

Gomez, Francisco Gustavo, *Late Cenozoic Tectonics of the Middle Atlas Mountains, Morocco: Continental Deformation in the Diffuse Western Mediterranean Plate Boundary*, Ph. D. Dissertation, Cornell University, 1999.

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**Abstract:**

The Atlas Mountains of North Africa, located in the African foreland of the Alpine mountain belts, comprise a 2,000 km long Cenozoic mountain chain whose development was guided by older Mesozoic rift structures. This dissertation examines one component, the Middle Atlas Mountains of Morocco, using geological and geophysical data to constrain the tectonic development of the mountain chain. These results are then placed in the broader context of regional deformation.

The NE-SW trending Middle Atlas Mountains are obliquely oriented within the late Cenozoic regional stress field, resulting in deformation partitioned into strike-slip faulting and thrust-related folding. Kinematic analyses of fault-slip data and earthquake focal mechanisms demonstrate that compressional deformation dominates the Folded Middle Atlas, whereas strike-slip faulting, with possible horizontal extension, predominates in the Tabular Middle Atlas. Geological field observations, digital topography, LANDSAT imagery, and seismicity provide evidence for recent tectonics in the Middle Atlas.

In the central Middle Atlas, cross-section balancing across the 20 km wide fold belt demonstrates about 4.7 km of Cenozoic horizontal shortening producing 800 m of structural relief. Other constraints on crustal thickening suggest a discrepancy between contraction and thickening. One possible explanation involves partitioning crustal deformation with depth: The upper crust shortens by thickening (faulting and folding), whereas the lower crust deforms laterally.

At the northern extent of the mountain chain, the Guercif Basin developed where the Middle Atlas abut the Rif thrust belt. Similar timing of extensional deformation and proximity with the Rif, suggest that the Guercif Basin has been influenced by Rif tectonics. Stratal relations demonstrate that uplift of the Middle Atlas is a late Cenozoic phenomenon.

In Morocco, shortening of the High and Middle Atlas Mountains accommodated 20-45% of the total African-Eurasian plate convergence since the Early Miocene. The diffuse plate boundary comprises large, relatively rigid crustal blocks (Moroccan Meseta, High Plateau, and Saharan Platform) bounded by narrow deformable zones (the Atlas). In this context, the Middle Atlas can be interpreted as an accommodation zone resulting from differential movements between two large crustal blocks impinging on stable Africa. The Atlas Mountains exemplify the possible structural influence of inherited crustal weaknesses in a diffuse plate boundary such as the western Mediterranean region.