Farwestern Tibet: evolution of the relief since Oligo-Miocene times, from sedimentology and low-temperature thermochronometry

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Western Tibet, between the Karakorum fault and the Gozha-Longmu Co fault system, is internally drained and has a 2-km-amplitude relief with km-large valleys and several peaks higher than 6000 m, as shown on Figure 1. These features differ from central Tibet, which has lower relief and mean elevation, and from southeastern Tibet, where the strong relief is due to river incision. Western Tibet relief is not systematically associated with active faults. This raises the question of the origin of a strong relief zone with no connection with major rivers, within the Tibetan plateau.

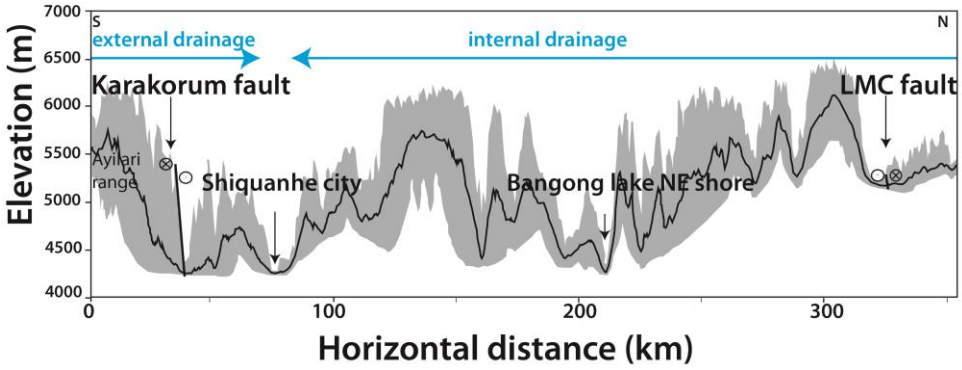

Figure 1. S-N topographic profile across Western Tibet. Grey envelope shows minimum and maximum elevations; mean elevation is shown by the black line. LMC : Lungmu Co strike-slip fault system. The external drainage area is connected to the Indus river.

We investigate the Oligocene-Miocene morphology evolution in the Lungmu Co - Rutog - Shiquanhe area by constraining the erosion history: its spatial distribution, timing, and rates. To do so, we combined mapping tertiary detrital sediments using field data and satellite imaging, and a sedimentology and geochronology analysis. Erosion rates are also investigated through exhumation reconstructions based on low-temperature thermochronometry. We performe a (U-Th-Sm)/He and $^{4}He/^{3}He$ study on apatites from a vertical profile in a granodiorite pluton south of the Bangong lake.

Tertiary continental strata (or red beds) lithology indicates a proximal, detrital fan depositional environment. U-Pb dating was performed *in situ* by LA-ICPMS on zircons from trachytic flows interbedded within the red beds, and indicates a deposition age range between 24.3 +/- 1.1 and 22.6 +/- 1.4 Ma. These results are similar to a previous $^{39}Ar/^{40}Ar$ dating by Kapp et al., 2003, and show that a detrital sedimentation coming from a local relief occurred at that time. Continental deposits are mostly distributed on flanks of km-large, 1000m deep valleys and seem to fill a palaeorelief formed by Cretaceous-Permian sediments. This suggests that the main valleys were already formed by the Oligocene.

Apatites cooling age range from 13 to 22 Ma, as shown on Figure 2. Age-elevation relationship indicate an apparent exhumation rate of 70 m/Ma, and modelled thermal histories based on AHe ages and $^{4}He/^{3}He$ data suggest that erosion rates were already low during the early Miocene.

Cite as: Gourbet, L., Mahéo, G., Leloup, P.H., Sorrel, P., Shuster, D.L., Paquette, J.-L., and Quillévéré F., 2014, Farwestern Tibet: evolution of the relief since Oligo-Miocene times, from sedimentology and low-temperature thermochronometry, in Montomoli C., et al., eds., proceedings for the 29th Himalaya-Karakoram-Tibet Workshop, Lucca, Italy.

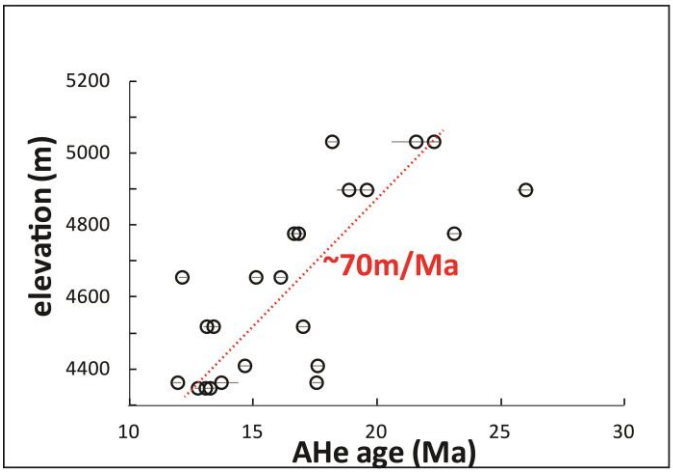

Figure 2. Apatites (U-Th-Sm)/He cooling ages from 8 granodiorite samples from an elevation profile south from the Bangong lake. Each open circle corresponds to a single apatite grain; grains at the same elevation come from the same sample. Ages at 23 and 26 Ma likely reflect U-rich inclusions inside the crystals. Grey horizontal lines are analytical errors. Linear regression through the median ages is shown by the red dotted line.

The modern 2-km amplitude relief appears to be incompatible with present day arid climate and very low erosion conditions. Therefore, we suggest that today's internally drained farwestern Tibet was externally drained until late Oligocene, and experienced significant fluvial incision. The relief carved by the incision was then preserved, presumably because the offset of the Karakorum fault partly blocked the palaeo-Indus drainage system.

References

Kapp P., Murphy M.A.,Yin A., and Harrison T.M., 2003, Mesozoic and Cenozoic tectonic evolution of the Shiquanhe area of western Tibet, Tectonics, 22, doi:10.1029/2001TC001332.