Seismicity and convergence partitioning in the eastern Himalaya

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Seismotectonics of the eastern Himalaya appears fundamentally different to the one in central and western Nepal. Potentially, this may indicate a current tectonic reorganisation of the Himalaya.

Present-day seismicity of the Himalaya has been interpreted in terms of (1) fault interaction by transfer of stress, both on timescales of earthquake sequences and aftershocks, and on longer timescales where the seismicity is associated with the inter-event time of the largest shocks that occur in a given region (Stein, 1999); and (2) the combination of crustal processes governing the Pliocene-Quaternary deformation of the Himalayan orogen. For example, kinematic models of seismic data in the central Himalaya (Cattin and Avouac, 2000) suggest that since the M 8.4 Bihar earthquake (1934), the Main Himalayan Thrust (MHT) in central and eastern Nepal has remained locked from the trace of the Main Frontal thrust (MFT) to ~100 km downdip. This process has resulted in stress build-up, triggering seismic activity observed in Nepal in a belt about 100 km from the foothills. The Himalayan seismic belt extends actually along the entire Himalayan arc, but the frequency of the earthquakes is not uniform, with the largest seismic gap in the Bhutan Himalaya (Gahalaut et al., 2011).

Causes of the Bhutan seismic gap may be multiple: (a) The entire MHT beneath the Bhutan Himalaya has been locked and a large (> M 8) earthquake is overdue; (b) The M ~8.1 “Great Assam earthquake” of 12 June 1897 that hit the northern Shillong Plateau (North-eastern India), has caused a stress shadow in the Bhutan Himalaya; (c) The partitioning of Himalayan contraction into the MHT and strike slip faults that dominate the seismotectonics of the eastern Himalaya.

We investigate the two latter possibilities by calculating the Coulomb stress changes along two seismically active faults and the resulting Coulomb stress changes along dozen potential receiver faults. Our calculations demonstrate that the Great Assam Earthquake caused only minor stress drop along the MFT of Bhutan, and it did not affect the MHT. However, the event has caused major stress loading in the eastern part of the Dauki fault, which is the principal fault bounding the Shillong plateau to its south. Dextral, NW striking Kopili fault has also received modest stress loading in its central segment. The M 6.9 Sikkim earthquake of 18 September 2011 and its aftershocks occurred along a zone parallel to the known Tista strike-slip fault, and is here named Gangtok fault. This event has caused moderate stress drip along a narrow segment of the MHT in Sikkim, and moderate stress increase along the seismically active strike slip faults along India-Bhutan border.

References

Cattin, R. and Avouac, J., 2000, Modeling mountain building and the seismic cycle in the Himalaya of Nepal, Journal of Geophysical Research, 105, B6, 13,389-313,407.

Gahalaut, V., Rajput, S. and Kundu, B., 2011, Low seismicity in the Bhutan Himalaya and the stress shadow of the 1897 Shillong Plateau earthquake, Physics of the Earth and Planetary Interiors, 186, 97-102.

Stein, R.S., 1999, The role of stress transfer in earthquake occurrence, Nature, 402, 605-609.

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