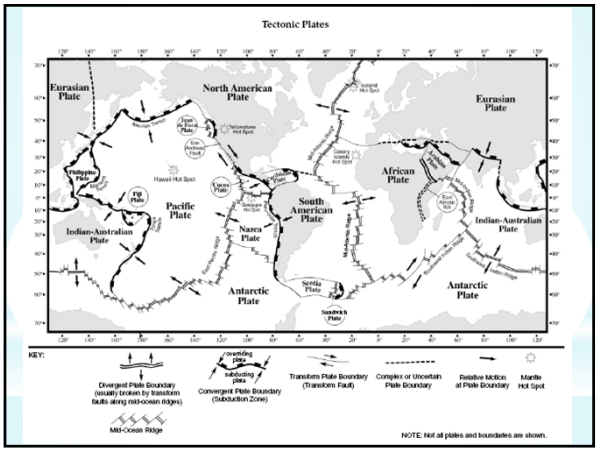
# Topic 12-3: Earthquakes

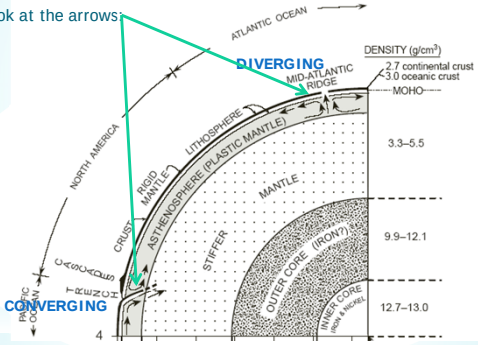
*NYS Lab on Earthquakes

## Earth's Dynamic Surface

- *Remember*:
- Earth's surface is constantly undergoing change.
- Earth's lithosphere is broken up into tectonic plates which "float" on the asthenosphere.
- **Convection currents** in the asthenosphere cause plates to move.

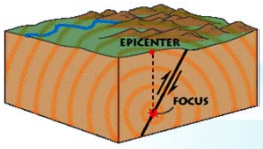


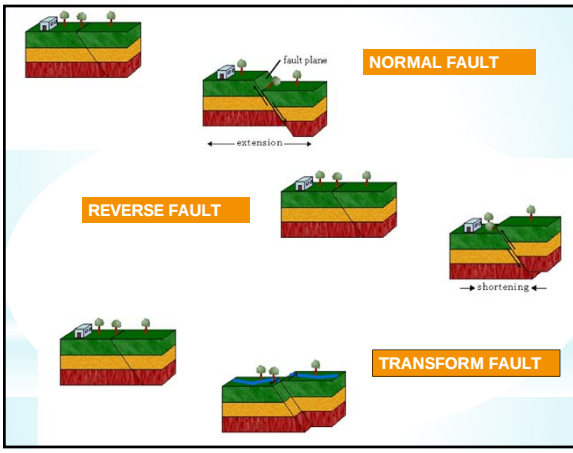

- Convection currents in the asthenosphere cause the plates to move in different directions.
- Look at the arrows:



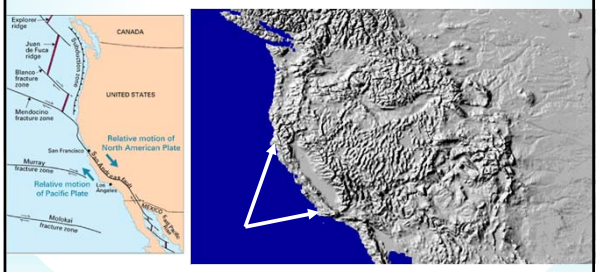

## Earthquakes

- Earthquakes occur along plate boundaries where two chunks of lithosphere scrape together.
- The **focus** is the location where the energy is released, where the earthquake begins.
- The **epicenter** is location on the earth's surface directly above the focus.
- **Faults** are cracks along which rocks slide.



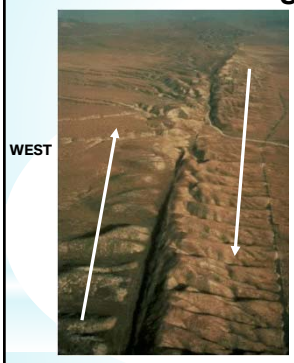



## San Andreas Fault (transform)




**FREQUENT EARTHQUAKES**

## SAN ANDREAS FAULT




**PACIFIC PLATE**

**WEST SIDE MOVES NORTH**

**NORTH AMERICAN PLATE**

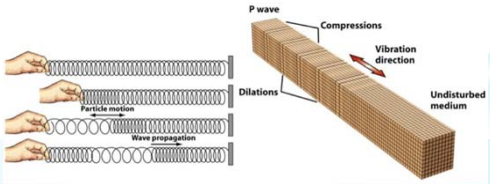
**EAST SIDE MOVES SOUTH**

## Seismic Waves

- During an earthquake, several types of waves are generated.
- The vibrations traveling through Earth are called **seismic waves.**

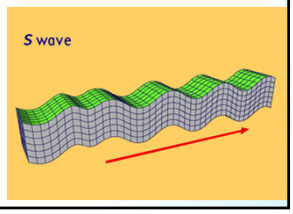
## P-Waves

- **Primary Wave** (**Compression** Wave)
- Travels **f**astest
- Arrives at a seismic stations **f**irst
- Passes through solids, liquids (magma), and gasses
- Push-pull wave: rock vibrates forward and backward in the same direction that the wave travels (like a slinky)




## S-Waves

- **Secondary Wave** (shear wave)
- Arrives at a seismic station second
- Slow wave (not as fast as the P-wave)
- **Solids** wave: Travels through **solids only**.
- Shake wave: vibrates side-to-side.

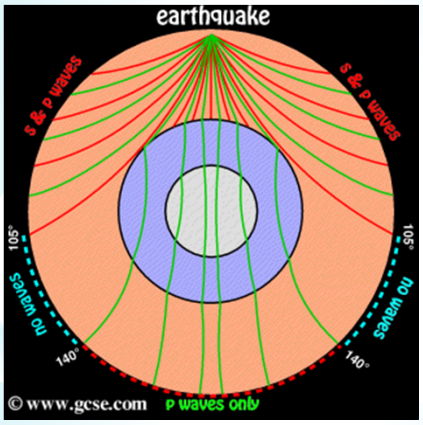



## Behavior Of Seismic Waves

- Velocity depends on the material they are passing through
- Increase density and pressure – increase velocity
- Waves are **refracted** or bent as they pass through material with different densities

## Earthquake Phenomenon: Shadow Zones

- Around the center of Earth (outer core), at an angle of 103°(11,000 km) from the epicenter, **both P and S waves disappear**.
- P-waves can again be detected at 142° (16,000 km).
- NO S-WAVES EVER APPEAR AGAIN
- This band of 39º, where no waves are detected is referred to as the **EARTHQUAKE'S SHADOW ZONE**



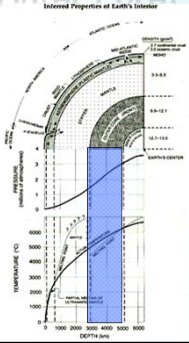

EARTHQUAKE SHADOW ZONES

P WAVES DISAPPEAR FROM 105º - 140º

S WAVES DISAPPEAR FROM 105º NEVER TO APPEAR AGAIN

## Why do S-Waves Disappear Once They Reach the Outer Core?

- S-Waves only travel through SOLIDS.
- If they cannot travel through the outer core, we can infer that it is liquid.
- S-Waves are stopped as they are absorbed by the liquid outer core.
- The P-waves are refracted (bent) as they change velocities in different density materials.
- This creates a zone in which no waves are picked up at all.

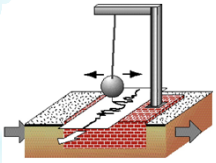


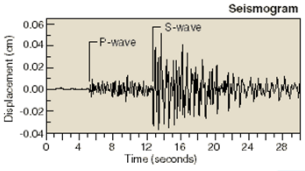
## Seismic Waves & Earth's Interior

- Analysis of seismic waves have resulted in inferences about Earth's interior.
  - (ESRT pg. 10)

## Measuring Earthquakes

- **Seismographs:** Instrument that detects and records seismic waves; produces a seismogram
- By studying a **seismogram**, we can determine a seismic wave's distance and size






## Locating The Epicenter Of An Earthquake

- The difference in travel time between P and S waves can be used to determine the DISTANCE from a station to the epicenter.
- The further a station is from the epicenter, the GREATER the time interval between the arrival of P and S waves.
- TO DETERMINE THE EXACT LOCATION OF AN EPICENTER, ITS DISTANCE FROM **3** STATIONS MUST BE DETERMINED AND 3 CIRCLES DRAWN.

**P WAVES TRAVEL FASTER THAN S WAVES**

## Seismic Travel-time Curve

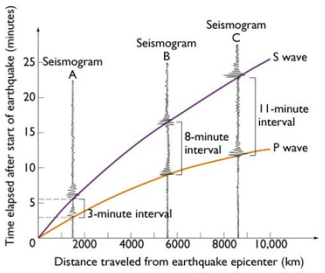
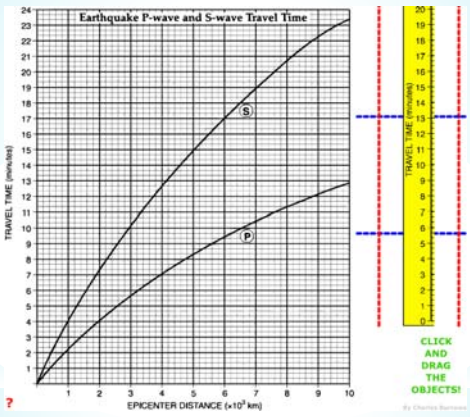
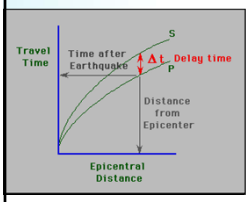



Fig. 18.9b

As distance from epicenter increases -the greater the time interval between P and S waves.




## * Locating Earthquake's Epicenter




**Locating the Epicenter**

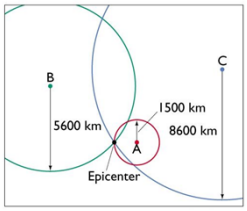



Fig. 18.9c

**Must have distance from 3 seismograph stations to determine epicenter!**

*This will be completed in your next lab.

## *Earthquake Summary

- *Most occur at transform fault boundaries.
- *P waves travel faster than S waves.
- *S waves can't move through liquid; that is why scientists theorize the outer core is liquid.
- *You must have 3 seismic stations to locate the epicenter of an earthquake.
- *You must be able to locate the epicenter for your Regents lab practical exam.