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PREDICTION OF MINERAL TRANSFORMATION IN THE SOILS OF BABYLON

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Abstract:

The current study selected soils from the districts and sub-districts of Babylon provainc within the soils of previous studies, as they are located between longitudes 32° 21` 4738`` - 32° 52` 8442``N, and between latitudes 44° 28` 2978`` -44° 42 `7610``E. This is to predict the aggravation of mineral transformations in the surface and bottom horizon soil clays of the studied soil pedons. The size distribution of the soil separates of the current study showed the predominance of sand, which ranged between 220-668 g kg-1 in the surface horizons, as well as the predominance of sand in the soils of the lower horizons, which ranged between 195-595 g kg-1. The total surface area of the upper horizons ranged between 115.40-208.07 m 2 g-1, and the lower horizons ranged between 252.18-117.59 m 2 g-1. The electrical conductivity was 3.10-20.13 and 5.67-22.51 dSiM-1. While the content of organic matter was between 1.82-13.92 and 9.87-12.07 g kg-1 for surface and bottom horizon soils respectively. The proportion of swollen chlorite within the composition of the applied mineral smectite-swollen chlorite ranged from 26.05-41.68% in the surface horizons soil clays. Within the composition of the applied mineral, chlorite-chlorite swelled between 29.53-48.65% in the lower horizons soil clays.

Keywords: Prediction, Mineral Transformation, Soils, Babylon.

Introduction:

Al-Watifi (2012) when studying the effect of the transformation of montmorillonite mineral towards chlorite minerals on the physicochemical properties of some Iraqi soils indicated the predominance of montmorillonite, kaolinite, chlorite and mica minerals in the clays of those soils. Even in the sabkha and al-Shura soils, the X-ray results showed a shift in the smectite minerals towards chlorite as a result of the deposition of the brucite layer between the inner layers of the mineral montmorillonite. The inner layers of smectite minerals (2:1) expanded, especially montmorillonite, and its transformation towards chlorite minerals, as shown in Figure (2). Among its causes is the nature of the soil reaction (pH) tilted to alkaline, and the abundance of magnesium ions, as well as the predominance of expanded clay minerals (smectite) in the soils of arid and semi-arid regions, which are characterized by the phenomena of expansion and contraction during successive wetting and drying processes. Which allows the passage of magnesium ions with the soil solution between the inner layers of the minerals mentioned, and gets obstructed by the effect of the density of negative charges on the surfaces of the clay minerals, and in the case of drying it crystallizes in the form of magnesium hydroxides forming the inner layer of brucite and the occurrence of the phenomenon of chlorination. From the results of the X-rays obtained by the researcher, he inferred the presence of swollen chlorite resulting from the deposition of the magnesium hydroxide layer between the inner layers of the mineral montmorillonite, as a result of the appearance of a basal distance of 14 angstroms in all treatments except for the heating treatment of 550 °C, which led to its disappearance. As well as its collapse when the heating treatment of

350°C, but it gave a limited expansion of 15 angstroms when treated with ethylene glycol, This depends on the degree of fullness and stability of the formed brucite layer to resist the temperatures. There are several studies that have clearly shown over the years the occurrence of mineral transformations in some clay minerals, according to the different prevailing environmental conditions and factors that encourage the sedimentation of the brucite layer. Especially in Iraqi soils, including the study of Al-Dahi (2009), Al-Mashhadani (2011), Al-Qaisi (2013), Al-Jubouri (2015) and Al-Bakri (2020). And it has become something that constitutes a mineral threat that threatens the properties of mineral soils (AL-Wotaify, 2013). However, all these studies and others did not count the size and aggravation of the expansion in mineral transformations due to the occurrence of the aforementioned phenomenon in Iraqi soils. Therefore, the study was directed to achieve the following aims:

1. Obtaining data on mineral transformations and their causes in soils from Babylon provainc, and calculating the percentages of metamorphic minerals.
2. Diagnosis of some clay minerals and the percentages of minerals in which mineral transformations occurred in the soils of the study, as well as the assessment of some physical and chemical traits.

Materials and methods:

After an extensive study of the results of X-rays, and some of the physical (Table 1) and chemical properties of the soils of the surface and bottom horizons of pedons, previous studies in the Babylon province showed the most important environmental conditions and factors affecting the occurrence of the phenomenon of chlorination.The percentage of swollen chlorite mineral was calculated (Table 2), arising from the deposition of the brucite layer between the inner layers of smectite minerals, and then the field procedures of the current study were carried out in the year 2021 AD by selecting surface and bottom horizons of pedons representing the soils of previous studies over the successive years , Starting from the study of Al-Watifi (2012) to the study of Al-Bakri (2020), and comparing it with the current study, it is possible that the phenomenon of chlorination was in the beginnings of its establishment and turned into its intermediate stages or moved from its intermediate to its final stages during those years.

Previous studies:

Al-Watifi (2012) studied the effect of montmorillonite mineral transformations into chlorite on the physicochemical properties of some Iraqi soils through the selection of soil pedons of varying conditions and environmental factors and surface and bottom horizons, as well as the implementation of a laboratory experiment with 96 samples of montmorillonite mineral added to some of them 3% organic matter. It was irrigated with magnesium chloride solution under four modes of wetting and drying. And among the most important conditions and environmental factors, including the effect of the rise and fluctuation of ground water, in addition to the agricultural exploitation of horticultural and palm trees, for a soil bedoun that was adjacent to the Shatt al-Hilla in the Alsiyahi area (P5), and the sixth pedons (P6) in the Al-Bunafa area.

Table 1: Some of the physical properties of the soils of the pedons horizons of the previous studies, which preceded the current study.

Previous studies	physical properties					depth (cm)	horizon	pedons	Region
	Total Surface Area (m2g-1)	Texture	Size distribution for soil separates (kg-1 gm) clay	silt	sand				
Al-Watifi (2012)	364.70	SiC	451.30	506.80	41.90	-30 70	C_1	P_5	alsiyahii
	388.90	SiL	129.70	568.90	301.40	-130 150	Ck_3		
	251.30	SiC	351.30	456.60	192.10	020-	Az	P_6	albunafie
	294.80	SiCL	297.60	574.90	127.50	-100 120	Cz_2		
alkaebi (2015)	-	L	300	450	250	35-0	Ap	P_1	University of Babylon
	-	SiL	230	550	220	30-0	Ap	P_8	Sinjar
Al-Salamawi (2017)	330	SiL	370	550	80	-78 110	C_3	P_4	
	385.90	SiL	300	630	70	-87 120	C_3	P_5	alhashimia
Al Jubouri(2017(	212.23	CL	320	420	260	36-0	Ap	P_2	
Al-Mamouri(2019(	323.10	SiC	448	468	84	33-0	Ap	P_2	rafieat
Al Jubouri(2017)	180.76	SiC	420	480	100	-101 140	C_3	P_1	Al-jumjumat Southern
Al-Bakri(2020)	-	SiCL	378.92	591.78	29.30	30-0	Surface soil sample		

Table 2: Some chemical properties of the soils of the pedons horizons of previous studies, and the percentage of puffy chlorite.

Previous studies	The percentage of the bloated	chemical properties						depth (cm)	horizon	pedons	Region
		forms of magnesium ions (cmol kg-1) Non-	mutual	dissolved	CEC)cmol+ kg^{-1}(	O. M.)g kg^{-1}(	pH				

	chlorite mineral	mutual									
Al-Watifi (2012(	20.19	192.59	5.55	0.54	24.50	2.90	7.90	-30 70	C_1	P_5	alsiyahii
	26.90	155.07	5.10	0.21	18.20	8.20	7.20	130 - 150	Ck_3		
	30.66	169.95	4.10	1.44	23.60	7.80	7.10	0-20	Az	P_6	albunafie
	43.62	56.06	5.60	1.93	13.80	0.60	7.30	100 - 120	Cz_2		
alkaebi (2015(	24.95	-	-	2.57	30.4	3.50	7.40	-0 35	Ap	P_1	University of Babylon
	24.91	-	-	1.12	24.5	7.40	7.50	-0 30	Ap	P_8	Sinjar
Al-Salamawi (2017(	25.38	-	-	0.15	16.45	11.60	7.40	-78 110	C_3	P_4	
	25.31	-	-	0.179	18.49	11.60	7.50	-87 120	C_3	P_5	alhashimia
Al-Mamouri(2019(	20.44	0.84	9.4	0.82	23.94	6.70	7.70	-0 36	Ap	P_2	
Al-Mamouri(2019(	44.57	-	-	-	15.11	1.56	7.70	-0 33	Ap	P_2	rafieat
Al Jubouri(2017(	27.79	0.32	5.6	0.50	19.99	2.60	7.80	101 - 140	C_3	P_1	Al-jumjumat Southern
Al-Bakri(2020(	50.83	22.57	3.20	2.44	-	11.20	7.40	-0 30	Surface soil sample		

The sixth pedons had a surface soil affected by the accumulation of salts, as well as the rise and fluctuation of the ground water level and the increase in the concentration of salt ions at its bottom depth. One of the most important things that was confirmed by the results of X-ray diffraction was the study of Al-Watifi (2012),As well as gravimetric and differential thermal analysis devices, and infrared technology, it is the presence of shifts in smectite minerals towards the swollen chlorite mineral as a result of the deposition of a layer of magnesium hydroxide (brucite) between the inner layers of smectite minerals, and the occurrence of chlorination in them.

Al-Kaabi (2015), when studying the preparation of mineral composition maps using the spatial variability of some soils of the Middle Euphrates region, showed the presence of chlorite minerainflated in the surface horizon clays of the pedon soil opposite the University of Babylon (P1), and the Sinjar region north of the city of Hilla (P8). The identified minerals ranked second after montmorillonite, with a percentage of 24.95 and 24.91%, respectively.

This was explained by the predominance of smectite minerals in the soils of arid and semi-arid regions, and the availability of conditions and environmental factors that encourage their transformation towards chlorite minerals, where a result of the properties of expansion and contraction in their inner layers.

This facilitated the entry and crystallization of magnesium ions to be deposited in the form of a brucite layer. This was confirmed by the results of his study of X-ray diffraction, which showed the limited expansion of montmorillonite mineral 15.76 angstroms in the ethylene glycol treatment, and the persistence of the basal distance with a value of 14.15 angstroms in the 350 °C heating treatment, which reflects the fullness of the formation and stability of the inner hydroxide layer.
The study of Al-Salmawi (2017) in the mineral variation of the sediments of the Tigris and Euphrates rivers at the cities of Kut and Hilla indicated the presence of the aforementioned mineral, and the beginnings of the occurrence of the phenomenon of chlorination in the clay of the soil of the lower horizon of Sinjar soil (P4), through the results of X-ray diffraction, which showed the continuity of the basal distance 14.10 Ankstrom when treating with ethylene glycol, and not appearing when heating 350 and 550 °C.

This is what Al-Salmawi (2017) found in the same study of the lower horizon clays of Al-Hashemite pedon soil (P5). This expresses the low amount of the chlorite mineral that is swollen, resulting from the beginnings of sedimentation and formation of the brucite layer.

The reasons for this were attributed to the rapid rise and fluctuation of the ground water and the time period of successive wetting and drying processes, which is one of the most important conditions encouraging the hydration and passage of magnesium ions between the inner layers of the expanded smectite (1:2) minerals, and thus the completion of the process of forming and crystallizing a polymer of magnesium hydroxides depends on the length of the drying period.This results in the sedimentation of a layer of brucite, especially since the pedons site was close to the right side of the Shatt al-Hilla shoulder for those two areas, and the soil had a vegetation cover of gardening and palm trees. This was reinforced by the study of Al-Jubouri (2017) on the use of some chemical criteria and geographic information systems in assessing the readiness of potassium and its relationship to mineral composition in the soils of Babylon province ,That the presence of the bloated chlorite mineral in the surface horizon clays of Al-Hashemite pedon soil (P2) was weakly crystallized with a base distance of 14.38 angstrom in the saturated with magnesium and air-dry treatment, and expanded to an interaction diffraction of 16.85 angstrom in the ethylene treatment, while it collapsed in the two mentioned heating treatments. Al-Mamouri (2019) when studying the contamination of soil and vegetation irrigated with the waste water of the Al-Maamira station in Babylon province with some heavy elements, indicated the presence of chlorite mineral bloated in the surface horizon clays of the pedon Al-Rafaiat soil (P2) through the presence of a basal distance of 14.47 angstroms, which was accompanied by the third and fourth scatterings. For the mineral chlorite swollen at the basal distances of 3.55 and 4.74 angstroms, respectively, It disappeared when the heating treatment was 550 °C, which indicates the formation and stability of the inner hydroxide layer between the layers of smectite minerals and the occurrence of chlorination phenomenon in it.Al-Jubouri (2017) reported in his aforementioned study the presence of the bloated, weakly crystalline mineral chlorite in the surface horizon clays of the soil of pedons aljumjumah south (P1) in the ancient city of Babylon. While the study of Al-Bakri (2020) confirmed the effect of the temporal and biological factor in some mineral transformations of the soil of the ancient city of Babylon, by the presence of the regular stratified mineral chlorite-chlorite swollen in the surface sample soil at a depth of 0-30 cm from District 15 of the southern aljumjumah region,He attributed this mineral transformation to the impact of agricultural exploitation of long-lived palm trees, where a result of the accumulation of tree residues and the decomposition of organic matter .In addition to the activity of organisms and their secretions over the length of time, transformations can occur in smectite minerals towards swollen chlorite, which represents an intermediate stage that ends with the transformation of smectite or swollen chlorite minerals into chlorite minerals.

Results and discussion:

The physical properties of the soils of the current study

Size distribution of soil separates :

Table 3 shows the size distribution of the soil separations of the horizons of the pedouns of the current study, as the predominance of sand particles in the surface horizons soils ranged between 220-668 g $kg^{-1,}$ followed by the silt separation between 100-400 g kg^{-1}, and then clay between 130-450 g kg^{-1}, indicating The results indicated that the soils were near the source of sedimentation, which would accumulate sediments of larger granular size, as a result of the heaviness of these particles compared to fine clay particles that were conducted greater distances according to the river flow rate (Atallah, 2009.(This confirmed the volumetric distribution of the soil separates of the lower horizons, in which sand prevailed in an amount ranging between 195-595 g kg^{-1}, and then silt and clay came in an amount ranging between 225-550 and 55-430 g kg^{-1}, respectively. The highest amount of sand in the surface horizon was from the soil of pedons al-Awwal (P1), which was along the Shatt al-Hillah in the tourist area, and with a texture class that was a sandy loam. While the least amount of sand was at the soil of the second pedons (P2), which was farther away in the Al-Bunafa area, and with a texture class that was a clay loam. The amount of sand in the soil of the surface horizon came from the soil of the fourth (P4) pedons in the Sinjar region, consistent with the soil of the first pedons in terms of the high amount of sand, and the soil texture itself was sandy loam.The least amount of sand was in the lower horizon at pedons al-Turbah itself (Al-Bunafa). Likewise, in the soil of the lower horizon of pedons , the soil of Al-Rafiyat, which was at a farther distance from the source of river sedimentation, and by class as well.

The total surface area of the soil

The specific surface area of a soil material is defined as proportional to the total surface area per unit volume (av) or mass (am) of particles, or per unit total volume of soil (ab) as shown by Hillel (1980) and Sepaskhah et al. (2010). Depending on the definition, Table 3 shows the results of the total surface area of the soil horizons of the pedons of the current study, as it ranged between 115.40-208.07 m ^{2} g^{-1} for surface horizon soils. The decrease in the total surface area coincided with the increase in the amount of sand in the soil of the surface horizon of first pedon, As for the highest value, it was in the soil of the surface horizon of the second pedons , which has the highest percentage of bloated chlorite mineral (41.68%), as shown in Table 6.While the total surface area of the soils of the lower horizons ranged between 117.59-252.18 m ^{2} gm^{-1}, and it was less valuable for the soil of the lower horizons than the soil of the first pedons , which had the least amount of clay. The highest value was in the soil of the lower horizon of the same bidoun, which had the least amount of sand, and the highest percentage of swollen chlorite amounted to 48.68 m ^{2} g^{-1} among the soils of the lower horizons.The results indicate that there is an effect of the size distribution and the type of soil classifiers, as well as the type of mineral prevailing in the soil clays, and the proportion of the mineral chlorite inflated in the specific and total surface area. The surface area is inversely proportional to the particle size, and the geometric shape of the particles, which increases as it is elongated.This was confirmed by the study of Ersahin et al. (2006), Fooladmand et al. (2011) that sand has a low specific surface area because of its granular size, and its geometric shape, which is mostly spherical, in contrast to clay, which is characterized by a high specific surface area because of its fine grain size less than 2µm, and its lamellar geometry. Likewise, what was shown by AL-Wotaify (2019) that the type of mineral in the soil clays has a role in the surface area.

Table 3 shows the size distribution of the soil separates of the study's pedons horizons and the total surface area of the soil

total surface area ($m^2.g^{-1}$)	Soil texture	Size distribution for soil separates (kg-1 gm)			depth)cm(	horizon	pedons
		clays	silt	sand			
115.40	SL	130	200	668	30-0	A_P	P_1
117.59	SiL	55	550	395	130-90	C_3	
134.02	CL	405	375	220	25-0	A_P	P_2
252.18	CL	305	500	195	150-110	C_2	
138.04	CL	230	375	375	25-0	A_{P3}	P_3
220.08	SL	160	250	590	140-110	C_3	

173.70	CL	255	275	470	30-0	A_P	P_4
140.36	SL	180	225	595	130-90	C_3	
162.55	SCL	280	100	295	30-0	A_P	P_5
205.47	CL	305	475	220	140-110	C_3	
208.07	CL	430	275	295	30-0	A_P	P_6
247.20	C	430	375	195	140-110	C_3	
155.50	L	155	400	445	30-0	A_P	P_7
240.62	CL	380	300	320	145-110	C_3	

As the presence of smectite minerals in the soil mud contributes to increasing the surface area, as a result of the ability to expand their surfaces, and unlike the minerals chlorite and kaolinite, with their presence, the surface area is low because their surfaces do not expand.While the presence of the swollen chlorite mineral has an important role in increasing the surface area, according to what was reinforced by the study of Chàvez-Garcîa (2006) and Al-Watifi (2012) on the effect of sedimentation and the degree of filling of the inner hydroxide layer between the inner layers of the smectite minerals, and its shift towards the swollen chlorite mineral contributes to the widening of the structure Composition of the external and internal surfaces. By observing the results, it appears that the percentage of chlorite mineral has an effect on the total surface area of the soils of the horizons of the pedons of the current study.As the soils of the upper horizons had a surface area and percentages of swollen chlorite less than in the soils of the lower horizons that had a higher surface area and percentages of the aforementioned mineral, regardless of the amount of sand. The reasons may be attributed to the severe conditions and environmental factors prevailing in the soils of the lower horizons, which led to the formation of a layer of brucite with a high quantity and degree of fullness between the inner layers of smectite minerals and its transformation towards the swollen chlorite.Including the rise and fluctuation of the ground water level solution rich in magnesium ions. Which increased the specific surface area of the clays, which reflected a high total surface area, compared to the surface horizons soil clays of the current study.

Table 4 shows some of the chemical properties of the soils of the current study

EC)dS m^{-1}(	pH	depth)cm(	horizon	pedons
3.10	7.91	30-0	A	P_1
6.25	7.02	130-90	C_3	
1320.	7.56	25-0	A_P	P_2
22.51	7.19	150-110	C_2	
4.09	8.01	25-0	A_P	P_3
5.67	7.98	140-110	C_3	
7.08	8.02	30-0	A_P	P_4
8.28	7.48	130-90	C_3	

11.79	7.74	30-0	A_P	P_5
18.89	7.62	140-110	C_3	
6.89	7.60	30-0	A_P	P_6
9.12	7.39	140-110	C_3	
13.69	7.30	30-0	A_P	P_7
12.12	7.39	145-110	C_3	

Chemical properties of the soils of the current study

Electrical conductivity (EC) and pH:

Table 4 shows that the pH of the surface horizons of the pedons of the current study (pH) ranged between 7.30-8.02, and for the soils of the lower horizons it ranged from 7.02-7.98.The results indicate that the interaction of the soils of the current study was neutral, inclined to basal, and within the ranges of soils of arid and semi-arid regions of calcareous origin, which works on the presence of large quantities of calcium carbonate, which itself has a buffering force.It makes the interaction of these soils moderately alkaline due to the effect of their decomposition and the release of hydroxyl ions (OH-) on the one hand, and the increase in the concentration of calcium carbonate, which leads to an increase in the saturation rate with bases on the other hand (Awwad, 1986 and Al-Zubaidi, 1989).The electrical conductivity values shown in Table 4 for surface horizon soils of the pedons of the current study ranged between 3.10-20.13 dSm^{-1}. For the soils of the lower horizons, the electrical conductivity ranged between 5.67-22.51 dSm^{-1}.From the observation of the results, the electrical conductivity values were lower in the soils of the surface horizons than those of the lower horizons, and the reasons can be attributed to the accumulation of salts in the soil of the lower horizons, where a result of the high level of ground water, which is one of the characteristics of the soils of the central and southern regions of Iraq.Among the most important factors influencing soil properties, according to what was indicated by several studies, including Al-Hassani (1984), Al-Mashhadani (1994), Al-Bazrangi (2001) and Salim and Al-Falahi (2009). It also has an important role in the transformations of soil minerals, especially the occurrence of chlorination in smectite minerals, including montmorillonite, which prevails in saline soils and turns towards swollen chlorite (Al-Hasani, 1984; Al-Watifi, 2012 and Al-Jubouri (2015).The variation in the process of salt accumulation, which is expressed in the difference in electrical conductivity values in the soils of the surface and bottom horizons, could be one of the reasons for the occurrence of the phenomenon of chlorination, and the high proportion of swollen chlorite in the clays of the soils of the lower horizons, compared to the surface horizons. As for the relationship of pH with electrical conductivity, according to the results of the current study, where shown by the values shown in Table 4, there is an inverse relationship between pH and electrical conductivity.The reason for this relationship may be due to the fact that an increase in the concentration of salts contributes to an increase in the exchange complex by saturation with bases and exchange with hydrogen ions whose concentration increases in the soil solution, which reduces the reaction of the soil solution medium.on the contrary, the low base ions exchanged on the exchange complex, and the retention of inactive hydrogen ions on the surfaces of the ion exchange complex makes the concentration of hydrogen ions low, compared to the hydroxyl ions in the soil solution tend to be towards the base reaction of the soil. This was confirmed by Al-Zubaidi (1989) that soil interaction values in general are associated with an inverse relationship with electrical conductivity values.

The mineral properties of the current study soils:

Table 5 shows the basal distances of the surface horizons soil clays, which gave basal distances that ranged between 29.19-29.89 angstrom in the sample saturated with magnesium and air-dry.It widened to reach the interaction diffraction ranged between 30.06-31.61 angstroms for the magnesium-saturated sample treated with ethylene glycol. While it decreased to a basal distance that ranged between 22.10-24.32 angstroms when treated with potassium saturation, heated to a temperature of 350 °C. Which indicates the presence of the layered mineral smectite-chlorite swollen, resulting from the interaction of layers of smectite minerals, which showed a base distance of 15.58 angstroms.Some of its layers turned into a swollen chlorite mineral, which gave a base distance of 14.31 angstroms when saturating with magnesium, and the dry air: 15.58 + 14.31 = 29.89 angstroms achieved by the surface horizon clays of the second pedons . When the sample saturated with magnesium, and treated with ethylene glycol, the basal distance of smectite minerals expanded, which reached the highest value of 17.31 angstroms, With the interference diffraction of the bulging chlorite mineral 14.31 angstroms, which resulted from the sum of the overlapping layers, the basal distance was 31.62 angstroms. What strengthened the existence of this type of stratified mineral mentioned is the collapse of the basal distance of the smectite minerals to reach an interaction diffraction of 10.01 Å,And the continuation of the basal distance of the swollen chlorite mineral 14.31 angstroms within the composition of the applied mineral when the potassium saturation treatment was heated to a temperature of 350 °C, and it disappeared when the potassium saturated treatment was heated to a temperature of 550 °C.

Table 5: The mineral properties of the surface and bottom horizon soil clays of the study pedons

Fluffy Chloride Percentage(%)	Basal distance at treatments(A°)				horizon	pedons
	K-550C°	K-350C°	Mg-EG	Mg-AD		
34.07	Crashes	24.58	30.06	29.90	A	P_1
43.72	13.39	24.45	28.48	28.49	C_3	
41.68	Crashes	24.32	31.62	29.89	A_P	P_2
48.65	24.01	28.45	28.87	28.97	C_2	
31.57	Crashes	24.30	30.22	29.80	A_P	P_3
33.71	23.10	28.12	28.55	28.77	C_3	
36.07	Crashes	24.18	30.22	29.23	A_P	P_4
30.14	24.12	28.15	28.33	28.71	C_3	
26.05	Crashes	26.36	31.11	29.09	A_P	P_5
29.53	13.96	24.08	30.22	28.75	C_3	
27.52	Crashes	22.10	31.11	29.24	A_P	P_6

31.41	24.19	28.05	28.23	28.51	C_3	
37.99	Crashes	24.31	30.61	29.12	A_P	P_7
40.25	23.80	28.15	28.75	28.94	C_3	

The soil clays of the lower horizons showed a basal distance, as shown in Table 5, that ranged between 28.49-28.97 angstrom when the treatment was saturated with magnesium, and it was air dry. It persisted with a basal distance that ranged between 28.23-28.87 angstroms when treated with magnesium and ethylene glycol. The same applies to the treatment saturated with potassium, heated to a temperature of 350 °C with a basal distance of 28.45 Å.Which indicates the applied mineral chlorite - swollen chlorite, due to the continuity of the base distance for the real chlorite mineral 14.45 and 14.31 angstroms for the swollen chlorite mineral. The basal distance of the swollen chlorite mineral collapsed to 10.06 angstroms, and the basal distance of the real chlorite mineral remained stable when the heating treatment was 550 °C (13.95 angstroms).The proportions of the swollen chlorite mineral in Table 3 for the clays of the surface horizons within the composition of the applied mineral smectite-swollen chlorite ranged between 26.05-41.68%, and for the clays of the lower horizons within the composition of the applied mineral chlorite-swollen chlorite between 29.53-48.65%.This indicates that the proportion of the bloated chlorite mineral within the composition of the applied mineral in the bottom horizons clays is higher than its percentage within the composition of the applied mineral in the surface horizons clays.This means that the transformation of smectite minerals towards swollen chlorite is in advanced stages within the composition of the applied mineral chlorite-swollen chlorite, and by environmental conditions and factors that encouraged sedimentation and an increase in the degree of brucite filling of the inner layers of smectite minerals in the lower horizons soil clays, including the high magnesium ions (Table 5), and their concentration In the ground water, which also played an important role in the passage of the aqueous solution between the inner layers during the humidification processes.Magnesium hydroxides crystallized during successive dehydration cycles in the form of polymers forming a layer of brucite within the inner layers of smectite minerals, transforming it into swollen chlorite within the applied mineral chlorite-swollen chlorite.This is achieved by the lower horizon of the second pedons with the highest percentage of swollen chlorite, compared to the surface horizon clays, and these differences can be due to the solid transformation mechanism and to the dissolution transformation mechanism, as shown by Banfield and Murakami (1998), as the sufficient moisture decrease for the complete transformation of smectite minerals into bloated chlorite mineral in the surface horizon clays, Perhaps it took place according to the solid transformation mechanism due to the decrease in the necessary energy required by the process of transformation of smectite minerals due to the decrease in the amount of precipitation to which the surface layers are exposed, and accordingly the drying processes increase and the moisture decreases that prevent the completion of the mineral transformation process. While the energy required for the transformation process is provided in the lower layers due to the rise and fluctuation of ground water,As well as increasing the concentration of dissolved magnesium ions in it encourages the transformation mechanism by dissolution. This is shown by

Al-Jaff (2006) in his study of the nature of the formation and presence of layered minerals and the factors affecting them in some Iraqi soils, which showed the mechanics of solid transformation and dissolution.

References

Al-Watifi, Abbas Sabr Sarwan (2012) The effect of montmorillonite transformations into chlorite on the physicochemical properties of some Iraqi soils, PhD thesis, College of Agriculture, University of Baghdad: 58-117.
Al-Zubaidi, Ahmed Haider (1989). Soil salinity - theoretical and applied foundations, College of Agriculture, University of Baghdad, Ministry of Higher Education and Scientific Research / Iraq.
Al-Hasani, Ali Abbas Muhammad. 1984. A study of the characteristics of sabkha and shura soils in some regions of Iraq. Master's thesis in Soil Sciences - College of Agriculture - University of Baghdad.
Al-Dahhi, Hashim Hanin Karim Muhammad (2009) The effect of vegetation cover on the weathering of mica minerals in some forest soils in northern Iraq, PhD thesis - College of Agriculture - University of Baghdad.
Al-Bakri, Salah Khudair Mugheer (2020) The effect of the temporal and biological factor on some mineral transformations of the soil of the ancient city of Babylon, Master Thesis, College of Agriculture, Al-Qasim Green University: 48-93.
Al-Qaisi, Ali Issa Hussein (2013) Evaluation of the thermodynamic state of potassium in the calcareous soils of the regions of the Middle Euphrates, Master Thesis, College of Agriculture, University of Babylon: 58-64.
Al-Mashhadani, Ola Nuri Ibrahim, 2011, A study of the mineral and micromorphological characteristics of sabkha and al-Shura soils in some regions of central Iraq, master's thesis - College of Agriculture - University of Baghdad.
Al-Bakri, Salah Khudair Mugheer (2020) The effect of the temporal and biological factor on some mineral transformations of the soils of the ancient city of Babylon, Master Thesis, College of Agriculture, Al-Qasim Green University: 48-93.
Al-Jubouri, Louay Manhal Jafat (2017) The use of some chemical standards and information systems to assess the readiness of potassium and its relationship to mineral composition in the soils of Babylon Governorate, master's thesis, College of Agriculture, Al-Qasim Green University.
Al-Salmawi, Nour Al-Huda Jawad Kazem (2017) Mineral Variation of Sedimentation of the Tigris and Euphrates Rivers at the Cities of Kut and Hilla, Master Thesis, College of Agriculture, Al-Qasim Green University: 37-71
Al-Kaabi, Ramy Iyad Shaker (2015). Preparing a map of mineral composition using the spatial variability of some soils of the Middle Euphrates region, master's thesis. Soil Science Department, College of Agriculture, Al-Qasim Green University.
Al-Barzanji, Ibrahim Mohamed Amin Ahmed 2001). The effect of temporal variation of land reclamation processes on some sedimentary soil properties from the middle of the sedimentary plain. PhD thesis. College of Agriculture, University of Baghdad.

Al-Jaf, Barzan Omar Ahmed Muhammad (2006). The nature of the formation and presence of stratified minerals and the factors affecting them in some Iraqi soils. PhD thesis. faculty of Agriculture . Baghdad University.

Al-Jubouri, Raad Farhan Shahd (2015). The effect of salt accumulation on the conversion of montmorillonite to chlorite in some middle Euphrates soils. Master Thesis. faculty of Agriculture . Al-Qasim Green University.

Atallah, Michel Kamel (2009). Fundamentals of geology. Dar Al Masirah for publication and distribution. Amman. Jordan.

Awwad, Kazem Mashut (1986). Soil chemistry. Ministry of Higher Education and Scientific Research. Albasrah university.

Al-Mamouri, Zaid Atta Sbeit (2019) Evaluation of soil contamination and irrigated plants with the waste water of the Al-Maamira station in Babil Governorate with some heavy elements. Master thesis, College of Agriculture, Al-Qasim Green University.

Al-Mashhadani, Ahmed Salih (1994) Surveying and Classifying Soils, University of Mosul, Ministry of Higher Education and Scientific Research.