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Preliminary fission-track data across a traverse in the High Atlas of Marrakech, Morocco

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The Moroccan High Atlas is a typical example of intracontinental chain formed by the tectonic inversion of the Atlasic Permian-Jurassic rift basins. The precise timing of the different phases of the inversion is still a matter of debate.

Eight samples coming from a traverse across the Western High Atlas along the route from Marrakech to the Tizi ‘n Tichka Pass and descending to the Aoulouz mine on the southern side of the chain were analyzed with fission-track method. The investigated traverse crosses the Western High Atlas where it attains the highest elevations and where its Precambrian basement connects to the Anti-Atlas chain. Along this traverse the Jurassic carbonatic cover is highly reduced, while magnificent outcrops of the Paleozoic and Triassic mostly continental sedimentary cover are preserved. Numerous ENE-WSW trending transpressive faults affect the entire succession, from the Precambrian granitoids to the most recent Miocene sediments.

Samples coming from the northern side of the traverse belong to the Paleozoic to Mesozoic sedimentary cover. Starting from the Tizi ‘n Tichka Pass, samples of the southern side come from the Precambrian Tidili granitoid.

Apatite fission-track ages span a wide range between 212 Ma and 20 Ma. At the base of the traverse on the northern side, samples have old ages ranging from 185 and 72 Ma. Sample bad quality (i.e., scarcity of apatites) prevented the determination of the length distributions. Samples from the upper portion of the traverse till the Tizi ‘n Tichka Pass yielded a younger age of about 20-25 Ma (mean length 13.9 μm and s.d. 1.51 μm) indicating a fast cooling – exhumation phase from temperatures above about 120˚C in early Miocene times. Lower altitude samples with older ages, before early

Miocene were at lower temperatures.

From a sample collected at 1820 m from Cretaceous sandstones two aliquots of different sizes (d>100 μm and 50 μm <d<100 μm) of apatite crystals were analyzed. The aliquot with the smaller size yielded a young age of 25 Ma while the one with larger size yielded an older age of about 86 Ma. Likely, the two aliquots have different provenances as well as different chemical compositions. This result suggests that the aliquot with larger size is composed of more resistive apatites and indicates that this sample before the early Miocene cooling phase was above but close to a temperature of about 120˚C. Assuming a mean surface temperature of 20˚C and a paleo-geothermal gradient of about 30˚C/km, this corresponds to an amount of cover removed above the 1820 m sample of 3-3.5 km.

Modelling of thermal histories of samples of the southern side seems to indicate that they participated to the early Miocene cooling phase but starting from temperatures well below 120˚C at which they resided for a consistent portion of their history (˜100-200 myr).

Here we present the first record of a Miocene rapid cooling-exhumation phase in the Moroccan Western High Atlas, which testifies an important tectonic pulse in Miocene times.