Exercise 3 Report

Sea-Floor Spreading and Plate Tectonics

NAME Key

DATE

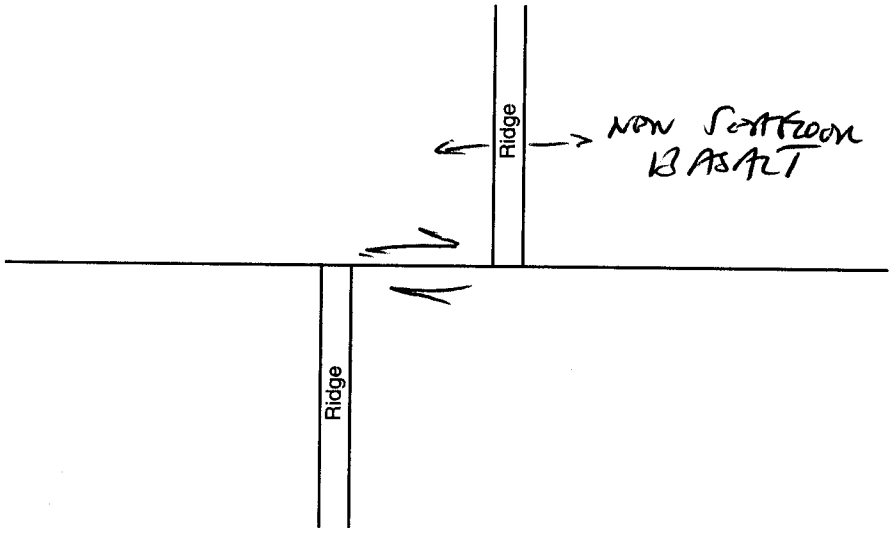
INSTRUCTOR

1. Name the type of boundary between the Pacific and North American plates at each of the following locations:
Southern California TRANSFORM
Northern California, Oregon, and Washington CONVERGENT / SUBDUCTION
Aleutian Alaska CONVERGENT / SUBDUCTION

2. (a) What type of plate boundary dominates the circum-Pacific belt? CONVERGENT / SUBDUCTION
(b) What geologic hazards accompany this type of plate boundary? EARTHQUAKES VOLCANIC ERUPTIONS

3. Which of these stresses—*tension* (two forces acting in opposite directions), *compression* (forces acting toward each other in the same plane), or *shear* (forces acting toward each other in different planes)—characterize each type of plate boundary?
Divergent TENSION
Convergent COMPRESSION
Transform fault SHEAR

4. A mid-ocean ridge is offset along the transform fault in the sketch below. Place arrows to show the relative motion of the plates on opposite sides of the fault and indicate where one would expect earthquakes to be generated. Indicate where new sea floor is forming and the rock type.



5. (a) Refer to Figure 3-5 and determine the half-spreading rate in centimenters per year for the three areas shown in the figure. Show your work.

South Atlantic 1680 Km / 73 m.y. = $(2.3 \times 10^{-5}\ Km/yr)\left(\frac{1 \times 10^5\ cm}{Km}\right) = 2.3\ cm/yr$

North Pacific 3100 km / 80 m.y. = $(3.9 \times 10^{-5}\ Km/yr)\left(\frac{1 \times 10^5\ cm}{Km}\right) = 3.9\ cm/yr$

Pacific Antarctic 1800 Km / 80 m.y. = $(2.3 \times 10^{-5}\ Km/yr)\left(\frac{1 \times 10^5\ cm}{Km}\right) = 2.3\ cm/yr$

(b) Which of the mid-ocean ridges has the fastest spreading rate? ~~NORTH PACIFIC~~

Which one has the slowest spreading rate? ~~PACIFIC ANTARCTIC~~

6. There is a 3 percent uncertainty in dating polarity events. The durations of the short polarity events on the time scale in Figure 3-3 are 10,000 to 50,000 years, and the longer events are many millions of years in duration. "Considering the wide range in the duration of different polarity events, why might the 3 percent uncertainty be an important factor to recognize when oceanographers are recording these seafloor patterns?" 3% of 10,000 yrs = +/- 300 yr
for very short events +/- 3% could have an overlap error of the time scale

7. In Figure 3-9 we see the trajectory of Wrangellia in its trek across the northwestern Pacific Ocean. Paleomagnetic data indicate it was near 20° latitude 180 million years ago and then "docked" (collided) in Alaska about 100 million years ago. Perform a "back of the envelope" calculation below to determine if Wrangellia's velocity is reasonable considering what we know about rates of plate motion.
[Hint: Wrangellia moved across at least 40° of latitude. There are 60 nautical miles in a degree of latitude, so the terrane traveled some 2400 nautical miles, or 4440 kilometers, in 80 million years (there are 1.85 kilometers/nautical mile and 10^5 centimeters/kilometer—see Appendix A for conversion factors).]
Simple multiplication and division will then tell us the annual rate at which Wrangellia has moved northward: 5.55 cm/year.

$\left(\frac{4440\ Km}{80 \times 10^6\ yr}\right)\left(\frac{10^5\ cm}{Km}\right) = 5.55\ cm/yr$

Is this rate reasonable in view of known rates of plate motion? YES - comparable
Assume that the eastward movement at these latitudes was about equal to the northward movement you calculated: _____ cm/year.
Is this reasonable in view of known rates of plate motion? YES

8. Find the following hot-spot lines of islands in Figure 3-6a: Hawaiian-Emperor Seamount Chain; Tuamotu-Line Island Chain; Austral-Gilbert-Marshall Islands Chain. Explain the change in direction of each of the hot-spot ridges or lines of islands.

change in plate motion direction from ~ 350° to 280° Azimuth

9. What would the earth be like if plate motion stopped; that is, how would it change physically, and what geophysical phenomena would increase, decrease, or cease altogether?

- Earthquakes, volcanism would stop
- min. blog would stop
- Geothermal energy → minimized