



Structural segmentation controlled the 2015 Mw 7.8 Gorkha earthquake rupture in Nepal

Rafael Almeida

Earth Observatory of Singapore, Singapore (ralmeida@ntu.edu.sg)

The ongoing collision of India with Asia is partly accommodated by slip on the Main Himalayan Thrust (MHT). The 25 April 2015, Mw 7.8 Gorkha earthquake is the most recent major event to rupture the MHT, which dips gently northward beneath central Nepal. Although the geology of the range has been studied for decades, fundamental aspects of its deep structure remain disputed. Here, we develop a structural cross section and a three-dimensional, geologically informed model of the MHT that are consistent with seismic observations from the Gorkha earthquake. A comparison of our model to a detailed slip inversion data set shows that the slip patch closely matches an oval shaped, gently dipping fault surface bounded on all sides by steeper ramps. The Gorkha earthquake rupture seems to have been limited by the geometry of that fault segment. This is a significant step forward in understanding the deep geometry of the MHT and its effect on earthquake nucleation and propagation. Inversions of InSAR data, precise aftershock relocations, and high frequency energy radiation all support this model, in particular the presence of ramps both updip and downdip of the rupture. Published models of fault locking do not correlate with the slip patch or our fault model in the vicinity of the earthquake, further suggesting that fault geometry was the primary control on this event. Shallow seismic data acquired in the Siwalik foothills show that there is another ramp located underneath the Sub-Himalaya, and implies the existence of lateral ramps along strike, which may contribute to further segmentation of shallow earthquake ruptures. Our result emphasizes the importance of adequately constraining subsurface fault geometry in megathrusts in order to better assess the sizes and locations of future earthquakes.