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Crustal shortening versus thermal origins of the unusual foreland domain of the High Atlas, Morocco.

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The Moroccan topography comprises two major intracontinental mountain belts, the Middle and High Atlas, linked with the Africa Europe convergence. They correspond to Cenozoic fold and thrust belts with moderate shortening (15% in the Middle Atlas; 15 to 24% in the High Atlas). Despite a very high topography (up to 4200m), it is striking to notice the very poor development of associated foreland basins, especially in front of the High Atlas belt, where shortening is the highest.

In this study, we focus on the South Atlas front, which is the northern limit of two Cenozoic flexural basins: the Ouarzazate and Souss Basins. Despite being in the same structural position in relation to the High Atlas belt, the Ouarzazate basin is uplifted at more than 1300m and undergoes erosion, whereas the Souss basin is slightly subsident and at an altitude running from sea level to 600 m. Between them, the foreland basin is replaced by the so-called Siroua Plateau, where the Precambrian basement culminates at 2500m. It supports a voluminous Miocene volcano, the Siroua s.s. (3300 m high).

Based on field work, SRTM and Landsat analysis, we propose an interpretation of those lateral discontinuities in the foreland domain, and a quantification of the processes which lead to this topography.

The topographic high between the basins can be partly explained by thermal doming above a thinned lithosphere. The geometry of the lithosphere is obtained with a modelling of gravity, geoid, topography and heat flow data. By comparison between the present-day topography and a topography modeled without lithospheric thinning, we quantify the contribution of the lithospheric thinning along 4 cross-sections. This effect is in the order of 1000 m in the Ouarzazate basin, 1100 m in the Siroua massif and around 1300 m in the Souss basin.

Structural effects also accounts for this unusual topography of the foreland. The South Atlas Front is well identified north of the Ouarzazate and Souss basins but is poorly known between them. Here we show that an old panafrican suture situated South of the Siroua Plateau is reactivated. The vertical throw can be estimated at about 500m. Cumulated with the effect of other smaller reverse faults affecting the Siroua plateau, crustal shortening could explain 25% of the 2100m mean topography of the Siroua Plateau.

Finally, the Siroua volcano has also a deep effect on the topography. We reconstructed the contact between Precambrian basement and volcano formations (pre-volcano surface). It exhibits an elongated dome, 500m higher than the border of the plateau, along a N160˚ direction. This dome which is superimposed with the volcanic centers, suggests that it results from magma injections in the upper crust.