EARTH/PHYSICAL SCIENCE LAB
HOW FAST IS THE OCEAN FLOOR MOVING

NAME_____

DATE_____HOUR_____

INTRODUCTION

Many earth scientists believe that the continents of Africa and South America were once joined together. What is the evidence for this belief? If it is true, how long has it taken for these two continents to break apart and move to where they are now? Is the earth's surface moving in other places.

One way to answer these questions is to study samples of sediment taken from the ocean floor. Sediment is loose rock, mineral debris, and plant and animal shells which have settled out of the water. In these activities you will use sediment data, like scientists do, to determine how fast the ocean floor is moving.

The deep sea sediments were obtained by the Glomar Challenger. The Glomar Challenger is a specially designed drilling ship that can take samples of sediment and rock from the floor of deep ocean basins. It recovers both sediment and rock cores. A core is a cylinder of sediment or rock obtained by using a hollow drill. In many cases, scientists must drill through hundreds of meters of sediment before reaching the solid igneous rock of the ocean floor. This igneous rock forms by cooling and hardening of molton rock material. It is the "floor" upon which the sediments settle.

OBJECTIVES

After you have completed these activities, you should be able to:

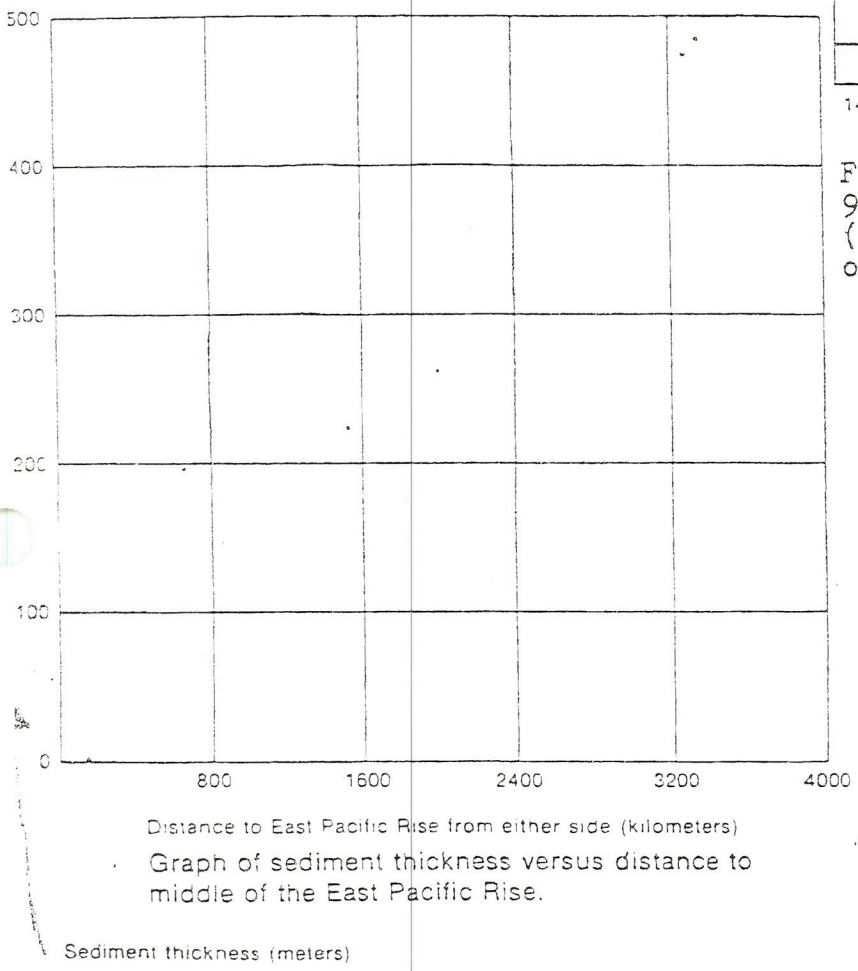
1. Make and interpret graphs which show the relationship between the thickness of a sediment sample and its distance from a mid-ocean ridge.
2. Make and interpret graphs which show the relationship between the age of deep sea sediments and their distance to a mid-ocean ridge.
3. Form hypotheses about sea-floor spreading based on data from sediment cores.
4. Calculate the rate of movement of the ocean floor from data on sediment thicknesses, ages of sediment, and locations of the drill sites.

BACKGROUND INFORMATION

The East Pacific Rise is also called the East Pacific Ridge. Published literature indicates that prominent scientists use these terms interchangeably. In this module use of the term East Pacific Rise conforms to historical precedent and popular usage.

The data used in this activity were gathered by the Glomar Challenger on Leg 9 of the Deep Sea Drilling Project. (The section of a cruise between two places is called a leg.) The Glomar Challenger is a specially designed drilling ship which under ideal conditions can take cores of the entire sedimentary sequence and the basaltic rocks of the

1. Using the sediment thickness data from Table 1, complete the graph below. Plot the distance to the East Pacific Rise along the horizontal axis. Plot the sediment thickness along the vertical axis. Do not plot data from Site 84 at this time. This site is unusual, and you will plot it later.



Graph of sediment thickness versus distance to middle of the East Pacific Rise.

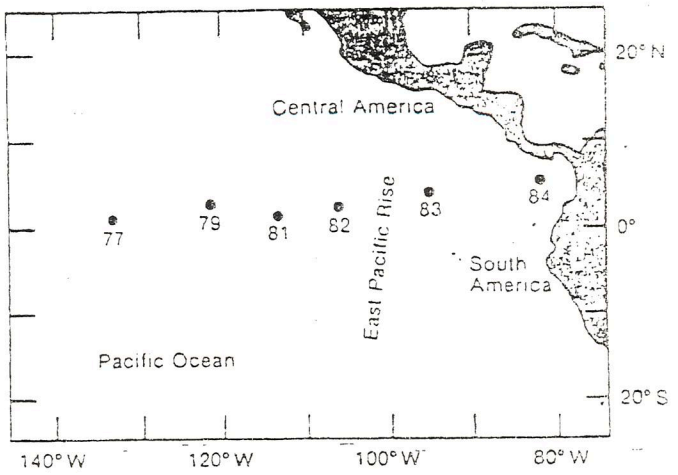


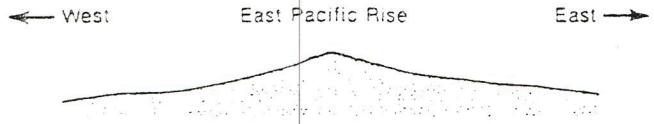
Figure 1. Site locations of Leg 9 deep sea drilling cores. (Modified from Hays, J.D., and others, 1970, p.12, with permission.

Table 1 contains data about position and thickness of deep sea sediments lying on top of the igneous rock of the ocean floor.

Table 1.
Glomar Challenger Deep Sea Cores, Leg 9.
(Modified from Hays, J.D., and others, 1970, p. 12, with permission.)

Drill Site Number and Location	*Distance from Middle of East Pacific Rise*	*Sediment Thickness Down to Igneous Rock*	*Bottom Sediment Age (millions of years old)*
77 (West of East Pacific Rise)	3,359 km	481 m	36
79 (West of East Pacific Rise)	2,086 km	414 m	21.5
81 (West of East Pacific Rise)	1,280 km	409 m	14.5
82 (West of East Pacific Rise)	549 km	214 m	9.5
Approximate Ridge Axis	0 km	none recovered	0
83 (East of East Pacific Rise)	797 km	241 m	10.5
84 (East of East Pacific Rise)	2,000 km	254 m	8.5

2. Shown below is a profile of the igneous rock ocean floor on each side of the East Pacific Rise. Sketch in how you think sediment thickness changes in both directions away from the middle of the East Pacific Rise.



3. Explain what your graph and sketch mean in the space below.

look carefully at the location of Site 84 on the core map. Compare its location on the National Geographic map, Pacific Ocean Floor. Sketch on the core map any feature of the National Geographic map which might help explain the unusual data from drill Site 84.

10. Suppose it costs $1,000,000 to drill a core, and you have just recei $4,000,000 to drill new cores. You are in charge of the drilling ship. You need more information to explain the unusual data at Site 84. Where would you locate new drill sites? Show your drill sites on the core map and explain the information that you hope to gain at each new site.

PART B: HOW CAN SEDIMENT DATA BE USED TO DETERMINE THE RATE OF MOVEMENT OF THE OCEAN FLOOR?

Suppose a car starts from a given point and is driven for 10 hours in a straight line. At the end of 10 hours it is found to have traveled 50 kilometers. How fast did the car move? You know that rate equals the distance traveled divided by the time, or,

$$\text{Rate} = \frac{\text{Distance}}{\text{Time}} \quad \text{therefore,}$$

$$\text{Rate} = \frac{50 \text{ km}}{10 \text{ hours}} = 5 \text{ km per hour.}$$

You can use this same formula as you investigate ocean-floor movement.

1. Using Table 1 you can see that the bottom sediment at Site 77 is 36 million years old. What is the rate at which the ocean floor moved to carry the bottom sediments 3,359 km from the middle of the East Pacific Rise? Write your answer in centimeters per year.

WORK →

2. Imagine that the Glomar Challenger drilled a core 7,100 km west of the East Pacific Rise. How old would you expect those bottom sediments to be?

WORK →