

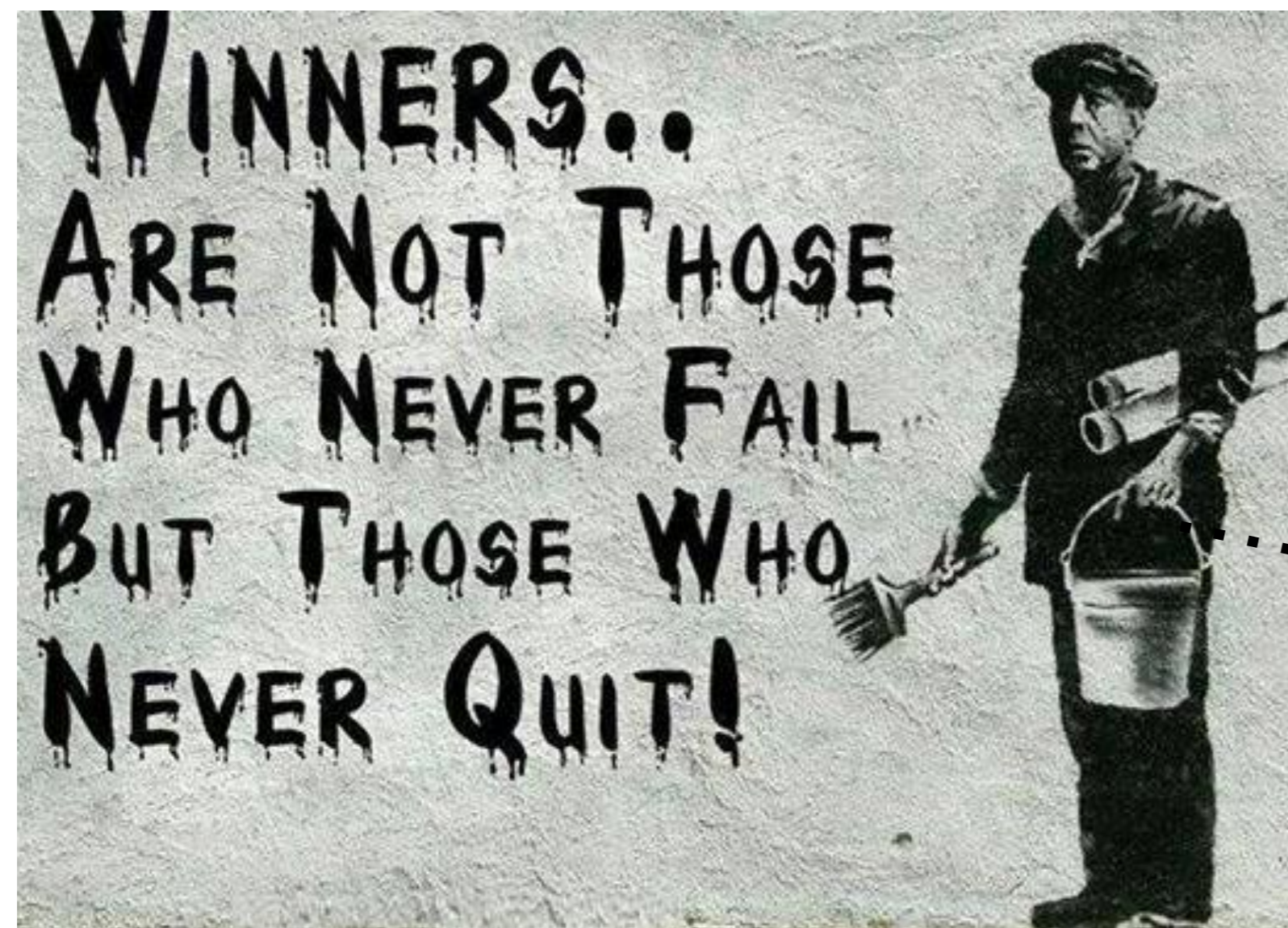
Introduction to Earth Science, Earth's Structure and Plate Tectonics

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GEOLOGY DEPARTMENT**

Presentation Outline

1. Introduction to Earth Science
 2. Earth's Structure and Plate Tectonics
-

1. INTRODUCTION TO EARTH SCIENCE



.....and thus,.....

The Secret of
Success:
Stop Wishing,
Start Doing.

Earth Science

- **Encompasses all sciences** that seek to understand:
 - Earth
 - Earth's neighbours in space.
 - Includes;
 - **Geology** – study of Earth
 - **Oceanography** – study of oceans
 - **Meteorology** – study of atmosphere & processes that produce weather
 - **Astronomy** – study of universe
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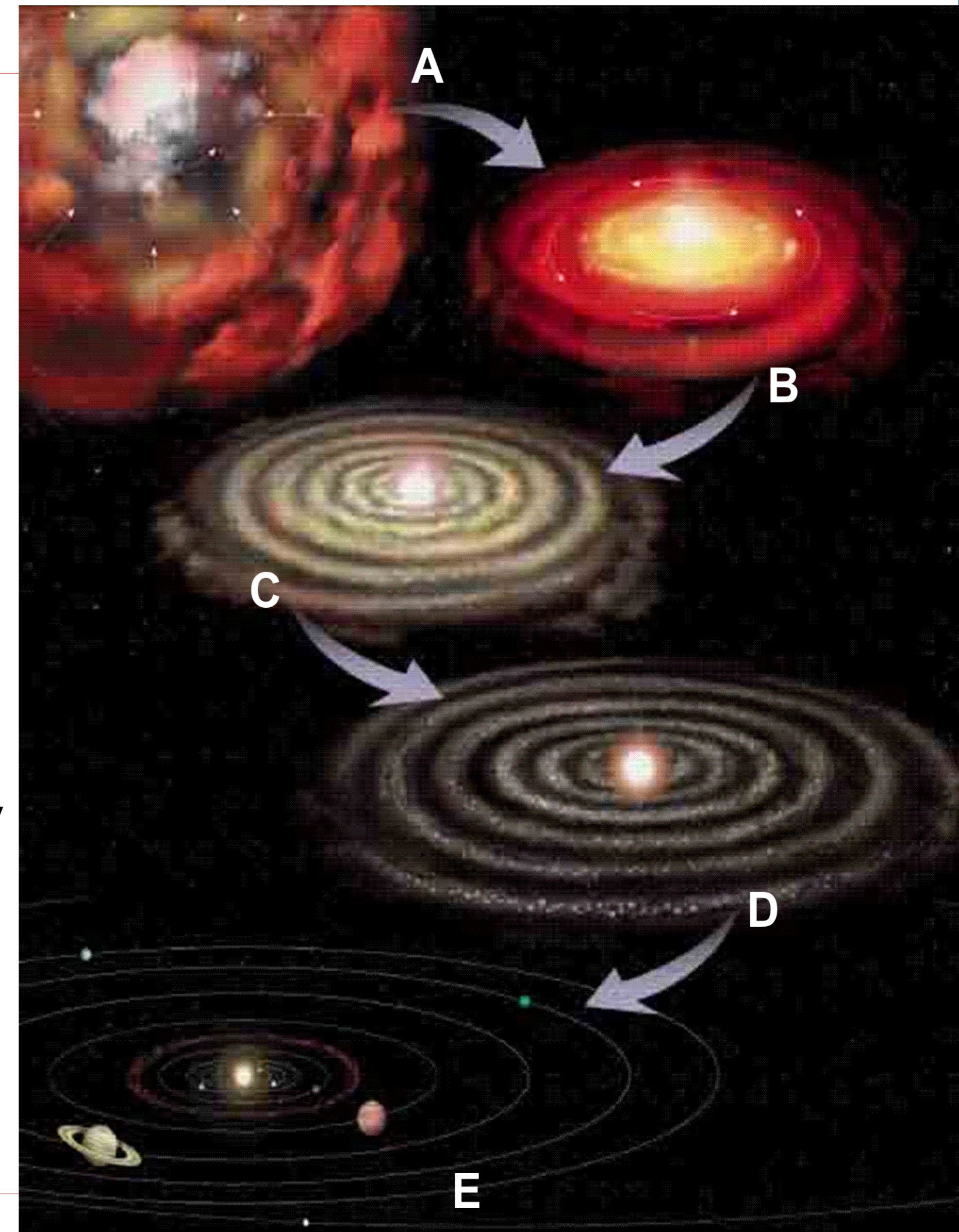
Earth Science....contd.

- In the formation of Earth, most researchers have concluded that
 - earth and other planets formed at essentially same time,
- but.....

Formation of the Earth

....according to **NEBULAR Hypothesis**:

- Solar system evolved from an enormous rotating cloud called **solar nebula** – **composed** mostly of **hydrogen & helium**, and that;
 - About 5 billion years ago, nebula began to contract (**A**)
 - nebula assumed a flat, disk shape (**B**)
 - Inner planets began to form from metallic and rocky clumps (**C & D**).
 - Larger outer planets began forming from fragments with a high percentage of ice (**E**).

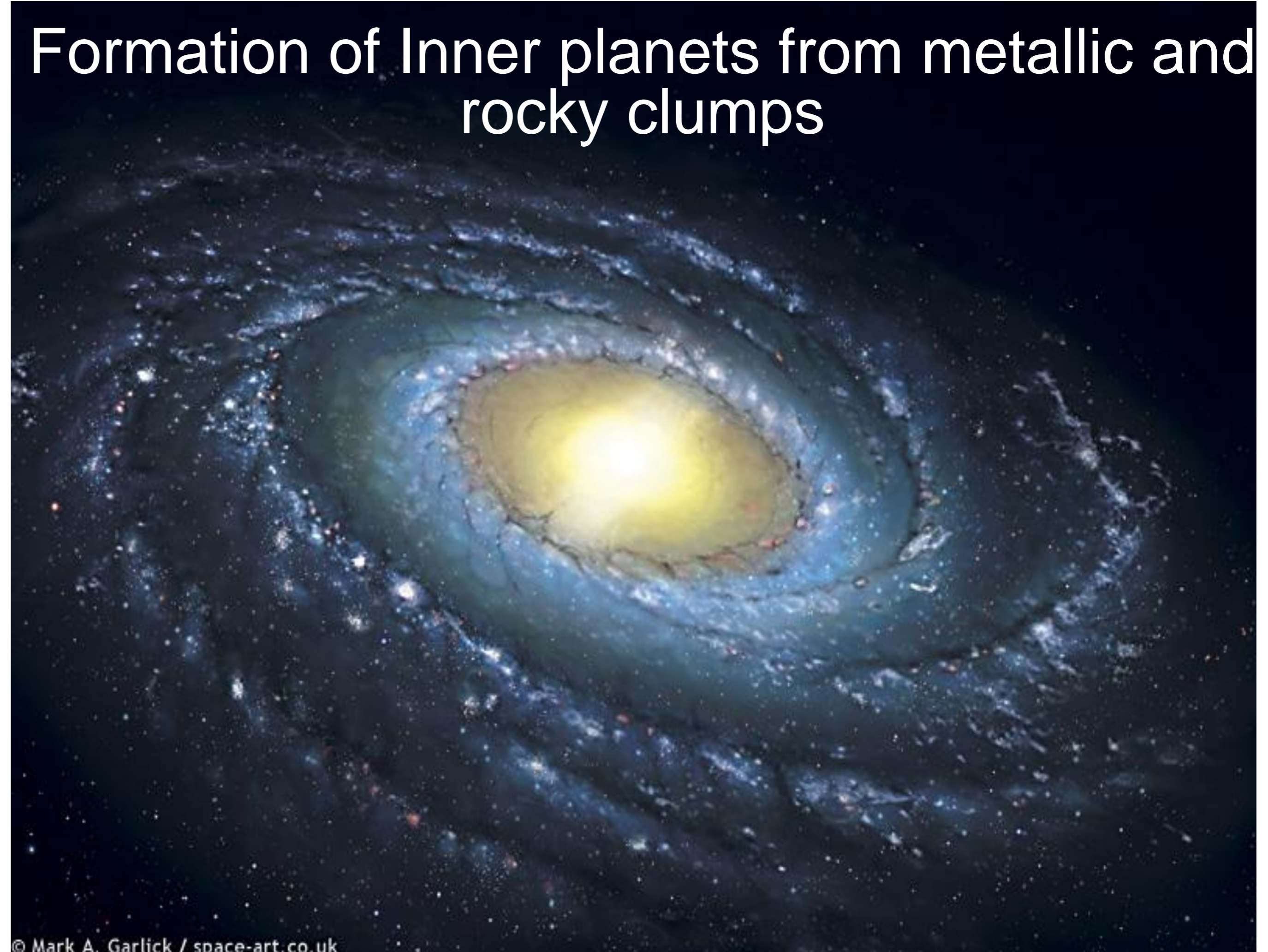


Formation of the Earth.....contd.

Nebula



Formation of Inner planets from metallic and rocky clumps



Formation of Earth Layers

- As **Earth formed**, decay of radioactive elements and heat from high-velocity impacts **caused temperature to increase**, resulting in:
 - **Lighter rocky components floating outward**, toward earth's surface.
 - **Gaseous material escaping from Earth's interior** to produce primitive atmosphere.
-

The Earth's Major Spheres

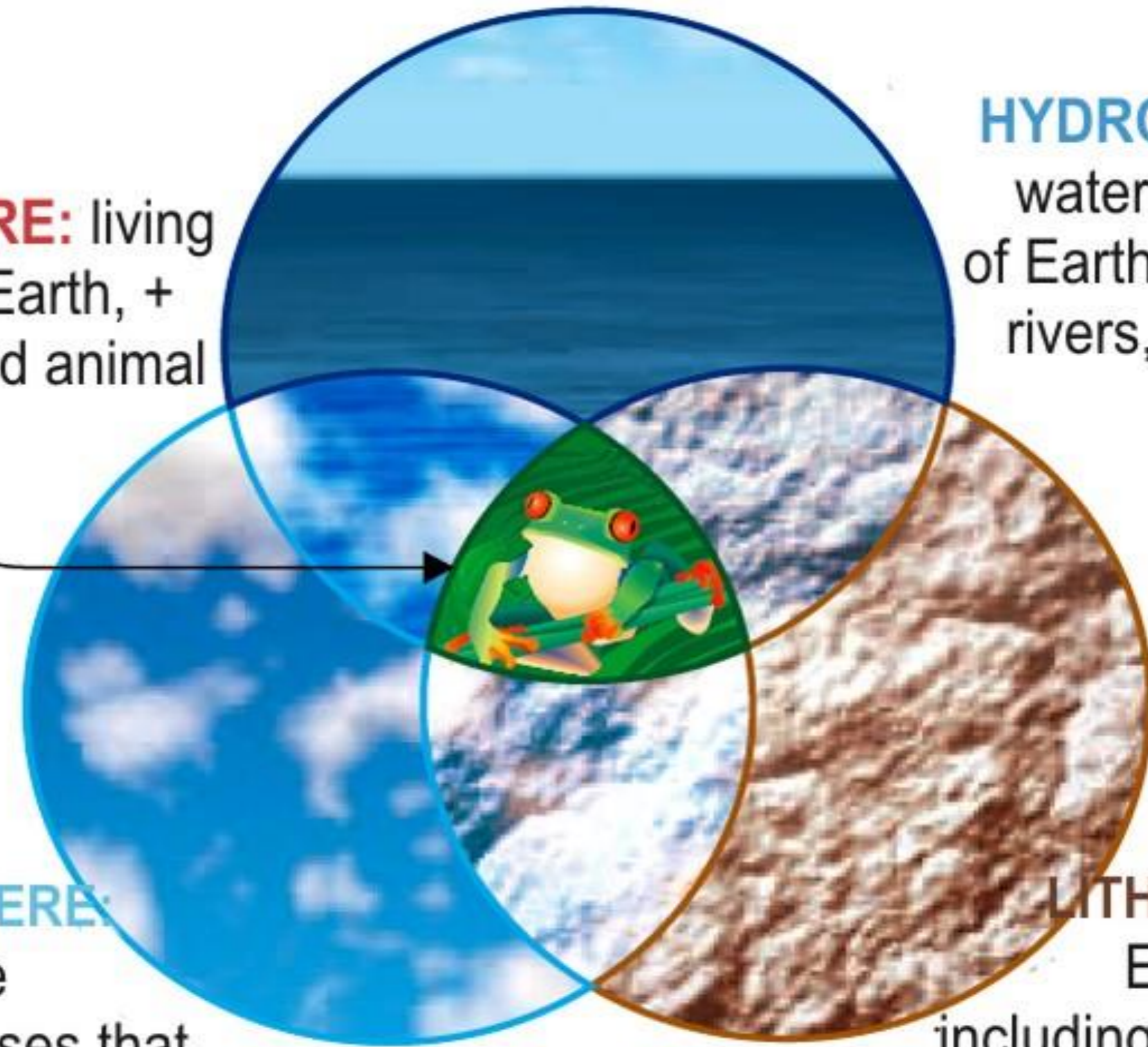
Foregoing process created
FOUR major Earth
Spheres:

BIOSPHERE: living
matter on Earth, +
all plant and animal
life forms

HYDROSPHERE:
water on surface
of Earth in oceans,
rivers, lakes, rain
and mist

ATMOSPHERE:
thin, fragile
layer of gases that
surrounds Earth

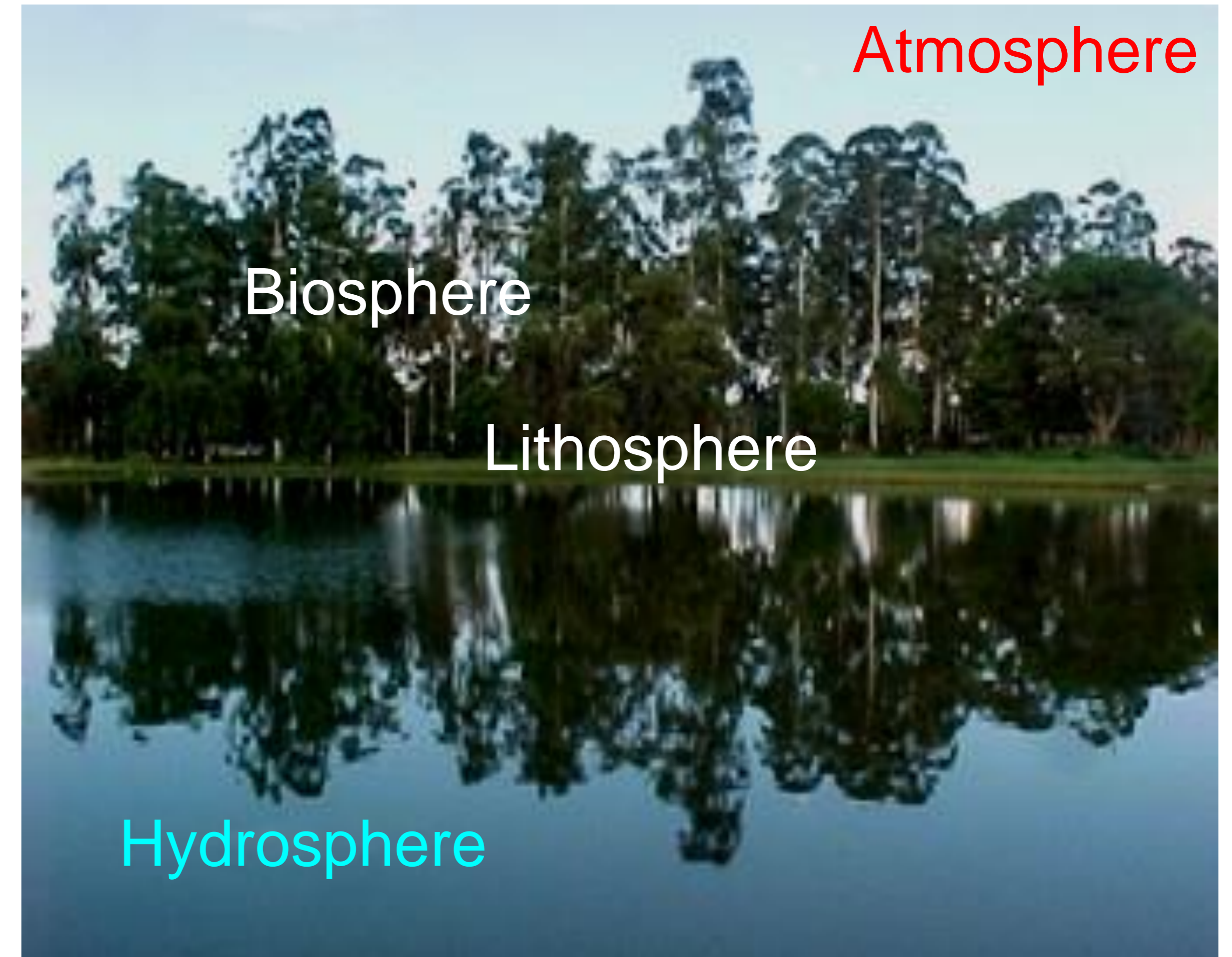
LITHOSPHERE:
Earth's crust
including landforms,
rocks and soils



The Earth's Major Spheres.....contd.

Spheres are closely connected,
such that:

- changes in one sphere often generate chain reactions, and;
- results in changes in others



The Earth's Major Spheres.....contd.

Examples of interactions **between spheres:**

- Deforestation \Rightarrow rain \Rightarrow erosion (*Bio – Hydro – Geo*);
 - Soil loading by erosion in water \Rightarrow increased turbidity (*Geo – Hydro*);
 - Turbidity \Rightarrow impacts water plants/animals (*Hydro – Bio*).
-

Drivers of Earth Systems' Processes

Earth's System's processes are driven by:

- Sun's heat, which propels;
 - ALL Earth's **external processes** – weather, ocean circulation & erosional processes.
 - Heat from Earth's interior, which powers;
 - **Earth's Internal processes**, including volcanoes, earthquakes and mountain building.
-

Drivers of Earth Systems' Processes.....contd.

So, GEOLOGY is the **scientific study** of Earth's Systems Processes, including:

- origin of the Earth
 - materials of which the earth is made
 - processes acting upon the Earth's materials.
 - structure of, and how **Earth's materials, structures, processes + organisms** have changed over time.
-

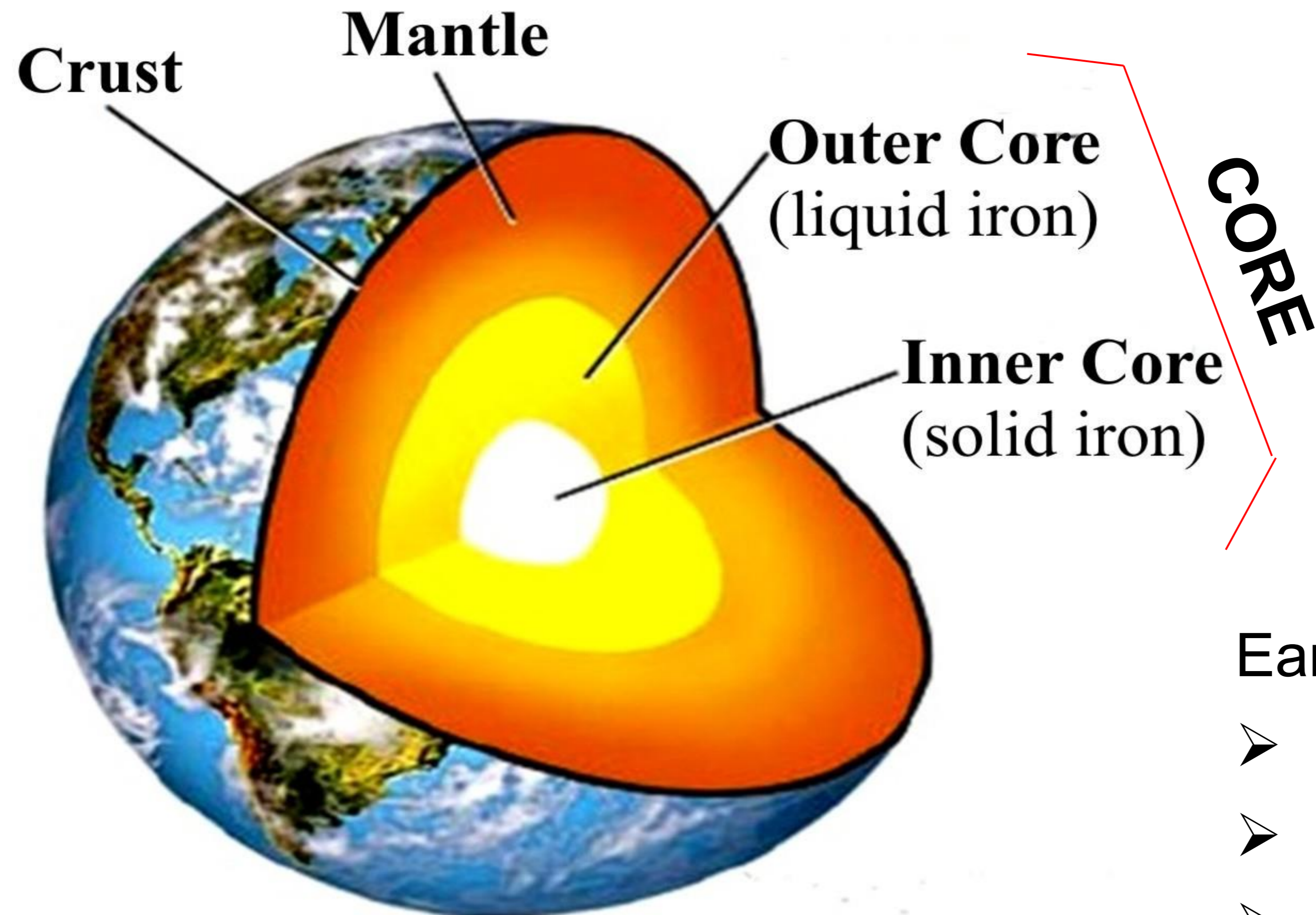
2. EARTH'S STRUCTURE AND PLATE TECTONICS

Every
thought
we think
is creating
our future.
— LOUISE HAY

**So, what other people think of you
must be none of your business.**

2.1 Earth's Structure

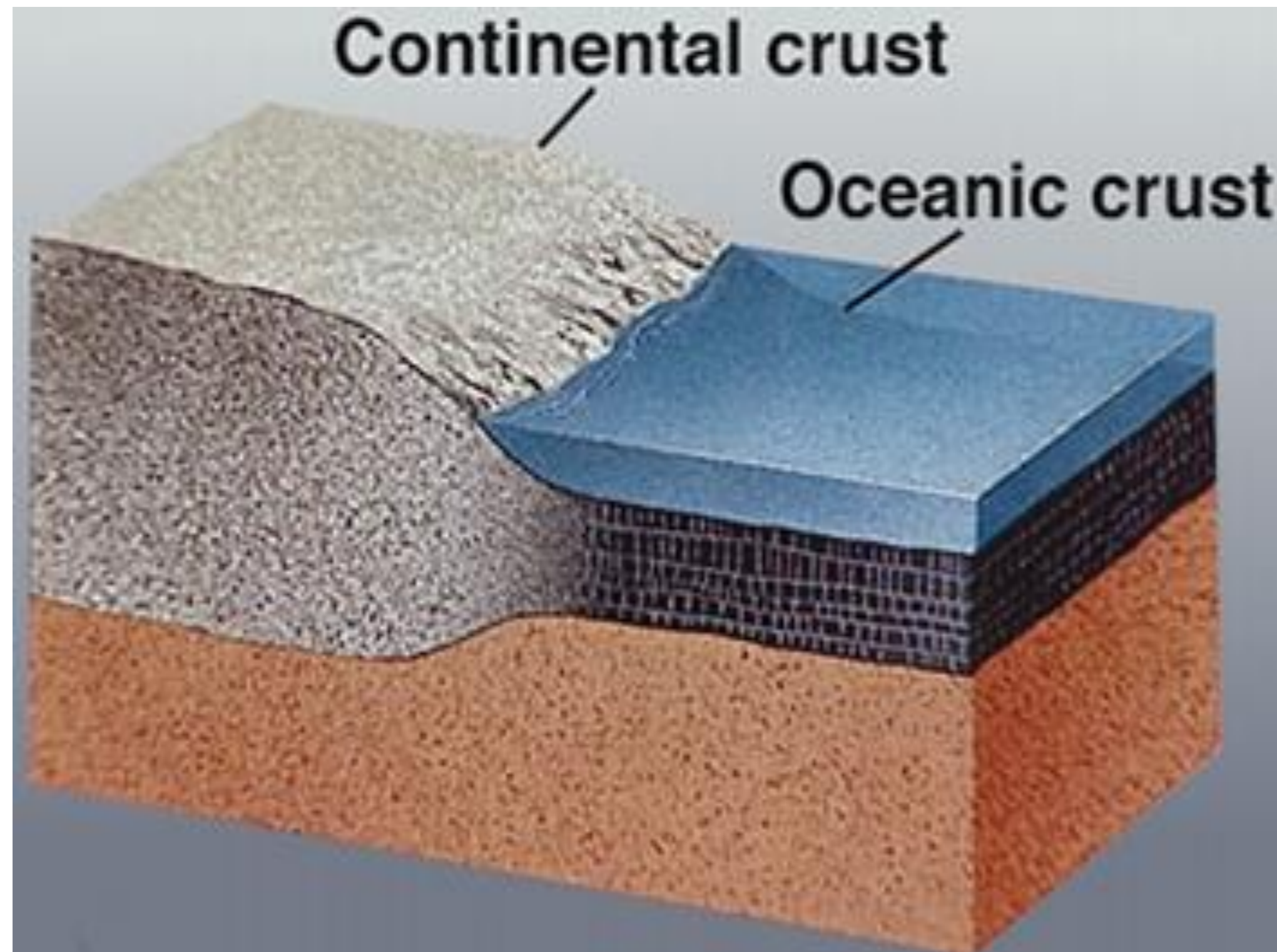
Earth is divided into **3 MAIN** layers:



Earth's layers are similar to an egg's.....

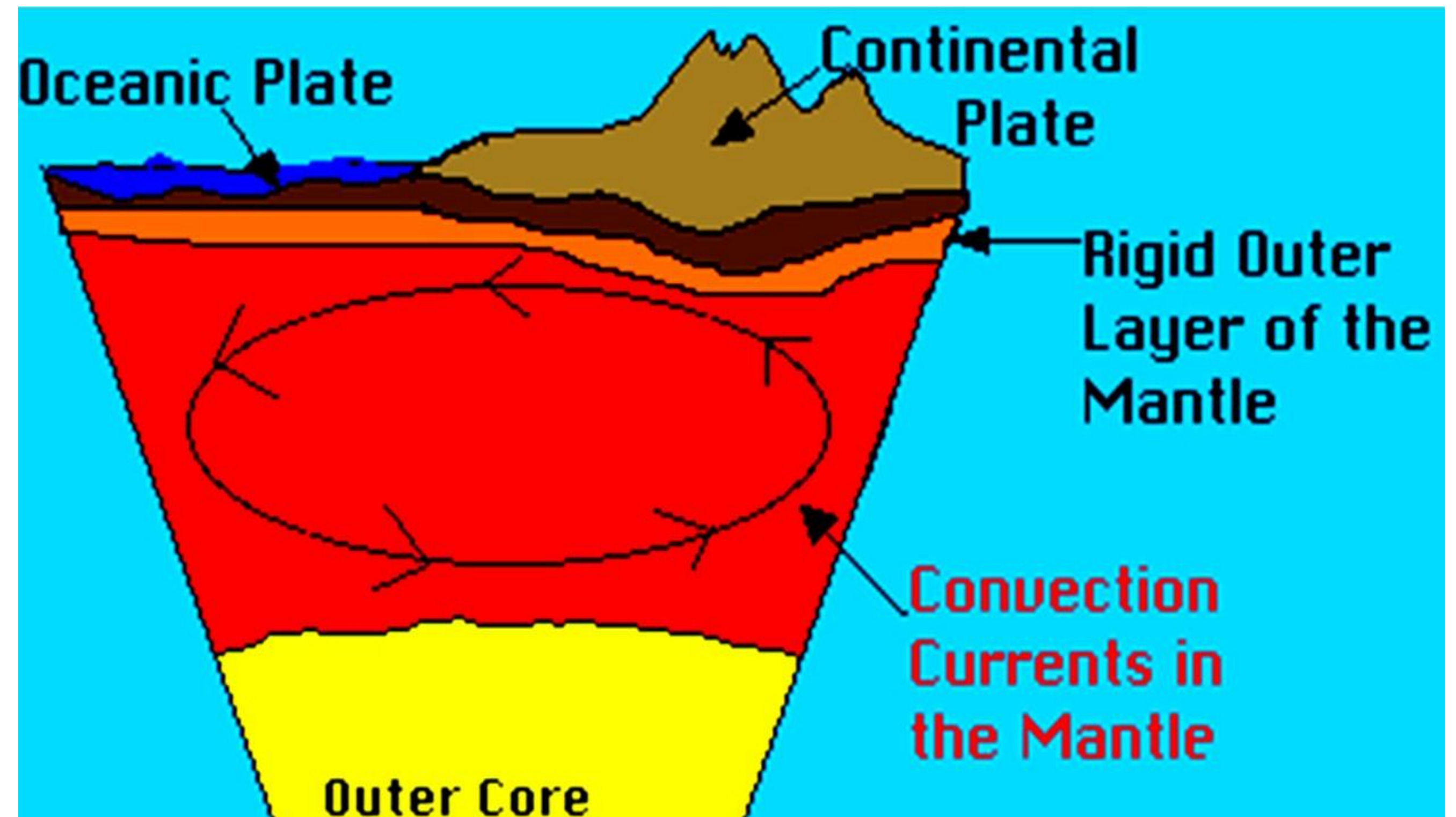
- Shell → CRUST
- Egg white → MANTLE
- Yolk → CORE

2.1 Earth's Structure.....contd.



Crust:

- The lightest of three layers
- extends 5-8 km beneath oceans, & 20-70 km beneath continents.

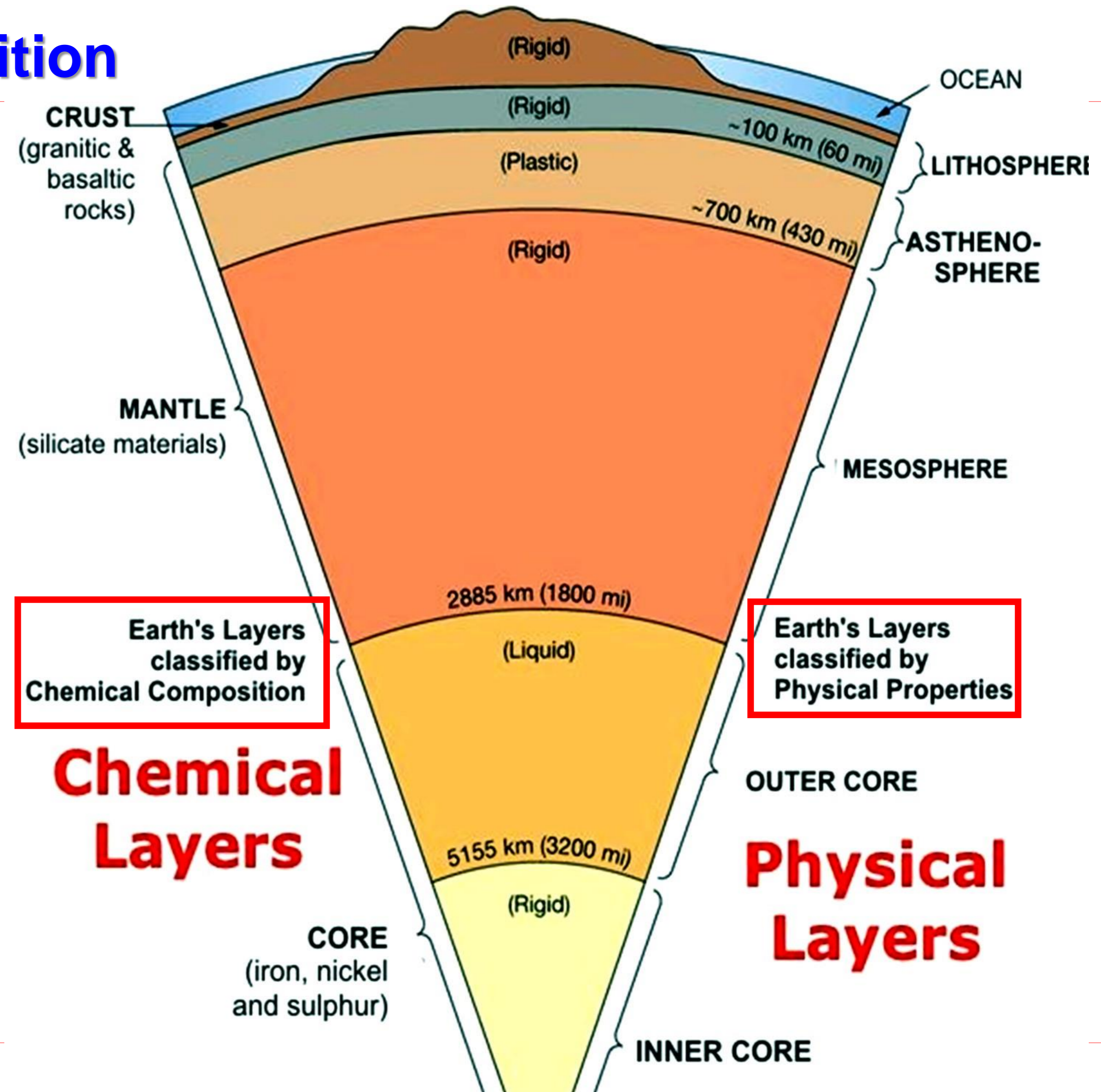


Mantle:

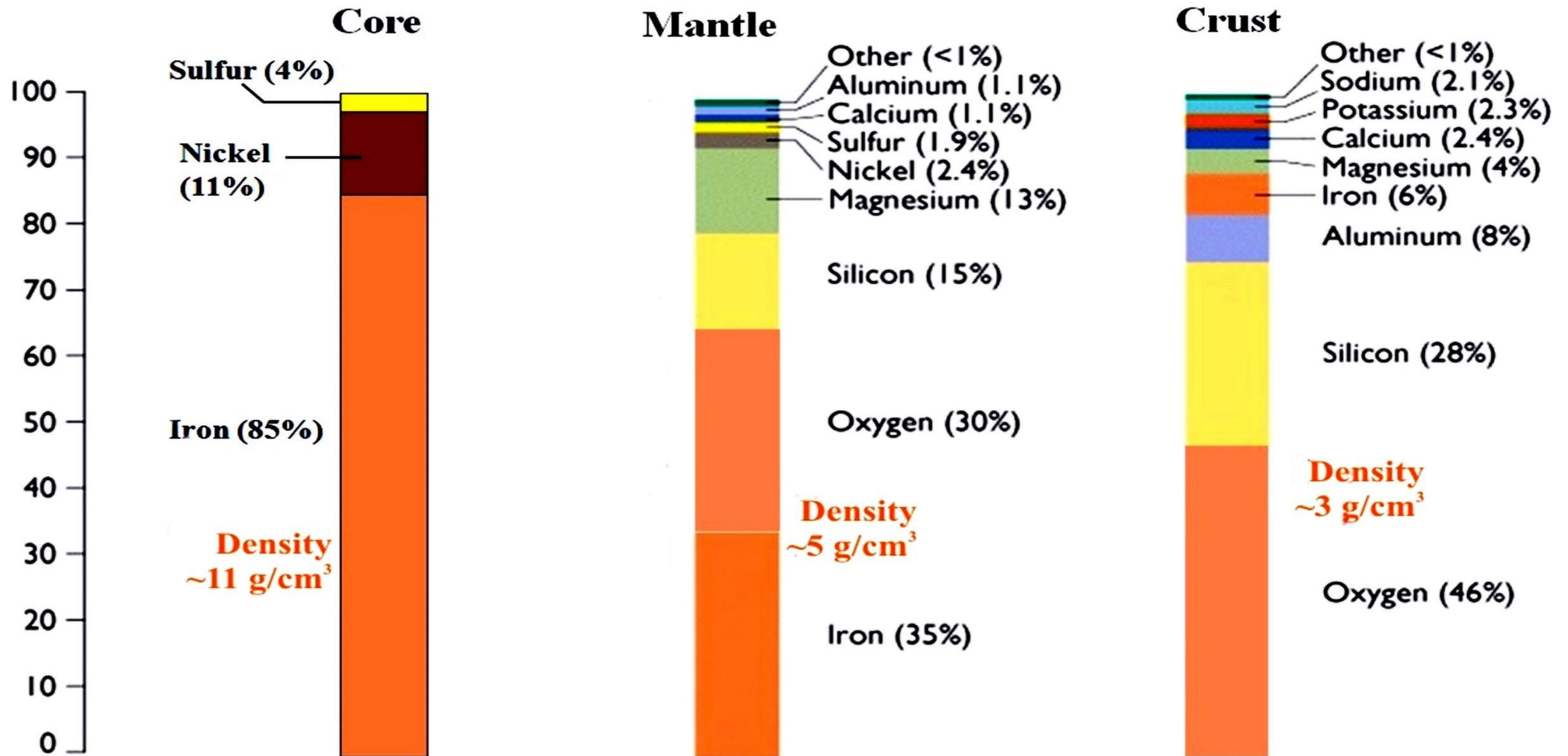
- Layer above Core
- is nearly 2900 km thick
- has convection currents.....

2.1 Earth's Structure – Composition

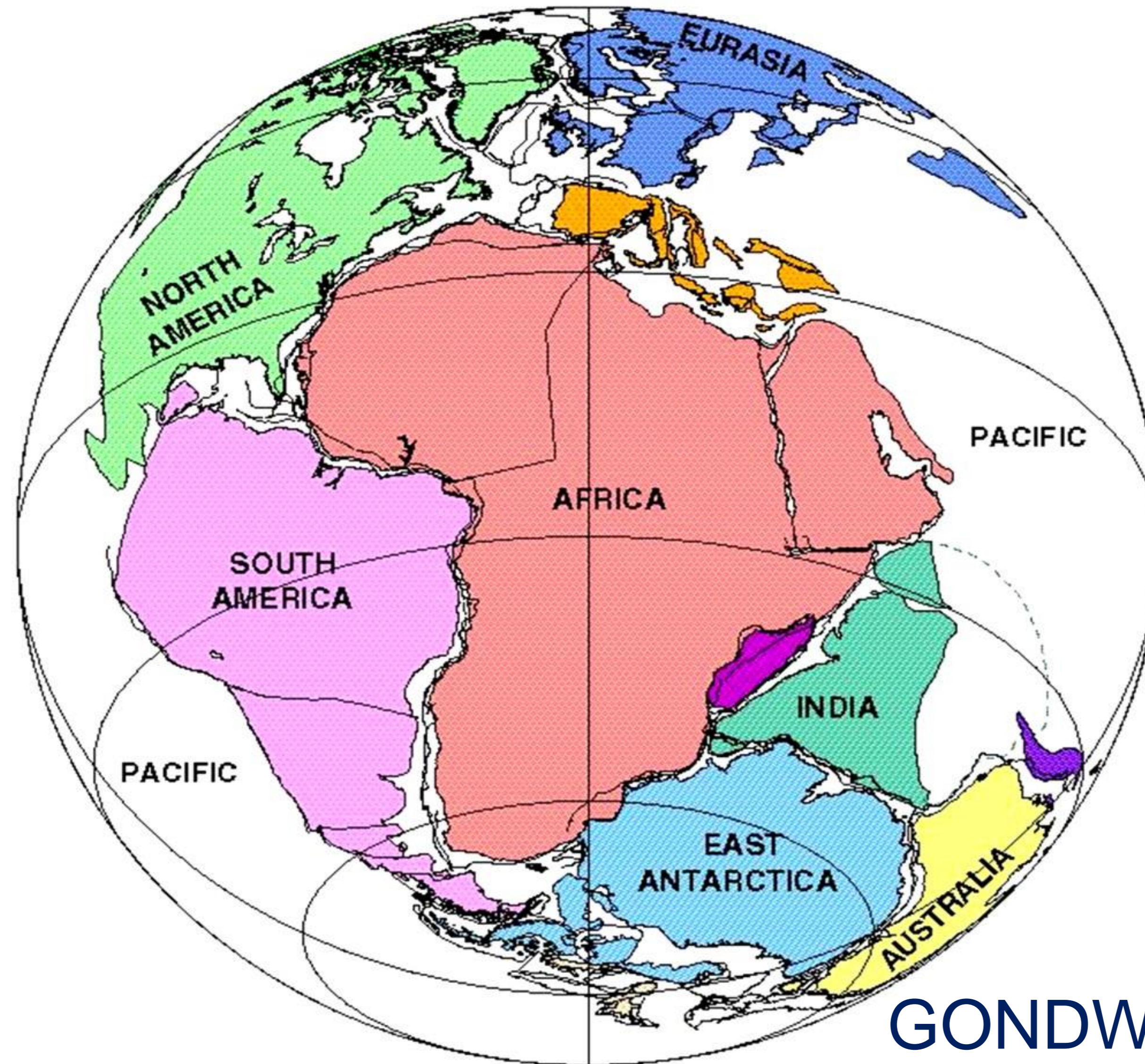
Earth consists of a series of concentric layers, which differ in **CHEMICAL** & **PHYSICAL** Properties:



2.1 Earth's Structure – Composition....contd.



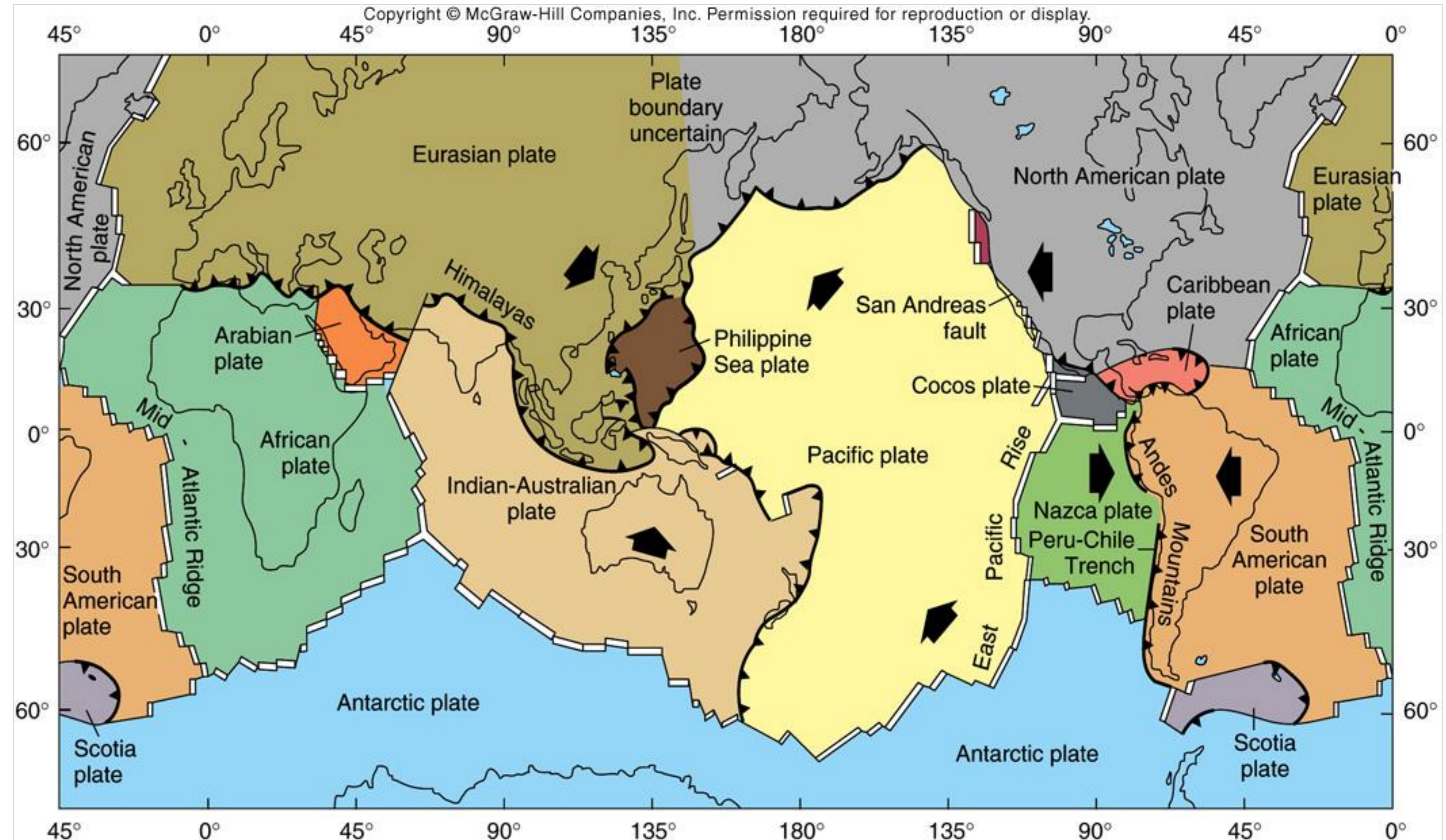
2.2 Plate Tectonics



GONDWANA – Super Continent

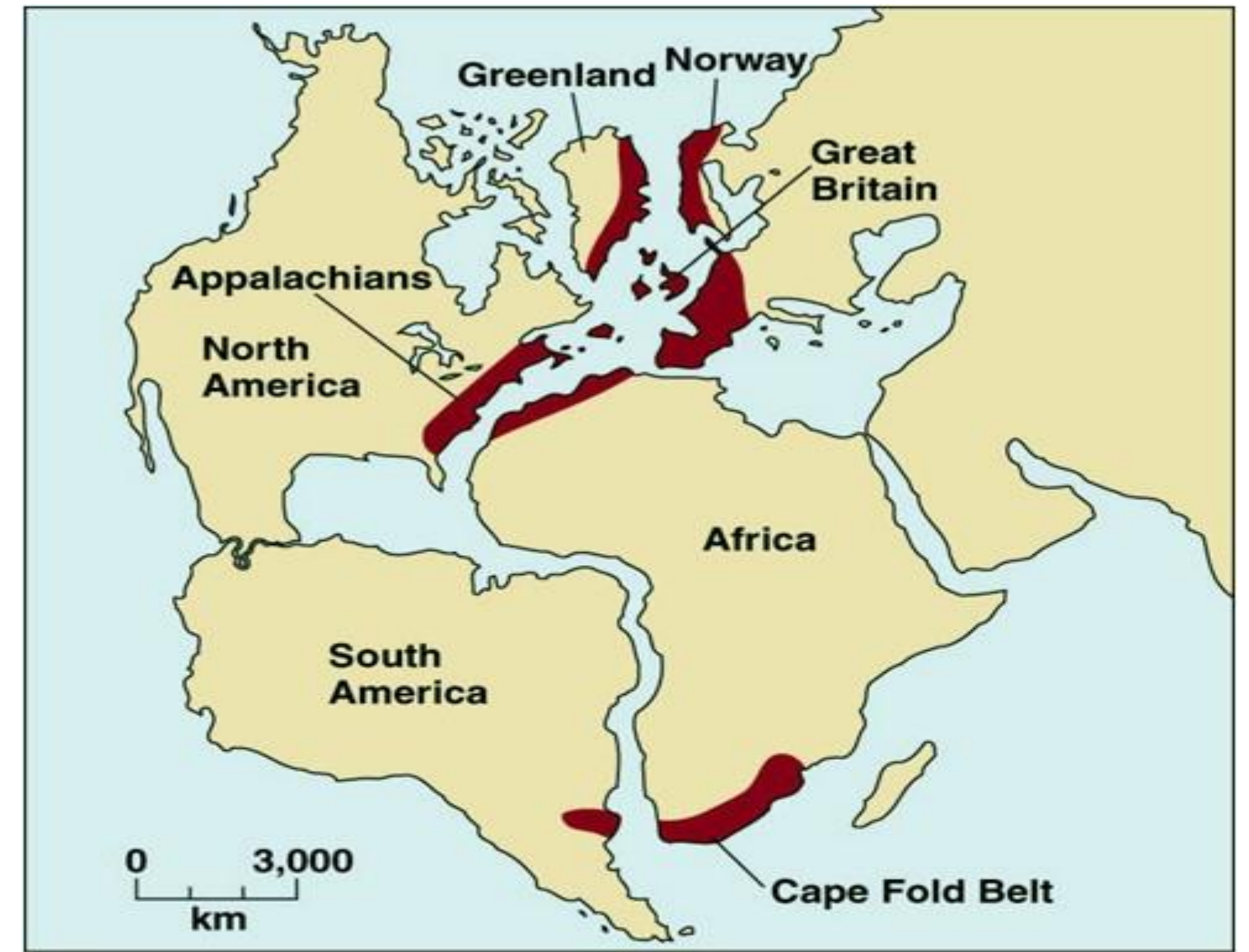
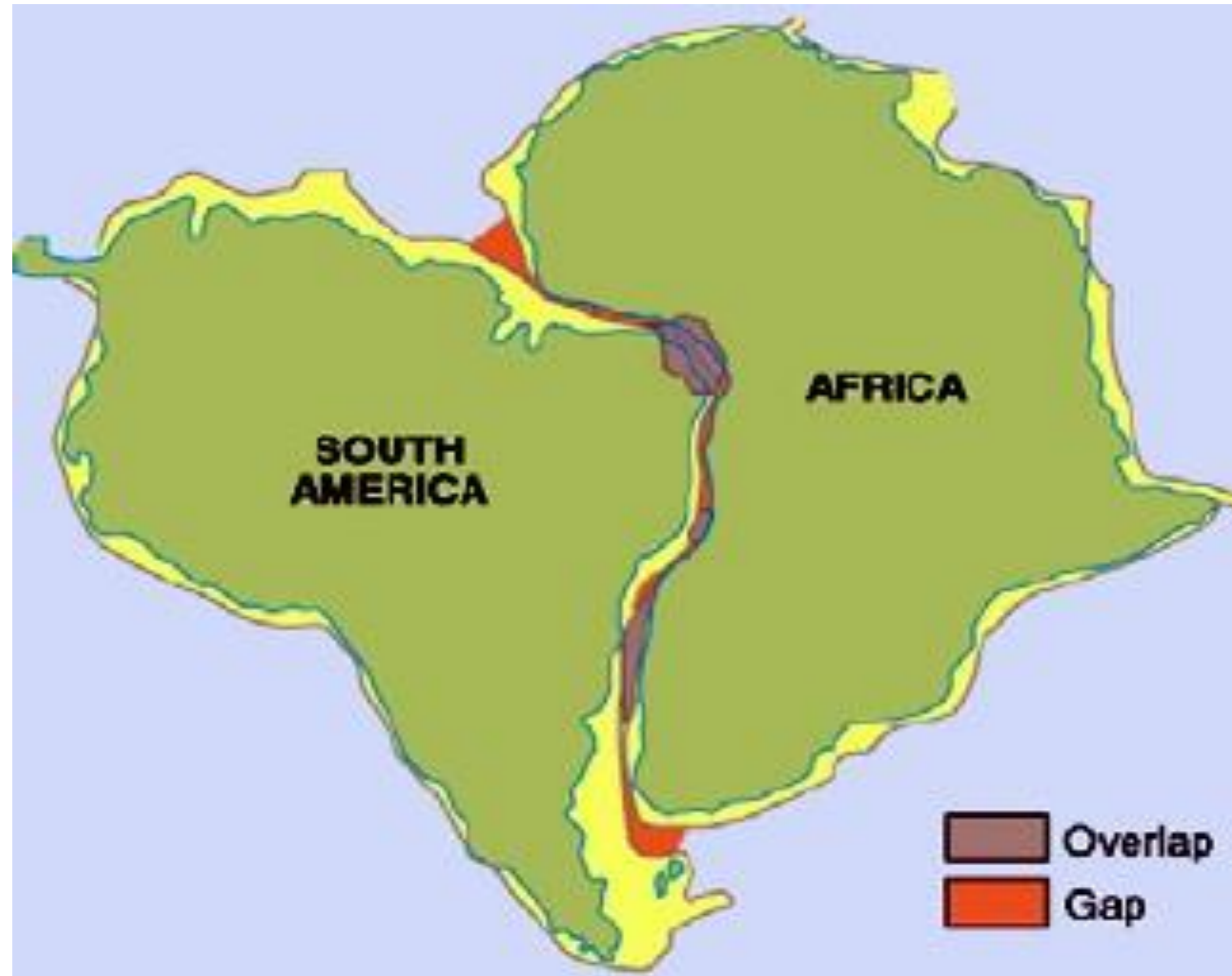
2.2 Plate Tectonics.....contd.

Gondwana
break-up
resulted in
several large
plates in Earth's
crust that now fit
together like a
jigsaw puzzle.



2.2.1 Evidence for Gondwana's Break-up

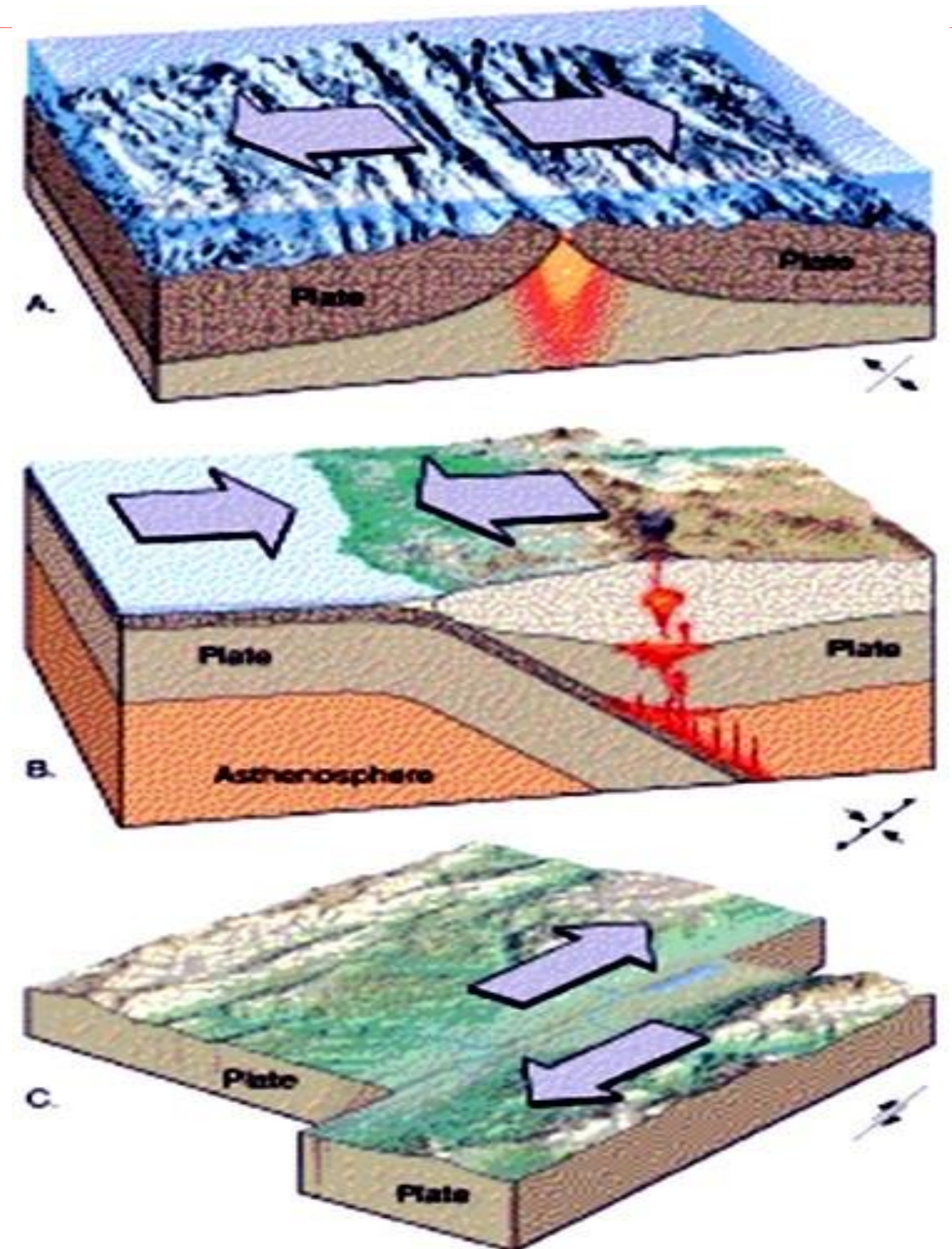
Evidence for:



2.2.2 Tectonic Plate Boundaries

There are 3 major types of plate boundaries:

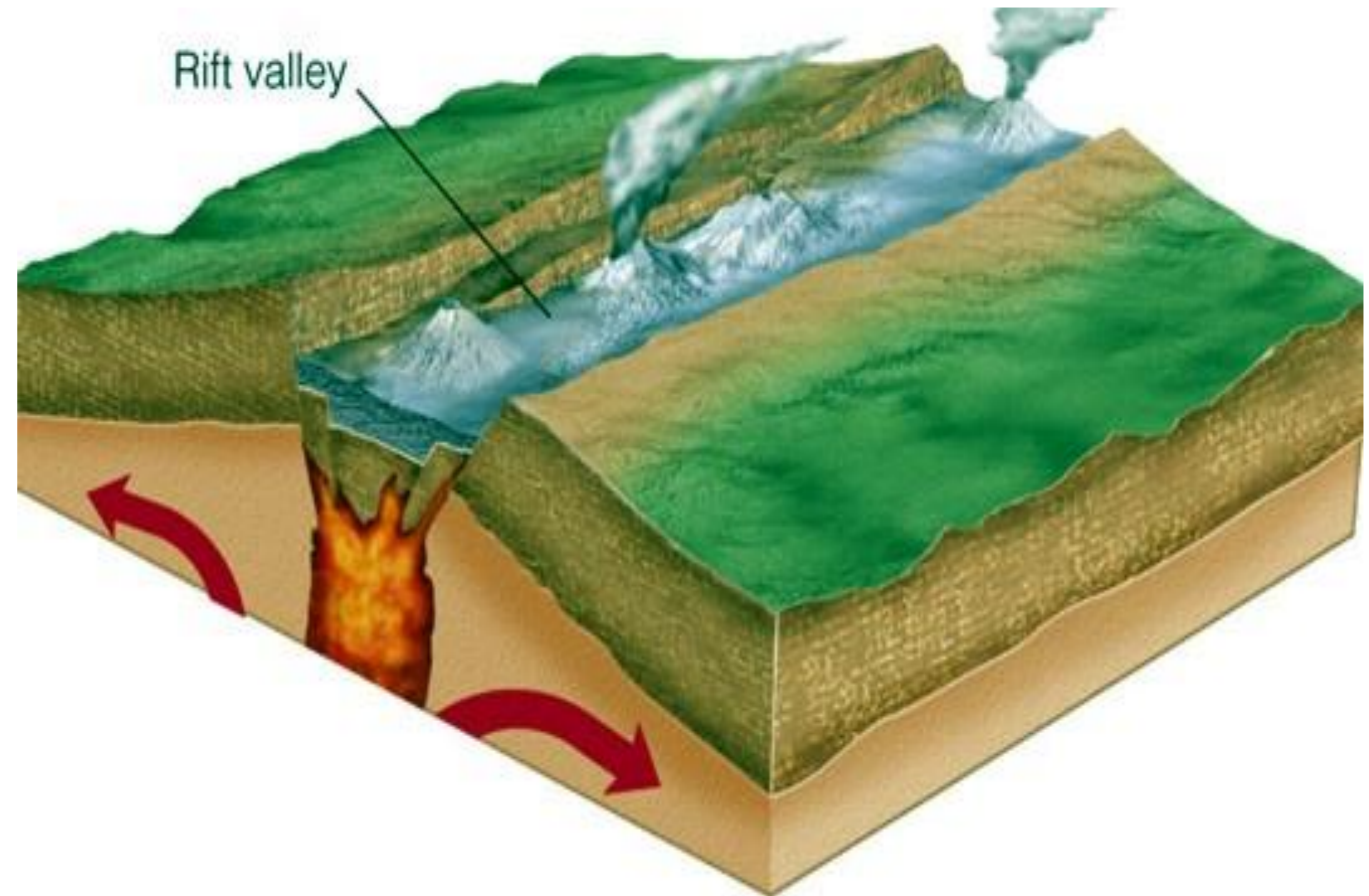
- 1. Divergent** – plates move away from each other (tension)
- 2. Convergent** – plates move towards each other (compression)
- 3. Transform** – plates grind horizontally against one another (strike-slip motion)



2.2.2.1 Divergent (Extensional) Boundaries

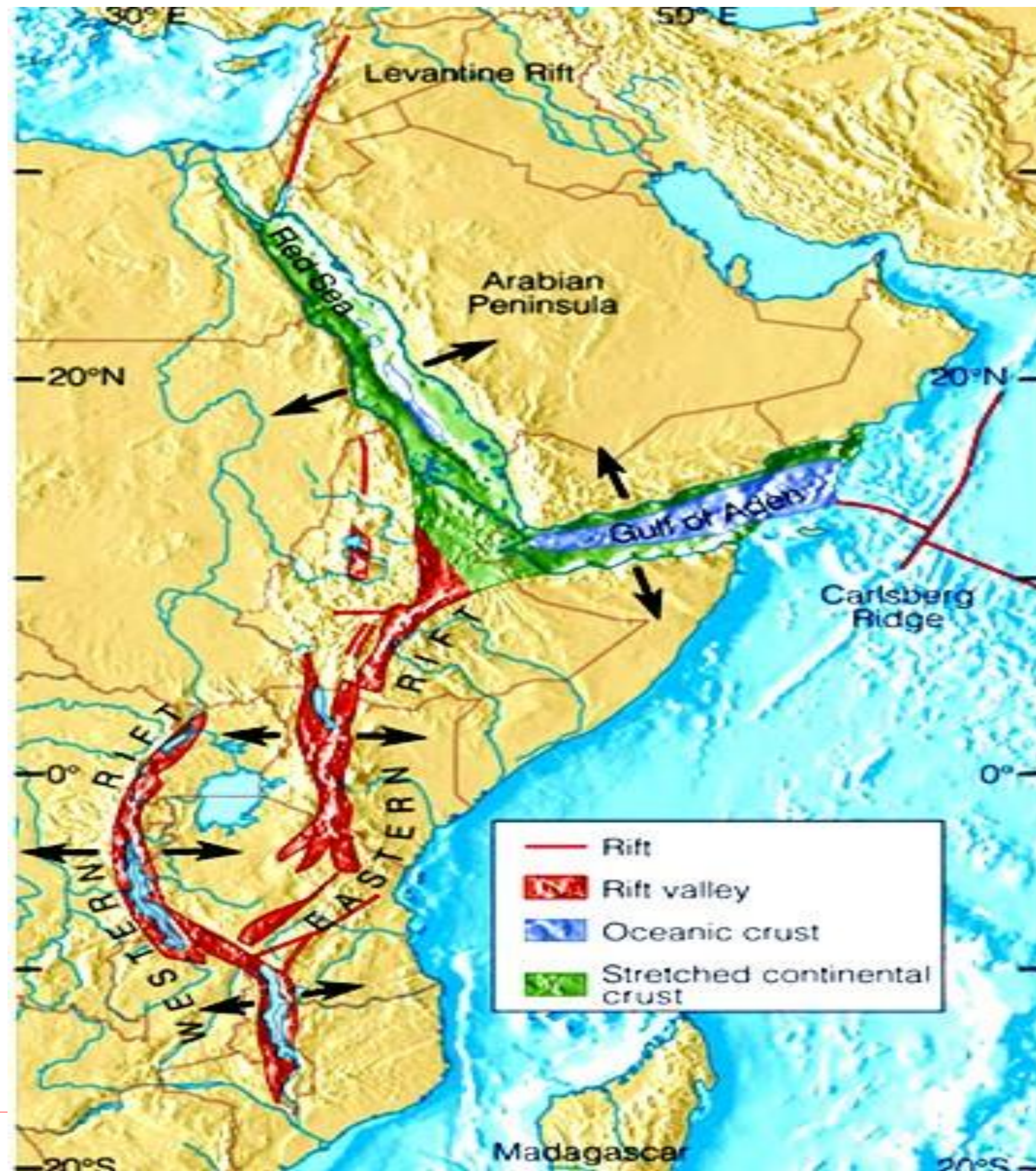
Resulted in formation of such features as Rift Valleys, where:

- magma typically intrudes into the fractures & flows onto valley floor.....

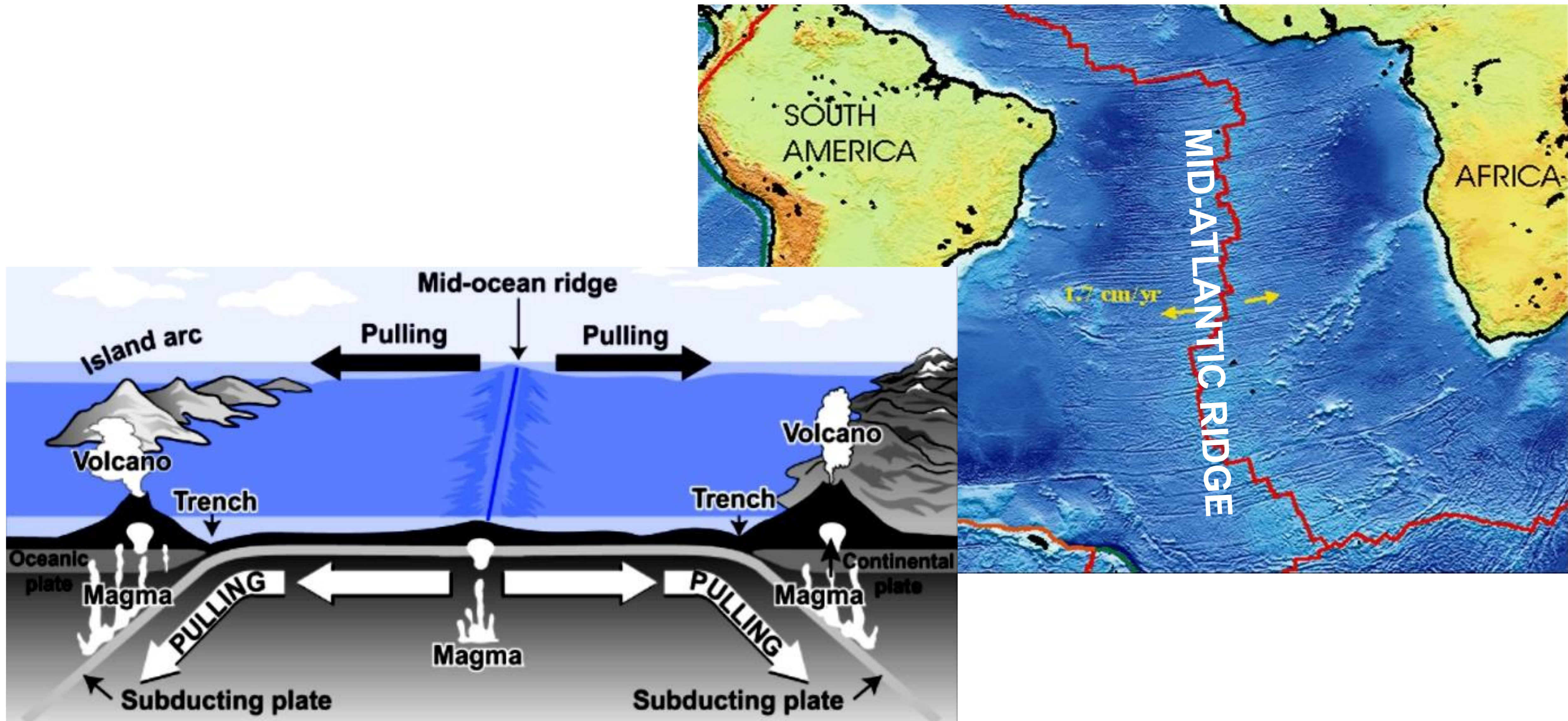


2.2.2.1 Divergent (Extensional) Boundaries.....contd.

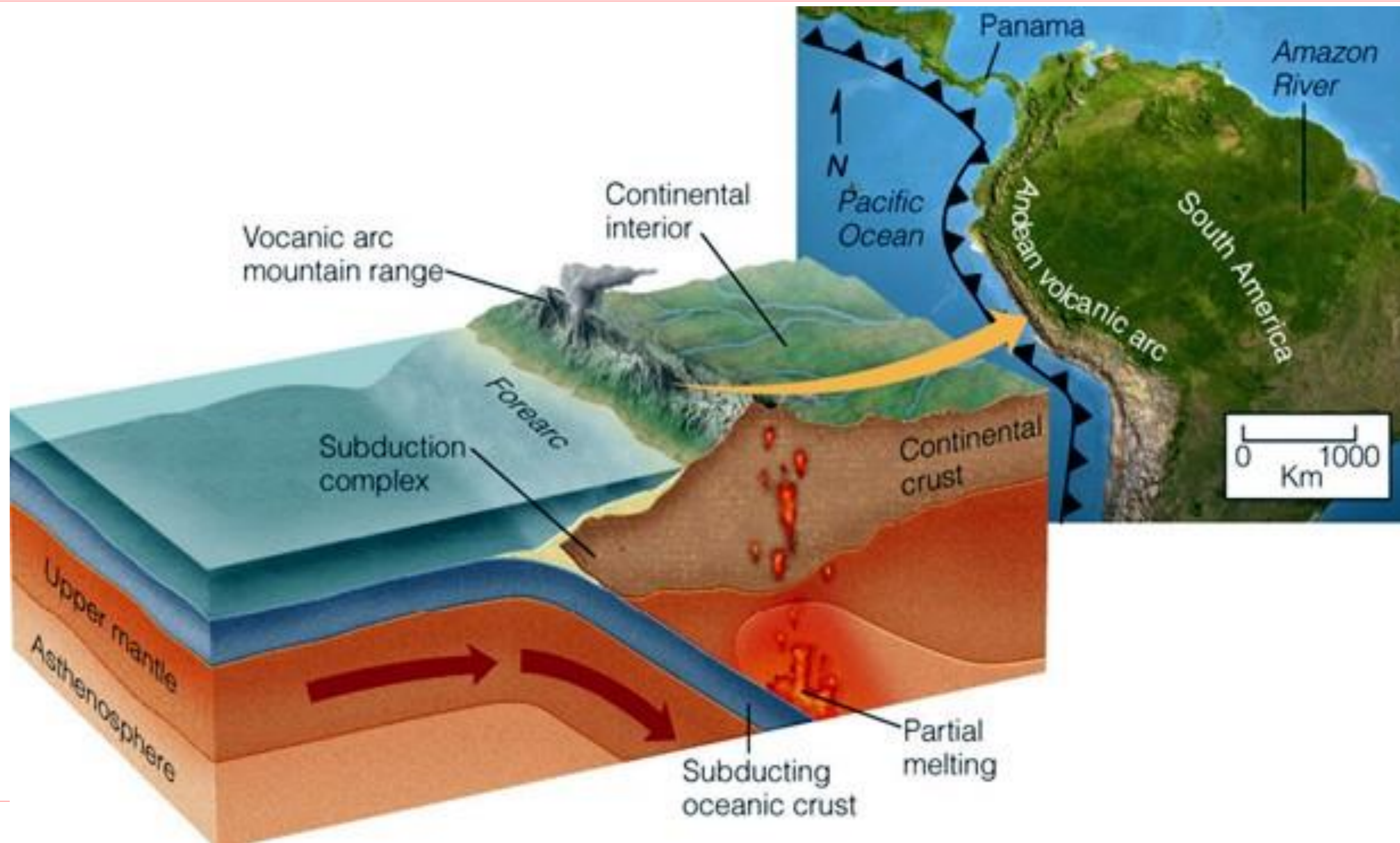
An example of rift valley is the East African Rift Valley



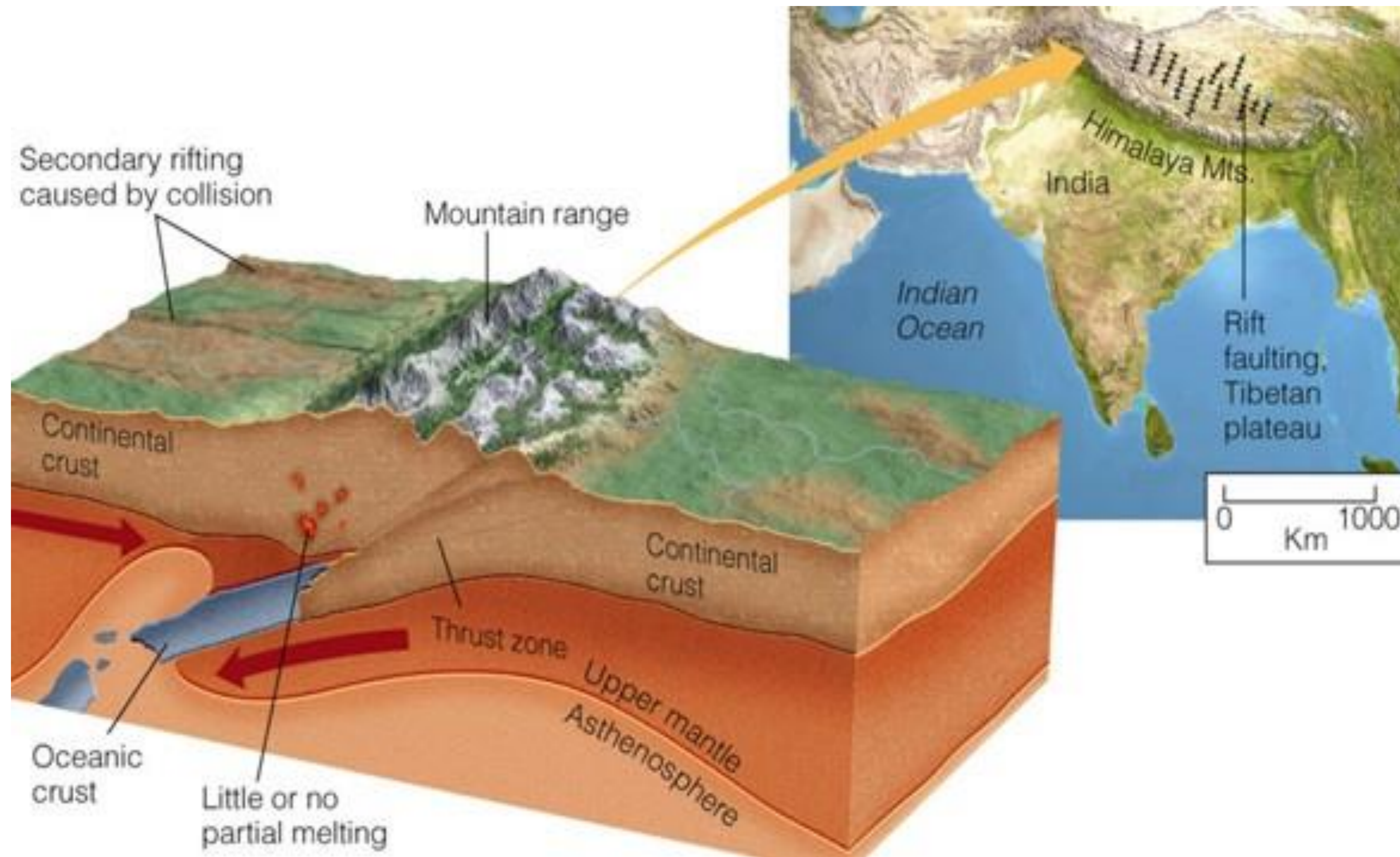
2.2.2.1 Divergent (Extensional) Boundaries.....contd.



2.2.2.2 Convergent (Compressional) Boundaries

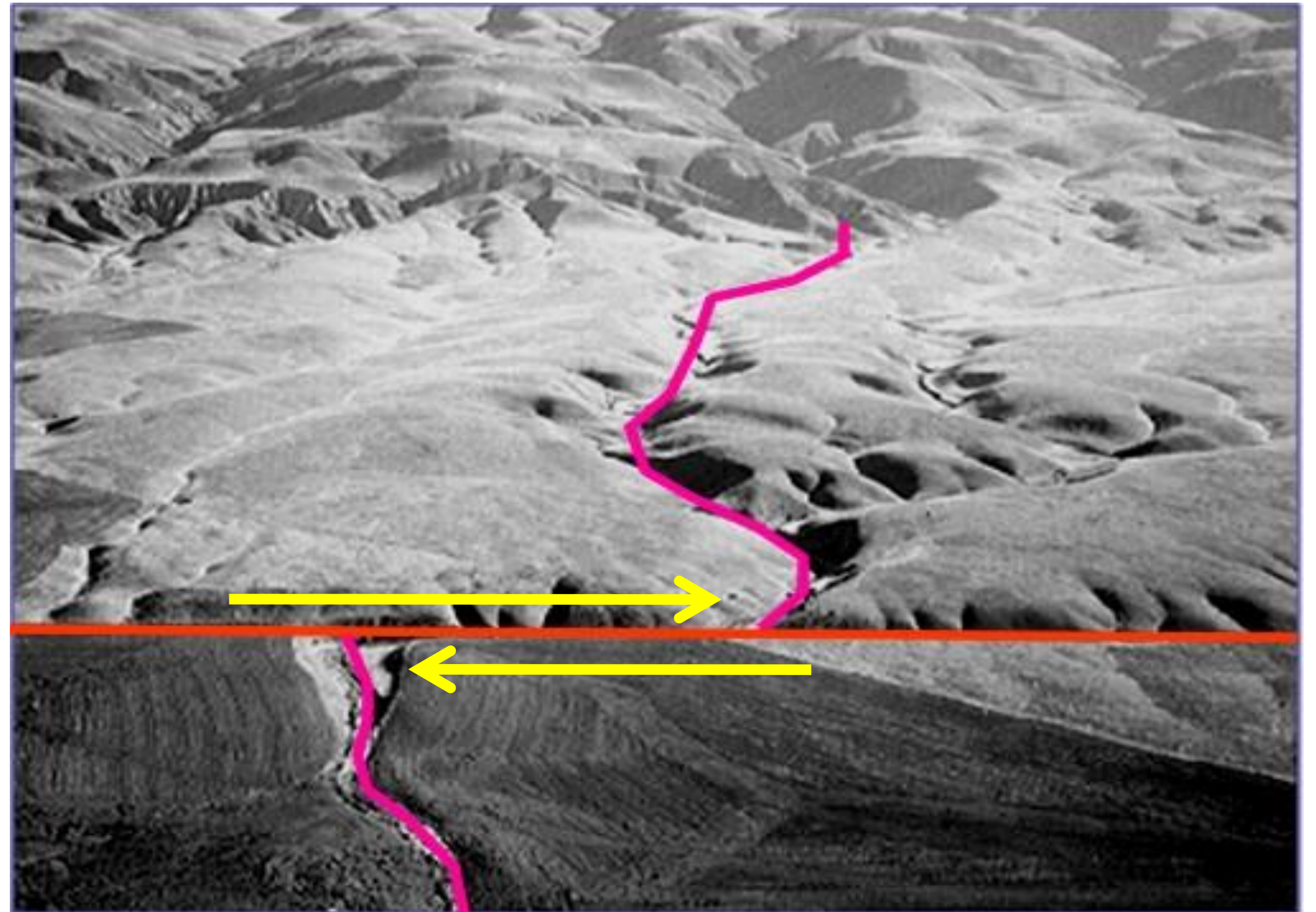


2.2.2.2 Convergent (Compressional) Boundaries.....contd.



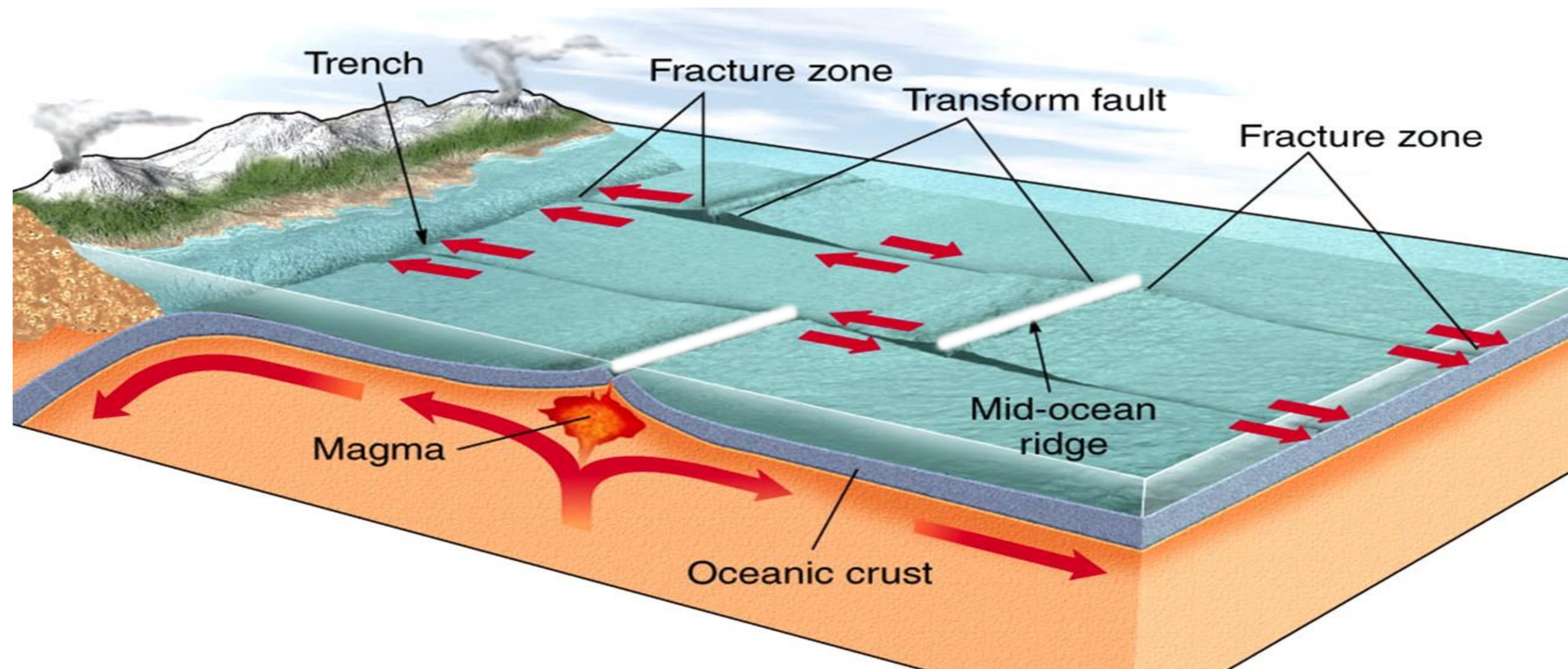
2.2.2.3 Transform Boundaries

where/when plates slide laterally past each other; roughly parallel to the direction of plate movement.



2.2.2.3 Transform Boundaries.....contd.

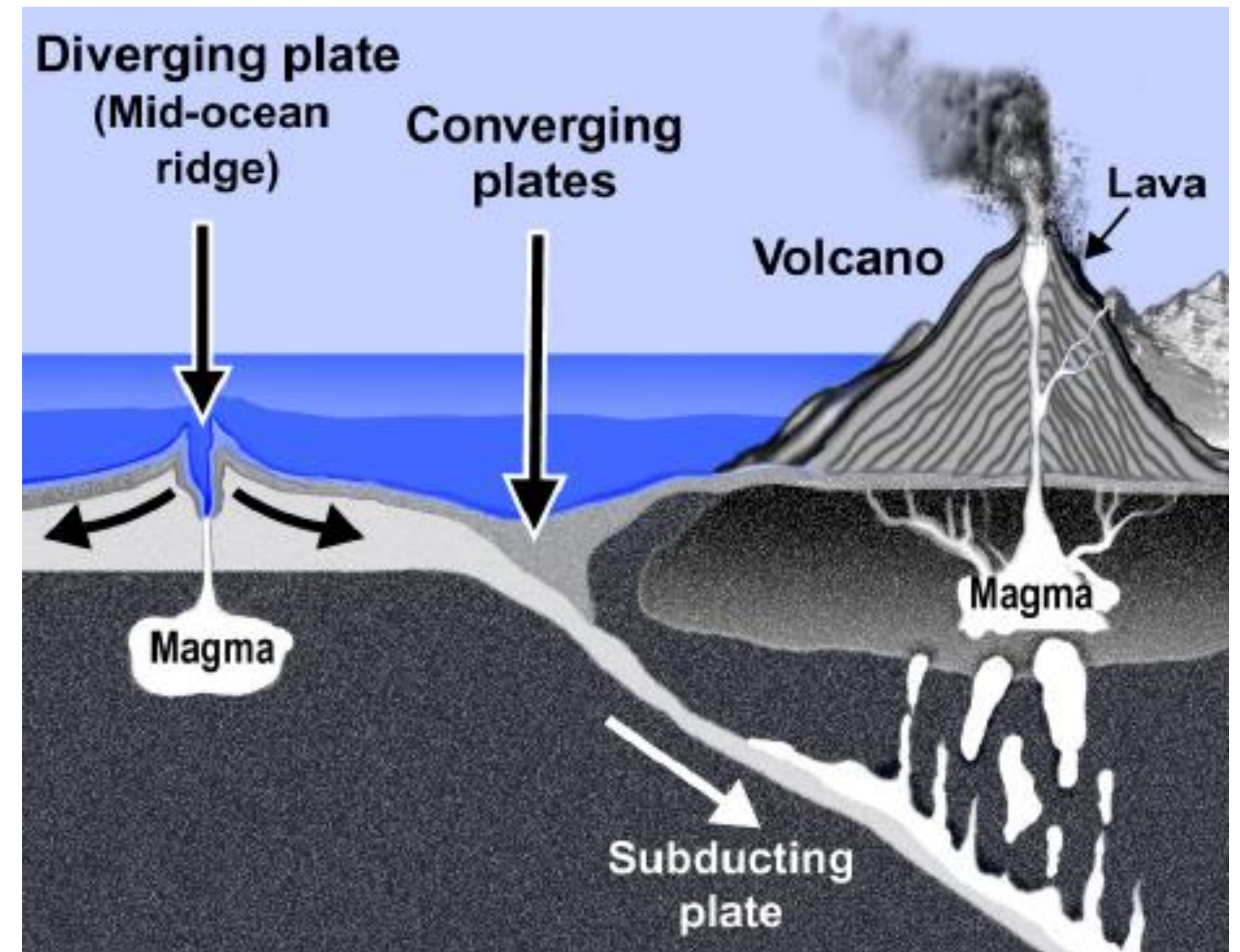
- Majority of transform faults connect two oceanic ridge segments, and
 - are marked by fracture zones



2.2.2.4 Volcanoes and Earthquakes

Most volcanoes and earthquakes are found at edges of tectonic plates, namely at:

- *divergent and convergent plate boundaries*



2.2.2.4 Volcanoes and Earthquakes.....contd.

The Ring of Fire is:

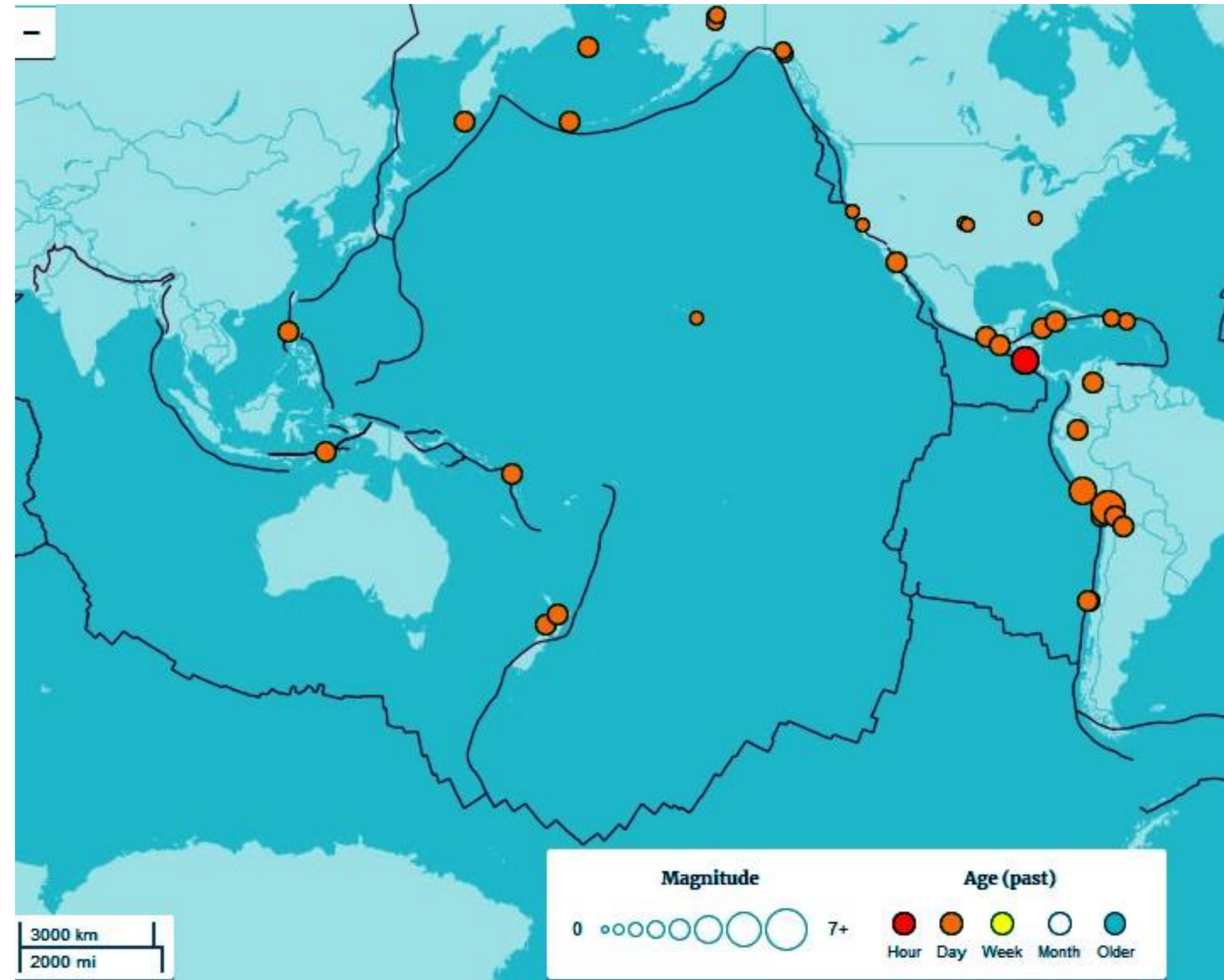
- a string of volcanoes & sites of seismic activity, or earthquakes
- around the edges of the Pacific Ocean.

Roughly **90%** of all **earthquakes occur along** the **Ring of Fire**.



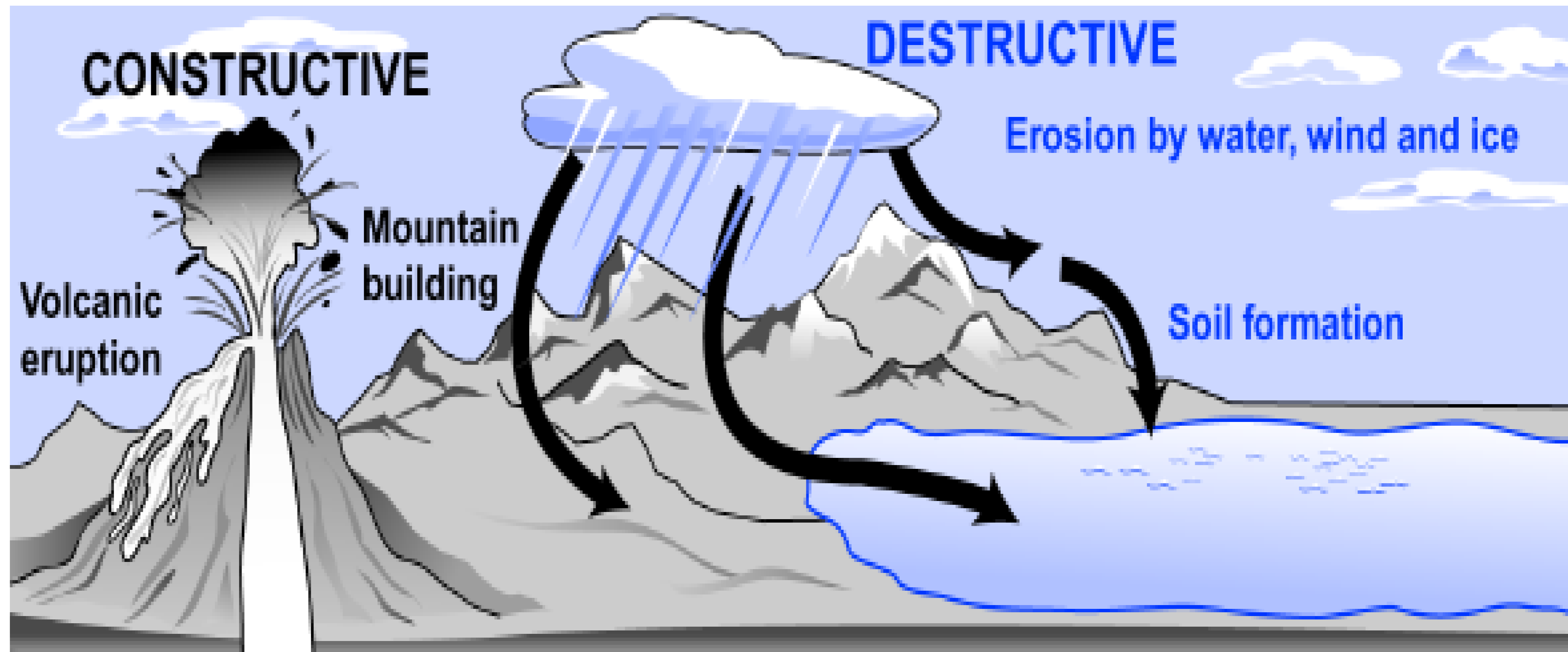
2.2.2.4 Volcanoes and Earthquakes.....contd.

Distribution and magnitude of earthquakes on 21:01:2018 at about 2030 hours in the Asia region.



2.2.3 Earth's Surface

Features we see on Earth's surface represent a dynamic balance between **CONSTRUCTIVE PROCESSES** and **DESTRUCTIVE PROCESSES**.



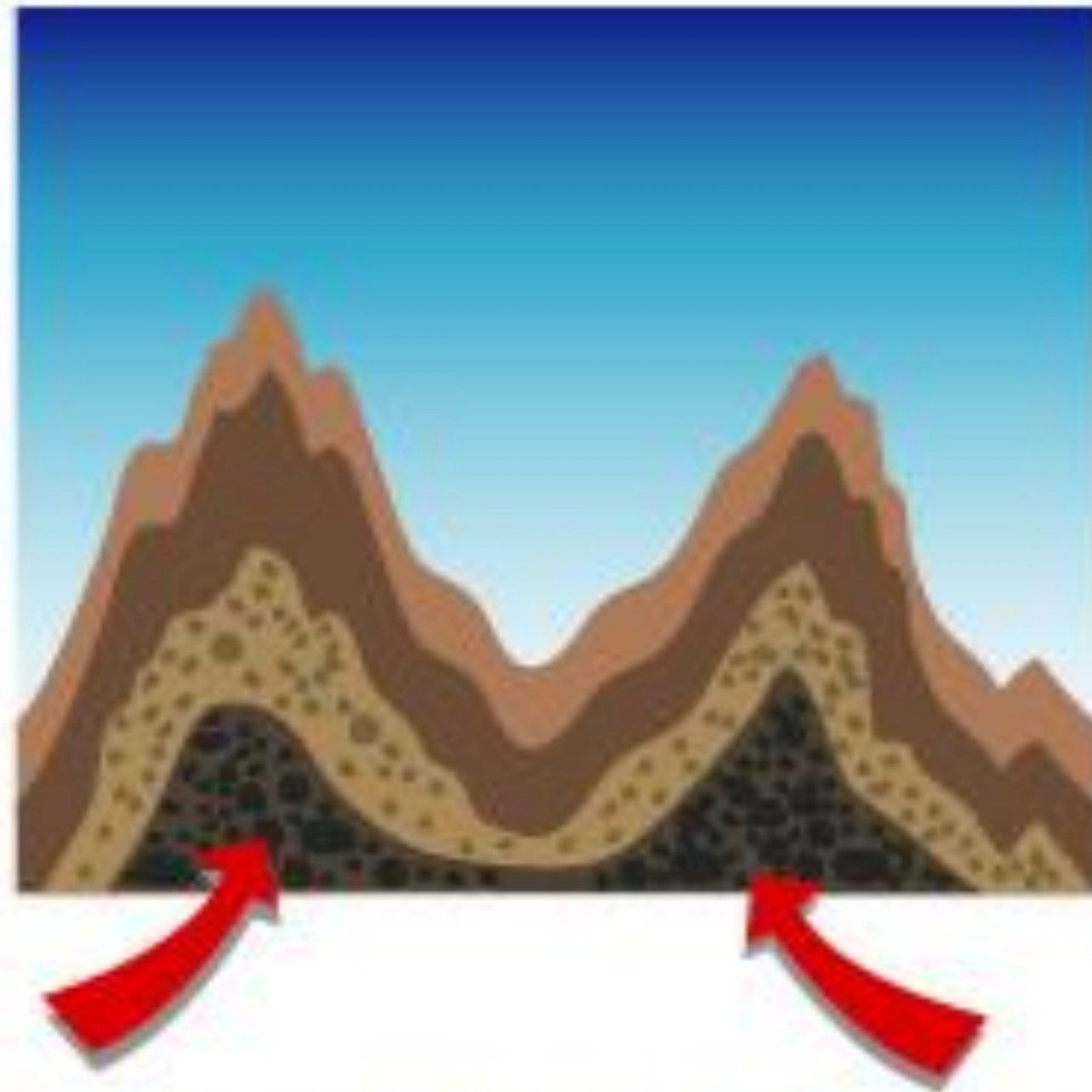
2.2.3.1 Mountain Building

- is a major **constructive** process.
- is promoted by three major processes:
 - folding at convergent plate boundaries
 - movement of chunks of land at faults
 - volcanic activity



2.2.3.1 Mountain Building....contd.

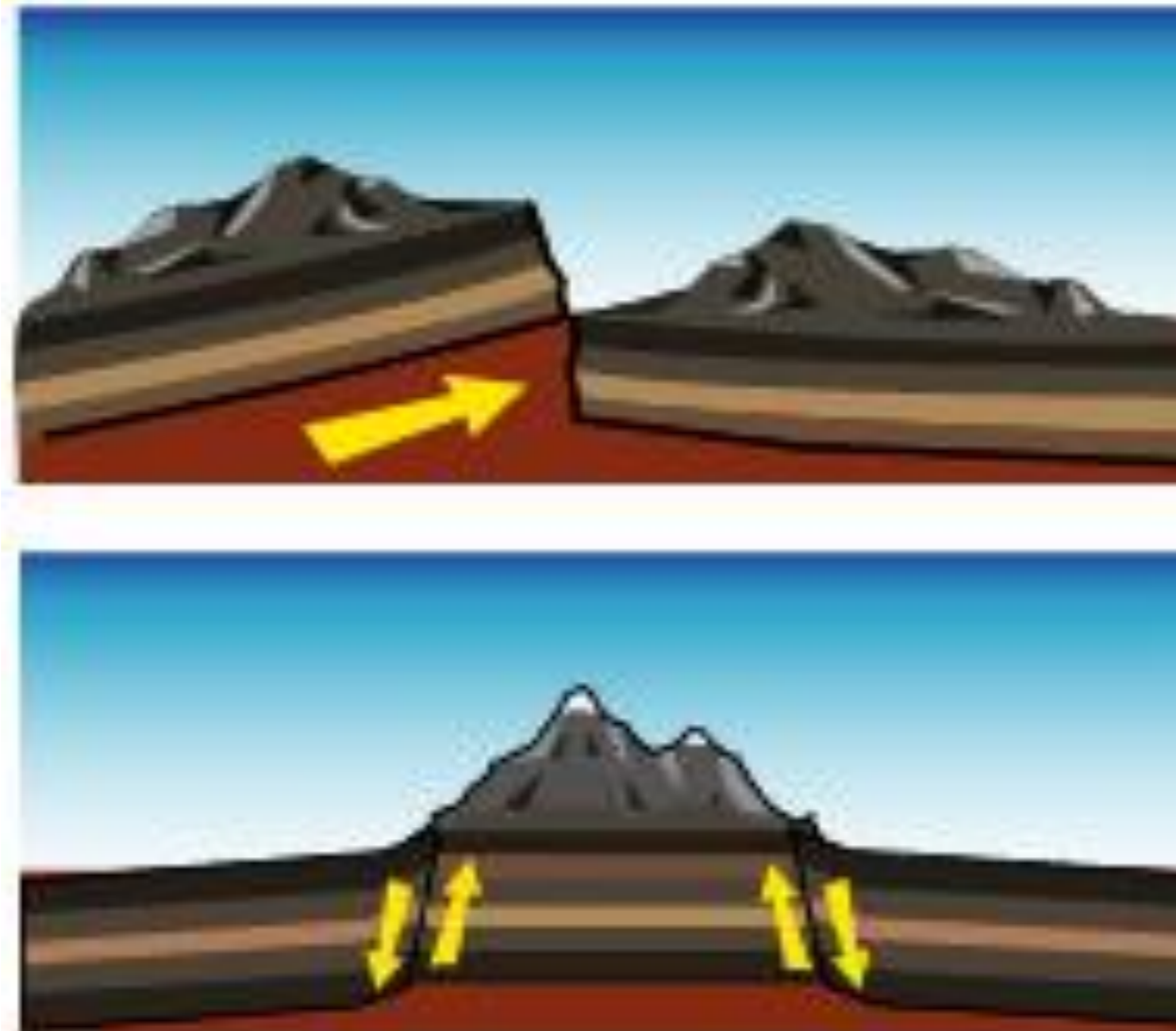
Fold mountains



Fold mountains include the Andes and Himalayan Mountains.

Fold mountains occur at convergent plate boundaries.

Fault-block mountains



Mountains along the San Andreas fault are examples of fault-block mountains.

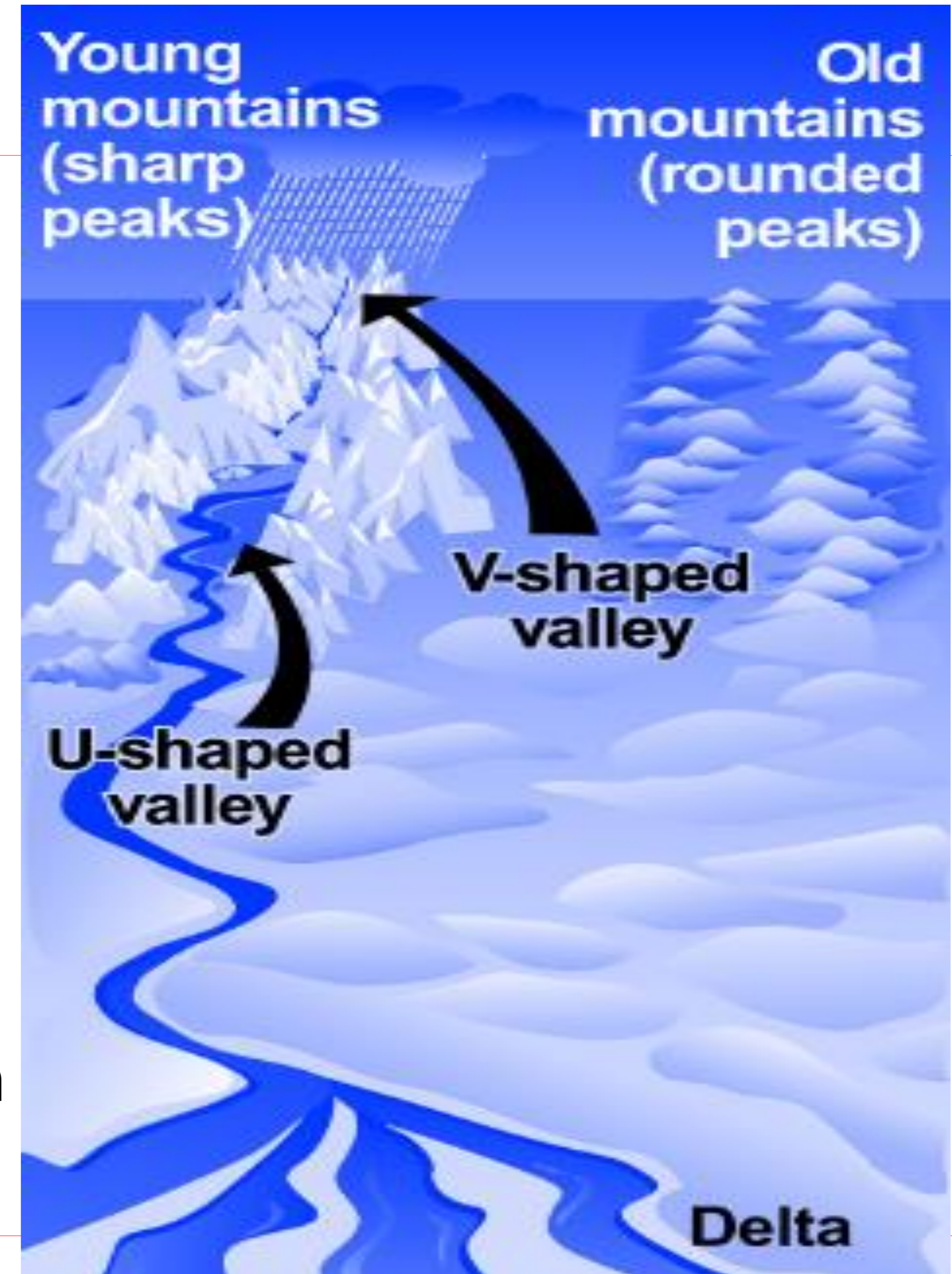
Volcanic Mountains



There are numerous volcanic mountains along the Ring of Fire. An example of a dome mountain is Mount Rushmore.

2.2.3.2 Erosion

- also known as *weathering*, is a major **destructive** process.
- describes continuous **physical** & **chemical** events that cause land and rock to wear down.
- its rate is related to
 - *height* and *steepness* of the mountain – the steeper mountain, the faster it erodes because it is easier to push material down steep slope than a gradual slope.



Summary

- Earth's System's processes are driven by **Sun's heat, which propels ALL Earth's external processes** – **weather, ocean circulation & erosional processes**
 - **Heat from Earth's interior powers Earth's Internal processes** – **volcanoes, earthquakes, mountain building.**
Earth consists of a series of concentric layers, which differ in **CHEMICAL & PHYSICAL** Properties.
 - plate tectonics deals with the structure of the earth's crust and many associated phenomena, which have resulted from interaction of rigid lithospheric plates that move slowly over the underlying mantle.
 - *weathering*, is a major **destructive** process, which is promoted by continuous **physical & chemical** events that cause land and rock to wear down
-

End of Lecture
