



Earthquake in Tibetan China and Nepal

For Prelims: [Earthquake](#), [Mt Everest](#), [Indian Tectonic Plate](#), [Himalayan mountain range](#), [Pangaea](#), [Bureau of Indian Standards](#)

For Mains: Tectonic Plate Movements , Seismic Zones of India, Tibetan Plateau and Earthquakes

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Why in News?

A magnitude 7.1 [earthquake](#) struck the [Tibetan region of China](#) and parts of [Nepal](#), causing widespread devastation. The quake's epicenter was in [Tingri County](#), within the [Lhasa Terrane](#), near the [Mt Everest region](#).

- This event aligns with findings from research identifying the [Qixiang Co Fault](#), a newly discovered tectonic [fault](#) facilitating the eastward movement of the Tibetan Plateau, thereby increasing seismic activity in the region.

What are the Causes of Earthquake in Lhasa Terrane?

- **Tectonic Plate Activity:** The earthquake is a result of the ongoing collision between the [Indian and Eurasian plates](#), which began around 50 million years ago.
 - The Indian plate continues to push into the **Eurasian plate** at a rate of about **60 mm per year**, causing tension to build up and eventually leading to earthquakes.
- **Historical Context:** Since 1950, more than 21 earthquakes of magnitude 6 or higher have been recorded in the **Lhasa terrane**.
 - The strongest of these was in 2017 near Mainling, Tibet Autonomous Region of China, with a magnitude of 6.9.

Indian Tectonic Plate

- Around 200 million years ago, during the breakup of the **supercontinent Pangaea**, the Indian plate, once part of **Gondwana**, began drifting northwards at 9 cm per year.
 - This movement led to a collision with the **Eurasian Plate**, resulting in the uplift of the [Himalayan mountain range](#), a process that continues today.
 - The Indian plate moves northeast at approximately 5 per year, driving Himalayan growth by underthrusting the Eurasian Plate.
 - The Indian Plate is bordered by the **Eurasian Plate to the north**, the **Australian Plate to the south-east**, the **African Plate to the south-west**, and the **Arabian Plate to the west**.

What is the Significance of Lhasa Terrane?

- **Lhasa Terrane:** The earthquake occurred in the Lhasa terrane, this region is home to large-scale infrastructure projects, including **China's world's largest hydroelectric dam**, which is being built on the [Yarlung Tsangpo River](#).
 - The Yarlung Tsangpo River enters India as the [Siang](#) and later the [Brahmaputra](#). This raises concerns in India regarding the potential impact on **water flow in Arunachal Pradesh and Assam**.
 - In 2004, a landslide in Tibet created a **glacial lake** that nearly flooded the Sutlej River, prompting India to monitor the situation closely.
- **Environmental Risks:** The Tibetan plateau holds significant water resources and is referred to as the '**third pole**' due to its **glaciers, rivers, and lakes**.
 - Earthquakes in the area can destabilize glaciers and change the course of rivers, increasing the risk of flooding.

What is the Qixiang Co Fault?

- **Geological Characteristics:** The QXCF is a **sinistral fault (left-lateral fault)**, meaning the blocks on either side of the fault move laterally in a left-handed direction relative to each other.
- **Significance in Tectonic Dynamics:** The QXCF serves as the most significant tectonic boundary across the **Qiangtang Terrane**, a major geological feature of the **Tibetan Plateau seismic zone** (one of China's five major seismic zones)
 - The QXCF helps central Tibet move eastward, adding to the region's complex changes caused by the collision of the Indian and Eurasian tectonic plates.
 - QXCF dynamics **may influence the frequency and intensity of earthquakes** in the area.

Why is the Himalayan Zone Seismically Active?

- **Tectonic Plate Convergence:** The Himalayas are the result of the collision between the Indian and Eurasian tectonic plates which are still converging at a rate of **40-50 mm/year**, causing constant tectonic stress and leading to seismic activity.
- **Continual Plate Subduction:** The Indian plate is being **continuously subducted beneath the Eurasian plate**, generating **strain** that is released through frequent earthquakes.
- **Presence of Fault Lines:** The region is crisscrossed by multiple fault lines, including the **Main Himalayan Thrust**, that are responsible for frequent seismic events.
 - These faults **store elastic energy that**, when released, causes earthquakes.
- **Complex Tectonic Interactions:** Besides the India-Eurasia collision, other tectonic features, such as the **subduction of the Eurasian plate beneath the Pamir Mountains**, also contribute to the region's seismicity.
 - This convergence of various tectonic forces increases the likelihood of earthquakes.

What is an Earthquake?

- **About:** An earthquake is the shaking of the Earth's surface caused by the **release of energy, generating seismic waves**.
 - These waves travel in all directions and are recorded on **seismographs**. The starting point beneath the surface is the **hypocenter**, and the point directly above it on the surface is the **epicenter**.
- **Types of Earthquakes:** There are four different types of earthquakes they are tectonic, volcanic, collapse and explosion.
 - A **tectonic earthquake** occurs when the [Earth's crust breaks](#) due to geological forces acting on rocks and adjacent plates, leading to physical and chemical changes.
 - A **volcanic earthquake** is triggered by **volcanic activity**, typically due to the movement of [magma within a volcano](#).
 - A collapse earthquake occurs in underground **caverns or mines**, caused by seismic waves from **surface explosions**. These earthquakes are **usually minor tremors**.
 - An explosion earthquake is an earthquake that is the result of the **detonation of a**

nuclear and/or chemical device.

- **Earthquake in India:** India is divided into four seismic zones by the [Bureau of Indian Standards](#): II, III, IV, and V. **Zone V is the most seismically active**, while Zone II is the least.
 - The [Indian Himalayan Region](#), being geologically active, primarily falls within Seismic Zones IV and V.

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EARTHQUAKE



ABOUT

- Shaking of the earth; caused due to release of energy, generating **seismic waves in all directions**

HYPOCENTER

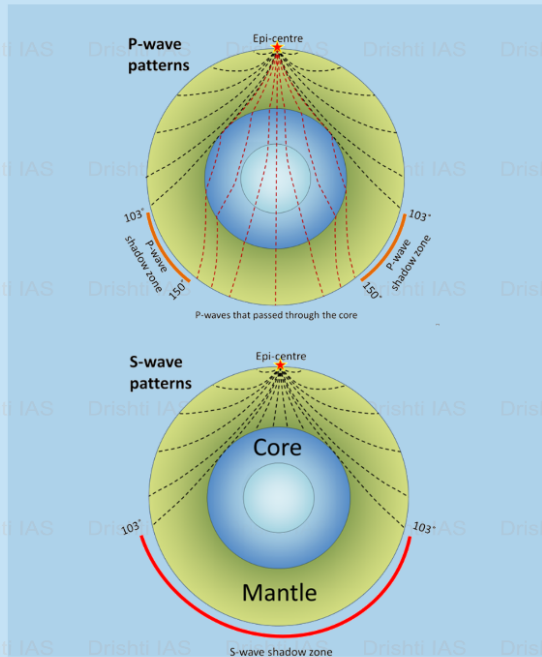
- Location where the earthquake starts (below earth's surface)

EPICENTER

- Location right above the Hypocenter (on the earth's surface)

EARTHQUAKE WAVES

- Body Waves:** Move in all directions travelling through the body of the earth
 - P Waves:** Move faster, First to arrive at surface, Similar to sound waves, Travel through gaseous, liquid and solid materials
 - S Waves:** Arrive at surface with some time lag, Travel only through solid materials
- Surface Waves:** Last to report on seismographs, More destructive, Cause displacement of rocks
 - Love Waves:** Same motion as S-waves (horizontal) without vertical displacement, Sideways motion perpendicular to the direction of propagation, Faster than Rayleigh waves
 - Rayleigh Waves:** Cause the ground to shake in an elliptical pattern, Spread out the most of all seismic waves, Move vertically and horizontally in a vertical plane



CAUSES OF EARTHQUAKES

- Release of energy along a **Fault/Fault Zones** (break in the crustal rocks)
- Movement of **tectonic plates (most common)**
- Volcanic eruption** (stress changes in rock-injection/withdrawal of magma)
- Human activities** (mining, explosion of chemical/nuclear devices etc.)

EARTHQUAKE IN INDIA

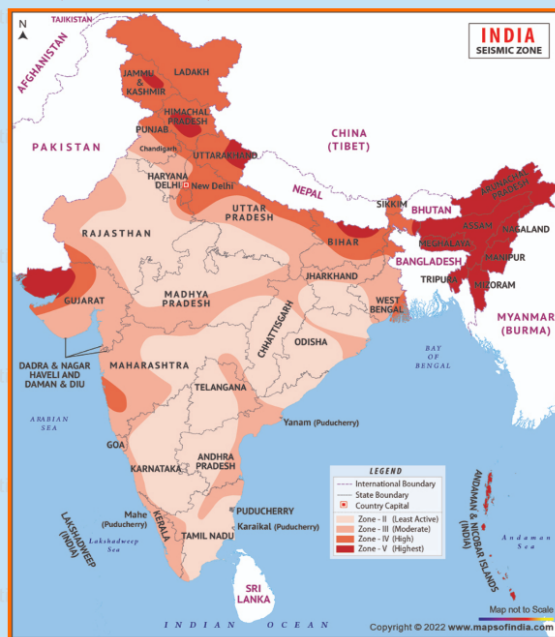
- India is one of the highly earthquake affected countries due to the presence of technically active mountains - the Himalayas.
- India has been divided into **4 seismic zones (II, III, IV, and V)**

MEASURING EARTHQUAKE

- Seismometers** - Measures seismic waves
- Richter Scale** - Measures magnitude (energy released; range: 0-10)
- Mercalli** - Measures intensity (visible damage; range: 1-12)

DISTRIBUTION

- Circum-Pacific Belt** - 81% of earthquakes
- Alpide Earthquake Belt** - 17% of the largest earthquakes
- Mid-Atlantic Ridge** - Mostly submerged underwater



Drishti Mains Question:

What are the factors contributing to high seismic activity in the Himalayan region, and how do the convergence of tectonic plates and fault lines increase earthquake likelihood?

UPSC Civil Services Examination Previous Year Question (PYQ)

Mains

Q. The frequency of earthquakes appears to have increased in the Indian subcontinent. However, India's preparedness for mitigating their impact has significant gaps. Discuss various aspects. **(2015)**

Q. Discuss about the vulnerability of India to earthquake related hazards. Give examples including the salient features of major disasters caused by earthquakes in different parts of India during the last three decades. **(2021)**

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