Activating Strategy:

Watch Ice Age: Scrat Continental Crack Up video clip and have students either answer individually or with a partner the following questions:

(1) Which part(s) of Scrat's adventure is accurate?

(2) Which part(s) of Scrat's adventure is not accurate?

Essential Question:
How does the constant movement of lithospheric plates cause major geological events on the earth's surface?

Standard:

S6E5e. Recognize that lithospheric plates constantly move and cause major geological events on the earth's surface.

One of the accurate events shown in Scrat's Continental Crack Up is that the continents were once joined together but moved apart.

An inaccurate representation is that the break-up and moving of the continents occurred quickly.

https://www.youtube.com/watch?v=ft-dP2D7QM4&index=1&list=PL5D8C1AA3D9734764

In 1912, a man named Alfred Wegener proposed that at one time the continents were joined together, but over time have moved slowly to their current locations.

His hypothesis is called Continental Drift.

Wegener called the once connected large landmass Pangaea.

Pangaea Flipbook

Other than the "puzzlelike" fit of the separated continents, what evidence was used to support the theory of continental drift?

Continental Drift Evidence Task

Rock, fossil, and climate clues were the main types of evidence for continental drift. Advances in technology have provided additional clues to help explain continental drift.

Continental Drift Video

http://www.sciencechannel.com/tv-shows/greatest-discoveries/videos/100-greatest-discoveries-continental-drift/

Continental Drift Song

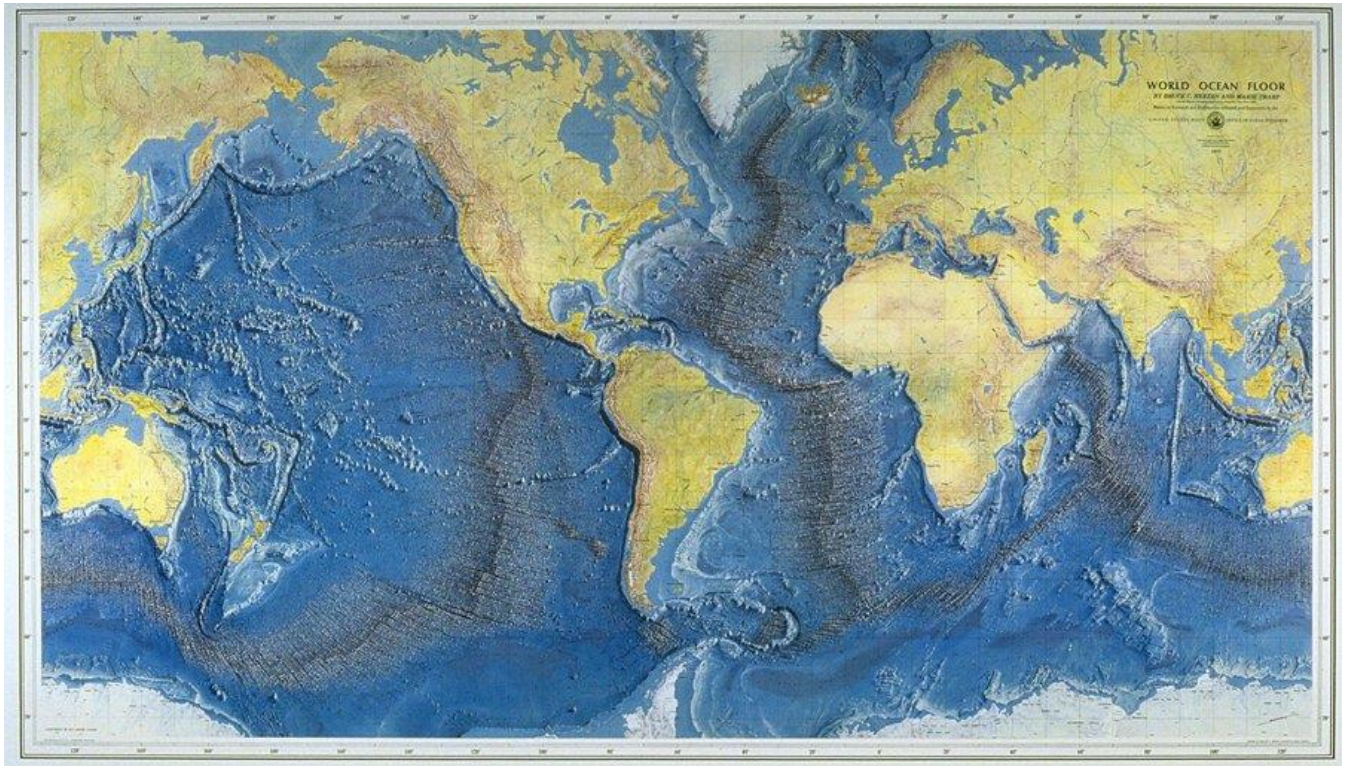
https://www.youtube.com/watch?v=T1-cES1Ekto

Turn to an elbow partner and discuss the following:

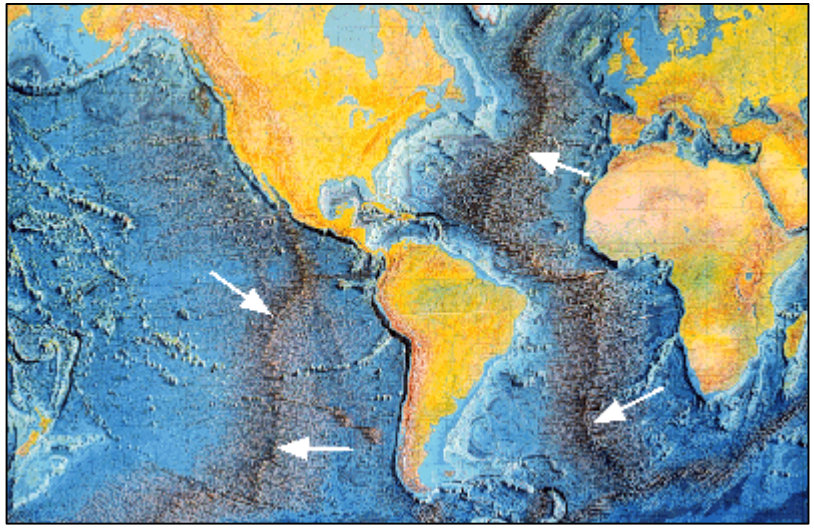
Will the continents continue to move? How do you know?

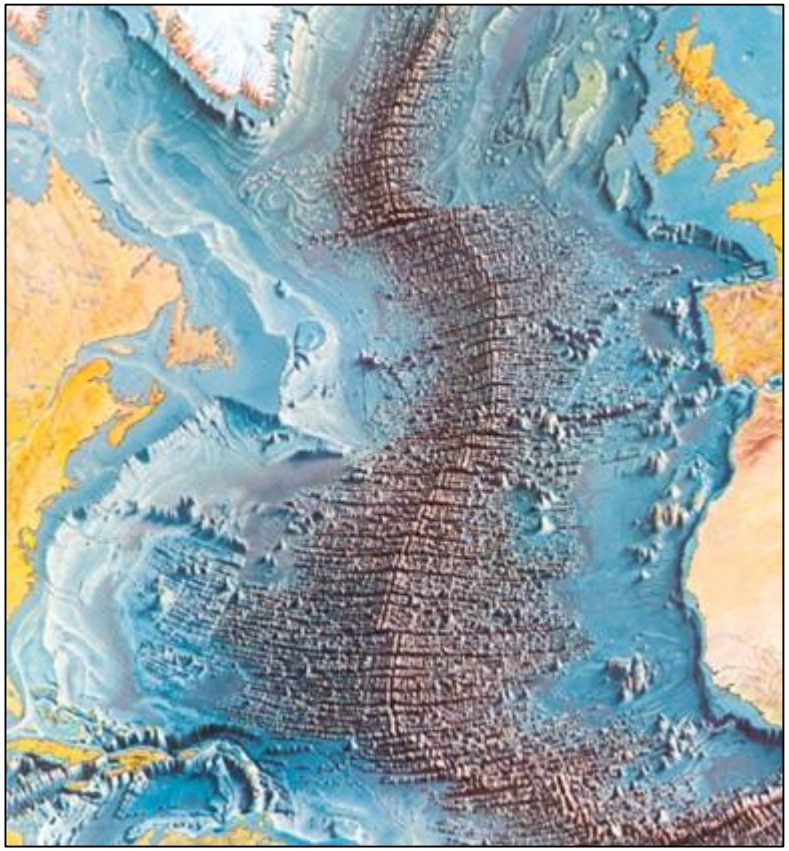
http://www.classzone.com/books/earth_science/terc/content/visualizations/es0807/es0807page01.cfm?chapter_no=visualization

During the 1940s and 1950s, using technology developed during World War I, scientists began using sound waves to map the ocean floor.

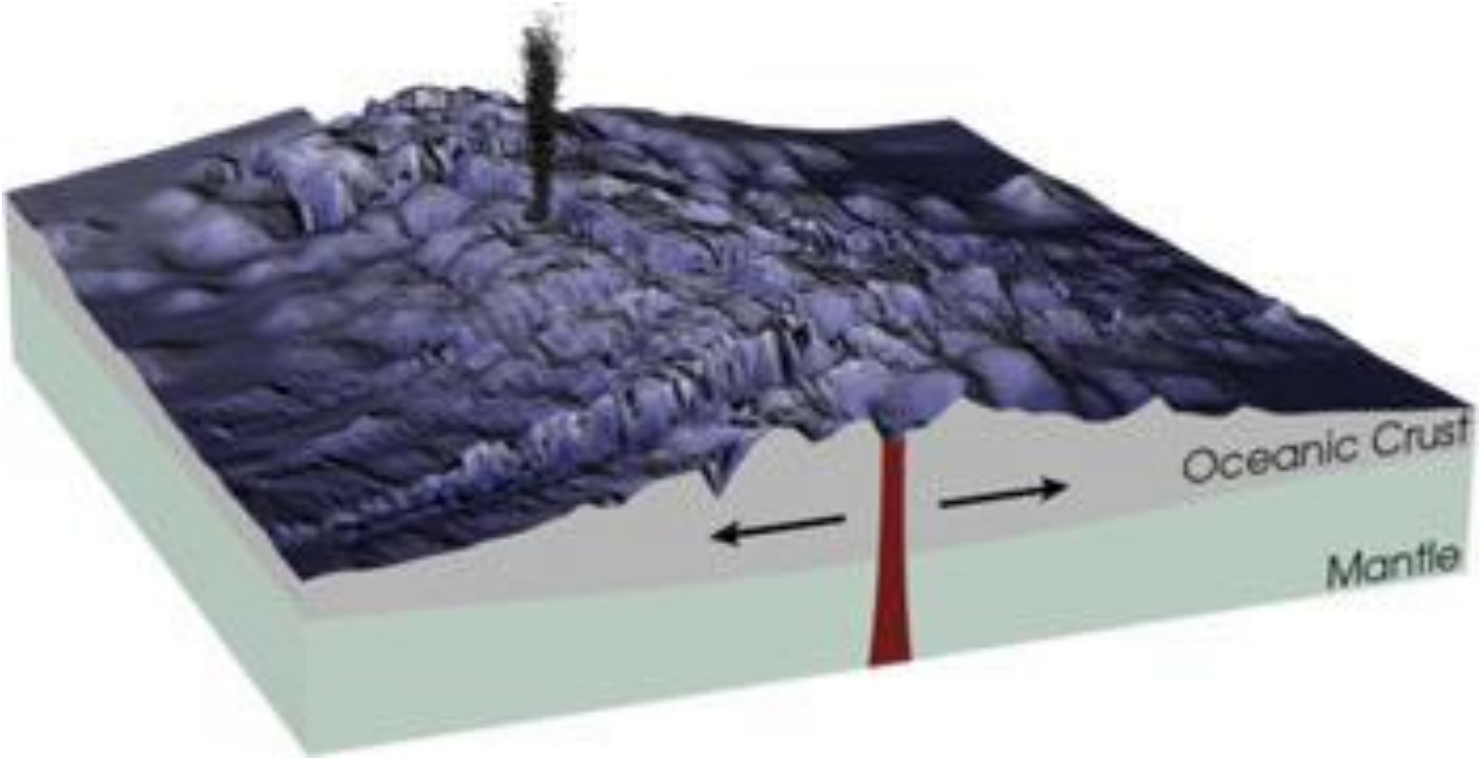


Researchers discovered an underwater system of ridges (mountains) and valleys like those found on the continents.

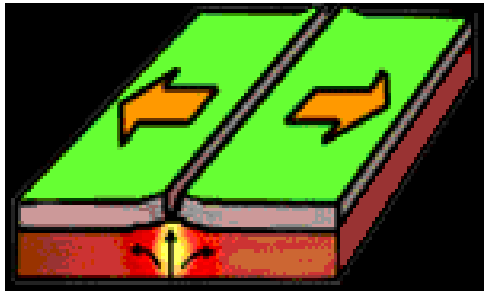




The theory of seafloor spreading explains the formation of the underwater mountain ranges.

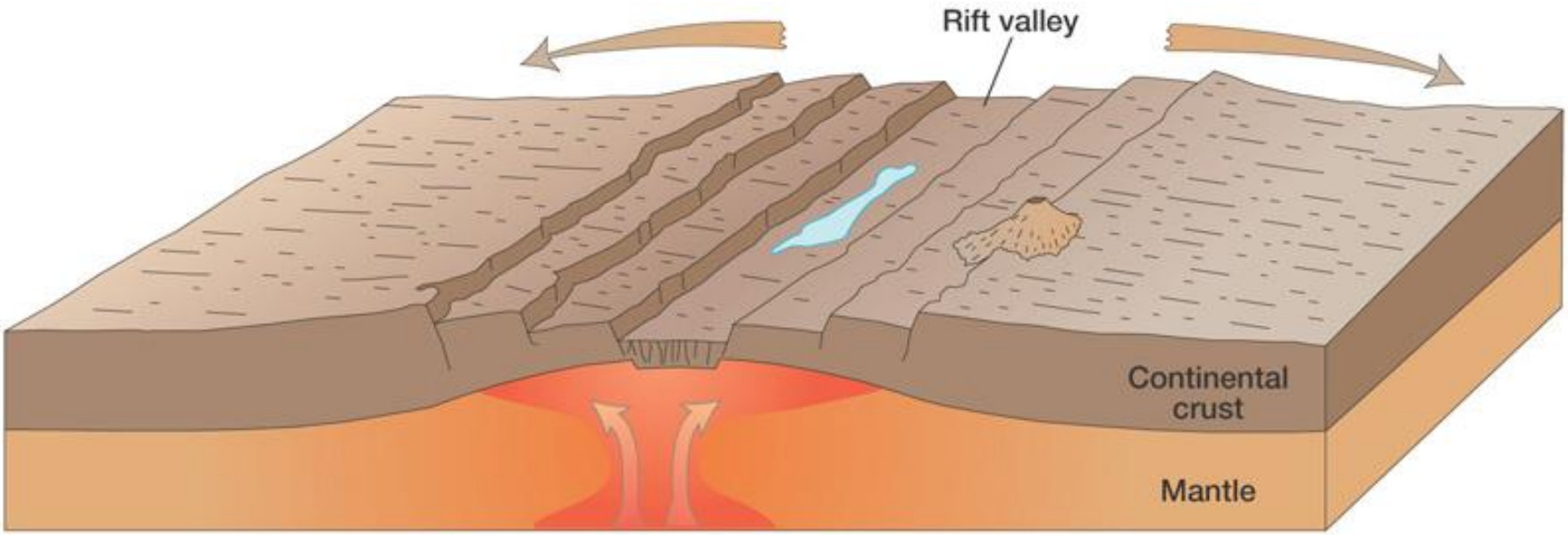


Seafloor Spreading



- Hot, less dense material below the Earth's crust rises toward the surface at the mid-ocean ridges.
- The seafloor spreads apart and magma is forced upward pushing the older seafloor away from the ridge in opposite directions.
- The magma becomes solid as it cools and sinks forming new seafloor.

Seafloor Spreading



http://www.absorblearning.com/media/attachment.action?quick=12n&att=2771

Seafloor Spreading Video Clip

http://www.sciencechannel.com/tv-shows/greatest-discoveries/videos/100-greatest-discoveries-sea-floor-spreading.htm

Age of Ocean Crust Activity

Seafloor Spreading Activity

[see resources]

If new crust is being added by seafloor spreading, does the Earth's surface just keep expanding?

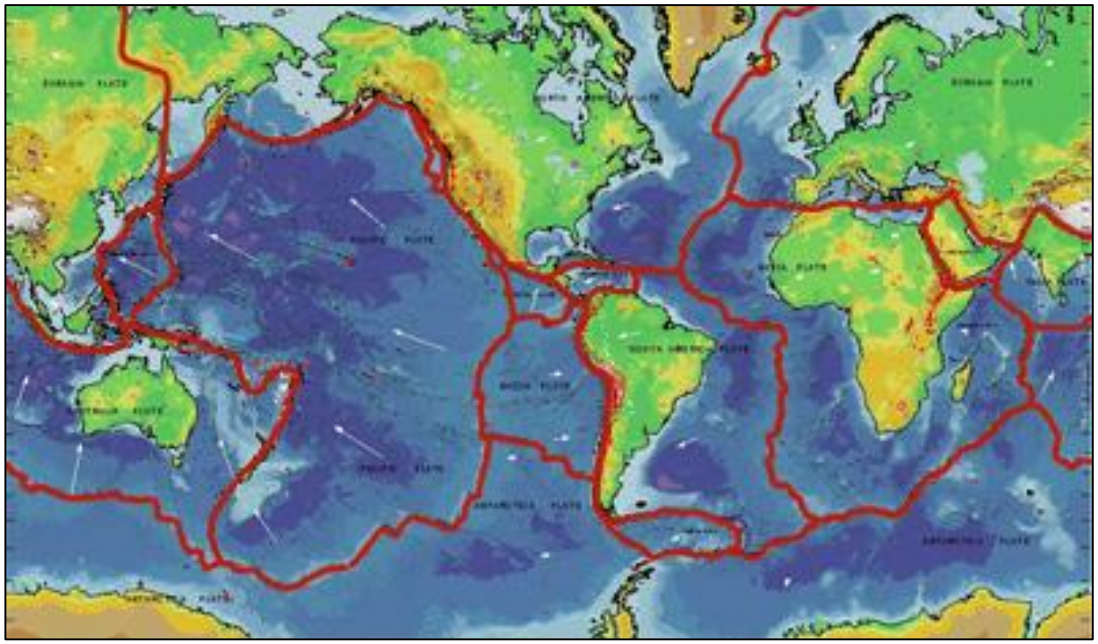
No, it does not keep expanding, but what happens to it?

Let's continue to find out.

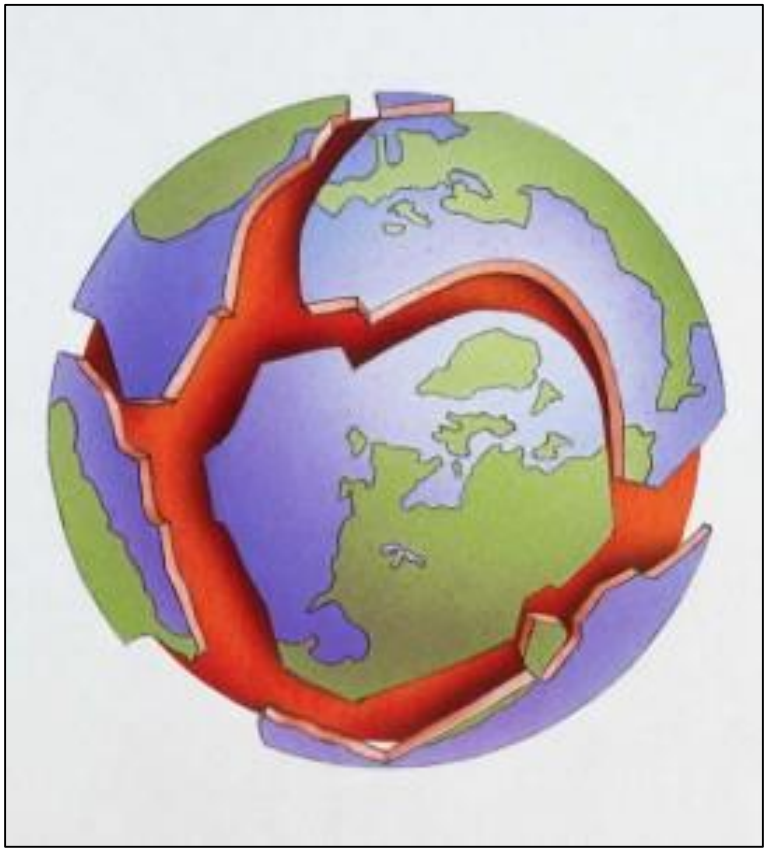
The idea of seafloor spreading showed that more than just the continents were moving, as continental drift had shown.

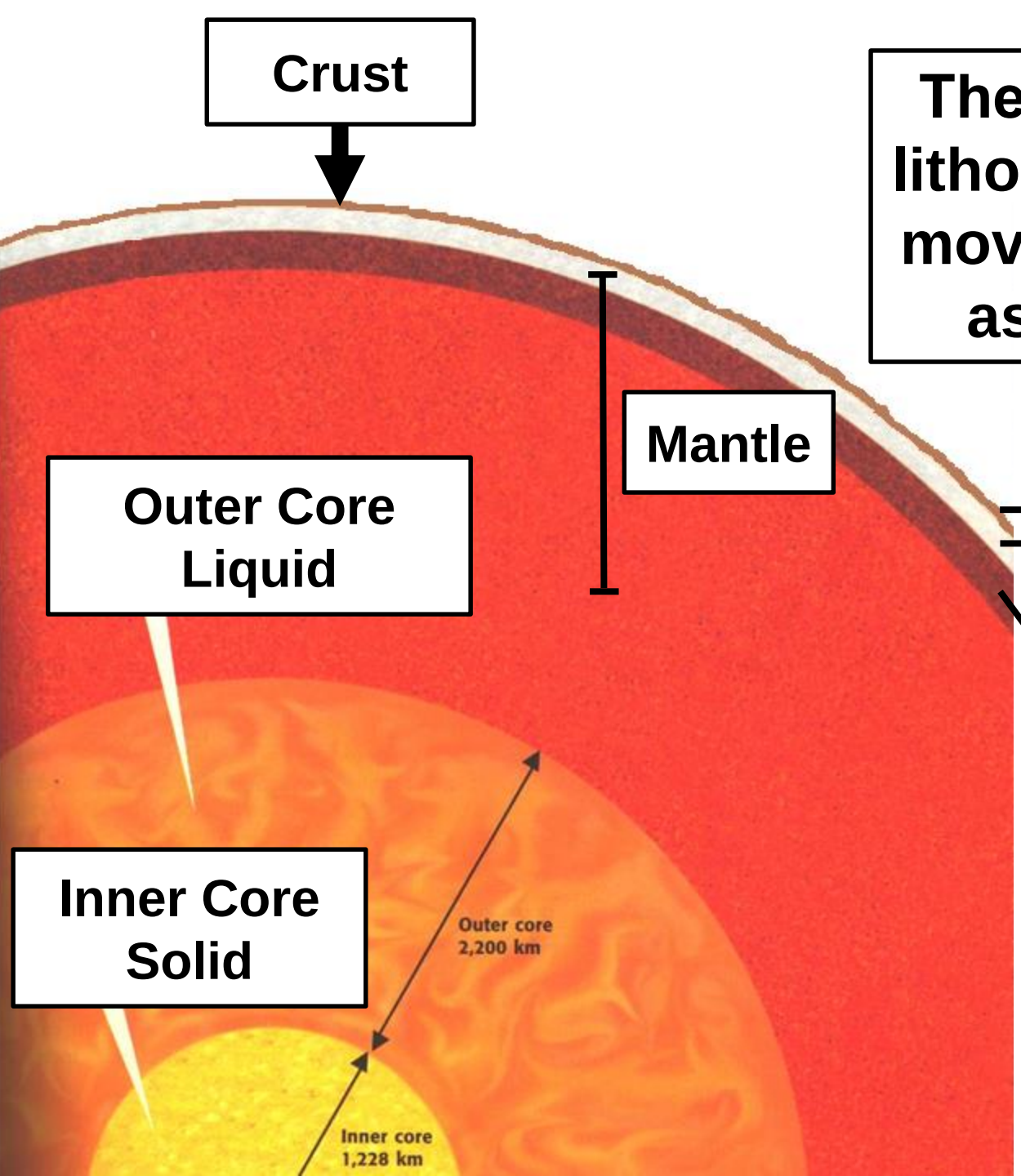
Scientists now believe that sections of the seafloor and continents move in relation to one another.

A new theory that combined continental drift and seafloor spreading was developed known as the theory of Plate Tectonics.



The theory of Plate Tectonics states that the Earth's crust and part of the Upper Mantle are broken into plates (sections) that move.





The "plates" of the lithosphere float and move around on the asthenosphere.

Lithosphere – Crust and Upper Layer of the Mantle

Layer of the Mantle (asthenosphere) that consists of hot rock of tar-like consistency, which slowly moves

https://www.youtube.com/watch?v=Z9Hr7V1S0pI

Plate Boundary Map

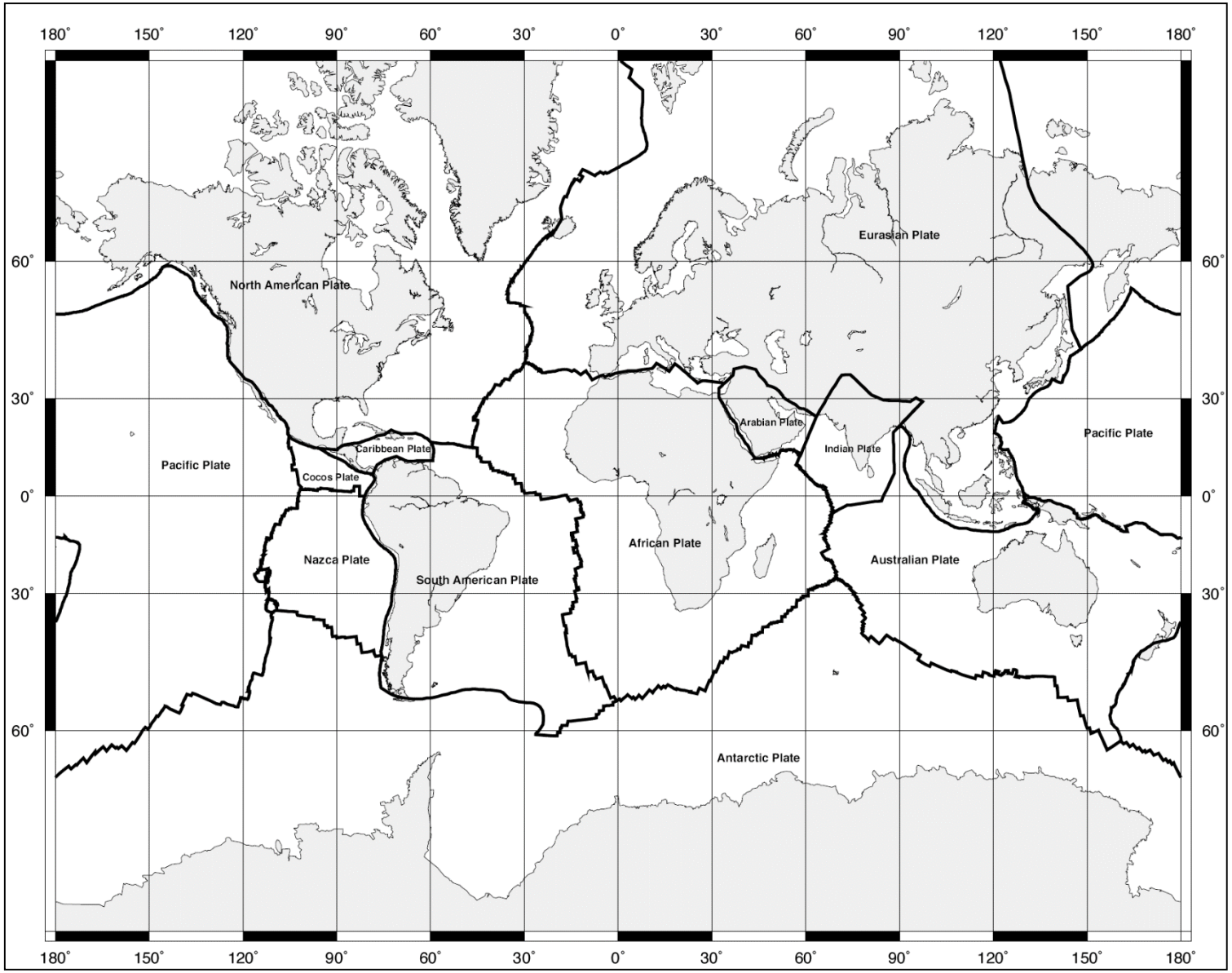
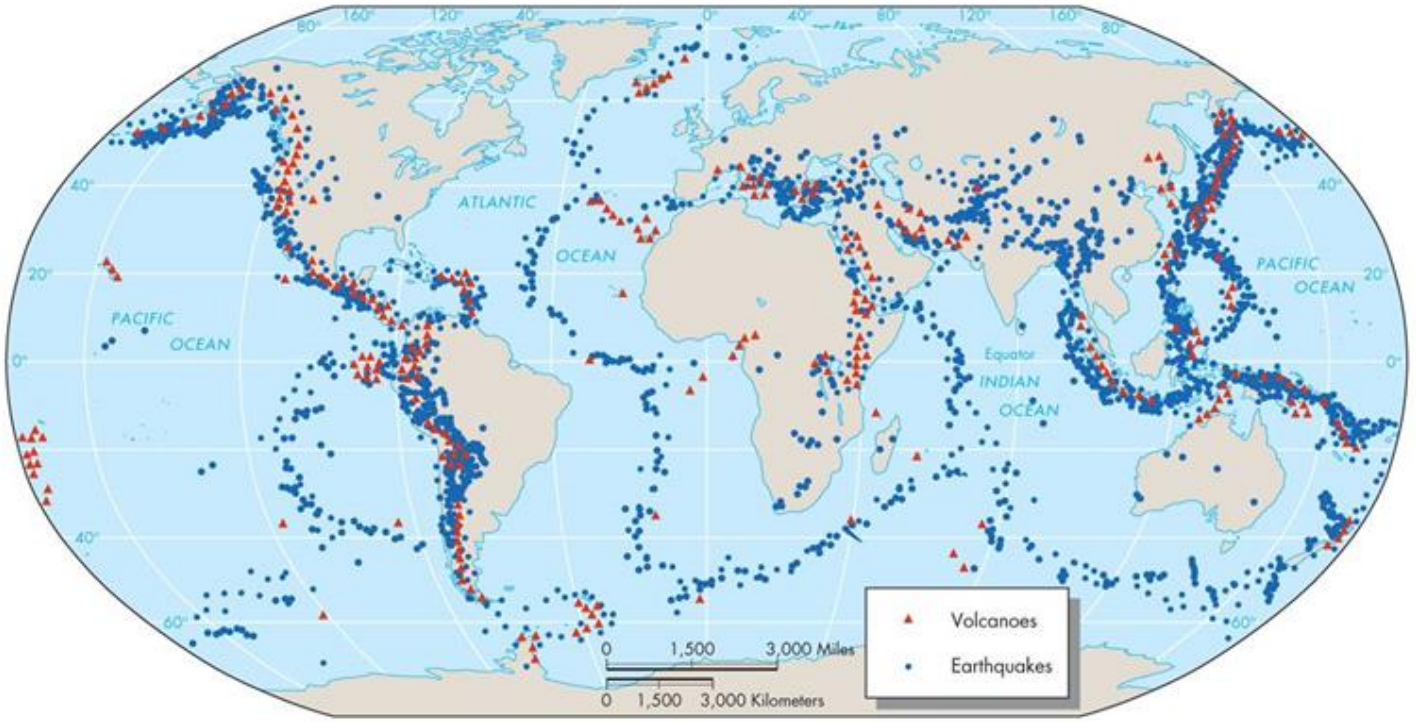


Plate Boundary Analysis Activity

What did you discover from the Plate Boundary Analysis Activity?



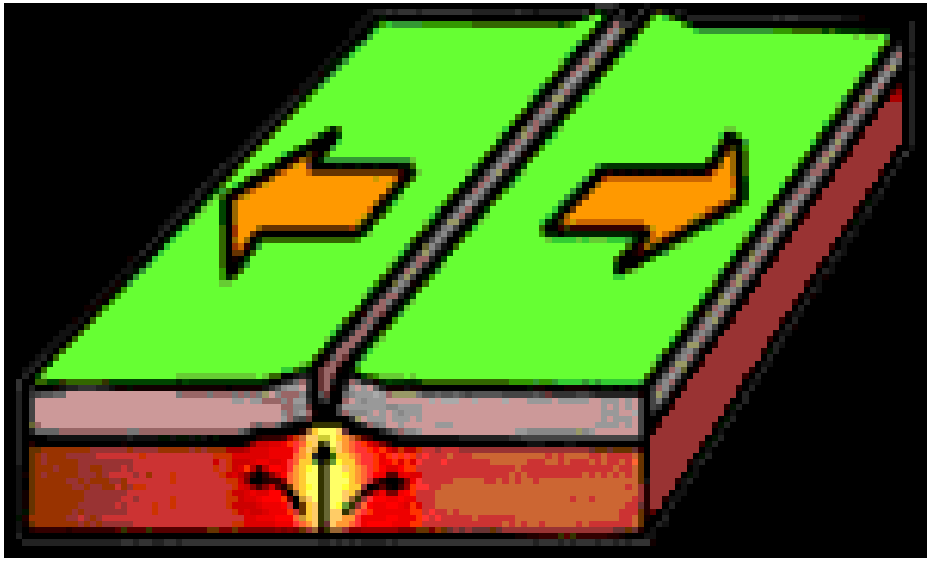
Volcanoes and Earthquakes form along tectonic plate boundaries? But Why?

When plates move, they can interact in several ways:

- They can move toward each other
- They can pull apart from each other
- They can slide alongside one another

The result of plate movement can be seen at plate boundaries.

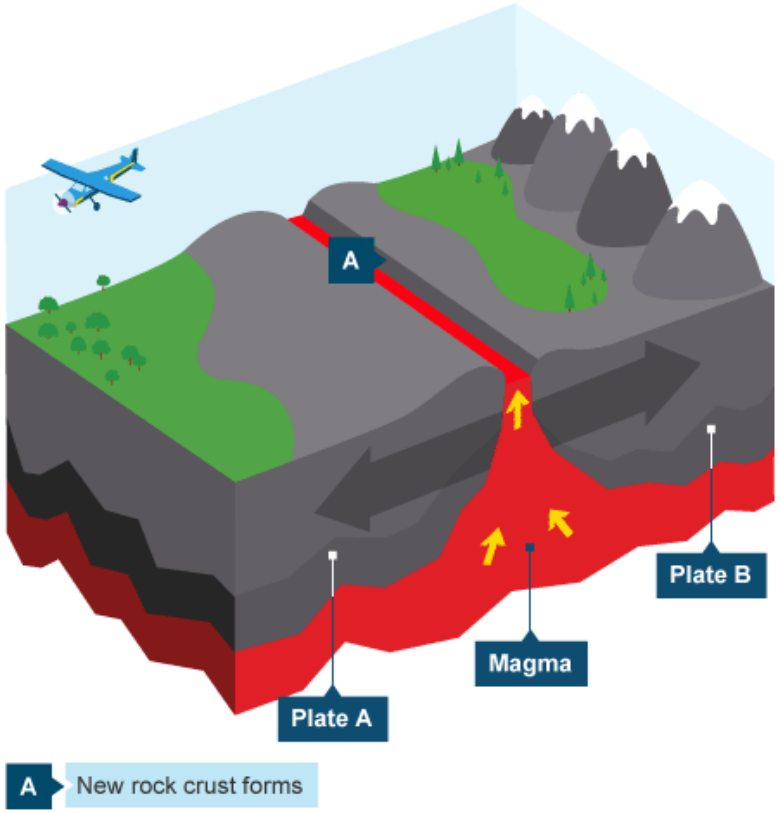
Divergent Plate Boundary: two plates are moving apart and new crust is created



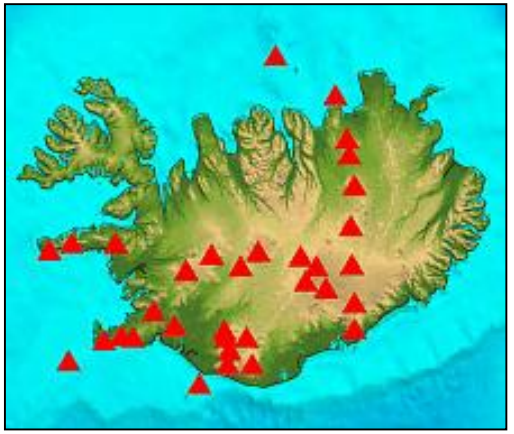
Divergent Plate Boundary:

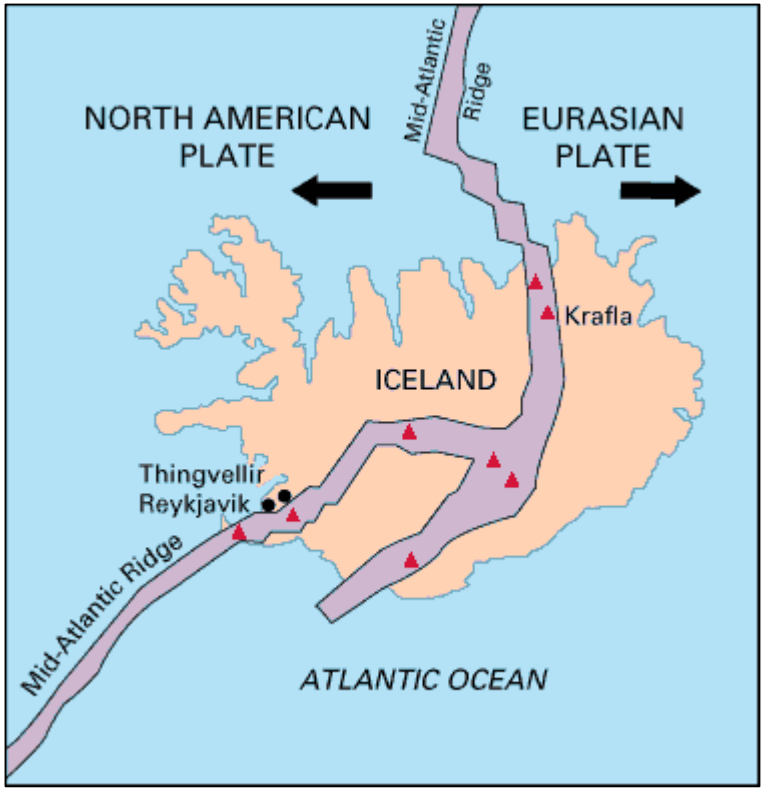
Continental Plate ⟵ ⟶ Continental Plate

When two continental plates spread apart rifts (cracks) begin. Magma can rise and squeeze between the cracks sometimes forming volcanoes.

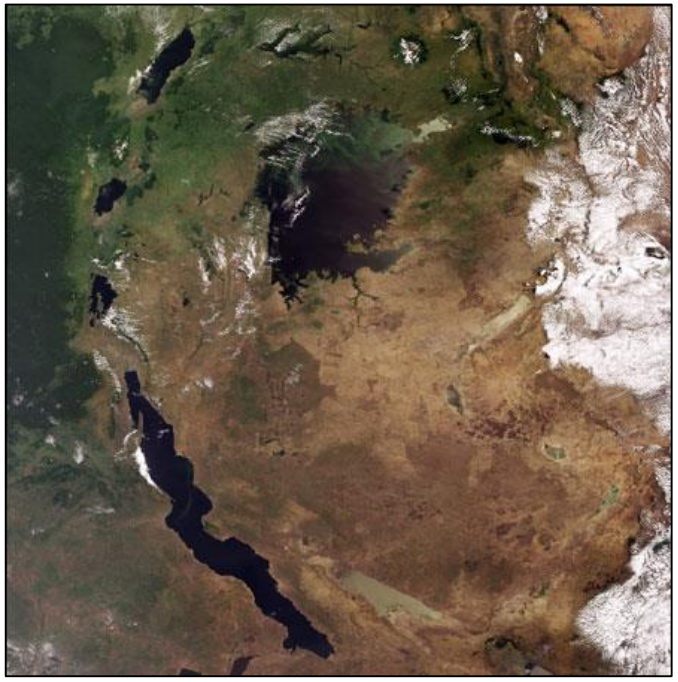


Divergent Boundary in Iceland



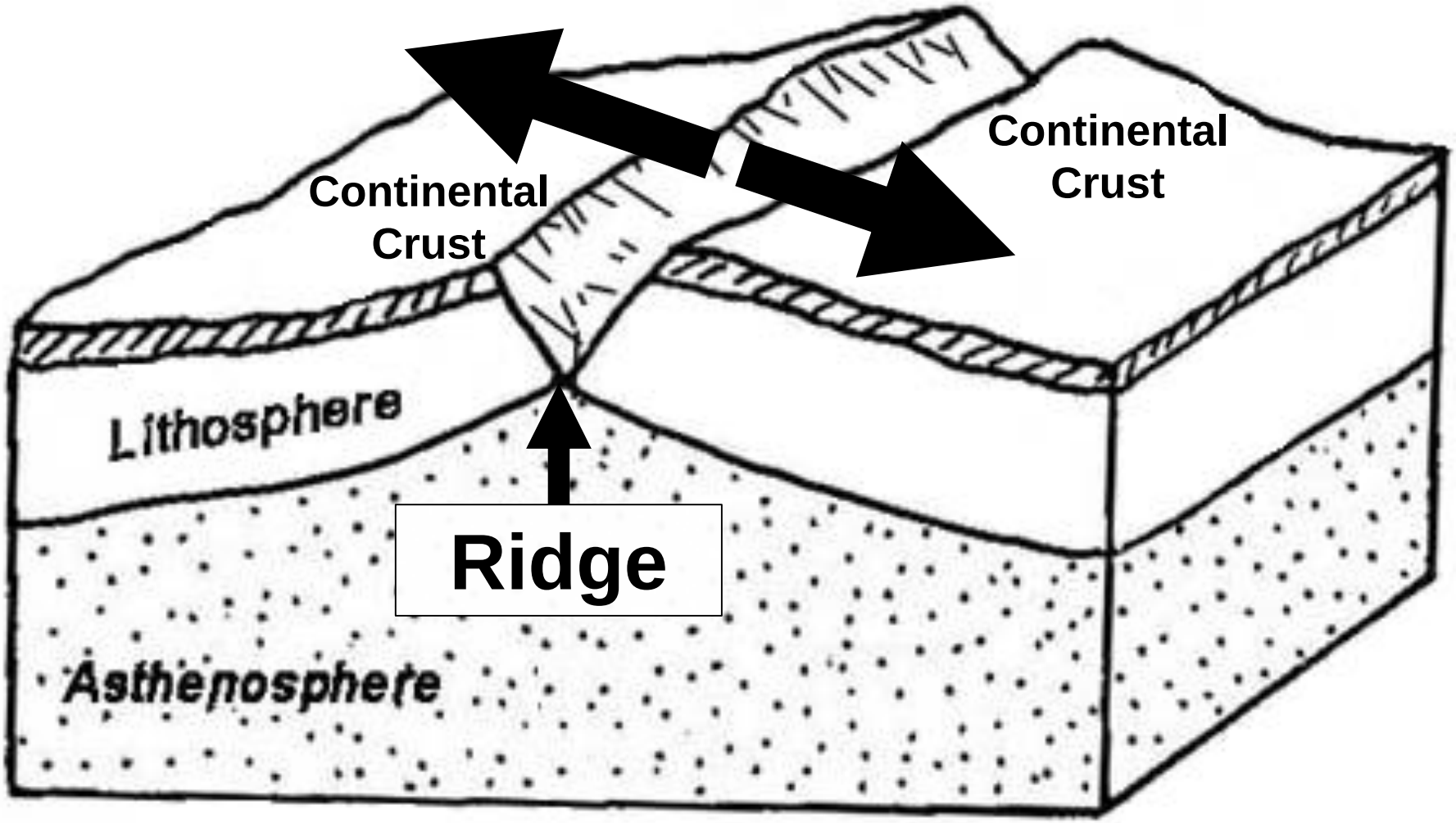


Divergent Boundary in Africa



Divergent Plate Boundary:

Continental Plate ← → Continental Plate



Divergent Plate Boundary:

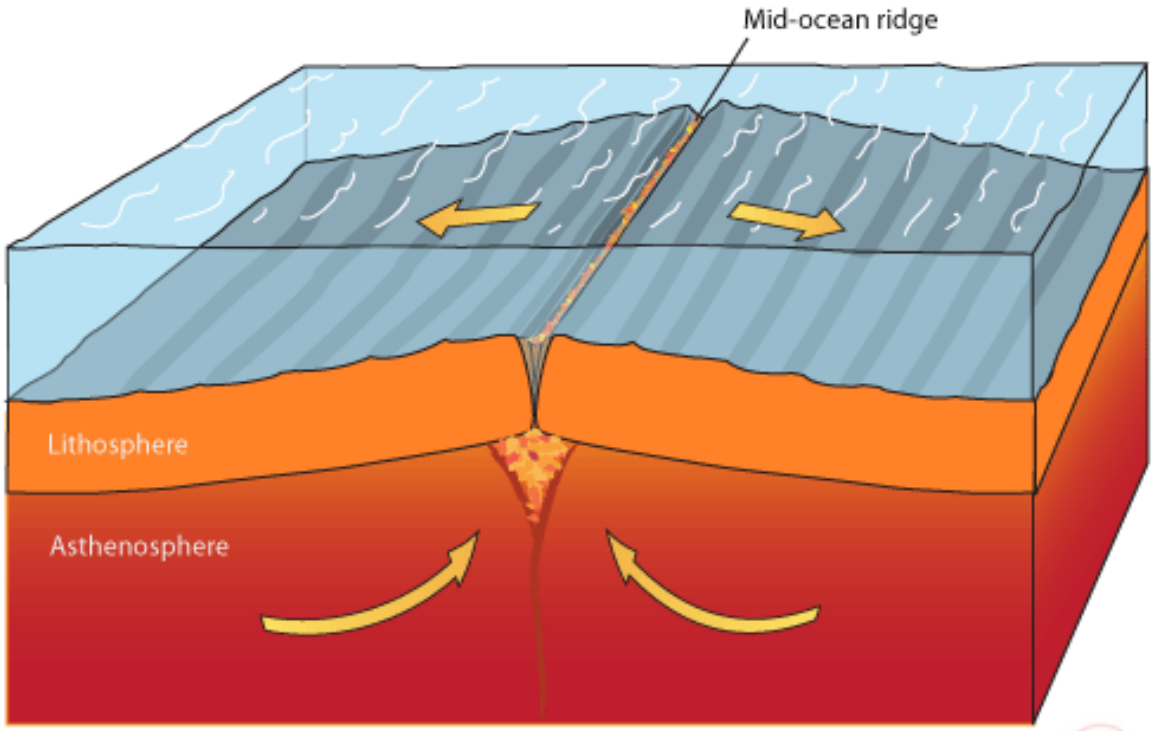
Oceanic Plate ← → Oceanic Plate

When two oceanic plates spread apart magma is forced upward pushing the older seafloor away in opposite directions forming a ridge.

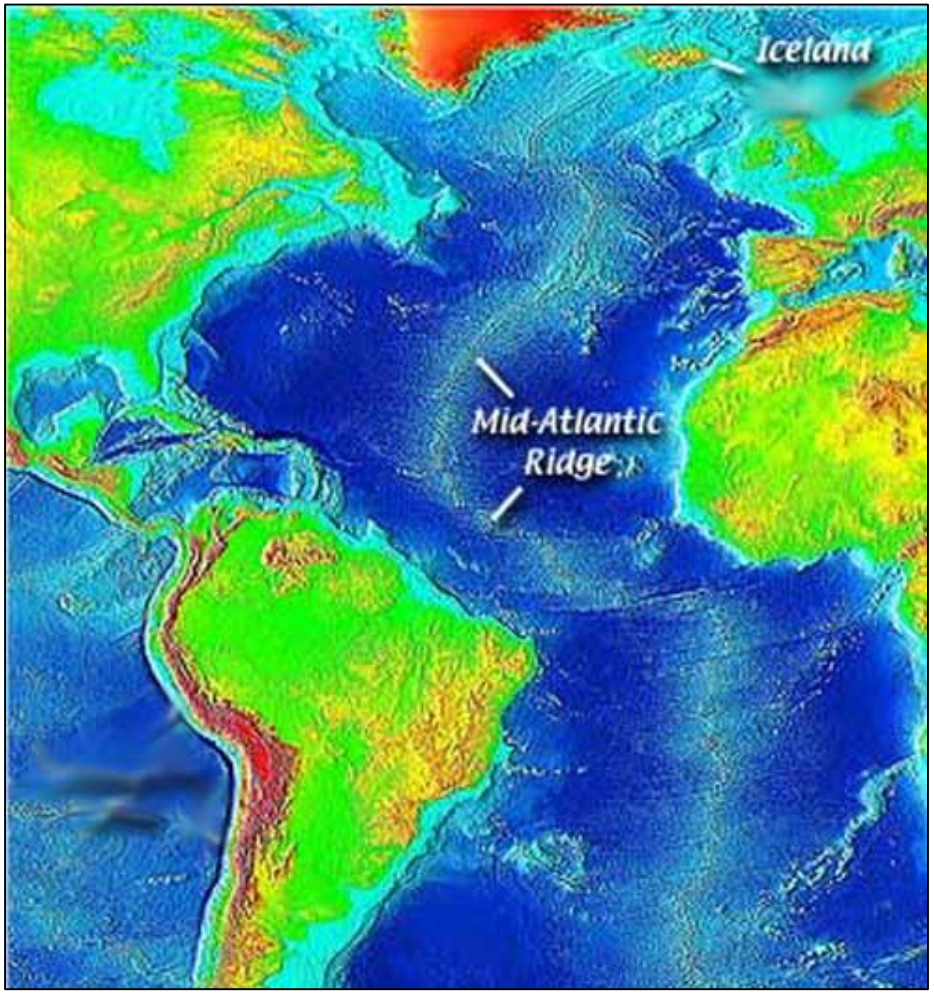
http://www.classzone.com/books/earth_science/terc/content/visualizations/es0903/es0903page01.cfm?chapter_no=visualization

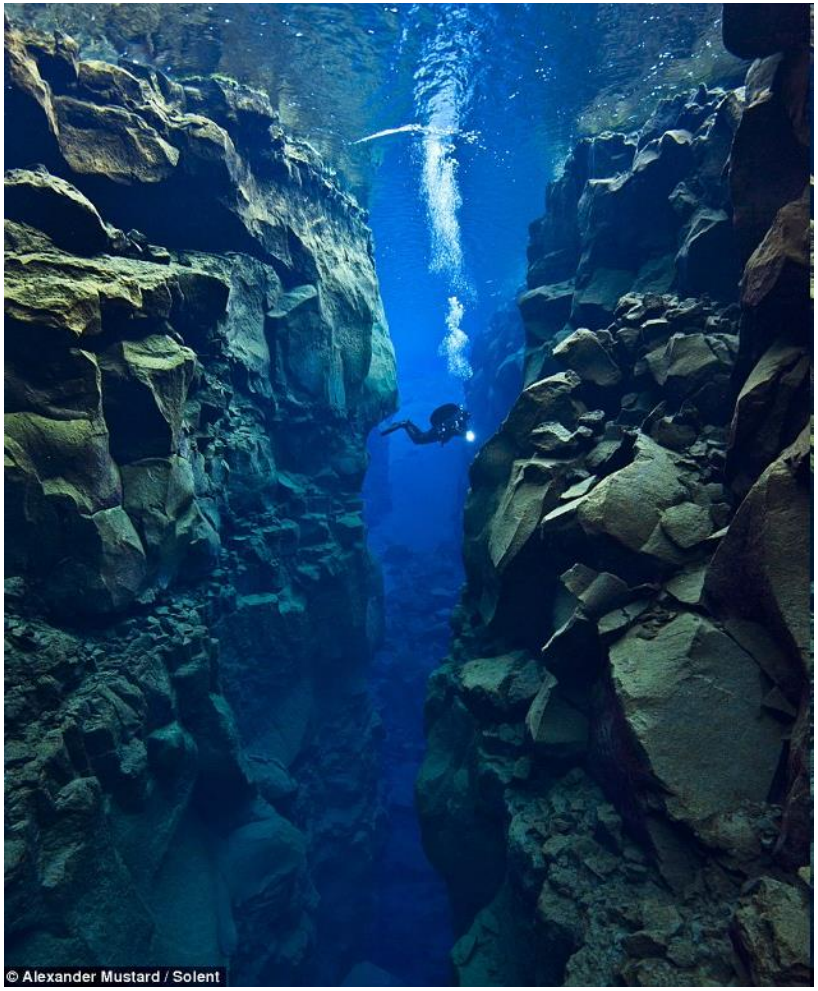
Divergent Plate Boundary:

Oceanic Plate ← → Oceanic Plate



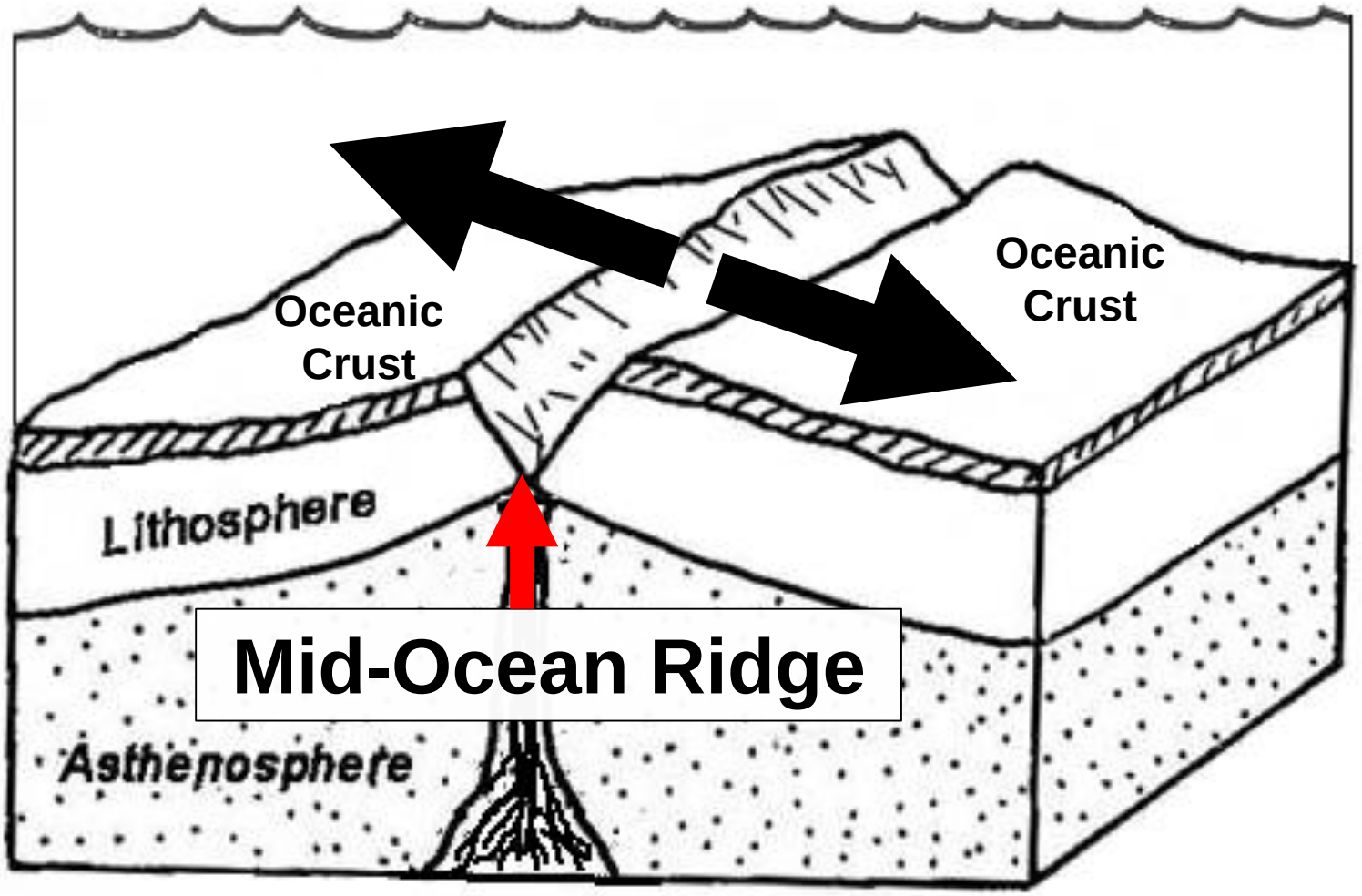
Divergent Boundary: Mid-Atlantic Ridge



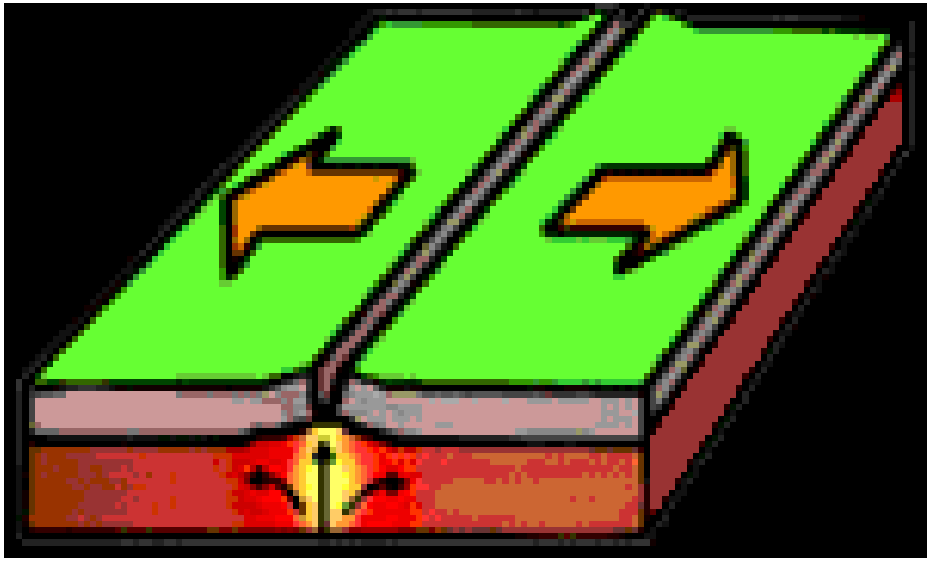


Divergent Plate Boundary:

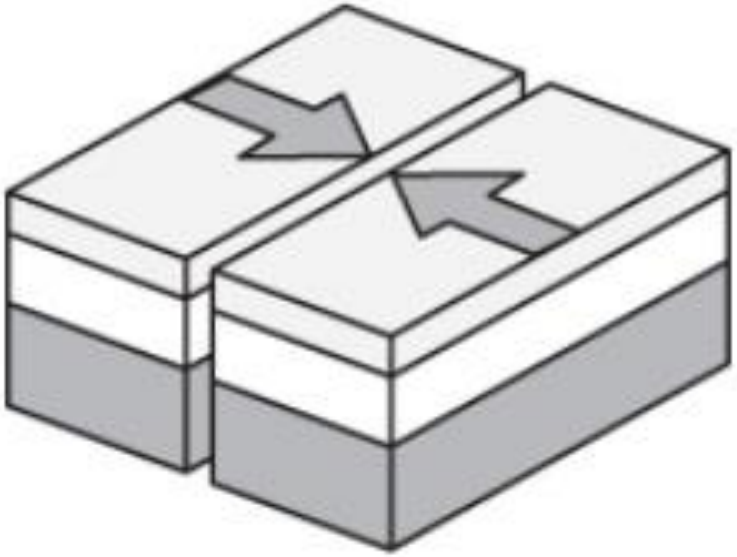
Oceanic Plate ← → Oceanic Plate



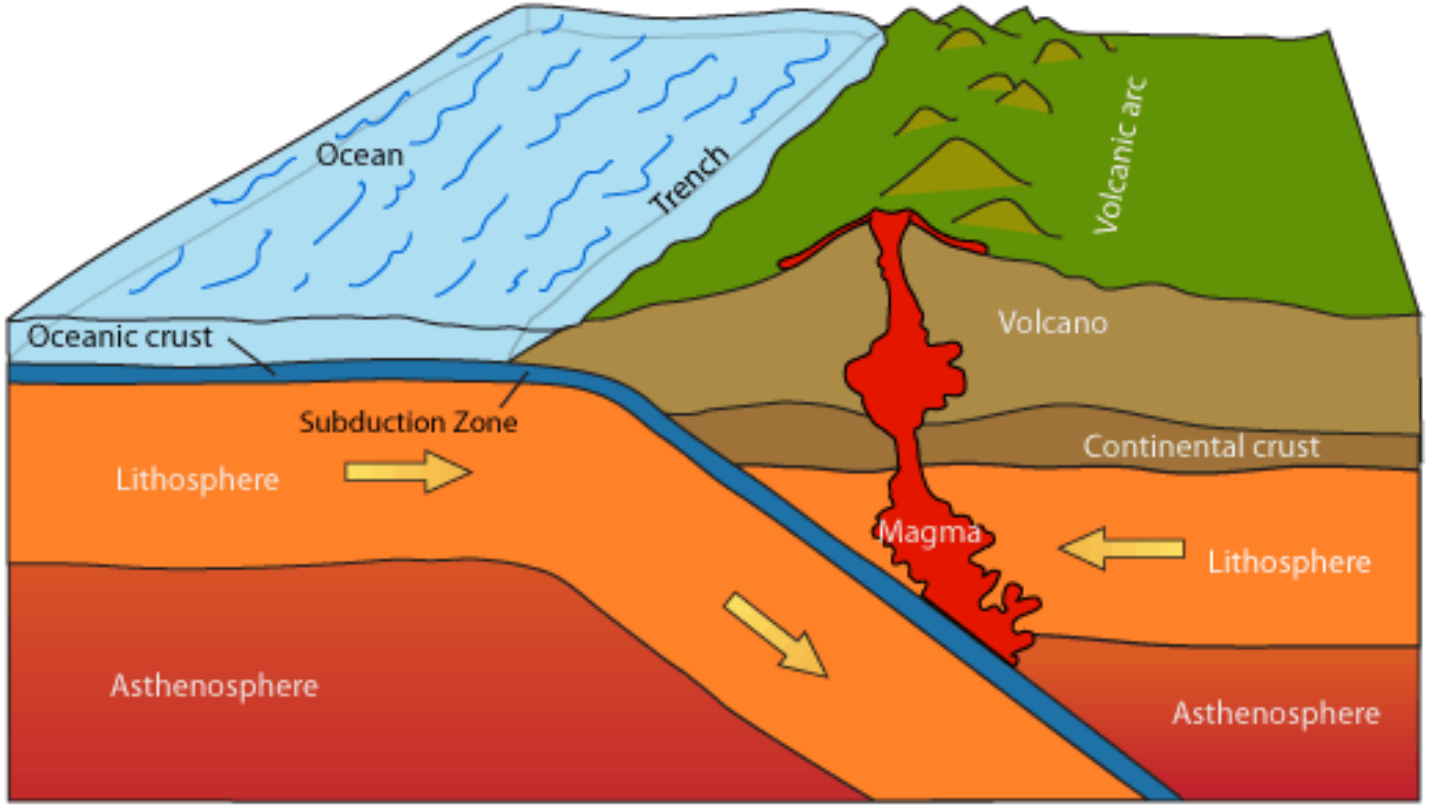
Turn to a seat partner and discuss the cause, effects, and importance of divergent boundaries.



Convergent Plate Boundary: two plates collide



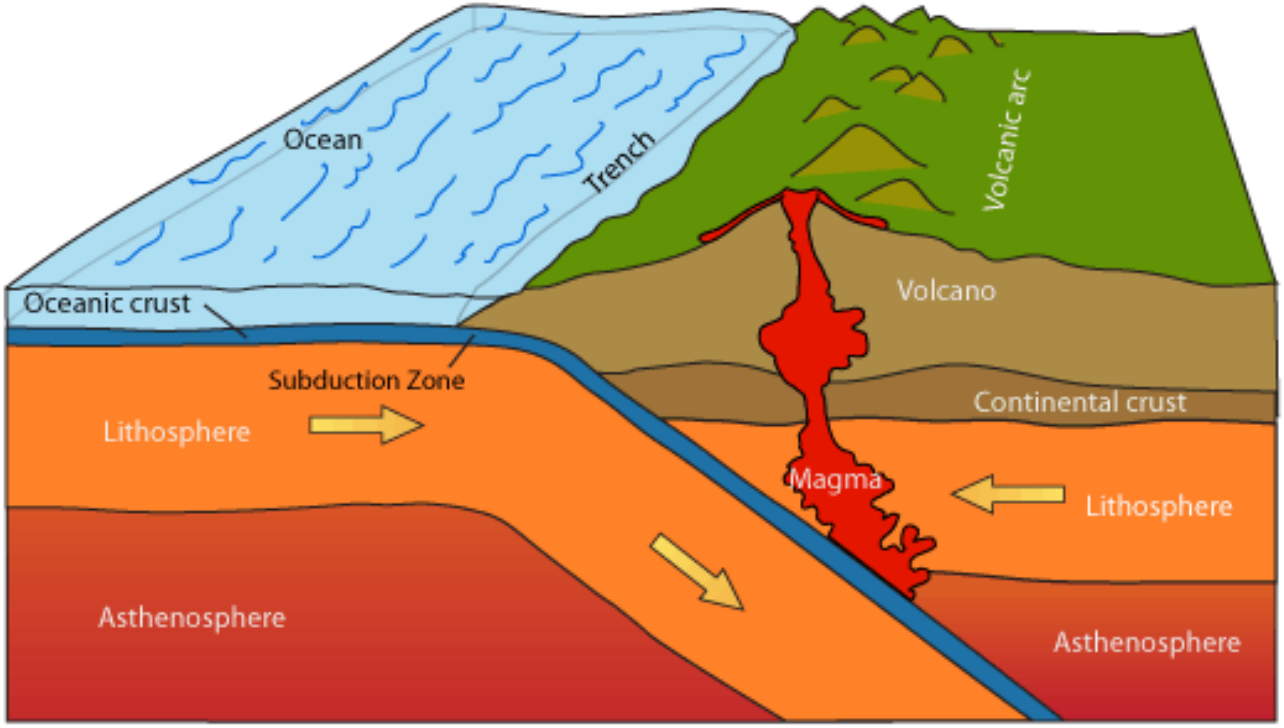
Convergent Plate Boundary: Oceanic → ← Continental



Convergent Plate Boundary: Oceanic → ← Continental

- The denser oceanic plate subducts (goes down), under the continental plate into the mantle.
- A deep sea trench is created where one plate bends and sinks.
- High temperatures cause rock to melt around the subducting plate as it goes under the other plate
- Newly formed magma is forced upward along these plate boundaries, forming volcanoes.

Convergent Plate Boundary: Oceanic → ← Continental

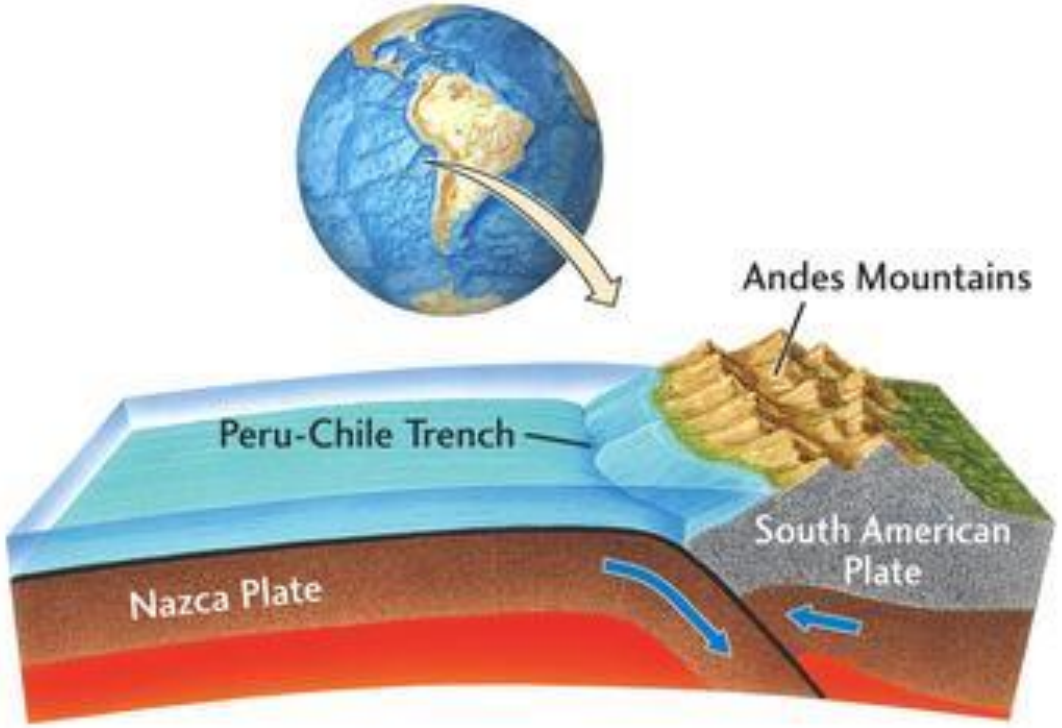


http://www.classzone.com/books/earth_science/terc/content/visualizations/es0902/es0902page01.cfm?chapter_no=visualization

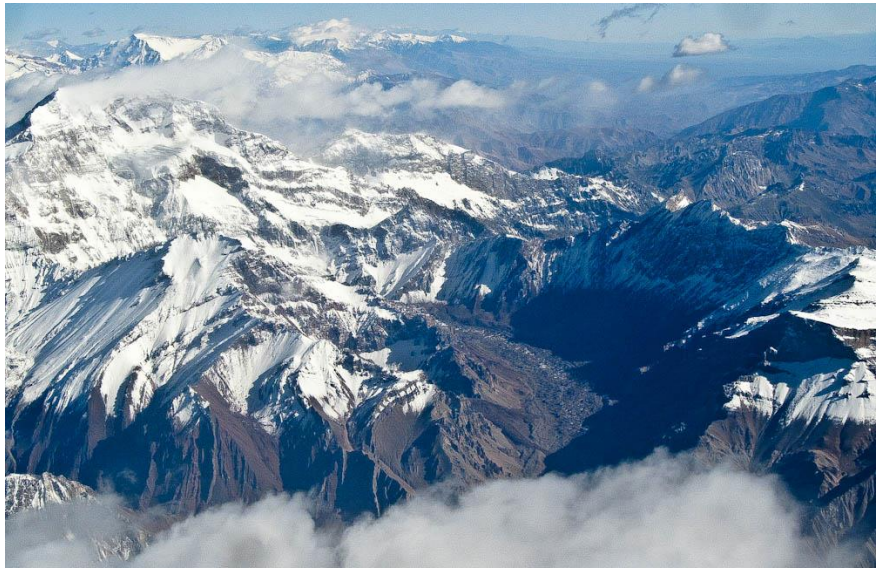
Model a Convergent Boundary with subduction:

- Place your hands in front of you with your palms facing the floor as shown in the picture.
- Push your left hand slightly under your right hand.
- This motion demonstrates what happens when one plate slides under the other.

Convergent Boundary



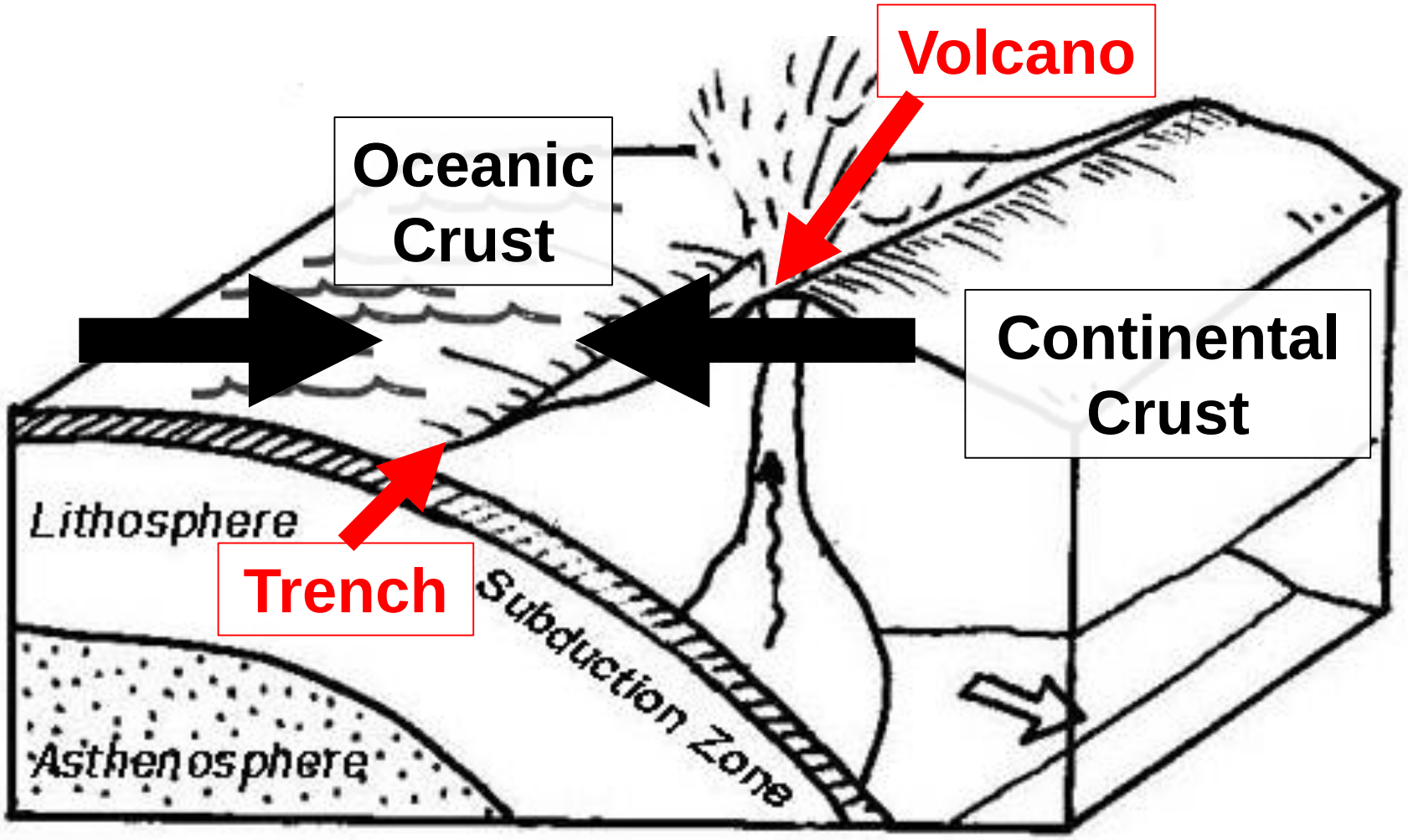
Andes Mountains



New crust is added at divergent boundaries while it disappears below the surface at the subduction zones of convergent boundaries.

https://www.youtube.com/watch?v=ryrXAGY1dmE

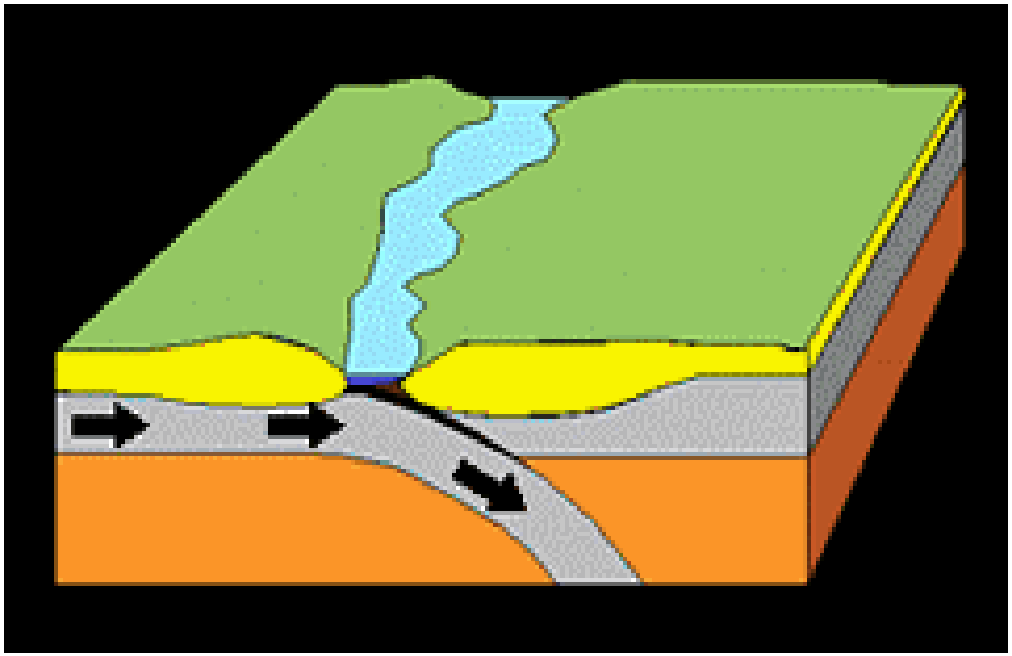
Convergent Plate Boundary: Oceanic → ← Continental



Convergent Plate Boundary:

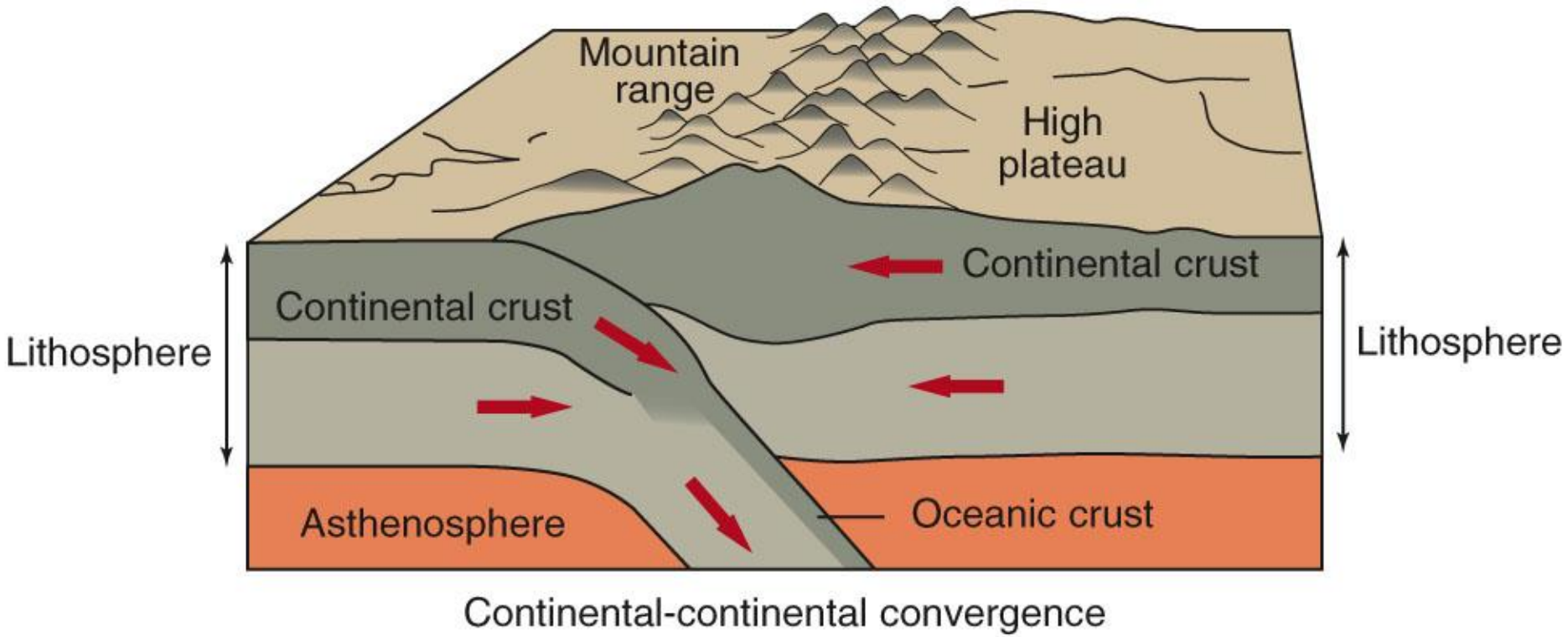
Continental Plate → ← Continental Plate

the crust buckles and pushes upward forming mountains



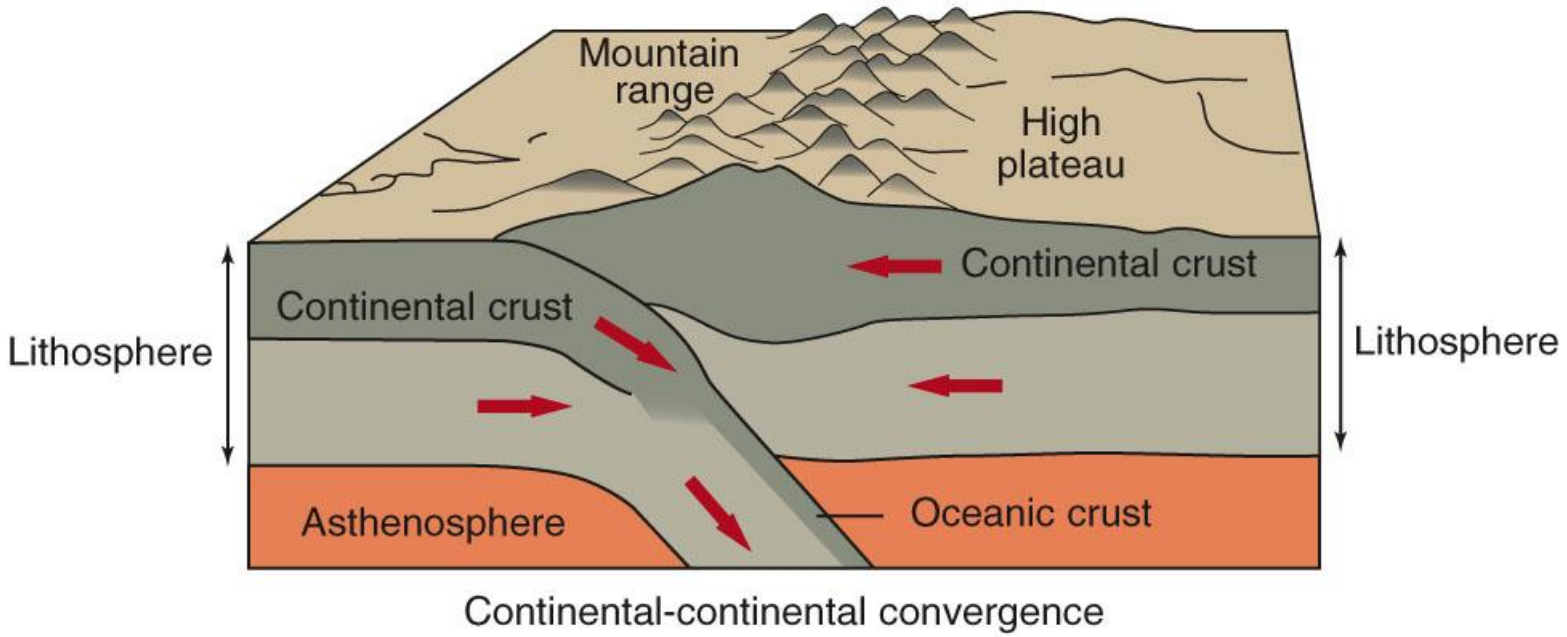
Convergent Plate Boundary

Continental → ← Continental



Convergent Plate Boundary

Continental → ← Continental



Continental-continental convergence

Earthquakes are common at these convergent boundaries, but volcanoes do not form because there is no, or little, subduction.

Model a Convergent Boundary

[see resources for simple models or demonstrations]

Convergent Plate Boundary

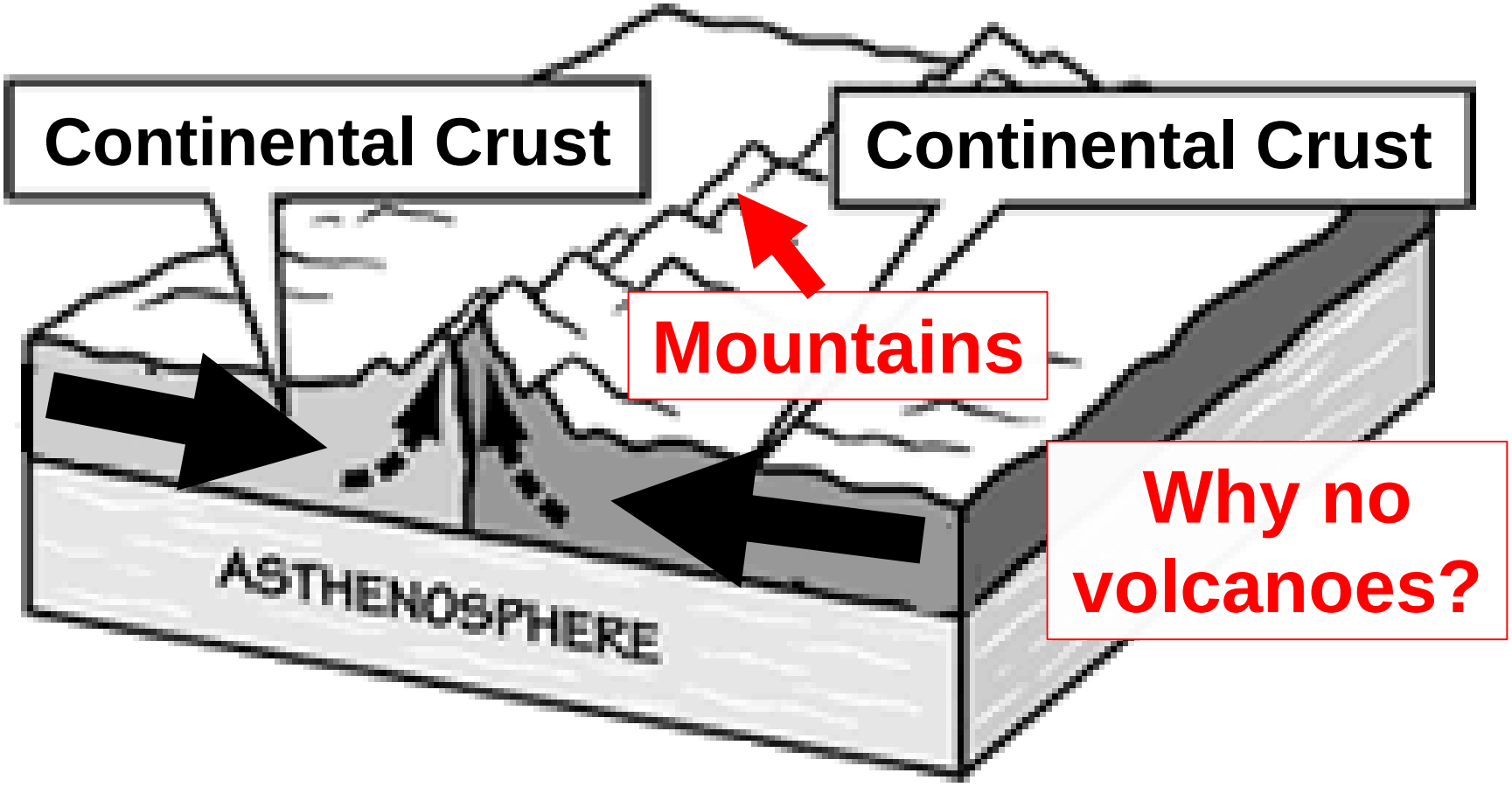
Continental → ← Continental

Himalayan Mountains

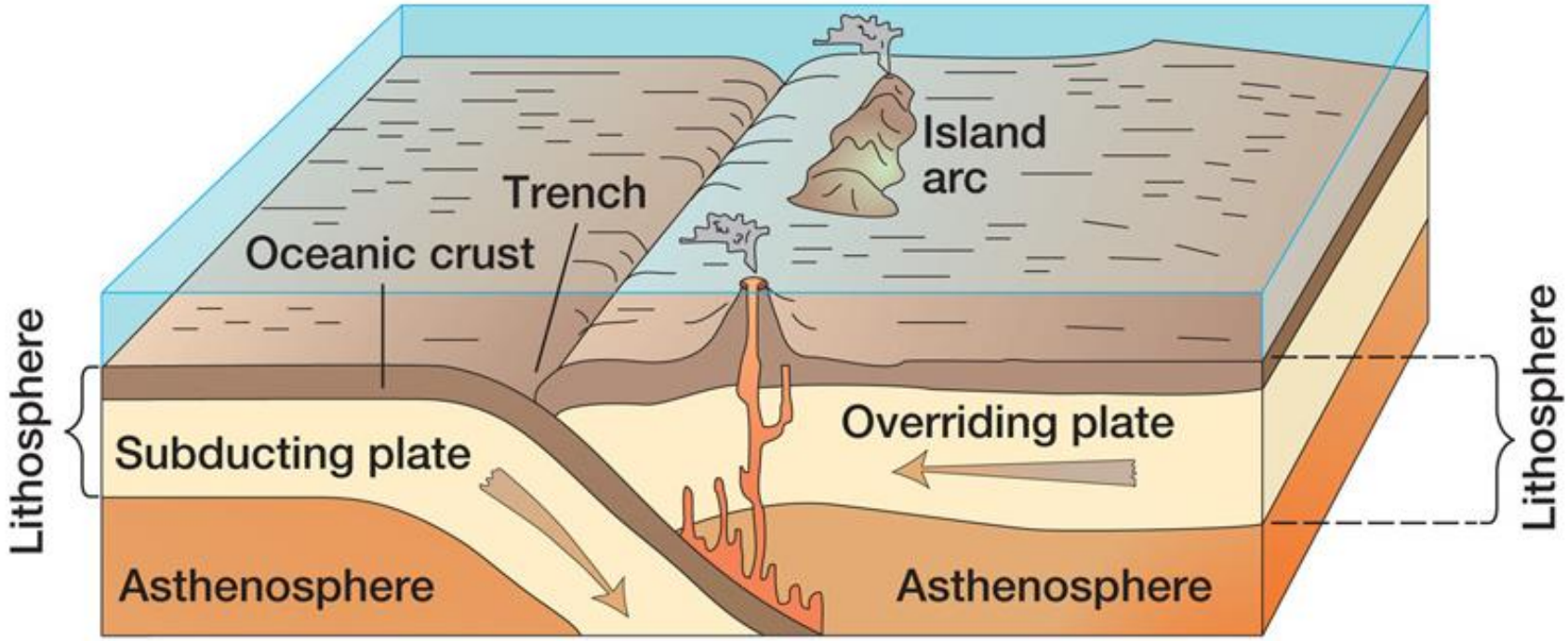
http://www.classzone.com/books/earth_science/terc/content/visualizations/es1105/es1105page01.cfm?chapter_no=visualization

Convergent Plate Boundary

Continental → ← Continental



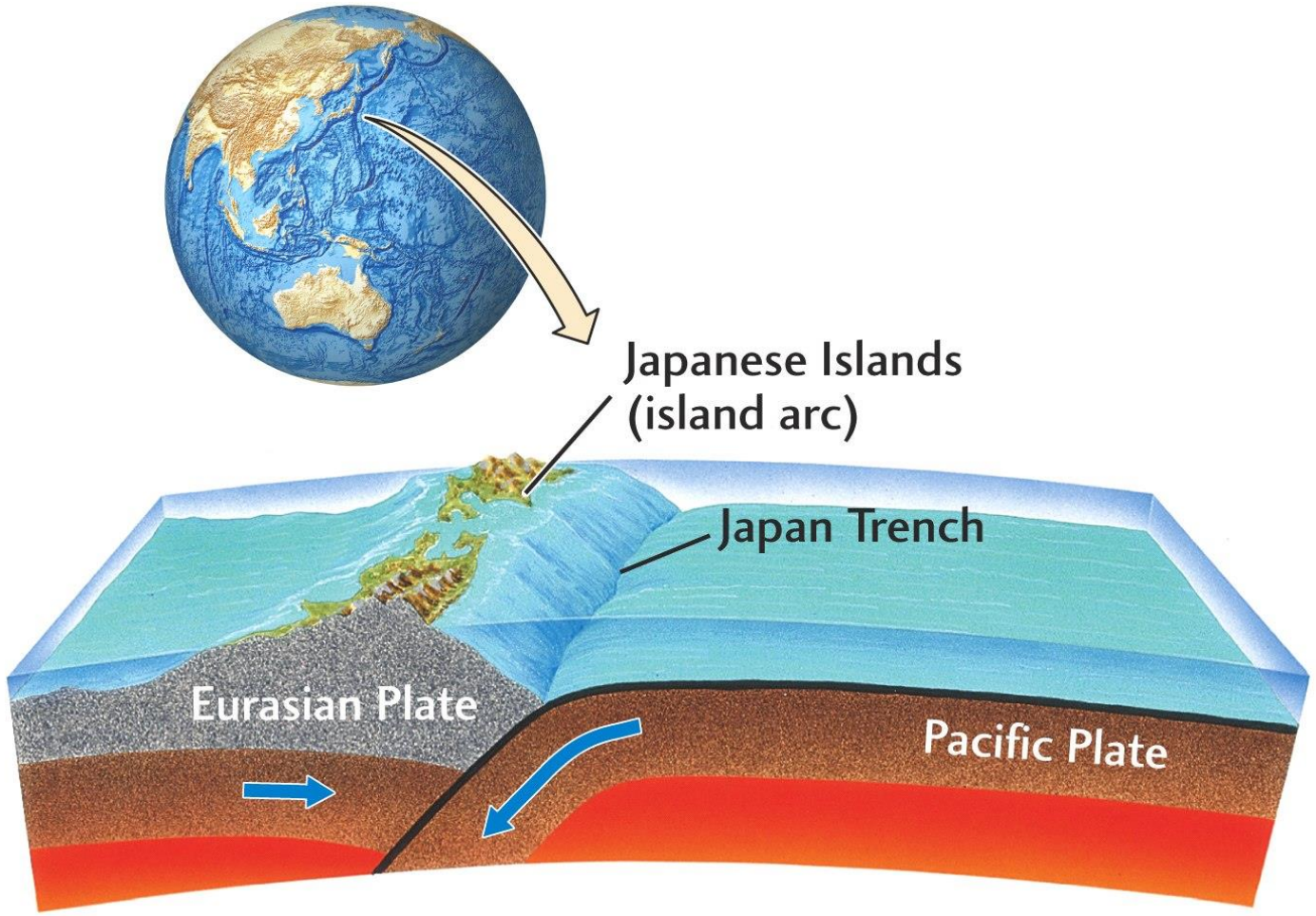
Convergent Plate Boundary: Oceanic → ← Oceanic



Convergent Plate Boundary: Oceanic → ← Oceanic

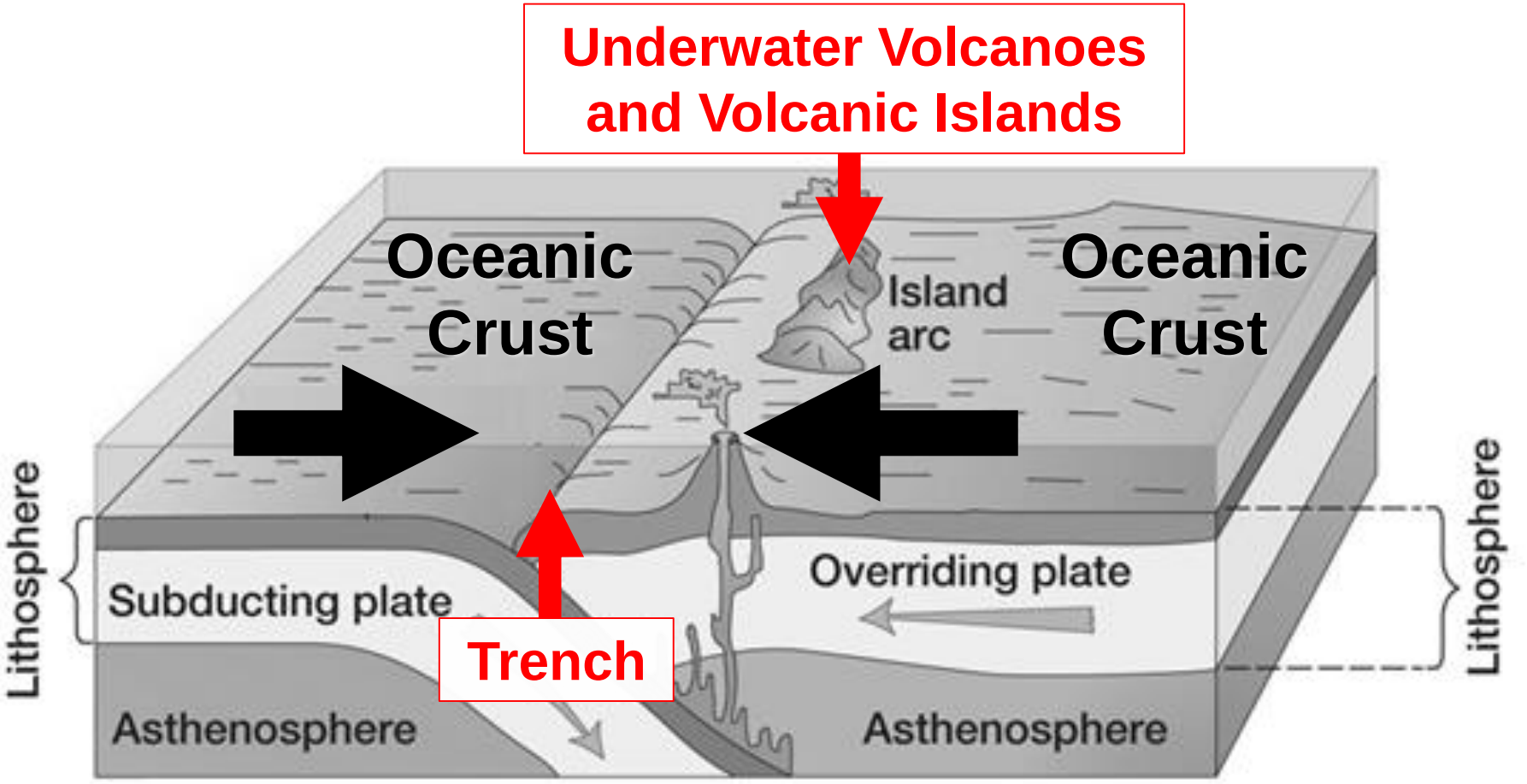
- A colder, older, denser oceanic plate subducts (goes down), under another oceanic plate into the mantle.
- A deep sea trench is created where one plate bends and sinks.
- High temperatures cause rock to melt around the subducting plate as it goes under the other plate
- Newly formed magma is forced upward along these plate boundaries, forming volcanoes.
- Over millions of years, erupted lava piles up until it rises above sea level to form volcanic islands.

Convergent Plate Boundary: Oceanic → ← Oceanic

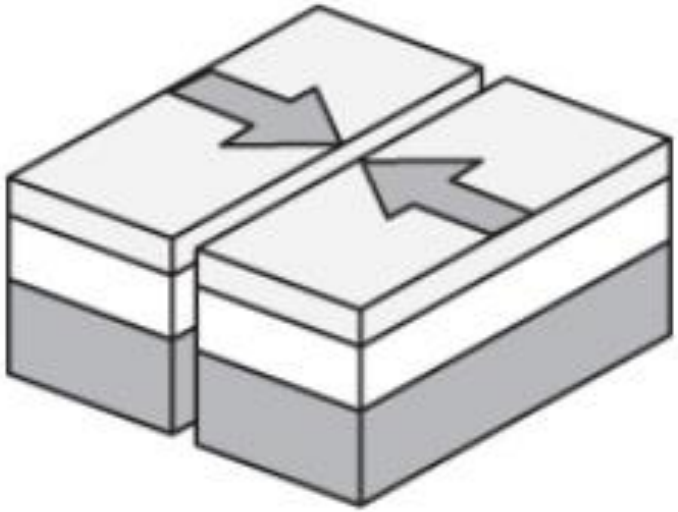


Convergent Plate Boundary:

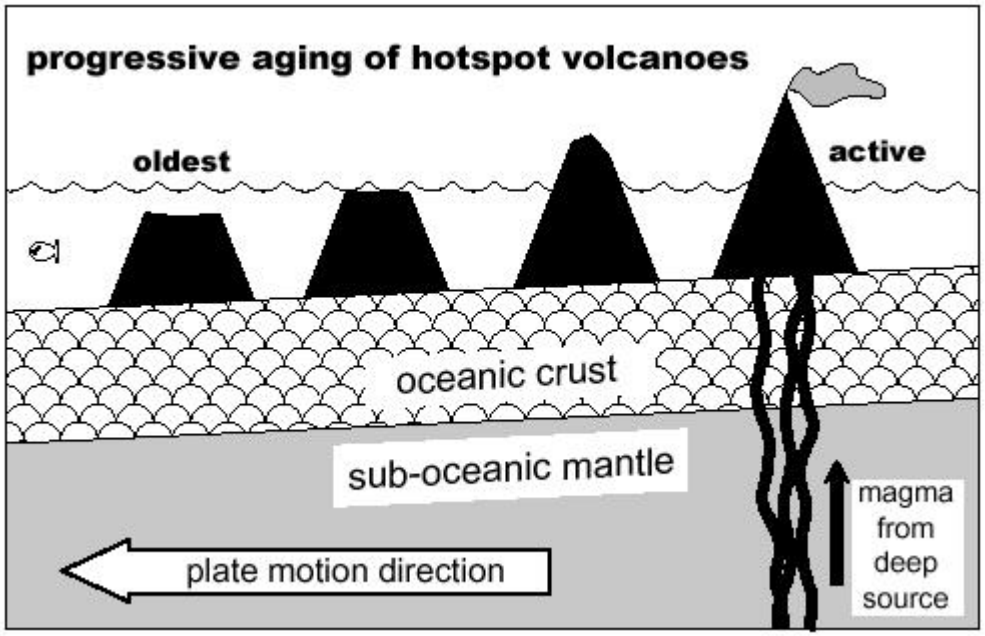
Oceanic → ← Oceanic



Turn to a seat partner and discuss the cause, effect, and importance of convergent boundaries.



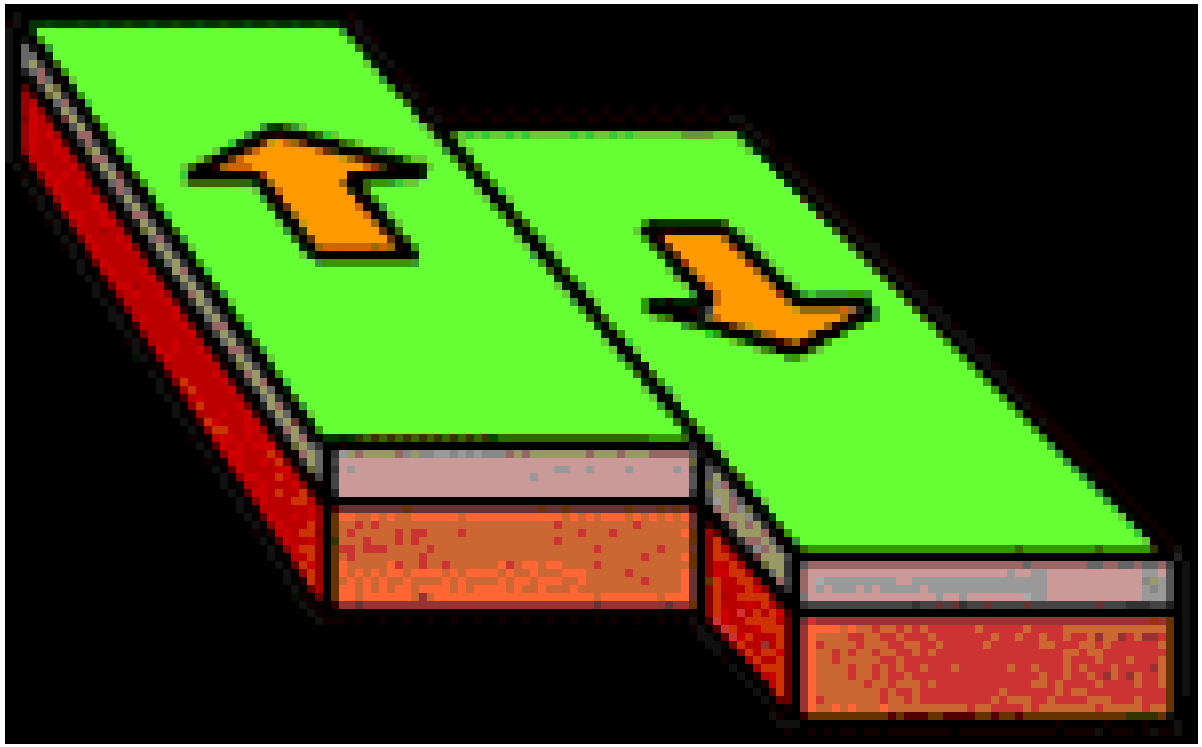
Sometimes volcanic islands form due to the movement of lithospheric plates over hot spots.



http://www.classzone.com/books/earth_science/terc/content/visualizations/es0904/es0904page01.cfm?chapter_no=visualization

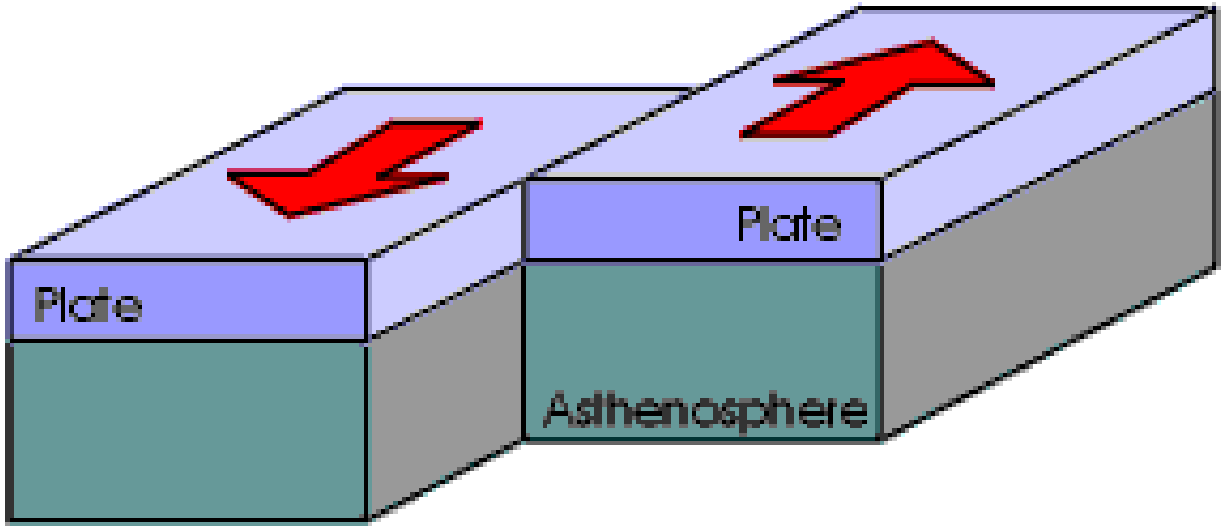
https://www.youtube.com/watch?v=6Z4as_imJfM
[video summary of the formation of volcanoes 4:48]

Transform Plate Boundary: Plates Slide Past Each Other

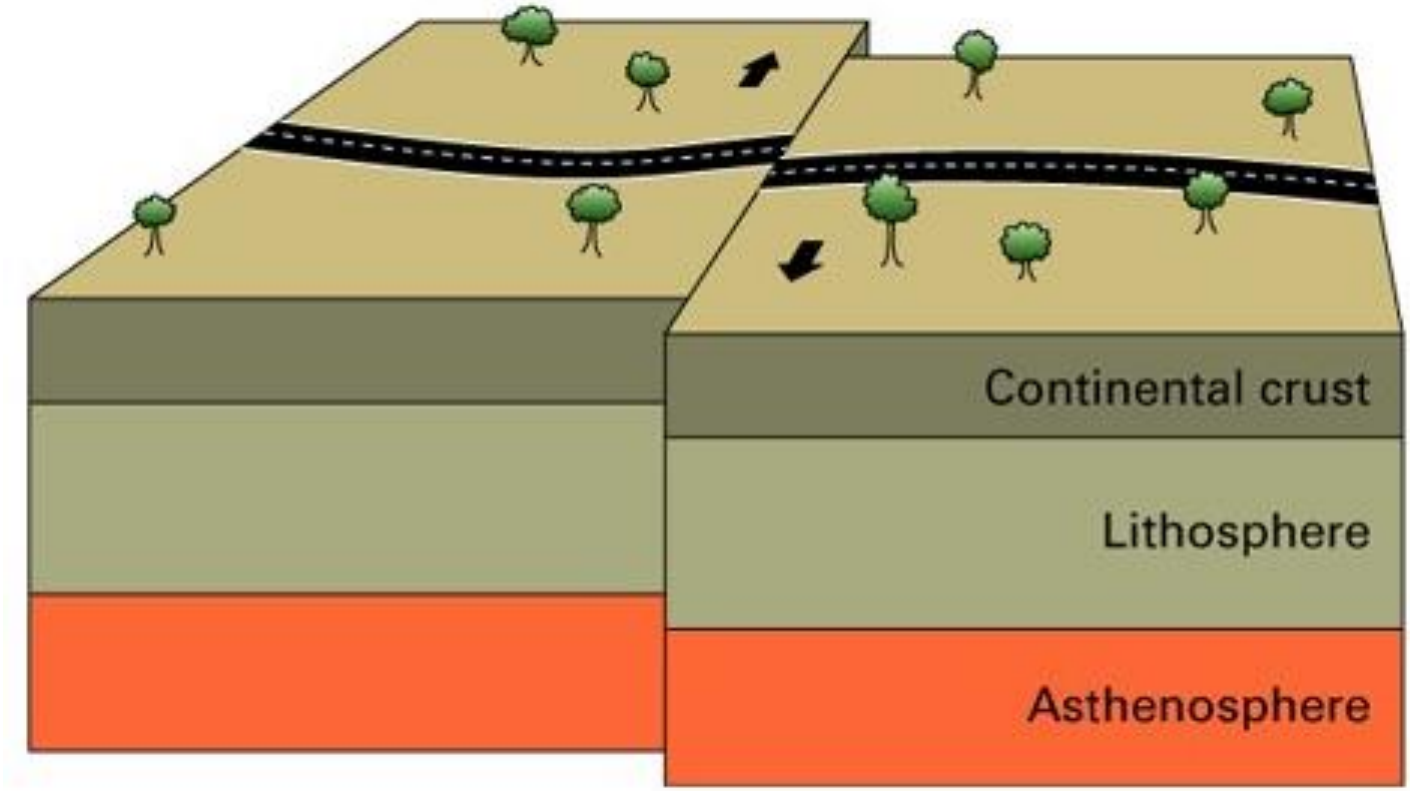


Transform Boundary

- **Plates move in opposite directions or in the same direction at different rates**
- **When one plate slips past another plate suddenly, earthquakes occur**
- **These plate boundaries do not destroy or build up Earth's crust.**



Transform Boundary

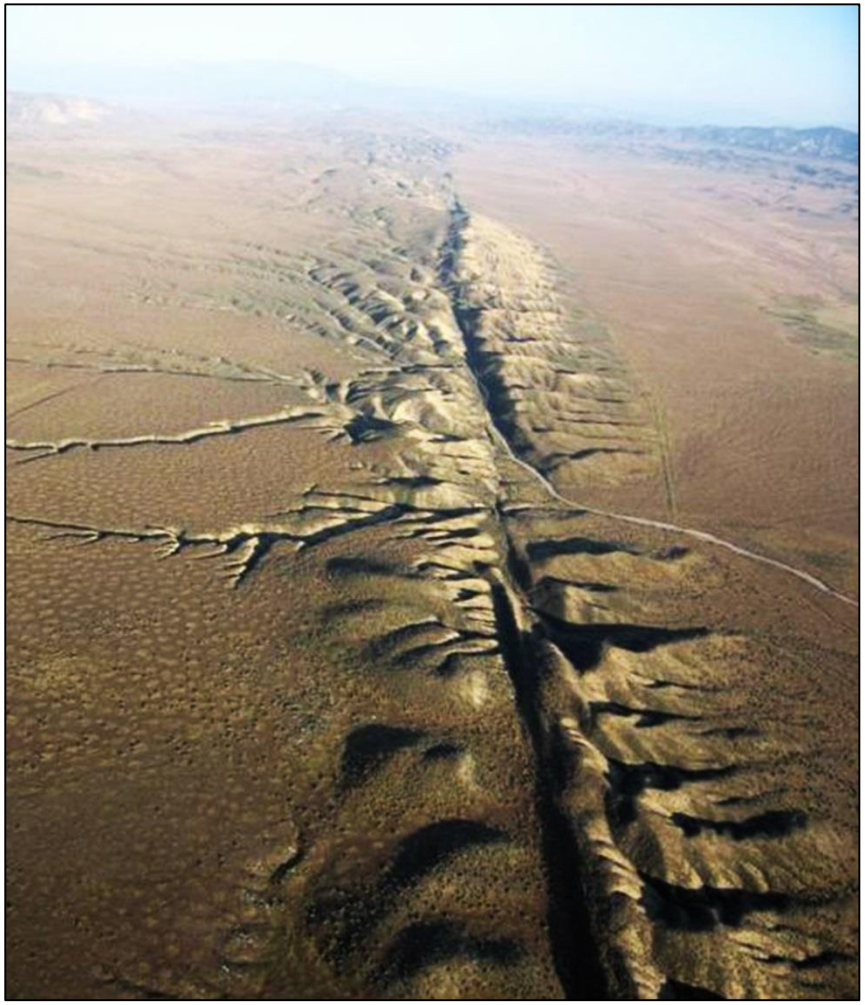


http://www.classzone.com/books/earth_science/terc/content/visualizations/es1103/es1103page01.cfm?chapter_no=visualization

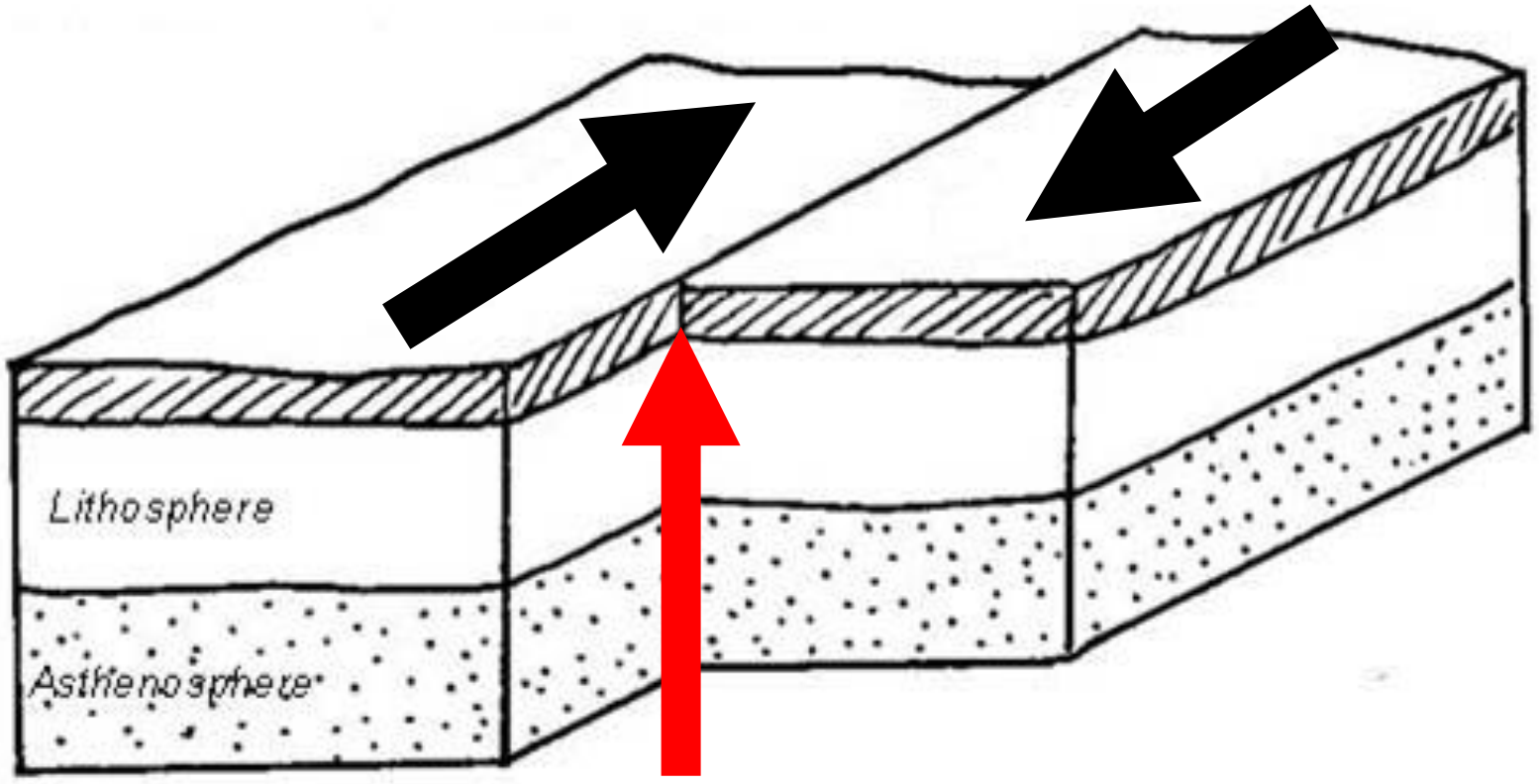
Model a Transform Boundary:

- Place your hands in front of you, side by side, with your palms facing the floor as shown in the picture.
- Move your right hand forward and your left hand backward.
- This type of movement occurs along the California coast at a transform boundary.

Transform Boundary: San Andreas Fault in California



Transform Boundary



Earthquakes

Plate Boundary Activities

- Push Those Plates Activity
- Milky Way Plate Tectonics
- Oreo Plate Tectonics
- Plate Boundary Cootie Catcher
- Plate Tectonics Vocabulary Match
- Meet the Boundary Activity
- Types of Plate Boundaries Map Identification – more for extension

Crust is in Pieces Song

Plate Tectonics Song

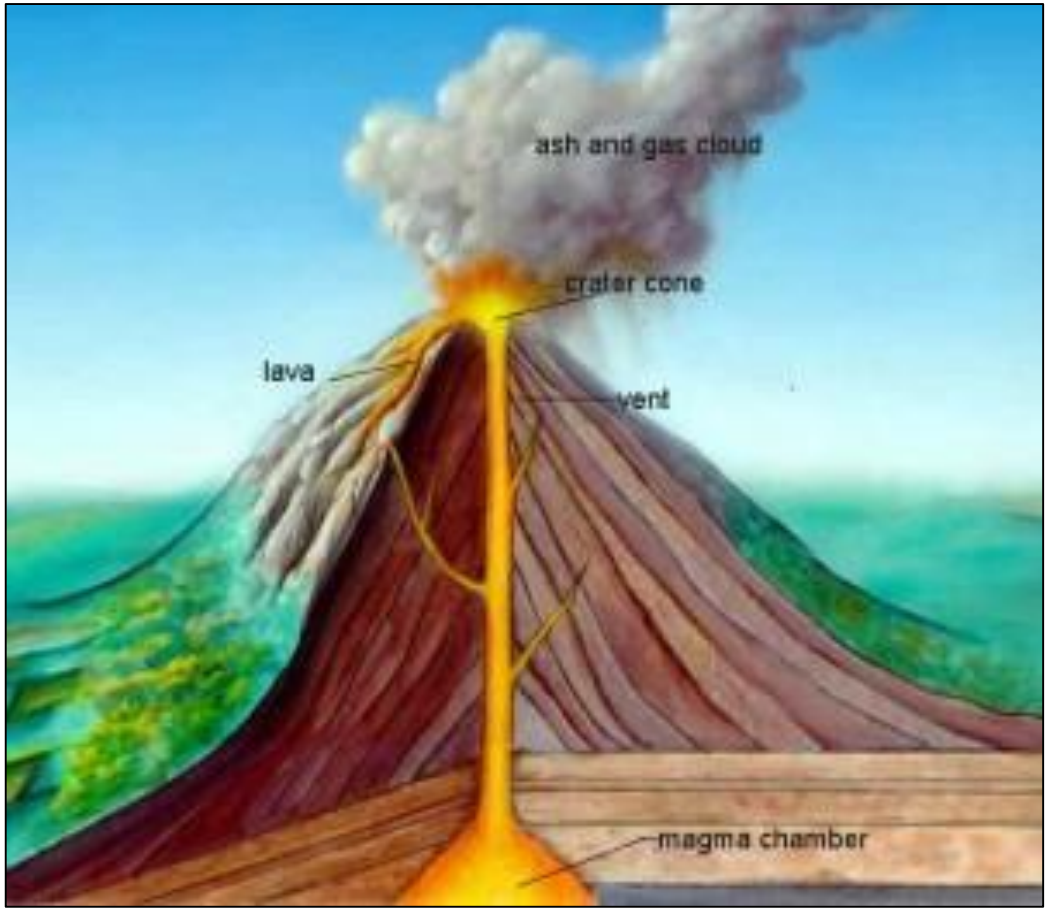
Based on what you have learned so far, what causes the lithospheric plates to move?

Convection Currents in the Mantle

http://education.sdsc.edu/optiputer/flash/convection.htm

Convection Currents in the Mantle cause lithospheric plates to move. As the plates move, they interact. These interactions produce many geological features and events.

Volcano



Volcano

- A volcano is a mountain that forms when layers of lava and ash erupt and build up
- Volcanoes form where plates are moving apart, moving together, and at locations called hot spots.

Volcano

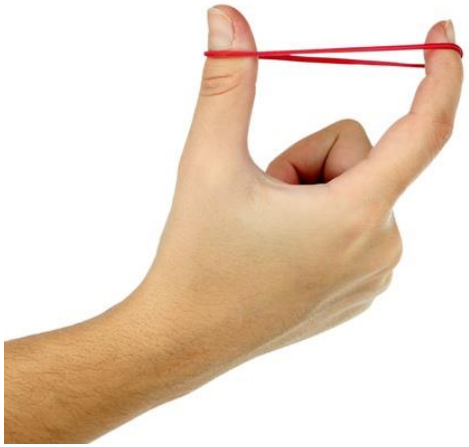
When the pressure from the rising magma in a volcano becomes too much, it erupts gases, ash, and lava

https://www.youtube.com/watch?v=WgktM2luLok

Ring of Fire Eruption Song:
https://www.youtube.com/watch?v=PnilQsno2WI&index=57&list=PLgTEqBBPoqwVTbS_6i2IsAmWTaW9312Fl

Have you ever stretched a rubber band too far and had it break? Or broke a stick?

What caused them to break?

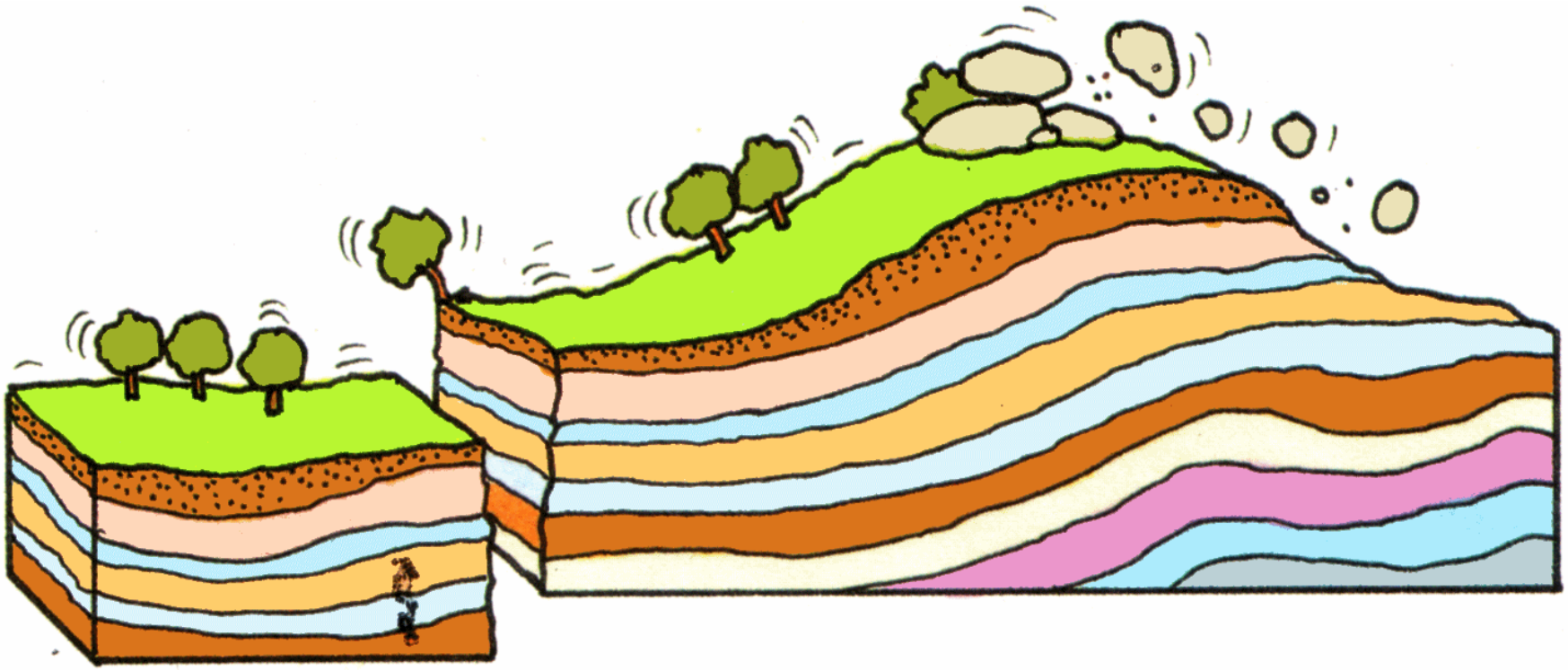


Movement of the lithospheric plates puts stress on the rocks near the plate edges.

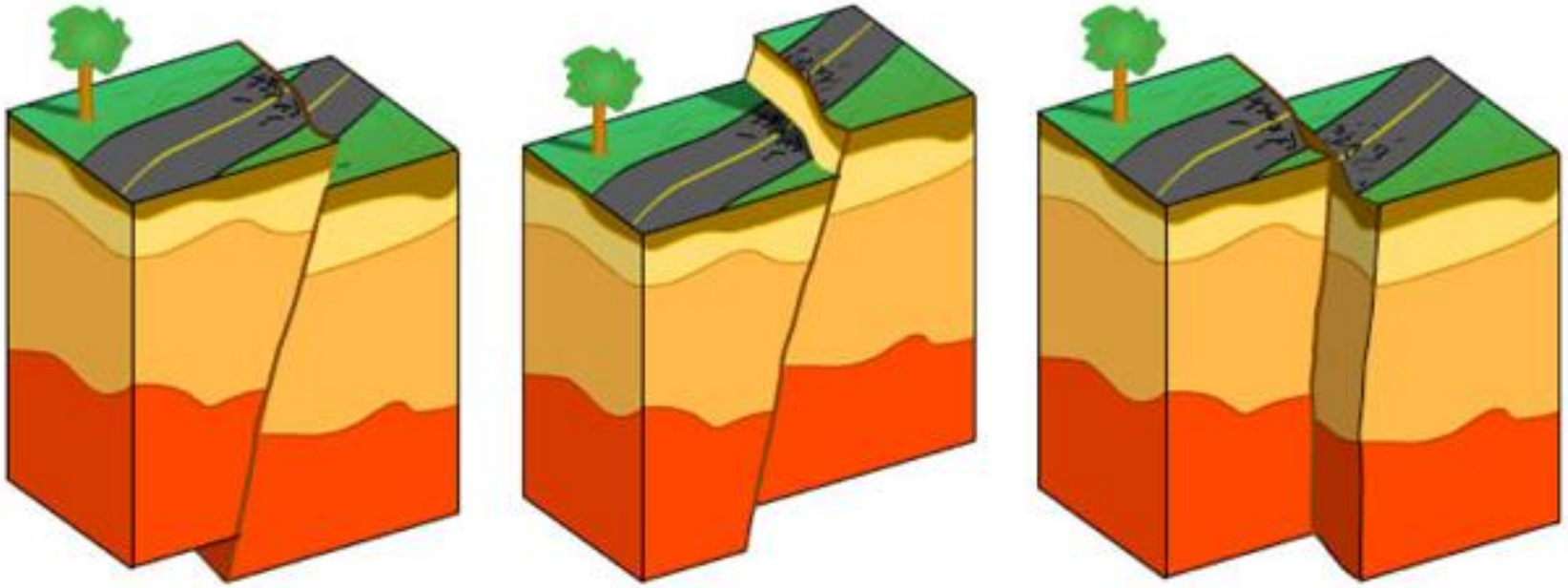
To relieve this stress, rocks tend to bend, compress, or stretch.

If the stress is great enough, the rocks will break.

Earthquakes are sudden breaks in crust continuously stressed by plate movement.



Along plate boundaries, the Earth's lithosphere fractures along faults. As plates move, blocks of crust shift along the faults. There are different kinds of faults.



http://www.classzone.com/books/earth_science/terc/content/visualizations/es1103/es1103page01.cfm?chapter_no=visualization

When rocks move suddenly along the fault, releasing stress, seismic waves travel through the earth's crust in the form of waves.

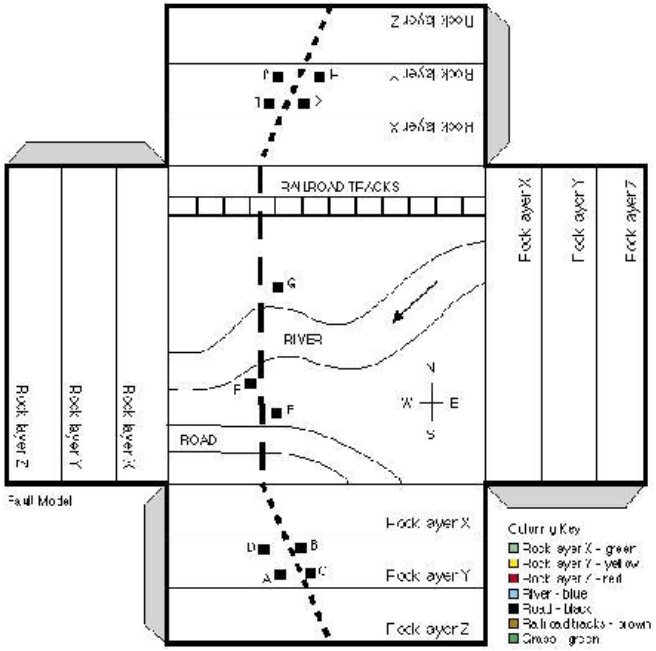
http://www.pbs.org/wnet/savageearth/animations/earthquakes/main.html

Earthquake is like a drip of water video:
https://www.youtube.com/watch?v=LoUocQyvVyI#t=10

It's an Earthquake Song:
https://www.youtube.com/watch?v=sA6oZ4YgKCA&list=PLqTEqBBPoqwVTbS_6i2lsAmWTaW9312Fl&index=53

Model of Three Faults Activity

A Model of Three Faults



1. Construct a fault model using the Fault Model diagram above. Color the fault model according to the color key provided.

2. Cut out the fault model and fold each side down to form a box with the drawn features on top.

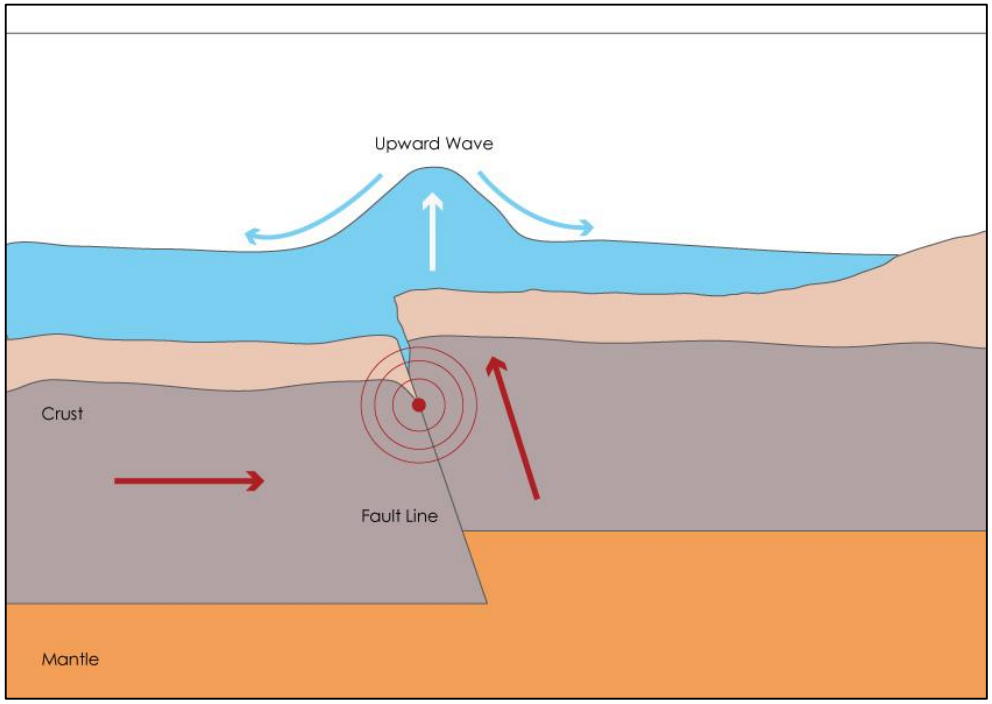
3. Tape the corners together. This box is a three dimensional model of the top layers of the Earth's crust.

4. The dashed lines on your model represent a fault. Carefully cut along the dashed lines. You will end up with two pieces.

5. Follow the directions on the student worksheet and answer the corresponding questions.

Modified from USGS Learning Web Lesson Plans

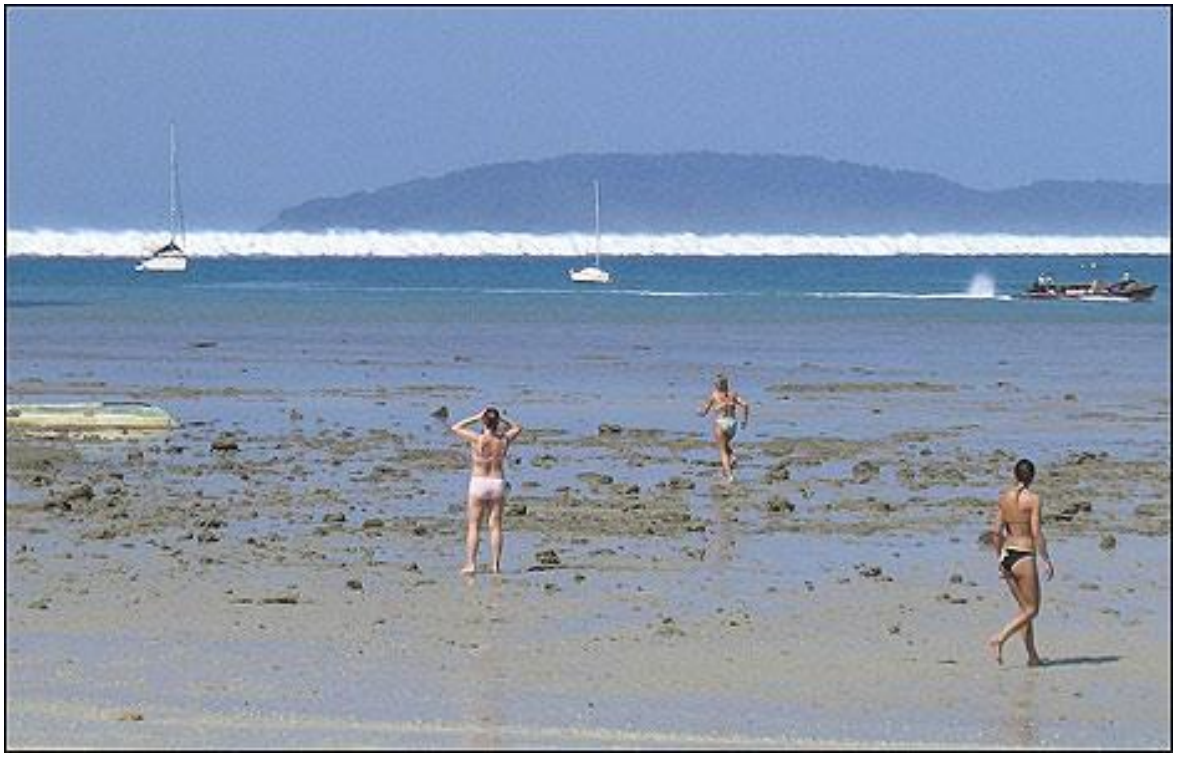
Tsunamis are ocean waves caused by earthquakes and landslides that occur near or under the ocean in oceanic crust.



https://www.youtube.com/watch?v=bG37DEAb3Bc

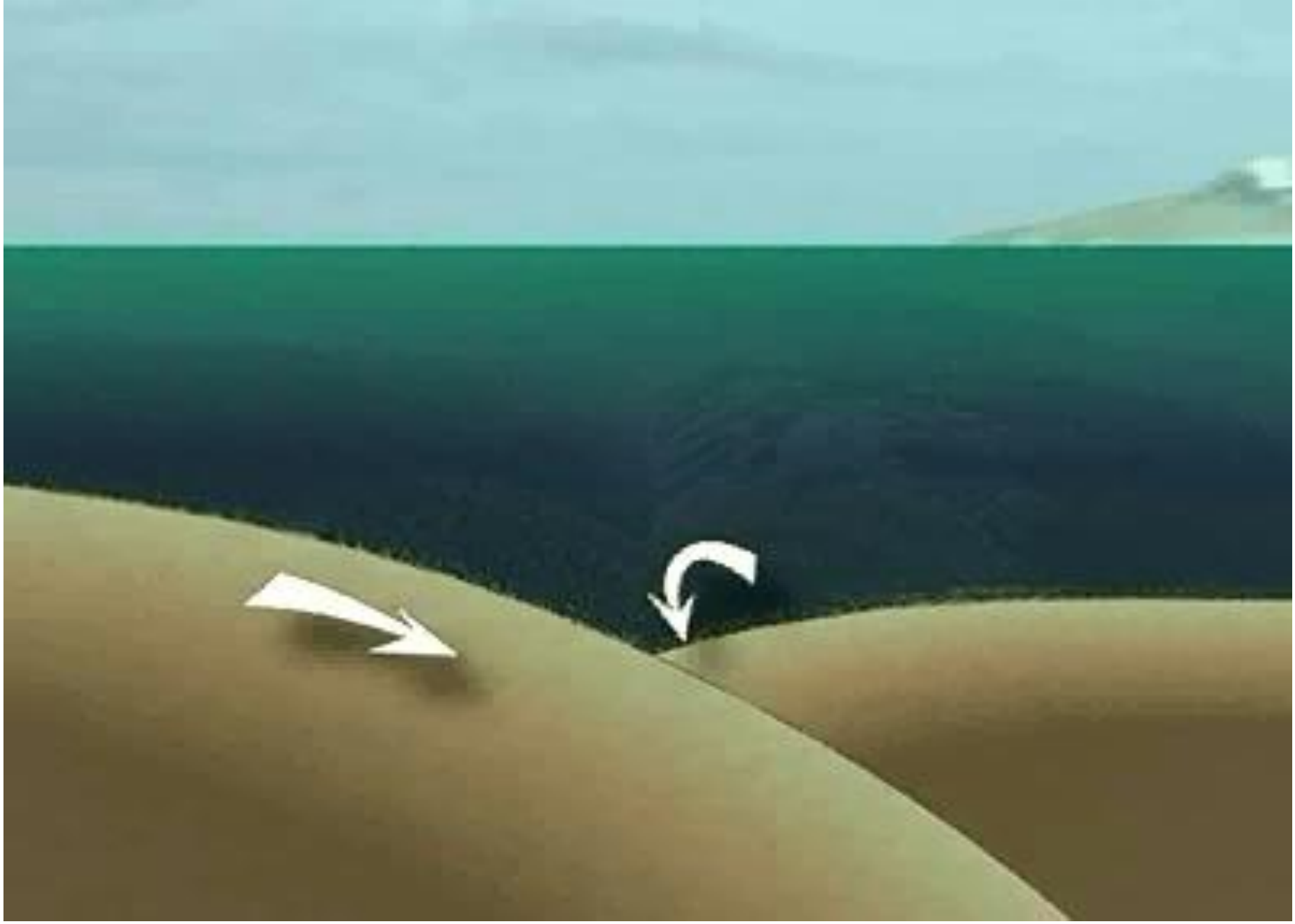
http://www.pbs.org/wnet/savageearth/animations/tsunami/index.html

The lowest point of a tsunami wave hits inland first and creates a vacuum that sucks up the coastal water near the shoreline away from the land, exposing the sea floor. This is the first indicator that the destructive part of the wave is on its way.



As a tsunami's waves travel across deep water they may be only a foot or so high and hard to detect. Once it reaches inland the surge can reach heights of 100 feet or more.

It is a massive wall of water that reaches land and can cause incredible destruction and loss of life.



Tsunami videos

https://www.youtube.com/watch?v=0NfKZAiWRoE

[1:01]

https://www.youtube.com/watch?v=tPQ5iTcnXW0

[longer 14:49 you can fast forward through some]

Crust Rolls Up Tsunami Song:
https://www.youtube.com/watch?v=gPaXXZhBAxg&index=59&list=PLqTEqBBPoqwVTbS_6i2lsAmWTaW9312Fl

Geological Events Summarizer

Geological Events Summarizer Name _____ Date ____

1. Use the diagram above to answer the three questions below.

a. Identify the concept shown _____

b. Describe the concept: _____

_____

c. Identify evidence used to support the concept: _____

_____

_____

2. Identify and describe process A and B shown in the diagram to the right.

Process A: _____

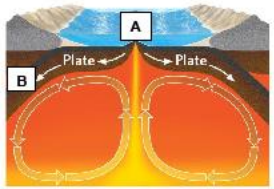
_____

_____

Process B: _____

_____

_____



3. Identify below the three types of plate boundaries, the direction in which they move, and the types of geological events they can cause.

_____

_____

_____

_____

_____

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_____