Salt Dome Geometries, Gulf of Mexico Shelf

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Summary

Detailed, 3D seismic based structural studies of approximately 20 salt domes in the Gulf of Mexico illustrate the complexities of the salt-sediment interface and the geometric and kinematic relationships between the salt and adjacent faults. Fault patterns adjacent to salt domes are primarily controlled by sub-regional salt evacuation and/or flexing of the sediments above the dome. Faults that intersect salt dome flanks typically curve and intersect the salt tangential to the salt-sediment interface.

Introduction

Many of the oldest and most prolific oil and gas fields in Gulf of Mexico are associated with salt domes. 3D seismic now allows for a better understanding of the complex and sometimes angular geometry of salt domes and the complex structures associated with them.

Methodology

For each of the 20 domes studied, we have made a complete interpretation of the salt-sediment interface and all nearby faults. In order to obtain a good representation of the salt dome geometries, the multi-valued surfaces that separate the salt from the sediments have been tessellated using proprietary Shell software. Map and timeslice displays plus 3D displays are used to illustrate the geometric features of the domes.

Routinely, fault planes are tessellated and contoured. Where necessary fault throw analysis is used to extrapolate faults into poor data zones near the salt. A number of horizon maps have been made in the vicinity of each dome. The best events are usually autotracked regional shale markers. Interval isochore maps are used to infer the history of salt movement from the feeder systems into the domes.

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Observations

Most salt domes on the Gulf of Mexico shelf occur in four structural settings:

1. Counter-regional domes: domes along north dipping counter-regional fault systems.
2. Edge domes: domes along the north-south trending edges of minibasins.
3. Hinge domes: domes within basins, usually associated with rollover anticlines.
4. Regional domes: domes along south dipping regional fault systems.

Counter-regional and regional domes usually separate areas significantly different depositional histories. Faulting directly associated with dome is most intense on the hangingwall side of the major expanding fault system and the dome is more overhung on the footwall side of the major expanding fault system. Edge domes may or may not separate basins with different depositional histories. They are commonly elongate in a north-south direction and occasionally accommodate different amounts of fault slip from one side of the dome to the other. This creates relative strike-slip displacement across an edge dome and can cause complex fault patterns at the northern and/or southern terminations of the dome. Edge domes are commonly overhung on both of the flanks parallel to the long axis and may be overhung on one or both of the other flanks. Hinge domes often modify sub-regional fault patterns, but do not separate areas with significantly different fault patterns. Hinge domes are more vertical and the overhang distribution is more symmetrical than other types of domes. Counter-regional and edge domes are the most common types of salt domes in the Gulf of Mexico.

Most domes initiated at the intersections of salt walls in an early minibasinsalt wall setting. Local salt promontories can sometimes be mapped where the now collapsed salt walls intersect a dome.

Conclusions

Salt domes occur in four structural settings. Although each salt dome is unique, domes within a specific setting share many common features. Fault patterns adjacent to salt domes are primary

Controlled by sub-regional salt evacuation and/or flexing of the sediments above the dome. Faults that intersect salt dome flanks typically curve and intersect the salt tangential to the salt-sediment interface. Salt domes have a cuspate shape where they are intersected by faults.