Physical Geology Lab – Earthquake Geology & Seismology

Date: **Lab Section:** **Student Name:**

The purpose of this lab is to provide students with information and hands-on experience to make effective use of the U.S. Geological Survey's web site on earthquakes; and to determine the epicenter of an earthquake from seismic data. As you work through the three parts this Lab, answer the questions, and then turn in this packet. Careful reading of the discussions and questions is important.

This U. S. Geological Survey earthquake web site is available at www.earthquake.usgs.gov.

Part 1.

Activity 1. Earthquake locations and frequency

The opening page for this site shows a world map and a U.S. map with several inset maps. Click on the world map and find out what the symbol colors and sizes represent. From this world map, and its captions and legends, answer these questions.

What time period does this map cover?

What is the smallest magnitude earthquake that will be shown in the U.S. on this map?

What is the smallest magnitude earthquake shown in the rest of the world?

From the left side menu on the world map select the "Earthquake Animations" tab and watch the animations for the world and for the U.S. Watch the clock and the symbols. Note that the ocean depths are shown in blue shades with the lightest being shallower (sea floor is higher).

Are the earthquakes randomly located on either map? Describe the distribution of earthquake locations in general:

Find the shallow spreading center ridges that run continuously around the entire Earth. Zoom in and click on a couple of earthquakes on these "mid-ocean" ridges.

What is the depth and magnitude of these earthquakes?

Activity 2. Go back to the world map and point at one earthquake symbol in the mid Indian Ocean, or Indonesia, and note that the magnitude is shown. Click on the symbol to see more details about that earthquake.

For this earthquake, list its catalog number, magnitude, the date and time it occurred (use Central Standard Time), the location in Latitude-Longitude coordinates, and the depth of the focus (hypocenter) of the quake. Also give the stated errors associated with the position and depth.

Next to the Details tab, what other tabs are shown for this earthquake?

Select the Maps tab and view 2 or 3 Location Maps and 2 Historical Seismicity maps.

What is the difference in dates of data between the first 2 Historical Seismicity maps?

How is the nearby plate boundary shown?

Extra Credit: On the Scientific tab view the Historic Moment Tensor Solutions map and the Theoretical P-Wave Travel Times map.

What are the unit of time on the P-Wave Travel Times map?

Explain the purpose of the "beachball" symbols used on these maps.

Part 2. Earthquake Epicenter Triangulation #1

The epicenter of an earthquake is determined by finding the distance from three or more seismographs that recorded the earthquake.

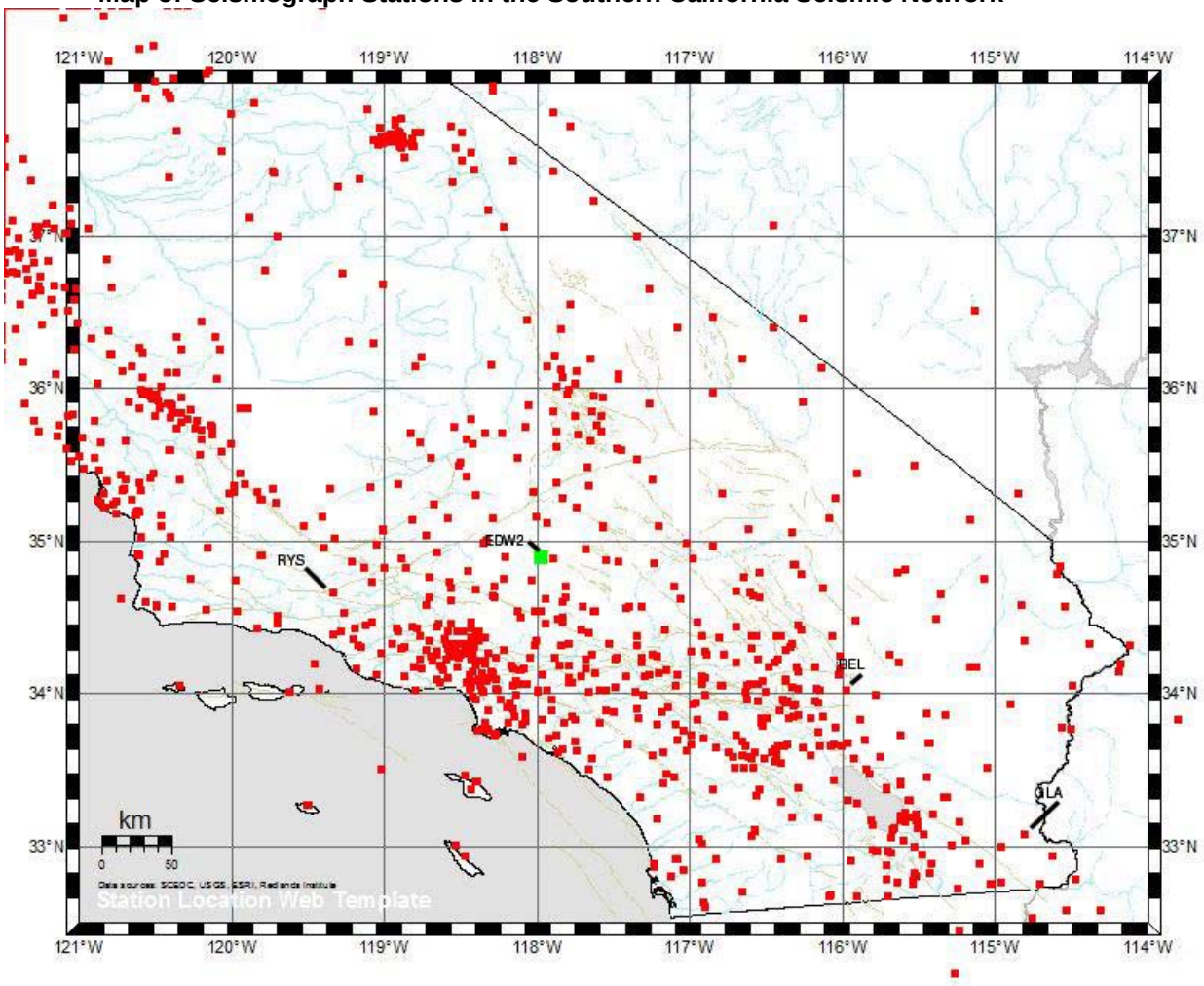
A quake occurred in early March, 2010, in California. The hypocenter (focus) was 4 miles deep and it had a Moment Magnitude of 5.4. The diagram on page 2 shows a sample of seismograms recorded from this earthquake.

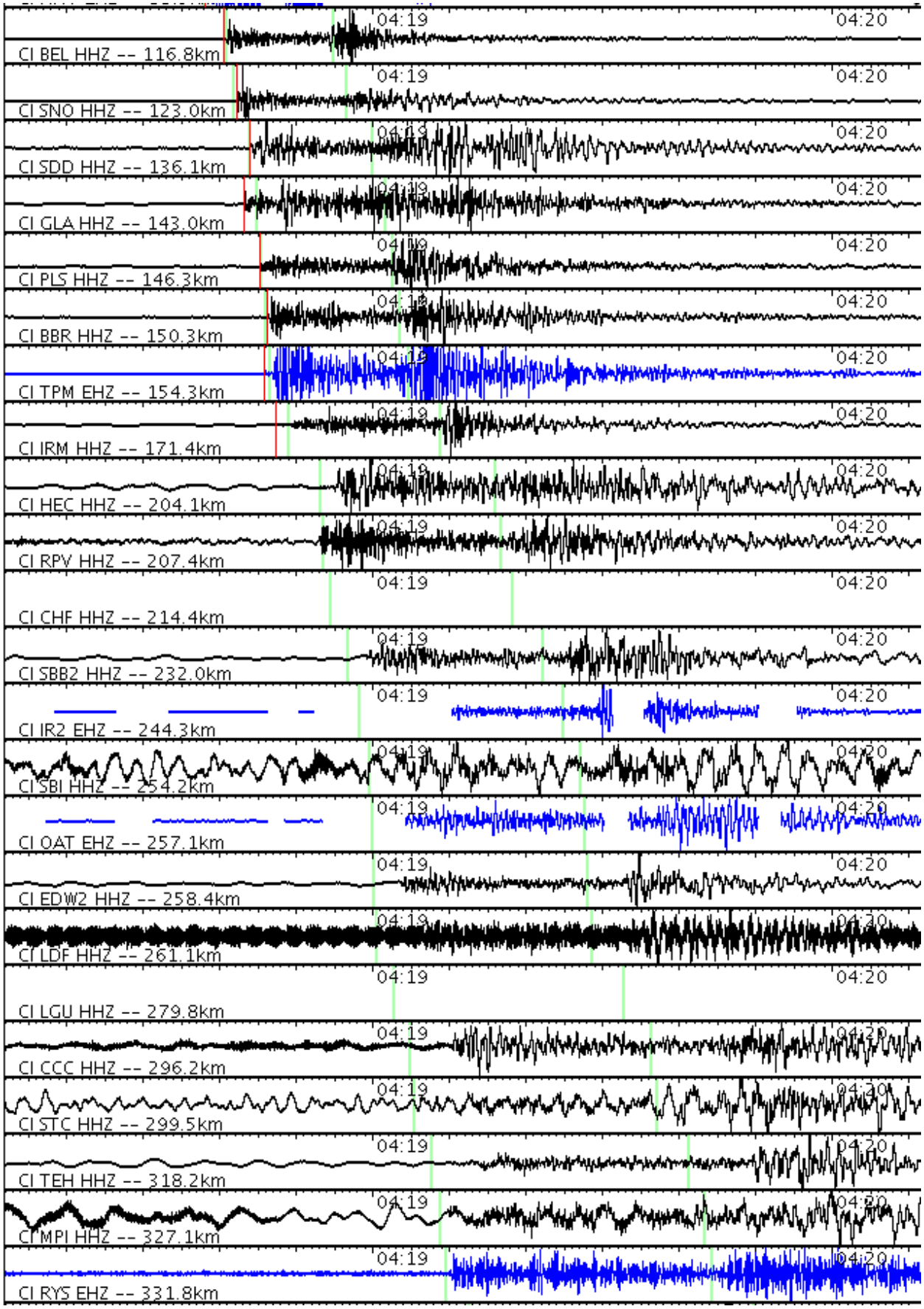
From the data on the seismogram display and map below, fill in the following table for the four seismograph stations listed. On the map carefully draw circles of the distance to the earthquake around each station. Use ruler, compass and the scale on the map.

	Seismograph Symbol	Location (approx Lat-Long)		Distance to Earthquake
1.	BEL	Lat=	Long=	km
2.	EDW2	Lat=	Long=	km
3.	GLA	Lat=	Long=	km
4.	RYS	Lat=	Long=	km

The intersection of the circles is the approximate location of the quake. Mark the location on the map and give the approximate latitude and longitude of the earthquake: _____

Map of Seismograph Stations in the Southern California Seismic Network





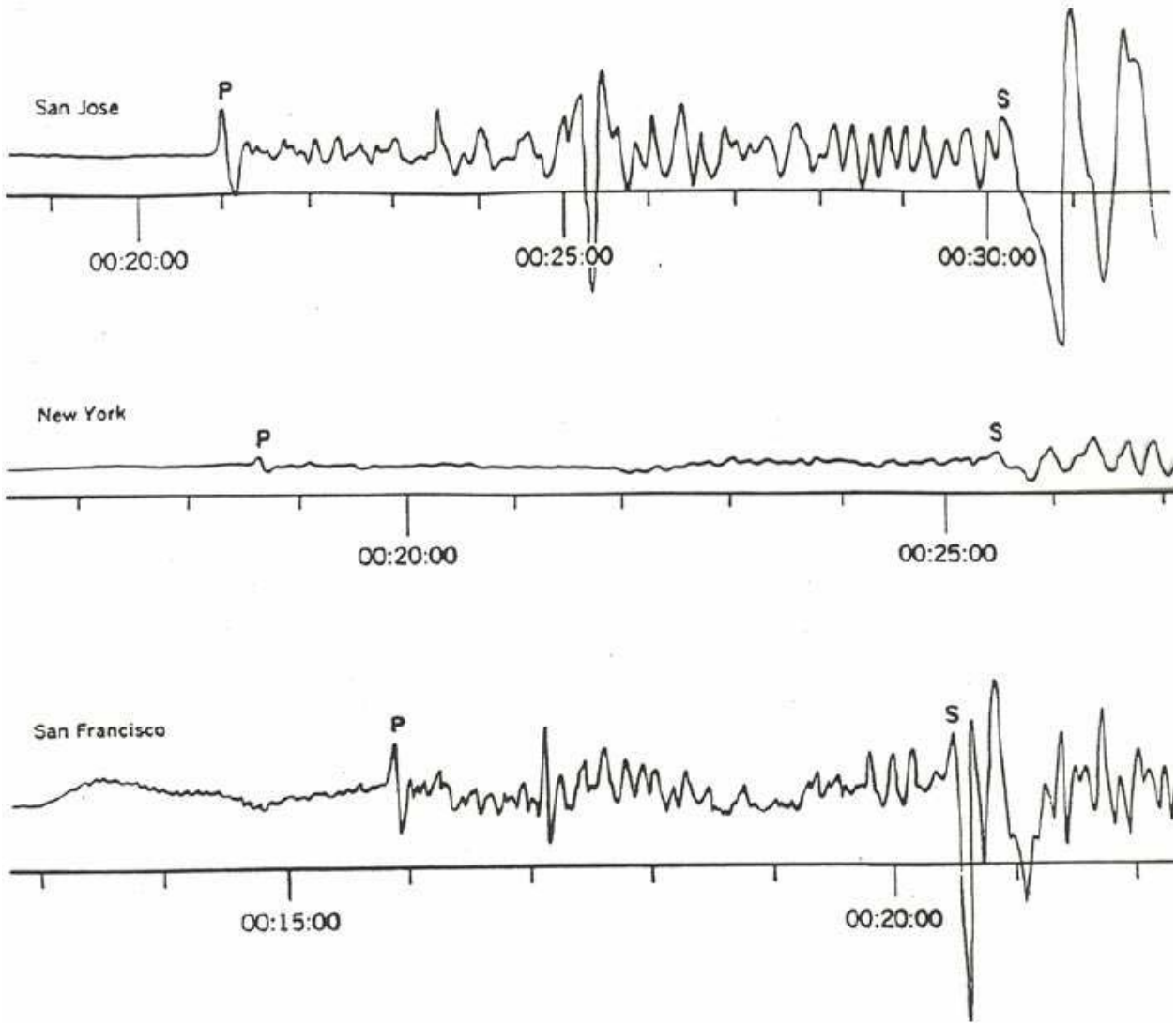
March 9, 2010 MM=5.4 4:18:21.87 a.m. Depth=4.0 km Vertical bars=expected arrival times of P and S.

Part 3. Earthquake Epicenter Triangulation #2

The epicenter of an earthquake is determined by finding the distance from three or more seismographs that recorded the earthquake. The following information and instructions are provided so that you can find the epicenter of a recent earthquake.

Here's the data for the earthquake.

Seismograms recorded at three location for a single earthquake. Time units are in minutes. First arrival times of the P and S waves are marked.



List arrival times of P and S waves for each seismograph recording, and compute the elapsed time between P and S for each. Try to be accurate to nearest 10 seconds.

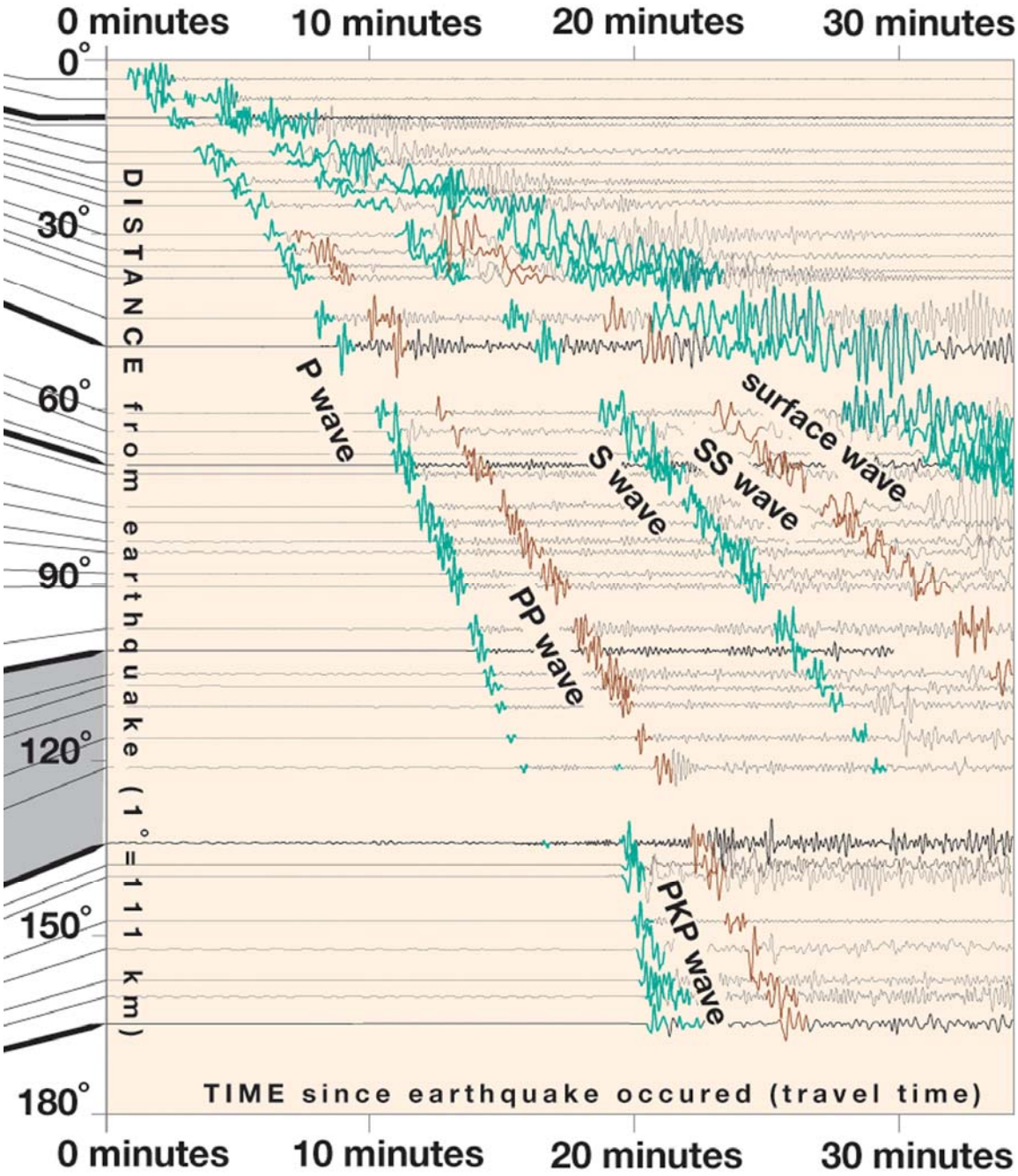
Seismograph Location	P arrival	S arrival	Difference
1.			
2.			
3.			

Here is how the Earth transmits seismic energy.

This diagram is a plot of the seismograms recorded at more than 40 location for the 1994 “Northridge Earthquake” (near Los Angeles). The individual seismograms are arranged in order of distance from the epicenter, and the time scale for each starts exactly at the time of the earthquake.

On the diagram below, sketch a smooth curve through the points of first arrival of P waves on this diagram. Then do the same for points of first arrival of the S waves. Be careful to make your “curves” as smooth and as neat as possible. The quality of the curves you draw have a big effect on your final results for this exercise.

These curves you have drawn are called P and S wave “travel time” curves, and indicate how fast the earthquake waves move through the crust and mantle to points of varying distance from the epicenter.



Here is a map to locate the epicenter on.

Complete the following table from information above. Then use a compass and draw circles of the appropriate distance (km) around the location of each seismograph. The intersection of the three circles is the approximate location of the epicenter of the earthquake.

Seismograph Location	P-S Arrival Difference	Distance in degrees	Distance in km
1.			
2.			
3.			

The earthquake occurred near what city/province/state/country/feature? _____