

Impact of microfacies, sedimentary environment, and diagenesis on the reservoir quality of Ilam formation in Yadman field

Mahsa Abedi^a, Mohammadfarid Ghasemi^{a*}

^a Department of Sedimentary Basin and Petroleum, Faculty of Earth Science, Shahid Beheshti University, Tehran, Iran

ABSTRACT

To investigate the microfossils, microfacies, depositional environment, and diagenetic processes within the Ilam Formation in Abadan Plain, Well Yadman-1 was studied. This research involved the study of 440 microscopic thin sections obtained from both core and cutting samples. The classification of carbonate rocks followed Dunham's method, microfacies were identified using Fluegel and Wilson's approach, and porosity was defined based on Choquette and Perry's classification. The microfacies analysis unveiled the existence of 10 distinct microfacies, which could be classified into 4 microfacies belts corresponding to shoal, mid-ramp, outer ramp, and basin environments. Notably, the studied facies exhibited a gradual transition and were devoid of reef facies, turbidite deposits, reworked carbonates, slumped and slid facies, oncoides, cortoids, and aggregate grains. These characteristics indicate the deposition of the Ilam Formation on a carbonate ramp of the single slope (homocline) type. Furthermore, various diagenetic processes were identified within the Ilam Formation, including dissolution, cementation, dolomitization, stylolite, pyritization, compaction, and fracturing. Based on the identified microfossils in the framework of two biozones with Santonian ages, zones 30 and 26 Wynd, the age of the Ilam Formation has been determined.

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*Corresponding author

E-mail address:
mo_ghasemi@sbu.ac.ir
(M. Ghasemi)

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1. Introduction

The relationship between sedimentological features, reservoir characteristics, and petrography is a key focus in reservoir studies (James and Wynd, 1965). Both sedimentary and diagenetic processes are critical in shaping the distribution of reservoir properties in hydrocarbon-bearing systems (Soleimani et al., 2022). Elements such as lithology, rock texture, and sedimentary facies, which are linked to depositional environments, significantly impact reservoir quality, while diagenetic processes can improve or reduce it (Ahr, 2008; Basso et al., 2020). Considering these considerations, this study focuses on the 130-meter-thick carbonate section of the Ilam Formation in Well A, located in the Abadan Plain. The Ilam Formation,

deposited during the Upper Cretaceous (Santonian to Campanian), is a major reservoir in the Abadan Plain segment of the Zagros fold belt, along with the Asmari and Sarvak Formations. Detailed insights into its reservoir features, depositional environment, and diagenetic influences are crucial for establishing an accurate depositional model. This research investigates the microfacies, depositional environments, and diagenetic changes of the Ilam Formation to develop a practical model for reservoir assessment and hydrocarbon exploration. In the analyzed well, the Ilam Formation includes both benthic and pelagic facies (James and Wynd, 1965). The formation has conformable contacts, with the



Gurpi Formation overlying it and the Lafan Shale Formation underlying it (Aghanabati, 2003). Lithologically, the formation consists of cream to off-white limestone, followed by light gray marl, dark brown dolomitic limestone, reddish-brown and dark brown claystone, and finally, semi-hard to hard cream to light brown limestone, often showing bitumen traces. Based on Wynd's biostratigraphic framework (James and Wynd, 1965), the formation is dated to the Santonian, as indicated by microfacies 26 and biozone 30. Adabi and Mehmandosti (2014) conducted a detailed investigation of the microfacies and geochemistry of the Ilam Formation in the Tang-E Rashid area. Their study identified four microfacies belts—tidal flat, lagoon, shoal, and open marine—indicative of a platform ramp environment. The analysis revealed that aragonite was the original carbonate mineral, with diagenetic processes occurring in a closed system, leading to variations in elemental and isotopic compositions. These findings laid the groundwork for understanding the complex depositional and diagenetic history of the Ilam Formation. Mehrabi et al. (2014) focused on the sequence stratigraphy of the Ilam Formation in the Dezful Embayment, identifying eighteen microfacies and their distribution across various depositional environments. Their study reinforced the concept of sequence stratigraphy as a framework for understanding the sedimentary evolution and reservoir characteristics of the Ilam Formation, integrating petrographic analyses to establish a comprehensive model of facies distribution. Expanding on these findings, Asadi Mehmandosti et al. (2016) investigated the geochemical and sedimentary characteristics of the Upper Cretaceous Ilam Formation. This study established a relationship between geochemistry and facies distribution, revealing twelve microfacies within lagoonal, shoal, and open marine environments. Their findings suggested that diagenetic processes such as compaction and dissolution significantly influenced reservoir characteristics, further elucidating the interplay between sedimentary environments and geochemical evolution. In a study focusing on the Darquain oil field, Khatir et al. (2019) analyzed the sedimentary environment and diagenetic processes affecting the Ilam Formation. Their research identified six microfacies associated with a homoclinal carbonate ramp, emphasizing the importance of

various diagenetic processes, such as dolomitization and bioturbation, in enhancing reservoir quality. Their results underscored the significance of understanding local sedimentary processes and diagenetic alterations when evaluating reservoir potential. The work of Mahmoodabadi (2019) further enriched this understanding by correlating the Sarvak and Ilam formations in the Shiraz area, identifying thirteen microfacies, and establishing sedimentary environments through sequence stratigraphy. This study highlighted the influence of relative sea-level changes on sediment deposition, providing insights into the broader geological framework governing hydrocarbon reservoirs in the region. Gholizadeh et al. (2020) conducted an in-depth study on the sedimentary environment and reservoir quality of the Ilam Formation across various subsurface sections. Their research revealed the impact of diagenetic processes on porosity and permeability, emphasizing the importance of evaluating flow units to understand reservoir potential. This work reinforced previous findings regarding the complex interplay between sedimentary processes and reservoir characteristics. Reza, (2020) conducted a study on the petrography, microfacies, sedimentary environments, and sequence stratigraphy of the Sarvak and Ilam formations by examining a stratigraphic section at MajAbad. Their facies analysis identified 13 microfacies and 2 lithofacies. The study of microfacies components, relative sea-level changes, and sequence stratigraphy indicated that these facies were deposited in a carbonate ramp environment across four facies belts: open marine, shoal, lagoon, and tidal flat during the Middle Cretaceous. Petrographic and microfacies analyses revealed that the Sarvak and Ilam formations in the study area consist of five third-order depositional sequences that sequences 5 correspond to the Ilam Formation. In subsequent research, Khodaei et al. (2021) explored the depositional and diagenetic controls on reservoir quality within the Abadan Plain. They characterized various geological aspects of the Ilam Formation through integrated sedimentological and petrophysical evaluations across six subsurface sections. Their work distinguished multiple depositional settings and identified five types of pore classes, contributing to a more refined understanding of reservoir dynamics and the factors influencing porosity and permeability.

Further exploration by Mehrabi et al. (2020) investigated the micrite textures in the Upper Cretaceous successions of the Zagros area. They identified six micrite textural classes, discussing their significance in reservoir quality and diagenetic environments. This study provided new insights into the distribution of porosity types within the Ilam Formation, highlighting the influence of stratigraphic positioning on reservoir characteristics. Recent studies have continued to explore the impact of active tectonics and fractures on the Ilam Formation's reservoir potential. Asadi Mehmandosti et al. (2020) focused on the sedimentary and diagenetic characteristics of the Ilam Formation in northwest Abadan, revealing various diagenetic processes and their impact on geochemical properties. This study provided further evidence for the complex relationships between sedimentary environments, diagenesis, and hydrocarbon reservoir quality. Poursoltani et al. (2021) employed microfacies analysis to predict reservoir characteristics in the East Gardan field, identifying the influence of diagenetic processes on porosity development. Their findings reinforced the necessity of integrating tectonic and sedimentological factors to predict reservoir behavior in the Ilam Formation. Gholizadeh et al. (2022) conducted a study investigating the formation sedimentary environment, diagenesis, sequence stratigraphy, and reservoir quality of four subsurface sections from the Dezful and Abadan Plain depression wells. Key findings are as follows: The Ilam Formation is mainly composed of limestones with interbedded shales and argillaceous limestones. Twelve microfacies and one shale petrofacies were identified, which were arranged in three facies belts—marsh, shale, and open marine—in a homoclinal carbonate slope setting. The formation has undergone meteoric, marine, and burial diagenetic processes. The studied wells revealed a third-order sedimentary sequence with sea-level fluctuations that are consistent with global patterns. Based on diagenetic and porosity-permeability data from one well, six flow units were identified. Flow unit number five showed the greatest potential for reservoir quality, while flow unit number six had the least desirability. Asadi Mehmandosti et al. (2023), investigated the Ilam Formation. Petrographic results showed that the Ilam Formation consists of 12 microfacies and one shale petrofacies,

which were deposited in lagoonal, barrier, and open marine facies belts of a carbonate ramp. Two third-order depositional sequences were identified, and geochemical evidence (such as the Ni/Co ratio) indicated that the Ilam limestones formed under oxic to anoxic conditions. The main diagenetic processes include compaction, dissolution, dolomitization, and cementation, which occurred in various diagenetic environments. Ghoreyshi et al. (2024) conducted a study on the reservoir quality of the Ilam Formation in the Abadan Plain. The results indicated that reservoir quality is strongly influenced by microfacies and diagenetic processes. The best reservoir zones are found within shoal and grainstone facies, which exhibit high porosity and permeability. Diagenetic processes such as dissolution and fracturing can enhance reservoir quality, whereas cementation and compaction tend to reduce it. In this research, a depositional model was proposed that can assist in improving hydrocarbon exploration and reservoir development in the region.

Geology of the Region of the Zagros Mountains, spanning southwestern Iran from the Iraq border to Bandar Abbas, have formed as a result of the Arabian plate's movement and the Red Sea's opening, resulting in significant tectonic compression as part of the Mesozoic-Tertiary orogeny (Falcon, 1974). The Main Zagros Thrust Fault, a major tectonic boundary, marks the northeastern edge of the Zagros Basin (Setudehnia, 1978). Three key structural orientations—north-south, northwest-southeast, and northeast-southwest—have shaped the region's petroleum system over various geological eras. The well under study is located in the Abadan Plain, in the southwestern Zagros Basin. This plain is bounded by the Zagros Fold Belt to the north-northeast, Iraq to the west, and the Persian Gulf to the south. Well A is situated within a small geophysical structure trending east-west in the northwest of the Abadan Plain structural subzone. This structure lacks surface anticline outcrops and maintains an undisturbed east-west alignment without fractures or faults (Fig 1). The Ilam Formation, deposited during the Upper Cretaceous, rests on the uneven Middle Cretaceous terrain within the Dezful and Fars depocenters. The Ilam Formation's shallow marine limestones (Santonian) were succeeded by the deeper marine shales of the Gurpi Formation. In the Lorestan region, deep marine

3.1. Petrography of the Ilam formation

Lithological data, gathered from both field observations and petrographic analyses, are crucial for identifying and interpreting depositional environments and microfacies within formations. These studies play a vital role in pinpointing economically significant zones and assessing limestone reservoirs (Flügel, 2010). The main skeletal components identified in this study include foraminifera, bivalves, rudists, gastropods, brachiopods, bryozoans, echinoderms, algae, and sponges. The primary non-skeletal components observed were pellets, peloids, and ooids (Figs 2 and 3).

3.2. Microfacies and sedimentary environment of the Ilam formation

The microfacies of the Ilam Formation were identified through analysis of the size, shape, and distribution of allochems and the predominant matrix in thin sections (Fig 4). The formation displays significant microfacies diversity, reflecting changes in sea level that drove facies migration either seaward (progradation) or landward (retrogradation) (Hassani Givo, 2003). This study presents an overview of these microfacies, their occurrence and frequency in the studied well and a proposed depositional model (Fig 5).

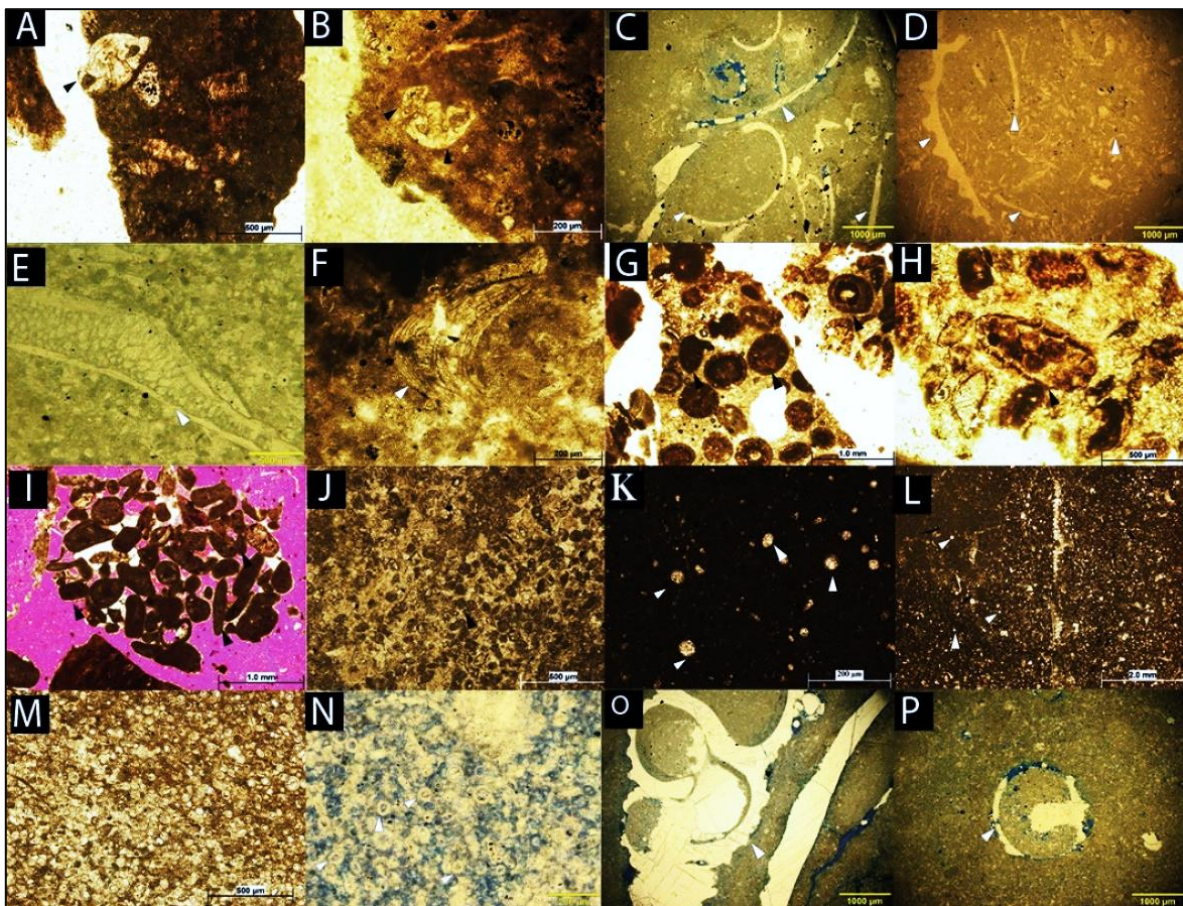


Fig. 2. Thin section images of the components (skeletal and non-skeletal) and identification of fossil types in the studied formation. A-B. Images of microfossils from the Rotalida family, dating to the Santonian age, were captured at various magnifications from different cutting sections of the Well A (muddy matrix, thin sections of drill cuttings, PPL). C-D. Microscopic images under PPL of cemented bivalves from the Ilam Formation, shown in various sizes and shapes (thin core sections). E-F. Rudist specimens in core and cutting sections (PPL). G-H. Images of multi-nucleus micritized ooids and radial-shelled ooids. In the ooid sections of the Ilam Formation, some microfossils are phosphatized, indicating reducing conditions. This formation, with minimal thickness, exhibits an ooid grainstone facies (thin sections of drill cuttings, PPL). I-J. Images of micritized peloids and intraclasts (Image I: thin section of drill cuttings, XPL). K-L. Microfossils of radiolarians, visible in small thicknesses from the studied depth in this formation (core sections, PPL). M-N. (The Blue color is from staining with a blue solution for porosity identification) Microfossils from the Calcisphaerulida group in a mud matrix, which are most abundant in the studied depths of this formation (core sections, PPL). O-P. Pelagic gastropods with large calcitic shells (core sections, PPL).

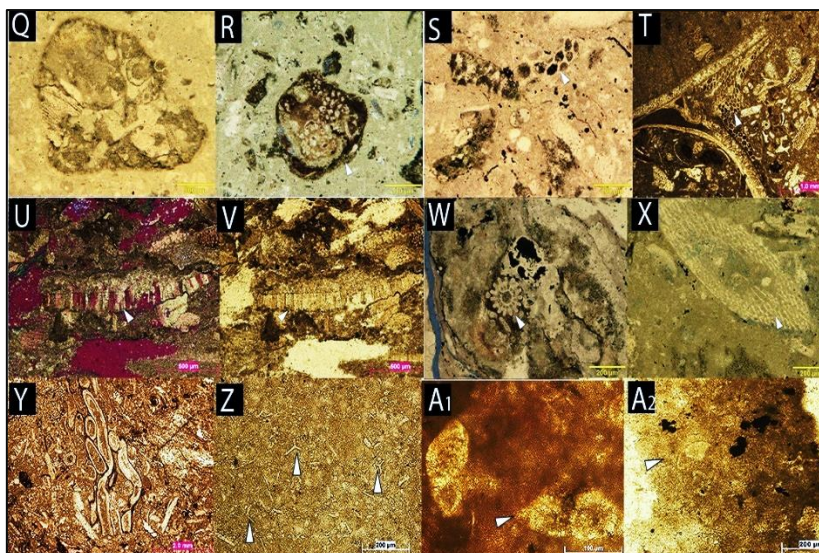


Fig. 3. Thin section images of the components (skeletal and non-skeletal) and identification of fossil types in the studied formation Q-R. Images of intraclasts containing fossils of echinoids, echinoid spines, and poriferans (core sections, PPL). S-T. Fossil bryozoans with regular, uniform-sized pores in core sections of the Ilam Formation (core sections, PPL). U-V. Examples of brachiopods under PPL and XPL. W-X. Images showing echinoid fragments and echinoid spines, dating from the Coniacian to Santonian. In the studied depths of the Ilam Formation, these microfossils are observed with an abundance of 5-25% in all microscopic sections (core sections, PPL). Y. Image of Serpulidae (worm tube) (core section, PPL). Z. Image of sponge spicules (core section, PPL). A1. *Rotalia truncata* (drill cutting section, PPL). A2. *Rotalia truncata ventricosa* (drill cutting section, PPL).

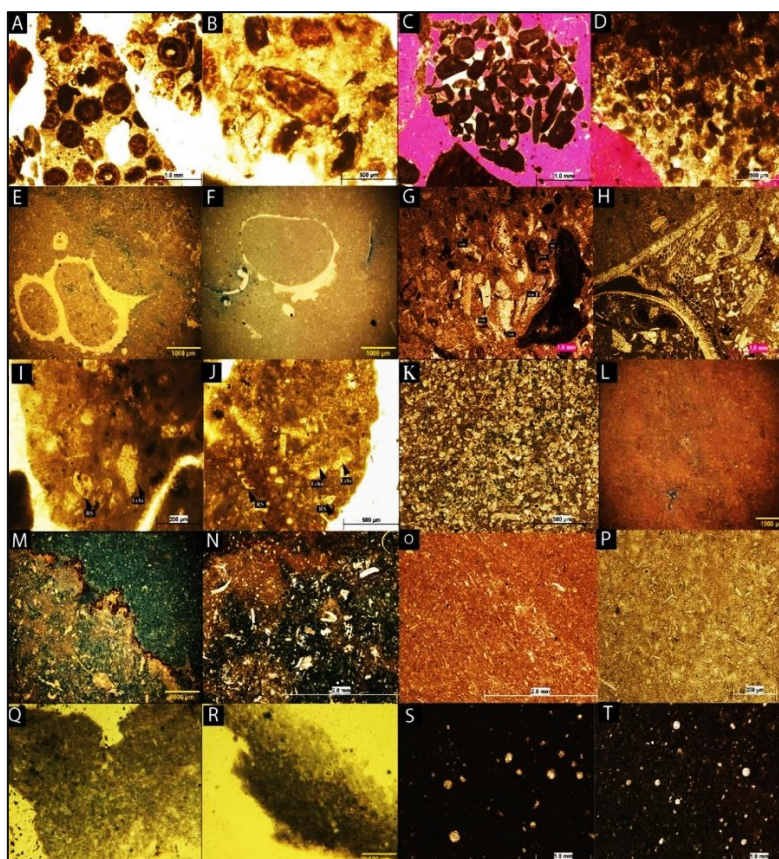


Fig. 4. Thin-section images of the Ilam Formation showcasing various microfacies: A-B: Microfacies 1: Ooid Grainstone. C-D: Microfacies 2: Intraclast Peloid Grainstone. E-F: Microfacies 3: Pelagic Gastropod Peloidal Packstone to Wackestone. G-H: Microfacies 4: Echinoid Wackestone to Packstone. I-J: Microfacies 5: *Rotalia* Mudstone to Wackestone. K-L: Microfacies 6: *Calcisphaerulid* Wackestone to Packstone. M-N: Microfacies 7: Pelagic *Calcisphaerulid* Wackestone to Packstone. O-P: Microfacies 8: *Calcisphaerulid* and Sponge Spicule Mudstone. Q-R: Microfacies 9: Pelagic Mudstone to Wackestone. S-T: Microfacies 10: Radiolarian Wackestone.

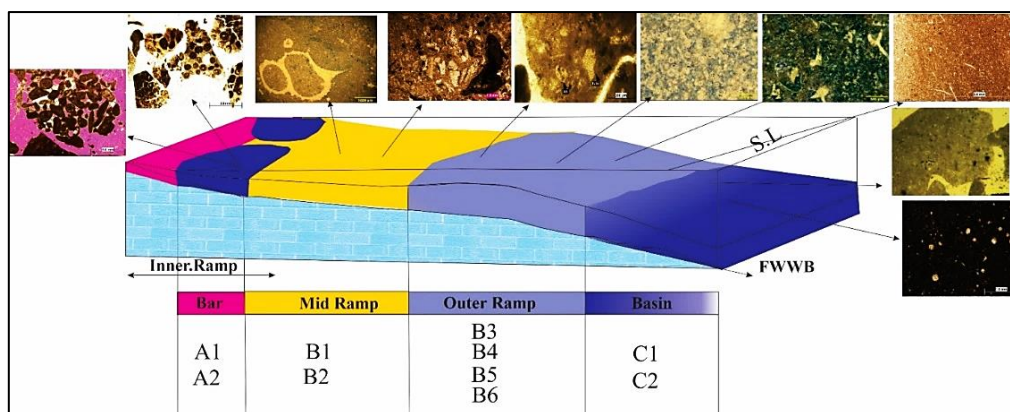


Fig. 5. Proposed Depositional Model for the Studied Section of the Ilam Formation in Well A (Burchette and Wright, 1992).

3.3. Carbonate shoal microfacies

A1) Ooid Grainstone: This microfacies has a grain-supported grainstone texture (Figs 4A, B), consisting mainly of ooids with smaller amounts of non-skeletal components like peloids and intraclasts, as well as skeletal fragments such as echinoderms, bivalves, and small foraminifera. The ooids, which are radial, biosparitic, composite, and often micritized, show some fracturing. The grainstone is well-sorted, with rounded grains and evidence of phosphatization. Sparry calcite cement binds the grains, limiting porosity, although some vuggy porosity is present. This microfacies indicates a shallow, low-energy setting, equivalent to RMF29 in Flügel’s classification (Flügel, 2010) and FZ6 in Wilson’s system (Wilson, 1975), and is found in the upper Ilam Formation within a carbonate shoal.

A2) Intraclast Peloid Grainstone: Primarily composed of peloids (Figs 4C, D), this microfacies also contains intraclasts and echinoderm fragments. Sparry calcite cement is limited, preserving intergranular porosity. This microfacies aligns with RMF30 in Flügel’s classification, suggesting a shoal environment with sufficient energy to prevent mud accumulation.

3.4. Open marine microfacies

B1) Pelagic Gastropods–Peloid Wackestone to Packstone: These facies contain peloids in a micritic matrix with large pelagic gastropods (up to 0.3 mm) and minor bivalve fragments (Figs 4E, F). Porosity is low and primarily due to fractures. It corresponds to RMF16 in Flügel’s classification and represents an open marine environment.

B2) Echinoid Wackestone to Packstone: Mainly composed of echinoid bioclasts,

including fragments and spines, along with bivalves and secondary elements like Serpulidae, bryozoans, and gastropods (Figs 4G, H). This facies shows unfilled fractures and oil staining, suggesting hydrocarbon presence. It aligns with RMF7 in Flügel (2010) and SMF10 in Wilson (1975), indicating a mid-ramp environment in the upper Ilam Formation.

B3) Rotalia Mudstone to Wackestone: This mud-supported facies primarily includes Rotaliida species, with secondary fragments of echinoids, bivalves, and algae. The fossil content suggests deposition in an outer ramp setting, with weak dolomitization and vuggy porosity. It corresponds to RMF5 in Flügel’s classification and SMF3 in Wilson’s, representative of outer ramp conditions (Figs 4I, J).

B4) Calcisphaerulid Wackestone to Packstone: This grain-supported facies, with a micritic matrix, is composed of over 30% Calcisphaerulida species and includes echinoids, bivalves, large pelagic gastropods, and planktonic foraminifera (Figs 4K, L). Intragranular and intergranular porosity are present, aligning with RMF3 in Flügel’s system and SMF8 in Wilson’s, indicative of an outer ramp in the lower Ilam Formation.

B5) Pelagic Calcisphaerulid Wackestone to Packstone: These facies contain Calcisphaerulida species along with foraminifera like Globigerina, Hedbergella, and Heterohelix in a micritic matrix (Figs 4M, N). Secondary elements include Rotaliida species, bivalves, and echinoid fragments, with bioturbation and chemical compaction (stylolites) evident. Moldic and intragranular porosity is present, indicating outer ramp sedimentation, consistent with RMF3 in Flügel’s and SMF8 in Wilson’s classification.

B6) Calcisphaerulid and Sponge Spicule Mudstone: These facies have a brownish clayey matrix containing calcified sponge spicules (~0.1 mm) and species like *Calcisphaerula*, *Pithonella*, and *Rotalipora* (Figs 4O, P). Pelagic foraminifera are secondary. It aligns with RMF4 in Flügel's classification and represents a transition from mid to outer ramp.

3.5. Deep basin microfacies

C1) Pelagic Mudstone to Wackestone: This facies features a micritic matrix with pelagic fossils like *Globotruncana*, *Globigerina*, *Heterohelix*, and echinoid fragments, with pressure dissolution and dolomitization as key diagenetic processes (Figs 4Q, R). It corresponds to RMF5 in Flügel's and SMF3 in Wilson's, indicative of deep basin sedimentation.

C2) Radiolarian Wackestone: Characterized by a dark brown clayey matrix with radiolarians (~1.0 mm), minor echinoderm fragments, and sponge spicules (Figs 4S, T). No porosity is observed, and diagenetic features include pyritization, fracture cementation, and pressure dissolution. This facies corresponds to RMF5 in Flügel's and SMF3 in Wilson's, indicating a deep basin environment in the FZ3 facies zone.

3.6. Diagenetic processes of the Ilam formation

Diagenesis is critical in shaping the reservoir quality of the Ilam Formation, as various diagenetic processes can enhance or diminish petrophysical properties. Key diagenetic alterations identified in the formation include dissolution, cementation, dolomitization, phosphatization, micritization, compaction (both physical and chemical), and pyritization.

3.7. Dissolution and carbonate porosity classification

Dissolution plays a major role in improving reservoir quality by increasing porosity types within carbonate rocks (Table 1). In carbonate reservoirs, porosity is a key factor in evaluating reservoir potential, as it directly influences permeability and fluid storage capacity. The Ilam Formation exhibits a variety of porosity types resulting from diagenetic processes, including intergranular, intercrystalline, intragranular, moldic, fracture, and vuggy porosities. The formation's dominant porosity types—microvuggy, intragranular, intergranular, moldic (either partially filled with sparry cement or left unfilled), intercrystalline, and fracture porosities—are characterized by small pore sizes (Fig 6). Proper classification and quantification of these porosities are essential to understanding the diagenetic history and its impact on the reservoir's storage and flow capacity.

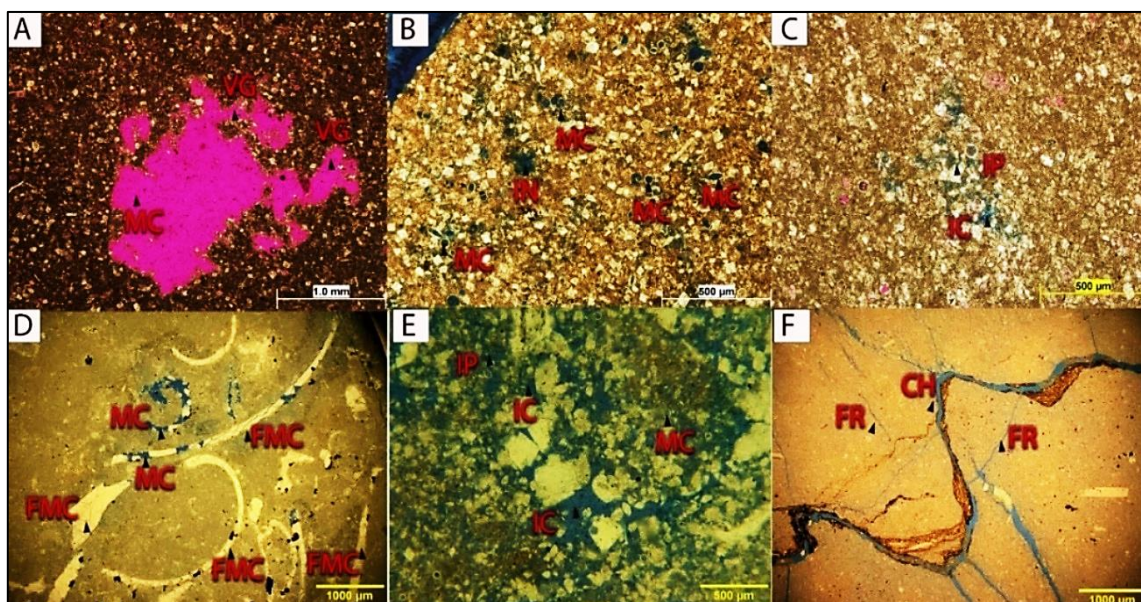


Fig. 6. Images of different types of porosities identified in thin sections of the Ilam Formation: A. Vuggy porosity, B. Intragranular porosity within calcispherulids, C. Intergranular and intragranular porosity. D. Moldic porosity (filled and unfilled), E. Intercrystalline porosity, F. Fracture and channel porosity caused by stylolite processes; these fractures are perpendicular to the stylolites. VG: Vuggy porosity, FR: Fracture, CH: Channel, IC: Intercrystalline, IP: Intergranular, MC: Moldic, FMC: Filled Moldic.

Table 1. Reservoir parameters of the Ilam formation in the Well A.

Reservoir quality (Ahr, 2008)	Microfacies Abadan Plain	thickness (m)	Medium porosity (%)
non-reservoir quality	MF1	2	4
Good intergranular porosity	MF2	1	15
non-reservoir quality	MF3	6	3
non-reservoir quality	MF4	12	8
non-reservoir quality	MF5	3	-
Intergranular and intragranular porosity	MF6	2	13
non-reservoir quality	MF7	17	5
Moldic - intragranular - intergranular - intercrystalline porosity	MF8	86	15
non-reservoir quality	MF9	1	-
non-reservoir quality	MF10	8	1

1) Fracturing and Filling: Fracturing, an early diagenetic process, facilitates fluid movement through rock formations, allowing for subsequent processes like dissolution, mineral deposition, and dolomitization to occur (Mohammed Sajed and Glover, 2020). In the Ilam Formation, fractures serve as conduits for fluids, enabling diagenetic changes to alter the

rock matrix. Most fractures observed in this study are filled with sparry calcite cement, which reduces porosity. However, some remain open, especially those formed in the later stages of diagenesis (Figs 6F and 7D). These open fractures may enhance the formation's permeability, improving its potential as a hydrocarbon reservoir.

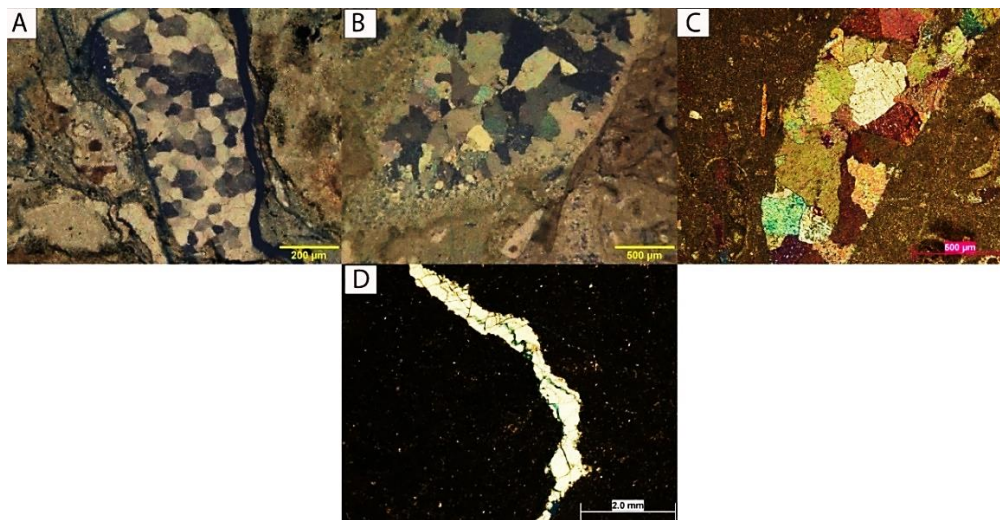


Fig. 7. Images of different types of cement identified in thin sections of the Ilam Formation. A. calcite rhomb mosaics cement B. Drusy mosaic cement C. Blocky cement D. Vein-filling sprite cement.

2) Cementation: Cementation is a major diagenetic process that generally follows dissolution and has a significant impact on porosity. In carbonate rocks, cementation typically reduces porosity by filling pore spaces, in contrast to dissolution, which usually increases it. The Ilam Formation displays four main types of carbonate cementation: equant or blocky sparry cement, vein-filling calcite cement (vein cement), parallel mosaic cement, and drusy mosaic calcite cement (Fig 7). These cement types are primarily composed of calcite, high-magnesium calcite, or aragonite. However, high-magnesium calcite and

aragonite tend to become unstable over time and with greater burial depth, often transforming into more stable calcite. Cementation can start shortly after deposition, with previously cemented fragments (intraclasts) commonly being redeposited into newer sediment layers. Understanding cementation is crucial to evaluating porosity evolution in carbonate reservoirs. While cementation reduces porosity by filling gaps between grains, the timing and extent of this process relative to other diagenetic processes like dissolution ultimately determine reservoir quality (Lucia, 2007; Moore and Wade, 2013).

3) **Compaction:** Compaction is an important process that changes the physical and chemical characteristics of rocks by decreasing their porosity and pore size. This reduction impacts the rock's hydraulic and electrical properties, leading to a significant decrease in permeability. There are two types of compactions: physical and chemical (Rashid et al., 2022).

Physical Compaction: This type occurs when overburden pressure pushes particles closer together, causing them to deform and reducing porosity. This effect is particularly noticeable in limestone mud, where porosity can drop from 70% to 40% at shallow depths.

Chemical Compaction: Also called pressure dissolution, this process involves the dissolving of grains at their contact points, resulting in the formation of stylolites, which are seams that do not contain minerals. This process further reduces porosity.

Both types of compactions are observable in the Ilam Formation. Microscopic studies show surface and convex contacts from physical compaction, while stylolites indicate chemical compaction. These features are closely related to increased overburden pressure and tectonic forces (Fig 8).

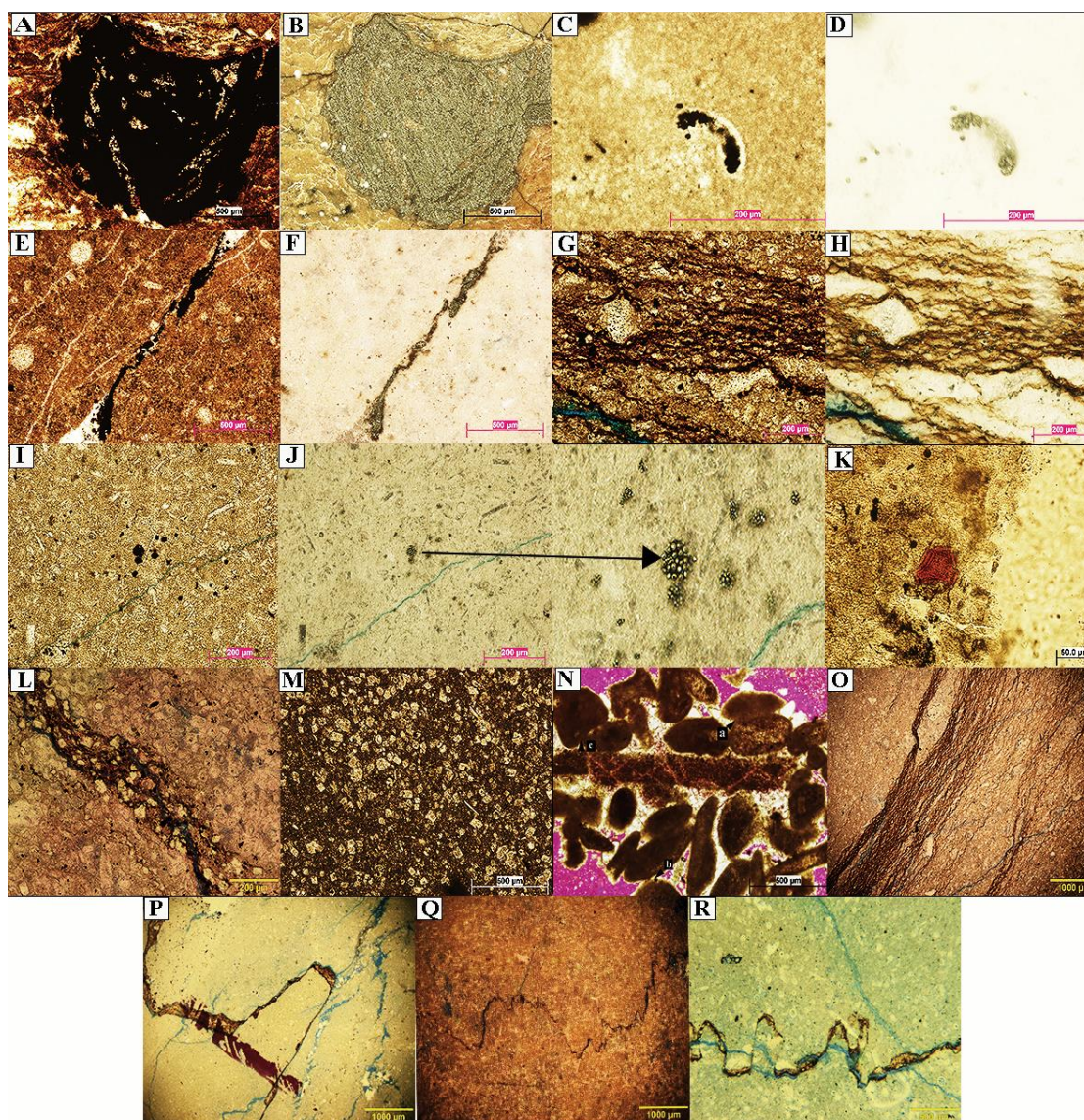


Fig. 8. Images of Diagenetic Processes Observed in Thin Sections of the Ilam Formation. A.B: Pyritization under electron microscope (core sections). C.D: Pyrite filling moldic porosity of microfossils (core sections). E.F: Pyrite filling veins (core sections). G.H: Pyritization along stylolites (core sections). I.J: Framboidal pyrite. K: Example of phosphate (cuttings). L.M: Dolomitization process along solution seams and the presence of secondary dolomites in the micritic matrix. N: Physical compaction: a. Surface contact, b. Point contact, c. convex contact; micritization is visible in this image. O: Chemical compaction along solution seams. P.Q.R: Various stylolites with long, medium, and short amplitudes.

dolomitization initially increased porosity, it later contributed to its reduction (Fig 8) (Tucker, 2009).

6) Micritization: Micritization is a process driven by microorganisms like fungi, bacteria, and algae, which create cavities in calcitic grains. These cavities are later filled with micrite, preserving the shape of the grains but damaging their internal structure. In the Ilam Formation, micritization is particularly evident in peloidal and ooidal samples, where microorganisms have modified the grains (Fig 8) (Irani Kourabbaslou et al., 2015). This process can significantly affect grain structure, impacting both porosity and permeability. Fig 9 summarizes the identified microfacies and porosities by depth in the studied well.

4. Conclusion

The Ilam Formation, an important reservoir in the Abadan Plain (well A), exhibits unique geological features and diagenetic processes. In the studied well, the Ilam Formation is divided into two parts: the upper part, which consists of alternating layers of limestone and marl, and the lower part, which consists of pure limestone. Based on the analysis and comparison with the standard Flugel facies model, this study identified ten microfacies at different depths in the formation. These microfacies include ovoid greenstone, endocoelic ploydy greenstone, pelagic gastropod paxton to paxton, echinoid paxton to paxton, rotalia paxton mudstone, calciferolid paxton to paxton, pelagic calciferolid paxton to paxton, calciferolid and sponge spicule mudstone, pelagic paxton to paxton, and radiolarian paxton. These microfacies are organized into four belts: shoal, mid-ramp, outer ramp, and basin, with most subenvironments belonging to the outer ramp. The gradual changes in microfacies and the absence of reef-related facies indicate that the studied environment is a single-slope homoclinal ramp. Considering the diagenetic processes, porosity types and porosity percentage in the Ilam Formation, the reservoir quality in the studied well is assessed as poor. This conclusion is based on several observations: dolomitization is more than 50%, cementation is up to 30%, there are high levels of pressure dissolution and stylolite formation, and many pores whether intragranular, intergranular or dissolution-induced - as well as

fractures, are filled with pyrite. The dominant porosities are microporosities, many of which are ineffective or disconnected, further reducing the reservoir quality.

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