Convection and Seafloor Spreading

- Understanding Continental Drift and Plate Tectonics, requires you to understand the internal processes of Earth.
- Convection currents happen in the asthenosphere, proposed by Arthur Holmes.

  Seafloor spreading idea, proposed by Harry Hess, provides evidence for a mobile Earth.

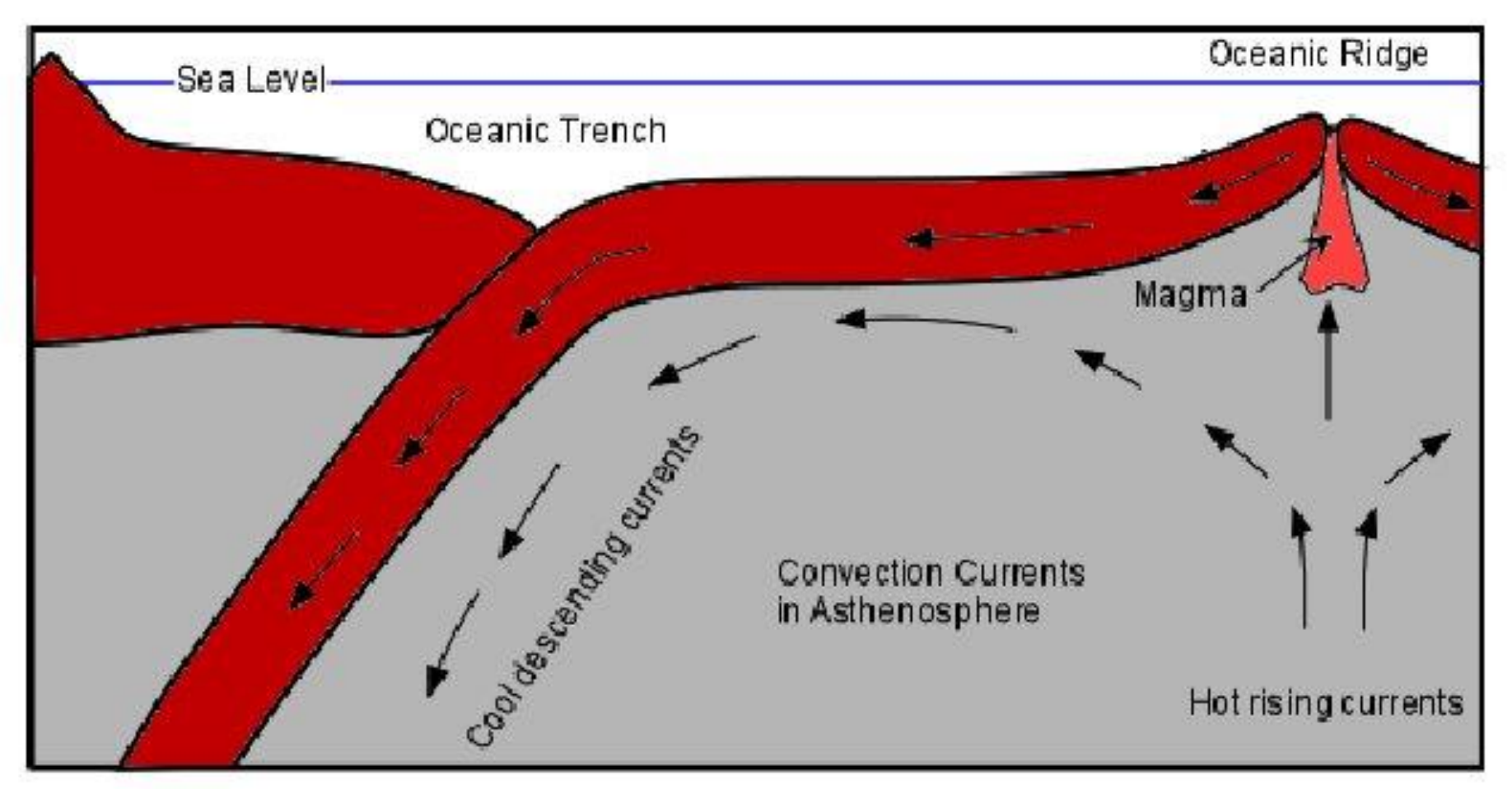
- Plate Tectonics became THE theory to explain crustal movements because it combines the seafloor spreading model with continental drift and is proved by earthquake information.

Reference:
Tarbuck and Lutgens
Pages 523-524, 547-548 CD 72, 74-75, 840-864

Convection Currents

- The plates that make up the earth's crust sit directly on a "plastic" layer of the mantle called the *Asthenosphere*. Holmes found evidence to prove that tectonic plates moved on what he referred to as *convection currents*.
- Remember: Convection happens because of heat in liquids.
  Heat in Earth comes from two main sources:
  1) radioactive decay and 2) residual heat.
- If the asthenosphere is moving because of convection, then this could be the mechanism responsible for plate tectonics.
- Hess using Holmes' ideas, said that deep within the asthenosphere, heated material expands, becomes less dense, rises, and pushes it way up through ridges. It then moves along the base of oceanic plates, pulling the plates in opposite directions. We call this *Seafloor Spreading*.

- When this slowly moving material reaches cooler areas it contracts and sinks causing one plate to move downward (subducting plate) beneath another (over-riding plate). This material is then recycled back into the mantle.



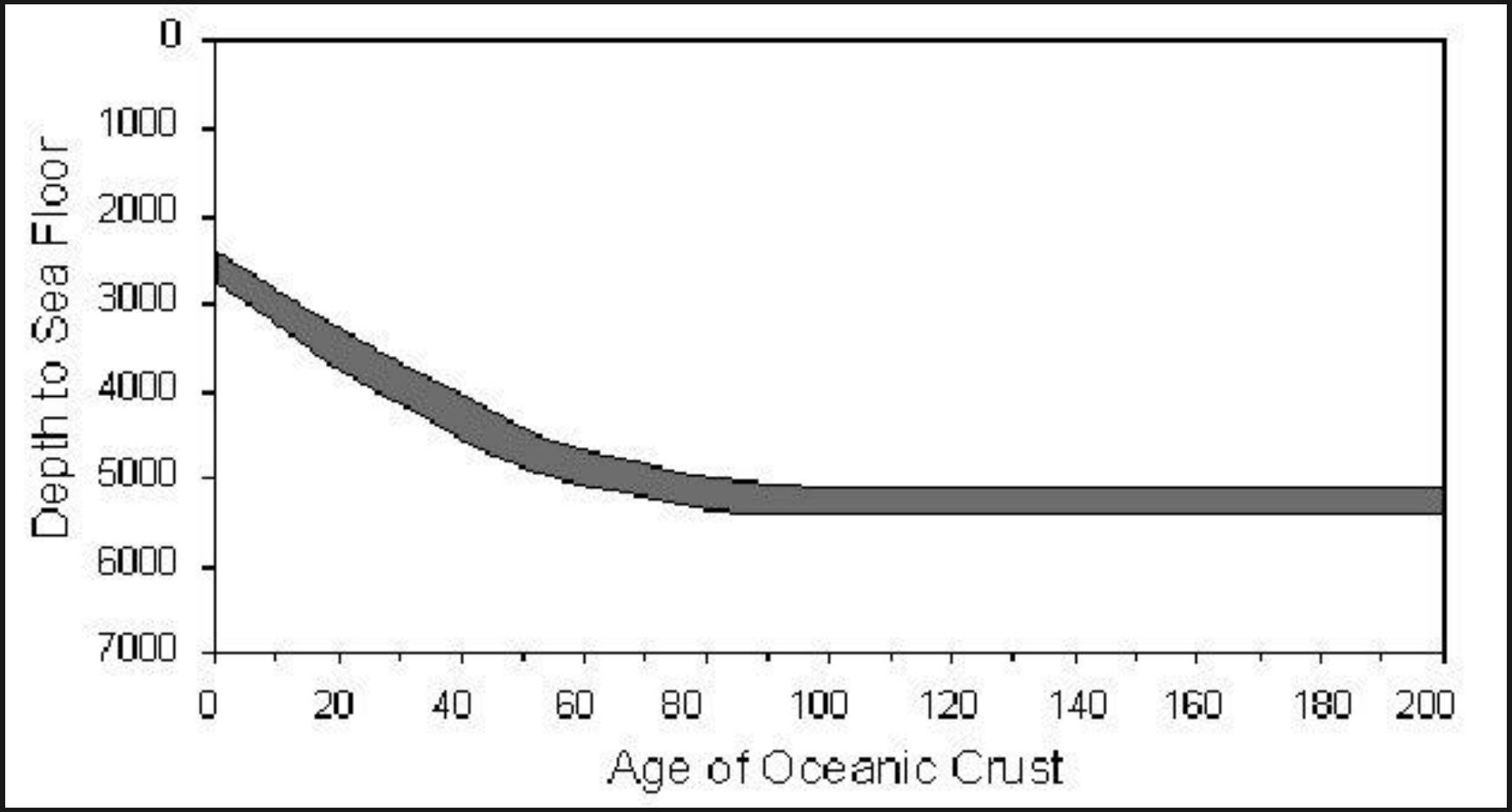
Ocean Depths

- In WW2, geologists employed by the military carried out studies of the sea floor, a part of the Earth that had received little scientific study.
- The topographic studies involved measuring the depth to the sea floor. The studies revealed the presence of two important features:

1) *Oceanic Ridges* - long sinuous ridges that occupy the middle of the Atlantic Ocean and the eastern part of the Pacific Ocean.

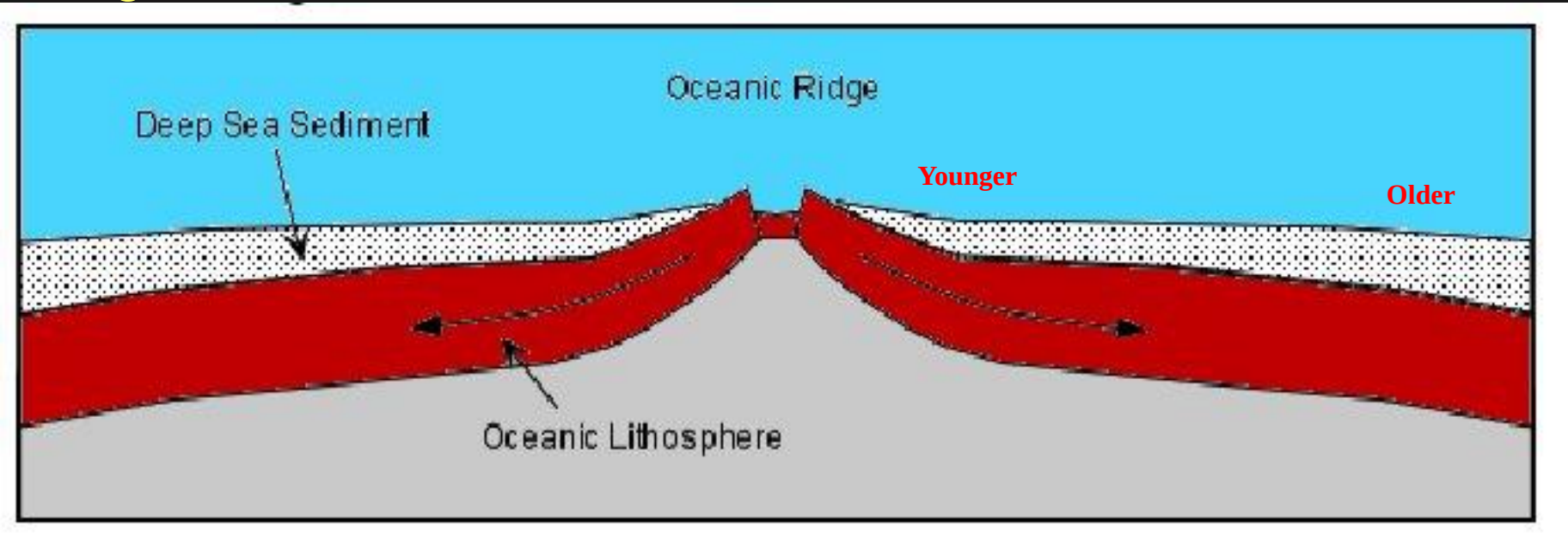
2) *Oceanic Trenches* - deep trenches along the margins of continents, particularly surrounding the Pacific Ocean.

- Studies also noted that as oceanic lithosphere moves away from the ridge, it cools and sinks deeper into the asthenosphere. Thus, the depth to the sea floor increases with increasing age away from the ridge.

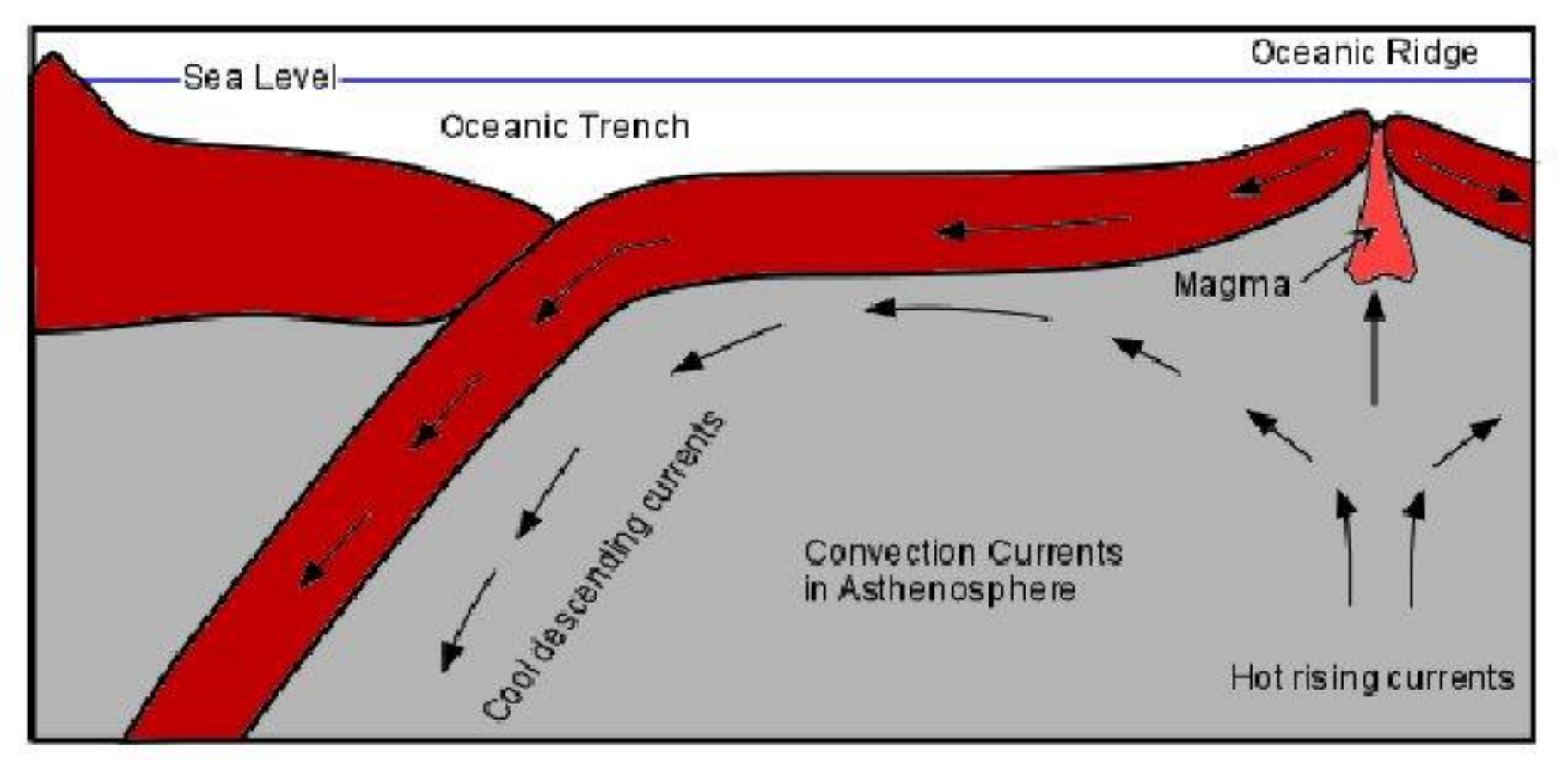


Seafloor Sediment and Age

- Oceanic ridges are areas of young crust. There is very little sediment accumulation on them. Sediment thickness increases in both directions away from the ridge. The older the crust the thicker the sediment.
- When oceanic crust is created it is pushed aside in two directions. So, the farther the crust is from the ridge, the older it gets.



- Oceanic lithosphere is created at ridges and destroyed at subduction zones (trenches). Oceanic basins are continuously being recycled and are relatively young. The oldest oceanic crust occurs farthest away from a ridge so in the Atlantic Ocean, the oldest oceanic crust is about 180 million years old (Jurassic).



Sample Problem

Explain why it is impossible for oceanic crust to be older than 200 million years.

Answer:

A geologic process called sea floor spreading causes the ocean floor to move. Ocean floor is created at oceanic ridges and is destroyed or consumed within Earth at subduction zones. This process of recycling the ocean floor occurs within a span of 180 - 200 million years.