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Distributed unroofing history in the central and eastern Lhasa Terrane: revealed by multiple thermochronometers on detrital samples

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Sediments eroded from the active orogens serve as the time capsule of surface process, which is a complicated feedback system involved with climatic and tectonic competition. Detrital materials from the deep ocean borehole, terrace stratigraphy, regional drill holes, and etc, provide a comprehensive view of the source terrain. Modern sediments, likewise, capture the transient information from the upstream drainage and represent the integrated features collected from the exposed surface. On Tibet, extensive studies via thermochronology are crucial to establish the evolution history of the plateau. In this study, with the aid of multiple thermo-chronometers, we are able to confront the problem of diverse age spectrum in detrital studies that has long hampered our understanding toward the relevant surface process. By studying the detritus and bedrock of some particular drainage, we have acquired a general exhumational pattern across the southern part of the plateau. Here we report the detrital zircon and apatite fission track (ZFT/AFT), U/Pb and Ar-Ar ages from the modern fluvial sediments collected along the Yarlung-Tsangpo and its two tributaries, Lhasa River in the west and Nyang River in the east.

Our ZFT and AFT single grain ages suggest that a fairly young age population (< 15 Ma) occurred in the central Lhasa Terrane (Lhasa River drainage). U/Pb and ZFT double dating results confirm that these young FT ages represent a recent exhumational stage instead of old magmatic emplacement. Although AFT and Ar-Ar ages both support the ZFT results, suggesting a large portion of the Lhasa River drainage has experienced a phase of recent unroofing. This exhumational signal, however, is not observed in the eastern part, Nyang River drainage. In the Nyang River only 15% of the detritus display the signal of young component (younger than ca. 15 Ma) while in the Lhasa River it can reach a high portion of 75%. This observation suggests that the unroofing rates and the surface process underneath are significantly different for the two studied catchments.

Ar-Ar results within the Lhasa River catchment indicate that the young age populations, in terms of ZFT/AFT/Ar-Ar, can be traced back to the upstream of the Lhasa River, where the E-W extension grabens are densely situated. Age discrepancy from the bedrock and adjacent river sediments explicates that the sediment flux is most likely to be focused as generated and related to the series of E-W extension in the central Lhasa Terrane. To sum up, our results have observed the recent exhumational pattern along the E-W extension system (Nyainqentanghla Shear zone). The significant high portion of the young grain ages implies the high sediment input from the active rifting areas. However, the magnitude and quantity of its impact toward the total sediment budget will require further deliberately examination.