West African deepwater plays

Tracking the Cretaceous mega-clastic systems

Mauritania and Senegal have jointly been producing gas, with the first shipments occurring during the first half of 2025, while Senegal has produced oil independently for a year. Despite this success, the deepwater basin domain remains underexplored, highlighting the importance of more robust de-risking of open acreage. The extent of hydrocarbon maturation along the margin and the degree of reservoir charging are still not fully understood. With a vast 3D data coverage having recently been added to the multiclient data library offshore Mauritania, play extents and prospects can be mapped over a greater area, inferring untapped subsurface potential. However, there is a need to better calibrate the subsurface evaluation with well data to entice re-investment. Similar trends are seen elsewhere along the West African margin, where exploration is moving into increasingly frontier areas. In Côte d'Ivoire, for example, extensive multiclient seismic coverage and recent exploration successes have broadened the scope of opportunities. Much of the Côte d'Ivoire basin remains underexplored, but recoverable reserves totaling 4.5 billion barrels of oil and 13 Tcf of gas from 82 fields underscores the potential yet to be realised.

This article highlights how extensive coverage of high-quality multiclient 3D enables more effective tracking of reservoirs already tested by exploration wells. The source-to-sink story becomes more concrete when fairways are mapped on mega-regional 3D data compared to hypotheses generated from regional 2D or patchy 3D survey coverage, as demonstrated by examples offshore Mauritania (Figure 1). Data quality also plays a crucial role in upstream ventures, as an example from offshore Côte d'Ivoire will show. In deepwater exploration, where higher risks are balanced by the potential for higher rewards, both data quality and coverage are especially vital, which we observe along the West African margin. As exploration continues to advance into greater water depths, modern multiclient 3D data proves essential in identifying and de-risking the next generation of targets prior to drilling.

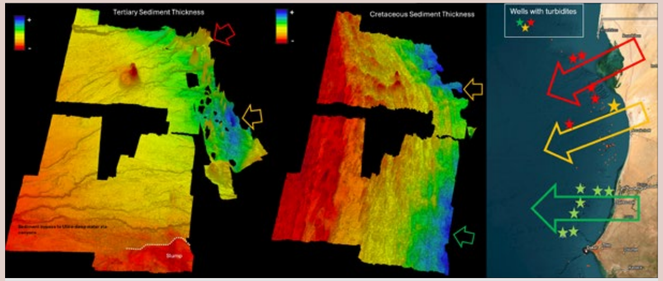

Figure 2: Sediment thickness map for Cretaceous and Cenozoic sequences.

Figure 1: East to West mega-regional arbitrary seismic line across the Mauritanian margin showing the key horizons mapping reservoir sequences and fairways from shelf edge into the deepwater domain.

Unlocking deepwater potential

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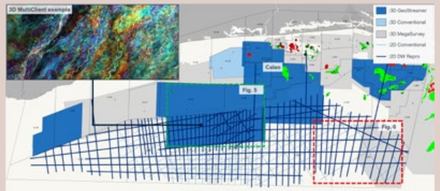

Figure 4: TGS data library coverage with Upper Cretaceous spectral decomposition surface, detailing a series of channels which extend beyond the 3D coverage, further outboard to the area covered by depth reprocessed 2D seismic (KPSDM). The location of the following 3D lead (Figure 5) and 2D lead (Figure 6) are highlighted by the dashed outline on the basemap, with Calao discovery labelled as a reference point.

EXPLORATION in the Mauritanian coastal basin has historically focused on the Cenozoic salt-draped channel plays, as proven by the discovery of the Chinguetti Field in 2001. Since this time, nearly 80% of exploration wells has targeted this play. Neighbouring Senegal has traditionally targeted clastics trapped over the carbonate shelf (edge), an example being the Sangomar field, which is in production. Whilst untested potential also exists in the deeper Jurassic-Lower Cretaceous carbonate platform and underlying syn-rift section, the most prolific of these hydrocarbon finds along the joint Mauritania and Senegal margin have been in Mid to Upper Cretaceous mixed turbidite-contourite deposits of the post-rift and drift sequences. For example, in the Greater Tortue Ahmeyim (GTA) wells, the Fan discovery with 950 mmbbl and the latest discovery, Orca, with 13 Tcf (2019).

In contrast to Mauritania, the prolific hydrocarbon province of offshore Côte d'Ivoire, further south along West Africa's coastline, has yielded several producing fields. Historically, exploration focused on structural traps on the shallow water shelf of Côte d'Ivoire. However, in recent years, similar to Mauritania, exploration activity has branched out into the deepwater domain, targeting deepwater Upper Cretaceous turbidite reservoirs, following analogues of Jubilee and Tweneboa fields. In 2024, the discovery of the Calao field was recorded as the second-largest discovery offshore Côte d'Ivoire. This expanded the geographical distribution of commercial hydrocarbon discoveries to the central deepwater basin domain, where previously discoveries had been concentrated in the eastern part of the basin.

NORTHWEST AFRICA MARGIN - MAURITANIA

Previous studies have identified several major clastic systems entering the Mauritania offshore Basin, depositing deltaic facies and associated down-slope channel and fan systems since the carbonate platform was drowned during the Early Cretaceous. The switch in major depo-centre from south to north is evident in Figure 2, and the main bypass routes are shown in Figure 3.

Upslope on the platform, sand facies have been penetrated at multiple stratigraphic levels, but often without significant thickness or net-to-gross (e.g., Courbine, Chinguetti 6-1 wells). Early wells targeted the continental shelf and were successful in Early Miocene channelized turbidites draped over salt structures (e.g. Chinguetti, Tiof, Tevet, Banda). In contrast, the Upper Cretaceous system has proven well-developed reservoir sands both on and off the shelf from the Coniacian to the Maastrichtian (e.g., Pelican, Aigrette, Lamatin, Fregate wells). The discovery of Pelican in 2003, an Upper Cretaceous turbidite channel play, unlocked the potential for Cretaceous clastics within the basin. This was soon followed by Faucon-1, Aigrette-1 and Cormoran-1, all of which discovered hydrocarbons in structurally closed Upper Cretaceous sand fairways. The lower to mid-Cretaceous system focused primarily on the southern and central parts of the basin and was fed by the Senegal River with a maximum deposition during the Apto-Albian. Significant bypass of the shelf is known to have occurred during this period, with large sand deposition downslope as proven in several deepwater wells

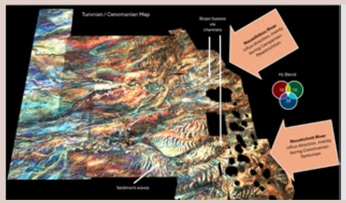

Figure 3: Slope bypass routes in the Late Cretaceous are showcased with a frequency blend map.

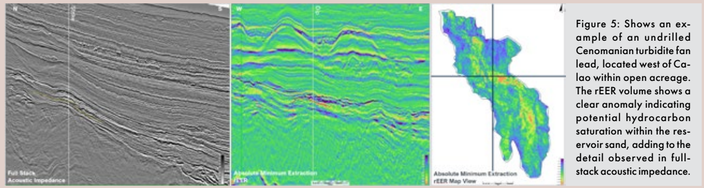

Figure 5: Shows an example of an undrilled Cenomanian turbidite fan lead, located west of Calao within open acreage. The rEER volume shows a clear anomaly indicating potential hydrocarbon saturation within the reservoir sand, adding to the detail observed in full-stack acoustic impedance.

(e.g., Tortue, Hippocampe, Marsouin). The Marsouin-1 well in 2015 and the Orca-1 well in 2019 discovered net pay in Cenomanian channel systems and previously untested Albian sands. Orca-1, was the largest discovery of 2019 with 13 Tcf directly after Zohr and reported excellent reservoir porosity (Kosmos Energy, Businesswire, 28 October 2019).

WEST AFRICA TRANSFORM MARGIN - CÔTE D'IVOIRE

Transform fault segmentation along the Côte d'Ivoire – Ghana margin is a key control on sediment transport, source rock distribution, and trap development. Recent analysis using TGS's extensive 3D seismic coverage has revealed multiple terrace-margin systems, settings where reservoir sands tend to pond. The Murene-1X well (Calao discovery) encountered oil, condensate and gas within several sandstone intervals in the Cenomanian, reporting good to excellent permeability. The reservoir unit ponded and is stratigraphically trapped against the faulted terrace structure. Potential resources (assumed in place) were announced between 1 and 1.5 billion barrels of oil equivalent. The magnitude of this recent success provides a valuable perspective on exploration trends, as operators branch out into more frontier acreage to the west and into deeper water with a focus on Upper Cretaceous clastic reservoirs.

Several Upper Cretaceous clastic systems have been identified to the west of Calao, within 3D GeoStreamer coverage (Figure 4), and further south, into the ultra-deep water covered by newly depth-reprocessed 2D seismic. Here, sediments ponded in topographic lows and pinched out against structural highs, forming stratigraphic traps. These units are interbedded by layers of shales and mudstones. Including the main source intervals Apto-Albian, Cenomanian and Turonian shales.

High-quality data is needed in deepwater environments due to the more subtle nature of stratigraphic traps in a conformable basin infill environment. Reservoir quality lithologies and potentially charged targets are easier to differentiate on a high-resolution suite of attributes, allowing the broadband frequency content and VpVs relationship to highlight undrilled targets. The detailed analysis of rock physics on seismic attributes by proxy offshore Côte d'Ivoire is especially crucial for another reason. The recent Calao discovery shows a subtle response on full and angle stack data, but can be mapped on relative impedance. A Relative Extended Elastic Reflectivity (rEER) workflow was carried out on Côte d'Ivoire GeoStreamer seismic to help distinguish sands and shales and highlight hydrocarbon saturation anomalies. Several leads have been identified within the GeoStreamer seismic coverage (Figure 5).

Côte d'Ivoire demonstrates further potential in its ultra-deep water setting. The Upper Cretaceous turbidites are extensive, reaching outboard of the 3D coverage, captured by the depth reprocessed 2D seismic (Figure 6). Within this basin setting, the change between continental, transitional, and oceanic crust occurs. In the past, this has had negative connotations for source maturity and the ability to charge nearby reservoir units. However, discoveries offshore Guyana (Liza, Ranger) have demonstrated that source maturity can be achieved over transitional and oceanic crust. More recently, Namibia (Venus discovery) has proven source maturity and migration in a similar setting with significantly less overburden. This helps de-risk exploration in the deepwater area offshore Côte d'Ivoire, opening up an exciting frontier part of the basin.

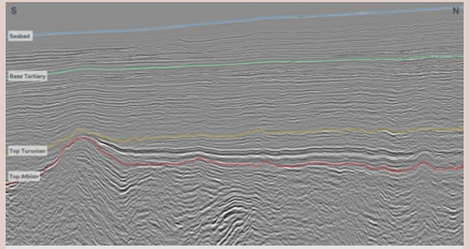

Figure 6: 2D depth reprocessed line (KPSDM) displaying stratigraphically trapped Upper Cretaceous fan lead in ultra deepwater basin setting.