DOI: 10.24996/ijs.2022.63.7.22

ISSN: 0067-2904

Stratigraphy and Basin Development of the Oligocene-Early Miocene Succession, Southeastern Iraq

Hussein Sh. Aoudah[1], Aiad Ali Hussien Al-Zaidy[2], Haider A. Falih Al-Tarim[1]
[1]*Oil Exploration Company, Ministry of Oil, Iraq*
[2]*Department of Geology, College of Science, University of Baghdad, Iraq*

Received: 4/8/2021 Accepted: 7/9/2022 Published: 30/7/2022

Abstract
The study area is situated in the northern part of the Arabian Plate. The evolution of the Zagros Foreland basin is related to the compressional tectonic system at the beginning of the Tertiary Period.
This study gives an adequate nomenclature for the Oligocene – Early Miocene Sequence is Missan Group. The Buzurgan Oilfield was chosen to represent the stratigraphic column corresponding to that period. These sediments were subdivided into two cycles, where each one ends by a sequence boundary, equivalent to the lowstand siliciclastic residues in the basin center. The first cycle, Paleocene-Oligocene Epoch, was deposited marly limestone with planktonic foraminifera in the basin center during the transgressive and highstand conditions. The Lower Missan Group was deposited during the latest Oligocene lowstand conditions and overlaid the deep marine Oligocene sediments.
The second cycle represented the Early Miocene Epoch (Aquitanian), by which the Euphrates Formation was deposited during the transgressive and highstand conditions and ended by the lowstand conditions sediments in the basin center as an Upper Missan Sandstone Member. These two cycles are conformably bounded by Lower Miocene (Jeribe Formation) and Oligocene (Tarjil Formation).

Keywords: Stratigraphy, Basin Development, Lower Miocene, Missan Group, Southeastern Iraq.

طباقية وتطور حوض تتابع الأوليغوسين–الميوسين المبكر ، جنوب شرق العراق

حسين شويل عبيد[1]، أياد علي حسين الزيدي[2]، حيدر احمد فالح الترم[1]
[1]شركة الاستكشافات النفطية، بغداد، العراق
[2]قسم علم الارض، كلية العلوم، جامعة بغداد، بغداد، العراق

الخلاصة
تقع منطقة الدراسة في الجزء الشمالي من الصفيحة العربية ، ويرتبط تطور حوض زاغروس فورلاند بالنظام التكتوني الانضغاطي في بداية العصر الثالث.
تقدم هذه الدراسة تسمية مناسبة لتتابع الاوليغوسين – أوائل الميوسين هو مجموعة ميسان. تم اختيار حقل بزركان النفطي لتمثيل العمود الطبقي المقابل لتلك الفترة. تم تقسيم هذه الرواسب إلى دورتين ، حيث تنتهي كل واحدة بحدود طباقية ، وهو ما يعادل الرواسب السليكاتية منخفضة المستوى في مركز الحوض. الدورة الأولى ، العصر الباليوسيني–أوليغوسيني ، ترسبت خلال الظروف المتجاوزة والمرتفعة من الحجر الجيري المارلي مع

*Email: aiadgeo@yahoo.com

فورامنيفيرا الطافية في مركز الحوض. بينما ترسبت مجموعة ميسان السفلى خلال ظروف الترسيب المنخفضة الأحدث للأوليغوسين واعتلاء رواسب الأوليغوسين البحرية العميقة.

تمثل الدورة الثانية حقبة الميوسين المبكر (Aquitanian) ، وقد ترسب تكوين الفرات خلال الظروف المتجاوزة والمرتفعة وتنتهي بظروف الترسيب المنخفضة الرواسب في مركز الحوض كعضو من الحجر الرملي العلوي في ميسان. ترتبط هاتان الدورتان بشكل متوافق مع الميوسين السفلي (تكوين جيريبي) والأوليغوسين (تكوين تارجيل).

Introduction

This study offers an adequate architectural model of the sedimentary basin. It identifies the factors (tectonics and eustacy) contributing to the deposition of the carbonate and siliciclastic sediments. This will permit a better understanding of the definition of the stratigraphic traps in the study area.

The study area is located in the Missan Province in southeastern Iraq (Figure1). The Oligocene-Early Miocene sediments called "Kirkuk Group" by Elf Iraq [1] in the Buzurgan -1 Well are represented by limestones, dolomitic limestone, and siliciclastic sediments. This sequence is subdivided into three subgroups (Upper Kirkuk, Middle Kirkuk, and Lower Kirkuk). The last two subgroups are of deep marine sediments in the Missan Basin.

Al-Siddiqi [2] considered this classification as irregular. This study attempts to reach the appropriate nomenclature by outsourcing regional studies, as in the neighbouring province of Khuzestan in southwestern Iran, which is located within the same sedimentary basin.

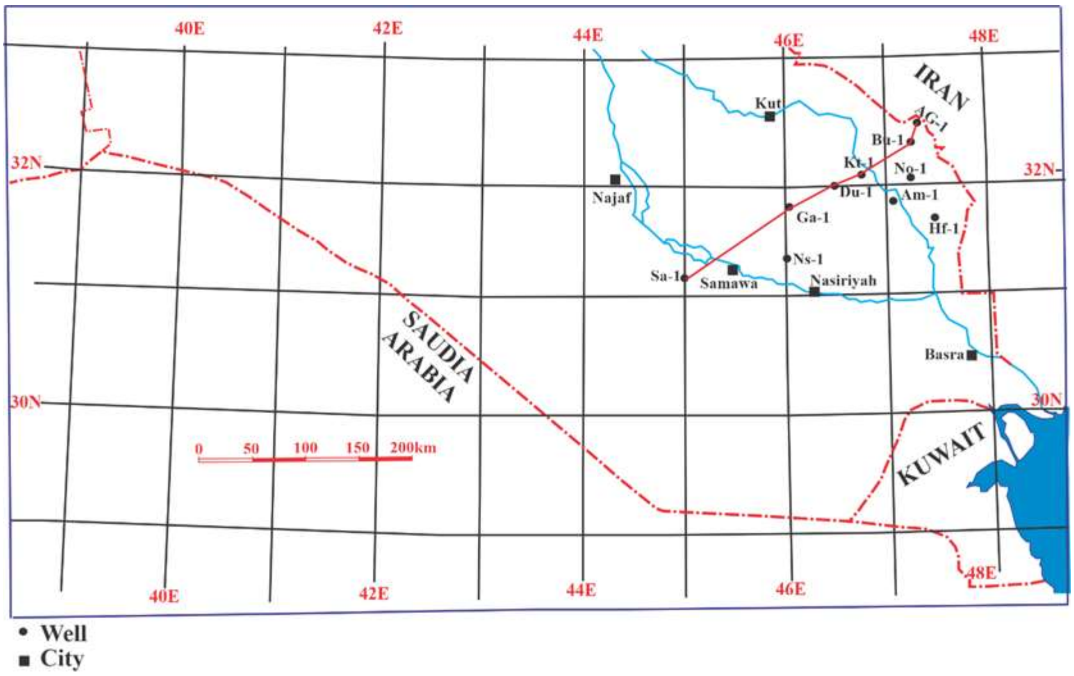

Figure 1- General location map shows the studied wells in the northeastern Missan Province (Modified after Aqrawi et al. [3]).

Methodology

1- Six oil wells in six oil fields were selected for the study using a lot of thin sections and well-log data to determine the depositional environments.

2- Sampling was made by taking rock samples from the cuttings and core available to the Miocene succession and then making a thin section. The sampling was done one slice per meter from a perfect oil field.

3- Petrographic and microfacies investigation for the current study was based mainly on Dunham's classification [4] by using a transmitted light microscope in the petrographic laboratory of the Oil Exploration Company laboratories. The petrographic study was based on more than 200 thin sections from cores and/or cuttings of the studied wells.
4- The well-logging tried to compare the micro-facies extracted from the laboratory work as Electrofacies, diagnose the horizontal and vertical facies change, and use well-log data to get the petrophysical characteristics for the wells in the studied area.

Tectonic Setting

The study area is situated in the north - northeast of the Arabian Plate, adjacent to the Turkish Bitlis Block in the north and the Iranian Central Block in the east [5].

The tectonic setting of the study area is the result of the relationship between the Arabian Plate and the blocks mentioned above (Eurasian Plate). The Eurasian Plate was separated from the Arabian Plate and bordered by the Neo-Tethys Ocean (Figure 2). This separation led to an extensional tectonic system's emergence and a passive margin [6]. This dynamic continued until the Middle Cretaceous [7, 5].

The second tectonic phase in the Arabian Plate, covering the period going from Middle-Late Cretaceous, was considered a transitional phase from extensional to compressional tectonic systems due to the decreasing distance separating the Arabian Plate from the Eurasian Plate by reverse migration.

The third tectonic phase was during the Tertiary Period, with the domination of the compressional tectonic system ending by closing the New-Tethys Ocean and the creation of the Zagros Foreland Basin, connecting the Mediterranean Sea in the north and the Indian Ocean in the south [8,9], as shown in Figure 3.

The distance between the Arabian Plate and Eurasia Plate continued to decrease, ending by closing the Tethyan Seaway as a consequence of the collision between two plates (Terminal Tethyan Event) [10].

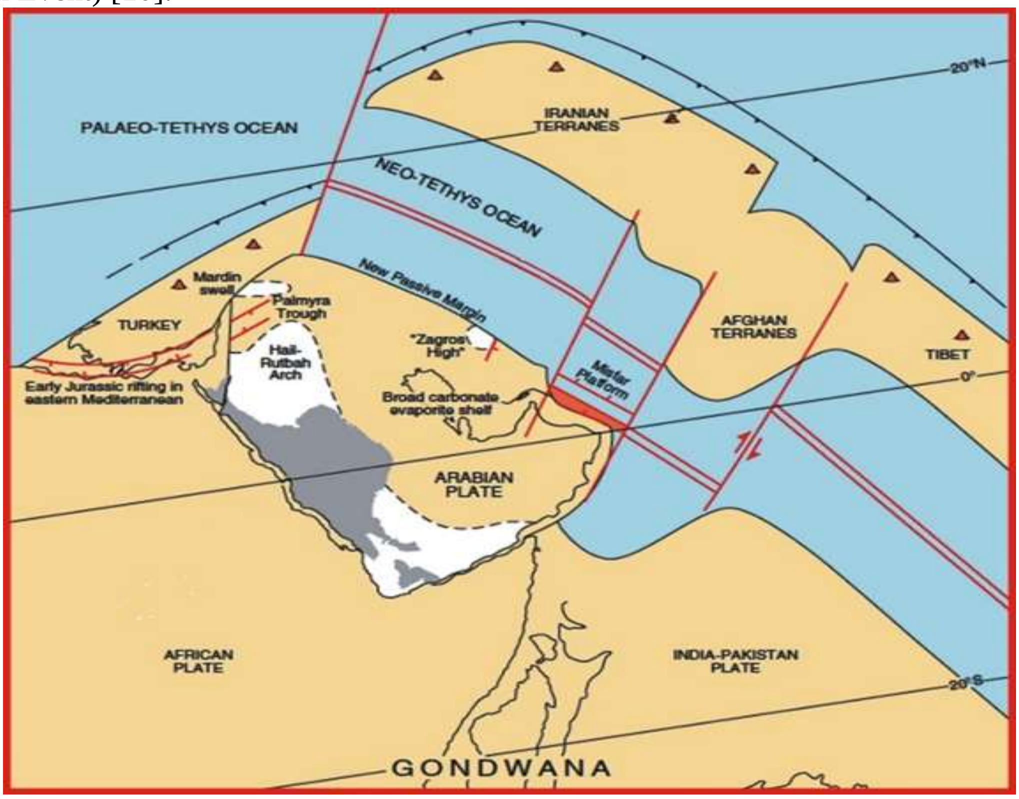

Figure 2- Schematic of the separation between the Arabian Plate and the Iranian terrenes and creation of the Neo-Tethys Ocean, the new northeast Arabian Plate passive margin (Modified after Sharland et al. [6]).

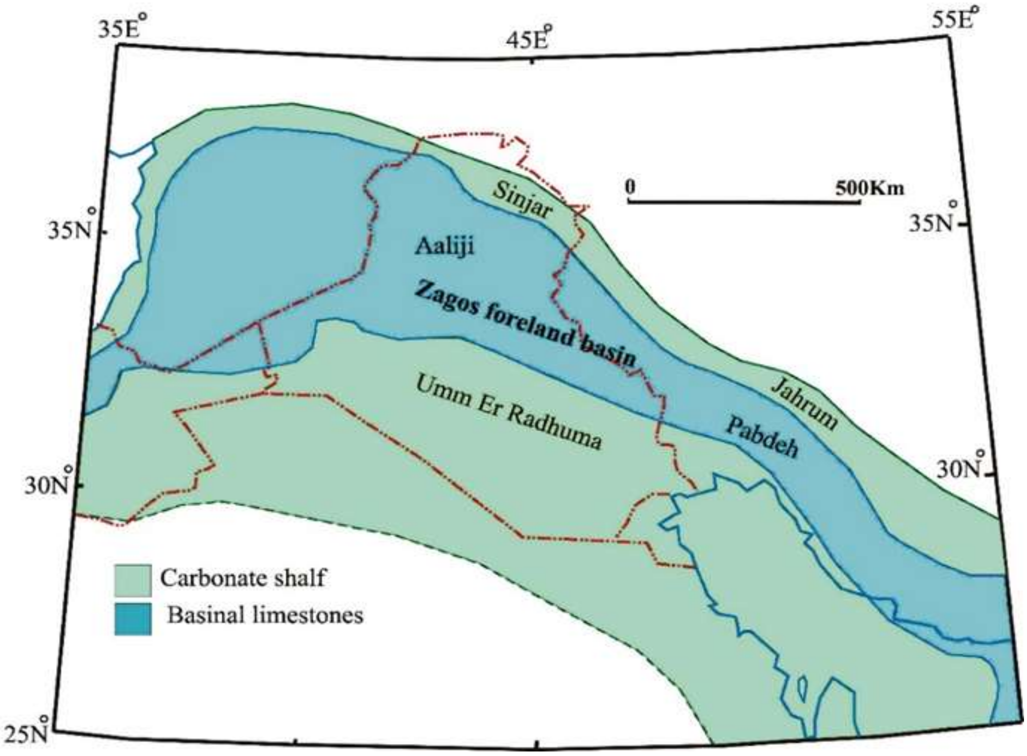

Figure 3- Schematic represents the closure of the Neo-Tethys Ocean and initialised emergence of Zagros Foreland Basin during (Paleocene Period) (Modified after Aqrawi et al. [3]).

Stratigraphic Sequence of Buzurgan-1 Well

Buzurgan-1 Well, located northeast of the Missan Province was chosen to describe the Tertiary succession (Figure 1). This oil well presents a complete stratigraphic sequence of the Missan Group (Kirkuk Group), extending from the Latest Oligocene to the Early Miocene (Figure 4).

The stratigraphic column of Buzurgan-1 Well shows the following successions:

1. **Bakhtiary Formation (Pliocene):** It extends from the surface to 248 m. It is composed mainly of sandstones, gravels, and marls.
2. **Upper Fars Formation (Late Miocene)**: It has 248m thick, composed of marly limestones, evaporites, conglomerates, and pebble.
3. **Lower Fars Formation (Middle Miocene)**: It is 849 m thick and composed of evaporites, marls and limestones. This formation is important as a significant regional cap rock because the lower layers are formed from evaporite rocks [1].
4. **Jeribe Formation (Burdigalian)**: It has a 45 m thick composed of limestone, dolomitic limestone, and evaporites.
5. **Missan Group: It** is composed of two siliciclastic sand members separated by Euphrates Limestone Formation:

A) Upper Missan Member (Latest Aquitanian), 101m thick (from 2896 to 2997m). It consists mainly of clastic sediments intercalated with limestones. The thickness decreases towards Abu-Ghirab-1 Well [11], see Figure- (6).

B) Euphrates Formation (Aquitanian), 35m thick (from 2997 to 3032m), consists mainly of limestone with large foraminifera like *Miogypsiniodes*, *Peneroplis* and *Archaias kirkukenis*, identified in Abu Ghirab – 1 Well, suggesting that age of Aquitanian [1, 11, 12, 2], see

Figure- (5). This formation is the equivalent of Aquitanian Middle Asmari Limestones in Iran [13].

C) Lower Missan Member: It has 114 m thick (from 3032 to 3146 m) and consists of siliciclastic sand interbedded with shale and limestone

6. **Tarjil Formation (Oligocene)**: It covers the section from 3146 to 3231m. It consists of marly limestones with planktonic foraminifera in the center basin, indicating the Oligocene Epoch [2, 12]. These sediments represent Fauqui Member [2] or Middle and Lower Kirkuk subgroups [11]. They are considered the Oligocene deep basinal sediments equivalent to Bajawan and Shurau formations. They were deposited in the shelf margin.

7**. Jaddala Formation (Middle-Late Eocene)**: It covers the section from 3231 to 3380 m. It consists of marly limestone containing planktonic foraminifera, representing deep marine sediments of the Middle-Late Eocene Epoch [14]. It is considered as time equivalent to the Dammam Formation.

8**. Aaliji Formation (Paleocene-Early Eocene Epoch)**: It covers the section from 3380 to 3476 m, consisting of marly limestones with chert. It is considered the deep marine equivalent to the Umm-Er Radhuma Formation.

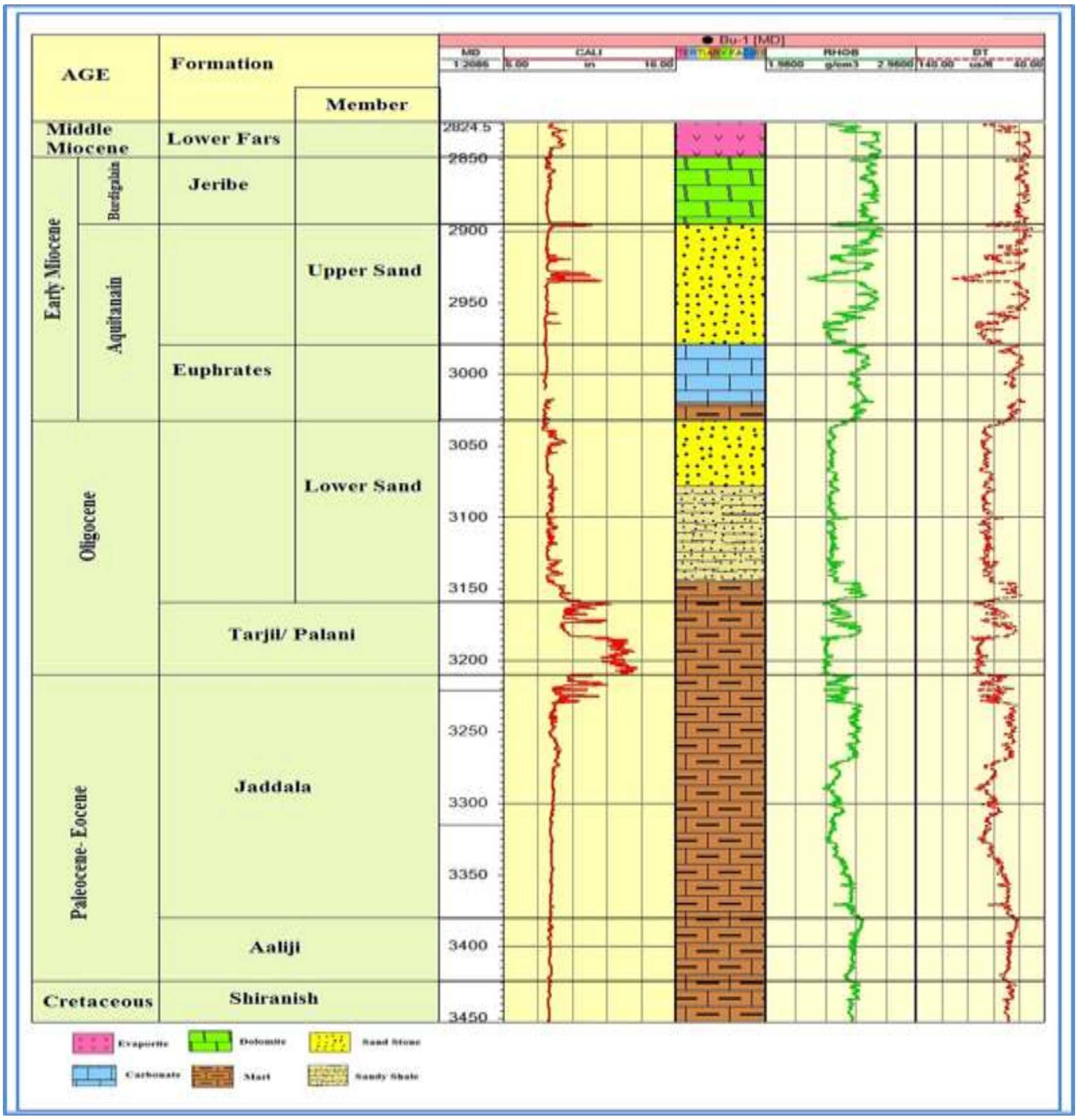

Figure 4- Well log lithostratigraphic columnar section of the Tertiary sediments in the Missan center basin , Buzurgan -1 Well.

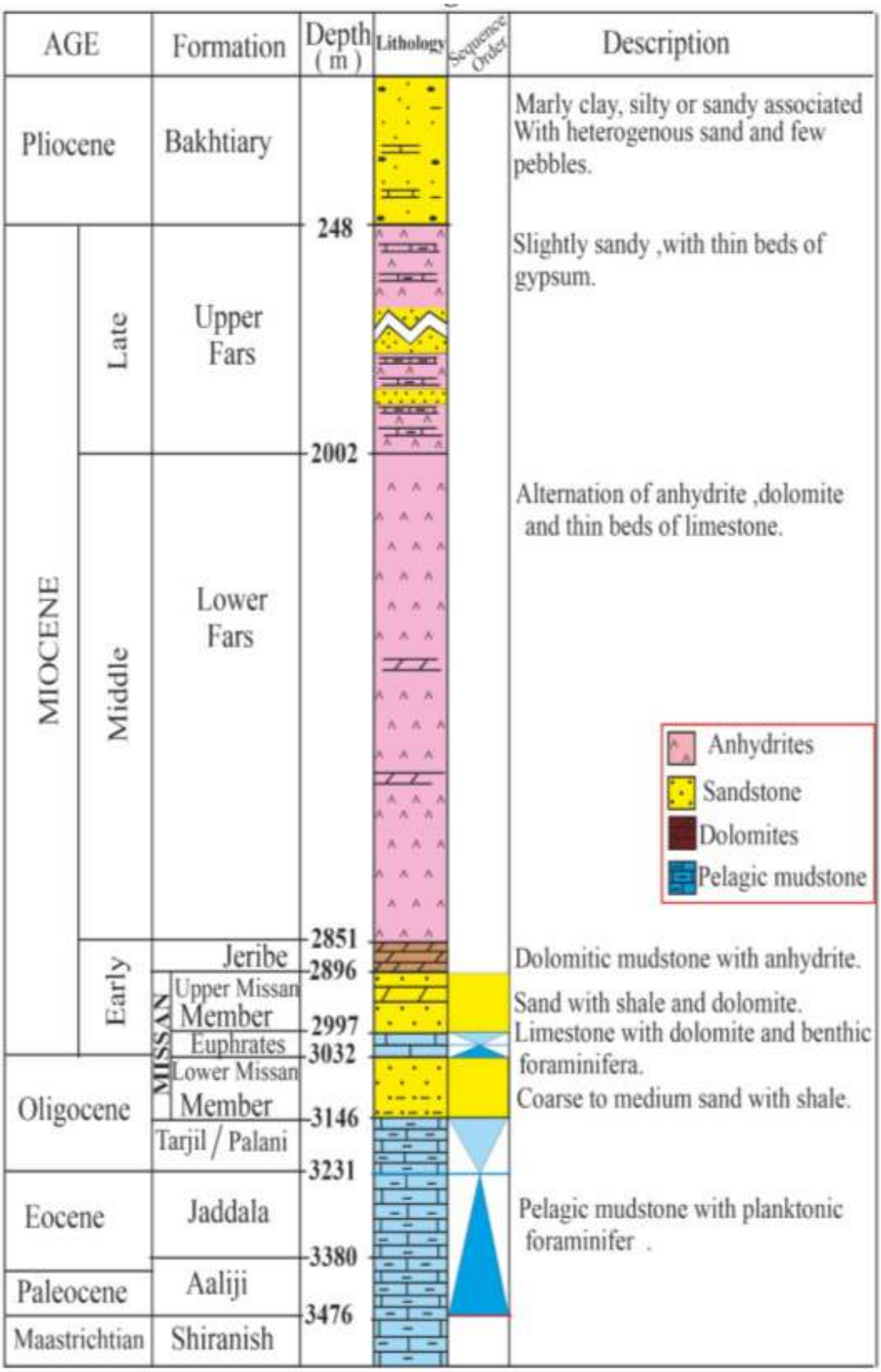

Figure 5- Stratigraphic succession of the Tertiary sediments in the Missan center basin (Buzurgan -1 Well).

Correlation

The correlation between the studied wells (Abu Ghirab-1, Buzurgan-1, Kumait-1, Dujaila-1, Gharaf-1 and Samawa-1) in southern Iraq is illustrated in Figure 4. The tertiary period is represented by two main sedimentary cycles:

The first sedimentary cycle is represented by the Um Er Radhuma and Dammam formations, penetrated in Samawa-1, Gharaf-1 and Dujaila -1 wells deposited in shallow shelf carbonate. They are equivalent to deep basin sediments, Aalij and Jaddala, formations and have penetrated Abu Ghirab-1, Buzurgan-1 and Kumait-1 wells.

The Oligocene sediments represented by Palani, Tarjil, Baba, and Bajwan formations penetrated the Gharaf-1 and Dujaila-1 wells in the southwestern part of the shelf margin platform. In contrast, the Abu Ghirab-1 well represents the beginning of the appearance of the northeast of the shelf margin platform. The Tarjil and Palani formations penetrated in Buzurgan-1 and Kumait-1 wells. These formations are considered a deep center basin equivalent. This cycle has been overlaying with regional unconformity surface. It is regarded as a time equivalent to the significant influx of siliciclastic sand deposited in the center basin (Lower Missan Sandstone Member). This member has been overlaid on the top of the Tarjil Formation with a conformable surface.

The Middle-Late Eocene basin is represented by a transgression stage with high subsidence, where the sea level had been raised and covered the northeastern and eastern parts of the studied area by deep-sea deposits (Jaddala Formation). The shallow sediments of the Dammam Formation characterised the other parts of the studied area. This period ended with a clear tectonic uplift occurring in the northeastern part and decreasing towards the southwest. This confirms the reactivation of the tectonic action from the northeast represented by the continental collision [15,16].

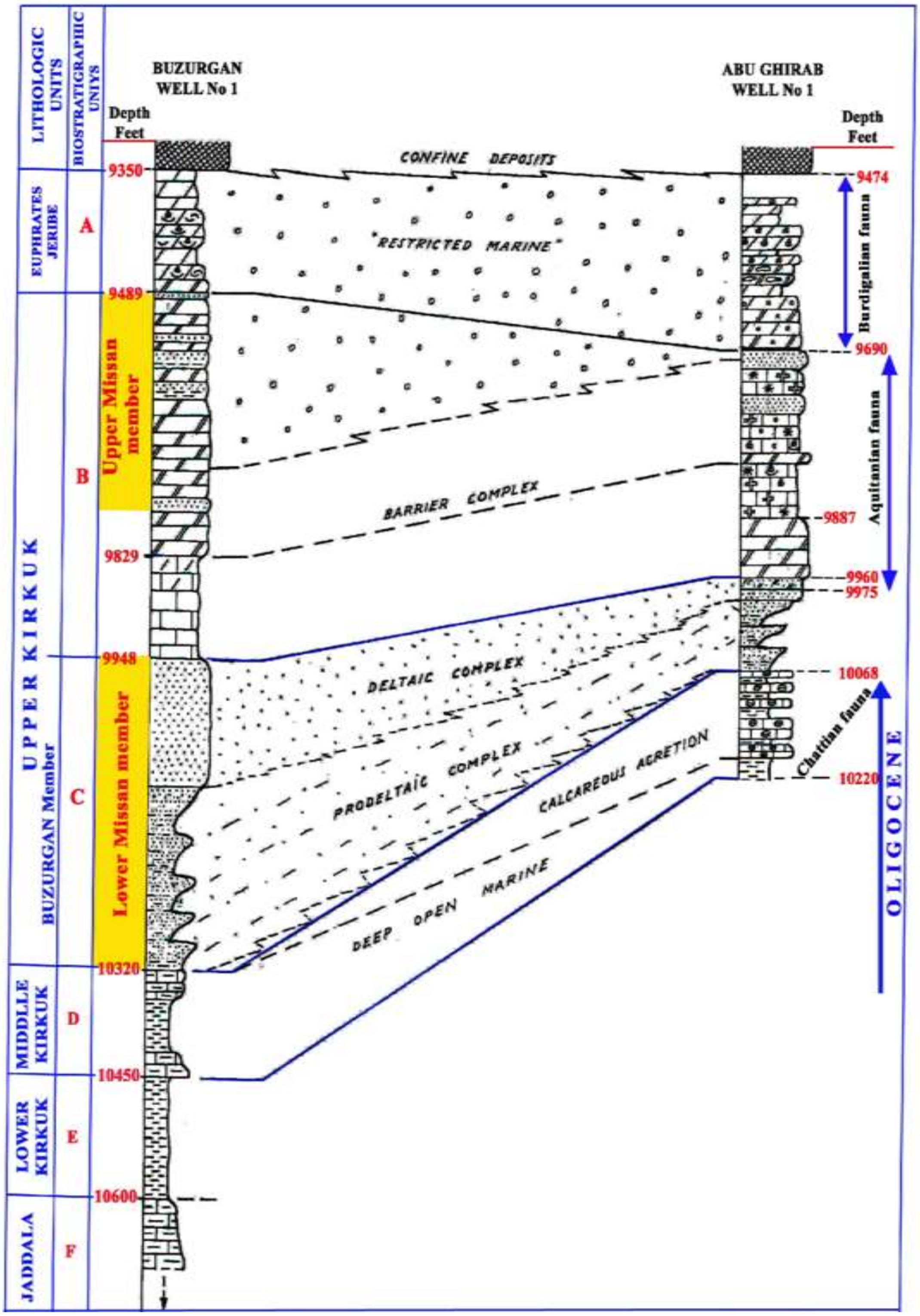

Figure 6- Correlation of the Missan Group between Buzurgan-1 and Abu Ghirab-1 wells illustrated decreased thickness toward AbuGhirab-1 Well (Modified after Cussey [11]).

The second sedimentary cycle, Early Miocene Epoch (Aquitania), represents Euphrates Limestone Formation. It overlaid the Lower Missan Sandstone Member but could not ascend the previous shelf margin. The siliciclastic sediments (Upper Missan Sandstone Member) penetrate in Kumait-1 and Buzurgan-1 wells. The Jeribe Formation was overlaid by the Upper Missan Sandstone Member with conformable surface and completely covered basin center sediments during transgressive conditions. This phase was continued until the Lower Fars Formation was deposited during Langhian Age. It has covered most of the Tertiary sediments and appears in most studied wells except Samawa-1 Well. It has been noticed that the Lower Fars Formation increases in thickness toward the basin center. The Buzurgan–1 Well seems to have the most significant thickness of this formation.

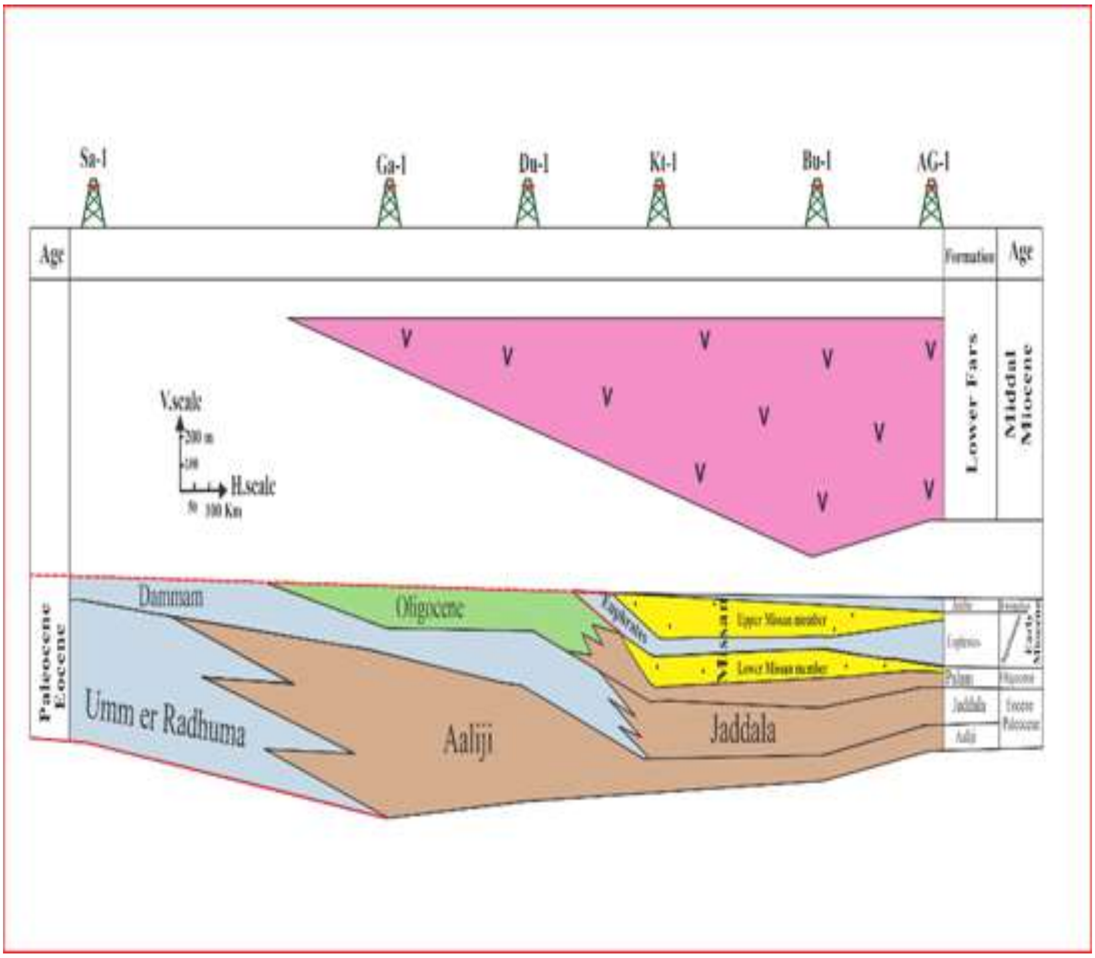

Figure 7- Sequence stratigraphic correlation of the Paleocene- Middle Miocene sediments in southern Iraq. Note the center basin sediments and lateral facies change among studied wells (Samawa-1, Gharaf-1, Dujaila-1, Kumait-1, Buzurgan-1, and Abu Ghirab-1).

Sequence Stratigraphy

Sequence stratigraphy looks at how the sediments collect under the influence of the tectonic and relative sea-level change. These two factors controlled the configuration and evolution of the Zagros Foreland Basin.

The Tertiary sediments consist of two main sequences (Figure 8), the first one extended from Paleocene – Oligocene epochs, while the other extended through the Early Miocene Epoch (Aquitanian).

Sequencing is the most significant architectural element in the analysis of sedimentary basins because it contains the different system tracts:-

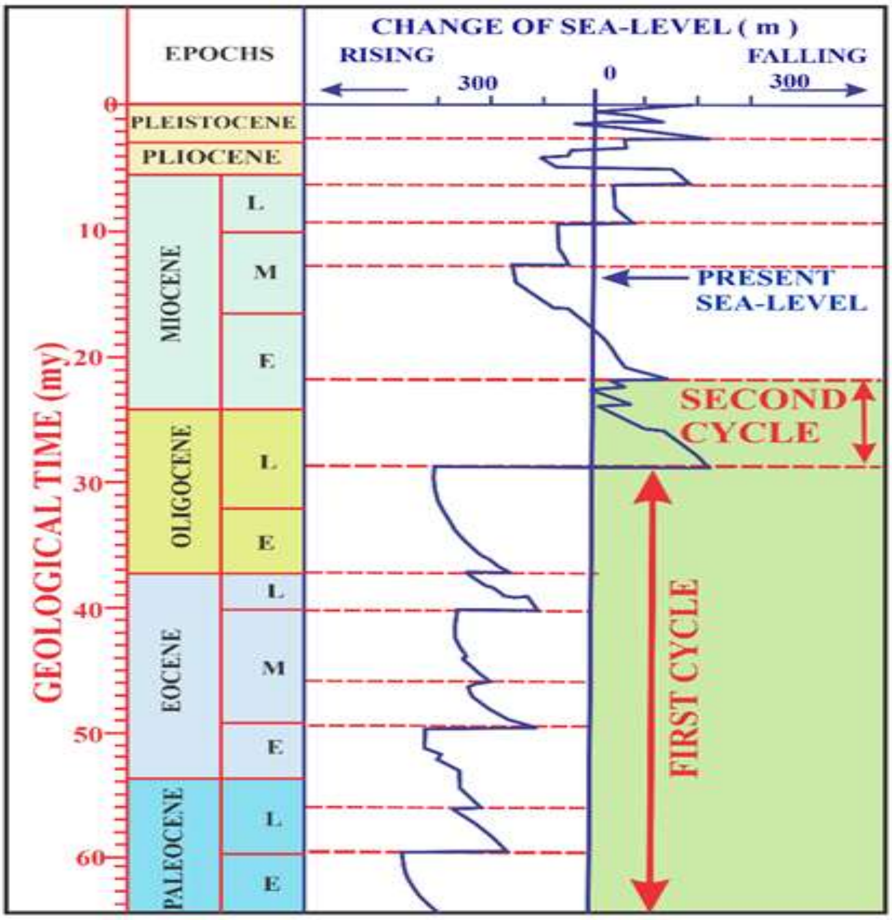

Figure 8- Schematic diagram shows global sea-level change and divides the Missan Group into two sediment cycles (Modified after Vail et al. [17].

***Transgressive** System Tract*

The shelf margin experiences sea level rise, resulting in deep basin sediments. These sediments consist of marly limestone containing glauconite with abundant planktonic foraminifera [18], as represented in Aaliji and Jaddala formations.

These sediments overlay regional unconformity surface (Late Cretaceous), formed retrogradation parasequence (Paleocene- Eocene Epoch) and contributed to the deposit of the Umm Er Radhuma and Dammam formations (Figure 9).

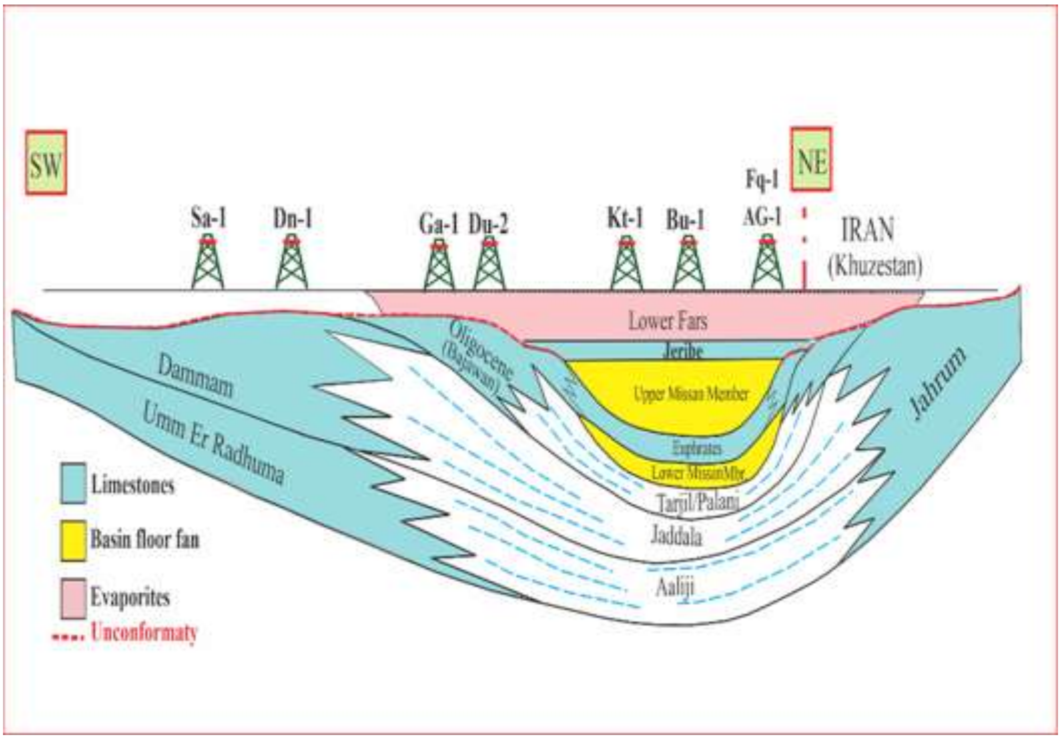

Figure 9- Schematic stratigraphic cross-section through the Tertiary Period in southern Iraq shows two types of lowstand conditions (Upper and Lower Missan members).

Highstand System Tract

This phase culminates with the emergence of the unconformity surface on the top of the Dammam and Bajawan formations (Figure 10). It represents Oligocene formations (Bajawan, Baba, and Shurau) on the shelf sediments. The deep sediments, consisting of marly limestone with planktonic foraminifera, including the Tarjil and Palani formations, have been regarded as equivalent deep basin sediments.

The first depositional cycle consists of the central basin of the Aalij, Jaddala, Palani and Tarjil formations, which are equivalent to the Pabdeh Formation in Khuzestan Province SW Iran [13].

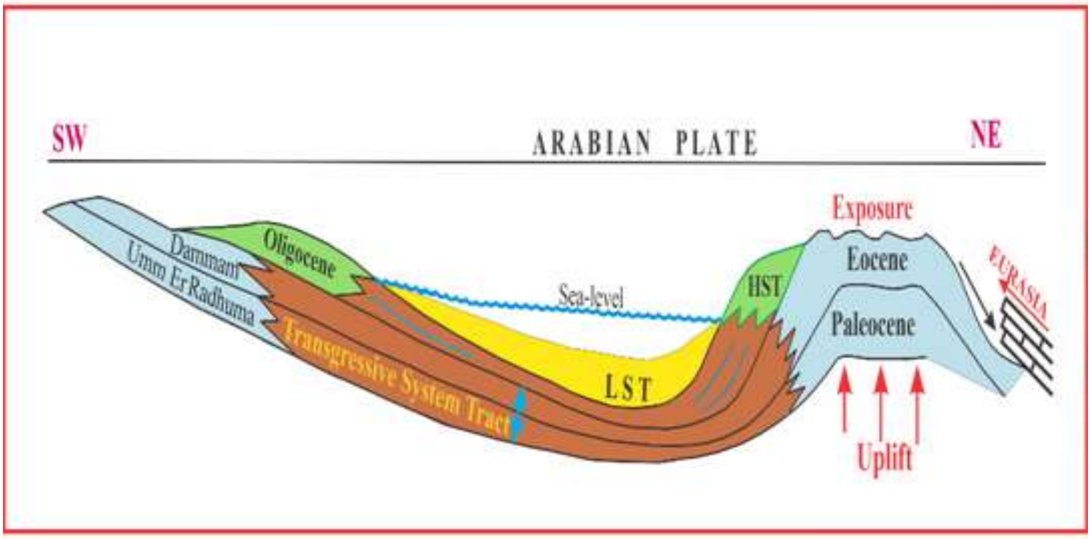

Figure 10- Schematic diagram shows the compressional tectonic system between Arabian Plate and Eurasia Plate (Modified after Dhihni [19].

Lowstand System Tract

This system tract is deposited during an interval of relative sea-level fall at the shelf margin. The river incises shelf deposits of the previous sequence (Emery & Myers, 1996) [20], where the rivers transport the siliciclastic sand from the hinterland to the center basin.

The unconformity surface occurred during Latest Oligocene and the Early Miocene (Latest Aquitanian) [12], see Figure 11.

The Aquitanian sediments cycle ended with the emergence of an unconformity surface, which contributed to the deposition of the Upper Missan Sandstone Member. Each of these unconformity surfaces is equivalent to the sandstone deposits that occupied the center basin during the lowstand conditions. The origin of these sediments was from the Arabian Shield [13].

The influencing compressional tectonic system on the Zagros Foreland Basin had been ceased at the end of the deposition of the Upper Missan Member because the stratal stacking pattern of the Jeribe Formation during the Burdigalian is entirely different from the previous stacking pattern. The Jeribe Formation represents transgressive conditions which overlaid the second sedimentary cycle; this has ended the influxes of sand sediments through the transgressive conditions [21].

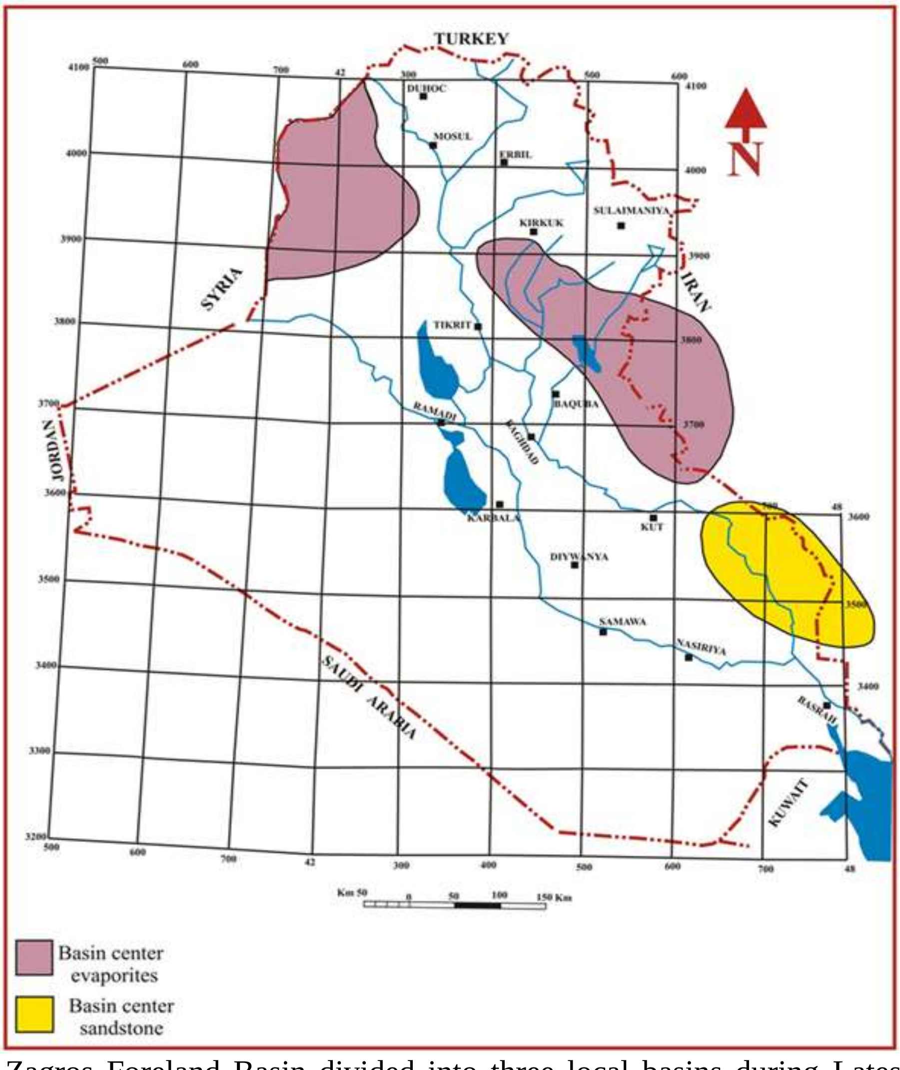

Figure 11- Zagros Foreland Basin divided into three local basins during Latest Oligocene (Modified after Dhihni [19]).

Missan Group

Elf-Iraq (1969) [1] was the first who give nomenclature as Kirkuk Group to the sediments specified between the Jeribe and Jaddala formations in Missan Province at the type section (Buzurgan-1 Well). The Kirkuk Group is divided into subgroups (Upper Kirkuk, Middle Kirkuk, and Lower Kirkuk) because they are equivalents to the stratigraphic section of the Oligocene sediments in northern Iraq. The north section has been firstly designated as Kirkuk Group by Bellen [22]. In contrast, Al-Siddiqi [2] and Youhana and Khalaf [12] have pointed out that these terminologies are irregular because they come without followers of the bases of the standard stratigraphic nomenclature.
Al-Siddiqi [2] mentioned the stratigraphic section of the siliciclastic sand and limestone between the Jeribe/ Euphrates and Jaddala formations to be called the Missan Group, which has been divided into Abu Ghirab, Buzurgan, and Fauqui members. Both Abu Ghirab and Buzurgan represented Early Miocene Period, while the Fauqui Member is equivalent to the Oligocene deep basin sediments (Figure12).

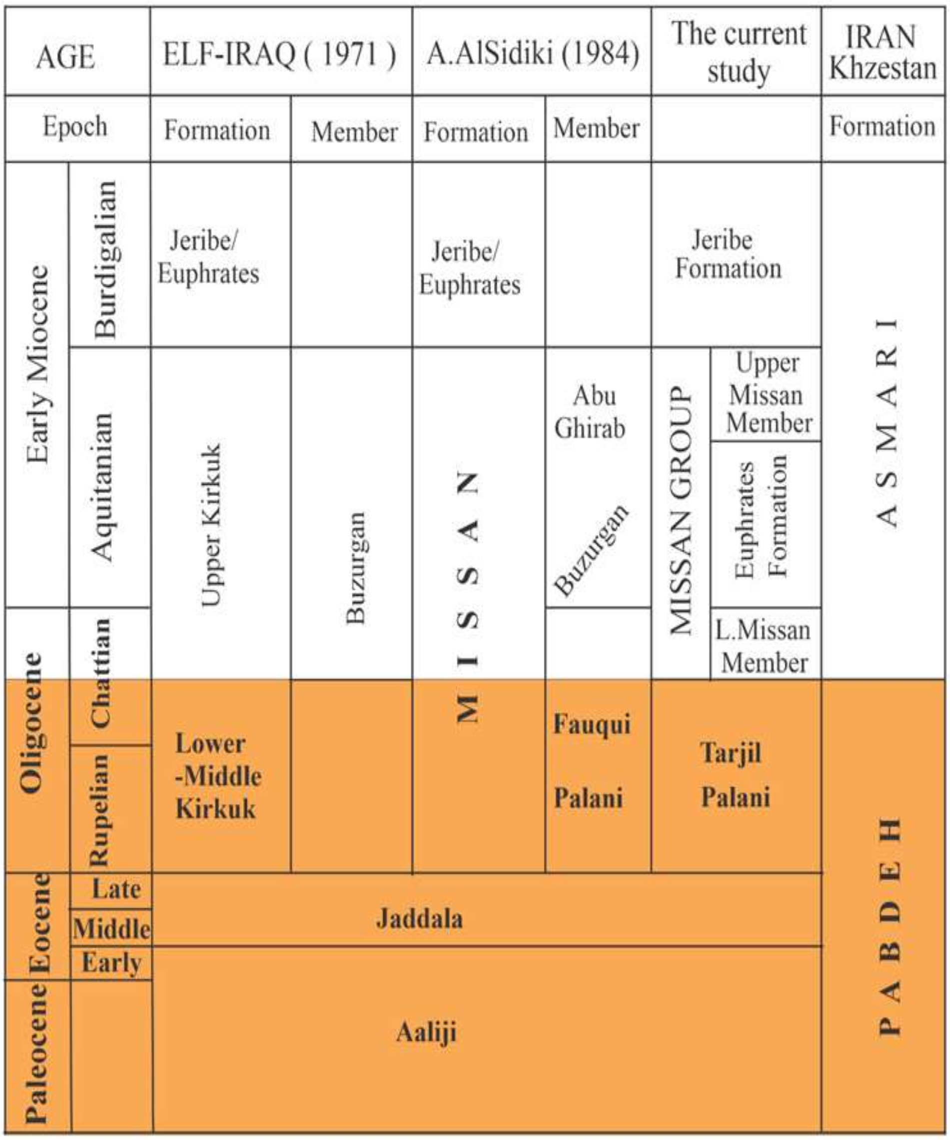

Figure 12- Schematic diagram compares Paleocene to Early Miocene periods in the current study and previous studies.

According to all previous studies and considering the comparison with the Asmari Formation in the Iranian oil fields adjacent to the studied area. The current study can nomenclature all siliciclastic sand above Oligocene deep basin sediments as Lower Missan Sandstone Member as the Euphrates Limestone Formation follows this member. The siliciclastic sandstone between the Euphrates and Jeribe formations is called the Upper Missan Sandstone Member. This study proposed to call the Missan Group because it consists of the Euphrates Limestone Formation and two sandstone members.

On the other hand, the name Asmari Formation includes both Jeribe Formation and Missan Group in southwestern Iran (Khuzestan Provence) [13].

Conclusions

The Tertiary period is represented by two main sedimentary cycles; the first sedimentary sequence represents the Um Er Radhuma and Dammam formations, while the equivalent of deep basin sediments Aalij and Jaddala formations, which were deposited in the Zagros Foreland starved basin. The Oligocene sediments are represented by the Palani, Tarjil, Baba, and Bajwan formations on the southwestern shelf margin. The Tarjil and Palani formations are considered the deep basin equivalent. This cycle has been overlaid with a regional unconformity. Therefore, it is considered time equivalent to the major influxes of siliciclastic sand deposited in the center basin (Lower Missan Sandstone Member). This member has overlaid on top of the Tarjil Formation.

The second sedimentary cycle (Late Miocene) represents Euphrates Limestone Formation. This cycle overlaid Lower Missan Sandstone Member and ended with the emergence of sequence boundary, which contributed to the deposition of Upper Missan Sandstone Member. Each of these cycles had completed with an unconformity equivalent to the sandstone deposits which occupied the center basin during the lowstand conditions. The Jeribe Formation boundary has been represented by a conformable surface with the Upper Missan Sandstone Member and completely covered basin center sediments in an onlapping manner during transgressive conditions. This phase continued until the Lower Fars Formation(Fatha Formation) deposit covered most Tertiary sediments.

The siliciclastic sand nomenclature above Oligocene deep basin sediments is named the Lower Missan Sandstone Member, as the Euphrates Limestone follows this member. The siliciclastic sand between the Euphrates and Jeribe formations is called Upper Missan Sandstone Member.

The Missan Group consists of two siliciclastic sand members and Euphrates Formation. The Missan Group with the Jeribe Formation are the equivalent to Asmari Formation in Khuzestan Province in southwestern Iran adjacent to the studied area.

Acknowledgements

Authors would like to acknowledge Dr. Abbas Al-Badri and Dr. Samir Al-Jawad for their continuous efforts and valuable feedback that facilitated me through the stages of completion of this research. Finally, my thanks to all who contributed to this research.

References

[1] Elf - Iraq, "Final well report of Buzurgan Well No. 1." (Unpublished), 1969.
[2] A.A. Al-Saddiqi, "Sequence Stratigraphy of Tertiary time in Missan area south Iraq" 1981..
[3] A.A.M. Aqrawi, J.C. Goff, A.D. Horbury, F.N. Sadooni, "The petroleum geology of Iraq". 21-275, 2010.
[4] R.J. Dunham," Classification of carbonate according to depositional texture, in Ham, W.E. (ed.), Classification of carbonate rocks". AAPG Memoir 1, p.108-121, 1962.
[5] Z.R. Beydoun, "Evoluation of the North eastern Arabian Plate Margin and Shelf: hydrocarbon habitat and conceptual future potential". Revue de I'Institut Francais du petrole, v.48, p.311-345, 1993.
[6] P.R. Sharland, R. Archer, D.M. Casey, R.B. Davies, S.H. Hall, A.P. Heward, "Arabian Plate Sequence Stratigraphy". GeoArabia special publication 2.P.14-94, 2001.

[7] R.J. Murris, "The Middle East: Stratigraphic evolution and oil habitat". American Association of Petroleum Geologists Bulletin, v.64, p.597- 618, 1980.

[8] A. Al- Mashadani, "Geodynamic evolution of the Iraqi sedimentary basins: consequences on the distribution of fluids", Pp.45-185, 1984.

[9] F.N. Sadooni, and A.S. Alsharhan, "Stratigraphy, lithofacies distribution and petroleum potential of the Triassic strata of the Northern Arabian Plate" .American Association of Petroleum Geologists Bulletn, v.88, No.4, pp. 515-538, 2004. .

[10] Reuter, M., W.E. Piller, M. Harzhauser. O. Mandie B. Berning, F. Rogl, A. Kroh. M.P.Aubry, U. Wielandt Schuster, A.Hamedani, 2009. The Oligocene-Miocene Qom Formation (Iran): Evidence for an early Burdigalian restriction of the Tethyan seaway and closure of its Iranian gateways.International Journal Science. Springer. Pp.627- 650.

[11] Cussey, "Sedimentological study of the Asmari Formation in Abu Ghirab Well No. 1." (Unpublished), 1971.

[12] A.Kh. Yohana, and F.H. Khalaf, "Palaeontologic study of Eocene-Oligocene section the Noor Well No. 1." P.1-6, 2002.

[13] G.A. James and .G. Wynd, "Stratigraphic nomenclature of Iranian oil consortium agreement area". American Association of Petroleum Geologists Bulletin, V.49 No.12, Pp.2224-2232, 1965..

[14] R.C. Van Bellen, H.V. Dunnington, R. Wezel and D.M. Morton, "Iraq Lexique Stratigraphique International", III, Asie, 10a, 333p., 1959.

[15] A. A. H. Al-Zaidy, "Geohistory analysis and basin development of the Neogene succession, NE Iraq". Arab J Geosci, V.6, N.7:2483–2500, 2013.

[16] M. A. Menshed, & A. A. H. Al-Zaidy, "Sedimentary Basin Reconstruction and Tectonic Development of Paleocene-Eocene Succession, Southern Iraq, by Geohistory Analysis". Iraqi Journal of Science, 62(4), 1213–1225, 2021.

[17] P.R. R.M. Vail, Jr. Mitchum, and S. Thompson, "Seismic stratigraphy and global changes of sea-level, Part 4: Global cycles of relative changes of sea-level", In: PaytonAYTON, C.E.(ed.) Seismic stratigraphy applications to hydrocarbon exploration. American Association of Petroleum Geologists Memoir 26, P.83-97, 1977.

[18] H.V. Dunnington, "Generation, migration, accumulation, and dissipation of oil in Northern Iraq". GeoArabia Gulf PetroLink, Bahrain, vol.10,No.2,,P.53-60. reprinted in the 2005, 1958.

[19] G.A. Dhihni, "Evaluation geology of Tertiary time Formations in Bai Hassan, Eismail and Quwair areas" (Unpublished), 1999.

[20] D. Emery and K. Myers, "Sequence stratigraphy", Black Wells, U.K.P., 1996.

[21] A.A.M. Aqrawi, S.N. Ehrenberg, N.A. H.Pickard, G.V. Laursen, S. Monibi, Z.K.Mossadegh, T.A. Svana, J.M.Mc. Arthur, and M.F. Thirlwall, "Strontium isotope stratigraphy of the Asmari Formation (Oligocene-Lower Miocene), SW Iran". Journal of Petroleum Geology, Vol.30 (2) April 2007, pp. 107 – 128, 2007.

[22] R.C. Van Bellen, "The stratigraphy of the (Main limestone of Kirkuk, Bai Hassan and Qara Chuq Dagh structures in North Iraq". Journal Institute Petroleum, vol.42, No.393, 1956.