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Biostratigraphic of Mishrif Formation , Southern Iraq .

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اقرار المشرف

أشهد بان موضوع البحث الموسوم..... والمنجز من قبل الطالب .....قد اجري تحت اشرافنا في قسم علم الارض كلية العلوم جامعة بابل كمتطلب جزئي لنيل شهادة البكلوريوس في علوم الارض وذلك للفترة من 2023/10/1 ولغاية 2024/4/1

التوقيع:

الاسم الثلاثي للسيد المشرف

اللقب العلمي:

التاريخ:

بسم الله الرحمن الرحيم
يرفَعُ اللهُ الذينَ أمَنوا منكم والذينَ أوتوا العلم
درجات واللهُ بما تعلمونَ خبير
صدق الله العظيم

)) الآية 11 ((سورة المجادلة

الاهداء

وصلت رحلتي الجامعية إلى نهايتها بعد تعب ومشقة... وها أنا ذا أختم بحث تخرجي بكل همة ونشاط. وأمتن لكل من كان له فضل في مسيرتي، وساعني ولو باليسير ،

إلى من أفُضِّلها على نفسي، ولِّمَ لا؛ فلقد ضحَّت من أجلي ولم تدخَّر جُهداً في سبيل إسعادي على الدوَّام)أ مِّ ُي الحببية(. نسير في دروب الحياة، ويبقى من يسُيطر على أذهاننا في كل مسلك نسلكه صاحب الوجه الطيب، والأفعال الحسنة. فلم يبخل عليَّ طيلة حياته)والدي العزيز(. إلى أصدقائي، وجميع من وقفوا بجواري وساعدوني بكل ما يملكون، وفي أصعدة كثيرة أقُدِّ م لكم هذا البحث، وأتمنىَّ أن يحوز على رضاكم.

شكر وتقدير

اقدم شكري الجزيل الى عميد وعمادة كلية العلوم جامعة بابل لرعايتهم العلمية والتربوية القيمة طيلة فترة دراستي وإنجازي بحث التخرج.

شكري وتقديري العميق الى الاستاذه مها رزاق على ذلك الاشراف على هذا البحث ولها اقتراحات ومساعدتي للتغلب على الكثير من العقبات التي واجهتني طوال هذا الدراسه

كما أود أن أشكر رئيس قسم علم الارض التطبيقي الدكتور مهند راسم عباس الجبوري على تشجيعه المستمر ومتابعته مراحل انجاز البحث.

والشكر موصول الى جميع أساتذة القسم الذين بذلوا كل جهد ووقت وعلم طيلة فترة اربع سنوات مدة دراستي في القسم، والذي تمكنت من خلالهم انجاز بحث التخرج المتواضع هذا.

اقدم امتناني ومحبتي الى جميع زملائي الذين رافقوني فترة دراستي في قسم علم الارض وخاصة الزملاء الذين دعموني في انجاز العمل الحقلي لبحث التخرج.

واقدم الشكر والتحية لجميع المعيدين والموظفين في القسم لجهودهم العلمية والعملية الرائعة طيلة فترة دراستي في القسم..

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Abstract

The late Cretaceous (middle Cenomanian-early Turonian) succession of the Mishrif Formation in southeastern Iraq was studied and interpreted using biostratigraphic concepts. The study includes two oil wells Amarah-1 and Majnoon-1- , where 30 thin sections have been used for litho- and biostratigraphic studies.Two biozones have been distinguished within the studied succession : ***Praealveolina cretacea*** partial range zone , and

Praealveolina tenuis range zone.

The diagenetic processes affecting Mishrif Formation in the study area include :

Cementation , micritization , dissolution , stylolization , compaction, neomorphism & Dolomitization .

CHAPTER ONE

1- Introduction

Mishrif Formation is one of the most important Formations in Iraq , both economically and geologically which was deposited during the Cretaceous period in the secondary sedimentary cycle(Cenomanian-early Turonian) and is regarded as the principal carbonate reservoirs in central and southern Iraq .

The Cenomanian Mahilban,Maotsi and Fahad carbonate formations of central Iraq are the lateral chronostratigraphical equivalent of the Mishrif , and equivalents of both Mishrif and Rumaila Formations southern Iraq. These units together represent single mid-cretaceous carbonate succession in the Mesopotamian basin. The Mishrif Formation, part of Wasia group (Al-Sharhan and Narin.1988) is a carbonate succession wide spread out through the Arabian Gulf. The Mishrif Formation in central Iraq reflects the continuous deposition of shallow shelf carbonates periodic rises in sea level which have led to episodes of deeper sedimentation down.

1-2 Aim of study:-

1- Studying the fossils of previously prepared thin sections of wells Amarah-1 and Majnoon-1 (15 core samples).
2- Delineating the possible biostratigraphic zones.

1-3 Procedure of the work :-

Using a polarized microscope to define petrographic . Also the work was based on a detailed foraminifera identifiedcation

1-4 The study area :-

The study area is located within the Maysan city in southeastern Iraq around the city of Amarah, fig (1-1) which includes two oil wells (Amarah-1) and Majnoon-1 According to the tectonic zones of Iraq (Al-Kadhimi et al., 1996) the study area is located on the unstable shelf. Fig (1-2)

Well No.	Coordinates	Bottom	Top
Amarah-1	695 300 E 3519 250 N	2870	3228

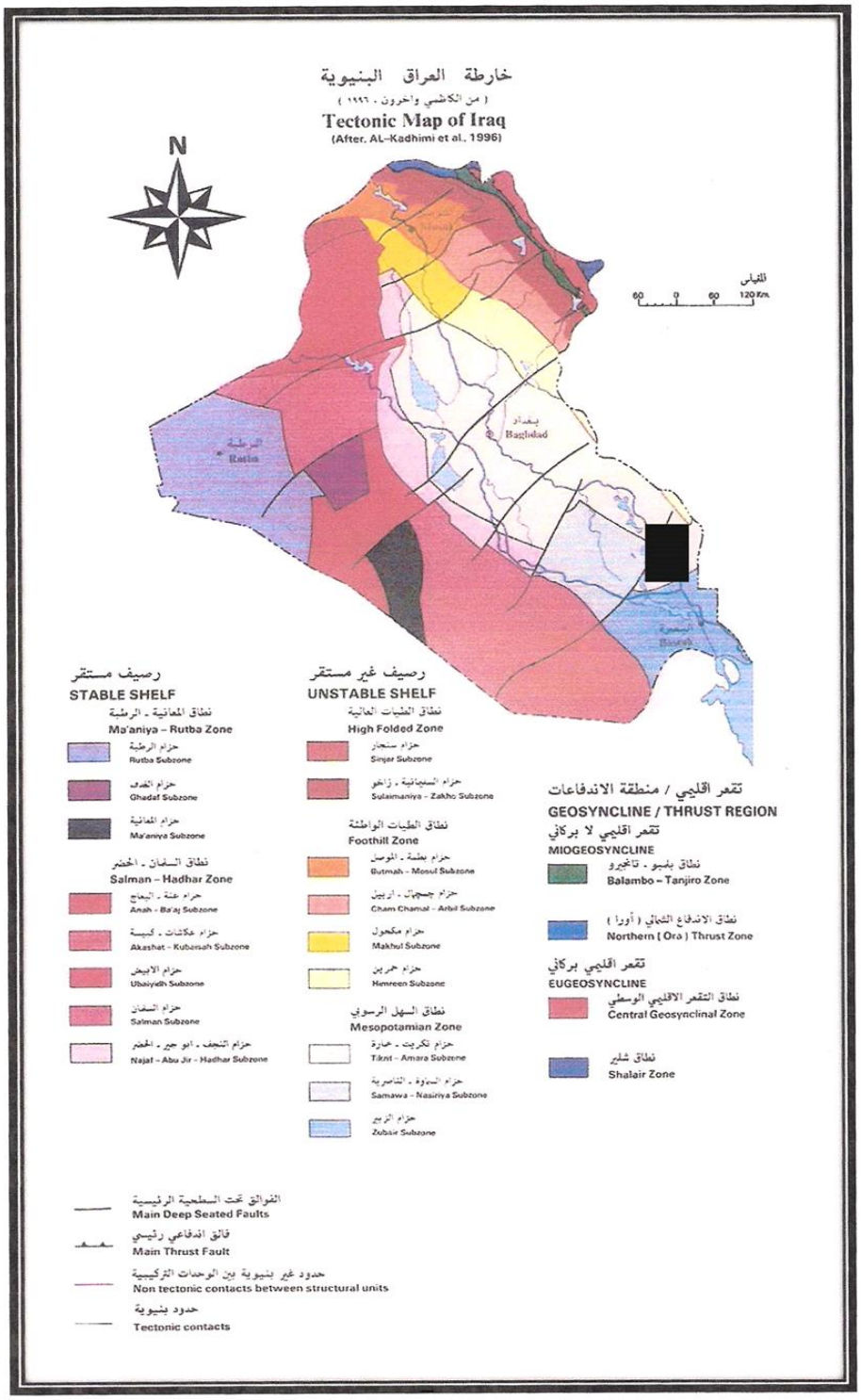
Majnoon-1	747 247 E 3446 656 N	2610	2374

Table-1: Location, top and bottom of Mishrif Formation of the study area

1-5 Palaeogeography :-

The aerial distribution of the Mishrif Formation shows two high-energy belts oriented NW-SE, parallel to the axis of the Mesopotamian Basin .The first belt is where the Mishrif Formation is thickest in the east of the basin along the Amarah palaeo-high .The Formation includes three rudist bearing units with several pay zones; two of these units are located within the upper sequence while the third is at the lower of the sequence.(Aqrawi , 1998)

The second belt is of high-energy facies and is located in the west of the basin; it consists only of a single rudist-bearing unit (with a few pay zones) within the lower sequence. This facies belt is near to the end parallel with the palaeo-shoreline; sub sidence rates on this side of the basin appear to have been relatively low. The two belts are separated by one intervening area dominated by shallow open-marine conditions. This area was connected to deeper water basinal area to the NE. This connection led to the deposition of thick open marine outer shelf deposits rich in planktonic foraminifera which overlies inner-shelf bioclastic deposits in the western and SW wedge-out belt of the rudest bearing units in the lower sequence from reservoir rocks. (Aqrawi *et al*, 1998)



fig(1-2)Tectonic map of Iraq show the study area

1-6 Sedimentological and stratigraphical status of the Mishrif Formation :-

The Mishrif formation was deposited within the subcycle (cenomanain-lower turonian),in which Rutbah formation deposited in the western parts of the basin and the facies graduated into Ahmadi formation then Rumaila formation in the deep parts of the basin.The Mishrif Formation on the other hand was deposited in a shallow neritic environment. In the late stages of this cycle ,Kifl evaporate Formation was deposited in the centeral part of the basin,where it formed a cover of evaporate rocks on Rumaila Formation and some parts of Mishrif Formation (AL-Khersan,*et.al*,1993).

Many researchers (Chatton and Hart,1961:Buday,1980)believed that Mishrif Formation was deposited on uplifted ridge or detached platform located to the north of Rumaila and Zubair oil field and extended from south of Kuwait towards north of Omara-Dujaila,Samara-Khleisia and to AL-Gharaf and Nasyria westerly.

This ridge divided the main basin into two parts; one part is located to the north east of this ridge called Balambo basin and the other at southeast of the ridge and extended from west of Rutba Uplift and is called Rumaila basin where its northern borders extended to Tikrit.

It is believed that this ridge was the result of tensile forces which dominated this part of Arabian plate which led to form fault inside the main basin together with subsidance and uplifting of some faulted blocks which led to the formation of this ridge (AL-Khersan,*et al*,1993).

Good reservoir characters of the formation result from the fact that its rocks contain the remnant of rudist skeletons and skeletone of calcareous algae,echindermata and shells of foraminifera , pelloides which gave the rocks of this formation good porosity and permeability. These reefal-skeletal faceis were interfingered ,in the southern ,western and northern parts with basinal or sub-basinal facies of Rumaila and Ahmadi formations to increase the possibility of forming oil stratigraphic traps in the location where such intertunging is present , (Al-Khersan , 1973 and Al-Khersan , *et.al*,1993) .the Mishrif Formation is equivalent the upper part of Magwa Formation in Kuwait (Owen and Naser,1958), the Sarvak Formation in the Zagros(Frust.1970), the lower part of Judea Formation in central and NE Syria (Ponikarvo,1967;Dubertret,1966). and the Mardin Formation in SE Turky (Beer 1966 and Weber,1963).

1-8 Previous studies:

The description of Mishrif Formation for the first time was given by (Rabanit,1952)in well Zubair-3 from the upper part of what was previously called Khatiyah Formation, which was divided later on into three separated formations , i.e.,Ahmadi ,Rumaila and Mishrif Formation . The formation was studied by Smout (1956) and Fox (1957).In (1958) Owen and Naser described the lithological cross-section of this formation in well Zubair-3; they considered it as a typical section.

Chatton and Hart(1961) studied the stratigraphic section of the Cenomanian-Turonian deposits and believed that Kifl evaporative (anhydrite) Formation is, in terms of time, equivalent to Mishrif Formation in its upper part and it represents late facies that deposisted in basins towards the end of marine regression. James & Wynd(1956) studied Sarvak Formation in Iran and they considered the upper part as representative of the typical Mishrif facies in Iran.

Al-Naqib (1967) studied Mishrif Formation and suggested that most of its rocks are limestone and contain small shale in some places and remnants of fossils and peloids.

Chatton and Hart(1961), Al-Naqib (1967) and Sherwani (1983) agreed to cancel Fahed , Mawtssi and Muhalban, putting them in Mishrif and Rumaila Formation ; Sherwani (1983) found that the lower part of Muhalban Formation was similar to Rumaila Formation in its' facies (lithologically and paleontologically) , .

Owen & Naser (1958) and Al-Naqib (1967) believed that the upper part of Wasia group in Saudi Arabia represents the time equivalent to Mishrif Formation .

EIf – Iraq company (1970) studied Mishrif Formation in Buzergan oil field southeast of Iraq ,Its biostratigraphy , depositional environments and reservoir specifications . They also studied the formation in Fuqa oil field , analysing its biostratigraphy and facies analysis .

Gaddo (1971) divided the depositional environment of Mishrif Formation into rudist marine reef environment which interferes with lagoon littoral – lake environment , algal facies with facies of basinal and sub – basinal environment .

Al-Khersan (1973) believed that Mishrif Formation was deposited within five marine environments ; they are intertidal , littorial , banks margins , banks and open sea environments .

Al- Siddiki (1978) studied Mishrif Formation in southeastern part of Iraq and he indicated that the formation is composed of limonite limestone , brown limestone and mud limestone .

Agip company (1980) studied facies and environment of Mishrif Formation in Halfaya field and draw a sedimentalogical and environmental model for this

formation in the studied area .

Rulet (1982) studied Mishrif Formation in south of Iraq,Its facies , depositional environment and reservoir specifications .

Belarabi (1982) studied depositional environments and facies distribution of the formation in south of Iraq .

Sherwani (1983) divided Mishrif Formation into five depositional environments .

Al- Nuaimy (1990) studied genres and types of large Foraminifera which include Alveolindne and their different kinds in Mishrif Formation .

Al-Therb (1996) studied the biostratigraphy and facies of the Formation with age (early Cenomanian – Turonion)in south of Iraq which includes Mishrif Formation .

Al- Jumaily (2001) studied Mishrif Formation in selected oil fields in south of Iraq , its facies and depositional environment and introduced a table indicating the horizontal and vertical relation for Albain – Turonian Formations .

Mahdi (2004) studied the sequence stratigraphy of Mishrif Formation in selected wells in the south of Iraq .

Al- Khaldi (2004) studied the reservoir specification and determined the effective porosity of the formation in Halfaya field southeast of Iraq .

Al- Ubaidy (2004) studied facies development , diagensis processes and sedimentological cycles of Mishrif formation .

Al-Kilaby (2009) studied Mishrif Formation in Abu Ghirab and Fauqi field , its porosity and reservoir characters .

Al-Rubiay (2009) studied the Sequence Stratigraphy in the wells of west Qurna and north Rumaila oil field, south of Iraq .

Chapter Two

Petrography

2-1 Preface

The carbonates of the Mishrif Formation in southern Iraq consist of various skeletal grains such as foraminifera (of different size),echinodermal plates,ostrocods and shells of mollusca (mainly rudists), non-skeletal grains components which are restricted to peloids,intraclasts and ooids . Facies description based on classification of Dunham (1962) modified by Embry and Kloven (1972). Fig(2-1)

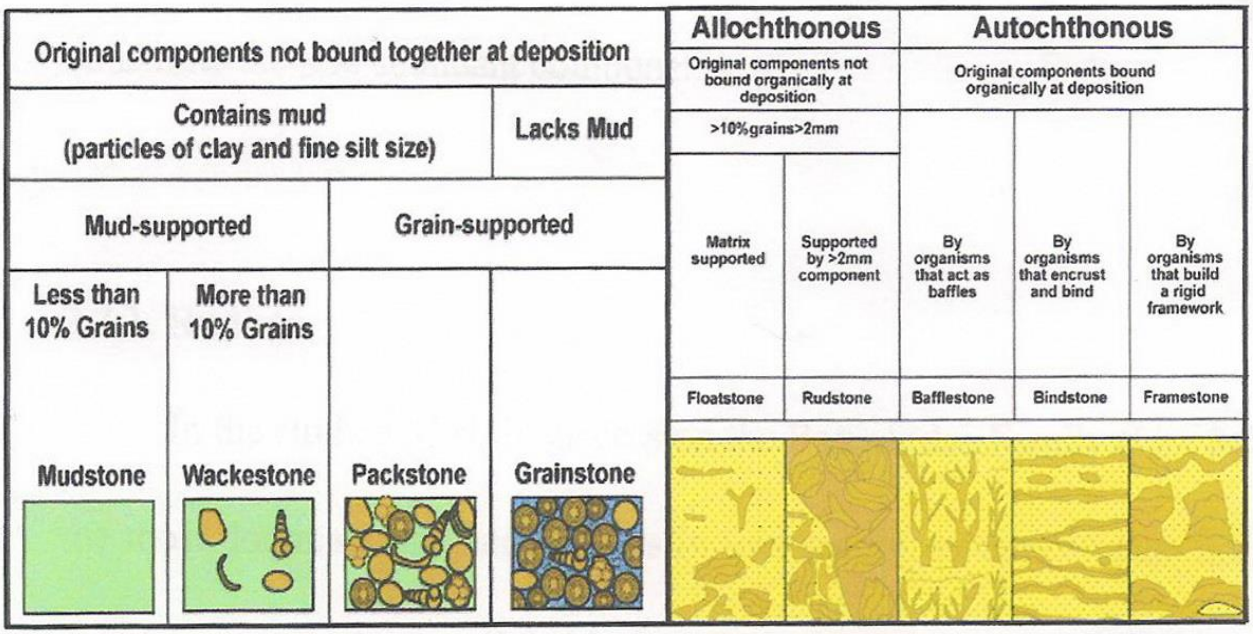


Figure (2-1) The classification of carbonate rocks (after Embry and Klovan, 1971).

2-2 facies elements :-

The texture of carbonate grains consist of two elements;carbonate grains and the matrix.

2-2-1 carbonat grains:-

Carbonat grains of the Mishrif Formation in the study area could be divided into two types:-

2-2-1-1 Skeletal grains:-

The Skeletal parts of organisms are commonly composed of calcite , magnesium calcite , aragonite or opaline silica . This mineralogy determines the susceptibility of the skeletal fragment to digenetic changes and so its current composition and fabric in a limestone or dolomite . Calcite skeletal grains , which contain less than 4 mole % magnesium in the calcite , include some foraminifera , ostracodes , and calcareous nannoplanktonic . Skeletal grains of magnesium calcite , that is with 4-20 mole % magnesium in the calcite, include those produced by echinoderms , foraminifera , and red algae . Aragonite skeletal grains are formed from corals , molluscas , green algae , and blue –green algae . Skeletal grains of biogenic opaline silica include spong spicules and radiolarians .(Flugel,2004), the skeletal grains of the Mishrif Formation are variable and are a bundant within all the three sections and they are : foraminifera (benthonic, planktonic), rudist, ostrocoda, echinoderms , corals, calcispheres .

a-Benthic Foraminifera:-

Benthic foraminiera are of various sizes and considered to be the most common skeletal grains in the Mishrif Formation . In the inner-shelf depositional unit, most of the benthonic foraminifra are complete,but usually highly altered by diagensis which makes them difficult to identify.

There are a lot of benthic species in the study area such as:-

*Praealveolina cretacea (*D´ARCHIAC *). Praealveolina tenuis* REICHEL,*Nezzazata simplex*(OMARA),*Nezzazata conica* (SAMOUT) ,Iraqia sp. ,*Biconcave bentori* HAMOUI , *Biloculina sp .Chrysalidina gradata* D´ORBIGNY *, Cisalveolina fallax* REICHEL

Cycledomia iranica(HENSON) Dicyclina schlumbergeri MUNIER - CHALMAS *,lenticulina macrodisca (REUSS),Multisparina iranensis* REICHEL*,N.convexa(SMOUT),Nummoloculina heimi* BONET*,Nummoloculina sp.,Orbitolina sp.,Orbitolinopsis sp.,Ovalvulina ovum(*D´ORBIGNY*),Praealveolina simplex REICHEL ,Pseudoliuonella reicheli* MARIE

Pseudotextulariella sp., Pseudorhapydionina dubai(DECASTRO),Qataria dukhani HENSON,*Quniqueloculina sp*.,*Spiroplectammina sp*.,*Tabrina bingistani* HENSON.

b. Planktonic Foraminifera:-

Planktonic foraminifera are common. but with the main restriction to the outer-shelf depositional unit. Plate.1 (fig.)

Hedbergella washitensis, *Hetrohelix* globules and various Oligosteginids are the dominant planktonic forms , which are very common in the lower parts of the Mishrif Formation that rests gradationally on the underlying Rumaila Formation(Ahmed,1979 and Aqrawi and khaiwka,1986 and 1989). These planktonic faunal assemblages are usually interpreted to indicate low-energy, open marine, outer shelf depositional environment below wave-base (flugel 1982).

c- Rudist:-

Rudists are good environmental indicators which interpreted to indicate patch-reef and fore-reef slope settings.In the studied Mishrif succession the Rediolitdae family is the most dominant one which appears in thin section as noncompact, normal cellular structure with radial ridges or folded ridges.(Mahdi, 2004), in this study it was able to define the rudist with the same mentioned features .

Most of rudists were found as debris, especially in the middle part of the Mishrif Formation and were associated with other components especially benthonic foraminifera,corals,and some echinoderms plate .The size of animal shells range from some cenetemeters to(1)meter(Moor *etal*,1952) (Wilson,1975) . The rudist is regarded as a biological builder of carbonate rocks.

e-Echinoderms:-

Echinoderms are composed of many individual magnesium calcite plates. The plate fragment and spines are scattered through the marine sediments of reefs, shallow shelves and deep-sea basins .Individual echinoderms plates

and spines from are easy to identify in thin section because the entire fragment extinguishes with cross-polarized light .

f- Corals:-

Reef-building corals thrive in shallow warm waters of normal marine salinity, but tolerate a wide range of temperature and salinity. Corals are important contributors to the growth of carbonate platefrom margines because of their rapid growth rates in reef settings and their ability to produce large amounts of sediment.Stony solitary or colonial corals have similar calcareous skeletons with basic skeletal element of aragonite or calcite fibres. (Tucker , 1985)

g- Calcispheres are small hollow spheres that may be fruiting bodies of certain green algae . The spheres apparently were to accumulate in quiet settings like intraplatform basins.

2-2-1-2- Non-skeletal grains

a- Peloids:-

Peloids are the main non-skeletal grains in the Mishrif Formation and range in size from silt to sand grade.Some peloids are probably micritized ooid were recorded in the Mishrif Formation in southern Iraq by Al-Khersan,(1975) and Sherwani(1983). Peloids occur in packstones and wackstones and are characterstic of shoal and subtidal enviroment respectively (Flugel 1982,Tucker and wright 1990).

.b- Intraclasts:-

Intraclasts are less common than peloids and are present in low percentages in peloidal and bioclastic wackestones and packstones.Intraclasts are interpreted to be reworked grains within the subtidal and intertidal parts of the Mesopotamian basin arising from current agitation . (Aqrawi *et al*, 1998) .

2-2-2 Ground mass:-

2-2-2-1- micrite:-

A large volume of any limestone is usually composed of carbonate mud or micrite because of the small size of the grains or crystals in the micrite .Identification of their origin is difficult to impossible.The grain size boundary between sand and mud that is used by geologists for carbonates varies ;for instance,Dunham(1962)puts it at 0.02 mm and Folk (1965) .04mm.

Micrite may be precipitated chemically or biochemically from seawater,

derived from the abrasion of pre-existing calcium grains, or form during disintegration of calcareous green micrite.

It accumulates in a variety of settings; in the still water of protected lagoons, below wave base, in deeper water, and even in agitated settings within and beneath the protection of algal mats.(Aqrawi *et al* ,1998)

2-2-2-2- Sparite:-

Sparite is a word used for the description of ground mass in texture of carbonate rocks which consist of big crystalline(more than 10 micron) . It is divided into two types:- **Orthosparit (Eo sparite),** this term is used for cement spar which fills the space between grains or inside it . **Pseudospariete(Neo sparite),** it is used for describing the spar resultant of neomorphism or recrystalization to mini size of micrite crystalline which leads to form a big size calcite crystalline. Some of the parts of ground mass change to pseodosparite because of recrystalization.(Folk 1959;Wolf and Conolly 1965; Nichols1967 and Flugel 1982).

2-3 Diagentic Processes :-

The carbonates of the Mishrif Formation have been altered by the following diagenetic processes.

2-3-1-Micritization: -

Micritized skeletal fragments are very common in the bioclastic wackestones and packstones of the Mishrif Formation.Micritization is an early diagenetic process and skeletal grains were micritized shortly after deposition. (Aqrawi *et al* ,1998)

2-3- 2-Compaction:-

The dominance of mud-supported fabrics in the Mishrif Formation,coupled with the thick overburden,resulted in significant compaction..Large skeletal grains in the wackestones and mudstones may be fragmented. Compaction in muddy calcarous sediments begins soon after deposition and increases steadily in intensity as the overburden thickens.

2-3-3- Dissolution:

Early diagenetic dissolution resulted in the formation of moldic and vuggy pores as unstable(mostly aragonite)grains were dissolved. This enhanced the pre-existing intergranular porosity, particularly in the rudist-bearing units which are rich in aragonitic shell fragments of various size and types .Late digenetic dissolution may also have occurred,providing a source for the calcite which was reprecipitated during late-phase cementation.

2-3-4- Neomorphism:-

Micrite matrix material is often recrystalized (Folk,1965)leading to the inversion of aragonitic micrite to microsparite,and that of calcitic micrite to microspar. Neomorphism commonly affects mud-supported micro facies in the Mishrif Formation . and is mostly early diagenetic in orign.

2-3-5-Cementation:-

Three types of cements have been recognized in the carbonates of the Mishrif Formation:

a-Syntaxial rim cements :- These are common particularly in wackestones and packstones.They are usually interpreted to be early diagenetic,and to indicate the near-surface meteoric environment (Longman,1980& 1982).

b-Druzy mosaic cements:-

These consist of big equal size crystalline that fills some pores and fractures . The big size of crystal indicates slow crystallization from under saturated solution .This type of cement occurs in subarial deposites and deep marine deposites . (Aqrawi *et al* ,1998)

d-Granular cements:-

These are present in various microfacies filling inter-and intragranular pores and fractures.These cements are believed to be of later diagenetic origin.

Cementation has led to occlusion of primary porosity in Mishrif Formation carbonates such as packstones and grainstones.However,dissolution is a more effective diagenetic process than cementation in most of the reservoir facies. (Aqrawi *et al* ,1998)

2-3-6-Dolomitization:-

Scattered, fine-grained dolomite rhombs occur within the mud-supported microfacies, and are often concentrated along stylolite surfaces. Probably late diagenetic origin . Also the author was able to identify fine grain size , rhombic dolomite within the mud-supported facies and it indicate their early-digenetic origin, particularly those present within intertidal mudstones.Larger dolomitic crystals.of a clear-rimmed cloudy-centred type probably formed during later diagenesis (Sibley,1982) ; but before stylolitization ,dolomitization has slightly enhanced the reservoir quality of some of the microfacies,particularly with the formation of secondary intercrystalline micropres within muddy microfacies.

2-3-7- Stylolitization:-

Pressur solution has resulted in the formation of dissolution surfaces ,clay seams and stylolites.Stylolites in both mud-and grain-supported microfacies took the from of horse-tail and irregular anastomosing sets(Logan and Semeniuk,1976).Organic material,and other relatively insoluble particles (dolomite rhombs,early calcite-cemented grain ,and clay particles)commonly occur on the stylolite surfaces-indicating a late –diagenetic origin.

2-4 POROSITY IN CARBONATE ROCKS:-

The carbonate rock is characterized by high porosity in the late stage after deposition . Som of epigentic proccesses such as (compaction and cementation) lead to decrease of porosity. Another way is thatsome of diagentic proccesses , like(dissolution,dolomitization&subsidance) lead to high increase of porosity (Tucker,1985).Porosity in carbonate rocks is divided into two types:-

1- primary porosity:-

This is formed by syndepositional processes which contains visual and non-visual pores between carbonate graines and intrapartical skeletal grains such as the chambers of foraminifral shells.

2- secondary porosity:-

This is formed after depositional processes . This type contains the pores which are created by dissolution processes and it be symitrical formed by selective dissolution ,which is called (moldic voids) , or asymitrical called (vuggy voids) or (channels) or(caverns) . It may also be intercrystalline voids formed by dolomitization processes or fractures voids formed by different physical stress (Tucker,1985).

CHAPTER THREE
BIOSTRATIGRAPHY

3-1 Preface:-

A study of more than (30) slides was carried out under a polarized microscope. Many fossils have been recognized through this study, especially planktonic and benthonic foraminifera which are used to give a simple idea about the biological content of Mishrif Formation. in the study area . On the basis of biological content Mishrif Formation could be divided into a number of bio- zones depending on index fossils present .

3-2 Index fossils of Mishrif Formation :-

A number of index fossils present within Mishrif Formation have been recognized in order to determine the age of Mishrif Formation . There were other index fossils which could be considered as synonyms . The most important index fossils which are found in the Formation are planktonic foraminifera which include *Hedbergella* and *Oligostegina* and which play an important role in recognizing the transitional zones between Mishrif and Rumaila Formations .In addition ,there are other planktonic foraminifera ,such as *Globogerina* and *Hetrohelix* which all of them are considerd environmental indications that refer to basinal environment which represents the transitional zone between Mishrif and Rumaila Formations.

There are many index species belonging to benthonic foraminifra and are important for biozonation of the Mishrif Formation these are :-

1- *Nezzazata simplex* Omara :-

This species was described for the first time in Egypt and Iraq in Cenomanian of neretic part of Sarvak Formation , and was described from early to late Cenomanian of the Mishrif Formation southern Iraq (AL- Naqib,1967, Gaddo,1971 & Brun,1970) ,and was described from Egypt and Yuogoslavia and Kuwait in Magwa Formation **.** In this study the Nezzazata simplex was identified at (2920-2983) m, (plate (1-E), (5-A,D), (6-B) , (11-A)

2-*Biconcava bentori* Hamaoui & Saint- Marc:-

This species was described from the Cenomanian- Turonian of the Palestine and Lebanon . This species is identified for the first time in Iraq, from the Mishrif Formation in oil wells , Majnoon-1, Zubair-49, Rifaiy-1. (Al- Nuaimy, 1990). In this study , the Biconcava bentori was identified at Amarah-1(2920-2965)m, (2925-2935)m, Plate(5-D).

3- *Praelveolina tenuis* Reichel:-

This species was described firs by Reichel (1936-1937)from En Castre (France) in the Cenomanian age; Sampo (1969) described this species from the Middle Cenomanian of Sarvak Formathion (Iran).

Late Cenomanian of Kuwait,Magwa Fromathion by (El-Naggar and AL-Rifaiy,1973).

In this study this species is identified at Amarah-1 at (2930-2960)m , Plate (1-A,B), Plate(4-B), (5-F), (6-F).

4- *Cisalveolina fallax* Reichel:-

This species is described from the Mishrif Formation, southern Iraq . According to AL-Naqib (1967) ,the age of this species is Cenomanian or Turonian according to Smout, Owen and Naser (1958). In this study the Cisalveolina fallax was identified at Amarah-1 (2920-2970)m, Plate (2-C) .

5- *Ovalveolina ovum* (d'orbigny):-This species was described from the late Cenomanian of Mishrif Formation (AL- Naqib ,1967) , and was found in Kuwait of Cenomanian age of Magwa Formation (AL- Nagger and AL-Rifaiy ,1973), and in Iran of late cenomanian age from Sarvak Formation (Sampo ,1969). In the present study this species was identified at Amarah-1 (3170-3160) m,

3-3 Biostratigraphy of the Mishrif Formation in study area:-

Foraminifera is used to divide the sedimentary section of Mishrif Formation to biostratigraphic zones. In well Amarah-1 . two zones are recognized , they are :-

1- *Praealveolina cretacea* partial rang zone:-

This nearly exteneds from the bottom of the Formation to middle , where the following species are found:-

Biconcava bentori , Cisalveolina fallax , Dicyclina schlumbergeri , Nezzazata simplex, Milioide , Nezzazata conica , Ovalveolina ovum , Praealveolina cretacea , praealveolina simplex , Pseudolitunella reicheli, Spiroplectammina sp., Planktonic.

2- *Praealveolina tenuis* rang zone :-

This represents the upper part of the Mishrif Formation . The following species are found in the formation :-

Chrysalidina gradate, Dicyclina schlumbergeri ,Biconcava bentori , Cisalveolina fallax , Lenticulina macrodisca , Miliolide , Nezzazata conica , N. simplex , Praealveolina tenuis , Praealveolina cretacea , Praealveolina simplex , Tabrina bingstani.

Besides , there are skeletal of echinodermata , calcareous algae , ostrocoda , spong spicules , corales , rudist .

Som of the most important biostratigraphic studies took a big area in the studies of Mishrif Formation . The important studies in the southern Iraq are the ones by (Brun,1971), (AL-Khersan, 1972) ,(Abdul-Kareem and yosif, 1990,1992) (Philip *et al*, 1995) ,(AL –tharb, 1996) , (K.M. Sharbazhery, 1999), (AL-Badri , 2005) .

K.M.Sharbazhrerys' study of Omara well-1- he divided the Mishrif Formation into two biozones ,as follows :-

1- *Rotalipora appennica , heterohelix globulosa* zone.
2-*Nezzazata simplex zone (Praealveolina cretacea , Cisalveolina leherni* sub zone) .

In another study carried out by AL-Badri (2005 , Mishrif Formation is divided into two biozones:-
1- *Praealveolina cretacea* partial range zone .
2- *Praealveolina tenuis* range zone.
The previous study totally coincides with the present study in termes of the presence of two wells in this study within the study area , in so far as the biological divisions and description are concerned .
In Mishrif cross section of well Majnoon-1- (Fig2-2) , the following two biozones were recognized:-

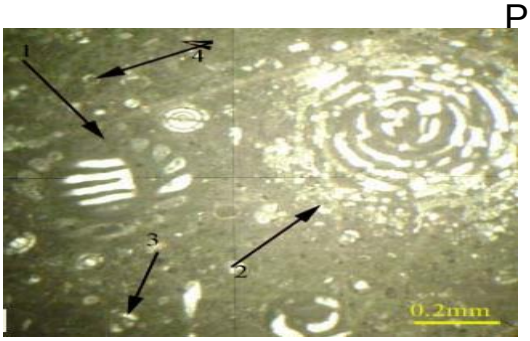
1- Praealveolina cretacea range zone :-
the following species are found :-
Biconcava bentori ,Chrysalidina gradate, Favusella, Cisalveolina fallax , Nezzazata sp. , praealveolina cretacea , Praeglobotruncana gibba , Pseudotextularella sp., Spiroplectamina sp. , Planktonic.

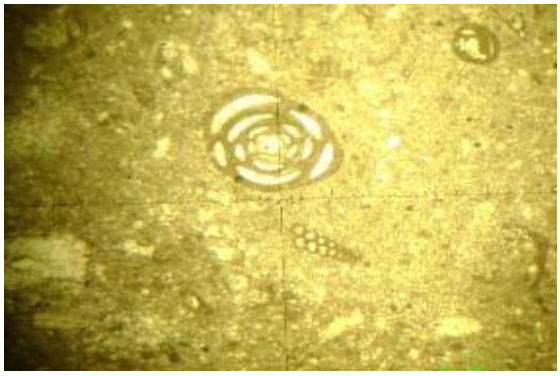
***2- Praealveolina tenuis* range zone:-**

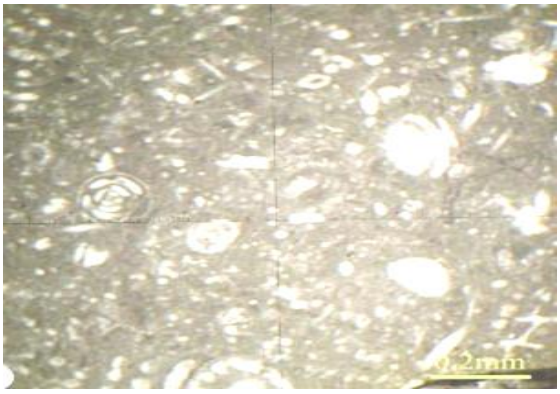
The following species are found :-
Chrysalidina gradate , Biconcava bentori , Cisalveolina fallax , Dicyclina schlumbergeri , Hedbergella sp. , Helvetglobotruncana Helvetica , Lenticulina macrodisca, Nezzazata simplex , N. conica , Orbitolina opsis sp., Praealveolina cretacea , Praealveolina tenuis, Pseudolitunella reichli , planktonic, in addition to debrise of rudist , calcareous alge, echinodarmata, coral , Gastropoda, spong spicules .
In majnoon-1-, one zone is recognized ,i.e Praealveolina tenuis rang zone .The following types are found:-
Nezzazata simplex , Biconcava bentori , Quniquloculina sp. , Dicyclina schlumbergeri, Multisparina iranensis, Miliolide, Planktonic.
In the study of (Abdul- Kareem and Yosif ,1990,1992), the Mishrif Formation was divided into five basic zones from bottom to top:-
1- *Oligostegina sp., Hedbergella washitensis* zone .
2- *Praealveolina cretacea – Ovalveolina ovum* zone wich divided into two sub zone :-
a- *Ovalveolina ovum* sub zone
b-*Cisalveolina fallax , Tabrina bingstani* sub zone
3-*Dicyclina schlumbergeri – Qataria dukhani* zone
4-*Rotalina sp*. Zone .
5- *Miliolide indet*. Zone
In another study carried out by Philip *et al* 1995 to Wasia formation equevilant to Mishrif Formation , the formation is divided into one zone **,i.e :-**
Praealveolina cretacea biozone
AL –Tharb (1996)divided the Mishrif Formation into biozones :-
1- *Praeglobotruncana delrionesis* rang zone .
2- *Praealveolina cretacea* sub zone.
In the light of the above division of biostratigraphy , we can say that the Mishrif Formation consists of two biozones :-
Lower zone :- Praealveolina cretacea partial range zone.
Upper zone:- Praealveolina tenuis range zone .
the following table shows the important previous studies of Mishrif Formation

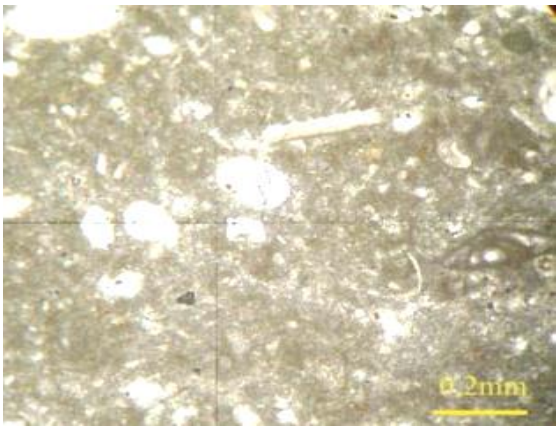
from the biostratigraphic point of view.

Plate 1



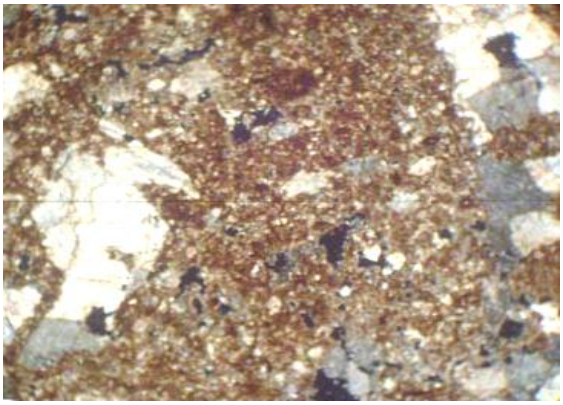


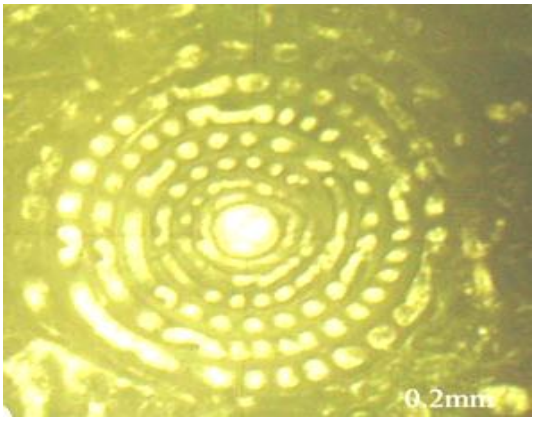




A-(1)Ovalveolina crassa with(4) calcisphere ,(3) Nezzazata simplex in foraminifral wackestone(AM-1).
B- Nezzazata sp.,Calcareous alge, Ostrocoda , ,calcisphere in foraminifral lim wackestone.
c-Miliolid, Spiroplectammina sp. And rudist in bioclastic foraminifral wackestone one (AM-1, (2953 m ,X10)
D- Milioid, calcisphere , ostrocoda ,spong spicules ,fragment in foraminifral packstone(AM-1,2966 m ,X10).
E- -Nezzazata simplex omara with calcispher and ostrocoda affected by dissolution in(AM-1, 2953 m ,X10).
F- -Dicyclina schlumbergeri with the calcisphere and clotted texture in foraminifral lim wackestone(HF-1, ,X10).

Plate **2**





A-Interpartical porosity (Mj -1, 2572 m .X10).
B- calcitation and replacement in foraminifral packstone (AM-1-, 2982 m ,X50).
C- Cisalveolina lehneri, spong spicules with pelloids in bioclastic foraminifral (AM-1-, 2982 m ,X50).
D--Rudist in bioclastic packstone(Mj-1-,2576 m , X50)
F-

REFERENCES

Abdul-Kareem, B.M. and Yousif , Y.R. , 1990, biofacies of the Mishrif Formatiom ,Rumaila north oil field, southern Iraq ,part -1, petroleum Research center , petroleum Engineering Departement .

Agip,1980, Halfaya Field petrographic and sedimentological study of the Mishrif Formation , OEC library , Baghdad unpublished report .

Al-Badri, A.M.S., 2005, Sequance stratigraphy of the Mishrif Formation in selective well in Meysan city –Southern Iraq , unpublished M.SC, universiry of Baghdad , College of Science , p,10-33.

Al-Jumaily ,S ,2001 , facies and depositional environment of the Mishrif Formation in selective wells southern Iraq , unpblished Ph.d. thesis , University of Baghdad , College of Sience . P10-11 .

Al-Khaldi, Z.A., 2004, Reservior specification and effective porosity of the Mishrif Formation in Halfaya field southeast of Iraq , unpublished M.Sc theises, university of Baghdad, College of Science

Al-Khersan ,H., 1973, Mishrif Formation regional study , INOC library, Baghdad , Iraq , unpublished report, p.82

Al-Khersan ,H. , 1975 , Depositional environment and geological history of the Mishrif Formation in Southern Iraq.

Al-Kilaby ,A. , 2009, Reservoir characters and porosity of the Mishrif Formation in Abu Girab and fauqi field southern Iraq, unpublish M.Sc,University of Bagdad, College of Science

Al- Naggar, Z. R. , and Al- Rifaiy , I.A., 1973, Stratigraphy and microfacies of type Magwa Formation of Kwait-Arabia , part 2, Mishrif Formation member, AAPG Bull., v .57 , no.11, p. 2263-2279 .

Al- Rubiay , H.H.F. ,2009, Sequence stratigraphy of the Mishrif Formation at West Qurnah North Rumaila , and Zubair Fields Southern Iraq, unpublished B.Sc. thesis , university of Baghdad ., College of Science p.9

Al-Sayab and Jassim,1996 ,Stratigraphic and biostratigraphic brief study to Mishrif Formation (Late Cenomanian- Early Turonian) in selected wells in south and middle Iraq, 12-60 p.

Al-Ubaidy,U., 2004, Stratigraphic control on facies and Diagenetic development of the Mishrif Formation , Zubair Field , M.Sc. thesis, University of Baghdad (Baghdad), 86p.

Aqrawi,AAM., Thehni, G.A.,Serwani G.H. and Kareem
B.M.A.1998,Mid-Cretaceous rudist bearing Carbonates of the Mishrif formation,an important reservoir sequence in the Mesopotamin basin , Iraq.Petrol.Geol.,21,PP.57-82 .

Belarabi,E.M.,1982,depositional environment and facies distributationof
Mishrif formation – Southern Iraq, unpublished M.S.C, university of Baghdad Collage of Science . P . 160 (in Arabian) .

Elf- Iraq, 1970, Sedimentological study of the Mishrif reservoir , Buzurgan , No.2 well , INOC . library (unpublished report).

Gaddo, J.Z.H. , 1971, The Mishrif Formation paleoenvironments in
Rumaila , Tubal\Zubair region of South Iraq . Jour. Geol. Soc.Iraq, V.4, p.1-12.

Mahdi, T.A, 2004, Sequance stratigraphy and reservoir characterization of the Mishrif Formation in Dujaila , Kwait, Amara , and Rifaiy fields , Unpublished M.SC thesies , university of Baghdad , Colege of science.

Reulet,J., 1982, Carbonate reservoir in marine shelf of Mishrif Formation
(Buzergan- Fauqui- Abu-Ghirib stractuers) –Misan oil field –Iraq , SENA
(P)., dir. Explor. Elf- Aquitaina, INOC library, Baghdad (unpublished report).

Sharbazhery, K.M., 1999, Biostratigraphy of the Mishrif Formation
Middle- Late Cenomanian – Early Turonian(Omara well-1), Southern
Iraq, department of geology , College of Science , university of Sulaimany , Kurdistan region, Northern Iraq ,(abstract), p 511-530.

Sherwani, G.H., 1983 Depositional environment and stratigraphic relationships of
Mishrif Formation an equivalents in selected boreholes
Southern and Middle Iraq, unpublished B.SC. thesies , university of Baghdad , College of Science