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Facies Analysis and Paleoenvironments of the Lower Jurassic Silisiclastic-Carbonate Succession, Western Iraq

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ABSTRACT

The Lower Jurassic Silisiclastic-Carbonate Succession of Western Iraq consist(from bottom to up) of Ubaid, Hussiniyat, and Amij succession. They were deposited within a variety of continental, transitional and marine environments. Microfacies analysis of the Ubaid Formation reflect deposition in different environments within the carbonate platform. Lithofacies analysis of the clastic unit of the Hussiniyat Formation reflect deposition within a meandering river system, the Coastal plain facies can also be recognized within the lower part of the upper carbonate unit. The Amij succession consist of a lower clastic unit with few carbonate interbeds and an upper carbonate unit. This succession consist of a wide range of lithofacies reflecting the different subenvironments of fluvial, transitional and shallow marine environments. The activity of the Rutba uplift and Anah Graben during the Early Jurassic greatly affected the paleogeography of the basin in the study area.

Introduction

The Lower Jurassic Silisiclastic- Carbonate Succession of the Western Iraq are exposed Northeast of Rutba, particularly along Wadi Hauran, Wadi Hussainiya and Wadi Amij. These formations are represented by the dominantly Carbonate Ubaid Formation and the Silisiclastic- Carbonate Succession of the Hussiniyate and Amij formations. These succession lies within the stable shelf of Iraq(Al Kaddhmi et al., 1996) Dunnington(1954 in Van Bellen et al., 1959) described the Ubaid Formation for the first time along Wadi Hauran in the Western Desert and assigned the Liassic age according to stratigraphic position. Al-Jumaily(1984) mentioned that the Ubaid Formation was deposited in a shallow lagoon changing upward to subtidal environment.

Al-Mubarak(1983) gave the name Hussainiat to the Upper Ubaid formation previously suggested by Buday and Hak(1980). Most geologists were concerned with the lower clastic unit of the Hussiniyat Formation due to its economic importance were substantial iron ore deposits were concentrated (Vasilev et al.,1965, Shocek et al.,1971;Jassim et al.,1981;A Hashimi,1981;Al Basam and Tamar Agha,1998) Buday andHak (1980) named Amij Formation for the sequence croppingout in the area between Wadi Hussainiya and Wadi Amij. .The aim of this study is to interpret the paleoenviromets of the Lower Jurassic succession and basin Development by using lithofacies and microfascies analysis, for this purpose five exposed sections were studied(fig.1)

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Stratigraphy

Detailed stratigraphic description of Ubaid carbonates and Silisiclastic-Carbonate Hussainyat and Amij formations in five exposed sections were carried out. In addition to microfacies analysis for the carbonate unit, and deposition of the clastic lithofacies.

1-Ubaid Formation

This formation varies in thickness from 95 in Wadi Hauran(Al Mubarak, 1983) to about 65meters in the area between Wadi Hussainya and Wadi Hauran. The formation grades laterally to the central part of Iraq into Butmah Formation with some different facies and lithology(Buday, 1980).In general the Ubaid Formation in the study area consist of dolomite rocks with chert nodules in the lower and upper parts and beds of marl and marly dolomitic limestone. The beds

shows evidence of bioturbations, fossiliferous in some places and stromatolite Structures.

Section U1

This section is located in Wadi Hauran about 2 km. west of Wadi Hyssainya with a total thickness of 21 meters (fig.2). It consists of grey to yellowish, hard marly limestone, it is overlained by pale grey, very hard, medium crystalline dolomite with stromatolite structures, followed by grey to light grey, laminated dolomite also with stromatolite structures and interbedded with yellowish friable marls. This is overlained by 3.5 meters of dolomite, its lower 2.5 meters is grey, very hard, jointed and laminated, the upper 1.0 meter is grey, marly dolomitic limestone with cavities and overlained by interbedded friable, yellowish marl with medium and hard weathered marly dolomitic limestone.

Section U2

The total thickness of this section is 26 meters (fig. 3), it lies about 5 km west of Hussiniya dam along Wadi Hauran. The lower 4m consists of hard grey fine crystalline bedded dolomite with chert nodules, grey fossiliferous dolomite, and followed by grey to pale yellow dolomite. The lower part is characterized by the presence of chert nodules becoming more common in the middle and upper parts, stromatolite structures and cavities are also common. .

2-Hussiniyat Formation

The Hussiniyat Formation is composed of two major units, the lower clastic unit and the upper carbonate unit, and it is underlained and overlained unconformably by the Ubaid and Amij formations successively.

The lower unit consist of different cycles of clay, siltstone and sandstone. These cycles can be shown in all studied sections. Different types of sedimentary structures can be recognized in this unit such as: fining upward, planar and trough cross stratification, ripple marks and parallel lamination, with iron pisolites especially in the lower part. Lateral variation in thickness and facies was observed in north and south outcrops. The upper carbonate unit of this formation is composed mainly of hard dolomites with bioturbation and fossiliferous in places. In the area of Hussiniya dam coastal plain sandstones were recognized which decrease in thickness towards the southwest.

Section H1

The total thickness of this section is 26 meters (Fig 4). It begins with yellowish to pinkish massive clay with iron concretions, followed by dark brown medium tough, laminated clay, overlained by brownish sandy clay and yellowish to brownish cross bedded sandstone, then fining upward brownish sandstone with iron pisolites. This is followed by whitish fine grained sandstone with planar cross stratification, overlained by interbedded clay and sandstones with clay lenses in the lower part, then overlained by pinkish to yellowish massive silty clay. This is followed by finning upward sandstone, overlained by thick bedded varicoloured fossiliferous dolomite with chert nodules, sandy in the lower part.

Section H2

This section was taken near the Hussiniya dam with a thickness of 42 meters (Fig 5) and starts with varicoloured (reddish, brownish and yellowish) laminated clay, followed by whitish poorly sorted sandstone with planar and trough cross stratification and fining upward trend, overlained by yellowish siltstone with iron posolites. Reddish and whitish clay alternation follows, This is followed by whitish to light grey pebbly friable sandstones with planar cross stratification and fining upward succession, overlained in turn by yellowish siltstone with iron concretions, followed by grey to pinkish clay and silty clay, this is overlained by friable yellowish to olive green marl and sandy marl with secondary gypsum in the lower part, followed by grey to pinkish massive dolomite, overlained by grey to yellowish sandy dolomite, fossiliferous in the upper part, followed by whitish to pale grey well sorted sandstone, then by grey to pale grey, very hard dolomite with chert nodules in the lower part.

3- Amij Formation

This formation was divided into two main units, the lower clastic unit and the upper carbonate unit (Buday and Hak, 1980). The lower unit consists of cycles of clay, silt, sand and sandy dolomite with sedimentary structures of planar, trough cross stratification, parallel lamination. The upper carbonate unit consists of varicoloured dolomite, sandy dolomite

and marl. The dolomite is hard containing gastropods and shells. The Amij Formation is underlained and overlained unconformably by the Hussiniyat and Muhaiwer formations successively (Al Mubarak, 1983).

Section A1

This section was taken through Wadi Amij with a total thickness of 16 meters (Fig 6) and begins with reddish, medium tough, massive clay, overlain by reddish to whitish sandstone interbedded with claystone, followed by reddish laminated siltstone with ripple marks, overlained by reddish oolitic grainstones, followed by interbeds of claystone, silty clay and siltstones, overlained by light brown very fine to medium sandstone, with parallel lamination, followed by reddish medium tough claystone. This is overlained by grey, hard sandy dolomite, followed by interbeds of claystone and laminated siltstone, followed by light grey planar cross stratified sandstone, reddish claystone and whitish fine well sorted sandstone. This is followed reddish to yellowish hard fossiliferous dolomite with abundant gastropods and bivalves.

Facies Analysis

1-Ubaid Formation

Microfacies analysis of the Ubaid Formation reflect deposition in different environments within the carbonate platform, these are: the restricted marine, shallow open marine and inner barrier environments.

Restricted Marine Environment

This environment is represented mainly by dolomitized mudstones interbedded by marls. These mudstone consist of crystalline and cryptocrystalline dolomite, few shell fragments were also observed as well as few sand grains within the lower part of the formation.

Shallow Open Marine Environment

This environment is represented by dolomitic bioclastic wackestones which is characterized by the abundance of mollusc fragments and complete shells with other fossils (foraminifera and ostracods). The molluscs are mainly bivalves and gastropods, the internal cavities of shells are mostly filled by micrite. The matrix is slightly dolomitized. This microfacies indicates deposition in shallow marine conditions with open circulation. .

Inner Barrier Environment

This is represented by dolomitic peloidal grainstones and dolomitic bioclastic peloidal packstones. The dolomitic peloidal grainstone microfacies is recognized in surface and subsurface sections containing a high percentage of peloids, these peloids are subrounded to elliptical ranging in diameter between 0.1-0.25mm. The internal structure is unclear, most of them are believed to be formed by micritization of allochems, especially ooids and bioclastics (Bathrust, 1976).

Depositional Environment

Microfacies analysis and facies stacking pattern of the Ubaid succession reflect deposition within a slowly subsiding carbonate platform. In the study area this platform represents a ramp setting where deposition of the Ubaid took place. In such a setting a relatively thick succession of inner ramp restricted marine facies can develop (Ahr, 1989). All the relative sea level fluctuations can be reflected in the facies stacking pattern (Fig.7), this was also reflected by the effect of the shifting mixing zone on the sediments, where intense dolomitization characterizes the Ubaid section in this area.

2-Hussiniyat Formation

-Lower Clastic Unit

Lithofacies analysis of this unit reflects deposition within a meandering river system, several lithofacies were recognized, and these include channel facies, point bar facies and floodplain facies. Coastal plain facies can also be recognized within the lower part of the upper carbonate unit.

Channel Facies

This facies is represented by pebbly pisolitic sandstones with planar and trough cross stratification. These sandstones are medium grained, moderately sorted. They consist mainly of iron pisolits as the major component in addition to quartz. This facies was observed in all sections at Wadi Hussiniya(Fig.8,9) .

Point Bar Facies

This facies is represented by coarse to fine grained, subrounded to rounded sandstones with a clear

fining upward trend. Planar and trough cross-stratification characterizes this facie . This type was observed in the section at the northern part of Wadi Hussiniya (Fig.9). .

Flood Plain Facies

The floodplain facies is characterized by grey to red colored laminated mudstones, rich with iron concretions especially in the southern part of Wadi Hussiniya . These mudstones consist mainly of kaolinite with abundant plant remains mostly in the lower part of the section. Thin sandstone and siltstone beds are also interbedded within this facies. .

Coastal Plain Facies

This facies is represented by light grey, fine to medium grain, wellounded and well sorted sandstones, characterized by planar cross stratification . It may reflect deposition within the upper shoreface (beach ridge). This facies was observed within the lower part of the Hussiniyat upper carbonate unit at the northern part of Wadi Hussiniya (Fig.9).)

-Upper Carbonate Unit

Microfacies analysis of the upper carbonate unit reflects deposition in various shallow marine subenvironments; these include the restricted marine, inner barrier and shoal environments . .

Restricted Marine Environment

This environment is represented by interbedded mudstones and marl units, sandy in places. Few shell fragments can also be observed in these mudstones. This microfacies was completely dolomitized forming a massive dolomite unit .

Inner Barrier Environment

The inner barrier facies is characterized in the studied sections by dolomitic peloidal packstones, this microfacies is characterized by the abundance of oval and subrounded peloids (up to 60%) as well as few shell fragments, the matrix is completely dolomitized. .

Shoal Environment

This environment is represented by dolomitized oolitic grainstones, these oolites consist of several layers with radial structure indicating deposition in a high energy environment where grainstone shoal formed.

Depositional Environment

Lithofacies analysis of the exposed Hussiniyat sections in the study area (Fig. 8,9) reflect deposition in a fluvial environment for the lower clastic unit, where the succession of floodplain, channel deposited, and finning upward point bar facies reflect a low gradient alluvial plain characterized by a very low rate of subsidence . This was indicated by the fact that the migrating channel deposits approximates to a one channel thickness (up to 10m), this also reflects deposition in a proximal setting in the absence significant subsidence .

Microfacies analysis of the upper Hussiniyat carbonates may reflect deposition on a slowly subsiding gentle carbonate ramp characterized by predominantly restricted marine conditions. Thin inner barrier and shoal facies were deposited in an area of high wave energy. At the section in the northern part of Wadi Hussiniya (Fig.9); the lower part of the carbonate unit is interbedded with thin coastal plain facies, this may indicate deposition in a proximal area near the shoreline with lower accommodation rates .

3- Amij Formation

The Amij succession of Western Iraq consists of a lower clastic unit with few carbonate interbeds and an upper carbonate unit. This succession consists of a wide range of lithofacies reflecting the different subenvironments of fluvial, transitional and shallow marine condition

-Lower Clastic Unit

Lithofacies analysis of the calstic unit was carried out in order to interpret the different depositional environments. Fluvial environment is represented by different floodplain facies. The coastal plain environment on the other hand is represented by the upper shoreface. Microfacies analysis of the carbonate interbeds reflect deposition within beach barrier and restricted shallow marine environments.

Flood Plain Facies

This facies is characterized by red-brown to pale yellow mudstones, silty mudstones and siltstones with parallel lamination. Some lenses of siltstone can be observed in the middle part of this unit. It may represent over bank, natural levee and creavese splay deposits. .

Coastal Plain Facies

This facies consists of white to light grey, fine to medium grained sandstones, they are well sorted and well rounded with parallel and cross stratification. Bands of heavy mineral concentrations are abundant reflecting the effect of high wave energy of swash zone alternation on the upper shoreface (Gayara and Al-Ubaidy, 2000).

Beach Barrier Environment

This is represented by dolomitized oolotic grainstones which is composed of fine superficial oolites with dolomitized cement . Some shell fragments of molluscs were also observed. This microfacies was recognized in all surface sections reflecting wave dominated environment along the shoreline forming beach ridges.

Restricted Shallow Marine Environment

This environment is represented mainly by dolomitic mudstones with few sand grains especially in the middle part of the clastic unit and lower part of the carbonate unit. Fine dolomite crystals were emplaced within the micrite

- Upper Carbonate Unit

According to microfacies analyses of the upper carbonate unit, three main depositional environments were distinguished, these include restricted marine, shallow open marine and shoal environments

Restricted Marine Environment

This environment is represented by dolomitic mudstones, the matrix is slightly dolomitic, with few shell fragments. This microfacies reflects deposition within restricted bays and ponds where quiet slow deposition took place along the tidal flat area (Wilson,1975).

Shallow Open Marine Environment

This is represented by dolomitic bioclastic wackestones, these bioclasts consist mostly of shell fragments (gastropods, bivalves, and foraminifera), they are coarse grained emplaced within dolomitic micrite

Depositional Environment

Lithofacies analysis of the Amij succession in the study area (Fig.10) reflects deposition in fluvial, coastal plain and shallow marine environments. The clastic unit of the Amij Formation shows a facies stacking pattern typica of fluvial facies in a proximal area .

It also represents a meandering or anastomozing river system characterized by scattered channel deposits where fine floodplain deposits makes up the bulk of sediments in this area. The floodplain facies are interbedded with thin units of the beach barrier grainstones and coastal plain sandstones as well as the restricted marine facies.

This may reflect deposition on a low gradient alluvial plain subjected at times to the effect of high wave energy along the shoreline where the coastal plain facies were deposited in this area of low rate of subsidence and relatively low accommodation. The upper carbonate unit is represented by a predominantly dolomitized restricted marine facies, and also reflect deposition on an inner ramp setting.

Conclusion

The Lower Jurassic Silisiclastic-Carbonate succession in Western Iraq are represented by Ubaid, Hussiniyate and Amij formations, reflect deposition within various environment. Microfacies analysis of the Ubaid Formation reflect deposition in different shallow marine environment, from the restricted marine, shallow open marine, and inner barrier. These are represented by dolomitized mudstone, dolomitic bioclastic wackestone, dolomitic bioclastic packstone and dolomitic peloidal grainstone

Lithofacies identified within the lower unit of the Hussiniyat Formation include, channel facies, point bar facies and floodplain faces, the reflect a very low gradient meandering river system. Coastal plain facies were also recognized. Three carbonate microfacies can be recognized within the upper Hussiniyat carbonate, these include; dolomitized mudstones, dolomitic peloidal packstones and dolomitized oolitic grainstone, they reflect deposition in restricted marine, inner barrier and shoal environments, Coastal plain sandstones were also recognized within the lower part of this unit.

The lower clastic unit of the Amij Formation is typical of fluvial facies and represents a meandering or anastomozing river system. It is characterized by scattered channel deposits within the floodplain and interbedded withthin units of beach barrier(oolitic grainstones), coastal plain facies and restricted marine facies which may reflect deposition in a proximal area

where low gradient alluvial plain was subjected at times to the effect of high wave energy along the shoreline. The upper Amij carbonate unit represents deposition within restricted marine condition. The early Mesozoic New-Tethys opening and onset of the Meditirranean rifting initiated uplifts and grabens in the Arabian plate. The activity of the Putaba uplift and graben during the Early Jurassic greatly affected the paleogeography of the basin in the study area

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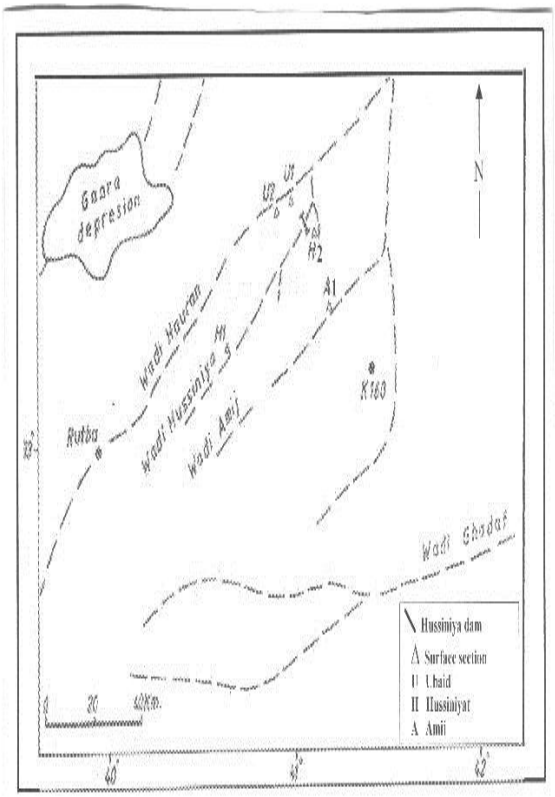
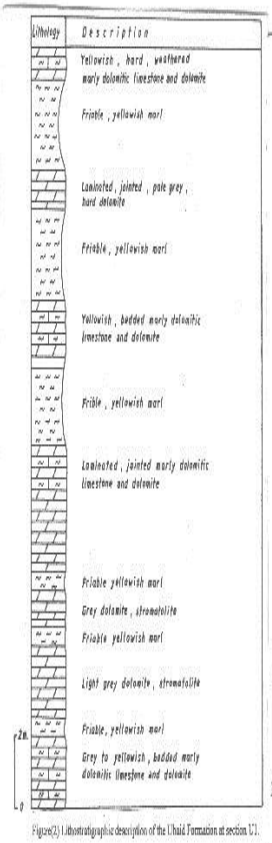
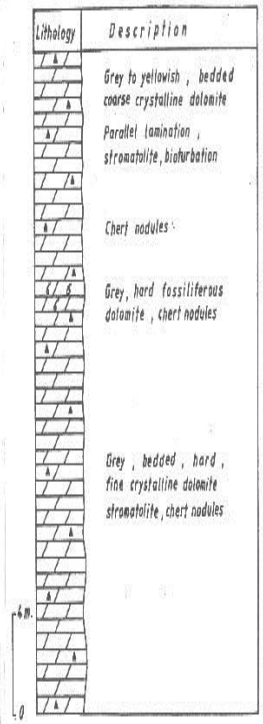


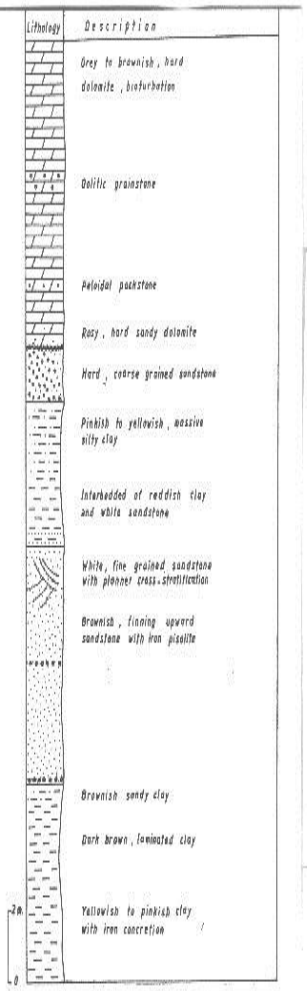
Figure (1) location map of the exposed studied sections in the study area



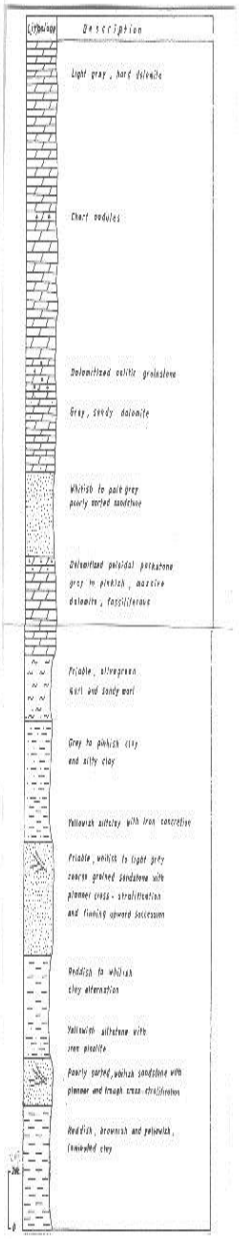
Figure(2) Lithostratigraphic description of the Ubaid Formation at section U1.



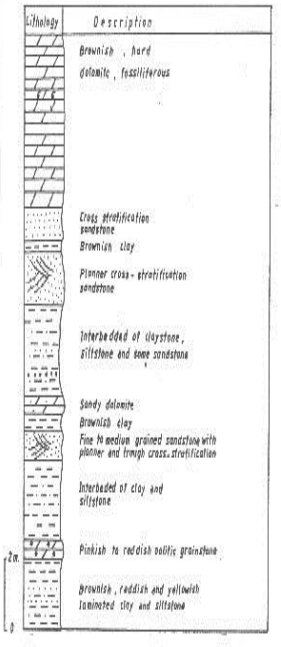
Figure(3) Lithostratigraphic description of the Ubaid Formation at section U2.



Figure(4) Lithostratigraphic description of the Hussiniyate Formation at section H1.



Figure(5) Lithostratigraphic description of the Hussiniyate Formation at section H2.



Figure(6) Lithostratigraphic description of the Amij Formation at section A1.

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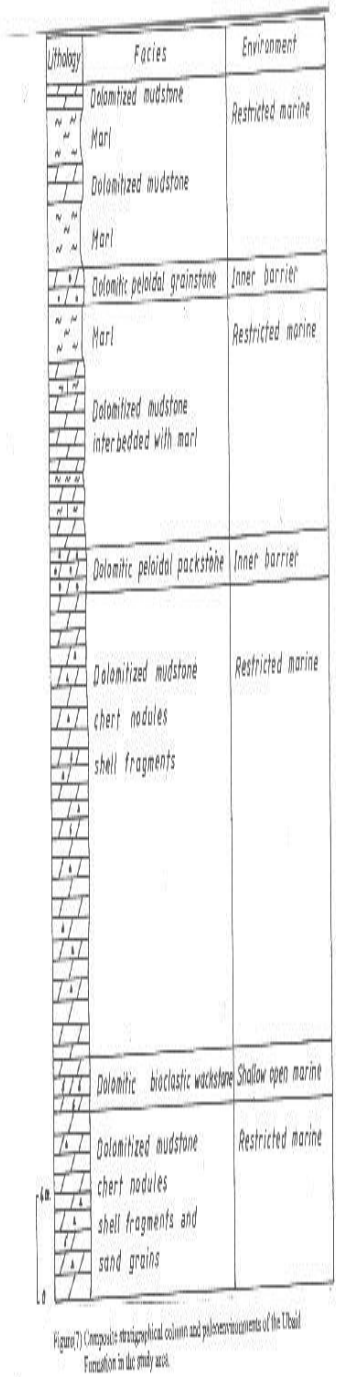
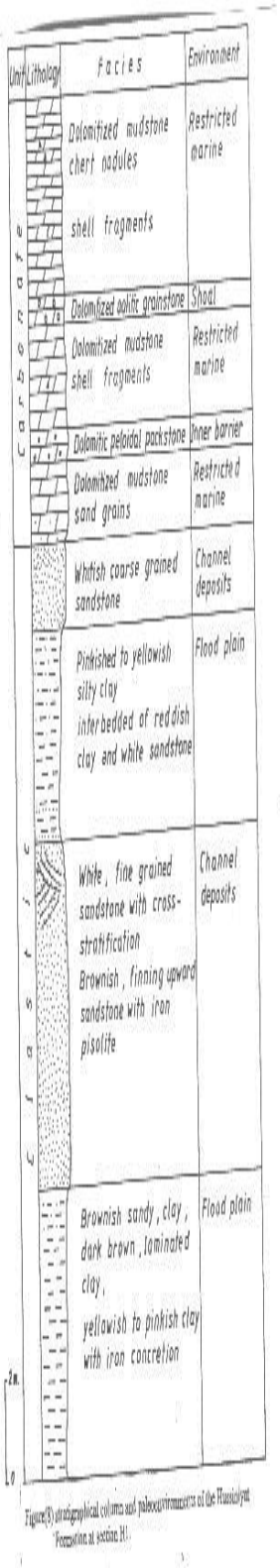
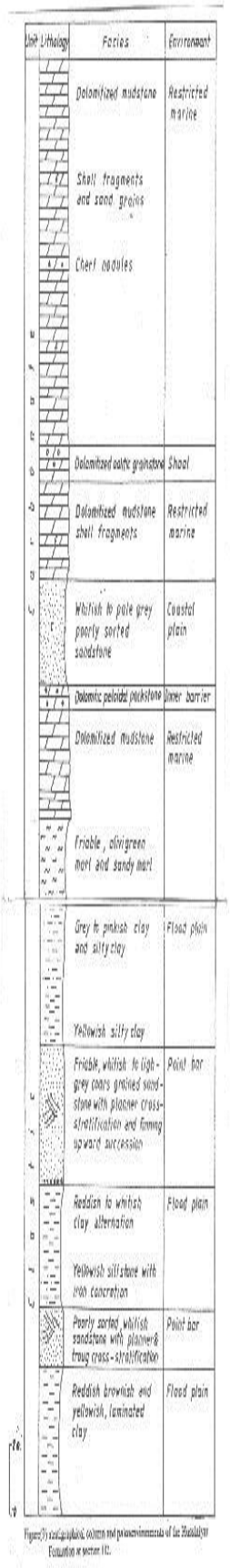


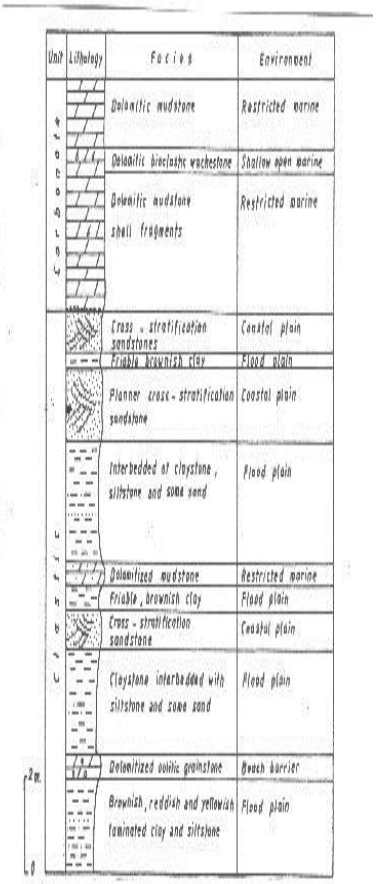
Figure(7) Composite stratigraphical column and paleoenvironments of the Ubaid Formation in the study area.



Figure(8) stratigraphical column and paleoenvironments of the Hussainiyat Formation at section H1.



Figure(9) stratigraphical column and paleoenvironments of the Hussainiyat Formation in section H2.



Figure(10) stratigraphical column and paleoenvironments of the Azaij Formation at section A1.

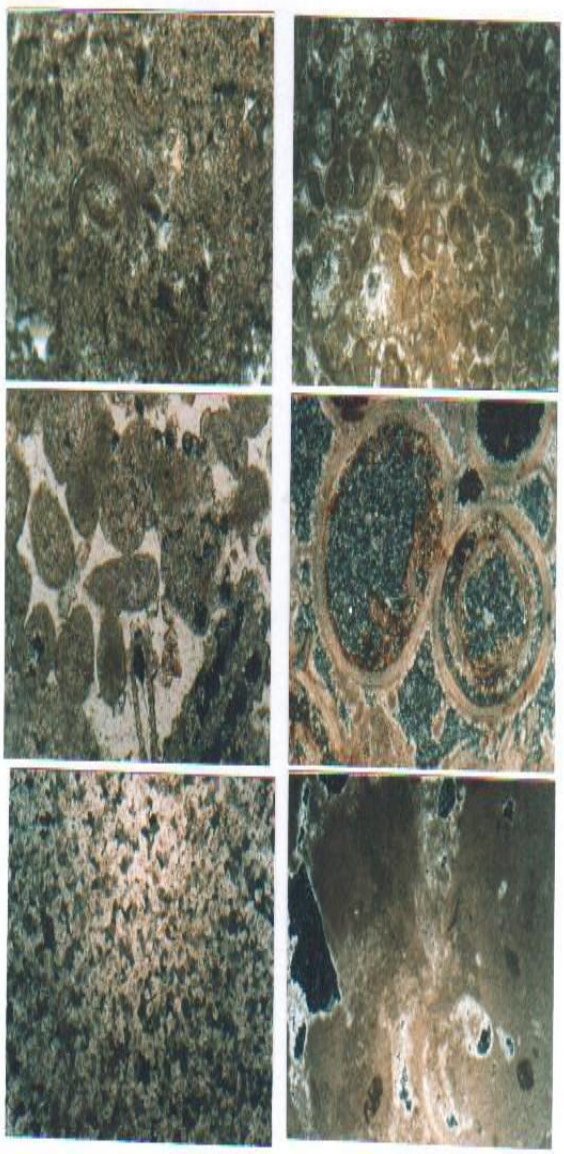


Plate I

A- Dolomitized mudstone with few sand grains, Ubaid Fn. 40X.
B- Dolomitic peloidal grainstone with subrounded to elliptical peloids,Ubaid Fn.10X.
C- Dolomitic peloidal packstone with oval to elliptical peloids. Hussiniya: Fn.40X
D- Dolomitized oolitic grainstone,Hussiniyat Fn. 40X.
E- Dolomitic mudstone. Amij Fn. 10X.
F- Dolomitic bioclastic wackestone with few shells of bivalves and gastropods. Amij Fn.10X.

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التحليل ألسحني والبيئات الترسيبية القديمة للتتابع ألفتاتي- الجيري للجوراسي الأسفل- غرب العراق

عامر سعدي صالح **علي داود كياره**

الخلاصة:

يتمثل التتابع ألفتاتي–الجيري للجو راسي الأسفل غرب العراق بتكاوين العبيد والحسينيات والعامج ،وقد أظهرت الدراسة السحنية للصخور الفتاتية بالإضافة إلى دراسة السحنات المجهرية للصخور الجيرية أنها ترسبت في عدد من البيئات الترسيبية . تكوين العبيد ترسب في عدد من البيئات ضمن المصطبة الجيرية. أما تكوين الحسينيات فأن الوحدة الفتاتية السفلى ترسبت ضمن النظام النهري ألالتوائي وبعض أجزاءه قد ترسبت في البيئة الشاطئية. تكوين العامج ترسب في البيئات النهرية والانتقالية والبيئة البحرية الضحلة.يعتبر مرتفع الرطبة ومنخفض عنه من أهم النشاطات التكتونية التي أثرت بشكل مباشر على الجغرافية القديمة للحوض الترسيبي خلال فترة الجوراسي الأسفل.