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Geodynamics and Seismo-Tectonics of North East India: A Review

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Abstract

The North Eastern Region (NER) of India is one of the most seismically active regions of the world. It consists of Eastern Himalayas, Indo-Myanmar Arc and Himalayan Syntaxis that lies between Eastern Himalayas and Indo-Myanmar Arc. Entire NER of India falls under seismic Zone V of Indian seismic zonation. Keeping the Indo-Myanmar Region (i.e. Nagaland, Manipur, Lower Assam and Mizoram) in seismic Zone V was argued by VK Gahalaut et al (2013) based on GPS studies. The presence of Shillong plateau adds the complexity of this region. This region is traversed by several major faults such as Sagaing fault (Myanmar), Dauki fault (Meghalaya, India), Kopili fault (Assam, India), Churchandpur Mao Thrust (Manipur, India) and Eastern Boundary Thrust or Kabaw fault (Myanmar). Even though there are evidences of subduction and presence of subducted slab under Indo-Myanmar arc, the recent GPS measurements and analysis by VK Gahalaut et al (2013) suggested that this boundary acts as a transform fault boundary. Seismo-tectonic study carried out by Nandy (2005) indicated the probability of large scale earthquake in Himalayan Syntaxis zone in near future.

Keywords; Eastern Himalayas, Indo-Myanmar Range, Syntaxis, Main Boundary Thrust, Seismic zonation, GPS, Churchandpur Mao Thrust, Eurasian plate

Introduction

The North Eastern Region (NER) of India is one of the most seismically active region of the world. It consists of Eastern Himalayas (subduction boundary between Indian plate and Eurasian plate), Indo-Myanmar Arc (subduction boundary between Indian plate and Myanmar plate) and Eastern Himalayan Syntaxis that lies between Eastern Himalayas and Indo-Myanmar Arc. This zone is characterised by high seismicity and erosion. Entire NER of India falls under seismic Zone V of Indian seismic zonation. This is considered to be most vulnerable to earthquake hazard. Chen and Molnar (1990) suggested that earthquake might have occurred within subducting Indian plate and not at the interface between the subducting Indian plate and overriding Eurasian plate. Indian and Eurasian plate started to converge during late cretaceous and followed by closing of Neo-Tethys sea. The Himalayan Mountain chain is formed due to this conversion movements of plates. Indo-Eurasian plate collision started since about 50 Ma before present and absorbs about 20mm/year (Sridevi Jade et al, 2016).NER has highly complex geological and tectonic evolutionary history. This region is traversed by several major faults such as Sagaing fault (Myanmar), Dauki fault (Meghalaya, India), Kopili fault (Assam, India), Churchandpur Mao Thrust (Manipur, India) and Eastern Boundary Thrust or Kabaw fault (Myanmar). Shillong plateau and its northern extension in Mikir hills have different geologic position that adds tectonic and seismic complexity in this region.

Discussion

Eastern Himalayas mark the collision boundary between under-thrusting Indian plate beneath Eurasian plate resulting in crustal shortening and rising Himalayas. Eastern Himalayan range is characterised by a series of north heading thrust. Important thrust are main boundary thrust (MBT), Main Central thrust (MCT) and Main Frontal Thrust (MFT). Seismicity in this region is due to the collision of Indian plate and Eurasian plate. Shallow earthquakes are located along MBT and MCT due to the movement of these thrust faults (Pulama

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Talukdar et al, 2012). MFT is considered as the surface exposure of Main Himalayan Thrust (MHT) that marks the end of the Himalayan orogeny towards the south (Sridevi Jade et al, 2016).

Indo-Myanmar Range evolves as an accretionary prism along the subduction margin of the Indian plate below the Myanmar plate. Indian plate moves towards north-east while Myanmar plate moves northward with transcurrent movement along Sagaing fault (Subhamenon, 2013). Guzman-Speziale and Ni (1996) suggested that the relative plate motion between Indian plate and Myanmar plate has been transferred from subduction along the arc to right lateral motion along Sagaing fault to the east.This accretionary wedge is consists of ophiolite (Cretaceous), pelagic sediments(Cretaceous to Eocene) and flysch (Eocene to Oligocene) overlain by Neogene shallow water sediments. Myanmar Central Basin (MCB) is separated from IMR by Kabaw fault. The median line of IMR is a major water divide in between Chindwin-Irrawaddy drainage system in the eastern side and Brahmaputra-Ganga drainage system in the western side.Subduction of Indian plate below Myanmar plate was detected by Fitch (1970) and followed by many workers. The complex geological and tectonic evolutionary history of IMR is closely related to the evolution of Bengal Basin, Central Myanmar Basin and Andaman Nicobar Island Arc. IMR is a broadly N-S trending arcurate fold thrust belt located between the Bengal Assam Basin to the west and Central Burma Basin to the east (Acharya, 2010). This range is characterised by Arakan Yoma, Chin Hills, Sagaing Fault, Naga thrust and Disang thrust. This is the most seismically active region of the north –eastern region of India (Pulama Talukdar et al, 2012).It is subdivided into Naga Hills, Chinhills and Arakan Yoma and continuous up to Andaman Nicobar Island Arc.It is characterised by intermediate earthquake suggesting subduction plate boundary. This region has experienced 20 large earthquake (Saurabh Baruah, 2008) and 3 great earthquakes in last 100 years (Pulama Talukdar et al, 2012).Churchandpur Mao Fault (CMF) is the present most active plate boundary fault or active deformation front between India and Myanmar plate (VK Gahalaut et al, 2013).Even though there are evidences of subduction and presence of subducted slab under Indo-Myanmar arc, the GPS measurements and analysis by VK Gahalaut et al (2013) suggested that this boundary acts as a transform fault boundary.

Eastern Himalayan Syntaxis is the meeting place of Himalayas and Myanmar Arc. This region consist of Lohit thrust, Mishmi thrust and a part of Disang thrust (Pulama Talukdar et al 2012). This place is characterised by shallow seismic activities and large magnitude (e.g. Shillong Earthquake, 1897). This may cause fatal destruction of this region. This tectonic block is traversed by important thrust like Mishmi thrust, Tiding suture, Lohit thrust and Po Chu fault (Pulama Talukdar et al, 2012). A cluster of earthquake has observed in the south-east part of this region. Shillong plateau had been activesince cretaceous to recent. Seismo-tectonic study carried out by Nandy(2005) indicated the probability of large scale earthquake in this zone in near future.

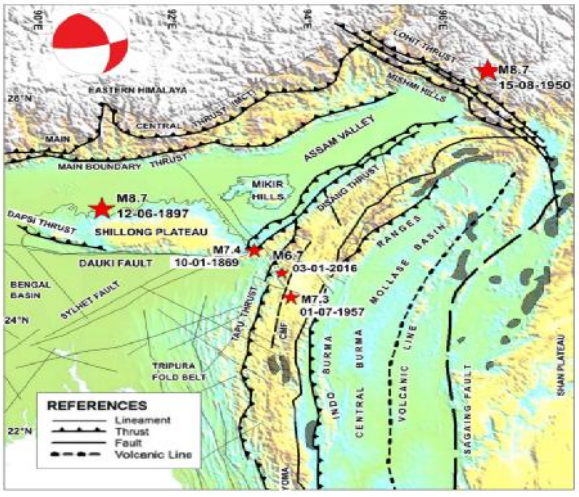

Fig.1 Seismo-tectonic map of north-east India. Stars show the epicentres of major earthquakes.
(Source: Arunkumar et al, 2016)

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In seismic hazard zonation map of India, entire NER is placed in seismic Zone V. However, putting the Indo-Myanmar Region (i.e. Nagaland, Manipur, Lower Assam and Mizoram) in seismic Zone V was argued by VK Gahalaut et al (2013) based on their findings.They opined that earthquake hazard in the Indo-Myanmar arc region due to great and major inter-plate earthquake is extremely low and modern seismological history of the past 50 years indicates seismicity within the subducted Indian plate (>40Km depth) which is considered as intraplate earthquakes.

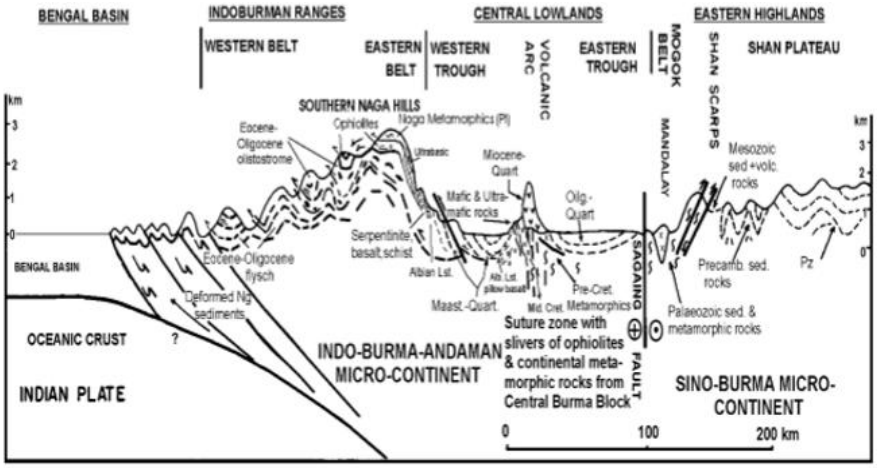

Fig. 2 Map showing cross section of major morphological and structural units of Indo-myanmar Range and Central Myanmar Basin (Source: Acharya, 2010)

Conclusion

The North Eastern Region (NER) of India is one of the most seismically active region of the world. This region has highly complex geomorphological structure and tectonic history. It consists of Eastern Himalayas, Indo-Myanmar Arc and Himalayan Syntaxis that lies between these two ranges. These folded region is criss cross by many faults and still they are active.So, seismic hazard are prone here. Seismo-tectonic study carried out by Nandy (2005) indicated the probability of large scale earthquake in Eastern Himalaya Syntaxis in near future. Shallow earthquakes are located along MBT and MCT due to the movement of these thrust faults (Pulama Talukdar et al, 2012). But, keeping of the Indo-Myanmar Region (i.e. Nagaland, Manipur, Lower Assam and Mizoram) in seismic Zone V was argued by VK Gahalaut et al (2013). Even though there are evidences of subduction and presence of subducted slab under Indo-Myanmar arc, recent GPS measurements and analysis by VK Gahalaut et al (2013) suggested that this boundary acts as a transform fault boundary and probability of large magnitude earthquakes are low.

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