Earthquakes in the Indian Plate

Distribution and ResposibleTectonics

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Outline

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Elastic Rebound Theory

what i understood from the previous presenations

- 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.

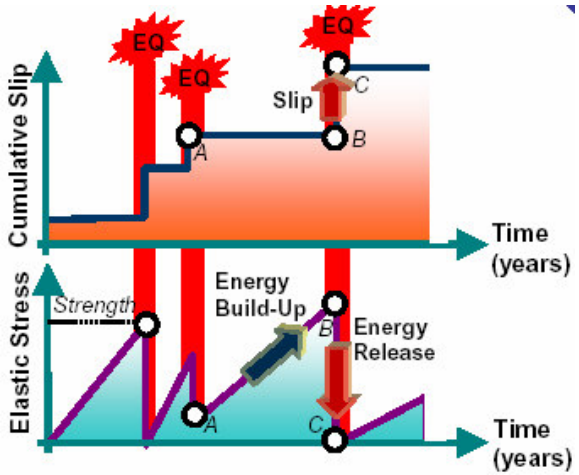


Figure : slip vs time and stress vs time

Outline

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'.

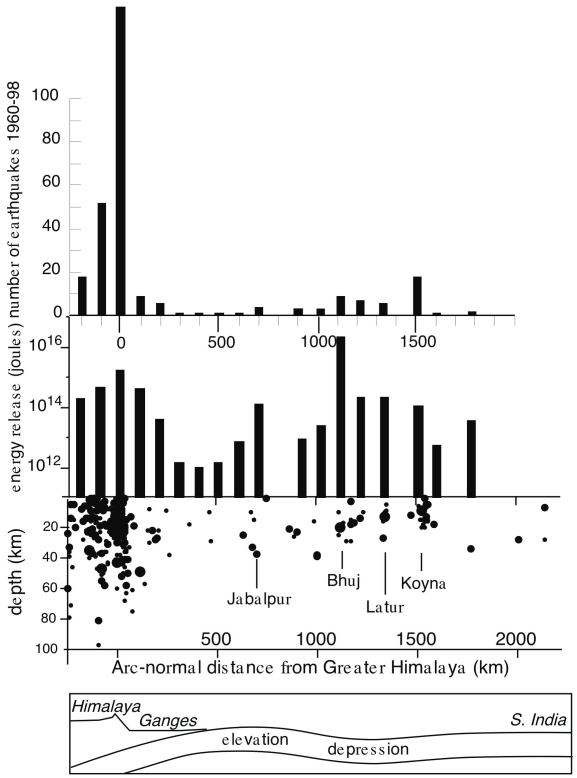


Figure : Seismic and structural sections through the Himalaya and Indian plate. Cumulative numbers of earthquakes since 1960, and their equivalent energy release, are binned in 100 km arc-normal distances. The locations of significant events are named. Note the absence of seismicity below 40 km in the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

Outline

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

Outline

The major prominent Rifts

hich 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 M 7.8 Allah Bund 1819 earthquake

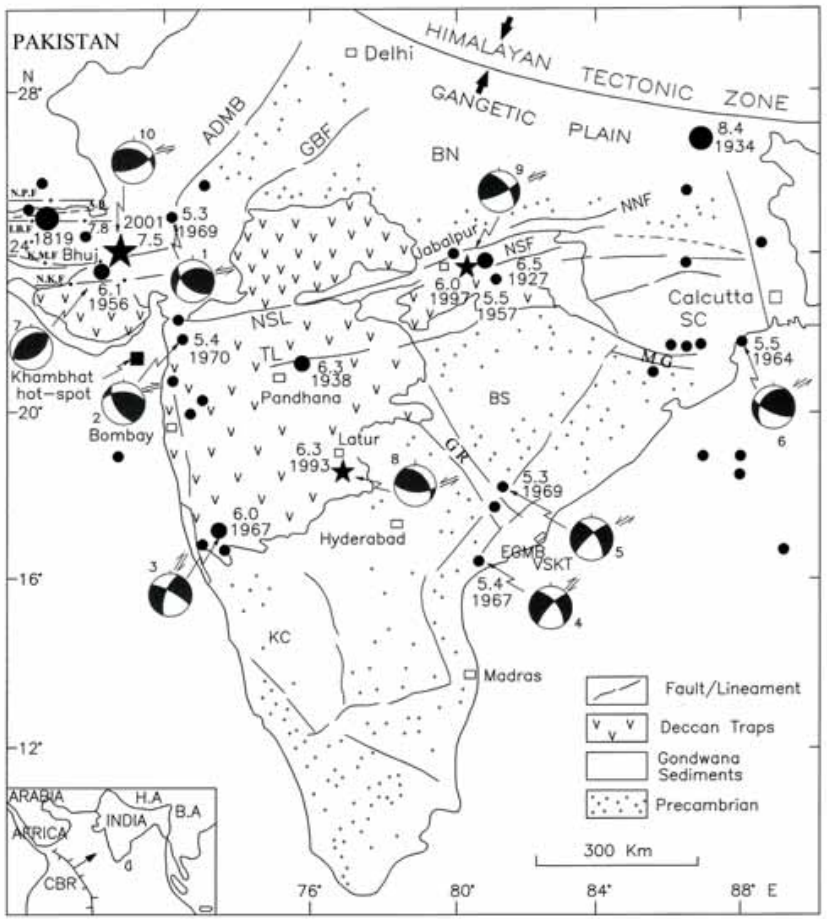


Figure : Map showing seismotectonic domains in peninsular India and the signficant earthquakes with fault plane solutions, the three strong earthquakes that occurred during the last decade are indicated by the star symbols

Outline

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).
- The Shillong plateau has been implicated with a pop-up tectonics associating the 1897 Great Earthquake of M 8.1
- The southern end of the Kopili fault is believed to have generated the 1869 Cachar earthquake of M 7.4.
- The Indo-Myanmar arc, sidelined by Patkoi-Naga-Manipur-Chin hills, has been associated with 1988 Manipur Earthquake of M 7.2

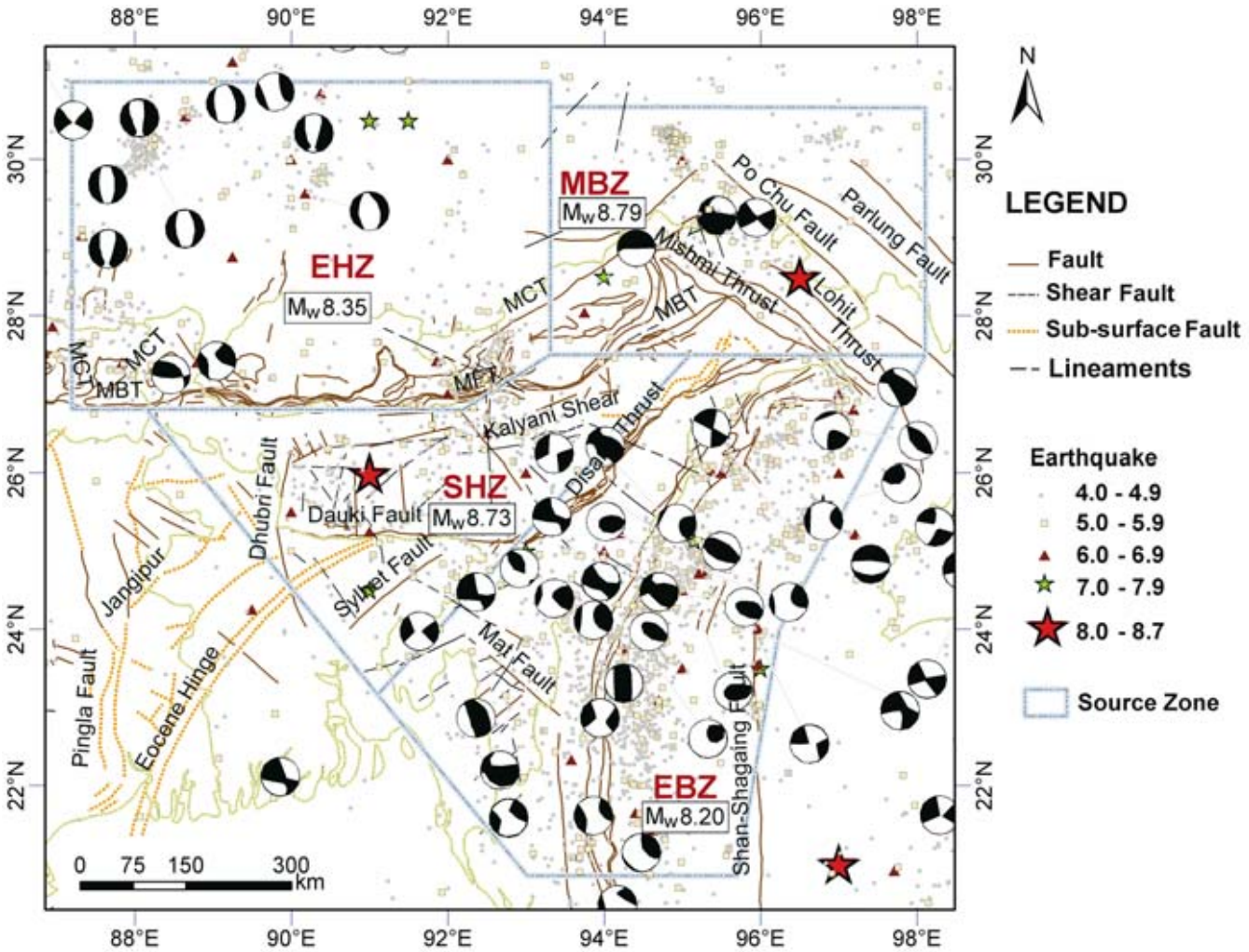


Figure : The four seismic source zones in the northeast Indian region. *Sankar Kumar Nath et al, 2008*

Outline

Regional seismicity of Indo-Burma Subduction Zone

- The Himalayan arc joins the Burma–Andaman-Sumatra-Sunda arc to the southeast, that defines a ˜5,500 km long boundary between the Indo-Australian and Eurasian plates from Myanmar (Burma) to Sumatra and Java to Australia (Curray et al., 1979).
- The Andaman-Sumatra section of the subduction zone has produced many large earthquakes in the past, some of which have also generated destructive tsunamis.
- The M 9.3 Sumatra-Andaman earthquake occurred by thrust faulting on the interplate thrust zone of the subducting Indian plate and overriding Burma plate;
- It ruptured more than 1300 km length of the arc in the north direction, from Sumatra to Andaman island, which included segments that were ruptured by the past large earthquakes

Outline

The Medvedev–Sponheuer–Karnik scale

The varying geology at different locations in the country implies that the likelihood of damaging earthquakes taking place at different locations is different. Thus, a seismic zone map is required so that buildings and other structures located in different regions can be designed to withstand different level of ground shaking. The zoning is done by the:

The Medvedev–Sponheuer–Karnik scale

also known as the MSK or MSK-64, is a macroseismic intensity scale used to evaluate the severity of ground shaking on the basis of observed effects in an area of the earthquake occurrence.

Outline

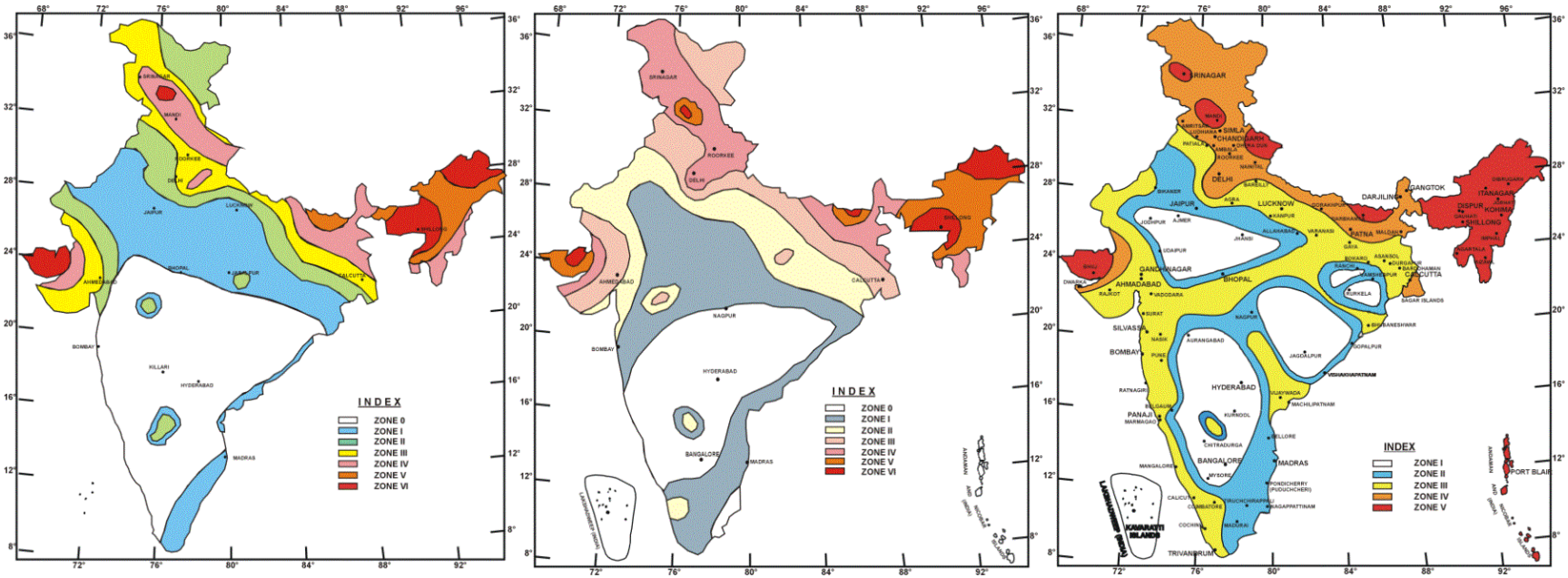
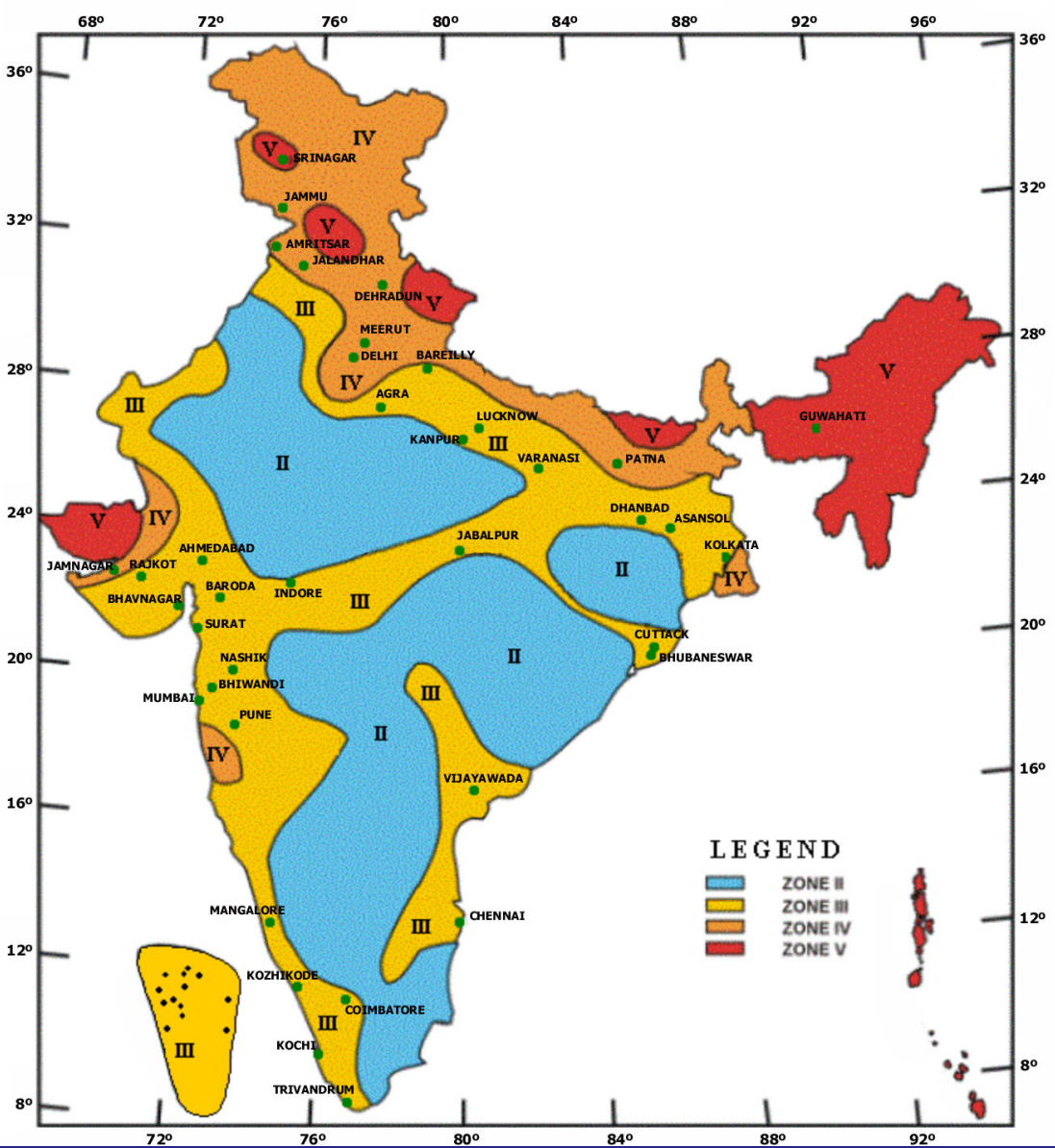


Figure : History of Seismic Zone Map of India: 1962, 1966, 1970

Recent Map indicating Earthquakes Zones in India (IS 1893 – 2002)



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.