# Geology of Miocene Gypsum Deposits in Northern Iraq A Review

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## Abstract

Miocene Evaporites sediments of northern Iraq are basically represented by Dhiban (Lower Miocene) and Fat'ha Formations (Middle Miocene), these two formations are found both in surface and subsurface sections. They consists of alternating cycles of three lithofacies; gypsum, limestone and marl. Eustatic sea level changes besides the vertical basement block movement play an important role in the development of cyclic sedimentological regime of Miocene sediments via the opening and closing of lagoons and coastal shallow basins. The prevailing of arid paleoclimate causing the deposition of evaporites. Gypsum rocks are of massive, nodular, and selentic types. Two types of gypsum textures are recognized; alabstrine and porphroblastic. The Miocene gypsum is of a secondary origin resulted from the hydration of pre-existing anhydrite. From a mineralogical point of view, the Miocene gypsum rocks consist mainly of gypsum as dominant mineral with minor amounts of anhydrite, dolomite, celestite, bassanite, and traces of quartz. Salinity, clay minerals contents, and diagenetic proceses controlled the distribution of major, minor, and trace elements in gypsum rocks under study. Great petrological and geochemical similarity was documented between Lower and Middle Miocene gypsum. Most of the economic gypsum deposits in Iraq occur in Fat'ha Formation, these deposits are generally pure (Insoluble residue 1-2%) and suitable for many industrial uses.

## Introduction:

Evaporite sediments in Iraq has wide geographic distribution, they are cropping out in different localities mainly northern Iraq and encounter in many subsurface sections (boreholes). This study focus on gypsum rocks exposed at Sheikh Ibrahim, Dhiban, Butmah, and Fat'ha Areas, Fig.(1). Evaporite sediments has been deposited mainly during two main ages; Jurassic (Qotnia Formation) and Miocene (Dhiban Formation- Lower Miocene and Fat'ha Formation- Middle Miocene)(Fig. 2). Al-Naqib (1970), and Sultan (2003), showed that gypsum rocks cropping out within Jabal Sanam Structure ( Diapric Salt Dome about 45 south west Basrah City), this structure is most probably related to Hurmoz Salt Series of Cambrian age. Jurrasic evaporites were detected only in subsurface sections.

Dhian Formation is a member of Early Miocene sequence which also comprises Ghar, and Euphrates Formations. Dhiban Formation comprises 72 m of gypsum, thin beds of marl and brecciated recrystallized limestone, salt may be encountered in subsurface sections as in south Sinjar Town (Jassim and Goff, 2006). Gypsum beds are mainly massive and nodular interbedded with thin beds of marl and brecciated recrystallised limestone (Van Bellen *et al*., 1959, and Abdul-Hameed,1983). It is worth to mentioning that Dhiban Formation only cropping out west of Sinjar anticline near Dhiban village northwest Iraq of 155 km west of Mosul (Fig, 1).

Fat'ha Formation (Formerly Lower Fars) represents the main gypsum bearing formation within the Iraq territories. This formation consists of alternating cycles of gypsum, marl, and carbonates. Fat'ha Formation is generally characterized by it's wide geographic distribution, it extends from southwest Iran across Iraq to northeast Syria (Fig, 3). Fat'ha Formation exhibits different thicknesses from one place to another, for instance, its thickness at sheikh Ibrahim (35 km west of Mosul city) is 310 m, while its thickness in Bashiqa (20 km northeast Mosul of City) is 100 m. This variation in thickness within this short distance might be the result of the different mobility in the basement blocks (Al-Rawi and Amin, 1979)

Fat'ha Formation represents the most conspicuous formation northern Iraq, it bears an important economic value; it forms the cap rocks of many Iraqi oil fields, furthermore, it could form a good reserve for native sulphur production via the extensive reduction of its sulphates members (e.g. Mushraq sulphur mine in northern Iraq). These rocks can also be used in building industry either as ornamentation stones or to produce building plaster (locally called Jus) (Mustafa, 1980, and Alkufaishi and Al-Marsoumi, 1988). It is worth to mentioning that Khalhur and Gachsaran Formations of south west Iran are equivalent to Dhiban and Fat'ha Formations respectively.

Multitudes have dealt mainly with the Miocene gypsum of Fat'ha, and for a lesser extent of Dhiban Formations. The current study attempts to employ the published and unpublished researches dealing with gypsum rock cropping out in Sheikh Ibrahim, Butmah, Sinjar, and Fat'ha areas (Fig, 1). In order to present a comprehensive review of petrological, sedimentological, and geochemical aspects of gypsum rocks.

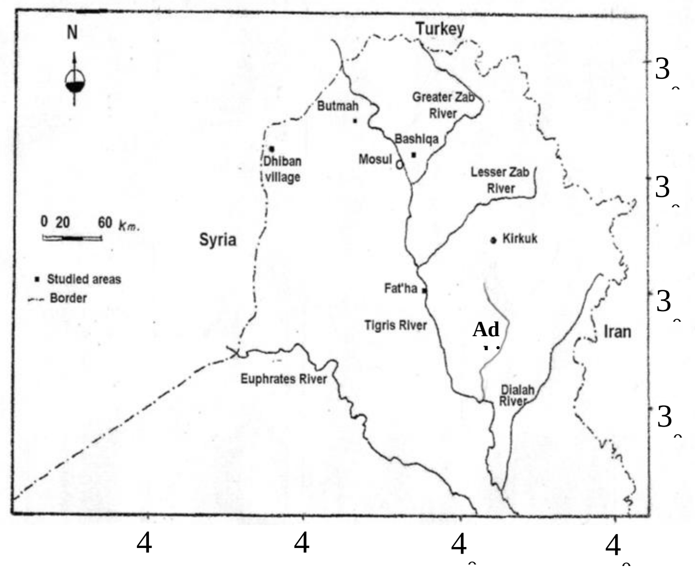



Fig.(1) Location

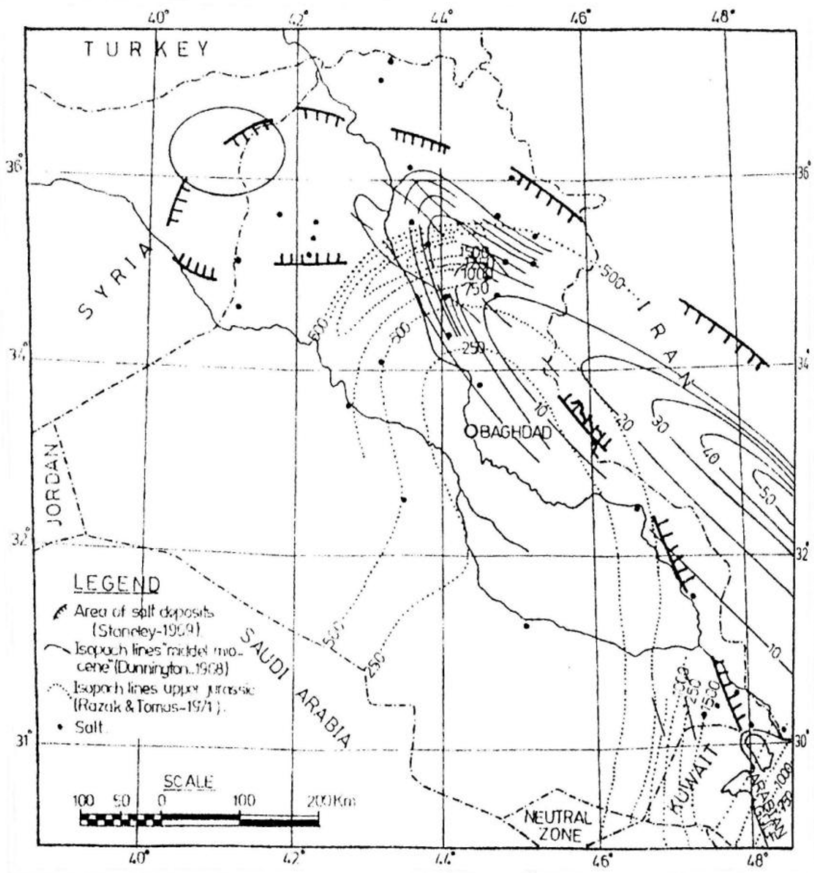



Fig.(2) Map of Iraq showing the Lower Miocene and Upper Jurassic isopachs compared to salt locations (After Al-Sinawi and Saadallah ,1971).

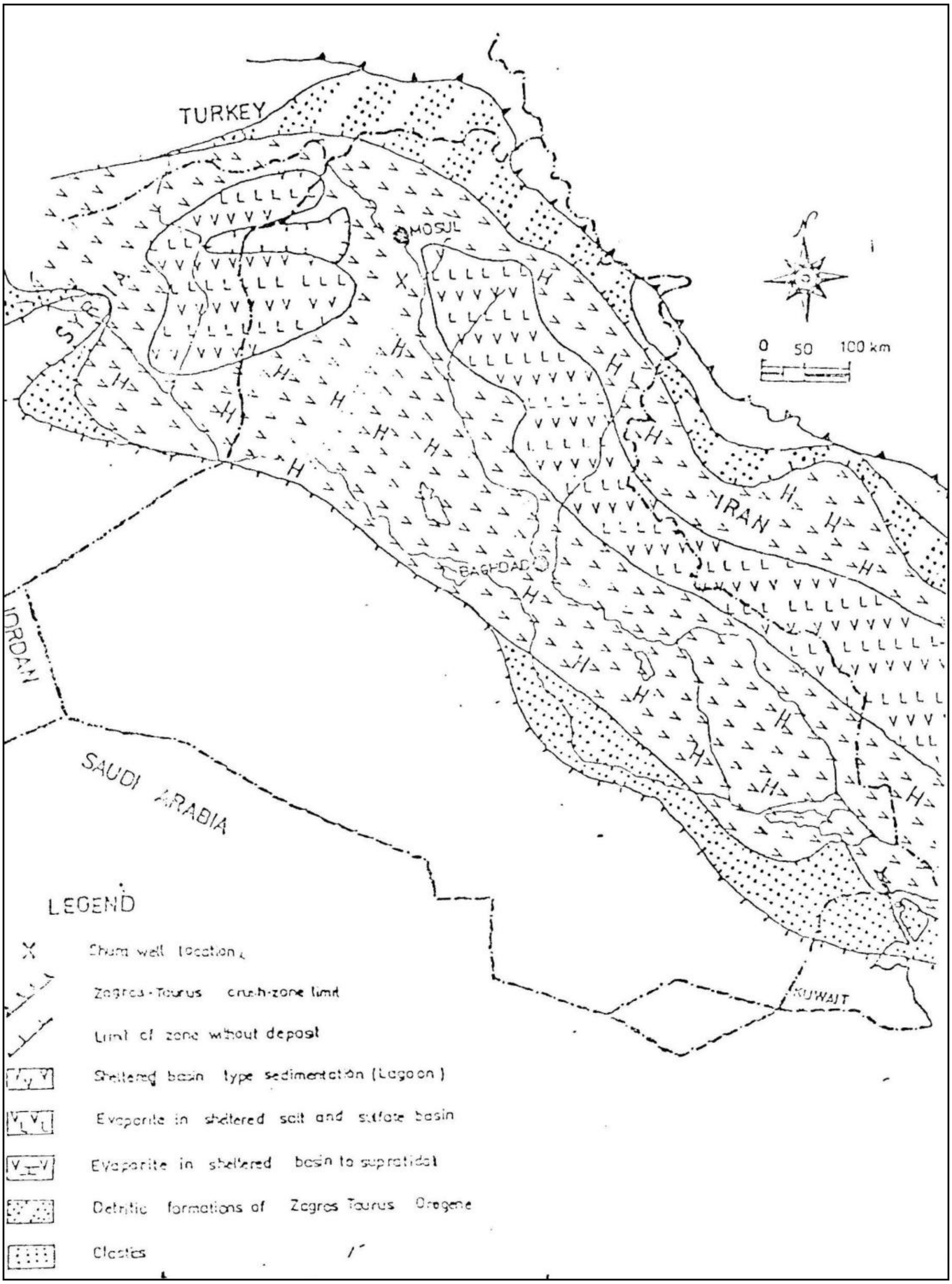



Fig.(3) Fat'ha lithofacies distribution (Middle Miocene) in Iraq (After Al-Mashhadani ,1984).

**Stratigraphy;**

The thickness of Dhiban Formation is variable within the ranges from 100 to 150 m. In average, thickness around 70 m is found Buday (1980). Depending on the stratigraphic relationships with other formations; the age of Dhiban Formation has been established as Early Miocene. In the type locality (Dhiban Village), Dhiban Formation overlies conformably Serikagni Formation and is unconformably overlain by Jeribe Formation. Dhiban Formation is characterized by its rhythmic alteration of gypsum, limestone and marl.

Regarding Fat'ha Formation, lithologically, this formation comprised rhythmic alteration of limestone, gypsum or anhydrite and green marls with rock salt in some areas. Mustafa (1980) has confirmed the nature of repetition in Fat'ha Formation using Markov chain statistical technique. The thickness of Fat'ha Formation is very variable; the formation is more than 900 m in a depocentre in Kirkuk basin and more than 600 m in a depocentre in the Sinjar basin (Jassim and Goff, 2006). The ratio of clastics to chemical sediments changes from place to another (Fig, 4), depends mainly on the location with respect to the depositional basin centre. For instance, gypsum forms about 50% of the total Fat'ha Formation sediments, in the central and slope part of the Rutbah Uplift. Buday (1980) illustrated that Fat'ha Formation laid down in semi-closed basin developed under semi-arid condition. It is disconformably underlain by Euphtrates/Jerbi Formations (Lower Miocene), and conformably overlain by Injana Formation (Upper Miocene).

Gypsum beds form the thickest horizons in the Fat'ha Formation, such horizons exhibit different types of textures and structures: Nodular, massive, and thinly bedded gypsum. The thick deposition of nodular-gypsum may represent the sediments of a very shallow, arid, semi restricted marine environment which has undergone " reflux" and "influx processes. These processes keep the salinity of basin in the field of sulphates precipitation. Therefore, more soluble evaporite minerals are not precipitated. At out crop, gypsum is mainly composed of the alabastrine types of Holliday, (1970) (Mustafa 1980, and Al-Marsoumi 1980). Owing to Shawkat and Tucker,( 1978) Sulphates of Fat'ha Formation is of alabstrine varieties of gypsum form as a replacement of anhydrite, due to the meteoric hydration.

Marl vary in colour from gray to green to shades of brown and red. They are often featureless, apparently structureless, fine-grained deposits, with variable carbonate contents (Shawket and Tucker, 1978). The grey marl is fractured with various degrees of fracturing, generally secondary gypsum fill the weakness planes such as bedding planes and fractures forming a network of veins selenite and satin-spar features (Mustafa, 1980).

Limestone forms about 10% of the total Fat'ha Formation thickness. This limestone also varies in thickness 0.1-4.0 m, and in colour; Gray, white, light brown (Al-bayati, 2007), some petroleum geologist used carbonate as a marker horizon in stratigraphic subdivision of Fat'ha Formation.

Fat'ha Formation sediments cover the marginal area of the stable shelf and almost the whole unstable shelf (Buday, 1980). On the stable shelf to the south and southwest of the Euphrates River i.e. on the slope of Rutbah Uplift Fat'ha Formation occurs as a narrow stripe only. To the north of the Euphrates River Fat'ha basin (the Jezira Basin) covered the whole stable shelf. The foothill and Mesopotamia zone are the main area of the formation's distribution. On the high folded zone Fat'ha Formation is missing or what is not yet fully proved-replaced by a clastic facies with some gypsum intercalations (Buday, 1980).

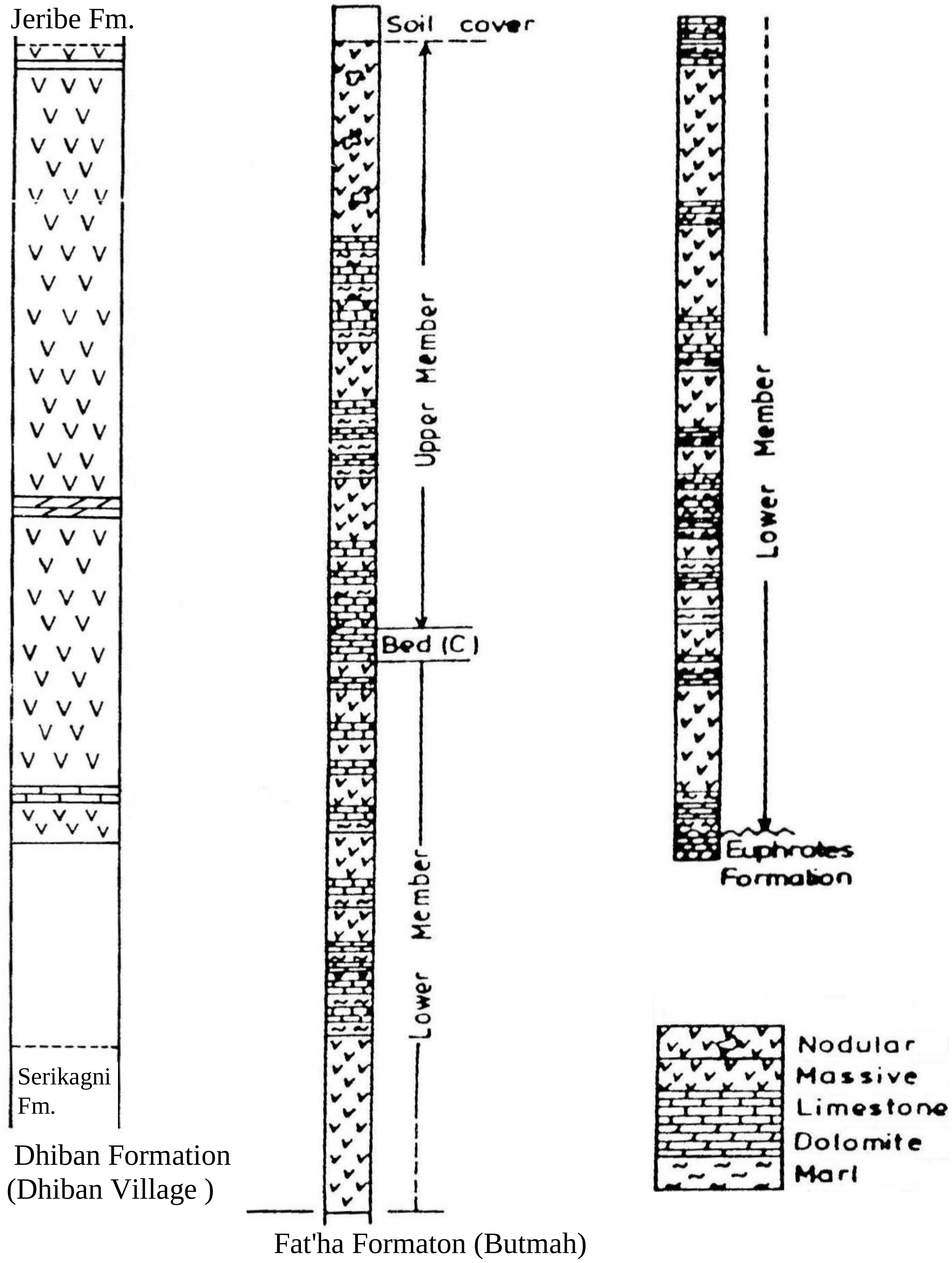



Fig.(4)Stratigrphic sections of Dhiban(After Abdul-Hammed,1983) and Fat'ha Formations. (After Al-Jubouri and Sulayman, 1996).

**Tectonic Setting:**

The area of Middle East is occupied by two main plates; Arabian and Iranian plates, the converging of these two plates lead to the clouser of New-Tethyes Ocean. The Arabian plate subducted beneath the Iranian plate brought about the initiation of early foreland basin (Fig,5). During the Lower Miocene period a shallow sea covered the area leading to the deposition of Jeribe, Serikagni/Euphrates, and Dhiban Formations in marginal basins. However, marine conditions became progressively more detached with plenty of lagoons that are occasionally replenished with sea water and gave rise to the cyclic deposition of the evaporites of Fat'ha Formation in the Middle Miocene (Numan, 1997). The gradual and contemporaneous movements of both Arabian and Iranian plates towards each other, forming "embryo" folds trending east-west. However, the lateral forces produced by the mutual lateral plate movements were translated into vertical block movements producing positive areas. Occasionally the elevated areas are distributed like islands within a flat depression called " Fat'ha Sea". it is believed that these movements resulted in creating many shallow basins or lagoons in which Fat'ha Formations was deposited. Tucker and Shawket (1980) believed that the absence of angular unconformities in the Tertiary sediments of Iraq (only disconformities and non-sequence are present) support the idea of vertical block movements and their role in creating the Fat'ha depositional basin.

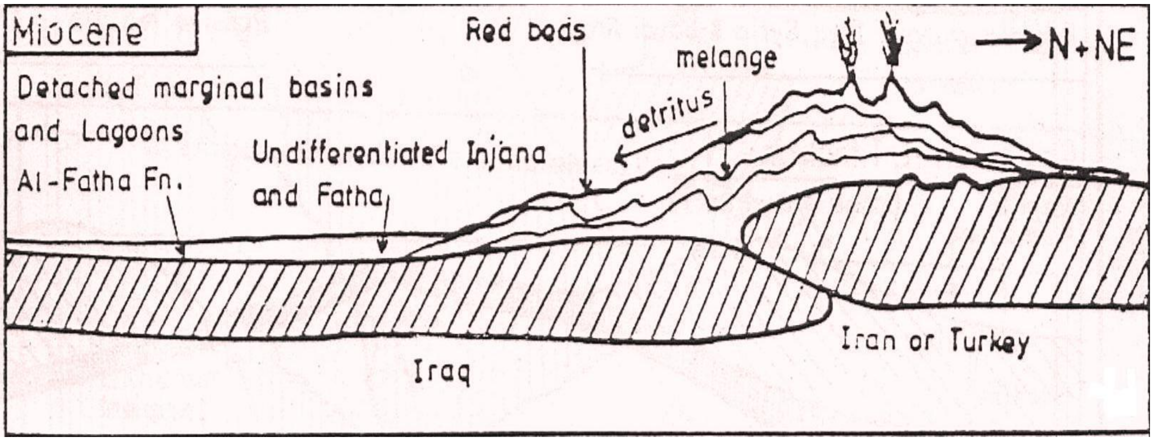



Fig.(5) The initiation of foreland basin during Miocene (After Numan, 1997).

**Regional Sedimentological Regime**;

Regarding Dhiban Formation, the depositional history of this formation could be summarized as follows; The probable depositional environment for the Dhiban Formation is shallow marine environment based on the " Bar Theory" with its modification. Buday (1980) believed that Dhiban Formation was deposited under lagoonal – evaporitic conditions, after the local movement closed the communication of the basin with the open sea. The basin of deposition is of the type "Basin center evaporite" (Abdul-Hameed, 1983). Owing to Buday (1980) the evaporitic sequence of Dhiban Formation is distributed in two local basins, separated by a narrow ridge area of the deposition of chemical limestone. The studied outcrops belong to the western basin which occupies the northwestern part of the former Khlesia uplift; the second basin roughly coincides with Makhul subzone to the southeast of the Tigris River. On the other hand, Jassim and Goff, (2006) stated that the Miocene sequence was deposited in a broad basin following a marine transgression during a phase of strong subsidence that overlapped the margin of the former Oligocene- Early Miocene basin, especially in NE Iraq. The main Fat'ha basin is elongated in a northwest-southeast direction, from northeast of Syria across Iraq to the southwest of Iran, a distance of about 1500 km with a maximum width of 300 km. This basin is fragmented into sub-basins: Kirkuk and Sinjar Basins. The Greater Zab River marked the boundary between them. Furthermore, Numan (1979 cited in Abdul-Hameed, 1983) demonstrated that Fat'ha Formation was deposited in both sub-basins, Kikuk sub-basin with its axis running parallel to Zagros Mountain Chain, and Sinjar sub-basin with its axis parallel to Torous Mountain Chain. Al-Hashimi (1979) suggested that the Fat'ha deposits may represent a major transgression from the Mediterranean Sea. This transgression was disrupted by repeated isolation of the basin. Prior to the end of the cyclic evaporites deposition, a clastic began to prograde into the basin from the northwest; these clastics eventually covered the whole evaporite basin leading to the deposition of Injana Foramtion( formerly Upper Fars F0rmation) ( Fig, 6)(Aqrawi *et al.*, 1989 cited in Sharland *et.al.*, 2001). Jassim and Goff, (2006) illustrated that Fat'ha Formation was deposited in rapidly subsiding sag basin which periodically became evaporitic with the formation of sabkhas and Salinas.

**Petrography**:

The petrographic study of Sheikh Ibrahim gypsum proved that gypsum rocks are of a secondary origin and are of two types; Alabstrine Secondary Gypsum (granular and fibrous), and Gypsum porphroblast. Based on the textural distribution, the surface sections of Sheikh Ibrahim and Fat'ha areas could be divided into three main parts, see table ( 1 ). The vertical distribution of gypsum texture in Sheikh Ibrahim and Fat'ha Areas is shown in Fig.( 7 ) and Fig.( 8 ). The mechanism of solution-precipitation is believed to be the main process of transformation of the pre-existing anhydrite on the surface or near it. The recrystallization process affected the gypsum rocks and caused the formation of large porphyroblast crystal from small ones (Plate, 1) (Al-Kufaishi and Al-Marsoumi, 1990). On the other hand, gypsum of Fat'ha Formation cropping out at Butmah area 60 km northwest of Mosul City (Fig, 1 ), exhibit the following types of gypsum; massive, nodular and selentic: The most common type is the massive gypsum as illustrated by Sulayman (1990), he also found that the most common textures are porphryblastic texture, and alabstrine secondary gypsum. Al-Baiaty (2007) found that gypsum beds form about 46% of the total thickness of Fat'ha Formation in Sheikh Ibrahim area. These gypsum rocks have different structures, the order of these structures owing to their abundance are; Nodular gypsum, massive gypsum, and fibrous gypsum. Whereas the texture of gypsum rocks at Sheikh Ibrahim area are porphyroblastic, and alabstrine texture. On the hand, Al-Kufaishi and Al-Marsoumi,(1990) proved that recrystallization processes which is documented in Fat'ha Evaporites attributed to the effect of stresses caused by the overburden load, whereas, the solution – precipitation is the most probable mechanism for the anhydrite-gypsum transformation.

Regarding the gypsum of Dhiban Formation, petrographic study proved that this gypsum is of a secondary origin derived from the hydration of the pre-existing anhydrite. This gypsum has two types of textures; porphyroblastic gypsum and alabstrine gypsum. There are also secondary celestite and relicts of anhydrite within this gypsum (Abdul-Hameed, 1983).

**Mineralogy;** Petrographic studies and X-ray analyses of gypsum($CaSO_4.2H_2O$) (Fig, 9, 10, and 11).proved that the examined gypsum rocks consist mainly of gypsum with minor amounts of dolomite $CaMg(CO_3)_2$, basinite ($CaSO_4.1/2H_2O$), clelstite($SrSO_4$), and anhydrite($CaSO_4$), and quartz ($SiO_2$) which represents the remnants of pre-existing anhydrite which altered to gypsum.. Celestite was detected only by X-ray technique (fig,10 ) due to its fine-grained and low percentage of occurrences. Anhydrite occurs as inclusions within large gypsum crystals (Sulayman, 1990) and represent relict of pre-existing anhydrite (Al-Kufaishi and Al-Marsoumi,1990). Bassanite mineral which represents the transitional phase during the hydration of anhydrite or dehydration of gypsum represented by bassanite ( Mossop and Shearman, 1973), this mineral was also detected especially in gypsum bed at shallow depth ( Fig,10 ). Traces of detrital impurities occurs as quartz mineral was detected (Fig,9 ).The scarcity and very fine grained of celestite, bassanite, dolomite, and quartz make them not observable in thin sections, but documented by X-ray techniques.

**Geochemistry:**

The geochemical study comprises the determination of the following major, minor and trace elements; Si, Al, Ti, Fe, MgO, CaO, Na, K, $SO_3$, $H_2O$, and Sr, (Table, 2 ). Generally speaking these components could be portioned between two fractions; chemical and clastics. The total amount of the major gypsum components; CaO, $SO_3$, and $H_2O$ range form about 98-99% of the studied gypsum rocks. This result is close to the ideal chemical composition of gypsum CaO 32.57%, $H_2O$ 20.93%, and $SO_3$ 46.50%, so we can came to conclude that analysed gypsum is of high purity. The remaining 1-2% rocks represent the other minor and trace components of $Fe_2O_3$, $Al_2O_3$, and $K_2O$ reflect the low amount of detrital impurities supply to the depositional basin. Based on Al-Jubouri and Sulayman (1996), the first component represents the evaporites mineral and second one represents detrital components.

The Mg concentration in sea water is 0.13% (Goldschmidt, 1958) , the concentration of Mg in evaporite rocks depends upon the salinity and the geographic position with respect to depositional basin (Braitsch,1971).This fact explains the high Mg concentrations and the fluctuation in Mg contents among the studied areas.

There are notable variation in Si, Al, Ti, Fe and K elements within gypsum rocks of different areas ( Table, 2 ), these variations are mostly attributed to the clay mineral contents. The field observations confirm the occurrences of clay and marls as thin film coating the gypsum nodules some times forming a net of anastomissing.

Regarding the alkali elements Na and K, their concentrations depend on the salinity of the depositional basin which in turn depends on the degree of evaporation. The fluctuation in Na concentration at a different area reflects the variation in salinity of depositional basin, which also could reflect isolation of the basin from the open sea.

The availability of strontium (Sr) in high concentration in evaporites is attributed to the salinity of their depositional environment. Generally speaking the Sr concentration in anhydrite is greater than gypsum (Al-Marsoumi, 1980), this phenomenon could be attributed to the possible replacement of Sr for Ca in the crystal structure of anhydrite which is more suitable to accommodate more Sr than gypsum crystal. Beside that and due to the hydration process in which anhydrite transformed to gypsum, some of the Sr in the original anhydrite structure will be expelled. The low concentration of Mn in the gypsum rocks may possibly be attributed either to its low concentration in a basin or due to the low amount of clay minerals, or both. Al-Marsoumi (1980) proved that Mn, Fe, and Mg can occur together as a solid solution within the gypsum crystal lattice, whereas the isomorphic substitution of Sr for Ca regulate the concentration of Sr in gypsum.

Most of the economic gypsum deposits in Iraq occur in the Fat'ha Formation, Mansour and Toma,(1977) mentioned by Al-Bassam cited in Jassim and Goff 2006, present a typical chemical analysis of gypsum rocks; $SO_3$ 43-46%, CaO 32-33%, $Fe_2O_3$+$Al_2O_3$ less than 0.1%, $H_2O^+$ 19-21 % and Insoluble Residue 1-2%. The chemical analysis shows that gypsum of Dhiban Formation (near Dhiban village) and Fat'ha Formation at sheikh Ibrahim areas is good for manufacturing building plaster (the Jus $CaSO_4$.1/2 H2O) (Al-Marsoumi, 1980, and Abdul-Hameed, 1983). Based on Iglesias *et al.*, 1999, the purity besides the very fine grained texture of some gypsum beds make them suitable to be used in cement fabrication as a retarding agent to control the hardening velocity of the cement.

Table (1) Textural contents in Sheikh Ibrahim and Fat'ha sections. (Al-Kufaishi and Al-Marsoumi, 1990)

| Section | Part | | Textural constituent (%) |
|---|---|---|---|
| Sheikh Ibrahim | Lower I | | Integrated gypsum 80%, unintegrated gypsum 10%, micritic 5%, and fibrous 5% |
| | Middle | II.A | Unintegrated gypsum 50%, integrated gypsum 40%, fibrous 5%, and micritic 5% |
| | | II.B | Integrated gypsum 60%, unintegrated gypsum 20%, porphyroblast 10%, micritic 5%, and porphyritic 5%. |
| | Upper III | | Coarse fibrous 50%, porphyroblast 45%, and unintegrated 5%. |
| Fat'ha | Lower I | | Micritic gypsum 60%, integrated gypsum 25%, unintegrated gypsum 10%, fine fibrous 5%. |
| | Middle | II.A | Unintegrated gypsum 65%, integrated gypsum 30%, and micritic 5%. |
| | | II.B | Integrated gypsum 60%, unintegrated gypsum 30%, porphyroblast 10%. |
| | Upper III | | Porphyroblast 70%, integrated gypsum 25%, and unintegrated gypsum 5%. |

Table (2) Average chemical composition of gypsum selected form different area of northern Iraq.

| Component | A | B | C1 | C2 | D1 | D2 | E |
|---|---|---|---|---|---|---|---|
| Si ppm | 606 | 720 | 2709 | 4362 | 2709 | 1961 | - |
| Al ppm | 236 | 44 | 211 | 284 | 343 | 372 | - |
| Ti ppm | 37 | 6 | - | - | - | - | - |
| Fe ppm | 385 | 56 | 154 | 196 | 227 | 269 | 690 |
| MgO % | 0.08 | 5146 | 0.034 | 0.078 | 0.21 | 0.067 | 0.46 |
| CaO % | 32.65 | 32.75 | 32.36 | 33.14 | 32.03 | 38.48 | 32.01 |
| Na ppm | 1315 | 143 | 408 | 267 | 59 | 266 | 0.148 |
| K ppm | 28 | 55 | 116 | 71 | 183 | 50 | 0.017 |
| $SO_3$ % | 46.49 | 56.79 | 46.13 | 47.19 | 46.47 | 53.85 | 45.93 |
| $H_2O^+$ % | 19.94 | | 19.36 | 17.37 | - | - | 19.75 |
| Sr ppm | 825 | 610 | 702 | 964 | 1015 | 795 | - |

A= Al-Jubouri and Sulayman (1996), West Butma.
B= Abdul-Hameed (1983), Dhiban Formation, Dhiban area, northwestern Iraq.
C1=Al-Aasams (1978), Khanaquin (Eastern Iraq) in Abdul-Hameed, (1983).
C2=Al-Aasam (1978), (Toz Khrmato).in Abdul-Hameed, (1983).
D1= Al-Bassam (1978) ( Dibs ) in Abdul-Hameed, (1983).
D2= Al-Bassam (1978) )(Makhmuor) in Abdul-Hameed, (1983).
E= Al-bayati (2007). Sheikh Ibrahim, Qand, and Ain Al-Safra area-Northern Iraq.

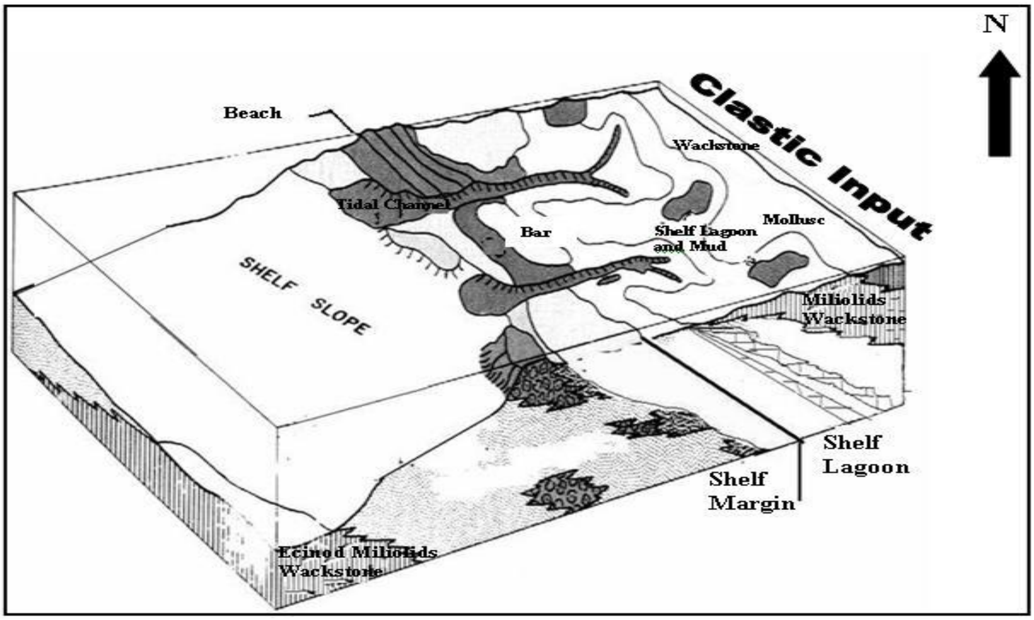
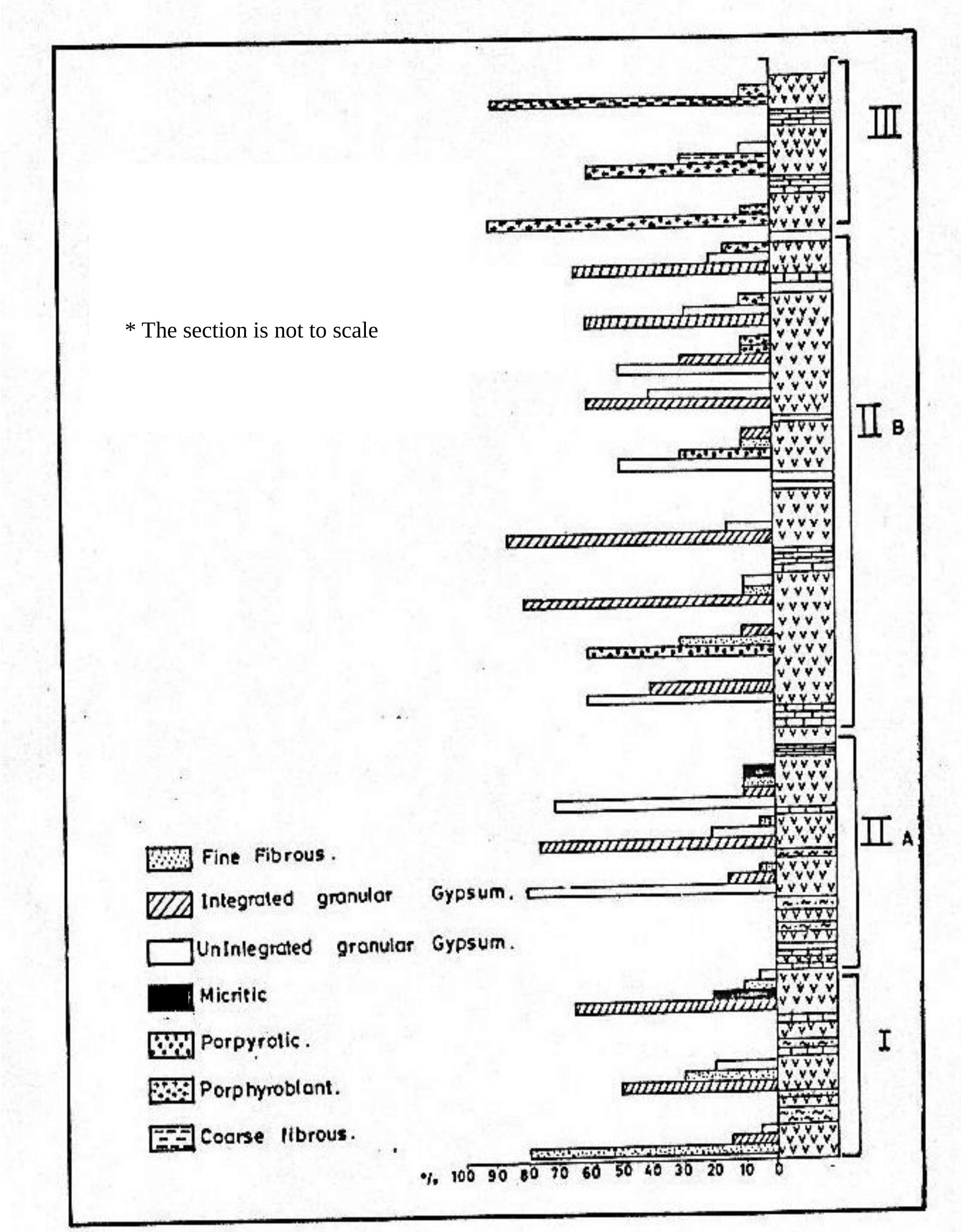
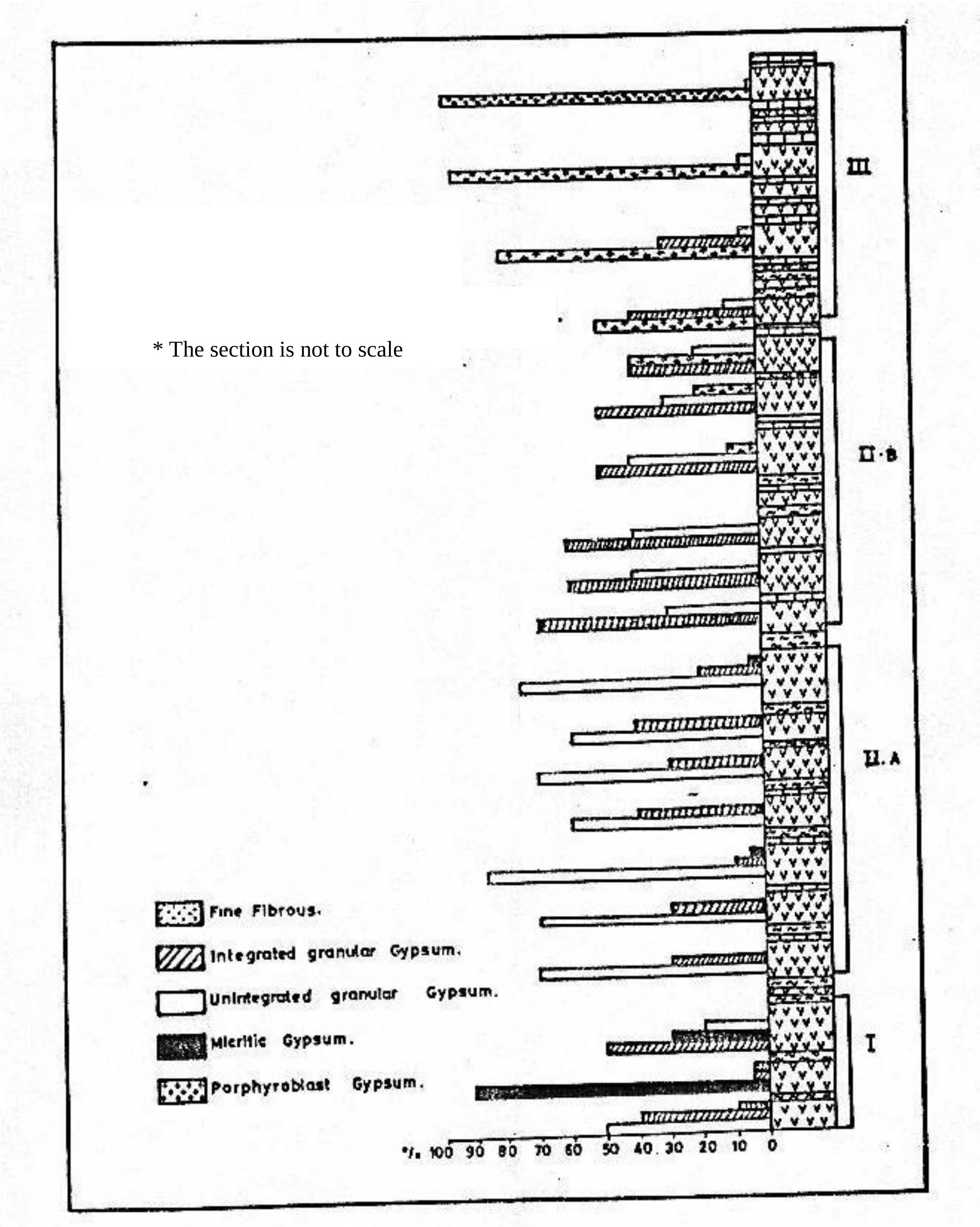



Fig.(6) Gelogical model for Fat'ha Formation (modified from Al-Asadi, 2003 in Al-Bayati,2007) .




Fig(7 ) Distribution of gypsum textures in Sheikh Ibrahim section (Al-Kufaishi and Al-Marsoumi, 1990)




Fig(8 ) Distribution of gypsum textures in Fat'ha section (Al-Kufaishi and Al-Marsoumi, 1990)

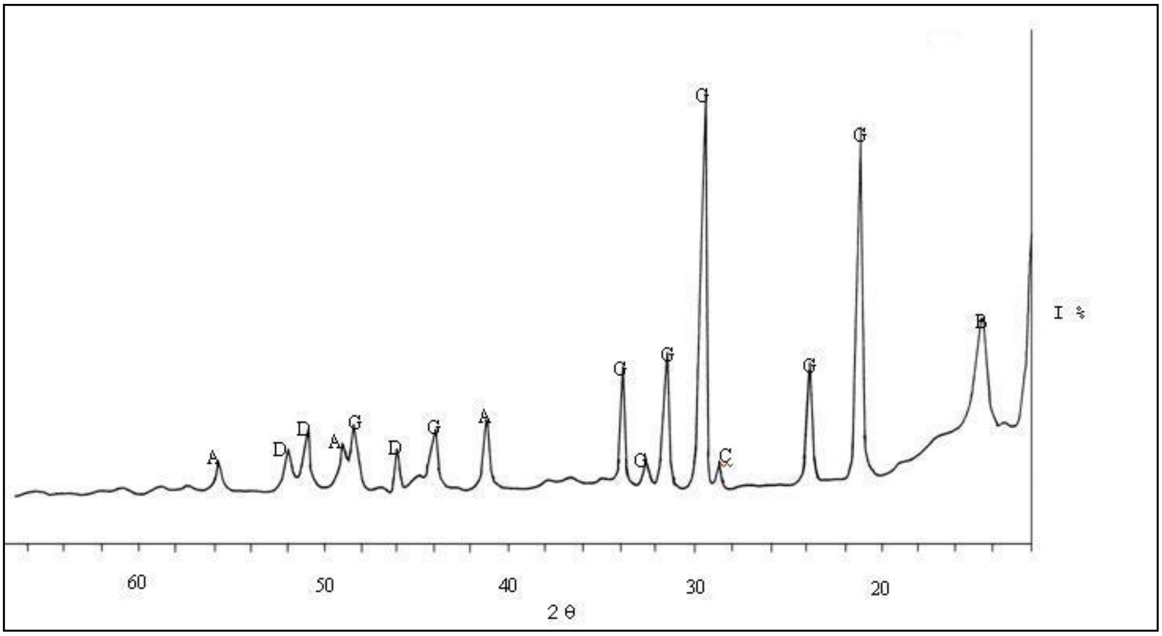



Fig.( 9 )X-ray diffraction pattern of gypsum – Sheikh Ibrahim area (Al – Baiaty, 2007)

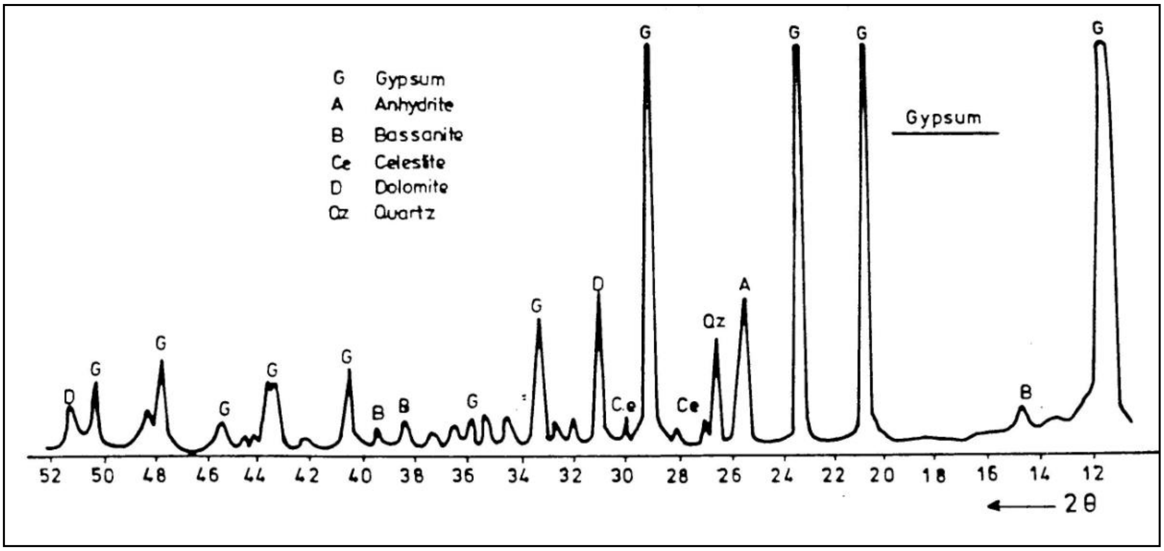



Fig.(10)X-ray diffraction pattern of gypsum – West Butmah area (Al – Jubouri and Al-Sulayman,1996)

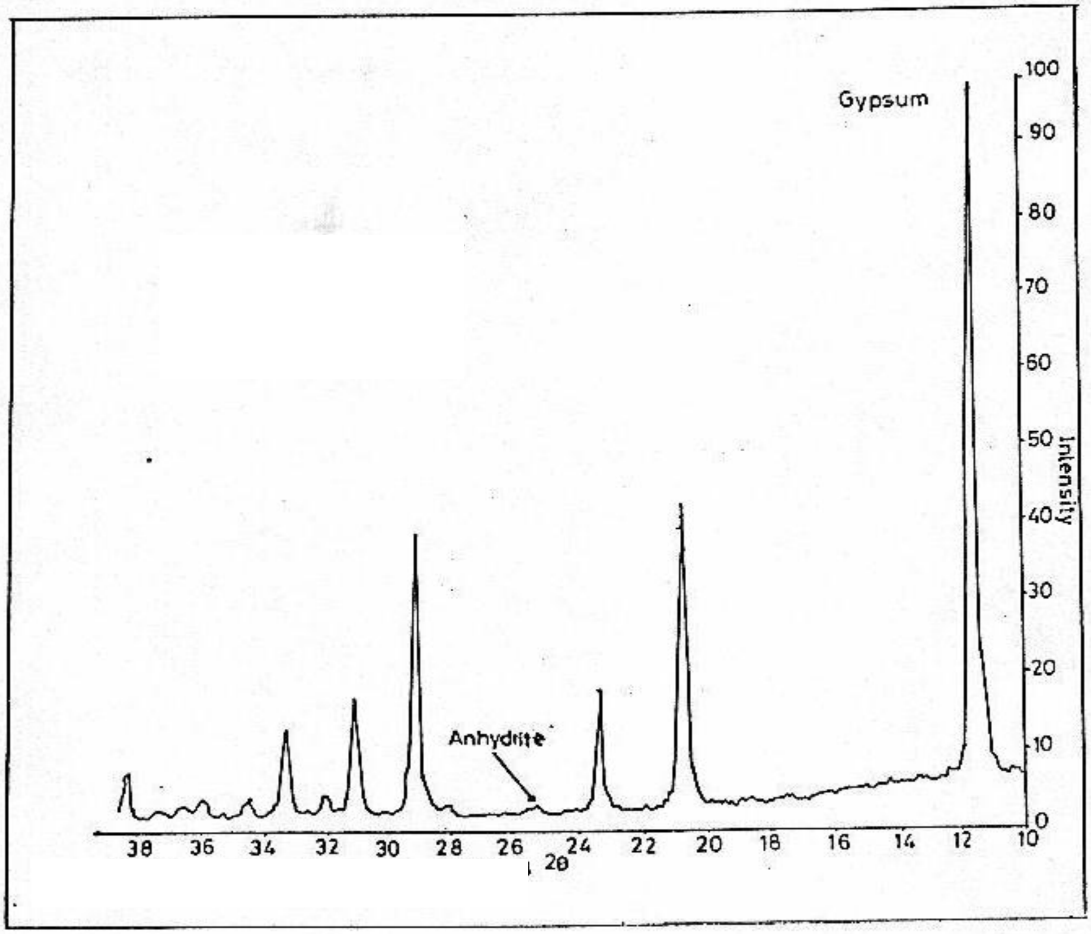
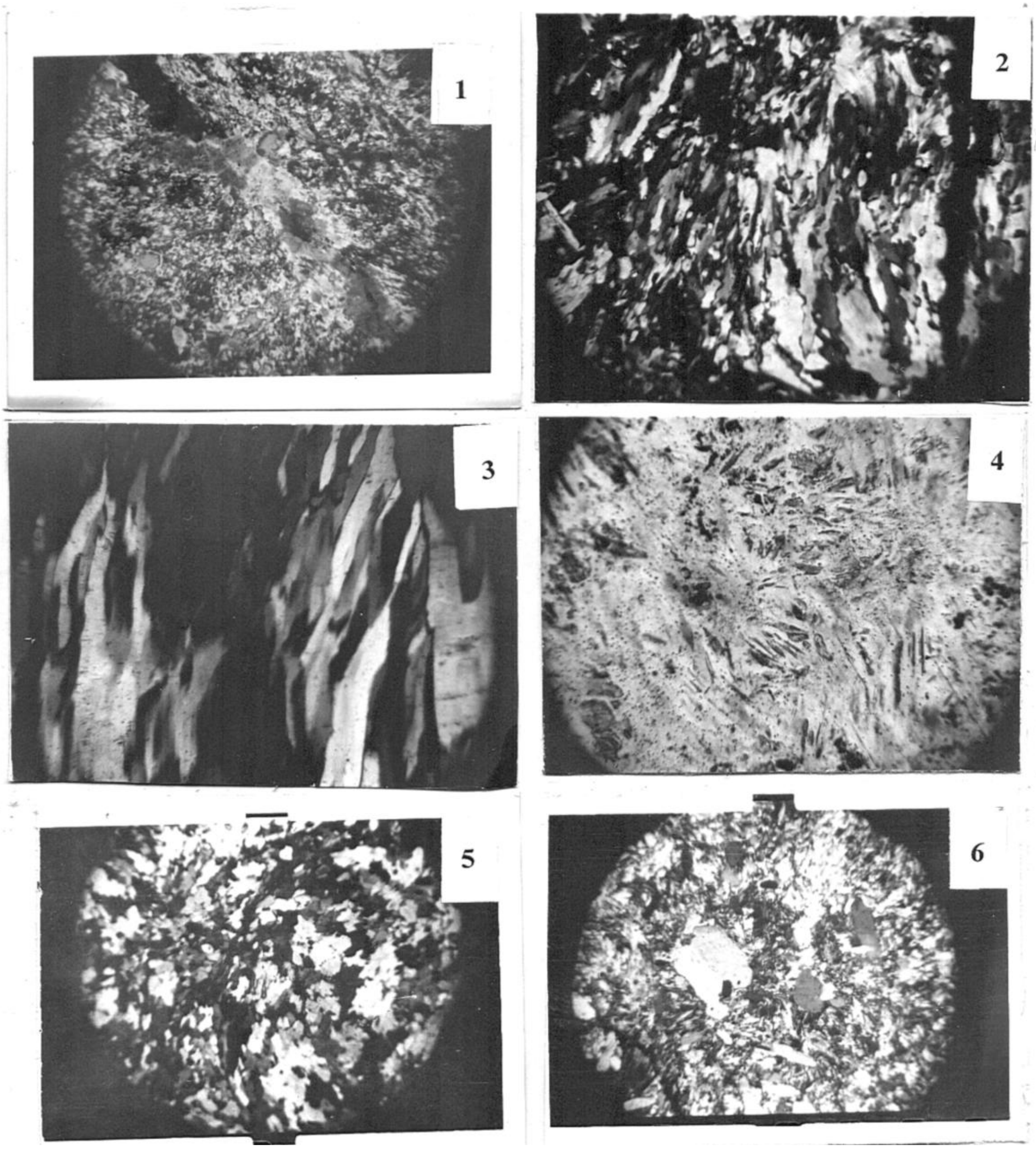



Fig.(11 )X-ray diffraction pattern of gypsum – Fat'ha area (Al-Kufaishi and Al-Marsoumi, 1990)

**Plate- I (**After Al-Marsoumi,1980**)**



1-Unintegrated and micritic gypsum, Fat'ha area 40X
2-Fine fibrous gypsum, Fat'ha area 60X.
3-Coarse fibrous gypsum, Sheikh Ibrahim area, 60X.
4-porphyroblast gypsum crystal with relicts of anhydrite, Sheikh Ibrahim, 60X.
5- Gypsum crystals showing early stage of integration, Fat'ha area, 40X.
6-Porphritic texture within ggypsum rocks, sheikh Ibrahim area, 40X.

**Conclusions**:

Evaporites sediments of the Miocene period represented by Dhiban and Fat'ha Formations northern Iraq are characterized by their cyclic sedimentological regime. Gypsum rocks form different percent of both Dhiban and Fataha Formations, this could be attributed to the variation in locations of outcrops with respect to the main depocentre of the basin; central and periphery part of the depositional basin, for instance gypsum occurs with high thickness in Sheikh Ibrahim area, this area represent the central part of the basin. Generally speaking Fat'ha Formation of Kikuk Basins posses a higher thickness than that of Sinjar Basin possibly due to high rate of subsidence of the former sub-basin. The thick gypsum deposits could reflect the aridity of paleoenvironment, and the strong subsidence of the depositional basin which provide the required space to accommodate the high sulphates deposits.

Owing to the textural evidence, the present gypsum rocks are of secondary origin derived from hydration of pre-existing anhydrite. Mineralogical and chemical results proved that Gypsum of Fat'ha and Dhiban Formations are of high purity. The absence of most soluble salt from evaporite deposits reflects that their basin of deposition may be subjected to pulses of fresh sea water keeping the salinity of basin water in the field of sulphates precipitation.

Geochemically, the composition of the present gypsum rocks could be portioned between two fractions; chemical (chemical precipitate mineral) and detrital fraction mineral incorporated within gypsum during compaction and diagenesis processes i.e. clay and marl. The ranges of the gypsum chemical components are match with that required for the production of building plaster as mentioned by Iraqi standard (I.S.O. No. 26/1969).

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# جيولوجية ترسبات جبس المايوسين في شمال العراق

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**المستخلص**

رسوبيات متبخرات عصر المايوسين في شمال العراق تتمثل أساسا بتكويني الذبان ( المايوسين الأسفل) و تكوين الفتحة ( المايوسين الأوسط). كلا التكوينين وجدا في المقاطع السحية و التحت سطحية. يتألف كلا التكوينين من دورات سحنية صخارية : الجس و الحجر الجيري و الطفل . التغير الايوستاتيكية في مستوى سطح البحر الى جانب الحركات العلوية للكتل الصخرية لصخور القاع لعبت دورا مميزا في نشؤ نظام الترسيب الدوري لرسوبيات عصر المايوسين من خلال الانفتاح والانغلاق للبحيرات الشاطئية و الأحواض البحيرية الضحلة الساحلية. كما إن وجود المناخ القاري ساهم في ترسيب المتبخرات. صخور الجبس عبارة عن صخور كتلية و عقدية و وسيلينايتية. أمكن تميز نوعين من النسيج الصخري لصخور الجبس هما الالباستيري و البورفيروبلاستي. جبس المايوسين هو جبس ثانوي الأصل تكون من تحول ألانهايدرايت. من وجهة النظر المعدنية تتكون صخور الجبس من معدن الجبس كمعدن أساسي مع كميات قليلة من ألانهايدرايت و الدولومايت و السلستايت و البسينايت كما سجل وجود المرو بكميات اثرية. الملوحة و المعادن الطينية و العمليات التحويرية تسيطر على توزيع العناصر الرئيسة و القليلة التركيز و الأثرية في صخور الجبس قيد الدراسة. سجل تشابه كبير بين صخور جبس عصري المايوسين الأسفل و الأوسط. اغلب الترسبات الاقتصادية للجبس متوافرة في تكوين الفتحة حيث تمتاز بنقاوتها العالية بدلالة قلة محتواها من الفضالة غير الذائبة وهي تعد صالحة لعدة أغراض صناعية.