Resolving structural complexity in the Deepwater SE Niger Delta

The Niger Delta has long been known as one of the most prolific hydrocarbon provinces in West Africa. As exploration pushes further into the deepwater domain, new imaging solutions are required to unravel the structural complexity of the deepwater Niger Delta and improve imaging around mobile shales, which have historically proven challenging to image on legacy datasets. In order to solve this problem, new long-offset acquisition with advanced processing techniques including elastic-Full Waveform Imaging (e-FWI) is key to fully resolve the shale bodies, faults and channels.

Following on from the successful acquisition and processing of the Awele MC3D, completed in May 2025, we now go one step further, utilising an enhanced workflow with e-FWI to capture the complexity of the southeastern offshore Niger Delta within the newly acquired Laide MC3D dataset. The Laide MC3D covers an area of 12,800 km2 and contains a host of structural domains including the inner fold & thrust belt/ shale diapir zone, a transitional zone with gentle folding passing into toe-thrusts of the outer fold and thrust belt. In addition to this, strike-slip faulting can also be observed in a N-S orientation, further increasing the structural complexity of the area.

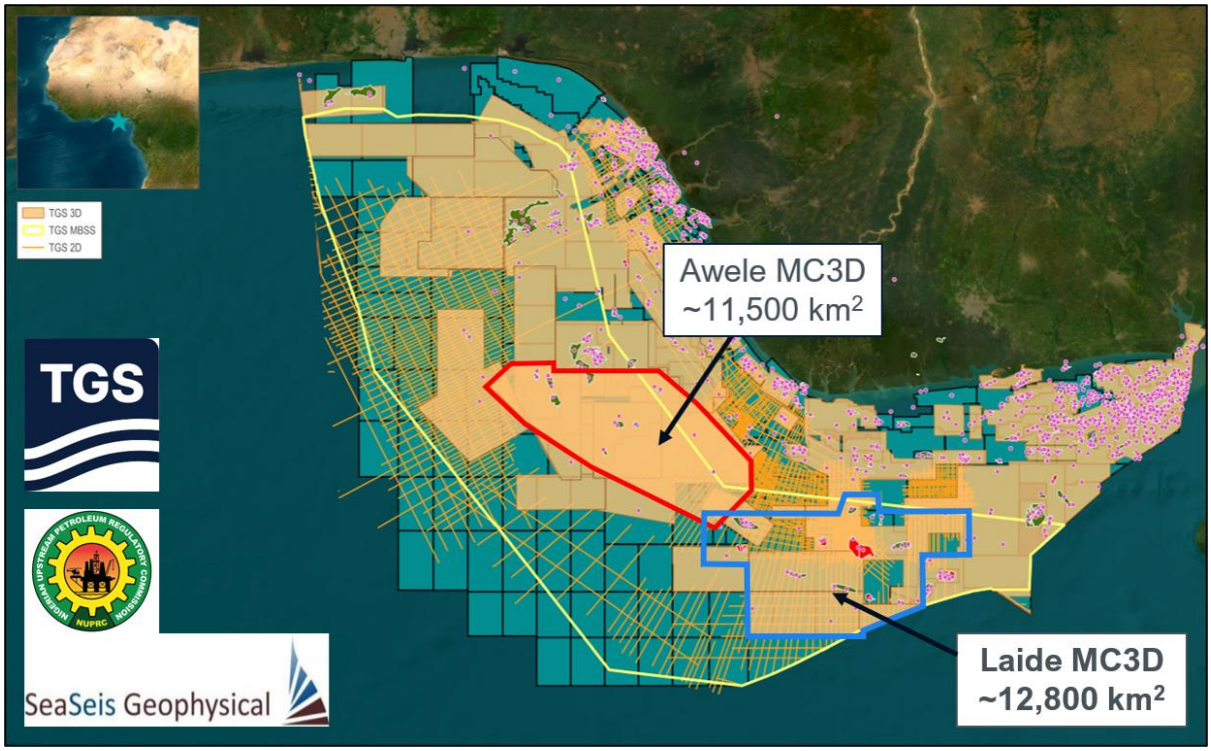


Figure 1: Available MC2D and MC3D data library offshore Nigeria. The Laide MC3D is located in the southeastern lobe of the offshore Niger delta.

Early results from an Ultra fast-track Kirchoff Pre-Stack Depth Migration (KPSDM) volume reveal an improvement in the resolution of the shallow section in comparison to legacy datasets, including better definition of thrust-faults (Figure 2) and channel systems in the Upper Agbada. We observe examples of channel ponding in the Upper Agbada, between the thrust fronts of the outer toe-thrusts and also channel-fan systems being deflected by syn-depositional movements of the thrusts and other compressional structures. It is important to understand the timing of deposition vs syn-depositional movements and how this has impacted fairway distribution.

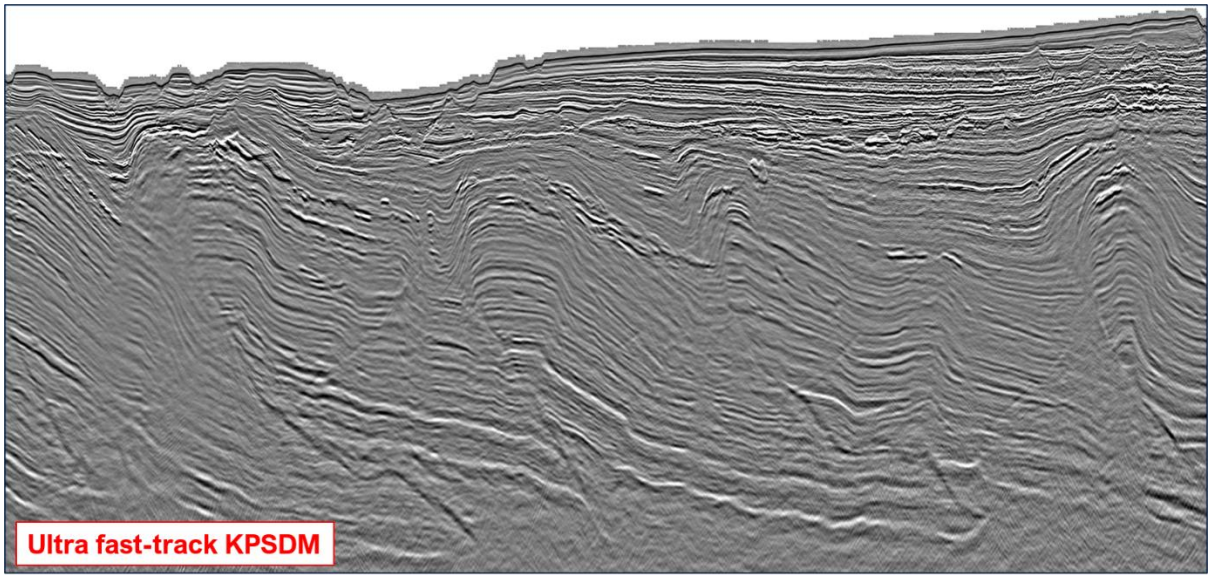


Figure 2: Stacked toe-thrusts of the Outer fold & thrust belt. A BSR can be seen crossing the crest of the shallow thrust-folds.

Pockmark trails associated with faults to surface and the margins of shallow channels have been identified on the seabed, indicating fluid flow and potential hydrocarbon escape (Figure 3). These pockmarks, in combination with the results of a Multi-Beam & Seafloor Sampling study and observed Bottom Simulating Reflector (BSR) help to de-risk the petroleum system away from existing fields and discoveries. This dataset will support near-field exploration in addition to opening up frontier blocks, de-risking a range of trapping configurations in the depth domain.

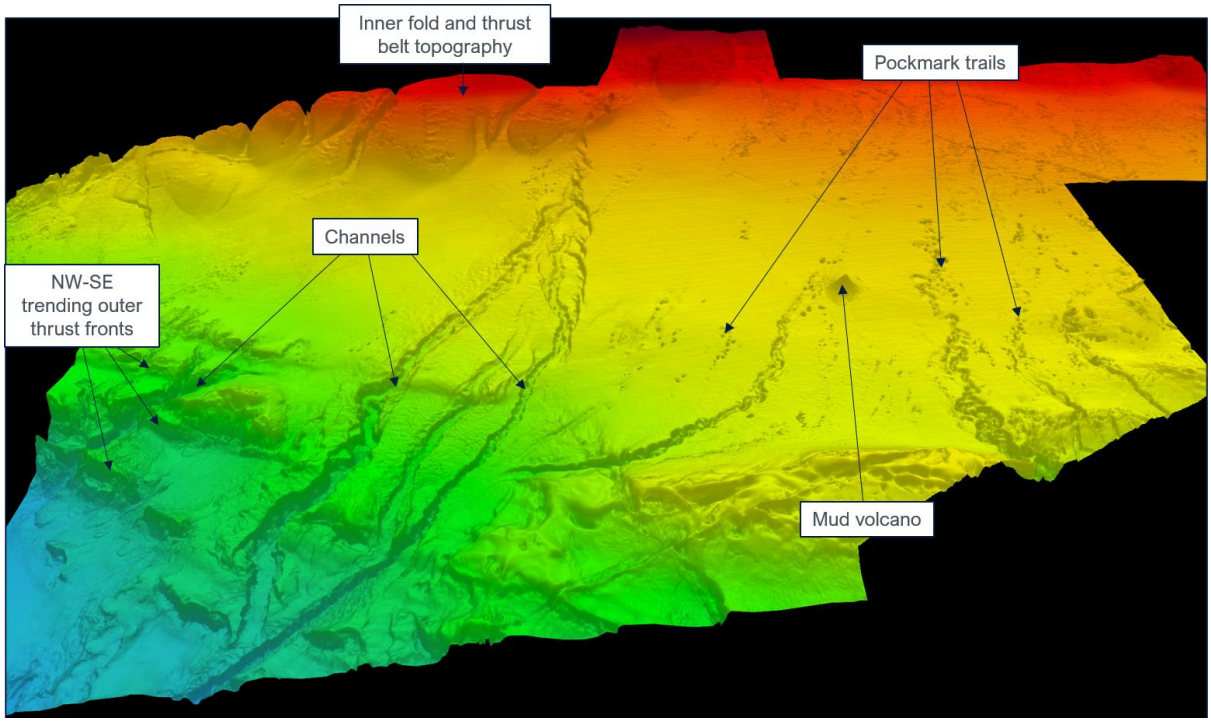


Figure 3: 3D display of the seabed – A range of surface features are present including channels, which cross-cut the NW-SE trending thrust fronts, pockmark trails and mud volcanos.