GEOL 10 Environmental Geology
Activity 5

Name: _____ Date: _____

Plate Boundaries and Seafloor Spreading

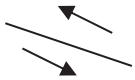
We will use the map Plate Boundaries (Bird, 2003). You will also benefit with a calculator and color pencils.

Part 1: Plate Boundaries of the Earth, Mollweide Projection.

1. Identify the major plate boundaries on the chart using the following colors and symbols:
   a. Divergent plate boundary (arrows showing direction of plate spreading)

(Red)

   b. Transform plate boundary (arrows indicating direction of plate motion)



(Blue)

   c. Convergent plate boundary (teeth on the upthrown plate)

(Green)

   * Indicate where 3 plates form a Triple Junction using the letters: **TJ**.
2. Hot Spots: There are about 30! Locate and label with a red circle and the name (e.g. Hawai'i, Yellowstone, Azores, Ireland, etc.)
3. Seamounts: Island and Seamount Chains form as seafloor crust moves over a hot spot. Locate seamount chains using a red line.
4. Transform Faults: Separate Mid Ocean Ridge (MOR) segments
5. Trenches: Indicate trenches using a yellow color pencil.
6. Lithospheric Plates: Color the primary lithospheric plates.

Part 2: Tectonic Plate Spreading Rates

We can calculate an average rate of seafloor spreading by measuring the distance between MOR's, then divide the distance by the and age of seafloor rocks collected there (e.g. such as from ODP cores).

Recall: Rate (r) = Distance (d) ÷ Time (t) or $r = d / t$

1. What is the average spreading rate of the Atlantic Ocean basin measured along the Equator? Use the outer edge of the continents of S America and Africa to determine the edge of the oceanic plate. The oldest ocean floor, basalt rocks collected at the base of the continental shelf are mid-Cretaceous in age. (**Show your calculations below**)

GEOL 10 Environmental Geology
Activity 5

2. What is the average 'half spreading rate' measured from the MOR to the continental margin of the Pacific Ocean basin along the Equator? Measure from the East Pacific Rise to the continental margin in the western Pacific Basin. The oldest seafloor, basalt rocks collected here are mid-Jurassic in age. (**Show your calculations below)**

You now can synthesize your knowledge of charts, map scales and plate tectonics to determine rate of plate movements. You will need a ruler and a calculator to make the 7 separate calculations (one for each of the Hawai'ian or Emperor Seamounts listed below). The radiometric age for each island or seamount is given in Ma, Millions of Annum. Show your work on a separate piece of paper and put your final answers in the Table below. One strategy to complete this is as follows:

1) Use latitude to determine the scale of the chart. To determine the scale, use a ruler to measure the distance on the chart (in cm) of 10° latitude. Since 1° latitude = 60 Miles, then 10° (of latitude) = 600M. Convert 600 M to centimeters (using conversion factors). Calculate the fractional scale by dividing the 600 M by the distance measured on the chart. Conversion Factors: 1 M = 1.852 km; 1 km = 100,000 cm
2) Measure the distance between the Big Island of Hawaii and each of the successive older islands in the chain.
3) Use the fractional scale to convert these to "real world" distances.
4) Divide the "real world" distance to the each island by the age shown and determine the rate of plate movement.

Show your calculations on a separate piece of paper and place your final answers in the table below.

3. Pacific Plate Motion Calculation: Calculate the average rate of seafloor movement of the Pacific plate over the Hawai'ian Hot Spot using the radiometric age of the volcanic islands with respect to the distance from the active Hawai'ian Island shown. Use the latitude graticule to determine the scale of the map. Assume that the scale of this map is at a scale that is appropriate for 2-D plate motion calculations.

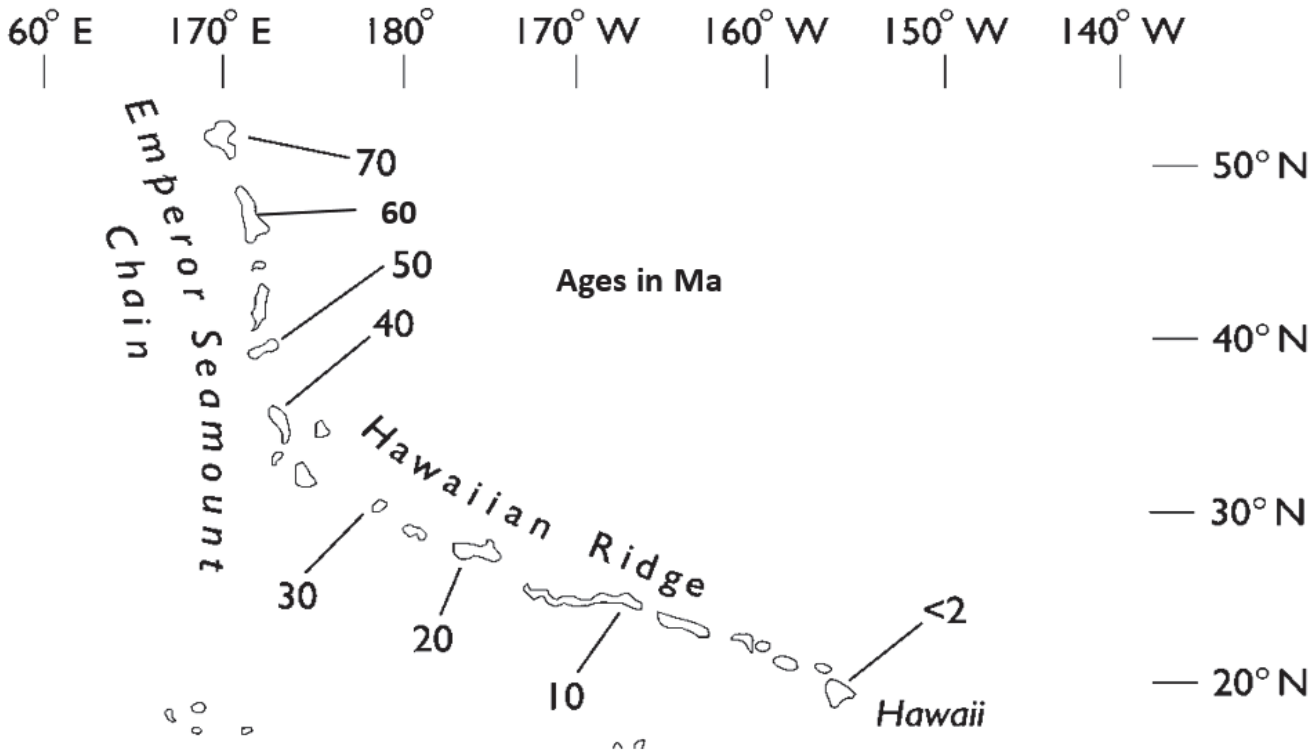
4. Sediment Thickness Calculation: Assume sediments accumulate on the sea floor at the rate of 2 mm per 1,000 years (2 mm/1000 yr). What is the expected thickness of the sediment cover for each of the 7 seamount ages listed (e.g. 10 Ma, 20 Ma, etc.) up to the oldest seamount. Put your answers in the table below and show your work below or on a separate sheet. A hint is that you can restructure the rate formula to solve this problem and that the sediment thickness can be considered a distance. So, r = d/t can be rewritten to be d = r X t.

5. Map Scale Determination: Determine the Relative Fraction (RF) scale of the map of Hawaiian Islands and Emperor Seamounts. This is typically stated in the format 1: xx,xxxx, where 1 unit on the map is equal to xx,xxxx units in the real world. If the RF scale is 1:24,000 it means that 1 mm on the map is 24,000 mm in the real world. Take your MD/RWD conversion ratio and reformulate it so that there is a 1 in the numerator. The denominator will be the relative fraction scale of the map.

GEOL 10 Environmental Geology

Activity 5

Scale: _____



Age (Ma)	**1)** Rate of Seafloor Movement (mm / yr)	**2)** Sediment Thickness (meters)
10		
20		
30		
40		
50		
60		
70		