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Introduction and Terms associated with earthquake

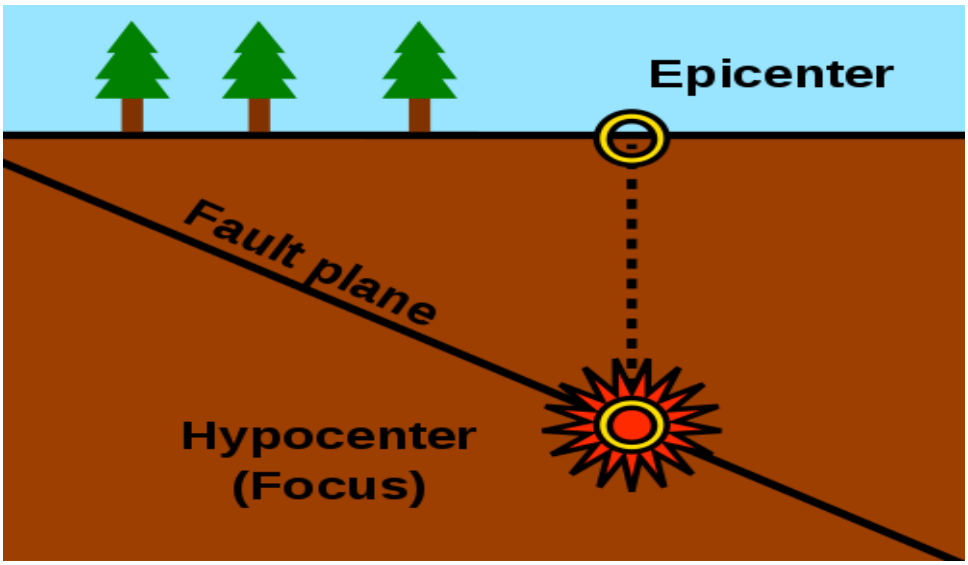
Earthquake also known as quake, tremor or temblor is the phenomenon where there is a sudden release of extreme energy from the earth crust resulting in shaking and displacement of the ground along with the creation of seismic waves. Its one of the worst natural hazards which often turn into disaster causing widespread destruction and loss to human life.

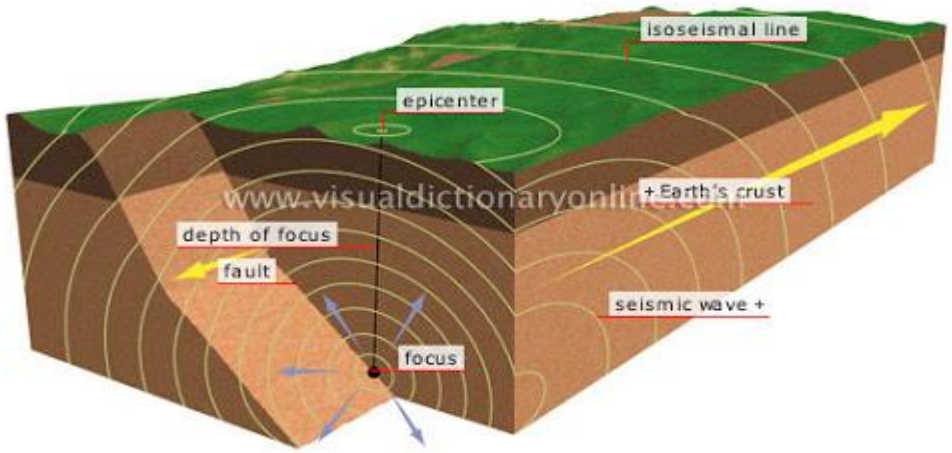
If the Epicenter of a larger earthquake is situated in the offshore (sea/ocean) seabed may be displaced sufficiently to cause Tsunami. It also triggers landslides and occasionally volcanic eruptions

For your better understanding When a stone is thrown into a pool, a series of waves spreads through the water in all directions. Similarly, when rocks are suddenly disturbed, vibrations spread out in all directions from the source of the disturbance. An earthquake is the passage of these vibrations.

Terms associated with earthquakes

1. **Focus/Hypocentre** - The focus or hypocentre of an earthquake is where the earthquake originated from.
2. **Epicentre** - The epicentre of an earthquake is the point on the surface of Earth directly above the epicentre.
3. **Fault** - fault is a planar fracture or discontinuity in a volume of rock across which there has been significant displacement as a result of rock-mass movement.
4. A ***fault plane*** is the plane that represents the fracture surface of a fault.
5. A ***fault trace*** or ***fault line*** is a place where the fault can be seen or mapped on the surface.
6. An **isoseismal** (line) is a contour or line on a map bounding points of equal intensity for a particular earthquake.





Types of Earth quake

1. **Non-Tectonic Earthquakes:** These are due to volcanic activities and man-made reasons e.g, nuclear testing, blasts, construction of large dams, deforestation etc

Volcanic earth quakes - Volcanic quakes are associated with active volcanism. They are generally not as powerful as tectonic quakes and often occur relatively near the surface. Consequently, they are usually only felt in the vicinity of the hypocentre.

Induced earth quakes - While most earthquakes are caused by movement of the Earth's tectonic plates, human activity can also produce earthquakes. Activities both above ground and below may change the stresses and strains on the crust, including building reservoirs, extracting resources such as coal or oil, and injecting fluids underground for waste disposal or fracking. Most of these earthquakes have small magnitudes. The 5.7 magnitude 2011 Oklahoma earthquake is thought to have been caused by disposing wastewater from oil production into injection wells, and studies point to the state's oil industry as the cause of other earthquakes in the past century.

2. **Tectonic Earthquakes:** These are due to sudden slip in the fault of the tectonic plates of the earth. Earthquakes caused by plate tectonics are called tectonic quakes. They account for most earthquakes worldwide and usually occur at the boundaries of tectonic plates.

How to Measure an earthquake

Magnitude and Intensity

Magnitude is the most common measure of an earthquake's size. It is a measure of the size of the earthquake source and is the same number no matter where you are or what the shaking feels like.

Intensity is a measure of the shaking and damage caused by the earthquake; this value changes from location to location

Ritcher Scale

The Richter scale measures the magnitude of an earthquake. It is measured using a machine called a seismometer which produces a seismograph. A Richter scale is normally numbered 1-10, though there is no upper limit. It is logarithmic which means, for example, that an earthquake measuring magnitude 5 is ten times more powerful than an earthquake measuring 4. Earthquakes measuring 1-

2 on the scale happen regularly, and they are so small that people cannot feel them. Earthquakes measuring upwards of 7 are less frequent but very powerful, and can cause a lot of destruction.

Mercalli scale

The intensity of earthquake shaking at any location is determined not only by the magnitude of the earthquake and its distance, but also by the type of underlying rock or unconsolidated materials. If buildings are present, the size and type of buildings (and their inherent natural vibrations) are also important.

Intensity scales were first used in the late 19th century, and then adapted in the early 20th century by Giuseppe Mercalli and modified later by others to form what we know call the modified Mercalli intensity scale. Intensity estimates are important because they allow us to characterize parts of any region into areas that are especially prone to strong shaking versus those that are not. The key factor in this regard is the nature of the underlying geological materials, and the weaker those are, the more likely it is that there will be strong shaking. Areas underlain by strong solid bedrock tend to experience much less shaking than those underlain by unconsolidated river or lake sediments.

Earthquake prediction

Earth quake 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 Earth quake is as following

- Water levels in wells
- Unusual animal behavior
- 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

After an Earthquake

- Keep calm switch on the transistor radio and obey instructions
- Keep away from beaches and low banks of river
- Do not enter badly damaged building and do not go near damage structures
- Turn off the water, gas and electricity
- Do not smoke, light match or use 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

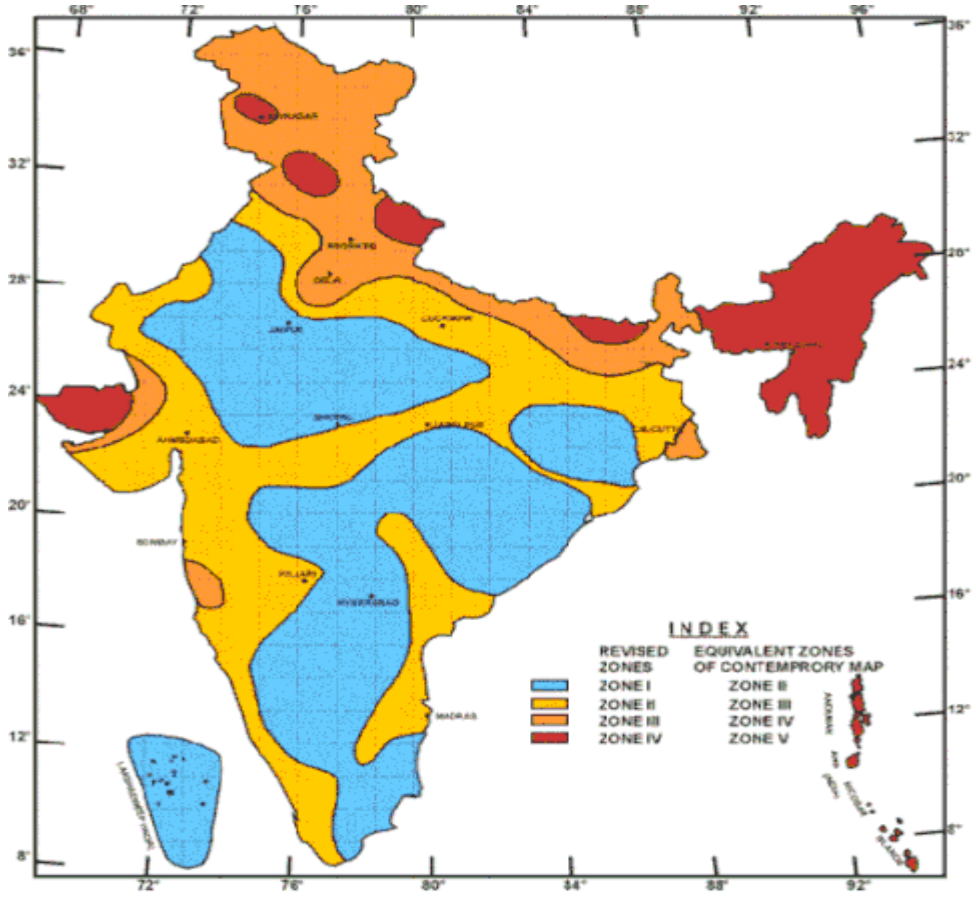
Earthquake Zonation in India

Zone-V covers entire northeastern India, some parts of Jammu and Kashmir, some parts of Ladakh, Himachal Pradesh, Uttarakhand, Rann of Kutch in Gujarat, some parts of North Bihar and Andaman & Nicobar Islands.

Zone-IV covers remaining parts of Jammu & Kashmir, Ladakh and Himachal Pradesh, Union Territory of Delhi, Sikkim, northern parts of Uttar Pradesh, Bihar and West Bengal, parts of Gujarat and small portions of Maharashtra near the west coast and Rajasthan.

Zone-III comprises of Kerala, Goa, Lakshadweep islands, remaining parts of Uttar Pradesh, Gujarat and West Bengal, parts of Punjab, Rajasthan, Madhya Pradesh, Bihar, Jharkhand, Chhattisgarh, Maharashtra, Odisha, Andhra Pradesh, Tamil Nadu and Karnataka.

Zone-II covers remaining parts of the country.



Case Study – Bhuj Earth quake, India – 26th January 2001

On Nation's 52nd Republic Day, a devastating earthquake occurred in the Kutch district of the state of Gujarat. The earthquake was felt as far away as Delhi in the north, Kolkata in the east. Bhuj town and the village Bhachau, 60 km east of Bhuj, were the worst affected and many other areas of Gujarat including its state headquarters Ahmedabad, were badly affected.

There were more than 20,000 deaths and 167,000 people injured Four districts of Gujarat lay in ruin and altogether, 21 districts were affected.

Around 300,000 families and at least 3 million children under 14 aged were affected.

Around 600,000 people were left homeless.

In the city of Bhuj, more than 3,000 Population of the city lost their lives; the main hospital was crushed and close to 90% of the buildings was destroyed.

There was significant damage to infrastructure with facilities such as hospitals, schools, electric power and water systems, bridges and roads damaged or destroyed.

Tsunami- Introduction

A **tsunami** is a series of waves sometimes reaching heights of over 100 feet (30.5 meters in a water body caused by the displacement of a large volume of water, generally in an ocean or a large lake. can cause widespread destruction when they crash ashore.

Tsunamis race across the sea at up to 500 miles (805 kilometers) an hour—about as fast as a jet airplane. At that pace, they can cross the entire expanse of the Pacific Ocean in less than a day. And their long wavelengths mean they lose very little energy along the way.

In deep ocean, tsunami waves may appear only a foot or so high. But as they approach shoreline and enter shallower water they slow down and begin to grow in energy and height. The tops of the waves move faster than their bottoms do, which causes them to rise precipitously.

A tsunami's trough, the low point beneath the wave's crest, often reaches shore first. When it does, it produces a vacuum effect that sucks coastal water seaward and exposes harbour and sea floors. This retreating of sea water is an important warning sign of a tsunami, because the wave's crest and its enormous volume of water typically hit shore five minutes or so later. Recognizing this phenomenon can save lives.

A tsunami is usually composed of a series of waves, called a wave train, so its destructive force may be compounded as successive waves reach shore. People experiencing a tsunami should remember that the danger may not have passed with the first wave and should await official word that it is safe to return to vulnerable locations.

Causes of Tsunami

These awe-inspiring waves are typically caused by large, undersea earthquakes at tectonic plate boundaries. When the ocean floor at a plate boundary rises or falls suddenly, it displaces the water above it and launches the rolling waves that will become a tsunami.

Most tsunamis–about 80 percent–happen within the Pacific Ocean's "Ring of Fire," a geologically active area where tectonic shifts make volcanoes and earthquakes common.

Tsunamis may also be caused by underwater landslides or volcanic eruptions. They may even be launched, as they frequently were in Earth's ancient past, by the impact of a large meteorite plunging into an ocean.

Case Study 2004 Indian Ocean Tsunami

The **2004 Indian Ocean earthquake and tsunami** (also known as the **Boxing Day Tsunami** and, by the scientific community, the **Sumatra–Andaman earthquake**) occurred at 07:58:53 in local time (UTC+7) on 26 December, with an epicentre off the west coast of northern Sumatra, Indonesia. It was an undersea megathrust earthquake that registered a magnitude of 9.1–9.3 M_w, reaching a Mercalli intensity up to IX in certain areas. The earthquake was caused by a rupture along the fault between the Burma Plate and the Indian Plate.

Communities along the surrounding coasts of the Indian Ocean were severely affected, and the tsunamis killed an estimated 227,898 people in 14 countries, making it one of the deadliest natural disasters in recorded history. The direct results caused major disruptions to living conditions and commerce in coastal provinces of surrounded countries, including Aceh, Indonesia, Sri Lanka, Tamil Nadu, India and Khao Lak, Thailand. Banda Aceh reported the largest number of deaths.

The earthquake was the third-largest ever recorded and had the longest duration of faulting ever observed; between eight and ten minutes. It caused the planet to vibrate as much as 10 mm

(0.4 in), and also remotely triggered earthquakes as far away as Alaska. Its epicenter was between Simeulue and mainland Sumatra