جيولوجيا الصحراء الغربية

GEOLOGY OF WESTERN IRAQI DESERT

4TH CLASS

APPLIED GEOLOGY DEPARTMENT
COLLEGE OF SCIENCE
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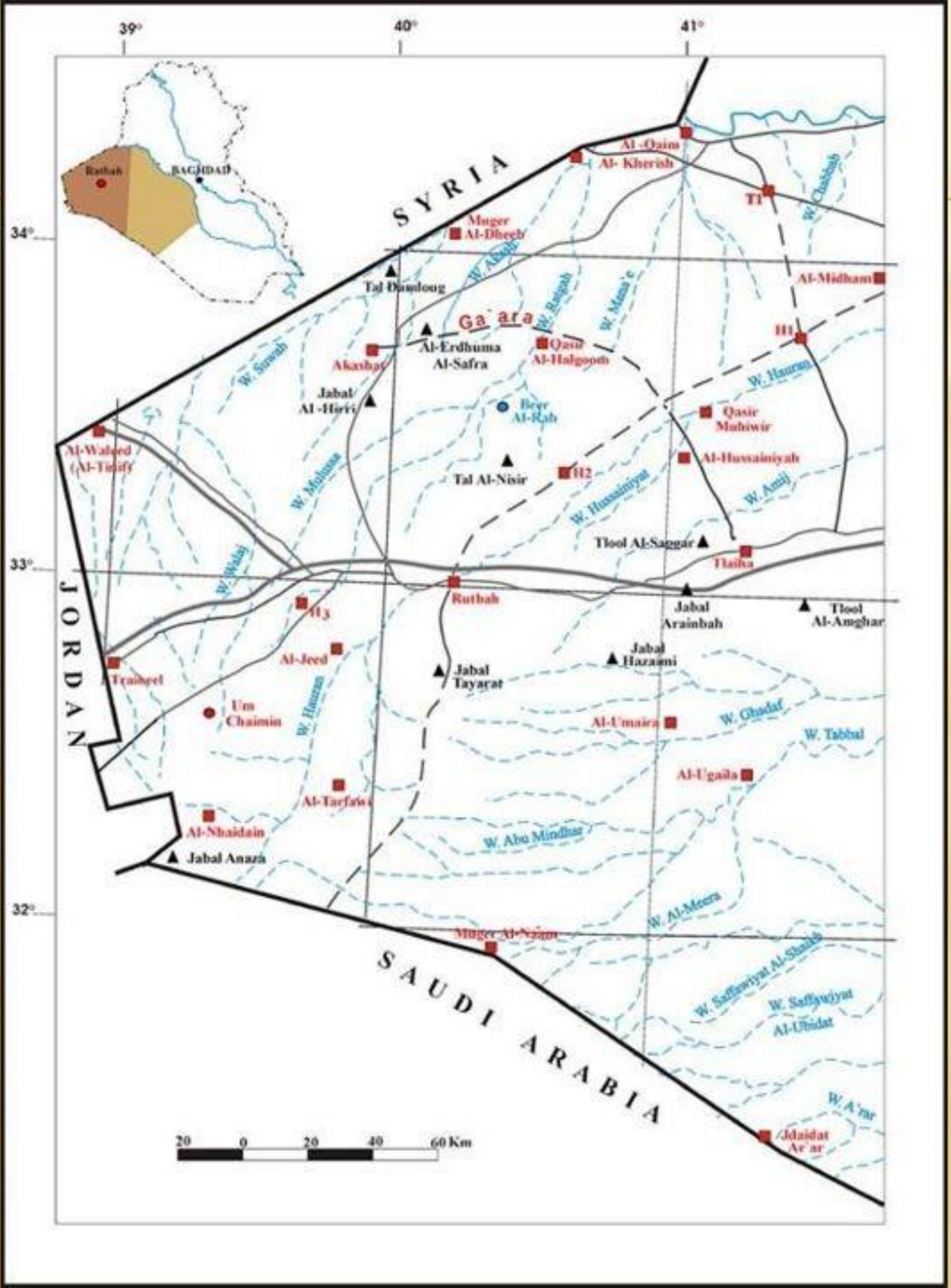
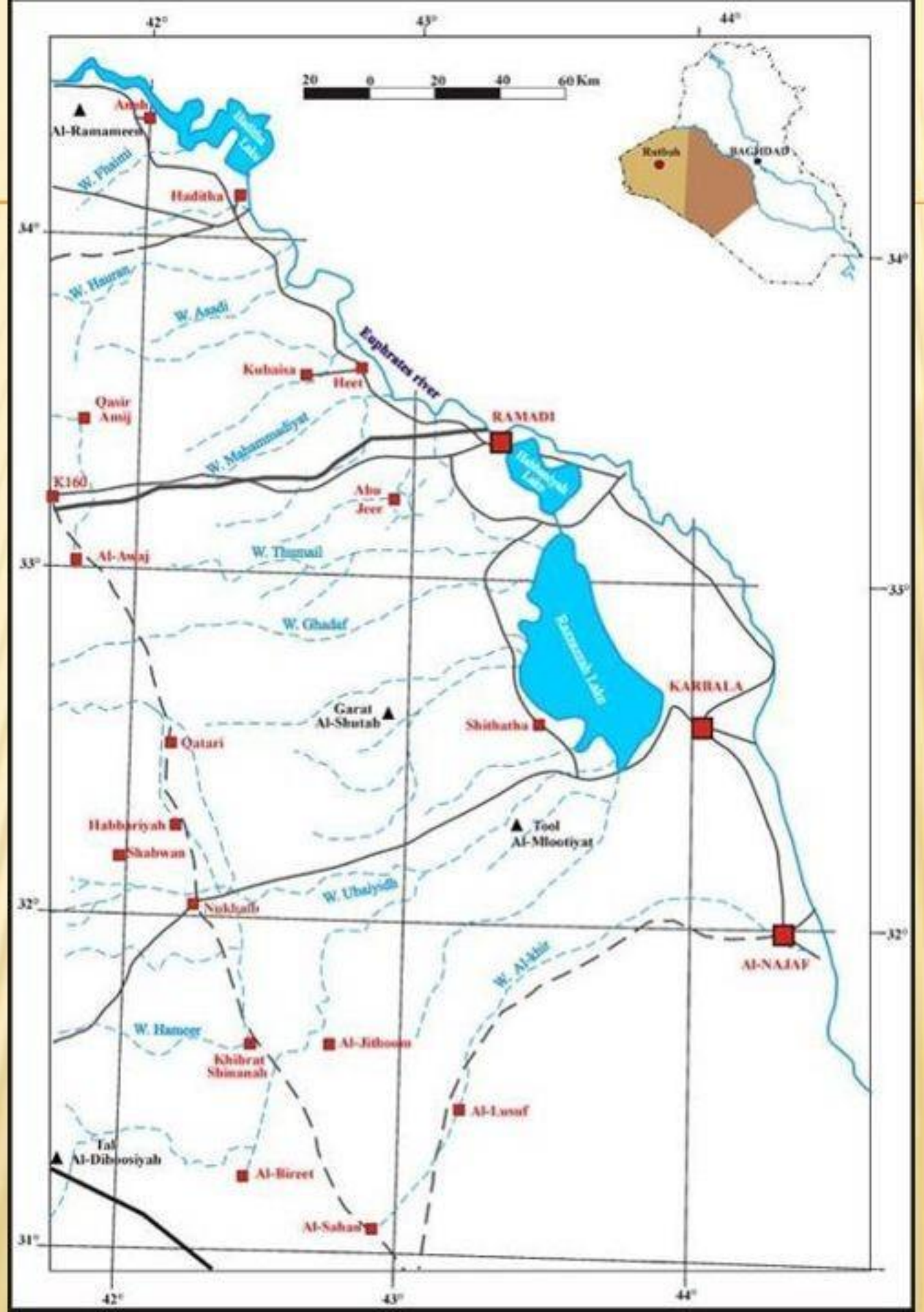
المحاضرة الاولى


39°
40°
41°
34°
33°
32°
SYRIA
JORDAN
SAUDI ARABIA
Rutbah
BAGHDAD
Al -Qaim
Al- Kherish
T1
W. Chabbab
Muger Al-Dheeb
W. Akash
Tal Daulong
W. Ratgah
W. Mana'e
Al-Midham
Ga'ara
Al-Erdhuma Al-Safra
Qasir Al-Halgoom
Akashat
H1
W. Suwab
W. Hauran
Jabal Al -Hirri
Beer Al-Rah
Qasir Muhiwir
Al-Waleed (Al-Tinif)
Al-Hussainiyah
H2
Tal Al-Nisir
W. Mulussa
W. Hussainiyat
W. Amij
Tlool Al-Saggar
Tlaiha
W. Walaj
Rutbah
Jabal Arainbah
Tlool Al-Amghar
H3
Al-Jeed
Jabal Hazaimi
Jabal Tayarat
Traibeel
Um Chaimin
W. Hauran
Al-Umaira
W. Ghadaf
W. Tabbal
Al-Ugaila
Al-Tarfawi
Al-Nhaidain
W. Abu Mindhar
Jabal Anaza
W. Al-Meera
Muger Al-Naam
W. Saffawiyat Al-Shaikh
W. Saffawiyat
Al-Ubidat
W. A'ar
Jdaidat Ar'ar
20 0 20 40 60 Km


42°
43°
44°
20 0 20 40 60 Km
Al-Ramamees
Anah
Habbaniyah Lake
W. Fhaimi
Haditha
34°
W. Hauran
W. Asadi
Euphrates river
Kubaisa
Heet
Qaim
Ansij
RAMADI
W. Mahammadiyat
Habbaniyah Lake
K160
Abu Jeer
33°
Al-Assaj
W. Thumail
W. Ghadaf
Razzazah Lake
KARBALA
Garat Al-Shutab
Shithatha
Qatari
Habbaniyah
Shabwan
Tool Al-Mlootiyat
W. Ubaiydh
32°
Nukhaib
W. Al-Khir
AL-NAJAF
W. Hamer
Khibrat Shimanah
Al-Jithoom
Al-Lusuf
Tal Al-Dibdoosiyah
Al-Bireet
Al-Sahaf
31°
Rutbah
BAGHDAD

GENERAL INFORMATIOMN

Administratively, four governorates share the area of the Western Desert.

- The majority of the area (more than 95%), however belongs to Al-Anbar Governorate, a small part belongs to Karbala Governorate and two very small parts belong to Al-Najaf and Babil Governorates.

-The centers of the four governorates are Ramadi, Karbala, Najaf and Hilla, respectively.

-The last one is out of the coverage area of the Western Desert.

-Because of the climate and deficiency of water, the majority of the Western Desert is not populated.

-Therefore, the present towns are located either on the boundary with the Mesopotamian Zone or along the Euphrates River.

Beside the aforementioned cities, the followings towns are present, from West to East: Qaim, Anah, Rutbah, Haditah, Haqlaniyah, Nukhaib, Baghdadi, Kubaisa, Heet, Shithatah and Hindiyah.

Moreover, small settlements with many hundred populations are also located in the area, among them are: Traibeel, Al-Waleed, Akashat, Kilo 160, T1, K3, Abu Jeer, Habbariyah, Rahaliyah, and Thumaili.

Drainage

-The Euphrates River forms the northern, northeastern and eastern limits of the Western Desert.

-Three lakes are located along its northern and eastern limits; these are Haditha, Al-Habbaniyah and Al-Razazzah.

-The first one forms the reservoir of the Haditha Dam, whereas the others are natural depressions, filled by water by means of controlling sluices, for irrigation and flood controls.

-Many large valleys drain the Western Desert; some of them drain into the Euphrates River, others into Al-Razazza Lake.

The main valleys are, from the West to the East: Al-Breem, Al-Walaj, Swab, Akash, Ratga, Manani, Halgum, Chabbab, Khazga, Qasir, Fhaimi, Akhdhar, Haqlan, Banat Al-Hassan, Zghaidan, Hauran, Asadi and Mohammadi, these valleys drain into the Euphrates river.

-Those which drain into the Al-Razazza Lake are: Hzaimi, Ghadaf, Abu Mindhar, Meela, Tabbal, Ubayidh, Hamir, Saffawiyat Al-Shaikh, Saffawiyat Al-Ubaidat and Khir.

The last one drains into Bahir Al-Najaf.

☐☐ Topography

-The Western Desert is generally a flat region, rising in elevation westwards.

-The main landscape is plateaus that are dissected by dense valleys, some of them are canyon-like with a few tens of kilometers long, and others are few hundred kilometers in length.

-Another characteristic landscape is the isolated hills, which range in height from a few meters to more than 50 m, being remarkable feature in the flat nature of the area and are visible from distance of few tens of kilometers.

- Among them are Damloug, Tinif, Jabal Anaza, Nehaidain, Al-Ramameen, Amghar, Al-Erdhuma Al-Safra, Jabal Al-Hirri, Tal Al-Nisir, Tlool Al-Saggar, Jabal Arainbah, Garat Al-Shutub, Tlailat Al-Zurug, Al-Milootiyat, Tal Al-Dabboosiyah, Jabal Hzaimi and Jabal Tayrat.

-Another characteristic feature is the depressions, which are either erosional or solution forms.

-They are in different shapes and sizes, mainly circular, oval and longitudinal.

Some of them are exceptionally large reaching few tens of square kilometers like Ga`ara, Habbariya, Faidhat Al-Shaikh, Al-Jithoom, Al-Birret, Amij, Al-Waz, and Um Al-Adhim.

-Deep depressions are also common; they may attain 50 m in depth like Salman Roza sinkhole, near Haditha and Um Chaimin, southwest of Rutbah (Fig.1).

The topographic gradient of the Western Desert increases from east to west in average of 5 m/Km, the highest and lowest points in the area are 987 and 77 m a.s.l., respectively.

-The former is in Jabal Anaza, whereas the latter is near Al-Najaf, in the eastern part.

Topography (Parson, 1955)

Parson (1955) divided the Iraqi Desert to 5 Topographic Units:-

أ- وحدة الحماد

وهي عبارة عن سهل منبسط ينحدر باتجاه الشمال والشمال الشرقي ويبلغ أعلى ارتفاع لهذه المنطقة في جبل عنزة عند الحدود العراقية – السعودية- الاردنية جوالي (٨٨١ م) ف.م. س.ب ويعد وادي الوليج أهم الوديان في هذه الوحدة مع تواجد العديد من المنخفضات فيها واهما منخفض أم الكمأ.

ب- وحدة الوديان العليا

تقع شرقي منطقة الحماد وتحتوي سهل واسع يرتفع قليلاً باتجاه الغرب وتقطعها شبكة كثيفة من الوديان باتجاه الشرق والشمال الشرقي، والتي تكون عبارة عن وديان عميقة وواسعة والتي تحدد بحروف صخرية وذات نظام تصريف شجيري، واهما وادي الرتكه والمانع وحوران في الشمال ووادي الغدف والابيض وعرعر في الجنوب، اضافة الى تواجد بعض المنخفضات واهمها منخفض الكعرة. وتشمل هذه الوحدة مكاشف صخرية لتكوينات العصر الترياسي الجوراسي والطباشيري والعصر الثلاثي.

جـ-وحدة الحجارة

وهي منطقة تقريباً منبسطة ومغطاة بقطع صخرية حادة الحواف من الحجر الجيري والصوان. وتتميز هذه المنطقة بتواجد منحدرات شديدة مختلفة الارتفاعات ولكن باتجاه شمال – شمال غرب، وهي التي تتحكم بطبوغرافية المنطقة مؤدية الى تكوين هضاب ذات أرتفاعات مختلفة ومتدرجة.

د- وحدة الوديان السفلى

وتشمل الاجزاء الشمالية والشرقية للصحراء الغربية وتمتاز بمظاهر طبوغرافية متنوعة، حيث أدت سيول الوديان التي تنحدر باتجاه نهر الفرات أو المنخفضات الواقعة الى الغرب منه في الاجزاء الشمالية منها الى تجزئة سطح هذه الوحدة، كما أدت الحركات التكتونية الى رفع حافاتها المجاذية لنهر الفرات والى خفض بعض المناطق مثل منخفض ابوديس والحبانية والثرثار.

هـ- وحدة الديدبة

وتقع خارج حدود محافظة الانبار

INTRODUCTION

-The Western Desert is a major plateau of a rocky desert.
-It has got the term desert because (***of low rainfall and absence of vegetation and thick soil cover***).
-The vast plain of the Western Desert is nearly featureless, rises gradually from east to west to a maximum elevation of 987 m, above sea level.
-The even surface has thin soil cover especially in the western parts, whereas the exposed carbonates and other rocks form the other part.
-The main topographic features are some positive features (mesas and buttes), cliffs, canyons, major valleys and depressions.
-The positive features are represented by Jabel Anah, in the north and Jabel Aneiza, in the west.
-Long low cliffs trend nearly parallel to each other giving the surface a step form character.
-Along the cliffs, mesas and hills are scattered.
-Several canyons cut the desert from west towards north, northeast and east.
-The canyons are deep, often steep walled.
-Major and minor depressions are common in the Western Desert.
-The major depression are represented by Ga`ara, Nukhaib, Shinana, Al-Birreet and Al-Juthoom as well as Haditha, Al-Habbaniya and Razaza Lakes.

-The landforms of the desert are result of the interaction between ***structure***, ***lithology*** and ***climate***, as indicated by the variable forms of the geomorphological units and features. Each landform reflects the influence of either two of the above mentioned factors or all of them, in its genesis.

The three factors are:-

1- Structure

-The Western Desert is a gently sloping plain with a gradient of 5 m/Km, towards east and northeast.

-The dip of the strata is almost horizontal, reaches (1 – 2) degrees.

-In the western part, around Ga`ara Depression, the beds dip in all directions, while in the eastern and middle parts the beds dip gently northeastwards.

- The gentle plain reflects the structural position of the Western Desert within the Stable Shelf (Buday and Jassim, 1984).

-Rutbah Uplift has played a great role in the historical geomorphology of the Western Desert.

- According to Buday (1980) and Buday and Jassim (1987) the crest of the uplift had remained as a ***dry land during Late Cretaceous***.

-Since that time the gradual rise of the uplift has caused increase of the dry land over the whole Western Desert, in form of major plateaus (Fig.1).

-At the same time the plateaus were dissected into many blocks.

-The common structural features in the Western Desert are **faults, joints, folds, grabens and ring structures.**

FIG.1: DISTRIBUTION OF POSITIVE AND NEGATIVE LANDS: DURING CAMPANIAN – MAASTRICHTIAN (A), PALEOCENE – LATE MIOCENE (B), LATE EARLY EOCENE – LATE EOCENE (C), OLIGOCENE (D), EARLY MIOCENE (E), MIDDLE MIOCENE (F) AND LATE MIOCENE – PLIOCENE (G)

Camp- Maast.

Paleoc.- l. Mioc.

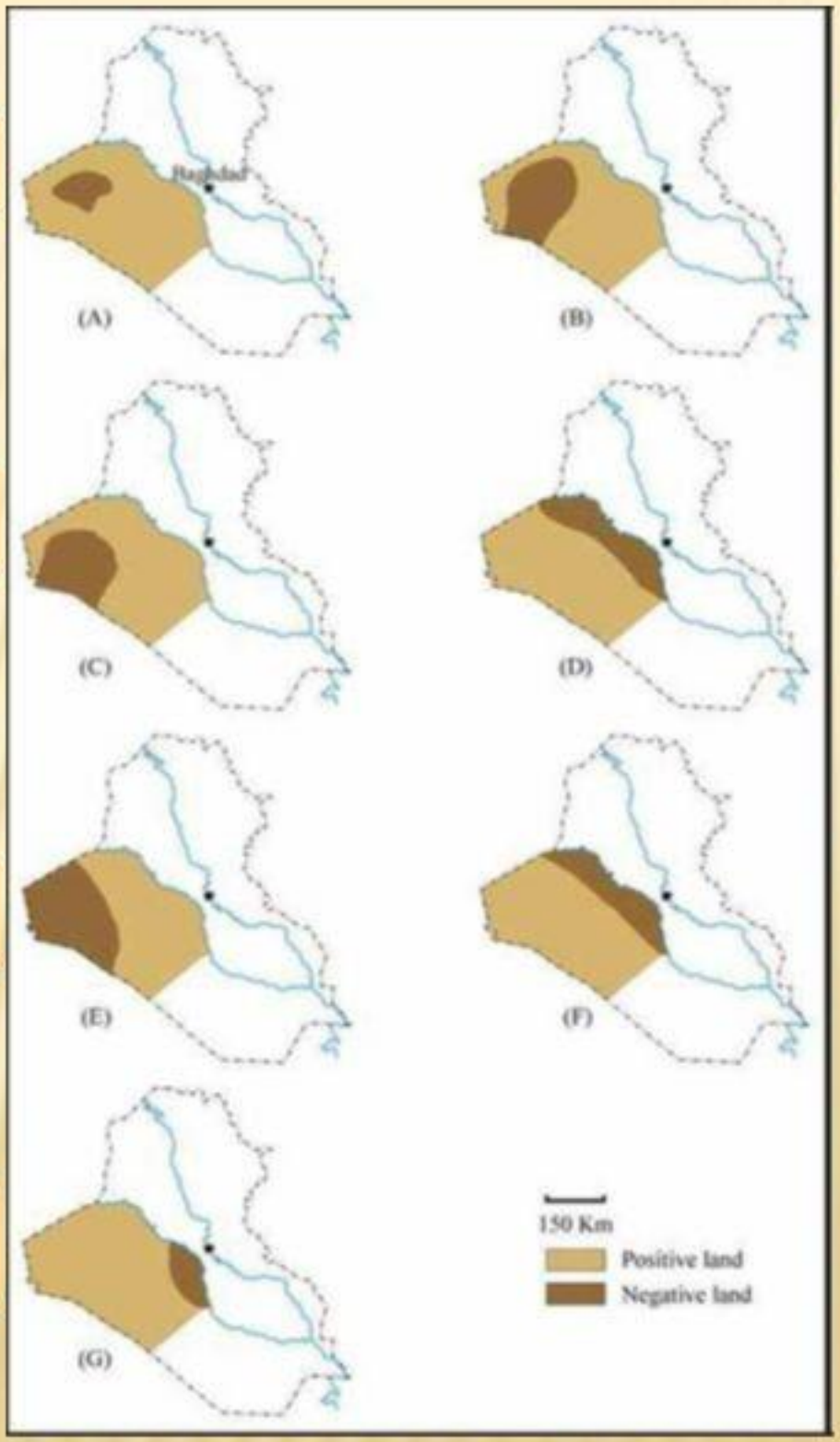
L. Early Eoc.- L. Eoc.

Oligocene

E. Mioc.

M.Mioc.

L. Mioc.- Pliocene



- **Faults**

Four sets of faults are ascertained in the Western Desert by means of interpretation of Landsat images on basis of drainage, cliffs, distribution of mesas and orientation of depressions.

The fault systems are N – S, NW – SE, E – W and NE – SW.

-The faults are related to very old Orogenies, Kibiran, Hijaz and Najid, which have been rejuvenated during Late Mesozoic and Tertiary by the Alpine Orogeny (Qasir et al., 1992).

-The faults are thought to be dissected through the basement and the overlying Paleozoic, Mesozoic and Tertiary sedimentary cover (Buday, 1980 and Buday and Haq, 1980).

The relation between drainage and faults is very visible on Landsat images and topographic maps.

Most of the major valleys start on the plateau around Rutba vicinity and extend towards north, northeast and east.

-In each drainage basin of the main valleys, the valleys change their trends at variable angles, between (45 –90)o, these changes coincide with the directions of fault systems (Fig.2).

-In addition to that the axes of the meanders that have developed along the courses of the valleys coincide with the trend of faults and joints.

A third visible example in (Fig.2) is represented by the cliffs developed in Umm ErRadhuma Formation along N – S and E – W faults.

FAULT SYSTEM

Fig. 4-7: Distribution of faults and fault zones (see text for description of individual systems)

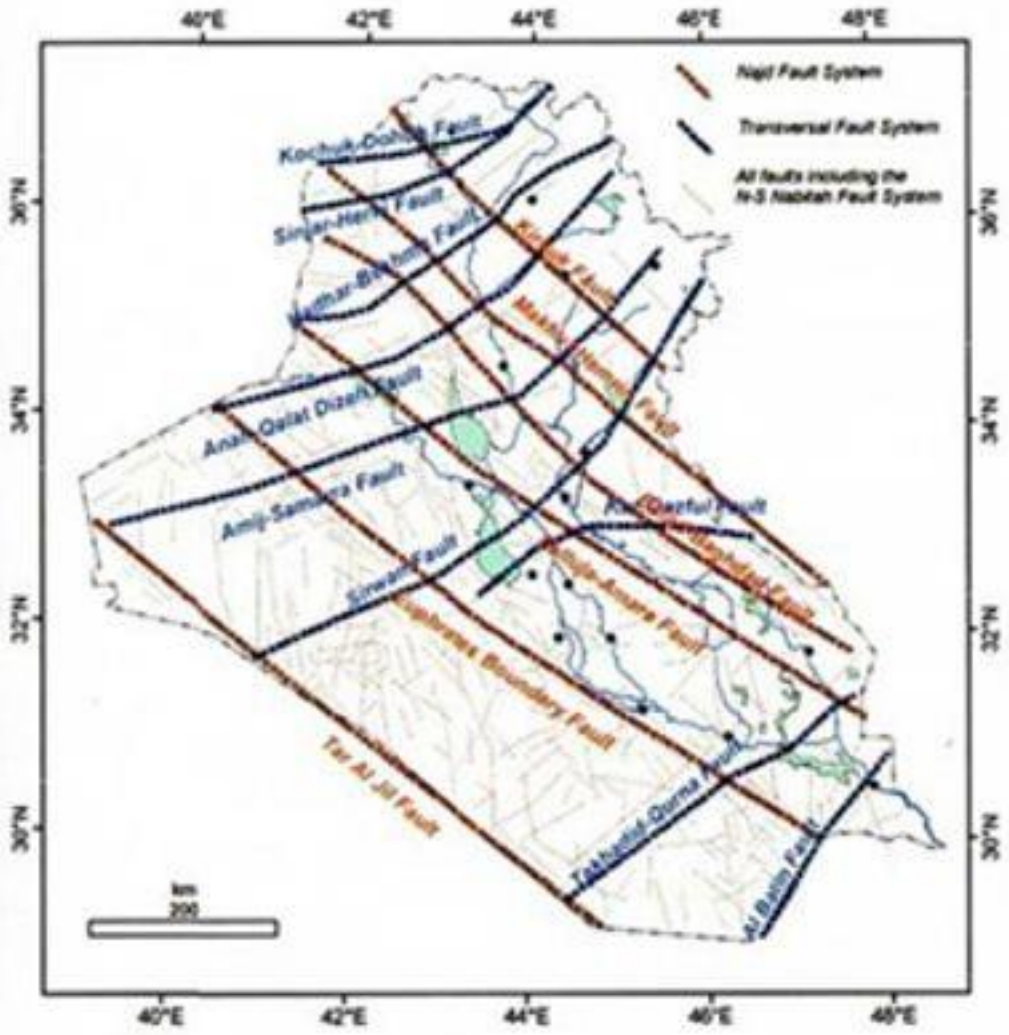
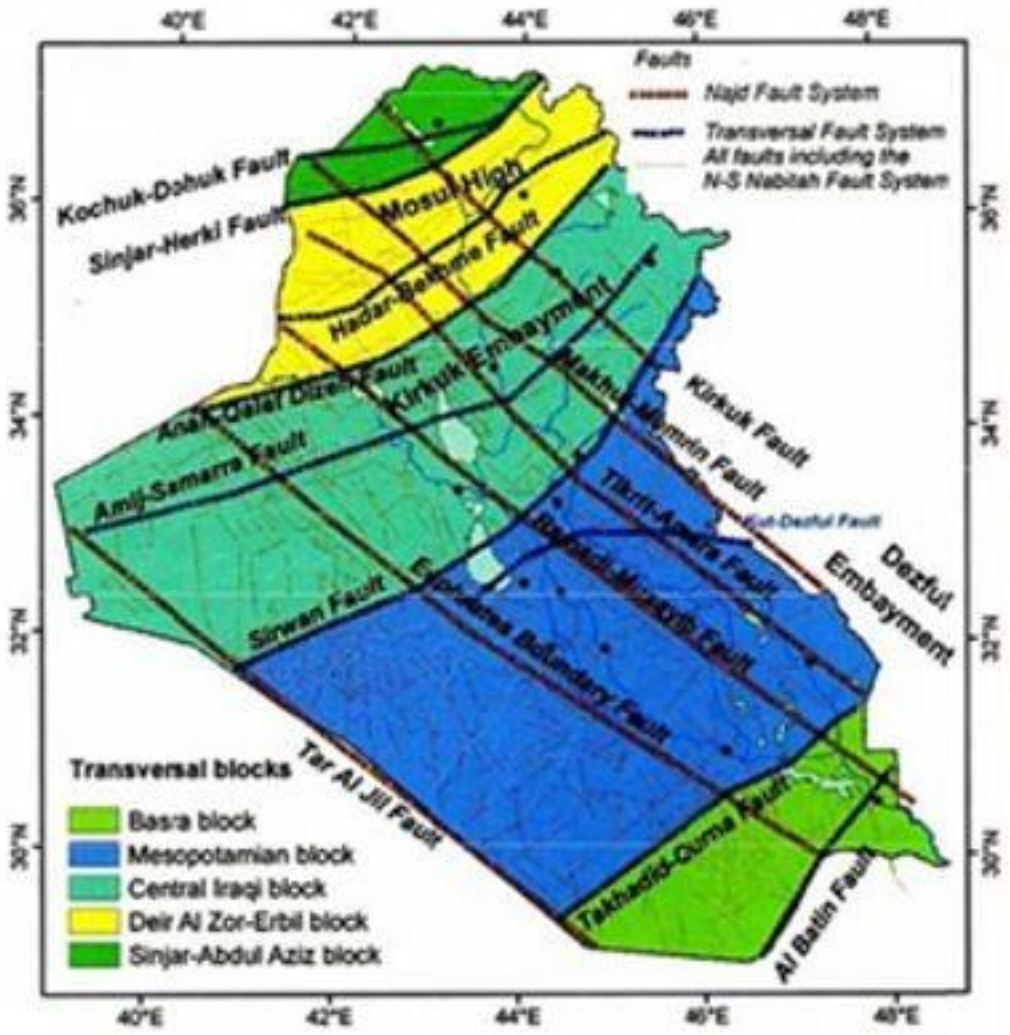


Fig. 4-8: Transversal blocks



-Wadi Swab and Wadi Ratga, which drain the northwestern part of the Western Desert, reflect clear relation between their trend and faults.
-The lower reaches of the wadies are in N – S direction and reflect their development along weak zone of the same trend.
-The tributaries of both wadies are also parallel to each other and are controlled by long joints of NW – SE and NE – SW directions.
-The western tributaries of Wadi Swab are toward NE direction, while the eastern tributaries of Wadi Ratga are toward NW direction.
- The upper reach of Wadi Swab is dissected by sets of NW – SE joints, resulted in formation of parallel tributaries and rectangular change of the Wadi course (Fig.3).
-The plateau on Hartha Formation is cut into well oriented mesas due parallel NW – SE trending joints (Fig.4).
-Al-Mubarak and Amin (1983) and Qasir et al. (1992 and 1993) have identified many faults of the same aforementioned directions, they missed many other faults, which might not be visible due to low displacement or not observed along their traverses, during geological mapping.
-The Tectonic Map of Iraq (Al-Kadhimi et al., 1996) show also some faults, of the same directions.

FIG.2: GEOLOGICAL MAP SHOWING EFFECTS OF FAULTS ON DRAINAGE, MEANDERS AND CLIFFS (AFTER SISSAKIAN AND YOUHANNA, 1995)

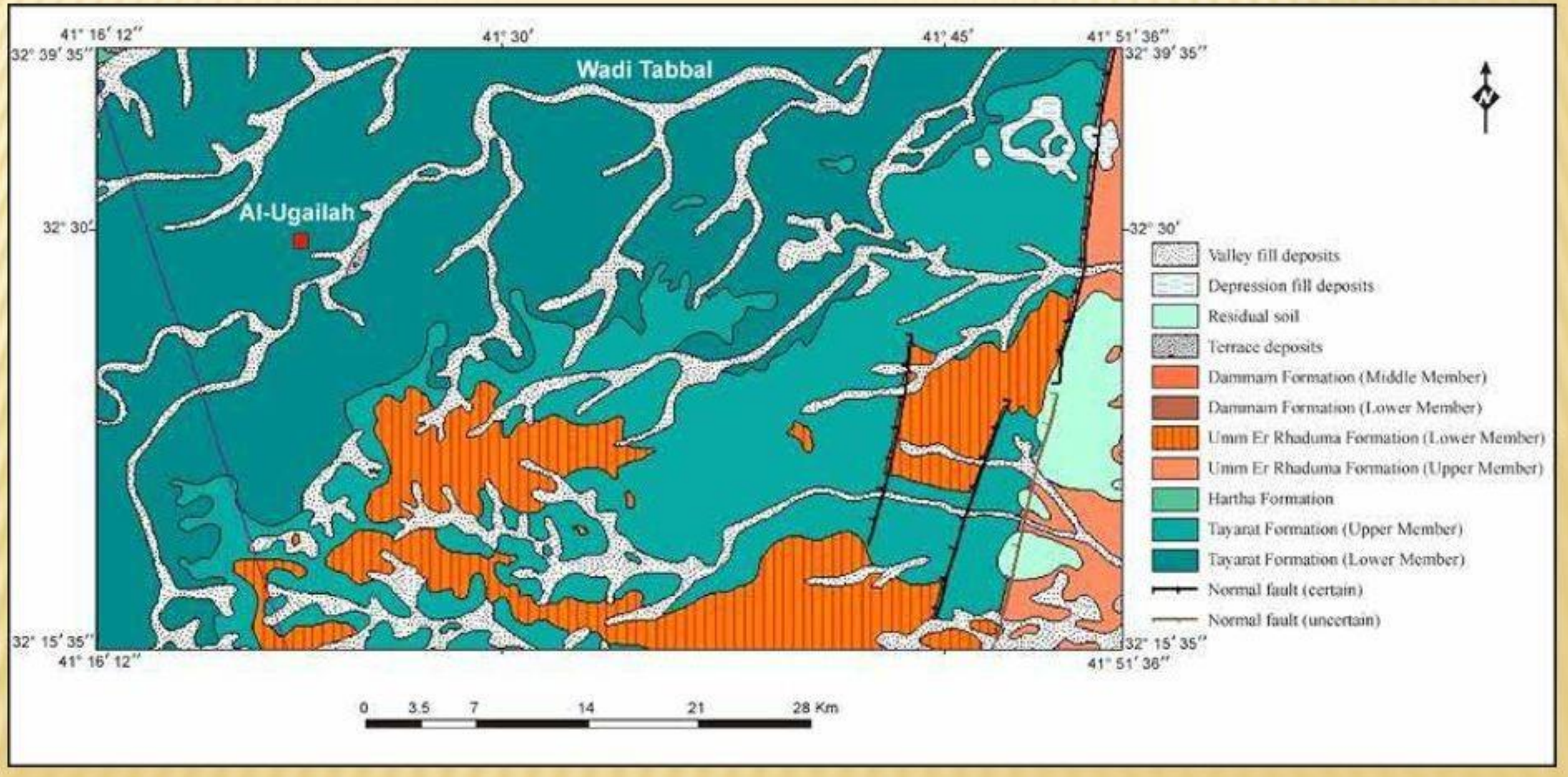
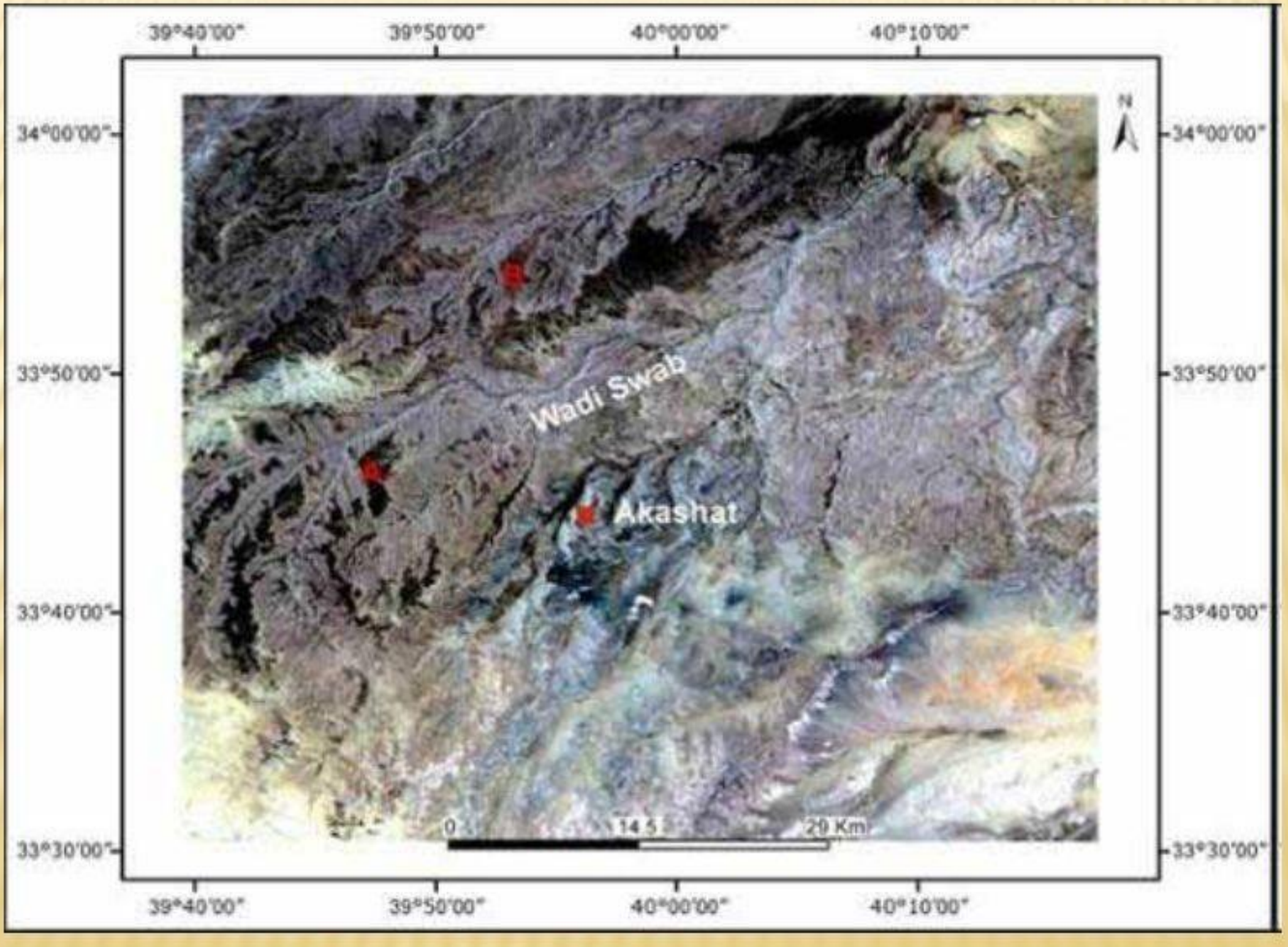
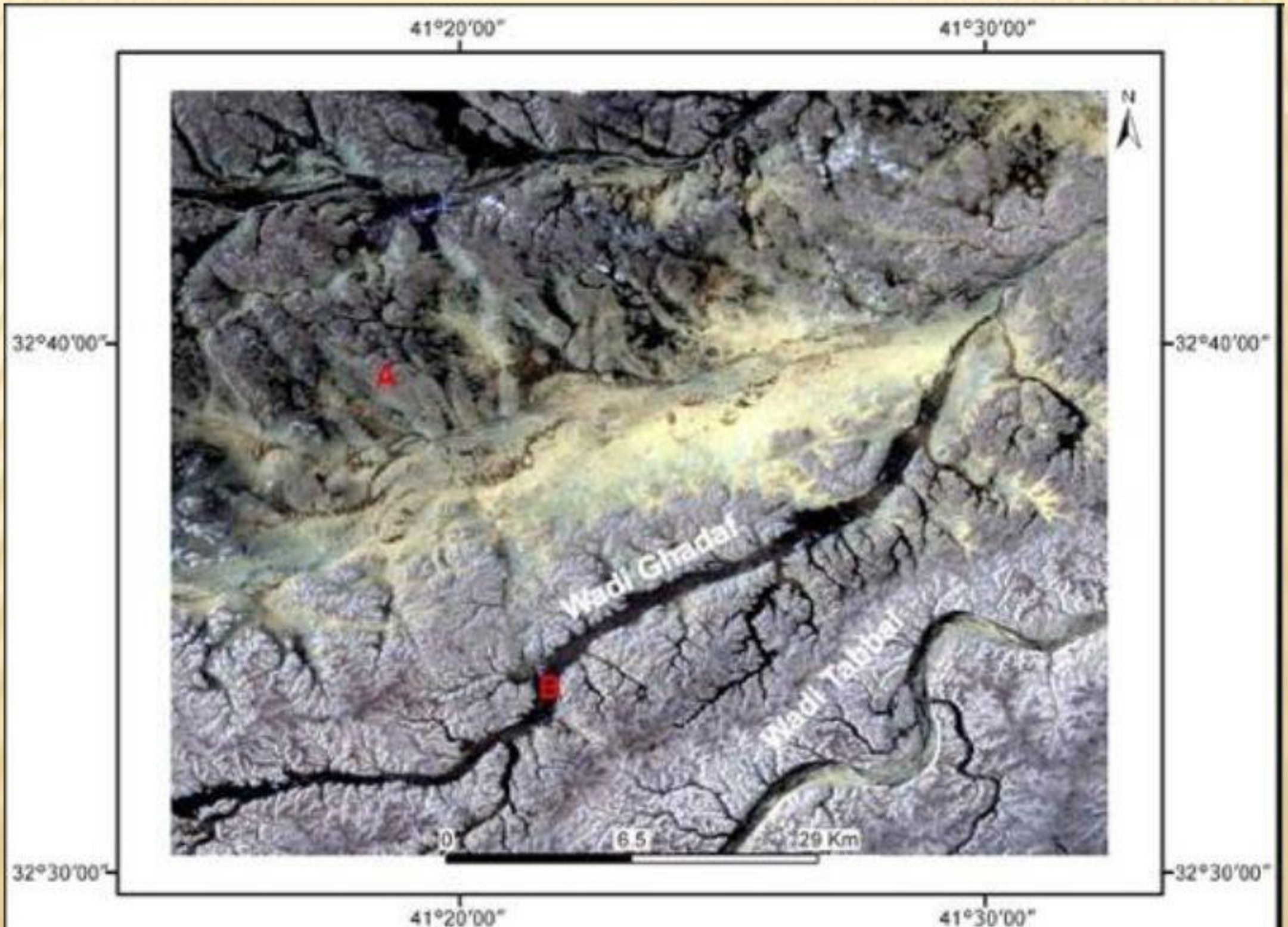


FIG.3: LANDSAT IMAGE SHOWING PARALLEL DRAINAGE CONTROLLED BY NW – SE JOINTS AT (A) AND FINE TEXTURED TOPOGRAPHY AT (B)



4- LANDSAT IMAGE SHOWING DISTRIBUTION OF MESAS ALONG NW – SE FAULTS AT (A) AND COARSE TEXTURED BADLAND AT (B)



- *Ring Structures*

Many ring structures are developed in the Western Desert.

-One ring structure is identified within Hussainiyat Formation in the upper reaches of Wadi Ghadaf (Fig.5).

The diameter of the feature is about 500 m.

- Its formation is related to block movements.

-Ring like structures are developed on rock beds of Zahra Formation due south of Al-Habbariyah Depression.

-The rings represent remnants of highly denuded rocks, which are deposited in depressions developed due to volume change of the gypsum of Russ Formation.

-In the Western parts of the Western Desert, tens of ring structures are developed, they are either of karst origin or hydrocarbon explosion (Hagopian, 1979). The diameters range form few hundred meters to few kilometers.

- Usually they from depressions on surface of Ratga Plateau.

-Tens of circular and oval depressions of different sizes are located in the western part of the Western Desert.

-They are developed in flat areas, built up by Ratga Formation, locally are called "Faidhah".

- Some of them are interpreted by geophysical means as ring structures.

2- Lithology

The exposed rocks in the Western Desert are of marine and continental origins, represented by limestone, dolomitic limestone, dolomite, sandy limestone, clayey limestone marl, sandstone, and claystone, with rare gypsum and phosphorite.

The primary and secondary characters of the exposed rocks have played a role in the development of different landforms, for example, the hard rocks gave the desert a plateau form.

Interbedded rocks of variable hardnesses have accelerated the dissection of the plateau into steps or minor plateaus.

The soluble rocks have led in forming of karst units and features.

The soft rocks contributed in development of eolian units.

3- Climate

The surface of the desert is built-up of landforms of different origins; structural – denudational, denudational erosional, fluvial, depositional, karst and eolian.

The development of these landforms reflects effects of paleo and recent climates.

Climatic changes had started since the beginning of the historical geomorphology of Western Desert in Late Cretaceous, the period during which first dry land was exposed on the surface.

During this period, the Western Desert had faced three types of climates; humid, tropic and arid.

These three types of climates were active during Late Cretaceous to Late Pleistocene.

During Holocene the climate generally changed to arid and gave rise to intensive mechanical break-down of the surface rocks and consequently development of Sarir, Hamada and eolian features.