

## MiSP Plate Tectonics Worksheet #1 L3

Name \_\_\_\_\_ Date \_\_\_\_\_

### SEA FLOOR SPREADING (L 1, 2, 3)

#### 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 also 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?

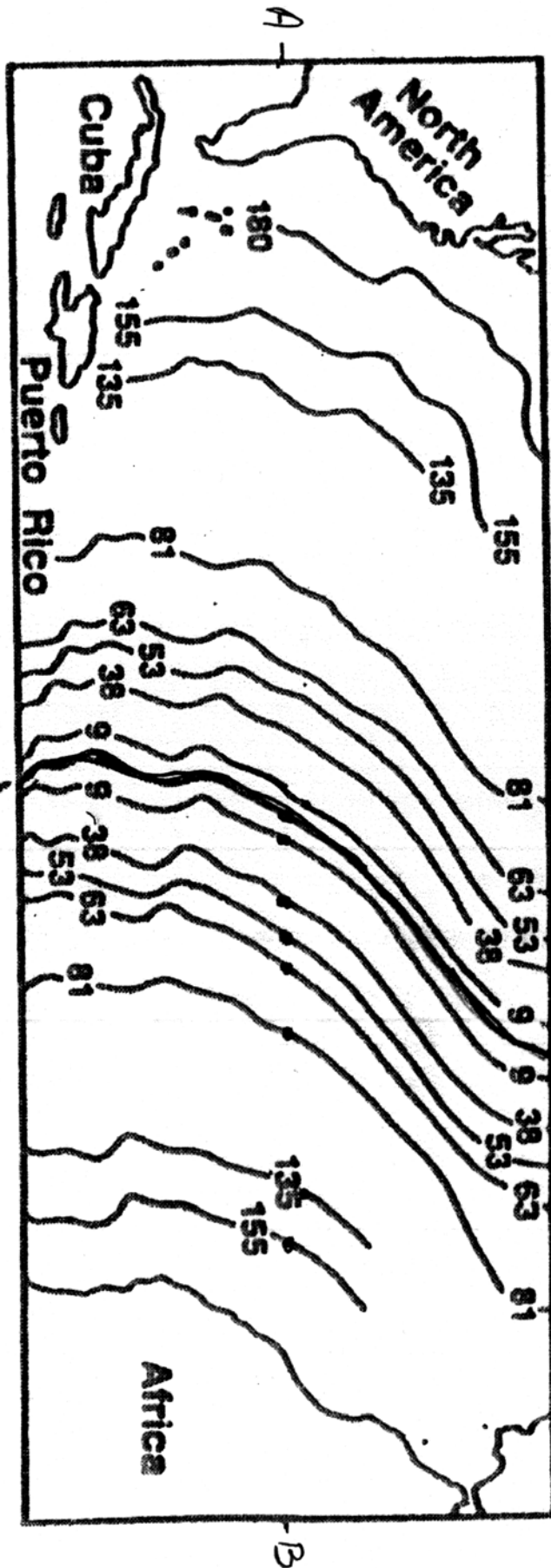
#### Procedures

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    |
| 38-63 million years   | blue   |
| 63-81 million years   | yellow |
| 81-135 million years  | green  |
| 135-180 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 positions shown by a dot. Put the measurements on the data chart in the column "distance from mid-Atlantic ridge 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



Mid-Atlantic Ridge

Mid-Atlantic Ridge

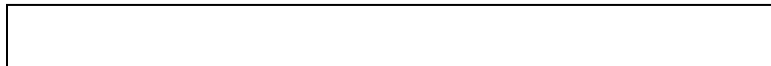
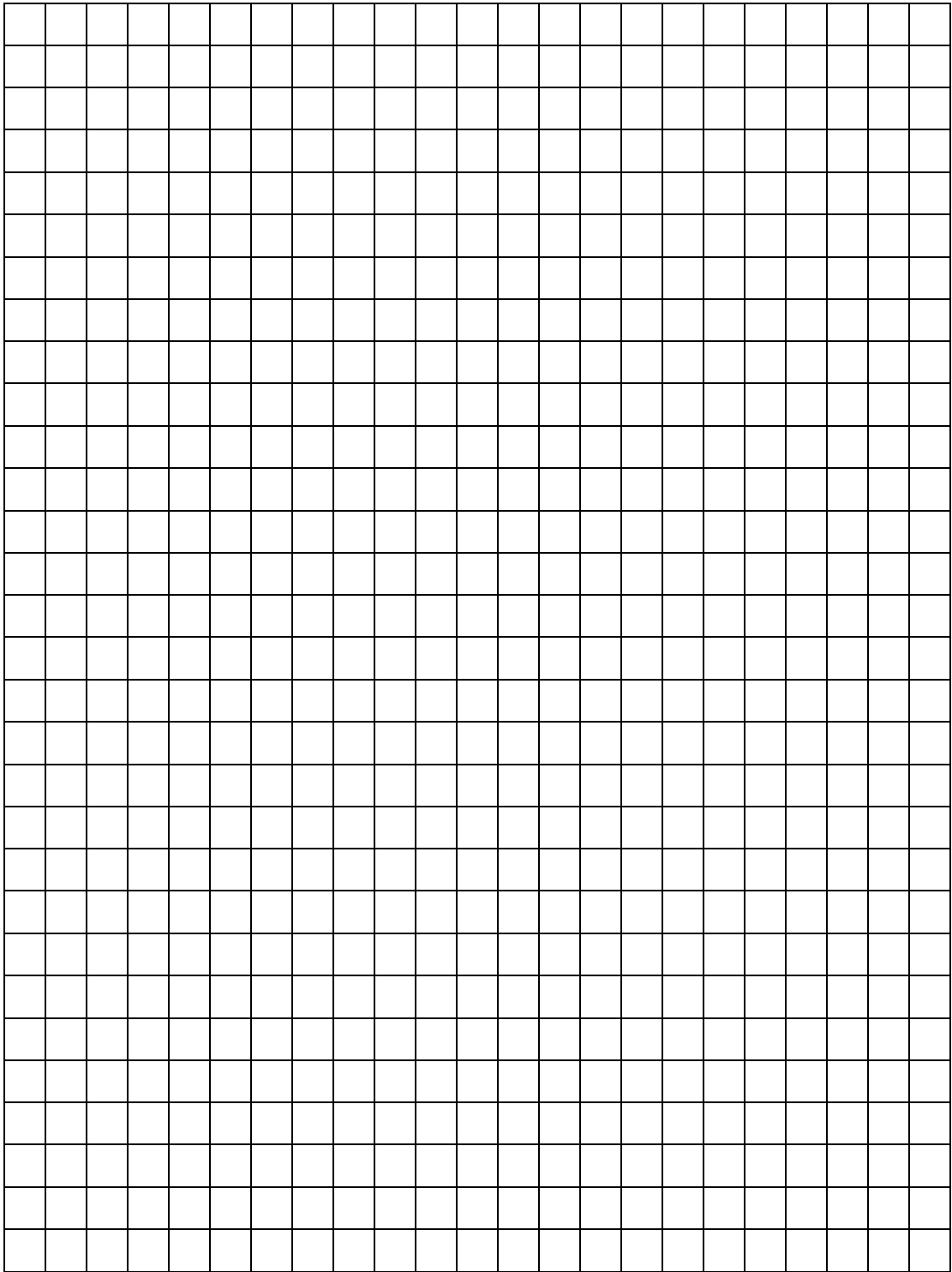
Scale: 1 cm = 500 km

Data table:

| A<br>Age of sea-<br>floor in<br>(millions of<br>year) at dots | B<br>Distance from<br>mid-Atlantic<br>ridge (cm) to<br>dots | C<br>Actual Distance (km)<br>cm $\times$ 500 km/cm<br>Column B $\times$ 500 = C |
|---|---|---|
| 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 the columns highlighted in grey.

- Label the X axis with age (millions of years).
- Label the Y axis with distance (km).
- Plot the data points and label each with the date
- Connect the data points
- Draw a best fit line



## Discussion L1-3

1. Use the information on your data chart and the formula below to determine the rate of sea floor spreading in the past 38 million years:

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

a. Distance (from chart) = \_\_\_\_\_ km

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

Distance = \_\_\_\_\_ cm

c. 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. Use the information on your data chart and the formula below to determine the rate of sea floor spreading in the past 135 million years:

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

a. Distance (from chart) = \_\_\_\_\_ km

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

Distance = \_\_\_\_\_ cm

c. 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. Based on your calculations and looking at the graph, has the rate (speed) of sea floor spreading been the same over the past 135 million years? Explain.

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4. Describe the pattern in the ages of rocks on the seafloor. -

-Where are the oldest rocks found?

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-What part of the ocean floor has the youngest rocks?

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

75 million years old would be - \_\_\_\_\_ km

185 million years old would be - \_\_\_\_\_ km

6. Will you be able to see changes in the sea floor during your lifetime?

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7. The oldest rocks on Earth are located on continents and are about 3.5 billion years old (3,500 million). Explain why the oldest rocks of the ocean floor are only 180 million years old?

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L2-3

8. 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<br>( $x_1, y_1$ )<br>( $x_2, y_2$ ) | $\Delta$ Distance (km)<br>$\Delta y$ | $\Delta$ Age (millions of years)<br>$\Delta x$ | Unit Rate of Change (slope)<br>$\Delta y / \Delta x$ |
|---|--------------------------------------|--|--|
|   |                                      |  |  |

9. 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 = \_\_\_\_\_

10. Compare the unit rate of change from #9 with your answers to 1 and 2.

-Are the units the same?

\_\_\_\_\_ (Therefore, slope is a way of measuring the speed of ocean spreading.)

-How do the numbers values compare in #1, 2, and 9? Explain any similarities or differences.

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Discussion L3

11. Determine the y-intercept for the best fit line on your graph. Use the equation for a line to calculate the y-intercept. Use the line or best fit line you used in #8. The equation for a line is

$y = mx + b$   
 where m is the unit rate of change (slope) and  
 b is the y-intercept

|                                       |
|---------------------------------------|
| Y Intercept                           |
| m =                                   |
| Ordered pair (x, y) = ( ____ , ____ ) |
| $y = mx + b$                          |
| Solve for b:                          |
|                                       |



12. Based on the unit rate of change that you calculated above and the y intercept, write an equation for the best fit line.

| Equation - Sea Floor Spreading Graph |
|--------------------------------------|
|                                      |

13. Use the formula to find the location on the ocean floor (distant from the mid-ocean ridge) where rocks 68.5 million years old can be found. Show work

X = 68.5 million years

Y = \_\_\_\_\_ kilometers