Features of Tectonic Plates

PowerPoint 12.2

The Earth's Layers

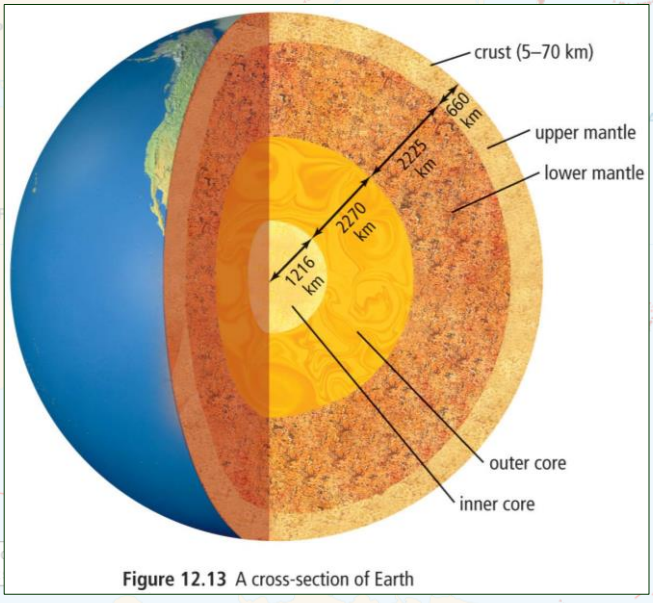


Figure 12.13 A cross-section of Earth

Crust

- Brittle
- Continental crust composed mainly of lower-density granite
- Oceanic crust composed mainly of **denser** basalt

Mantle

- Denser than the crust
- Upper is molten
- Lower is solid

Outer core is liquid.

Inner core is solid.

Further Divisions of the Earth's Layers

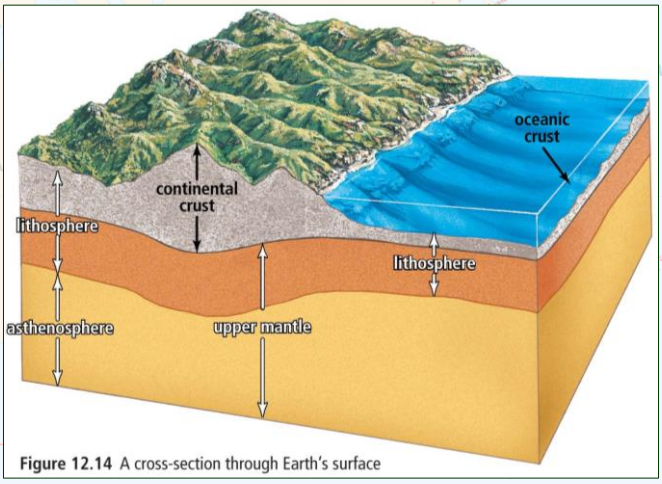


Figure 12.14 A cross-section through Earth's surface

Tectonic plates make up the ***lithosphere***, a layer consisting of the crust and the uppermost mantle.

The lithosphere "floats" atop the ***asthenosphere***, the molten layer of the upper mantle. The temperature of the asthenosphere varies throughout.

Convection Currents

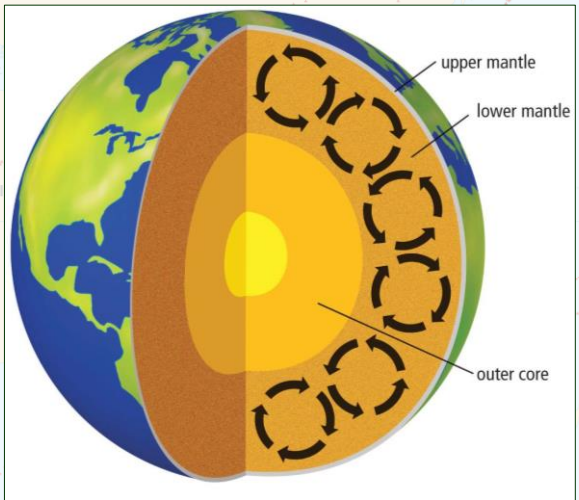


Figure 12.15 Convection currents in Earth's mantle circulate heat and magma.

Convection currents cause heated magma rise, cool, then sink down again only to be reheated once again.

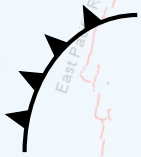
Mantle convection is a driving force of tectonic plate movement.

Plate Boundaries

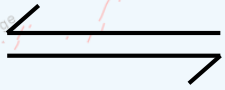
The region at which tectonic plates are in contact is called a ***plate boundary***. There are three main types,

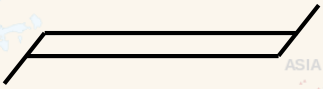
1. Divergent (spreading apart)

2. Convergent (colliding)



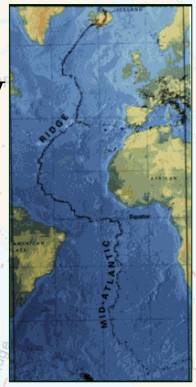
3. Transform (sliding against one another)



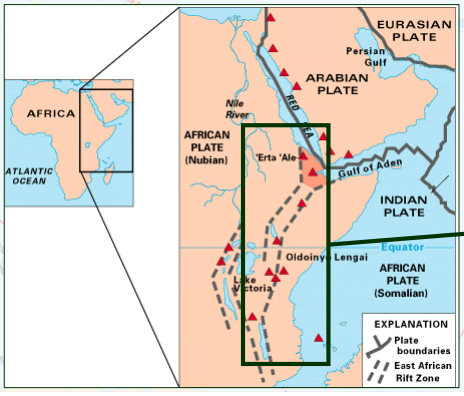


Divergent Plate Boundary

The Mid-Atlantic Ridge is a divergent plate boundary between oceanic plates.



The East African Rift Valley is continental divergent plate boundary.



Oceanic-Continental Plate Convergence

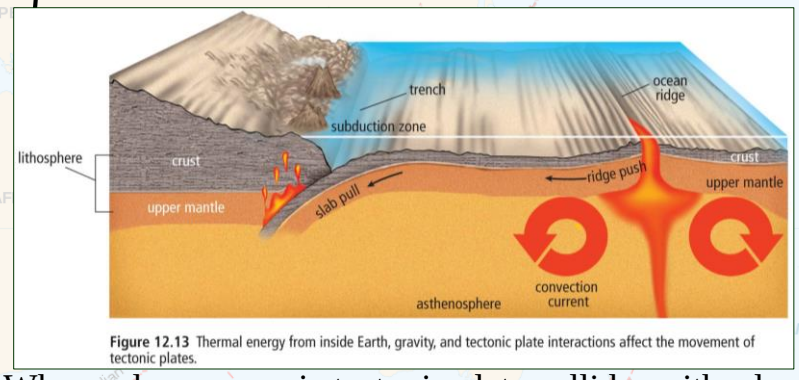


Figure 12.13 Thermal energy from inside Earth, gravity, and tectonic plate interactions affect the movement of tectonic plates.

A deep ***trench*** is often formed during this convergence along with volcanoes.

When a dense oceanic tectonic plate collides with a less dense continental plate, ***subduction*** is the typical result. Subduction is facilitated by,

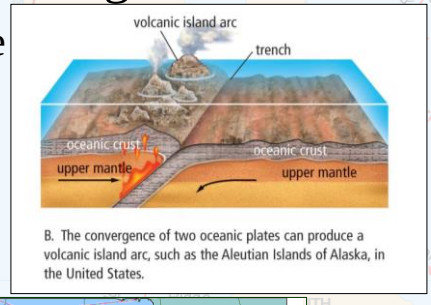
1. slab pull
2. ridge push
3. convection currents

Oceanic-Oceanic Plate Convergence

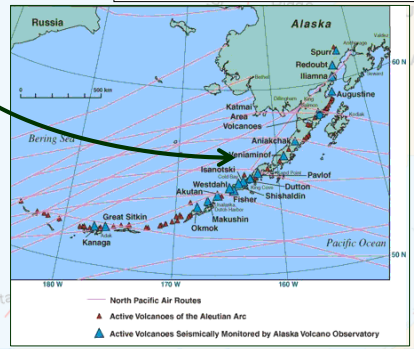
One plate will typically be cooler and more dense which will cause it to be subducted under the less dense plate.

Volcanic island arcs are often the result.

The Aleutian Islands and the Kuril Islands are examples.



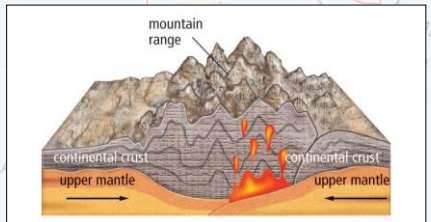
B. The convergence of two oceanic plates can produce a volcanic island arc, such as the Aleutian Islands of Alaska, in the United States.



Continental-Continental Plate Convergence

As densities are typically similar, this convergence will result in folding and crumpling of tectonic plate resulting in mountain formations.

The Himalayan Mountains and B.C.'s Coast Mountain ranges are examples.



C. The convergence of two continental plates is gradually forcing the Himalayas higher.

Figure 12.19 Convergent plate boundaries

Transform Plate Boundary

Convection currents cause plates to slide past one another.

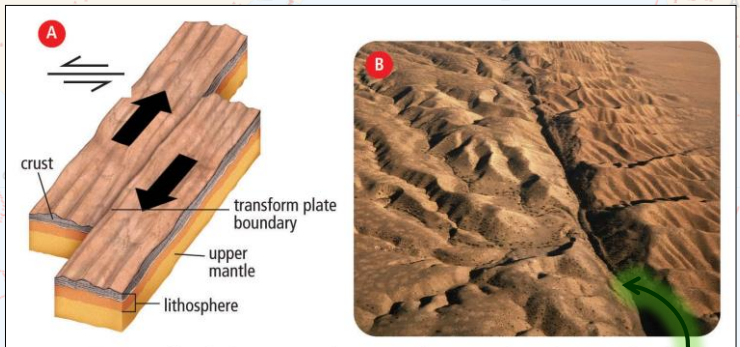


Figure 12.20 Transform faults can occur when tectonic plates move alongside one another (A). The San Andreas Fault is in the United States (B).

Transform fault

Shallow focus earthquakes and ***faults*** often result, as in the case of the San Andreas Fault.

Earthquakes

An ***earthquake*** is a massive release of energy that shakes the Earth's crust.

- On the Westcoast of British Columbia, all three plate boundaries can be observed, which produce earthquakes and volcanic activity.

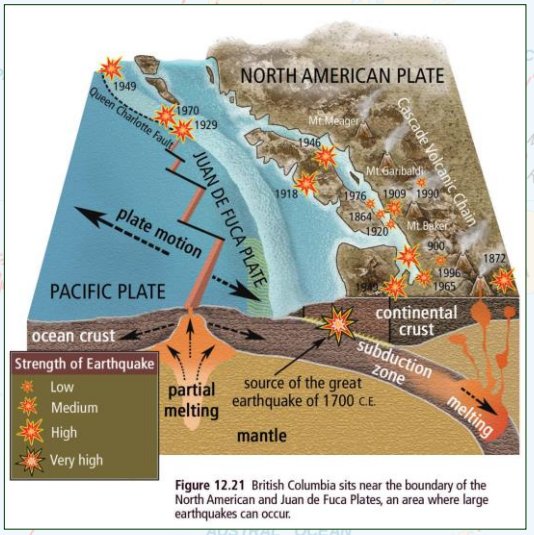


Figure 12.21 British Columbia sits near the boundary of the North American and Juan de Fuca Plates, an area where large earthquakes can occur.

Anatomy of an Earthquake

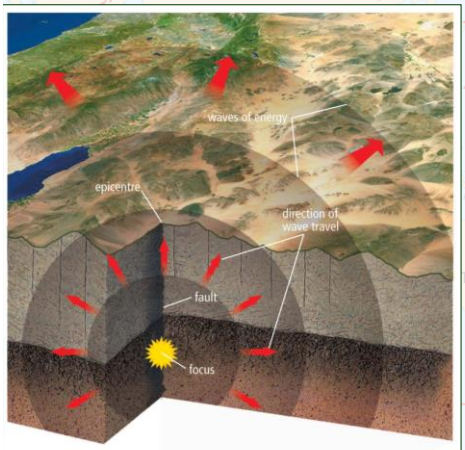


Figure 12.12 Waves of energy travel outwards from the focus of an earthquake. The epicentre of an earthquake is the point on Earth's surface directly above the focus.

The ***focus*** (plural is foci) is the location inside the Earth where an earthquake starts.
The ***epicentre*** is the location on the Earth`s surface directly above the focus.

- Scientists classify earthquakes based on the depth of foci.

Classification	Depth of focus
Shallow focus	0 – 70 km
Intermediate focus	70 – 300 km
Deep focus	Greater than 300 km

Forms of Waves Produced by Earthquakes

Primary wave — P

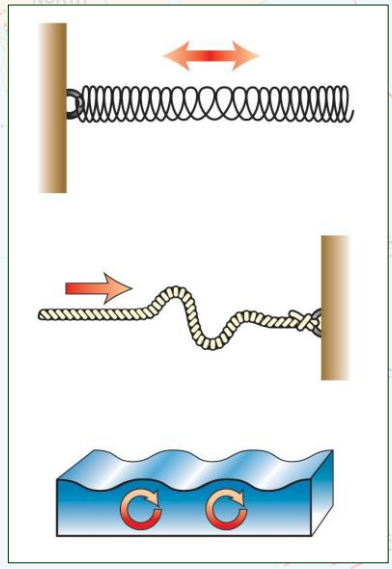
- Type of body wave
- First to arrive (fastest)
- Ground squeezes and stretches in directions of wave travel.
- Travels through solids, liquids, and gases

Secondary wave — S

- Type of body wave
- Second to arrive (slower)
- Ground motion is perpendicular to direction of wave travel.
- Travels through solids but not liquids

Surface wave — L

- Travels along Earth's surface
- Last to arrive (slowest)
- Ground motion is a rolling action, like ripples on a pond.
- Often more destructive



Displacement of P, S, and L Waves

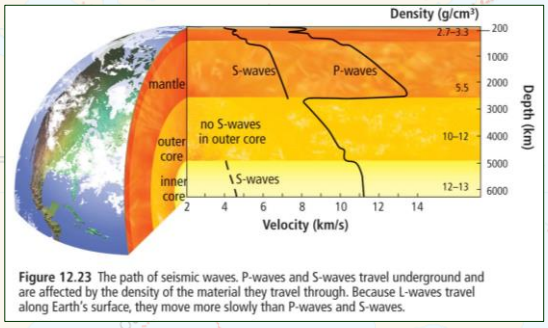


Figure 12.23 The path of seismic waves. P-waves and S-waves travel underground and are affected by the density of the material they travel through. Because L-waves travel along Earth's surface, they move more slowly than P-waves and S-waves.

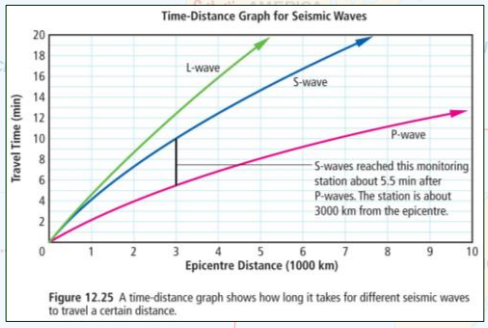
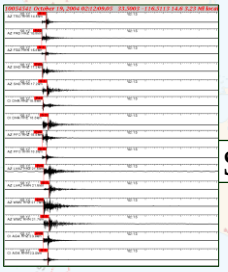


Figure 12.25 A time-distance graph shows how long it takes for different seismic waves to travel a certain distance.

Because P and S waves travel underground at different rates and travel differently in different materials, they can be utilized to gain information about inner layers of the Earth.

Measuring Earthquakes

Seismographs, or seismometers, measure various types of ground motion associated with earthquakes.



Seismogram

Seismograms are produced which provide information on the start time, duration, and amount of movement.

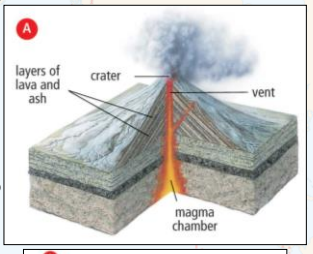
The magnitude of an earthquake indicates the amount of energy associated with an earthquake, often called the Richter scale.

Logarithmic scale, like the pH scale.

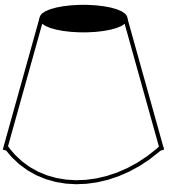
Volcanoes

Three categories of volcanoes are,

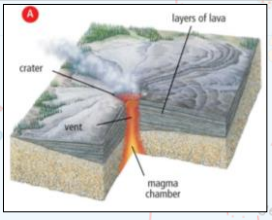
1. Composite
   - Thicker lava
   - Cone-shaped
   - Located near subduction zones
   - Violent eruptions



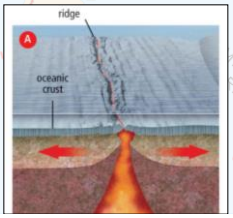
Map Symbol



2. Shield
   - Form over hot-spots
   - Often forms in ocean basins (Hawaii)
   - Thinner, easy-flowing lava



3. Rift eruptions
   - Form in long cracks in the lithosphere
   - Curtain-like lava expulsion
   - Less violent eruptions (Mid-Atlantic Ridge)



Provincial Exam Question

Question

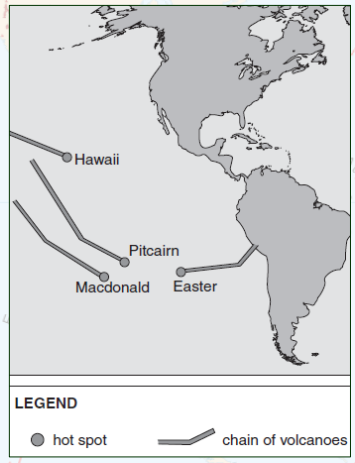
Which of the following geological processes causes apparent opposing motion of the Macdonald and Easter Islands hot spots?

A. ridge push at the East Pacific Rise

B. slab pull at the Eastern edge of the Pacific Plate

C. divergence of the North America Plate and the Pacific Plate

D. mantle magma rising at several locations along the hot spot island chain

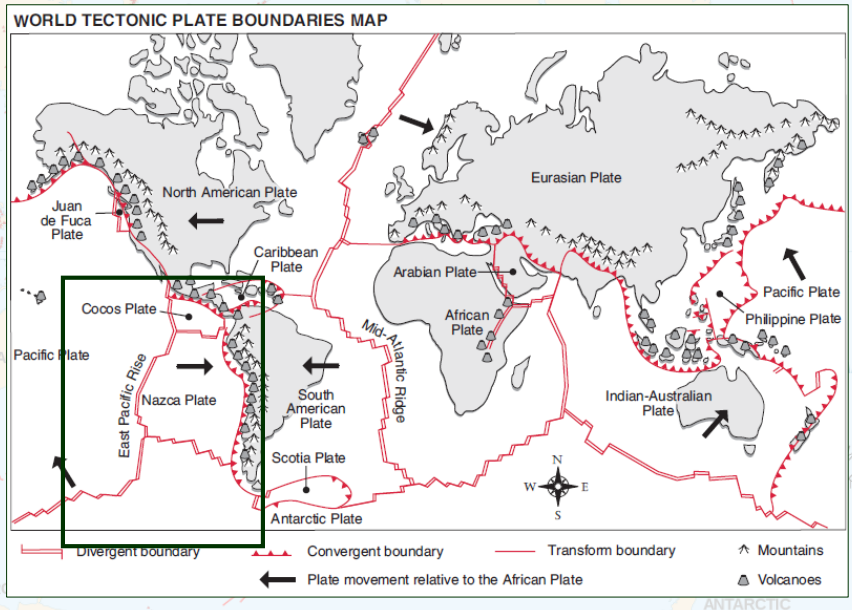


Provincial Exam Question

Answer

A.

Because the chain of volcanoes appear on either side of the East Pacific Rise, they must have formed due to the movement of both the Pacific Plate and the Nazca Plate. Therefore, ridge push is associated with both as this would have moved both the Nazca Plate over their respective hot spots.



Provincial Exam Question

Question

Alfred Wegener's Continental Drift Theory was based on which of the following observations?

A. I and II only	I fossil distribution
B. II and III only	II jigsaw puzzle fit of continents
C. I, II and III only	III matching up of mountain ranges
D. I, II, III and IV	IV magnetic reversals in the ocean crust

Answer

D.

The magnetic striping was associated with Henry Hess, not Alfred Wegener, however Wegener did utilize the other three for his Continental Drift Theory.

Provincial Exam Question

Question

Which of the following thermal energy sources are responsible for producing mantle convection?

I decay of radioactive isotopes
II heat left over from Earth's formation
III friction from tectonic plate movement

A. I and II only
B. I and III only
C. II and III only
D. I, II and III

Answer

A. Friction from tectonic plate movement does not cause mantle convection, but the other two do.

Summary

The Earth is divided into several layers,

- Crust
- Mantle
- Outer core
- Inner core

Lithosphere comprises the crust and uppermost mantle.

Asthenosphere comprises the upper liquid mantle.

Plate boundaries can be ***convergent***, ***divergent***, or ***transform***.

Earthquakes

- Originate at ***foci***, directly below the ***epicentre***,
- involve ***P***, ***S***, and ***L waves***.

Three types of volcanoes are ***composite***, ***shield***, and ***rift***.