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The eastern Central Pamir Gneiss Domes: temporal and spatial geometry of burial and exhumation

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We present a structural and thermochronologic study of the Gneiss Domes and their cover in the Central Pamir. Emphasis is laid on presentation and discussion of new 40Ar–39Ar dates embedded in two structural profiles through the central Muskol and western Shatput domes.

The structure of the Central Pamir is dominated by Cenozoic deformation related to the India-Asia collision. Only few structures of the Phanerozoic amalgamation of the Pamir were not reactivated. The Cenozoic structural development of the Central Pamir can be simplified into three phases:
1) Between initial collision of India and Asia to 28-20 Ma (peak metamorphism, U-Pb monazite) the emplacement of large thrust sheets led to strong north-south shortening;" in the eastern Central Pamir the major thrust sheet has a minimum displacement of 35 km. The stratigraphic thickness of this nappe is ∼7 km but its internal structure and thus its true thickness is weakly constrained by the available data. Klippen of Early Paleozoic strata of this thrust sheet south of the Central Pamir Muskol and Shatput domes cover Carboniferous to Triassic strata of the footwall; they can be linked to the Akbaital nappe previously mapped by Russian geologists north of the domes. In the Sasaksu valley of the Muskol dome, the thrust sheet is intruded by a ∼36 Ma granodiorite (new U–Pb zircon dates).
(2) This crustal imbricate stack is cut by east-trending normal faults and shear zones that define the Central Pamir Gneiss Domes. Normal shear is concentrated along the northern margin of the domes and was the main process associated with exhumation of the domes from ∼30 km depth at 20-15 Ma (U-Th/Pb titanite and monazite, Ar–Ar, fission-track geo-thermochronology). One granite at ∼35 Ma (U–Pb zircon) pre-dates exhumation while three leucocratic dykes (18–20 Ma U–Pb monazite and zircon) are dated to be coeval with the initial stages of exhumation.
Detrital U–Pb zircon ages of the high-grade metasediments indicate that the protoliths of the domes are Paleozoic. Detrital zircon data from the low-grade cover and surrounding units of the Muskol dome suggest that low-grade cover and high-grade dome formed from the same Paleozoic, possibly early Mesozoic strata. This indicates that the upper crust of the Central Pamir thickened to at least 30 km in phase (1). Based on our data and those of Robinson et al. (2012) underthrusted Karakul-Mazar (Songpan-Ganze) material (as discussed by Schwab et al. 2004), in analogy to the Tibetan Qiangtang domes (Kapp et al. 2000), can be ruled out as protolith for the Muskol and Shatput domes.
(3) Neogene shortening is bi-vergent: top-to-S back-thrusting north of the Central Pamir Gneiss Domes opposes top-to-N thrusting in the south. Neogene deformation affected ∼18 Ma (Ar-Ar) coarse fluvial and alluvial fan strata with basaltic dikes and flows south of the dome; restoration of these strata yielded up to 40% shortening. Total shortening by thrusting of the Central Pamir is at least 40% in the Shatput–Muskol area with a minimal total shortening of 70 km; internal deformation with recumbent north-verging folds within the domes and its cover indicate much higher values.

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