Exhumation History of the Tangra Yumco Rift, South-Central Tibet: Insights from Zircon (U-Th)/He Thermochronometry

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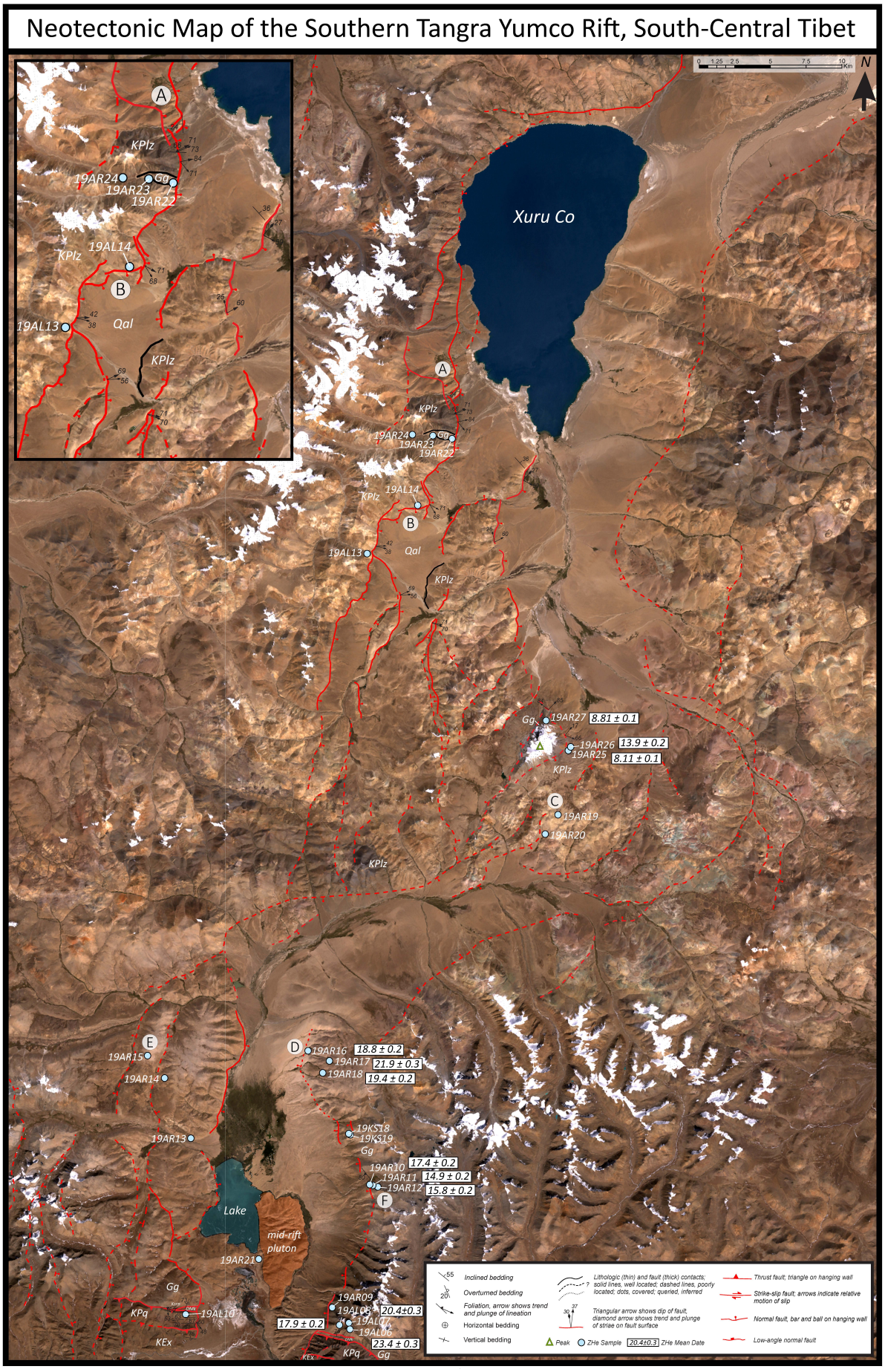
14:20 - 14:35

Abstract

Numerous dynamic models are proposed to explain east-west extension of the Tibetan Plateau, including (1) removal of dense lithosphere, (2) weakening of Tibetan lithosphere, (3) decreasing horizontal collisional stress, and (4) increasing crustal thickness by underthrusting India. Most tectonic models constrain the onset of extension during mid-Miocene time (~16-12 Ma), but struggle to reconcile an observed acceleration of extension rates ~5-10 Myr later. India underthrusting links rift acceleration to the northward propagation of the Indian plate beneath Asia, but has been tested in only one locality. The Tangra Yumco (TYC) rift in south-central Tibet is one of the longest (~250 km) north-south striking rifts on the Plateau, providing an ideal natural laboratory to test dynamic models of extension through geologic mapping, zircon (U-Th)/He thermochronology (ZHe), and thermo-kinematic modeling. Here, we utilize the ZHe method to determine spatio-temporal trends in extension onset and rates, which are then compared to dynamic model predictions. Relationships between fault displacement over time, age of extension onset, and timing and rates of exhumation additionally inform mechanisms of fault growth through time (e.g., tip propagation, segment linkage, or constant fault length).

We conducted geologic mapping over ~2,000 km^2 in the south half of the TYC rift and present a 1:100,000 scale map from this work and new ZHe dates from across key structural relationships. TYC is bounded by two approximately north striking high angle (~45-70°) active normal faults that alternate dominance along strike, exhuming ~2 vertical km of granodiorite in the footwall. Seventy single-grain ZHe analyses yield dates between 25.72 Ma and 7.58 Ma, with median dates falling between ~23 Ma and ~8 Ma. Sample transects collected from the exhumed footwall indicate an older in the south (~20 Ma) to younger in the north (~8 Ma) trend in rift age along strike, in agreement with India underthrusting model predictions. Hanging wall rocks consist of Quaternary alluvial fan deposits that display synthetic graben structures in the central rift, whereas in northern and southern rift segments, deposits are cut by a stepped sequence of high angle normal faults which likely sole into the main rift-bounding fault at depth. Footwall granodiorite shows pervasive northeast dipping foliation, with slip lineations and fault plane striations suggesting northeast directed oblique sinistral-normal slip. This detailed work from the TYC rift yields insights into dynamic processes that drive changes in crustal thickness and evolution of topography during orogenesis. Tibet is often cited as an example of an orogen undergoing synconvergent extension; therefore, this study may illustrate how analogous structures evolved in other

synconvergent settings, such as the North American Cordillera.


Neotectonic Map of the Southern Tangra Yumco Rift, South-Central Tibet
Xuru Co
N
0 1.25 2.5 5 7.5 10 Km
A
B
C
D
E
F
KPlz
Qal
Gg
KPg
KEx
19AR24
19AR23
19AR22
19AL14
19AL13
19AR27 8.81 ± 0.1
19AR26 13.9 ± 0.2
19AR25 8.11 ± 0.1
19AR19
19AR20
19AR16 18.8 ± 0.2
19AR17 21.9 ± 0.3
19AR18 19.4 ± 0.2
19AR15
19AR14
19AR13
19KS18
19KS19
19AR10 17.4 ± 0.2
19AR11 14.9 ± 0.2
19AR12 15.8 ± 0.2
Lake
mid-rift pluton
19AR21
19AR09
19AL05 20.4±0.3
19AL07
19AL06
17.9 ± 0.2
23.4 ± 0.3
19AL10
Inclined bedding
Overturned bedding
Foliation, arrow shows trend and plunge of lineation
Horizontal bedding
Vertical bedding
Lithologic (thin) and fault (thick) contacts; solid lines, well located; dashed lines, poorly located; dots, covered; queried, inferred
Triangular arrow shows dip of fault, diamond arrow shows trend and plunge of striae on fault surface
Peak
ZHe Sample
20.4±0.3 ZHe Mean Date
Thrust fault; triangle on hanging wall
Strike-slip fault; arrows indicate relative motion of slip
Normal fault, bar and ball on hanging wall
Low-angle normal fault

First Author

R

Aislin Reynolds
Montana State University

Author

L

Andrew K Laskowski
Montana State University

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