JNCSR study projects imminent earthquake in populous Himalayan foothills

Researchers from Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR), Bengaluru, an autonomous institute under the Department of Science & Technology, have carried out a study on the recurrence pattern of great earthquakes in the central Himalayas and its prognostications for future.

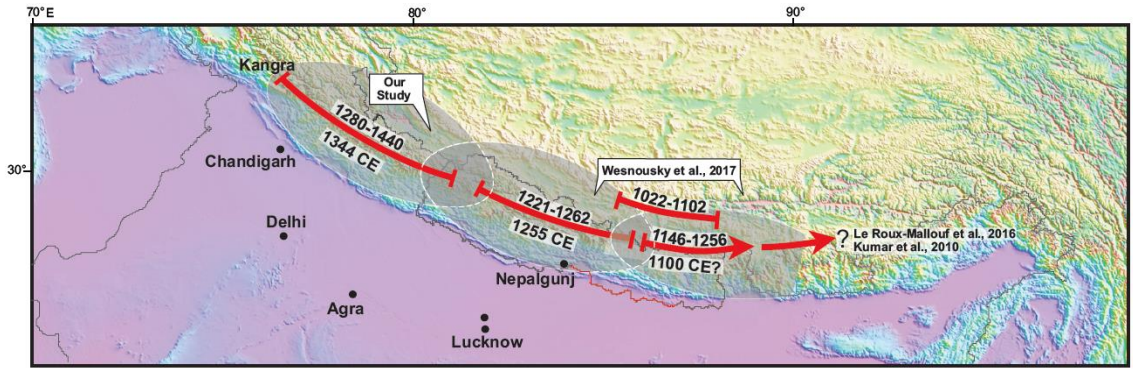
The study, which shows a seismic gap of 600 to 700 years, implies huge stacking up of seismic strain and projects an earthquake of less than 8.5 Richter scale in populous Himalayan foothills as well as the Indian alluvial plains.

Dr. C P Rajendran and his team from JNCASR in their research have underlined that the frontal thrust in the central Himalayas (covering the Indian and eastern Nepal parts) has remained seismically quiet, since the medieval pulse of great earthquakes, a and a seismic gap in temporal as well as spatial sense is real. And, if the past is the key, the long-elapsed time of 600-700 years implies enormous stacking up of strain in the region portends at least one M ≥8.5 earthquake in one of these overlapping segments of the central Himalaya, anytime in future.

Also, in the backdrop of the low seismic productivity in the region and the postulated fast plate convergence, a renewal time of ~600 years has been suggested for great earthquakes, and at least one is considered imminent as per their studies. These projections have grave risk implications for populous Himalayan foothills as well as the Indian alluvial plains.

Their study series have been published in the Geological Journal, Tectonophysics, Journal Asian Earth Science, Earth Science Reviews.

The team has used various geological techniques to unravel the faulting history stored in the rock and sedimentary formations along with the major thrust systems of the Himalaya. Their study addresses some outstanding questions regarding earthquake recurrence in the central Himalaya, the most important question being the timing of the last great earthquake and the second being its rupture length. Another question addressed is whether there was any temporal variation in strain release.



Dr. Rajendran evaluated the geological database along with other inputs to determine the timing of the last earthquake on the frontal thrust of the central Himalaya and its possible magnitude. Funded by the Ministry of Earth Sciences, Government of India, their study, along with the frontal thrust in the Indian part of the central Himalaya, discloses an earthquake between 14th and 15th century.

How frequently the frontal thrust in the central Himalaya gets ruptured in great earthquakes is one of the most vexing geological questions with many societal implications. The analyses of the historical and archeological data suggest no great earthquakes of magnitude M 8 on the moment magnitude scale and above occurred in the central Himalaya (comprising Kumaun and Garhwal) in the recent history. In the backdrop of the low seismic productivity in the region and the postulated fast plate convergence rate, at least one great earthquake is considered imminent in the Himalaya. These projections, if validated, can have grave risk implications for populous Himalayan foothills as well as the Indian alluvial plains. Thus, understanding the seismic hazard and the recurrence history of great earthquakes assume great importance. Seismic hazard and risk assessment models largely rely on the rupture dimensions of past earthquakes, mostly based on historical and geological evidence.

From the historical perspective, the Indian sources hint at a restoration phase for the mid-14th century monuments in the northern plains and coeval destruction to the ancient temples in the central Himalaya. The previous and currently acquired geological data from multiple trenches across the frontal thrust show that the last faulting event occurred between the 13th and 14th centuries – the time interval is coinciding with the historical 1344 CE earthquake.

The results of Dr. Rajendran's study also agree with results obtained from elsewhere that provide additional constraints for the 1344 CE earthquake along with two previous ones in 1255 and 1100. The consilience of multiple pieces of evidence from India and Nepal in combination with the new data inputs, thus implicate the 1344 CE as the last of the medieval sequence of earthquakes. They also report that an earthquake of similar size is overdue in this part of the Himalaya, considering the long-elapsed time of $\leq$700 years.

Using the geological studies, the team also concluded that a great earthquake between 1315 and 1440 CE had unzipped a stretch of about 600 km (the length of central seismic gap from Bhatpur (west of Chandigarh) to beyond Mohana Khola – far western Nepal) with an average displacement of 15 m and a moment magnitude of Mw $\geq$8.5. The historical information from the region agrees with the geological proposition of a mid-14th century earthquake in the region. The co-seismic slip for this medieval event was found to be apparently greater on the central part of the rupture zone of the earthquake, somewhat plateauing toward east and west in the present study.