

Environmental Geology - Chapter 2

Earth from a Larger Perspective

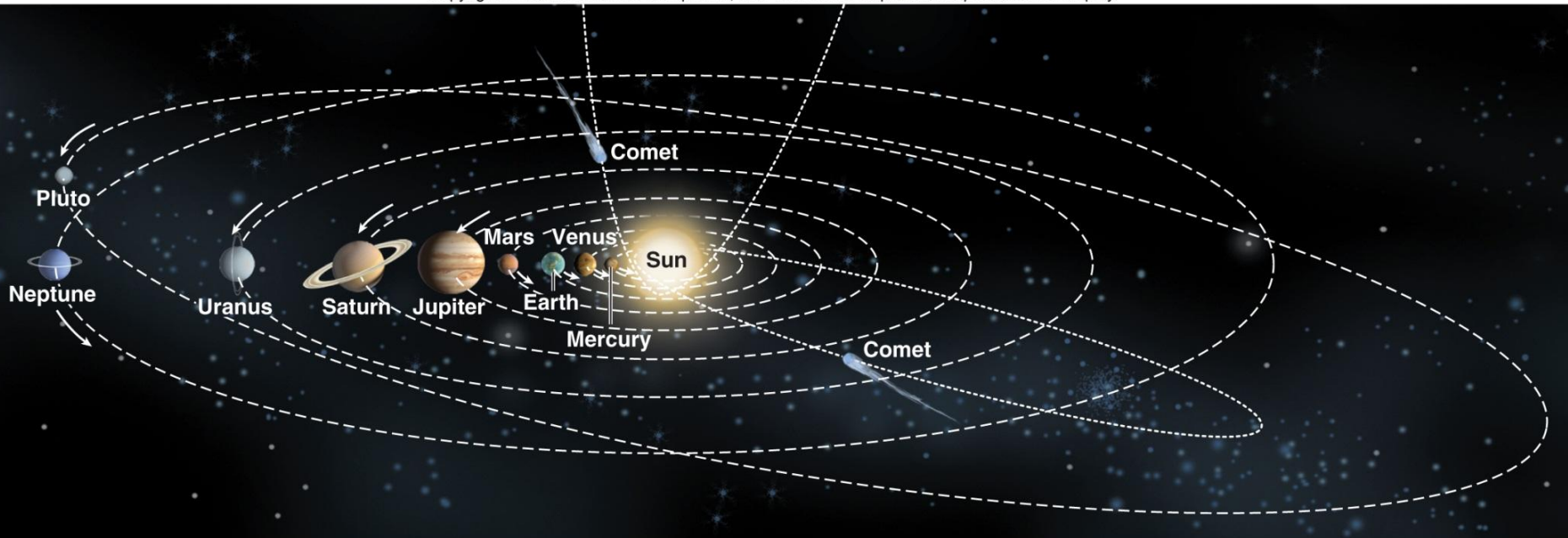


We're Affected by What's in Space

- Wave energy from the sun drives our climate
- Moon's gravity affects tides, ocean currents
- Other planets' gravity affects asteroids in Earth's orbit
- We have been and are hit by meteorites
- Space and ground based telescopes

The Solar System

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□ See figures on pages 38 and 39 of textbook.

Our Sun an Average Star

- Hot dense center surrounded by an outer, less dense atmosphere
- Nuclear fusion of hydrogen (H) and helium (He) caused by sun's gravity produces wave energy. See Fig. 2.7 B, page 39.
- Releases electromagnetic radiation – energy that travels in series of waves and is converted to heat when it reaches a planet
- When H is used up, nuclear fusion continues producing heavier elements (C, Ni, Fe, O) until star goes supernova

The Planets

- Terrestrial planets
 - Have rocky surfaces
 - Small
 - Mercury, Venus, Earth and Mars
- Gas planets
 - Made up of H and He, no solid surface
 - Large
 - Jupiter, Saturn, Uranus and Neptune

Pluto

- Demoted as a planet in 2006 but has enough gravity to maintain solar orbit
- Rocky, cold and small, frozen water/methane
- Very far away, last in solar system

New Horizons Probe to Pluto

- Launched Jan. 19, 2006
- Arrived July 13, 2015
- Pluto's largest moon named Charon
- Variations in atmospheric pressure, may have liquids on surface
- <http://www.nasa.gov/feature/one-year-later-new-horizons-top-10-discoveries-at-pluto>

New Horizons Probe to Pluto

Pluto



Charon (moon)



Comets and Asteroids

■ Comets

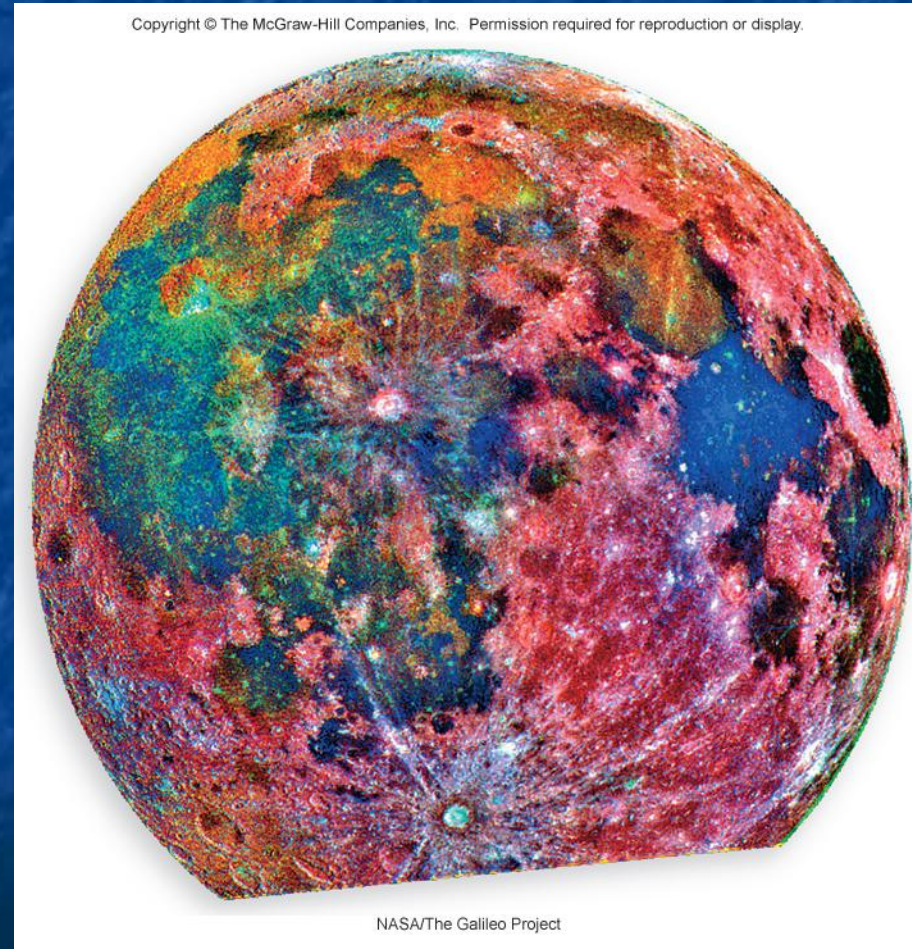
- Small, 1-10 km in diameter
- Rocky fragments in ice and frozen gases
- Tail caused by evaporating ice
- Highly elliptical orbits

■ Asteroids

- Small, mostly rock and metallic materials
- Most from asteroid belt between Jupiter and Mars

The Moon

- Earth's only satellite
- Gravity controls tides and helps stabilize Earth's "wobble"
- Color coding – reddish is older rocks and bluish represents younger rocks from lava flows

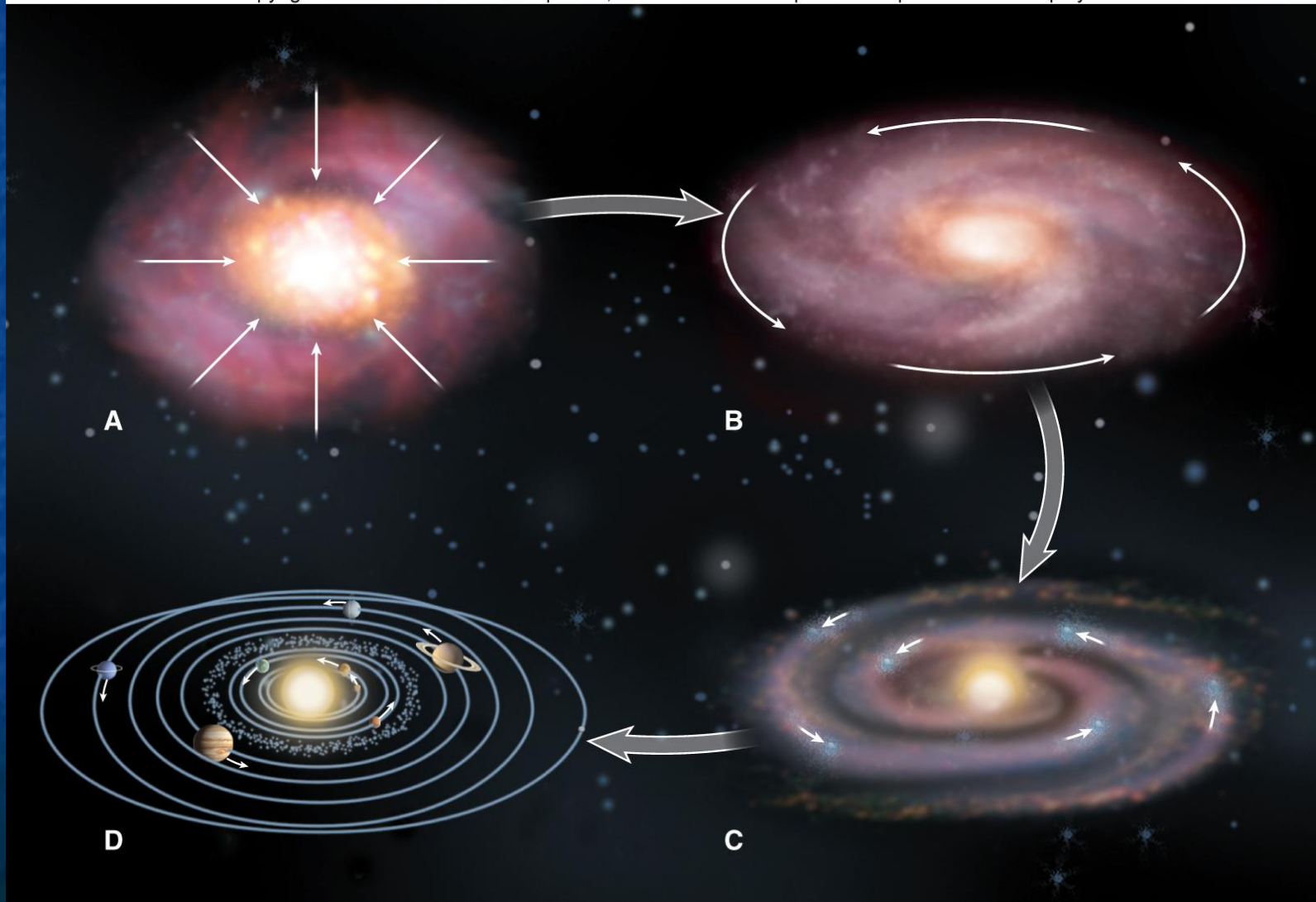


Origin of the Solar System

- Nebular Hypothesis
 - Solar system formed from rotating cloud of gas and dust (nebula)
 - Gases mainly hydrogen and helium
 - Disturbed by supernova, cloud contracted
 - Higher temperatures and pressures
 - Solid material formed, accretion due to gravity
 - Planetesimals + more accretion = Planets
 - Enough nuclear fusing w/ H and He that new star was born (our sun)

Nebular Hypothesis

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How Reliable is Nebular Hypothesis?

- Most bodies rotate and revolve counter-clockwise (Venus is the exception)
- All bodies in same plane with solar equator
- Most craters occurred early in the solar system's history
- Accretion disks and planetary systems have been found around other stars
- Radiometric dating

Other Stars in the Universe

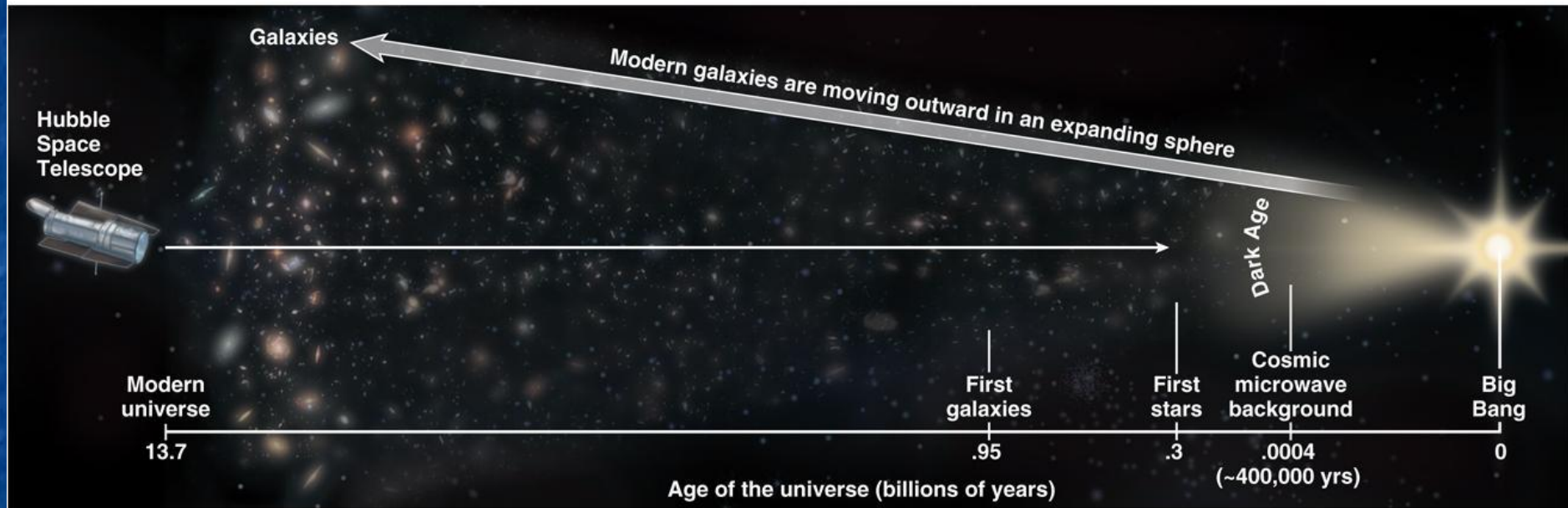
- Galaxy – large groupings of stars
- Our galaxy is the Milky Way
- Most bright points in the night sky are galaxies
- The Big Bang Theory explains how the universe was formed from a central explosion

Big Bang Theory

- Proposed in 1927 that all matter had once existed in a single point
- 1929 Edwin Hubble proved all galaxies are moving away from each other
- Measurements from Hubble and Spitzer space telescopes
- Cosmic radiation coming from all of deep space not a single source

Other Stars in the Universe

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Clockwise Rotating Galaxy Similar to The Milky Way



European Southern Observatory

Does Life Exist Beyond Earth?

■ Life on Earth

- Earth is 4.6 billion years old
- Life started in extreme conditions
 - Extremophile bacteria
- Need liquid water
- Orbit in habitable zone
 - Distance from sun or star that liquid water can exist

Possible Intelligent Life

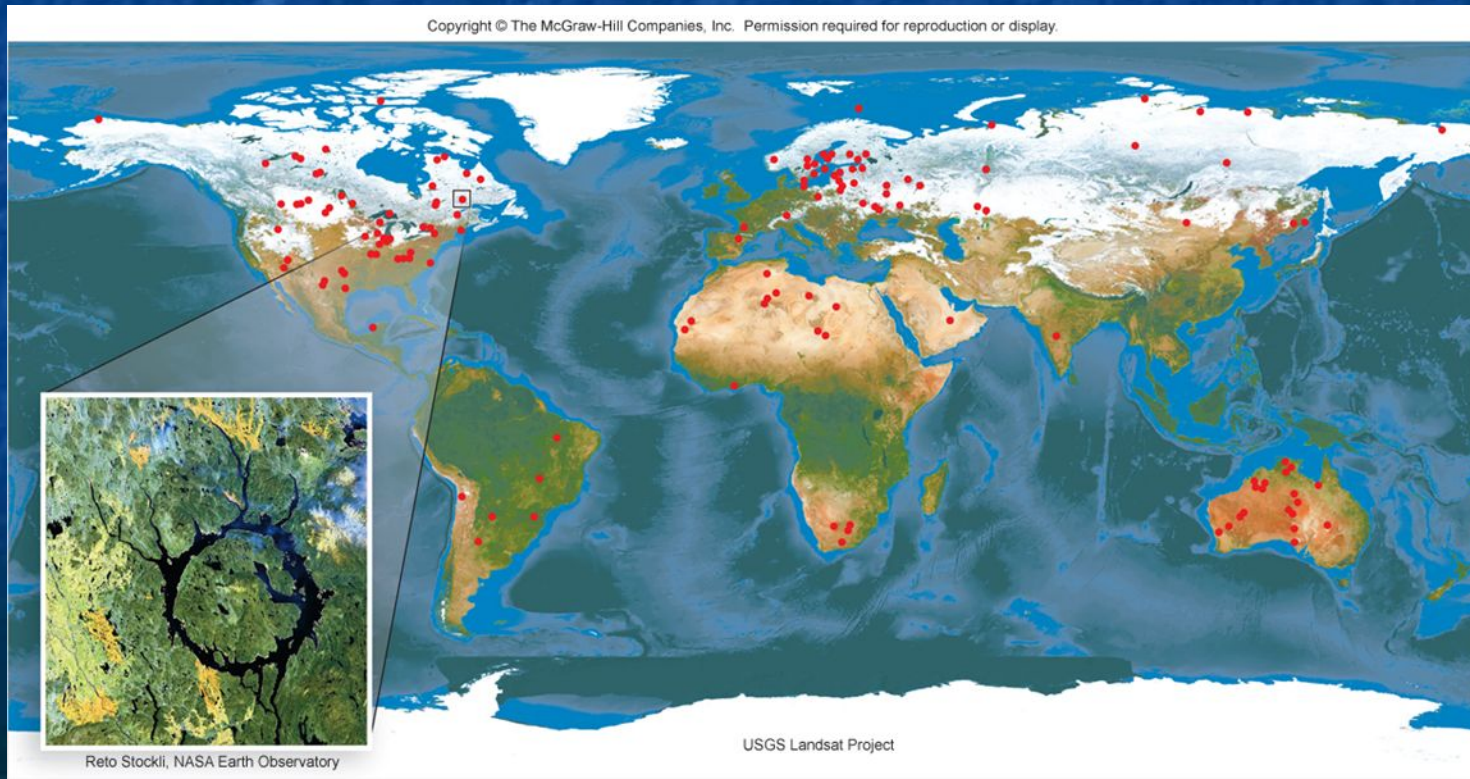
- Rare Earth Hypothesis
 - Energy output of sun fairly stable
 - Earth's processes help regulate CO₂
 - Jupiter 'catches' asteroids and comets
 - Moon has reduced wobble of Earth's axis

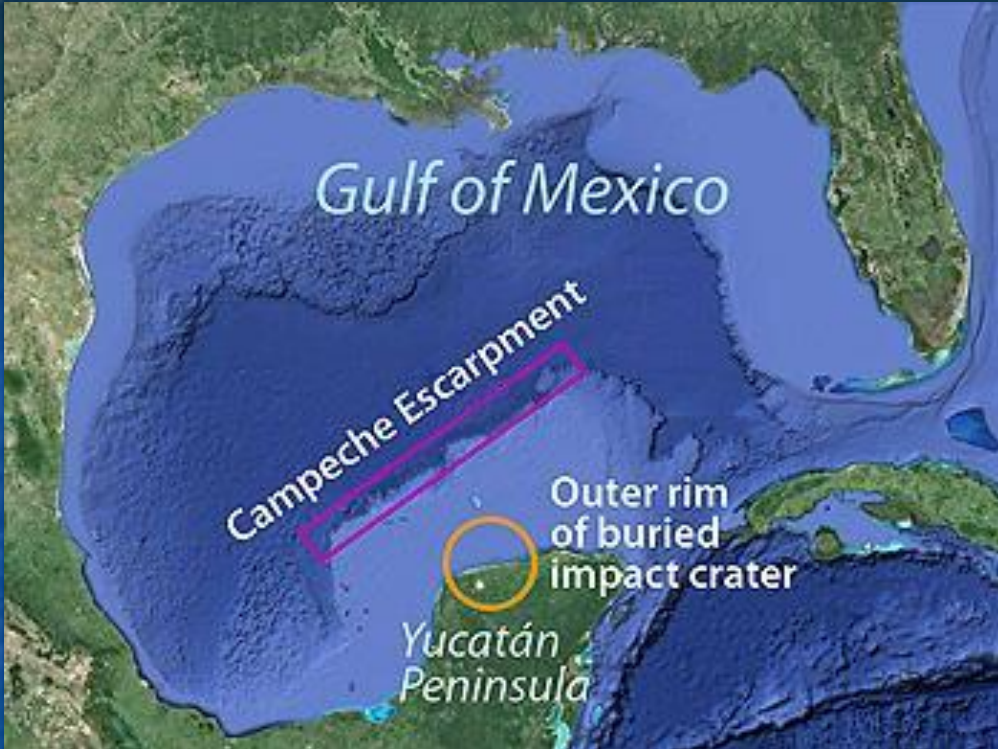
Solar System Hazards

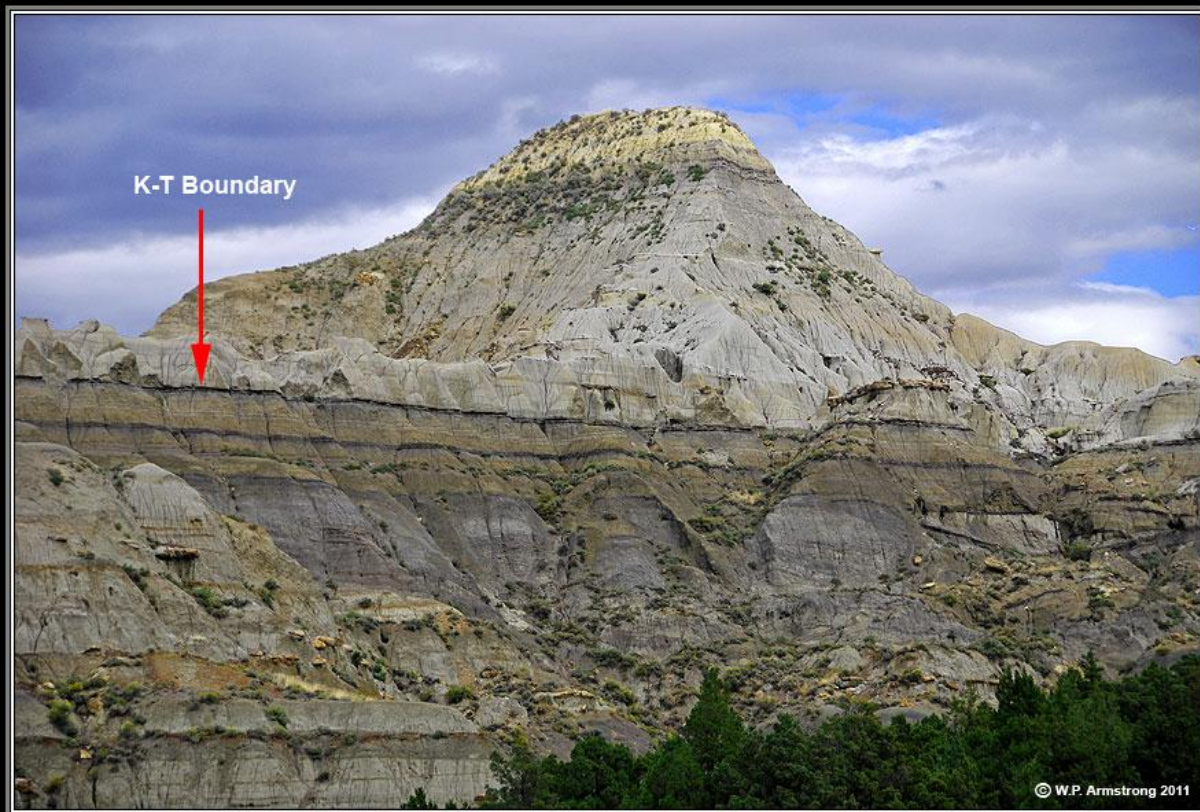
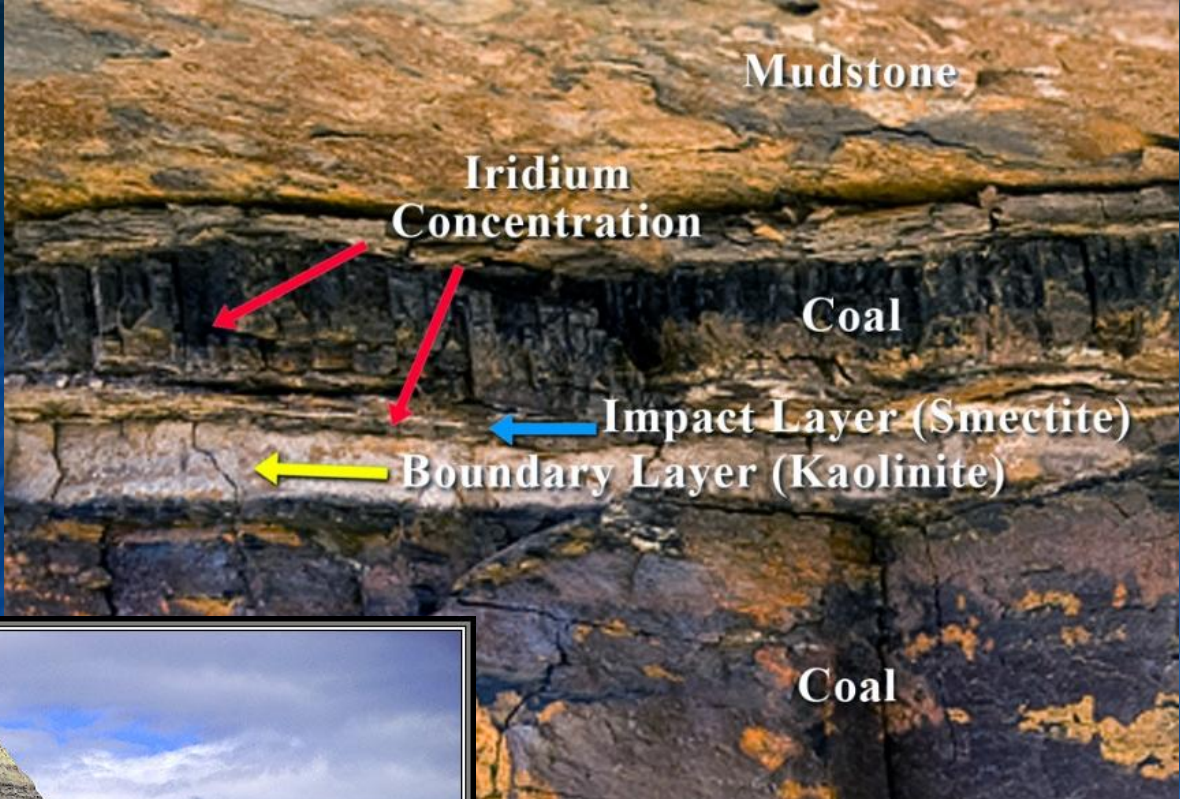
- Electromagnetic radiation – damages living cell tissue
- UV radiation and the ozone layer
- Chlorine and fluorine based gases (CFCs) deplete O₃
- 1987 Montreal Protocol – nations agree to phase out use of CFCs
- Gamma ray burst from exploding stars destroys O₃

Solar System Hazards

- Asteroid and comet impacts
- About 175 impact sites discovered on Earth
- 214 million year impact site due to asteroid >3 miles in diameter

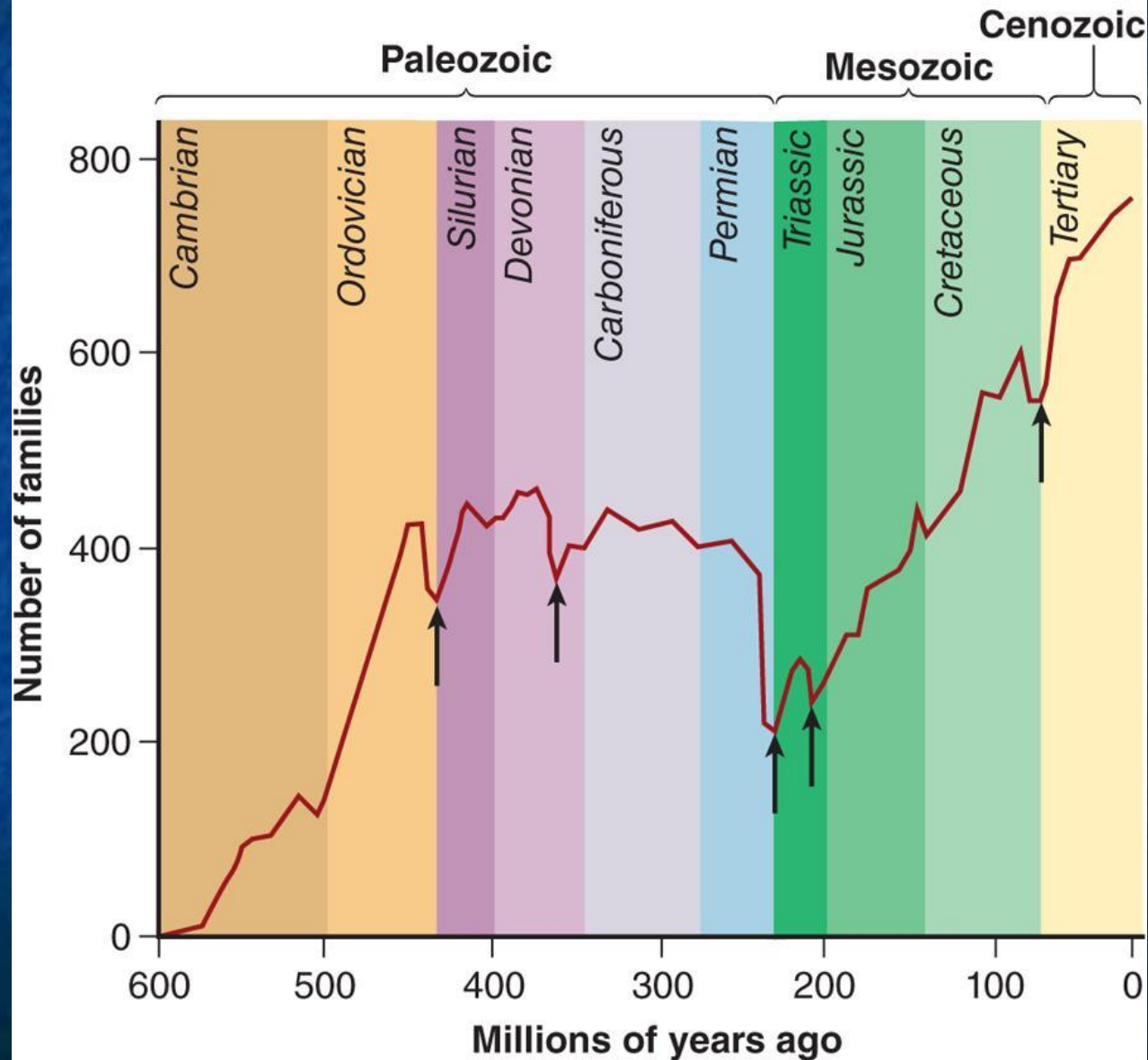






Solar System Hazards

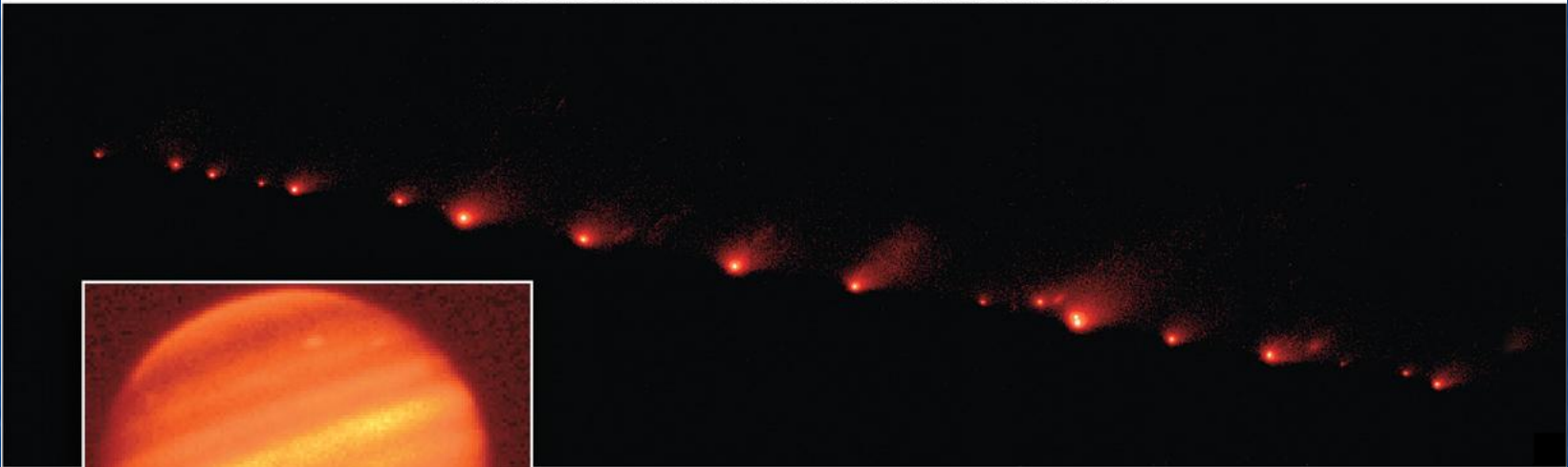
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Impacts

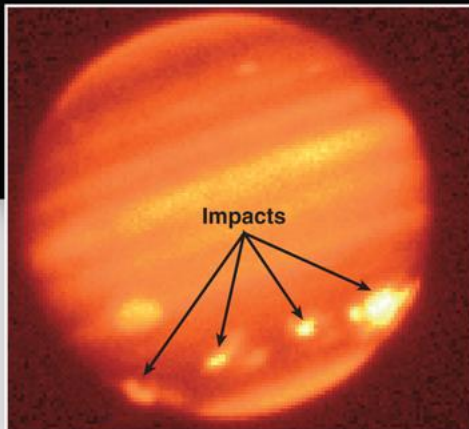
- Mesozoic/Cenozoic extinction event – KT boundary 65 mybp
- 1994 - impact on Jupiter

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NASA, ESA, and H. Weaver and E. Smith (STScI)

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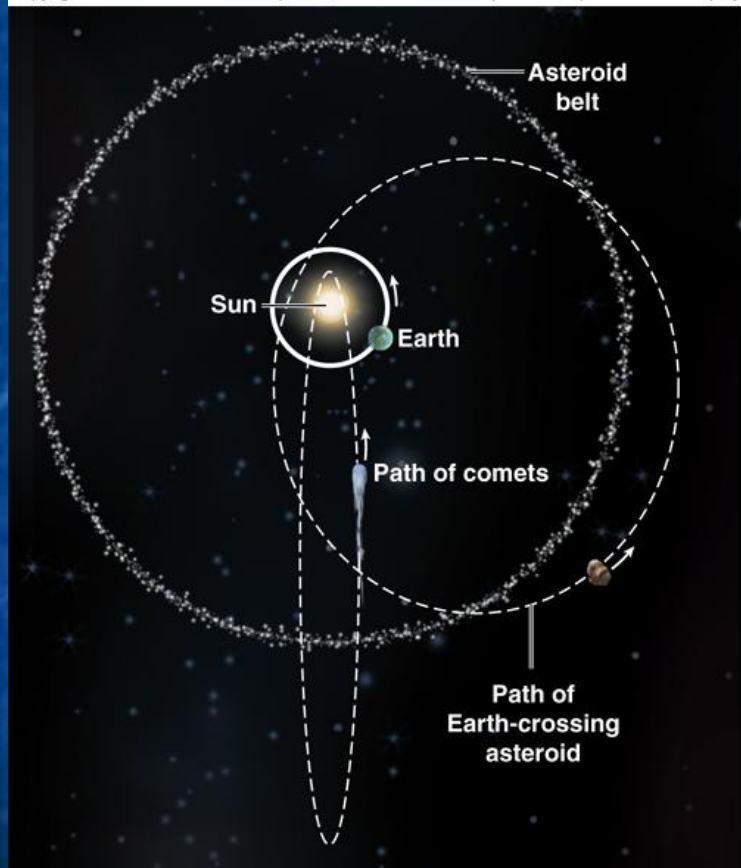


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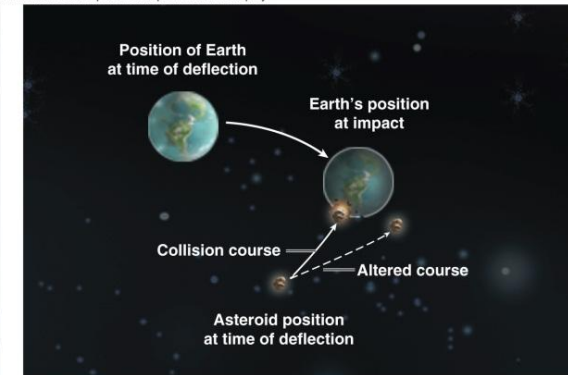
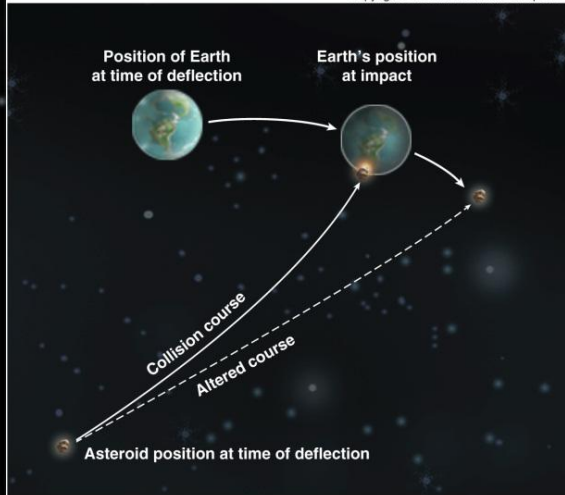
NASA and STScI

Impact Risk

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