SEA FLOOR SPREADING

Introduction

You have already learned about Continental Drift, divergent, convergent, and transform plate boundaries, mid-ocean ridges, subduction, and the role that convection currents in the earth's mantle play in causing these phenomena. It seems that the different parts of our planet are moving. This movement has caused changes in the continents over time and causes major geologic events like earthquakes and volcanoes. Are the earth's plates moving quickly or slowly -- should we have a seatbelt on when we are at home, sitting in a chair, and watching television?

Problem

How fast is the sea floor spreading? Has the sea floor always moved at the same speed?

Procedures

Scientists have been able to establish the ages of vast areas of rocks on the ocean bottom. The pattern in the ages of the rocks across the Mid-Atlantic Ridge is used as evidence of sea-floor spreading. In this activity, you will observe the pattern and learn to calculate the rate of sea floor spreading. The diagram on the next page represents a section of the ocean floor in the North Atlantic. The numbers give the ages in millions of years for the rocks on the ocean floor located along the lines.

1. Locate the Mid-Atlantic Ridge and trace it in red.

2. Lightly shade in the age bands as follows:

0-9 million years	white
9-38 million years	red
38-53 million years	brown
53-63 million years	blue
63-81 million years	yellow
81-135 million years	green
135-155 million years	orange

3. Draw a line on the map from **A** to **B** with a ruler. This represents a path across the Atlantic Ocean from North America to Africa.

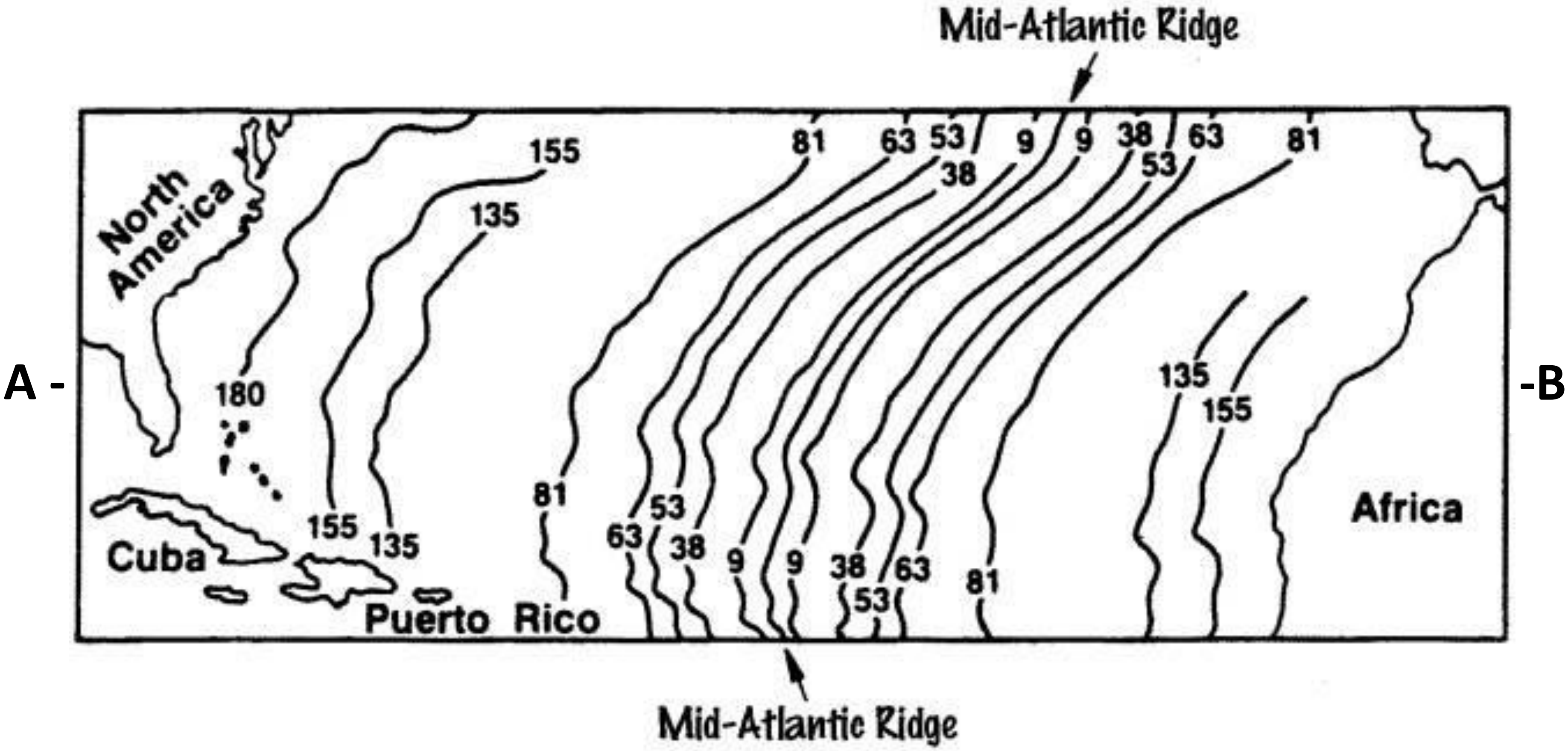
4. Use a ruler to measure the distance in **cm**, to the nearest tenth (0.1), from the mid-ocean ridge to each of The age bands. Put the measurements on the Data Chart in the column "Distance from Mid-Atlantic Ridge age line in (cm)."

5. Complete the rest of the Data Chart by finding the actual distance in kilometers (1cm = 500km).
   Actual distance: (km) = column B (cm) x 500 km/cm

6. Graph the data

7. Calculate the Rate of Movement of each age band

8. Complete column **D** on the Data Chart



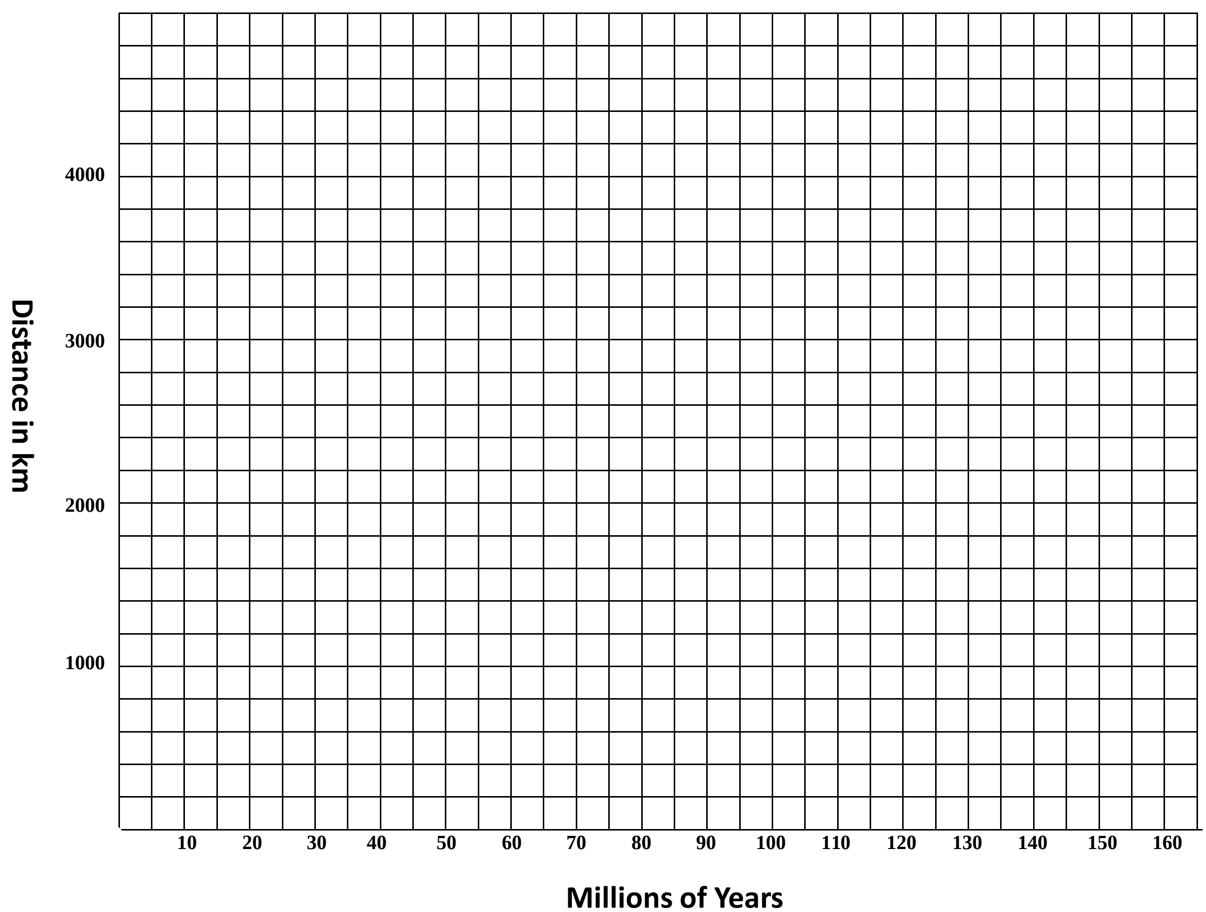
Scale: 1 cm = 500 Km

Data Table

A Age of Sea-Floor at age band in (millions of years)	**B** Distance from Mid-Atlantic Ridge to age line in (cm)	**C** Actual Distance in (km) cm (Column **B)** x 500 km/cm = actual distance	**D** Rate of Movement (cm/yr) = $\frac{\text{distance moved (cm)}}{\text{time (years)}}$
9			
38			
53			
63			
81			
135			
155			

Graph the data in the chart to show the relationship between age (millions of years) and the distance (km). Use the data in columns **A** and **C**.

- X axis is labeled with age (millions of years).
- Y axis is labeled with distance (km).
- Plot the data points
- Connect the data points
- Draw a line of best fit using a **Blue** colored pencil



Calculate the Rate of Movement of ***each*** age band

Rate of Movement (cm/yr) = distance moved (cm) / time (years)

$$\text{Rate of Movement (cm/yr)} = \frac{\text{distance moved (cm)}}{\text{time (years)}}$$

1. Age of **first** age band = _______________ million years

   Distance (from chart) = _______________km

   Convert this distance into centimeters by multiplying by 100,000. (100,000 cm = 1 kilometer).
   Distance = ___________________cm

   Use the equation above to calculate the rate. Note – add 6 zeros to the number in the years column so that your calculation will produce the centimeters per year.

   Show work: Rate = _______________cm/year

2. Age of **second** age band = _______________ million years

   Distance (from chart) = _______________km

   Convert this distance into centimeters by multiplying by 100,000. (100,000 cm = 1 kilometer).
   Distance = ___________________cm

   Use the equation above to calculate the rate. Note – add 6 zeros to the number in the years column so that your calculation will produce the centimeters per year.

   Show work: Rate = _______________cm/year

3. Age of **third** age band = _______________ million years

   Distance (from chart) = _______________km

   Convert this distance into centimeters by multiplying by 100,000. (100,000 cm = 1 kilometer).
   Distance = ___________________cm

   Use the equation above to calculate the rate. Note – add 6 zeros to the number in the years column so that your calculation will produce the centimeters per year.

   Show work: Rate = _______________cm/year

4. Age of **fourth** age band = _______________ million years

   Distance (from chart) = _______________km

   Convert this distance into centimeters by multiplying by 100,000. (100,000 cm = 1 kilometer).
   Distance = ___________________cm

   Use the equation above to calculate the rate. Note – add 6 zeros to the number in the years column so that your calculation will produce the centimeters per year.

   Show work: Rate = _______________cm/year

5. Age of **fifth** age band = _______________ million years

   Distance (from chart) = _______________km

   Convert this distance into centimeters by multiplying by 100,000. (100,000 cm = 1 kilometer).
   Distance = ___________________cm

   Use the equation above to calculate the rate. Note – add 6 zeros to the number in the years column so that your calculation will produce the centimeters per year.

   Show work: Rate = _______________cm/year

6. Age of **sixth** age band = _______________ million years

   Distance (from chart) = _______________km

   Convert this distance into centimeters by multiplying by 100,000. (100,000 cm = 1 kilometer).
   Distance = ___________________cm

   Use the equation above to calculate the rate. Note – add 6 zeros to the number in the years column so that your calculation will produce the centimeters per year.

   Show work: Rate = _______________cm/year

7. Age of **seventh** age band = _______________ million years

   Distance (from chart) = _______________km

   Convert this distance into centimeters by multiplying by 100,000. (100,000 cm = 1 kilometer).
   Distance = ___________________cm

   Use the equation above to calculate the rate. Note – add 6 zeros to the number in the years column so that your calculation will produce the centimeters per year.

   Show work: Rate = _______________cm/year

8. Based on your calculations and looking at the graph, has the rate (speed) of sea floor spreading been the same over the past 155 million years? Explain why or why not.

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9. Use the graph to predict the distance (km) from the mid-ocean ridge where rocks:

75 million years old would be __________________ km. 110 million years old would be __________________ km

10. Will you be able to see changes in the sea floor during your lifetime? Explain why or why not?

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11. The oldest rocks on Earth are located on continents and are about 4 billion years old (4,000 million). Explain why the oldest rocks of the ocean floor are only 180 - 200 million years old.

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12. Look at the graph you drew. Notice that as time passed rocks moved farther and farther from the mid-ocean ridge. Examine the distance that the sea floor spread over time by calculating the unit rate of change (slope). Use the best fit line you drew. (When using a best fit line, the ordered pairs to determine slope must be from the best fit line, not from your data chart.)

$$\text{Unit Rate of Change} = \frac{\Delta \text{ Distance (km)}}{\Delta \text{ Age (millions of years)}} = \frac{\Delta y}{\Delta x} = \frac{(y_2 - y_1)}{(x_2 - x_1)}$$

Unit Rate of Change (slope)

Ordered Pair used for calculation (x_1, y_1) (x_2, y_2)	Δ Distance (km) Δy	Δ Age (millions of years) Δx	**Unit Rate of Change (slope)** Δ y/Δ x

The units of the unit rate of change are kilometers per millions of years. Change that number to one that is more comprehensible by converting it to centimeters per year (remember that there are 100,000 cm per meter):

- multiply the numerator by 100,000
- add 6 zeros to the denominator to change to years
- divide

Unit rate of change (slope) in cm/year = ____________________________

13. How do the numbers values compare in from #12 with your answers to 1 through 7. Are the numbers values similar? __________ If yes, slope of the line of best fit is then a way of measuring the speed of ocean spreading.

Explain any similarities or differences.

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