Earthquake

Prepared by

Asst.prof.Mamata Rajgor

Introduction

• Earthquakes constitute one of the worst natural hazards which often turn into disaster causing widespread destruction and loss to human life.

• The effects of earthquake vary upon the magnitude and intensity. Earthquakes occur every now and then all round the world, except in some places where earthquakes occur rarely. The devastation of cities and towns is one of the effects of earthquake.

Earthquake is the result of a sudden release of energy in the earth's crust that creates seismic waves.

- The seismic activity of an area refers to the frequency, type and size of earthquakes experienced over a period of time

For example:

If you throw stone in a pond of still water,series of waves are produced on the surface of water,these waves spread out in all directions from the point where the stone strikes the water.

similarly, any sudden disurbances in the earth's crust may produce vibration in the crust which travel in all direction from point of disturbances.

Introduction

- Most unpredictable and highly destructive
- Earthquake that are of tectonic origin have proved to be the most devastating and their area of influences is also quite large.
- The earthquakes associated with volcanic eruption , rock fall , landslides, subsidence , particularly in the mining areas, impounding of dams and reservoirs etc. have limited area of influence and the scale of damage.

Reasons

- Excessive accumulation of energy between into Australian and Eurasian plate results in building up of stress.
- Release of energy leads to tremors ,leading earthquake.

Earthquake

- Some of the most vulnerable union territories /states are Jammu and Kashmir ,Ladakh,Himachal Pradesh ,uttrakhand,Sikkim,and the Darjeeling subdivision of west bangal ,and all the sevens states of the northeast.
- Apart from these regions ,the central western pars of India ,particularly Gujarat (1819,1956,and 2001)and Maharashtra (1967 and 1993)have also experienced some severe earthquakes.

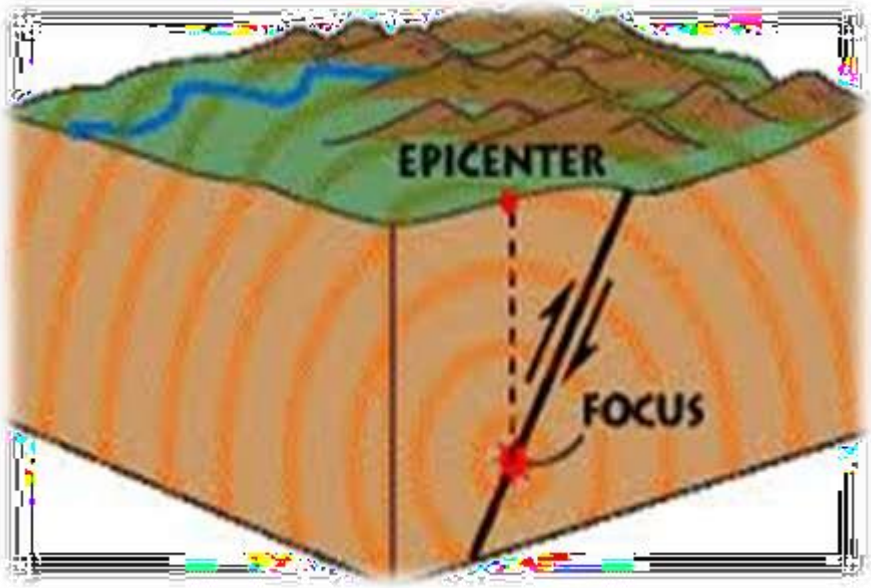
Earthquake in Peninsular

- Earth scientists have found it difficult to explain the occurrence of earthquakes in one of the oldest ,most stable and mature landmass of peninsular block for a long time.
- Recently, Some earth scientists have come up with a theory of emergence of a fault line and energy build up along the fault line represented by the river Bhima (Krishna) near Latur and Osmanabad (Maharashtra) and the possible breaking down of the Indian plate.

Terms Related To Earthquake

Focus(Hypocenter):

Focus is the point on the fault where rupture occurs and the location from which seismic waves are released.



Epicenter:

Epicenter is the point on the earth's surface that is directly above the focus ,the point where an earthquake or underground explosion originates.

Cont…

Fault Line:

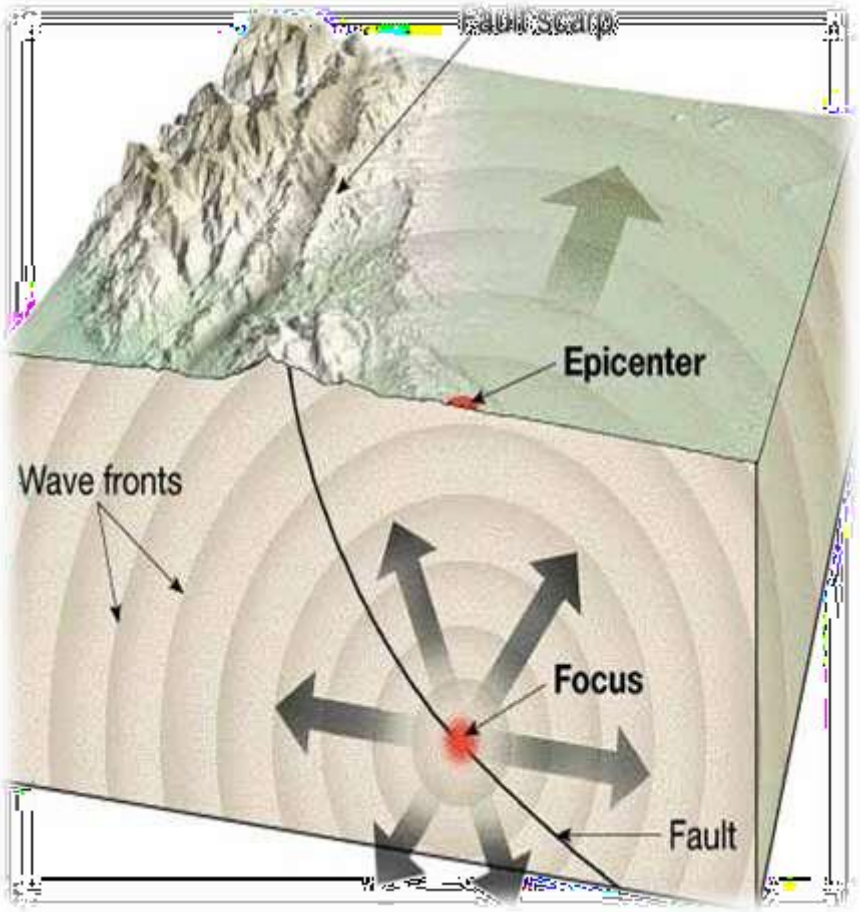
A Fault line is the surface trace of a fault, the line of intersection between the earth's surface.

Fault plane:

Fault plane are the crackes or sudden slips of the land .

Fault Scrap:

A Fault scrap is the topographic expression of faulting attributed to the displacement of the land surface by movement along faults.



Causes Of Earthquake

The primary cause of an earthquake is **faults** on the crust of the earth.

"A Fault is a break or fracture b/w two blocks of rocks in response to stress."

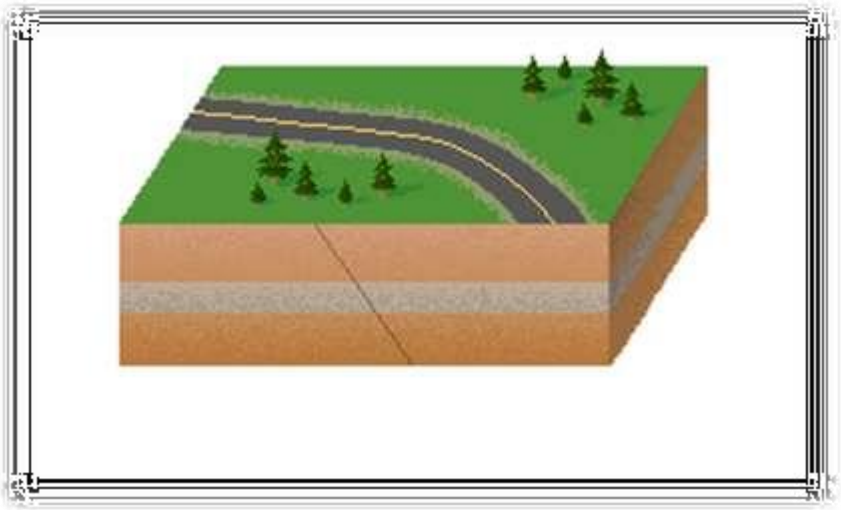
- This movement may occur rapidly, in the form of an **earthquake** or may occur slowly, in the form of **creep.**

- Earth scientists use the **angle of the fault** with respect to the surface (known as the dip) and the **direction of slip** along the fault to classify faults.

Classification Of Faults

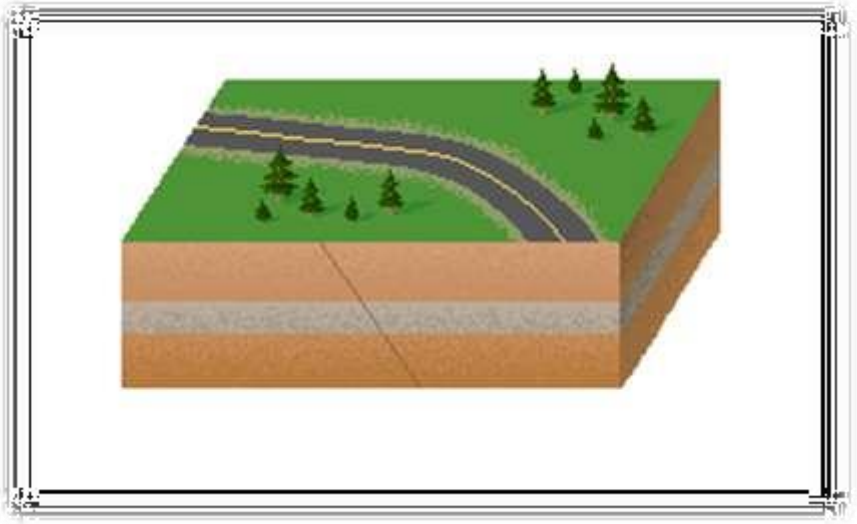
Normal fault:

a dip-slip fault in which the block above the fault has moved downward relative to the block below.



Thrust (reverse)fault:

a dip-slip fault in which the upper block, above the fault plane, moves up and over the lower block.



Strike-slip fault:

- **A left-lateral strike-slip fault :**

It is one on which the displacement of the far block is to the left when viewed from either side.

- **A right-lateral strike-slip fault:**

It is one on which the displacement of the far block is to the right when viewed from either side.

Some major causes of earthquakes on basic of its causes are:

- Surface causes
- Volcanic causes
- Tectonic causes

Surface cause:

Great explosions, landslides, slips on steep coasts, avalanches , railway trains, heavy trucks, some large engineering projects cause minor tremors. some of them are man made, other are natural.

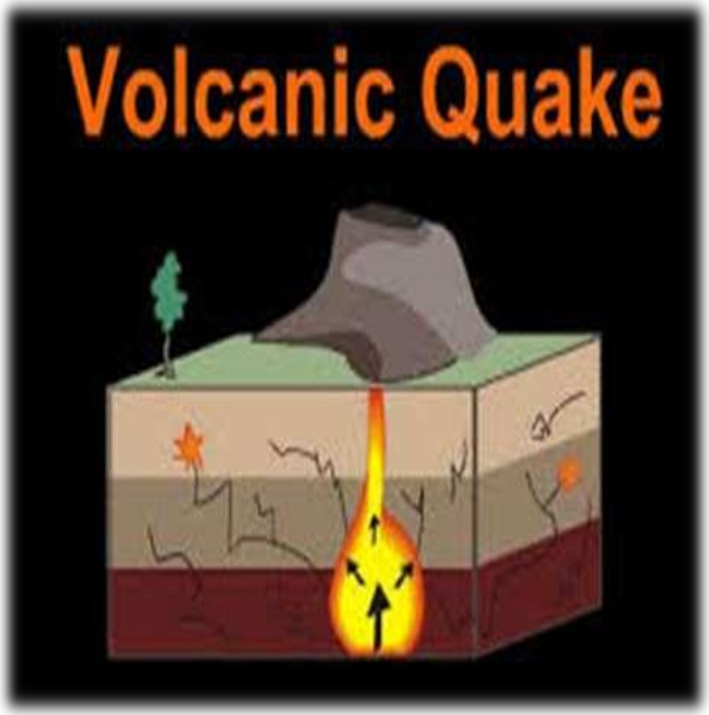
Volcanic cause:

Volcanic eruptions produce earthquakes. Earthquakes may precede, accompany and frequently follow volcanic eruptions.

They are caused by sudden displacements of lava within or beneath the earth crust.

There are two general categories of earthquakes that can occur at a volcano:

- volcano-tectonic earthquakes
- long period earthquakes.



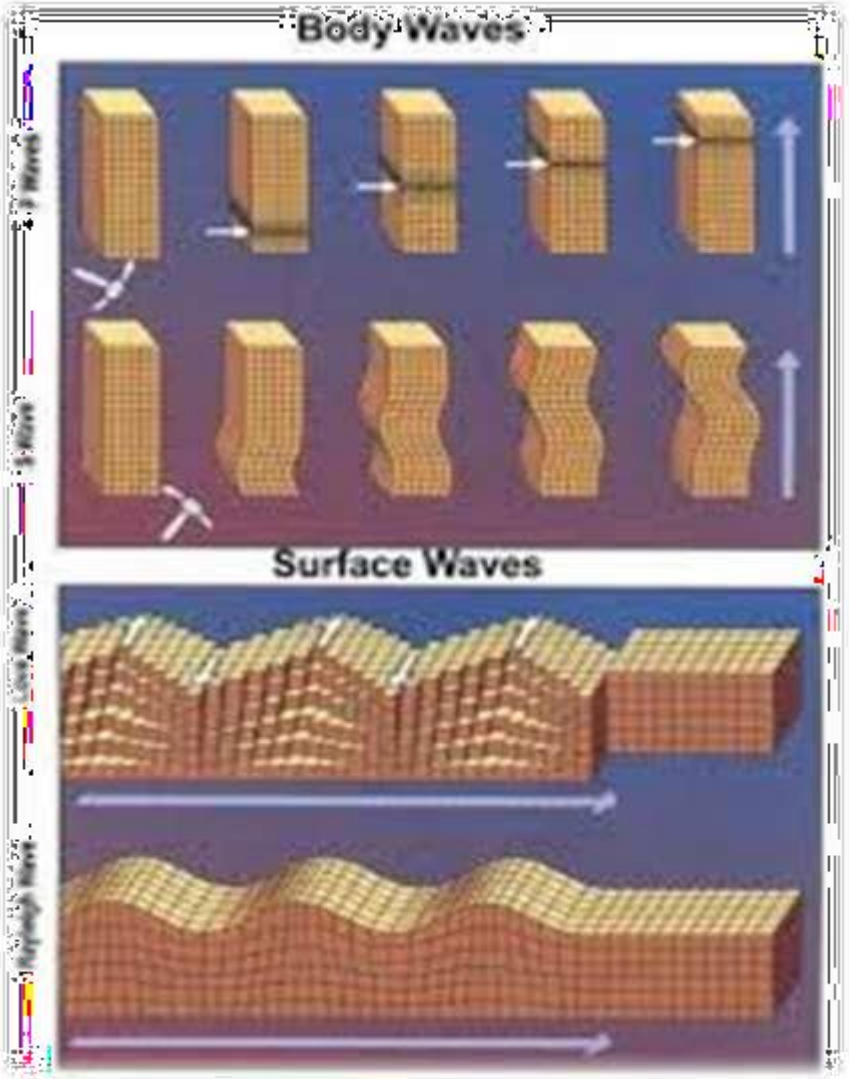
Tectonic cause:

- Structural disturbance resulting in the parts of the lithosphere is the main cause of this type of earthquake. Most of the disastrous earthquakes belong to this category and occur in areas of great faults and fractures.
- Sudden yielding to strain produced on the rocks of accumulating stress causes displacements especially along old fault zones known as great transform faults.

Waves produced due to Earthquake

Seismic waves produced due to earthquake are basically divided into two major types:

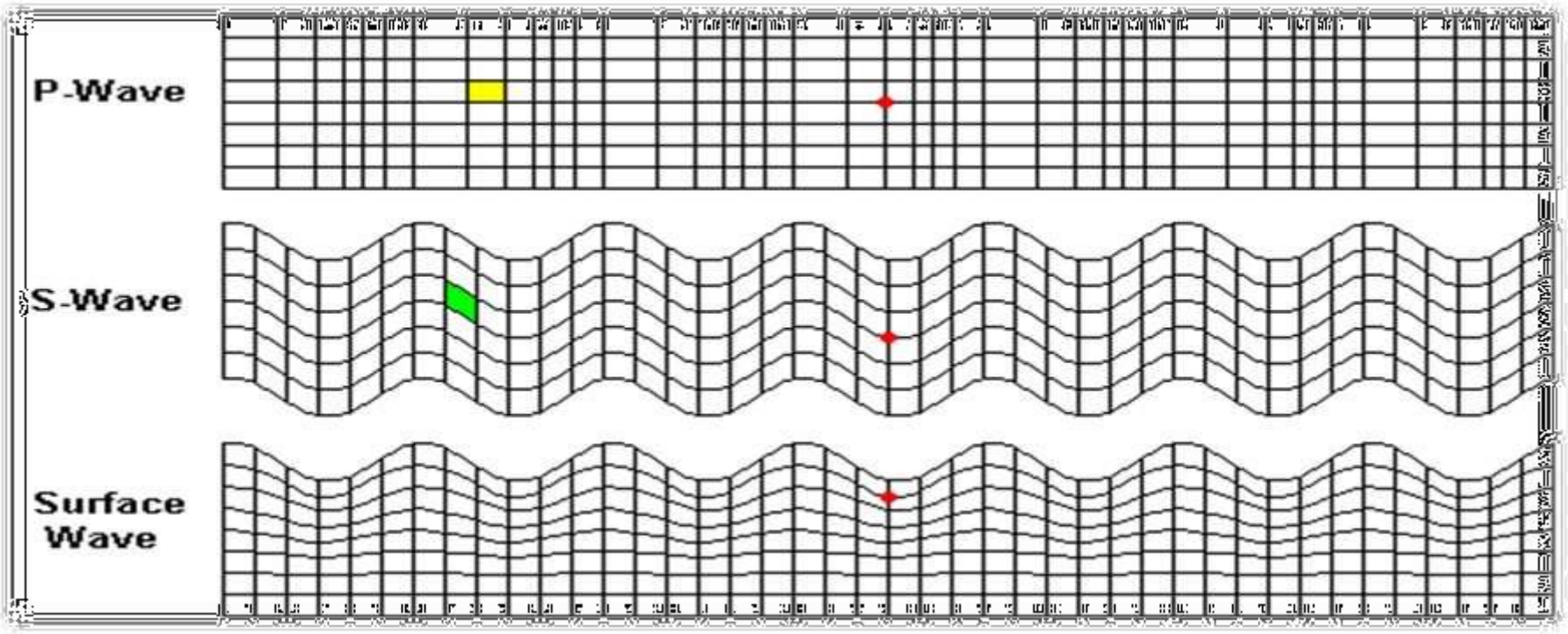
- Body waves
- Surface waves



Body waves:

Body waves travels through the interior(body) of earth as they leave the focus. Body waves are further divided into following types:

- **Primary (P) waves**
- **Secondary(S) waves**

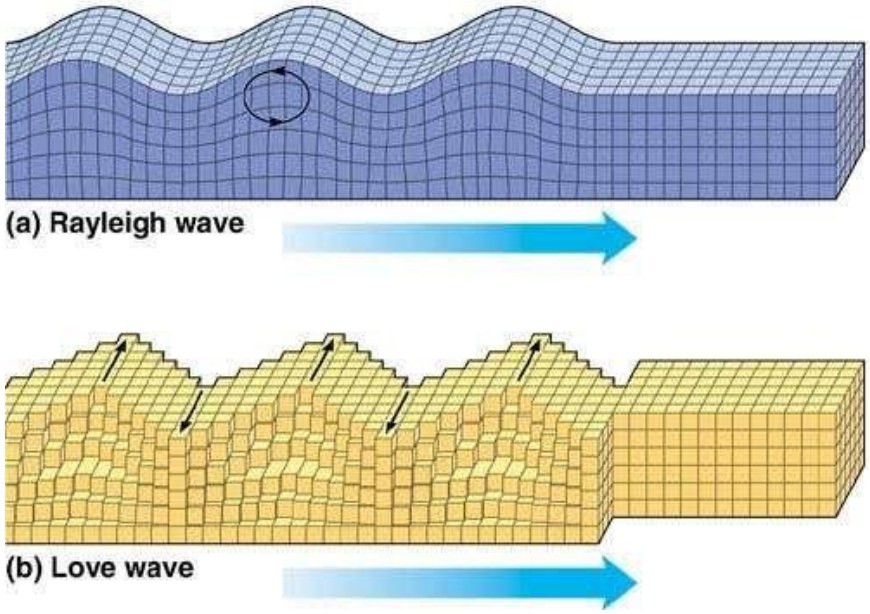


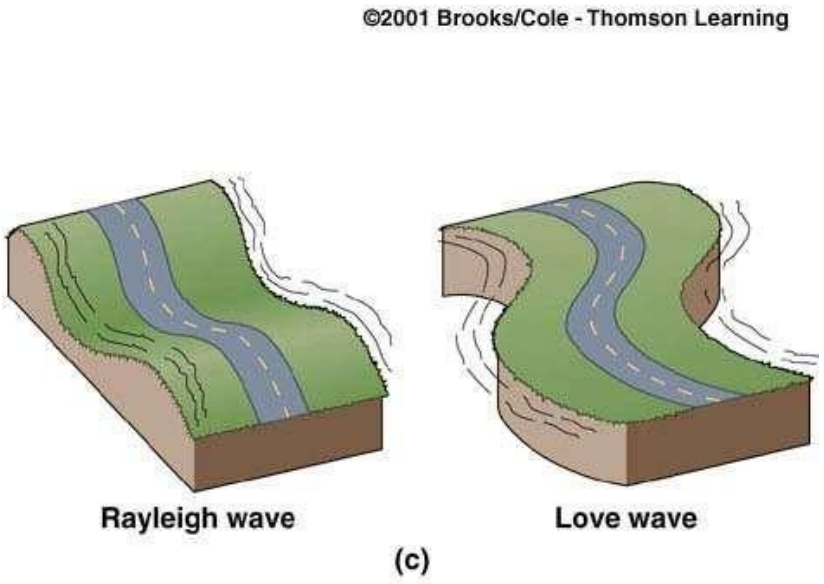
Primary Waves (P-waves)	Secondary Waves(S-wave)
High frequency	High frequency
Short Wavelength	Short Wavelength
Longitudinal waves	Transverse waves
Pass trough both solids and liquids	Can not move through liquids
Move forwards and backwards as it compressed and decompressed	Move in all direction from their source
P-wave is faster	S-wave is more slower than P-wave
First P-wave arrive	After P-wave,S-wave is arrive

Surface Wave:

Surface waves travels parallel to the earth's surface and these waves are slowest and most damaging. Surface wave are divided into following types:

- **Love waves**
- **Rayleigh waves**





Love Waves	Rayleigh wave
Guided waves	Guided waves
Displacement is parallel to the free surface	Displacement is perpendicular to love-wave displacement
Love wave is faster	Rayleigh wave is slower
Causes horizontal shifting of the earth surface.	Ground move in circular motion.

Strength Of Earthquake

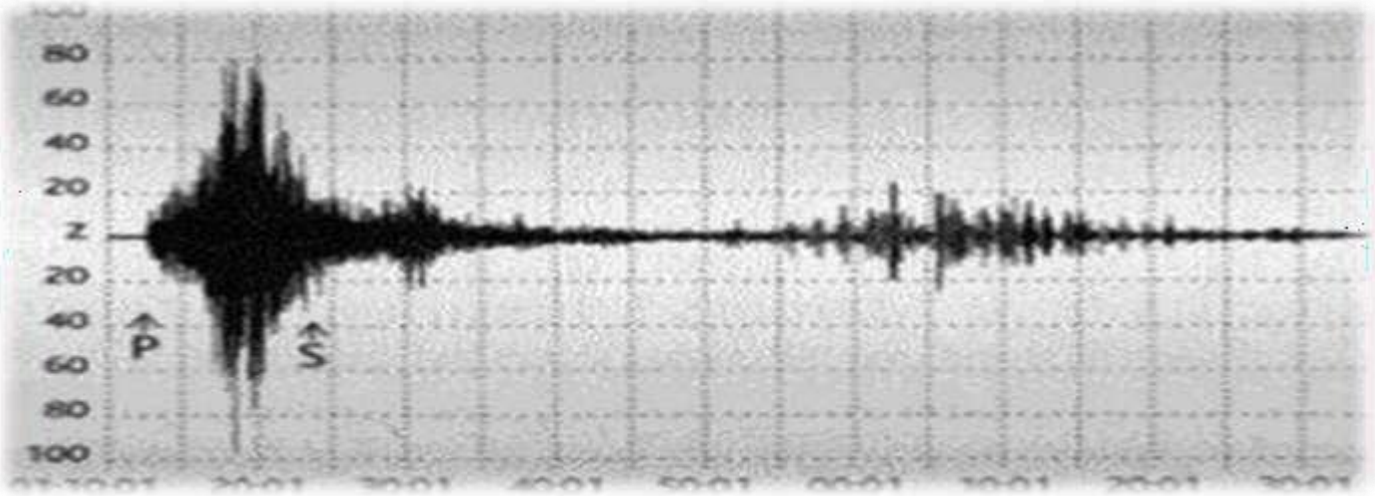
The intensity and strength of an earthquake is measured on Richter scale,the scale invented by Charles Richter California ,USA in 1935.which categories earthquake on the basis of energy released.

Defintion:

"the logarithm to base ten of the maximum seismic-wave amplitude recorded on a standard seismograph at a distance of 100 kilometers from the earthquake epicenter."

Scientists measure the strength of earthquakes using machines known as **seismographs.**

- **Seismology** is the scientific study of earthquakes and the propagation of elastic waves through the Earth.



GROUP	MAGNITUDE
Great	8 and Higher
Major	7-7.9
Strong	6-6.9
Moderate	5-5.9
Light	4-4.9
Minor	3-3.9
Very Minor	<3.0

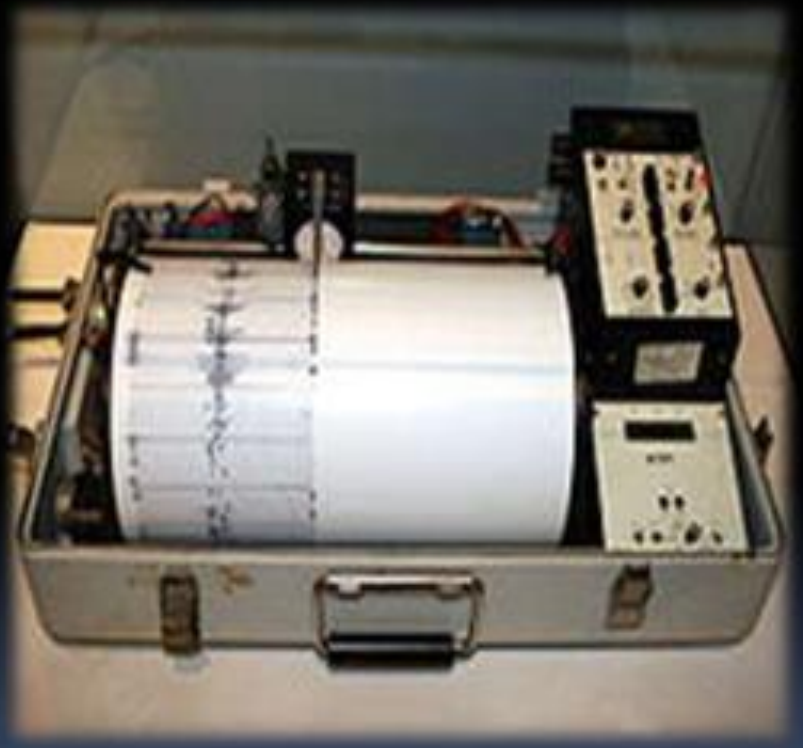
Amount of energy released during different Earthquake:

Intensity Of Earthquake On Richter Scale:	Energy Release (Amount Of TNT):
1.0	170 Grams
2.0	6 Kilogram
3.0	179 Kilogram
4.0	5 Metric Tons
5.0	179 Metric Tons
6.0	5643 Metric Tons
7.0	179100 Metric Tons
7.5	1 Mega Tons
8.0	564300 Metric Tons

Seismometers-The measurement of earthquake

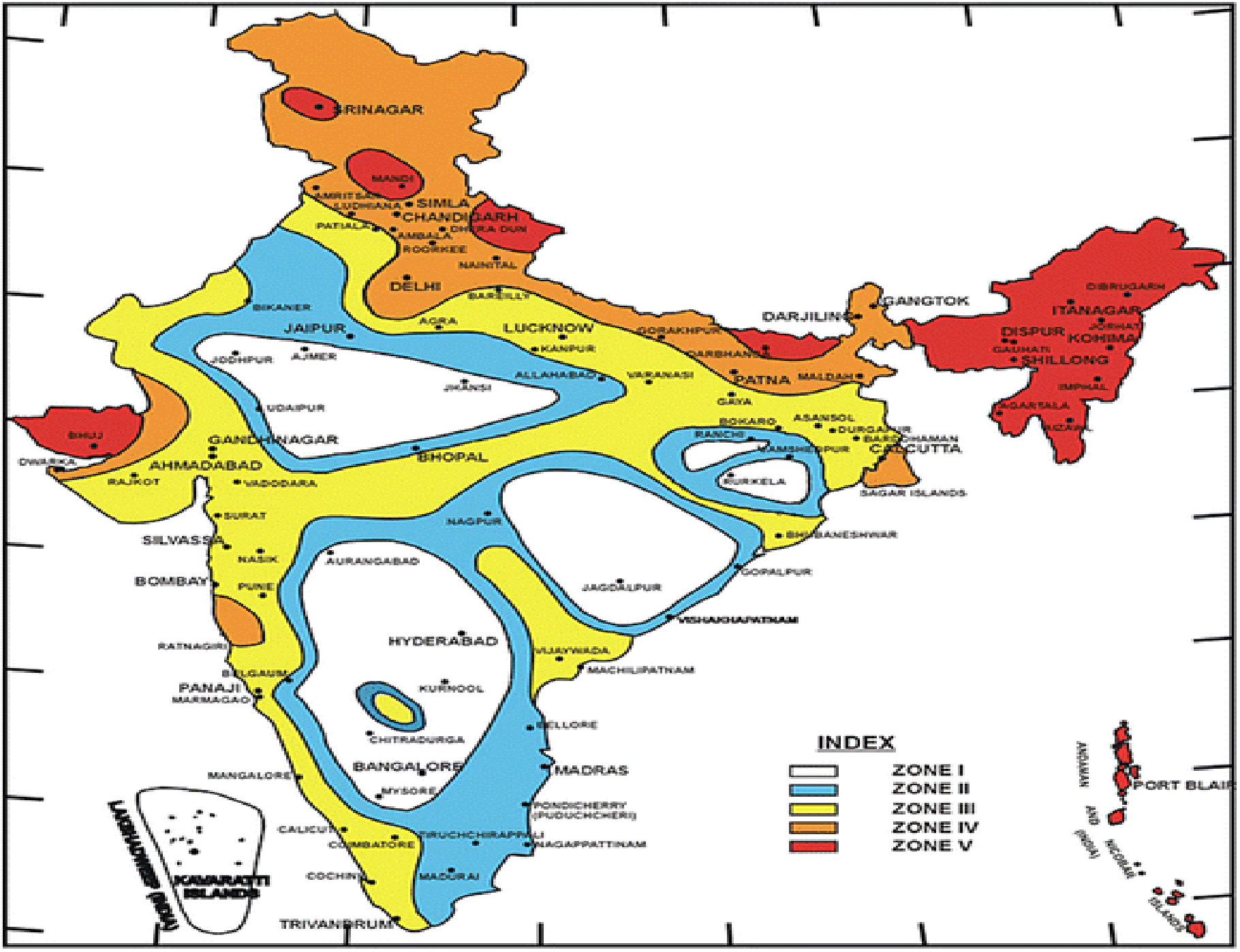
- **Seismometers** are instruments that measure motions of the ground, including those of seismic waves generated by earthquakes, volcanic eruptions, and otherseismic sources.

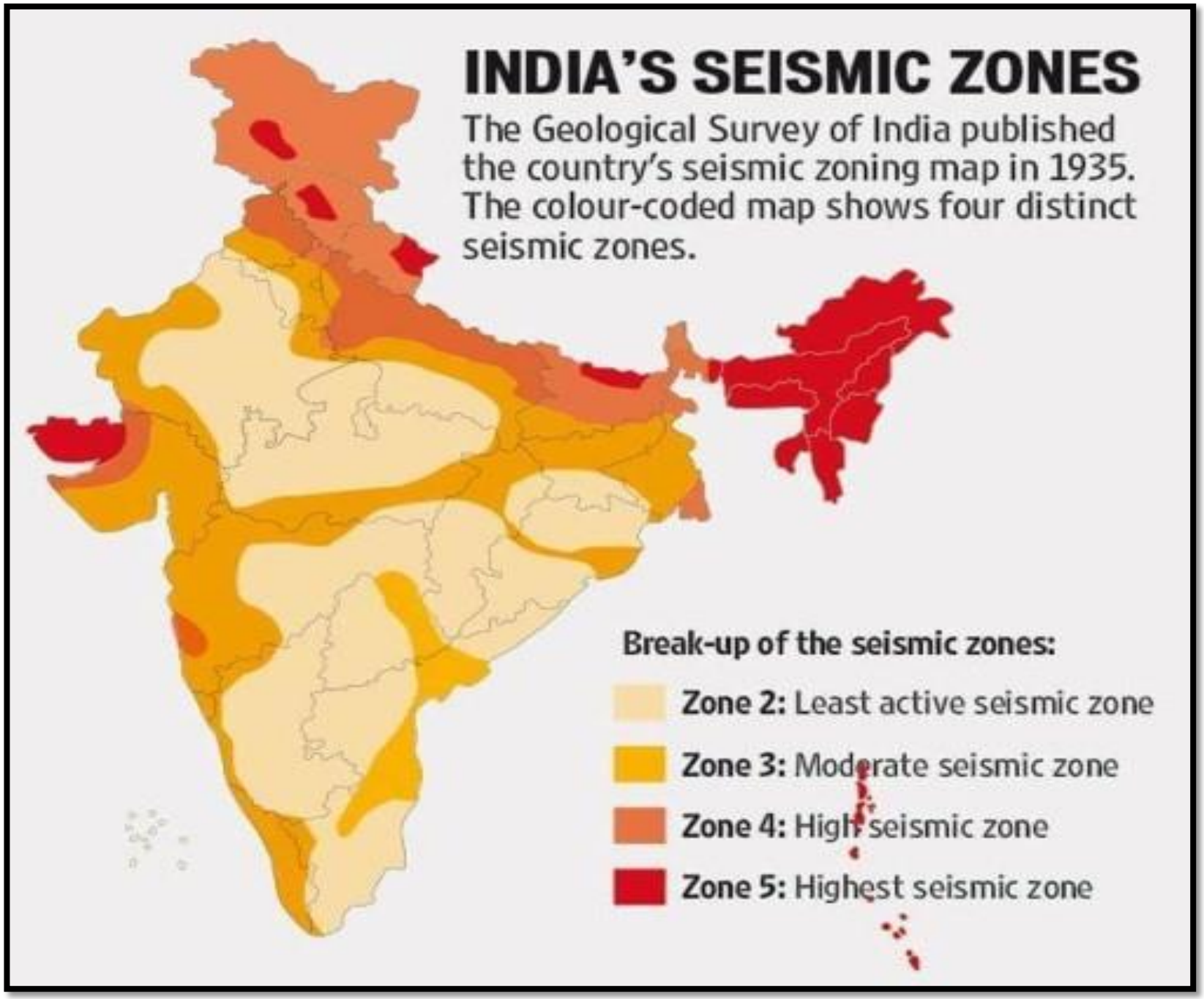
- Seismometers may be deployed at Earth's surface, in shallow vaults, in boreholes, or underwater.



- National Geophysical laboratory, geological survey of India , Department of Meteorology ,Government of India ,along with the recently formed National institute of Disaster Management ,have made an intensive analysis of more than 1200 earthquakes that have occurred in India in different years in the Past, and based on these
- They divided India into following five earthquake zones

1. Very high damage risk zone
2. high damage risk zone
3. Moderate damage risk zone
4. Low damage risk zone
5. Very Low damage risk zone


SRINAGAR
MANDI
SIMLA
CHANDIGARH
LUDHIANA
PATIALA
AMBALA
DHERA DUN
ROORKEE
NAINITAL
DELHI
BAREILLY
BIKANER
JAIPUR
AGRA
LUCKNOW
GORAKHPUR
KANPUR
DARBHANGA
JODHPUR
AJMER
ALLAHABAD
VARANASI
PATNA
MALDAH
JHANSI
GAYA
UDAIPUR
BHUJ
GANDHINAGAR
BHOPAL
DWARKA
AHMADABAD
RAJKOT
VADODARA
SURAT
NAGPUR
SILVASSA
NASIK
AURANGABAD
BOMBAY
PUNE
RATNAGIRI
BELGAUM
PANAJI
MARMAGAO
HYDERABAD
KURNOOL
CHITRADURGA
BANGALORE
MANGALORE
MYSORE
CALICUT
COIMBATORE
TIRUCHCHIRAPALLI
COCHIN
MADURAI
TRIVANDRUM
LAKSHADWEEP (INDIA)
KAVARATTI ISLANDS
MADRAS
PONDICHERRY (PUDUCHCHERI)
NAGAPPATTINAM
CUDDALORE
VIJAYWADA
MACHILIPATNAM
VISHAKHAPATNAM
JAGDALPUR
GOPALPUR
BHUBANESHWAR
ROURKELA
RANCHI
JAMSHEDPUR
BOKARO
ASANSOL
DURGAPUR
BARRACKHAMAN
CALCUTTA
SAGAR ISLANDS
DARJILING
GANGTOK
DIBRUGARH
ITANAGAR
JORHAT
DISPUR
KOHIMA
GAUHATI
SHILLONG
IMPHAL
AGARTALA
AIZAWL
INDEX
ZONE I
ZONE II
ZONE III
ZONE IV
ZONE V
ANDAMAN AND NICOBAR ISLANDS
PORT BLAIR


INDIA'S SEISMIC ZONES
The Geological Survey of India published the country's seismic zoning map in 1935. The colour-coded map shows four distinct seismic zones.
Break-up of the seismic zones:
Zone 2: Least active seismic zone
Zone 3: Moderate seismic zone
Zone 4: High seismic zone
Zone 5: Highest seismic zone

Earthquake Prediction

Earthquake prediction is usually defined as the specification of the time , location , and magnitude of a future earthquake within stated limits.

But some evidence of upcoming Earthquake are following:

- Unusual animal behavior
- Water level in wells
- Large scale of fluctuation of oil flow from oil wells
- Foreshocks or minor shocks before major earthquake
- Temperature change
- Uplifting of earth surface
- Change in seismic wave velocity

Effect Of Earthquake

- Loss of life and property
- Damage to transport system i.e.

roads, railways, highways, airports, marine

- Damage to infrastructure.
- Chances of Floods – Develop cracks in Dams
- Chances of fire short-circuit.
- Communications such as telephone wires are damaged.
- Water pipes, sewers are disrupted
- Economic activities like agriculture, industry, trade and transport

are severely affected.

Cont...

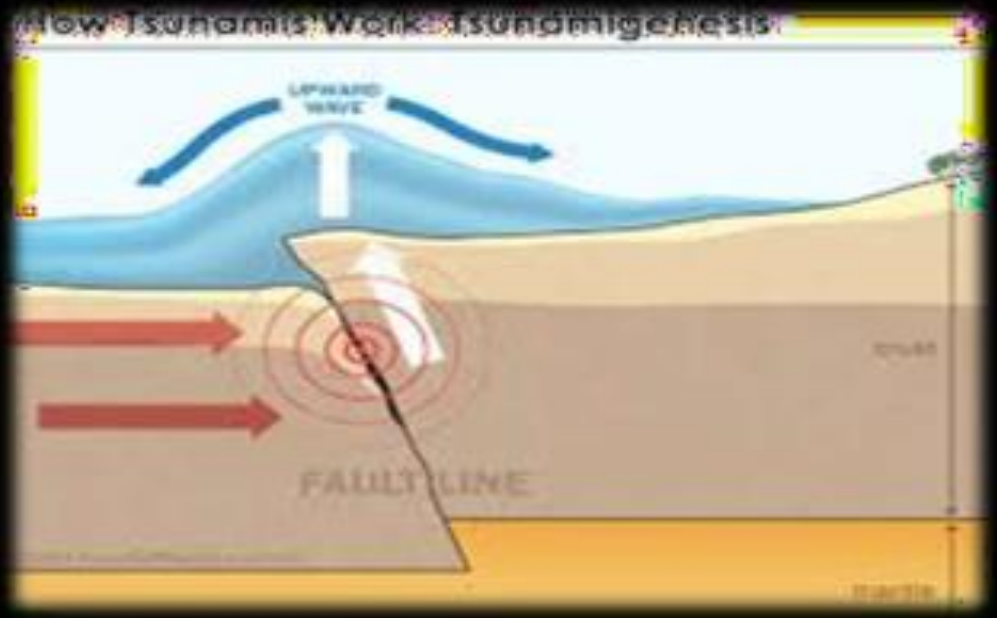
Landslides

Shaking and ground rapture

Fires

Soil liquefaction

Tsunami



Floods

Earthquake Safety Rules

If you are in house;

• Don't use lift for getting down from building.

• Be prepared to move with your family.

If you are in shop ,school or office;

• Don't run for an exit.

•Take cover under a disk/table.

•Move away from window glass.

•Do not go near electric point and cable. Keep away from weak portion of the building and false ceiling.

If you are outside;

•Avoid high buildings , walls , power lines and other objects that could fall and create block.

• Don’t run through streets.

• If possible , move on to an open area away from hazard including trees.

If you are in vehicle;

• Stop in a safe open place.

• Remain inside vehicle.

• Close window , doors and vents.

After An Earthquake

- Keep calm, switch on the transistor radio and obey instructions.
- Keep away from beaches and low banks of river. A huge wave may sweep in
- Do not re enter badly damaged buildings and do not go near damage structures.
- Turn off the water, gas and electricity.
- Do not smoke, light match or use a cigarette lighter
- Do not turn on switches there may be gas leak or short circuit
- If there is any fire, try to put it out or call fire brigade.

Cont..

- Do not drink water from open containers without having examined it.
- If you aware of people have been buried, tell the rescue team. Do not rush and try not to worsen the situation.
- Avoid places where there are loose electric wires and do not come in contact with any metal object.
- Eat something. You will better and more capable of helping other.
- Do not walk around the streets to see what is happening. Keep the streets clear so rescue vehicles can access the roads easily.