
EARTHQUAKE

INTRODUCTION

- Earthquake also known as quake , tremor or temblor is the phenomenon where there is a sudden **release of extreme energy** from the earth crust resulting in shaking and displacement of the ground along with the creation of **sesmic waves.**

- If the Epicenter of a larger earthquake is situated in the offsore (sea/ocean) seabed may be displaced sufficiently to cause **Tsunami.**

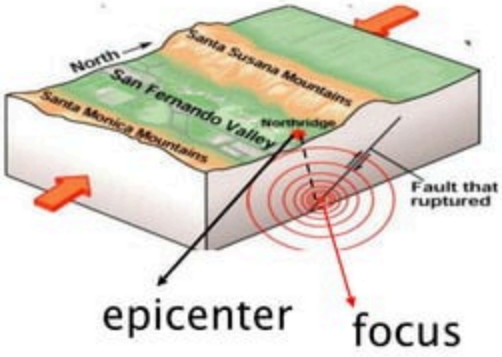
- It also triggers land slides and occassionally volcanic eruptions.

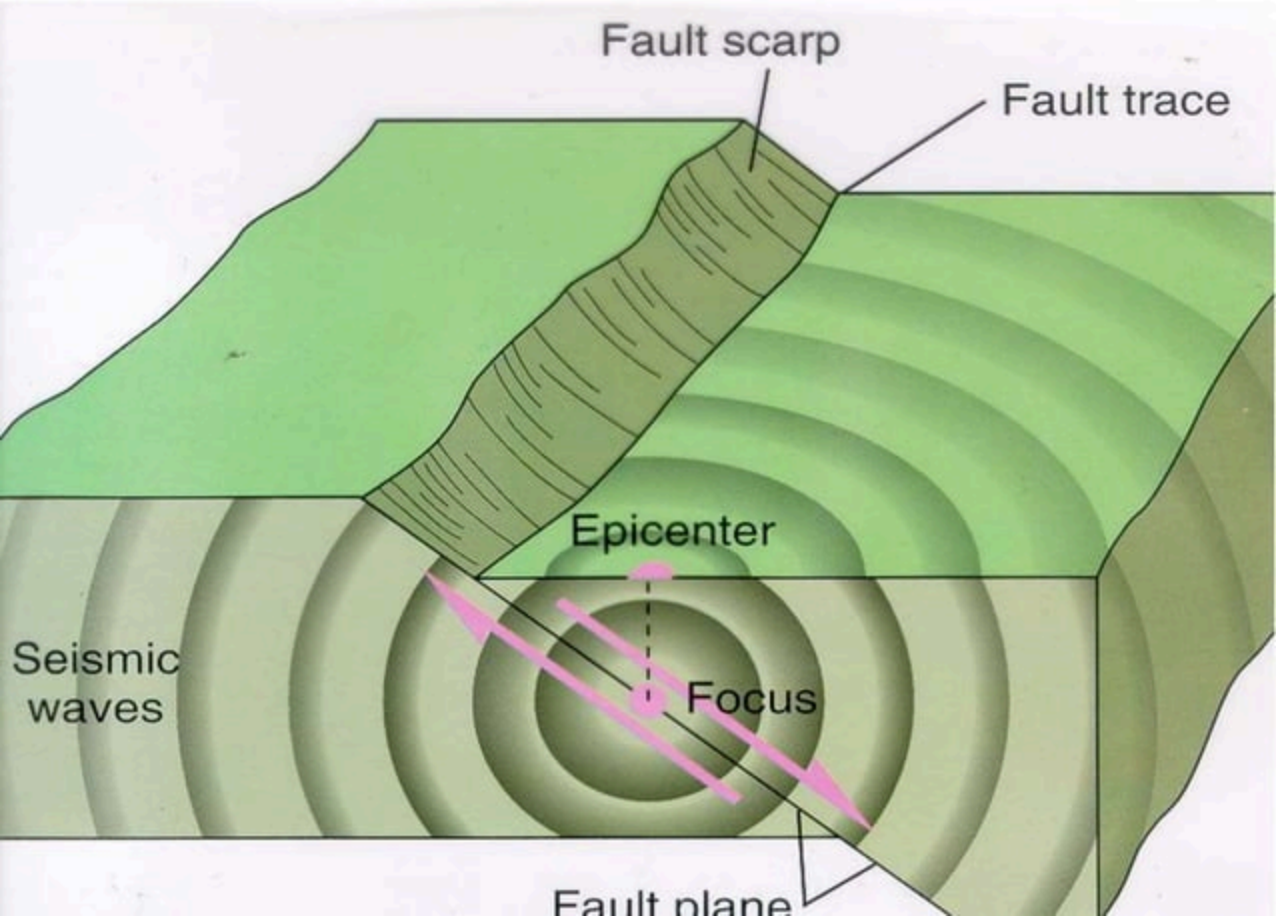
Contd.....

- Earthquake shaking may cause loss of life and destruction of property.
- In a strong earthquake the ground shakes violently.
- Buildings may fall or sink into the soil. Rocks and soil may move downhill at a rapid rate.
- Such landslides can bury houses and people.

Definitions

- Earthquake = Vibration of the Earth produced by the rapid release of energy
- Seismic waves = Energy moving outward from the focus of an earthquake
- Focus= location of initial slip on the fault; where the earthquake origins
- Epicenter= spot on Earth's surface directly above the focus




Fault scarp
Fault trace
Epicenter
Seismic waves
Focus
Fault plane

Why do Earthquakes Occur???

- Geological Faults.
- Volcanic Eruptions.
- Mine Blasts.
- Nuclear Tests.

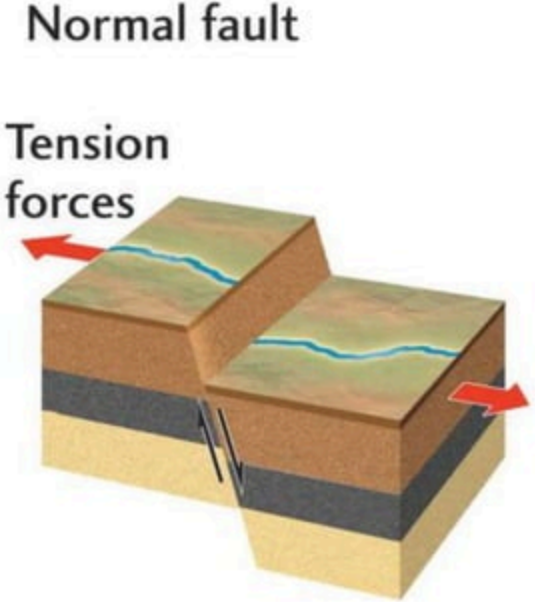
Geological Faults

- A fault is a planar fracture or discontinuity in a volume of rock, across which there has been significant displacement.

- There are three main types of faults, namely
  a) Normal Fault.
  b)Thrust Fault.
  c)Strike Slip Fault.

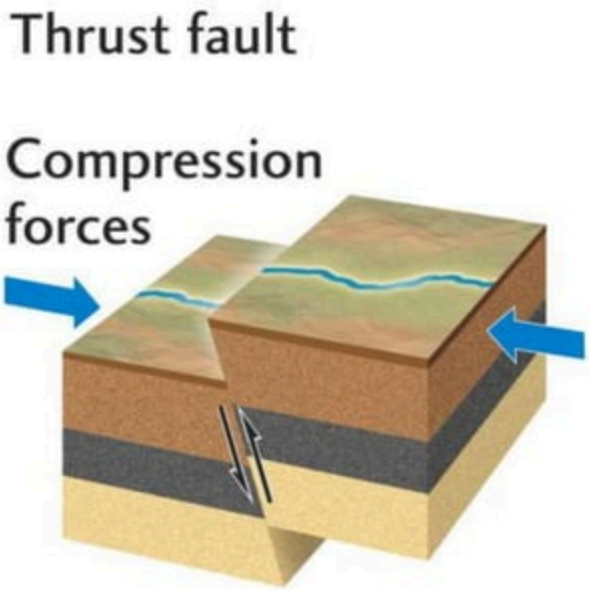
Normal Fault

- A normal fault occurs when the crust is extended. The hanging wall moves downward relative to the footwall



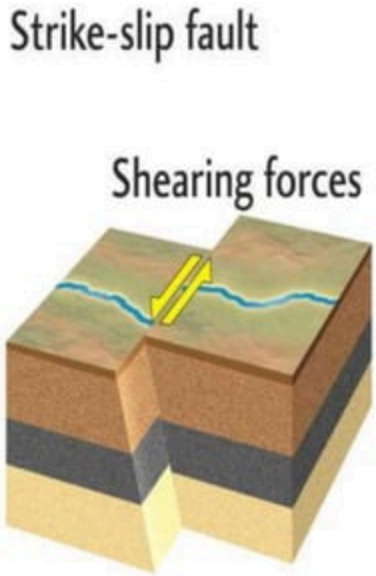
Thrust Fault

- A thrust fault occurs when the crust is compressed. The hanging wall moves upward relative to the footwall

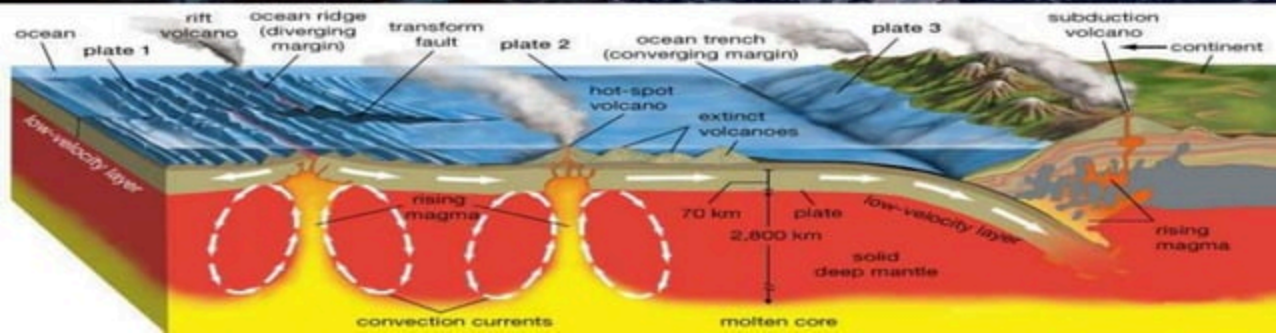


Strike Slip Fault

- The fault surface is usually near vertical and motion results from shearing forces



VOLCANOES


ocean
plate 1
rift volcano
ocean ridge (diverging margin)
transform fault
plate 2
ocean trench (converging margin)
plate 3
subduction volcano
continent
hot-spot volcano
extinct volcanoes
low-velocity layer
rising magma
70 km
plate
2,800 km
solid deep mantle
low-velocity layer
rising magma
convection currents
molten core

Classification of Earthquakes.

- **Based on Magnitude**:

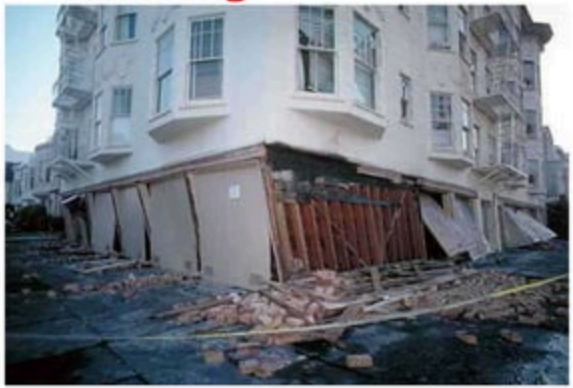
MAGNITUDE	CLASSIFICATION
$M \geq 8.0$	Great Earthquake
$7.0 \geq M < 8.0$	Major / Large Earthquake
$5.0 \geq M < 7.0$	Moderate Earthquake
$3.0 \geq M < 5.0$	Small Earthquake
$1.0 \geq M < 3.0$	Microearthquake
$M < 1.0$	Ultra Microearthquake

Based on Distance

CLASSIFICATION	DISTANCE
Teleseismic Earthquake	> 1000 km
Regional Earthquake	> 500 km
Local Earthquake	< 500 km

Effects of Earthquakes

Primary Earthquake Hazards: Rapid Ground Shaking



Structural Damage

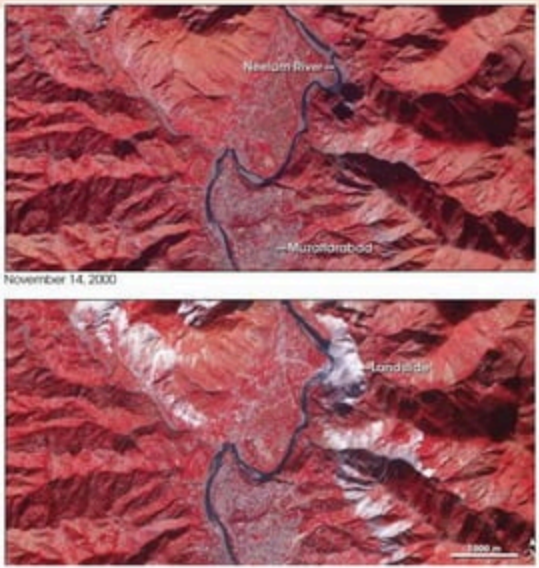
Buckled roads and rail tracks

Secondary Earthquake Hazards:

Landslides

Avalanches

Secondary Earthquake Hazards:



Alterations to Water Courses

Fire resulting from an earthquake

Tsunamis

Seismic sea waves; "tidal" waves - can grow up to 65 m.

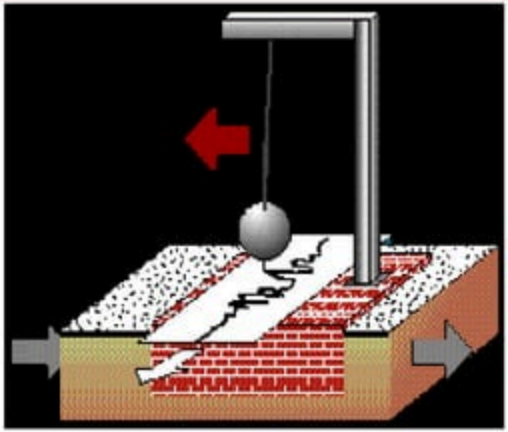
Chedi Resort in Phuket, Thailand

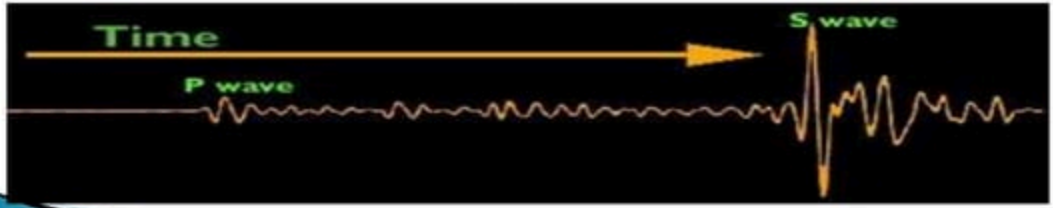
Hide 2004 Indian Ocean Tsunami & Damage

Tsunami inundating the Chedi Resort in Phuket, Thailand on December 26, 2004 (JOANNE DAVIS/AFP/Getty Images)

Measuring earthquakes

- Seismometers: instruments that detect seismic waves.
- Seismographs: Record intensity, height and amplitude of seismic waves





Measuring the Size of Earthquake.

1. **Magnitude**: **Richter Scale**
   a) Measures the energy released by fault movement.

   b) Logarithmic-scale; **quantitative** measure.

Measuring the Size of Earthquake.

2) Intensity: Mercalli Scale:

What did you feel?

- Assigns an intensity or rating to measure an earthquake at a particular location (**qualitative)**
- Measures the destructive effect

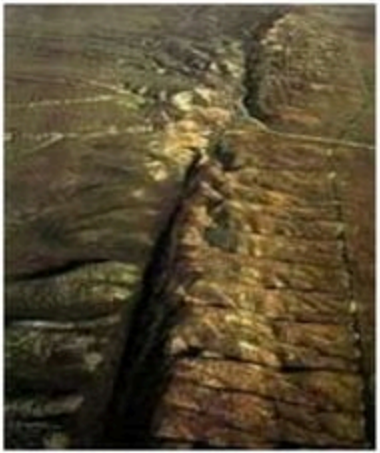
❖ **Intensity is a function of**:

- Energy released by fault
- Geology of the location
- Surface substrate: can magnify shock waves

Earthquake Monitoring:

- Identification of Faultlines:

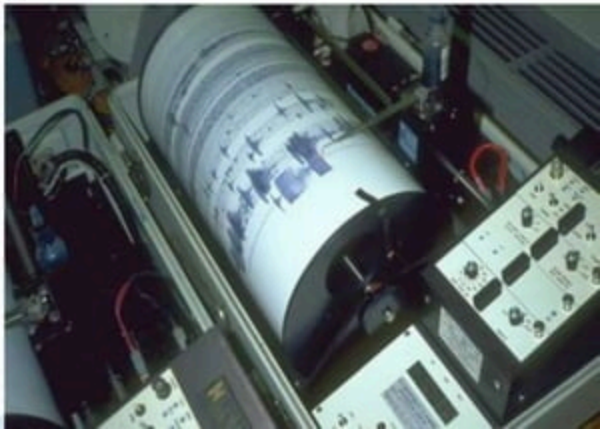
New Madrid, Tennessee



San Andreas Faultline

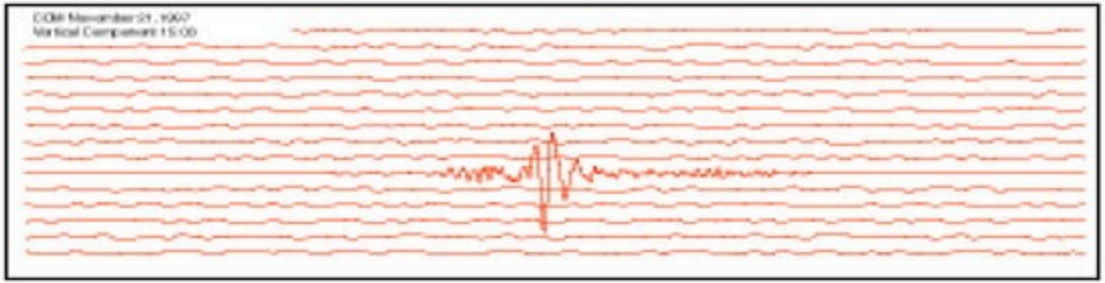
Earthquake Monitoring

- Remote Seismograph Positioning.
  - Scientists consider seismic activity as it is registered on a seismometer.
  - A volcano will usually register some small earthquakes as the magma pushes its way up through cracks and vents in rocks.
  - As a volcano gets closer to erupting, the pressure builds up in the earth under the volcano and the earthquake activity becomes more and more frequent

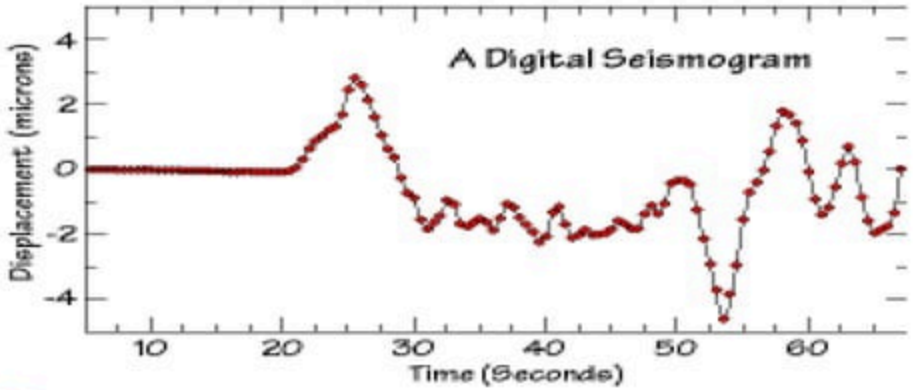


Earthquake Monitoring

- **Analog Image:**
  - This is an image of an analog recording of an earthquake. The relatively flat lines are periods of quiescence and the large and squiggly line is an earthquake.



- **Digital Seismogram.**
  - Below is a digital seismogram. The data is stored electronically, easy to access and manipulate, and much more accurate and detailed than the analog recordings.



Earthquake Monitoring:

- Tiltmeter:
  - Tilt meters attached to the sides of a volcano detect small changes in the slope of a volcano.
  - When a volcano is about to erupt, the earth may bulge or swell up a bit.

Installing a tiltmeter

Earthquake Monitoring:

- **Changes in Groundwater Levels.**
  - Hydro geological responses to large distant earthquakes have important scientific implications with regard to our earth's intricate plumbing system.
  - Improves our insights into the responsible mechanisms, and may improve our frustratingly imprecise ability to forecast the timing, magnitude, and impact of earthquakes.

Earthquake Monitoring:

- **Observations of Strange Behaviors in Animals.**

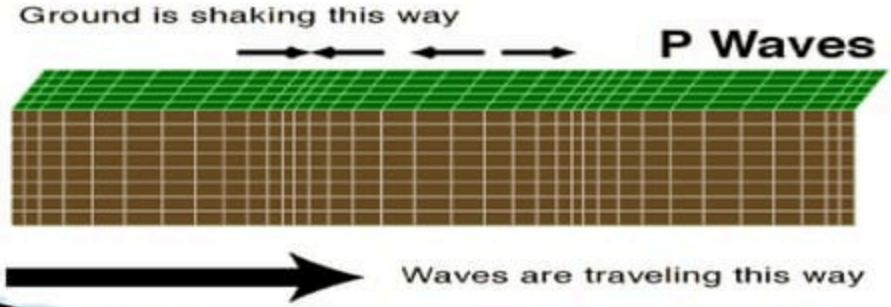
The cause of unusual animal behavior seconds before humans feel an earthquake can be easily explain-ed.

- Very few humans notice the smaller P wave that travels the fastest from the earthquake source and arrives before the larger S wave.
- But many animals with more keen senses are able to feel the P wave seconds before the S wave arrives.

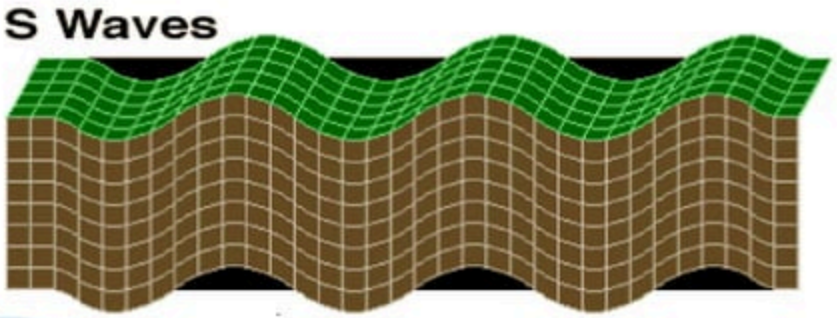
indeed it's possible that some animals could sense these signals and connect the perception with an impending earthquake.

Seismic Waves

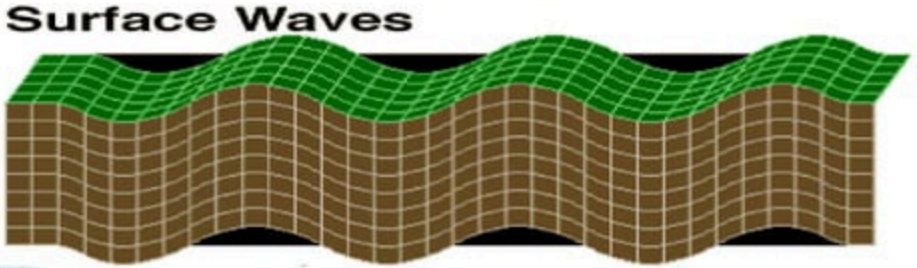
- **Primary Waves**:
  - called compressional, or push-pull waves.
  - Propagate parralel to the direction in which the wave is moving.
  - Move through solids, liquids



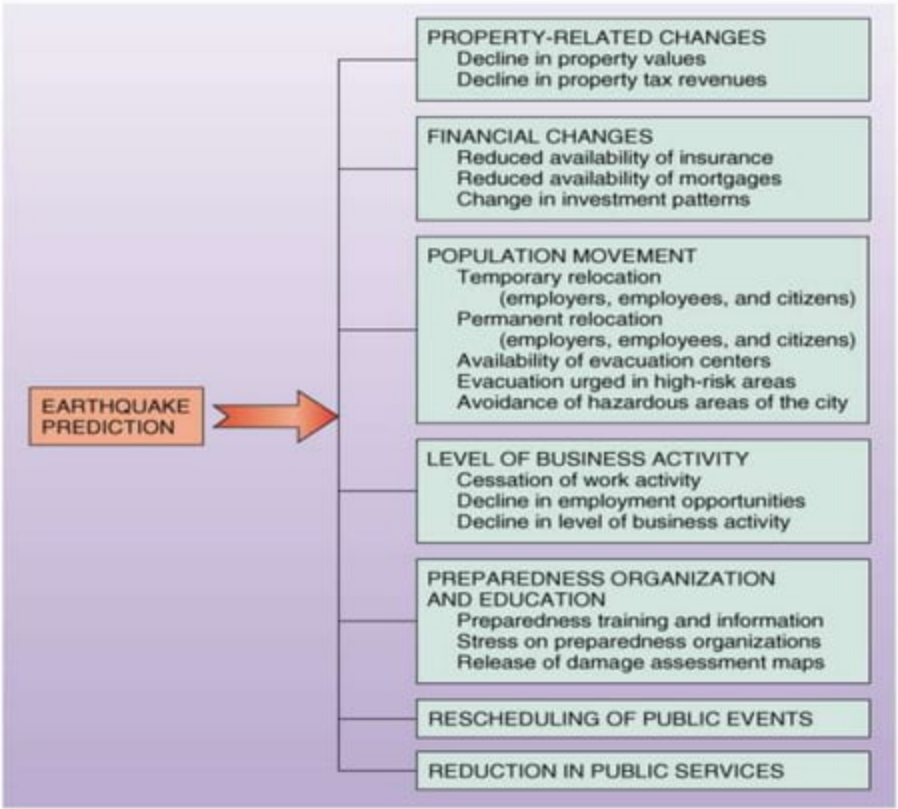
- **Secondary Waves (S);**
  - Called shear waves.
  - Propagate the movement perpendicular to the direction in which the wave is moving.



- **Surface Waves:**
  - Complex motion.
  - Up-and-down and side-to-side.
  - Slowest.
  - Most damage to structures, buildings.



Impacts of Earthquake Prediction



India, Gujarat earthquake Jan 26, 2001


THANK YOU