The Role of Pre-Orogenic Faulting and Salt Diapirism on Atlassic Deformation in South Tunisia: Combining Balanced and Restored Cross-sections with Gravity Modeling

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Abstract

During the Cenozoic, Atlassic thrust systems in south Tunisia were constrained by pre-existing fault networks and halokinetic structures. Published geological maps, seismic reflection profiles calibrated by exploration wells and field data have been used to construct a new ~62 km-long balanced and restored cross-section across the eastern part of the Southern Tunisian fold-thrust belt. This cross-section highlighted the presence of a deformed Jurassic-Early Cretaceous salt diapir embedded within the thin-skinned thrust sequence underlying the Bouhedma anticline. Further south, Upper Paleozoic extensional faults were identified below the Triassic salt, were reactivated as thick-skinned thrusts, verging southwards towards Menzel El Habib and Jebel Itama. The field and exploration well-supported restoration suggest growth of the Bouhedma diapir and flanking mini-basins occurred primarily during Jurassic to Barremian time. Variations in original salt thickness related to Triassic extensional faulting may have localized subsequent diapiric movement. The restoration also indicates the presence of a Paleozoic high just South of the Bouhedma anticline reactivated during the Cenomanian-Turonian. Late Paleozoic extensional faults intersecting the southern part of the section, were also reactivated at this time and are now represented by north-facing tilted blocks beneath the Jebel Itama and Menzel El Habib anticlines. Gravity inversion modelling reveals a distinct, negative gravity anomaly south-east of the Bouhedma anticline. This appears to correspond to a compensated syncline formed in response to intra-salt thrusting at this locality. Just to the South, Sebkhet En Noual antiform is represented by a positive gravity anomaly quite separate from Manzel Habib plain. Model densities, in this larger region, provides a detailed image of the subsurface structuring with a pronounced transition at 7kms between low-density sedimentary cover and high-density Precambrian crystallo-metamorphic basement. This transition is rather undulatory suggesting that the top basement is structured with high and low blocks. The striking contrast, between the low-density sedimentary cover and the high-density basement, suggests the presence of a master detachment surface linked to the more surficial faulting. The restored section supported by gravity modeling emphasize the importance of (i) pre-orogenic salt structures responsible for constraining thrust emplacement of the Bouhedma anticline and (ii) earlier basement to Paleozoic faults which have controlled the position of later thrusting. Our restoration demonstrates up to 5.4km (8.6%) orogenic shortening in the eastern part of the southern Atlassic Front, accommodated by reactivation of old basement normal faults and pre-orogenic diapiric salt structures, originally formed along the southern margin of ancient Tethys.