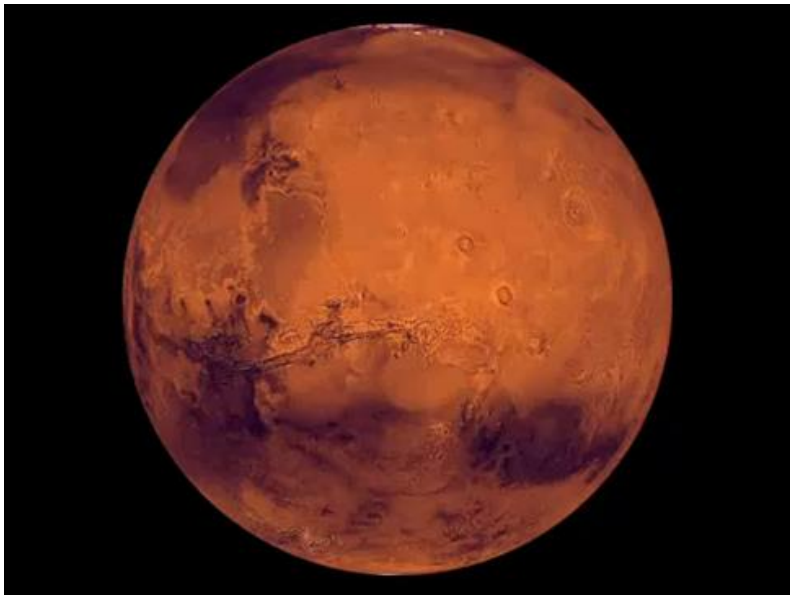
# Solar System Tour
# Mars

With Jim Paradise

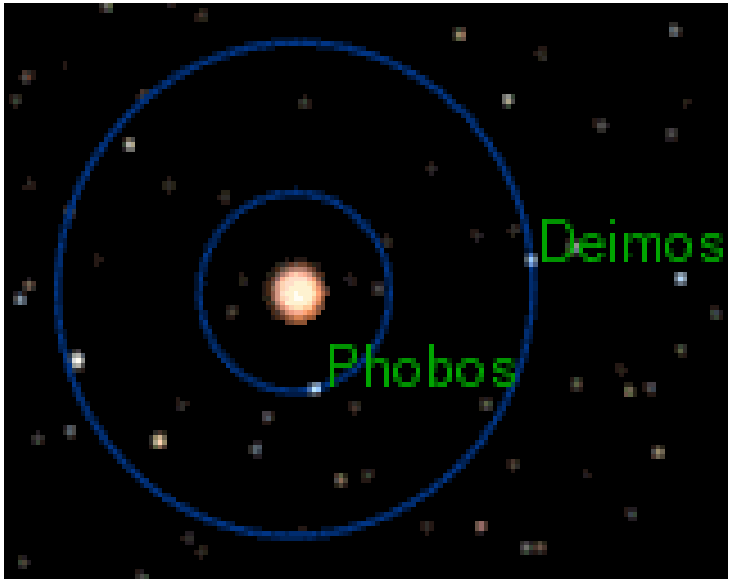
sun

**Mars**



Average Distance From Sun:
142 Million Miles

- Average Temp: -85°F
- Surface Temp: -220°F to +80°F
- Atmosphere: 1% of Earth
- Diameter: 4,200 miles
- Orbital Period: 1.9 years
- Rotation: 24.7 hours
- Moons: 2



# Deimos –Mars smallest moon (8 miles diameter)

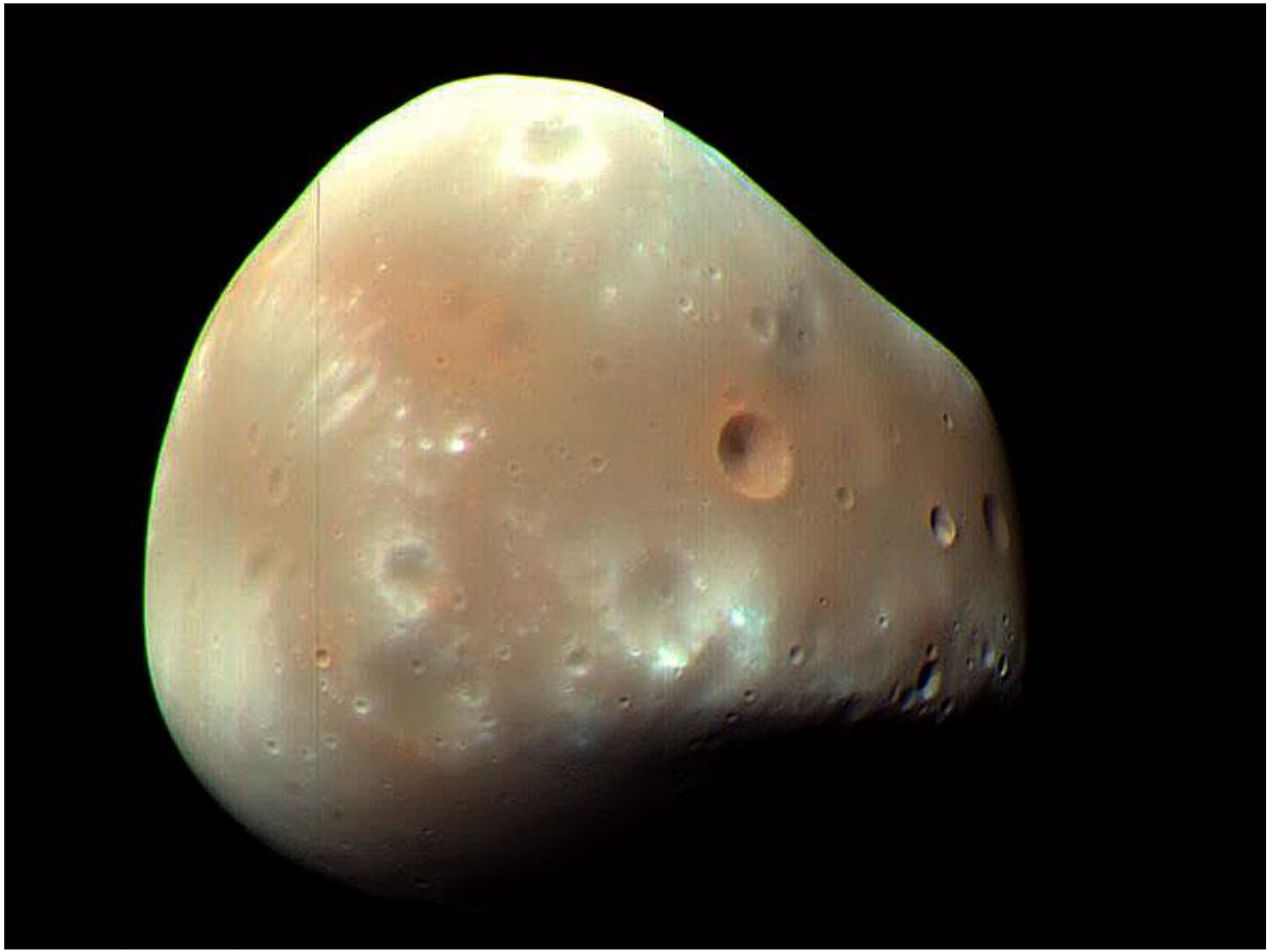


Image credit: NASA/JPL-Caltech

Phobos

Phobos – Mars biggest moon (14 miles diameter)

**Escape Velocity: 24 mph**

Image credit: NASA/JPL-Caltech

March 3, 2010:

Previous flybys of Phobos have shown that it is not dense enough to be solid all the way through.

It must be 25-35% porous.

This has led planetary scientists to believe it is a dust covered 'rubble pile' circling Mars, or is hollow, or has caverns.

# Mars Odyssey

**Launched: April 7, 2001**
**MOI: October 24, 2001**
**Controlled from Denver, CO**

## Major Instruments:

- **Thermal Emission Imaging System (THEMIS)**
- **Gamma Ray Spectrometer (GRS)**
- **Mars Radiation Environment Experiment (MARIE)**

# Melas - The Grand Canyon of Mars

credit: NASA/JPL-Caltech


Image credit: NASA/JPL-Caltech

# Mars Reconnaissance Orbiter (MRO)

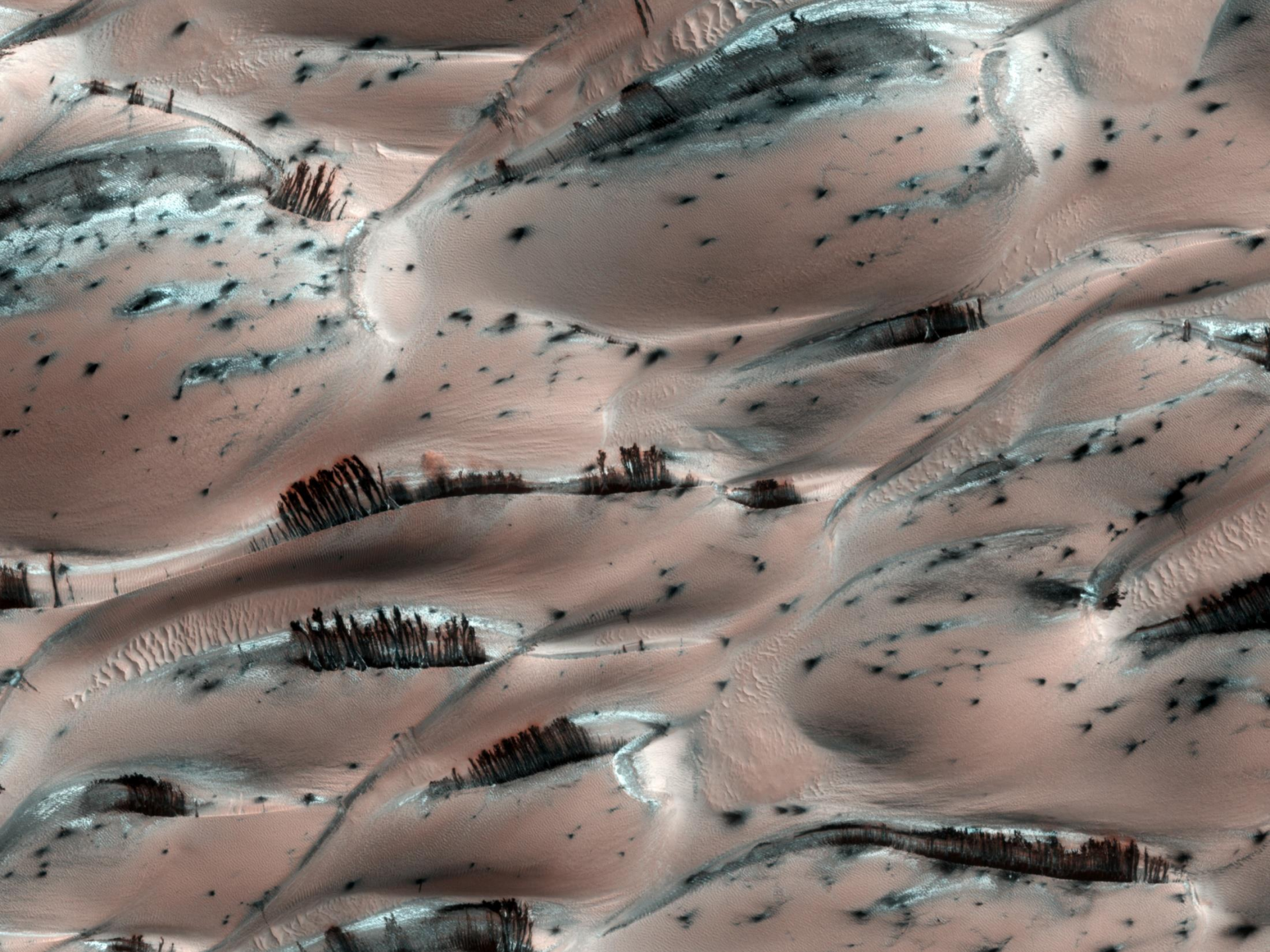
**Launched: August 12, 2005**
**Arrived: March 10, 2006**
**10x resolution over Odyssey**
**Controlled from Denver, CO**

Image credit: NASA/JPL-Caltech

**Major Instruments:**

- **Context Camera (CTX)**
- **Mars Color Imager (MARCI)**
- **High Resolution Imaging Science Experiment (HiRISE)**
- **Compact Reconnaissance Imaging Spectrometer for Mars (CRISM)**
- **Shallow Radar (SHARAD) (can see up to 1 km into ground)**

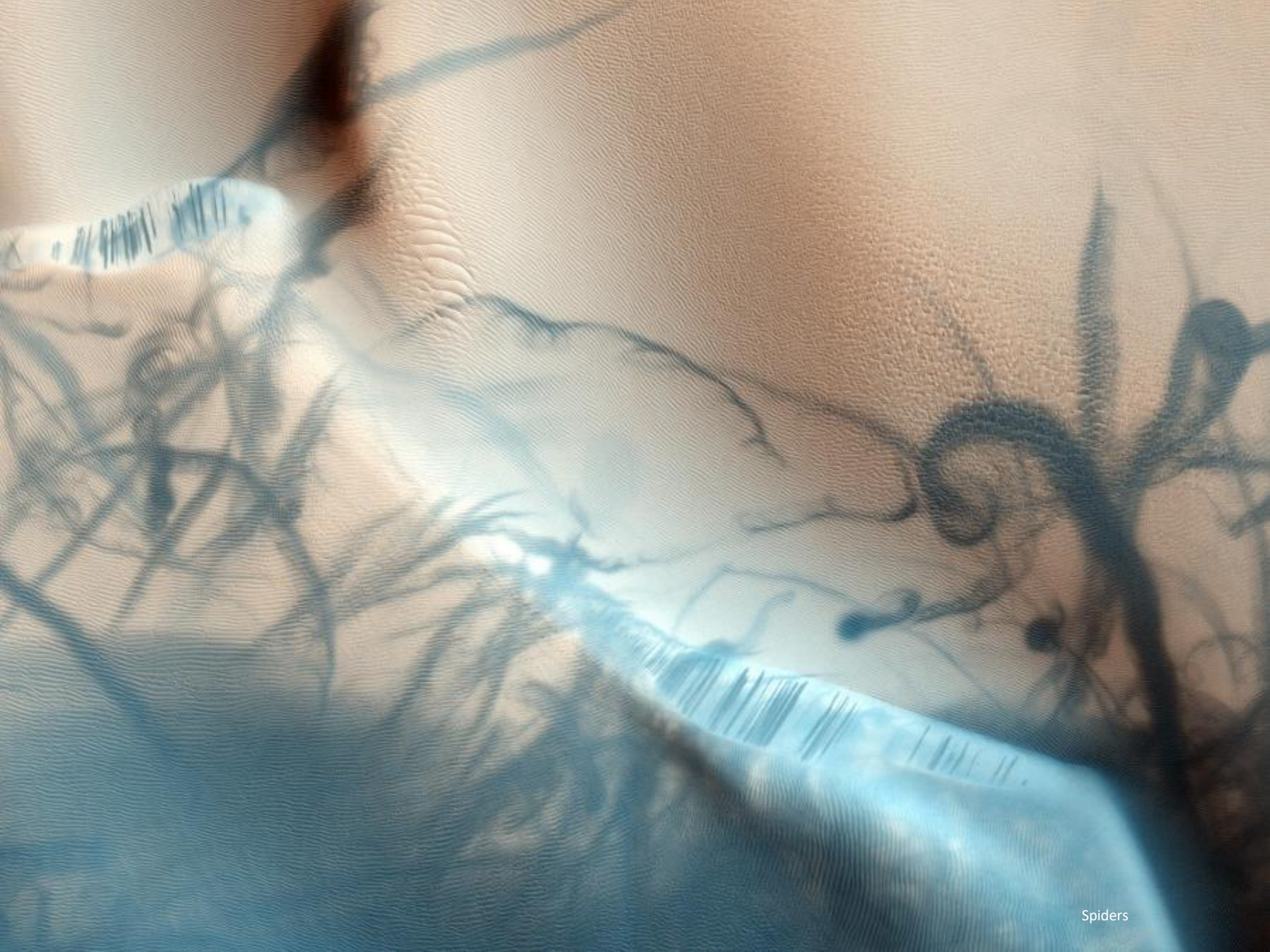
# Sand Dunes / Ripples



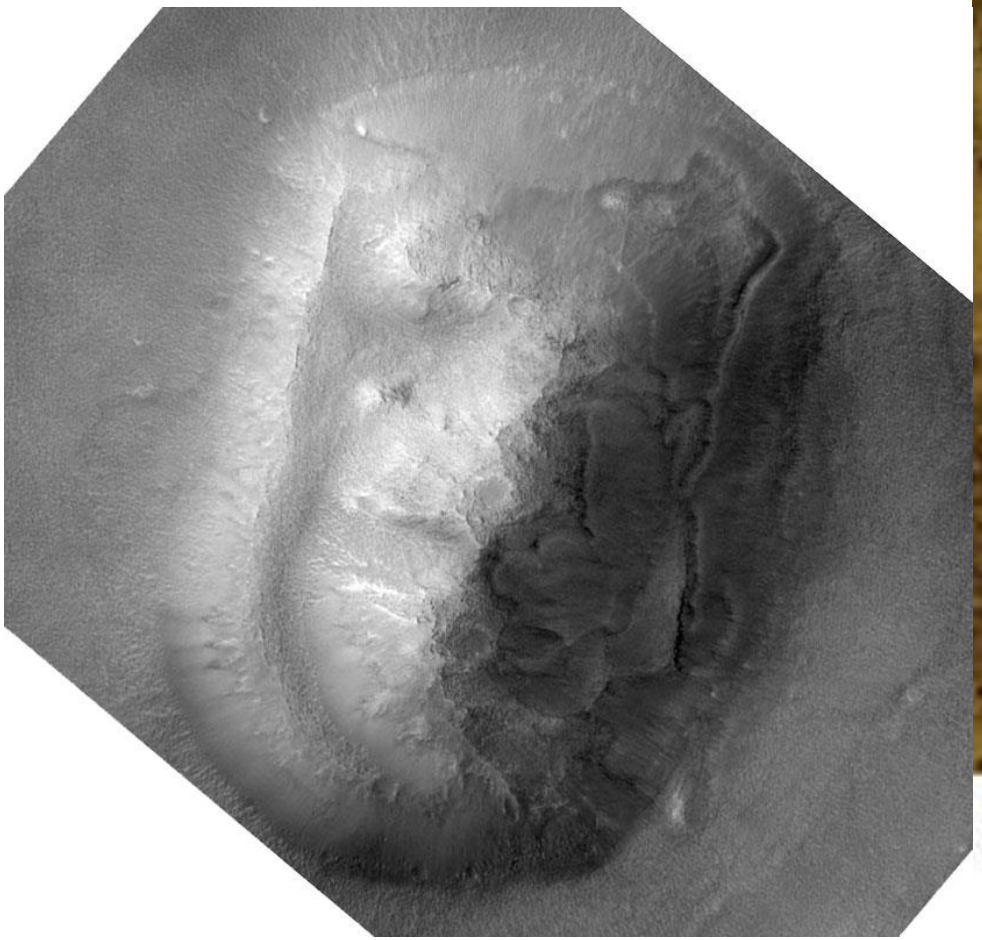
Dust devils


Sediments


MOC2-141a
Malin Space Science Systems/NASA


Spiders

# Face on Mars



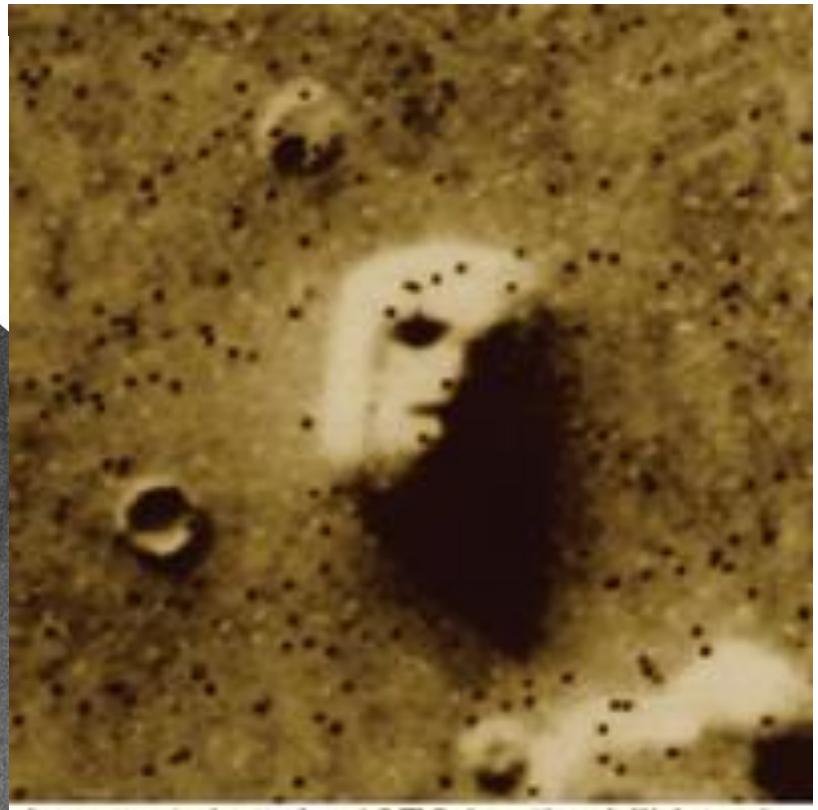


*Image taken in 1976 by the Viking 1 Orbiter.*

Sojourner

Launched Nov 18, 2013

Mars Orbit: Sept 21, 2014

Controlled from Denver, CO

Mars' loss of its protective magnetic field may have triggered the loss of its atmosphere.

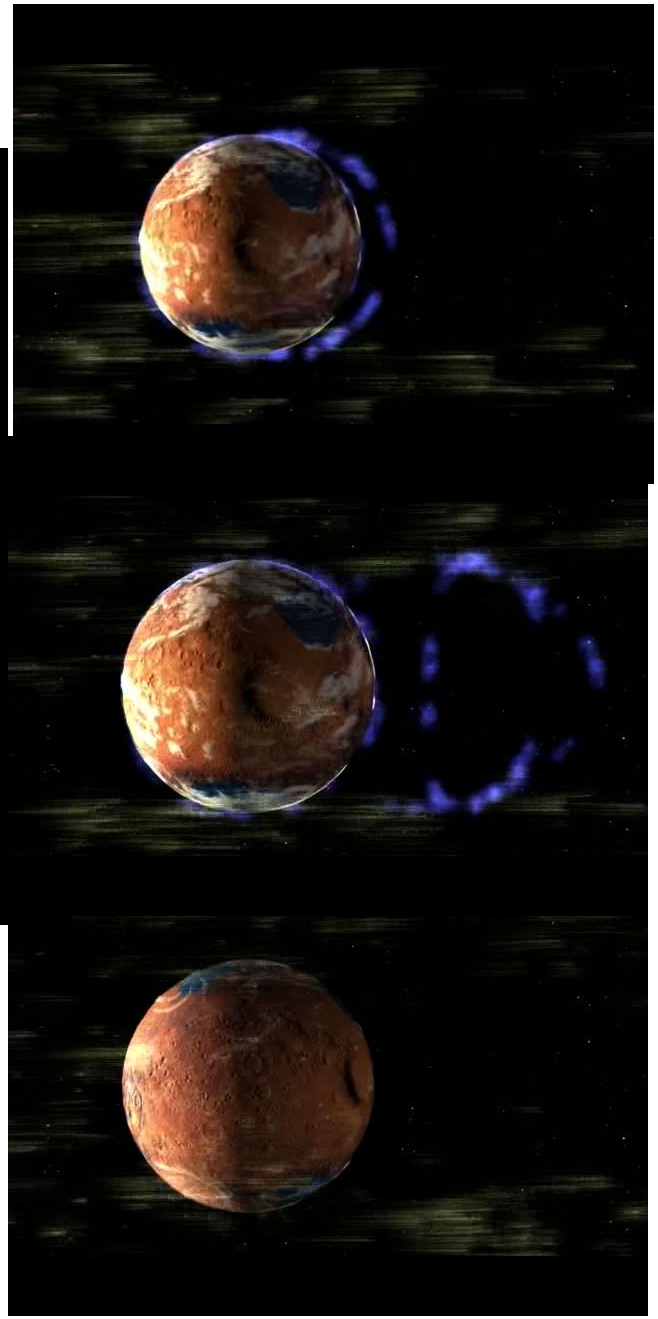


Image credit: NASA/JPL-Caltech

Asteroid Belt

## Mars 1997

## Sojourner

**Launched:** Dec 4, 1996

**Landed:** July 4, 1998

**Lasted:** 92 days

**Size**
- Small
- Length: 20 inches
- Height: 10 inches

Image credit: NASA/JPL-Caltech

# Mars Pathfinder Landing Site

July 4, 1997

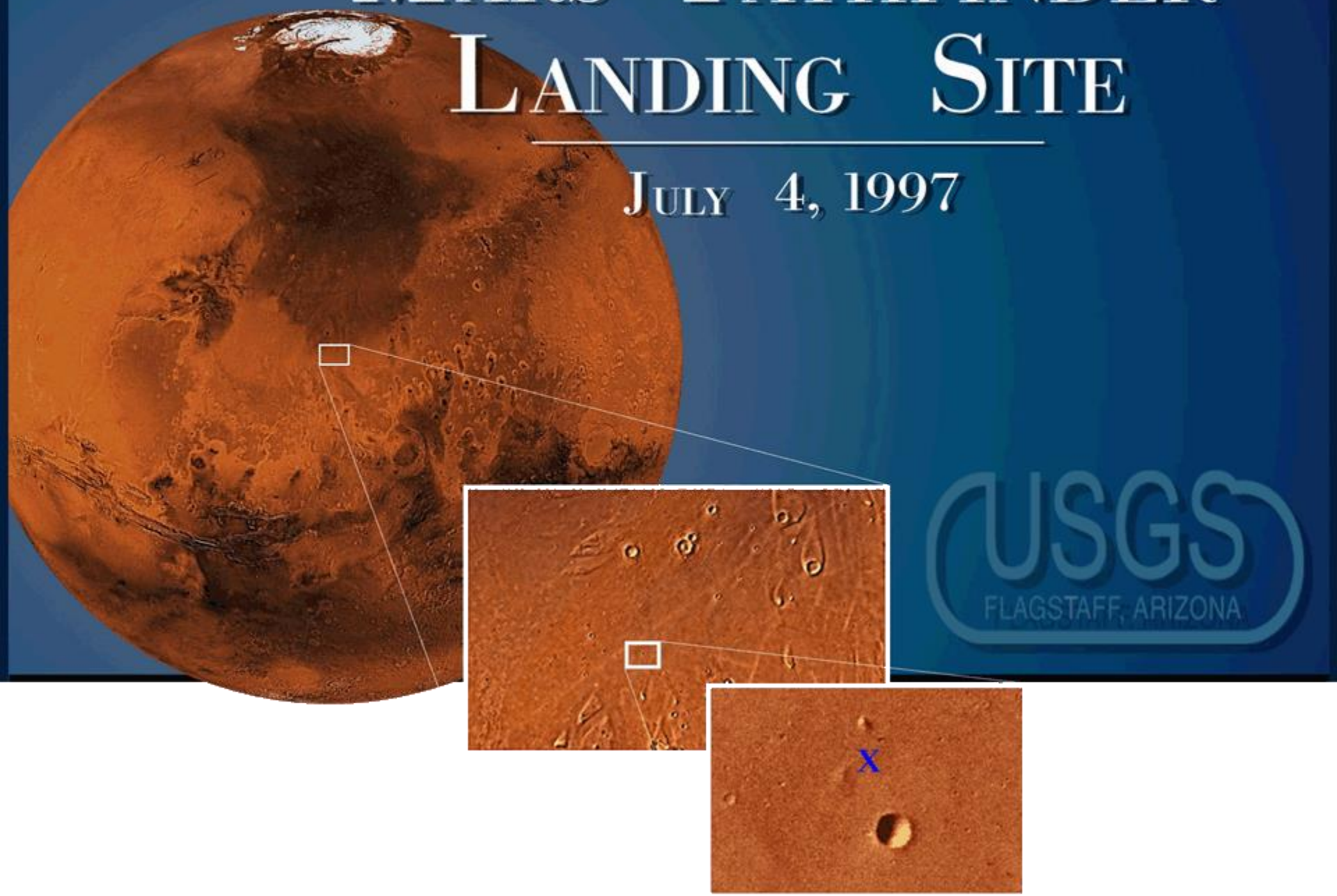


Image credit: NASA/JPL-Caltech

# Sojourner on Mars

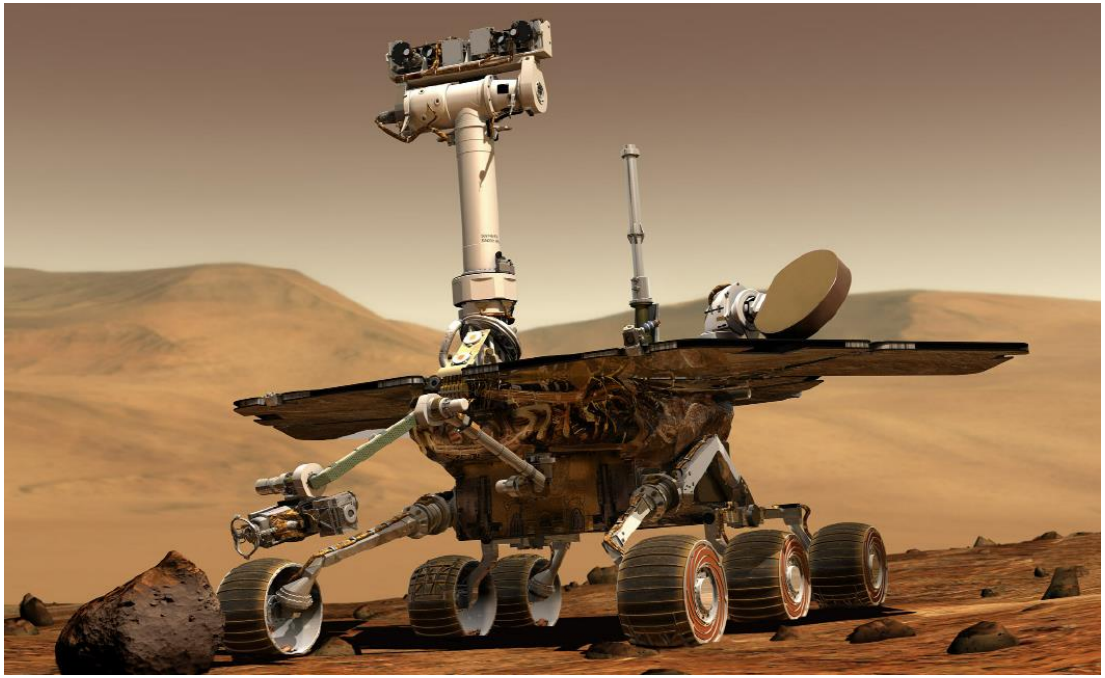
# Mars 2003 Mars Exploration Rovers (MER)

## Spirit:

**Launched: June 10, 2003**
**Landed: January 4, 2004 at Gusev Crater**
**Got stuck at Troy 8/5/2009**
**Traveled 4.8 miles total**
**Last communication: 3/22/2010**

## Opportunity:

**Launched: July 7, 2003**
**Landed: January 24, 2004 at Meridian Planum**
**Still rolling after more than 9.5 years**
**Traveled 14.3 miles so far**
**Next Destination: Solander Point**



## Size: Golf Cart Size / 400 pounds

Landing sites on opposite sides of Mars.
**The mission was planned to last for 90 days each**.
The rovers were designed to travel up to 350 feet each Martian day, or sol (approximately 24 hours, 37 minutes).

Image credit: NASA/JPL-Caltech

video

Mars 1/25/2004
Opportunity on Mars

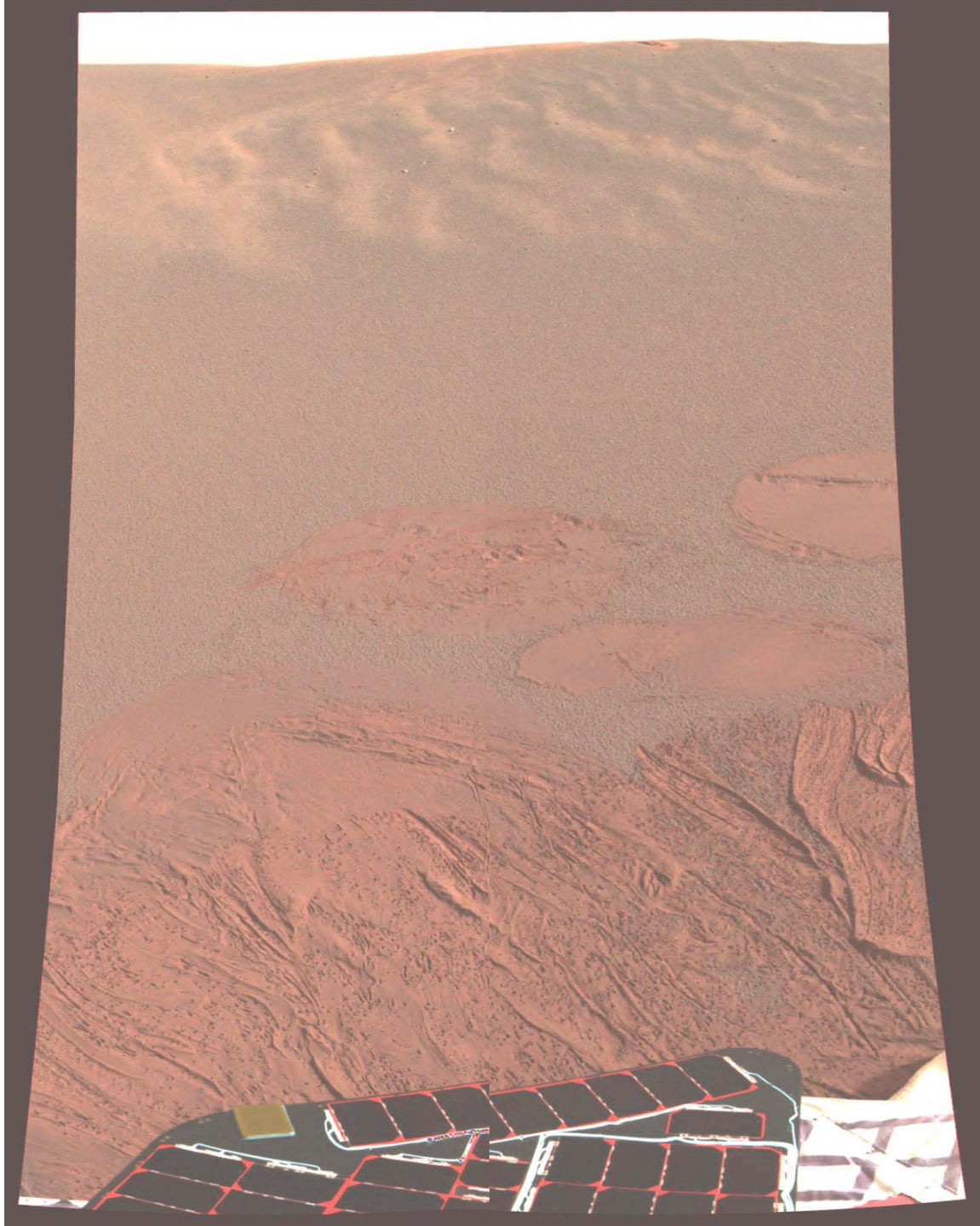


Image credit: NASA/JPL-Caltech

# Opportunity checking out it's landing airbag…

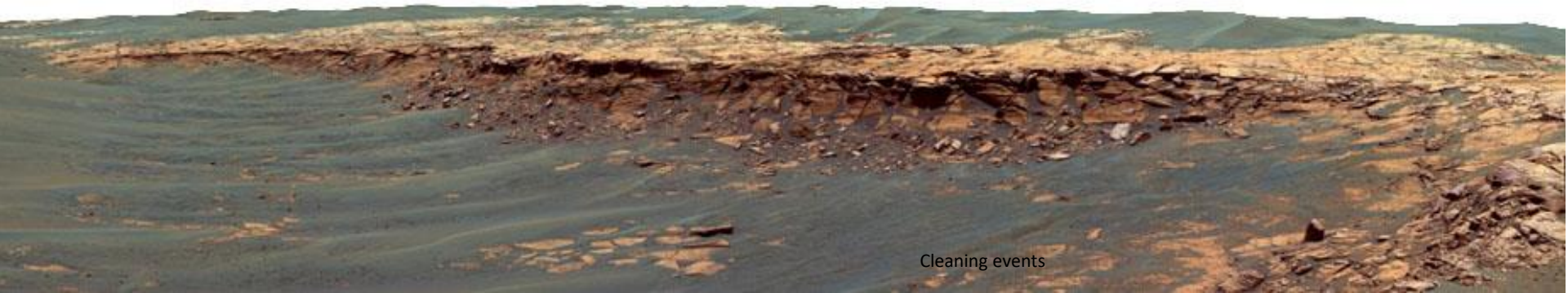
Image credit: NASA/JPL-Caltech

# Sand Dunes

Image credit: NASA/JPL-Caltech

Image credit: NASA/JPL-Caltech

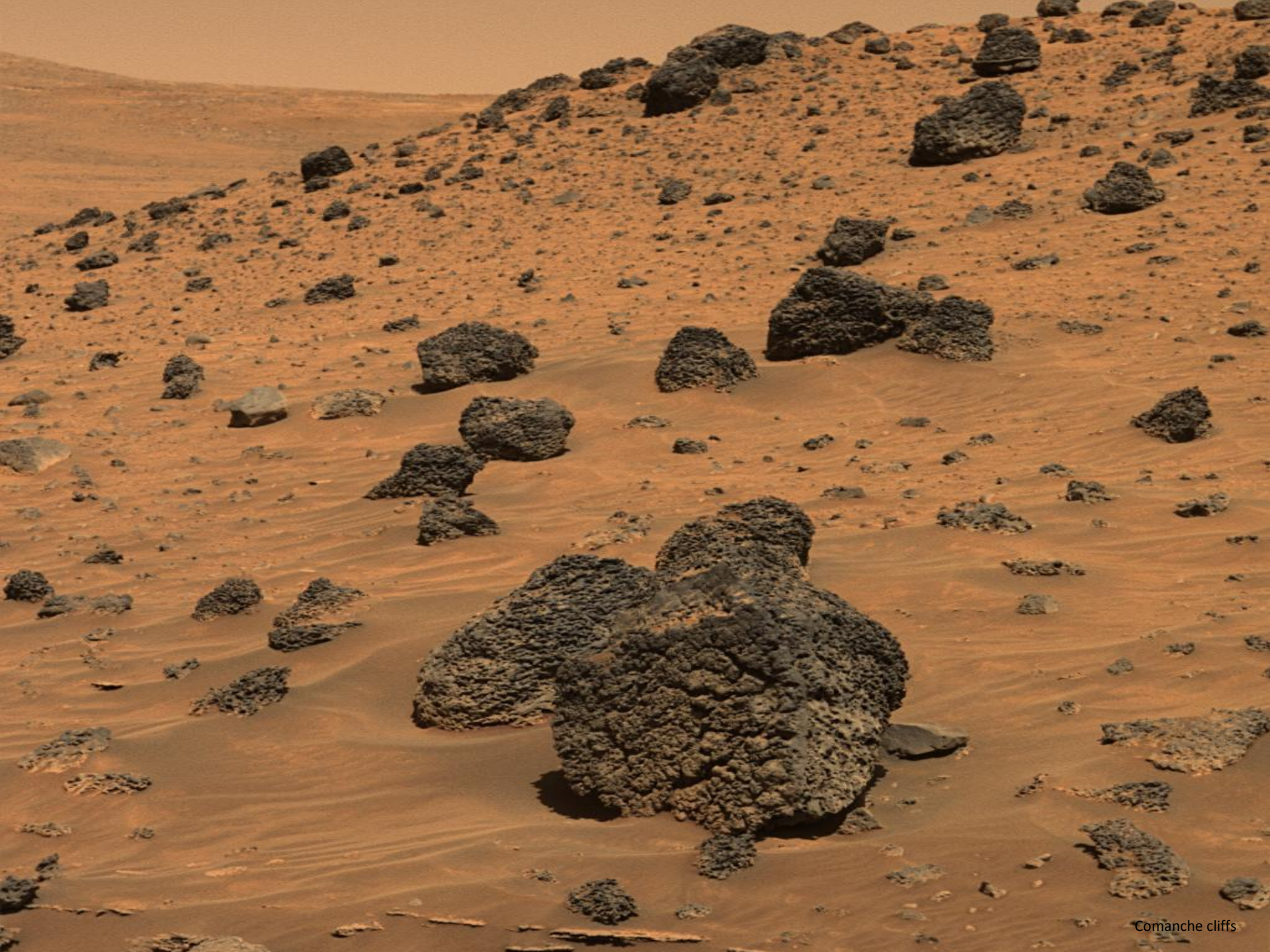
# A rocky outcrop



# Spirit's Landing Area on Mars

Image credit: NASA/JPL-Caltech

Volcanic hills



Comanche cliffs

# Spirit at Comanche Cliffs

Image credit: NASA/JPL-Caltech

# Spirit stuck in white dry powder at Troy (final resting place)

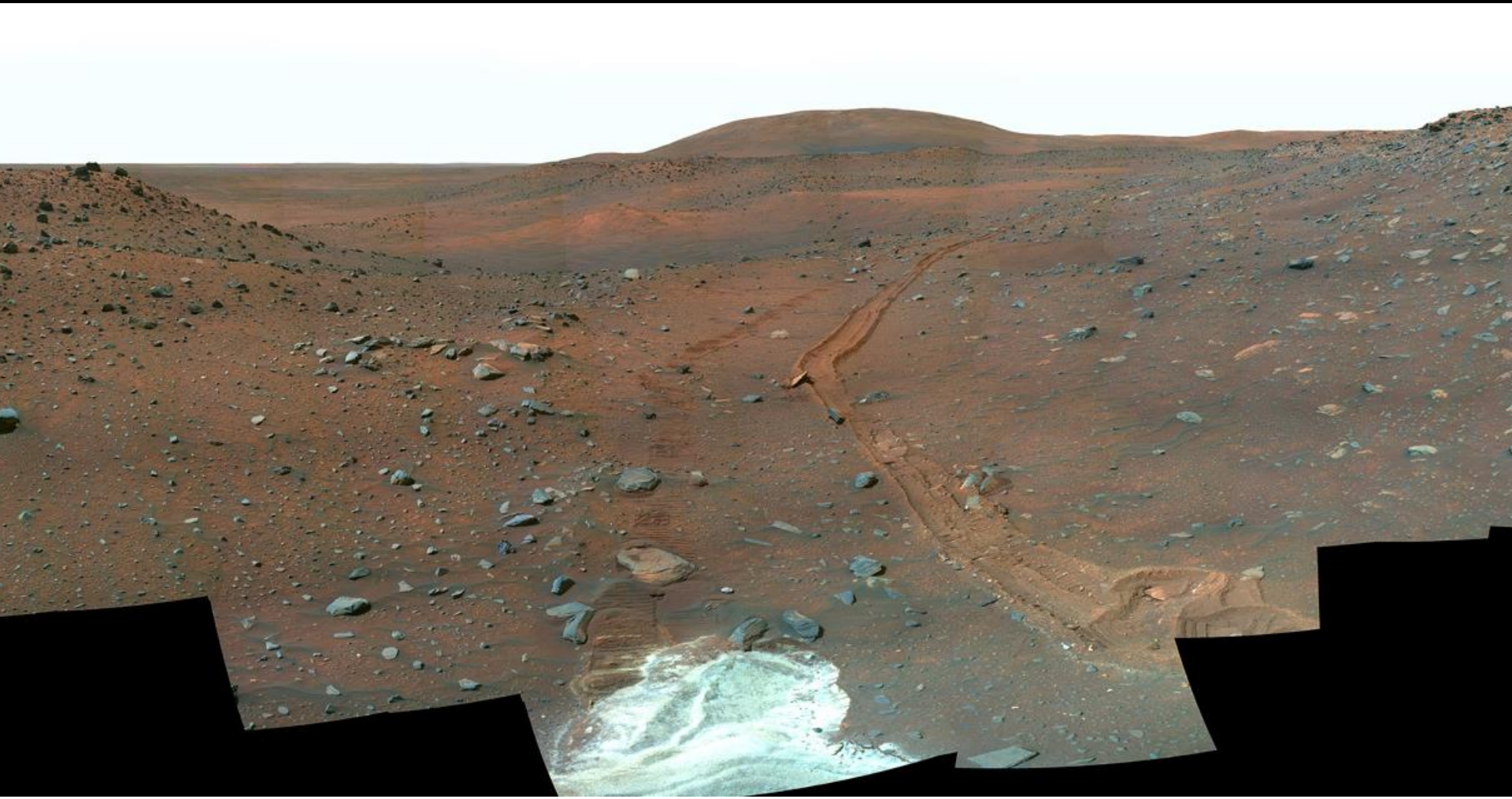


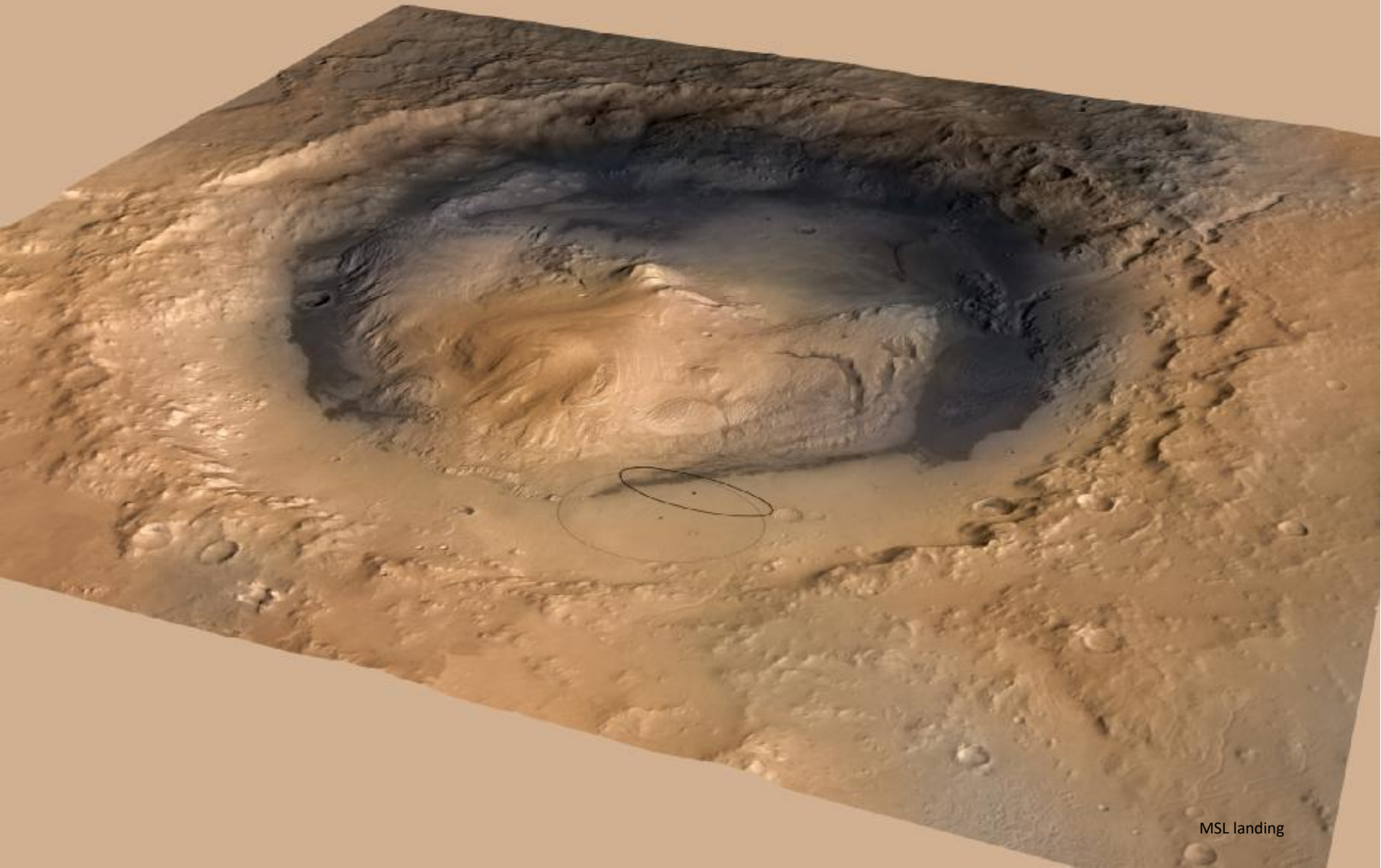
Image credit: NASA/JPL-Caltech

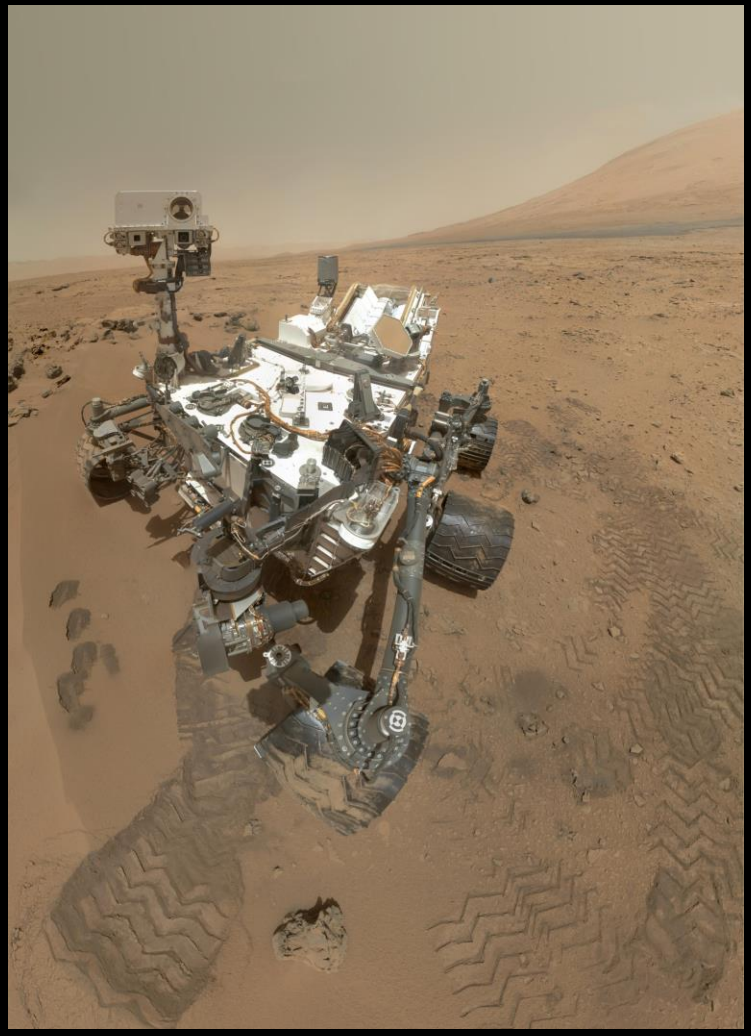
What would you do different?

# Curiosity Rover (Launched: Nov 26, 2011)

Image credit: NASA/JPL-Caltech

# Landed in Gale Crater in August 5, 2012
# Mount Sharp in the crater





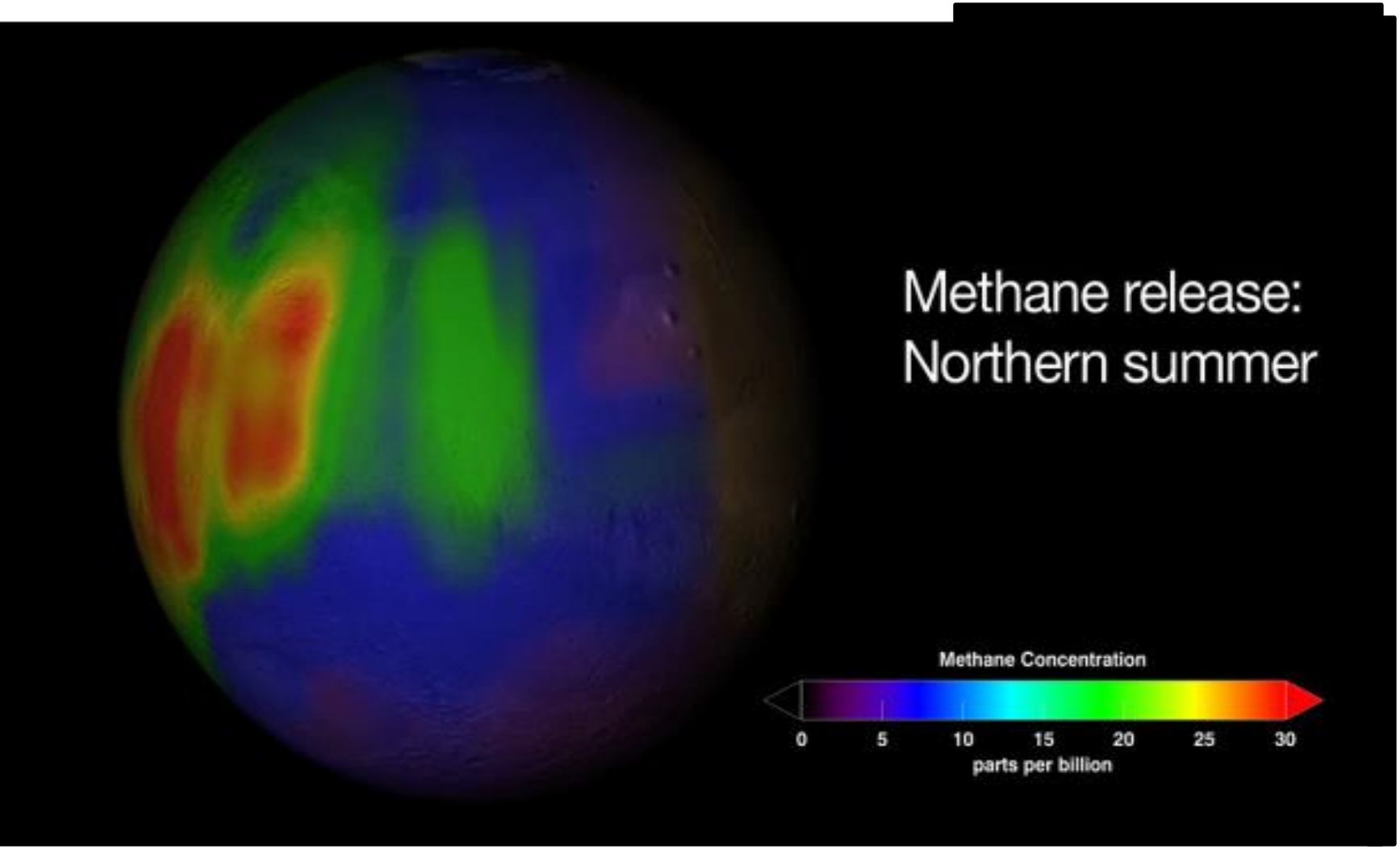
## Sedimentary Layers at Yellow Knife Bay

Water in soil

Pebbles – Remnants of an ancient streambed on Mars

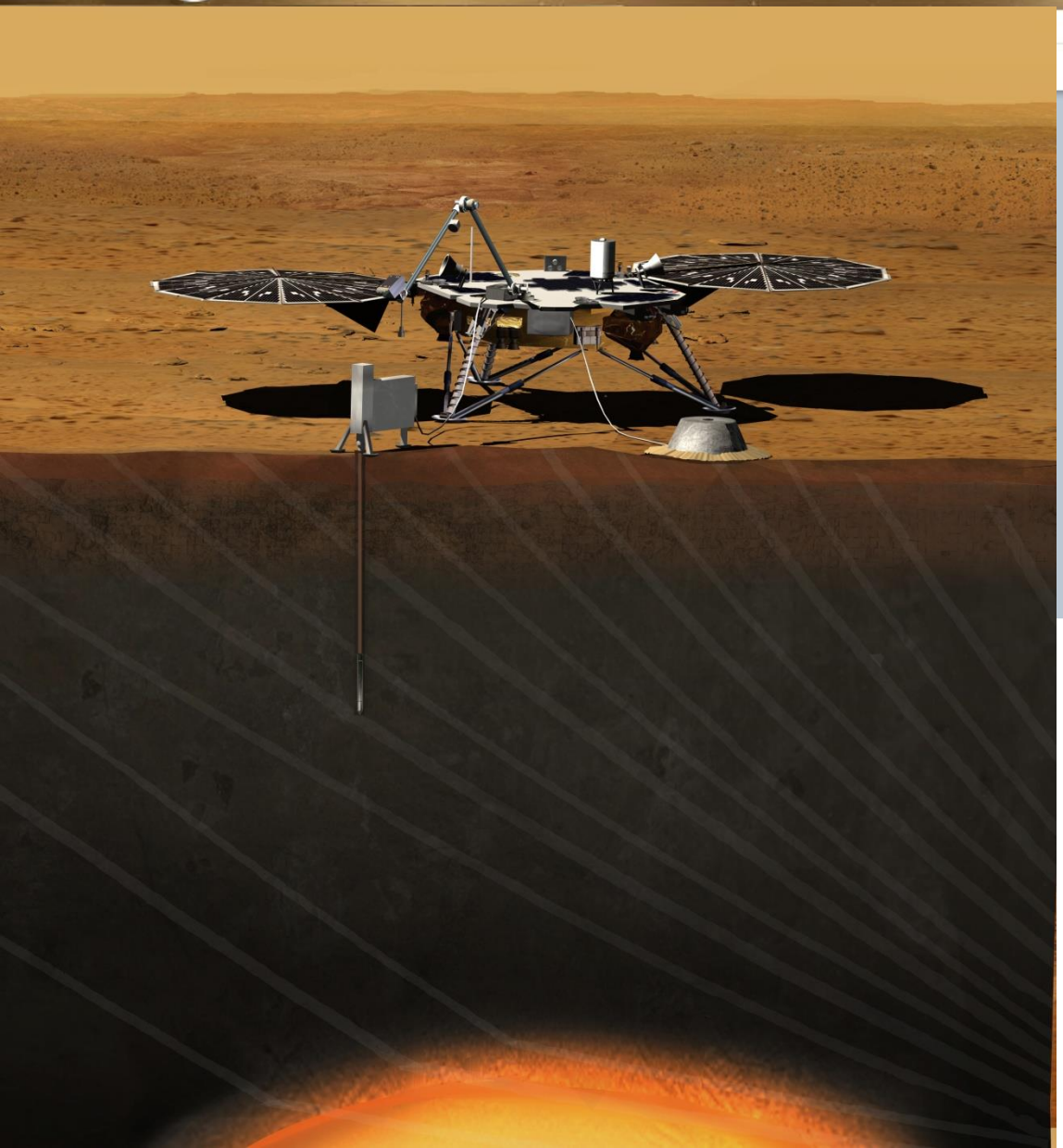
Curiosity is now on a one year journey to the base of Mount Sharp, about 5 miles away

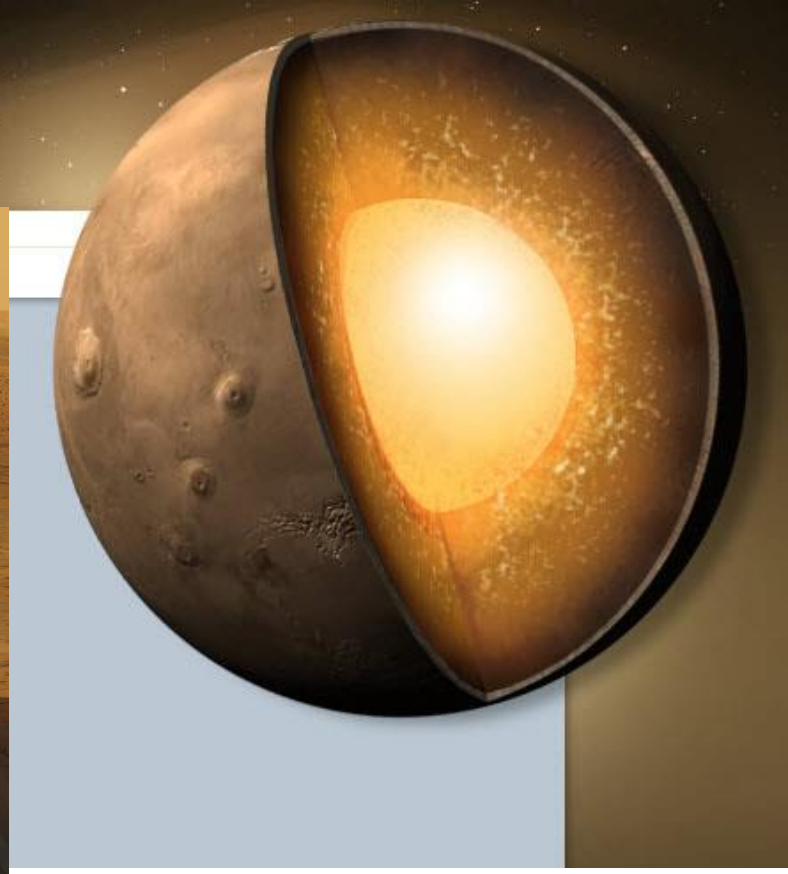

Image credit: NASA/JPL-Caltech


Methane release:
Northern summer
Methane Concentration
0
5
10
15
20
25
30
parts per billion

# InSight

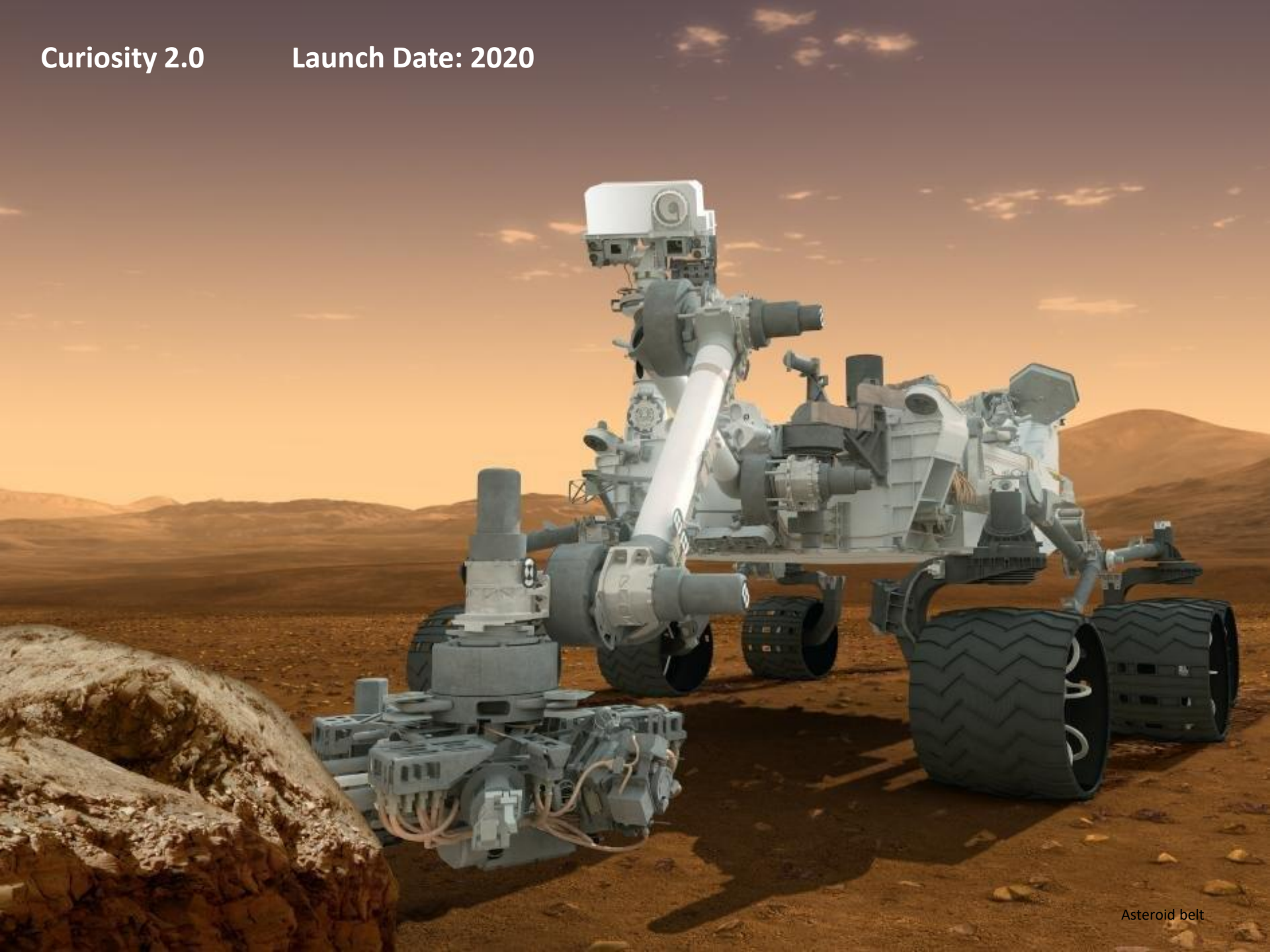
... into the early evolution of terrestrial planets.





- Launch:  March, 2016
- Landing: Sept 20, 2016
- Surface Operations
  - 1 Martian year (720 days)
- Seismic Exp. for Interior Structure
- Heat Flow & Physical Properties

**Curiosity 2.0** **Launch Date: 2020**



Asteroid belt