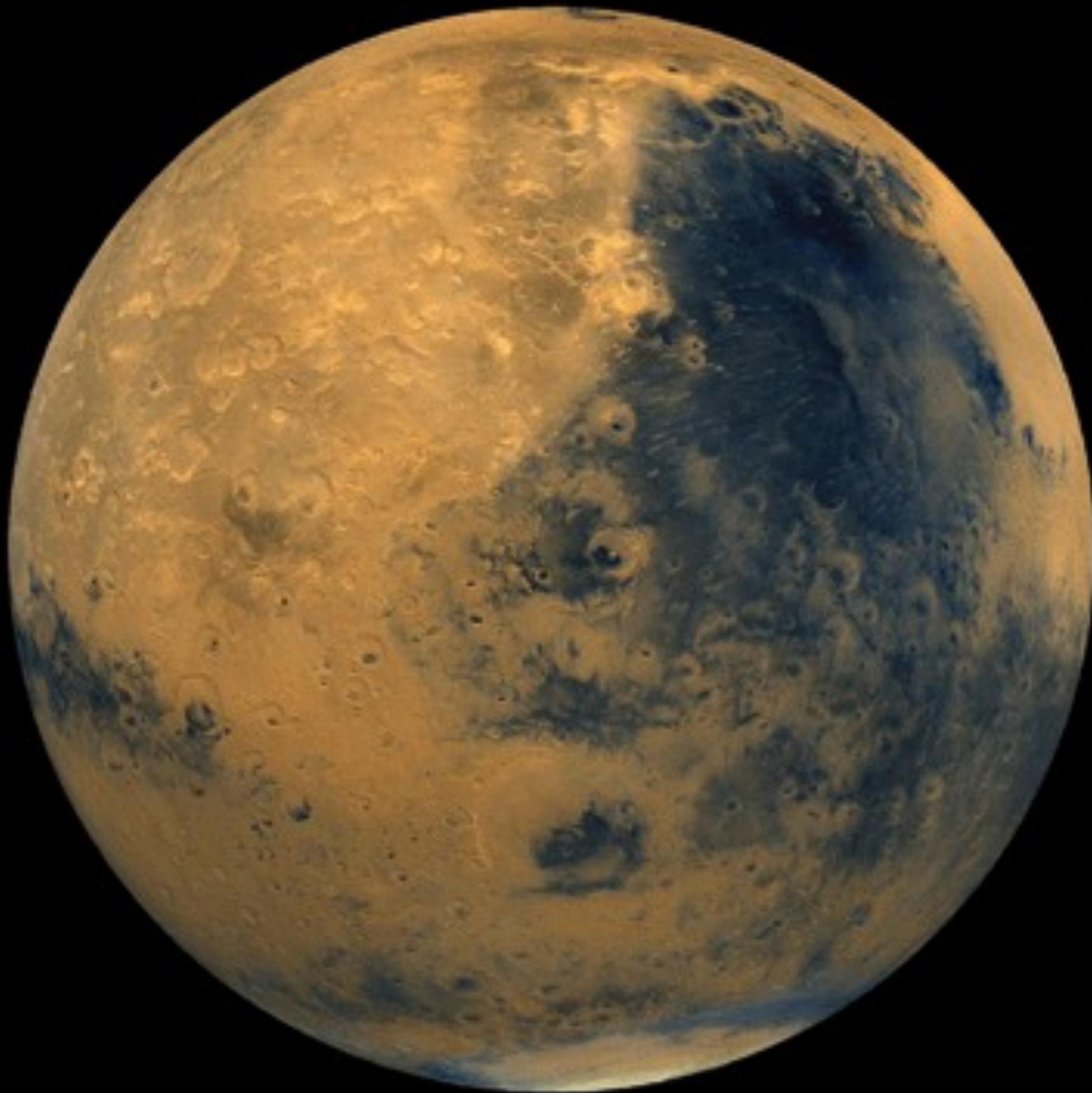




WATER ON MARS

We have found it.

Mars – telescope view

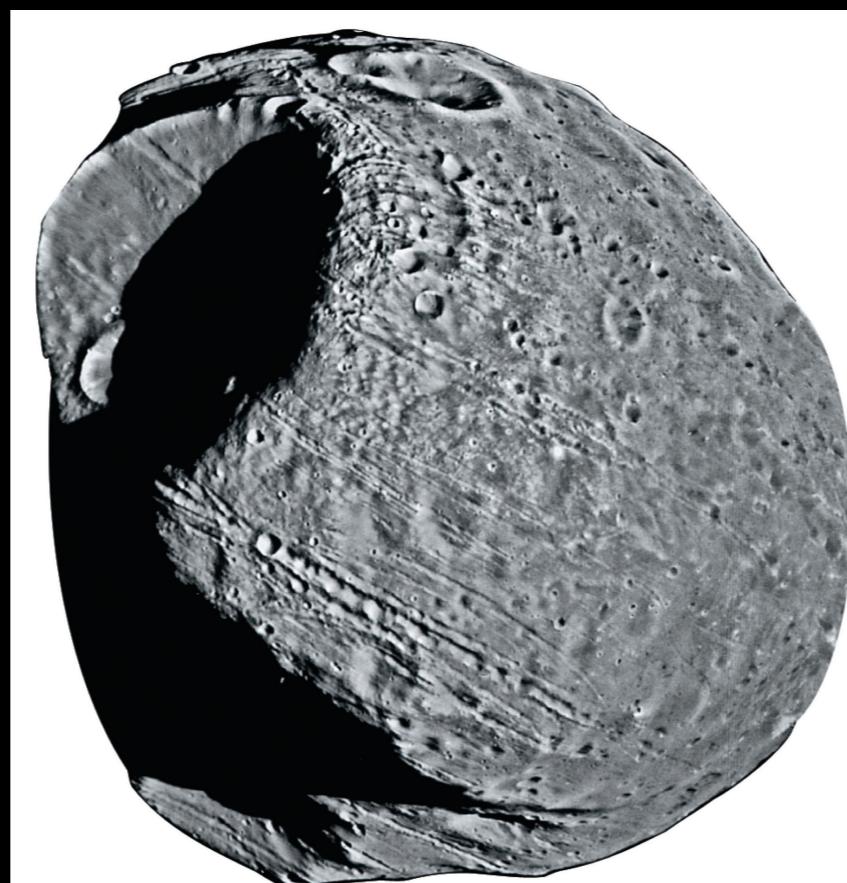


Basic facts about Mars

- About half of Earth's size, but only 1/10th the mass.
Therefore, Mars has only 71% of the density of Earth.
- The Red Planet is about 1.5AU from the Sun.
- Mars has 38% of the gravity that we experience on Earth.
If you weigh 100 lbs here, you weigh 38 lbs there!
- The Mars year is almost twice as long as an Earth year.

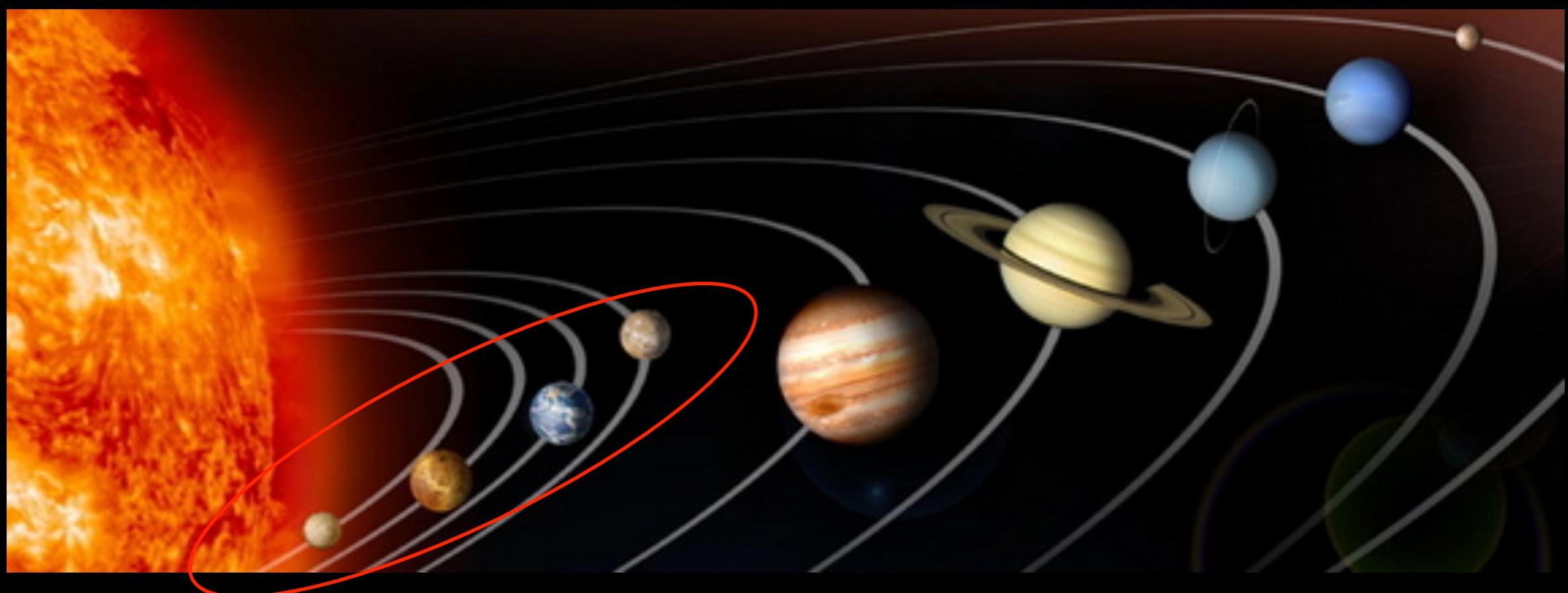
The Moons of Mars

- Unlike Mercury or Venus, Mars has moons.
 - Phobos is $28 \times 23 \times 20$ km in diameter.
 - Deimos is $16 \times 12 \times 10$ km in diameter.



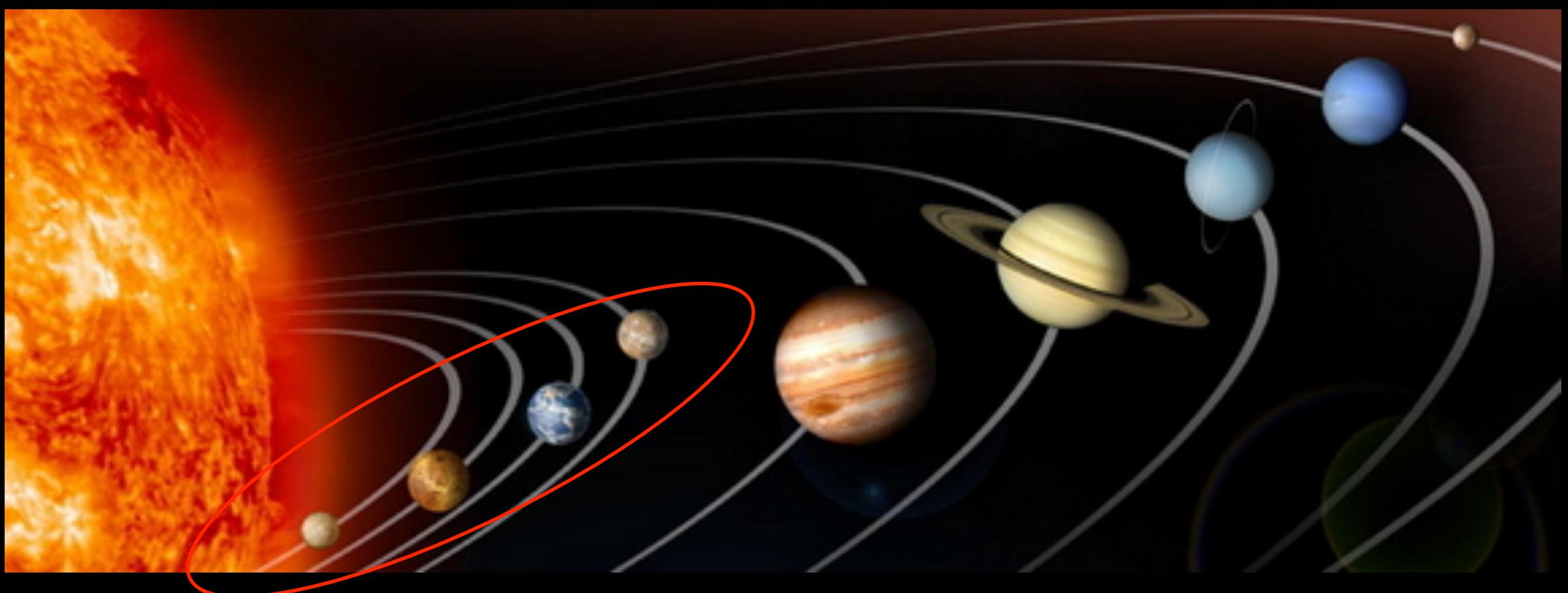
There are multiple aspects of **terrestrial** (or rocky) planets we will focus on

- 1) Interiors
- 2) Surfaces
- 2) Atmospheres
- 3) Magnetic fields

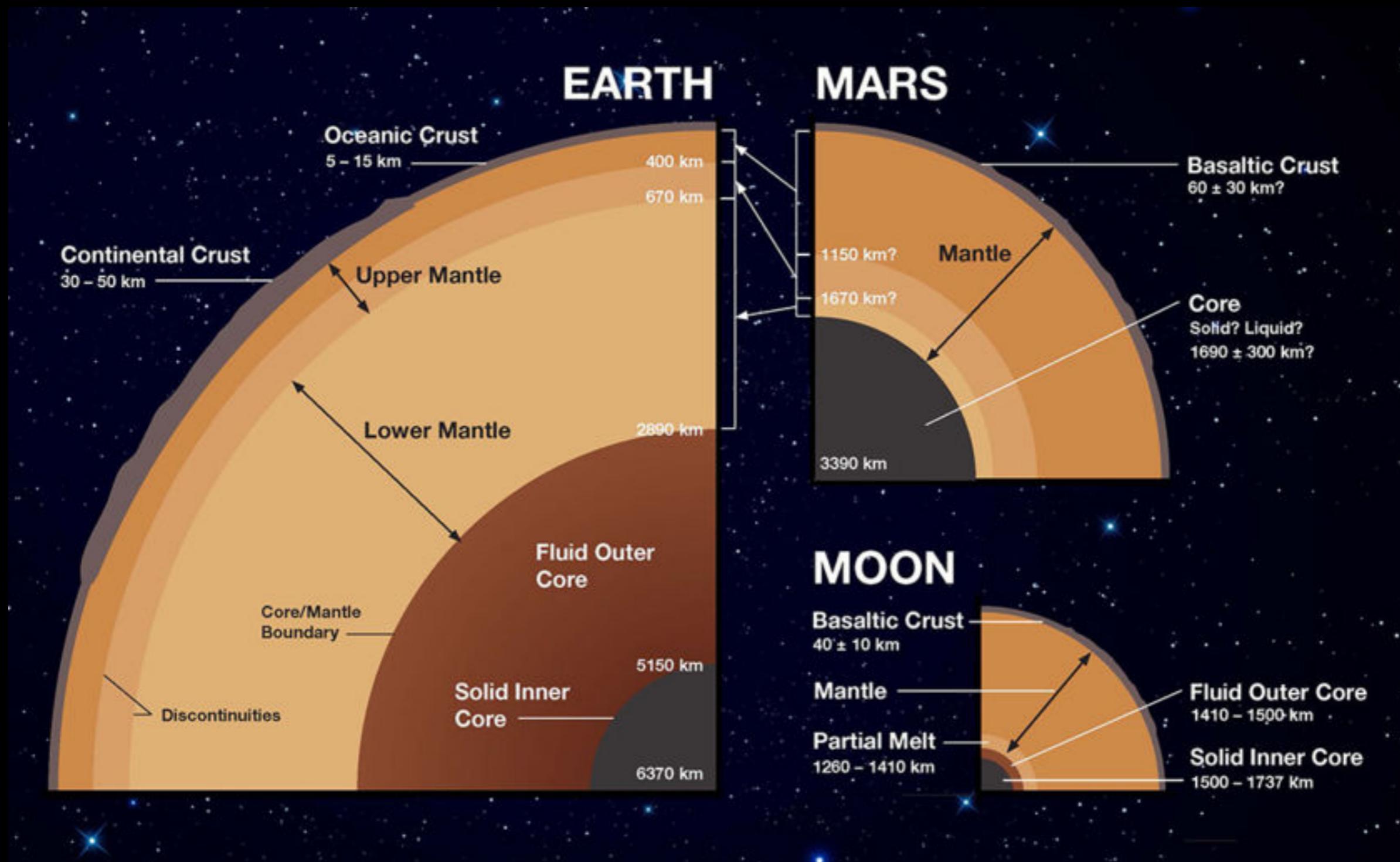


There are multiple aspects of Mars we will focus on

- 1) Interior
- 2) Surface
- 2) Atmosphere
- 3) ~~Magnetic field~~



Interiors



Mars' core may be similar to Earth's, but we're not yet sure.

Inside Planet MARS

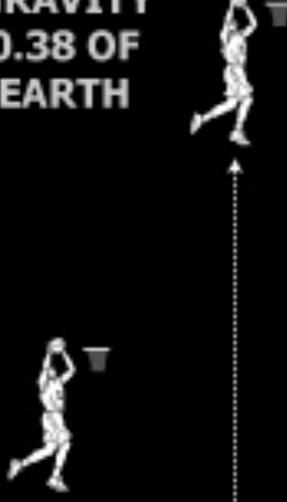
SPACE.
COM

Often visible as a reddish light in Earth's sky, Mars captured the imaginations of those who dream of space travel. The planet's thin atmosphere is hostile to human life, but Mars has many interesting geological features similar to those on Earth, such as volcanoes and canyons.

THIN ATMOSPHERE

95.32% carbon dioxide, 2.7% nitrogen, 1.6% argon, 0.13% oxygen, 0.08% carbon monoxide

GRAVITY
0.38 OF EARTH



EARTH	MARS
10 ft	26.3 ft
dunk	dunk

SURFACE CONDITIONS

AIR PRESSURE: 0.7% of Earth
AVERAGE TEMPERATURE:
-67°F (-55°C)



Martian sunset photographed by the Spirit rover at Gusev crater in 2005

LIQUID IRON-SULPHUR CORE

MANTLE
CRUST

POSSIBLE SOLID INNER CORE



Mars, 4,222 mi (6,794 km) in diameter, is slightly over half the size of Earth

Atmosphere

MARS FACTS / ATMOSPHERE

OVER 100 TIMES DENSER THAN MARS' ATMOSPHERE



Earth

- 78% NITROGEN
- 21% OXYGEN
- 1% OTHER

- 96% CARBON DIOXIDE
- <2% ARGON
- <2% NITROGEN
- <1% OTHER



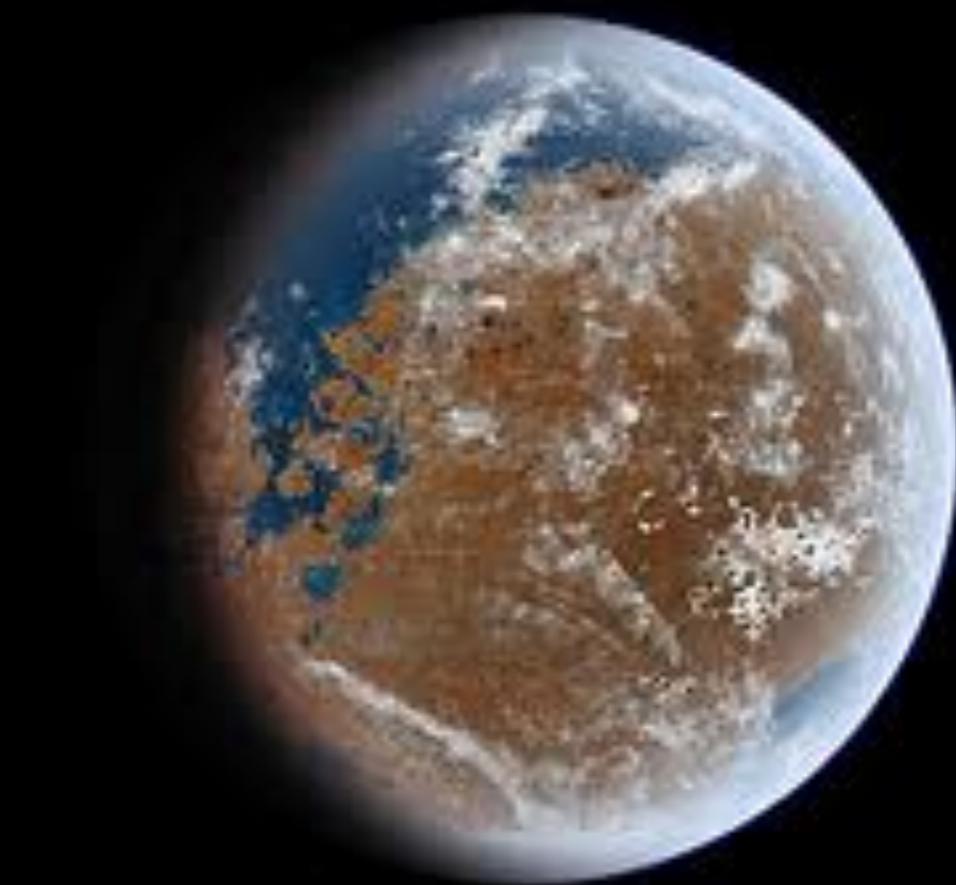
Mars

#JOURNEYTOMARS
mars.nasa.gov

- Mars' atmosphere is similar to the composition of air on Venus.
- However, the Martian atmosphere is very thin.
 - It is less than 1 percent as dense as Earth's atmosphere.
 - It is $1/10,000$ as dense as Venus's.
- Very little water
- But it *can* have high winds at times!



- The climate on Mars has changed as the atmosphere gradually became thinner.
 - Atmospheric gases and water were lost to space-“runaway refrigerator effect.”
 - The volcanic activity that could have replaced them had nearly stopped

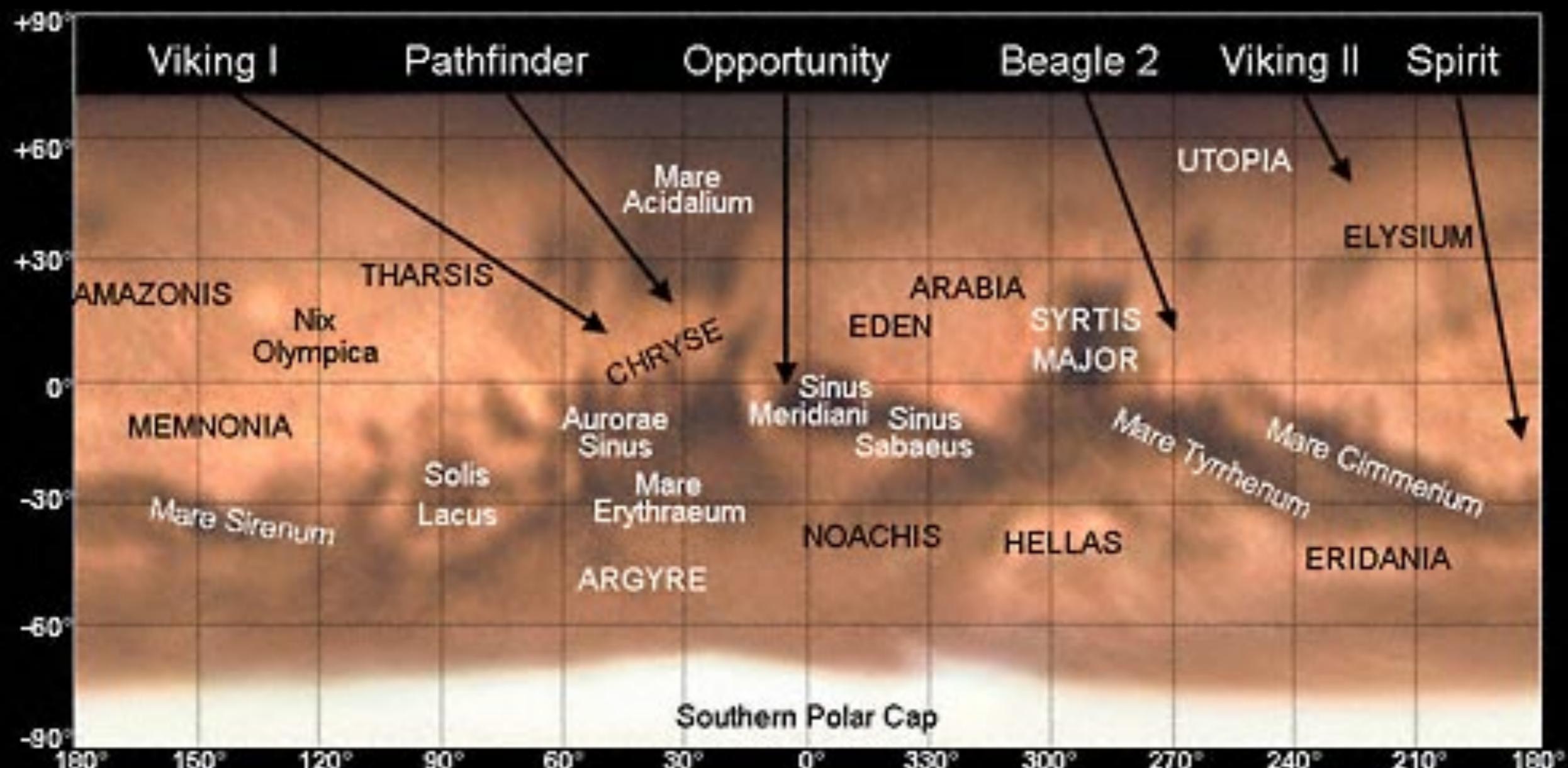


Runaway refrigerator effect

- Mars was probably warmer in the past (greenhouse effect)
- But it has low gravity, so molecules in its atmosphere can easily escape to space.
- Loss of atmosphere → less greenhouse heating → remaining water freezes
- Mars likely became cold and dry within a billion years of its formation

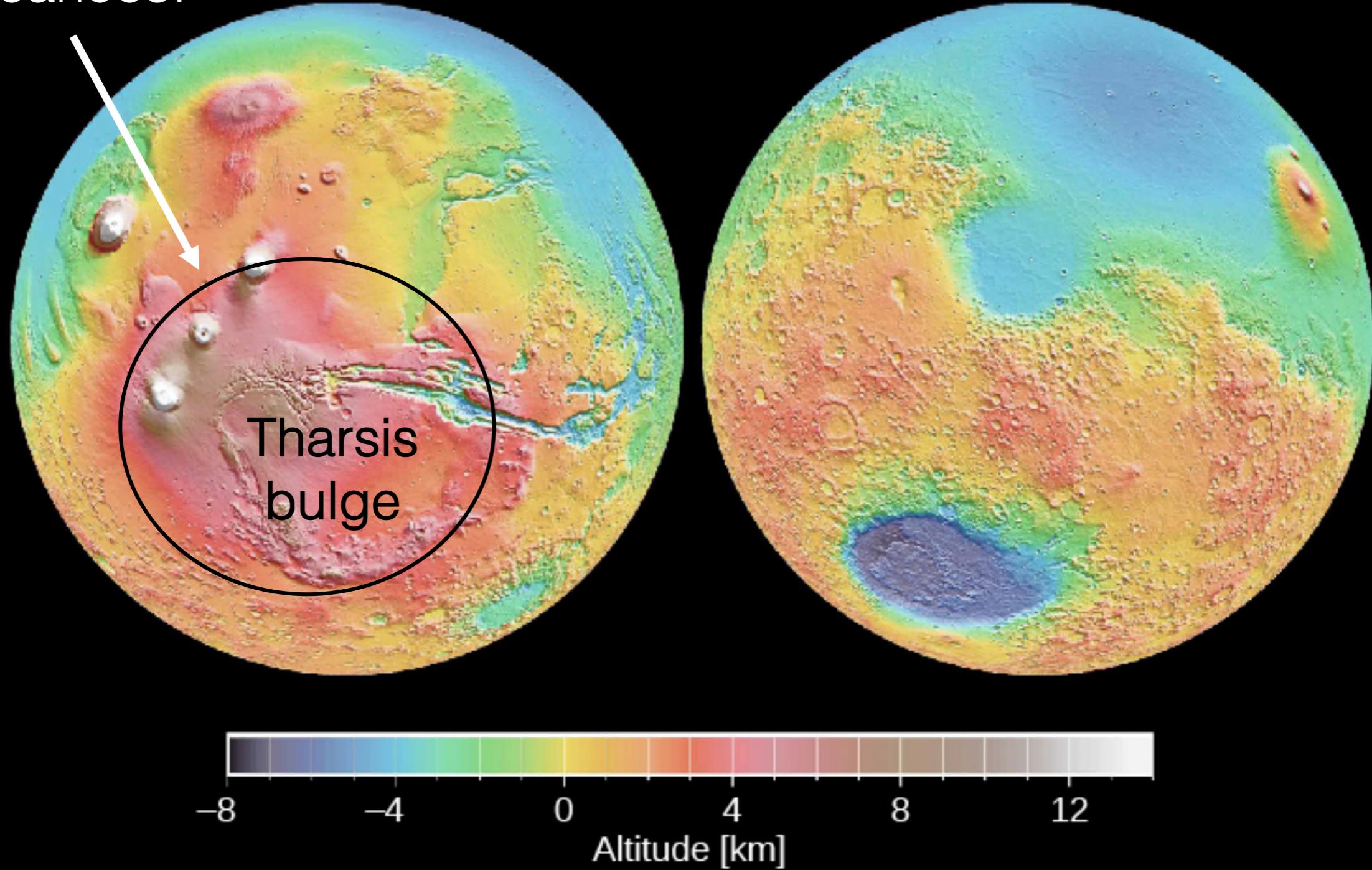


The Surface of Mars



Mars – radar view

volcanoes!

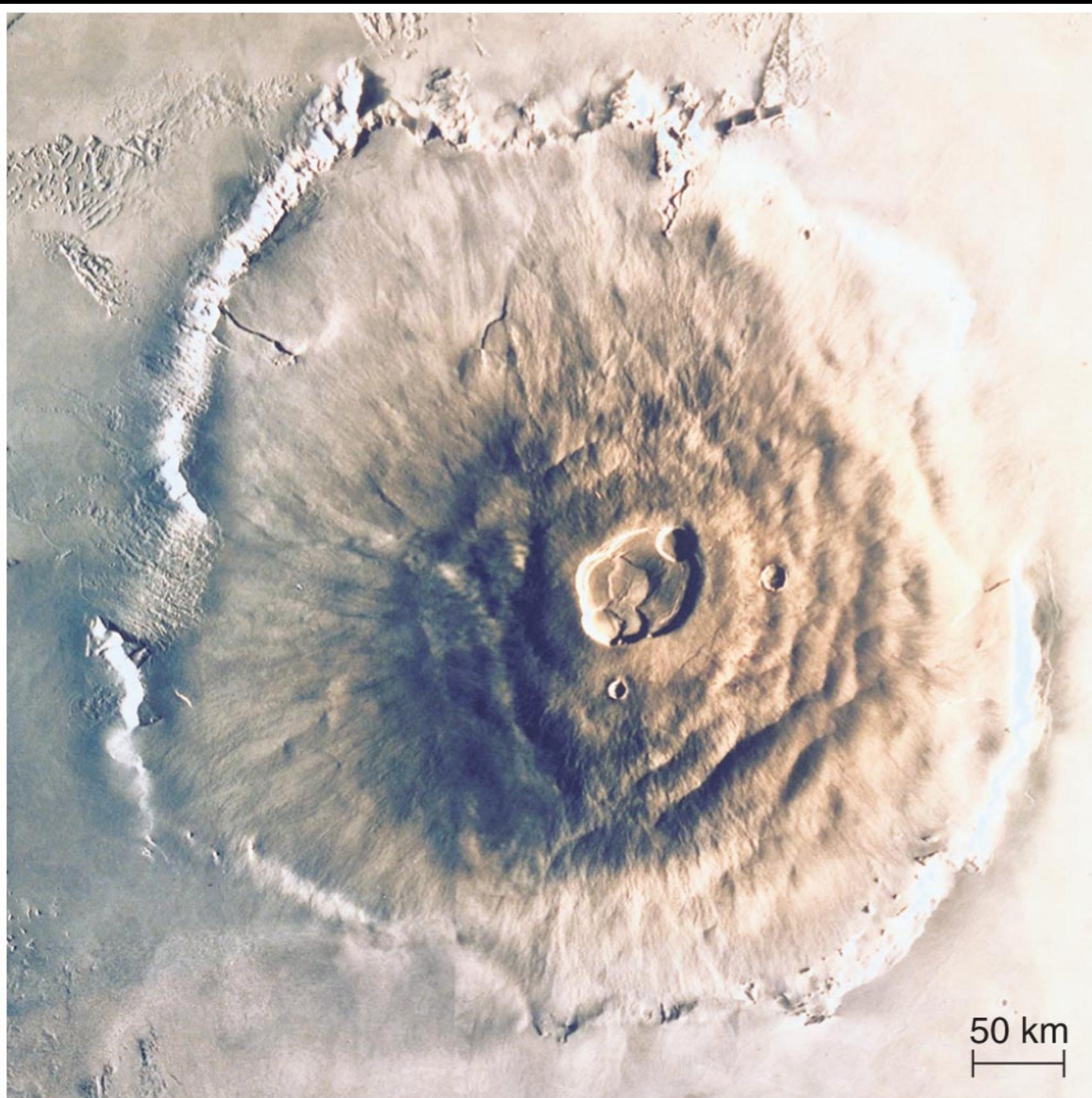


Older highlands and younger, lower plains

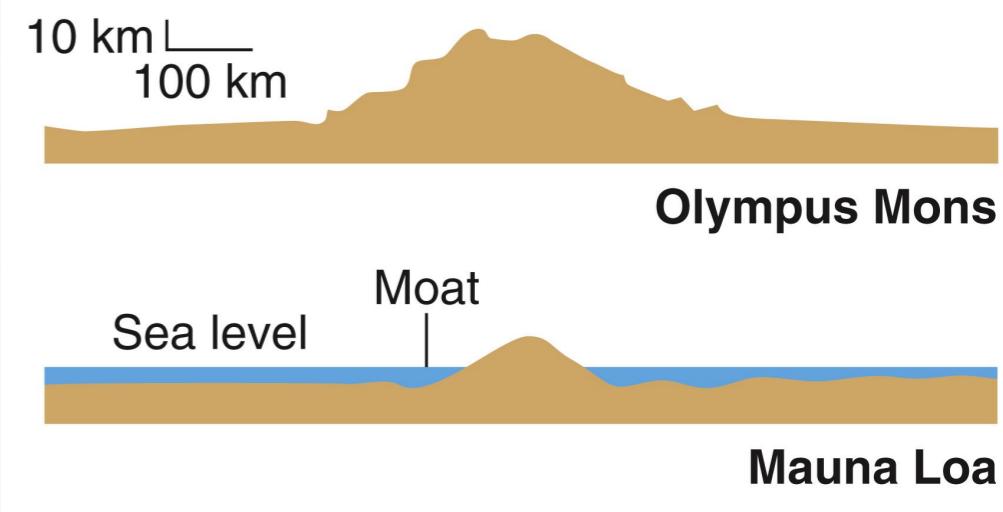
Volcanic activity

- The youngest surfaces of Mars were produced by flowing lava that cooled (similar to the lunar maria)
- Most prominent volcanoes in the Tharsis region, but smaller volcanoes all over the surface
- The freshest lava flows are “only” 100 million years old- could some of the volcanoes become active today??

Olympus Mons volcano

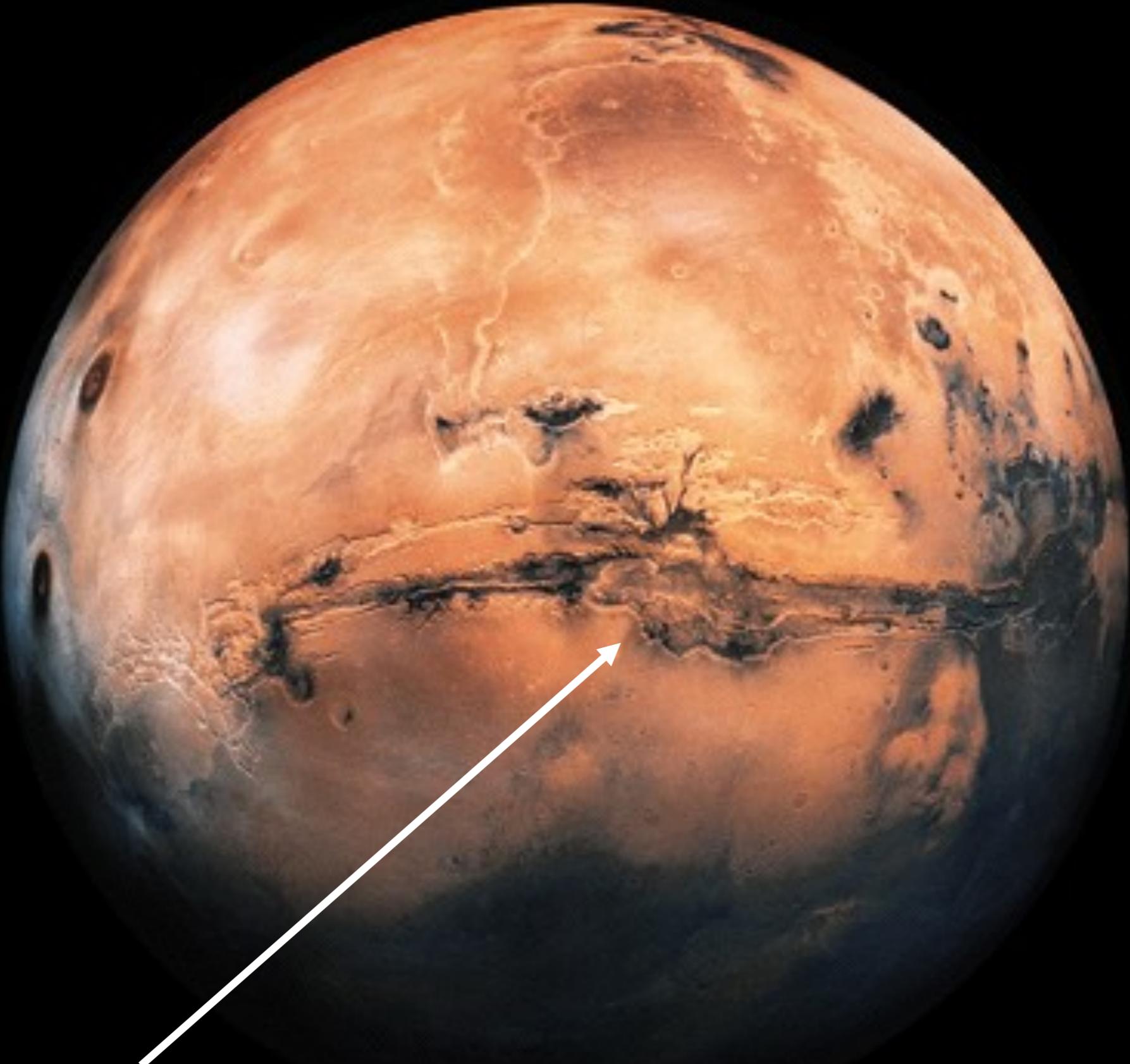


The size of Nevada
and 16 miles high!

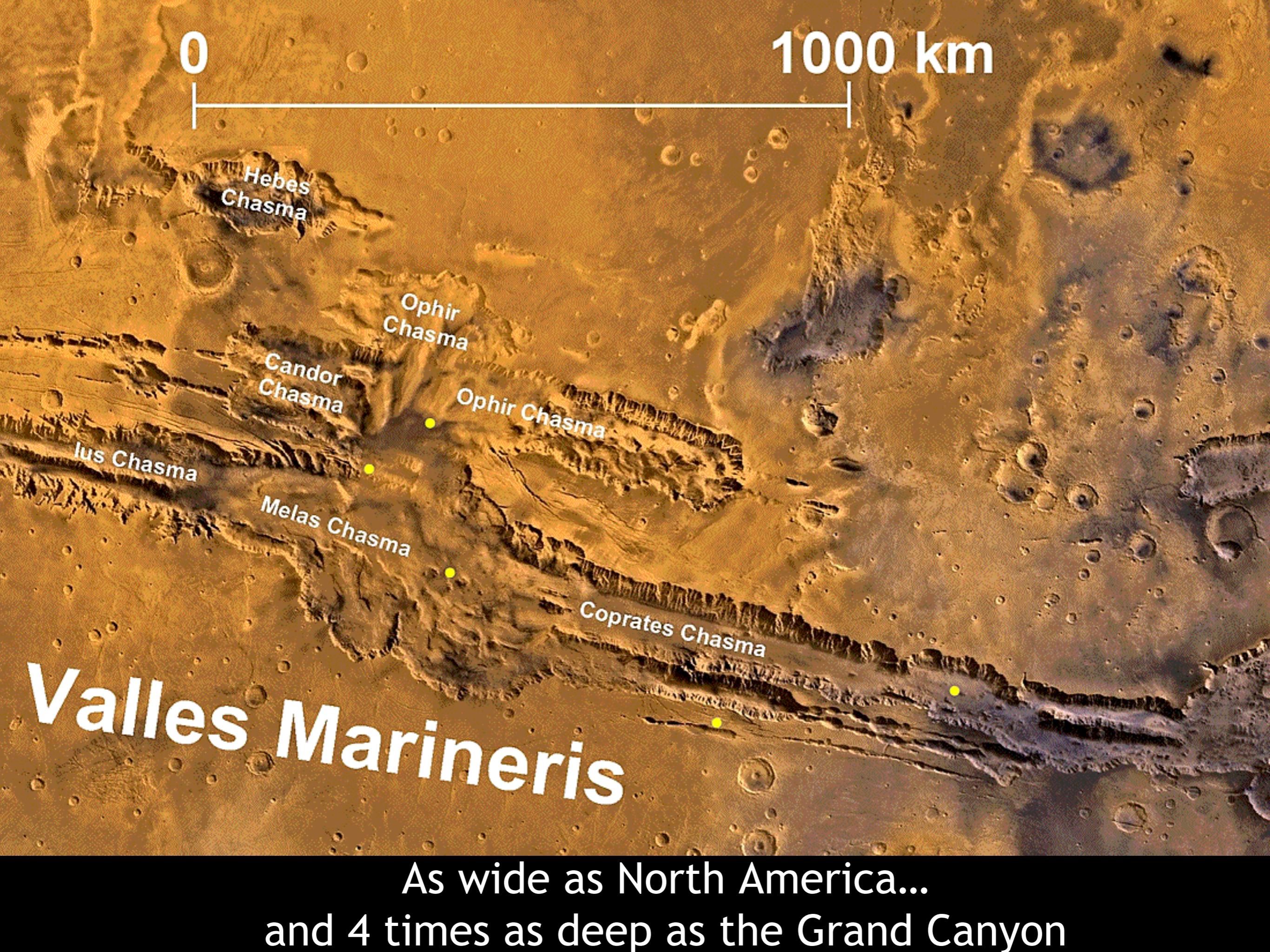


Tectonics

- Tectonic forces pushed some regions of Mars (e.g., Tharsis bulge) upward
- They also created canyon-like features that are thousands of kilometers long
- Most prominent volcanoes in the Tharsis region, but smaller volcanoes all over the surface
- Less tectonic features visible than on Venus because wind has redistributed some of the surface layers.



Valles Marineris is as big as the entire United States



0

1000 km

Hebes
Chasma

Ophir
Chasma

Candor
Chasma

Ophir
Chasma

Ius Chasma

Melas Chasma

Coprates Chasma

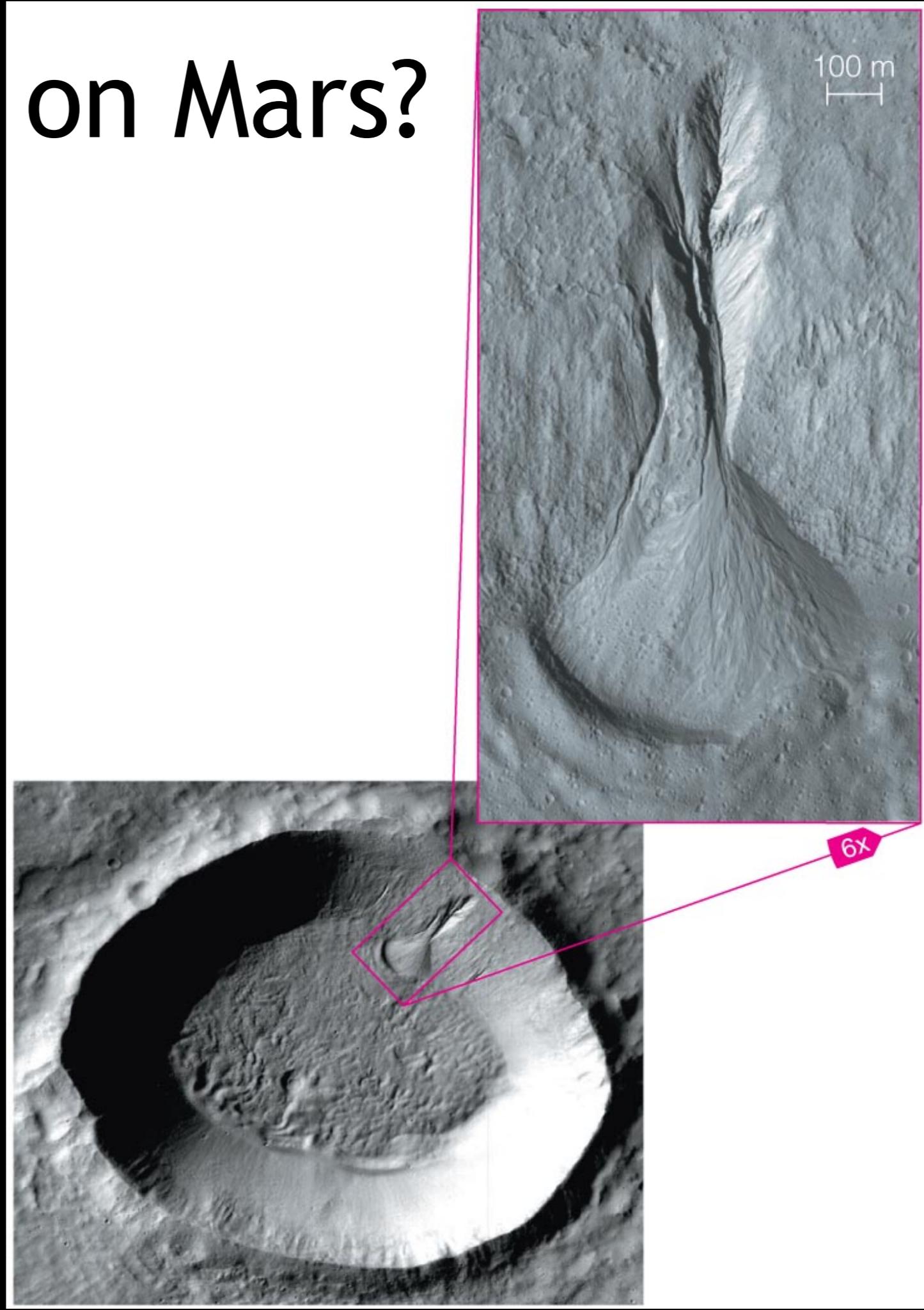
Valles Marineris

As wide as North America...
and 4 times as deep as the Grand Canyon

Water on Mars?

YES and NO...

- Gullies on crater walls suggest occasional **liquid water** flows have happened less than a million years ago.
- Currently, we only see **water ice**

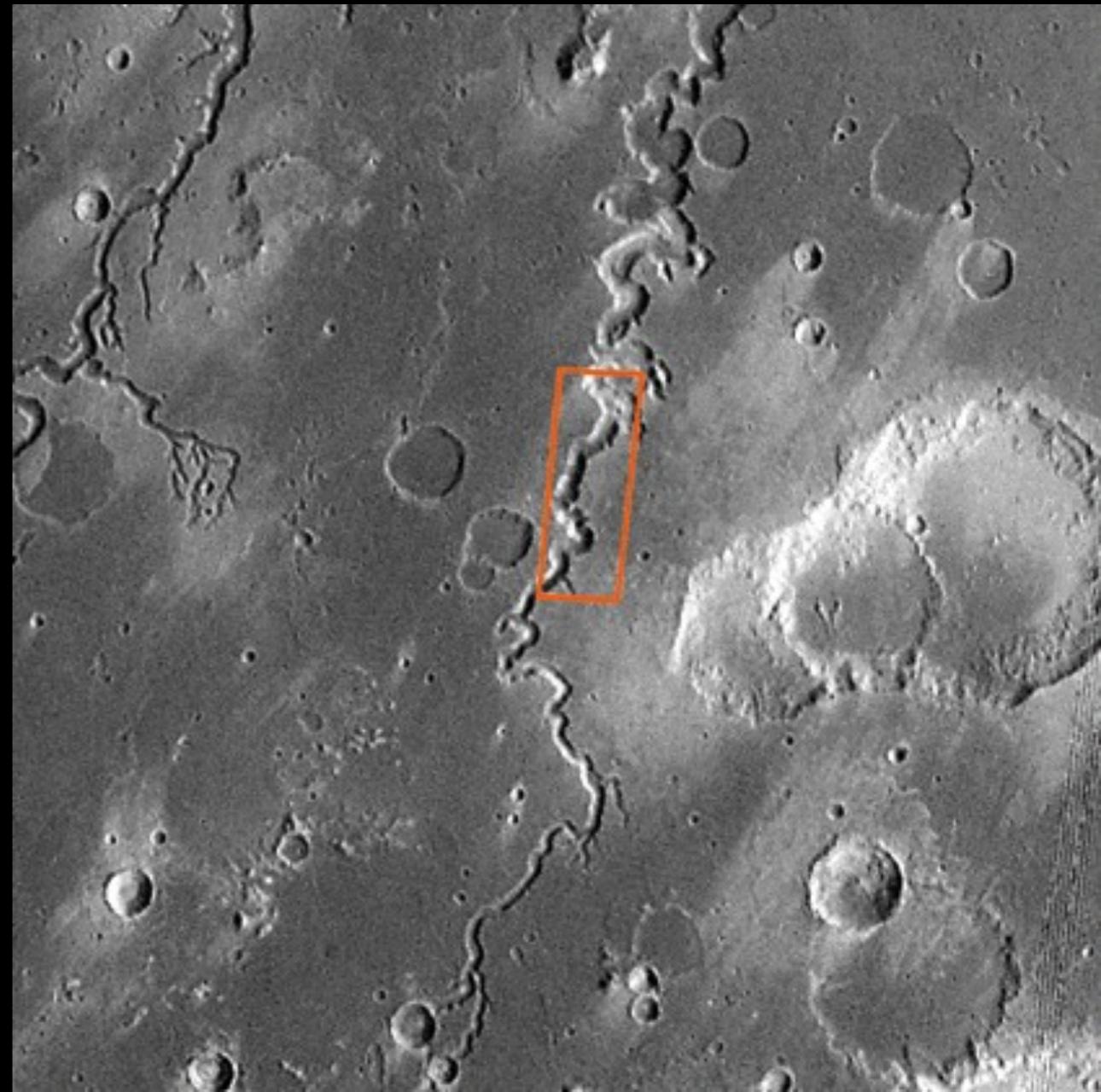


Surface features indicate that water once flowed on Mars.

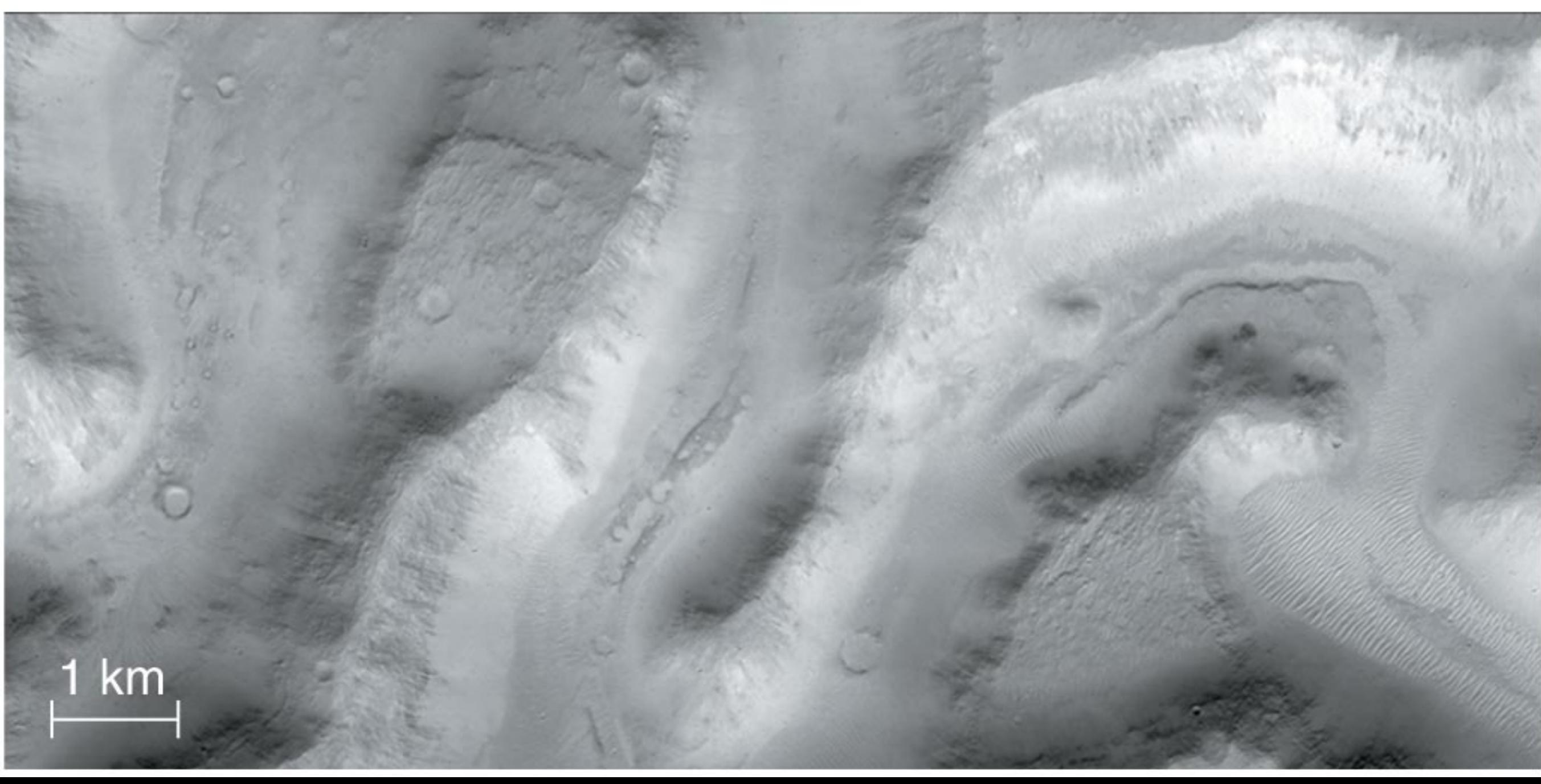


Ohio
River
valley
on
Earth

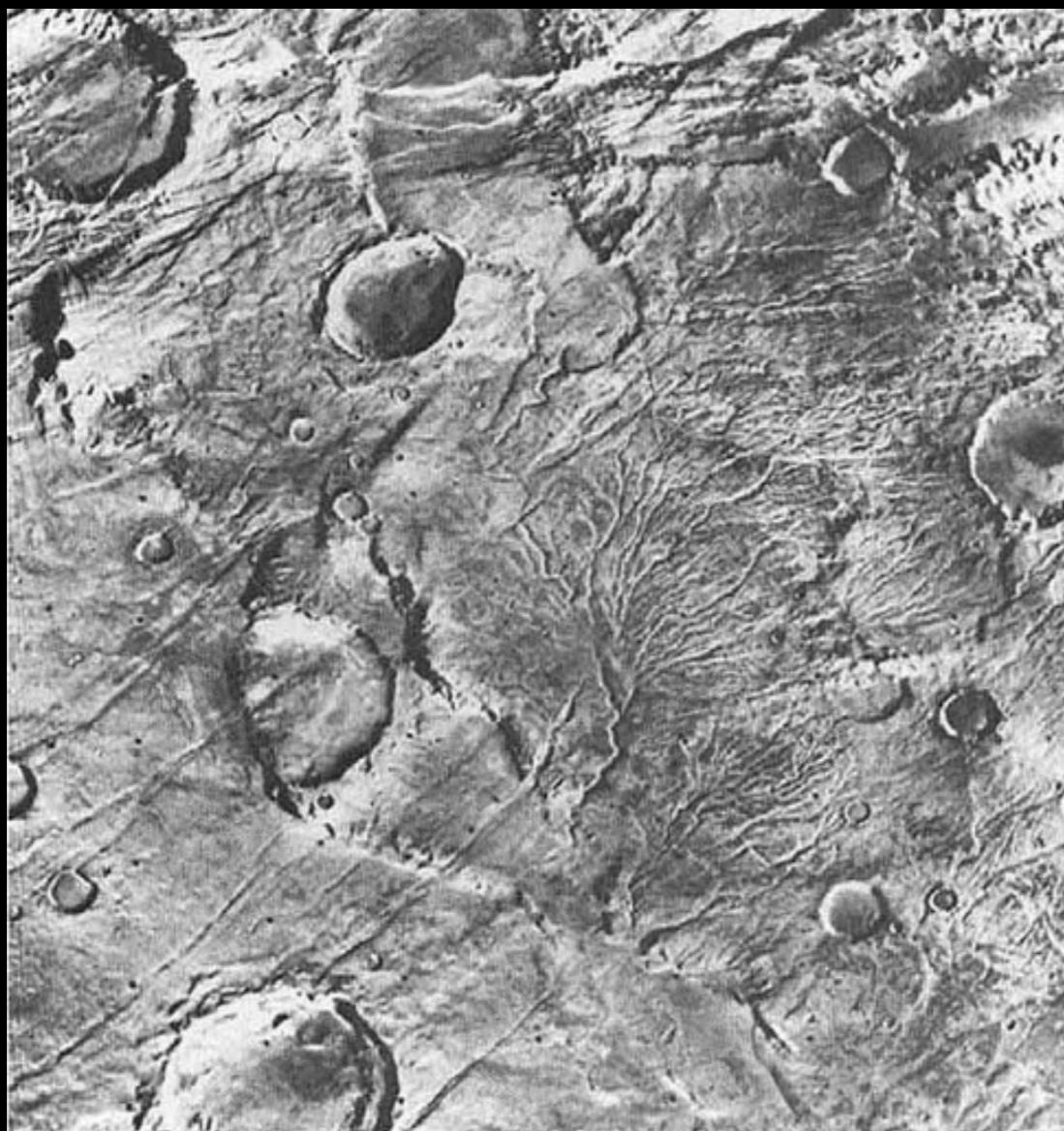
River
channels
on Mars



Close-up photos of Mars show what appear to be dried-up riverbeds.



Three types of watercourses



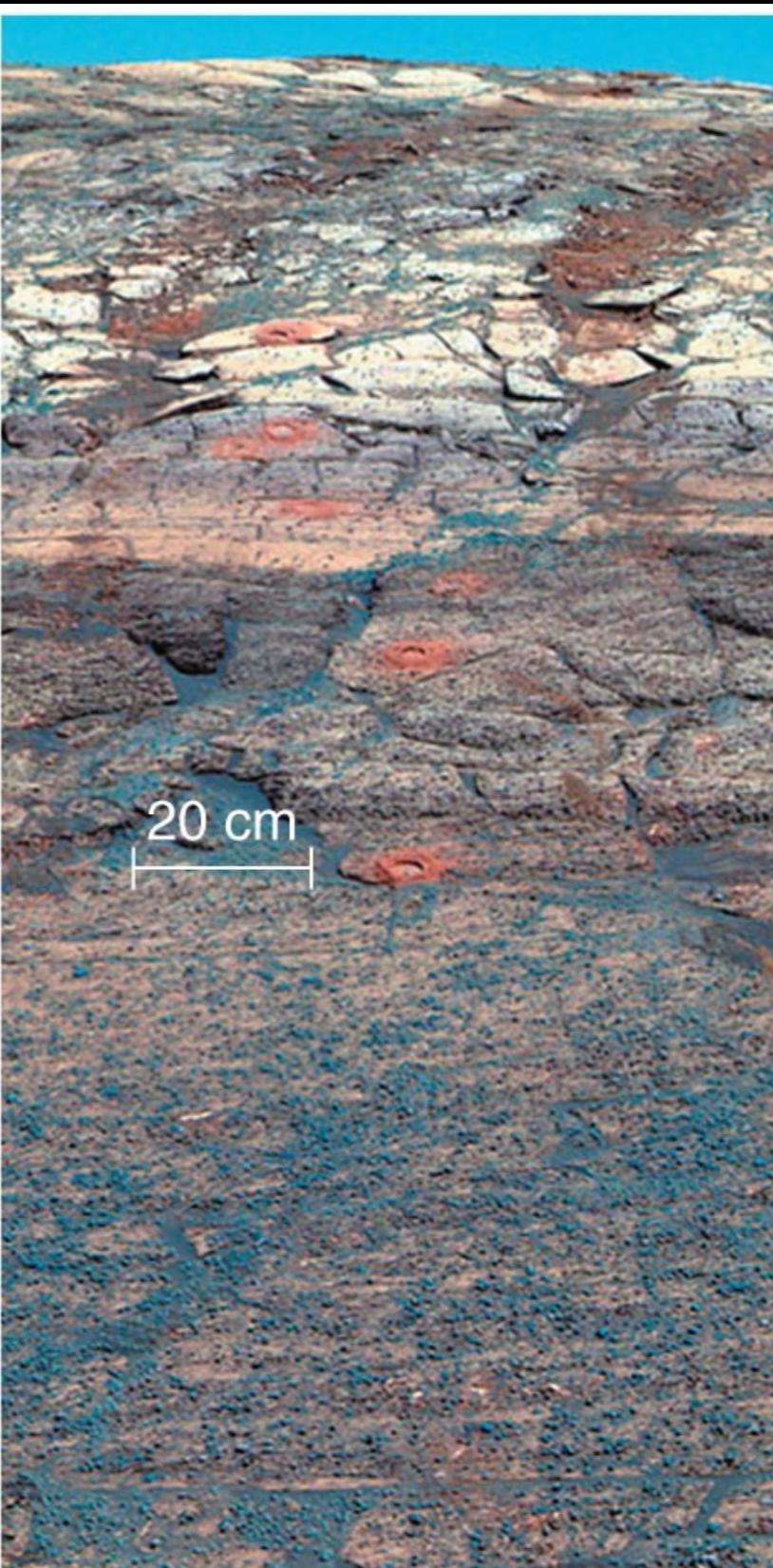
(a)



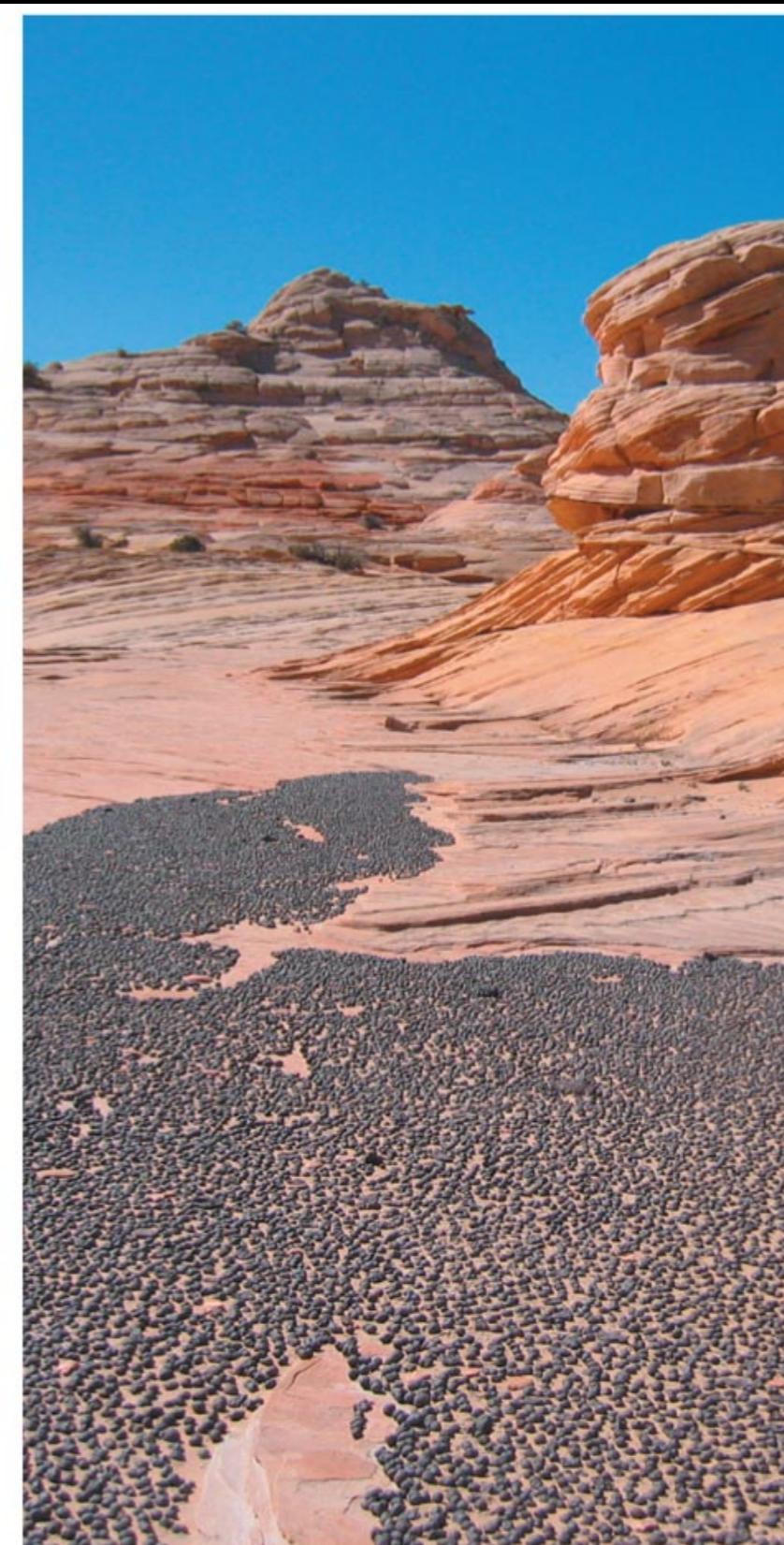
(b)

Run-off channels, outflow channels and gullies

Mars rovers have found rocks that appear to have formed in water.

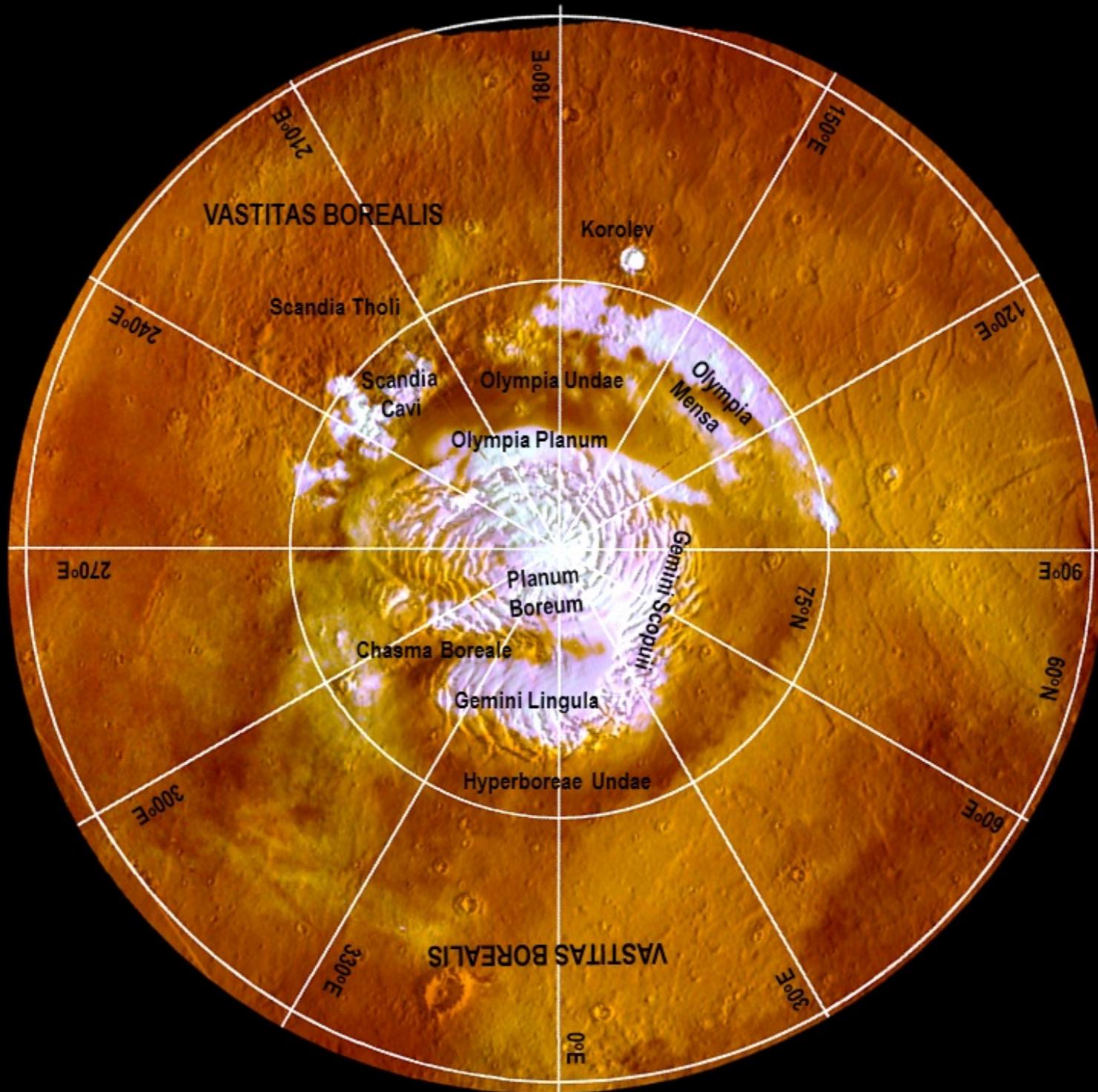


Mars (Endurance Crater)

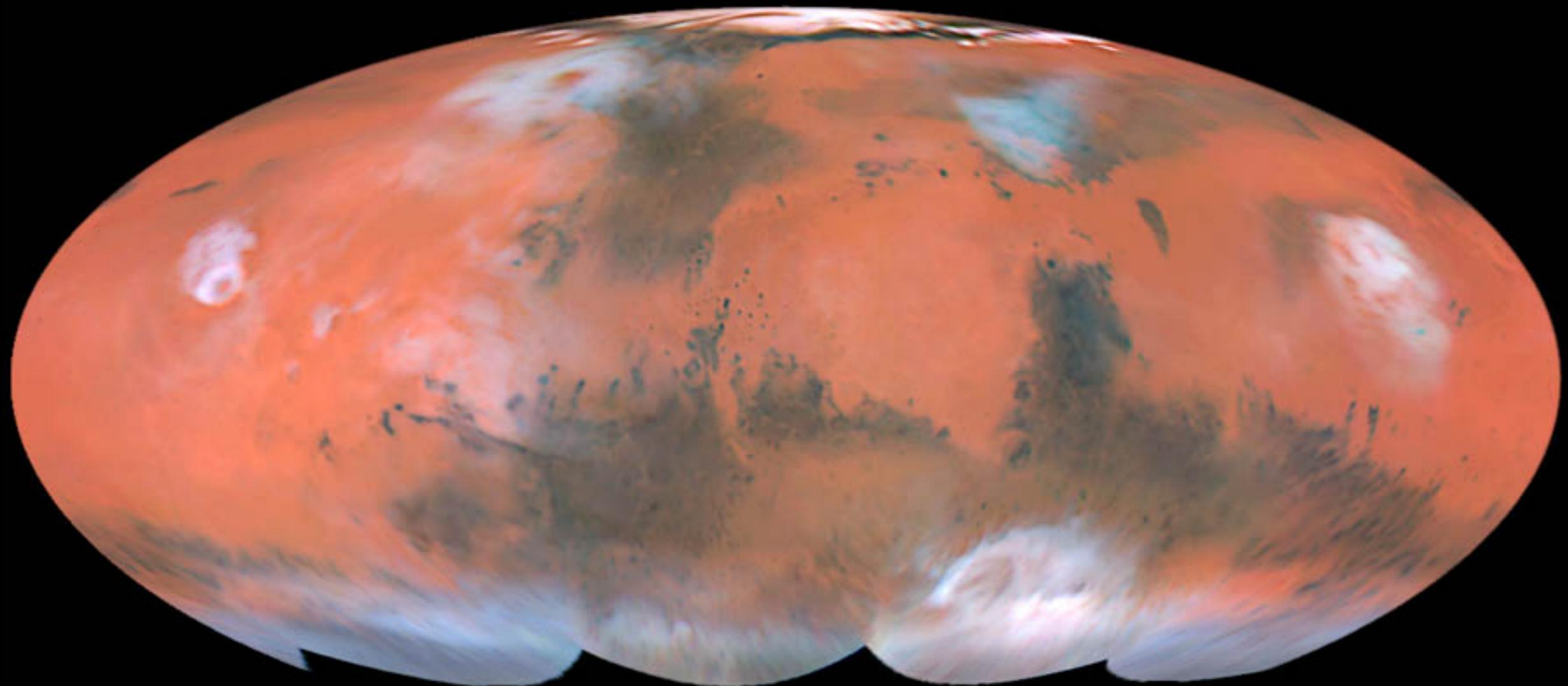


Earth (Utah)

Water ice at the north polar cap of Mars



Ice caps dominate the poles during different times of the year



Top 10 things to know about Mars

- 1) Furthest terrestrial planet from the Sun and 2nd smallest
- 2) Its home to the largest volcano in the Solar system - Olympus Mons, a shield volcano
- 3) Also home to the largest canyon - Valles Marineris
- 4) The Tharsis region is a bulge on the side caused by volcanic activity
- 5) Shows signs of PAST presence of liquid water
- 6) Has two polar caps made of water ice and dry ice (frozen CO₂)
- 7) Its atmosphere is currently composed of 95% CO₂, 3% N₂, 2% Ar, O and CO
- 8) Has been visited by multiple orbiting spacecraft, landing craft and rovers
- 9) Temperatures range from 70F in the summer (day on equator) to -200F in the winter
- 10) There has been NO clear evidence for life on this planet!

Property	Mercury	Venus	Moon	Earth	Mars
Atmosphere		X		X	X
Tectonics				active	dead
Craters	X	X	X	X	X
Magnetic Field	weak			X	gone
Weather		X		X	X
Volcanism	dead	active		active	dead
Erosion				X	X
Oddity	hot and cold	extreme greenhouse	we landed there	life	biggest volcano

