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STRATIGRAPHY AND PETROGRAPHICAL OF JERIBE FORMATION ZURBATIYA AREA, SOUTH-EAST OF IRAQ

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ABSTRACT

The current study of Jeribe Formation (Middle Miocene) at Zurbatiya area, South-East of Iraq. It is, structurally, located in the Low Folded Zone. The topic depends mainly on the study of microfacies under a microscope. One surface section in the Zurbatiya area is represented in the Wadi Al-Numur section. It is composed basically of dolomitic limestone. Petrography provides a diversity of fauna, such as benthic foraminifera Miliolid, *Borelis melo curdica*, and Rotalia in addition to Ostracoda, Algae, Coral, and Mollusks. *Borelis melo curdica* is considered an index fossil for the Jeribe Formation. The non-skeletal grains like peloids, ooids intraclasts, and extraclasts. The Jeribe Formation was affected by many diagenetic processes like neomorphisim, dissolution, cementation, dolomitization, compaction, and silicification. Sedimentary microfacies are classified into three main microfacies, which are dolomudstone, dolowackestone, and dolopackstone. These microfacies were divided into many submicrofacies, which are peloidal dolomudstone, ostracods dolomudstone, rotaliids dolowackstone, miliolid dolowackstone, bioclasts dolowackstone, green and red algae dolowackstone, red algae dolopackestone, and coral dolopackestone. The evidence from petrography and microfacies analysis supports that the Jeribe Formation was deposited in the back reef, reef, and lagoon environments.

INTRODUCTION

The Miocene is the first geological epoch of the Neogene Period and extends from about 23.3 to 5.3 million years ago (Ma). The Langhian period is the third stage of the Miocene period, spanning from 15.97 to 13.82 million years ago, for about 2.15 million years (Edward, 2010). The feature of the Middle Miocene that the sedimentary basin, which reached its complete development, and the construction movement of mountains (Orogeny belt) that formed the general framework to distribute the sedimentary basins, which helped to deposition the rocks of this period. This study is one of the most important studies because of the widespread the sediments of Jeribe Formation in the Zurbatiya area. Bellen *et al*. (1959) suggested that the Jeribe Formation was deposited in lagoonal, back reef, and reef environments. AL-Saigh (2010) reported about the Jeribe Formation as a medium to very hard recrystallized dolomitized limestone and marly limestone. It is also containing very porous chalky limestone as well as some bituminous limestone. Abdula *et al*. (2017) studied petrographical and microfacies study of the Jeribe Formation (M. Miocene) in Ashdagh Mountain, Kurdistan region, Iraq. They concluded that the Jeribe Formation was deposited in the ramp environment, which represents relatively low to high energy.

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The study area is represented by one section in the Zurbatiya area within the district of Badra in Wasit Governorate, southeast Iraq. The total thickness of the Wadi Al-Nomur section is about (65 m), This area is located near the longitude 45°57'11.23" and 33°23'43.89" latitudes. It is far (18) Km from the Badra district, near the border with Iran. Tectonically, the study area is located within the Low Folded Zone of the Unstable Shelf according to the classification of Jassim and Goff (2006) (Figure 1).

In the study area, the Jeribe Formation consists of thick dolomite beds. The lower contact is unconformable with the Dhiban Formation while the upper contact is conformable with Fatha Formation. The main aim of this study is to focus on microfacies to deduct subenvironments of the Jeribe Formation in the Zurbatiya area.

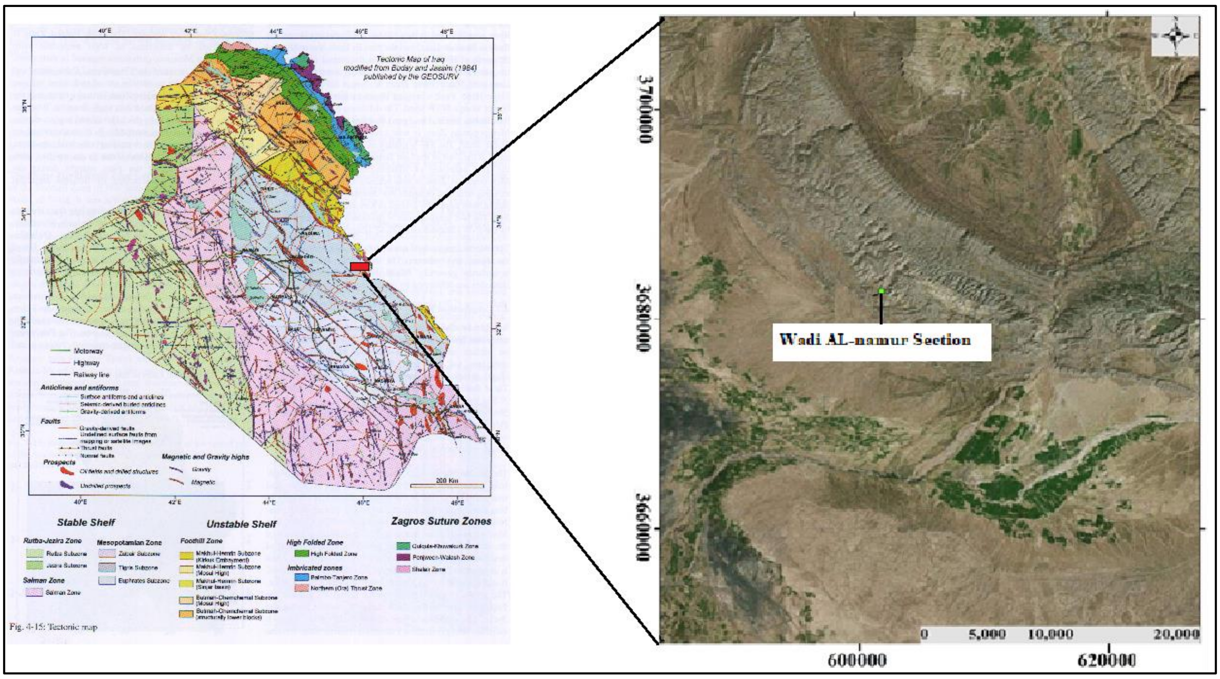

Figure 1: Tectonic map and location of the study area in the Zurbatiya area near Iranian borders.

METHODOLOGY

Detailed fieldwork was carried out in the study area including the following steps to study the microfacies.

1. Select the best section after reconnaissance work for each region.
2. Stratigraphic description of studied section, bed thickness, facies types, and lithology in the field using X10 hand lens.
3. Collecting 21 samples.
4. Picking up detailed field photographs for all lithofacies, and bed sequences.
5. Twenty thin sections are prepared for the petrographic examination to study the microfacies.

STRATIGRAPHIC AND TECTONIC SETTING OF THE STUDIED AREA

Megasequence AP11 is here subdivided into three sequences of the latest Eocene-Oligocene, Early-Middle Miocene, and the Late Miocene-recent age. The Middle Miocene age is the most important in the present study because the expected succession in the studied area is within this cycle. The middle Miocene sequence was deposited in a broad basin following a marine transgression during a phase of strong subsidence that overlapped the margins of the former Oligocene-Early Miocene basin, especially in Iraq. The sequence was also deposited in the red beds' basin of the Zagros Suture. Within the intra-shelf area, the sequence comprises a shallow water carbonate (Jeribe Formation) overlain by thick evaporates, carbonate, and marl of the Fatha Formation. In the Zagros Suture, the sequence comprises a conglomerate-carbonate unit (Govanda limestone) overlain by continental clastics (Merga red beds). The sequence is thicker than 1000 m in the foothill than in the Mesopotamian Zone. The sequence is missing in the Rutba-Jezira Zone and the southern part of the Salman Zone. It is relatively thin on the Abu Jir high (Jassim and Goff, 2006).

JERIBE FORMATION

This formation is described for the first time by Bellen (1959). It is located near Jaddala village in Jabal Sinjar anticline. Its thickness in the type section is 73 m, and it consists of recrystallized and dolomitized limestone, which is generally massive. Bellen (1959) showed that both the upper and lower boundaries of this Formation in the type locality are unconformable with the underlying Serikagni Formation and overlying Fatha Formation. The isopach of the Jeribe Formation and Govanda Limestone (Figure 2) The Formation in the study area comprises dolomitic limestone. The total thickness of the formation is 65 m. The lower contact of the Jeribe Formation with the underlying Dhiban Formation is conformable. The upper contact is conformable with the overlained of Fatha Formation.

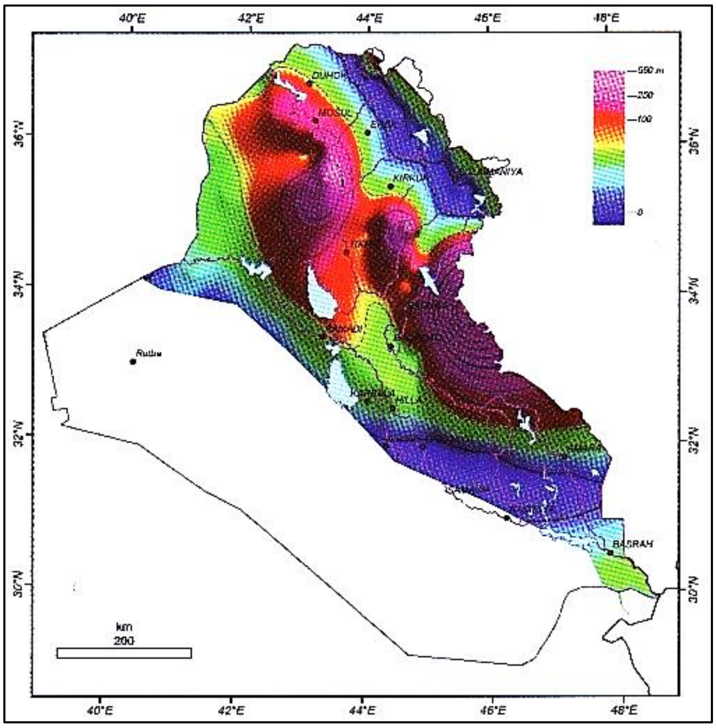

Figure 2: Thickness of the Jeribe and Govanda formations (Jassim and Goff, 2006).

ISOPACH MAP OF JERIBE FORMATION

Six coordinates of the thickness of the Jeribe Formation in Iraq were taken from the southeast to the northwest. In the current study, we depend on the thickness information. Figure (3) shows that the contour lines converging to each other indicate a strong tendency towards the bottom of the sedimentary basin (depocentre). Figure (4) represents an isopach map of the Jeribe Formation, as well as, appears the largest thickness in northwestern Iraq, and also represents the center of the sedimentary basin. The lowest thickness of the sedimentary basin is located in the southeast and it is considered the shallowest of the basin. While Figure (5) represents the profile of the Jeribe Formation from northwest to southeast of the Zurbaitya, Kirkuk, and Mosul areas, Jeribe Formation has the largest thickness in the Zurbaitya area, which represents the center of the sedimentary basin with a thickness of 65 m, while the Kirkuk area has a thickness is medium, with a thickness of 45 m, and in the Mosul area, the thickness is the lowest, which represents the edges of the sedimentary basin with a thickness less than 45 m.

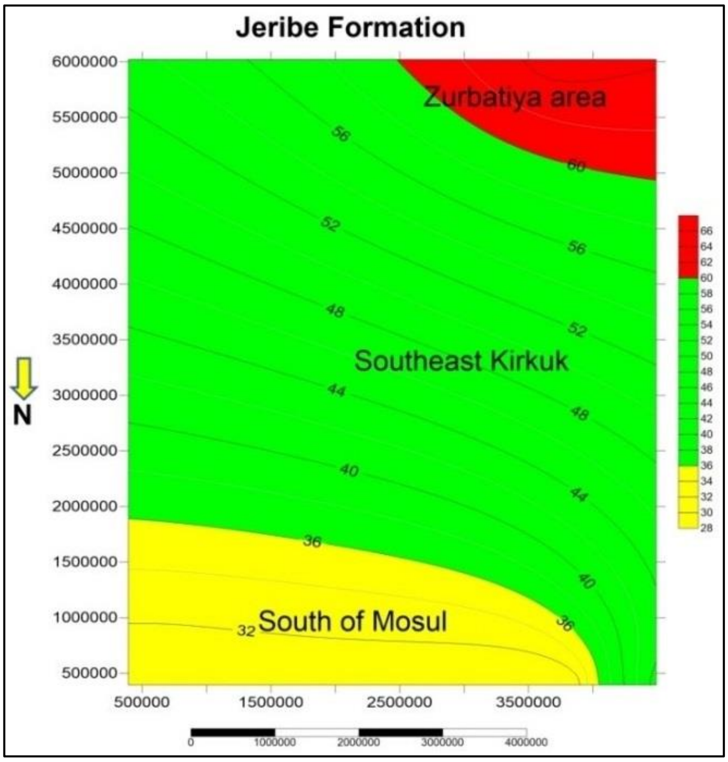

Figure 3: Contour map of the Jeribe Formation.

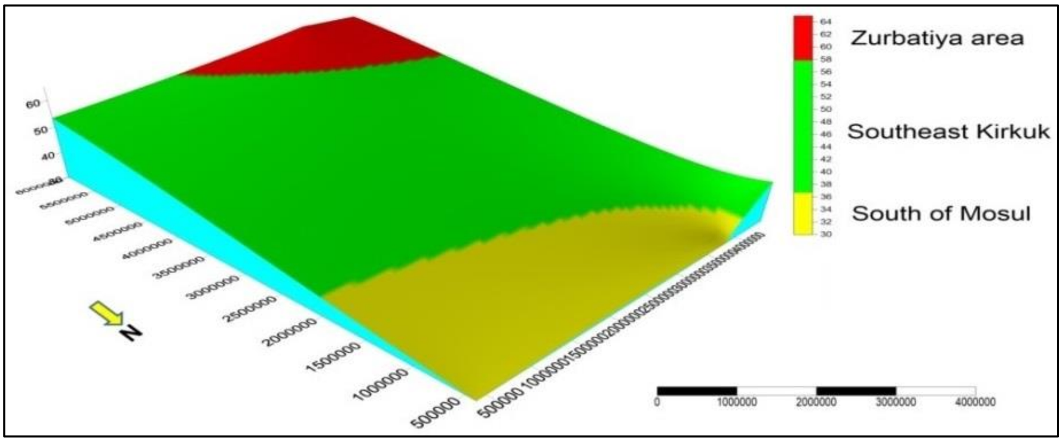

Figure 4: Isopach map of the Jeribe Formation.

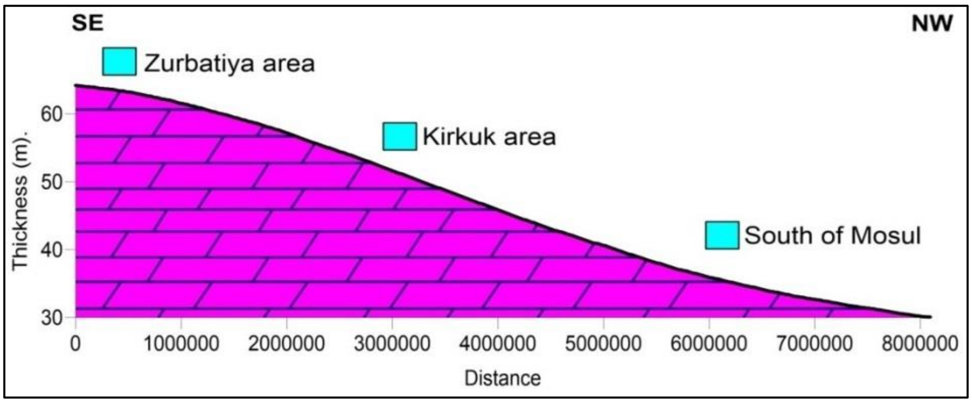

Figure 5: Profile from northwest to southeast of the Jeribe Formation.

DESCRIPTION OF THE STUDIED SECTION

The present study includes one outcrop section on the surface, and 21 taken from the Al-Numur section. This section is located east of the Zurbatiya area near the Iraqi-Iranian border at 45°57'11.23" longitude and 33°23'43.89" latitude. Figure (6) shows the stratigraphic column of the Jeribe Formation. Figure (7) shows the stratigraphic column of the Jeribe with a photo. Figure (8) shows the total thickness of this section is 65 m. Figure (9) explains the upper contact of the Jeribe Formation.

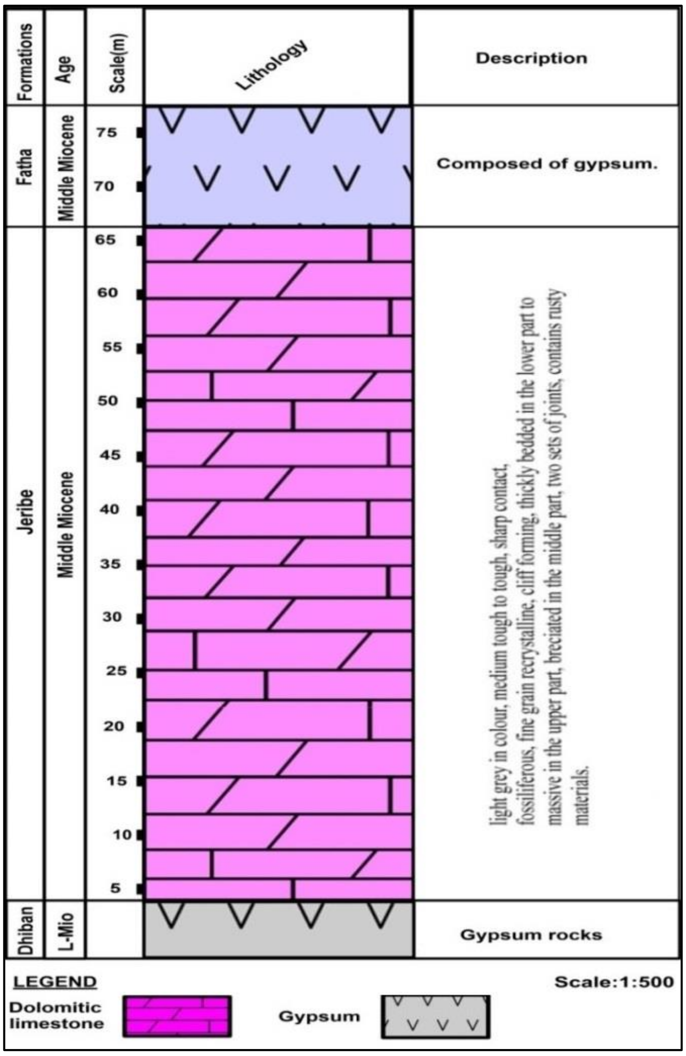

Figure 6: A stratigraphic column of the Jeribe Formation in the studied area.

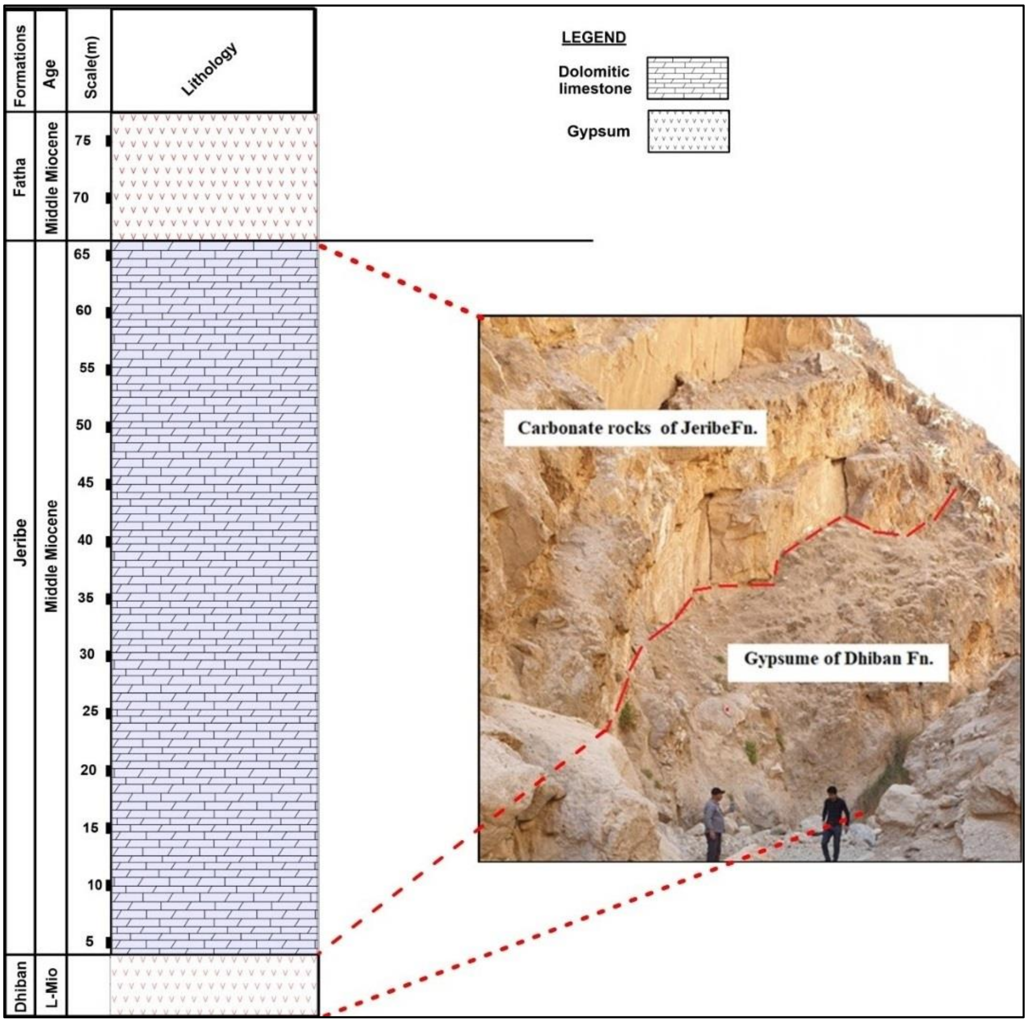

Figure 7: A stratigraphic column of the Jeribe Formation with photo.

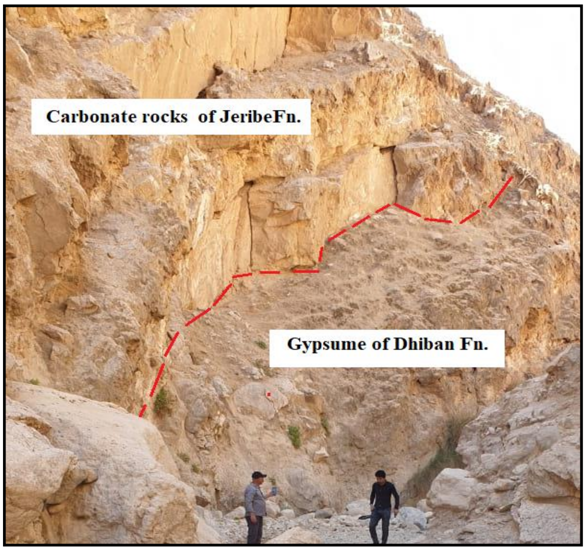

Figure 8: The contact between of Jeribe and Dhiban formations.

Figure 9: The upper contact of Jeribe Formation.

LITHOFACIES STUDY OF JERIBE FORMATION

The Jeribe Formation is composed mainly of dolomitic limestone, As follows, describing this facies.

- **Dolomitic Limestone Lithofacies**

This facies occurred in all parts of the studied section. The thickness of this facies is very big, they are light grey, thickly bedded in the lower part to massive in the upper part, brecciated in the middle part, two sets of joints, contains rusty materials, the total thickness of the facies reached to 65m (Figure 10), also it contains evidence of oil migration (Figure 11), nodular chert (Figure 12), and sulfur grains (Figure 13).

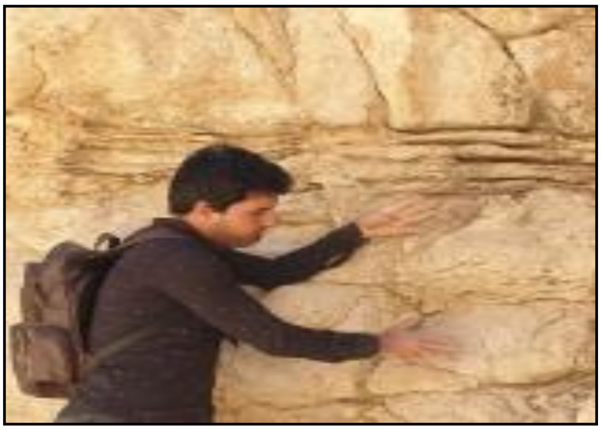

Figure 10: Dolomitic limestone lithofacies.

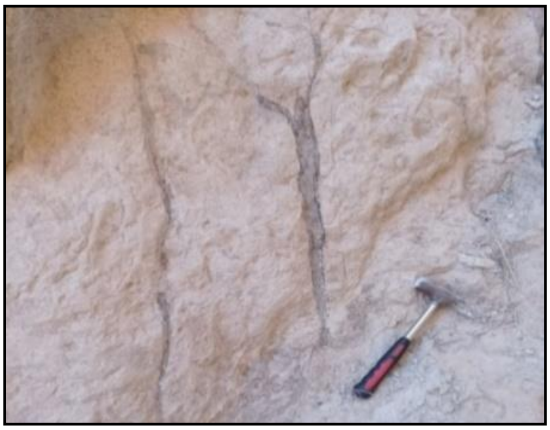

Figure 11: Evidence of oil within the Jeribe Formation.

Figure 12: Chert nodular withithe n Jeribe Formation.

Figure 13: Sulfur grains within the Jeribe Formation.

PETROGRAPHY

Using the polarizing microscope, thin sections of dolostone samples were examined to study the petrography constituents. The dolostone consists mainly of matrix and grains.

- **Micrite**

The micrite is a part of carbonate rocks, which has a small size of the semi-crystalline calcite. It attaches the grains, has a brown or dark color, and grain size of less than (5) µm (Folk, 1959). The limestone, which is mud-supported and gives evidence low energy environment (which consists of a high percentage of micrite) is deposited in a low-energy environment (quiet). micrite was observed in the Jeribe Formation (Figure 14a).

- **Microsparite**

Microsparite has a grain size of (5 – 20) µm (Flugel, 1982). It was observed in the Jeribe Formation (Figure 14b).

- **Sparite**

Sparry cement deals with crystalline carbonate material associated in general with shallow marine shoal environments. Sparry cement is crystals of calcite semi-transparent to light, the size of grains is (20) µm or larger, and is characterized by the largest volume of crystals (Flugel, 2004). It was observed in the Jeribe Formation (Figure 14c).

GRAINS

The petrographic analysis exposed that the Jeribe Formation comprises generally of different skeletal grains. Below is a detailed description of the types of skeletal grains:

- **Skeletal grains**

The skeletal grains are either fragments or complete shells of organisms and are of size from 0.05 mm to many centimeters. The skeletal grains are composed of calcite, low and high Mg-calcite, aragonite, or silica (Flugel, 2010). Since skeletal remains of organisms furnish most of the sediments deposited in carbonate environments, the grain composition of carbonate sediments and rocks often directly reflects their environment of deposition because of the general lack of transport in carbonate regimens and the direct tie to the biological components of the environment (Moore, 1984). Petrography has provided a diversity of fauna, such as benthic foraminifera Miliolid, Borelis melo curdica, and Rotalia in addition to Red algae, Echinoids, and Ostracoda.

– **Benthonic foraminifera:** The distribution of benthic foraminifera is closely associated with chemical and physical parameters of oceanic water, such as depth, salinity, and photic zone. The occurrence of benthos foraminifera is evidence of normal marine to the transitional restricted marine environments in hard to firm substrate and worm water environments (Flugel, 2010).

The exclusive benthonic foraminifera, which is recognized in the Jeribe and Fatha formation are Miliolid, *Borelis melo curdica*, and Rotalia. (Figure 14d, e, and f). In addition to Red algae**,** Green algae, Corals, Echinoids, Ostracods, and Bioclasts. (Figure 16a – f). Figure (15) shows the percentage of major grain types in the dominant depositional environments of the Jeribe Formation.

- **Non- Skeletal grains**

Non-skeletal grains were observed in the current study like peloids, ooids, intraclasts, and extraclasts (Figure 17a, b, c, and d).

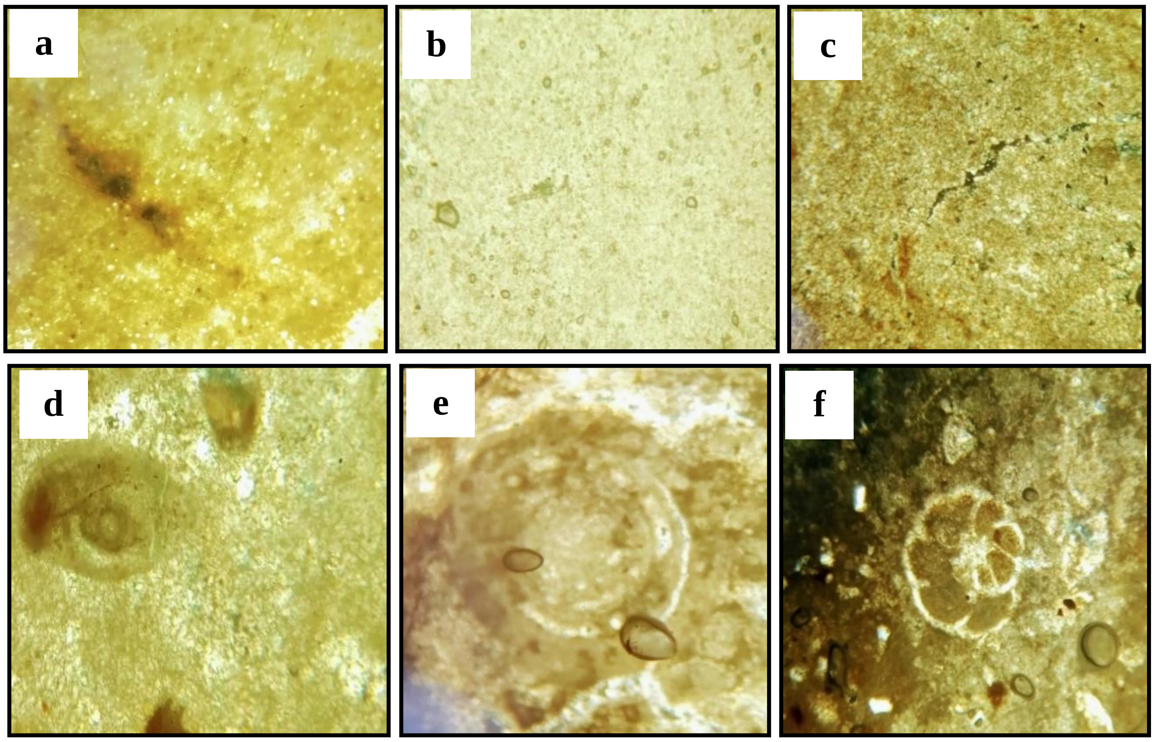

Figure 14: **a)** Micrite, within dolomudstone submicrofacies, was observed in the Jeribe Formation (10X). **b)** Microsparite, within dolomudstone submicrofacies, was observed in the Jeribe Formation (10X). **c)** Sparry cement, within dolomudstone submicrofacies, was observed in the Jeribe Formations (10X). **d)** Benthonic foraminifera (Miliolid) Miliolid dolomudstone submicrofacies, were observed in the upper part of the Jeribe Formation, as in samples 18 and 19 (10X). **e)** Benthonic foraminifera (*Borelis melo curdica*), within Miliolid dolomudstone submicrofacies, was observed in the upper part of the Jeribe Formation, as in sample 18 (10X). **f)** Benthonic foraminifera (Rotalia), within Rotaliids dolowackstone submicrofacies, was observed in the middle part of the Jeribe Formation, as in sample 12 (10X).

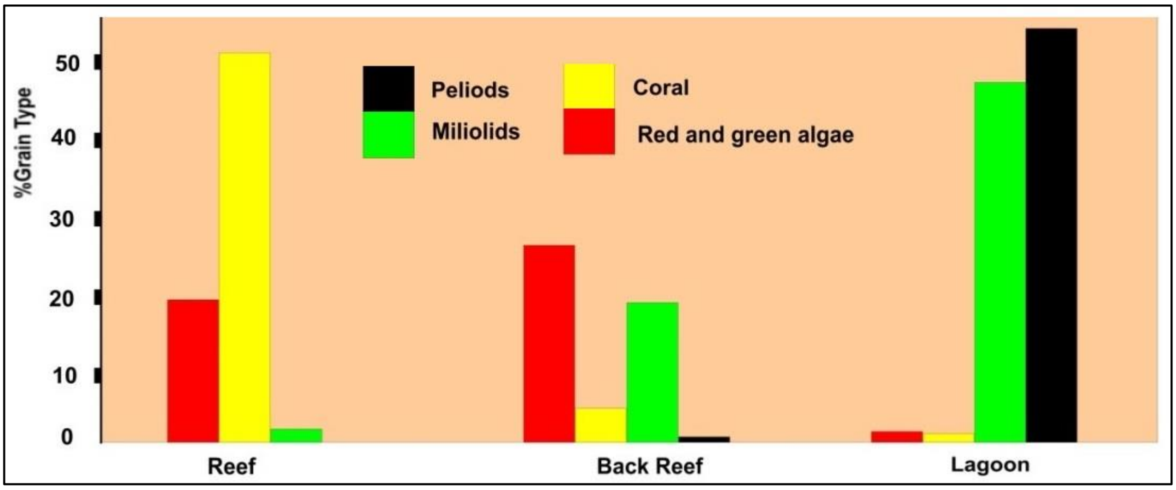

Figure 15: showing the percentage of major grain types in the dominant depositional environments of the Jeribe Formation.

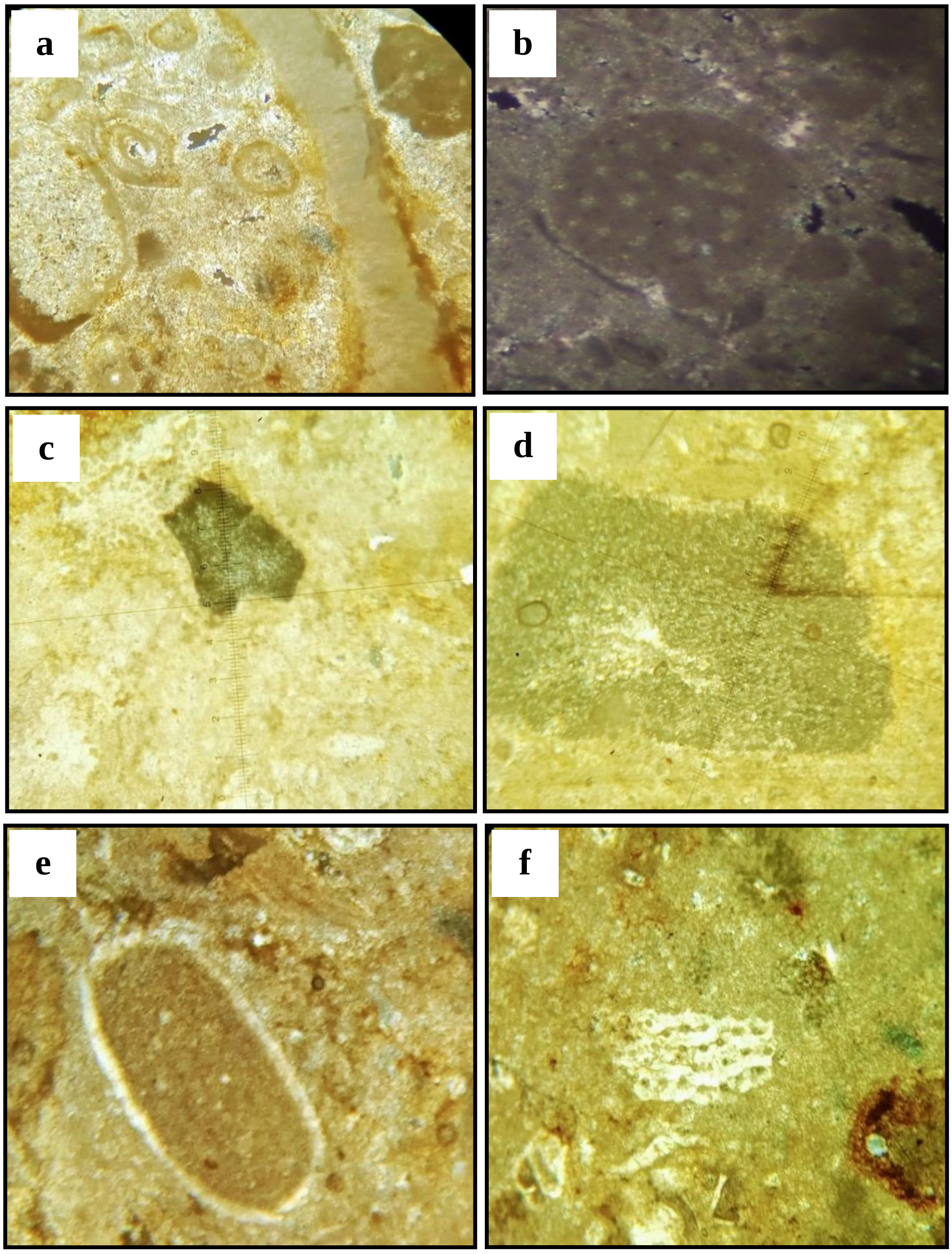

Figure 16: **a)** Red algae, within red algae dolowackstone submicrofacies, was observed in the lower part of the Jeribe Formation, as in sample 2(10X). **b)** Green algae, within green and red algae dolowackstone submicrofacies, was observed in the middle part of the Jeribe Formation, as in samples 13 and 14. **c)** Coral, within coral dolopackstone submicrofacies, was observed in the upper middle of the Jeribe Formation, as in samples 9 and 10 (10X). **d)** Echinoids within dolowackstone submicrofacies, were observed in the lower part of the Jeribe Formation, as in sample 4 (10X). **e)** Ostracods within Ostracods dolomudstone submicrofacies, it was observed in the lower part of the Jeribe Formation, as in sample 5 (10X). **f)** Bioclasts, within bioclasts dolowackstone submicrofacies, were observed in the upper part of the Jeribe Formation, as in sample 17 (10X).

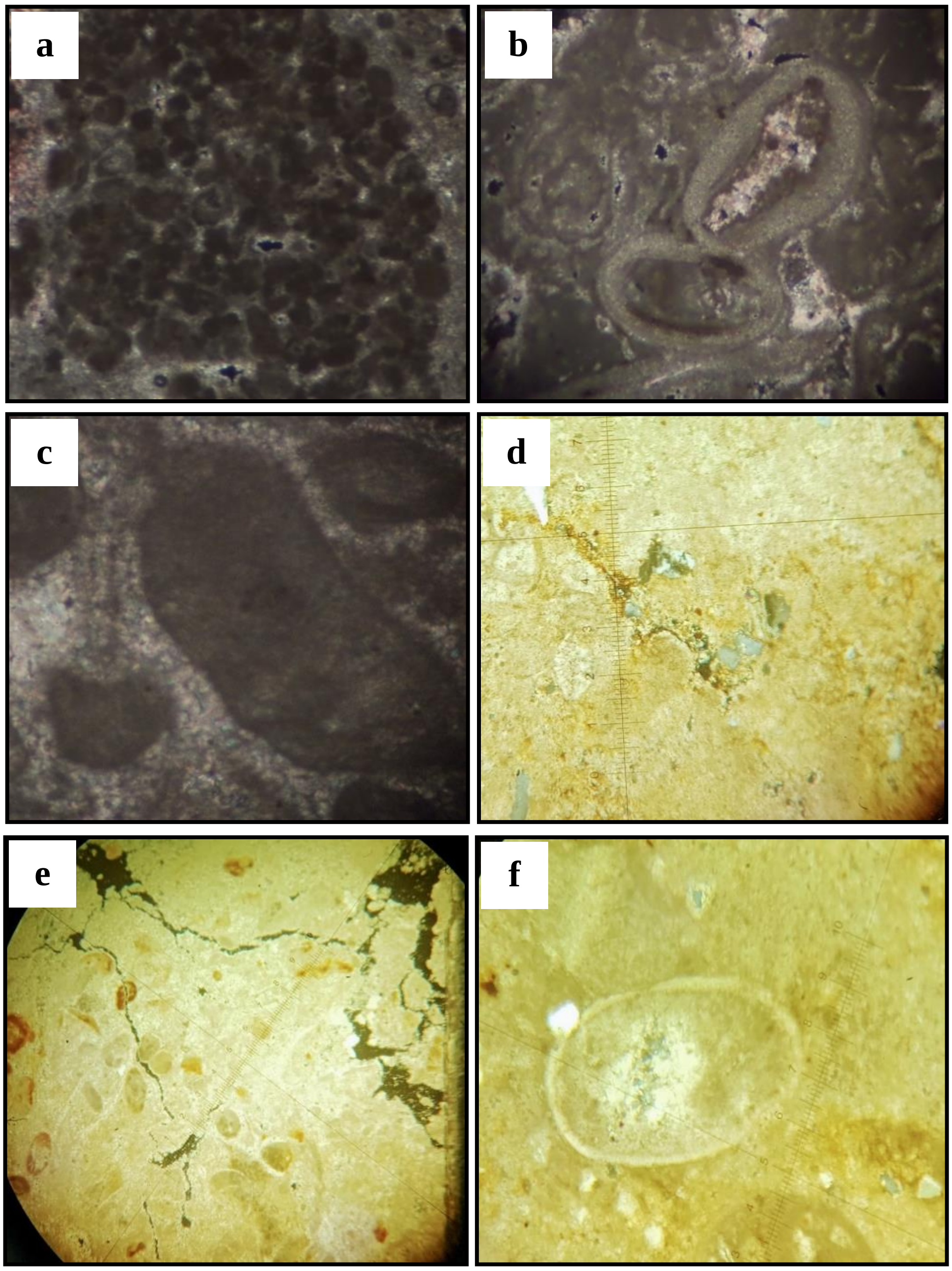

Figure 17: **a)** Peloids, within peloidal dolowackstone submicrofacies, it was observed in the upper part of the Jeribe Formation, as in samples 20 and 21 (10X). **b)** Ooids, within green and ooids dolowackstone submicrofacies, were observed in the middle part of the Jeribe Formation, as in samples 13 and 14 (10X). **c)** Intraclasts within dolomudstone submicrofacies, were observed in the Jeribe and Fatha Formation (10X). **d)** Extraclasts within dolowackstone submicrofacies, it was observed in the lower part of the Jeribe Formation, (10X). **e)** Peloidal dolomudstone submicrofacies, was observed in the Jeribe Formation sample number 20 and 21 (10X). **f)** Ostrocods dolomudstone submicrofacies, were observed in the Jeribe Formation as in samples 5 and 6 (10X).

MICROFACIES ANALYSIS

The microfacies study is one of the important studies, that we can through knowing the sedimentary environments and the sedimentary history during the deposition period, this search included studying and analyzing the sedimentary microfacies, and any changes in microfacies will reflect the changes of physical, and chemical and biological condition during the rocks deposition period. Flugel (1982) defines microfacies as phenomena of bioproperties and deposition, which are distinctive at thin sections. The main microfacies of the Jeribe Formation with their detailed components identified in thin sections upon the petrographic study are as below:

- **Dolomudstone Microfacies (M)**

This microfacies widespread is in Jeribe Formation, and it is a first grade in the Jeribe Formation, the skeletal grains in this microfacies are less than (10%) depending on Dunham (1962). The skeletal grains are floating in the matrix and have non-contact with each other, this microfacies was determined in the lower and upper parts of the Jeribe Formation, and it was divided into two submicrofacies:

– **Peloidal Dolomudstone Submicrofacies (M1):** This submicrofacies was observed in the upper part of the Jeribe Formation. (Figure 17f). It was observed in samples 20 and 21. The thickness of this microfacies in the formation is about 4 m. It is composed of non-skeletal grains of peloids. The percentage of Peloids in this microfacies is more than (10%). The matrix is composed of micrite and microspar. This submicrofacies was affected by the diageneses like dolomitization, chemical compaction, and cementation, The cement types determined in this submicrofacies is granular, and the types of porosity were observed in this submicrofacies are fractures, intraparticles porosities. while the authigenic mineral observed is pyrite, This microfacies evidence shows that the sedimentation happened in low low-energy environment (Lagoon). This submicrofacies match with the standard microfacies (SMF-8) which precipitated within the facies zone (FZ-7), known with the shelf lagoon shallow) according to the classification of (Wilson, 1975; Flugel, 1982).

– **Ostrocods Dolomudstone Submicrofacies (M2):** This submicrofacies was observed in the middle Jeribe Formation as in samples 5 and 6 (Figure 18a). Their matrix is microspare, and this submicrofacies is mainly composed of ostracods. This submicrofacies was affected by dissolution and cementation processes, while the authigenic minerals observed in this submicrofacies are pyrite and quartz. The cement types observed in this submicrofacies are only granular cement, whereas the porosity is one type represented by the intraparticle porosities. This submicrofacies does not give any sedimentation environment.

- **Dolowackstone Microfacies (W)**

It was observed in the middle and upper parts of the Jeribe Formation and this microfacies is widespread in Jeribe Formation. The skeletal grains in lime wackestone microfacies are less than (20%) of the total skeletal. The matrix is composed of microspare. It consists of different skeletal grains like Miliolid, Red algae, Rotaliid, coral, and green algae. The thickness of this microfacies in the formation is about 20 m. microspare is the main component in this submicrofacies. This submicrofacies was affected by the diagenesis-like dolomitization and cementation process. The cement types determined in this submicrofacies is granular, and the types of porosity observed in this microfacies are channel, moldic, intraparticle, and extraparticle porosities. This microfacies evidence shows that the sedimentation happened in a high-energy environment (Reef-Back reef). This microfacies is equivalent to SMF-7 which precipitated in the microfacies zone (FZ-1), known as with platform margin (Wilson, 1975; Flugel, 1982). It is related to the (Reef-Back reef) environment. it was divided into four submicrofacies:

– **Rotaliids Dolowackstone Submicrofacies (W1):** This submicrofacies was observed in the middle of the Jeribe Formation as in samples 11 and 12 (Figure 18b). It is composed of skeletal grains of rotaliid, red algae, and green algae the addition to ostrocods. The percentage of skeletal grains in this submicrofacies is more than (10%). The matrix is composed of microspar. This submicrofacies were affected by diageneses like dissolution, cementation, and neomorphism, while the cement types determined in this submicrofacies are granular and drusy cement, and these submicrofacies consisted of pyrite grains. The types of porosity were observed in this submicrofacies are interparticle and extraparticle porosities. Rotaliids represent an environment of shallow turbulent water less than (40 m) water depth in the shore zone, on reefs, and in inter-reef areas (Geel, 2000) This microfacies is equivalent to SMF-7 which precipitated in the microfacies zone (FZ-1), known with platform margin according to (Wilson, 1975: Flugel, 1982). It is related to the (Back reef) environment.

– **Miliolid Dolowackstone Submicrofacies (W2):** This microfacies is identified in the upper part of the Jeribe Formation as samples 18 and 19 (Figure 18c). The thickness of this submicrofacies is 5 m, the main component of the skeletal grains in this submicrofacies is Miliolid, with a few of the existences benthic foraminifera. The matrix is composed of micrite to microspar. The diagenetic features associated with this submicrofacies are dissolution, cementation, compaction, and neomorphism, while the cement types determined in this submicrofacies are blocky and drusy cement. The presence of milliolide provides a shallow closed environment, this submicrofacies match with the standard microfacies (SMF-18) which precipitated in the facies zone (FZ-7), according to (Wilson, 1975; Flugel, 1982). represented by the lagoon environment (Shelf lagoon with open circulation).

– **Green and Red algae Dolowackstone Submicrofacies (W4):** This submicrofacies was observed in the upper of the Jeribe Formation as in samples 13 and 14 This microfacies is composed of red and green algae with assemblages of benthic foraminifera (Figure 18e). The diagenetic process acts in this microfacies are cementation (microspar) and dolomitization, while the cement type determined in this submicrofacies is granular cement. The types of porosity were observed in this microfacies are extraparticle and intraparticle porosities. This microfacies is equivalent to (SMF-7) which precipitated in the microfacies zone (FZ-1), known as with platform margin (Wilson, 1975: Flugel, 1982). It is related to the (Back reef) environment.

- **Dolopackestone Microfacies (P)**

This microfacies is less spreading in the Jeribe Formation. It is the third grade in the formation. The percentage of skeletal grains in this microfacies is more than (5%) according to (Dunham, 1962). It was represented by one submicrofacies as follows:

– **Red algae Dolopackestone Submicrofacies (P1):** This submicrofacies consists of green algae more than (50%). This submicrofacies was observed in the lower of the Jeribe Formation as samples 1, 2, 3, and 7 (Figure 18f). This submicrofacies was affected by the cementation process, While the matrix was composed of sparite. The authigenic minerals were observed in this submicrofacies represented by pyrite, This microfacies is equivalent to (SMF-7) which precipitated in the microfacies zone (FZ-1), known with platform margin according to (Wilson, 1975: Flugel, 1982). It is related to the (reef-to-back reef) environment.

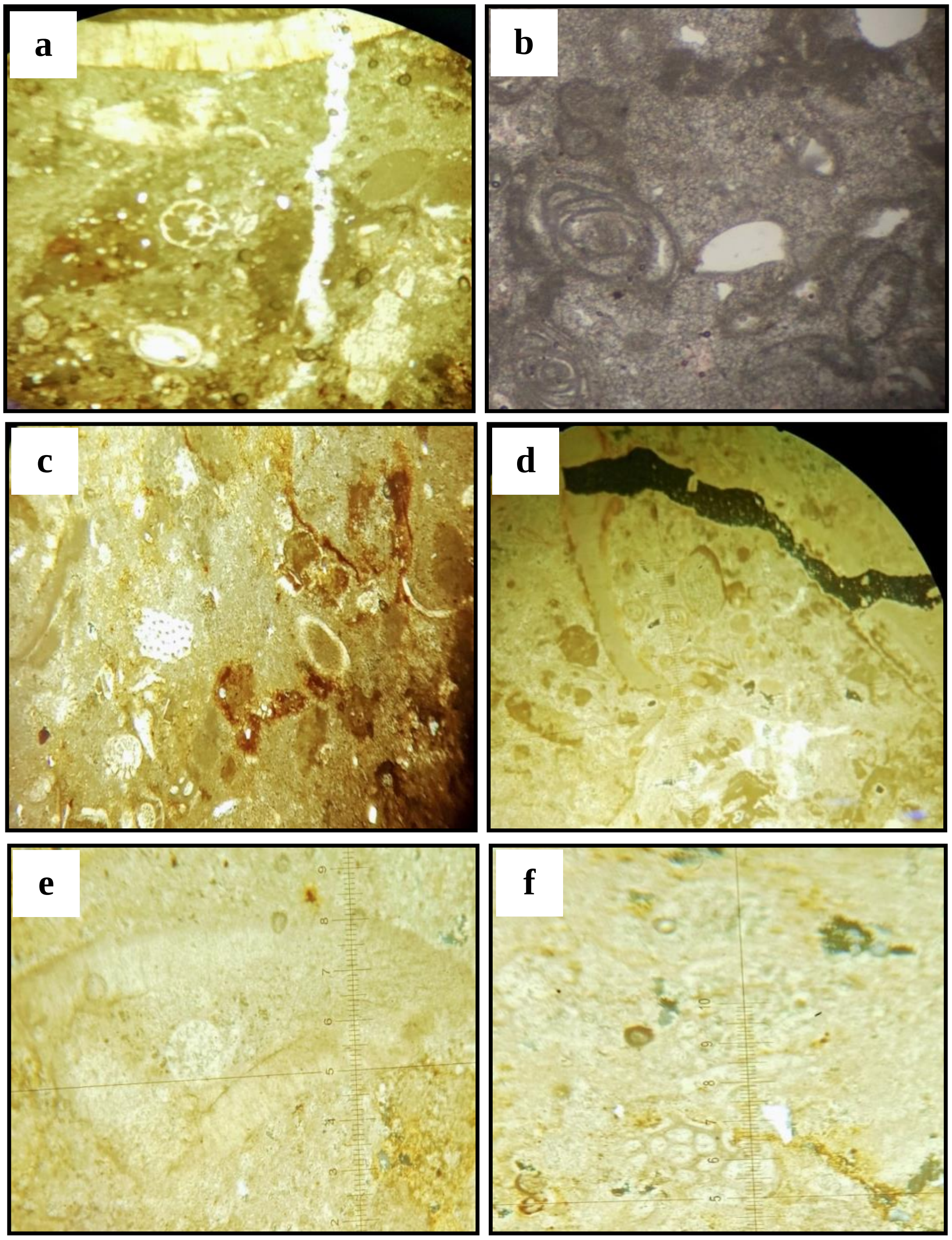

Figure 18: **a)** Rotaliids dolowackstone submicrofacies was observed in the Jeribe Formation as in samples 11 and 12 (10X). **b)** Miliolid dolowackstone submicrofacies was observed in the Jeribe Formation as in samples 18 and 19 (10X). **c)** Bioclasts dolowackstone submicrofacies was observed in the Jeribe Formation as in samples 16 and 17 (19X). **d)** Green and red algae dolowackstone submicrofacies was observed in the Jeribe Formation sample number as in samples 13 and 14 (10X). **e)** Red algae dolopackestone submicrofacies was observed in the Jeribe Formation sample number 1, 2, 3, and 7 (10X). **f)** Coral dolopackestone submicrofacies was observed in the Jeribe Formation as in samples 9 and 10 (10X).

– **Coral Dolopackestone Submicrofacies (P2):** This microfacies reveal predominate coral, which is mostly identified in the middle part of the Formation. This submicrofacies was affected by the silicification, cementation, and dissolution Process. The matrix is composed of microspare. The authigenic minerals were observed in this submicrofacies represented by pyrite and quartz, While the porosity types were determined in this submicrofacies represented by intraparticle porosity. This microfacies evidence shows that the sedimentation happened in a high-energy environment. This microfacies is equivalent to (SMF-7) which precipitated in the microfacies zone (FZ-1), known as with platform margin (Wilson, 1975; Flugel, 1982). It is related to the (Reef) environment.

SEDIMENTARY ENVIRONMENTS

The sedimentary environment is any part of the earth's surface that can be distinguished from neighboring parts depending on the differences in the conditions (Selley, 1976). Jeribe Formation is part of the Middle Miocene (Langhian period). It consists of dolostone, the formation consists of benthonic foraminifera represented by *Borelis melo curdica*, Rotalia, Ostrocods, and Miliolid in addition to Coral and Algae with non-skeletal grains like Peloids.

In the present study, we depended on the information from the microfacies and the existence of benthic foraminifera to explain the paleoenvironment of the Jeribe Formation. The Jeribe Formation consists high percentage of the benthic foraminifera with a few other grains. *Borelis melo curdica*, which for a long time has been considered an index fossil for this formation. These organisms provide on lagoon, reef, and back reef environments. According to Wilson (1975), Flugel (1982), and Dunham (1962), the sediments of the Jeribe Formation are shallow submicrofacies, the Jeribe Formation consists high percentage of the benthonic foraminifera, and these organisms are provided on a shallow environment. The standard microfacies that were determined in Jeribe Formation are (SMF-18,3,4,) which were precipitated within three facies zones (FZ-7) lagoon, (FZ-5) back reef (FZ-3) reef. Microfacies analysis of the Jeribe Formation showed that the deposition took place within three environments as follows:

- **Lagoon Environment**

The lagoon proper includes the area landward of the barrier reef and seaward of the mainland shoreline (Purdy *et al*., 1975). This environment was represented by a Shelf lagoon with open circulation and facies zone, which included (FZ-8), This environment was determined by the grains components and the nature of the matrix. Through the microscopic study, it was observed that the main Jeribe Formation submicrofacies was deposited in the Lagoon environment and these submicrofacies contain a high percentage of the benthonic foraminifera and micrite. The submicrofacies that were determined in the Jeribe Formation are (M1) and (W2). The benthonic foraminifera is more found, this high percentage of benthonic gives evidence for the shallow environment, The presence of Peloids gives evidence of the shallow environment (lagoon). Miliolids reflect a lagoonal environment with high salinity. These microfacies evidence give that the sedimentation happened in low energy environment (Lagoon).

- **Back reef Environment(Shallow water lagoon)**

The back reef includes the shallow lagoon between the shore and the coral reef. This habitat includes small patches of corals, sea grass beds, and sand plains. The back reef is often warmer because of the shallow depth, reduced water flow, and protection from waves. Salinity can also fluctuate due to freshwater inputs (Geary, 2007).

This environment was represented by the back reef and facies zone, which included (FZ-5), This environment was determined by the components of the grain. Through the microscopic study, it was observed that the main Jeribe Formation submicrofacies was deposited in the back reef environment, these submicrofacies contain a high percentage of the benthonic foraminifera and green and red algae in addition to bioclasts. The submicrofacies that were determined in the Jeribe Formation are (W1), (W3), (W4), and (P1). Bioclasts provide good evidence for a high-energy environment. The bioclasts give evidence for the back reef environment, these microfacies evidence that the sedimentation happened in a high-energy environment (Back reef). The presence of Rotalia, red algae and green gives evidence of the back reef environment. These microfacies evidence give that the sedimentation happened in high energy environment (Back reef).

- **Reef Environment (Reef flat)**

A reef (Coral reef) is an underwater ecosystem characterized by reef-building corals. Reefs are formed of colonies of coral polyps held together by calcium carbonate. Most coral reefs are built from stony corals, whose polyps cluster in groups (Leichter *et al*., 2003). This environment was represented by the reef and facies zone, which included (FZ-5), this environment was determined by the components of the grain. Through the microscopic study, it was observed that the main Jeribe Formation submicrofacies was deposited in the reef environment, these submicrofacies contain a high percentage of the coral. Submicrofacies was determined in the Jeribe Formation (P2). The coral gives evidence for the reef environment, These microfacies evidence that the sedimentation happened in a high-energy environment (reef). This microfacies evidence shows that the sedimentation happened in a high-energy environment (reef environment).

SEDIMENTARY MODEL FOR JERIBE FORMATION

Depending on the results in this search that were observed from biologically and sedimentary indicates. The ideas were collected for constructing the sedimentary model for how deposition formation of the present study area in the area of (Zurbatiya) in the east of Iraq will distinguish it by the sedimentary model. Depending on the information in this present study, a model for Jeribe Formation in the study area as in (Figure 19).

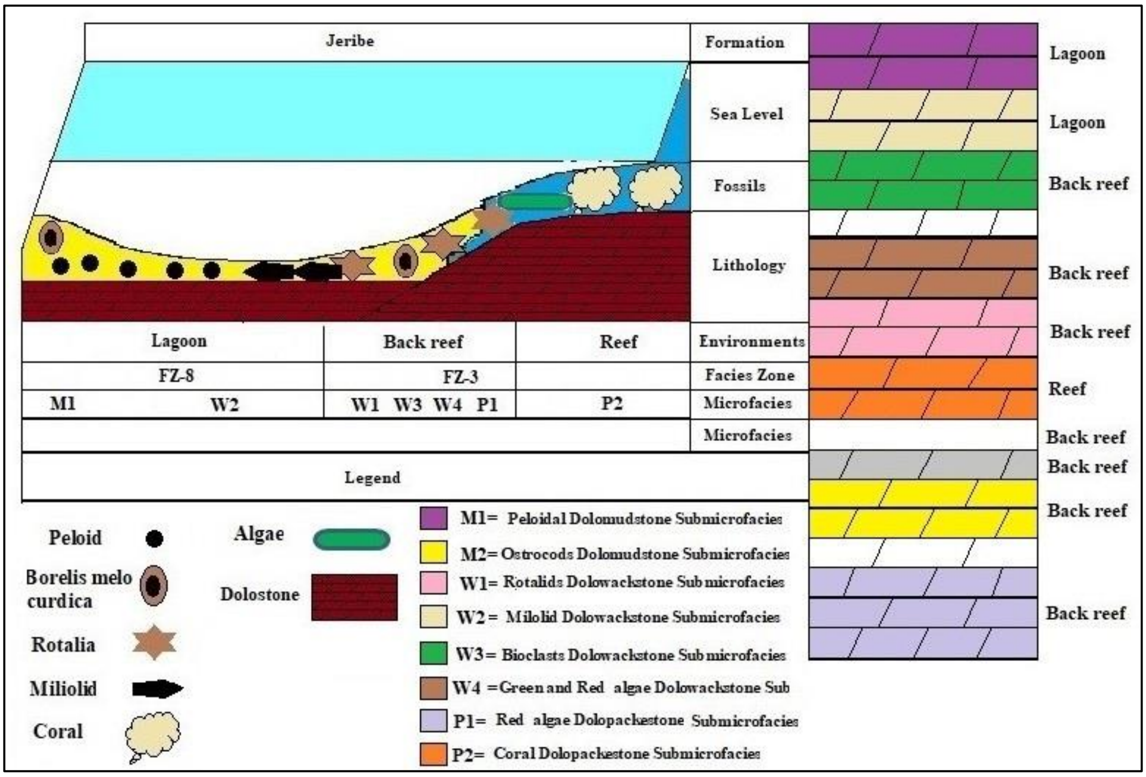

Figure 19: Depositional model for the Jeribe Formation in the study area.

CONCLUSIONS AND RESULTS

The following is a summary of the conclusions that have been drawn from this study:

- Jeribe Formation in the Zurbatiya area is 65 m thick and composed of dolomitic rock. The lower contact is unconformable with the Dhiban Formation while the upper contact is conformable with Fatha Formation.
- Jeribe Formation has the largest thickness in the Zurbaitya area, which represents the center of the sedimentary basin with a thickness of 65 m, while the Kirkuk area has a thickness is medium, with a thickness of 45 m, and in the Mosul area, the thickness is the lowest, which represents the edges of the sedimentary basin with a thickness less than 45 m.
- We infer that the rocks of formation contain fossils like benthic foraminifera including Miliolid, *Borelis melo curdica*, rotaliids, and o strocods in addition to red algae, green algae, and Coral.
- The Jeribe Formation rocks were influenced by many diagenesis processes such as dissolution, cementation, neomorphasim, compaction, dolomitization, and silicification.
- The recognized main microfacies within the Jeribe Formation are dolomudstone, dolowackestone, and Dolopackestone microfacies according to Dunham's (1962) Classification. This microfacies were divided into submicrofacies according to their component presence in formation.
- Based on the petrographic study and microfacies analysis, the Jeribe Formation was mainly deposited in the reef, back reef, and lagoon environments, which represent relatively low to high-energy environments.
- The thickness of the Jeribe Formation in the Zurbatiya area is about 6.

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