
Fracture Patterns within Mudstones on the Flanks of a Salt Dome: Syneresis or Slumping?

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ABSTRACT

Mud-prone facies within the Upper Oligocene and Lower Miocene strata on the flanks of the complexly faulted Vinton Dome Field in the northwest Gulf of Mexico show fine-scale, sub-seismic polygonal fracture patterns, averaging 200 ft (approximately 60 m) in diameter. These facies may relate to gravitational slumping away from the salt dome or to dewatering during compaction. Similar dewatered polygons have been identified in mudstones in 3D seismic surveys from the Miocene aged strata in the North Sea and from Cretaceous strata in Alberta but have never been described from the Gulf of Mexico. Well control and modern seismic attribute analyses reveal the relationship between the depositional environment, structural patterns, and salt tectonics. The dome is characterized by a counter-regional fault and three peripheral fault sets, each having a different outline and basis for its formation. The structural setting of the Miocene shelf is the result of the hereditary Upper Oligocene structural design and substantial evolution of sediment dispersal. Salt movement set the stage for thinning and thickening of the Chattian (28.5 to 23.8 Ma) strata creating unconformities and onlap against the salt plug, whereas the overlying Aquitanian (23.8 to 20.52 Ma) strata is generally characterized by major syn-depositional faults. Different lithologies are characterized by non-rigid polygons, suggesting rheological control on fracture density. Homogeneous polygonal features and fracture intensity support a strong link between the major faults and smaller-scale polygonal faults. Fracture systems could be open, healed, or partly open, but significant structural complexity of the shales might affect seal integrity.