

Earthquake activity along the Himalayan orogenic belt

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The collision between the Indian and Eurasian plates formed the Himalayas, the largest orogenic belt on Earth. The entire region accommodates shallow earthquakes, whereas intermediate-depth earthquakes are concentrated at the eastern and western Himalayan syntaxis. Here we investigate the source and structural properties of three earthquake sequences, which are located at the western, central and eastern areas of the Himalayan orogenic belt, respectively.

The Pamir-Hindu Kush region is located at the western Himalayan syntaxis and is characterized by extreme shortening of the upper crust and strong interaction of various layers of the lithosphere. Large intermediate-depth earthquakes occur frequently at the western Himalayan syntaxis about every 10 years on average, including the 2015 Mw7.5 Afghanistan-Pakistan border earthquake. These earthquakes present a clear south-dipping layer and unusual horizontal T-axes. The continental slab beneath the western Himalayan orogenic belt deforms in a complex manner, combining tension, shearing and necking with plate subduction.

The 2015 Mw7.8 Gorkha, Nepal, earthquake is located in the central Himalaya. It is a typical megathrust earthquake that occurred on the Main Himalayan Thrust (MHT), the detachment that separated the underthrusting Indian plate from the overriding Eurasian plate. Most of our well-located aftershocks are shallower than the main shock, and the deeper edge of the aftershock distribution aligns with the geometry of the MHT. These observations provide direct constraints on the lateral variation of the MHT in the source area of the Gorkha earthquakes.

The 2017 Mw6.4 Mainling earthquake is located at the northeastern Himalaya, where the strike of the plate boundary suddenly changes from nearly east-west to nearly north-south. Dense seismic array observations that we carried out in the source area indicated that the Mainling earthquake occurred on the NNW-trending Xixingla fault. The major tectonic features for this region are the NE-dipping thrust beneath the Namche Barwa syntaxis combined with the lateral extrusion and southeastern escape beneath the eastern Tibetan plateau.