Opening and inversion of the Tizi-n-Test Triassic graben (Western High Atlas, Morocco)

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The Tizi-n-Test basin is a Triassic halfgraben located in the basement-dominated "Massif Ancien" of the western Moroccan High Atlas. In contrast with the central High Atlas, dominated by mid-jurassic rocks of late rifting stages, this study area provides unique opportunities to analyze the deep fault structure and kinematics of the Mesozoic Atlas rift, in terms of extensional geometry and its subsequent inversion during Cenozoic times.

The Tizi-n-Test area has been the subject of earlier works which arrived at diverse conclusions concerning its implications for the evolution of the Atlas system. In this study we add new detailed field data (including a geological map and cross sections) that provide a better characterization of rifting and later inversion.

As regards to the extensional evolution, three main sedimentary units have been distinguished in the basin, related with distinct stages of rift development. The first stretching stage is represented by the Basal Conglomerate (Olenekian -Early Triassic-) and the siltstones of the undated Ramuntcho Fm, both forming a wedge-shaped geometry in the hangingwall of a NNW-dipping normal fault located south of the basin (Iguer fault). The second stage corresponds to the maximum fault-induced subsidence, represented by a sandstone unit, 200 to 400 m-thick, belonging to the lower Oukaimeden Fm. This unit was controlled by the Tinmel fault, a normal fault dipping to the SSE located north of the Iguer fault. During the third stage, the narrow confined graben widened, becoming a major basin whose boundaries have been eroded, although the expansive associated deposits (upper Oukaimeden Sandstone –Late Carnian- and Upper Siltstone) onlap the basement of the rift shoulders N and S of the basin.

The well-known Atlas orogeny deformed the Tizi-n-Test graben by fault inversion, creation of shortcut or bypass thrusts, and a significant degree of folding, which arched the graben into a large-scale syncline with important tilting of Triassic and basement rocks alike, apparently with little mechanical contrast. Basement-involved pop-up thrusts attest for upward escape of the squeezed syncline core. In contrast to previous studies we show that simple fault reactivation is not the main shortening mechanism in the basin, and we emphasize the role of internal deformation and large-scale folding. No large strike-slip components have been detected in the faults bounding or deforming the basin.