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Sedimentology and Basin Development of the Middle Miocene Succession in the Zurbatiya Area, Eastern Iraq

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Abstract

The present study is focused upon the sedimentology and basin development of the Jeribe and Fatha Formations by using the field observations and microfacies analysis. The area of study situated in the Zurbatiyah area to the south of the Shur sharin valley about 21 km northeast of Badrah city to the southeast of Baghdad. This area lies within the Zagros foreland basin, and located between the Zagros mountains at the northeastern and the Arabian shield at the southeastern.

The studied succession which including the Jeribe and Fatha Formations were deposited within four associated facies for the Jeribe Formation and three for the Fatha Formation, as shown below: -

Jeribe Formation includes dolomitized mudstone-wackstone (semi restricted); Milliolid wackstone-packstone (shallow open marine), Dolomitic packstone (lagoon).

Fatha Formation includes pelecypods bioclastic wackstone-packstone (lagoon); peloidal bioclastic packstone (lagoon); massive gypsum (evaporitic lagoon); laminated gypsum (supratidal and evaporitic lagoon)

The facies analysis for the studied succession showing two stages of deposition:- The first stage is represented the final transgression stage in the studied area. The fall sea level gradationally appeared by shallowing up-ward and more dolomitized upward from the middle part of the Jeribe Formation.

The second stage the deposition was started when the first beds gypsum and anhydrite is appeared for the Fatha Formation refer to the restricted and supratidal environment. The uplifted of the eastern and northeastern parts of Iraq generate a tectonic depositional ridge to the west and northwestern resulted in the formation of restricted basins and regional regression in the Arabian plate.

Keywords: Sedimentology, Basin Development, Middle Miocene Succession, Zurbatiyah

رسوبية و تطور حوض تتابع المايوسين المتوسط في منطقة زرباطية، شرق العراق

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الخلاصة

لقد ركزت الدراسة الحالية على رسوبية وتطور الحوض الرسوبي لتكويني جريبي والفتحة باستخدام المشاهدات الحقلية وتحليل سحنات صخورهما. ان منطقة الدراسة تقع في منطقة زرباطية إلى الجنوب من وادي شورشيرين حوالي ٢١ كم شمال شرق مدينة بدة إلى الجنوب الشرقي من بغداد. تقع هذه المنطقة داخل حوض زاكروس المتقدم وتحدها من الشمال الشرقي جبال زاكروس وعلى الجنوب الشرقي من الدرع العربي.

ترسب التتابع المدروس المتضمن تكويني جريبي و الفتحة في ثلاث سحنات صخرية لتكوين جريبي واربعة لتكوين الفتحة، كما هو مبين أدناه:

تكوين جريبي؛ يتضمن سحنة الحجر الجيري الطيني و الواكي (بيئة شبه محجوزة) و سحنة الحجر الجيري الواكي والمرصوص الميلوليدي (بيئة البحر الضحل المفتوح) و الحجر الجيري المرصوص المتدلتمت (لاغون). بينما يتضمن تكوين الفتحة سحنة الحجر الجيري الواكي والمرصوص الحامل لمكسرات بطنيات القم (بيئة محجوزة) و سحنة الحجر الجيري البلويدي المرصوص (لاغون) و الجبس الكتلي (بيئة تبخرية ضحلة) و الجبس المترقق (بيئة فوق المدية التبخرية).

ان تحليل سحنات التتابع المدروس اظهر ثلاث مراحل للترسيب :-

المرحلة الأولى تمثل مرحلة التقدم البحري النهائي في المنطقة المدروسة. حيث ظهرت تتابع السحنات تضحل نحو الاعلى ، وخصوصا بتدلتمت الصخور الجيرية كمؤشر لانخفاض مستوى سطح البحر بشكل تدريجي بعد النصف الاول من الجريبي.

في المرحلة الثانية من الترسيب عند ظهور أول طبقة من الجبس والأنهيدريت لتكوين الفتحة والتي تشير إلى البيئة المحجوزة و فوق المدية. ان ارتفاع شرق وشمال شرق العراق والتي ادت الى تكون حواجز من الرواسب التكتونية إلى الغرب والشمال الغربي سبب ادى الى تشكل حوض محجوز و تراجع اقليمي للبحر في الصفحة العربية.

Introduction

The latest Eocene-Recent Megasequence is associated with collision of Neo-Tethyan terrains along the north and east sides of the Arabian plate, and the opening of the Gulf of Aden and red sea on the south and west sides of the plate. The opening of the red sea and Gulf of Aden was associated with thermal uplift, flood basalt, and rifting. The opening of Gulf of Aden was end first in Oligocene time followed by the Red Sea opening in the early Miocene (Makris and Henke,1992 and Hughes and beydoun,1992 in [1]. The north and northeast drift of Arabia and the closure of the Neo-Tethys resulted in folding and thrusting of the neo-Tethyan terranes along the new margin of the Arabian plate [1].

This Megasequence is subdivided in to three sequences of latest Eocene-Oligocene, Early-Middle Miocene including the Ghar, Euphrates, Serikagni and Dhiban formations, and the Late Miocene-recent age is including the Jeribe and Fatha formations (Figure-1) [2]. The latest two subdivisions are the more important in the present study, because of the expected succession in the studied area is within these cycles.

The area of study situated in the Zurbatiyah area to the north of studied area at N33°23'55.99" E45°58'22.23" about 31 km northeast of Badrah city to the southeast of Baghdad (Figure-2). This area lies within the Zagros foreland basin, bordered on the northeast by the Zagros mountains and on the southeast by the Arabian shield, and consists of linear and high-amplitude folds that trend in a northwest-southeast direction.

The aim of the present study is the sedimentology and basin development of the Jeribe and Fatha Formations by using the field observations and microfacies analysis.

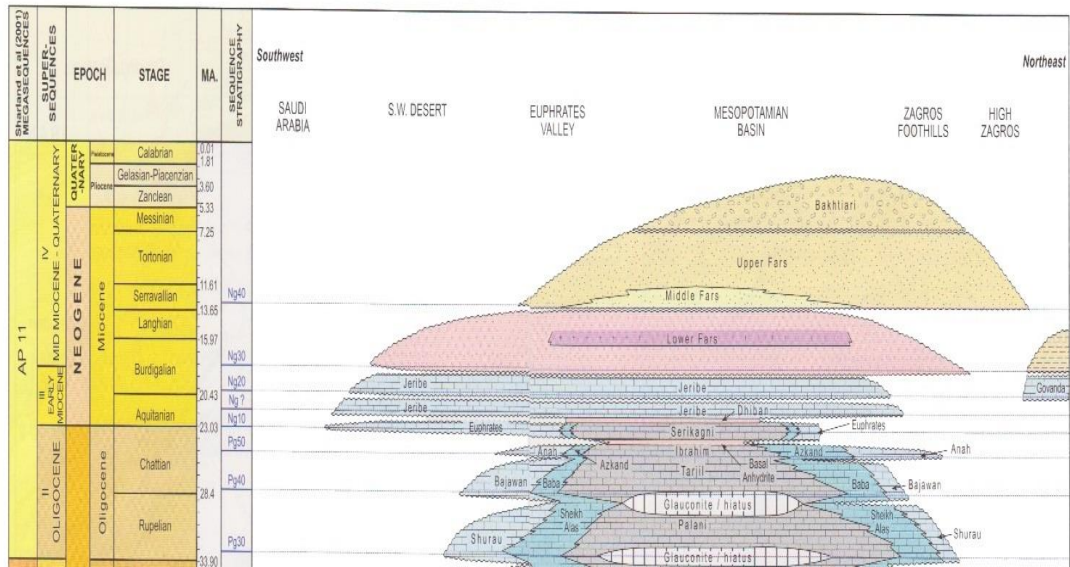


Figure 1-stratigraphic cross section shows the studied succession [2]

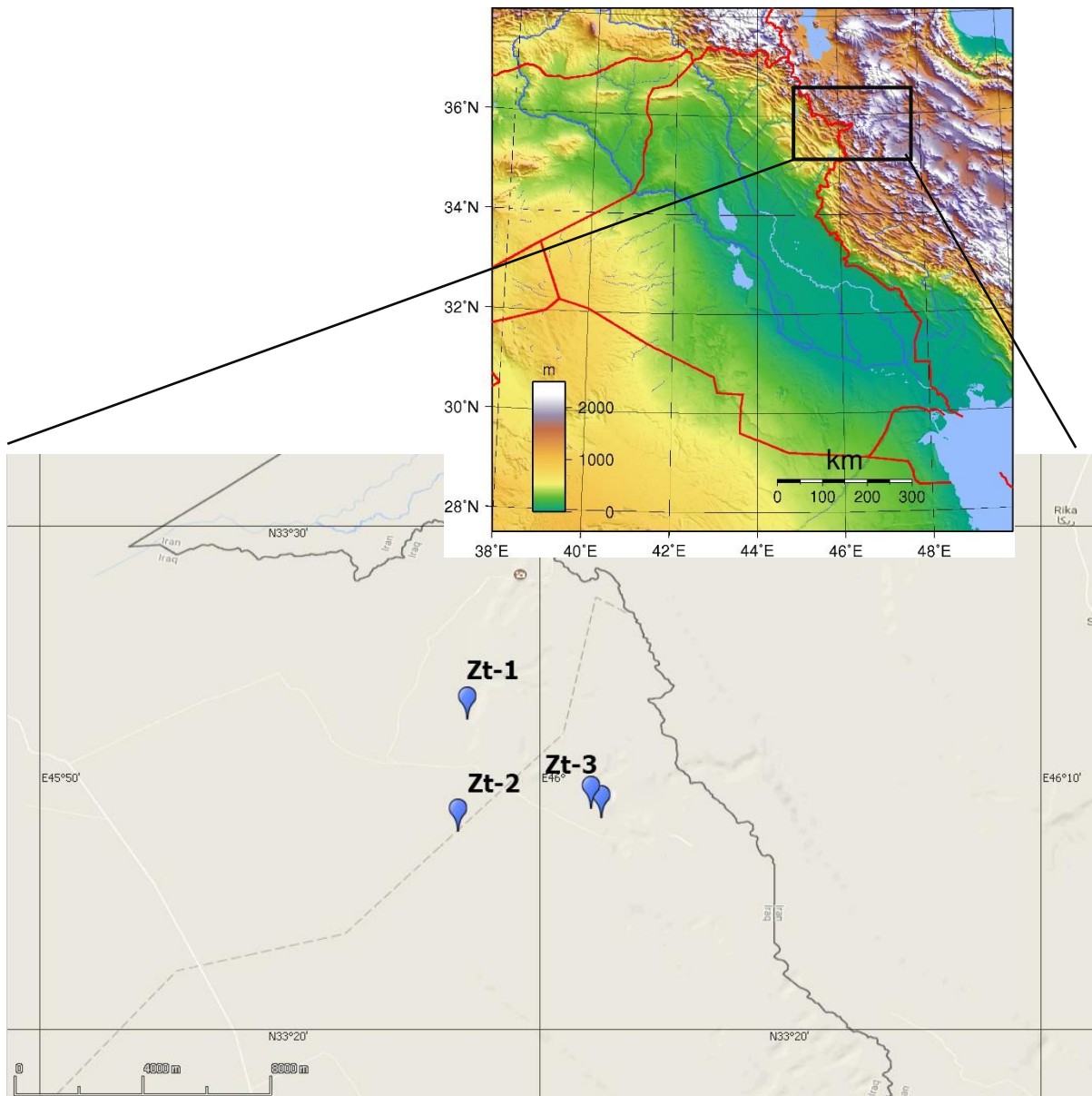


Figure 2-Location map of studied area.

Methodology

The present study was completed by two main stages:

1. Field observation and sampling stage: This stage is represented by the field measurements, sampling, description of the sedimentary structure, the geometry and the unit rocks relationships Figures-(3, 4, and5).
2. Laboratory work:- this including thin sections preparation for the collecting samples in order to study the microfacies in these successions.

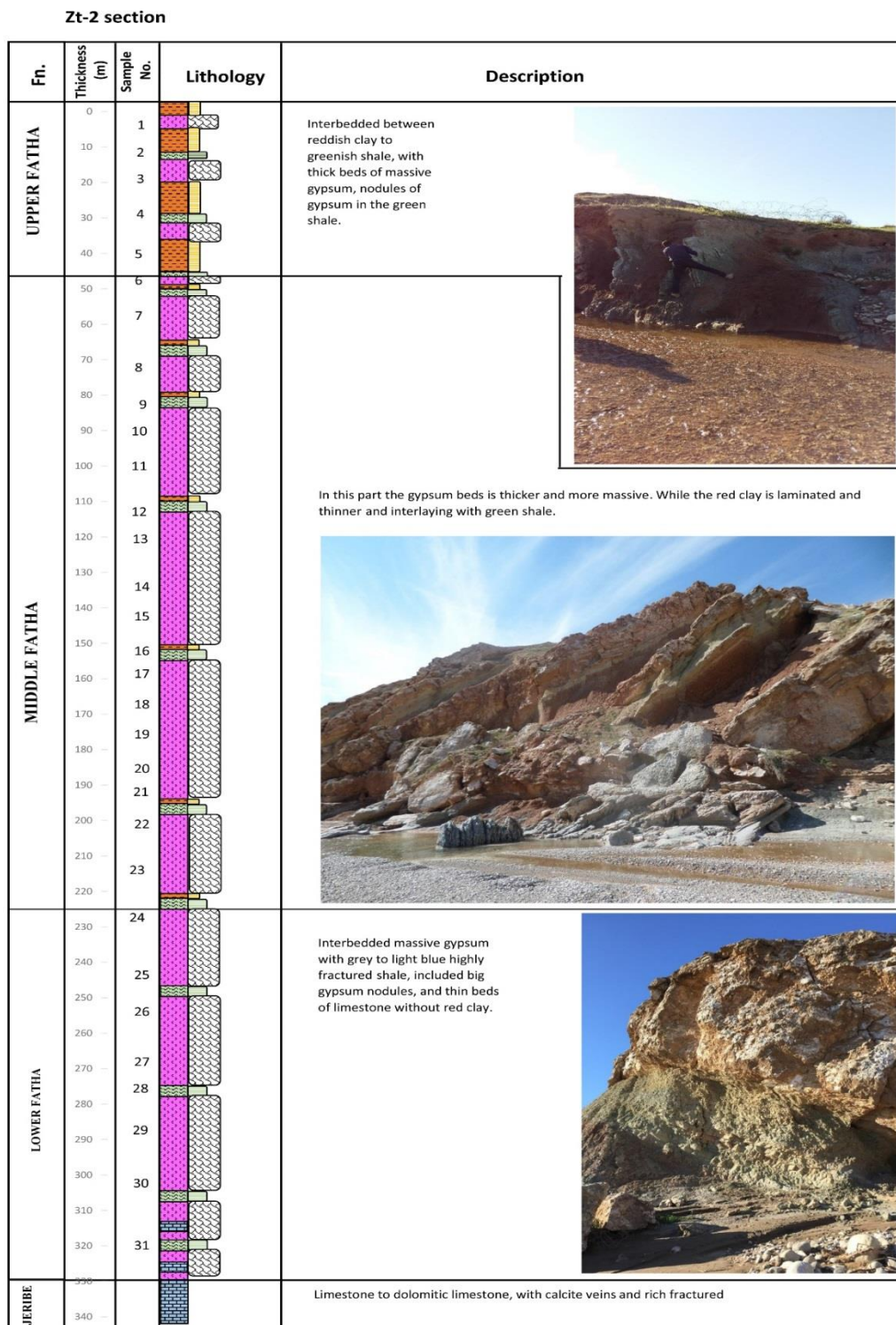


Figure 3-shows lithologic section of Zt-2 section with major differences among the lower, middle and upper parts of Fatha Formation.

Zt-3 section

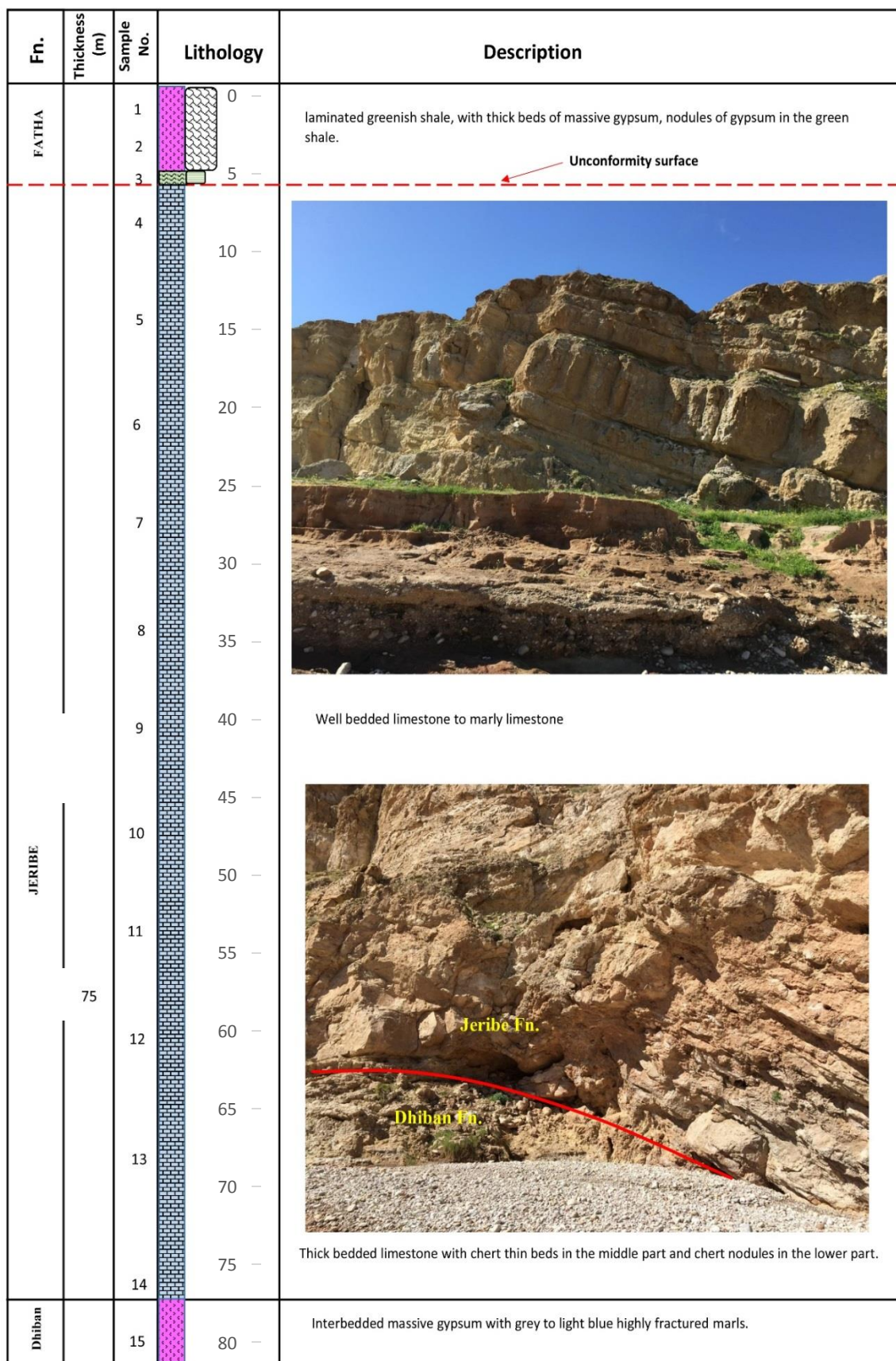


Figure 4-shows lithologic section of Zt-3 station with major differences of Jeribe Formation.

Facies analysis

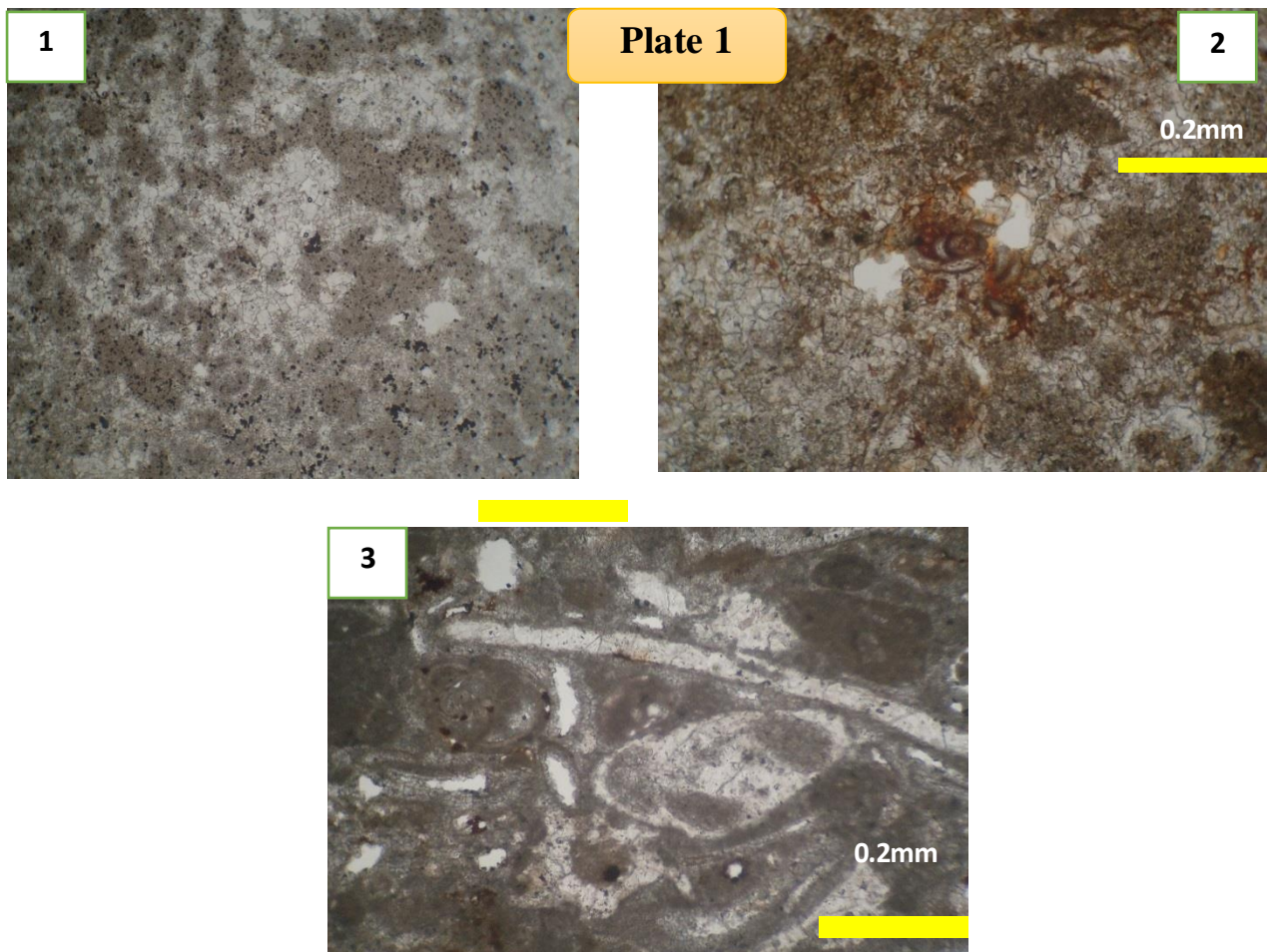
Jeribe Formation

The Jeribe Formation is exposed in the Shur Sharin Valley (to the south east of section Zt-2) to the north of studied area at N (33° 24' 12.57 ") E(46° 01' 13.7") at the section Zt-3. The thickness of the Jeribe Formation in this section is about 70.5m, and unconformably underlies Fatha Formation and overlying Dhiban Formation with conformable surface. This formation consists mainly of crystalline limestone and dolomitic limestone. There are three main microfacies within two standard microfacies of Wilson's (1975) [3] and Flügel's (2010) [4] in studied succession:

1. Dolomitized mudstone-wackestone, dolomitized mudstone appears at upper part near contact with Fatha Formation (plt-1.1). It represents deposition of semi restricted at SMF-23 within Facies Zone 8 (FZ8).
2. Milliolid wackestone-packstone is considered as important facies in this formation, with skeletal grain such as foraminifera especially milliolds in addition to rare percence of mollusks, bryozoa, algae, bioclasts and echinoderm. The non-skeletal grains include peloids, intraclasts (plt-1.2). It represents deposition of shallow open marine at SMF-10 within Facies Zone 7 (FZ7).
3. Dolomitic packstone facies is common at the lower and middle parts, which include skeletal and non-skeletal grains (plt-1.3). It represents deposition of lagoon at SMF-16 within Facies Zone 8 (FZ8).

The upper contact is unconformably overlain by the Fatha Formation while the lower contact is conformable with the Dhiban Formation (Figure-5). The thick gravel bed at the base of the Fatha and overlying the Jeribe may indicate important unconformity at the contact [5].

According to Al-Hashimi and Amer (1985) [6] the Jeribe Formation is homogeneous in lithology and in faunal assemblage's content. It is composed of dolomitized limestone, containing various fauna like: Borelis species, miliolids, rotallids, peneroplids, molluscs, bryozoa and algae. These fossil assemblages recognized in different areas (Sinjar, Kirkuk, Hit). It reflects a restricted environment on marine platform, mainly of lagoonal facies, of calm and warm water, with relatively high salinity.



- 1- Dolomitized mudstone-wackstone. Zt-3 (Depth from the top 6.0 m.) Jeribe Fn.
- 2- Milliolid wackstone-packstone. Zt-3 (Depth from the top 25.0 m.) Jeribe Fn.
- 3- Dolomitic packstone. Zt-3 (Depth from the top 66.0 m) Jeribe Fn.

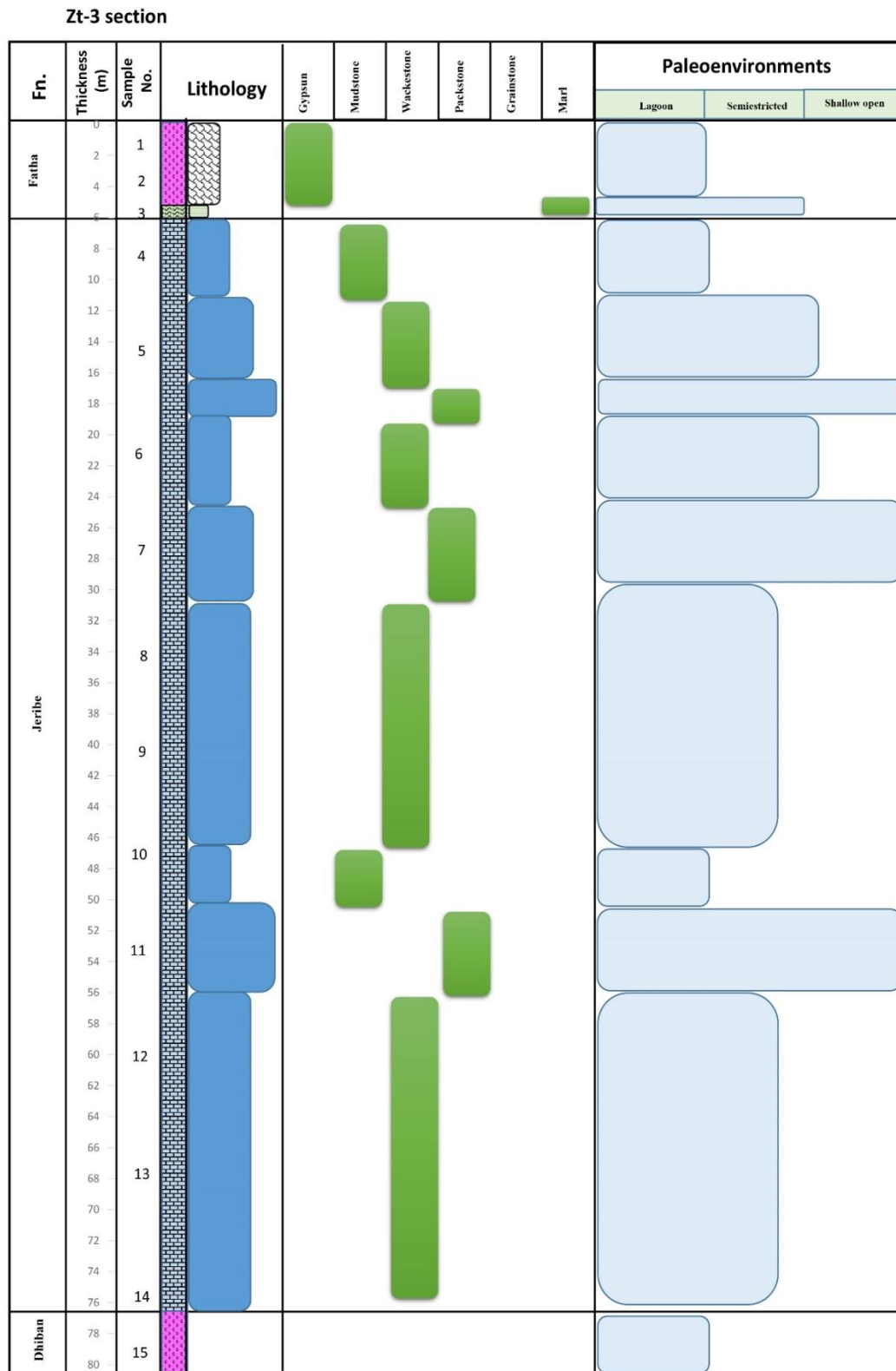


Figure 5-shows the Zt-3 geological columnar section with microfacies and diagenesis distribution

Fatha Formation

The Fatha Formation is located to exposed with total thickness about 330m to the northwest of the Shur Sharin Valley in section Zt-1 at N33°26'12.18" E45°58'33.06" and in the section Zt-2 the Shur Sharin Valley at N33°23'57.42" E45°58'21.94". The lower contact of the Fatha Formation with the underlying Jeribe Formation is unconformable. In some areas, however, the formation overlies older rock units, especially near the shoreline of the basin. The upper contact with the Injana (Upper Fars) is gradational and diachronous [5].

Four major microfacies are recognized in this study, two in carbonate rocks and two in evaporite rocks:-

A. Pelecypods bioclastic wackestone-packestone microfacies: This microfacies is the most dominant in the Fatha Formation. The skeletal fragments are mostly represented by complete shells or fragmented gastropods and echinoderm fragments (Plt.2. 1). It represents deposition of lagoon at SMF-21 within Facies Zone 8 (FZ8).

B. peloidal bioclastic packstone -: This microfacies is common and recognized in many intervals (Plt.2.2). It is characterized by large bioclasts and echinoderm fragments. It represents deposition of lagoon at SMF-16 within Facies Zone 9 (FZ9).

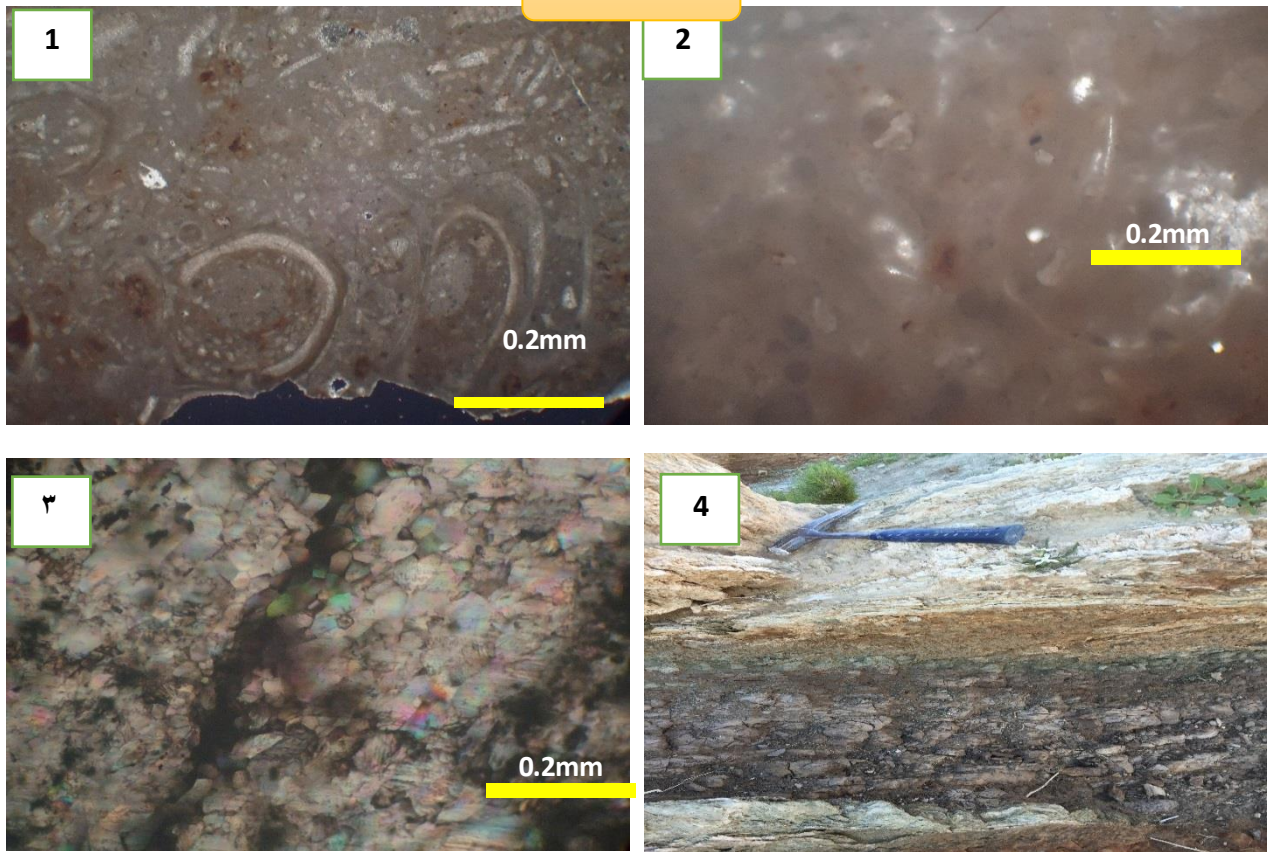
C. Massive gypsum (plt.2.3) is the main part of the formation, which represented the lower part. It represents deposition of restricted and evaporitic lagoon at SMF-25 within Facies Zone 9 (FZ9).

D. Laminated gypsum with red mudstone and grey marl alternative (Plt. 2-4). It represents deposition of supratidal and evaporitic lagoon at SMF-26 within Facies Zone 9 (FZ9).

According to Al-Hashimi and Amer (1985) [6] The Fatha Formation seems to be deposited under very restricted environment (closed lagoon) of hypersaline condition, indicated by the cyclicity of gypsum sediments and by abundant occurrences of miliolids, rotallids and Elphidium species in carbonate sediments. The accumulation of dominant Pelecypoda shells (coquina) debris forming shoal wall reflect a quite marine condition; whereas the well formed ooids, and well coated grains and fossils, reflect a high energy environment of tidal bars.

A lacustrine facies is indicated by the near shore sediments of the Fatha Formation where increased terrigenous materials and reduced evaporite are in countered.

Plate 2



1. Pelecypods bioclastic wackestone. Zt-2 (Depth from the top 308 m.) Fatha Fn.
2. peloidal bioclastic packstone. Zt-2 (Depth from the top 310 m.). Fatha Fn.
3. Massive gypsum Zt-2 (Depth from the top 90.0 m.). Fatha Fn.
4. Laminated gypsum with red mudstone Zt-2 (Depth from the top 80.0 m.). Fatha Fn.

Paleoenvironment and basin development

The facies analysis for the studied succession showing presence of three microfacies for the Jeribe Formation and four microfacies for the Fatha Formation (Figure-6).

The middle Miocene succession was deposited during three stages of the sea level volatility such as the follow:-

First stage:- In early Middle Miocene time widespread shallow water lagoonal and reefal carbonates (Jeribe Formation) were deposited on a broad carbonate platform. The Abu Jir block was re-activated and separated two lagoonal basins in which the Fatha Formation was deposited. Carbonates and thin evaporites were deposited over this high [1]. Therefore, the fourth stage is represented the final transgression stage in the studied area. The fall sea level gradually appeared by shallowing upward and more dolomitized upward from the middle part of Jeribe Formation (Figure-(6a).

Second stage:- the deposition of the first beds gypsum and anhydrite for the Fatha Formation refer to the restricted and supratidal environment. The Abu Jir block was re-activated and separated two lagoonal basins in which the Fatha Formation was deposited. Carbonates and thin evaporites were deposited over this high [1]. The uplifted of the eastern and northeastern of Iraq and generated of tectonic-deposition ridge to the west and northwestern due to the restricted basin (Figure- (6b)

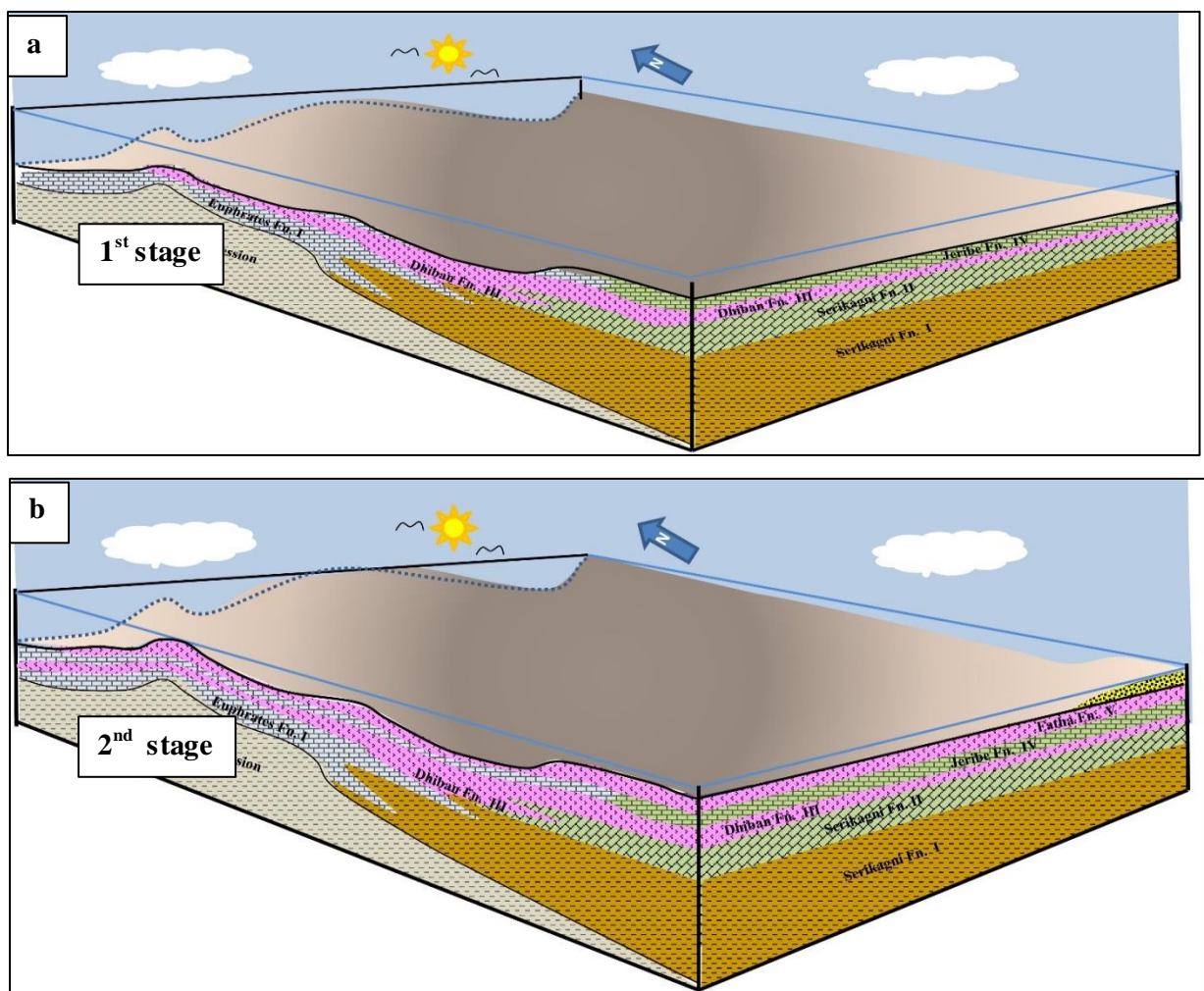


Figure 6-Depositional models for the 1st and 2nd stages basin and paleoenvironment.

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