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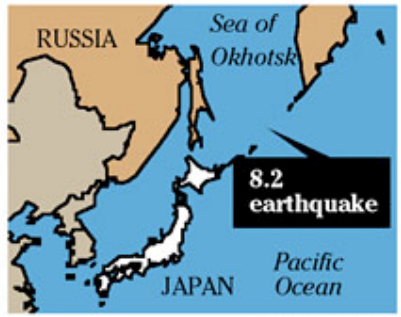
Tsunami watch surges Hawaii fears

An earthquake off Japan leaves the state on alert for three hours before word that no destructive wave is expected

Star-Bulletin staff
citydesk@starbulletin.com

Hawaii was under a tsunami watch for three hours last night after an estimated 8.2-magnitude earthquake struck east of the Kuril Islands off Japan.

The Pacific Tsunami Warning Center canceled the watch about 9:30 p.m. after determining that even if a tsunami reached Hawaii shores, it would be too small to be significant.



STAR-BULLETIN

"We don't expect much, maybe waves of a foot or two," said warning center geophysicist Barry Hirshorn. "We don't expect a destructive tsunami. There is no threat of damage in Hawaii."

However, center officials said they were concerned about unusual wave action, currents and tides. They warned that people should remain off the beaches for a few hours after midnight and be aware of ocean conditions.

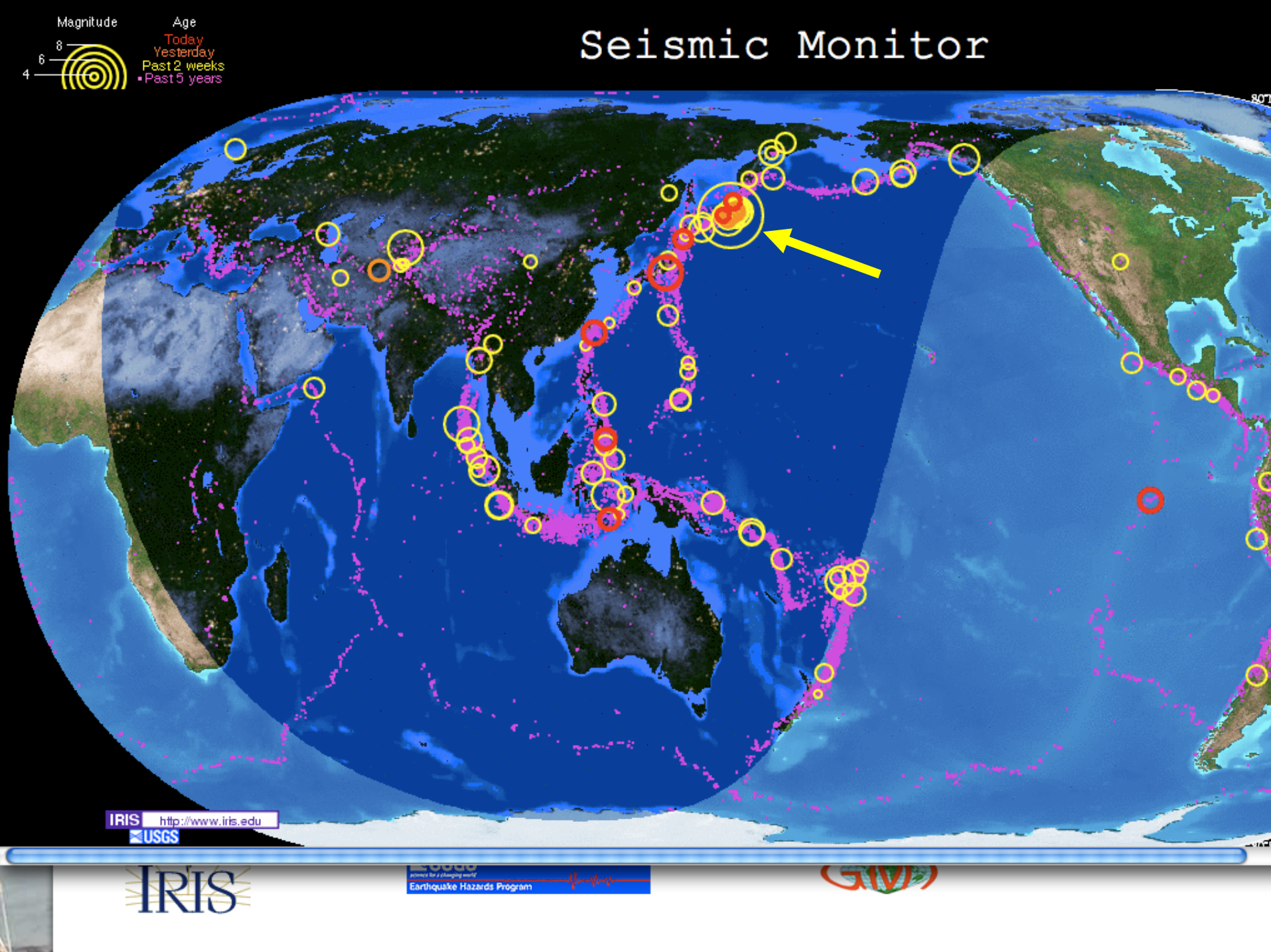
"In any coastal area people should exercise some caution," said Victor Sardina, a geophysicist at the center. "It's not going to be what we call a damaging effect. But if waves are even a foot high, if you're in the wrong place, that can cause damage. I think people should be very careful."

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Christian ministry providing unbiased direction to families.
www.loving-shepherd.org

Chinese Motherland Tour
A tour for Chinese-American adoptees and their families.
www.collectibletours.com


Magnitude
8
6
4
Age
Today
Yesterday
Past 2 weeks
Past 5 years
Seismic Monitor
IRIS
http://www.iris.edu
USGS
IRIS
Earthquake Hazards Program

Loading "USGS Earthquake Hazards Program » Magnitude 8.2 – EAST OF THE KURIL ISLANDS"
http://earthquake.usgs.gov/eqcenter/eqinthenews/2007/us2007xmae/#details
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USGS Earthquake Hazard...

Magnitude 8.2 - EAST OF THE KURIL ISLANDS

2007 January 13 04:23:20 UTC

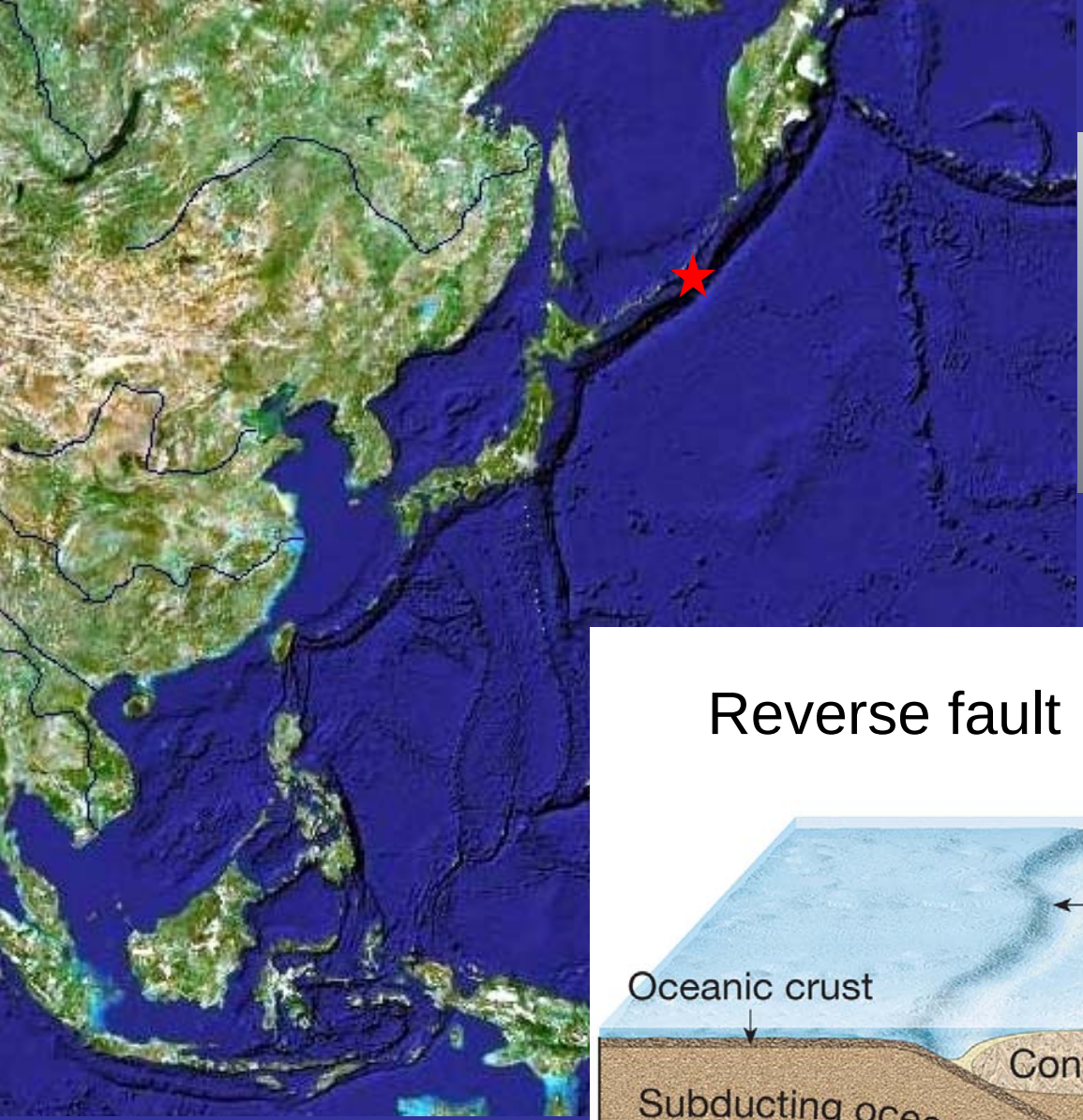
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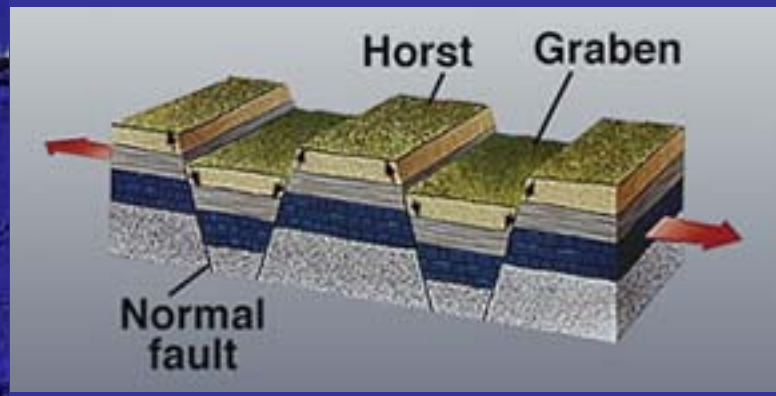
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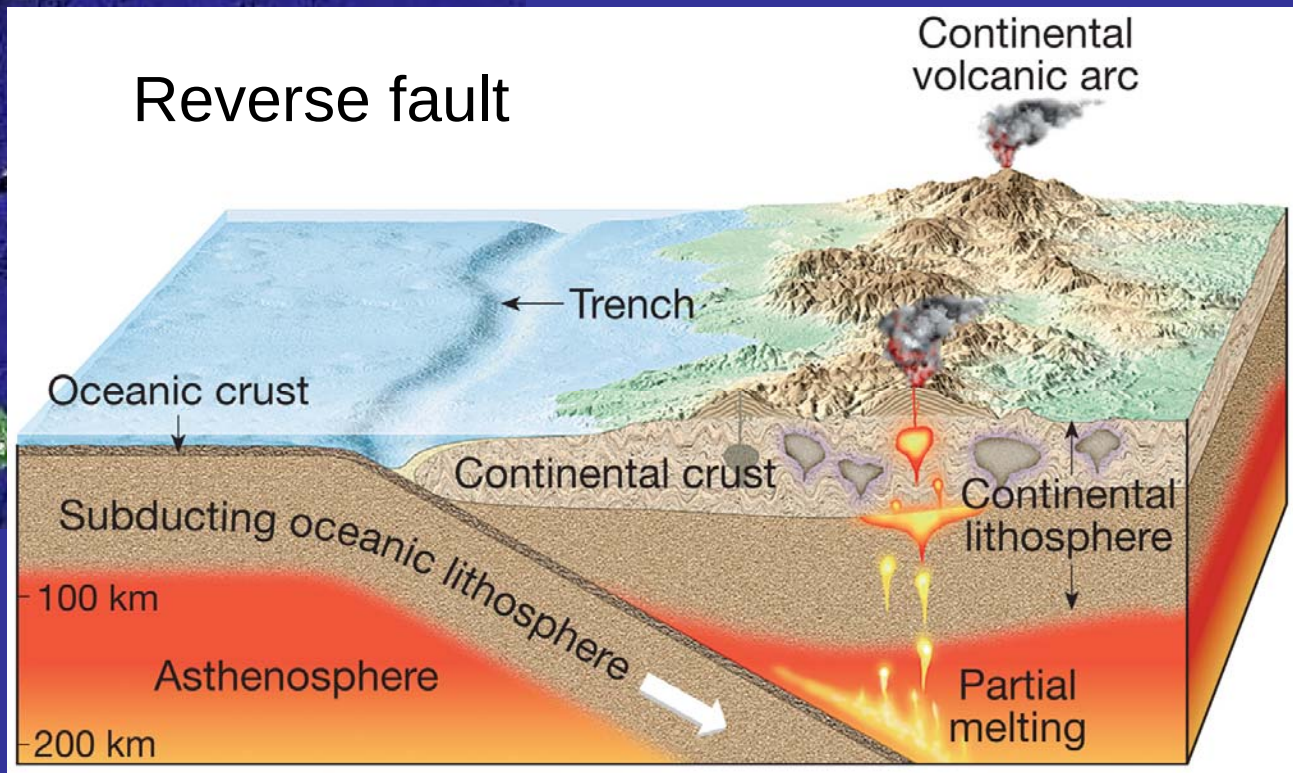
Earthquake Details

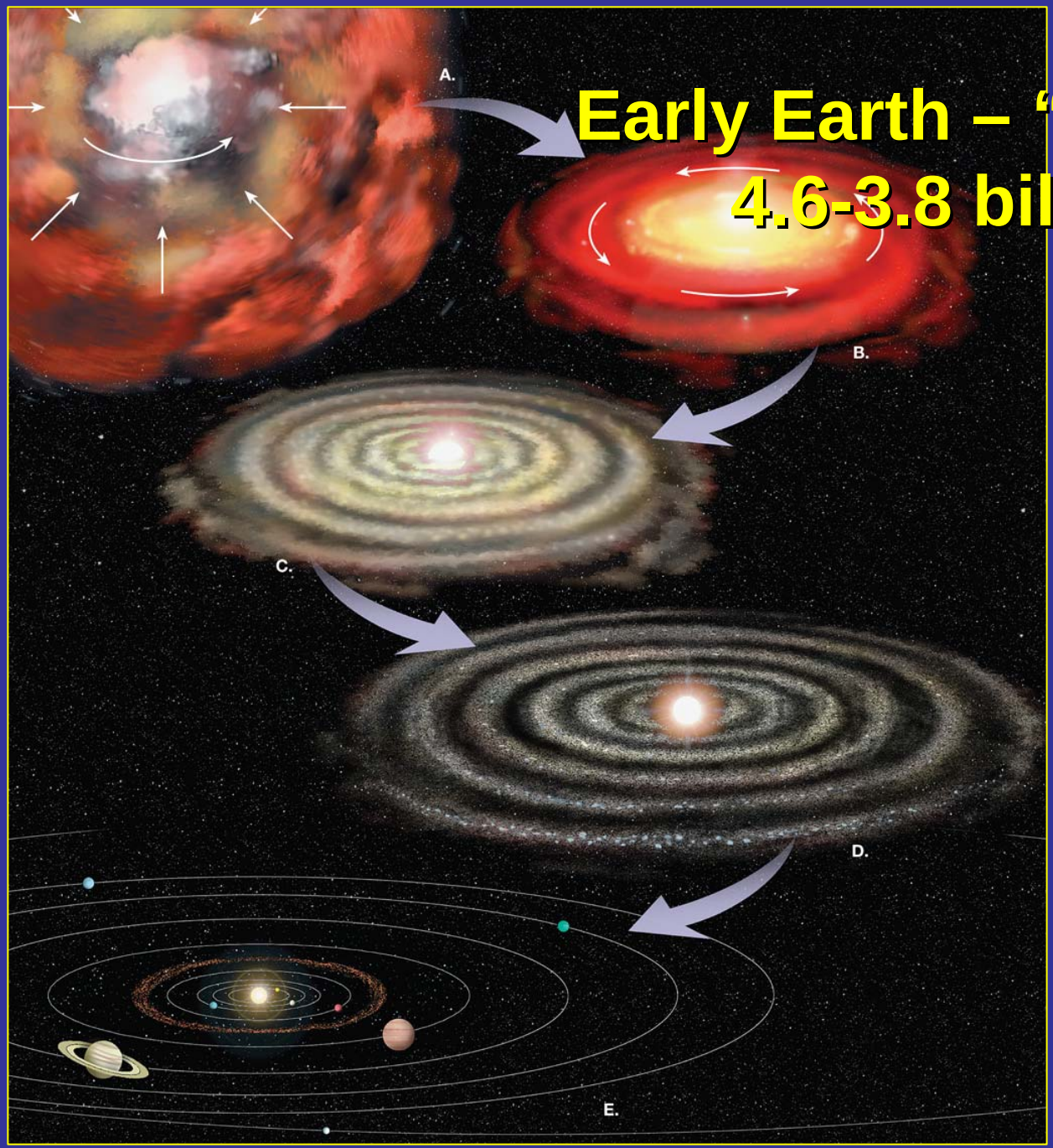
Magnitude	**8.2** (Great)
Date-Time	**Saturday, January 13, 2007 at 04:23:20 (UTC)** = Coordinated Universal Time **Saturday, January 13, 2007 at 2:23:20 PM** = local time at epicenter Time of Earthquake in other Time Zones
Location	46.272°N, 154.455°E
Depth	10 km (6.2 miles) set by location program
Region	EAST OF THE KURIL ISLANDS
Distances	505 km (315 miles) SSW of **Severo-Kuril'sk, Kuril Islands, Russia** 525 km (325 miles) ENE of **Kuril'sk, Kuril Islands** 1710 km (1060 miles) NE of **TOKYO, Japan** 7260 km (4510 miles) NE of **MOSCOW, Russia**
Location Uncertainty	horizontal +/- 4.3 km (2.7 miles); depth fixed by location program


1000 km




Horst
Graben
Normal fault


Reverse fault
Continental volcanic arc
Trench
Oceanic crust
Continental crust
Continental lithosphere
Subducting oceanic lithosphere
100 km
Asthenosphere
200 km
Partial melting

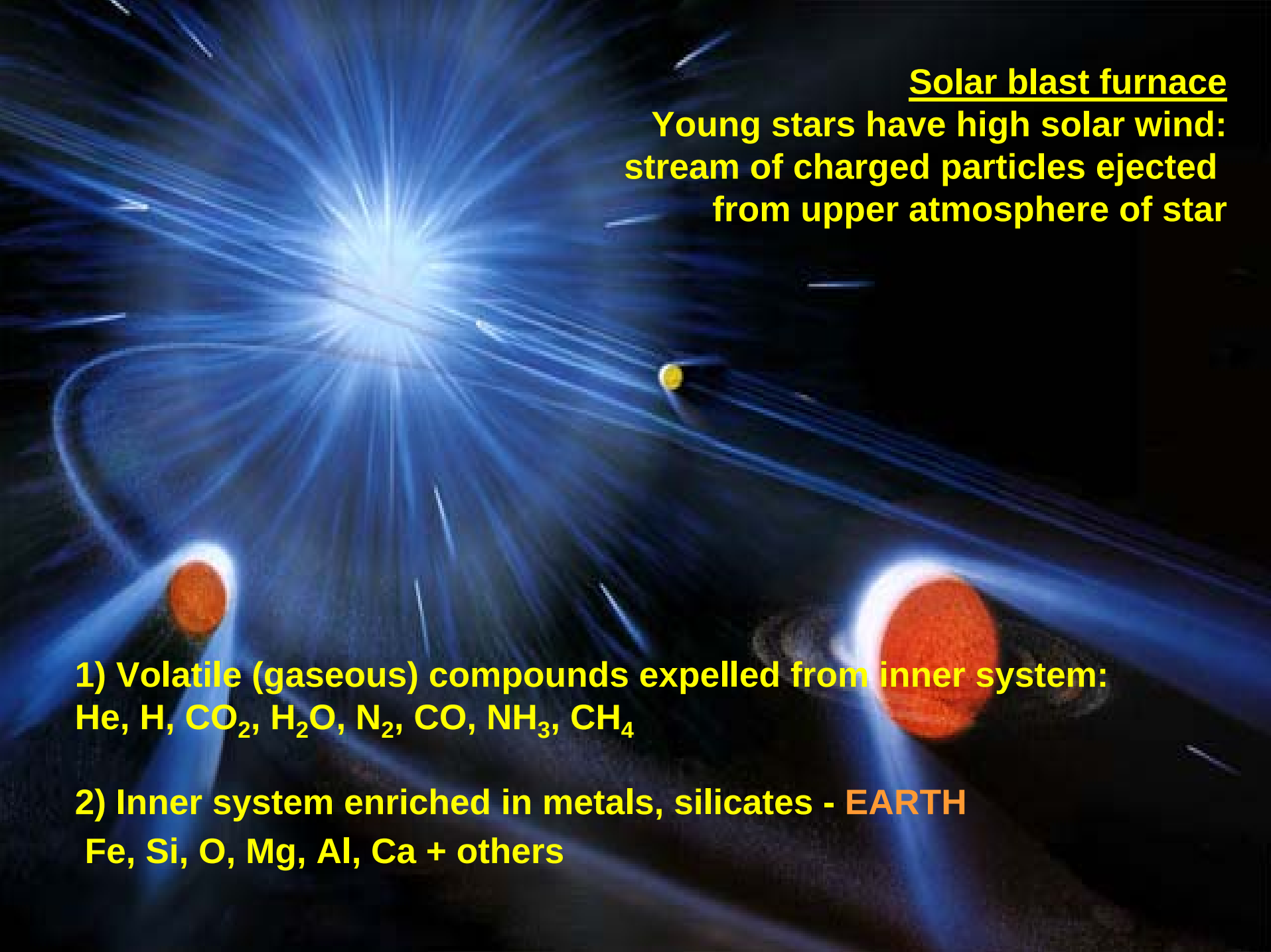


Early Earth – "Hadean Eon" 4.6-3.8 billion years ago

The spinning solar nebula segregated into:

1) the inner nebula core that was to become the Sun

2) a cooling outer accretion disc of rocky fragments and dust - planets



Solar blast furnace

Young stars have high solar wind: stream of charged particles ejected from upper atmosphere of star

1) Volatile (gaseous) compounds expelled from inner system:
He, H, CO_2, H_2O, N_2, CO, NH_3, CH_4

2) Inner system enriched in metals, silicates - EARTH
Fe, Si, O, Mg, Al, Ca + others

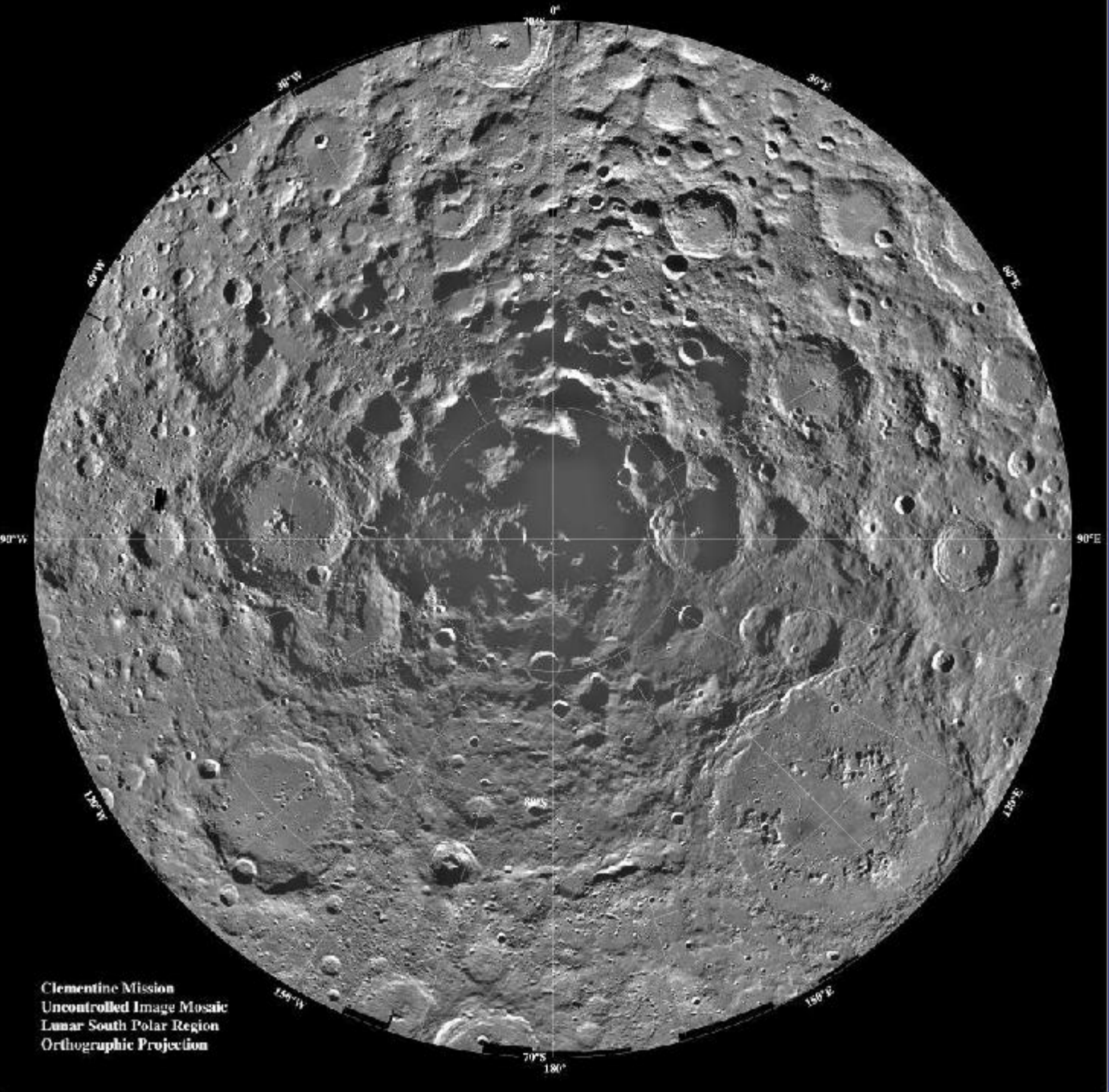


Planetesimal accretion ongoing….

Phase I:
Bombardment by planetoids/asteroids

(Earth is already a planet, but just a fraction of its current size)

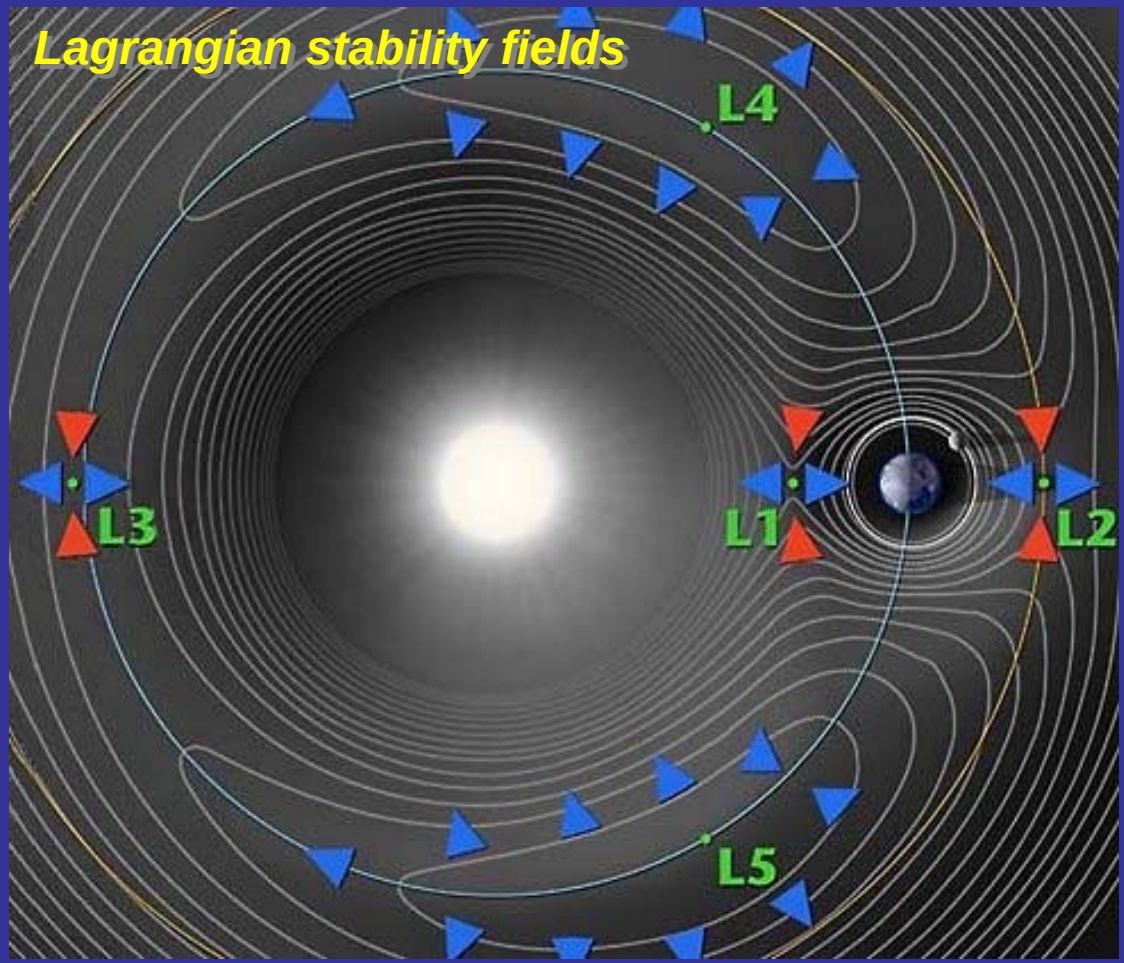
How do we know this was happening?

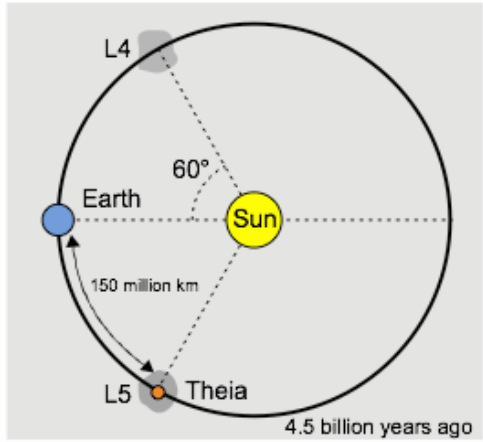


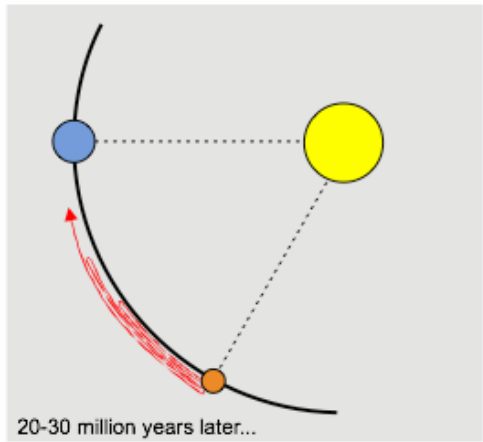
Early Bombardment

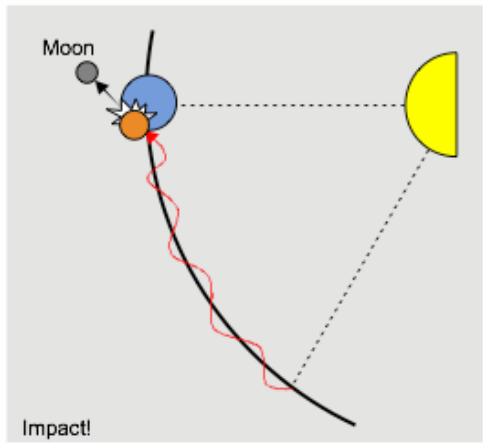
Craters preserved on surface of Moon

How was our Moon formed?









Giant Impact Hypothesis

Theia collides with Earth

~4.5 billion years ago





What happens to the impact debris?
What happens to Earth?



What happens to the impact debris?
What happens to Earth?



Phase II: Earth is molten planet

Rock is a good insulator – stores heat from…?

1. …
2. …
3. …
4. …



Phase II: Earth is molten planet

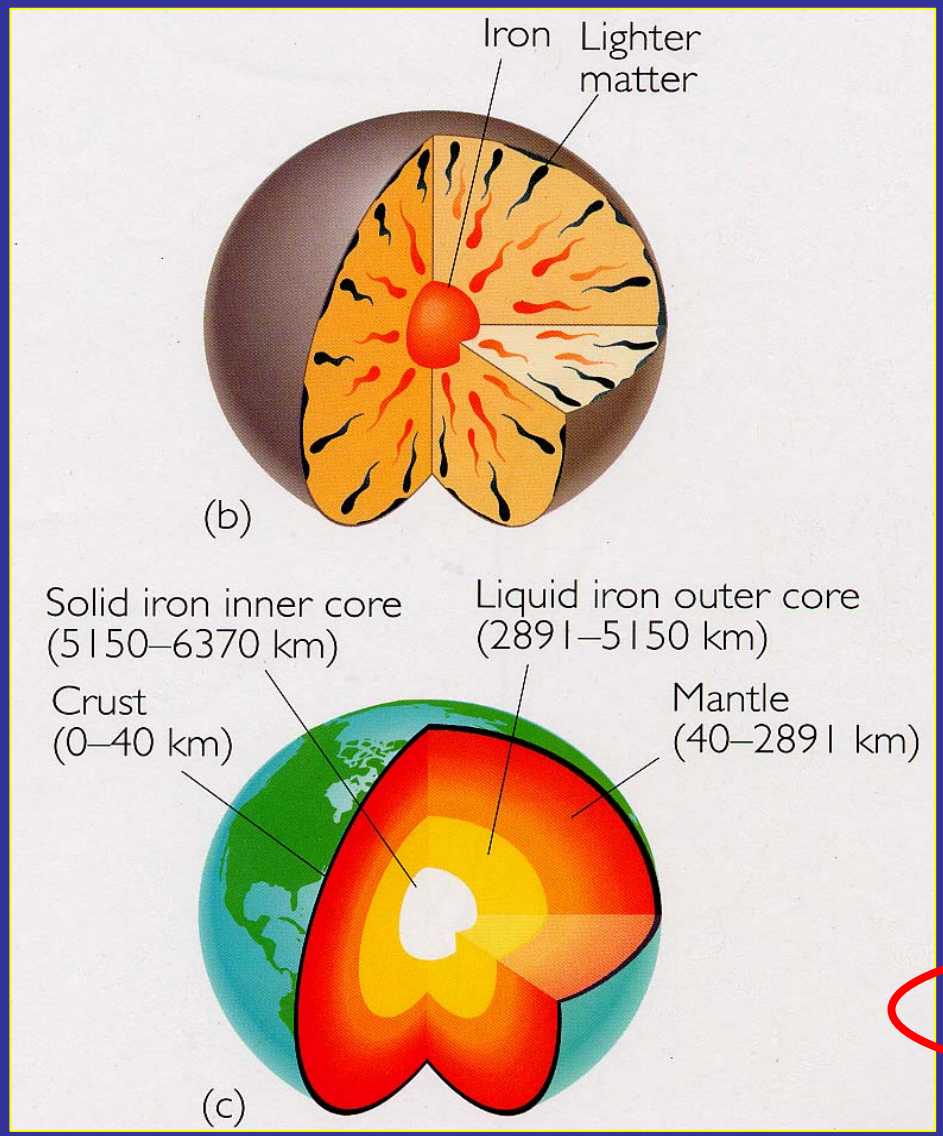
Rock is a good insulator – stores heat from…?

1. **Residual heat from solar nebula**
2. **Collisions**
3. **Gravitational contraction**
4. **Radioactive breakdown**

What happens to the planet as a result of being liquid?



“Iron Catastrophe”



Planet becomes chemically differentiated

Temperature reached melting point of iron (1538°C):

1) Liquid iron flowed inward
2) Friction raised temperature
3) Liquid Silicon and Oxygen flowed outward (Ca/Na/Al/K)

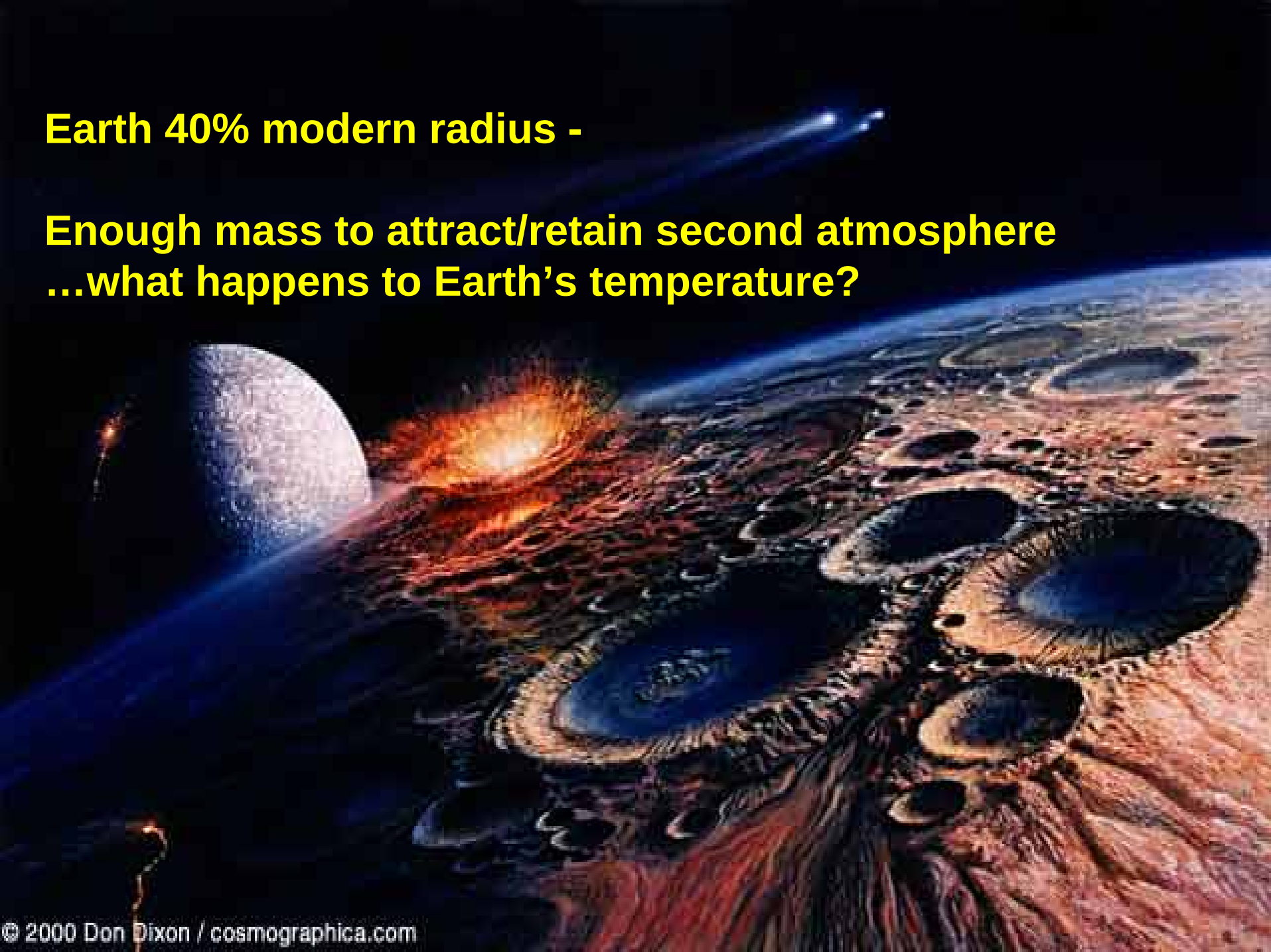
First atmosphere created


…but, Earth is still relatively small so what happens to these atmospheric gases…?
nographica.com


…Earth’s first atmosphere of H, He
blown away by solar wind
and Earth’s own heat.
nographica.com

Earth 40% modern radius -

Enough mass to attract/retain second atmosphere
…what happens to Earth's temperature?



Temperatures drop…

…what happens to molten planet?




Outermost layer of molten planet begins to solidify
© 2000 Don Dixon / cosmographica.com



Beginnings of modern atmosphere:

1) Ammonia
2) Methane
3) Water vapor
4) Carbon dioxide
5) Nitrogen
(low Oxygen)

What are the sources of these gases?



Beginnings of modern atmosphere:

1) Ammonia
2) Methane
3) Water vapor
4) Carbon dioxide
5) Nitrogen
(low Oxygen)

Meteor impacts
Volcanic eruptions



Beginnings of modern atmosphere:

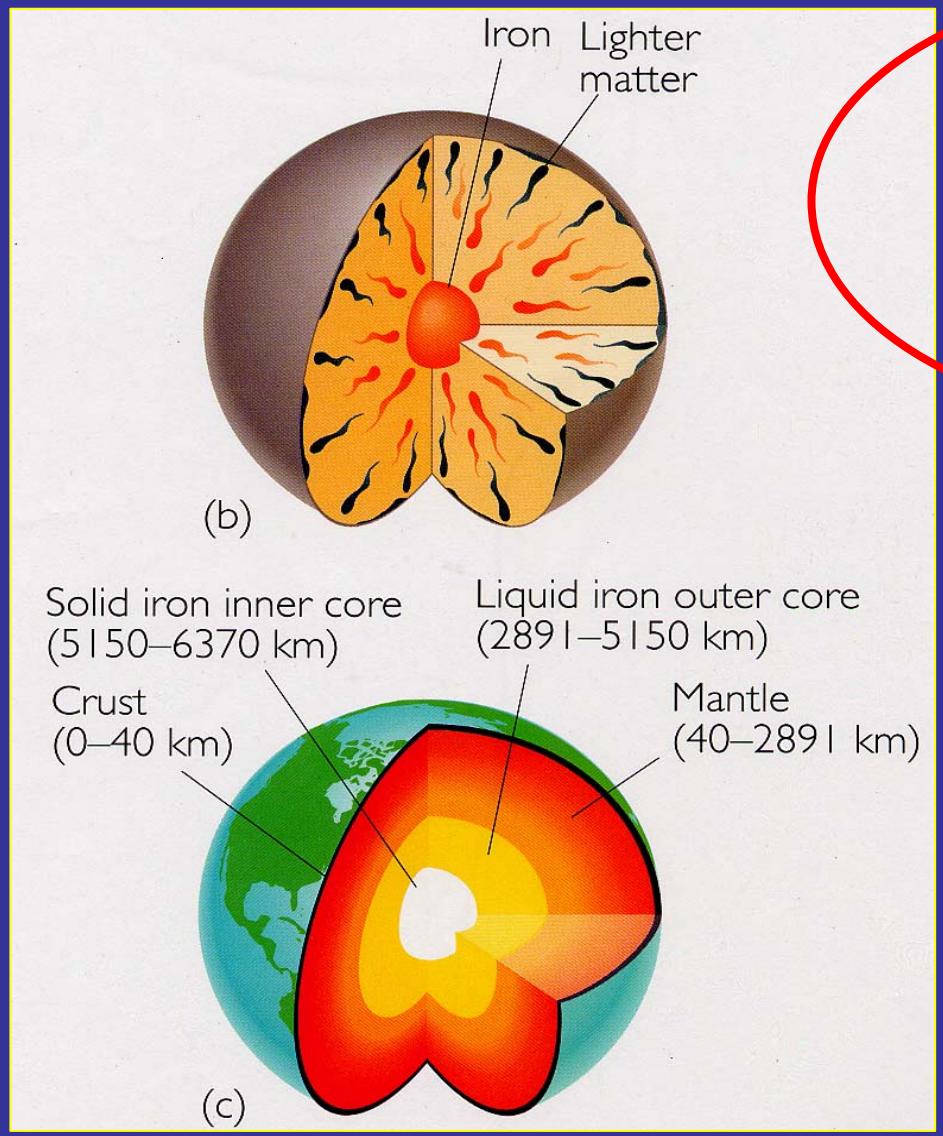
1) Ammonia
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4) Carbon dioxide
5) Nitrogen
(low Oxygen)

What does the atmosphere generate?

Formation of oceans ~4.4 billion years ago



“Iron Catastrophe”

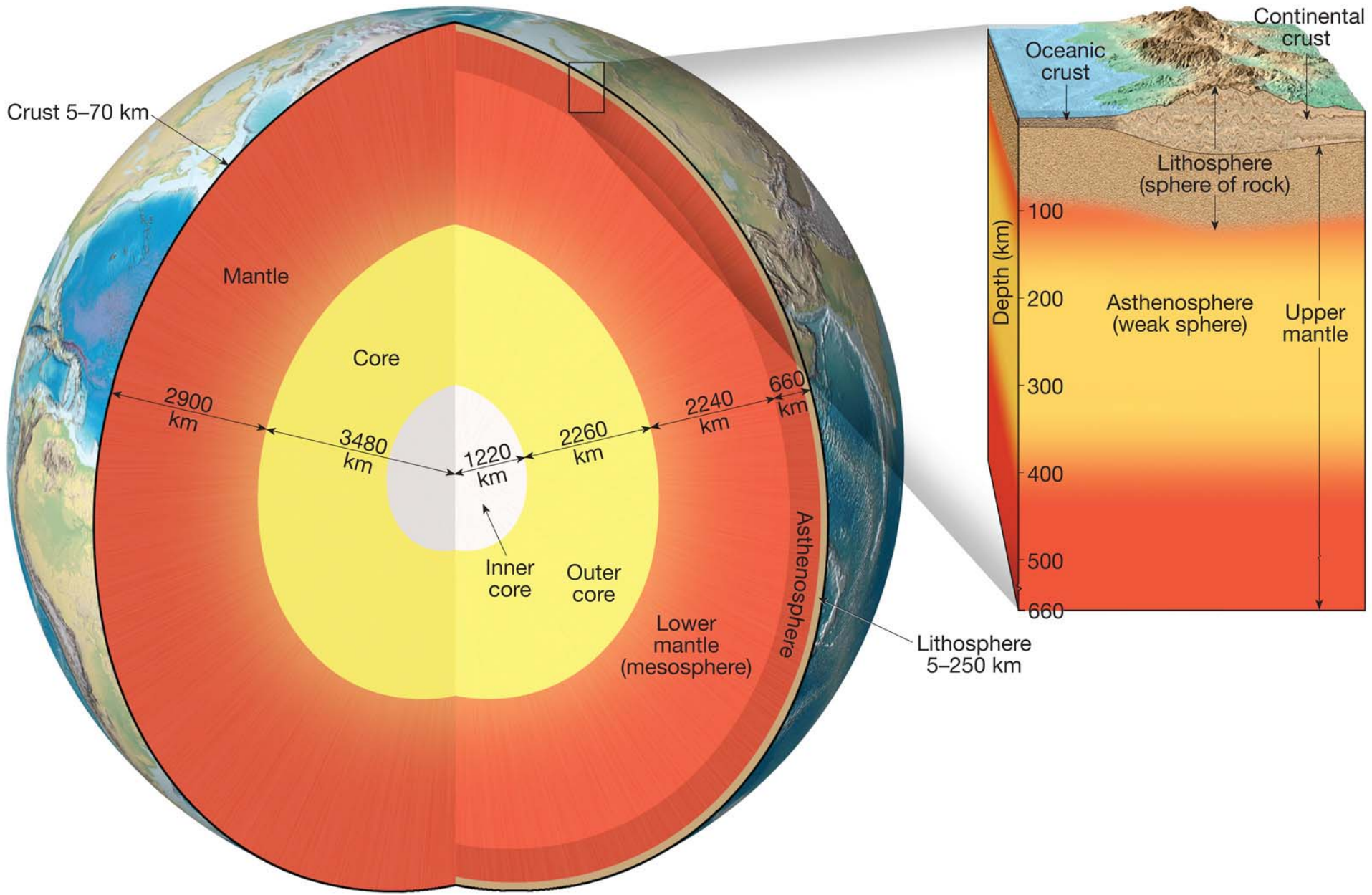


Planet becomes chemically differentiated

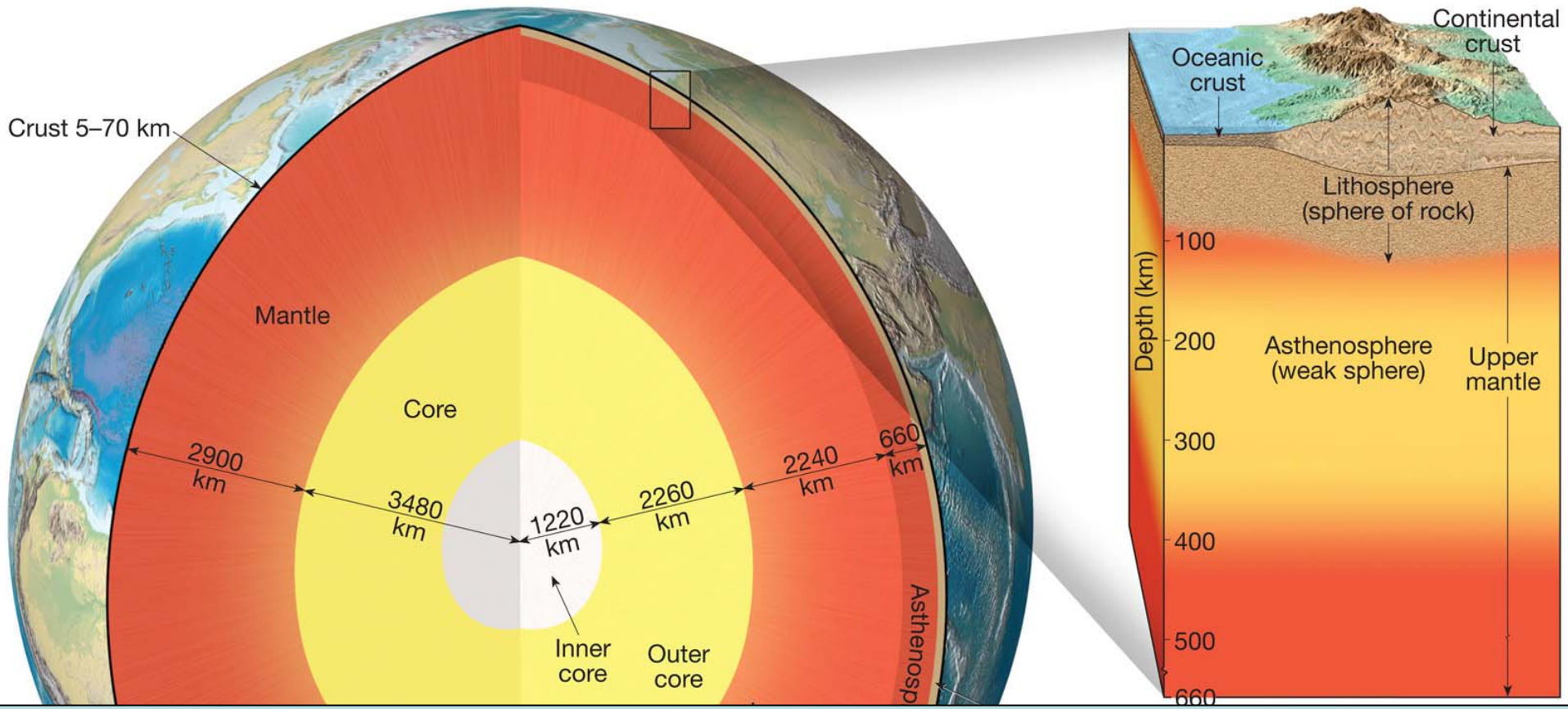
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First atmosphere created

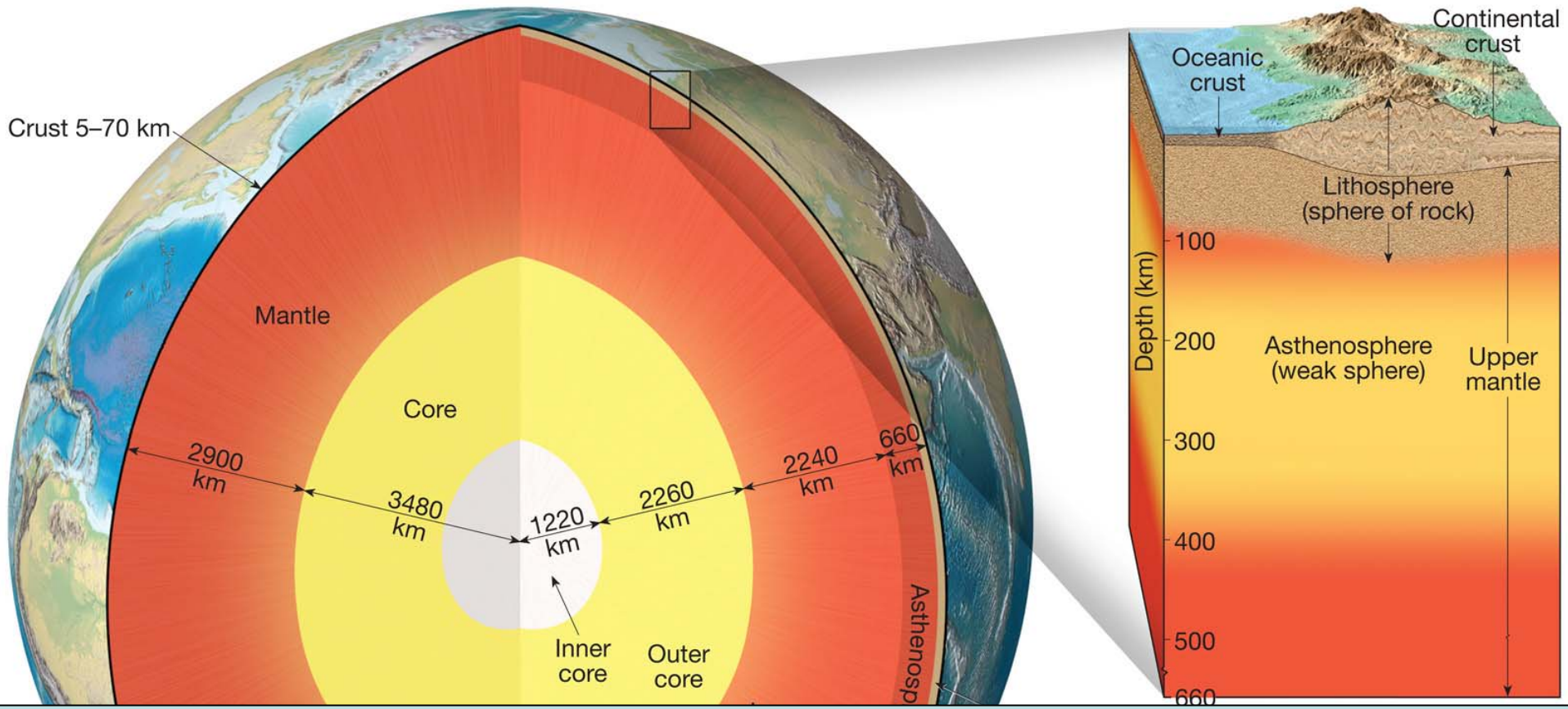


Earth's Internal Structure



EARTH'S INTERNAL STRUCTURE DENSITY TEMPERATURE

- **Inner core – Fe/Ni solid**
- **Outer core – Fe/Ni/Mg liquid**
- **Mantle – Fe/Mg solid rock capable of flow**
- **Lithosphere – Fe/Mg/Si/O**
  - **Lower lithosphere - Fe/Mg**
  - **Crust – Si/O/Fe/Mg/Ca/Na/K/Al**
    - **Oceanic crust – Fe/Mg/Ca**
    - **Continental crust – Si/O/Na**

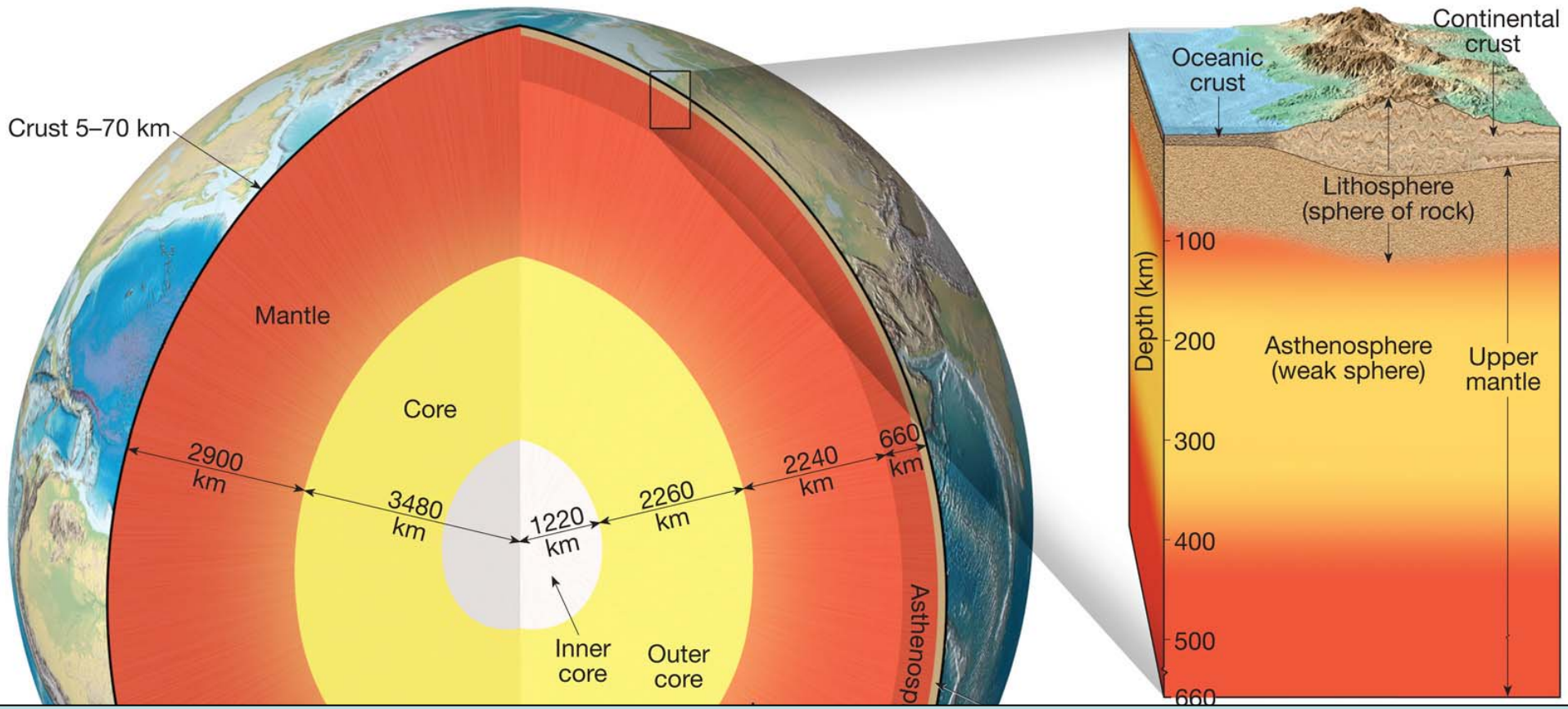


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    - **Continental crust – Si/O/Na**

DENSITY ↑

TEMPERATURE ↑

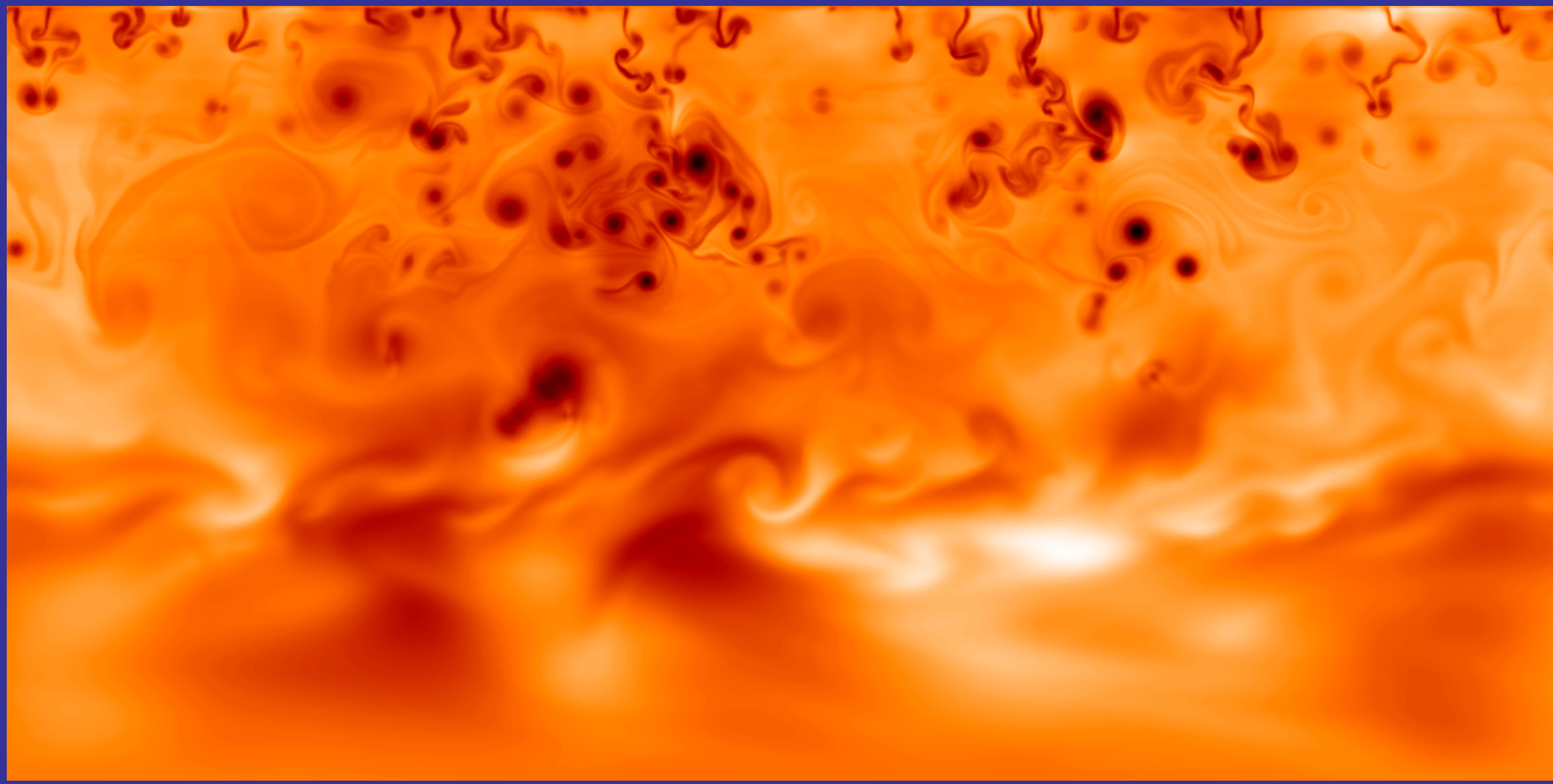


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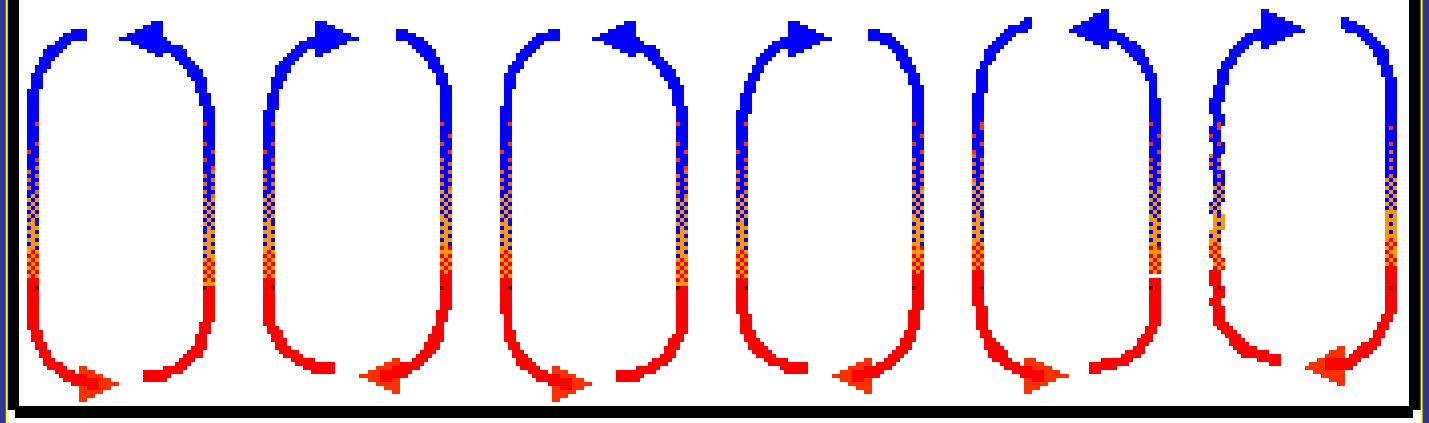
CONVECTION





What’s happening here?

Fluid cools by losing heat from surface



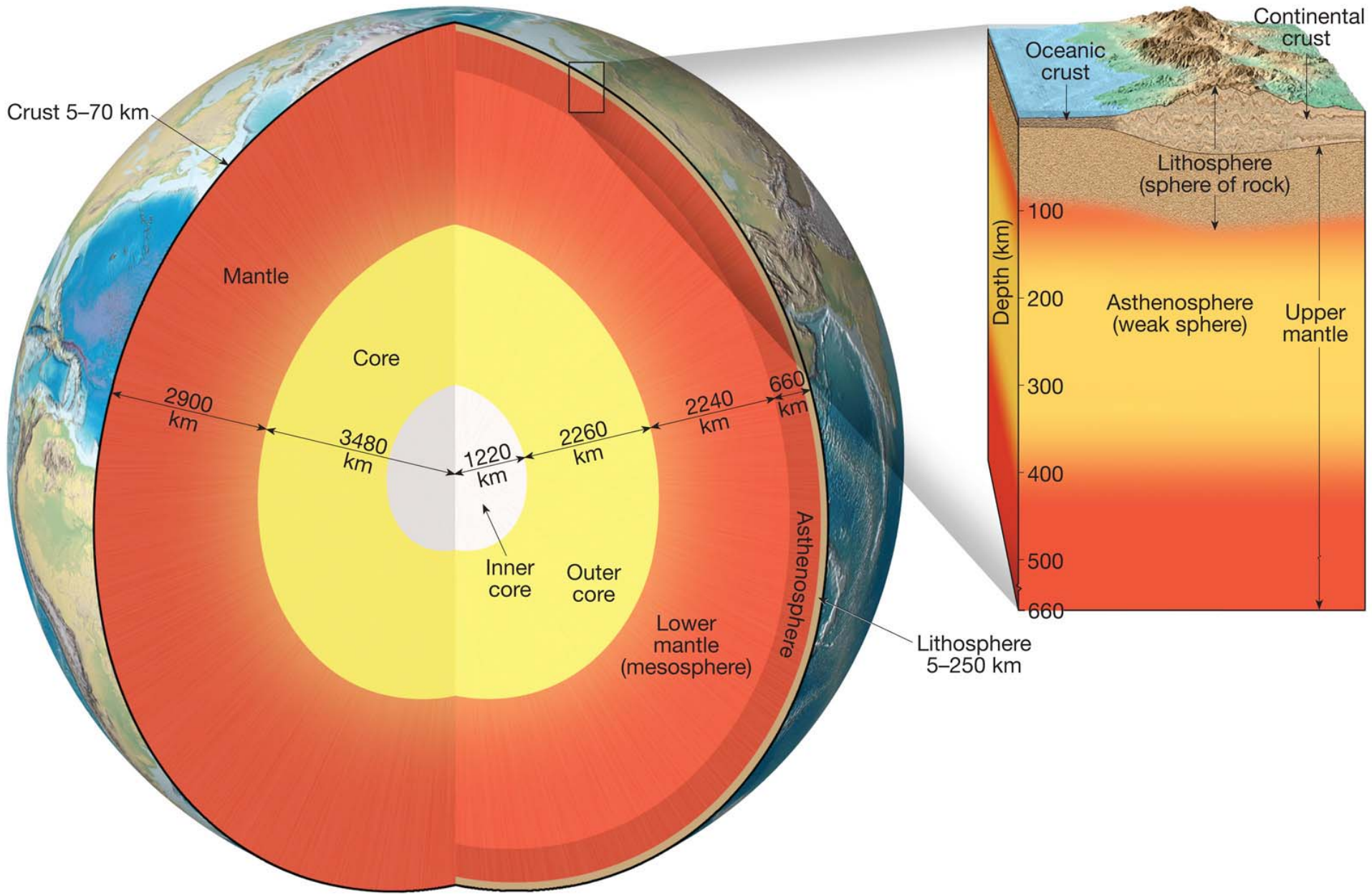


Convection cell

Warm, low density fluid rises

Cool, high density fluid sinks





Where does convection occur?

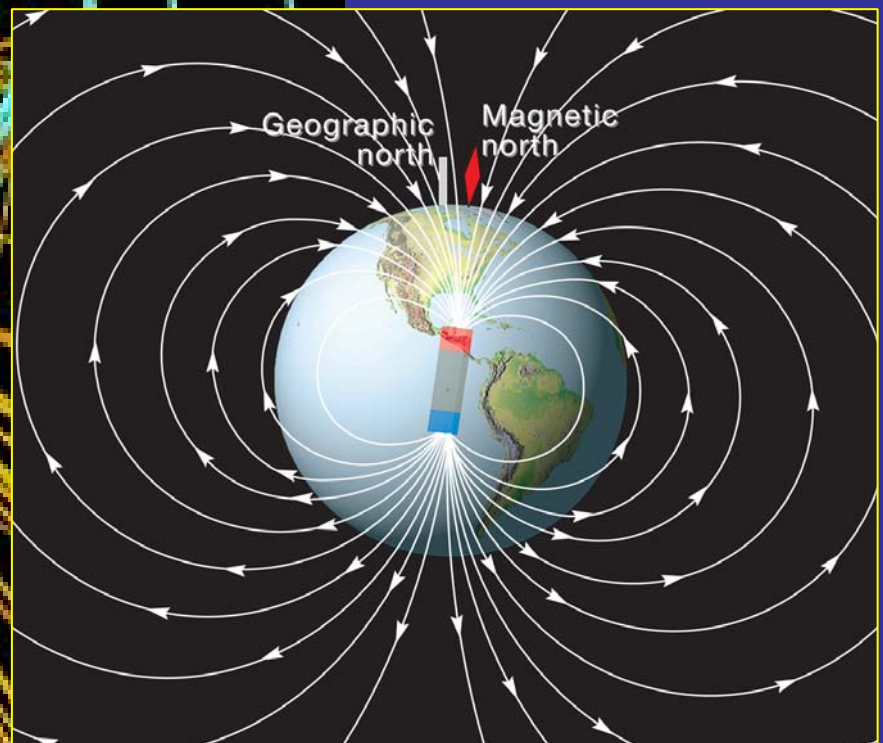
1) OUTER CORE

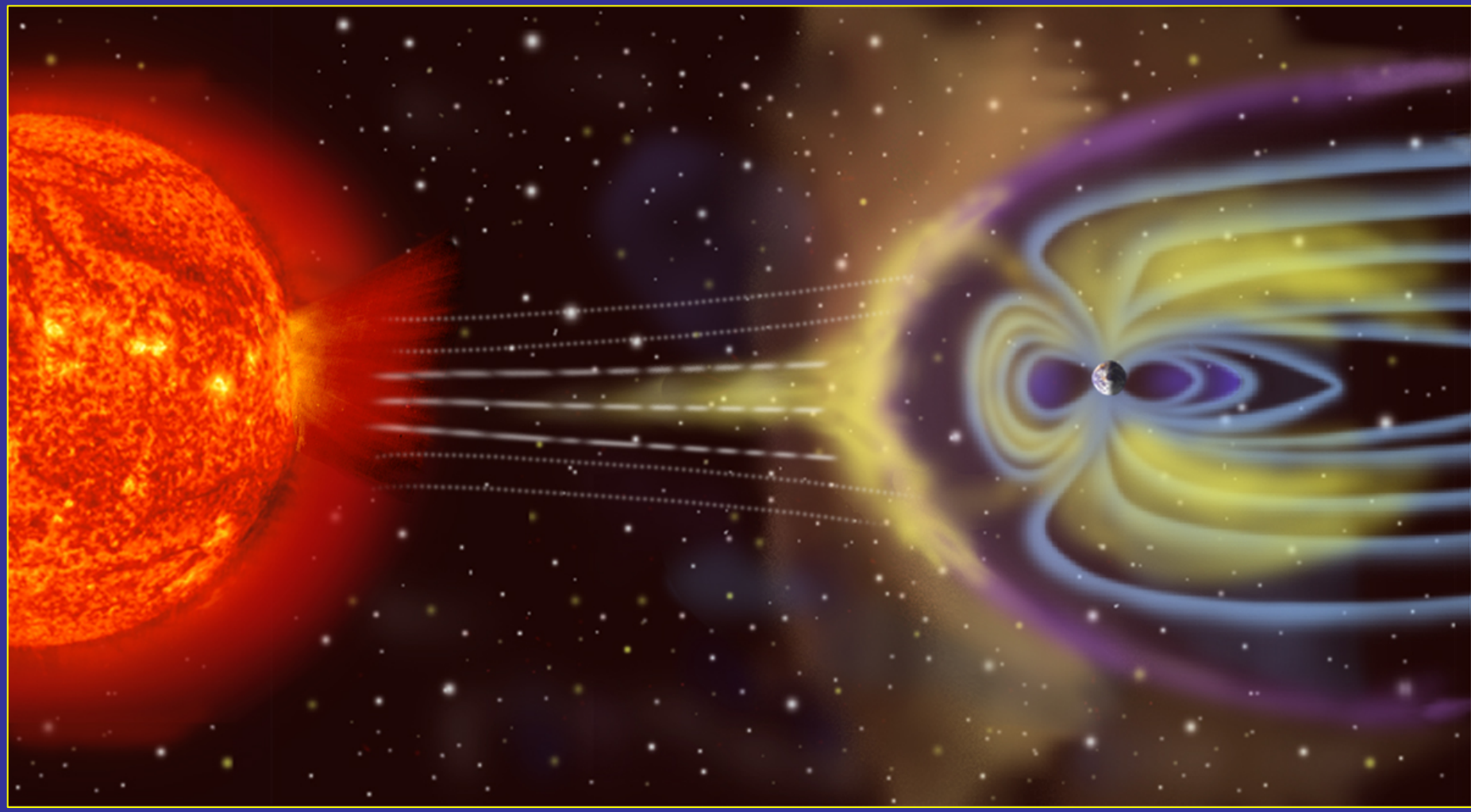
Magnetosphere

Magnetism gained from early nebula is magnified by:

1) Turbulent iron/nickel fluid of outer core

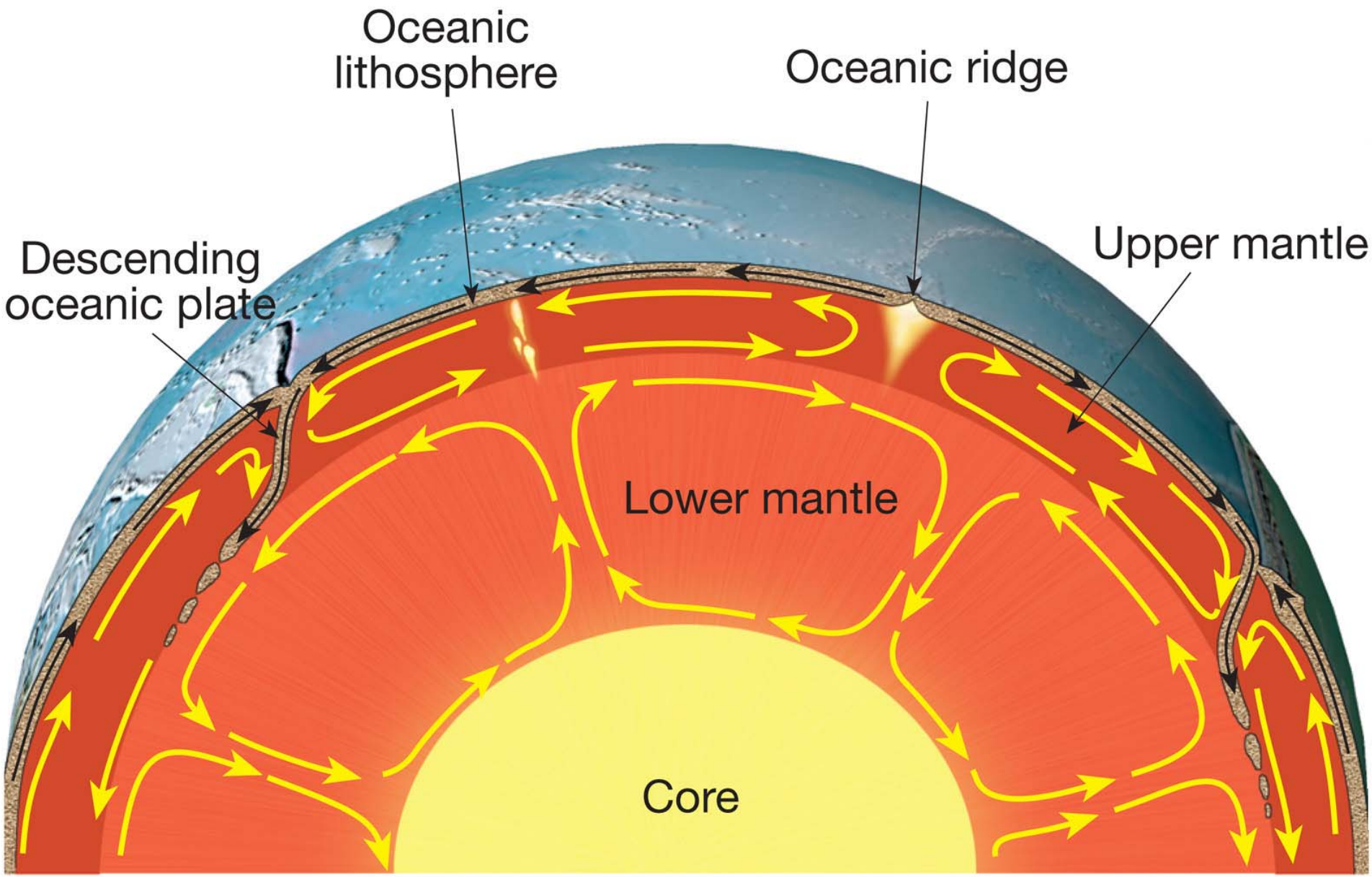
2) Earth's rotation.

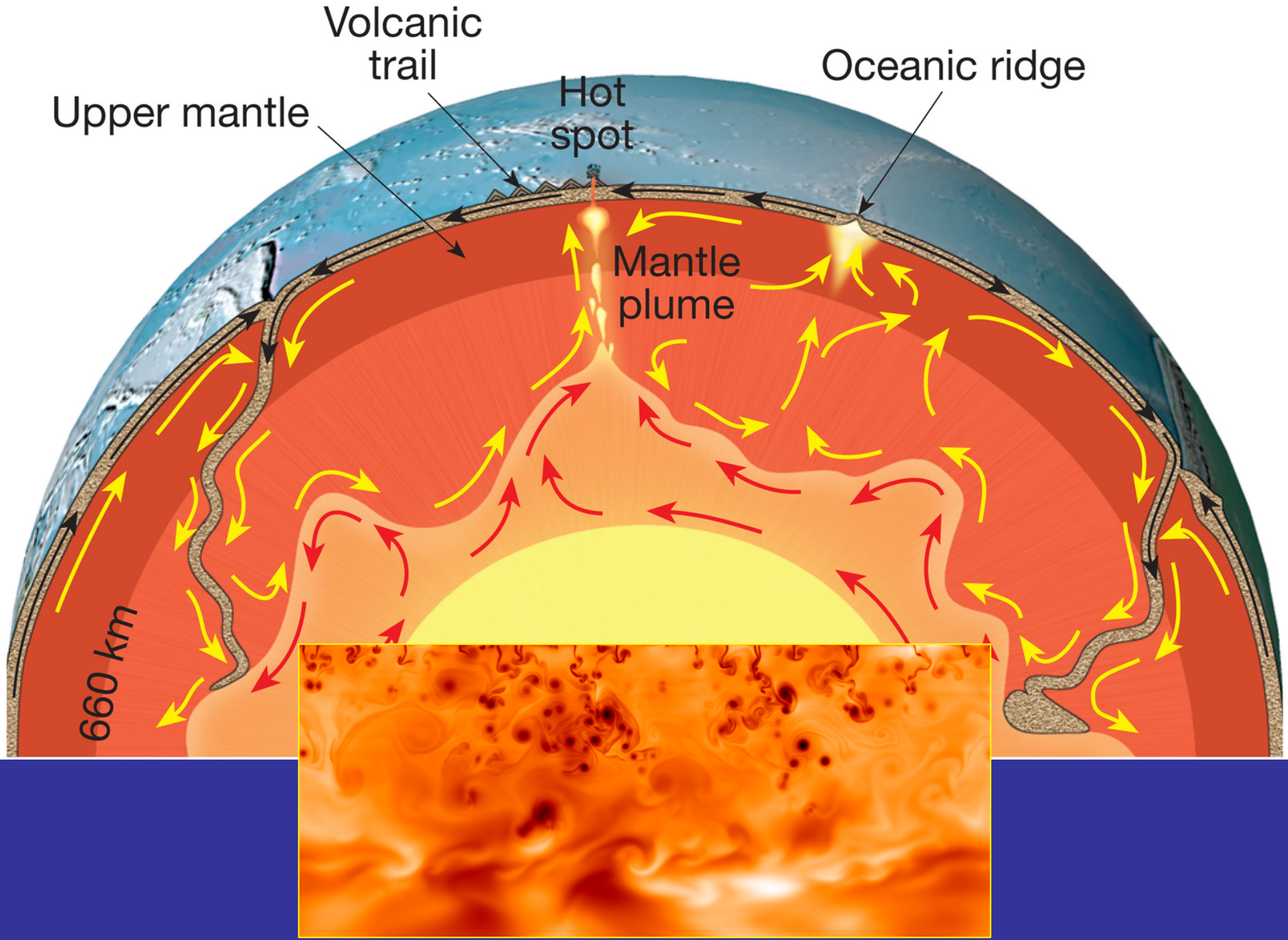


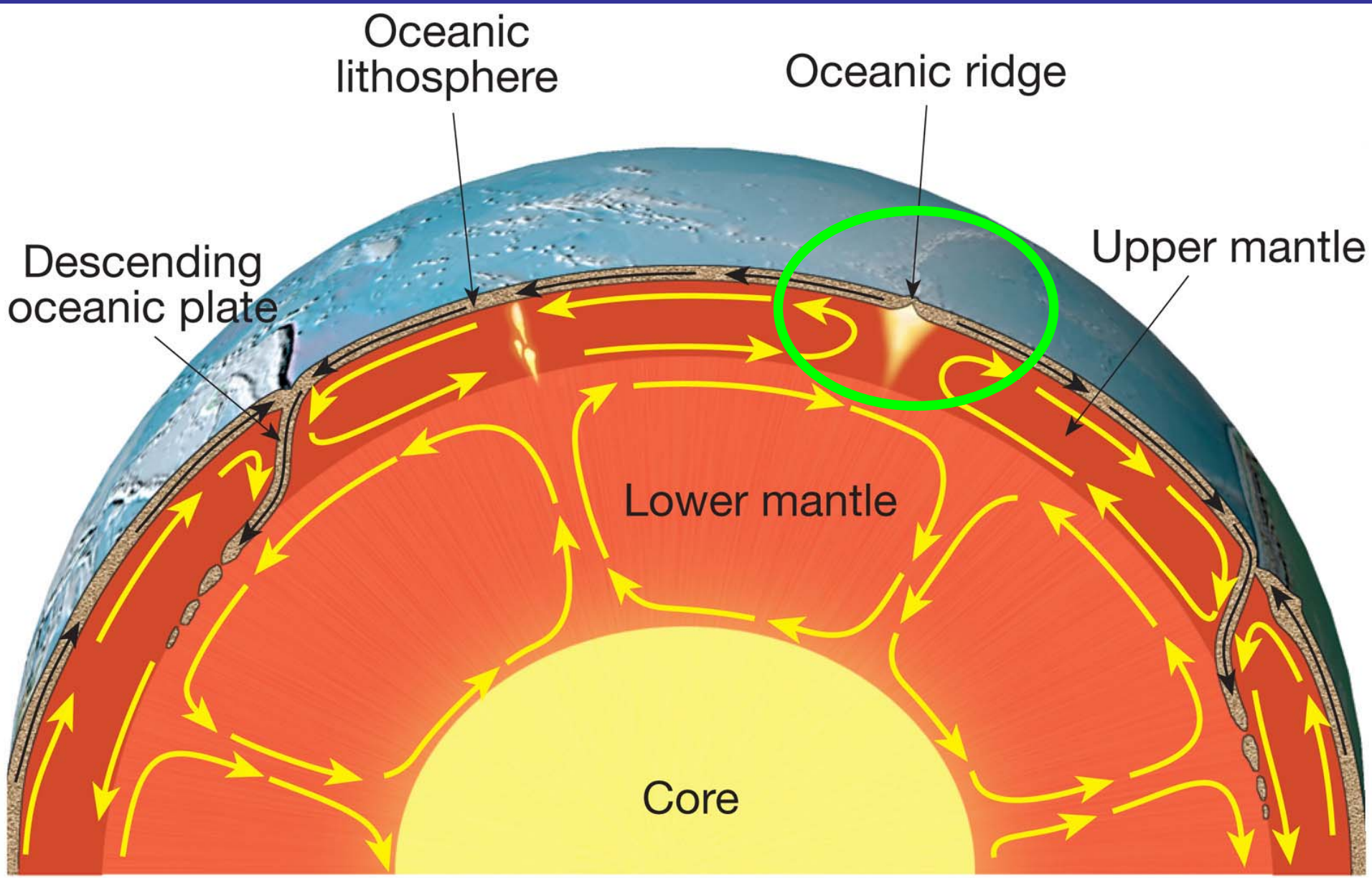


Earth’s magnetic field protects us from solar flares

2) MANTLE CONVECTION – drives Plate Tectonics




Volcanic trail
Upper mantle
Hot spot
Oceanic ridge
Mantle plume
660 km


Oceanic lithosphere
Oceanic ridge
Descending oceanic plate
Upper mantle
Lower mantle
Core

Early Earth summary…

1) Phase I - bombardment/accretion

1.1) Great Impact forms Moon

2) Phase II - molten planet

2.1) "Iron Catastrophe" - first atmosphere

2.1.1) Earth too small to retain first atmosphere

2.1.2) Continued growth through accretion

2.1.3) Second atmosphere from volcanism/meteors

2.1.4) Formation of oceans

2.2) Chemical differentiation - Earth's layers

2.2.1) Core convection - magnetosphere

2.2.2) Mantle convection - plate tectonics