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Comparing the structure of the Main Frontal Thrust in Central and Eastern Nepal – Implications for seismic hazard estimates

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The foreland thrust belt of the Himalayan orogen has been active since at least 2 Ma. The structures there deform the Siwaliks Group, a 5-6 km thick section of continental Miocene-Pliocene strata. The thrust belt is bounded by the Main Boundary Thrust (MBT) to the north and by the Main Frontal Thrust (MFT) to the south. To characterize the structural style of the Sub-Himalaya in this region we have acquired some of the first seismic reflection profiles imaging the MFT. These profiles were acquired with a 7-ton Vibroseis source and a 264-channel seismic recording system. In the area around the town of Bardibas in Central Nepal we acquired 12 parallel 2-D profiles totalling ~70 km. In Eastern Nepal we acquired 4 seismic lines of ~10 km each in length. These data, acquired during three field seasons in 2014 and 2015 along ephemeral river beds that cross the range-front more or less orthogonally, allow us to visualize the MFT system down to a depth of 2-2.5 km and observe variations along strike.

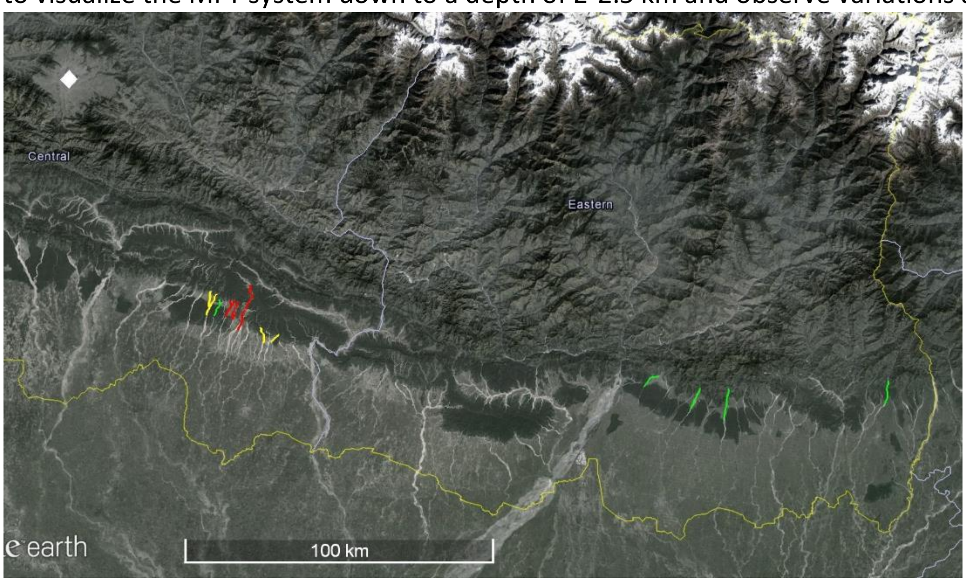

Figure 1: Map of Central and Eastern Nepal showing the location of the acquired seismic lines. Red, yellow and green lines were acquired in Spring 2014, Fall 2014 and Spring 2015, respectively. White diamond shows location of Kathmandu.

The variations along strike in the foreland fold and thrust belt are poorly studied. Its plan-view width has been related to the intensity of rainfall and erosion [1], but there are first-order features such as the sinuosity of the range front and variations in elevation of the foothills that are not well understood. Our data show that the MFT in Central and Eastern Nepal are very different. In Central Nepal, the MFT is composed of multiple stepping strands that dip 30°-40°, some surface emergent, and others blind (buried by several hundred meters of growth strata). The related deformation is characterized by pure-shear, fault-propagation folding [2]. In Eastern Nepal, the fault dips gently (<10°, based on early processing results), reaches the surface and has little associated folding at the tip. These differences affect the way active deformation indicators, such as trenches, uplifted terraces and topography should be interpreted. The 2015 Gorkha earthquake was a dramatic reminder of the potential for large earthquakes along this fault system. However, that earthquake was small in the context of both past earthquakes and projected earthquakes. We expect that our data will allow further constraining and refining of the Holocene slip history of the Main Frontal Thrust in Nepal, which should lead to a better understanding of earthquake frequency and magnitude.

References:

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