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Chapter 9

LABORATORY MANUAL

• Locating an Earthquake 30

When an earthquake occurs, the shock sends outward vibrations in all directions. Both minor and major shocks are recorded by instruments called seismographs. When reports from at least three stations conducting earthquake watches are compared, the location of the epicenter can be determined. The epicenter is the point on Earth's surface directly above the focus, the actual rock break that caused the earthquake.

The first vibration wave to reach the seismograph is called the P or primary wave. P-waves travel like sound waves, alternately compressing and expanding the rocks through which they pass. A second wave, the S-wave, takes twice as long to reach the station as the P-wave. S-waves are shear waves that shake the rocks in a manner similar to the way a bow vibrates violin strings.

Strategy

You will compute the distance of five different seismograph stations from a strong earthquake.
You will use information from five seismograph stations to compute the location of the epicenter of an earthquake.

Materials

compass (drawing)
metric ruler

Procedure

1. Using the P-wave arrival times, compute the distance of each station from the earthquake center. The P-wave travels at a speed of 6 kilometers per second. Record the distances in Table 30-1.
2. On the map, Figure 30-1, draw an arc from each station using the computed distance as the radius of the circle.
3. Locate the epicenter of the earthquake. It is the point at which all arcs intersect (cross).

Formulas & Notes:

- 1 minute = 60 seconds
- P waves travel 6 km per second.
- Map Scale: 1 inch = 800 km
- When dividing, please round to 1 decimal point.

Data and Observations

Table 30-1

Station	P-wave arrival time	Number of Seconds	Distance from epicenter using P-wave	Radius of the Circle
Rockville, MD	3 min, 20 sec			
Newport, WA	7 min, 55 sec			
Tucson, AZ	5 min, 50 sec			
Rapid City, SD	3 min, 45 sec			
McMinnville, TN	1 min, 15 sec			

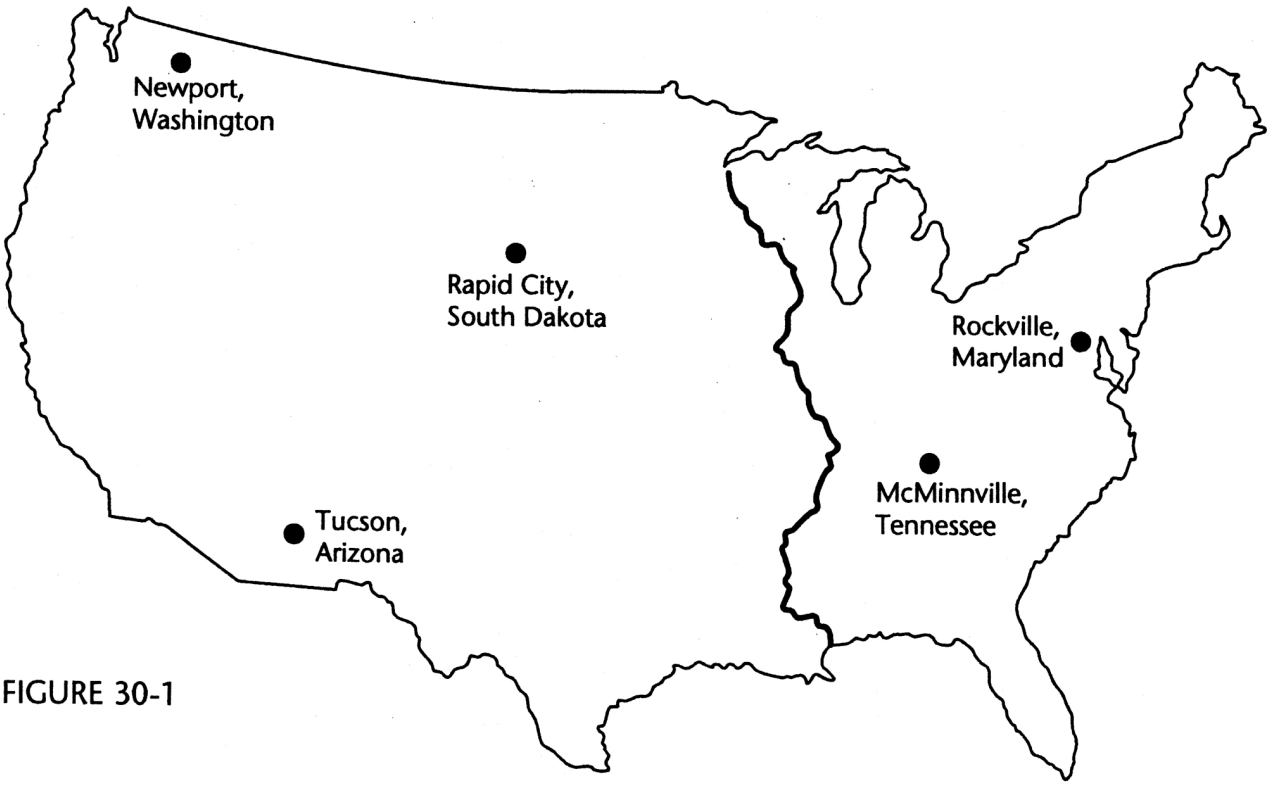

FIGURE 30-1

Questions and Conclusions

1. Where is the epicenter of an earthquake? _____

2. Near what city did the earthquake occur? _____

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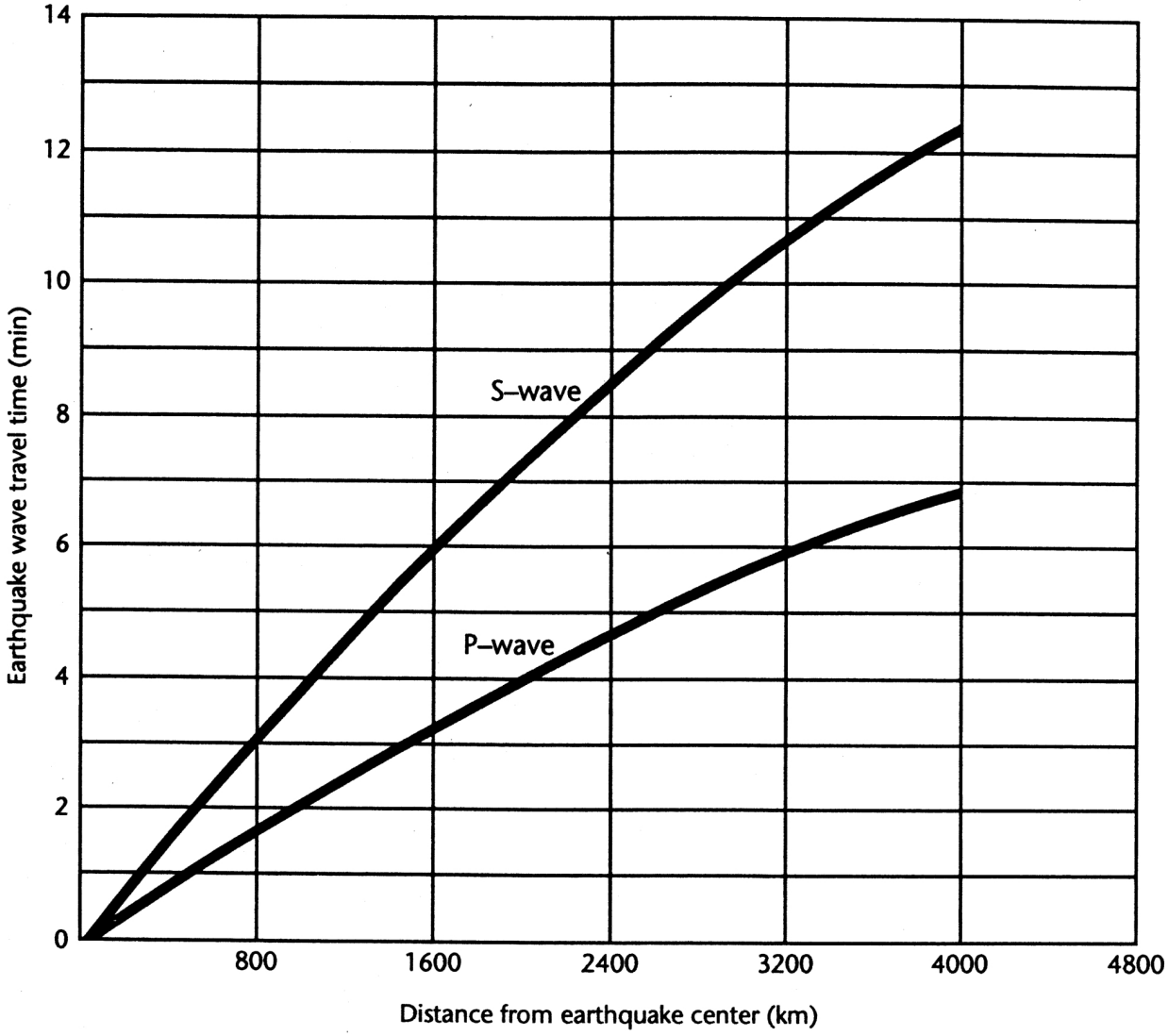
Using earthquake-wave arrival times for many earthquakes, scientists have plotted travel-time curves. Travel-time curves are line graphs that show how long it takes for a type of earthquake wave to travel a certain distance. Use the travel-time curve below to answer the following questions.

Earthquake Travel Time

Table 30-2



3. If a seismograph were located 1600 kilometers from the earthquake's focus, how long would it take the P-wave to travel this distance? _____

4. How long would it take the S-wave to travel 1600 kilometers? _____

5. How long would it be after the seismograph recorded the arrival of the P-wave before the seismograph recorded the arrival of the S-wave? _____

6. An earthquake was recorded at three different stations, *A*, *B*, and *C*. Use the travel-time curve to determine the distance from each station to the earthquake epicenter.

Station	Time between P- and S-wave arrival (min)	Distance to epicenter (km)
A	1 minute	
B	2 minutes	
C	4 minutes	

Sections of seismograms, records traced by a seismograph, from three stations, *A*, *B*, and *C*, are shown below. Each vertical line represents 1 minute of time. Use the diagram to help you answer the following questions.

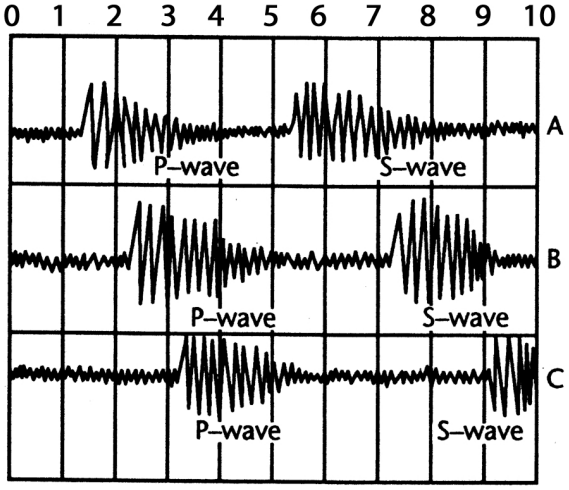


FIGURE 30-2

7. Estimate to the nearest half-minute the arrival times of the P- and S-waves at each station.

	Time of P-wave arrival	Time of S-wave arrival	Time difference
Station A	_____	_____	_____
Station B	_____	_____	_____
Station C	_____	_____	_____

8. Which station is closest to the epicenter? _____

Which station is farthest from the epicenter? _____

Strategy Check

____ Can you compute the number of kilometers from each station to the epicenter using P-wave arrival times?

____ Can you pinpoint the epicenter of the earthquake using your computed distances and the resulting arcs?