SEDIMENTOLOGICAL , PETROGRAPHICAL AND CLAY MINERAIOGICAL STUDY OF THE GRAVEL AND CONGLOMERETE FACIES OF THE NORTHERN PART OF SAMARRA CITY ,IRAQ

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دراسة رسوبية وصخرية ومعدنية الاطيان الى سحنات الحصى والمدملكات في منطقة شمال مدينة سامراء،العراق

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الملخص:

ترسبات الحصى والمدملكات والترسبات المرافقة لهما في منطقة الدراسة ربما تمثل ترسبات بيئة مروحة نهرية.الدراسة الرسوبية بينت بان الترسبات تشتمل على ثلاث سحنات وهي :الحصى والمدملكات (سحنة Q1) والرمل والصخور الرملية (سحنة Q2) والجبكريت والطين المحتوي على الجبسوم والصخور الطينية المحتوية على الجبسوم (سحنة Q3) .هذه السحنات على الاغلب تمثل الجزء الوسطي لترسبات المروحة النهرية وانها نقلت على الارجح بواسطة الجريان التياري او المتدفق .

صخارية الحصى والمدملكات والرمل والصخور الرملية (الترسبات الخشنة) بينت بان القطع الصخرية الرسوبية تشكل الجزء الرئيسي لمكوناتها .الدراسة بينت ان اصل هذه الترسبات هو موضعي ومشتق من التكوينات المتكشفة في شمال وشمال شرق منطقة الدراسة.

المعادن الطينية التي تم تميزها فى الترسبات الناعمة تشمل المونتموريلونايت والكلورايت والكاولينايت والباليكورسكايت.معدن الباليكورسكايت استنتج بانه معدن موضعي الاصل اما بقية المعدن فانها فتاتية.

ABSTRACT

The gravels, conglomerates and the associated sediments in the studeid area, most probaly were deposited in an alluvial –fan environment . Sedimentologically, the sediments consist of three facies association: gravel and conglomerate(facies Q1),sand and sandstone

(facies Q2)and gypcrete, gypseous mud and gypseous mudstone (facies Q3).These Facies most likely represent a mid-fan deposits and their material had been transported to the fan by stream flow condition .

The petrography of gravels, sands and sandstones (The coarse sediments) reveal that the sedimentary rock fragments are the main constituents. The study indicates local origin of these sediments and had been derived from the older formations exposed in the north and northeast of the studied area .

The clay minerals of the fine grained sediments include: montmorillonite, chlorite, kaolonite and palygorskite. The palygorskite is considered as authogenic in origin whereas the other minerals are detrital.

INTRODUCTION

The sedimentological , petrographical and clay mineralogical study of the Pelistocene sediments was carried out in northern part of Samarra city and in particular in Baiji , AL – Mihzam and AL – Abbasiya localities (Fig.1) .No much published works were performed in the sediments of the studied areas;however , the available works are presented by (1 ,2, 3 , 4 and 5) . The Quaternary sediments in the studied areas are represented by Pleistocene gravel, conglomerate, gypcrete and gypseous claystone sediments and Holocene deposits as valley filling , flood deposits, sebkhas ,slope sediments and eolian sand dune and sand sheet sediments as indicated by (1and 2) . The exposed gravel body along the Tigris river between Baiji and Samarra cities was considered an alluvial fan likes sediments (3) .

The contact between Quaternary and Tertiary sediments was taken at the base of gravel or conglomerate units or at the base of gypseous mud and gypcrete units . The base of last gravelly sand or sandstone units which pass vertically into gravelly units or into gypceous mud and / or gypceous mudstone and gypcrete units was also taken as a contact in some of the studied boreholes and domestic pits .

The aim of the present paper is sedimentological, petrographic description and the clay mineralogy of the studied sediments. The collected data were based on the sediments from the domestic pits and boreholes drilled in the studied areas. The work is part of a project carried out by State Company of Geological Survey and Mining for engineering puposes and presented as a report deposited in its library (4)

DESCRIPTION OF THE SEDIMENTS

The Pleistocene sediments are composed mainly of gravel, slightly indurated conglomerate, sand, sandstone, gypcrete, gypseous mud and gypseous mudstone sediments.

The gravels and conglomerates are widly distributed and extended from AL-Fatha and Makhaul and Hemrin Mountains Ranges to the south of Samarra city along both sides of Tigris River.The gravels and conglomerates units are mostly gradually changed vertically to gravelly gypcrete or gypseous mud and gypseous mudstone then into gypcrete units . On the basis of the following criteria, the above sediments were considered as alluvail fan deposits.

1-Widely and laterally extensive distribution of the gravel and conglomerate sediments.

2-Vertically the gravel and conglomerate sediments are mainly changed gradually into gravelly gypcrete or gypseous mud and gypseous mudstonese then into gypcrete units without passing by any sandstone units which might indicate very rapid processes and wanning of the stream condition . However, sandstone units are, sometimes interrupted the gravel and conglomerate sediments

3-The gravel and conglomerate sediments are mostly of sandy matrix which might suggest very rapid processes also and typified the alluvial fan rather than any type of environment such as fluviatile channel fills.

4-The low percentages of sand and sandstone units interrupted the gravel and conglomerate units.

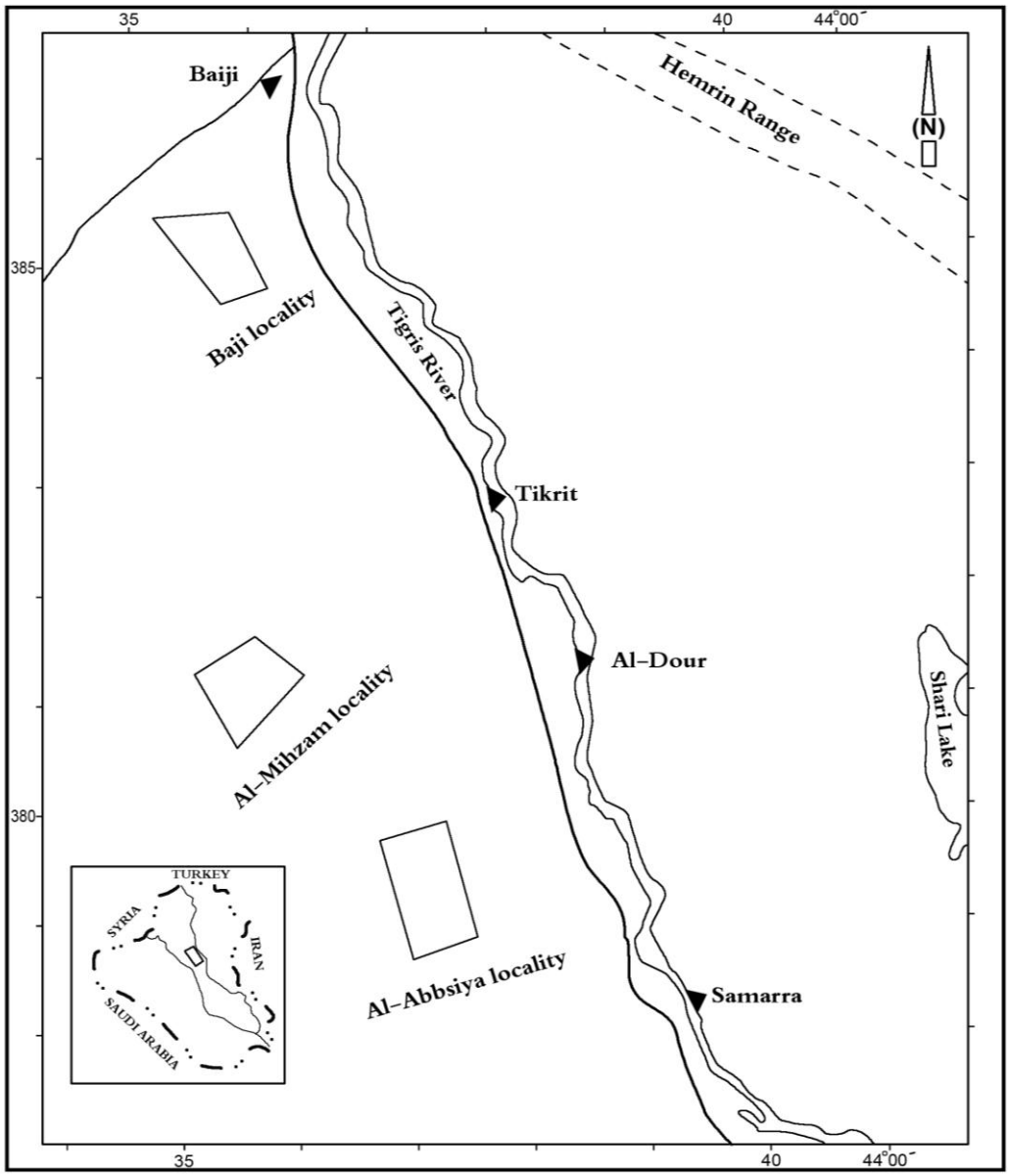


Fig.1.Location map of the studied area and localities (scale 1:500 000).

LEGEND

- Town
- Road
- River
- Locality
- Studied area

Lithologic Facies

Sedimentologically the studied sediments are subdivided into different lithologic facies(Fig.2). The subdivision was based on the field description from the studied domestic pits and boreholes drilled in the studied area . The percentages of the grain size were determine visually and also by comparison with prepared standard samples of different grain size . The recognized facies are :

1-Gravel and conglomerate Facies(Q1).

This facies is well developed in AL-Mihzam and AL-Abbasiya localities and it recognized only in the southern part of Baiji locality.It is composed of well stratified gravel units with subordinate conglomerate units and it ranges in thickness from 3.9 m.(Baiji locality) to13.4 m.(AL-Abbasiya locality). The gravels and slightly induraled conglomerate are mostly gypseous , laterally impersistance, consist of clasts less than 5 cm. in size,more rarely matrix support and classitied as fine gravels and fine conglomerates. Tabular cross- stratification are observed in some units and most of the units revealed an erosion-surfaces of amplitude reach up to 30 cm.The sediments of this facies are poorly sorted and with variable matrix content of muds and sands.Carefule field observation of gravel and conglomerate units enables the distinction of four types of sediments; muddy gravel or conglomerate, muddy sandy gravel or conglomerate, sandy muddy gravel or conglomerate and sandy muddy gravel or conglomerate

The stratified nature of the gravel and conglomerate units, the lateral impersistance, the erosive bases and the absence of boulders suggested that this facies represents a turbulent stream flow deposits of alluvial fan, by comparism to the sediments described by (6,7,8 9,10 and 11).

2-Sand and sandstone facies(Q2).

The sediments of this facies consist of units range in thickness from 30 cm. to 9.4 m.which are either massive or cross-bedded and in some places of erosional surfaces. They are mostly gypseous and contain sparce clasts, generally 1-3 cm in length .The sand and sandstone units of this facies are either interbedded with the gravel and conglomerate

units or pass directly into gravel and conglomerate units . However , sometimes the sand and sandstone units pass directly into gypseous mud and / or gypseous mudstone and gypcrete units when the gravel and conglomerate units are missing.

The association of this facies with the gravel and conglomerate facies(facies Q1), the missining of gravels and conglomerates as in the southern part of Baiji and the presence of cross-stratification , suggested a waning stage of stream flow as a site of environment . Moreover marginal subenvironment is suggested when the gravel and conglomerate facies are missing as in Baiji locality, similar to those described by (9 and 12).

3-Gypcrete , gypseous mud and gypseous mudstone facies (facies Q3).

These sediments are massive and of gradual nature with the underlying gravel and conglomerate facies or with the sand and sandstone facies. It is grey in colour and ranging in thickness from about 2 m.to 4 m.In the gypcrete units the gypsum content is more than 50 % . Siltstone sediments as thin units are sometimes present.

The grey in colour , the massive nature and the gradual change of this facies to the underlying facies, suggested that its sediments is represented deposition formed during

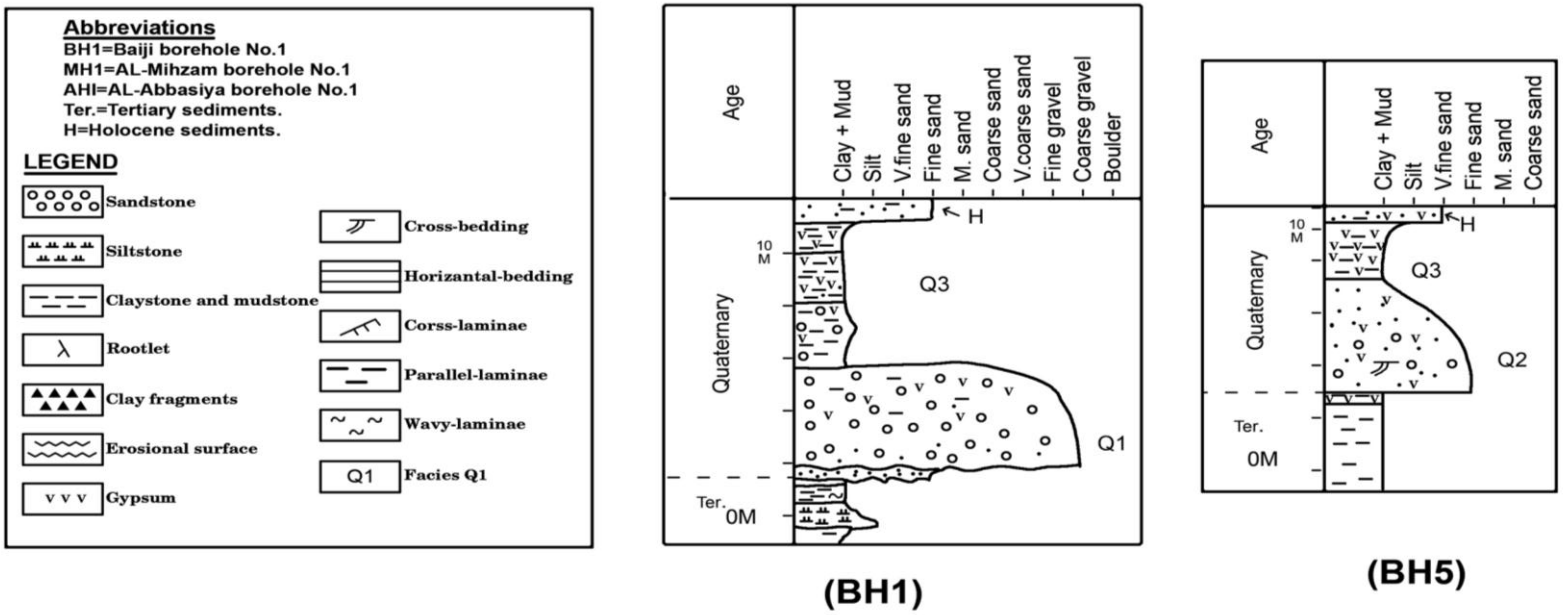
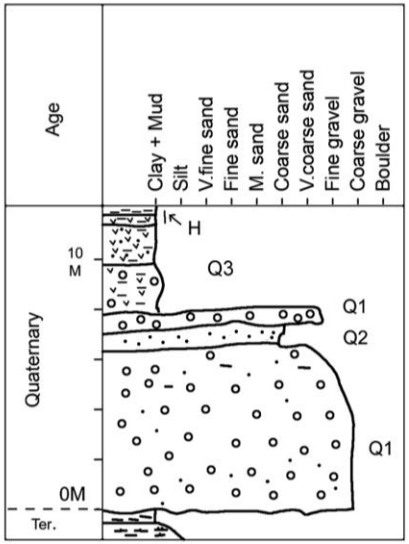
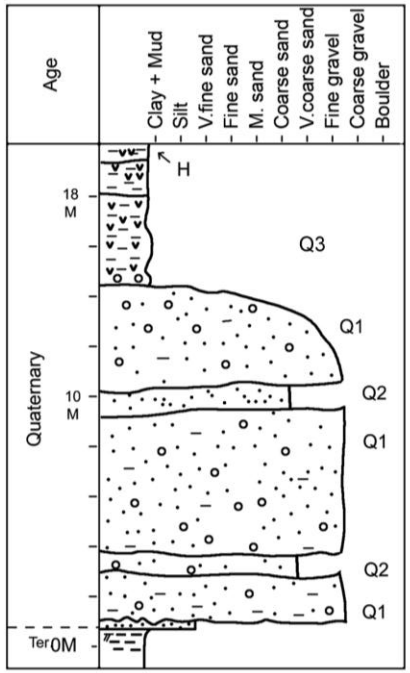


Fig.2. Graphical logs to show representitave facies in the Quaternary sediments. The collected data were based on the boreholes and the nearby excavated and domestic pits.



(MH1)



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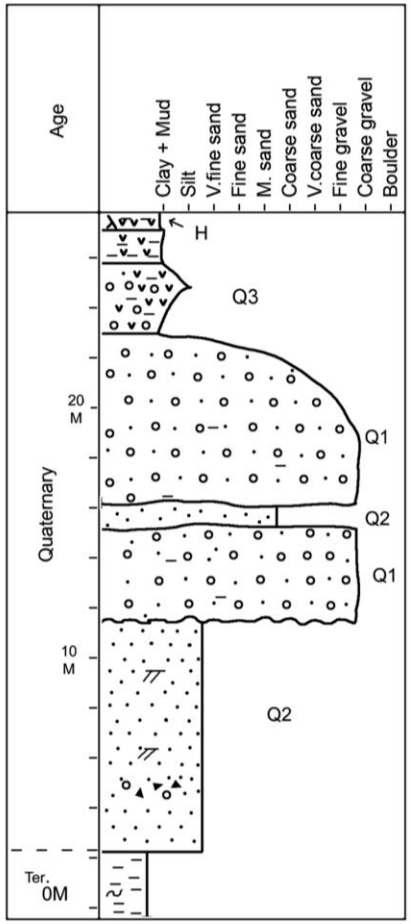

(AH3)

Fig.2. Continued ....

the waning stage of stream flow condition, after the deposition of gravel and conglomerate facies(facies Q1)or the sand and sandstone facies(faciesQ2).

Petrography

The petrography of gravel, sand , sandstone, gypcrete , gypseous mud and gypseous mudstone sediments were carried out in the studied area. The studied samples were mostly collected from five domestic pits in each locality and five samples were taken from each pit. Moreover,some mud, mudstone, sand and sandstone samples were collected from the boreholes also.

Gravels

19 samples of gravel were studied petrographically from Baiji, AL-Mihzam and AL-Abbasiya localities. About 250 gravels of size interval between 4 – 64 mm. were chosen in each sample .The petrographic study was carried out visually and also by polarized microscope from thin sections for some unidentified gravels . The gravels are classified as polymictic (13) and the recognized types are chert, terrigenous , carbonate, quartz fragmert ,metamorphic and igneous gravel (Table 1) .The chert ranges from 51.2% to 61.7% in percentage and have a variety of colour which indicates a multisource in origin. Some of the chert fragments are radiolarian. The terrigenous fragments consist of sandstones (quartzarenite with subordinate litharenite types), siltstones and claystones as indicated in the thin sections of some gravels .

The high percentages of sedimentary gravels (74.3% to 82.4%) suggested that the source area was mainly of sedimentary origin. Moreover, the presence of carbonate, claystone, siltstone and sandstone of litharenite fragments indicate very short distance of transportation

Sands and sandstones

The petrographic study of 30 sand and sandstone samples was carried out and the average percentages of each mineral obtained by point counter of about 300 graines from each thin section is presented in table 2. The main constituents of the sands and sandstones are quartz and rock fragments . They hand been classified as litharenites (14). The sands and sandstones in all of the studied area , are immature, poorly

sorted and mostly clayey.They are composed essentially of sedimentary rock fragments followed by quartz and then by metamorphic and igneous rock fragments .The sedimentary rock fragments are composed mainly of carbonate , then followed by chert , argillaceous and sandstone grains . In the sandstones, these components are cemented by carbonate , ironoxid and gypsum.

Fine grained sediments

These sediments are forming gypcrete, gypseous mud, gypseous mudstone and siltstones units . The gypcrete units contain more than 50% gypsum with subordinate clay minerals, calcite and quartz.The gypseous mud and gypseous mudstone units contain mainly of clay minerals with subordinates calcite , quartz and less than 10% gypsum .

Semiquantitative analysis of clays was carried out by crushing 10 gram of the samples and adding 25% of acitic acid to dissolve the carbonates. The samples then dried and weighted to determine the weight of the clay minerals. Oriented samples were made by using Gipson method (15) and analysed by XRD using Cu and K radiator. The clay minerals were identified and calculated by the method described by(16) and classify according to the classification presented by (17). The identified clay minerals are, montmorillonite, chlorite, kaolinite and palygorskite (Table 3).

Discussion and conclusion

The sediments of the studied area are considered as deposits of alluvial fan environment. This suggestion is achieved by the laterally extensive gravel and conglomerate sediments accumulation typified the alluvial fan rather than river deposits. Alluvial fans environments are common in Iraq during the Quaternary period. Alluvial fans sediments were reported during the Quaternary period from the northern and northeastern part of Iraq(18 and 19).

In the studied sediments, the predominancy of stratified gravel and conglomerate facies and the absence of boulders revealed that facies Q1,Q2 and Q3 are possibly represented midfan part in the alluvial fan sediments. In Baiji locality a lateral part or marginal of the midfan could be suggested on the basis of the absence of gravel and conglomerate facies (which are only recognized in the south and east of Baiji locality) and on the high proportion of sand and sandstone sediments. It is

suggested that in some areas of the lateral part or marginal of the midfan, no gravel sediments were accumulated and instead only sands and muds were deposited (facies Q2 andQ3).

The petrographic study shows that the gravels are composed mainly of sedimentary fragments and represented by chert , mudstone, sandstone and carbonate fragments.Based on the presence of the terrigenous (mudstones and sandstones of litharenite type) and carbonate fragments, these sediments interpreted to be derived and transported locally from Fatha, Injana and Mukdadiya Formations which are exposed in Makhual and Hemrin Mountains Ranges at the north and northeast of the studied area . Measurments of some available cross-bedding in the conglomerates and sandstones indicate northeast direction. The gravels of Mukhdadya formation in the southern part of Hemrin Range are composed of chert, carbonate , sandstone, igneous, metamorphic and quartz fragments as indicated by (20 and 21).

The sands and sandstones of the studied sediments are almost similar in composition to the sediments of Injana and Mukdadiya Formations in the studied area (4) and also to the same formations exposed at the southeast and northeast of the area(1 and 20). They differ only by the presence of gypsum grains and by relatively high percentages of sandstone rock fragments of litharenite type.Based on these petrographic results , the studied sediments are considered to be derived and transported locally (similar to the gravels) from Fatha , Injana and Mukdadyia Formations which are exposed at the north and northeast of the studied area.

The studied fine grained sediments are composed of clay minerals, gypsum, calcite and quartz.The recognized type of clay minerals are kaolinite, chlorite , montmorillonite and palygorskite (Table 3). The presence of kaolinite, chlorite and montmorillonite and the absence of palygorskite in the underlying Tertiary sediments were reported by (4) which they considered the kaolinite, chlorite and montmorillonite as detrital minerals .Therefore , the kaolinite , chlorite and montmorillonite are interpreted detrital in origin, as they are present in the studied Pleistocene sediments and the underlying Tertiary fluviatile claystone, mudstone, and sandstone sediments.

The palygorskite is considered as authogenic in origin .This interpretation is based on the absence of palygorskite in the underlying Tertiary sediments of the area (4) , on its connection with evaporite

secondary mineral (gypsum) and on the presence of calcite mineral .It is expected that during the evaporation processes the Mg++ will increased and consequently palygorskite was deposited due to deposition of evaporite mineral (e.g .gypsum). The palygorskite was considered as authogenic mineral formed by the increases of Mg++ due to evaporation in arid and sedimarid climate in the Holocene sediments of Babylon Distrtict in Iraq(22). Moreover,in the calcrete of arid and semiarid condition ,calcite deposited and consequently Mg / Ca ratio increased and the palygorskite is deposited as indicated by (23).

The mechanism of gypsum formation in gypcret and other gypseous units is similar to the processes in sabkha envirorment which were described in Arabian Gulf by (24and 25) . The type of climate and the geology of the surrounding area are the main factors for the deposition of evaporites .In the studied area, the climate is arid and Fatha Formation of alternated carbonate, marl and gypsum units is exposed at Makhaul and Hemrin Mountain Ranges at the N and NE boundaries of the area.Moreover , the gypcrete and gypseous units occur as continous lithified units , mainly in the places where the lowermost gravel units are present .

It is suggested that in the studied sediments the deposition of soluble salts is dependent on the ground water salinity which is expected to be recharged laterally from Makhaul and Hemrin Ranges and also might dependent on other factors such as sediments texture
(highly permeable gravels) and the shallower depth of the groundwater . The major processes for the formation of the gypsum is that of brine migration from the groundwater upward in the sediments similar to the processes described by (26 and 27) . The migration of brine is to replace those lost by evaporation in such arid climate and consequestly gypsum was deposited by capillary concentration in the gypcrete and in gypseous mud and gypseous mudstone units.

Table (2) The average percentages of the constituents in the sandstones of the studied area.

Constituents / Locality	Quartz	Feldspar	Sedimentary Rock Fragments	Igneous Rock Fragments	Metamorphic Rock Fragments	Heavy Mineral	Cement and Matrix	Unidentified
Baiji	28.1	5.8	45.3	1.5	1.4	2.4	13.2	2.1
Al-Mihzam	31.5	4.4	37.4	0.8	8.3	2.3	13.6	1.2
Al-Abbasiya	30.6	6.1	39.1	1.3	1.3	3	18.5	---

Table (3) The percentages of clay minerals in the studied area.
(Mont. = Montmorillonite, Paly. = Palygorskite)

Locality	Sample Number	Mont.	Chlorite	Paly.	Kaolinite	Total	Rock Name
Baiji	1	8	8	26	---	42	Gypcrete
	2	---	3	8	---	11	Gypseous Mudstone
	3	7	---	5	1	13	Gypseous Sand
	4	7	3	5	<1	12	Gypcrete
	5	6	---	4	<1	13	Gypseous Sand
Al-Mihzam	1	---	---	8	---	8	Gypcrete
	2	---	2	14	2	18	Gypcrete
	3	---	1	4	1	6	Gravelly Gypcrete
Al-Abbasiya	1	---	---	8	---	8	Gypcrete
	2	34	---	7	---	41	Gravelly Gypcrete

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