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Paleoenvironments and Sequence Development of the Miocene succession , Western and Southern Iraq

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ABSTRACT

The Miocene succession of western and southern Iraq is represented by the Euphrates, Ghar, Jeribe, Nfayil, Fatha, and Injana formations. The Euphrates Formation (Early Miocene) consists mainly of shallow marine facies; it`s equivalent the Ghar Formation (Early- Early Middle Miocene) is represented by continental clastic facies. The Jeribe Formation (Early Middle Miocene) represents shallow marine environment. The Nfayil Formation (Middle Miocene) also of shallow marine environment, it`s equivalent the Fatha Formation is represented mainly by supratidal marine environment. The Injana Formation (Late Miocene) represents the clastic continental facies.

The studied succession was highly affected by many diagenetic processes such as dolomitization, dedolomitization, dissolution and cementation with less effective micritization, neomorphism, and compaction.

Four third order cycles were recognized in the studied sections, These include: cycle A of the Miocene Euphrates Formation and it`s equivalent the lower part of the Ghar Formation, cycle B of the Early Middle Miocene Jeribe Formation and it's equivalent the upper part of the Ghar Formation, cycle C of the Middle Miocene Nfayil Formation and it`s equivalent the Fatha Formation, and cycle D of the Late Miocene Injana Formation. Each third order cycle can be subdivided into a number of fourth order cycles. All of the fourth order cycles are assymmetrical reflecting an imbalance between the relative sea level and carbonate production. A variation between the different sections in nature of cyclic deposition reflects the difference of local tectonic effect on the sequence development.

Keywords: Paleoenvironments, Sequence Development, Miocene Succession

البيئات القديمة وتطور تتابع المايوسين لغرب وجنوب العراق

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الخلاصة:

يتمثل تتابع المايوسين في غرب وجنوب العراق بتكوينات الفرات ومكافئه الغاروالجريبي و النفايل ومكافئه الفتحة وتكوين انجانة.

يتمثل تكوين الفرات (المايوسين المبكر) بصورة اساسية من سحنات البيئات البحرية الضحلة وهو مكافئ لتكوين الغار المتمثل بترسبات قارية فتاتية لعمر المايوسين المبكر – المايوسين الاوسط المبكر. تكوين الجريبي (المايوسين الاوسط المبكر) يمثل تعاقباً من بيئات بحرية مفتوحة ضحلة مع بيئات بحرية معزولة، أما تكوين

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النفايل (المايوسين الاوسط) فيشابه تكوين الجريبي من الناحية البيئية وهو مكافئ لتكوين الفتحة المتمثل بصورة رئيسية من بيئات بحرية مدية. يمثل تكوين انجانة (المايوسين المتاخر) بترسبات قارية فتاتية.

تأثرت المقاطع المدروسة بدرجه عالية بعمليات تحويرية مثل الدلمتة واعادة الدلمتة والسمنتة والاذابة مع عمليات اقل تأثيراً مثل المكرتة وإعادة التشكيل والاحكام.

تم ملاحظه اربع دورات ترسيبية من الدرجة الثالثة في المقاطعقد الدراسة ، دورة A لعمر المايوسين المبكر (تكوين الفرات ومكافئه الغار)، دورة B لعمر المايوسين الاوسط المبكر (تكوين الجريبي والجزء الاعلى من تكوين الغار). دورة C لعمر المايوسين الاوسط (تكوين النفايل ومكافئه الفتحة)، دورة D لعمر المايوسين المتأخر لتكوين إنجانة القاري .

كل دورة من هذه الدورات يمكن تقسيمها الى دورات غير متناظرة من الدرجة الرابعة تعكس عدم التوازن بين مستوى سطح البحر ومعدل انتاج الصخور الكاربوناتية. التباين في الطبيعة الدورية للترسيب بين المقاطع المدروسة يعكس التاثير التكتوني المحلي على تطور التتابع.

Introduction

The Miocene succession of western and southern Iraq is represented by the Euphrates, Jeribe, and Nfayil formations and their equivalent the Nfayil Formation, the Fatha Formation in Hit area which is distinguished by the existence of primary gypsum beds. The succession in the southern desert is represented by the Euphrates, Jeribe, and Nfayil formations with interfingering of the Ghar Formation with the Euphrates in the south of Nasiriya and the existence of Upper Miocene, Injanah Formation in Karbala – Najaf area at the scarp of Tar – al- Najaf - Tar- Al-Sayed.

The main aims of the present study are depositional environment interpretation based on detailed petrographic study and microfacies analysis of eight selected sections within the study area (Fig.1). This is one of the main requirements of sequence stratigraphic analysis in order to depict the Miocene sequence development in Western and Southern Iraq.

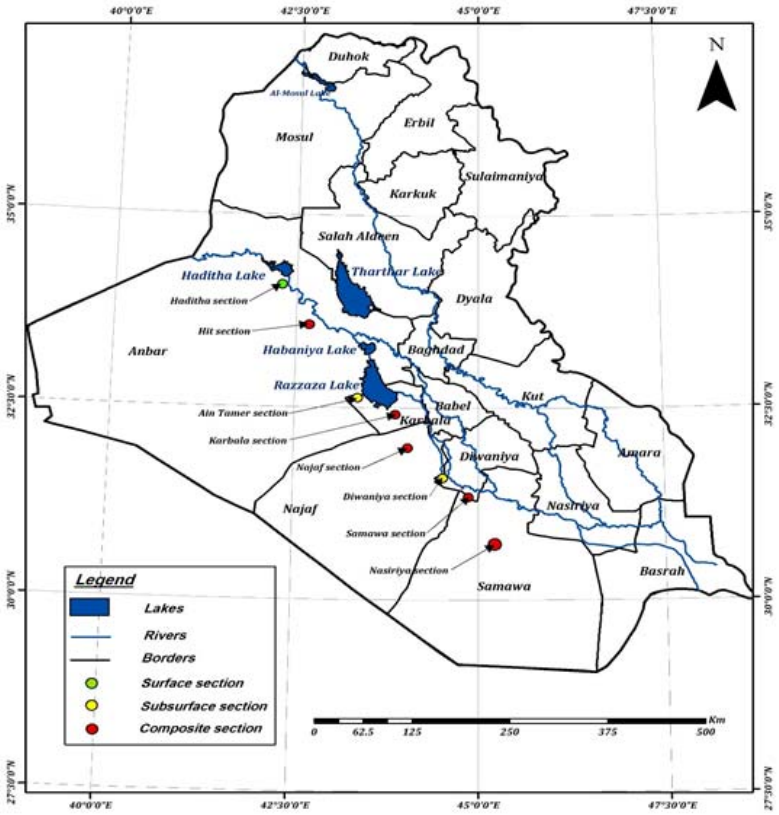

Figure 1- Location map of the study area.

Stratigraphy

The Miocene succession of Western Iraq is equivalent to Megasequence AP11 of Sharland, et. al, (2001) in [1] (Figure -2), It was affected by the closure of the of the Neo Tethys [2]. In the Early Miocene to Early Middle Miocene where limited tectonic subsidence occurred in the Arabian plate [1] and the Mesopotamian basin became narrow and shallower as the western part of Arabian plate was uplifted [2].

The Euphrates Formation represents the Lower Miocene shelf carbonates which is equivalent to the basinal Serikagni Formation and the clastic Ghar Formation of the inner shelf [2]. It is the most widespread of the Miocene cycle formations. It was first described by Boeck, 1929 and later amended by [3].The type locality lies in Wadi Al- Fuhaimi in the west of Iraq [4] and reaches its maximum thickness of over 50 meters in the Jambur structure [1]. It comprises fossiliferous packstones dominated by benthic foraminifera, gastropods and algae with non skeletal grains of peloids and ooids. The limestones are commonly dolomitized and evaporitic in the upper parts.

The Ghar Formation was first defined by Owen and Nasr (1958) from well Zubair-3 of South of Iraq. It comprises 100 – 150 meters of thick sandstones and conglomerates with rare anhydrate, clays and sandy limestone beds [3]. The Formation was mapped north of Bussayiah and south Nasiriya by [5] and [6]. An Age of Early- Middle Miocene was suggested for the Ghar by [7].

The Jeribe Formation is the Latest unit of the Burdigalian age below the Lower Fars (Fatha Formation) which was deposited uniformly throughout the basin with a maximum thickness of 63 meters in Injana-5 well. It comprises restricted marine carbonates and evaporites interbedded with porous open marine carbonates [1]. The Jeribe Formation was considered as an equivalent of the Govanda Formation with age of Early Middle Miocene [7].

The Fatha Formation was originally described by [3], no type section was defined, It was named at first as the Lower Fars Formation. Al- Rawi, et. al, 1992 in [1]. In the western and southern Desert the equivalent of Fatha Formation, Nfayil Formation is exposed with two members: Lower carbonate Member composed of three cycles of limestone and marl intercalations and Upper clastic Member of sandstone and claystone with thin layers of limestone [8].

The Injana Formation was first named as the Upper Fars Formation and renamed as Injana Formation by Al- Rawi 1992 IN [1]. This formation comprises varicolored marls and siltstones with beds of sandstone and grits. Occasional beds of fresh water lacustrine carbonates occurs.

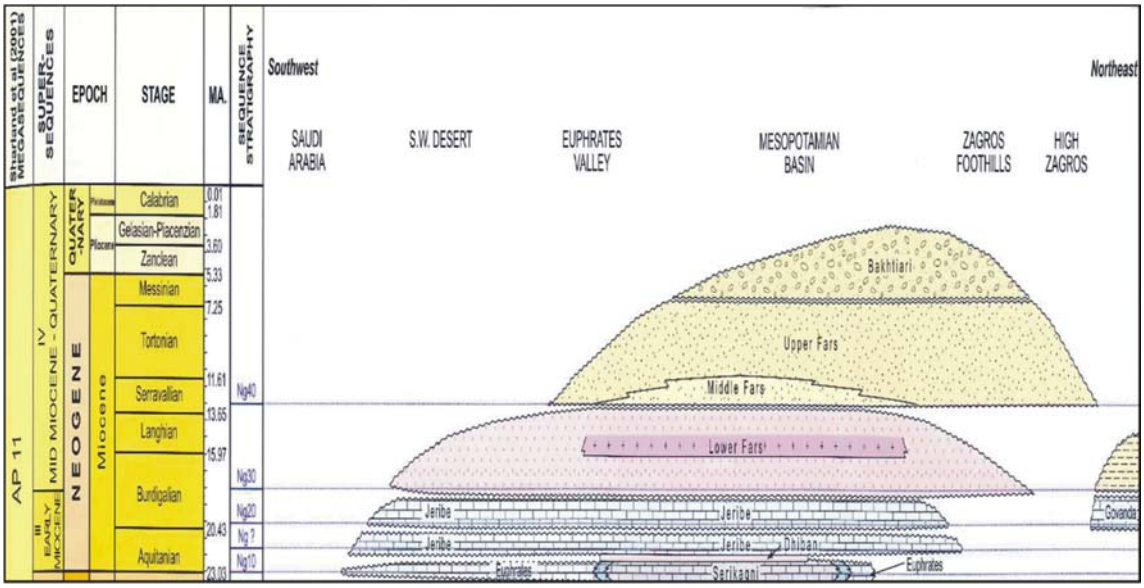

Figure 2- Stratigraphic correlation of Meqasequence AP11 after (1).

Microfacies and Paleoevironments

Formations of the Miocene succession in the study area reflect deposition in a variety of depositional environments. They range from continental environments as in the case of Ghar and Injana formations which also shows some marine influence in some parts to shallow marine (restricted and open) in the

case of the Euphrates, Jeribe, and Nfayil formations (Figure -3). Since most of the studied sections consist of carbonates; detailed microfacies analysis was carried out taking into consideration the depositional texture and type of skeletal and nonskeletal grains to interpret the nature of environments. The stnandard microfacies of Wilson (1975) and their revision by [9] were also considered.

Euphrates Formation

The Euphrates Formation in the studied sections represent deposition in restricted and shallow open marine environments.

Restricted marine environment

This environment was recognized by the following microfacies:

a- Dolomitic Mudstone: it was the most common microfacies of restricted environment seen in all sections, in some sections it contains fossils of benthic forams or some silty or sandy grains of authigenic and detrital quartz.

b- Lithoclastic bioclastic wackestone: appears in most sections, sometimes sandy.

Shallow open marine environment:

It is characterized by:

a-Boundstone: this microfacies was recognized in one bed at Haditha section, the associated fauna was octa coral.

b-Fossiliferous packstone: with peloids with diversity of skeletal grains and forams such as: Gastropods, Pelecypods, Ostracods, *Rotalia*, and Miliolids, It may contain authogenic quartz.

c-Peloidal lithoclastic silty wackestones and bioclastic wackestones, with variable bioclasts of Echinoderms, Bryozoans, Mollusks and Forams.

d-Fossiliferous, peloidal packstone: with Echinoderms, Gastropods, Pelecypods, Ostracods, Bioclasts, *Ammonia* Sp, *Dentritina*, *Miogypsina*, *Peneroplis*, and Miliolids.

Jeribe Formation

Three subenvironments were recognized within the Jeribe Formation:

Restricted marine Environment:This was represented by the following microfacies:

a-dedolomitized mudstone and dolomitic mudstone: this microfacies is so common in all sections, may contain fossils or bioclasts, lithoclasts and quartz grains with some iron oxides or bitumen especially in contacts areas.

b-Lithoclastic silty wackestones: contains quartz grains in some sections such as in Haditha and Karbala sections.

Shoal Environment: This environment was recognized in two sections (Hit and Karbala), and represented by the following microfacies:

a- peloidal bioclastic grainstone: in Hit section bioclasts of Mollusks and benthic forams dominates.

b- Fossiliferous bioclastic grainstone: in Hit and Karbala sections.

Shallow open marine environment: The associated microfacies within this environment were:

a-peloidal bioclastic packstone: with echinoids, gastropods, Algaes, forams, and bioclasts.

b-Llithoclastic wackestone to packstone: Echinoids, Gastropods, Pelecypods, Bioclasts, Bryozoans were recognized within this microfacies.

c-Bioclastic wackestones: Gastropods, Ostracods and forams were observed in this microfacies.

d-Bioclastic packstone with Echinoderms and bioclasts.

Nfayil Formation

The Nfayil Formation was deposited mainly within the restricted and shallow open marine conditions.

Restricted marine environment

It is represented by three microfacies:

a-Dolomitic mudstone: the most common microfacies in restricted environment of the Nfayil Formation, peloids or silty with quartz grains änd some fossisl or bioclasts.

b-Fossiliferous silty packstone: pelecypod shells and quartz grains.

These microfacies were recognized in all sections.

Shallow open marine environment

The recognized microfacies in this environment were:

a-Sandy fossiliferous wackestone: with Echinoderms, Algaes, Pelecypods, foramns , and Bioclasts..

b-Echinodermal, silty packstone; Echinoids, Algaes, Ostracods were observed.

c-Bioclastic wackestone: with shells of Mollusks and Ostracods.

Most of the sections show these microfacies in the Nfayil Formation.

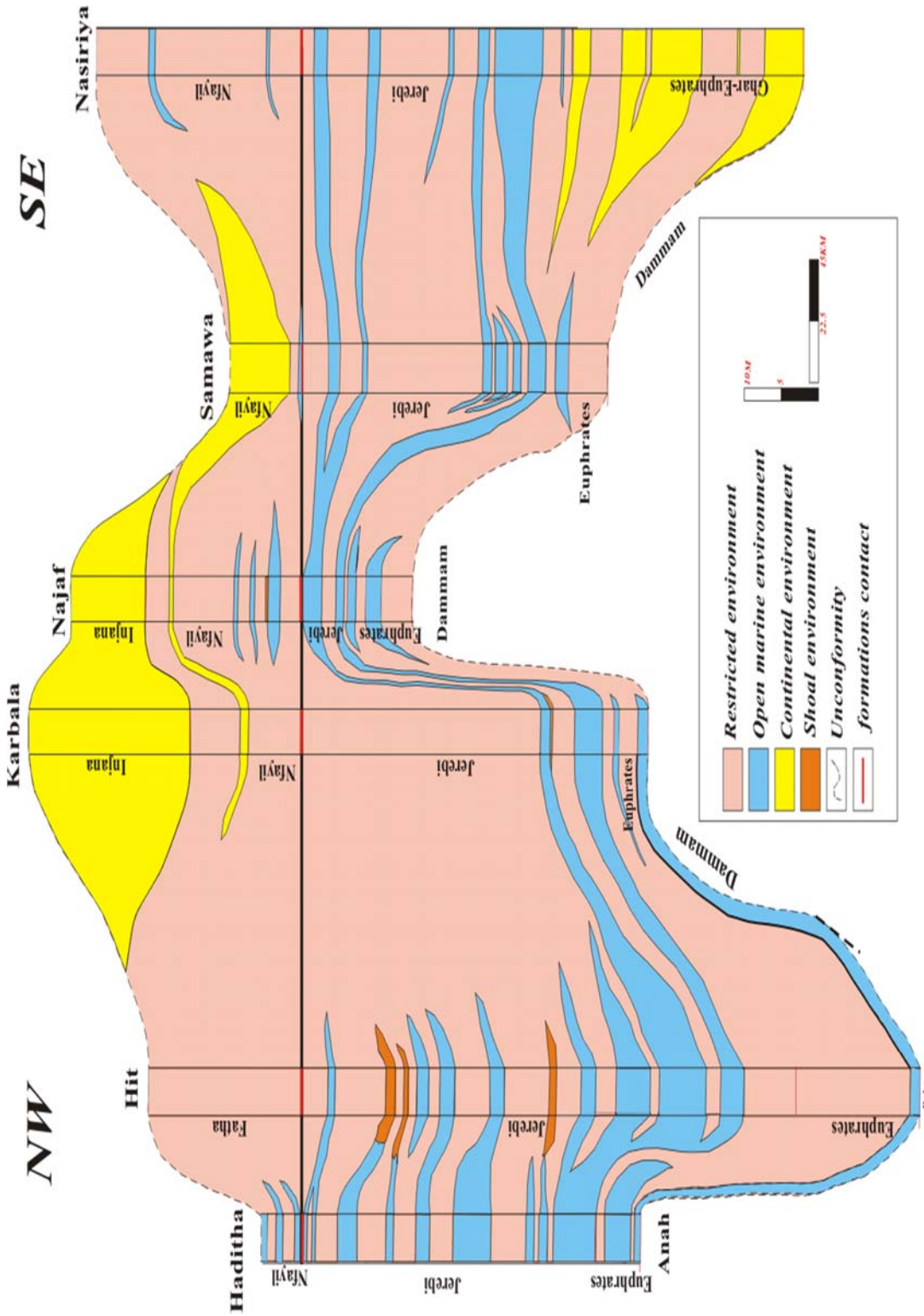

Figure 3.-Stratigraphic cross section showing distribution of paleoenvironments in the study area (The Jeribe – Nfaiyl boundary as a datum).

Sequence Development

Four third order cycles were recognized in the studied sections (Figure -4), these include: cycle A of the Early Miocene Euphrates Formation and it`s equivalent the lower part of the Ghar Formation, Cycle B of the Early Middle Miocene Jeribe Formation and it's equivalent the upper part of the Ghar

Formation, Cycle C of the Middle Miocene Nfayil Formation and it`s equivalent the Fatha Formation, and Cycle D of the Late Miocene Injana Formation. Each third order cycle can be subdivided into a number of fourth order cycles.

All of the fourth order cycles are assymmetrical reflecting an imbalance between the relative sea level and carbonate production. The variation between the different sections in nature of cyclic deposition reflects the difference of local tectonic effect which is the main controling.factor on sequence development.

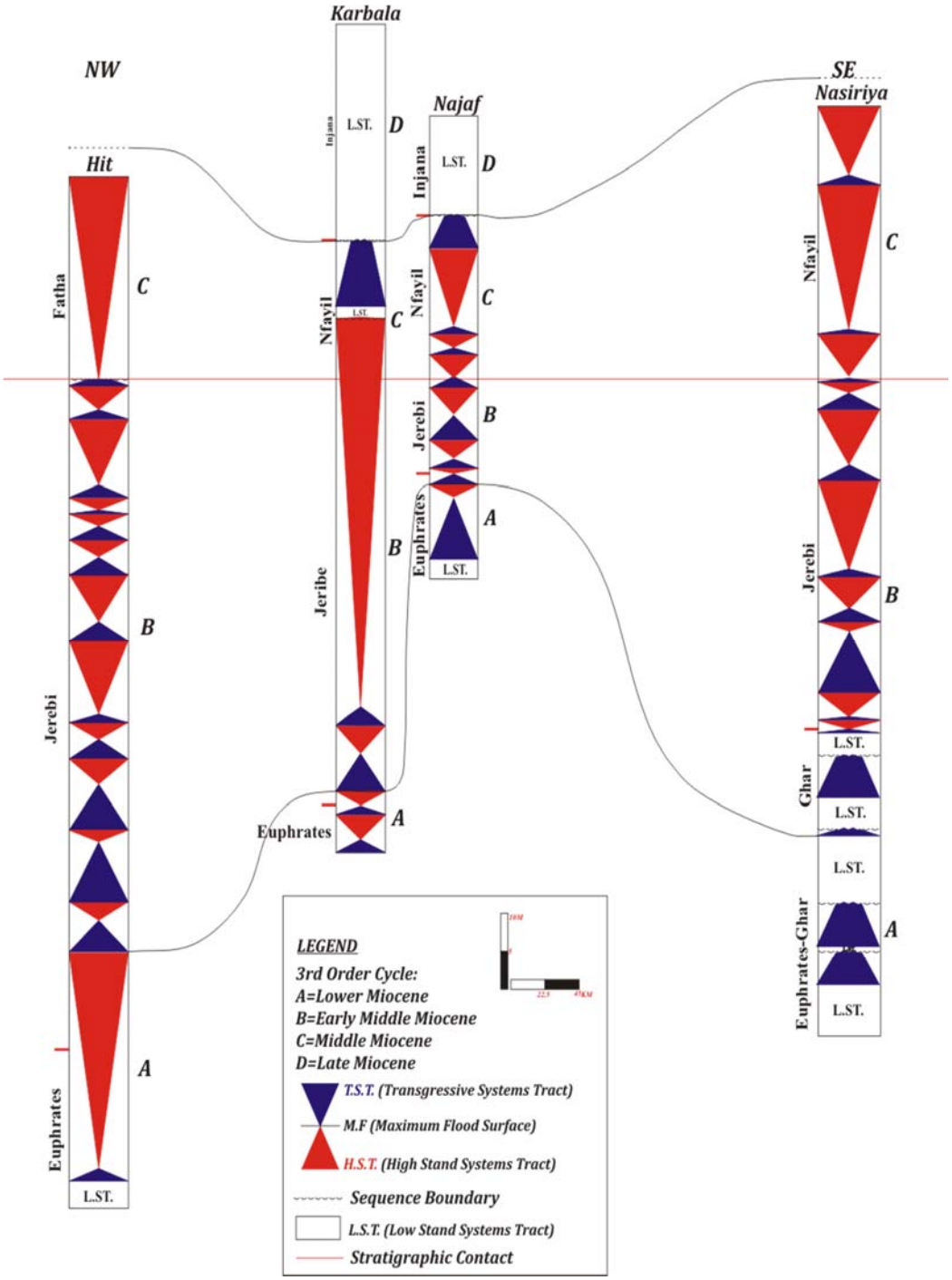

Figure 4- Sequence stratigraphic sudivisions of the Miocene succession of western and southern Iraq, (The Jeribe – Nfaiyl boundary as a datum).

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