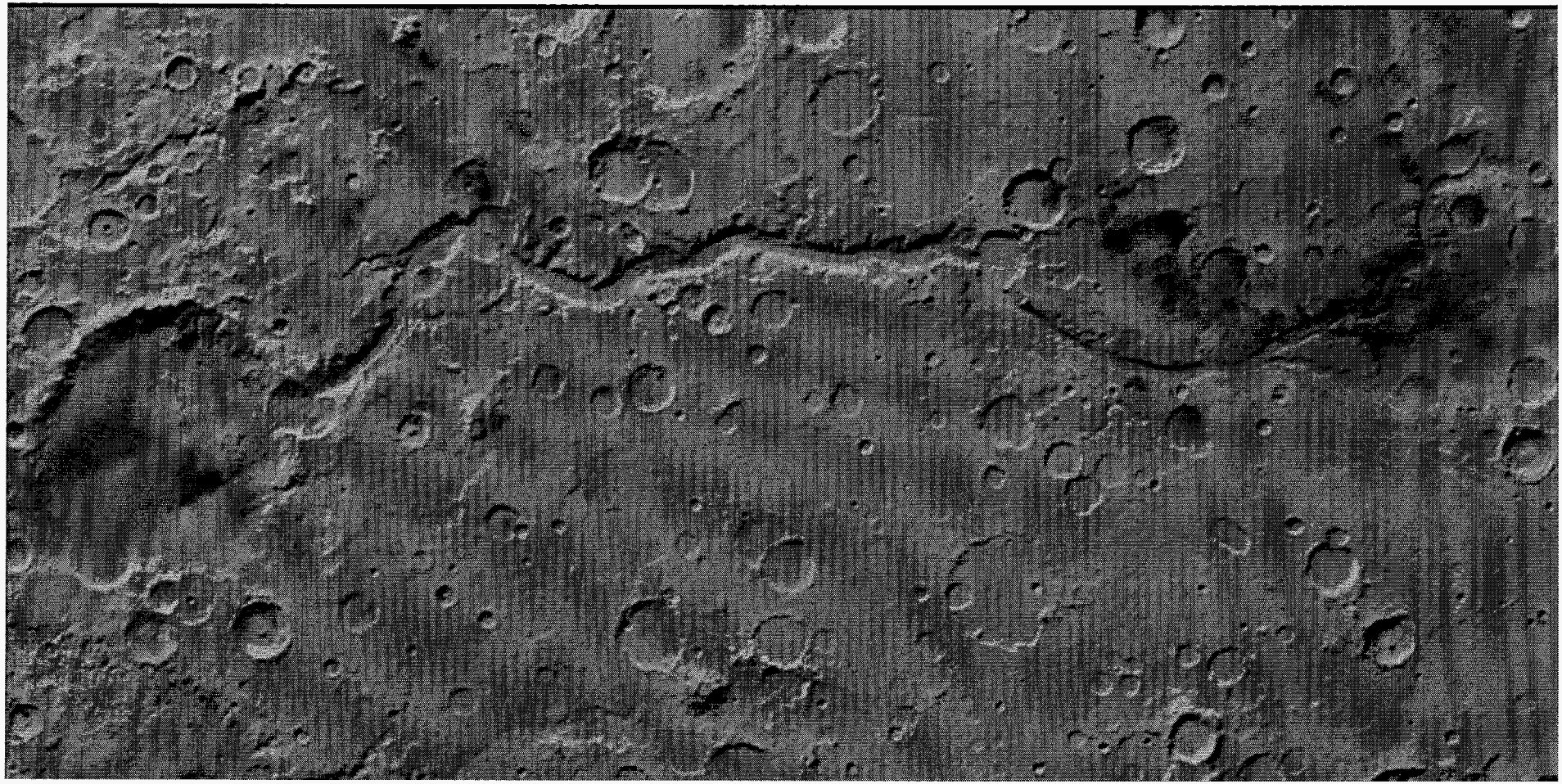
HUMAN

Ancient Mars had large rivers and floods.

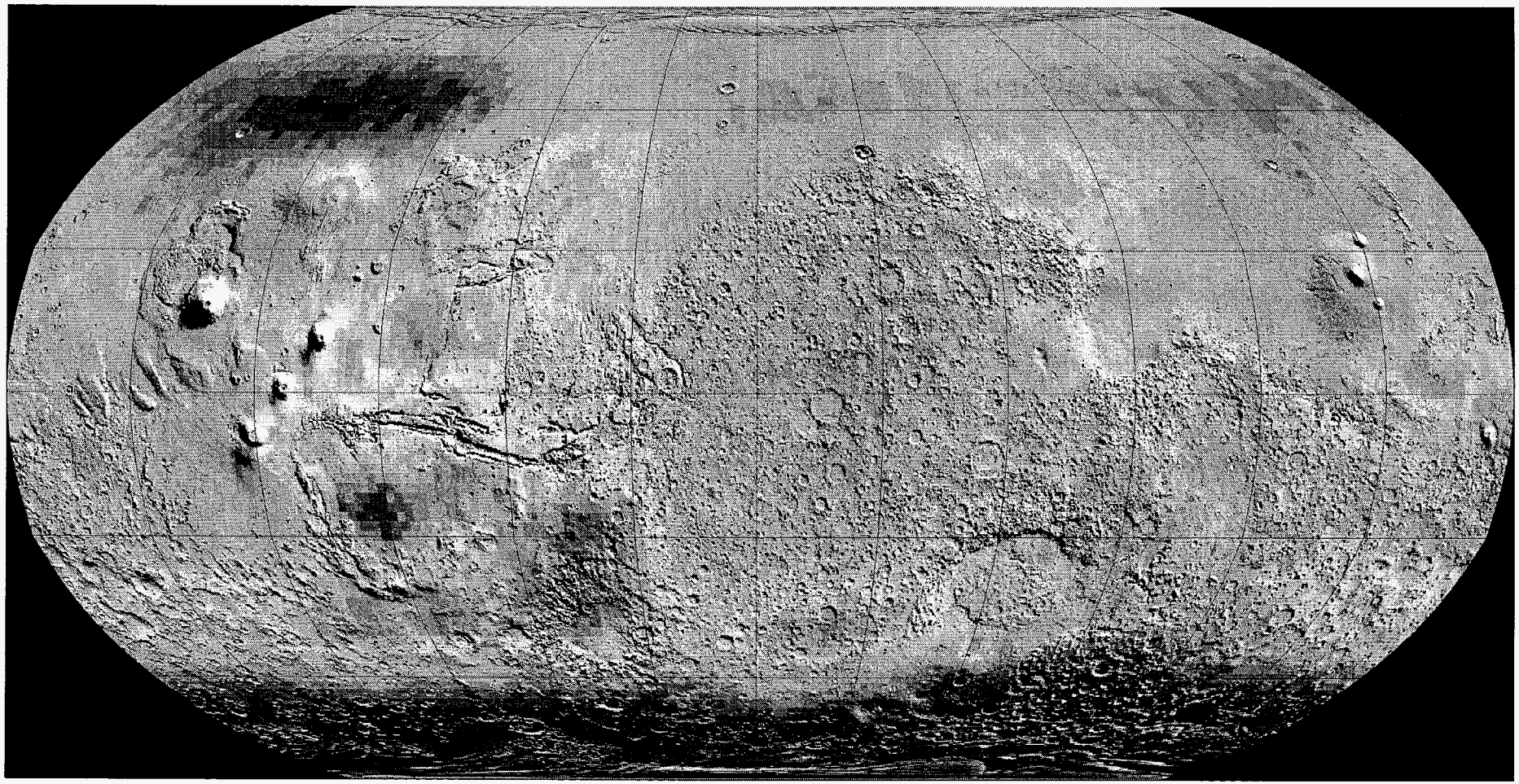




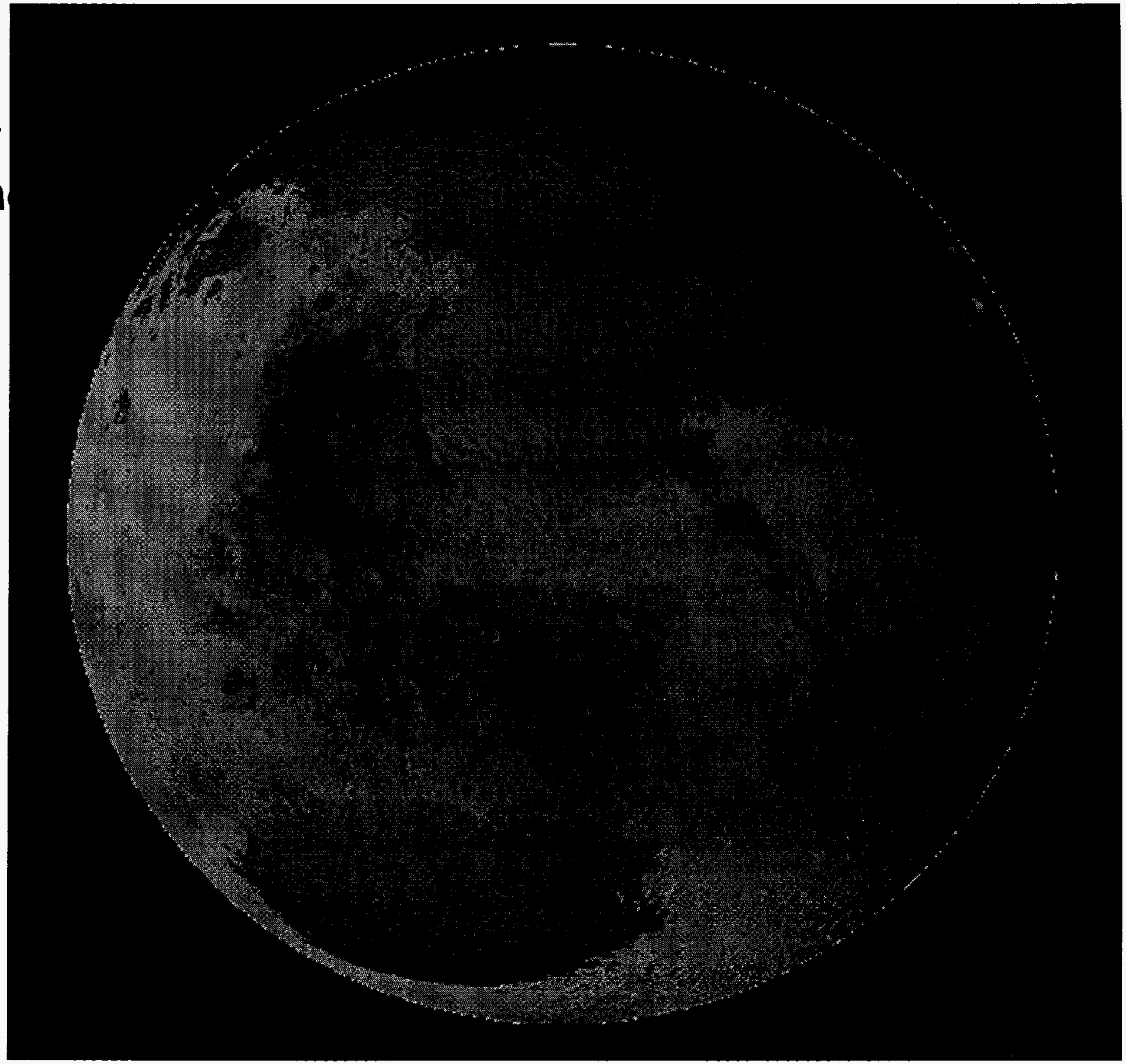
Ma'adim Vallis and Gusev Crater



Mars Odyssey Found Evidence of Water Ice



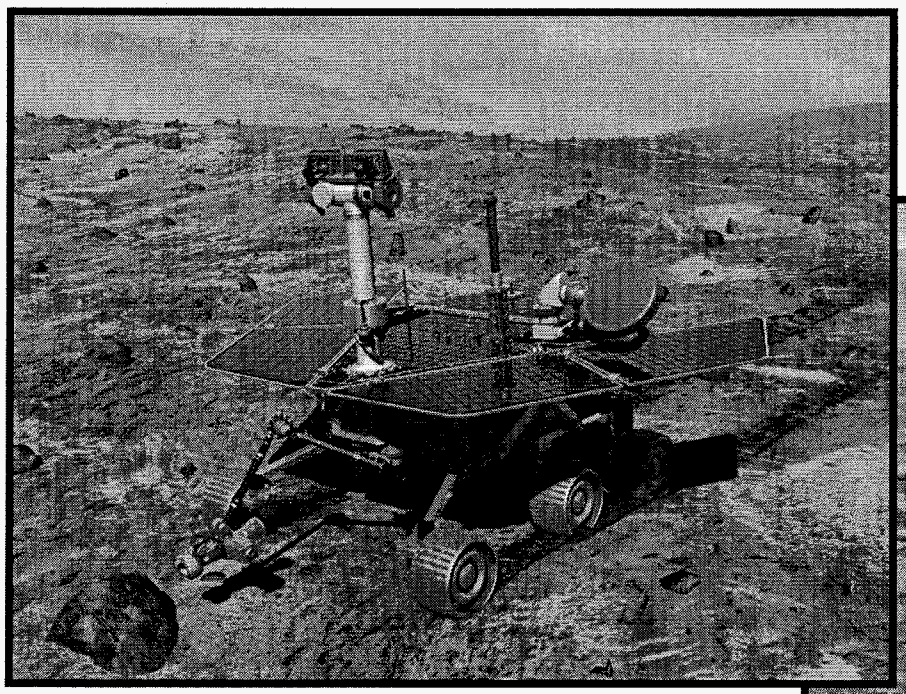
A long time
Mars might
even have h
an ocean.

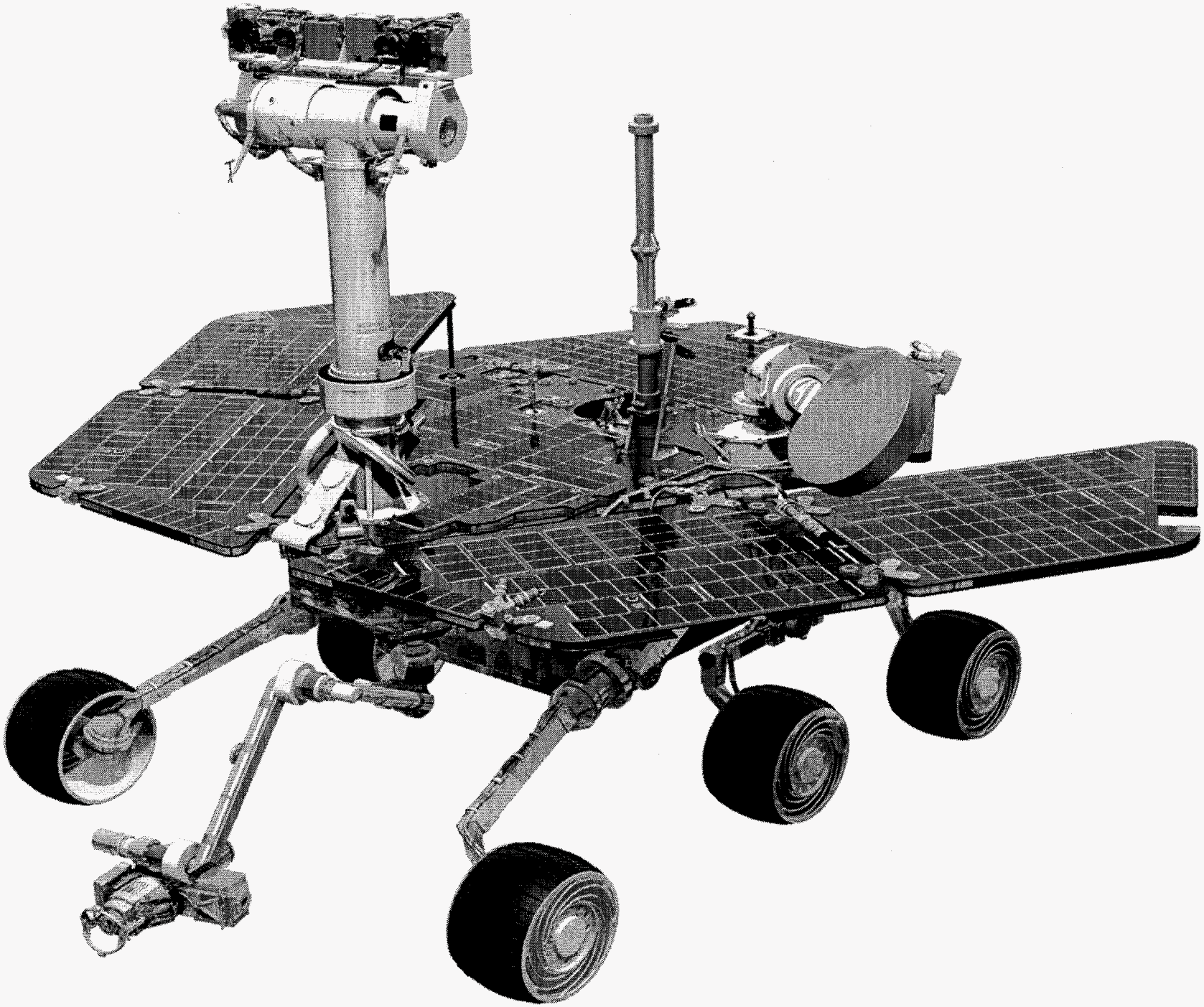


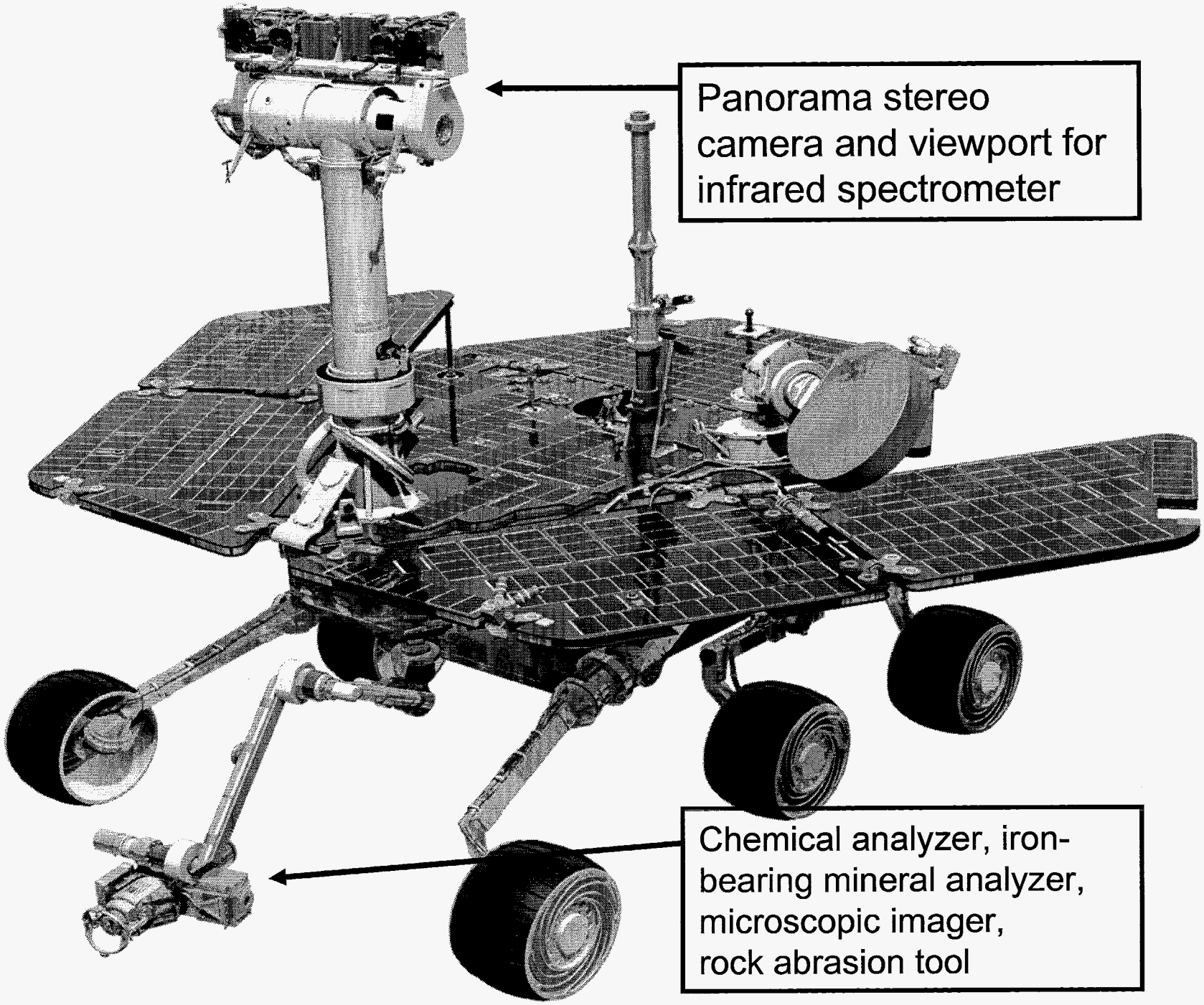
Scientific Instruments

Robot Geologists!

Mars Exploration Rovers are ideally equipped to “read the rocks.”

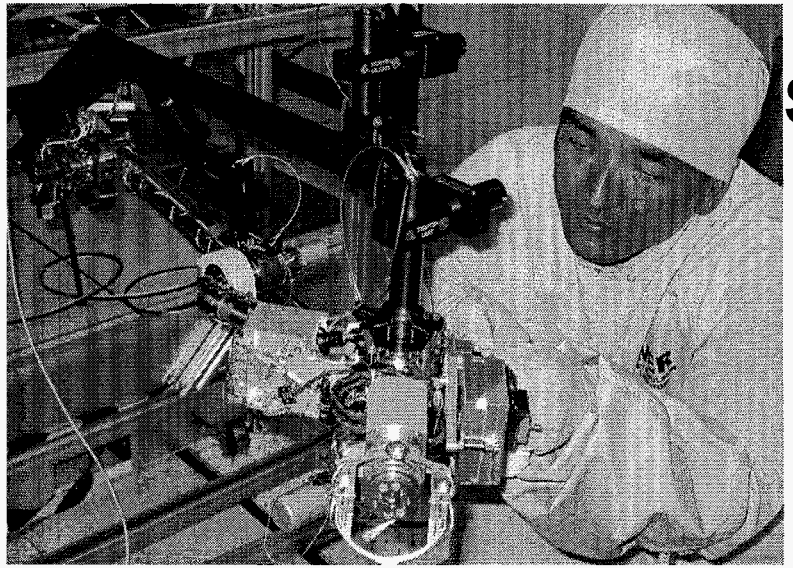


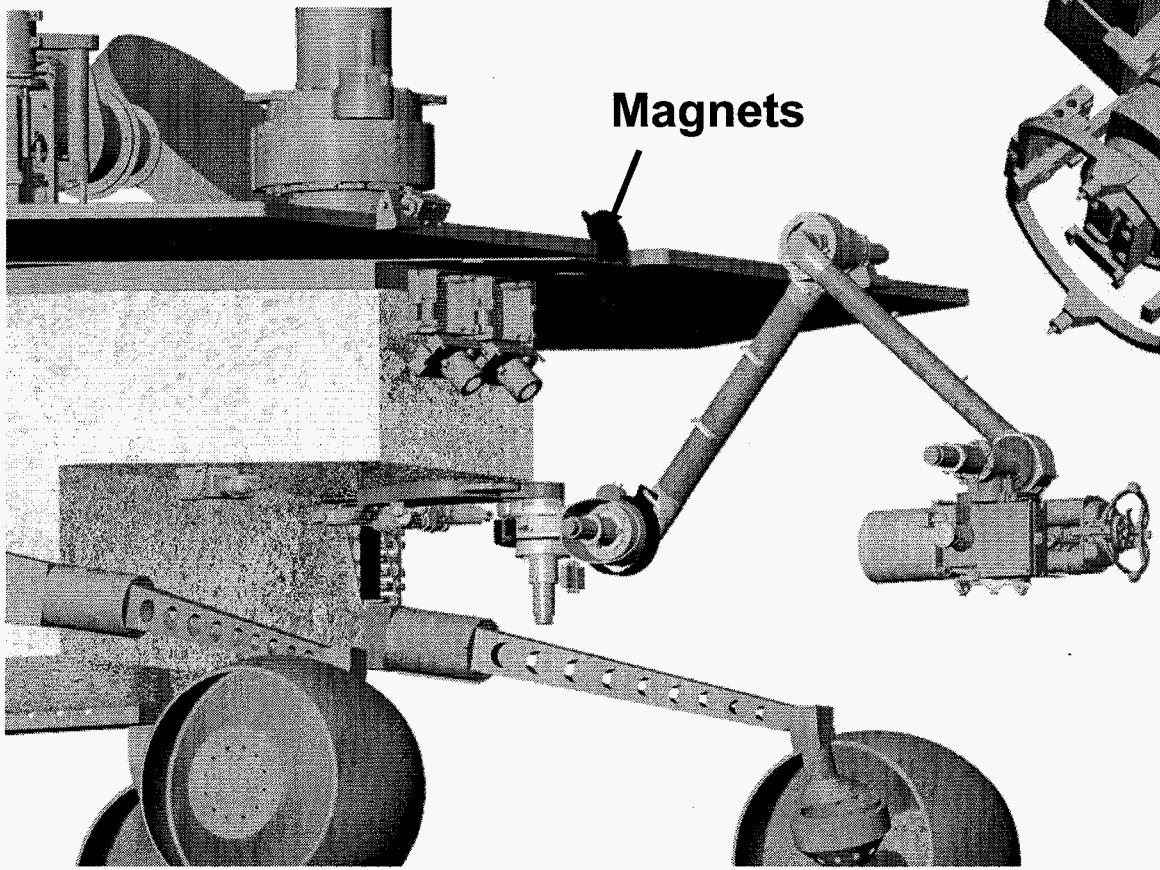


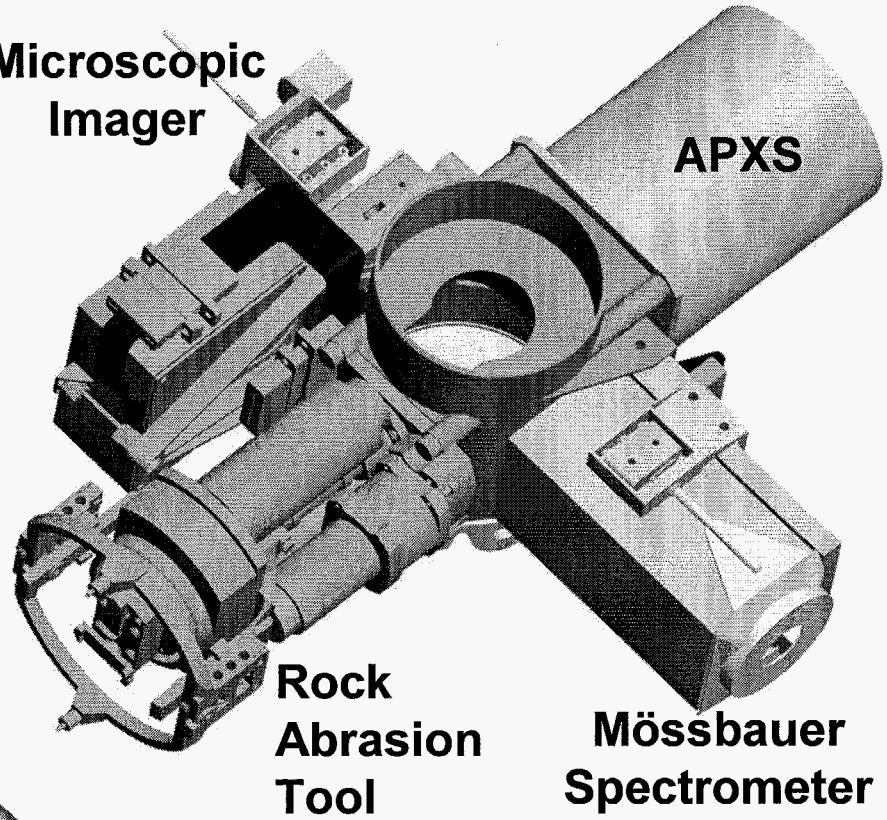

Panorama stereo camera and viewport for infrared spectrometer
Chemical analyzer, iron-bearing mineral analyzer, microscopic imager, rock abrasion tool

Landing Sites

Science Payload on the Robotic Arm





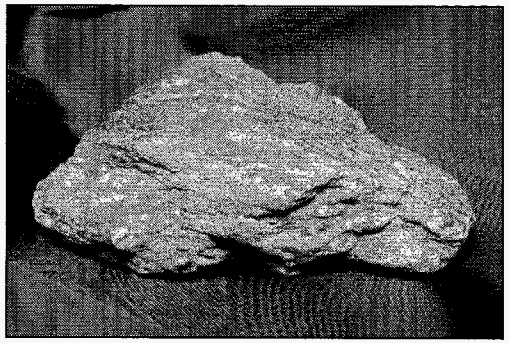


3 cm

Spot size

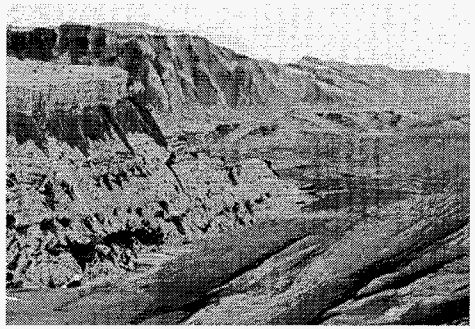
And the winners are ...

Meridiani

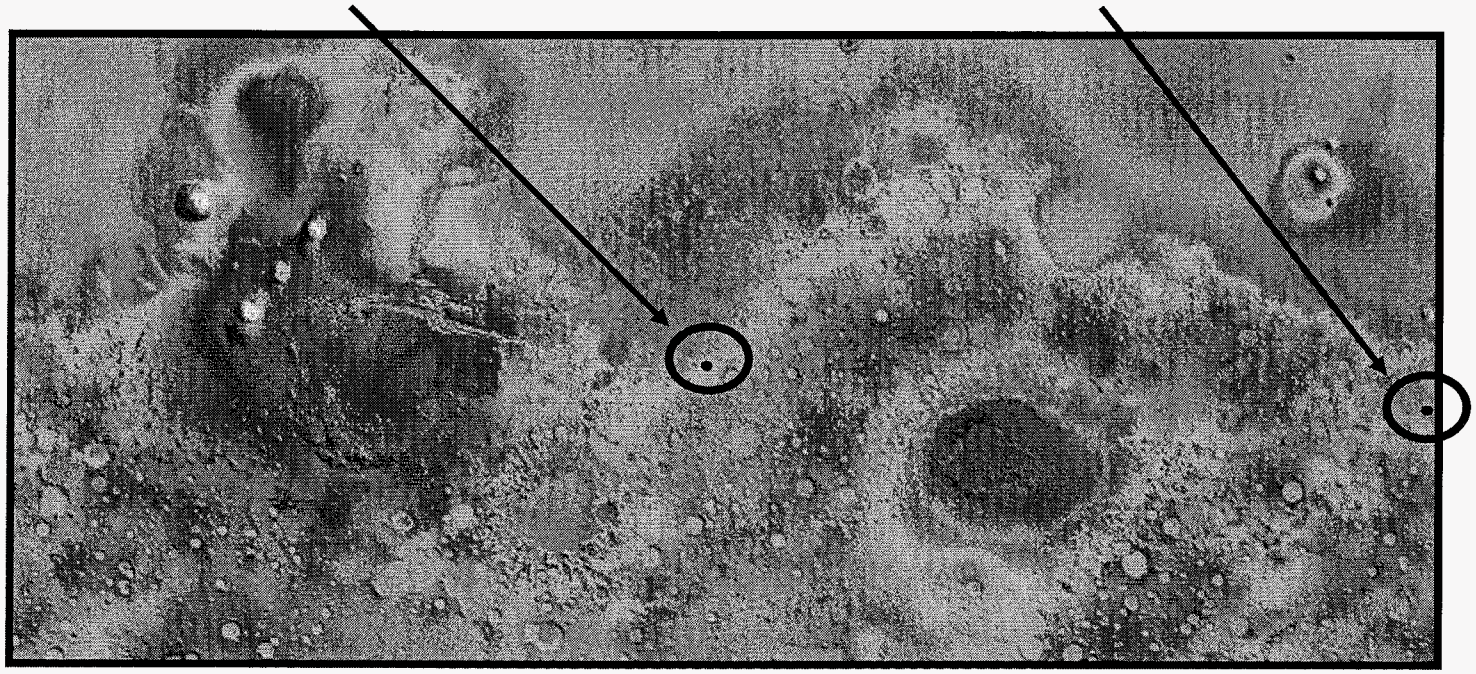


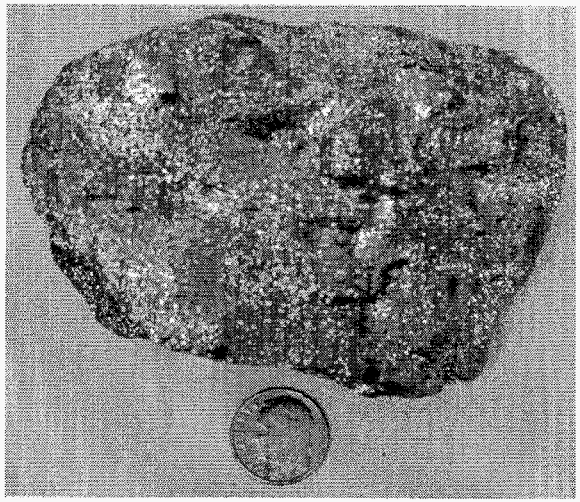
Water-formed hematite?

Gusev Crater



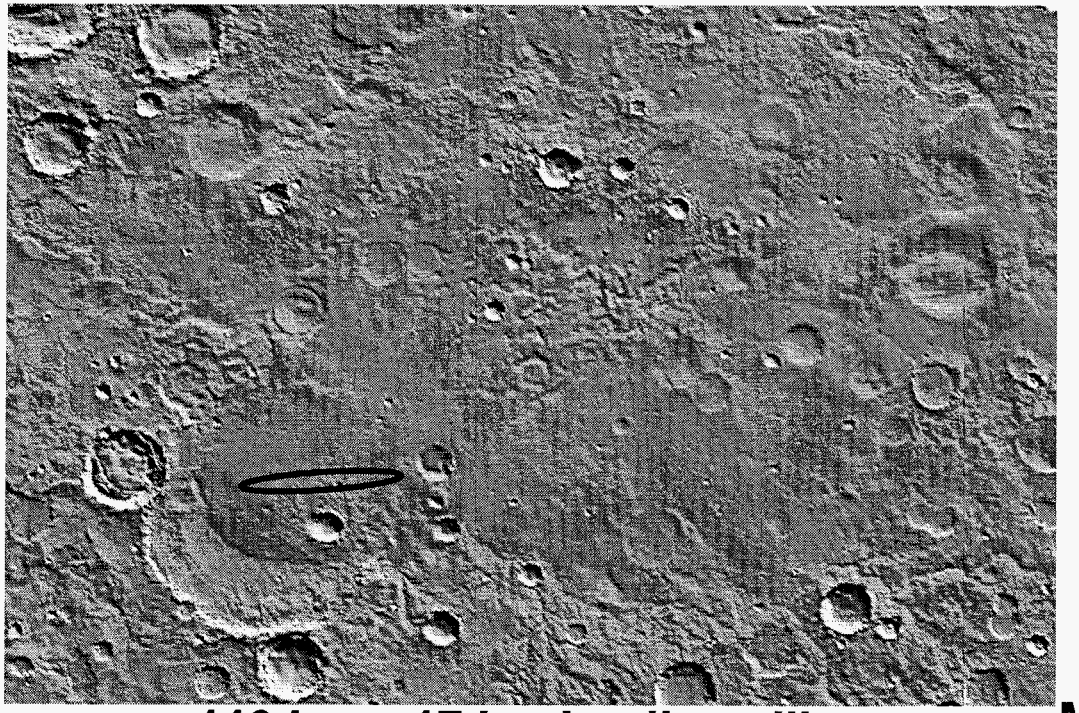
Ancient lake sediments?



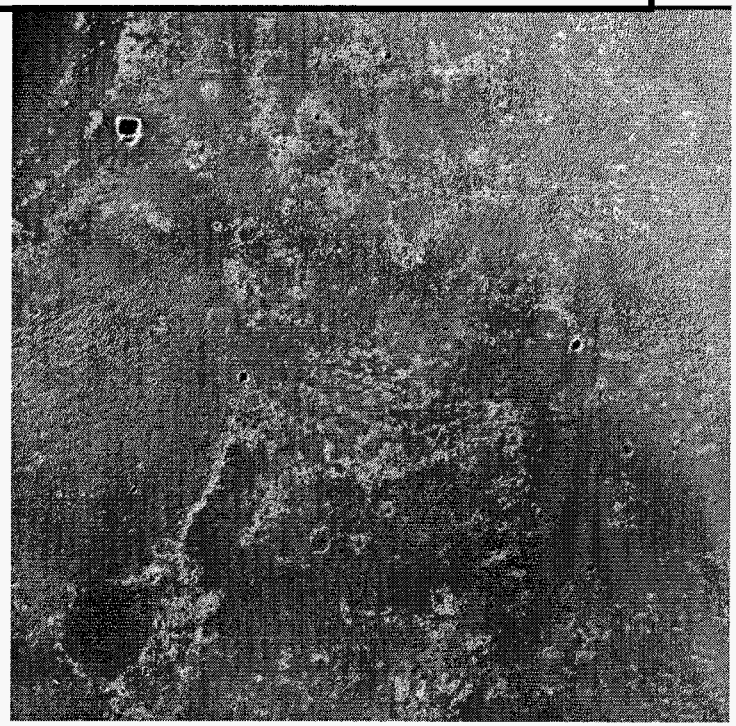


Meridiani Planum

Gray hematite: Precipitate from large standing body of water? Precipitate from warm percolating water? Cold ground water? Surface weathering coatings on rocks? High-temperature oxidation of volcanic rock?



119 km x 17 km landing ellipse (75 miles x 11 miles)

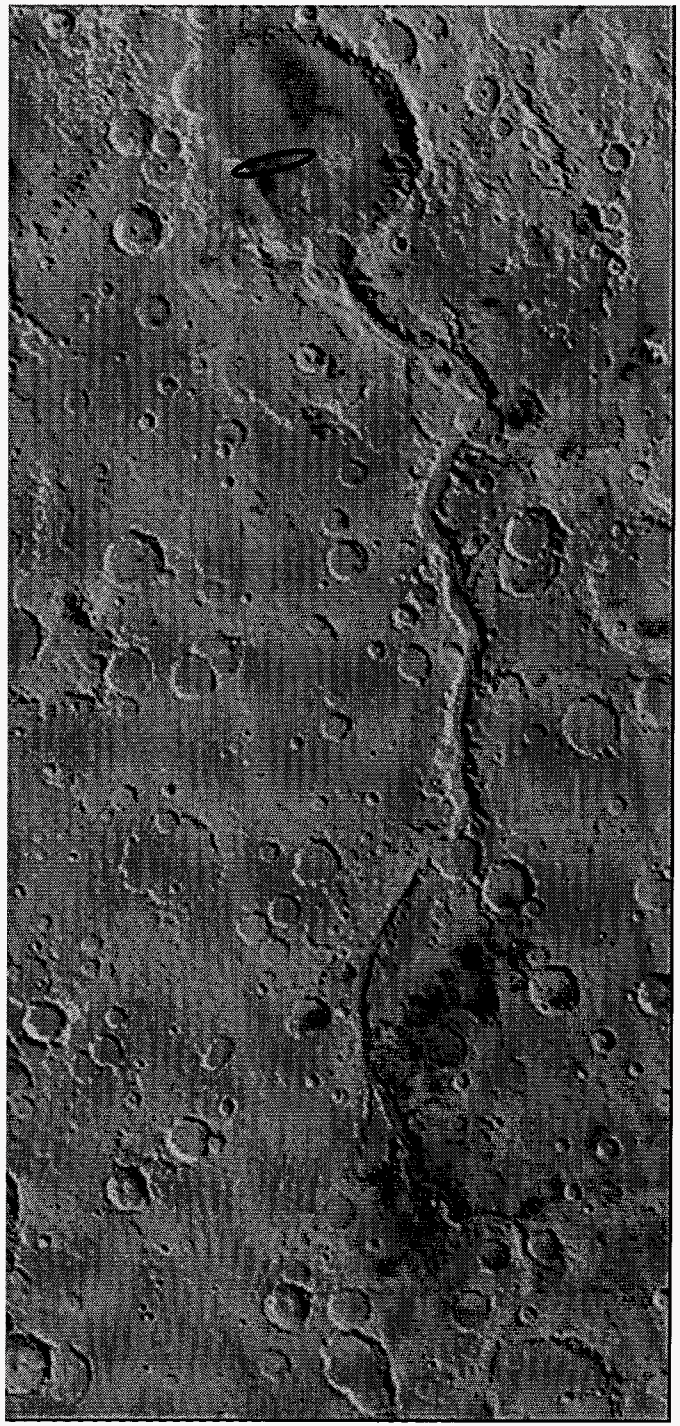


MOC image 3 km across, 3 m/pixel (2 miles across, 10 feet/pixel)
NASA/JPL/MSSS

Gusev Crater

- Compelling evidence that water ponded in the crater
- Lakebed deposits can preserve substantial evidence of past water-related processes, environmental conditions, and habitability
- Ice-covered lake? Short-lived playa lakes? Muddy debris flows? Ancient highland rocks deposited in the crater?

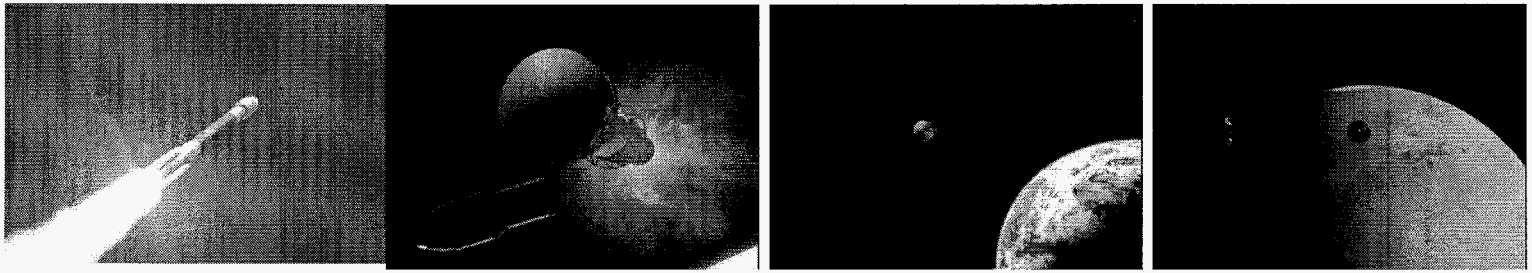
Crater diameter: 150 km (93 miles)



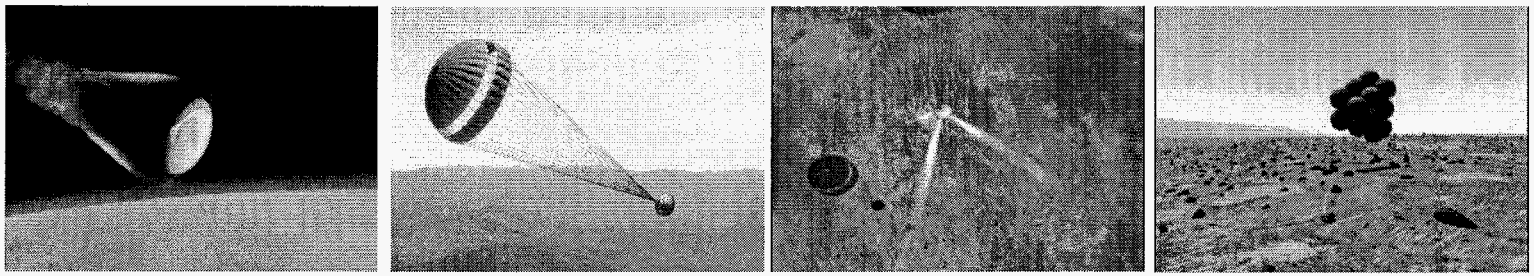
The Mission

The Three Challenging Mission Phases

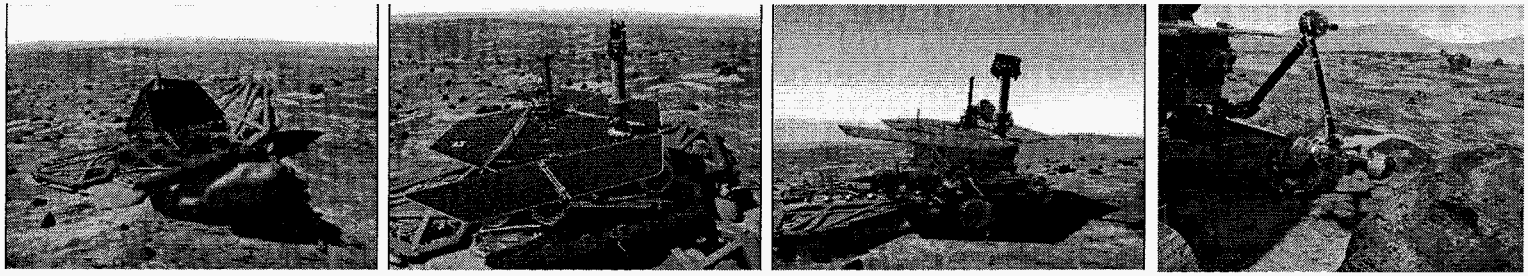
Launch & Cruise



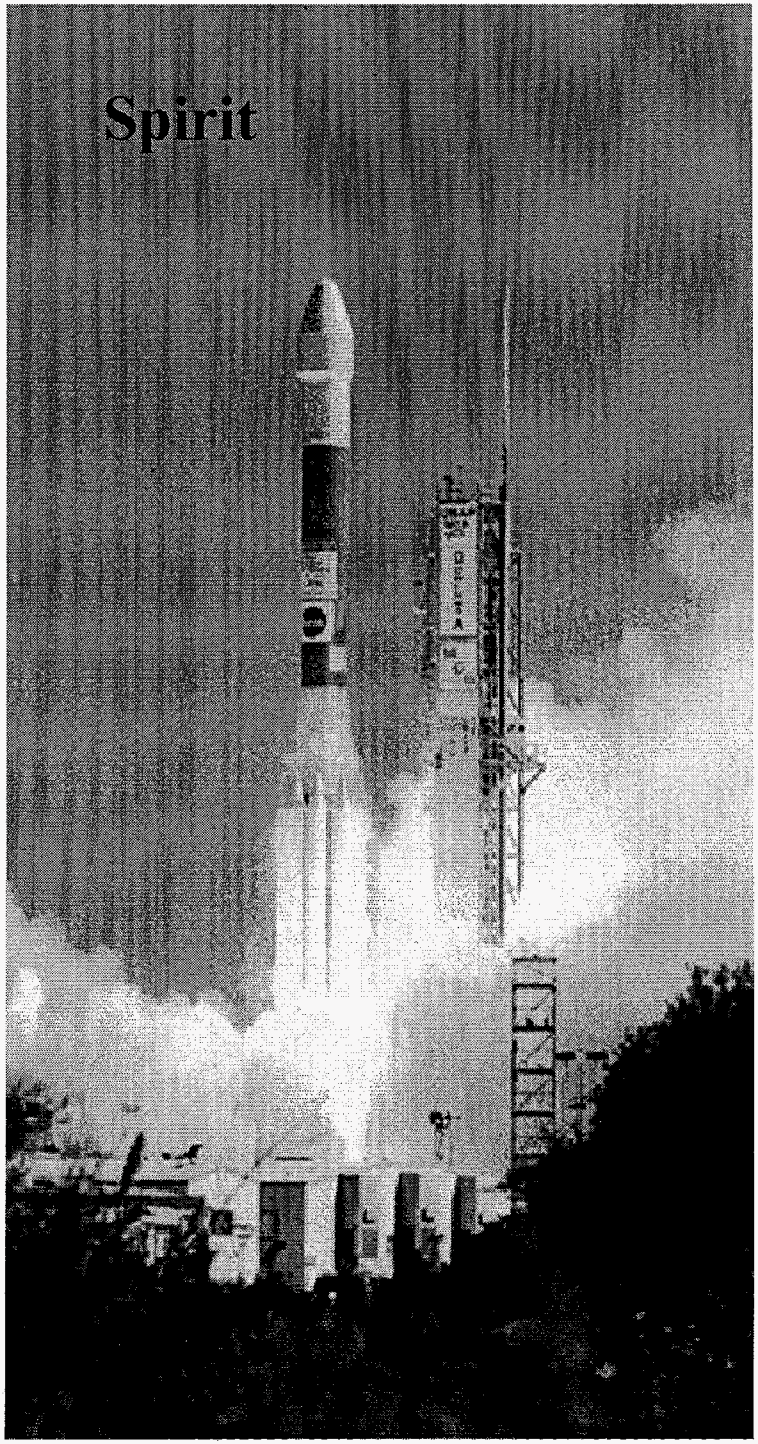
Entry, Descent & Landing

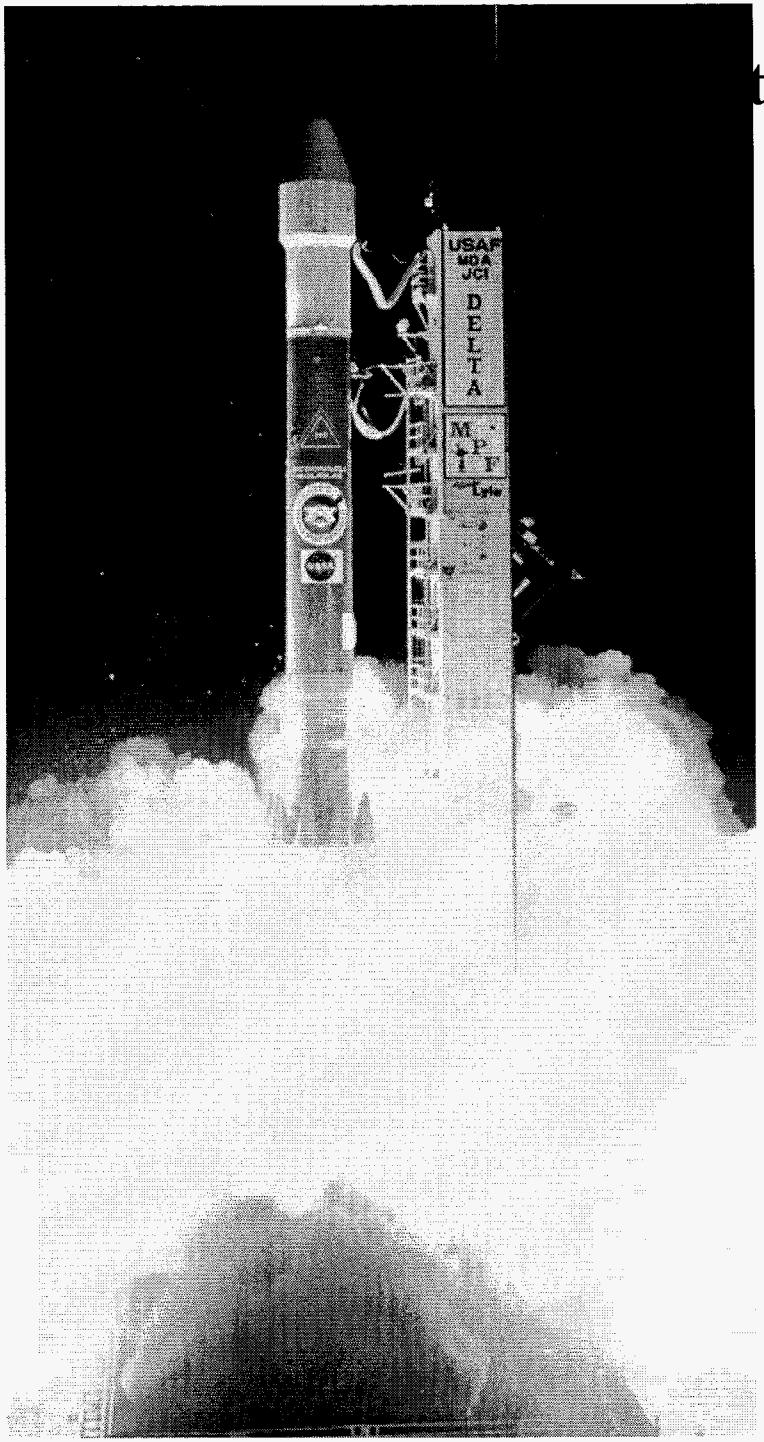


Egress & Surface Operations



Images From Mission Animation by Dan Maas





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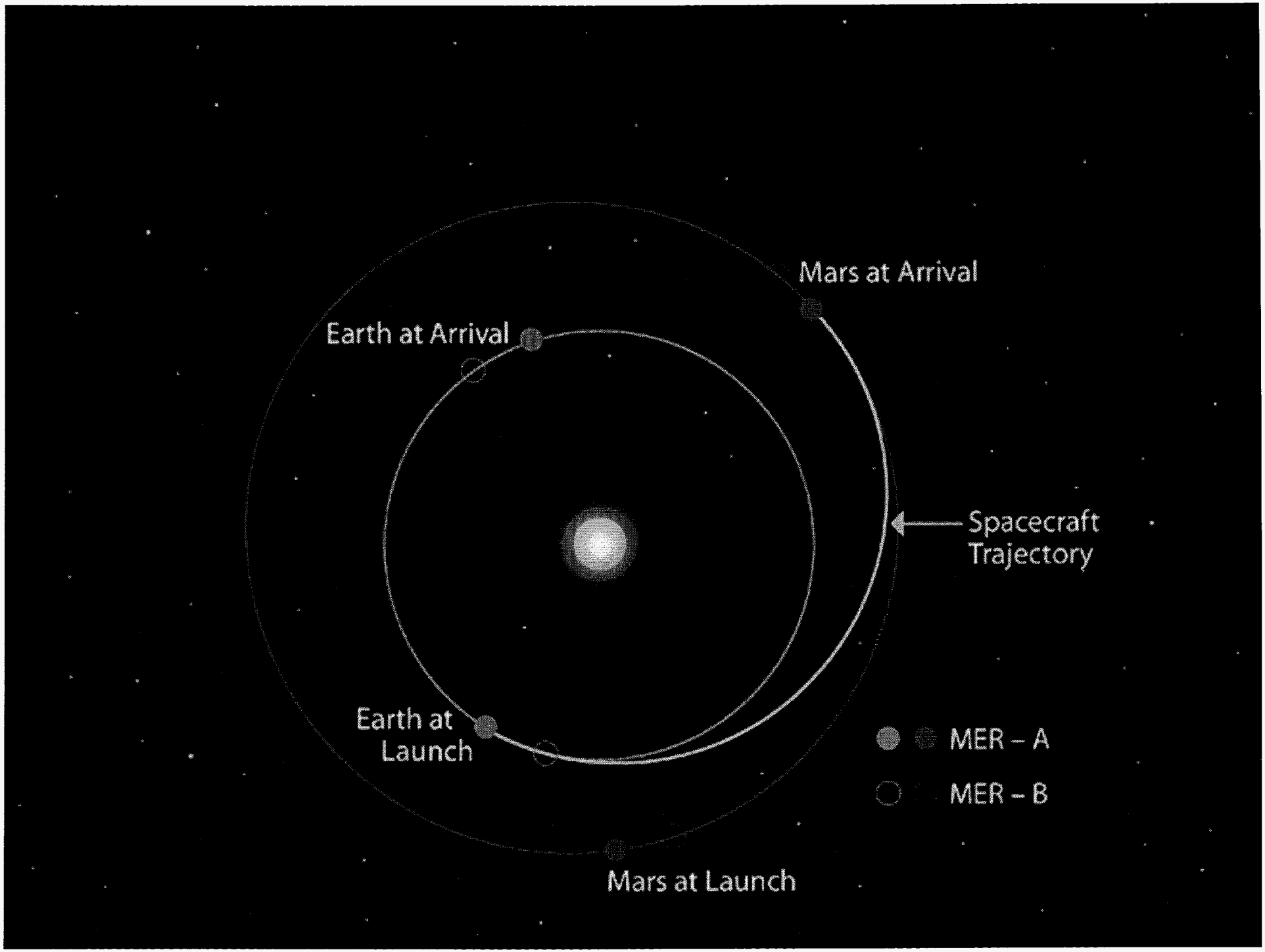
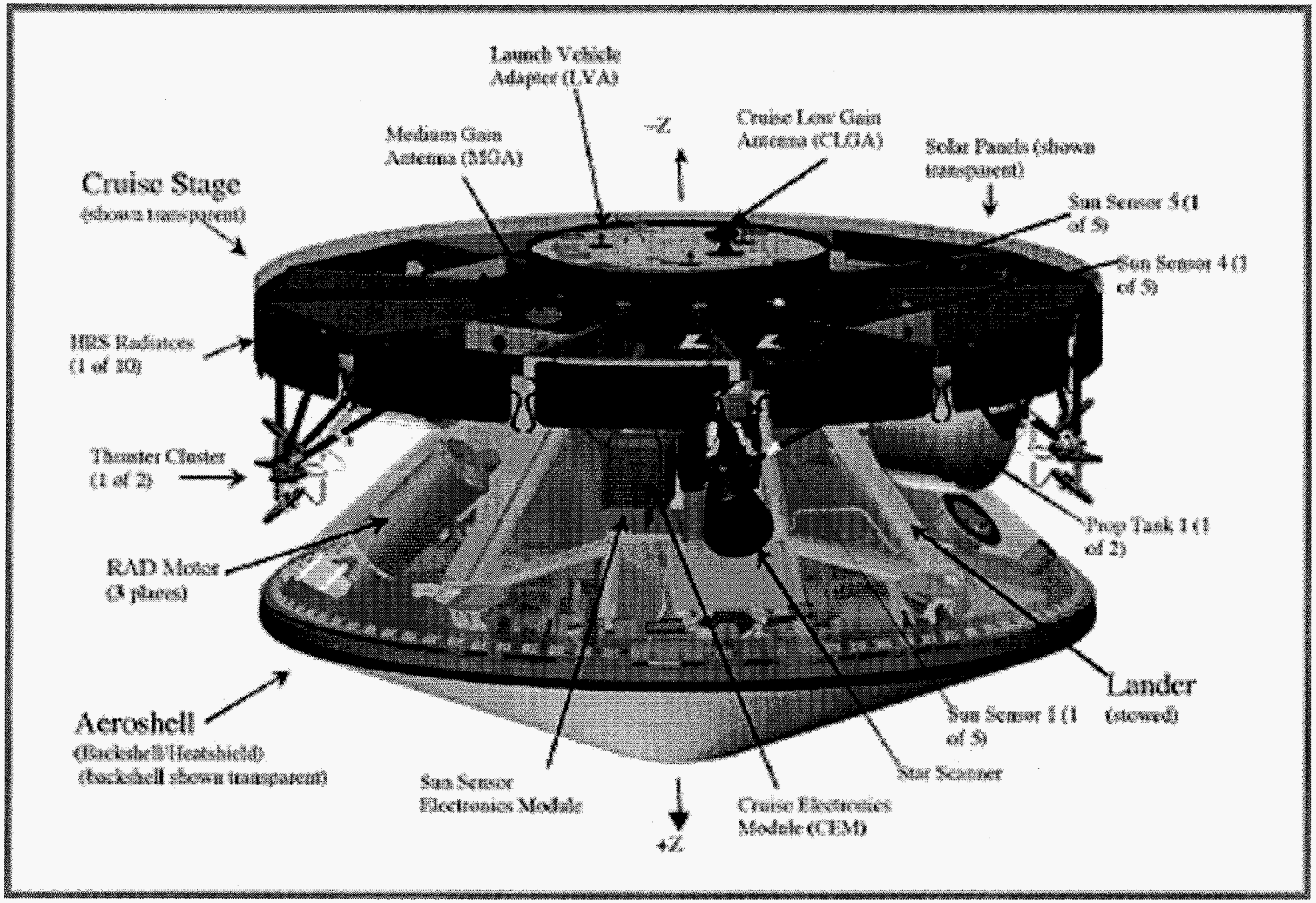

Mars at Arrival
Earth at Arrival
Spacecraft Trajectory
Earth at Launch
MER – A
MER – B
Mars at Launch

Cruise Configuration

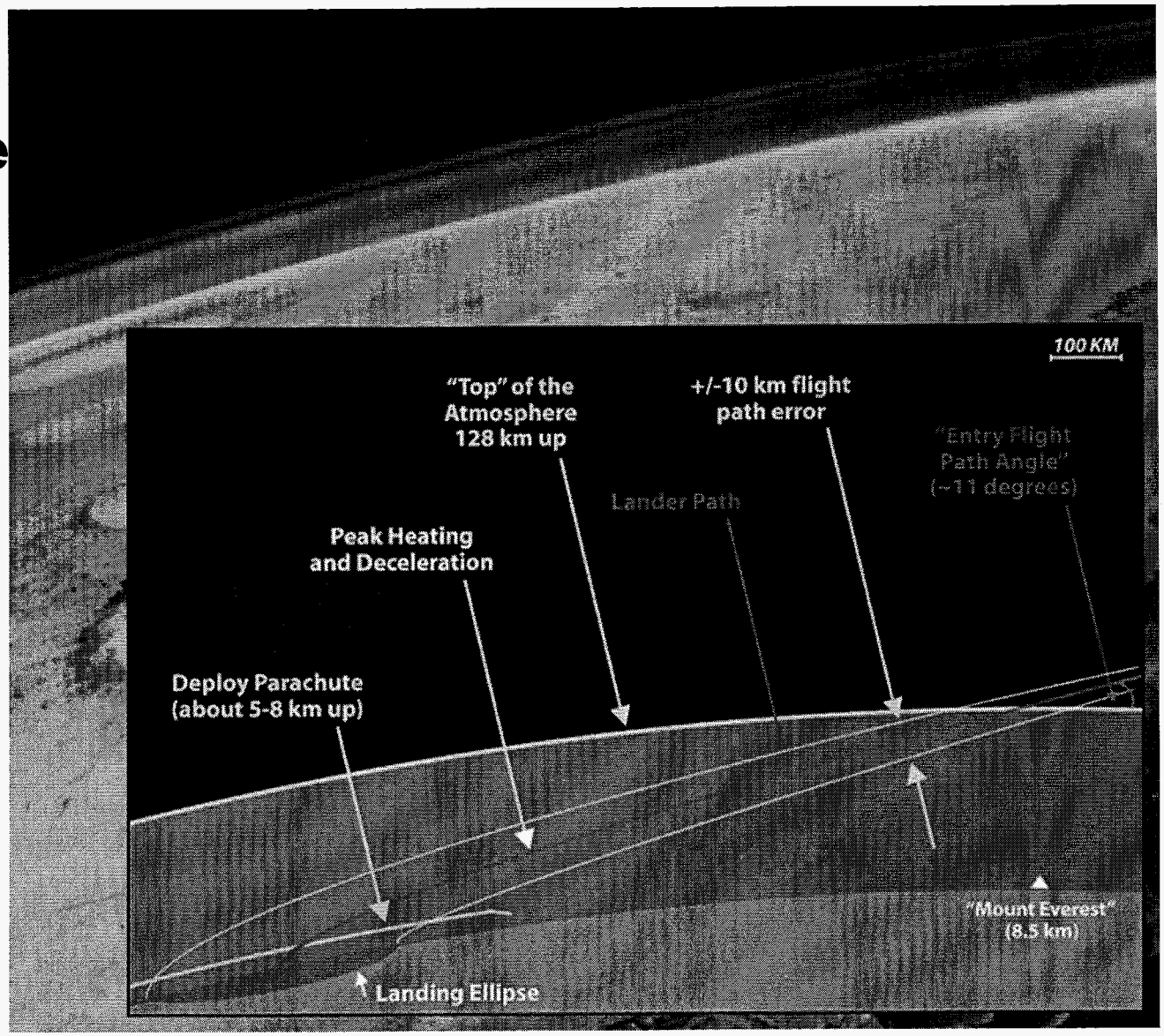


Entry, Descent and Landing

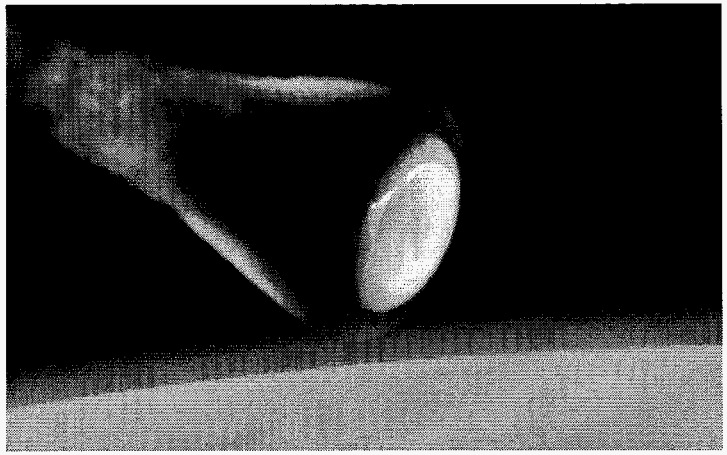
Entry: 11 Degre

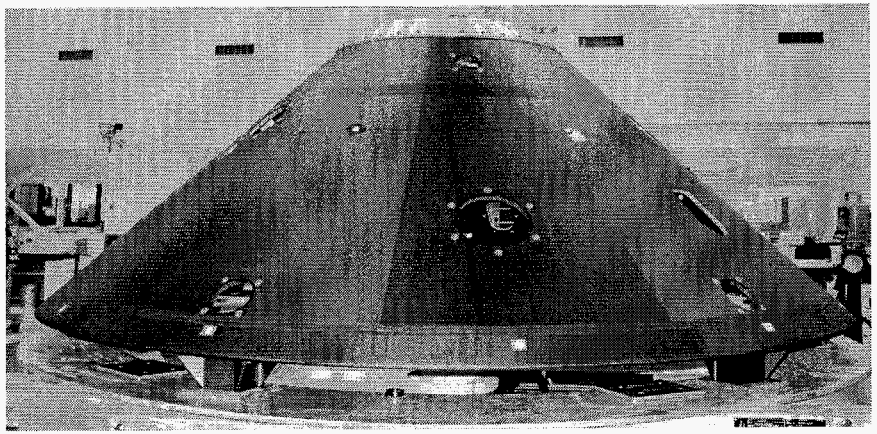
Any steeper and you get to the ground too fast!

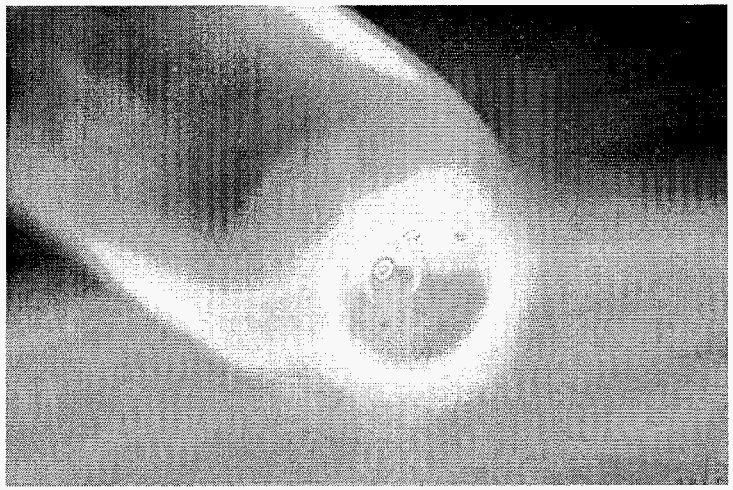
Any shallower and you "skip out" back into space!

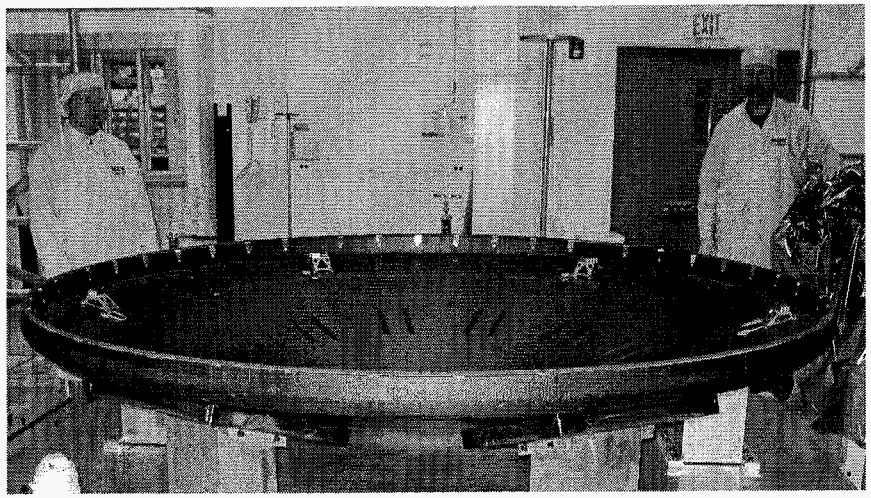


Heatshield takes out 99% of the energy

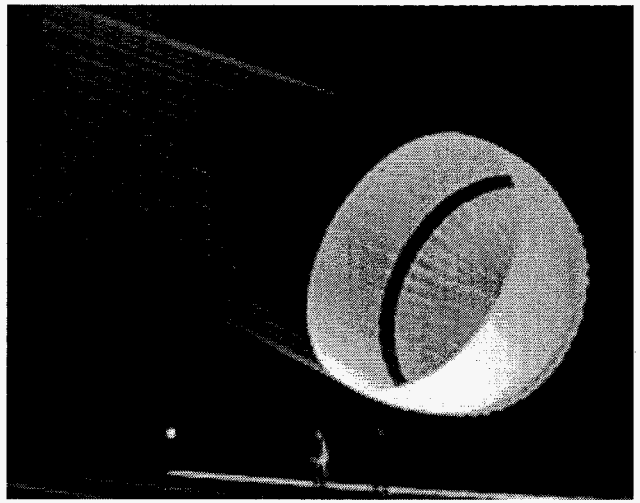


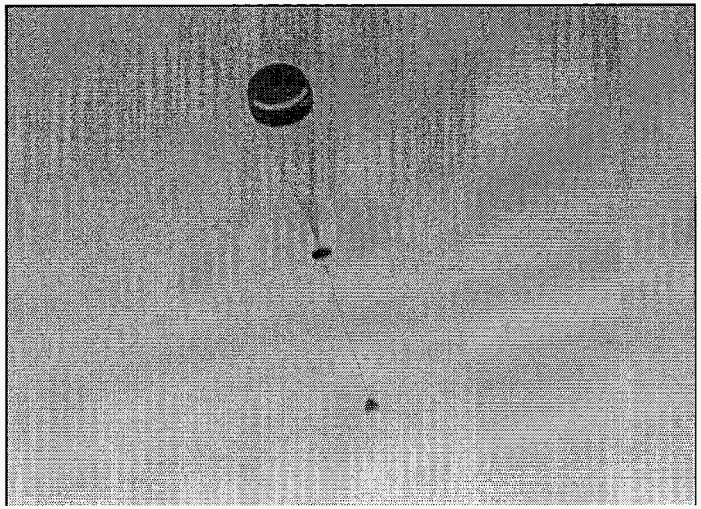


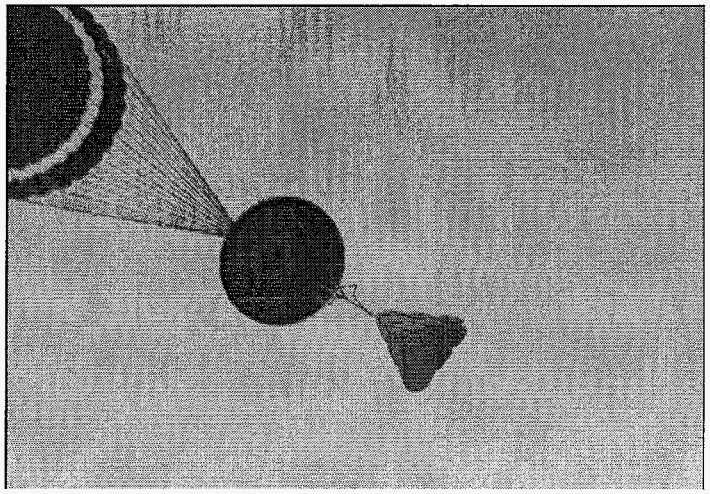


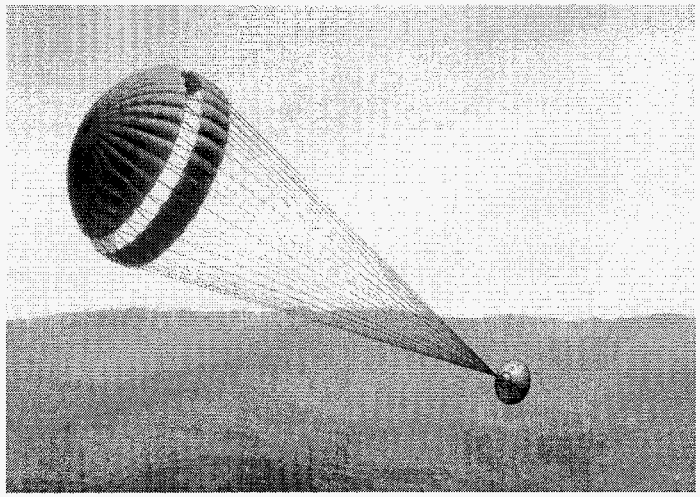


Parachutes open at Mach 1.3 and slow the lander to 250 km/hr

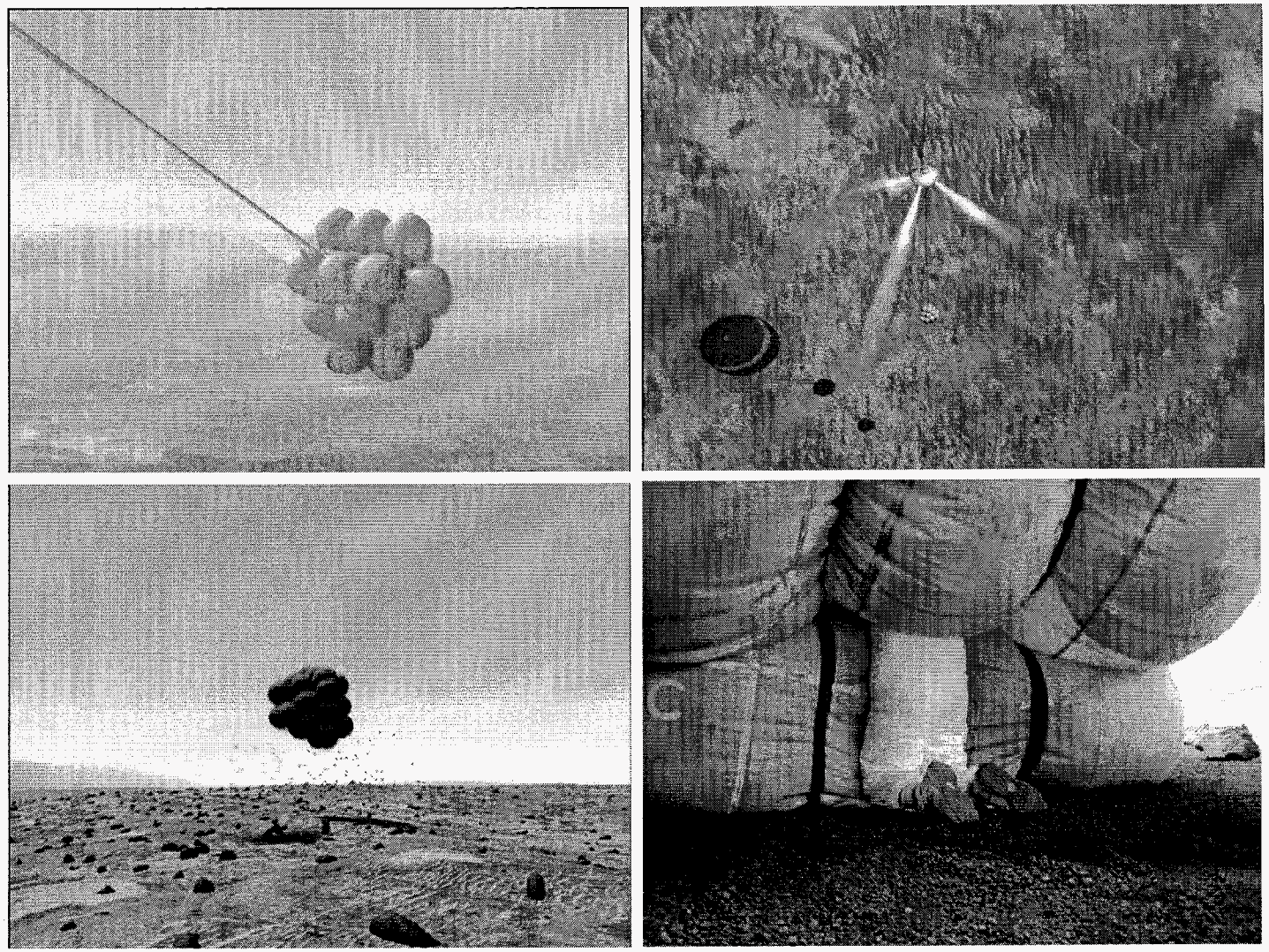




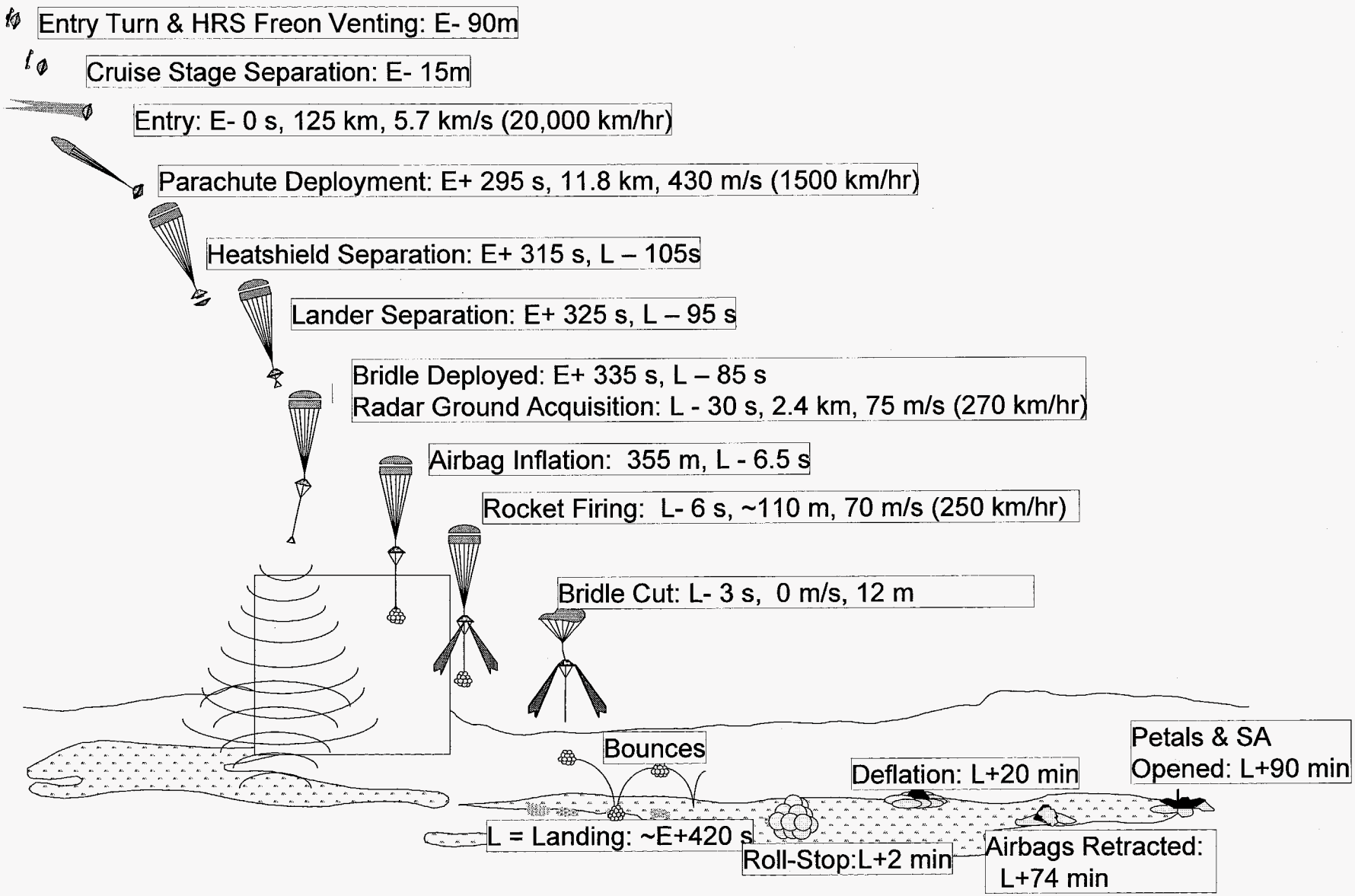




Rockets and airbags do the rest



Entry, Descent & Landing Timeline

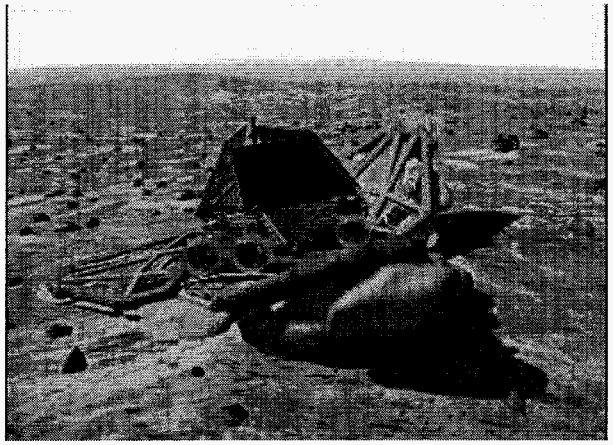
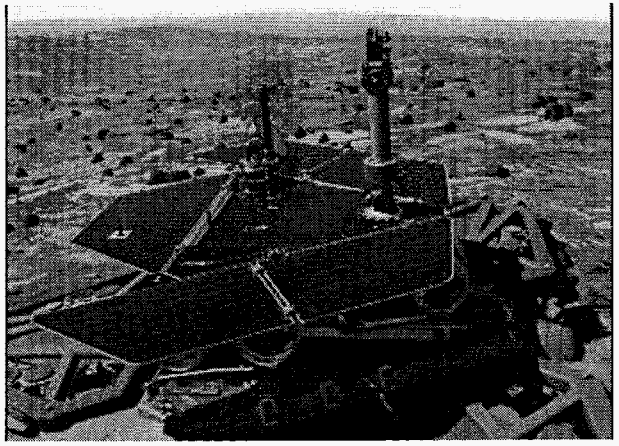
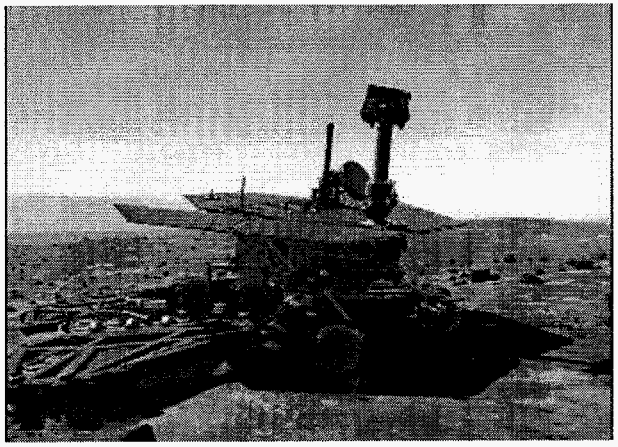


Once safe on the surface, it's time to:

Open up the lander and unfold the rover,

Call home,
Look around,

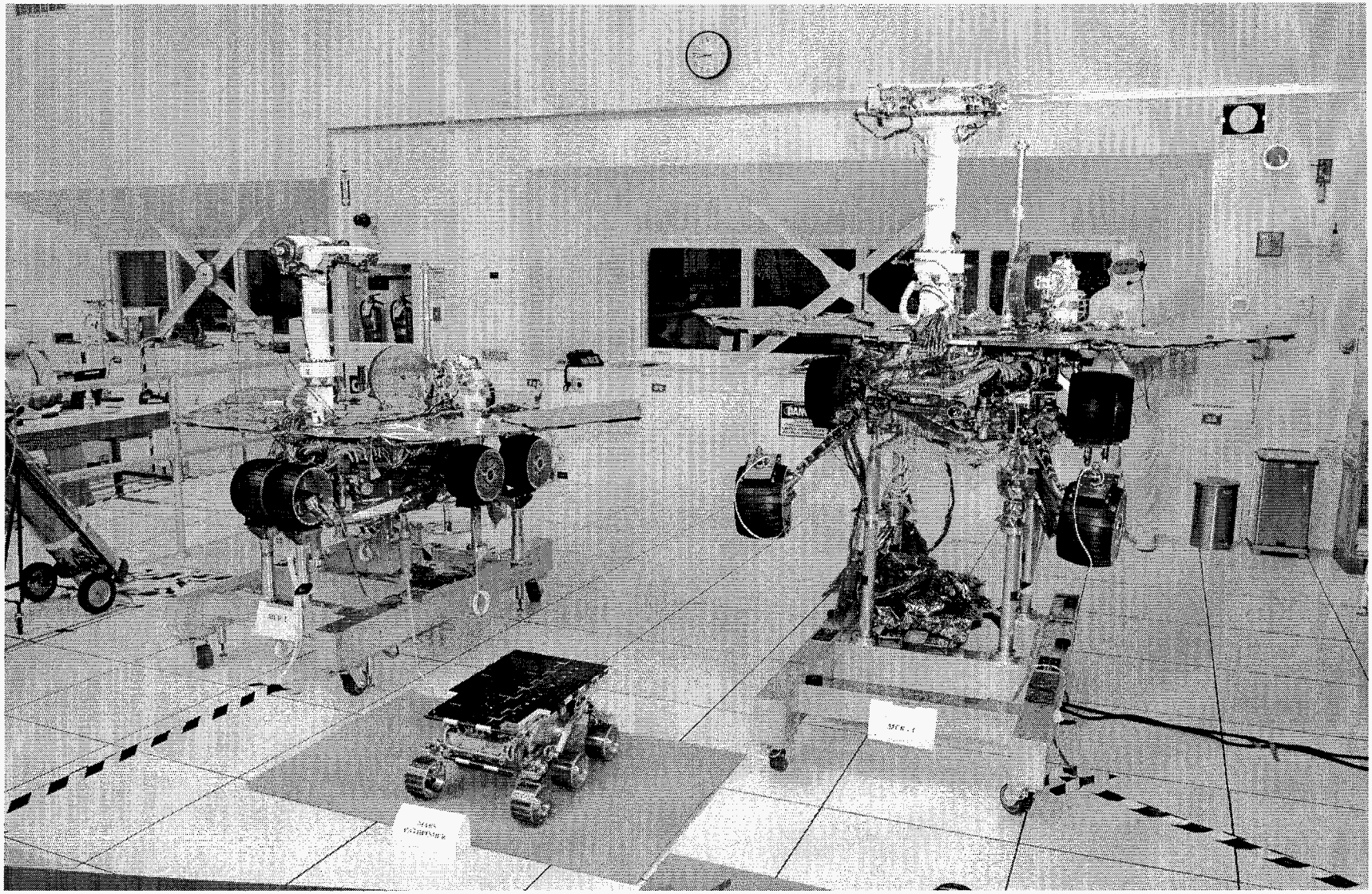
Get moving

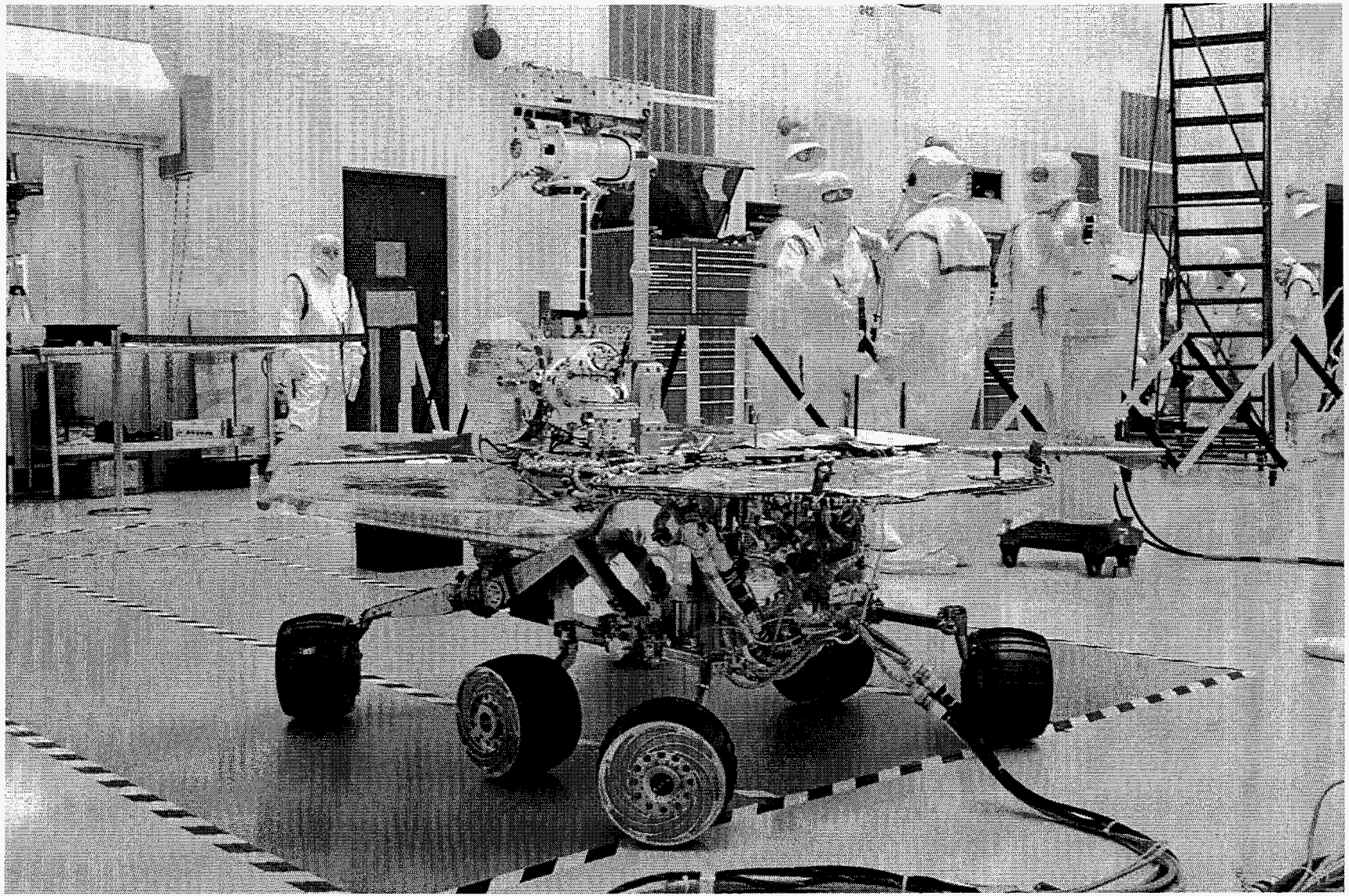
Pictures

MER #1, MER #2, & Sojourner Spare Rovers

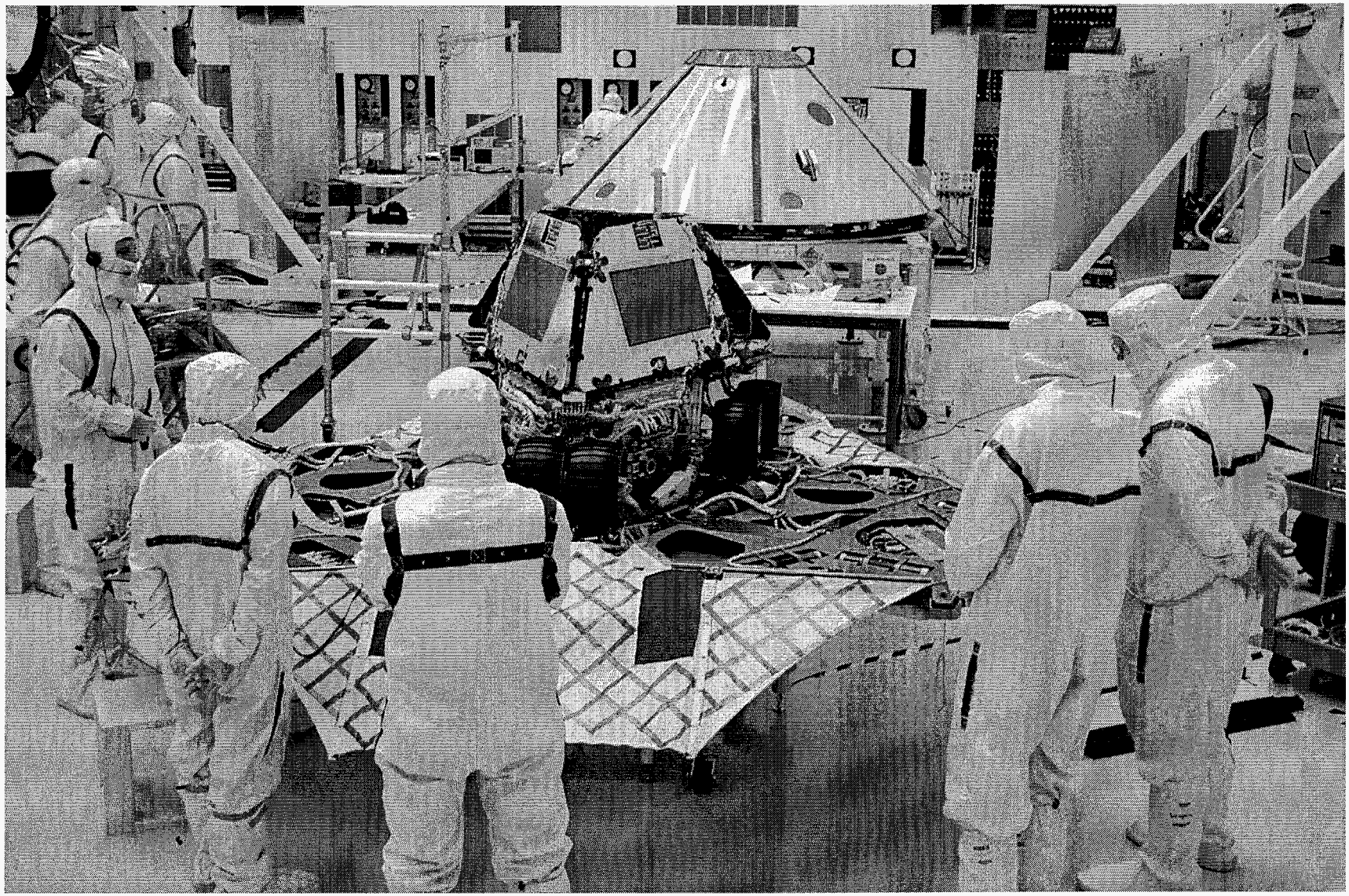
February 10, 2003



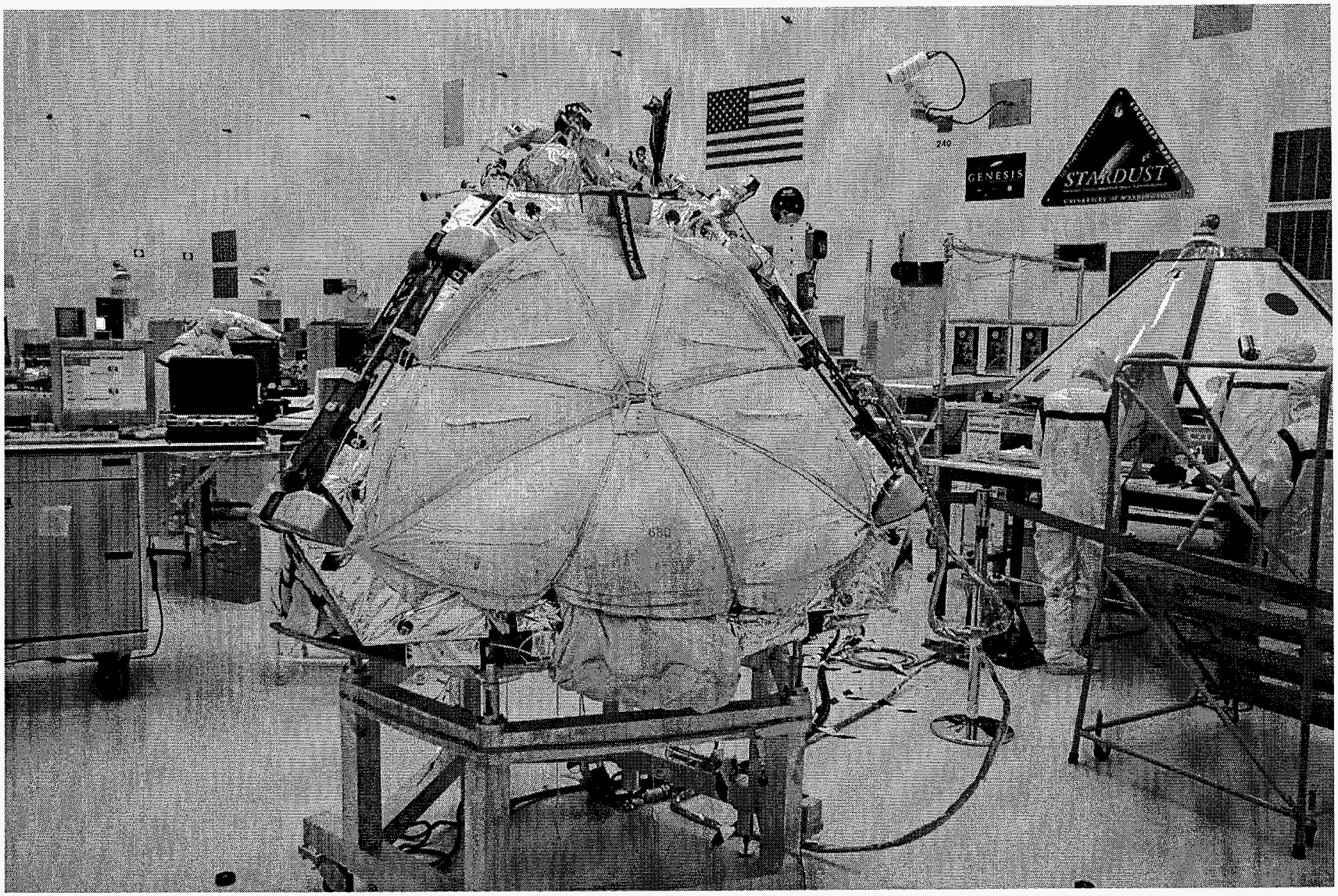
Spirit Driving Testing at KSC



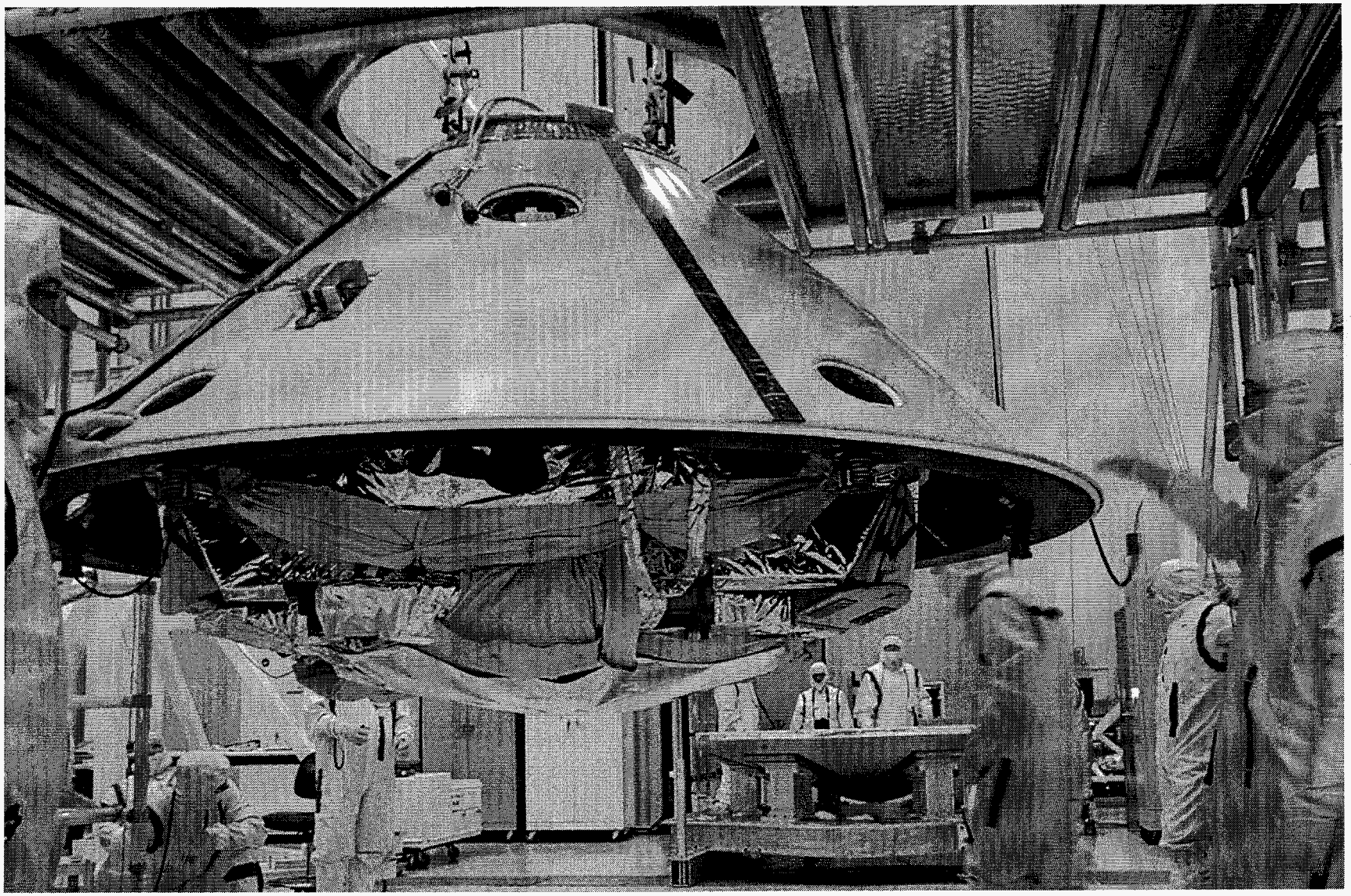
Stowed Rover and Lander



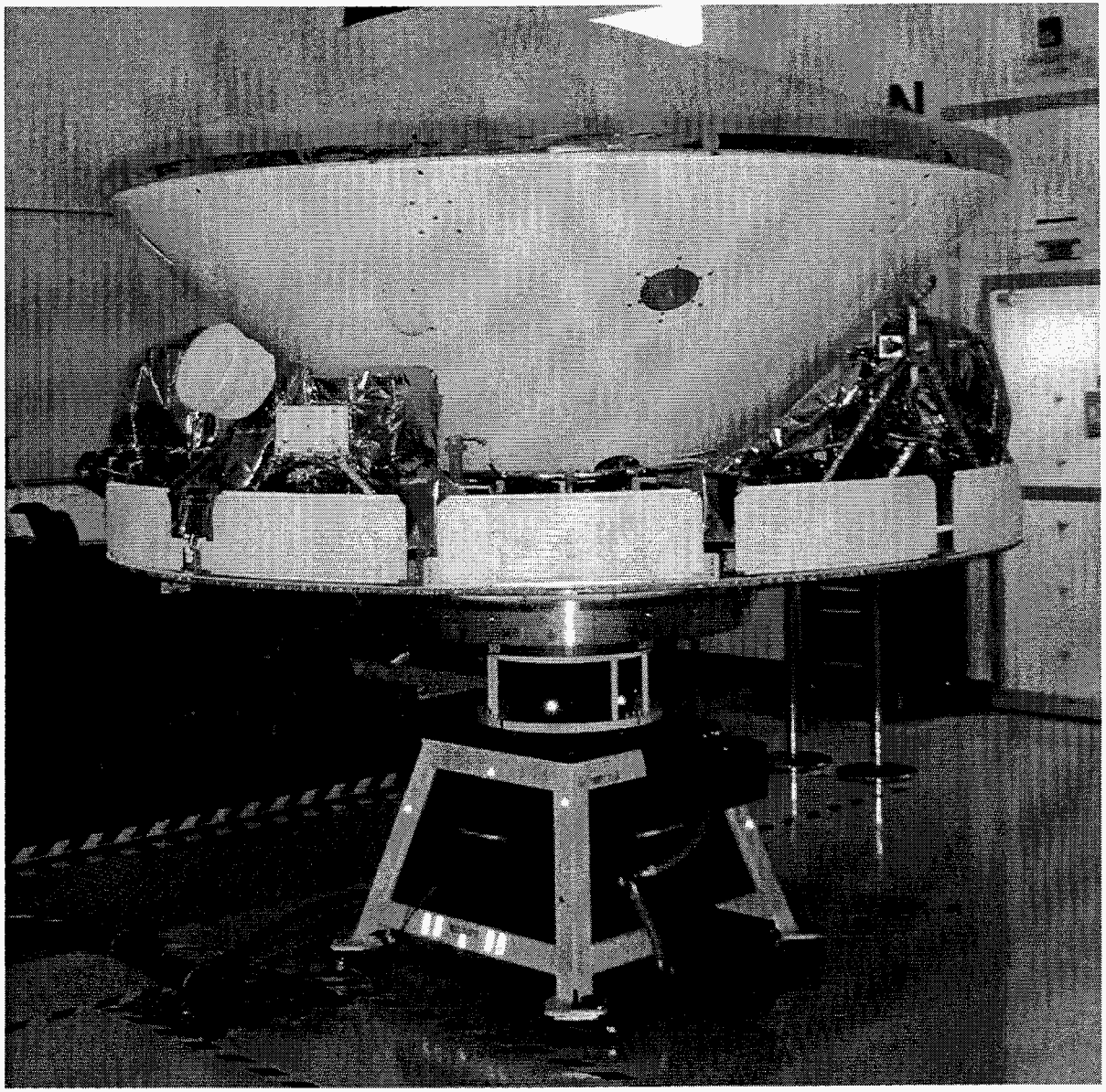
Integrated Lander



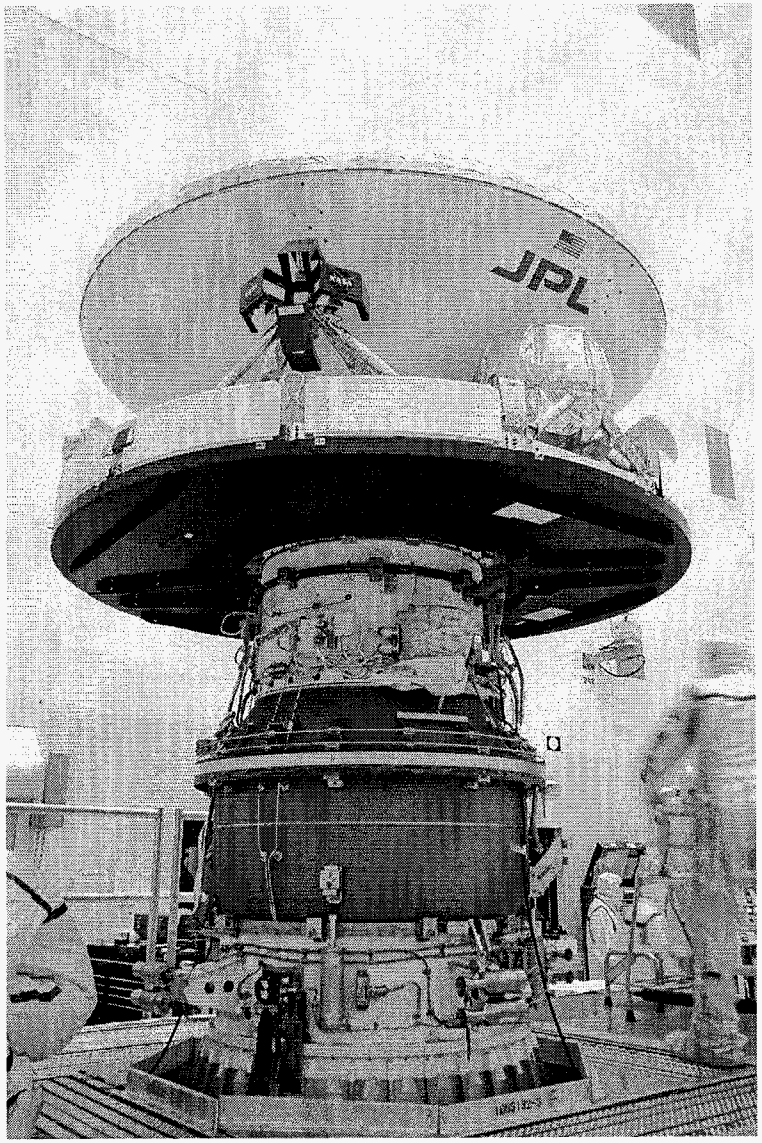
Lander in Backshell

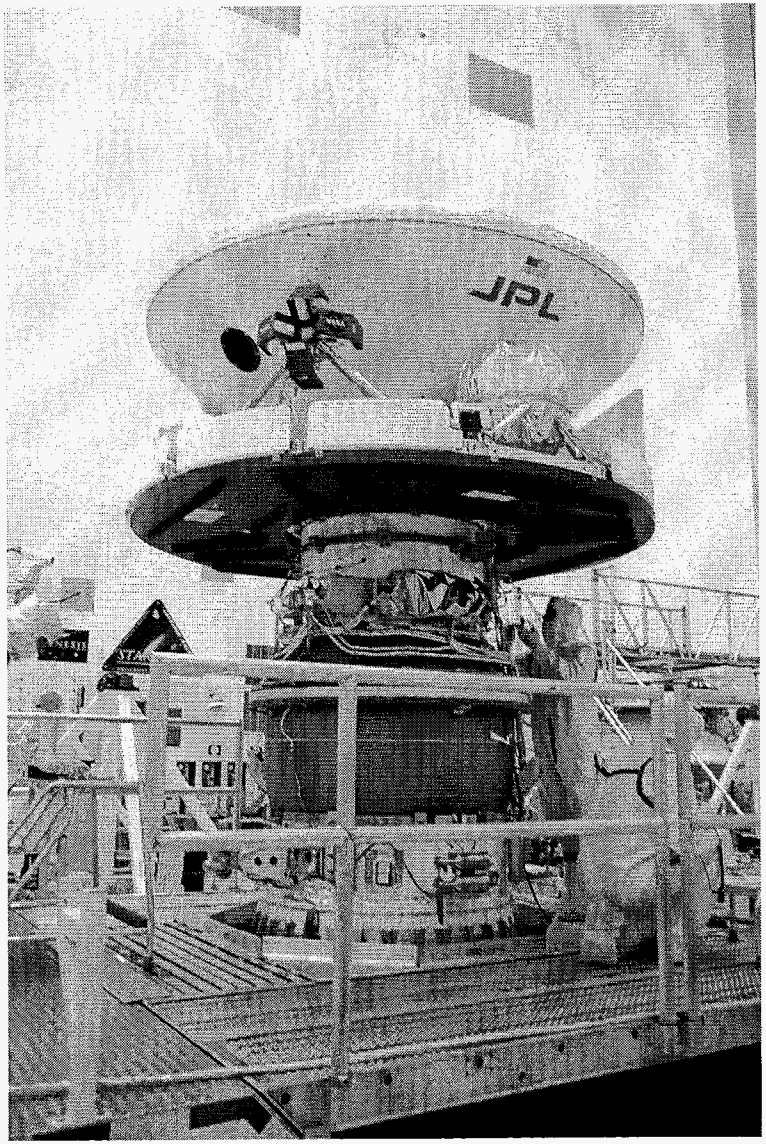


Launch / Cruise Configuration

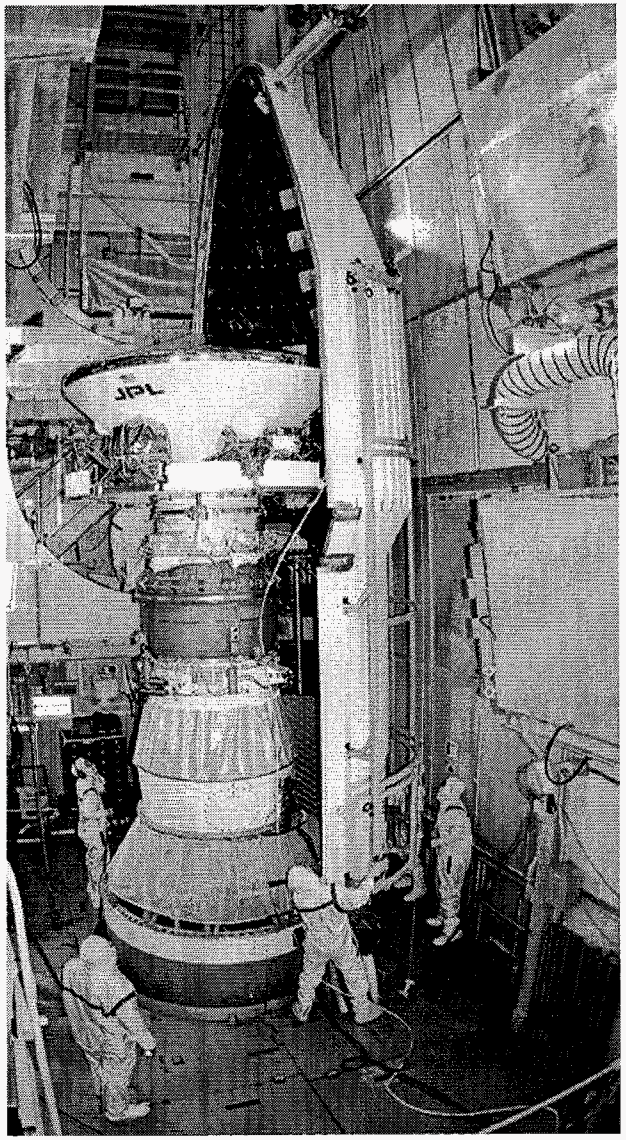


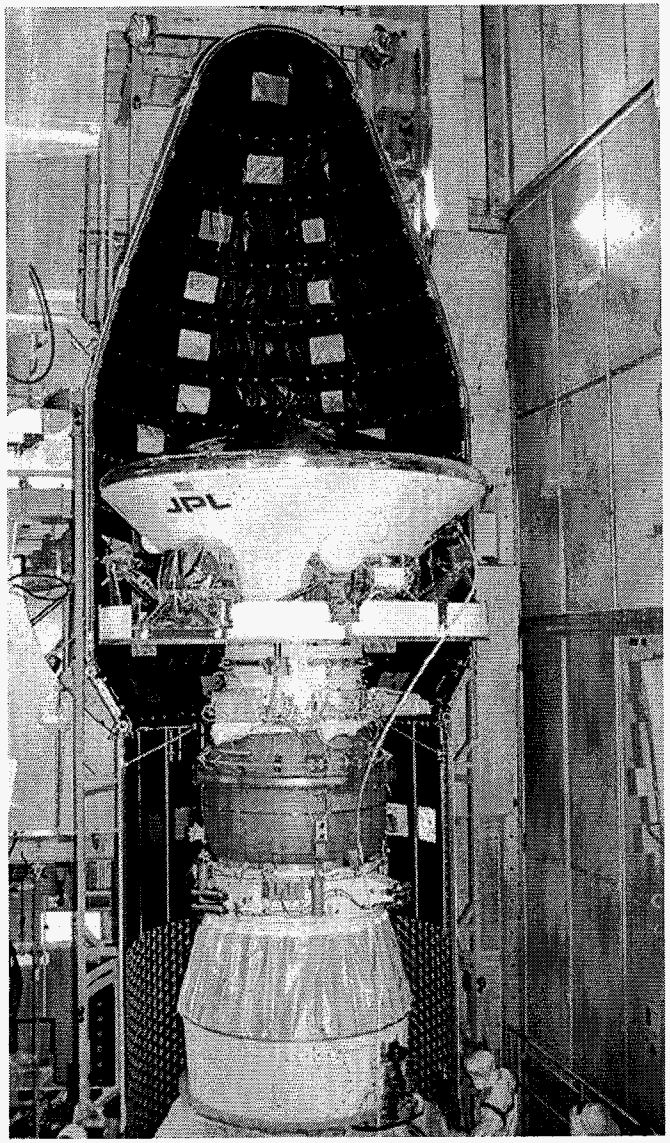
On the Third Stage





Spirit in the Fairing





QuickTime™ and a
YUV420 codec decompressor
are needed to see this picture.

In 41 attempts by the space-faring nations, 26 missions have failed.

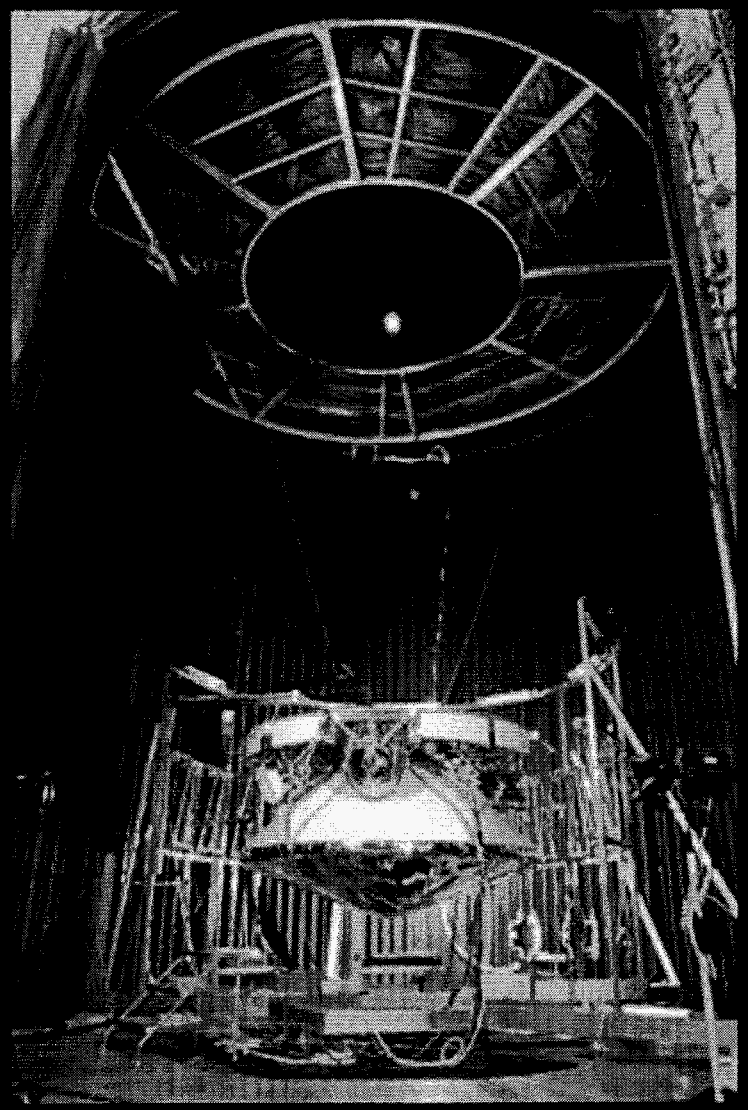
27 orbiters,

12 landers &

2 probes.

No mission has yet brought samples of Mars back and no one has been to Mars.

To help ensure success, we have to test…



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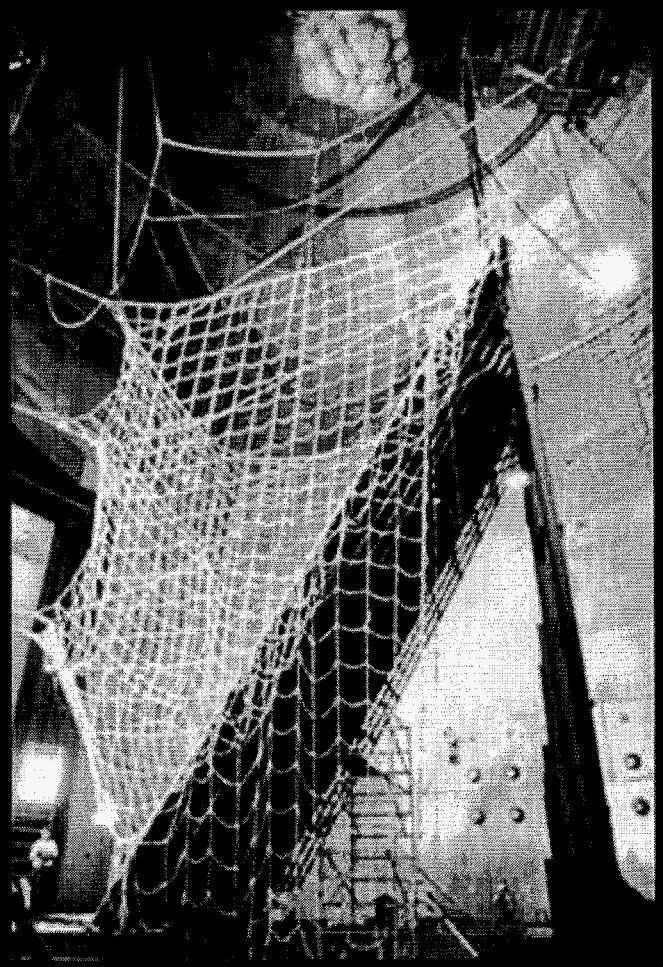
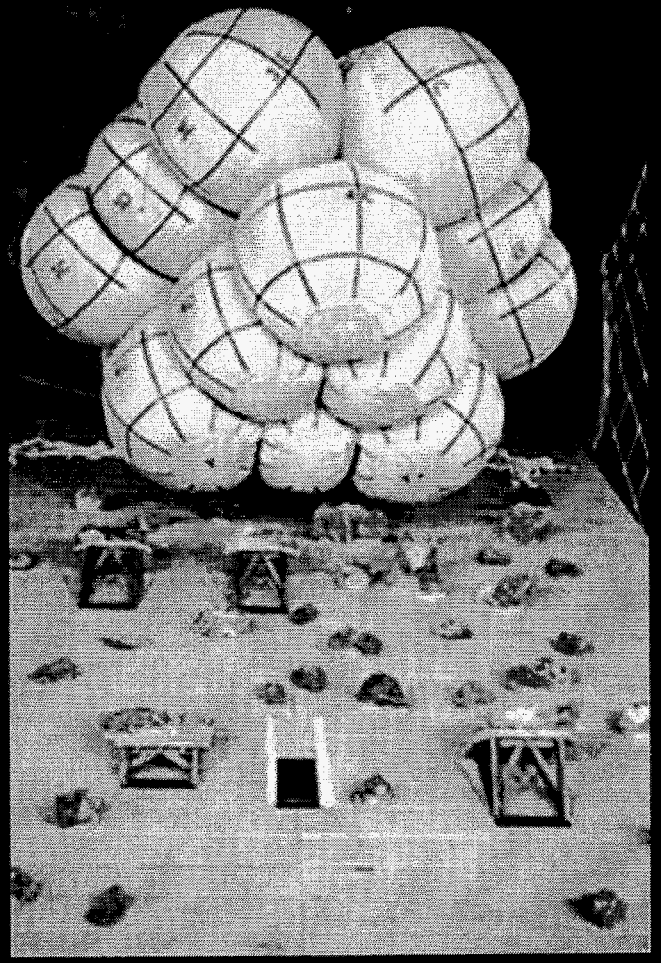
Mars Pathfinder Project

JPL

Plum Brook Full Scale Airbag Drop Tests Simulated Martian Conditions

NASA





MPF
R. Anderson

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are needed to see this picture.

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