Constraining Deformation in the North Pamir and the Westernmost Tarim Basin

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The Main Pamir Thrust (MPT) is the updip projection of the Alai subduction zone, which accommodates much of the convergence between the Pamir and the Tien Shan [1]. This north-vergent structure is seismically active; the geodetic convergence rate is 10-15 mm/yr [2]. Seismologic data shows that the downgoing Alai slab extends for at least 250 km [3], attesting to 17-25 Ma of subduction, based on the risky assumption that the present convergence velocity has remained constant. Despite the importance of this structure, there is little direct data that constrains when the system initiated nor how it has developed. A limited amount of thermochronologic data, primarily apatite fission track dating (AFT), suggest that the system was moving northward by ca. 20 Ma [4]. Significant exhumation in the hanging wall commenced at ~25 Ma; however, it is unclear if this cooling reflects erosion in the hanging wall of the MPT or regional deformation and erosion prior to the initiation of subduction [5, 6].

On the southern flank of the westernmost Tarim Basin, the MPT places the North Pamir over Cretaceous and Cenozoic strata; farther west, in the Trans-Alai, the outcropping footwall includes Paleozoic strata with Tien Shan affinity [7, 8]. Much of the shortening is now accommodated along the Pamir Frontal Thrust system (PFT), which lies tens of km north of the MPT and places basinal units on strata as young as Quaternary [e.g., 9]. In the eastern area, the accretionary belt north of the MPT incorporates almost exclusively Cenozoic strata while in the western region, thrust sheets include Paleozoic units with Tien Shan affinity as well as Mesozoic and Cenozoic strata. Note that our definition of the MPT and PFT differs from older studies which defined all of these faults as the MPT. Stratigraphic relationships demonstrate that the MPT-PFT has propagated northward during the middle Miocene - Pliocene [e.g., 10]. We interpret this propagation to result from the latest Miocene - Present influx of syn-tectonic sediments into the Alai and westernmost Tarim Basins and deformation within the downgoing Alai slab; this thickened the crust, resulting in increased coupling, which promoted subduction accretion.

The deformation history described above is quite complex; unfortunately, age constraints on the deformation remain sparse. To address this issue, we have collected two N-S profiles for thermochronology across the major structures in the Chinese Northern Pamir as well as several samples from the immediately adjacent region in Kyrgyzstan. These are being analyzed using apatite and zircon (U-Th-Sm)/He and AFT thermochronology. We combine our data with published thermochronologic (summarized in [6] plus newer results in [11-13]) and stratigraphic-structural [9, 10] data. This sheds light on the deformation sequence in this region.

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