Pliocene exhumation of the Trumsing La area (Eastern Himalaya, Kingdom of Bhutan) as documented by apatite (U-Th-Sm)/He thermochronology

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The ongoing convergence between India and Eurasia since continent-continent collision ~55 Ma ago has formed the Himalayan orogen, the highest mountain range on Earth. Remarkably continuous tectonostratigraphic units and structures along the strike characterize its 2000 km-long range front. The topographic uplift of the range has induced perturbations of atmospheric circulations patterns sometime between ~20–35 Ma and led to the establishment of the Indian Summer Monsoon (ISM) along the southern flank of the Himalaya. The monsoon is responsible for about 80% of the annual rainfall along the range front and results from the condensation of wet air derived from the Bay of Bengal to the South and travelling northward before being blocked by the Himalayan Mountains. Consequently, strong interactions between tectonic and climatic processes have likely conditioned the exhumational and landscape evolution of the range in the Late Tertiary. Furthermore, the only raised topography outboard the Himalayan range front, the Shillong plateau, is located south of Bhutan on the ISM trajectory and was uplifted in the Pliocene. The Shillong plateau concentrates 30–40% on monsoonal rainfall along its southern slope and consequently central and eastern Bhutan receives about half of the rainfall as the Sikkim Himalaya situated further west. The object of this study is to quantify Late Tertiary potential changes of exhumation rate in the Trumsing La area (central Bhutan) located in the rain shadow of the Shillong plateau. Four bedrock samples collected along a vertical profile will be dated using (U-Th-Sm)/He thermochronology on apatite crystals (AHe). The effective closure temperature of this thermochronometric system is about 70 °C and will help to derive exhumation rates of the upper 1–2 km of the crust. Published apatite fission-track results, a method providing information on the exhumation of deeper crustal levels (closure temperature is 120 °C), obtained from the same samples yielded an exhumation rate of 1.6 ± 0.6 mm/year in the Late Miocene. We anticipate obtaining Pliocene AHe ages with exhumation rates that may either decrease or increase during this period of time. A decrease in exhumation rates could be attributed either to (i) reduced erosion due to the rain shadow effect induced by the orographic barrier or to (ii) partitioning of the India-Eurasia horizontal convergence into the Shillong plateau that would decrease rock uplift rates along the southern Himalayan front in Bhutan. Conversely, in case of an increase of Pliocene exhumation rates the effects of the uplift of the Plateau may have being overshadowed by more powerful climactic and erosional effects from the documented onset of glaciations in the late Pliocene. Other explanations include renewed tectonic activity in the orogenic wedge, although as of yet, this is undocumented.

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