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Syntectonic Extension and Dome Development during Formation of the NE-Chinese Pamir

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It has been proposed that increased worldwide climatic cooling and instability accelerated erosion over the past ∼2.8 Ma. The geologically young NE Chinese Pamir are characterized by growth, ongoing syntectonic extension and the rise of two giant metamorphic dome complexes, the Kongur Shan (7719 m) and Muztagh Ata (7546 m) since the late Miocene. Our goal is to better constrain the temporal and spatial variation of exhumation and to utilize this data to determine if strengthening of glacial and/or fluvial erosion can be recognized in the exhumation history of the domes during the Quaternary.

Both domes are situated in the footwall of the west dipping Kongur detachment system. In the hanging wall, a large intra-mountain basin has been filled with Quaternary sediments. The ridgeline of both domes form a pronounced orographic feature towering ∼ 2000 m over the surrounding Pamir mountain chain and collecting abundant moisture. Extensively carved glacial valleys in the core of both domes and along its flanks indicate deep seated glacial erosion as the first order mechanism responsible for dome degradation above an elevation of 3km. Previous petrologic analysis of high-grade metamorphic gneissic footwall rocks suggest subsequently to peak-metamorphism at 8-6 Ma the onset of rapid rock exhumation from a depth of∼27km. Previous studies have proven rapid exhumation and proposed an acceleration of exhumation; however, low-temperature chronologic constrain have been limited

Twenty new apatite fission-track (AFT) and nine new zircon U-Th-Sm/He (ZrHe) cooling ages from a series of vertical profiles in the footwall and spot samples from the hanging wall along the length of the Kongur detachment have been analyzed. In general, our new AFT and ZrHe cooling ages show significantly younger cooling ages in the vicinity of the domes compared to rock samples analyzed further along strike and from the hanging wall rocks. They are consistent with previous published data. In the central portion of the detachment, around and between the Kongur Shan and Muztagh Ata domes, we obtained youngest ages between <1 and 2 Ma and older ages both toward the NW as well as along southern termination of the Muztagh Ata dome where ages range from 3 to 6 Ma. We observe that in regions with the youngest ages, thermochronologic results are not concurrent, as ZrHe were often younger then AFT-ages.

Taken together, these results suggest that exhumation is focused in the vicinity of the two domes and that the Kongur detachment fault accommodates the majority of displacement over the last 6 Ma. Preliminary 1D thermo-kinematic and erosion modeling suggests that dome exhumation rates between the time of peak metamorphism and the present has been as high as >3 mm/a. In contrast, towards the NW, we obtain exhumation rates of <1 mm/a before 3 Ma as 40Ar/39Ar ages are not reset during the Miocene and ∼0.7 mm/a after ∼3 Ma. At the southern Termination of Muztagh Ata, exhumation must have been high between ∼10 to ∼5 Ma (>3 mm/a), however, since then exhumation rates have not achived rates <0.5 mm/a. Rocks forming the hanging wall of the Kongur Detachment have been affected by relatively low exhumation rates of between 0.3 and 0.5 mm/a over the last 10 Ma, if not longer.

These results suggest that enhanced, focused erosion and exhumation has been limited mainly to the vicinity of the domes over past 3 Ma, allowing them to exhume with up to threefold higher rates then the surrounding Pamir, however, if exhumation rates have changed is without the resolution of the data.