Kinematic and Sequence Stratigraphic Frameworks of the Gulf of Mexico and the Niger Delta: Contrasts and Analogs

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Interpretation of more than 30,000 and 75,000 km of high-quality, modern seismic data from the Niger Delta (ND) and Gulf of Mexico (GOM), respectively, has revealed fundamental kinematic and stratigraphic similarities between these two highly prolific, unstable continental margins. They are characterized by (1) Mesozoic oceanic crust formation and subsequent rapid subsidence; (2) early deposition of a thick section (salt in GOM, mud in ND) that later developed into a ductile substrate; (3) an early phase of compressional deformation demonstrated by a distal fold belt (GOM) and imbricate thrusts (ND); (4) massive amounts of synsedimentary extensional strain accommodated by flow in the ductile substrate; (5) mappable Tertiary sequences and systems tracts; and (6) good evidence of deep-water reservoir sandstones, in basin-floor fans and lowstand slope-fan systems tracts. In both margins, the early Tertiary was dominated by seaward progradation of a growth-fault-modified, unstable, ramp-type continental margin. In contrast to the horizontal salt, which largely obscures the deep structure in the GOM, in the ND, diapiric overpressured shale permits seismic imaging of the deep structure. Oceanic crustal relief, corroborated by gravity data, has had a major influence on the structural and stratigraphic development of the ND, whereas in the GOM, the oceanic crust appears to be much smoother in current data. We suggest a new model of the Niger delta, emphasizing the interplay between deep canyon formation with deposition of lowstand systems tracts and intervening paralic and deltaic complexes during highstands. In the GOM, we attribute the scarcity of analogous deep canyon cuts to differences in sedimentation rate between the two margins.

Tectonostratigraphic Reconstruction and Lithofacies Distribution of Tertiary Slope Sedimentary Rocks in the Western Mississippi Canyon Area

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The distribution of upper Tertiary, sandstone-prone, deep-water sedimentary rocks from the vicinity of Cognac field, Mississippi Canyon (MC) 194, south of Mars field (MC763) is presented based on an integrated sequence stratigraphic analysis of seismic, well log, and biostratigraphic data. Paleo-salt distributions were reconstructed by plotting the changing positions of depocenters on five isopach maps generated from six key sequence boundaries. Depositional trends, projected under allochthonous salt sheets, indicated subsalt prospectivity. Sixteen sequences were interpreted and subdivided into three lowstand depositional units (basin-floor fan, slope fan, and prograding wedge). Thirty isochron/seismic facies maps were made to reveal the stratigraphic pattern through the late Tertiary.

During the early Miocene, a salt-rimmed syncline centered north of Mars field in MC455 accumulated sediments. The salt rim collapsed, creating a middle Miocene turtle structure. Middle–late Miocene sand-rich turbidites bypassed this structure and were deposited to the south around Mars field and beyond. At the same time, another depotrough 30 mi east of Mars field channeled deep-water sands to the MC730 area. A late Miocene–early Pliocene counterregional fault striking parallel to the shelf edge formed as salt evacuated the area on the south side of the Cognac (MC194) and Lena (MC280) fields. This fault trapped the Pliocene reservoir sandstones that produce in these fields. Sedimentation during the late Pliocene–early Pleistocene was very slow (0.2 m/1,000 yr) and characterized by thin, stacked, condensed sections of hemipelagic shale. Since the mid-Pleistocene, the Mississippi River has supplied sediments to the Mississippi Canyon area that have induced salt deformation that has in turn affected recent sedimentation.