Lithology and Fluid Prediction Using AVA Analysis and Forward Modeling of Deep Gas Reservoirs, Funiwa Field, OML-86, Niger Delta

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Non-associated gas (NAG) reserves are typically entrapped within deep reservoirs where seismic quality and resolution are poor. However, with a good forward model and medium to good quality seismic data, a better interpretation of the subsurface can be achieved and a more robust static model can be constructed. Towards these ends, amplitude versus angle (AVA) analysis and forward modeling were used to predict fluid type and seismic response in the deep gas-bearing reservoirs at Funiwa Field, OML-86, Niger Delta.

Well A, which saw the major gas reservoirs in this field, was used for the modeling. The entire well was blocked into alternating layers of sand and shale; sands were fluid-substituted to 100% brine, 100% oil, and 100% gas. Elastic properties of these fluid-substituted sands were estimated using the Batzle and Wang equation as well as the Gassmann equation; results were used in AVA analysis. Forward modeling was conducted to predict seismic response away from the well.

Result showed that sand Alpha (10540 - 10750 TVDSS ft) exhibits a typical CLASS III AVA response while sand Beta (interval 110650 - 11900 TVDSS ft) has a CLASS IIn AVA response. Gradient-Stacks plots, Hiltermann Acoustic Impedance (HAI) versus Poisson's Ratio (PR) plots, and the AVA models indicate that hydrocarbon-bearing sands are distinguishable from brine sands. Both the sands and the hydrocarbon type become more seismically resolvable with increasing thickness and porosity. Seismic direct hydrocarbon indication (DHI) and lithologic delineation would be better defined in the shallower sand Alpha than the deeper sand Beta. Significant overlaps exist between oil and gas plots because the modeled oil had a high gas/oil ratio (GOR) of 3586; this indicates discrimination of light oil from gas could be difficult.

These models have shown that good quality seismic data acquired over this prospect would be useful in deriving reservoir properties from seismic (RPFS), lithologic differentiation and in hydrocarbon identification for establishing reservoir connectivity and fluid distribution.