Low-temperature thermochronology of central and northwestern Pamir gneiss domes

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Central Asia offers the most spectacular area in active intra-continental deformation. In the Pamir, at the northwestern edge of the Tibetan Plateau, the Cenozoic orogeny formed high-relief mountains of about 500 km north-south extent. High-grade metamorphic and associated igneous rocks covers about 30% of the surface exposure of the Pamir. These rocks exhumed in Cenozoic syn-orogenic domes, which provide an opportunity to look into the deeper crust of the Asian plate.

The Central Pamir gneiss domes, from east to west the Shatput, Muskol, Sarez, and Yazgulom domes, form a nearly continuous anticlinorium of greenschist to mostly amphibolite-facies crystalline rocks, framed by mostly unmetamorphic volcano-sedimentary rocks. The crystalline rocks contain Paleozoic, Mesozoic, and Cenozoic intrusives. The Cenozoic evolutions of these rocks shows a documented ~34–20 Ma prograde evolution and a post-~20 Ma retrograde evolution, accompanied by N–S extension that is replaced since ~10 Ma by renewed N–S shortening. Cenozoic magmatic activity spans 40–15 Ma [Schmidt et al., 2011; Stearns et al., 2013; see also abstracts of D. Rutte et al. and Malz et al. at the same conference].

Here, we focus on the characterization of the post-~20 Ma exhumation history in the Central Pamir domes, employing low-temperature thermochronology, i.e., apatite and zircon fission-track and (U–Th)/He dating. The Central Pamir domes yield apatite fission-track ages between 15 and 5 Ma. The youngest ages and youngest time-temperature paths occur in the Yazgulom dome of the western Central Pamir. This is interpreted as an effect of the increased erosional exhumation in the deeply incised western Pamir, overprinting the earlier tectonic denudation, best recorded by the Ar-Ar geochronology. The temperature-time paths indicate that this late rapid exhumation occurred after ~5 Ma; it is likely ongoing today. Age versus elevation relationships indicate most rapid exhumation at ~10 Ma. In the Southern Pamir, low-temperature thermochronology records a longer extensional exhumation history, ending at ~5 Ma in the Alichur dome and ~2 Ma in the Shakhdara dome [Stübner et al., 2013a,b; see also abstracts of K. Stübner et al. at the same conference]. In the Northern Pamir, the Triassic Kurgovat gneiss dome shows Cenozoic exhumation from less than 10 km depth; exhumation is earlier than in the Central and Southern Pamir domes with apatite fission-track ages between 5 and 28 Ma.

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Key words: Pamir, Tibet Plateau, Cenozoic, thermochronology