

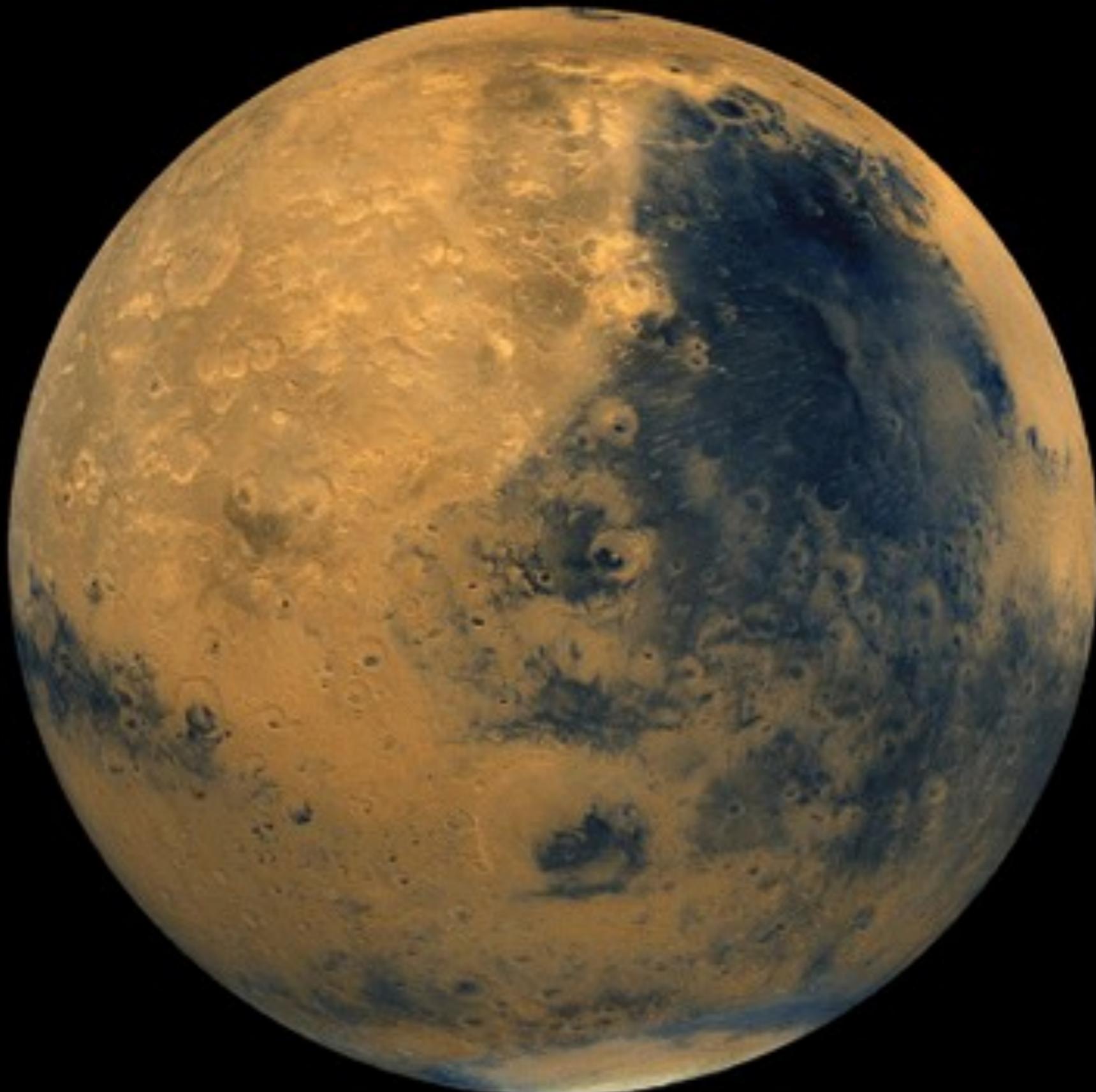
THAT'S RIGHT...  
KEEP SENDING PROBES OVER HERE...

MY SUPER-ROBOT  
ONLY NEEDS A  
FEW MORE PIECES  
BEFORE IT'S  
COMPLETE!

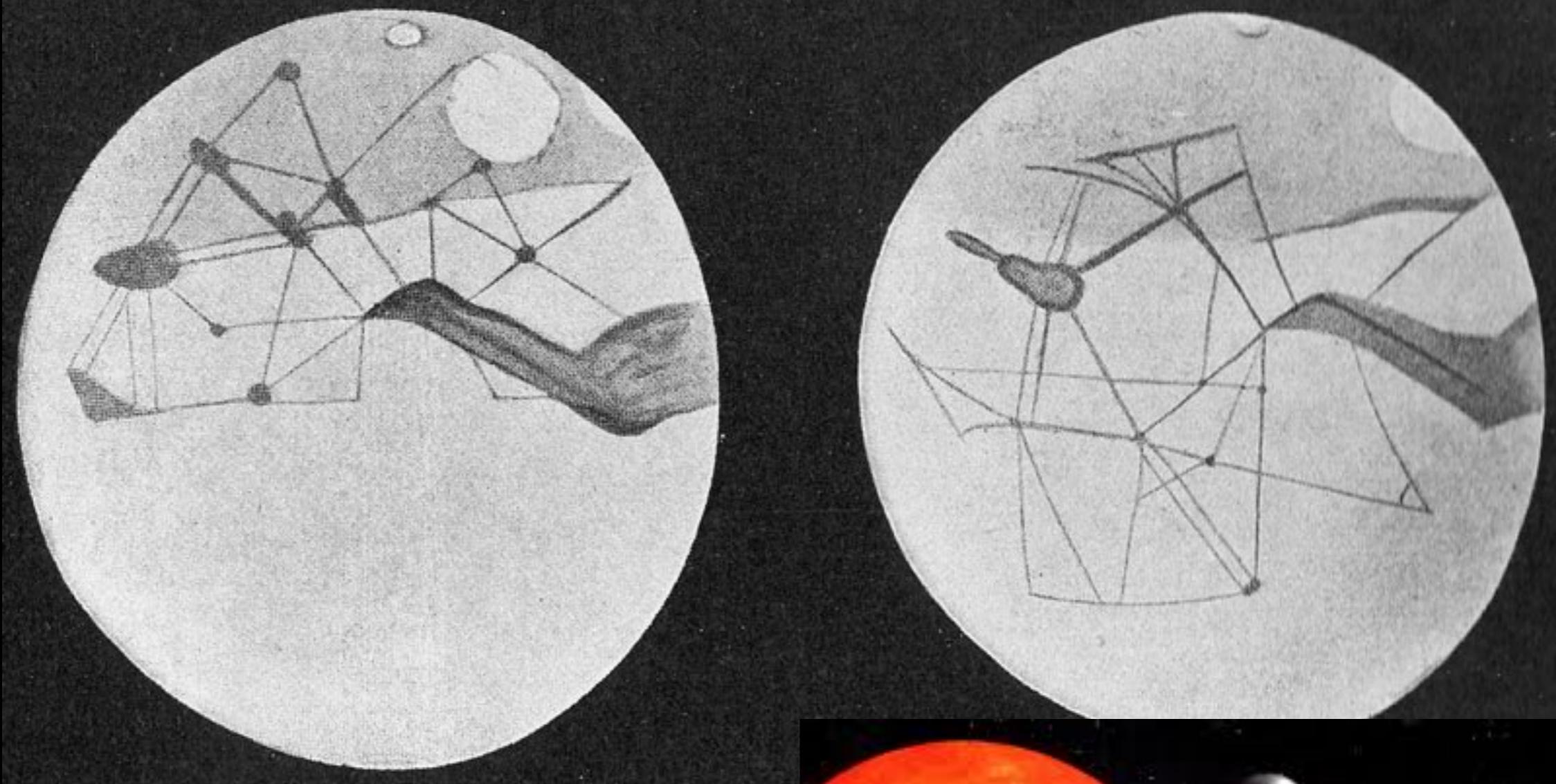


Irma

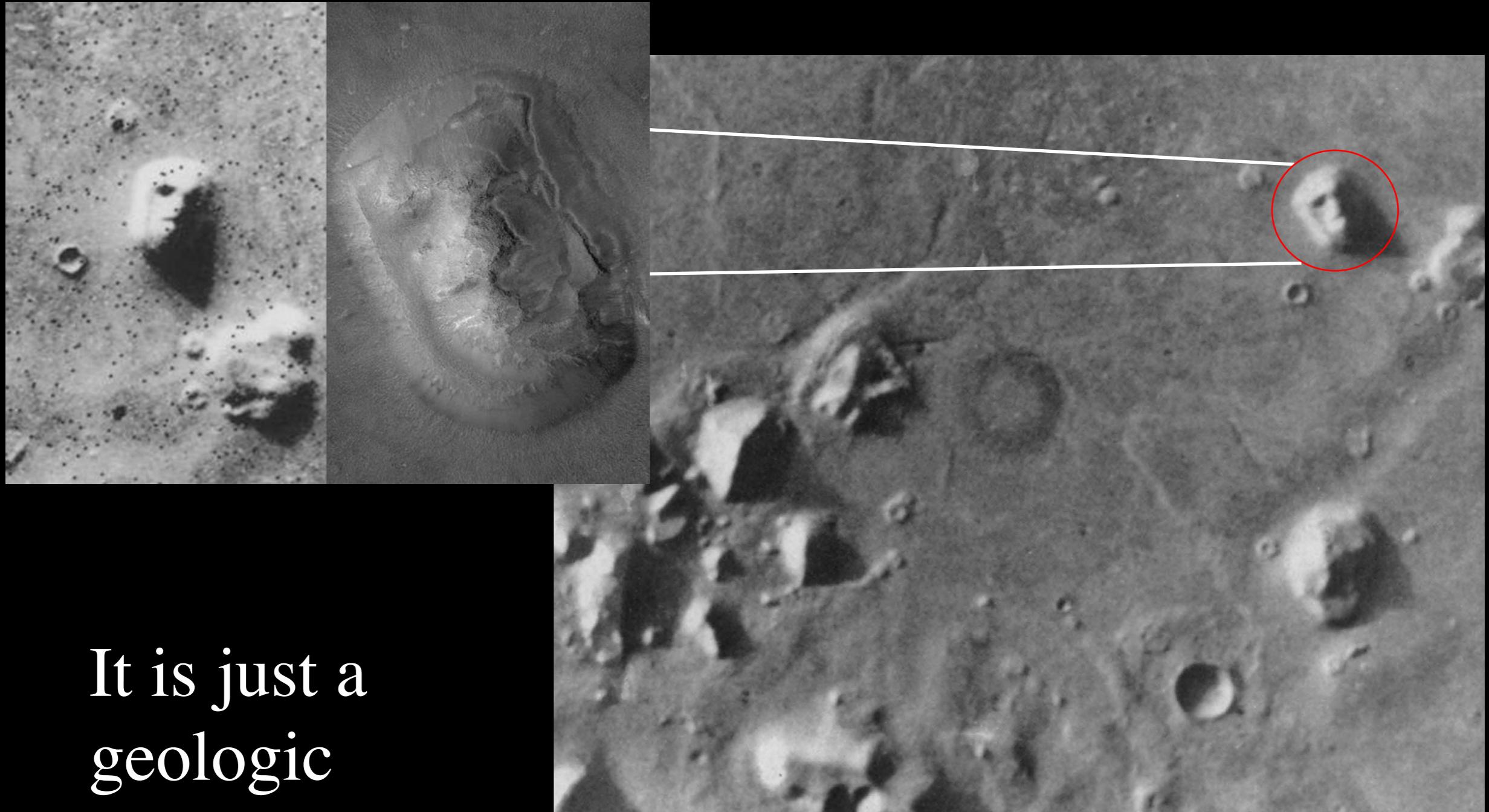
# Mars, part II



One hundred years ago Percival Lowell published books describing canals on Mars



# The “face” on Mars

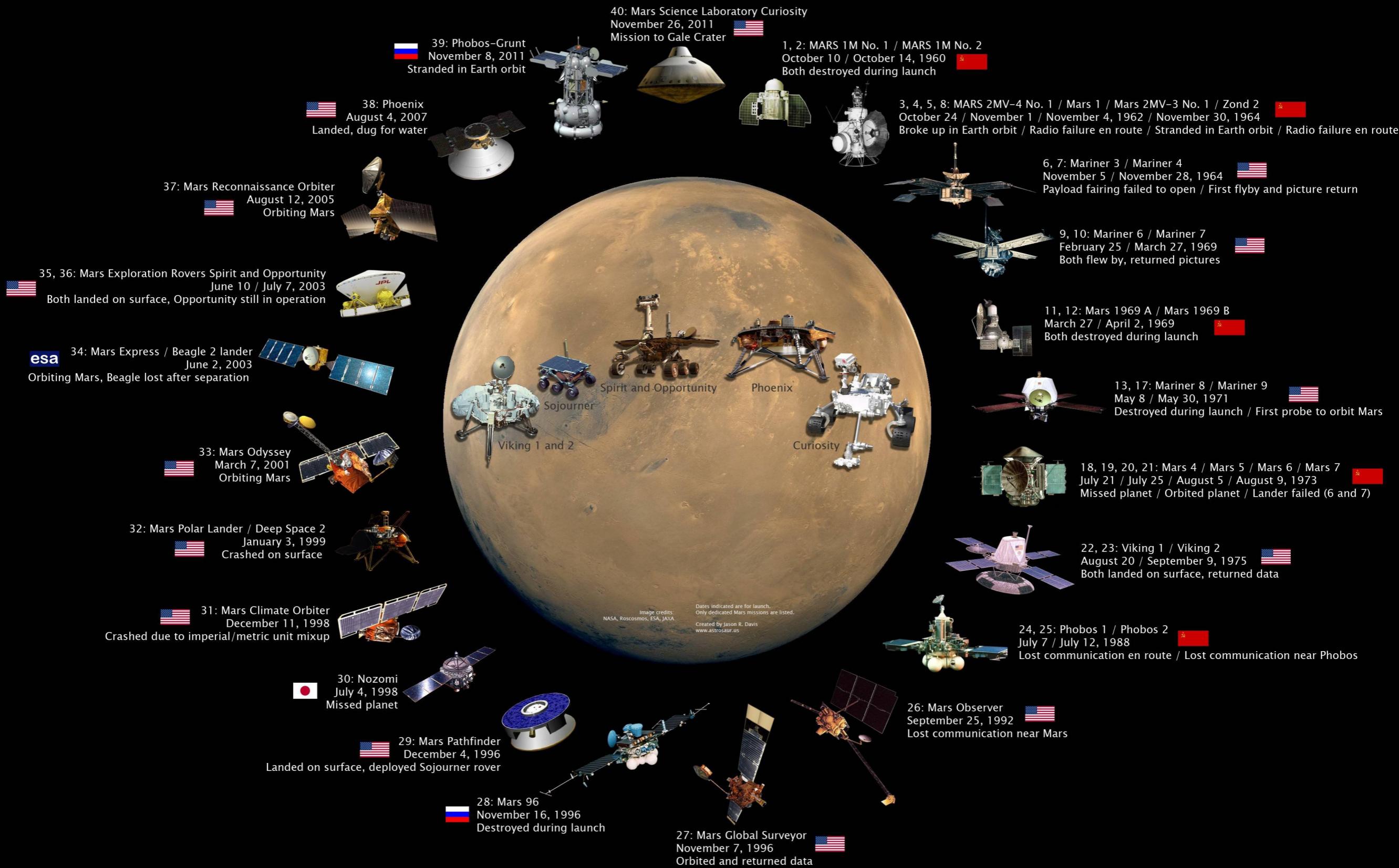


It is just a  
geologic  
formation!!

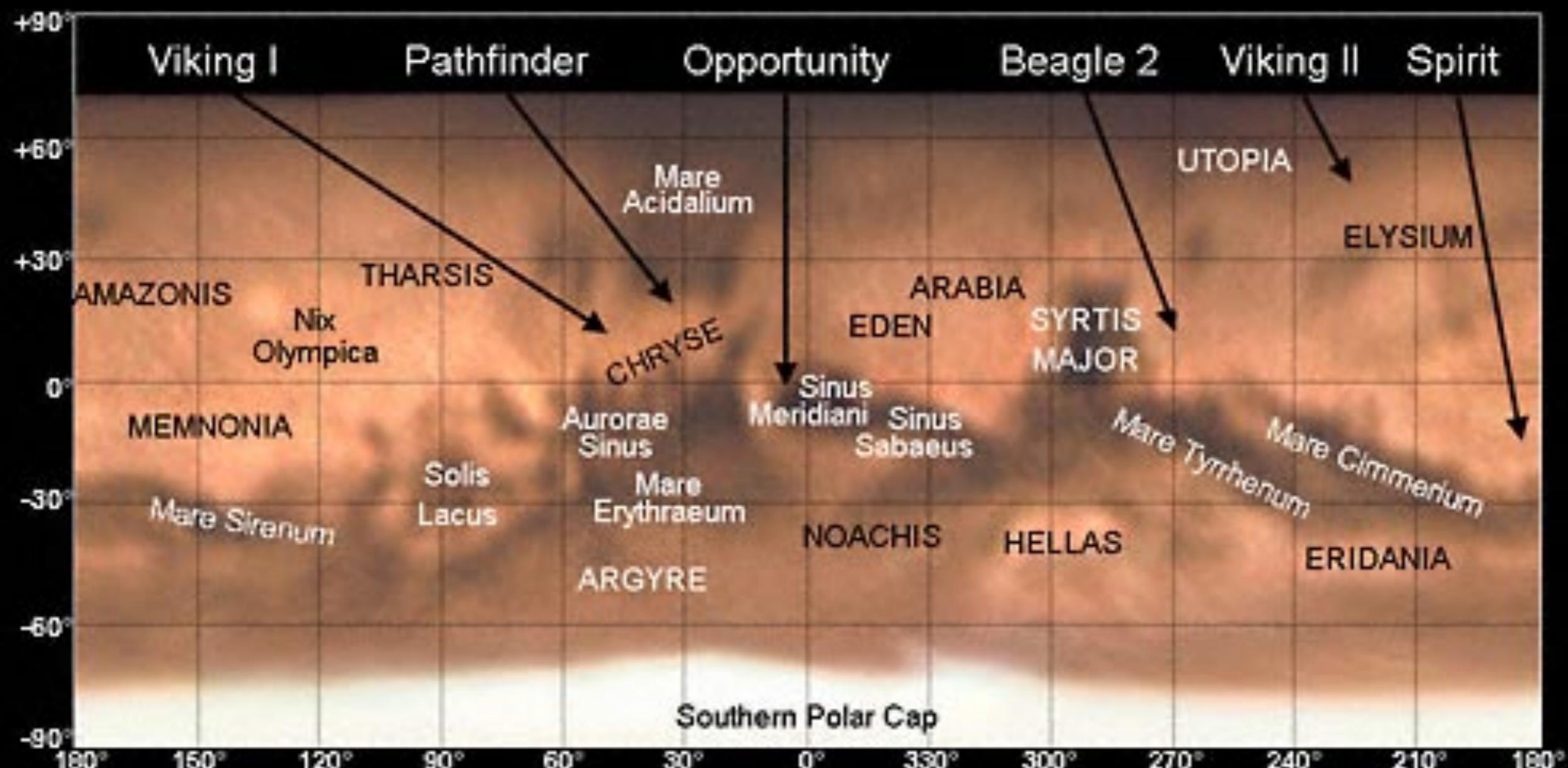
# Missions to Mars

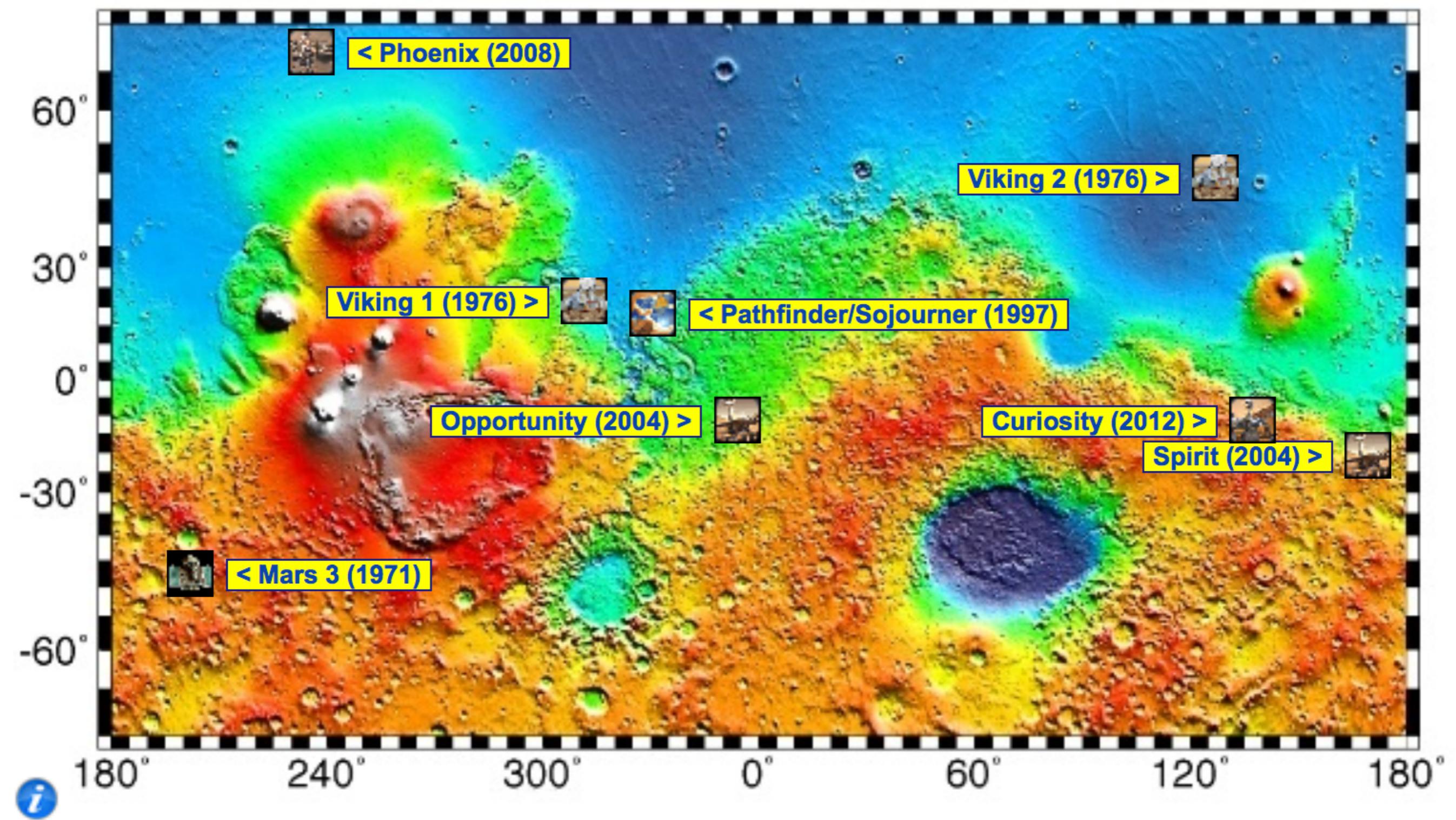
- Started in the early 1960s, with USSR and US
- More than 50 spacecraft have been launched toward Mars, but only half were successful
- First success was Mariner 4 in 1965 → sent 22 photos of a cratered world
- 1970s: Mariner 9 and Viking → first orbiters and landers on another planet
- Big gap in the 1980s :(
- Finally Mars missions took off again in the 1990s and beyond → rovers!

# Mars Exploration Family Portrait



# Our visits to Mars





# Mariner missions (1970s)

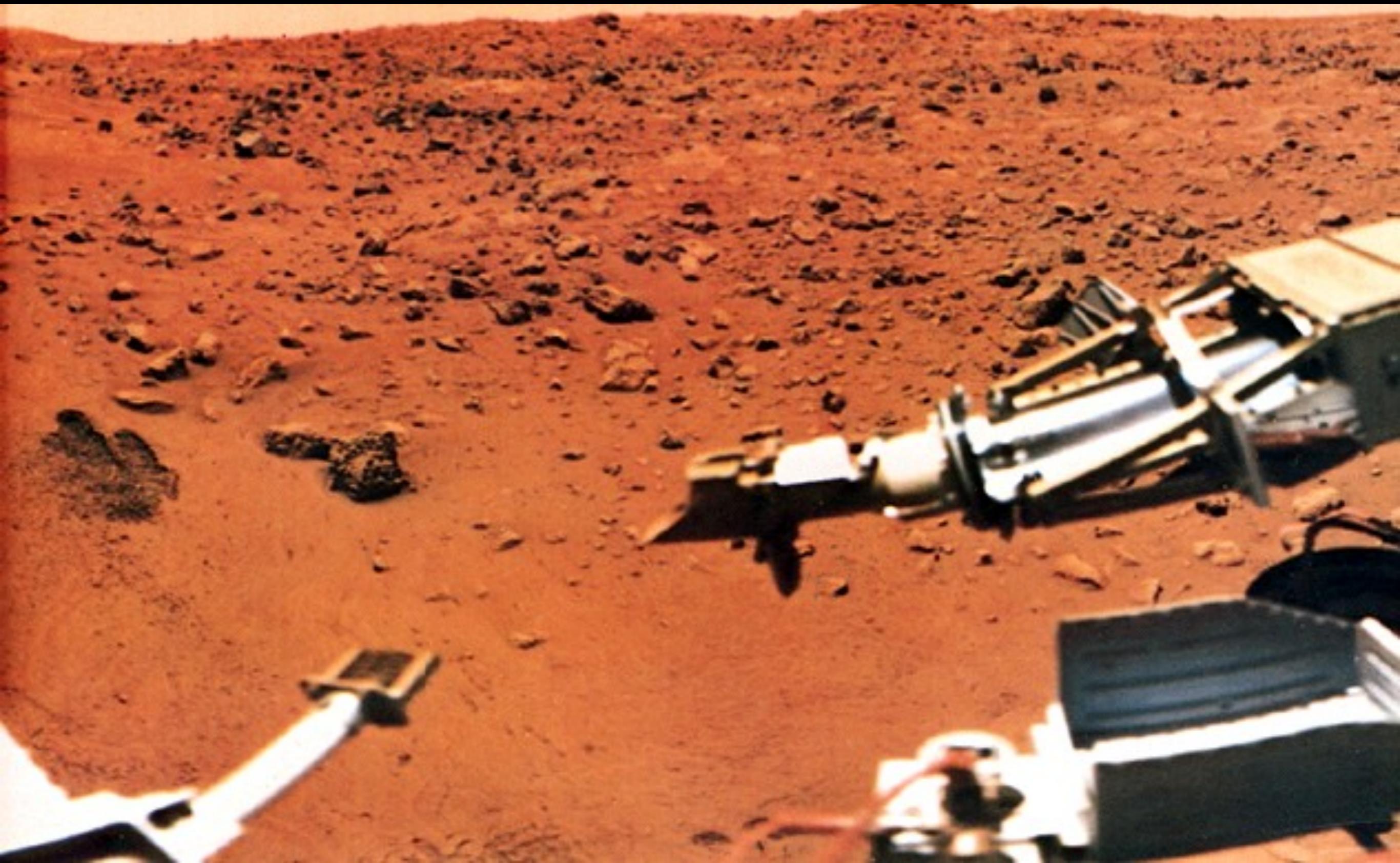
- Mariner 9 mapped Mars' surface to 1km resolution in 1971
- Found volcanoes, canyons, channels, polar cap layers



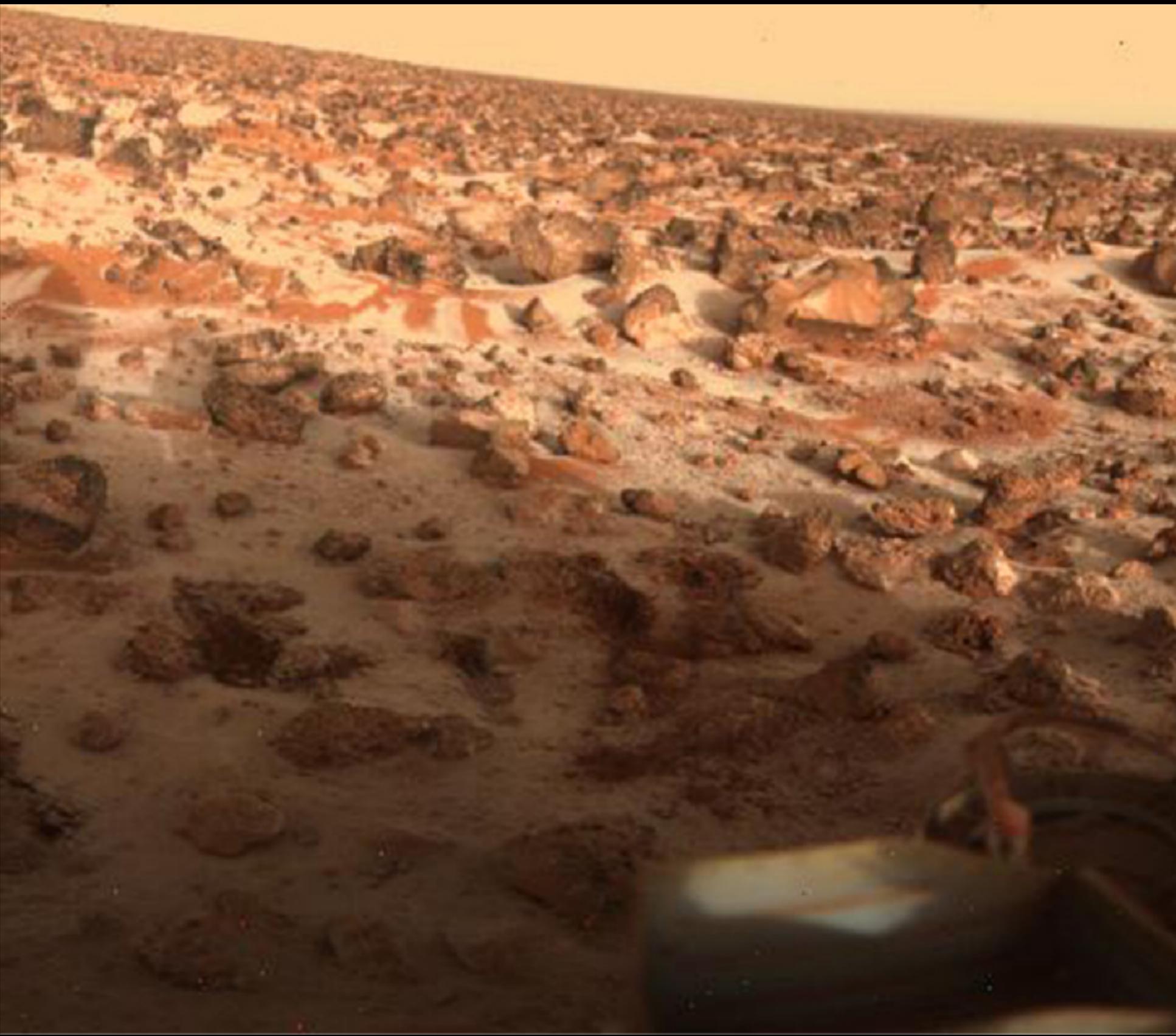
# Viking spacecraft (1975-)

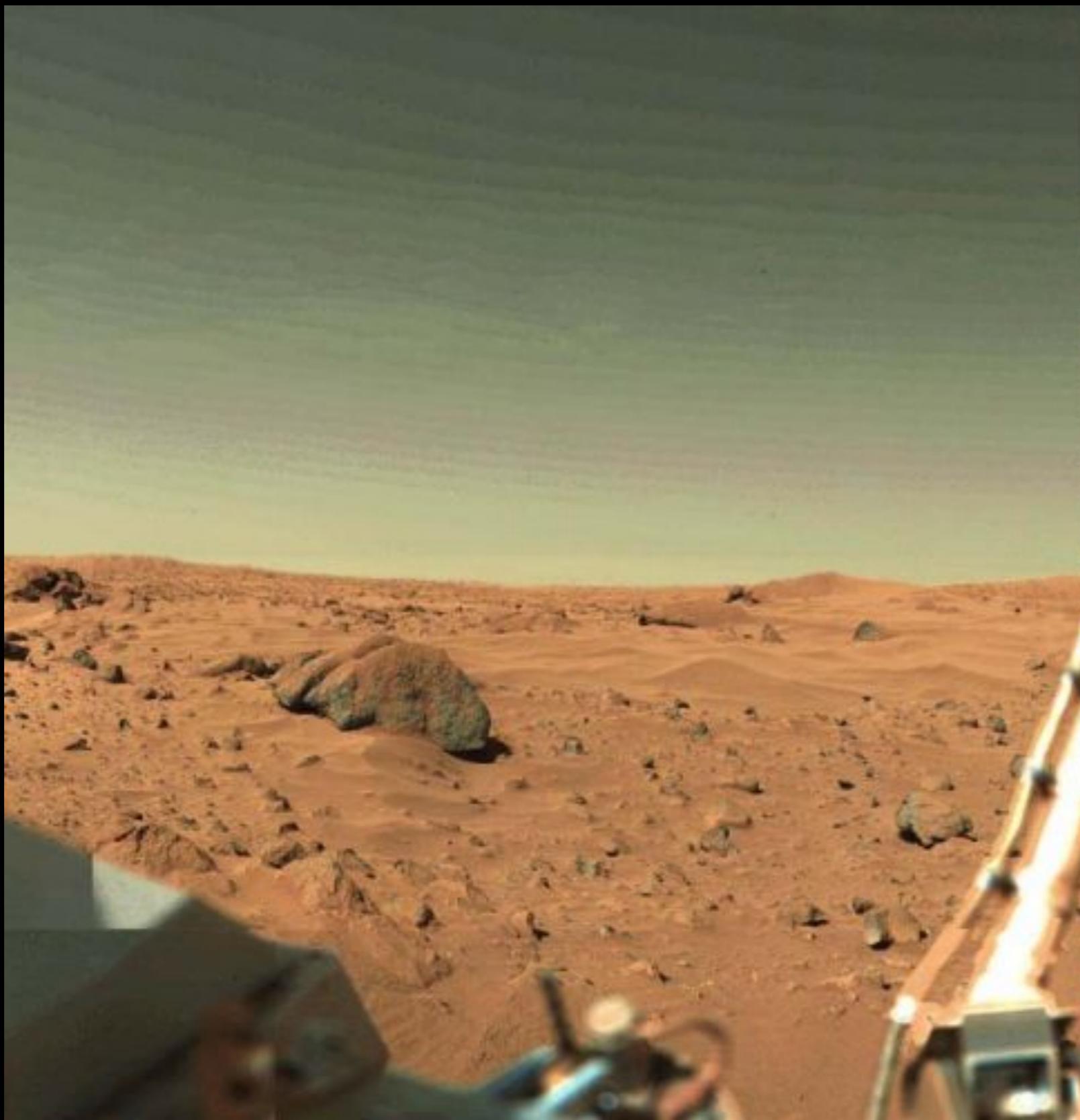
- Two orbiters and two landers
- The orbiters served as communication relays
- The landers dropped down into Chryse Planitia and Utopia, two months apart
- Landed in relatively flat areas
- They set up weather stations that operated for a few years
- Also experiments to search for life

# Viking I Lander Picture from 1976



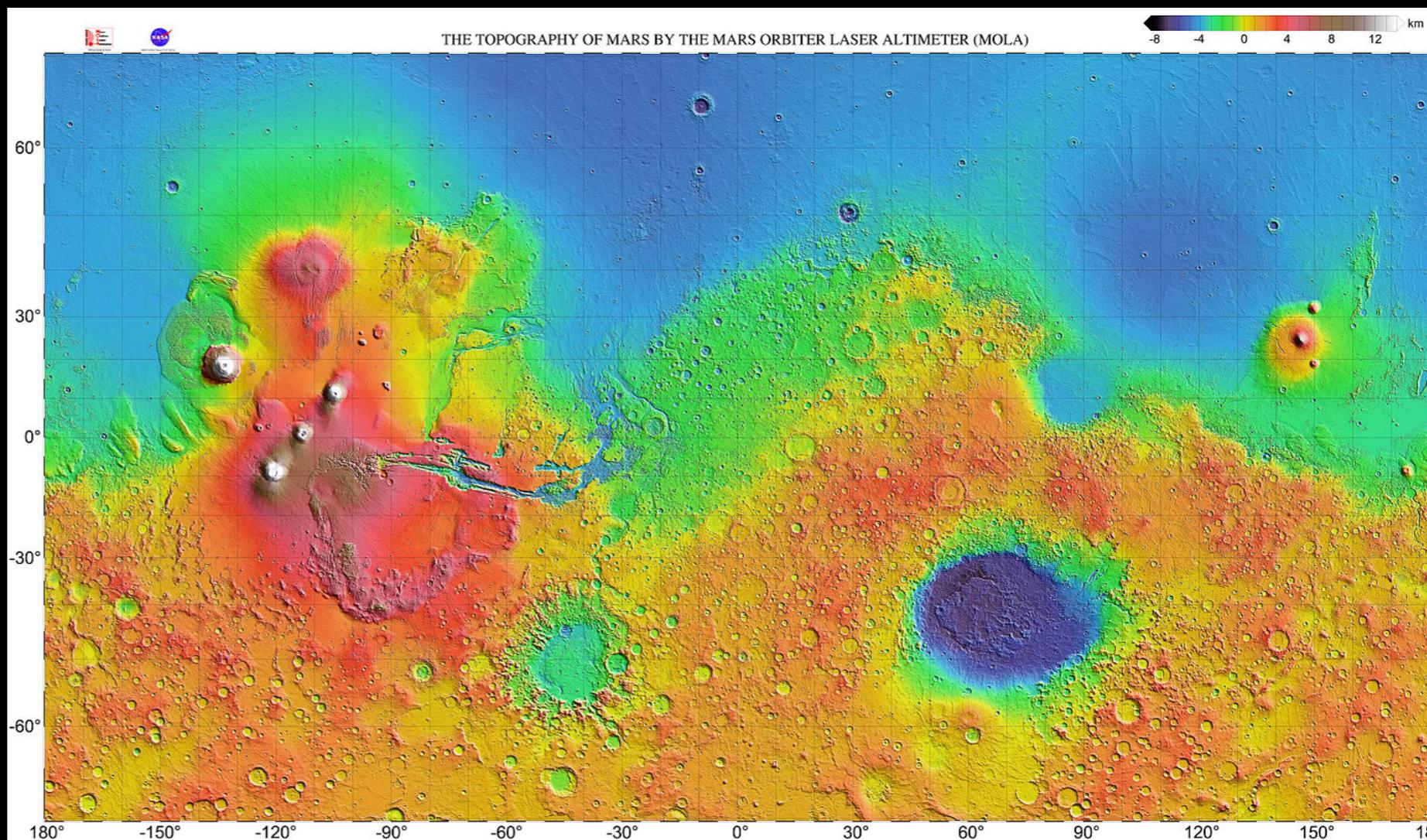
# View from Viking 2 lander – water frost





# Mars Global Surveyor (1996-2007)

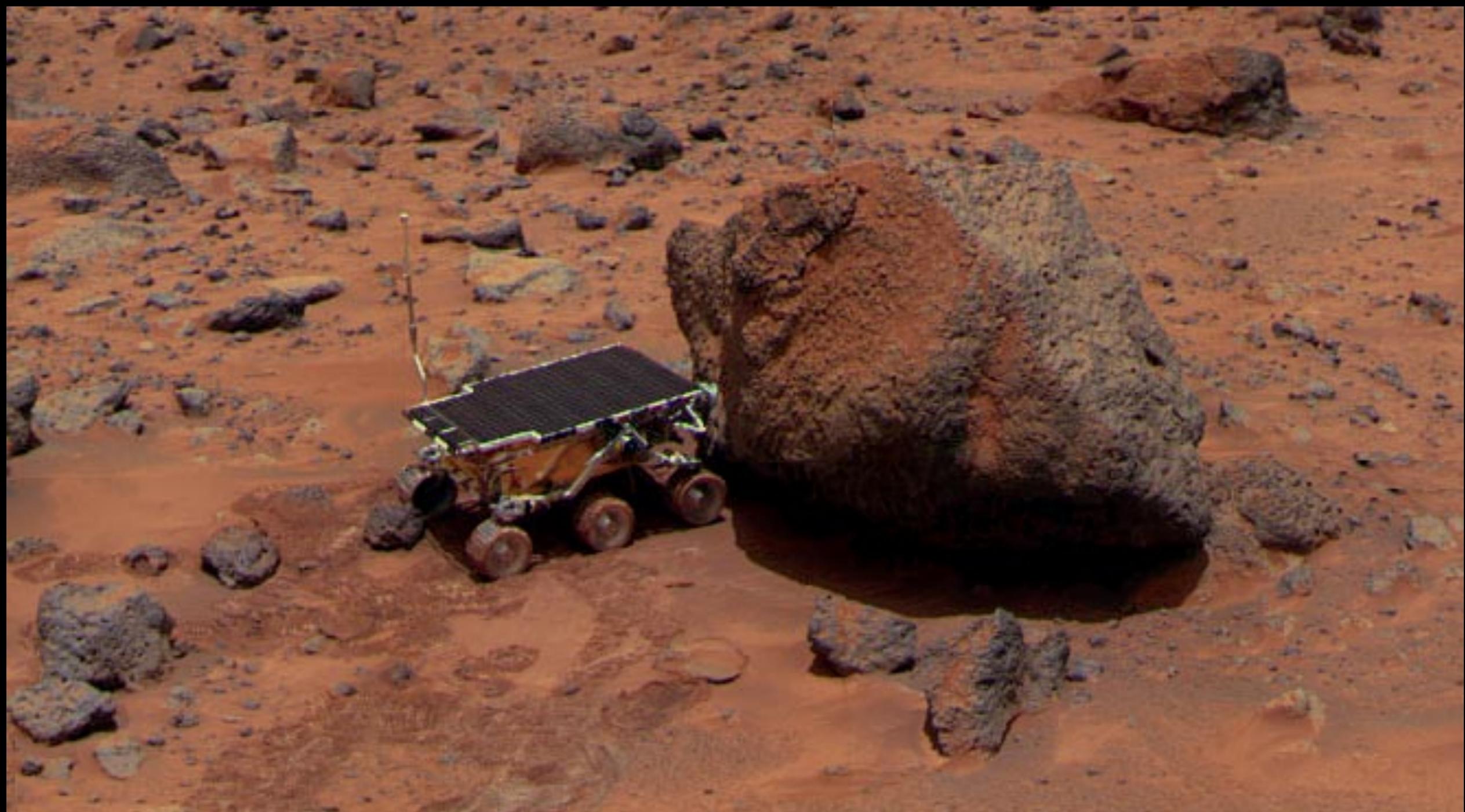
- First Mars mission in two decades
- Orbited the red planet and took high-res images
- Spent over a decade observing, and saw storms, moving rocks, and changes in the polar caps

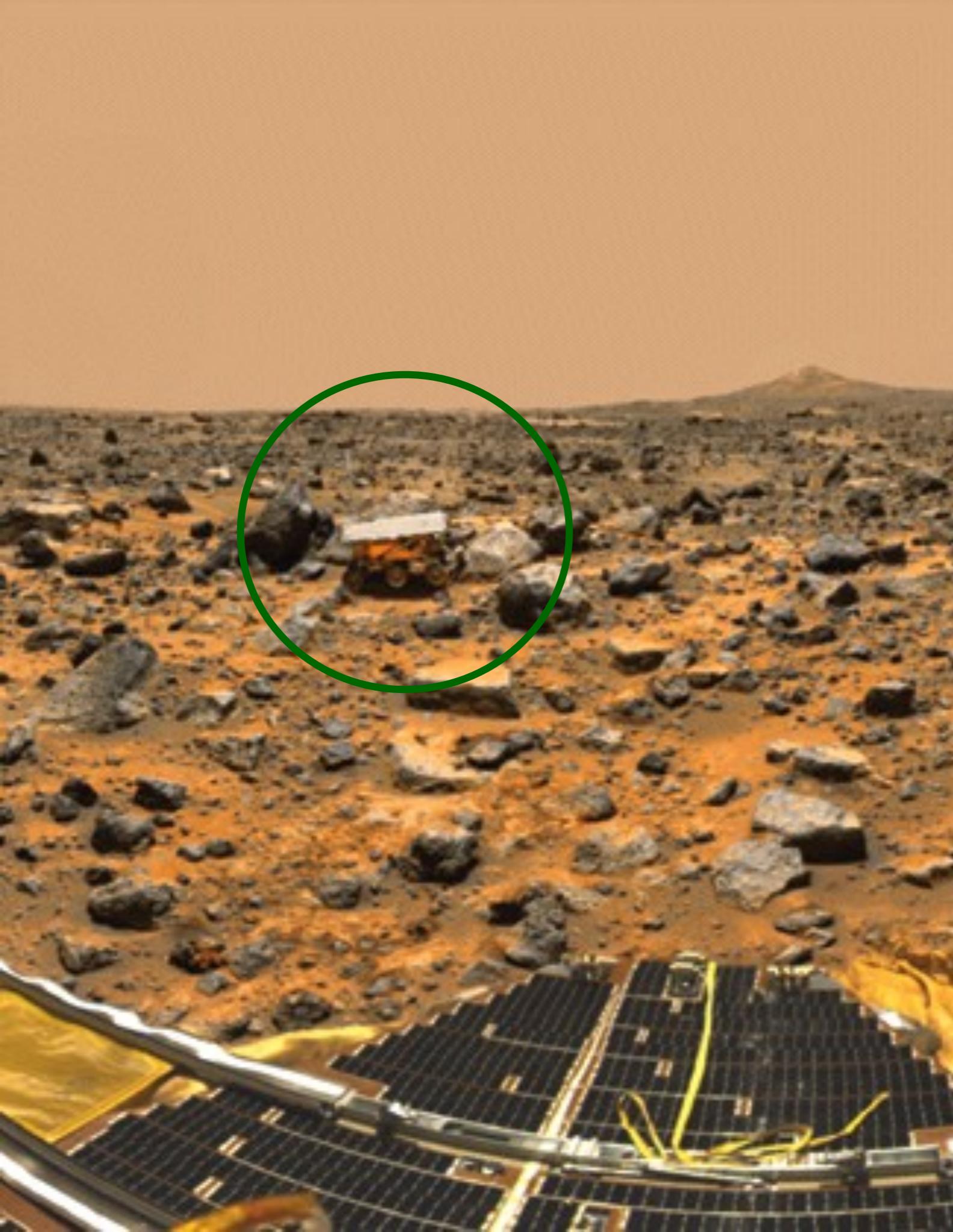


The Mars Global Surveyor also served as a communications link with rovers that were to land on the red planet.



In 1997 the Pathfinder probe landed on Mars and became the Sagan Memorial Station and Sojourner rover





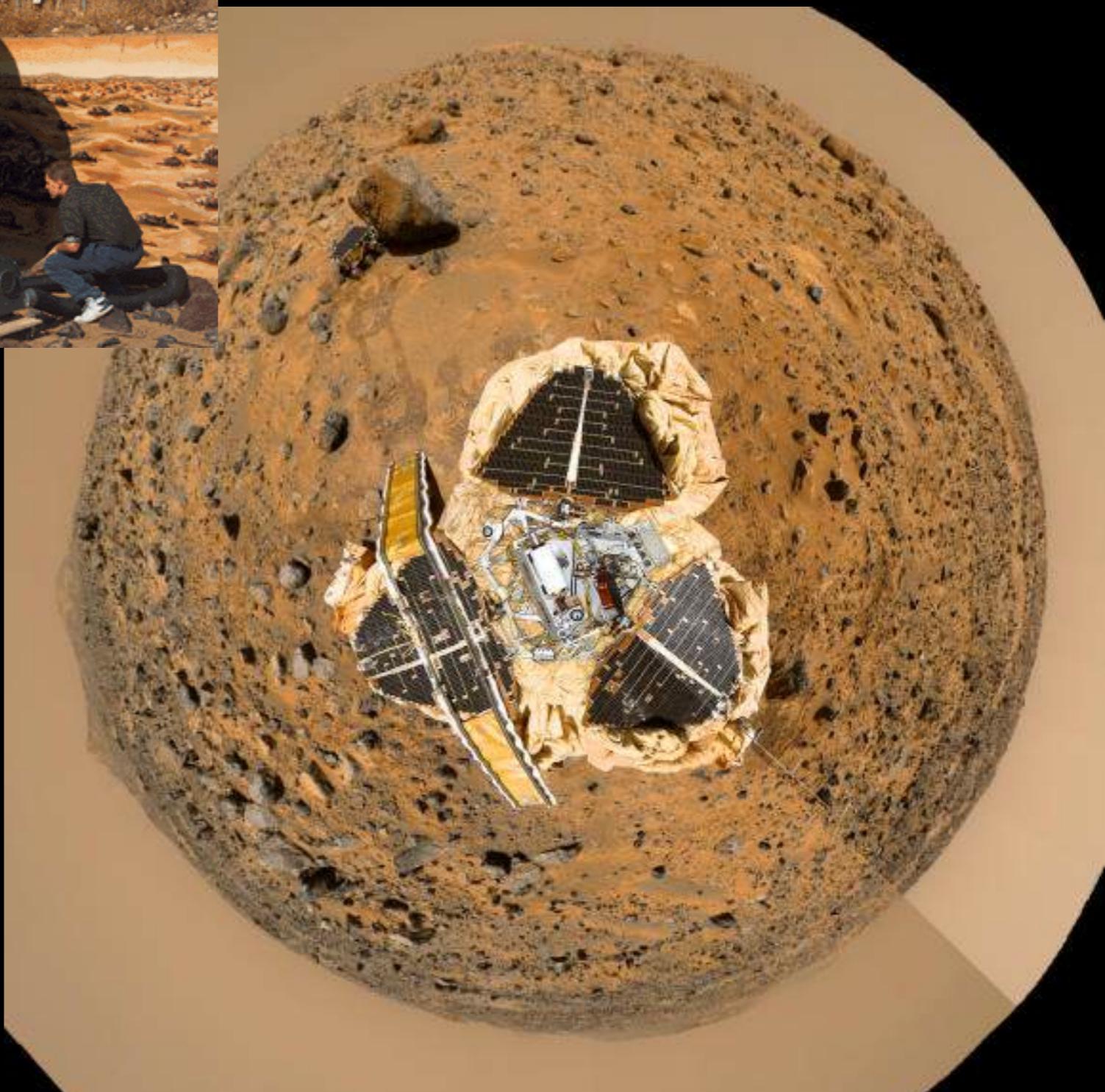
1999 Picture  
from the Mars  
Pathfinder  
Lander

Note the  
remote-control  
rover,  
Sojourner, next  
to a Martian  
rock

Technology  
demonstration...



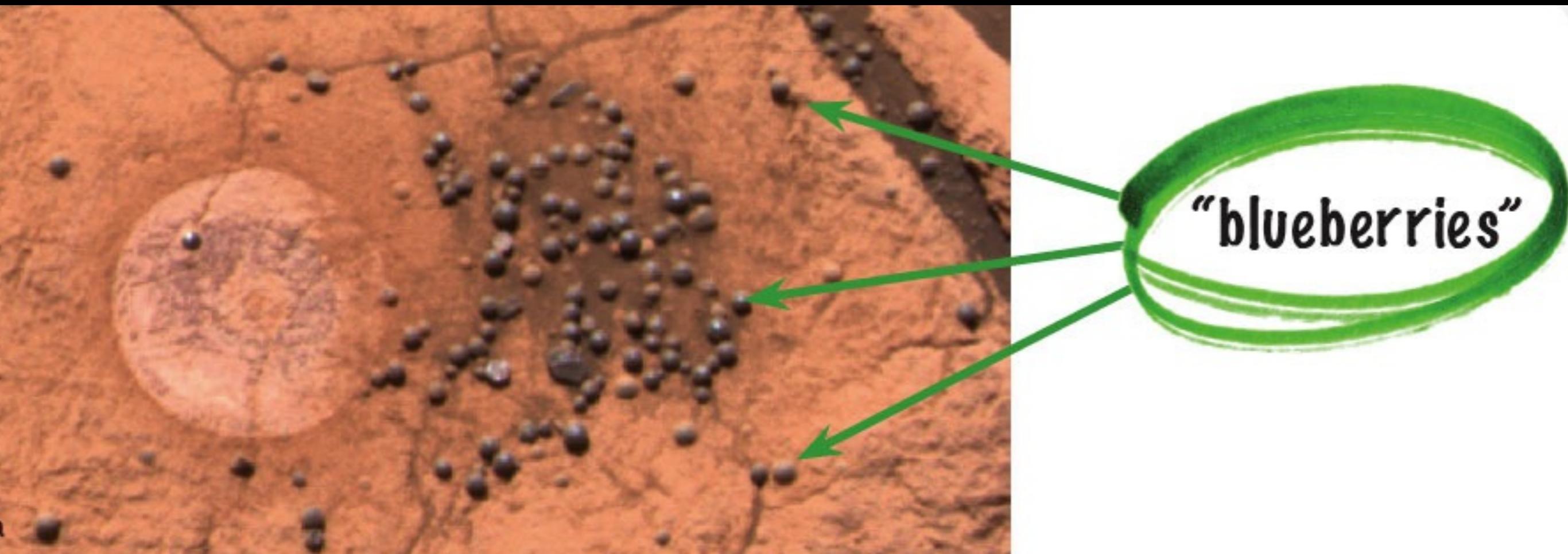
...for both landing  
and roving!



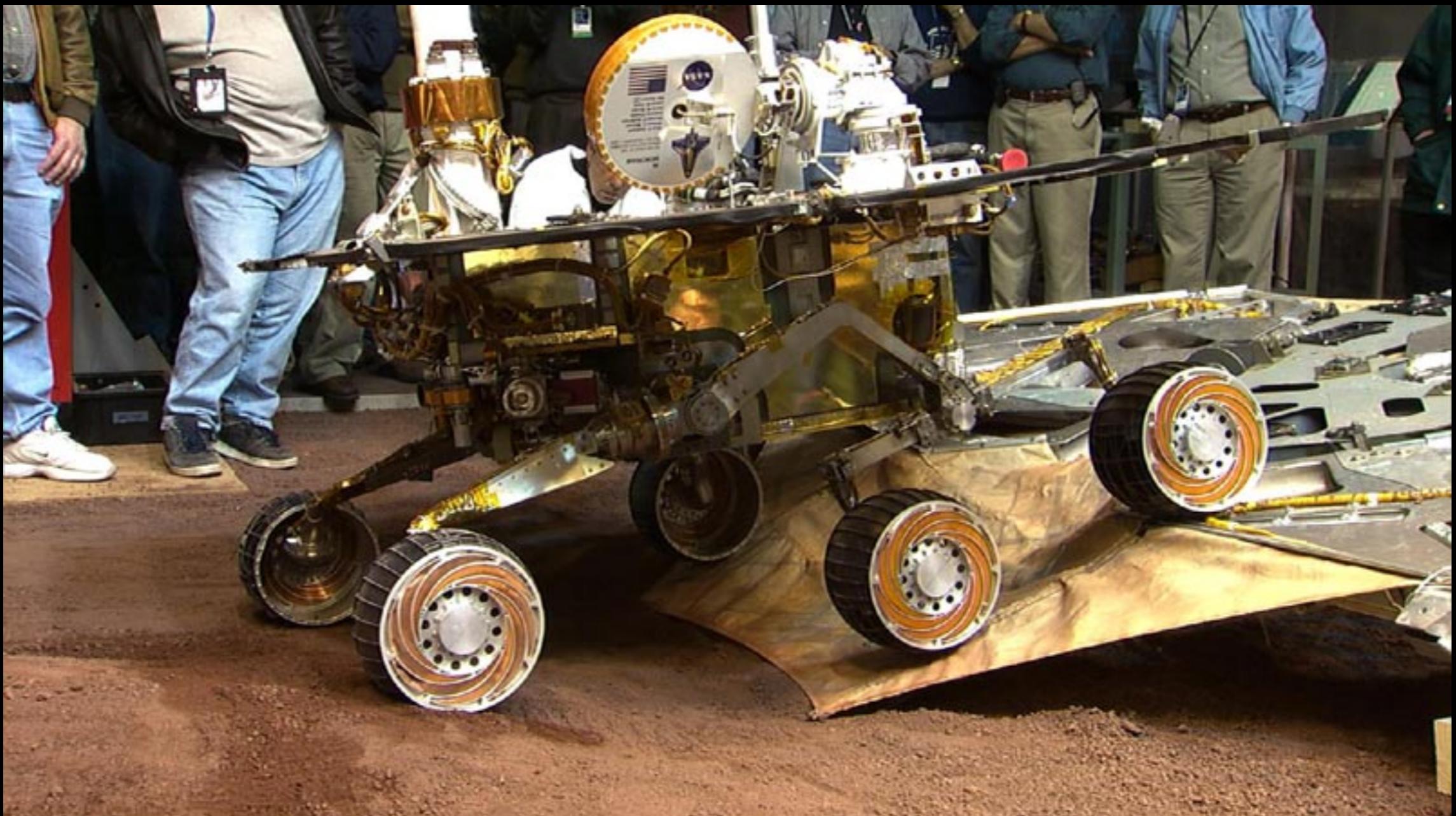
# Mars Expedition Rover mission (MER)

Rovers named Spirit and Opportunity landed in January 2004.

Both rovers landed in areas suspected of having had water on their surfaces.



# 2004 testing Opportunity Lander at Jet Propulsion Laboratory







2004 “Opportunity” Landing Site – and tracks

# 2004 “Opportunity” picture of Crater Wall

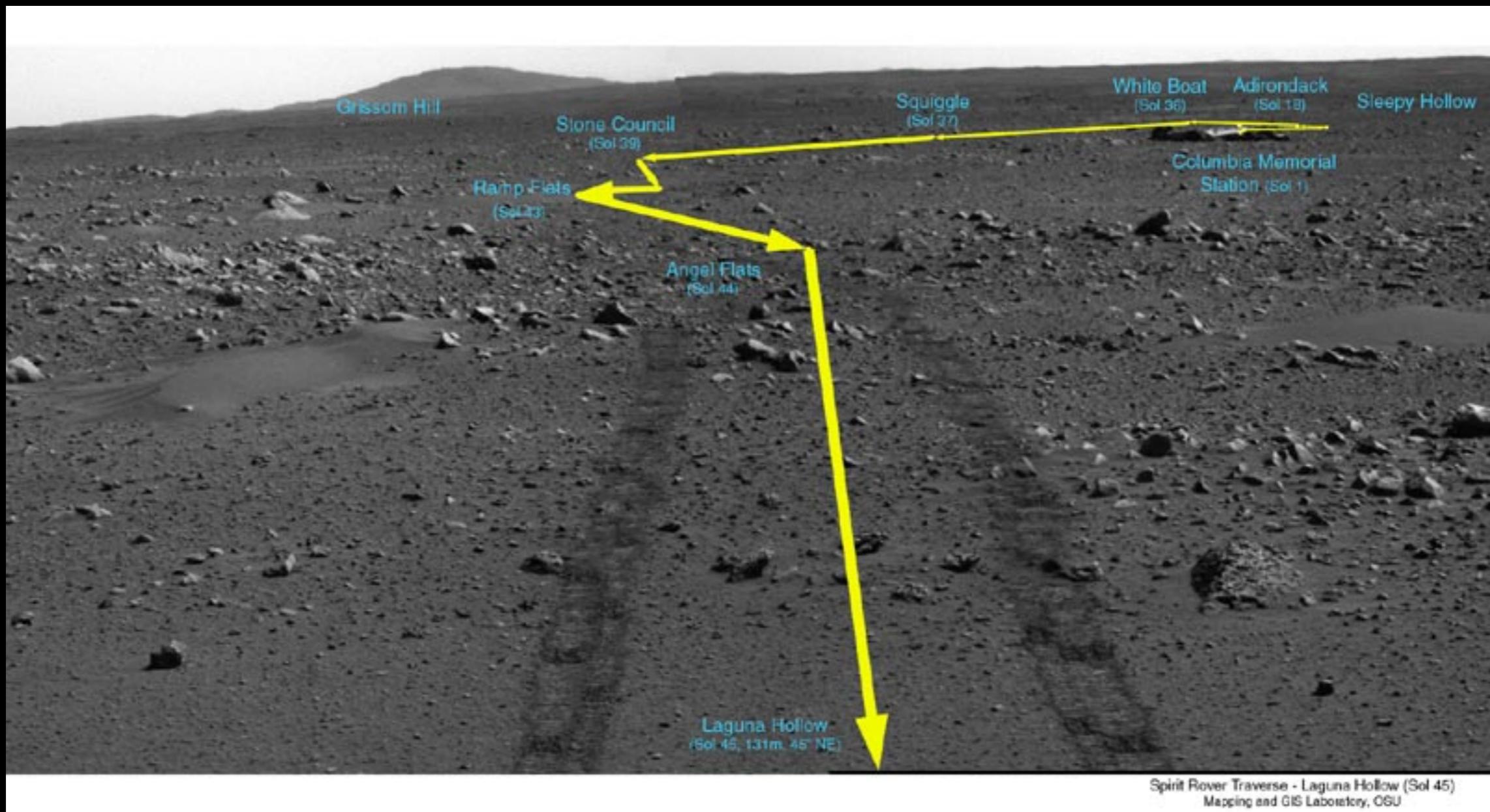


Opportunity drove around Mars until 2018 when it could not replace a battery after a dust storm ☹

2004 “Opportunity” drilling holes in crater  
wall with robotic arm

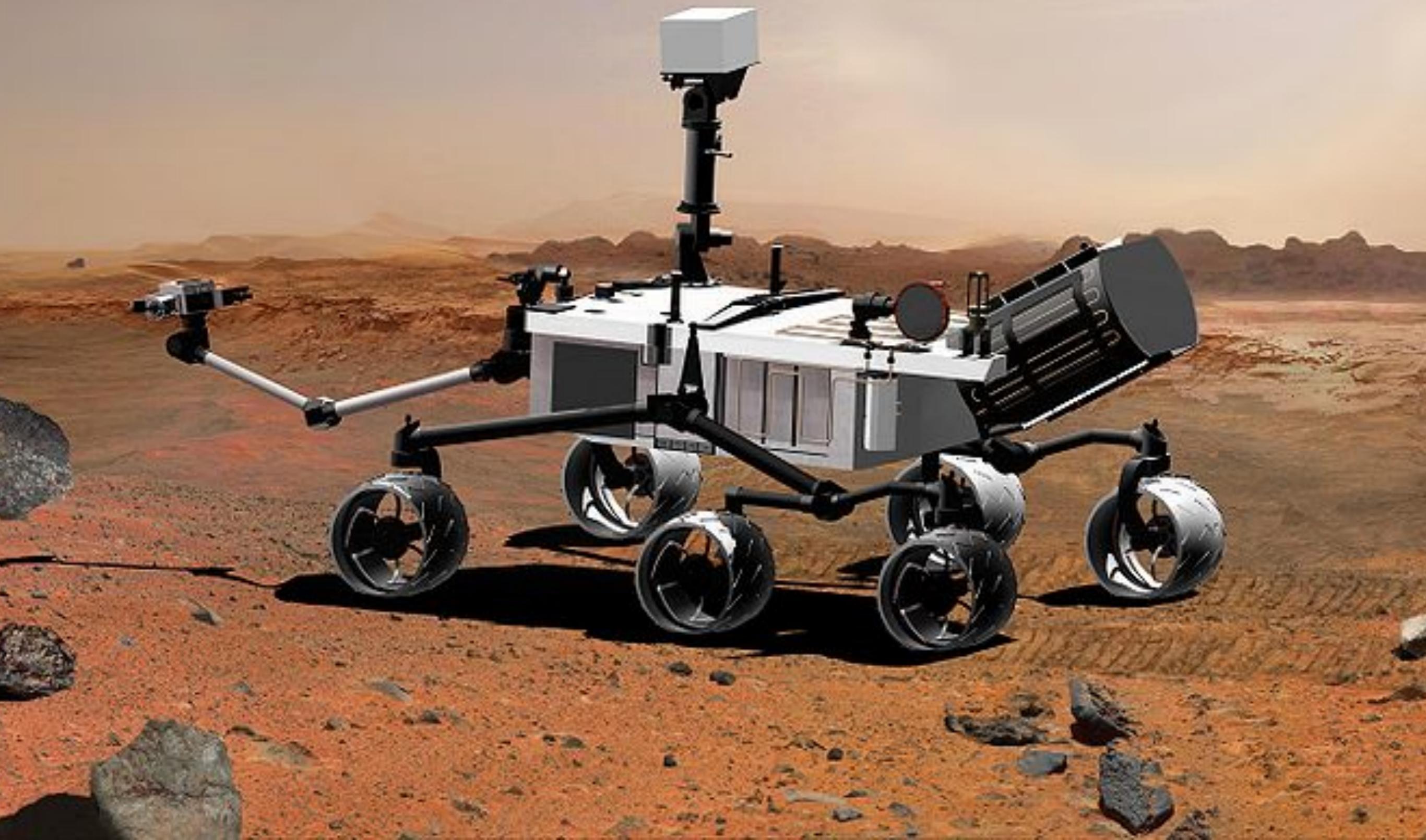


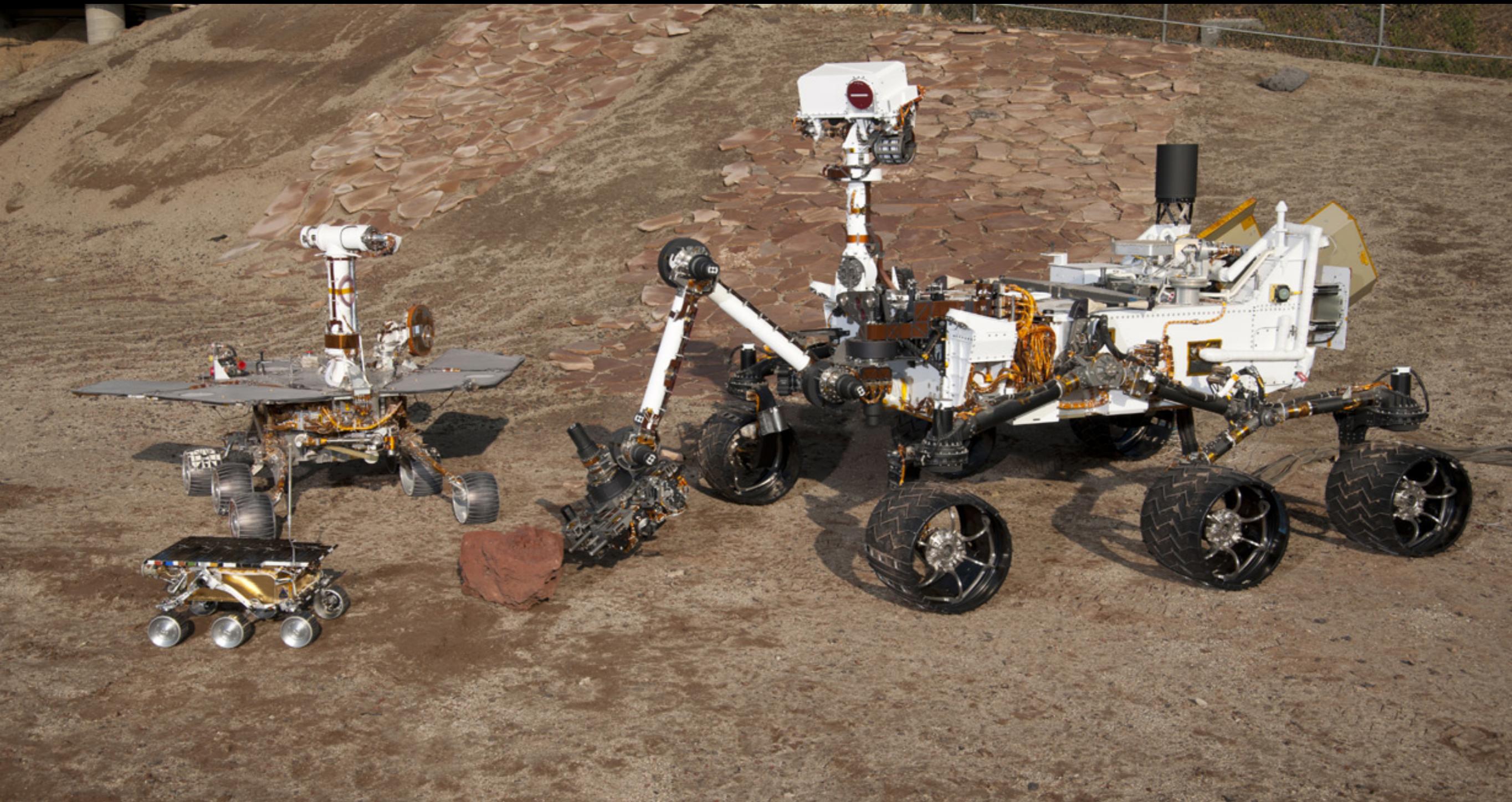
# 2004 Spirit tracks back to landing site



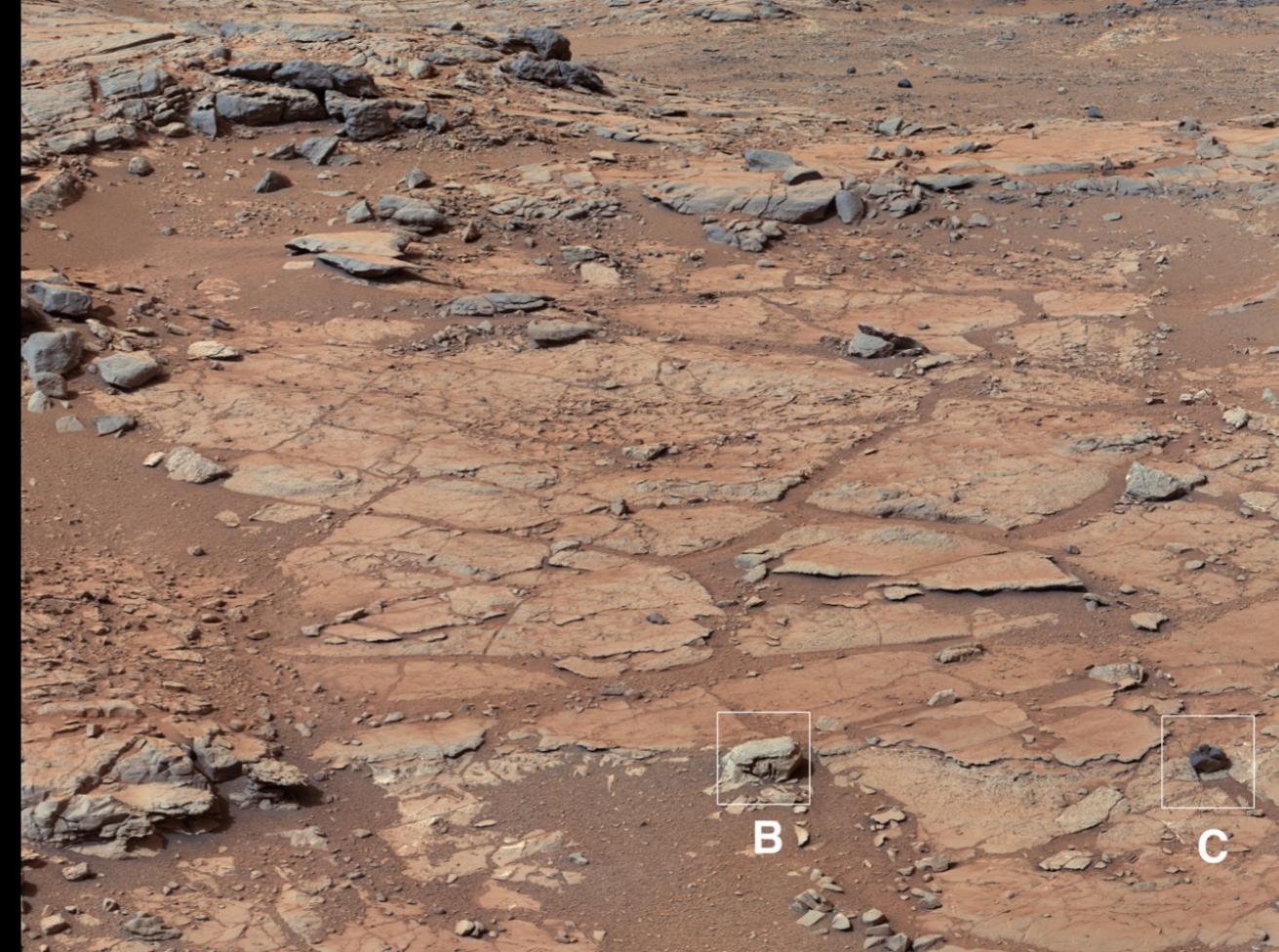
It drove around Mars until 2010; may it over 7km total.

Curiosity: most expensive lander since Viking





2011 - launch of Curiosity  
August 2012 - landing on Mars



Curiosity was landed in the Gale Crater.

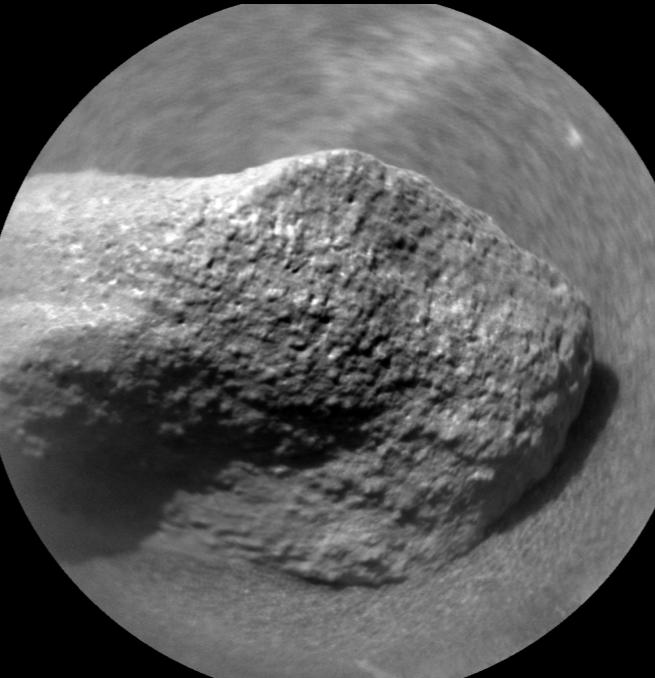
# Landing Curiosity on Mars



<https://youtu.be/nSGbmtdg5y0>

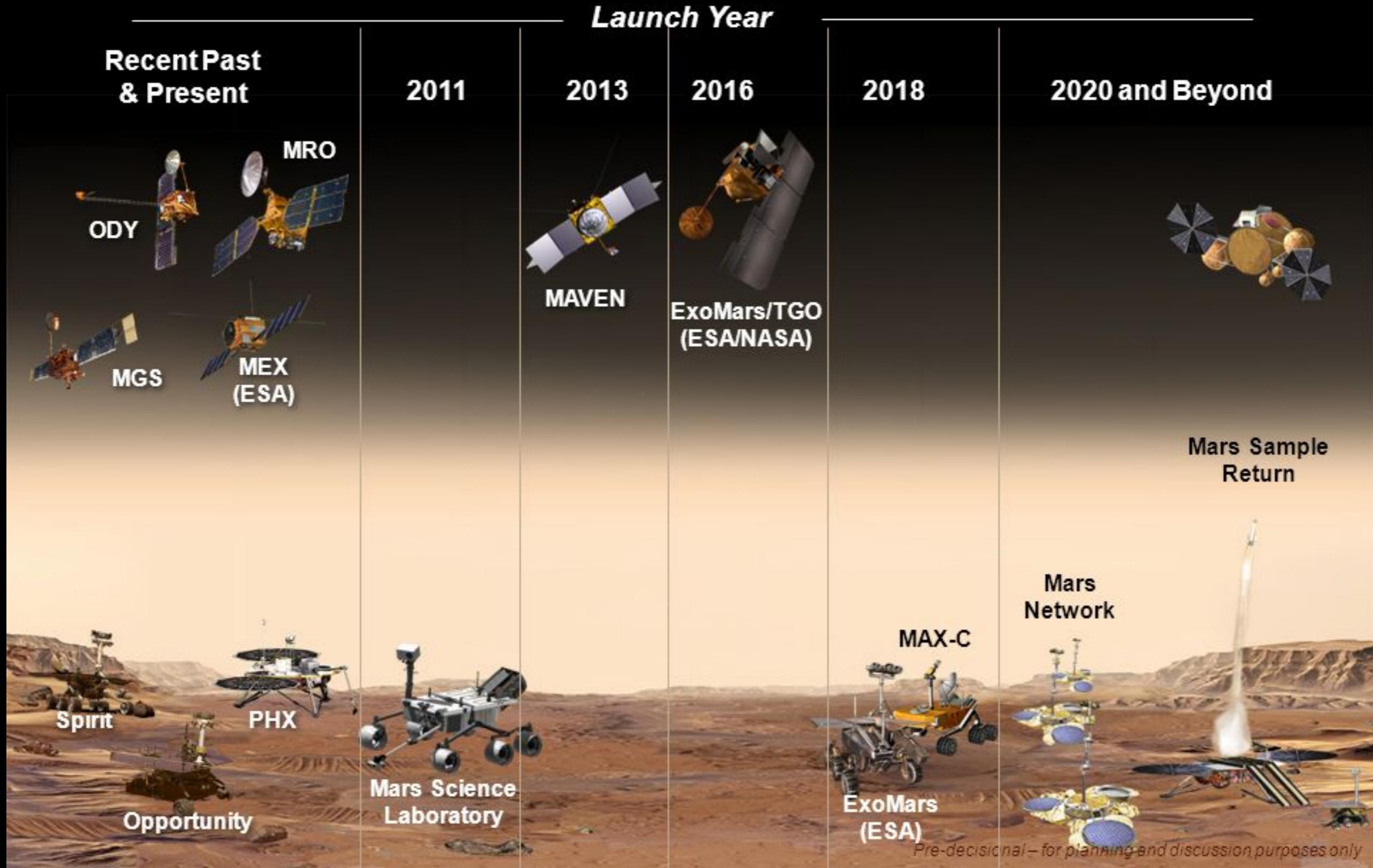
Missions engineers Bobak Ferdowsi (left) and Adam Steltzner — also known as "Mokawk guy" and "Elvis guy," respectively — helped land the Mars Curiosity

# What is Curiosity up to now?



It is maneuvering around, digging, and doing chemistry!  
<https://mars.nasa.gov>

# Expected Mars Exploration Program Timeline & Missions



# Mars samples thus far – from meteorites



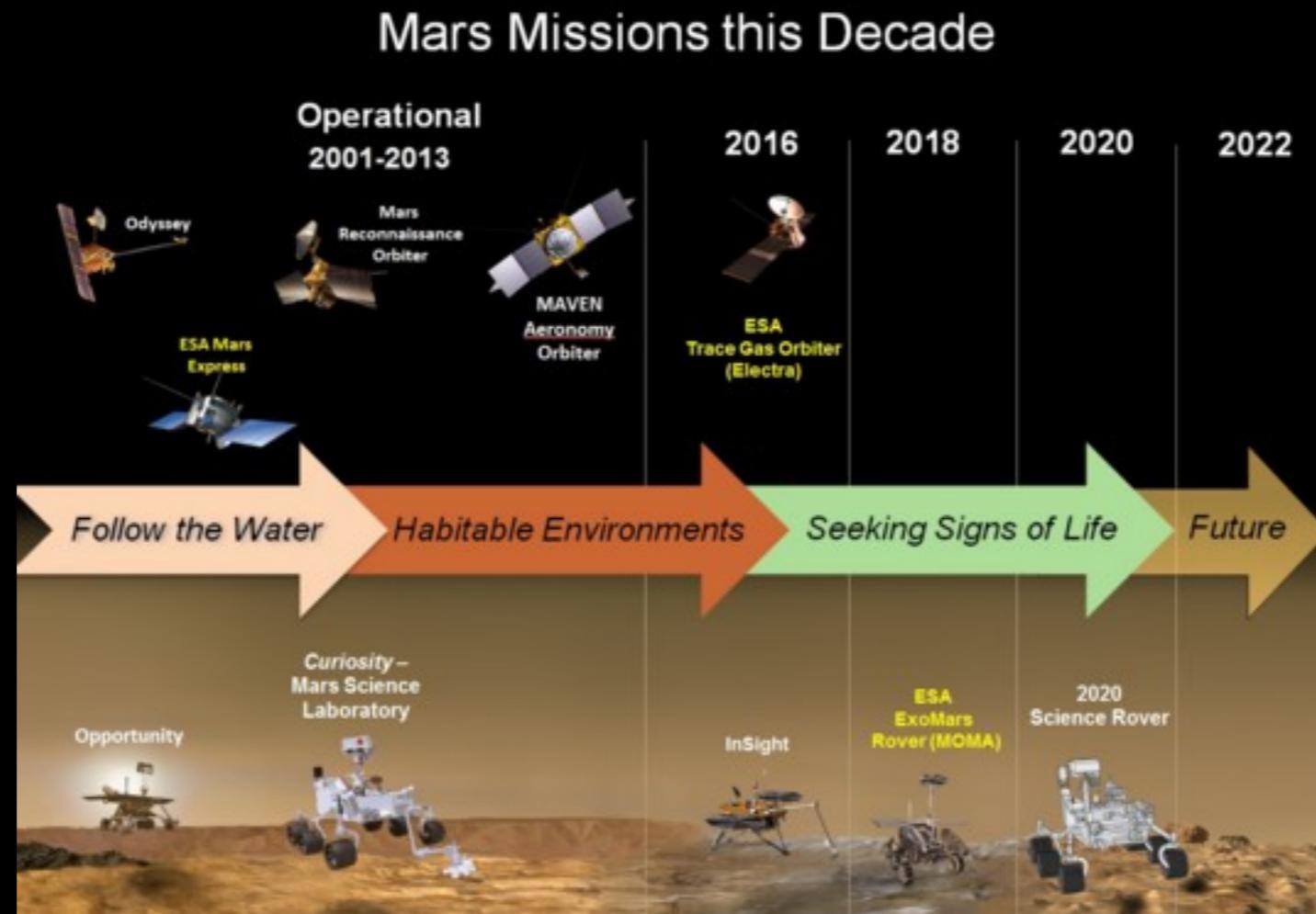
# Mars samples thus far

- We just have meteorites that fell to Earth
- Volcanic basalts that do not match moon or Earth's composition
- We confirmed their origin by looking at gas bubbles and comparing with Mars' atmospheric composition as measured by Viking
- The samples have shown both water and organic compounds!



# The Future is Bright for Mars

- The InSight lander is currently on the red planet's surface performing studies (Mars quakes!)
- Another rover is due to launch this coming August and will test new technology (helicopter!)
- We are learning more and more about the past history and current state of the Red Planet



# One of NASA's new 'Turtle' astronauts may walk on the moon ... or even Mars

By [Chelsea Gohd](#) January 11, 2020



The first astronaut class to graduate under the Artemis project, graduated today (Jan. 10).  
(Image: © NASA)

NASA is looking for new astronauts!  
<https://astronauts.nasa.gov>