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STRUCTURAL AND SEDIMENTOLOGICAL EVOLUTION OF THE MESOPOTAMIAN GEOSYNCLINE (N.-IRAQ)[1]

by

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(4 figures)

SUMMARY.- The type and the facies of the sediments are discussed in relation to the various kinds of tectonic movements.

A facies change from NW to SE in the Lower Jurassic indicates the existence of NE-SW trending basement blocks, along which horizontal and vertical movements took place.

Facies changes and the variation in tickness of the Gercus Formation (Eocene) observed in a number of structural units provides proof of synsedimentary folding.

A shift in the axis of the northern basin from a NW-SE trend in the SE part of Iraq to E-W strike in NW Iraq was apparently controlled by faults.

INTRODUCTION

The scope of the present paper is the elaboration of the geologic data to fit probable synsedimentary folding (saxonic folding) in northern Iraq as well as basement block faulting.

Many tectonic concepts are dealing with the genesis of the folded zone in northern Iraq (HENSON 1951, BUDAY 1970 and others). HENSON 1951 is emphasizing the role of vertical movement in forming the folded zone while other authors are assuming a simple lateral pressure. The results of detailed facies-analysis are discussed in relation to the various kinds of tectonic movements and a summary of basin-development is given.

1.- BASIN DEVELOPMENT AND SEDIMENTOLOGICAL HISTORY

The Precambrian basement in northern Iraq is subdivided after BUDAY (1970) into several transversal blocks (NE-SW) separated from one another by deep seated faults. These deep seated faults (basement dislocations) do not cut the overlying sediments but manifest their existence in them by thickness and facies changes. The basement itself is an extension of the Nubioarabian platform.
The transversal blocks are themselves split by second order dislocations NE of Mosul (fig. 1).

Along the deep seated faults lateral and vertical movements took place, which have been limited both areally and temporally.

It is difficult to estimate the vertical displacement of these blocks.

The sediments in northern Iraq reveal at least two facies groups :

a) Shelf facies (shallow water)
b) geosynclinal facies (deep water).

Most of the sediments in Iraq, except those in the NE part, are characterized by a platform nature. The Paleozoic in Iraq is characterized by the sediments of shelf facies (AL-RAWI 1975) ranging from clastics to chemical and biogenic sediments.
The deformations in this era were the result of oscillation movements, which are reflected even in the change of current direction from NW in Khabour-Quartzite (Ordovician) to N in Pirispiki Red Beds (Devonian) (SEILACHER 1963), as well as occurrence of basic volcanic activities (fig. 2).

More than 2 km of sediments were deposited during the Paleozoic. A reconstruction of a paleographical map of the Paleozoic in Iraq seems to be impossible due to the occurrence of few small exposures.

The Triassic sediments lie unconformably on the Chia Zairi Limestone (Permian) ; the first sign of deepening of the basin is recognizable in this time interval. The Triassic, as well as the Jurassic sediments are represented mainly by chemical limestones and shales.
Less vigorous movements in the shelf led to a restricted circulation of oceanic water, where in certain areas evaporites were deposited. The organic materials predominate in the Upper Jurassic.
The Triassic and Jurassic periods are relatively a time of no tectonic disturbance.

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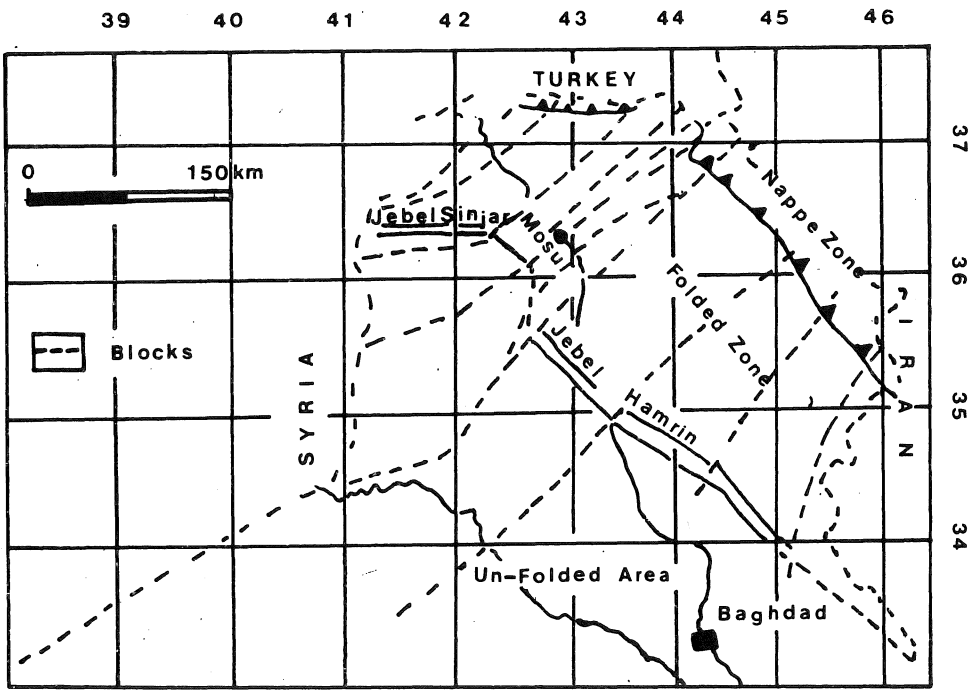

Figure 1.- Location map

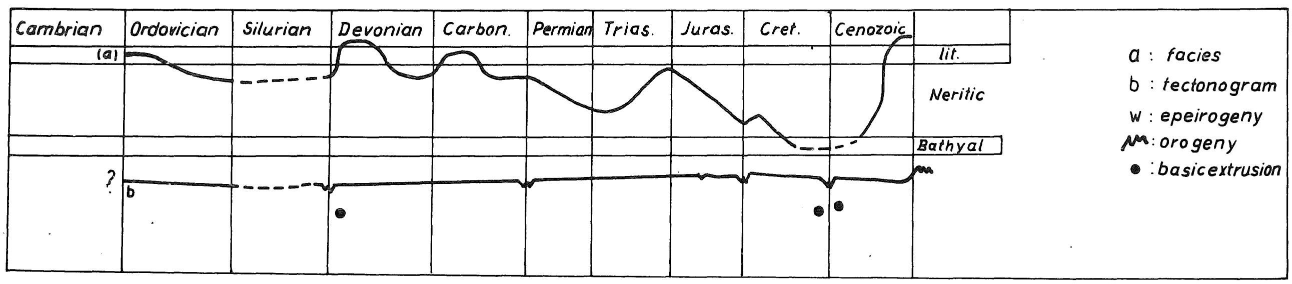

Figure 2.- Tectonogram of the sediments in N-Iraq

The thickest sedimentation in the Jurassic period, which represent the centre of the foreland basin, lying to the west of Mosul, while in the Tigris area a synsedimentary trough was developed (DUNNINGTON 1958).

The sediments prevailing in the NE-part of Iraq in the Jurassic time are mainly carbonate facies complex, while the western area is characterized by evaporite facies (fig. 3).

The lower Jurassic is characterized by a facies change from NW to SE (DUNNINGTON 1958), which points to the existence of basement blocks.

The following important tectonic movements can be recorded at the Jurassic/Cretaceous transition.

1) An elevation of an area west and northwest of Mosul which represented in the earlier time the deepest part of the basin,

2) pronounced shift in the facies boundaries.

The elevated area west of Mosul was bounded most probably by faults of N-S and E-W directions. A deepening of the basin began again in Lower Cretaceous. The Albian-Cenomanian time shows clearly a lateral and vertical variation in the facies.

Sediments of deep water facies in the Lower Cretaceous can be found for the first time in the western area of the basin while part of it represented a land area in the Jurassic time. A sharp E-W change in the sediments from carbonate facies complex in the Tigris area to clay facies complex West of Mosul is controlled by E-W faulting.

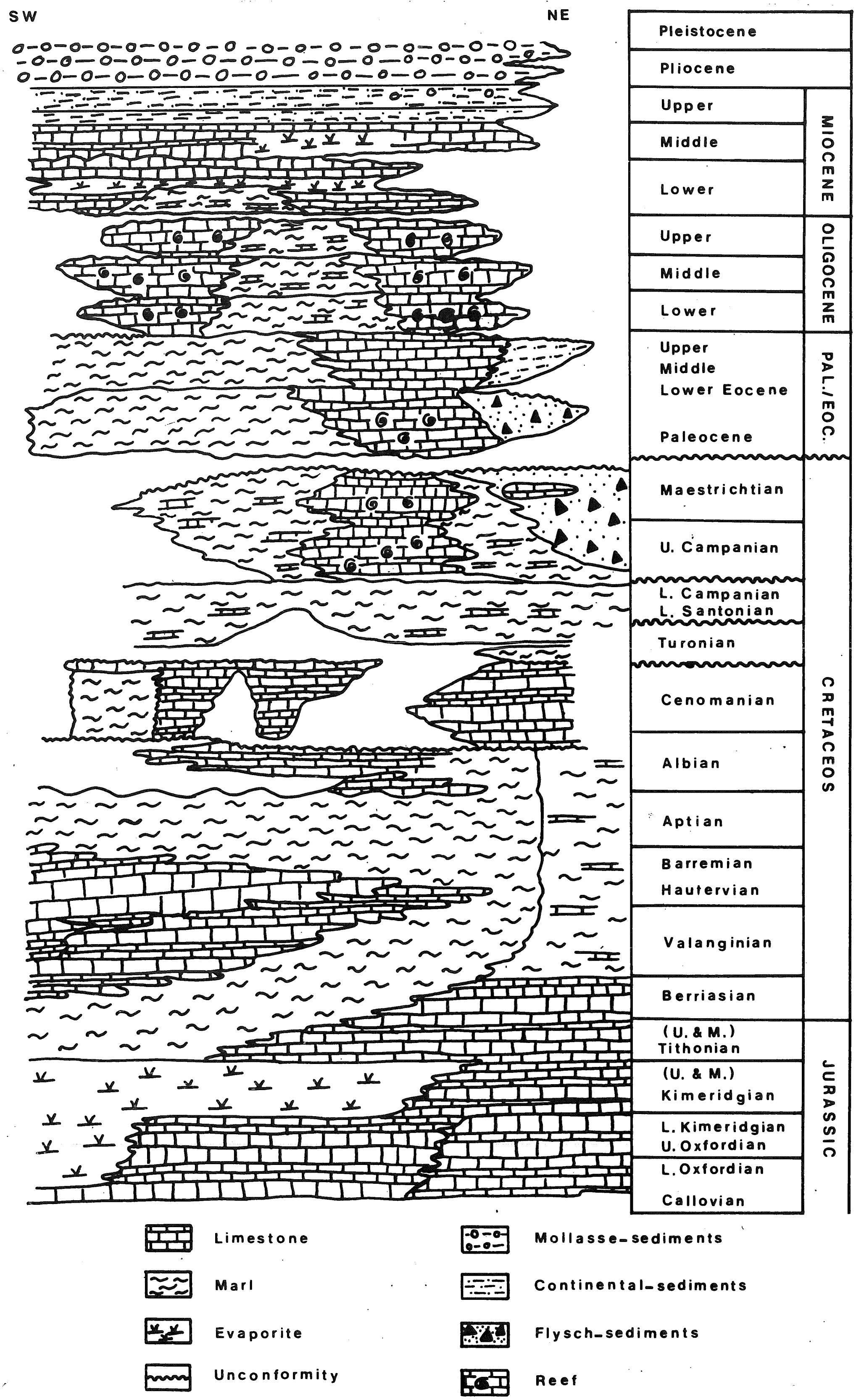

Figure 3.- A schema of sediments and facies distribution

Such inverse structures are the result, where individual blocks sometimes drift asunder and sometimes press against each other. In other words uplift and subsidence elements are a complementary system. Less vigorous movements during the Albian-Cenomanian time led to deposition of anhydrite at the western margin of the basin.

The oscillation movements were diverse, provided by negative and positive direction and were of local extension. In the Upper Cretaceous, the forelands basin in the west is characterized by east-west individual sedimentary and synsedimentary troughs and in the NE by a NW-SE running trough which is probably a result of faulting in the basement. It is worth mentioning again that most of the Tigris area is characterized by deep water sediments (globigerinal marls and limestones), while on the submarine highs reef limestones were developed. The Upper Cretaceous is a period of intensive facies changes both laterally and vertically. In other words, the basin designates a high grade of irregularities due most probably to the heralding of the diastrophism in the extreme NE-part of Iraq.

The sediments of the NE-geosyncline (orthogeosyncline), part of Iranides, were folded and thrust up in Upper Cretaceous (probably during the Campanian, DUNNINGTON 1955). The eroded materials were laid down in a foredeep, which trends NW-SE. The geosyncline polarity (in the sense of AUBOUIN 1965) migrates SW toward the foreland in late Mesozoic (LAW, 1957, p. 53).

The sediments are known as Tanjero clastics (flysch-sediments). In other words, the Cretaceous period was a time of widespread uplifting accompanied by regressions and transgressions (fig. 4).

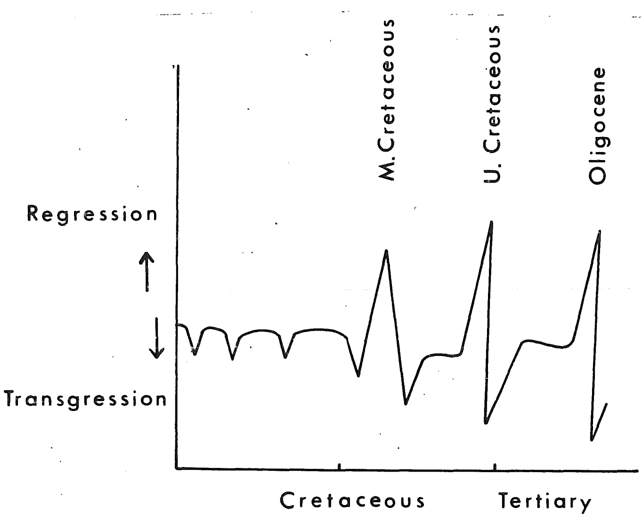

Figure 4.- Transgressions and regressions during the Mesozoic and Cenozoic.

The sedimentation of flysch-like sediments went on through the Tertiary in the NE-part of northern Iraq. Segments of highlands trending NW-SE and E-W are documented in this time interval, e.g., a barrier running south of Sinjar (W-Mosul), around which reefal limestone were developed. The Oligocene-time is characterized in the foreland by the occurrence of reefs, which bear genetically a relationship to the heralding of the diastrophism in the NE-geosyncline of Iraq.

This geosyncline, which is first evident in Upper Cretaceous time, was folded and thrusted for the first time in the Oligocene (BOLTON 1958).

Evaporite deposition is a prior phase of the continental deposition of the Fars and Bakhtiari Conglomerate. The following facies complexes have been identified by the basin development of northern Iraq.

1. Clastics and chemical deposits of shallow-water facies
2. Flysch facies in the Upper Cretaceous and Paleocene in the NE-part of the basin
3. Finally post orogenic sediments of mollasse type = Bakhtiari Conglomerate.

2.- TECTONIC AND SYNSEDIMENTARY DEFORMATION

The tectonic intensity should be reflected in the different blocks by the frequency of occurrence of the folds. The area W of Mosul reveals frequent occurrences of the folds and corresponds to the zone of maximum subsidence in the Jurassic, which manifest relatively a broader basement block than the other blocks. This structural phenomenon was not taken into account by BUDAY (1970), because the greater the basement mobility, the broader the transversal blocks. Furthermore these folds are generally characterized by N-vergence. Thus a distinct relationship can be deduced between the tectonic deformation and the thickness of the sediments.

Deep water facies sediments correspond to high mobility of the basement, while carbonate sediments indicate the decreased tectonic mobility of the basement e.g. : The subsidence of the area W of Mosul in the lower Cretaceous is contemporaneous with the deposition of a marl facies complex (globigerinal marl) and with the initial phase of alpine orogeny as well as with the E-W shifting in the facies. Measurements of sedimentary structures and petrographic-analysis of clastic materials were carried out by KUKAL & SAADALLAH (1970) to reconstruct the paleocurrent which is transversal to the axis of the basin.

Changes in the orientation of the strain, both in time and space, manifest themselves in the rotation of the primary axis of sedimentional area from N-S to NW-SE at the Jurassic/Cretaceous time.

Mollasse-like sediments can be found in Gercus Formation (Eocene), where the colours of terrigenous materials can be taken as proof of the intensive weathering. A change of facies and thickness in the Gercus Formation indicates synsedimentary folding (AL-RAWI, paper in print). Synsedimentary movements are limited both temporally and areally.
Although a detailed analysis of the facies and stratigraphic development doesn't reflect the position of the basement blocks, while the variation in the subsidence influence heavily the thickness and the facies of the sediments.
The function of the blocks is provided with different grade of mobility and they are representing mobile units, moving together and relatively each to other.

3.- CONCLUSION

The foregoing discussion shows that two types of facies predominate, a neritic facies of limestones and sandstones and a bathyal-abyssal facies of marls and shales. The Lower Jurassic reveals a facies change from NW-SE, which manifests the existence of basement blocks (NE-SW). These blocks are separated by deep seated faults, along which horizontal and vertical movements took place.
These deep seated dislocations were not observed in northern Iraq, because the basement blocks were probably of low mobility. The first appearance of flysch sediments was recorded in Upper Cretaceous due to the diastrophism in the extreme NE-part of Iraq.
Development of reefs in Upper Cretaceous and Oligocene in the foreland, as well as tensional structural elements, are due to compensation movements equivalent to Cretaceous orogeny. Facies change and variation in the thickness of Gercus Formation (Eocene) in many structural units documented synsedimentary folding.

Even slump structures can be useful to identify syntectonical unstability in Lower Fars Formation (Miocene) in northern structural units (KNETSCH, 1957, p. 560).

Rapid subsidence within the blocks corresponds to the maximum thickness of marls, flysch sediments (U. Cret.) and mollasse sediments (Pliocene).
The folding is of saxonic type which designates a paratectonic (STILLE 1924).

The evolution of the shifting from NW-SE in the SE-part of Iraq to E-W in the NW-part of Iraq can be recorded by the type of sediment and facies development :

1. The shifting is recorded for the first time in Lower Cretaceous, where carbonate changes laterally into marl facies complex from E-W.
2. In Paleocene time the flysch sediments change laterally into carbonate facies complex from E-W. In other words the shifting is corresponding to the maximum subsidence in the area, which is the result of intensive tectonic deformation.

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