Anisotropic 3-D Pre-Stack Time Migration Processing of Oguali 3-D Survey in Cental Niger Delta

Tunde I. Okunuga [1], Robinson S. Dike [1], Timothy J. Brooks [2], and Lawrence Ajabor [2]
[1]Geosolutions, Shell Petroleum Dev. Co. Nigeria, Port Harcourt, Nigeria.
[2]Seismic Processing, IDSL/Western Geco Alliance, Port Harcourt, Nigeria.

The Oguali field is located in OML16, 14 km south of Assa North in the Northern Niger Delta. The field has numerous hydrocarbon objectives including a deep marine/marine paralic sequence at 10,000 ft ss, developed in a pronounced footwall closure bounded by two intersecting faults. The shallower hydrocarbon objectives lie below a regional marine shale at approximately 8000 ft ss. There is a reversal in structural dip from north dipping at deeper levels to the south dipping at shallower levels, also observed in Assa North field. Velocity anisotropy is observed in Assa North. This may be related to the overpressure which is predicted in the area based on information from nearby wells.

This 3D seismic data processing therefore incorporated velocity anisotropic analysis in velocity model building and migration to fully image the complex structure of the area and mitigate chances of mis-positioning and/or false structures. It is also important to determine which levels exhibit seismic anisotropy and to quantify their anisotropy parameters. The degree to which anisotropy is present and its spatial continuity are critical in being able to accurately measure the anisotropy. We explore the capability of WesternGeco's full ray tracing time migration technique for anisotropy analysis. WesternGeco's full ray tracing workflow derives true vertical interval velocity and interval eta values instead of averages. Therefore the method compensates separately for curved ray effects in large offsets as well as for the true earth's anisotropy (VTI) effects.

In the Niger Delta region, which is generally characterized by repeated sequences of finely layered sediments (sand/shale alternations), the anisotropy is mainly Transverse Isotropy (TI) defined by a single symmetry axis with a vertical (VTI), horizontal (HTI), or tilted (TTI) orientation. For practical purposes therefore, the anisotropy is fully quantified in terms of Thomsen's parameters Delta, epsilon, and eta.

In this paper we present the results of anisotropic analysis in the prestack time migration of Oguali 3D seismic data. The results are reliable vertical velocity functions suitable for pore pressure prediction (PPP) workflows. Both Vnmo and the anisotropic parameter effective eta are analyzed simultaneously, enabling the generation of an anisotropic field that complements the conventional stacking velocity equivalent.