Pliocene Deepwater Sands, Niger Delta, Africa: Sequence Stratigraphy, Depositional Facies, Sand Body Geometry and Stacking Patterns

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Hundreds of closely spaced wells, combined with thousands of feet of core, and recent 3-D seismic data provide an unparalleled opportunity to document depositional patterns of Pliocene deepwater sands of the eastern Niger Delta and have led to a clearer understanding of the factors responsible for these patterns.

The Niger Delta is a mixed-energy delta, with wave, tidal, and fluvial energy in near equilibrium, resulting in a radial pattern of distributaries. In Mobil's joint venture acreage, sand from these distributaries was fed through numerous canyons incised into the shelf edge and upper slope, rather than from a single point source. Most sand deposition occurred in fairways both within canyons and in channel levee complexes on the open slope. Individual channels are straight to sinuous, confined by levee deposits or canyon walls. They show little evidence of lateral migration. The ancient channels broke through levees, yielding anastomosing patterns. Multiple incisions within canyons are common. Deposition was also influenced by subsea bathymetry inherited from an earlier shelf margin collapse and by movement along faults.

Stacking patterns are distinctly cyclic. Allocyclic deposition relates to four lowstands of relative sea level. These are punctuated by higher frequency cycles that are both allocyclic and autocyclic. Within the deepwater succession, grain size is a function of stratigraphic forcing mechanisms and climate cycles. In a typical area, the facies within the channel deposits are composed of upward-fining successions 3 to 40 meters thick. They may contain relatively thin intervals of intraslope slumps and debris flows at the base, overlain by turbidite sands. Turbidite intervals range from graded, pebbly coarse grained sands up to 2 meters thick to fine and very fine-grained sands displaying complete Bouma sequences. Many of the slumps and debris flows were apparently generated by bed shear from the coarse-grained turbidity flows. Mass movements of shelf facies or processes for transport of sand into the basin other than by turbidite flow was rare.

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