Geology of Iraq

Lecture-4

(Rutba-Jezira Zone)

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1-The Rutba-Jezira Zone

*is *an inverted Palaeozoic basin*; the inversion began in the Late Permian.

*Its basement was relatively *stable* during Mesozoic-Tertiary time and *more mobile* during Infracambrian and Palaeozoic times.

*Basement depth ranges from 5 km in the Jezira area to 11 km **S** of Rutba

**The Jezira area was part of the Rutba Uplift domain in Late Permian to Early Cretaceous time*.

* Following the Cretaceous the Jezira area *subsided* while the Rutba area remained uplifted; these two areas are thus differentiated as separate subzones.

*The Rutba Uplift dominates the Rutba-Jezira Zone.

*It has previously been linked to the wider Hail-Rutba-Mardin High.

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*However the thickness and facies of its Mesozoic sequences suggests it has often acted as a separate block sometimes affecting **NW** Saudi Arabia and **NE** Jordan but mostly affecting **E** Syria and Wand **NW** Iraq.

*The Hail Uplift, based on gravity data, is a ***N-S trending Hercynian uplift*** that terminates in **SW** Iraq; it was later partially affected by Mesozoic arching.

*The Mardin High is an **E- W** trending uplift that affected **SE** Turkey and persisted from Triassic to Albian time.

This zone represent syn- Hercynian depression

The Anah-Qalat Dizeh Fault divides the Rutba-Jezira - Zone into :

a-the more stable *Rutba Subzone* in the S and

b-the *Jezira Subzone* in the N; the latter being more mobile since the Late Cretaceous.

Both subzones contain large basement highs:

-the Rutba-Ga'ara high in the S and

- the Deir Al Zor - Khlesia high in the N.

The unit between the two highs is the Anah Trough (often referred to as the Anah Graben).

*The *Rutb a-Jezira Zone* contains thick Palaeozoic sediments. Upper Permian, Lower to Middle Triassic and pre Albian Lower Cretaceous sediments are absent.

*The *Jezira subzone was* uplifted and eroded during Mid Devonian (Caledonian) time; the Rutba Subzone was mostly not affected by this deformation.

*The *Jezira Subzone also subsided* **during Late Eocene to Miocene time when the Rutba Subzone was** *uplifted*.

*A **NW-SE** cross section from Syria to the Rutba area is shown in (Fig. 5-1).

*The Tanf- Khlesia Zone of Getech and Jassim (2002) shown in the cross section is a continuation of the Jezira Subzone of Iraq; the Silurian sequence has been deeply eroded .

** The Upper Permian and most of the Triassic section is absent in both subzones.*

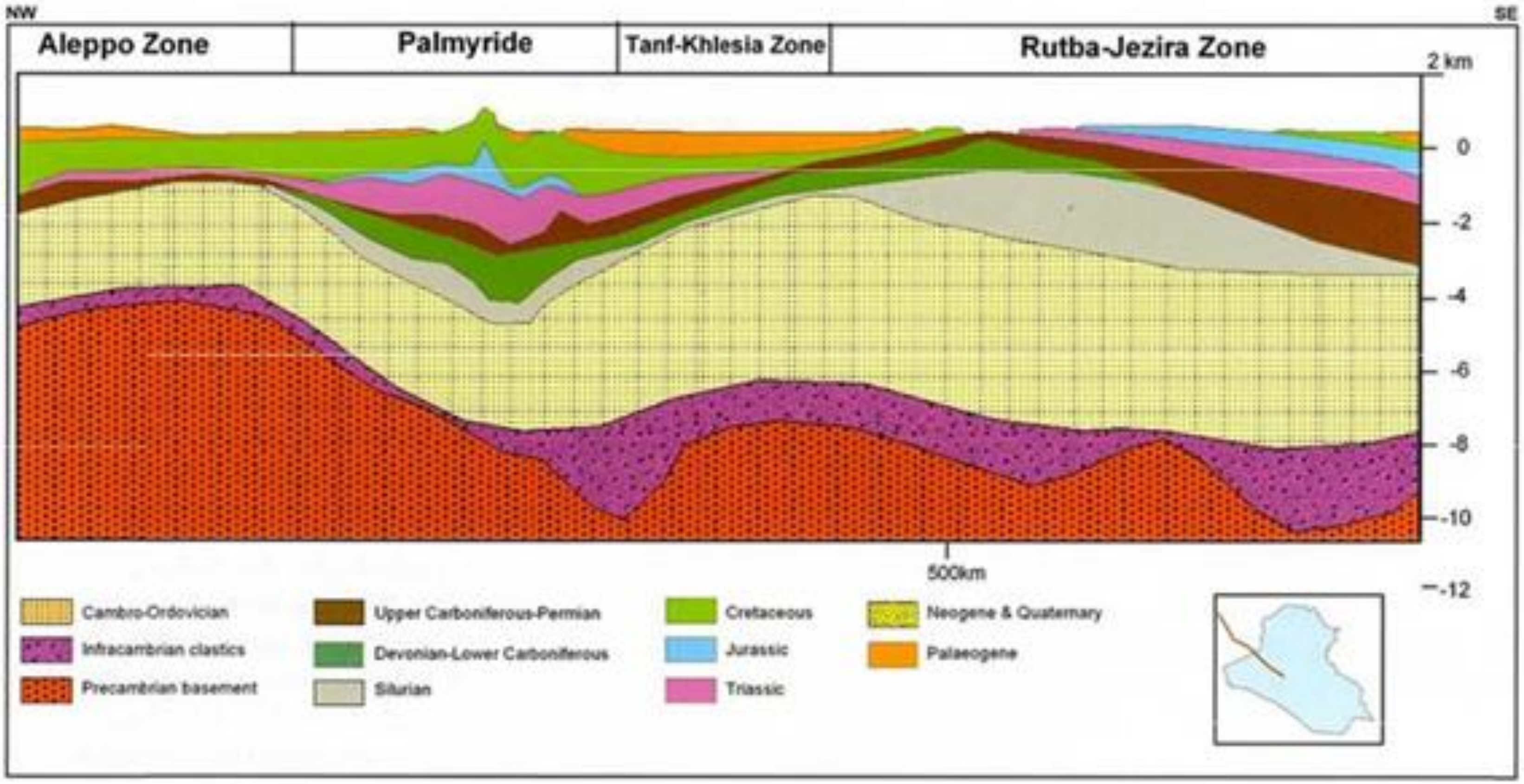


Fig. 5-1: Cross section within the Stable Shelf of Western Arabia starting from Aleppo in the NW and terminating at the Nukhaib Graben in the SE

A-The Rutba Subzone

The *Rutba Subzone* is the most *extensive and uplifted* part of the Rutba-Jezira Zone, *dominated by*;-

-the huge Rutba Uplift active in Late Permian- Palaeogene time,
- the Cretaceous Ga'ara anticline and
- the ENE- WSW trending Hauran anticlinorium .

The sedimentary cover of the Rutba Subzone starts with the :-

*Infracambrian section (3 00-1500 m thick).

*The Palaeozoic section thickens from 3500 m in the **N** to 8500 m in the S.

*Triassic, Jurassic and Lower Cretaceous sediments are absent in the northern part of the subzone; they are up to 800, 1000 and 300 m thick respectively in the SE.

Upper Cretaceous sediments are up to 800 m thick.

Palaeogene and Neogene sediments are up to 500 and 2 00 m thick respectively in the SE.

Geological and geomorphological characteristics

The ***Rutba Subzone***

*contains the Ga'ara depression which is located above the broad **N-S** trending Rutba Uplift, and the **E-W** trending Ga'ara anticline.

*Numerous unconformities occur within the Mesozoic and Palaeogene. Section. ;-

-The Lower Permian Ga 'ara Formation is unconformably overlain by Upper Triassic carbonates that form the cliffs on the southern rim of the depression.

-Along the **W, N** and **E** side of the depression, the Lower Permian sediments are unconformably overlain by Upper Cretaceous, Palaeocene and Eocene beds.

-To the **SE**, the Triassic carbonates are unconformably overlain by Jurassic cyclic sequences (Fig. 52); each sequence comprises fluviatile and shallow marine clastics which pass transitionally up into neritic carbonates.

-The Jurassic strata strike **NE-SW**; the Lower Cretaceous beds strike **ENE-WSW** and the Upper Cretaceous beds strike **E- W.**

-Numerous **NW-SE** trending normal faults were mapped in the outcropping Jurassic sequences (Fig. 5-2).

They were probably ***active*** in Tithonian to Early Senonian time.

Fig. 5-2: Geological map of the Rutba Subzone. Solid purple lines are mapped faults

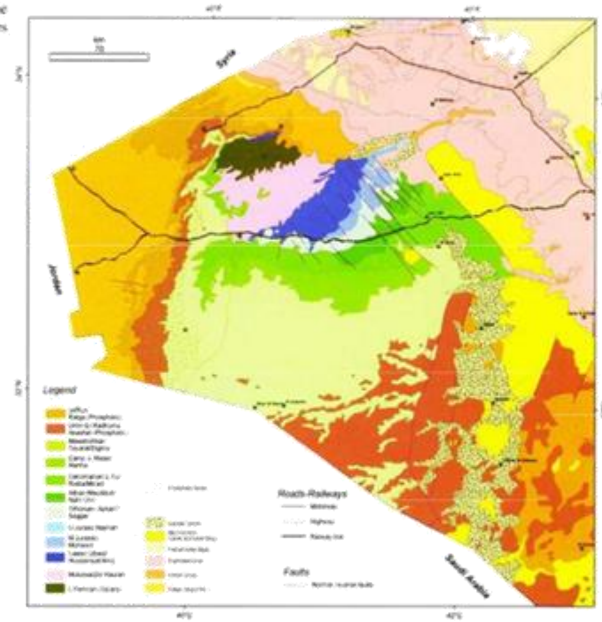
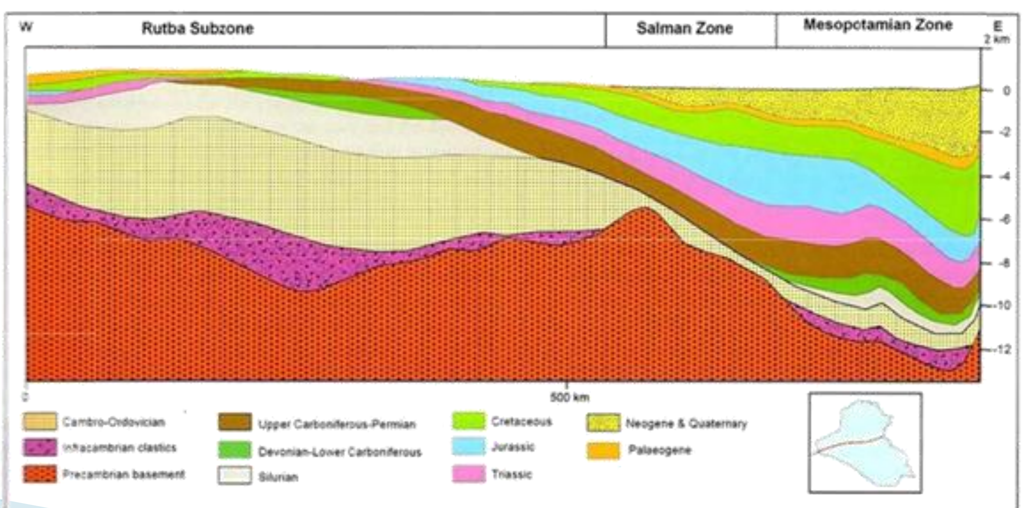


Fig. 5-3: Profile between Risha, NE Jordan to the Iranian border near Naft Khana



*The area W of Rutba is dominated by N-S trending Campanian-Palaeogene strata that are **characterized** by relatively deep water phosphorites.

*On the SE flank of the Rutba High, Lower Miocene transgressive shallow water carbonate and clastics outcrop.

**Quaternary gravel deposits fill surface depressions. A profile through Iraq (connecting the Risha area in NE Jordan and Naft Khaneh in the Foothill Zone in E Iraq) shown in Fig. 5-3 indicates the subzone is mainly an inverted Palaeozoic basin with an almost complete Palaeozoic sequence compared to the neighbouring zones to the E and W.*

*The western desert of Iraq has a NE-inclined land surface with a gradient of 10-20 m per kilometer from the Iraq Jordan-Saudi border point (980 m elevation) to the Euphrates River (l00-200 m elevation).

*It is usually a plane surface mostly covered by ***desert pavement*** (Serir) but locally it is very rocky where dissected by active wadis producing ***the Hamada*** land surface (Central and SE parts, Fig. 5-4).

There are four distinct drainage systems:

1) a strongly incisive E- W wadi system to the S and SE of Rutba.

2) the incisive NE-SW trending Wadi Hauran and its tributaries which are controlled by the strike of the Triassic and Jurassic sequences that contain alternating softer clastics and relatively harder carbonates (Fig. 5-8 inset B).

3) a shallow, broad N-S trending system Wand SW of Rutba controlled by the N-S strike of Palaeogene strata (Fig. 5-8, inset C) and

4) a moderately incisive NNE-SSW trending system north of the Ga'ara area flowing through Miocene outcrops to the Euphrates River.

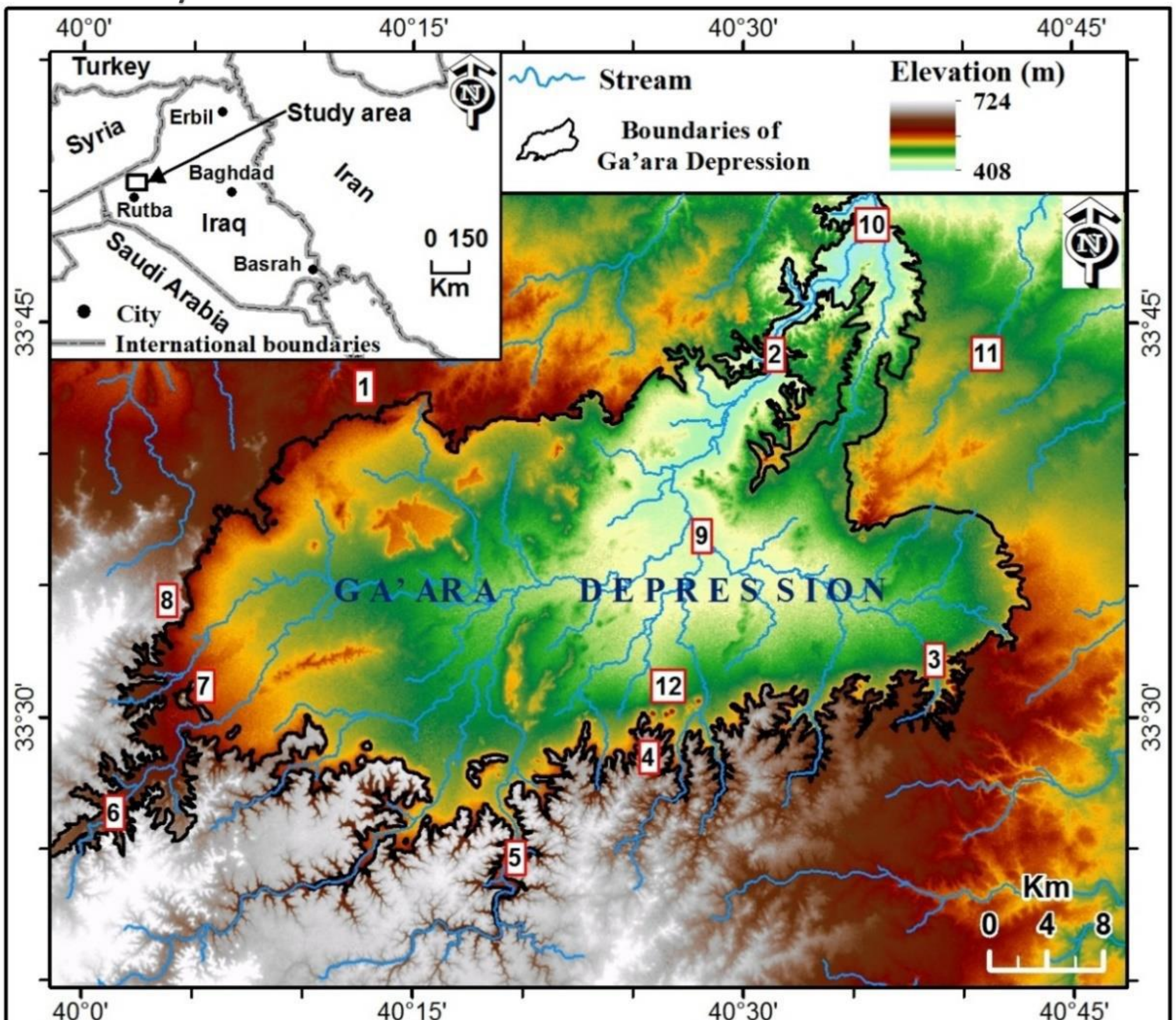
Important depressions within the Rutba Subzone comprise:-

- the Ga'ara depression (a structural-denudational unit),

-the Umm Chaimin crater (formed by an impact or gas explosion)

-the Ma' ania depression (a structural depositional unit).

Color coded of DEMs adopted from SRTM (resolution 1 Arc) showing the location and gradient in elevation of Ga'ara Depression. Geographical locations: 1= Marbat El Hsan, 2= Al-Halqoom, 3= Al-Ujrumiyat, 4= Al-Qasir, 5= Wadi Al-Ouja 6= Wadi Al-Mulussi, 7= Chabid Al-Abid, 8= Al-Na'jah, 9= Al-Rah water well, 10= Wadi Ratga, 11= Wadi Al-Mani'ai, 12= Al-Afayef Hills



*The *Ga'ara depression* formed by erosion of thin carbonate beds which overlie softer less resistant Permocarboniferous clastics.

*The *Ma'ania depression* which lies above the Nukhaib Graben (Figs. 5-8 and 5-9) is over 100 km long, 20 km wide and 20 m deep.

*Palaeocene rocks outcrop on both sides of the depression; Middle Eocene limestones occur in isolated outcrops protruding through -20 m of gravel (Nukhaib Gravel) in the middle of the depression.

All the E- W wadis **SE** of Rutba drain into the depression forming coalescing fans which lead into one exit drainage point (Wadi Ubayidh).

*The depression is structurally controlled by the Nukhaib Graben.

The Um Chaimin crater is located about 45 km WSW of Rutba.

It is 2 km wide (Fig. 5-8, inset B and Fig. 5-6) and was previously assumed to be an impact feature.

*The crater is hidden in a flat desert plain formed of Lower Eocene carbonates.

*Massive metric size boulders of silicified limestone of Lower Eocene age are strewn around the crater.

*The rim of the crater is formed of massive to thick-bedded, silicified Lower Eocene carbonates (about 45 m thick); Which are overlain in the N and NW by Middle Eocene silicified lithographic limestone with chert nodules

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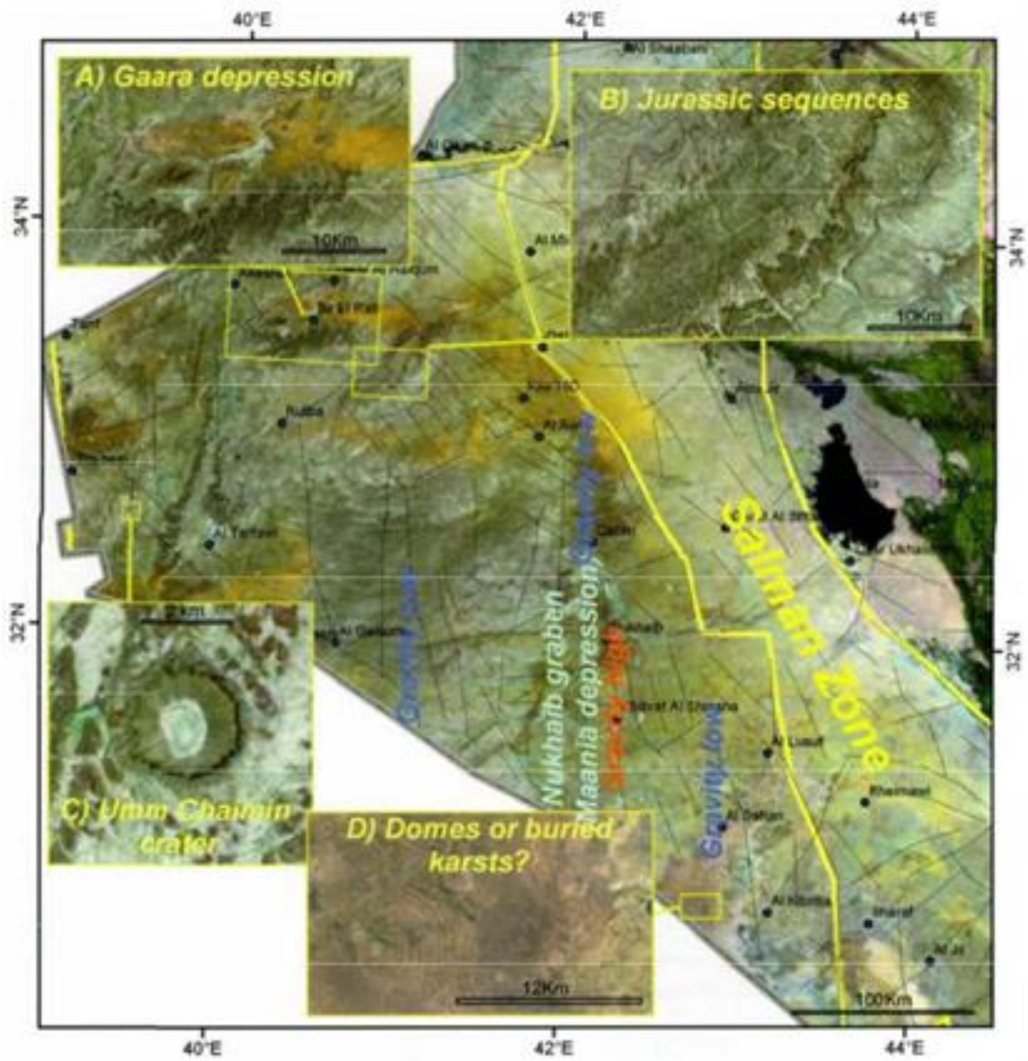
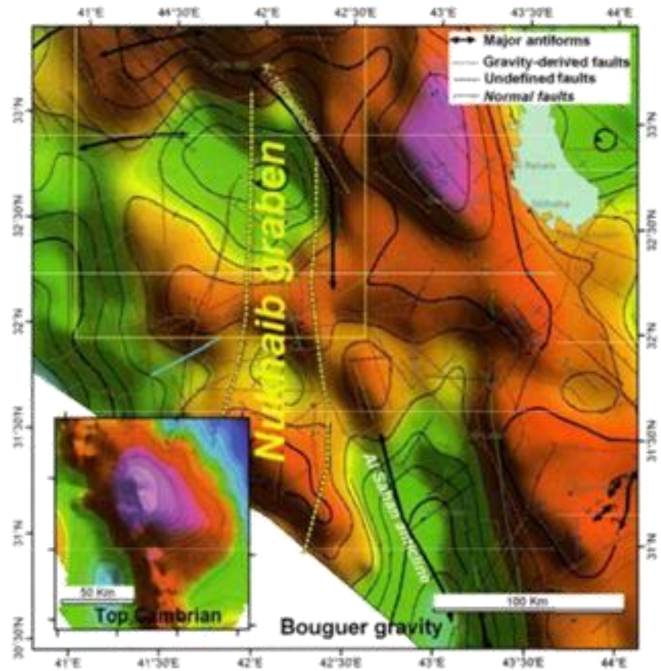


Fig. 5-4: Satellite image of the Rutba Subzone with inset for the Ga'ara depression (Inset A), the Jurassic system exposure area (Inset B), the Umm Chaimin crater (Inset C), and the contorted Palaeogene sequence east of the Nukhaib graben (Inset D)

Fig. 5-5: The gravity low associated with the northern part of the Nukhaib Graben and the inset Top Cambrian map (modified from Al-Bassam et al., 1992). Red (main map is high gravity, in inset map is structural high) blue (main map low gravity, in inset map structural low)



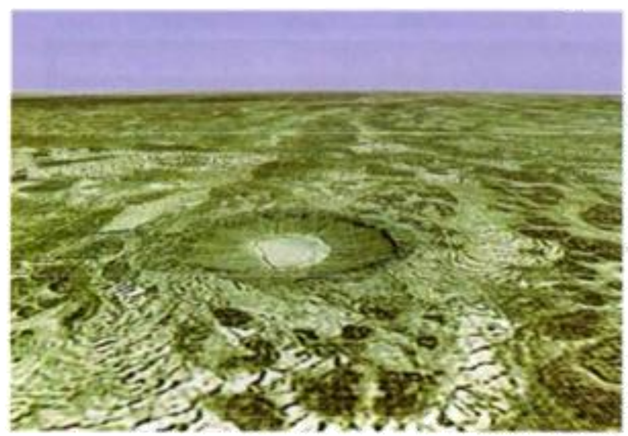


Fig. 5-6: Inclined view of the Umm Chaimin crater with 3 times vertical exaggeration. Note the N-S trails of the Walaj and Wulaij wadis on both sides of the crater (Courtesy of Earth Google)

Structures

The Rutba Subzone is dominated by ;-

-the mega *Rutba Uplift* which formed due to inversion o f the Palaeozoic basin of W Arabia during Latest Permian-Middle Eocene time.

- Major antiforms or arches are located on the flanks of this megastructure.

- The most prominent structures were active during the Cretaceous and Palaeogene. ***They include :-***

*the ENE-WSW trending Hauran anticlinorium,

* the E- W Ga'ara anticline,

*the NW-SE trending Akashat anticline,

*the Traibeel anticline in the NW and the E- W trending Tlaiha and Qatari anticlines in the SE.

These structures are shown on the base Cretaceous structure map (Fig. 5- 7)).

Some N-S antiforms occur in the E part of the zone especially to the E of the Nukhaib graben (Fig. 5-8).*

The Hauran anticlinorium* ***is over 300 km long and consists of a series of* culminations (Fig . 5-7) cut by several NW-SE trending normal faults forming horst and grabens displacing preCampanian strata.

*These NW-SE striking grabens are often associated with thick alluvial sandstones at the base of the Saggar Formation.

The structure is visible on the structure map (Fig. 5-7). It is truncated by Lower Miocene sediments in the NE.

Fig. 5-7: Structural map of the base of the Cretaceous (metres from Sea Level) based on data of Al-Bassam et al. (1999)

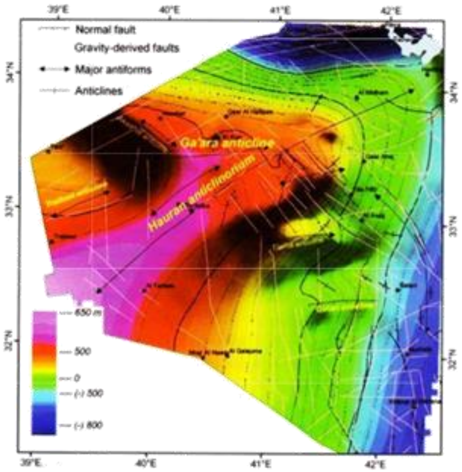
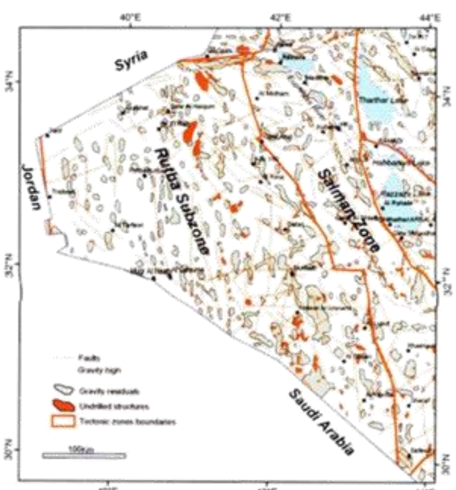


Fig. 5-8: Residual gravity anomalies (grey polygons) and undrilled structures (red polygons) and the fault systems of the Rutba Subzone



-The *Ga'ara anticline*

*It is an E- W trending 130 km long structure associated with a 1 km high subsurface elevation on top of the Precambrian basement that extends into SE Syria through the Akashat anticline (see Fig. 5-7).

* *Facies changes within the Upper Cretaceous and Palaeogene sediments around these structures suggest that it was active in Late Cretaceous-Palaeogene time.*

-The E- W trending *Traibeel anticline* deforms the Eocene strata and is associated with a well-defined surface lineament.

-There are two smaller E- W trending antiforms SE of the Hauran anticlinorium

A- ***Tlaiha*** and

***B*-Qatari anticlines**).

-Two important antiforms were mapped near the E boundary of the Rutba Subzone;-these are ;-

*the *NNW-SSE trending Kilo160*

*and the *N-S trending Al Sahan antiforms* (Fig. 5-9).

*The Kilo l60 antiforms start near K-160 settlement in the N (half way between Ramadi and Rutba towns) and extends as far south as Wadi Ubayidh (latitude 32°).

Subsurface structures within the subzone have been mapped from residual gravity anomalies (Fig. 5-8).

* Many of the gravity residuals may be associated with N-S trending lineaments possibly related to Precambrian fabric or "Hercynian" structures.

*The NW-SE trending anomalies may be associated with Cretaceous horsts and grabens.

They mostly occur along the Najd fault system to the **E** of Rutba and along the Iraq-Saudi border.

-**The Akkas structure** in the northern part of the subzone is one of these NW-SE trending structures.

-Along Wadi Hussainiyat some NW-SE trending folds were also observed.

-**E- W** trending anomalies are rare and are mostly restricted to the northern boundary of the subzone and to the Anah-Qalat Dizeh Fault.

These structures are collectively referred to as the Anah anticline or more correctly monocline.

The Rutba Subzone is dominated by:-

* the N-S Nabitah (Idsas) system which is a Precambrian system reactivated during the Late Carboniferous and Early Permian (Syn-Hercynian).

*The second system is the NW-SE Najd system which is well developed near and E of Rutba (extension of the Euphrates Boundary Fault), and along the Iraq-Saudi border (extension of the Al Tar Fault).

* ***These faults formed in the Late Precambrian and were probably reactivated during the Cretaceous***.

*The E-W fault system is best developed in the SE and S part of the Subzone where it controls the Widyan drainage system (extension of the Sirwan and Amij-Samarra Transversal Faults), and along the northern margin of the subzone near the Euphrates River (Anah-Qalat Dizeh Fault).

Reference:-

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-Varoujan K. Sissakian, Shihad,A.T.& Al-Ansari,N. 2018.The Geology and Evolution of the Ga'ara Depression,Iraqi Western Desert. Journal of Earth Sciences and Geotechnical Engineering, vol . 8, no. 1, 2018, 65-90 ISSN: 1792-9040 (print version), 1792-9660 (online) Scienpress Ltd,
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