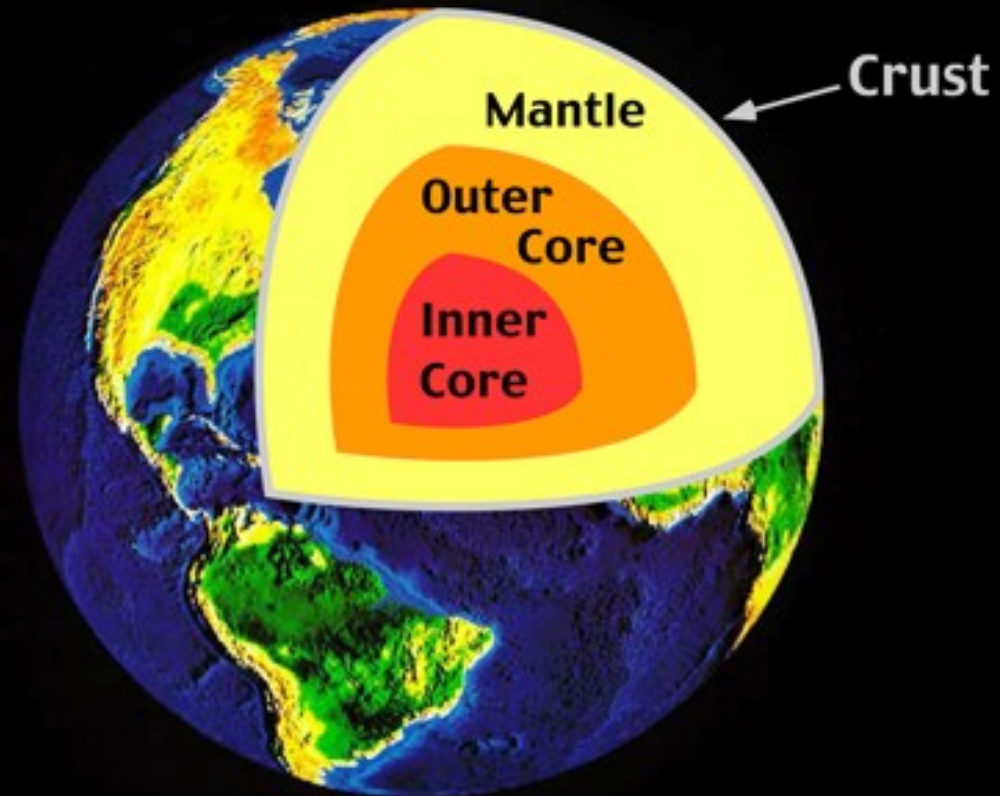
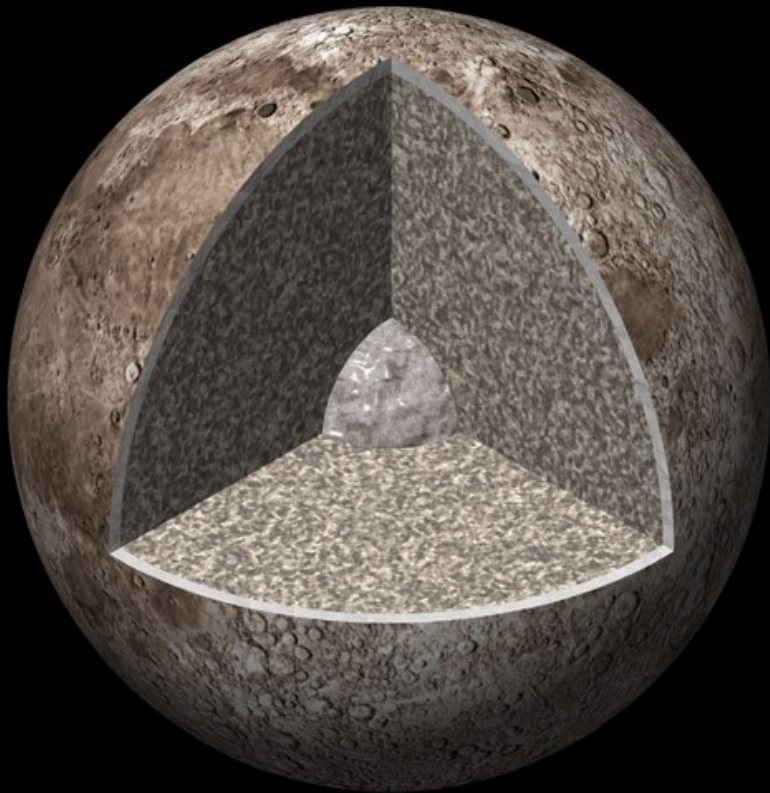


“A pupil from whom nothing is every demanded which he cannot do, never does all he can” John Stuart Mill



Structure #1 (we will have 5)

Thin atmosphere over
Rocky crust over
Rocky mantle over
Rocky core.



**We assume that all objects in our solar system
were made at the same time.**

So any younger surfaces indicate geologic processes.

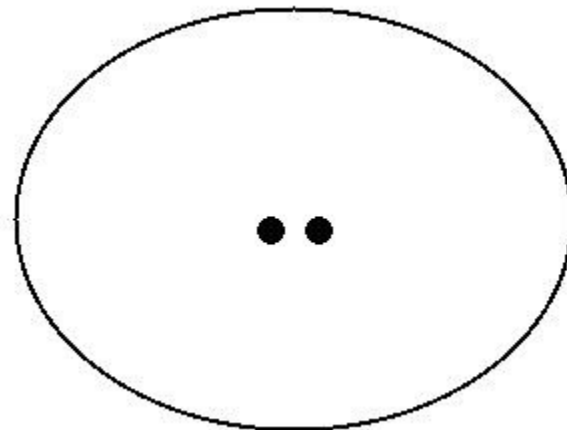
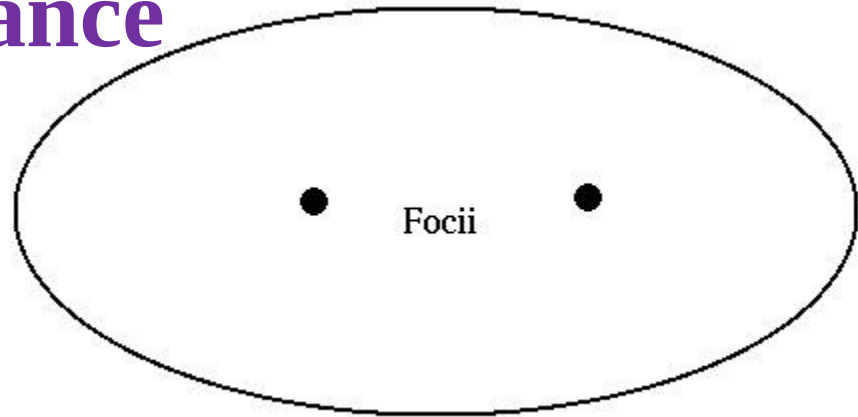
Solar system Age: 4.6 billion years.

Kepler's 3 laws of planetary motion

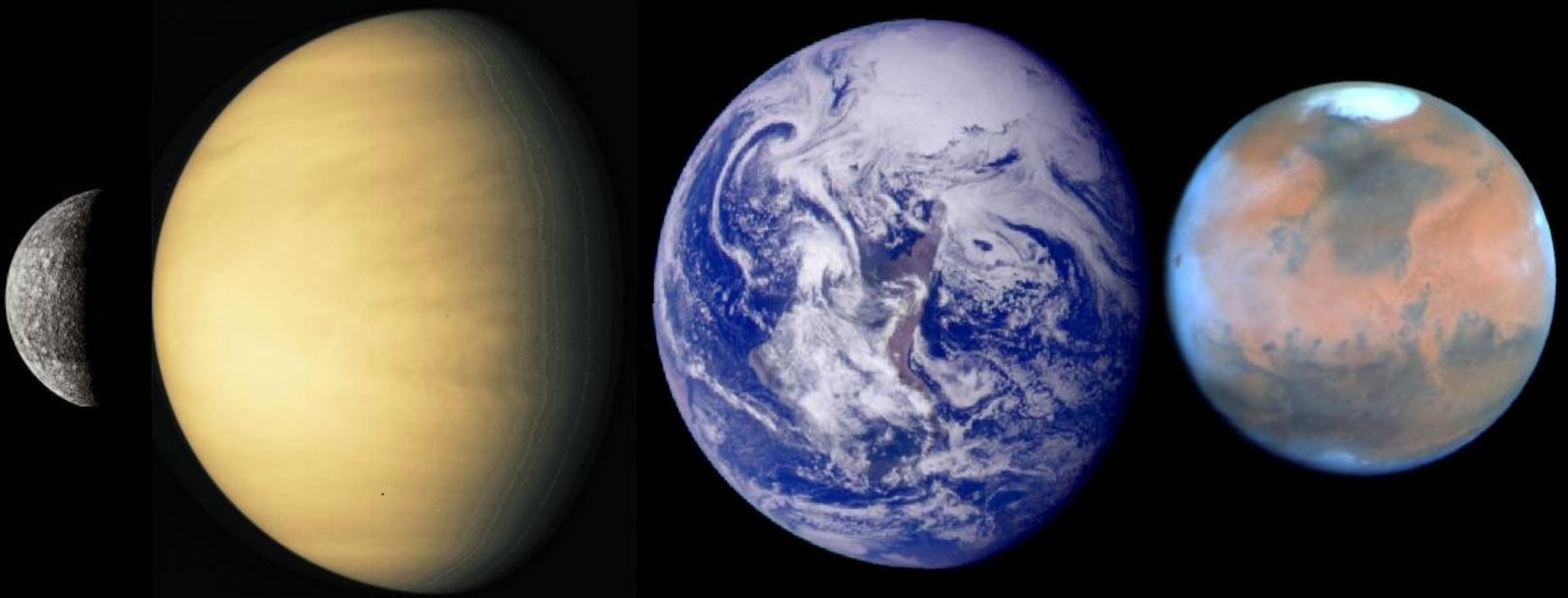
- 1) Elliptical orbits
- 2) Closer = faster, farther away = slower

3) $P^2 = a^3$ $P = \text{Earth years}$,
 $a = \text{average orbital distance}$

In AU (astronomical
Units = average
Earth-Sun distance)



Starting with the Terrestrial planets.



Mercury

- Density: 5.4 g/cc
- Structure: Terrestrial
 - Thin cracked rocky crust
 - Rocky mantle
 - Iron core

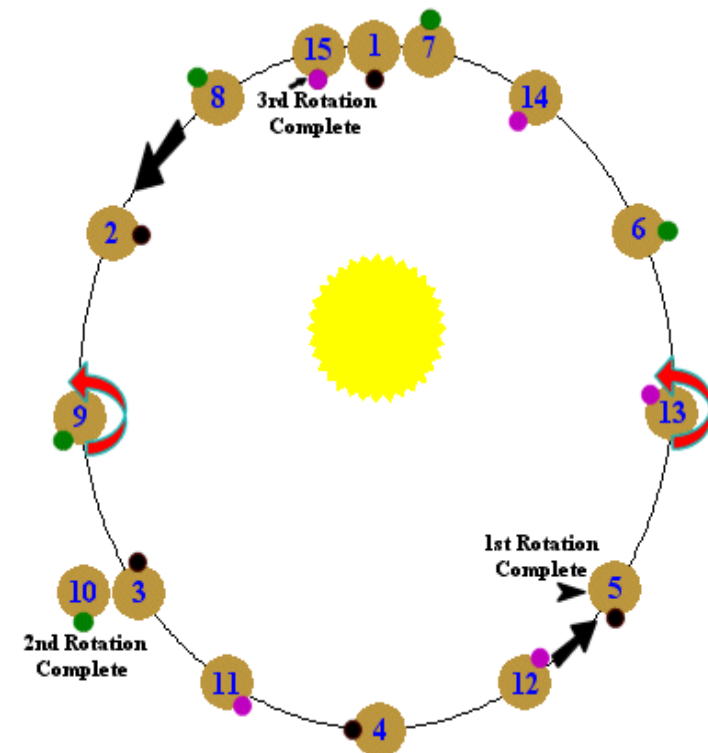
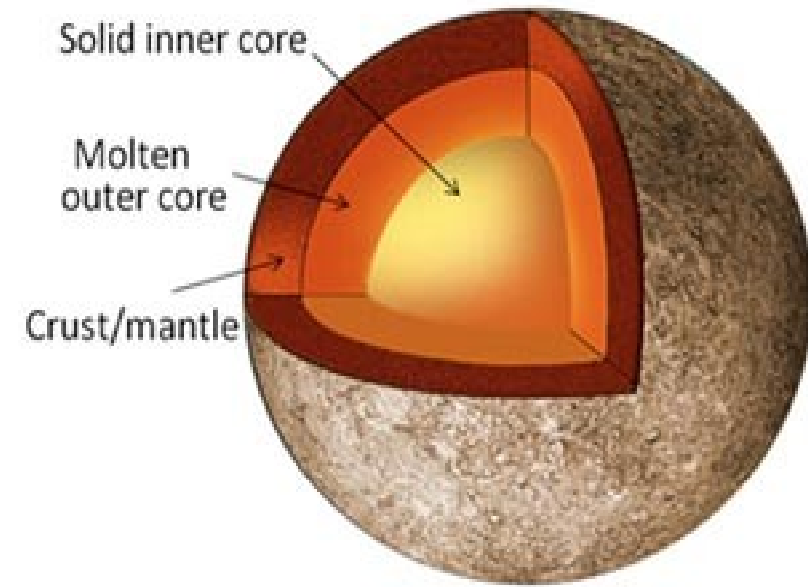
Temperature: Daytime 441F,

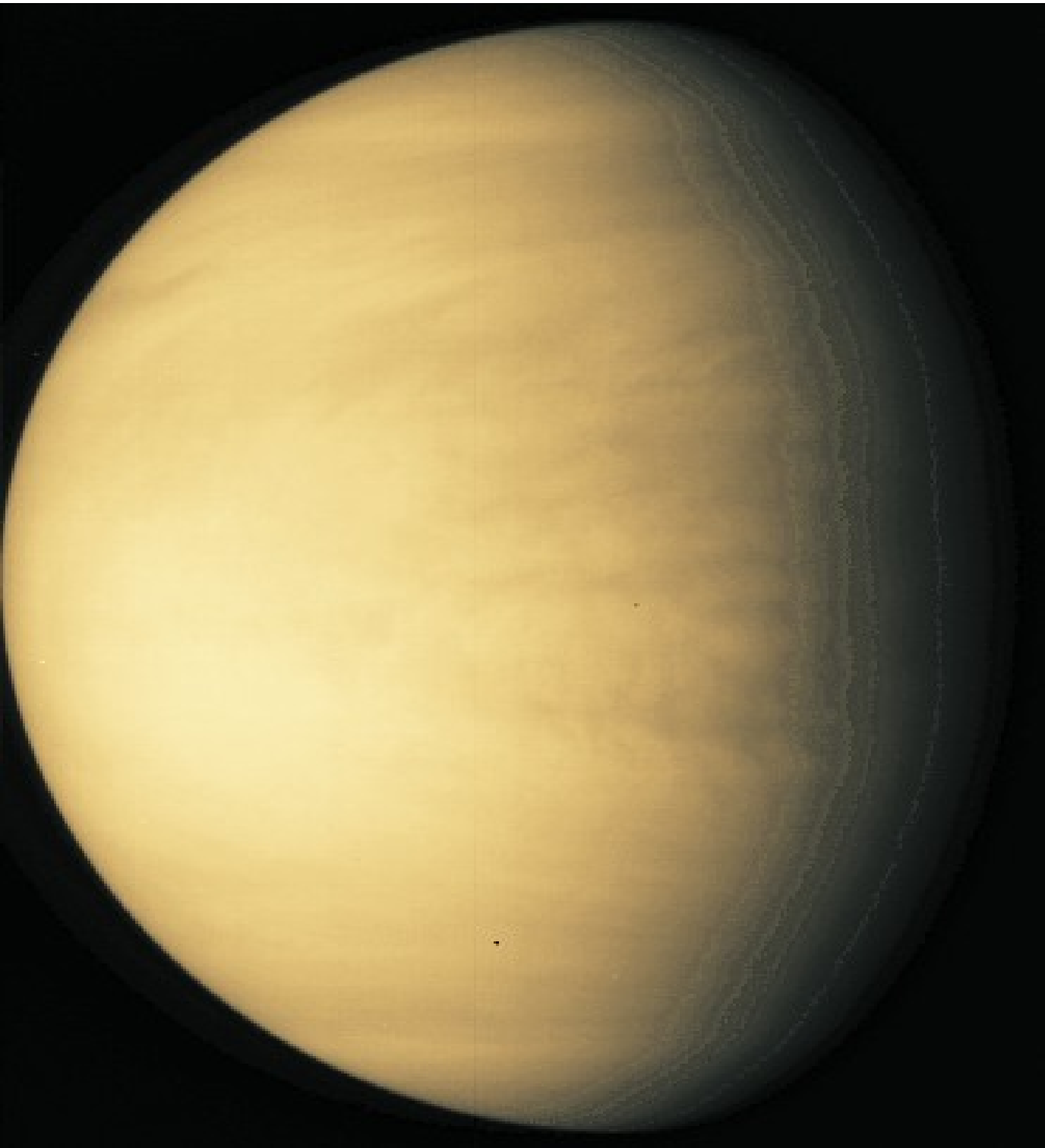
Night -279F

No moons.

Tidally locked 3:2

3 spins every 2 orbits





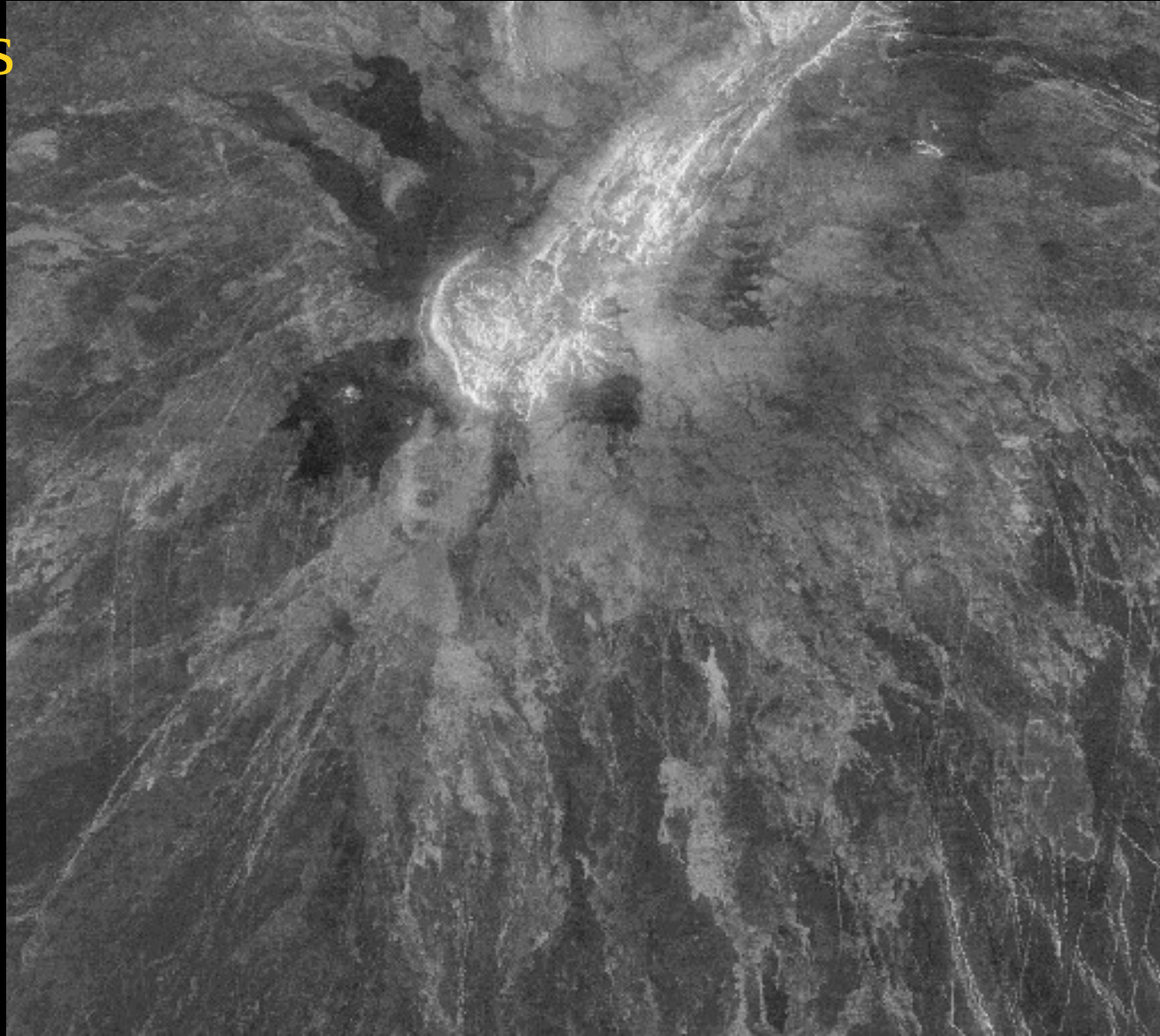
Venus is a rocky planet, like Earth, but it's always covered with clouds.

4,000 miles of rock,
200 miles of clouds.

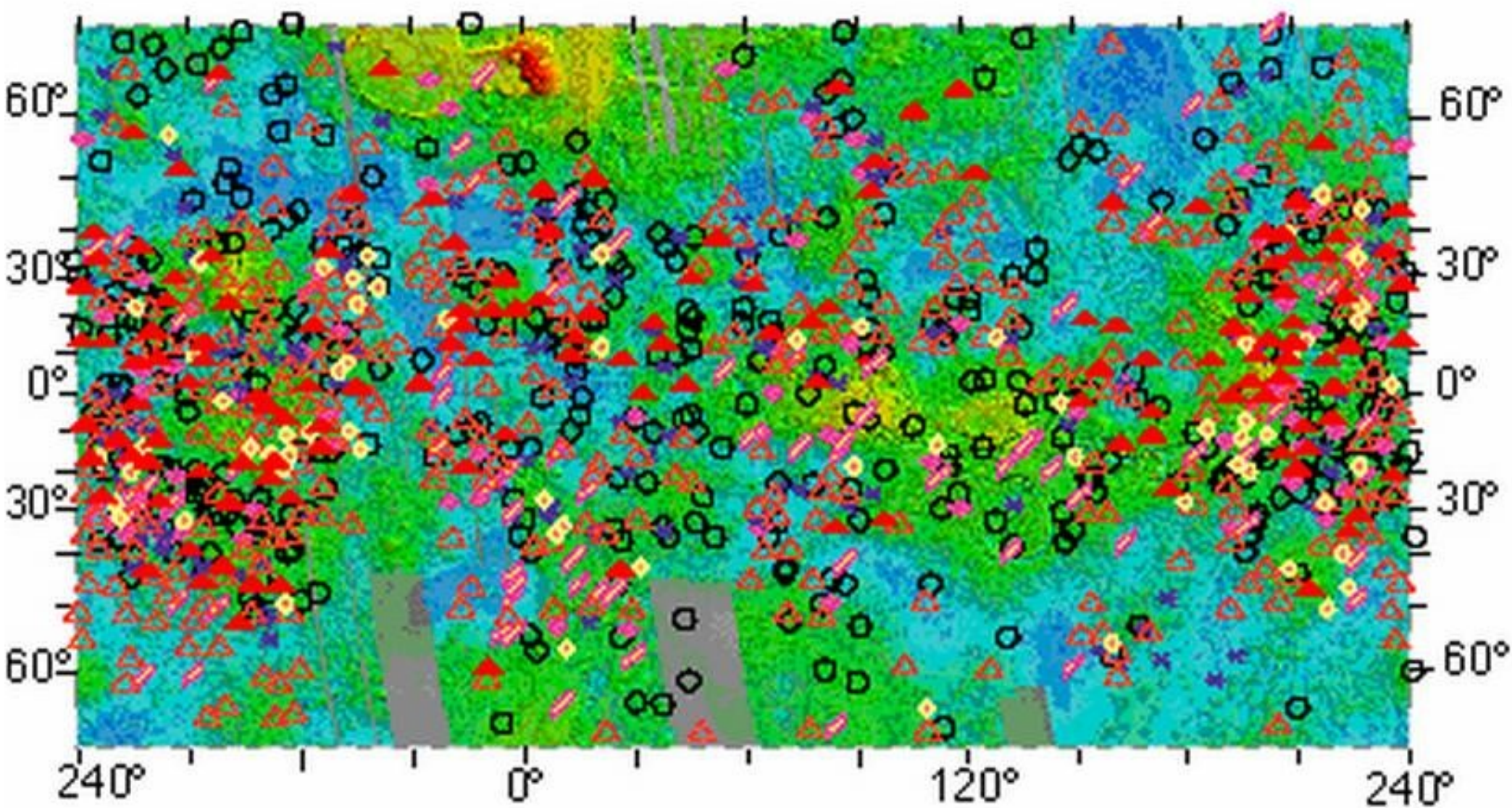
1) Venus has some craters (surface Age estimate 500-800 million years old)

2) Lots of volcanic activity!! The entire surface was essentially re-written 500-800 million years ago!

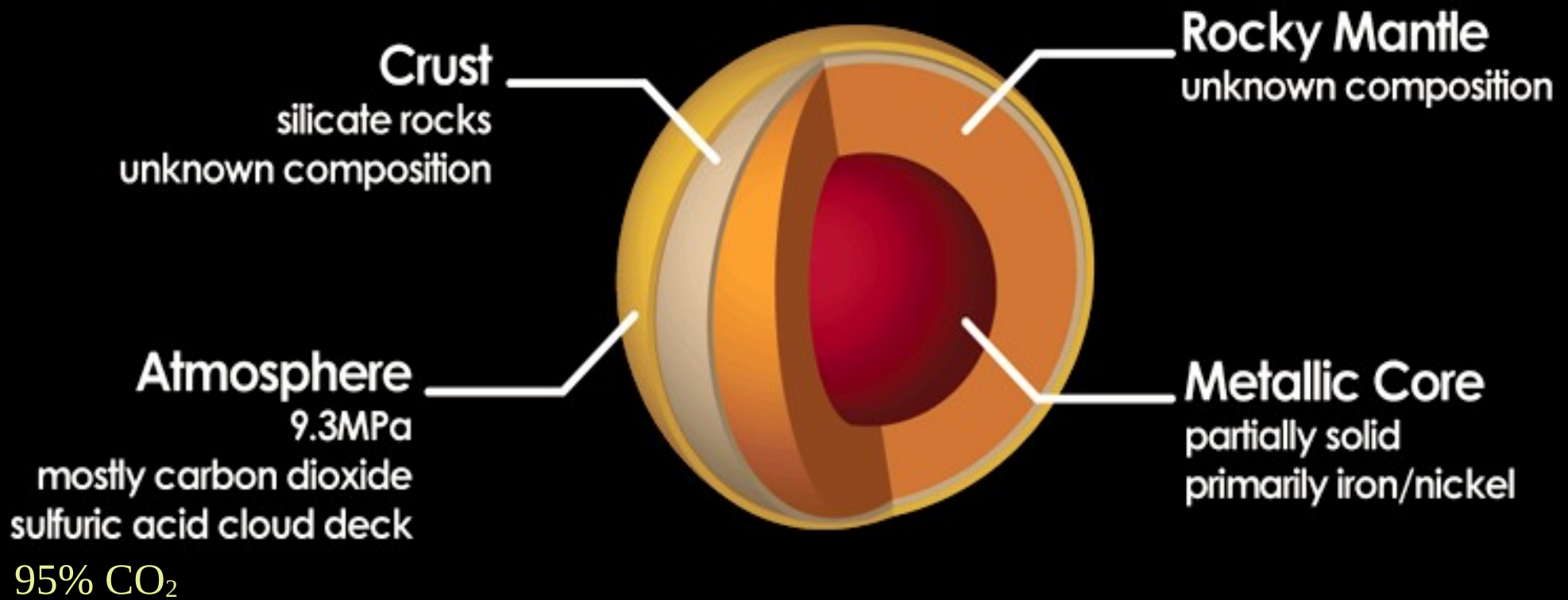
3) Tectonic activity, but not as plates.



Volcanoes on Venus



- ▲ Large shields
- Smaller Volcanoes
- △ Volcano Fields
- ◆ Calderas
- ✱ Ticks, Pancakes, etc.
- Tectono-Volcanic Structures
- ▨ Channels, Large Flows



Structure of Venus

Venus' Density = 5.2 g/cc

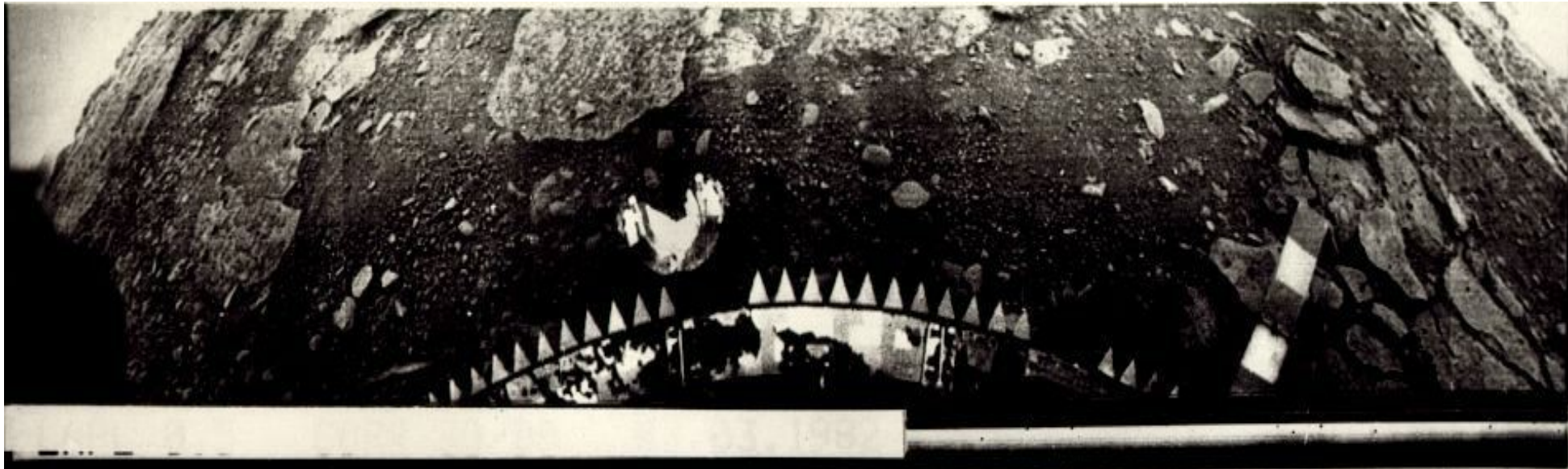
Earth's density = 5.5 g/cc

Mercury's density = 5.4 g/cc

Bizarre Venus

- Sidereal Rotation period: 243 days (**longer than the year!**)
 - Rotation is retrograde! (clockwise as seen from above Earth's north pole) which produces about **2 solar days per Venusian year!**
 - So a **solar** day (noon to noon) is 116.8 Earth days.
- Greenhouse effect gone crazy!
 - Even though a night lasts 58.4 Earth days, it is not any colder than the day side. The entire surface of Venus is at roughly a constant temperature. ~800F!
- Winds: At the cloud tops are 350 km/hr, but only 0.3 km/hr at the surface.

Venus' landscape! Soviets landed a series of probes on Venus in the 60s and 70s. Though they only lasted a few minutes to hours, they provided images from the surface... and information.

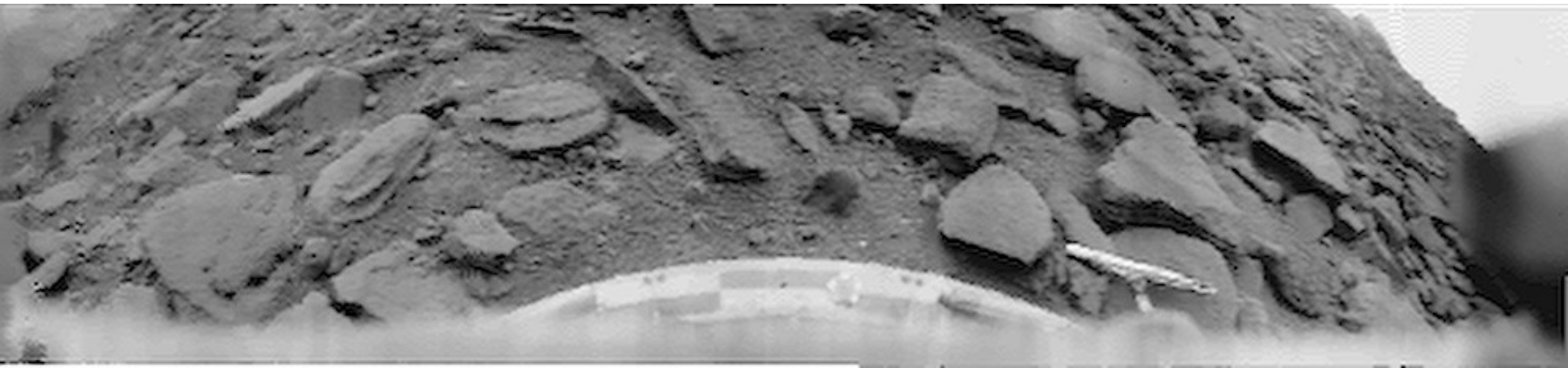


Venus looks rocky! Venus is made of similar compounds as the Earth. However **the temperature on Venus' surface is ~730 Kelvin (~800F)!**

The surface pressure is 92 times that on Earth!

Though the clouds are ~25km thick, the surface is as bright as a cloudy day on Earth.

It is clear on the surface. You can easily see to the horizon!



Venus is rocky planet with a cloudy 95% CO₂ atmosphere. It is a massive, round planet with many seemingly dormant volcanoes. It has a surface age of 300-500 million years when the planet was entirely resurfaced in a massive event. It spins retrograde (backwards) which causes 2 solar days per year, yet the greenhouse effect keeps the entire planet at about 800°F.



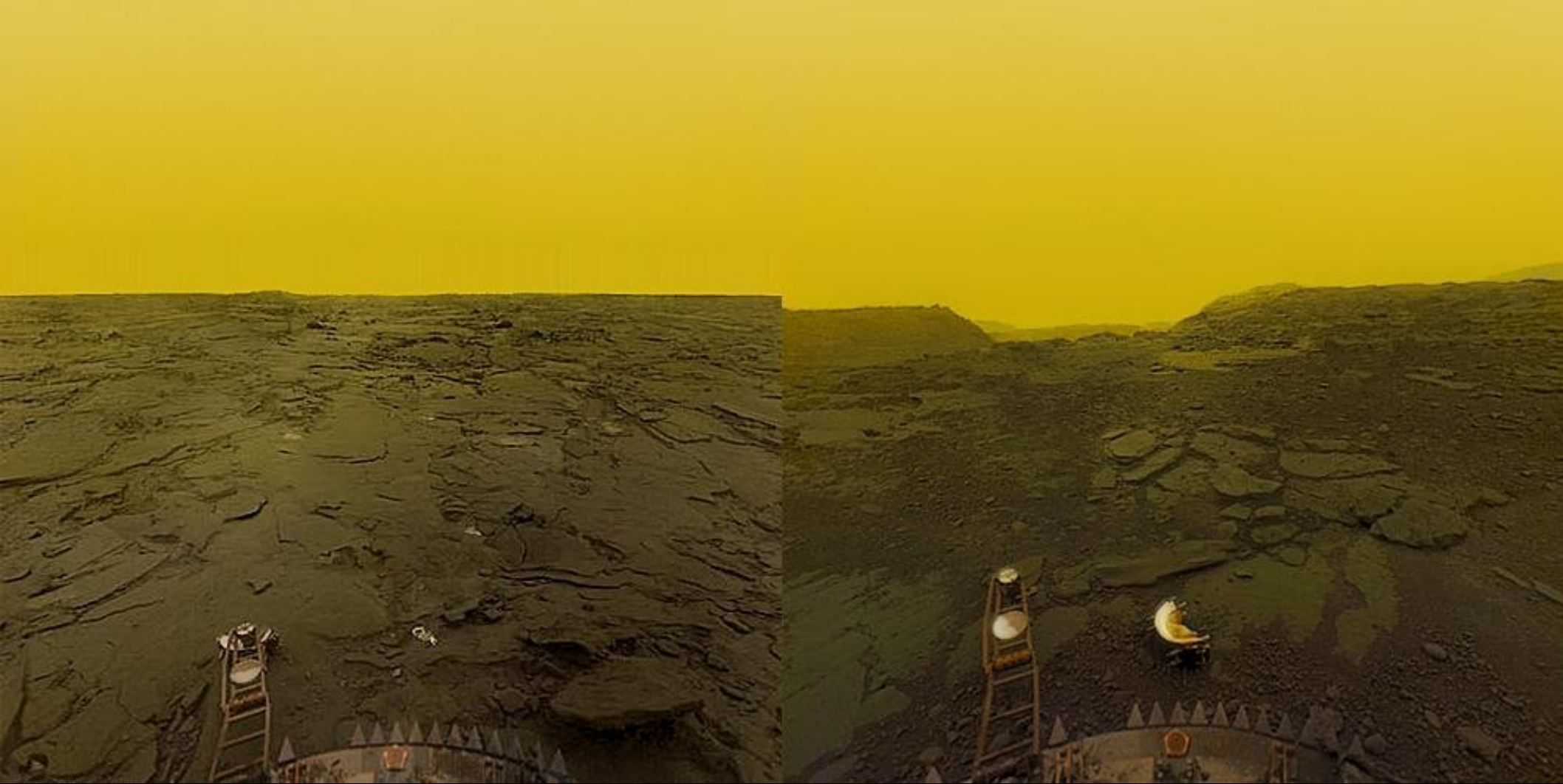
OUTPOST 10 OF SPACE FORUM

Don P. Mitchell

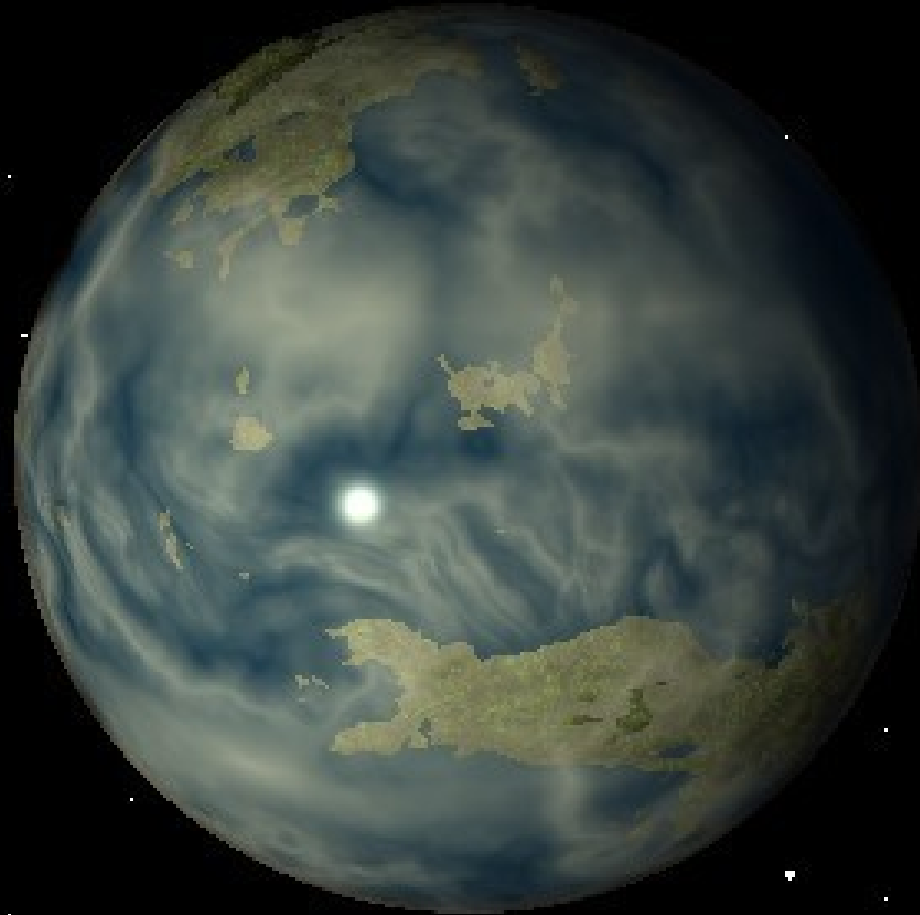


OUTPOST 10f SPACE FORUM

Don P. Mitchell



Venus probably had about as much water as the Earth,
but mostly it has been lost to space.



Uncertainty- liquid on the surface or just steam in the
atmosphere?

Venus missions in progress

Japan's Akatsuki- current.

NASA's DAVINCI planned for 2029

ESA's EnVision planned for 2030

NASA's VERITAS planned for 2031

Time to do the HW1

Please have your homework out to help you answer the multiple choice questions.

This is a test-like situation in that there should be **no talking**. **Do your own work**.

I will show the question, and you can read it while I write the answers on the board. Then I will set the 30 second timer. **That will be the end of time for that question.**

Question 1: What is the ecliptic?

- A) A day on Venus.
- B) Earth's orbital plane.
- C) Mercury's spin around the Sun.
- D) The Moon's evaporative atmosphere.

Question 2: What is the difference between a sidereal and a solar day?

- A) Sidereal=according to the stars, solar=according to the Sun.
- B) Sidereal=orbit (year), solar=spin (day).
- C) Sidereal=spin, solar=orbit.
- D) Sidereal = revolution, solar = spin.

Question 3: What is the structure of
Terrestrial planets?

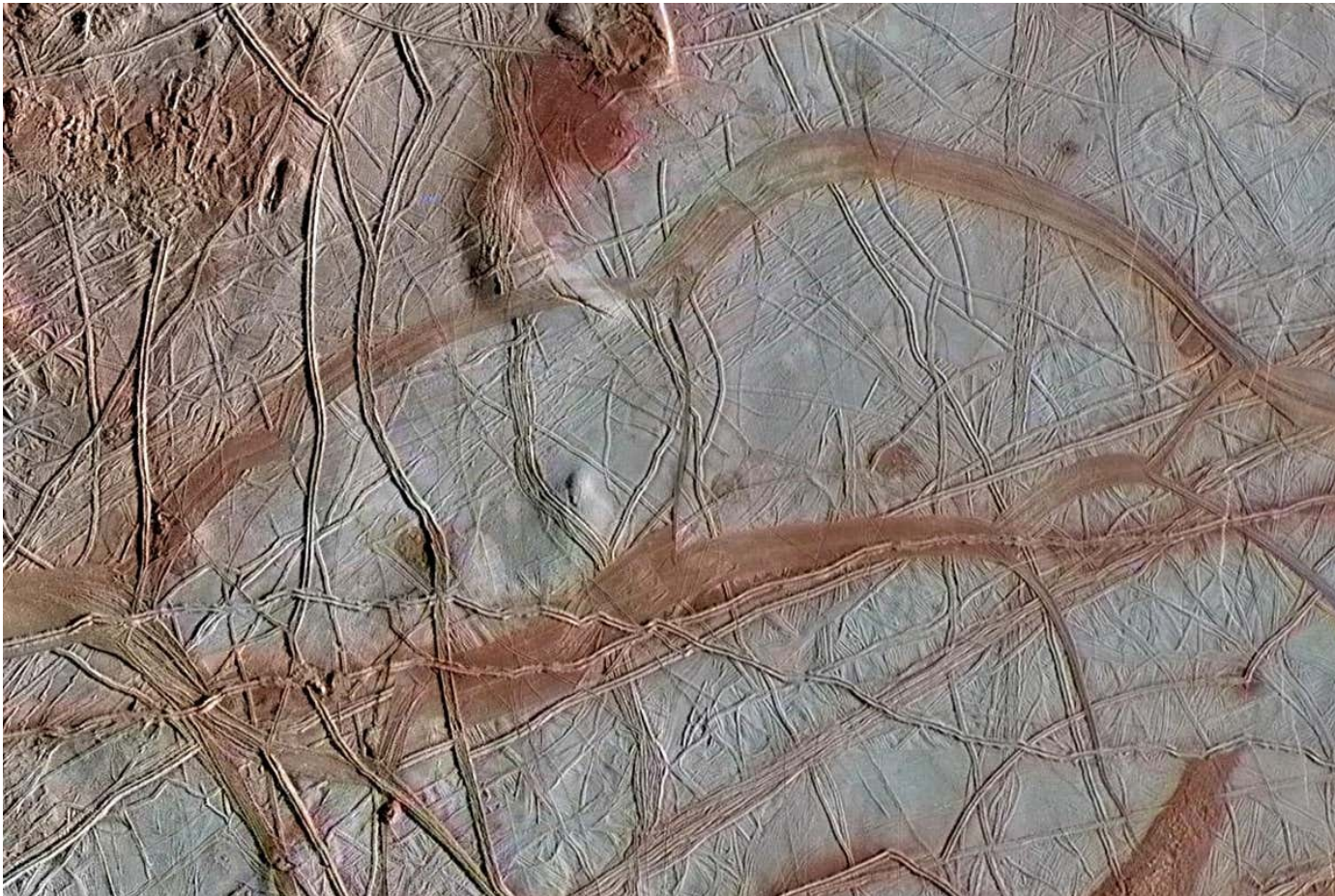
A) Salty oceans, candy land, gummy
centers.

B) Big, huge atmospheres over rocky bits.

C) Thin atmosphere over rocky crust,
rocky mantle, rocky core.

Question 4: Is this a solid, liquid, or a gas?

- A) Solid B) Liquid. C) Gas.
D) None of the others.



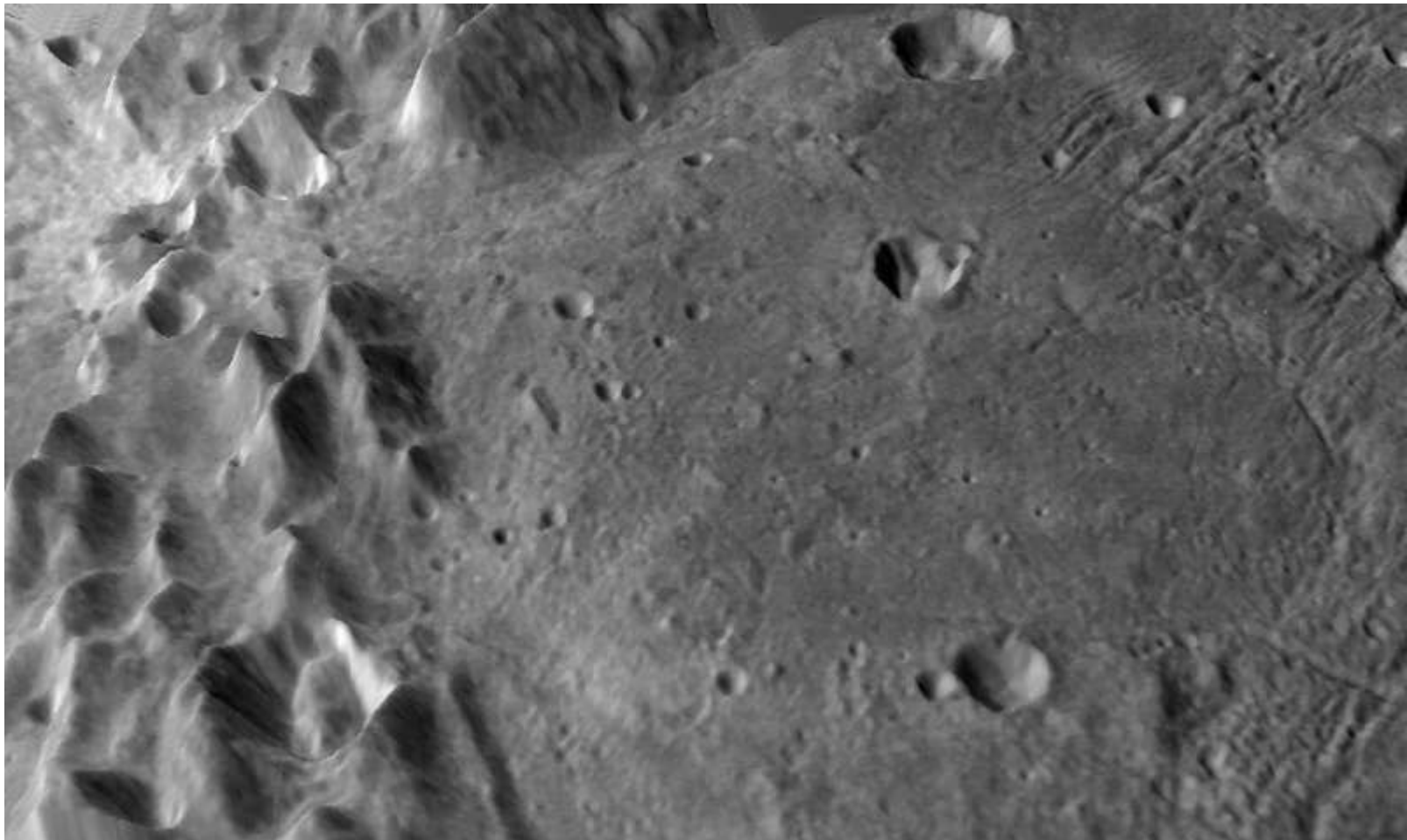
Question 5: About how old is the surface?

A) <few Myrs.

B) 100-300 Myrs.

C) 2-3 Gyrs.

D) 4-4.5 Gyrs



Question 6: Why are there no craters in the image (on Earth)?

- A) The Earth does not get hit by meteorites.
- B) The Earth is made of liquid.
- C) The atmosphere protects us.
- D) Erosion and resurfacing erases/covers them.

Question 7: What is the main difference between the white and brown in the image?

A) Composition.



Question 8: What is the point of science?

A) For mathematicians to have jobs.

B) To understand the world (and universe) around us.

C) To make people feel stupid.

D) To make things up so we can fool the public into giving us grant money.

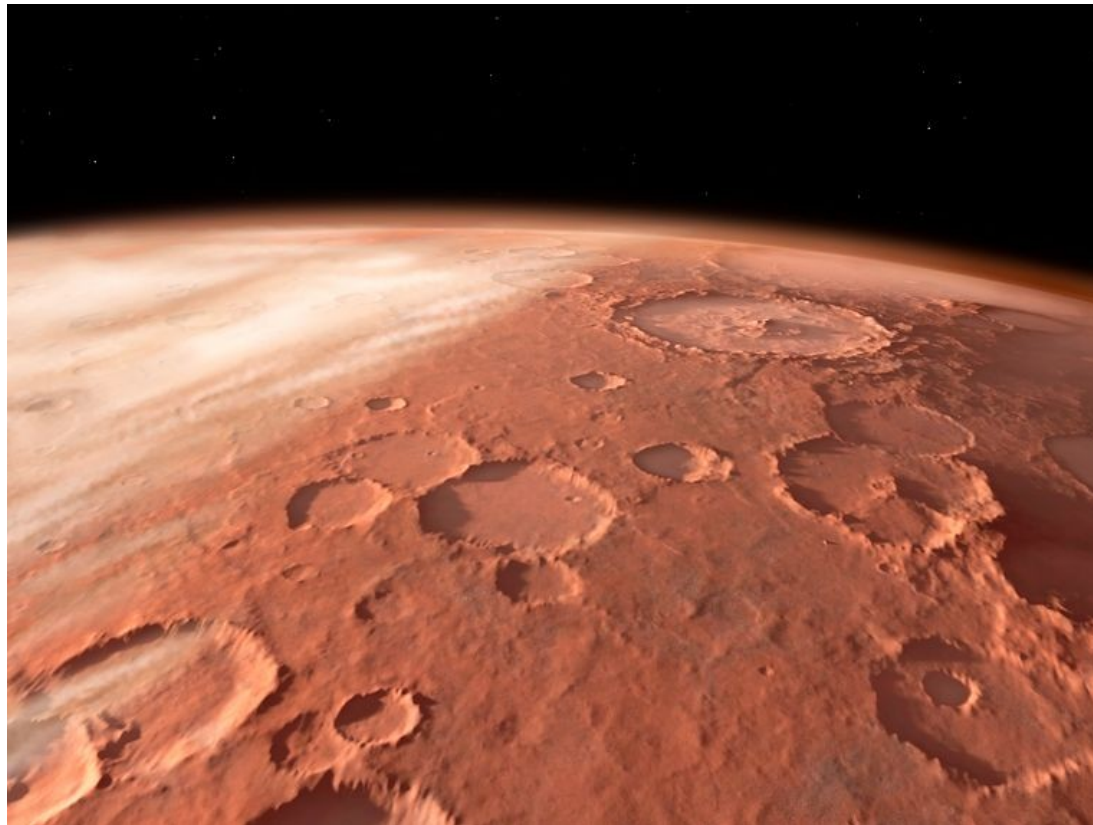
Question 9: About how old is the surface?

A) <few Myrs.

B) 100-300 Myrs.

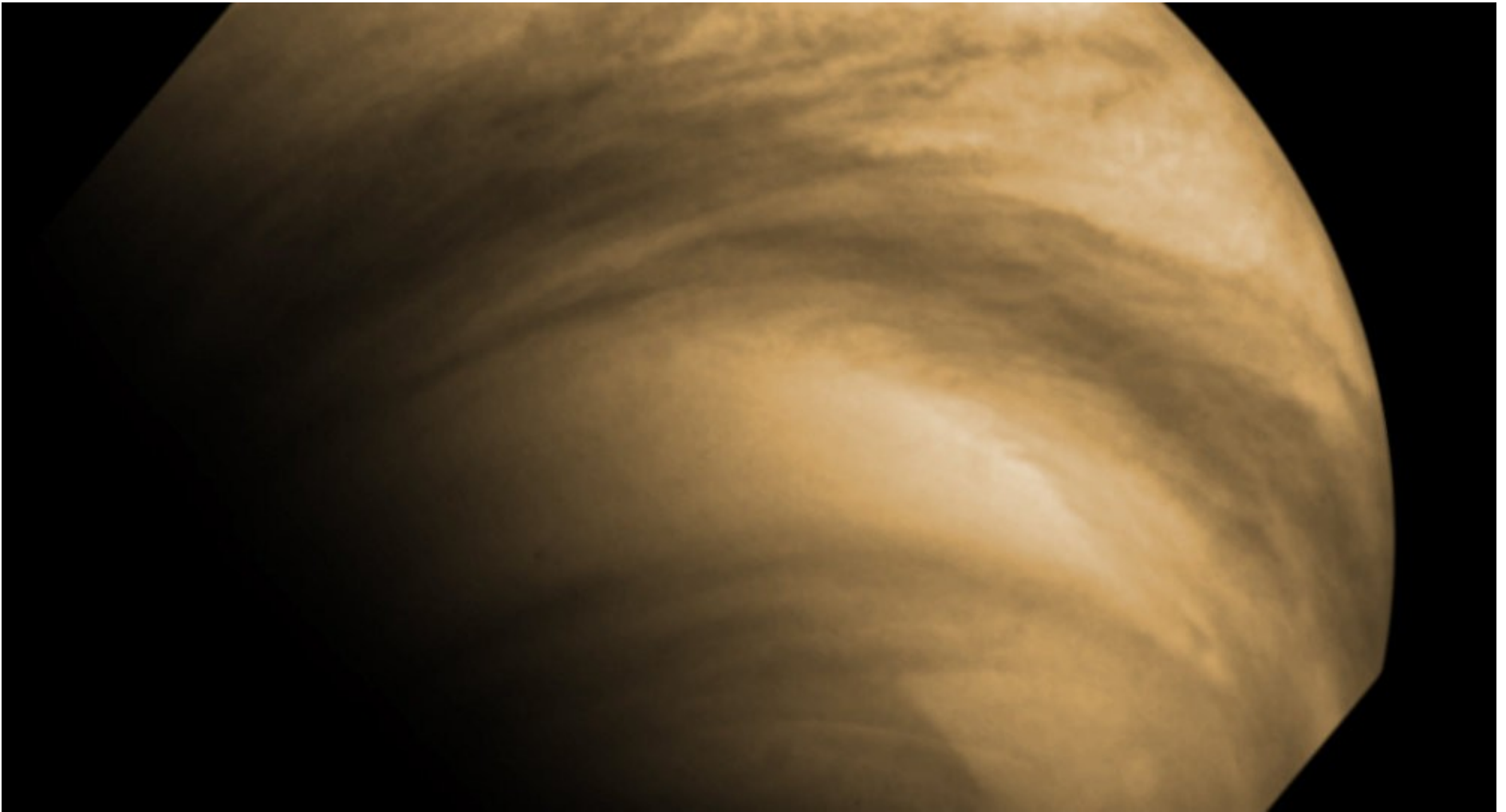
C) 2-3 Gyrs.

D) 4-4.5 Gyrs



Question 10: Is this a solid, liquid, or a gas?

- A) Solid B) Liquid. C) Gas.
D) None of the others.



Question 11: The Earth-Moon system has been the same (rotation/orbital periods and distance between them) since they were formed.

A) True.

B) False.

Done

Be sure to have your complete name and row letter on your homework.

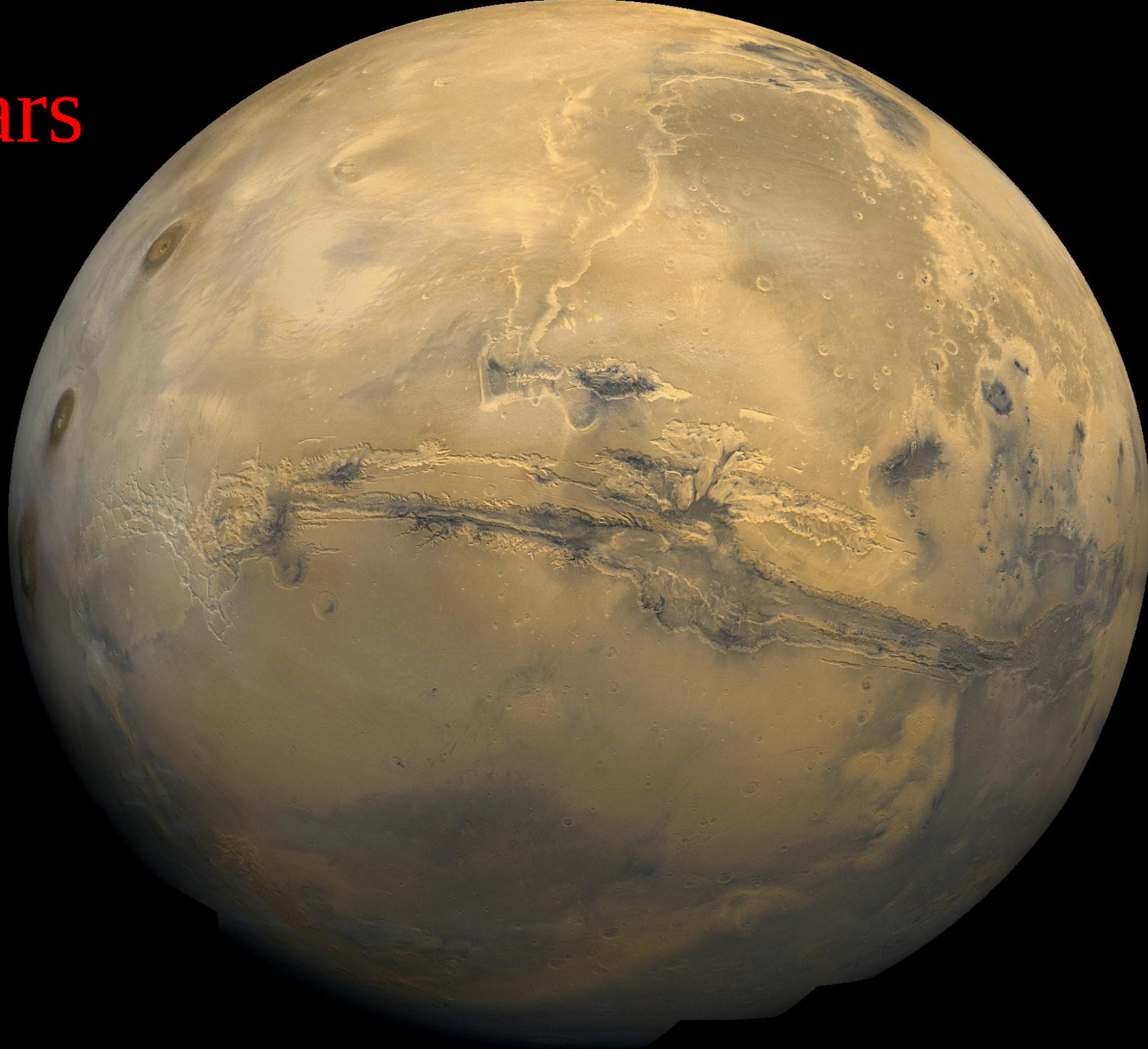
Pass it to your right.

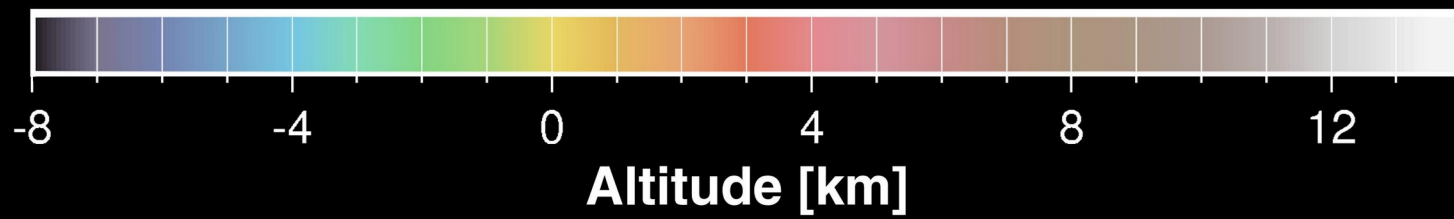
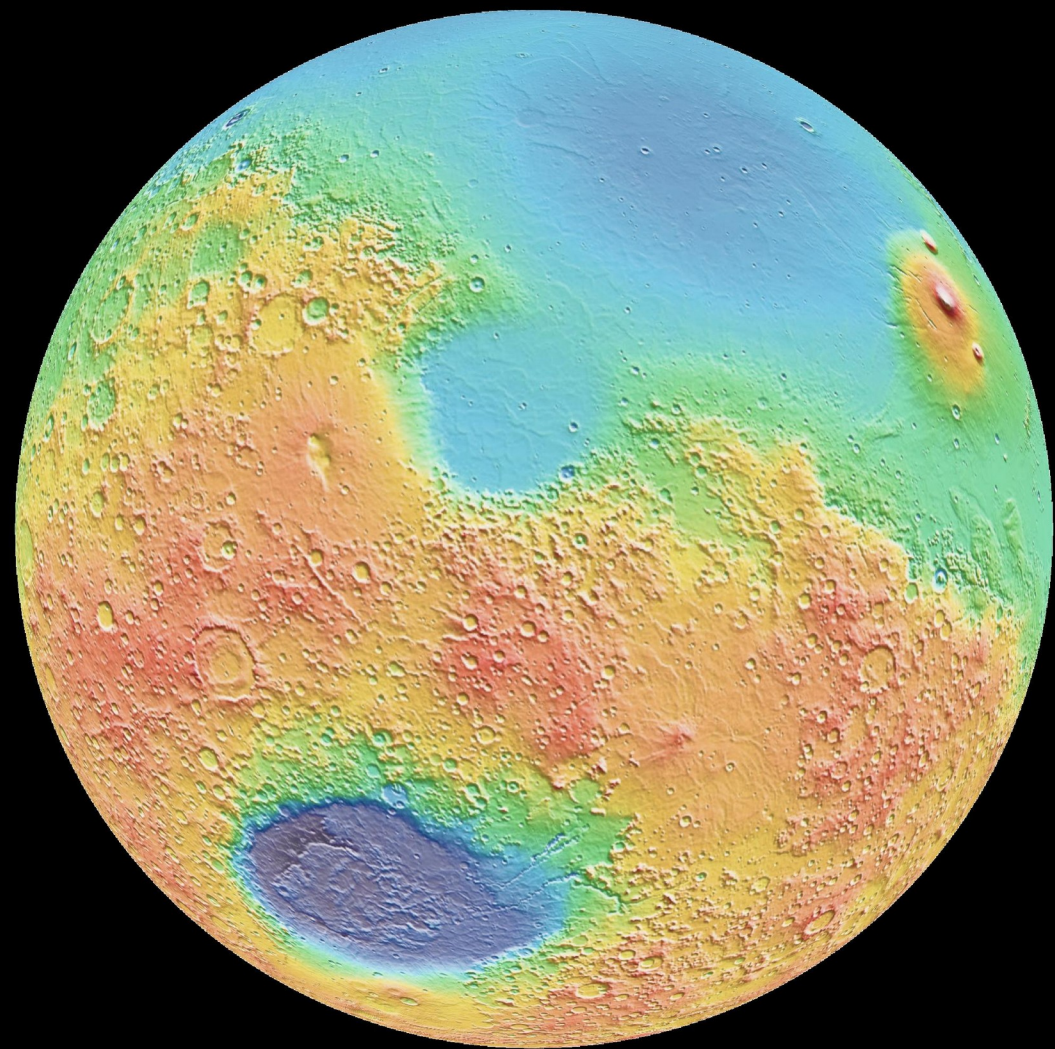
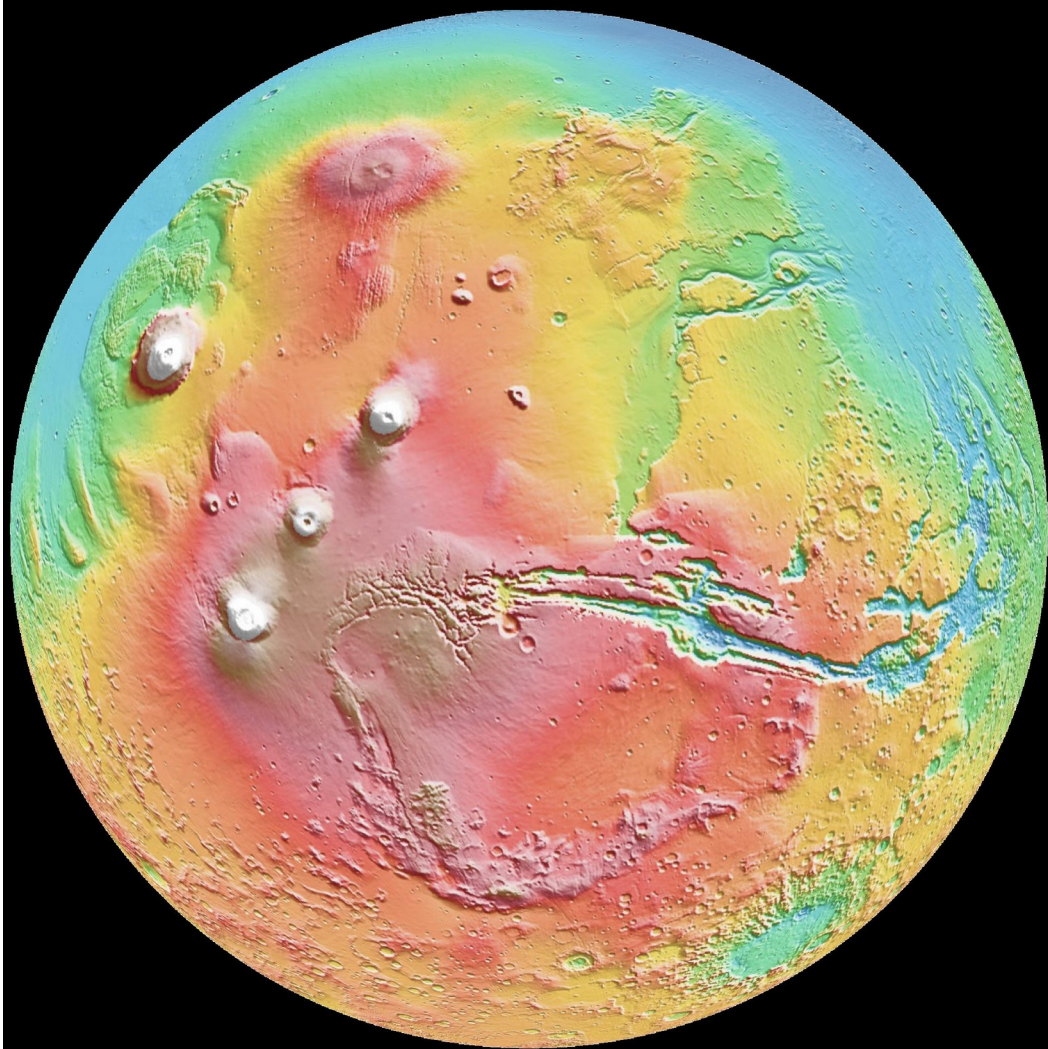
In 1 week I will post solutions and pass back this homework.

Late work accepted for $\frac{1}{2}$ credit

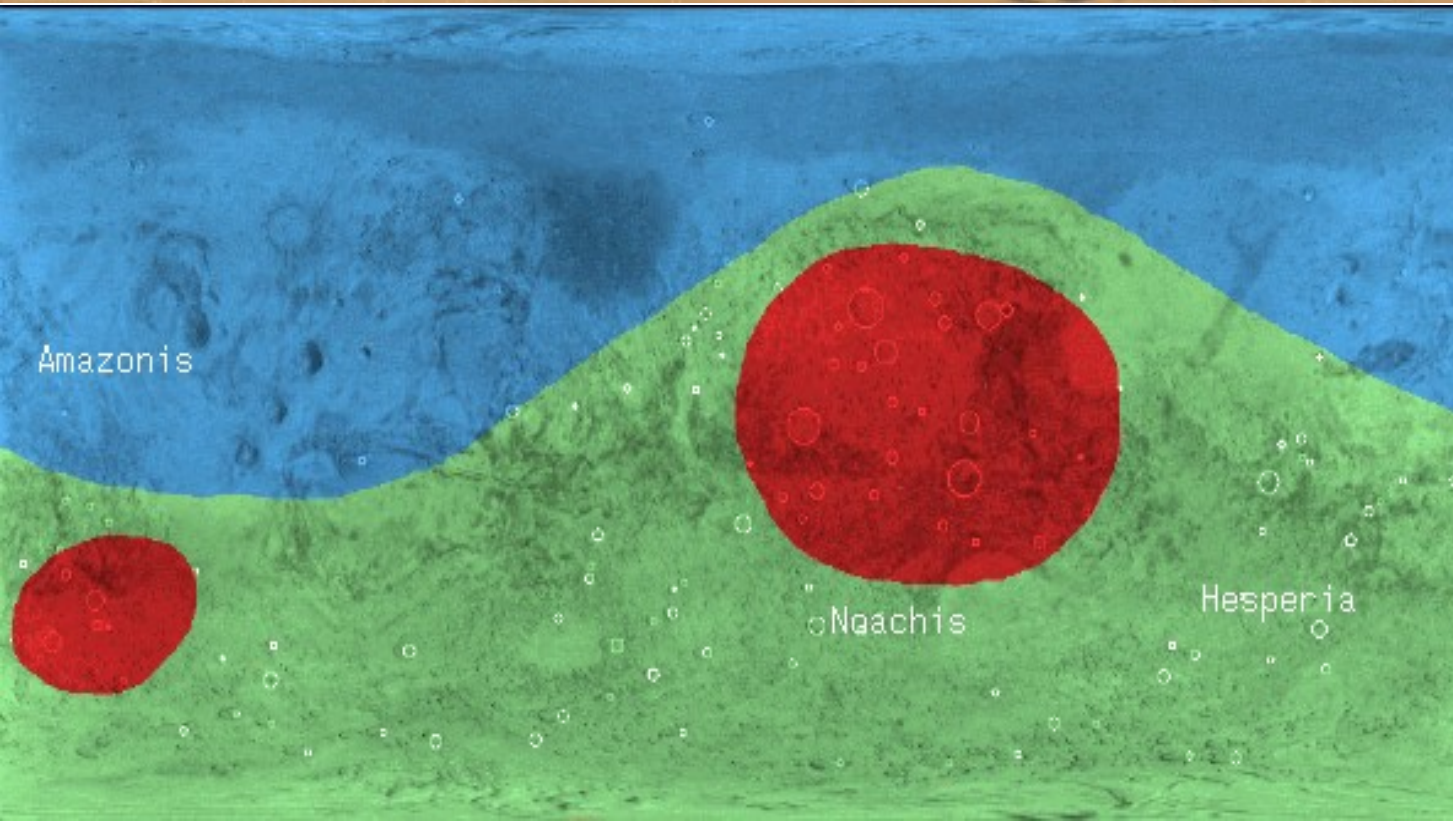
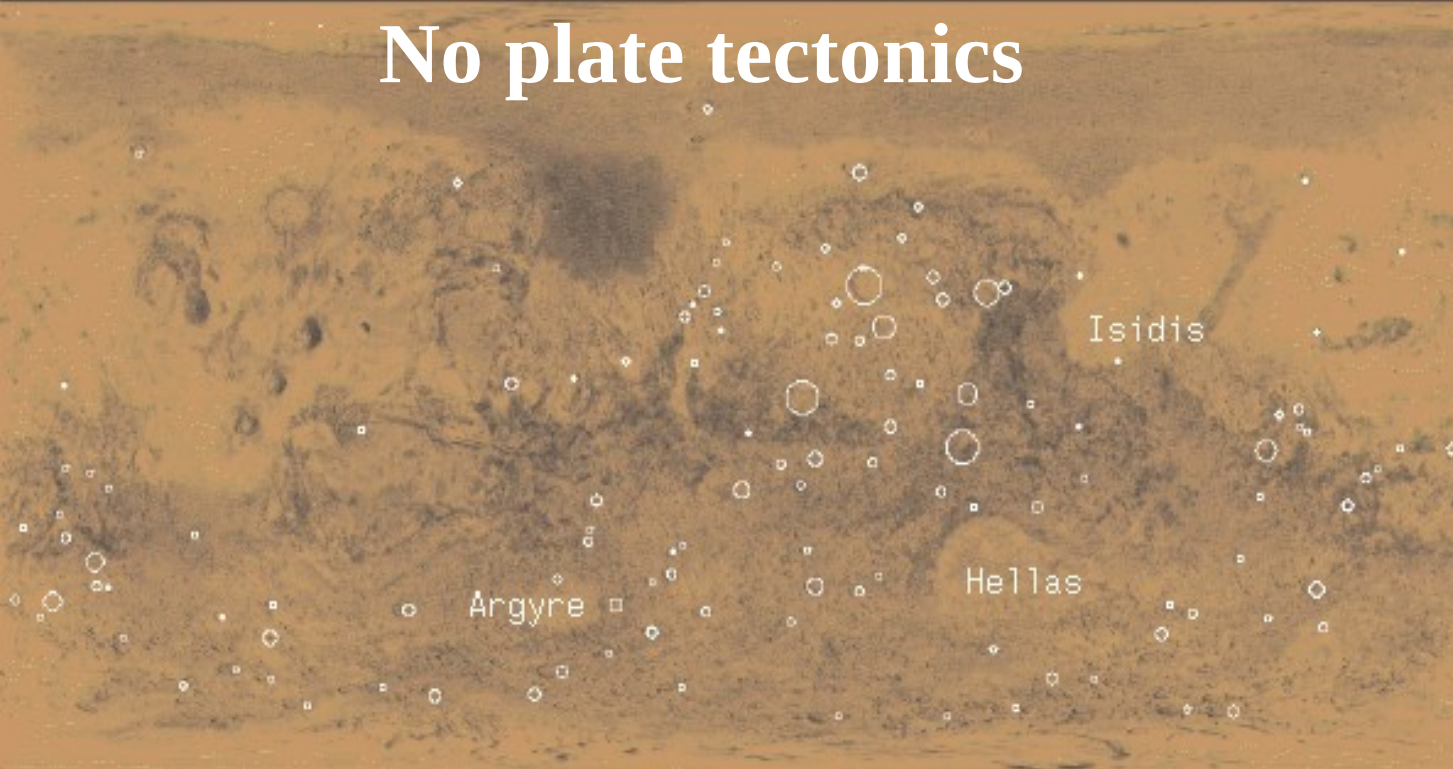
No late work accepted after solutions are posted and hw is handed back.

Mars





No plate tectonics

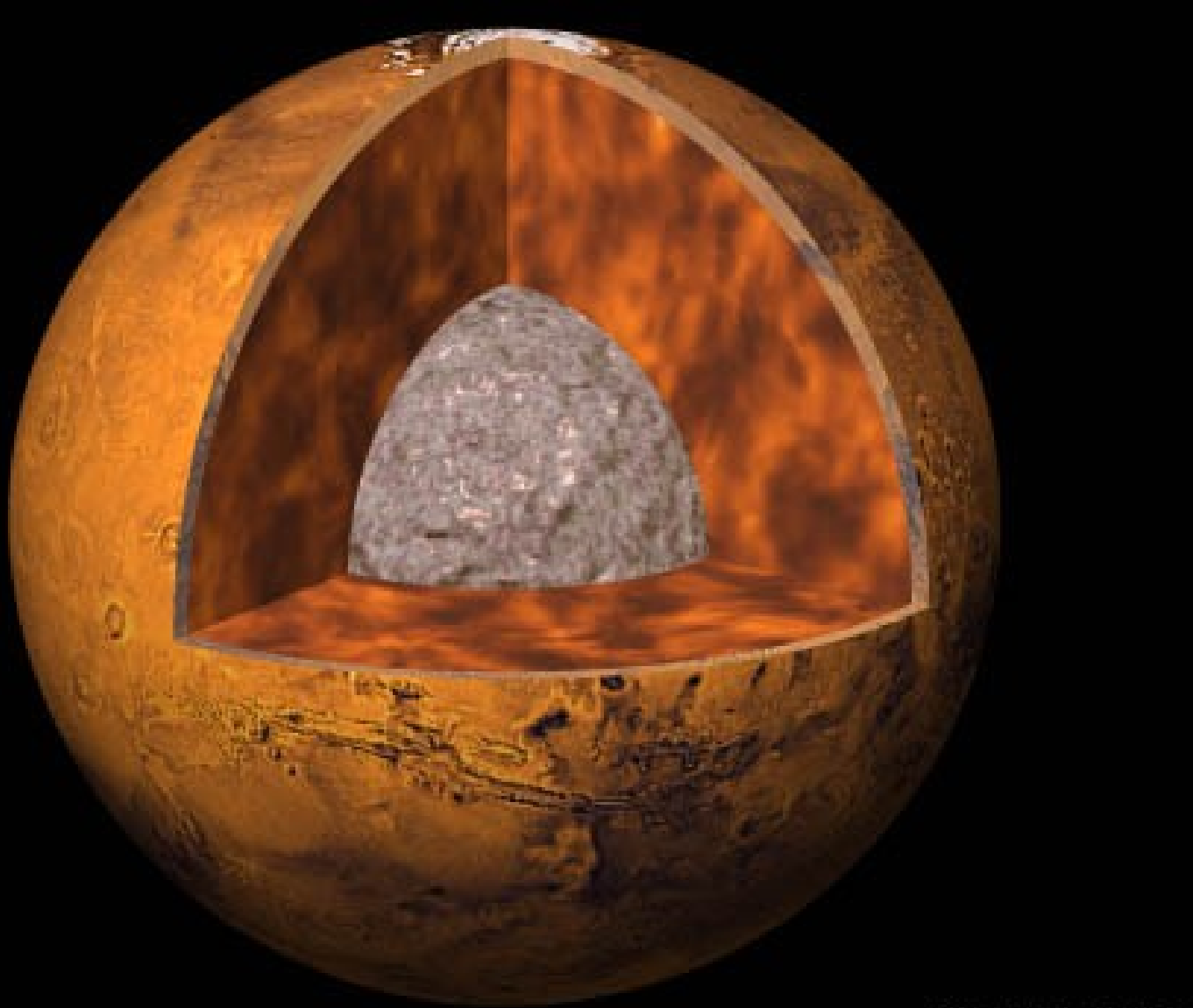


The blue areas are around 1.2 billion years old and the red ones are about 4 billion years old. The green is between 3 and 4 billion years old.

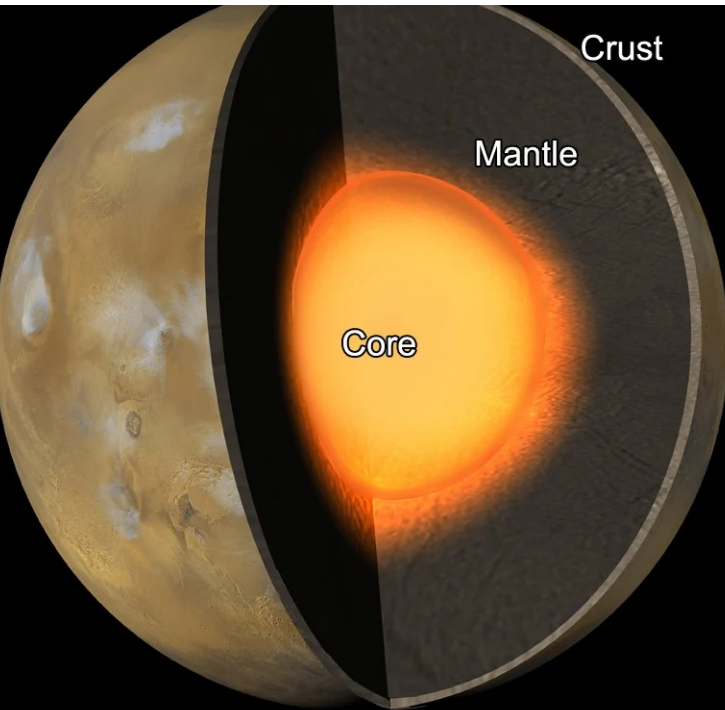
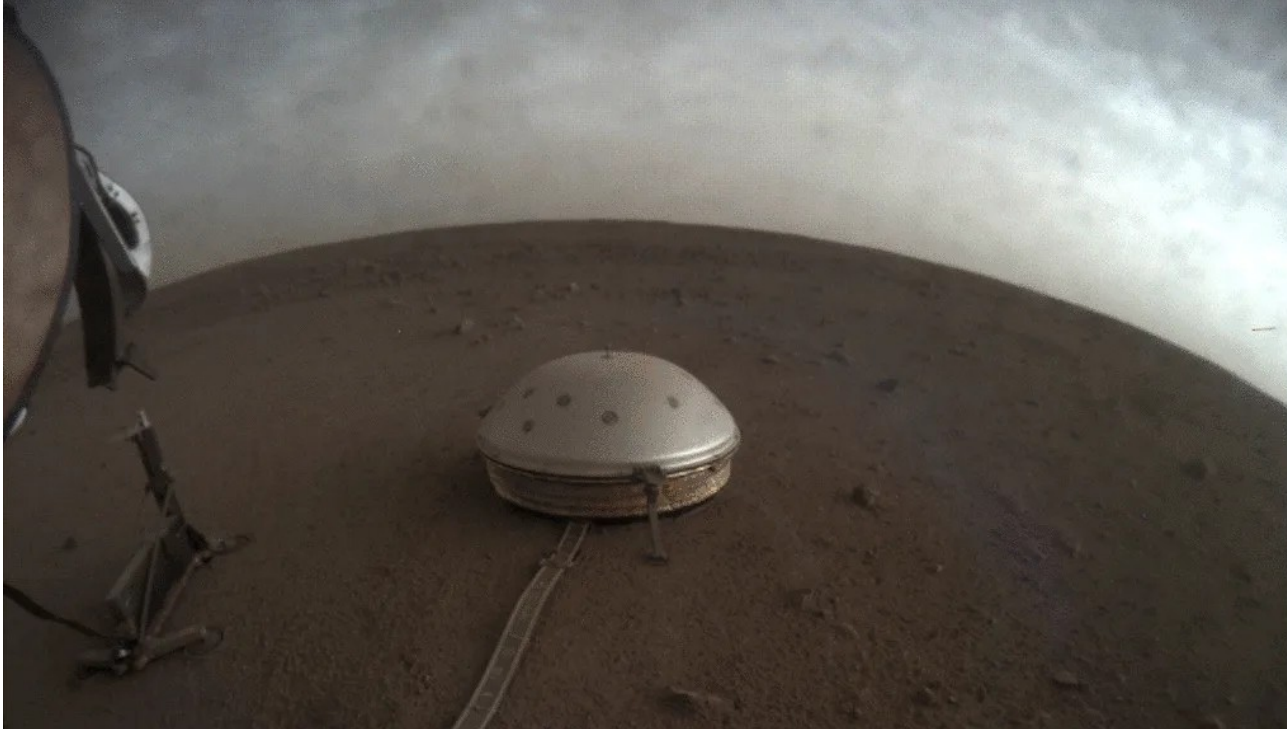
Now with radiometric dating!!!!

Mars interior:

- 1) Crust- much like Earth's
- 2) Mantle- again much like Earth's, but a little less dense
- 3) Core- probably smaller than Earth's or made out of lighter material



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



The Interior of Mars

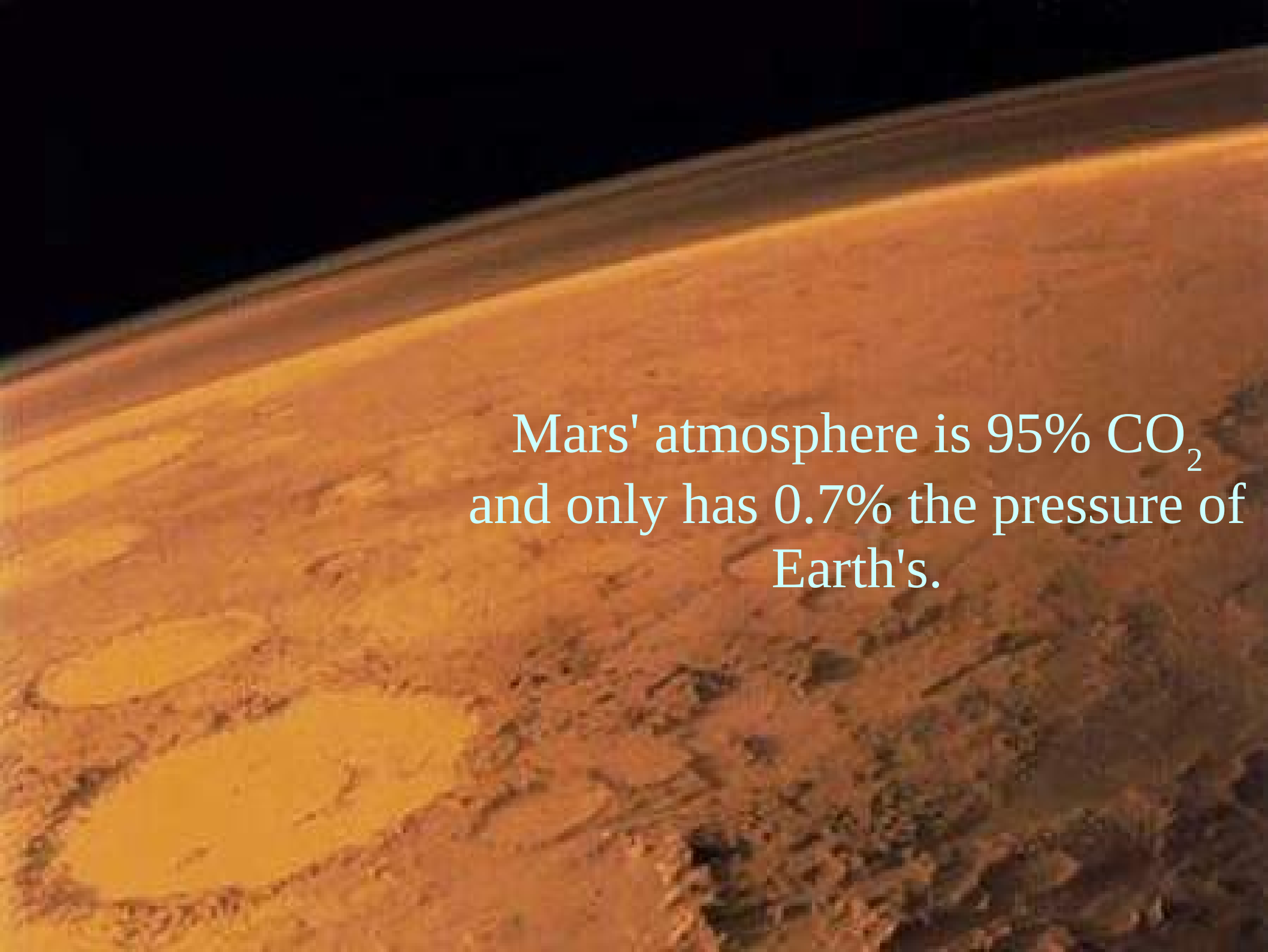


Mohorovicic Discontinuity (Moho) ~ 35 km

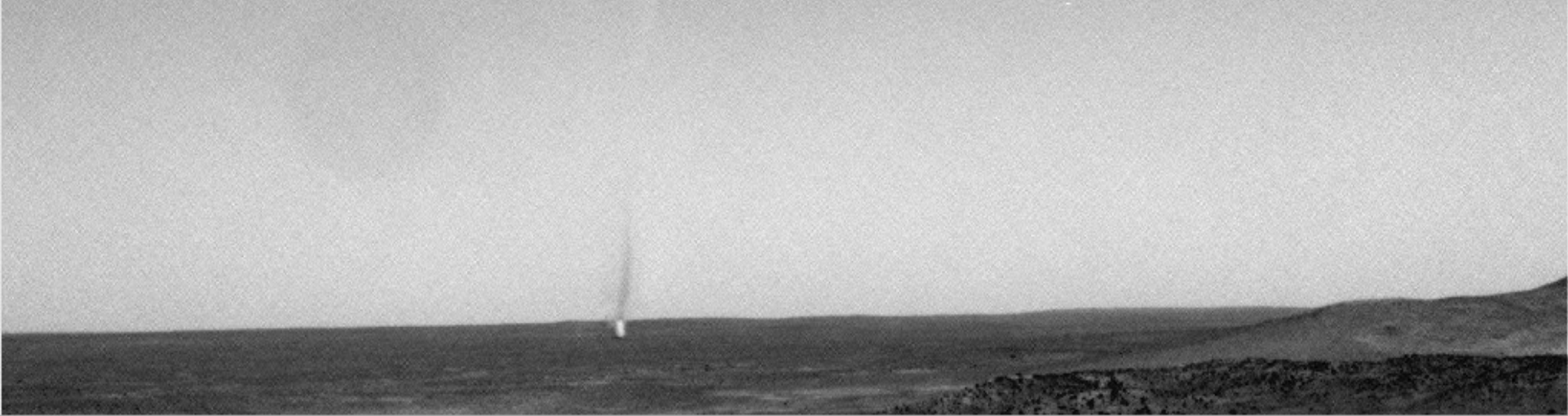
Olivine-Wadsleyite Transition - 1140 ± 30 km

Core-Mantle Boundary - 1520 ± 40 km

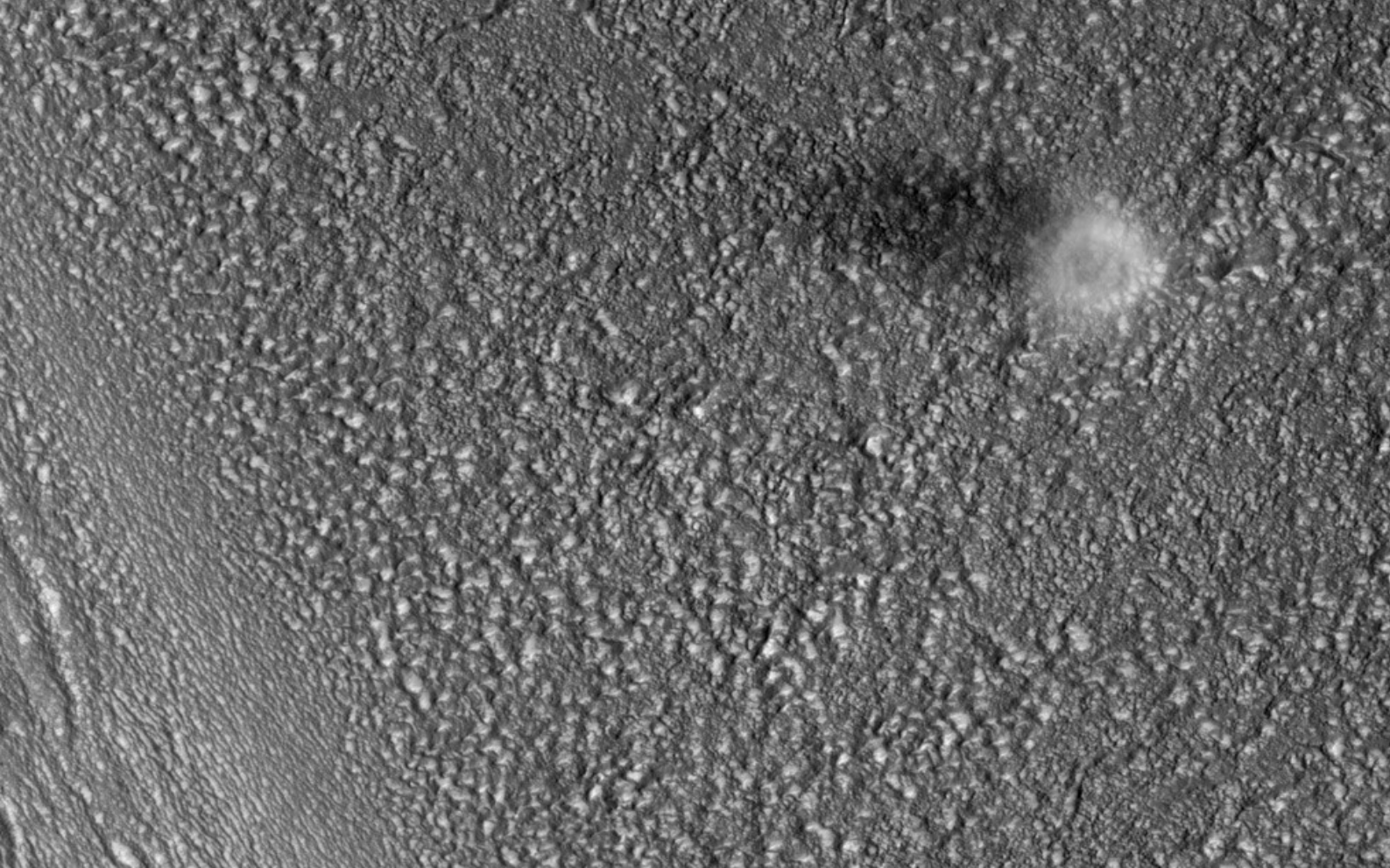
Seismic signal from SEIS, NASA InSight
Deng & Levander, 2020



Mars' atmosphere is 95% CO₂
and only has 0.7% the pressure of
Earth's.

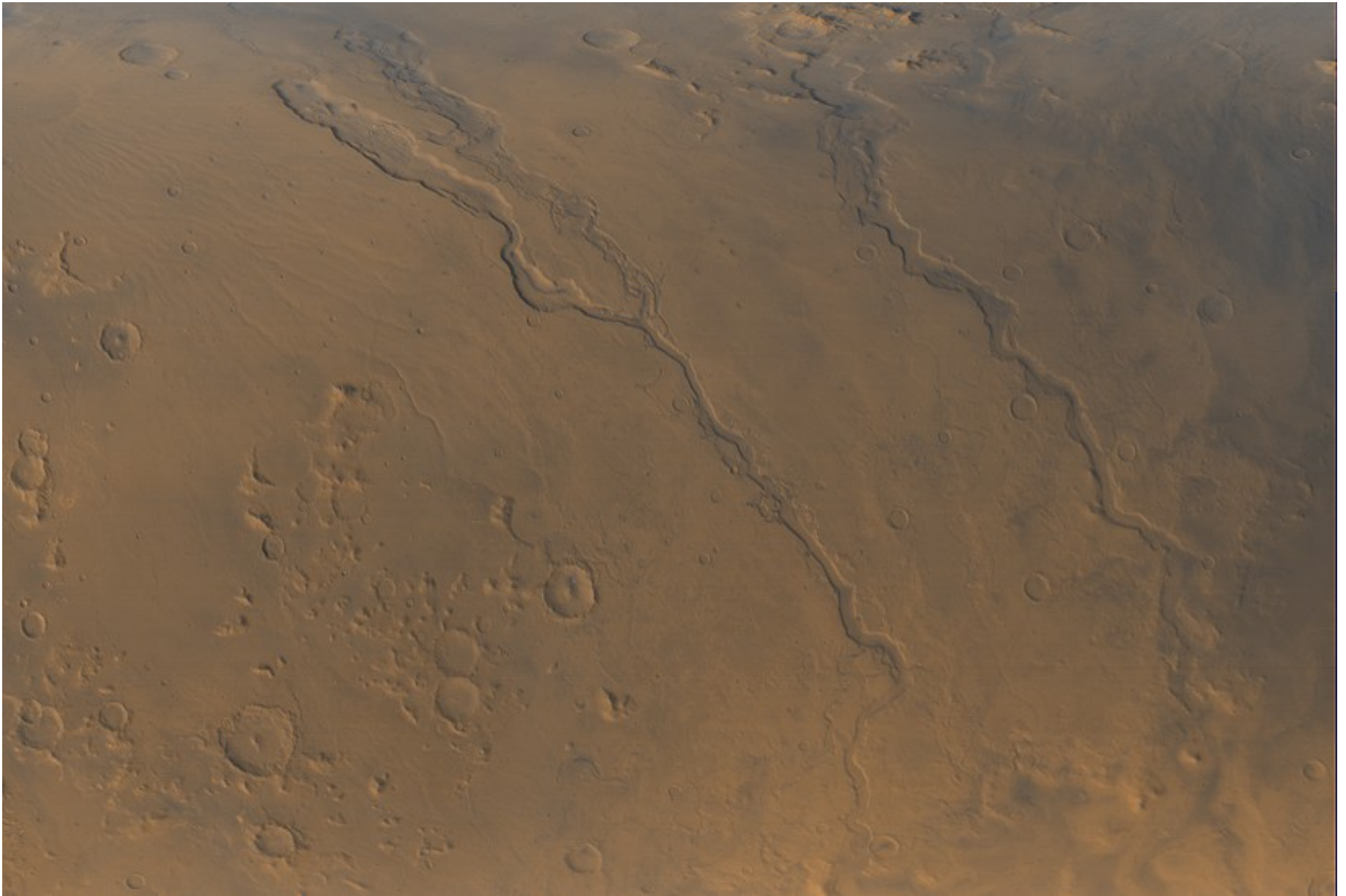


0000



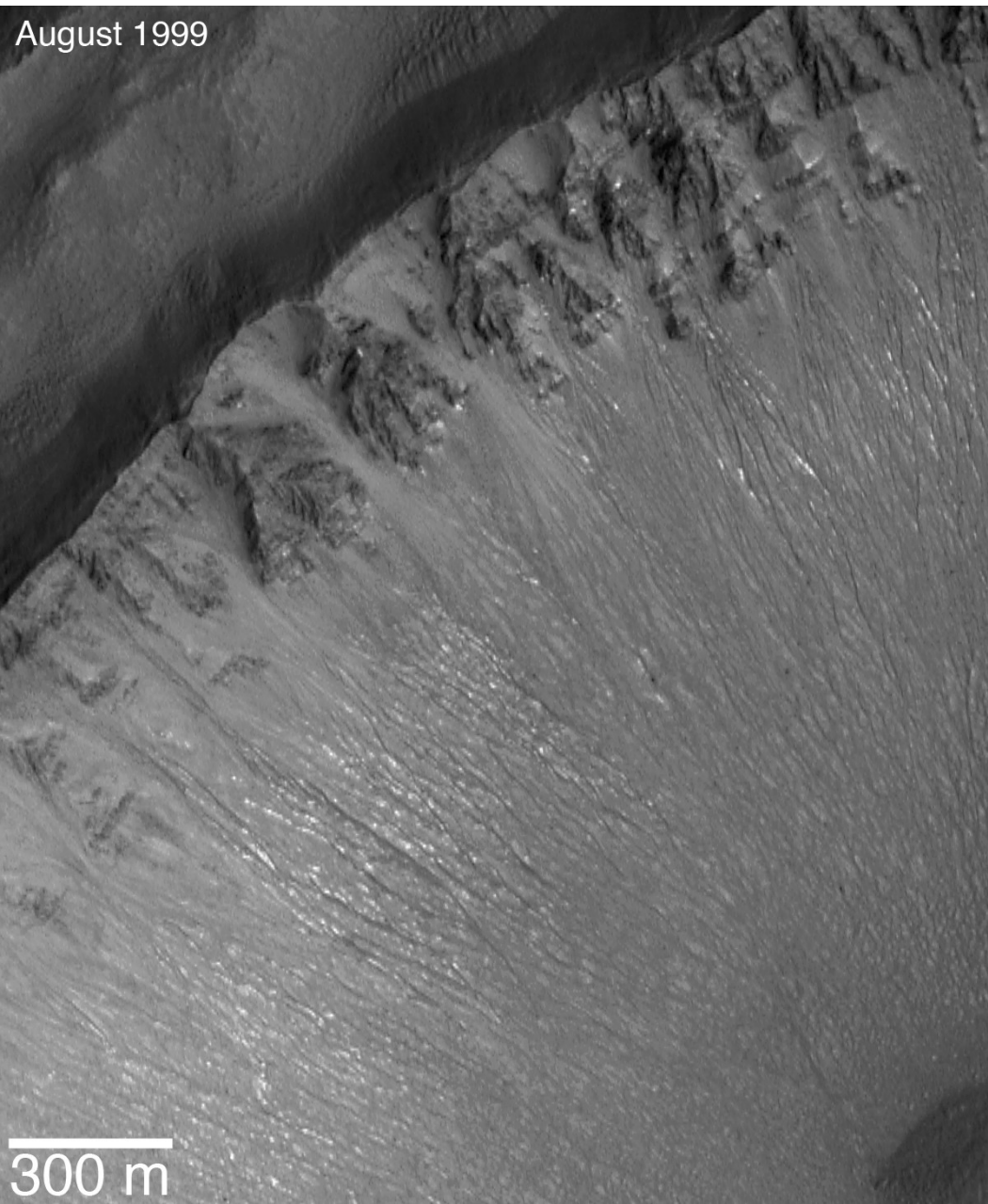
Storms can completely cover Mars with dust clouds. Wind and water erosion are evident on Mars.

Good evidence that there was once lots of water on Mars.



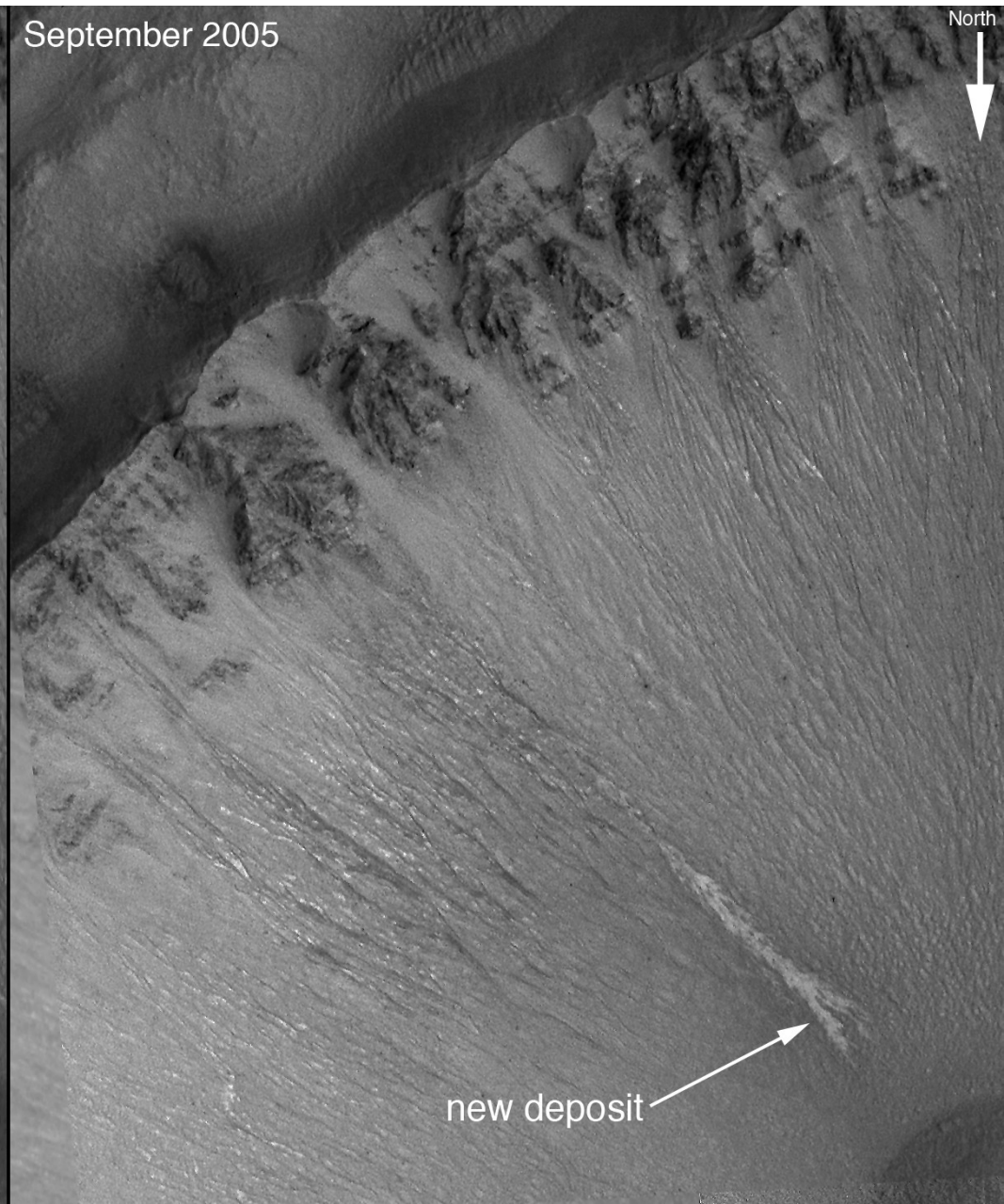
Water is currently (occasionally) flowing on Mars' surface!

August 1999



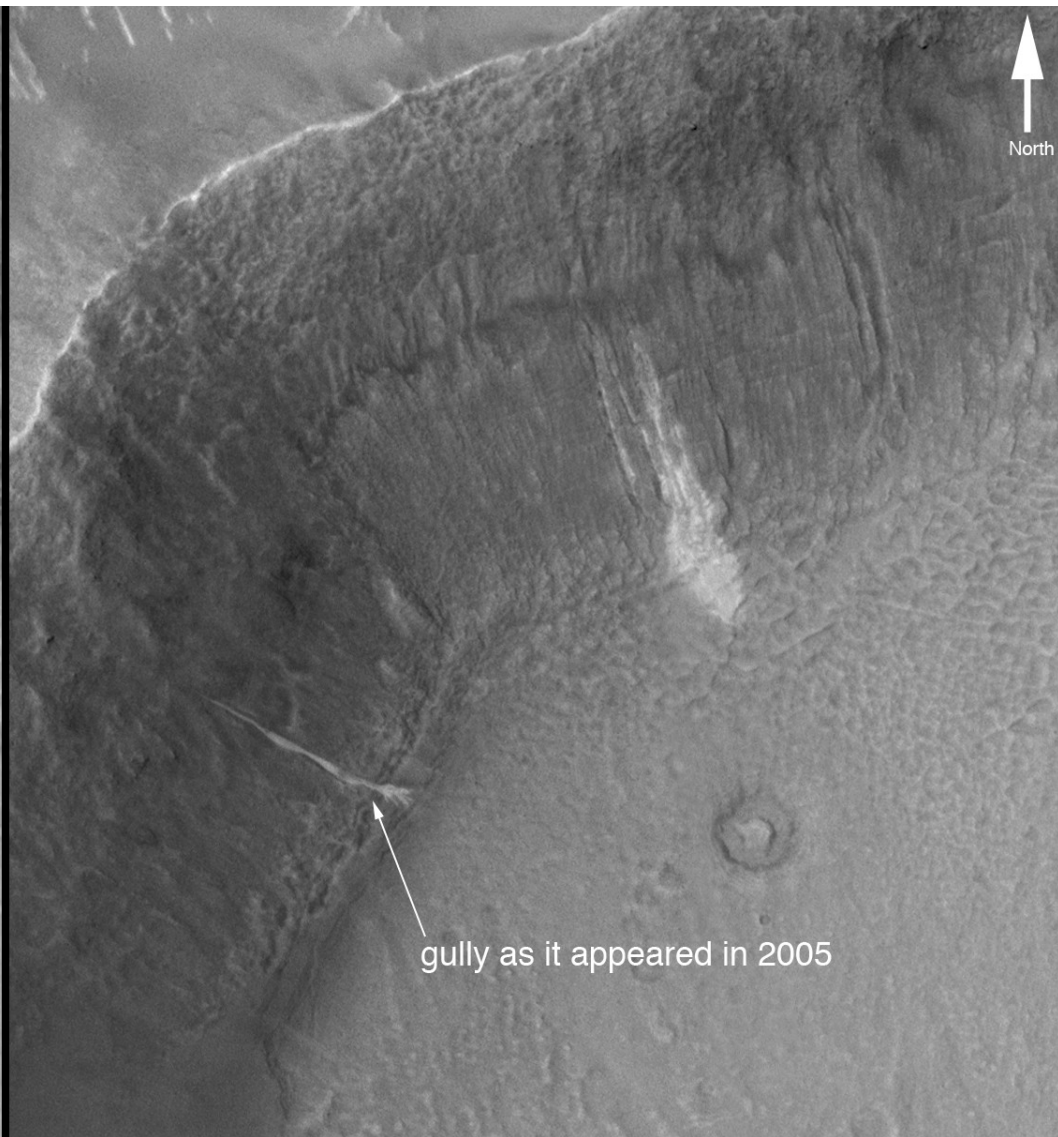
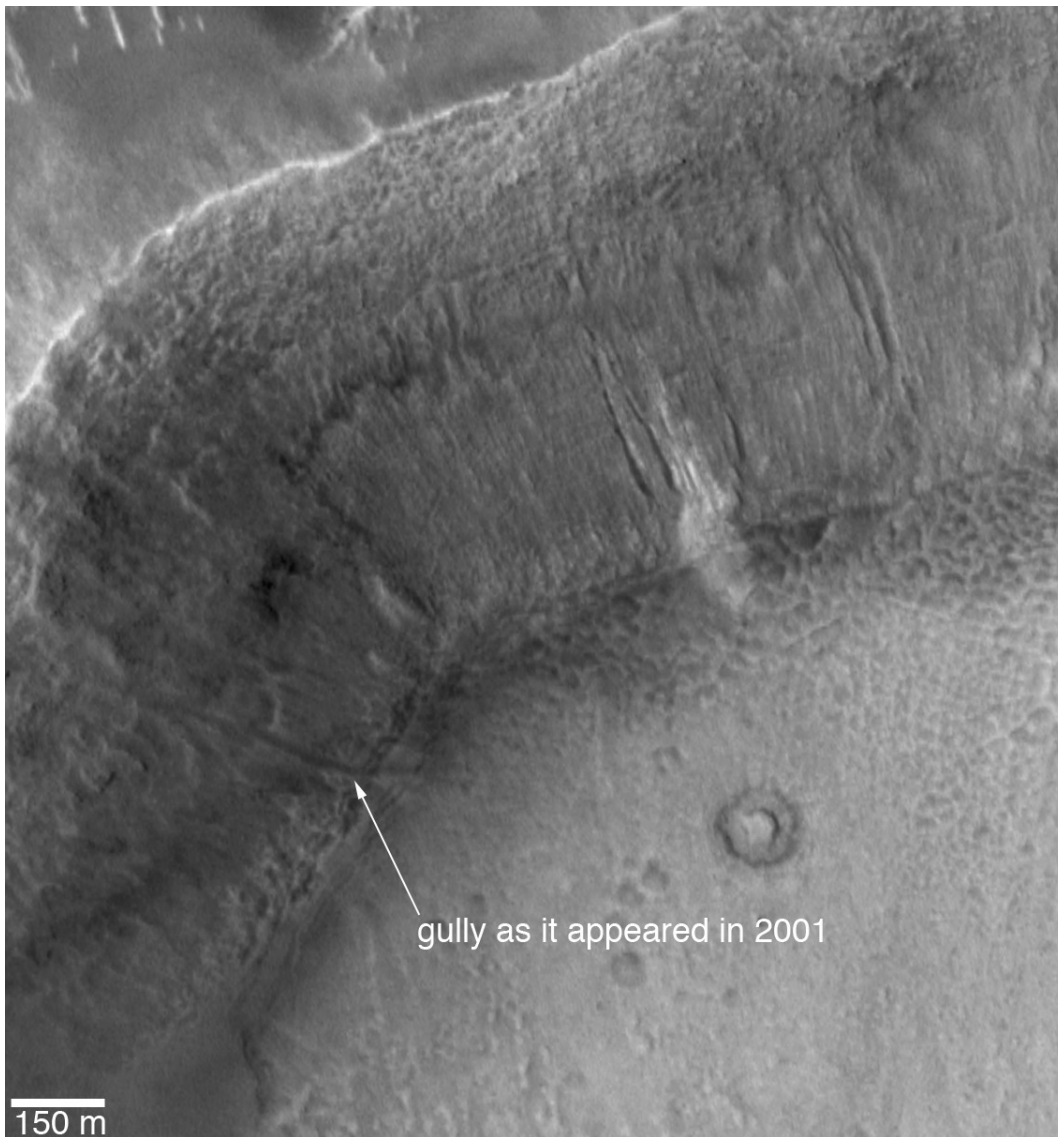
300 m

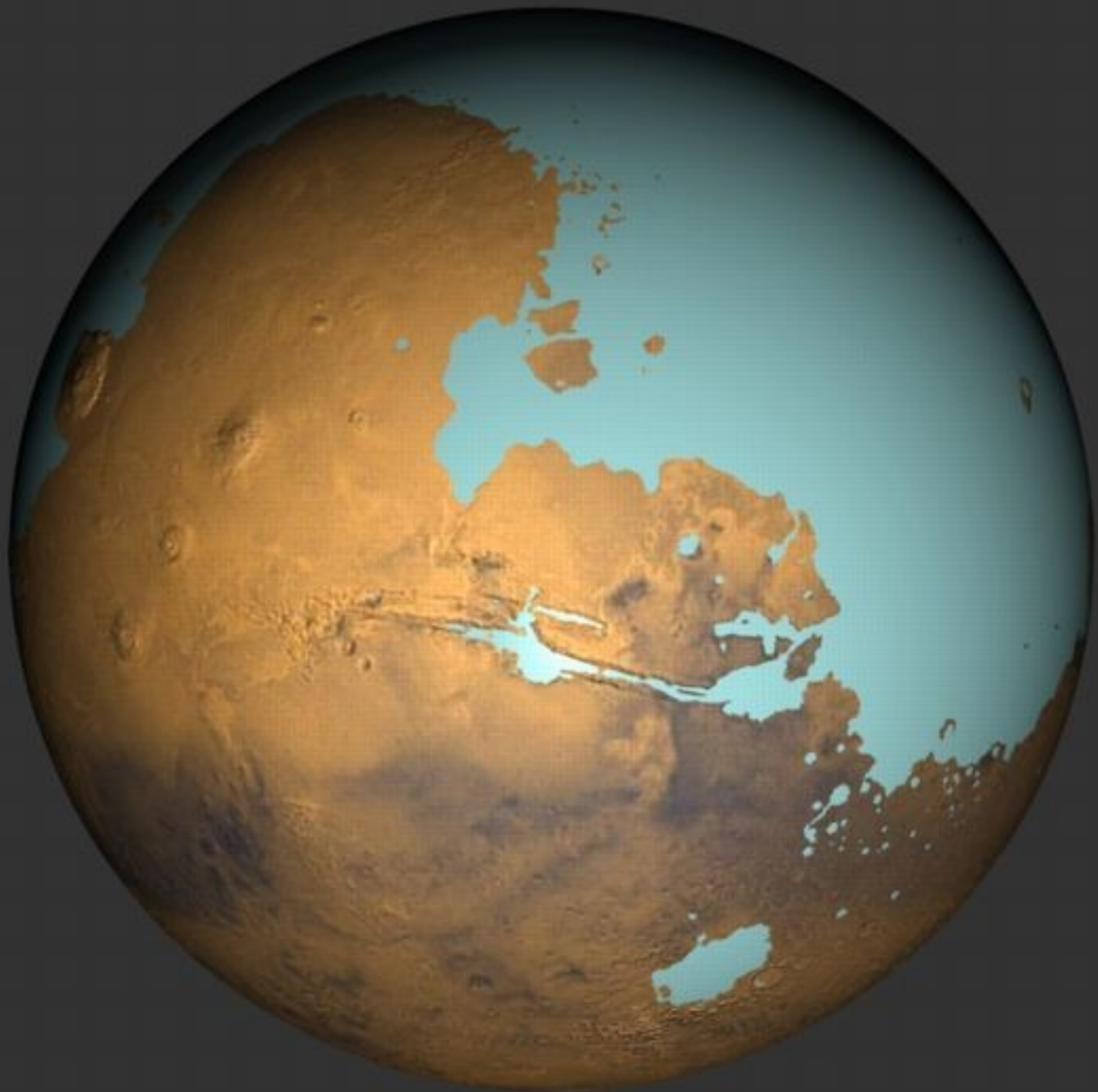
September 2005



new deposit

North







4.0



3.8



3.5



2.0



1.0



Now