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Development of Ratawi Oil Field, Southern Iraq

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Abstract

Ratawi Field is a promising hydrocarbon bearing structure conforming several reservoirs, and lies northwest of the Basrah city and west of Northern Rumaila Field. Kinetic Analysis referred to that the type of Fold of Ratawi Structure similar to the types which are associated with Salt Structure activity. Geophysical Interpretation referred to the presence of Salt Structure beneath Ratawi Structure. The Isopach Maps shows that the crest thickness is less than the limbs, this characteristics is always due to those of salt structures beneath Ratawi field. Both of Tectonic Movement and Salt Structure play a great role in forming and development of Ratawi Structure.

Keywords: Ratawi field, Kinetic analysis, Salt structure, Tectonic movements.

تطور حقل رطاوي النفطي في جنوبي العراق

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الخلاصة

حقل الرطاوي هو تركيب واعد حامل للهيدروكربونات و متعدد المكامن . يقع حقل رطاوي النفطي في جنوبي العراق ، شمال غرب مدينة البصرة و غرب حقل الرميلة الشمالي . اشار التحليل الحركي الى ان التركيب مشابه لنوع التراكيب التي تكون مصاحبة لنشاط التراكيب الملحية ، اشارت المعلومات الجيوفيزيائية الى وجود التركيب الملحي تحت تركيب الرطاوي . من جانب اخر فان تفسير خرائط السماكة للتكاوين المختارة اشار الى وجود اختلاف في السمك بين القمة والاجنحة ، وبصورة عامة لوحظ ان سمك القمة اقل من سمك الاجنحة في هذا التركيب والذي يحتمل انه تكون نتيجة تأثير التراكيب الملحية . يبدو ان كلا من الحركات التكتونية ونشاط التركيب الملحي قد لعب دورا كبيرا في نشوء وتطور تركيب رطاوي

1. Introduction

Ratawi Field is located about (70 km) northwest of the Basrah city and approximately (12 km) west of Northern Rumaila Field. The study area is about (35) km long and (20) km wide, with surface area about (700) km² [1]. The area lies within the Universal Transverse Mercator (UTM) coordinates given in the Table-1, Figure-1.

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Table 1- Coordinates of the study area

Point	Northern (m)	Eastern (m)
A	3400 000	690 000
B	3400 000	710 000
C	3365 000	690 000
D	3365 000	710 000

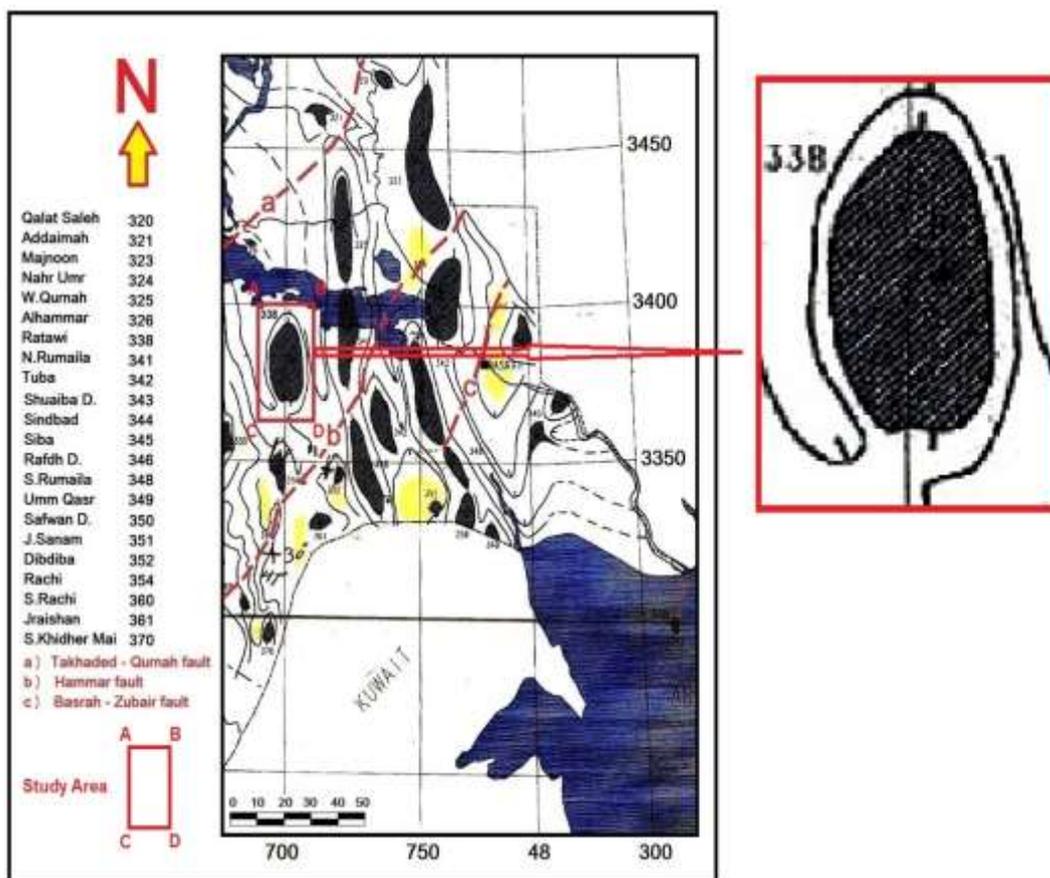


Figure 1- Location of Ratawi Structure and surround area [2].

The northern parts covered by Quaternary deposits, while the southern and middle parts are covered by Pleistocene alluvial fans. Seven exploration and evaluation wells are drilled in Ratawi field to evaluate the stratigraphic column and the fluid content. The deepest and most complete one was Ratawi – 3 (Rt – 3), Figure-2, which went deep to late Jurassic Najmah Formation. The target of this study is to integrate all data (well, geophysical data and isopach maps) to carry out the kinetic analysis for Ratawi structure.

ERA	PERIOD	EPOCH	FORMATION NAMES	LITHOLOGY	DEPTH (m)	
C E N O Z O I C	T E R T I A R Y	M I O C E N E	U P P E R	D I B D I B B A	177	
			M I D D L E	F A T H A	335.5	
			L O W E R	G H A R	446.5	
		E O C E N E & P A L E O C E N E	D A M M A M	663		
			R U S	825.5		
			U M M E R R A D H U M A	1261		
		M E S O Z O I C	C R E T A C E O U S	M A A S T R I C H T I A N	T A Y A R A T	1468
				U P P E R C A M P A N I A N	S H I R A N I S H	1620
					H A R T H A	1825
				L O W E R C A M P A N I A N	S A D I	2008.5
				T U R O N I A N	T A N U M A	2054
					K H A S I B	2098
					M I S H R I F	2216
C E N O M A N I A N	R U M A I L A			2329		
A L B I A N	A H M A D I			2458.5		
	M A U D D U D			2583		
A P T I A N	N A H R U M R			2824.5		
B A R R E M I A N	S H U A I B A			2891		
	Z U B A I R			3307.5		
V A L A N G I N I A N	R A T A W I			3664.3		
B A R R I A S I A N	Y A M A M A	3803				
T I T H O N I A N	S U L A I Y	4078				
J U R A S S I C	K I M M E R I D G I A N	G O T N I A	4474			
		O X F O R D I A N	N A J M A H	4774		

Figure 2- Shown the Lithological Column of Well (Rt – 3) modified from [3].

2. Geological Setting

According to [4], Ratawi field lies within the Stable Shelf, Zubair subzone as a part of Mesopotamian Zone. This subzone has a uniform structural style controlled by the underlying basement and Infracambrian salt [5]. The Zubair subzone is bounded from the north by the Takhadid – Qurnah Transversal Fault. The southern boundary of the subzone is either located at Albatin Fault or a long a transversal fault in Kuwait. This subzone forms the most southern units of the Mesopotamian zone. The structure of this subzone are long and relatively narrow anticlines, separated by broad synclines, especially in the east. Shorter and oblique trending anticlines are the Zubair and Rumaila structures. Shorter, often broader structures include Nahr Umr, Majnoon, Rachi, Ratawi, Subba and Luhais. [6] , mentioned that the investigation studies and seismic surveys of Mesopotamian zone carried by the Iraqi oil company, demonstrate the existence of many subsurface structures, generally N – S trending anticlines and synclines of different sizes.

3. Kinetic Analysis of the Ratawi Structure

The determination of the movement paths that rocks or parts of rocks have taken during transformation from the un deformed to the deformed state. This subject includes, for example, use of features in rocks to define the direction of movement on a fault, [7]. Geophysical Interpretations referred to two combined main forces are Salt Structures and Alpine Orogenic Movements worked together to forming Ratawi Structure.

3.1 Geophysical Interpretations

The interpretation of final output images shows the association of negative gravity and magnetic residual anomalies with some anticlinal structures, while positive residual are associated with the others. The positive residuals could be due to basement uplift, and the reversed values could be due to deep – seated light core probably salt beds [8]. The gravity anomaly of Ratawi Structure is (- 2 mgal), [9], Figure-3. In the northern Arabian Gulf basin gravity interpretation shows that most oil bearing structures of southern Iraq (south of the Takhadid – Qurna Transversal Fault) are associated with negative gravity residuals. Which suggests that they are underlain by Infracambrian salt [5], Figure-4.

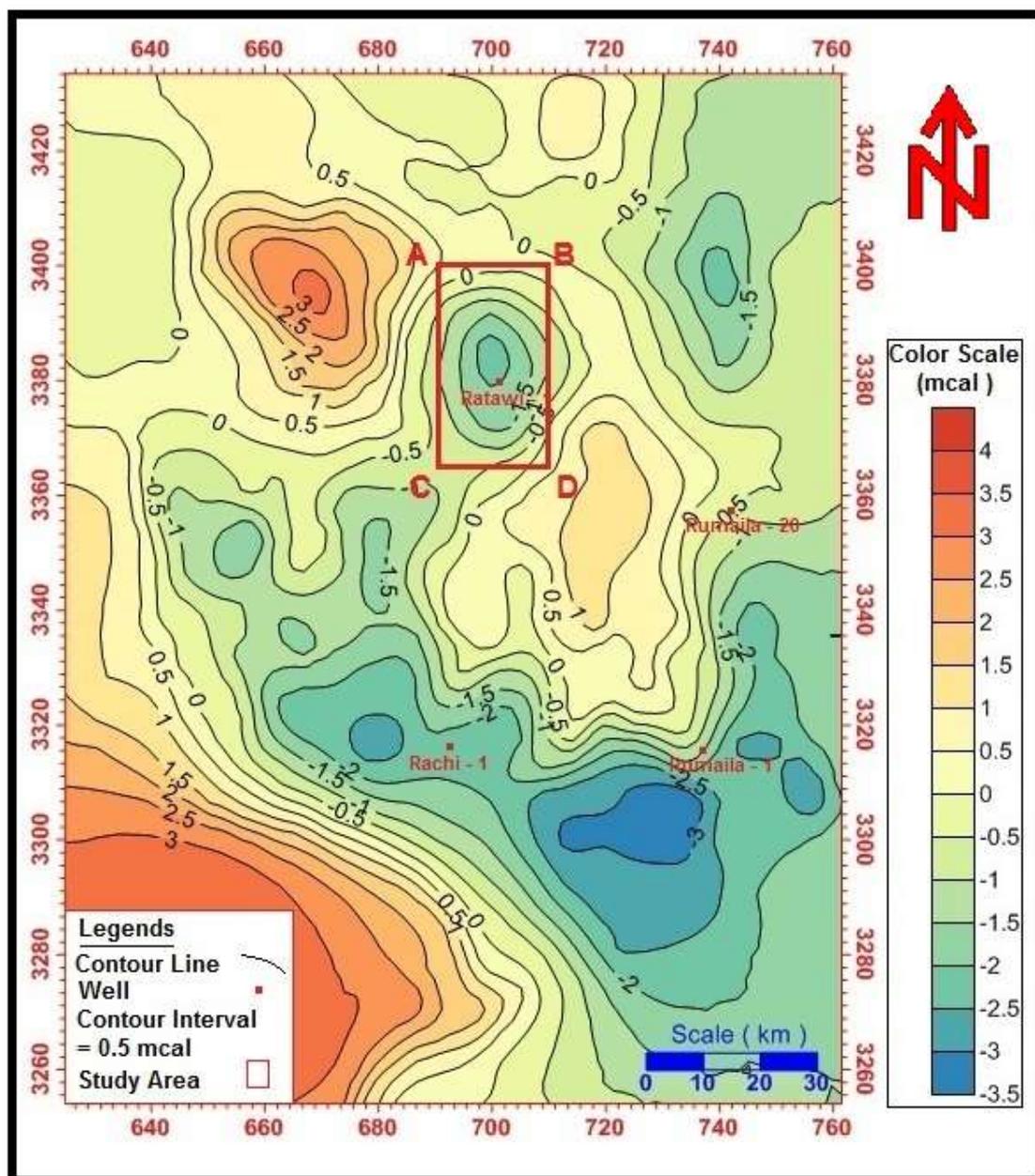


Figure 3- Residual Gravity Map of Study Area and surrounding area [9].

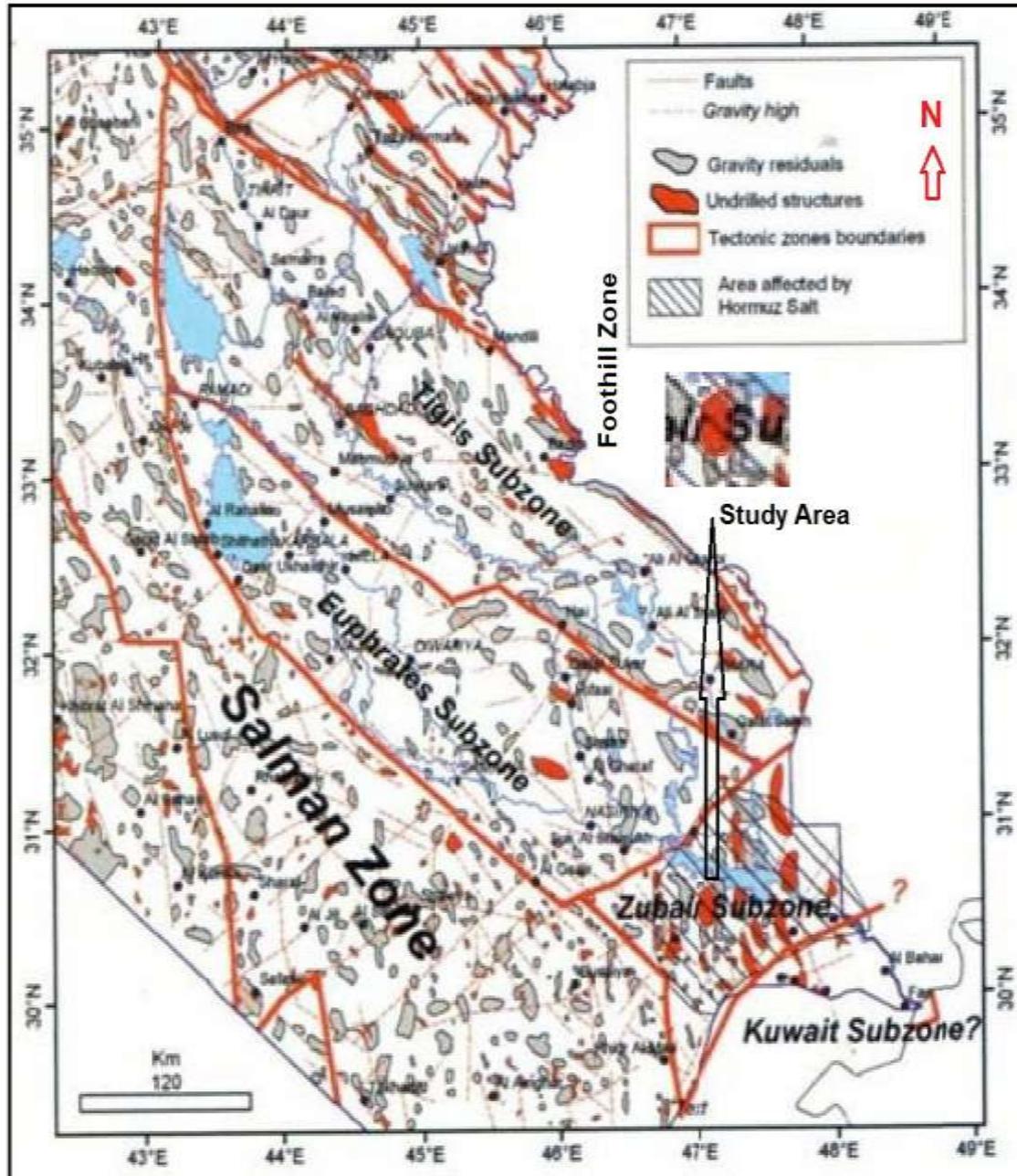


Figure 4-Residual gravity anomalies (grey polygons) and undrilled structures (red polygons) of the Mesopotamian, modified from [5].

3.2 Role of Salt Structure

Geophysical evidences proved to the existence of salt rocks below Ratawi Structure and it may have a major role in forming the structure [8]. This salt may be the thick bed of Infracambrian Hormuz Salt Basin, which surrounds the area of the southern Arabian Gulf [10]. [7] outlined the mechanism of salt structure as follows: (1) Density inversion, (2) Differential loading, and (3) Gravity spreading. These mechanisms and buoyancy force are worked together to drive salt up through the overlying layers until it arrives level of neutral buoyancy. Arching and thinning of the strata above the diapirs are derived by extensional tectonic [11]. This leads to the forming normal faults over the tops of the domes, [7]; [11]; [12]; [13].

3.3 Role of Tectonic Movements

The interpretations of geophysical data (gravity and magnetic anomalies) have shown that the lower Mesopotamian region is controlled by recent activities. These activities are responsible for the uplift and the subsidence [6]. [14] divided the movement influencing Arabian Gulf and adjacent areas into three movements: (1) Pre – Pliocene Movements, these movements represent all movements were in Precambrian, Paleozoic, Mesozoic and most of Tertiary period. The effect of these movements disappears because of later movements, as well as, the role of sedimentation processes. (2) Plio – Pleistocene Movements – the Zagros orogeny folding, these movements lead to make many structures such as folds, salt domes, and faults. Therefore many salt domes are formed in this period in the Arabian Gulf and SW of Iran. (3) Quaternary Movements, generally, the effects of Quaternary Movements are less than the effect of Plio – Pleistocene Movements. This effect takes local modification shape to the precedent phenomenon and structures. The most important of Quaternary Movements are the Intruded salt domes.

4. Interpretation the Isopach Maps of Ratawi Structure

The isopach maps, Figure-5 show that there are differences in thickness between the thickness of the crest at well (Rt – 1) and the thickness of the limb at well (Rt – 6) and for each cycle, as example, The age of Najmah Formation is about (155 M.Y.), while the age of Zubair Formation is about (124 M.Y.), the difference in age between them is (31 M.Y.). The Isopach map of Zubair – Najmah show that, the thickness at the crest of the structure was (1577.9 m), and the thickness at the limb was (1632.5 m), the difference in thickness between the crest and the limb is (54.6 m). Resulting division of the difference in thickness and the difference in age is the Growth Rate. Subsequent to, by using the same method, we will calculate the growth rate for each period, as shown in Table-2.

Table 2- The rate of Ratawi Structure growth per M.Y. based on the difference in thickness at crest and limb for different periods.

Formations	Difference in Time (M.Y.)	Thickness (m)		Difference in Thickness	Growth (m per M.Y.)
		Crest	Limb		
Rus – Tayarat	30	574.6	648.5	73.9	2.463
Tayarat – Hartha	9	336.8	339	2.2	0.24
Hartha – Mauddud	23	866.5	899	32.5	1.413
Mauddud – Zubair	27	417	427.4	10.4	0.385
Zubair - Najmah	31	1577.9	1632.5	54.6	1.761

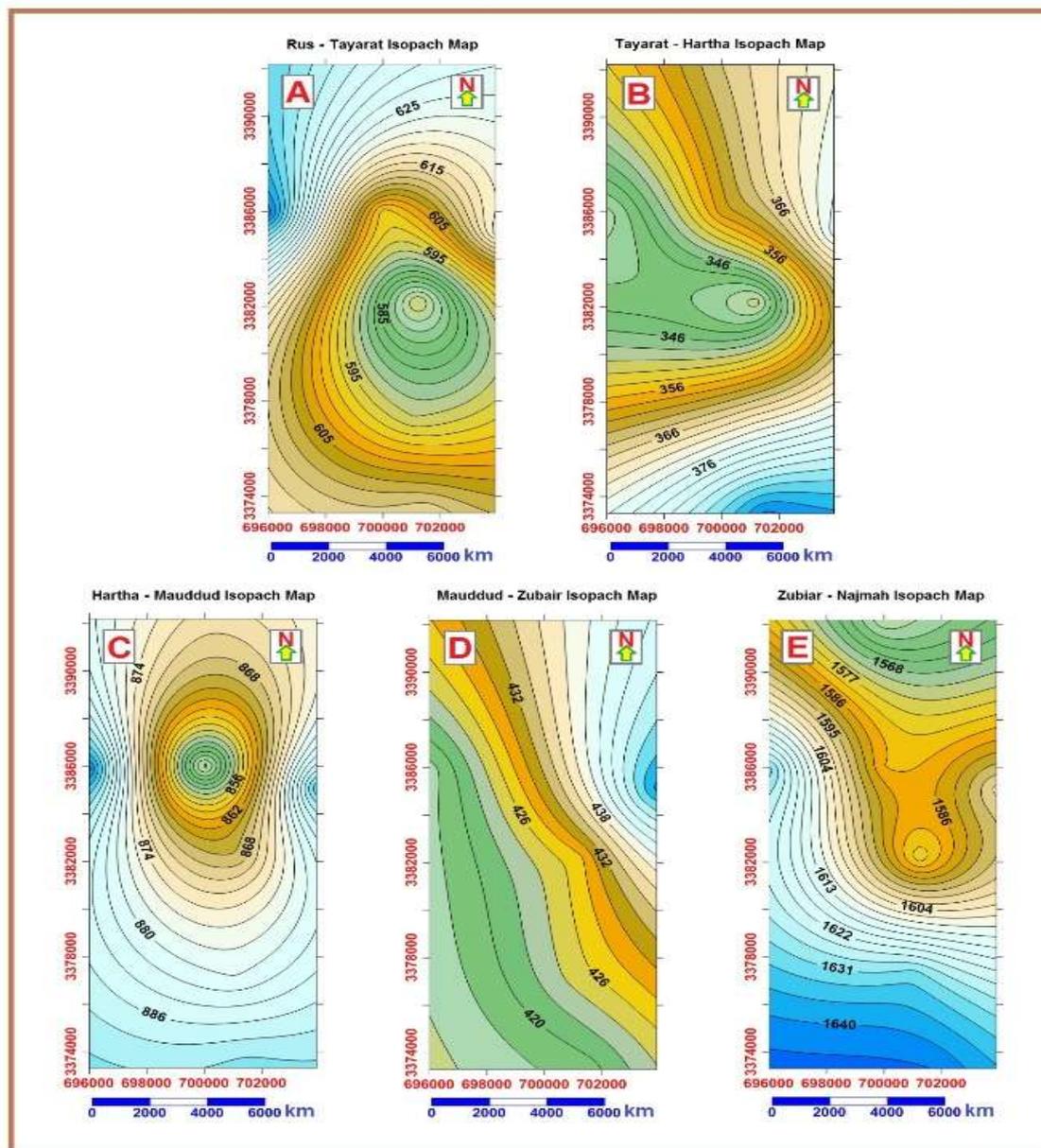


Figure 5- Isopach Maps of Ratawi Structure. (A) Isopach Map for Rus – Tayarat period. (B) Isopach Map of Tayarat – Hartha period. (C) Isopach Map of Hartha – Mauddud period. (D) Isopach Map of Mauddud – Zubair period. (E) Isopach Map of Zubair – Najmah period.

5. Discussion

As the study mentioned above the geophysical interpretations confirmed the presence of salt rocks in addition to tectonic movements during the geologic history. These factors worked together to many subsurface structures and one of them is the Ratawi Structure. The difference in thickness between crest and limbs of the structure where the thickness of crest is less than the thickness of limbs in all the formations of the structure referred to the effect of the vertical force may attributed to the effect of salt rocks movement below the structure. The salt may move upward due to salt mechanisms or may because of the effect of basement rocks activity which is induced the salt rocks to form the structure. The dips values of limbs of Ratawi Structure increase towards the older formations, and vice versa. This may be because the older formations are closed to the effect of salt rocks activity.

Finally, the geophysical evidences, the role of salt structures and tectonic movements, proved that the salt structure combined with tectonic activity to form Ratawi Structure.

6. Conclusions

According to the available geophysical and geological information Ratawi structure seems to be created and developed due to salt structure and tectonic movement.

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