Determine the morphostructure phenomenon, East Khor Al-Zubair by Space Imageries

Dr.TorhanAlmofti *** *Ahmed Ibrahim Saleh Al-Naemi***
Expert – Prof *Chief geologist*

Abstract

Through the use of satellite data taken by the Landsat satellites a color phenomenon was detected east of Khor Al-Zubair, southern Iraq, and a detailed study was carried out on this area and an oblate shape morphostructure phenomenon was detected towards (northeast-southwest) with a length of about 30 km and a width of about 15 km. It was distinguished by a color reflection that differs from its surroundings.

What confirms the existence of this phenomenon is the identification of the previous trace of the Shatt al-Arab, which indicates a recent tectonic activity, represented by Uplifting of the study area. knowing that the topographical height of this phenomenon in its highest part is 23 meters from the mean sea level.

As the area surrounding this phenomenon contains important oil and gas fields, it is possible that this phenomenon is a structure oranticline fold with promising hydrocarbon potentials, similar to the fields and structures surrounding it.

تحديد ظاهرة مورفوتركيبية شرق خور الزبير باستخدام البيانات الفضائية

د. طورهان المفتي* أحمد ابراهيم صالح النعيمي**

الخلاصة

من خلال استخدام البيانات الفضائية الملتقطة بالأقمار الصناعية (Landsat) لوحظ وجود ظاهرة لونية شرق خور الزبير، جنوب العراق، وتم إجراء دراسة تفصيلية لهذه المنطقة وتشخيص ظاهرة مورفوتركيبية مفلطحة الشكل باتجاه (شمال شرق – جنوب غرب) بطول حوالي ٣٠ كم وعرض حوالي ١٥كم والتي كانت مميزة بانعكاس لوني يختلف عن ما يحيطها.

ان ما يؤكد وجود هذه الظاهرة تحديد الاثر السالف لشط العرب الذي يشير إلى نشاط تكتوني حديث متمثل بارتفاع المنطقة (Uplifting)، ومن جانب اخر فإن عدم استمرار توسع ما يشبه شكل المروحة لخور الزبير بالاتجاه الجنوبي يشير بوضوح إلى وجود الظاهرة المورفوتركيبية ايضا، علما ان الارتفاع الطوبوغرافي لهذه الظاهرة في أعلى جزء منها هو 23 مترا من مستوى سطح البحر.

وبما ان المنطقة المحيطة بهذه الظاهرة تحوي على حقول نفطية وغازية مهمة فمن المحتمل ان تكون هذه الظاهرة عبارة عن تركيب او طية محدبة ذات احتمالات هيدروكربونية واعدة اسوة بالحقول والتراكيب المحيطة بها.

*www.Torhanmufti.com : E_Mail:muftitorhan@yahoo.com (خبير في وزارة الاتصالات)
**. E_Mail:Ahmedalnaemi330@gmail.com (رئيس جيولوجيين، قسم الجيولوجيا / شركة نفط الشمال)

Introduction

Morphotectonic is considered one of the important intro dictions to Neotectonic studies, which deals with the latest structural features resulting in the Earth's crust and its activity throughout its tectonic history extending since the end of the Neogene Age to the first half of the Quaternary era [1 and 2], and accordingly, the terrestrial movements extending from the Miocene era to the present time can be considered to have significance in the formation of the morphotectonic elements of any area [3], which included the probability of the previous effect of the river, the meandering function and the width of the valley, depending on the space data and the field study Available.

The Shatt al-Arab River consists of the confluence of the Tigris and Euphrates at the Qurna region, representing the course of the Shatt al-Arab canal from the town of Qurna (about 70 km north of Basrah) and emptying into the Arabian Gulf at the Faw city, south of the Basrah city. Note on data satellite, That the Shatt al-Arab River is one of the antecedent rivers, as there is a previous trace impact in the western region of it that encouraged the establishment of this morphotectonic study.

The Shatt al-Arab Basin represents a very low-lying area, where the topographic gradient is about (1 cm / km). Its river channel displays different styles that differ between (straight, sine, zigzag, and braiding) [4]

Location of study area

The study area is located in the southern part of the Mesopotamian Basin, where the Shatt al-Arab Basin is located on the unstable shelf of the Mesopotamian Basin, according to the tectonic division of Buday and Jassim [5]. This part has a thick sedimentary cover and the subsurface structures are not reflected on the surface [5 and 6].

Geographically, the study area is located in Basrah Governorate, southern Iraq, with a linear extension of 31° 00 '- 30° 00' North and lines 49° 40 '- 47° 20' East and to the western side of the Shatt Al-Arab River, Figure (1).

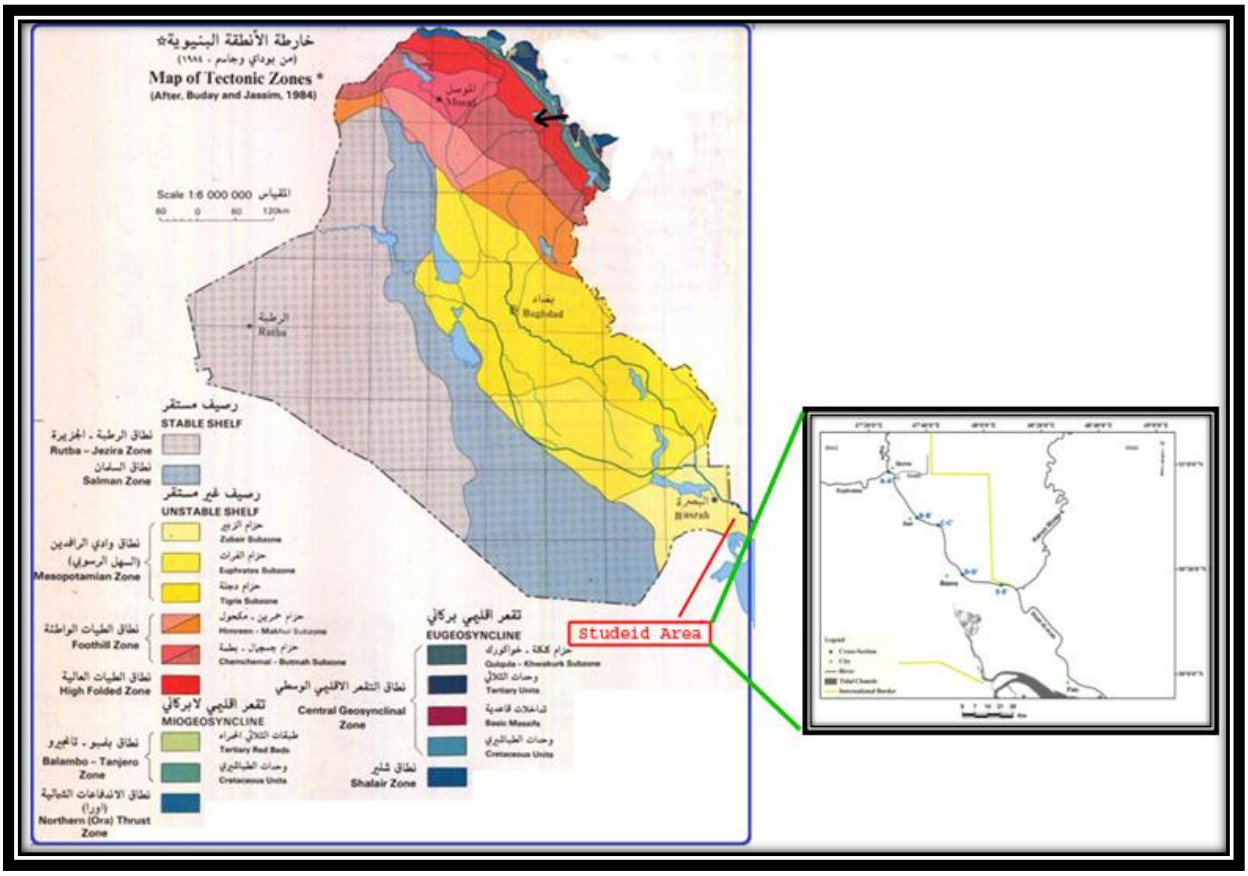

Figure -1 location of study area modified from [4 and 7].

Objective of research

The main objective of this research is to determine the ancestral effect of the Shatt al-Arab River and the recent tectonic activity in the region and its relationship to the subsurface geological structures, in addition to trying to explain the lack of continued expansion of the fan-these are like shape of the Khor Al-Zubair towards the south.

Tectonic setting of study area

The study area is located in the southern part of the wing near the deep sea platform of the Mesopotamian Foredeep region [7], Near Platform Flank of Mesopotamian Foredeep, as it is located within the secondary Zubair area of the sedimentary plain which represents the largest unit of unstable pavement units. Longitudinal structures extending in a north-south direction broken by a number of transverse faults extending in a northeast-southwest direction, Figure 1 and2.

Many researchers agreed that the mechanism of formation of structures in the area that includes the study area is due to two main reasons, the first is the reactivation of the deep base faults, and the second is the effect of the Hormuz Precambrian salts. In certain parts of southern Iraq, which has proven its existence through the values of

residual gravity and negative repercussions on the main structures such as the Nahr Omar (residual gravity value - 6 millical), Zubair, Tuba, and Ratawi structures , especially those that take semi-circular shapes in their structures, which It is explained by the penetration of saline compositions dating back to deterministic eras and returning salt deposits, which may be the upper Jurassic diapers (CotniaFormation salts) and their development into dipole structures responsible for the negative gravitational anomalies of subsurface structures[4].

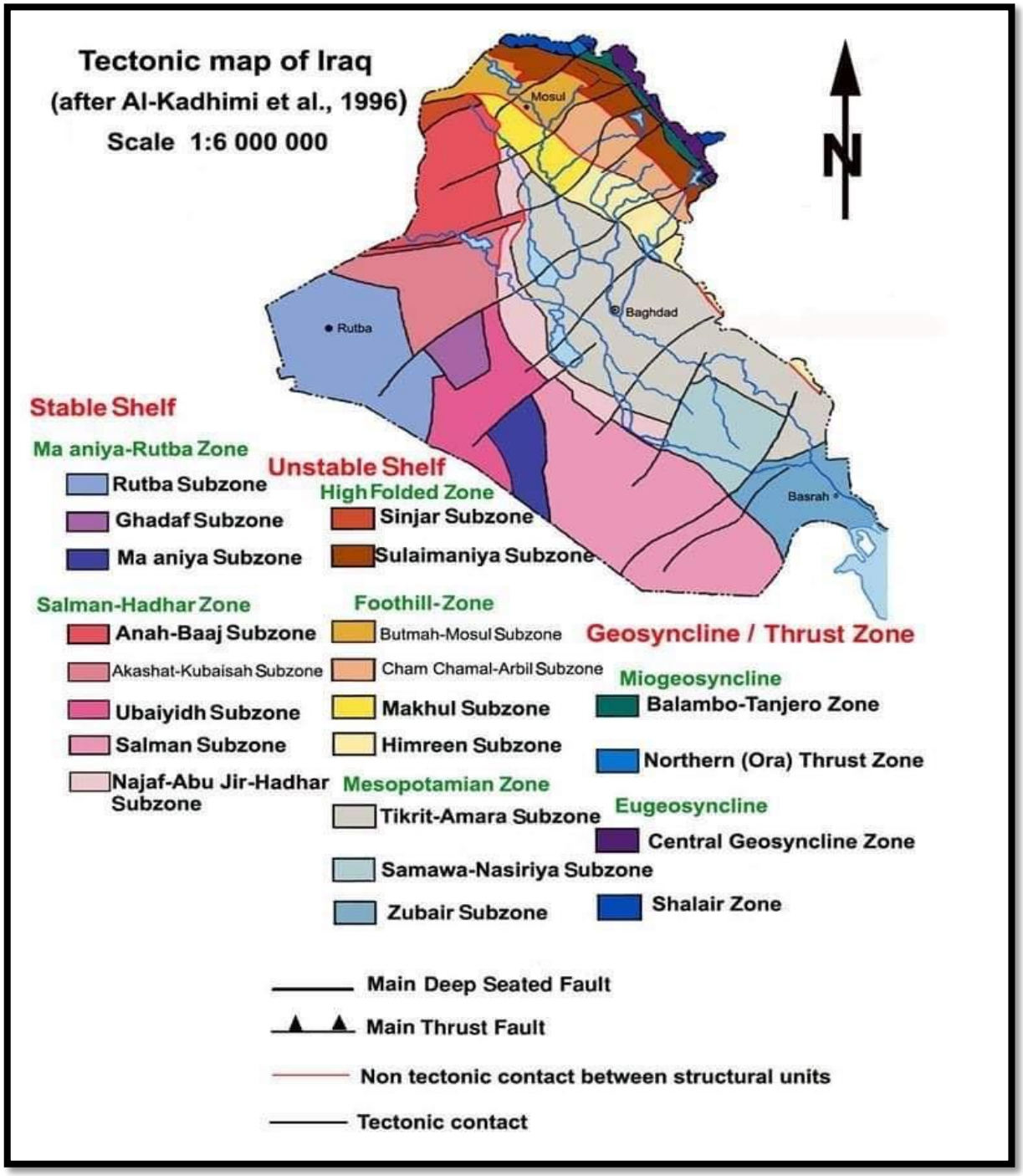

Figure-2 Tectonic map of Iraq (after Al-Kadhimi et. Al.,1996)

Geological setting

The Shatt Al Arab river flows in the Tertiary and Mesozoic northwest – southeast trending Zagros fold belt. The river is formed by the confluence of the Tigris and Euphrates Rivers, which flow through central and eastern Iraq. A third river, the Karun River, which flows in west-central Iran and drains the Zagros mountains joins the Shatt Al Arab waterway just north of the recent delta, With a total length about204 km, the Shatt al Arab widens over its course, expanding from a width of 250 -300 m near the Euphrates-Tigris confluence to almost 700 m near the city of Basrah and more than 800 m a sit approaches the river pours. Figure-3.

Most parts of the study area are lands with flat surface terrain in general and their height does not exceed 23 meters above mean sea level, and the area is covered with alluvial deposits and fine sand representing the riverine environment for the modern era interspersed with sediments from the Miocene period.

Figure-3 shows the geological surface for study area

Stratigraphical setting

The stratigraphic column of southern Iraq is characterized by the presence of thick deposits of the Cretaceous period with important oil, Figure- 4 .

The stratigraphic sequence of the Nahr Omar field, which is located in the north of the study area and within the basin of the Mesopotamian valley in its southern part, which

in turn represents part of the semi-platform of the Arab plate, was used as a result of the successive structural movements that in turn affected the deep base faults that later developed, generating continental basins. In land within the Arabian plate, this basin was filled with an ideal sedimentary column consisting of source and reservoir rocks in addition to the cap rocks and with a regional extension to the same sedimentary basin.

The sedimentary conditions and the quality of the sediments in the Omar River field area in general are similar with the conditions and the quality of the sediments in the fields in southeastern Iraq, of which the study area is part, which is composed of shallow and deep marine environments that consisting of several sedimentation cycles.

The Mushrif and Zubair formations represent the most oil reservoirs pay, especially in the Zubair and Rumaila fields, due to the similarity of the origin of these two fields and that they are produced from source rocks generating one hydrocarbon, which is either the Sargelu formation (Middle Jurassic) or Mirge Mir (Lower Triassic)[8].

The oil produced from reservoirs of the Cretaceous period is one of the finest extracted in Iraq. The oil produced from the Nahar Omar reservoir in the Nahar Omar field is light oils with a density of 42 degrees according to the scale of the American Petroleum Institute, while in the fields of Rumaila and Zubair, it ranges between 35-42,Oil from the Mushrif reservoir in the Zubair and Rumaila fields has a density of 26, and finally the lower Fars formation in the Zubair Field, which has a density of 10-20 API [8].

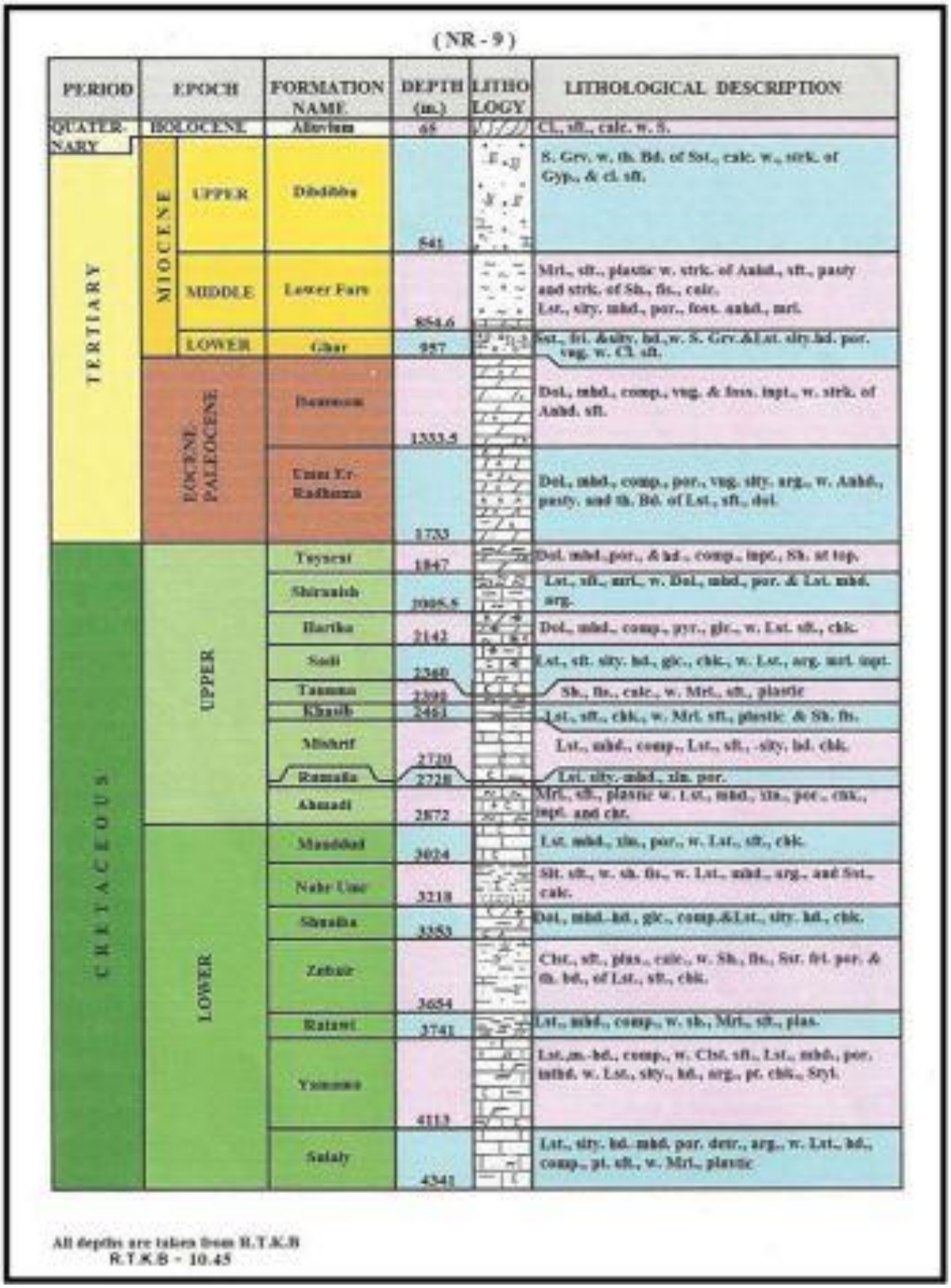

Figure- 4 shows the stratigraphical Column in surrounded study area[8].

Morphometric characteristics of a river bed.

- **Evolution of river curves**

The development of the river curves is not limited to the migration of the river sideways, but the folds increase in curvature and widening and these folds

gradually migrate towards the estuary. Excessive direction in this direction leads to an increase in the meandering of the river, the intensification of its river folds, and the convergence of the contiguous folds at the syncline axes so that only a narrow plain neck separates them from each other (Al-Husseini, 1991, p.22), figure-5.

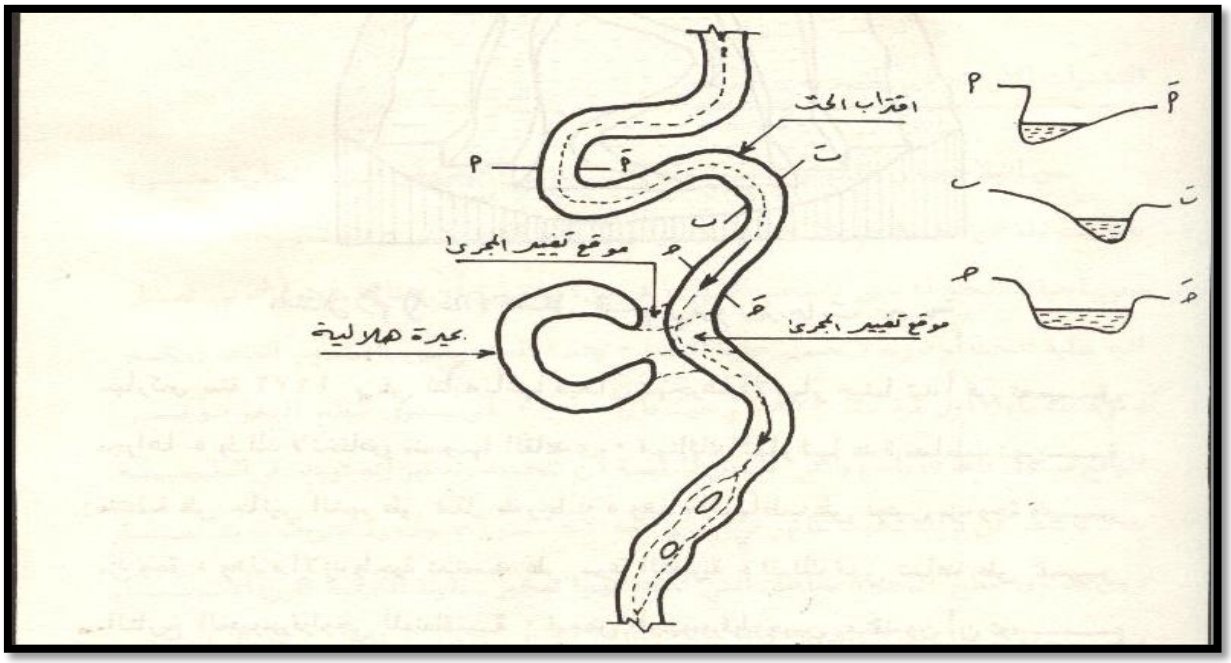

Figure-5 represents the geomorphological phenomena formed by the river bed and their morphometric dimensions [9]..

River curves are one of the main features of rivers of different sizes, and these curves (meanders) are characterized by the symmetry of their dimensions by digging, and the presence of these barriers and potholes at the bottom of the Shatt al-Arab stream creates a state of instability that leads to the diversion of the river current from one side to the other, specifically towards Iraqi lands.

It is noted that most of the concave sides of the curves are inside Iraqi lands, as carving in these directions and sedimentation on the convex sides inside Iranian lands lead to the migration of the river lateral (lateral migration), despite the long distance in which the Shatt al-Arab runs between Qarna district from the meeting point of the river the Tigris and the Euphrates and up to its estuary in the Arabian Gulf, the dimensions of the most prominent folds and river curves of the Shatt al-Arab River course were measured (seven curves) and their development was followed for the period from 1952 to 2009, which is from north to south (Al-Sweib and Al-Zuraiji, and al-Tanumah andAl-Siba, where the river rotates near cycle shape, the Bahar, Aldoura, and Al-Ma'ameer near the

delta region), These curves are named after the largest cities and villages located on them.[10, 11, 12 and 13]. (Table 1 and 2).

Table -1 Dimensions of the river curves of the Shatt Al-Arab stream for the year 2009

series	The bend	Length(km)	Breadth(km)	curvature radius(km)	Average course width(m)	Zigzag ratio
1	Al-Sweib	10	5.5	2.5	480	2.2
2	Al-Zuraiji	40	30	5.5	550	5.45
3	Tanumah	22.5	25	4	560	6.2
4	Al-Siba	22	17.5	6	680	2.9
5	Bahar	21	17.5	5.5	870	3.18
6	Aldoura	16.5	15	5	670	3
7	Ma'ameer	17.5	12.5	2.5	1220	5

Table-2 Dimensions of the river curves of the Shatt Al-Arab stream for the year 195]

series	The bend	Length(km)	Breadth(km)	curvature radius(km)	Average course width(m)	Zigzag ratio
1	Al-Sweib	5	2.5	1.5	406	1.6
2	Al-Zuraiji	20	19	9	400	2.1
3	Tanumah	21	25	8	360	3.1
4	Al-Siba	13	10	14	550	2.1
5	Bahar	13	7.5	2.5	490	3
6	Aldoura	13.5	10	3.5	430	2.8
7	Ma'ameer	11	9.5	2	600	4.7

previous trace of the river

By examining the satellite images of the study area, it is possible previous trace effect (ancestral)of the Shatt al-Arab River to the west of the current course of the river, where tectonic lifting operations in the region may lead to the displacement of the Shatt al-Arab River in the eastern direction gradually and in a manner consistent with the increase in tectonic lifting operations, with the continuation of the lifting operations The fold and the unbalanced and uneven growth in the area led to the increase in the study area (the western part of the Shatt al-Arab River) in a greater manner, leading to the creeping of the river little by little to the current site and its stability due to the ease of drilling in this area, Figure (6).

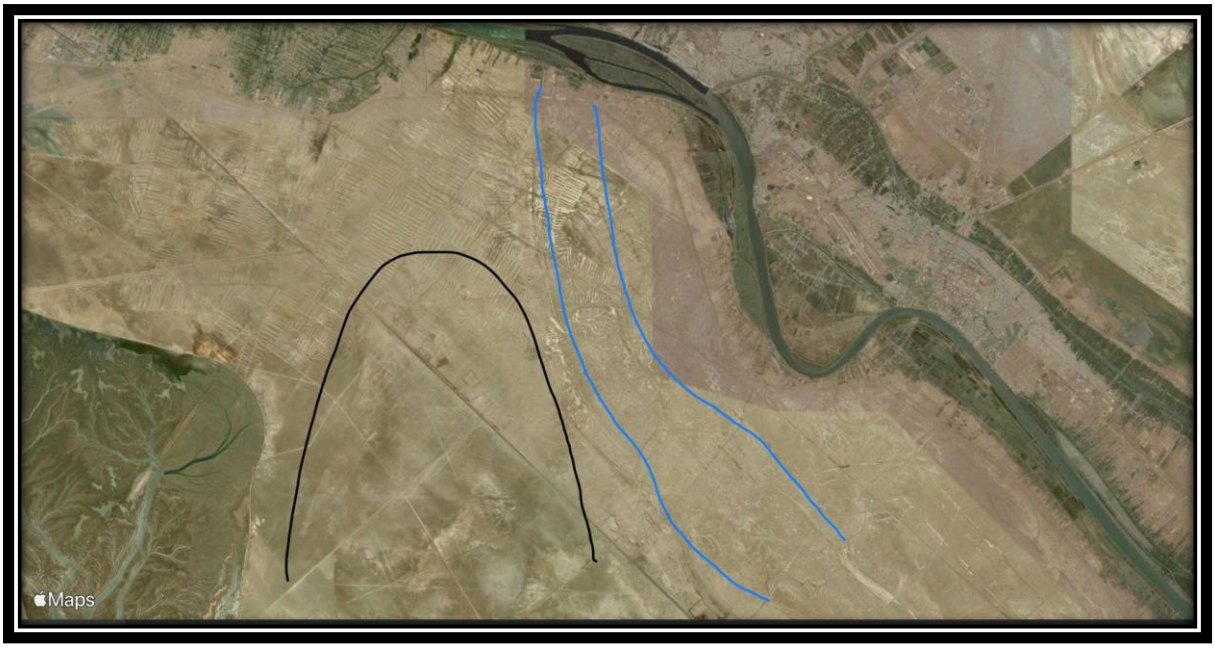

Figure-6 shows the previous trace (antecedent)of the Shatt al-Arab in study area.

When using space data and processing it with modern software (the Geomatica program used in analyzing images and colors), we notice different color reflections, as the area near Khor Al-Zubayr differs in color from what surrounds it, which at first glance indicates the topographical difference, Figure-7.

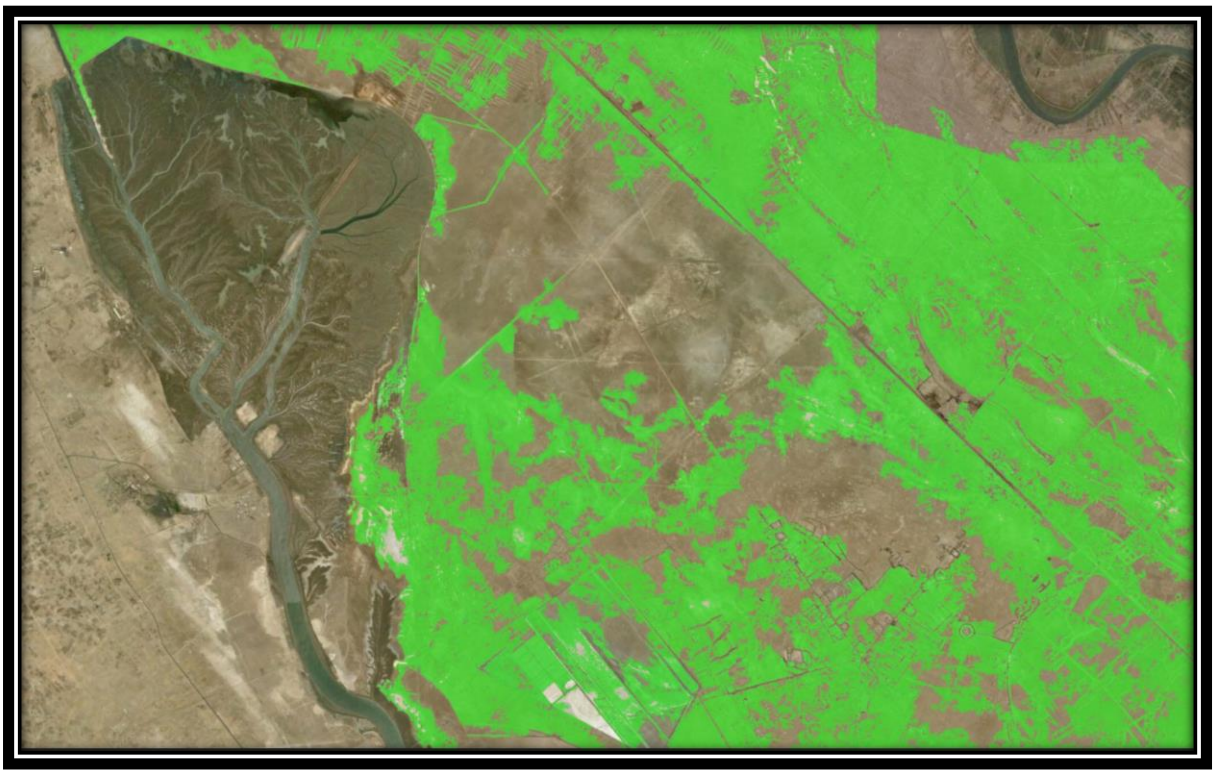

Figure-7 shows the a color reflection of morphotectonic phenomena for study area.

The topographic height of the study area

When examining the topography of the study area, we noticed that the highest area is the area near Khor Al-Zubair, which is located to the east of it, with a topographical height (75 feet) about 23 meters from sea level, to measure the topographical height of the study area, two sections were drawn:

- The first (Northeast - Southwest), which showed that the average highest elevation in it is 36 feet (about 11 meters) from mean sea level, Figure-8.
- The second (Northwest - Southeast), which showed that the average highest altitude is 28 feet (about 8.5 meters) from mean sea level, Figure-9.

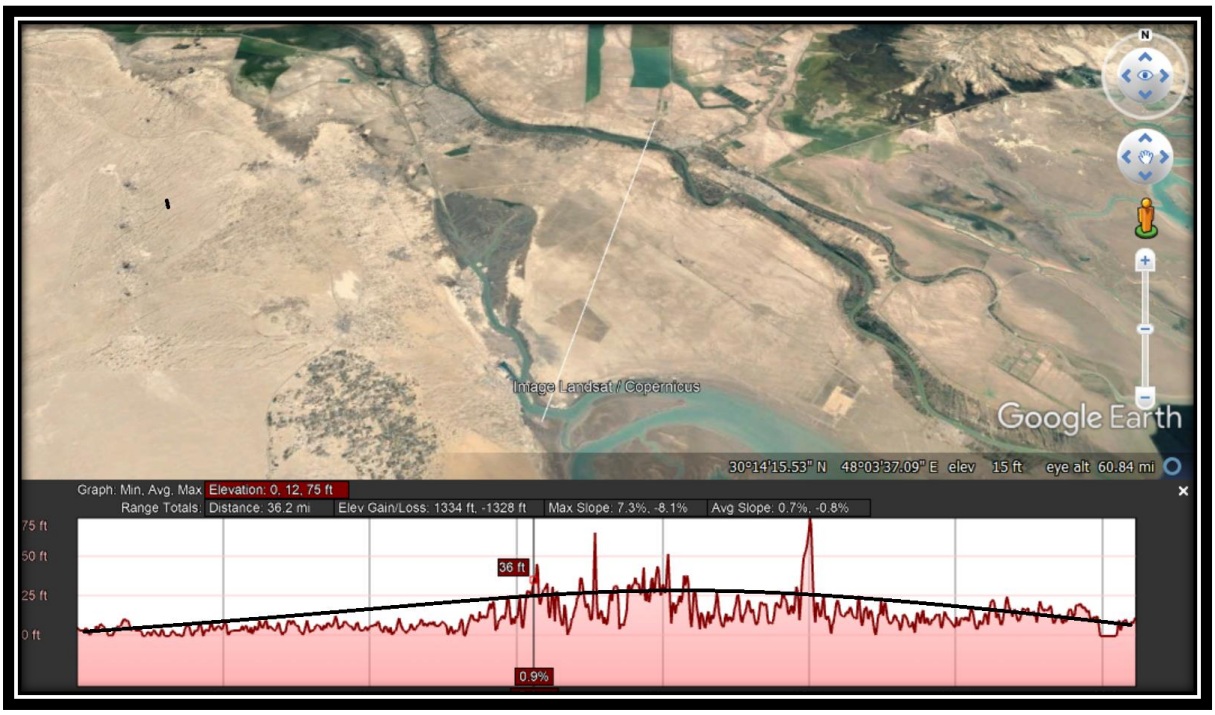

Figure-8 shows first topographical section in the study area

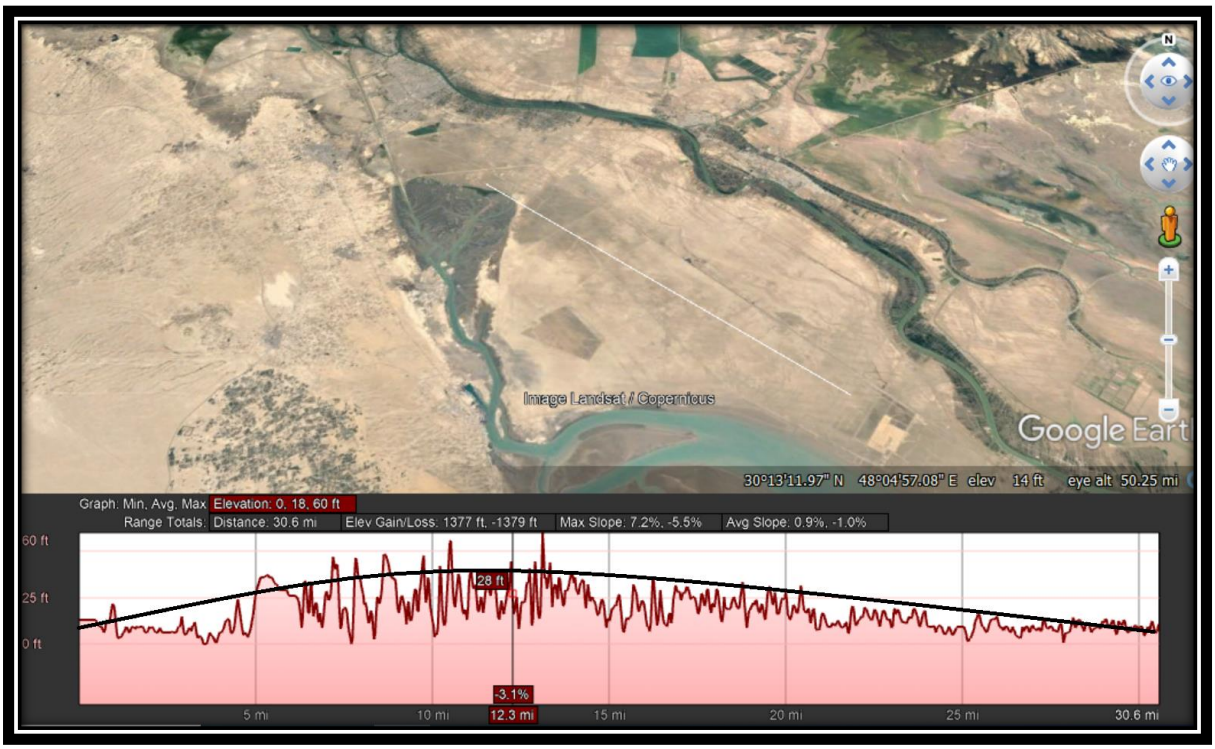

Figure-9 shows second topographical section in the study area.

Drainage patterns in the study area

The drainage patterns are considered important and useful indicators in giving a first picture of the reflections of the subsurface structures, and the drainage patterns differ from one place to another due to several factors, including: the geological structure, the rock composition, the slope, the climate, and the geomorphological development of the river basin, and the most important of these patterns are the following:

1- **Dendritic drainage.**

2- **Trellis drainage.**

3- **Rectangular drainage.**

4- **Parallel drainage.**

5- **Centripetal drainage.**

6- **Radial drainage.**

7- **Deranged drainage.**

8- **Annular drainage.**

9- **Barbed drainage.**

Four areas were selected in the study area to determine the drainage patterns (figure-10), and they are following:

- **An area like to the Khor Al-Zubair fan.**

  We notice in it the presence of drainage patterns of the Dendritic and Centripetal types, where the central drainage pattern prevails in the basin areas with internal water drainage, as is the case in the Khor Al-Zubair fan, (Figure-10, area 1).

- **Central area.**

  We notice the presence of drainage patterns of the Dendritic and Radialtypes, and Dendriticname was derived from the Latin term "Dendron", meaning tree. This pattern prevails in areas of homogeneous sedimentary rocks, especially clay, and in which river courses bifurcate to an extent that resembles a tree, where the tributaries meet with each other and the main river at sharp angles, while, the Radialtype is a reverse image of the previous central pattern and is

also found in domes and rocky heights. And where waterways descend from these high peaks, these patterns spread and radiate in all directions. (Figure-10, area 2).

- **Southern area.**

  We notice in it the presence of drainage patterns of the tree type and the direction of the current course of the Shatt al-Arab River, (Figure-10, area 3).

- **The eastern area near the course of the Shatt al-Arab River**

  We notice in it the presence of drainage patterns of the tree type as well, (Figure-10, area 4).

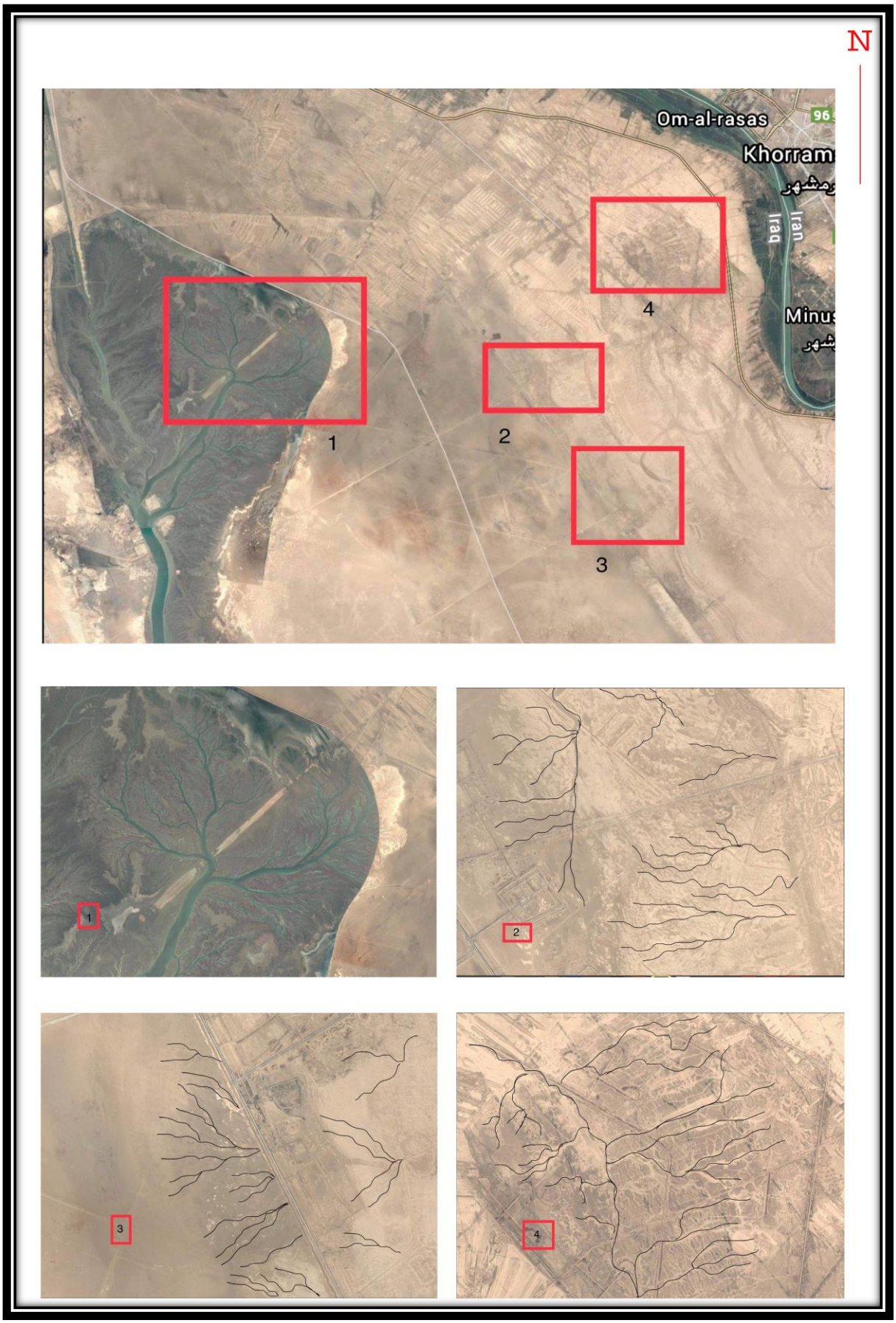

Figure-10 shows the drainage patterns in study area

Discuss results

The study area is located within the Mesopotamian basin, which contains oil structures and fields. The area surrounding the study area contains many structures and fields, including the fields of Nahr Omar, Zubair, Al-Tuba, Al-Siba, and Rumaila in Iraq, and al-Rawdatain and Bahra fields in Kuwait, (figure – 11). These structures and oil fields include Important cretaceous reservoirs with good oil.

From the foregoing, it can be said that changing the course of the Shatt al-Arab River and its encroachment towards the east is nothing but evidence of recent tectonic activity in the region, as well as the growth of a flattened morphotectonic phenomenon at a height of about 23 meters from sea level, with a length of about 30 km and a width of 15 km, which could be A subsurface structure containing hydrocarbon reservoirs, similar to the fields and structures surrounding it.

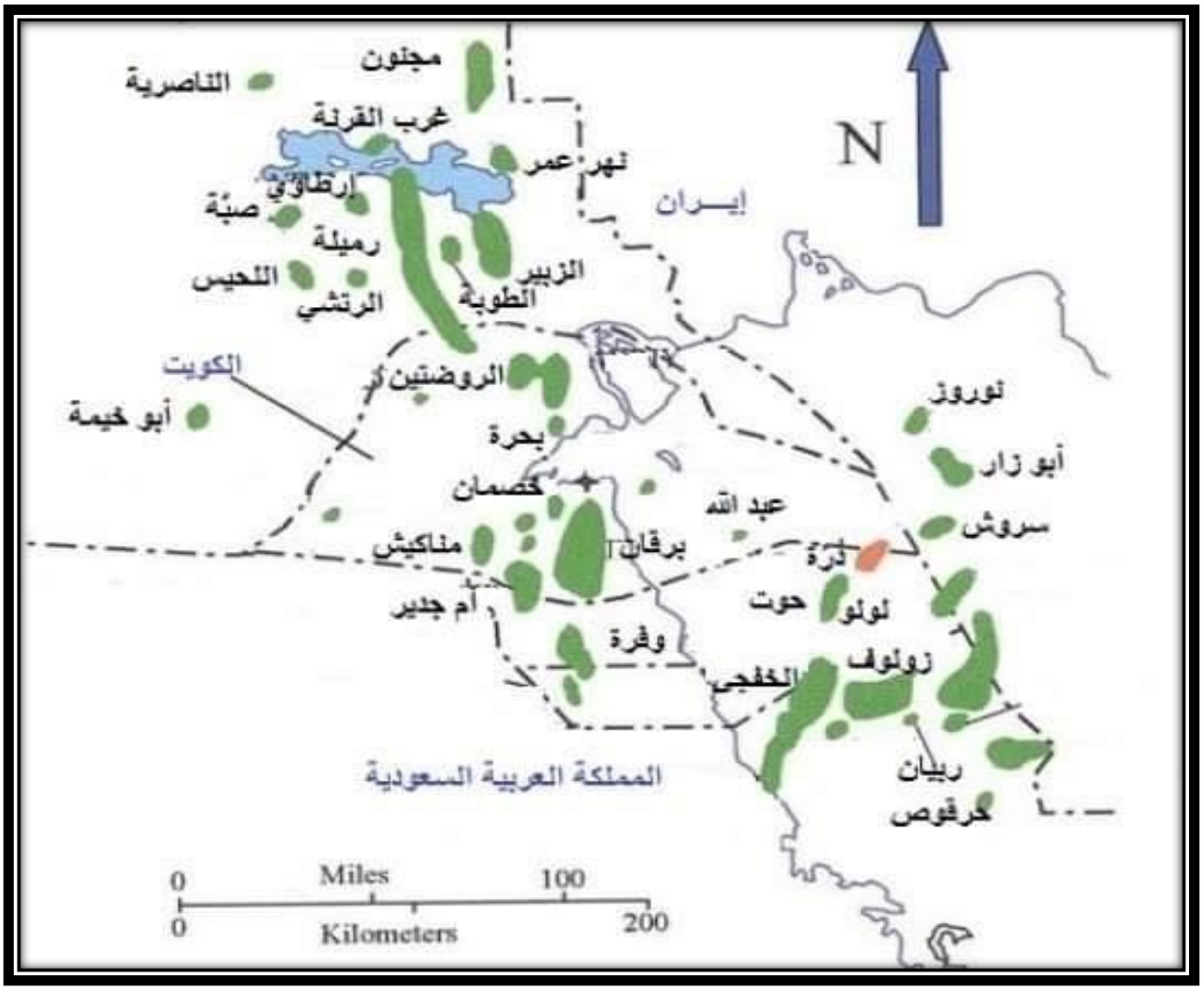

Figure-11 shows the structures and Oil Field in surrounded study area

Conclusions:

1- Confirm the existence of morphotectonic phenomenon through identification of the previous trace of the Shatt al-Arab, which indicates a recent tectonic activity, represented by Uplifting of the study area. knowing that the topographical height of this phenomenon in its highest part is 23 meters from the mean sea level.
2- The morphostructure phenomenon was detected with a length of about 30 km and a width of about 15 km. It was distinguished by a color reflection that differs from its surroundings.
3- As the area surrounding this phenomenon contains important oil and gas fields, it is possible that this phenomenon is a structure or anticline fold with promising hydrocarbon potentials, similar to the fields and structures surrounding it.

References:

[1] Vicente, G.D., Giner, J.L., Munoz– Martin, A., Gonzales- Casado, J.M. and Lino, R.,(1996). Determination of presen day stress tensor and neotectonic interval in the Spanish central system and Madrid basin, central Spain. Tectonophysics . 266 : 405-424.

[2] Bloom, A.L., (1998). Geomorphology . Asystematic Analysis of Late Cenozoic Landforms . Prentice Hall, 482pp**.**

[3] Zhiming, C., (1993). An outline of China`s geomorphology . China Cartographic Publ. House.

[4] Al-Kubaisi& Hussein, (2014). Morphotectonics of Shatt Al-Arab River Southern Iraq. Iraqi Journal of Science, Vol 55, No.3A, pp:1051-1060.

[5] Buday, T and Jassim, S. Z. (1987). The Regional Geology of Iraq.Volume 2, Tectonism, Magmatic and Metamorphism.Geological Survey and Mineral Investigation. Baghdad.

[6] Jassim, S. Z. and. Goff, J. C., (2006). Geology of Iraq.Dolin, Pragueand Moravian Museum, Brno.

[7] Ditmar, V. and Iraqi – Soviet Team (1972). Geological conditions and hydrocarbon prospects of the Republic of Iraq. Vol. 11, South Iraq. Manuscript report, lNOC Library, Baghdad, Iraq.

[8] Jafer, M. S. A, (2000). The effect of structural forming on the petroleum system of lower Fars oil reservoir (M. Miocene) in NahrUmr field – Southern Iraq.Oil Exploration Company, Baghdad, JRSP,N.19.

[9] Adnan Baqer Al-Naqash, AsadorHumbarsum, (1985). Geomorphology and Geology. structure and Geology of Iraq, Baghdad University College of Science, p. 12 (in Arabic).

[10] Alkhafaji, SarhanNaim, (2000). Changes in the course of the Shatt al-Arab River and their impact on Iraqi lands.University of Al-Mutha, College of Education.College of Arts Journal, Issue 93.

Other references

[**11] General Commission for Survey, (2008).**Topographical Maps of the Shatt al-Arab, Scale 1: 50,000, Baghdad.**(in Arabic).**

[12] Area Visuals, (2009).US Landsat Satellite Series, ETM Scanner.

[13] General Survey Authority, (1952). Detailed maps of the Shatt al-Arab area, scale 1: 50,000, Baghdad .**(in Arabic).**