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Source fault geometry of the 2015 Gorkha earthquake (Mw 7.9), Nepal, derived from a dense aftershock observation and earthquake reflection analysis

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The megathrust of the Himalayan foothills produced the Mw 7.9 Gorkha earthquake, on 25 April 2015, in Nepal. The geometry of the source fault provides basic information for understanding the active tectonics of the area and for forecasting seismic hazards. We tried to obtain the seismic image of source fault, using precise hypocentral determination and detection of reflectors based on crustal earthquake seismograms. To constrain the geometry of the source fault, observation of aftershocks by dense linear array was performed across the focal area from Hetauda to Syabru Besi, passing through Kathmandu, along a 90 km-long, NS trending seismic line. The aftershocks were observed at 35 stations, deployed at intervals of 3 – 10 km. Earthquakes were recorded using 4.5 Hz three-component sensors and off-line recorders for a total of two months in two separate deployments between August 15 and November 28, 2015. A total 716 of earthquake events were detected and their hypocenters determined using a 1-dimensional velocity structure. Precise hypocenters were determined for 609 events, with an error of less than $\pm$0.5 km per event, using Double-difference tomographic analysis. The obtained hypocenter distribution portrays a gently northward-dipping fault zone at 5-10 km depth. The aftershock distribution accords well with the rupture area estimated from the analysis of crustal movements. Seismicity is very low in the area 65-85 km north of the Main Boundary Thrust (MBT), which coincides with an area of large co-seismic slip as deduced from InSAR and GPS data. Using the seismograms of dense linear array, two reflectors were identified between 60 to 80 km north from the MBT. Shallower reflector corresponds to the plate boundary and lower reflector is in the Indian slab. Estimated source fault geometry from hypocentral distribution and earthquake reflection, is divided into two parts by 80 km from the MTB; southern part is dipping north by 5 degrees and northern part dips 13 degrees. The obtained source fault is shallower in depth and lower in dip angle than previous geological estimates. The earthquake reflection is the reciprocal situation to VSP-CDP method and it is effective for mapping of low-angle reflectors, such as a plate interface.