

Part II
Discovering the Nature and Evolution of the Solar System

Kit Activity 8-1

Earthquakes

When you have completed this activity, you should be able to do the following:

- Given a seismograph record showing P- and S-waves, and a graph showing the arrival times for the waves as a function of distance, determine the location of a seismic epicenter.

Use the answer sheet at the end of the Activity.

This discovery activity requires a compass with a sharp pencil for drawing a circle.

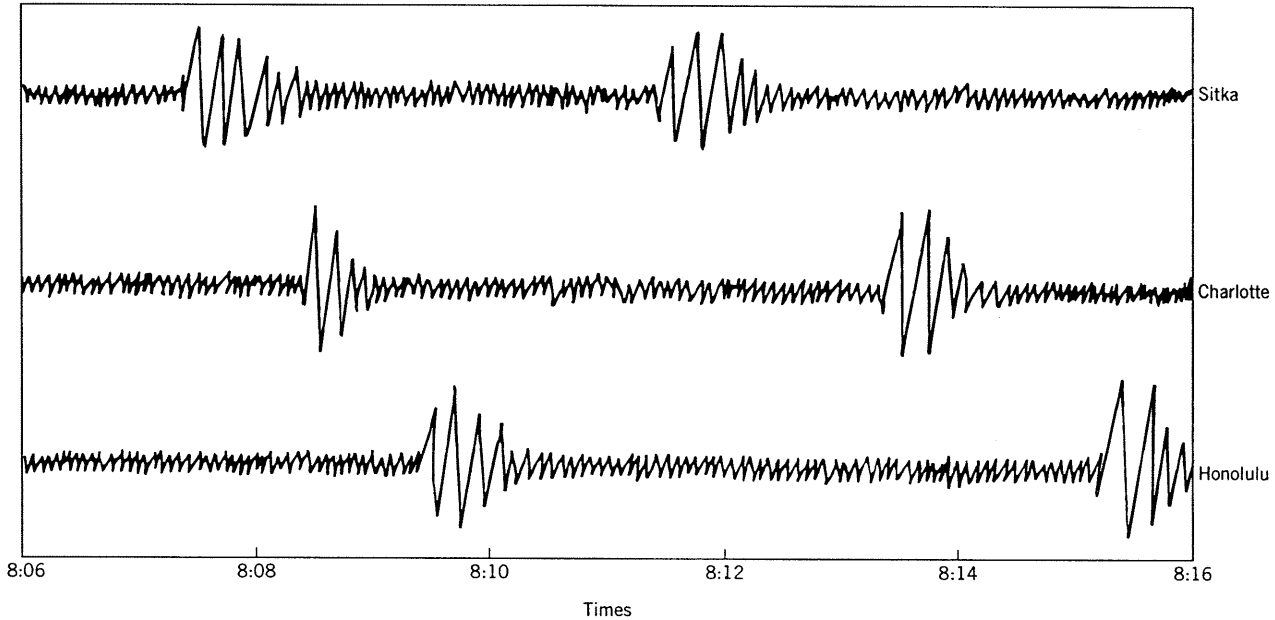
An **epicenter** is the location on the Earth's surface above the place where an earthquake takes place. The actual location is called the **focus**. For this exercise, you will determine only the epicenter. Similar techniques may be used on any planetary surface on which a network of seismographs exists.

In **Kit Figure 8-1-1** are seismograms from three cities: Sitka, Alaska; Charlotte, North Carolina; and Honolulu, Hawaii. The first wave on each tracing is the primary (P-wave) and the second is the secondary (S-wave). The seismograms have all been adjusted to refer to the time in Charlotte.

- **Kit Inquiry 8-1a** At what times were the waves first detected at each location? Estimate the time to a tenth of a minute.

The time required for each type of wave to travel a certain distance through the Earth is shown in **Kit Figure 8-1-2**. The vertical distance between the curves labeled S and P is the difference in arrival times of the two waves and is an observed quantity. Once the delay in arrival time is observed, this graph can be used to determine the distance from the seismograph station to the epicenter. Use this travel-time curve to determine the distance from each seismograph station to the epicenter. Do this by placing a blank piece of paper along the time axis. Place a dot on the paper at the zero marking, and a dot at each of the S-minus-P time intervals you determined in the table above. Then, keeping the paper parallel to the vertical axis, slide the paper with the zero

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Kit Figure 8-1-1 Seismograms recorded at the city of Sitka, Charlotte, and Honolulu. The times shown have been adjusted to correspond to the time in Charlotte. (Reprinted with the permission of Macmillan Publishing Company from *Laboratory Manual in Physical Geology 3/E* by (American Geological Institute), Richard M. Busch. Copyright © 1990, 1993 by Macmillan college Publishing Company, Inc.)

dot always on the P curve until the dot for a given city is on the S curve. You can then read off the distance to the epicenter by reading where the edge of the paper intersects the horizontal axis. Repeat for the other S-minus-P times for the other cities.

• **Kit Inquiry 8-1b** What is the distance of the epicenter from each station?

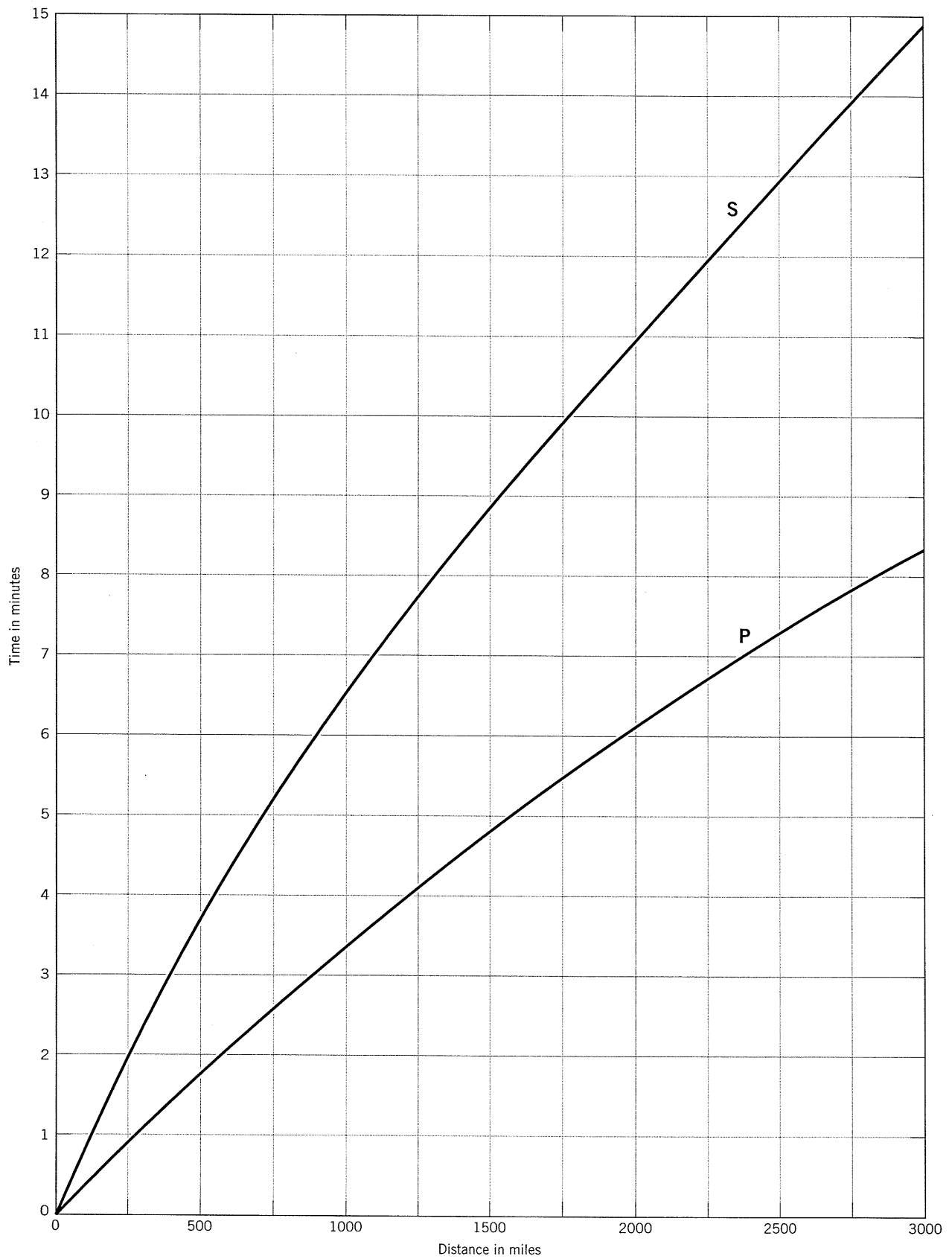
To find the epicenter, you need to use the world map in **Kit Figure 8-1-3**. First, locate and mark the location of each station using the latitude and longitude as follows:

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	Latitude	Longitude
Sitka	57° N	135° W
Charlotte	35° N	81° W
Honolulu	21° N	158° W

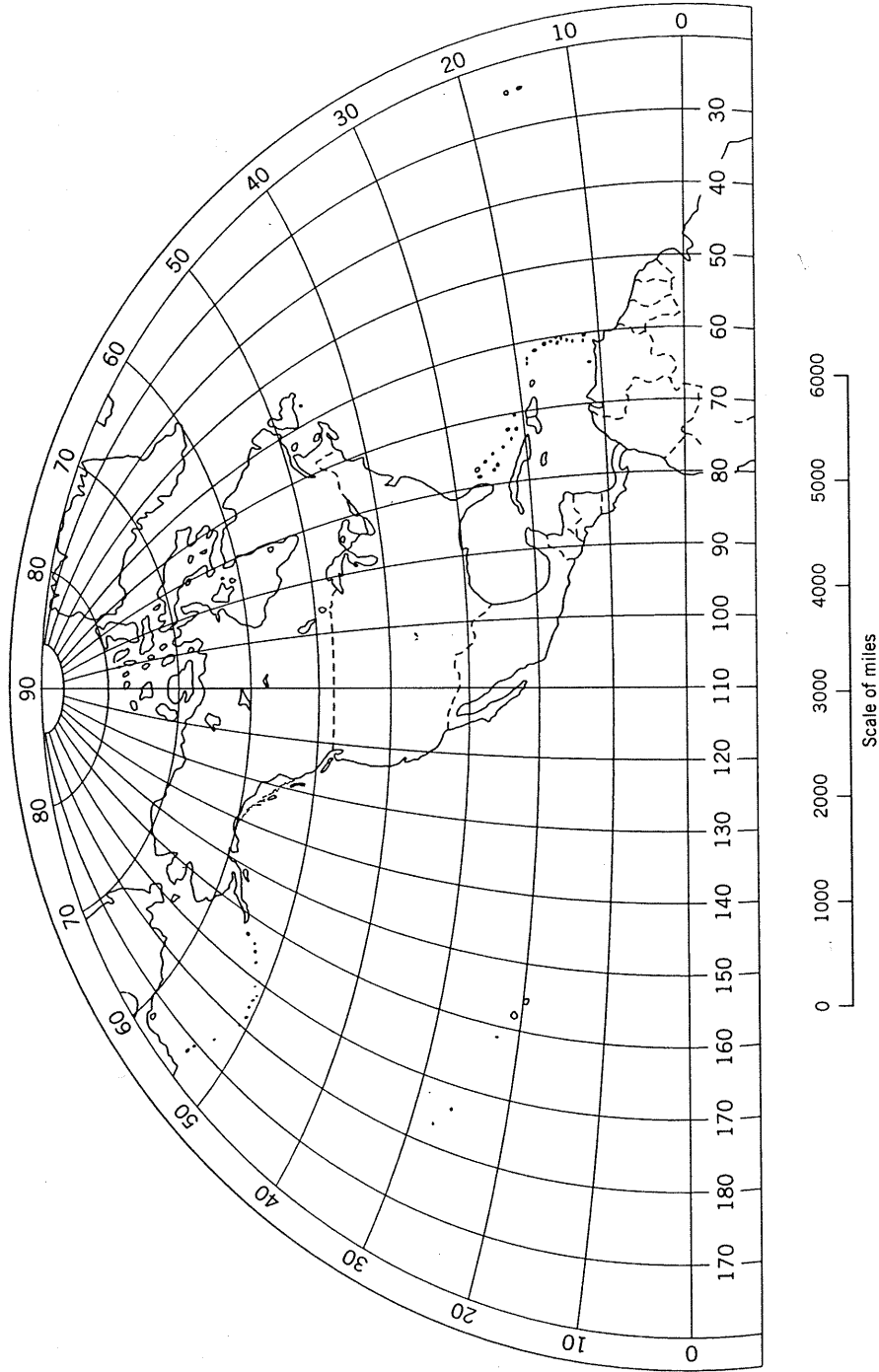
Next, place the point of your compass at the appropriate city on the map, and draw a circle having a radius equal in distance to the epicenter. Repeat for each station. Ideally, all three circles intersect at a point, which is the epicenter. More than likely, they do not intersect at one point. However, there may be a small triangle, with curved sides formed by pieces of the circles. The center of this triangle is the location of the epicenter. (If there is no such triangle, estimate the best location from the graph.)

- **Kit Inquiry 8-1c** What is the longitude and latitude of the epicenter?



Kit Figure 8-1-2. Travel-time curves for the P- and S-waves through the Earth. (Reprinted with the permission of Macmillan Publishing Company from *Laboratory Manual in Physical Geology 3/E* by (American Geological Institute), Richard M. Busch. Copyright © 1990, 1993 by Macmillan college Publishing Company, Inc.)

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Kit Figure 8-1-3. Map of the world for plotting seismic results. (Reprinted with the permission of Macmillan Publishing Company from *Laboratory Manual in Physical Geology 3/E* by (American Geological Institute), Richard M. Busch. copyright © 1990, 1993 by Macmillan college Publishing Company, Inc.)

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Activity 8-1**Earthquakes**

Answer Sheet

NAME _____

Kit Inquiry 8-1a:			
	P-Wave arrival time	S-Wave arrival time	S minus P (time)
Sitka			
Charlotte			
Honolulu			

Kit Inquiry 8-1b:	
	Distance
Sitka	
Charlotte	
Honolulu	

Kit Inquiry 8-1c:

The epicenter is located at a latitude of _____ and a longitude of _____.