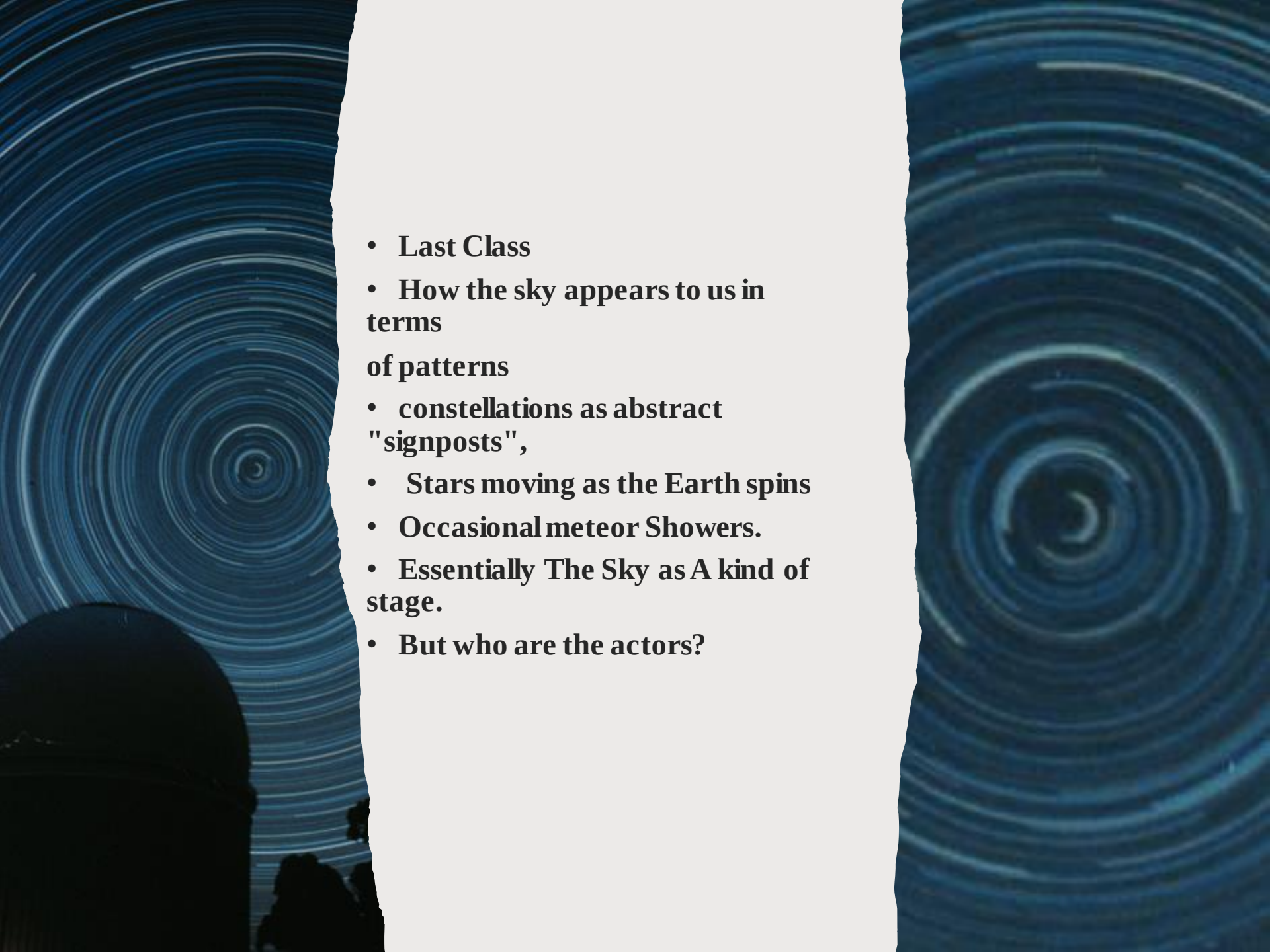
Evening Classes

Week Two

The Planets and Solar System

Presented by John Campbell



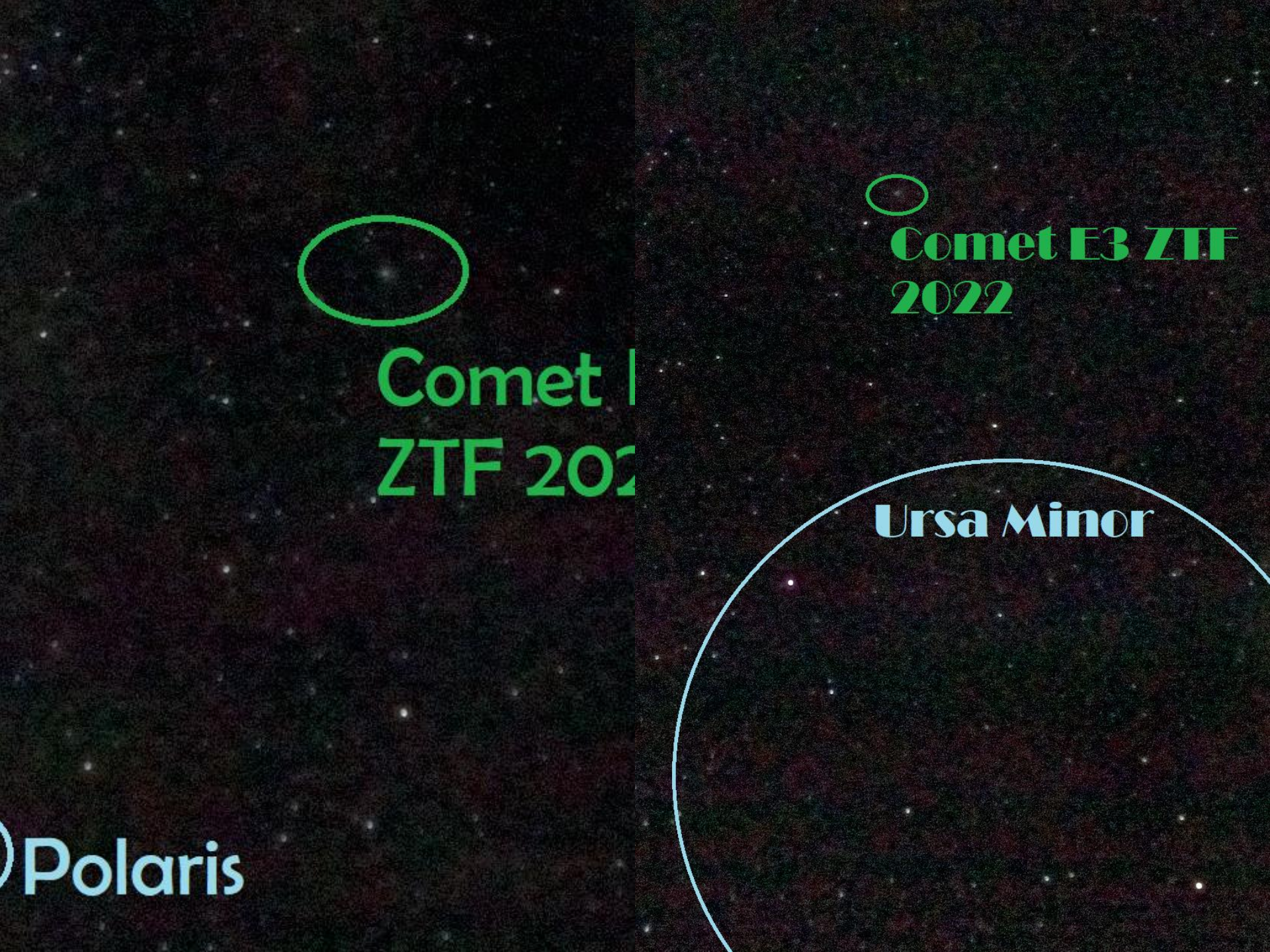
- Last Class
- How the sky appears to us in terms

of patterns

- constellations as abstract "signposts",
- Stars moving as the Earth spins
- Occasional meteor Showers.
- Essentially The Sky as A kind of stage.
- But who are the actors?


The planets

And Comets!

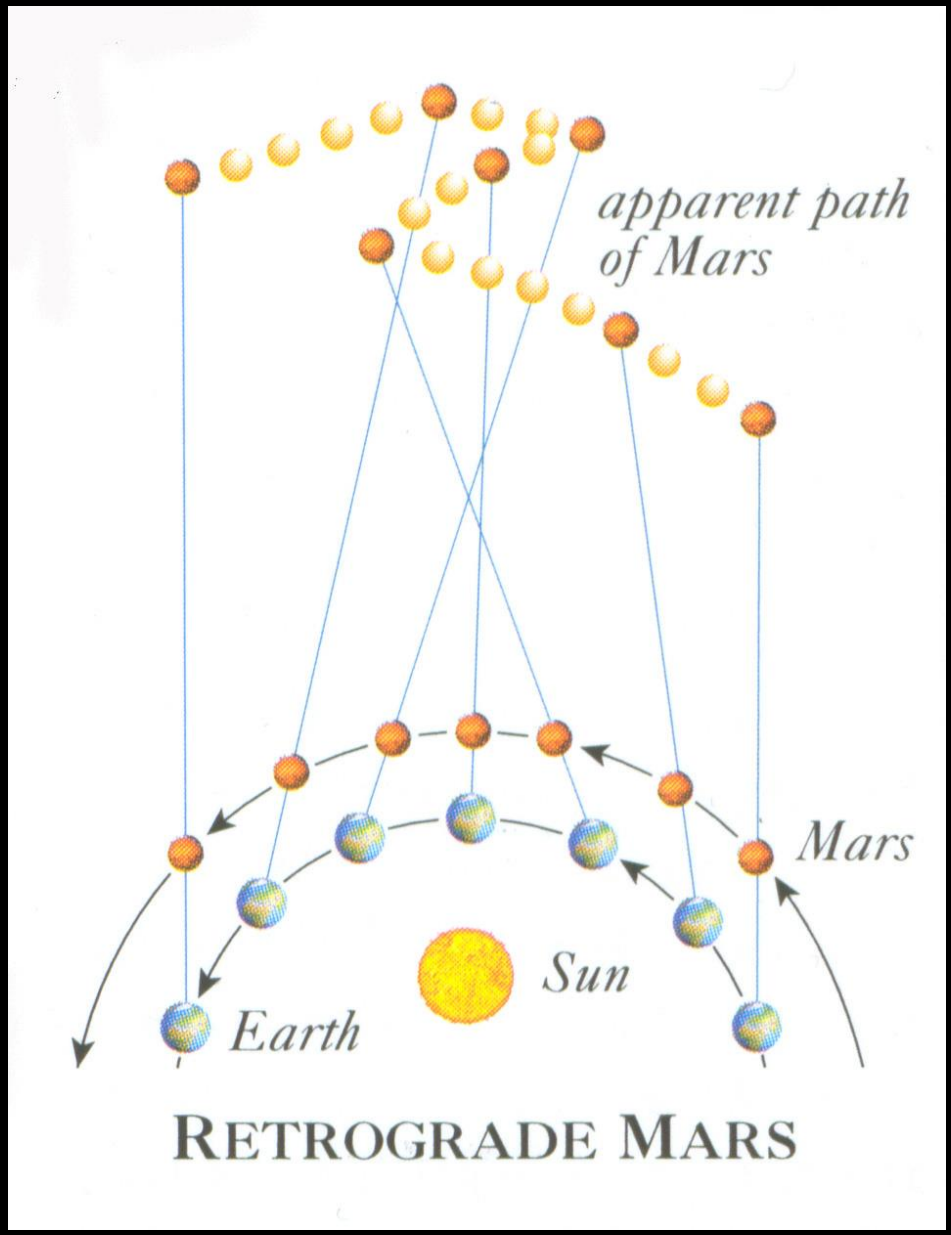

Comet E3 ZTF
2022
Ursa Minor
Polaris

Comet ZTF (C/2022 E3) at 11 p.m. Central Time
Facing north

‘Planet’ means ‘wanderer’

Retrograde Motion

As Earth passes Mars, Mars appears to move from east to west.




Mid September
October 31st

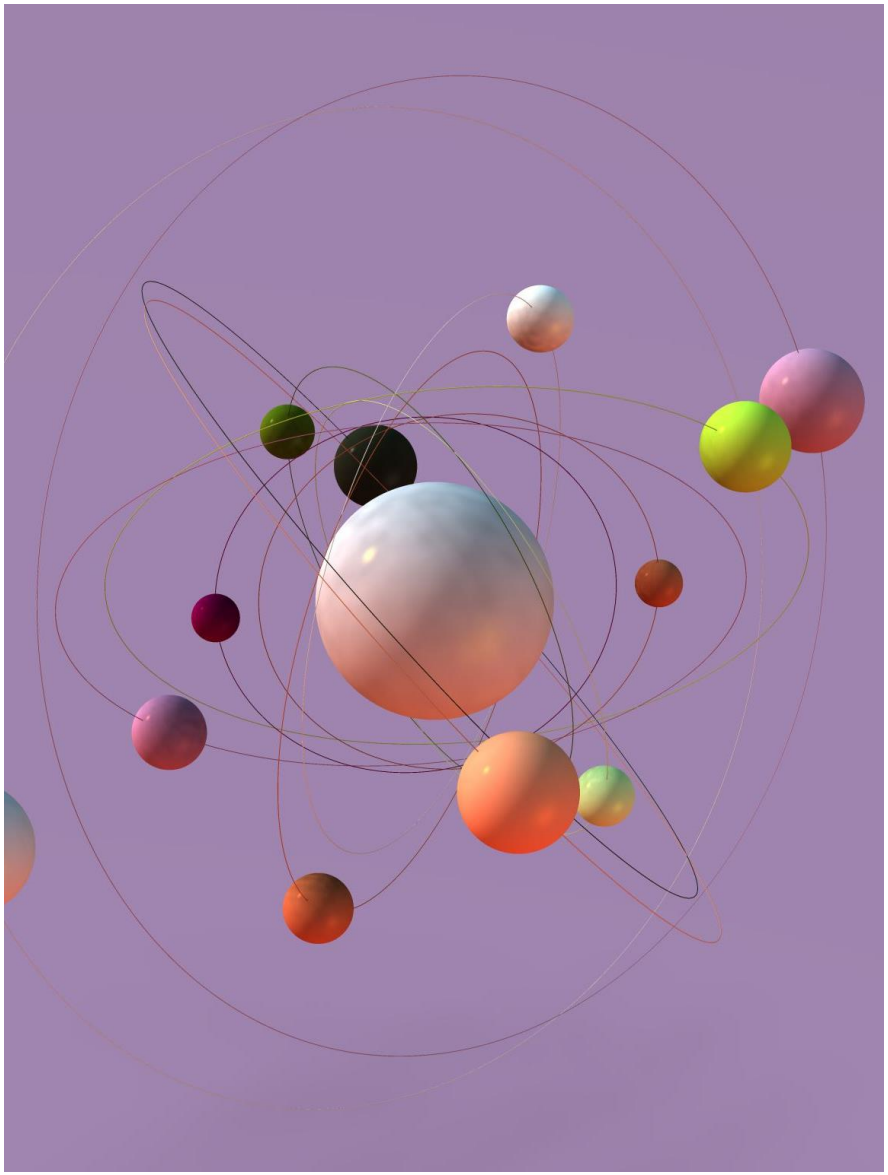
Predicting the Future...Mars will appear to go backwards! We call this Retrograde Motion

October 31st

January 12th(retrograde ends)


Mars
Taurus

- In between the time when planetary retrograde begins and the time when planetary retrograde ends the planet in question appears at its brightest
- The question of course is Why?

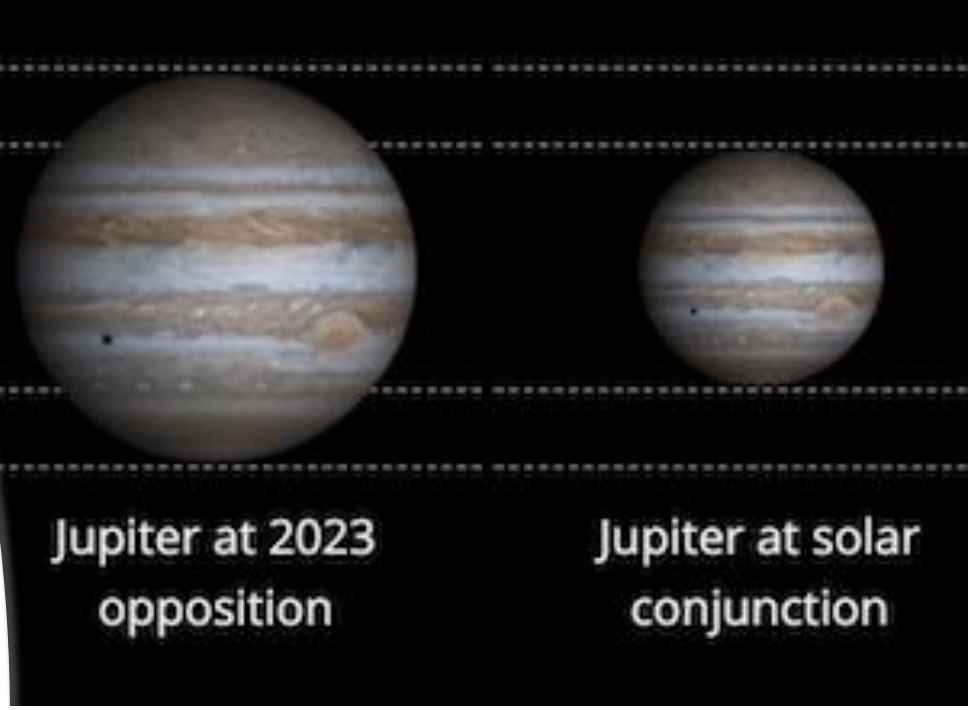


The planet is closest to the earth at the halfway point in the retrograde because the earth has,in its own orbit, "caught up" with the other planet in its own orbit.

In other words at this point (called opposition) the Earth and the Planet in question are at their closest distance.

For Mars this was on December 7th 2022

Jupiter at Opposition = Very Bright!



have a look to

the east, to that big bright yellow "star"

This is Jupiter reaching opposition

following a period of prograde motion

towards Aries and the Pleiades (Taurus)

it is now in retrograde

After opposition, Jupiter will continue

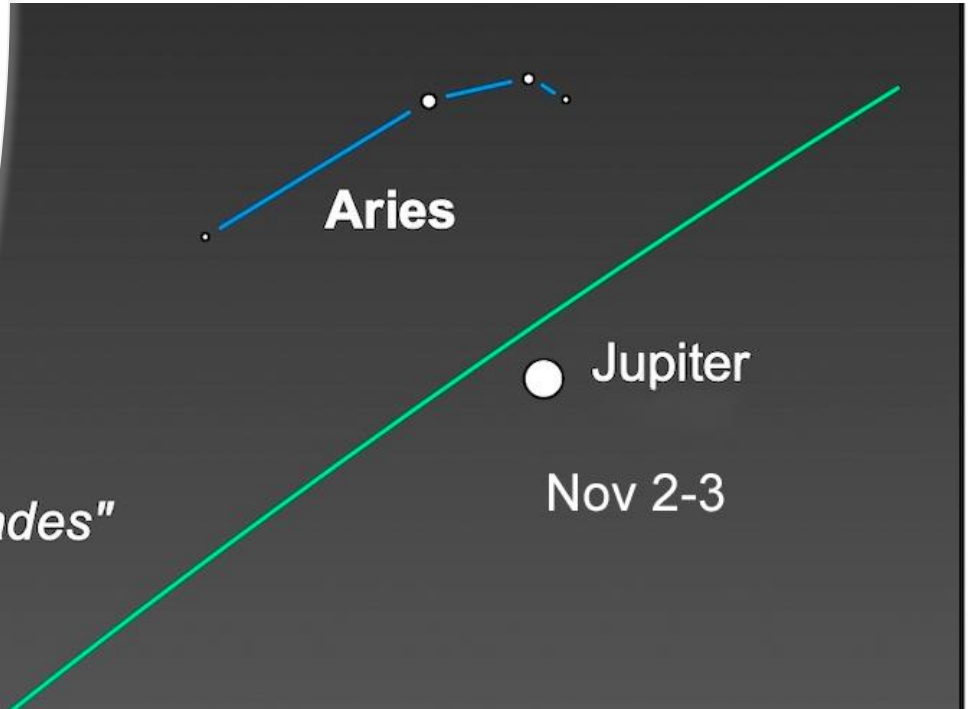
Retrograde motion as the earth

"overtakes" Jupiter in its orbital

"laneway"

It will enter prograde again in December 31st 2023

And will continue to move toward Taurus again



Conditions for Observing Planets

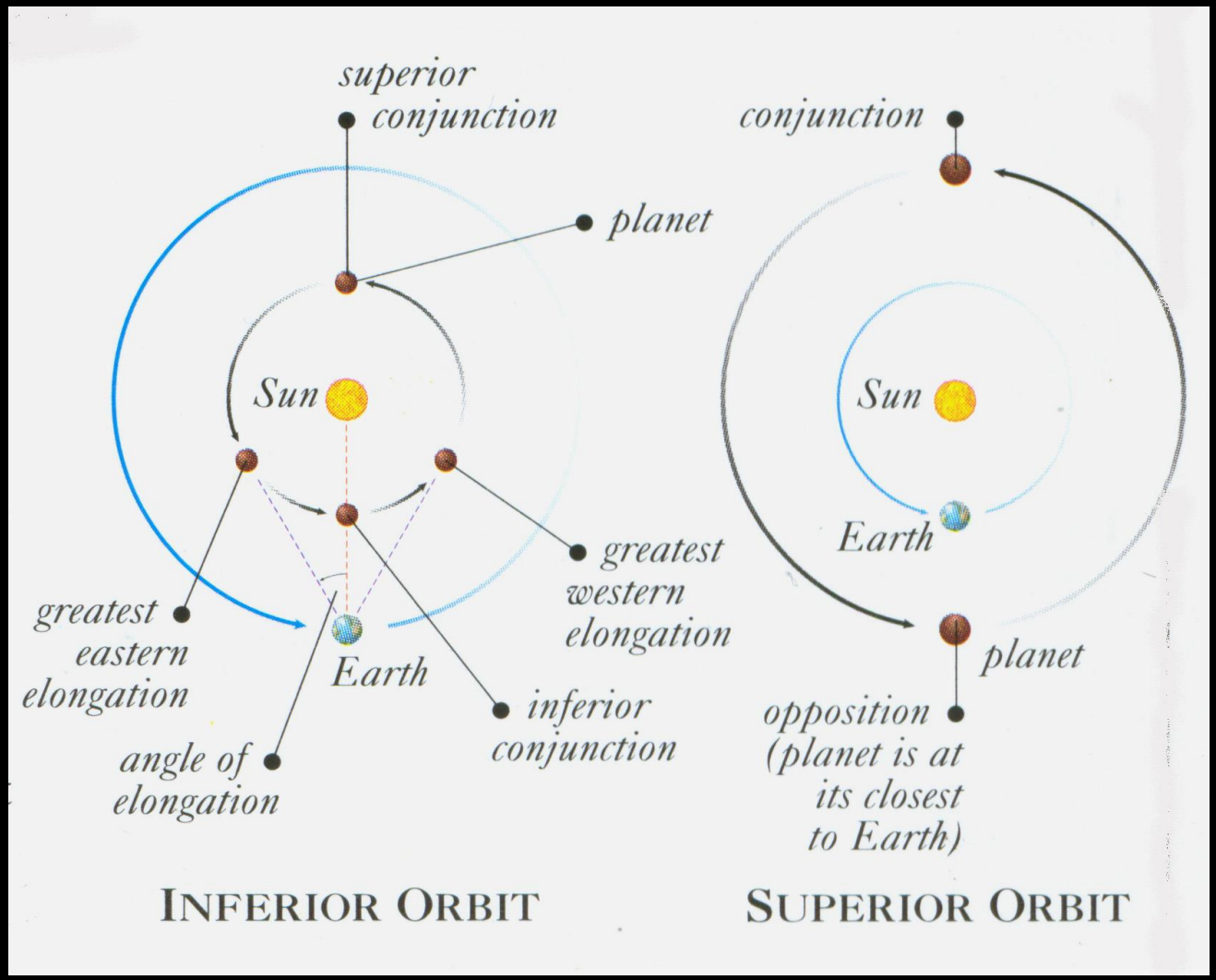
- Where the Planet is relative to Constellations/Moon
- Is the planet at Opposition
- Light pollution

- Small apertures okay

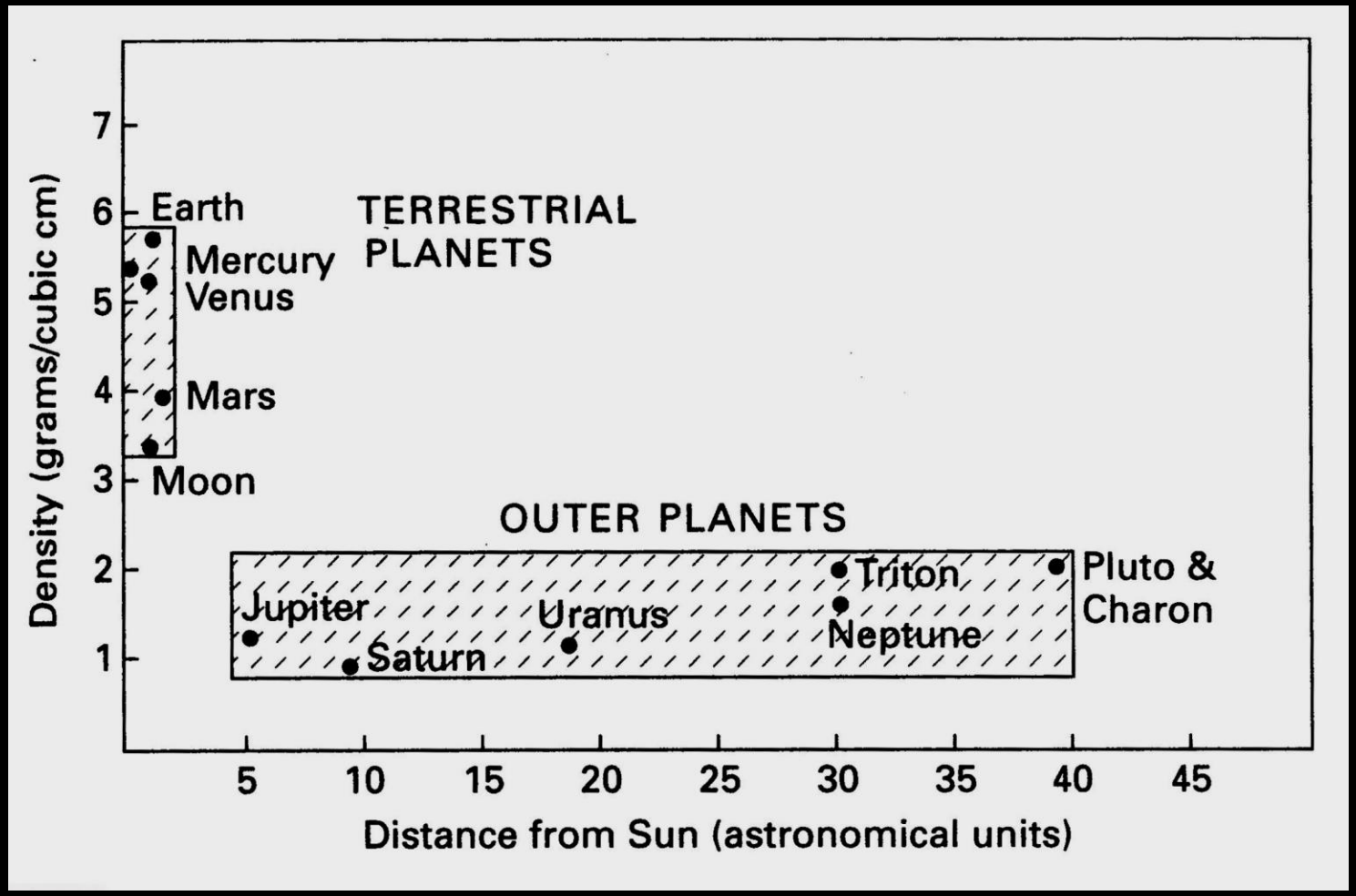
- High magnification (100x – 250x)

- Steady ‘seeing’

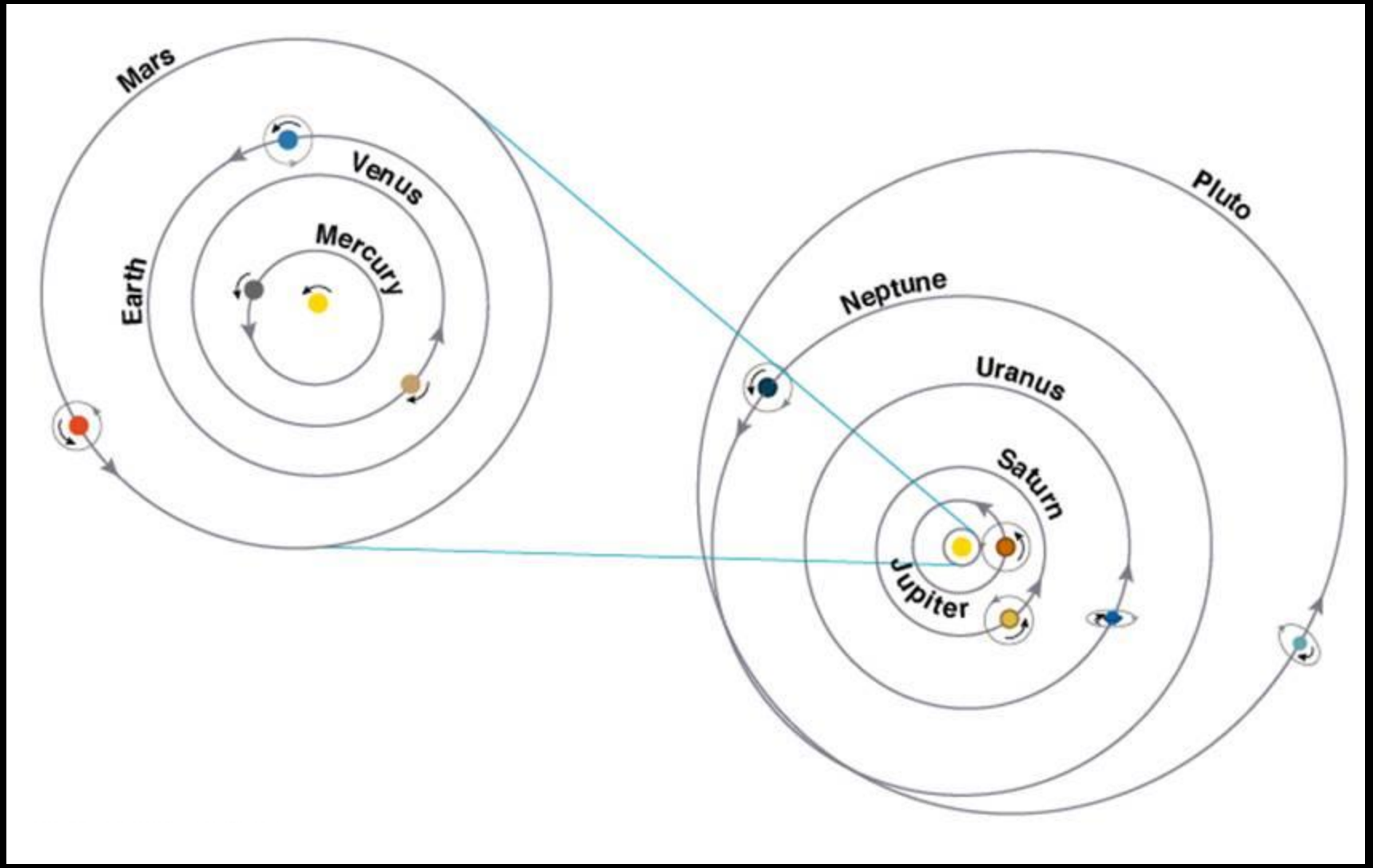
Planetary Alignments



Planets are a varied lot

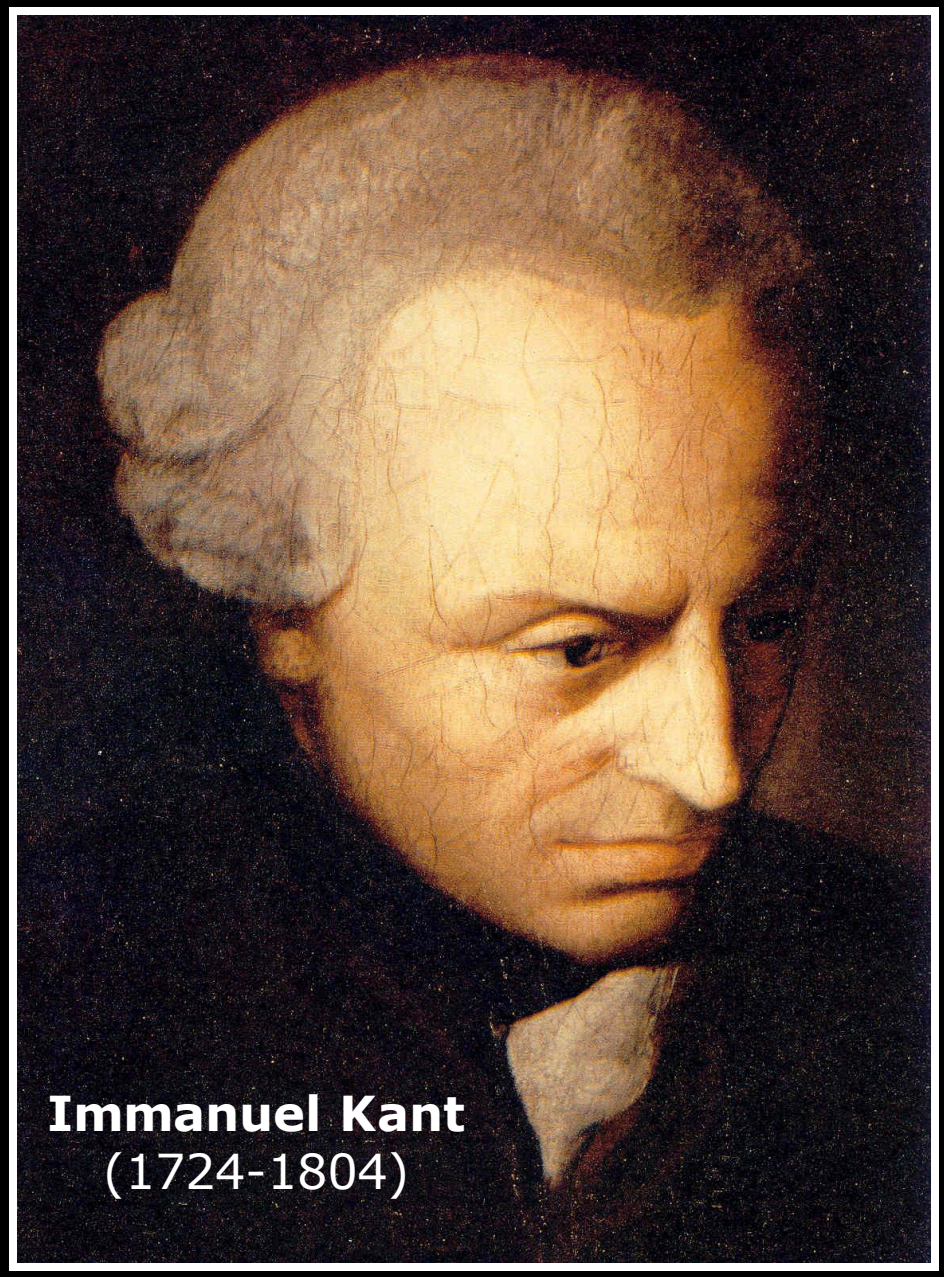


The Inner Solar System

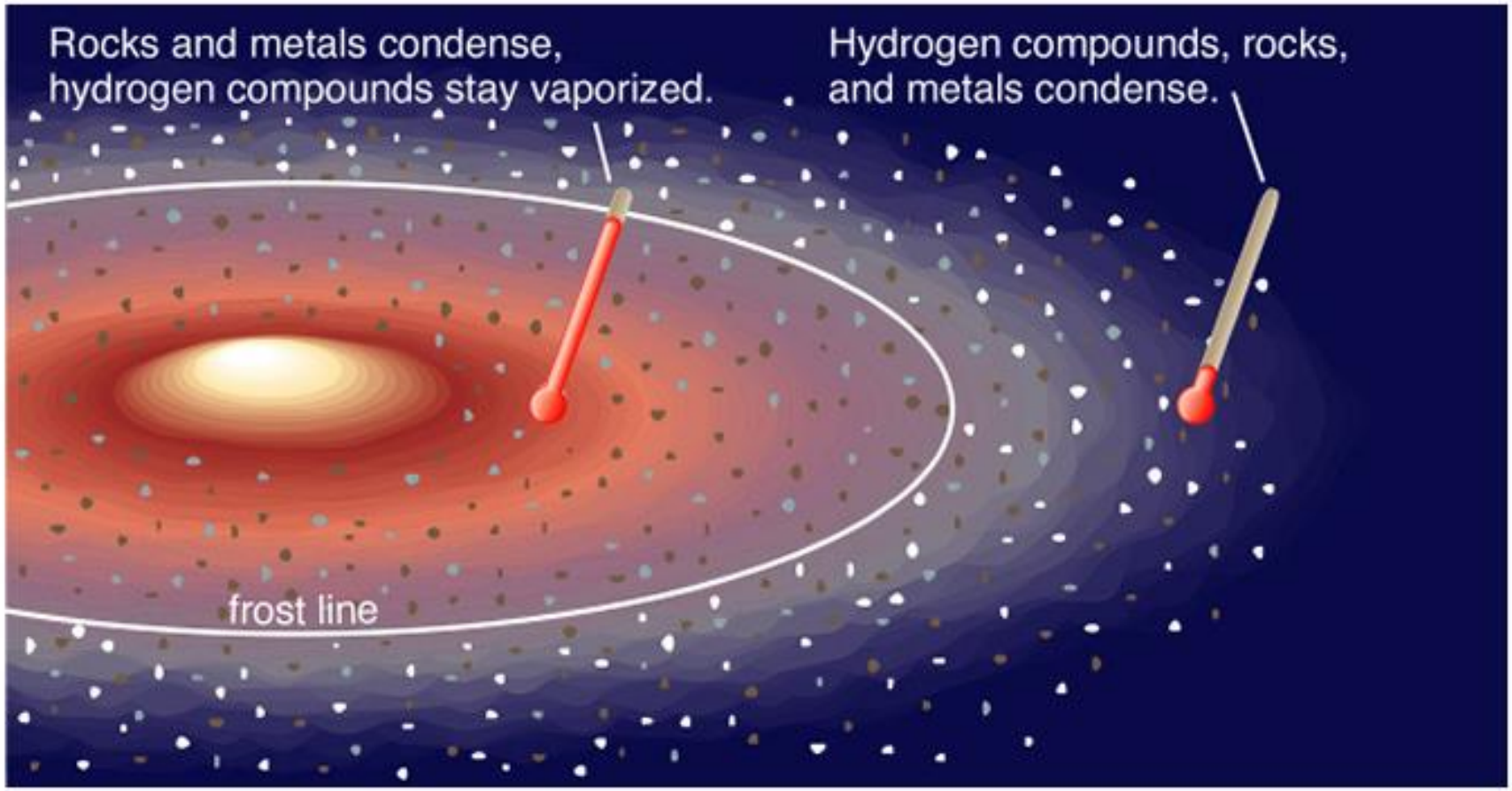


The Nebular Hypothesis

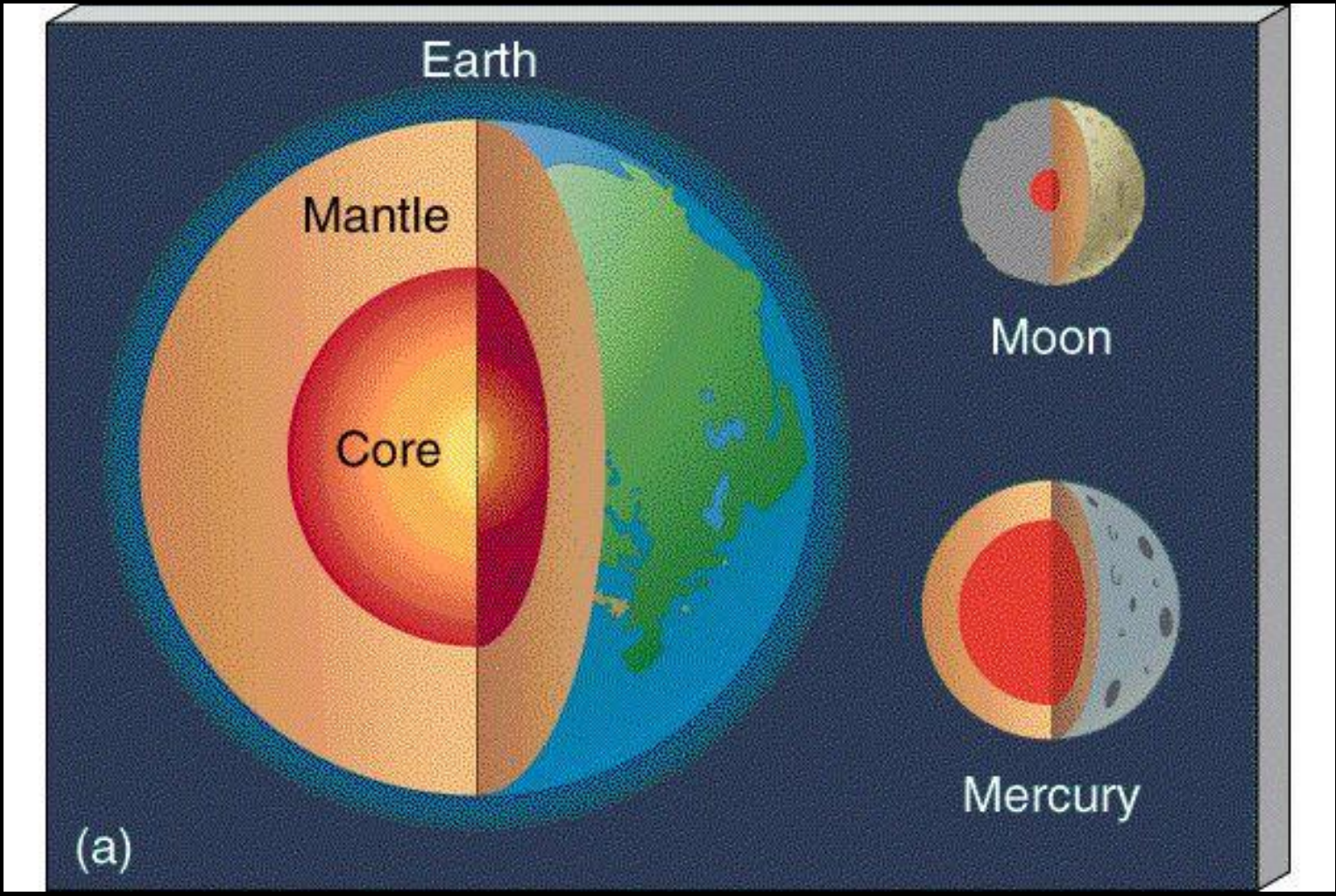
"The Sun & planets formed together from the gravitational collapse of a nebula"



Why planetary compositions differ



The interiors of the terrestrial planets



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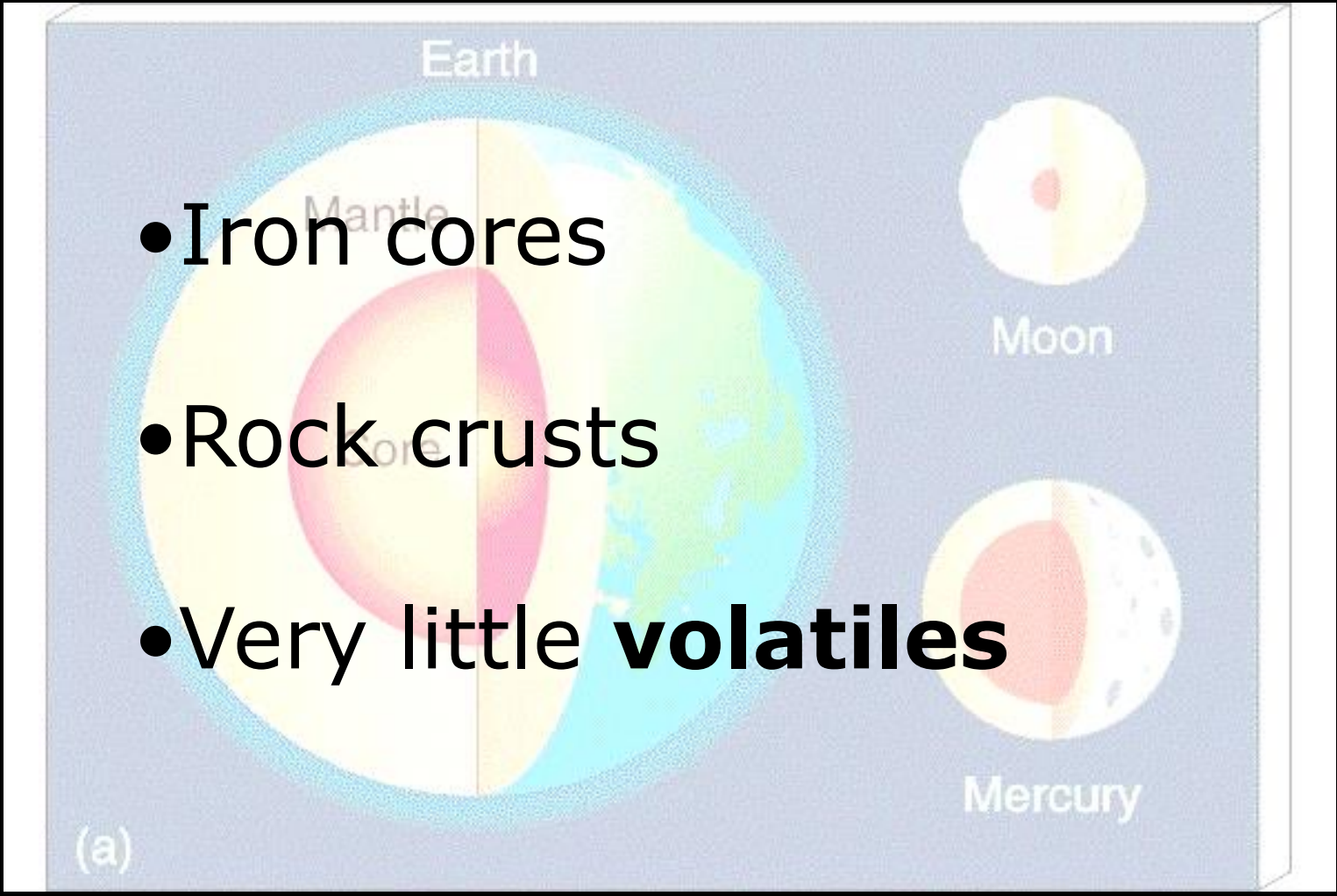
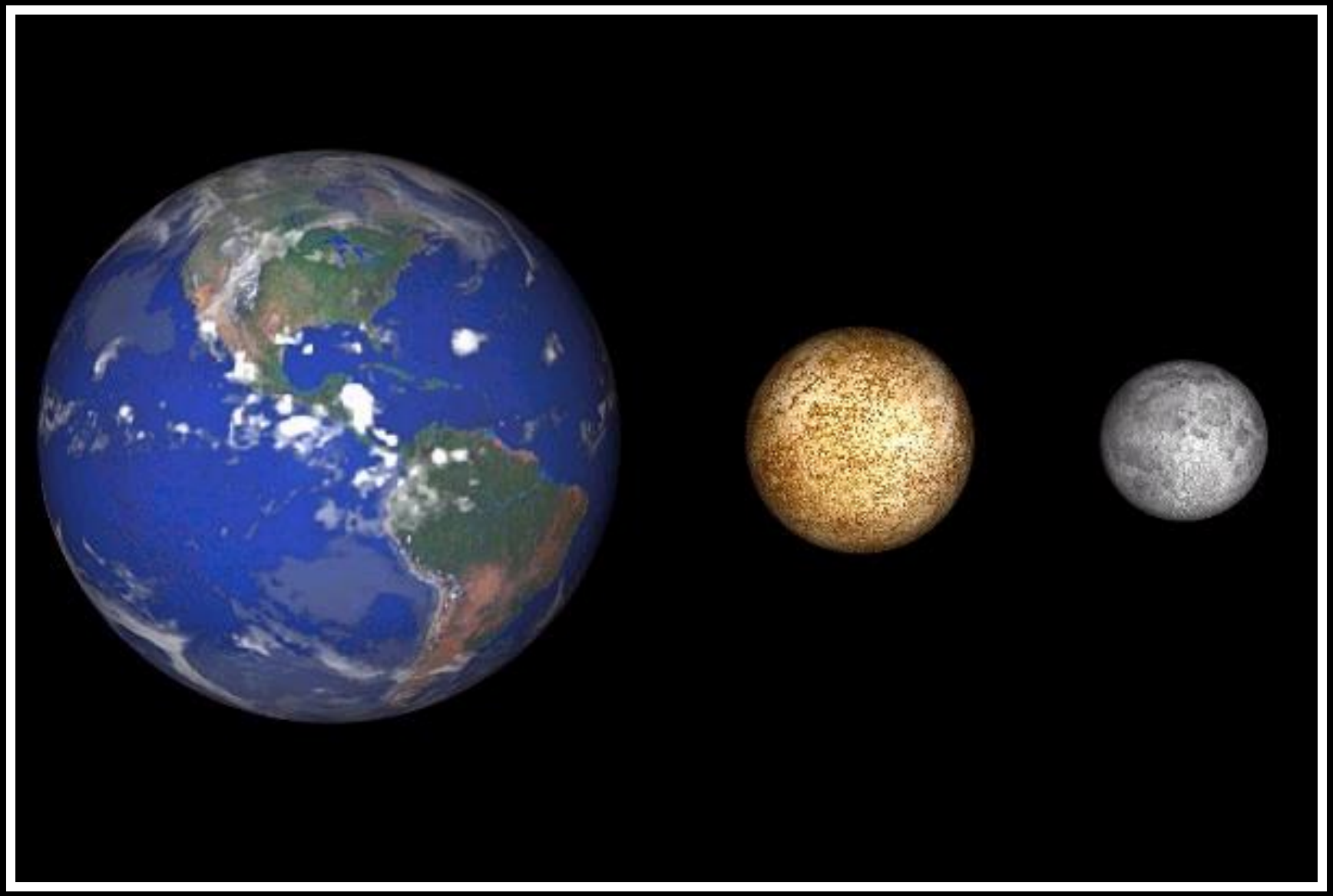


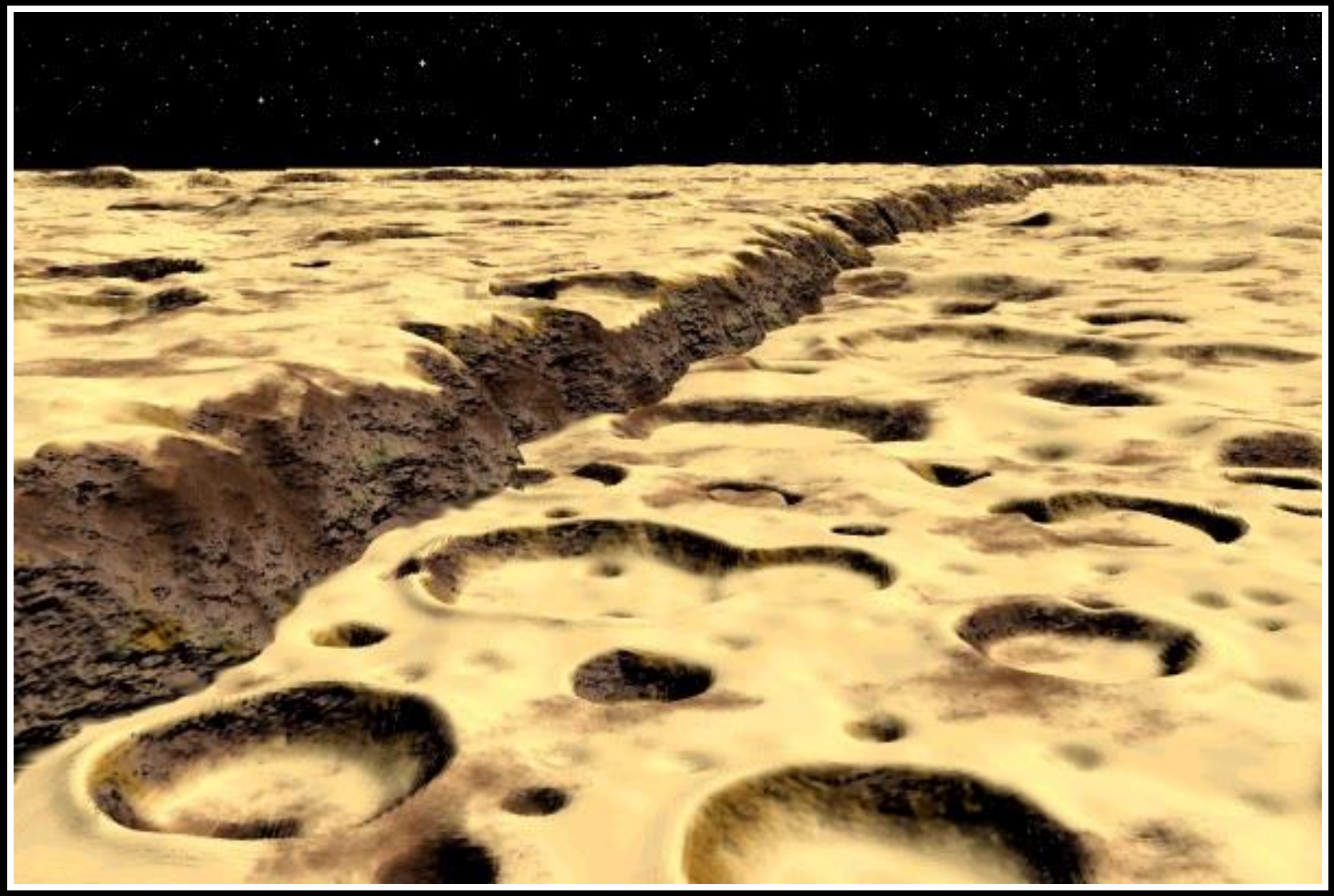
- Iron cores
- Rock crusts
- Very little **volatiles**

Mercury

Earth, Mercury & Moon size comparison



Mercury's faulted landscape



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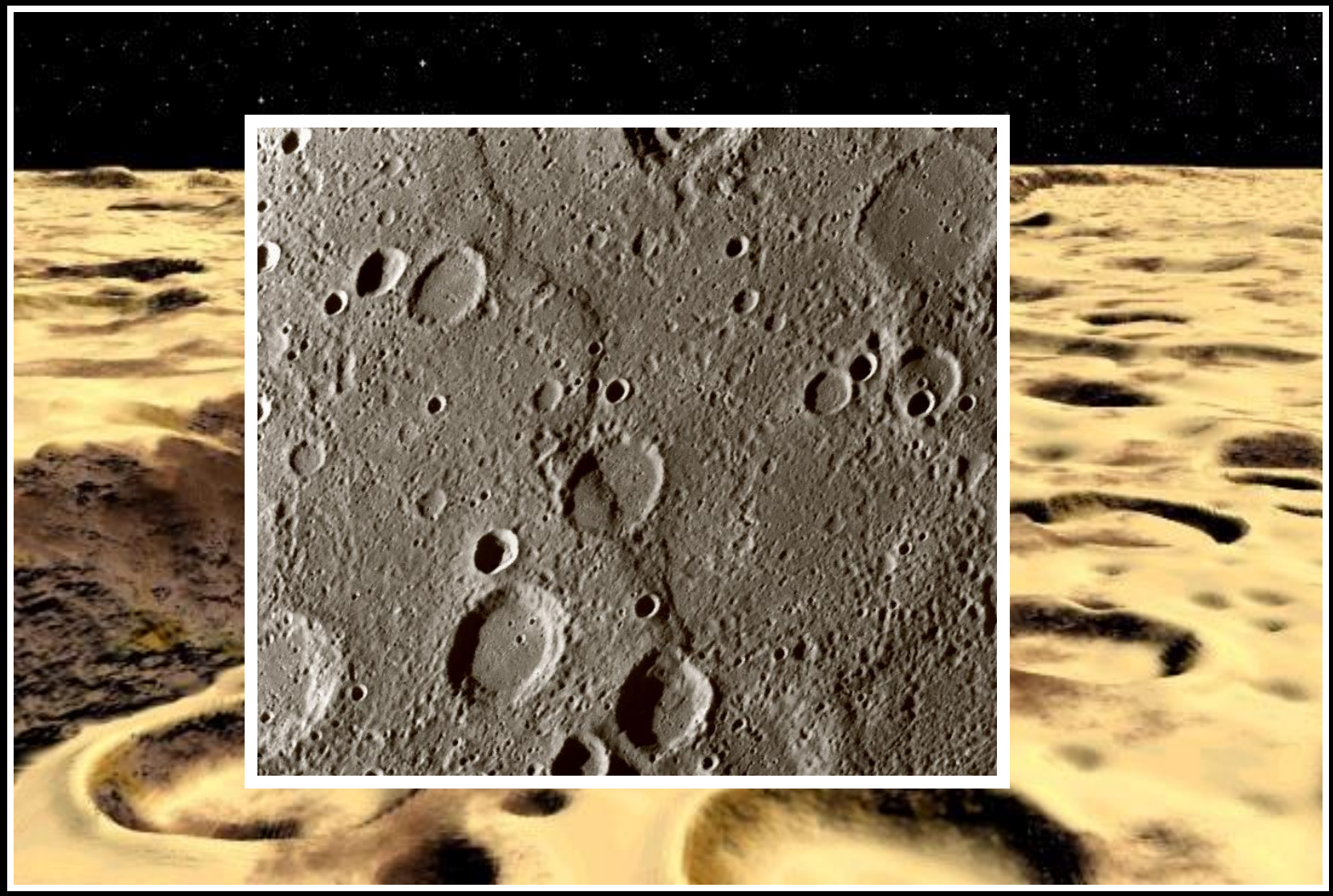
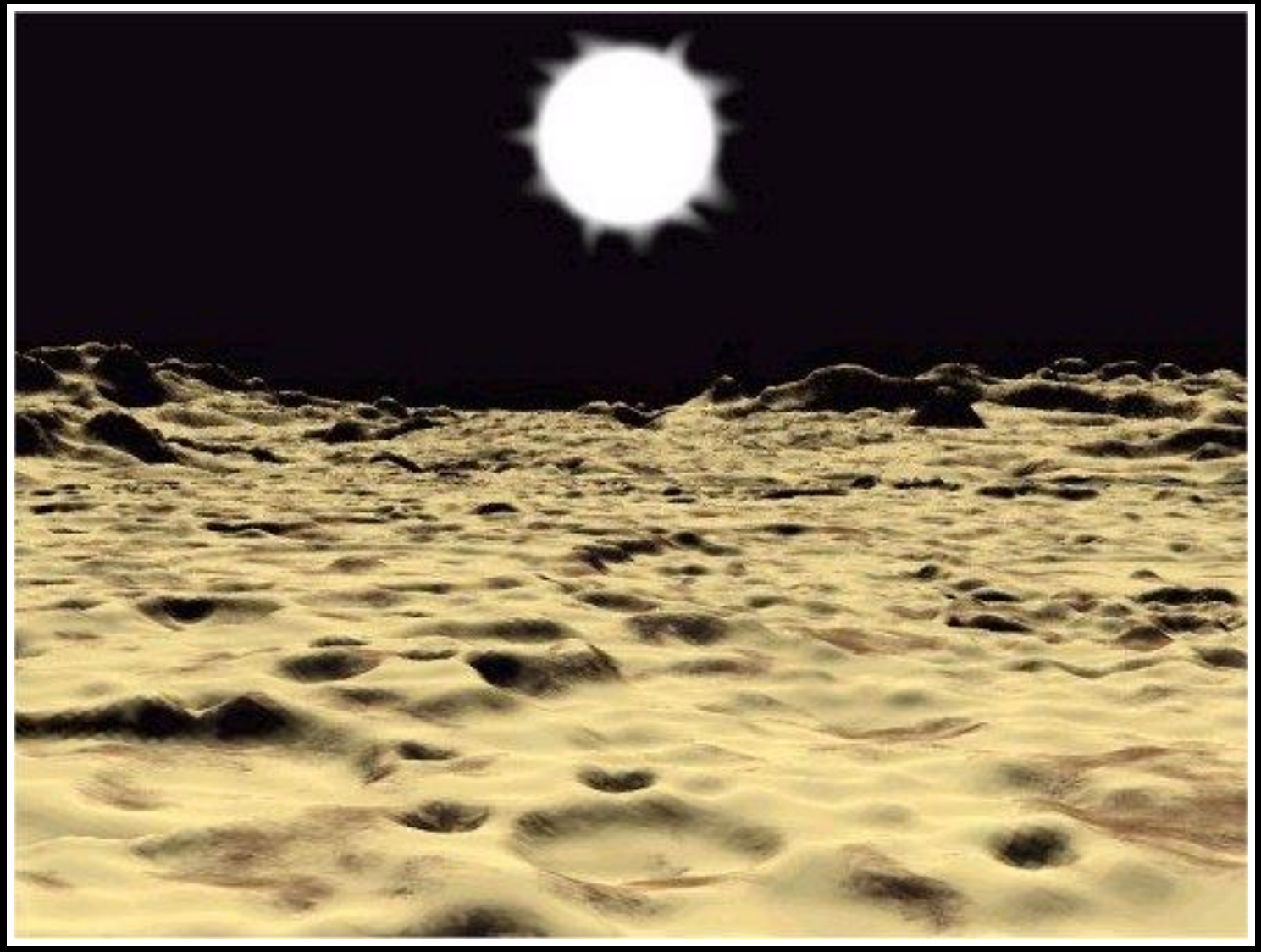
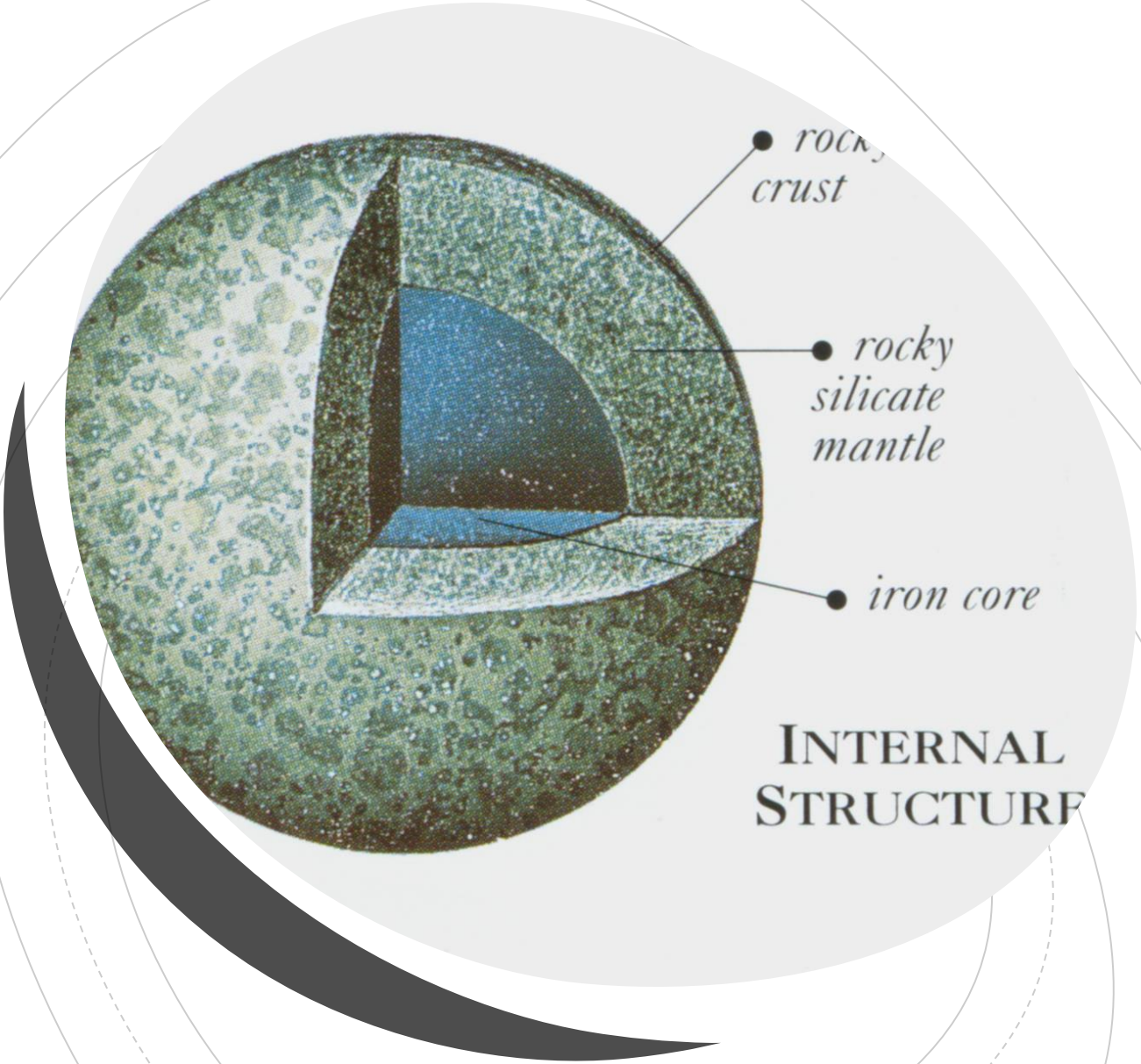
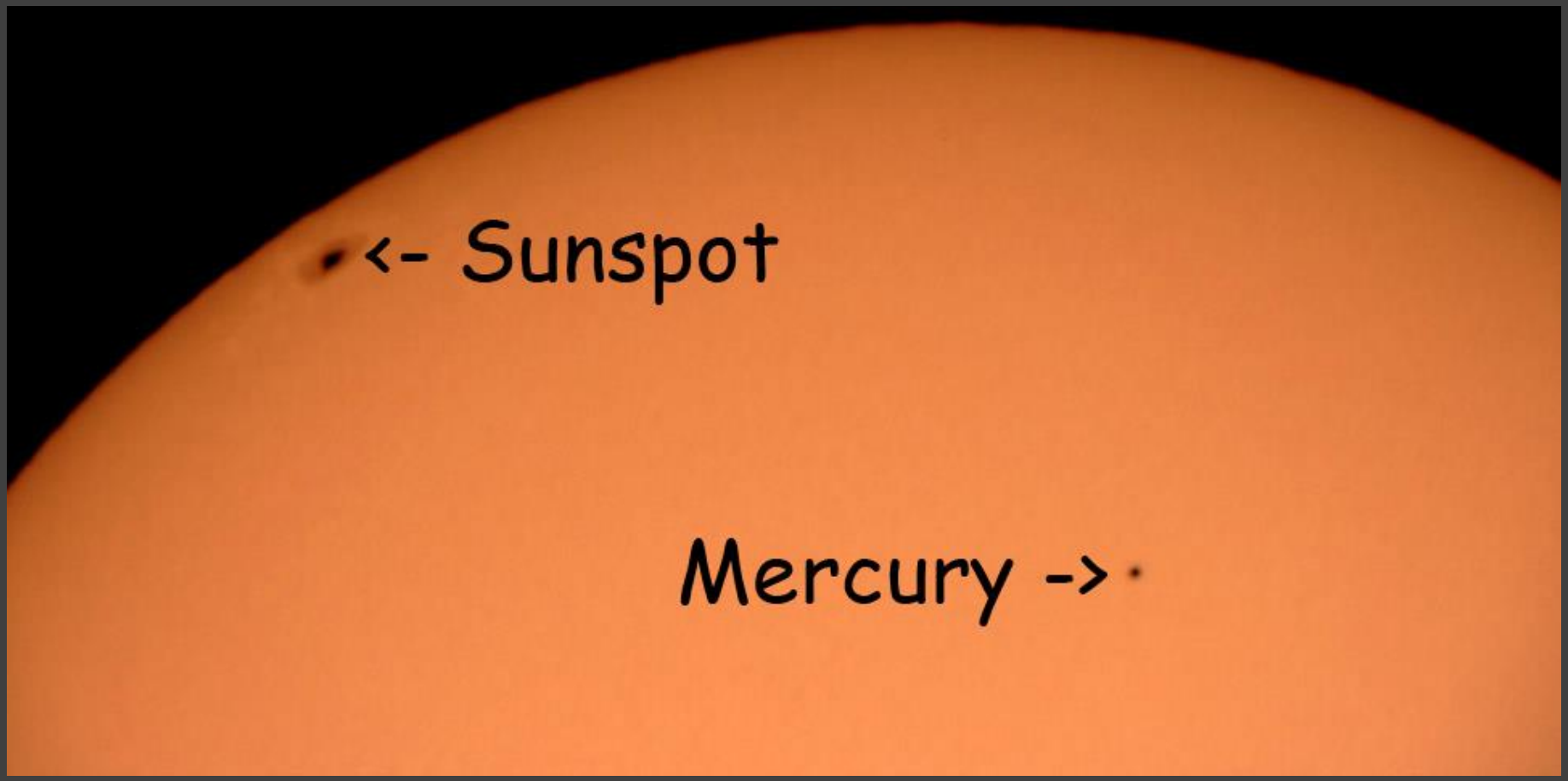


The Sun is 7 times as large in the sky





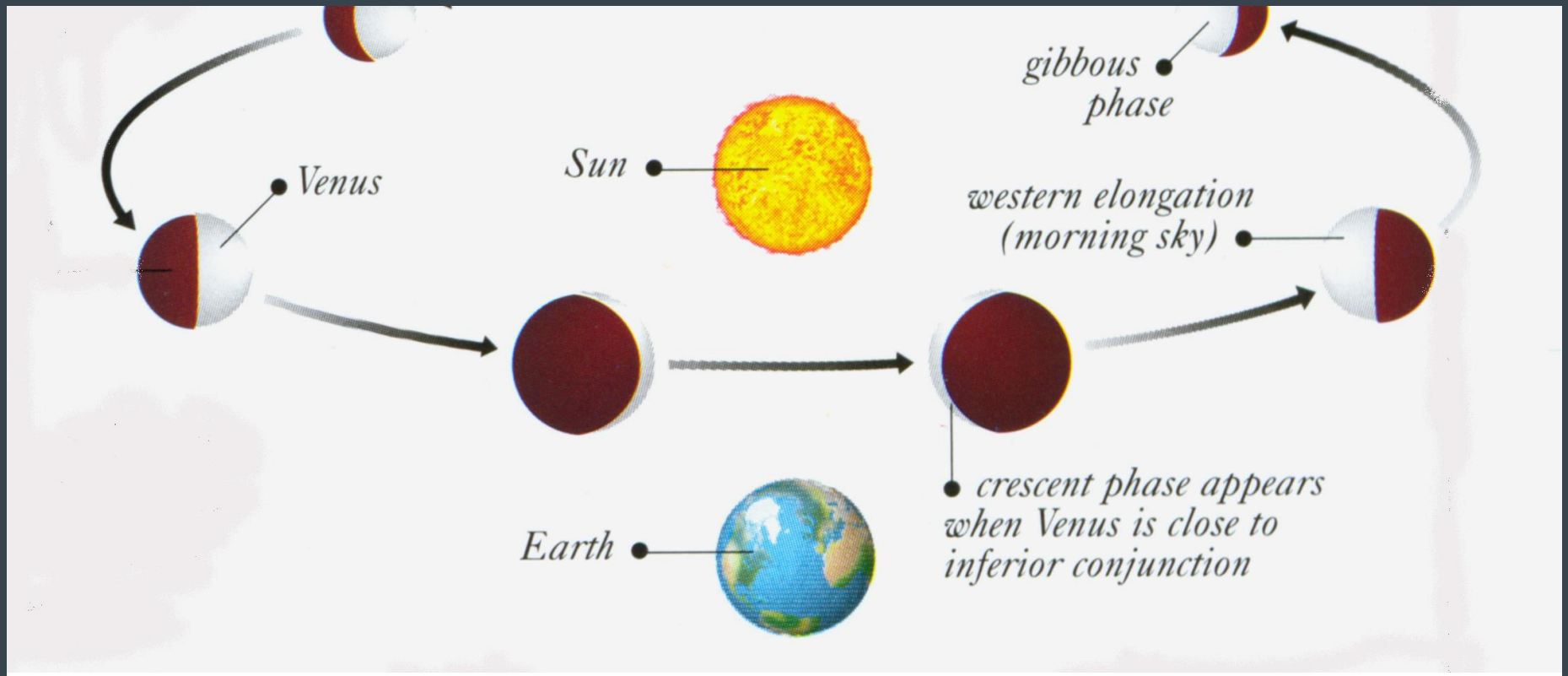
Mercury's Interior - iron ball dipped in mud



- Mercury, like Venus, is closer to the Sun than Earth. So on Earth we can occasionally see Transits of Mercury across the Sun

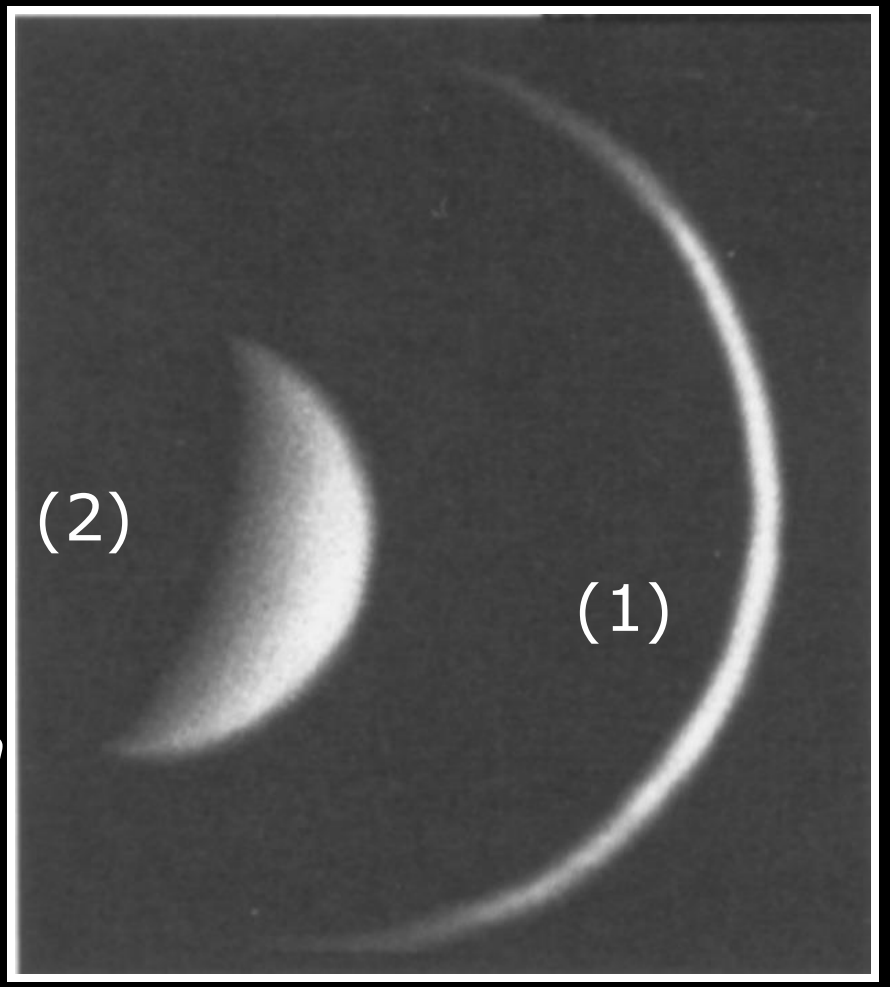
- Mercury is so close to the Sun that it has a tail!
- Made of sodium ions
- Possible to image using specialised cameras and filters (589nm)
- Forms a component of the solar wind (cosmic rays)

Earth & Venus – size comparison
Most similar planets in size.



The phases of Venus

Appearance of Venus



(1)Inferior conjunction
Venus at brightest
(which is ironically at its
Sharpest crescent) always
Follows its greatest elongation

(2)Greatest western
Elongation -

Venus will be at greatest elongation
– farthest from the sunset – on **June 4, 2023**

First planet explored
The Venera Landers

Venus has a hellish environment

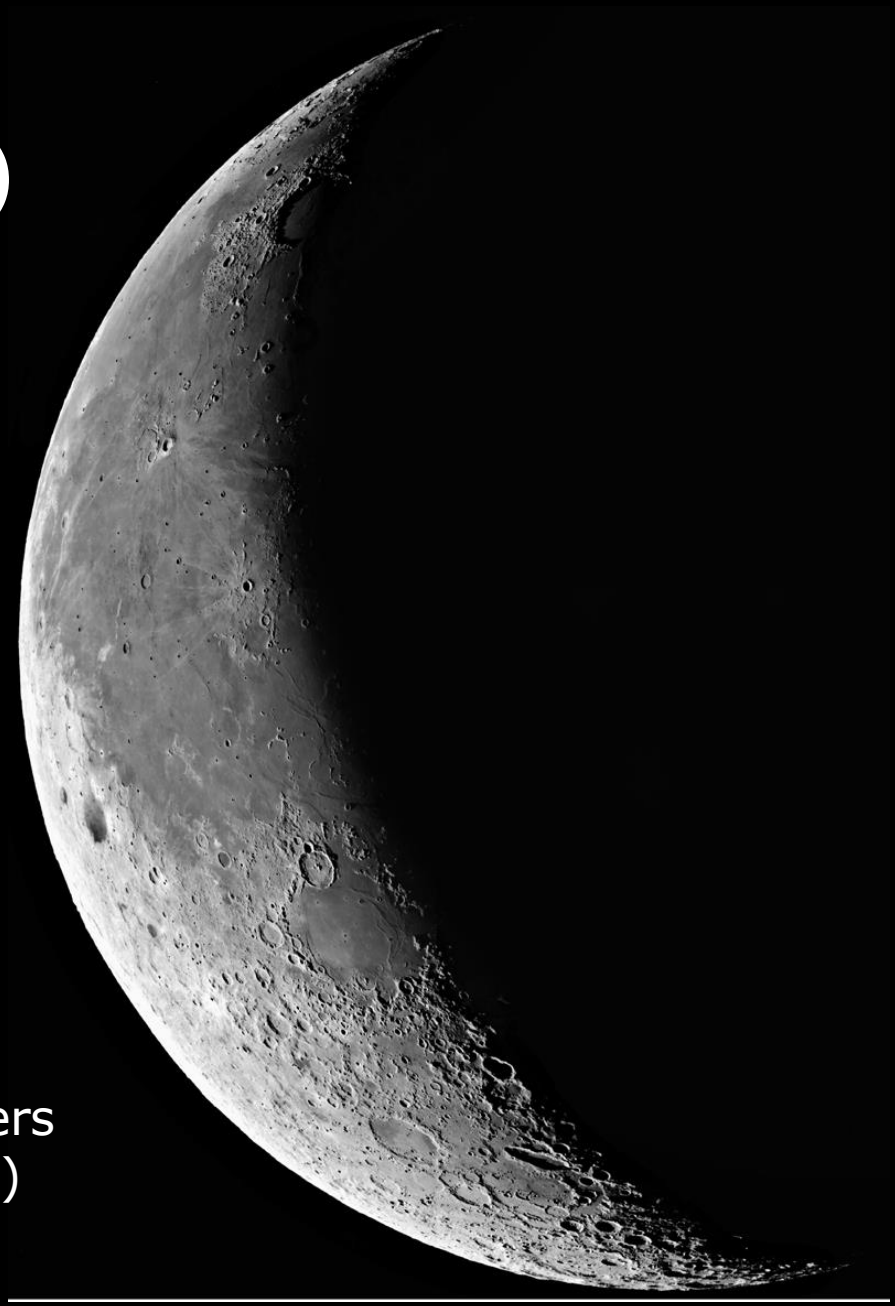
The Earth's Moon (The Moon or Luna)

(1) Surface like Mercury's – airless & cratered.

(1) Very small core – Moon contains very little metals – low gravity: 17% Earth's.

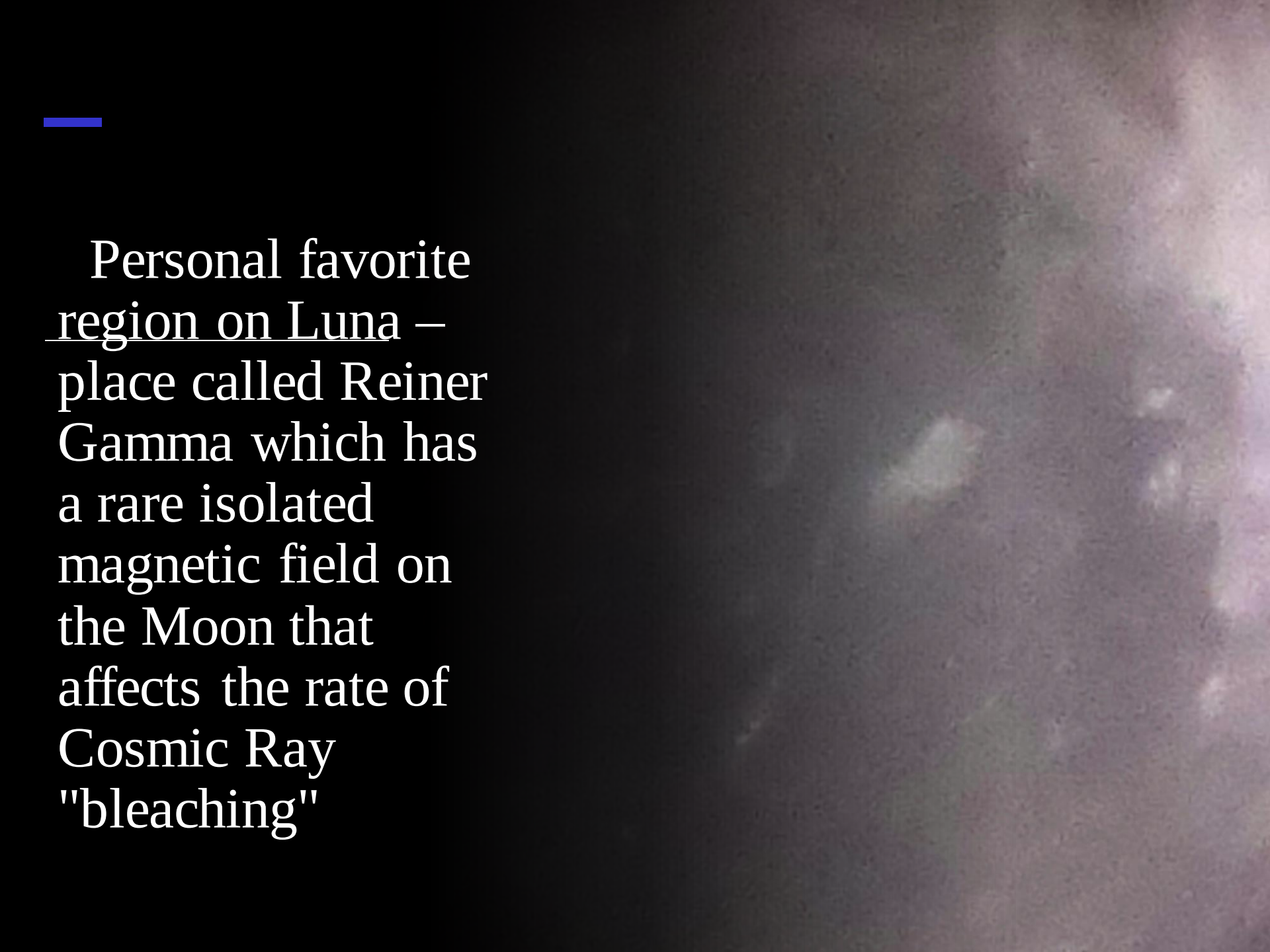
(1) Geologically inactive – few minerals & no volcanism in 3 billion years.

Some interesting very interesting craters
And regions of high brightness (albedo)

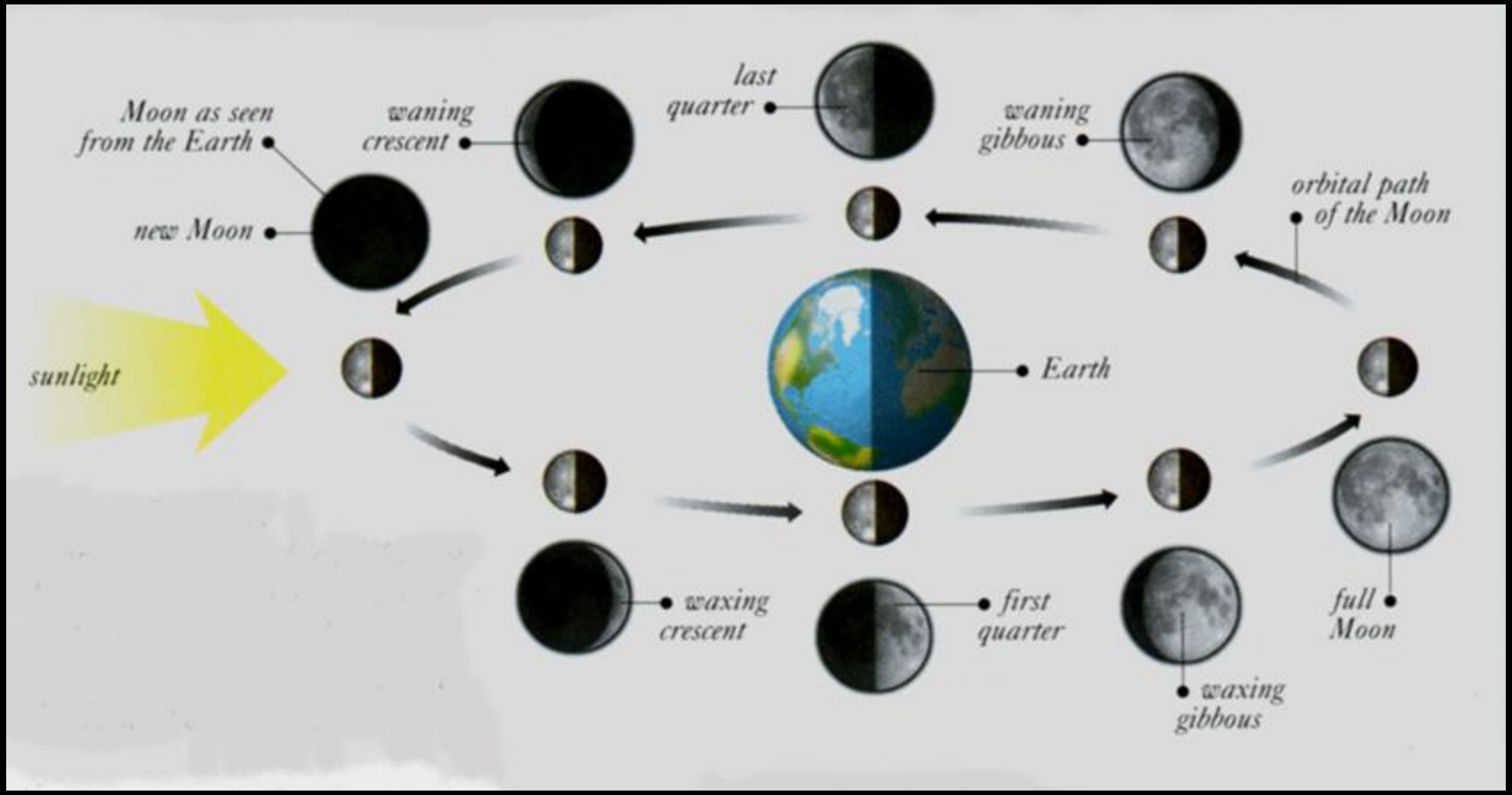


- **Maria- so called** "Seas" are really
- plains of erupted
- basalt with much
- fewer craters (are
- younger) < 3 byo
- & found only on
- Nearside.
- Moon is Tidally Locked with Earth
- Some other regions of high reflectivity
- due to lunar rock (regolith)
- Bleached by billions of years of
- Cosmic rays

Personal favorite region on Luna – place called Reiner Gamma which has a rare isolated magnetic field on the Moon that affects the rate of Cosmic Ray "bleaching"

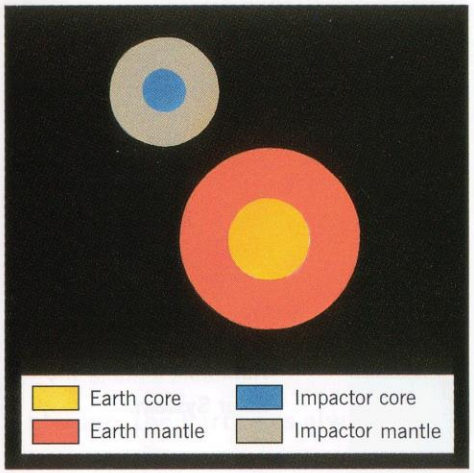


The Moon's Phases

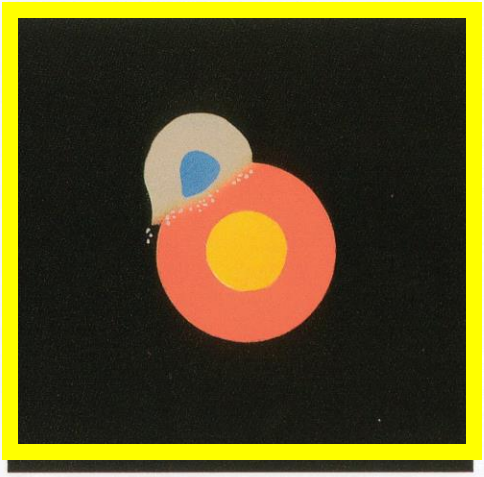


(1) – A Mars–sized object strikes Earth 4.4 bya

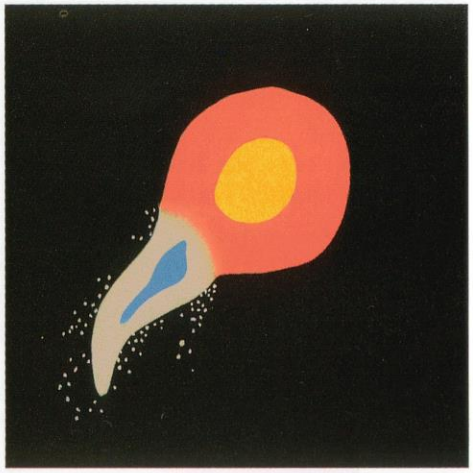
(2) The collision liquefies both bodies



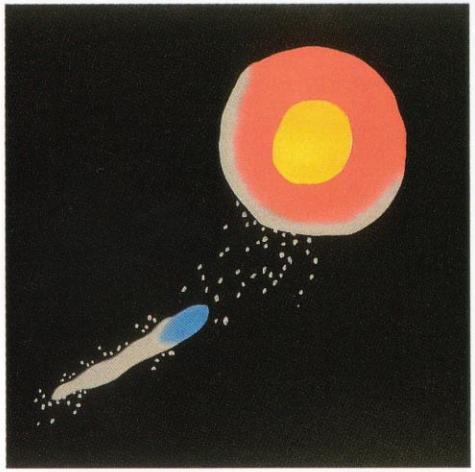
A body about the size of Mars comes close to the Earth, after the Earth has formed its core.



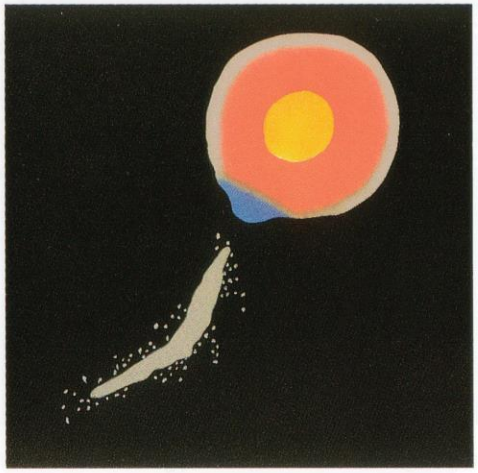
It hits the Earth, vaporising parts of both its own and the Earth's mantle.



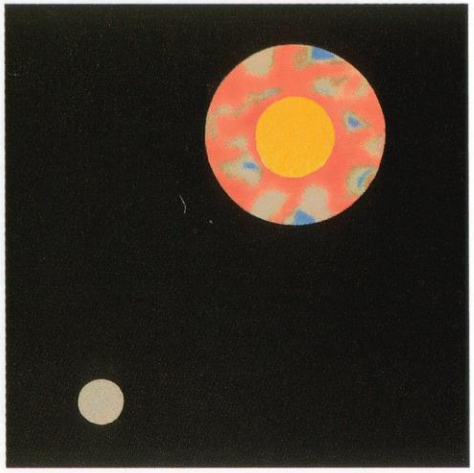
Material is thrown back into space.



Some falls back to the Earth's surface.



A disk of material is left orbiting the Earth.

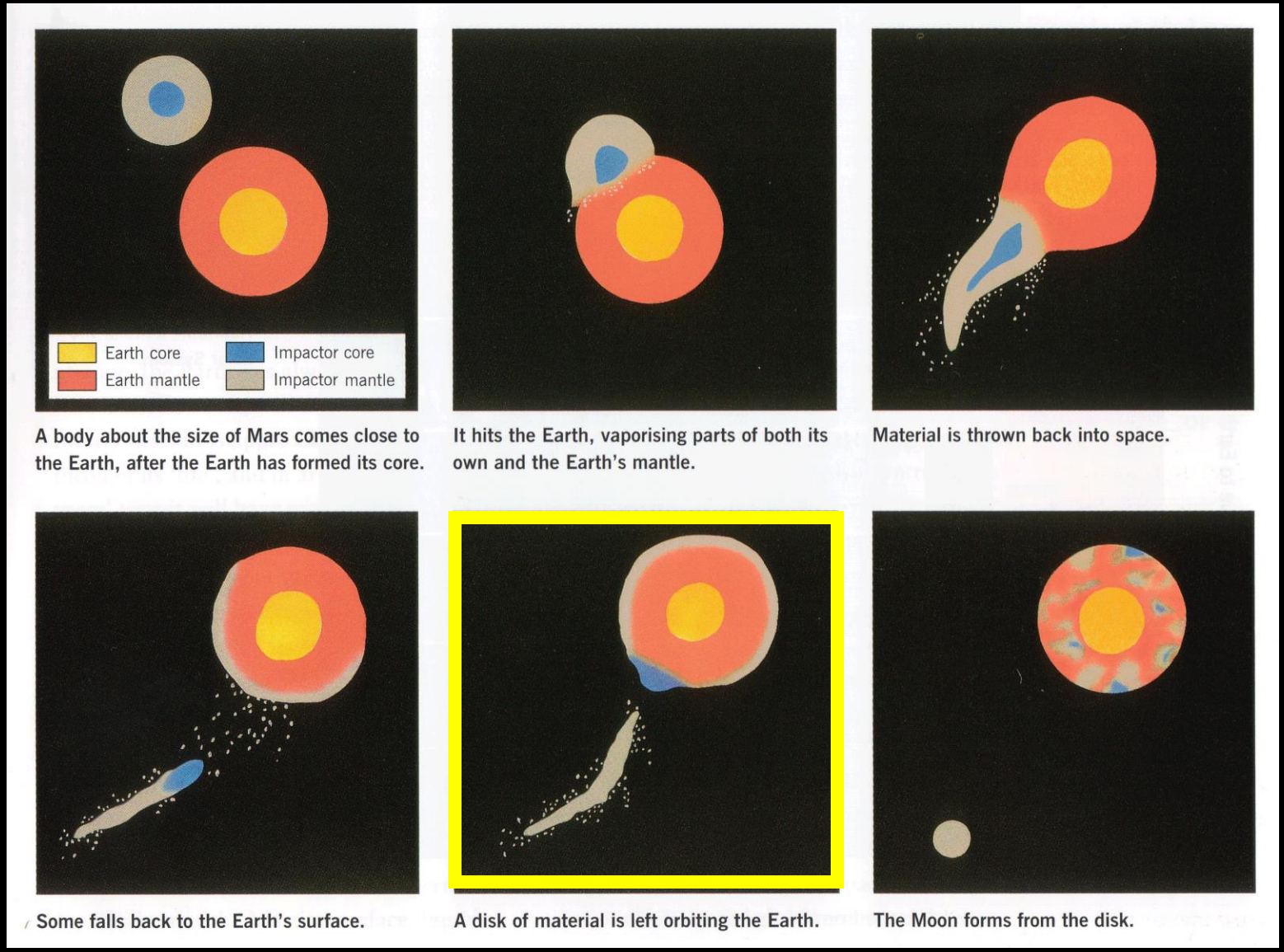


The Moon forms from the disk.

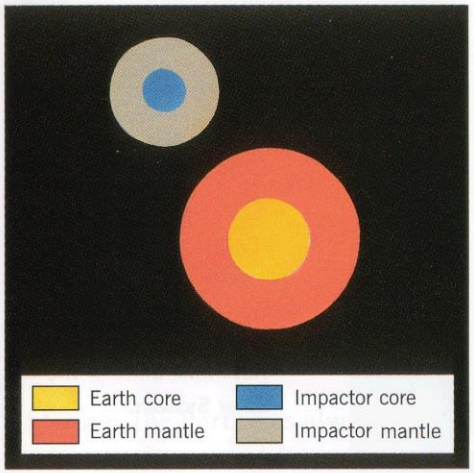
(3) The vapourised impactor orbits Earth.

(4) The impactor's core falls back to Earth.

(5) Lighter, mantle material says in orbit.



(6) The Moon forms from this lighter material.



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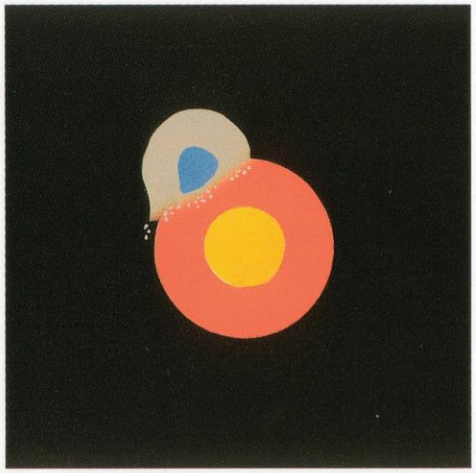

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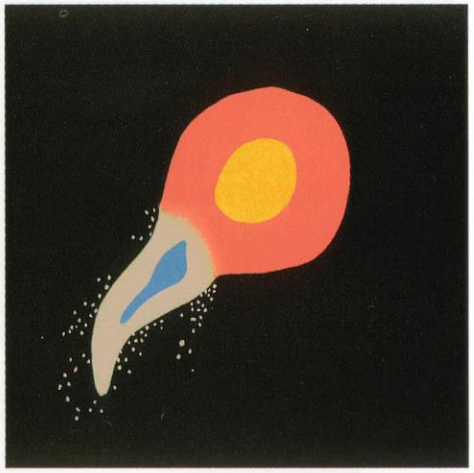
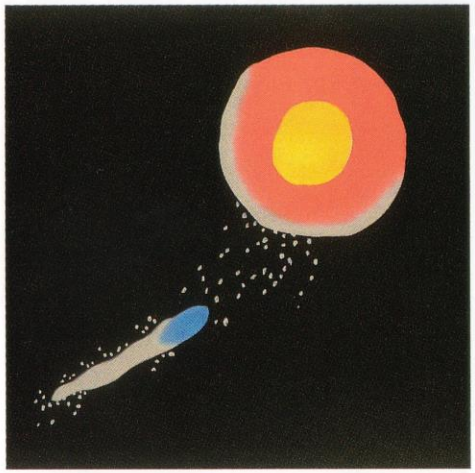
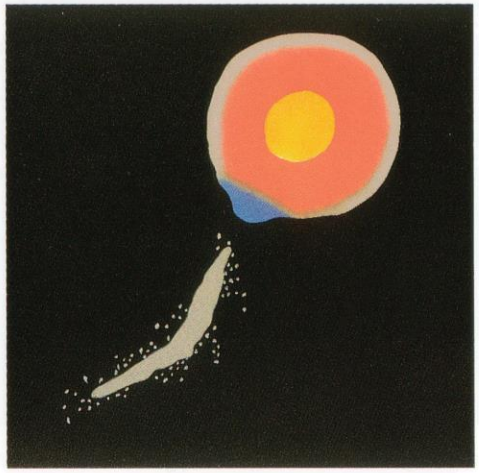


Material is thrown back into space.



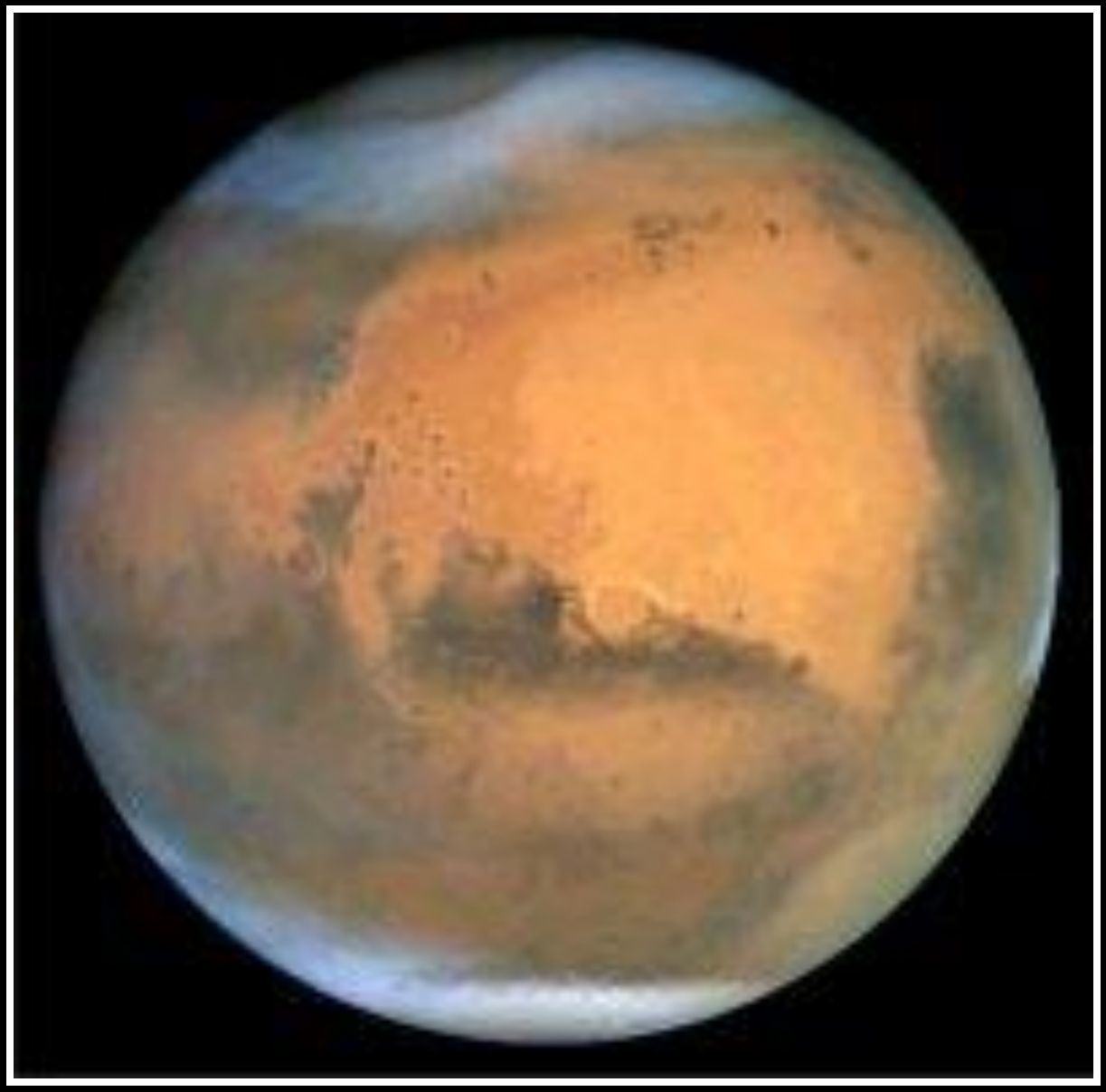
Some falls back to the Earth's surface.



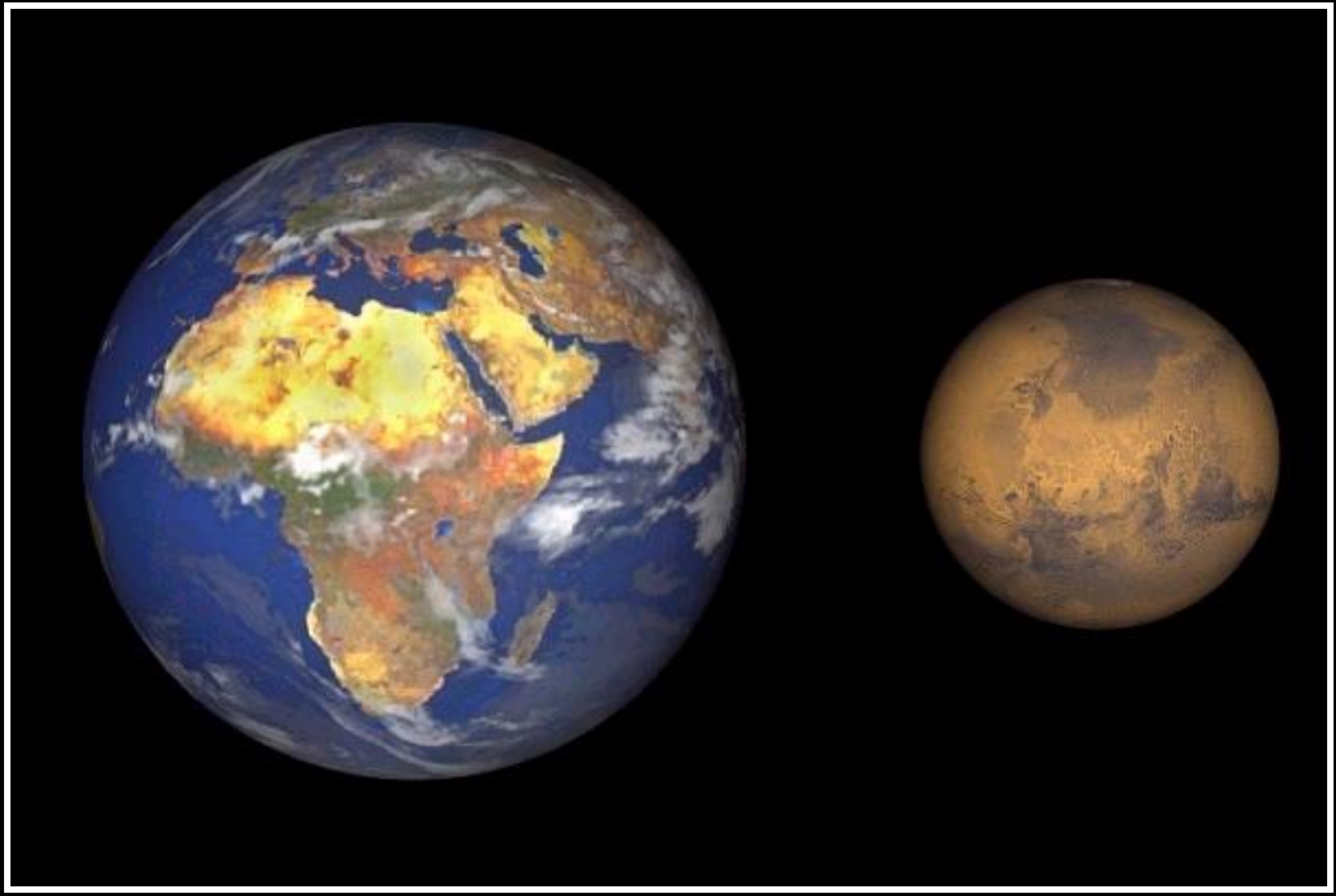
A disk of material is left orbiting the Earth.

The Moon forms from the disk.

Mars

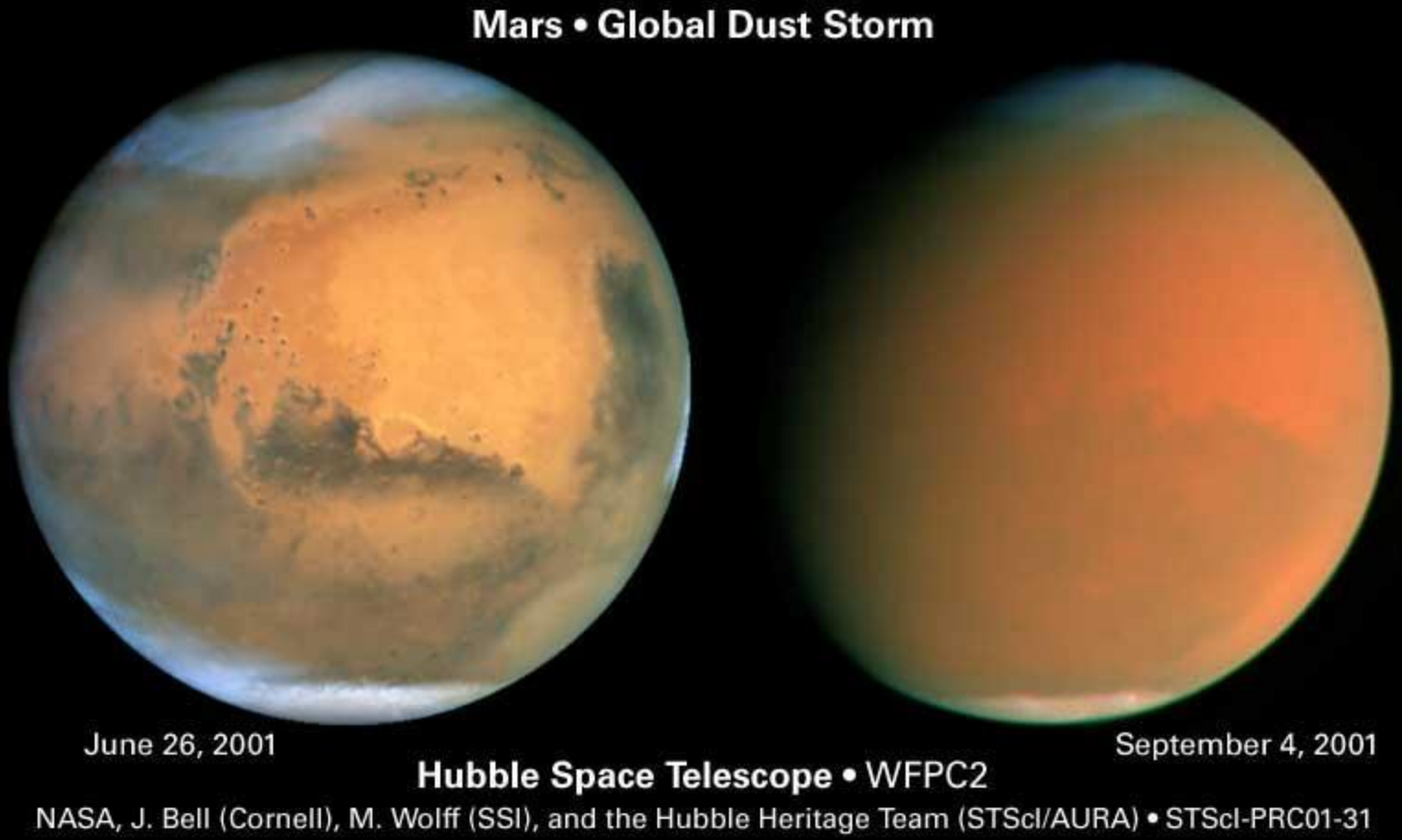


Earth & Mars size comparison



	MARS	EARTH
Land Area	144 m sq. km	148 m sq. km
Distance from Sun	207 – 249 m km	147 – 152 m km
Orbital Period	687 days	365 days
Axial Tilt	25.2º	23.5º
Length of Day	24:39:23	24:00:00
Gravity	0.38 G	1.00 G
Atmos. Contents	CO_2	N_2 & O_2
Atmos. Pressure	7 – 10 millibars	1013 millibars

Global Dust Storms



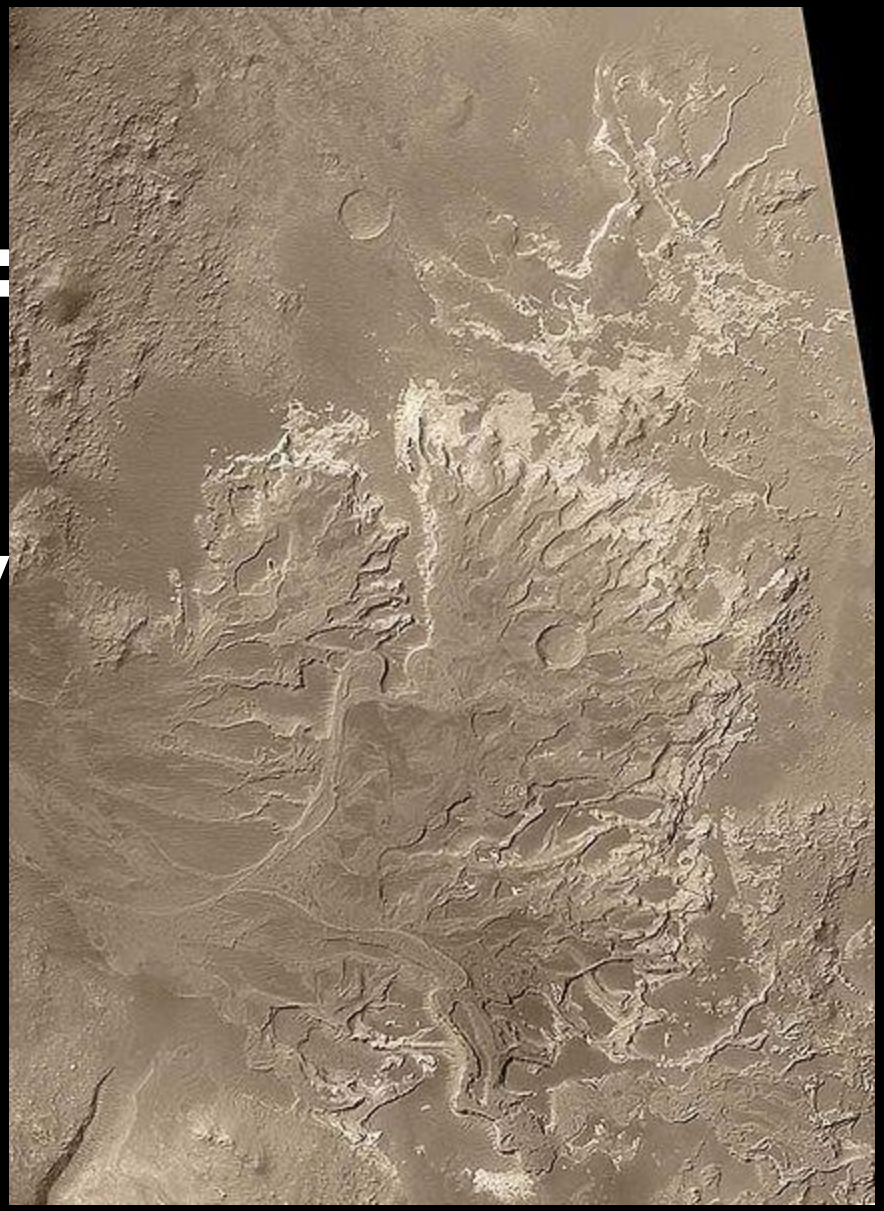
Powerful One in Summer2018 – increased Brightness but killed the Opportunity Rover

Water on Mars.

Up until recently:
Ice/Vapour

Recent discovery
Briny liquid?

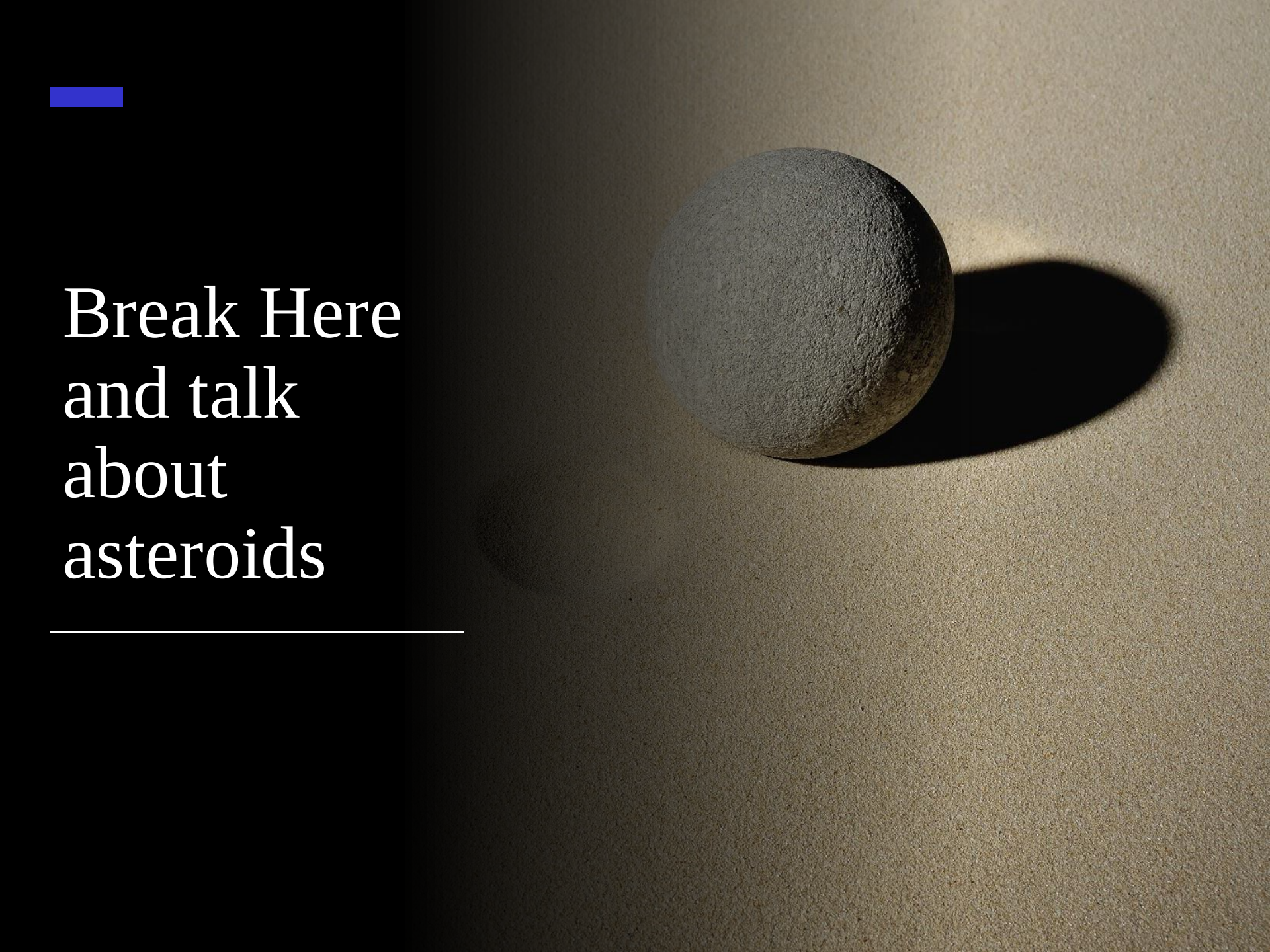
Were definitely
Rivers, seas in
the past

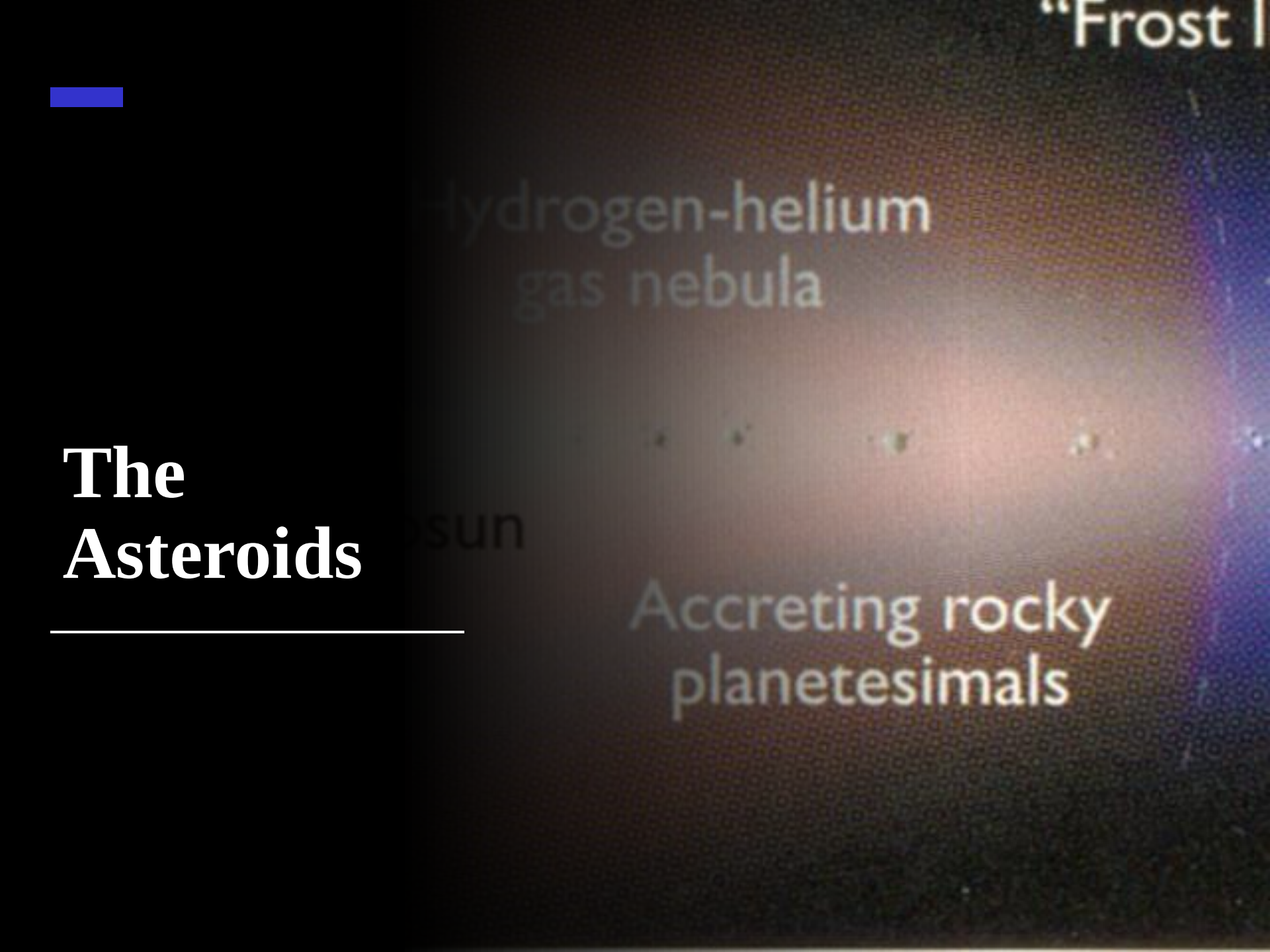



MARTE
LA CONQUISTA DE UN SUEÑ

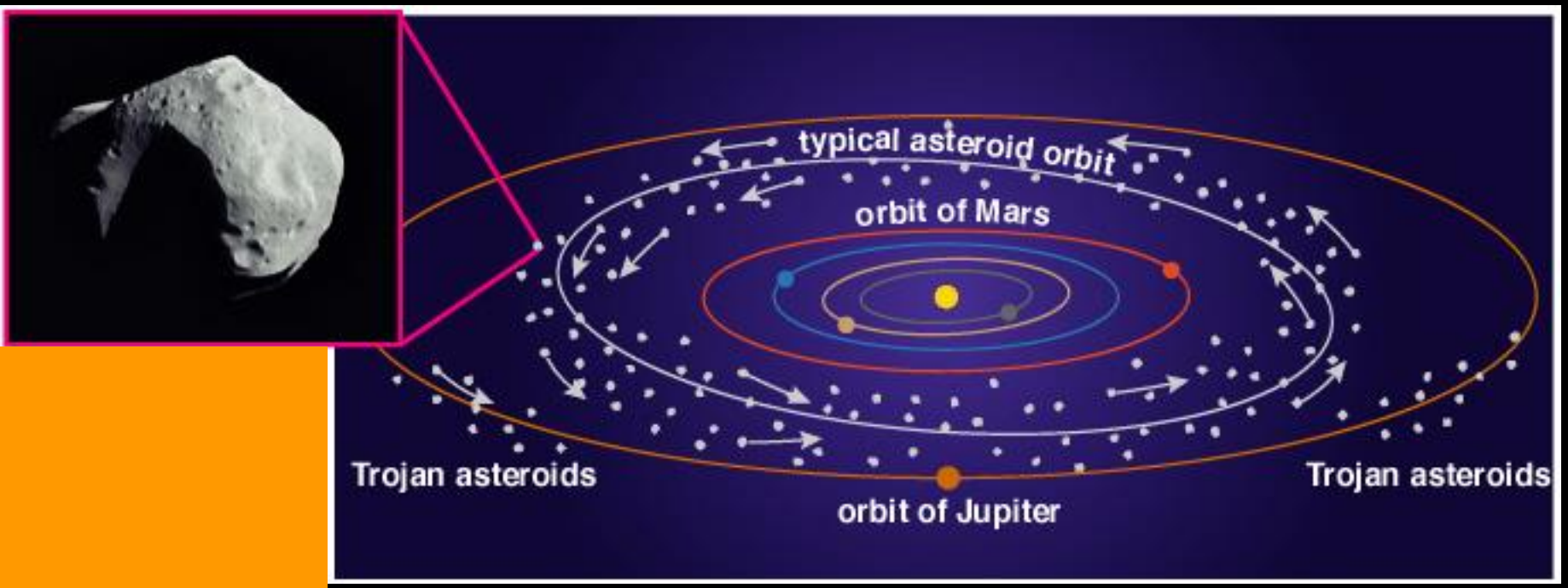

THE DAY MARS INVADED EARTH

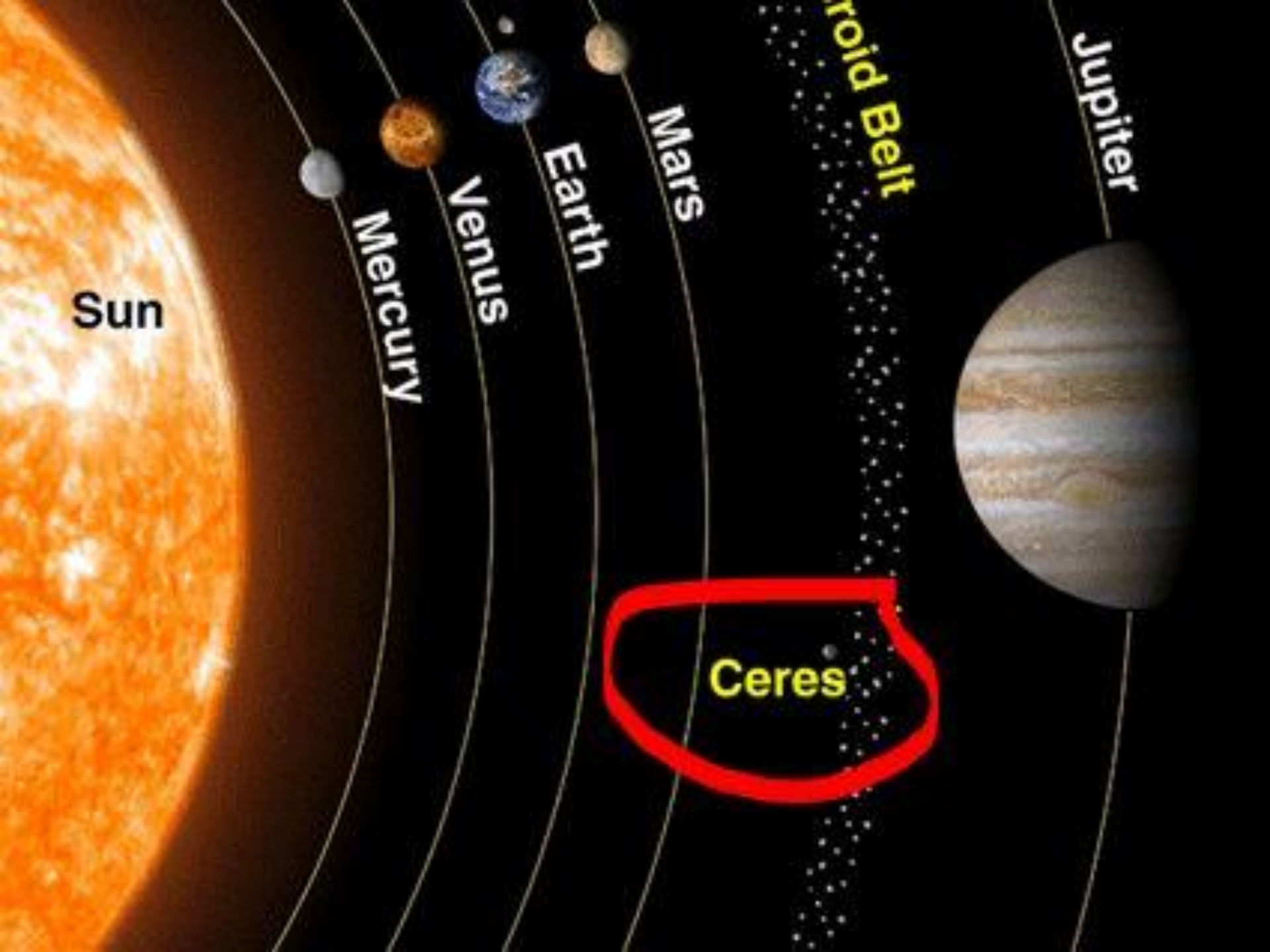
Break Here and talk about asteroids

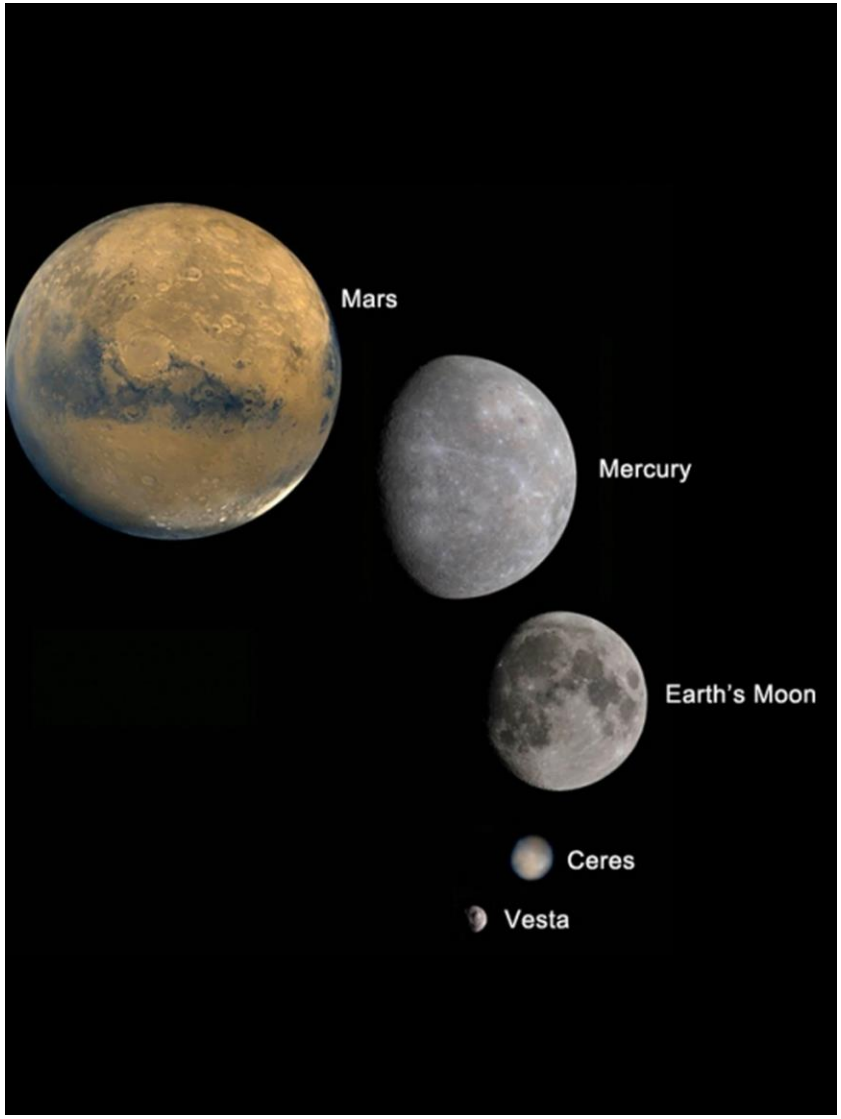


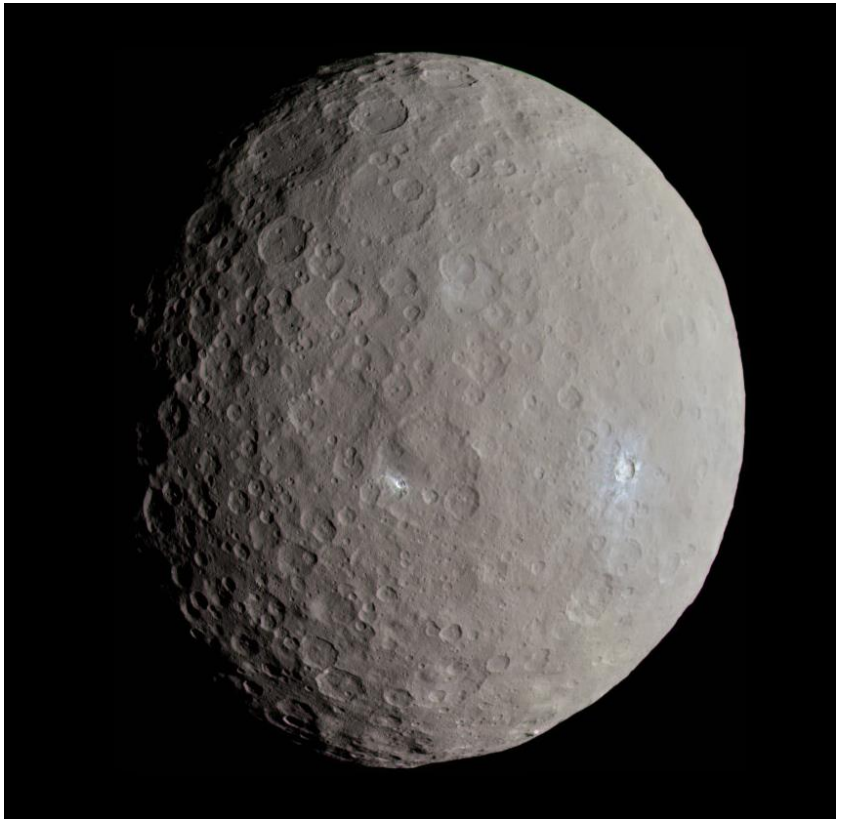


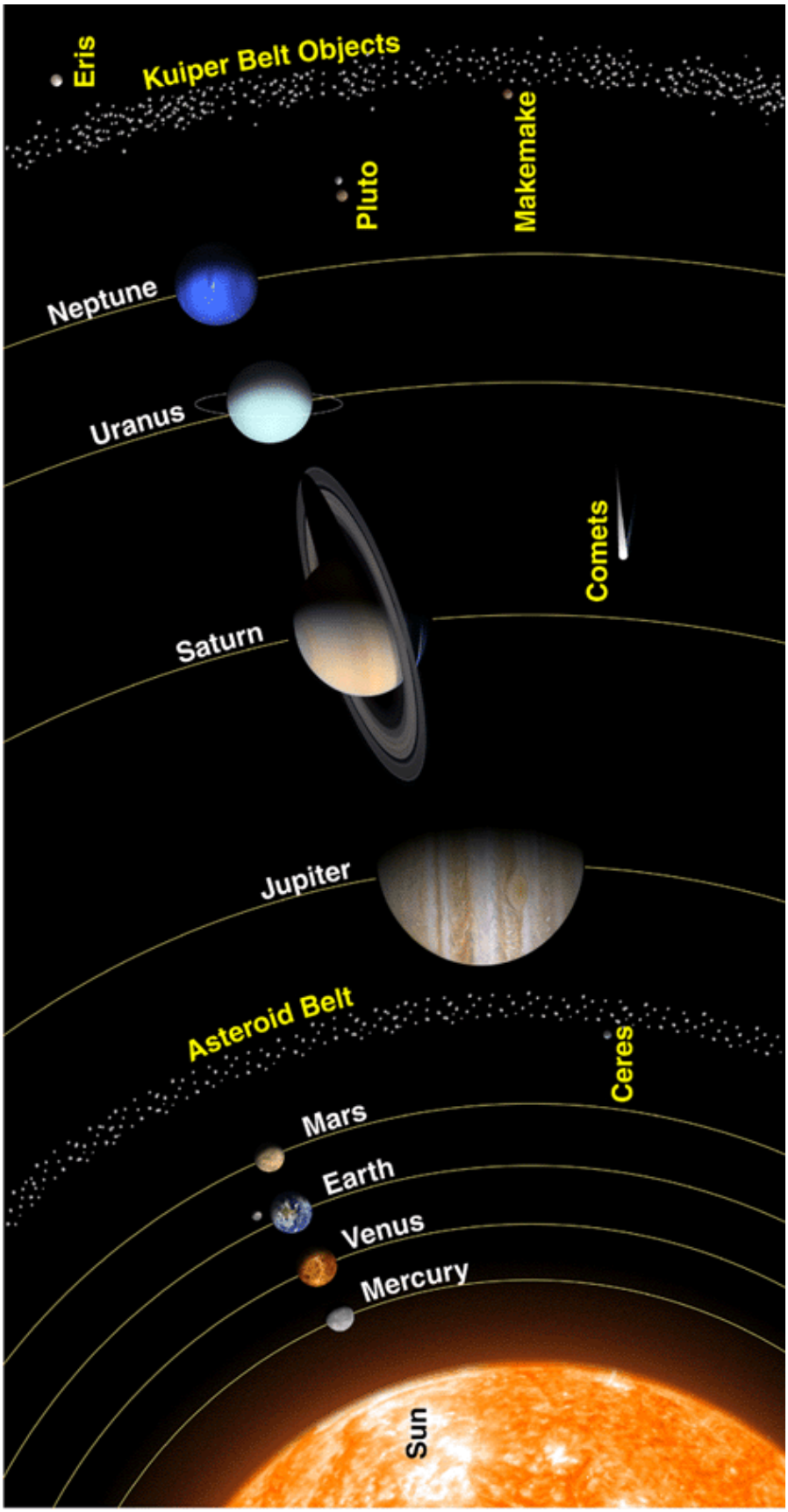
The Asteroids

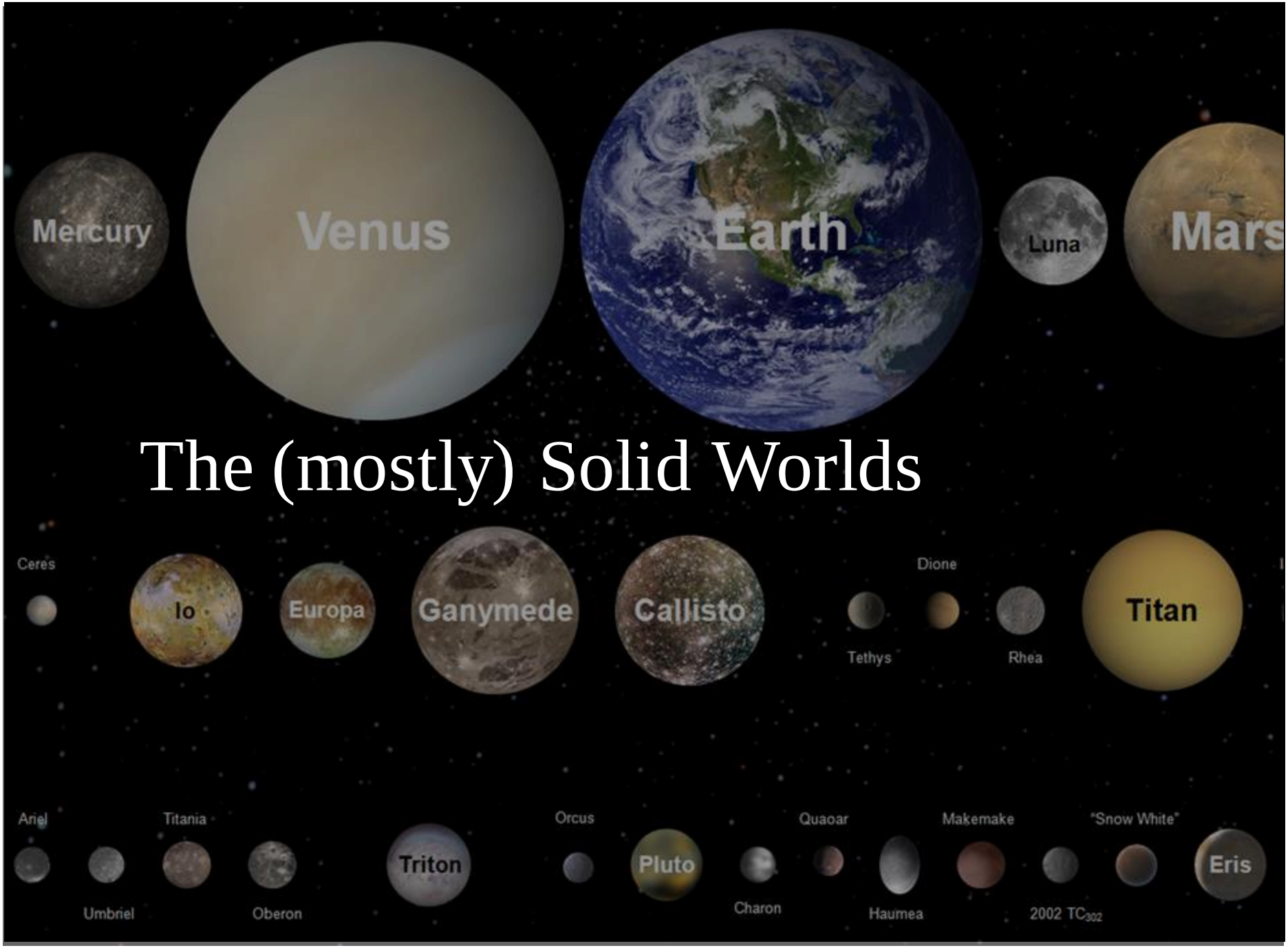

typical asteroid orbit
orbit of Mars
Trojan asteroids
Trojan asteroids
orbit of Jupiter


Sun
Mercury
Venus
Earth
Mars
roid Belt
Jupiter
Ceres


Mars
Mercury
Earth's Moon
Ceres
Vesta

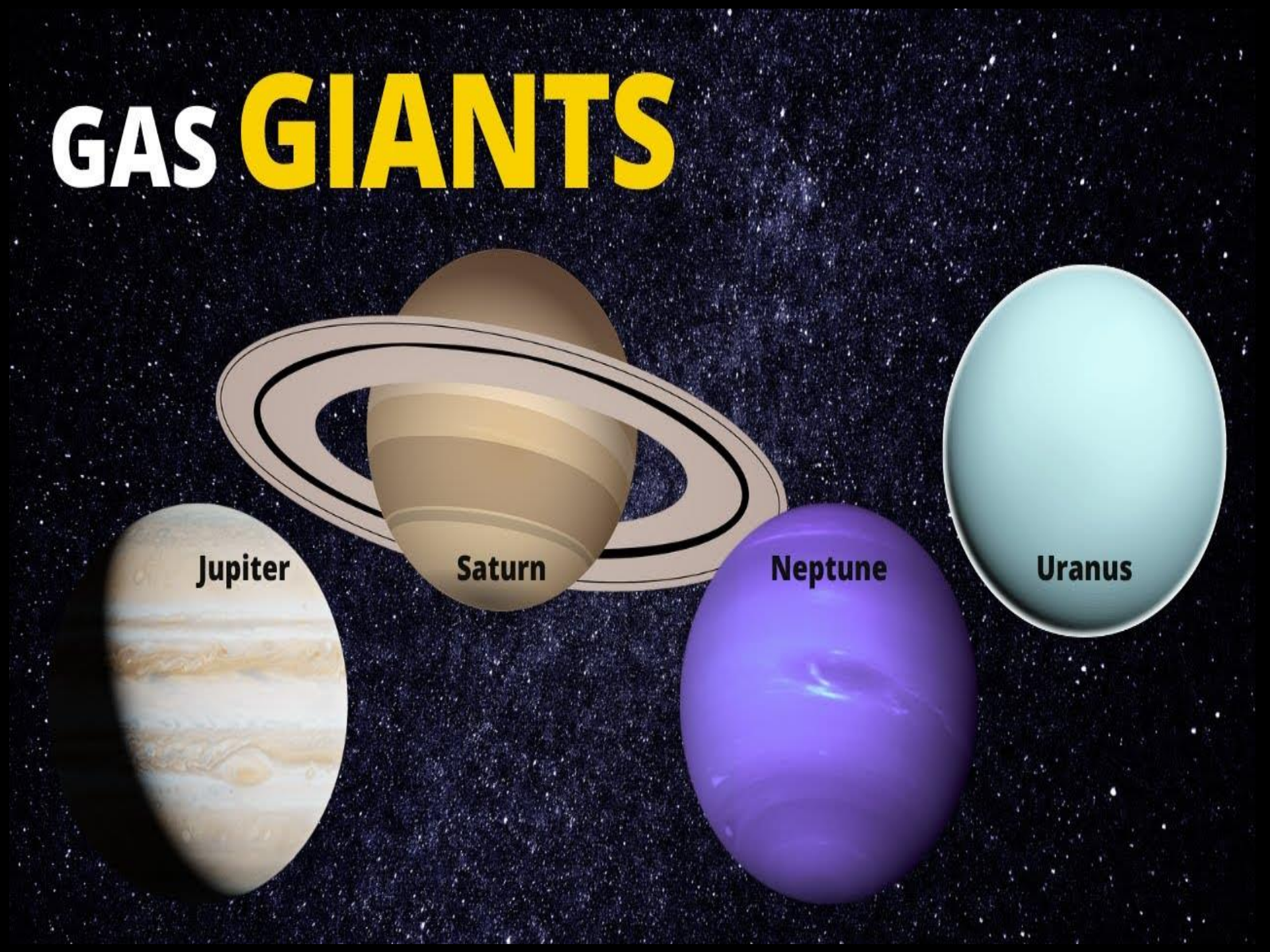


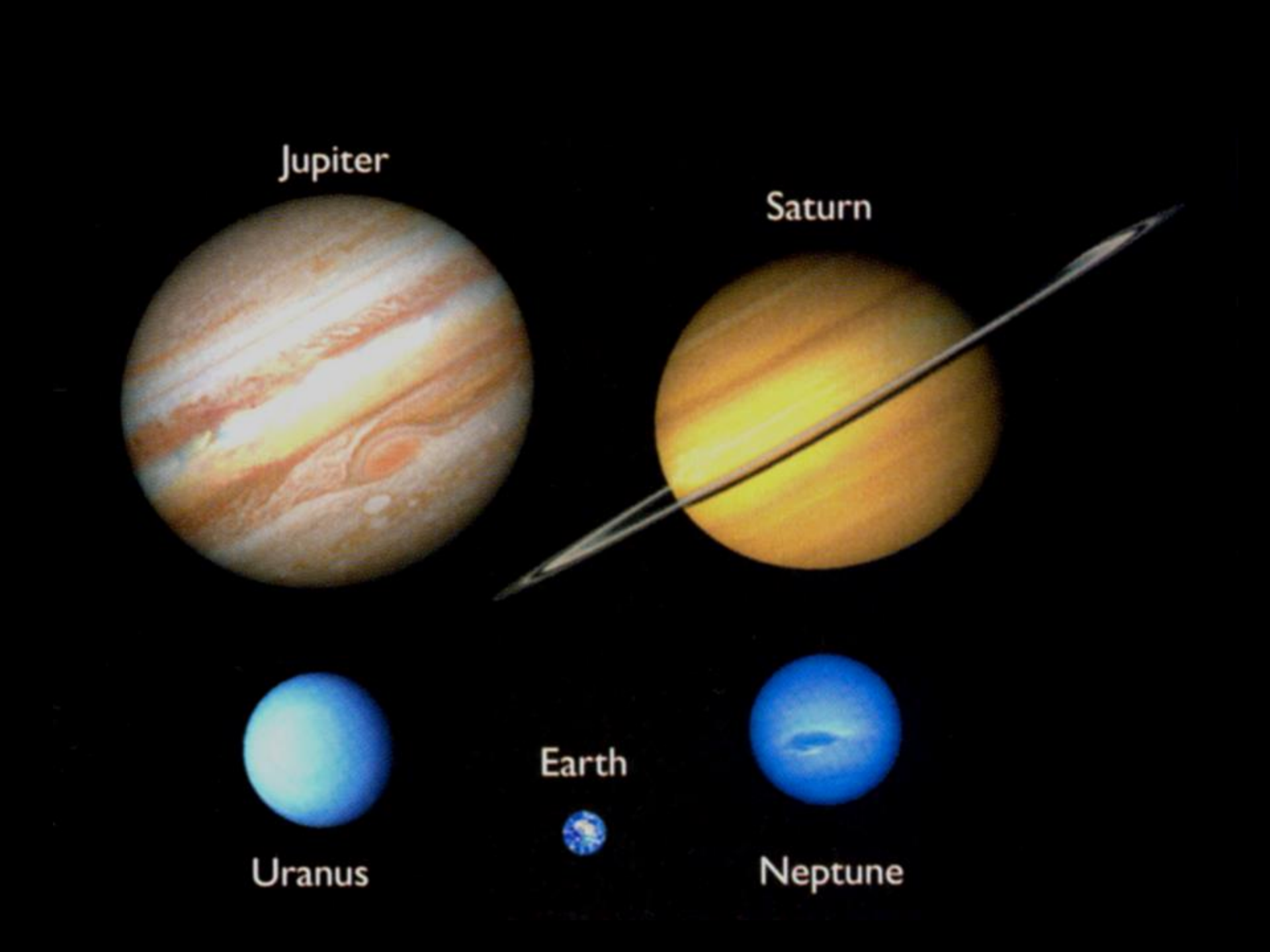

Eris
Kuiper Belt Objects
Pluto
Makemake
Neptune
Uranus
Comets
Saturn
Jupiter
Asteroid Belt
Ceres
Mars
Earth
Venus
Mercury
Sun



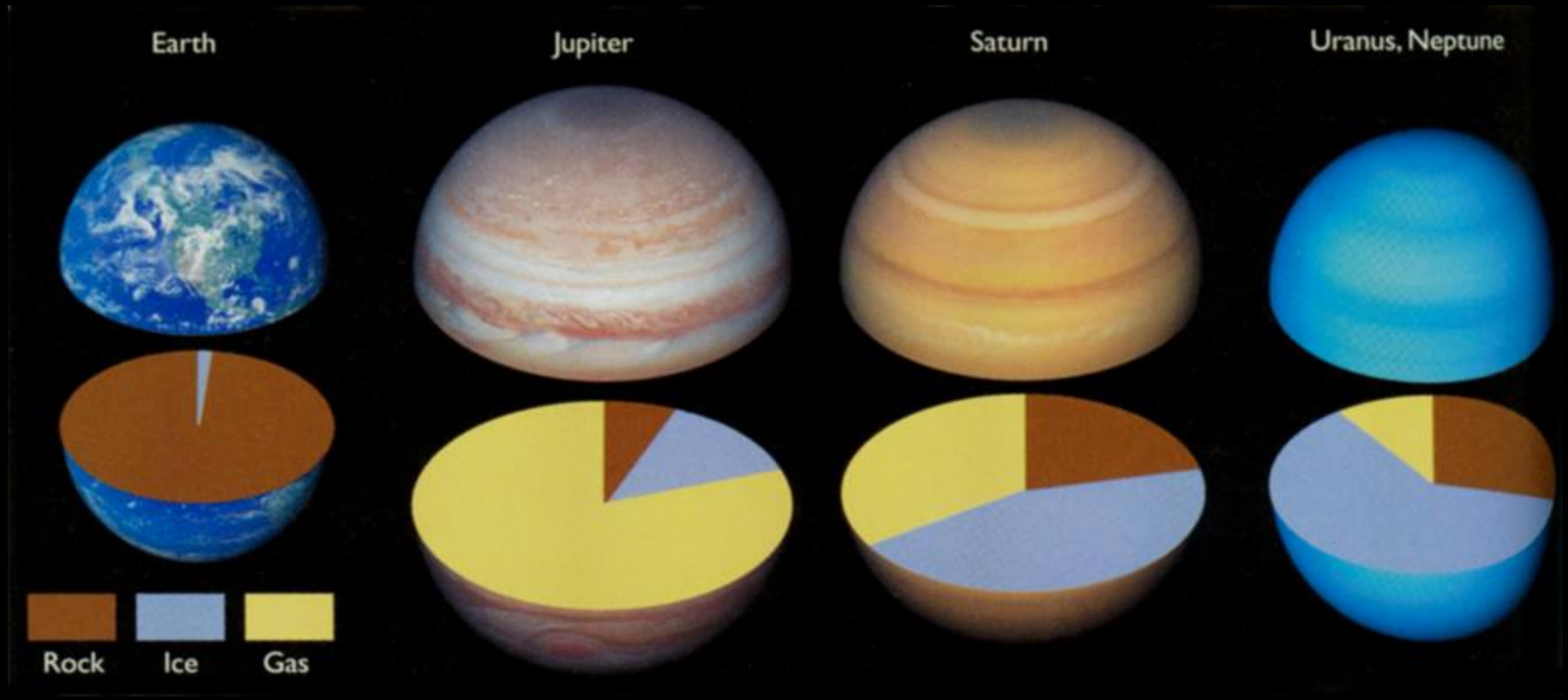
The (mostly) Solid Worlds

GAS GIANTS

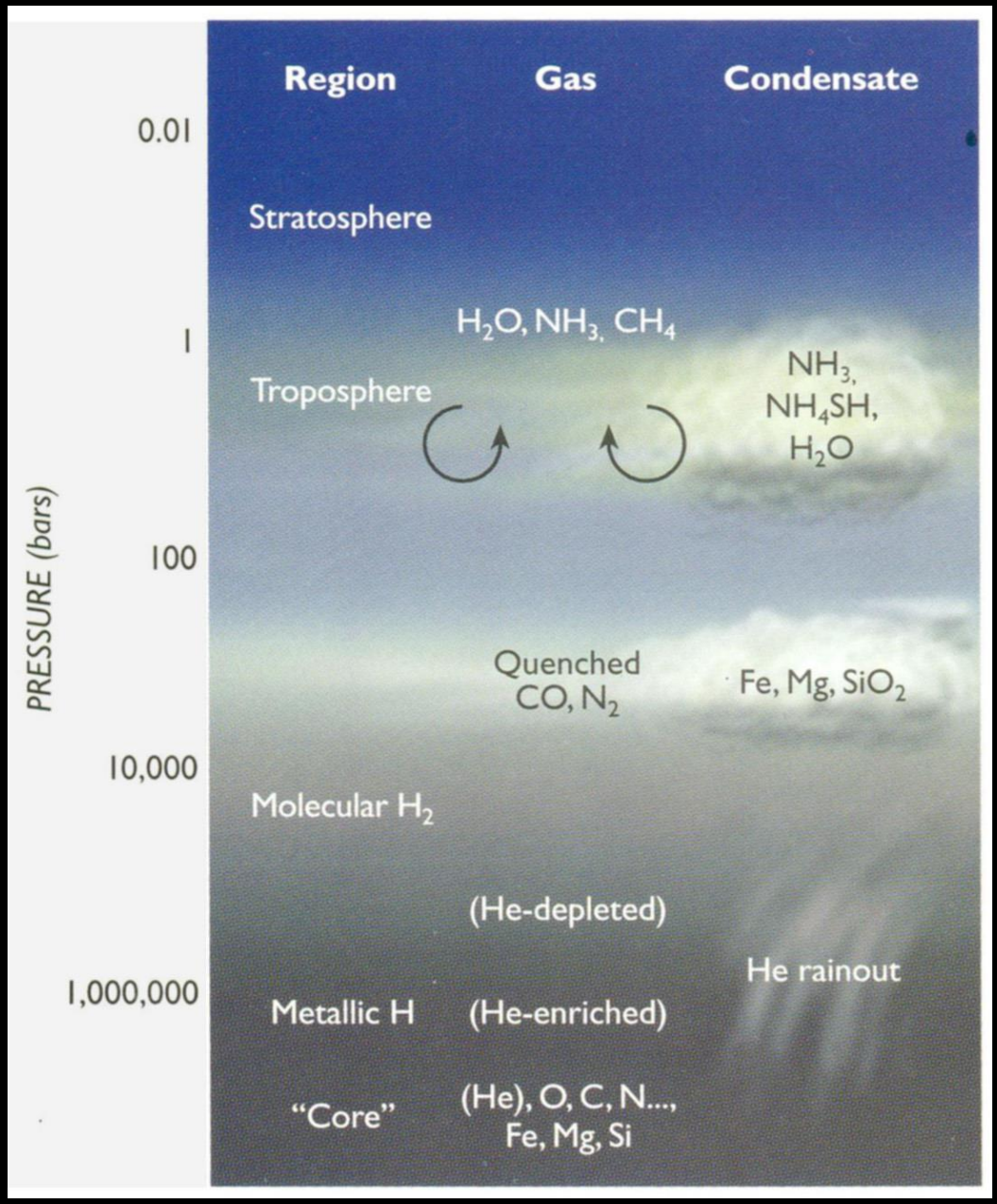



Jupiter
Saturn
Uranus
Earth
Neptune

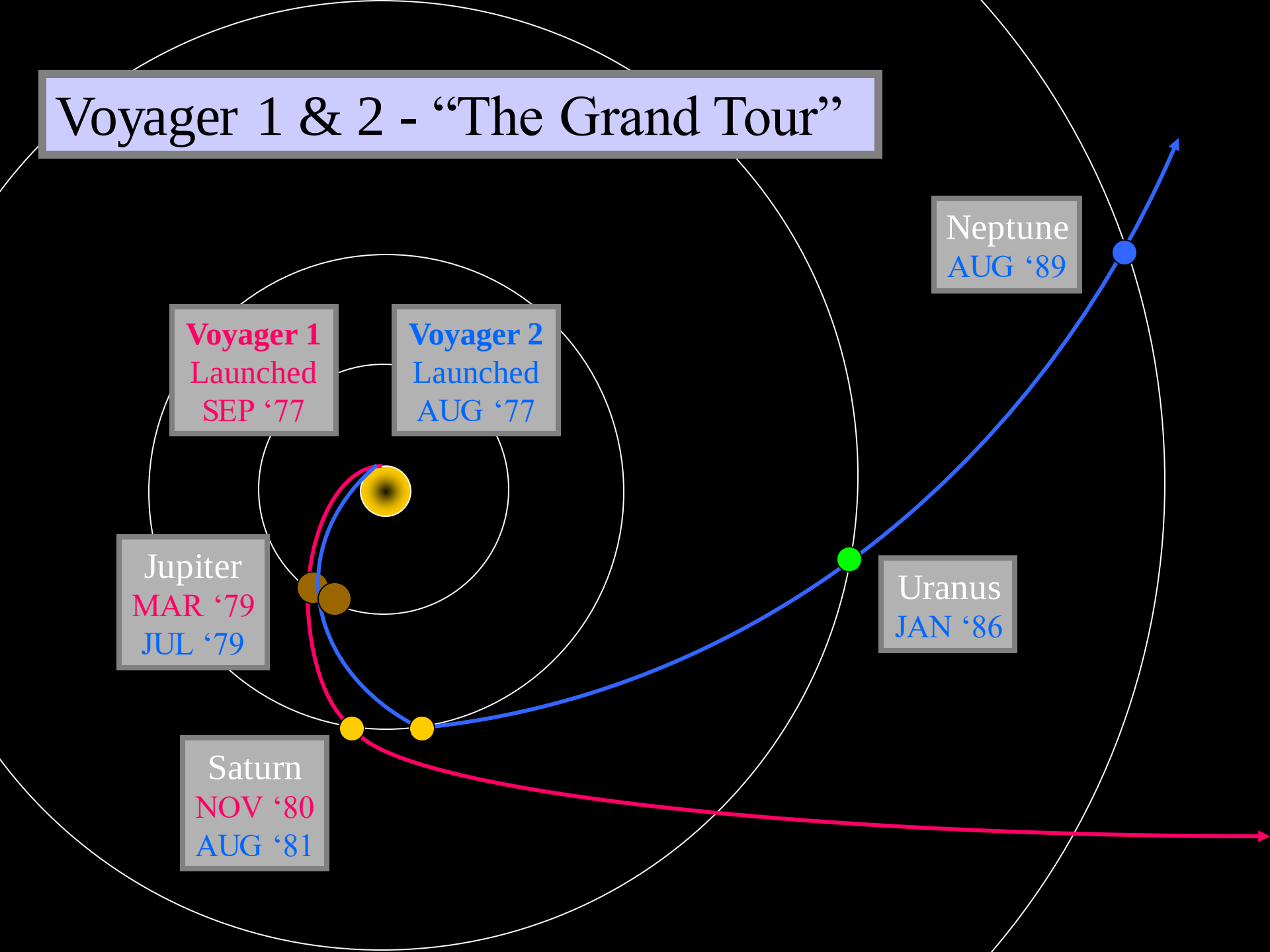
Comparative compositions of planets



Atmosphere & stratiagraphy of a typical giant planet

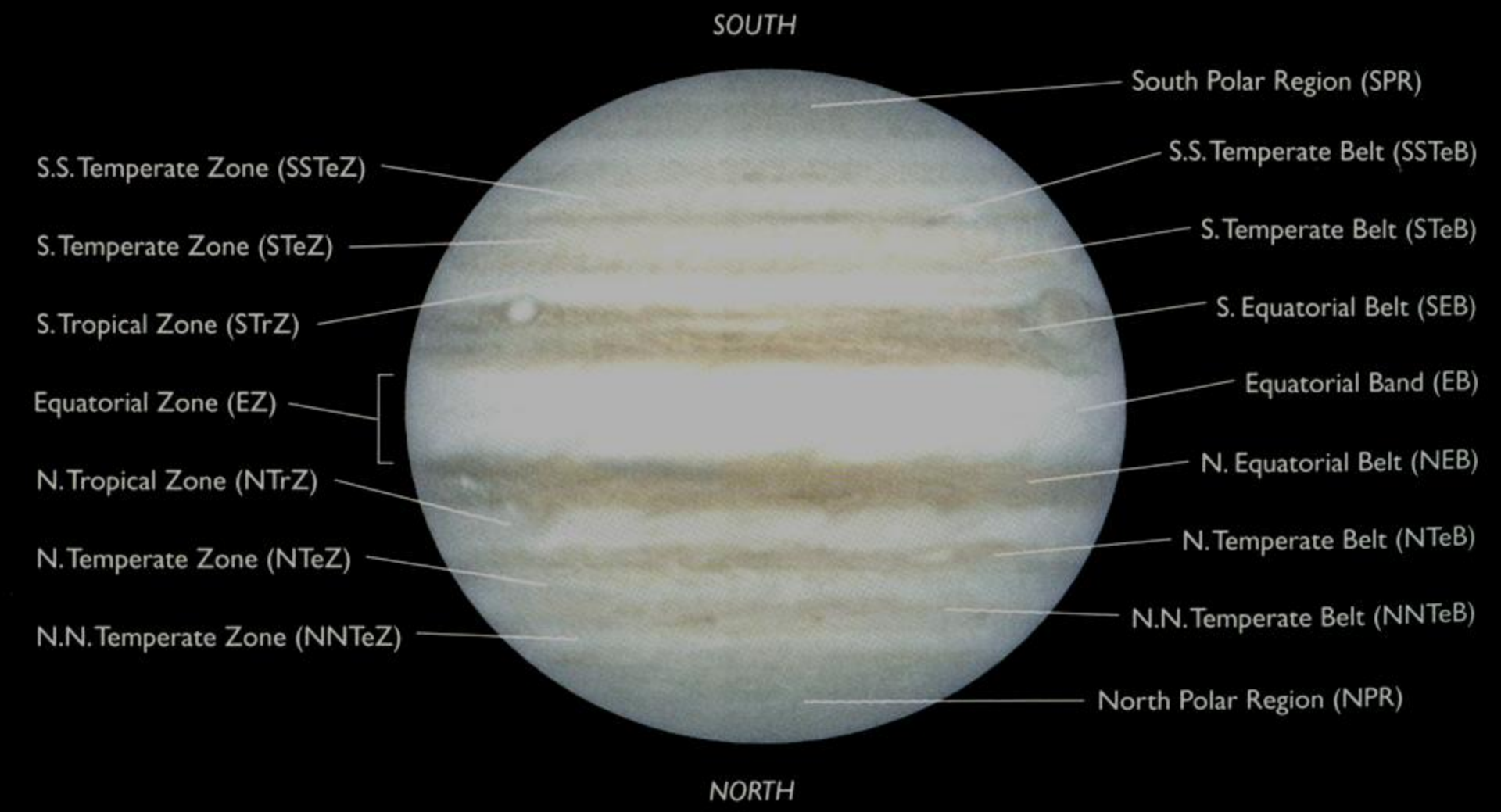


Voyager 1 & 2 - “The Grand Tour”

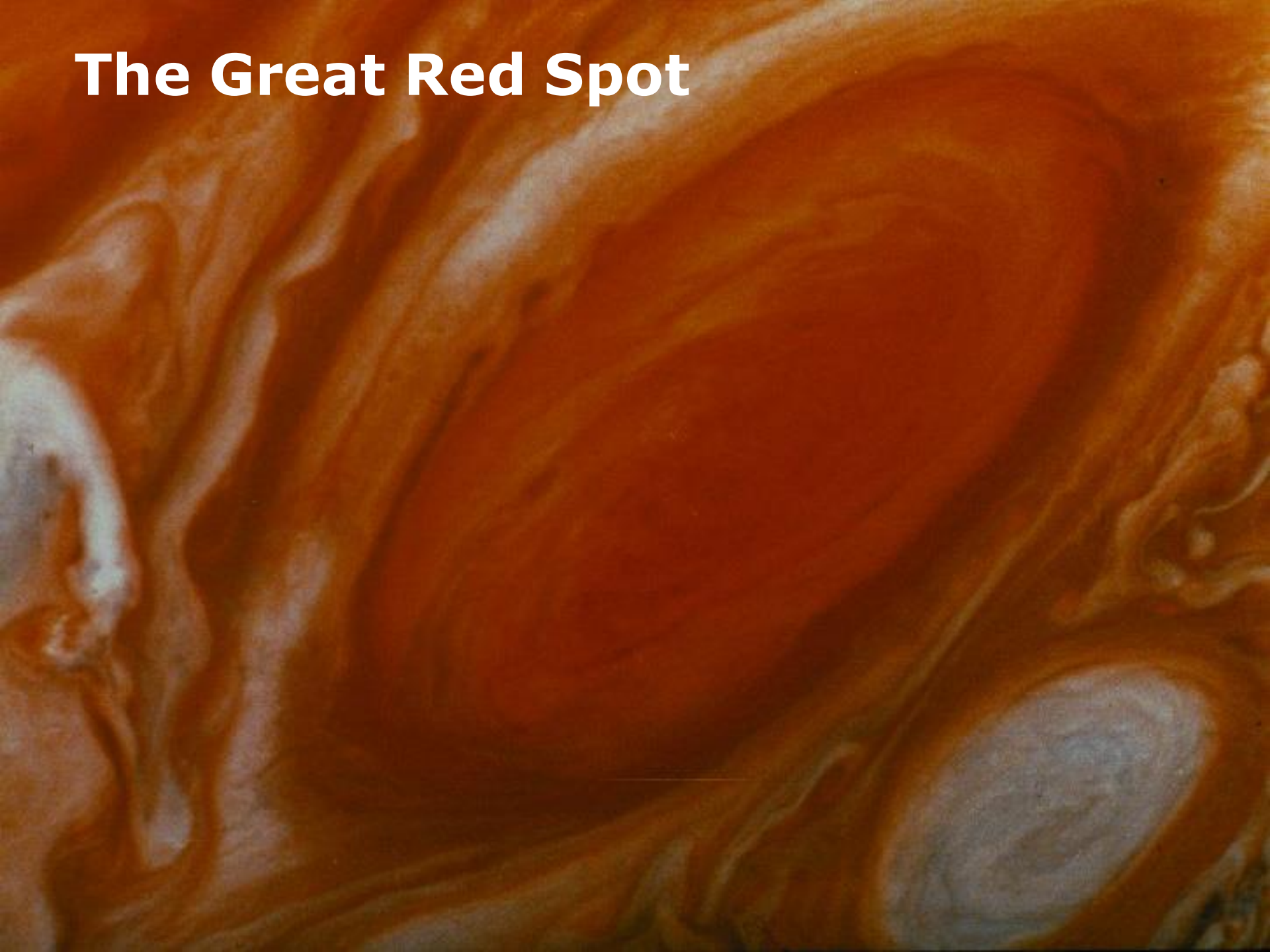


Jupiter

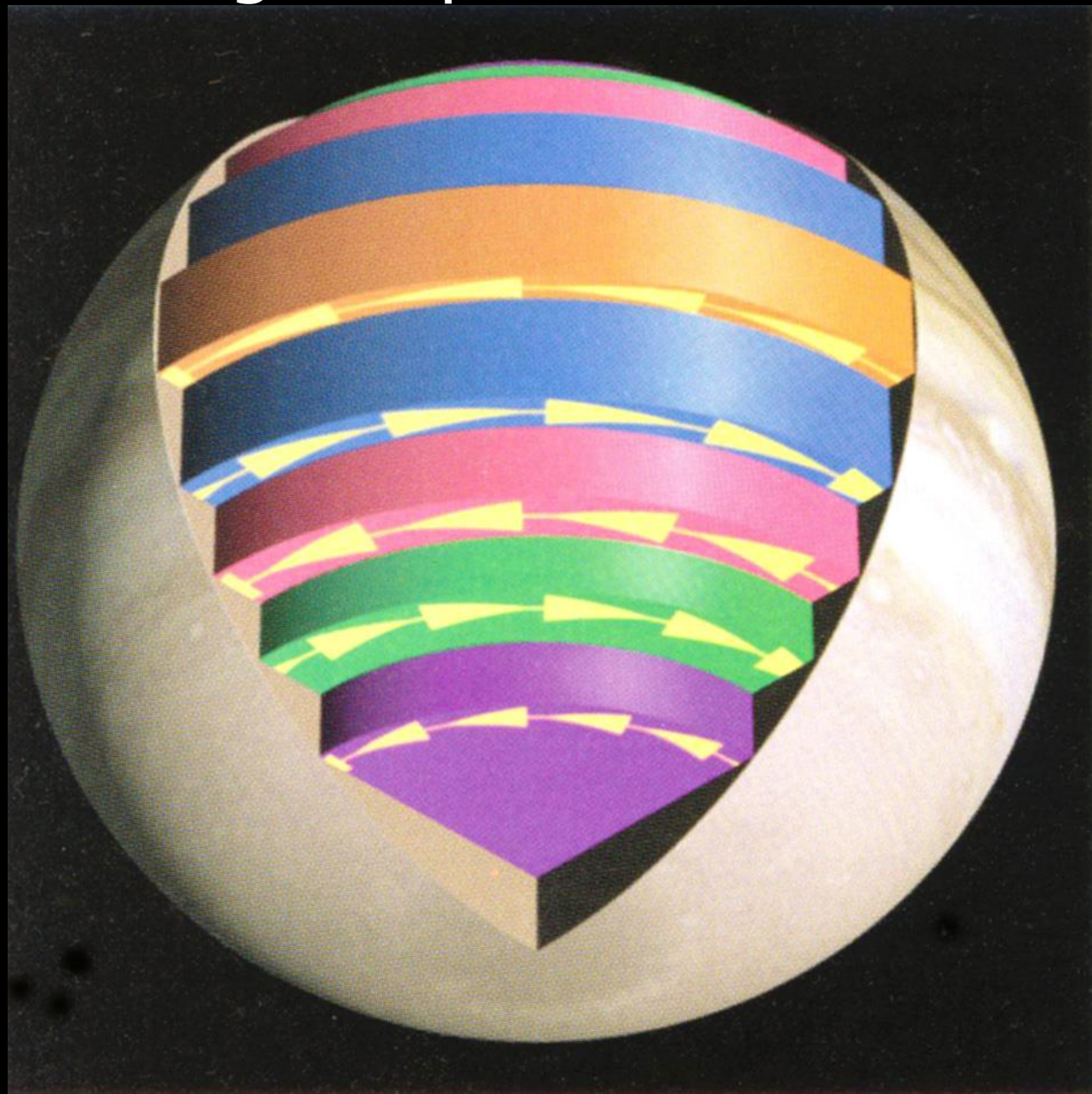
Jupiter's Atmosphere



The Great Red Spot

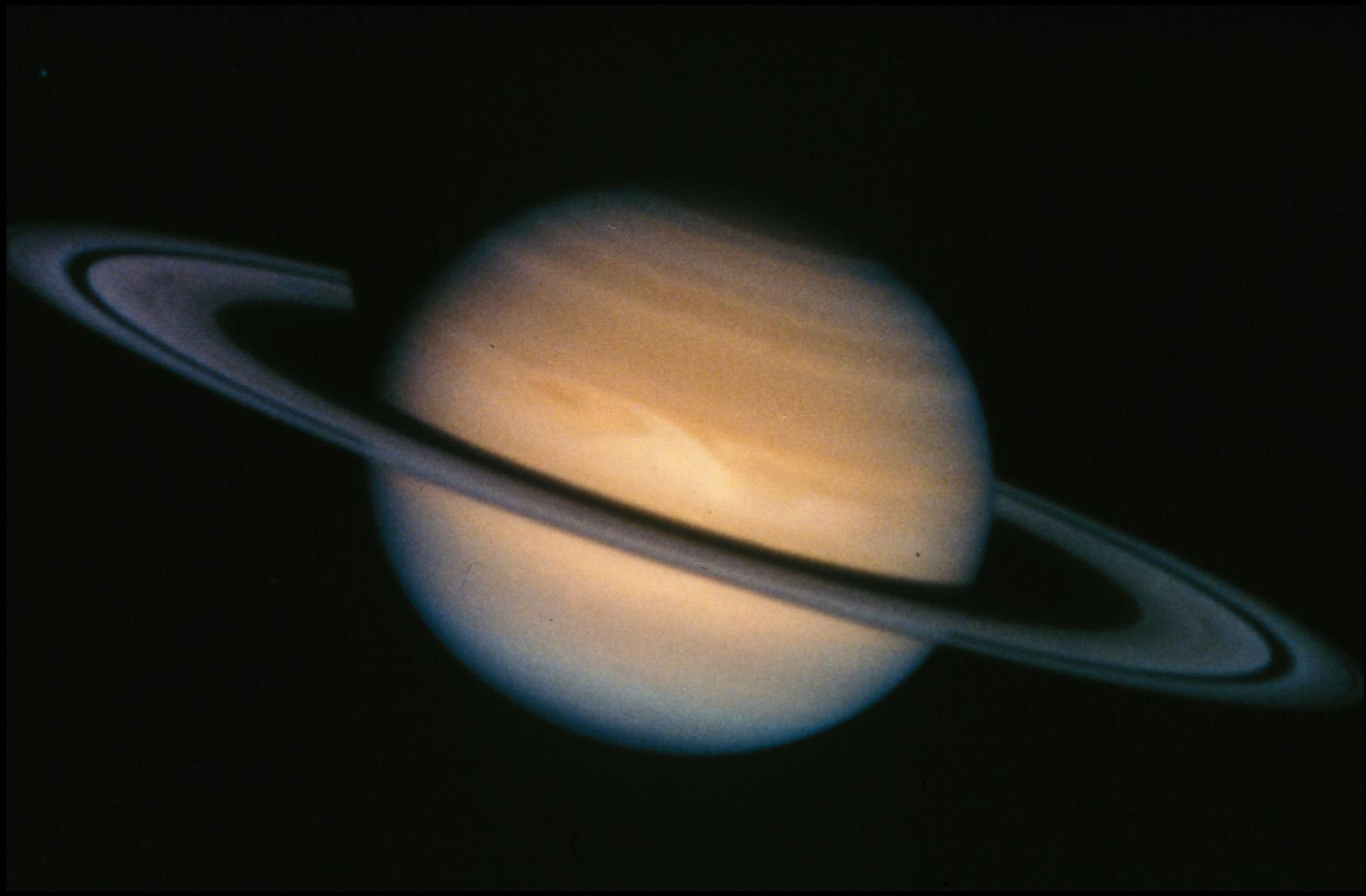


Possible model for giant planet interiors.



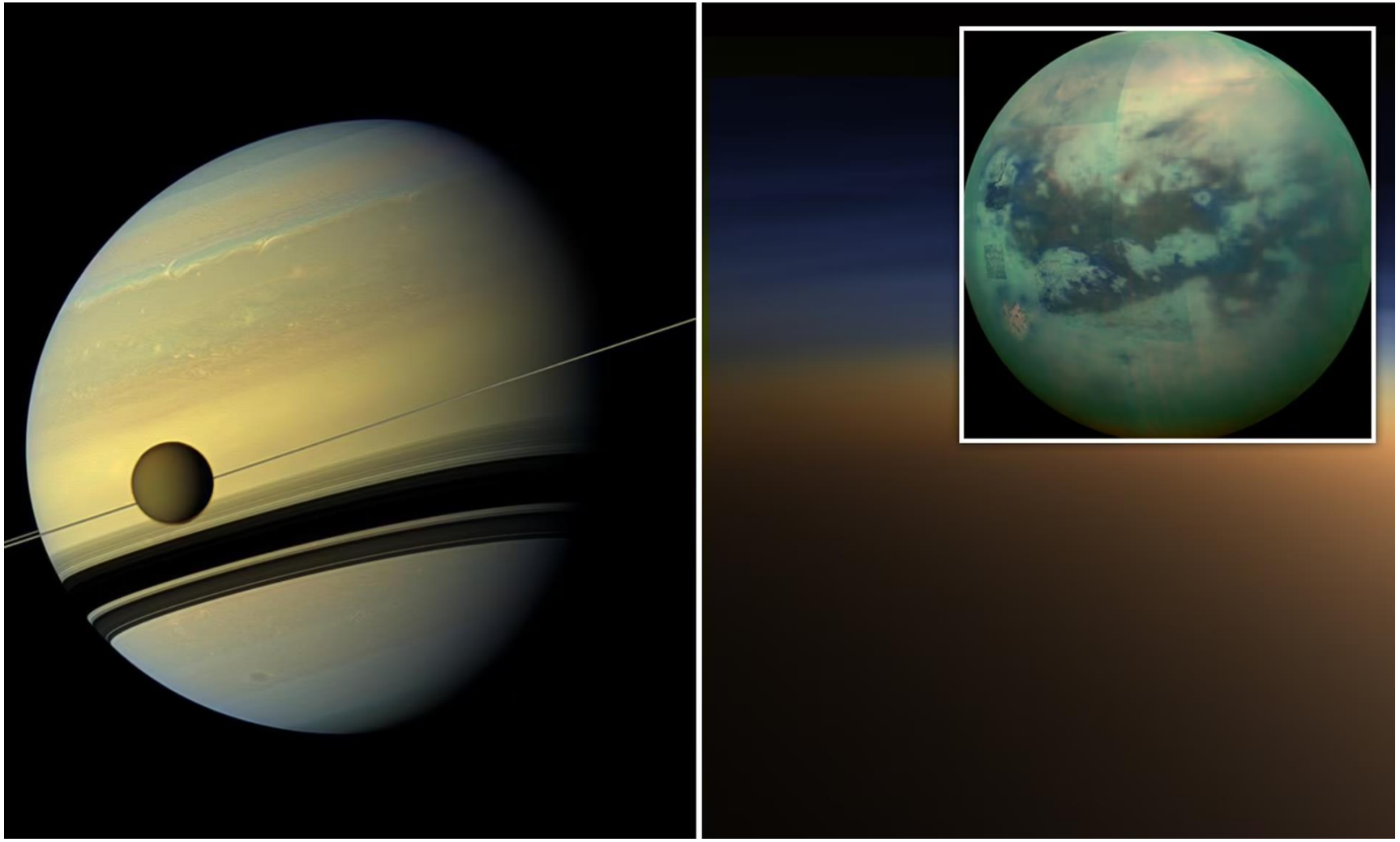
Jupiter at low magnification

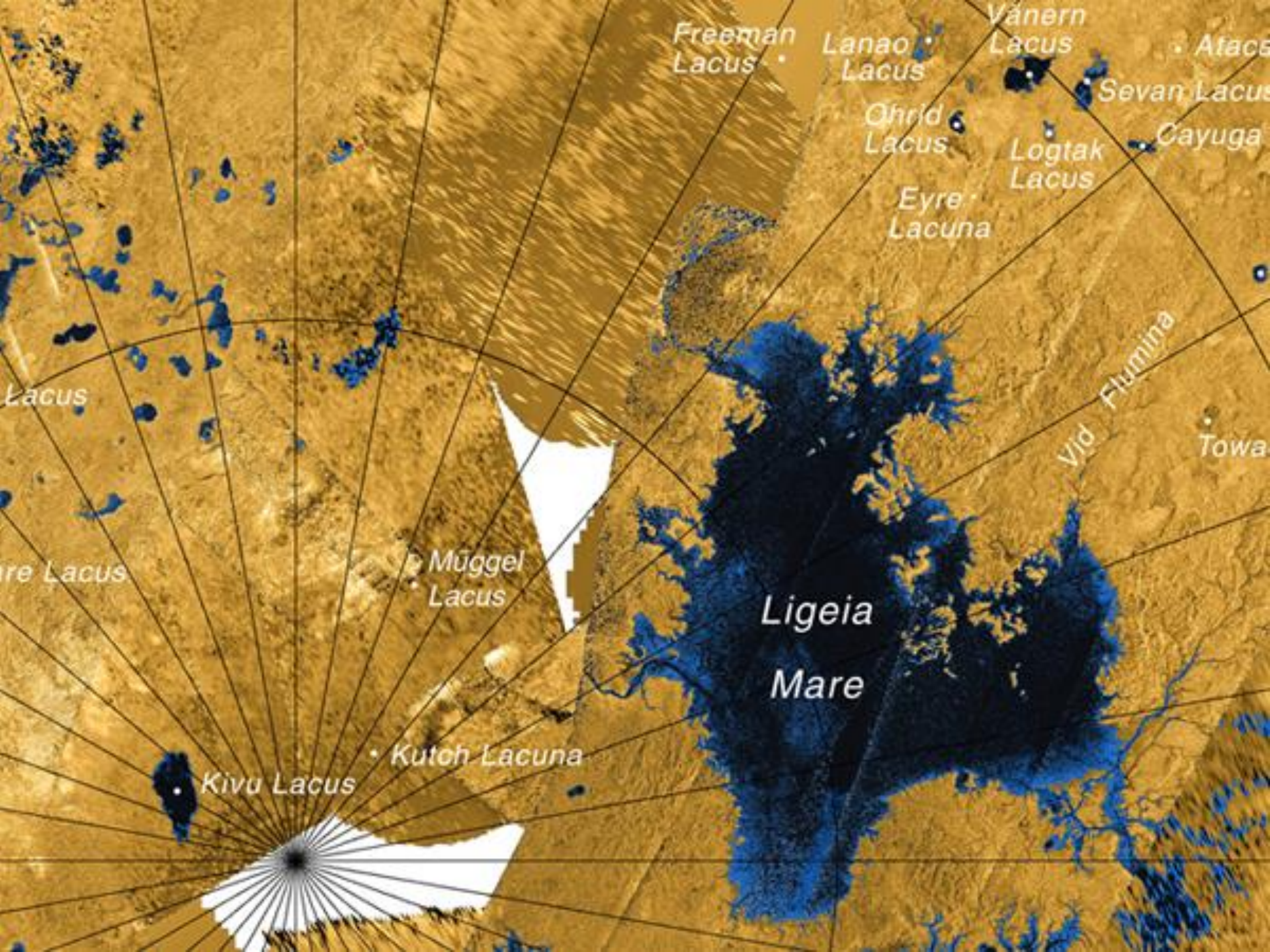
Saturn



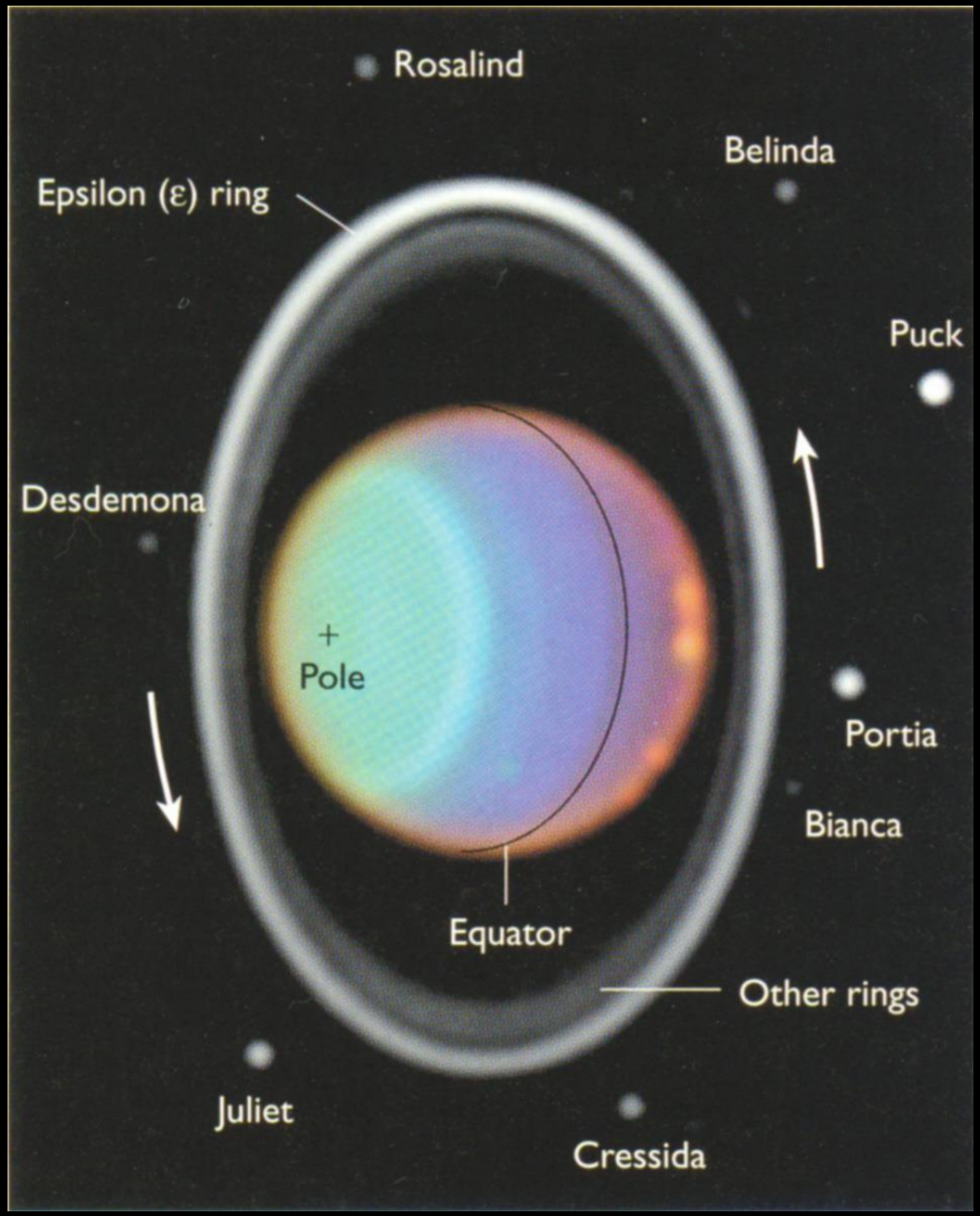
Saturn's Rings

Saturn's Largest Moon – Titan



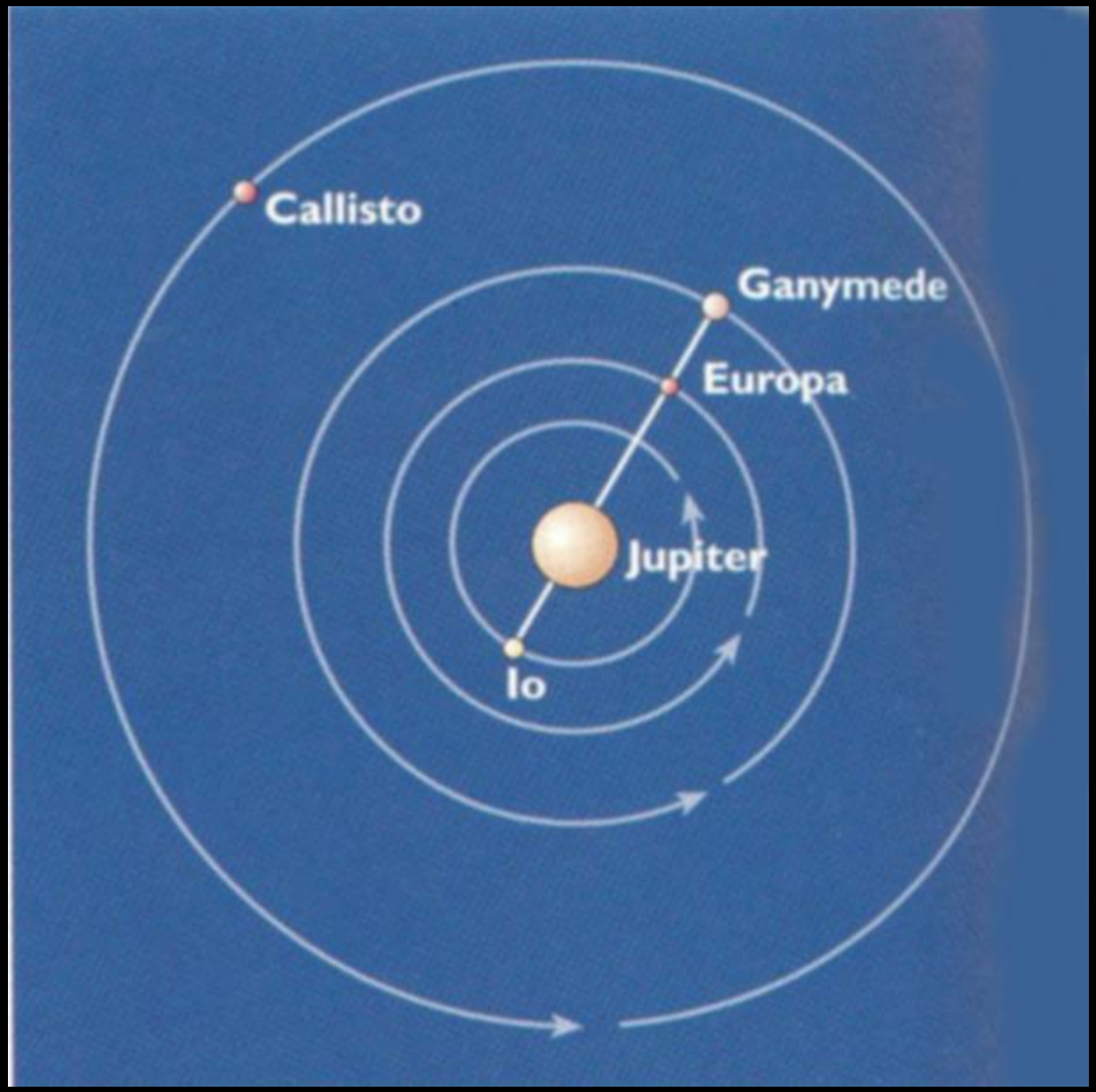

Freeman Lacus
Lanao Lacus
Vänern Lacus
Sevan Lacus
Ohrid Lacus
Cayuga
Logtak Lacus
Eyre Lacuna
Vid Flumina
Towa
Lacus
Müggel Lacus
Ligeia Mare
Kutch Lacuna
Kivu Lacus

Uranus

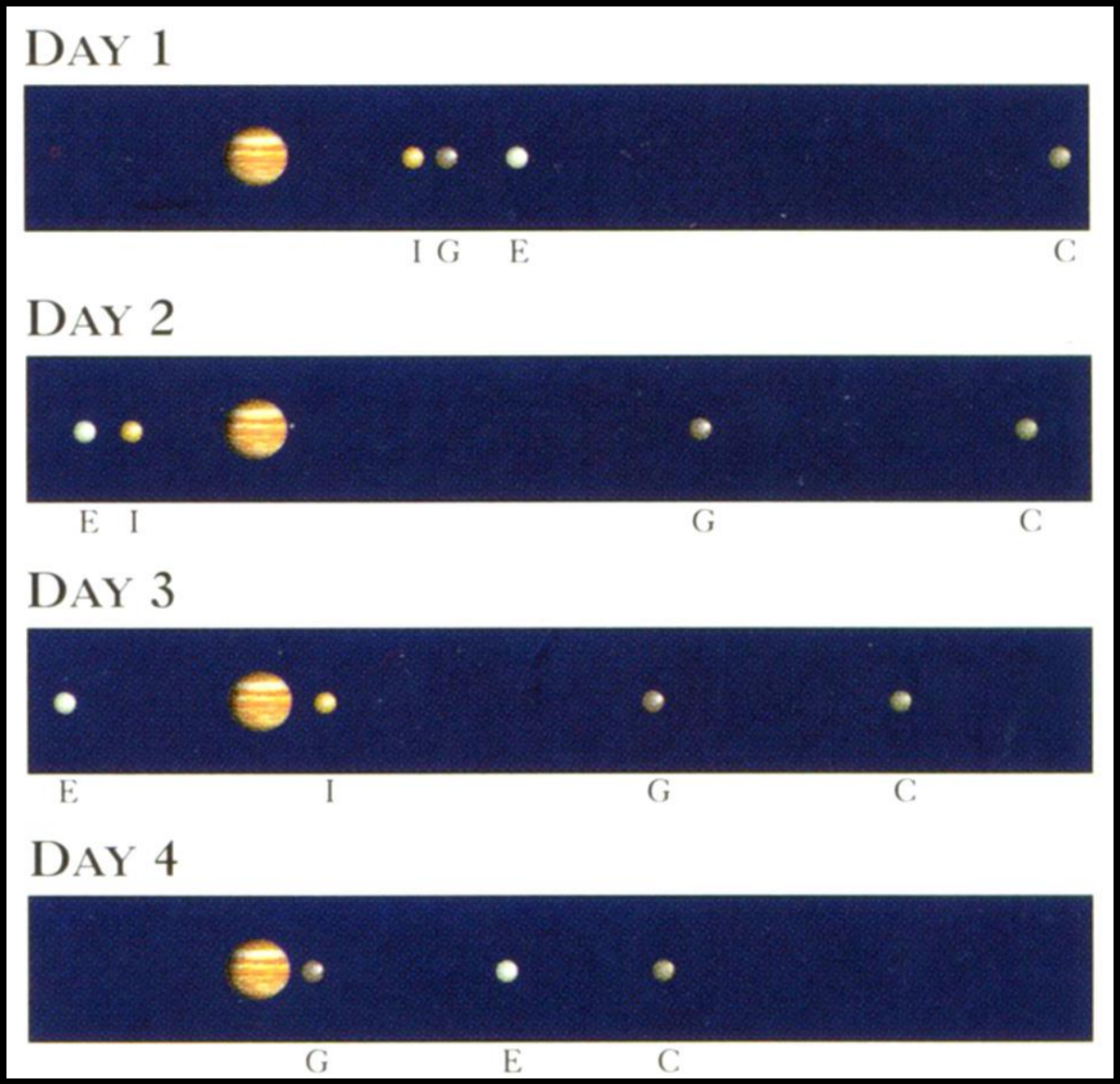

Rosalind
Belinda
Epsilon (ε) ring
Puck
Desdemona
Pole
Portia
Bianca
Equator
Other rings
Juliet
Cressida

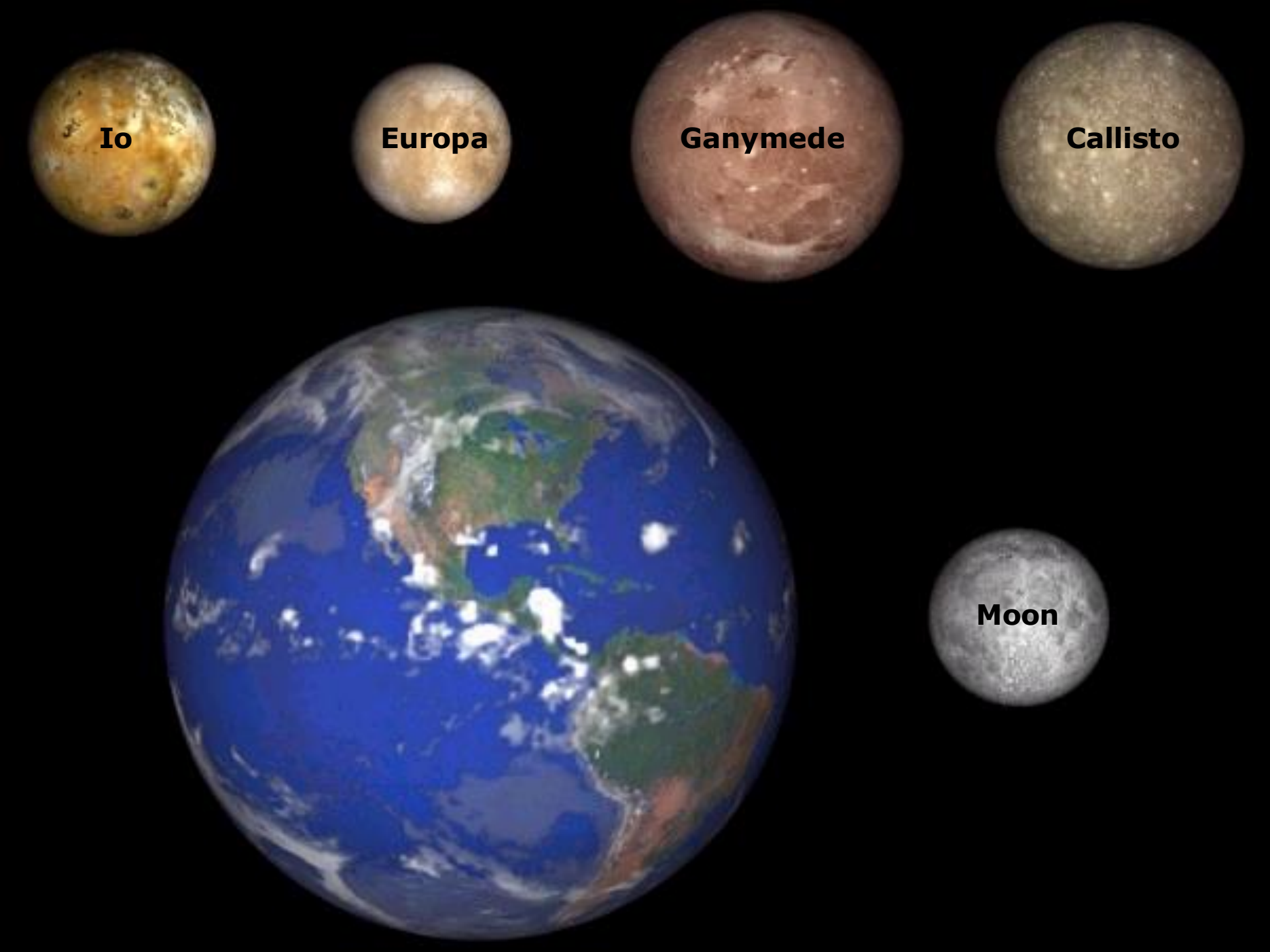
Neptune

Orbits of the Galileans

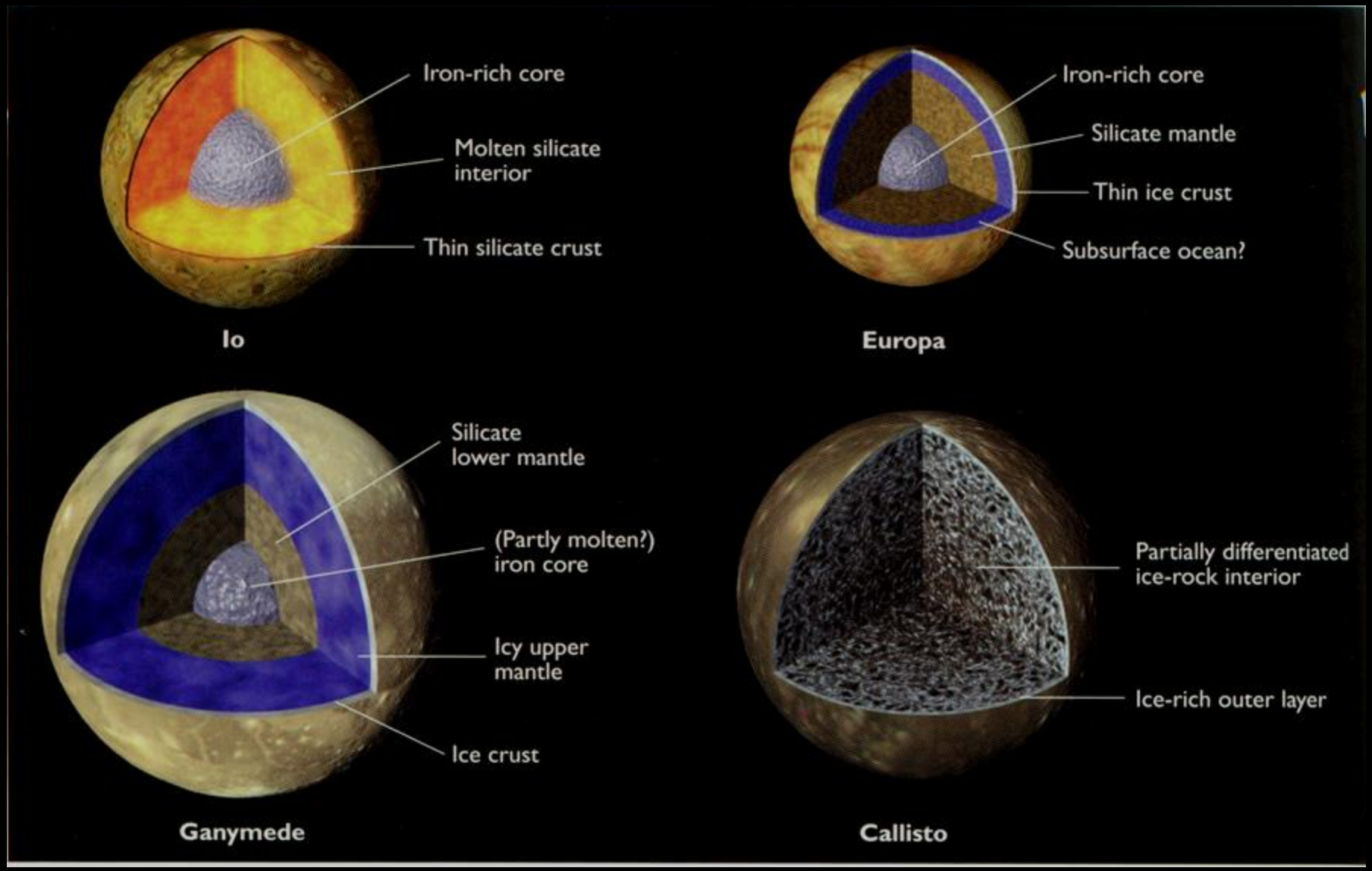


Observation of the Galileans

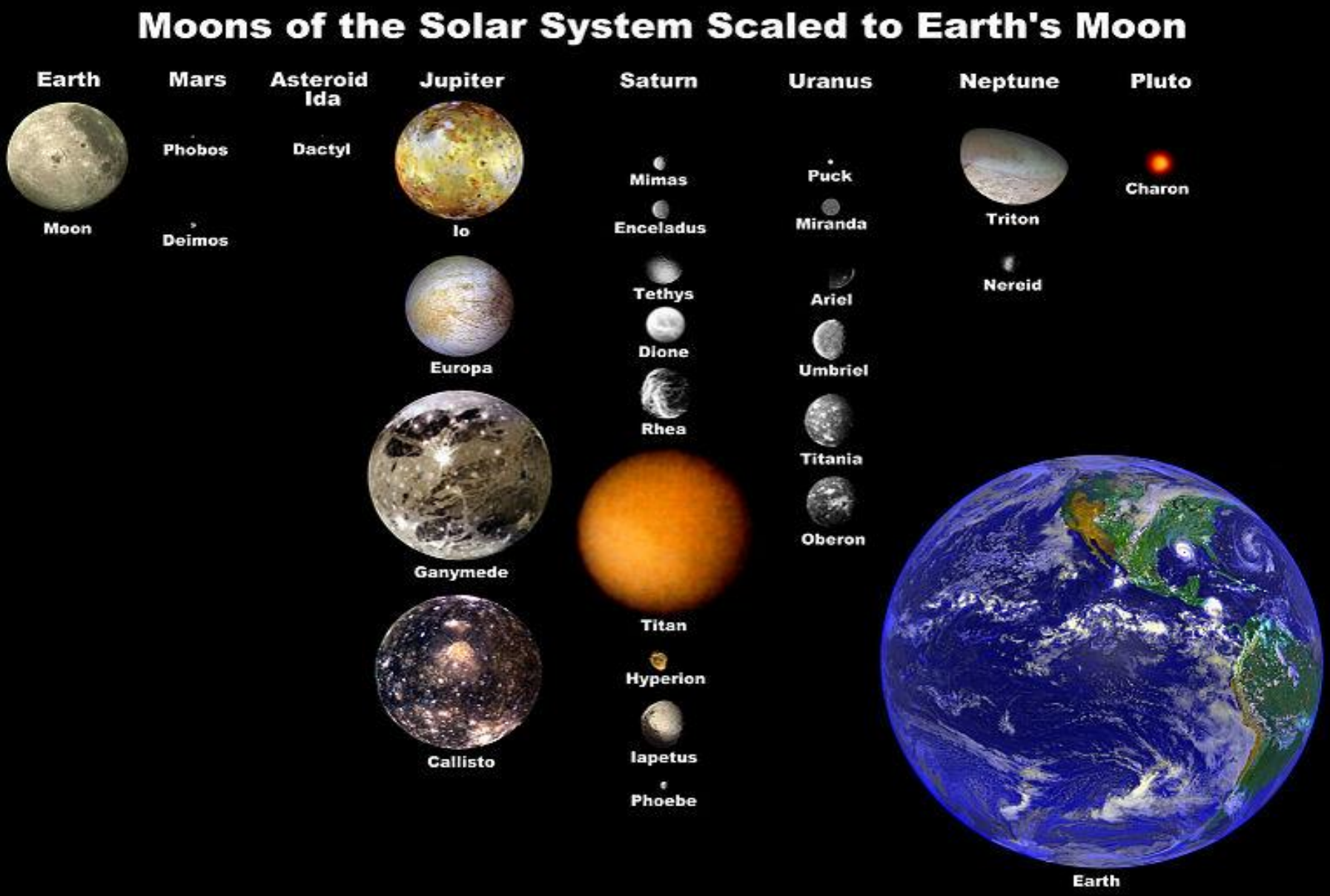



Io
Europa
Ganymede
Callisto
Moon

Interiors of the Galileans



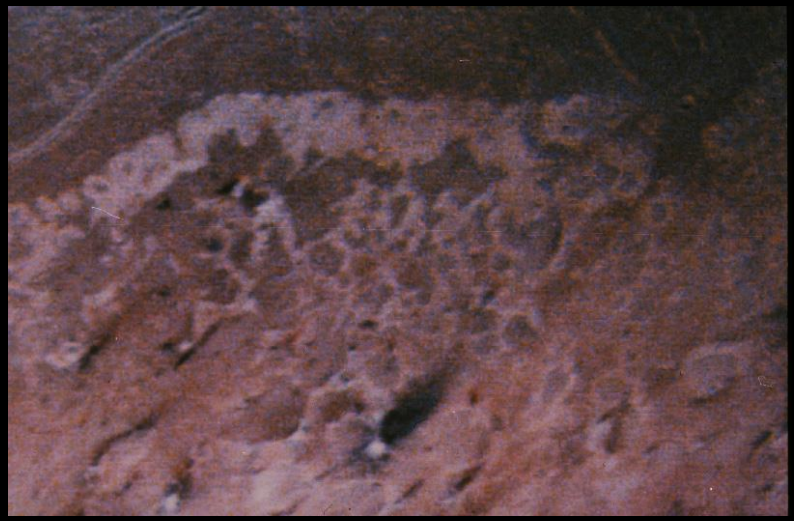
Moons - Hierarchv



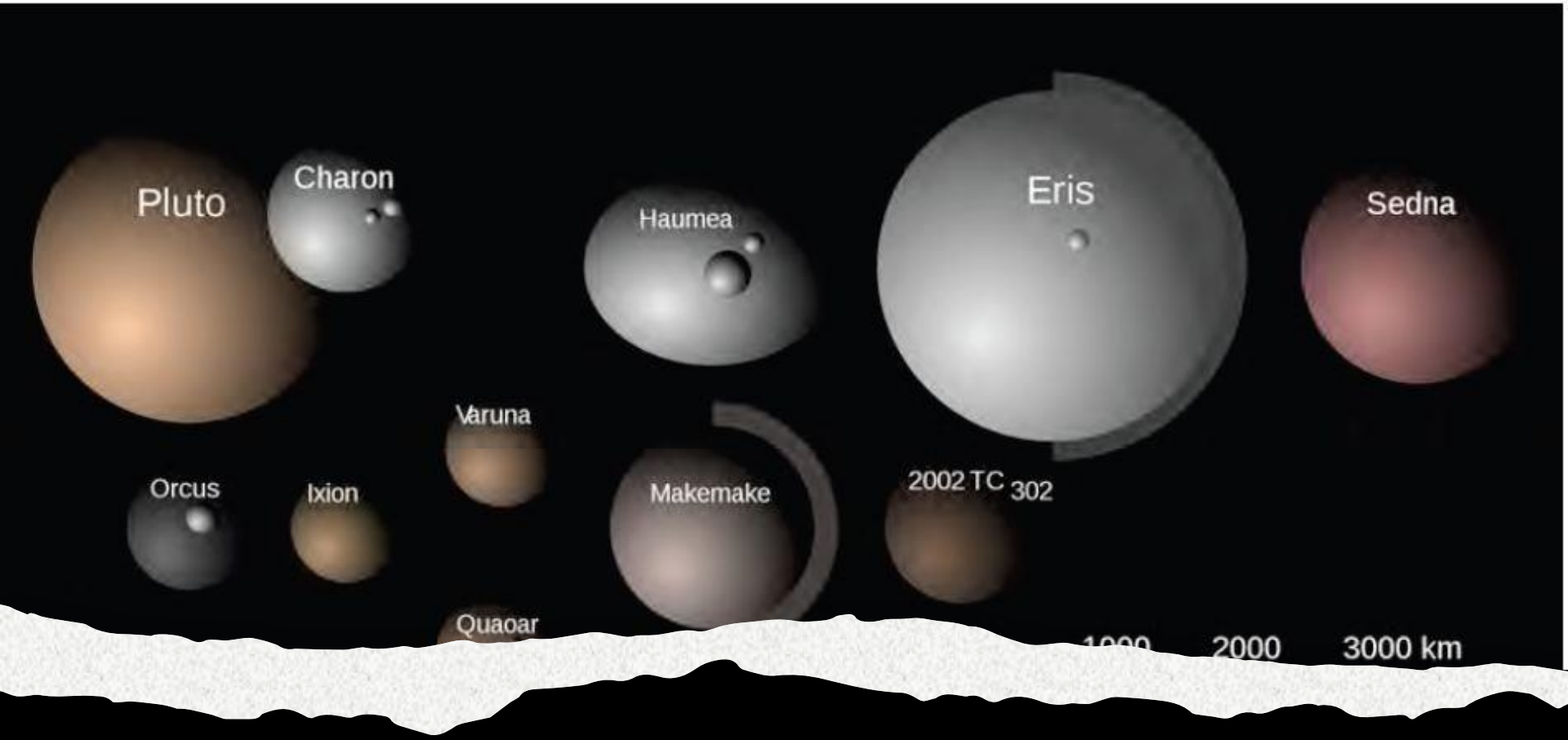
Triton – Captured Moon(most likely a dwarf planet from Kuiper Belt that came to close to Neptune)

Triton’s varied terrain

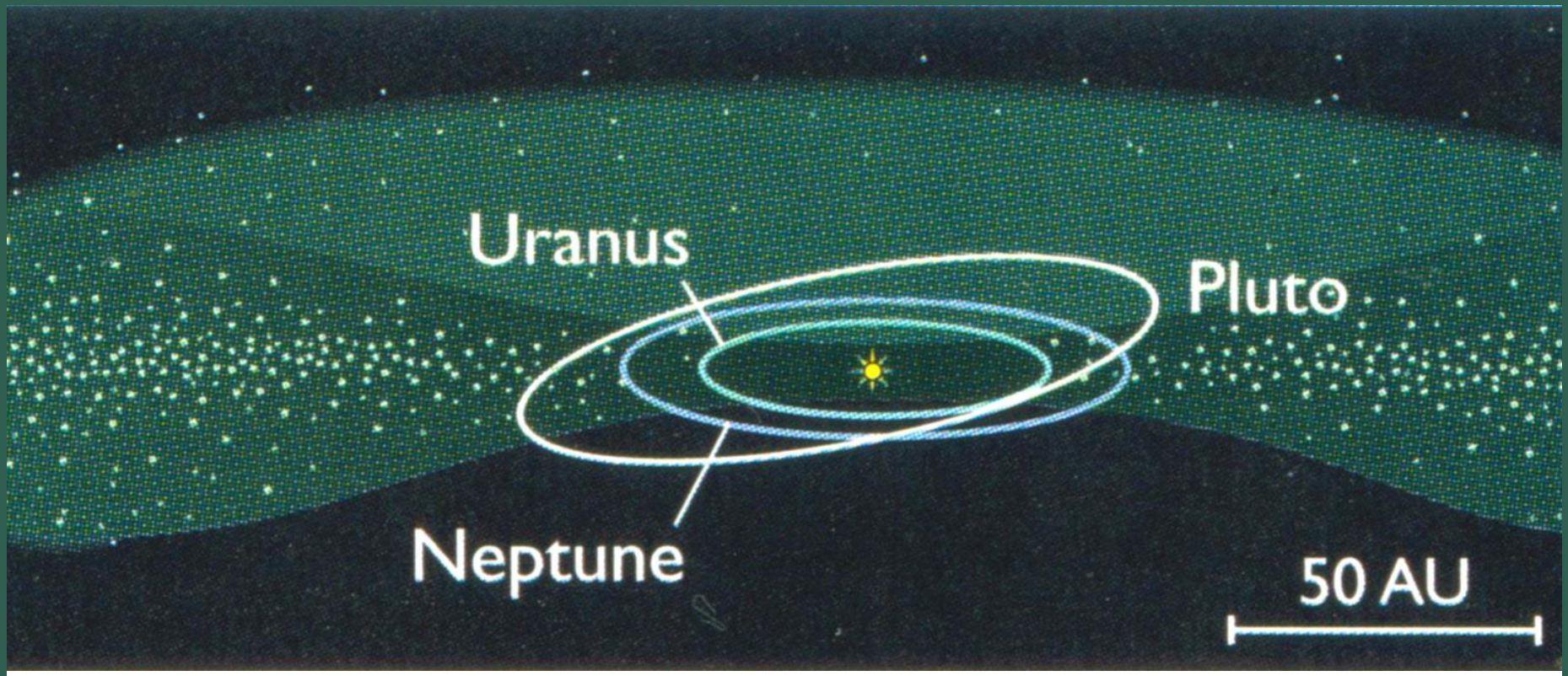
Cryo-Volcanism



Strange Planet Pluto?



Or Not so Strange Member of the "Dwarf Planets" or "Kuiper Belt Objects"

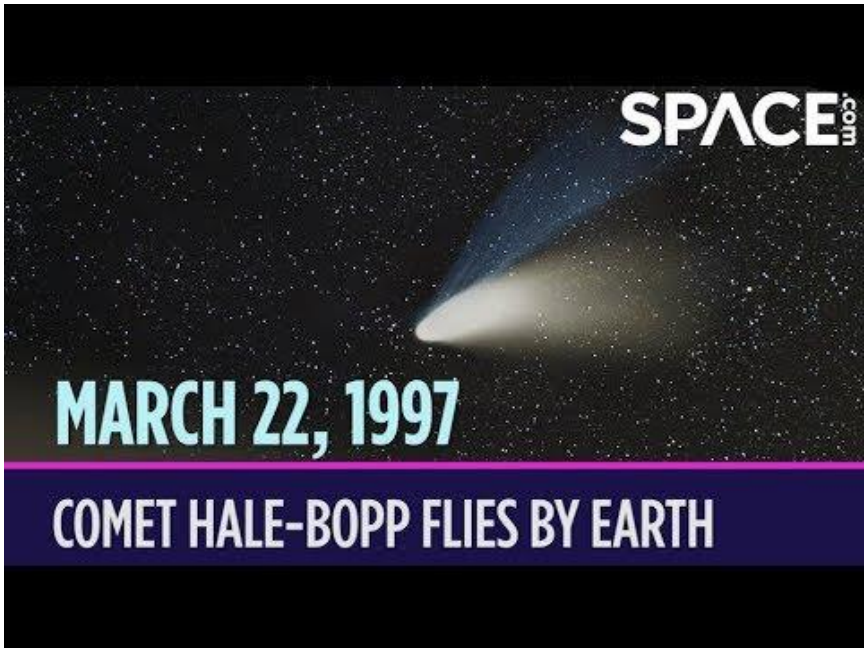


The Kuiper Belt

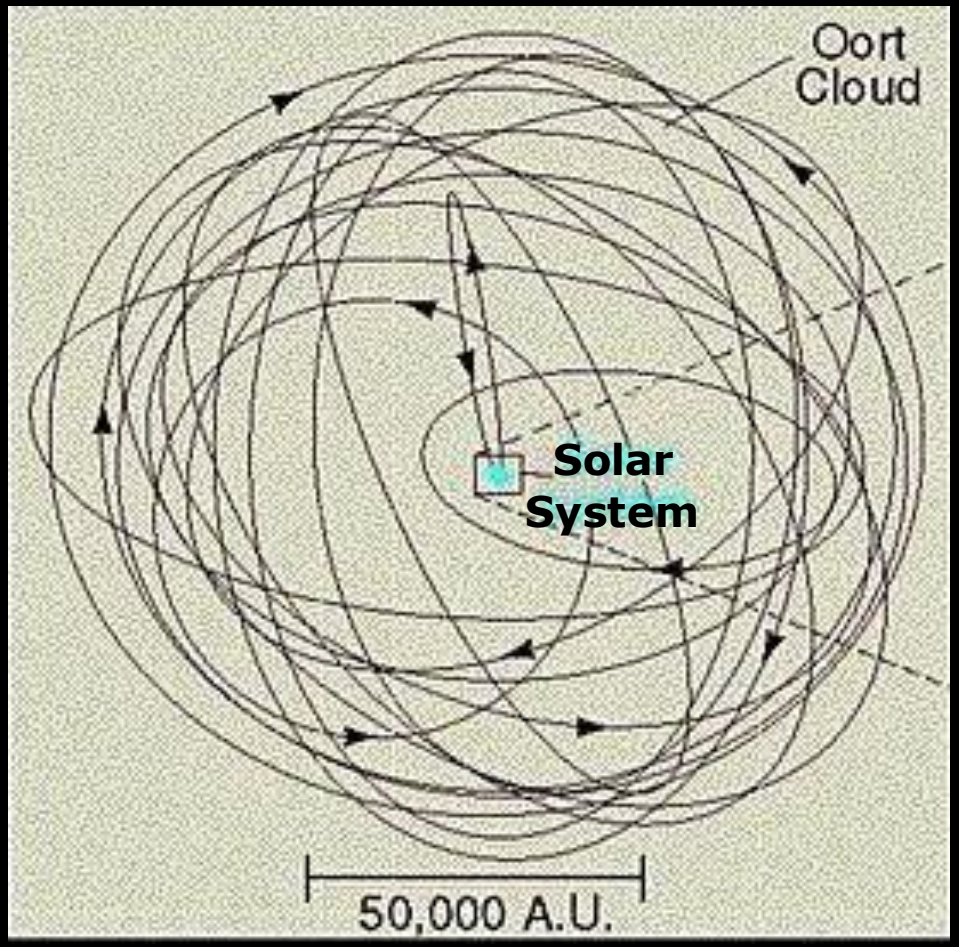
Comets

Comets up close

Comet Hale-Bopp and Comet NEOWISE



The Oort Cloud



Useful websites

www.astronomy.ie/handouts

www.stellarium.org

Thank You