

Summary Of The Initial Seismic Studies Of Nassiria Oil Field

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Abstract:

Nassiriya area surveyed for the first time in(1973-1974)as an exploratory survey of Nassiriya-Hilla-Diwaniyah areas, this survey showed the existence of a structure in the Nassiriya city, (Ns-1)well drilled in(1978), after that during(1980)and(1981) Iraqi second and third teams surveyed Nassiriya structure and an interpretation study were made in(1982), after drilling two assessment wells(Ns-2)(Ns-3)in(1984-1985) showed that the structure enclosure doesn't match the discovered oil columns which led to the reinterpretation of the seismic info of Nassiriya structure(1986), the study shows the existence of several enclosures and a transversal faults splitting Nassiriya structure into three parts, then drilling two assessment wells(Ns-4)(Ns-5)(1986-1988)and seismic surveying in(1987) the results of this study shows that there are no faults, in(1989)a working team made a geological study on Nassiriya oil field and the conclusion was that the evaluation of Nassiriya oil field is incomplete ,a working team was formed in(1993)to make a geological study to the oil field ,the conclusion of this study was that there are still an ambiguity in the structural image, A reinterpretation study of the seismic information was made in(1994)this study concluded that there are one structure and its Nassiriya structure ,there was no faults noticed,

in(2001)an evaluation study was made to Mishrif formation in Nassiriya oil field by the(G.E.D), some foreign companies was supplied by the available seismic information in purpose of reprocessing it, So to investigate how the nassiriya oil field structure is taking shape with every survey and reinterpretation study by analyzing the different results these surveys and studies are giving.

Keywords: (primary seismic studies, Nasiriyah oil fields, structural picture).

ملخص الدراسات السيزمية الأولية لحقل نفط الناصرية

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الملخص:

تم مسح منطقة الناصرية لأول مرة في (١٩٧٣-١٩٧٤) كمسح استكشافي لمناطق الناصرية - الحلة - الديوانية ، أظهر هذا المسح وجود هيكل في مدينة الناصرية ، بئر (Ns-1) تم حفره عام (١٩٧٨) ، بعد ذلك خلال (١٩٨٠) و (١٩٨١) قامت الفرق العراقية الثانية والثالثة بمسح هيكل الناصرية وتم عمل دراسة تفسير في (١٩٨٢) ، بعد حفر بئري تقييم (Ns-3) (Ns-2) في (١٩٨٤-١٩٨٥) أظهرت الدراسة أن الهيكل الهيكلي لا يتطابق مع أعمدة النفط المكتشفة مما أدى إلى إعادة تفسير المعلومات الزلزالية لهيكل الناصرية (١٩٨٦) ، وأظهرت الدراسة وجود عدة حاويات وأعطال عرضية تقسم هيكل الناصرية إلى ثلاثة أجزاء ، ثم الحفر. بئرين للتقييم- (Ns-4) (Ns-5) (1986) (1988) والمسح الزلزالي عام (١٩٨٧) تظهر نتائج هذه الدراسة عدم وجود عيوب ، في عام (١٩٨٩) قام فريق عمل بإجراء دراسة جيولوجية على الناصرية. حقل نفط والاستنتاج ان تقييم حقل الناصرية غير مكتمل ، تم تشكيل فريق عمل عام (١٩٩٣) لإجراء دراسة جيولوجية لحقل البترول ، وخلصت هذه الدراسة إلى أنه لا يزال هناك غموض في الصورة الهيكلية ، وقد أجريت دراسة إعادة تفسير للمعلومات الزلزالية عام (١٩٩٤). خلصت هذه الدراسة إلى وجود هيكل واحد وبنيته الناصرية ، ولم يلاحظ وجود عيوب ، في عام (٢٠٠١) تم عمل دراسة تقييمية لتشكيل مشرف في حقل الناصرية النفطي من قبل (G.E.D) ، وتم تزويد بعض الشركات الأجنبية من خلال المسح الزلزالي المتوفر. معلومات بغرض إعادة معالجتها ، وذلك للتحقيق في كيفية تشكل هيكل حقل نفط الناصرية

مع كل دراسة مسح وإعادة تفسير من خلال تحليل النتائج المختلفة التي تقدمها هذه المسوحات والدراسات.

الكلمات المفتاحية: (الدراسات السيزمية الأولية، حقول نفط الناصرية، الصورة الهيكلية).

1. Introduction

Nassiriya oil field was proven to be found in three different formations (Mishrif ,Nahr Umr ,Yamama). seismic surveys were made since 1973 to 1988, many interpretations were made based on that five oil wells were drilled. these interpretation also included the study of ten reflectors seven of them were in the Cretaceous Era ,two in the Jurassic Era ,and one represented in the upper Triassic Era.

Time ,Speed ,and Depth maps was prepared of the upper layer of all the main reservoir units ,to clarify the field structural image and its NW extensions , this study results showed **in the time domain the existence of an open structure in the west direction ,but in the depth domain the same structure is represented as an asymmetrical convex fold** ,its dimensions were (35.5Km,14.5Km,70m) in the Mishrif formation level ,and its dimension were (34.7Km,16.5Km,80m)in the Yamama formation level.

2. Materials and Methods

2.1.Method:- by investigating how the nassiriya oil field structure is taking shape with every survey and reinterpretation study and

by analyzing the different results these surveys and studies are giving.

2.2.The Surface Geology and the Topography of the Area:-

The study area are covered by quaternary era clastic and alluvial sediments(unsolidified), with a thickness of 250m made of Pleistocene deposits that's characterized by rough sediments and Holocene deposits that's made of sand ,silt ,mud ,and silty sand.

The vast majority of the area are flat without any surface structures, **the NW side of the study area is rising making a high plateau.**

2.3.The Tectonic Setting of the Study Area:-

Nassiriya structure is located near the NE side of the Arabian-African plate of the Mesopotamia sedimentary basin, In a structurally uncomplicated spot.

the base rocks are uncomplicated and its general dip is in the NE direction, there are no significant tectonic effect on the lithological column, ,However **the area have been through light horizontal movements in the upper Jurassic that was the reason of forming closed longitudinal structures.**

Nassiriya structure is unaffected by the Zacros mountain building movement.

the causing factor of the formation of Mesopotamian structures (including Nassiriya structure) which is the existing

of topographic heights in the basin rocks that left its print on the deposited sediment.

Nassiriya oil field is located within the Mesopotamian zone that's subdivided into:-1-Zubair subzone, 2-Tigris subzone, 3-Euphrates subzone.

Nassiriya oil field is laying in the Euphrates sub zone that's characterized by being a monocline fold dipping in the NE direction, and having many longitudinal folds in the NW-SE direction parallel to the Euphrates fault, **these folds is the result of Horst & Graben in the basin rocks.**

From studying the space photos as well as the magnetic ,gravity ,and seismic maps, the conclusion states that there are three faults systems in Iraq:-

1-Hijaz fault system in the N-S direction:-it was formed during the Precambrian by the mountain building Hijaz movements .

2-Najd fault system in the NW-SE direction:- includes Euphrates fault system which is considered as step fault that makes the separating line between the Quaternary era sediments in the Mesopotamian plane.

3-transverse faults in the E-W direction:- was formed (during the Precambrian and after it) as a result of the rotary motion of the Arabic plate and crashing into the northern and northeastern plates which caused it to break into smaller pieces separated by faults in the NW-SE direction ,and it was activated during the late Jurassic

,causing the forming of transverse blocks in Iraq ,and one of the most importance transverse faults is the faults system that's located to the south of the study area.

Based on what been discus above Nassiriya structure is located within the transitional area that represent the continental slop domain, which suffered since the end of Jurassic of mass uplifting forces in old normal faults that coincided with the geological depositional sequence (Syndepositional faults) ,and continued to the cretaceous until the Turonian. **This type of movement (Epiorogenic movement) led into making the Mesopotamian basin into local doms and basins that reflected the old normal faults into reversed faults, This differentiation was the cause of the complication of facies ,lateral change ,and vertical change(in the Mesopotamian basin) which led to the formation of a stratigraphic traps.**

2.4.Previous Geophysical Surveys:-

1-Gravity Survey:-nationalized Basra petrolum company (BPC) launched a gravity survey during the forties and fifties to the southern areas of Iraq ,this survey resulted in drawing Bouguer anomalies maps, shows parallel gravity contour lines to the Euphrates fault, and to the east of the study area (basin center) we notice an expanding oval negative anomaly with a gravity value reaching (70-)mGal ,and this indicate a high reduction in the density ,using qualitative interpretation of the Bouguer anomaly

map which separate the local anomalies from the regional anomalies using different analytic ways (like Trend surface analysis),the first ,second ,third ,fourth ,and fifth residual dispersion maps shows a negative anomaly to the south of Nassiriya city extending to the south of Samawa city in the NW-SE direction ,**this type of anomaly might be the result of the existence of acidic igneous rocks with low density.**

2- Aerial and Land Magnetic Surveys:-the aerial survey map shows the flatness of the base rocks under (8)Km in depth ,and the base rocks starts to slope in the NW-SE direction also showing a NE-SW direction fault splitting the west side of the area.

From the residual magnetic land survey we can see an oval anomaly covering the middle and west side of the study area in (Gama) value ,it stretches from Nassiriya city in the NW direction to the south of kut city ,this anomaly location coincide with the one shown in the bouguer anomaly map above.

3-Seismic Surveys ,Drilled Wells Results ,Seismic Studies ,and Previous Geology:-

many exploratory and deep detailed seismic surveys including the study area were made (1973-1986) by the first ,second ,third ,and eighth Iraqi seismic teams ,as well as drilling five oil wells (including Ns-1) ,exploratory in(1978) and the rest are evaluative (1984-1988) which resulted in many interpretation studies and reinterpreting geological studies ,a summarized description of

these surveys ,studies ,and results in the correct time sequence can be shown below:-

1-Nassiriya area was surveyed by the first seismic team in (1973-1974) as a part of the exploratory survey of Nassiriya-Hilla-Diwaniyah areas using explosives as an energy source. the size of work on the Nassiriya structure reached around (950)Km/length, four reflectors were captured , this study also shows the existence of a structure in the Nassiriya city and the geological structure image of Nassiriya structure at shuaiba formation level, based on the results of this study (Ns-1) well was drilled in (1978).

2-during (1980) and (1981) Iraqi second and third deep surveyed Nassiriya structure by a work size of (704)Km/length covering 2400% and 3000% ,and an interpretation study were made in (1982) which captured six reflectors three of them were in the Jurassic era and they showing similarity between the deep formations structural images (of Jurassic era) and the formations structural images (of cretaceous era) ,this study recommended drilling a second well on Nassiriya structure.

3-after drilling the two assessment wells(Ns-2)(Ns-3) in (1984) and (1985) differences in the depths of the penetrated formations have appeared from the ones given by the results of the seismic information ,the drilling also shows that the structure inclosure doesn't match the discovered oil columns which led to the reinterpretation of the seismic info of Nassiriya structure (1986)

after using deep survey lines that been processed by a **new restrictions** the study shows the existence of several inclosures in many levels and a transversal faults splitting most of the captured reflectors also splitting Nassiriya structure into three parts.

4-after drilling the two assessment wells (Ns-4)(Ns-5) in (1986-1988) and deep seismic surveying in (1987) in a work size of (447)Km/length spread over 17 seismic lines by the second Iraqi seismic team. a study was mad to the deep detailed seismic survey interpretations in (1988) ,the results of this study shows that **there are no faults** and an increase in the structure dimensions ,as well as an increase in the degree of Nassiriya structure enclosure with depth.

Based on the drilling info and the last structural image of the (1988) seismic study ,a working team made a geological study on Nassiriya oil field in (1989) and the most important conclusion of this study was that **the evaluation stage of Nassiriya oil field is incomplete.**

Based on some notes about the accuracy of (1989) study from the geologic stand point and the oil reserves ,and the credibility of the structural images ,a working team was formed in (1993) to make a complete geological study to the oil field (the most important conclusion of this study was that **there are still an ambiguity in the structural image of Nassiriya oil field).**

5-to update the structural image of Nassiriya oil field in the main formations levels (Mishrif ,Nahr Umr ,Yamama) which are being studied for the first time ,and updating how it looks in the NW edges ,and by using the seismic lines of the detailed survey of east Samawah ported in (1985-1989) with a work size of (550)Km/length and re interpreting the slope lines from it. A reinterpretation study Of the seismic information of the Nassiriya oil field was made in (1994)(4) this study reached in its conclusion that **there are one structure and its Nassiriya structure** and its axis is in the east southeast-west northwest direction ,as well as an increase in the size of Nassiriya oil field and its enclosure ,this study also showed that the structure axis location is fixed with depth in all levels ,there was no faults noticed ,the features of the NW oil field extensions(the start of an additional enclosure) were cleared ,and based on that this study recommended reinterpreting the seismic information of the northwest part of the current study area ,it also recommended drilling a well to explore the deep lithological column (lower Jurassic) on the top of Nassiriya oil field or deepening one of the existing wells.

6-in (2001) an evaluation study was made to Mishrif formation in Nassiriya oil field by the geologic exploration department, this study shows that lower Mishrif rocks have good reservoir quality cause it has shallow sediments facies that contain rudist ,the oil

water contact was established at (2058)m in depth from the sea water level ,**this study also shown an improvement in the reservoir characteristics of the oil field in the west direction ,and that was done by comparing the facies in different drilled wells in the area ,in the other side the geological sedimentary sample shows an increase in the reservoir characteristics in the east direction and if heading in the west direction the facies become deep (towards Kifl basin/ sandy) this indicate that the well facies analysis don't match the suggested sedimentary geological model.**

7-some foreign companies was supplied by the available seismic information of the oil field in the purpose of reprocessing it and making a complete study of the oil field ,and actually some studies were made :-

a-the study of Repsol company the previous study was updated using their old available info and our company didn't get the updated copy.

The Spanish Repsol company made a structural and topographic study for the first time in (1995) to the lower Mishrif ,Nahr Umr ,Yamama on the (NN) lines after photo scanning the paper sections. **The results of this study shows the structure size in the time and depth maps half the size that the (1994) exploration study shows above** ,and the topographic drawings and topographic seismic study shows the probability of the

existence of two mound complex within the lower Mishrif formation ,one of them is around (4-5)Km to the west of (Ns-2) well and the other one in (5-9)Km to the south of (Ns-4) well ,the study also shows a pinch out in the SW direction ,as for Yamama reservoir this study shows a progradation in the SW direction and a possibility of the existence of a pinch out in the level of the lower Yamama unit. There was no topographic studies made for Nahr Umr reservoir.

b-the Italian Agpe company made a structural study (1996) to (Mishrif ,Nahr Umr ,Yamama) formations based on the seismic lines (NN&SE). The results of this study gives a few depth and time maps of the three formations above,this study shows a similarity in the size and enclosure of the structure with what the Italian Agpe company study results shows. The results of this study shows **a possibility of the existence of a lateral facies change** that caused a lateral changes in the seismic speeds in the NW side of the oil field. And **these information cant be covered using the present speed information** ,it needs information from a drilled well ,this study recommended making a 3D seismic survey for Nassiriya oil field.

8- in (2008) the Italian Eni company made a seismic reservoir study by depending on the Italian Agpe company structural study ,five good continuous reflectors were captured for the purpose of

conducting the application of the seismic aftershock ,and these reflectors are:-

1-a reflector up to (900)millisecond (representing the upper seismic reflector).

2- a reflector representing lower Mishrif.

3-a reflector representing lower Nahr Umr.

4-a reflector within Yamama formation.

5-a reflector up to (200)millisecond (representing the lower seismic reflector).

Using (Strata) software from the (Hampson Russel) company to extract the seismic attributes specially the acoustic impedance (AI) and relying on it for knowing the porosity and other reservoir characteristics in the field ,this study also showed a **good linear relationship between the acoustic impedance (AI) and The porosity** specially in the limestone reservoirs ,it was possible to divide Mishrif formation into three reservoir units ,the upper unit with a high porosity are surrounded with two insulation units ,as for Yamama formation it have a few units with a good porosity surrounded by a thin insulation layers ,and the porosity distribution direction of Yamama formation is in the NS in a chaotic way.

9-Nippon company study (2008):-it's a structural-topographic study made using the (Petrel) software ,(18) reflectors were

captured that belongs to the cretaceous and Jurassic periods ,the structural results of this study shows a relative similarity in the big enclosures of the depth maps of upper Mishrif and upper Yamama formations with a small difference in the borders. **this study also shows a possibility of the existence of a main fault and a secondary fault along the structure in the deep parts of the seismic sections (penetrating the Jurassic formations and possibly reaching Yamama).** To make the structural data compatible with the oil column in the wells an integrative speeds information was concluded from the average speed information of the following wells (Nassiriya ,Garraf-1 ,Abo Amood-1) and from the regional speeds ,as well as putting different hypothetical wells speeds (pseudo well) on the structure ends (flank). And these information aren't as accurate as its required so this study recommended a **3D seismic survey and drilling evaluation wells at the structure ends** to show a more reliable structural image of the oil field ,this company also made a limited stratigraphic study as well as a seismic reflector study on the seismic sections ,and studying the relationship between the porosity and the acoustic impedance (AI) ,this study shows that there is a good linear relation between the acoustic impedance (AI) and the porosity specially in the limestone reservoirs and was able to divide Mishrif formation into three reservoir units.

As for Yamama formation its made of several units with good porosity surrounded by thin layers.

3. Results and Discussion:-

1-the results of the interpretations and reinterpretations of Nassiriya oil field made by the oil exploration company and other foreign companies **were different in the structure dimensions and enclosure ,and couldn't find a suitable solution to match the oil column with the structure enclosure.**

2-the results of the seismic stratigraphic study made by Spanish Rebsol company (1995) shows two stratigraphic mount complex within lower Mishrif formation ,one of which is (4-5)Km to the west of (Ns-2) well ,the other one is (5-9)Km to the south of (Ns-4) well ,this study also shows a lateral pinch out in the SW direction ,as for Yamama formation the study shows a sea progression in the SW direction as well as a lateral pinch out at the lower Yamama unit , this study also shows an existence of anomaly speeds information at the south and west of the field.

3-the results of the Italian Agpe company study (1996) shows a structural sign in the direction of the east Samawa survey ,it also shows the **possibility of the existence of a lateral facies change causing a lateral changes in the NW parts from the oil field ,so** this study recommended drilling a well in the northwest parts of the oil field.

4-the Italian Eni company study (2008) shows by using (strata) software that there are a **good linear relationship between the acoustic impedance (AI) and the porosity specially in the limestone reservoirs** ,based on that Mishrif formation was divided into three units ,the middle one has high porosity ,as for Yamama formation its made out of a few units with good porosity surrounded by a thin insulation layers ,and the porosity distribution map of Yamama shows a NS general direction in an incompatable way ,and the Nippon Japanese company study confirmed the same results using a similar application.

5-the results of the Japanese Nippon company study(2008) showed that **there is a main fault and a secondary fault along the structure extension** ,and in the deep parts of the seismic sections (it penetrate the Jurassic formations and possibly reaching Yamama formation) to make the structural data compatible with the oil column in the wells ,integrative speeds information was concluded from the average speed information of Nassiriya oil field and the neighboring oil fields wells ,as well as putting different hypothetical wells speeds (pseudo wells) on the structure ends (cause there was no real wells information) And these information aren't as accurate is its required so this study recommended a 3D seismic survey and drilling evaluation wells at the structure ends to show a more reliable structural image of the oil field.

5. Conclusions and Recommendations

5.1. Conclusions

1-Nassiriya oil field area and its surrounding oil fields in the south of Iraq are characterized by containing more than a complete petroleum system ,one of which drilling made it through in Nassiriya oil field which is the one from the cretaceous era ,and the rest are considered a promising exploration goal in Nassiriya oil field petroleum system from the Jurassic era.

2-observing the development of Nassiriya structure from one survey to another reveals the importance of the field restrictions in obtaining the closest image we can get to what's structures there are beneath the surface, there is no doubt that the present technologies still unable to give an absolute image of the subsurface, but what is important is to apply the right field restriction in the right place to achieve the lowest possible error percentage.

3- Models should be selected for their operational suitability
There is no model that is ideally suited to all purposes We must be aware of the varied characteristics and make informed choices.

5.2.Recommendations

1-the previous studies indicate the drilling wells is the only determining factor that's true a hundred percent .

2-lateral facial changes can't be detected from the available speed info, it is necessary to drill wells.

3-the main problem Nassiriya oil field suffer from is that his west of the structure is clear, and all the previous studies changed the speed values to get the desired enclosure in the depth map of the reservoir.

4-Ensure source and receiver line spacings are sufficiently small to deliver the desired fold within the maximum useable offsets.

5-Where affordable, allow grid density tighter than the minimum predicted necessary density

6-Cover beyond the anomaly.

7-Alignment with Strike / Dip or Land Boundaries.

8-Avoid irregular shapes (inside corners).

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