Miocene exhumation revealed by detrital minerals of Tajik rivers: Implications for the tectonic evolution of the Pamir

C.E. Lukens[1], B. Carrapa[1], B.S. Singer[2], G. Gehrels[3]

[1] Department of Geology and Geophysics, University of Wyoming, Laramie, WY 82071, U.S.A., clukens@uwyo.edu
[2] Department of Geoscience, University of Wisconsin-Madison, Madison, WI 53792, U.S.A.
[3] Department of Geosciences, University of Arizona, Tucson, AZ 85721, U.S.A.

The highest mountains on Earth are located in areas of continent-continent collision, such as the Himalaya, the Alps, and the Pamir of central Asia. Collision-related shortening and crustal thickening are undoubtedly some of the most important processes controlling exhumation in these orogenic systems. Exhumation is recorded by thermochronologic ages in the hinterland and in syn-tectonic detritus shed into adjacent foreland basins. Cenozoic India-Asia collision in the Himalaya has resulted in widespread Eocene-Oligocene exhumation, but it is unclear how the same processes have affected the Pamir Mountains of Central Asia.

New multi-crystal laser total fusion $^{40}Ar/^{39}Ar$ thermochronologic data from detrital white mica in samples from five rivers that drain the western Pamir in Tajikistan (Vanch, Yazgulem, Bartang, Gunt, and Murghab Rivers, Figure 1) give ages significantly younger than previously published thermo- and geo-chronologic data from the magmatic belt (Schwab and others, 2004). Apparent ages range from 14 to 348 Ma with young age peaks at 18 Ma in four samples and 38 Ma in the one sample (Figure 2). These new data suggest 1) the presence of undocumented mid-late Cenozoic plutons within the western Pamirs, and/or 2) deep mid-late Cenozoic exhumation.

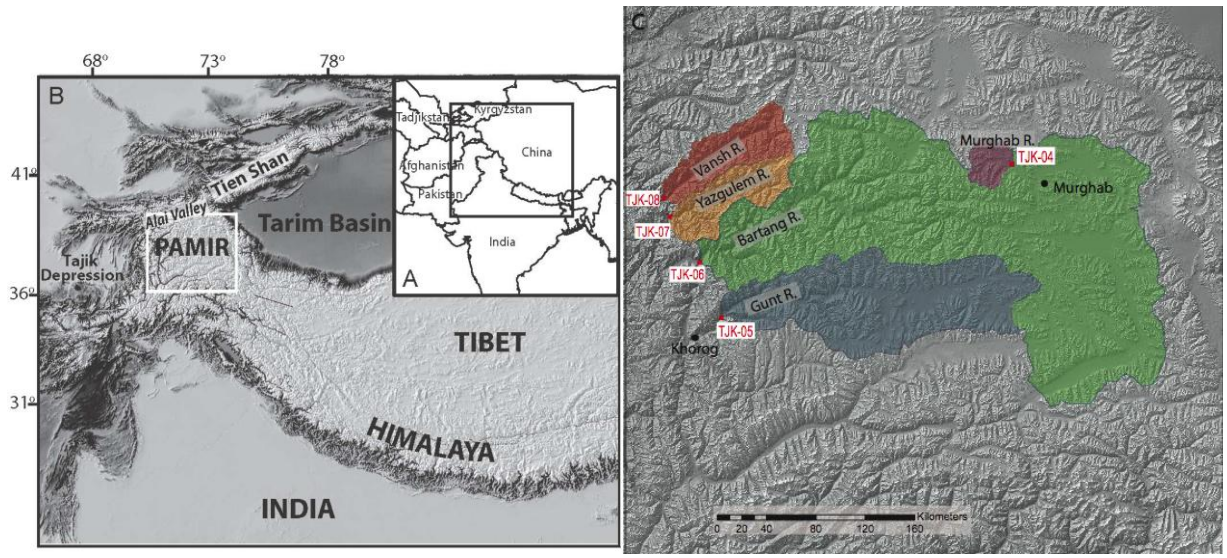

Figure 1. Location maps (A, B) for the Pamir. White box in B is area represented in C. Map C: sampling locations on five major rivers in the western Pamir

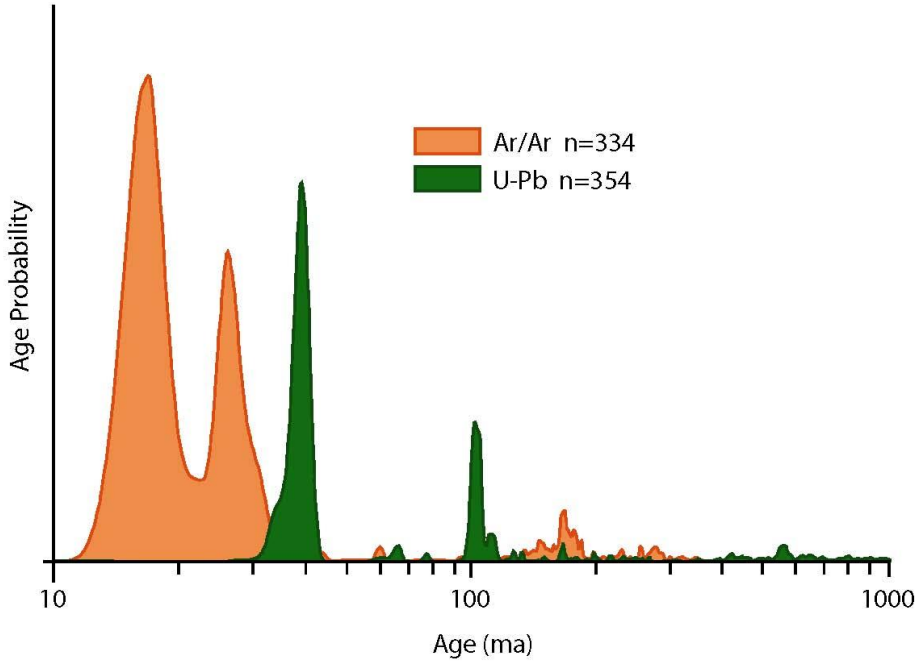

Figure 2. Relative age probability for $^{40}Ar/^{39}Ar$ and U-Pb data for grains younger than 1 Ga. All $^{40}Ar/^{39}Ar$ ages are younger than 1 Ga; a total of 49 grains from all five samples have U-Pb ages older than 1 Ga.

U-Pb dating of zircons from the same sediment samples was also performed, and yielded grains no younger than 33 Ma, suggesting that the Miocene $^{40}Ar/^{39}Ar$ ages reflect exhumation rather than the rapid crystallization of young magmatic bodies (Figure 2). Exhumation at this time is also supported by an increase in foreland basin subsidence and the deposition of > 5 km of coarse alluvial material in the Tajik Depression, west of the Pamir (Nikolaev, 2002).

The regionally uniform exhumation signal documented in our data contrasts with the northward propagation of deformation through time expected from India-Asia collision alone, which should produce exhumation ages that are younger to the north. Though open questions remain on the mechanism responsible for Miocene exhumation, processes related to intra-continental subduction are favored, due largely to support from geophysical data (e.g. Hamburger and others, 1992; Burtman and Molnar, 1993; Negredo, 2007). If this is the case, this process results in high magnitude, regionally-distributed, episodic exhumation, mimicking a 'collisional' signal.

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