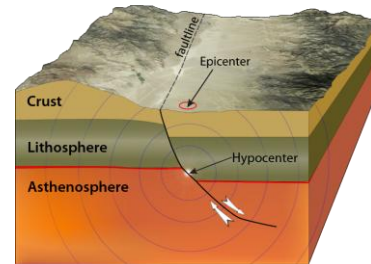


Earthquakes and seismology

GS106

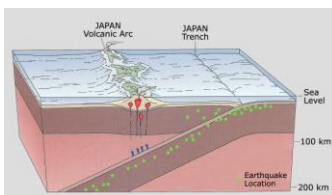
Epicenter & Focus of Earthquakes

Epicenter—Location directly above EQ on Earth's surface.



Focus:
or hypocenter; point within Earth where the EQ occurred.

Why are there earthquakes? Brittle vs. ductile

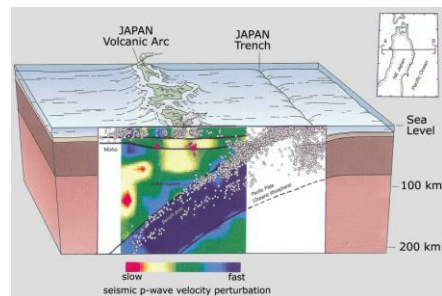


Example:

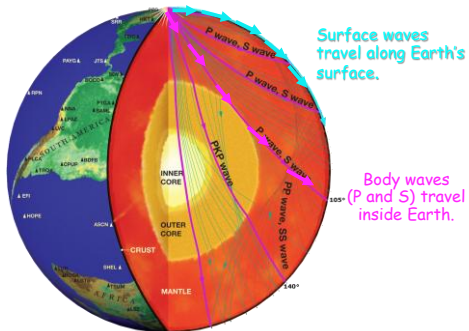
Subduction-zone earthquakes occur in discrete areas on and between plates.

Why?

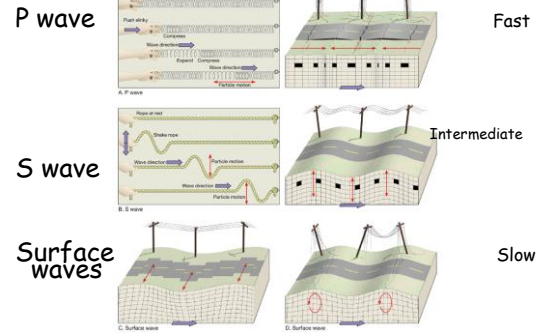
Why are there earthquakes? Brittle vs. ductile



Seismic Waves: Body Waves and Surface Waves

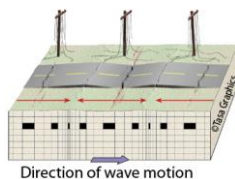
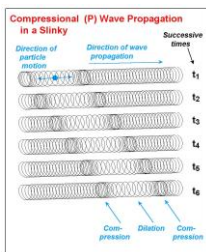


Types of seismic waves



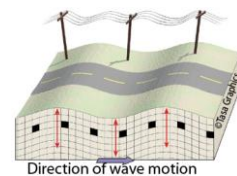
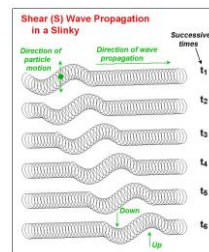
Body waves

P waves are compressional



Body waves

S waves are shear waves

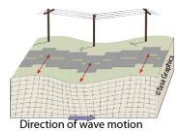
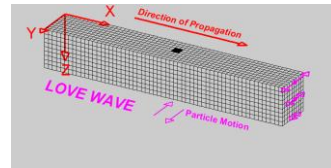
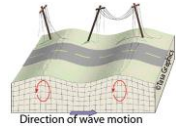
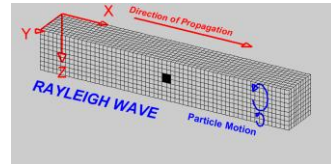


Activity

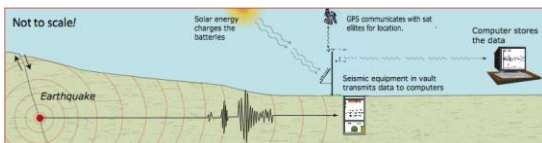
Modeling seismic waves in the classroom

Surface waves

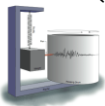
Rayleigh & Love Waves



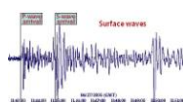
How do scientists detect earthquakes?



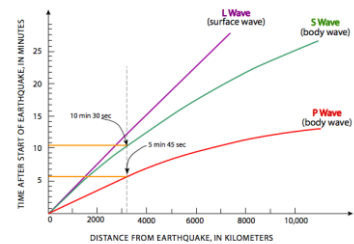
A seismograph detects and records EQs.



A seismogram is the EQ record.



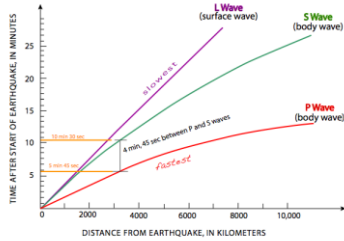
How far away was the earthquake?



Calculate S-arrival time minus P-arrival time using this graph of travel-time curves.

ACTIVITY:

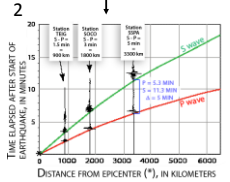
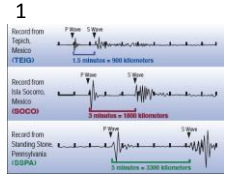
Graph of travel-time curves



How can you use this information to locate an earthquake?

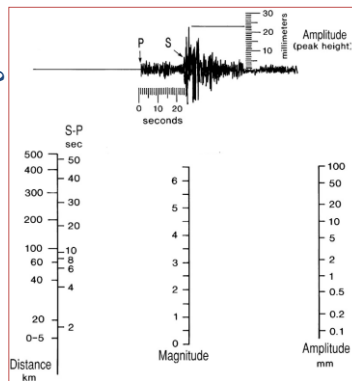
Locating an Earthquake

- 1) Determine distance of EQ (from S and P waves)
- 2) Plot them on the travel-time graph.
- 3) Intersection of the circles gives the location.



How big was it? The Richter Scale

What is the Richter magnitude of this EQ?



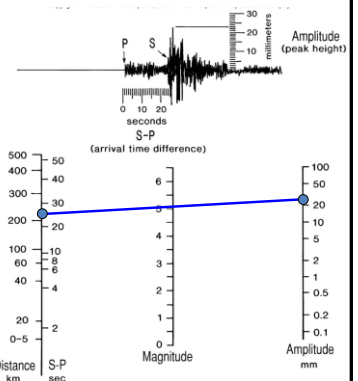
How big was it? The Richter Scale

What is the Richter magnitude of this EQ?

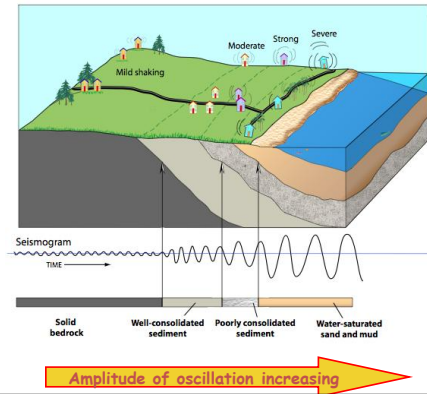
$$S - P = 26 \text{ sec}$$

$$\text{Amplitude} = 23 \text{ mm}$$

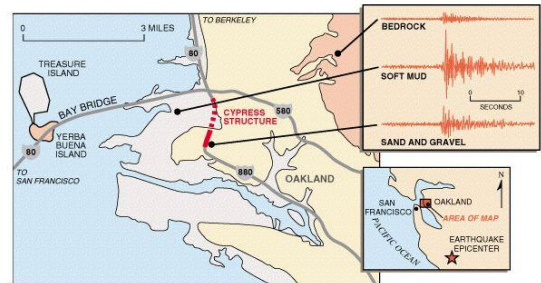
$$\text{Magnitude} = 5$$



Seismic intensity is affected by rock type.



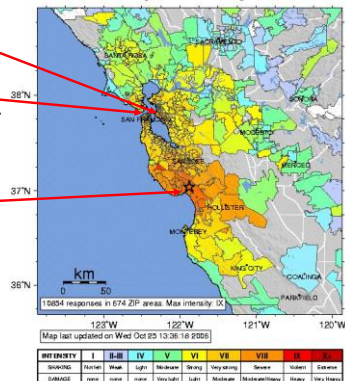
Amplification of Ground Motion



Damage from Loma Prieta EQ 1989

West of Oakland.
Marina District
of San Francisco.

Santa Cruz.



Liquefaction experiment

What happens to a structure built on a weak foundation when an earthquake strikes?



Niigata, Japan 1964
Source: National Geophysical Data Center

Discussion: Why is building damage selective?



Building design:

If the resonant frequency of a building is equal to the frequency of ground oscillation, then damage or collapse is likely.

What is resonant frequency?

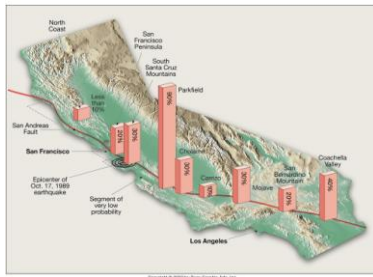
Building design



Resistance to shear is critical.

Earthquake prediction eludes us.

EQ forecasting
is more realistic
and perhaps
more useful.



What is the difference?