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EFFECT OF PHYSIOGRAPHIC LOCATION ON SAND MINERAL DISTRIBUTION IN DIFFERENT REGION FROM MESOPOTAMIA PLAIN

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Abstract

A field study was conducted in 2019, to know the effect of the physiographic site on the distribution of sand minerals and some soil traits in the area extending from the left side of the Euphrates River to the end of the AL-Musiab project site with coordinates (44.22° and 44.54° E) and two latitude circles (33.32° and 32.44° N). The four secondary physiographic sites were chosen, which are the unit of river levee soils represented by the MW3 series, the irrigation levees represented by the MW5 series, the DM97 river basin unit and the MF11 silted basins unit. The soil properties were detected, morphology described and samples were obtained for the purpose of laboratory analysis. The results indicated that all soil series represent sedimentary soils of transported river origin and different textures that depend on the physiographic location, where the texture is smoothed where we move away from the source of sediments; the sand separation prevailed in the series of river levee unit, while the clay separator prevailed in the series of silted basins. Mineral analysis of fine sand separated showed the dominant of quartz minerals, followed by Calcite and feldspar for light minerals, while opaque minerals, pyroxene and amphibole were dominant. The results of weathering index showed low values indicating a decrease in the rate of weathering in the soil.

Key words: Sedimentary plain, physiographic units, sand minerals, weathering index

Introduction

The Iraqi sedimentary plain is one of the physiographic divisions of the surface of the Iraq soil. It has an area and is characterized by its lack of general slope. Its origin dates back to the Pleistocene era. The rivers levee is natural phenomena in flood plains areas and their soils are rich in nutrients and most of their particles is silt. They are located close to the sources of sediment transport (major rivers) and their exposure to successive cycles of moisture and drought may lead to a change in their mineral composition. There is also a unit of river basins and is characterized by being lower in relation to the rivers levee, as well as having the advantage of containing soft-tissue particles formed due to sediments deposited by the river far from its streams, The middle of this range is characterized by a great expansion with a gradual slope as we go towards the south. This zone is characterized by the fact that the groundwater is close to the surface (Al-Ani, 2006). Issa and Al-Shaikhly (2001), indicated that the study of soil minerals is of great importance in understanding soil chemistry because minerals, especially colloidal ones, are very important for cation exchange, in addition to chemical weathering that liberates plant nutrients .Salih and Muhaimid, (2007) showed in their study of the nature of the mineral formation of some Series of river levee in the middle of the Iraqi sedimentary plain that opaque minerals are distributed irregularly in the soil horizons and reflect the influence of the geomorphological processes, especially the sedimentation processes that took place in the region, The group of Amphibole Minerals occupied the main rank in the distribution of minerals of a heavy sand separator. The results also showed the predominance of quartz mineral within the fine sand joint due to its resistance to weathering processes due to its strong crystalline building bonds as well as its inheritance from the parent material. Al-Zaidi, (2011) showed that the Iraqi sedimentary plain is one of the main components of the Iraqi surface. Its length in the horizontal dimension is about 650 km and its average width is about 135 km. The plain is the result of the sediments of the Tigris and

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Euphrates rivers and its surface is almost flat and includes some heights such as archaeological hills and depressions that are continuously submerged by water called Marshes and that the soils of the sedimentary plain are igneous and sedimentary rocks origin that were obtained by weathering processes in the areas of the two rivers and were transported and then deposited in these areas when the momentum of the river decreased from the transfer of its materials and that the sediments that existed near the river are called river banks, while the sediments that settled further away They are called river basins. Al-Jaf, (2013), that the nature of the mineral composition and the formal characteristics of the fine sand separating particles differ according to the difference in the depth of the soil. While some of the minutes appear yellow, which is due to iron oxides, as for the minutes in the depths of the soil, they are in a light colour, which returns to the color of the original material, It also found a predominance of quartz minerals within the minerals of light sand, which is due to the nature of the original material, while the lady was of the opaque minerals within the minerals of heavy sand. Al-Fatlawi, (2016), in her study of the mineral properties and heavy elements of the soils of the Iraqi sedimentary plain within the two sites of Wasit and Maysan province indicated that the mineral composition of light fine sand separates between the dominance of the rock fragments, followed by quartz minerals, flint, girt, clay and feldspar, As for heavy sand minerals, opaque minerals prevailed and lower values of Staurolite, kyanite, Rutile and tourmaline minerals, along with weak mineral weathering processes, due to the lower values of zircon and tourmaline compared to the higher content of pyroxenes and amphiboles.

Materials and methods

The study area is located in Babylon province between the Tigris and Euphrates rivers and on the left bank of the Euphrates River 2 km from the Hindiya Barrage and ends at the borders of the AL-Musiab project, about 80 km east of the Euphrates River and within the geographical coordinates between longitudes (44.22° and 44.54° east) and two latitude (33.32° and 32.44° N), which is part of the sediments of the floodplain known as the Iraqi Flowage Plain (Abdul Amir, 2016). The eight sites representing the physiographic units of the area were selected (river levee, irrigation levees, river basins and silted basins) and on the right side of the sediment conveyor source (Euphrates River) in order to determine the mineral characteristics of the Series representing each physiographic site, The MW3 series represented the river clutch unit, the MW5 series the irrigation levees unit, the DM97 series the river basin unit, while the MF11 series represented the silted basins unit. After determining the estimations to be studied and by using the GPS system with a UTM coordinate system, the location of the estimators was determined for the studied area. Then it revealed the properties of the soil, described its morphology and took samples from it from the horizons, according to the Soil Survey Manual 1960. Then the soil samples were dried, milled and passed through a sieve with a diameter of 2 mm pits for the purpose of measuring soil characteristics that represent some of the physical and chemical properties of the soil, which included the size distribution of soil particles by the method of condensation and soil interaction (pH) using a pH meter and electrical conductivity (ECe) in the saturated soil paste extract using Electrical Conductivity Bridge and cation exchange capacity (CEC) using ammonium acetate 1N NH_4OAc at (pH = 7.0) and the soil content of calcium carbonate minerals ($CaCO_3$) using acid (HCl 1N), The acid residue was titration with NaOH (1N) and the soil content of calcium sulfate minerals ($CaSO_4.2H_2O$) by sedimentation with acetone and soil organic matter content (OM) by wet digestion according to the methods presented in Jackson, 1958 and Black, 1965. The mineral analysis included removing the bonding materials and included removing salts from the samples by washing them with distilled water three times, then removing calcium carbonate using corrected sodium acetate with a 5 reaction degree (Kunze, 1962), The organic matter was removed using a 14% sodium hypochlorite solution (Anderson, 1963) and then the free oxides were removed by NA-citrate-bicarbonate-dithionite according to the method (Mehra and Jackson, 1968). Then the separation and Fractionation process for the particles greater than 50 microns by the wet sieving method, then the clay particles (less than 2 microns) were separated by sedimentation according to the method (Kilmer and Alexander, 1949) mentioned in Black, 1965 and testing the X-ray diffraction of the clay separator.

The clay separates simples were prepared on glass slides and were treated with five treatments :

A- Magnesium and air drying

B- Magnesium and ethylene glycol

C- Potassium and air drying

D- Potassium and heating at 350° C.

E- Potassium and heating at 550° C

And using the X-ray diffraction pattern to obtain the pages of radiation diffraction, then diagnosing the types of clay minerals according to the method given in Jackson, 1979 and the mineral dominance was calculated according to the intensity of the curve and the height above the ground of the curve (to reflect the area of the curve). According to the estimation of clay minerals by the American Soil Survey Laboratory and X-ray fluorescence (XRF) device was used to estimate the oxide ratios using soil models, including dissolved salts, calcium carbonate and organic matter were removed and milled into a very fine powder and placed in discs for the purpose of complete elemental analysis And calculate the weathering evidence according to the methods presented in Jackson, 1968. Sand minerals (53-100 microns) and their light and heavy types were separated by using a Bromoform solution, the specific weight of which was 2.89. For the purpose of preparing slides and testing materials according to their optical properties according to the method mentioned in Kerr, 1959, using the Polarized Microscope, then determining the percentage of each mineral within the field of vision.

Results and discussion

Morphological characterization of the soil units of the study area

The detection of soil types, their locations and areas and their distribution in the pedological perspective, represents the scientific basis for soil surveying operations, as well as determining their best uses (Al-Ani and Al-Aqidi, 2000). On this basis, the characteristics of each of the soil units of the study area were determined distributed among 11 pedons, as well as the general morphological characterization of the soil surface and the extent of the spread of natural vegetation in relation to fallow soils and Salt soils ones in comparison with the irrigated soils used for agricultural purposes that are characterized as higher fertility and less degraded than the previous one, In general, the soils of the region are characterized by being sedimentary, which varies in their textures according to the different stages of sedimentation factors as well as the nature of the transport medium, which leads to the occurrence of stratification, as it is an inherent characteristic of it and is defined pedologically as the heterogeneity of the soil separations (Al-Mashhadani, 2005), The most prominent chemical characteristic that can be described morphologically is the presence of pale-coloured complexes, most of which are due to calcium carbonate compounds, thus it appears that the calcification process is highly dominant on all other pedogenic processes. The soil origin material is of calcified river sedimentary type (Calcareous Alluvium). The local conditions of the study area are represented by the arid climate, the weakness of the natural vegetation cover and the dependence on the cultivation of annual plants with the transfer of salt compounds from the abandoned soils to the cultivated soils as well as the predominance of calcium carbonate did not lead to the development of a shallow diagnostic horizon in itself and that the dominant horizon is the Ochric horizon, which has the advantage of being rudimentary in development, pale in color, except for soils treated with organic matter or subject to continuous cultivation that may tend towards a dark brown color, as well as a complete absence of the developed subsurface diagnostic horizons (Al-Mashhadani, 2012) and table 1 indicates that The most

Table 1: Morphological features for pedons in the study area.

Soil Series	Hori-zons	Depth in cm.	Color		Texture class	Struc-ture	Consistency				Boun dary
			Dry	Moist			Dry	Moist	Wet		
									Stick.	Plastic.	
MW3river levee units	A_p	0-27	10YR6/3	10YR5/3	SCL	1mg	dL	mvfr	wns	wnp	as
	C_1	28-63	-	10YR5/3	SL	1msbk	ds	mfr	wns	wnp	cs
	C_2	64-110	-	10YR4/3	SL	1msbk	ds	mfr	wss	wnp	cs
	C_3	111-150	-	10YR4/3	SL	1msbk	dh	mfr	wss	wnp	-
MW5irrigation levees units	A_p	0-27	10YR6/3	10YR4/3	SiL	1mg	dL	mvfr	wns	wnp	as
	C_1	28-62	-	10YR5/3	SiL	1msbk	ds	mfr	wss	wsp	cs
	C_2	63-104	-	10YR4/3	SiL	2msbk	ds	mfr	wss	wsp	cs
	C_3	105-142	-	10YR4/6	SiL	2mabk	ds	mfr	wss	wsp	-
DM97river basins units	A_p	0-28	10YR5/3	10YR5/2	SiCL	3mg	dL	mfr	wss	wsp	as
	C_1	29-65	-	10YR5/6	SiCL	2mabk	dh	mfr	ws	Wp	cs
	C_2	66-110	-	10YR3/3	SiC	2msbk	dh	Mfi	ws	wvp	cs
	C_3	111-140	-	10YR3/4	SiC	2mabk	dh	Mfi	ws	wvp	-
MF11silted basins units	A_p	0-29	10YR8/2	10YR3/3	SiC	2msbk	dh	mfr	wss	wsp	as
	C_1	30-76	-	10YR5/3	SiC	3msbk	dh	Mfi	ws	wp	cs
	C_2	77-112	-	10YR4/3	SiC	3msbk	dh	Mfi	ws	wvp	cs
	C_3	113-140	-	10YR4/4	SiC	3mabk	dh	Mfi	ws	wvp	-

important morphological characteristics of the studied soil Series.

MW3 Series

A series of sedimentary soils that arose from newly formed sediments of river origin materials transported to the Euphrates River and are located within the physiographic unit of river levees with coordinates 32° 44¹47º N 44° 22¹34.02º East and are classified as Typic Torrifluvents, the soil body consists of one classification layer with a rough texture. Its internal drainage grade is good and the slope is about 1-2%. The color of the upper horizon is light brown in the dry state and brown in the wet state and the soil texture of the surface horizon is a sandy clay mixture SCL The structure is granular with rounded edges weak to moderate. The spot appears with a depth of more than 137 cm and the depth of the groundwater at 180 cm. As for the predominant plants in this series, they are Silybum marianum, Monotropa and toothed. This soil is usually grown with summer and winter vegetables, legumes and sometimes alfalfa.

MW5 Series

A series of sedimentary soils that arose from newly formed sediments of river origin materials transported to the Euphrates River and are located within the physiographic unit of the levees of irrigation channels, with coordinates 32° 44¹58º N 44° 38¹59º E and their classification is Typic Torrifluvents, the soil body consists of a single classification layer with a medium rough texture. Its internal drainage grade is good and the slope is about 1-2%. The color of the upper horizon is light yellowish brown in the dry state and brown in the wet state .Soil tissue of the surface horizon is Silty clay loam. Mass construction with rounded rims is weak to medium. And the spot appears with a depth of more than 110 cm and the depth of the groundwater at 165 cm. The dominant plants in this series are the *Silybum marianum*, Monotropa and toothed. These soils are usually cultivated with yellow corn with two loops, wheat, barley, legumes and sometimes millet and sesame.

DM97 Series

A series of sedimentary soils that arose from sediments of transported river origin materials and are located within the physiographic unit of the river basins, with coordinates 32° 42¹12º N 44° 47¹05º E and classified as Typic Torrifluvents, with medium textures for the upper horizons and soft for the deeper horizons within the classification section and the degree of natural drainage is medium and slope 1- 2% and the thickness of the upper horizon is 28 cm and the color becomes darker when the sand separations decrease. The depth of spotting is at 75 cm from the surface of the soil and the depth of the groundwater is at 145 cm. Soil salinity is medium to high and its stiffness increases in wet conditions and changes from friable to firm with increasing depth. The structure is granular for the upper horizons and masses with corners or rounded edges in the deep horizons. Organic matter is low and natural vegetation is dominated by thistle plants, brains and yellow scoops. It is used in the surface irrigation system And by means of cultivation of wheat, barley, legumes and feeds crops.

MF11 Series

A series of sedimentary soils formed from modern sediments transported by river from the Euphrates and located within the physiographic unit the silted basins with coordinates 32° 33¹59° N 44° 46¹24 E and their classification is *Typic Torrifluvents*. The soil body is composed of a single stratum layer with a fine texture of silty clay. Its internal drainage class is imperfectly drained as it shows spotting at a depth of (46) cm and the depth of the groundwater at 85 cm. Its topography is flat, the slope is about (1-2%). It is fallow (uncultivated) lands and is spread by halophytic or high salinity plants, such as *Schanginia aegyptica*, *Aeluropus lagapiodus* and *Tamarix mannfera*.

Soil Texture and chemical properties

The sequence of sedimentation processes, the sequence of floods and the variation in intensity and momentum between turbulence and calm led to a gradually diversified deposition of the transported sedimentary materials. The textures of the Series were alternated and varied, ranging from moderate to coarse and smooth, depending on the speed and distance travelled by the conveying water. In addition to the lack of slope, the shortness of its length and the variation in the lengths of the transmission distances, it leads to sedimentation of coarse joints first, then deposition of smaller particles, followed by sedimentation of suspended particles when the conveyor speed decreases. This explains the presence of heterogeneity of naturally occurring sediments and their containment of particles of various sizes (Al-Aqili, 1986). Table 2 refers to the percentages of soil separators in the study pedons, where the sand content ranged from 162.8 $g.kg^{-1}$ at the last horizon of the classification section of the MF11 series to 485.2 $g.kg^{-1}$ at the surface horizon of the MW3 Series. The height and decrease in the content of this separates are affected by the nature of Sedimentation and physiographic location. So, it is noticed that the highest sand content was found in the soil Series belonging to the physiographic site of the river cliffs unit, in which coarse and medium-fine Texture is spread. This

Table 2: Soil separates and some chemical properties of the study areas.

Physiogr-aphic site	Series	Depth (cm)	soil separates($g.Kg^{-1}$)			Soil texture	ECe $ds.m^{-1}$	CEC Cmole	($g.Kg^{-1}$)		
			sand	Silt	Clay				$CaCO_3$	$CaSO_4$	O.M
River levee	MW3	0-27	485.2	208.7	306.1	SCL	5.6	16.7	210.7	0.9	7.2
		28-63	414.2	385.5	200.3	L	3.8	15.1	225.9	1.4	5.6
		64-110	426.9	412.7	160.4	L	2.1	14.2	275.2	1.1	4.7
irrigation levees channel	MW5	0-27	211.8	510.4	277.8	SiL	9.2	18.5	217.4	1.2	7.9
		28-62	197.9	576.8	225.3	SiL	5.6	16.6	237.6	0.7	6.3
		63-104	232.1	509.3	258.6	SiL	3.1	15.1	251.8	0.7	3.8
River basins	DM97	0-28	189.7	499.6	310.7	SiCL	14.7	19.7	228.7	0.8	9.3
		29-65	185.8	504.6	309.6	SiCL	11.9	18.1	241.8	0.7	7.6
		66-110	168.2	413.3	418.5	SiC	5.6	20.2	267.0	0.6	5.1
silted basins	MF11	0-29	183.5	405.6	410.9	SiC	23.5	23.1	227.6	1.3	13.6
		30-76	176.2	402.9	420.9	SiC	13.4	18.2	339.2	0.7	11.4
		77-112	162.8	410.4	426.8	SiC	7.3	16.7	254.2	0.6	7.2

is also reflected in the clay content. So, the increase in the clay content is at the expense of the decrease in the other separated sands, sand and silt. Here, we notice that the highest content of clay was 426.8 g. Kg^{-1} in the last horizon for the MF11 series, while the lowest content of it was in the last horizon, at 160.4 g. Kg^{-1}, which belongs to the MW3 series. The percentage of silt ranged from 208.7 g. Kg^{-1} at the surface horizon of the MW3 series to 576.8 g. Kg^{-1} at the subsurface horizon of the MW5 series. It is noticed from the soil series spread in the study area that they were in various Texture ranging from coarse, medium and soft. This is due to the nature of the vector and the sedimentation periods during which soils were formed, in addition to the location of that soil on the biological perspective and the physiographic units it constitutes. This is what distinguishes sedimentary soils from the rest of the soils because they have wide heterogeneity in soil textures and that the soil texture, distribution and variability from one site to another contributes to knowing how the soil is formed, the nature of sedimentation and the factors affecting the formation of these Texture and their effect on the distribution of the pattern of the sedimentation process of the soils of the studied chains and their effect on the distribution of Soil minerals horizontally and vertically (Iqbal et al 2005). The results of table 2 show some of the chemical characteristics of the soil series studied in the AL-Musiab project. The soil salinity values ranged from 2.1 $ds.m^{-1}$ at the C3 horizon for the MW3 series to 23.5 at the surface horizon for the MF11 series, with a rate of 8.82 dSiMiSM1 for general. The prospects for the studied soil series, The high salinity of the soil in that series is due to the decrease in its physiographic location, which forms transition areas between depressions and irrigation basins and to the high percentage of clay and the activity of the capillary property that led to the accumulation of salt on the surface, In the MW3 series, the low values of soil salinity in it are due primarily to the high physiographic location that forms the rivers levees and irrigation channels, in addition to the fact that the soil Texture helps to wash more salts when water is available. The values of the exchange capacitance of the positive ions ranged from 14.2 to 23.1 Cmol. Kg^{-1} and has an average charge of 17.68 Cmol. Kg^{-1} for the general horizons of the studied soil Series, where the high values for this characteristic are related to the clay content, where it was the highest value in the first horizon of the MF11 soil Series, which is characterized by the silty clay Texture in the control section of that series. As for the low value, it was on the last horizon of the DW3 soil series, which is characterized by a rough, sandy loam texture in the control section of the same chain. The reason is clear, as there is a positive relationship between the clay content and the exchange capacity of the positive ions (Hepper *et al.,* 2006). As for the values of carbonate minerals, they ranged between 210.7 - 339.2 g. Kg^{-1}, with a rate of 248.09 g. Kg^{-1} in the general horizons of the studied soil series. This is what characterizes the calcareous sedimentary soils in the Iraqi sedimentary plain, where the percentage of carbonate minerals increases as a result of secondary sedimentation from the soil solution and their accumulation in the soil, as well as the fact that the soils arose from calcareous materials (Beckwith and Hansen 1982). Gypsum did not show a high content in the soil, as its values ranged between 0.6 - 1.4 g. Kg^{-1} and a rate of 0.89 g. Kg^{-1} due to the increase in solubility of this compound as well as the cumulative preference for calcium carbonate compared to aqueous calcium sulfate (McCauley *et al.,* 2005), It is noticed that the values of chemical properties such as salinity, organic matter and cation exchange capacity showed a clear decrease in their values with the depth of the soil, while the values of calcium carbonate and the degree of interaction with depth increased (Bragadeeswaran *et al.*, 2007). The characteristic of gypsum content in the soil did not show a clear trend in its values with depth due to the nature of the accumulation of these minerals with depth in soils of arid and semi-arid regions.

Fine sand minerals

The results shown in table 3 show that the percentage of Fine minerals in the sand separator in the studied series soils ranged between (88.6% - 94.5%), which is an indication of the weakness of weathering processes in these sediment materials. And the dominance of the mineral quartz, followed by calcite, then the minerals of the feldspar group, then the mineral gypsum and the group of mica and finally the mineral girt. The highest percentage of quartz mineral was (42.5%) at the surface horizon of the MF11 series and the lowest value (33.2%) at the subsurface horizon of the MW3 series, at a rate of (38.3%). This can be due to its resistance to weathering due to the nature of its chemical bonds, its hardness which is 7 on the Mohs scale of hardness, its lack of cracks and its lightweight, as it is carried by the tanker water to great distances as it is deposited when the momentum of the transport forces is reduced. Therefore, it is the most stable mineral under sedimentary conditions and is usually from second and third sedimentation cycles (Tucker, 1991). It is followed by calcite mineral in terms of dominance and it is found at a rate ranging between (16.4%) in the surface horizon of the MW3 series and the lowest value is (7.1%) at the last horizon of the MW5 series at a rate of (10.35%), then the group of feldspar minerals (orthoclase and black oclase) As its highest value is (12.2%) at the surface horizon of the MW3 series and its lowest value is (6.3%) at the last horizon of the MF11 series at a rate of (8.84%). The presence of feldspar in abundance is an excellent indicator of the existence of a dry climate in its environment. Interpretation of the existence of palaeoclimates (Folk 1974). Its relationship with quartz is considered an important key to knowing the history of sediments. As the size of Feldspat decreases relative to quartz, it indicates the effect of physical forces on its weathering (Ali and Saadallah, 1991). And the effect of these forces is more than chemical weathering processes in dry climate regions, then gypsum mineral with its highest value (8.2%) at the surface horizon of DM97 series and lowest value (5.8%) on the subsurface horizon of MW5 series at a an average of (6.62%). It is followed by mica minerals (Muscovite and Biotite), whose percentage is noticeably lower compared to the previous minerals and ranged between the highest value (9.7%) on the first horizon of the MW3 series and the lowest value (3.7%) on the subsurface horizon of the MF11 series, at a rate of (6.21%), This can be due to its weak weathering resistance and to weathering with smectite minerals under arid and semi-arid conditions. It is a flaky mineral with a hardness (2 - 3 mohs) and a parallel opacity and because of its lamellar shape, it can be washed from coarse sand and tends to aggregate and precipitate in the size of fine silt and finally the gyrite mineral where it has the highest value for it (5.2%) at the surface horizon of the MW5 series, the lowest value is (3.6%) at the subsurface horizon of the MW3 series, the subsurface horizon of the DM97 series and the last horizon of the MF11 series, at a rate of (4.11%). It is followed in order by the particles of rock fragments, where it was the highest value (38.5%) on the final horizon of the MF11 series and the lowest value (11.9%) in the surface horizon of the MW3 series with a rate of (25.60). It is one of the common fines in coarse sand and can be found in fine

Table 3: The percentages of Light Sand Minerals.

Physiogr-aphic site	Series	Depth (cm)	%	Quartz	Feldspar group	Calcite	Gypsum	Girt	Mica group	Weathering minerals	Weathering index
Physiog-raphic site River levee	MW3	0-27	91.2	38.4	12.2	16.4	7.5	3.9	9.7	11.9	1.755
		28-63	89.6	33.2	9.8	13.2	7.1	3.6	9.1	24	1.089
		64-110	90.5	34.1	7.4	15.1	6.2	4.1	8.2	24.9	1.183
irrigation levees channel	MW5	0-27	92.5	39.8	9.4	8.2	6.3	5.2	5.9	25.2	1.301
		28-62	93.4	37.8	8.5	7.3	5.8	4.1	5.2	31.3	1.053
		63-104	91.7	39.2	6.3	7.1	6.1	4.3	5.7	31.3	1.157
River basins	DM97	0-28	90.2	37.6	11.7	11.3	8.2	4.1	4.8	22.3	1.226
		29-65	89.3	41.7	9.2	9.7	6.7	3.6	7.6	21.5	1.476
		66-110	88.6	38.1	8.2	9.1	6.2	3.7	4.1	30.6	1.077
silted basins	MF11	0-29	93.2	42.5	7.6	8.2	6.2	4.5	4.3	26.7	1.370
		30-76	94.5	38.6	6.9	8.3	6.5	4.1	3.7	31.9	1.101
		77-112	91.4	34.7	6.3	6.7	6.1	3.6	4.1	38.5	0.855

sand. Despite its many types, Carbonate Rock Fragment is common in calcareous soils, which indicates its dry climate (Pettijohn, 1975). It may be accompanied by crystals of feldspar and some ferromagnetic minerals. The rock particles are soft and more sensitive to weathering. Therefore, one of the characteristics of sand deposited in aqueous sedimentary conditions is that it is rich in quartz and rock fragments that do not last long in sediments (Folk, 1974) and that their percentage increase in MF11 series horizons materials indicates Its proximity to the source of sedimentation and it did not cover long distances. As the survival of the rock fragments during the process of transport by the river is not easy because the size of most of them is reduced to be the size of clay or silt. And its percentage may increase due to additions from the branches of the channels, which compensates for the deficiency resulting from the erosion process (Pettijohn, *et al.*, 1973). And it may be due to mechanical erosion that overcame chemical weathering under conditions of rapid erosion that can quickly transfer materials or particles by water. Therefore, unstable minerals do not have sufficient time to undergo weathering and corrosion processes, so their proportions remain high percentage in sediments (Pettijohn, 1975), The difference in the proportions of minerals in these series is due to the possibility of variation in the weathering resulting from the influence of the management methods used in exploiting these soils such as plowing, irrigation and fertilization, in addition to the mineral deposits carried during their deposition. The weathering that occurs in sedimentary soils includes mineral weathering at its original source, as well as mechanical weathering during transport, then weathering that can take place on it while it is stable. It is, therefore and in general, it does not give real value to each of these stages, which may differ in their values. As for the weathering evidence, it indicates the weakness of the weathering processes, due to the high percentage of rock fragments and a decrease in the percentage of Chert mineral, while quartz and feldspar minerals appeared within the specified levels of sedimentary soils, The highest value of weathering index was 1.755 in the surface horizon of the MW3 series,

Table 4: The percentages of heavy sand minerals.

Physiographic site	Series	Depth (cm)	%	Opaque Mineral	Biotite	Muscovite	Pyroxene	Amphibole	Chlorite	Zircon	Gamet
River levee	MW4	0-27	8.8	39.6	3.1	4.8	9.2	7.2	5.3	4.3	2.8
		28-63	10.4	36.8	3.6	4.7	8.8	6.9	5.7	3.8	3.2
		64-110	9.5	38.1	3.5	5.2	8.9	6.7	5.6	4.6	3.5
irrigation levees channel	MW5	0-27	7.5	41.2	6.3	6.7	9.4	8.1	6.2	4.2	3.5
		28-62	6.6	38.4	5.7	7.3	8.4	7.5	6.7	3.9	3.8
		63-104	8.3	39.7	6.2	6.8	8.7	7.3	7.3	4.8	3.2
River basins	DM97	0-35	8.5	39.6	6.1	7.4	8.1	7.3	5.8	5.8	3.7
		36-70	7.9	41.1	5.9	7.8	7.9	7.5	5.9	6.3	2.9
		71-108	9.2	38.1	5.4	8.2	7.5	6.8	6.4	6.8	3.6
silted basins	MF11	0-29	6.8	39.4	4.5	6.9	7.8	7.6	6.7	7.3	3.5
		30-76	5.5	38.6	4.9	6.4	8.2	6.9	7.1	7.4	3.8
		77-112	8.6	37.9	6.2	7.6	8.1	7.2	7.3	6.7	4.1
Physiographic site	**Series**	**Depth (cm)**	**%**	**Epidote**	**Rutile**	**Tourmaline**	**Kyanite**	**Staurolite**	**Other**	**Wrh***	
River levee	MW4	0-27	8.8	3.2	1.5	4.5	1.7	2.2	10.6	0.537	
		28-63	10.4	3.1	1.7	3.8	2.1	2.6	13.2	0.484	
		64-110	9.5	3.5	2.1	4.1	1.9	3.4	8.9	0.558	
irrigation levees channel	MW5	0-27	7.5	3.1	1.9	3.1	2.4	3.5	0.4	0.417	
		28-62	6.6	3.5	1.8	4.2	2.1	2.9	3.8	0.509	
		63-104	8.3	3.2	2.4	4.7	2.2	3.1	0.4	0.594	
River basins	DM97	0-35	8.5	3.3	1.7	3.8	2.3	2.6	2.5	0.623	
		36-70	7.9	2.8	2.4	3.7	1.9	3.2	0.7	0.649	
		71-108	9.2	3.4	2.3	3.8	2.8	2.7	2.2	0.741	
silted basins	MF11	0-29	6.8	2.9	2.1	4.3	2.4	2.8	1.8	0.753	
		30-76	5.5	3.1	1.9	4.1	2.1	3.1	2.4	0.762	
		77-112	8.6	3.3	1.7	3.9	1.9	3.2	0.9	0.693	

*Wrh = (zircon + Taurmaline) / (amphibole + pyroxene).

while the lowest value was 0.855 at the last horizon of the MF11 series, with a rate of 1.22 for all studied sites. This can be due to the fact that these horizons may have been geomorphological surfaces with moist environmental conditions that contributed to the weathering of their minerals and then they were covered with fresh sediments. And their decline in some horizons may be due to the fact that they are sediments that have not been weathered for a long period of time or have not had sufficient time to weather their minerals (Al-Aqili, 2002).

Heavy sand minerals

Heavy minerals are associated with the geological components of soils and clearly reflect the characteristics of the original source of rocks. And which are usually derived from igneous and metamorphic rocks exposed in northeastern Iraq and its neighbouring regions, the proportions of heavy minerals in the fine sand separated as indicated in Table 4 range between (5.5-10.4%) and a rate of 8.13% for the general horizons studied, The opaque minerals were dominant and gave the highest values, which amounted to 41.2% in the surface horizon of the MW5 series, at a an average of 39.04% for the general horizons. The minerals group followed pyroxene where its highest value was 9.4% at the surface horizon of the MW5 series also at a an average of 8.42%, then the group of amphibole minerals, which had the highest value of 8.1% in the surface horizon of the MW5 series at an average of 7.25%, then came the minerals of muscovite, chlorite, zircon, biotite, tourmaline, carnate and Epidote. Staurolite, Kyanite and finally Rutile, Also, the Weathering minerals appeared at rates ranging between 0.4-13.2% and a an average of 3.98%, opaque minerals appeared in a heterogeneous distribution vertically for soil agglomerates, while pyroxene minerals decreased with depth in the MW3, MW5 and DM97 soil series, while they increased with depth at MF11 series. As for the weathering index values, they ranged between 0.417-0.762, which are low values due to the high percentages of amphibole and pyroxene compared to zircon and tourmaline. The results were consistent with what Al-Mashhadi, 2003 found, when studying the Latifiya project series.

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