# Seafloor Spreading


**Essential Standard 2.1: Explain how processes and forces affect the lithosphere**

**Objective 2.1.1: Explain how the rock cycle, plate tectonics, volcanoes, and earthquakes impact the lithosphere.**

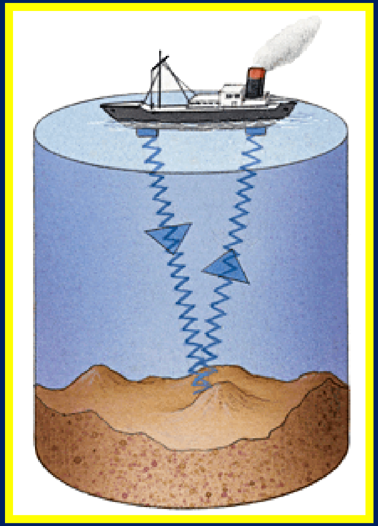
# Early Concept

People used to think that the ocean floor was flat and covered with sand and had no desire to find out more.

But that changed when a German U Boat (submarine) was able to make it to the coast of NC without being detected, during WW2.

Now necessary it became necessary to have technology that helped detect what was under the water.

# New Technology



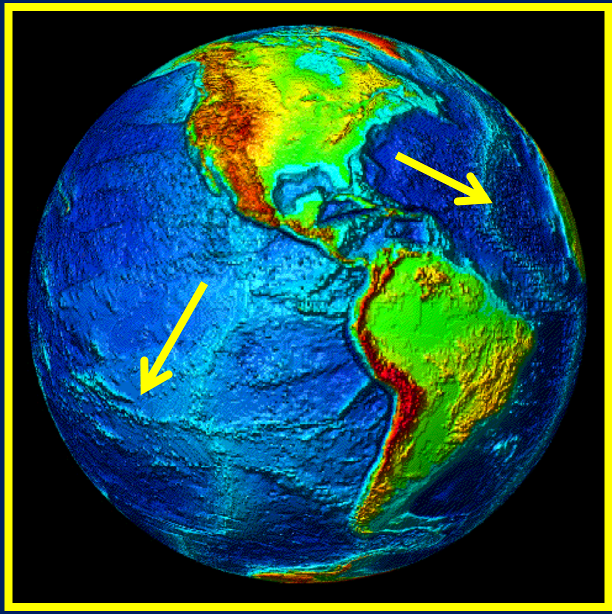
Sonar sends out sound waves and then measures the time it takes for sound waves to return.

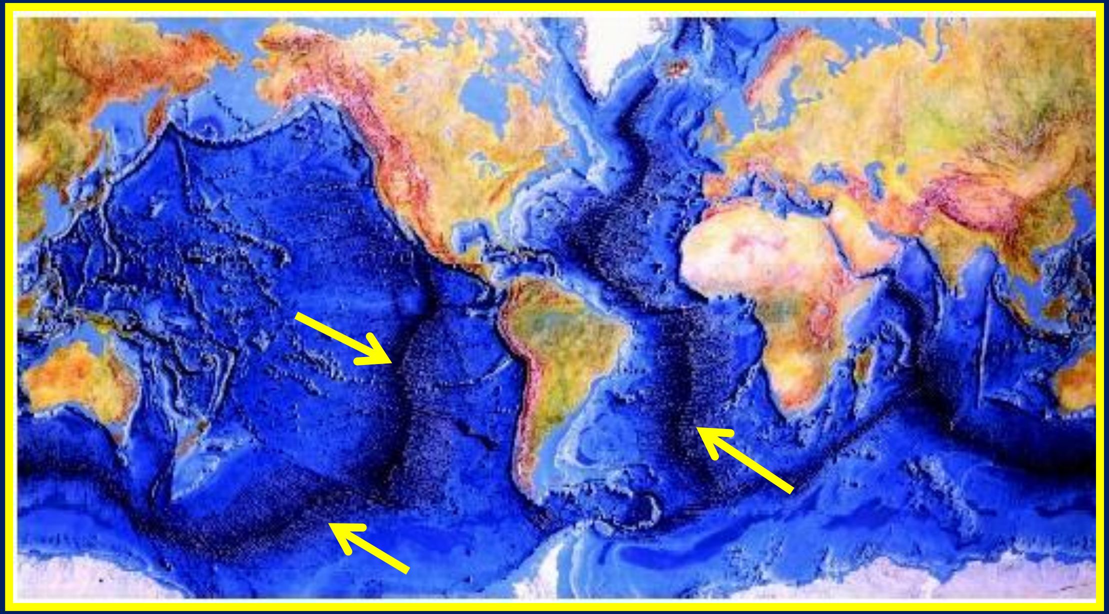
In 1946, a geologist and Navy Submarine commander, Harry Hess, used sonar to map ocean floor.

Harry Hess found that the ocean floor was not flat, nor covered with sand. Instead, there were underwater mountain chains and extremely deep valleys.

# Mid Ocean Ridge

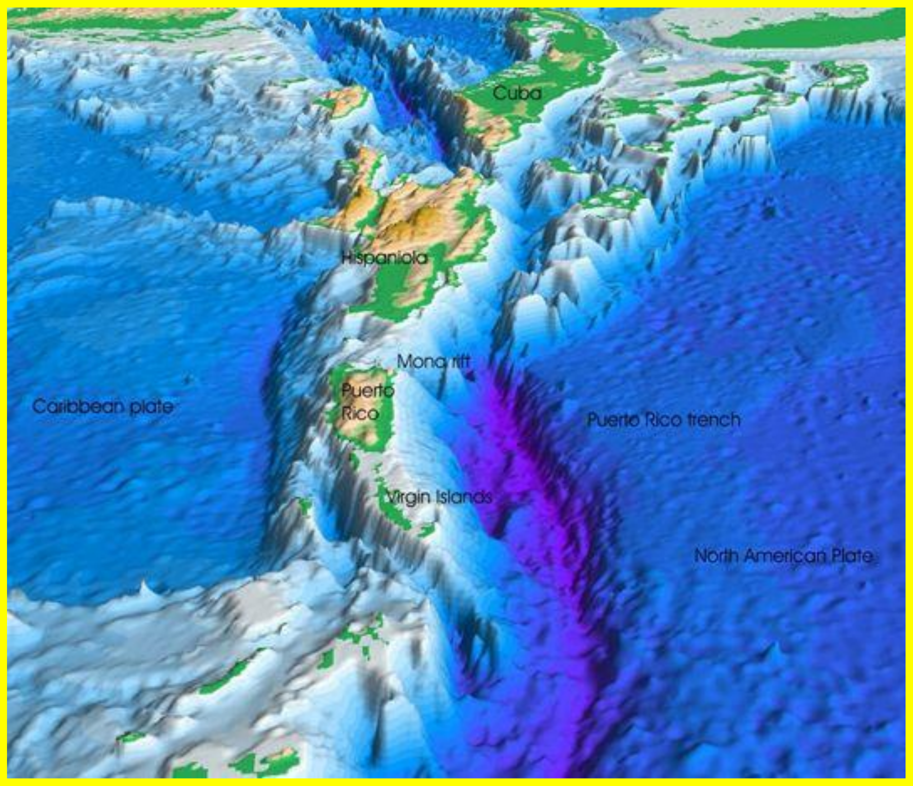
Further studies showed these underwater mountain ridges existed in all oceans and were given the name of mid-ocean ridges.





# Deep Sea Trenches

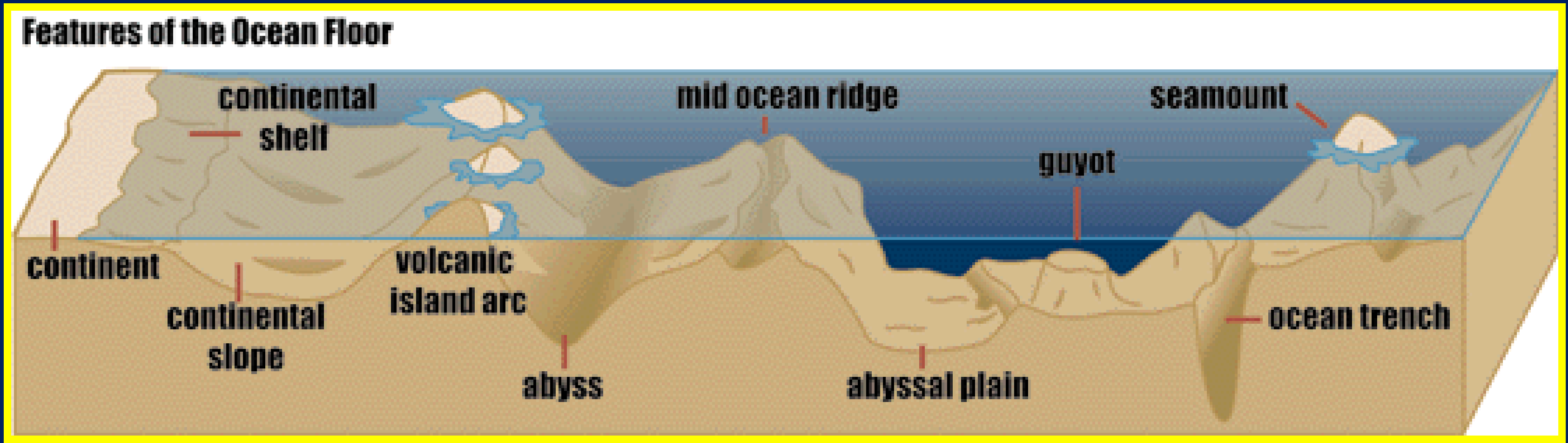
Elongated depressions or valleys were also found and were given the name of Deep Sea Trenches.




Deepest Trench
Marina Trench
Pacific Ocean
11 km deep

# New Concept

Mapping the ocean floor showed that the topography of the ocean floor was just as varied as the land on top of continents.



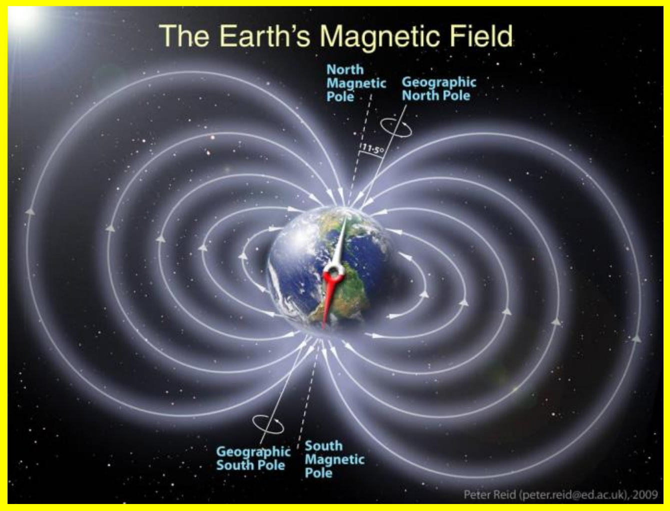
# Paleomagnitism

Another new technology used Paleomagnetometers to measure changes in the magnetic field on the ocean floor.

Oceanic crust is made up of a rock called Basalt that has a high iron content.

# Earth's Magnetic Field

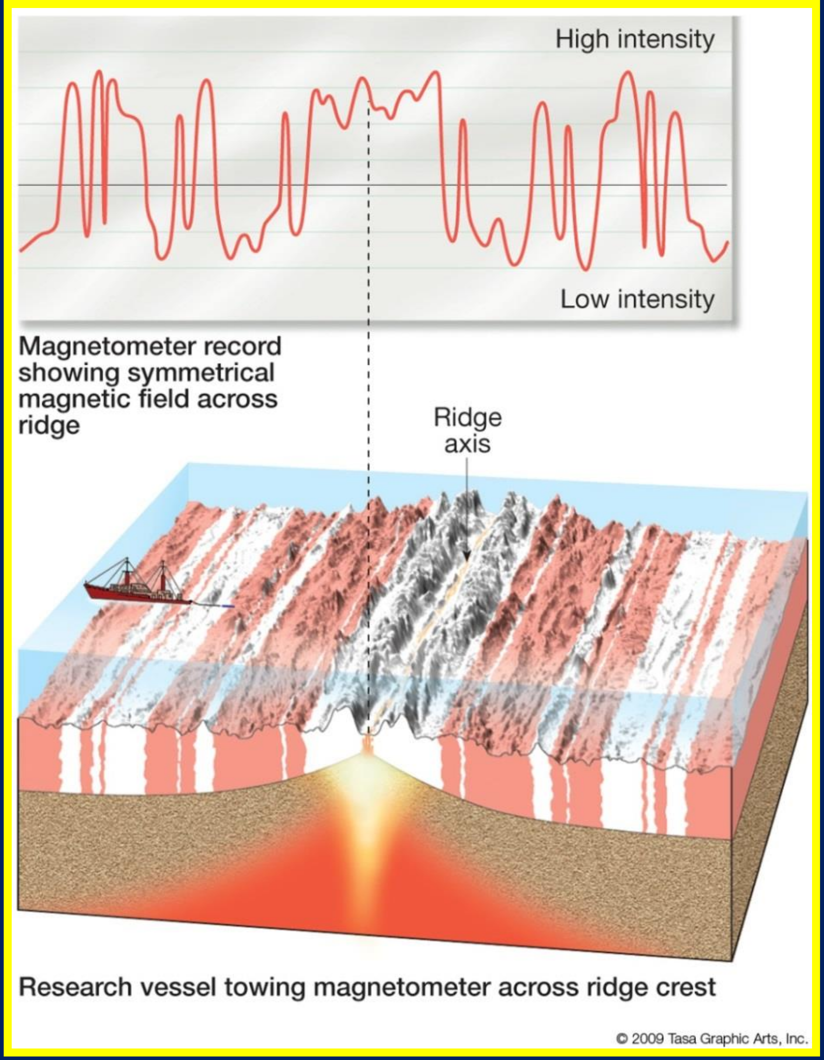
Before the magma cools, the iron minerals line up with Earth's magnetic field.




When the magma cools to form basalt rock, the iron minerals are locked into place creating a record of Earth's magnetic field.

# Paleomagnitism

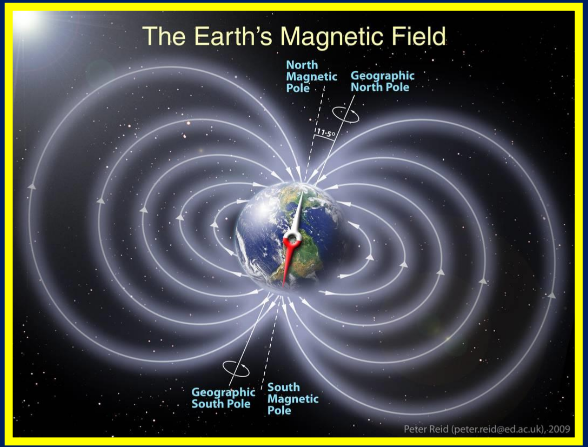
Records of the magnetic field showed that the iron on the ocean floor had lined up in alternating strips that extended outwards from mid ocean ridges.

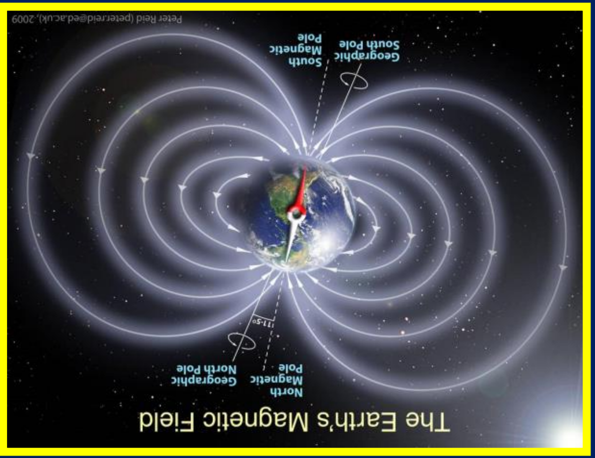


# Earth’s Magnetic Field

It was then discovered that throughout history, Earth’s magnetic field periodically reverses its poles.

For thousands of years, the north magnetic pole is located near the north geographic pole.

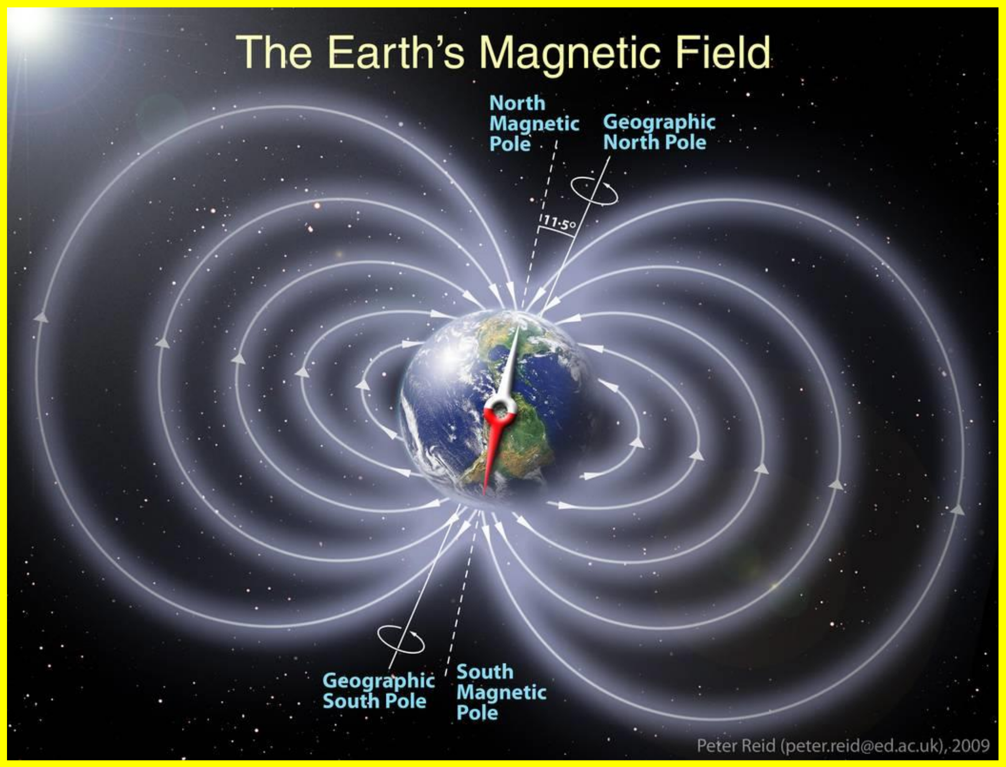



But then, for the next few thousand years, the north magnetic pole is located near the south geographic pole.

# Earth's Magnetic Field

Even today, the north magnetic pole is not located right at the north geographic pole.

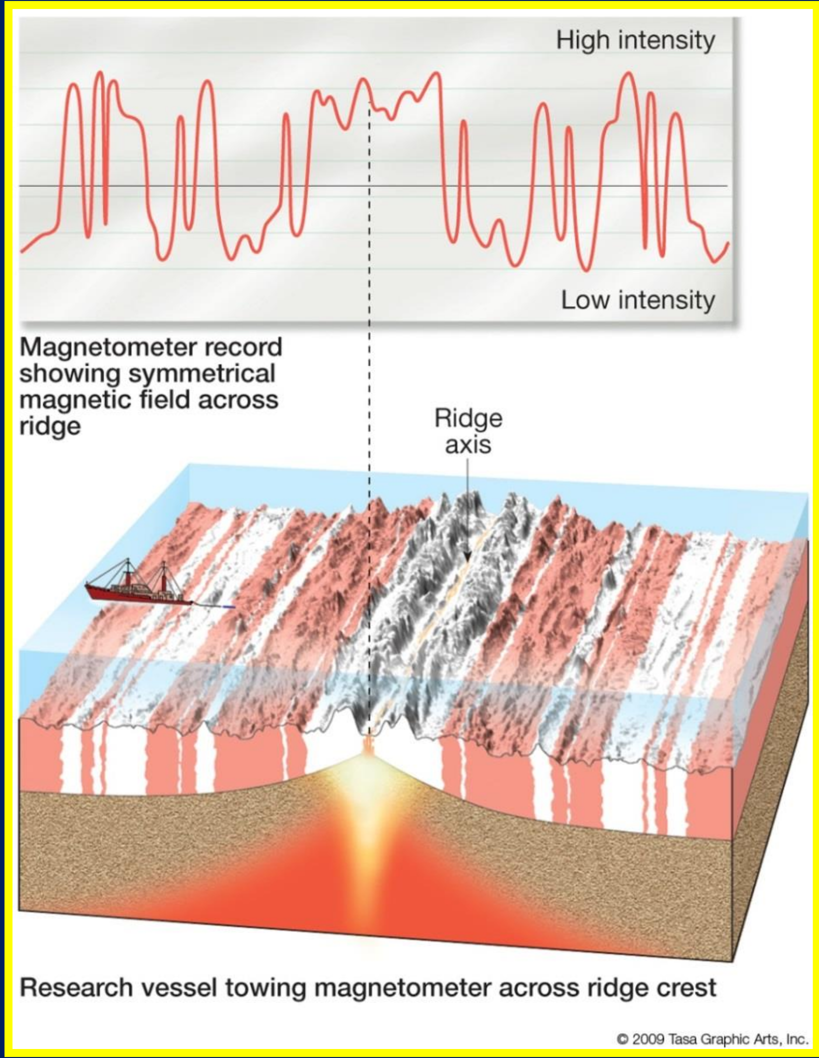



The north magnetic pole is actually located in Canada, about 500 kilometers away from the north geographic pole.

# Alternating Magnetic Strips

It was then realized that the basalt rock on the ocean floor had recorded a history of the changes in Earth's Magnetic Field.

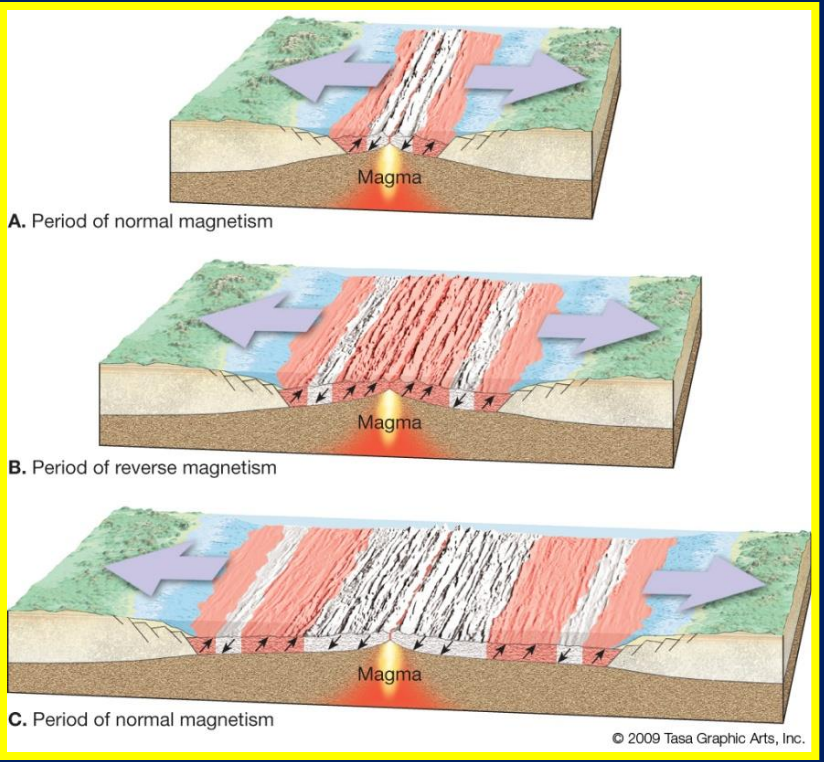
But the way that the iron lined up in alternating strips on both sides of the ridges also told the scientists something else.



# Alternating Magnetic Strips

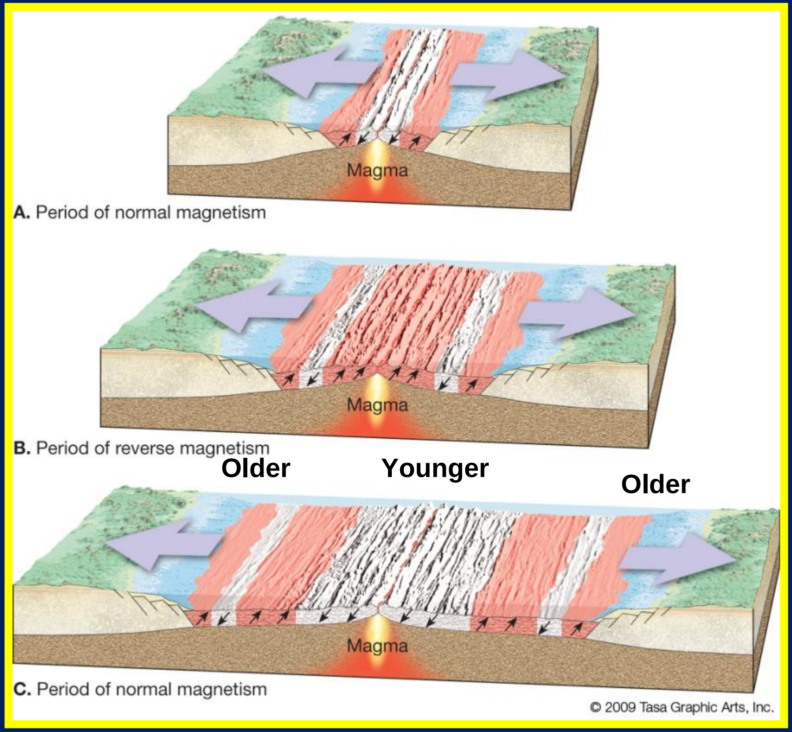
The alternating magnetic strips indicate that magma was rising out of the ridges and solidifying into basalt rock on both sides of the ridges.

Overtime, the basalt rock was pushed outwards, in both directions, as more magma rose and cooled to form basalt rock.



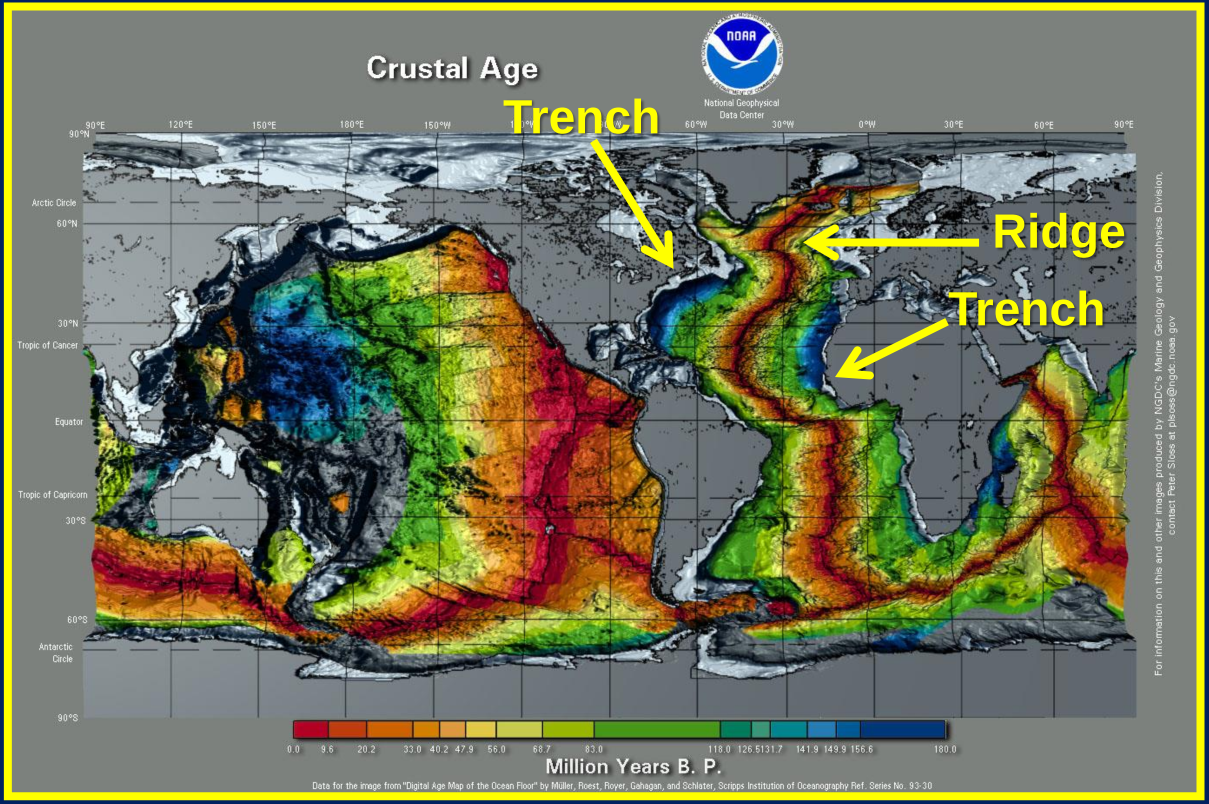
# Dating Ocean Sediments

Collecting and dating oceanic rocks confirmed that younger rocks were located closer to the ridge and older rocks were located further out, on both sides of the ridge.



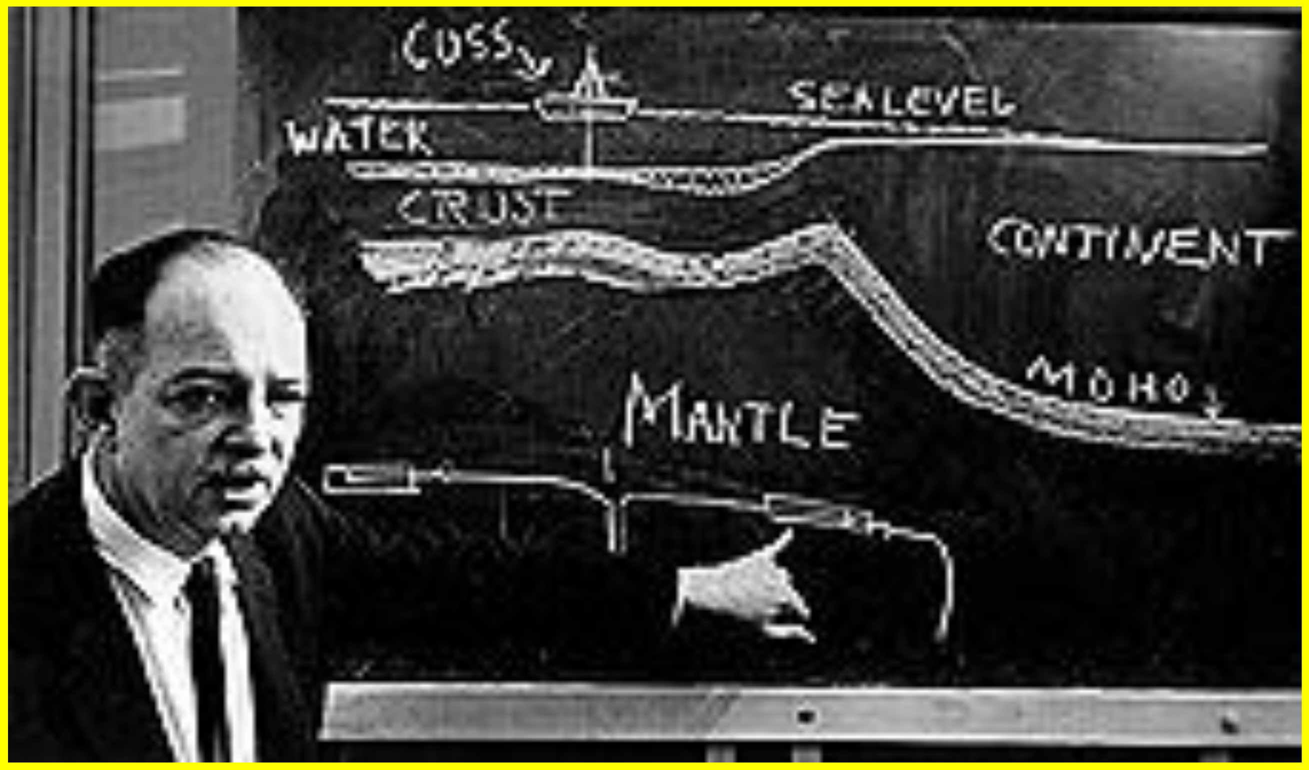

# Seafloor Spreading

Putting all this data together, it became clear that the seafloor was spreading outwards from the ridges towards the trenches.



# Convection Currents

In 1960, Harry Hess, now a geology professor at Princeton, realized that convection currents in the mantle must be behind the crust's movement.



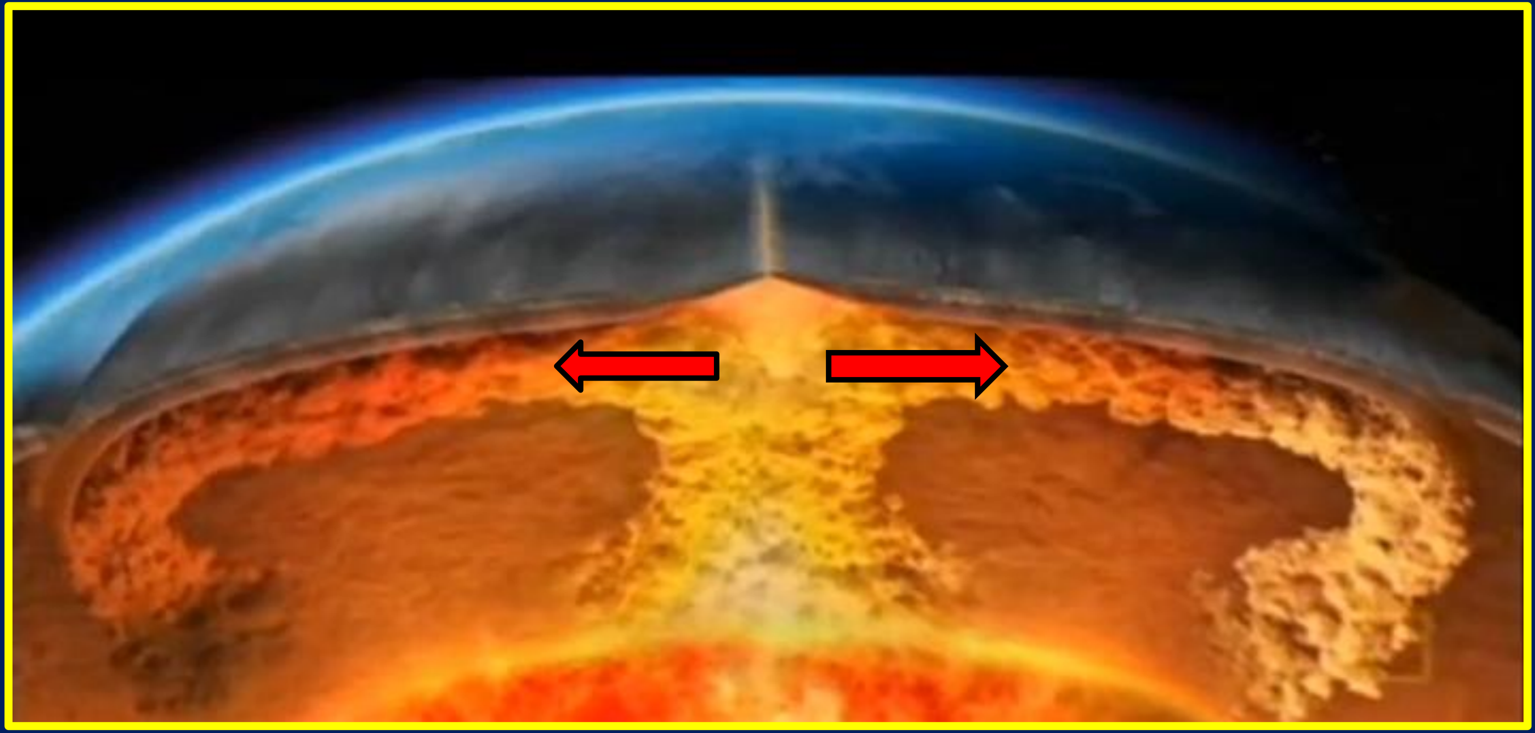
# Convection Currents

Hess theorized that under Earth's crust, the deeper magma heats up due to the heat from Earth's core.

The magma rises toward the crust, pushing the crush upwards.

# Convection Currents

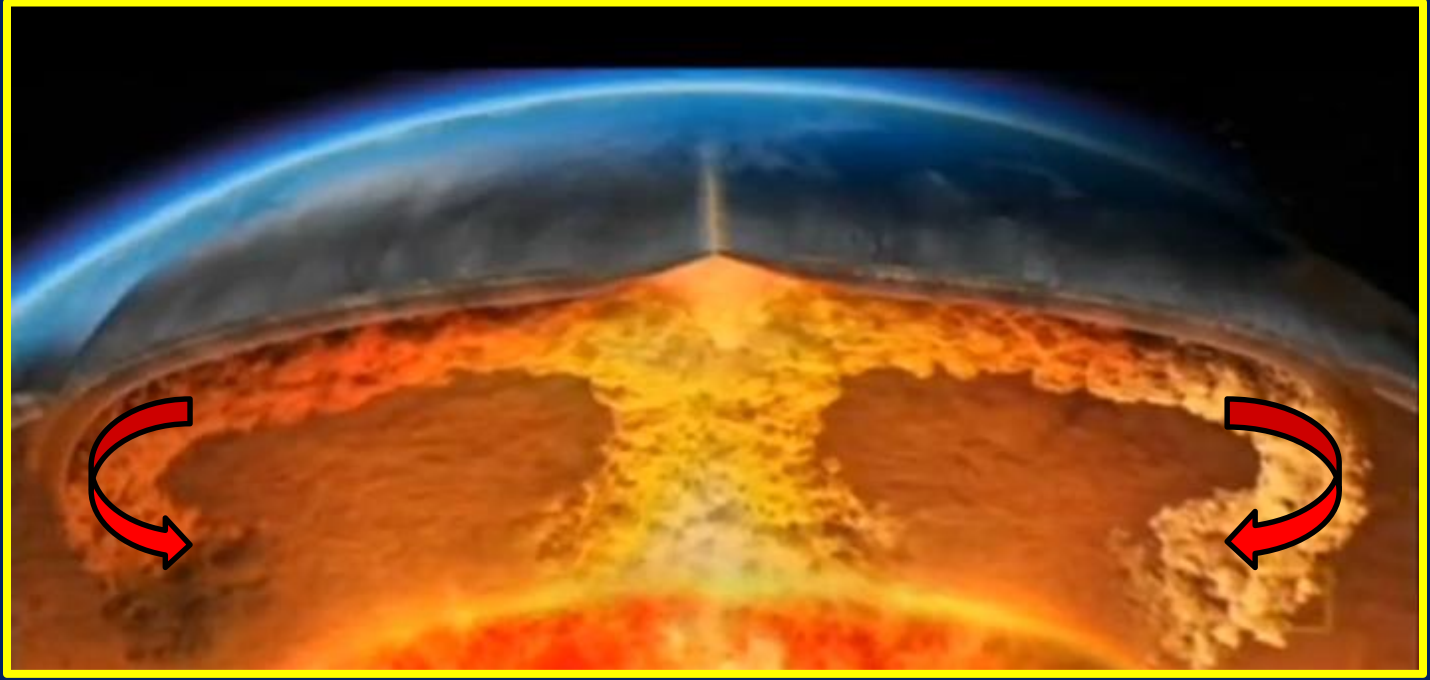
Some of the magma escapes to form new crust.



But most of the magma is pushed aside, as new magma rises.

# Convection Currents

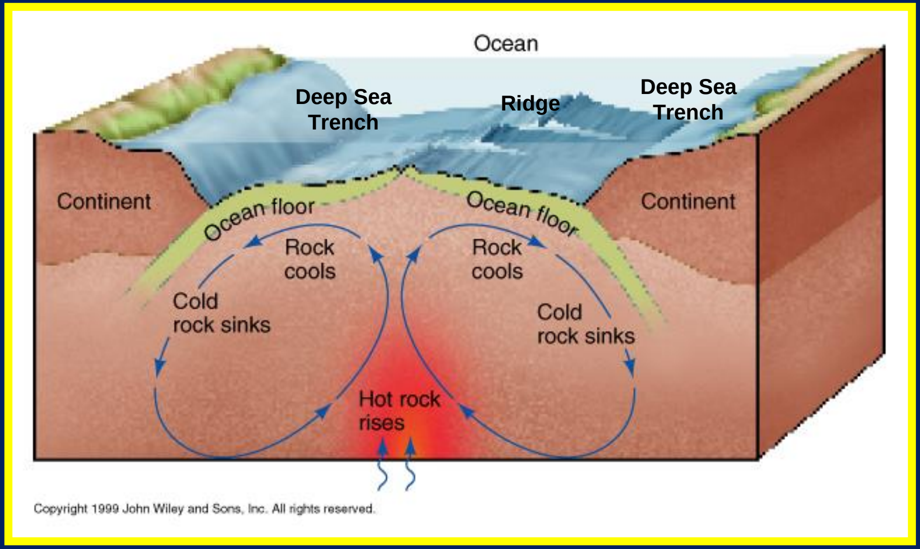
As the magma is pushed aside, it cools, becomes more dense, and sinks.



The end result are continuous convection currents in what is called the mantle, beneath Earth’s crust.

# Ridge Push – Slab Pull

New crust is formed as magma rises and pushes up the crust to form the mid-ocean ridges.



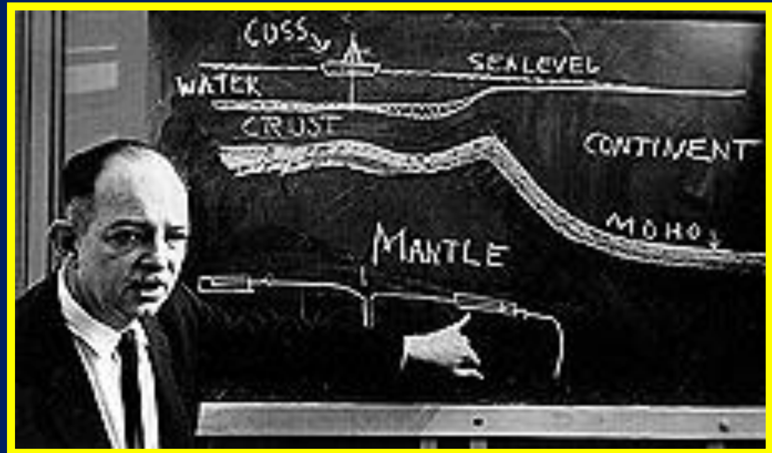

As new crust formed, the crust is pushed outward, from the ridge, towards the trenches.

At the deep sea trenches, the crust is pulled downward with the sinking magma and is melted back into back into molten rock.

# The Missing Link

Harry Hess provided the missing link that explained the force that was great enough to move large continents across Earth's surface.






Continents are merely passengers that ride with oceanic crust as it slowly moves away from ocean ridges, due to convection currents in Earth's mantle.

# Now Everybody Sing

Yee Hah

Alfred Wegener

You are a brilliant, brilliant man!