Intra-continental, two-stage shortening along the Alai valley, Pamir–Tien Shan, Central Asia

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The Alai Valley is situated between the Pamir frontal range and the southern Tien Shan. As a remnant of a previously 10s of km wide Cenozoic sedimentary basin, it connects the Tajik basin to the west and the Tarim basin in the east [1]. The 'Main Pamir Thrust Zone' absorbs up to one-half of the present India-Asia convergence and possibly marks the main site of thrusting of the Tajik-Tarim crust underneath the Pamir along a highly seismically active zone [2]. Late Cenozoic deformation is separated into different segments and the lateral transients are accommodated by complex areas of transfer faults and thrust systems [3]. Map interpretation and evaluation of structural data indicate up to 40 to 50° clockwise rotation of the shortening direction from NNW-SSE to NNE-SSW since the late Miocene. Local block rotations caused differences in the fault patterns between several segments of the northern Pamir, and between the northern Pamir and the southern Tien Shan. Active deformation of the Pamir frontal range mostly occurs along the western and central segments.

Currently available information on the age of deformation was basically obtained by the tectonic interpretation of facies variation in shallow marine and continental sedimentary rocks [4]. During the late Oligocene to early Miocene, distributed north-south contraction occurred, with shortening resuming in the middle Miocene. Based on $^{40}Ar/^{39}Ar$ geochronology, the southern Tien Shan cooled through 300°C at ~275 Ma and locally later through ~100°C at ~11 Ma. Sandstone samples of Paleogene and Miocene strata from a NE-trending intra-montane basin in the southern Tien Shan yielded detrital apatite and zircon fission-track data with age peaks at ~ 330, 250, 170, 145, and 75 Ma that are not reset during the Cenozoic. Detrital apatite and zircon of Cretaceous sandstone samples from the Pamir frontal range, yielding age peaks at ~240 Ma and ~140 Ma, are unreset, too. Only the nappes in the interior of the range, where Lower Cretaceous and Paleozoic volcanoclastic rocks are involved yielded Cenozoic cooling ages.

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[1] V. S. Burtman. Cenozoic crustal shortening between the Pamir and Tien Shan and a reconstruction of the Pamir–Tien Shan transition zone for the Cretaceous and Paleogene. Tectonophysics, v. 319, p 69–92 (2000).
[2] M.W. Hamburger, D.R. Sarewitz, T.L. Pavlis, and G.A.Popandopulo. Structural and seismic evidence for intra-continental subduction in the Peter the First Range, central Asia. Geological Society of America Bulletin, v. 104, p 397–408 (1992).
[3] J.R. Arrowsmith and M.R. Strecker. Seismotectonic range-front segmentation and mountain-belt growth in the Pamir-Alai region, Kyrgyzstan (India-Eurasia collision zone). Geological Society of America Bulletin, v. 111, p. 1665–1683 (1999).
[4] I. Coutand, M.R. Strecker, J.R. Arrowsmith, G. Hilley, R.C. Thiede, A. Korjenkov, and M. Omuraliev. Late Cenozoic tectonic development of the intra-montane Alai Valley (Pamir-Tien Shan region, central Asia): An example of intra-continental deformation due to the Indo-Eurasia collision. Tectonics, v. 21, p 1053, doi:10.1029/2002TC001358 (2002).

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