Activity 4: Locating an Earthquake Epicenter

Objectives: If you complete all the problems, you should be able to:

- Identify P, S, and surface waves on a simple seismogram.
- Locate the epicenter of an earthquake using seismograms and travel-times curves.
- Complete an earthquake intensity may by drawing isoseismals from intensity data.
- Describe how the geology of a region can affect the intensity of an earthquake.

Examining Seismograms

The three basic types of seismic wave generated by an earthquake at its focus are P-waves, S-waves, and Surface waves. P and S-waves are body waves and travel through the interior of the earth. P-waves have the greatest velocity and reach the seismic station first. S-waves arrive at the seismic station after the P-waves. The amount of time that passes between the P-wave arrival and the S-wave arrival is important in helping seismologists determine the epicenter of the earthquake.

Today we will be using a travel-time graph, where the vertical separation between the P and S curves is equal to the difference in the arrival times between the P-wave and S-wave. To accurately locate an earthquake epicenter, records from three seismograms are necessary.

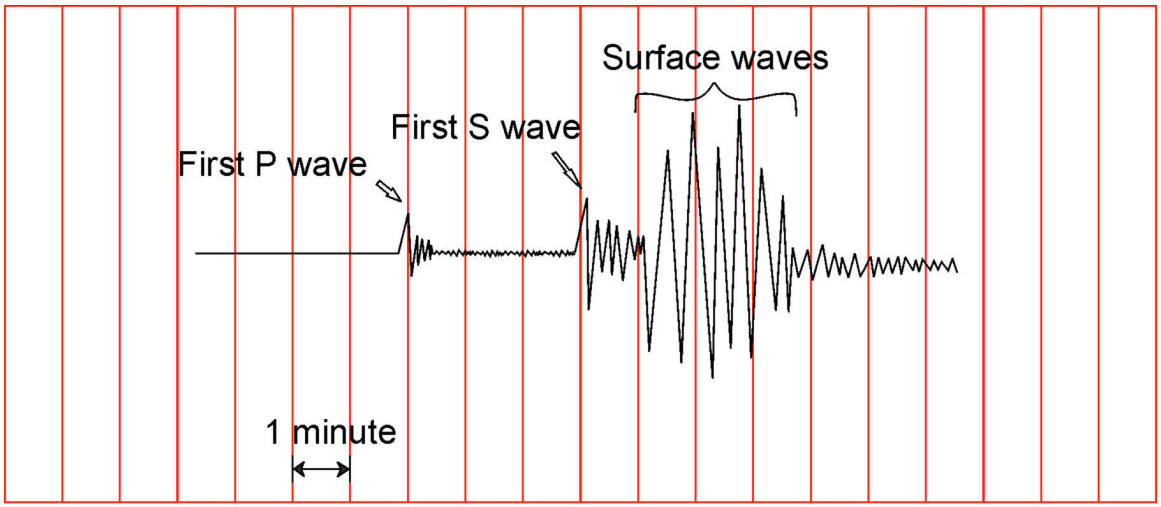
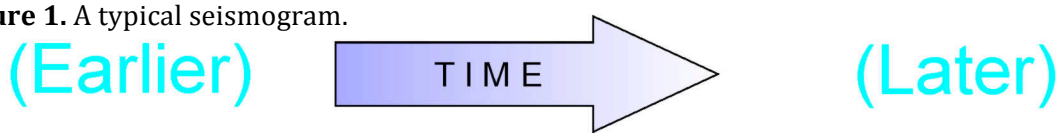


Figure 1. A typical seismogram.



Using a travel-time graph

1. Use Figure 2 to determine the difference in arrival times (in minutes) between the first P-wave and first S-wave for stations that are the following distances from an epicenter.

   700 miles: _____ minutes difference

   450 miles: _____ minutes difference

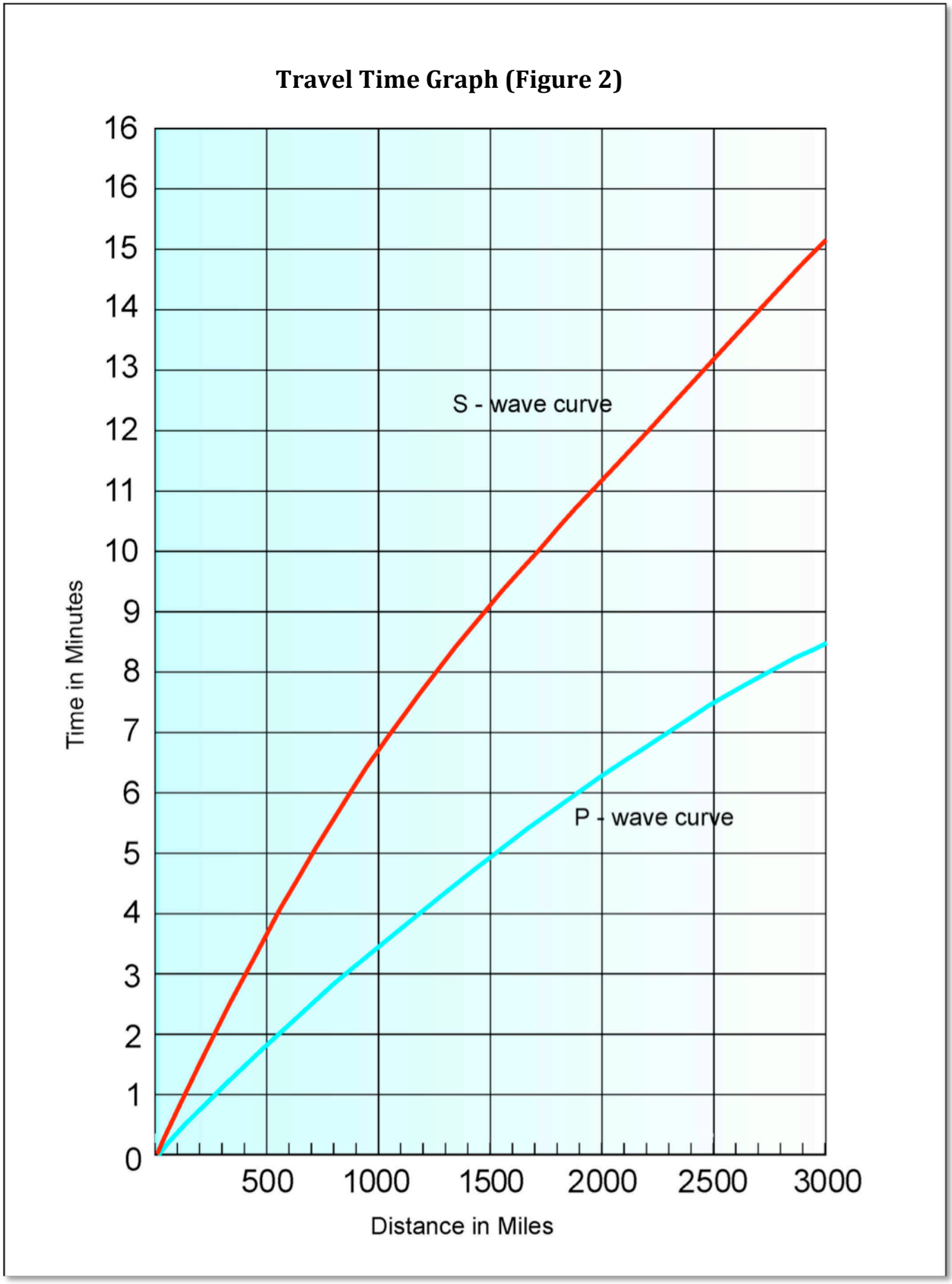
   2500 miles: _____ minutes difference

2. From the seismogram in Figure 1, the differences in arrival times between the first P-wave and the first S-waves equal (3, 7, 10) minutes. Circle your answer:

3. Refer to the travel-time graph. What is the distance from the epicenter to the station that recorded the earthquake in Figure 1?

   _____ miles

Travel Time Graph (Figure 2)



Directions:

Figure 3 illustrates seismograms from the same earthquake recorded at Los Angeles, CA, St. Louis, MO and Houston, TX. Use this information to answer the following questions.

1. Use the travel-time graph, Figure 2, to determine the distance that each station in Figure 3 is from the epicenter. Write your answers in the epicenter data table, Table 1.

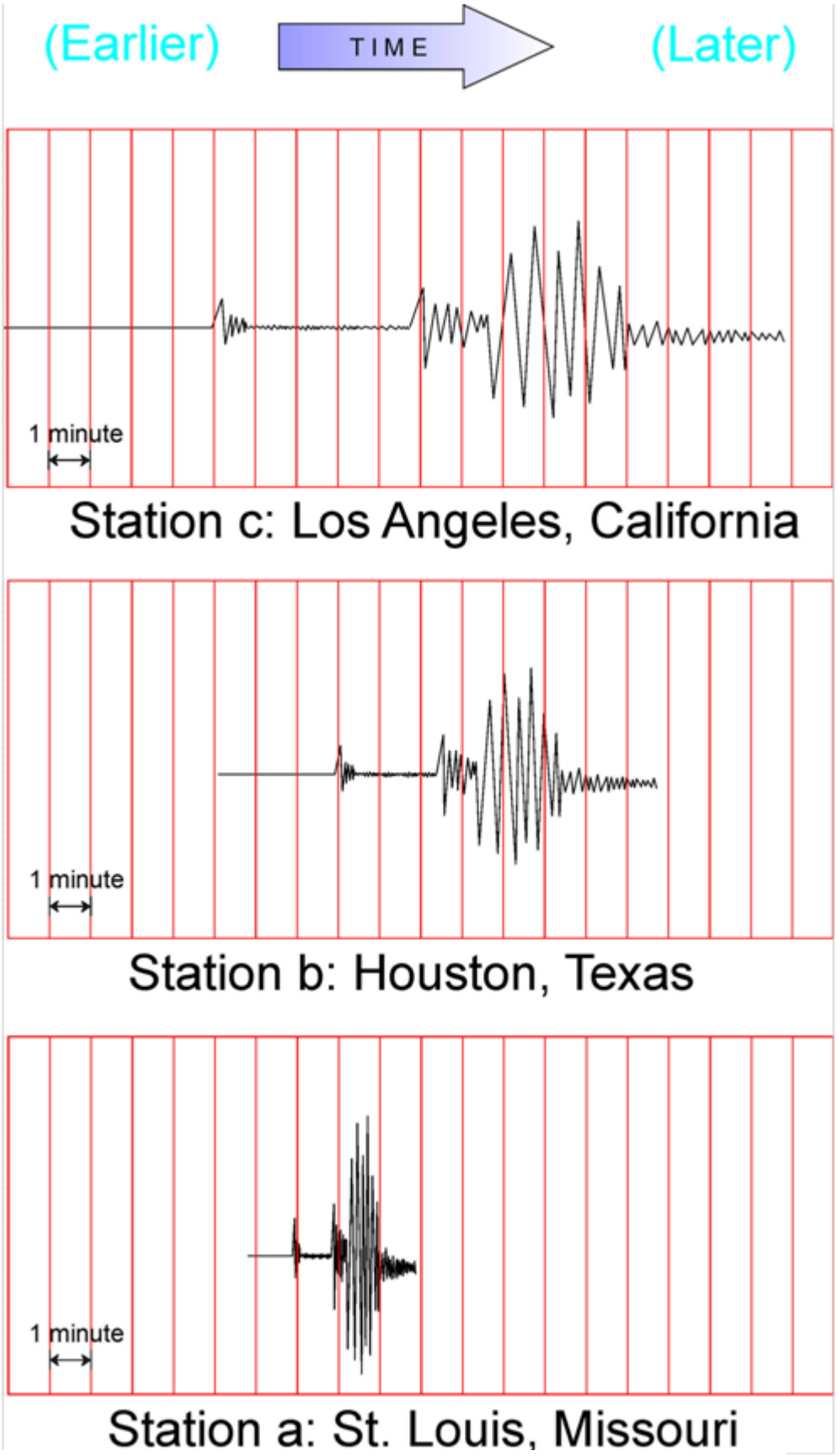
2. After you have determined the distance that each station is from the epicenter, use the drawing compass provided to draw a circle around each of the three stations with a radius, in miles, equal to its distance from the epicenter. Use the map of the United States.

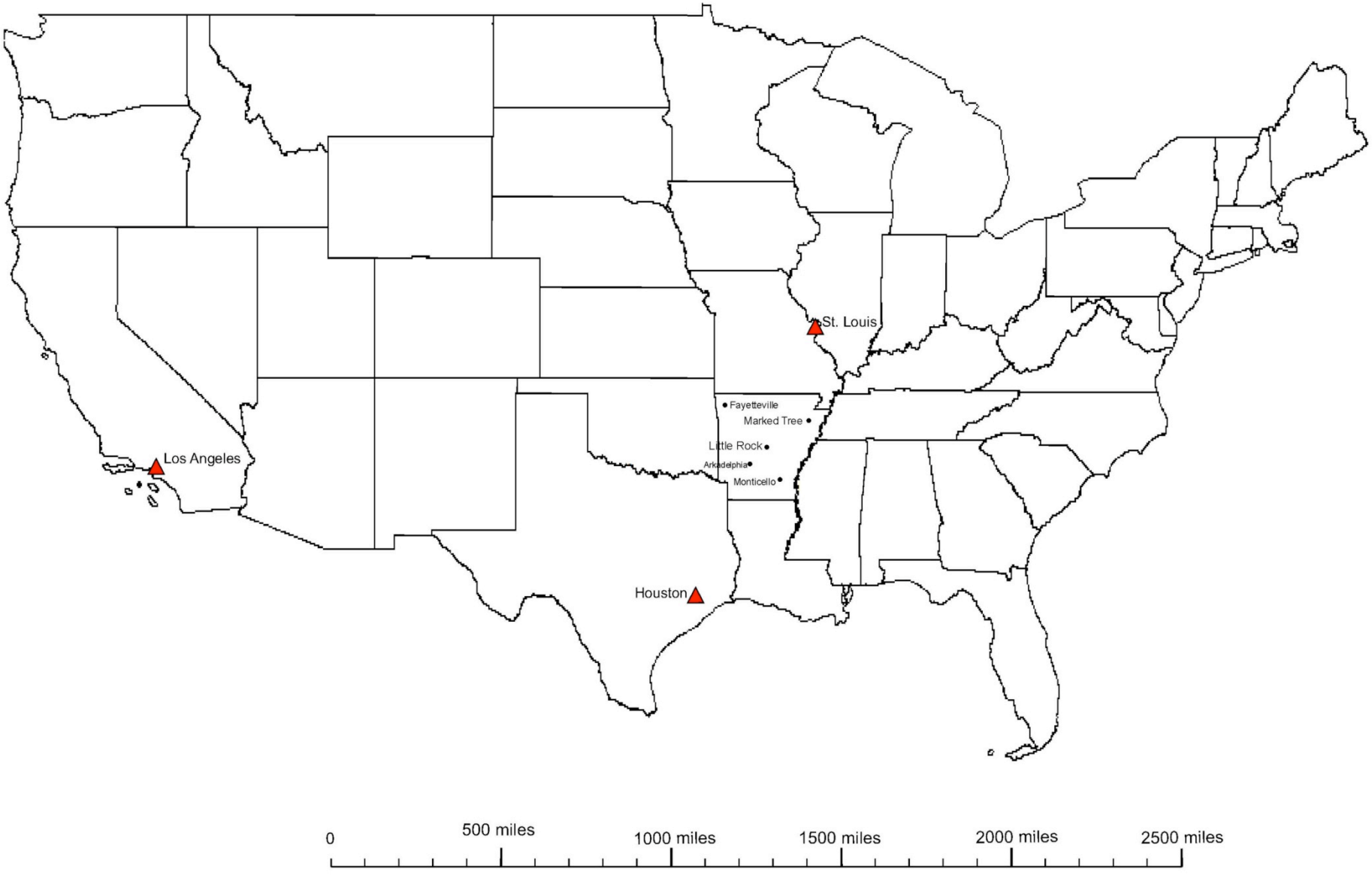
   (Note: Use the distance scale provided on the map to set the distance on the drawing compass for each station.)

Table 1. Epicenter data table.

	Los Angeles, CA	St. Louis, MO	Houston, TX
Elapsed time between first P and S waves (minutes)			
Distance from epicenter in miles			

Figure 3.


(Earlier)
TIME
(Later)
1 minute
Station c: Los Angeles, California
1 minute
Station b: Houston, Texas
1 minute
Station a: St. Louis, Missouri


St. Louis
Fayetteville
Marked Tree
Little Rock
Arkadelphia
Monticello
Los Angeles
Houston
0
500 miles
1000 miles
1500 miles
2000 miles
2500 miles

Determining an Earthquake Epicenter

1. Did all three of the circles drawn with the compass overlap in one spot?

2. This earthquake occurred closest to which city, in which state?

3. This earthquake occurred in a well-known seismic zone. What is the name of this seismic zone?

4. To the best you of your ability, use a pencil, or colored pencil to draw the approximate location of the seismic zone named in question 3. Be sure to label the seismic zone on the map.

Brainstorming:

Assume that the same earthquake occurred, but the seismic station in Los Angeles malfunctioned, and did not record the earthquake. With only the information from seismic stations in St. Louis and Houston, brainstorm how a geologist might determine the location of the earthquake epicenter?