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Quaternary exhumation mechanism of the Central Himalayan, evidence from fission track and (U-Th)/He data

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Within the study area in the Goriganga Valley (Kumaon Himalayas, India) between Munsyari and Martoli villages four units, separated by major tectonic lines, are exposed. From North to South these are: a) the Tethys Himalaya (TH), composed of low-grade Proterozoic to Mesozoic sediments juxtaposed along the STDZ on b) high-grade gneisses of the Higher Himalayan Crystalline (HHC). The HHC has been thrust along the Vaikrita Thrust (VT), an equivalent of the MCT over c) micaschists and Proterozoic orthogneisses of the Lesser Himalayan Crystalline (LHC). The Munsyari Thrust (MT), in footwall position with respect to the LHC, represents an imbrication zone incorporating rocks from the LHC and sediments from (d) the Lesser Himalayan Sediments.

Based on zircon and apatite (U-Th)/He and fission track data, we discuss here the final cooling stages of the central High Himalayan Metamorphic Belt. The break in the cooling path marked by 2.5 Ma (U-Th)/He zircon ages north of the South Tibetan Detachment Zone (STDZ) and by 0.5 Ma ages south of it, resulted from Pliocene brittle normal faulting along the reactivated STDZ. Zircon data from the Himalayan Metamorphic Belt show a systematic southward increase of both fission track and (U-Th)/He ages. Within the High Himalayan Crystalline the cooling ages increase from 0.5 to 1.2 Ma, whereas within the Lesser Himalayan Crystalline they increase from 1.0 to 1.7 Ma. Lesser Himalayan sediments have cooling ages between 1.3 and 1.8 Ma. By contrast, apatite cooling ages do not display north-south variations within single crustal units and cluster around 0.4 Ma in the Higher Himalayan Crystalline and around 0.7 Ma in the Lesser Himalayan Crystalline. We consider two different mechanisms to explain the observed age distributions.

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(1) During an early of Quaternary extrusion tectonic exhumation was dominant with decreasing rate towards the south. During this phase the recent topography with pronounced break-in-slopes at the major tectonic lines was created. Tectonic exhumation rates exceed erosion rates, leading to the positive slopes of ages in the (U-Th)/He and FT zircon ages.

(2) The uniform apatite cooling ages within the distinct crustal domains are explained by accelerated Quaternary erosion with rates proportional to the slope of the relief.

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