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Late Quaternary deformation of the sub-Himalaya on 100 kyr timescales

Chloé Bouscary[1], Georgina King[1], Djordje Grujic[2], Jérôme Lavé[3], György Hetényi[4], and Frédéric Herman[1]

[1]Institute of Earth Surface Dynamics, University of Lausanne, Lausanne, Switzerland (chloebouscary@gmail.com)
[2]Department of Earth and Environmental Sciences, Dalhousie University, Halifax, Canada
[3]CRPG, UMR 7358 CNRS, University of Loraine, Nancy, France
[4]Institute of Earth Sciences, University of Lausanne, Lausanne, Switzerland

In mountain accretionary wedges, it is generally considered that the preservation of a topography in mechanical equilibrium is modulated by the activation of faults, sometimes internal to the prism, sometimes frontal. The folds of the Himalayan foothills correspond to the most frontal structures of the Himalayan prism. Understanding the timing of the initiation and the activity of these frontal folds can provide valuable information on the deformation sequences within the range (reactivation of the MCT, prograde sequences and transfer to frontal folds, ...) in response to tectonic and climatic forcing. Late Cenozoic climatic changes, including glaciations, might have impacted the denudation of the Himalayan range. The study of recent deformation rates is thus key for understanding lateral variations in deformation along the entire Himalayan arc, which will bring new constraints on the interactions between tectonics and surface processes at different scales time, as well as deepen our understanding of the seismic behaviour of the range.

Here we quantify exhumation rates in the Himalayan foothills using luminescence thermochronometry, which is a recently developed very-low temperature thermochronometer applicable between tens of years and a few hundred kyr. In contrast to classical methods, it can resolve thermal histories from the upper few km of the Earth's crust, allowing spatial variations in exhumation rates across the Himalayas to be deciphered on sub-Quaternary timescales. An extensive data set of more than 40 Siwalik rock samples, from Western Nepal to Eastern Bhutan, was measured to complement other thermochronometric data and understand the sub-Quaternary deformation on the Himalayan foreland.

The results show along-strike variations in exhumation rates in the Himalayan foothills during the late Quaternary, with exhumation rates across the sub-Himalaya varying locally independently of precipitation trends and changes in the modern convergence rates. These along-strike variations may suggest that over the last 300 kyr, Himalayan shortening has not only been accommodated by

the most frontal faults along the Himalayan range.