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Tectonic exhumation and paleoseismic events from the Higher Himalayan Crystallines (HHC), NW Himalaya: evidences from fission track (FT) dating

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In the NW Himalayas, the Sutlej-Baspa Rivers drain about 15 - 20 km thick HHC, that is bounded by the Main Central Thrust (MCT) at the base, Vaikrita Thrust (VT) in the middle, Himalayan Detachment (HD) at the top, and a seismogenic Kaurik-Chango Fault Zone (KCFZ) in the north. Beyond confluence of these rivers, 6 FT apatite ages on hanging wall of the VT vary from 1.5±0.4 to 2.3±0.2 Ma, while 4 apatite ages vary between 0.7±0.1 to 0.9±0.1 Ma within the KCFZ. 4 apatite ages from eastern side of KCFZ fall between 2.4±0.4 and 4.6±0.8 Ma and FT zircon ages of 3 samples range from 8.7±0.3 to 10.0±0.6 Ma.

Above FT apatite ages reveal extremely fast exhumation of 3.8±1.8 mm/a since 0.8 M a within the KCFZ, possibly due to reactivation of NS-trending extensional seismogenic fault, which controlled the main Kinnaur Earthquake 1975 and its aftershocks. The geological evidences of paleoseismic events and their chronology based on IRSL dating of seismites along the KCFZ indicate its paleoseismological history dating back to at least Late Pleistocene [1-3].

Comparatively older apatite ages up to 4.6 Ma on either side of the KCFZ and separated by distinct young (0.9 to 0.7 Ma) ages within this zone indicate resetting of apatite ages probably due to thermal overprinting by fault-induced shear heating[4] without affecting the FT zircon clock. It appears that sub-crustal tectonic activity controlled fault movements from shallow depth ~3-4 km in a temperature range ~110-150°C (assuming geothermal gradient of 40°C/km). Therefore, the KCFZ must have been active during 0.9 to 0.7 Ma, and when complemented with above IRSL seismite ages, the following chronology of paleoseismic events can be inferred along this fault zone: 920 Ka and 710 Ka (FT Apatite), 90 Ka, 61 Ka, 37 Ka and 26 Ka (IRSL, seismites).

From the western section of the HHC in the Sutlej valley[5], have interpreted variation in FT apatite ages between 4.9 Ma in basal parts and 1.5 Ma on foot wall of the Vaikrita Thrust due to tectonic exhumation resulting from an interplay of differentially-moving, both southwestward and northeastwards, crustal wedges during late tectonothermal evolution in Plio-Pleistocene. Variations in present FT data reveals tectonic control over exhumation patterns along the Sutlej-Baspa valleys rather than erosional-controlled[6] because of non-selective erosion by active monsoon precipitation.

Keywords: Tectonic Exhumation; Fission Track Dating (FTD); Himalaya; Paleoseismic Events.

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