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SHORT NOTE

MESO-CENOZOIC TECTONICS OF THE CENTRAL KYRGYZ TIEN SHAN (CENTRAL ASIA), BASED ON APATITE FISSION TRACK THERMOCHRONOLOGY

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(2 figures)

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ABSTRACT. Apatite fission track thermochronology on the Kyrgyz Tien Shan basement revealed a polyphased thermal history of the study-area. We interpret the Mesozoic and Cenozoic cooling-events as periods of tectonic reactivation.

KEYWORDS: Central Asian orogenic system, geochronology, thermal history, intracontinental reactivation, tectonic denudation.

The Central Asian Orogenic System (CAOS) is the world's largest and most active intracontinental deformation belt. It stretches north from the Tibetan Plateau to the Baikal rift in Siberia (Dobretsov *et al.*, 1996). Located in the southern part of the CAOS, the Tien Shan zone (TSZ) is dominated by east-west trending mountain ranges, often separated by large intramontane basins. This large intracontinental mountain belt is for the most part located in Kyrgyzstan and West-China (Xinjiang). In the northern part of the Kyrgyz Tien Shan, the mountain ranges are basement cored and mainly consist of an Ordovician batholith. This granitic batholith is related to the closure history of the Palaeozoic Turkestan Ocean and the development of the ancestral TSZ within the tectonic framework of accretion and growth of the Eurasian continent (Allen *et al.*, 1992; Yin and Harrison, 2000; De Grave *et al.*, 2007b). During this progressive amalgamation, several microcontinents, island-arcs and subduction-accretion complexes collided to the Eurasian margin (Buslov *et al.*, 2001). As a consequence, de TSZ was reactivated several times during its geological history. These reactivation episodes seem to be predominantly controlled by the inherited Palaeozoic structural architecture in which pre-existing zones of weakness in the lithosphere act as preferential deformation sites. At present, the area is again reactivated as a distal effect of the continuous convergence between India and Eurasia. It is this vast collision that is responsible for the building of the modern TSZ as a transpressive intracontinental orogen (De Grave *et al.*, 2007a).

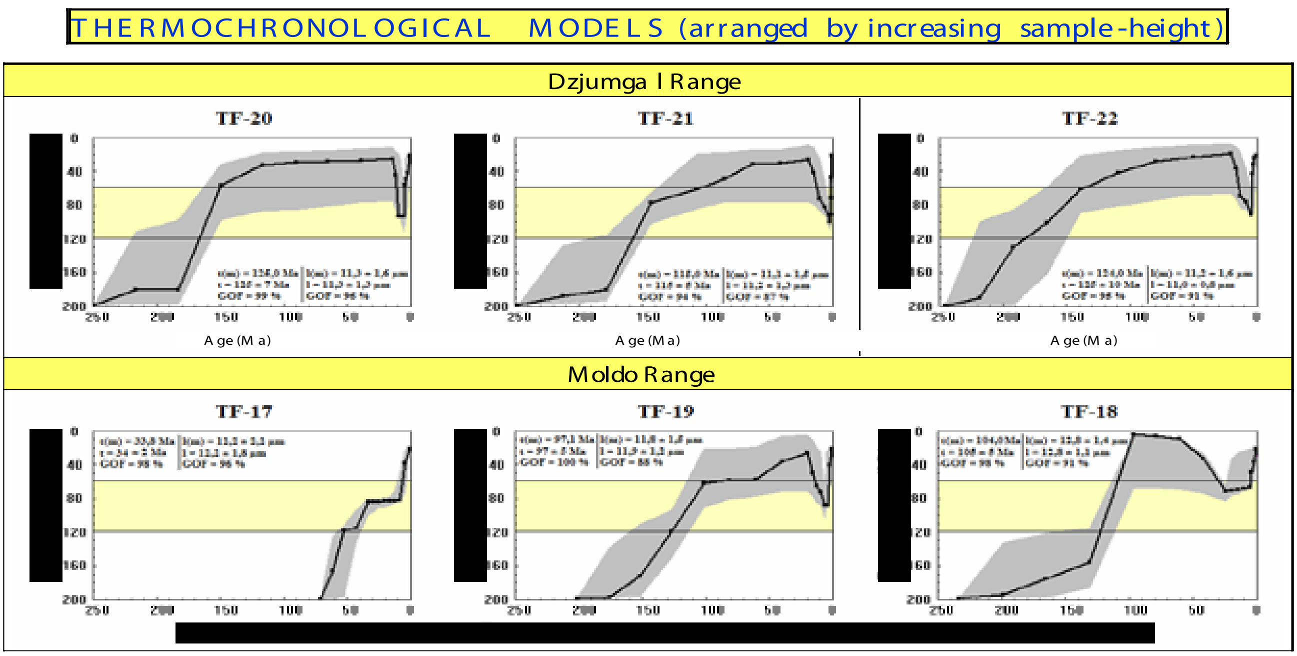

Figure 1: Resulting thermal history models for the Tien Shan samples (using AFTSolve software).

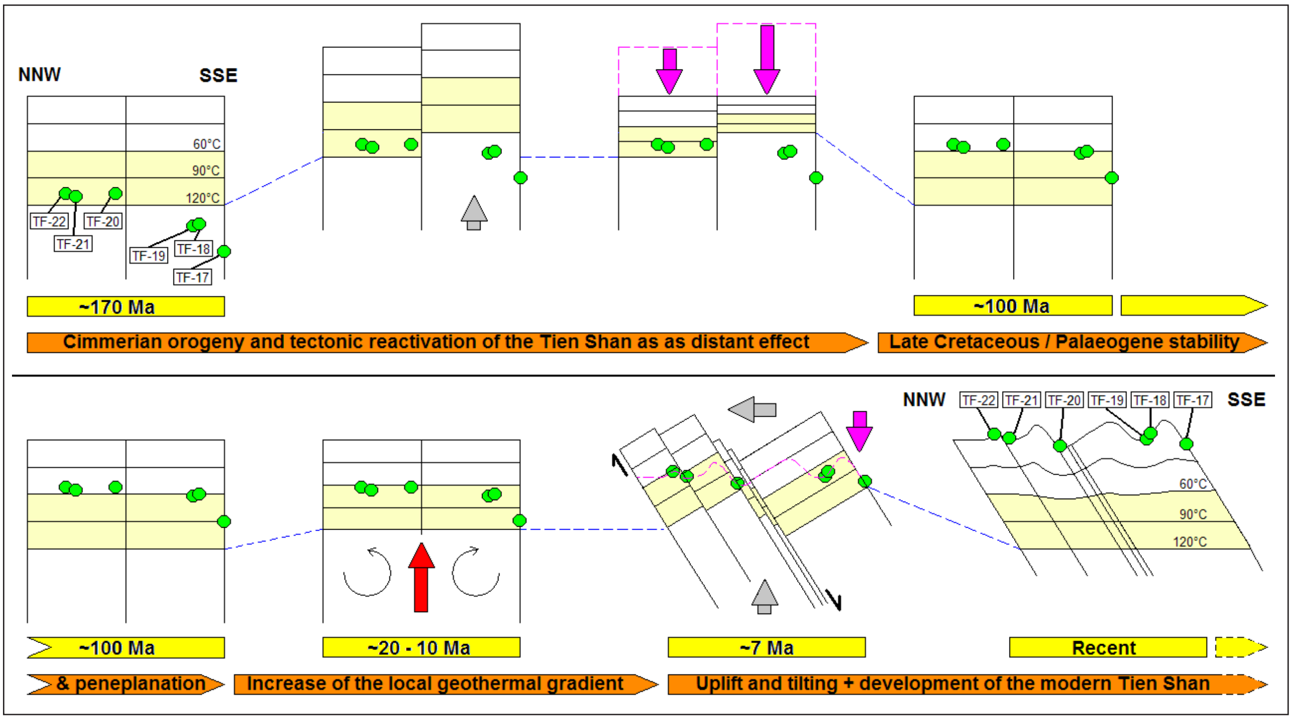

Figure 2: Simplified model, reconstructing the tectonic evolution of the sampled area, based on the AFT results.

The main goal of this study was to reveal the low-temperature thermal history of the northern Tien Shan batholith, and to increase our present understanding of intracontinental deformation in terms of mountain building and associated denudation. Therefore, we performed an Apatite Fission-Track (AFT) study on samples from the southern edges of this batholith. Specifically, granite and granodiorite samples were collected in the Moldo and Jumgal ranges, south of the Suusamyr valley in Central Kyrgyzstan. After a conventional calibration procedure, we calculated apparent AFT-ages for the Tien Shan samples under investigation (Glorie et al, 2007). Most AFT-ages are Early Cretaceous and cluster between ~100 and 140 Ma. Length measurements on horizontal confined fission tracks yielded mean lengths between 11.0 and 12.8 μm and broad, asymmetric length-distributions with a positive skewness, testifying to a complex thermal history. Based on Dpar-measurements (c-axis parallel etch pit diameters) and chemical analyses, we show that the apatite from the Moldo and Jumgal ranges is almost pure fluorapatite, wich is a useful constraint for the subsequent thermal history modelling we carried out based on the AFT age and length data.

We performed aforementioned numerical thermal history modelling, using the AFTSolve program (Ketcham *et al.*, 2000) and the Laslett *et al.* (1987) annealing-equations. Except for one sample, the models were consistent and suggest a four-stage Meso-Cenozoic thermal history for the Tien Shan samples (figure 1). Mesozoic cooling was recorded from the Middle/Late Jurassic (~180-140 Ma) until the Early Cretaceous (140-110 Ma). The exact time depends on the specific location and altitude of the samples. This cooling event emplaced the sampled rocks at temperatures of ~60°-70 °C, corresponding to a depth of ~2-3 km, when considering a geothermal gradient of 25-30 °C/km. Subsequently, a period of thermal stability or slow cooling in the Late Cretaceous / Palaeogene left the rocks more or less at these temperatures, until a Late Oligocene / Early Miocene (~25-15 Ma) reheating event forced the rocks back to temperatures of ~70-100 °C. A Late Cenozoic phase of rapid cooling from ~10-3 Ma brought the rocks to the surface temperatures at their present outcrop position. This implies Late Cenozoic exhumation rates of ~0.2 to 1 km/Ma, considering the geothermal gradient mentioned above. These results are in good agreement with those obtained for adjoining regions in the Kyrgyz, Terzkey, Kungey and Kindil Las ranges in the north of the Tien Shan (Bullen *et al.*, 2001 and 2003; Sobel *et al.*, 2006; De Grave *et al.*, 2007a).

We interpret this modelled thermal history in function of the tectonic context of the sampled area (figure 2). Mesozoic cooling resulted from denudation and exhumation of the Tien Shan basement during a pulse of tectonic reactivation. This reactivation can be associated with the accretion of the Tibetan blocks to the southern Eurasian margin during the Cimmerian orogeny (Yin & Harrison, 2000). The second phase, the period of Late Cretaceous / Palaeogene thermal stability, can be interpretted as an episode of tectonic quiescence, since the structure and position of the isotherms in the crust were not or scarcely affected. The Oligocene / Early Miocene reheating event can be attributed to the effect of a thermal anomaly in the upper crust and its corresponding increase in geothermal gradient. The associated widespread presence of Palaeogene basaltoids bears witness to this thermal activity (Sobel & Arnaud, 2000, Bazhenov & Mikolaichuk, 2002). The Late Cenozoic phase of rapid cooling resulted from a new period of intense mountain building and related denudation during the Late-Cenozoic. Based on stratigraphic evidence and structural-geological observations, it can be proven that the Tien Shan uplift was accompanied by a recent regional tilting of crustal blocks along major faults (Burbank et al, 1999). The inter-sample correlation and geographical configuration of our AFT results is in agreement with this process of crustal tilting. This Late-Cenozoic reactivation of the Tien Shan resulted in the present imposing mountain belt, where basement rocks are further subjected to denudation and are ultimately exhumed to their present outcrop positions.

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