Timing of slip across the South Tibetan detachment system and Yadong-Gulu graben, Eastern Himalaya

HANWEN DONG[1]*, KYLE P. LARSON[2], DAWN A. KELLETT[3], ZHIQIN XU[4], GUANGWEI LI[4], HUI CAO[1], ZHIYU YI[1]

[1] Key Laboratory of Deep-Earth Dynamics of Ministry of Natural Resources, Institute of Geology, Chinese Academy of Geological Sciences, Beijing, 10037, China
[2] Earth and Environmental Sciences, IKBSAS, University of British Columbia Okanagan, 3333 University Way, Kelowna, BC V1V 1V7, Canada
[3] Geological Survey of Canada, Natural Resources Canada, 1 Challenger Drive, Dartmouth, NS B2Y 4A2, Canada
[4] School of Earth Science and Engineering, Nanjing University, Nanjing, 210023, China

The Himalayan orogen is the largest active continent-continent orogen on Earth and is generally regarded as the type-example for this style of collision. Despite the predominance of ongoing north-south convergence between the Indian and Eurasian continents, two major sets of extensional structures occur in the orogen, found in southern and/or central Tibet. One such set of structures comprises the South Tibetan detachment system (STDS), a family of approximately east-striking, shallowly to moderately north-dipping normal-sense faults and shear zones that have been traced along ca. 2000 km the length of the Himalayan system. The second set of extensional structures includes numerous, middle Miocene to recent north-south striking rifts (NSSRs) within the Tibetan plateau that accommodate(d) east-west extension. Detailed information on the timing of movement across the different sets of extensional structures is key to understanding the kinematic relationships between them.

The Yadong-Gulu graben, one of the NSSRS, provides an opportunity to evaluate the kinematic and temporal relationships between east-west directed extension in southern Tibet and north-south extensional strain in the Himalaya. In the Yadong region, distinct upper and lower top-down-to-the-north segments of the South Tibetan detachment system (STDS) are recognized. New U-Pb zircon geochronology demonstrates that the cessation of the Yadong shear zone, the structurally lower, ductile portion of the STDS, occurred ca. 20 Ma and that motion along the structurally higher brittle-ductile Zherger La detachment continued after ca. 16.6 Ma. This new age is compatible with the similar structures in nearby Everest-Sikkim and indicates that the STDS was laterally continuous across the Everest-Sikkim-Yadong portion of the Himalayan orogen. Cooling paths outline distinct early and late Miocene cooling stages. We suggest that these two stages related to N-S and E-W extension, respectively. The second cooling stage (14~5 Ma) specifically is interpreted to define the onset of the Yadong-Gulu graben, which represents a minimum age for the STDS it offsets. Our data, combined with published geochronologic constraints, demonstrate that the Yadong-Gulu rift system generally propagated progressively towards the north, with segments such as that in the Yadong region, locally propagating in the opposite direction.