Mineralogy and Geochemistry of Quaternary Mud Deposite at Turkiskan Region, South Kirkuk. IRAQ

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Abstract

This study is based on ten samples that were collected from selected sites at the quaternary recent deposits, with varies depths illustrated among 1.5 and 5.6 m within Kirkuk area (Turkishkan region) , northeastern Iraq . They were subjected to laboratory studies including grain size(using sieve (0.063 mm), by wet sieving), mineralogical (using X-ray diffraction analysis, type Panalytical Xpert PRO MPD with Ni-filtered and Cuα radiation) and chemical analysis (using polarized energy dispersive XRF) . Grain size distributions indicate that the deposits are mainly composed of clay and silt with very small amount of sand. Most of the studied sediments characterized as silty clay (50%), sandy clay (30%) and clayey mud (20%) as texture .

Chemical analysis showed that all samples have high concentration in SiO_2 and CaO in comparison with Al_2O_3, MgO, Fe_2O_3, K_2O, Na_2O and SO_3. These results are generally in agreement with the mineral composition. Mineralogically, the essential mineral contents in the studied sediment samples are quartz, calcite, feldspar with very small proportions of dolomite. Clay minerals assemblages consist of (Chlorite 35.28%, Kaolinite 20.73%, Illite 19.46%, Palygorskite 14.23% and Smectite 10.29%). The nature and abundance of clay minerals, in addition to the resemblance in their sediments forming mineral, refers that these sediment were a similar mineral components but differ only in the proportions of the presence of these minerals. Also reveals that these sediments were derived from rocks of similar mineralogical and chemical composition. The clay mineral assemblages proved that the major phase transformations were not observed in these sediments. The deposition environment of these minerals may be characterized by an arid to semi-arid climate in the source area.

Key words: Grain size analysis, Clay minerals, Quaternary deposits and Turkishkan region .

Introduction

A study of Quaternary and recent sediments in the near shore and river settings provides the basis for defining the physiochemical and ecological settings of the natural environments and the changes caused to them by earth processes and anthropogenic activities [1,2] .

Mud deposits are the most abundant of all the rocks of the earth's crust, constituting some 45 to 55% of the components of sedimentary rocks [3]. They have covered more than one third of the surface area of Iraq[3]. Mostly within the Mesopotamian Plain, where they comprise fluviatile, Lacustrine, deltaic and Aeolian sediments that replace each other both horizontally and vertically.

Outside the Mesopotamian Plain,a Quaternary sedimentary veneer of polygenetic origin covers large areas in the synclines of the Foothill Zone [4]. The term clay materials refer to those materials having earthy properties and become elastic when mixed with water .

They consist of hydrous alumino phyllosilicates, magnesium and iron as well as organic matter and soluble salts . They resulted by various weathering and erosion processes of igneous, metamorphic and sedimentary rocks, which can be deposited practically in any environment, although the major depositional sites are river floodplains and lakes, large deltas and the ocean floors .

The aim of the current work was to study the mud deposits of Quaternary recent sediments at selected sites within Kirkuk area (Turkishkan region), northeastern Iraq (Fig. 1), to gather more information about mineralogical, geochemical characteristic and sedimentary fabric to detect the prospected origin of clay minerals assemblages and their depositional environments.

Geological setting

The study area is of about 801 km^2 and located upwards 14 km in the southern part of Kirkuk city and upwards 3 km in the northwestern part of Laylan (Kara Hasan) township abutting to Turkshkan village from the southern part, northeastern Iraq between longitudes 44° 26' to 44° 34'E and latitudes 35° 18' to 35° 22'N .

The study area lies within the Foothill Zone consists mainly of Upper Miocene and Pliocene coarse detrital sediments which are gently folded along the NW–SE axis parallel to the structural trend of the Zagros Mountains [5], which appear it is outcrops at a distance of 5 km about the studied area along the northeastern part (Fig.1). The Foothill zone, especially in the Kirkuk Embayment is characterized by long anticlines with Miocene cores flanked by very broad and shallow synclines exposing Mio-Pliocene molasse along their flanks. The inner parts of the synclines contain Quaternary deposits (which study area lie), referred to here as the Polygenetic Synclinal Fill. The thickness of this Quaternary veneer is variable but is greater than 120 m in some water wells [4]. The surface of the study area is smooth having no geological structures (such as folds or faults or joints) . The surface is almost representing by flat plain topographic slopping gently from east to west consisting of recent friable Quaternary clay deposits suitable for agriculture and cement industry[4]. And overall, the studied area covered by quaternary deposits, periodically flood and soil deposits [6]. The soils of the area are formed of materials consisting mainly of mixture of gravel, boulders, sands and clay [4] .Therefore, the soil of Kirkuk city is alluvial, formed by periodic deposition and erosion during the different stage of river flooding and it is clayey silt sandy and gravel .These synclines often have a central river system that cuts across, or flows parallel to, their axes. These rivers connect the main tributaries of the Tigris River (Fig. 1). In the some synclines, the rivers are braided (often shallow and dry) and periodically flood . The beds of these rivers are often gravel-dominated. Some synclines contain meandering rivers with finer sediments . The catchment of the synclinal rivers is from the flanking anticlines but the main river catchments may extend far beyond the Foothill Zone . Slope sediments have formed along the flanks of the structures, usually in narrow belts; along high mountains thick accumulations of limestone scree occur. The sediments filling the synclines consist mainly of a mixture of gravel and clay. They form pediment deposits, developed on the flanks of anticlines, passing laterally into river deposits towards the center of the depressions. Some rivers breaking out from the anticlines produce alluvial fans locally merge to form bajada .

Accumulation terraces occur at three levels along large rivers . They consist of boulders, gravels, sands and clays that are often poorly cemented . Sheet run-off sediments cover flat areas between anticlines and comprise clay, silt and sand, sometimes covered by scattered gravels. Locally developed valley fill deposits, flood plain and sabkha sediments, and sand dunes are also common within the synclinal areas of the Foothill Zone [4].

The main geomorphological features within the study area are wide valley which adjacent to the region from the southern part .

Ranging in width from 5 to 8 meters and a depth of 3 meters and the valley filled with gravel deposits.

The difference in height between the highest and lowest point of 15.9 meters and gradually descend the region from the north-east to south-west, as well as from the side of the valley (Fig. 1) .

Materiale and methodos

Ten sediment samples were collected from selected sites at the mud deposits, with varies depths illustrated among 1.5 and 5.6 m, and that the distance between the samples is one kilometer (Fig. 2 and Table 1). All samples were sun-dried and then were disaggregated by the use of an agate mortar and pestle. Disaggregation was done gently in order to retain, as much as possible, the intrinsic grain sizes of the samples .

Grain size analysis is carried out to separate sand from the silt and clay using sieve (0.063 mm), (230mesh) by wet sieving. The silt and clay fractions downward from (230 mesh) sieve were separated using sedimentation tube method according to [7, 8]. The statistical parameters of the grains were calculated using the equations proposed by [9] .

Chemical analysis is performed for all samples by using polarized energy dispersive XRF. A part from each sample was ground into fine powder in an agate mortar. The samples were sieved to pass through of 200 μm, and then pressed into thick pellets of 32mm diameter using wax as blinder. USGS standards, GEOL, GBW 7109 and GBW-7309 Sediment equally pressed into pellets in a similar manner as the samples, and these used for quality assurance [10, 11]. The PEDXRF analysis was carried out at the Earth Sciences Research and Application Center of Ankara University, TURKEY. The instrument model used in this study was Spectro XLAB 2000 PEDXRF spectrometer which was equipped with a Rh anode X-ray tube, 0.5mm Be side window. The detector of spectrometer is Si (Li) by liquid N_2 cooled with resolution of < 150eV at Mn Kα, 5000 cps. Total analysis time for each addition element was 30 min. The sample measurements by PEDXRF mainly done by three types of targets [12]:

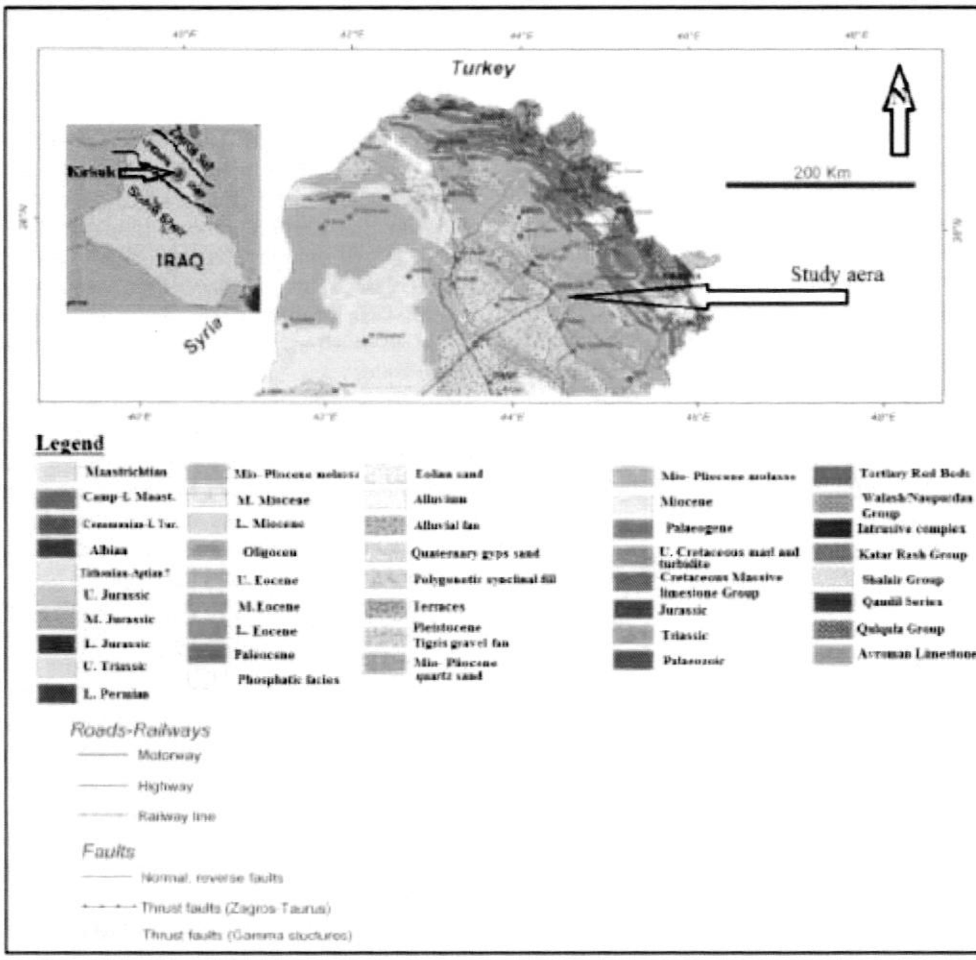

Fig. 1. Geological map of northern Iraq (modified from the [4])

i. Light element targets of high density designed for efficient scattering and polarization of polychromatic source radiation. This target is suitable for the excitation of elements with Z > 22 and this target named as Barkla target.

ii. The second target is oriented crystal target, mosaic and single crystals; this will generate very intense source radiation of more specific energies. This target is suitable for light elements up to Z = 22 and can be named as Bragg targets.

iii. The last target is pure metal target, generate very intense near monochromatic X-ray sources, include unpolarized and polarized radiation scattered from the X-ray tube.

This target is suitable for specific elements or small groups of adjacent elements. In addition this target is useful for generating Compton scatter peaks which can be used for matrix correction. Mineralogical characteristics of the samples were determined by using X-ray diffraction analysis, type Panalytical Xpert PRO MPD with Ni-filtered and CuKα radiation, for the purpose of diagnosis and assessment of mineral components as well as identifying the type of clay minerals (<2 μm) in the isolated clayey size. Both randomly oriented powder and oriented slides samples were prepared depending on the procedures described by [13] and [8] . They were scanned over the range from 5° to 40° 2θ at a scanning speed 2° 2θ/min. The oriented slides were analyzed in different stages (non-treated, treated by Glycol ethylene at 60°C/2 hr. in order to distinguish the expandable mineral phases, the slides were heated at 550°C/2hr . for chlorite detection) .

All basal reflection peaks of minerals were diagnosed according to ASTM cards [14]. The semi quantitative determination of relative amounts of major clay minerals was calculated by using Panalytical X'Pert HighScore software depending up on specific reflections and intensity factors.

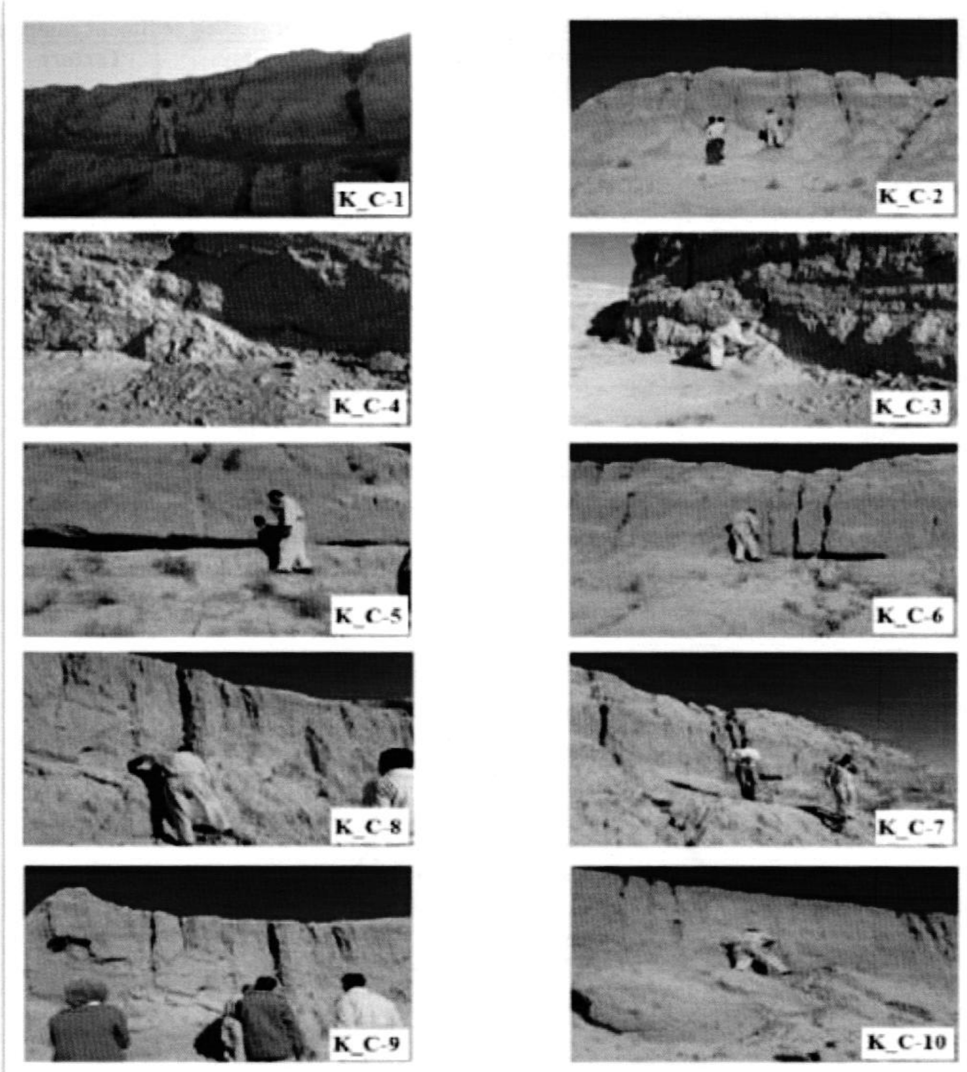

Fig. 2. Locations of studied sediment sample

Results and Discussion

Grain size distribution

The results of the grain size analysis of the studied samples are given in Table (1), which shows the percentages of the sediments components of sand, silt and clay. The clay portion was high in all sites 44-70% with an average 56.7%. While the quantity of silts was less than clay, and ranges between 14-40% and 28.8 % in average. The results indicate of clearly a decrease in the percentage of sand in the sediments with the range between 2-24% with an average 14.5%. The majority of sediments fall in the clay and fine to medium silt category indicating that the sediments were deposited at low energy conditions[8]. And confirms near the sediment supplier source rocks. That's where most appearance geological formations in the region consist of sandstone, mudstone and shale [15, 16]. To classify the studied sediments used the triangular percentage for clay, silt and sand [17] which was shown in Fig (3).

According to [17] classification, most of the studied sediments can be characterized as Silty clay, Sandy clay and Clayey mud type, which constitutes 50%, 30% and 20% respectively of the total sediment samples analyzed Fig.(3and 4). [18] illustrated that the variation in the size distribution of the deposits associated with prevailing climatic conditions and source of sediment, as well as along the distance of transportation, because the quality and nature of the supplied source rocks that were appears in the depositional basins play an important role in the estimation of the quality and quantity of load water rivers .

Table1. Results of the grain size analysis and common textures of studied sediment samples

Sample Number	Depth (m)	Sand Fraction (%)	Silt Fraction (%)	Clay Fraction (%)	Texture
K_C-1	2.5	15	35	50	Silty clay
K_C-2	1.5	2	40	58	Silty clay
K_C-3	5.6	24	18	58	Sandy clay
K_C-4	4.5	20	36	44	Clayey mud
K_C-5	2.5	22	15	63	Sandy clay
K_C-6	3.5	11	40	49	Clayey mud
K_C-7	2	12	35	53	Silty clay
K_C-8	3.5	12	29	59	Silty clay
K_C-9	4.5	23	14	63	Sandy clay
K_C-10	3.5	4	26	70	Silty clay
Min.		2	14	44	
Max.		24	40	70	
Mean		14.5	28.8	56.7	

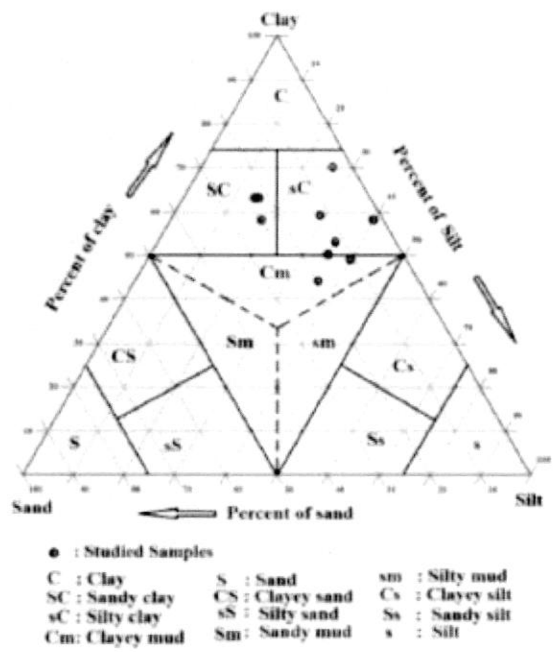

Fig.3. Triangular plot of texture classifications of common recent sediments and studied sediment samples (after [17])

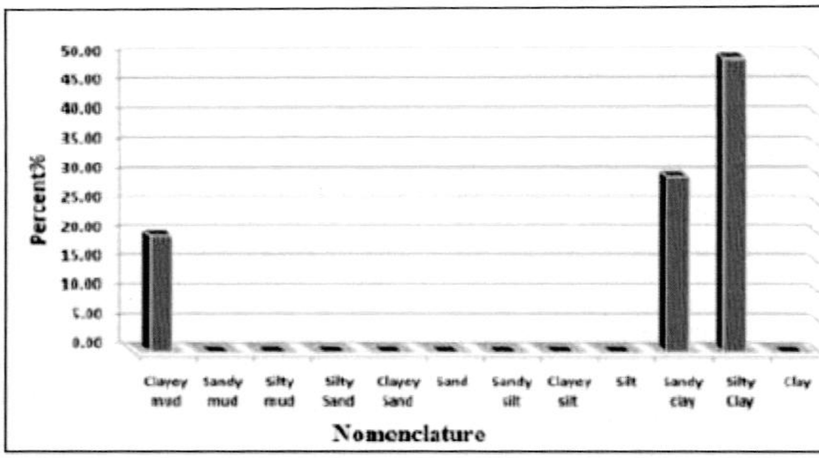

Fig.4. The bar shape illustrates relationship between type of sediment and the percentages for each type

Mineralogical analysis

Generally, clay minerals showed diversity and complexity in their structures and mineralogy, due to their small grains and their occurrence in low or different crystalline degrees, in addition to wide variation in their chemical composition. Therefore, the mineralogical characterization of the studied sample was based on X-Ray diffraction analyses of bulk samples and clay fraction samples are shown in Figures (5 and 6), which reveals the existence of clay and non-clay minerals. And also refer that this sediment has a similar mineral components but differ only in the proportions of the presence of these minerals. Quartz, calcite and feldspar are the essential mineral contents in the studied sediment samples with very small proportions of dolomite, as shown in Figure 5 as well as quantities of clay minerals. The mean content of the clay minerals in the clay fractions are given in Table2.

Non – Clay minerals

Quartz is the most abundant non-clay mineral in the studied samples of clay deposit. It was characterized by the peaks (3.34 and 4.26 °A) for reflections (101 and 100), respectively (Fig. 5). Calcite is the second abundant non-clay mineral in the studied clay deposits, it was characterized by the peaks (3.04 and Å) for (104) reflections, whereas Feldspar was determined as plagioclase which is characterized by the peak (3.2 Å) for (002) reflection (Fig.5).
Generally, Dolomite is present in a small amount.
The X-ray scanning showed dolomite with characteristic peak of (2.89) Å for (104) reflection (Fig.5) .

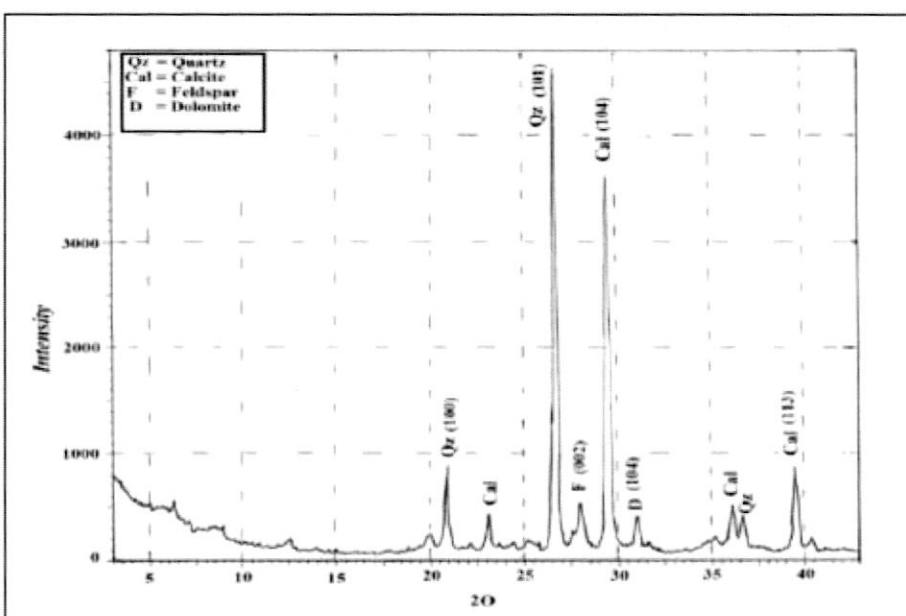

Fig.5. X-ray Diffraction pattern showing the main detected minerals of studied bulk sample

Clay Minerals

The presences of clay minerals in the clay fraction of the studied area are:

Chlorite

Chlorite is characterized by reflections (14.2, 7.13 and 4.7) Å at (001, 002 and 003) hkl reflections, respectively. The (001) smectite peak and (001) kaolinite peak are identical with the 001 and 002 hkl reflections of the chlorite [19]. Chlorite can be distinguished from smectite by the expansion of the later to 17 Å or more, when the sample is glycolated and distinguished from kaolinite by heating to 550°C, the later collapses at this degree only (Fig. 6). As a result of this identification method, chlorite average content in clay fraction is 35.28 % and ranges between (28.88 – 38.68) %, (Table 2.).

Kaolinite

It is a dioctahedral mineral of the Kaolinite group. The primary structural unit of this group is composed of one octahedral sheet condensed with one tetrahedral sheet [20]. Kaolinite yield X-ray diffraction patterns and characterized by 001 reflection (7.0) Å, without treatment and when glycolated . This reflection disappears when heated to 550°C. Reflections of 002 and 003 hkl were (3.57 and 2.36) Å, respectively (Fig.6) . Kaolinite average content in clay fraction of studied sediment samples is about 20.73% and ranges between (14.04 – 27.01) % (Table2).

Illite

The X-Ray results showed Illite with characterized by reflections (10.0 and 5.0) Å at (001 and 002) hkl reflections, respectively. The main reflections of Illite does not change when treated with ethylene glycol, also does not change when heated to 550, While the increase in the apparent and intensity of the reflection at (10) Å is due to the loss of some of minerals to water particles when heated such as Smectite, And its transformation to the Illite structure [13] (Fig.6). Illite average content in clay fraction is 19.46 % and ranges between (14.18 – 25.21%), (Table 2) .

Palygorskite

The X-Ray results showed palygorskite with characteristic peak at (10.5) Å for (110) hkl and (6.34) Å for (200) hkl (Fig.6). Glycolation had no effect about this reflection, where [20, 21, 22] illustrated that the palygorskite minerals could not effected by organic maters. At 550C° the 10.5Å peaks were collapses due to further dehydration and possible folding of the mineral structure [13, 23]. Depending on the width of 110 peak in the midhigh, it is possible to determine the crystallization degree of the palygorskite mineral [24] . From XRD Figures of the studied samples, we can clearly notice that the palygorskite peak appeared as a sharp peak and consequently reflected high degree of crystallization. Palygorskite average in clay fraction of studied samples is about (14.23%) and ranges between (9.82 – 20.36) % (Table 2) .

Smectite

It is a series of hydrous clay minerals that belong to the family of expandable three layer type. Smectite was characterized by reflections between (12 - 15) Å and exactly basal reflection (14.2) Å at (001) hkl reflection (Fig. 6). In this study The (001) Smectite peak is identical with the (001) hkl reflections of the chlorite. When the sample is glycolated the smectite expansion to 17 Å or more, while the chlorite remains at (14.2) Å, In most cases these reflections cannot be separated, while there are still a broad range of reflection that are located between (14) to (16.3) Å. Upon heating to 550 degrees the smectite minerals will lose water molecules and turn into Illite lattices , Which is illustrated by the increase in the intensity of the Illite at (10) °A. Smectite average content in clay fraction is 10.29 % and ranges between (7.43 – 12.09)%, (Table 2) .

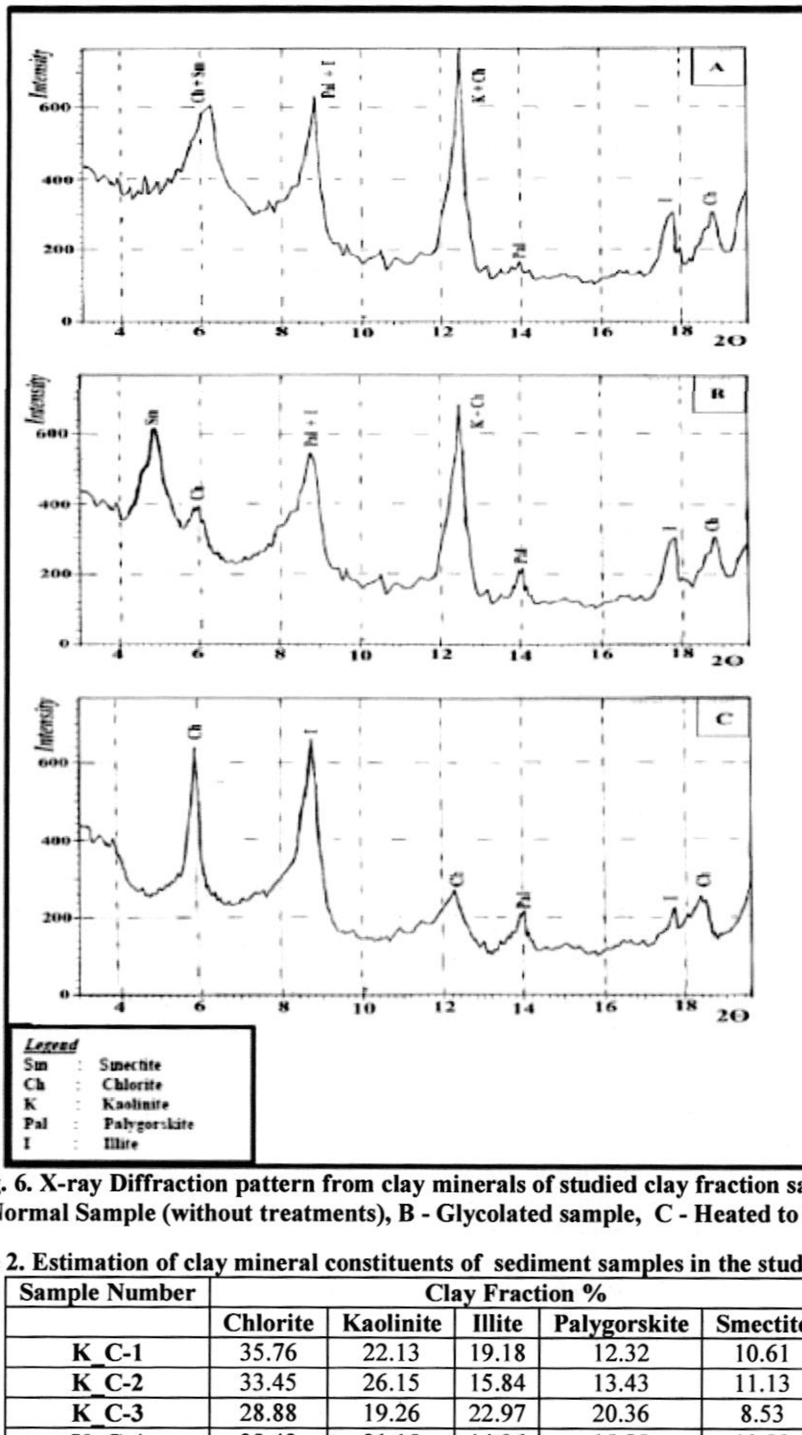

Fig. 6. X-ray Diffraction pattern from clay minerals of studied clay fraction sample A - Normal Sample (without treatments), B - Glycolated sample, C - Heated to 550 C^0.

Table 2. Estimation of clay mineral constituents of sediment samples in the studied area

Sample Number	Clay Fraction %				
	Chlorite	Kaolinite	Illite	Palygorskite	Smectite
K_C-1	35.76	22.13	19.18	12.32	10.61
K_C-2	33.45	26.15	15.84	13.43	11.13
K_C-3	28.88	19.26	22.97	20.36	8.53
K_C-4	38.42	21.15	14.36	15.85	10.22
K_C-5	34.82	14.04	25.21	15.04	10.89
K_C-6	38.12	15.23	22.95	14.16	9.54
K_C-7	36.51	14.18	23.77	18.11	7.43
K_C-8	38.68	22.05	15.44	12.71	11.12
K_C-9	30.56	26.11	20.71	10.53	12.09
K_C-10	37.62	27.01	14.18	9.82	11.37
Min.	28.88	14.04	14.18	9.82	7.43
Max.	38.68	27.01	25.21	20.36	12.09
Mean	35.28	20.73	19.46	14.23	10.29

The clay minerals diagnosed above were derived from different sources of igneous, metamorphic and sedimentary rocks. The clay minerals may be transported by rivers and deposited as alluvial deposits often bearing inherited properties from the weathered parent rocks. The weathering and erosion that affect to the river basins and streams lead to the configure of a mixture composed of different minerals [25]. And it can be transmitted different amounts of kaolinite, chlorite, illite and other minerals by the rivers and each mineral from all of these minerals moved from its source along the riverbed . So it is possible to use these minerals as tracer to elucidate the sources area, as well as to know the nature of drainage basins in addition to clay minerals reflect the nature and characteristics of parent rocks [20]. Accordingly, depending on the analysis of clay minerals can be summarized possible origin of these minerals as follows :

Mixed layers of clay minerals are formed by the stacking of layers of different type or composition, and the digenetic alteration processes are the main causes of increasing mixed layers [26] . So, these processes are responsible for increasing in the abundance of chlorite-smectite mixed layers of clay mineral in the study area. Chlorite and palygorskite minerals usually derived from the rich sources of iron, magnesium and calcium consisting these minerals (Fig. 5 and 6). These minerals are alteration products of ferromagnesian minerals belonging to the basic igneous or metamorphic rocks [25, 27]. [28] illustrated that paly gorskite deposited in different geological environments, including marine, lagoonal, lacustrine and fluvial. And palygorskite was formed by authigenesis in evaporitic environments, whereas the other clay minerals are detrital in origin . [29] explained the new formation of palygorskite from layer transformation of smectite .

Illite can be produced by the weathering of potasic feldspar minerals in a continental environment, but when it is found with chlorite indicating the shale or metamorphic source rocks [20, 25, and 30]. And also It can consist of by the weathering of a laminar clays are available in molasses deposits in the Triassic and Oligocene to Quaternary [25]. As well as through digenetic processes may turn detritus origin of biotite to Illite and Kaolinite [31, 16] .

Kaolinite can be formed by weathering of potash feldspar minerals [20] or as a result of re-erosion of ancient sediments [32], it may exist in the fluvial or coastal environments [20] .

The original source is either detrital coming from the high drainage channels or as a result from diagenetic processes during transportation by leaching of other minerals. The origin of kaolinite in current samples could be detrital and transported by rivers as a well-known mineral in the Iraqi sediments .

The absence of montmorillonite in all sediments may be due to its transformation to illite by illitization or to chlorite by chloritization. The illite or chlorite produced from montmorillonite when all the exchange positions are occupied by (K^{+}) or (Mg^{+2}) ions respectively from certain condition [20]. Chemical analysis indicated the presence of these ions with sufficient concentration which are necessary to achieve these transformation processes. Therefore, the clay minerals found in the present samples indicated that they are derived from the basic igneous and metamorphic rocks, and the less acidic igneous and sedimentary rocks. The depositional environment of these minerals may be characterized by an arid to semi-arid climate in the source area

Geochemistry

The concentrations of major elements (SiO_2, CaO, Al_2O_3, MgO, Fe_2O_3, K_2O, Na_2O and SO_3 in weight %) and the percentage of L.O.I are given in Table (3). The chemical composition of the studied samples changes in relative to their mineralogical composition. SiO_2 is the main constituent from all studied samples. And it is concentration is the highest percentage of the total oxides in all samples, where it ranges from 38.35-40.11%, with an average of (39.39%). Its highest value in the studied area is attributed to increasing of the silt fractions Table (1) .

The aluminum oxide (Al_2O_3) is nearly constant in all the sediments ranging from 8.94 - 10.15% and average 9.75%; while the iron oxide (Fe_2O_3) values range between 3.11 - 4.85% and average 5.18%. It was noted that magnesium oxide has a range between 5.37 and 6.22% and average 3.85%, and these values are correlated with dolomite and some clay minerals like chlorite and palygorskite (Fig. 5 and 6).

Where the Erosion and weathering of the rocks and minerals plays an important role in providing the sediments with a variety of elements since many phases of clay and heavy minerals are the main holder for these elements [33]. Study of the clastic sediments and their content of heavy and clay minerals are among the numerous processes the earth scientists adopts in understanding depositional environments, transportation processes and the physiochemical activities releasing these clay minerals [33, 34].

The concentration of CaO ranges between 18.78 and 21.28% and 20.17% in average, it is correlated with calcite ($CaCO_3$), dolomite ($CaMg(CO_3)_2$) and mixed layer chlorite-smectite that contributes to a few percentage and these minerals have appeared in the XRD patterns (Fig. 5 and 6) .

Table 3. Major element concentrations and the percentage of loss on ignition (L.O.I) of the studied samples

Element	SiO_2%	MgO%	Al_2O_3%	Na_2O%	K_2O%	SO_3%	CaO%	Fe_2O_3%	LOI%	Total
K_C-1	40.02	3.40	9.81	0.85	1.02	0.05	21.28	3.60	19.17	99.20
K_C-2	40.11	3.70	9.89	1.22	1.24	0.08	19.20	3.66	20.14	99.24
K_C-3	40.00	3.60	9.90	0.91	1.90	0.05	20.04	3.11	19.23	98.74
K_C-4	39.92	3.55	9.90	1.22	1.50	0.05	20.92	3.25	19.01	99.32
K_C-5	39.53	4.67	8.94	0.08	1.48	0.20	19.28	4.85	20.38	99.41
K_C-6	39.08	4.10	10.01	1.34	1.06	0.22	21.23	3.42	19.04	99.50
K_C-7	39.18	4.21	9.46	1.05	1.21	0.28	20.23	3.72	19.50	98.84
K_C-8	39.15	4.21	10.15	1.14	1.28	0.06	18.78	4.80	19.30	98.87
K_C-9	38.60	3.81	9.78	0.92	1.33	0.07	20.76	3.32	20.70	99.29
K_C-10	38.35	3.98	9.66	0.87	1.35	0.06	20.01	4.55	20.32	99.15
Min.	38.35	3.40	8.94	0.08	1.02	0.05	18.78	3.11	19.01	98.74
Max.	40.11	4.67	10.15	1.34	1.90	0.28	21.28	4.85	20.70	99.50
Mean	39.39	3.92	9.75	0.96	1.34	0.11	20.17	3.83	19.68	99.16

The percentage of Na_2O ranges between 0.08 and 1.34% and average 0.96%, whereas K_2O ranges between 1.02 - 1.90% and average 1.34%. K_2O is controlled by the proportion of illite, and Na_2O is correlated to smectite and dissolved salts. The percentage of SO_3 is ranges between 0.05 % - 0.28 and average 0.11 and it is almost constant in all samples. The source of the sulfate is the contribution of the dry climate and high evaporation in the deposition of salts in the soil. The percentage of loss on ignition (L.O.I) reflects the high proportion of carbonate, organic matter, free and crystallized water content during ignition range between 19.01 and 20.70% with an average of 19.68%.

Conclusions

1. Grain size analysis of the studied deposits shows that the clay portion was high in all sites, while the quantity of silts was less than clay and the results indicate of a decrease in the percentage of sand in the sediments.

Most of the studied sediments characterized as silty clay, sandy clay and clayey mud type texture.

2. Clay minerals in the studied deposits were derived from different sources of igneous, metamorphic and sedimentary rocks. The origin of chlorite, illite, kaolinite and palygorskite clay minerals are detrital but chlorite-smectite mixed layers are authogenic. They resulted from the weathering of source rocks and surrounding area during transportation.

3. The absence of montmorillonite in all sediments due to its transformation to illite by illitization or to chlorite by chloritization. The mixed layers chlorite-smectite are the most abundant clay minerals in all sites and depths, indicating high intensity of diagenetic alteration processes in depositional environment.

4. All samples have high concentrations in SiO_2% and CaO% in comparison with Al_2O_3%, MgO%, Fe_2O_3%, K_2O%, Na_2O% and SO_3% and that generally coincides with their mineral composition.

The concentrations of Al_2O_3%, MgO%, Fe_2O_3%, MnO%, Na_2O% and K2O% of studied sediments are significantly controlled by Ferro manganese oxides ydroxides and clay mineral abundances.

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معدنية وجيوكيميائية ترسبات أطيان العصر الرباعي لمنطقة تركشكان (ليلان) ، جنوب كركوك – العراق

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الملخص

اعتمدت الدراسة الحالية على عشرة نماذج لترسبات اطيان العصر الرباعي والتي جمعت من مواقع مختارة وباعماق ما بين 1.5 -5.6 م في محافظة كركوك ، جنوب شرق العراق . اشتملت الدراسة المختبرية لهذه العينات على توزيع الحجم الحبيبي (باستخدام منخل حجم 0.063 ملم وبطريقة التحليل الحجمي الرطب) والتحليل المعدني (باستخدام حيود الاشعة السينية نوع Panalytical Xpert PRO MPD مع مرشح من الـ Ni واشعاع من الـ CuKα) والتحليل الكيميائي (باستخدام جهاز تشتت الطاقة المستقطبة XRF) . تشير نتائج توزيع الحجم الحبيبي بان هذه الترسبات الحديثة تتالف وبشكل رئيسي من الطين والغرين مع وجود كمية قليلة جدا من الرمل، وان النسجة الغالبة لهذه الرواسب هي الطين الغريني (50%)، الطين الرملي (30%) والوحل الطيني (20%) .

اظهر التحليل الكيميائي ارتفاع نسبة اكاسيد SiO_2 و CaO مقارنة بالاكاسيد (Al_2O_3 ، MgO، Fe_2O_3، K_2O، Na_2O_3 و SO_3) الاخرى والتي تتوافق مع التركيب المعدني لهذه الترسبات في جميع النماذج قيد الدراسة . بين التحليل المعدني ، بان المعادن الاساسية المكونة لهذه الرو اسب هي الكوارتز، الكالسايت ، الفلدسبار مع نسبة قليلة جدا من معدن الدولومايت . اما اهم المعادن الطينية فقد كانت الكلورايت(35.28%)، الكاؤلينايت (20.73%) ، الالايت (19.46%) ، الباليكورسكايت (14.23%) والسمكتايت (10.29%) . تشير طبيعة ووفرة المعادن الطينية في الرواسب وتشابهها بنوعية المعادن الاساسية المكونة لها الى تشابه المكونات المعدنية لهذه الرواسب واختلافها فقط في نسب وجود هذه المعادن، وكذلك يوضح تشابه المكونات المعدنية والكيميائية للصخور المصدرية التي اشتقت منه هذه الرواسب . كما يتضح من تجمعات المعادن الطينية عدم حدوث اية تحولات طورية حادة في هذه الرواسب . وان هذه الرواسب قد تكونت في بيئة تتميز بمناخ جاف الى شبه جاف في منطقة المصدر.

الكلمات المفتاحية : تحليل الحجم الحبيبي، المعادن الطينية، ترسبات العصر الرباعي ، منطقة تركشكان .