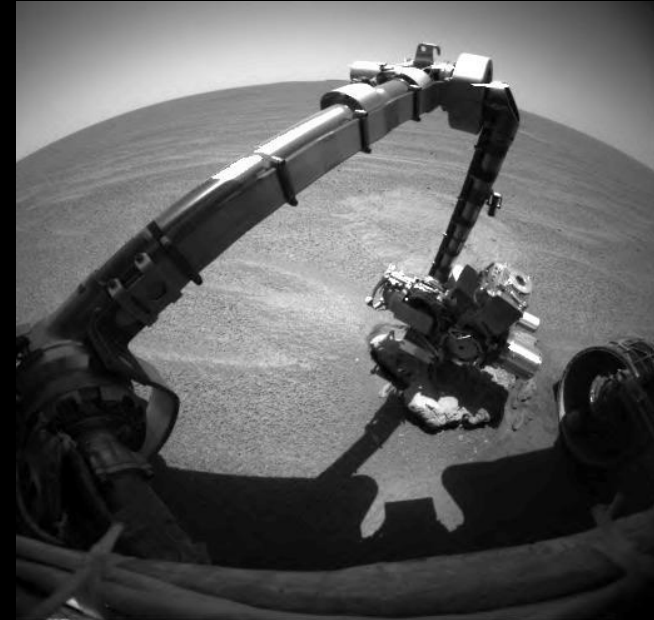
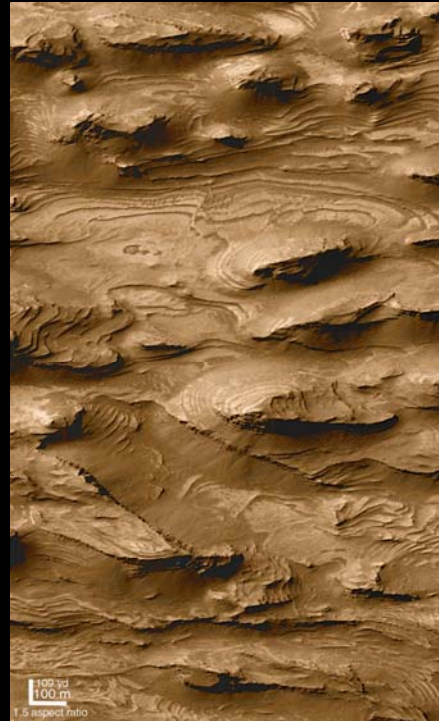
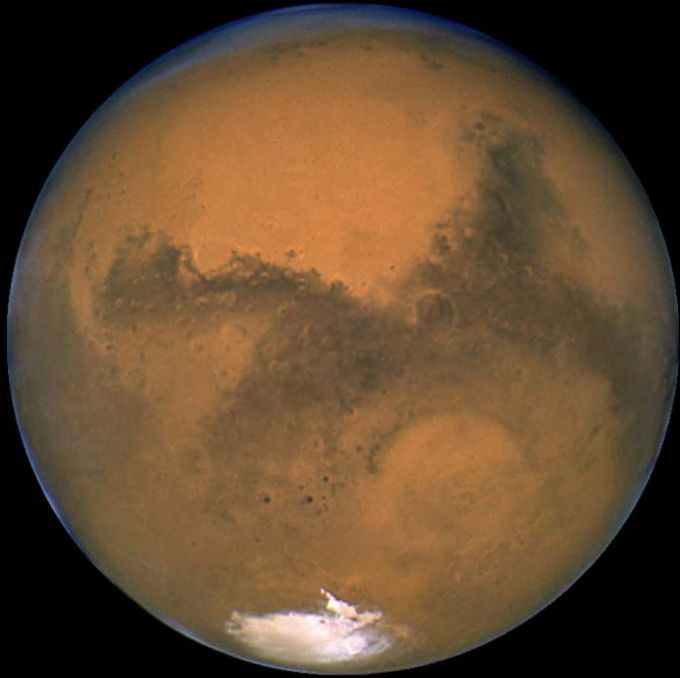


Mars Exploration



James Zimbelman and John Grant
Center for Earth and Planetary Studies
National Air and Space Museum
Smithsonian Institution

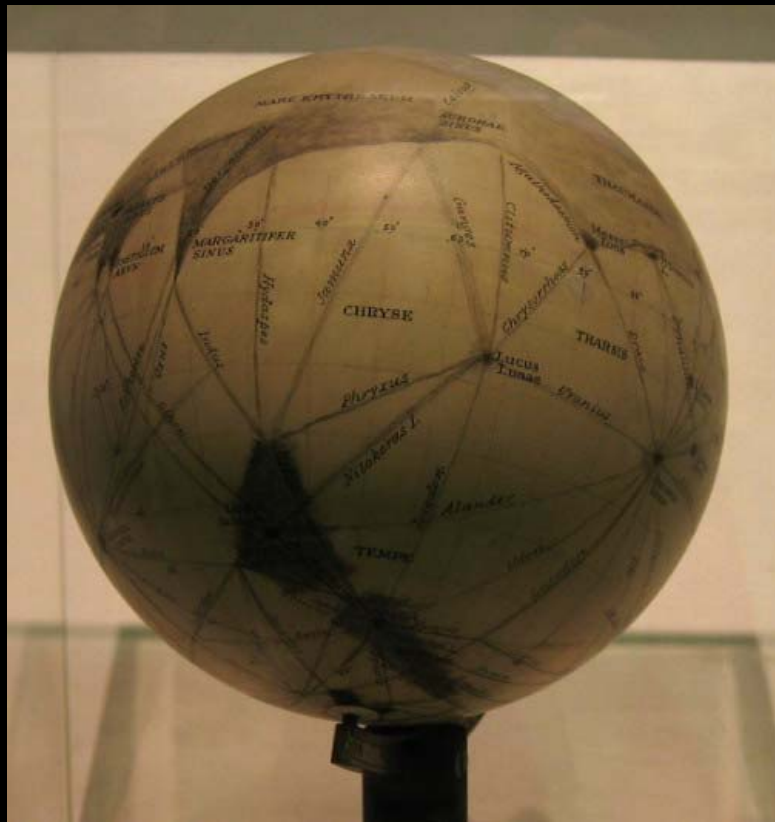
Why Study Mars?

Science goals of the Mars Exploration Program

- Determine whether life ever arose on Mars
- Characterize the climate of Mars
- Characterize the geology of Mars
- Prepare for human exploration

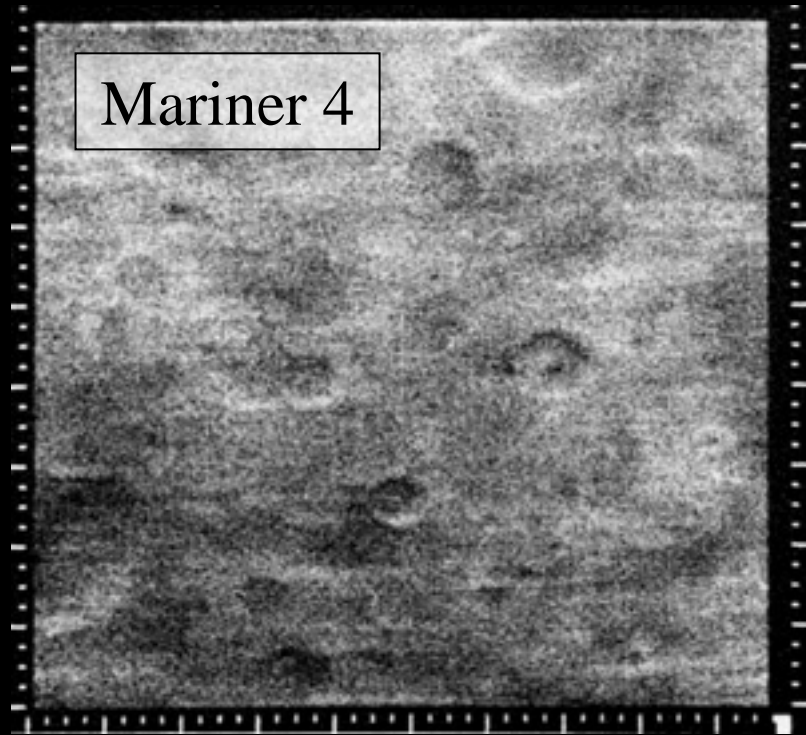
Water is the common thread ..





Percival Lowell's 1902 globe, NASM

(7/14/65)



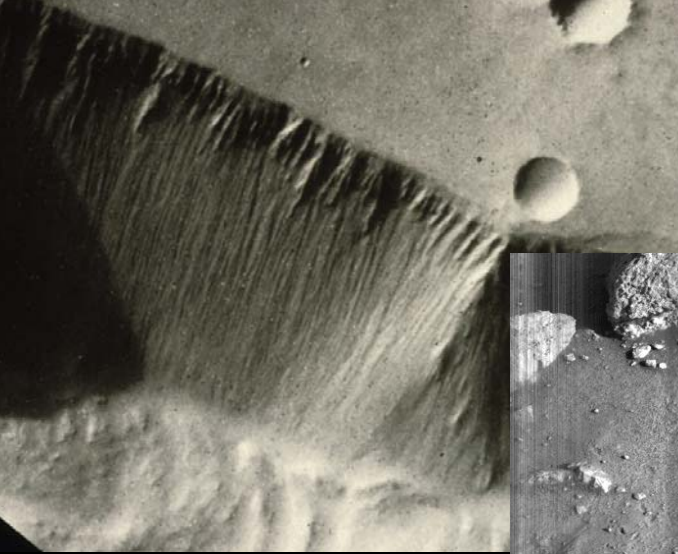
Mariner 4

(11/13/71 -
10/27/72)



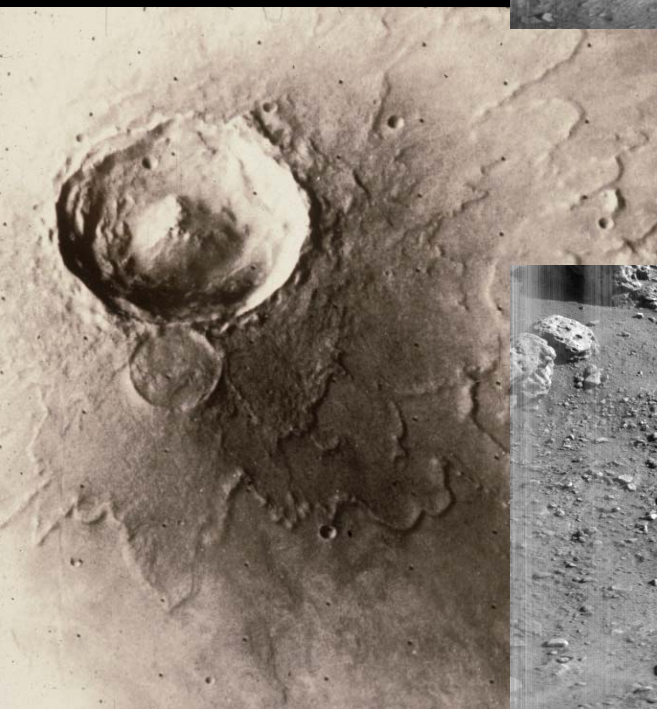
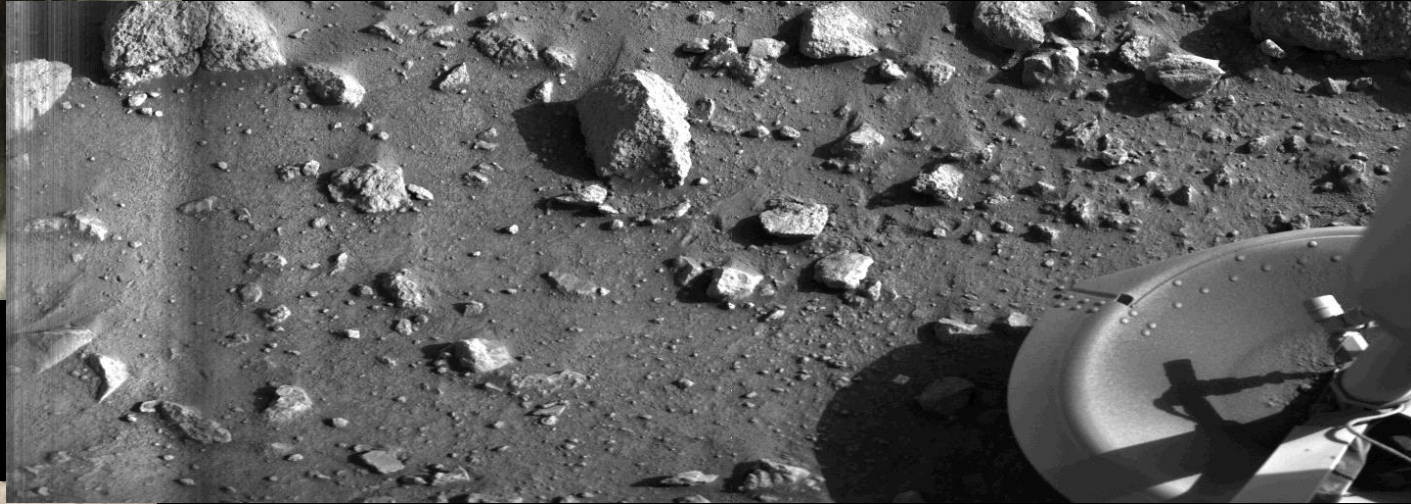
Mariner 9

Changing perceptions of
water on Mars ...



Viking 1

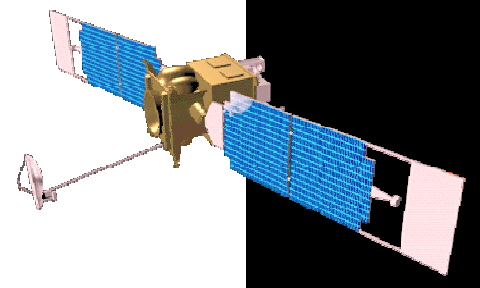
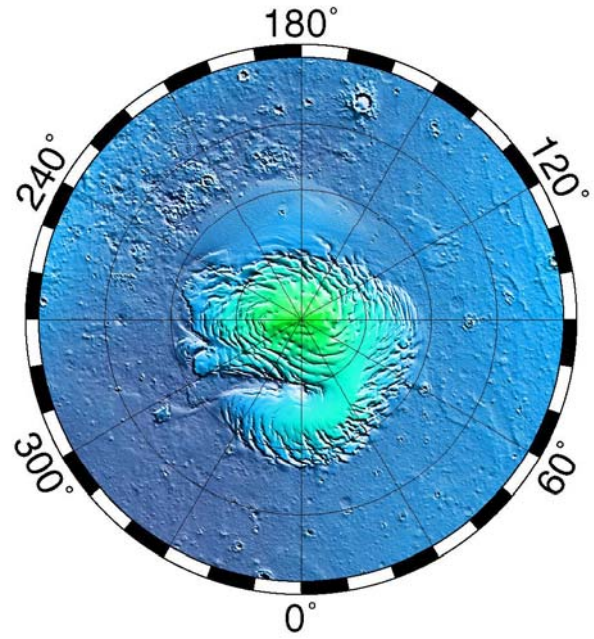
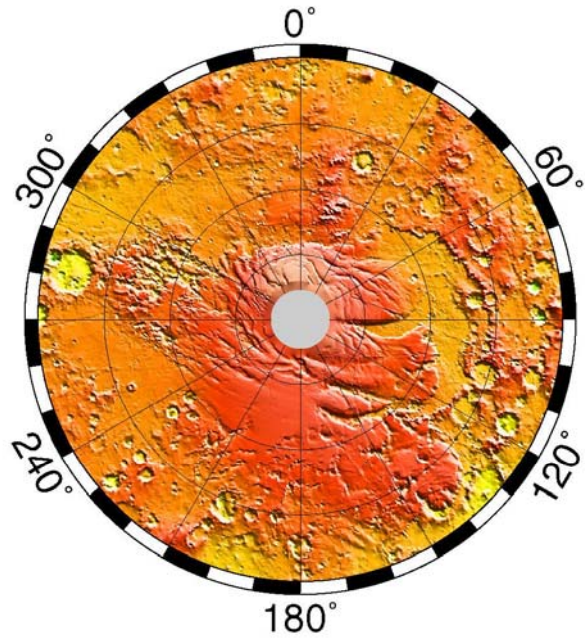
Orbiter (6/19/76 - 80)
Lander (7/20/76 - 82)
Chryse Planitia



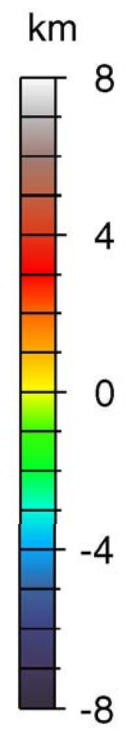
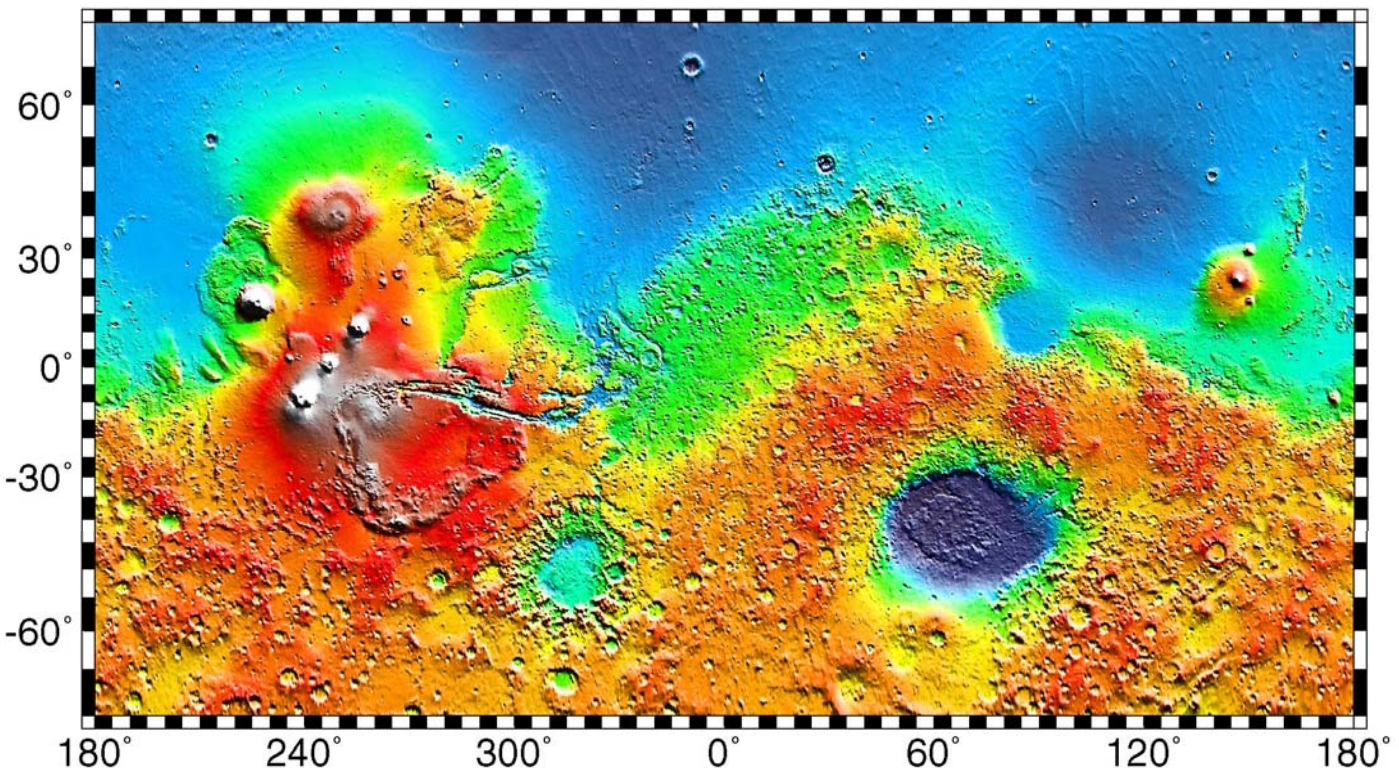
Viking 2

Orbiter (8/7/76 - 81)
Lander (9/3/76 - 80)
Utopia Planitia



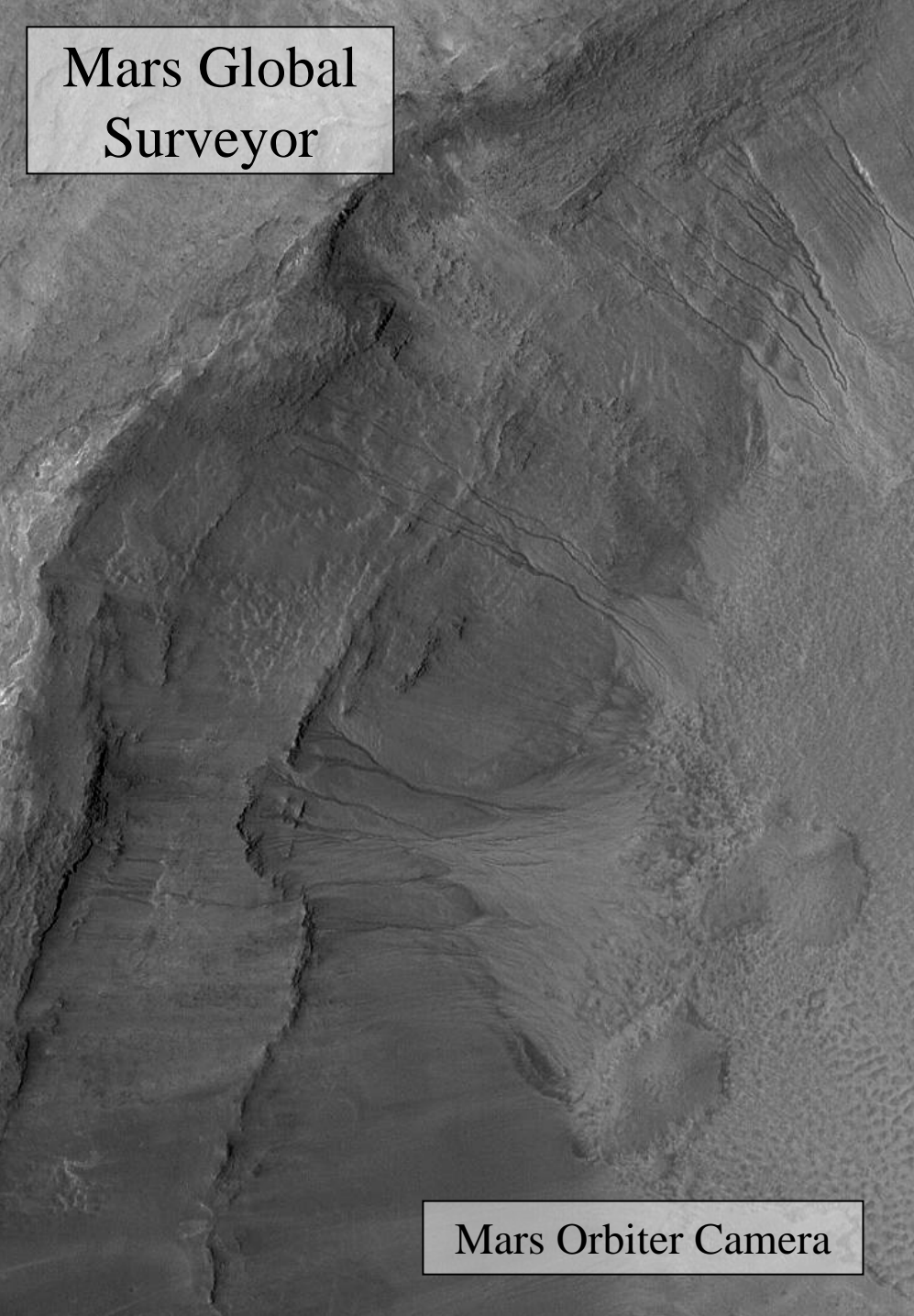


Mars Global Surveyor

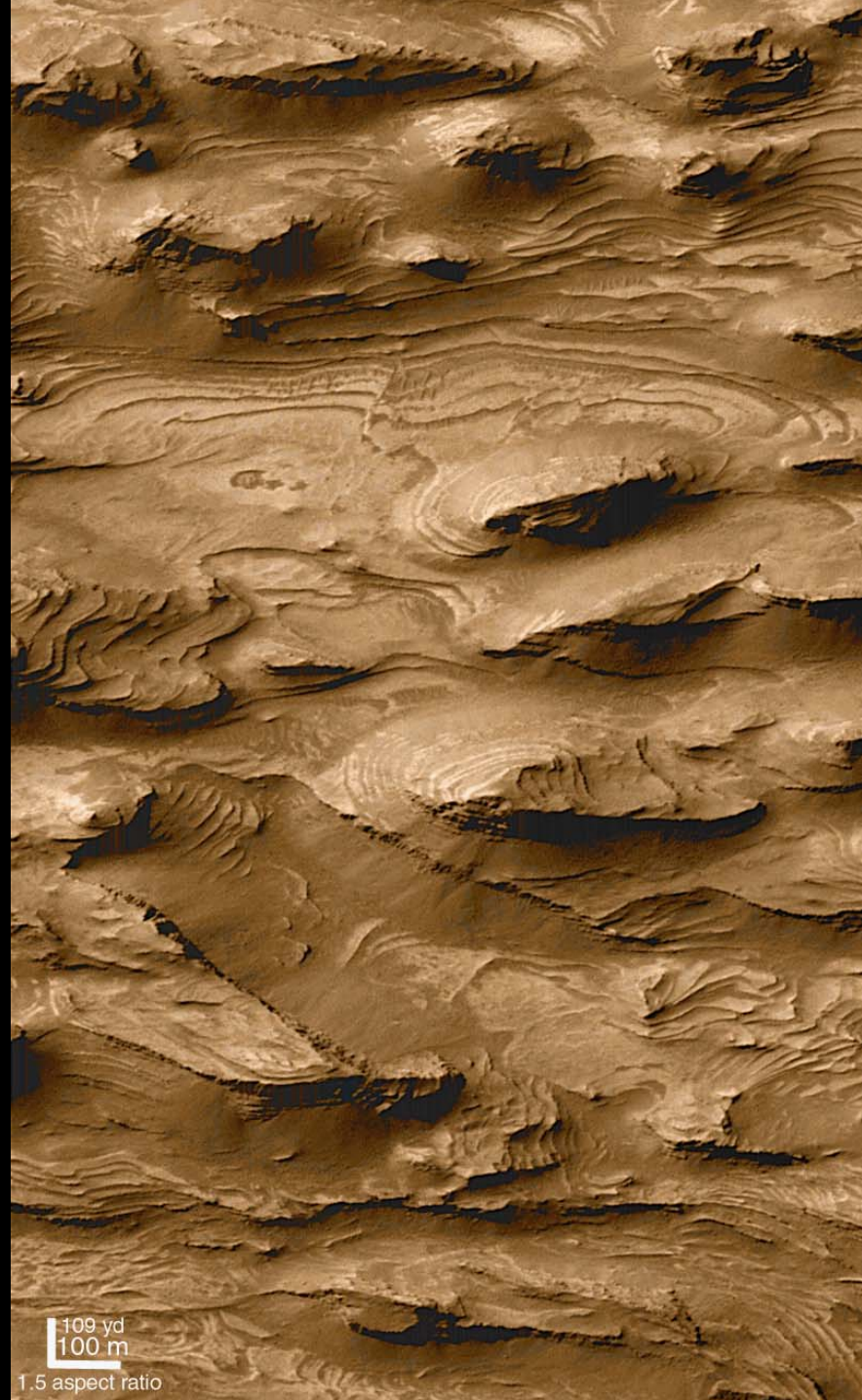


Mars Orbiter Laser Altimeter

Mars Global Surveyor



Mars Orbiter Camera

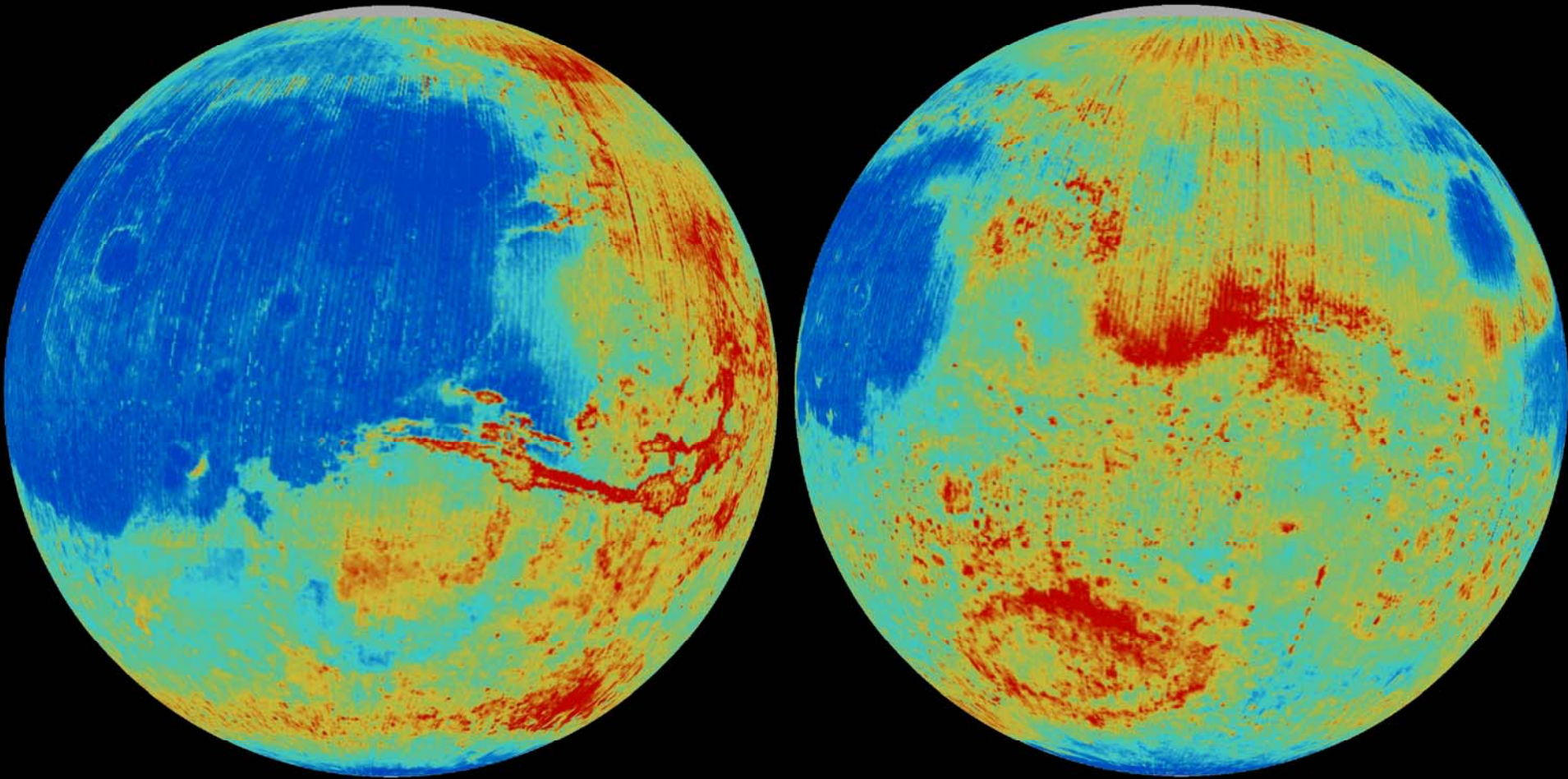


109 yd
100 m

1.5 aspect ratio

Thermal Emission Spectrometer

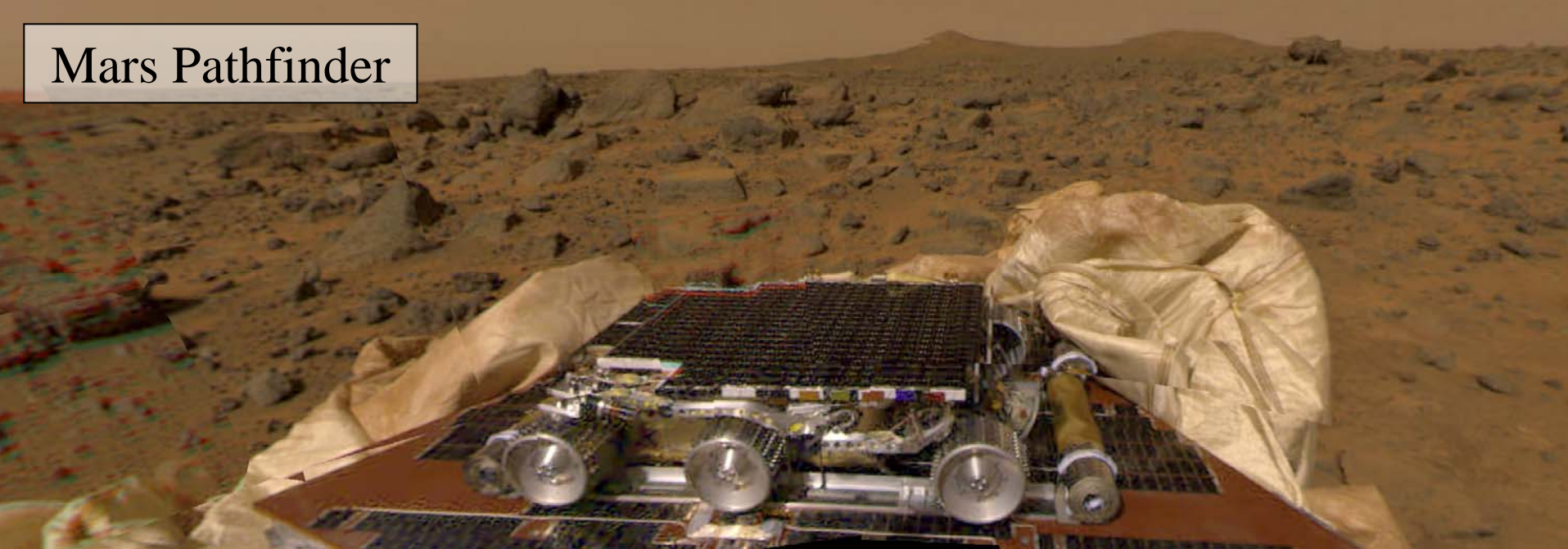
Mars Global
Surveyor



Thermal Inertia [$\text{J/m}^2\text{K s}^{1/2}$]

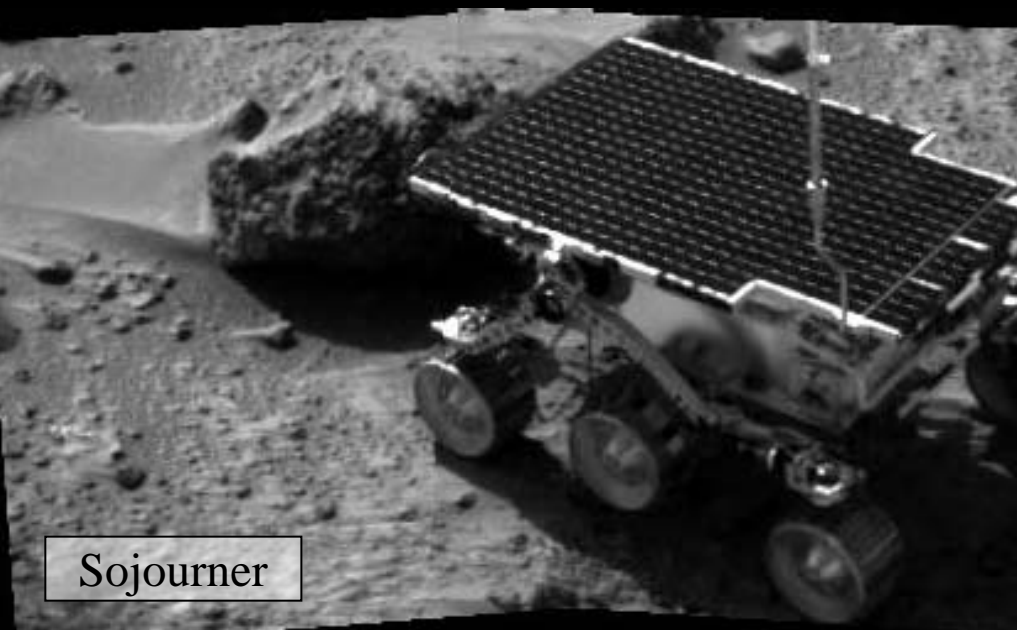


Mars Pathfinder



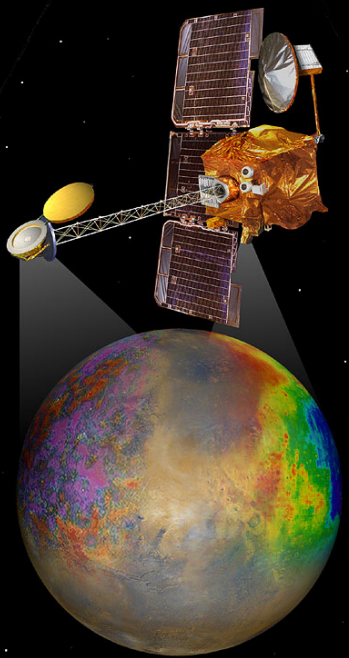
Mouth of Ares and Tiu Valles

(7/4/97 - 9/97)



Sojourner





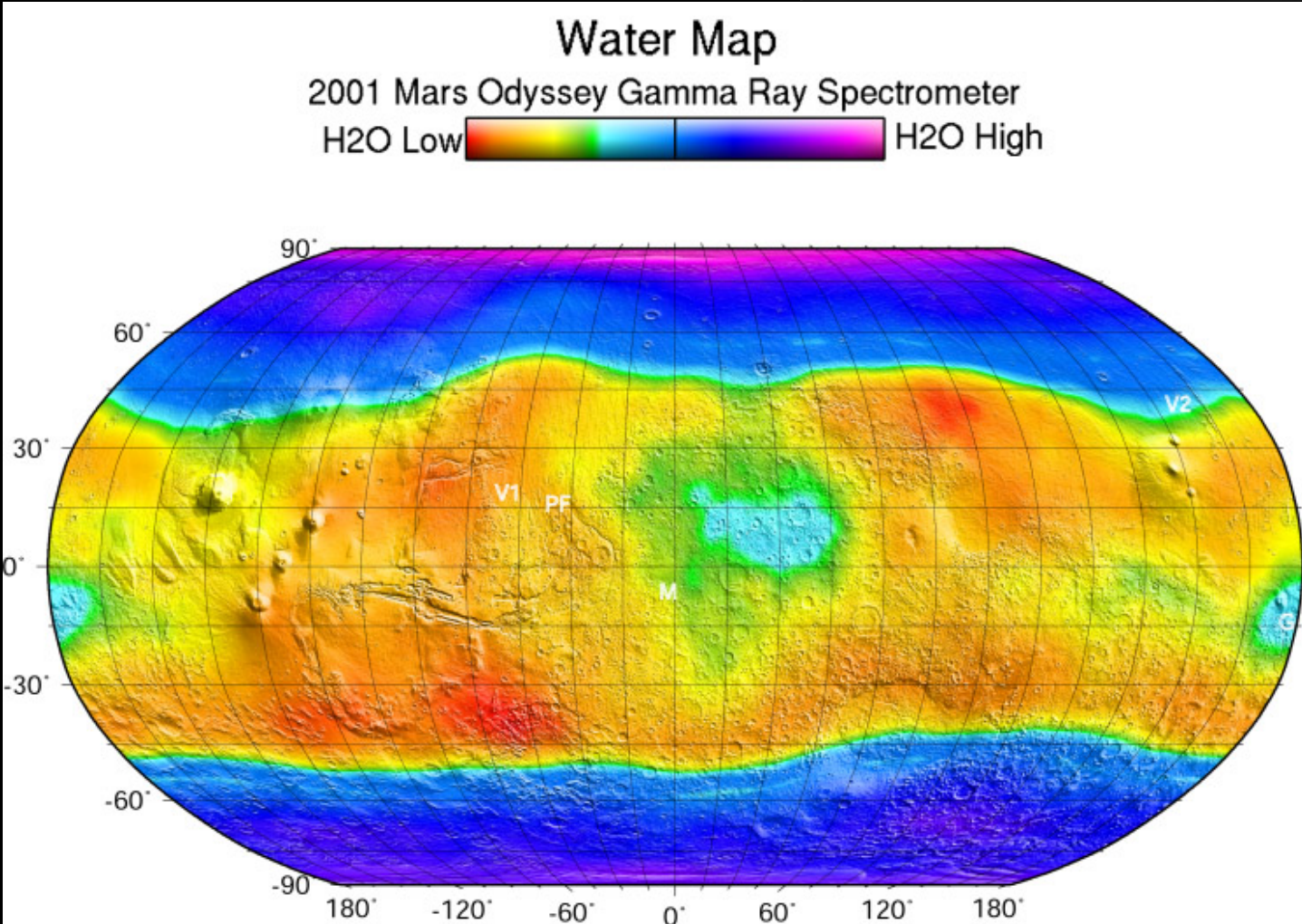
Mars Odyssey

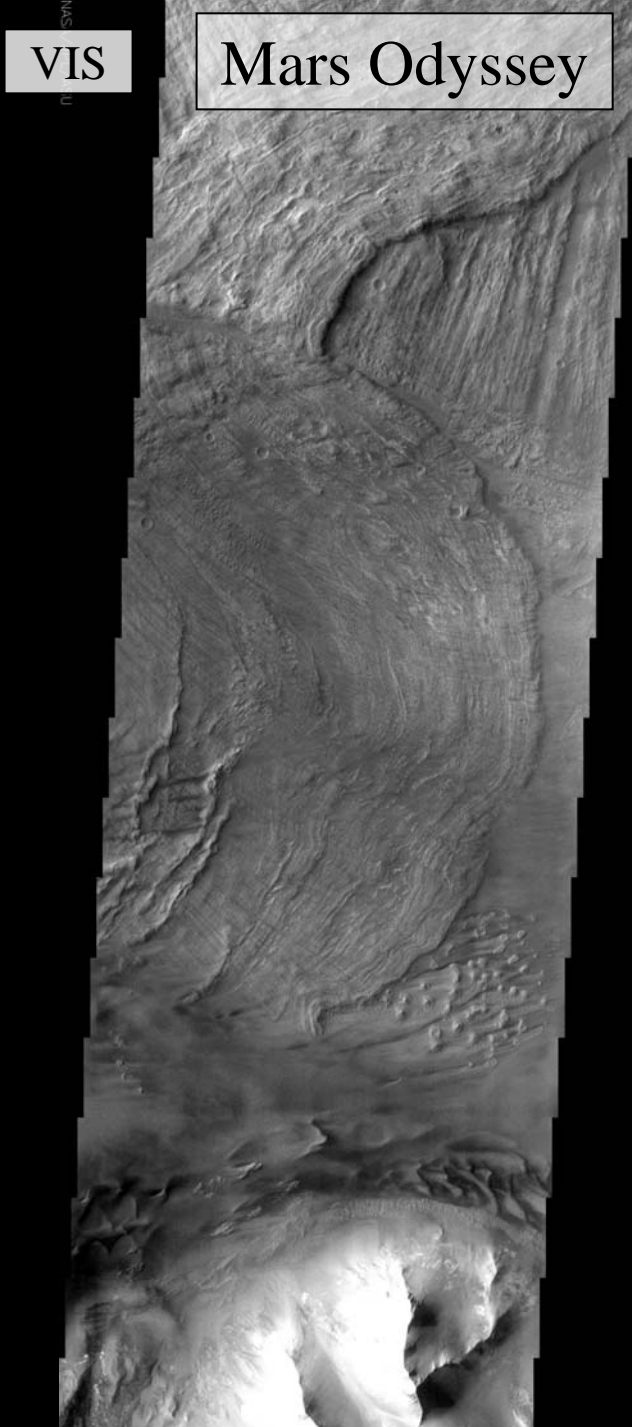
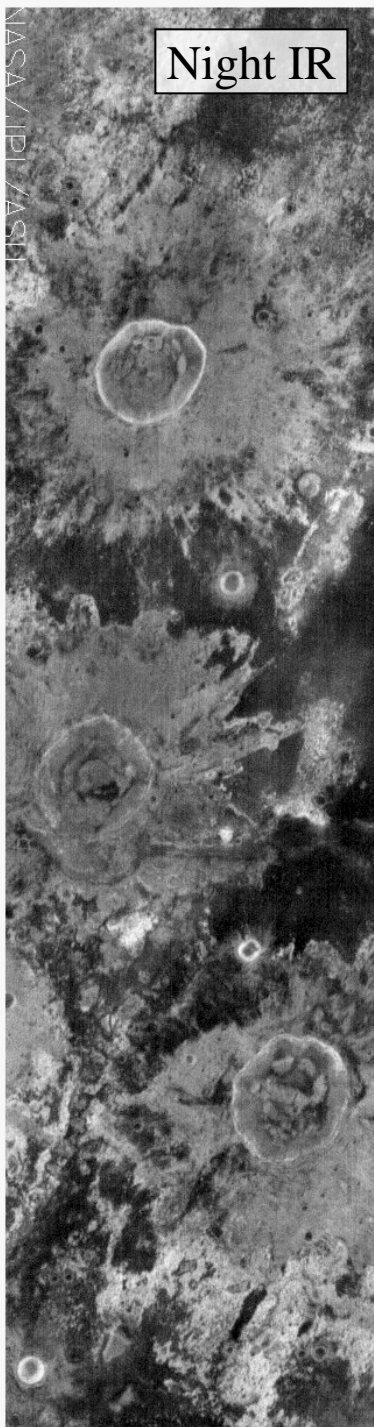
(10/23/01 - pres)

Odyssey from MGS
(90 km range; 5/19/05)

Gamma
Ray
Spectrometer

(hydrogen
abundance,
inferred to
show water
abundance)





Thermal Emission Imaging System

Mars Exploration Rovers

Spirit

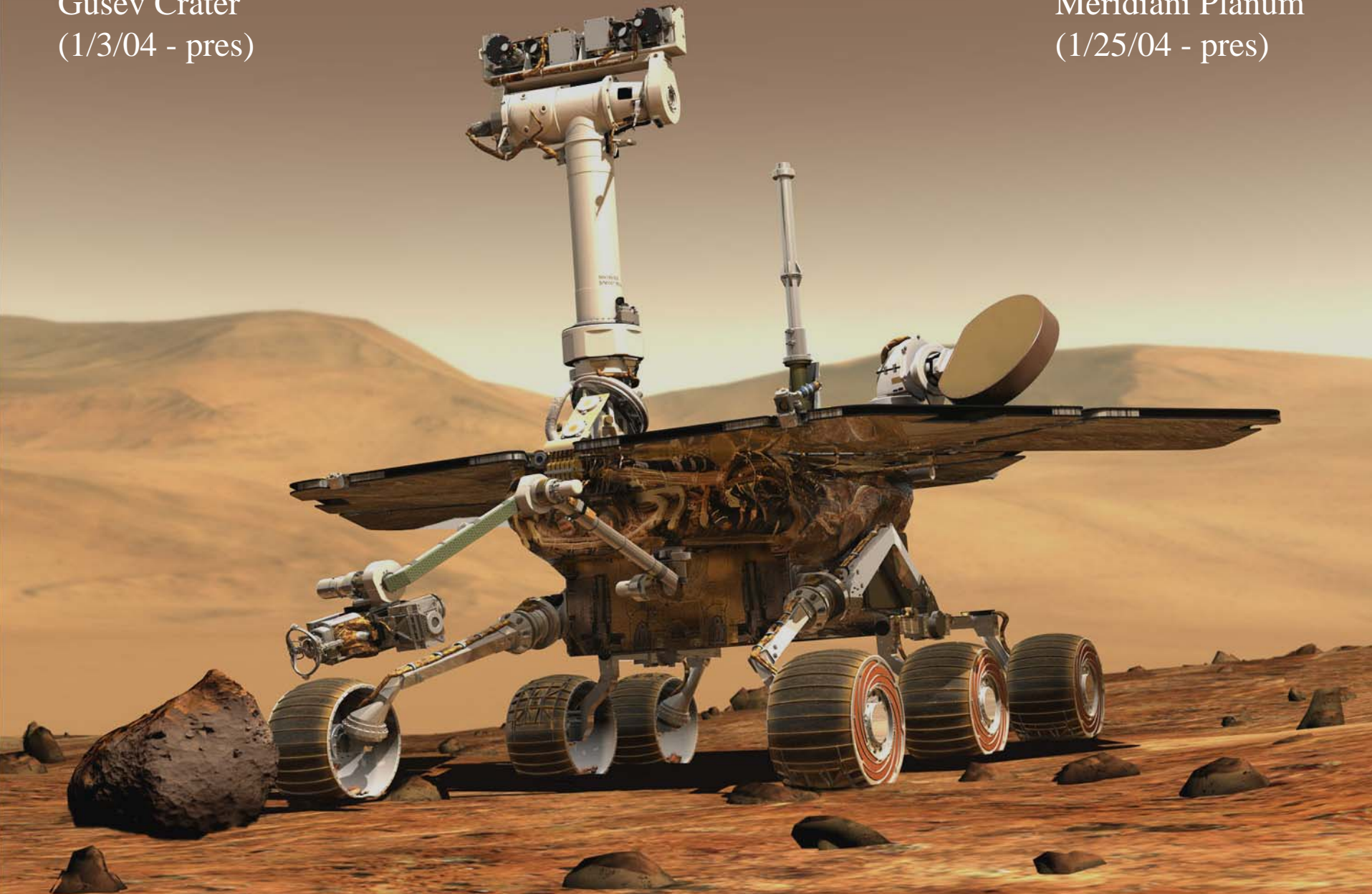
Gusev Crater

(1/3/04 - pres)

Opportunity

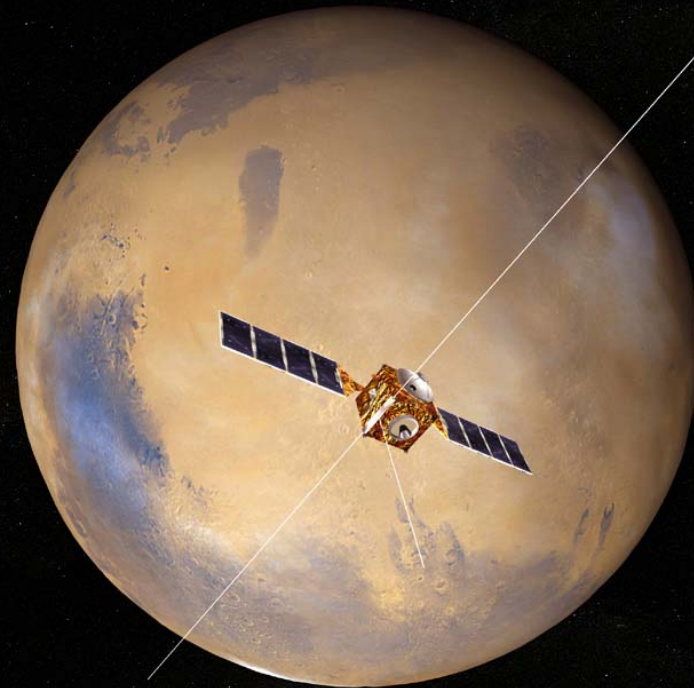
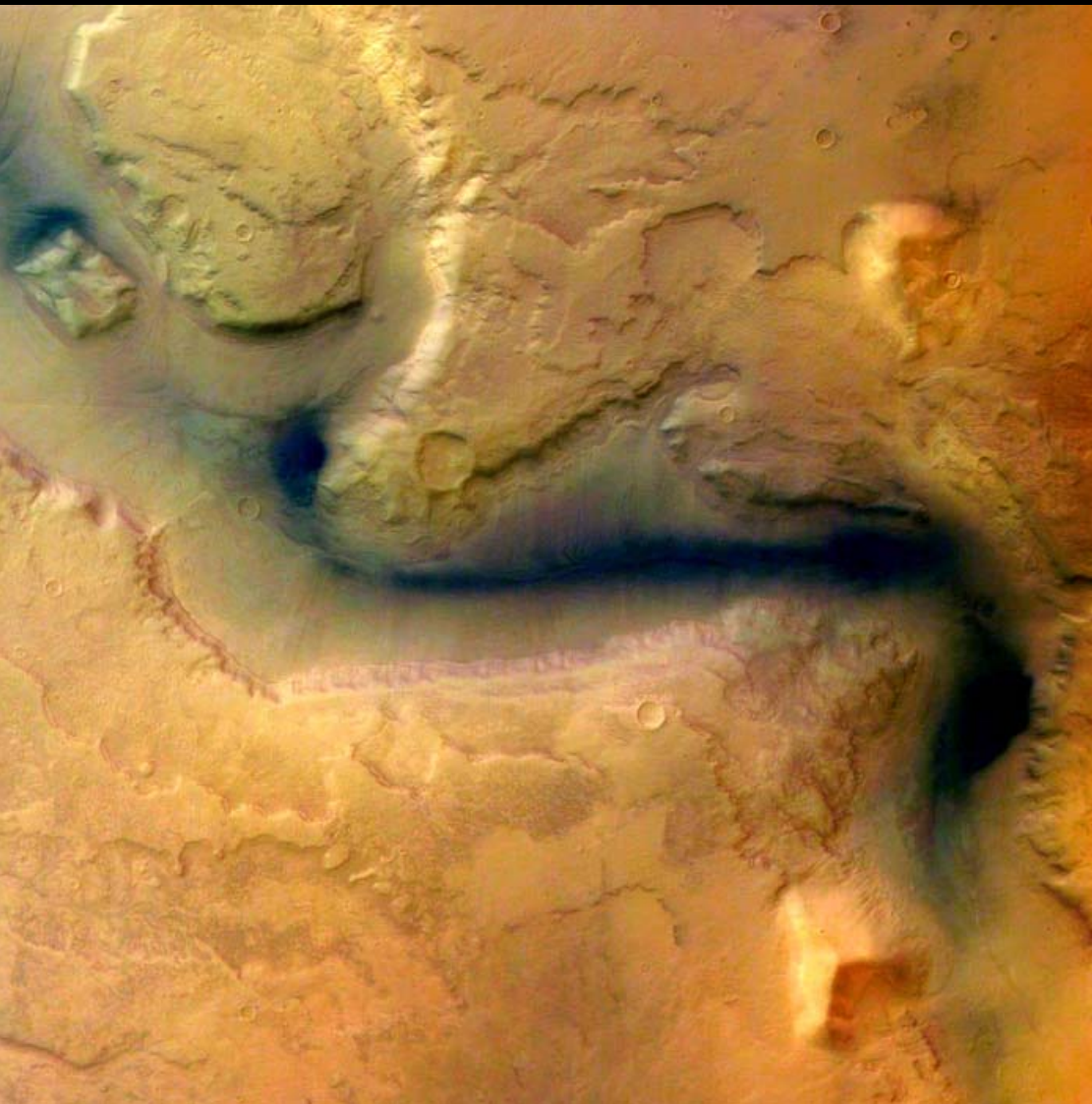
Meridiani Planum

(1/25/04 - pres)



Mars Express

High Resolution Stereo Camera

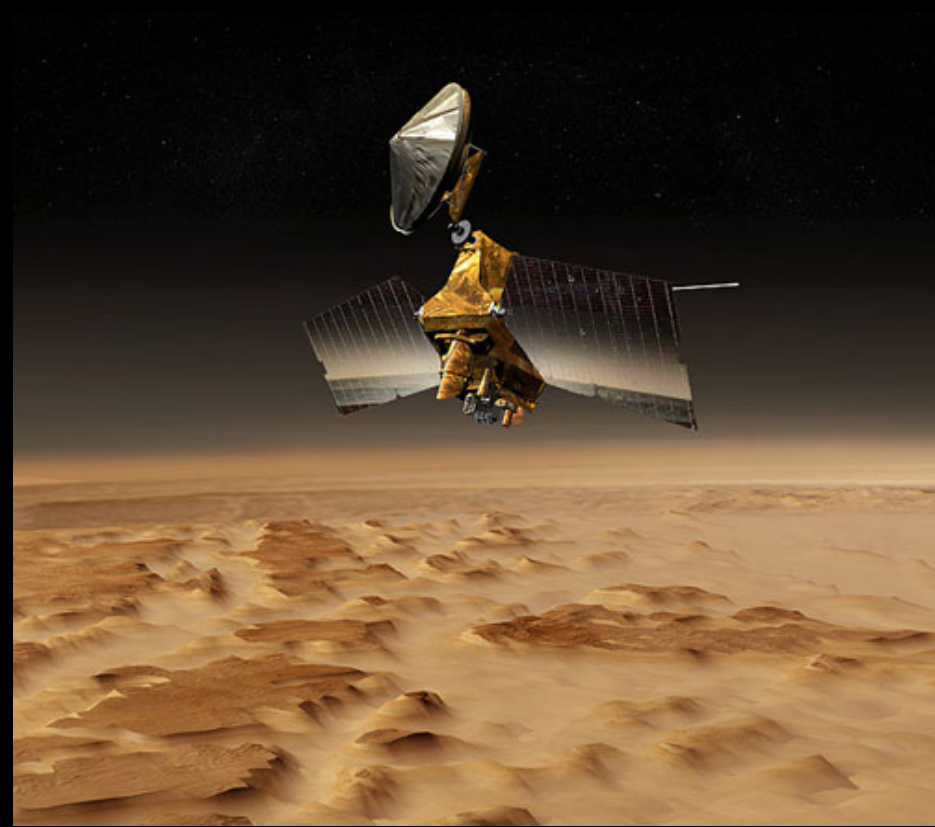


MARSIS (radar sounder)

(12/25/03 - pres)

(European Space Agency)

Mars Reconnaissance Orbiter

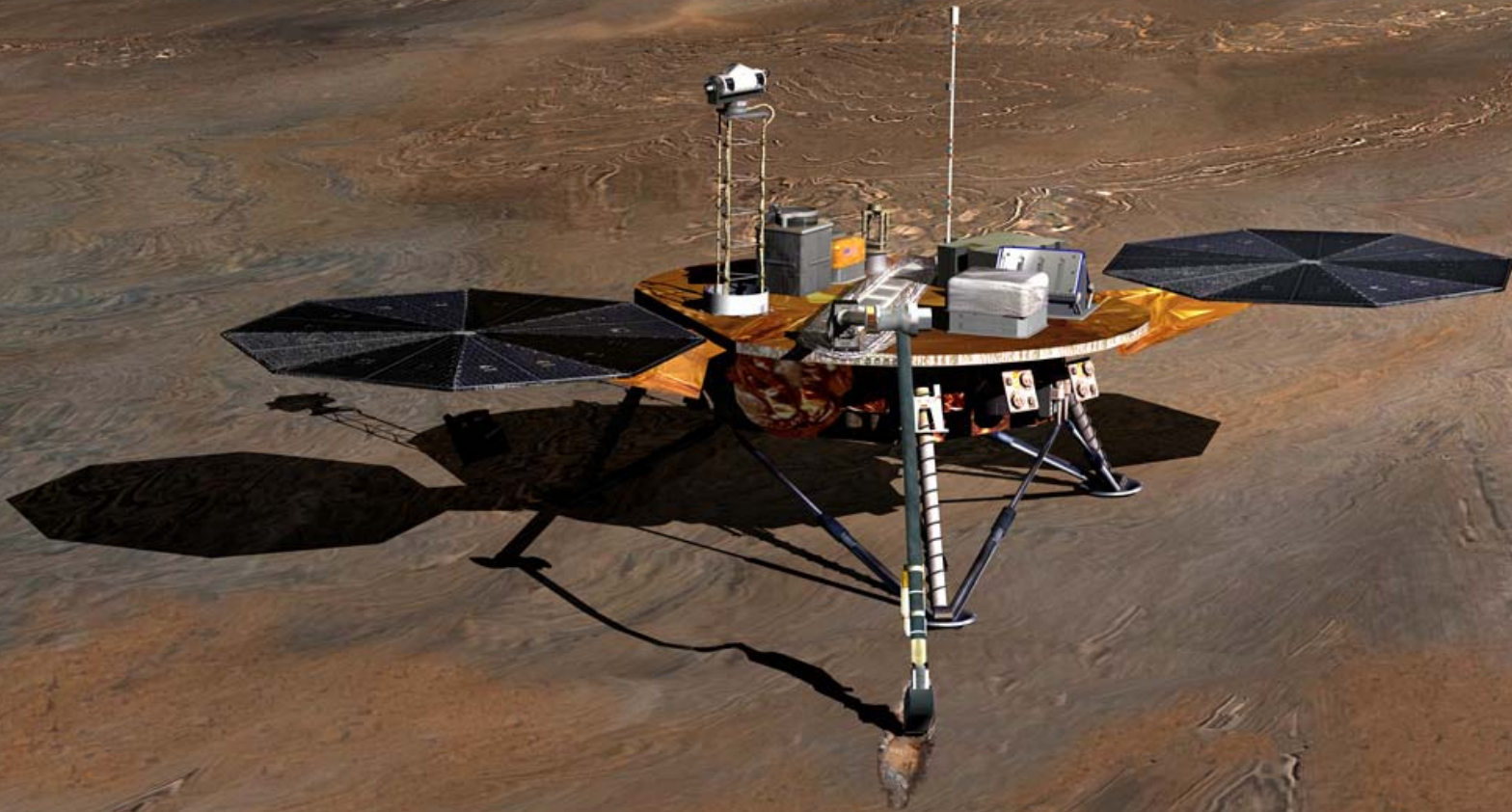


The Moon, from 10 million km
(9/8/05)



Launch: 8/12/05
Orbit: 3/10/06

Phoenix



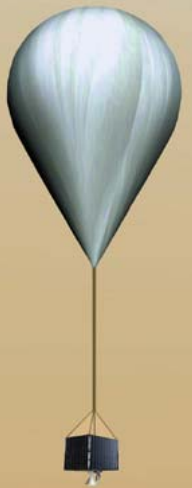
Launch: 8/07
Landing: 5/08

Mars Science Laboratory

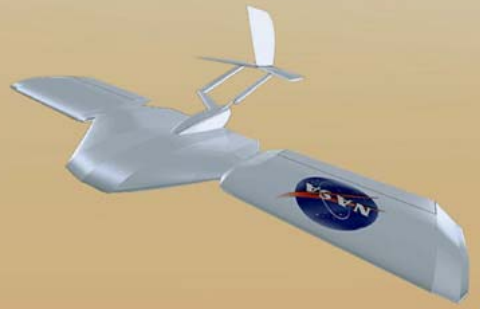


Launch: 12/09?

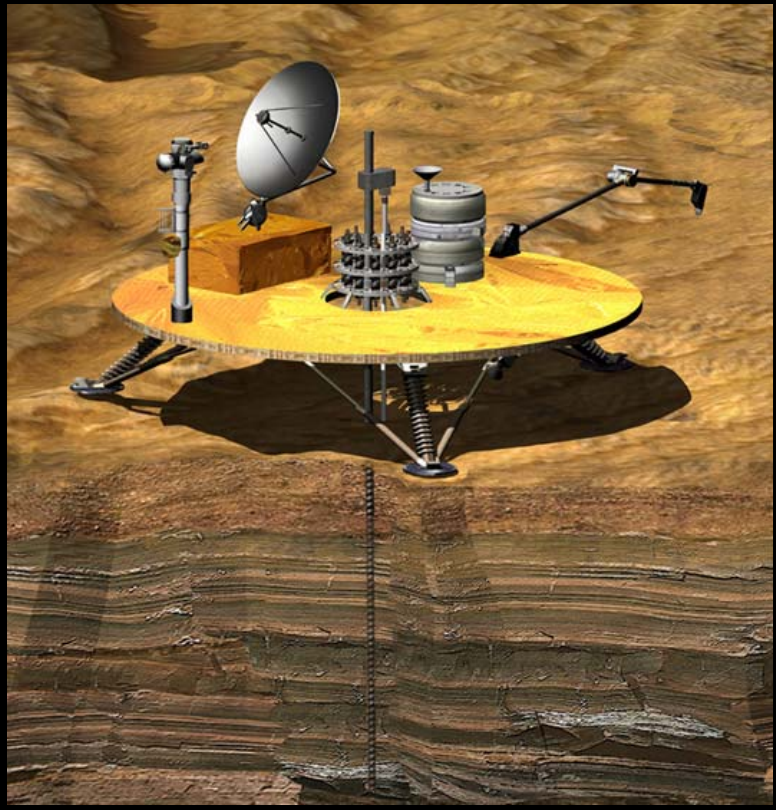
Beyond 2009



Balloons



Airplanes



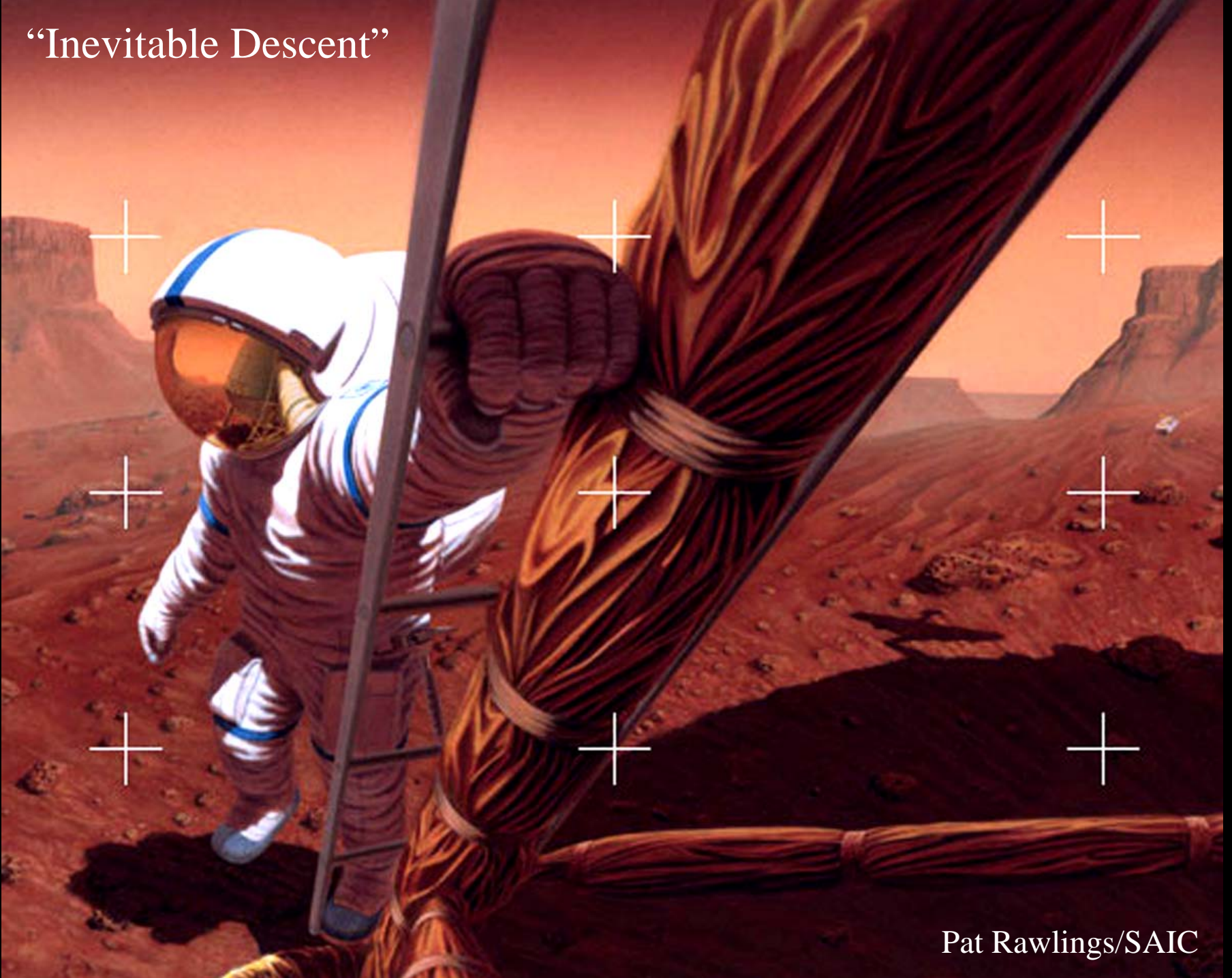
Astrobiology
Field Laboratory

Deep Drilling



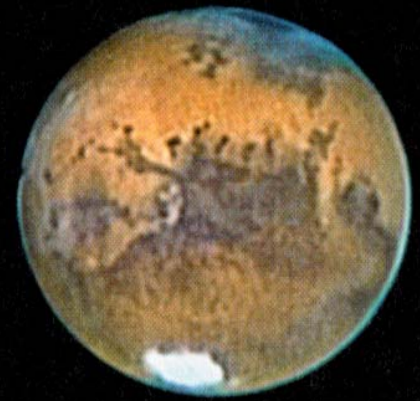
Mars Sample Return

“Inevitable Descent”



Pat Rawlings/SAIC

Mars Opposition November 7, 2005



Sept. 4, 2003, 09:34 UT

CM = 47°

(photo by an
amateur
astronomer
with a 14" telescope!)

