

# Earthquakes in the Indian Plate

## Distribution and Responsible Tectonics

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# Outline

## ① Introduction

Looking Back

Tectonic Provinces in India

## ② Tectonic setting and related seismicity

The major thrust/fault systems of the Himalayan arc

Major prominent Rifts

Regional seismicity of the North-Eastern Region

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# Elastic Rebound Theory

what i understood from the previous presentations

- The sudden slip at the fault causes the earthquake.
- Large elastic strain energy released spreads out through seismic waves that travel through the body and along the surface of the Earth.
- After the earthquake is over, the process of strain build-up at this modified interface between the rocks starts all over again.

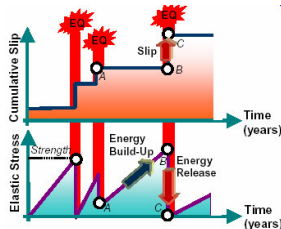


Figure : slip vs time and stress vs time

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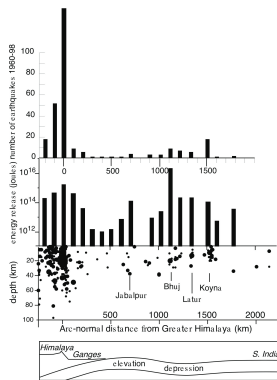
# Tectonic Provinces in India

The Indian landmass, covering an area of about 3.2 million sq km, has three broad morphotectonic provinces, namely

- Himalaya and Tertiary mobile belt
- Indo Gangetic Alluvial Plains (IGAP)
- Peninsular shield
- Indo-Burma Arc

Peninsular India constitutes one of the most prominent and largest Precambrian shield areas of the world. It is exposed to the south of the IGAP, which separates the Himalayas to the north and the peninsular India to the south.

While the Himalaya is a region of dominant compressional tectonics and the IGAP is a region of relatively less eventful recent sedimentation, peninsular India, in contrast, is a region marked by Early Archaean cratonisation with associated Proterozoic belts; the cratons are separated by 'rifts'.



**Figure :** Seismic and structural sections through the Himalaya and Indian plate. Cumulative numbers of earthquakes since 1960, and their equivalent energy release, are binned in 100 km arc-normal distances. The locations of significant events are named. Note the absence of seismicity below 40 km in the Indian plate. (Roger Bilham et al. 2003)

- India is currently penetrating into Asia at a rate of approximately 45 mm/yr and rotating slowly anticlockwise

## Plate-Boundary

The Himalaya marks the largest active continent-continent collision zone that has witnessed four great earthquakes in a short time span of 53 years between 1897 and 1950

## Stable(relatively) Continental Region

The Peninsular India is a mosaic of Archaean nucleus with peripheral Proterozoic mobile belts, Cretaceous volcanism and rift-drift Mesozoic passive coastal basins.

- It was reported that the seismicity of peninsular India is low despite its ongoing collision with Central Asia (Chandra, 1977).



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# The major thrust/fault systems of the Himalayan arc

spanning the entire length from north to south, are:

- the Indus Suture Thrust (IST)
- the Main Central Thrust (MCT)
- the Main Boundary Thrust (MBT)
- the Himalayan Frontal Thrust (HFT)

## Main Himalayan Seismic Belt

The seismicity between the MCT and MBT is defined as the Main Himalayan Seismic Belt (MHSB). Many large ( $M > 7.0$ ) and great earthquakes ( $M \geq 8.0$  and above) occurred in this belt.

During the last decade, two strong earthquakes ( $6.0 < M < 7.0$ ) occurred in the western Himalaya tectonic zone, the 1991 Uttarkashi and the 1999 Chamoli earthquakes and the 2005 Kashmir Earthquake.



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# The major prominent Rifts

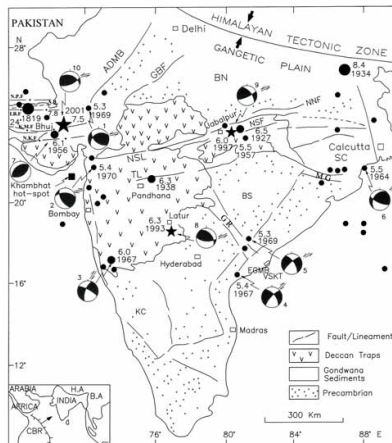
high separate the northern and southern blocks of the shield, are

## SONATA (Son-Narmada-Tapti Lineament) Zone

It is about 1000 km long and 50 km wide in the central part of India. Three strong/large earthquakes (M 6.0 7.7) occurred in peninsular India: the 1993 Killari earthquake in the southern block of the shield, the 1997 Jabalpur earthquake in the central SONATA zone

## Kutch rift

Kutch rift at the northwest at margin of the Indian shield has been plagued by the occurrence of the M 7.6 Bhuj 2001 earthquake less than two centuries after the 7.8 Allah Bund 1819 earthquake



**Figure :** Map showing seismotectonic domains in peninsular India and the significant earthquakes with fault plane solutions, the three strong earthquakes that occurred during the last decade are indicated by the star symbols

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# Regional seismicity of the North-Eastern Region

The high seismicity of the northeast Indian region has been attributed to a complex tectonic province displaying juxtaposition of the E–W trending Himalaya and the N–S trending Arakan Yoma belt.

The major tectonic background includes

- the eastern Himalayan structures,
- the Mishmi massif,
- the Indo Myanmar arc,
- the Brahmaputra valley, and
- the Shillong plateau.

The movement along the Po Chu fault, in the north- eastern part of the region, is believed to have caused the 1950 Great Assam Earthquake of M 8.7 (Ben-Menahem 1974; Thingbaijam et al 2008).

## Regional seismicity of the North-Eastern Region

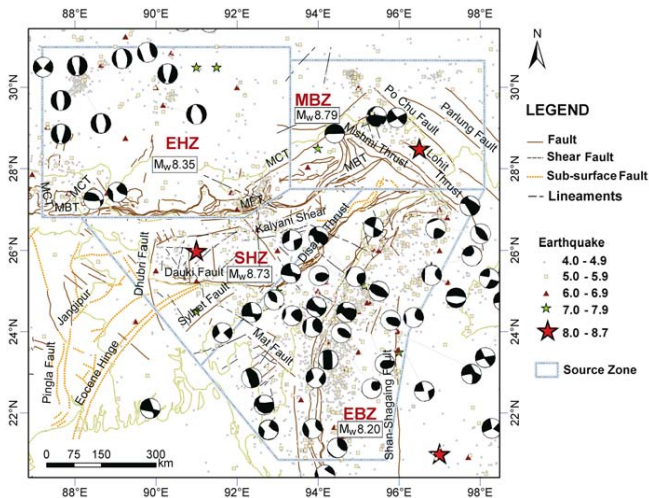


Figure : The four seismic source zones in the northeast Indian region



# Summary

- The **first main message** of your talk in one or two lines.
- The **second main message** of your talk in one or two lines.
- Perhaps a **third message**, but not more than that.
- Outlook
  - Something you haven't solved.
  - Something else you haven't solved.

# For Further Reading I



A. Author.

*Handbook of Everything.*

Some Press, 1990.



S. Someone.

On this and that.

*Journal of This and That*, 2(1):50–100, 2000.