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والبحث العلمي

جامعة ديالى

كلية العلوم

قسم جيولوجيا النفط والمعادن

السحنات الدقيقة والطباقية الحياتية لتكوين اليمامة في ابار مختارة من حقل الفيحاء النفطي، جنوب العراق

رسالة

مقدمة الى مجلس كلية العلوم - جامعة ديالى وهي جزء من متطلبات نيل درجة الماجستير في (الجيولوجيا / علم الارض)

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بكالوريوس في جيولوجيا النفط والمعادن ٢٠٢٠

بإشراف

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Microfacies analysis and biostratigraphy of Yamama Formation in selected wells of Faihaa Oilfield, Southern Iraq

A Thesis Submitted to the Council of the College of Science, University of Diyala in Partial Fulfillment of the Requirements for the Master Degree in Geology/ Earth Science

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المستخلص

يعد تكوين اليمامة احد اهم المكامن النفطية المنتجة في جنوب نطاق بلاد الرافدين. ركزت الدراسة الحالية على تحديد عمر تكوين اليمامة بالاضافة الى دراسة السحنات الدقيقة في ثلاثة ابار مختارة من حقل الفيحاء النفطي الذي يقع في محافظة البصرة جنوب العراق وهذه الابار هي فيحاء ١، فيحاء ٢ وفيحاء ٣. الطباقية الحياتية في تكوين اليمامة تحتوي نطاقين حياتيتين من الفورامينيفرا القاعية وهي:

(*Prachsalidinainfractecure – Pseulocyclammin lituus* interval zone), و(*Trocholina sagittaria* range zone).

تم تحديد عمر تكوين اليمامة من خلال المتحجرات الدالة للفورامينيفرا القاعية بالطباشيري المبكر (البرياسي-الفلانجاني).

الدراسة الحالية لتكوين اليمامة صنفت العمليات التحويرية الى نوعين: العمليات التحويرية الهدامة :الاحكام (الكيميائي والفيزيائي)، الاذابة الكيمائية (بنوعيها المسامية الانتقائية وتشمل المسامية بين الحبيبات والمسامية داخل الحبيبات والمقولبة

وكذلك المسامية غير الانتقائية مثل القنوات والفجوات) وايضا المكرتة. العمليات التحويرية البناءة: التشكل الجديد، الدلمتة، التكسرات, وتشمل السمنتة(Blocky, Drusy, Syntaxial rim).

السحنات الدقيقة والبيئات المترابطة في هذه الدراسة لتكوين اليمامة هي: الحجر الواكي-الحجر المرصوص الحاوي على الفورامنيفرا، الحجر المرصوص ذو الفتات الحياتي، والحجر المرصوص ذو الفتات الحياتي والدمالق، والحجر المترابط الطحلبي. وتم تحديد البيئة القديمة لتكوين اليمامة ببيئة المنصة الداخلية الى البيئة الحوض العميق

CHAPTER ONE
INTRODUCTION

Introduction

1.1 Preface

Yamama Formation was defined by Steinke and Bramkamp in 1952 (Powers *et al*., 1967) from outcrops in Saudi Arabia, The Yamama Formation is one of the most significant oil production reservoirs in the Southern Mesopotamian zone, south part of Iraq.

The Mesopotamian Zone contains four separate depocentres that are roughly N-S and NW-SE orientated, as well as a smaller depocenter close to Kirkuk. In the Euphrates region near Najaf, the Formation can reach a thickness of 400 meters, while in southeast Iraq, it can reach a thickness of 360 meters(Jassim and Goff, 2006).

According to (Sadooni, 1993), the upper 203m of the Yamama Formation consists of 12m of specular and brown detrital limestone with thin shale beds overlain by 191m of micritic and oolitic limestone.

Several NW-SE trending depocentres have oolitic reservoir units (Sadooni, 1994). According to (Douban and Medhadi, 1999). According to (Bellen, *et al*. 1959), the Formation is Berriasian-Valanginian in age.

The Yamama Formation was formed in alternating habitats of oolitic shoal and deep inner shelf, possibly under the direction of modest structural highs within a carbonate ramp (Sadooni, 1993)

The Formation is a subsurface unit made up of many types of limestone, including argillaceous limestone, fossiliferous limestone, and vuggy limestone. Sulaiy and Ratawi Formations can be conformed to by the

lower and higher contacts of the Yamama Formation, respectively (AL-Hassani and AL-Duiaime,2021).

Benthic foraminifer's fossils served as the primary source of information for biostratigraphic analyses of the Yamama Formation. Benthic foraminifera was utilized in the current biostratigraphic and age determination.

1.2 Location of the study area

The Faihaa oil field is located in the south of Basrah Governorate, in the southern part of Iraq. West Nahr Umr Field, south Sindibad Field, and north Majnoon Oil Field. It has a convex area of (2866 km^2). Table (1-1) The geographic coordinates,depth and thicknes of the studied wells, Figure (1-1) Location of Fiahaa oilfieid in Basrah Governorate southern Iraq.

Table (1-1): The geographic coordinates,depth and thicknes of the studied wells

No	Well name	Coordinate		Depth(m)		Thicknes (m)
		X	Y	Top	Bottom	
1	Fh-1	481`3.125"E	30`56`2.658"N	4028.5	4350	322m
2	Fh-2	48`1`9.423"E	30`59`33.036"N	4056.5	4353.7	297m
3	Fh-3	48 ' 1`28.53"E	30`52`44.074"N	4016.5	4147.7	131m

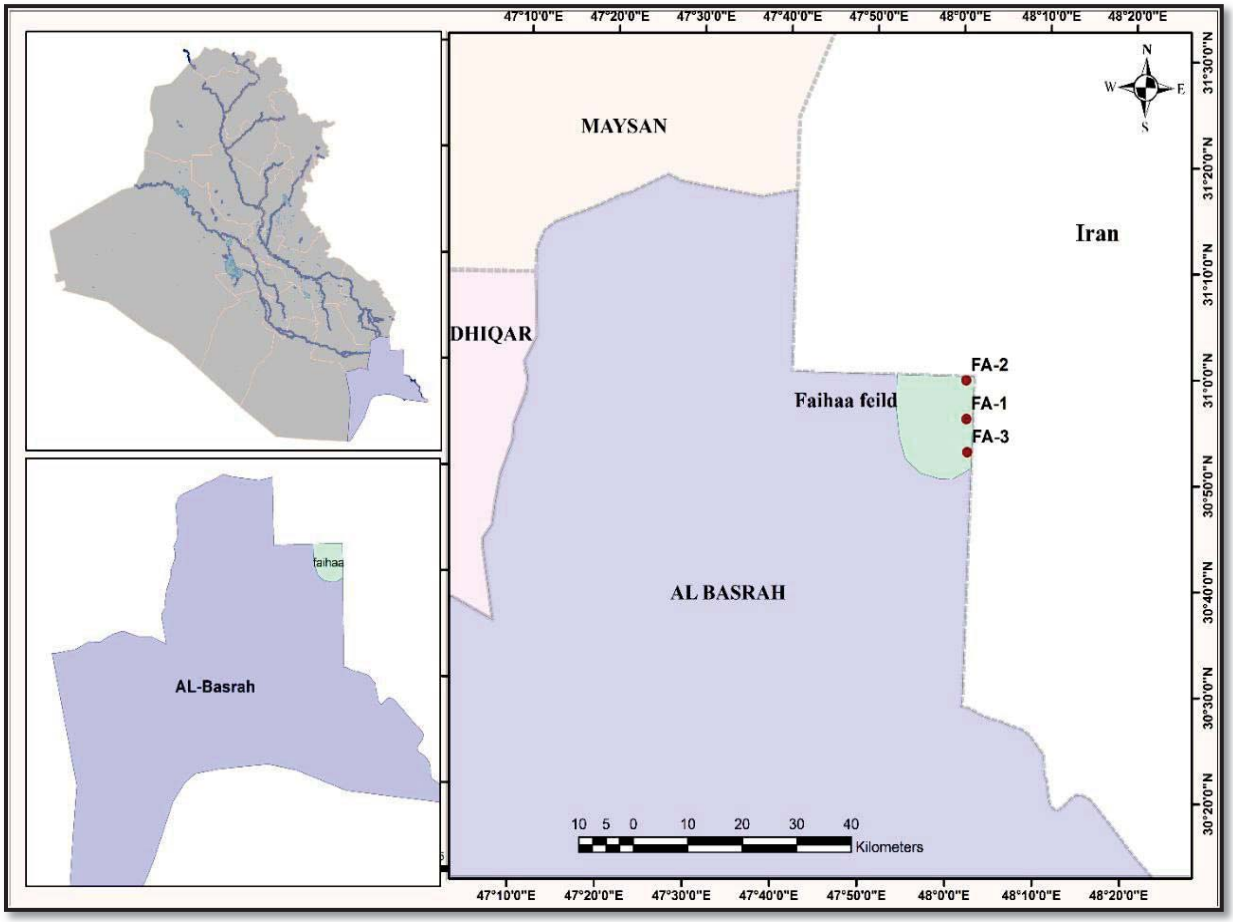

Figure (1-1) Location of Fiahaa oilfield In Basrah Governorate southern Iraq.

1.3Aim of the study

1- Determination the Biostratigraphy and the age of Yamama Formation.

2- Microfacies analysis to interpretation of the palenvaronment of the Formation.

3- Determination of diagenesis processes inYamama Formation in Faihaa oil field

1.4 Geologic setting

1.4.1 Tectonic setting

The study area is located in the Zubair subzone of the stable shelf of the Mesopotamian, which represents a part of the south of Iraq (Jassim and Goff, 2006). Two faults, one from the Al-batin fault zone and the other from the Najd fault system between the Ramadi-Musaiyib fault zone in the southwest and the Tikrit-Amara fault zone in the northeast, encircle this area.

The Arabian and Iranian plates colliding caused a regional compression impact that resulted in fold structures with a NW-SE trend Early Cretaceous extensional pressures led to ritfing and tectonic movements in Turkey and north of Arabian plate. This tectonic movement began in the Early Cretaceous and resulted in the formation of the Yamama basin in the Berriasiain-Valanginian(Jassim and Goff, 2006).

The tectonic history of the Cretaceous period resulted in rifting occurring along borders, which had an impact on the Arabian plate. (Koop and Stonely, 1982). The Faihaa oilfield lies in the east of the Mesopotamian Basin, in the Zubair subzone. It includes a Quaternary sediment-covered geologic structural subsurface and is situated between two faults: first, the Al-Batin fault zone, which is located in south from the bottom, and the Al-Karana fault zone, which is located at the top. Second, based on the Najd fault system, which runs between the Tikrit-Amara fault zone in the northeast and the Ramadi-Musaiyib fault zone in the southwest (Al-Husain,2017).

Figure (1-2) Tectonic map of Iraq (Fouad, 2015).

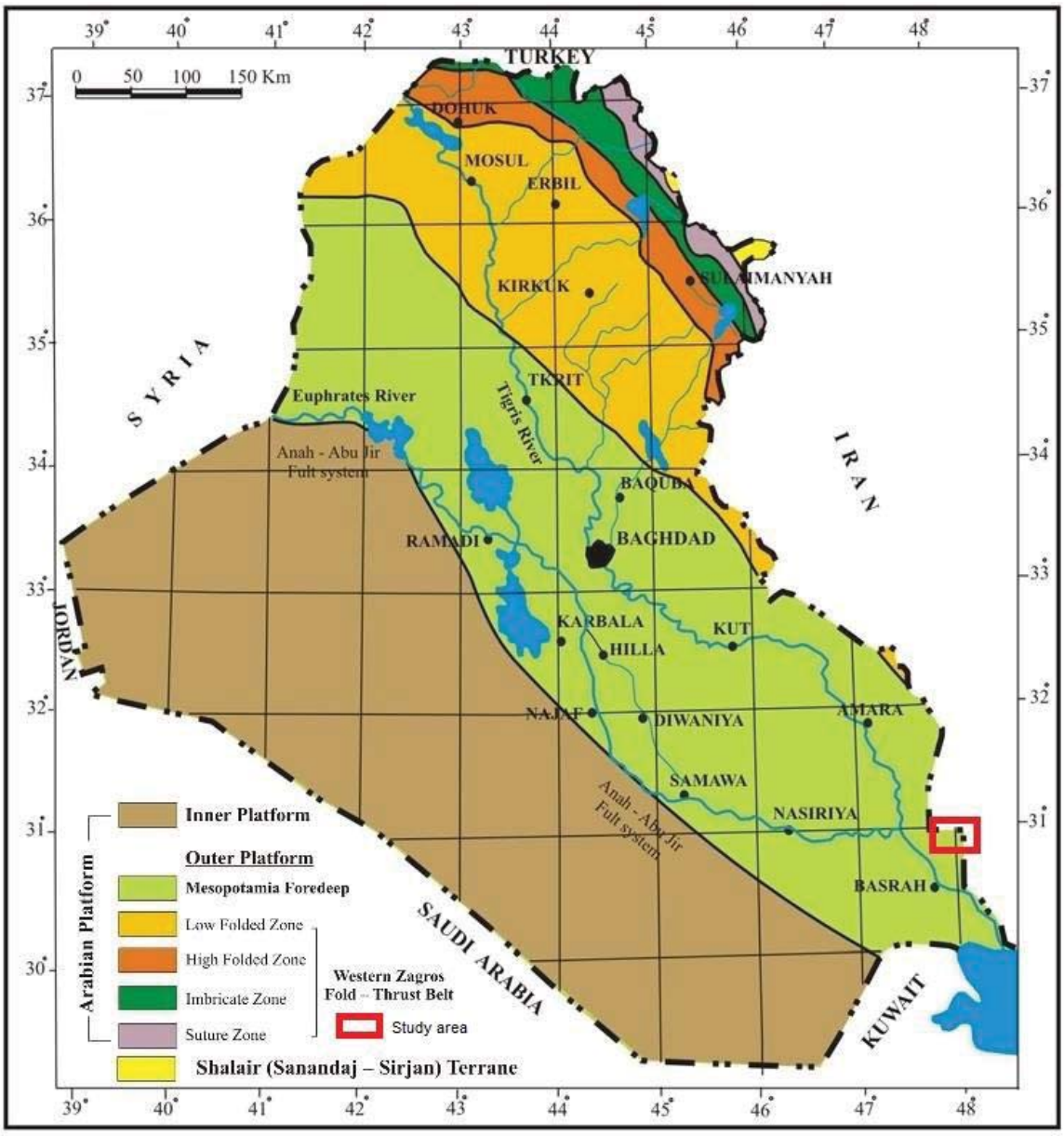

Figure (1-2): Tectonic map of Iraq (Fouad, 2015).

1.4.2 Paleogeography of Yamama

The Southern Neo-Tethys opened during the Late Tithonian-Valanginian period when the Bisitoun (Avroman) microplate split off from Arabia. The palaeogeography of the Yamama Formation summarizes Figure(1-3), spanning from Upper Berriasian to Lower Valanginian. The

inner and outer shelf (basinal) portions made up the intra-shelf basin (Jassim, and Goff, 2006).

Repeated open marine incursions into the Mesopotamian Zone resulted in the deposition of outer shelf marls and alternating shallow water carbonates. The transgression Sulaiy and Yamama Formations initiated the process of sedimentation, and it concluded with the Ratawi Formation being deposited during a highstand (Douban and Medhadi. 1999) as shown in Figure (1-3). The argillaceous outer shelf limestones and the oolitic, pelloidal, pelletal, and pseudo-oolitic shoal limestones made up the Yamama Formation in southern Iraq.

Numerous depocentres trending NW-SE contain oolitic reservoir units (Sadooni, 1993), an inner shelf environment, and the corresponding Minagish Formation in Kuwait (Douban and Medhadi,1999) was deposited as a transgression unit.

The age of the Formation is Berriasian-Valanginian (Bellen, *et al*., 1959). Given its stratigraphic position, an age range of 140–136 Ma, from Upper Berriasian to Lower Valanginian, seems most likely. The Yamama Formation in Kuwait has been given a Berriasian age (Douban and Medhadi, 1999). The oolitic shoal and deep inner shelf conditions that alternated throughout the deposition of the Yamama Formation were likely regulated by minute structural highs inside a carbonate ramp (Sadooni, 1993).

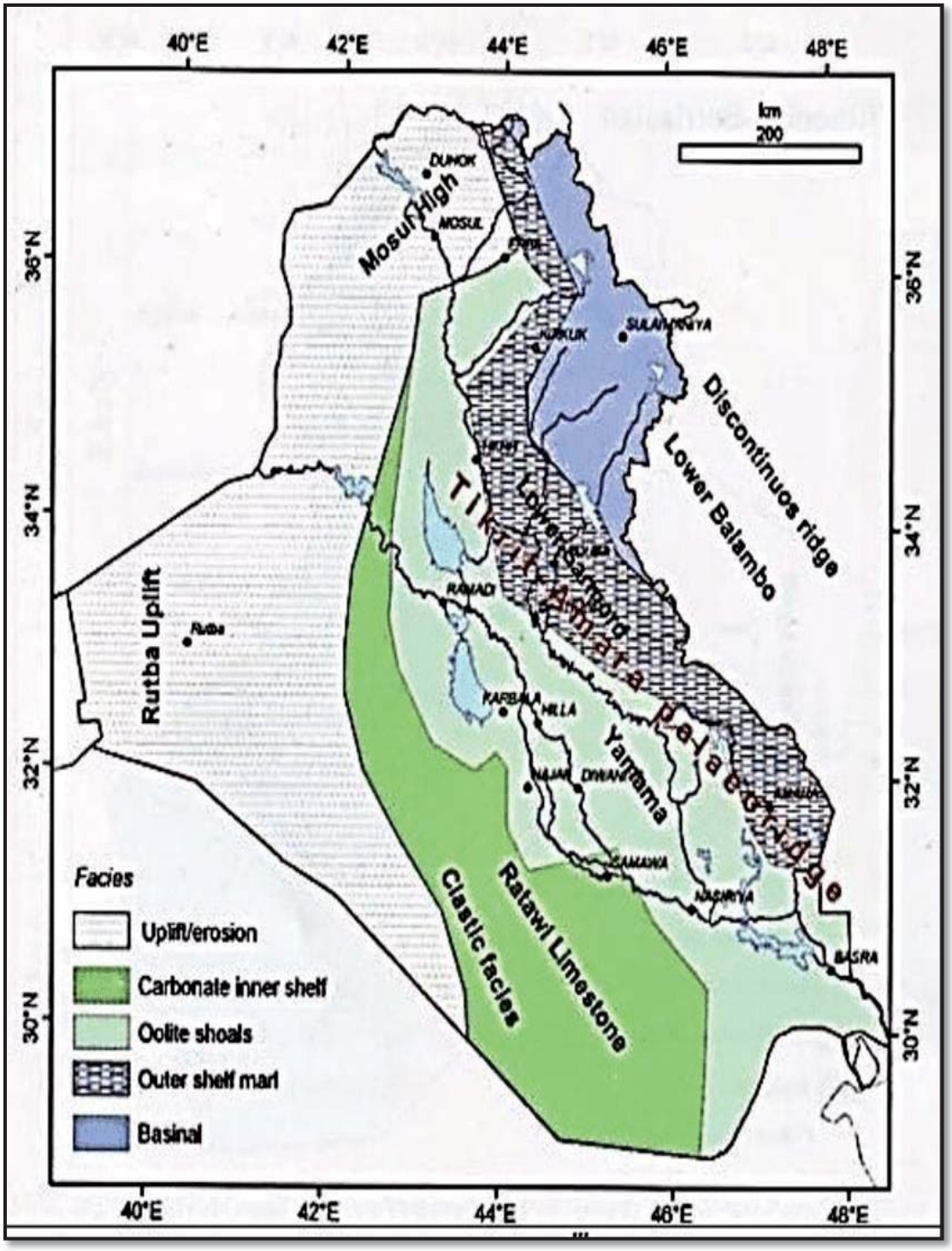

Figure (1-3): Paleogeographic of Iraq (Jassim and Goff, 2006)

1.6 Stratigraphic Setting

The Yamama Formation, which is part of the Late Berriasian-Aptian cycles, is the primary lower Cretaceous carbonate reservoir in southern Iraq. Zubair depicted this cycle in the shallow to deep basin, lower Balambo, Ratawi, Garugu, Yamama, Shuiaba, Sarmod Formations. The neritic lithofacies of the regressive carbonate cycle are represented by the Yamama Formation. The main point of contention relates to the stratigraphy of the Ratawi Formation and Yamama Formation. Yamama Formation comprises three depositional cycles; where top cycle contains oolitic grainstone inner ramp facies which pass down into finer- grained peloidal facies, middle-ramp (bioclastic, coral, stromotoporoid) packstone-wackestone and outer-ramp bases cycle comprise thick grey shale with stringers of chaiky mircrit (Sadooni, 1993).

The previously identified contact between the Ratawi and Yamama Formation was determined to be composed of silty sandstone and siltstone based on information from the core description and the thin section analysis.

The thickness of Yamama Formation is up to 400m (Jassim & Goff, 2006). The maximum thickness reaches 322m in well Fh-1, 297m in well Fh-2, and the minimum thickness is Fh-3 131m. The Yamama's upper contact is conformable with the Ratawi Formation, while its lower contact is conformable with the Sulaiy Formation (Jassim and Goff 2006).

1.7 Previous studies

- Bellen *et al.* (1959) described the combined Yamama/Sulaiy Formation as peloidal limestone underlain by the Ratawi Formation, hypothesized the existence of an unconformity between the early and late Berriassian, and divided the Yamama Formation into six units.

- Fuloria (1976) Concluded and suggested that, generally, the Garagu zangor Sarmord (including Makhul), Karimia, and Chiagara Formations of the Musayyab-Falluja area correspond to the Upper Yamama, Lower Yamama, Upper Sulaiy, and Lower Sulaiy of the Basra area. He also concluded that all the argillaceous and carbonate rocks in the Yamama section.

- **Siddiki (1977)** redescribed the Yamama Formation, and as a result, it was found that the top of Yamama was made of the clean limestone unit that was located underneath the argillaceous limestone and shale of the Ratawi Formation.

- Buday (1980) According to its fossils, the Zangura Formation (Berriassian-Valanginian) and Garague Formation are thought to be comparable to the Yamama Formation (Late Berriassian – Valanginian).

- Sadooni (1994) Divided the Yamama Formation into two units, the peloidal grainstone wackestone to packstone and reefal boundstone, in order to study the depositional system of the Yamama Formation of the West Qurna oil field. This allowed him to see the direct impact of barriers at the shelf edge on the facies composition of the shelf in the upper part of the Yamama Formation, which is between 60 and 80 meters deep. The middle oolitic unit of the Minagish oil field in Kuwait and the Yamama Formation

were correlated by Sadooni, he divided the Yamama Formation into two main lithostratigraphic units (A and B) that were separated by barriers.

- Dhihny (1993) divided the Yamama Formation into six depositional cycles, each of which represents a general regressive sequence.

- Rozarian (1995) showed that carbonate ramped up its deposition between the Late Berriassian and Hauterivian, covering Kuwait, southern Iraq, and the northeastern part of Saudi Arabia. He also pointed out the three major oolitic belt zones. He separated the Upper Yamama and the Lower Yamama, two reservoir units that are separated by barriers, from one another in the Yamama Formation in southern Iraq.

- Saleh (1999) Mentioned that the Yamama/Sulaiy succession is deposited in a shallow ramp setting that dips gently eastward. Shoals that trend north to south divide the shallow marine environments from the basinal environments. Argoilaceous limestone with deep basinal facies dominates the lower part of the succession.

- Al-Shahwan (2002), conducted research on the lower Cretaceous succession in southern Iraq and came to the conclusion that the Sulaiy, Yamama, and Ratawi Formations serve as source rocks, with the Suliay Formation's source rocks being very good to the Yamama and Ratawi Formations' source rocks being good.

- Al-Sharaa (2004) investigated the Yamama Formation's sequence stratigraphy in a few field in southern Iraq. Sequence 1 is a transgressive phase, with migration pointing on lapping on the sequence boundary landward; sequence 2 is a down lapping phase, with migration pointing on migration basin ward; and sequence 3 is a retrograde and prograde phase,

with migration basinward, followed by the transgression phase, which culminated in the Yamama to Ratawi Formation.

- Al-lessa (2012) evaluation the Yamama Formation's Facies and Reservoir in the Ratawi field, south of Iraq. To assess the reservoir, the Ratawi area's Yamama Formation was investigated. The Yamama Formation is predominantly limestone with some dolomite and little shale, as shown by the log, the Matrix identification (MID), and M-N cross plots. The permeability of the Formation was predicted using the traditional Rose and Bruce work and flow zone indicator methods.

- **AL-Hakeem (2014)** evaluated the reservoir properties of the Yamama Formation in the Ratawi oilfield and came to the conclusion that the Yamama Formation is made up of alternating three reservoir zones (YR-A, YR-B, and YR-C) and separated by two tight lime-mudstones (barriers), (YB-1, YB-2), and that the best oil potential is mostly found within the oolitic shoal and the cleaner reefal facies, except around (R It was challenging to determine the OWC level for the Yamama Formation using only the (L.P.O:last proven oil) that was demonstrated by laterolog LLD and microspherical focused log MSFL value.

- **AL-Husain (2017)** Studied Mishrif-Yamama Formation's geology and reservoir in the southern Iraqi provinces of Faihaa and Sindbad oil field. The porosity of Faihaa-1 in the Yamama Formation was better from Fh-2 and Sn-3 oil field wells. The Yamama Formation was divided into 6 units in the Faihaa oil field and 7 units in the Sindbad oil field.

- Khudhair (2018) studied the petrophysical development of the Yamama Formation's carbonate reservoir in five wells of the Gharaf oil field in southern Iraq.

- Al-Hakeem (2019) described the petrophysical characteristics of the Yamama Formation in three studied fields in southern Iraq (Ratawi, Subba, and Luhais Oil Fields). In Subba and Luhais fields, the formation began with barrier YB-1 and represents three order cycles with five barriers (YB-1, YB-2, YB-3, YB-4, YB-5) and five reservoirs (YRA, YR-B, YR-C, Y The Yamama Formation has six microfacies in the fields under study.

- Idan (2020) studied the depositional environments, facies distribution, and porosity analysis of Yamama Formation in Majnoon oilfield. Sequence stratigraphic approach.

- Al-Hassani and AL-dalame (2021): described the three wells (Fh-1, Fh-2, and Fh-3) in the south Iraqi oilfield of Faihaa were investigated for the Yamama Formation. Microfossils and a biozone were identified by examining thin sections in the Formation .

- Abd, (2020) According to the results of the study on the petrography of the Yamama Formation in the West Qurna Oil Field, there are six facies that represent the sedimentary environment of the Yamama Formation, which formed in variable environments like shallow lagoons, shoals, and foreslopes that were affected by diagenetic processes, primarily cementation associated with dissolution. Other significant diagenesis processes include micritization, compaction, and dolomitization, which had an impact on the Yamama Formation's porosity system and caused variations in porosity ratios both vertically and laterally.

- **Al-Ghuribawi (2020)** Based on oil samples, available core samples, thin sections, and well logs from the Sindbad, Siba, and Zubair oil fields, an integrated study of the biomarker, reservoir evaluation, and depositional environment of the Yamama Formation was conducted.

- Mohammed (2021) The Yamama Formation was studied petrographically in the North Rumaila Oil Field in Southern Iraq. The study's findings indicated that the Formation was deposited in a variety of settings within the carbonate platform, including inner ramp, middle ramp, and outer ramp settings. Due to the dominating packstone and the six diagenetic processes .Due to the increasement in pressure at the bottom, the reservoir characteristics of the formation.