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Geometrical variations of extensional fault-related folds in the southern Sirt Basin, Libya

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The Sirt basin (Libya) represents an economically important rift basin on the northern part of the African craton. In the southwestern margin of the basin, (between N25–27˚ and E16˚30'–18˚) Panafrican basement rocks, folded lower Paleozoic and flat-lying Upper Jurassic to Lower Cretaceous clastics were covered by uppermost Cretaceous to Oligocene sequence, consisted of alternation of fine-grained siliciclastics and platform carbonates.

Brittle deformation was accommodated by a combination of discrete brittle faults and divers fault-related folds, showing a complete range of geometrical variations. Peculiar structures include oppositely dipping monoclines, forming simple anticline, syncline, or a fold with multiple hinges ("box fold"). Fold limbs are deformed by mesoscale structures, which were rotated during progressive folding. Fault-related folds are progressively breached by coalescing fault segments, which show along-dip ("vertical") segmentation at their early stage of evolution. Fault-related folding is further complicated by diapiric appraisal of gypsiferous sediments, which caused "reverse drag" of strata near the faults. Fault-related folds replace discrete faults near fault tips, where deformation is transferred to another structure through overlap zones.

Fault-related folding and along-dip segmentation occurred because of the intercalation of thick intervals of poorly lithified marl, clay, or gypsum. This lithology accommodated and transferred the displacement at segment tips by shale/marl smearing, differential compaction, or diapiric movement and maintains the integrity of interlayered cemented carbonate banks. Syn-deformational diagenesis increased the rigidity of certain folded levels and contributed to structural complexity.