

**Origin and Mineralogy of Construction Materials  
of Gravel and Sand in Tikrit Area**

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**ABSTRACT**

Gravel and sand deposits forming thick layers of immature sediments represent terraces around the banks of Tigris river which were deposited during the Quaternary time. The gravel are mostly formed of carbonate with percentage (37-41.5)%, sandstone (14-17)%, quartz and chert (22 - 33)%, igneous (7-8)% and metamorphic (6-8)%. The origin of these gravels are mostly derived from the older rocks such as Fatha, Injana and Mugdadia Formations. The shape of the gravel are different according to origin and composition.

These deposits mostly immature and forming alluvial thick deposits bodies characterized by many types of sedimentary structures such as cross bedding, trough bedding and channel fillings. The matrix materials forming about 40% of the gravel bodies and formed of particles of coarse sand, gypsiferous particles and silt and clay, which give the immature nature to the gravel bodies. The sand bodies are mostly forming lenses and Tongues bodies which rich in particles of carbonate and fragments of gypsum.

The degree of roundness of the gravel are mostly moderate to well round.

### **Introduction:**

The stratigraphical and sedimentological studies of the Quaternary were mostly neglected in detailed studies of Iraqi geology. Quaternary sediments cover more than one third of the surface area of Iraq. Mostly within the Mesopotamian plain where they comprise fluvial, lacustrine, deltaic and aeolian sediments.(Al-Shammari and Yehya,1993). Outside the Mesopotamian plain a Quaternary sediments of polygenetic origin covers large area in synclines of the foothill zone. Terraces of Euphrates and Tigris and their tributaries are present along river courses generally in narrow belts that usually do not extend more than two kilometers on either side of the rivers, occasionally expanding to cover over (10) km (Baziang and Karim,2007). Aeolian deposits are restricted to three belts associated with the Mesopotamian zone.( Jassim,1981, Jassim and Goeff,2006)

The Quaternary sediment in north and middle Iraq consider the main aquifer for shallow ground water. Also the clay of Mesopotamian are also important for both agriculture and the brick building industry.

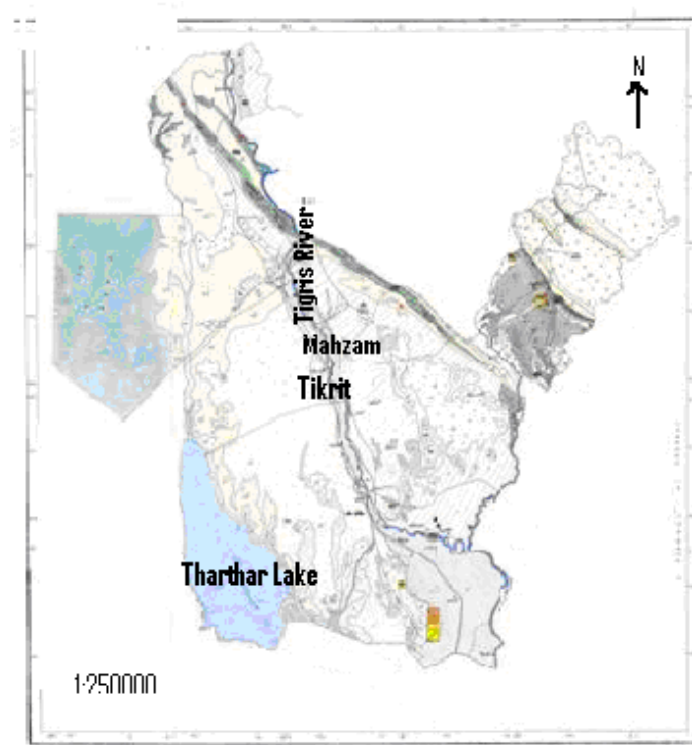
In the present studied area, most of quarries of gravels and sand are of Quaternary deposits which consider the main source of construction materials. The Quaternary deposits comprised of Pleistocene and recent deposits. These deposits include alluvial deposits which consist of a mixture of gravel, sand, silt, clay and conglomerates derived of the post Pliocene deposits (Hamza et al.,1989).

The sedimentology and mineralogy of Quaternary sediment have been studied by (Kadem et al.,2010) they pointed out that the thickness of Quaternary sediment on the east bank of Tigris river

between (25-35)m. and they indicated that the gravel with different shapes and composed mainly of sedimentary composition (75%), metamorphic (18%) and igneous (7%) , also they mentioned that the sediment deposited in river fluvial environment.

Al-Samaray,2005 studied the gravel deposits in the channel of Tigris river between Baiji and Balad and he found a change in the shape of the gravel..

Two locations have been selected on the banks of Tigris river, one north of Tikrit city in Mahzam area and the other located at Tikrit city Figure (1).



**Fig.(1): Sallahadin's map illustrates the study area**

**Aim of the study:**

The present study aims to throw light on origin and nature of the Quaternary sediment and as follows:

1. Sedimentological and mineralogical aspect of Quaternary gravel and matrix criteria .
2. Texture analysis of the deposits .
3. Study of the sorting degree and maturity of the sediments.
4. Study the nature of the matrix within the gravel layers.

**Field study and materials:**

The field study include the following:

1. Selection of two sections of the Quaternary sediments from the cutting banks of the Tigris river in Tikrit city and in Mahzam area north Tikrit.
2. Collection of gravel samples for shape analysis and mineralogical studies.
3. Collection of representative samples from sandy gravel layers and sand and clay layers within the deposits.
4. **Previous studies:**

Most of the Pleistocene studied sediment sections located around the Tigris river valley. Four Pleistocene terraces were described by (Jassim and Goeff ,2006) at elevation of 95m, 35m, 20m and 12m above the present river level and correlated the gravel fans between Baiji and Baghdad with the highest and oldest of the terraces.

Saadallah and Jassim, 1972 in (Jassim and Goeff,2006) studied the sedimentological and mineralogical aspect of gravels of Mugdadia

Fm. and Quaternary river terraces in Samara-Tikrit-Baiji areas and concluded a difference in the mineralogical and sedimentological aspects .

Hassan and Jawadi,1976 indicated that the Quaternary sediment cover more than 90% of the area between Samara and Baiji.

Jassim ,1981 pointed out that the Quaternary sediments deposited as river terraces and indicate the distribution and the composition of some of these terraces .

The river terraces on the banks of the Tigris river with maximum thickness about (30m) and contains many sedimentary structures such as cross bedding ,trough bedding and ripple marks and the nature of the sediment indicate that deposited in alluvial fans flood plain environments ,also the sediment derived from the older formations such as Mugdadia, Injana and Fatha. (Kadim et al, 2010).

#### **Shape analysis of gravels:**

Dimension of (500) gravels for shape analysis have been selected from the studied sites with size (2-64mm)(-1.0 to -6.0 Ø) Table -1-

**Table(1): particles shape and the percentage of each type.**

| Gravel shape        | C   | CP | CB   | CE  | P  | B  | E  | VP  | VB | VE |
|---------------------|-----|----|------|-----|----|----|----|-----|----|----|
| Percentage (Tikrit) | 7.8 | 5  | 11.2 | 4.2 | 16 | 18 | 10 | 4.8 | 16 | 7  |
| Percentage (Mahzam) | 9.8 | 3  | 10.5 | 5   | 12 | 22 | 7  | 10  | 9  | 11 |

C:compact, CP:compact platy, CB: compact Bladed, CE: compact elongated, P: platy, B:bladed, E: elongated , VP: very platy, VB: very bladed, VE: very elongated.

### **Petrographical and Mineralogical Composition of gravel :**

Four hundred samples of gravel have been collected from the Quaternary gravel from the two studied sections .The Petrographical and Mineralogical Composition of gravel help in the study of resources rocks and in determination the distance of transportation of the sediment from the source to the basin of deposition .(Folk,1974)

The gravel mostly composts of carbonate ,chert and quartz ,sandstone ,igneous and metamorphic.Table-2-.

**Table(2): Mineralogical composition of gravel .**

| Mineral Type        | Carbonate | Chert & quartz | Sandstone | Igneous | Metamorphic | Others |
|---------------------|-----------|----------------|-----------|---------|-------------|--------|
| Percentage (Tikrit) | 41.5      | 22             | 17        | 7       | 6           | 6      |
| Percentage (Mahza)  | 37        | 33             | 14        | 8       | 8           | 0      |

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It is found that the carbonate gravel forming the high percentage of the mineral composition in both sections, also the limestone gravel are of different types such as dolomite, chalky limestone and calcite, which indicate different sources of limestone derived from the older carbonate formations. The chert and quartz gravels are more abundance in Mahzam section than in Tikrit section and mostly with dark colors and well rounded. The source rocks of chert and quartz are mostly derived from the older formations such as Mugdadia and Bi-Hassan. The sandy gravels formed of different sizes of sand particles and the cementing material are mostly carbonate .In addition to the sandstone gravel some gravels composed of siltstone and claystone. The igneous and metamorphic gravels also present in the Quaternary gravel with less percentage and mostly derived from the older detrital formations such as Fatha and Injana.

### **Sand and sandstone petrography**

Six samples of sand and sandstones have been examined for petrographic constitute , the main minerals are : quartz, rock fragments and rare feldspare.(Table-3-). Sandstone classified as litharenite (Pettijohn et al.1972) The sandstone is immature and rich in clay and silt particles. The rock fragments mostly of sedimentary type and in low percentage igneous and metamorphic fragments. The cementing material mostly of carbonate ,also iron oxide cement present .



Table -3- Mineral constitutes of sand and sandstone.

| Mineral Type        | Quartz | Feldspar | Sedimentary Fragments | Igneous Fragments | Metamorphic fragments | Others |
|---------------------|--------|----------|-----------------------|-------------------|-----------------------|--------|
| Percentage (Tikrit) | 36     | 4.5      | 41.5                  | 4.5               | 5.5                   | 18     |
| Percentage (Mahzam) | 32     | 3        | 44.5                  | 6.5               | 4.5                   | 9.5    |

### Clay minerals:

Two samples of clay layers have been examined by XRD with different treatment (untreated, ethylene glycol, heating 550 C ) (figure 2). The recognized minerals : montmorillonite, palygorskite, illite and kaolinite in addition to calcite and quartz. The montmorillonite mostly formed by degradation of micas during weathering (Kadem,1990). The high percentage of illite in clays may be related to high consternation of mica of source rocks.( Macchi,1987, Stevens et al.1987).

Kaolinite is product of weathering and soil formation under strong acid leaching conditions (Wilson et al. 1984).

Palygorskite are mostly formed by transformation of other clay minerals such as smectite under certain conditions (Tamar-Aga and Al-Janabi, 2000).

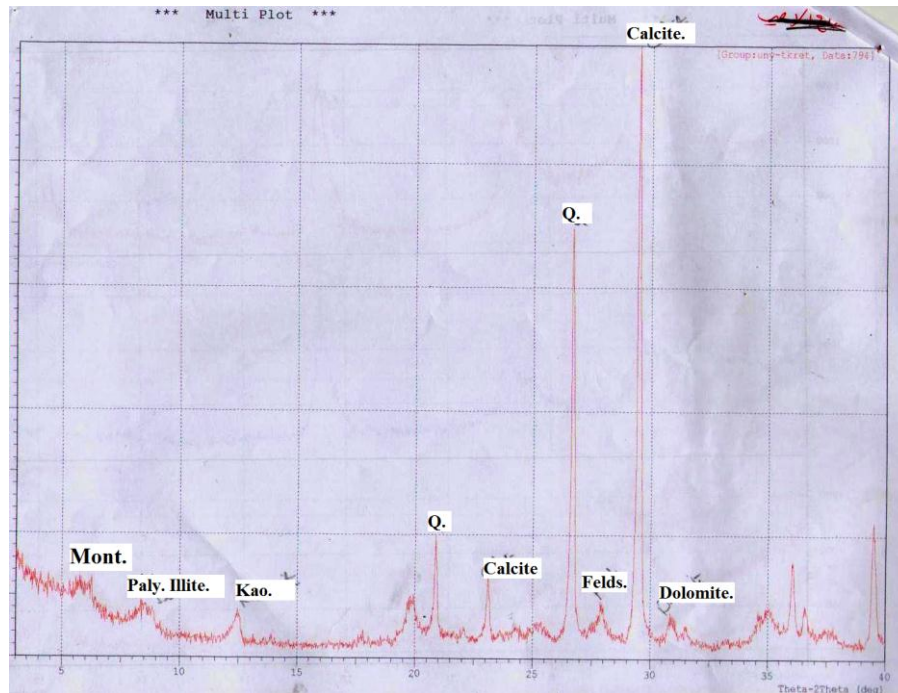


Figure (2) Representative XRD of Quaternary clay deposits.

### Conclusions and Recommendations

1. The Quaternary sediments are mostly immature and that related to the short distances of transportation and high density of currents .
2. The gravel are mainly composed of carbonate ,in addition to sandstone ,quartz and chert and other component in low degree.
3. The sandstone layers mostly of litharinite type rich in carbonate fragment.

4. The recognized clay mineral are illite, montmorillonite, Kaolinite and Palygorskite.
5. We recommend detail mapping of the Quaternary sediment in the area and chemical study of the different sediment composition.

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### ملخص البحث

تتكون ترسبات الحصى والرمل من طبقات سميكة من الرسوبيات الفتاتية التي تمثل ترسبات الشرفة النهرية التي تكونت خلال العصر الرباعي ز الحصى المعدني تكون من الحصى الكربونية (٣٧-٤١.٥) %، الحجر الرملي (١٤-١٧) %، حجر الصوان والمرو (٢٢-٣٣) %، الصخور النارية (٧-٨) % والصخور المتحولة.

أصل الحصى غالبا مشتق من التكاوين الاقدم المكشوفة في المنطقة مثل انجانة والفتحة، شكل الحصى مختلف استنادا الى اصلها.

تكون هذه المواد الفتاتية ترسبات غرينية وتحتوي كثير من التراكيب الرسوبية مثل التطبيق المتقاطع والتطبيق القاعي والقنوات الممتلئة. المواد الحشوية تؤلف ٤٠ % تقريبا وتتكون من خليط من الفتات الرملي والسلتي والطيني. تكون الاجسام الرملية اشكال مختلفة مثل التراكيب اللسانية والعدسية. درجة الاستدارة للحصى متوسطة الى جيدة.