المحاضرة الحادية عشر

The Jezira Subzone

-The Jezira subzone was part of the greater W Arabian Palaeozoic basin until the Late Silurian.

-It was uplifted in Late Silurian-Mid Devonian time forming a NE-SW trending arch.

It formed part of the Rutba – E. Palmyride Permocarboniferous N-S trending basin.

-It was part of the Rutba Uplift from Late Permian to Early Eocene time though it was intermittently submerged.

-It subsided during Eocene to Middle Miocene time. It was uplifted in Late Miocene-Recent time.

-It is dominated by the Khlesia Basement Uplift which is part of the N-S trending Rutba Uplift.

It is segmented by two E- W trending grabens and a trough;

these are :-

1-the Anah Trough and

2-the Tayarat and Khlesia Grabens.

The sedimentary column of the Jezira Subzone consists of Palaeozoic (3300-5000 m thick), Triassic (mainly Upper Triassic, 200-700 m thick), Lower Cretaceous (100-250 m thick), Upper Cretaceous (generally 50 m but over 1500 m thick in the Anah and Tayarat grabens), Palaeogene (300 m thick), and Neogene sediments (200-1000 m thick).

Geological and geomorphological characteristics

-The oldest rocks outcropping in the Jezira Subzone are the Upper Oligocene Kirkuk Group, which outcrops at the S boundary of the subzone along the E- W section of the Euphrates River between the Syrian border and Anah.

-The Middle Miocene Fatha and the Upper Miocene Injana formations outcrop over most of the subzone.

-One major surface anticline is observed north of the Euphrates river (the ENE-WSW trending Tayarat anticline); the N flanks of this anticline are visible on satellite image.

-The Tayarat anticline forms a topographic high. It drains towards the Euphrates River in the S, the Khlesia Graben in the N, the Tuwaila playa in the W and the Tharthar valley in the E.

-The short drainage systems end in small playas which suggest active karstification in the evaporites of the Fatha Formation is occurring.

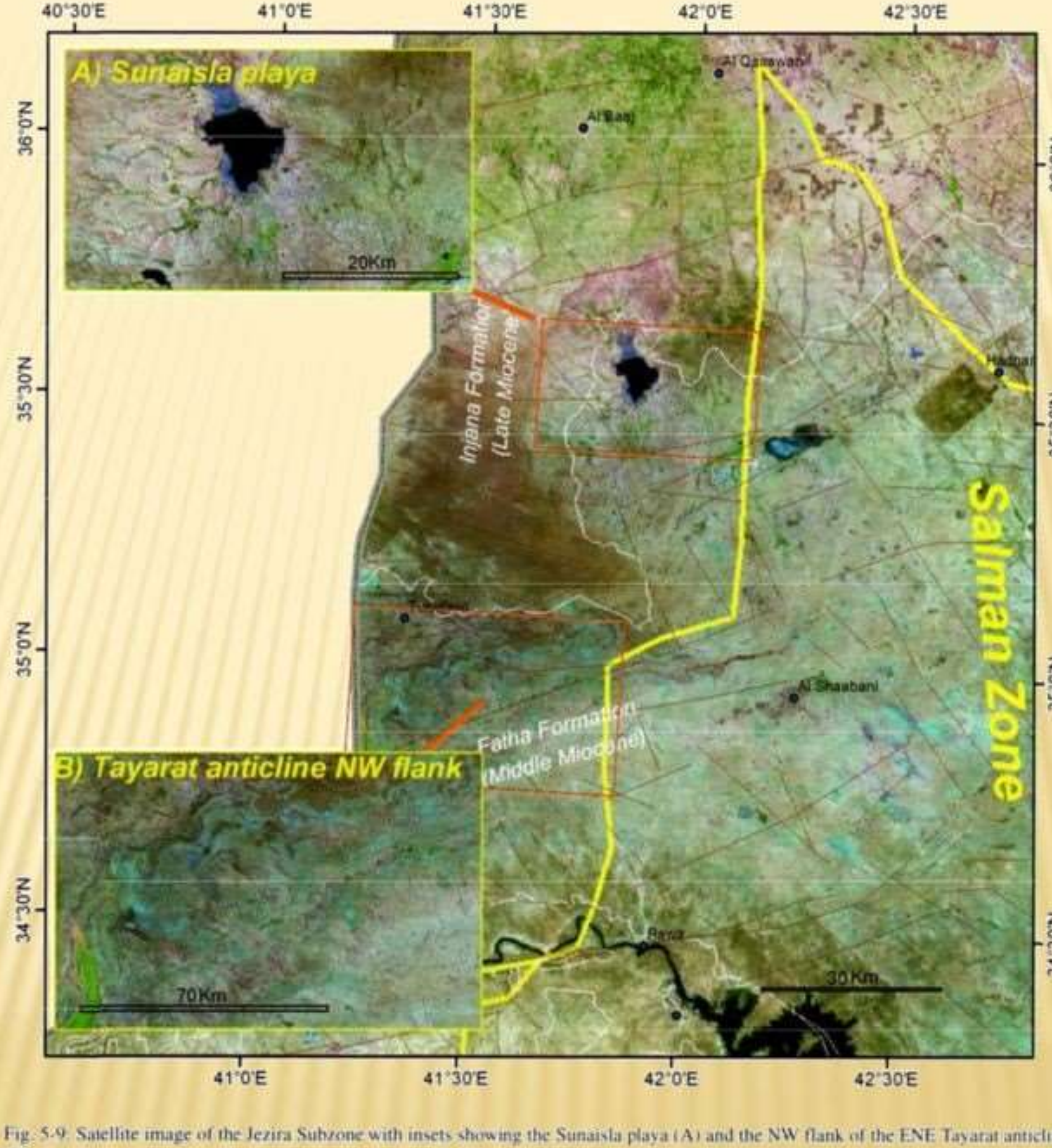

Fig. 5-9: Satellite image of the Jezira Subzone with insets showing the Sunaisla playa (A) and the NW flank of the ENE Tayarat anticline (B)

Structures

-The Jezira Subzone is part of the ancient wider Rutba Uplift.

-It is segmented into two highs by the Tayarat Graben:

1- the Tayarat High in the S and

2- the Khlesia (Abu Ras sain) High in the N.

The Khlesia Graben overlies the Khlesia High.

Both the Tayarat and Khlesia grabens are visible on the satellite images and on the Top

Of Triassic structure map .

-The Tayarat anticline overlies the Tayarat Graben indicating inversion occurred during Plio-Pleistocene compression.

-The Tayarat High is separated from the Rutba High by the Anah Trough of the Jezira Subzone.

-The structural highs and grabens of the Jezira Subzone which starts from the Jordanian border and ends near the Turkish border in the N.

The Anah Trough lies between the Rutba and Jezira Subzones.

-The trough appears narrow at the surface.

-At depth it is bounded by a series of E- W trending step faults.

The Anah Graben formed by *transtension* in Late Cretaceous time; it contains up to 2000 m of Upper Cretaceous sediments.

-The Tayarat Graben strikes E- W and probably formed synchronously with the Anah Graben.

-Its bounding faults have 1700 m of displacement on the top of the Triassic Kurra Chine Formation.

-The Khlesia Graben shows very little displacement at the top of the Kurra Chine Formation (-150 m).

-Drainage patterns suggest it was active in the Quaternary; salt playas developed along it.

-The northern boundary of the sub zone is located along the *Sinjar-Herki Transversal Fault* which defines the southern boundary of the Foothill Zone and the Late Cretaceous Sinjar-Abdul Aziz basin which extends into N Syria.

-*Small anticlines occur throughout the zone*.

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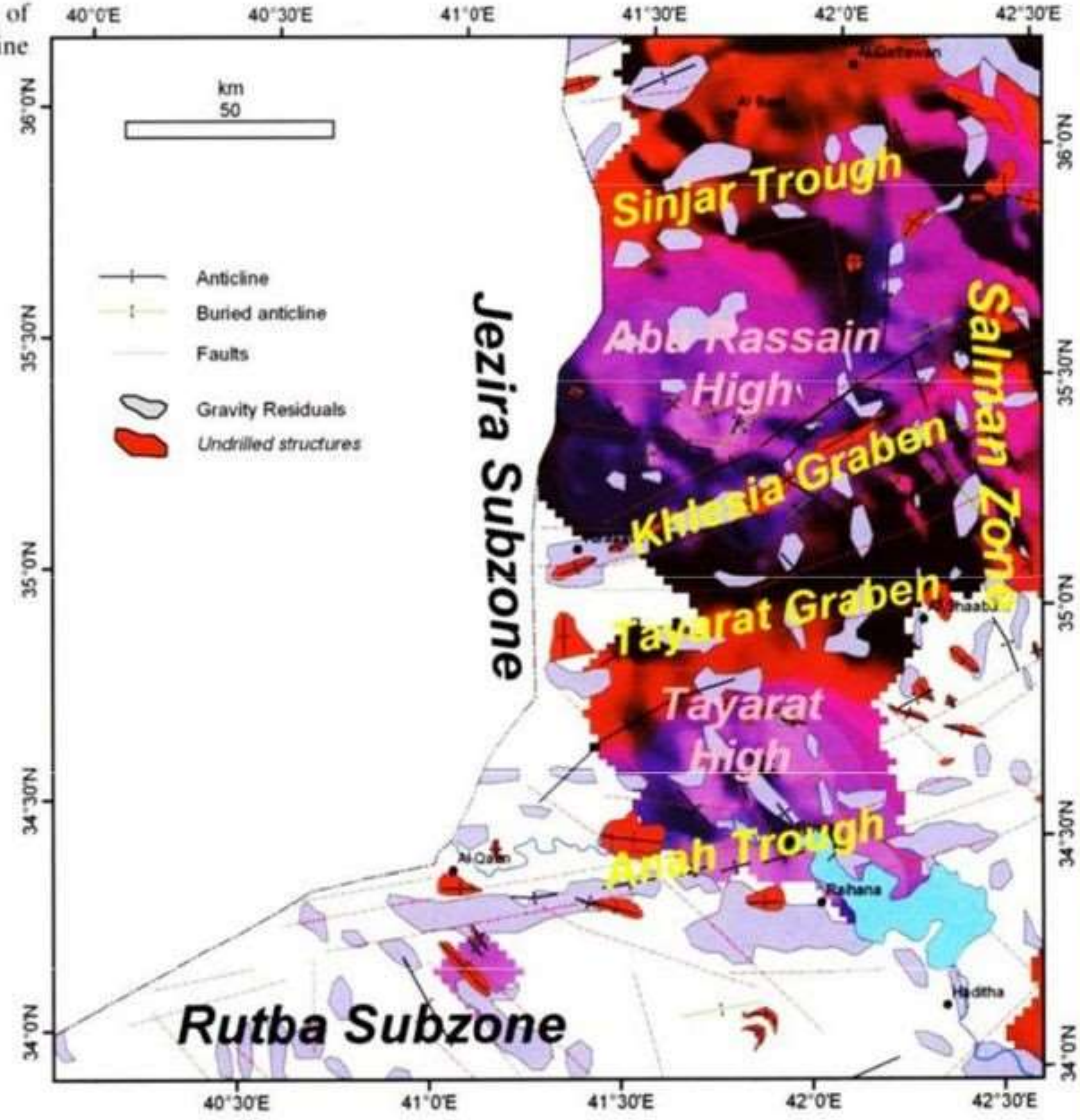
Fig. 5-10: Structural map on the top of the Upper Triassic Kurra Chine Formation



Salman Zone

-The Salman Zone is part of the Salman-Summan Zone of Getech and Jassim (2002) which extends into W Kuwait and central E Saudi Arabia.

-It is generally associated with gravity and magnetic highs indicating a shallow basement at a depth of 5-7 km.

-It was formed during the Late Precambrian Nabitah orogeny, and reactivated during Late Carboniferous and Early Permian time.

As in Saudi Arabia and Kuwait, the Upper Permian sediments unconformably overlie older Palaeozoic strata or the Precambrian basement.

-The western boundary is poorly defined in the north; in the south the western boundary is associated with a line of faults and residual gravity anomalies and strong karstification of the Eocene strata.

-The eastern boundary is associated with a strong gravity gradient along the Euphrates Boundary Fault in the S and along the western shores of the Razzaza and Habbaniya lakes, and with the Tharthar faults in the N.

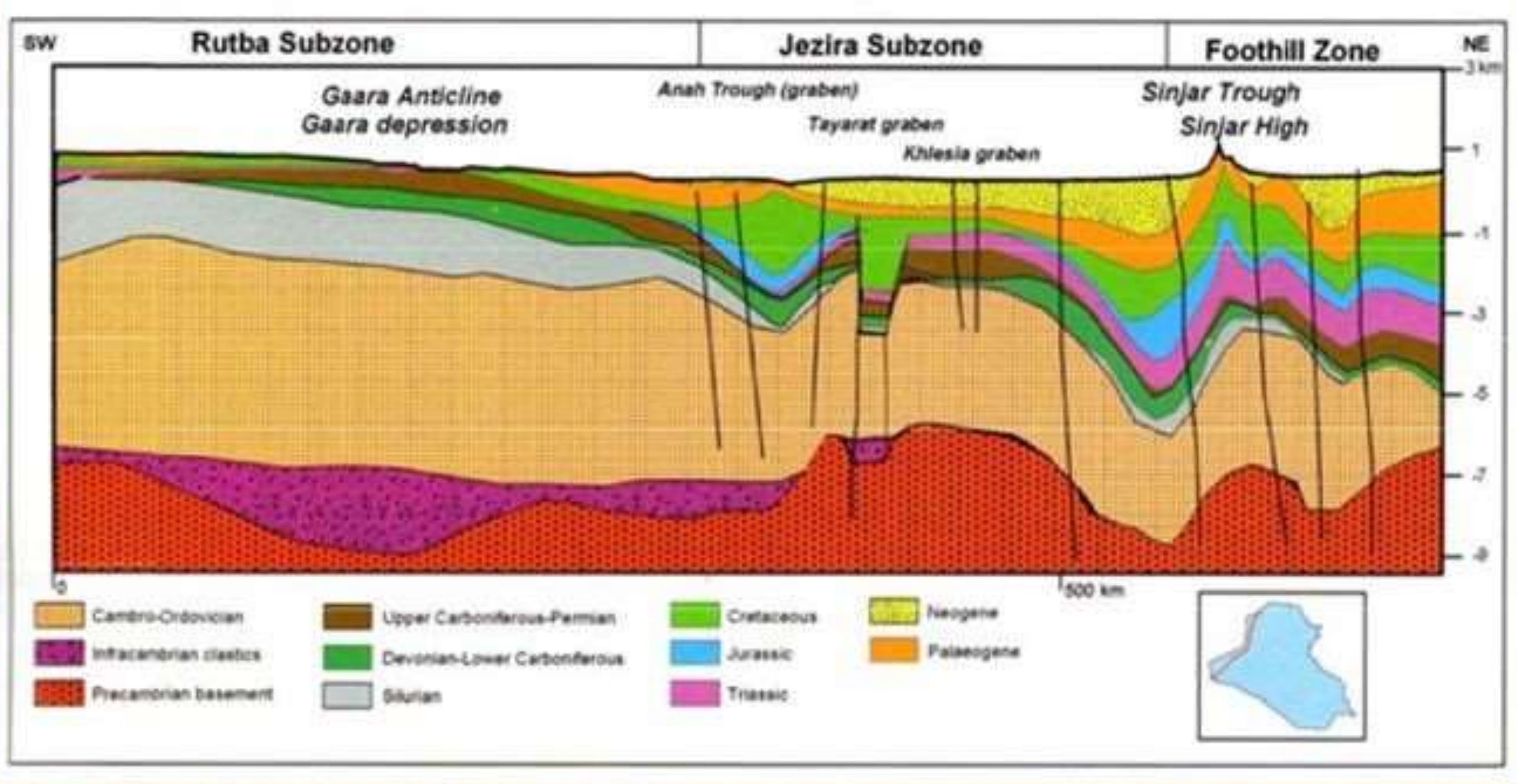
-The eastern boundary has been slightly modified from the original definition of Buday and Jassim (1984, 1987), especially near the lakes. Some small changes to the boundary were also made near the Sinjar-Herki Fault.

-The Salman Zone h as a *shallower basement* than the Rutba Jezira Zone to the W and the Mesopotamian Zone to the E. It is part of the Upper Precambrian Ar Rayan Terrane that was uplifted during the Late Carboniferous (Hercynian) time and partly during the Early Permian; the Lower Palaeozoic section was deeply eroded prior to Late Permian transgression . - Basement depth in the Salman Zone is 5-8 km, mostly 6-7 k m; along the boundary with the Mesopotamian Zone the basement depth increases to 8 -9 km.

The Infracambrian megasequence is thought to be absent.

The Lower Palaeozoic section is 1500-300 0 m thick; Permocarboniferous sediments may be preserved locally in Hercynian grabens. The thicknesses of the Mesozoic and Tertiary units are as follows: Triassic: 700 -2000 m, Jurassic: 100 0-1400 m, Lower Cretaceous: 300 - 1000 m, Upper Cretaceous: 800-1000 m, Palaeogene: 400-90 0 m and Neogene: 0-200 m

Fig. 5-11: Profile from the Risha area in NE Jordan to the Mushorah area in N Iraq passing through the Rutba Subzone, Jezira Subzone and the Foothill Zone. Cretaceous troughs and grabens are clearly visible in this profile



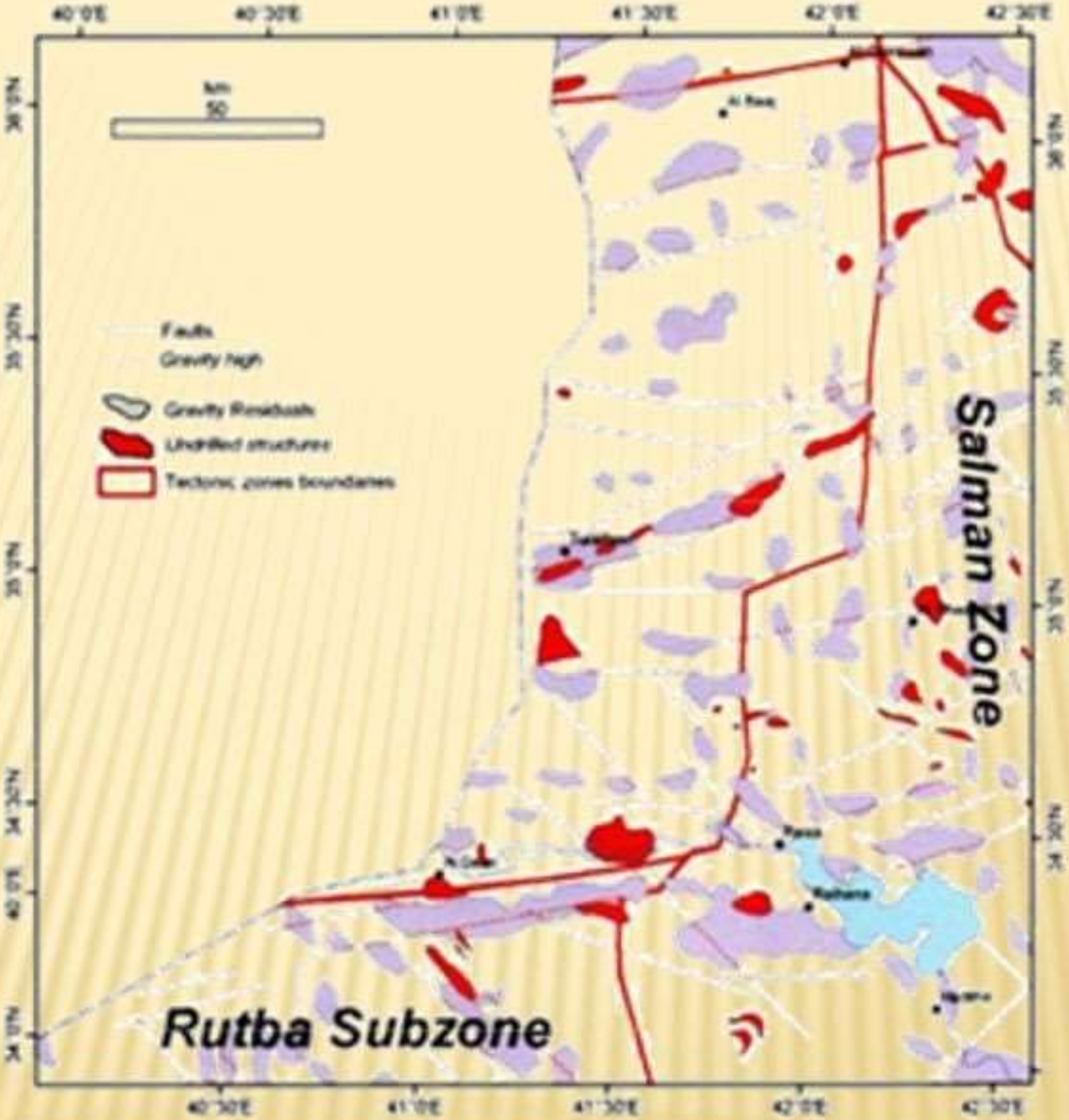


Fig. 5-12: Residual gravity anomalies (grey polygons) and undrilled structures (red polygons) of the Jezira Subzone

Geological and geomorphological characteristics

-The Salman Zone is a *monocline* dipping towards the Euphrates River;
-Middle-Upper Eocene strata outcrop in the W and Lower and Middle Miocene beds outcrop in the E.
-The S part o f the zone is a sandy plain formed by Miocene clastics.
Eocene carbonates are pock-marked; depressions are filled by Pliocene fresh water limestones and clastics.
-There are also numerous buried (or abandoned) river courses that have been strongly influenced by karst.
-They are usually aligned with the NE-SW trending faults .
-These features are associated with present day wadi courses.
They need to be investigated in detail due to their importance for groundwater exploration.

Structures

-The Salman Zone *subsided* from Late Permian time onwards.
-It comprises NE-S W and prominent NW-SE trending uplifts and depressions, bounded by faults.
-The most conspicuous structures in the Salman Zone strike NW -SE...
-They are relatively narrow, long anticlines, often accompanied by faults.
Broader N-S trending structures, indicated by gravity data are buried Hercynian horsts which are mostly restricted to the S and SW part of the zone.
-Other parts of the zone contain relatively short anticlines and structural noses, many of which are located along transversal faults.
-In the north, these structures trend N-S to NW -SE.
-Transversal faults control the sinuous course of the zone's borders.
Other faults mostly trend NW-SE in the Centre of the Zone and along the NE margin of the zone. N-S trending faults are frequent in the S and SW.
- The northern part of the zone has fewer faults.
Folds of unknown origin occur in the S part of the zone. Gravity residuals show a series of N-S trending anomalies possibly indicating buried Hercynian antiforms. -However such features have not been identified from seismic surveys.
- NW-SE trending faults are dominant in the southern part of the zone.
-Transversal faults occur throughout the zone.
NW-SE trending faults are common in the NE part of the zone.-

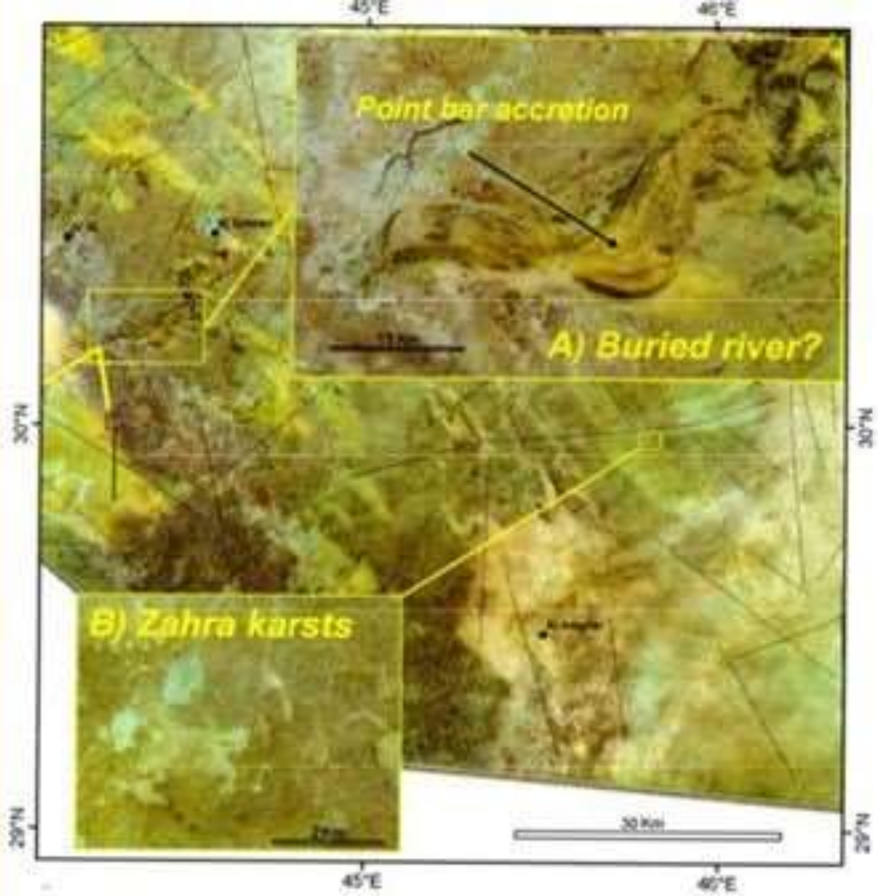


Fig. 5-13: Satellite image of the southern part of Salman Zone with insets showing buried river beds W of Salman depression (A) and the typical karsts scattered throughout the zone (B)

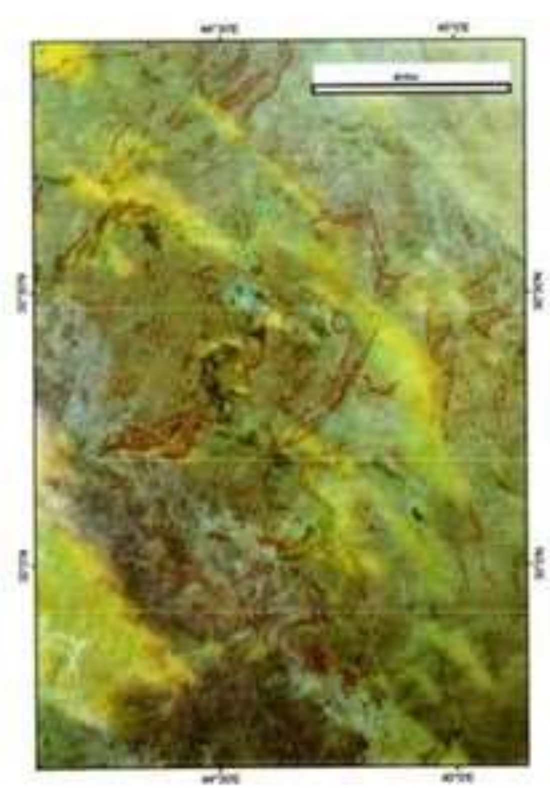


Fig. 5-14: Satellite image of the Salman Zone with tracing of some of the arcuate features that may be related to buried or abandoned river systems

Mesopotamian Zone

-The Mesopotamian Zone is the easternmost unit of the Stable Shelf.
It is bounded in the NE by the folded ranges of Pesh -i-Kuh in the E, and Hemrin and Makhul in the N.
The SW boundary is controlled by faults.
-The zone was probably ***uplifted*** during the *Hercynian* deformation but it ***subsided*** from Late Permian time onwards.
-The sedimentary column of the Mesopotamian Zone thickens to the east.
It comprises up to 1500 m of Infracarnbrian , 2500-5000 m of Palaeozoic, 1500-2200 m of Triassic, 1100 m of Jurassic, 500-700m of Lower Cretaceous, 700-1400 m of Upper Cretaceous, 2 00-900 m of Palaeogene, and 15 0-1500 m of Neogene and Quaternary section.
Quaternary sediments alone are up to 300 m thick.

This zone is divided to 3 sub zones:

1- Zubair sub zone
2-Tigris sub zone
3- Euphrates sub zone

-The Euphrates Subzone lies in the W of the Mesopotamian Zone.
-It is a *monocline* dipping to the NE with short anticlines (10 km) and structural noses.
-Some longer NW -SE oriented anticlines (20-30 km long) lie near to and parallel with the Euphrates Boundary Fault especially between Samawa and Nasiriya.
-They are related to *horsts and grabens* developed along the fault zone.
-The Euphrates Subzone is *the shallowest unit* of the Mesopotamian Zone. The basement is generally 7-9 km deep but has thicker Quaternary sediments compared with the Tigris Subzone.

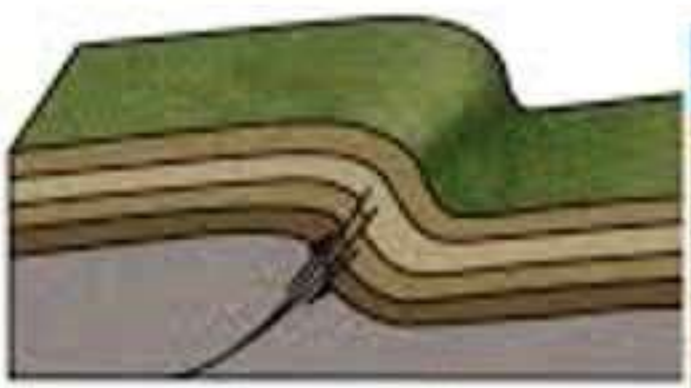
Fig. 5-17: Residual gravity anomalies (grey polygons) and undrilled structures (red polygons) of the Mesopotamian

WHAT IS MONOCLINE FOLD?

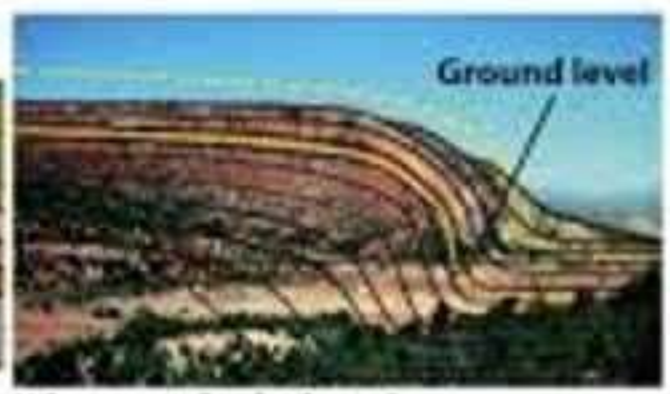
3 Fold Types

Monocline – like a carpet draped over a stairstep.

- Fold with only 1 steep limb- "a ½ fold"
- Due to "blind" faults in subsurface rock
- Displacement folds overlying rocks



Monocline



What a geologist imagines