



Ch 8.2: Measuring Earthquakes

Objective: Be able to...

- *Identify the three types of seismic waves.*
- *Describe the different ways earthquakes are measured.*

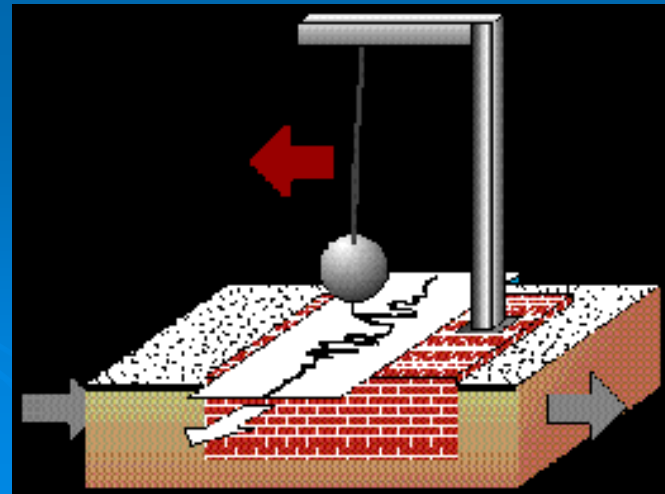
Who studies Earthquake?

- A **seismologist** is a person who studies earthquakes and the mechanics of the earth.
 - *seismos-from the Greek meaning earthquakes*
 - *ologist-meaning a person who studies (something).*



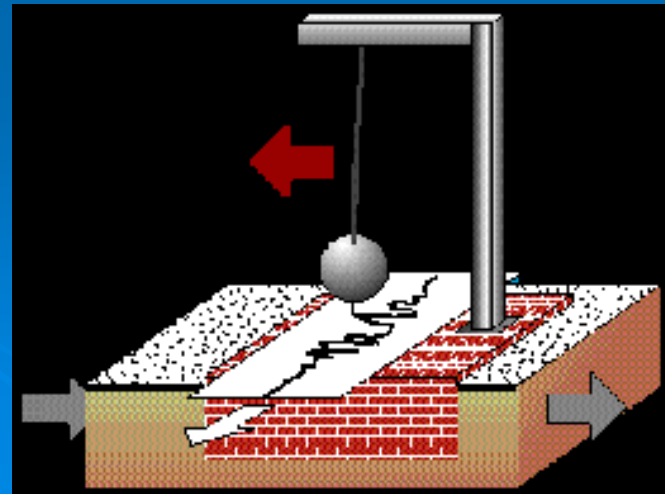
Earthquake Tools

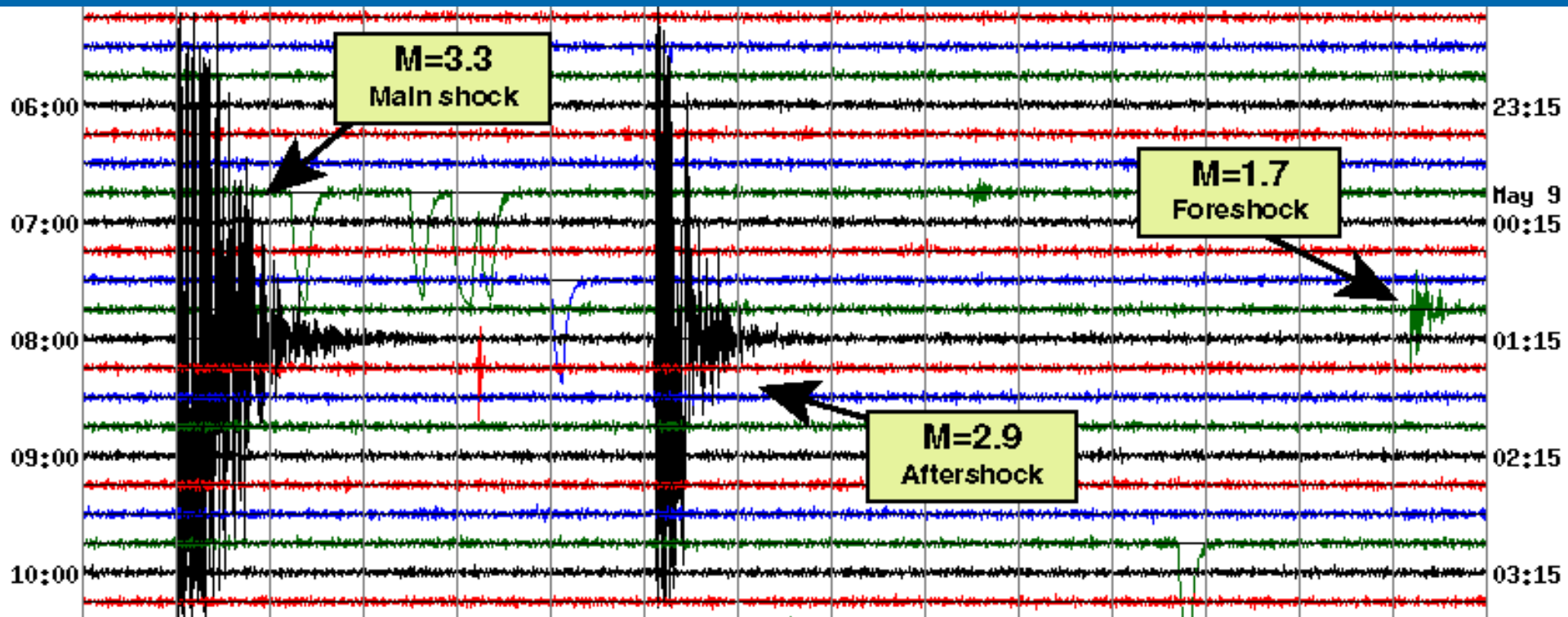
- ***Seismograph*** are instruments that record earthquake waves.
- *Can also be used to determine the distance to the epicenter of the earthquake.*



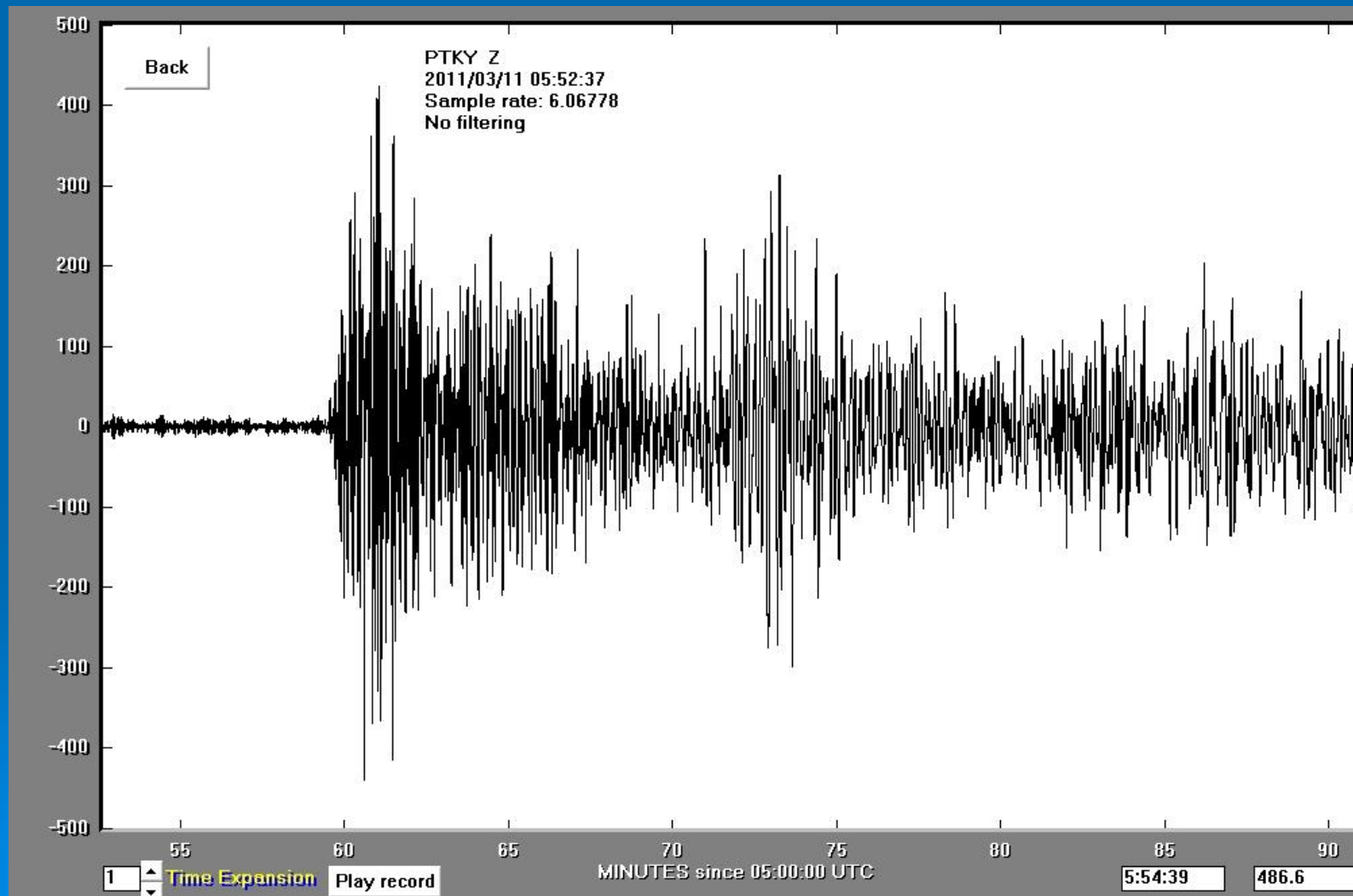
Earthquake Tools

- ***Seismogram*** is the trace the seismograph records.





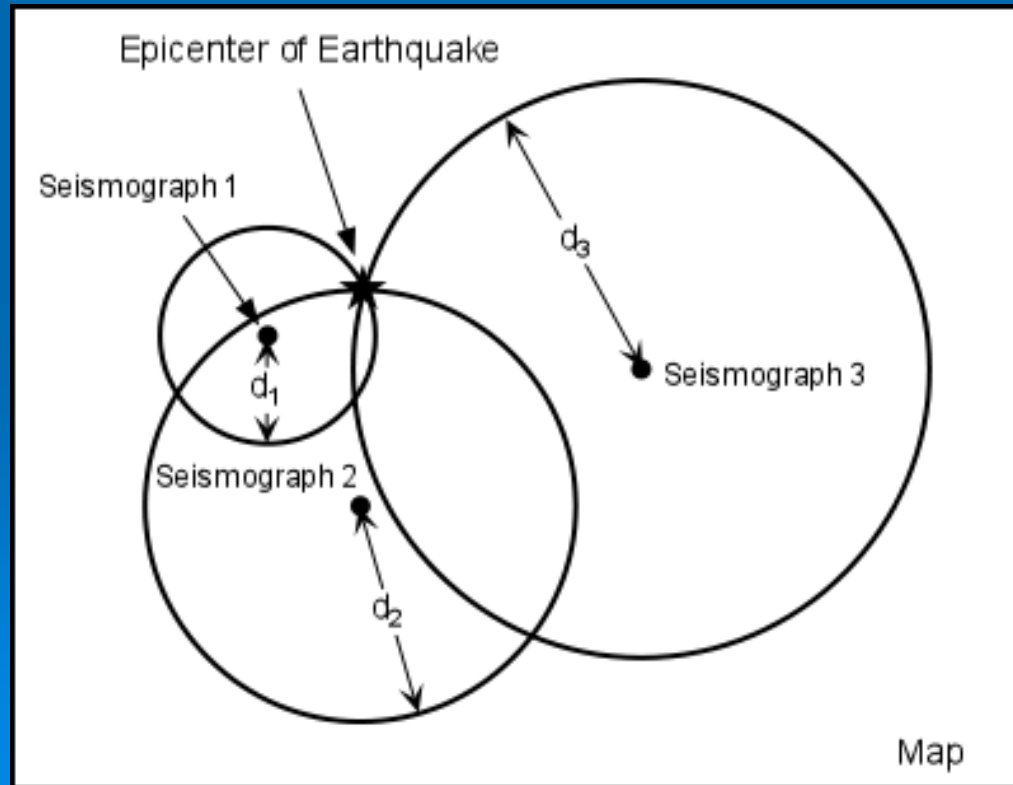
3/11/11 Japan Earthquake Seismogram

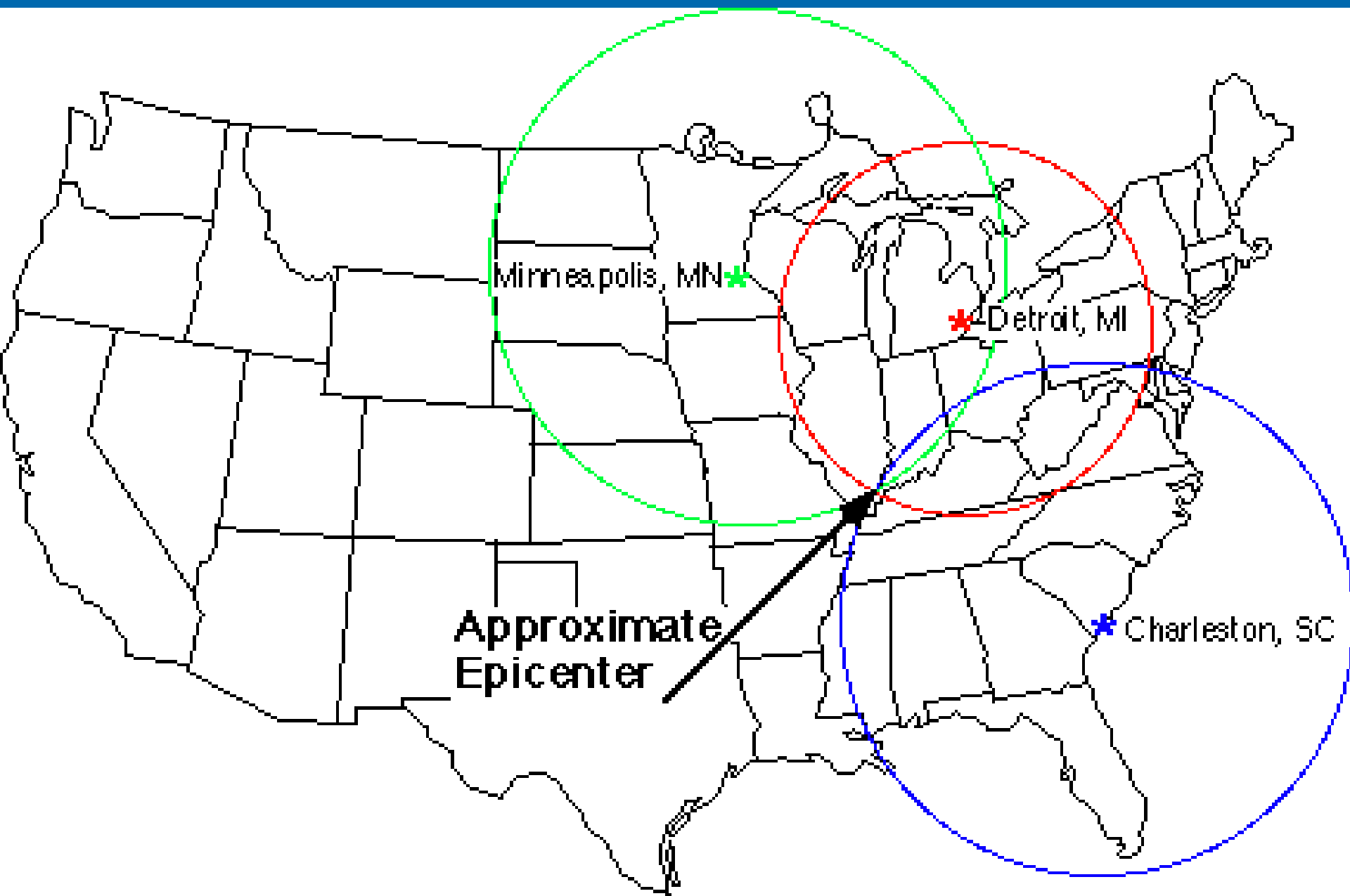




Earthquake Tools

- You need **3** seismographs to find the exact location or epicenter of an earthquake.

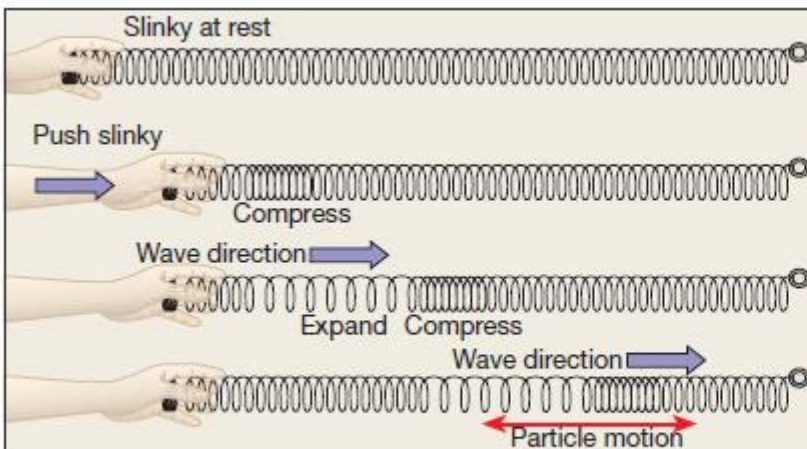
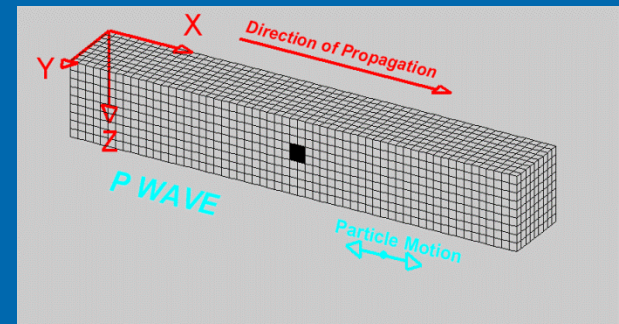




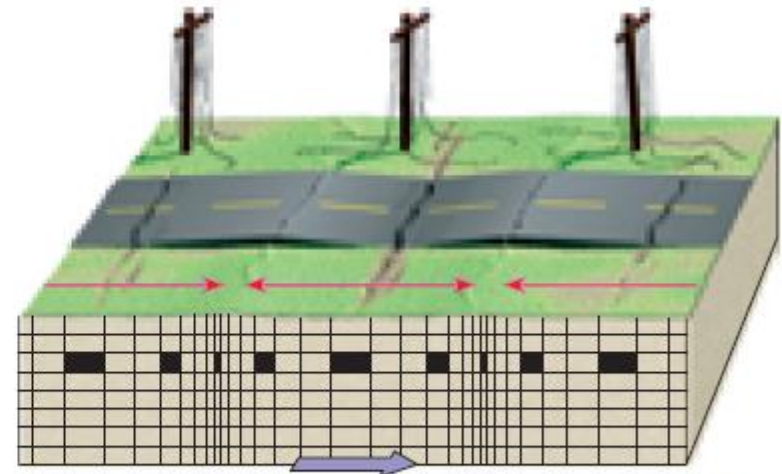
Body Waves

➤ P waves:

- Travel through all Earth's interior.
- Fastest wave
- Push-pull waves
- Also known as compression waves.



A P waves are compression waves that alternately compress and expand the material through which they pass.

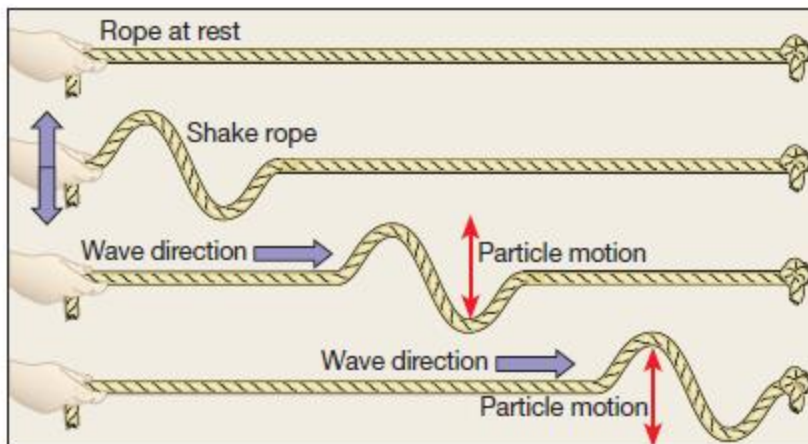
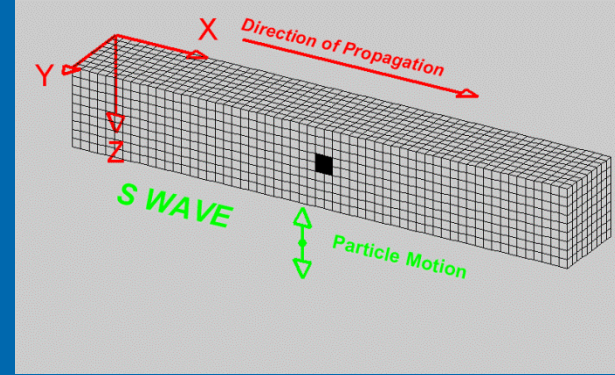


B The back-and-forth motion produced as P waves travel along the surface can cause the ground to buckle and fracture.

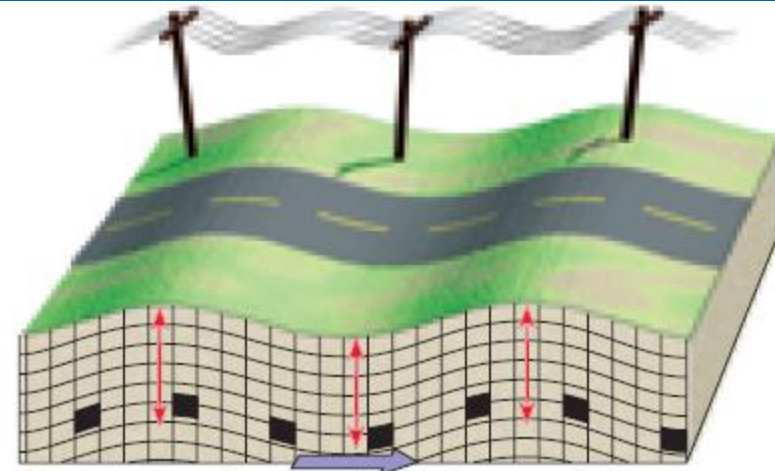
Body Waves

➤ S waves:

- Travel through Earth's interior, except for liquids and gases.
- Slower than P waves.
- Wave has a side-to-side motion.



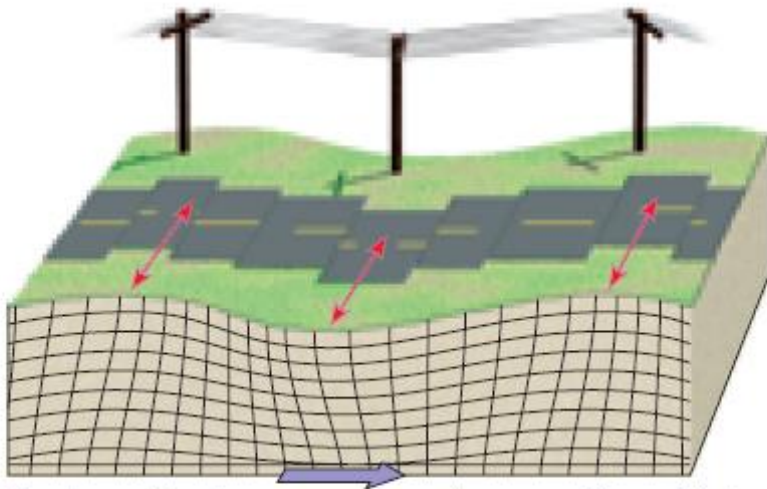
C S waves are transverse waves which cause material to shake at right angles to the direction of wave motion. The length of the red arrow is the displacement, or amplitude, of the S wave.



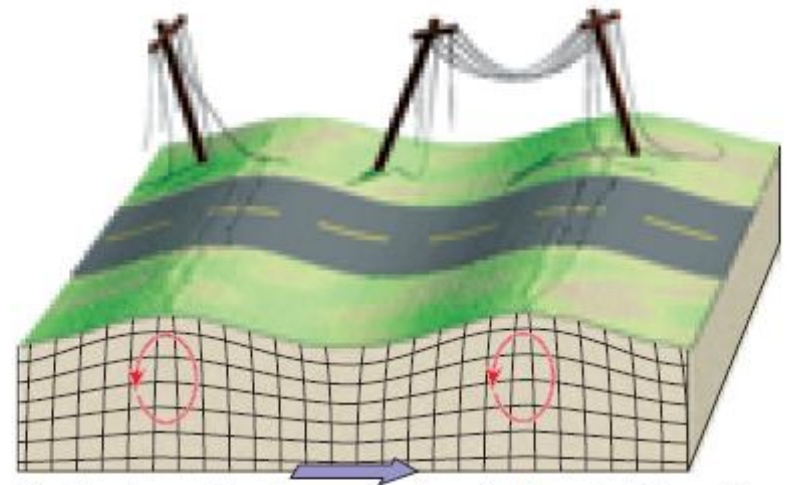
D S waves cause the ground to shake up-and-down and sideways.

Surface Waves

- Travel on the surface.
- They move up and down, as well as a side-to-side.
- Slowest of all seismic waves.
- These movements make surface waves the most destructive earthquake waves.



E One type of surface wave moves the ground from side to side and can damage the foundations of buildings.



F Another type of surface wave travels along Earth's surface much like rolling ocean waves. The arrows show the movement of rock as the wave passes. The motion follows the shape of an ellipse.

Seismic Waves

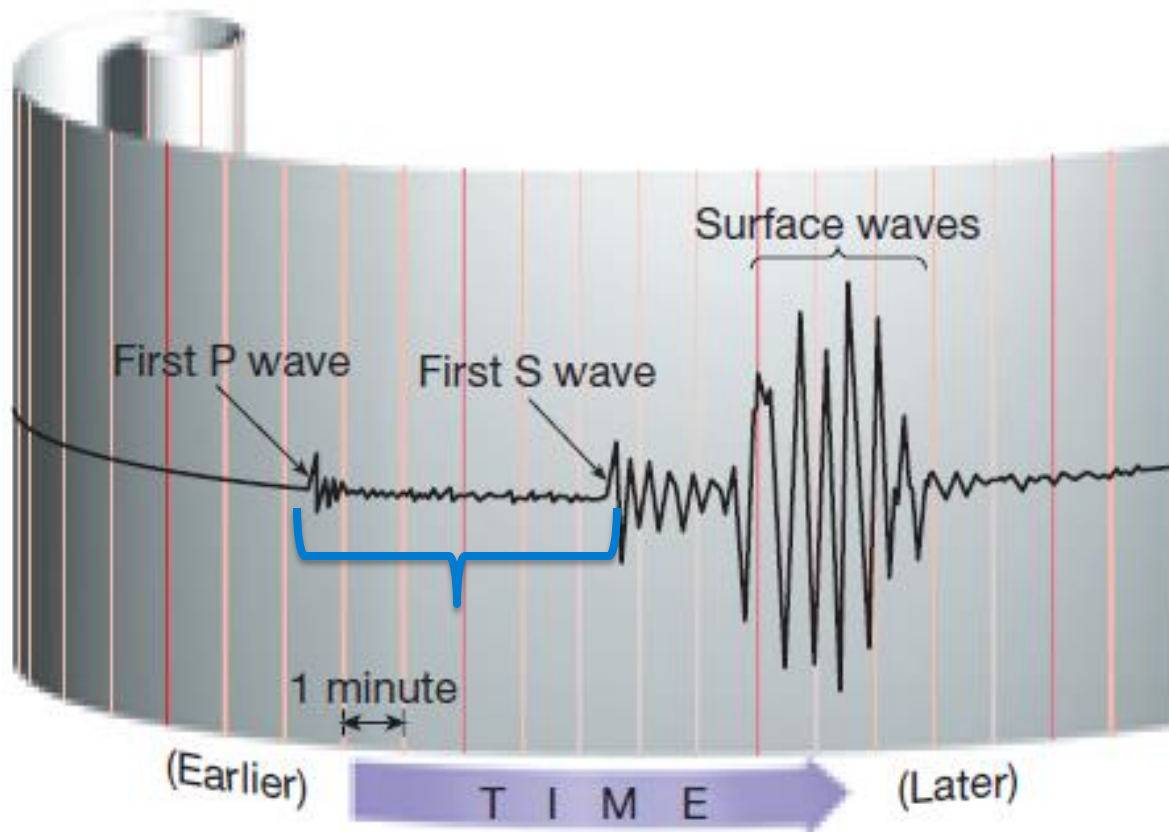
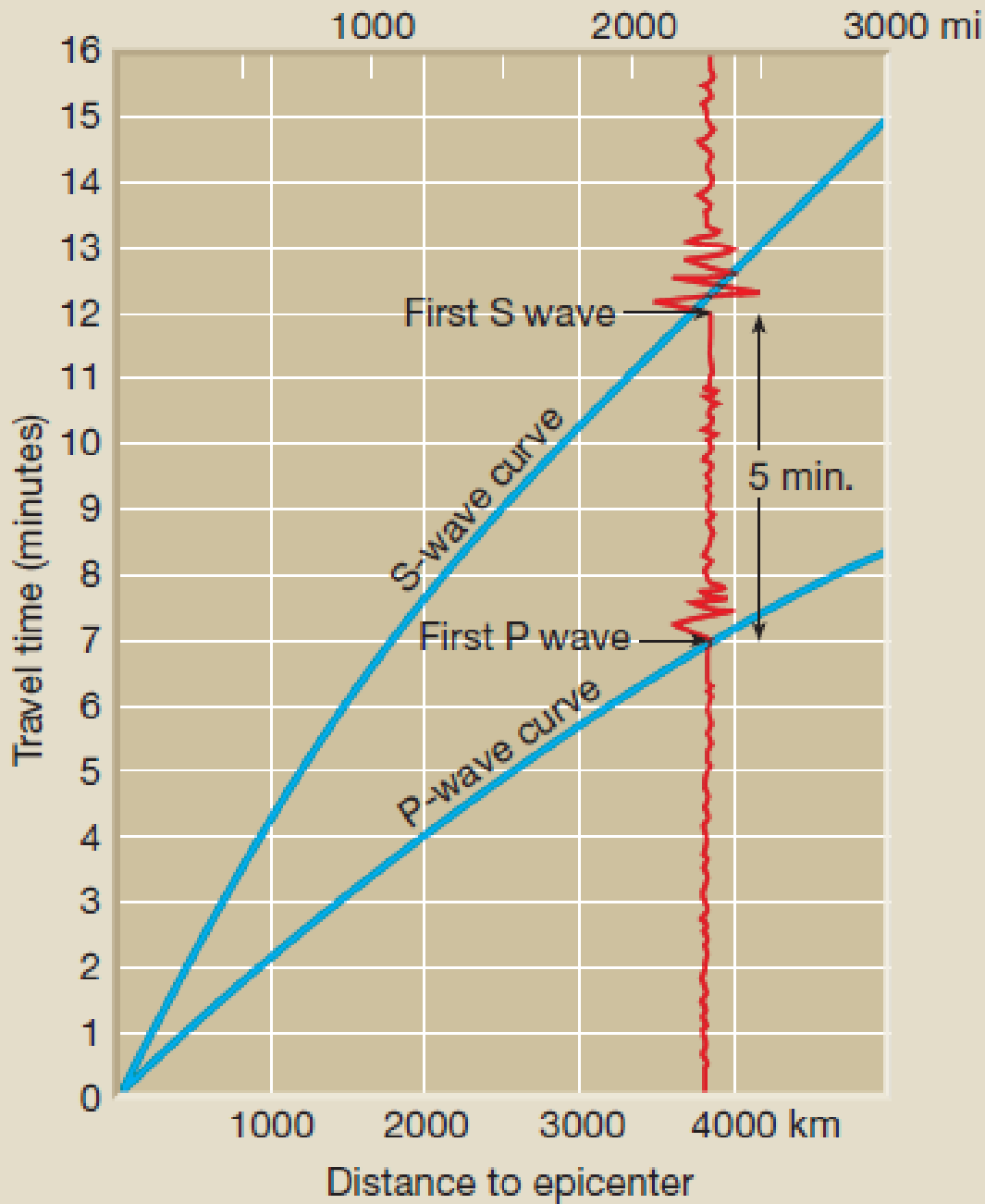


Figure 6 Typical Seismogram
The first wave to arrive is the P wave, followed later by S waves. The last waves recorded are the surface waves.

Measuring What is the time interval in minutes between the start of the first P wave and the start of the first S wave?



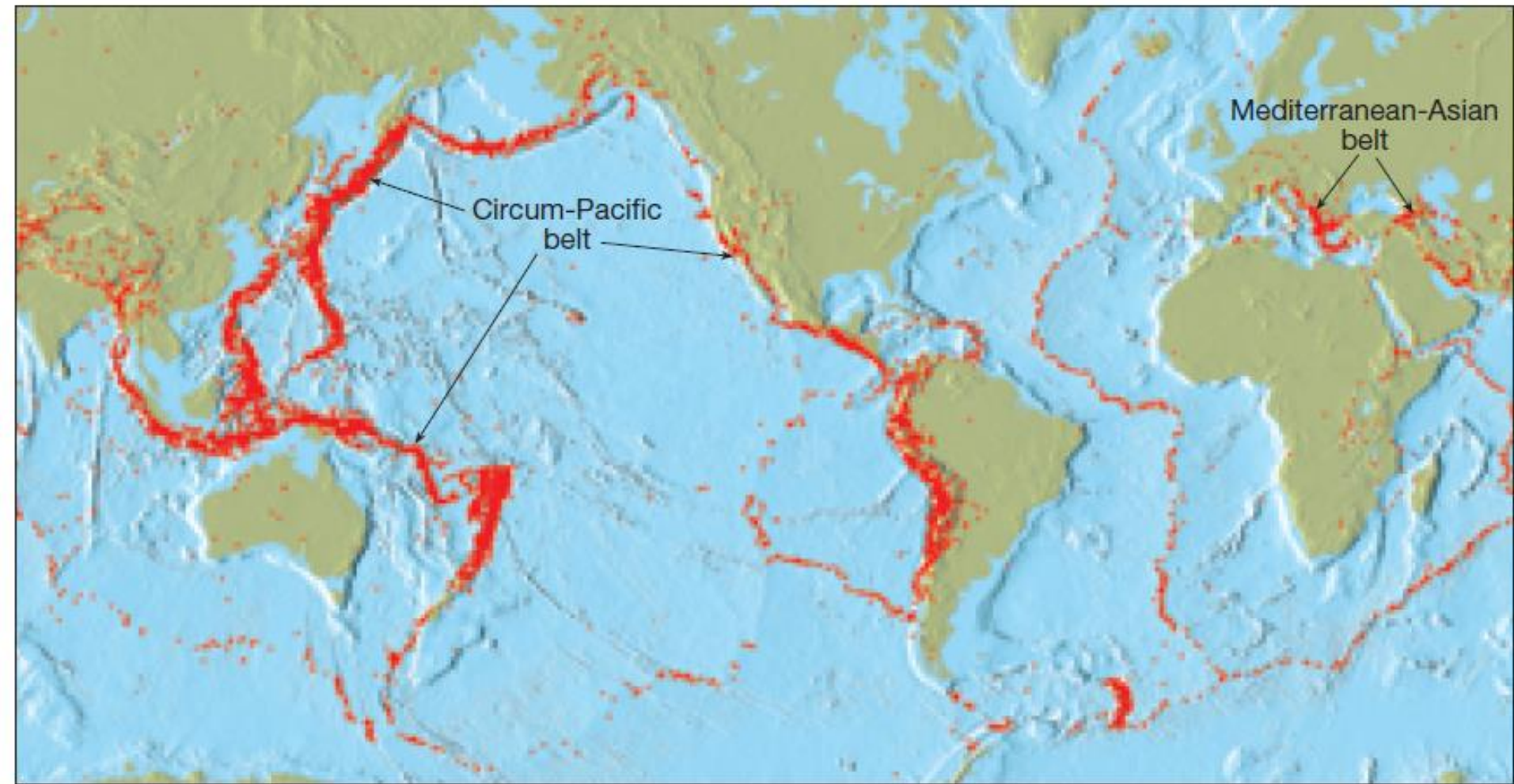
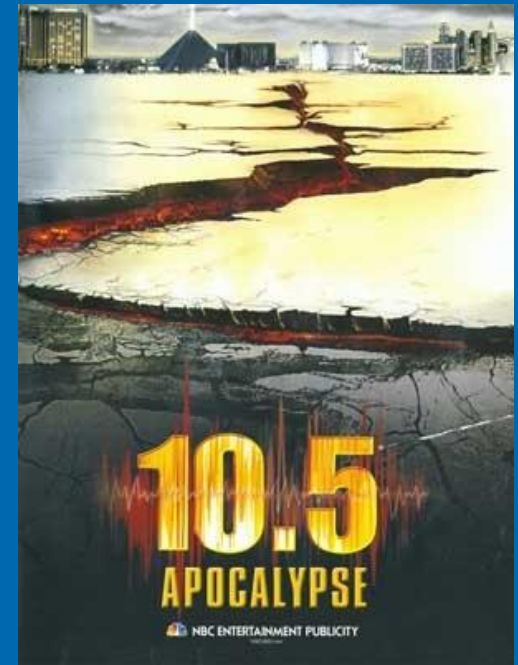


Figure 9 Distribution of the 14,229 earthquakes with magnitudes equal to or greater than 5 from 1980 to 1990.
Observing *Where do you find most of the earthquakes—in the interiors of the continents or at the edges?*

Measuring Earthquakes

- Scientist have used two different types of measurements to describe the size of an earthquake:
 - **Intensity** – *ground shaking causing damage.*
 - **Magnitude** – *measure of seismic waves.*

Earthquake scales



Value Potential Hazard

10	Extraordinary
9	Outstanding
8	Far-reaching
7	High
6	Noteworthy
5	Intermediate
4	Moderate
3	Minor
2	Low
1	Insignificant

➤ Richter scale:

- (0-10 rating) rates earthquakes based on measurement of the times and amplitude of seismic waves.
 - Measure the amplitude of the largest wave.
 - *familiar but outdated.*

Earthquake scales

➤ Moment Magnitude Scale:

- (M_w) the most useful scale for geologists.
- More precise
- The only scale that estimates the energy released by earthquakes.
- derived from the amount of displacement that occurs along a fault zone

Moment Magnitudes	Effects Near Epicenter	Estimated Number per Year
< 2.0	Generally not felt, but can be recorded	> 600,000
2.0–2.9	Potentially perceptible	> 300,000
3.0–3.9	Rarely felt	> 100,000
4.0–4.9	Can be strongly felt	13,500
5.0–5.9	Can be damaging shocks	1,400
6.0–6.9	Destructive in populous regions	110
7.0–7.9	Major earthquakes; inflict serious damage	12
8.0 and above	Great earthquakes; destroy communities near epicenter	0–1