

The Central Pamir domes as tracer of gravitational disequilibrium and deformation phases forced by deep-seated lithospheric processes

Daniel Rutte (1,2), Matthew Fox (1,2), and Lothar Ratschbacher (3)

(1) Berkeley Geochronology Center, (2) Earth and Planetary Sciences, UC Berkeley, (3) Geologie, TU Bergakademie Freiberg

Miocene gneiss domes in the Pamir allow unique insight into crustal-scale processes forming the Asian crust of the Pamir-Tibet Plateau. They were exhumed along normal-sense shear zones in an intermittent phase of N-S extension while earlier and later structures document N-S shortening. Recently, Schmidt et al. (2011), Stearns et al., (2013; 2015), Rutte et al. (a & b, accepted), and Hacker et al. (submitted) established a vast structural, petrologic, and geochronologic dataset for the Central Pamir domes. These studies interpreted the domes as a product of gravitational collapse. The dataset includes (micro)structural observations constraining the mechanism of exhumation, thermobarometry of the metamorphic rocks, petrochronologic data constraining timing of pro- and retrogression, a vast multi-method thermochronometric dataset including age-elevation and age-distance data, dates for normal-sense shear zones and barometric data on intrusive rocks. These data constrain the time-temperature, pressure-temperature, and time-pressure history of the dome rocks.

We explore the dataset using one-dimensional thermal models. Our code solves the heat transfer equation and gives a transient solution allowing for variation of the geothermal gradient and thermal diffusivity. At this stage, our models suggest that exponential decay of an initially high exhumation rate of ~ 6 km/Myr at ~ 22 Ma to ~ 0.5 km/Myr at ~ 13 Ma best explains the dataset. This suggests a one-time input of gravitational potential energy (GPE) that is successively decaying through crustal extension. Both, Asian crustal foundering or Indian slab breakoff may concur with this result.

While the Central Pamir domes extend >400 km along strike of the orogen, little variation in timing of most of exhumation during N-S extension is observed. This suggests that the underlying mechanism - be it crustal foundering or slab breakoff - varied little along strike as well.

References

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