Deciphering central Asia's exhumation history using apatite, titanite and zircon fission track and U-Th-Sm/He thermochronology

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Multi-method thermochronology (apatite and titanite fission track; and apatite and zircon U-Th-Sm/He data) elucidate the exhumation history of Central Asia, the world`s largest and most active intracontinental deformation zone, located between Tibet and Siberia.

Besides the occurrence of preserved Early Mesozoic geomorphic features (such as internally drained plateaus or old erosion surfaces), most of the current Central Asian relief is related with an important phase of Late Jurassic – Early Cretaceous exhumation. This Mesozoic exhumation pulse is thought to be related with the progressive consumption of the Palaeo-Tethys Ocean and associated collisions of Gondwana-derived terranes to Eurasia in the south and to the closure of the Mongol-Okhotsk Ocean to the northeast. Major fault systems within southern Central Asia (Tian Shan) record Cenozoic episodes of fault-induced rapid exhumation during the Early Palaeogene (~55-45 Ma) and Oligocene (~33-22 Ma) to Miocene (~10-8 Ma), related with the consumption of the Neo-Thetys and subsequent India-Eurasia collision. Fault systems within northern Central Asia (Altai-Sayan) mainly record rapid fault-induced exhumation during the Late Cretaceous – Early Palaeogene (~90-60 Ma), which is thought to be a far-field response of the collapse of the Mongol-Okhotsk Orogen between Siberia and China-Mongolia. In addition, a renewed phase of Plio-Pleistocene (~3-1 Ma) reactivation was documented, which enhanced the present northern Central Asian mountainous relief.

Although many of the hypothesised links between intracontinental exhumation and the prevailing plate-margin tectonic processes need to be tested further, they allow a first-order insight into stress propagation pathways from the Eurasian margin to the continental interior. We further highlight the strength of combining multiple thermochronometers for exhumation studies.