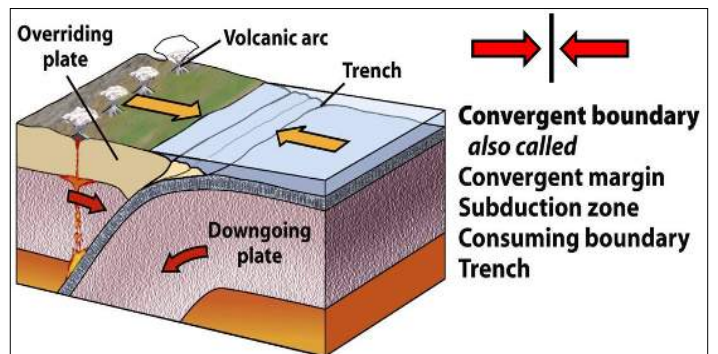
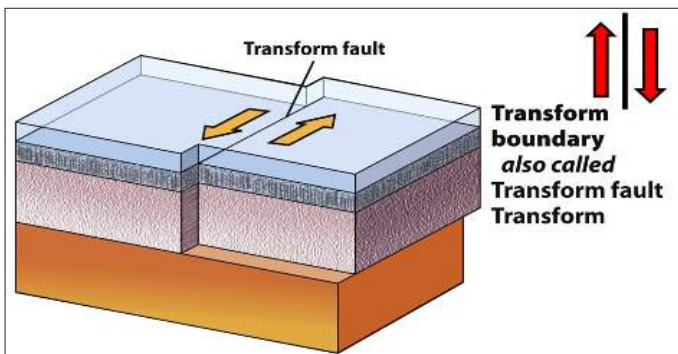
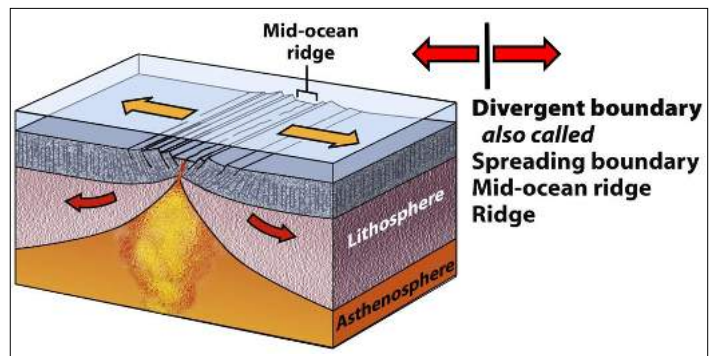


GEOPHYSICAL PHENOMENA

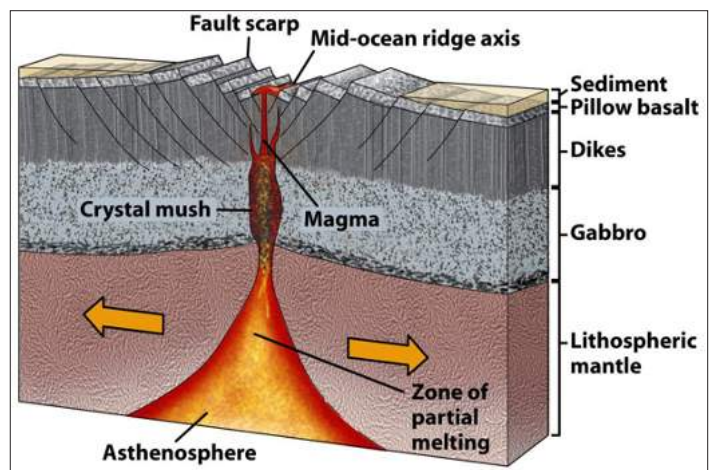
Plate Boundaries: 3 Types

- **Divergent** – Tectonic plates move apart.
- **Convergent** – Tectonic plates move together.
- **Transform** – Tectonic plates slide sideways.



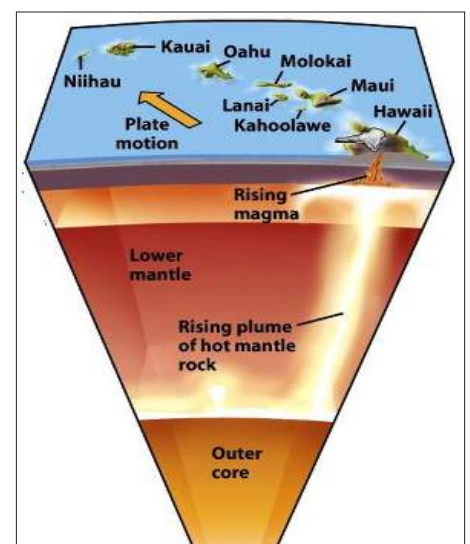
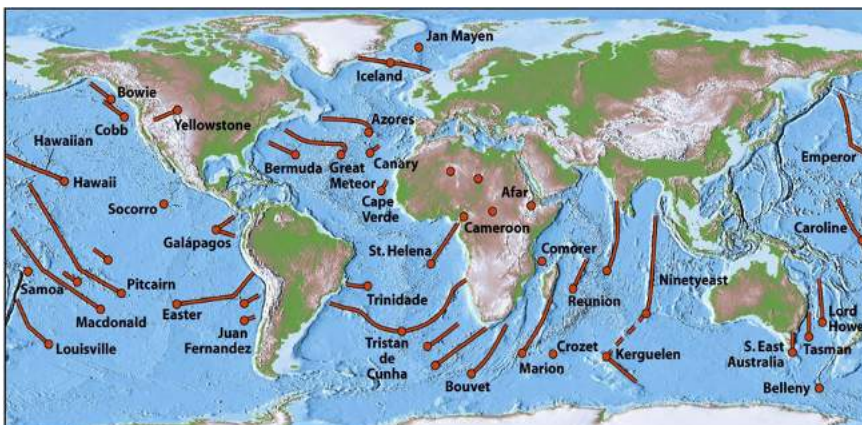
Mid-Ocean Ridges

- Sea-floor spreading opens the axial rift valley.
- Rising asthenosphere melts, forming mafic magma.
- Pooled magma solidifies into oceanic crustal rock.
 - ✓ Pillow basalt – Magma quenched at the sea floor.
 - ✓ Dikes – Preserved magma conduits.
 - ✓ Gabbro – Deeper magma.



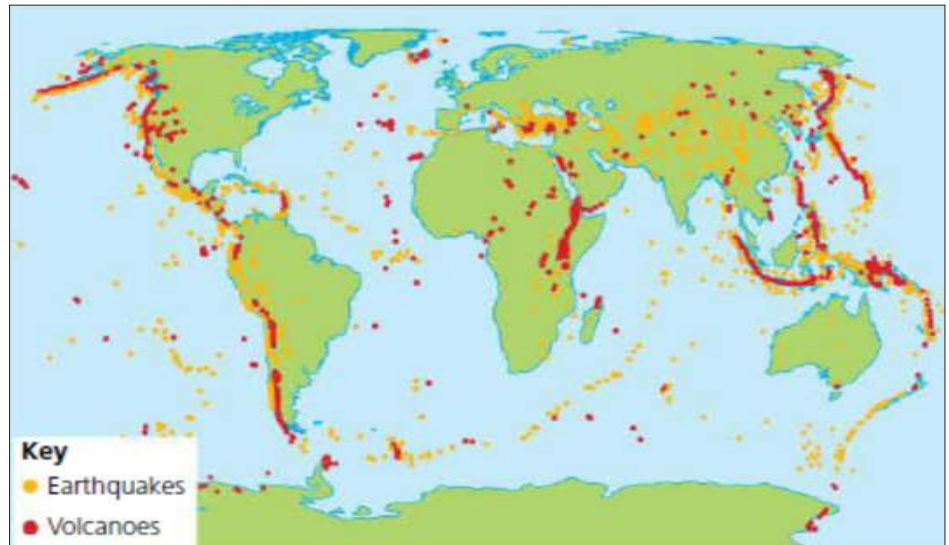
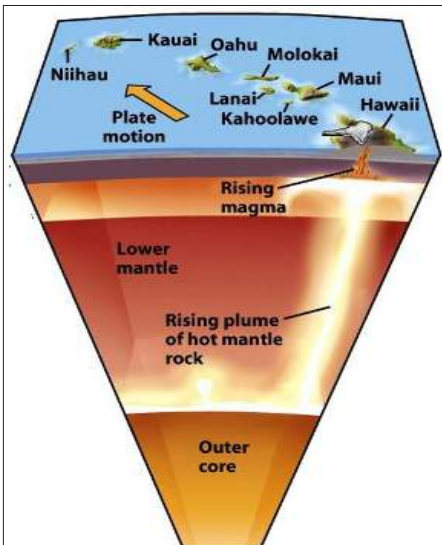
Hot Spots

- Volcanic plumes independent of tectonic plates.



VOLCANO & VOLCANISM

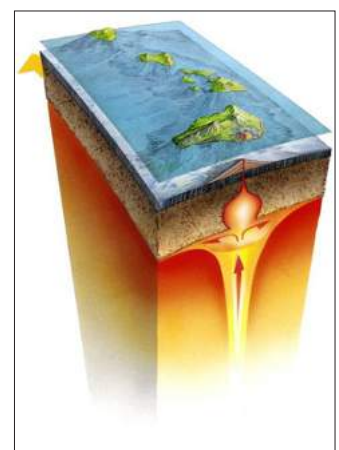
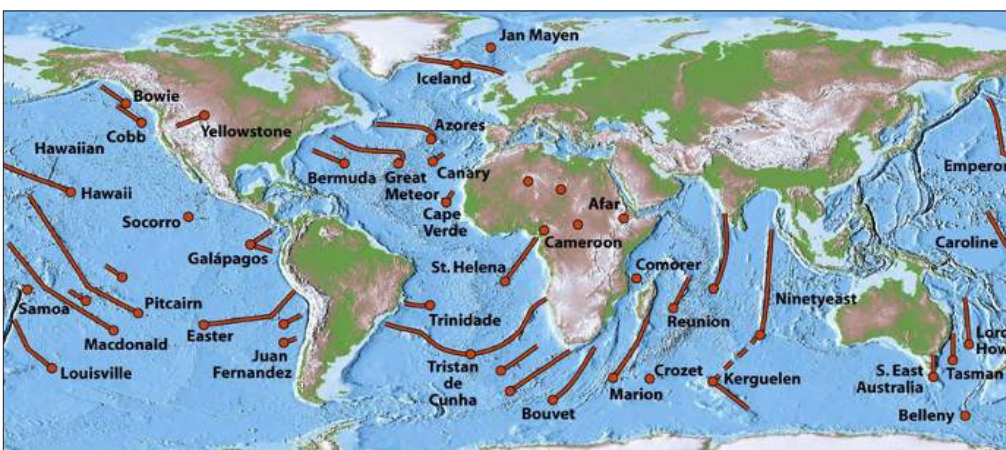
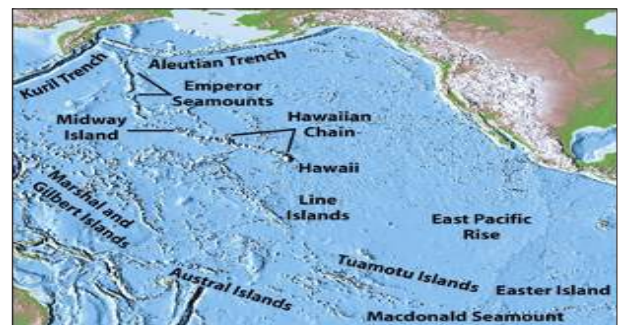
Volcanism



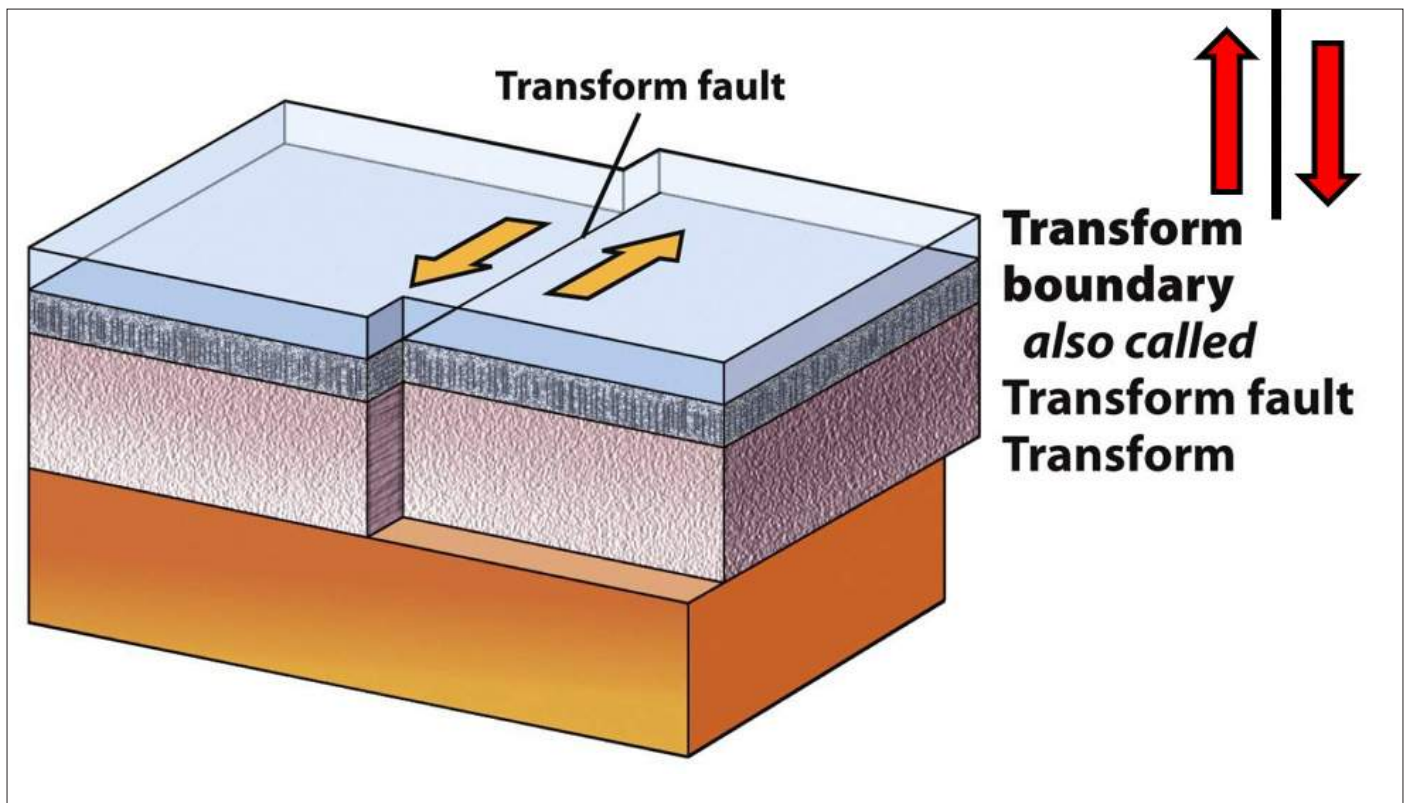
- **Volcanism** is the eruption of **molten rock** at the earth's surface, often accompanied by **rock fragments and explosive gases**.
- **Greatest volume** of volcanic matter is produced **along the oceanic ridge systems** that are essentially **divergent plate boundaries**.
- The '**Ring of Fire**', which is the **most active volcanic belt** bordering the Pacific Ocean, is associated with **subduction plate boundaries**.
- The **volcanic Islands of Hawaii** in the mid-Pacific and the famous hot water geysers of the **Yellowstone region** of North America are examples of such **in-plate volcanoes**.

Hot Spots

- **Volcanic plumes** independent of tectonic plates.
- Volcanoes **perforate overriding plates**.
- Hot spot volcanoes create **seamounts**.
- Seamounts **age away from originating hot spot**.



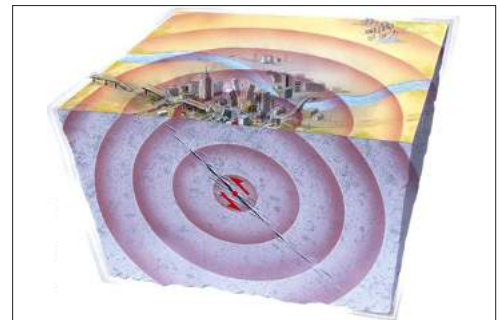
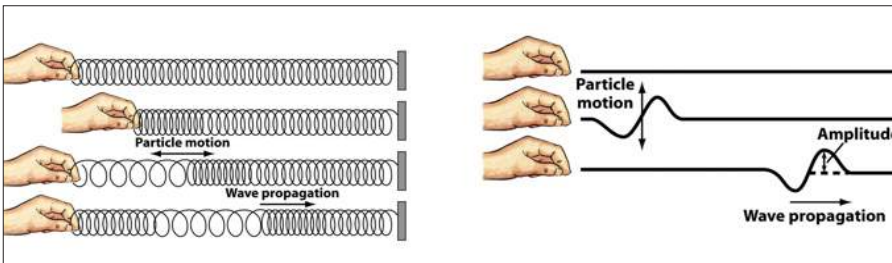
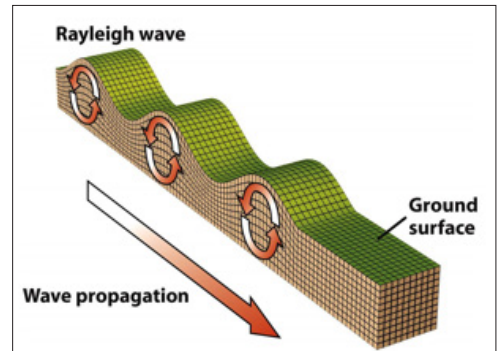
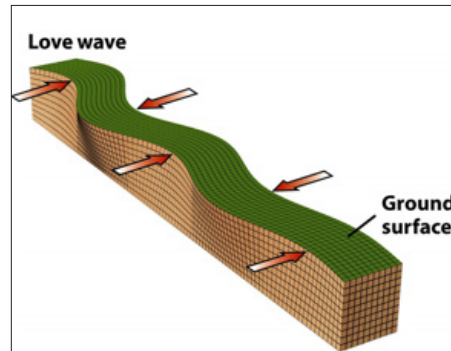
Volcanic Landforms



EARTHQUAKES & SEISMICITY

Earthquakes

- Earth shaking caused by a rapid release of energy
- Seismicity (earthquake activity) occurs due to:
 1. Tectonic Volcanic causes
 2. A sudden change in mineral structure.
 3. Meteorite impacts.
 4. Nuclear detonations.



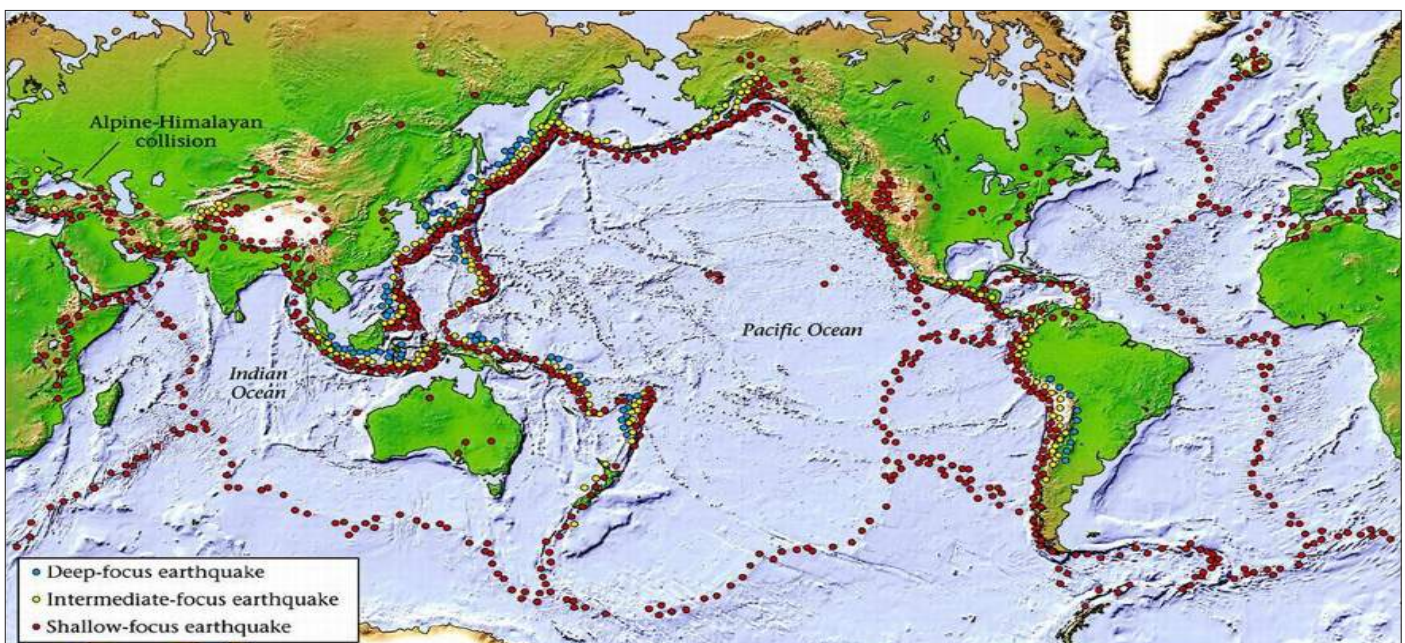
When rocks break, **stored elastic strain is released**.

This **energy radiates outward** from the hypocenter.

The energy, as waves, generates vibrations.

Earthquake Occurrence

- Earthquakes linked to plate tectonic boundaries.
- Shallow – Divergent and transform boundaries.
- Intermediate and deep – Convergent boundaries.



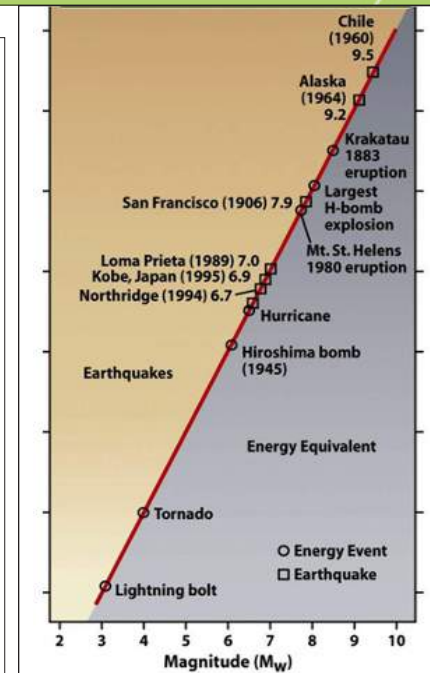
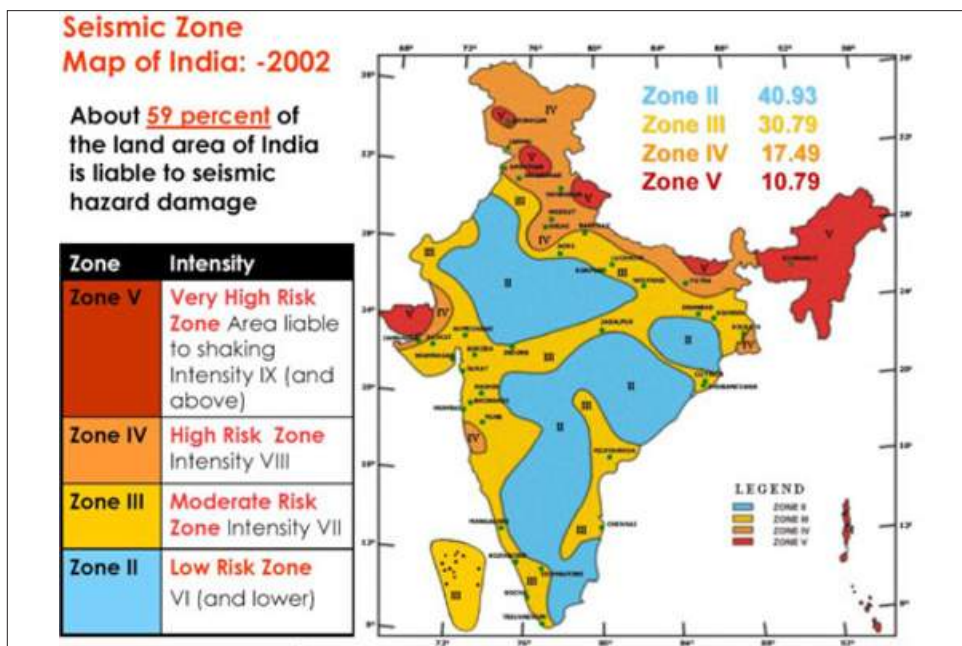
Earthquakes in Continental Crust

- Continental transform faults (San Andreas, Anatolian).
- Continental rifts (Basin and Range, East African Rift).
- Collision zones (Himalayas, Alps).
- Intraplate settings (ancient crustal weaknesses).

5% of earthquakes are not near plate boundaries.

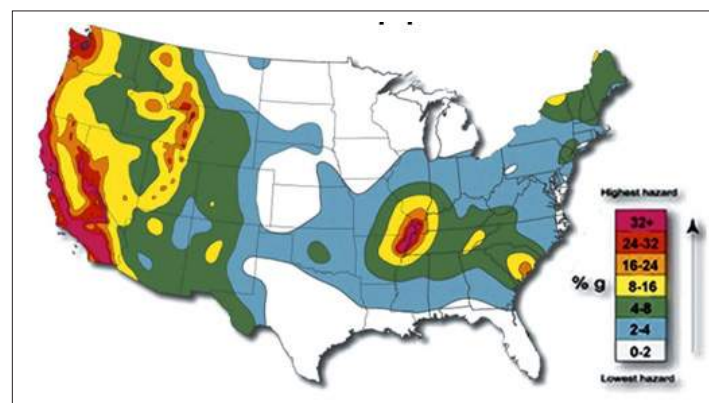
Earthquake Size

- **Magnitude** – The amount of energy released.
- Magnitude is measured by **Richter scale**.
- Magnitude scales are **logarithmic**. (Increases of 1 unit = 10-fold increase in ground motion.)
- Two of the strongest earthquakes in **southeastern Türkiye, of 7.8 and 7.7 magnitude**, occurred on Monday 6 February, 2023.
- **Intensity** – The amount of energy released.
- Magnitude is measured by **Mercali scale. (I-XII)**.



Earthquake Prediction

- Prediction would help reduce catastrophic losses.
- Can we predict earthquakes? Yes and no.
 - ✓ They CAN be predicted - long-term (10-100s of years).
 - ✓ They CANNOT be predicted - short-term (hours-months).
- Seismic hazards are mapped to assess risk.



Earthquake Preparedness

We can't stop them **but we can be ready for them:**

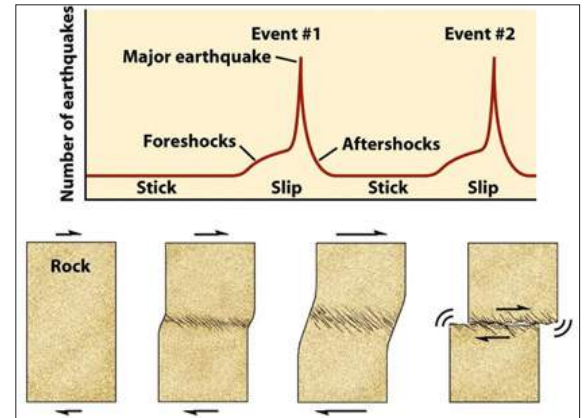
- Understand what happens during an earthquake.
- Map active faults and areas likely to liquefy from shaking.
- Develop construction codes to reduce building failures.
- Regulate land use to control development.

Earthquakes do have precursors.

Clustered foreshocks:

Possibly...

- Water level changes in wells.
- Gases (Rn, He) in wells.
- Unusual animal behavior.



2019: GS Paper I

Q1. Explain the formation of thousands of islands in Indonesian and Philippines archipelagos.

2014: GS Paper I

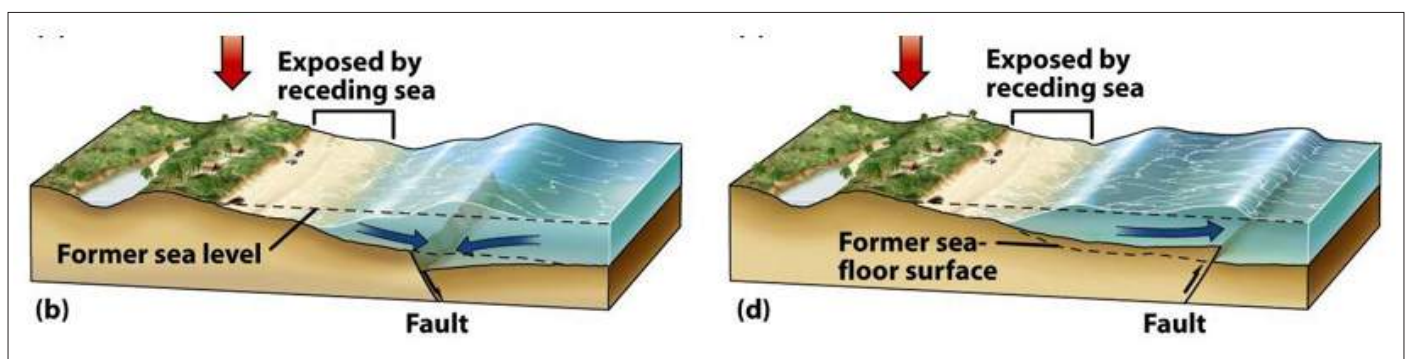
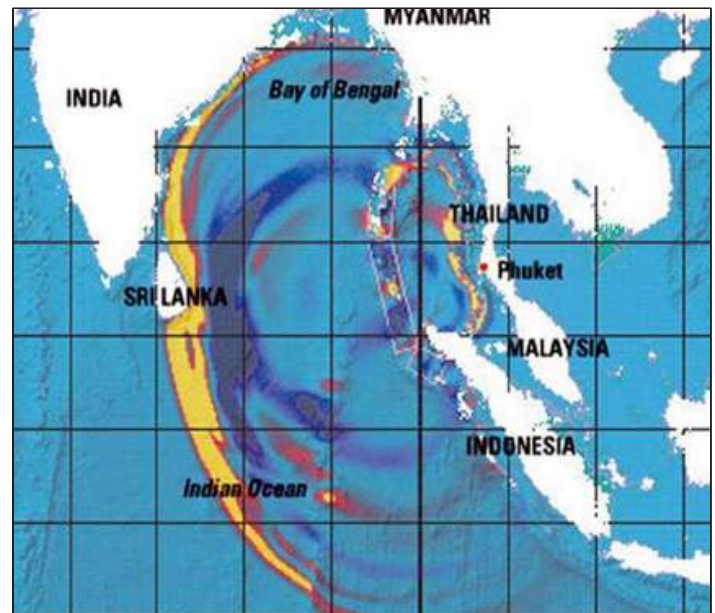
Q2. Explain the formation of thousands of islands in Indonesian and Philippines archipelagos.

Q3. Why are the world's fold mountain systems located along the margins of continents?

TSUNAMI

Tsunami/ Seismic Wave (Harbour Wave)

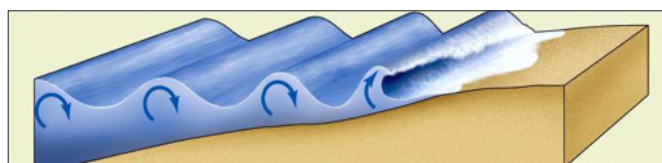
- Tsunamis result when earthquakes change the seafloor.
- Normal faulting drops the seabed; thrusting raises it.
- This displaces the entire volume of overlying water.
- A giant mound (or trough) forms on the sea surface.
- On December 26, 2004, a strong megathrust earthquake (M9.0+) originated in the trench to the west of N. Sumatra.
- Killed nearly 3 lakh people in 10 countries surrounding the Indian Ocean.



Tsunami vs. Wind Waves

Wind Waves	Tsunami Waves
Influence the upper ~100 m.	Influence entire water depth
Have wavelengths of several 10s to 100s of meters.	Have wavelengths of several 10s to 100s of kilometers.
Wave height and wavelength related to windspeed.	Wave height and wavelength unaffected by windspeed.
Wave velocity maximum several 10s of kph.	Wave velocity maximum several 100s of kph.
Waves break in shallow water and expend all stored energy.	Waves come ashore as a raised plateau of water that pours onto the land.

Wind-driven waves contain a small volume of water, and do not submerge higher areas.



Tsunamis are so wide (measured perpendicular to shore that, like a plateau of water, they submerge the land.

