Geophysical Research Abstracts
Vol. 18, EGU2016-4788, 2016
EGU General Assembly 2016

An integrated approach to study the exhumation of rocks in Neelum valley, NW Himalayas, Pakistan.

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Tectonics and erosion have both been suggested as alternative driving mechanisms for rapid exhumation of rocks in the western Himalayan syntaxis. This debate could be resolved by understanding the plan view-geometry of the exhumation of rocks in the region: does it follow the major structures?, or is it related to the drainage geometry? In order to resolve this geometry we have undertaken a low-temperature thermochronologic study, using crystalline rocks, of a critical region of the western syntaxis: Neelum valley region, Pakistan. Apatite (U-Th-Sm)/He (AHe), fission track (AFT) and U-Pb dating has been combined with geomorphic stream power analysis in order to discern the relationship of exhumation of rocks to tectonics (main faults) or erosion. Pooled AFT ages show a range of 2.2 $\pm$ 0.4 to 7.0 $\pm$ 0.4 Ma (1σ). Recoil corrected AHe ages exhibit a range from 2.0 $\pm$ 0.1 to 8.7 $\pm$ 0.5 Ma (1σ). U-Pb ages could be used to divide the samples in three groups: ages that are completely-, partly- and not- affected by Himalayan tectonics. The range of apatite U-Pb ages displayed by both completely- and partly- affected samples is from 17.0 to 43.0 Ma (2σ, unanchored, i.e. constrained by isochrones alone) and 6.0 to 48.3 Ma (2σ, anchored using the Stacey and Kramers terrestrial Pb evolution model). Stream power analysis of the Neelum river catchment indicates a region with high steepness index (*Ksn*, normalized to reference concavity, θ_{ref} = 0.45) values of $>$ 500 $m^{0.9}$ which coincides well the region sampled.

In combination with earlier published ages, our data indicate that exhumation contours run more or less parallel to the major structures in the region. The boundary between samples with unaffected and affected U-Pb ages as well as transition from high *Ksn* to lower *Ksn* values along the main Neelum river fits well with the mapped trace of the Main Central Thrust (MCT), corroborating the presence of the MCT in the southeastern parts of our study area. Thermal history modeling of the AFT and AHe ages indicates recent rapid exhumation of rocks through the upper 5 - 6 km of the crust. Also, the AFT ages are younger in proximity to the main faults. This new data supports a model with tectonics as the main driving mechanism for exhumation of rocks and may indicate quite recent re-activation of MCT or one of the other major structures near it.