

جيولوجيا الصحراء الغربية

# GEOLOGY OF WESTERN IRAQI DESERT

4<sup>TH</sup> CLASS

APPLIED GEOLOGY DEPARTMENT  
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# المحاضرة الثانية

## ***GEOMORPHOLOGICAL UNITS***

The landforms of the Western Desert are grouped in six major units related to the agents and processes contributing to their development. The units are:

### ***1- Units of Structural – Denudational Origin***

Four types of landforms are developed within this type, these are:

#### ***- Plateaus***

Plateaus form one of the widest landforms of the Western Desert, because of its structural position within the Stable Shelf.

The plateaus are surface formed during past geological periods on variable rocks.

Some of the plateaus represent contact surfaces between geological formations; others are formed on members within geological formations.

The Ga`ara Uplift had suffered continuous uplifting, faulting and erosion since Maastrichtian till Late Tertiary.

The aforementioned processes had exposed old formations on the surface and developed the plateaus on their surfaces.

The plateaus form belts of crescentic shape around the trough of Ga`ara Depression from the south.

The extension of the plateaus towards north terminates at a line of E – W direction, which runs nearly parallel to the axis of the Ga`ara Depression.

The plateaus are listed hereinafter according to their age of exposure to denudation.:-



1- Plateau on Zahra Formation

2- Plateau on Nfayil Formation

3- Because the formation is built-up of several rock types, therefore several sublevels of plateaus are developed, these are:

\* Plateau on the Clasic Member

The plateau is developed west of Al-Razaza Lake. Its surface is covered by gypcrete and dissected by dendritic infilled valleys

\* Plateau on the Carbonate Member

The plateau is developed in a narrow strip along the right bank of the Euphrates River between Haditha and Al-Ramadi.

4- Plateau on Euphrates Formation

5- Plateau on Ghar Formation

6- Plateau on Dammam Formation

7- Plateau on Umm Er Radhuma Formation

8- Plateau on Tayarat Formation

9- Plateau on Hartha Formation

10- Plateau on Hartha Formation

11- Plateau on Rutbah and Ms`ad formations

12- Plateau on Mauddud Formation

13- Plateau on Mauddud Formation

14- Plateau on Najmah Formation

15- Plateau on Muhaiwir Formation

16- Plateau on Amij Formation

17- Plateau on Hussainiyat Formation

18- Plateau on Ubaid Formation

19- Plateau on Zor Hauran Formation

20- Plateau on Mulussa Formation

21- Plateau on Ga`ara Formation

The plateau represents the youngest one developed in the western part of the Western Desert. The plateau is exposed in parts of the Ga`ara Depression, especially on both sides of Wadi Mulussa, which dissects the depression from west to east. At the southern part of the depression and along the base of the cliff, the plateau is covered by thick sediments of bajada and talus. In many places of the depression the surface of the plateau is dissected by wide infilled valleys.



# Mesas

Mesas are very common in the Western Desert.

They occur along the cliffs, which separate the plateaus from each other and are developed due to deep erosion along crossed joints that dissect the outer parts of the plateaus.

-Some of the mesas are far from the cliffs.

*This indicates that the plateaus, from which the mesas are separated, have widely retreated.*

-The mesas are of variable sizes and shapes. They suffer from erosion and mass wasting (toppling), which changed some of them into buttes or hills.



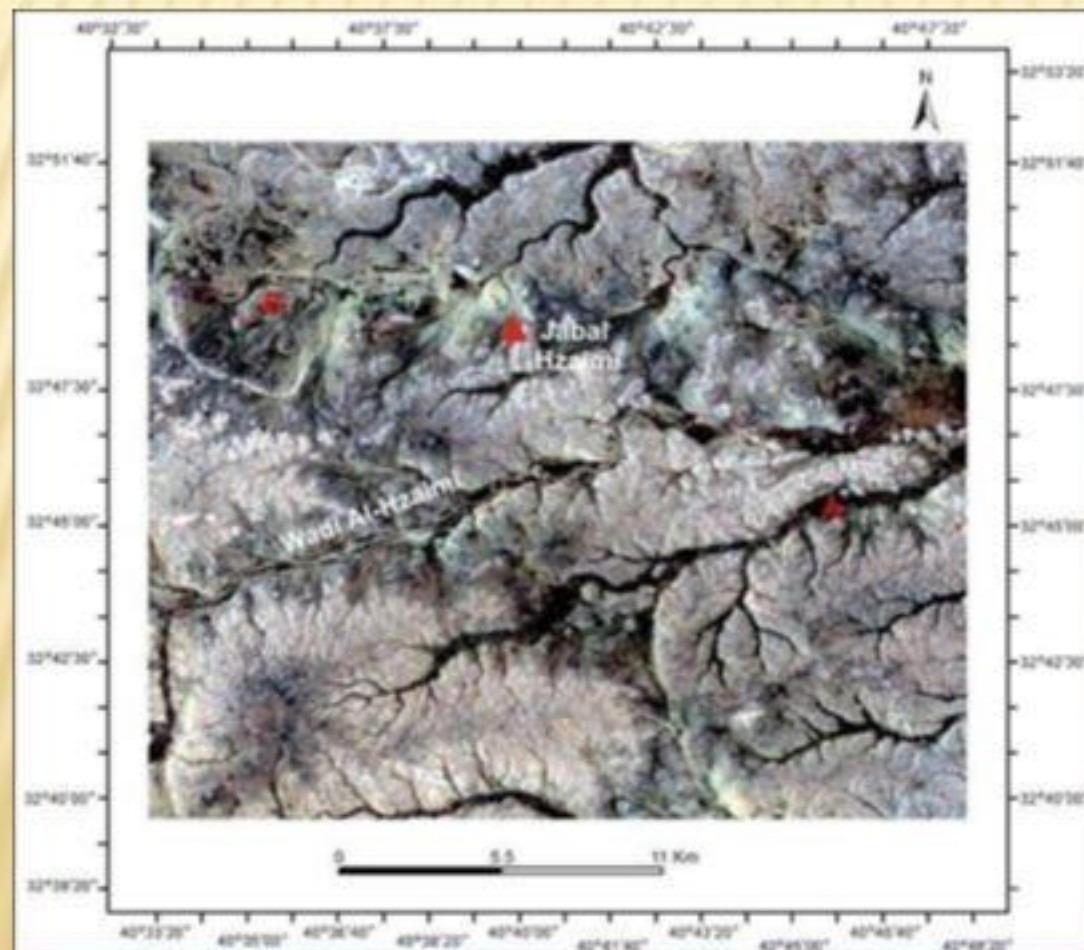


# Cuestas and Hogbacks

This type of landforms is well developed in the area south of Al-Nukhaib Depression

The features are exposed in ring shapes, representing remnants of domes, which are formed of rocks of Zahra Formation; the features cover an area that reaches about 70 Km in width.

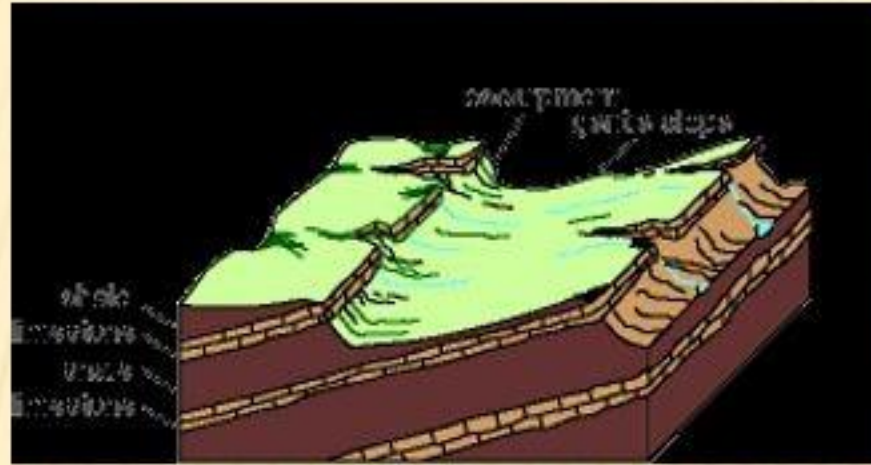
Relics of hogbacks occur in the upper reach of Wadi Tabal and Wadi Thumail basins. The features reflect short and long folds composed of rocks of Hartha and Tayarat formations (Fig. below).



**5- Landsat image showing remnants of fold at (A) and ring structure at (B)**



A **cuesta** is a hill or ridge with a gentle slope on one side, and a steep slope on the other. In geology the term is more specifically applied to a ridge where a harder sedimentary rock overlies a softer layer, the whole being tilted somewhat from the horizontal. This results in a long and gentle backslope called a dip slope that conforms with the dip of resistant strata, called caprock. Where erosion has exposed the frontslope of this, a steep slope or escarpment occurs. The resulting terrain may be called scarpland



In geology and geomorphology, a **hogback** (or hog's back) is a long narrow ridge or series of hills with a narrow crest and steep slopes of nearly equal inclination on both flanks





# Anticlinal Ridges

This unit is represented by Anah Anticline.

The fold is E – W trending along the left bank of the Euphrates River.

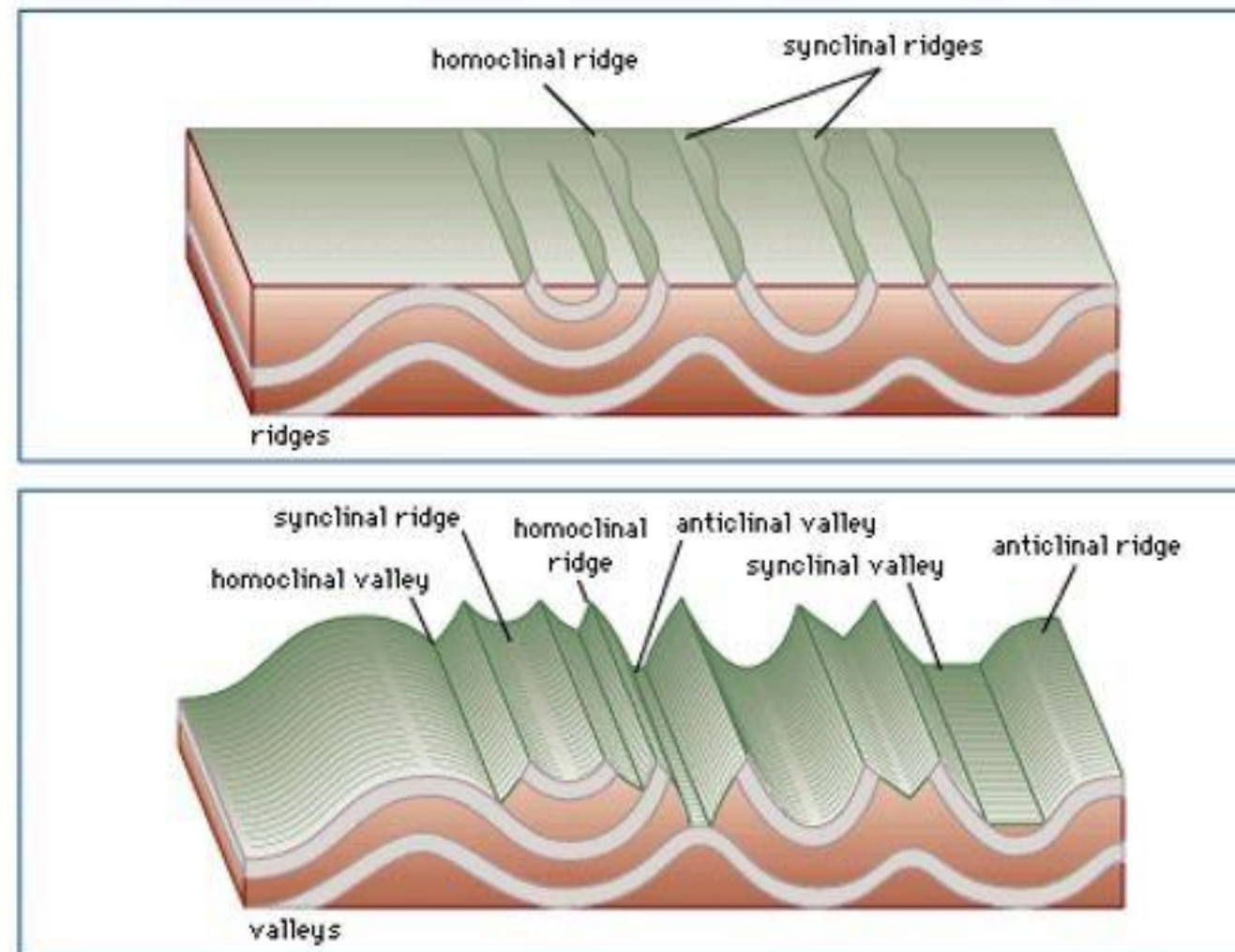
The anticline is about 7 Km wide and about 75 Km long (Al-Mubarak, 1974).

It is an asymmetrical one. Its northern limb is steeper than the southern one; this has caused the development of anticlinal ridges.

Both limbs are dissected by parallel valleys.

The anticline is dissected by deep canyons (Wadi Khazgah Al-Sharji and Khazgah Al-Gharbi), which drain from south towards the Euphrates river.

The crest of the structure is subjected to head wards erosion leading in formation of small peaks.





## 2. UNITS OF DENUDATIONAL ORIGIN

*In geology, denudation involves the processes that cause the wearing away of the Earth's surface by moving water, by ice, by wind and by waves, leading to a reduction in elevation and in relief of landforms and of landscapes.*

*Four types of landforms are developed in western desert within this type:*

### **Bad lands**

Badland topography is well developed in the Western Desert.

Its formation is related to structure (fault and joints), lithology and climate.

- Percolation of rain water through jointed and faulted permeable rocks during wet seasons causes **erosion** of the rocks and development of rills, gullies and valleys, *density of which depends* on spaces between the **structural features**, **rock strength** and **quantity of water**, as erosional agent.

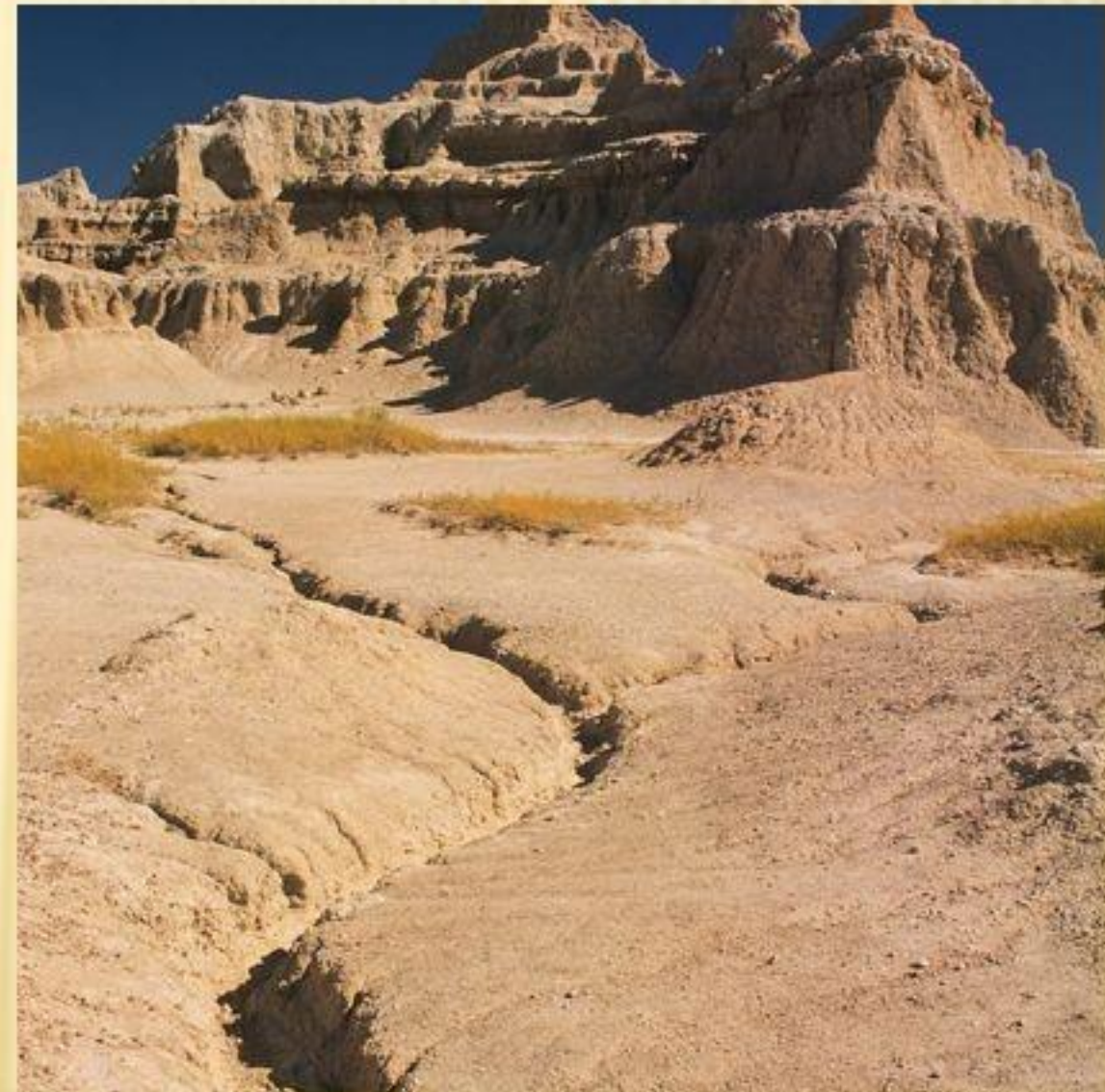
*The badlands in the Western Desert are either fine or coarse textured.*

Best example of coarse textured badland is formed on rocks of **the Lower Member of Tayarat Formation** in the upper reach of Wadi Tabal and Wadi Thumail Basins, (Fig.5).



**Badlands** are a type of dry terrain where softer sedimentary rocks and clay-rich soils have been extensively eroded by wind and water.

They are characterized by steep slopes, minimal vegetation, lack of a substantial regolith, and high drainage density.



Badland is also developed along lower reach of Wadi Hauran, down stream of the junction of Wadi Hussainiyat and Wadi Amij.

The formation of the badland is greatly related to NE – SW and NW – SE joints.

- The divide lines between the valleys are cut in form of hills.

The badland is developed on rocks of Ubaid, Hussainiyat and Euphrates formations.

On both sides of the branches of the upper reach of Wadi Swab narrow belts of **fine textured** badlands are formed (Fig.4).



## □□ Pediments

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*Erosional* and *depositional* pediments are identified on landsat images along the base of Anah Anticline.

*The erosional pediments are formed on bedrocks of the Euphrates Formation, while the depositional pediments are formed on relics of bajada deposits.*

The pediments on the northern side of the anticline are wider than those on the southern side.

Surface of the pediments is highly dissected by valleys.

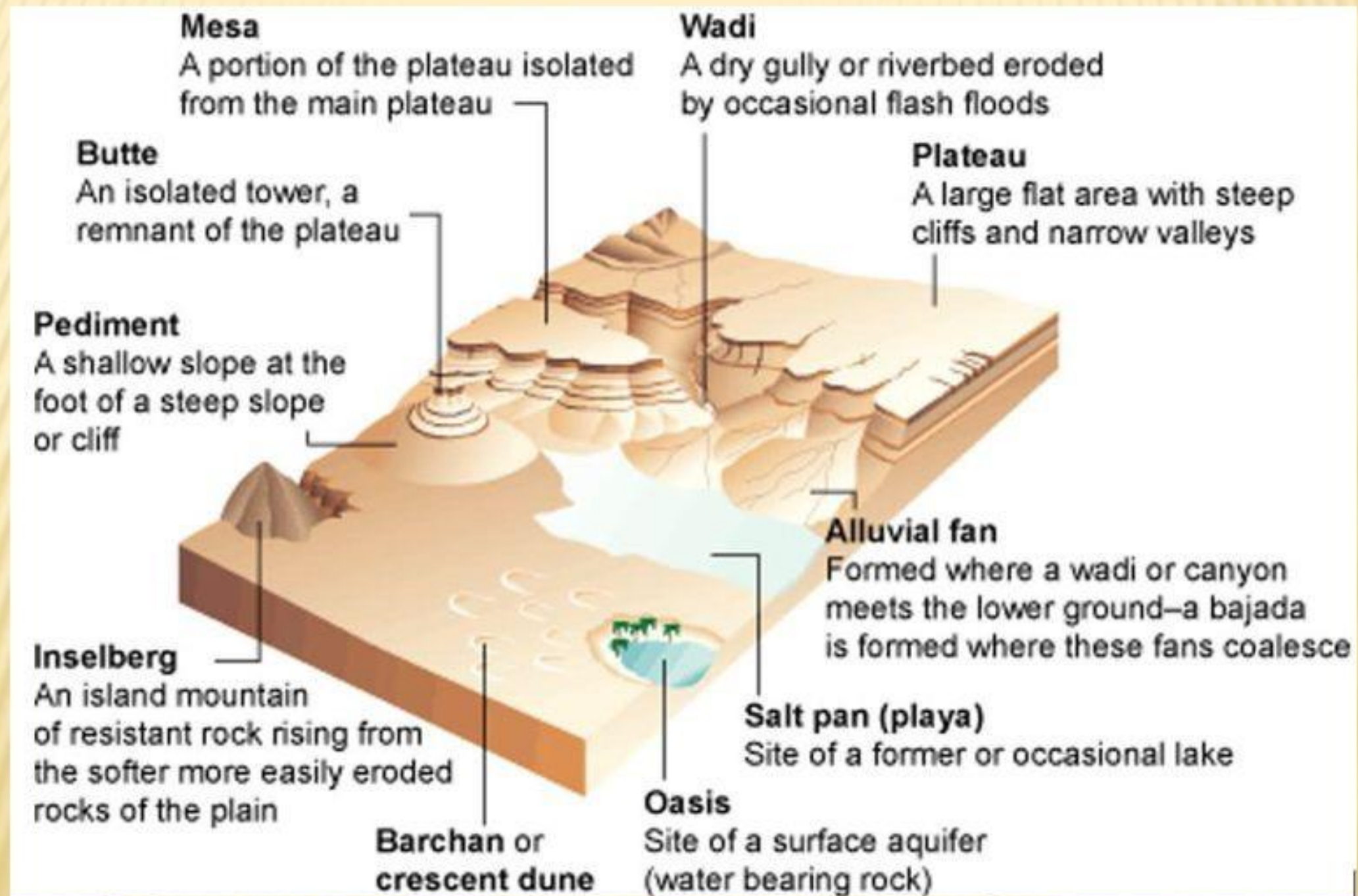
Along the base of the northern rim of Ga`ara Depression a wide belt of **depositional pediment** is developed.

The surface of the pediment is smooth.

-Small sized erosional and depositional pediments are also developed at the base of the cliffs like Al-Kheish, Shinana, Al-Jithoom and Al Birret.



**A pediment** is a very gently sloping ( $.5^{\circ}$ - $7^{\circ}$ ) inclined bedrock surface. It typically slopes down from the base of a steeper retreating desert cliff, or escarpment, but may continue to exist after the mountain has eroded away. It is caused by erosion.





## □□ HILLS (BUTTES)

Hills are common in the Western Desert.

-They occur in scattered form on surface of all plateaus.

*-The hills are relics of mesas which are reduced in size and changed in shape by head wards erosion and toppling.*

Many hills within Ratga Formation cover a large area north of Ga`ara Depression.

- The hills are well oriented, reflecting erosion along crossed joints.

-In H1 area hills within Ghar Formation are common on surface of the plateau on Euphrates Formation.

-Many well known hills are developed in different parts within different formations due to aforementioned reasons, among them are Al-Ramameen (south of Anah), Al-Umghar (south of Kilo 160), Garat Al-Shutub (west of Karbala), Damloog (west of Akashat), Nhaidain (southwest of Rutbah) and Tlool Al-Zurrug (west of Al-Birreet) (Fig.1, of the PREFACE).



## □□ Depressions

-Large size depressions are common in the Western Desert.

The main depressions are *Ga`ara, Al-Habbariya, Shinana and Al-Birreet.*

*-The most important element in development of the depressions is the existence of faults along which denudation is very effective.*

-Ga`ara Depression is the largest one. Its dimension is about (30 x 55) Km.

The depression is oval shape, extends E – W.

It is surrounded by cliffs of variable heights.

The cliffs in the south reach up to 120 m in height, whereas in the north and east are much lower ranging (15 – 55) m.

The cliffs are still suffering retreat *due to head-ward erosion.*

-Rocks of the oldest formation (Ga`ara Formation) are exposed in patches in the floor of the depression.

The depression is filled by valley fill, cones, fans and calcrete.

***The depression is part of the Ga`ara Uplift, which has suffered continuous denudation since Cretaceous – Paleocene break.***

-In the end of Paleocene the morphology of the depression seems to have started to be formed.

*During Late Pleistocene the floor of the depression was few meters higher than its present level, as indicated by the mesas of calcrete and alluvial fan levels.*



\* *Al-Habbariyah, Shinana and Al-Birreet* Depressions are developed in the southeastern part of the Western Desert.

*They are younger in age than the Ga`ara Depression, as evidenced by the exposures of Zahra formation on their both sides.*

-The depressions were formed by denudation along N – S trending faults and enlarged by retreatment of their cliffs.

The depressions are (35 x 70, 8 x 50 and 7 x 40) Km in dimension, respectively.

-They are filled by fine and coarse sediments.

-The fine sediments were laid down by the wadis, which cross the depressions, whereas the coarse materials are ***gravels of alluvial fans***, which extend along the western side of the depressions.

The depressions are surrounded by cliffs in the east are of medium height, while those in the west are lower.