Recent earthquakes in Arunachal Himalaya

Of late, there has been a rise in the number of earthquakes in the North East Region (NER) of India. Very recently, a mild tremor shook the East Kameng district of Arunachal Himalaya, when a shallow-depth (16.8 km) earthquake of \( M_w \) 5.5 with epicentre 27.707°N and 92.890°E struck at UTC 09 h 22 m 15 s (14 h 52 m 14 s ITC) on 19 July 2019 (refs 1, 2). Importantly, within half an hour two aftershocks were recorded, one in the same epicentral zone of the \( M_w \) 5.5 earthquake and another at the southern site of East Kameng district\(^2\) (Table 1). A \( M_w \) 4.9 earthquake was recorded at UTC 22 h 54 m 24 s (04 h 24 m 23 s ITC) on 20 July 2019) with epicentre 27.736°N and 92.810°E and depth of 10 km. The highest impact of these earthquakes was felt in the epicentral zone of East Kameng district and in the adjoining regions of Arunachal Pradesh, Guwahati and other parts of Assam and Dimapur, Nagaland. The NER is one of the highly seismically active regions\(^3,4\) and falls in the zone V in the seismic zoning map of India (BIS 2004)\(^5\). In this context, these felt events are significant because of their epicentral region being located in the NER itself. Figure 1 shows the epicentral plot of the earthquakes and focal mechanism of two earthquakes (from USGS) with prominent tectonic elements of NE India.

The workshop also helped explore career options available for women with an interest and understanding of science. It provided baseline information for career building and guidance to skill up as a science journalist. The entire session was devoted to the researchers for understanding their moral obligation to develop science temper in the society. The secret for becoming a science journalist is hidden in the personal commitment made to oneself to take charge of one’s own career. The workshop imparted an appetite for career in science journalism by empowering the participants with values, networking and collaboration. The facilitators gave a mantra for a successful career in science journalism – SMART (S, specific, M, measurable, A, agreed, R, realistic, T, time-based) action approach to make specific time-constrained, self-motivating goals.

Bharati Patel*, Jawaharlal Nehru Tropical Botanic Garden and Research Institute, Thiruvananthapuram 695 562, India; Binita Shah, National Institute of Industrial Engineering, Mumbai 400 087, India. *e-mail: bharati.patel09@gmail.com
Main Boundary Thrust (MBT) are the major crustal discontinuities spanning along the northernmost boundary of NE India.

The dominant mechanism behind the active seismicity of NE of India is presumably ascribed to the continental collision between the Indian and Eurasian Plates. GPS measurements indicate continental drift. GPS observations in NE India indicate that about 15–20 mm/yr of convergence is being accommodated in India, indicating that about 15–20 mm/yr of continental drift. GPS observations in NE India indicate that about 15–20 mm/yr of convergence is being accommodated in India. The movement on thrust faults. The focal mechanism solution of these three earthquakes indicate collision or underthrusting of the Indian Plate below the Himalaya and seismically very active under higher stress.

Considering this growing rise in felt tremors, there is a need for preparedness so that probable damage can be reduced. As earthquakes cannot be averted, we can effectively mitigate the hazard through a synergistic approach by policy makers and subsequent scientifically robust implementation.

**Table 1. Parameters of Arunachal Himalaya earthquakes**

<table>
<thead>
<tr>
<th>ID</th>
<th>Date</th>
<th>Origin time (UTC)</th>
<th>Latitude (°N)</th>
<th>Longitude (°E)</th>
<th>Depth (km)</th>
<th>Magnitude</th>
<th>Strike/rake/dip</th>
<th>$M_w$ (N-m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>USGS1</td>
<td>Ev1 19 July 2019 09:22:15.635</td>
<td>27.707</td>
<td>92.809</td>
<td>16.8</td>
<td>5.5 ($M_w$)</td>
<td>244/32/108</td>
<td>2.136e+17</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ev2 19 July 2019 09:52:02.213</td>
<td>27.729</td>
<td>92.773</td>
<td>10</td>
<td>4.7 ($M_w$)</td>
<td>219/77/55</td>
<td>2.416e+16</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ev3 19 July 2019 22:54:24.709</td>
<td>27.736</td>
<td>92.810</td>
<td>10</td>
<td>4.9 ($M_w$)</td>
<td>219/77/55</td>
<td>2.416e+16</td>
<td></td>
</tr>
</tbody>
</table>

Figure 1. **a**, Tectonic settings of North East Region of India and surrounding regions with focal mechanism solution of three recent earthquakes. The great earthquakes of 12 June 1897 and 15 August 1950 are shown by two big stars. The seismic stations operated by IMD are shown by black triangles. The major tectonic features in the region are also indicated. MCT, Main Central Thrust; MBT, Main Boundary Thrust; DF, Dauki Fault; DT, Dapsi Thrust; Dhubri Fault; OF, Oldham Fault; CF, Chedrang Fault; BS, Barapani Shear Zone; KF, Kopili fault; NT, Naga-Disang Thrust; MT, Mishmi Thrust; LT, Lohit Thrust; Kabaw Fault. (Inset) Earthquakes with different magnitude range.

Main Boundary Thrust (MBT) are the major crustal discontinuities spanning along the northernmost boundary of NE India.

The dominant mechanism behind the active seismicity of NE of India is presumably ascribed to the continental collision between the Indian and Eurasian Plates. GPS measurements indicate continental drift. GPS observations in NE India indicate that about 15–20 mm/yr of convergence is being accommodated in the NE Himalaya wedge and also suggest that Eastern Himalaya is rotating clockwise at a very slow rate with respect to the Tibetan block in the north. Different studies on crustal structure imaged the Indian lithosphere dipping northward from ~150 km beneath the Himalaya to about ~210 km further north. Northward underthrusting of India beneath Eurasia generates numerous earthquakes and consequently makes this area one of the most seismically vulnerable regions on Earth. The largest earthquakes in the Himalayan region are caused mainly by the movement on thrust faults.

The focal mechanism solution of two recent earthquakes of 19 July 2019 ($M_w$ 5.5 and 4.9) indicates primarily thrust faulting. Another $M_w$ 5.9 earthquake was also recorded in the Eastern Himalayan Syntaxis at UTC 20 h 15 m 50 s on 23 April 2019 with epicentre at 28.407°N, 94.561°E and depth 14 km. The focal mechanism solution of this event (strike: 234, rake: 15, Dip: 62) also shows thrust faulting (Figure 1). These earthquakes are recorded south of the MCT and focal depth is estimated to be less than 20 km. The focal mechanism solutions of these three earthquakes indicate collision or underthrusting of the Indian Plate below the Himalaya and seismically very active under higher stress.

Considering this growing rise in felt tremors, there is a need for preparedness so that probable damage can be reduced. As earthquakes cannot be averted, we can effectively mitigate the hazard through a synergistic approach by policy makers and subsequent scientifically robust implementation.


Dipok K. Bora*, Department of Physics, Diphu Government College, Diphu 782 462, India; Rajib Biswas, Geophysical Lab, Department of Physics, Tezpur University, Tezpur 784 028, India.

*e-mail: dipok23@gmail.com