

## Seismic Scenario of North East, India: A Mini Review

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### Abstract:

No region in India can be considered as earthquake free due to the ongoing seduction of the Indian plate under the Eurasian plate. In this study, a review has been made to compare some of the major the Earthquake happened in the north-East India in the past that has led to severe damage. Magnitude and other parameters of earthquakes in the region are collected from various sources like International Seismological Centre, Volcanodiscovery.com and many other research papers etc. Then, those data's were analyzed. North East region is classified under high risk seismic zone of India. This region has witnessed devastations due to many earthquake in past. One of the biggest earthquakes was recorded on the evening of 15 Aug, 1950. This study attempts to provide an overall perspective of past North-East Indian earthquakes and interesting features of the same.

**Keywords —Earthquake, North-east India, Depth of earthquake, The great Assam earthquake**

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### 1. INTRODUCTION

The Indian subcontinent has a history of many devastating earthquakes in the past. The main reason for the high frequency and intensity of earthquake is that the movement of Indian plate towards the Eurasian plate at a rate of about 50 mm/year. According to BIS in 2002, Indian earthquake zoning map is divided into 4 seismic zones (Zone 2, 3, 4 and 5). Where zone 5 is with the highest level of Seismicity and Zone 2 associated with the lowest level of seismicity. Earthquakes in North-East India have shown some remarkable features which have implications on strategies for reducing earthquake disasters in the country [1]. For instance, during 1897 to 2019, the Region was hit by more than 20 earthquakes with magnitudes greater than 7.0. However, the frequency of moderate earthquakes (with magnitude 6.0 to 7.0) in the country is rather low. Also, we have also not

seen earthquake shaking intensity of more than VIII or IX in the last 70 years [2].

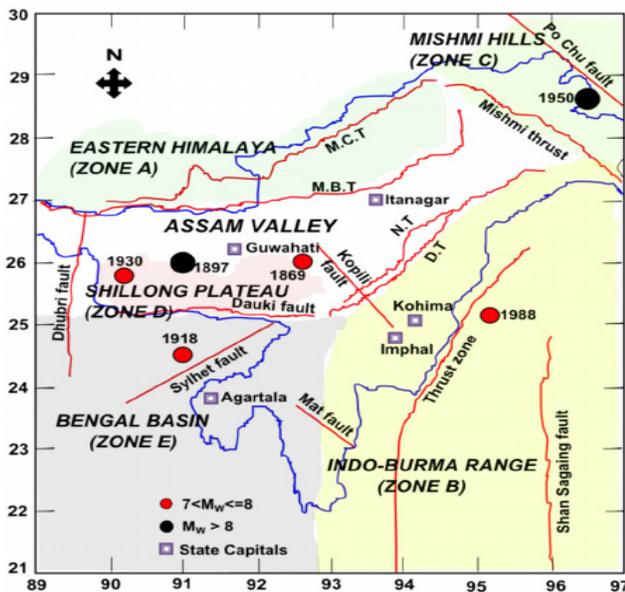
### 2. STUDY AREA

The northeast Indian region has been placed in zone V, the highest level of seismic hazard potential, According to the seismic zonation map of India (BIS 2002). Geographically, apart from the Brahmaputra, Barak and Imphal valleys and some flatlands in between the hills of Meghalaya and Tripura, the remaining two-thirds of the area is hilly terrain interspersed with valleys and plains; the altitude varies from almost sea-level to over 7,000 metres (i.e 23,000 ft) above Mean sea level. As such there have been incidents of two great earthquakes – 1897 Shillong Earthquake, and 1950 Assam Earthquake in the region [3]. The Geology and tectonics of the region have been discussed by Brunschweiler (1966) and Evans

(1964).The Area comprises the following major tectonic units-

- 1.Eastern Himalaya
- 2.Mishmi block, including Mishmi and Lohit thrusta
- 3.Assam valley
- 4.Shillong Plateau and Mikir Hills
- 5.Araikan-Yoma Folded Belt
- 6.Bengal Basin.

The Himalayan structures comprise of thrust planes namely Main Central Thrust (MCT), Main Boundary thrust (MBT), Main Frontal Thrust (MFT),and their subsidiary thrusts[4]. The Mishmi region traversed by Mishmi thrust, Lohit thrust, Po Chu fault, and Tidding suture forms a prominent tectonic intricacy.



### 3.METHODS

The study was conducted from data's collected from various sources like International Seismological Centre, Volcanodiscovery.com,

United States Geological Survey and many other research papers etc. Parameters like Frequency and Depth of earthquake in the region are analyzed in this paper from 1897 to 2020. To find a overall perspective of past earthquakes, results are compared with the help of Frequency curve and Bar graphs.

### 4. DISCUSSION

The great Assam Earthquake of 1897 with magnitude 8.7 is the largest known Indian intraplate Earthquake at 26.0 N, 91.5 E[5]. Over Shillong plateau. The Shillong pleatu is even now one of the most active areas of the region having experience a major earthquake in 1923 near Dauki in Meghalaya and the 1930 near Dhubri district of Assam. The Burmese folded Belt including the Arkan-Yoma and the Burmese Molasse Basin is the Most active area of the region. There are several events of magnitude occurred which are greater than 7.0 have taken place in 1897,1906,1908,1915,1918,1923,1930,1931,1932, 1938,1943,1946,1947,1950,1950,1954,1957,1976,19 88 and 1991.The Assam valley to the east of Mikir hills has experienced an event of magnitude 7.2 in 1943. In eastern Himalaya an event of magnitude 7.7 has taken place near the Crystalline Thrust in 1947.In Bengal basin an event of magnitude 7.6 took place in August at Srimangal in 1918[6].Northeast India is seismically one of the six most active regions of the world, the other five being Mexico, Taiwan, California, Japan and Turkey[7]. One of the most devastating earthquakes in Indian history with magnitudes 8.5 took place in August 1950 to the North-East of Lohit Thrust. The north-eastern part of the India is not only located at the centre of one of the most active earthquake prone regions of the country, but is also exposed to very high damage given the nature of the terrain.

Sl. No.	Year	MMd D	HHMM	SS.S	Lat(N)	Long(E)	Depth(KM)	Mag
1	1897	0612	1106	0.0	25.900	91.000	60	8.7
2	1906	0831	1457	30.0	27.000	97.000	100	7.0
3	1908	1212	1254	0.0	26.500	97.000	0.0	7.5
4	1915	1203	0239	19.0	29.500	91.500	0.0	7.1
5	1918	0708	1022	7.0	24.500	91.000	15	7.6
6	1923	0909	2203	42.0	25.300	91.000	35	7.1
7	1930	0702	2103	34.0	25.800	90.200	0.0	7.1
8	1931	0127	2009	21.0	25.400	96.800	60	7.6
9	1932	0814	0439	39.0	25.800	95.700	120	7.0
10	1938	0816	0427	55.0	22.500	94.500	65	7.3
11	1943	1023	1723	17.0	26.800	94.000	15	7.2
12	1946	0912	1517	17.0	23.900	96.200	60	7.5
13	1947	0729	1343	20.0	28.800	93.700	60	7.7
14	1950	0815	1409	28.5	28.460	96.660	15	8.7
15	1950	0826	0633	06.0	26.800	95.000	0.0	7.0
16	1954	0321	2342	17.0	24.200	96.100	180	7.3
17	1957	0701	1930	22.0	24.380	93.760	41	7.2
18	1976	0529	1400	18.50	24.530	98.710	10	7.0
19	1988	0806			25.150	95.130	91	7.5
20	1991	0105	1457	11.50	23.610	95.900	20	7.1
21	2011	0918	1240	51.0	27.730	88.155	20	6.9

Table1: List of some major earthquakes in North-East India from 1897 to 2020

*4.1. Frequency of Earthquake in North-East region:*

The great Assam Earthquake of 1897 with magnitude 8.7 is the largest known Indian intraplate Earthquake. It raised the northern edge of Shillong plateau by more than 10 m, resulting in the huge destruction of structures over much of the plateau and surrounding areas, which causes flooding in the Brahmaputra and Sylhet floodplains. There was a minimum displacement on the main fault of 11 m, although up to 16m has been calculated, one of the greatest for any measured earthquake. The calculated area of slip extended 180 km along strike and from 9-45 km below the surface, indicating that the entire thickness of the crust was involved. In Cherrapunji, it resulted in a landslide, which led to 600 death. In Goalpara, it resulted in waves from the Brahmaputra river, on

which bank the town is situated, destroying the market. In Guwahati, the earthquake lasted for 3 minutes. The Brahmaputra river rose by 7.6 ft. Damage was caused to Umananda temple and railway lines. The 1950 Assam-Tibet earthquake, also known as Medog earthquake occurred on evening of August 15, and had a magnitude of 8.7. It is the sixth largest earthquake of the 20<sup>th</sup> century. The epicentre was destructive in both Assam and Tibet, and 48,00 people were killed. According to Dr. S.K Banarji (Rao,1952 ),the energy of the earthquake was of the order of 10.27 Ergs. The conclusion of Dr. Banarji studied that in this earthquake a block of rock extending 200 km × 100 km and 10 km thick must have been subjected to breaking stress on the surface. Earthquake of magnitude of 6.9 on Richter Scale struck Sikkim on September 18, 2011. This earthquake caused huge destruction of property and loss of lives. Sikkim one of the states of Northeast India falls in the seismic Zone-IV, while other states of the region in the highest seismic risk Zone-V[12]. The earthquake is notable as being the largest recorded quake caused by continental collision rather than subduction, and is also notable for the loud noises produced by the quake and reported throughout the region. It is also the biggest known earthquake to have not been caused by an oceanic subduction.

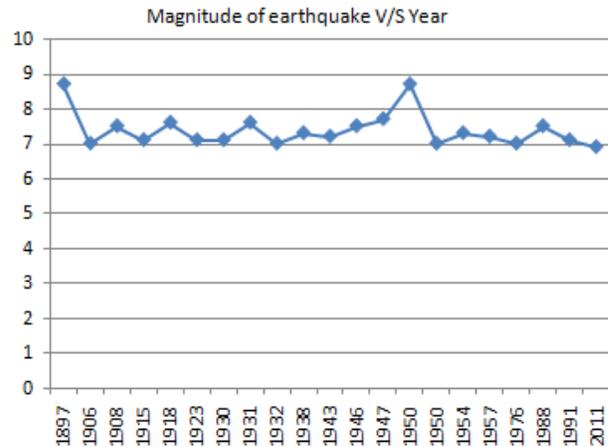


Fig1: Frequency Curve for Earthquakes with high magnitudes.

#### 4.2. Depth of Earthquake

A quake destructive force depends not only on its strength, But also on location, distance from the epicentre and depth. Depth of Earthquakes are basically divided into three zones depend of depth on depth range of 0-700 km. Those are shallow, intermediate and deep. Shallow earthquakes are between 0 and 70 km deep, intermediate earthquakes, 70-300 km deep and deep earthquakes, 300-700 km deep. Shallow Earthquakes generally tend to be more damaging than the deeper quakes. Seismic waves from deep quakes have to travel farther to the surface, losing energy along the way. Also, the depth of earthquakes gives us information about the earth's structure and the tectonic setting where the earthquake is occurring. Seismic velocities depend on the properties of material such as composition, pressure and temperature of the media through which seismic waves pass. Seismic wave travels faster in denser medium and generally travel more quickly with depth. Hot areas below the earth's surface slow down seismic waves. Seismic waves move more quickly through a solid than a liquid.

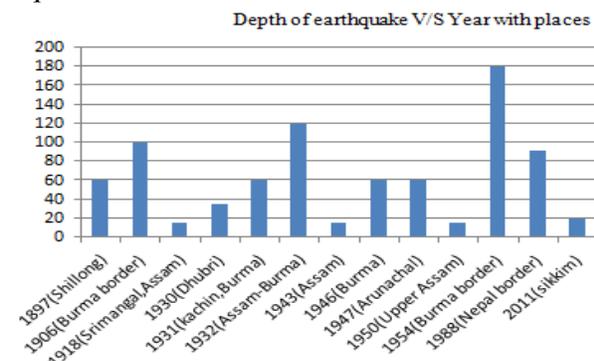


Fig2: Bar diagram for Depth of earthquakes with years and places.

Molten areas within the earth slow down P-waves and stop S-wave because their shearing motion cannot be transmitted through a liquid. Partially molten areas may slow down the P-waves and attenuate or weaken S-waves.

if we compare the depth of some of the major earthquakes in the North-East India till now, Depth of earthquake in 1950 of Upper Assam was very less than the others and the depth of 1954 earthquake in Manipur-Myanmar border is very high. We can say, this is also a reason the shock damages more in Assam in terms of property loss than the earthquake of 1897.

#### 5.CONCLUSIONS

Northeast India is one of the intense zone for earthquakes, which cannot be prevented from occurring. So, we have to learn to live the earthquake hazard looming and try to minimize its adverse impact on human civilization. Earthquake hazard is one the most deadly natural disasters which claims the lives of large number of person without any warning. These deadliest destructions were mainly caused due to the collapse of structures and buildings. Hence, to mitigate this natural disaster following are the some pre preventive measures we can follow-

- Know well about seismic zone areas of own locality and ensure experts to help in making our houses earthquake resistant.
- School, colleges and other organisations should make some awareness programs.
- Prepare an emergency kit and place it in safe place so you can use it in needy hours.
- As prediction of earthquake is not possible till date, So don't listen to or spread rumours.

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