Fission track analysis and the problematic (U-Th)/He thermochronology of the Shandong Province, NE China - a rifted cratonic margin

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In an ongoing study of the low-temperature thermochronology of cratonic regions we have undertaken an apatite fission track (AFT) and (U-Th)/He (AHe) thermochronometry study on the North China Craton (NCC). The NCC is a unique area which has been postulated to have undergone dramatic lithospheric thinning from thick, cold refractory lithosphere (>200km) in the Palaeozoic to thin, hot lithosphere (<80km) in the Cenozoic. We report data from 29 samples taken across the eastern Shandong Province (SP), which lies in the easternmost NCC and is situated directly to the south of the Bohai Basin. The Tan-Lu Fault, a major lithospheric structure, extending over 2000km, lies in the eastern SP. Our fluorapatite samples include a vertical profile west of the Tan-Lu Fault at Mount Taishan, which has relief of ~1200m. AFT ages range from 27 Ma (~300m elevation) to 55 Ma (~1500m elevation). Across the broader study area, AFT ages range from 29-63 Ma, with samples east of the Tan-Lu Fault representing most of the oldest ages. Preliminary findings suggest that there were two major periods of uplift and erosion, at ca. 65 Ma and at ca. 24 Ma. The older event coincides with the Late Yanshan Movement, a broad event of regional uplift and denudation affecting much of the NE China Block and the North China Block. The younger event coincides with the cessation of rifting and the onset of post-rift thermal subsidence marked by a prominent Early Miocene unconformity in the adjacent Bohai Basin. AHe ages are problematic, as they are predominantly older than their coexisting AFT ages and numerous samples replicate poorly. This has prompted further investigation into the possible causes of problematic AHe ages. Micro-inclusions, U/Th inhomogeneity and alpha implantation have been considered as possible causes of ‘excess He’, and apatite air abrasion experiments have been conducted to remove apatite grain rims possibly affected by external alpha implantation.