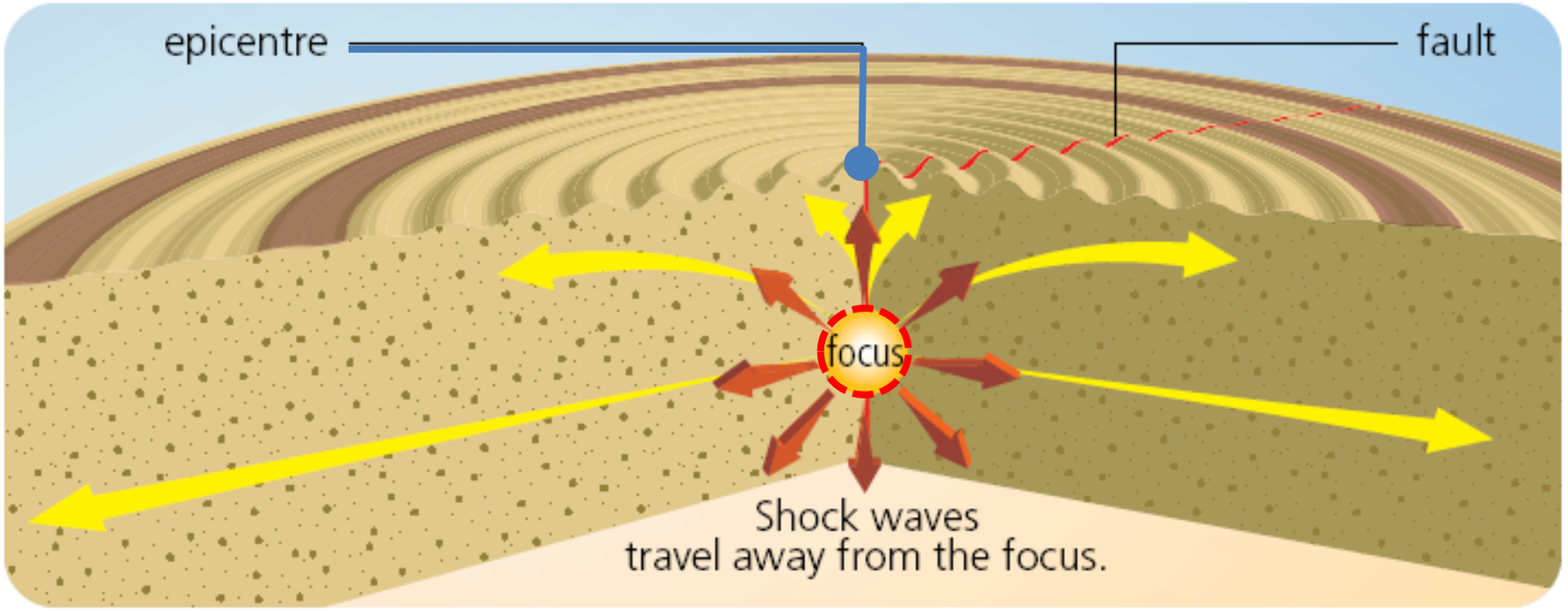
Earthquakes

What is an earthquake?

Earthquake is the vibration (shaking) and/or displacement of the ground produced by the sudden release of energy.

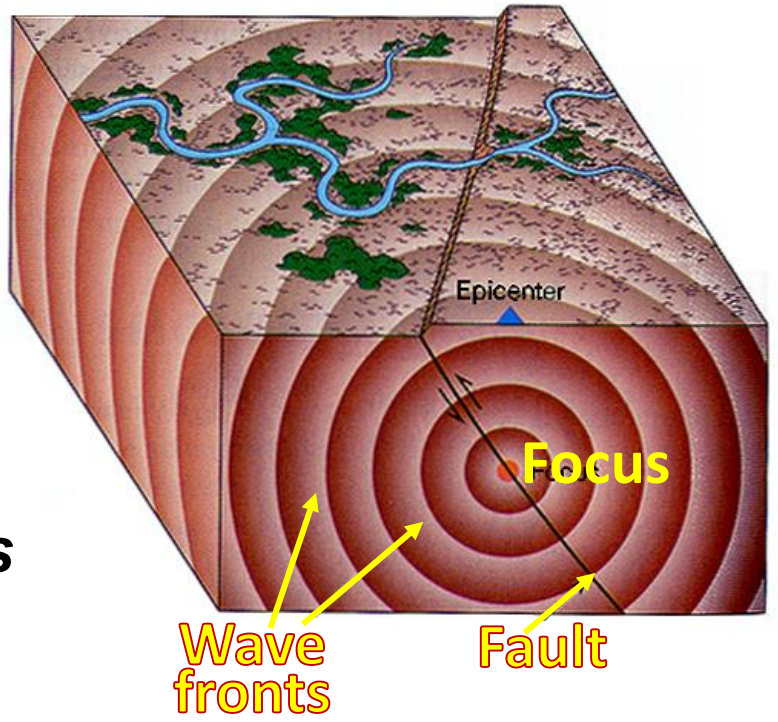
- **Rocks under *stress* accumulate *strain energy* over time.**
- **Stress results from tectonic plate movement, magmatic or volcanic activity.**
- **When stress exceeds strength of rocks, rock breaks and slips.**
- **Rock slippage/rupture occurs at the weakest point *(fault)*.**
- **Strain energy is released as seismic waves.**

Focus and Epicenter



- **Focus – point inside the Earth where an earthquake begins (*point of initial rupture*). The majority of tectonic earthquakes originate in depths not exceeding tens of kilometers.**
- **Epicenter – point on the surface of the Earth directly above the focus where the shaking is usually felt most strongly.**

Seismic Waves



- **Energy released from the earthquake source (its focus) radiates in all directions.**

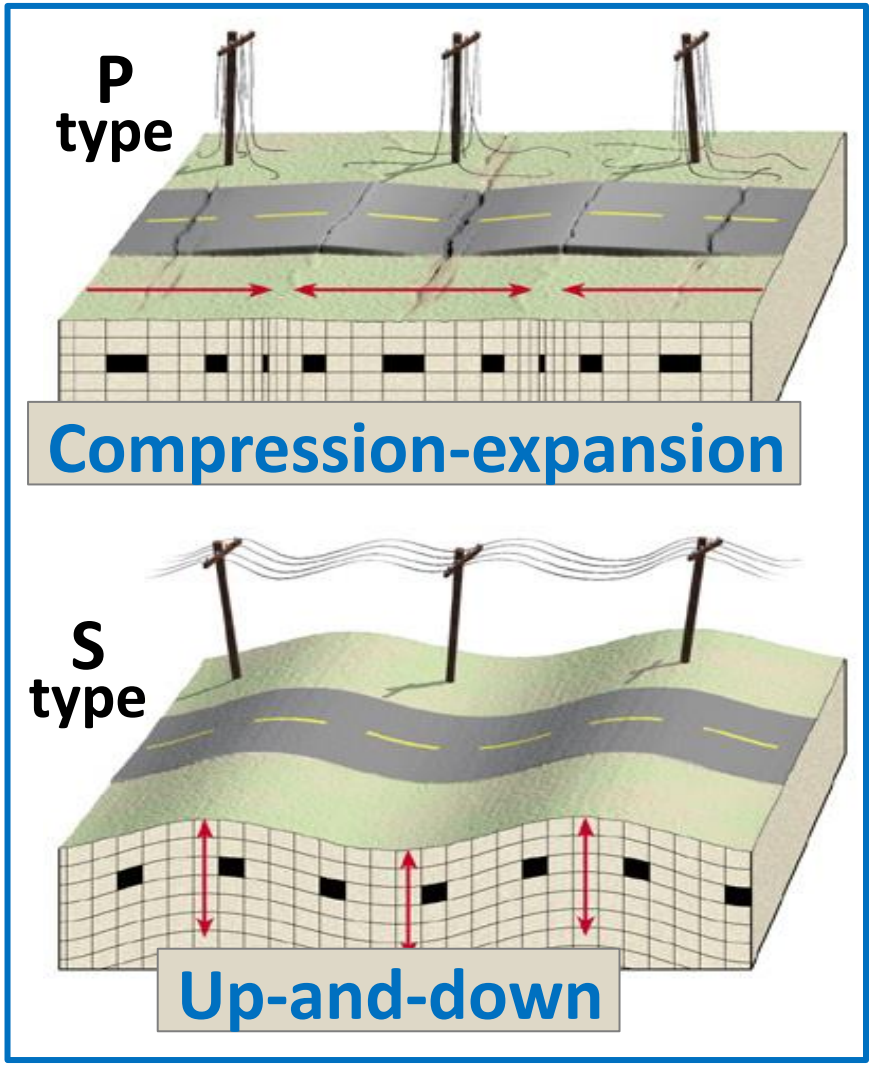
- **Energy is in the form of *waves* called seismic waves:**

1. **Body waves (*Primary* waves and *Secondary* waves) - travel fast through the Earth interior.**

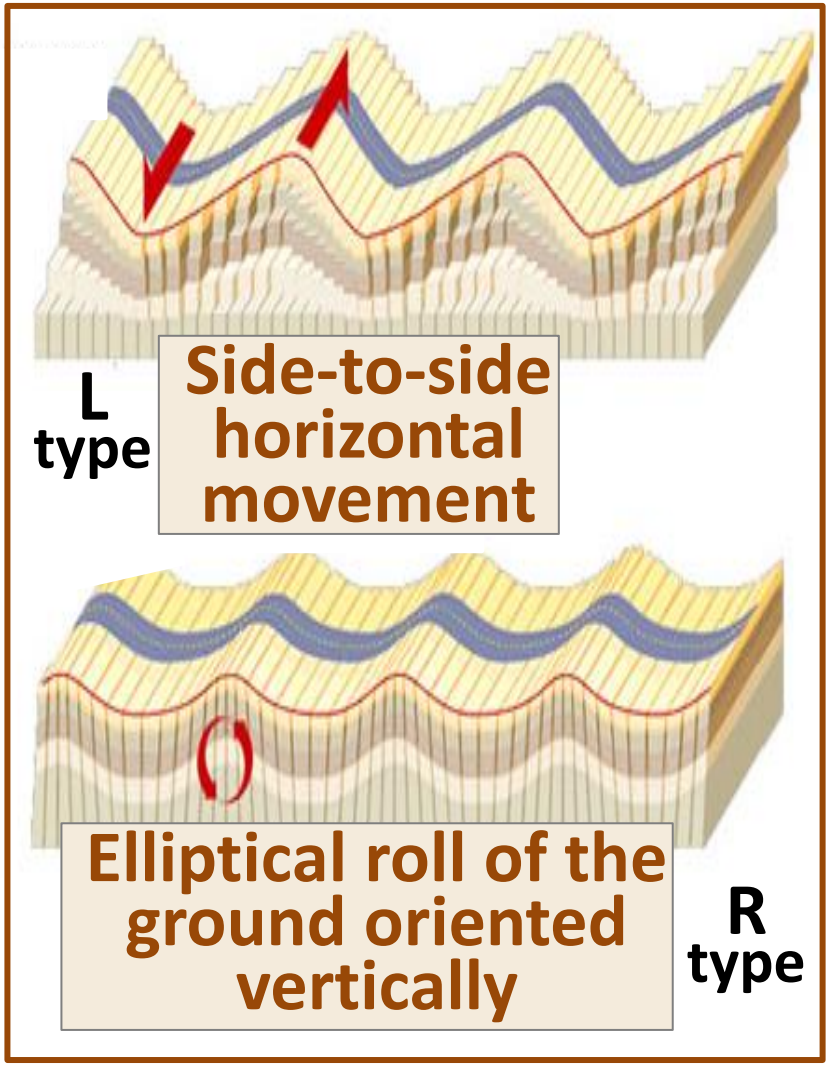
2. **Surface waves (*Love* waves and *Rayleigh* waves) - travel on the Earth surface; have lower frequency and travel more slowly than body waves - more destructive.**

Types of Seismic Waves

BODY WAVES

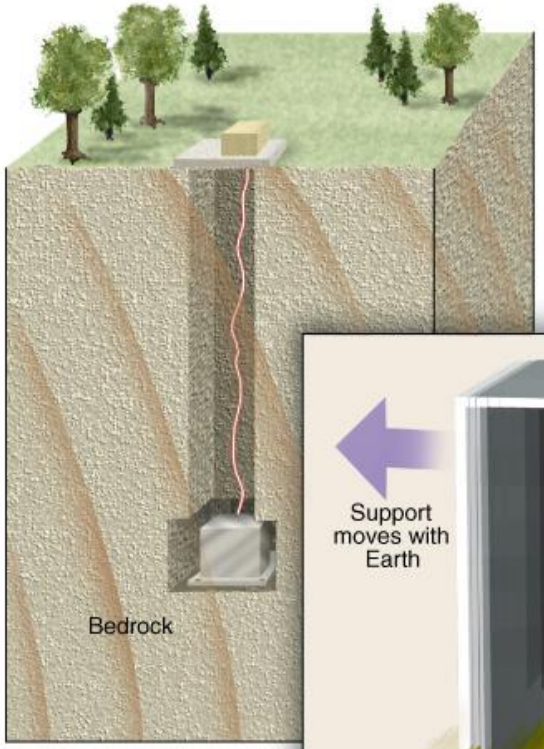


SURFACE WAVES



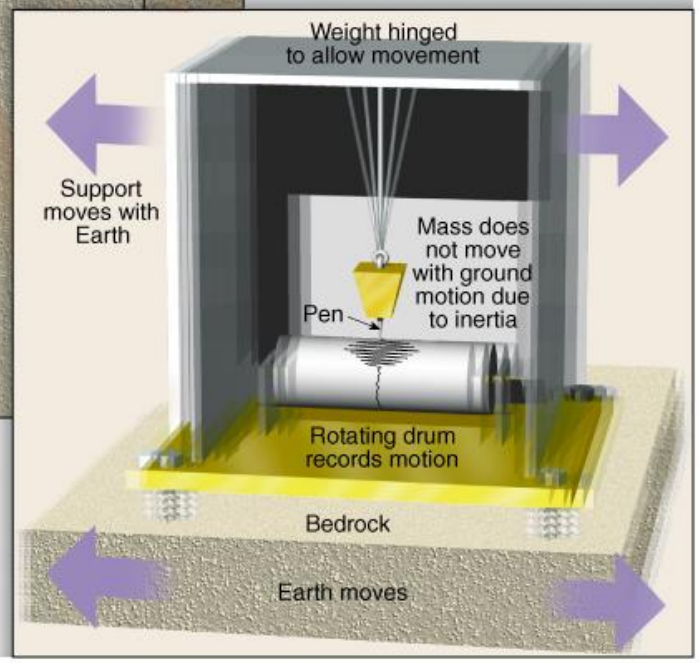
Measuring an Earthquake

Earthquakes are measured using observations from seismographs, instruments that record seismic waves.

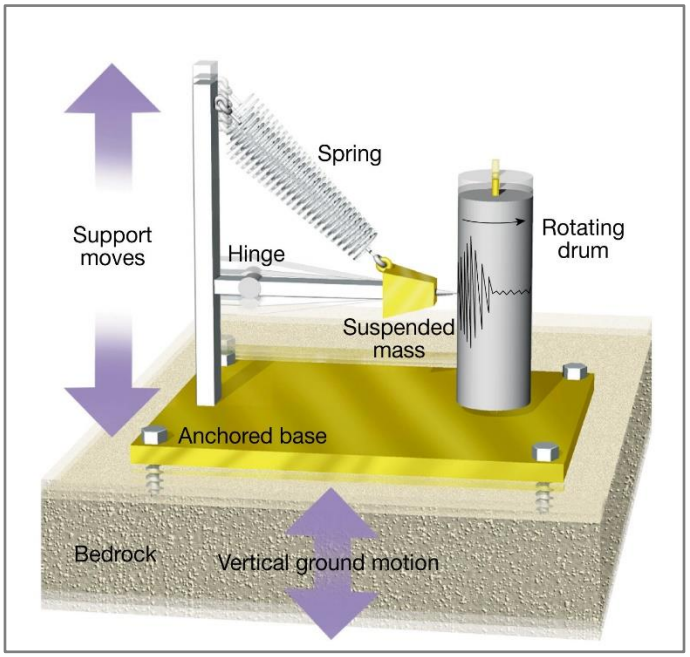


Different *seismograph types* are needed to record both <u>vertical</u> and <u>horizontal</u> ground motion:

Horizontal

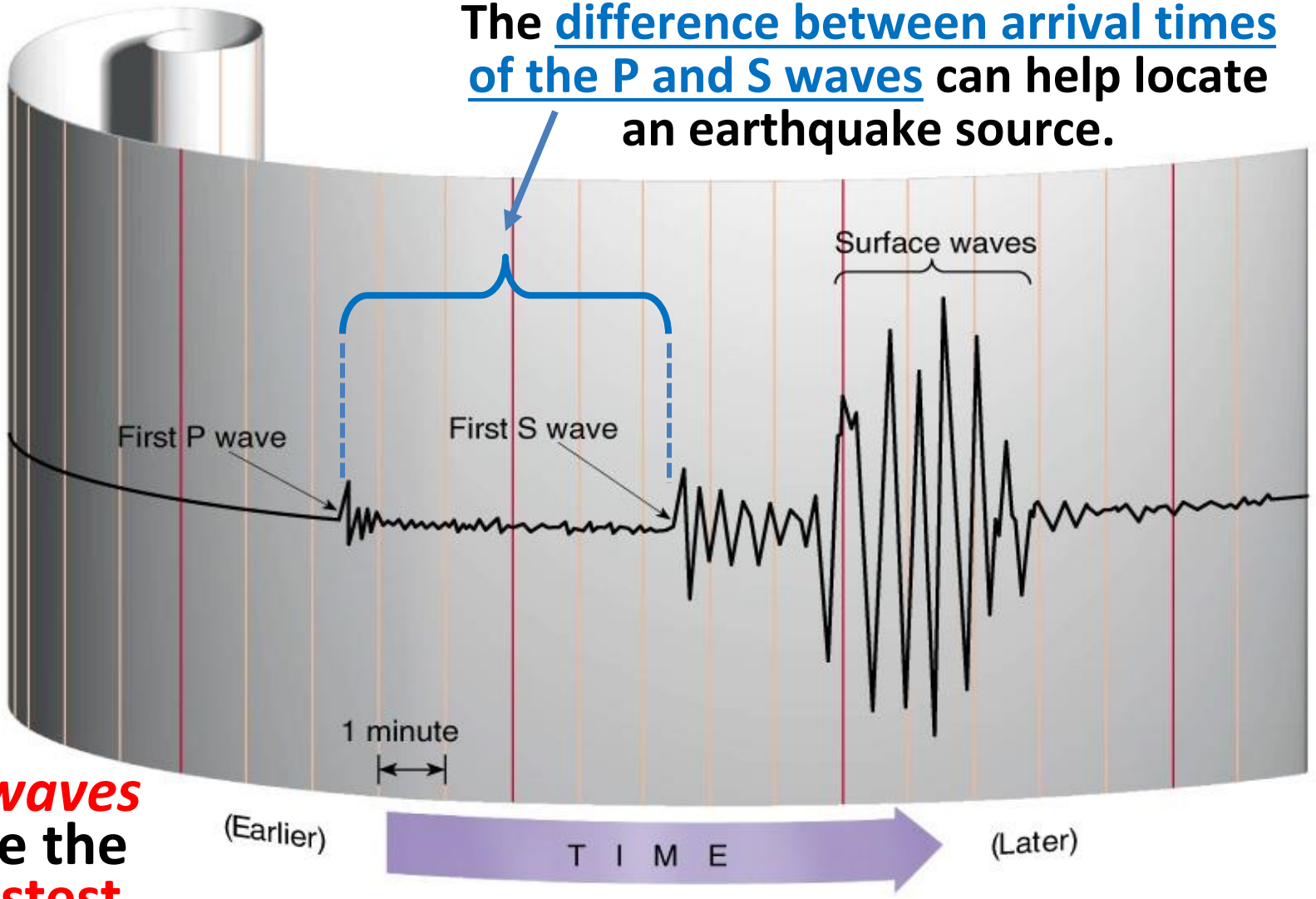


Vertical



Simplified Seismogram

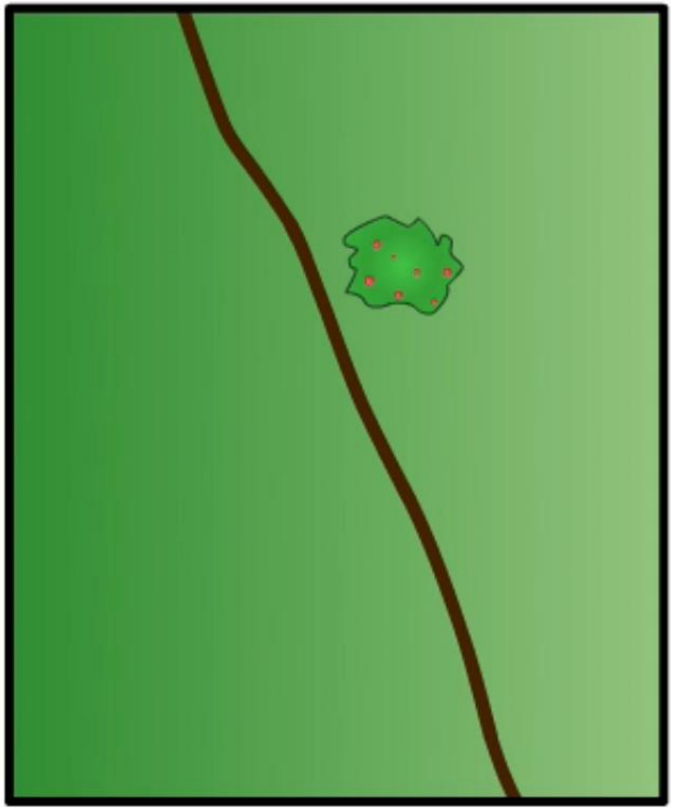
The difference between arrival times of the P and S waves can help locate an earthquake source.



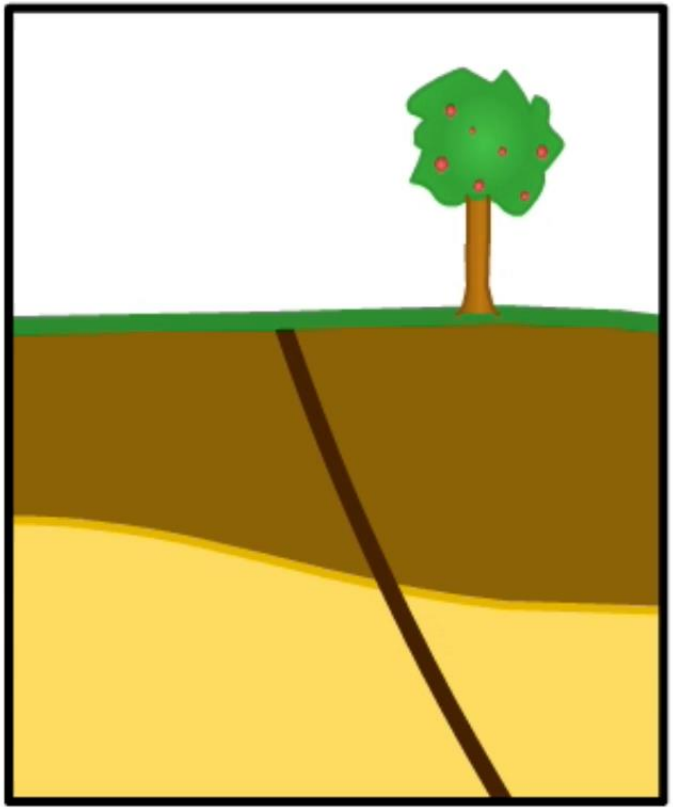
P waves **are the** **fastest**

Earthquakes often occur as a sequence rather than individual events

Foreshock Mainshock Aftershock

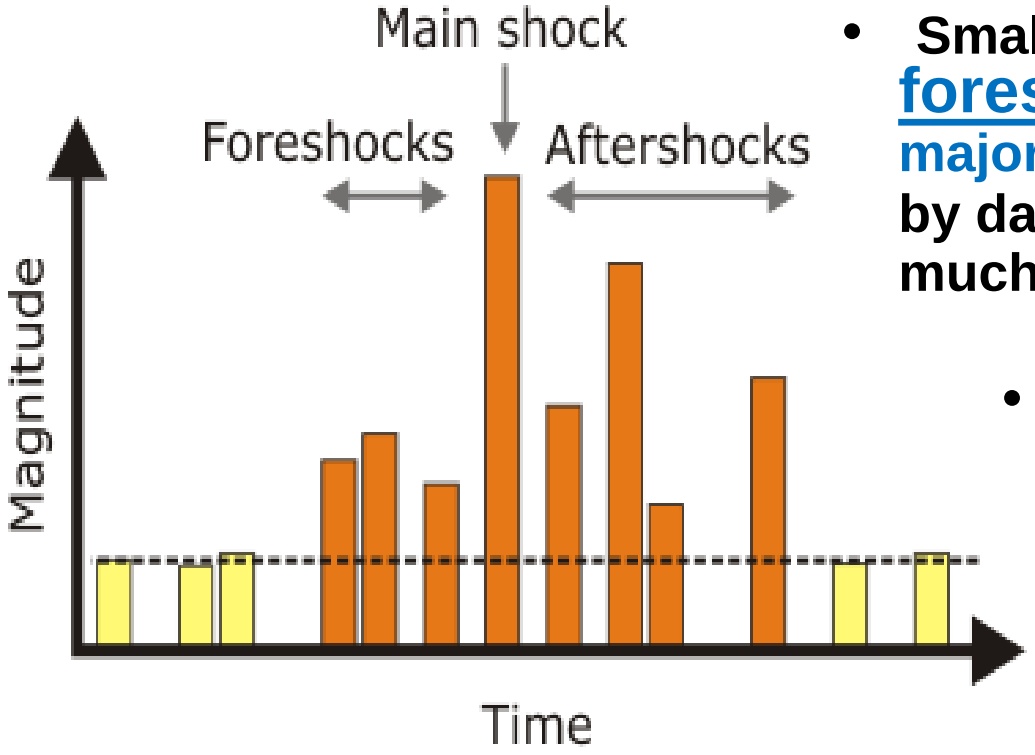


Map View



Cross-Section View

Foreshocks and Aftershocks



- **Small earthquakes, called foreshocks, often precede a major earthquake (main shock) by days or, in some cases, by as much as several years.**

- **Adjustments of crust (redistribution of stress on the fault) that follow a major earthquake often generate smaller quakes in the same area called aftershocks.**

- ***Bigger* earthquakes often have *more and larger* aftershocks and the sequences can last for years.**
- **Earthquake swarms are sequences of earthquakes striking in a specific area within a short period of time in which no single earthquake has notably higher magnitudes than the other.**