Seismicity and 3-D velocity structure of the Himalayan Collision Zone: Lateral variations in lithospheric structure

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Using P and S arrival time data from the 29-station Himalayan Nepal Tibet Seismic Experiment (HIMNT), we performed local earthquake tomography for eastern Nepal and southern Tibet, Results suggest that local earthquakes beneath the network reach depths up to 100 km below sea level, and over a hundred seismic events locate in the upper mantle. These subcrustal earthquakes suggest that in some areas beneath the Himalayan collision zone, the upper mantle deforms by brittle processes. There are no clear gaps in the vertical distribution of the seismicity. Tomographic images show a south to north increment in the crustal thickness beneath the network, with a large Moho slope beneath the High Himalayas. The presence of earthquakes around Moho depths and high P wave velocities (up to 8.7 km/s) in the upper mantle beneath the High Himalayas and southern Tibet suggest a relatively cold upper mantle (500 to 700 degrees Celsius). Most of the lower crustal and subcrustal earthquakes beneath the High Himalaya and southern Tibet are concentrated east of longitude 86.5E, where the lower crust has relatively low P wave velocities (between 6.2 and 6.5 km/s). West of that longitude, earthquakes deeper than 50 km are almost absent, and P wave velocities in the lower crust are as high as 7.5 km/s. We interpret these high lower crustal velocities as the result of metamorphic reactions causing partial transformation into eclogite of materials in the lower Indian crust. The Vp/Vs ratio is anomalously low (an average of 1.66) in the upper crust of southern Tibet (Tethyan Himalaya), which may correspond to a very silicic basement of the sedimentary sequence seen at the surface.