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# Development of a hidden fold and thrust belt in the Himalayan piedmont and distribution of active tectonics

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The pattern of active deformation of Himalayan frontal structures is complex with out-of-sequence reactivations in the chain and development of scarps associated to earthquake ruptures reaching the surface in the piedmont. We analyze passive seismic records using the Horizontal-to-Vertical Spectral Ratio method along three North-South trending profiles of the Darjeeling Himalayan piedmont, revealing subsurface structures down to 600 meters and imaging the Siwalik sedimentary rocks / recent deposits interface. We find evidence for a thrust fold system hidden beneath the plain correlated to geomorphologic scarps revealed by topographic profiles. These morphological surfaces are incised by large rivers of the piedmont by several tens of meters during phases of low sedimentation, thus slightly emerging in the plain. These scarps are supposedly induced by thrust deformation related to great earthquakes propagating south of the morphological front and inducing subsurface ruptures in the piedmont. This interpretation is comforted by the lateral correlation of the imaged thrusts and associated folds with previously evidenced fault scarps associated to active thrusts of the Darjeeling piedmont. In the piedmont of East/Central Nepal, oil company seismic profiles image similar thrusts and associated folds that can also be correlated to both local incision of small rivers draining the southern flank of the Siwalik hills, and uplift evidenced by a previously analyzed leveling profile.

The long-term kinematic evolution of this hidden thrust fold belt is slow, with a tectonic uplift of the hangingwall lower than the subsidence rate of the foreland basin, i.e., less than ~ half a millimeter per year. The evolution of the hidden structures corresponds to that of an embryonic thrust belt affected by a layer parallel shortening (LPS) acting in the long term with a shortening rate of the order of 5-10% of the shortening rate of the whole Himalayan thrust system. An aseismic deformation associated with the LPS structures that could absorb the entire deformation of the embryonic thrust belt in East/Central Nepal is suggested by the comparison of the long term structural evolution with geodetic and paleoseismological studies. The amplitude of this aseismic deformation is however too limited to significantly reduce the seismic hazard in the Himalayan piedmont.