Seafloors: Characteristics and Spreading

Studying the Seafloor

Study Tip

Using what you know from plate tectonics, come up with your hypothesis of why seafloor spreads. Then, compare yours to the one by Harry Hess.

These are ways scientists learn about the deep ocean:

- **Seafloor bathymetry:** scientists used to drop a line over the side of ships. Now they use **echo sounders**, which have been used to map the entire seafloor
- **Sampling remotely:** take samples from different depths to contrast ocean chemistry
- **Submersibles:** samples of seawater and rocks collected by scientists in submersibles
- **Remotely operated vehicles:** used to study the seafloor in a safe way

Seafloor Features

Here are some of the major features of seafloors:

- **Mid-ocean ridges:** underwater mountain ranges that rise miles from the deep seafloor
- **Rift zones:** zones in the middle of mid-ocean ridges that are lower than the mountain ridges around them
- **Deep sea trenches:** depressions usually several miles deep located on the edges of continents near active volcanoes
- **Abyssal plains:** underwater plains, some dotted with volcanoes

More than a quarter of the ocean basin consists of **continental margin**, which is a transition from continental crust to oceanic crust ("land" to "deep sea").

Magnetic Evidence on the Seafloor

Magnetic polarity is present within the seafloor. Using a **magnetometer**, scientists were able to plot symmetrical striped patterns using points of normal and reverse polarity. These patterns revealed that:

- Stripes of normal and reverse polarity alternate across the ocean
- Stripes form mirror images on either side of mid-ocean ridges
- Stripes abruptly end at the edges of continents, sometimes at deep sea trenches

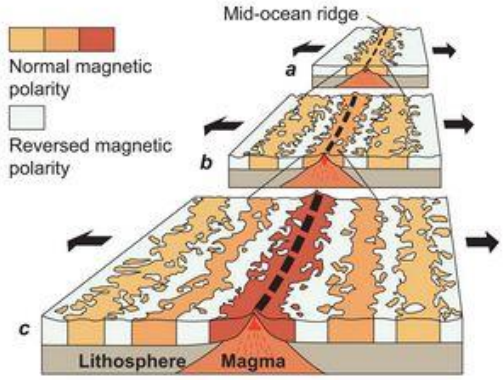
Example of striped pattern formed by points of polarity. Notice how the polarity continues to constantly reverse across the seafloor.

Seafloor Magnetic Periods

Seafloor Age: There have been four magnetic periods over time:

- Gilbert reverse - 5.3 million years ago to 3.4 million years ago

- Gauss normal - 3.4 million years ago to 2.48 million years ago
- Matuyama reverse - 2.48 million years ago 730,000 years ago
- Brunhes normal – 730,000 years ago to present



Older sediment is located further away from mid-ocean ridge crests and newer sediment is located closer to them. The oldest seafloor is less than 180 million years old. Characteristics of sediment as it progresses further away from ridge crest are described below:

	Rock ages	Sediment thickness	Crust thickness	Heat flow
At ridge axis	youngest	none	thinnest	hottest
With distance from axis	becomes older	becomes thicker	becomes thicker	becomes cooler

Seafloor Spreading Hypothesis

Seafloor Spreading Hypothesis: Harry Hess designed this hypothesis by combining the ideas of Wegener's continental drift hypothesis and Holmes' mantle convection hypothesis. As lava rose to the surface, existing seafloor was pushed in opposite directions. Cooled lava then formed different stripes. Since magnetite crystals face the North Pole, the different stripes show the different ages of the seafloor. Therefore, each of the magnetic periods has its own layer of igneous rock with different magnetic polarity from the layers around it.

Hess also realized that the oldest oceanic crust must be recycled somehow because new oceanic crust is constantly being created but the Earth can't get any bigger. He then came up with the following conclusions:

- The continent moves away from the ridge axis as oceanic crust moves away from ridge crests.
- Crust sinks into trenches as it reaches them.
- Older crust lies deeper in the ocean because newer crust is hotter and more buoyant.

Concept Check

- Describe the major features of seafloors.
- What are the magnetic polarity characteristics of the seafloor?
- What are the four magnetic periods?
- Summarize the seafloor spreading hypothesis.