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Shortening rates and seismotectonic model along the Himalayan arc of Nepal

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The Himalayan orogen represents the archetype of mountain building in continental collision setting. Its primary features are now understood, but the details of its seismotectonic behavior, as well as of the seismic hazards that those densely populated regions face, are still only partially documented. To expand former pioneering study led in the sub-Himalaya of central Nepal, south of Kathmandu [Lavé and Avouac, 2000], we analyzed geomorphic evidences of recent crustal deformation in the sub-Himalaya across the Main Frontal Thrust fault (MFT) all along the Himalayan arc of Nepal. Active faulting and folding at the MFT is quantified from structural geology and deformed fluvial terraces along ten rivers from West to East. Those Holocene fluvial terraces were dated using 14C on charcoals within sandy/silty material of the terraces, or measuring 10-Be cosmogenic nuclides in boulders on top of the terraces or in exposed strath terraces.

The dated terraces and deformation profiles, complemented by paleoseismic trenches, indicate that:

* Structural style of folding may largely vary along the MFT. If rock uplift profiles are found to express fault bend folding for mature folds, more complex relationships between uplift and structural section are observed for nascent folds or MFT step over regions with uplift rates locally exceeding 20 mm/yr close to MFT surface expression.

* For most profiles, except one along Sapt Kosi, thrusting along the MFT has absorbed around 20 mm/yr of N-S shortening on average over the Holocene period, i.e. slightly more than modern GPS shortening rates across the whole Himalayan range. At the scale of Nepal and of the Holocene, the MFT is definitively the most active Himalayan structure.

* Along most of the Himalayan arc of Nepal, despite disparities in Siwaliks geometry, microseismicity distribution, or topography of the range, it appears that the seismotectonic model proposed by Lavé and Avouac [2000] can be generalized. The interseismic elastic strain accumulation beneath the High Himalaya, due to Main Himalayan Thrust (MHT) locking $\sim$100km north of the MFT, is fully released by large (Mw $\sim$ 8) to very large (Mw > 8.5) earthquakes with seismic ruptures breaking the MHT up to the surface or the near surface at the MFT. Those conclusions are fully consistent with the recent paleoseismic evidences of very large surface ruptures at the MFT all along the Himalayan arc.