

# Detrital Mineral Thermochronology in Active Fluvial Systems and the Evolution of Modern Orogenic Landscapes

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In order to explore the relationship between tectonics and climate in active orogenic systems, it is important to establish short-term erosional histories. At present, some of the most powerful tools available for such studies are the  $^{40}\text{Ar}/^{39}\text{Ar}$ , (U-Th)/He, and fission-track cooling ages that can be obtained for detrital minerals in stream channels and young river terraces. The  $^{40}\text{Ar}/^{39}\text{Ar}$  method is well-suited to such studies; the micas (particularly muscovite) are relatively resistant to grain-size comminution and alteration during erosion and transport and yield information pertaining to the cooling of source regions through the  $\sim 375\text{-}325^\circ\text{C}$  temperature range. Modern laser microprobe systems permit the routine determination of 100 single-grain  $^{40}\text{Ar}/^{39}\text{Ar}$  dates – enough for statistically significant characterization of the age population in most detrital samples – in 24-36 hours. Himalayan case studies will be presented to show how such data may be used to model both catchment-wide and regional erosion rates, and to monitor the kinematics of recent deformation.

Unlike most  $^{40}\text{Ar}/^{39}\text{Ar}$  thermochronometers, the (U-Th)/He and fission-track thermochronometers – zircon, monazite, xenotime, titanite, and apatite – have closure temperature ranges ( $\sim 225\text{-}65^\circ\text{C}$ ) sufficiently low that the geometry of their closure isotherms mimic surface topography in rapidly eroding orogens. As a consequence, these low-temperature thermochronometers can be extremely valuable indicators of changes in the landscape during orogenesis. Unfortunately, most detrital fission-track and (U-Th)/He studies involve analytical protocols that are much more time consuming than those used for laser microprobe  $^{40}\text{Ar}/^{39}\text{Ar}$  studies. As a consequence, generating a sufficient number of single-grains dates to achieve a representative sampling of the total population in a detrital sample is a major undertaking. For (U-Th)/He work, laser microprobe technologies offer great promise for improving sample throughput. Early applications of this emerging tool will be reviewed at the presentation.