Exploration Lab

Paleomagnetism and the Ocean Floor L2

Objectives

In this activity, students will

- interpret diagrams of seafloor sections with respect to paleomagnetism.
- measure the distance that different ocean basins have opened.
- calculate the rate of seafloor spreading in different ocean basins based on magnetic polarity reversals.

Address Misconceptions

Students may think that the rocks on the ocean floor change their polarity every time Earth's polarity reverses. Remind students that magnetic polarity cannot be changed after rock material crystallizes. Ask: **What causes a substance to be magnetic?** *(The molecules in the substance are all aligned in the same direction.)* Tell students that once the substance solidifies, its molecules are held in a rigid lattice and cannot change their alignment.

Skills Focus **Observing, Comparing and Contrasting, Inferring, Calculating, Measuring, Interpreting Diagrams**

Prep Time 20 minutes to copy diagrams

Advance Prep Copy the diagrams on these two pages and distribute them to students.

Class Time 30 minutes

Teaching Tips

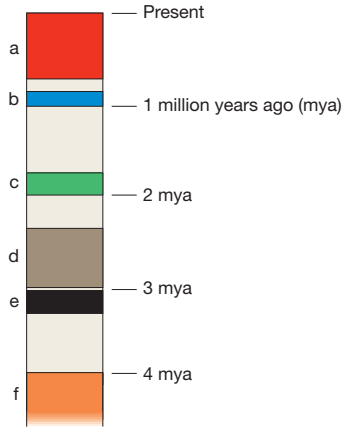
- Copying and handing out the diagrams in this lab will ensure that students will not write in their textbooks.
- Have students review the material on paleomagnetism before they begin the lab.

Expected Outcome Students will find that the left side of the Pacific basin has spread about 80 km in 2 million years, whereas the left side of the North Atlantic basin has spread only 37 km during the same time period. During this time period, the ocean basins opened by the following distances: Pacific—approximately 160 km; North Atlantic—approximately 74 km; South Atlantic—approximately 78 km

Exploration Lab

Paleomagnetism and the Ocean Floor

In the continental drift hypothesis, the ocean floors were not really involved. The continents were proposed to move through the oceans like icebreaking ships plowing through ice. Later studies of the oceans provided one of the keys to the plate tectonic theory. You will observe how the magnetic rocks on the ocean floor can be used to understand plate tectonics.



Problem

How are the paleomagnetic patterns on the ocean floor used to determine the rate of seafloor spreading?

Materials

- pencil
- metric ruler
- calculator
- photocopy of diagrams on page 273

Skills

Measuring, Interpreting Diagrams, Calculating

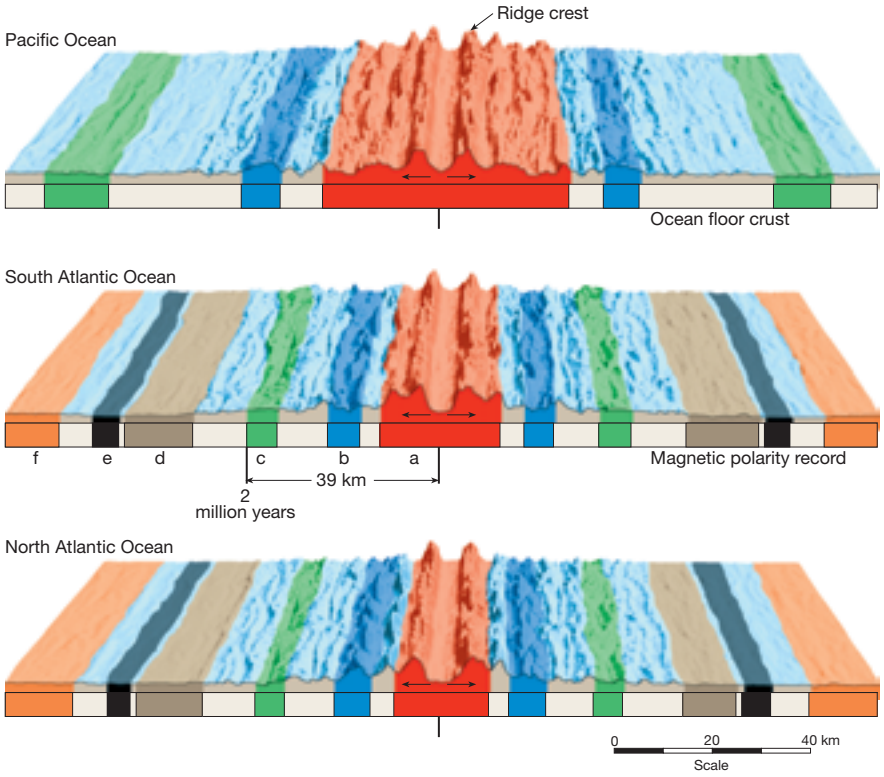
Procedure

1. Scientists have reconstructed Earth's magnetic polarity reversals over the past several million years. A record of these reversals is shown above. Periods of normal polarity, when a compass would have pointed north as it does today, are shown in color. Periods of reverse polarity are shown in white. Record the number of times Earth's magnetic field has had reversed polarity in the last 4 million years.
2. The three diagrams on the next page illustrate the magnetic polarity reversals across sections of the mid-ocean ridges in the Pacific, South Atlantic, and North Atlantic oceans. Periods of normal polarity are shown in color and match the colors in the illustration above. Observe that the patterns of polarity in the rock match on either side of the ridge for each ocean basin.
3. On the photocopy of the three ocean-floor diagrams, identify and mark the periods of normal polarity with the letters *a–f*. Begin at the ridge crest and label along both sides of each ridge. (*Hint:* The left side of the South Atlantic has already been done and can act as a guide.)
4. Using the South Atlantic as an example, label the beginning of the normal polarity period c, "2 million years ago," on the left sides of the Pacific and North Atlantic diagrams.
5. Using the distance scale shown with the ocean floor diagrams, determine which ocean basin has spread the greatest distance during the last 2 million years.
6. Refer to the distance scale. Notice that the left side of the South Atlantic basin has spread approximately 39 kilometers from the center of the ridge crest in 2 million years.

Analyze and Conclude

1. **Analyzing Data** How many kilometers has the left side of the Pacific basin spread in 2 million years?
2. **Analyzing Data** How many kilometers has the left side of the North Atlantic basin spread in 2 million years?
3. **Inferring** How many kilometers has each ocean basin opened in the past 2 million years?
4. **Calculating** If both the distance that each ocean basin has opened and the time it took to open that distance are known, the rate of seafloor spreading can be calculated. Determine the rate of seafloor spreading for the South Atlantic Ocean basin in centimeters per year. (*Hint:* To determine the rate of spreading in centimeters per year for each ocean basin, first convert the distance from kilometers to centimeters and then divide this distance by the time, 2 million years.)
5. **Calculating** Determine the rate of seafloor spreading for the North Atlantic and Pacific Ocean basins.
6. **Drawing Conclusions** Which ocean basin is spreading the fastest? The slowest?
7. **Inferring** Do ocean basins spread uniformly over the entire basin? Explain.

Go Further Use the library or the Internet to research the spreading rates for other divergent plate boundaries on Earth. Where is the fastest spreading rate? The slowest spreading rate?



Answers to Procedure Questions

1. five times
5. The Pacific Ocean basin has spread the greatest distance.

Analyze and Conclude

1. approximately 80 km
2. approximately 37 km
3. Pacific: approximately 160 km; North Atlantic: approximately 74 km; South Atlantic: approximately 78 km
4. The South Atlantic Ocean basin's spreading rate is 3.9 cm/yr.
5. The Pacific Ocean basin's spreading rate is 8.0 cm/yr. The North Atlantic Ocean basin's spreading rate is 3.7 cm/yr.
6. Fastest: Pacific; slowest: North Atlantic
7. No, large basins such as the Pacific Ocean basin are spreading at various rates along their spreading ridges.

Go Further

The fastest spreading rate is the northern part of the Pacific plate, which is spreading at approximately 15.6 cm/yr. The slowest spreading rate is the Southwest Indian Ridge, between the African plate and the Antarctic plate, which is spreading at 1.4–1.5 cm/yr.
Visual, Logical