EWCE 203

Geology and Geomorphology

Geology

What we discussed in previous class?

- **Some Chronological Events of the Earth Development**
- **Mid ocean ridges**
- **Sea-floor Spreading**
- **Significance of sea-floor spreading**
- **Theory of plate tectonics**

What we are going to discuss today?

Composition and Structure of the Earth

- Earth Crust
- Lithosphere and Asthenosphere
- Convection Current within the earth's mantle
- Engineering Geology
- Environmental Geology

Composition and Structure of Earth

Division Based on Composition:

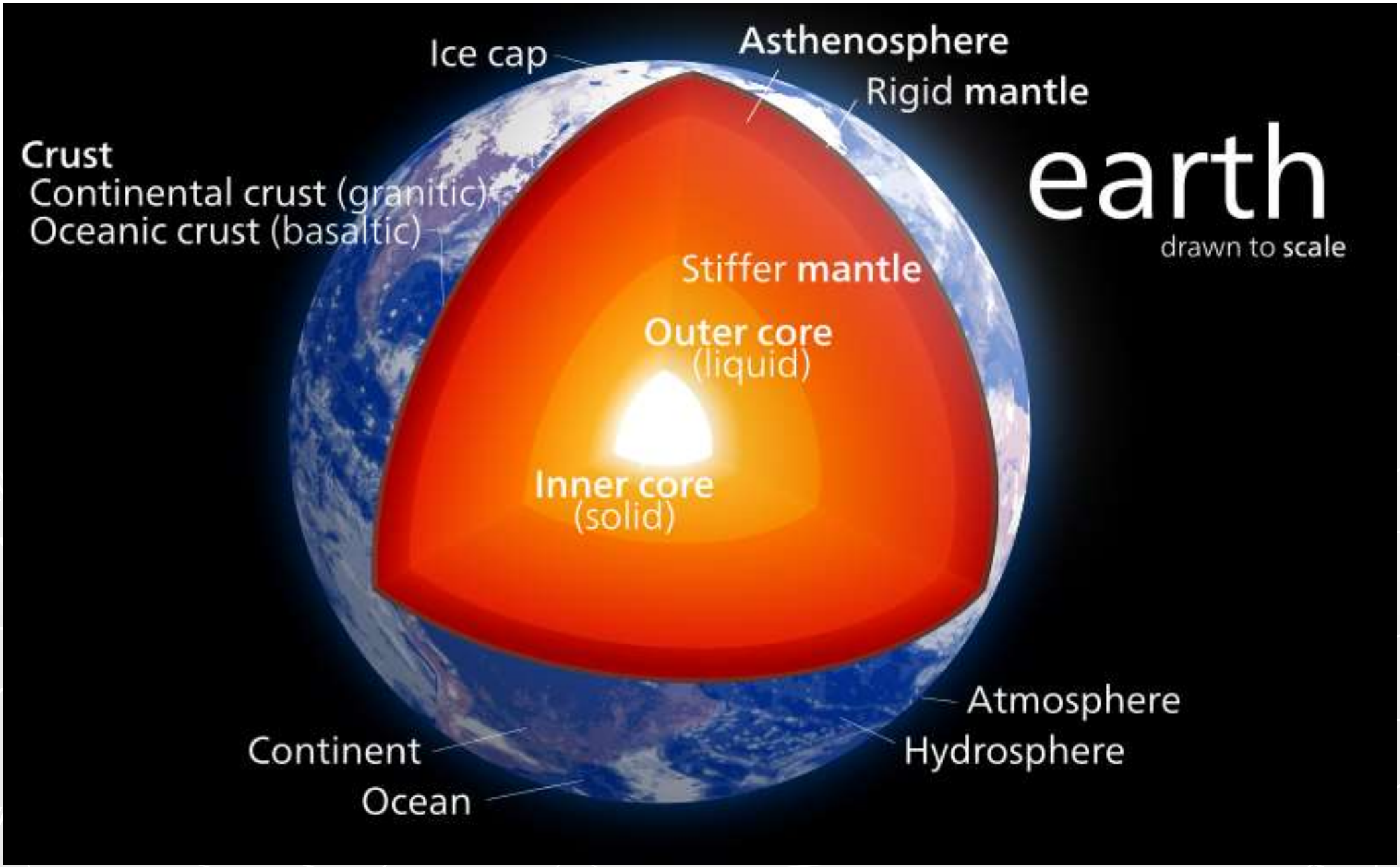
- **Core,**
- **Mantle, and**
- **Crust.**

Crust: makes up less than **1 percent of Earth by mass**, consisting of oceanic crust and continental crust is often more felsic rock.

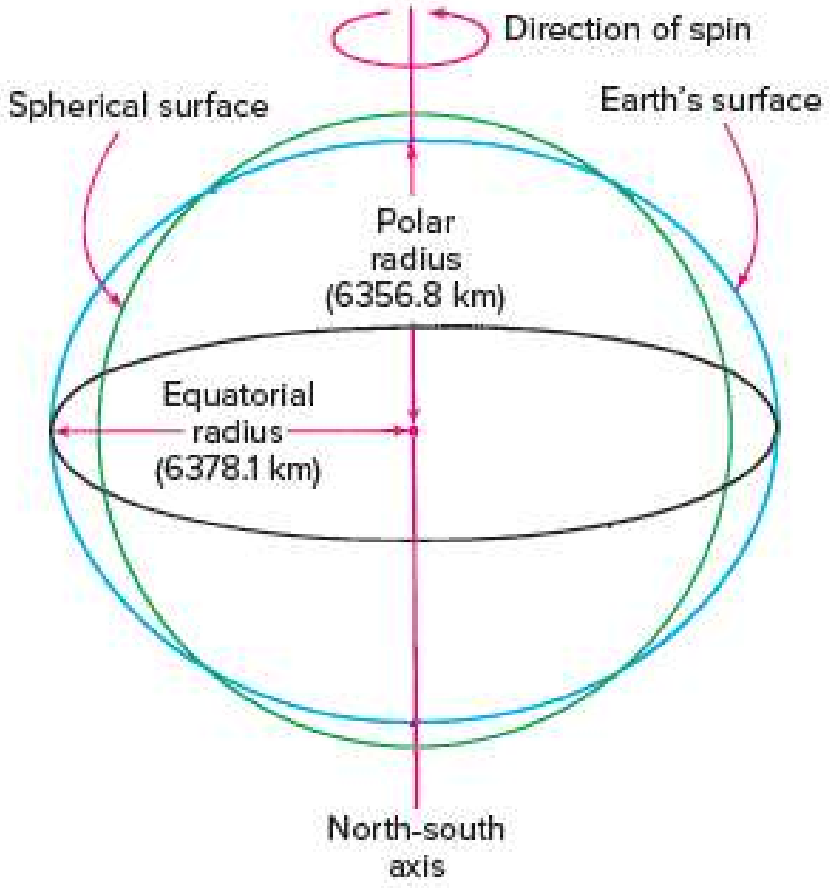
Mantle: Hot and represents about **68%** of Earth's mass. (Upper+Lower)

Core: It is mostly iron metal. The core makes up about **31%** of the Earth's mass. (Outer+Inner)

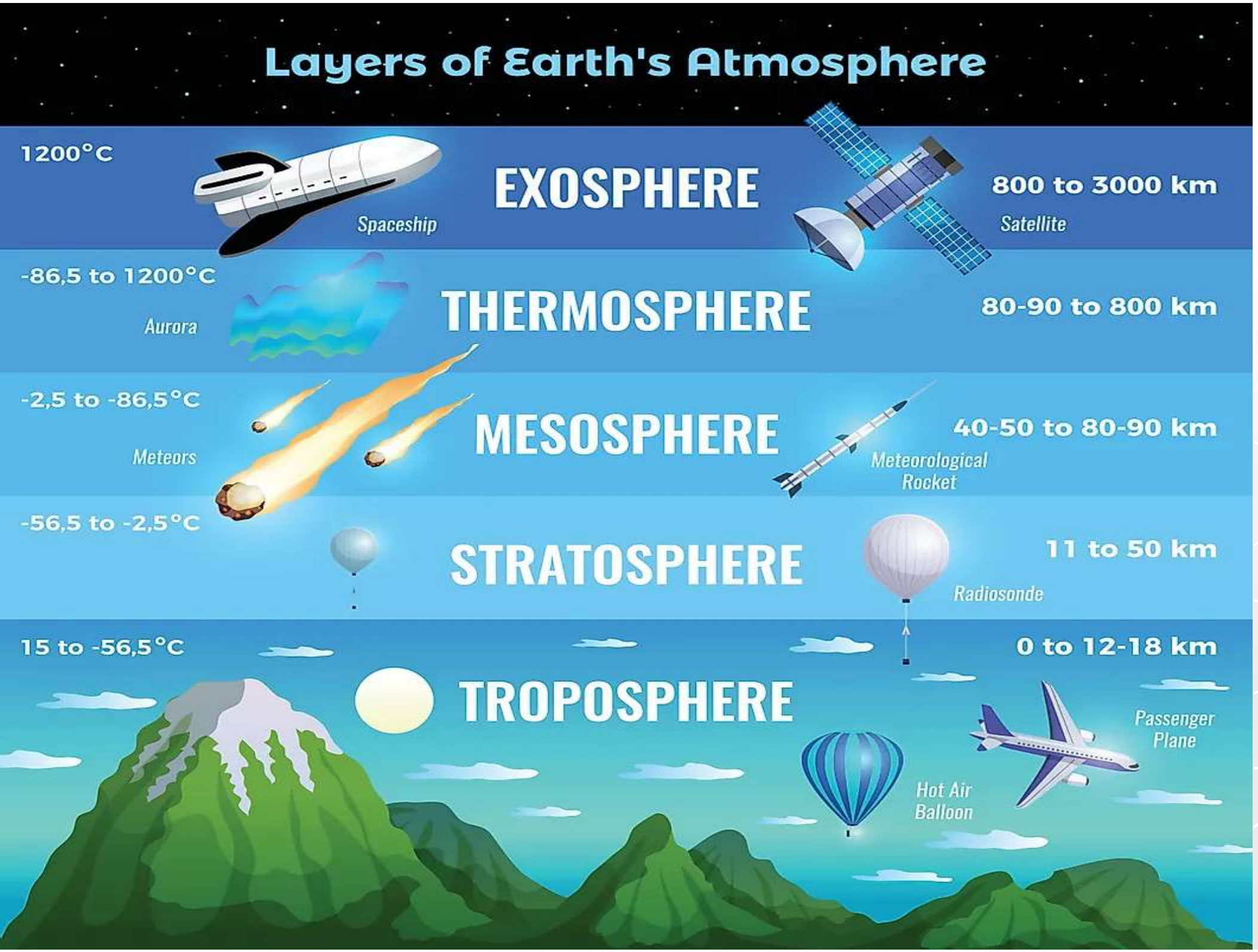
Composition and Structure of Earth



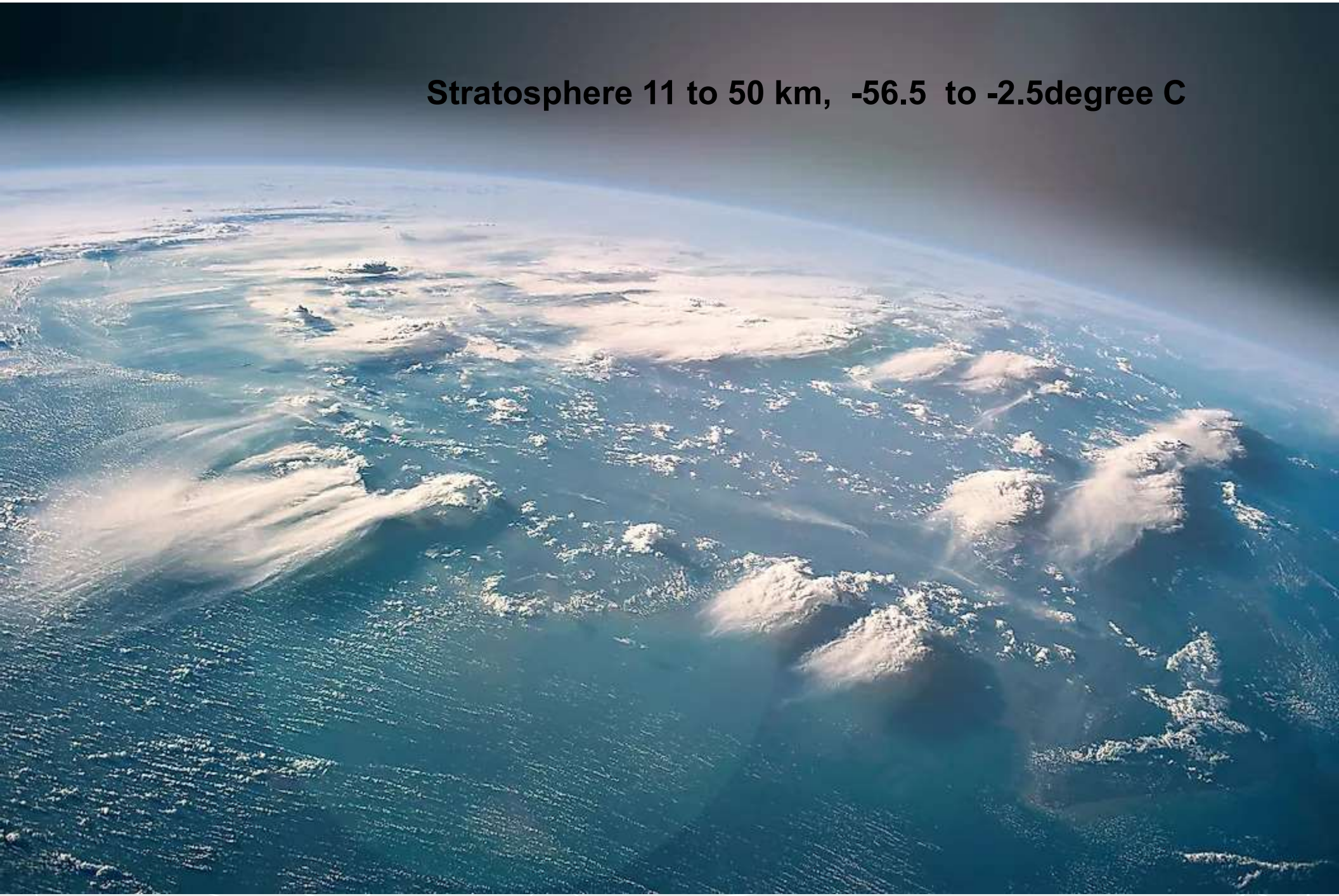
Radius of Earth



Layers of Earth's Atmosphere

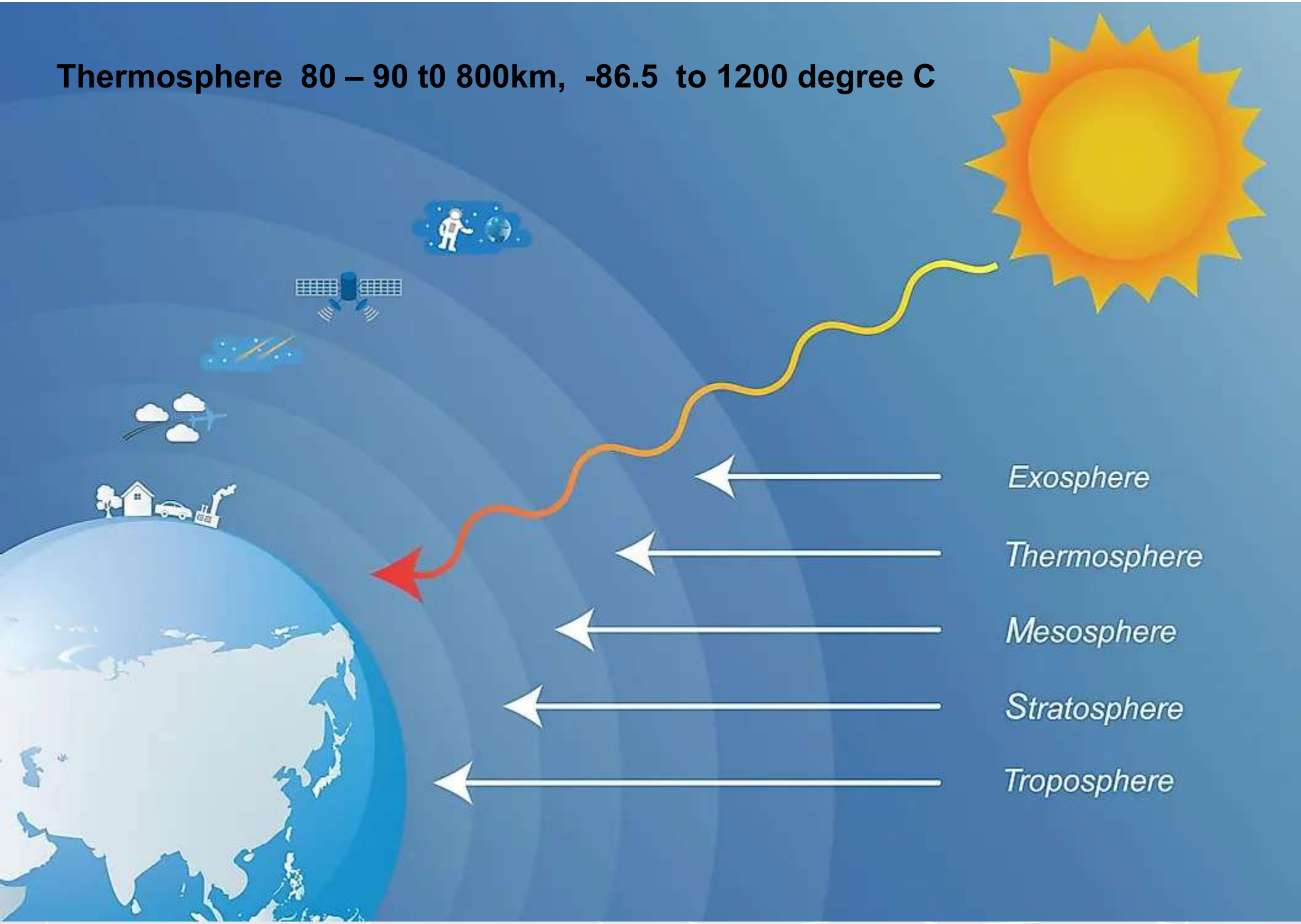



Troposphere 0 – 12 to 18 km, -56.5 degree C


Stratosphere 11 to 50 km, -56.5 to -2.5degree C


Mesosphere 40-50 to 80 - 90km, -2.5 to -86.5.5degree C

Thermosphere 80 – 90 t0 800km, -86.5 to 1200 degree C



Exosphere 800 to 3000km, 1200 degree C



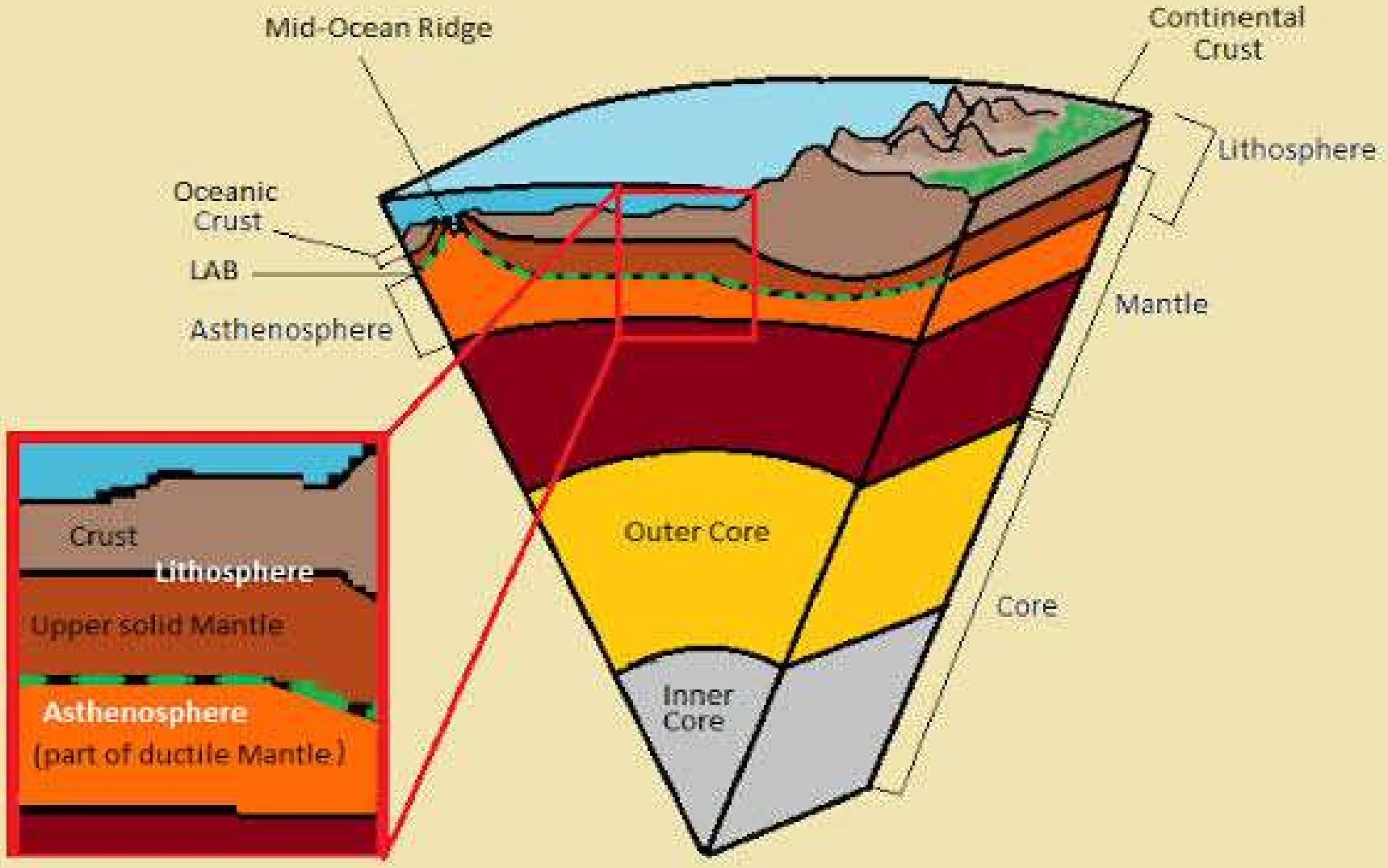
Composition and Structure of Earth's Crust

Divisions based on mechanical properties:

- **Lithosphere and**
- **Asthenosphere**.

Lithosphere: It is composed of both the **crust and the portion of the upper mantle** that behaves as a **brittle, rigid solid.**

Asthenosphere: It is **partially molten upper mantle material** that behaves **plastically** and can flow.


Mid-Ocean Ridge
Continental Crust
Lithosphere
Oceanic Crust
LAB
Asthenosphere
Mantle
Outer Core
Core
Inner Core
Crust
Lithosphere
Upper solid Mantle
Asthenosphere
(part of ductile Mantle)

Earth's Crust

Crust:

- Earth's outer surface is its crust; a cold, **thin, brittle outer shell made of rock.**
- Crust is very thin, relative to the radius of the planet.

Types of crust:

Oceanic crust:

- Composed of **magma** that erupts on the seafloor to create basalt lava flows or cools deeper down to create the intrusive igneous rock gabbro.

- Composed of **sediments**, primarily muds and the shells of tiny sea creatures, coat the seafloor.

- **5 km to 10 km thick**.

Continental crust:

- Made up of many different types of igneous, metamorphic, and sedimentary rocks.
- Average composition is **granite.**
- **30 km to 50 km thick**.

How the planet's Oceans are formed?

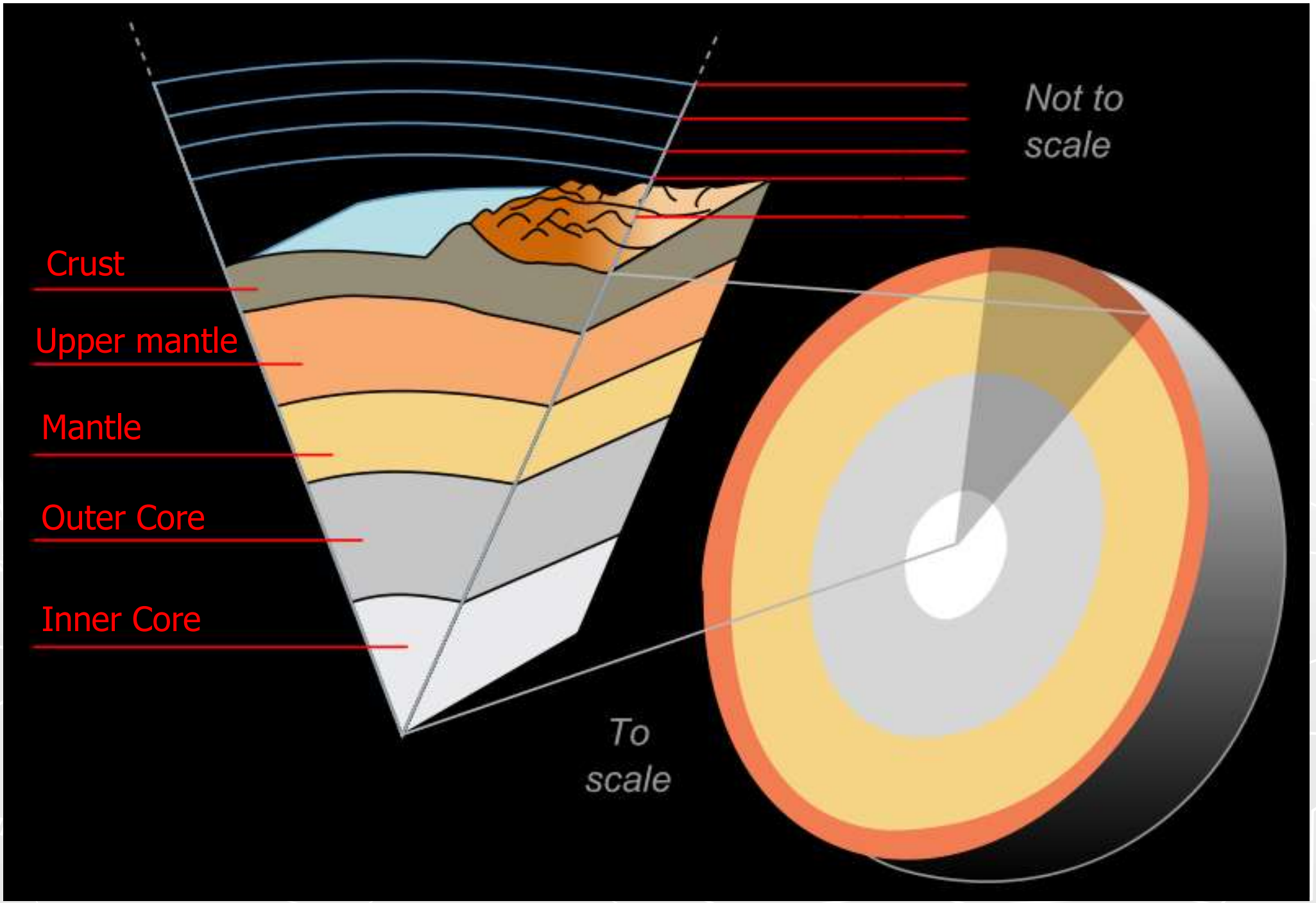
- Because it is thick and has relatively **low density**, continental crust **rises higher** on the mantle than oceanic crust, which **sinks into the mantle to form basins**. When filled with water, these basins form the **planet's oceans**.

Lithosphere

Lithosphere:

- It is the **outermost** mechanical layer, which behaves as a brittle, rigid solid.
- Lithosphere is about **100 kilometers** thick.
- It includes the **crust and the uppermost mantle**, which are both brittle.
- Since it is rigid and brittle, when **stresses act on the lithosphere,** it breaks.
- This is what we **experience as an earthquake**.

How you experience an EQ?


Not to scale
Crust
Upper mantle
Mantle
Outer Core
Inner Core
To scale

Mantle:

- Mantle is made of mainly **semi molten solid rock**, and it is hot.
- Made of **ultramafic rock peridotite**, which is made of the iron- and magnesium-rich silicate minerals.
- **Extremely hot** because of the heat flowing outward from it and because of its physical properties.
- **Convection currents** within Earth's mantle, form as material near the core heats up.

What is convection current within the Earth's Mantle?

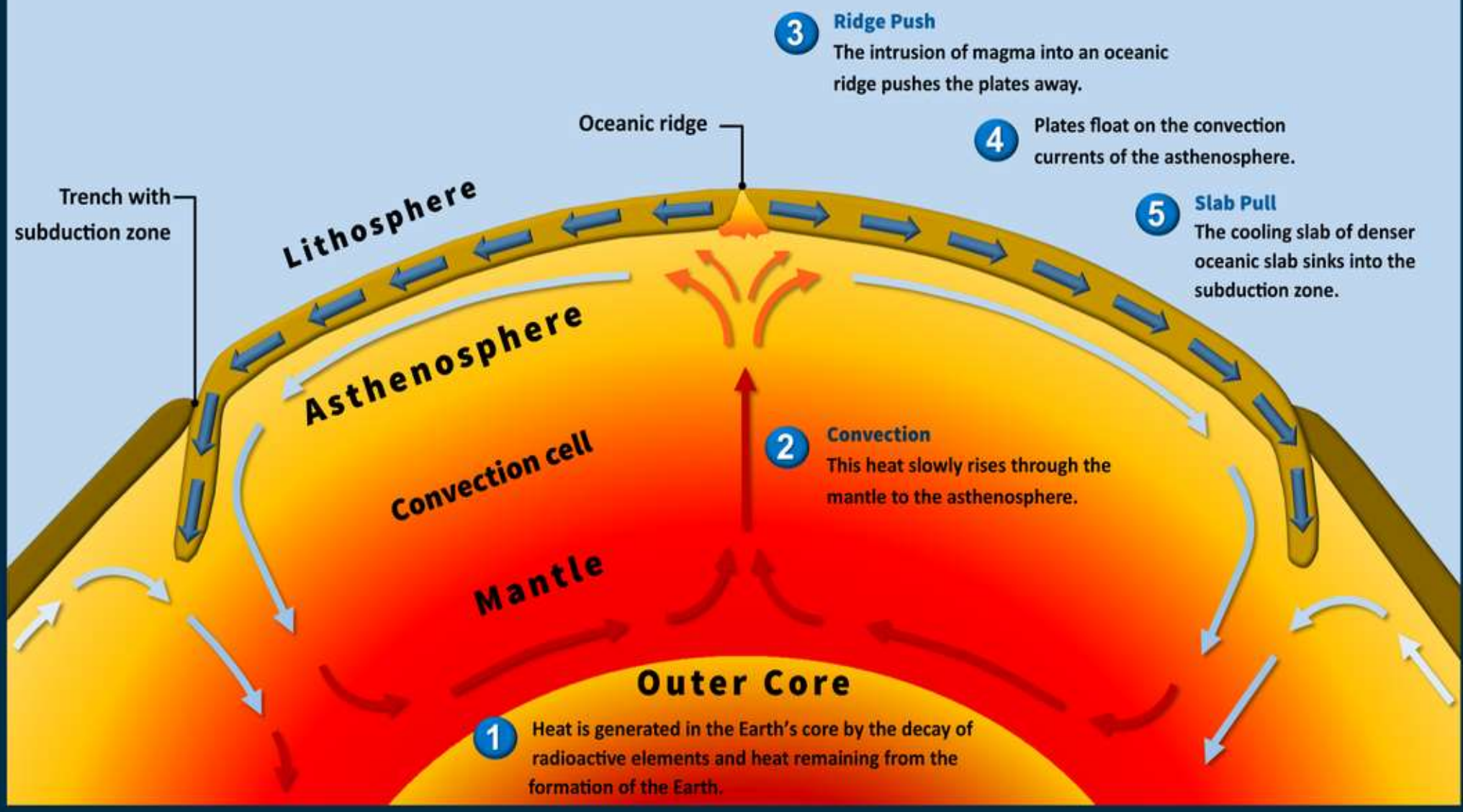
- **Heat Transfer:**
  - -Conduction
  - -Convection
  - -Radiation

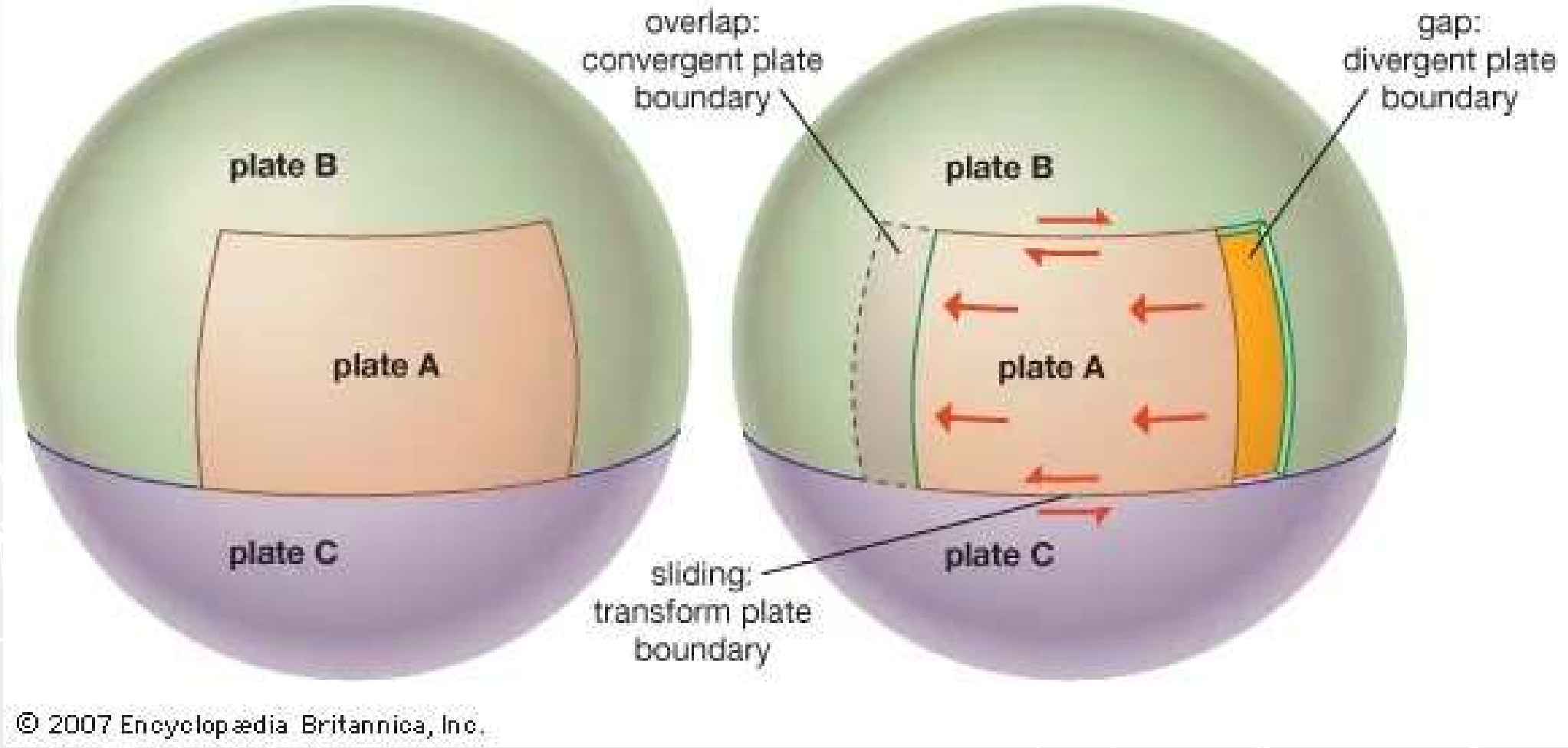
- Heat in the mantle **comes from the Earth's molten outer core.**
- Heat warms the **base of the mantle** to an estimated 4000°C.
- At the **mantle-crust boundary**. the mantle's temperature is an estimated 200°C.

- **For heat transfer, convection occurs** in the mantle.
- Relatively **cooler rock from higher in the mantle slowly sinks** toward the mantle.
- As the warmer material rises, it also cools, eventually pushed aside by warmer rising material and **sinking back toward the core.**
- **Mantle material flows slowly.**

Convection Currents

Scientists believe that tectonic plates move because of convection currents that flow up from the core of the Earth and circulate under the asthenosphere.

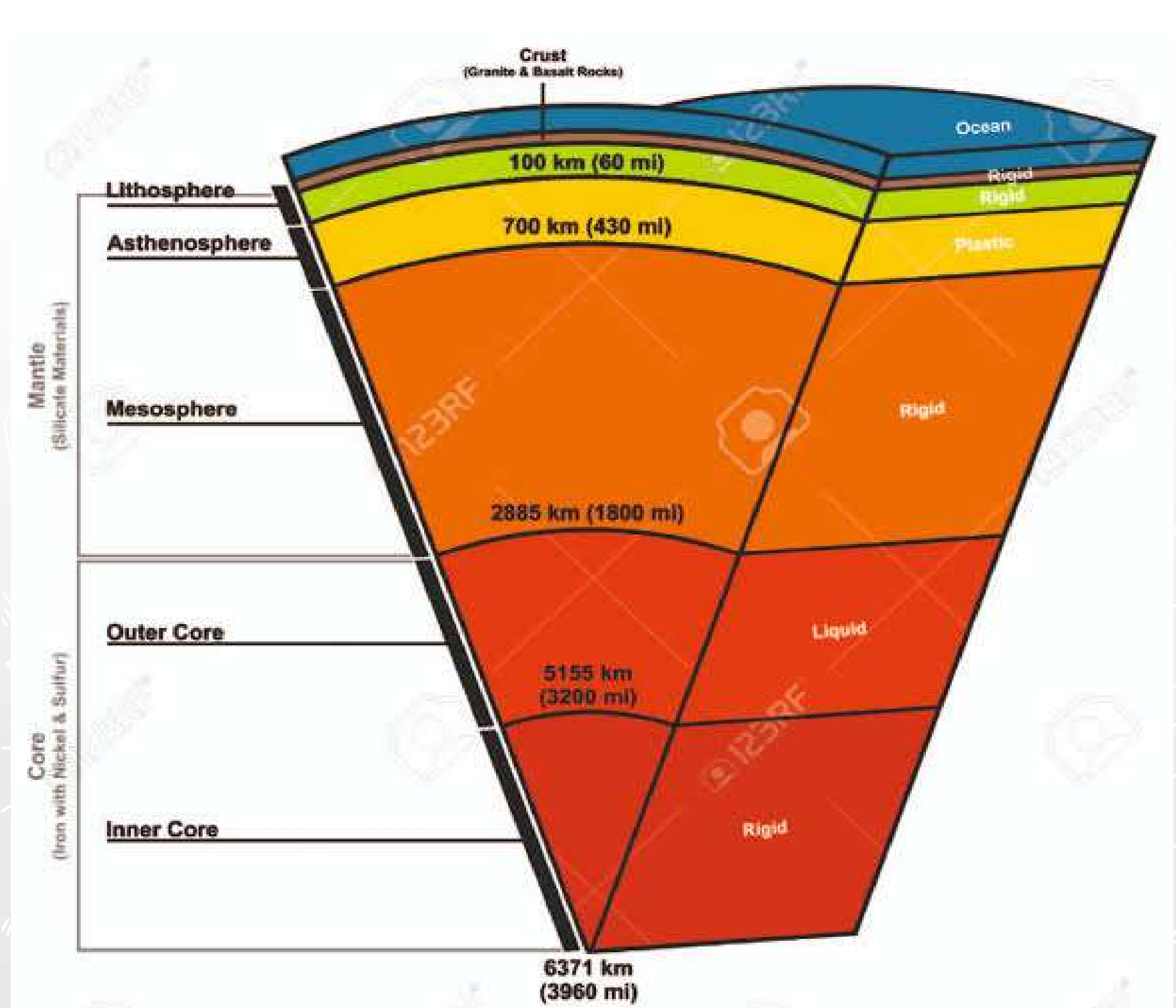




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Core: 31% of Earth's mass

- At the **planet's center lies** a dense metallic core.
- **Outer core** is liquid **(2700km)** and the inner core (1500km) is solid.
- **Outer core** is extremely hot (**4500 – 5500 ºC)**
- **Inner core** temperature is about (5200 ºC) but remain solid due to intense pressure.


Crust
(Granite & Basalt Rocks)
Ocean
100 km (60 mi)
Rigid
Rigid
Lithosphere
700 km (430 mi)
Asthenosphere
Plastic
Mantle
(Silicate Materials)
Mesosphere
Rigid
2885 km (1800 mi)
Outer Core
Liquid
5155 km
(3200 mi)
Core
(Iron with Nickel & Sulfur)
Inner Core
Rigid
6371 km
(3960 mi)

Engineering geology

Definition: Engineering geology is the **application of the geology to engineering study.**

Purpose:

To assure that the **geological factors** regarding the **location**, **design, construction**, **operation** and **maintenance of engineering works** are **recognized** and **accounted for**.

Engineering geologist's work

Engineering geologists provide **geological and geotechnical recommendations,** works include:

- **Geological hazard** assessments,
- **Geotechnical** assessment,
- **Material** properties,
- **Landslide**, and **slope** stability,
- **Erosion**,
- **Flooding**,
- **Dewatering** and
- **Seismic investigations**, etc

Environmental Geology

Definition: Environmental geology is the **geology applied to livings**.

What is Environment?

- Environment is the **sum of all** the features and conditions surrounding an organism that may influence it.

- Physical Environment encompasses **rocks** and **soils**, **air** and **water**, **light** and **temperature**, and **other organisms**.

- **Social environment** might include a network of family and friends, a particular political system, and a set of social customs that affect one's behavior.

Why study Geology?

- Geology is the **study of the earth**, and **earth provides the basic physical environment** in which we live.
- To know the **way** the **earth works**.
- To know **how and why** of **natural phenomenon happens.**
- To **solve the different environmental and engineering problems** facing on the earth's surface and decisions to be taken.

Thanks