Geology Topics

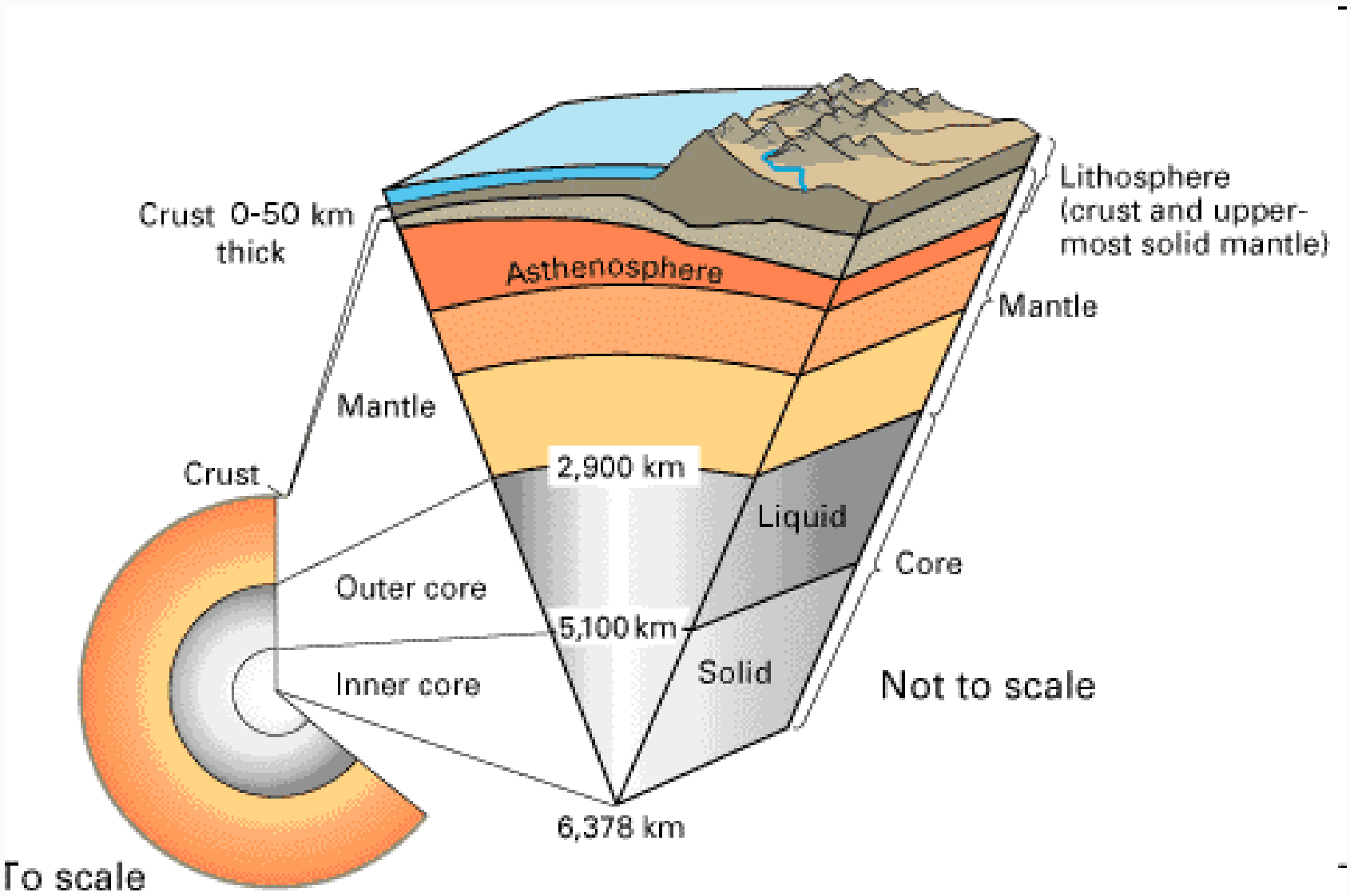
Unit 6 Notes

Composition of the Earth

Earth is layered due to density differences.

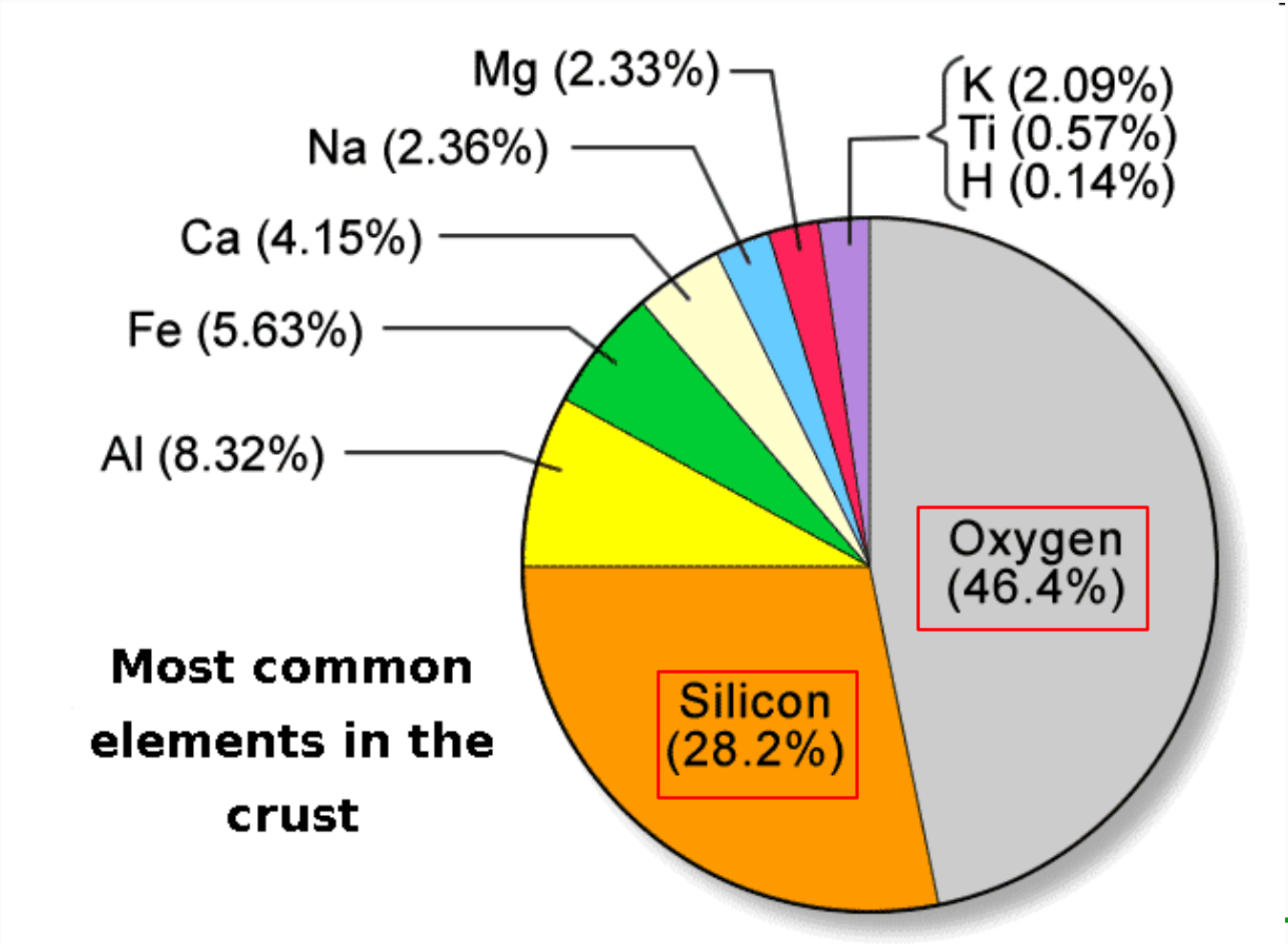
- **Crust** – thin outer layer, solid, made up of continental and oceanic crust
- **Mantle** – rocky layer below the crust
- **Outer Core** – liquid (molten) iron and nickel
- **Inner Core** – solid iron and nickel
- **Lithosphere** – crust and upper mantle, brittle
- **Asthenosphere** – layer of mantle below the lithosphere that has the ability to flow because of the enormous heat and pressure in this layer

Composition of the Earth



Earth's Crust – Abundance of Elements

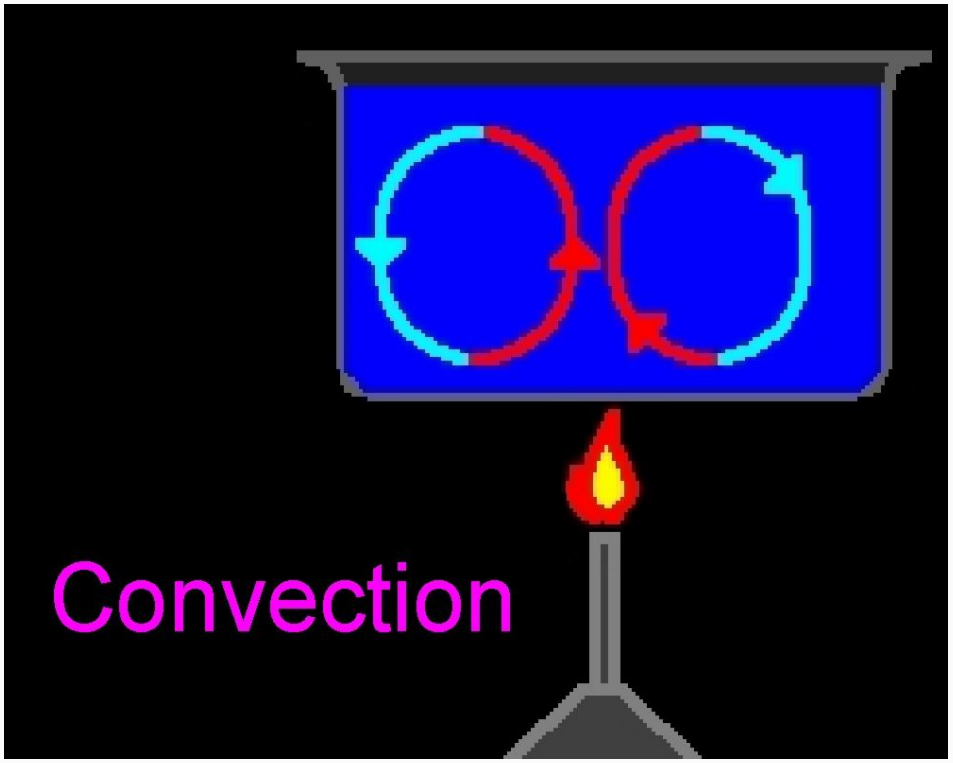
Most common elements in Earth's crust



Quartz and Feldspar – two common minerals – are made up of Oxygen and Silicon

Convection and Plate Tectonics

- **Convection - the transfer of heat by the motion of a fluid in the form of currents**
  - **The flow of energy and heated material in the mantle's convection cells cause the tectonic plates to move extremely slowly atop the denser asthenosphere.**



Major Features of the Earth's Crust and Upper Mantle

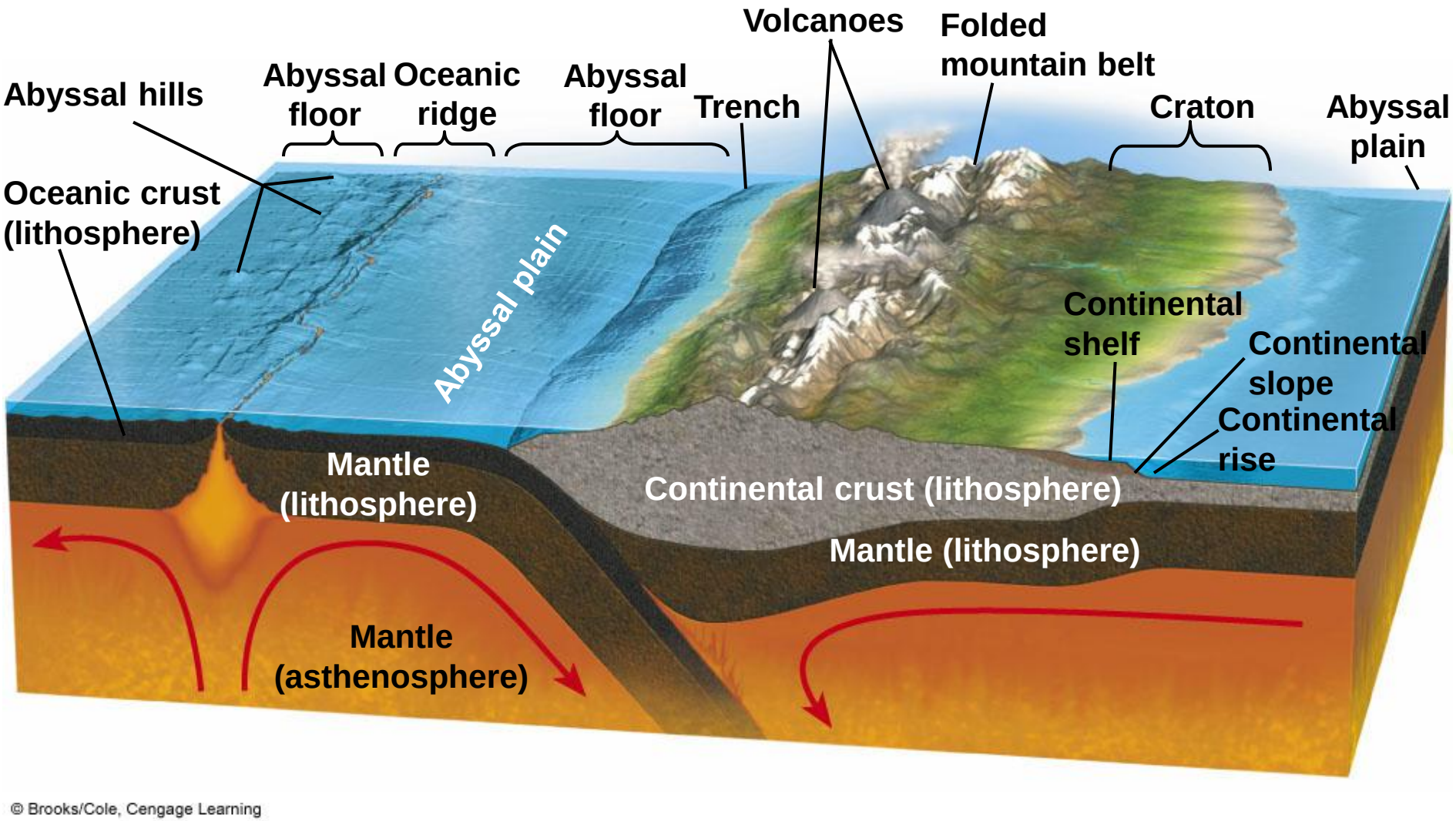


Fig. 14-2, p. 346

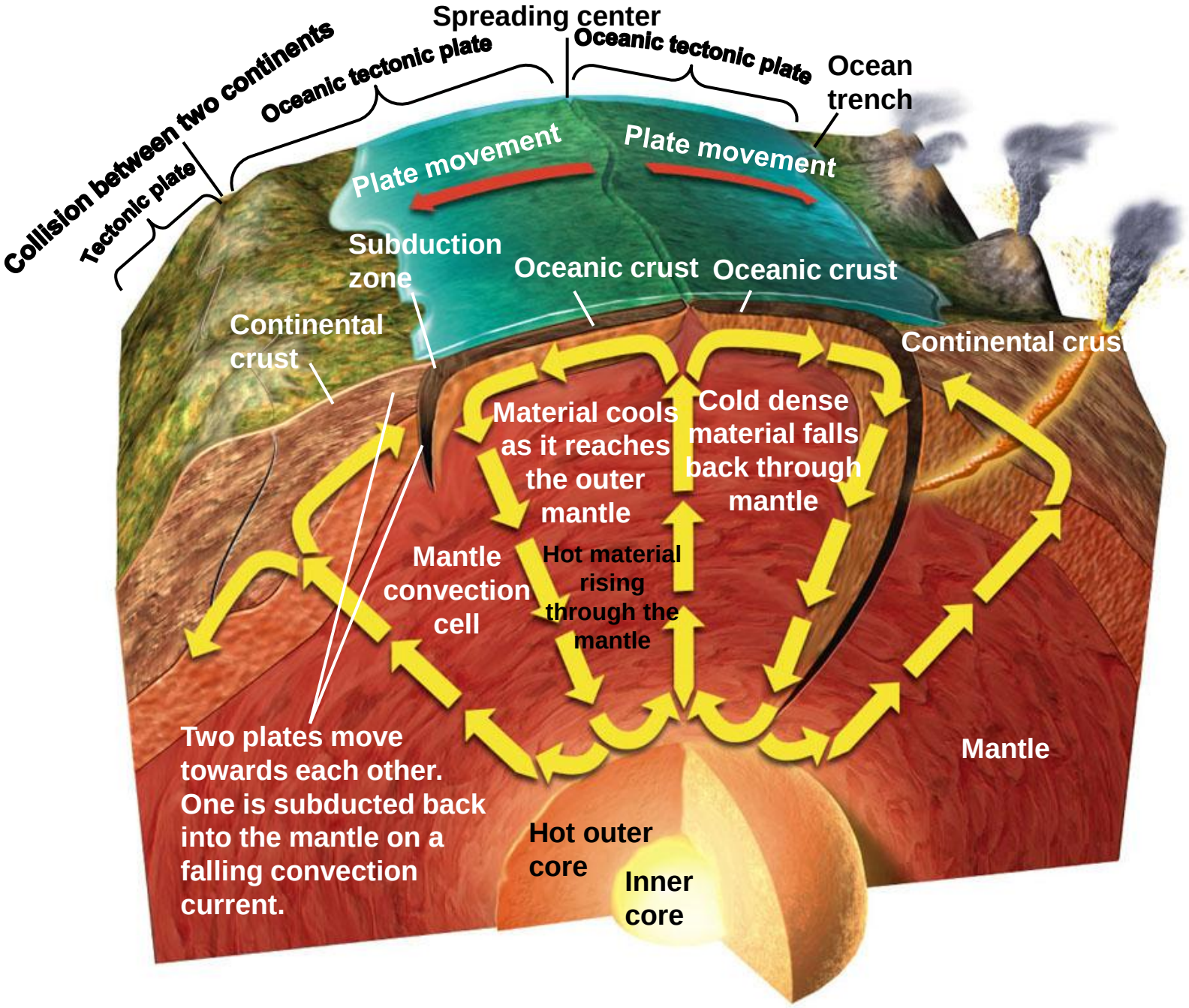


Fig. 14-3, p. 346

The Earth's Major Tectonic Plates

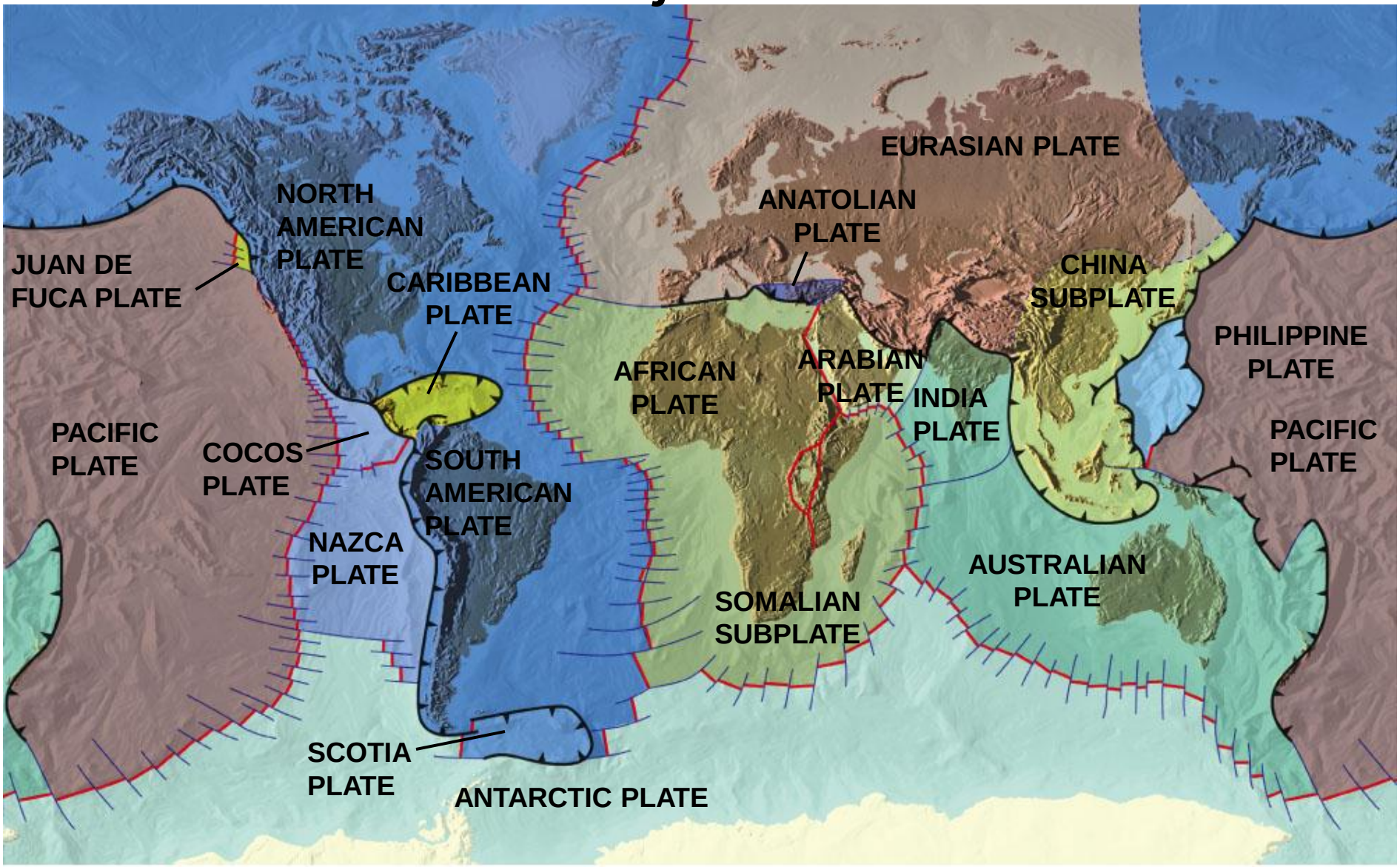


Fig. 14-4, p. 347

Chunk and Chew

Using the information we just talked about answer the following question with your partner:

Why do the tectonic plates happen where they do?

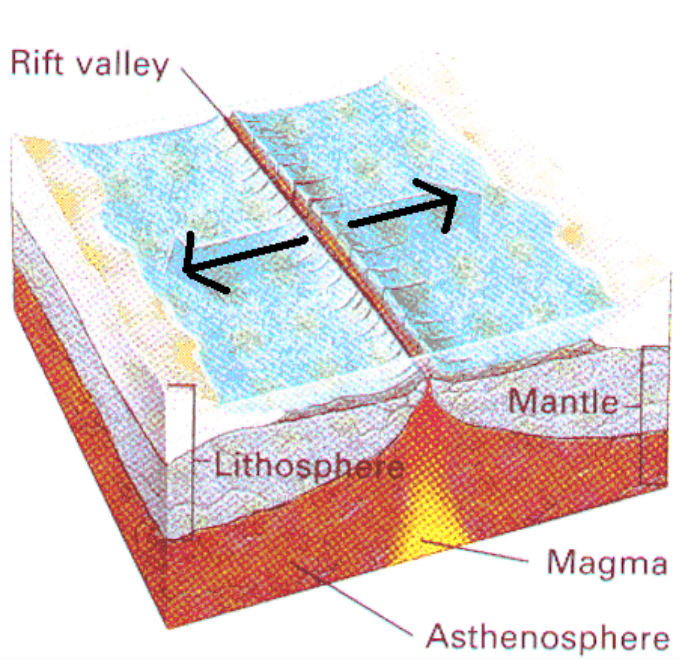
Be ready to share your answer after 1 minute

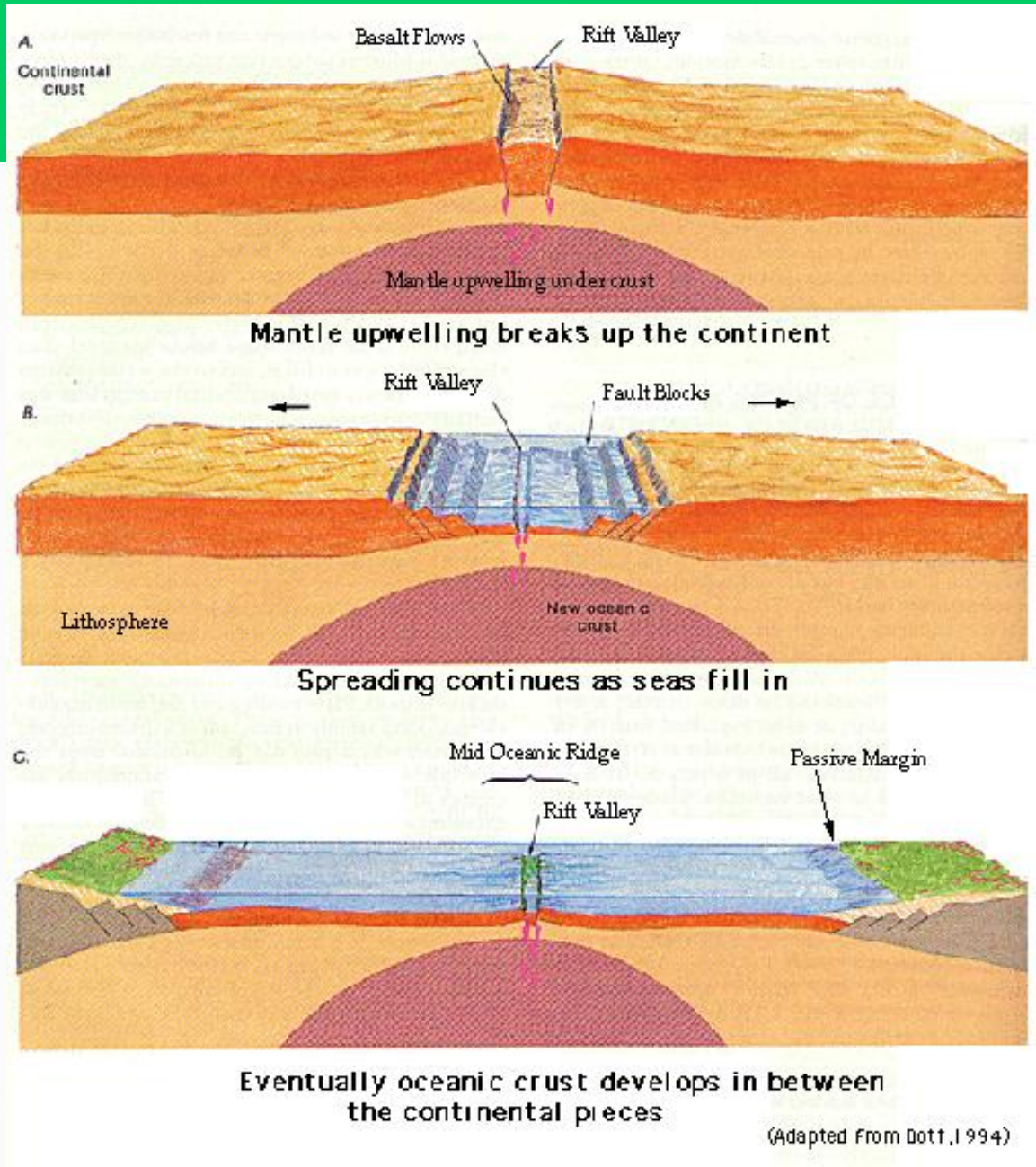
Plate Boundaries

Divergent Plate Boundaries

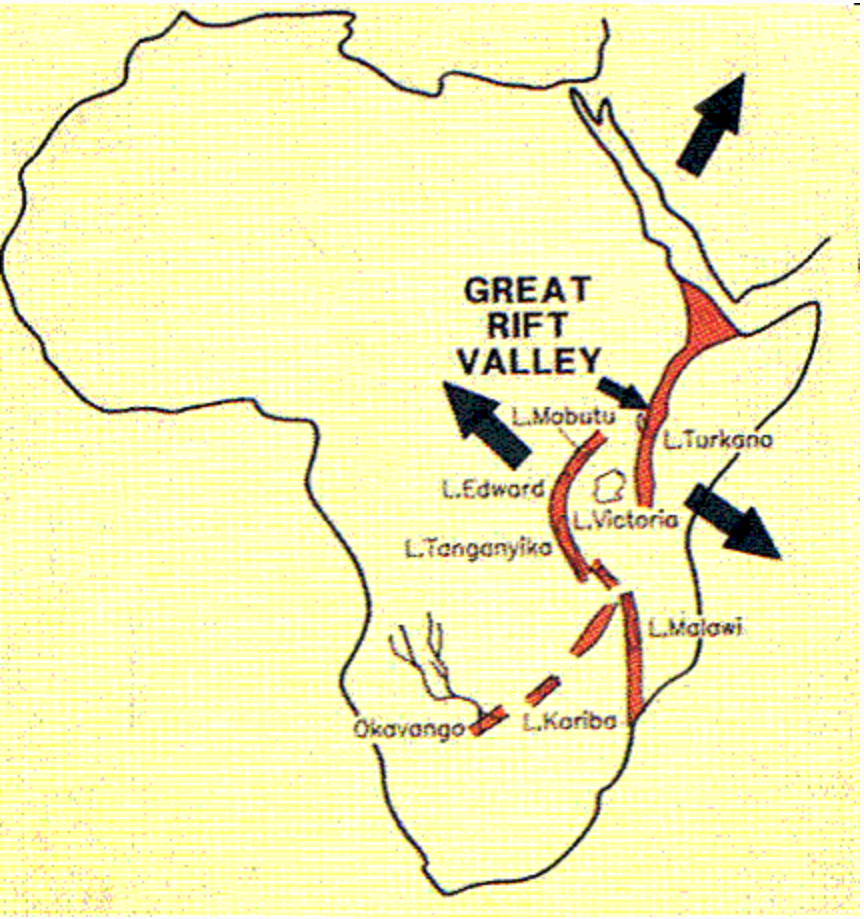
- Plates are moving apart
- New crust is created
- Mid-Ocean Ridges and Sea-Floor Spreading – New Oceanic Crust (Basalt) is formed as magma solidifies
  - Middle of the Atlantic Ocean (classic example)
- Can also occur in continental crust (Great Rift Valley of East Africa) – Land sinks into a valley as two plates are moving apart.

Plate Boundaries





East African Rift Valley



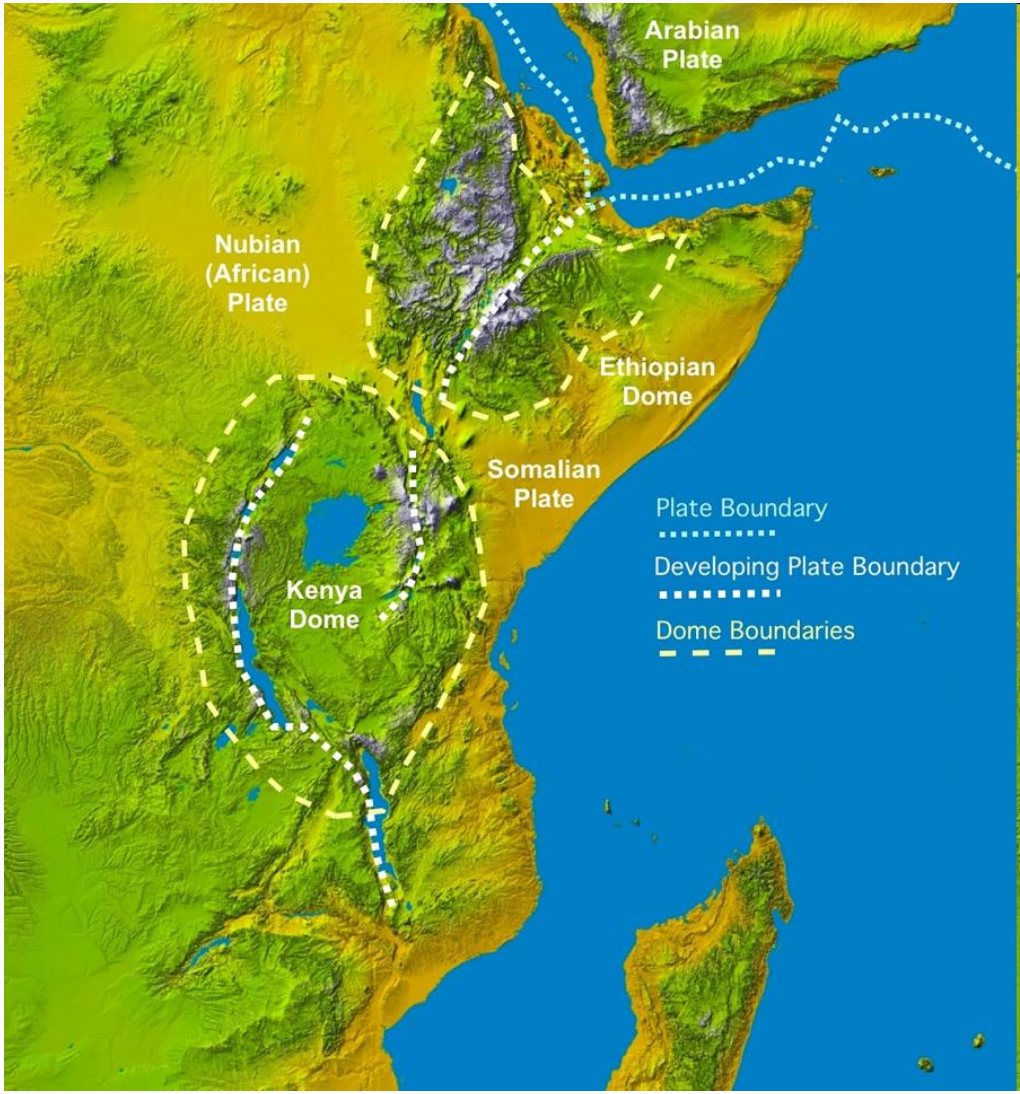
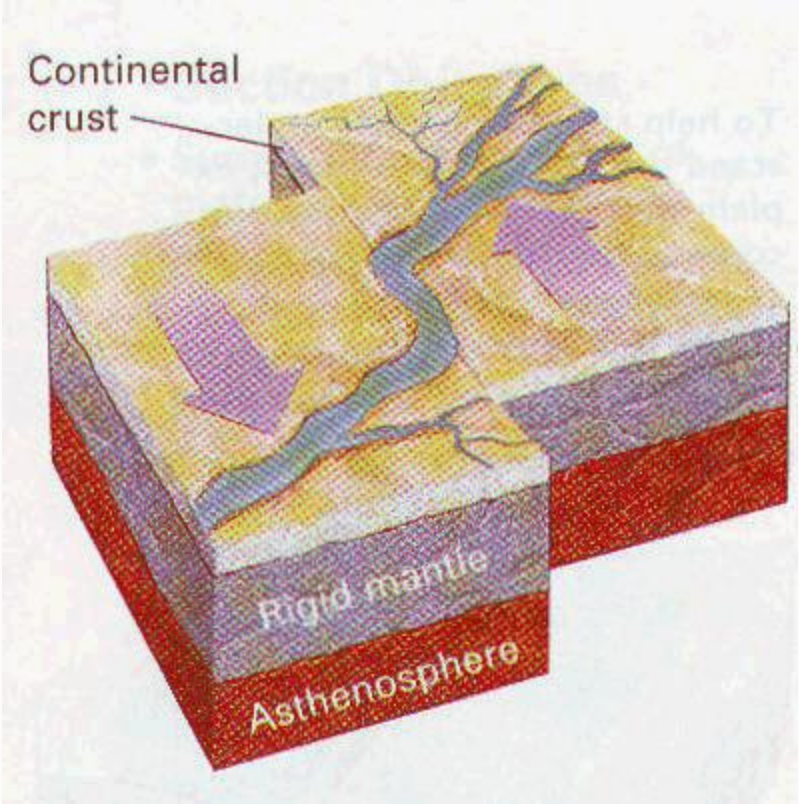


Plate Boundaries

Transform Plate Boundaries

- Two plates are sliding past each other
- Crust is neither created or consumed
- Example: San Andreas Fault in California – build up of friction and pressure between the two plates often results in earthquakes
- Volcanic activity is NOT associated with this type of plate boundary

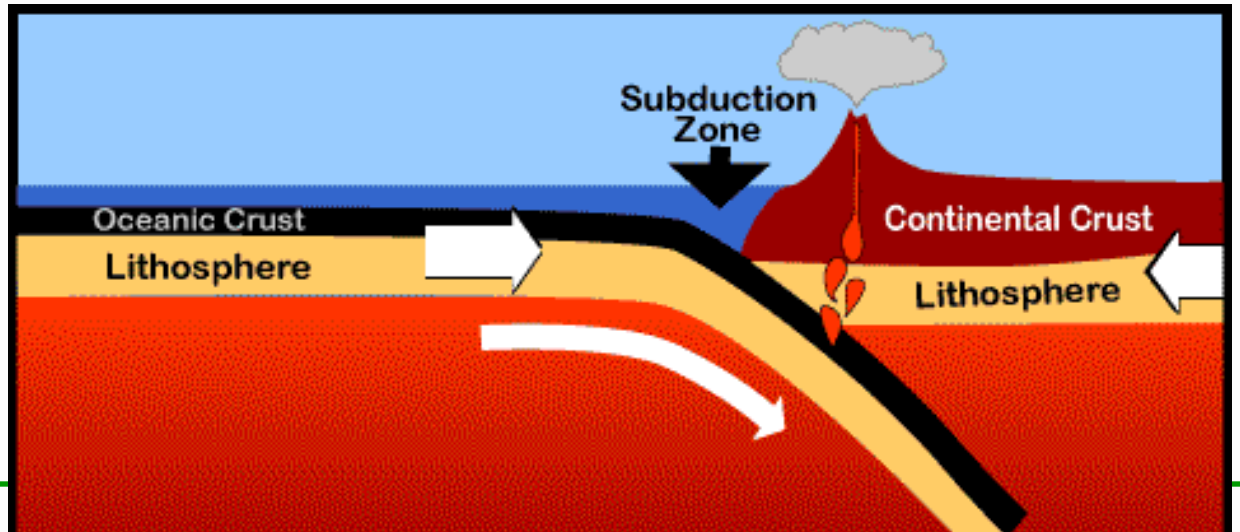


The San Andreas Fault as It Crosses Part of the Carrizo Plain in California, U.S.

Plate Boundaries

Convergent Plate Boundaries

- Two plates are colliding – the plate that is more dense will slide underneath the less dense plate – called subduction (oceanic plates are more dense than continental plates)
- Crust is consumed and melts into the underlying mantle as it is subducted



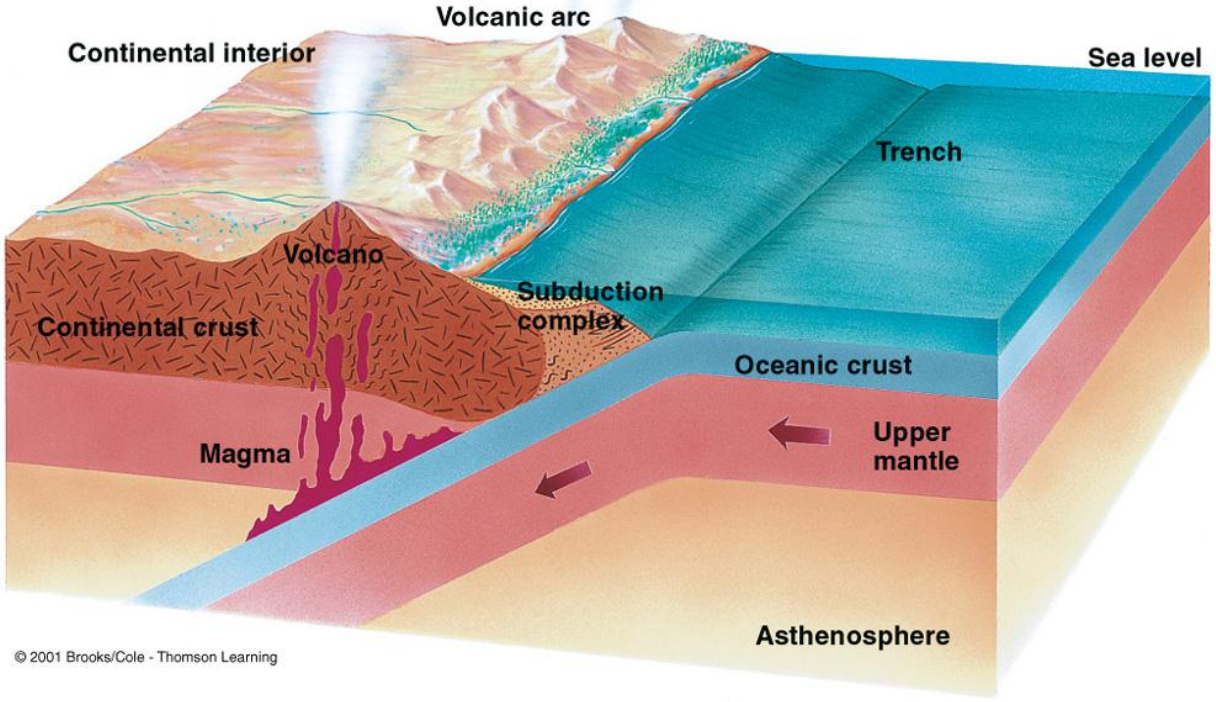
Three Types of Convergent Boundaries

Oceanic-Continental Convergence

- Occurs when an oceanic plate is subducted beneath a continental plate
- A deep ocean trench is formed.

• A **volcanic arc** is found on the continent at the Earth's surface.

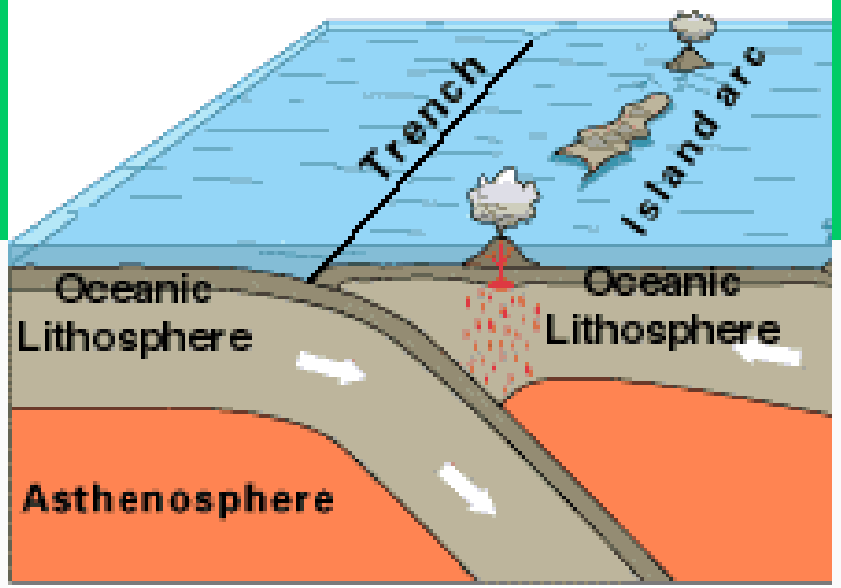
• Examples: Andes Mountains, Cascade Range (Western US)



Three Types of Convergent Boundaries

Oceanic-Oceanic Convergence

- An oceanic plate is subducted beneath another oceanic plate
- Produces a volcanic **Island Arc** (volcanoes in the ocean)
- Often located a few hundred kilometers from a deep ocean trench
- Example: Philippines and Japan (Pacific and Philippine Plate Subducted beneath Eurasian and China Plate)



Oceanic-oceanic convergence

Three Types of Convergent Boundaries

Continental-Continental Convergence

- Neither plate subducts because continental crust is very buoyant
- Both continental plates collide and push upward into mountains
- Example: Himalayas, Alps, Appalachian Mountains

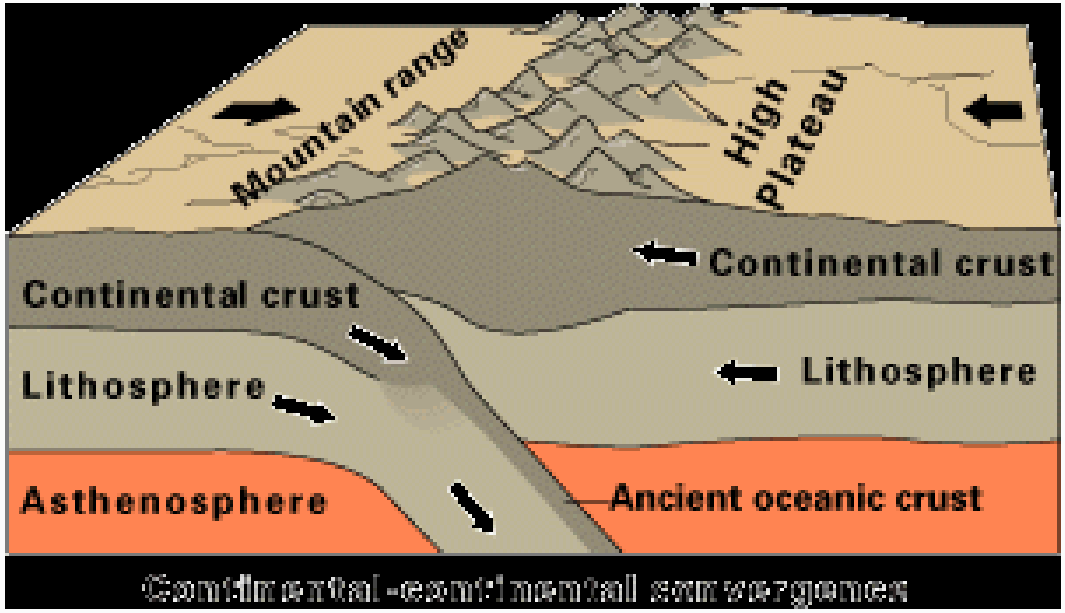
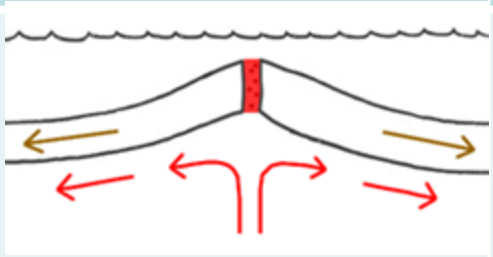
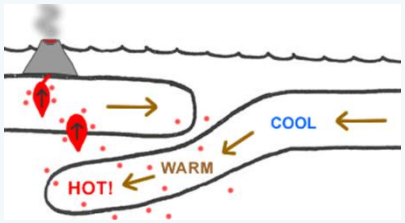
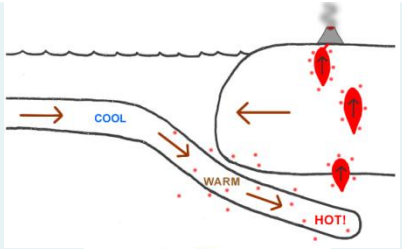
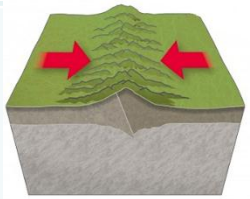


DIAGRAM	TYPE OF BOUNDARY AND MOTION	FEATURES FORMED	EXAMPLES
	**Divergent** Moving Apart	Rifts Mid Ocean Ridges	Middle of Atlantic Ocean Red Sea Great Rift Valley of East Africa
	**Convergent** Oceanic Plates Collide	Row of Volcanoes in the Ocean (Island Arc) and Deep Ocean Trenches	Japan Aleutian Islands
	**Convergent** Oceanic plate collides with continental plate	Row of Volcanoes on Land (Volcanic Arc)	Andes Cascades
	**Convergent** Continental Plates Collide	Folded Mountains	Himalayas Alps
	**Transform** Slide Past	Transform Fault	San Andreas

Chunk and Chew

Using the information we just talked about answer the following question with your partner:

What is the biggest difference between the types of convergent boundaries?

Be ready to share your answer after 1 minute

Fact or Fiction:

Decide which number is the fact, hold your fingers up based on the # you picked:

1. Which is the most abundant element in Earth's Crust?

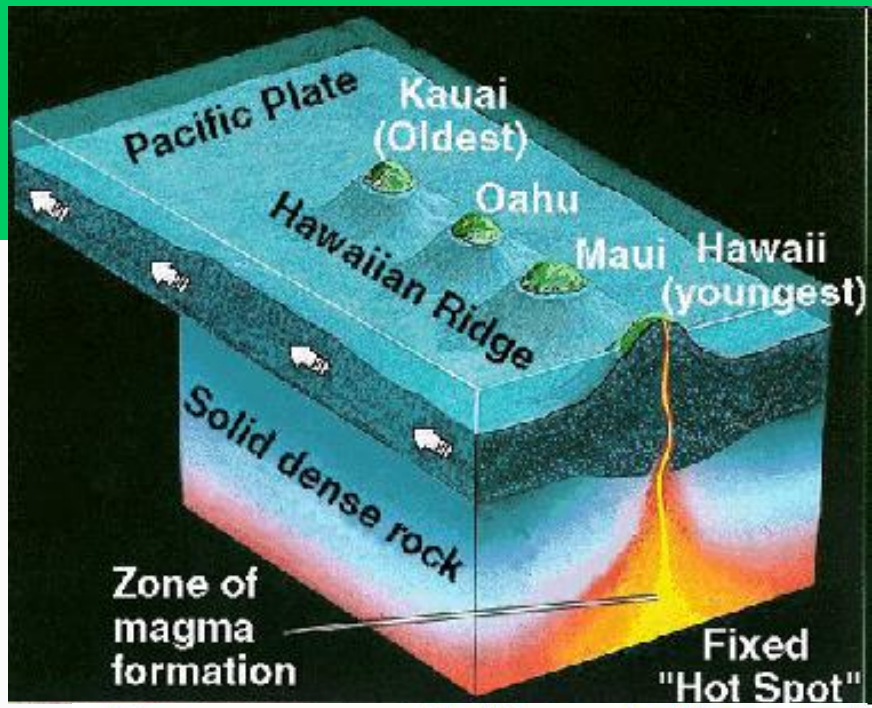
1. Oxygen
2. Aluminum
3. Iron
4. Argon

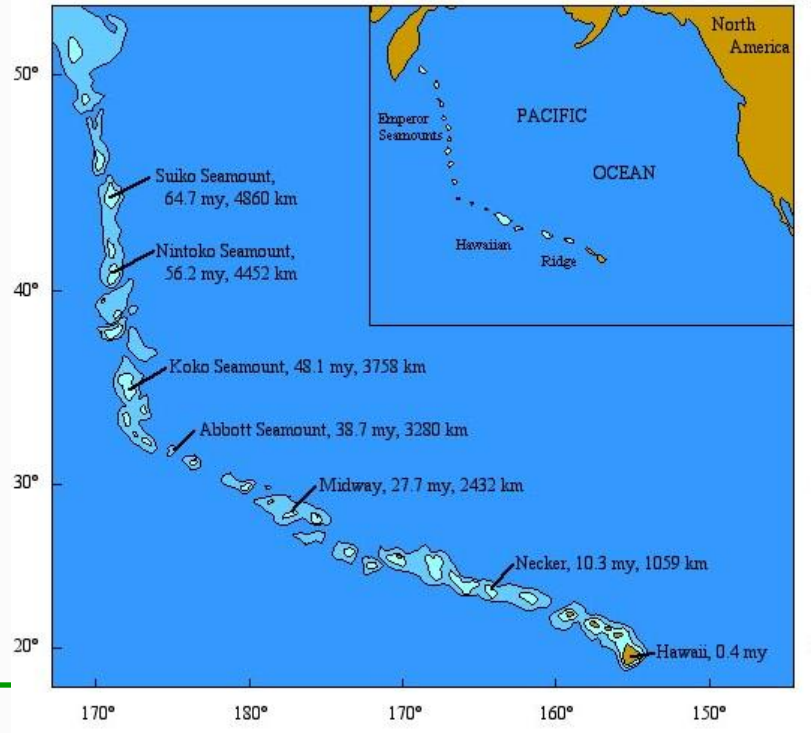
2. Which is the most abundant element in Earth's Core?

1. Oxygen
2. Aluminum
3. Iron
4. Nitrogen

Hot Spots – Formation of the Hawaiian Islands

- Hot spots form where columns of solid, hot material from the deep mantle, called mantle plumes, rise and reach the lithosphere.
- This can form volcanoes WITHIN a tectonic plate. (NOTE: Most volcanoes form on plate boundaries)
- A chain of volcanoes forms as the lithospheric plate moves over the stationary hot spot.





Weathering and Erosion

Weathering – the breakdown of rock into smaller particles that help build soil.

- Physical, Chemical, and Biological (examples on next slide)

Erosion – weathered material is transported to a new location

- Flowing streams and Rain
- Wind
- Human activities
- Glaciers – slowing flowing bodies of ice

Weathering: Biological, Chemical, and Physical Processes

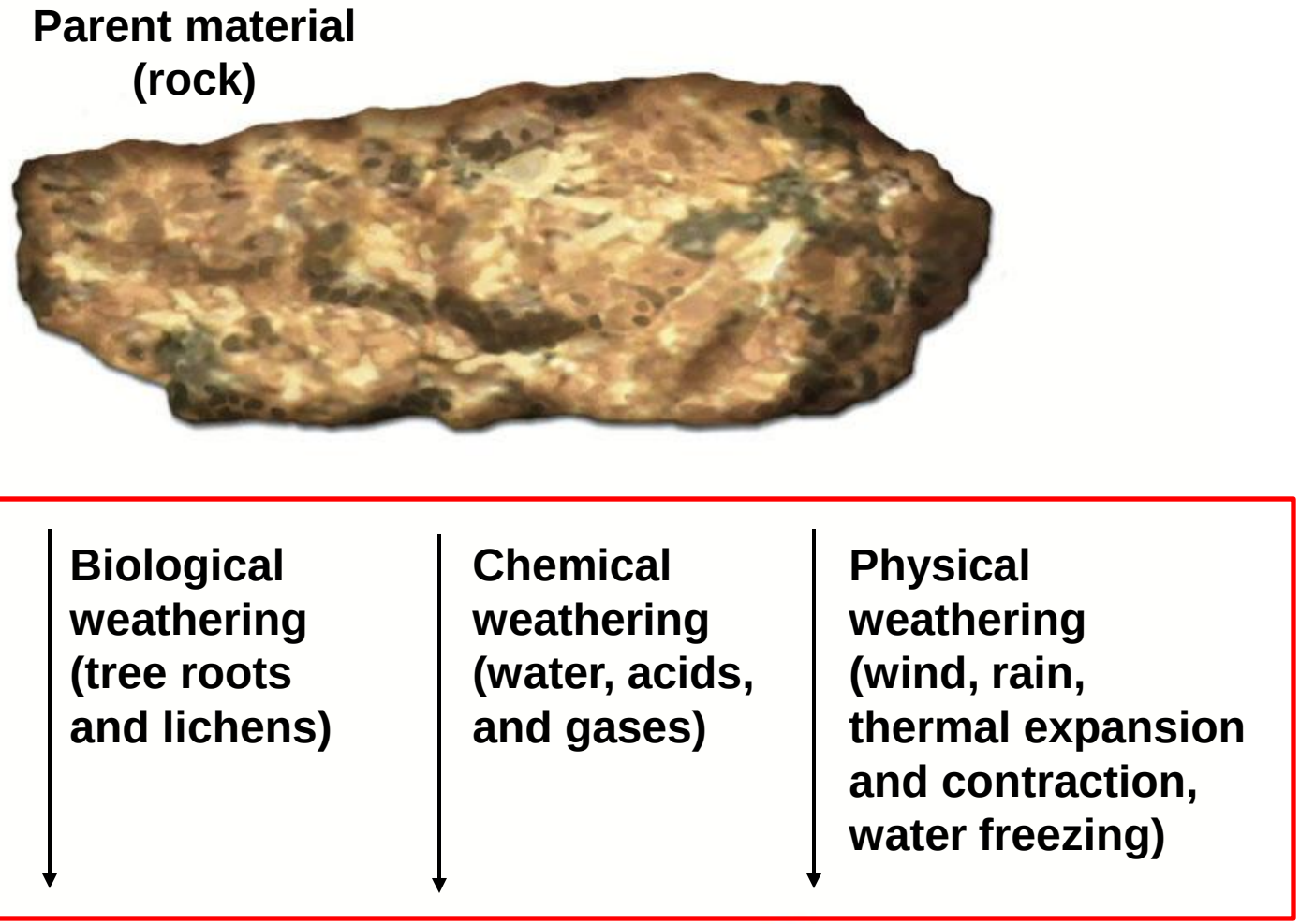


Fig. 14-6, p. 348

Earthquakes

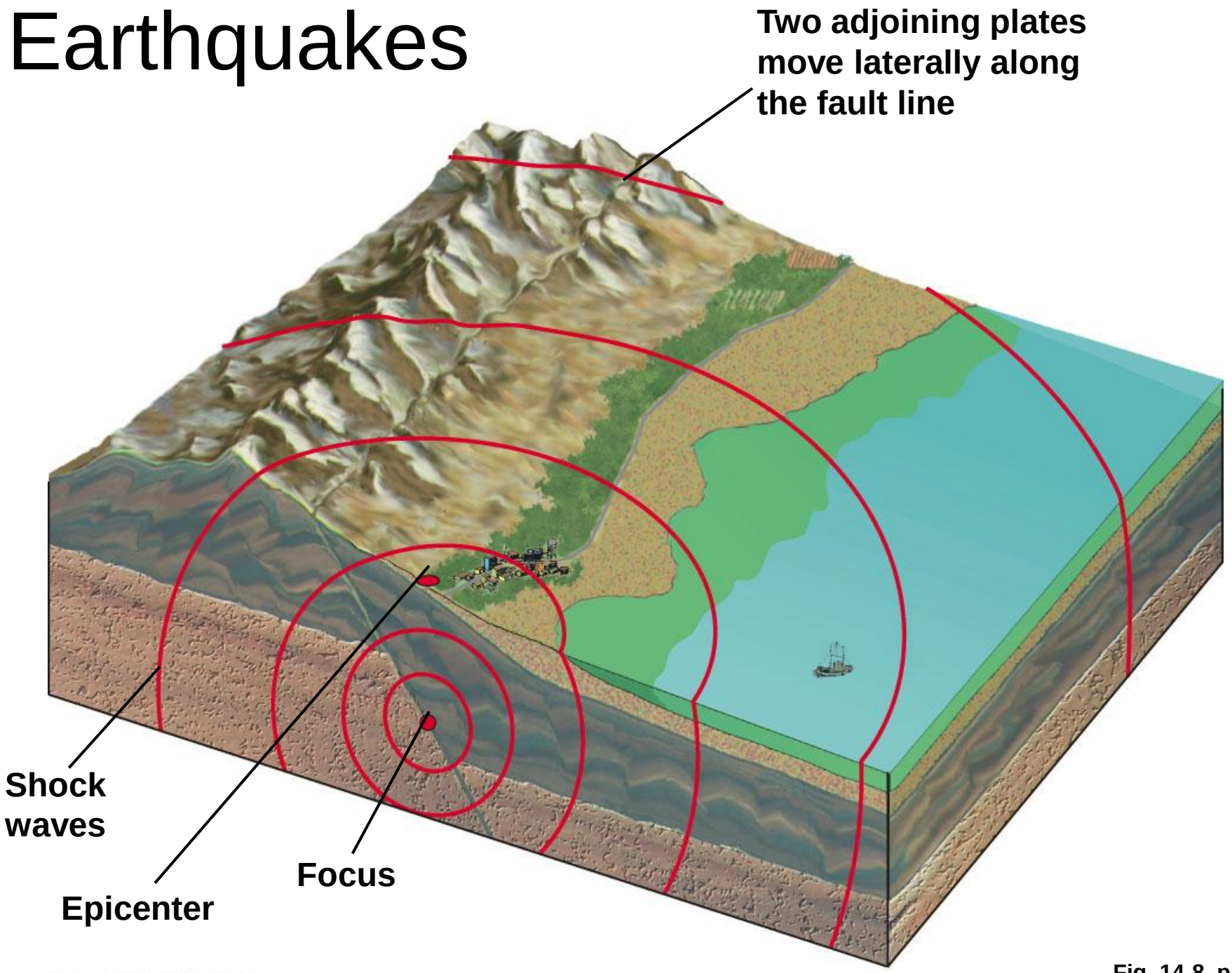


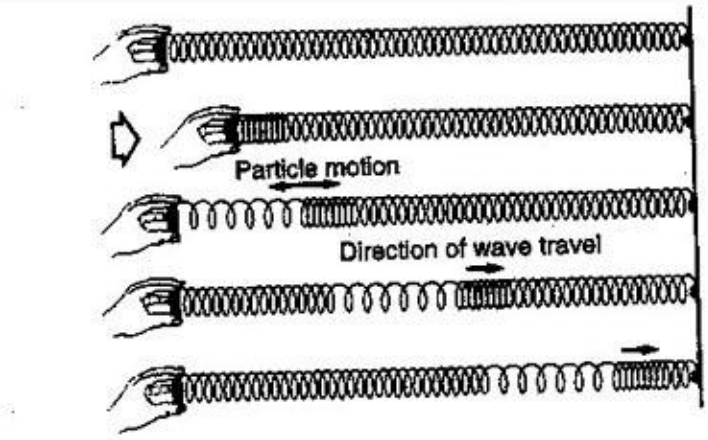
Fig. 14-8, p. 350

Earthquakes

Seismic Waves – waves generated by earthquakes

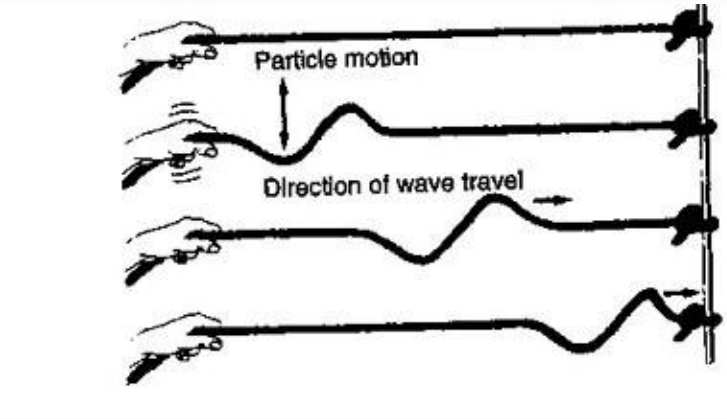
P-Waves

- Compressional Waves
- Oscillate back and forth in the same direction as their direction of motion
- Travel through solids and liquids



S-Waves

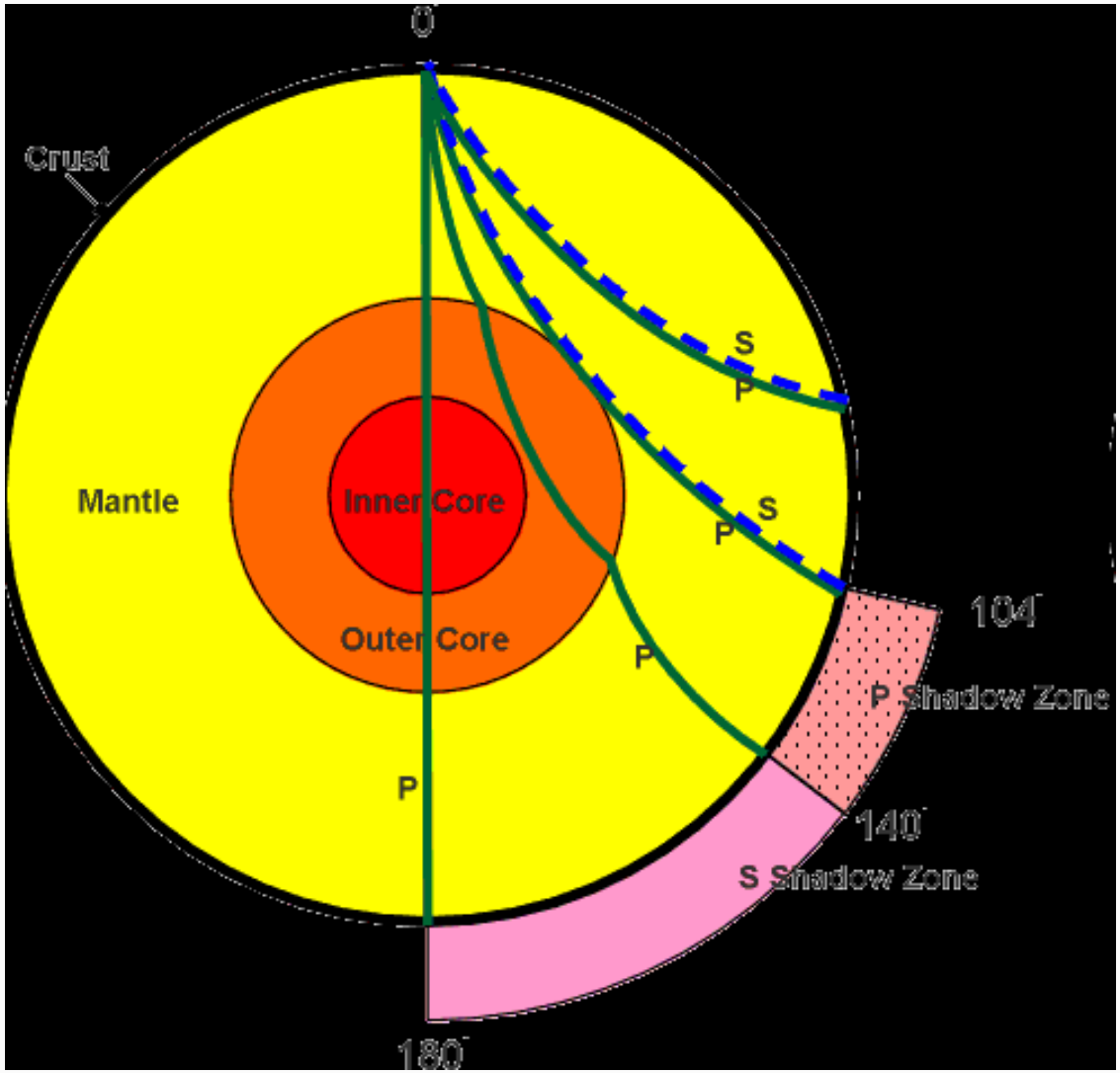
- Shear Waves
- Oscillate at right angles to their direction of motion
- Only travel through solids
- Cannot travel through liquids



Seismic Waves Determine Earth's Composition

S-Wave
Shadow Zone

P-Wave
Shadow Zone



Areas of Greatest Earthquake Risk in the United States

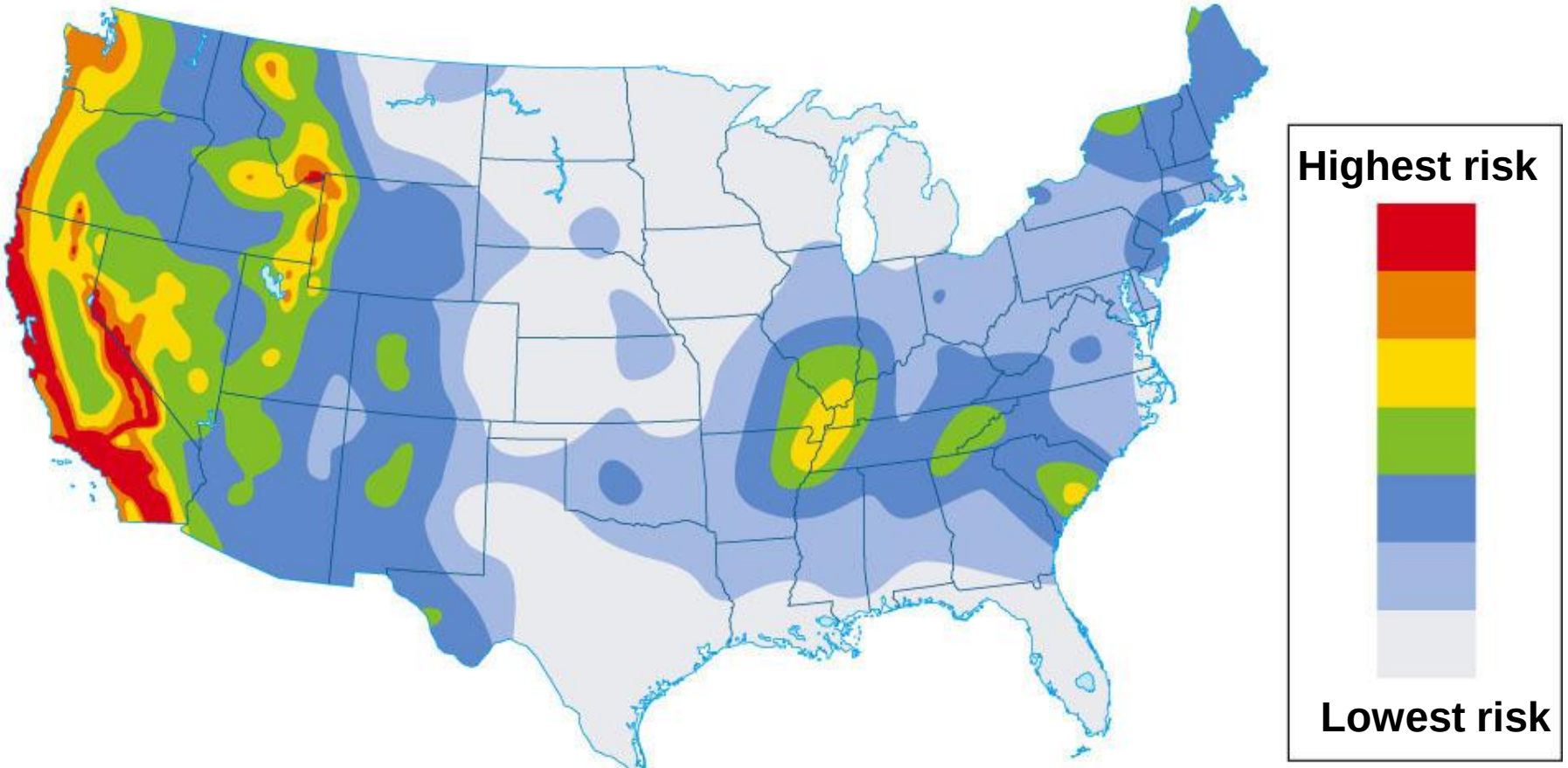


Fig. 14-9, p. 350

Earthquakes on the Ocean Floor Can Cause Huge Waves Called Tsunamis

- **Tsunami (tidal wave) –** a series of large waves generated when part of the ocean floor suddenly rises or drops (underwater earthquake along a fault zone)

- December 2004: Indian Ocean tsunami
  - Magnitude of 9.15 earthquake produced waves that grew to 100 feet when they approached shore
  - coral reefs and mangrove forests in parts of Thailand protected the people from the force of the huge waves (ecosystem service)
  - Worst damage – Sri Lanka – illegal coral mining and reef damage caused severe beach erosion

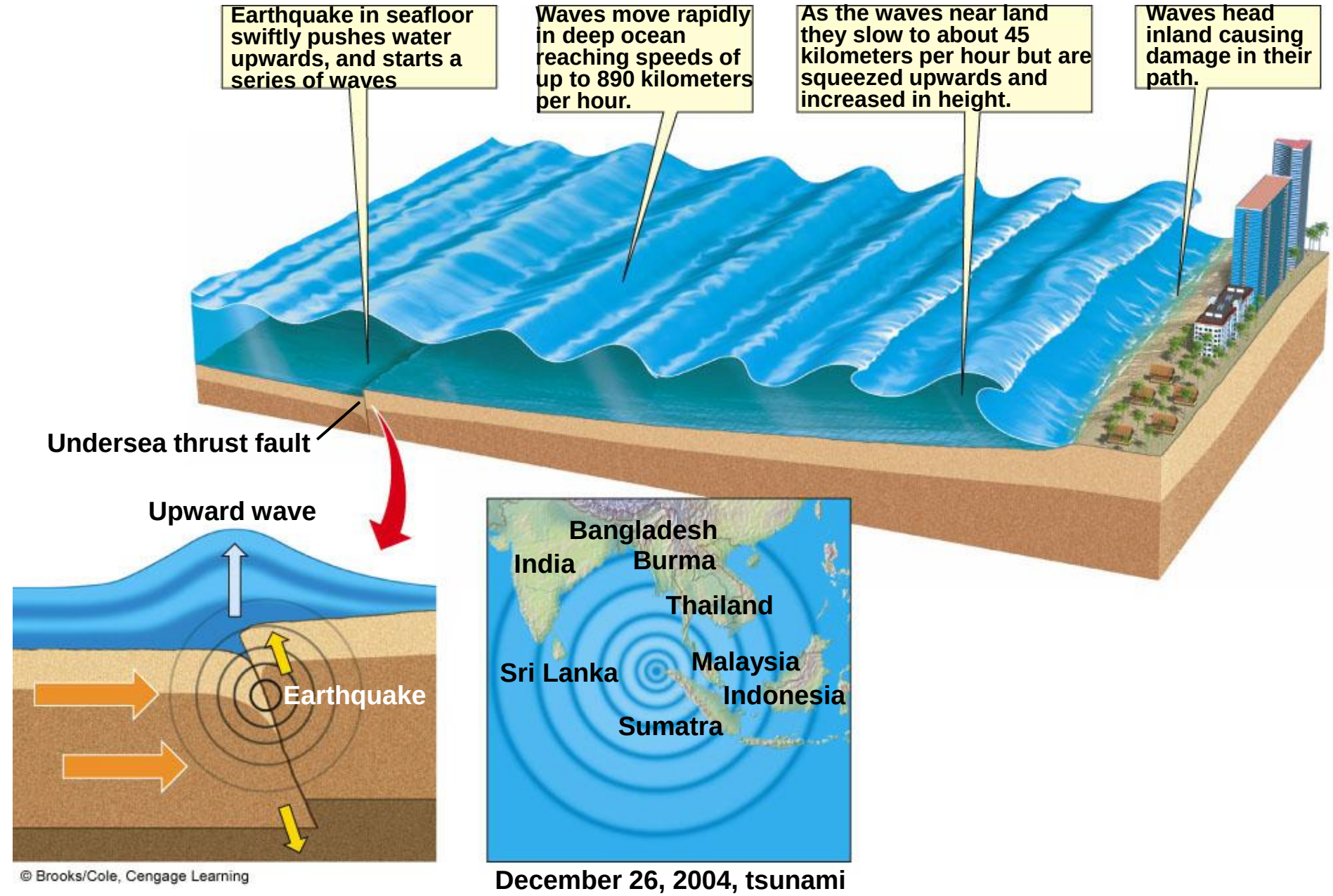


Fig. 14-11, p. 352

Shore near Gleebruk in Indonesia before and after the Tsunami on June 23, 2004

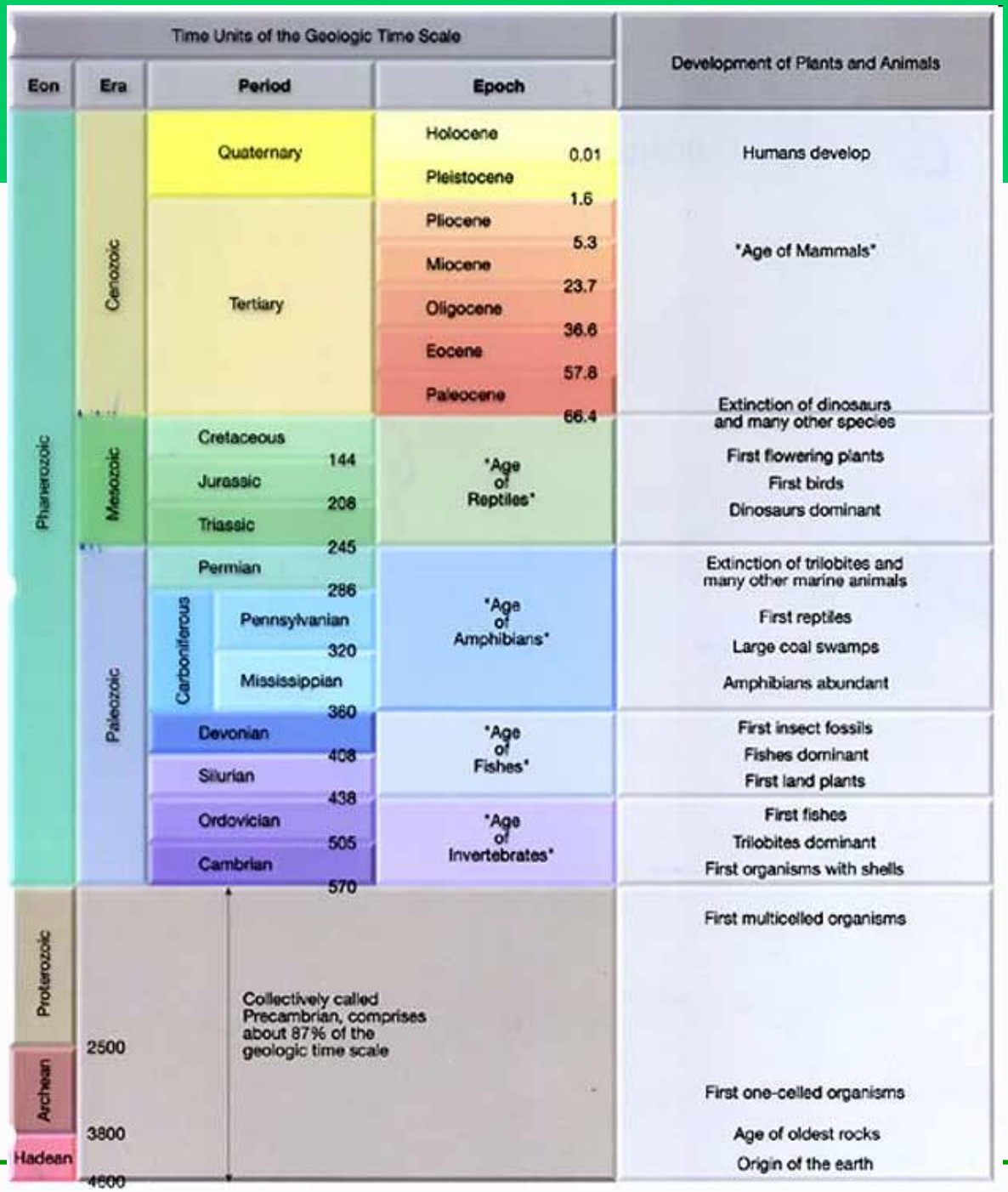
Fact or Fiction

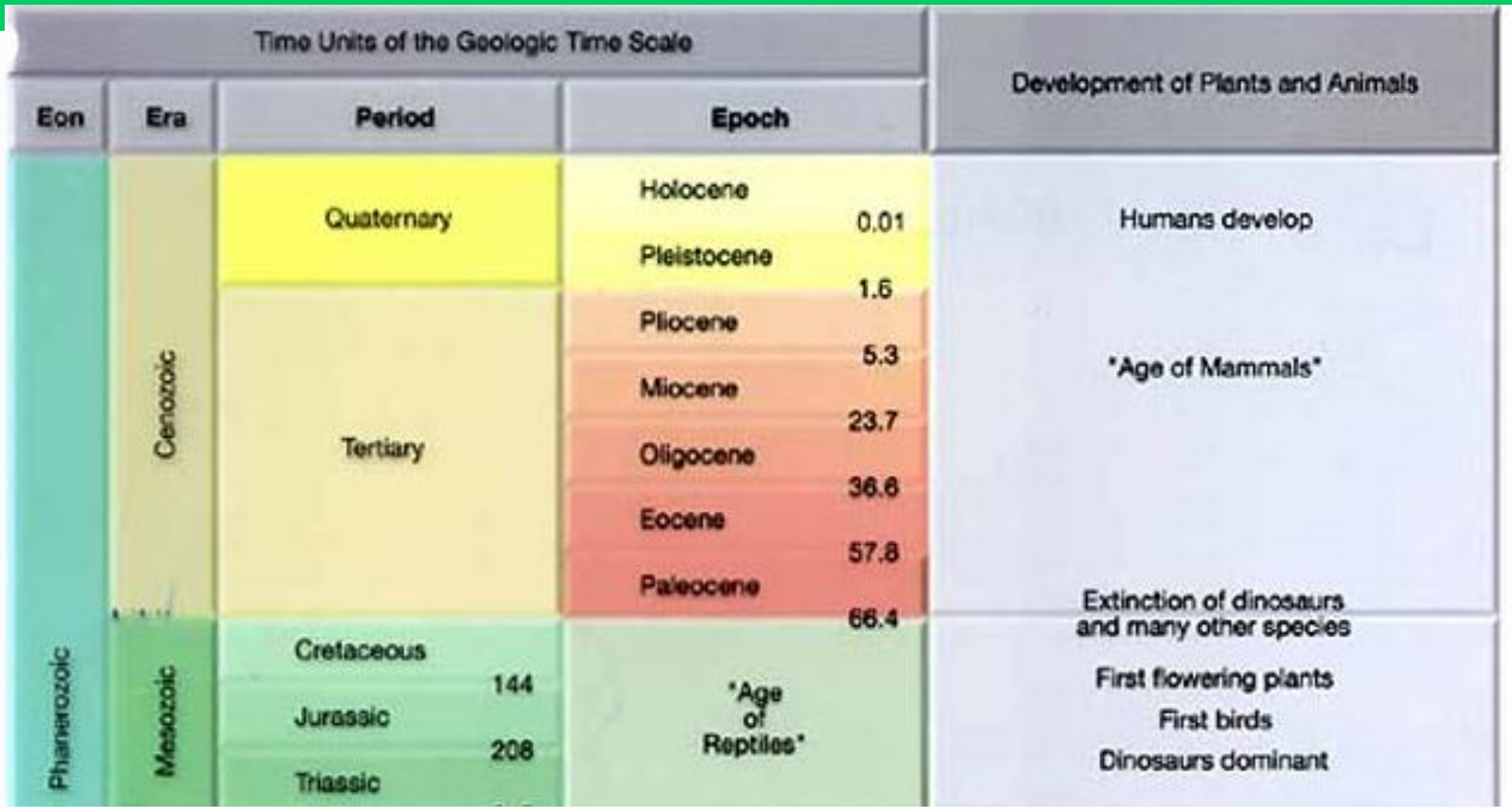
Decide which statement is the fact, hold your fingers up based on the statement you picked:

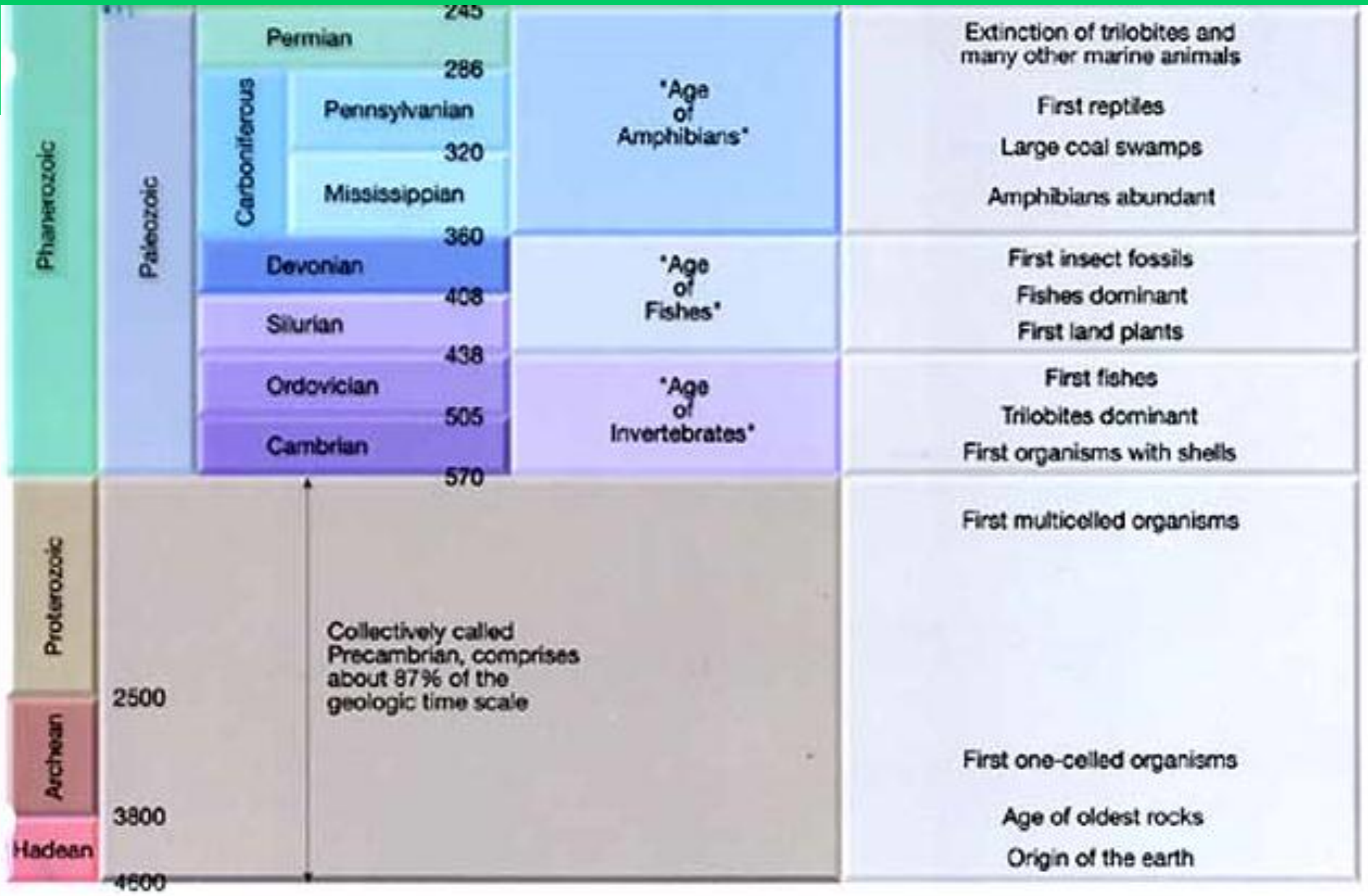
1. S waves go through solids
2. P waves go through liquids and solids
3. S waves oscillate parallel to their direction of motion
4. P waves oscillate parallel to their direction of motion

Earth's History

- Earth is 4.6 billion years old.
- The Geologic Time Scale outlines the development of Earth and life on Earth
- The geologic history of Earth is marked by major changes in Earth's surface, climate and types of organisms.
- A unit of geologic time is generally characterized by fossils of a dominant life form.
- Mass extinctions often mark the end of a geologic time period.


Time Units of the Geologic Time Scale
Eon
Era
Period
Epoch
Development of Plants and Animals
Phanerozoic
Cenozoic
Quaternary
Holocene
0.01
Pleistocene
1.6
Humans develop
Tertiary
Pliocene
5.3
Miocene
23.7
"Age of Mammals"
Oligocene
36.6
Eocene
57.8
Paleocene
66.4
Extinction of dinosaurs and many other species
Mesozoic
Cretaceous
144
"Age of Reptiles"
First flowering plants
Jurassic
208
First birds
Triassic
245
Dinosaurs dominant
Paleozoic
Permian
286
Extinction of trilobites and many other marine animals
Carboniferous
Pennsylvanian
320
"Age of Amphibians"
First reptiles
Large coal swamps
Mississippian
360
Amphibians abundant
Devonian
408
"Age of Fishes"
First insect fossils
Fishes dominant
First land plants
Silurian
438
Ordovician
505
"Age of Invertebrates"
First fishes
Trilobites dominant
Cambrian
570
First organisms with shells
Proterozoic
First multicelled organisms
Collectively called Precambrian, comprises about 87% of the geologic time scale
Archean
2500
First one-celled organisms
Hadean
3800
Age of oldest rocks
4600
Origin of the earth


Time Units of the Geologic Time Scale
Development of Plants and Animals
Eon
Era
Period
Epoch
Phanerozoic
Cenozoic
Mesozoic
Quaternary
Tertiary
Cretaceous
Jurassic
Triassic
Holocene
Pleistocene
Pliocene
Miocene
Oligocene
Eocene
Paleocene
"Age of Reptiles"
0.01
1.6
5.3
23.7
36.6
57.8
66.4
144
208
Humans develop
"Age of Mammals"
Extinction of dinosaurs and many other species
First flowering plants
First birds
Dinosaurs dominant


Phanerozoic
Paleozoic
Permian
245
Carboniferous
286
Pennsylvanian
320
Mississippian
360
Devonian
408
Silurian
438
Ordovician
505
Cambrian
570
"Age of Amphibians"
"Age of Fishes"
"Age of Invertebrates"
Extinction of trilobites and many other marine animals
First reptiles
Large coal swamps
Amphibians abundant
First insect fossils
Fishes dominant
First land plants
First fishes
Trilobites dominant
First organisms with shells
Proterozoic
Archean
Hadean
2500
3800
4600
Collectively called Precambrian, comprises about 87% of the geologic time scale
First multicelled organisms
First one-celled organisms
Age of oldest rocks
Origin of the earth