

# Astronomy 100

Chapters 20, 21:  
Moon, Mercury, Venus

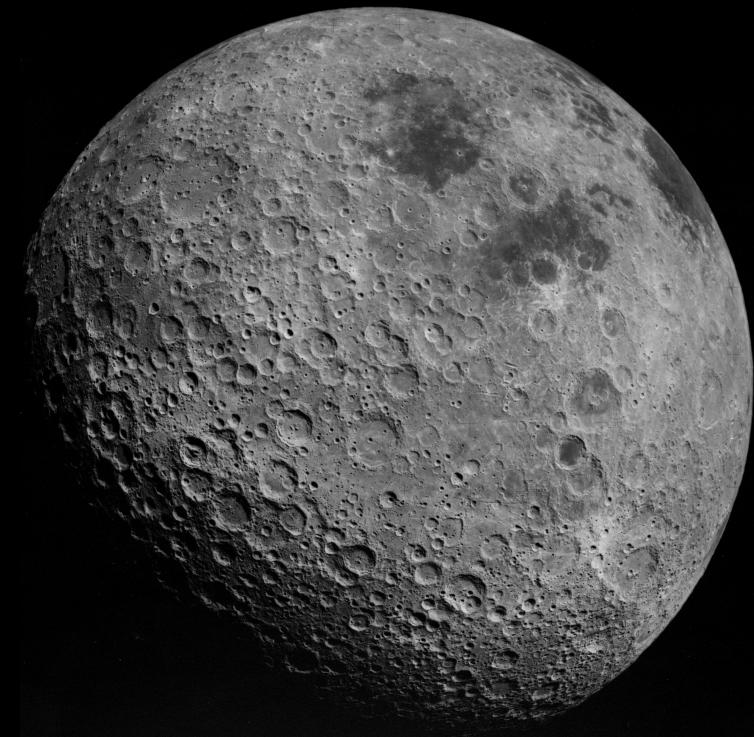
Vera Gluscevic

# The Moon

# Evolution of the Moon

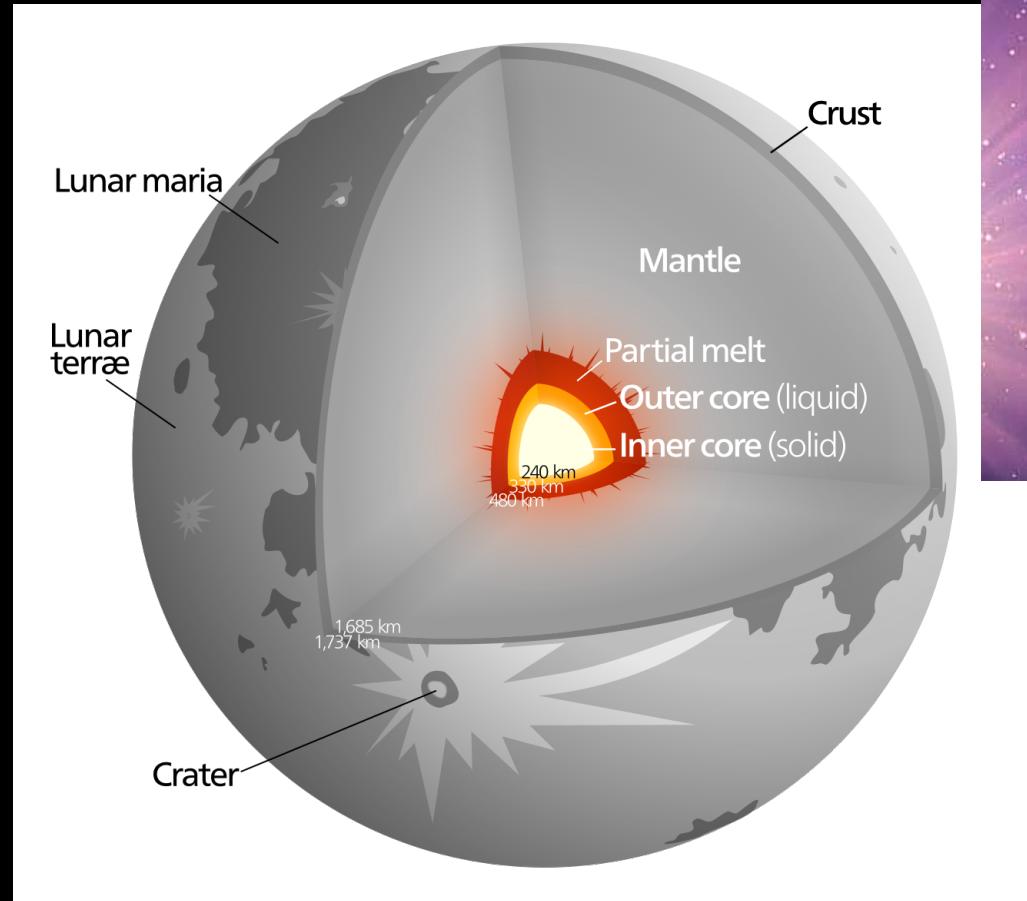
## Earth's Moon

- Moon is “tidally locked” to Earth and shows the same side to Earth (the near side is on the left).
- Formed about 4.4 Gya.



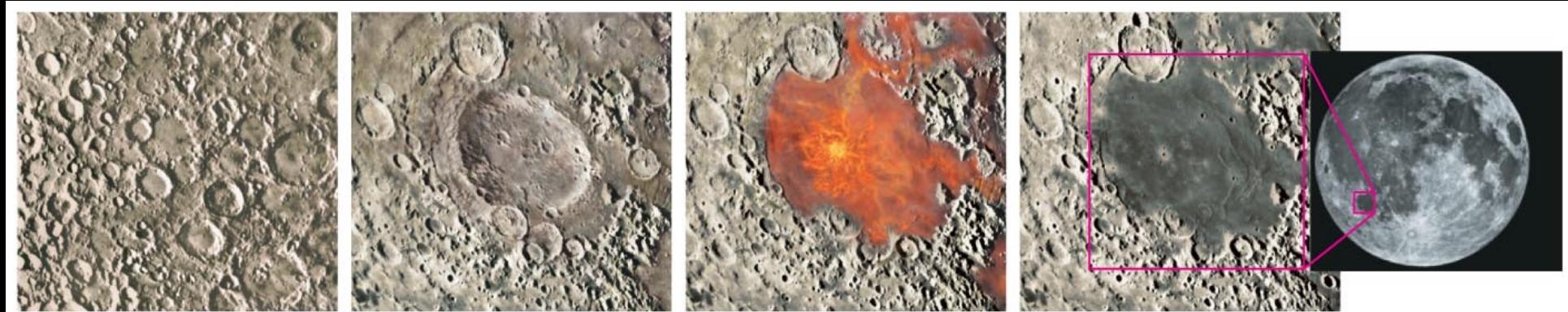
# What's Inside?

Moon has a small core (partly liquid) and is no longer geologically active.



# The Lunar Maria

- Lunar “maria” (seas) formed right after the period of late heavy bombardment, when hot magma from underneath Moon’s thin crust seeped out, filling the impact craters.



# Fine dust from micrometeorites

The Moon's surface is constantly bombarded with micrometeorites that slowly pulverize Moon rocks, creating a coating of fine dust---**lunar regolith**.

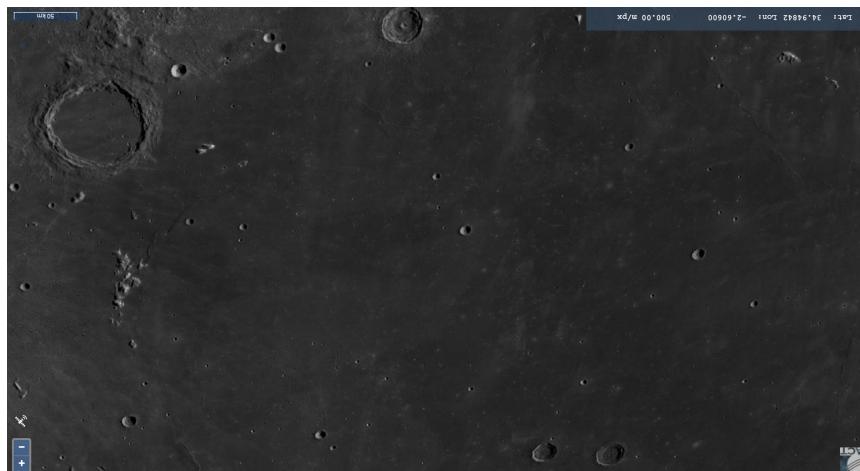


# question for you



Which surface is younger? Younger surface would be changed in a more recent geological history.

A



B

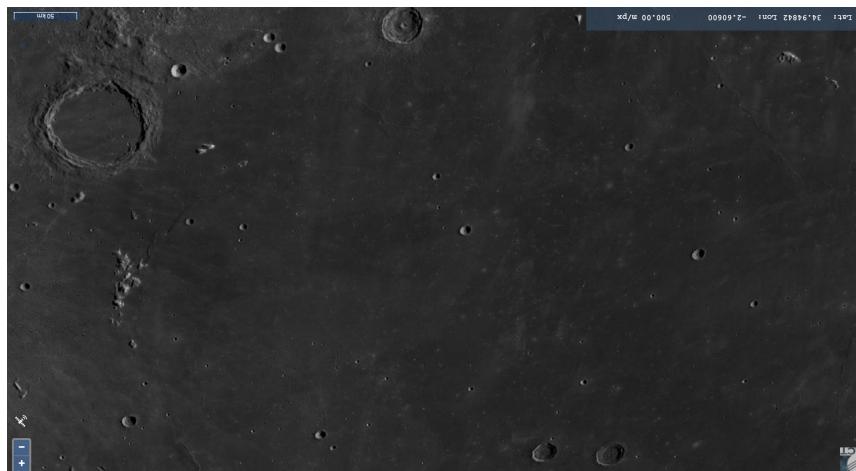


# question for you



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A



B



# Crater Counting

The more cratered a surface, the older it is (think late heavy bombardment!).



Mare region is younger – fewer craters.

[quickmap.lroc.asu.edu](http://quickmap.lroc.asu.edu)

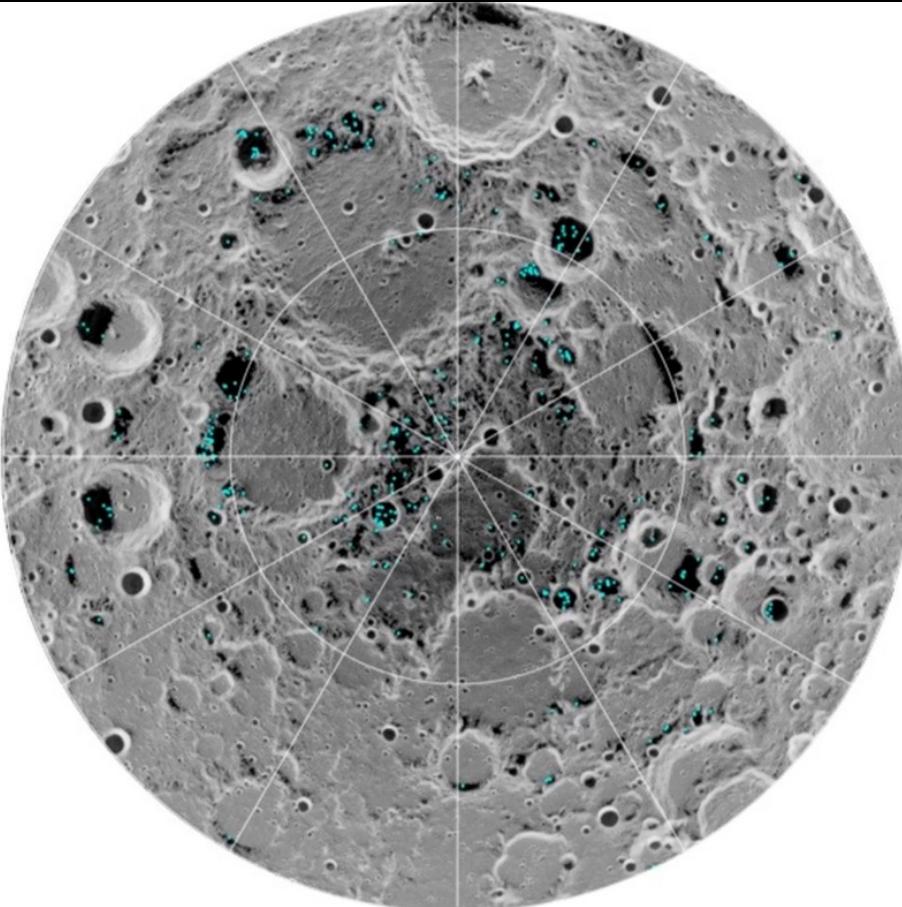
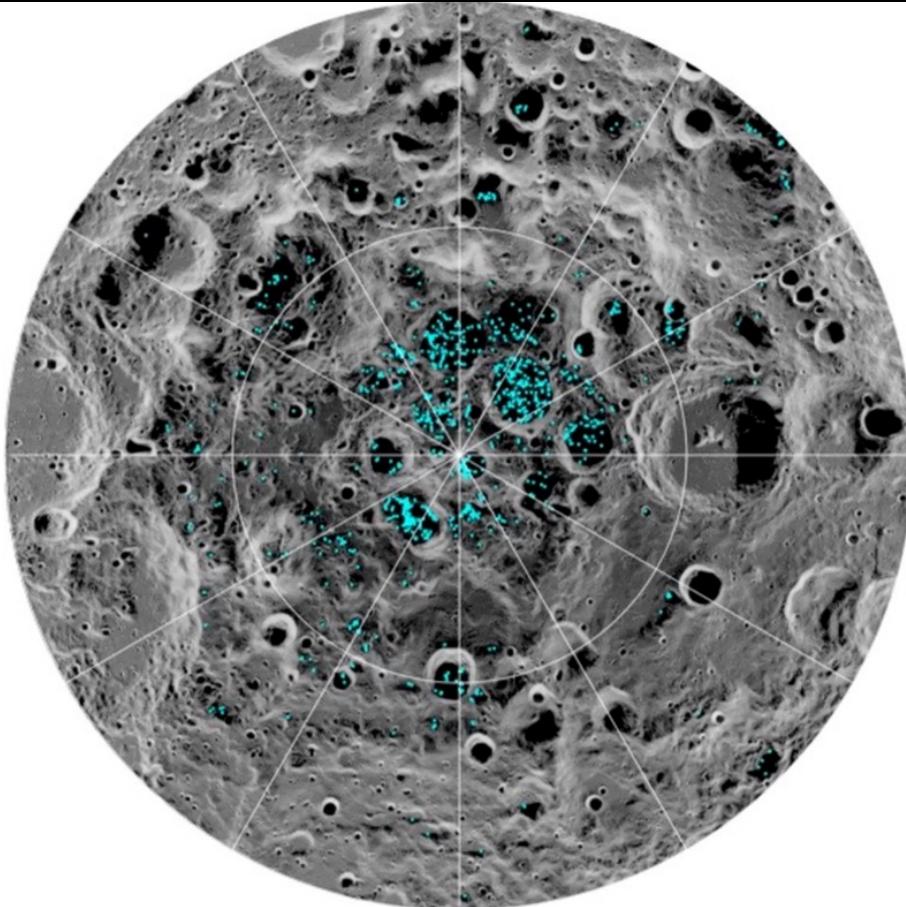
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# Water Ice on the Moon

- Water ice on or just below the surface at the south and north poles was found in permanently shaded regions.
- In 2020, presence of water molecules in sunlit regions was also confirmed by SOFIA mission.



# Mercury

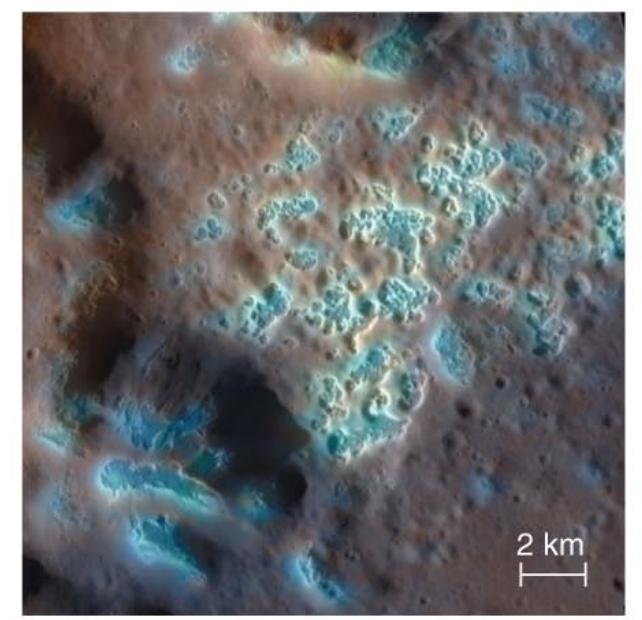
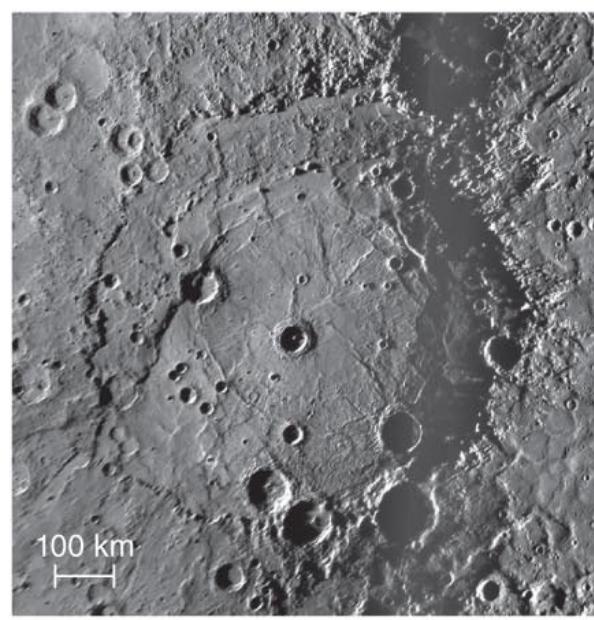
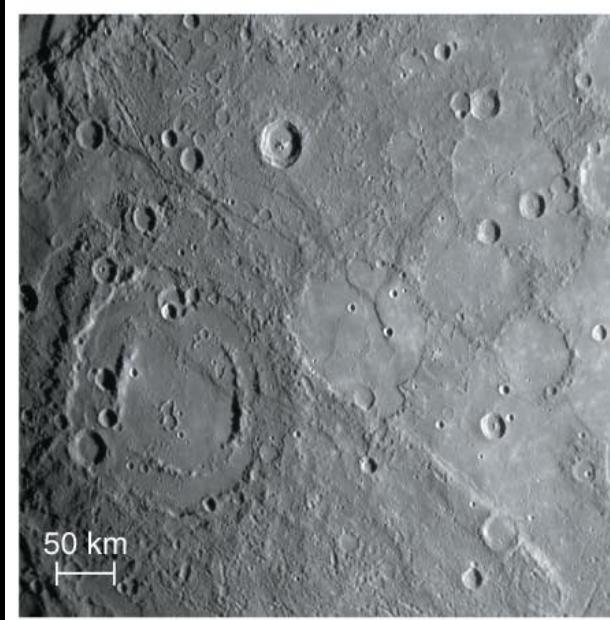
# Mercury

- Radius 2400 km (smallest planet, twice as large as dwarf planet Pluto).
- Elliptical orbit with 0.31 AU perihelion and 0.47 AU aphelion.
- Receives 4 – 10 times more sunlight per square meter than Earth.
- Gets very hot ( $427^{\circ}\text{C}$ ;  $800^{\circ}\text{F}$ ) during the day and very cold ( $-173^{\circ}\text{C}$ ;  $-280^{\circ}\text{F}$ ) at night.
- Rotation and revolution are in 3:2 resonance, spinning 3 times in 2 orbits (orbits in 88 days, sidereal period is 59 days, and the time between successive noons is 176 days=2 years).



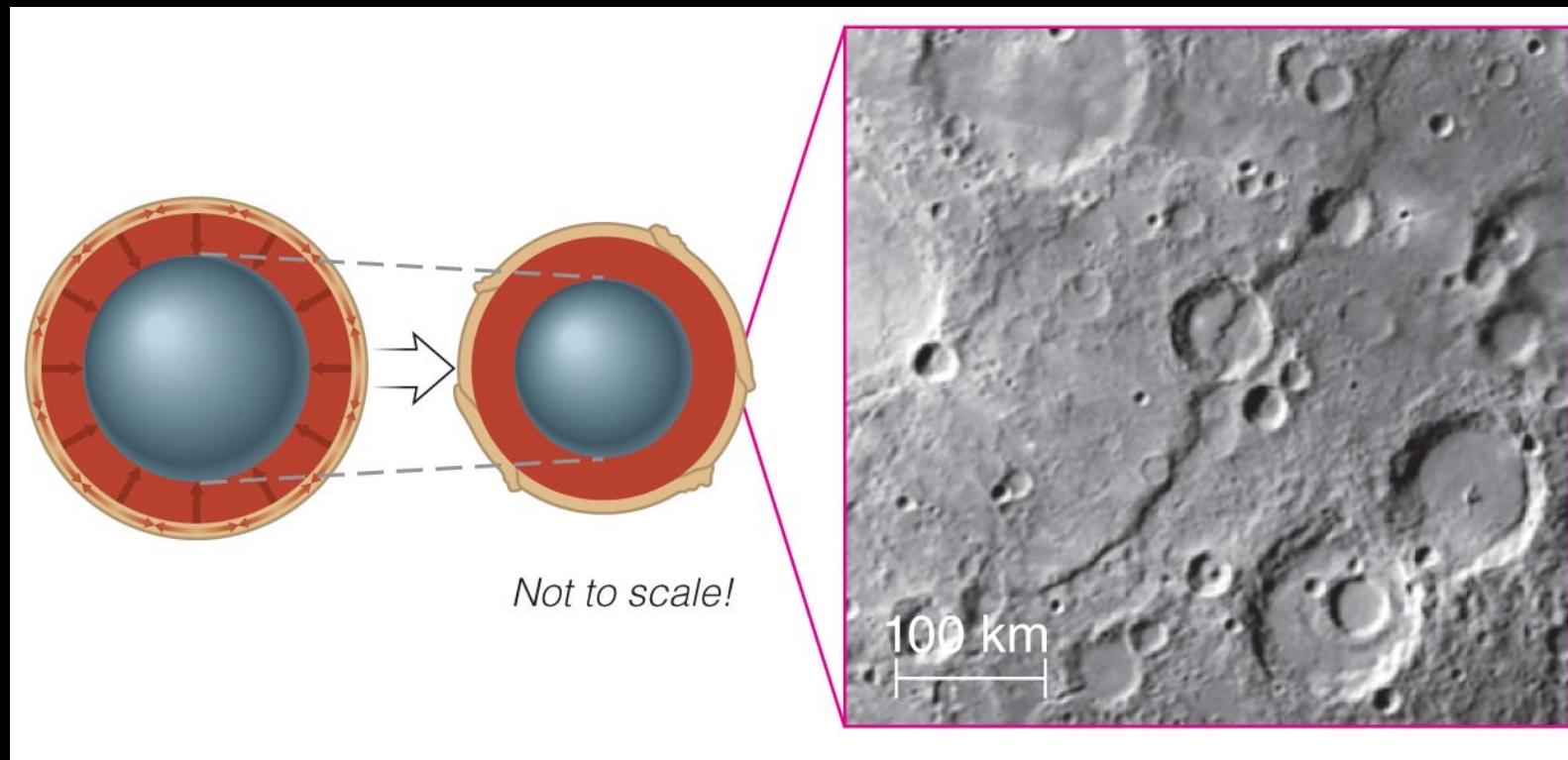
# Mercury's “exosphere”

Because of the temperature extremes, Mercury's surface is subject to the evaporation of volatiles.



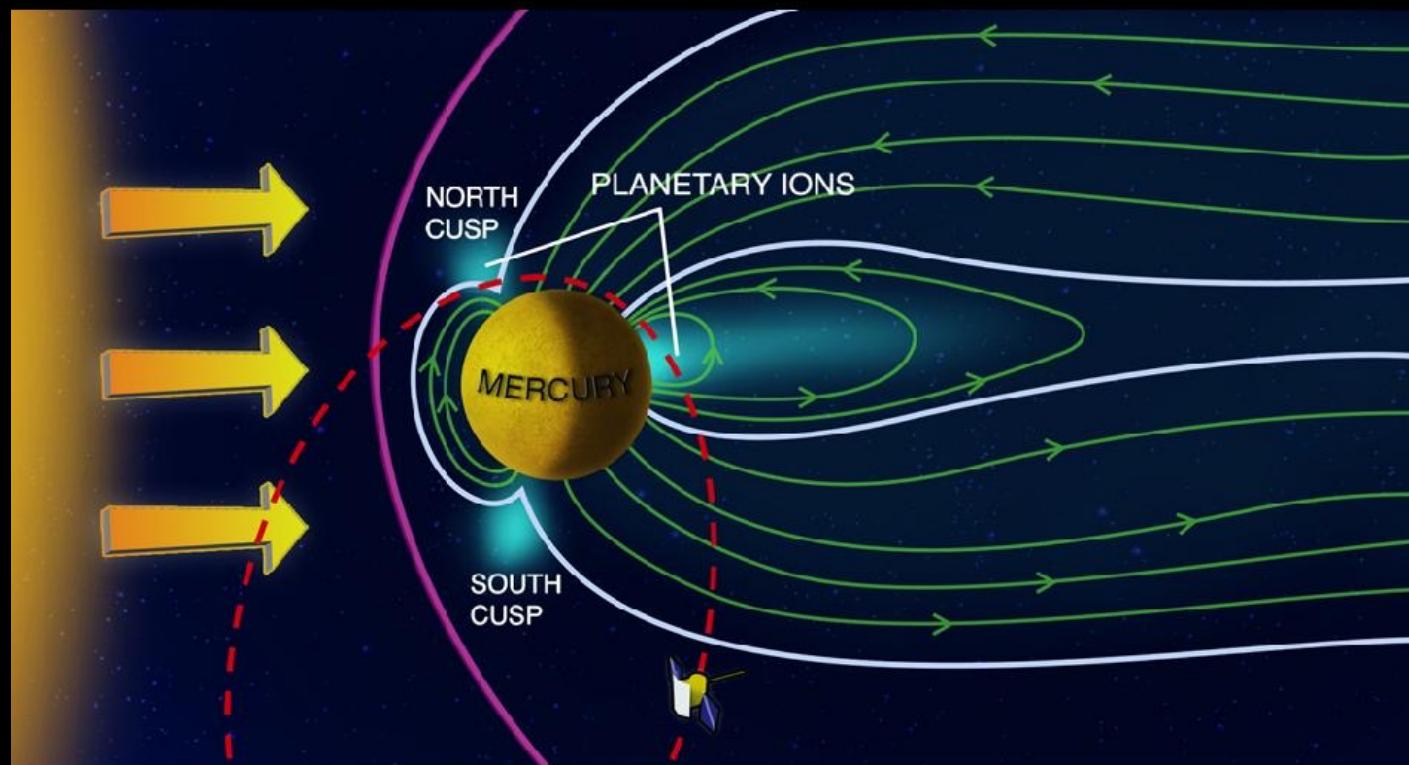
# Mercury, the tectonically active planet!

- Small scarps are evidence of recent geologic activity.
- As Mercury's core cools, it contracts, causing the crust to buckle.



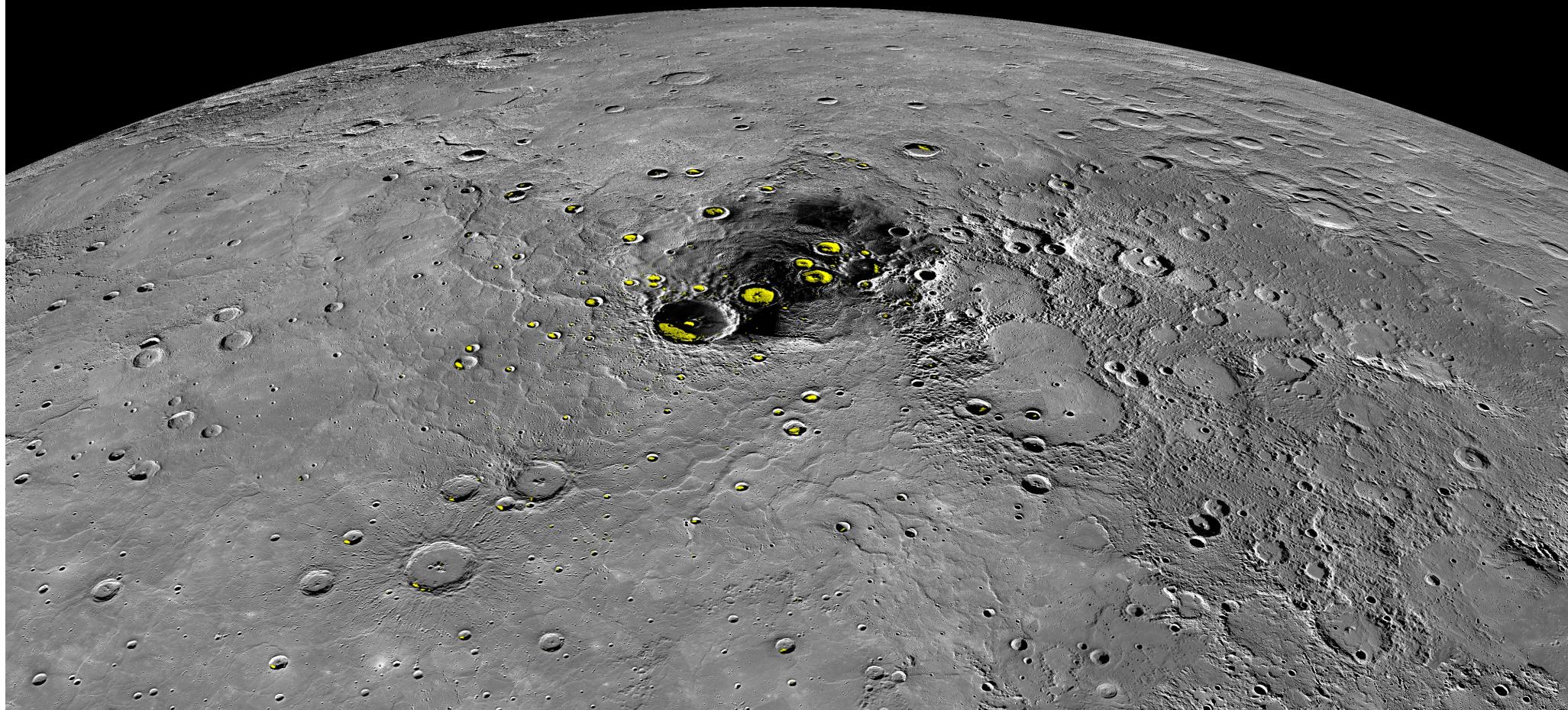
# Mercury's magnetosphere

Shields the planet's surface from the solar wind.



# Water Ice on Mercury

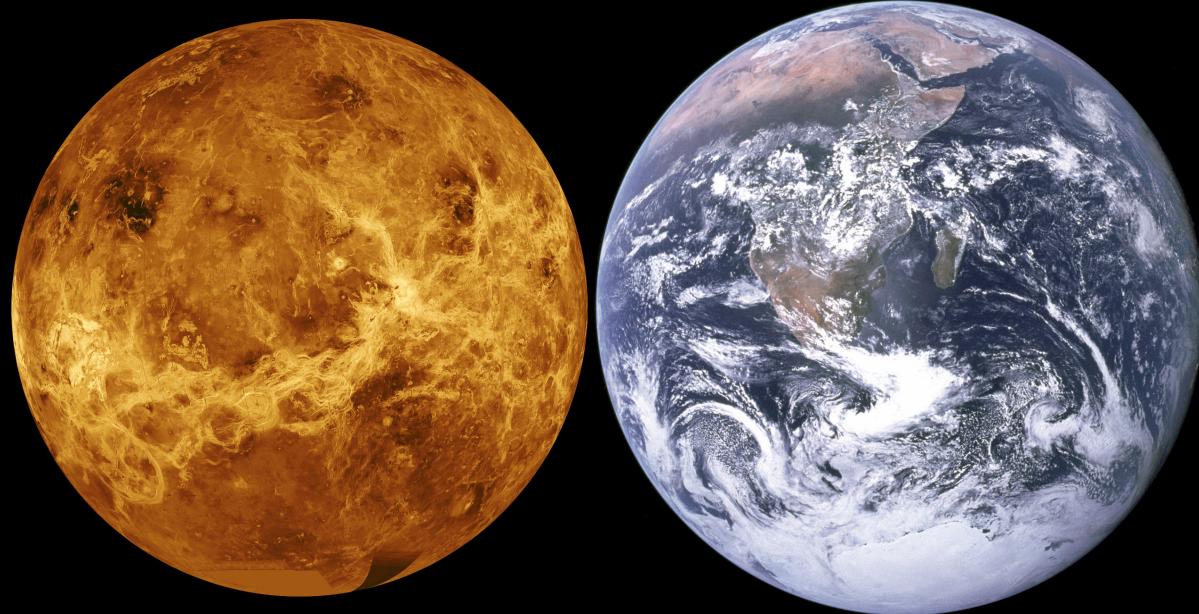
Water ice is found on or just below the surface at the poles, in permanently shaded craters (just like on the Moon)



Venus

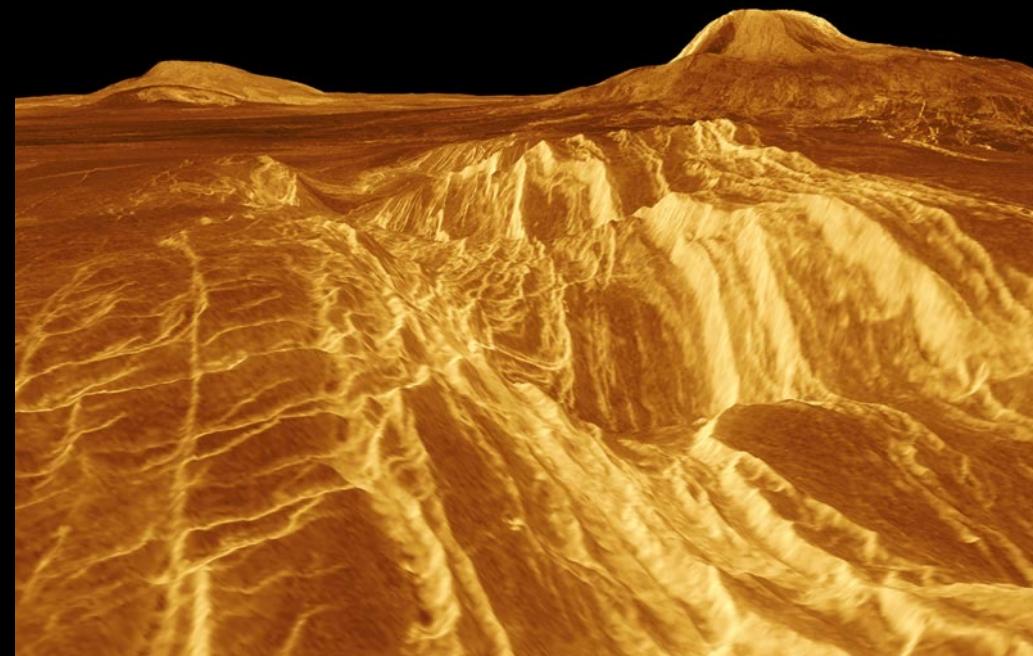
# Venus: Earth's “sister planet”?

- Average distance from the Sun ~108 million km.
- Mean radius 6051 km (95% of Earth's, which is ~6400 km)
- Mass: ~0.8 Earth's mass
- Surface gravity:  $8.87 \text{ m/s}^2$  (0.904 g)



# Venus: Not really a sister planet.

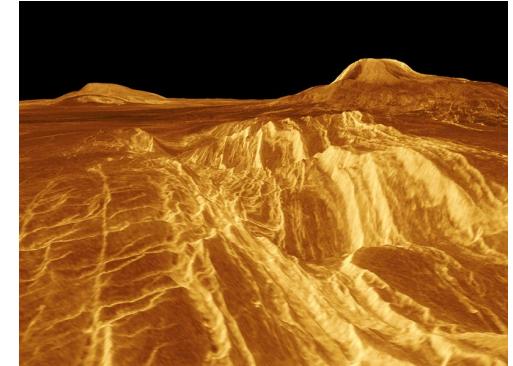
- Slow retrograde rotation.
- A “day” (period of rotation) is 243 Earth days long (compare to Venusian year of 224 days).
- Surface temperature 880 °F (450 °C, enough to melt lead)
- Atmospheric pressure **~100x pressure at sea level on Earth.**
- Atmosphere of **carbon dioxide and sulfur**



# question for you



If Venus has a thick, opaque atmosphere, how do we make images of its surface, such as the one shown here?

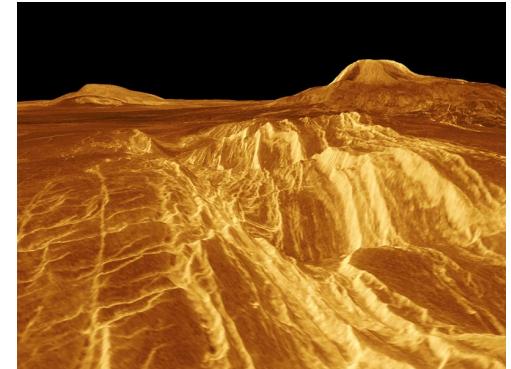


- A. We have to land on the surface.
- B. We use some of the best space telescopes available today.
- C. We scan the surface using ground-based telescopes and cameras that can see in infrared.
- D. We use orbiters with radio and infrared cameras.
- E. I have no idea.

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# Venus: runaway greenhouse effect

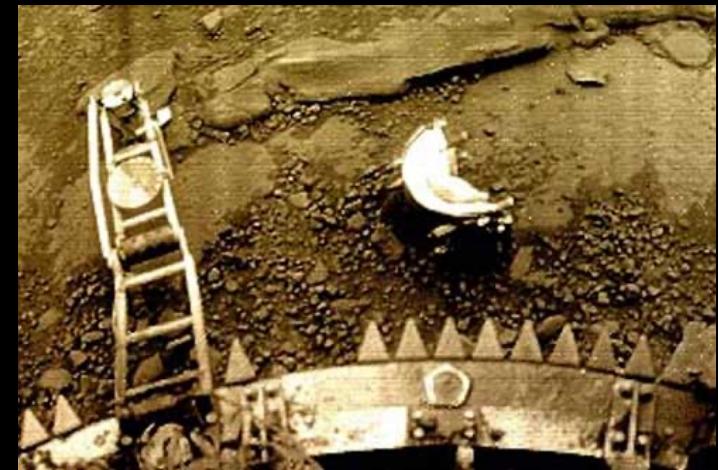
Earth and Venus probably started with similar amounts of CO<sub>2</sub> outgassed from volcanoes, and water from comet impacts.

Differences:

❖ **Earth:** water is in oceans and it takes CO<sub>2</sub> out of the atmosphere and turns it into **limestone (carbonate rocks)**.

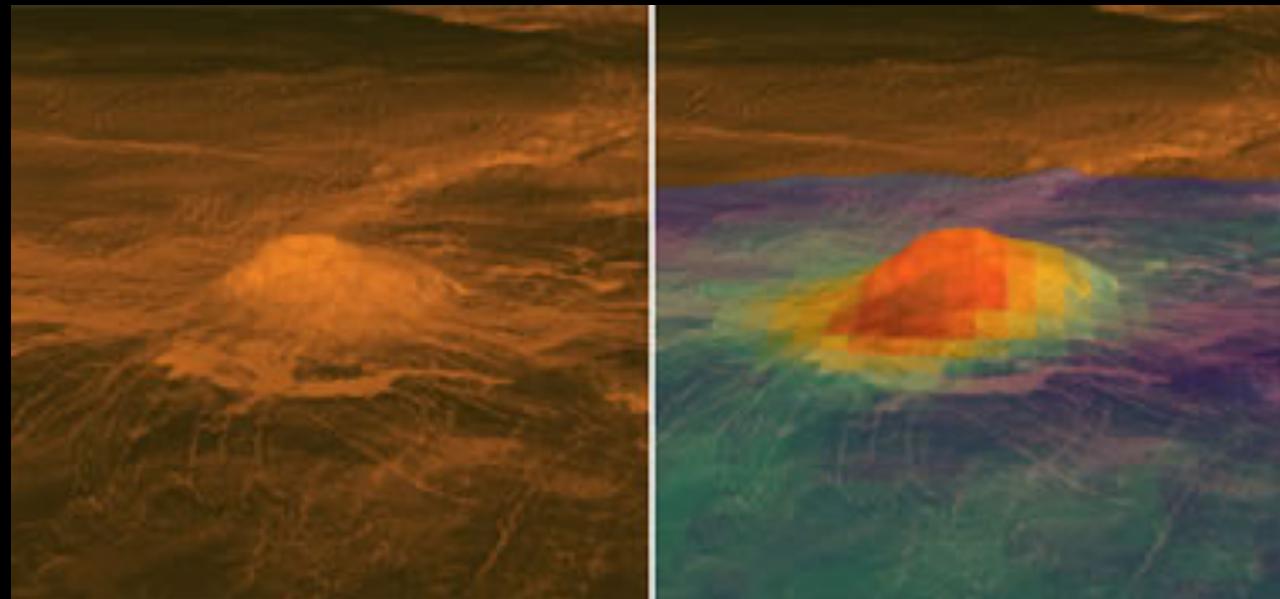


❖ **Venus:** all CO<sub>2</sub> is in the atmosphere and water has disappeared. Proximity to the Sun, absence of life and magnetic fields played a role.



# Volcanoes and water on Venus?

- Visited by lander Venera, orbiter Magellan, orbiter Venus Express.
- Shield volcanoes on Venus are 400 – 700 km wide, and 1 – 2km high; comparing to Hawaiian volcanoes, 150 km wide, 8 km high.
- Venus shows a very **small amount of impact cratering**, indicating its **surface is younger** than about 500 million years.
- There is some evidence of current volcanism on Venus: some volcanoes are still warm, some minerals indicate fresh lava flows.
- Some evidence of granite rocks indicate that Venus has oceans in the past.



## What did we learn in Chapter 20?

- Solar system explored by five types of missions: flyby, lander/probe, rover, orbiter, sample return.
- Earth's moon probably has very small iron core.
- Lunar maria formed when heat from radioactive decay melted a portion of the crust.
- Crater counting is a technique used to determine the relative age of surface regions on terrestrial planets.
- Mercury has a very large iron core. Cooling and shrinkage of this core are causing tectonic effects on the surface.
- Mercury has a substantial magnetic field, but only a very tenuous atmosphere of volatiles evaporating from its sunlit surface.