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(Research Article)

The use of innovative method of p-s wave seismic reflection technology in hydrocarbons exploration

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Abstract

This study endeavor aims to provide a very detailed explanation of seismic reflection survey-based hydrocarbon exploration. The purpose of the research is to determine why some oil industry wells still remain dry after being drilled. Emphasis was placed on the potential application of innovative methods with the goal of developing a novel response to this trend. A more in-depth examination of the arguments for using seismic technology based on (p-s) waves rather than p-wave alone for hydrocarbon exploration is stressed in order to fully understand this approach. This clears the way for dealing with seismic abnormalities and pitfalls that could be contributing to the need to drill dry wells. According to drilling suggestions, the P-S wave was used in this study to achieve a spectacular result. The precise location of the gas-trapped in sandstone deposit is at coordinates (5250m, 2200–2400m). This indicates that there is a 200-meter-wide gas-promising zone here as well, so in order to recover the formation gas, drillers must proceed to a depth of 5250 meters starting between 2200 and 2400 meters below the profile's surface, ideally at 2300 meters. The precise location of the limestone's trapped gas formation is at coordinates (8750m, 600--900m). This indicates that the prospective zone for gas deposits is extended out by roughly 300m. Therefore, drilling must be done ideally at 750m on the surface and sidetrack about 150m both left and right to a depth of around 8750m (8.75km), in order to retrieve the reserve gas or trapped gas. Thess findings are crucial for a hydrocarbons exploration to be successful and reduce the likelihood of digging dry wells in the oil industry.

Keywords: Hydrocarbon; Exploration; P- wave; P-S Wave; Seismic reflection

1. Introduction

A seismic survey is one of the geophysical techniques that uses Snell's law and the law of reflection to measure earth properties. According to [1], seismic reflection is one of the most dynamic and widely used geophysical techniques for hydrocarbon exploration. It uses seismology principles to help petroleum geologists and geophysicists find oil and gas deposits that are hundreds of meters beneath the Earth's surface. Petroleum geology is the branch of science that studies the exploration of oil and gas. Seismic surveys measure the Earth's geological characteristics using a variety of physics concepts, including electric, gravitational, thermal, and elastic theories, among others. A corporation called Seismic used it to great effect for the first time in Texas and Mexico in 1923. Seismology has since been employed by numerous oil firms to predict the presence of probable hydrocarbons. The seismic technology has been extensively investigated by major oil firms and has been used in several other studies by experts throughout the world. The technique calls for creating a controlled source of energy that can send seismic waves into the earth. A highly sensitive receiver that can detect seismic waves being reflected from the earth is then used to record the earth's response. The depth of the formation can optionally be determined using the time delay between sending and receiving signals; as a result, the time delay is dependent on the reflector. Since the densities of different formation layers vary, so do the speeds at which they reflect back seismic waves. This feature can be utilized to determine the target formation's depth. Shale and other

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rock formations that can serve as reservoir or cap rocks often make up the target formation. Seismic surveys form a part of the preliminary exploration surveys and form the basis for further study of the area under consideration [2].

1.1. Location and Geology of Study

Atala Oil Field, currently known as Bayelsa Oil Company, with a total area of 34 km and OML 46, was the site of this research project. It is located in the south-western part of the Bayelsa State. The possibility was found in 1982 by the Shell oil company, and a well was sunk there to a depth of 4,058 meters (4.1 kilometers). After finding hydrocarbons, the well was cased with potential reserves having a 10% probability of production (P10). On this field, 3-D seismic operations were conducted in 2012, 2015, and 2018 in correlation with electromagnetism and electrical geophysics. Due to processing limitations, only about 12.5km of the targeted depth, which was intended to be studied to a depth of around 60km, was actually investigated. Bayelsa State's location is defined by its latitudes, which are 4 A 15 north, 5 A 22 west, and 6 A 45 east. The state is bordered on the north by Delta State, on the east by River State, and on the west and south by the Atlantic Ocean.

The lower delta plain, which is where Bayelsa State is geologically situated, is thought to have been created during the Holocene of the quaternary period by the buildup of hydrocarbon-rich sedimentary formations. Sedimentary alluvium is the state's main geological feature. Due to the abundance of river Niger tributaries in this plain and the abundance of abandoned beach ridges throughout the state, significant geological changes are still evident everywhere. Generally speaking, Bayelsa State has a low relief with coastal beaches, tidal flats, beach ridge barriers, and flood plains. the state's predominant relief features, including cliffs, lagoons, and other natural features. The Niger Delta's upper and lower delta plains are adjacent to the state, which suggests a low-lying relief. The wide plain has a little incline. Downstream, there is a drop in elevation or height. Consequently, there are various streams with United States that vary in volume and speed. Rivers Nun, Ekoli, Brass, Koluama, and others are among them.

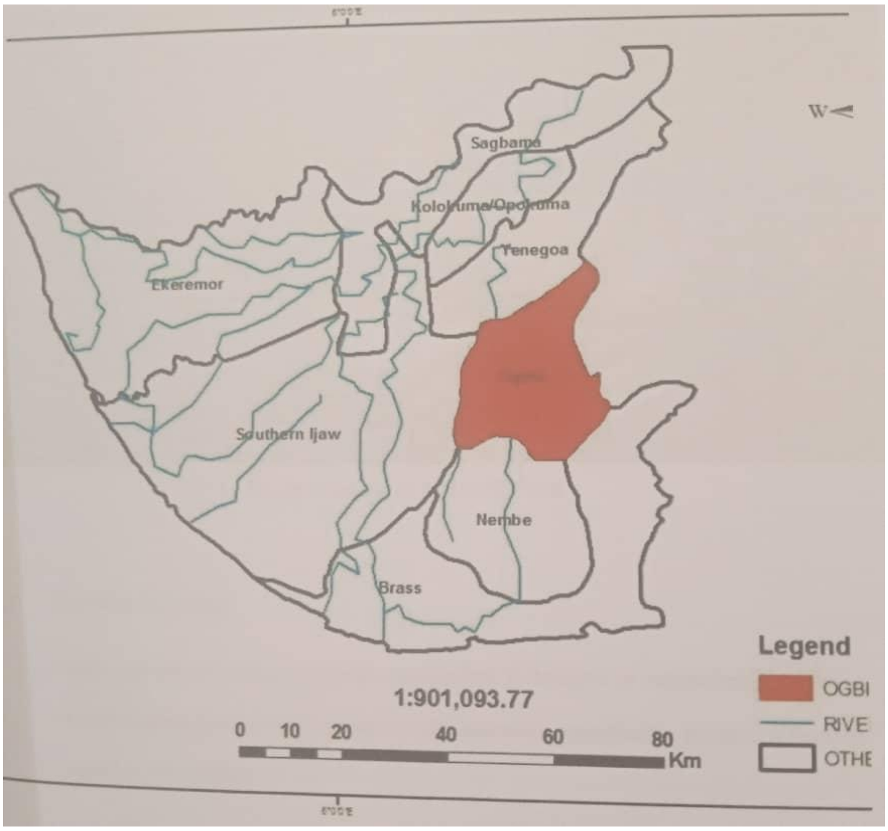

Figure 1 Map of Bayelsa State showing the study location

1.2. Problem Statement

Since the development of seismic survey, particularly the seismic reflection method for imaging the subsurface structure of the earth by seismo in 1924, this has helped to rationalize the level of output of hydrocarbons in the oil industries.

Investigations, however, have shown that there are still some cases of drilling dry wells by oil prospecting companies, which increased the risk of exploration [3]. This pattern has prompted a number of inquiries, like: Why is a dry well being drilled? Is the drywell drilling being done because there aren't enough people with the necessary training to carry out proper data acquisition, processing, and interpretation (API) to improve effective geophysical activities? Is there a dearth of advanced geophysical techniques equipment to manage the many tasks related to seismic survey operations in the oil industries? Little or insufficient research has been done on these concerns, especially since they led to seismic pit falls that have an impact on the oil industry. Most oil industries have seen risk implications as a result, casting doubt on the success of the techniques employed and pointing to the need for a shift in strategy for this activity to produce sustained productive wells. This research work is limited to seismic reflection survey method for exploration of hydrocarbons by hydrocarbon industries deploying the approach of (p-s) waves using Atala oil field in Bayelsa state as case study.

In order to promote a solution to the problem of drilling dry wells, the goal of this study is to investigate seismic reflection techniques in hydrocarbon exploration

n. The specific goals of this study are to: (1) Examine geological reports of the Atala oil field and their relationship to dry well drilling. (2) To evaluate the various geophysical methods applied by the oil industry in its exploratory activities. (3) To assess the production of productivity at Bayelsa State's Atala Oil Company. Operators in the oil business in general and Atala oil company in particular will benefit from this study. The research will help advance understanding of the P-S wave technology's thereby optimizing oil industry productivity output. The research outcome will be used by oil firms as a quick research case study.

1.3. Theoretical framework

Disturbances that travel through a medium are called seismic waves. When these waves enter a medium, the particles inside that medium are moved around and elastically distorted to allow the waves to flow through. Seismic waves come in two different varieties: surface waves and body waves. 2005's Downton

Body Waves are waves or energies that move through the medium's physical structure. As the distance from the source grows, they gradually transition from spherical waves to plane waves as a result of the wave front's lessened curvature. There are two types of body waves: longitudinal waves and transverse waves. Waves that travel through a medium in a series of rarefactions (dilatations) and compressions are known as longitudinal or compression waves. The vibrations along the y and z directions, which are parallel to the wave front and transverse to the direction of propagation in the x-direction, are referred to as transverse or shear waves. The vertical and horizontal components, which are orthogonal, can be used to resolve the general shear wave motion inside the wave front's plane. By the equation [4] for the vertical component in the z-direction.

$$\frac{\partial 2w}{\partial t2} = \boldsymbol{\beta}^2 \frac{\partial 2w}{\partial x2} \quad (1)$$

describes the shear wave with particles displaced in the z-direction. This wave is thought to have vertical polarization. With particles moved in the y-direction, the horizontal component on the y-axis is equivalent to the equation above. The resulting wave, which has a horizontal polarization, is known as an SH-wave. The equation yields the shear wave in the x-direction [5].

$$\frac{\partial 2\psi}{\partial t2} = \boldsymbol{\beta}^2 \frac{\partial 2\psi}{\partial x2} \quad (2)$$

where ψ is the rotational vector and $\boldsymbol{\beta} = \frac{\sqrt{\mu}}{\rho}$ (3)

Since longitudinal waves travel the fastest, they are the first seismic waves to reach a seismometer after an earthquake. The primary waves (P-waves) are the initial arrivals. Due to their compressibility, P-waves can pass through solid, liquid, and gas. On the other hand, transverse waves arrive at recording stations later since they travel at a considerably slower speed. Secondary waves (S-waves) are what these waves are known as. They can pass through solids but not through liquids or gases.

Seismic exploration surveys use concepts of reflection seismology to estimate the subsurface properties from generated controlled seismic energy into the earth, as was previously stated explicitly in the introduction.

Because of this, seismic exploration in the oil and gas industry uses seismic reflection to estimate the features of the earth's subsurface, particularly the location of pockets of lower density material. A seismic wave experiences seismic resistance as it passes through layers of different rocks under the impact of pressure. Because the molecules in rocks are elastically connected to one another, extra pressure causes a wave to propagate through the solid. As a result, the time of seismic waves' reflection arrivals is what makes a seismic reflection survey important, because the densities of different formation layers vary. They reflect seismic waves back at various speeds. Shale (i.e., source rock) and reservoir rock are examples of target formations that often have lower densities and can be estimated using this aspect. Preliminary exploration surveys consist of seismic exploration surveys, which serve as the foundation for additional research into the area in question [6]. The wave's direction of travel and the resulting impedance are represented as

$$Z = \rho * V \qquad (4)$$

Where ρ is the density of the material and V=is the acoustic velocity [7]

1.4. Seismic Velocity

Velocity is crucial in the understanding of data. When determining the depth and dip of reflectors and refractors as well as the overall assessment of the nature of the rocks and interstitial fluids in the subsurface, knowledge of seismic velocity data is absolutely essential. Velocity can be determined by field measurements, well logs, or laboratory samples [8]. Various types of velocity exist, according to [9]. These include the following: the normal move out velocity, the stack velocity, the root mean square velocity, the average velocity, the interval velocity, the instantaneous velocity, and the apparent velocity.

The time taken divided by the distance traveled is how average velocity is calculated. A given ray path's root mean square velocity is the speed at which it moves through the layers. On the other hand, interval velocity is the average speed over a certain segment of the travel path. The sole difference between stacking velocity and NMO velocity is the spread length. While NMO velocity is based on the tiny spread hyperbolic trip time, stack velocity is essentially a parameter that generates the best fits data over the entire spread length, producing the perfect hyperbola. velocity It approximates Vrms and is used to adjust the quasi-hyperbolic primary reflection event to temporal alignment with zero offset [10] Instantaneous velocity is the velocity with which a wave front passes through a point measured in the direction of travel. Apparent velocity refers to the apparent speed of a given phase in a particular direction usually, spread direction on the surface.

1.5. Seismic Velocity Analysis

Because the seismic velocity associated with each layer strata provides information about the layer strata itself, seismic velocity is the most crucial component in the acquisition, processing, and interpretation stages of seismic data. Furthermore, it will be unable to perform CMP stacking, migration, time-depth conversion, NMO, DMO, and Static corrections without knowing the seismic velocity. It is really quick because of this. As a result, the goal of velocity analysis is to identify the seismic velocity of subsurface layers so that geophysicists and geologists can establish the position and dip of rock formations and their fluid-property characteristics [11]

2. Literature review

This study uses the Poisson ratio approach from (P-S) waves data to predict the location of hydrocarbons, which is a thorough analysis of the overall impact of

P-wave and (P-S) waves technology of seismic reflection method of geophysical surveying for hydrocarbon exploration in Atala Oil field [12]. The major case study for this research is the Atala oil field, also known as Bayelsa Oil Company, which is situated in the south-west of the state of Bayelsa and has a total area of 34 km2 with Oml 46. Shell made the discovery of this field in 1982 after drilling a well to a total depth of 4,058 meters, where Stocked Hydrocarbon was found.

In this field, a 4-D seismic reflection survey was performed in 2012, 2015, and 2018 to a maximum depth of 12.5 km. Hydrocarbon was discovered in 5 defined layers, including the till layer, mud stone layer, sand stone layer, lime stone layer, and dolomite layer. It was supported by electrical resistivity and electromagnetic geophysical methods. The primary objective of this work is to verify the accuracy of the oil field report using the Poisson ratio application from (P-S) waves data, which is regarded to be more trustworthy than using only P-wave data [13].

As part of this research, six (6) reflection activities that were carried out at various periods, in various places, and for varied purposes were reviewed. The cases analyzed in this article were chosen after careful consideration. This will make contrasting the various approaches to data processing and interpretation, which mostly used p wave technology to examine seismic properties or (DHI) to picture geologic structures, simpler.

The following cases are among those examined in this study: (1) COCORP'S deep seismic reflection profiling in the Williston; (2) Reflection seismic and ground-penetrating radar for Study of previously mined (lead/zinc) ground, Joplin, Missouri [14], (3) Seismic reflection investigation of C-l to E-l sector of the Superconducting Super Collider (SSC) ring west of Wa and (6) Emi field, offshore Niger Delta, Nigeria, structural and stratigraphic mapping [1]. For want of time and space only two cases are documented below

Case 1: COCORP'S Deep Seismic Reflection Profiling in the Williston Basin (Comparison of Explosive and Vibroseis Source Energy Penetration)

A combination of explosive/vibroseis experiment was planned for the Williston basin in North Dakota and Montana for the fall of 1990. However, due to permit and responsibility concerns, the dynamite experiment was not carried out. The trial using vibroseis proved successful. A significant finding from the vibroseis experiment was the apparent lateral truncation of prominent mono reflectivity close to the Trans-Hudson Orogen's western boundary, which interpreters hypothesized might be related to phase changes involved in the development of the orogen by Nelson et al. (1993).

Using the 1990 survey as a basis, COCORP (Consortium for Continental Reflection Profiling), with assistance from LITHOPROBE, went back to North Dakota and Montana to gather a new set of explosive/vibroseis data.

The objective of the new survey was to confirm the extent of prominent mono reflections as specified by the earlier survey, collect a north-south profile providing 3D control on Trans-Hudson structure, and re-image key portions of the 1990 vibroseis profiles with explosive sources [16]. Testing the viability of deploying an explosive source in low-fold mode for deep reflection profiling was another goal of the survey. The comparison between the 1990 vibroseis survey and the 1992 explosive survey in terms of effective imaging of deep structures is the survey objective that is of most importance to this review [17]. The 1992 study collected three sets of explosive data in the Williston basin: MT12, ND2 and ND3, each with a distinct goal. MT12 was created to test moho-reflectivity, ND2 was gathered to confirm the along-strike correlation of primary crustal fabrics as suggested by comparing the COCORP's data with later LITHOPROBE surveys in the Saskatchewan to the north [18] and ND3 was acquired to further image the bounding superior craton east of the Trans-Hudson Orogen. For the MT12, ND2, and ND3 surveys, 129 shots were taken in total, 97 of which were used to examine shot-to-shot variability. Vibroseis data were collected with a high fold of 30, whereas explosive data were collected with a low fold of 6.

Multiple DFS V systems, each with a 120-channel recording system, were employed for the 1992 explosive survey. The spacing between explosive sources was set at a notional 3 kilometers. Explosive rounds ranged in weight (from 9.5 to 90 kg) and were fired from depths of 22 to 38 meters (140 to 180

feet). This resulted from the placement of shots in various medium (clay, sand, shale, and sand stone). Multiple DFS V systems were utilized in line to generate a 24–30km spread for the MT12 survey, which was taken from west to east. As detectors, nine (9) L21A(10Hz) geophones were employed. Amoco's 600+ channel telemetric recording equipment with radio-linked seismic group recorders deployed in a roll-along configuration was employed during the vibroseis survey in 1990. The source was made up of eight (8) Mertz vibrators that formed a 40-meter-long in-line linear array and had a peak force P-wave of 52,000 Ib (23, OOON). The source array was swept one pad length at a time, with 200 m-apart vibration spots. Each station had twelve (12) SM-7 (lOHz) geophones working as detectors. For the ND2 and ND3 production shots, 45 kg of explosive was placed in two shot holes that were 85 meters apart [19]. From the review it was deduced that Seismic amplitude normalization, also known as DHI, was employed for the effective imaging of the deep structure between the seismic surveys conducted in 1990 using p-waves from vibroseis and 1992 using p-waves from dynamite, according to the case's aims and objectives.

Case 6: Structural and stratigraphic mapping of Emi field, offshore Niger Delta, Nigeria.

Emi field spans an area of 58.24 km2 and is situated in the offshore de-pobelt (temporally and genetically connected families of expansion fault trends or macro-structures) of the Niger Delta. The Cenozoic-aged Niger Delta basin is located in equatorial West Africa on the continental border of the Gulf of Guinea. The Cretaceous Abakaliki anticline, which continues to the southeast as the Afikpo syncline and Calabar flank, marks the northern border of the delta. The Benue hinge line, which is physically defined, is to the northeast of the Niger Delta, and the sediments of the Okitipupa ridge form the delta's western border [19]. According to [20], the Niger Delta classic wedge, which covers an area of about 75,000 km2 in southern Nigeria and the Gulf of Guinea offshore Nigeria, is home to the 12th largest concentration of hydrocarbon reserves in the world. It has estimated reserves of 34 billion barrels of oil and 93 trillion cubic feet of gas. Three major lithostratigraphic units make up the Niger Delta deposits: the Oligocene-recent fluvial facies of the Benin formation, the Eocene-recent paralic facies of the Agbada region, and the basal palocene to recent pro-delta facies of the Akata region [21] The goal of the current work under review was to identify the subsurface geometry, geology, and hydrocarbon potential of the Emi field, off-shore Niger Delta, by fusing 3D seismic reflection data with the well logs that were at hand. To address the shortcomings of well logs in the definition of lateral variation of subsurface parameters, the integration of seismic data with well logs became necessary. As a result, combining seismic data with well logs will significantly increase the degree of dependability in mapping complicated structural and stratigraphic sub-surfaces, such as those of the Niger Delta [22] [9]. The study's objectives included characterizing the stratigraphy and geometry of the subsurface, figuring out how well the field could trap hydrocarbons, and locating and defining any viable hydrocarbon possibilities. Gamma ray, SP, resistivity, calliper, acoustic, and neutron-density logs made up the composite logs. Well logs can be used to achieve vertical resolution of the physio-chemical properties of the geologic formations of boreholes [23]

On a scale of 1:250000, the survey area was 58.24 sq km in size. Emi-1, Emi-3, Emi-4, and Emi-5 wells were chosen for the investigation based on the consistency and quality of the data as well as the depth column covered by logs. For the study, the data set included 42 3D seismic sections, of which 27 were cross-lines shot parallel to the dip direction and the remaining 15 were in lines shot parallel to the strike direction. Both the in-lines and the cross-lines have seismic sections spaced apart by 400 m. Gamma ray, SP, caliper, resistivity, and neutron-density composite logs for six wells and two sidetrack wells were also provided, as well as a continuous velocity log for the Emi-3 well [24] The amplitude seismic response from P-wave was the primary conclusion that could be obtained from this study case in terms of seismic properties employed for imaging hydrocarbon in place

Application of (P-S) Waves for Hydrocarbon in-Placed.

The Poisson's ratio (σ) is regarded as an important lithology and fluid discrimination parameter, and is directly associated with the Vp/Vs ratio [25]

According to [26]), the Poisson's ratio (σ) is an elastic constant that describes a porous reservoir rock's fluid content. It is also known as the transverse to longitudinal strain ratio and is expressed by the ratio K/U of the bulk modulus (K) to the shear modulus [27] Simply said, the higher the compressibility and the lower the bulk modulus (K) of a sedimentary rock are two related concepts [28] below in figure 2.

According to the research by [29] gas is more compressible than any other rock-fluid.

As a result, this study demonstrates that (σ) is more applicable to hydrocarbon searches than other searches [30].

According to the equation [1], Poisson's ratio is related to Vp/Vs. Table 1 provides the Poisson ratio computation for the hydrocarbon essential index.

$$\left(\frac{V_p}{V_s}\right)^2 = \frac{2(1-\sigma)}{1-2\sigma} \quad (5)$$

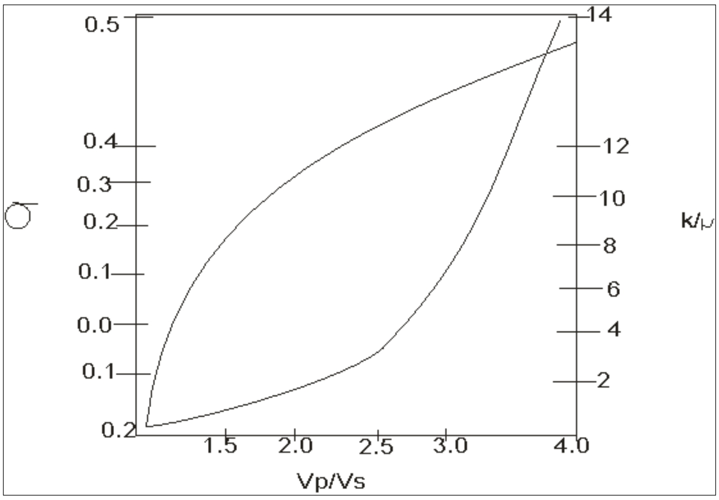

Figure 2 Is plot showing the inter relation of poission's ratio, bulk to shear modulus ratio(k/u) and velocity ratio (Vp/Vs).Increase in one shows increase in other ratios as all vary similarly though not linearly[18]

2.1. Velocity & Poison's Ratio Crucial Index for Sedimentary Rocks and its Fluid Contents (Rock---Fluid Properties)

According to [31] the Poisson's ratio (σ) for sedimentary rocks typically varies between 0.2 and 0.4. The Poisson's ratio ((σ) is highest in hard rocks like limestone, then shale and water-saturated sandstone.

According to [32], the Poisson's ratio for gas-saturated rocks typically has a much lower value of 0.15-0.17. The results of this study showed that the Poisson ratio (σ) and Vp/Vs for shale rocks ranged from 2.1 to 2.4, 1.8 to 1.9 for oil rocks, 2.0 to 2.1 for rocks saturated with water, and 1.5 to 1.7 for rocks saturated with gas [33]. This is outlined in Table 1, which is utilized to forecast the placement of hydrocarbon in this study effort.

Table 1 (V_p/V_s) and σ crucial index for rocks – fluid properties [34]

	Vp/vs	σ
Gas	1.5 – 1.7	0.15 – 0.17
Oil	1.8 – 1.9	0.2 – 0.3
Water	2.0 – 2.1	0.33 – 0.35
Shale	2.1 – 2.4	0.36 - 0.4

Conclusion: Despite the merits and cons described in this research, P-wave technology continues to dominate seismic reflection geophysical techniques for imaging geologic formations. However, due to its limitations, P-S waves data should be given more credit since it can image seismic obstruction structures of the earth's subsurface more clearly than P-wave data can. This will reduce seismic pitfall and reduce the danger of drilling a dry well during exploration [3]

The fact that velocity analysis for hydrocarbon search will serve as the best indication than other seismic properties (DHI) as far as reflection seismology is concerned is also highly crucial when P-wave and S-wave data are properly acquired [3].

3. Materials and methods

The acquisition parameters used for the seismic reflection survey are:

- Dynamite (energy source)

- 24 p-wave geophones with 28Hz
- 24 s-wave geophones with 28Hz
- geophones cable
- Switch cable
- 24v battery
- Seismograph (ES-3000) data recording system

Table 2 Data Acquisition Parameter or Equipment and its Application used for the Profile

Type of Survey	**3- D SRAIGHT LINE**
Nominal spread	end on / shoot through
Nominal fold	24
Energy source parameter	Dynamite
Nominal shot spacing	100m
Charge size	0.5-3kg
Recording parameters: Numbers of active recording channel	24
Recording length	20s (for depth conversion of 60km)
Sampling rate	2ms
Maximum offset	2500m (2.5) km
Geophones	24 of 28 H3
Total profile length	2.5km

Field Operation for Conducting the Seismic Reflection Survey in Accordance to Step-By-Step Instructions

- Number of channel - 25
- Depth of investigation - 12 kilometers
- Seismic source - Dynamite
- Lay out the geophone spread:
- The span of the geophone spread, which is the number of channels, should be long enough to accommodate the geophones.
- The profile length is 2400 meters (25 channels x 24 geophone spacing or spread).
- The geophones are distributed across an area of approximately 2400 meters and are spaced at equal intervals of 100 meters.
- Place a geophone in the ground 100 meters away from the position of the shot (i.e., this was the first geophone, also known as channel one). The second geophone (i.e., channel two) was put into the ground 200 meters away from the position of the shot. This order of dispersion is likewise received by channels three to twenty-five.
- The spread should look like the following. Channels 1 is on the left and channels 25 is on the right, where 1,1 -------- 24,24 representing each vertical and horizontal (P-W & S-W) recording geophone.
  - Make sure, the P-wave geophones are inserted as vertically as possible while the S-wave geophones are in horizontal that each is in the ground tight, by placing your finger on the top of the geophone and try to wiggle it. Ensure that it is in the ground tight
  - enough. If necessary, it can be stomped in with your boot.
  - Lay out the geophone cable and
  - connect up the geophones.
- Run in the dynamite into the hole of about 75m-100m deep with the switch while the end of the switch cable is outside the surface.
- The dynamite source hole is at the zero offset which is 100m apart between the first geophone.
- Place the seismograph and the battery near the end of the geophone
- spread farthest from the shot location, within each of end of the geophone cable.

- Walk to this point and begin paying (allow to pulled out) the trigger cable as you walk to the first shot point location.
- Connect the trigger cable to the seismograph.
- Connect the geophones cable to the seismograph.
- Connected the battery cable to the seismograph.
- If you are using a Goode, connect the seismograph to your field Pc using the Network interface box (NB). If you are using ES-3000. It is best to find shade if it is available.
- Power up the system|
    - Geode: set the switch on the Network interface box to “enable power up”, the start Scs on the laptop.
- If for ES-3000: start Scs on the laptop.
- Smart sees: turn on the seismograph with the power switch.
- Set up the acquisition soft ware by opening and filling out the necessary dialog boxes as prompted by the system. Few example of the dialog boxes are as shown below:

1. Survey>>New Survey: You were invited to enter "for the survey name," for instance, "TEST-SURVEY," and then click OK. In other words, the survey's name is Test-Survey.
2. Geom>> Survey Mode: This asks you to choose the survey approach. Consequently, say reflection. This indicates that you are using the seismic reflection survey method to collect data.
3. \3. Geom>> Geophone interval: This asks you to specify the distance between the geophones. So say, "100 meters and click." Therefore, there are 100 meters between each geophone.
4. Geom>> Group/shot location: This prompts you to enter the shot coordinate and the initial geophone coordinate and reads as follows. The first geophone coordinate is 100 and the shot coordinate is O. This indicates that the shot position is 100 meters away from the first geophone and at zero offset.
5. Acquisition > sample duration record length. You were then asked to enter the sample interval and record length. So, enter 2ms for the sample interval and 20000ms for the record length. This indicates a 20 second data acquisition time with a 2 millisecond sample interval.

The following dialog boxes to fill out include those for trigger choices, display boundary/gain style (such as fixed gain, AGC, or normalize), display filters, and noise monitor activation. Now that the dialog boxes have been filled with all the essential information, modify. Finally, dynamite is fired, which activates the seismograph, which stacks the data automatically by stating "stack D: I." This will display a table bar, and you should see data in the shot window as shown in Figure 3.

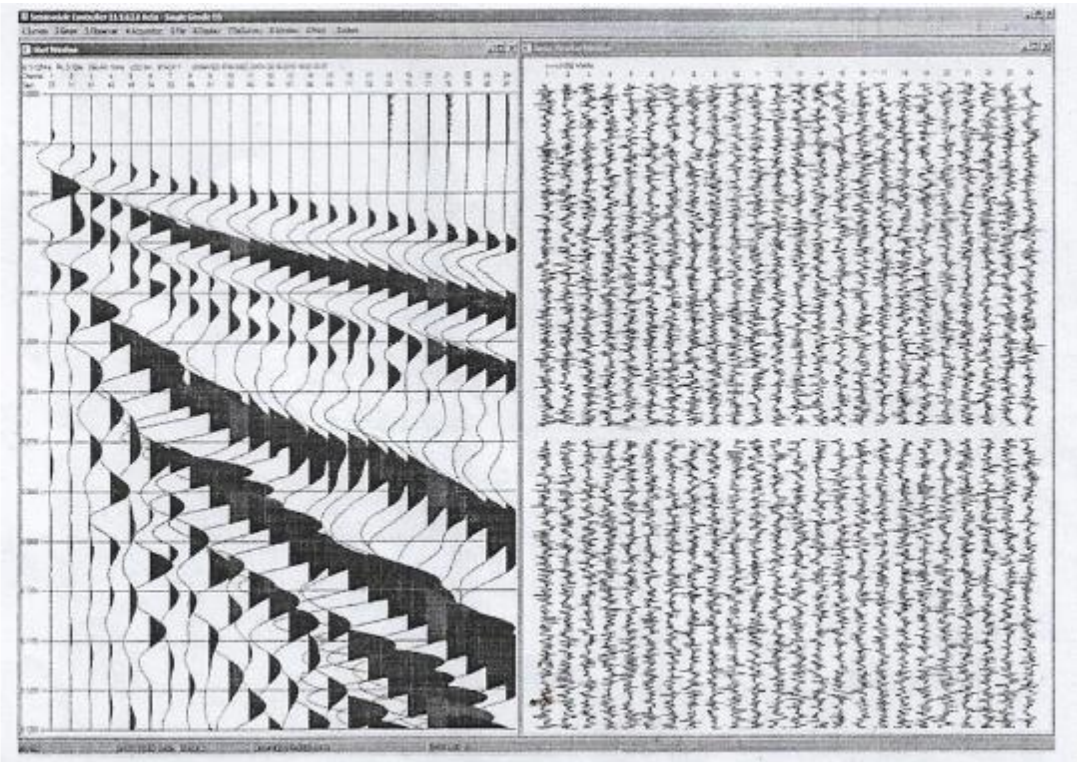

Figure 3 Seismic Data Seismogram for the reflection seismic survey [31]

4. Results

The seismic reflection survey's observed parameters, which were the necessary information gathered at the Atala oil field for the imaging of the geologic formation, were listed in table 3. These numbers represent the static and dynamically corrected times for each layer of inquiry that each geophone detected. They are the normal move out (NMO) and vertically two ways travel time (TWTT), both measured in seconds. In other words, they are the variable applied to the normal moveout velocity (Vnmo) as given in equation 4.1 which were used to compute the velocity structure of each layer; When the arrivals time is plotted against the geophone spreads on the (t-x) curve, Tm,0 represents the intercepts on the time axis. According to the graph that may be used to calculate the normal move out velocity (Vnmo), this is the twtt of each layer of research for all the layers that produce their own hyperbolas.

$$V_{nmo} = \frac{nx}{\sqrt{2t_{m,o}\Delta t_n}} \qquad (6)$$

M = total earth layers of investigation. (i.e m = 1 – 8)
$\Delta t(g_1)$ - $\Delta t(g_n)$ = Are the Nmo recorded by the first to the last geophones in all the layers.
X = 100m which is the geophones spread interval.
n = 1 – 24 (i.e number of geophones used).

Thus: the velocity of each layer is been analyzed by the 24 geophones which was calculated for all the layers and recorded in table 4 [38]

Velocity stacking was also done, this simply refers to adding up all the traces to construct the ideal hyperbola in the seismic profile line using the method in equation (7) below. For effective resolution, this improved the signal to noise ratio [7]

$$V_{st}\,(p\text{-}s) = \frac{X_1}{\sqrt{2t_{1,0}\Delta t_1}} + \frac{X_2}{\sqrt{2t_{1,0}\Delta t_2}} + \frac{X_n}{\sqrt{2t_{1,0}\Delta t_n}} = \sum_{n=1}^{24}\left(\frac{nx}{\sqrt{2t_{m,0}\Delta t_n}}\right)/N \qquad (7)$$

The sum of all the traces from the first term, second term, and last term is found in equation (7) Where the first term represents the Vnmo recorded by the first geophone, the second term represents the Vnmo recorded by the second geophone as well as the final geophone for the first layer,

In order to further determine the interval velocity in the corresponding layers and anticipate the amount of rock fluid present, the distribution of the stacked velocities in all layers of examination is shown in table 5 [39].

Table 3 Seismic reflection survey data gathered from Atala oil field. [14]

Layer (s)	**Dry Sand**		**Clay**		**Wet sand**		**Till**		**Mud stone**		**Sand stone**		**Lime stone**		**Dolomite**		
TWTT (S)	0.16/	0.6	0.24/	0.8	1.6/	2.7	2.1/	3.5	2.24/	3.4	2.6/	4.15	3.6/	7.4	4.24/	8.6	X
Dt (g_1)	19mS/	63.5mS	8.1mS/	19.5ms	751mS/	1.5mS	372µS/	121µS	122µS/	214µS	88µS/	153µS	50µS/	75µS	32µS/	37µS	100
Dt (g_2)	69mS/	251mS	31mS/	79mS	2.9mS/	5.6mS	1.4mS/	3.3mS	500µS/	864µS	350µS/	620µS	160µS/	0.5mS	130µS/	150µS	200
Dt (g_3)	151mS/	554mS	70mS/	170mS	6.7mS/	5.6mS	3.3mS/	7.4mS	1.1mS/	1.9mS	780mS/	1.4mS	370µS/	0.6mS	300µS/	340µS	300
Dt(g_4)	279mS/	980mS	114mS/	310mS	12mS/	22.7mS	5.9mS/	13mS	2mS/	2.5mS	1.4mS/	2.4mS	650mS/	1.2mS	530µS/	610µS	400
Dt(g_5)	431ms	/1.4ms	190mS	/490Ms	19ms/	35.5mS	9.2mS/	29mS	3.1mS/	5.4mS	2.2mS/	3.4mS	1.0mS/	1.8mS	640µS/	951µS	500
Dt(g_6)	611mS	/2.3s	280mS	/710mS	26mS/	51.2mS	13mS/	29mS	4.5mS/	7.6mS	3.1mS/	5.4mS	1.5mS/	2.7mS	1.2mS/	1.4mS	600
Dt(g_7)	833mS	/3.2s	380mS	/960mS	37ms/	68.6mS	18mS/	39Ms	6.2mS/	11.1mS	4.3mS/	7.6mS	2mS/	3.7mS	1.6mS/	1.8mS	700
Dt(g_8)	1.06S	/3..2S	500mS	/1.2S	47mS/	91.1mS	20mS/	52mS	8.1mS/	14mS	4.9mS/	9.7mS	2.6mS/	4.8mS	2.1mS	2.4mS	800
Dt(g_9)	1.3S	/3.1S	630mS	1.6S	61mS/	111.3mS	29mS/	66mS	10.2mS/	17mS	5.9mS/	12mS	3.3mS/	6.1mS	2.7mS/	3.0mS	900
Dt(g_{10})	1.3S	/6.4S	780mS	/1.8S	75mS/	142mS	37mS/	81mS	12mS/	20mS	5.6mS/	15mS	4.1mS/	7.6mS	3.3mS/	3.8mS	1000
Dt(g_{11})	2.06S	/6.8S	950mS	2.0S	110mS/	171mS	45mS/	97mS	15mS/	26mS	6mS/	18mS	4.9mS/	9.2mS	4mS/	4.4mS	1100
Dt(g_{12})	278S	/6.9s	1.12S/	2.4S`	150mS/	021S	53mS/	110Ms	18mS/	30mA	13mS/	20mS	5.9mS/	21mS	4.8mS/	5.5mS	1200
Dt(g_{13})	2.57S	/13.4S	1.32S	3.4S	155mS/	0.22S	63mS/	140mS	21mS/	36mS	15mS/	21mS	6.9mS/	29mS	5.8mS/	7.4mS	1300
Dt(g_{14})	4.8S	/11.1S	1.5S	4S	150mS/	0.37S	73mS/	160mS	25mS/	42mS	17mS	23mS	8.1mS/	30mS	6.5mS/	7.9mS	1400
Dt (g_{15})	3.6S/	12S	1.8S/	4.3S	170mS/	0.37S	83mS/	180mS	28mS/	48mS	28mS/	48mS	9.2mS/	34mS	7.0mS/	84mS	1500
Dt (g_{16})	4.15S/	12S	2S/	5.1S	190mS/	0.4S	95mS/	190mS	32mS/	54mS	22mS/	28mS	11mS/	38mS	7.5mS/	9.7mS	1600
Dt (g_{17})	4.61S/	15.9S	2.3S/	5.7S	210mS/	0.4S	110mS/	230mS	36mS/	62mS	25mS/	30mS	13Ms	48mS	8.5mS/	11mS	1700
Dt(g_{18})	5.3S/	15.7S	2.5S/	6.7S	240mS/	0.4S	120mS/	270Ms	50mS/	69mS	28mS/	31mS	13.4mS/	49mS	9.6mS	12mS	1800
Dt(g_{19})	6.11S/	22.7S	2.8S/	6.9S	270mS/	0.5S	130mS/	330mS	55mS/	79mS	31mS	34mS	14mS/	54mS	12mS/	13mS	1900
Dt(g_{20})	6.4S/	21.3S	3.1S/	7.9S	300mS/	0.5S	150mS/	360mS	60mS/	86mS	35mS/	34mS	16mS/	61mS	13mS/	15mS	2000
Dt(g_{21})	7.7S/	21.2S	3.4S/	8.5S	330mS/	0.6S	160mS/	390mS	67mS/	94mS	38mS/	37mS	18mS/	66mS	14mS/	16mS	2100
Dt(g_{22})	9.09S/	30.2S	3.7S/	9.5S	260mS	0.67S	180mS/	420mS	68mS/	100mS	42mS	38mS	20mS/	73mS	16mS/	18mS	2200
Dt(g_{23})	9.11S/	41.1S	4.1S/	10.5S	390mS/	0.75S	200mS/	470mS	70mS/	114mS	46mS/	39mS	22mS/	80mS	17mS/	19mS	2300

Dt(g_{24})	8.89S/	45.9S	4.5S/	11.25S	430mS/	0.85S	210mS/	490mS	72mS/	124mS	50mS/	40mS	24mS/	87mS	18mS/	22mS	2400
Dt(g_{25})	11.01S/	41S	4.9S/	11.9S	475mS	0.9S	230mS/	520mS	78mS/	130mS	59mS/	41mS	27mS/	91mS	19mS/	28mS	2500

Table 4 Distribution of normal move out velocity (V_nmo) calculated from the parameter in table 3

Layer (s)	**Dry Sand**		**Clay**		**Wet sand**		**Till**		**Mud stone**		**Sand stone**		**Lime stone**			**Dolomite**		
TWTT (S)	0.16/0.6		0.24/0.8		1.6/2.7		2.1/3.5		2.24/3.4		2.6/4.15		3.6/7.4			4.24/8.6		100
V (g_1)	1450&	410	1611&	620	2118 &	1115	2609 &	1310	4313 &2510		4860.1	&2810	5899 &	3010		5920 &	3910	200
V (g_2)	1412.2	&401.5	1610.4	&599.1	2139 &	1110	2683 &	13109	4219 &	2510	4810 &	2816	5979 &	3014		6019 &	3899	300
V (g_3)	1414.2	&401.3	1603.6	&602.1	2116 &	1107	2611 &	1301	4264 &	2502	4804 &	2801	5895 &	3012		5943 &	3914	400
V (g_4)	1416.2	&412.1	1521 &	596.9	2102 &	1111.9	2614 &	1311	4221 &	2510	4821 &	2819	5932 &		3010	5959 &	3910	500
V (g_5)	1399.1	&410.8	1622 &	599.2	2094 &	1101.3	2606 &	1299.9	4233 &	2501	4800 &	2809.1	5897 &	3020		5953 &	3920	600
V (g_6)	1412.5	&415.0	1603.6	&600.4	2148 &	1100	2631 &	1300	4216 &2516		4819 &2799		5858&	3001		5941 &3909.8		700
V (g_7)	1402.9	&398.9	1605.9	&602.9	2101 &	1109.9	2609 &	1301	4190.7&2599.9		4500 &	2799	5916 &	3000.1		6002 &	3900	800
V (g_8)	1412.5	&410.8	1608	&604.9	2108 &	1100	2582 &	1300	4903 &	2519	4500 &	2799.3	5930 &	3089.9		5988 &	3990	900
V (g_9)	1399.7	&419.8	1603.6	&610.4	2103.9	& 1109	2642 &	1301	4200 &	2598.2	4500 &	2801	5922 &	2999.5		5941 &	3905	1000
V (g_{10})	1410	&371.1	1601.3	&600.8	2108 &	1109.4	2599 &	1304	4134 &	2501	4500 &		5903 &	3009.9		5971 &		1100
V (g_{11})	1412.1	&379.1	1596 &	599.2	2106 &	110.1	2593 &	1315	4233 &	2500	4500 &	2800	5939 &	2990.8		5966 &	3990	1200
V (g_{12})	1412.3	&398.2	1402.5	&402	2089 &	110	2606 &	1301	4216 &	2501	4800&	280.1	590 &	3000		5941 &	3908	1300
V (g_{13})	1411&	405.2	1401 &	401.3	2082 &	1109	2590 &	1305	4229	& 2509	4706 &	2800	5915 &	2999.5		5959 &	3910	1400
V (g_{14})	1401.1	&393.9	1407.1	&3998.9	2088&	1103.4	2590&	1310	4179 &	2501	4747 &	2810	5911 &	3009		6011 &3910		1500
V (g_{15})	1399.2	& 396.8	1581.2	610.3	2100 &	1109	2603 &	1319	4225 &	2505	4793 &	2799.3	5766 &	2799.8				1600
V (g_{16})	1410.6	& 399.9	1600		2119 &1100		2596&	1300	4216 &2510		4824 &	278.1	5866 &	3008		6000 &3950		1700
V (g_{17})	1409.9	& 411.8	1585.5	&599.9	2142 &	1101.9	2563 &	1309	4224 &	2499.9	4808 &	281o	59967&	2999.7		5953 &	3915	1800
V (g_{18})	1407.2	& 407.1	1609.9	&597.8	2121 &	1100	2598 &	1310	4242.6	& 2570	4811 &	2810	5967 &	3020		6014 &	3900	1900

V (g_{19})	1398.9	&407.9	1605.8	&6019	2111&1101.3		2635 &1308		4222 &2510		4826 &	2790	6069 &3101			5998 &3940		2000
V (g_{20})	1400.3	& 413.3	1606.4	&609.8	2108	1109	2582 &1301		4216 &	2501	4781 &	2798.3	5976 &	3109		5941 &3900		2100
V (g_{21})	1403 &	410.1	1610 &610.1		2111 &1109		2695 &1300		4183 &	2510	4818 &	2789.1	5916 &	3120		5945 &3910		2200
V (g_{22})	1379.2	&410.3	1617 &	603.1	2117 &	1100	2593 &	1314	4234 &	2500	4801 &	2800	5880	3099		5966 &	3899.3	2300
V (g_{23})	1395	& 399.8	1606.4	& 600.1	2126 &	1109	2571 &	1314	4188 &	2501	4795.7&	2798.3	5861 &	3089		4795&	39941.8	2400
V (g_{24})	1402.4	&401.5	1600 &	609.2	2126 &	1100	2619	1301	4216 &	2501	4800 &	2810	5855 &	3000		5972 &	3900	

Table 5 Stacked velocity for (p-s) waves and its twtt.

Layer	**V_{st}(p)**	**twtt**	**V_{st}(s)**	**Twtt**
Dry sand	1521.2	0.16	425.2	0.6
Clay	1713.2	0.24	637.2	0.8
Wet sand	2321.1	1.6	1118.1	2.7
Till	2731.2	2.1	1325.6	3.5
Mud stone	4344.4	2.24	2519.3	3.4
Sand stone	4835.1	2.6	2851.5	4.15
Lime stone	5954.2	3.6	3208.2	7.4
Dolomite	5999.5	4.24	3825.4	8.6

The interval velocity associated with the earth layers of this research work was determined by the application of the Dix formula into interval velocity equation , by simply substituting the stacked velocity in table 5 above.

Therefore the interval velocity for the first layer is the same as the V_{nmo} judging by the interconnection equation of average velocity and interval velocity which is:

$$V_{rms} = \sqrt{\frac{V_1^2\,t_1 + V_2^2\,t_2 \ldots + V_n^2\,t_n}{t_1 + t_2 \ldots t_n}} = \sqrt{\frac{\sum_{i=1}^{n} V_i^2 t_i}{\sum_{i=1}^{n} t_i}} \quad (8)$$

Table 6 Distribution of Interval Velocity of (p-s) Waves, Poission's Ratio and Velocity Ratio

Earth's Layer	P - wave Vlayer m/s	P - wave TWTT in sec	S - wave Vlayer m/s	S - wave TWTT in sec	Vp/vs	Poisson's ratio
Dry sand	1,613.5	0.16	392.8	0.6	4.10	0.45
Clay	2,100.5	0.24	1,000.2	0.8	2.10	0.33
Wet sand	2,511.6	1.6	1,287.6	2.7	1.95	0.38
Till	3,021.2	2.1	1,616.4	3.5	1.87	0.29
Mud stone	3,069.9	2.24	1,973.7	3.4	1.56	0.17
Sandstone	3,326.7	2.6	2,017.8	4.15	1.65	0.13
Limestone	3,869.2	3.6	2,691.1	7.4	1.44	-.09
Dolomite	6,769.6	4.24	4,592.7	8.6	1.47	0.07

4.1. Discussion

Following Clay, Wet Sand, Till, Mud Stone, Sand Stone, Limestone, and Dolomite as the eight bed rocks (reflectors) determined from the analysis of the seismic reflection data gathered as previously reported. Dry Sand is the outermost layer. The area of rock petrology, also known as rock physics, which is concerned with the study of rocks types, led to the discovery of a table of various velocities rocks matrix, which was used to assess the identification of the lithology or strata [40].

4.2. Result of Velocity Analysis

According to the processed velocity study, the seismic response for dry sand had average and formation velocities of 1521.2m/s, 425.2m/s, and 1,613.5m/s, 392.8m/s (P- S) wave, respectively.

- Clay: For (p-s) waves, the average and formation velocities were 1713.2m/s, 637.2m/s, and 2,100.5m/s, 1000.2 m/s, respectively.
- Sand that is moist: The average and formation velocity for wet sand was 2321.1m/s, 1118.2 m/s, and 2,511.6 m/s, 1287.6.4 m/s respectively.
- Till: The average and formation velocity for the till layer, respectively, were 2731.2m/s, 1325.2 m/s, and 3,021.2m/s m/s, 1616.4 m/s (p-s).
- Mud stone: For mud stone, the average and formation velocities were 4344.4m/s, 2519.3 m/s, and 3,069.9m/s, 1973.7 m/s, respectively.
- Sand stone: The average and formation velocities for sand stone were 4835.1m/s, 2851.5 m/s, and 3,326.7m/s, 2017.8 m/s respectively.
- Limestone: The average speeds and formation velocity for limestone were 5954.2m/s, 3208.1 m/s, 3,869.2m/s,26911.1 m/s respectively. Last but not least, the formation velocity and average speeds for dolomite were 5999.5m/s, 3825.4 m/s, and 6,769.6m/s, 4592.7 m/s.

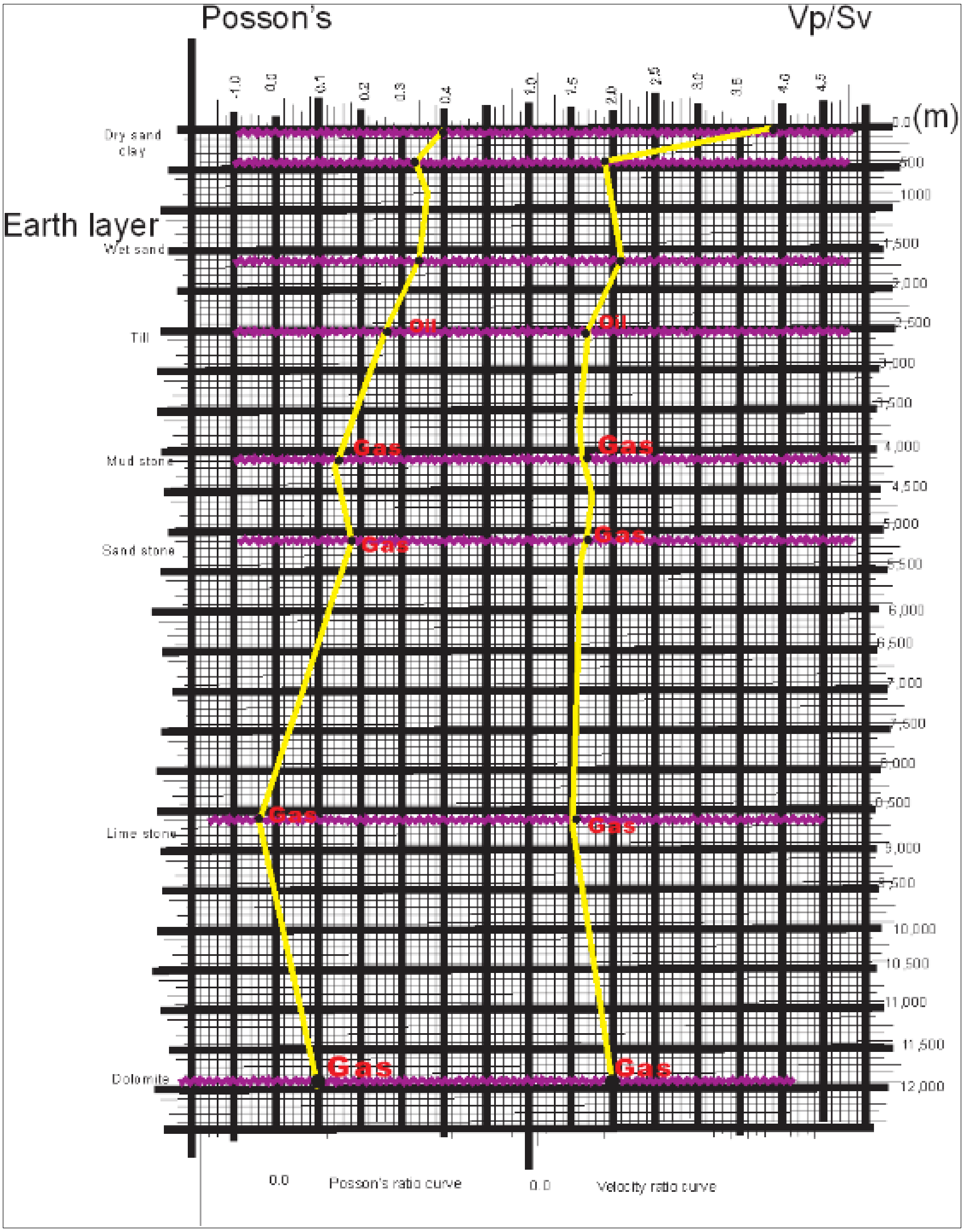

Figure 4 the Poisson's ratio (σ) variation in comparison with velocity ratio (Vp/Vs) on seismic reflection curves of the data acquired in the case study. [40] (Image of geologic rock-fluid formation, Bys oil Coy)

4.3. Results of Rock Fluid Observation

The relationship between the Poisson ratio and velocity ratio is shown in Figure 4 for the examination of the probability of hydrocarbon in locations where change in one curve corresponds to change in the other. According to [41], the relief or character of the curve's reflection reveals the creation and location of gas and oil with respect to its depth in meters. Therefore, it can be shown from this explanation that eight different reflectors were found. By comparing the reflectors with Poisson's ratio and velocity ratio crucial index for rock fluid characteristics as shown in table 1, it is clear that trapped gas was seen in certain spots in mud stone, sand stone, lime stone, and dolomite with oil trapped in till layer. Looking at the reflection of the curve is the fastest way to determine whether or not the rock-fluid has hydrocarbon potential. If the curve falls between (1.0 - 1.9) in terms of velocity ratio and (0.10 - 0.19 in terms of possions ratio). Then, such a layer is situated, rich in hydrocarbon. However, if the curve's reflection is between a Poisson ratio of 0.2 and above and a velocity ratio of 2.0 or higher. The rock-fluid is then little more than rock that has been saturated with water and lacks hydrocarbon potential.

As a result, starting from the till layer and moving down to the dolomite layer, the curve for both Vp/Vs and σ lie and move along a Poisson's ratio (σ) of 0.15 - 0.17 and Vp/Vs of 1.5 - 1.9. This implies that all layers are hydrocarbon-rich, with the exception of wet sand, clay, and dry sand, where the curve lies above (σ) of 0.3 and Vp/Vs of 2.0. Seismologists rely on this foundation to determine whether a geologic formation is hydrocarbon-rich or not. According to the research, the limits for the rock-fluid characteristics Poisson's ratio (σ) and (Vp/Vs) are 0 0.4 and 0 Vp/Vs 4.5, respectively [42].

However, I dislike the notion that the Poisson ratio is a trustworthy hydrocarbons indicator that is used as the cornerstone for work. Seismic pitfall is still present, though, and this is a sign of important information that will be considered at this level of interpretation. It all comes down to how uncertain the precise location of the trapped gas is with respect to the zero offset. This indicates that utilizing Poisson's ratio (σ) and Vp/Vs for hydrocarbon in place prediction may only identify the existence of hydrocarbons in a certain bed rock(s), but cannot be able to suggest the horizontal distance from the zero offset or from the impact [9]. Therefore, the study found that employing Poisson's ratio (σ) and velocity ratio (Vp/Vs) exclusively for hydrocarbon in situ prediction lacked merit in the field of showing the horizontal placement, which poses a major constraint. This is known as the sag "

EFFECT," which is a pull-down of reflections of traces below the normal reflections of traces in the seismic response line. This effect is caused by low velocity due to presence of gas [43] This further explained that, where there is presence of hydrocarbons in place, the reflections directly below the normal reflections of traces in the seismic response line will be pulled down. Therefore the fig 4.2 is the "sag" effect derived from the data set of the case study which was used to indicate the exact coordinate of the trapped gas and oil.

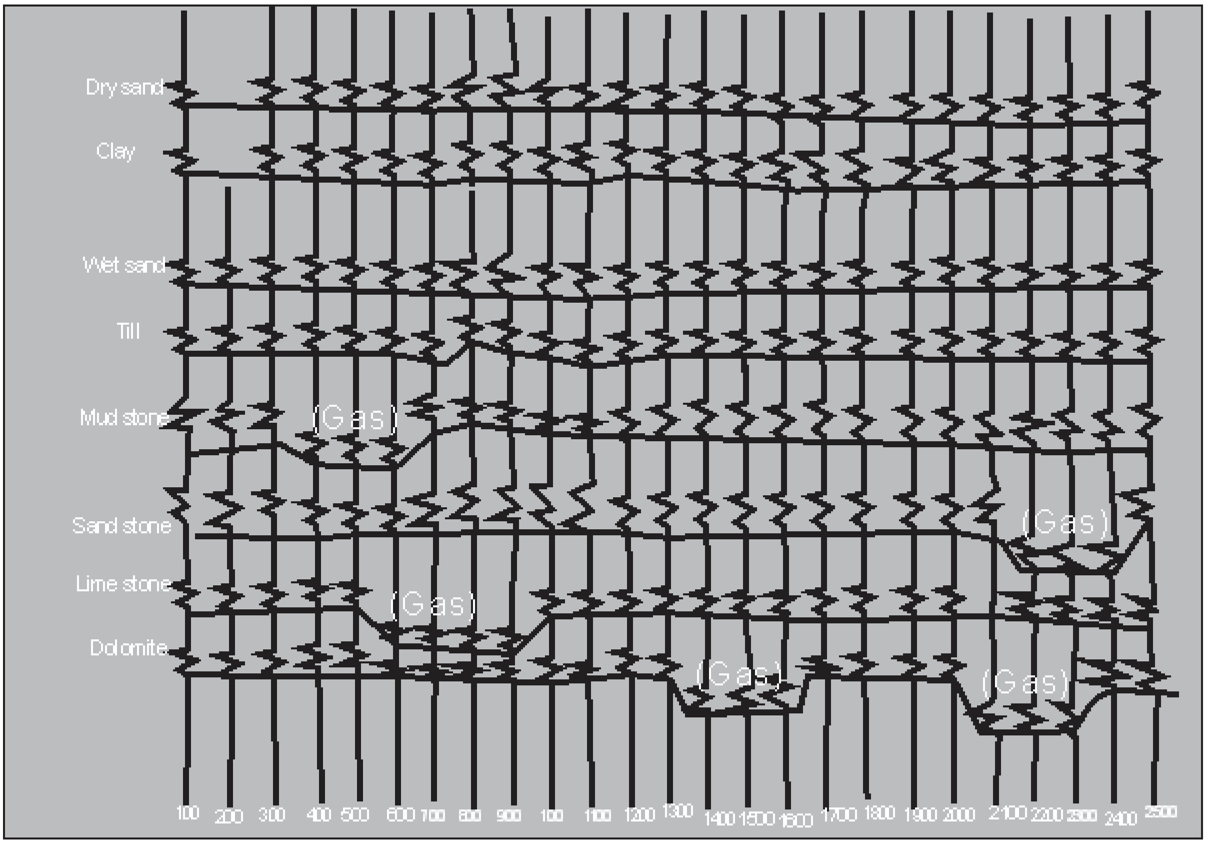

Figure 5 Sag effect of the seismic response of the location of the seismic line segment profile, for the reflection survey of Atala oil field)

4.4. Drilling Recommendation

Since drilling a well to recover hydrocarbons is expensive, the most information possible regarding the likelihood of finding petroleum in the structures must be derived from seismic data. Therefore, based on the data acquired via this research effort from the Poisson’s ratio (σ) and Vp/Vs curve as well as the "sag" effect (DHI) analysis shown above, the researcher on this research study provided recommendations of drilling decision for hydrocarbons recovering.

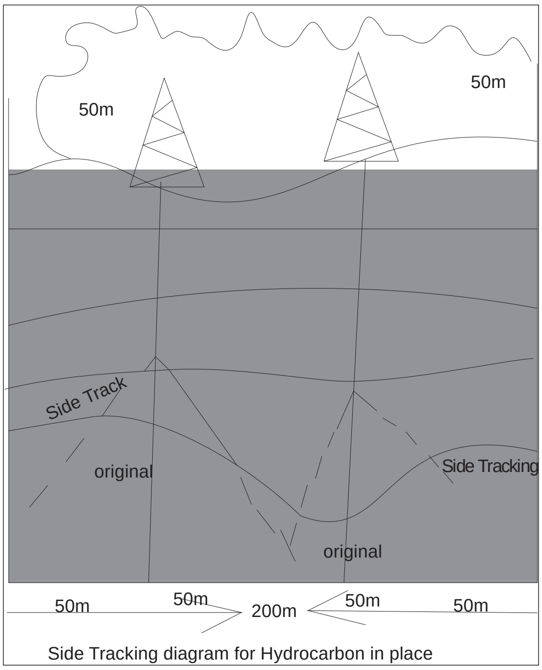

Figure 6 Side tracking diagram for recovering hydrocarbon in place, [34], [14].

4.5. Trapped Gas Coordinates in Sand Stone

The precise location of the gas-trapped sandstone deposit is at coordinates (5250m, 2200–2400m). This indicates that there is a 200-meter-wide gas-promising zone here as well, so in order to recover the formation gas, drillers must proceed to a depth of 5250 meters starting between 2200 and 2400 meters below the profile's surface, ideally at 2300 meters.

4.6. Trapped gas Coordinate in Limestone

The precise location of the limestone's trapped gas formation is at coordinates (8750m, 600--900m).

This indicates that the prospective zone for gas deposits is extended out by roughly 300m. Therefore, drilling must be done ideally at 750m on the surface and sidetrack about 150m both left and right to a depth of around 8750m (8.75km), in order to retrieve the reserve gas or trapped gas.

5. Discussion

In order to avoid seismic traps and make the best use of the available technology, adequate survey design, acquisition, and processing are essential for successful interpretation of seismic reflection survey data conducted on land or at sea.

The investigation has been able to show the benefits and drawbacks of a certain method for seismic reflection operations. Additionally, it has been able to demonstrate that the seismic reflection method continues to be a crucial and essential instrument for subsurface structural research and mapping.

Today, the exploration industry has seen a steady increase in technological advancements. Examples of these advancements include the 4-D seismic survey (time-lapse), multi-streamer and multi-vessel survey for marine seismic operations, and enhanced oil recovery (EOR), which are popular seismic survey trends for evaluating reservoirs, forecasting future productions, and recovering hydrocarbons. The study of energy sources other than P-waves, which make up only a portion of the wave field, such as S-waves that reach the surface is becoming more and more popular today. These additional sources of energy can be produced using a down-going impulsive source or a shear wave source that can produce both compressional and shear waves.

Based on the fact that changes in P-velocity alone due to the rock fluid can occasionally be ambiguous as they also depend on other facts such as lithology, clay contents, and features (rocks shapes), the velocity analysis of using (P-S) waves data for prediction of rock fluid properties in this research work has been able to demonstrate the usefulness and limitations of using only P-wave data. Furthermore, it could be challenging to identify the causal rock because numerous rocks may have P-velocities that overlap. On the other hand, the S-wave velocity attributes behave in a certain way as a result of different wave qualities and are helpful in determining the characteristics of rocks.

With S-waves being known to be fluid-insensitive, the (P-S) waves' velocities fluctuate differentially for changes in rock-fluid characteristics. The Vp/Vs ratio can be used to equalize the diverse differential responses of the P- and S-velocities to various elastic moduli of rocks. This parameter gives a more accurate indicator of rock and fluid properties than any one velocity can.

This work has demonstrated the value of technologically interactive software that enables users to tweak parameters and watch impacts play out virtually instantly on the screen in animated form. To improve the interpreter's performance, such software has been connected with measurements, analysis, interpretation, and reservoir attributes. Petrel, proMAX®, Rad EXpro®, IGeOS®, and VISTA® are only a few instances of the softwares. This study has been able to demonstrate that the seismic reflection velocity analysis method employed in the study is capable of producing depth models and locating the presence of anomalous positions even in the lack of bore hole control velocity data. Due to their strong penetration ability and capacity to produce a better image than vibrating data, explosive sources are suitable for deep exploration of hydrocarbons, as was also demonstrated by the analytical study.

It also shown that reflection seismic survey may be used to map the borders of former mining sites as well as bedrock and its associated features like faults. understanding of shear zones and faults. Road design was improved by the detection of sinkholes and other possible dangers during highway and/or construction.

Compliance with ethical standards

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Disclosure of conflict of interest

No conflict of interest to be disclosed.

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