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Science news

Big danger buried under the Himalayas

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The Himalayas could experience major earthquakes, according new findings by a team of researchers at the National Geophysical Research Institute (NGRI) in Hyderabad, India, and Stanford University in the United States[1].

Their inference is based on seismic imaging of the region below Garhwal Himalayas. Seismic imaging — somewhat similar to medical imaging — is a geophysical technique to investigate sub-surface structures from measurements made at the surface.

The Himalayan range was formed, and remains currently active, due to the collision of the Indian and Asian continental plates initiated about 50 million years ago. "This convergence is manifested by shortening across the Himalaya, building up of strain and occurrence of great earthquakes," Shyam Rai, chief scientist of NGRI and project leader from the Indian side told *Nature India*.

Since 1800, six great earthquakes (of magnitude ~8 on the Richter scale) have occurred in north India. The last one in the Garhwal region was in 1803 that led to large scale destruction as far as Lucknow in Uttar Pradesh. Uttarakhand has experienced several recent, deadly though moderate sized earthquakes, the most prominent being the 1991 Uttarkashi and the 1999 Chamoli earthquakes.

Scientists have known for some time that India is subducting under Asia. They have only recently begun studying in great detail the complexity of this collision zone, particularly the Main Himalayan Thrust (MHT), the fault that separates the Indian continental plate from the Asian plate. The MHT has historically been responsible for a magnitude 8 to 9 earthquake every several hundred years.

The researchers seismically imaged the subducting Indian plate in a transect across the Garhwal Himalaya, and related this image to the seismicity, geomorphology, and tectonics of the collision zone.

The data was collected for 21 months by an array of 21 broadband seismometers spanning the MHT — one of the densest hi-fi network in the Himalaya. The array, operated by the NGRI, had been deployed by India's Department of Science and Technology in 2002 apparently motivated by the Chamoli earthquake of March 1999.

Seismic images of the MHT created by the Stanford-NGRI group showed that deformation in the Himalaya is localized on MHT and there is a single large 'ramp' vertically beneath the main central thrust at the transition from the lesser to the higher Himalaya. "Such a ramp has been postulated to be a nucleation point for massive earthquakes in the Himalaya," says Stanford's Warren Caldwell, the principal author of the paper.

The images further revealed the northern segment of MHT dipping more steeply (15 degrees downward) than suggested by previous observations. The researchers predict that this segment will break over a larger area of the fault and create a larger magnitude earthquake than previously thought.

The scientists make it clear that their research was not aimed at forecasting an earthquake; it was merely to present structural constraints and indicate how big the earthquake could be whenever it occurs. "What we're observing has implications in predicting earthquake magnitude," Caldwell said.

Because of the high density of population in the Gangetic plain, such an earthquake would have a devastating effect such as landslides and catastrophic floods, Rai said. "The catastrophe could be reduced by building earthquake resistant buildings and developing and enforcing codes and proper land use planning. This is unfortunately lacking and finds poor response from planners," he added.

Image showing the 21 seismometers across the Main Himalayan Thrust.

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References

1. Caldwell, W. B. *et al*. Characterizing the main Himalayan thrust in the Garhwal Himalaya, India with receiver function CCP stacking. *Earth Planet. Sc. Lett.* (2013) doi: 10.1016/j.epsl.2013.02.009

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