

Earthquakes and seismic risks

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I Earthquakes

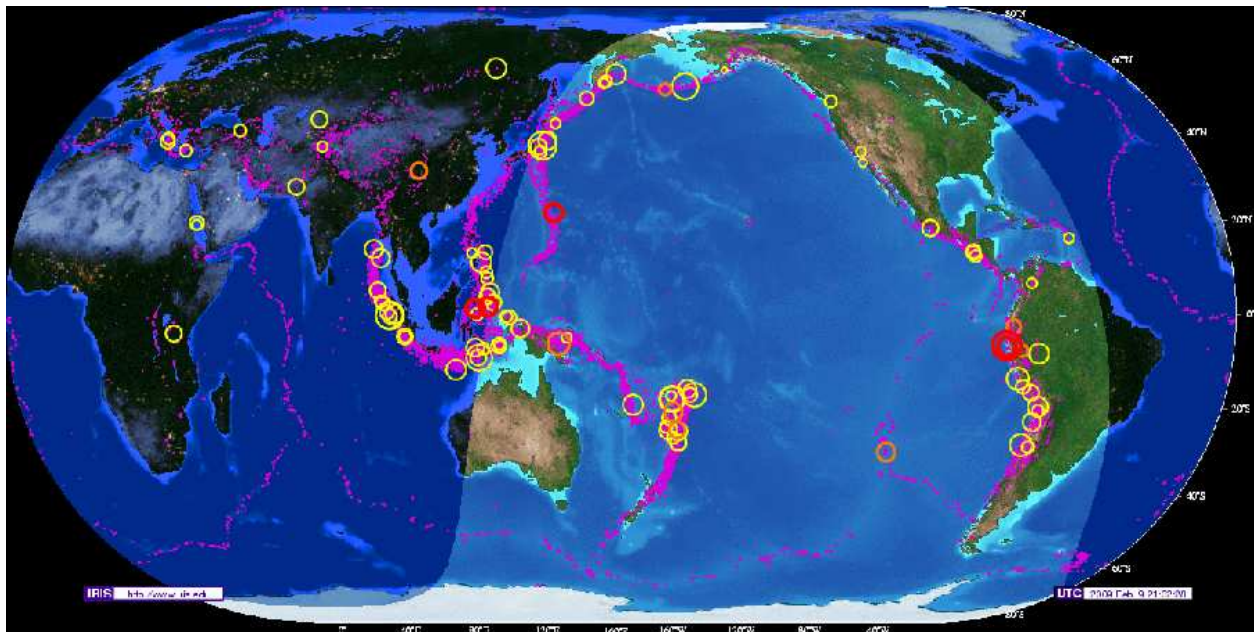


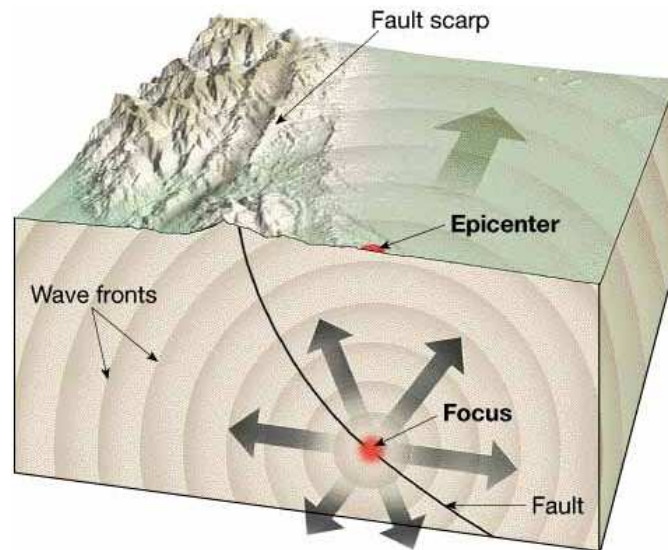
Figure 1: Recent earthquakes. Yellow circle: Past two weeks; and Pink dots are the occurred in the past 5 years. [Link](#)

A Why do earthquakes happen?

- Plate tectonics —horizontal movements of plates—create stress in the crust.
- A brittle part of the crust has a elastic limit (fail at some point).
- When a part of crust snaps, it releases the accumulated elastic energy as an earthquake (creates seismic waves.).
- Movements along faults can cause tsunami.

B Some terminologies

- **Epicenter:** The point on the surface directly above the focus.
- **Focus/hypocenter:** The origin of earthquake, ie, where the initial slip/rupture occurred along fault.



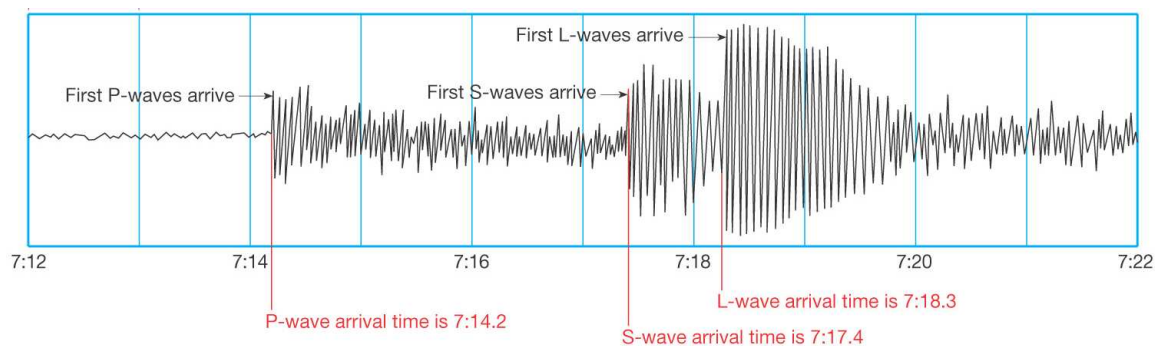
II Seismic Waves

- They measure the ground shaking with **seismograph**—a ground shake recorder.
- The record of seismic waves is called **seismogram**.
Animation
- There are two types of waves (Body waves and Surface waves).

A Body waves (P-wave and S-wave)

Go inside the earth (Crust, Mantle, Core). Spread into three dimensions. The deeper the waves go, the faster the waves get. (Because of high density.)

- **P-wave: Fastest** (~ 4 mi/sec), arrive first, **compressional** Animation
- **S-wave: Second fastest** (~ 2 mi/sec), arrive second, **shear** Animation



B Surface waves (Love wave)

Travel only near the surface (Crust). Spread into two dimensions.

- **L-wave: Slowest**, arrive after P and S wave, **the most destructive of all**.
Click for animation
- Earth shaking and damage to buildings occurs more on **uncompacted/loose** materials than on **compacted/rigid** materials.

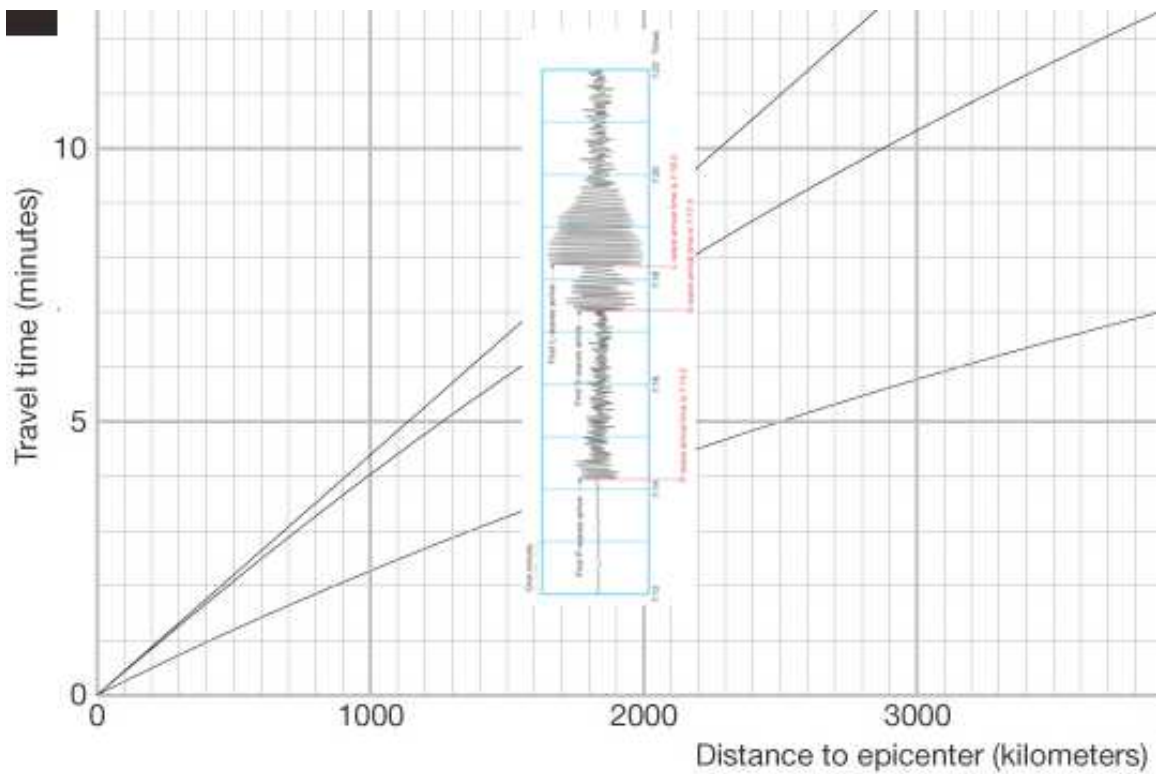
III How to locate earthquakes?

Your mission:

A car (60 mile/hour) and an bicycle (20 mile/hour) left unknown location at unknown time. We only know that they left same time and go at the constant speed. Find the distance to the starting location.

A Find P-S travel time interval.

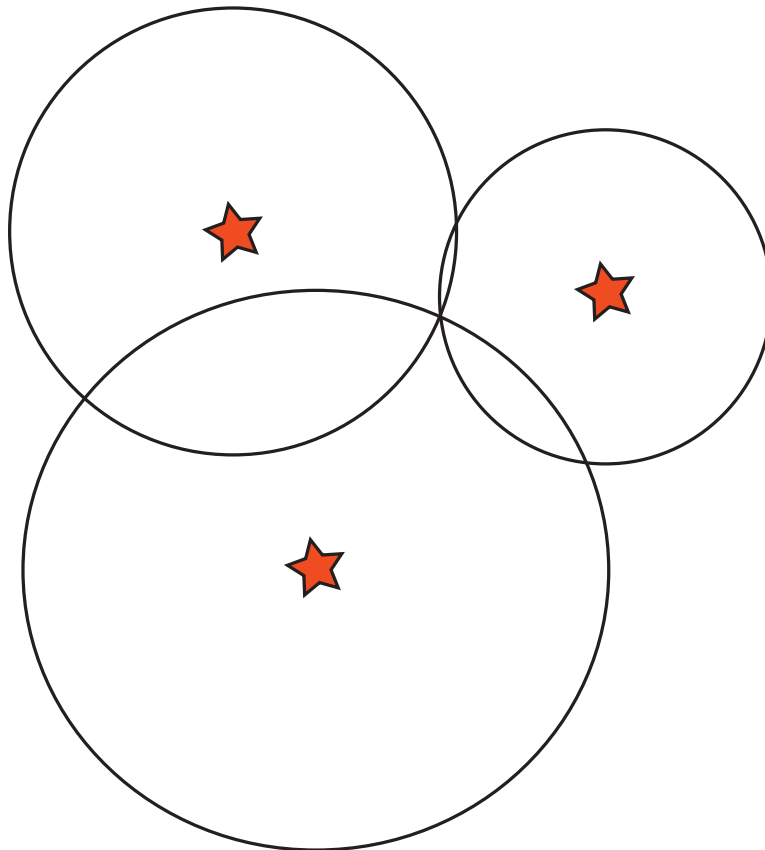
- P-S travel time interval is proportional to the distance.
- The further the distance to focus, the longer the P-S travel time interval.



B Triangulate the epicenter

Once we know the distance to the earthquake, we triangulate the epicenter.

- For each station we draw circles from each station with the corresponding diameter.
- The earthquake occurred at the point where all three circles intersect.



Question Set

Do all questions of each question set. Words in parentheses are hints. Show the calculation processes or you get zero point.

- 77 [p. 146] d. Pay your attention to P wave.
- 78 [p. 148, 149] Round "Difference in P-S (min)" to one decimal point.
ex. QBC - 0.68 should be treated as 0.7 to find Approximate Distance.
- 79 [p. 151]

