

The exhumation of the westernmost Tien Shan (Tajikistan, Uzbekistan)

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The westernmost segment of the Tien Shan and the Tajik-Afghan basin of Tajikistan and Uzbekistan (Central Asia) lie northwest of the Pamir and southeast of the Turan platform. The Tajik-Afghan Basin comprises up to 10 km thick, mostly clastic deposits, ranging in age from Lower Jurassic to Quaternary. A thin-skinned fold-and-thrust belt developed within the Cretaceous through Neogene sedimentary rocks; the basal detachment runs along the Lower Jurassic evaporates. In Uzbekistan, crystalline basement of the Ghissar unit of the westernmost Tien Shan is involved in the folding/thrusting of the Jurassic to Neogene sediments, proving thick-skinned deformation and suggesting basement involvement below the Jurassic evaporites underneath the Tajik-Afghan basin. Most of the thrusts in the region trend (NNE-SSW), proving an ~E-W shortening component during the India-Asia collision.

We collected more than forty samples from the basement rocks of the Tien Shan and the Cretaceous clastic rocks of the Tajik-Afghan Basin above the major thrusts to constrain the timing of deformation and exhumation of the region using apatite fission-track (AFT) and apatite (U-Th)/He (AHe) thermochronology. The samples from the Ghissar Range of Tajikistan and from the southern part of the Tajik-Afghan Basin yielded fully reset apatite ages, ranging between 11.1 ± 0.7 and 7.6 ± 0.3 Ma; we interpret these ages as recording cooling as result of shortening within the fold-and-thrust belt and coeval erosion. In the Kurgan section in the central Tajik-Afghan Basin, the samples are partially reset and the mean ages range between 26.2 ± 1.2 and 17.2 ± 0.9 Ma. Heavy ion irradiation and multiple edging provided a statistically significant amount of confined fission tracks to allow temperature-time history modeling. Cooling in this part of the Tajik-Afghan Basin likely started at ≤ 20 Ma.

The basement samples from the Tien Shan in Uzbekistan have AFT ages ranging between 12.5 ± 0.8 and 6.7 ± 0.7 Ma; temperature-time history models support rapid cooling within this period. The simplest interpretation of the combined data in the Tajik-Afghan Basin and in the crystalline basement of the Uzbek Tien Shan suggests a two-phase exhumation/cooling history: (1) Regional exhumation likely initiated at ≤ 20 Ma. (2) Exhumation/cooling by erosion initiated by deformation in the fold-and-thrust belt started at 13-7 Ma, reflecting slip along the Upper Jurassic evaporate detachment and faults in the sub-detachment basement.

Key words: Tajik Basin, Western Tien Shan, Thermochronology, Apatite fission track dating, (U-Th)/He dating.