Bonga Main Turbidite Characterization: A Novel Approach to 3-D Seismic Stratigraphy and Static Modeling Integrated with 4-D Response

Deborah Akingbade, Oghogho Effiom, and Sidney Weaver
Shell Nigeria Exploration and Production Company, Lagos, Nigeria.

Deep water developments have become increasingly challenging due to the heterogeneity of the reservoirs where complex architectures associated with turbidite deposition often results in reservoir compartmentalization and complex drainage pathways. This has necessitated the integrated application of high resolution 3D and 4D seismic, well logs and cores to achieve optimum reservoir management.

The understanding of sub-regional to reservoir scale seismic stratigraphy has been used in framing the geological constraints that reduce uncertainty in the depositional architecture of the Bonga field reservoirs and form the basis for building realistic static models. The improved 3-D reservoir models are generated by a hierarchical workflow where large scale structures are modeled first such as the structural framework including the faults and the reservoir top and base horizons. The internal geometries of the channel complexes are captured as a property based on the loop-scale seismic stratigraphic interpretation for easy update without altering model framework. The lithofacies are modeled within each major stratigraphic unit by first interpreting the facies based on the well logs on well-to-well basis and then applying the stochastic techniques of channel and levee placement.

Loop-scale seismic stratigraphy is used to extract the maximum information from the seismic data. Different from standard interpretation which simply links the seismic top and base, loop-scale interpretation seeks loop morphology supported by sub-seismic data like logs and cores coupled with geologic concepts from outcrop and modern analogs. This approach gives an insight to the location of sub seismic baffles within and between reservoir depositional elements such as channel belts and lobe complexes. 4D seismic and production logs confirm the encroachment of the flood front within channel axes flow paths interpreted with this integrated stratigraphic approach.

In conclusion, the application of the loop-scale 3D seismic stratigraphic interpretation, 3D seismic rock property inversion, 4D seismic monitoring and improved geological modeling technology has helped in the understanding of reservoir net sand prediction and connectivity which in turn leads to better reservoir management, placement of development wells and identification of bypassed oil.