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Thesis of the doctoral dissertation (PhD)

Depositional Sequences and Diagenetic Controls on the Lower Cretaceous Yamama Reservoir, Southern Iraq: Implications for Petroleum Exploration and Basin Evolution

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I. Scientific background and aims

Nearly 65% of world oil and natural gas production takes place in the Middle East, being hosted mainly by carbonate rocks (Burchette 2012), such as the Cretaceous Yamama, Thamama Group, Kharaib, Shuaiba, Mauddud, and Mishrif formations. Carbonate reservoirs, which host over 60% of the world's oil and about 40% of the gas reserves (Moore and Wade 2013) globally, are strongly heterogeneous. Despite their economic importance, carbonate reservoirs are notoriously complex due to their strong lateral and vertical heterogeneity. This heterogeneity results from rapid subtle facies and related porosity-permeability changes, sensitivity to diagenetic reactions, and multimodal pore sizes (Lucia 2007; Morad et al. 2018). This heterogeneity imposes challenges for acquiring accurate reservoir characterization for efficient hydrocarbon production and recovery operations and optimization of the field developments plans and management (Burchette 2012).

Diagenetic alterations, such as cementation, dissolution, micritization, dolomitization and compaction, can overprint depositional porosity-permeability in unpredictable ways, both enhancing and degrading reservoir quality at different times (Lucia 2007; Morad et al. 2019). These diagenetic alterations are often diachronous and varying significantly at a field and basin scales, making it difficult to correlate reservoir characteristics predictively. Therefore, this limitation necessitates the incorporation of diagenetic alteration into depositional sequence analysis (Morad et al. 2012; Seibel and James 2017).

The Yamama Formation is a prolific hydrocarbon-bearing unit in southern Iraq and across parts of the Arabian Gulf region. However, its reservoir characteristics remain poorly understood due to the complex interplay between depositional heterogeneity and post-depositional diagenetic alteration. Furthermore, the formation exhibits variable reservoir quality across different oilfields, ranging from dry zones in some localities to productive intervals with successful hydrocarbon flow in other places. Moreover, in southern Iraq, the Yamama is deeply buried, reaching up to 4100 m, which rises significant challenges for acquiring essential subsurface data such as the core samples and well logs. Although several local studies have addressed its petrophysical properties and general depositional setting (Saleh 2014; Al Mafraji and Al-Zaidy 2019; Handhal et al. 2020; Idan et al. 2020; Al-Iessa and Zhang 2023; Li et al. 2024), Limited studies have specifically addressed the controls of facies/microfacies and diagenetic alterations on reservoir evolution across spatial and stratigraphic units at the field and regional scales.

There is a lack of detailed integration between facies/microfacies analysis, petrographic diagenetic alteration, fluid inclusion thermometry, and stable isotopic signatures, which are critical to reconstruct the diagenetic history and to constrain the thermal and geochemical conditions under which reservoir properties evolved. Furthermore, the spatial variability of porosity-reducing versus porosity-enhancing diagenetic processes across the carbonate ramp and their depositional sequences context remain unclear.

This study aims to fill critical gaps in the understanding of the Lower Cretaceous Yamama Formation in southern Iraq through an integrated sedimentologic, petrographic, and geochemical approach. I used cores, borehole data, and geological information from several oilfields within the Mesopotamian Foreland Basin.

The aims are:

- To synthesize current knowledge on the sedimentological and diagenetic factors controlling reservoir quality and heterogeneity of the Yamama Formation in Iraq and the Middle East. This critical review enhances the understanding of Lower Cretaceous reservoirs and their implications for hydrocarbon exploration and production.

- To evaluate the petrophysical properties such as porosity, permeability, shale content, and fluid saturation to distinguish between reservoir and non-reservoir units and to examine the reservoir heterogeneity.

- To analyze and interpret the depositional facies/microfacies of the Yamama Formation and to establish their spatial and stratigraphic distribution across different oilfields through constraining the primary depositional environments.

- To identify and characterize the key diagenetic processes influencing the reservoir quality including cementation, dissolution, dolomitization, compaction and micritization.

- To constrain the timing, temperature, and geochemical conditions of diagenetic fluid events. This is achieved through a combination of petrography, scanning electron microscopy, fluid inclusion microthermometry, and stable isotope analysis ($\delta^{13}C$ and $\delta^{18}O$).

- Finally, the integration of diagenetic evolution into a depositional sequence framework provides new insights into how sea-level fluctuations controlled fluid flow patterns and drove diagenetic alteration, thus, shaping reservoir heterogeneity in the Yamama Formation.

II. Materials and methods

My research employed multiple approaches to investigate the controls on reservoir quality of a carbonate reservoir from southern Iraq, including sedimentological investigation of cored samples (from three different drilled wells), petrographic analysis of thin sections, facies characterization, diagenetic assessment, integration of well-log and core data, stable isotope ($\delta^{13}C$ and $\delta^{18}O$) measurements, and fluid-inclusion micro-thermometry.

- I synthesized the current knowledge on sedimentological, and diagenetic factors influencing reservoir quality and heterogeneity of the Yamama Formation (the focus of this study) in Iraq and adjacent countries in the Middle East through a critical review to enhance the understanding of the Lower Cretaceous reservoirs and the implications for hydrocarbon exploration and production.

- I used well logs data including gamma-ray, density, neutron, sonic and resistivity to define the lithofacies and empirically calculate petrophysical properties such as volume of shale (Vsh), total porosity ($PHIT$), effective porosity ($PHIE$), sonic-derived porosity ($PHIS$), and water saturation (Sw). Well logs are widely used effective tools for accurately estimating petrophysical properties of subsurface rocks (Archie 1942; Wyllie et al. 1958; Schlumberger 1974; Asquith et al. 2004). I integrated the calculations with porosity and permeability measurements and petrographic data. This analysis assessed to distinguish between the reservoir and non-reservoir intervals.

- I analysed and identified the sedimentological depositional facies/microfacies from a total of about 400 meters core intervals of Yamama Formation from three different drilled wells. The analysis was performed based on sediment textures, structures, lithology, and fossil content. A total of 170 representative samples (from the reservoir and non-reservoir intervals) were prepared as thin sections. I examined the thin sections petrographically under transmitted light to assess textures, pore types, microfossil contents and diagenetic alterations. Following the microfacies analyses worked out by Flügel (2010), I constructed the primary depositional environments and establish the formation's spatial and stratigraphic distribution.

- I identified and evaluated the diagenetic processes influencing reservoir quality in the reservoir and non-reservoir units of the formation, focusing on cementation, dissolution, dolomitization, compaction and micritization. Thin sections were examined under transmitted light and, where necessary, scanning electron microscopy (collaborating with Dr. Kristály Ferenc, the Institute of Exploration Geosciences, University of Miskolc) to recognize mineral phases, textural relationships, and paragenetic sequences. These observations allowed the reconstruction of diagenetic pathways and their impact on porosity and permeability evolution.

- I assessed the impact of microfacies and diagenetic processes on reservoir petrophysical properties through an integrated qualitative approach. Petrographic investigation of thin sections was combined with core descriptions and well-log data to link depositional facies and diagenetic alterations with porosity and permeability trends. The analysis focused on identifying which microfacies types and diagenetic processes most strongly controlled the reservoir quality.

- I constrained the timing, temperature, and geochemical conditions of diagenetic fluid events through an integrated approach combining petrographic observations, scanning electron microscopy, fluid-inclusion microthermometry (collaborating with Dr. Juan Diego Martín, University of Barcelona,), and stable-isotope ($\delta^{13}C$ and $\delta^{18}O$) analyses (measured in the University of Ottawa, Canada). This allowed to constrain the timing and diagenetic effects on the porosity/permeability evolution in the different reservoir/non-reservoir and in the different facies/microfacies. This allowed to constrain and predict a paragenetic sequence model in a carbonate ramp.

- I integrated diagenetic evolution into the depositional sequence framework to provide insights into how sea-level fluctuations controlled fluid-flow patterns and drove the diagenetic alteration of reservoir, thereby improving predictions of reservoir distribution within the sequence.

III. Scientific results/Theses

Thesis 1:

Through the integration of cored intervals, and well log interpretations, I identified that the Yamama Formation is heterogeneous consists of six distinct lithofacies (marly, argillaceous, pure, dolomitic, bioturbated dolomitic, and chalky limestones) and five electrofacies (EF-1 to

EF-5). These vary vertically in the reservoir and non-reservoir units (Figure 1). I divided the formation into four reservoir units (YRA-YRD) separated by four non-reservoir units (B0-B3).

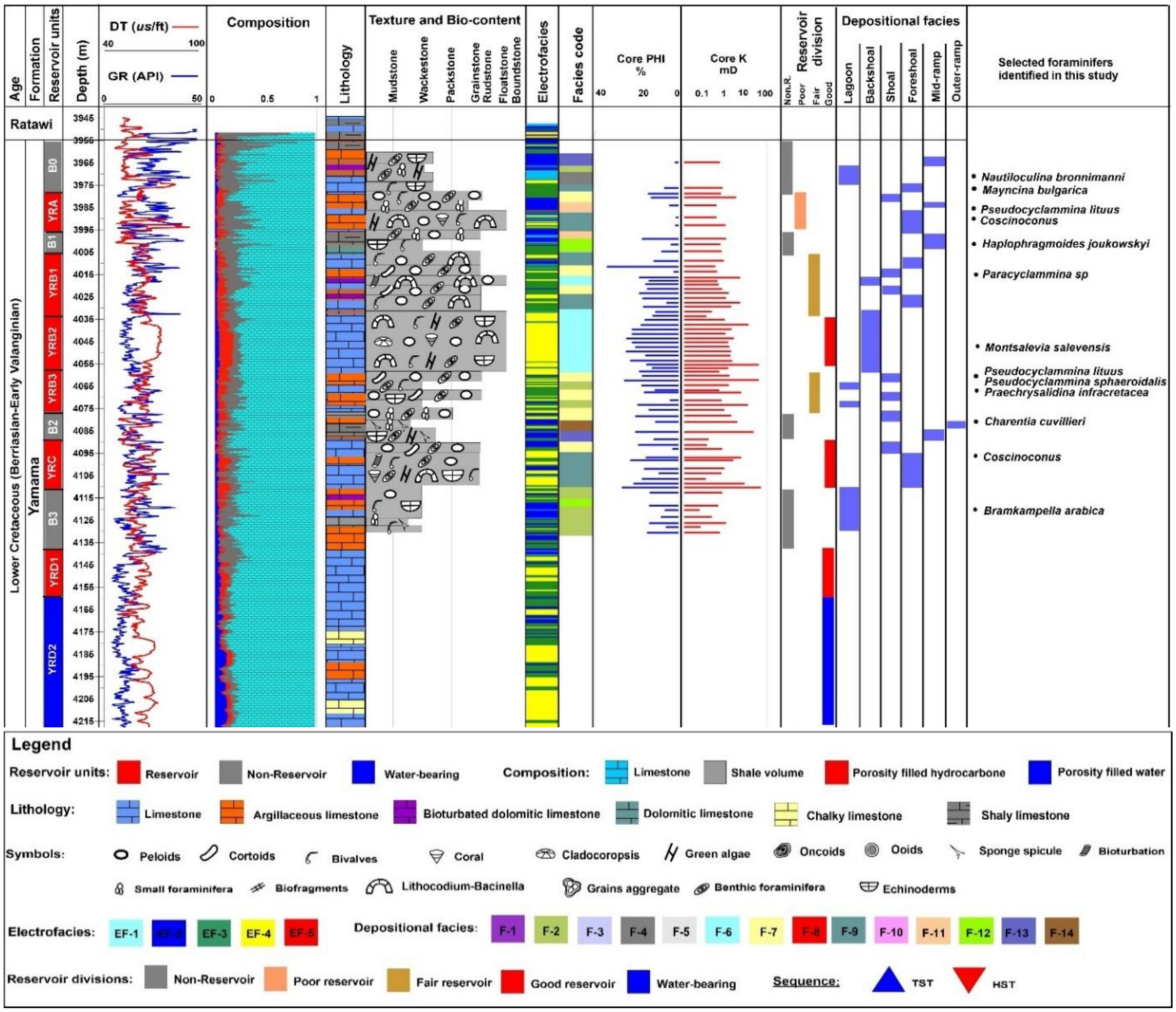

Figure 1. *Detailed graphic and wireline logs of the Yamama Formation in Ah'Dimah Oilfield, showing that the formation is heterogenous and consists of six different lithology types, seven facies vary with depth, effective and sonic porosity (PHIE and PHIS), percentage of porosity filled with hydrocarbon and with water, gamma ray and sonic logs, core porosity (PHI) and permeability (K), depositional environments of each facies and distribution of foraminifers*.

Thesis 2:

I classified and analysed fourteen distinct depositional facies/microfacies types (F-1 to F-14). They vary with depth in the different localities within the reservoir and non-reservoir units (Figure 1 and Table 1). I divided them into grain-supported (intertidal F-1, shoal facies F-5 to F-10), and mud-supported (lagoonal facies F-2 to F-4; middle-ramp facies F-11 to F-13; and outer-ramp facies F-14). Based on their petrophysical properties, facies F-6 to F-10 are good reservoir facies. Facies F-2 to F-4, F-11 to F-14 are non-reservoir facies. While F-1 and F-5 are moderate reservoir facies (Table 1).

Table 1. *Summary of microfacies types, composition/description, energy level, facies association, thickness, percentage, and average petrophysical properties values (derived from*

well logs) including effective porosity (PHIE), sonic-derived porosity (PHIS), volume of shale (Vsh), and water saturation (Sw) in each different facies.

Facies/microfacies	Description, composition, and diagenetic features	Energy level	Facies association	Reservoir quality	Thickness m Percentage %	Average			
						PHIE %	PHIS %	Vsh %	Sw %
F-1 Peloidal oncoidal grain- to rudstones	Oncoids, peloids, ooids, grain aggregates. Interparticle and channel pores. Equant cement.	High	Intertidal	Water-bearing	25.5 6.9	11	7	7	86
F-2 Bioclastic mud- to wackestones	Thick shells and bivalve fragments, minor sponge spicules, peloids and echinoderms, stylolite.	Moderate - low	Lagoonal	Poor to non–reservoir	60.8 16	6	4	14	55
F-3 bioclastic cortoidal wacke- to packstones	Cortoids, peloids, skeletal fragments. Minor moldic pores. Micritization. Equant calcite filling interparticle pores, stylolite.				26.5 7	4	3	12	67
F-4 bioclastic dasycladalean wacke- to packstones	Dasycladaleae algae, skeletal fragments, bivalves, large and small foraminifera, minor peloids. Minor moldic pores. Equant calcite filling moldic pores. Micritization, stylolite.				27.8 7.3	5	4	11	45
F-5 Pelletal peloidal pack- to grainstones	Fine laminated, pellets, occasionally dolomitic, few ooids. Interparticle and channel pores. Circumgranular cement. Dolomitization.	Moderate	Backshoal	Fair	6.5 1.7	11	7	3	43
F-6: Lithocodium-Bacinella float- to boundstones	Lithocodium-Bacinella, shell fragments, echinoderms, and coral debris. Occasionally peloids and intraclasts occurred.Dolomitization.			Good	46.6 12.2	15	14	10	19
F-7 Peloidal grainstones	Peloids, cortoids, large foraminifera, bivalves, echinoderms. Interparticle, vugs, molds and channels. Circumgranular and extensive syntaxial overgrowth calcite cement.	High	Shoal	Fair-good	67.3 17.7	12	10	10	38
F-8 Ooidal peloidal grain- to rudstones	Intermittent crossbedding, peloids, ooids, oncoids, cortoids, large foraminifera, bivalves and echinoderms. Interparticle and moldic pores. Circumgranular and dogtooth cement, grains dissolution grains.	High		Good	9.9 2.6	16	12	2	23
F-9: Reef debris float- to rudstones	Lithocodium-Bacinella, coral, Caldocoropsis, large foraminifera, gastropods, echinoderms, also peloids and intraclasts occasionally occurred, vuggy.	Moderate - high	Foreshoal	Fair-good	37.2 9.8	12	9	15	27
F-10 Bioclastic grainstones	Intermittent cross bedding, peloids, echinoderms and bivalves' fragments, and few small foraminifera. Interparticle pores. Syntaxial overgrowth cement, dissolution of grains.			Good	5.0 1.3	17	12	4	39
F-11: Miliolidal pack- to grainstones	Well sorted, fine peloids and cortoids with abundance of the small size foraminiferas.	Low	Middle ramp	Non-reservoir	4.7 1.2	4	3	19	29
F-12 Bioturbated dolomitic wackestones	Skeletal fragments, sponge spicules, small foraminifera, few benthic foraminifera, dolomitic burrows patches, bioturbation. Moldic pores. Equant/blocky calcite cement, stylolite.				19.5 5.1	5	4	12	58

F-13: Bioclastic foraminiferal wackestones	Bioclasts, large and small foraminifera, echinoderms, sponge spicules, stylolite.				25.0 6.6	4	4	22	26
F-14 Spiculitic skeletal mud- to wackestones	Skeletal fragments, sponge spicules, small foraminifera. Moldic pores. Equant/blocky calcite cement, stylolite.		Outer ramp		19 5	4	3	11	56

Thesis 3:

I have established the depositional facies and constrained the depositional environments in the different oilfields. The facies deposited in intertidal to outer ramp settings in west-east homoclinal shallow-marine carbonate ramp, distally slightly steepening to the east (Figure 2).

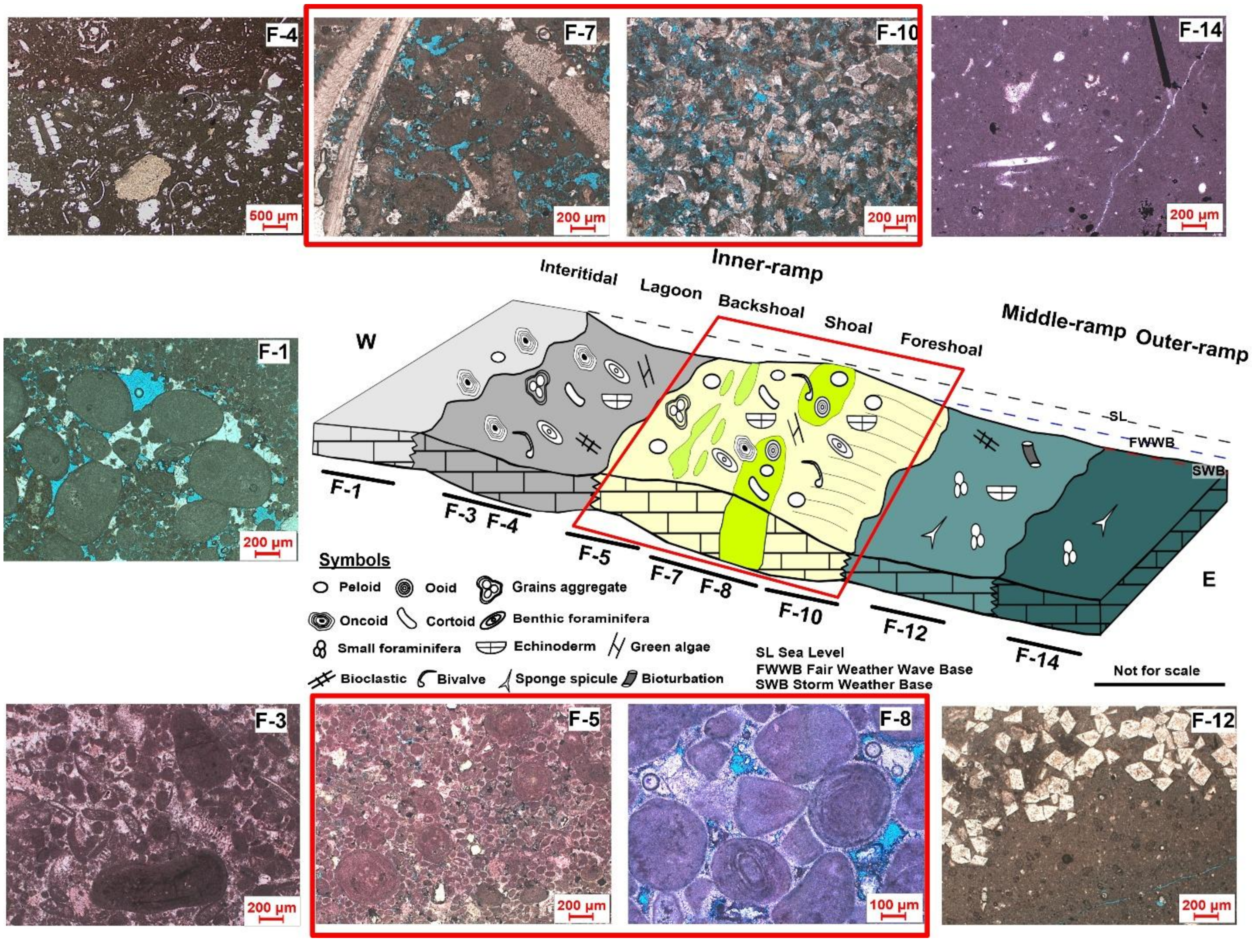

Figure 2. *A conceptual depositional model of the Yamama Formation shows the distribution of different facies across intertidal to outer ramp settings in homoclinal shallow-marine carbonate ramp which is distally slightly steepening. The shoal grain-supported facies represent the best reservoir facies. This model is applicable for Nasiriya Oilfield.*

Thesis 4:

I have recognized that the shoal grain-supported ooidal, peloidal facies, Lithocodium-Bacinella floatstones- to boundstones, and reef debris facies represent good reservoir facies due to their high interparticle and intraparticle pores, in addition to the vuggy pores (Figure 2 and 3). The early circumgranular cement (around grains) as well as small amounts of scattered syntaxial calcite overgrowths and equant calcite cement protected the porosity from compaction. Consequently, these cements helped preserving the primary porosity and permeability even at depth of about 4100 meter. The dissolution of grains locally enhance porosity, due to episodes of subaerial exposure and later by hydrothermal alteration.

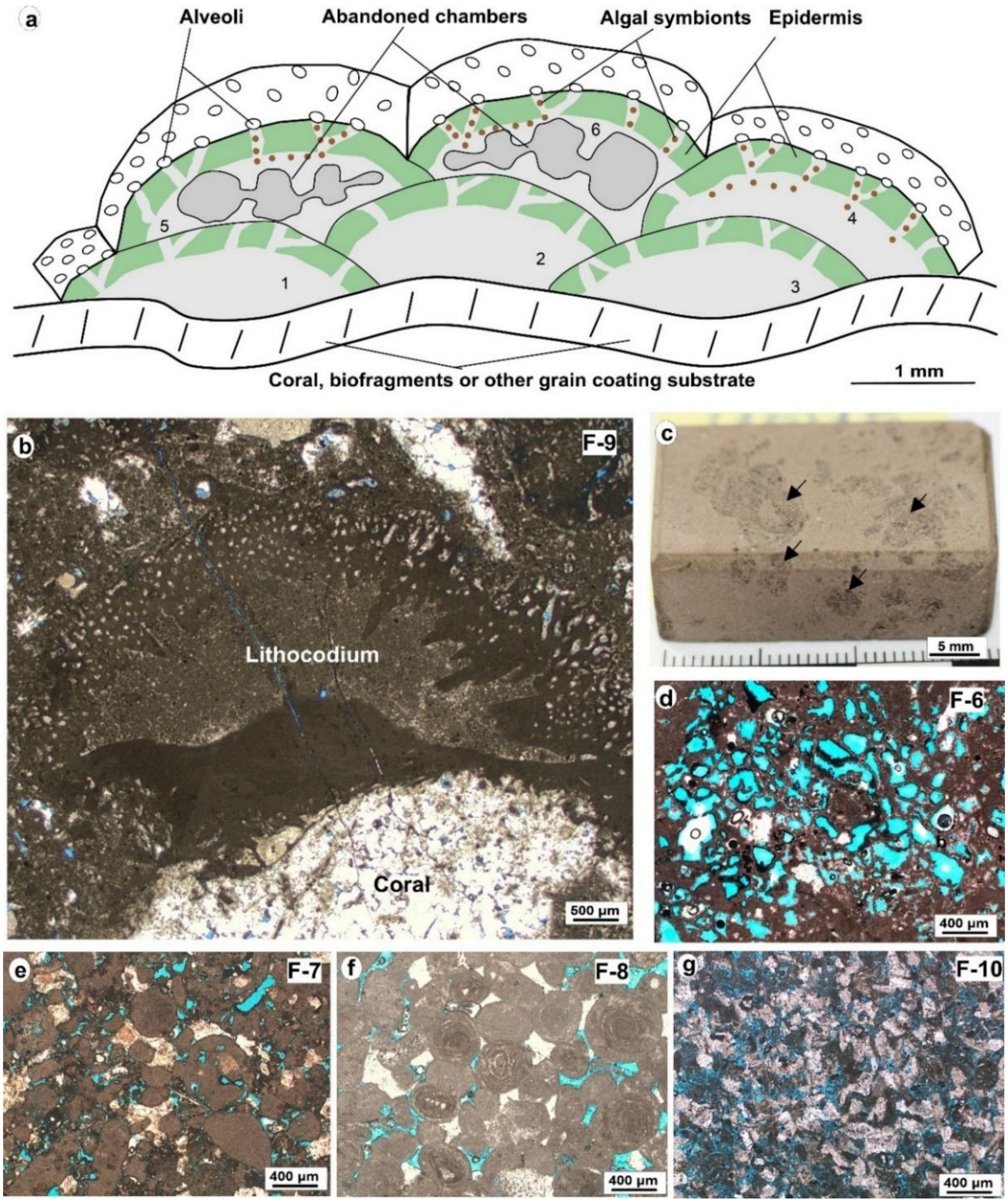

Figure 3. *a) A schematic diagram of the Lithocodium-Bacinella, shows 6 chambers. Adapted from Schmid and Leinfelder (1996). b) Lithocodium-Bacinella encrusting a coral (F-9). c) Core slabbed photo showing the Lithocodium-Bacinella floatstones (F-6). d) plan view of the dominated vuggy and intraparticle porosity within F-6 and F-9. e-g) micrographic images showing the facies F-7 to F-10 respectively, interparticle pores are dominant.*

Thesis 5:

I have found that the Lithocodium-Bacinella float- to boundstones (F-6) and reefal debris rudstones (F-9) facies formed build-ups within the reefal patches along the carbonate platform margin, and they are of significant interest for the development of the Yamama Formation (Figure 3 and 4). Special attention should be directed towards areas of these facies for further exploration and development efforts.

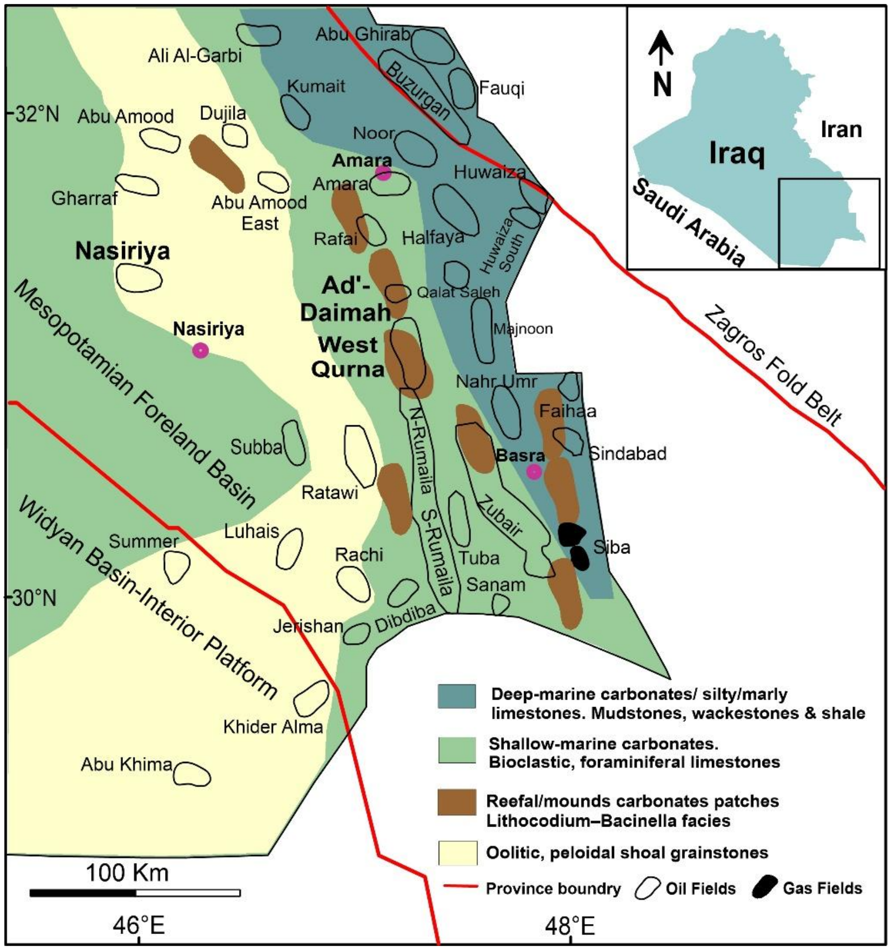

Figure 4. *Paleofacies map of the Yamama Formation in south and southeast Iraq, showing facies transition from shallow-marine and shoal facies in the west to deep-marine facies in the east, with reefal patches along the platform margin.*

Thesis 6:

I found out that mud-supported lagoonal, middle and outer ramp facies represent poor to non-reservoir facies. These facies controlled by compaction and calcite cement of the isolated moldic pores and the calcite micro-overgrowth of the micritic mud. The pore-filling kaolin and saponite further reduced porosity through mineral precipitation during early and burial diagenesis. Kaolin formed during burial from alumina-bearing acidic brines migrating along stylolites, during tectonic compression. While saponite developed earlier from micrite–brine reactions under restricted, evaporative conditions. Framboidal and euhedral pyrite indicate a diagenetic shift from early microbial to burial thermochemical sulphate reduction, both contributing to porosity loss through pore-filling and dolomite replacement.

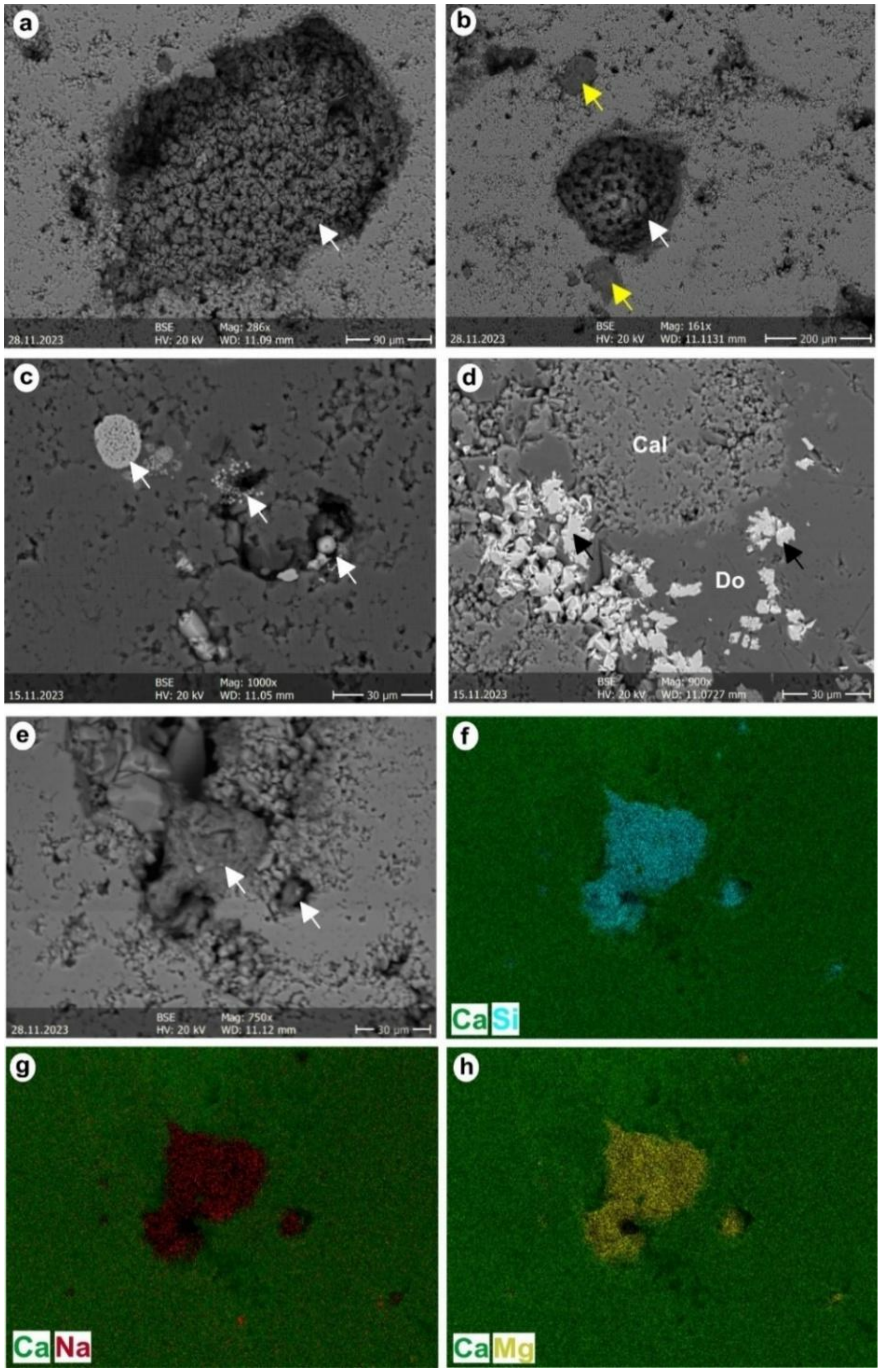

Figure 5. *Backscattered electron (BSE) images and Energy Dispersive Spectroscopy (EDS) maps shows pore-filling clay minerals and pyrite in the non-reservoir units of the Yamama Formation. (**a**, **b**) Pore-filling kaolin (white arrows) and saponite (yellow arrows) in the lagoonal facies. (**c**) Framboidal pyrite (white arrows). (**d**) Euhedral pyrite crystals (black arrows) replace dolomite. (**e**) Pore-filling saponite (white arrows). (**f**–**h**) EDS elemental maps: (**f**) Calcite-silicon Ca–Si, (**g**) Calcite-sodium Ca–Na, and (**h**) Calcite-magnesium Ca–Mg, and Na-rich saponite.*

Thesis 7:

I recognized that micritization of the grains resulted in the formation of abundant intraparticle micropores in the grain-supported limestones. This process converted the macropore dominated grain-supported limestones to bimodal macro- and microporous limestones with high content of high-water saturation. Moreover, these limestones are characterized by high total porosity and commonly low permeability.

Thesis 8:

I found that the dolomitization is restricted to bioturbated sites (e.g., F-12), which was due to local increase in carbonate alkalinity of the pore waters by oxidation of organic matter, had local impact on improvement of reservoir properties by the formation of intercrystalline pores. These dolomites were later affected by the rhomb's overgrowth around the cores which had led to porosity reduction. The backshoal dolomitic pelletal limestones most likely formed through early diagenetic evaporative reflux under restricted, high-Mg conditions. The occurrence of dolomite along stylolites confirms that the stylolites acted as conduits for brine migration during deep burial.

Thesis 9:

Through the integration of isotopes and fluid-inclusions analysis, I found that the blocky calcite filling moldic/vuggy pores precipitation took place at temperatures ranging from 85-140°C from brine composed of NaCl-KCl-H_2O with a total salinity of 10 wt.% NaCl eq and $\delta^{18}O_{VSMOW}$ of +4‰ to +8‰. Precipitation at elevated temperatures corroborates the negative $\delta^{18}O_{VPDB}$ (mostly -6.9‰ to -5.6‰).

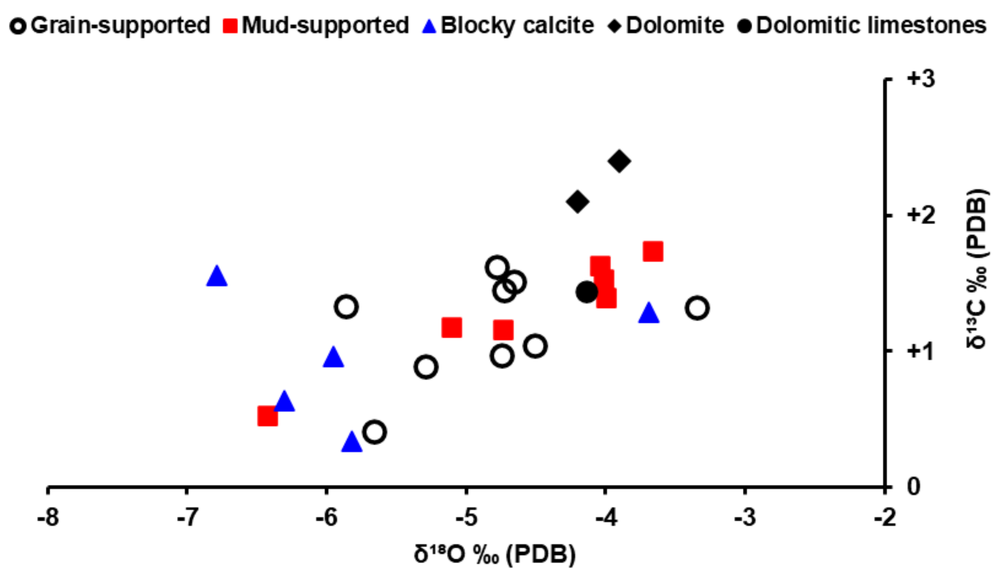

Figure 6. *Cross plot of $\delta^{13}C$ and $\delta^{18}O$ isotope values for various components in the Yamama Formation, illustrating isotopic variations among different carbonate facies and components.*

The carbon isotopic signatures and presence of the calcite cement in the vicinity of stylolites suggest that dissolved carbon was derived from the pressure dissolution of host limestones. The low $\delta^{18}O$ values of the mud-supported and grain-supported limestones reflect the abundance of calcite cement (Fig. 6), including micro-overgrowths in mud-supported limestones, and to the circumgranular and the scattered equant cements in grain-supported limestones confirmed by the lowest $\delta^{18}O$ values measured in the blocky cement itself.

<u>Thesis 10:</u>

The shoal ooidal, peloidal facies, Lithocodium-Bacinella float- to boundstones, and the reef debris facies represent fair to good reservoir facies, while mud-supported lagoonal, middle and outer-ramp facies are poor to non-reservoir facies. The intertidal oncoidal and the backshoal pelletal grainstones facies form fair reservoir facies.

I established a conceptual model (Fig. 7) illustrates the diagenetic evolution and porosity development/modification of the Yamama Formation based on the integrated sedimentologic, petrographic, fluid-inclusion, and isotopic observations. This model serves as a valuable analogue for understanding diagenetic and reservoir evolution in similar carbonate systems with considering the effect of burial on the different depositional facies.

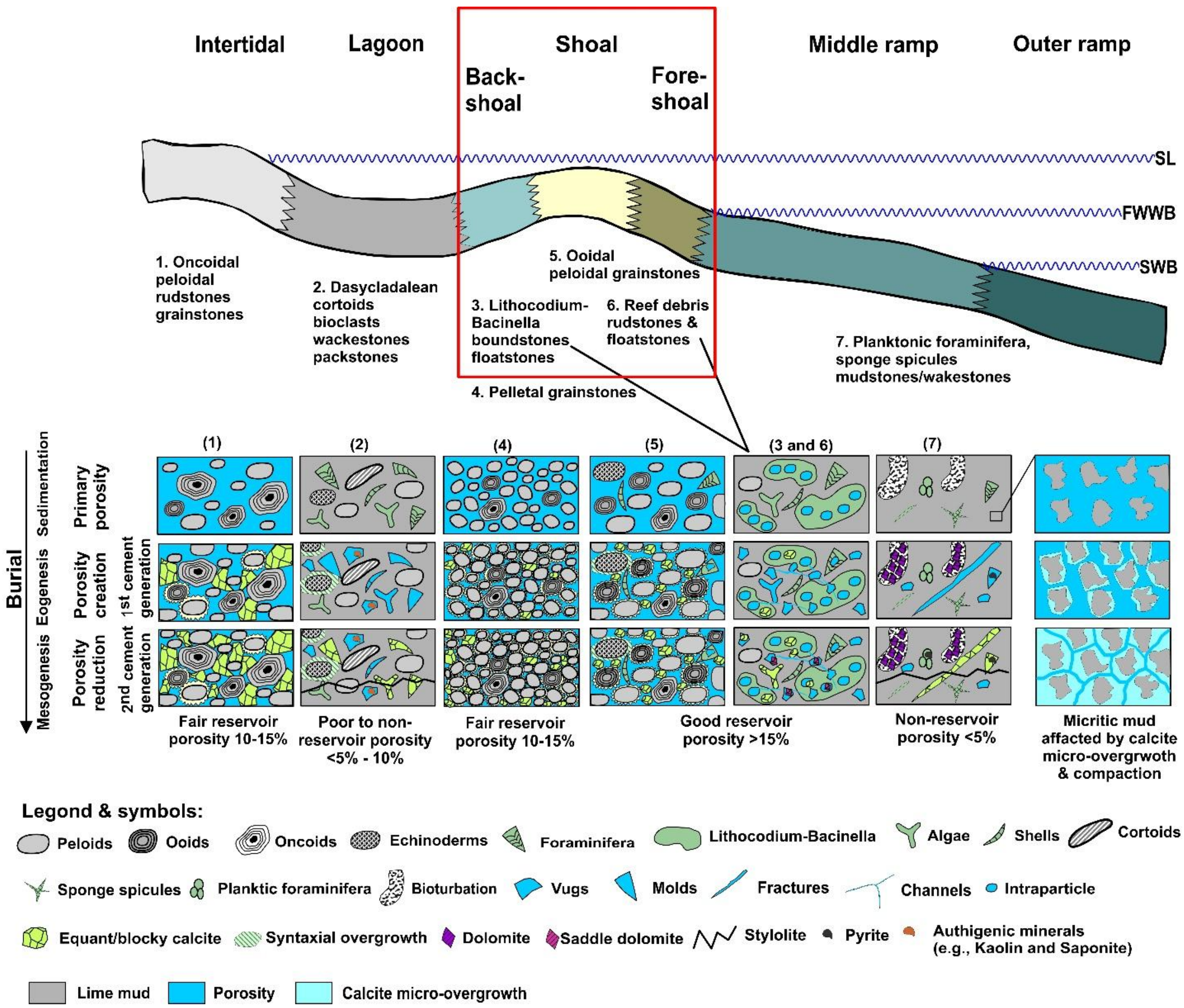

Figure 7. *Conceptual model shows porosity and diagenetic processes evolution across the Yamama carbonate ramp during burial. The three panels on the right illustrate the progressive compaction and cementation of lime mud with depth, representing the diagenetic evolution of lime mud in mud-supported facies (lagoonal, middle and outer ramp). The shoal ooidal, peloidal facies, Lithocodium-Bacinella float- to boundstones, and the reef debris facies represent fair and good reservoir facies, while mud-supported lagoonal, middle and outer-ramp facies are poor to non-reservoir facies. The intertidal oncoidal and the backshoal pelletal grainstones facies form fair reservoir facies.*

Thesis 11:

I found out that the reservoir units align mainly with regressive, grain-supported facies, while transgressive intervals are dominated by mud-supported, non-reservoir limestones.

I identified key stratigraphic surfaces of the Yamama Formation such as top, bottom, sequence boundaries (SBs), maximum flooding surfaces (MFSs) through an integrated analysis of well logs, cores, petrography, and regional correlations. This approach improved the understanding of reservoir distribution within the depositional sequences. The formation comprises four 3rd-order cycles bounded by three Type-2 correlative sequence boundaries representing minor subaerial exposure. Its lower and upper contacts with the Sulaiy and Ratawi formations correspond to MFSs (Fig. 8).

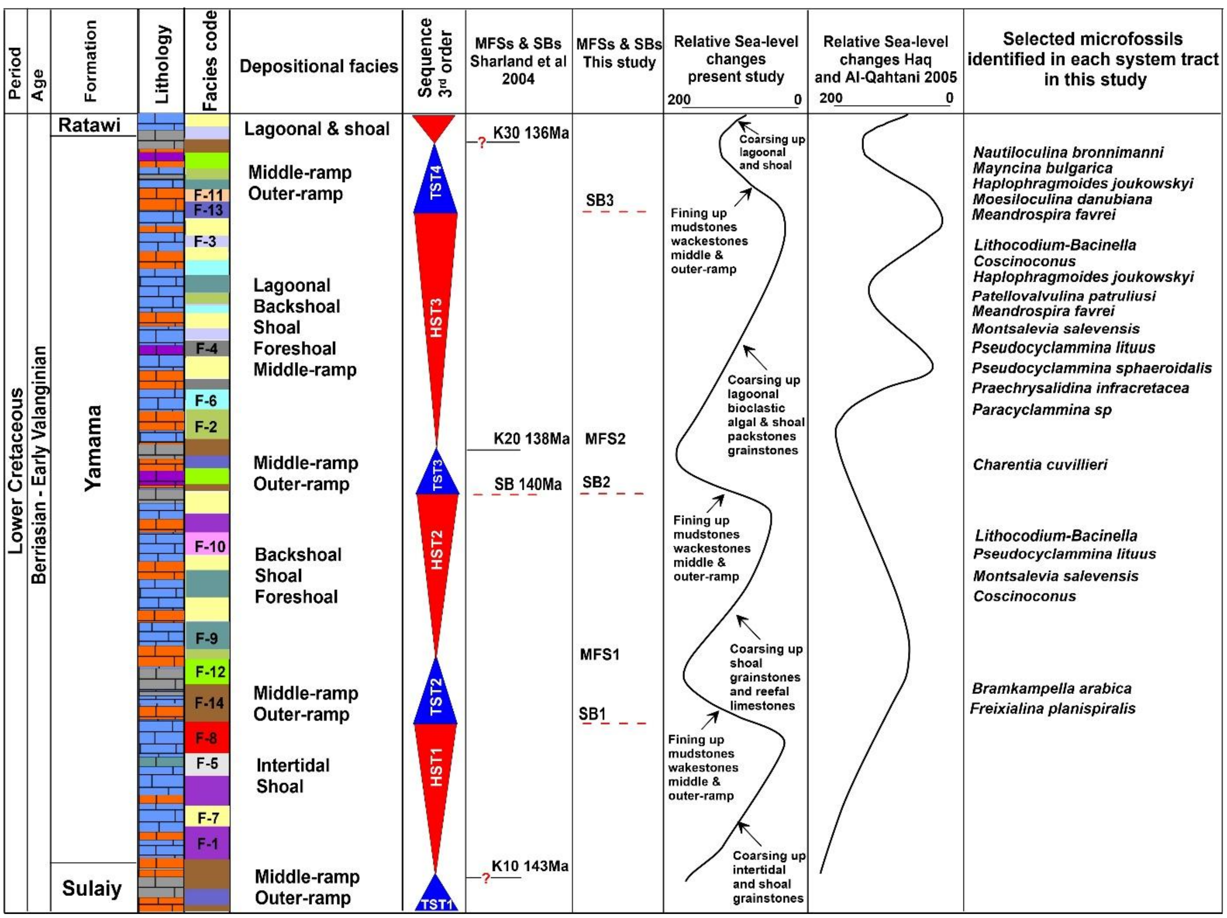

Figure 8. *Synthetic sedimentological/graphic log of the Lower Cretaceous Yamama Formation showing lithology, microfacies, depositional environments, and the distribution of foraminifers*

in each system tract. Color-coded facies are used to interpret third-order depositional sequences and relative sea-level changes. MFSs (K10, K20, K30) and sequence boundaries (SBs) are correlated with Sharland et al. (2004) and compared with the regional sea-level curve of Haq and Al-Qahtani (2005), highlighting transgressive–regressive trends and reservoir-related facies transitions, refer to the legend in Figure 1.

IV. Applicability of the results

The integration of facies/microfacies, electrofacies, and petrophysical data provides a refined framework for distinguishing between reservoir and non-reservoir units in the carbonate reservoirs. This offers a practical guide for reservoir zonation, well targeting, and enhances the predictability of fluid distribution and improves hydrocarbon recovery strategies.

The recognition of grain-supported shoal and Lithocodium–Bacinella reefal facies (F-6 to F-10) as excellent reservoir facies emphasizes the importance of targeting these lithologies in exploration and development. Their distribution along a homoclinal carbonate ramp controlled by regional sea-level fluctuations suggests predictable trends that can be mapped regionally. Areas with Lithocodium–Bacinella buildups and reefal debris rudstones are of interest in exploration plans.

The study highlights the dual role of diagenetic processes in both preserving and destroying reservoir quality. Early cementation helped maintain primary porosity, whereas later cementation and authigenic mineral precipitation reduced pore space in mud-supported facies. Understanding these diagenetic pathways allows operators to better predict heterogeneity and reservoir quality across different facies in a carbonate ramp.

The stable isotope and fluid inclusion data reveal the influence of basinal brines, stylolites, and tectonic compression on fluid flow and cementation. These highlight the roles of regional tectonic activities (e.g., Oman ophiolite obduction and Zagros orogeny) in modifying reservoir quality through fluid migration. This is applicable to broader Middle East carbonate systems where similar tectono-diagenetic processes occurred.

The establishment of a depositional sequence model linked to reservoir and non-reservoir intervals provides a predictive tool for correlating facies architecture across fields. Grain-supported reservoir facies are commonly associated with regressives cycles, while transgressive cycles are dominated by mud-supported non-reservoir facies. This can be applied in other oilfields within the area to anticipate reservoir distribution and continuity.

The study demonstrates how an integrated sedimentological, petrographic, geochemical, and stratigraphic approach can reveal the complexity and heterogeneity of Lower Cretaceous reservoirs. The findings are relevant to carbonate ramp systems in other parts along the Tethyan Ocean, offering analogs for exploration and production in comparable settings.

Related publications:

Mohammed, A. and Velledits F. (2022) Diagenesis Controls on The Porosity of Carbonate Reservoir - An Example: Early Cretaceous Yamama Formation, South of Iraq. In: Szabó, N. P., Virág, Z. (ed.) Új eredmények a műszaki föld- és környezettudományban 2022, Miskolc, pp. 8-21., ISBN 978-963-358-269-5

Mohammed, A. and Velledits,F. (2024). Microfacies impacts on reservoir heterogeneity of early Cretaceous Yamama carbonate reservoir in South Iraq. Scientific Reports 14, 24184. https://doi.org/10.1038/s41598-024-74640-w

Mohammed, A. and Velledits, F. (2024). Well Logs Interpretation of a Carbonate Reservoir: Case Study From South of Iraq. In: Szabó, N. P., Virág, Z. (ed.) Új eredmények a műszaki föld- és környezettudományban 2024, Miskolc, pp. 159-164., ISBN 978-963-358-269-5

Mohammed, A. and Velledits, F. (2024). Facies-related reservoir heterogeneity of grain-supported limestones: insight from the Early Cretaceous Yamama Formation, southern Iraq. Carbonates Evaporites 39, 118. https://doi.org/10.1007/s13146-024-01037-1

Mohammed, A. and Velledits, F., 2025. Evaluating reservoir quality of the Yamama Formation in southern Iraq. In: N.P. Szabó and Z.I. Virág, eds. Proceedings of the 1st International Earth Science and Engineering Conference, Hungary, University of Miskolc, Faculty of Earth and Environmental Sciences & Engineering, pp. 20–25. ISBN 9789633583357

Mohammed, A. et al. (2025: under revising). Depositional facies, sequence stratigraphy and diagenesis of Lower Cretaceous carbonate reservoir, Southern Iraq: Implications for petroleum exploration. Journal of Petroleum Geology.

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Abbas Mohammed and Felicitász Velledits, The Controls on Reservoir Quality of The Early Cretaceous Yamama Formation, South of Iraq. 1st international Earth science and Engineering Conference, EAGE Miskolc, Hungary, 21-22 March 2024.

Abbas Mohammed and Felicitász Velledits, Microfacies analysis and depositional environment of the Yamama Formation, Mesopotamian Basin, South of Iraq. University of Miskolc, Faculty of Earth and Environmental Sciences and Engineering, PhDs conference, University of Miskolc, Miskolc, Hungary, 23 November 2023.

Abbas Mohammed and Felicitász Velledits, The improvement of carbonate porosity in the Early Cretaceous Yamama reservoir, south of Iraq, University of Miskolc Faculty of Earth Science and Engineering PhD conference, University of Miskolc, Miskolc, Hungary, 17 November 2022.

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