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Plio-Pleistocene exhumation of the eastern Himalayan syntaxis and its domal 'pop-up'

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The eastern termination of the Himalayan orogen forms a structural syntaxis that is characterised by young (from 10 to < 1 Ma) mineral growth and cooling ages on a wide variety of thermochronometers and geochronometers. This region is a steep antiform that folds the suture zone between the Indian and Asian plates, with a domal 'pop-up' structure at the core corresponding to the area of youngest bedrock ages. Exceptionally high relief and one of the deepest gorges on Earth have developed where the Yarlung Tsangpo's tortuous route crosses the Namche Barwa–Gyala Peri massif (>7 km in elevation)

We reviewed the extensive scientific literature that has focused on the eastern syntaxis and provide new zircon and rutile U-Pb, white mica Ar-Ar and fission track zircon data on its bedrock and erosion products to constrain the age of inception of the very rapid uplift and erosion and discuss its cause. Numerical modelling of heat flow and erosion is used to model the path of rocks from peak metamorphic conditions of ∼800°C to <250°C. Our new data include U-Pb bedrock rutile ages as young as 1.4 Ma from the Namche Barwa massif and 0.4 Ma from the river downstream of the syntaxis.

The domal zone is comprised of Greater Himalaya rocks that equilibrated at about 700–800°C and 20–30 km depth. These conditions persisted into the latest Miocene and perhaps Pliocene time, with possible modest decompression prior to the Pleistocene. In the interval of latest Miocene to Pleistocene the northern part of the syntaxis began to buckle, fold, and fail via south-vergent thrust faulting, creating a ∼20 km amplitude antiformal dome, with an antecedent Yarlung Tsangpo River flowing through this core of the future syntaxis. Our new data demonstrate that rocks were >575°C only 1–2 Myr ago within the dome and that present geothermal gradients of >100°C/km are expected. Detritus within the Neogene Surma Basin of Bangladesh, representing deposits of the palaeo-Brahmaputra River, does not record evidence of rise and erosion of this dome with its distinct thermochronological signature until late Pliocene time at the earliest.

In the Pleistocene between ∼12 and 21 km of rock were uplifted and eroded within the core of the syntaxis, exposing rocks at amphibolite facies conditions to surface erosion at rates of at least 4 km/Ma. This changed dramatically the characteristics of the sediment delivered downstream of the gorge to comprise, as it is observed today, up to 50% of the sediment load derived from the domal uplift. A decrease in lag-times (white mica Ar-Ar and ZFT data) in ∼ 6 Ma foreland Himalayan deposits (Lang et al. 2016, GSA Bull.) SW of the syntaxis followed by relatively constant lag-time value for each chronometer up section, recorded a period of rapid exhumation of a source within the syntaxis near to or along strike to the southwest of the current domal pop-up. This source could be a migrating domal feature produced by the indentation process of the Indian plate progressing north-eastwards.