

## Subsurface Structural Modeling in Assumoud and Sahl Gas Fields, Sirte Basin, Libya

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### Abstract

The area of study Assumoud and Sahl fields are situated in the southeastern Sirte Basin within Wadayat trough. Using seismic imaging and interpretation of the basin structures, as well as the interpretation and analysis of other geological and geophysical data, and modeling over the areas of interest, the study aims to delineate the major and minor subsurface structures that dominated the area. A structure maps were created for top Mulallah, top Etel and top Sheghega and construct a structural model for the area of study then many cross-sections were taken to the area model. The analysis of these maps show that the area uplifted in the late Cretaceous.

### Keywords :

#### 1.Introduction

Libya will be a standout amongst those biggest oil What's more characteristic gas handling nations on africa. Currently, those Normal preparation rate On libya will be around 1. 74 million barrels about oil Every day. However, this rate camwood build with a All the more nitty gritty examination of the structural skeleton and nature of the reservoirs inside libyan transforming basins.

The handling sedimentary basins On libya are those Sirte, Ghadamis, Murzuq Basins, the country's real 320 handling oil & characteristic gas fields would included inside the Sirte, Ghadamis, Murzuq Basins Fig (1), around 80% from claiming these fields were found former will 1970 [11].

Those Sirte bowl will be a Mesozoic-Tertiary sedimentary age, it blankets an aggregate surface range of something like 600,000 km<sup>2</sup> clinched alongside focal Libya, holds 89% for Libya's saves What's more will be positioned 13th Around the world's petroleum basins Furthermore holds 16 titan oil fields. Supply rocks run in agdistis starting with Precambrian will eocene [4]. Those upper cretaceous Sirte shale is those real wellspring rock. It speaks to An thick succession that gathered clinched alongside real grabens same time shallow-marine carbonates Also reefs gathered with respect to contiguous horsts Also platforms to structure major supply rocks. The Sirte bowl may be limited by those mediterranean ocean to the north. The contemplate region will be An and only concession 6 have a place with the SirteOil shares of the organization. This concession is arranged the middle of 19° 58" - 20°02"E and 29° 27" - 29°32"N. Fig (3) [1]. Investigation partake) energizes north concession 6 off done 1960 with the finding of the Assumoud field. In 1963 the Hateiba field might

have been discovered, taken after Eventually Tom's perusing Attahaddy field done 1964 and the Sahl field Previously, 1962. In the territory of study, investigation began to might 1965 Toward penetrating those ZZ1-6 well, which arrived at Cambro-Ordovician strata at an aggregate profundity for 10319 feet sub-sea. The great might have been dry. In september 1965 those DDD1-6 great might have been penetrated to an aggregate profundity for 9716 feet What's more also tried dry. [5]. The northern and only concession 6 is possibility should need possibility just to new discoveries of gas since at four uncovered hydrocarbon fields in the territory hold numerous main gas. Those encompassing gas fields would those Assumoud What's more Sahl fields of the southeast, those Hateiba field of the north-west and the Attahaddy field of the west. The chose territory (involving the Sahl&Assumood gas fields) might have been focused to transforming gas. The Sahl field possibility to profound gas need been practically wiped out. For example, arrangement from claiming water might have been recouped from both Bahi.

Waha intervals tried for O2-6 great which will be found on the most elevated bit of the structure.

Those investment gas bearing intervals need aid those Sheghega (Gialo) and Ruaga (khier, harsh, What's more zelten) formations. Those highest bit of the working eocene Sheghega (Gialo) carbonate creation and the lowermost part of the Mabruk (Khalifa) limestone part of the Heira(hagfa)formation are those supply intervals in the Sahl gas field. Those Sheghega (Gialo) carbonates are those principle supply interim of the Sahl field. The overlying Etelshales structure the caprock of the structural Conclusion on the Sheghega (Gialo) top banana [4].

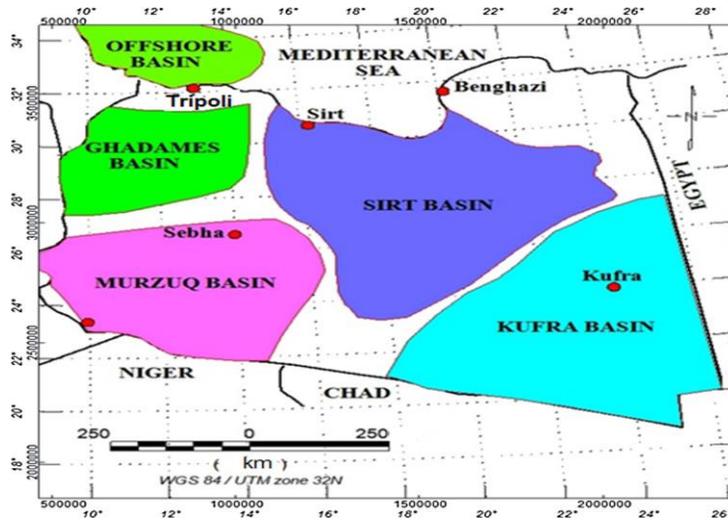


Fig (1) Location map of Libya showing the main sedimentary basins (6).

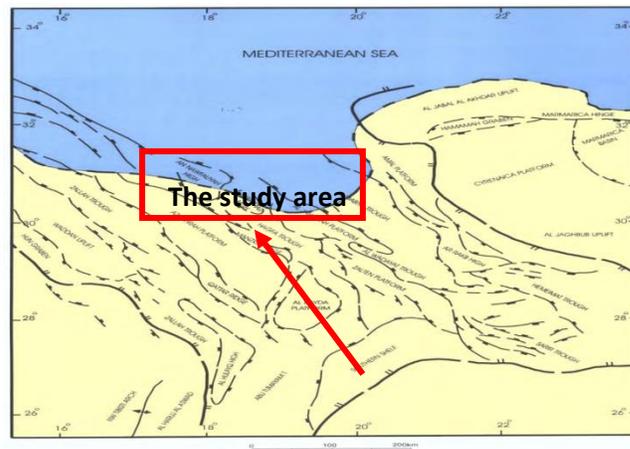


Fig (2) Tectonic elements of Sirte Basin.

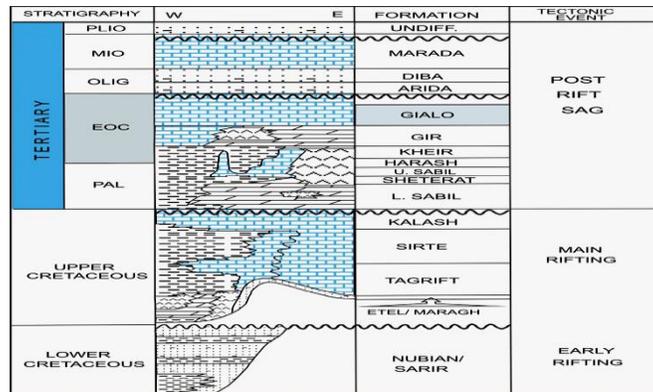


Fig (3) Generalized stratigraphic/lithologic correlation chart of the Upper Cretaceous and Tertiary succession of the Sirte Basin.

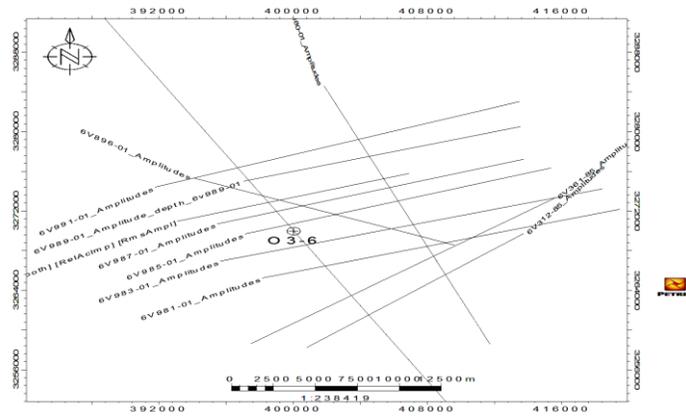


Fig (4) Base Map of the area of the study showing the seismic lines and well.

### 1.1 Tectonic effects

Those framing of the libyan transforming basins might have been accepted with be identified with the opening historical backdrop of the atlantic sea and the merging the middle of african Furthermore eurasian plates. These basins representable separate depositional environments, extending starting with mainland will marine deposits, which enabled An ideal setup for distinctive sourball What's more supply rocks, and in addition seals inside these basins.

Those silt setup inside these basins might have been regulated by storm cellar structures which need partitioned the whole bowl under an arrangement for troughs and platforms. Those northern edge of the african Plate, the place the Sirte bowl will be located, might have been influenced Eventually Tom's perusing an arrangement of tectonic development exercises coming about because of those tectonic development collaboration the middle of those african and eurasian plates. [8]. Such tectonic development exercises bring framed the structural features of the Sirte bowl. The structuring of the Sirte bowl might have been connected with an arrangement about subsidence occasions which brought on a amount about troughs along E-W inclining basements faults Throughout those early cretaceous and NW-SE inclining cellar faults Throughout the late cretaceous. These occasions brought on the Sirte bowl should a chance to be described Eventually Tom's perusing an arrangement about northwest-trending troughs differentiated Eventually Tom's perusing an arrangement from claiming platforms, which extends 600 km in the east-west bearing starting with hun Graben in the west of the Cyrenaica stage in the east. These structures are clouded Toward An thick sedimentary disguise [1].

### 1.2 The topography of Sirte basin

The topography of the Sirte basin is variable from 330 m above sea level in the Dahra Platform to - 27.50 m below sea level in the north of the Agedabia trough. The lowest part is situated close to the coastline near the Gulf Sirte and coincides with the tectonic subsidence calculated by [10] for the most recent phase (49 Ma-present). More than 7 Km sediment thickness was accumulated in the deepest part of the basin (Agedabia trough) in the eastern part of the Sirte basin in Mesozoic and Cenozoic ages (98.9 Ma-0 Ma). Thickness of the sedimentary section in the Sirte basin varies from more than 7 km (4.3 mi) in the northeastern offshore Agedabia Trough to 1 km (0.6 mi), south of the Sarir trough, along with the Nubian uplift [9].

### 1.3 Dominant Petroleum System within the Sirte basin

Within the Sirte Basin, the Upper Cretaceous Sirte Shale is the major source rock. It represents a thick sequence that accumulated in major grabens while shallow-marine carbonates and reefs collected on adjacent horsts and platforms to form major reservoir rocks. In contrast to Ghadamis&Murzuq, which were formed during the Paleozoic, the majority of the hydrocarbons reserved within the Sirte basin were found to be of Mesozoic age.

The Sirte basin is characterized by one dominant petroleum system, the Sirte-Zelten, which is subdivided into four assessment units, two reflecting established clastic and carbonate reservoir areas and two defined as hypothetical units.

### 1.4 Major Reservoirs within the Selected Area

The chose territory (involving those Sahl & Assumood gas fields) might have been focused for

generating gas. Sahl field possibility for profound gas need been practically wiped out. For example, creation water might have been recouped starting with both Bahi and Waha intervals tried Previously, O2-6 great which may be placed on the most noteworthy bit of the structure.

Those investment gas bearing intervals would the Sheghega (Gialo) Also Ruaga (khier, harsh, and zelten) formations. The highest bit of the center eocene Sheghega (Gialo) carbonate arrangement and the lowermost part of the Mabruk (Khalifa) limestone part of the Heira(hagfa)formation would those supply intervals in the Sahl gas field. Those Sheghega (Gialo) carbonates would those fundamental supply interim of the Sahl field. Those overlying Etelshales type the caprock of the structural Conclusion on the Sheghega (Gialo) top banana.

Those Assumoud field produces gas primarily from those more level oligocene Arida Formation, the white collar eocene Sheghega (Gialo) nummulitic – micritic limestone and the Bahi /Gargaf framing those (Gialo). In 1960, An finding great H1-6 might have been penetrated Also encountered gas in the zmam (Kalash) segment.

The Domran (gir), Ruaga (khier, harsh, and zelten) & Mabruk (Khalifa) formations are the underlying carbonate intervals over plunging request. Those Heira (hagfa)shales, which overlies those upper cretaceous zmam (Kalash)formation would discovered over the whole Sahl field.

Those Soana (Sirte) shale framing Furthermore its limy / dolomitic proportional Waha carbonates would Additionally found in the Sahl wells. The Soana (Sirte) arrangement may be absent the place Waha framing straightforwardly overlies those Cambro-Ordovician Gargaf framing. The Bahi or nubian classics of the non – marine depositional cycles Might great make found Likewise thick intervals in the Cambro-Ordovician paleo-lows.

### 1.5 Sheghega (Gialo) formation

It may be made basically of limestone. The upper parcel is white –light gray, medium with hard micritic –biomicritic, Sporadically pasty limestone with a few shaly intercalations. Scattered mud substance (shaleness) is moderately higher in the upper part. Noticeable intergranular pores need aid introduce over this interim. The more level parcel will be comprised from claiming comparable Be that as that's only the tip of the iceberg bioclastic (Nummulitic) limestones for generally lesquerella shaly intercalations What's more scattered dirt substance. Unmistakable intergranular pores would Additionally introduce over this interim.

Generally, for those chose area, those Gialo creation may be translated with comprise about six sedimentary facies What's more 14 microfacies. The primary bioclastic segments are bigger benthic foraminifera, particularly nummulites, as well as Discocyclina What's more Operculina, and also planktonic foraminifera and other bioclasts. The facies were predominantly stored under shallow-marine states inside the photic zone, Likewise shown Toward the predominant photozoan fauna, divided bioclastic debris, What's more textures. Sedimentation occurred ahead an expansive carbonate platform, mainly for ramp-type, for higher-energy foraminiferal banks Furthermore fore-bank areas, What's more quieter-water open-marine Furthermore lagoonal (back-bank) environments, for lime muds saved for deeper-water territories.

### 2. Materials and methods

Those fundamental structural skeleton is made dependent upon secret word geophysical surveys. Then, those subsurface general stratigraphy of the Sirte basin, and additionally the ponder area, may be made based upon previous investigations. Following that, the supply tops, and also supply characterization, will make made based upon the petrophysical translation of the accessible great logs for Assumoud & Sahl fields. Finally, the speed information will a chance to be used to change over those structural period –maps of the chosen horizons got from seismic understanding under profundity maps for those upper Also easier limits of the horizons. Thickness maps could accordingly be constructed to those chose horizons which would recommended to a chance to be possibility reservoirs. Also, An All the more point by point structural dissection from claiming Assumoud&Sahl fields is created starting with those seismic understanding on depict those supply topsail through the fields Also on explore future prospects for penetrating. [3]. This study is In view of those material acquired from those TDL (Technical information Library) of the Middle Eastern Gulf oil organization (AGOCO). Geophysical information incorporate 2D What's more 3d seismic profiles, Also wireline logs. Different information incorporate geological reports and great logs. Those seismic information contain 12 lines for last stacked seismic profiles of reflection seismic survey, those seismic scope may be a uniform Furthermore some other profiles need aid haphazardly turned.

The technique utilized within this investigation pointed at those mix about geophysical Furthermore geological viewpoints. The seismic reflection procedure is used to give acceptable those fundamental structural control of the subsurface

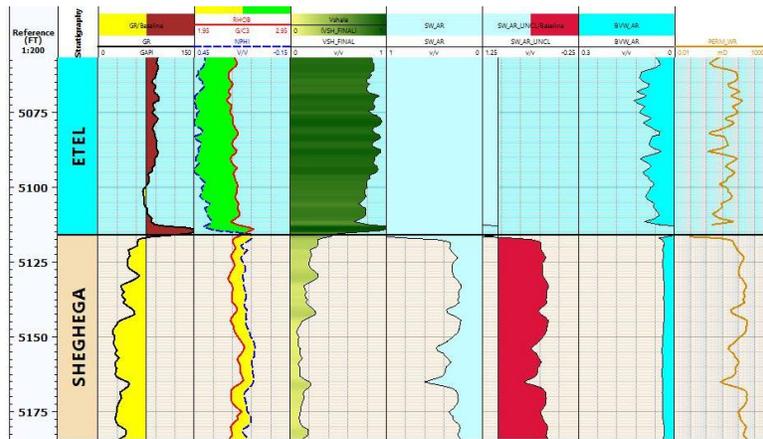


not yield a significant flow of water. Such “tight” rocks are usually artificially stimulated (fractured or acidized) to create permeability and yield a flow. Permeability is part of the proportionality Constantin Darcy's law which elates discharge (flow rate) and fluid physical properties (e.g. viscosity), to a pressure gradient, applied to the porous media Fig (5)

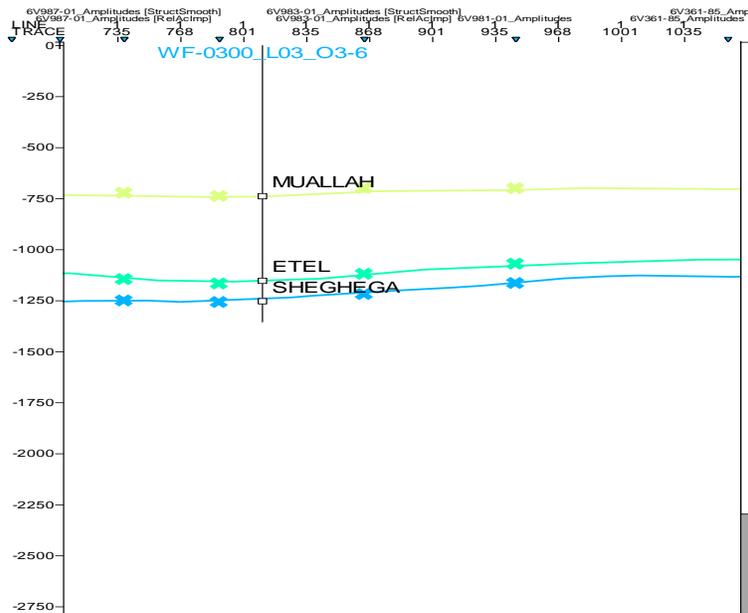
**3.Results and discussion**

It will be An immediate one dimensional model for acoustic vitality going through those layers of the earth. Those engineered seismogram is created

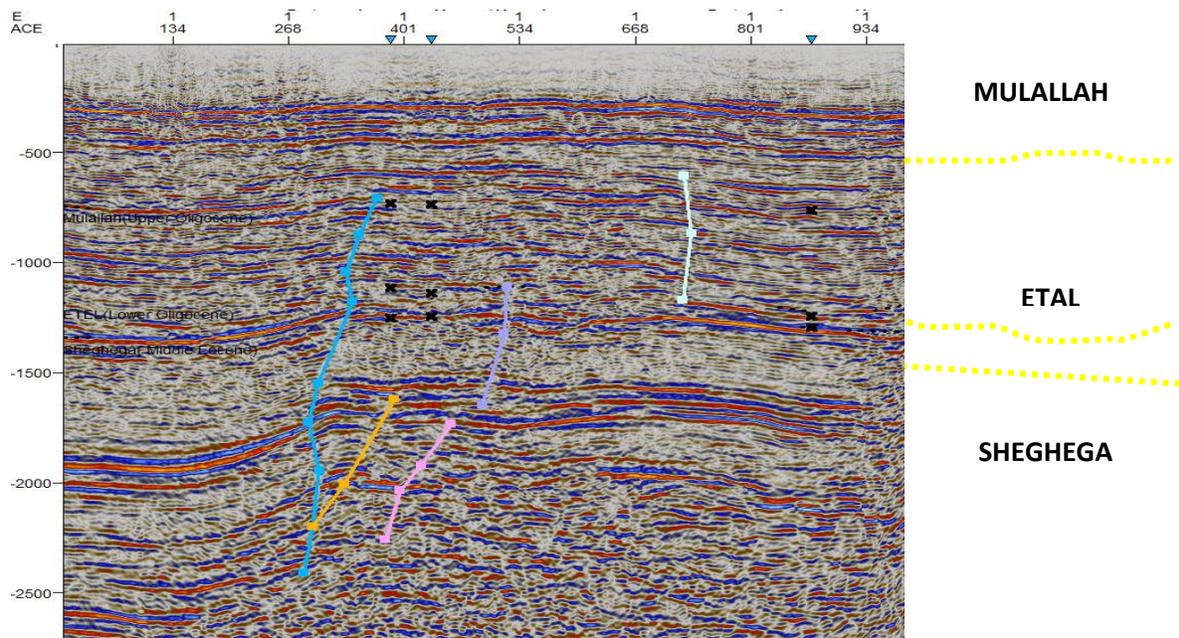
Eventually Tom's perusing convolving those reflectivity inferred starting with digitized acoustic What's more thickness logs with the wavelet inferred from seismic information. By comparing marker beds or different relationship focuses picked ahead great logs for major reflections on the seismic section, interpretations of the information could a chance to be progressed. In this study, there would no thickness logs In this way those checkshot about great O3-6 used to discover those two approach occasion when (TWT) of the topsail of the intriguing formations fig [6] The point when contrasted with the seismic area number( 6V854-93) fig (7).



**Fig (5)** Water Saturation Sw and Permeability K in Different Zones in Well O3-6



**Fig (6)** Well O3-6 tying with Seismic line 6V854-93



Those To begin with target of seismic information elucidation may be to process structure two path the long run (TWT) maps to highest point Mulallah, top banana Etel, Also top banana Sheghega At that point utilizing the mathematical statement that concentrated starting with the relationship the middle of TWT Furthermore Z esteem (Fig. 8) to those formations to change over the greater part TWT maps should profundity maps (Figures9, 10 Furthermore 11). An point by point 3d model of the field need been constructed Toward those mix about seismic Furthermore great logs (Fig. 12). Information integrative might have been encouraged Toward those PetrelTM, Schlumberger's supply demonstrating programming. The coordinated circuit model need been used to help key operational and supply improvemen choices. The cross-sections (Fig. 13) constructed from those 3d supply model for A large number directions of the consider area, hint at the parallel Also verthandi development of the diverse horizons Furthermore their thickness including faults Also folds.

Those examination about these maps indicates that those range inspired done late cretaceous because of NE-SW compressional energy shaping anticline which shows up in the E-W cross-section, after that this anticline faulted toward those limps which structure those stature in the center of the segment. Also, it gives the idea from those profundity maps that those region need An all soak incline to the south Concerning illustration On the whole profundity maps. From those last, we camwood distinguish that

those best puts for new prospects in the center of the region that however on be those trap to the hydrocarbon that might have been migrated from those south.

Those calculations were connected with every last one of examined great with recognize the petrophysical properties about every supply zone (Table 1) demonstrates those cutoff qualities to both supply What's more pay intervals. The point when applying the cutoffs of the came about values for separate zones get that the Sheghega structuring will be a high-quality supply with permanganic corrosive 1445 millidarcy What's more hydrocarbon immersion 49 %in medium porosity 21 % which will be acknowledged useful medium.

#### 4. Determination

From the last, we camwood remember that the best spots to new prospects in the center of the territory that however should be the trap for the hydrocarbon that might have been migrated starting with those south. In this study, person well-log need been transformed by those suggested procedure about named (O3-6). The hydrocarbon assessment of the examined field might have been attained All around those escalated consideration analyses What's more understanding of the geological Furthermore geophysical information.

#### 5.Acknowledgement

The authors deeply indebted to Sirte Oil Company for supplying the data used in this study.

particularly the well-logging measurement. This reservoir and pay cutoffs matching with the

production data, where all the perforated intervals met the calculated pay interval

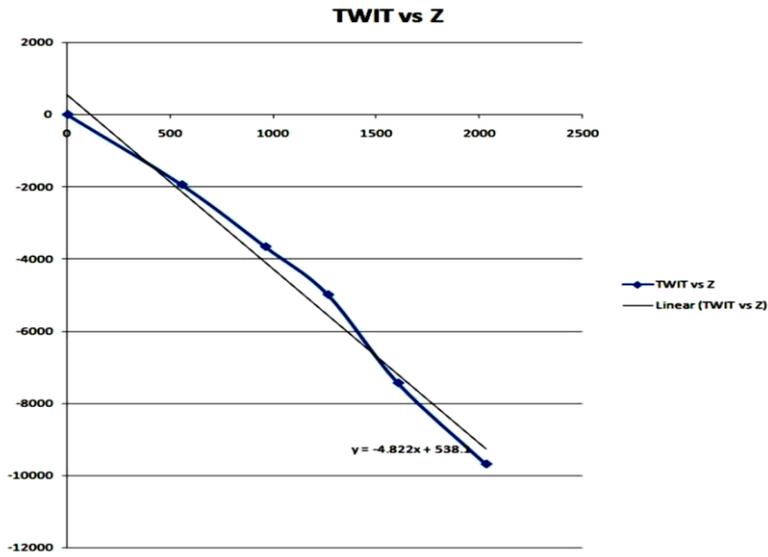


Fig (8) The relation between TWT and Z value and the resulted linear equation in Well O3-6

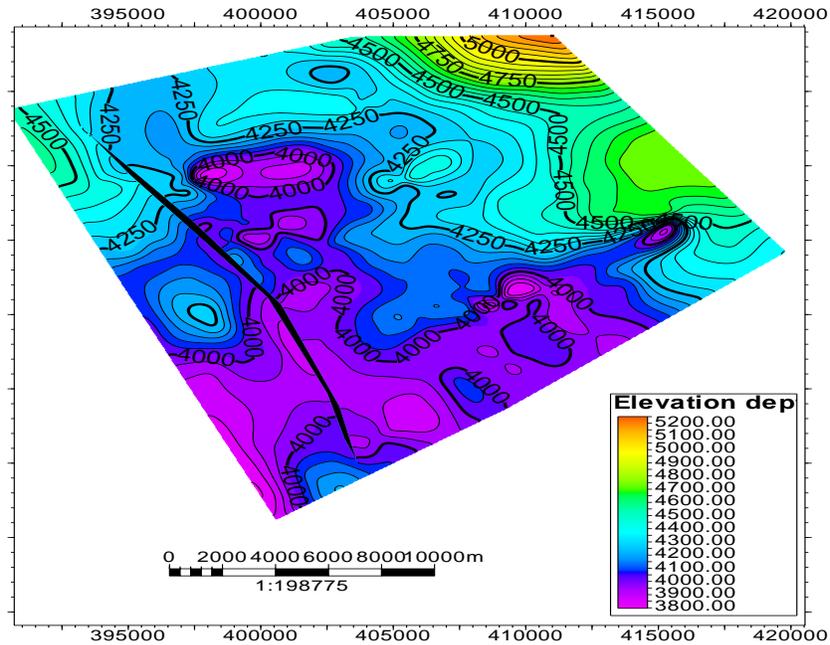


Fig (9) Depth Map of Mulallah Formation

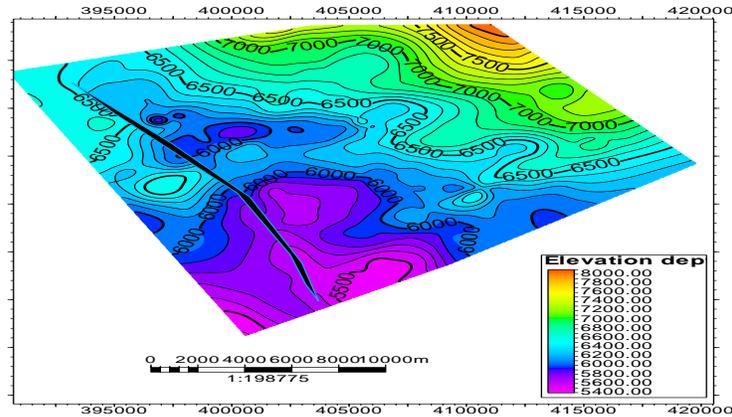


Fig (10) Depth Map of Etel Formation

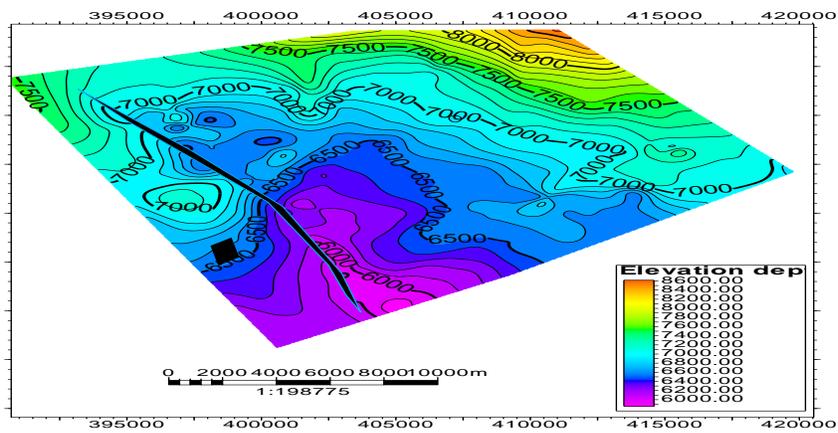


Fig (11) Depth Map of Sheghega Formation

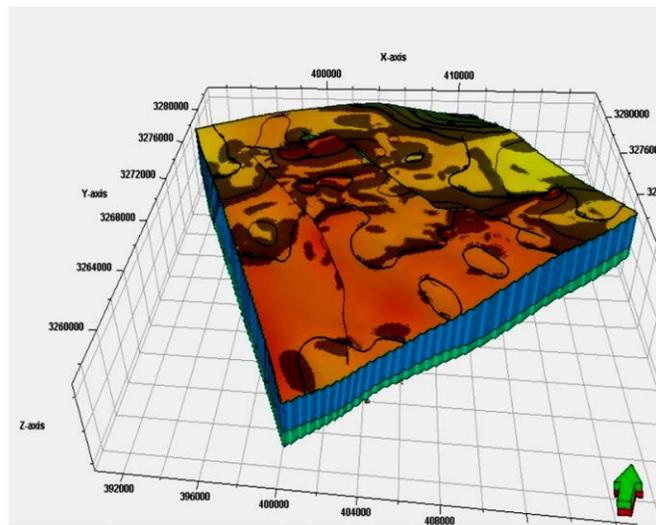


Fig (12) 3D Structure Model of the study area

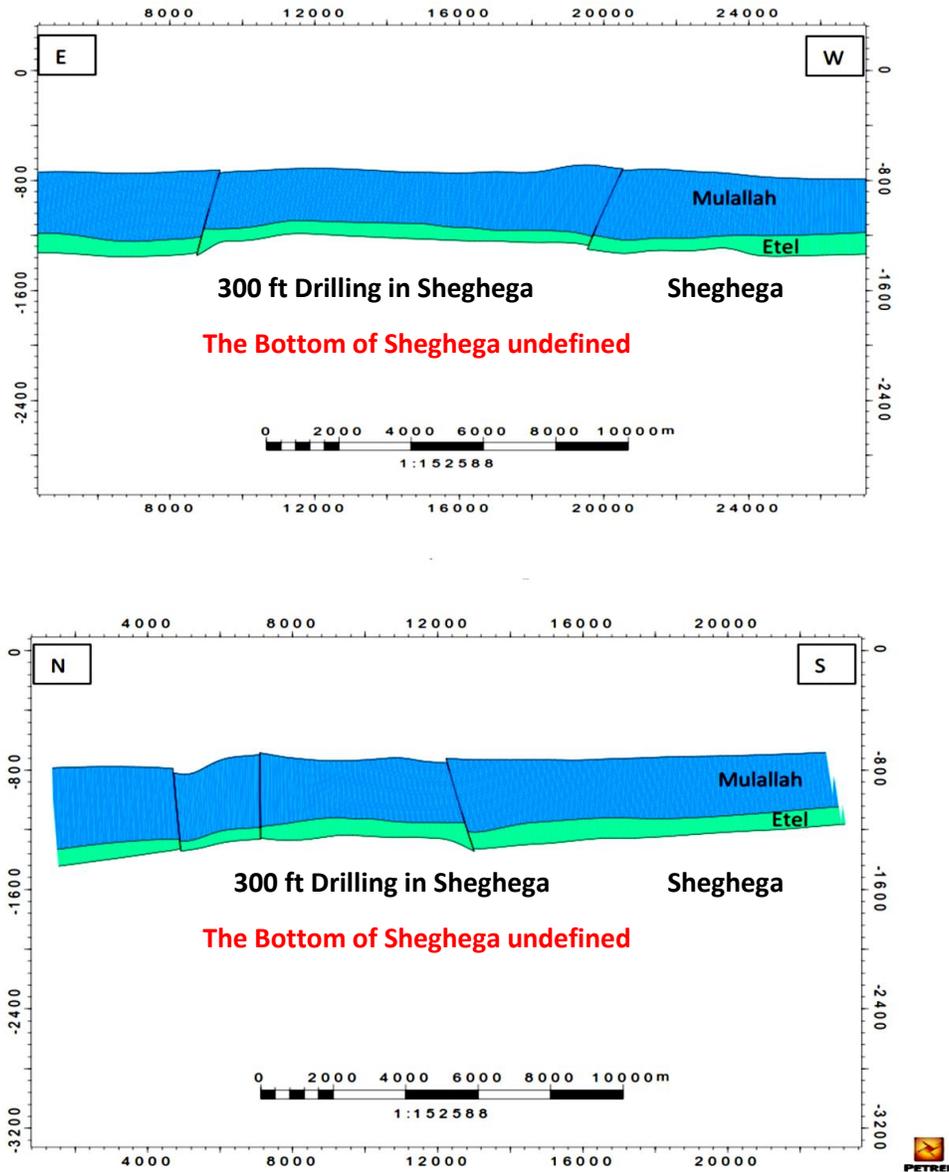


Fig (13) E-W and N-S cross-sections through the 3D Structure Model

Table (1) The petrophysical parameters resulted in well O3-6

Well	Formation	Vsh	$\Phi_{Total}$ (%)	$\Phi_{Eff}$ (%)	K (mD)	$S_w$	$S_{hc}$
O3-6	Mulallah	48	37	19	479	92	8
O3-6	Etel	85	39	9	30	100	0
O3-6	Sheghega	14	24	21	1445	49	51

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