Tectonic History and Structural Development of the Zallah-Dur al Abd Sub-Basin, Western Sirt Basin, Libya

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Abstract

This study examines the tectonic history and structural development of the Zallah-Dur Al Abd Sub-Basin located in the western Sirt Basin, Libya. The sub-basin is part of a Cretaceous-Tertiary rift/sag basin that formed on a basement composed of Pan-African to Paleozoic-aged rocks in North Africa. By utilizing surface and subsurface geology maps, the research investigates various local and regional formations within the study area, aiming to determine the relative timing of geological events and fault movements.

The analysis identifies six lithostratigraphic sequences (phases) that are considered the stratigraphic framework of the study area. A significant geological phenomenon observed during the Late Eocene epoch is the presence of a complex network of branching segmented normal and strike-slip faults, primarily oriented in a NNW-SSE direction. Complementing this, satellite image analysis supports the interpretation of sinistral strike-slip kinematics based on various surface structural parameters.

The study reveals the existence of relay ramp systems and elongated asymmetric synclines within the study area. These features are a result of the development of hanging walls adjacent to west downthrowing normal faults.

The structural trends observed reflect Cretaceous/Tertiary extensional tectonics, influenced by both the underlying Pan-African basement fabrics and ENE-WSW trending Hercynian structures. Through the analysis of borehole data, time structure contour and thickness maps provide insights into the regional-scale structural and stratigraphic relationships. Notably, the majority of the oil fields in the study region are associated with structural hinge zones and adjacent highs.

By conducting remote sensing analysis, seven major fault systems have been identified, effectively dividing the study area into elevated blocks and depressions. The presence of oil fields within the study area is predominantly associated with structural hinge zones and nearby highs. This multidisciplinary study establishes a strong correlation between surface and subsurface structures and identifies potential areas for petroleum exploration.