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From rifting to continental collision, new insights on the Atlas Mountains building using low thermal chronometries (High Atlas of Marrakech, Morocco)

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We present apatite (U-Th)/He and fission track results in order to constrain the vertical movement's history of the western and central High Atlas Mountains of Morocco. Samples were collected along a 200 km long transect stretching from the Jebilet Massif in the North to the northern border of the Central Anti-Atlas chain in the south thereby traversing the Old Massif of Marrakech and the Siroua Plateau. Fission track and (U-Th)/He ages range from 10 to 163 Ma and from 8 to 152 Ma, respectively. Thermal modeling using this data as input resulted in five heating and/or cooling phases in the Late Jurassic-Early Cretaceous, Late Cretaceous, Eocene, Miocene and post-Miocene. Ages generally display an overall trend of rejuvenated ages from both margins (13-162 Ma) towards the axial zone (8–73 Ma) of the orogenic belt.
Following the end of rift-related subsidence in the Liassic, extension stopped in the north margin but continued until the Dogger to Late Jurassic in the southern edges of the belts. Thermal modeling of samples collected from the northern external zones of the High Atlas suggests an unexpected phase of Middle-Late Jurassic exhumation (with a rate of 150-300m/Ma), which is generalized to the whole Atlas system from Late Jurassic to Early Cretaceous, bringing rocks at the Earth's surface before the Late Cretaceous. Exhumation that brought rocks at the Earth's surface before the Late Cretaceous, is followed by a quiet tectonic period with little vertical movements (110 to 90Ma).
After a quiet tectonic period in the Cenomanian-Turonian time, vertical movements renewed with subsidence (Ĩ20m/Myr) throughout the entire Atlas domains before the Senonian. From the end of the Late Cretaceous onwards, inversion take place, signaling the onset of a final exhumation phase. Exhumation began in the external domains (Jebilet, Northern Sub-Atlas zone and Siroua) at rates of 33-130m/Ma affecting the Axial zone of the belt somewhat later, where higher amounts and rates of exhumation (100-400m/Ma) are detected from the Eocene onward. The data presented provide new important kinematic constraints on vertical and indirectly horizontal movements during the Mezosoic-Cenozoic evolution of the High Atlas, from the rifting to the intraplate belt building, leading to conclude that the Atlas intraplate belt is mainly of tectonic and erosion origin.