DJS Vol. 48(2) (2024) – pp.99-113 ISSN: 1012-5965

ACCREDITED 2016

1969

Delta Journal of Science

Available online at

https://djs.journals.ekb.eg/

Research Article

GEOLOGY

3D Static Model for Pore Pressure Prediction Using Seismic Velocity to Evaluate the Hydrocarbon Potential of Oligocene Traps, Baltim Gas Field, Nile Delta Basin, Egypt

Hassan Hassan El-Kadi[1] and Khalil Gad[2]*

[1]Geology Department, Faculty of Science, Al Azhar University, Nasr City, Cairo, Egypt

[2]Belayim Petroleum Company, Nasr City, Cairo, Egypt

***Corresponding author:** *Khalil Gad* **e-mail:**kgad1982@gmail.com

Received: 6/7/2024 **Accepted**: 14/8/2024

KEY WORDS

Nile Delta;

Baltim Field;

Pore Pressure;

Exploration

Prospects

ABSTRACT

The Nile Delta, located in northern Egypt, is a significant gas province known for its vast hydrocarbon reserves due to its sedimentary succession, which indicates significant gas potential. Baltim Field is located in the offshore Central Nile Delta, approximately 10 kilometers off the Egyptian coast. As most of the main producing reservoirs of Messinian deposits became brown fields, so the discovery of the deeper reservoirs of Oligocene (Tineh Formation) become an urgent need. Accurate pore pressure estimation is crucial for both exploration and drilling these deeper reservoirs. One of the most trap failure mechanisms of such deeper reservoirs is the abnormal high pore pressure of these reservoirs as it inhibit the hydrocarbon accumulation causing the escaping of the hydrocarbons to low pressure regime reservoirs, also trap integrity can be compromised in high reservoir pressures especially in the Oligocene section, furthermore the geopressure prediction is crucial in planning of the wells targeting these deeper reservoirs. This study is aimed to investigate the relationship between seismic velocity and pore pressure in the Baltim gas field. By utilizing seismic velocity data, we aim to develop predictive models for accurately estimating pore pressure in this geological setting. Velocity curves have been extracted from seismic data and pore pressure calculations were done in both one and three dimensions. This type of modeling assessed in the hydrocarbon trapping evaluation of the Oligocene reservoirs besides planning and ranking for the best locations for drilling the exploratory prospects.

List of Abbreviations:

1D: one dimensional	VSP: vertical seismic profiling
3D: three dimensional	LOT: leak off test
PSI: pound square inch	PA: pascal
M/S: meter per second	FT: feet
FT/S: feet per second	HPHT: high pressure high temperature

Introduction

A key concept in the domains of geophysics, petroleum engineering, and hydrogeology is pore pressure, which is the pressure that the fluids inside a rock formation's pores exert **(Eaton, 1975)**. For both exploration and drilling projects, pore pressure estimation is crucial **(Jamali and Sokooti 2008)**. Precisely forecasting pore pressure during the exploration stage aids in evaluating the hazards related to fluid migration and seal integrity **(Hearn and Meulenbroek 2011; Swarbrick et al. 2005)**. Since upnormally pore pressures will cause a destructive problems such as wellbore instability, blowouts, and drilling fluid losses, the accurate pore pressure prediction and management are very important in the drilling operations. Three general categories of pore pressure exist: subnormal, abnormal (or overpressure), and normal. The hydrostatic pressure that a column of water exerts as it descends from the surface to the depth of the formation is known as normal pore pressure. The upnormally high pore pressure, occurs when its gradient increased to be higher than the normal hydrostatic gradient due to many reasons such as tectonics effect, fluids expansion or rapid sedimentation. Such this high pore pressure gradient will cause a lot of drilling problems like well bore instability and blowouts. The subnormal low pressure occurs when the hydrostatic pressure is higher than pore pressure and this will happen when the reservoir becomes depleted. The understanding of these types of pore pressure is very important in the drilling operations management **(Bourgoyne et al., 1991; Dake, 2001; Fossen, 2016)**. The earliest approaches of this issue relied on the real observations and local geological knowledge. **(Eaton, 1975)** proposed one of the most influential strategies to estimate the anomalous pore pressures by using well log data, more especially, variations from typical compaction trends. Because of its reliability and practical usefulness, this technique has become a cornerstone in the business. The modern technologies and methods produced very good approaches and enhanced the ability to precisely predict and estimate the pore pressure. Precise pore pressure models facilitate the identification of zones rich in hydrocarbons, enhance production tactics, and facilitate improved reservoir management. In regions like Egypt's Nile Delta, where geological successions suggest substantial gas potential, the ability to estimate and comprehend pore pressure is crucial for the effective exploration and extraction of hydrocarbon resources. Even though most exploration efforts in the Nile Delta basin have concentrated on Miocene to Plio-Pleistocene targets, and because few wells have been reached the pre-Miocene sequence, the older (deeper) targets are poorly known, the Nile Delta still has a notably high hydrocarbon potential, especially in the Oligocene sequence, which is primarily made up of turbiditic channels. The most important character for these channels is their good porosity and permeability, so it considered as good reservoirs. The available data of well logs and seismic velocity curves are used to construct the 1D models and by using these 1D models as a control points, the 3D models were constructed and the resulted pore pressure prediction became more effective as it cover all the study area.

Location of the Study Area

Baltim field is an offshore gas condensate reservoirs field located into the northern portion of the Abu Madi Paleo valley, in the offshore Nile Delta, about 15 Km off the Egyptian Coast, where water depth of the Mediterranean Sea varies between 45-60 m. The length of Baltim fields is about 30 km and its width is about 5 km.

Objective of the Study

This study is aimed to integrate well logs with seismic velocity to build predictive pore pressure models of Oligocene reservoirs which is very important to evaluate its hydrocarbon potentiality and also to drill it in safe way as the effective pore pressure prediction helps to mitigate the associated risks with fluid migration and seal integrity, which lead to successful exploration and development strategies for drilling these HPHT reservoirs.

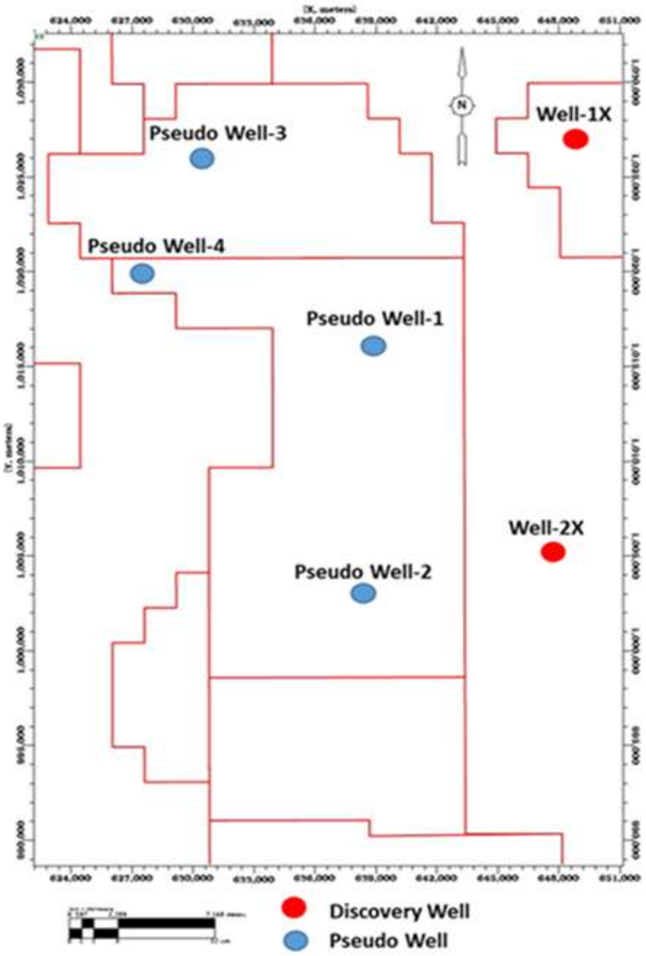

Fig. (1): Location Map of the Study Area

GEOLOGIC SETTING

Due to the location of the Nile Delta in the northeastern part of the African plate and due to the tectonic effect resulted by the contact between the African plate and Eurasian plate, the tectonic history of the Nile Delta was influenced by this type of contact which played a very important role in its sedimentary succession deposition and hydrocarbon generation and accumulation.

Tectonic settings

The first opening of the eastern Mediterranean Basin at the Mesozoic era due to the tectonic events which separated the African and Eurasian plates was associated with the development of the Nile Delta. Substantial extensional tectonics during the Late Cretaceous to Early Tertiary periods lead to the formation of many rift basins, which were subsequently filled with thick layers of clastic sediments produced by the erosion of the African continent **(Dolson et al., 2001)**. The Nile Delta developed primarily as a result of such extensional tectonics. The extensional pressures connected to the African Plate's northward movement were responsible for the region's sinking and the opening of spaces for the deposition of sediment. The hydrocarbon reservoirs need a good sedimentary sequences and this extensional regime made it easier for them to be formed **(Rizzini et al., 1978)**. During the Cenozoic era, the African and Eurasian plates collided resulting in compressional forces affected on the Nile Delta and produced some compressional features like thrust faults and folds. According to **Mascle and Benkhelil (1990)**, these compressional structures are important for the hydrocarbons' trapping mechanisms in the delta. There are some extensional and strike-slip processes exist in the current tectonic regime, and they have a good impact on the delta's structural and geological development. The complex subsurface structure that is essential for hydrocarbon exploration and production is a result of these tectonic processes **(Cohen & McClay, 1996).**

Stratigraphy and Sedimentation

The Nile Delta Basin was characterized by depositional regimes which fairly differentiated in Pleistocene and Pliocene: The Pliocene and Pleistocene ages were characterized by the rapid sedimentation resulted in the existence of high pressure regimes especially in Kafr El Sheikh Formation. This time frame is crucial for the Nile Delta's hydrocarbon potential as there is thick deltaic and shallow marine sediments were deposited during the Pliocene age. During the Pliestocene age thick deposits were formed due to the delta continued to receive huge amount of sedimentary supply reflecting important tectonic event, temperature changes and major eustatic sea level changes.

Jurassic to Cretaceous: The continental deposits making up the majority of the earliest sediments found in the Nile Delta basin is related to the Jurassic age. These continental deposits were overlaid by marine deposits of the Cretaceous age indicating the start of the Nile Delta basin major marine transgression.

Tertiary: the Paleogene (Paleocene to Oligocene) was characterized by the deposition of both fluvial and shallow marine sediments. The Eocene age was characterized by the deposition of carbonate platforms, which were interbedded with clastic deposits of shale and sandstones. The Oligocene most depositional or sedimentary features were the turbiditic channels which are good reservoirs from petrophysical characters point of view. These turbiditic facies were deposited as submarine fans and channels, are good reservoirs for hydrocarbon exploration **(Dolson et al., 2001)**. During the Miocene, thick clastic and non-clastic sediments were deposited. Because of the Mediterranean Sea's isolation, evaporites like salt and anhydrite (Rosetta Formation) were deposited in the Late Miocene, especially during the Messinian Salinity Crisis, and due to the effectiveness of such evaporites as strong seal for underlying hydrocarbon reserves, this time is critical **(Hegazy & Rizzini, 1990).**

Pleistocene and Pliocene: The Pliocene and Pleistocene ages were characterized by the rapid sedimentation resulted in the existence of high pressure regimes especially in Kafr El Sheikh Formation. This time frame is crucial for the Nile Delta's hydrocarbon potential as there is thick deltaic and shallow marine sediments were deposited during the Pliocene age. During the Pliestocene age thick deposits were formed due to the delta continued to receive huge amount of sedimentary supply.

Hydrocarbon Potential

The Nile Delta is characterized by the presence of significant gas reserves accumulated in reservoirs ranging in age from the Pliocene and Miocene ages. The thick sedimentary succession, rapid sedimentation, substantial source rocks and trapping mechanisms are the main reasons for the Delta’s hydrocarbon potential **(Rizzini et al., 1978)**.

MATERIALS AND METHODS

Basic Theory

Overburden Pressure Gradient

Overburden pressure is the pressure exerted by the total weight of overlying sediments and fluids. In term of geomechanical and pore pressure prediction investigations, it has an important role. According to **(Zoback 2007)**, the fundamental formula for figuring out the overburden pressure (S) at a specific depth is:

$$\mathbf{S_{(ppg)} = \rho b_{(ppg)} * TVD_{(ft)} * 0.433} \quad \textbf{(Equation\#1)}$$

Where:

- S : is the overburden gradient

ρb: is the bulk density including the rock matrix and fluid matrix

- TVD : is the true vertical depth in feet
- 0.433 : is the conversion from specific gravity (sg) to pound per gallon (ppg)

Pore Pressure Gradient

Pore pressure, also known as formation pressure or reservoir pressure, refers to the pressure of fluids within the pores of a rock. To determine pore pressure, methods such as Bowers' or Eaton's can be used. Terzaghi's effective stress principle defines the relationship between pore pressure, total stress, and effective stress. According to Terzaghi's principle (Terzaghi 1925), the effective stress is the difference between the total stress and the pore pressure, which can be used in conjunction with Eaton's or Bowers' methods to predict pore pressure accurately.

$$P_p = \sigma_v - \sigma \quad \textbf{(Equation \# 2)}$$

Where:

- P_p = Pore Pressure
- σ_v = Overburden pressure (total vertical stress)
- σ = Effective stress

Bowers' method (Bowers 1995) relates the effective stress to the seismic velocity. The formula is given as:

$$\sigma = \frac{1}{a}(V_{int} - V_{mudline})^{\frac{1}{b}} \quad \textbf{(Equation \# 3)}$$

Where:

- σ = Effective stress (usually in units of pressure such as psi or Pa).
- a = Empirical constant or coefficient, typically derived from calibration with well data.
- $Vi_{nt=}$ Interval velocity, which is the seismic velocity within a specific subsurface interval (often in units of m/s or ft/s).
- $V_{mudline}$ = Mud line velocity, which is the seismic velocity at the seafloor or the top of the sediment column (also in units of m/s or ft/s).
- b = Empirical constant or coefficient, similar to a, and is derived from data calibration.

Eaton's equation **(Eaton, 1975)** for predicting pore pressure (Pp) using sonic velocity data is given by:

$$P_P = P_o\_(P_o - P_h)\left(\frac{V_{norm}}{V_{abs}}\right)^n \quad \textbf{(Equation \# 4)}$$

Fracture Pressure Gradient

Fracture pressure is the minimum lateral stress that must be overcome to fracture the rock.

LOT is the best way to get an accurate value of the formation fracture pressure. The following formula published by **(Zoback, 2007)** is used taking into account the effective stress and pore pressure:

$$FG = K * \left(\sigma_{V-\alpha P_P}\right) + \alpha P_P \quad \textbf{(Equation \# 5)}$$

Where:

- FG = Fracture gradient
- K = Stress ratio or fracture gradient coefficient (dimensionless)
- σv = Total vertical stress or overburden pressure
- α = Biot's coefficient (dimensionless), typically ranges between 0 and 1
- Pp = Pore pressure

Data Availability

Data availability is a crucial aspect of the pore pressure prediction workflow, as the accuracy and reliability of the models depend heavily on the quality and extent of the data used. In this study, the following types of data were available and utilized:

Well Logs:

- Well log data from two discovery wells (Well-1X & Well-2X). These logs included gamma ray, resistivity, sonic, density, neutron and other relevant logs.
- Four Pseudo wells distributed in the study area including synthetic logs like sonic and density derived from velocity curves coming from velocity cube (Pseudo Well-1, Pseudo Well-2, Pseudo Well-3 and Pseudo Well-4).

Seismic Data

- A total of thirty seismic lines covering the study area were available.
- Geological and Geophysical Reports: Access to geological and geophysical reports for the wells and previous studies for the study area provided additional context and background information on the study area's stratigraphy, structural features, and depositional environments. These reports were valuable for interpreting the well log and seismic data, aiding in the construction of more accurate models.

Workflow

In this study, the pore pressure prediction has been done following a two-step workflow that began with 1D modeling followed by 3D modeling**.**

1D Modeling using Techlog (Schlumberger Software):

- The workflow's first stage was devoted to modelling 1D pore pressure. The 1D models were built using the well logs and velocity curves that were available.
- Pore pressure was predicted by analyzing the well data using Schlumberger Techlog software. This involved estimating the pore, fracture, and overburden pressures (Figure 2).
- The 1D models provided a detailed vertical profile of pore pressure at specific well locations, enabling the identification of pressure regimes and overpressure zones.

Using the aforementioned formulas, 1D pore pressure prediction was carried out for the wells under study, producing six pore pressure profiles for those wells (Figure 3a, b, c, d, e & f). The 3D workflow then used these profiles as control points to create 3D cubes representing pore pressure, fracture pressure, and overburden pressure. The subsurface pressure distribution was represented with more accuracy and comprehensiveness because to this integration.

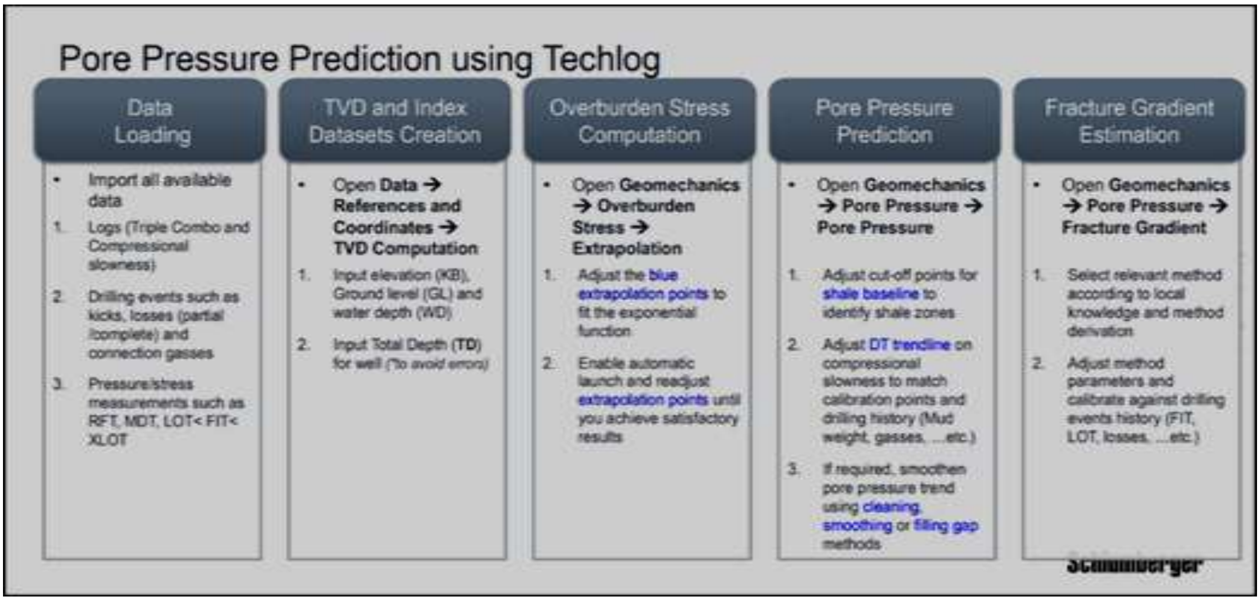

Fig. (2): Simplified 1D Pore Pressure Prediction Workflow Using Techlog Software

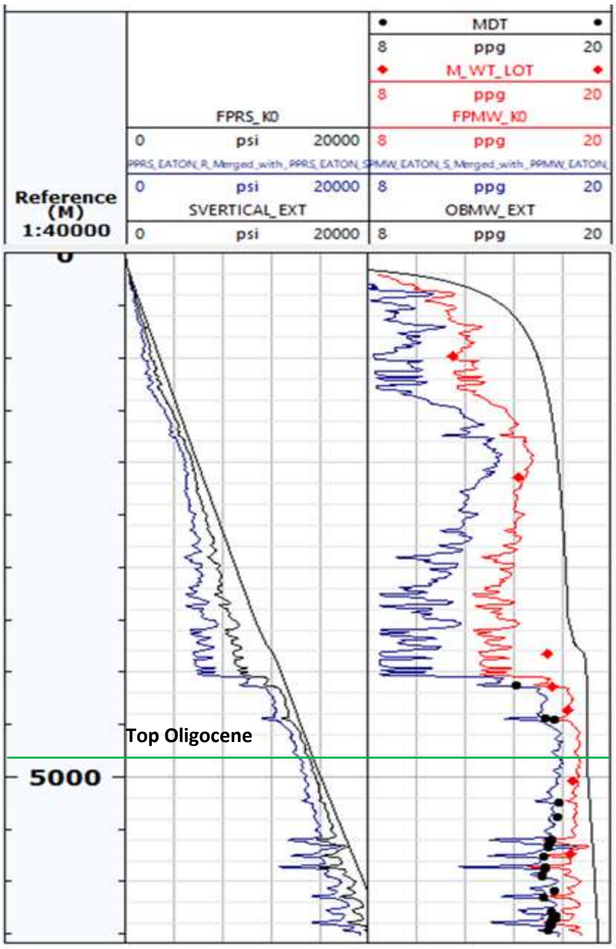

Fig. (3a): Pore Pressure Profile of Well-1X, Baltim Field

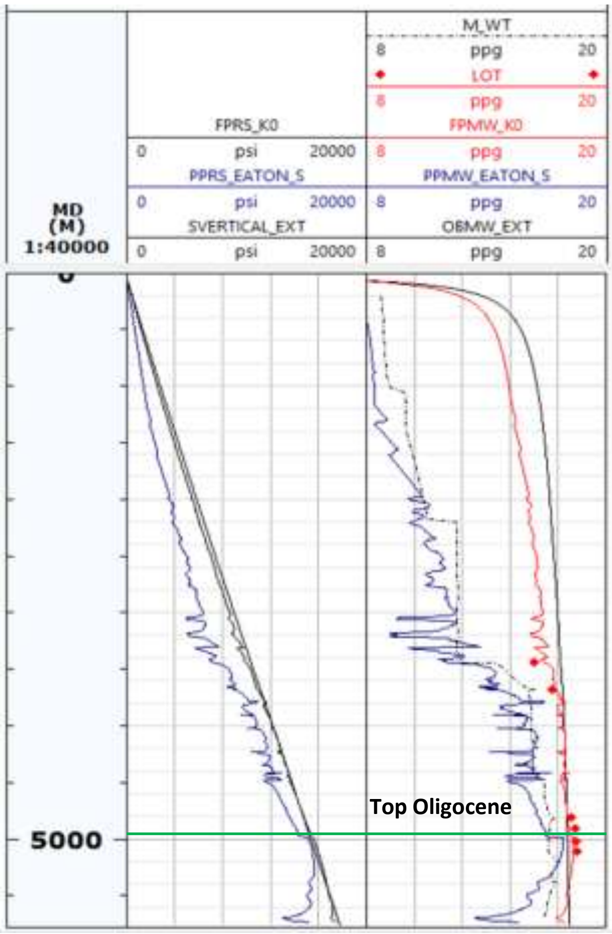

Fig. (3b): Pore Pressure Profile of Well-2X, Baltim Field

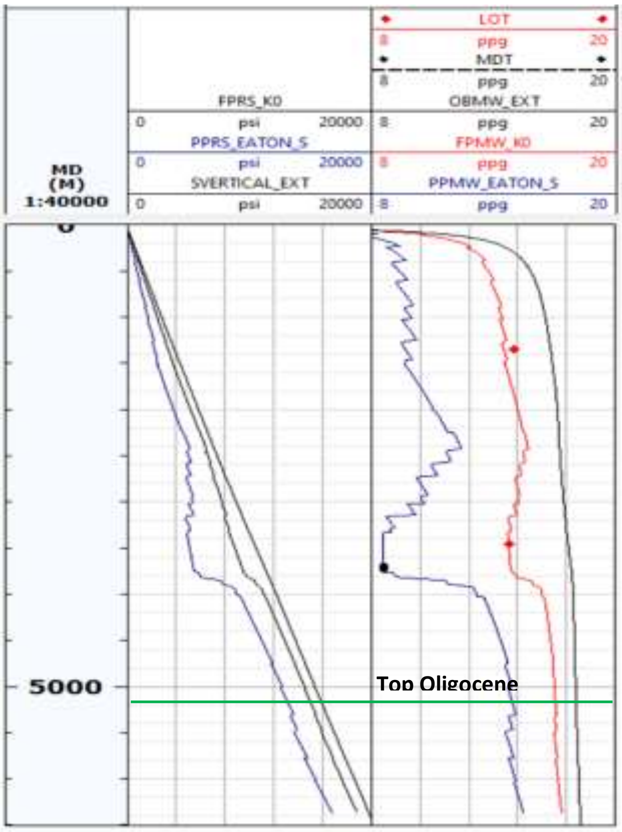

Fig. (3c): Pore Pressure Profile of Pseudo Well-1, Baltim Field

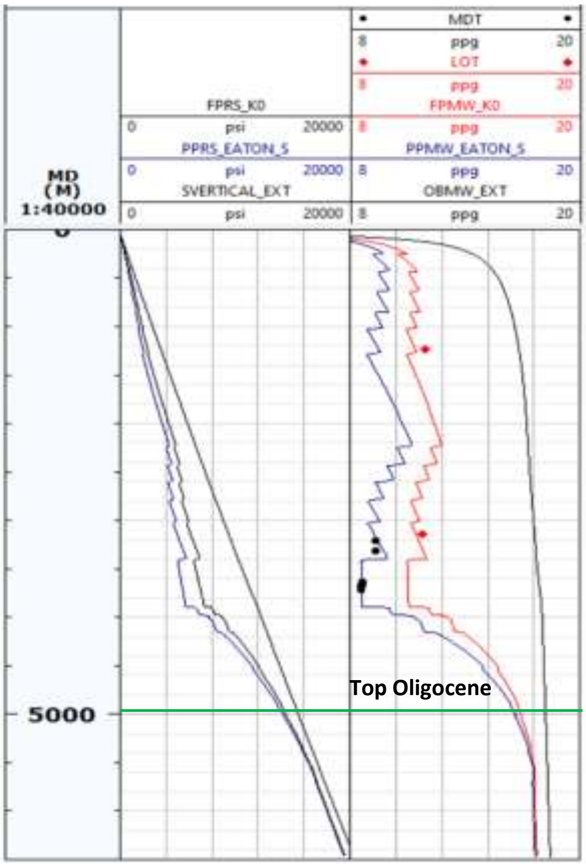

Fig. (3d): Pore Pressure Profile of Pseudo Well-2, Baltim Field

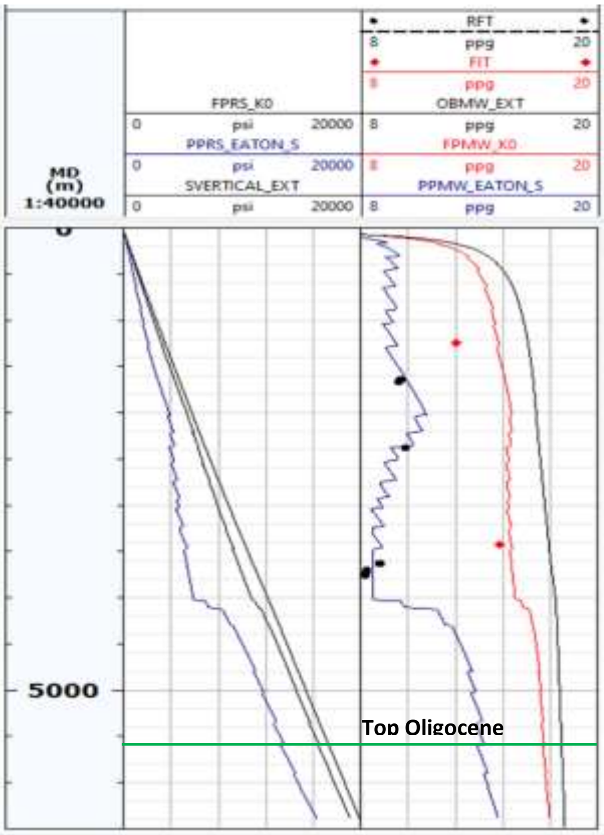

Fig. (3e): Pore Pressure Profile of Pseudo Well-3, Baltim Field

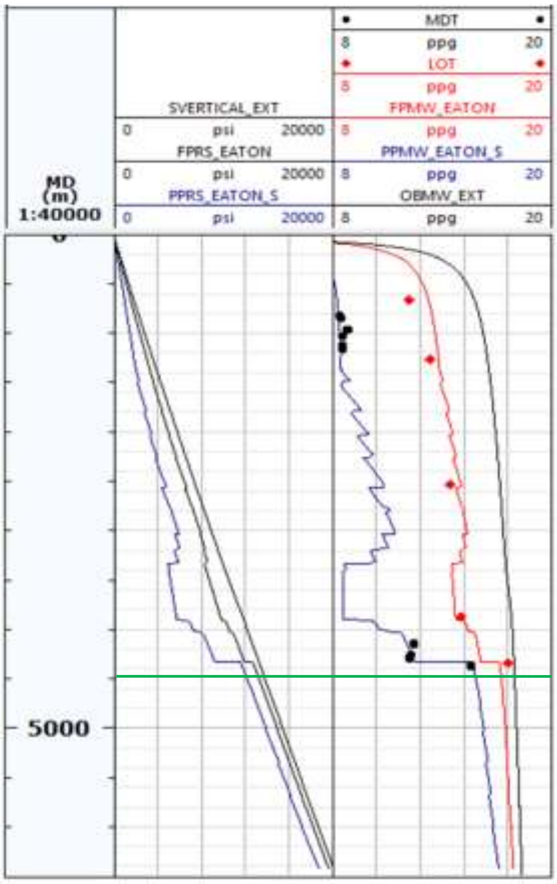

Fig. (3f): Pore Pressure Profile of Pseudo Well-4, Baltim Field

3D Modeling using Petrel (Schlumberger Software):

- A 3D model was then built using the inputs from the 1D modelling findings.
- The purpose of this 3D model's development was to offer a thorough geographic depiction of the distribution of pore pressure throughout the research area.
- By combining seismic velocity data with the outcomes of 1D modelling, the 3D model was improved, guaranteeing more precise pore pressure prediction.
- By using the 3D pore pressure static model, the risk assessment and decision making for exploration and drilling projects especially the deeper ones that have HPHT character will be easier.

Making a 3D velocity cube with seismic lines, check shots, VSPs, and well data was the initial stage in the 3D procedure. After that, Gardner's equation was used to create a density cube. Overburden pressure cubes were then created by applying Zoback's formula. To construct the pore pressure cube, both Zoback and Bowers formulas were employed. The final step was to obtain the fracture pressure cube using the property distribution workflow. All these steps were carried out using Petrel software. To evaluate the seal integrity of the proposed locations for future prospects, the pore pressure cube was subtracted from the fracture pressure cube. A positive value indicated a sufficient margin between fracture pressure and pore pressure, suggesting the presence of a regressed pressure reservoir. This implies that the reservoir is likely to maintain its hydrocarbons without significant risk of leakage. Conversely, a negative value indicated that the pore pressure exceeded the fracture pressure, raising the risk of hydrocarbon escape to lower pressure areas. Such locations, even with good structural closures, are considered risky. This 3D workflow has been done for the Oligocene reservoirs (Tineh Formation) which subdivided in to six sandstone reservoirs starting from Oligocene-1 to Oligocene-6, in this study we focused on Oligocene-3 as it is the best reservoir facies. Figures (4 - 8) showing the output from this workflow.

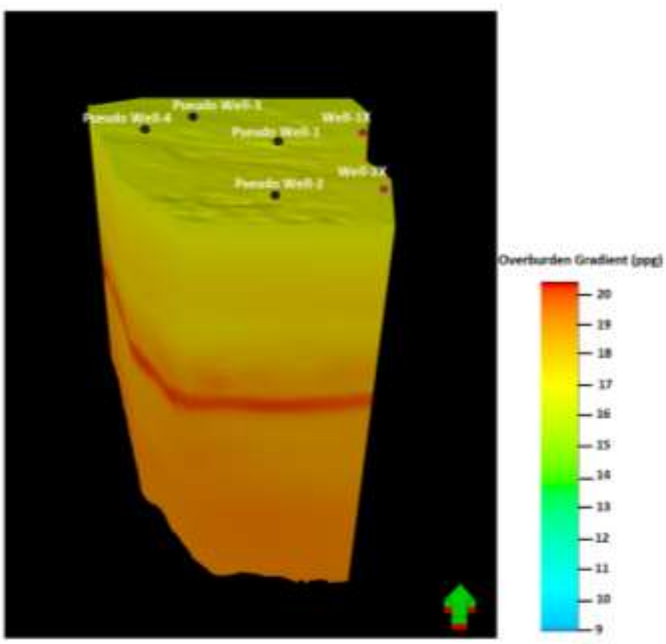

Fig. (4): 3D Overburden Pressure Gradient Cube

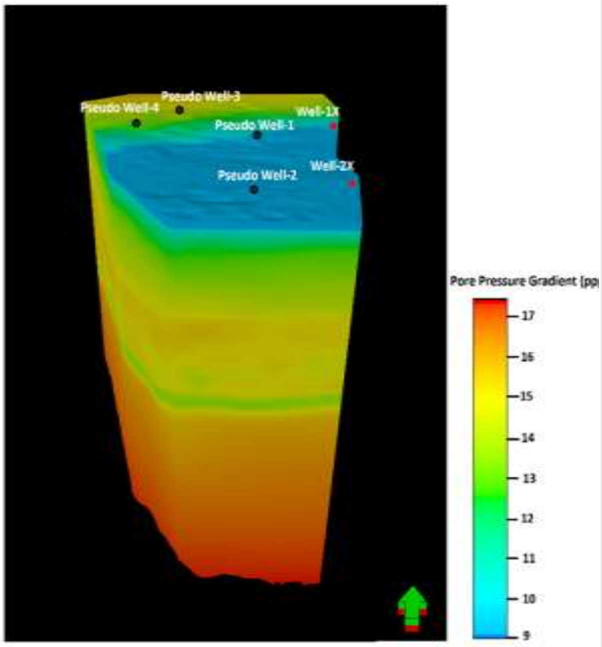

Fig. (5): 3D Pore Pressure Gradient Cube

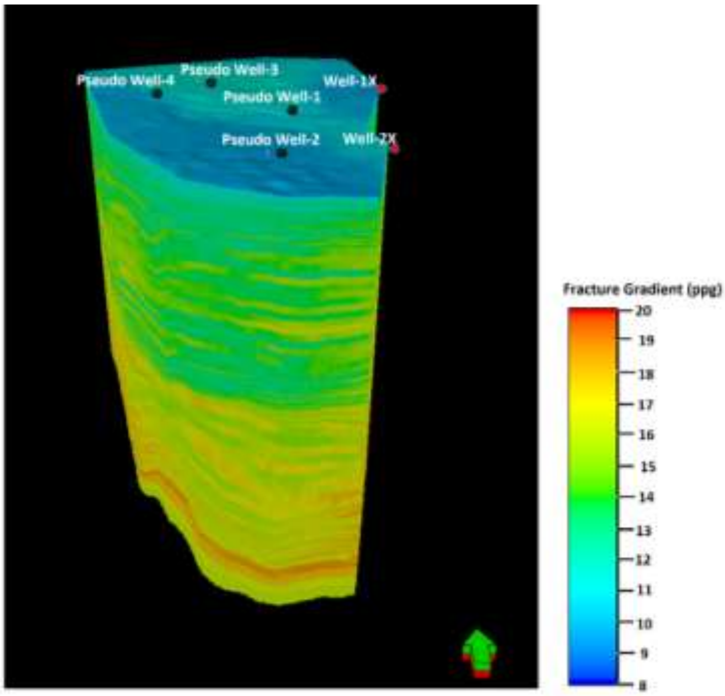

Fig. (7): 3D Fracture Pressure Gradient Cube

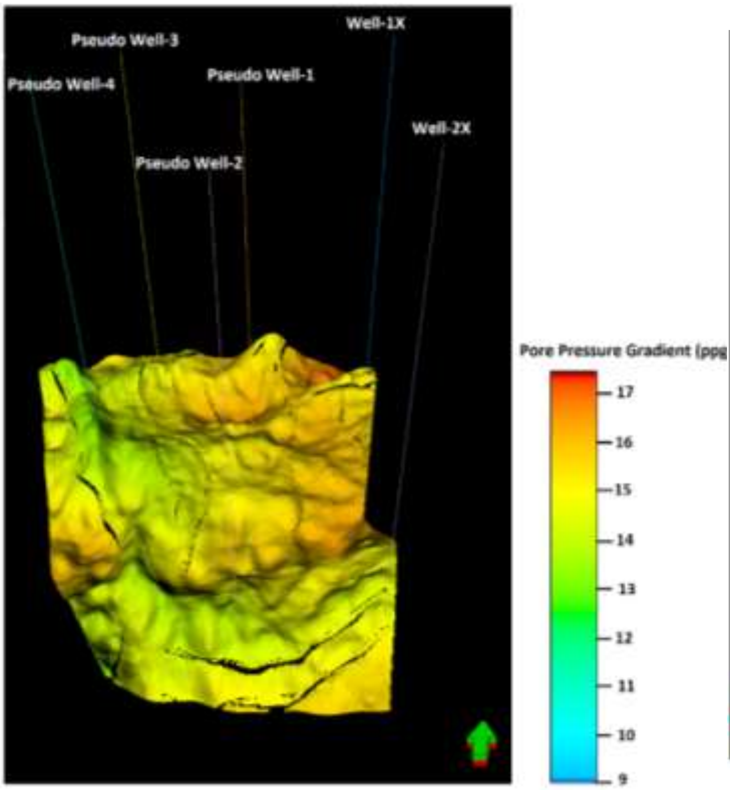

Fig. (6): 3D View of Pore Pressure Gradient of Top Oligocene-3 Reservoir

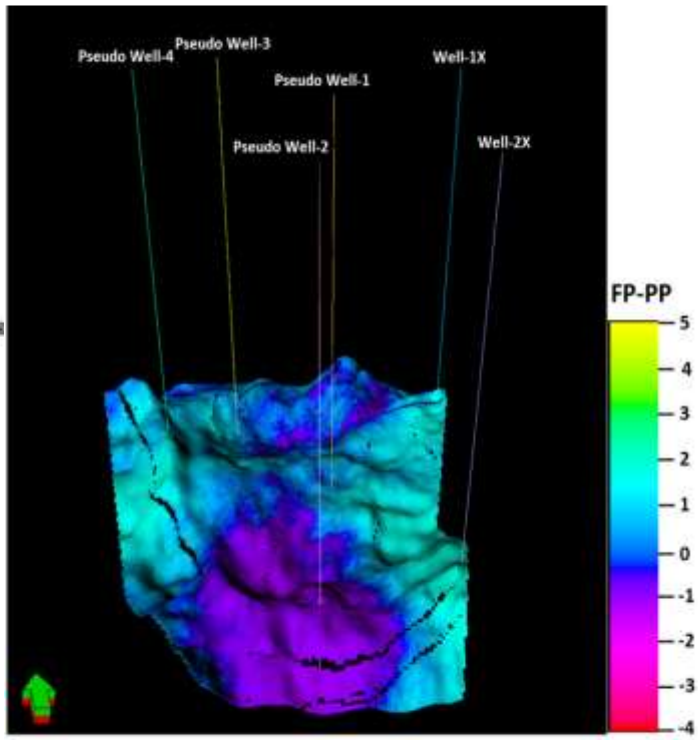

Fig. (8): 3D View of Top Oligocene-3 Reservoir Seal Integrity

RESULTS

- After applying both 1D and 3D pore pressure prediction workflows, the following results were obtained:

- Six pore pressure profiles for two discoveries and four proposed locations as exploration prospects.

- 3D overburden, pore pressure and fracture cubes can be used for the future to extract the overburden, pore pressure or fracture pressure profile for any proposed location in the study area besides the future modeling of the area geomechanics.

DISCUSSIONS

Discussion of 1D Pore Pressure Prediction Results:

After applying the 1D pore pressure prediction workflow, six pore pressure profiles were generated for two discovery wells (Well-1X and Well-2X) and four proposed exploration locations.

Key Observations from 1D Results:

Pressure Ramp Characteristics:

A distinct pressure ramp was observed starting immediately after the Abu Madi formation, reaching its peak in the Oligocene section. This indicates a significant increase in pore pressure with depth in this geological interval.

Discovery Wells Analysis

Well-1X: The difference between pore pressure and fracture pressure in Well-1X provided sufficient room to preserve hydrocarbons in most of the drilled reservoirs. However, some reservoirs exhibited poor porosity and permeability, affecting their ability to retain hydrocarbons effectively.

Well-2X: the margin between pore pressure and fracture pressure was adequate only in the last reservoir unit. The upper reservoirs lacked sufficient margin to act as regressed pressure reservoirs, inhibiting hydrocarbon accumulation. An important observation in Well-2X was the narrow margin between fracture pressure and overburden pressure in the Oligocene section. This margin became negative, indicating that fracture pressure exceeded overburden pressure, likely due to the reverse faults formed by the compressional movements of the Syrian Arc during the Oligocene.

Proposed Wells as Exploration

Pseudo Well-2: The pressure profile of Pseudo Well-2 showing that the pore pressure trend increased rapidly at the beginning of Oligocene section and become more than the fracture pressure of the overlaying cap rock which has a bad impact on the hydrocarbon accumulation. The other profiles of the three pseudo wells didn’t show any abnormal changes which mean that wells are locating in normal pressure regime.Prospects:

Discussion of 3D Pore Pressure Prediction Results

The 3D pore pressure cube, created from the integration of seismic lines, check shots, VSPs, and well data, provides a comprehensive tool for future pore pressure profiling and geomechanical modeling in the study area.

Key Observations from 3D Results:

Risk Assessment Based on Pressure Differences:

By subtracting the pore pressure cube from the fracture pressure cube, the study identified some high-risk areas and other low risk areas :

Pseudo Well-2: The location of Pseudo Well-2 is deemed very risky despite the presence of good structural closure. The high-pressure regime in this area likely prevents hydrocarbon accumulation, making it a less favorable location for exploration.

Pseudo Well-1and Pseudo Well-3: Although the two well locations are acceptable from the high pore pressure regime point of view, but still they have some concerns from the s tructure point of view.

Pseudo Well-4: As this well located in low pressure regime and also has a very good structure, so it was the best location as an exploratory prospect to be drilled in the future.

Conclusions

Understanding the subsurface pressure regimes of the research area has been made possible by the merging of 1D and 3D pore pressure prediction procedures. The results underline crucial areas for safe and efficient hydrocarbon exploration, highlighting in particular the significance of taking fracture pressure and pore pressure into account when evaluating the viability of reservoirs and seal integrity. Specifically, the 3D pore pressure cube is a powerful tool that can be used for geomechanical modelling both now and in the future. This helps with the strategic planning of exploration and drilling operations.

Recommended future work

The exploratory Pseudo Well-4 should be drilled since it is in the ideal location in terms of structure and pore pressure regime. It also has an excellent seal integrity, which is indicative of hydrocarbon accumulation.

Acknowledgements

The Egyptian General Petroleum Corporation and Belayim Petroleum Company are much appreciated by the authors for granting permission to get the data used in this paper.

References

Bourgoyne, A. T., Millheim, K. K., Chenevert, M. E., & Young, F. S. (1991). Applied Drilling Engineering. SPE

Bowers, G.L. (1995). "Pore pressure estimation from velocity data: Accounting for overpressure mechanisms besides undercompaction." SPE, 10(02): 89-95.

Cohen, M. C., & McClay, K. R. (1996). Sedimentary Basins and Petroleum Geology of the Middle East. Elsevier, 215-231.

Dake, L. P. (2001). The Practice of Reservoir Engineering (Revised Edition). Amsterdam: Elsevier.

Dolson, J., Boucher, P., Casford, K., et al. (2001). Petroleum Potential of the Nile Delta. AAPG, 85(5): 641-662.

Eaton, B.A. (1975). "The equation for geopressure prediction from well logs." SPE, 5544.

Fossen, H. (2016). Structural Geology (2nd Edition). Cambridge: Cambridge University Press.

Hearn S, Meulenbroek A (2011) Ray-path concepts for converted-wave seismic refraction. Explor Geophys 42:139–146

Hegazy, I., & Rizzini, A. (1990). Messinian Salinity Crisis and its Implications for Hydrocarbon Exploration in the Nile Delta Basin. JPG, 13(2): 199-214.

Jamali J, Sokooti MR (2008) Processing of vertical seismic profiling information of well Sefid Zakhour -1. Exploration Direction of NIOC.

Mascle, J., & Benkhelil, J. (1990). The Geodynamic Evolution of the Eastern Mediterranean Basin. Tectonophysics, 182(1-2): 1-20.

Rizzini, A., Cococcioni, R., & Gava, R. (1978). Sedimentary Evolution of the Nile Delta Area. Marine Geology, 27: 261-276.

Swarbrick RE, Seldon B, Mallon AJ (2005) Modelling the Central North Sea pressure history. Petroleum Geology Conferences Ltd

Terzaghi, K. (1925). "Principles of soil mechanics: IV - Settlement and consolidation of clay." ENR, 95(19): 742-746.

Zoback, M. D. (2007). Reservoir Geomechanics. Cambridge University Pres.

نموذج ثلاثي الأبعاد سكوني للتنبؤ بضغط المسام باستخدام سرعة الموجات السيزمية لتقييم إمكانات الهيدروكربونات في مصائد الأوليجوسين، حقل غاز بلطيم ، حوض دلتا النيل، مصر

ا.د./ حسن حسن القاضى[1] ، خليل جاد[2]

١ـ قسم الجيولوجيا، كلية العلوم، جامعة الأزهر، مدينة نصر، القاهرة، مصر.

٢ـ شركة بترول بلاعيم، مدينة نصر، القاهرة، مصر.

دلتا النيل، الواقعة في شمال مصر، تعتبر من أهم مناطق الغاز المعروفة باحتياطاتها الهيدروكربونية الواسعة بسبب التتابع الرسوبي الذي يشير إلى إمكانات غازية كبيرة. يقع حقل بلطيم في المنطقة البحرية لوسط دلتا النيل، على بُعد حوالي ١٠ كيلومترات من السواحل المصرية. ومع تحول معظم الخزانات الرئيسية المنتجة من رواسب العصر الميوسيني إلى حقول متقادمة، أصبحت الحاجة لاكتشاف الخزانات الأعمق من العصر الأوليجوسين (تكوين طينة) ضرورة ملحة. يُعد التقدير الدقيق لضغط المسام أمرًا بالغ الأهمية لاستكشاف وحفر هذه الخزانات العميقة. إحدى آليات الفشل الأكثر شيوعًا لهذه الخزانات العميقة هي الضغط المرتفع غير الطبيعي للمسام، حيث يمنع تراكم الهيدروكربونات مما يؤدي إلى هروبها إلى خزانات ذات ضغط منخفض. كذلك يمكن أن يتعرض تكامل المصيدة للخطر في حالة الضغوط العالية، خاصة في تكوينات الأوليجوسين. علاوة على ذلك، فإن التنبؤ بالضغط الجيولوجي يعد أمرًا بالغ الأهمية في تخطيط الآبار المستهدفة لهذه الخزانات العميقة. تهدف هذه الدراسة إلى التحقيق في العلاقة بين سرعة الموجات الزلزالية وضغط المسام في حقل بلطيم الغازي. من خلال استخدام بيانات سرعة الموجات الزلزالية، نسعى إلى تطوير نماذج تنبؤية لتقدير ضغط المسام بدقة في هذا السياق الجيولوجي. تم استخراج منحنيات السرعة من البيانات الزلزالية، وتمت حسابات ضغط المسام في كل من الأبعاد الأحادية والثلاثية. أسهم هذا النوع من النماذج في تقييم احتجاز الهيدروكربونات في خزانات الأوليجوسين، بالإضافة إلى التخطيط والتصنيف لأفضل المواقع لحفر الآبار الاستكشافية.