Porosity Evolution and Sequence Stratigraphy of Khasib Formation (Late Turonian-Coniacian) in Selected Oilfields, Central Iraq

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Abstract
The evolution of porosity and sequence stratigraphy study of the Khasib Formation (Late Turonian-Coniacian) in two wells, in central Iraq was conducted. In the first well EB-X, the Khasib Formation sequences are confined to a depth of 2182-2285 m, with a thickness of about 103 meters, and in the second well Hf-Y, the Khasib Formation sequences are confined to a depth of 2941-2860 meters, with a total thickness of 81 meters. The lithology of the formation is predominantly dark chalky limestone rich in planktonic fossils, with a few thin layers of black shale. The formation lithology progressively shifts higher to shaley limestone rich in planktonic fossils and Calcispheres. On the other hand, the depositional environment of the formation was established by diagnosing six mudstone submicrofacies, five wackestone submicrofacies, and a packstone microfacies, which indicate the formation depositional settings in deep marine environments. Furthermore, the formation is split into three zones based on porosity values: A, B, and C, which are characterized by productive reservoir rock, low-yielding reservoir rock, and medium-productive reservoir rock, respectively. The Khasib formation sequences formed during the Late Turonian to Early Coniacian. As a result, the overall sedimentation period reached 3.1 million years, and the stratigraphic sequence is of the third order.

Keywords: Porosity; Sequence Stratigraphy; Khasib; Baghdad; Halfiya; Oilfields

1. Introduction
Khasib Formation is one of the components of the secondary sedimentation cycle extending from the Middle Turonian to the Early Campanian in central and southern Iraq, this secondary cycle constitutes the conclusion of the main sedimentary cycle extending from the Cenomanian to the end of the Early Campanian. Given the good oil discoveries in the formations of this secondary cycle, it has attracted remarkable interest, especially in the central regions of Iraq.

Rabanit (1952; in Bellen et al., 1959) was the first to use the term Khasib. He picked the Zubair well Zb-3 as the type section for this formation, which was previously only known in southern Iraq. Following a significant increase in drilling efforts, (Chatton and Hart, 1961) and (Ditmar et al., 1971 and 1972) proposed adding the equivalent part of the Pilsener Formation to the formations of this cycle. The studied formation is one of the important oil reservoirs in the giant East Baghdad field and the rest of the fields in central Iraq. As a result, interest in the formation grew, and research on its geological

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and petrophysical properties, and sedimentary environments were enlarged. There are many studies on the Khasib Formation in terms of age determination such as the study of Al-Ali et al. (2020) who indicated that the age of the formation is Turonian–Coniacian. Mohammed et al. (2020) studied the Khasib Formation in the Amara oil field about 10 Km southern Missan Governorate, and he mention that the formation consists of three microfacies precipitated in (FZ1) Gratonic deep water basin.

The formation is around 50m thick in its type section and is separated into two parts, the lower part (20 m) comprised mainly of dark gray shale to greenish intertwined with limestone, and the upper part (30 meters), is composed of gray marly limestone, and it seems that the presence of such a binary division in all areas is difficult due to the loss of shale in some of them. And confining it to chalky limestone intertwined with marl, this difference in the rock components of the formation from one region to another causes many problems in the stratification and the reconstruction of the old geography. in the lack of shale, and hence the absence of a binary partition, the formation is comparable to the Saadi Formation (Buday, 1980). The aims of this study are determining the sedimentary environment and sequence stratigraphy of the formation, as well as, recognize the nature of characteristics reservoir.

2. Geological Setting

The study area is located in the East Baghdad oilfield, specifically within the Mesopotamian Basin, and the zone of the unstable shelf. The East Baghdad oilfield is represented by a monoclinic fold and densely fractured in the shape of a flower, thus affecting the distribution pattern of reservoirs in the field.

The current study is based on samples taken from two wells: The first (EB-X) well, where the Khasib Formation sequences are confined to a depth of 2182-2285 meters, with a thickness of about 103 meters, and the second (Hf-Y) well, where the Khasib Formation sequences are confined to a depth of 2941-2860 meters, with a total thickness of about 81 m (Fig. 1).

![Fig.1. Late Turonian-Early Campanian paleogeography and studied locations (Jassim and Buday, 2006)](image)

3. Paleogeography

Iraq is part of the submerged Arabian Platform with its eastern and northern edges under the Iranian and Anatolian pages, respectively. As a result of the collision of these blocs with each other, starting in the Jurassic period, it later led to the emergence of the Alpine Orogeny movement in the Cretaceous and Tertiary periods.
The influential power in Iraq extended in two directions: northeast-southwest and north-south. According to Buday (1980), the development of sedimentary basins in Iraq had started with a regional progress of the sea in northern Iraq with the middle of the Turonian and continued to the Early Campanian. This last development of the basin did not begin until after the conclusion of the sub-Hercynian bout of the Early Turonian Period. Buday (1980) confirms that this episode was characterized by successive pulses and high intensity. Although the duration of this kinetic episode was relatively short, as it started with the beginning of the Turonian and ended roughly in the middle, it led to a change in many geological trends and patterns that prevailed in the region. On the other hand, this movement renewed the movement of some faults, leading to the formation of linear basins and heights running parallel to the edges of the Tethys Ocean and barriers (Alveolinids-Radiolaria) (Saint-Marc, 1978; Murris, 1980). The renewed movements that took place just before the end of Turonian raised the northeastern parts of Iraq and drop its contiguous southwestern parts. Thus, a sedimentary basin was created that covered most of Iraq. In its northeastern parts, a sedimentary basin began to be deposited, followed by Mashura. In the northwestern regions, the sediments of the cycle (Upper Turonian-Upper Campanian) were restricted to Mashura facies only (Buday, 1980; Kaddouri, 1982).

The sedimentary processes in the Late Turonian-Early Campanian basin began with a marine transgression spanning the southern and central regions of Iraq, which resulted in the formation of the Khasib and Balambo formations. This was followed by a relative withdrawal of the sea, which affected southern and central Iraq, and subsequently in the Balad and Samarra areas. This was accompanied by the deposition of the Tanumah Formation in Iraq's south and center (Fig. 2).

![Fig. 2. The Early Senonian Paleogeography (Jassim and Goff, 2006)](image_url)

4. Materials and Methods

The current study relied on two wells (EB-X and Hf-Y) from east Baghdad oilfield, to obtain data, where 56 thin sections were prepared and examined using polarized microscopy, after taking samples and making thin section to these samples, followed by description and drawing columnar sections. The current study adopted the Dunham, (1962) system in classifying rocks, due to its ease of use and its strong showing of the textural relationships reflecting the levels of sedimentary energy, and then the naming of the standard microfacies known by short (SMF), which was proposed by (Wilson, 1975) and it was later developed by (Flügel, 2010).
The Khasib Formation consists of a succession of dark chalky limestone rich in planktonic fossils and thin layers of dark shale rich in organic matter. The lithology of the formation gradually changes upward to shaley limestone rich in planktonic fossils and Calcispheres. The lower contact of a Khasib Formation is unconformable defined by the last occurrence of the limonite bearing limestone rich in green algae of the Mishrif Formation (Sherwani, 1983). As for the upper conformable surface of the formation, it is determined by the disappearance of the chalky limestone containing planktonic foraminifera of Kassib Formation, and the beginning of the black shale rich in benthic shells and relatively large organic detritus belonging to the Tanuma Formation (Al-Hamdani, 1986).

Thus, the formation sequences were divided into six mudstone submicrofacies, five wackestone submicrofacies and a packstone microfacies, as shown below. As well as relying on subsurface information approved by two wells (Hf-Y and EB-X) to study the stratigraphy of sequences and pore evolution.

5. Results and Discussion

5.1. Microfacies Analysis

The studied formation is made up of three main microfacies (Lime mudstone, Wackestone and, Grainstone) and eleven submicrofacies, that reflect the paleoenvironment of the formation

5.1.1. Lime mudstone microfacies (M)

This microfacies is mostly composed of micrite, accounting for more than 90% of the total microfacies components; hence, the percentage of grains in this facies does not surpass 10% of the total microfacies components. With a rate of about (51.9%), it is one of the most significant facies in formation. It was classified into six submicrofacies based on its granular composition, which are as follows:

- **Bioclastic Lime mudstones submicrofacies (M1)**

  This microfacies appear in the EB-X well. The skeletal particles in this microfacies are made up of debris from invertebrates, crustaceans, echinoderms, and calcareous algae, besides, a minor amount of planktonic and benthic foraminifera. The organic grains in this microfacies have sharp, non-rounded edges and poor sorting, whereas the matrix is pure uniform micrite (Fig. 3a). This facies exhibits traces of cohesion and compression, as evidenced by the presence of pressure solution veins (Stylolite) and organic grains that run parallel to the bedding surfaces. According to Flügel (2010) this microfacies is associated to the open shelf basin zone, and it appears intermittently in the formation sequences, albeit it is reasonably prevalent in the lower portion of the formation.

- **Rotaliid Lime mudstone submicrofacies (M2)**

  The skeletal grains in this microfacies have poor sorting and roundness. The chambers of Rotalid shells are filled with micrites, and occasionally with sparite. The matrix is constructed of pure micrite coherent homogenous material. The dolomite mineral spreads throughout it in the form of irregular crystals, filling the voids in certain shells and their shattering. This microfacies is the most common in the investigated formation. The Rotalid has been classified by most experts as an organism that lives in a semi-confined marine habitat, Murray, 1968, and Reeckmann and Friedman, 1982 recognized the brackish inner shelf environment as a suitable environment for these benthic habitats.

- **Bioclastic Globigerinid Lime mudstone submicrofacies (M3)**

  The matrix is made up of pure, coherent micrite with a homogeneous texture that is scattered by Globigerinid shells and randomly repeats this microfacies in a Khasib Formation, as there is no specific direction of increase or decrease, and it is one of the facies characteristics of the open marine environment (Flügel, 2010).
• **Globigerinid Lime mudstone submicrofacies (M4)**
  The bulk of the grains in this microfacies are planktonic foraminifera, particularly *globigerinid*, with minor amounts of skeletal grains with sharp edges and round Calcipheral shells dispersed equally. The matrix is composed of pure micrite with a homogeneous texture unaffected by bioturbation, as dolomite crystals spread randomly in it. Many scholars, including Reeckmann and Friedman, (1982) associate this facies with a rather deep marine habitat far away from the impacts of ocean waves and currents (below the effective wave base).

• **Miliolid Lime mudstone submicrofacies (M5)**
  The grains of this microfacies consist mainly of the benthonic foraminifera, as Miliolid, and a few bioclasts. These grains are characterized by medium sorting and weak roundness (Fig. 3b). The matrix composed of impure micrite due to the presence of clay and organic materials, as well as pores filled with granular cement. This microfacies is one of the few minute facies common in formation sequences. According to Murray,1968 the lack of diversity of the benthic foraminifera shells at a given facies and its limitation to the Miliolid family indicates a saline lagoon environment (Hypersaline).

• **Calcispheral Lime mudstone submicrofacies (M6)**
  The shells of globular calcisphers make up the majority of the grains in this microfacies, with modest numbers of globigerinid and other planktic foraminifera shells spread evenly. These shells are notable for their excellent preservation and the fact that their chambers remain empty. The matrix is made up of homogeneous pure micrite with random diffusion of transparent dolomite crystals.

  There are three opinions regarding the semantics of calcisphers in deducing the ancient depositional environment: Bishop,1972 and Banner,1972 in Master and Scott,1978 refer that the calcisphers has an open and deep marine connotation. While all of (Rupp, 1968 in Master and Scott,1978) indicated that the presence of calcisphers indicate a shallow marine environment with warm waters. Whereas Bein and Reiss, 1976 believe that calcisphers live in an intermediate environment between the shallow marine Rudist ridge and the deep sea. Al-Hamdani, 1986, pointed out that the difference in these views is due to the variation in the pattern of the presence of calcisphers. At times it accompanies the organisms that indicates the deep marine environments, and sometimes it accompanies the algal reef, and at other times it accompanies the organisms indicating the shallow environment.

5.1.2. **Lime wackestone microfacies (W)**

This microfacies is the second in the list of formation sequence facies. The percentage of granules for this facies surpasses the 10% threshold, occasionally reaching 55% of the total components. It has been classified into five sub microfacies based on the diversity of its granular material and dominance:

• **Globigerinid- Bioclastic Lime Wackestone Submicrofacies (W 1)**
  The allochems of this microfacies consist mainly of echinoderms, crustaceans, mollusks and the remains of calcareous algae, as well as the shells of Globigerinid (Fig. 3c). The micritic matrix of this microfacies is characterized by its homogeneous texture, with the exception of parts exposed to bioturbation. The existence of this facies is confined to the upper part of the formation, and usually deposited in the semi-isolated marine environment, specifically towards the open sea (Flügel,2010).
Fig. 3. Photomicrographs of Kasib Formation showing microfacies types a) Bioclastic Lime mudstones submicrofacies; b) Milolid Lime mudstone submicrofacies; c) Globigerinid-Bioclastic Lime Wackestone Submicrofacies

- Globigerinid Lime Wackestone Submicrofacies (W 2)
  The grains of this microfacies are composed of the well-preserved foraminifera shells such as Globigerinid and calcisphers, as well as a small proportion of small bioclasts. Certain transparent dolomite crystals occur with the scattered pyrite nodules in some samples the matrix is composed homogeneous pure micrite devoid of bioturbation. Such microfacies is usually deposited in the deep marine environment, far from the effects of ocean waves and currents (Flügel, 2010).

- Calcipheral Lime Wackestone Submicrofacies (W 3)
  It is consisting of spherical and oval calcisphers, as well as other planktic foraminifera shells such as Globigerinid and a few bioclasts, the matrix is composed of pure micrite with a homogeneous texture (Fig. 4a). This microfacies is found sparingly in a Khasib formation. The sedimentation conditions of this facies are similar to those of Calcicrobial Lime mudstone microfacies, as they indicate open, calm and relatively deep marine conditions (Flügel, 2010).

- Mollusca Lime Wackestone Submicrofacies (W 4)
  The granules of these microfacies are made up of Mollusca debris and generally in the shape of tiny rectangular fragments with poor sorting and sphericality (Fig. 4b). It seems that the grains of this facies may have formed under relatively high energy conditions, but later they moved to another area of low energy, and this reflects the open marine shelf environment (Flügel, 2010). The existence of this facies is restricted to the lower Khasib sequences.

- Rotalid- BioclasticLime Wackestone Submicrofacies (W 5)
  The granules are consisting of echinoderms debris, crustaceans, mollusks, remains of calcareous algae and benthic foraminifera, particularly Rotalid. This facies is characterized by the diversity of its fossils, and weakness of its granules sorting, and sphericality. In addition to the presence of a thin black layer of insoluble residues around some of its grains, and stylolite veins spread in this facies to indicate to compression. Such facies are usually deposited in the semi-insulated marine environment, specifically in the inner Shelf (Flügel, 2010).

5.1.3. Peloidal lime packstone microfacies (G)

This microfacies is placed third among the facies that make up the formation sequences. It is mostly composed of peloids (Fig. 4c), which account for more than 80% of the total microfacies components. They come in a variety of forms, including spherical, oval, and irregular shapes, but they
Fig. 4. Photomicrographs of Kasib Formation showing microfacies types a) Calcipheral Lime Wackestone Submicrofacies; b) Mollusca Lime Wackestone Submicrofacies; c) Peloidal Lime Packstone Microfacies

are normally of good sorting and rounding, and are distributed within a micrite matrix. In general, it is uncommon in Khasib deposits, and this microfacies is devoid of dolomite, with only tiny levels of pyrite present. According to previous studies, this facies is deposited in shallow coastal intertidal zones with calm seas (Flügel, 2010).

5.2. Sequence Stratigraphic Analysis

Sequence stratigraphy is a relatively recent mechanism that investigates a type of sediment aggregation (Type of Accumulation). In doing so, it becomes easier to understand how sedimentary systems respond to sea level changes. Sequencing stratigraphy is a practical way to understand and analyze the stages of carbonate platforms evolution (Sarg, 1988; Rudophhand Lehrmann, 1989; Handford and Loucks, 1990).

The Khasib Formation sequences formed during the Late Turonian (91.8) to Early Coniacian (88.7) million years ago. As a result, the overall sedimentation period reached (3.1) million years, and the stratigraphic sequence, according to Imbrie classifications (1985), is of the third order. The biozones were identified based on Hammoudi’s (1995) biozones due to the very near distance between the (EB-X) and (EB-2) wells in the East Baghdad field, and the well (Hf-Y) from the well (DH-2) in the Dhafariya field, as well as their similar thickness of the same configuration.

During the Turonian period, the Arabian plate was exposed to two compression and tension systems. After the sedimentary basin was compressed during the Late Turonian-Early Coniacian period, it was followed by a relaxation period characterized by a relative tension process, which resulted in the deposition of the Khasib Formation (Sharland et al., 2001). All deposits that return to the Khasib Formation are represented by a single stratigraphic sequence that begins at the bottom with a sequence boundary type one (SB-1). According to the investigations, the Khasib Formation sedimentary environment is the middle shelf to the outer shelf, and it may extend to the deeper slope at times and to the inner shelf at others (Hammoudi, 1995).

5.2.1. Sequence stratigraphy for the well (EB-X)

There is a global unconformity (SB-1) between the Mishrif and Khasib formations. According to Haq (1987); Sherwani (1988); Van wagoner et al. (1988), this surface arose from a reduction in world sea level. The progressive system track (TST) is constructed on top of this surface by the retrogradation pattern indicated by (M1, M3, M4, M2) (Fig. 5).

The thickness of this sequence is 35 meters, and the successions of this track indicate an increase in the depth of the sedimentary basin towards the top. The depth (2250 meters) represents the maximum
flooding surface (MFS) of this succession. Khasib Formation are characterized by pelagic and hemipelagic facies containing the various planktic foraminifera indicating the progressive system track (TST), while the maximum flooding surface (MFS) in this sequence is represented by chalky limestone rich in planktic foraminifera, which represents the beginning of the upper part succession of the formation, this is followed by the precipitating high system track (HST) with a progressive accumulation pattern represented by facies (M1,M5, M4, M2, M1, M2, M4). The Rotalid Lime Wackestone Submicrofacies and Bioclastic Lime Wackestone Submicrofacies usually reflects the open sea environment. The thickness of this track is (68) meters, and is determined from the top by a succession of the second type (SB-2). Thus, the total sequence thickness is 103 m.

5.2.2. Sequence stratigraphy for the well (HF-Y)

The global sequence boundary type one (SB-1), (Haq, 1987) (Sherwani, 1988) (Van wagoner, et al., 1988), Overlined by the progressive system track (TST) formed by the retrogradation pattern represented by (G1) (Fig. 6). This sequence about (25) meters thickness indicates a deepening upwards, with a depth (2925 meters) that symbolizes the maximum flooding surface (MFS) represented by chalky limestone rich in planktic foraminifera shells, which reflects the beginning of the upper part of the Khasib Formation. The maximum flooding surface is followed by the high system track (HST) sediment with a progressive accumulation pattern represented by the facies M4 that reflects the open sea environment. The thickness of the HST system is about (18) meters, where it is bounded on the top by the second type sequence boundary (SB-2) and the total thickness of the successive in this well is about (81 meters).

![Fig. 5. Sequence stratigraphy subdivision of Khasib Formation in East Baghdad oilfield](image-url)
5.3. Porosity Measurement Using Porosity Sensors

The CNL and FDC techniques were used to measure the porosity of the fertile formation rocks of (EB-X) and (Hf-Y), as shown below:

1. Neutron compensator (CNL): This technique is used in direct measurement of the porosity of formation rocks.

2. Bed density (FDC): This technique is used to indirectly measure the porosity of rocks by measuring the density of rocks in a probe and employing it in calculating the porosity according to the following equation:

\[ \phi = \frac{(\rho_{ma} - \rho_b)}{(\rho_{ma} - \rho_f)} \]  

Where: \( \phi \): the porosity value using the density log  
\( \rho_b \): Bulk density from log  
\( \rho_{ma} \): Matrix density  
\( \rho_f \): Fluid density

According to the matrix density values (\( \rho_{ma} \)) computed by Schlumberger, 1972, the matrix density of carbonate Khasib Formation is (2.71 gm / cm3) and for the fluid (\( \rho_f \)) used (saline mud) in drilling operations for the selected wells are (1.1 gm / cm3). To obtain true and accurate values of the porosity of the successions of the selected wells (EB-X, Hf-Y) and for the purpose of eliminating the associated effect of the shale, the porosity correction equation was used. This equation differs from one well to another according to the required data:

A well equation (EB-X) to calculate true porosity and remove the effect of the shale:

\[ \Theta_{cor} = \Theta_s + [V_{sh} (\rho_{sh} - \rho_{ma})/(\rho_{ma} - \rho_f)] \],  
\[ \Theta_{cor} = \Theta_s + [V_{sh}(2.32-2.71)/(2.71-1.1)] \]
\[ \Omega_{t_{\text{cor}}} = \Omega_a + [V_{sh}(2.32-2.71)/1.61] \]
\[ \Omega_{t_{\text{cor}}} = \Omega_a - 0.24226 \times V_{sh} \] (3)

\( \Omega_{t_{\text{cor}}} \): True porosity value
\( \Omega_a \): Porosity value calculated from the neutron log
\( V_{sh} \): Shale volume value
\( \rho_{sh} \): Shale density calculated from 83API = GR clean
\( \rho_{ma} \): Matrix density, it is a constant value for every type of rock
\( \rho_f \): Fluid density

A well equation (Hf-3) to calculate true porosity and remove the effect of the shale:
\[ \Omega_{t_{\text{cor}}} = \Omega_a + [V_{sh} (\rho_{sh} - \rho_{ma})/(\rho_{ma} - \rho_f)] \]
\[ \Omega_{t_{\text{cor}}} = \Omega_a + [V_{sh}(2.1-2.71)/(2.71-1.1)] \] (4)
\[ \Omega_{t_{\text{cor}}} = \Omega_a + [V_{sh}(2.1-2.71)/1.61] \], \[ \Omega_{t_{\text{cor}}} = \Omega_a - 0.3788 \times V_{sh} \] (5)

\( \Omega_a \): Porosity value calculated from the neutron log
\( V_{sh} \): Shale volume value
\( \rho_{sh} \): Shale density calculated from 72API = GR clean
\( \rho_{ma} \): Matrix density, it is a constant value for every type of rock
\( \rho_f \): Fluid density

As for the calculation of effective porosity (\( \Omega_e \)) for the well succession, they are calculated, (after removing the influence of the shale (\( V_{sh} \)) on them), from the correction equation (\( \Omega_{t_{\text{cor}}} \)) established by (Schlumberger, 1979)
\[ \phi_e = \phi_{t_{\text{cor}}} \times (1 - V_{sh}) \] (6)

By adopting the values of effective porosity (\( \Omega_e \)) and total porosity (\( \Omega_{t_{\text{cor}}} \)) it becomes possible to calculate the dead porosity (\( \Omega_d \)), by subtracting the first from the second (\( \Omega_d = \Omega_{t_{\text{cor}}} - \Omega_e \)). Fig. (7) shows the distribution of the values of porosity: total, effective and dead depending on the well depth.

![Porosity distribution](image)

**Fig. 7.** The vertical distribution of porosity (\( \Omega_t, \Omega_e, \Omega_d \)) in two wells

### 5.4. Porosity Evolution

Porosity is one of the most important reservoir properties of rock succession, which determine the ability to store in reservoir rocks, and there are many methods used in studying this property, in the
forefront of which is the study of geological logs (FDC, neutron compensator CNL, and BHC sound), which were mainly relied upon in this study. Whereas the GR log was used to identify the petrology and divide the succession into several units, and according to the data available through the logs, gamma rays and the division of the reservoir, the sequences were divided into three zones, as follows:

Zone A, this zone is represented by the succession of the formation's lowest member, which is approximately 28 meters thick in an EB-X well and 16 meters in a Hf-Y well. These sequences are distinguished by vuggy, intergranular, fractional, and moldic porosity. Its porosity ranges from 12 to 26 percent, making it a productive reservoir rock. It also has a high gamma ray (GR) ratio. In a number of places, the original porosity value is high, owing mostly to the impact of hydrocarbons on different modification processes such as dissolution, dolomitization, and recrystallization. The effective porosity value is very small, represented by Khasib Sequence 1 and the Progressive System track (TST).

Zone B, this zone is represented by successions of the upper part of lower member, which is about (10) meters thick in the (EB-X) well and (60) meters in the (Hf-Y) well. It is distinguished by the presence of vuggy, intergranular, fractional, and moldic porosity. The porosity ranges between (2-12%). As a result, it is classified as a low-yielding reservoir rock. It is worth noting that the lowest portion of this sequence has a high gamma ray ratio (GR). The presence of such a huge rise in the values of the initial porosity implies the presence of a specific effect, which is commonly represented by fracture. According to Nelson (1994), fractures are one of the most important factors contributing to the emergence of reservoirs in mud-sovereign rocks (Mudstone, Wackestone), which were affected by some tectonic processes that resulted in the formation of fractures and breaks, which played a positive role in increasing and activating the porosity of formation rocks.

It is represented by the Khasib sequence (1) and the progressive system track (TST), while the upper part in which the ratio of gamma rays is few and affected by various diagenetic processes such as compression and cementation, represented by the sequence (Khasib Sequence2) and the high stand system track (HST).

Zone C, this zone is represented by the upper member successions of the formation. The porosity of these sequences is limited to the two classes of porosity (fracture and channel). The porosity of these rocks is limited between (12-26%) It is thus a medium-productive reservoir rock. The ratio of gamma rays to GR is low, and affected by various diagenetic processes such as compression and cementation, represented by Khasib sequence 2 and the high stand system track (HST).

6. Conclusions

The present study is based on samples of Khasib Formation taken from two wells; the first is in East Baghdad field and the second is in Halfiya field. The Khasib Formation consists of a succession of dark chalky limestone rich in planktonic fossils and thin layers of dark shale rich in organic matter. The lithology of the formation gradually changes upward to shaley limestone rich in planktonic fossils and Calcspheres. Six mudstone submicrofacies, five wackestone submicrofacies and a packstone microfacies which were reflects the depositional environments of the formation in deep marine environment. According to the porosity values, the formation divided to three zones they are (A, B and C), characterized by productive reservoir rock, a low-yielding reservoir rock and medium-productive reservoir rocks respectively.

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