Quantifying active deformation within the Southwestern Foothills of Taiwan, from incised fluvial terraces and sedimentary data

Philippe Steer¹, Valentine Lefils²,³, Martine Simoes², J. Bruce H. Shyu⁴, Magali Rizza⁵, and Lionel Siame⁵

¹Université Rennes 1, Geosciences Rennes - UMR 6118, Rennes, France (philippe.steer@univ-rennes1.fr)
²Université de Paris, Institut de physique du globe de Paris, CNRS, Paris, France
³Laboratoire de Géologie, Ecole Normale Supérieure, CNRS, Paris, France
⁴Department of Geosciences, National Taiwan University, Taipei, Taiwan (ROC)
⁵CEREGE, Université Aix-Marseille, CNRS, Aix-en-Provence, France

The Taiwan mountain range stands as one of the most active regions on Earth. With an overall shortening rate of ~40 mm/yr and an average erosion rate of ~4 mm/yr, this mountain range appears ideal to better understand the interactions between tectonics and surface processes, and how these shape active landscapes. Here we explore the geomorphic and sedimentary record of active deformation within the Southwestern Foothills of Taiwan, and we quantify from there the kinematics of active faults. In particular, we investigate the downstream portion of the meandering Tsengwen river - one of the largest rivers of this region - where we identify and correlate remnants of 7 terrace levels, progressively abandoned over the last ~5 kyr. The incision of these terraces is interpreted as being controlled to the first-order by folding and uplift related to underlying active faults. The evolution of the river is reconstructed from correlated terrace remnants, and our results indicate that the overall river sinuosity and gradient did not vary significantly during the past ~5 kyr in response to tectonics. Incremental tectonic uplift is retrieved from terrace incision corrected for sedimentation at the mountain front, and is used to derive the incremental shortening since terrace abandonment. Downstream, within the Coastal Plain, the Tsengwen river reaches its base level and aggrades. Sedimentary facies within boreholes of the Coastal Plain record vertical displacements relative to sea level, spatially consistent with potential blind active faults. When corrected for eustatic variations, these data allow for quantifying tectonic uplift rates within the Coastal Plain over the last ~20 kyr. Taken altogether, our quantitative analysis of the Tsengwen river record, from terrace incision to downstream aggradation, reveals that the most frontal active faults absorb a shortening rate of at least ~35 mm/yr, that is most of - if not all - the shortening rate to the absorbed across the whole mountain range.
