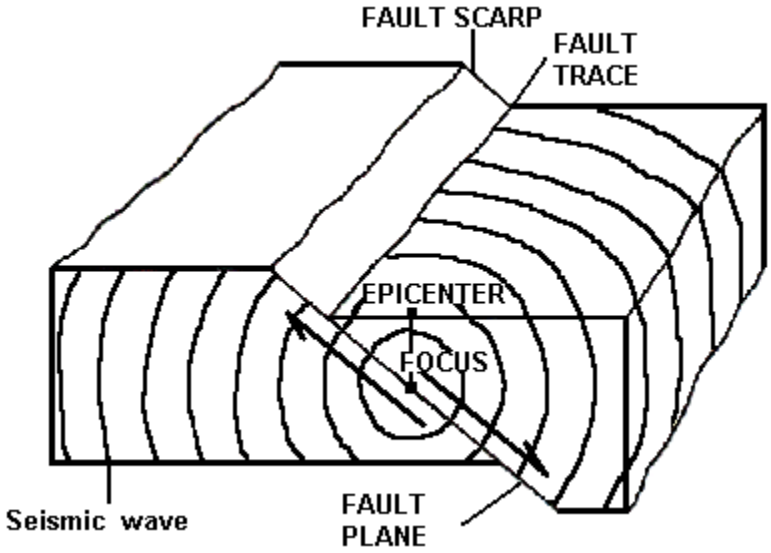
October 19, 2003

EARTHQUAKES

EARTHQUAKE is a sudden motion or trembling in the earth created by the slow accumulation energy in rocks. A rapid movement along a fault.
Every rock has a limit beyond which it cannot deform elastically (ELASTIC LIMIT).
Energy is converted to sudden motion when it snaps ===> rupture.... brittle fracture.
Sudden motion

LOCATION = focus

EPICENTER = surface directly above the focus.



SEISMIC WAVES

Energy is transmitted in the form of seismic waves. Seismic waves propagate by vibration of constituent rock particles.

TYPES OF SEISMIC WAVES

P-waves or **PRIMARY**. Compression and expansion in the direction of movement.

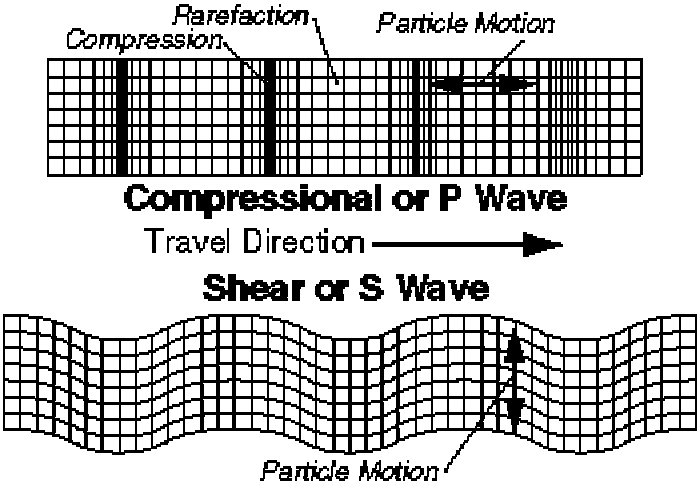
S-waves or **SHEAR.** Vibration perpendicular to the movement of direction.

October 19, 2003

TYPES OF SEISMIC WAVES

P-waves or **PRIMARY**. Compression and expansion in the direction of movement.

S-waves or **SHEAR.** Vibration perpendicular to the movement of direction.



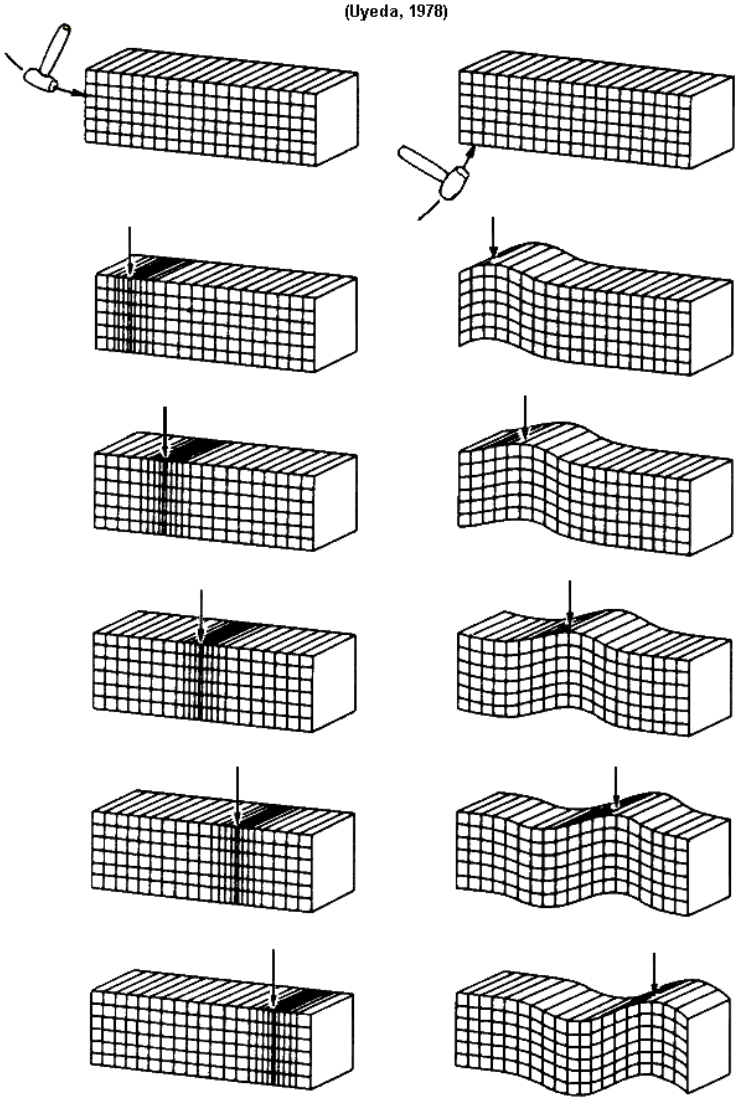
October 19, 2003

BODY WAVES

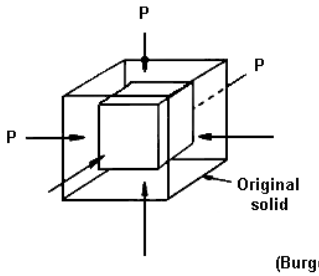
P-waves.
Longitudenal ground motion along the direction of travel.

S-waves.
Transverse vibration perpedicular to the direction of travel.

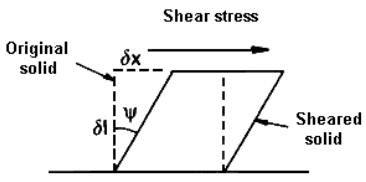
(Uyeda, 1978)



Deformation by change in volume due to compression



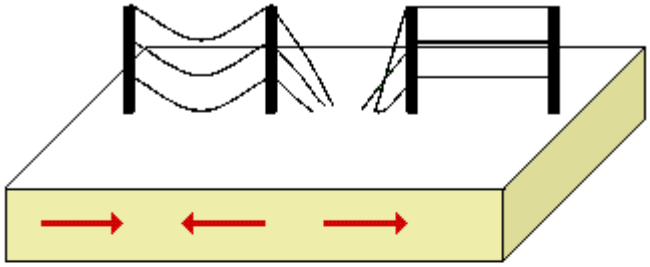
Deformation by change of shape due to shear strain with lower side fixed



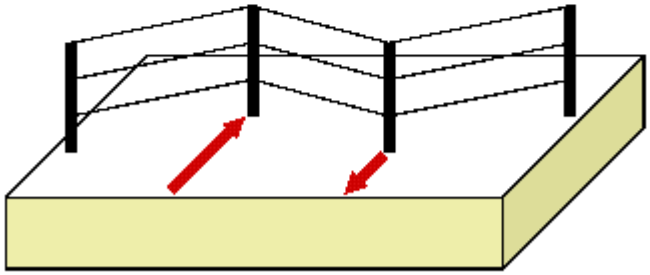
(Burger, 1992)

October 19, 2003

Seismic waves effects



P-waves



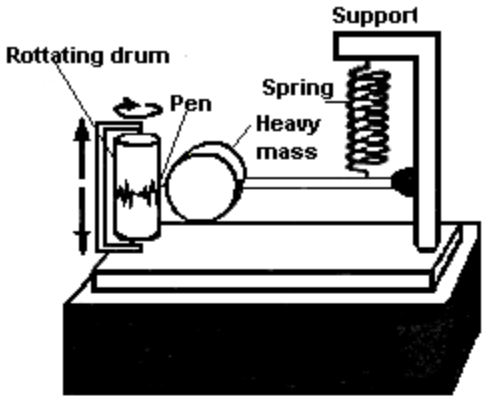
S-waves

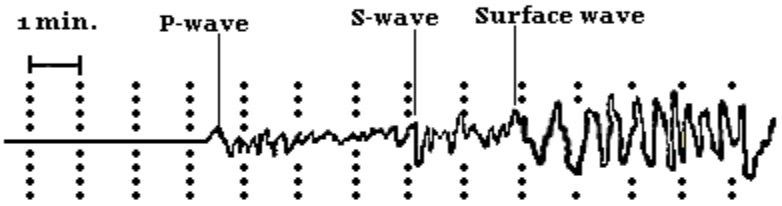
October 19, 2003

SPEED OF THE SEISMIC WAVES. Depends on the type of the wave, rock properties (rigidity density, compressibility)

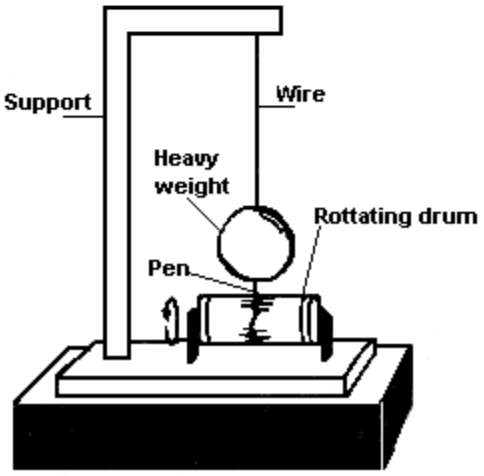
DENSER ROCKS are less compressible and more rigid = GREATEST VELOCITIES

S-waves travel slower than P-waves and cannot be transmitted through liquid.

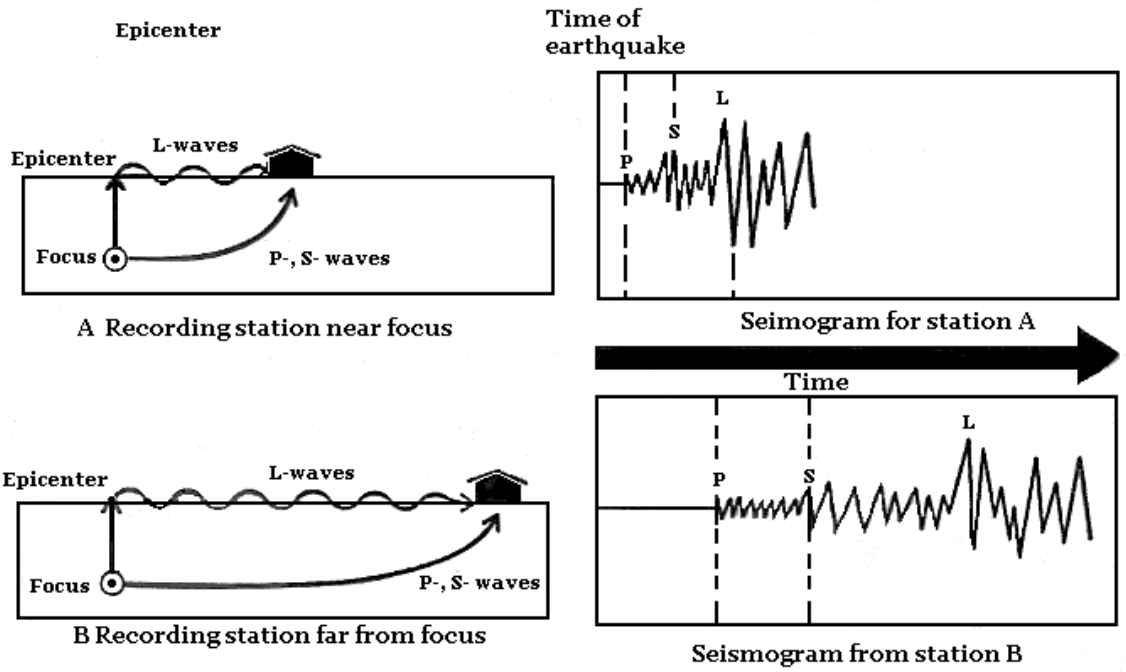




A seismograph record showing three waves (seismogram)



October 19, 2003

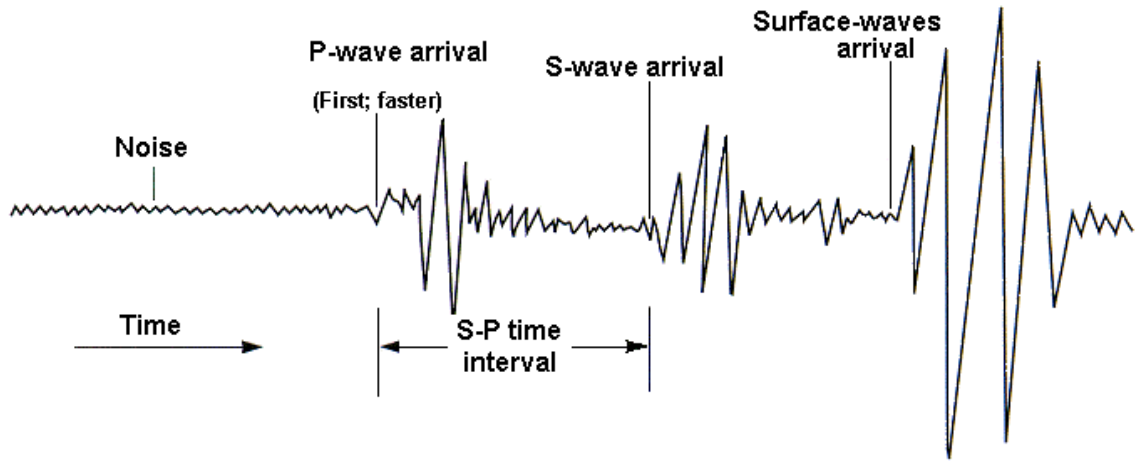


An earthquake generates two type of body waves:
P-waves arrive at a given location first, followed by S-waves.

The time intervals between arrivals of P-, S-, and L-waves at a recording station increase with distance from the focus of an earthquake.

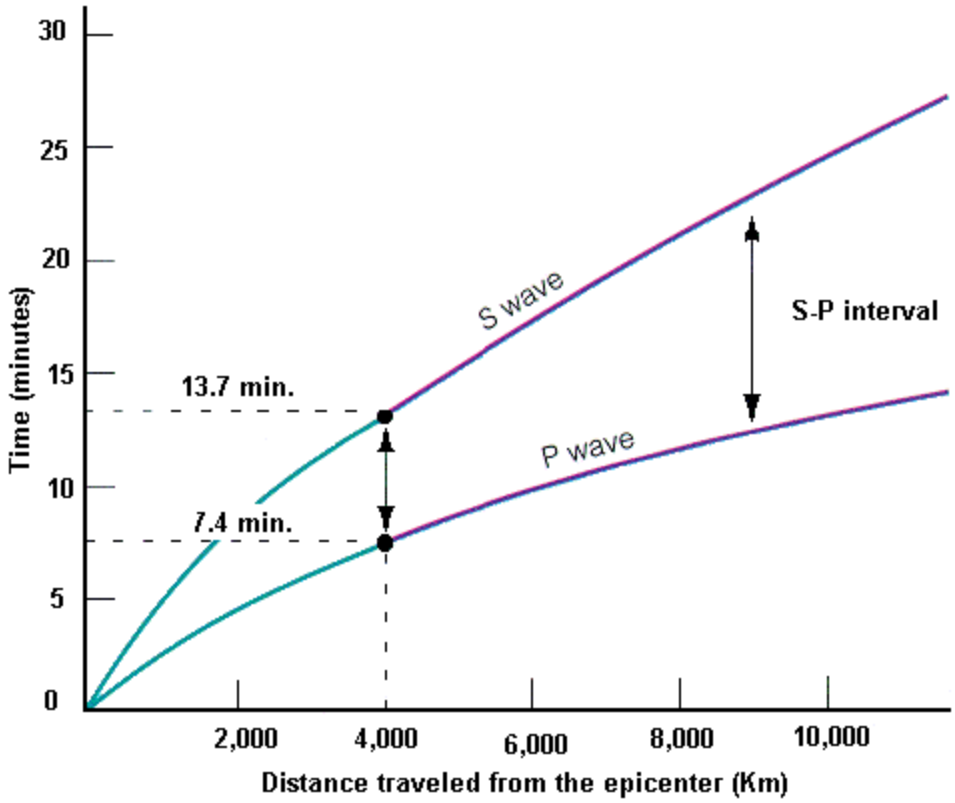
SEISMOGRAMS. Record vibrations. Measure seismic waves

P- S- seismic waves are generated simultaneously at the focus point (where the earthquake occurs). They arrive at distant seismographs at different times (They travel at different speeds).



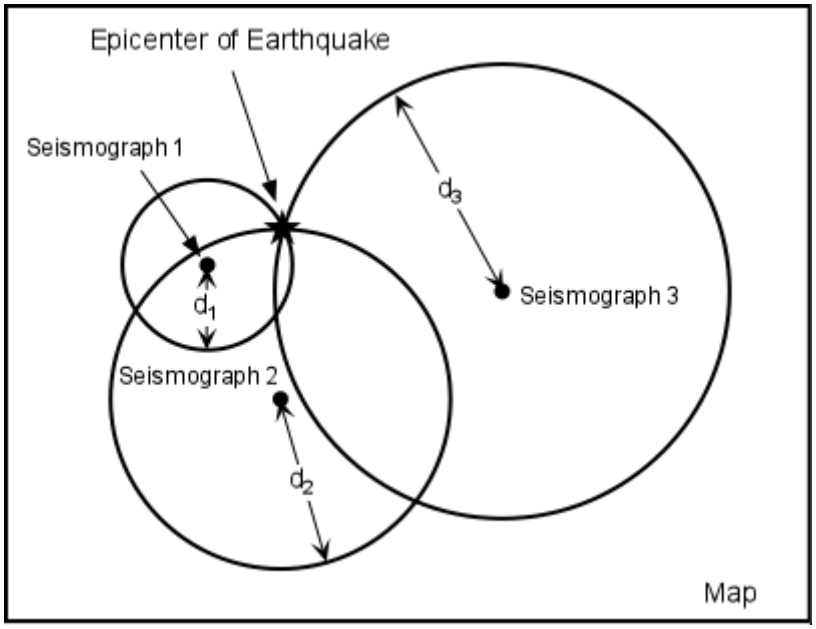
October 19, 2003

TIME TRAVEL CURVES. Are used to locate the epicenter of earthquakes, By using the difference in time of arrival of the P- and S- waves. They have been calculated by using natural and man-made earthquakes. All the different types of seismic waves can be identified according to their average time travel.



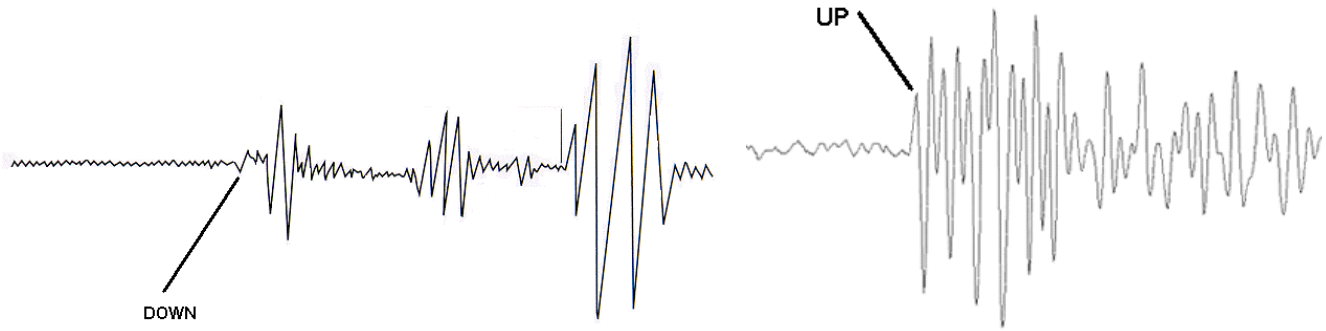
October 19, 2003

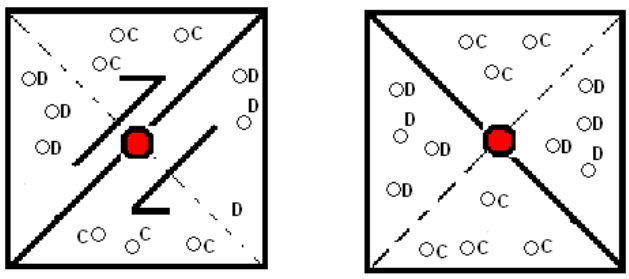
At least three stations are needed to localize an epicenter.
Intersection of various circles =====> gives the location of the epicenter



First motion.

Up = Compression
Down = Dilatation
Direction of movement: Away from D





ADD ARROWS INDICATING MOVEMENT

October 19, 2003

MAGNITUDE OF AN EARTHQUAKE.
RITCHER SCALE. Determined by measuring the amplitude of the largest wave recorded by a seismogram.

LOGARITHMIC SCALE. An increase of one unit on the scale represents a 10-fold increase in the amplitude of a recorded earthquake wave
Magnitude 7 = 30 times greater than 6 and 900 times greater than 5

6.5 10^{21} ergs = atomic bomb in Hiroshima