

EPICENTER DETERMINATION

1. In Figure II-3.2 use the time scale to determine the lag in arrival time between the P and S waves at four stations: St. Louis, Missouri (SLM); Bloomington, Indiana (BLO); Minneapolis, Minnesota (MNM); and Bowling Green, Ohio (BGO). The first major impulse on the left in the seismogram indicates the arrival of the first P wave at the station; the second impulse, the arrival of the first S wave. The lag time, T, is given by the difference between S and P waves. Enter the lag time value for each station below:

SLM: _____sec BLO: _____sec

MNM: _____sec BGO: _____sec

2. To determine the distance from the earthquake to each seismograph station we must first determine the time lag for a given distance, say 100 km, knowing the average velocities of the P and S waves. If the average velocity of the P wave is 6.1 km/sec and the average velocity of the S wave is 4.1 km/sec, what is the time required for each wave to travel 100 km?

P waves travel 100 km in _____seconds.

S waves travel 100 km in _____seconds.

Thus the time lag at 100 km (T_{100}) is _____seconds.

3. Remembering that for longer distances there is proportionally longer lag time, we can construct a simple equation to calculate the unknown distance x to each station:

$$\frac{x}{T_x} = \frac{100}{T_{100}}$$

where x = unknown distance in km

T_x = lag time for distance x

T_{100} = lag time at 100 km

Since values for T_x are known from Question 1 and the value of T_{100} from Question 2, the equation can be solved for x for each station. More than one station is needed to determine the epicenter since the information from one station can only give the distance to the earthquake and not the direction. The minimum number of stations needed to locate an epicenter is _____.

Using the data from Figure II-3.2 and the equation above, determine the distance to the earthquake epicenter from each station and enter below.

SLM: _____ km BLO: _____ km

MNM: _____ km BGO: _____ km

4. a. The epicenter of the earthquake can be pinpointed by drawing compass arcs from _____ of the stations with radii corresponding to the distances calculated in Question 3. The intersection of these radii marks the epicenter. Do this in Figure II-3.3.
- b. Where is the epicenter? (Give location within a state.)
- c. Label it on the map (Figure II-3.3).
- d. At what time did the earthquake occur? (Refer to Figure II-3.2)

From: Foley, D., McKenzie, G. D., and Utgard, R. O. (1993),
Investigations in Environmental Geology, Macmillian
Publishing Company, New York, pgs. 56-59.

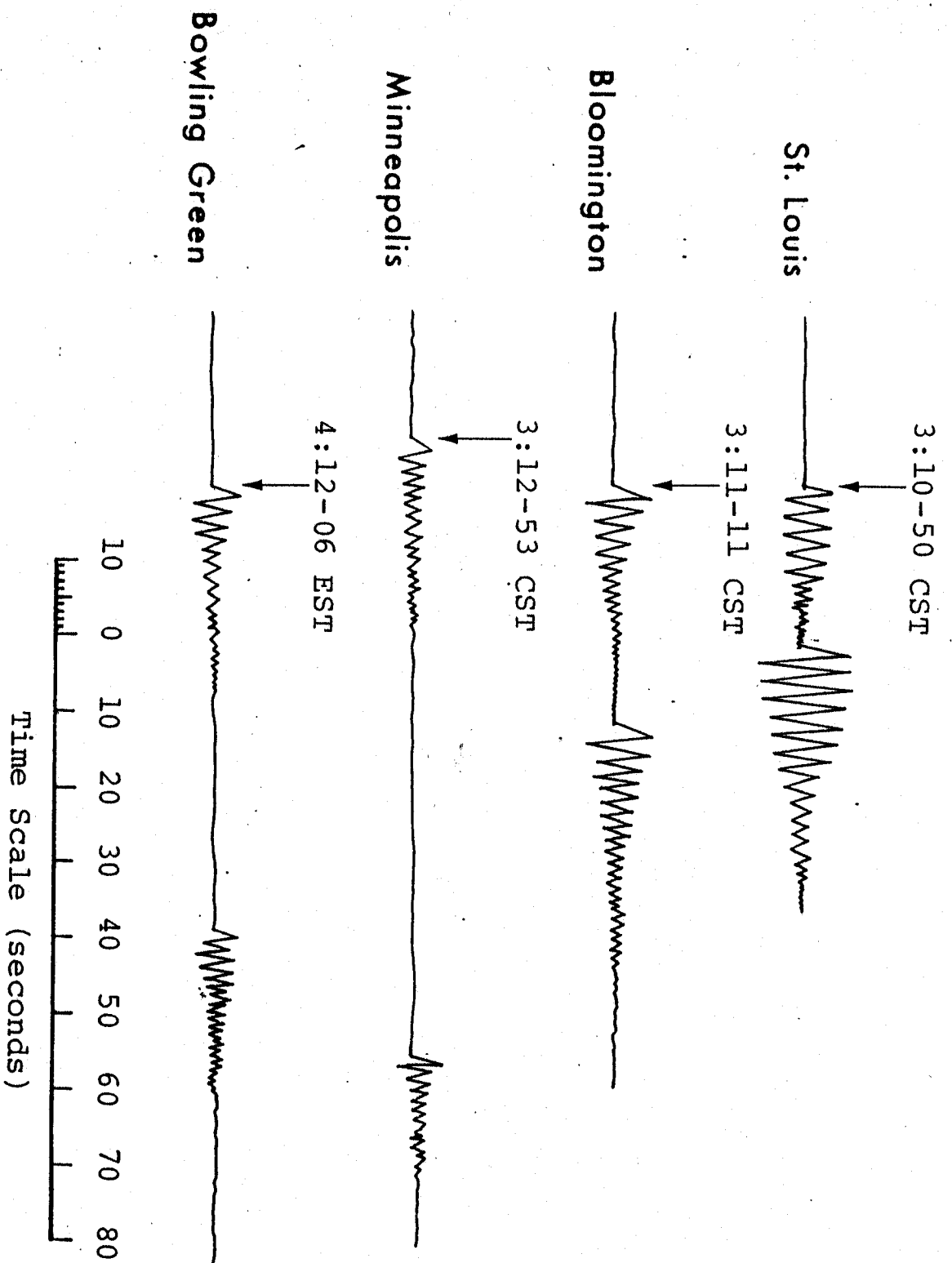


FIGURE II-3.2 Partial seismograms for an earthquake. The P wave arrived at the St. Louis seismograph at 10 minutes and 50 seconds after 3:00 p.m. CST. The second disturbance on the seismogram represents the arrival of the S waves.

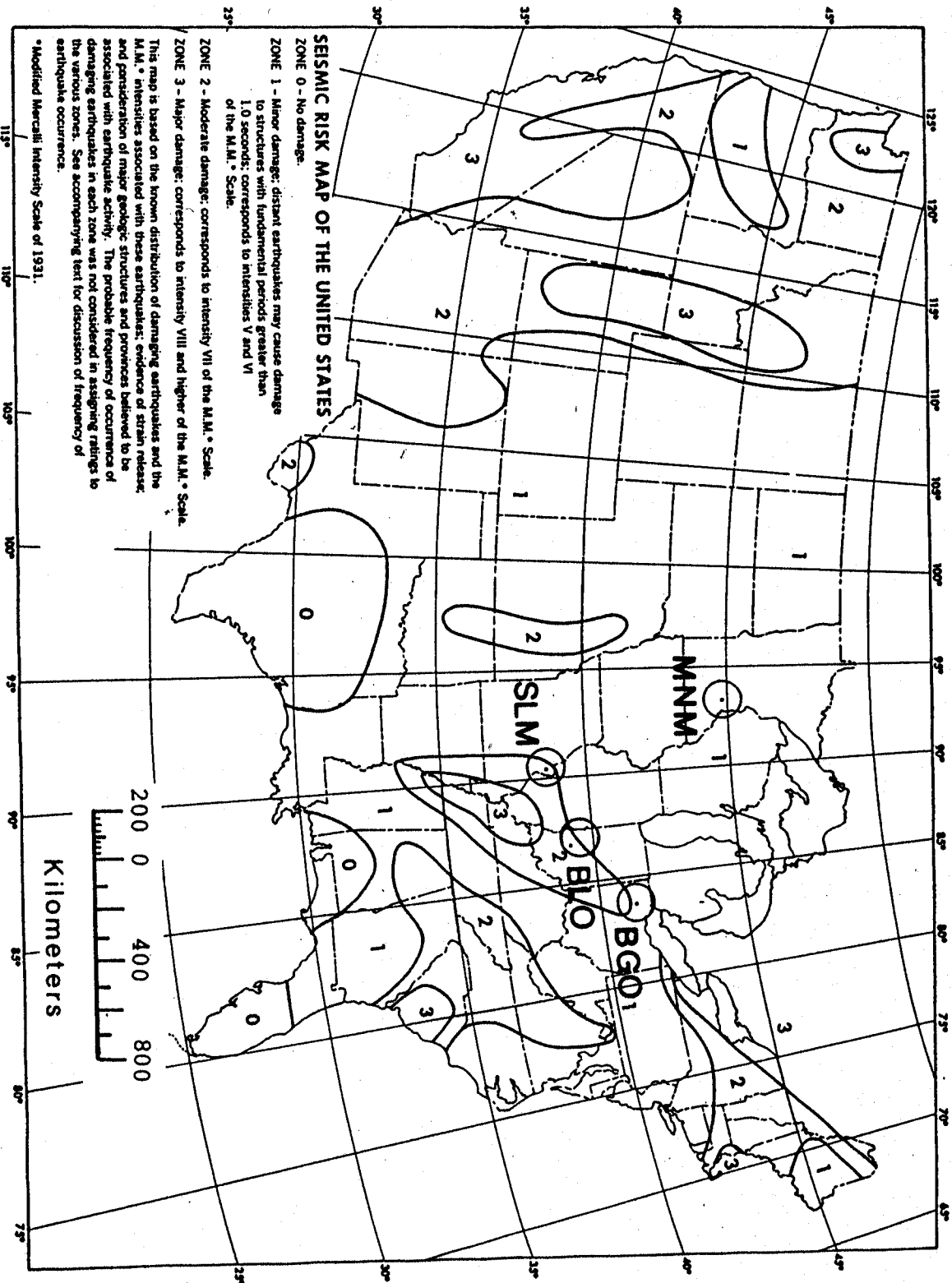


FIGURE II-3.3 Seismic risk map of the United States. (Executive Office of the President, Task Force on Earthquake Reduction, 1970)