Côte d'Ivoire: West Africa's Rising Star in Exploration

Drilling down into the prospectivity of Côte d'Ivoire's Tano Basin

Activity in the Tano Basin along the Côte d'Ivoire and Ghana shelf is not a new phenomenon. Various phases of seismic acquisition and drilling activities have been undertaken since the 70s, with oil production beginning in the 2000s with the Espoir field, followed by further developments.

Subsequent highlights include the discovery of Ghana's Jubilee field which heralded a period of intense exploration across Africa's Equatorial margin and exploration beyond 2,000 m water depths in Côte d'Ivoire which began in 2011. The discoveries made at that time, such as Paon and Pelican, proved the extension of the Upper Cretaceous plays into the distal parts of the Tano Basin.

The play-opening 2021 Baleine discovery (carbonate shelf edge play) - the largest discovery made so far along the Ivorian margin - had a significant impact upon the country's production outlook with estimated volumes of 2.5 Bnbbl of oil and 3.3 Tcf of associated gas. Followed by the second largest discovery, Calao (Murene-1X), in 2024, it's small wonder that these discoveries have attracted renewed exploration interest in offshore Côte d'Ivoire, with recent exploration acreage awarded to several IOCs making it the current exploration hotspot.

Understanding = De-Risking

Given its status as a highly topical exploration hotspot, Viridien continues to be active in the region. In association with Direction Générale des Hydrocarbures (DGH) and PETROCI Holding, we are re-imaging a significant portion (16,000 km^2) of the Ivorian margin seismic **(Figure 1**), the objective being to provide the industry with a solid foundation upon which to build a regional understanding and de-risk the potential of the Tano Basin. The survey overlaps with the Calao discovery and is adjacent to the Baleine field **(Figure 1**).

Exceptional Technology Gains Imaging Uplift

Here, we're sharing Viridien's final data from the multi-client CDI23, 3D PSDM re-imaging project (6,434 km^2). Four separate surveys, acquired over multiple blocks between 2000 and 2014 from the shelf to the outer slope domain, were merged to create a contiguous seismic volume that had differing cable depths and streamer profiles along with significant variations in legacy processing workflows. **(Figure 1**). The re-imaging was undertaken from field tapes using state-of-the-art technologies for Ghost Wavefield Elimination (GWE), Demultiple, and Time-Lag Full Waveform Inversion (TLFWI) for the model building.

Figure 1 Location and coverage map of Viridien's 16,000 km2 multi-client PSDM re-imaging program along the Côte d'Ivoire margin showing current held acreage, fields and recent discoveries.

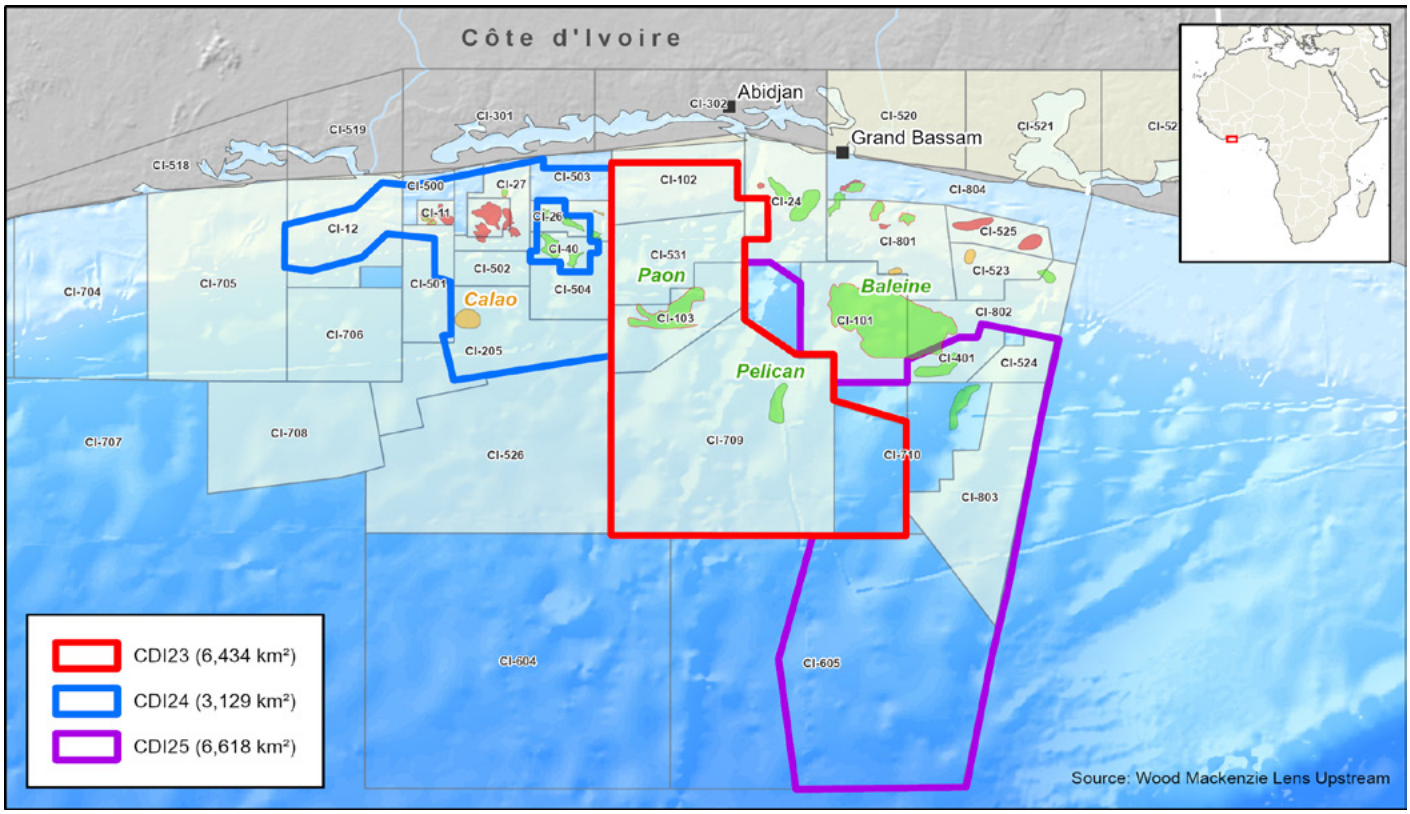

Image: Viridien Earth Data

The final 3D volume shows a significant imaging uplift compared to the legacy data **(Figure 2)**. The uplift in data quality can be attributed to improved bandwidth and a detailed velocity model, which have enabled better imaging of the basin architecture, better resolution and delineation of faults, and better imaging of the Upper Cretaceous reservoir intervals.

Figure 2 Legacy stack and velocity (A,C) and re-imaged data (B, D). The re-imaged data shows improved imaging of the sub-Albian section and higher resolution thanks to de-ghosting. Time-Lag Full-Waveform Inversion details the stratigraphic complexity of the shelf–slope domain.

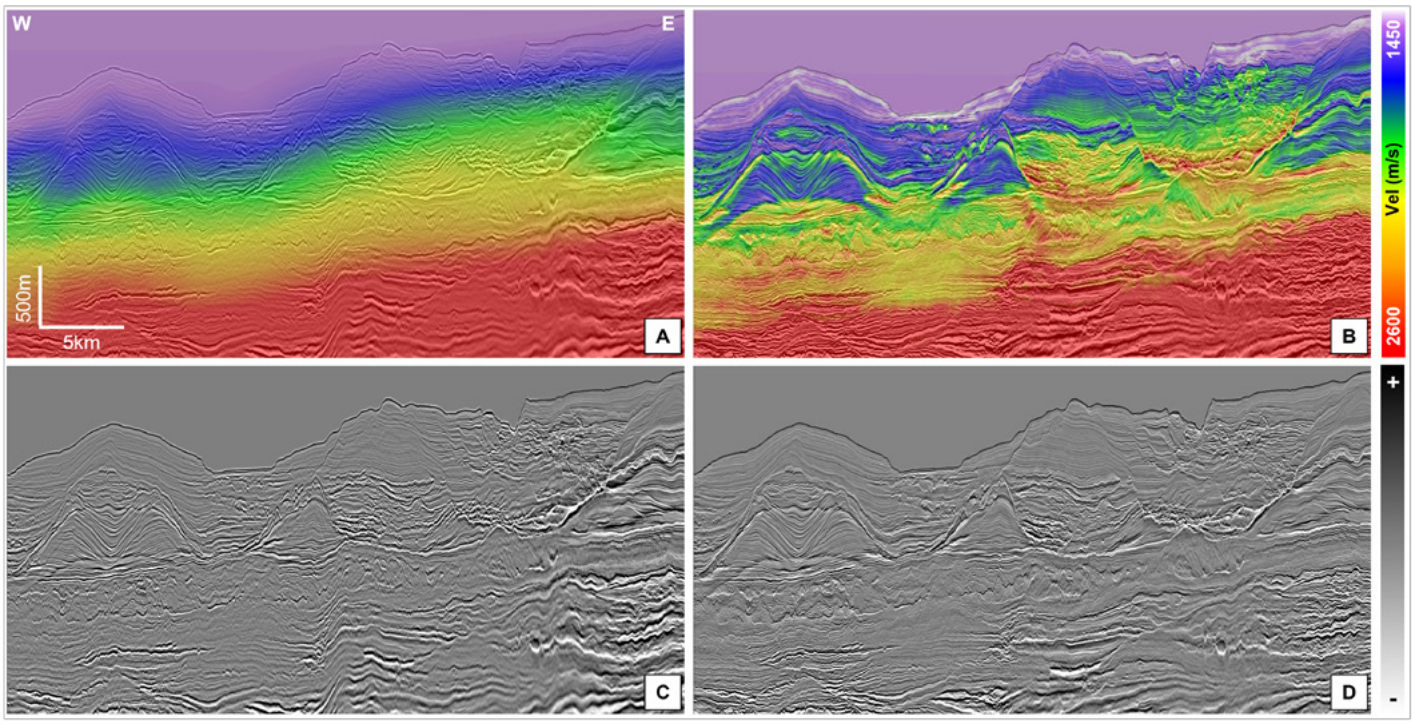

Image: Viridien Earth Data

Figure 3 The results from the multi-client re-imaging CDI23 programme show a NW-SE 115 km profile giving remarkable insight into the basin architecture and key stratigraphy of the highly prospective basin. The inset map shows the key structural elements of the basin along with the line location.

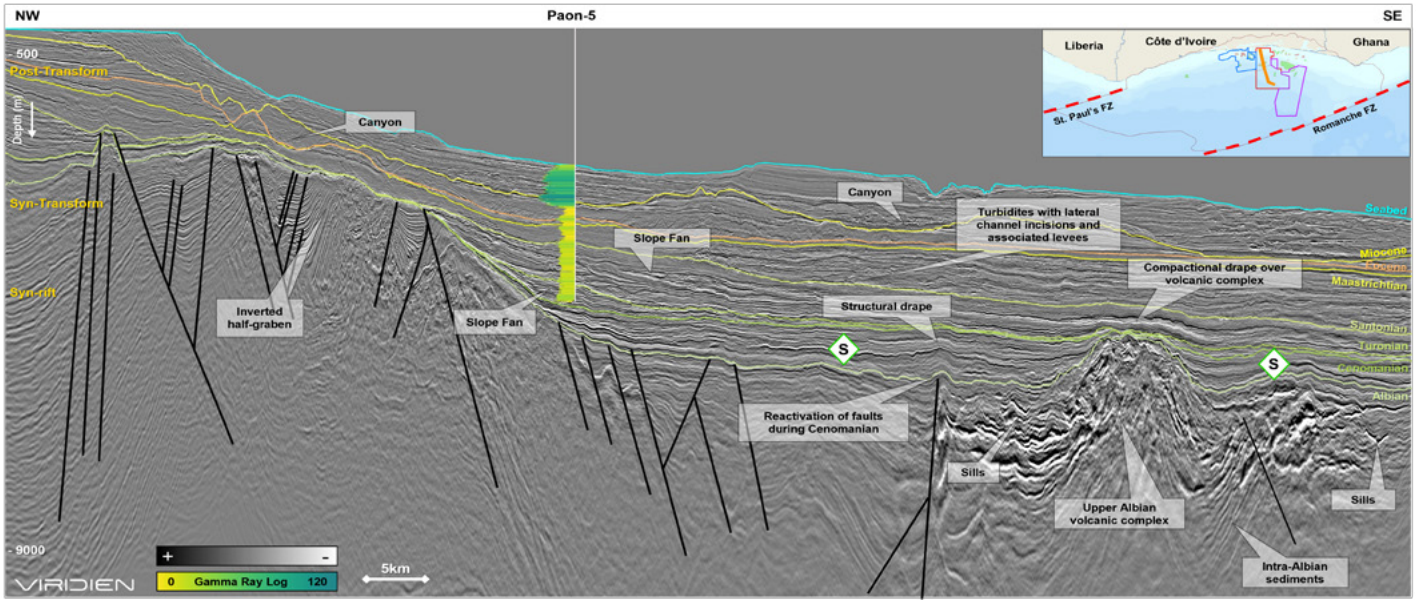

Image: Viridien Earth Data

Tano Basin – a Walk Through History

The CDI23 re-imaged survey covers the transform margin of the Tano Basin, situated between the Romanche Fracture Zone (west) and St Paul's Fracture Zone (east). This basin emerged through dextral-oblique divergence between the African and South American continental plates **(Figure 3)**.

The basin's evolution progressed through several distinct phases:

Taking us back roughly 120 million years to the Aptian-Early Albian period, pull-apart rifting created rotated fault blocks and (half-) grabens, which filled with continental and marginal marine sediments, as evidenced in wells like Baobab-1.

By mid-Albian, the basin underwent a transform phase, developing crustal oblique-slip faults and en-echelon folds (Scarselli et al., 2018). Crustal weakening along these major faults facilitated the formation of mid to late Albian volcanic centres **(Figure 2)** and sub-volcanic sill complexes.

The Cenomanian period brought additional strike-slip movement, inverting existing structures. This significantly influenced both the deposition and trapping of lower Upper Cretaceous turbidite reservoirs while creating migration pathways for hydrocarbons. Carbonate deposition occurred along the shelf edge and atop fault block crests, as demonstrated in the Baleine field.

Figure 4 W-E line through the Paon field and Pelican-1X oil discovery showing key reservoir facies within the Upper Cretaceous.

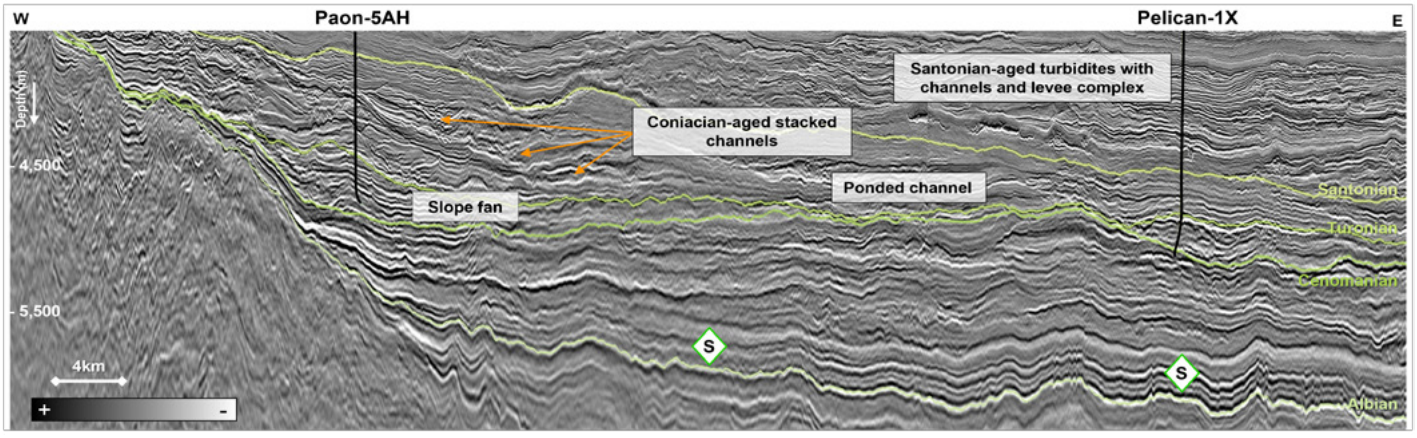

Image: Viridien Earth Data

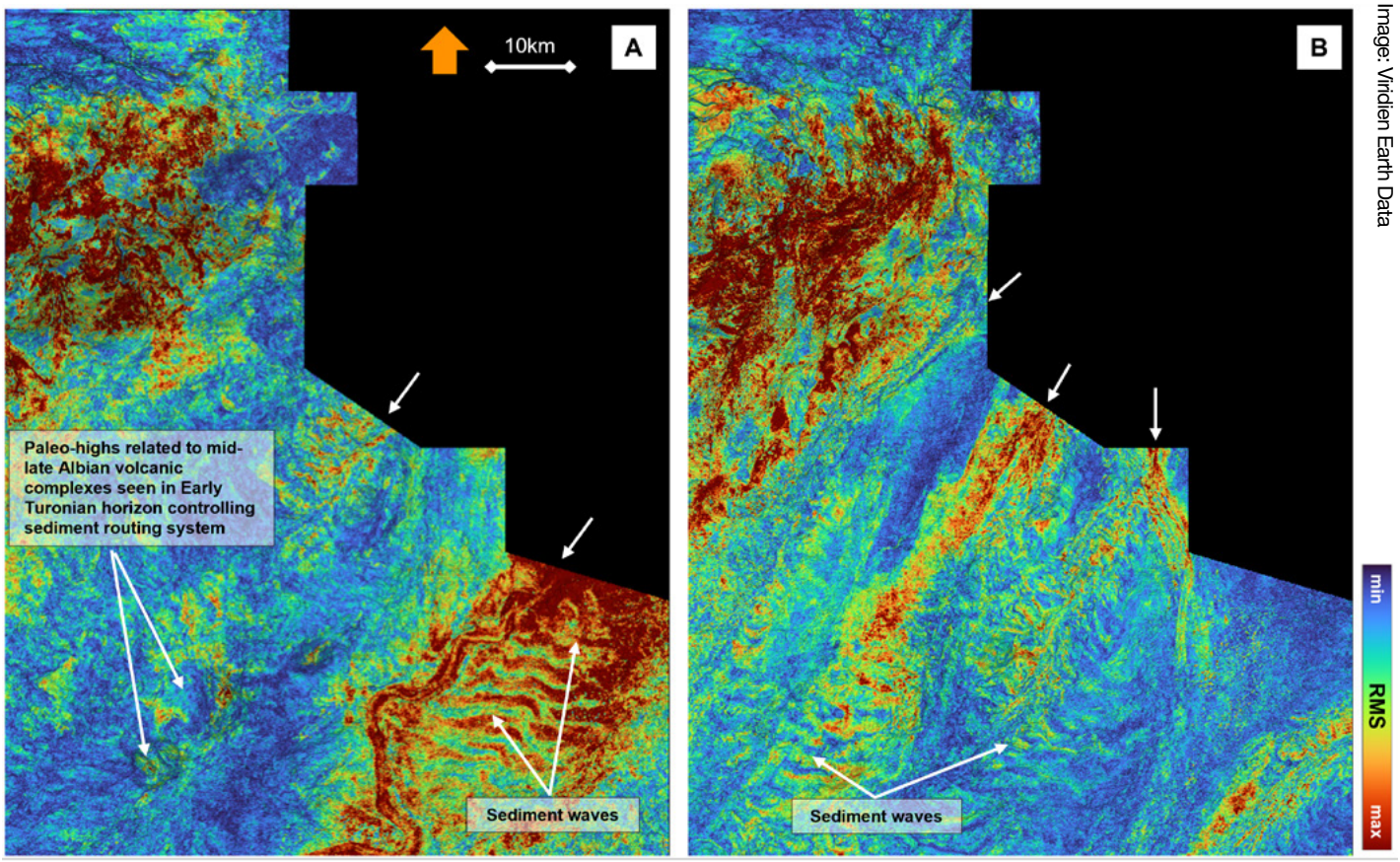

Image: Viridien Earth Data

Figure 5 RMS amplitude extraction for two stratigraphic slices through Turonian channels and turbidites. A) Lower Turonian horizon shows a high-sinuosity channel system that fully traverses the survey and crosses an area with well-defined sediment waves that may represent contourites. B) Upper Turonian stratal slice shows three distinct sediment transport pathways with channels widening into fans to the southwest. The variability in depositional elements and their organisation is merely a snapshot of the complex stratigraphic evolution during the Late Cretaceous while showing the potential of the newly re-imaged and merged dataset.

The Upper Cretaceous and more recent post-transform phase sediments were deposited in deep marine environments, forming ponded and channelised turbidite systems, basin floor fans, contourites, and off-axis hemipelagics—all exceptionally visualised in the final data **(Figure 4)**.

A highly effective working petroleum system has been proven through drilling in the Tano Basin (Paon, Pelican, and Baleine wells). The basin's primary source rocks include Albian, Cenomanian, and Turonian shales, with optimal maturity currently observed throughout the basin.

New Geological Insight – a Valuable Tool

This regional PSDM dataset serves as a valuable resource for seismic interpretation and attribute analysis of the complex Cretaceous section. The dataset enables identification and mapping of depositional architecture details, including leveed channel complexes, slope and basin floor fans, and sediment wave sequences. Root Mean Square (RMS) amplitude extraction along stratigraphic slices through the Upper Cretaceous interval **(Figure 5)** provides particularly illuminating insights. Notably, the dataset reveals multiple sediment transport pathways and deepwater sediment dispersal systems that extend into the deeper basin.

Next Steps…

Completed in Q4 2024, the re-imaging of the CDI23 survey will be complemented by an additional 9,747 km² of data from the current multi-client reimaging programmes (CDI24 and CDI25). The CDI23 PSDM re-imaged data provides interpreters with greater insight into exploring subtle stratigraphic and/or combined trap prospects.