

## 8.2 Continental Drift Theory and Sea-Floor Spreading

*How do Earth's Tectonic Plates  
Help to Create Landforms?*

# Intro Brain Teaser

- Why are the continents located where they are today? Have they always been there?
- Are the continents moving right now?
  - If yes, WHY?
  - If no, WHY?



# A RADICAL Change!

- Until the 1600s people thought that the continents were always in the same place
- Scientists **OBSERVED**: coasts of continents looked like they fit together. . .
- So Alfred Wegener made an important **INFERENCE**. . .

# Theory of Continental Drift

- Theory is ????

# Continental Drift: What the Theory Says

- Wegener said continents were once together in giant super continent called "Pangaea"
  - Pangaea Means "all Earth"
- Slowly over time Pangaea *broke apart* and the *pieces drifted* to different parts to form today's continents

# Continental Drift: The Evidence

## ■ **SHAPE**

- Observation: *The shape of the continents look like they once fit together like a jigsaw puzzle*
- Inference: continents were once connected in one landmass

# Pangaea: Continents Connected in One Landmass



# Continental Drift: The Evidence

## ■ **FOSSILS**

- Observation: *Same type of fossils found on coast of South America and Africa and the animal could not swim or fly*
- Inference: two continents were once connected
- Example: freshwater *Mesosaurus* could not survive swim across salty ocean



# *Mesosaurus*



# Continental Drift: The Evidence

## ■ **ROCKS**

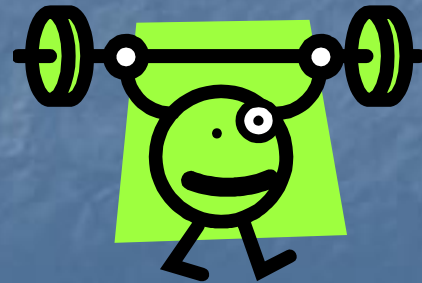
- Observation: *same type of layered rock found on coast of S. America and Africa*
- Inference: thought that the rocks must have been joined at once time; therefore, continents were once connected

# What about the other side?

- Why would you doubt Wegner's theory during this time?
- How is his argument weak? What is he missing?

# Reason to Doubt Continental Drift

- Wegener did not have a reason why the continents moved
- What force was strong enough to move continents????



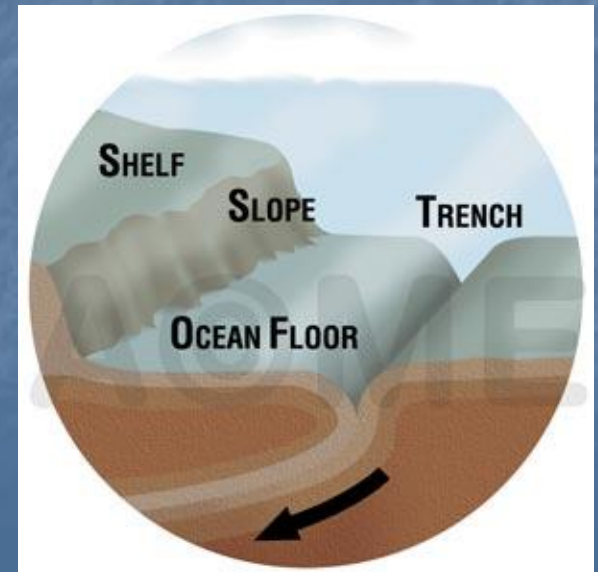
# Years later, Wegener gets some Help!!!

- In the twentieth century technology advanced so a scientist named Herry Hess discovered a process that provided the missing link to Wegener's theory. . .



# We learn about landforms under water

- Scientists discovered trenches (dips) and ridges (mountains) at bottom of oceans
  - Mid-Atlantic Ocean Ridge— mountains along floor of Atlantic Ocean
  - Ocean ridges are like seams on baseball



# Mid-Atlantic Ocean Ridge



# How do these ridges and trenches form????

- Herry Hess asked, “how did these underwater ridges and mountains form?”
- Answer→ Sea Floor Spreading



# Video on Sea Floor Spreading

- Discovery
  - Exploring the Earth

# Seafloor Spreading Definition

- The process that forms new underwater ridges which involves magma pushing up through the crust

- **Magma**

- Molten (melted) rock that forms underground



# WHY??

- Why was Harry Hess able to discover seafloor spreading?
- Better technology developed → scientists could map ocean floor

# Break it Down!

- Let's take a look at the steps in this process!!!!

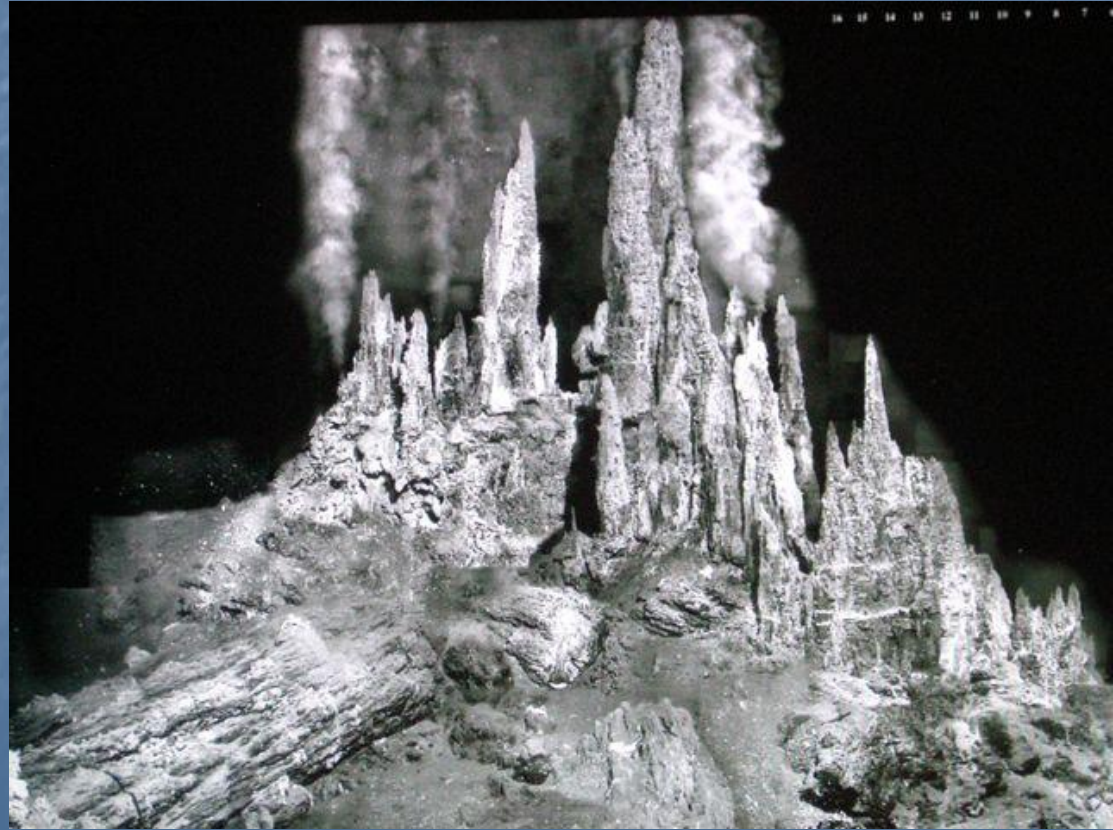
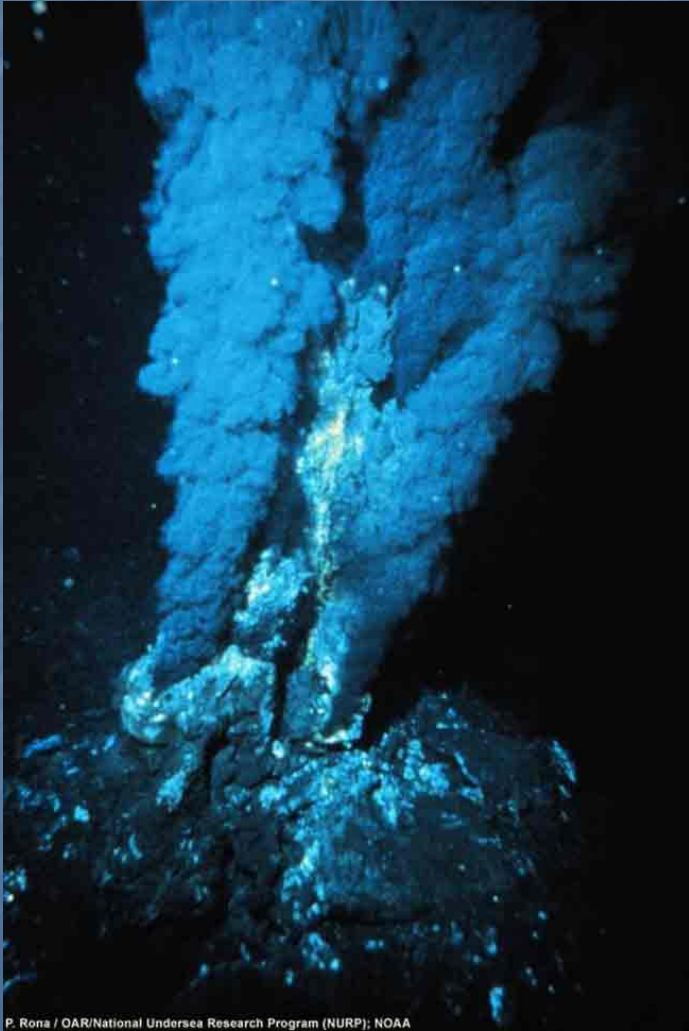
# Sea Floor Spreading Process

- Step 1: Core heats rock in mantle and it rises to crust due to convection currents
  - Convection currents:
    - the process of rock heated in inner mantle
    - turns to magma
    - rises since hot materials weigh less
    - Eventually magma cools, gets heavy and falls back, and process repeats

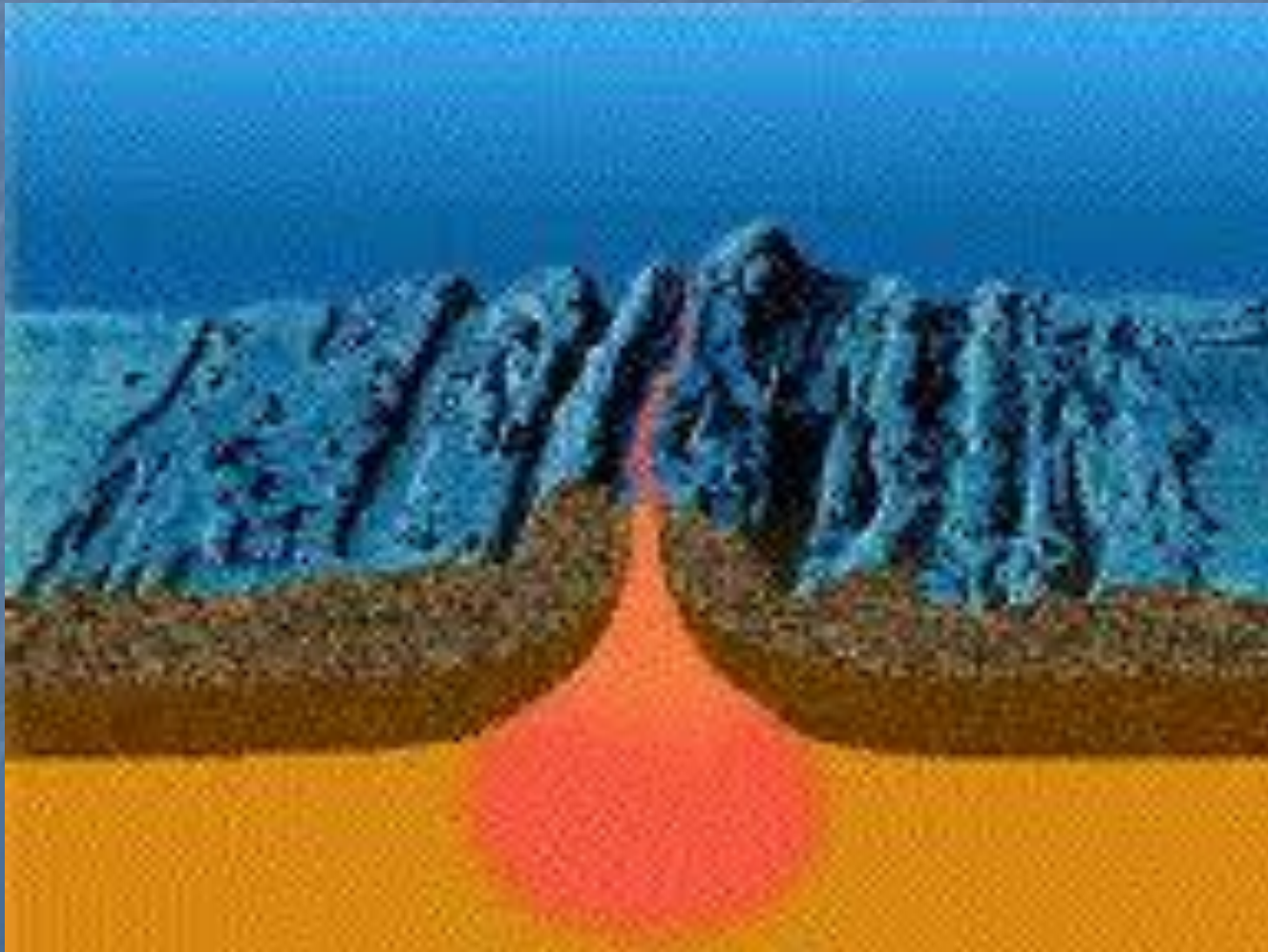
# Sea Floor Spreading Process

- Step 2: Magma bursts through oceanic crust into ocean, slows down in cold, and hardens into rock
  - Comes through to form mid-ocean ridge

# Image of Mid Ocean Ridge



# Image of Mid Ocean Ridge





# Sea Floor Spreading

- Step 3: More magma pushes through crust and this pushes existing rock/crust to either side as it bursts through. The crust/rock near the mid-ocean ridge is the youngest and the crust/rock furthest from the ridge is the oldest.

# Evidence of Seafloor Spreading

## Evidence

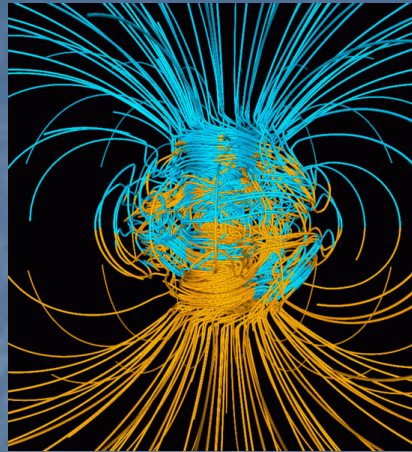
- Magnetic patterns
- Age of Rocks
- Appearance of Rocks

# Evidence of Sea Floor Spreading

## ■ **Magnetic Patterns**

- Magnetic poles reverse over time so rocks in crust showed alternating markings of the direction of magnetic poles

# Earth's magnetic field



is the [magnetic field](#) that extends from the [Earth's](#) interior to where it meets the [solar wind](#), a stream of charged particles emanating from the [Sun](#). Its magnitude at the Earth's surface ranges from 25 to 65 micro [Tesla](#) (0.25 to 0.65 [Gauss](#)). It is approximately the field of a [magnetic dipole](#) tilted at an angle of 10 degrees with respect to the rotational axis—as if there were a bar magnet placed at that angle at the center of the Earth. However, unlike the field of a bar magnet, Earth's field changes over time because it is generated by the motion of molten iron alloys in the Earth's [outer core](#) (the [geodynamo](#)).

The North Magnetic Pole wanders, but does so slowly enough that an ordinary compass remains useful for navigation. However, at random intervals, which average about several hundred thousand years, the Earth's field reverses, which causes the north and South Magnetic Poles to change places with each other. These reversals of the geomagnetic poles leave a record in rocks that allow paleomagnetists to calculate past motions of continents and ocean floors as a result of plate tectonics.

# Evidence of Sea Floor Spreading

## ■ **AGE OF ROCKS**

- Infer→ how do you think the rocks would be arranged (in terms of their age) to support the idea of sea floor spreading?

# Evidence of Sea Floor Spreading

## ■ **AGE OF ROCKS**

- Oldest rocks were found farthest away from eruption point
- Newest rocks found in middle (at eruption point)

# Evidence of Sea Floor Spreading

## ■ **APPEARANCE OF ROCKS**

- Infer—what do you think rocks would look like if they formed after the magma erupts from the earth's crust at the bottom of the ocean?



# Evidence of Sea Floor Spreading

## ■ **APPEARANCE OF ROCKS**

- Rocks are *MOLTEN*
- Rocks found on ocean floor looked like pillows or toothpaste
- This is what rocks look like after magma has hardened

# Pillow or Toothpaste Rocks



# How we Detect Oceanic Ridges

- **SONAR**

- Method of bouncing sound waves off objects and measuring the time it takes for wave to return

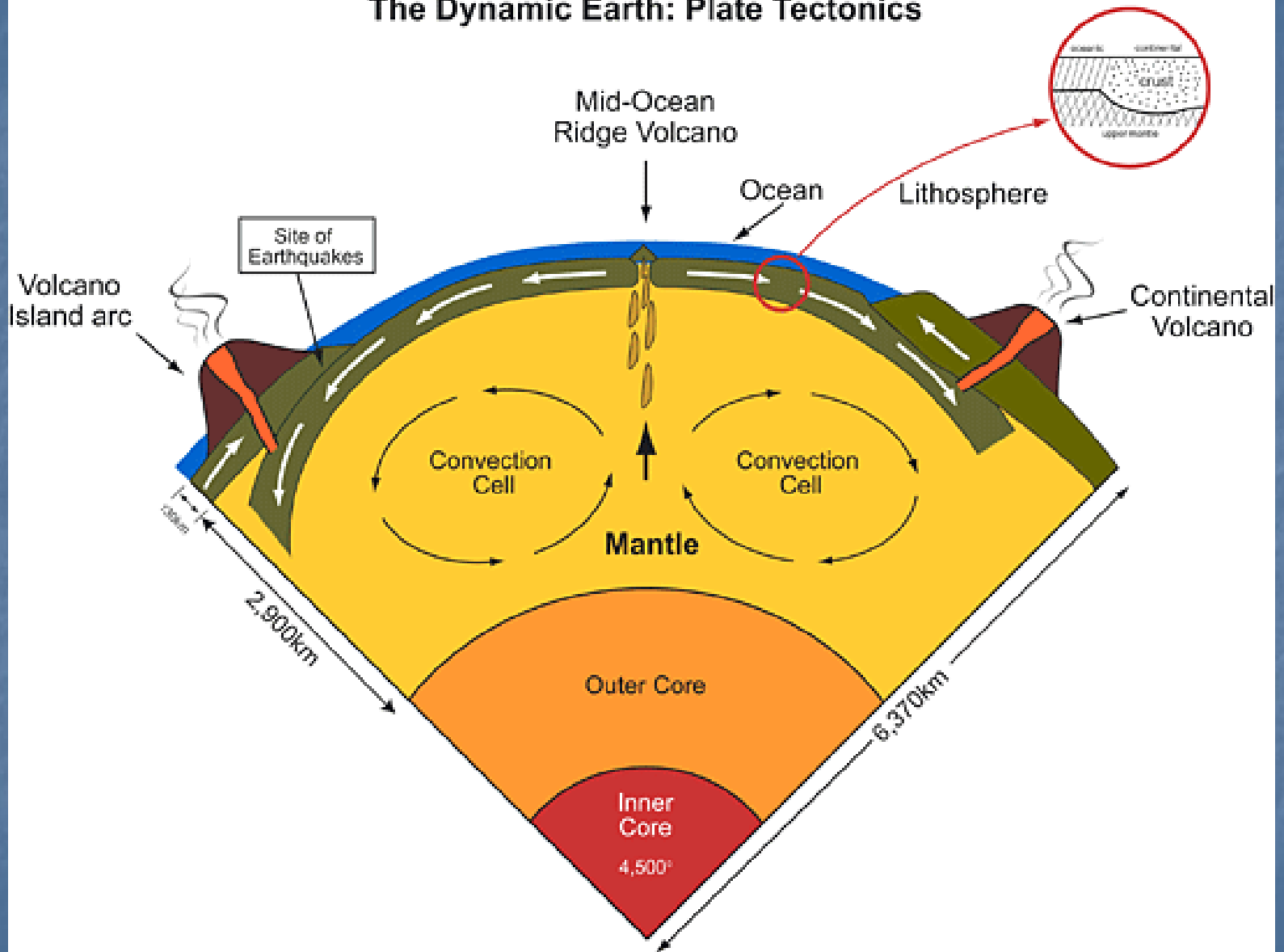
# INFER!!! Make the Connection!

- How does the process of sea-floor spreading connect back to prove continental drift theory?

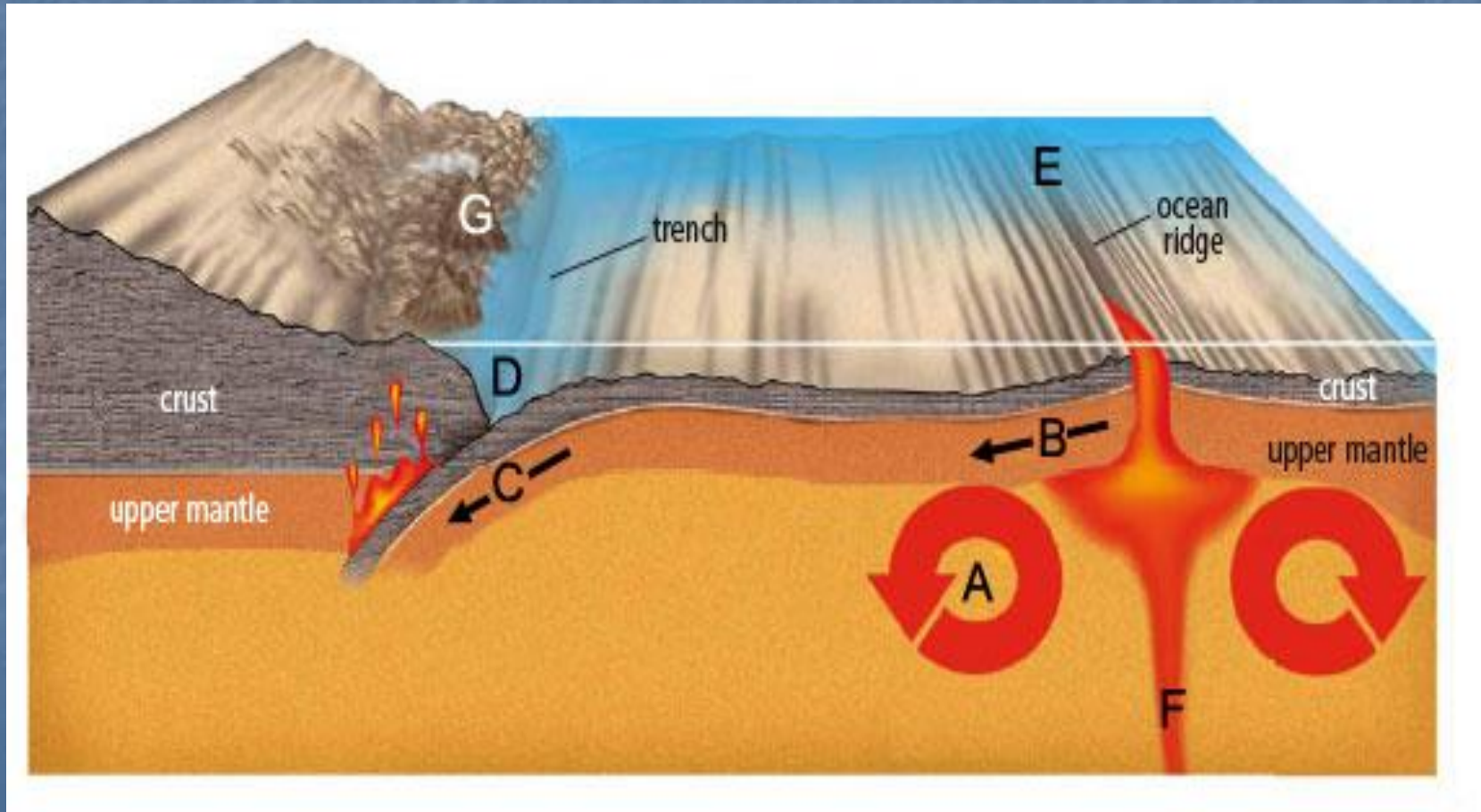
# Connection to Continental Drift

- Seafloor spreading is the force strong enough to push the continents

# The Dynamic Earth: Plate Tectonics



# Sea Floor Spreading



# What's Happening Now?

- North America is being pushed west toward Asia
- Atlantic Ocean is widening; Pacific Ocean is shrinking