3D SEISMIC INTERPRETATION OF THE PERE FIELD, OFFSHORE, NIGER DELTA, NIGERIA

By

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DEPARTMENT OF PHYSICS

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A THESIS SUBMITTED TO THE DEPARTMENT OF PHYSICS

FACULTY OF PHYSICAL SCIENCES, UNIVERSITY OF BENIN, BENIN CITY.

IN PARTIAL FULFLMENT OF THE REQUIREMENTS FOR THE AWARD OF A BACHELOR OF SCIENCE (B.Sc.) DEGREE IN APPLIED GEOPHYSICS.

September, 2023.

CERTIFICATION

This is to certify that this research work titled **"3D SEISMIC INTERPRETATION OF THE PERE FIELD, OFFSHORE, NIGER DELTA, NIGERIA"** was carried out and presented by OVIE-NYOREME OGHO of the Department of Physics, Faculty Of Physical Sciences, University Of Benin City, Edo State, Nigeria

____________________________ ____________________________

Mr J. Osaze Date

Supervisor

____________________________ ____________________________

Dr. O. D. Osahon Date

Head of Department

____________________________ ____________________________

(External supervisor) Date

DEDICATION

This project work is dedicated to God for his faithfulness, never ceasing mercy, protection, grace and throughout my studies and for the completion of this project. For my faith in God has kept me strong through all the ups and down. I also dedicate this work to my parents - Dcn and Mrs Ovie and my siblings - Eguonooghene, Oghenefejiro, kparobo, Joshua and Divine.

ACKNOWLEDGEMENT

My sincere gratitude goes to God almighty, who has kept me alive and healthy to sojourn in the University of Benin as well as to embark on this project. May he be praised both now and forever.

I express my profound gratitude to the University of Benin for giving me this great opportunity. I also wish to appreciate the head of department, physics Prof. O.D Osahon and my course adviser Dr John Airen.

It is important at this point to acknowledge the efforts of my project supervisor, Mr John Osaze for granting me the opportunity to have a firsthand experience on seismic data interpretation and giving me the foreknowledge needed for carrying out this research work.

I am deeply thankful to my parents Dcn Clement Ovie and Mrs Olivent Ovie for their efforts in bringing me up morally and academically. Also, I appreciate my siblings Eguonooghene, Oghenefejiro, kparobo, Joshua and Divine for their support and continuous admonitions throughout this journey. Without you all, I genuinely could not have accomplished this. You all are my world, therefore I want to thank you for the prayers and for everything that was done to make sure I was comfortable and successful. I ask God to abundantly bless each and every one of you for all that you have been and all that you are.

I specially appreciate Ighofovwe Ogheneochuko and my friends Dafe, Sophia, Emmanuel, Ejiro kokoricha, Simdi and Esther for the continuous support and encouragement. This journey won’t have been easy without you.

Finally, a big thank you to my course mates and the staffs and members of Department of physics, University of Benin.

ABSTRACT

Niger Delta Basin is one of the world's most active oil producing basins made up of structural features that, if poorly understood could prevent the best possible hydrocarbon production. In Order to develop the field, it is crucial to understand the complex structural links between the region's fault networks and stratigraphic stacking patterns. The only tools available for studying and interpreting geologic structural subsurface characteristics are 2D and 3D seismic data paired with drilling data. Utilizing the Petrel 2017 software, 3D seismic, well log and structural interpretation were done to evaluate the reservoirs potential for hydrocarbon production.

The study makes use of advanced seismic data collecting and processing techniques to build 3D subsurface models with a high level of detail. This research aims to locate probable hydrocarbon reservoirs, evaluate their geometry, estimate reservoir characteristics, and assess the total reservoir potential within the Niger Delta Basin by integrating geological and geophysical data.

Our research focuses on locating structural elements, stratigraphic variations, and fluid interactions inside the reservoirs. We develop thorough geological models using state-of-the-art software and visualization tools, allowing precise reservoir mapping and volumetric calculations.

The results of this project offer useful advice for the sustainable use of the area's hydrocarbon resources in addition to deepening our understanding of the geological complexity of the basin

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CHAPTER 1

INTRODUCTION

1.1 GENERAL INTRODUCTION

Natural resources buried underneath the subsurface of the earth requires the application of various geophysical methods to reveal the possibilities of hydrocarbon presence and other essential minerals at the subsurface of the earth and these methods have been of great importance to the oil and gas industries. Seismic method is useful in petroleum and natural gas exploration while magnetic and gravity methods are used for reconnaissance surveys to delineate areas of interest.

The purpose of oil and gas exploration is to define the scope of finds in field assessments and development also to locate and outline structural or stratigraphic traps suitable for economically viable accumulations. It has been noted overtime that structural traps play a significant role in hydrocarbon exploration. Majority of the shelf and structural closure have been found and exploited, making hydrocarbon development more challenging. Seismic and well log data as exploration tools helps to identify and delineate structural and stratigraphic features such as faults, anticlines, depositional environments, lithofacies and hydrocarbon reservoirs. They help to map the subsurface with high degree of accuracy and provide high resolution data.

In our research study, the goal is to carry out seismic structural interpretation and analysis of the Pere field, Niger Delta basin In order to identify the earth's structure with the seismic survey, data are acquired with either the reflection or refraction method which can be carried on land or sea. The seismic acquired data are interpreted

thereafter for clearer knowledge and image of the subsurface. The process of interpreting the seismic
data, which is a component of seismic surveying, involves determining information ab out the earth's subsurface as well as the data's geologic importance. Using all available data, including seismic section, check shot data and well log. It also entails building a geological model of the subsurface. The petrophysical properties and seismic sequences of the location is also analyzed. The goal of this study is to advance the knowledge of the underlying geology of the field with a focus on its geologic structural elements, as well as to add to earlier research on the subject.

1.2 STATEMENT OF RESEARCH PROBLEM

The statement of problem in seismic interpretation revolves around the challenges and uncertainty researcher's faces while analyzing seismic data and constructing accurate subsurface models. Seismic interpretation of data is often associated with different limitations and difficulties. These can lead to wrong predictions, poor performance and failures.

Poor knowledge and understanding of the structure and stratigraphy of the field surveyed leads to difficulty in the data acquisition process. The earths subsurface can contain intricate geological formations, such as faults, folds and salt domes which are challenging to image and interpret accurately. Without a proper understanding of the terrain of the study area, data acquisition may be difficult. In the case of mountainous terrain, locations where volcanic rock is predominant interpretation may be very challenging.

1.3 AIM AND OBJECTIVES OF STUDY

The aim of this study is to obtain structural geological data on the present day form of the subsurface of the Pere field, in the Niger Delta and portray it, as well as to investigate the processes that lead to the final form. The objectives of the study include to:

- determine the geological distribution and geometry of subsurface geological structures such as faults, folds and stratigraphic layers of the study area by carrying out extensive research on the geology, structure and geologic processes of the study area.
- locate potential hydrocarbon reservoirs, traps and prospects on the application of 3D seismic survey for structural analysis of the study area.
- identify valuable information about the formation and fluid content of the rock and estimating the petrophysical properties of the reservoir rocks.
- integrate well logs and interpretation of the faults on the seismic inlines and cross lines.
- Carry out seismic attribute analysis to enhance the seismic information leading to a better geophysical interpretation.

1.4 SCOPE OF STUDY

The scope of the 3D seismic structural interpretation is a critical aspect of petroleum geosciences and it involves the analysis and understanding of subsurface geological structures using 3D seismic data. This study involves many aspects of the full geoscience study. Nonetheless, it will typically achieve those objectives that fall within the purview of undergraduate education. It ranges from the seismic data acquisition and processing, data visualization, horizon picking, fault interpretation, structural mapping and integration of well log data. This interpretation involves processes that analyze seismic data to decipher the subsurface geological structures.

1.5 LOCATION OF STUDY AREA

The study area is located offshore of the Niger Delta basin, Nigeria (figure 1.1). The Niger Delta basin is a vast sedimentary basin located in West Africa, specifically in Nigeria and extending into some parts of neighboring countries.

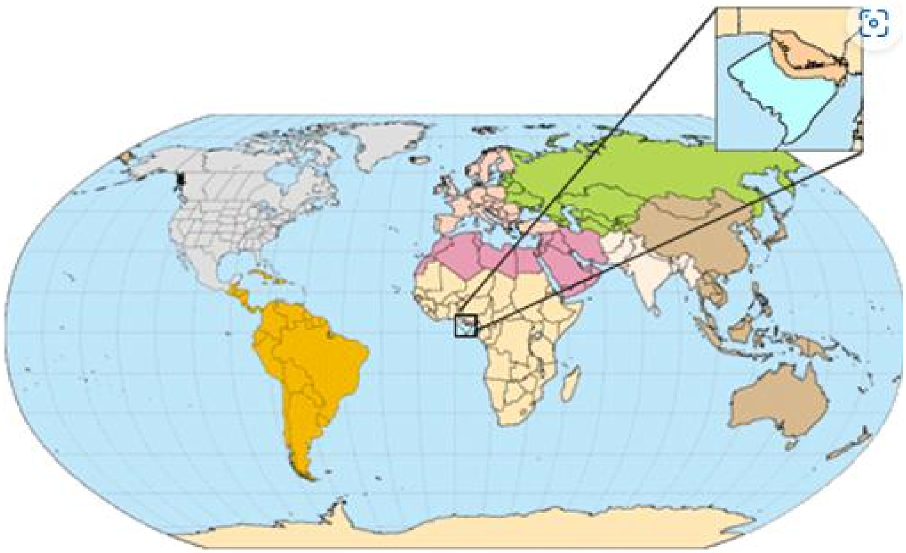


Figure1.1: Location of the Niger Delta basin on the world map (Tuttle et al, 1999).

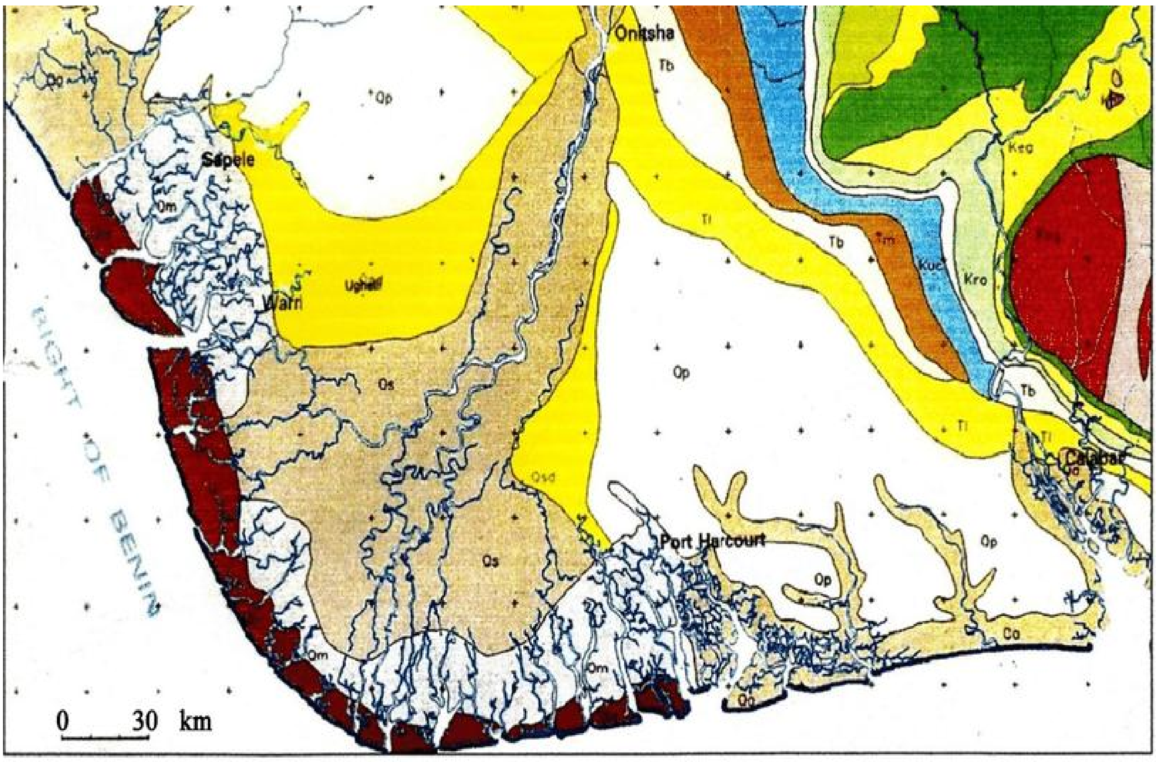
CHAPTER 2

LITERATURE REVIEW

2.1 GEOLOGY OF THE STUDY AREA

The Niger Delta basin is one of the most significant geographical features in Nigeria and is located in the southern part of the country. It is the largest delta in Africa and the third-largest in the world. The basin covers approximately 70,000 square kilometers and is formed by the Niger River as it flows into the Gulf of Guinea. The Niger Delta basin was formed during the Cenozoic era, approximately 66 million years ago, as a result of the accumulation of sediments carried by the River Niger and other smaller rivers into the Gulf of Guinea. These sediments were deposited in layers over time, creating the vast sedimentary basin.

The Niger Delta basin is characterized by a wide range of depositional environments, including fluvial (river), deltaic (river delta), estuarine, and marine settings. As the river flows into the sea, the sediment-laden water slows down, and the sediments settle, creating the deltaic environment. Over time, as more sediment accumulates, the delta progrades (extends) into the sea.



QUATERNARY		
Meander belt, Backswamps	Qa	Alluvium
Freshwater swamps	Qs	Sands, gravels and clays
Mangrove swamps	Qm	Sands, clays and mangrove swamps
Abandoned beach ridges	Qbr	Sands and pebbles
Sombreiro deltaic plain	Qsd	Sands, clays and mangrove swamps
Coastal plains sands	Qp	Sands and clays

TERTIARY		
Lignite formation	Ti	Clays, sandstone, lignite and shales
Bende Ameki group	Tb	Clays, clayey sand and shales
Imo clay-shale group	Tm	Clays and shales with limestone

Figure 2.1: Geologic map of the Niger Delta basin

2.2 PREVIOUS WORKS

Ologe et al (2013) did a study on the 3D seismic structural interpretation of a part of Aloo-field, southwestern Niger Delta, Nigeria. The aim of this investigation was to ascertain the subsurface structural characteristics and hydrocarbon reservoirs retentive capacity in the three horizons studied. The analysis of 3D seismic data was done using the petrel software. Structural maps where generated which revealed different structural styles present in the studied area which included growing fault trending W-E and dipping towards the east, anticlinal structures, rollover anticlines and crustal faults. They also confirmed the presence of hydrocarbon in two of the studied horizons. One horizon having a gas-water contact (GWC) and the other horizon having an oil-water contact (OWC).

Etuk et al. (2020) carried out a study on the evaluation of seismic attributes for reservoir characterization over Edi field, Niger delta, Nigeria. In this study, five faults were identified and mapped along with four horizons that were chosen along the in-lines and cross-lines. The findings indicated that the region is heavily faulted and also demonstrated where the Niger delta is located tectonically. Time structural maps and attribute maps were produced.

Satti et al. (2014) worked on an integrated seismic interpretation, offshore peninsular Malaysia. For this study, advanced seismic characteristics and seismic inversion was used to map out stratigraphic traps for his investigation, while 3D high resolution seismic data was used to understand formations that favour the deposit of hydrocarbon. The study demonstrated the significance of seismic interpretation in defining geological formation such as subterranean channels.

2.3 TECTONIC AND STRUCTURE OF THE NIGER DELTA BASIN

The Niger Delta basin exhibits a Deltaic shape with a network of distributaries, tidal channels and levees. Its structural and tectonic characteristics play a very crucial role in the accumulation and preservation of hydrocarbons. These basins such as the Benin, Agbada and anambra basins are separated by structural highs and fault systems, which influences the migration and trapping of hydrocarbons.

The Niger Delta basin is marked by growth faults resulting from differential compaction of sediments and tectonic movements. These faults create structural traps where hydrocarbons can accumulate beneath the sedimentary layers, thick deposits exists formed during the ancient west Africa Rift systems. Salt tectonics have influenced the basins structural evolution, giving rise to salt diapirs and other salt related structures which can also serve as hydrocarbon traps (Stauble et al 1967). The formation is influenced by a combination of subsidence and sediment accumulation. Subsidence occurs due to the loading of sediments as well as tectonic processes related to the opening of the Atlantic Ocean. The Niger Delta basin is highly prospective for hydrocarbon resources. The combination of sedimentary deposition, burial and tectonic processes has created favorable conditions for the formation and preservation of hydrocarbon reservoirs.

2.4 GEOPHYSICAL METHODS

Geophysical methods generally are applied to delineate the variation of the earth's physical properties from inferring on the physical parameter measured on the surface (Roy, 2008; Telford et al, 1990). The application of certain geophysical techniques reveals natural resources with presence of essential minerals buried underground and these methods have been of great relevance to oil and gas industries.

There are various geophysical methods used for survey with high resolution image of the subsurface geological features. The two main categories of geophysical approaches includes:

Natural methods: This involves the study and observation of naturally occurring phenomena that provide information about the subsurface without any human intervention. Some examples of natural geophysical techniques include:

- Magnetic
- Radiometric
- Gravity
- Electrical methods such as resistivity, electromagnetism and telluric method.

Artificial methods: These are methods where signals are deliberately generated or external sources are applied to study the subsurface. Some examples of artificial geophysical techniques include:

- seismic
- Ground penetrating radar.

2.4.1 THEORY OF SEISMIC REFLECTION METHOD

Seismic survey method is a geophysical technique involving generation of waves and recording of the time taken to travel into the ground and reflect back to the subsurface of the formation. The reflected waves is recorded and analyzed to create images and profiles of the subsurface structures and rock layers. The time taken is known as the two way travel time (TWT).

The objective of seismic exploration is to deduce information about the rock especially about the attitude of the beds, from the observed arrival time and from variation in amplitude, frequency and waveform. The survey method uses two techniques including:

- Reflection method
- Refraction method

The seismic reflection method is carried out in three phases; seismic data acquisition, seismic data processing and seismic data interpretation.

Seismic data acquisition refers to the operational principles of instruments used is obtaining information of the subsurface structures. The processing involves series of steps to convert raw seismic data collected from the field into interpretable subsurface images. The purpose of the seismic data processing is to enhance the quality, remove noise and interpret the raw data.

Seismic reflection surveying aims to make the earth's structure as clear as possible. The process of identifying information about the earth’s subsurface as well as the geological meaning of the seismic reflection data is known as seismic interpretation, which is a component of seismic surveying. The creation of a geological model of the subsurface until using all available data, including seismic section, check shot data and well log is another step in seismic interpretation

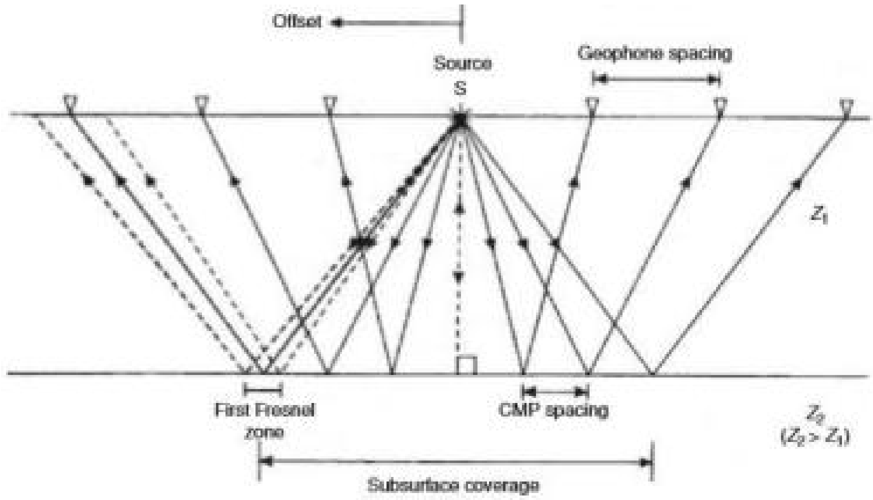


Figure 2.2(a): Diagram of reflection ray paths across a horizontal interface.

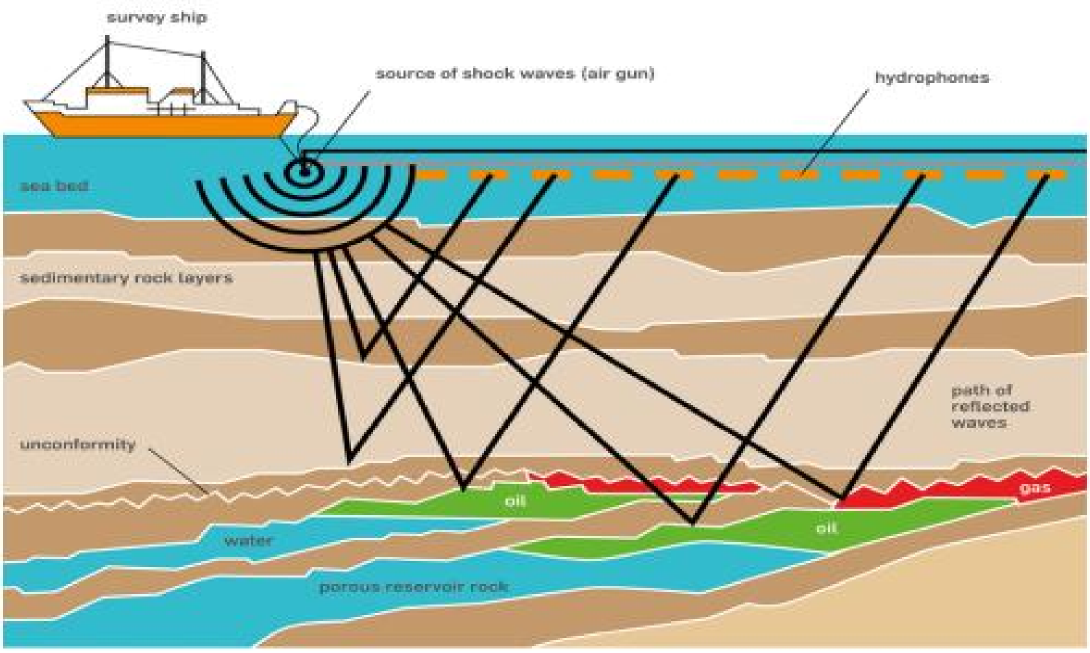


Figure 2.2(b): Seismic data acquisition.

WELL LOGS

Well log is a record of measurements obtained during the drilling of a borehole that provides vital information on the subsurface geology, rock formations and fluid contents. Well logs are utilized in a variety of sectors including geology, hydrogeology and petroleum exploration. The different logs include;

1.5.1 Gamma ray logs

The gamma ray log measures the natural gamma radiation emitted by rocks. It is useful for identifying different rock types and stratigraphy. The GR log can be recorded in already cased wells, which makes it useful for correlation purpose.

1.5.2 Resistivity log

The resistivity log measures the electrical resistivity of formations and helps to differentiate between different lithology's and assess fluid content.

1.5.3 Density log

This tool works by generating gamma radiation and measuring how much of it returns to the detectors on the tool. The amount of radiation returned is related to the electron density of the material blasted, which is proportional to the formations overall density.

1.5.4 Neutron log

This log measures the number of neutrons emitted by rocks .It provides insights into porosity and lithology.

CHAPTER 3

METHODOLOGY

3.1 INTRODUCTION

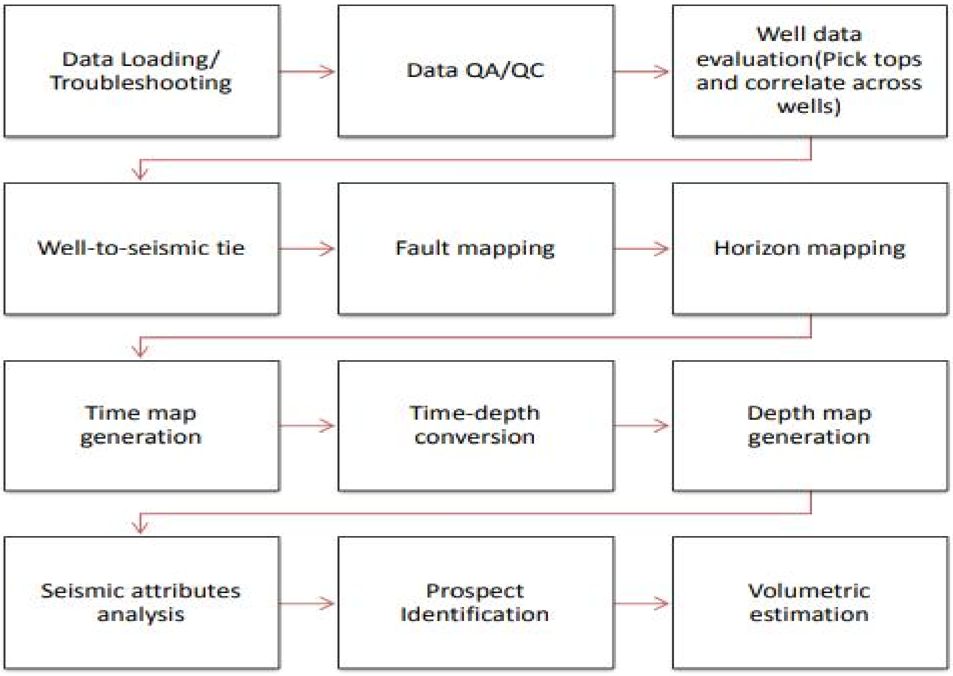
The PETREL workstation, a Schlumberger interpretation tool for visualizing seismic models and reservoir characterization, was used to conduct this investigation utilizing the most up-to-date seismic interpretation technology.

3.2 DATA AVAILABILITY

The data made available for this study includes;

- Post stacked 3D Seismic reflection data.
- The area has 2 wells which includes tuja 1 and tuja 2.
- Well logs were generated for the study. Other data sets made available base map, check-shot data and a geological map of the Niger Delta basin used in structural analysis.

3.3 WORKFLOW



3.4 DATA LOADING

The available data set was put into the petrel program to start this study. This was accomplished by:

- Importing the seismic data in SGY format first, after which the wells were loaded one at a time. The LAS File contained the well data.
- The directional data (ASC File) for the deviated wells were loaded.
- Checkshots data were then loaded for the various wells. The checkshots were in text document format.

3.4.1 DATA QUALITY CHECK

Data quality testing was done after data loading. The purpose of the data assessment was to determine the data's quality as well as the availability of specific data, including well logs. The interpreter gets a plan of attack from this step for the interpretation.

3.5 WELL LOG CORRELATION

LITHOLOGY IDENTIFICATION AND CORRELATION

Using the Gamma ray logs and Resistivity logs, reservoirs were found and correlated among the six wells, as shown in Figure 3.3. The Gamma ray log was used to identify the lithologies that the wells had penetrated. A basic line for shale was created. Shale (non-reservoir lithology) was interpreted as the deflection of the Gamma ray log signature to the right of the shale base line, while sand (reservoir lithology) was understood as the deflection to the left of the shale base line. Deflections on the resistivity log were classified as high resistivity (low conductivity) or low resistivity (low resistivity) depending on their direction. Reservoirs that contain hydrocarbons are characterized by high resistivity. Following the identification of the reservoirs, calculations of petrophysical parameters including porosity, water saturation, and hydrocarbon saturations were made. In order to help with the arrangement of the wells, a composite line was constructed over the base map.

Well Name/ Log type	Gamma	Resistivity	Neutron	Density
Tuja 1	x	x	X	x
TUja 2	X	x	X	x

O – Available

x – Not available

Table 1: Well logs summary in the study area.

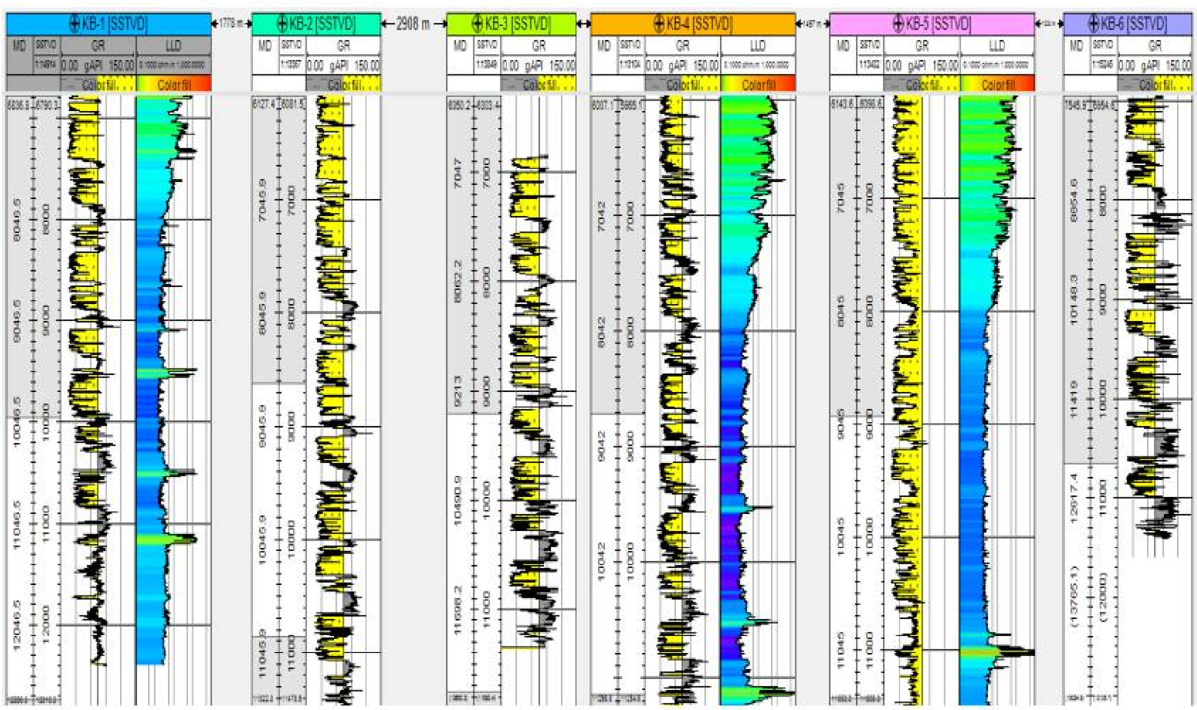


Figure 3.1: Diagram of the gamma ray and resistivity logs showing lithology encountered across the wells.

3.6 PETROPHYSICS

Petrophysis was used in this study to better understand the reservoir, how the pore spaces are connected and how these factors affect the movement and buildup of hydrocarbons. Lithology, porosity, water saturation, density and permeability of the rocks were examined. It is common practice to do these measurements using well logs.

1. **Shale Volume Estimation**

   The formula in equation (1), which employs numbers from the gamma ray (GR) in equation (2), was used to calculate the volume of the shale (Vsh).

   $V_{sh} = 0.083^{(2(3.7\times 1GR)}-1.0$

   $1GR = \frac{GR_{LOG} - GR_{MIN}}{GR_{MAX} - GR_{MIN}}$

2. **Porosity Determination**

   The proportion of voids to the total volume of rocks is known as porosity. Equation (3) was used to calculate this parameter by substituting the bulk density data from each reservoir's formation density log.

   $$\Phi_b = \frac{\rho_{ma} - \rho_b}{\rho_{ma} - \rho_f} - Vsh\frac{\rho_{ma} - \rho_b}{\rho_{ma} - \rho_f}$$

3. **Water Saturation Calculation**

   Using the porosity and resistivity logs from the clear water zone, it was possible to calculate the water saturation Sw, of the uninvaded zone using the water resistivity, Rw value at formation temperature.

   $$Rw = \frac{\Phi^m - R_o}{a}$$

Where R_o and Φ are the deep resistivity and total porosity values in the water zone respectively. Tortuosity factor is represented as "a" and m is the cementation factor usually 2 for sands.

Water saturation is calculated using the Archie's method given by:

$$Sw = \left(\frac{R_w}{R_{wa}}\right)^{\frac{1}{n}}$$

4. **Hydrocarbon Saturation Calculation**

   The proportion of pore volume of a deposit that is filled with hydrocarbons is known as hydrocarbon saturation, or Sh. By deducting the water saturation value from 100%, it was calculated.

   S_h= (100 – Sw) %

5. **Permeability Calculation**

   The ability of a rock to convey fluids is known as permeability, or K. Equation (7) served as the calculation tool.

$$K= \sqrt{\frac{250 \ x \ \Phi^2}{S_{wirr}}}$$

3.7 FAULT INTERPRETATION

A fault is a discontinuity in a mass of rock when there has been substantial displacement as a result of movements of the rock-mass. Plate tectonic forces are the cause of large faults in the crust of the Earth. The mapping out of fault networks on the seismic data was crucial for our study. Before being traced out on the cross-lines, faults were mapped along the in-lines. Along the in-lines, the faults were mapped with a 25 m line spacing. The following seismic behaviors, which are signs of faults

(Figure 3.9), were used to locate faults on the seismic sections:

1. Abrupt terminal of reflection events.
2. Abrupt change in dip along continuous reflections.
3. Obvious displacement along fault plane lines on the seismic section.
4. Breaks in reflection events.
5. Pattern change of reflection events across a fault.
6. Structural deformation in beds above the zone of faulting.

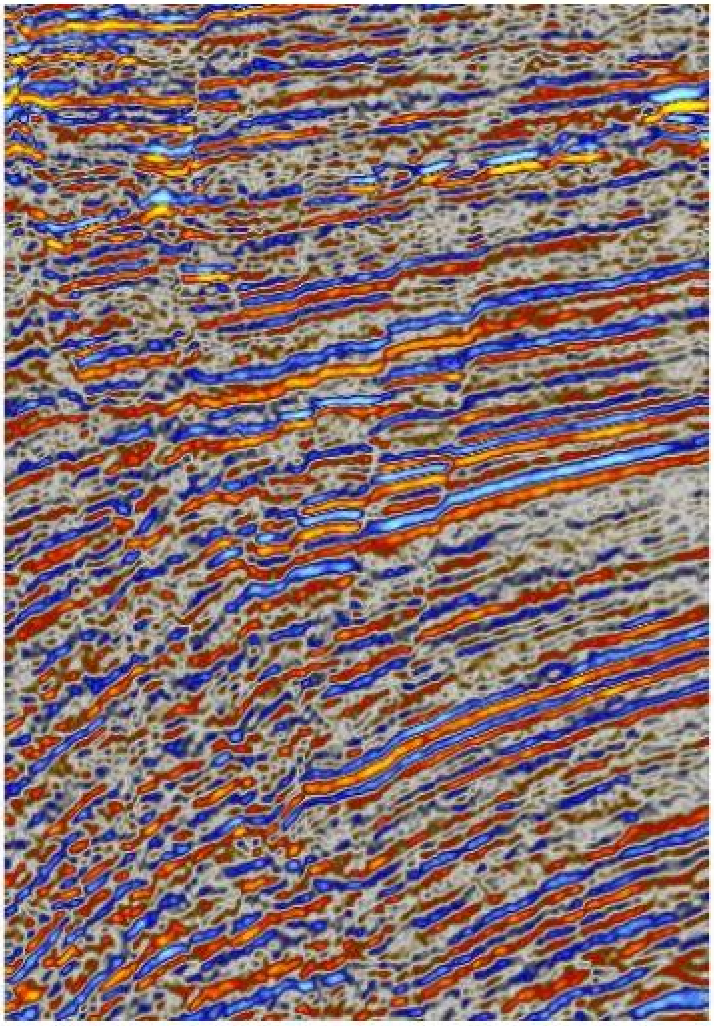


Figure 3.2: Seismic In-line data (inline 5800) showing discontinuities in amplitude signal.

PROSPECT IDENTIFICATION

Locating areas of reducing contour values and selecting the configuration—four-way closure, fault assisted, or fault dependent—can be used to identify hydrocarbon. Seismic features can be used to support prospect identification.

VOLUMETRIC ESTIMATIONS

The maps and the specific reservoir's petrophysical data must be used to compute the volume of the reservoir in order to do the volumetric estimation. To determine the original oil in place (OOIP), original gas in place (OGIP), and stock tank oil initially in place (STOIIP), volumetric estimation was done.

STOIIP = GRV * NTG * Porosity * (1-Sw)/FVF

CHAPTER 4

RESULTS AND DISCUSSION

4.1 INTRODUCTION

This chapter presents and discusses the reservoirs found in the different wells along with their geological and geophysical properties. The field geological and geophysical characteristics including numerous maps and models are provided. This chapter presents all the maps, test them, identifies the prospects and estimates the reservoir volumes.

4.2 WELL CORRELATION AND EVALUATION

4.2.1 WELL CORRELATION

A lithostratigraphic correlation was performed across the wells by mapping the top and base of each reservoir units as seen in Figure 4.1(a). Two reservoir units were correlated sand A and B.

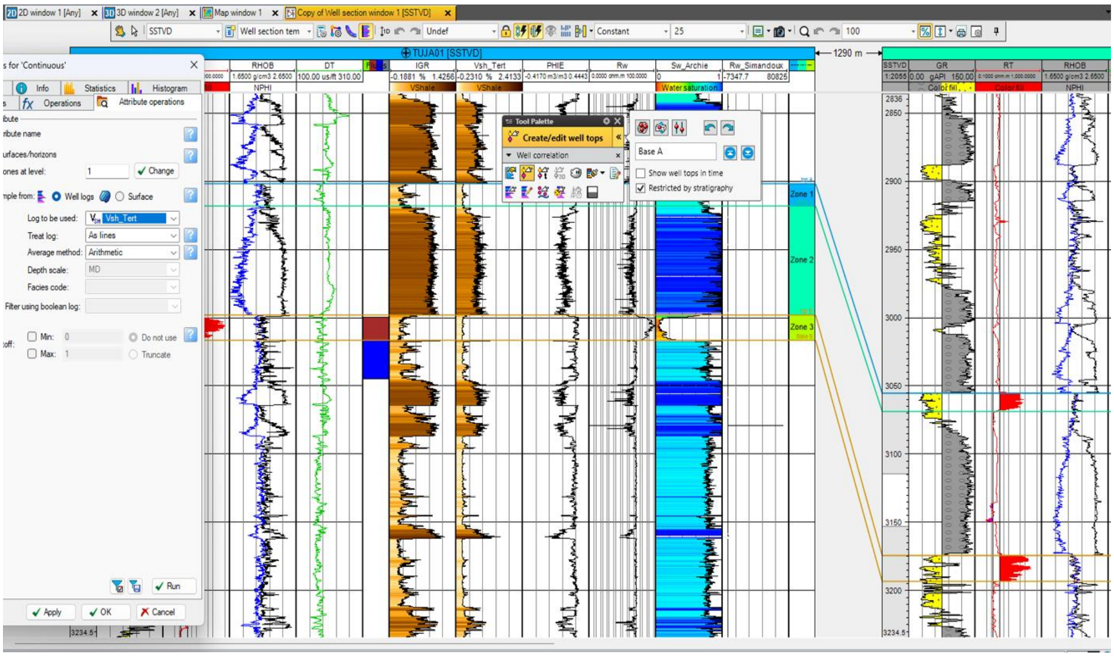


Figure 4.1(a): Lithostratigraphic correlation across logs.

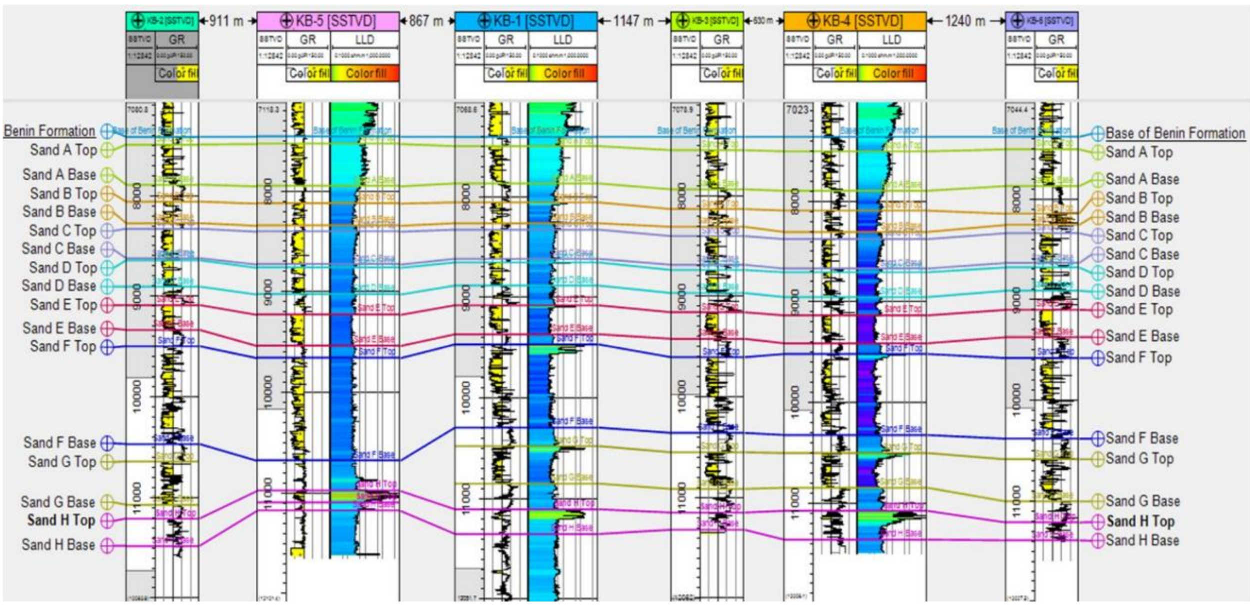


Figure 4.1(c): Lithostratigraphic correlation across all wells showing the top and base of the reservoirs correlated.

4.3 FAULT INTERPRETATION

Faults were plotted on each of the seismic sections. They were acquired in a direction that is perpendicular to the regional fault trend hence, the faults were more visible on the inline. The uninterpreted seismic section is depicted and the interpretation faults are depicted in Figure 4.2(a), 4.2(b), 4.2(c), and 4.2(d). Seismic data were analyzed to reveal 10 faults designated as F1, F2, F3, F4, F5, F6, F7,F8, F9 and F10 (Table 4). The principal regional growth faults F1 and F4 are two large faults that span the entire field. They are believed to represent the principal regional faults separating the coastal swamp depo-belts from the offshore and central swamp depo-belts. (Doust and Omatsola, 1990). Synthetic and antithetic faults were also interpreted from the seismic section.

FAULTS	DIRECTION OF DIP	INLINE COVERED	FAULT TYPE
F1	south	5800-6200	Regional growth fault
F2	south	5800-5896	Synthetic fault
F3	North	5800-5944	Antithetic fault
F4	south	5800-6200	Regional growth fault
F5	North	5800-5960	Antithetic fault
F6	south	6020-6200	Synthetic fault
F7	south	5800-5820	Synthetic fault
F8	North	6160-6200	Antithetic fault
F9	south	5800-5820	Synthetic fault

F10	North	5800-5860	Antithetic fault

Table 2: Faults interpreted showing fault type, dip direction and extent across field

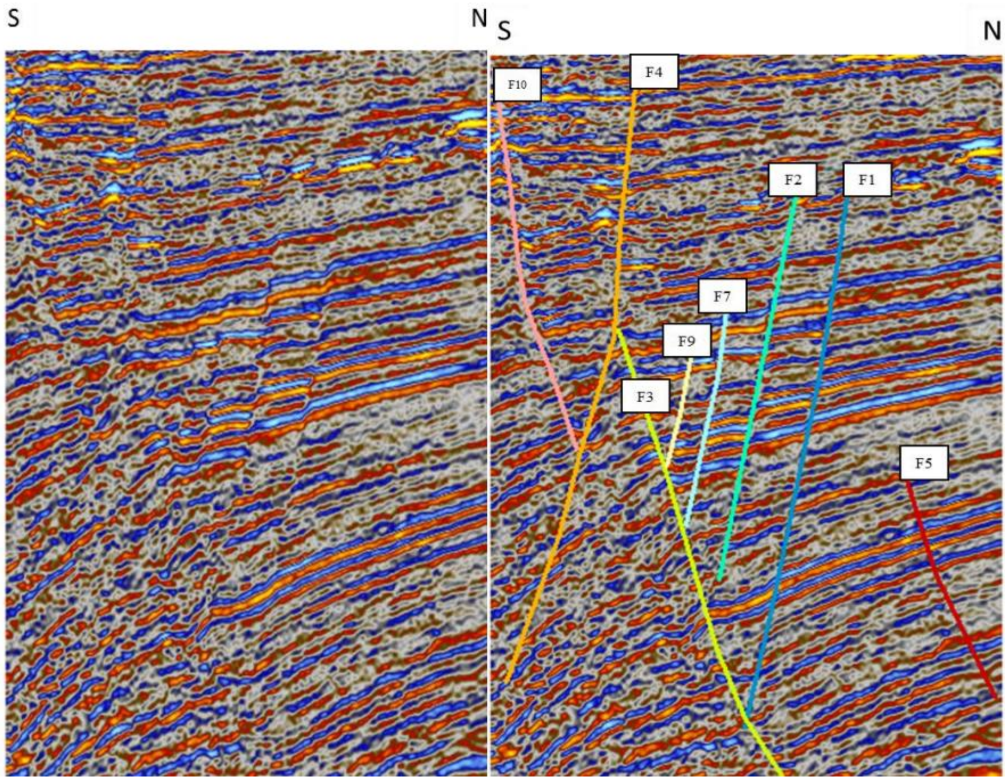


Figure 4.3(a) Interpreted Seismic section (Inline 5800) showing the faults interpreted.

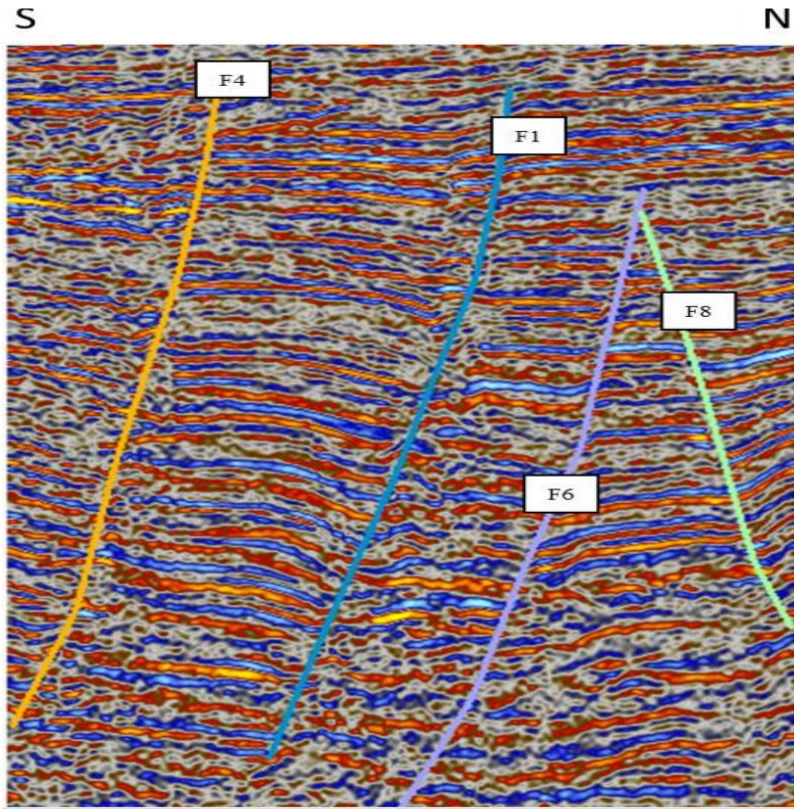


Figure 4.3(b): Interpreted Seismic section (Inline 6200) showing the faults interpreted.

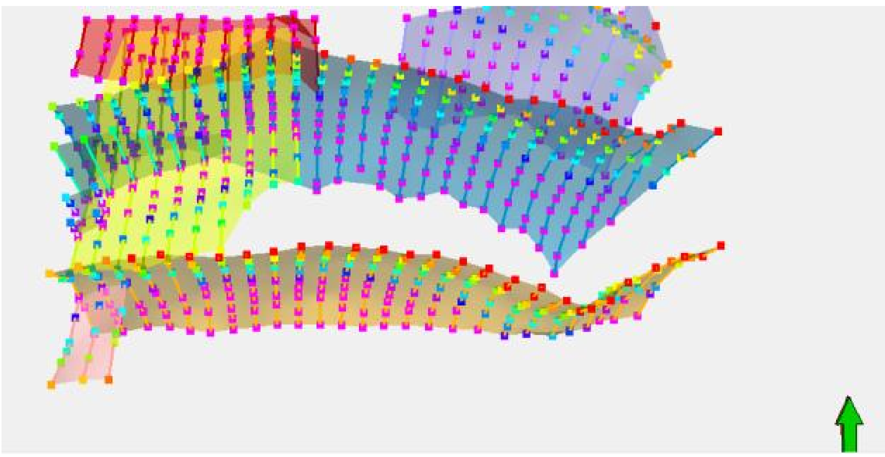


Figure 4.3(c): Interpreted fault sticks in 3D view.

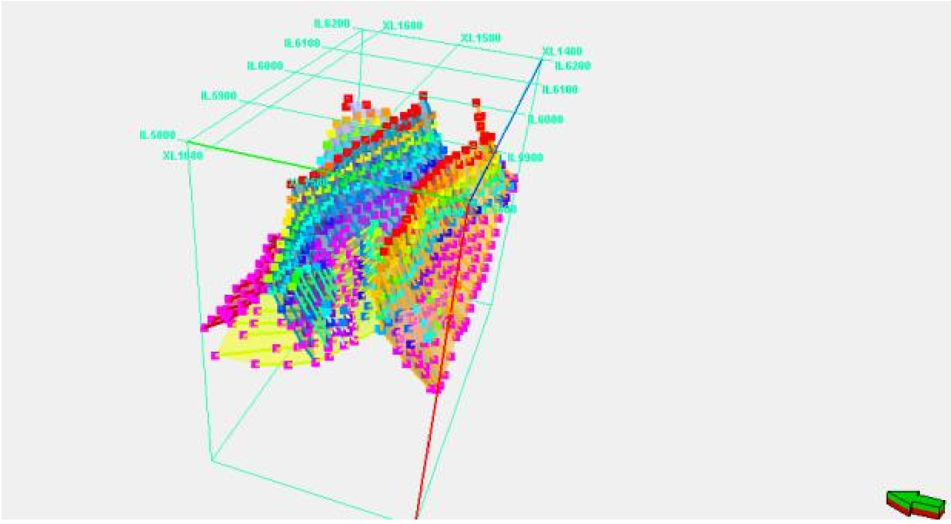


Figure 4.3(d): Interpreted fault sticks in 3D view showing their positions in the survey area.

CHAPTER 5

CONCLUSION AND RECOMMENDATIONS

3D seismic interpretation was carried out on the Pere field data and well logs were used to analyze the seismic data. Eight sand bodies (sand A, B, C, D, E, F, G and H) were interpreted using the gamma ray logs and resistivity logs from six wells used in this investigation. The sand bodies B, C, D and F exhibit it an aggradational stacking pattern that suggests a channel fill and a blocky gamma ray design. Sand A, E, G and H have funnel shaped successions that are caused by coarsening of shallow sediments with increased deposition energy, which has been interpreted as a prograding marine shelf environment.

Seismic inlines were used to interpret ten faults designated as F1, F2, F3, F4, F5, F6, F7, F8, F9, and F10. Growth faults (F1 and F4) synthetic faults (F2, F6, F7 and F9) and antithetic faults (F3, F5, F8 AND F10) are all considered to be normal defects. Neither thrust nor strike-slip faults exists in this study case. The north dipping antithetic fault F3, which is to be blame for trapping hydrocarbons in wells KB-1, KB-3, KB4, and KB-6, is a critical fault.

These five horizons H1, H2, H3, H4 and H5 were chosen for mapping. The field's hydrocarbon zones were located using horizons. The structural maps showed that the hydrocarbon accumulation is connected to anticlines, faults-assisted closures and fault-dependent closures. The seismic attribute maps that were analyzed validated the tested locations from all sands. The seismic characteristics maps only supported prospects in sand A, G and H.

The Niger Delta reservoir sands exhibit petrophysical values for porosity, Net to gross, water saturation, and hydrocarbon saturation that are nearly ideal, with an average por osity value of 0.24, a water saturation value of 0.52, and an average Net to Gross valu e of 0.6.

The reservoir sand has a higher hydrocarbon saturation level the lower the water satur ation level.According to the volumetric estimates, Sand F has the smallest hydrocarbo n zone while Sand G has the largest hydrocarbon zone.

5.2 RECOMMENDATIONS

I recommend that the seismic data is properly preprocessed which includes noise reduction, static correction, static correction and data regularization. I also recommend that reservoir engineers should be collaborated with to integrate geological and geophysical data reservoir models. This ensures that reservoir simulation models accurately represent the subsurface.

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