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Spatial and temporal patterns of intracontinental tectonism in the Kyrgyz Tien Shan

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Determining whether intracontinental mountain belts such as the Tien Shan develop by in-sequence or diachronous fault propagation allows the importance of inherited structures in focusing deformation to be investigated, as well as providing information necessary to differentiate between the effects of climate and tectonics. The compressive stresses responsible for creating the Tien Shan are a far flung effect of the ongoing India-Eurasia collision, with the western portion of the range currently accommodating $\sim$20mm/yr of convergence, predominantly along high angle reverse faults.

Quantifying the rate at which this compressive stress has propagated through the Tien Shan can be achieved by dating the onset of deformation across the range by utilizing thermochronology. This has previously been done in the southern and northern parts of the western Tien Shan, but not in the central portion of the range, and has typically placed the onset of deformation in the Oligo-Miocene (24-20Ma) to the south in the Chinese Tien Shan or in the late Miocene (11-10Ma), as in the Kyrgyz Range to the northwest. Our study area lies in the eastern Kyrgyz Tien Shan, south of lake Issyk Kul, and occupies a relatively central position in the range.

Age-elevation relationships derived from apatite fission track and (U-Th-Sm)/He vertical profile data from the Teresky Range, in the south of the Northern Tien Shan terrane date the onset of deformation. It has been found that within the Teresky Range, deformation initiated in both the Oligo-Miocene (24-20Ma) and late Miocene (11-10Ma), with major faults separating areas of different onset ages. The confinement of initiation ages in the middle of the Tien Shan to those two periods suggests that deformation did not progressively propagate northwards in-sequence across the range during the Miocene. Instead it seems that Cenozoic shortening started in the Tien Shan in the Oligo-Miocene (24-20Ma), with a second tectonic event occurring in the late Miocene (11-10Ma).

Diachronous fault propagation therefore seems to operate, with pre-existing structures influencing the spatial and temporal pattern of deformation, and potentially resulting in non-uniform erosion across the range. The Nikolaev Line, which separates the Northern and Middle Tien Shan terranes, was reactivated during the Cenozoic, and may explain the observed differences in erosional histories across the fault system. The Middle Tien Shan has experienced significantly less erosion than the Northern Tien Shan, and is characterised by the occurrence of older apatite fission track ages at comparatively similar elevations and by the retention of larger areas of the pre-tectonic erosion surface. Less erosion in the Middle Tien Shan can be explained either by having deformation and subsequent rock uplift initiate later than in the north, or by having lower erosion rates due to tectonic or climatic processes. The former case requires that deformation commenced to the north, and at some stage stepped back into the orogen, exhuming the Middle Tien Shan and resulting in rapid rock cooling. These scenarios will be tested by modelling of apatite fission track length data.

Although the underlying causes for the onsets of tectonism in the Northern and Middle Tien Shan remain unclear, and their significance in the regional setting is only beginning to be unravelled, it is clear that these periods reflect major changes to the dynamics of Central Asian tectonics, and are likely to have affected the regional climate.