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Seismic attribute analysis for 3-D structural interpretation of the offshore South Marsh Island, Gulf of Mexico

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Structural and seismic attribute analyses of 3-D seismic reflection data from southwest offshore South Marsh Island, Louisiana, Gulf of Mexico, reveal complex structures affected by salt tectonics triggered by interaction between salt, faults and rapid deltaic sedimentation on the shallow continental shelf. Salt exercises the main control on the sedimentary processes in the study area to move, to divert sediment, to create instability, and to block sediment transport pathways. The depths of salt range about 4,300 m (14,000 ft) to 6,500 m (21,600 ft). Salt is very deep and forms a thin sheet in the southwestern part of the area, whereas it rises to shallow depths, forming a dome in the central part. Salt is seen at relatively shallow stratigraphic levels in the northwest and south where it forms thin salt rollers. The margins of Miocene strata are deformed by salt movement and faulting in the study area. The study area is riddled by numerous normal faults which are mostly E-trending and some N- and NW-trending with southward gradual increase in growth factors. Eight main normal faults were interpreted from seismic data which are mostly E-trending S-dipping, and are accompanied by smaller secondary faults. Three of E-trending down-to-the-basin growth faults cut across the study area separating the area into four blocks. These faults form a stair-stepping structure in the south direction. Two conjugate-crossing normal faults are located over the central salt dome which may indicate active salt doming. Seismic attribute analysis was applied as output of seismic volumes, and horizon and time-slice maps in order to identify the structure of study area. These attribute volumes together with time- and horizon-slices gave amplitude anomalies at discontinuities (faults) and lithological changes (sand to shale, salt). Faults interpreted and mapped from seismic profiles and those identified by seismic attribute slices are compatible, therefore, seismic attribute analysis can be labeled as a robust technique for structural interpretations. Amplitude anomalies associated with potential structural hydrocarbon traps, faults mostly associated with these traps, and morphological features of delta complexes could be identified by seismic attribute techniques.