GEOL 111

Homework assignment #3

IF YOU NEED HELP OR DO NOT UNDERSTAND ANY PART OF THIS ASSIG NMENT, COME TO MY OFFICE HOURS OR EMAIL ME.

PART I (10 points)

Objectives:

- to develop an understanding of the relation between amount of offset and rupture area during an earthquake and moment magnitude (M_W).
- to practice some simple calculations.

Background:

In class, we have talked a number of times about the amount of slip or offset and rupture area during an earthquake and how those relate to M_W. One of the important concepts that you need to take away from this class is a sense of scale: exactly what does it mean if an earthquake had a M_W of 5, 6, 7, or 8.

In this assignment, you will calculate the M_W for a set of earthquakes given rupture length, depth, and amount of offset for that earthquake. Remember that M_W is calculated from the following equation:

$M_W = (2/3)\log(\mu SA)-10.7$

Where:
μ = strength of the rock = $3x10^{11}$ dyne/cm^2
S = amount of fault offset
A = area of rupture

Assignment: Four pre-instrumental earthquakes are recorded in the geologic record along t he right-lateral strike-slip Owens Valley fault. Your mapping reveals that these earthquakes have the following characteristics:

earthquake #	amount of offset	length of rupture	depth of rupture
1	0.01 m	10 km	8 km
2	15 m	200 km	20 km
3	4 m	80 km	10 km
4	0.1 m	50 km	12 km

Calculate the M_W for each earthquake using the equation for M_W given above. Follow the e xample that we discussed in class. Because the units of μ are in cm, be sure to convert mete rs (m) and kilometers (km) into cm before completing your calculation. **To receive full cre dit, show your work!**

PART II (15 points)

Objective:

❖ to develop an understanding of techniques used to locate earthquakes.

Background:

In class, we discussed the techniques required to locate earthquakes from travel time charts a nd arrival times of P- and S-waves.

Follow that procedure (and the instructions given below) to do this homework. Make sure you answer all the questions. If you wish to practice this procedure before completing this portion of the homework, go to the web site

http://vcourseware1.calstatela.edu/VirtualEarthquake/VQuakeIntro.html

Read the introduction and supporting material, and follow the directions provided.

Assignment: An earthquake has occurred in the Pacific Northwest. Your job is to discover the epicenter location using the techniques we learned in class. You will need a piece of scr atch paper and a compass.

1. Determine the differences in arrival times between the P-waves (first wave to arrive) and S-waves for each of the 3 seismic stations Portland, Bend and Seattle. List these below in s econds. **On a piece of scratch paper, mark off the difference in arrival time of P- an d S-wave for each station.**

The arrival of the P-wave is marked by the first motion of the pen on the seismogram. The arrival of the S-wave is marked by a pronounced increase in amplitude (height of peak). Th e time scale is marked at the bottom of the page. **To receive full credit, mark the first P-wave and first S-wave on the seismograms.**

PORTLAND _____seconds

BEND _____seconds

SEATTLE _____seconds

2. Using your scratch paper and the travel time chart, slide the scratch paper up and down B ETWEEN the P- and S-curves until the ticks line up. **Draw a vertical line from where t he ticks line-up to the x-axis (distance from the epicenter)**. Read off the distance fro m epicenter on the x axis (in km). List these distances below. **THIS REPRESENTS TH E RADIUS OF A CIRCLE ON WHICH THE EARTHQUAKE EPICENTER IS LO CATED.**

PORTLAND _____km

BEND _____km

SEATTLE _____km

3. Using a compass, go to the map of the Pacific Northwest and draw a circle centered on P ortland with a **RADIUS** equal to the distance to epicenter (the answers in #2). Repeat this

with Seattle and Bend. **ON THE MAP, CLEARLY MARK THE INTERSECTION O F THESE 3 CIRCLES; THIS IS THE EARTHQUAKE EPICENTER.**

4. In what city was the earthquake epicenter? _____

5. Can you locate the earthquake epicenter with:

2 seismic stations? (yes, no) _____

1 seismic station? (yes, no) _____

4 seismic stations? (yes, no) _____