

## Geological Interpretation of Seismic Section of an X-Field in the Niger Delta, Southern Nigeria

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### Abstract

### Original Research Article

The Niger Delta Basin represents one of Africa's most prolific hydrocarbon provinces, with complex structural and stratigraphic frameworks controlling petroleum accumulation. This study presents a geologic interpretation of seismic data from an X-field located in the southern Niger Delta, Nigeria, aiming to delineate structural features, identify hydrocarbon indicators, and establish the relationship between interpreted seismic signatures and the regional geological setting. Four inlines (5908–5932) were interpreted manually using basic seismic interpretation techniques, involving fault picking along vertical sections and horizon identification on laterally continuous reflections. The seismic sections revealed multiple fault systems comprising major, minor, and growth faults distributed across interpreted horizons (H0–H4). The results demonstrate that the area is structurally deformed, with fault density varying significantly across horizons, from zones with no faulting (H0–H1) to highly faulted intervals containing up to seven major faults (H1–H2 on inline 5916). Growth faults were identified, confirming the extensional tectonic regime characteristic of the Niger Delta's depobelts. Direct hydrocarbon indicators (DHIs), including bright spots and dim spots representing amplitude anomalies, were observed across all interpreted sections, suggesting possible hydrocarbon accumulations within fault-bounded traps. The interpreted horizons correspond to the three principal stratigraphic units of the Niger Delta: the Benin Formation (continental sands), Agbada Formation (paralic reservoir sequence), and Akata Formation (marine source rocks). Hydrocarbon potential appears concentrated within the Agbada Formation equivalents, where structural traps formed by growth fault-related rollover anticlines provide favorable accumulation conditions. This study demonstrates that manual seismic interpretation remains valuable for preliminary basin analysis, successfully identifying structural features and hydrocarbon indicators that warrant further detailed investigation using advanced seismic attributes and quantitative interpretation methods.

**Keywords:** Niger Delta, Seismic Interpretation, Growth Faults, Hydrocarbon Indicators, Agbada Formation.

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## INTRODUCTION

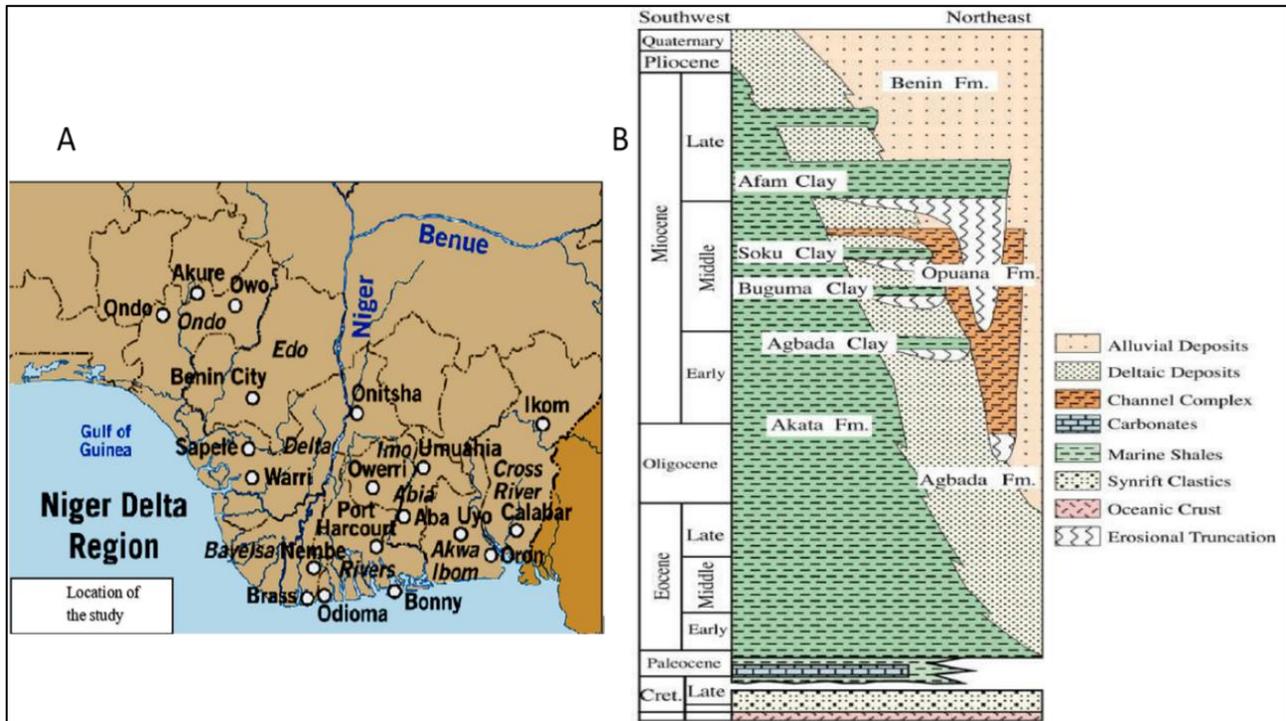
The major feature of the petroleum habitat in the Niger Delta Basin (province) is the association of petroleum traps with growth faults. The Niger Delta Basin is an extensional rift basin located in the Niger Delta and the Gulf of Guinea on the passive continental margin near the western coast of Nigeria with suspected or proven access to Cameroon, Equatorial Guinea, and São Tomé and Príncipe. The Niger Delta Basin is one of the largest subaerial basins in Africa. It has a subaerial area of about 75,000 km<sup>2</sup>, a total area of 300,000 km<sup>2</sup>, and a sediment fill of 500,000 km<sup>3</sup>. The sediment fill has a depth between 9 and 12 km. The Niger Delta Basin lies in the south-westernmost part of a larger tectonic structure, the Benue Trough. The other side of the basin

is bounded by the Cameroon Volcanic Line and the transform passive continental margin (Eze *et al.*, 2024).

Because of the significant role of these faults in hydrocarbon accumulation and redistribution in the basin, a good understanding of the timing of fault motion has now been shown to be vital for successful exploration of fault-bound prospects. In most petroleum habitats, structural elements such as fault patterns, their kinematics, geometry, timing, and size of the structures control the distribution of hydrocarbons in adjacent fault blocks (Obiadi and Obiadi, 2016). The success or otherwise of an exploration well in such areas depends on the location of such a well relative to the structural closure interpreted from the seismic data. The fields studied are located on adjacent fault blocks within a part of the greater Ughelli Depo-belt of the Niger Delta basin.

This area (Figure 1A) falls within the extensional zone of the Niger Delta Basin (Oyanyan, 2025). Knowledge of the number, size, and distribution of small or

subseismic faults informs inferences about their influence on fluid flow and the probability of top-seal leaks (Wu et al., 2017).



**Figure 1: The map of the Niger Delta Region of Nigeria (A). Stratigraphic column showing the three formations of the Niger Delta (B)**

Structural interpretation of seismic data entails identifying, picking, and tracking laterally consistent seismic reflectors for the primary objective of mapping geologic structures, depth of primary reflector, stratigraphy, and perhaps to probe reservoir architecture (McQuillin *et al.*, 1984; Allstair, 2011; Avseth *et al.*, 2005). The appropriate result would be to detect possible hydrocarbon traps, delineate their extent, and calculate their volumes. Several authors have attempted a structural interpretation of the Niger Delta using seismic data (Obiekezie, 2014; Odoh *et al.*, 2014), primarily to evaluate stratigraphy and geologic structures and delineate traps with probable hydrocarbon accumulation.

Seismic attributes allow geoscientists to interpret faults and horizons, recognize depositional environments, and unravel structural deformation history more rapidly. They are also used in checking the quality of seismic data for artifacts delineation, seismic facies mapping, prospect identification, risk analysis, and reservoir characterization (Oyeyemi and Aizebeokhai, 2015). Seismic attributes often organize features into displays that provide enhanced images for either a human interpreter or for modern geostatistical or neural-network computer analysis. While seismic attributes are sensitive to lateral changes in geology, they are, however, also quite sensitive to lateral changes in noise (Oyeyemi and Aizebeokhai, 2015).

Ajisafe and Ako (2013) carried out an integrated interpretation over the “X” Field in the Niger Delta area of Nigeria using seismic data and check shot data with the aim of characterizing reservoir rocks using quantitative seismic attributes and petrophysical properties. Seismic attribute maps revealed the presence of hydrocarbons in the identified sands. There was a good correlation between the structural high and zones of anomalous amplitude. It was concluded that seismic attributes could be used to predict reservoir rock properties and characterize the reservoir.

The Niger Delta's hydrocarbon system is controlled by three key structural features: mega-structural or depobelts, growth faults with roll-over anticlines, and diapiric structures. The delta is divided into distinct depobelts, units bounded by growth faults landward and counter-regional faults seaward that formed due to variable sediment supply and subsidence rates, each representing a break in regional dip (Harvey and Ken, 1996). The basin consists of three main stratigraphic units Benin Formation (Oligocene-recent): Continental sands with shale intercalations, forming the main aquiferous unit (up to 2,000m thick), Agbada Formation (Eocene): The primary reservoir sequence (up to 4,500m thick) containing Niger Delta's oil and gas resources, consisting of paralic siliciclastics with sandy units and shale intercalations, and Akata Formation (basal unit): Marine shales serving as the primary source

rock (Type II/III kerogen), typically overpressured, with turbidite sands as potential deep-water reservoirs (Figure 1B)

The delta prograded through depositional cycles, creating sub-basins (depobelts) striking NW-SE, each with its own tripartite assemblage. Hydrocarbons accumulate primarily in the crestal portions of the Agbada Formation within these sub-basins. Seismic interpretation integrates geological understanding with reflection timing and velocity data to map structures, starting from well control points with synthetic seismograms to establish structural styles and stratigraphic components. This study aims to provide a basic interpretation of seismic data and its relationship to Geologic settings in the Niger Delta Basin.

## METHODOLOGY

Seismic data was interpreted manually using basic interpretation techniques. The data will be extracted from a seismic volume within the Niger Delta basin. Four (4) Inlines were used for the Interpretation. To delineate the geologic history of the basin entails

visually inspecting the seismic section for reflection discontinuities, vertical displacement of reflection events, and abrupt termination of events, overlapping of reflections, changes in pattern and strength of reflection events across the section, and reflection characteristics of the section are analyzed in terms of reflection strength, amplitude, continuity, and configuration.

## Seismic Interpretation

The first phase of the interpretation involved fault interpretation. Faults were picked on vertical sections along the direction of maximum transport and correlated along the fault trace on semblance slices. Horizon interpretation constituted the second phase of interpretation. Horizons were picked on laterally continuous reflections, starting from the well locations.

## RESULTS

In this study, the hydrocarbon-bearing reservoir intervals of the X-field in the Niger Delta have been delineated and mapped from surface seismic data. Horizons were identified at the time levels from inline 5908 – 5932 in the seismic section.

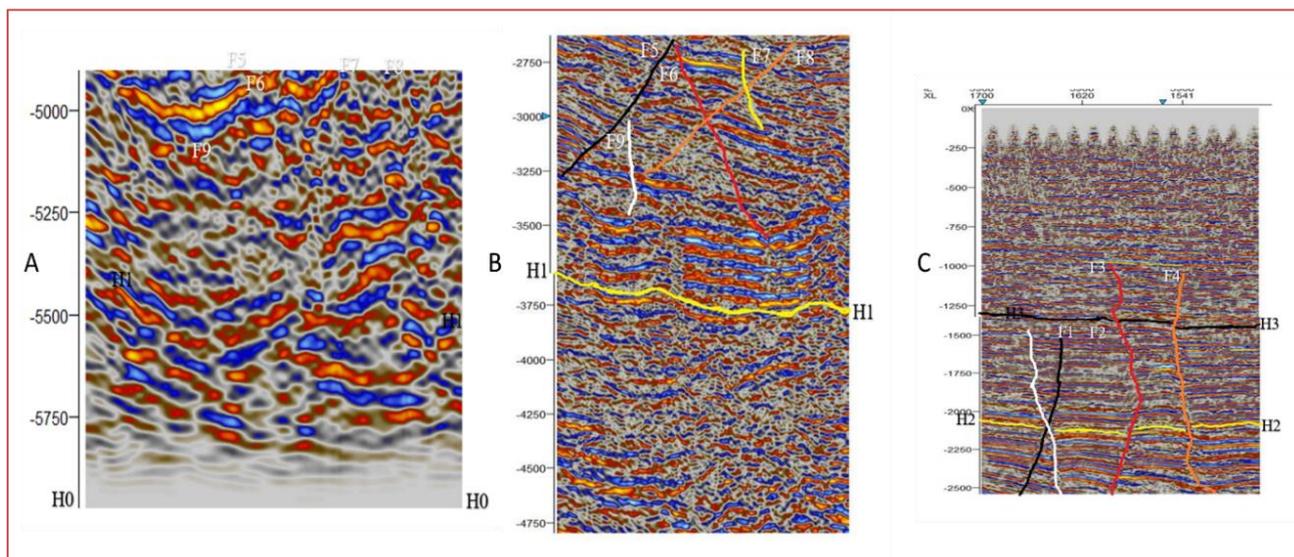
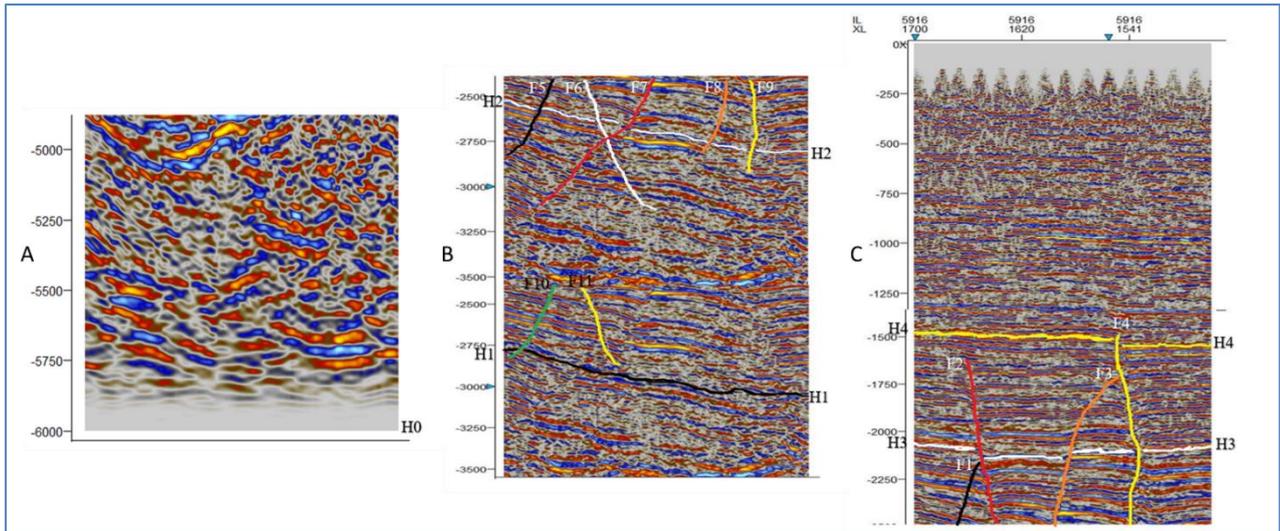


Figure 2: Inline 5908: Seismic section one (1)

Fig 2. Seed seismic line showing fault sticks and horizons interpreted. **H0 – H1**: Sediments were deposited in the basement rock. This area is distorted, the reflectors are discontinuous to continuous, there was no fault found in this area, and the presence of bright spots and dim spots, which are amplitude switch anomalies indicative of possible hydrocarbon occurrence (DHI). **H1 – H2**: Sediments were deposited in the basement rock, the reflectors are discontinuity to continuity, there were so many faults found in this area, three (3) major

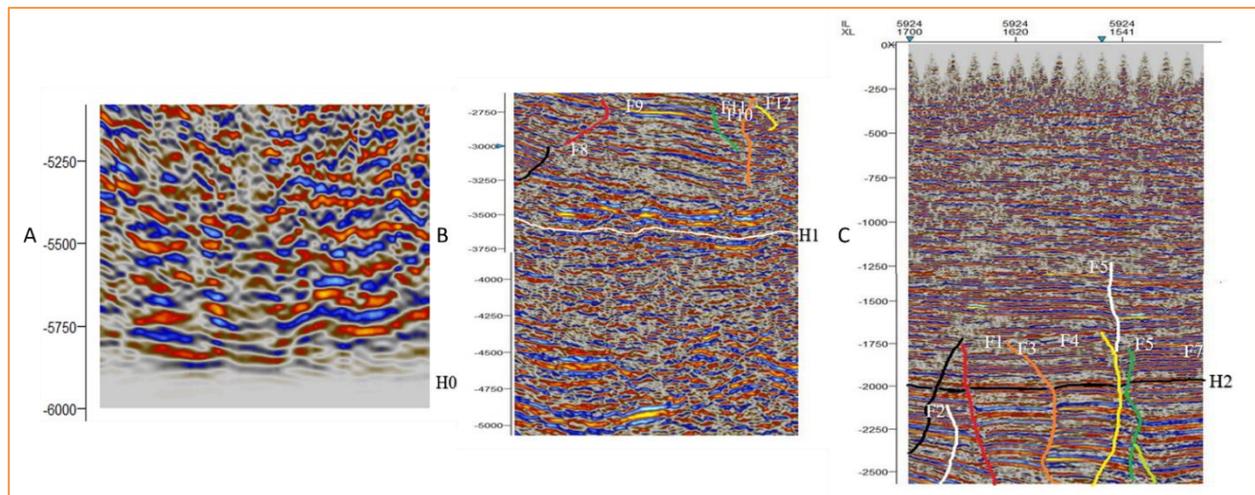
faults and two (2) minor faults (F1, F2, F3, F4, F5, F7, F8, F9), and presence of bright spot and dim spot, which are Amplitude switch anomalies indicative of possible hydrocarbon occurrence (DHI). **H2 – H3**: Sediments were deposited in the basement rock, this area is distorted, the reflectors are discontinuous to continuous, there were so many faults found in this area, four (4) major faults (F1, F2, F3, F4), and Presence of bright spot and dim spot, which are Amplitude switch anomalies indicative of possible hydrocarbon occurrence (DHI).



**Figure 3: Inline 5916: Seismic section two (2)**

Fig 3. Seed seismic line showing fault sticks and horizons interpreted. **H0 – H1**: Sediments were deposited in the basement rock. This area is distorted, the reflectors are discontinuous to continuous, there was no fault found in this area, and the presence of a bright spot and a dim spot which are amplitude switch anomalies indicative of possible hydrocarbon occurrence (DHI). **H1 – H2**: Sediments were deposited in the basement rock, the reflectors are discontinuity to continuity, there was so many faults found in this area, seven (7) major faults (F5, F6, F7, F8, F9, F10, F11), and the presence of bright spot and dim spot which are Amplitude switch anomaly indicative of possible hydrocarbon occurrence

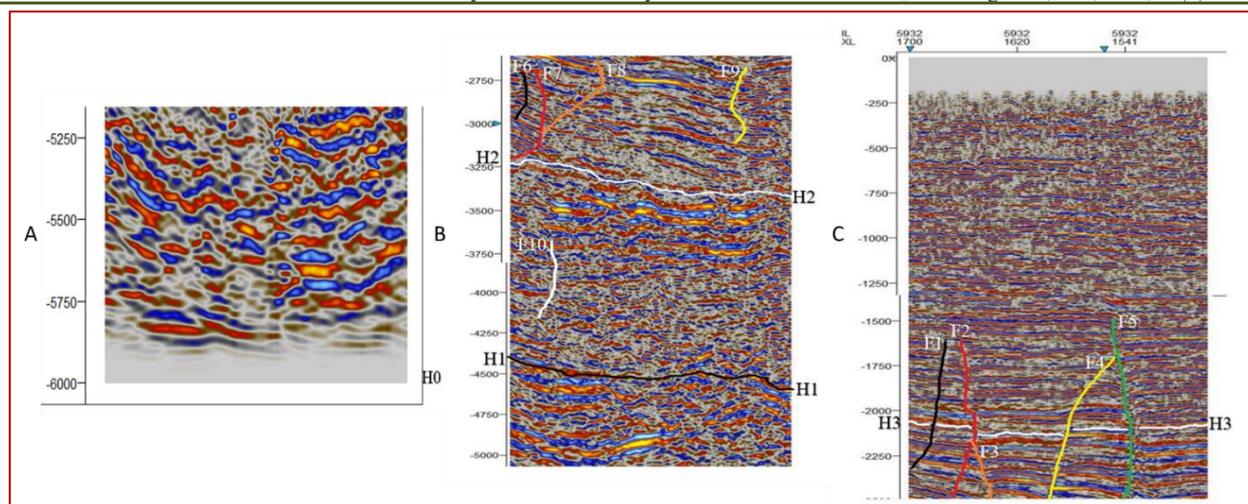
(DHI). **H2 – H3**: Sediments were deposited in the basement rock; the reflectors are discontinuity to continuity. There were so many faults found in this area, four (4) major faults (F1, F2, F3, F4), and the presence of a bright spot and a dim spot, which are Amplitude switch anomaly indicative of possible hydrocarbon occurrence (DHI). **H3 – H4**: Sediment was deposited in the basement rock. The reflector is discontinuous to continuous; there were many faults found in this area. Three (3) major faults were found (F1, F2, F3), and the presence of bright and dim spots, which are amplitude anomalies indicative of possible hydrocarbon occurrence (DHI).



**Figure 4: Inline 5924: Seismic section three (3)**

Fig 4. Seed seismic line showing fault sticks and horizons interpreted: **H0 – H1**: Sediments were deposited in the basement rock. This area is distorted. The reflectors are discontinuous to continuous; there was no fault found in this area, and the presence of a bright spot and a dim spot which are Amplitude switch anomalies indicative of possible hydrocarbon occurrence (DHI). **H1 – H2**: Sediments were deposited in the

basement rock, the reflectors are discontinuity to continuity, there are so many faults found in this area, five (5) major faults and minor (6) minor faults and one (1) growth faults (F5, F7, F8, F9, F10, F11, F12), and the presence of bright spot and dim spot which are Amplitude switch anomaly indicative of possible hydrocarbon occurrence (DHI).



**Figure 5: Inline 5932: Seismic section four (4)**

Fig 5. Seed seismic line showing fault sticks and horizons interpreted: **H0 – H1**: Sediments were deposited in the basement rock. This area is distorted, the reflectors are discontinuous to continuous, there was no fault found in this area, and the presence of a bright spot and a dim spot which are amplitude switch anomalies indicative of possible hydrocarbon occurrence (DHI). **H1 – H2**: Sediments were deposited in the basement rock, the reflectors are discontinuity to continuity, one fault was found in this area, one (1) major fault (F10), and the presence of bright spot and dim spot, which are amplitude switch anomaly indicative of possible hydrocarbon occurrence (DHI). **H2 – H3**: Sediments were deposited in the basement rock, the reflectors are discontinuity to continuity, there are so many faults found in this area, four (4) major faults and four (4) minor faults and one (1) growth fault (F1, F2, F3, F4, F5, F6, F7, F8, F9), and the presence of bright spot and dim spot which are amplitude switch anomaly indicative of possible hydrocarbon occurrence (DHI).

## DISCUSSION

The seismic interpretation conducted across four inlines (5908–5932) of the X-field in the southern Niger Delta provides significant insights into the structural framework and hydrocarbon potential of the area. The results reveal a complex deformational history characterized by varying fault densities, multiple fault types, and consistent amplitude anomalies across interpreted horizons, all of which have important implications for hydrocarbon exploration and production in this part of the Niger Delta basin.

### *Structural framework and fault analysis*

The interpreted seismic sections demonstrate that the X-field lies within a structurally deformed zone of the Niger Delta, consistent with its location in the extensional tectonic domain of the basin (Pochat *et al.*, 2004). The identification of major faults, minor faults, and growth faults across all inlines confirms that extensional tectonics, driven by gravitational sliding and

sediment loading, has profoundly influenced the structural evolution of this area. The varying fault densities observed between horizons, from unfaulted intervals (H0–H1) to intensively faulted sections containing multiple fault systems, suggest changes in deformation intensity through time, likely corresponding to different phases of basin evolution and sediment supply rates.

The presence of growth faults is particularly significant, as these structures are fundamental to hydrocarbon trapping in the Niger Delta (Evamy *et al.*, 1978). Growth faults form syndepositionally in response to rapid sediment accumulation and differential compaction, creating accommodation space on their downthrown sides while generating rollover anticlines that serve as structural traps. The identification of growth faults in the X-field (inline 5924, Figure 4; inline 5932, Figure 5) indicates that this area experienced syndepositionary deformation, with fault movement contemporaneous with sediment deposition. This timing is critical because syndepositional faulting can create structural closures before hydrocarbon migration, increasing the probability of accumulation.

The distribution of faults across horizons reveals important patterns. Horizon H0–H1 consistently shows no faulting across all inlines, suggesting either a tectonically quiescent period during deposition of these sediments or that this interval represents a relatively undeformed basal section. In contrast, horizons H1–H2 and H2–H3 exhibit intense faulting with up to seven major faults identified on inline 5916. This vertical variation in fault density may reflect changes in the mechanical properties of the stratigraphic section, with more competent units (sandy intervals) favoring fault propagation while shale-rich intervals may accommodate deformation through ductile flow. Alternatively, these variations could indicate pulses of tectonic activity related to periods of increased sediment supply or basin-margin instability.

The identification of both synthetic and antithetic faults (implied by the presence of major and minor faults with varying orientations) has important implications for trap geometry and hydrocarbon retention. Complex fault arrays can create multiple fault blocks with independent hydrocarbon-water contacts, potentially compartmentalizing reservoirs. While compartmentalization can complicate production strategies, it also allows for multiple independent accumulations within a single field, increasing overall hydrocarbon potential. The fault geometries observed in the X-field, particularly where faults intersect, likely create fault-dependent closures suitable for hydrocarbon accumulation.

#### ***Hydrocarbon indicators and amplitude anomalies***

The consistent observation of bright spots and dim spots across all interpreted sections represents one of the most significant findings of this study. These amplitude anomalies, classified as direct hydrocarbon indicators (DHIs), provide compelling evidence for hydrocarbon occurrence within the X-field. Bright spots, characterized by anomalously high reflection amplitudes, typically indicate the presence of gas-charged sands, where the acoustic impedance contrast between low-density gas sands and surrounding shales produces strong reflections (Anstey, 1980; Huang and Fu, 1982). Dim spots, representing amplitude decreases relative to background trends, may indicate oil-bearing zones or lithological changes.

The distribution of these amplitude anomalies within fault-bounded intervals suggests that structural traps formed by the interpreted fault systems are likely charged with hydrocarbons. The association between structural highs (implied by fault geometries and rollover structures) and amplitude anomalies supports the interpretation of fault-dependent traps, where hydrocarbons migrate along fault planes and accumulate in structural closures against fault seals. This relationship between structure and amplitude anomalies has been documented elsewhere in the Niger Delta (Ajisafe and Ako, 2013; Oyeyemi and Aizebeokhai, 2015) and represents a reliable exploration indicator.

The occurrence of both bright and dim spots within the same intervals suggests possible hydrocarbon phase variations or complex fluid distributions. Bright spots may indicate gas accumulations in structurally high positions, while dim spots could represent oil-water contacts or zones of residual hydrocarbon saturation. Alternatively, these amplitude variations might reflect lithological heterogeneity within reservoir intervals, with clean sands producing different amplitude responses than shaly sands. Without well control and synthetic seismograms, definitive discrimination between fluid and lithology effects remains challenging, but the systematic occurrence of these anomalies within structural traps strongly supports a hydrocarbon origin.

#### ***Stratigraphic implications and reservoir potential***

The interpreted horizons (H0–H4) correspond to reflections from stratigraphic boundaries within the Niger Delta succession. Based on the regional stratigraphic framework (Short and Stauble, 1967; Weber and Daukoru, 1975), the upper section (H0–H1) likely corresponds to the Benin Formation, characterized by continental sands with minor shale intercalations. The absence of faulting in this interval is consistent with the Benin Formation's relatively homogeneous lithology and its position above the main detachment surface. The lack of amplitude anomalies in this interval suggests minimal hydrocarbon occurrence, consistent with the Benin Formation's role as the regional aquifer rather than a primary reservoir.

The intermediate interval (H1–H3) exhibiting intense faulting and abundant amplitude anomalies almost certainly corresponds to the Agbada Formation, the principal hydrocarbon-bearing unit of the Niger Delta. The Agbada Formation's paralic succession of interbedded sands and shales provides ideal reservoir-seal pairs, with sandy units serving as reservoirs and interbedded shales as intraformational seals. The fault density observed in this interval is typical of the Agbada Formation, which has experienced significant extensional deformation due to its position above over pressured Akata Formation shales that serve as detachment surfaces. The amplitude anomalies concentrated in this interval support the interpretation that the Agbada Formation hosts the X-field's hydrocarbon accumulations.

The deepest interval (H3–H4) likely represents the upper Akata Formation or the transition zone between Agbada and Akata Formations. While this interval contains faults and some amplitude anomalies, the reflection character differs from the overlying Agbada interval. The Akata Formation's marine shales, which serve as the principal source rock for Niger Delta hydrocarbons (Evamy *et al.*, 1978; Tuttle *et al.*, 1999), typically produce weak, discontinuous reflections due to their homogeneous lithology. The presence of amplitude anomalies in this interval might indicate turbidite sands within the Akata Formation, which represent potential deep-water exploration targets increasingly important in the Niger Delta's offshore development.

#### ***Implications for hydrocarbon exploration and development***

The structural and stratigraphic interpretation presented here has several important implications for hydrocarbon exploration and development in the X-field and analog settings within the Niger Delta. First, the identification of multiple fault-dependent traps across several horizons suggests that significant hydrocarbon potential exists at multiple stratigraphic levels. Exploration strategies should therefore target not only the obvious structural closures at the Agbada Formation's crest but also deeper objectives within the lower Agbada

and possibly upper Akata intervals. Stacked pay scenarios, where multiple reservoir intervals are charged within a single structural culmination, could significantly increase field economics.

Second, the variation in fault density across horizons indicates that reservoir compartmentalization may be significant, particularly in the most intensively faulted intervals (H1–H2 on inline 5916). Development planning must account for potential compartmentalization through appropriate well placement and completion strategies. Early appraisal drilling should include pressure measurements and fluid sampling from multiple fault blocks to establish compartment boundaries and hydrocarbon-water contacts. Three-dimensional seismic attributes, particularly coherence and curvature attributes, would help refine fault interpretation and improve compartment mapping (Chopra and Marfurt, 2008).

Also, the consistent occurrence of amplitude anomalies suggests that seismic attribute analysis could significantly enhance reservoir characterization in this field. Quantitative interpretation techniques, including amplitude-variation-with-offset (AVO) analysis and seismic inversion, could provide valuable information about fluid types, saturation distributions, and reservoir quality. Integration of these attributes with petrophysical data from exploration wells would enable more accurate volumetrics and reduce development risk.

In addition, the identification of growth faults confirms that this area lies within an extensional depobelt of the Niger Delta, with implications for understanding hydrocarbon migration pathways. Growth faults often serve as conduits for hydrocarbon migration from deeply buried, mature Akata Formation source rocks to shallower Agbada Formation reservoirs. The timing of fault movement relative to hydrocarbon generation is critical; faults active during migration facilitate charging, while post-migration fault movement may breach seals and cause leakage. Although absolute timing cannot be determined from seismic data alone, the syndepositional character of growth faults suggests they were active during the critical period when the Akata Formation entered the oil window.

## CONCLUSION

This study presents a geologic interpretation of seismic data from an X-field in the southern Niger Delta using four manually interpreted inlines to delineate structural features and identify hydrocarbon indicators. The X-field lies within a complexly deformed zone containing major, minor, and growth faults, with vertical fault density variations. Growth faults confirm an extensional tectonic regime with syndepositional deformation favorable for trap formation, creating structural closures with rollover anticlines. Based on the regional framework, H0–H1 represents the Benin Formation, H1–H3 corresponds to the Agbada

Formation (primary reservoir), and H3–H4 represents the upper Akata Formation. Bright spots and dim spots (direct hydrocarbon indicators) were consistently observed within fault-bounded Agbada intervals, suggesting structural traps are likely charged. Multiple fault-dependent traps suggest stacked pay potential, while variable fault density indicates possible reservoir compartmentalization requiring careful well placement. Manual seismic interpretation successfully identified structural features and hydrocarbon indicators, confirming that the area possesses essential petroleum system elements: growth fault-related traps, Agbada reservoir rocks, hydrocarbon charge indicated by amplitude anomalies, and the stratigraphic framework characteristic of the Niger Delta, with findings supporting continued exploration activity.

## REFERENCES

- Eze OE, Okiwelu AA, Ekwok SE, Abdelrahman K, Alzahrani H, Ben UC, Ibrahim A, Akpa C, Andr  s P, Ugar SI and Eldosouky AM (2024). Delineation of deep-seated crustal structures from magnetic data in the southeastern part of the Niger Delta basin, Nigeria. *Front. Earth Sci.* 12:1439199. doi: 10.3389/feart.2024.1439199.
- Obiadi, I.I. and Obiadi, C.M. (2016). Structural Deformation and Depositional Processes: Insights from the Greater Ughelli Depobelt, Niger Delta, Nigeria, *Oil Gas Research*, 2(3). DOI: 10.4172/2472-0518.1000118. Available at: <http://repository.unizik.edu.ng/handle/123456789/848>.
- Oyanyan, R.O. (2025). Growth Faulting, Rate of Oligocene Sediment Accumulations, and Stratal Geometries in a Greater Ughelli Depobelt Oil Field, Niger Delta Basin, Nigeria, *Lithology and Mineral Resources*, 60, pp. 621–633. Available at: <https://www.semanticscholar.org/paper/Growth-Faulting%2C-Rate-of-Oligocene-Sediment-and-in-Oyanyan/0cb13c1902a125903bb95e2e33bc689a9b66e379>.
- Wu Yunyun, Ma Lichi, Yang Guili, Liu Xiaolin, Wang Zhiying, Zhao Yuehan, Xie Chuanjin (2017). Fault characteristics and their controls on hydrocarbon accumulations in Neogene, Kendong area, Bohai Bay Basin[J]. *PETROLEUM GEOLOGY & EXPERIMENT*, 39(1): 65-70. doi: 10.11781/sysydz20170106.
- McQuillin R, Bacon M, Barclay W (1984). An introduction to seismic interpretation: reflection seismic in petroleum exploration, Graham & Trotman Ltd. (2nd Ed.) London.
- Allstair RB (2011). Interpretation of 3D seismic data (seventh edition). The American Association of Petroleum Geologists and Society of Exploration Geophysics, Tulsa, Oklahoma, USA.
- Avseth P, Mukerji T, Mavko G (2005). Quantitative seismic interpretation. Cambridge University Press pp. 168-170.

- Obiekezie TN (2014). Hydrocarbon exploration in Odo field in the Niger delta basin Nigeria, using a 3-D seismic reflection survey. *Sci. Res. Essays* 9(17):778-784.
- Odoh BI, Ilechukwu JN, Okoli NI (2014). The Use of Seismic Attributes to Enhance Fault Interpretation of OT Field, *Niger Delta. Int. J. Geosci.* 5:826-834. Ogboke O (2006). Mapping of structural trap using 3D interpretation tool in Asin field, Niger Delta, Unpublished M.Sc. Thesis, University of Southern Venezuela.
- Oyeyemi, K.D. and Aizebeokhai, A.P. (2015). Hydrocarbon trapping mechanism and petrophysical analysis of Afam field, offshore Nigeria, *International Journal of Physical Sciences*, 10(7), pp. 222-238. doi: 10.5897/IJPS2015.4275.
- Ajisafe, Y.C., and Ako, B.D. (2013). 3-D Seismic Attribute for Reservoir Characterization of “Y” Field, Niger Delta, Nigeria. *IOSR Journal of Applied Geology and Geophysics*, 1(2): 23-31.
- Harvey A C and Ken M (1996). Sedimentation and shale tectonics of the northwestern Niger Delta front. *Marine and Petroleum Geology*, 13 (3), pp. 313-328, 1996.
- Tuttle, Michele; Charpentier, Ronald; Brownfield, Michael (1999). *The Niger Delta Petroleum System: Niger Delta Province, Nigeria, Cameroon, and Equatorial Guinea, Africa*. United States Geologic Survey. United States Geologic Survey. Retrieved 6 March 2015.
- Evamy BD, Haremboure J, Kamerling P, Knaap WA, Molloy FA, Roelands PH (1978). Hydrocarbon Habitat of the Tertiary niger delta. *Am. Assoc. Pet. Geol. Bull.* 62:277-298.
- Chopra, S., and Marfurt, K.J. (2008). Seismic attributes for stratigraphy feature characterization. AAPG search and discovery article, GeoConvention, Canada.
- Anstey NA (1980). Seismic Exploration for sandstone reservoirs. *Int. Human Res. Dev. Corp*
- Huang, K.Y. and Fu, K.S. (1982). Decision – Theoretic Pattern Recognition for the Classification of Ricker Wavelets and the Detection of Bright Spots. Presented at the 52<sup>nd</sup> annual international SEG (Society of Exploration Geophysicists) meeting, October 20, 1982, Dallas
- Pochat, S., Castelltort, S., Van Den Driessche, J., Besnard, K. and Gumiaux, C. (2004). A simple method of determining sand/shale ratios from seismic analysis of growth faults: An example from upper oligocene to lower miocene Niger Delta deposits. *AAPG Bulletin*, 88(10), pp. 1357-1367. doi: 10.1306/04010403021.