Geology of Iraq

Lecture-2

(Fault System)

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3ad CLASS

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Fault Systems

The distribution of faults (background brown lines) is shown in Fig.

- Major fault zones correspond to the NW-SE Najd Fault System (red) and the NE-S W Transversal System (blue).

-Five major transversal blocks are identified bounded by major transverse faults.

The three major fault systems are;

1- the N-S Nabitah (Idsas) System,

2- the NW-SE Najd System and

3- the NE-SW or E-W Transversal System.

These fault systems formed during Late Precambrian Nabitah orogeny.

They were *re-activated* repeatedly during the Phanerozoic.

The transversal blocks are show n in Fig. 4-8.

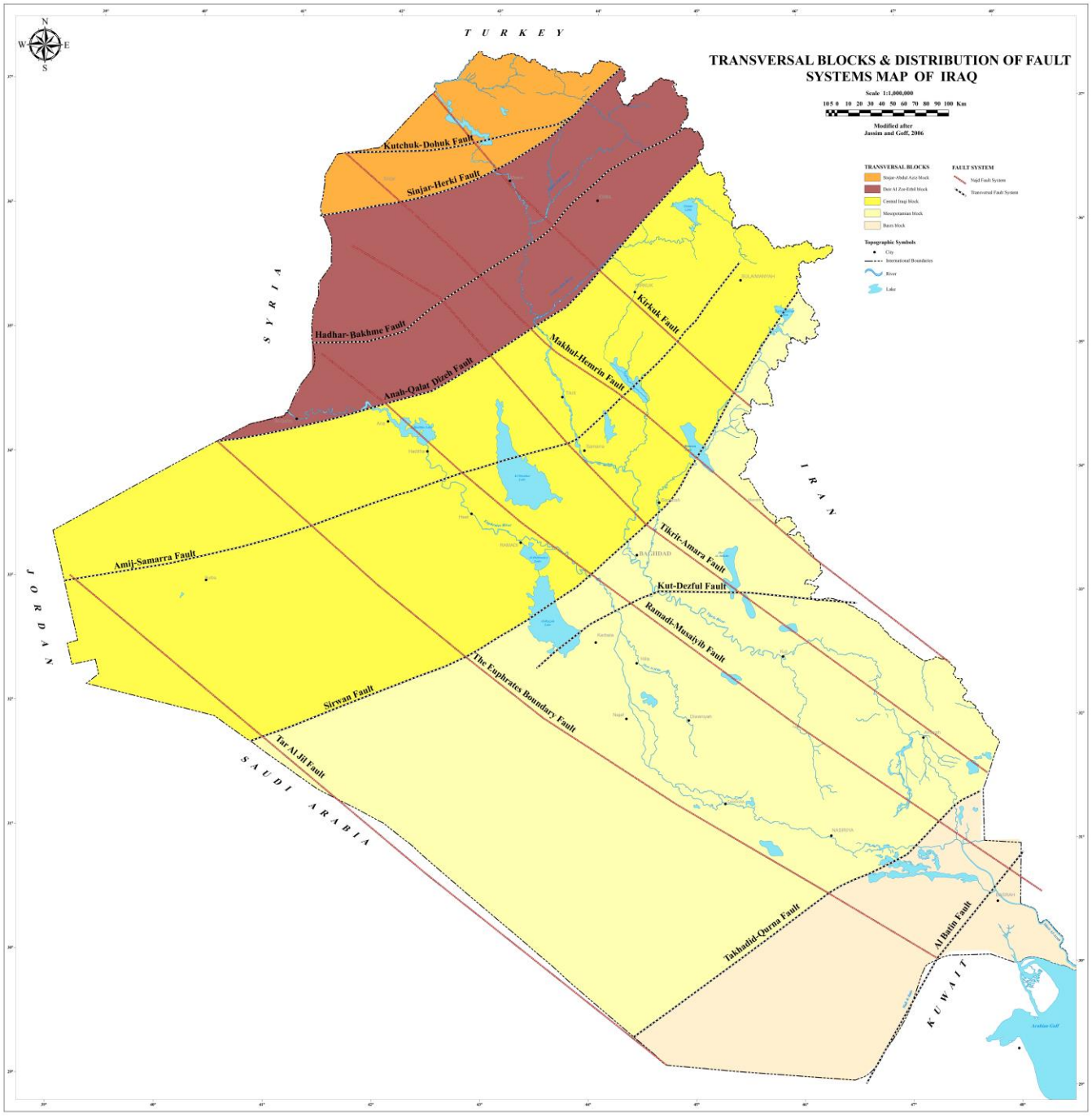

TRANSVERSAL BLOCKS & DISTRIBUTION OF FAULT SYSTEMS MAP OF IRAQ
Scale 1:1,000,000
105 0 10 20 30 40 50 60 70 80 90 100 Km
Modified after
Jassim and Goff, 2006
TRANSVERSAL BLOCKS
Sinjar-Abdul Aziz block
Dair Al Zor-Rifdi block
Central Iraqi block
Mesopotamian block
Basra block
FAULT SYSTEM
Najd Fault System
Transversal Fault System
Topographic Symbols
City
International Boundaries
River
Lake
Kutchuk-Dohuk Fault
Sinjar-Herki Fault
Hadhar-Bakhme Fault
Anah-Qalat Dizeh Fault
Kirkuk Fault
Makhul-Hemrin Fault
Tikrit-Amara Fault
Kut-Dezful Fault
Ramadi-Musaiyib Fault
The Euphrates Boundary Fault
Amij-Samarra Fault
Sirwan Fault
Tar Al Jil Fault
Takhadid-Qurna Fault
Al Batin Fault
TURKEY
SYRIA
IRAN
JORDAN
SAUDI ARABIA
KUWAIT
Arabian Gulf

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

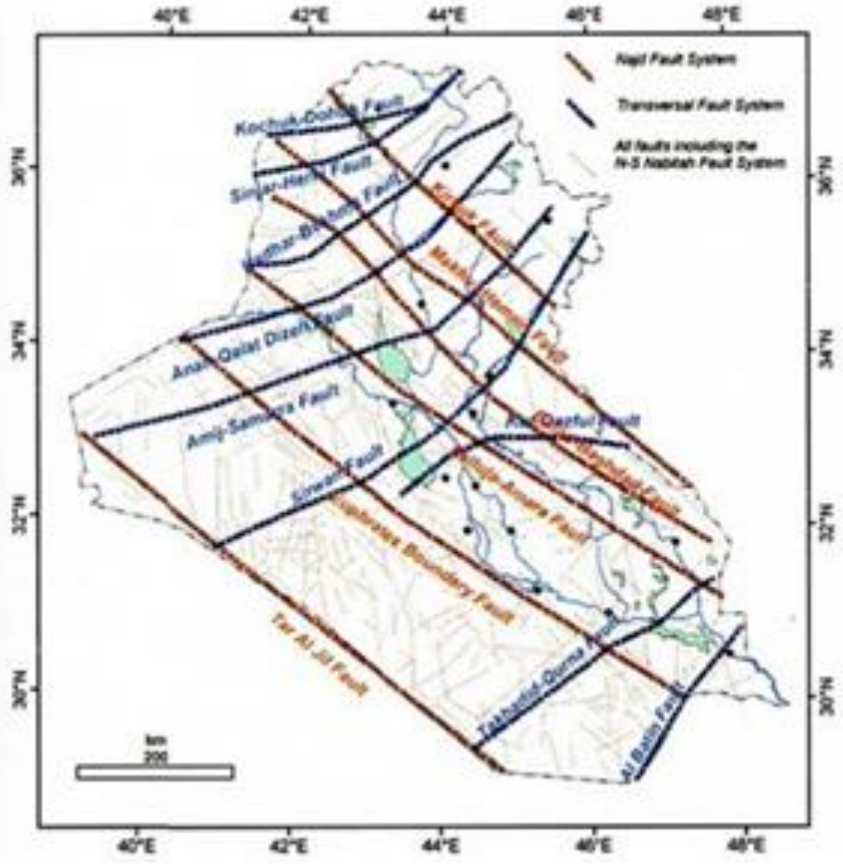
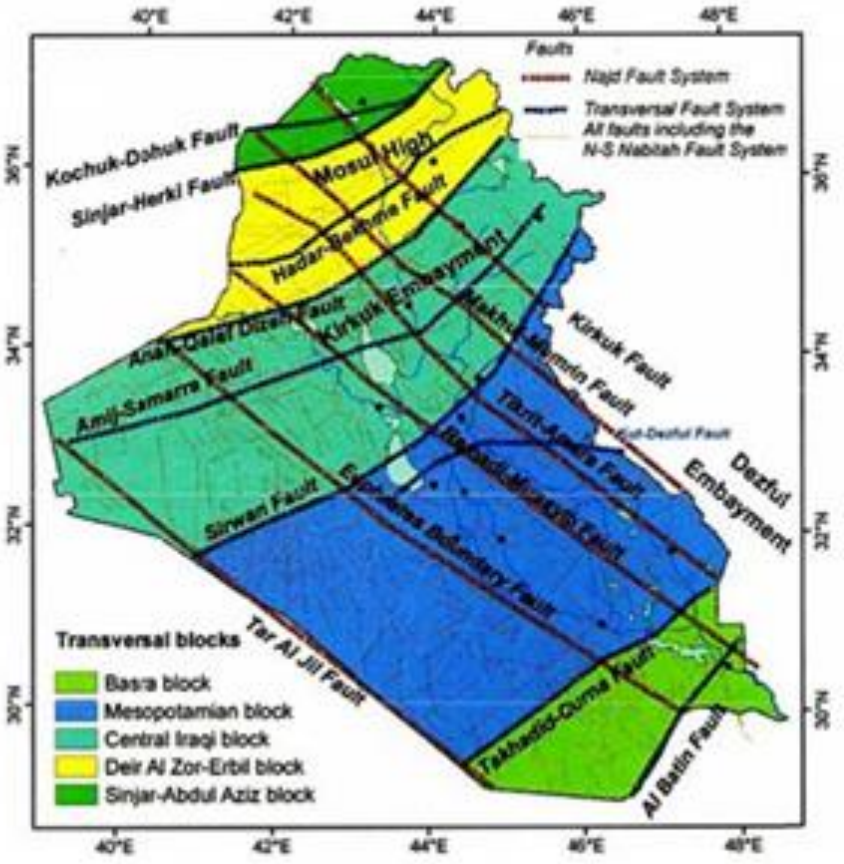


Fig. 4-8: Transversal blocks



Nabitah (1dsas) Fault System

The N-S trending Nabitah FaultSystem is prominent in S and W Iraq. It affects the thickness of the Infracambrian and Palaeozoic & to lesser extent the Triassic section.

The fault system resulted from E- W compression, which formed major N- S trending thrust (collapse) basins during the Nabitah Collision-anticlines and associated molasse -filled fore deep

*The system in Iraq has been mostly identified from gravity data and is most commonly observed in SW, S and W Iraq and less commonly in NW Iraq.

*Not all the N-S trending features shown are faults; some may be due to lateral changes in basement composition.

The Nabitah System is older than the Najd system and originated around 680 Ma.

'*Extension probably occurred along this trend to form the NS Infracambrian rift basins.

It was reactivated during the *"Hercynian"* events in Late Carboniferous time as indicated by the isopach of the Palaeozoic.

**Erosion* occurred over the Salman Zone which forms the central longitudinal unit in Iraq (Fig. 4-9B).

*Further *reactivation* of the Nabitah system occurred in the Late Cretaceous as indicated by depositional thinning and the presence of unconformities over some of the N-S trending structures of Kuwait and E Saudi Arabia.

**Neotectonic movements* may have occurred along some structures of this system, including the Abu Jir and Tharthar faults in central and N Iraq and the Nukhaib Graben in SW Iraq .

Najd Fault System

*The *Najd Fault System* is very significant in Iraq as it forms boundaries not only of the Precambrian terranes but also of t he tectonic zones, especially in central, E and NE Iraq.

*The system developed in ***a sinistral transpressional shear zone*** during the Nabitah orogenesis .

*The displacement along some of the Najd shears decreases to the NW, largely due to partitioning of stress along some of the N-S trending Nabitah shear zones .

*The Najd System originated as a ***sinistral strike-slip faulting system*** around 670 Ma and was associated with deep ductile deformation that resulted in the rise of gneiss domes (Nehliget.al,2002).

* later developed as an ***extensional system*** from (640 -530 Ma.).

Vertical movement along the Najd Fault System occurred during Jurassic to Quaternary time

The following fault zones are related to the Najd Fault System:-.

1-*The Tar Al Jil Fault Zone* runs along the Iraqi-Saudi border. It is associated with an escarpment of Palaeocene strata, facing a depression to the SW filled in with Mio-Pliocene clastics and fresh water limestones.

The fault has thus been active in Late Tertiary time. It continues into W Iraq, NE Jordan and SE Syria.

2-*The Euphrates Boundary Fault Zone* is one of the most prominent Najd fault zones.

It runs along the Euphrates River in S Iraq and continues towards the Rutba area in W Iraq.

**In the S the fault zone comprises a series of step faults sometimes associated with grabens, and forms the boundary between the Quaternary Mesopotamian Plain and the rocky desert of SW Iraq.*

**It is associated with a large number of sulphur springs.*

*In W Iraq the fault zone was *reactivated* during Late Jurassic and Cretaceous time forming small fault bounded depressions filled in with fluvial sandstones.

3-*The Ramadi-Musaiyib Fault Zone* is a prominent feature on the gravity gradient map.

* It controls the course of the Tigris River between Baghdad and Kut.

*It is associated with long NW-SE buried anticlines in S Iraq and controls the location of the buried W Baghdad structure.

*It continues NW toward Anah in W Iraq to the point where the Euphrates River changes direction from E to SE.

*The fault zone was probably *active* during the Mio-Pliocene time.

4- *The Tikrit-Amara Fault Zone :-*

extends from the Jezira region in NW Iraq through Tikrit and Balad into Baghdad and Nahrawan. It continues along the **SE** trending stretch of the Tigris River between Kut and Amara.

* Major buried anticlines are located along this fault zone (Rafidain, Nahrawan, E. Baghdad, Balad and Tikrit).

5- *The Makhul-Hemrin Fault Zone :-*

has a magnificent surface expression represented by one of the longest anticlinal chains in the Middle East that includes Makhul in the NW, Hemrin North and Hemrin South in the Middle and Pesht-i-Kuh along the Iraq-Iran border in the SE.

*The same trend continues into **SW** Iran along some of the anticlines forming the **NE** coastline of the Arabian Gulf.

* ***This fault zone may be the boundary between the Eastern Arabian and Zagros Precambrian terranes and also forms the boundary between Stable and Unstable shelf.***

*Late Cretaceous ***extension*** may have occurred along this fault zone.

*It was strongly **reactivated** during the Pliocene and forms the **SW** boundary of the area affected by Late Tertiary folding.

*It is still ***active*** at the present day.

6- *The Kirkuk Fault Zone:-*

expressed on the surface by the 300 km long anticlinal range of Kirkuk and forms the boundary between two subzones of the Foothill Zone.

It was ***active*** during the Plio-Pleistocene.

Transversal Fault System and transversal blocks

The Transversal system includes two main trends,:-

1- the ***easterly trend*** which is more dominant in **W**and **NW** Iraq and
2-the ***northeasterly trend*** that dominates the **E** and **N** parts of Iraq.

These two trends merge into each other to form arcuate faults.

*The Transversal systems may have formed in Late Precambrian times.

*Poorly defined **E- W**and **NE-SW** trends occur in the Arabian Shield.

*The **NE-SW** trend might be a conjugate trend to the Najd Fault System.

The Transversal System was reactivated from Late Jurassic times onwards resulting in the formation of transversal blocks.

*Some faults of this system underwent ***sinistral strike slip*** movement in Quaternary time; at least 2 km of horizontal displacement has occurred along the Anah-Qalat Dizeh Fault at Al Fatha in the last few million years.

*Many Foothill Zone anticlines are segmented into separate domes and their fold axes are bent at the intersections with transversal faults.

*The Transversal Fault System may represent old planes of weakness which controlled the position of transform faults active during ***Neo- Tethyan Ocean spreading***, and ***during the opening of the Red Sea***..

* ***The transversal faults influenced the thickness of the Jurassic to Neogene sequences .***

The system has been divided into major fault zones(from south):-

1-The Al Batin Fault Zone

runs from the SW to the NE along the Wadi Al Batin that forms the border between Kuwait and Iraq and originates from the eastern extremity of the Arabian Shield.

2-The Takhadid-Qurna Fault Zone

It forms the northern boundary of the Basra Transversal Block. This block subsided during the Late Cretaceous and Palaeogene. N-S trending structures are predominant in the Stable Shelf. In the Mesopotamian Zone they comprise prominent long buried anticlines and faults.

3-The Kut-Dezful Fault Zone

These faults influenced subsidence and sedimentation in Palaeogene time.

They separated the Palaeogene phosphatic facies in the NW from the lagoonal- evaporitic facies in the SE.

4-*The Sirwan Fault Zone*

runs along the Sirwan (Diyala) River in N Iraq.

*It extends into central and **SW** Iraq, defined by the horizontal gravity gradient.

* it forms the **SE** limit of the Kirkuk Embayment.

*The Sirwan Fault forms the **N** boundary of the Mesopotamian Transversal Block (Fig. 4-8) whose **S** boundary is controlled by the Takhadid-Qurna fault.

The Mesopotamian Block contains thick Cretaceous and Palaeogene sequences that thin to the **NW** of the Sirwan Fault.

The Mesopotamian block is the largest Transversal Block with the deepest basement which dips uniformly to **NE**.

5-*The Amij-Samarra Fault Zone* runs from the **W** towards central Iraq, just N of Samarra.

6-The Anah-Qalat Dizeh Fault Zone:-

is the most impressive transversal fault both morphologically and tectonically.

*It controls the course of the Euphrates River for a distance of over 100 km.

*The fault zone starts in **W** Iraq as a series of **E- W** trending step faults producing the so-called Anah Graben.

*They were ***active*** during the Late Cretaceous, producing a graben with over 2000 m of Upper Cretaceous sediments; on the adjacent footwall blocks the Upper central Iraq but without significant displacement.

*They pass into a fault zone that intersects and displaces the Makhul-Hemrin range at Al Fatha.

Plio-Pleistocene tectonic activity in the Stable Shelf is indicated by monoclines along the southern fault of the Anah-Qalat Dizeh Fault zone.

*Neotectonic activity is proven by several recorded earthquakes .

*The fault forms the **N** limit of the Kirkuk Embayment, the Central Iraqi Block and the **SE** boundary of the Mosul High.

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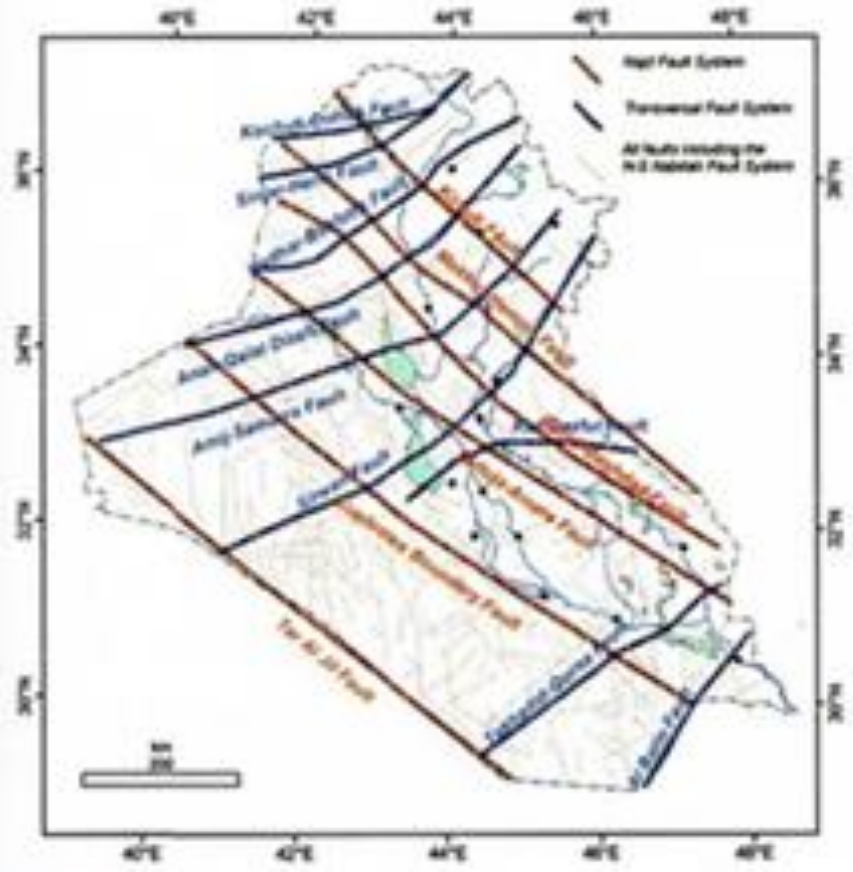
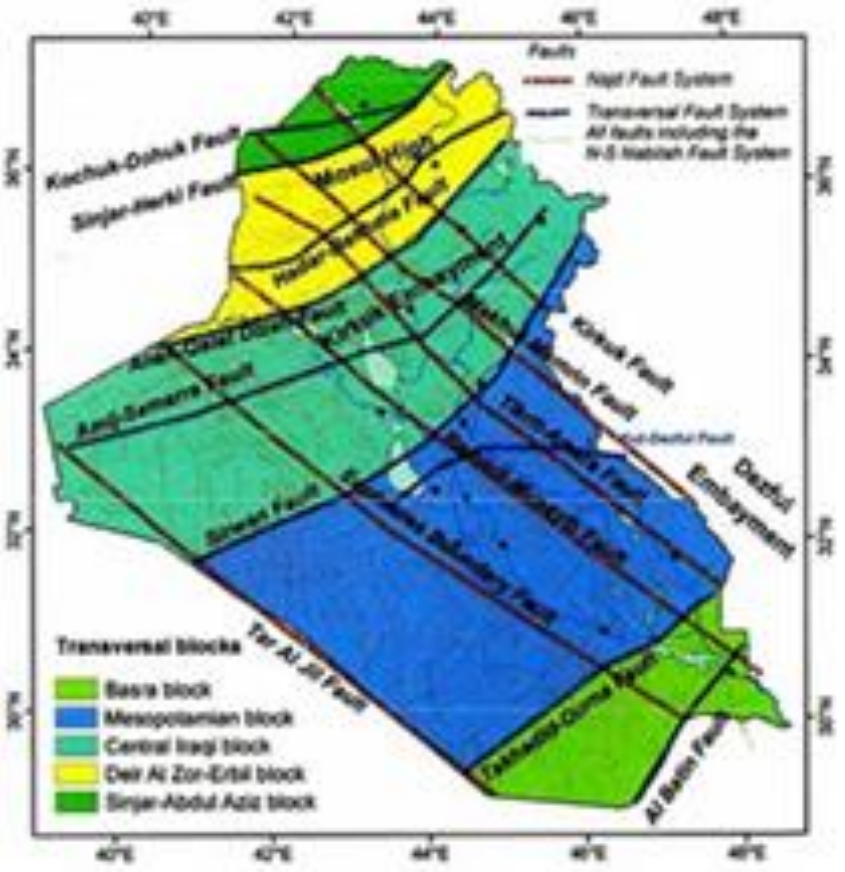


Fig. 4-8: Transversal blocks



7- The Hadhar-Bakhme Fault Zone :-

starts in Syria and NW Iraq. Its strike changes from W-E to NE-SW towards the folded belt.

*It passes through Qaiyarah and runs along, and slightly S of, the Greater Zab River.

*Recent salt playas are located along the fault zone suggesting that it is *active* at present.

*The overall vertical displacement of the fault zone is towards the south. The fault forms the southern boundary of the crestal block of the Mosul High.

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8-The Sinjar-Herki Fault Zone:-

forms the southern boundary of the Foothill Zone of NW Iraq and the Sinjar-Abdul Aziz Basin of Syria.

*It was *active* during Late Cretaceous time and probably during the Triassic.

The fault zone has an easterly trend in the Stable Shelf area and a northeasterly trend in the folded belt.

*It forms the N boundary of the crestal block of the Mosul High with an overall displacement towards the N.

*The Sinjar-Herki transversal fault forms the N boundary of the Deir Al Zor-Erbil block (Fig. 4-8) whose S limit is located along the Anah-QalatDizeh transversal fault.

8-The Kutchuk-Dohuk Fault Zone

Reference:-

Jassim,S.Z.& Goff,J.C. (ed.). Geology of Iraq,2006.DOLIN, Prague.