Surface rupture and landscape response within the core of the great Mw 8.3 1934 earthquake mesoseismal area: the case of the Khutti Khola

Magali Riesner¹, Laurent Bollinger¹, Magali Rizza², Yann Klinger³, Soma Nath Sapkota⁴, Cyrielle Guérin¹, Çağil Karakaş⁵, and Paul Tapponnier⁶

¹CEA, DAM, DIF, F-91297 Arpajon, France (magali.riesner@gmail.com)
²Aix Marseille Univ, CNRS, IRD, Coll France, CEREGE, Aix-En-Provence, France
³Institut de Physique du Globe de Paris, Paris, France
⁴Department of mines and geology, Nepal
⁵Schlumberger Stavanger Research Center, 4056 Tananger, Risbergvegen 3, Norway
⁶EOS, Nanyang Technological University, Singapore, Singapore

Great earthquakes generated along the Himalayan mega-thrust plate boundary have been shown to rupture the surface. The Mw 8.3 1934 Bihar-Nepal earthquake is one of these major seismotectonic events. Previous studies focused on sites located at the western end of the fault trace concluded that the surface rupture associated with this earthquake is still locally preserved. Here we document a new site, along the Khutti Khola rivercut, in the core of the mesoseismal area. The effects of the earthquake in that area were described as cataclysmic, generating massive damages, landslides blocking one of the local rivers at 4 sites. The Khutti river cuts the frontal range, incising a 4 m- high cumulated scarp exposed along a 19 m-long stretch of Siwaliks claystone-sandstone and alluvial deposits. A detailed study of the river cut revealed the presence of faults emplacing Siwaliks over quaternary alluvials. These units are sealed by a colluvial wedge and wash as well as by recent underformed alluvials. The C14 radiocarbon analyses of 10 detrital charcoals collected reveal that the last surface-rupturing event at that site occurred after the 17th century and prior to the post-bomb deposition of the young alluvials. The only historical earthquake known within that period is the 1934 earthquake, inferring that for this event the rupture reached the surface at that site. The rupture was followed by rapid aggradation and sealed by ~2 meters of sediments. In addition to being another rare example for the preservation of the 1934 earthquake, these observations demonstrate that, despite their magnitude and potential surface rupture, the study of the great Himalayan paleo-earthquakes are still challenging however necessary to constrain their lateral extent.
