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MICROFACIES AND DEPOSITIONAL MODEL OF THE SHUAIBA FORMATION (LOWER CRETACEOUS), IN SELECTED WELLS, SOUTHERN IRAQ

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ABSTRACT

The Shuaiba Formation (Aptian age) is an important formation due to its wide extent in Iraq and Arabian Gulf. In northern Iraq, it is called Qamchuqa Formation and has an important role in contracting the Arabian plate. The study focused on several wells, which are: ZB-290, WQ1-353, RU-358, R-624, and R-5 from several selected fields, such as Zubair, Rumaila, and West Qurna in southern Iraq. The purpose of the study is to determine the sedimentary and paleontological components of the Shuaiba Formation. The lithology of the Shuaiba Formation consists of very fine crystalline massive limestone that gradually converts to chalky limestone with a large percentage of dolomites, especially in the middle part of the formation. The thickness of the studied formation is about 50 – 110 meters and its main microfacies are two types, which are carbonate and dolomite. The carbonate is subdivided into five secondary types, which are burrowed bioclastic lime mudstone, planktonic foraminiferal lime mudstone, larger foraminifera wackestone, algal wackestone and mixed planktonic, and benthonic Foraminifera wackestone, in addition, to dolostone microfacies. The effect of the diagenesis in the formation is distinguished and most of these processes are destructive, such as dissolution and stylolite. The first depositional stage of the investigated area began with sea level rise following the deposition of the Zubair Formation from still stand. Shuaiba Formation deposited within the ramp setting as the water level rose. During the late Aptian, tectonic and sea levels were the active factors that controlled the deposition of the formation. According to data collected from microfacies and diagenesis processes, the Shuaiba Formation has several depositional environments, which are from the shallowest: restricted, open marine (inner ramp), mid ramp, and finally outer ramp. Generally, toward the upper sequence, the formation reflects deep deposits and then starts to be less deep until it is a shallow basin (Nahr Umr).

INTRODUCTION

In Iraq's geologic succession, the Shuaiba Formation is a crucial formation due to its wide extent in Iraq where it hosts oil in some areas. Iraq is intensely studied for its petroleum aspect as either Shuaiba or Qamchuqa formations. This study is interested in a substantial age of geological history because the majority of the country's oil was accumulated during that time. Owen and Nasr originally described the Shuaiba Formation in 1958 (Al-Shawi *et al*., 2019). Jassim and Goff (2006) attribute the formation to the Early Cretaceous (Aptian). The formation in the studied wells ranges in thickness from 50 m to 110 m, and there seem to be substantial thickness fluctuations around the region. The Formation's fossils include

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Globigerinids, *Orbitolina cf. discoidea* Gras, *Choffatella decipiens* Schlumberger, and pseudo-oolitic limestone (Ali *et al*., 2018). Al-Shawi *et al*. (2019) determined the *Hedbergella tunisiensis* Range Zones biozone, which comprises all the ages of the Shuaiba Formation in the Mesopotamian plain. Shuaiba Formation is part of the Albian-Aptian Sequence (Wasi'a Group), within carbonate-clastic succession (Ali *et al*., 2018). It belongs to AP8 with the division of Sharland *et al*. (2001). It has two regional transgressions K70 (120 Ma) and K80 (116 Ma). This research is characterized by the lack of studies, as there are no core samples for it because this formation does not produce oil, However, there are a few references for it, such as Bellen *et al*., (1959); Jassim and Goff (2006); Al-Qayim, (2013); Al-Zaidy and Amer (2015); Ali *et al*. (2018); Ahmed, (2020). The study's objective is to characterize the microfacies of the Shuaiba Formation and to depict the proposed sedimentary model for the formation by studying many thin sections.

GEOLOGICAL SETTING

Zubair subzone is the southernmost unit of the Mesopotamian zone of Iraq and the most oil-producing region in Iraq. The study area is located in several oilfields, which are Zubair, North and South Rumaila, in addition to West Qurna, which are situated in the Zubair subzone (Figure 1). The majority of the oil fields in this region have simple, elongated anticlinal structures that resemble north-south trends (Razoian, 2002). West-Qurna oil fields are used as a reference because of the vast number of different types of data that are available there. As a result of the collision between the overriding Iranian plate and the under-riding Arabian plate, anticlines began to be created in the Late Tertiary (Eocene-Recent) and have persisted to the present day. This collision resulted in the formation of the Bitlis-Zagros Fold-Thrust Belt and the foreland basin within the Arabian plate (Almuturi and Alasadi, 2008). Folds and salt domes are the two structures that hosted oilfields in the Zubair Subzone (Jassim and Goff, 2006).

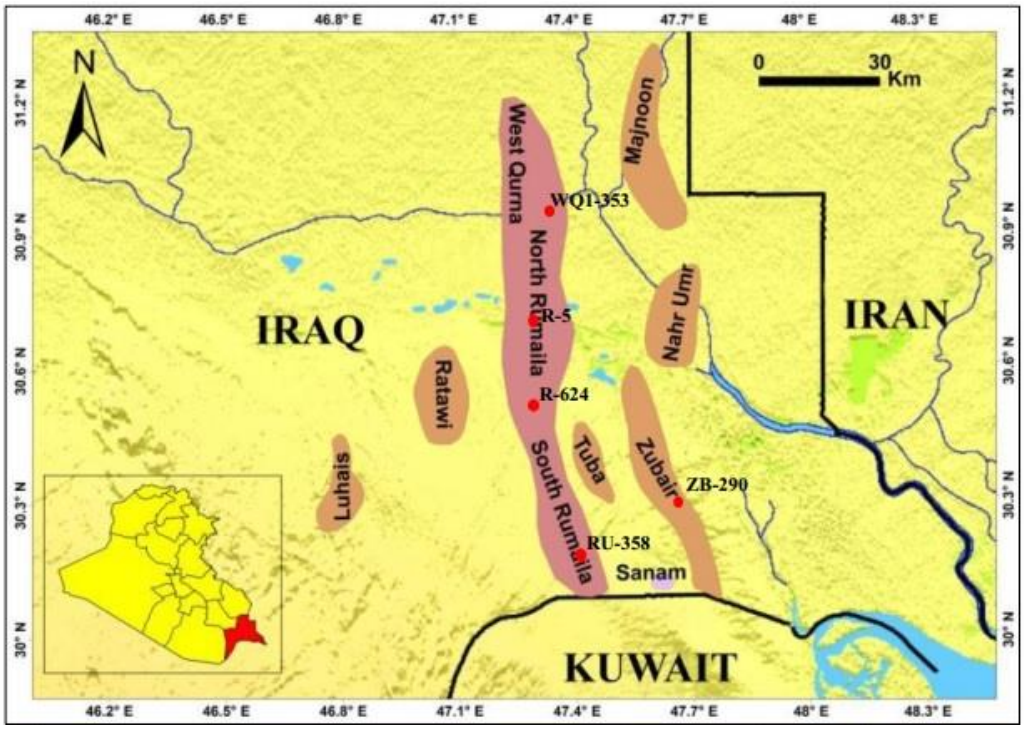

Figure 1: the location map of the studied wells (red circles), in the Zubair subzone, southern Iraq (Jaffar, 2018).

While the salt structures are mostly impacted by salt tectonics, the anticlines are primarily impacted by the Alpine orogeny and basement faults (Al-Kaaby *et al*., 2023). However, with the recent tectonic division to Iraq, the study area lies within Mesopotamia foredeep in the outer platform (Fouad and Sissakian, 2011).

The formation was deposited in an open marine environment and comprised of thick limestone that grades into chalky limestone and shale at its top near its contact with the Nahr Umr Formation (Ahmed, 2020). Two types of lithologies in studied wells: **1)** Limestone which is pale yellowish brown, medium light grey, occasionally slightly reddish brown, micro to fine crystalline, sub blocky, chalky thin layers, no visual porosity. **2)** Dolomite has pale orange, brown, pinkish gray, yellowish gray in place, slightly hard to moderately hard, occasionally firm, fine crystalline, sub blocky, commonly sucrosic, occasionally vuggy porosity, no oil show (Figure 2) (Final Report, 2013). Shuaiba Formation lies above the Zubair Formation with a conformable and gradational contact, whereas the Nahr Umr Formation lies above it in an unconformable contact (Al-Shawi *et al*., 2019).

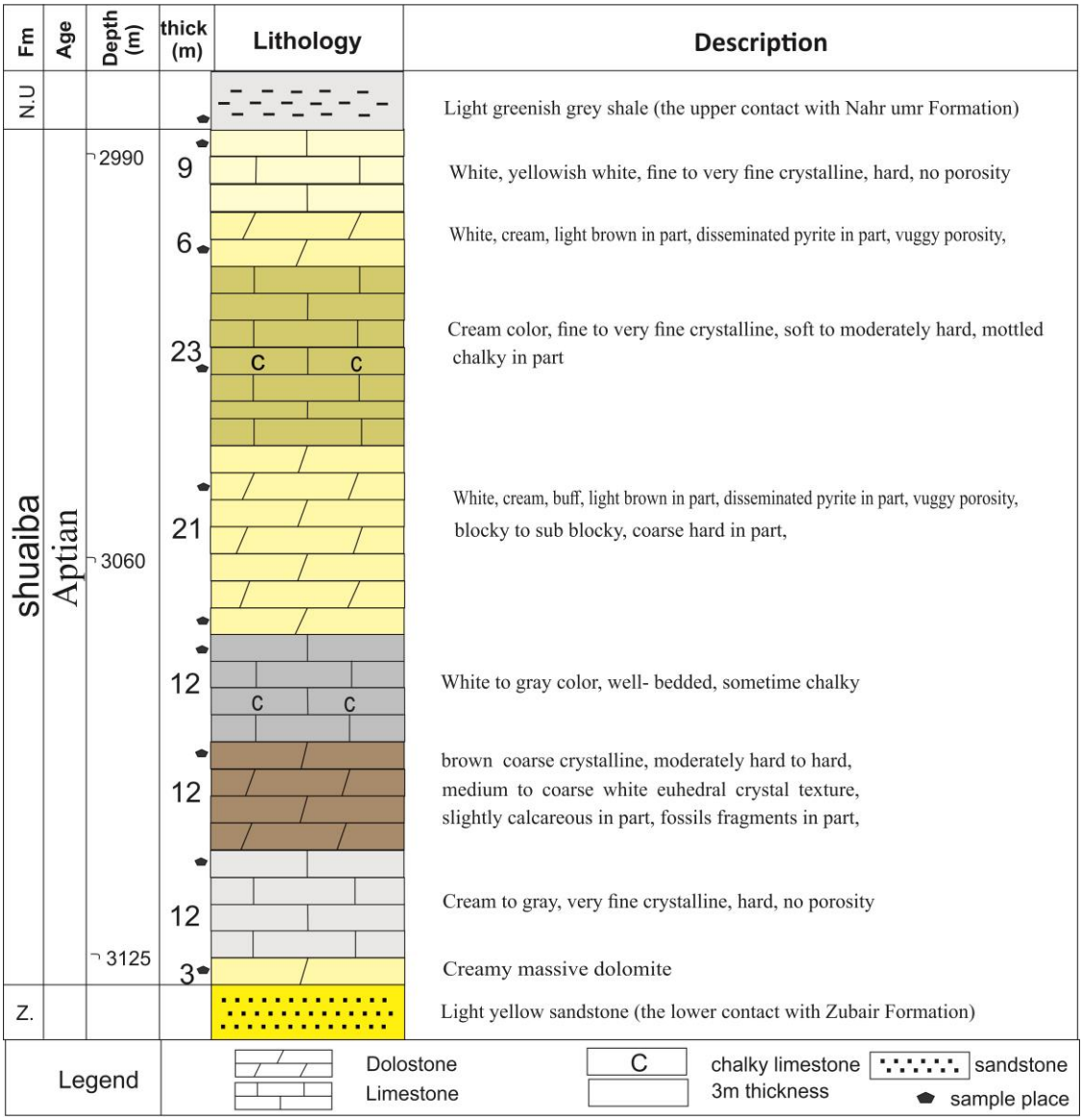

Figure 2: The typical stratigraphical section of the Shuaiba Formation in WQ1-353, Southern Iraq.

METHODS AND MATERIAL

Twenty-six cutting samples were prepared for examination as thin sections, distributed on the studied oilfields (Zubair, North and South Rumaila, and West Qurna), ten samples were taken from WQ-353, while 4 samples were taken for each studied field. 26 thin section slides prepared in the laboratory of the College of Science, University of Basrah. Also, 50 thin section slides borrowed from the Basrah oil company followed to West Qurna oilfield, this rock column is considered as a reference section to compare all the results with it. The description of the geological report to the Shuaiba Formation is as follows: it is composed mainly of Carbonates (Limestone and/ or Dolomite). It is picked by the appearance of Limestone and/or Dolomite with a fast rate of penetration.

The average thickness of the Shuaiba Formation is 100 m. partial/ Complete Mud losses of circulation are highly possible while drilling the Shuaiba Formation in the West Qurna oilfield (Table 1). Limestone: white, off-white, chalky, creamy white, vuggy, high dolomitic occasionally. Shuaiba Formation is an oil-bearing reservoir in some fields. It is highly recommended to control the rate of penetration while drilling the Shuaiba formation as it is a highly porous formation to avoid (Final Report, 2013).

Table 1: the location of the chosen wells in various oil fields south of Iraq.

No.	Well	Thickness (m)	N	E
1	ZB-290	50	30º 21' 41.91"	47º 38' 53.81"
2	WQI-353	100	30º 50' 20.59"	47º 18' 37.89"
3	RU-358	105	30º 13' 8.86"	47º 22' 47.17"
4	R-624	100	30º 26' 1.53"	47º 19' 56.11"
5	R-5	110	30º 34' 40.95"	47º 19' 52.12"

MICROFACIES

For this article, Dunhm's (1962) classification is applied which is crucial for describing the grains' origin and their kinds, as well as the kind and energy of the sedimentary environment. The identification of the fossils depends on several resources, which are: (Caron, 1987); (Sliter, 1989); (Soleimani *et al*., 2013). The carbonate of Shuaiba microfacies is divided into three main microfacies and five submicrofacies. The results of the microfacies are:

- **Lime mudstone microfacies**

It divided into two submicrofacies

– **Burrowed bioclastic lime mudstone submicrofacies:** 90% of the mixture is mud, while about 5% is grains. It has bivalves and algae fragments that may have generated pyrite (Figures 3a, b, and c). Also, Gastropoda fossils have been noticed in this microfacies. The cubic dolomite was diagnosed in this submicrofacies. The diagenesis processes are presented by channel dissolution and tiny spaces could belong to moldic porosity for planktonic fossils. The thickness of this microfacies is about 20 m and usually concentrated in the lower and middle part of the studied formation in WQ1-353, while the other studied fields (ZB-290, RU-358, R-624, R-5) appear only in the lower part. Depending on Flugel's (2010) classification for the ramps (RMF), this microfacies is located in RMF 2, indicating the outer ramp into the basin environment.

– **Planktonic Foraminiferal Lime mudstone submicrofacies:** This facies has a higher proportion of carbonate grains than Burrowed bioclastic lime mudstone with a higher

percentage of dolomite, which could compose 60% of the total studied submicrofacies. Planktonic foraminiferal and green algae are present. *Heterohelix*, *Globotruncana*, and *Hedbergella* are three significant genera that can be recorded in these facies (Figure 3d and e). The diagenesis process is displayed by a layered structure and a dissolving channel filled with drusy and blocky cement. Laminate algae are also present in this microfacies. The thickness of this submicrofacies is varied, ranging between 20 – 30 m. It is recorded in all studied fields. The submicrofacies is RMF 5, which indicates a mid-ramp to the outer environment (Flugel, 2010).

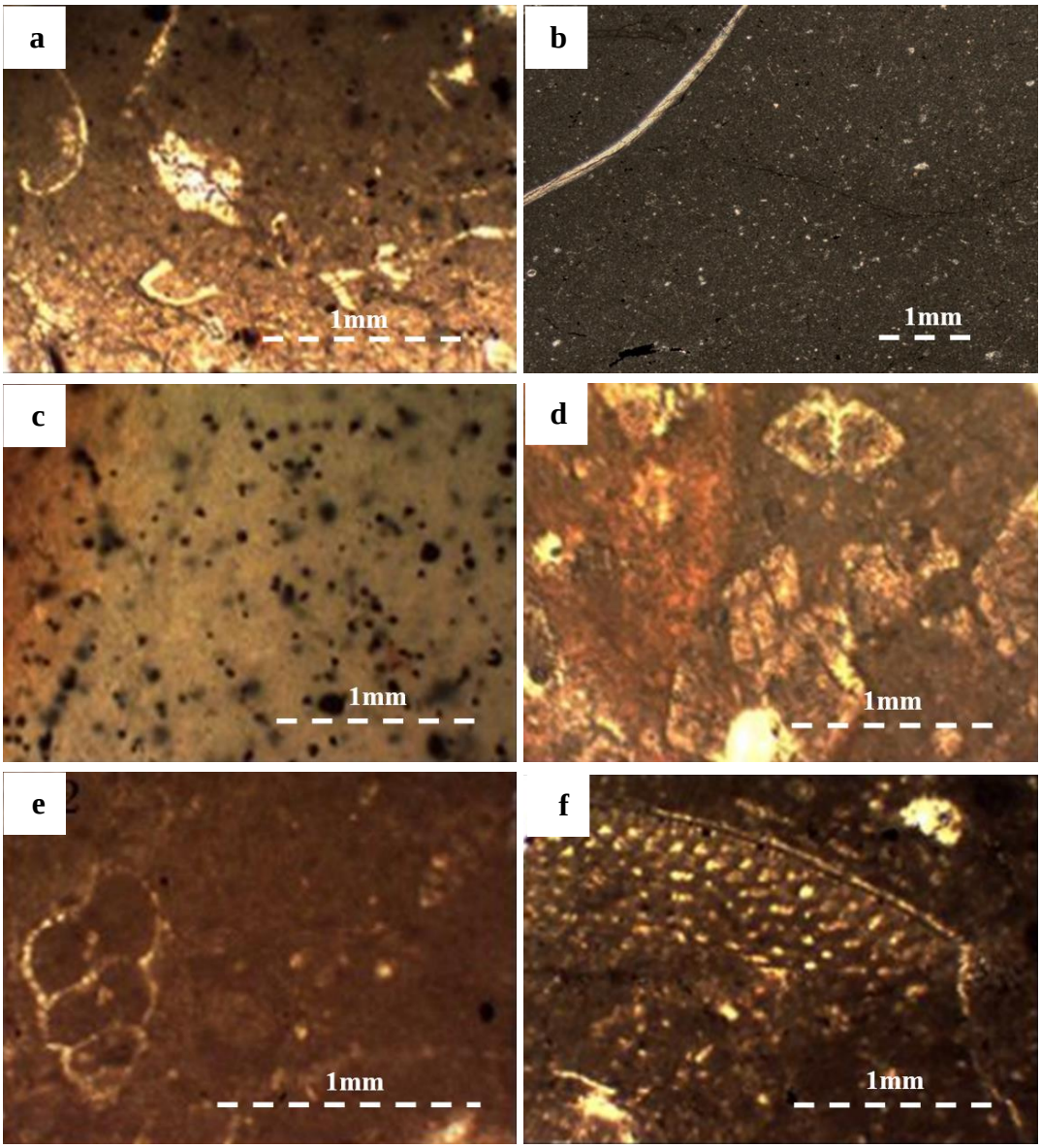

Figure 3: **a and b)** Burrowed bioclastic lime mudstone microfacies (Zb-290 depth 3130 m); **c)** framboidal pyrite in lime mudstone microfacies (R-5, depth 3040 m); **d and e)** planktonic foraminiferal Lime mudstone microfacies, planktonic foraminifera (*Globotruncana* and *Heterohelix*) (R-624, depth 3055 m); **f)** larger foraminifera Wackestone, *Orbitolina* sp. (Zb-290, depth 3140 m).

- **Wackestone microfacies**

This microfacies have three submicrofacies

– **Larger Foraminifera Wackestone:** Carbonate mud makes up 30% of the mixture, whereas the rest consists of skeleton grain. These facies host *Orbitolina* sp. that underwent pyritization as a result of the reduction process brought on by oxygen depletion, together with a few fragments of dispersed algae (Figures 3f and 4a). Molluscan fragments and dolomite are noticed in these microfacies, which pointed to a late stage of diagenesis. This microfacies contain some calcisphere and low-altitude stylolite. The orbitolinid group is surrounded by stylolite, and some *Orbitolina* sp. underwent dolomitization. This facies occasionally contains unique fossils like *Globotruncana* and *Nezzazata*. This submicrofacies presents the first indicator of the progress of the sea level towards land, it overlies directly above the Zubair Formation. The suggested RMF is RMF 13, which indicates restricted to open inner ramp environments (Flugel, 2010). It was recorded in contact with the Zubair Formation in all studied fields.

– **Algal wackestone microfacies:** Mud makes up 60% of the mixture, and skeleton grain makes up roughly 40%, most of these grains are formed by algae (Figure 4b). Also, the dolomite in this microfacies is available, which is produced during the late diagenesis process, the dolomite is dispersed throughout the laminated green algae. Likewise, some planktonic foraminifera are recorded such as *Hedbergella* sp., the distribution of the algae fossils is reflected shallow environment different from the other microfacies, it noticed in the upper part of the studied formation. The thickness of this submicrofacies is 10 to 20 m. This submicrofacies is located within RMF 17 which reflects a restricted environment (Flugel, 2010). It is a good indicator of to retreat of the sea level at the end of the deposition of the Shuaiba Formation.

– **Mixed planktonic and benthonic Foraminifera wackestone microfacies:** These facies include many of the benthonic organisms such as Orbitolina, Echinodermata, Bivalves, and Ostracoda. But the microfacies are characterized by many types of planktonic foraminifera including *Andamookia* sp., *Macroglobigerinelloides ultramicrus*, *Vercorsella arenata*, *Debrina Hahounerensis*, *Ovalveolina crassa*, *Hedbergella tunisiana*, Miliolids and Textulariids. This microfacies include green algae, peloids, and dolomite (Figure 4c, d, e, and f). This facies also contains cubic pyrite. This microfacies include several diagnostic procedures where block cement is used to fill channels with bivalve shells and Ostracoda. The middle part of the studied formation is the location of this submicrofacies, which also reflects periods of regression sediments. This submicrofacies reflect the wide range of environments extending from RMF 16 to 18, the typical environment for this microfacies is restricted (Flugel, 2010).

- **Dolostone microfacies**

This facies is totally transformed into a dolomite rock, which is found in the uppermost part of the Shuaiba Formation and is much larger and contains less than 2% clay. Many dolostones in the stratigraphic record contain fossils that suggest typical marine habitats of deposition, which is a sign of dolomitization as a result of the partial and total replacement process of mineral calcite or aragonite (Nichols, 2009). The influence of the dolomite zone concentrates in the upper and sometimes middle of the Shuaiba Formation. The present study manifested a variety of shapes, such as fine crystal to conventional cubic (euhedral) as shown in (Figure 4g and h).

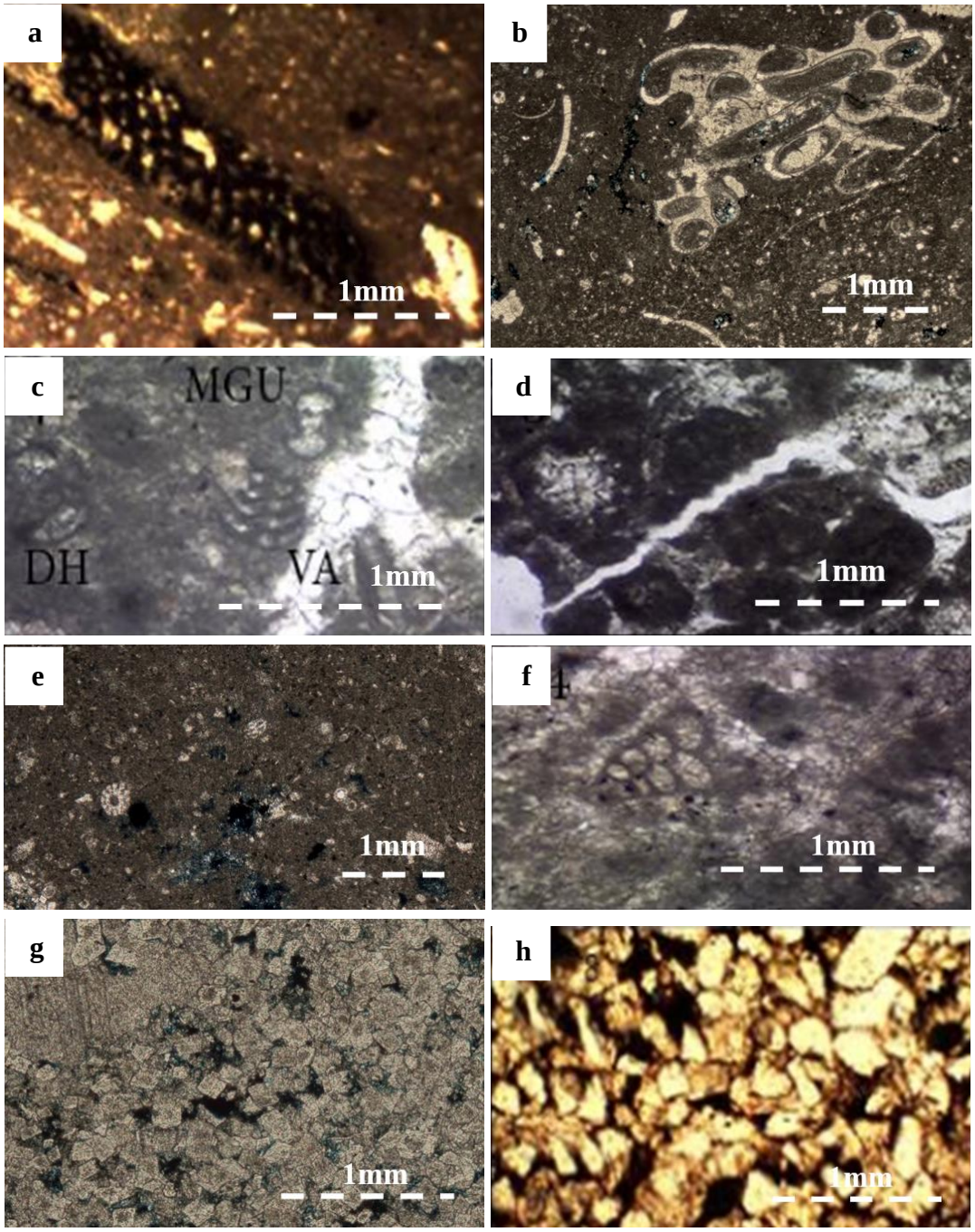

Figure 4: **a)** Larger foraminifera wackestone, *Orbitolina* sp. affected by oxygen depletion (Ru-358, depth 2980); **b)** algal wackestone microfacies (WQ1-353, depth 3070); **c, d, e and f)** mixed planktonic and benthonic foraminifera wackestone microfacies; **c)** MGU: *Macroglobigerinelloides*, DH: *Debrina Hahounerensis*, VA: *Vercorsellaarenata*, (R-5, depth 3067); **d)** Peloids with mollusca fragments (R-624, depth 3090); **e)** echinoids with planktonic foraminifera(WQ1-353, depth 3055); **f)** textulariids, Zb-290, depth 3166); **g and h)** dolostone microfacies (WQ1-353, depth 3087).

DISCUSSION

Shuaiba Formation was deposited within the ramp setting (Wells *et al*., 2019). It is deposited above the plastic Zubair Formation; the main sedimentary environment of Zubair Formation is a prograding delta (Jassim and Goff, 2006), covered these deposits with deep carbonate facies represented by larger foraminiferal wackestone, it reflects an open inner ramp environment. Globally, the sea level rise is recorded during the Aptian between 108 – 113 My (Haq *et al.*, 1987).

In the platform area especially in the quasiplatform area (Studied area), the deposition of the formations happened as a repetitive sequence of clastic and calcareous rocks during the upper Jurassic (Late Tithonian)-Paleocene, the result of the changes in tectonic events (Numan, 1997). There are several important tectonic events in the Obduction of the Iraqi suture zone ophiolites of the Thrust Zone at the Aptian-Cenomanian interval (Numan, 2000). The Alpine orogeny led to three stages for the subduction in the studied area, one of them is called the normal Chilean subduction which happened during the Aptian-Late Cenomanian (Numan, 2001). Also, important eruptions dated in 122 – 115 MY. (Barremian-Aptian) (Jassim and Goff, 2006). This process appeared to have continued regularly for 35 Ma as the Atlantic Ocean widened enough to allow major mixing of waters across the equator (Jenkyns, 2003). The Arabian plate changed from extensional to compressional tectonics in the Middle Cretaceous, which resulted in the reverse reactivation of earlier normal faults and marginal folding (Aqrawi *et al*., 2010). Locally this tectonic inversion has affected the Mesopotamia basin and led to rapid subsidence in Mesopotamian Plain (Abdulnaby *et al*., 2021). Generally, Tectonic subsidence caused the high to moderate subsidence that was present from the Upper Jurassic to the Mid-Cretaceous (Handhal and Mahdi, 2016). The bottom microfacies reflect the deep environment and then start to fluctuate between mid-ramp and open marine. All these factors were controlled in the depositional environments, the shallowest basin was recorded at the upper part of the formation, which is the restricted environment accompanied by dolostone rocks, while the deepest environment is located in the outer ramp (Figure 5). The suggested model for the studied formation revealed a similarity between the microfacies of the studied oilfields (West Qurna and Rumaila) because all of these oil fields are located on one line, except for the Zubair field, where the Zubair oilfield microfacies reflected a different scene, as it included deep microfacies as a result of the spread of planktonic foraminifera.

CONCLUSION

Most of the studies depend on wireline logs to determine the lithology and the other geological data, but this study relies on cutting samples to determine the fossils and sedimentary microfacies. Shuaiba Formation was deposited during an important age (Aptian) in the geological history of the Mesopotamia basin, where several factors contributed to its deposition, the most important of these factors are tectonic activities and sea level rise, where a huge regional rise was recorded during the early and middle Aptian age, that covered all the Arabian plate, where it was deposited on deep carbonite ramp over shallow clastic sediments. The change in the tectonic events in the region led to the transgression and regression of the sea, which led to a diversity of sedimentary environments from the inner ramp to the outer ramp.

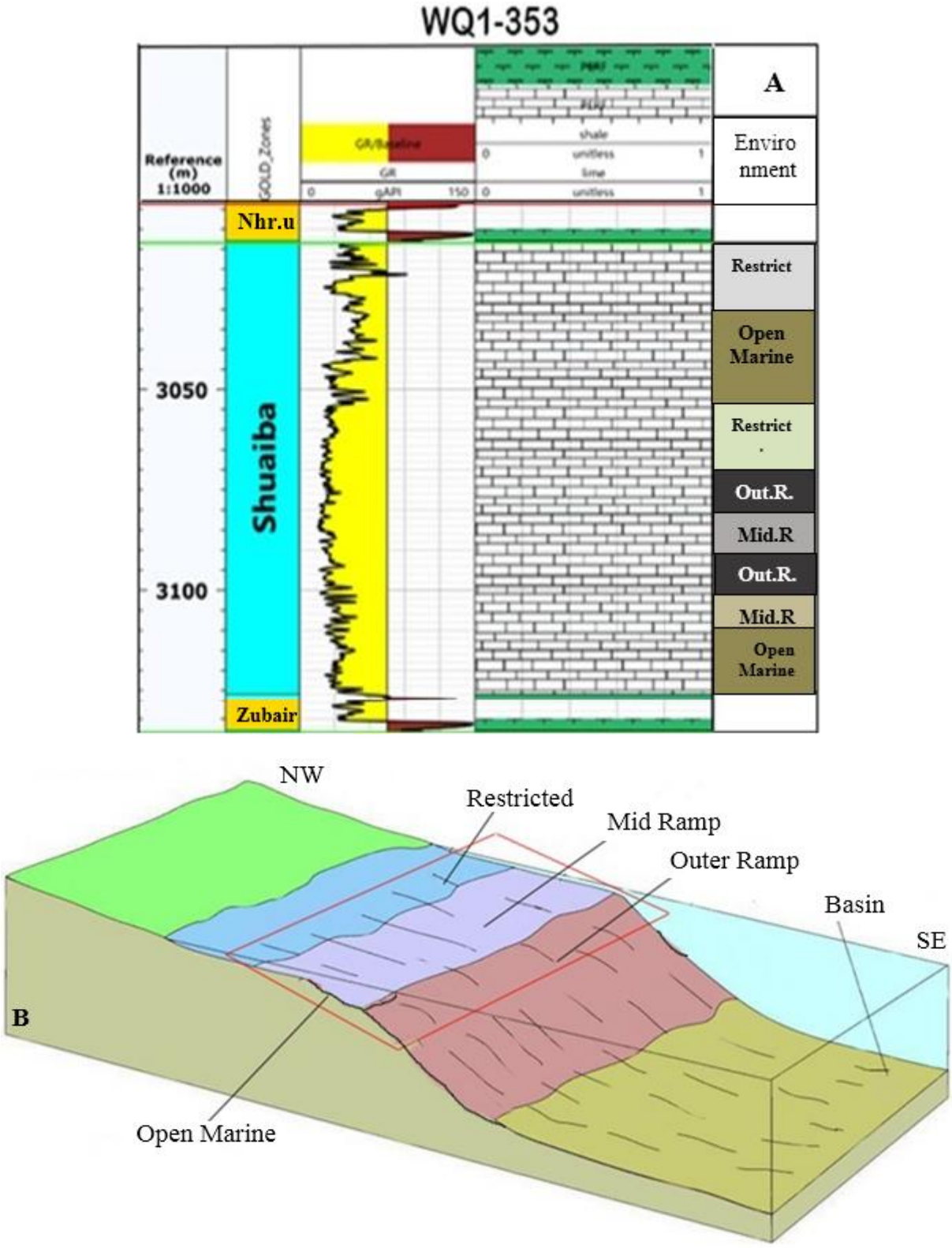

Figure 5: The suggested model for the Shuaiba Formation, A. the typical stratigraphical section with fluctuation of the environments in WQ1-353. B. the environments of the Shuaiba Formation that are surrounded by red squares (modified of geologylearn, 2015).

REFERENCES

Abdulnaby, W., Motaghi, K., Shabanian, E., Mahdi, H., AlShukri, H. and Gok., R., 2021. Crustal Structure of the Mesopotamian Plain, East of Iraq, Tectonic, RESEARCH ARTICLE, 10.1029/2020TC006225.

Ahmed, M.J., 2020. Microfacies analysis and depositional development of Shuaiba formation in the West Qurna oil field, Southern Iraq, Modeling Earth Systems and Environment, doi.org/10.1007/s40808-020-01036-w

Al-Kaabi, M., Hantoosh, D., Neamah, B., Almohy, H., Bahlee, Z., Mahdi, M. and Abdulnaby, W., 2023. The Structural Analysis of the Oilfields in Zubair Subzone, Southern Iraq, African journal of earth sciences, Vol.197, 104770pp.

Aqrawi, A.A.M., Goff, J.C., Horbury, A.D. and Sadooni, F.N., 2010. The Petroleum Geology of Iraq. Scientific Press Ltd, 424pp.

Ali, K.K., Al-Sharaa, G.H. and Rasheed, A.H., 2018. 3D Seismic Structural and Stratigraphy Study of Shuaiba Formation in Kuwait Oil Field-Southern Iraq, Iraqi Journal of Science, Vol.59, No.3C, p. 1665 – 1672.

Almutury, W.G. and Al-Asadi, M.M., 2008. Tectonostratigraphic History of Mesopotamian Passive Margin during Mesozoic and Cenozoic, South Iraq. Kirkuk University Journal for Scientific Studies, Vol.3, No.1, p. 31 – 50.

Al-Qayim B., 2013. Reservoir Characterization of Shuaiba Formation (Aptian), Khabaz Oil Field, Kirkuk Area, NE Iraq, conference poster, DOI: 10.3997/2214-4609.20131473

Al-Shawi, Z., Mahdi, M. and Mohamed, A., 2019. New records of planktonic foraminifera in the Shuaiba Formation (Aptian Age), Mesopotamian plain, South of Iraq, Iraqi Journal of Science, Vol.60, No.6, p. 1322 – 1335.

Al-Zaidy, A.A. and Amer, Z., 2015. Facies Analyses and Diagenetic features development of Albian-Aptian Succession in the West Qurna oil field, Southern Iraq, Iraqi Journal of Science, Vol.56, No.4A, p. 2887 – 2901.

Bellen, R.C., Dunnington, H.V., Wetzel, R. and Morton, D.M., 1959. Lexique stratigraphique international, Iraq. Internat. Geol. Cong. Comm. Stratig., (3) Fasc. 10a, 333pp.

Caron, M., 1987. General Cretaceous Planktonic Foraminifera, In Bolli, H.M., Saunders, J.R. and Perch-Nielaem, K. (eds.) Planktonic Stratigraphy, Cambridge Univ. Press, p. 17 – 86, Figs.37.

Dunham, R.J., 1962. Classification of carbonate rocks according to depositional textures. A Symposium AAPG Memoir, Vol.1, p. 108 – 121.

Final report, 2013. Basra oil company, West Qurna1, No.123.

Flugel, E., 2010. Microfacies of carbonate rocks, analysis, interpretation, and application of Springer-Verlag. New York, 1004pp.

Fouad, S.A. and Sissakian, V., 2011. Tectonic and structural evolution of the Mesopotamian plain. Iraqi Bull. Geol. Min. Spec. Issue No.4, p. 33 – 46.

Handal, A. and Mahdi, M., 2016. Basin modeling analysis and organic maturation for selected wells from different oil fields, Southern Iraq, Model. Earth Syst. Environ, Vol.2, No.189, p. 1 – 14.

Haq B.U., Hardenbol, J. and Vail, P.R., 1987. Chronology of fluctuating sea levels since theTriassic. ScienceV. 235, PP.1156-1167. http://geologylearn.blogspot.com/2015/06/carbonate-platforms.html.

Jassim, S.Z. and Goff, J.C., (Eds.) 2006. Geology of Iraq. DOLIN, distributed by Geological Society of London, 341pp.

Jenkyns, H.C., 2003. Evidence for rapid climate change in the Mesozoic – Palaeogene greenhouse world. Philosophical Transactions of the Royal Society of London. Series A: Mathematical, Physical and Engineering Sciences, Vol.361, No.1810, p. 1885 – 1916.

Jaffar, H.M., 2018. Structural Geology of Rumaila Oilfield in Southern Iraq from Well Logs and Seismic Data, Unpub. Msc. Thesis, University of Basrah, 104pp.

Nichols, G., 2009. Sedimentology and Stratigraphy, 2nd Ed. A John Wiley and Sons, Ltd., Publication, The Atrium, Southern Gate, Chichester, West Sussex, 41pp.

Numan, N.M.S., 1997. A plate tectonic scenario for the Phanerozoic Succession in Iraq. J. Geol. Soc. Iraq, Vol.30, No.2, p. 85 – 110.

Numan, N.M.S., 2000. Major cretaceous tectonic events in Iraq. rafidain J. Sci., Vol.11, No.3, p. 32 – 52.

Numan, N.M.S., 2001. Cretaceous and Tertiary Alpine Subductional History in Northern Iraq, rafidain J. Sci., Vol.1, No.2, p. 59 – 74.

Razoian, A.M., 2002. A study to improve enhanced oil recovery of Mishrif reservoir in north Rumaila and westQurna and main pay in south Rumaila fields (MSc Thesis). University of Basrah, Basrah, 145pp.

Sharland. P.R., Archer, P.R., Casey, D.M., Davies, R.B., Hall, S.H., Heward, A.P., Horbury, A.D. and Simmons, M-DS., 2001. Arabian plate sequence stratigraphy, an intedrated approach, Geo Arabia speciel publcaition, Manama, Bahrain, 340pp.

Sliter, W.V., 1989. Biostratigraphic zonation for Cretaceous planktonic foraminifers examined in thin section. The Journal of Foraminiferal Research, Vol.19, No.1, p. 1 – 19.

Soleimani, B., Bahadori, A. and Meng, F., 2013. Microbiostratigraphy, microfacies and sequence stratigraphy of upper cretaceous and Paleogene sediments, Hendijan oilfield, Northwest of Persian Gulf, Iran, Natural Science, Vol.5, No.11, p. 1165 – 1182.

Wells, M., Bowman, A. and Kostic, B., 2019. Campion, N., Finucane, D., Santos, C., Kitching, D., and Brown, R., Lower Cretaceous Deltaic Deposits of the Main Pay Reservoir, Zubair Formation, Southeast Iraq: Depositional Controls on Reservoir Performance, AAPG., 16, p. 219 – 260. https://doi.org/10.1306/13642170M1183802

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