“A stroke from the brush does not guarantee art from the bristles.”

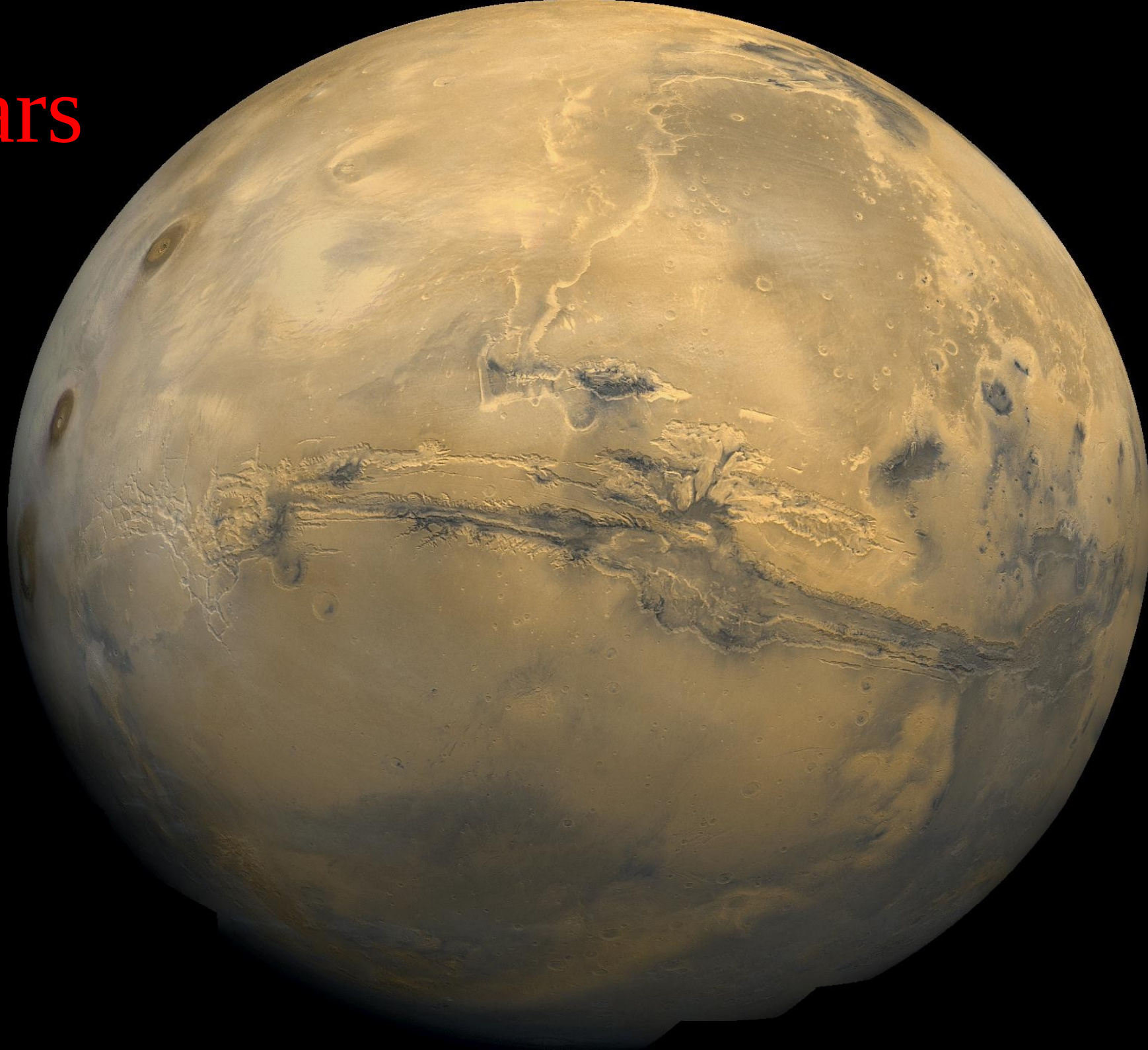
Kosh, Babylon 5

Test 1 is 2 weeks from today.

HW2 is on-line and due in 1 week

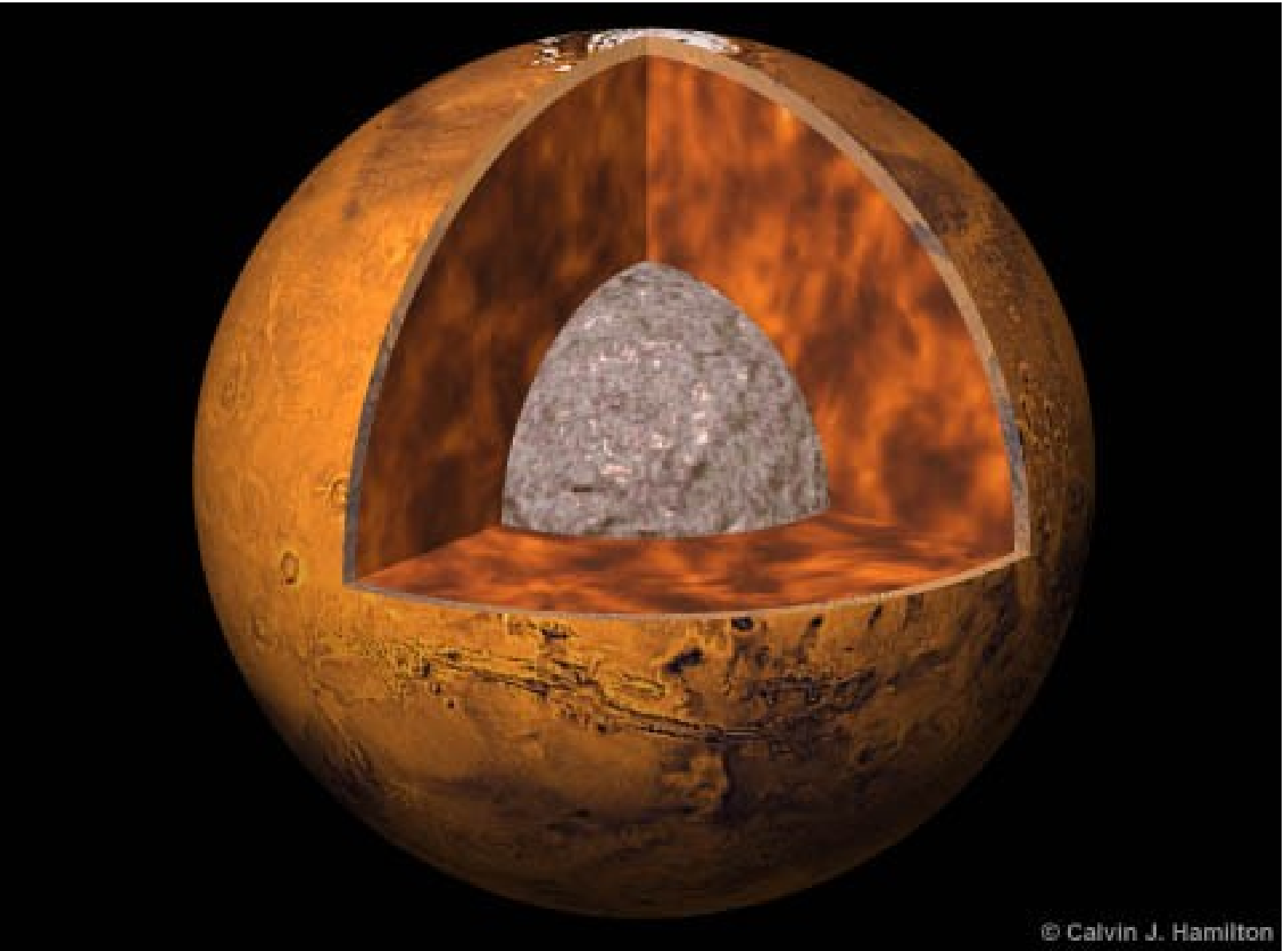
Quiz 1 scores updated on blackboard for those with ‘clicker’ issues.

Mars



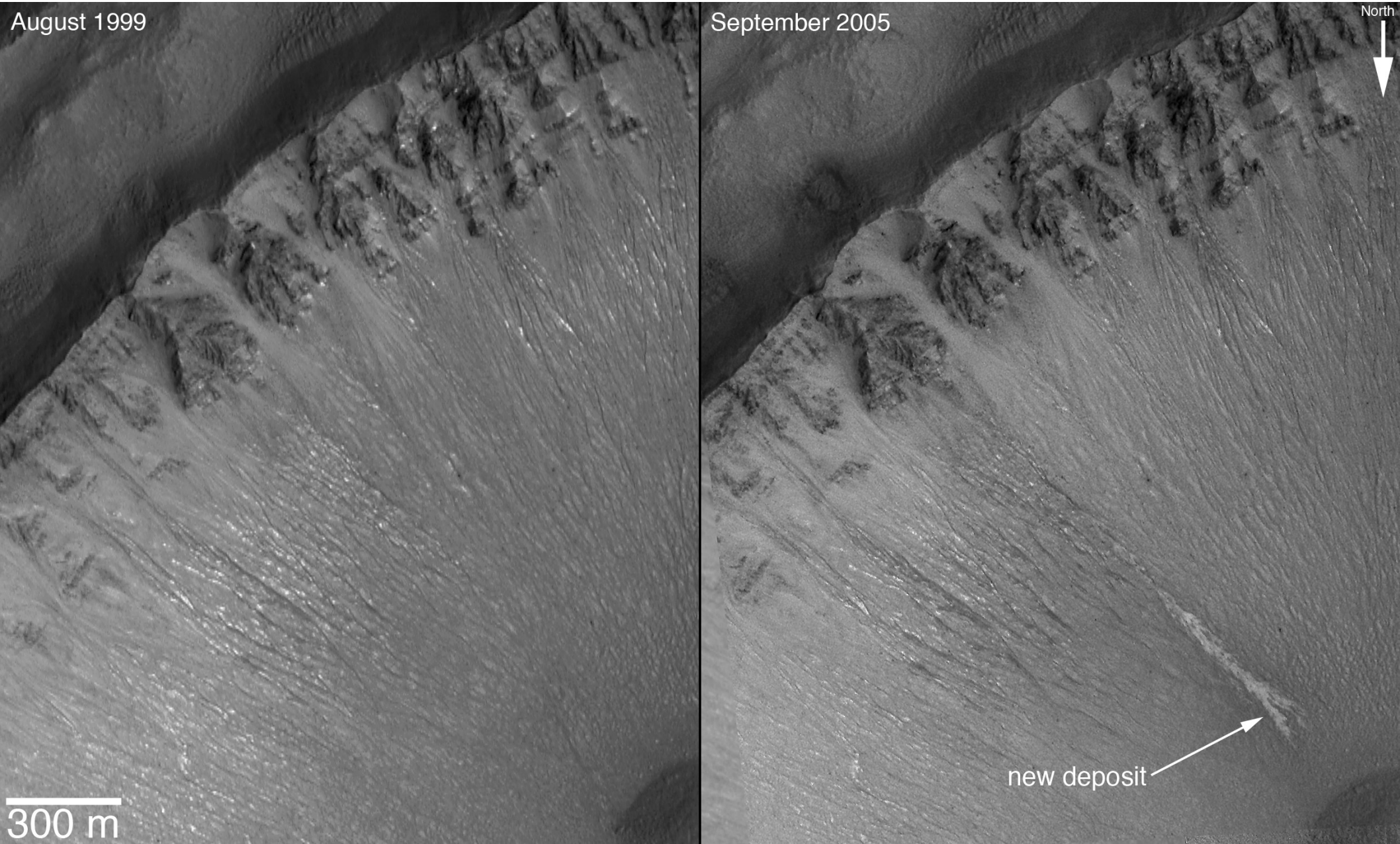
Mars interior:
1) Crust-
2) Mantle-
3) Core- All made of rock.

Mars' atmosphere is 95% CO_2 (like Venus, but much less dense)



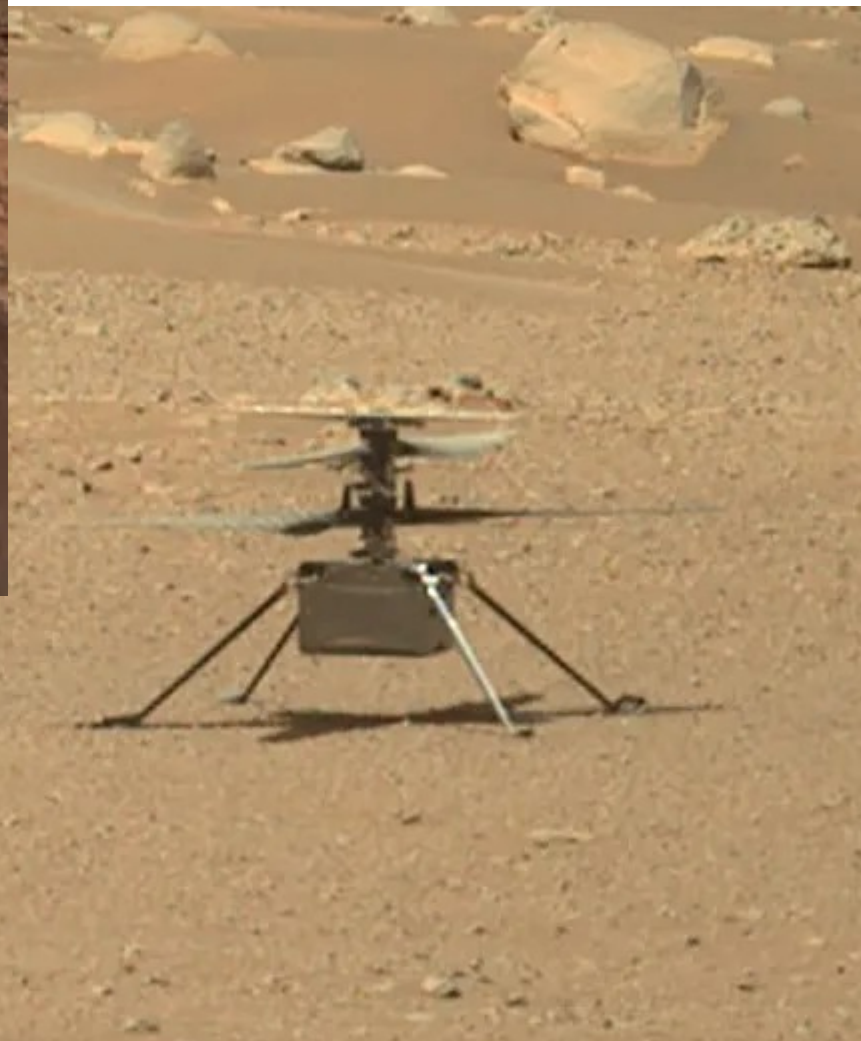
Density is 3.9 g/cc. (Earth=5.5 Moon=3.3)

Mars has underground aquifers, like Springfield.



Curiosity rover landed in August, 2012

Perseverance rover and Ingenuity helicopter arrived February 2021.
Ingenuity flew 73 times!

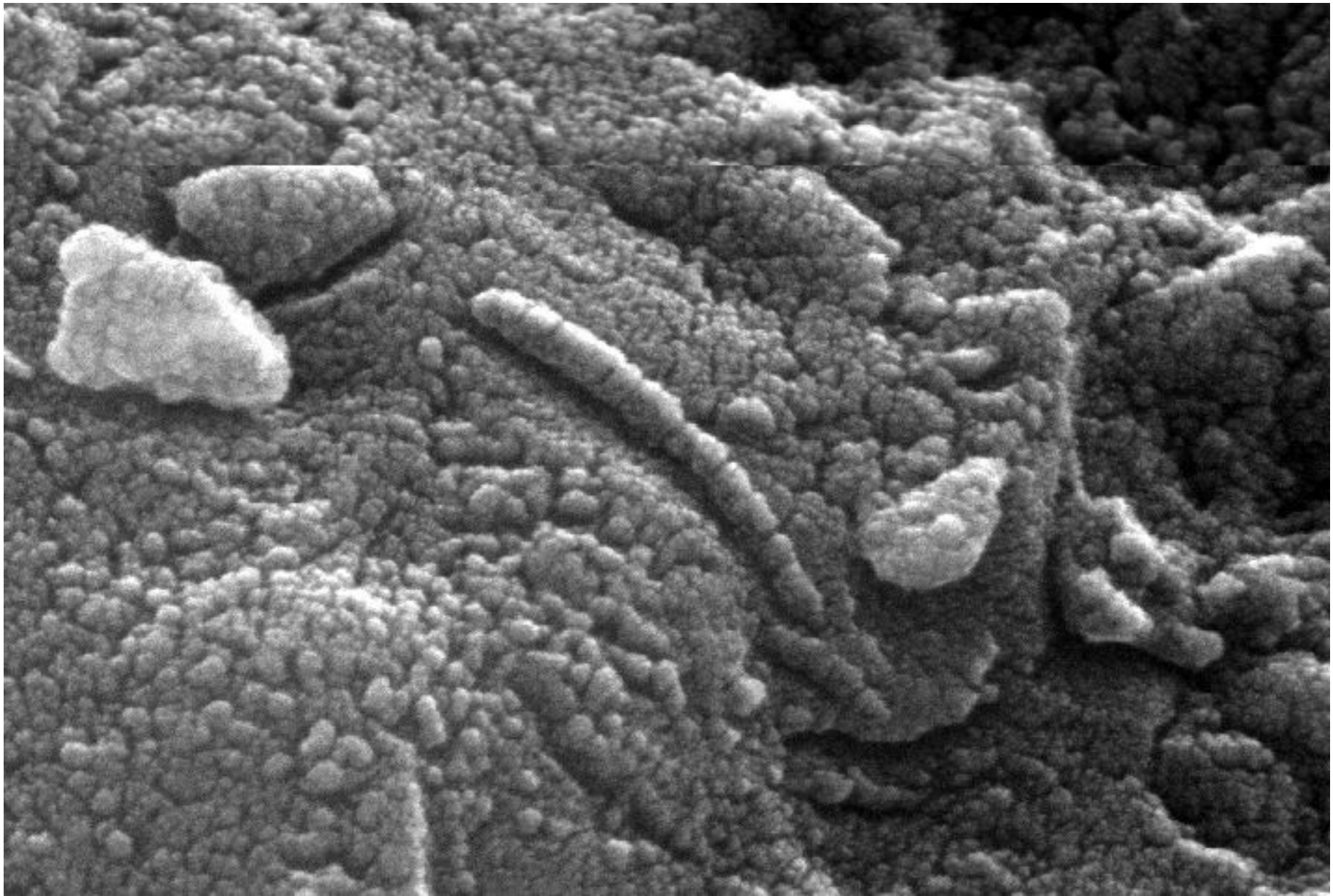


6 other missions are currently studying Mars

Mars is often considered our twin planet
(though that's not so accurate)

- It has an atmosphere with weather:
  *seasonal ice caps
  * winds, erosion, dust storms
- It has water, underground but formerly on the surface. Still, underground aquifers.
- It's cold, but sometimes just above freezing.

Life on Mars?

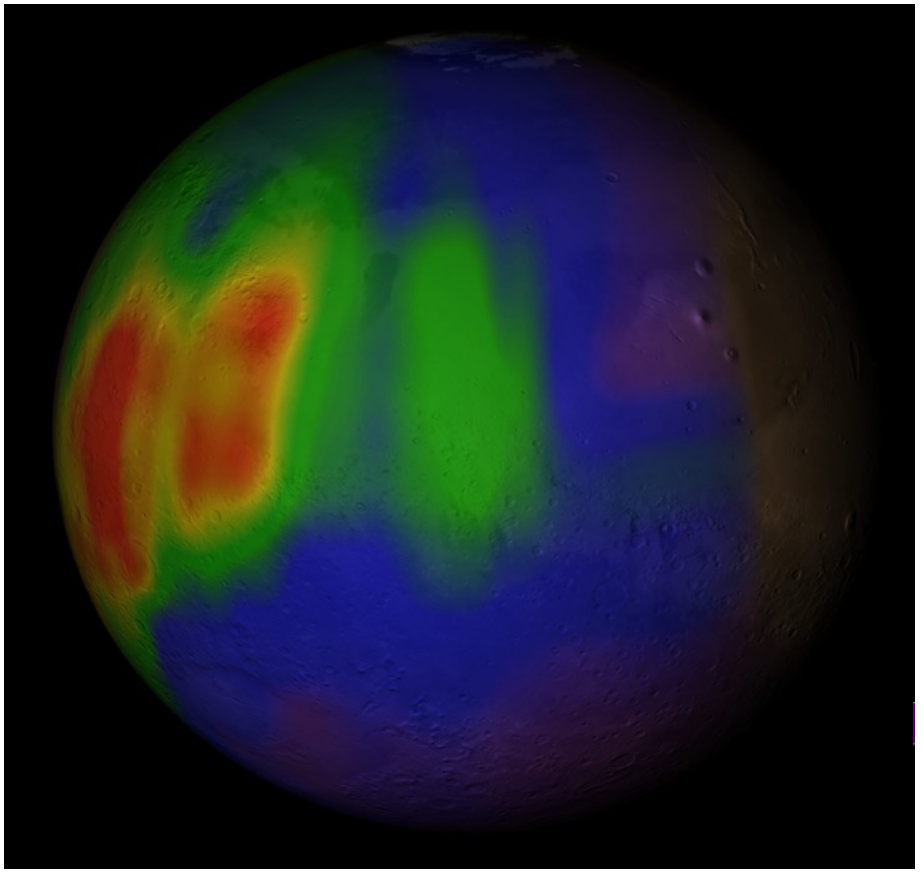


Life on Mars?

- Evidence of fossilized bacteria in meteorite from Mars.
- Viking landers tested soil for life
  - No organic materials were detected in the soil.
  - But the soil seemed to be chemically active
- Methane detected in the atmosphere.

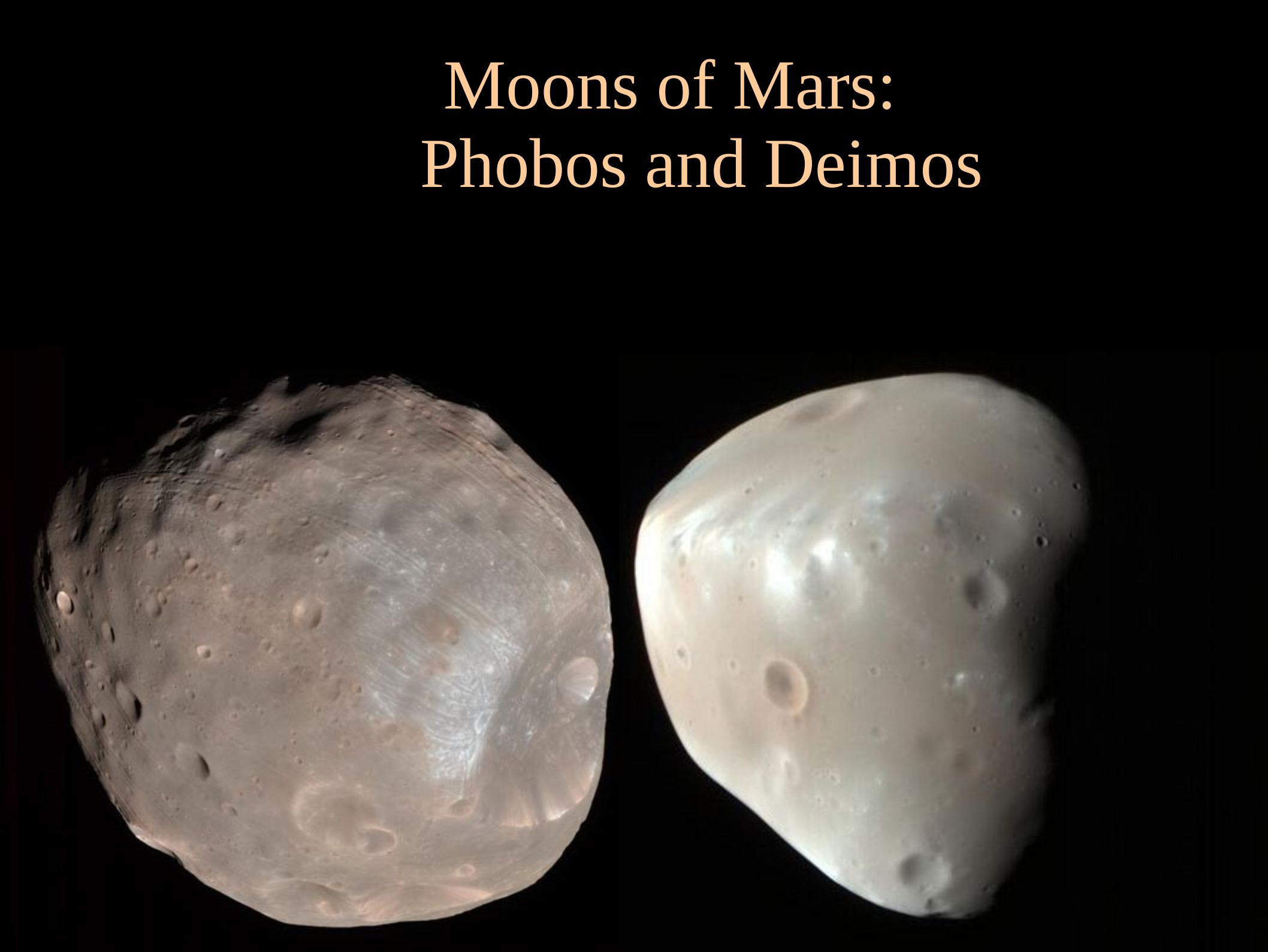
Methane in the Martian Atmosphere

- Methane gas has been detected in Mars' atmosphere
- The methane gas distribution is patchy and changes with time
- Most methane in Earth's atmosphere is produced by life, raising questions about its origin on Mars



View of Mars colored according to the methane concentration observed in the atmosphere. Warm colors depict high concentrations.

Moons of Mars:
Phobos and Deimos



The Curiosity rover watches the 2 moons pass each other.

How did these 2 moons form?

They are both small (11 and 27 km across),
both not round!!! (so not massive)
orbit over Mars' equator (not in the ecliptic)
both orbits are nearly circular
Deimos' orbit is nearly geosynchronous.
Phobos' orbit is decaying and eventually Phobos will fall onto Mars...in about 40-50 million years.

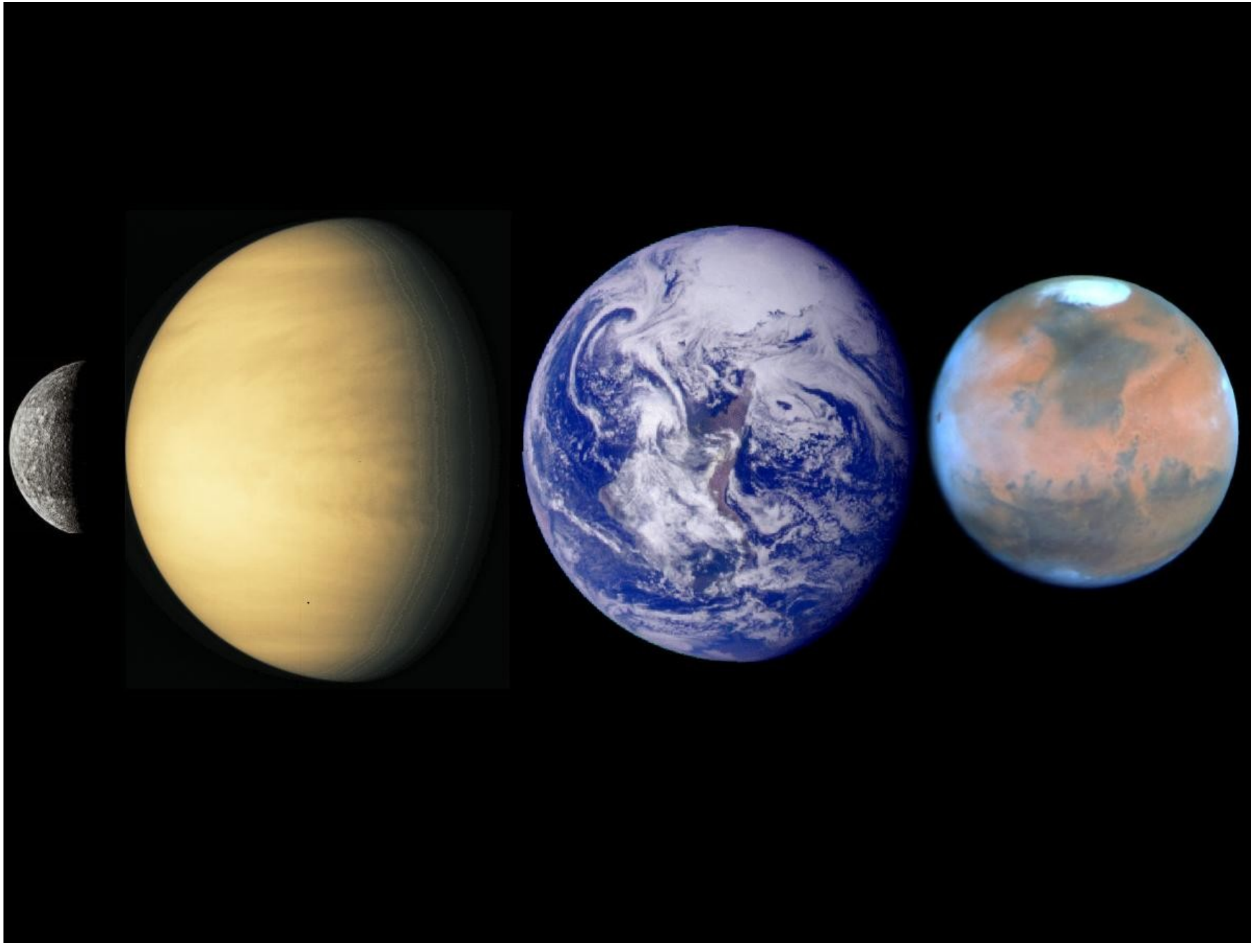
How did these 2 moons form?

Two theories:

1) they are captured asteroids.

2) Another body (stray asteroid?) passed too close to Mars and broke into bits. Over time, all the other bits (and Phobos in a few million years) have fallen onto Mars.

Terrestrial planets.



Terrestrial Planet Atmospheres

Mercury- very thin, evaporative atmosphere
Venus- thick 95% CO_2 atmosphere
Earth- thick N, O, CO, CO_2 atmosphere
Mars- thin 95% CO_2 atmosphere

Terrestrial Atmospheres

The original atmospheres of terrestrial planets probably all started as H, which was quickly lost to space.

Most of the Universe is H

Terrestrial Atmospheres

The second atmospheres of terrestrial planets probably all started the same- mostly CO_2, H_2O, SO_2, NH_3.

Why do planetologists say this?

Terrestrial Atmospheres

The second atmospheres of terrestrial planets probably all started the same- mostly CO_2, H_2O, SO_2, NH_3.

Assumes the source of the atmosphere is volcanic.

Terrestrial Atmospheres

The second atmospheres of terrestrial planets probably all started the same- mostly CO_2, H_2O, SO_2, NH_3.

So what happened?

Based on mass (escape velocity) of the body, mass and temperature of the gas.

Terrestrial Atmospheres

Mercury: not enough mass & hot.

Atmosphere escapes

Venus: Too hot: water escaped over time or reacted with NH_3; CO_2 remains.

Earth: non-equilibrium atmosphere. Life artificially keeps oxygen. Oceans remove carbon.

Mars: Right ingredients…. But devolved?

Quiz 2: The only terrestrial planet which shows plate tectonics is….

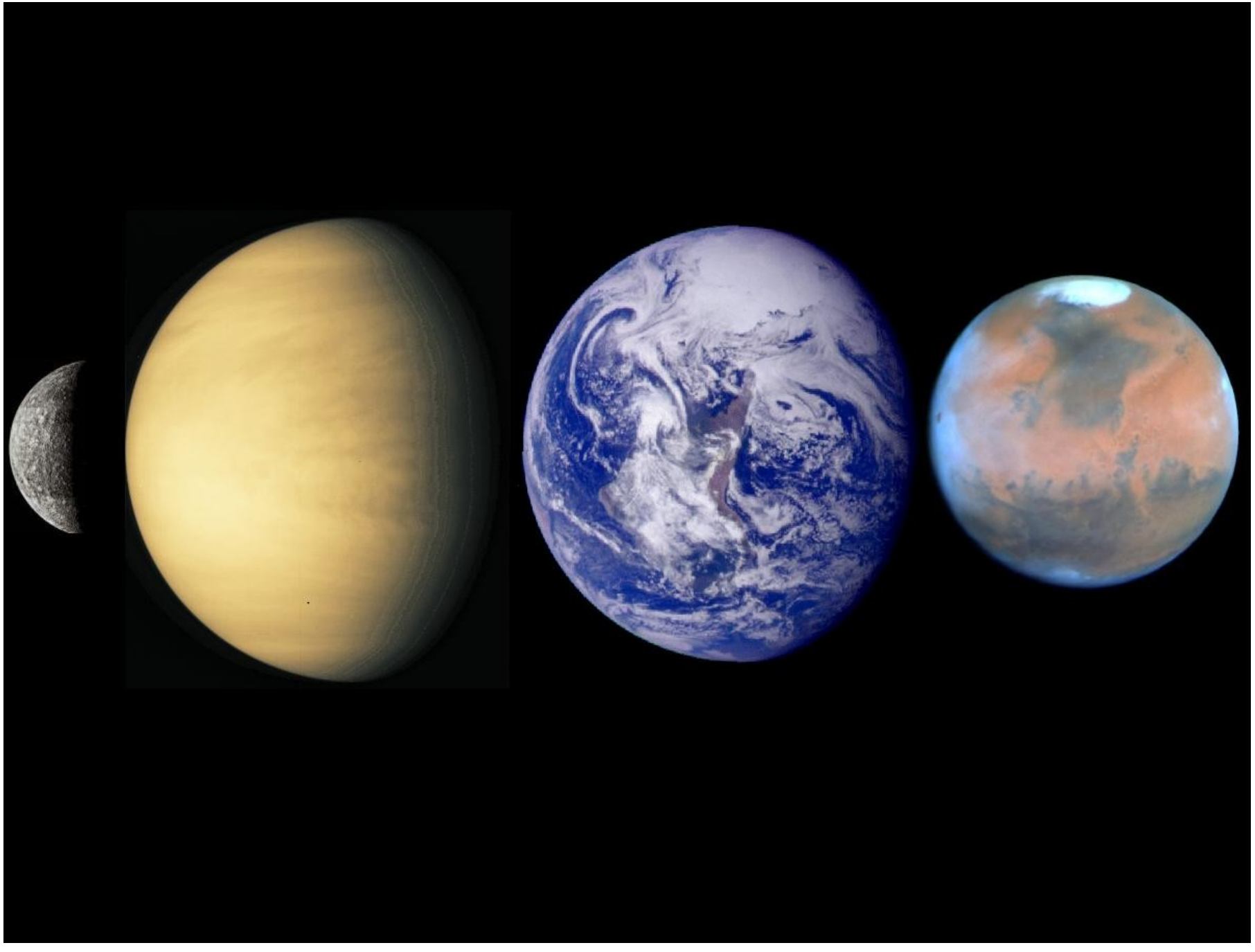
A) Mercury

B) Venus

C) Earth

D) Mars

Common properties of Terrestrial planets.



The Terrestrial Planets

1) The 4 planets closest to the Sun.
2) They are all solid objects made of rock.
3) They all have thin (compared to amount of rock) atmospheres.
4) Each has two or less (no) moons.

The Terrestrial Planets: Magnetic fields

Earth: caused by liquid iron core dynamo.

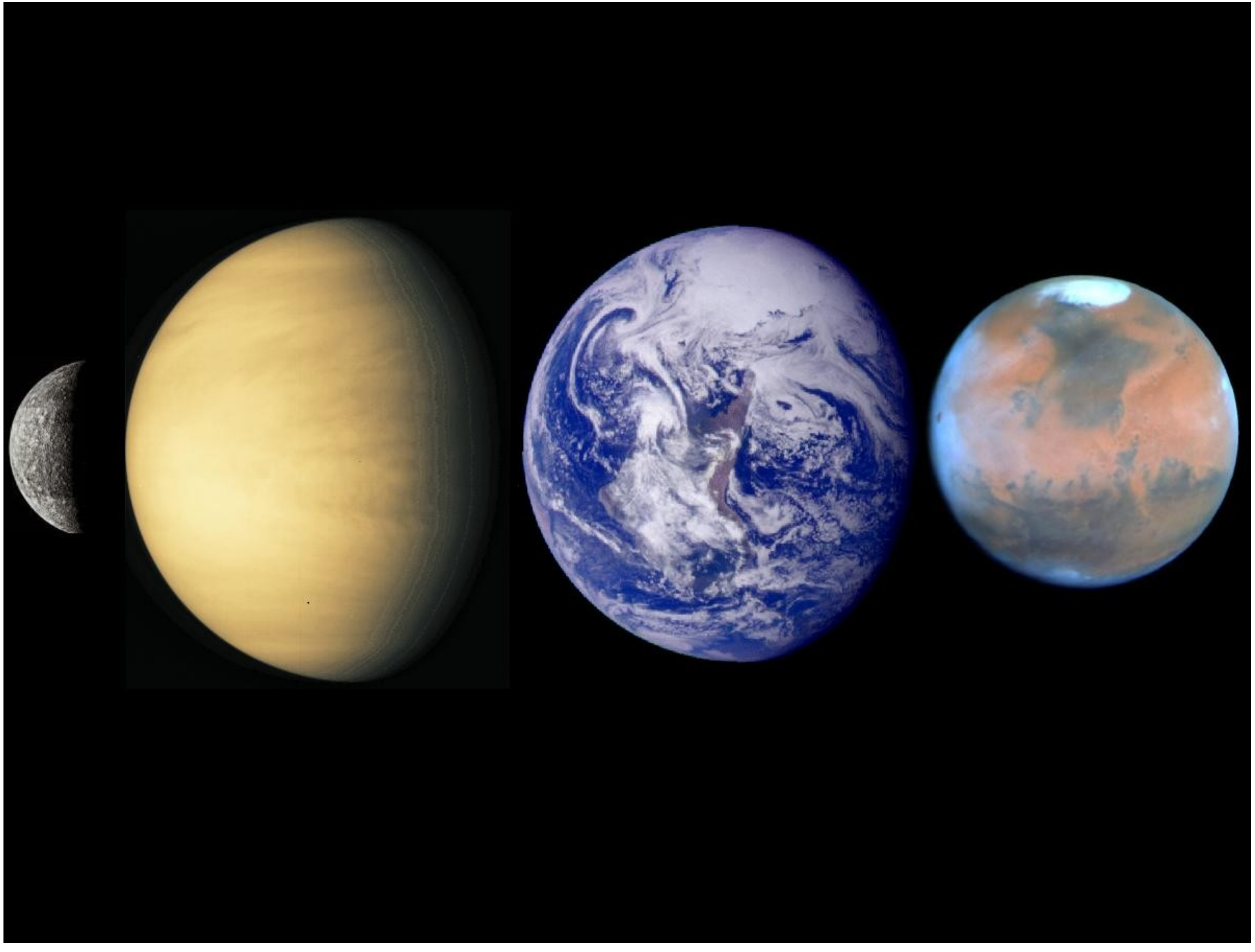
Mercury: caused by dynamo (liquid core is most likely). 100x weaker than Earth's.

Venus: No global field (rotation too slow or no solid core?)

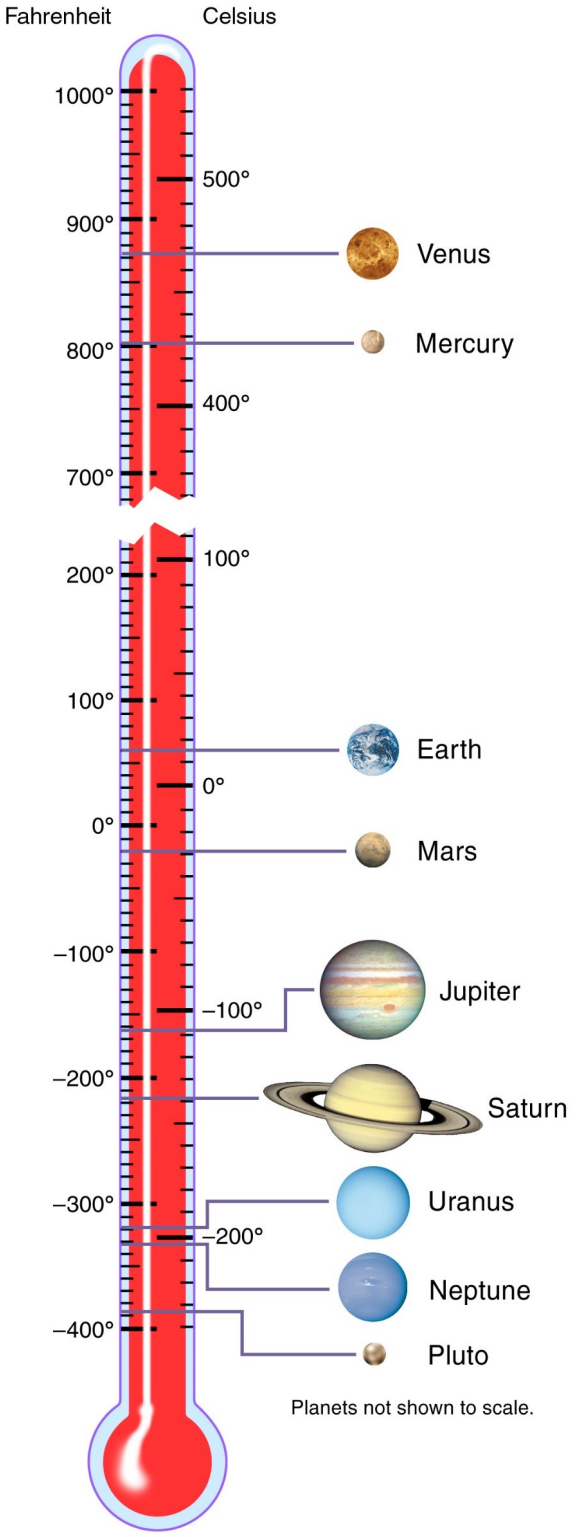
Mars: Only a 'frozen in' field, no global dynamo (no liquid core?). Mars once had a field similar to Earth's but it stopped long ago.

The Moon: Also has a 'frozen in' remnant field from an earlier dynamo.

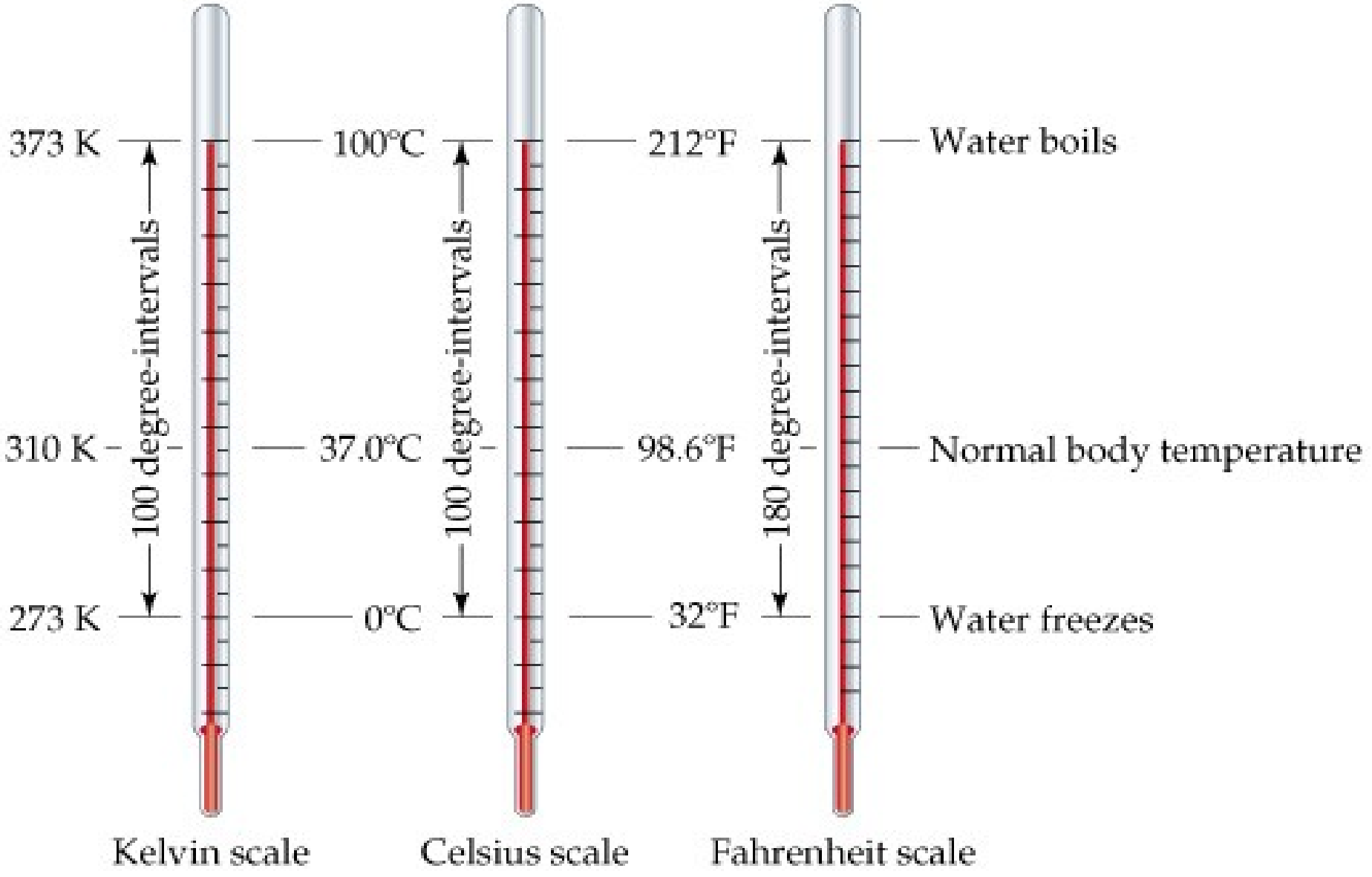
Done with Terrestrial planets.

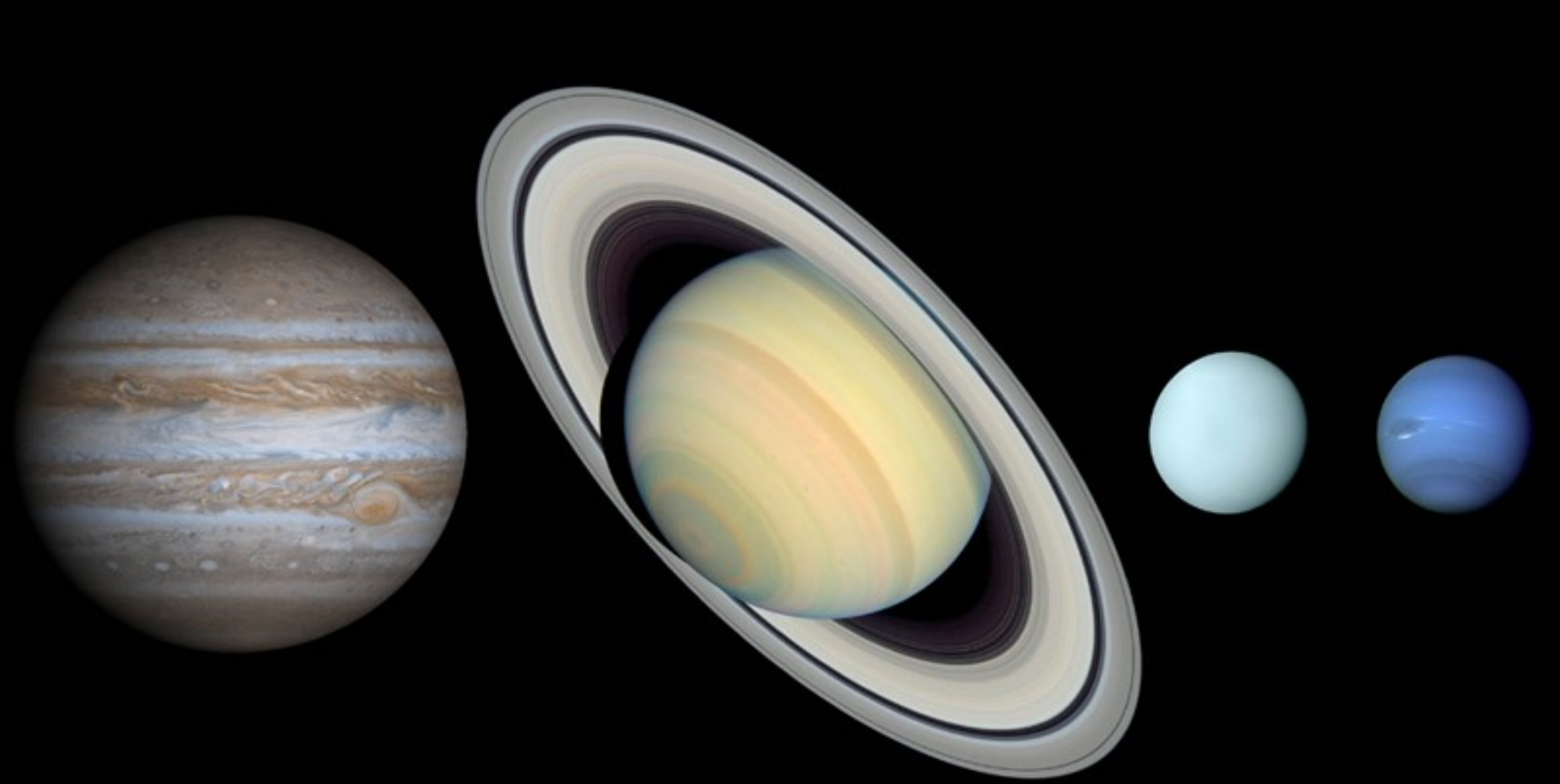


As we go further away from the Sun, the solar system gets colder and colder.



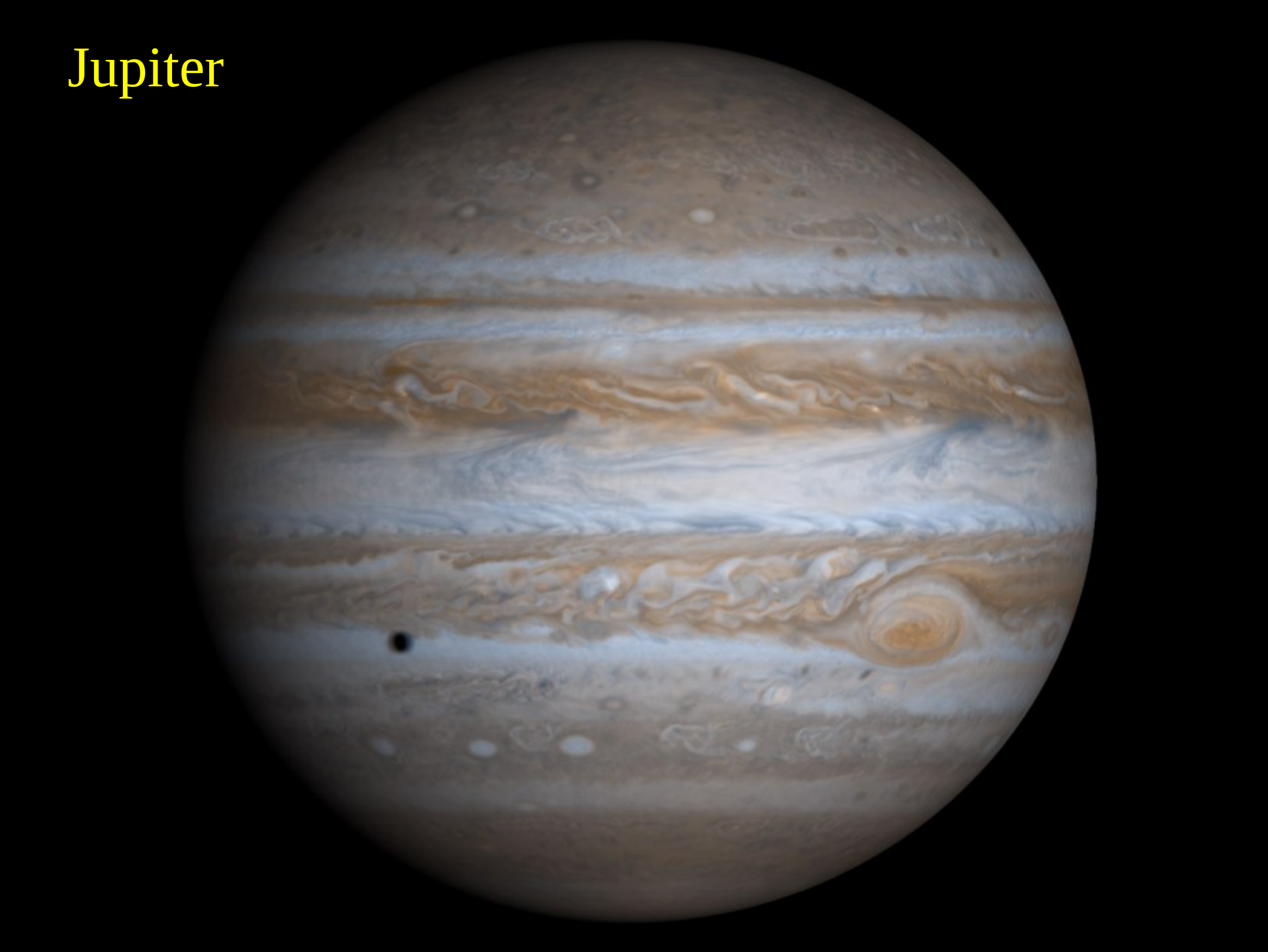
Note on temperature scale: We use Kelvins because there are no negative values. For large Kelvin values, just double it to get Fahrenheit.

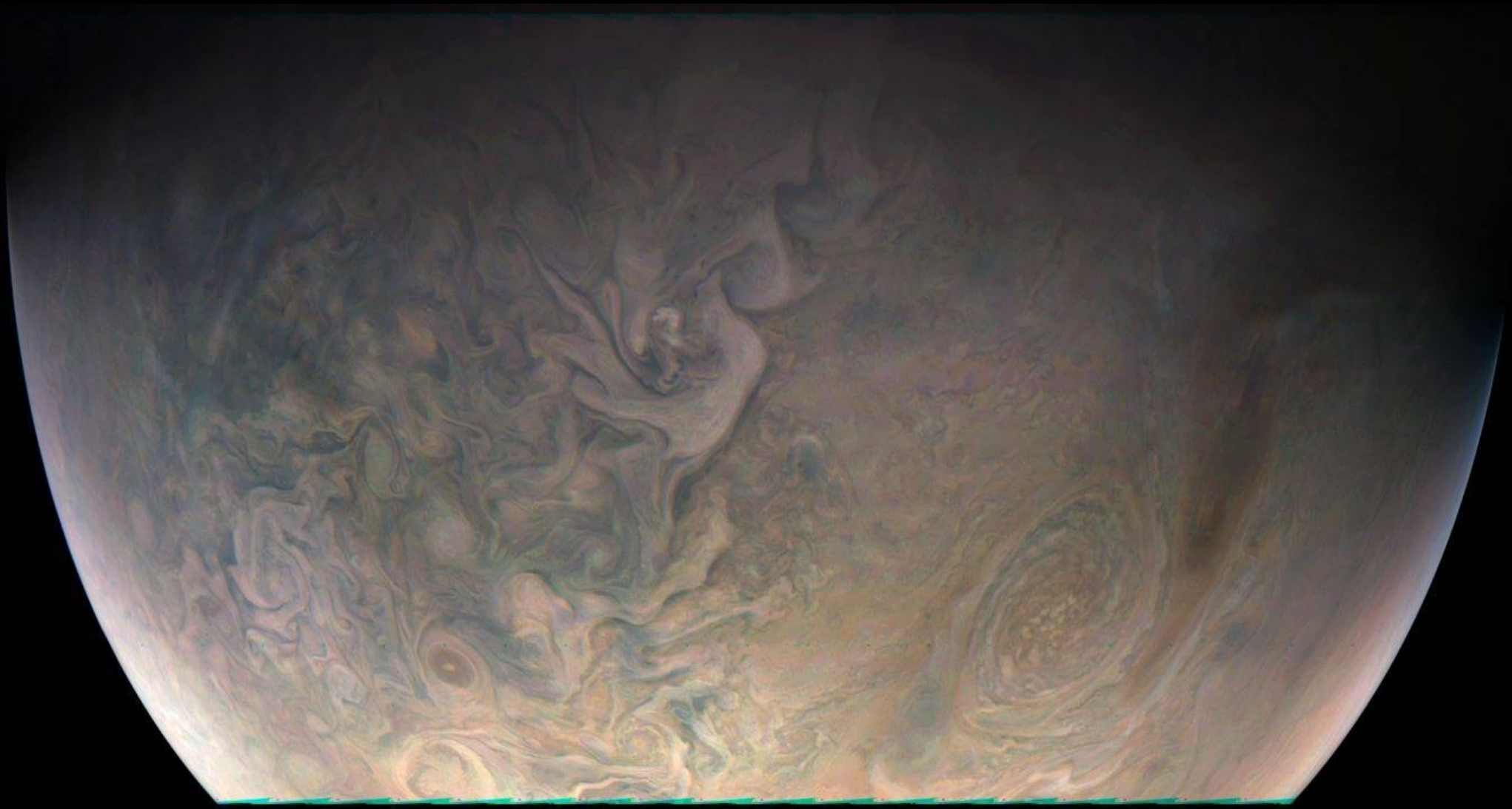


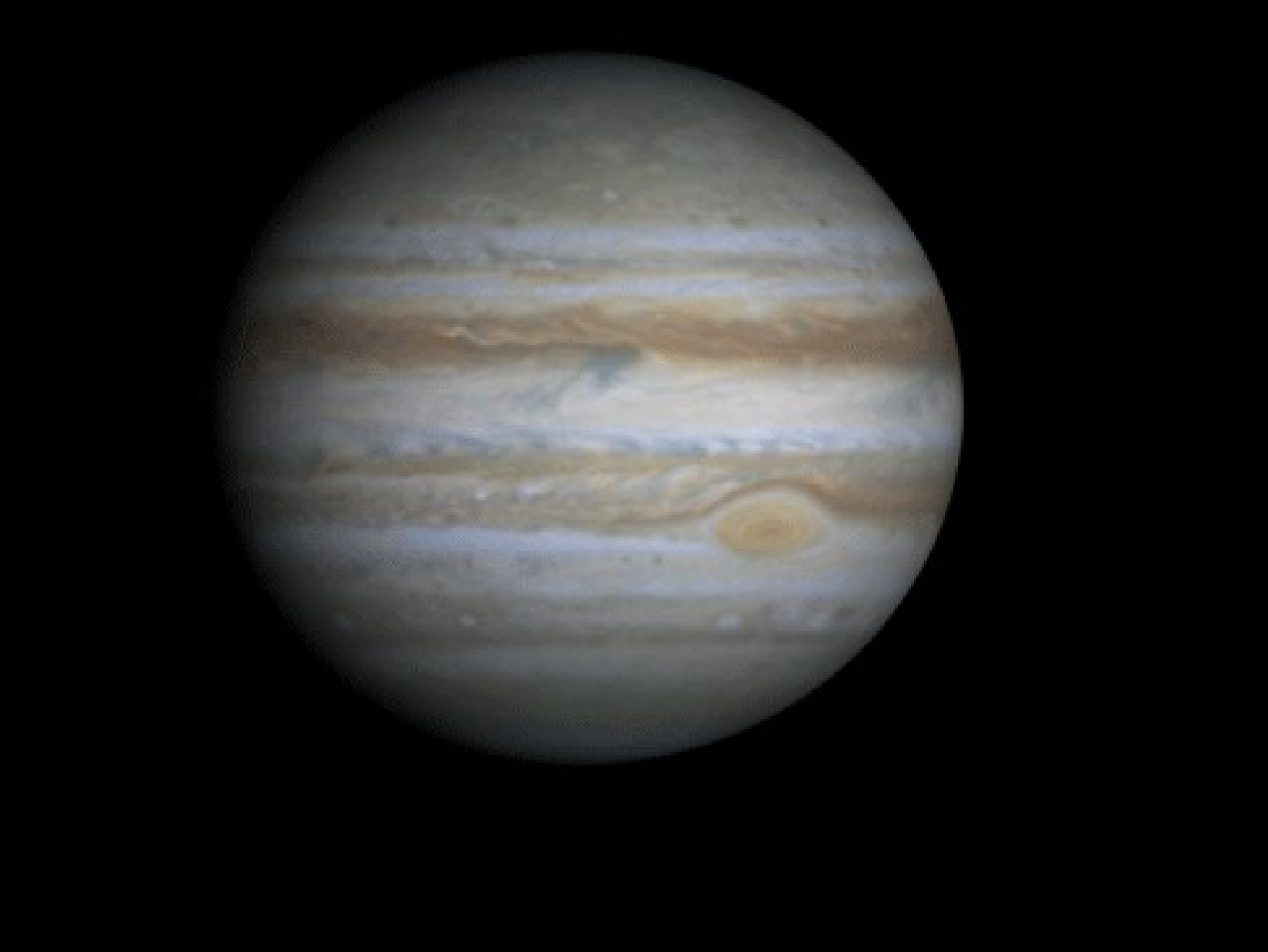


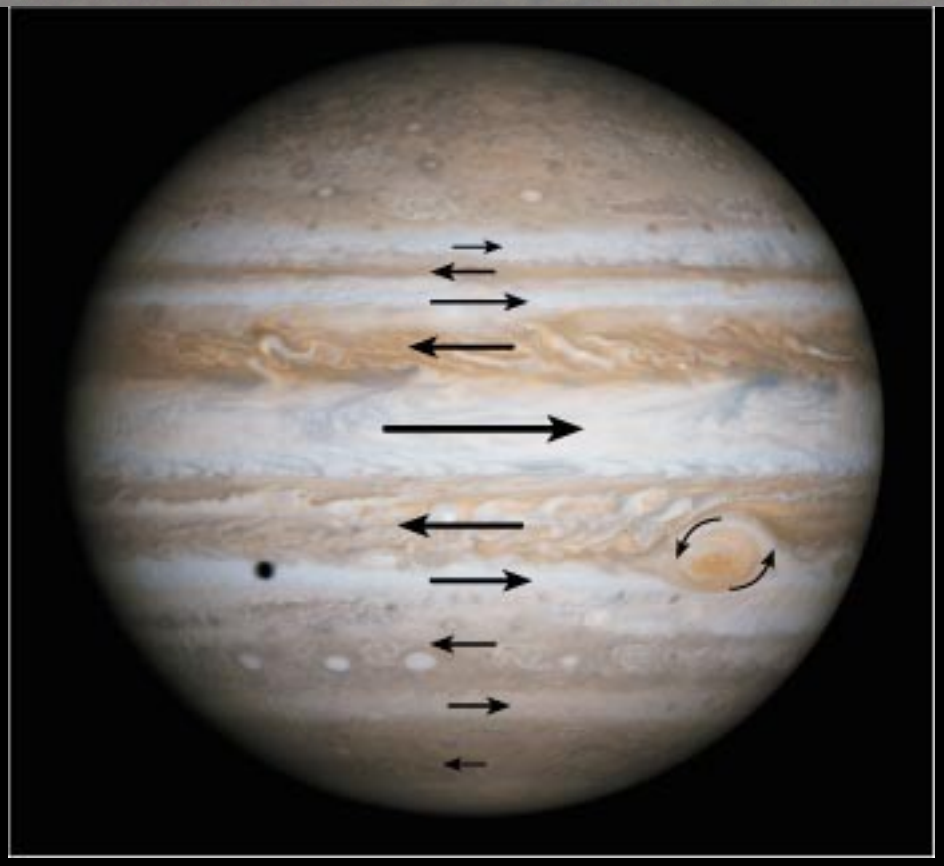
Beginning the Gas Giant Planets
Jovian and Neptunian

Jupiter









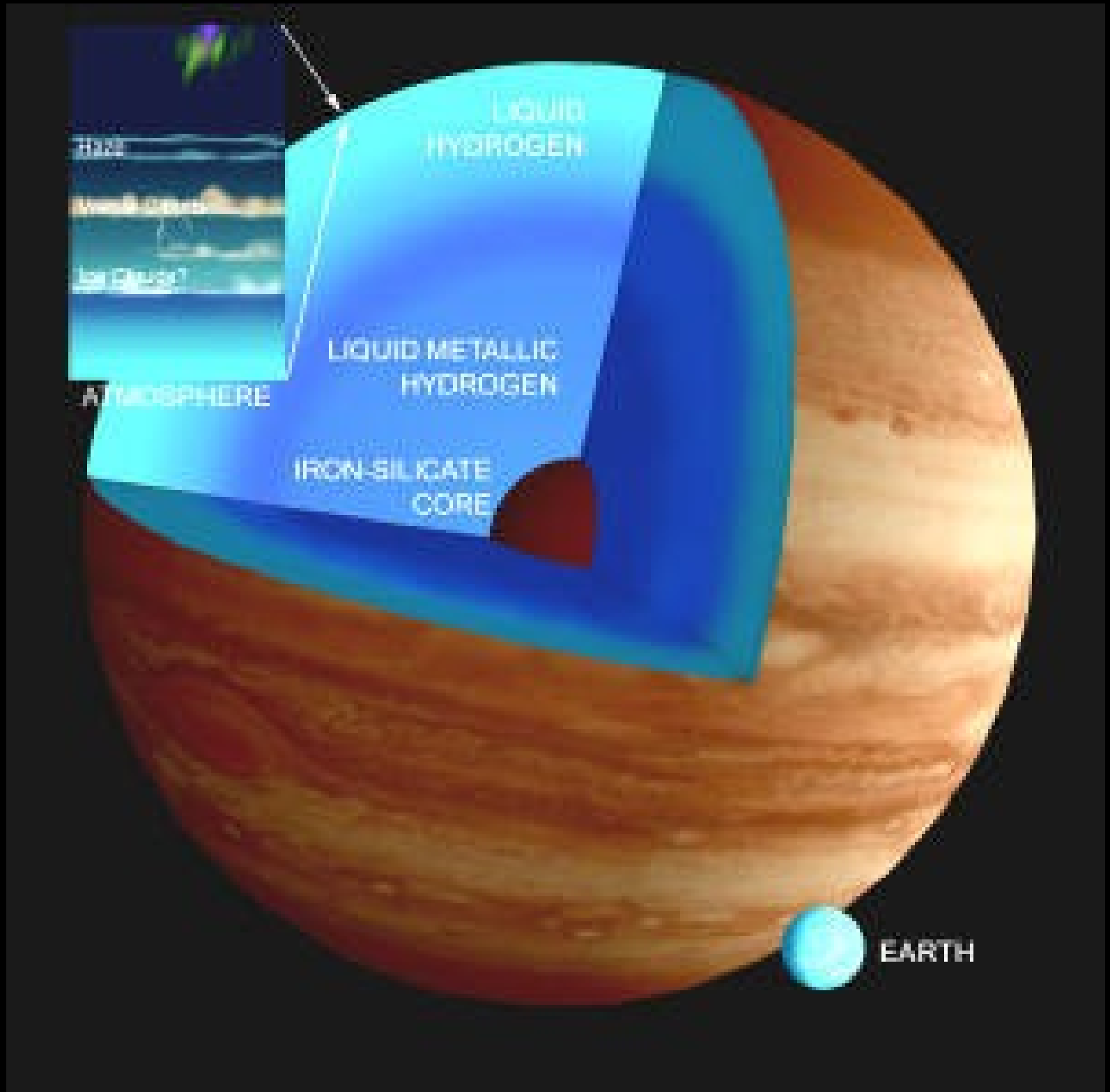
Jupiter

- Density: 1.33 g/cc
- Spins in less then 10 hours!
- made mostly of H and He (just like our Sun)
- 318 times more massive than the Earth

Jupiter's Structure

- Top: clouds eventually thicken to liquids
- Middle (and mostly): liquid metallic hydrogen (10 million times the pressure of this room!), generates a strong magnetic field.
- Core Rocky, metallic core.
  - 15-30 Earth masses.
  - Probably 20,000 Kelvin (40,000^{o}F)!

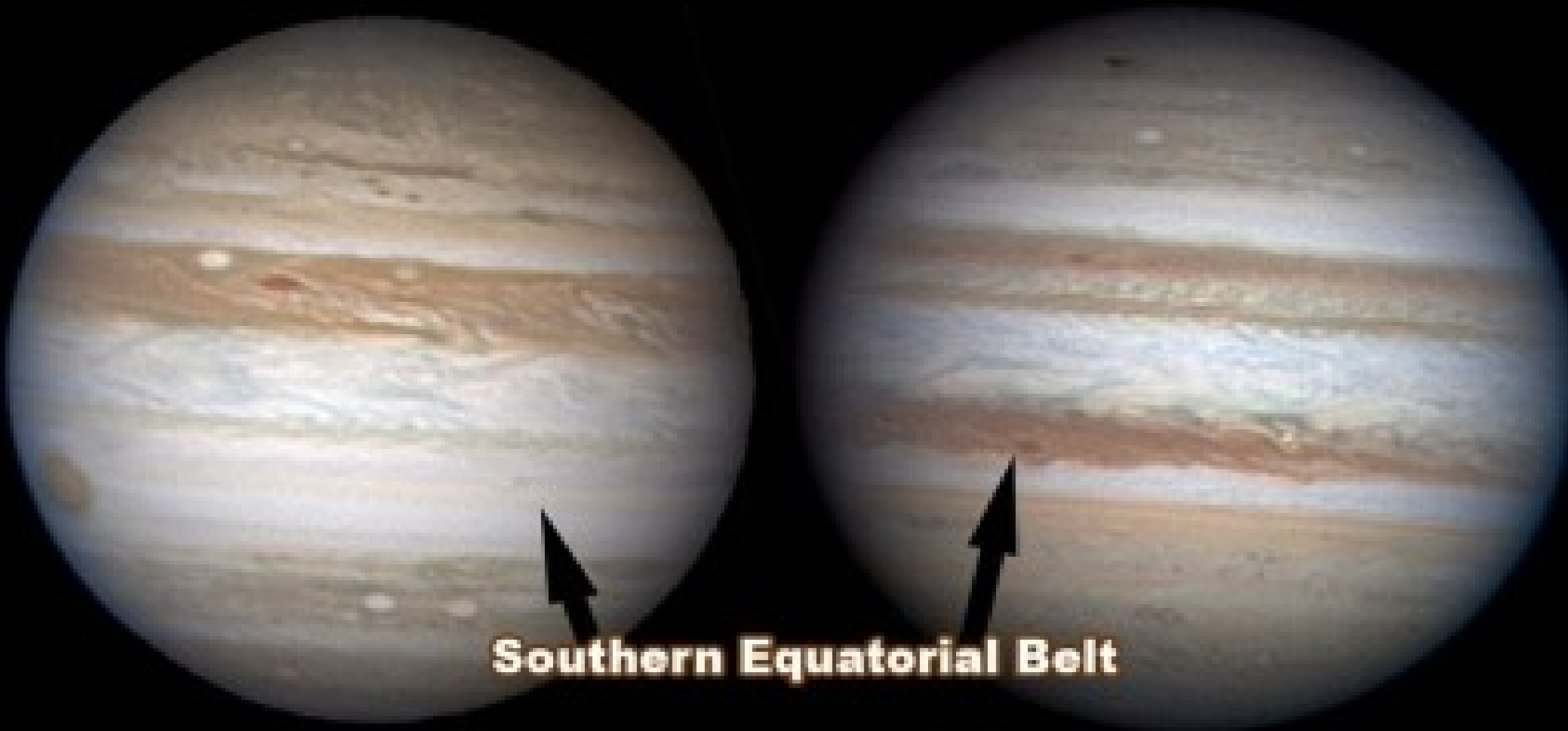
Jovian Planet Structure (our 2nd of 5!)

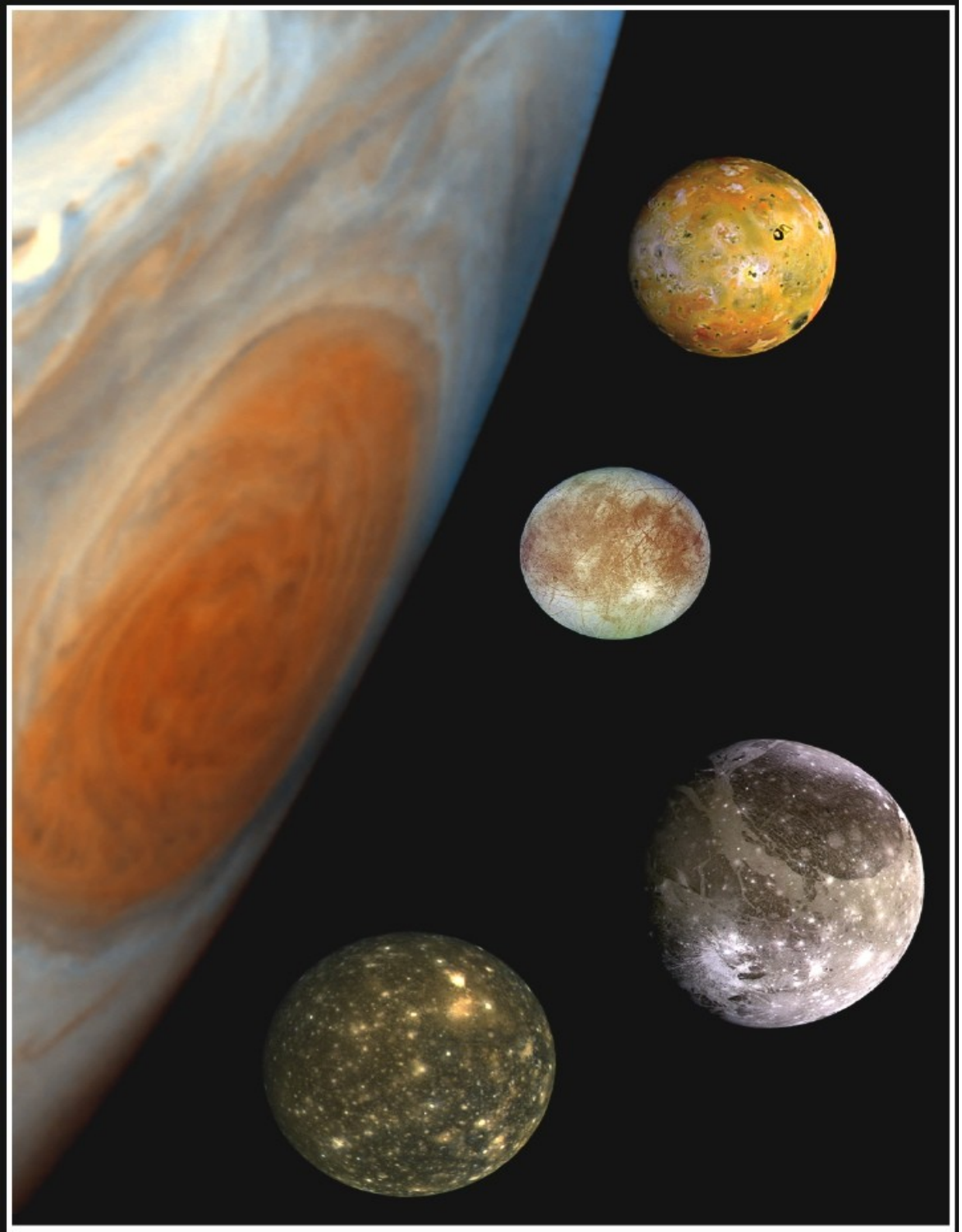

Haze
Ice Clouds?
ATMOSPHERE
Liquid
HYDROGEN
LIQUID METALLIC
HYDROGEN
IRON-SILICATE
CORE
EARTH

Jupiter contd.

- The Great Red Spot is a storm that has raged on Jupiter for at least 300 years! However, it is not permanent.
- The clouds vary.....

And sometimes a belt will go missing!





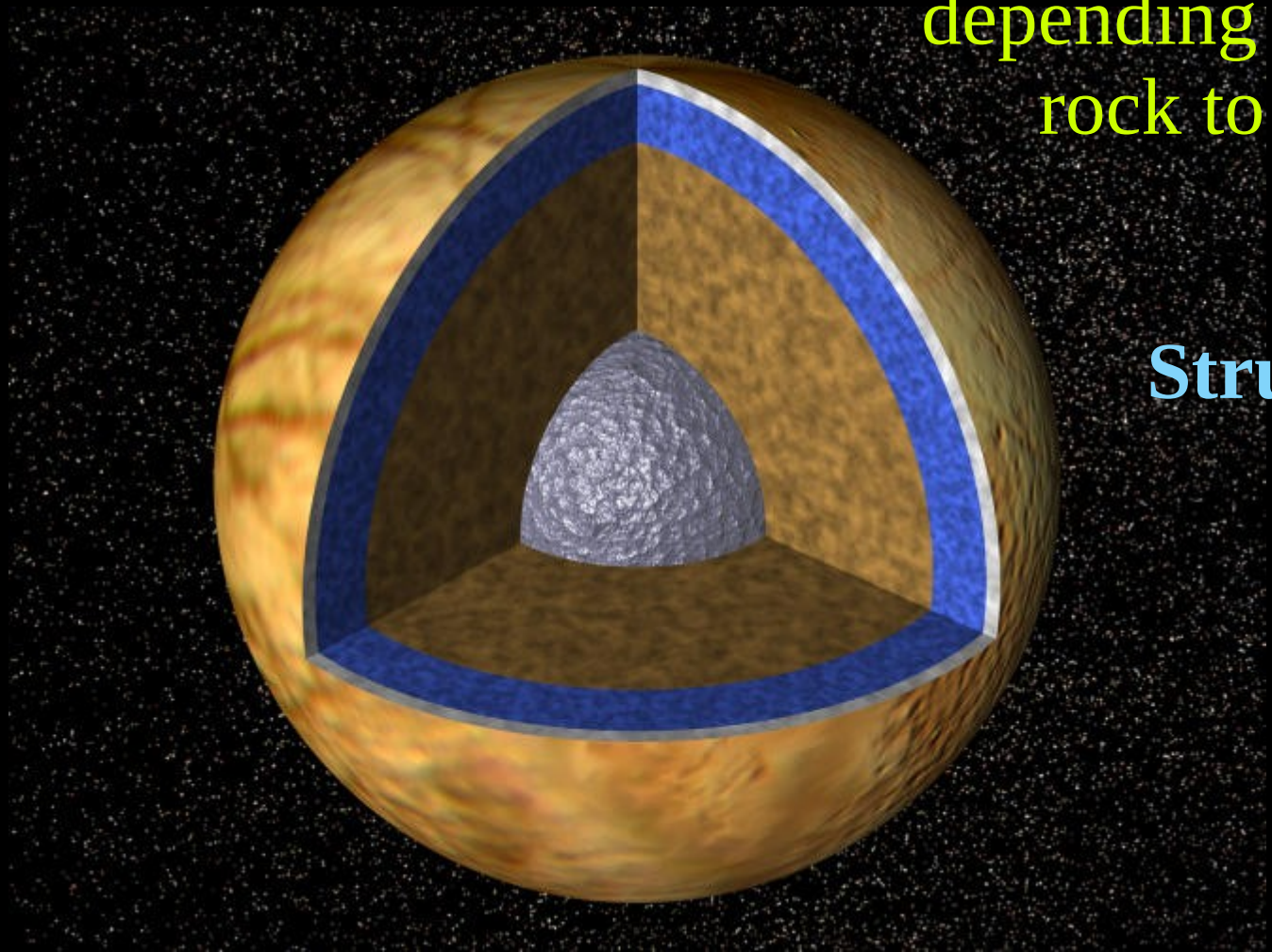
Jupiter's moons

Jupiter has at least 63 moons.
The 4 largest are known as the Galilean moons,

(Warm interior) Icy moon structure

Crust made mostly of water-ice.
Underneath lies a vast liquid layer of water
Rocky mantle.
Rocky (iron) core.

Densities ~ 2 g/cc depending on how much rock to water/ice.

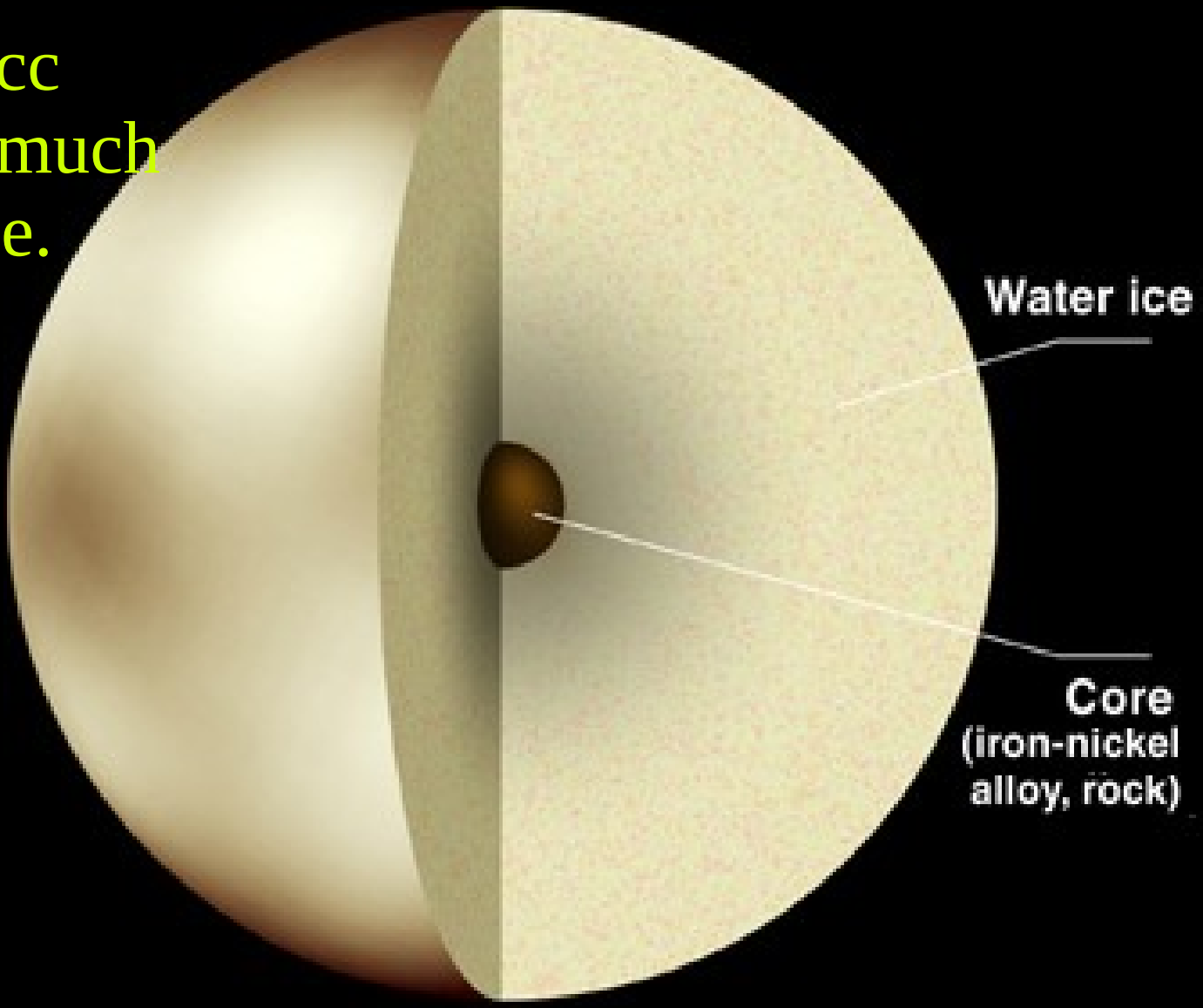


Structure #3

(Cold interior) Icy moon structure

Rock/ice mixture surface/mantle
Rocky (iron-mix) core.

Densities ~ 2 g/cc depending on how much rock to water/ice.



Structure #4