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Identification of Salt phases and mineralogical Composition of Saline Soils in Alwihda project

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Abstract

This study was conducted to identify the salt phase and the causes of the chloritization phenomenon, which transforms the group of smectite or montmorillonite minerals into chlorite, or the chlorite originally present, inherited from the parent material of these soils. This negatively affects the soil properties, such as the specific surface area (SSA) and the cation exchange capacity (CEC), thus affecting the soil's chemical and fertility aspects. The research was carried out in the Al-Wahda project in Wasit Governorate, which is subject to conditions of drought and salinization. (6) surface samples representing the region's soil were collected to a depth of (0-30) cm. Chemical and mineralogical analysis was carried out using X-ray technology. However, the salinity standards were determined and the predominant salt phases in the samples under study were identified. The results indicated that the salt phases ranged between the chloride phase, which indicates the predominance of chloride salts, and the sulphide phase, which indicates the predominance of sulphide salts. Moreover, the results revealed the presence of the mineral chlorite type (Real chlorite), which causes the prevailing chloritization phenomenon in the study area, and not of the type of chlorite formed pedogenically. As well as the presence of metamorphic mica minerals was also identified, the most prevalent of which is mica-smectite as an interstratified mineral, and the mineral biotite, which belongs to a group of minerals Tri-octahedral, affects the exchange reactions in these soils and also the availability of nutrients in the exchange complex.

Keywords: (Real chlorite, Sulphide phase, Chloride phase, Tri-octahedral group of minerals).

Introduction

Saline soils, or those that are constantly under the influence of salinization, have wide importance in the agricultural sector. In recent years, studies have been directed towards the deterioration caused by the phenomenon of salinity in arable lands, which can be defined as soils that were formed due to the accumulation of a large percentage of easily soluble salts in water, which causes its

deterioration and departure from its usual agricultural range. There are two types of salinization. The first includes the sources from which the soil was formed, which is called primary salinization. The second occurs as a result of the accumulation of salt in the soil with time, which is called secondary salinization [1] and [2]. The gradual accumulation of salts in the soil occurs as a result of a large number of geochemical and pedogenic processes taking place in the upper part of the surface layer of the earth's crust. The phenomenon of soil salinization is common in the arid and semi-arid regions of the world as a result of the prevailing conditions in them of high temperatures, low annual precipitation rates, and high evaporation rate of groundwater near the surface of the soil with high salinity levels[3,36]. The salinization phases differ in Iraqi soils, especially in the alluvial plain, from Shura to Shura, sabkha, and sabkha, and these are local names used to express salinity relative to its predominance of salts and the nature of the salt phases in it, which naturally reflects its surface crust, color, and nature of its consistency [4]. The mineral composition of the soil is among the important properties that indicate the severity of soil formation factors and the extent of homogeneity in the soil body. Studying soil-forming minerals of various kinds and then tracking the path of their physicochemical transformations from one mineral to another is considered an absolute necessity in understanding each of their chemical and fertility properties [5,6,7,8,9,37]. Chloritization is among the natural phenomena that may be observed in some soils, which in turn depends on the chemical, mineralogical, and pedological properties of the soil and as a result of the deposition of hydroxides of each of the ions (magnesium, aluminum, and iron) in the inner layers within the composition of minerals 1:2 such as montmorillonite (MMT), to gradually shift with the aging of time to the 1:1:2 chlorite. This layer of deposits of hydroxides in these minerals is called the inner layer of magnesium hydroxide (brucite) $Mg(OH)_2$ if the deposits of magnesium ions are prevalent in it. In the case of aluminum ions being deposited, they are then called gibbsite $Al(OH)_3$, and if the iron ions are deposited in the inner layer of the mineral, they are called (the inner iron hydroxy layer), with that soil being exposed to successive cycles of wetting and drying, and the time factor having a direct effect on the gradual transformation of the montmorillonite mineral towards Chlorite mineral and its negative effects on soil properties in terms of affecting CEC, the specific surface area of the soil and the minerals prevalent in it [10,11,12,13,38]. Likewise, the fact that some soils contain high concentrations of magnesium ions as a result of the accumulation of salts in them has a direct effect on the deposition of a layer of magnesium hydroxide in the inner layers of the montmorillonite mineral. This causes the phenomenon of chloritization in some saline soils and through high groundwater levels, causing successive cycles of wetting and drying, with the predominance of the mineral montmorillonite in these soils. As [13,14,15,16,39,40] stated among the most important factors encouraging the occurrence of this phenomenon in Iraqi soils are (soil pH, oxidation, and reduction processes, its content of organic materials, wetting and drying processes, ratio of the presence of positive ions to hydroxyl ions in the inner layer of the mineral, salts accumulation in soil, size of clay mineral particles, filling degree of the inner layer, high groundwater levels, prevailing positive ion concentration, and the chronological age of deposition in the inner layer as a result of wetting and drying cycles).

Research materials and methods

The sampling sites for the study area were determined through repeated field visits to the area using the reconnaissance survey method for the period from 1/11/2023 to 30/11/2023, as surface samples were taken from different areas of the study soil to a depth of (0-30) cm from the soil located under

the influence of salinity in six samples. It was dried air-dried and struck with a wooden hammer, then passed through a sieve with holes diameter of 2 mm, and then packaged and preserved in plastic bags, with detailed information written on them. Later transported to specialized laboratories to conduct the required analyses. Table 1 shows some of the physical and chemical characteristics of the study soils. Table 2 shows some salinity standards and the prevailing salt phases in soils.

Physical analyses:

- Particle size distribution

The International Hydrometer method was used to estimate the size distribution of soil separates according to what was mentioned in [33].

Chemical analysis:

- Soil reaction number (pH) and electrical conductivity (EC_e).

They were estimated in the saturated dough extract using the pH meter and EC-meter according to what was mentioned in[17].

- Cation exchange capacity (CEC)

The soil cation exchange capacity was estimated using the sodium acetate method according to [18].

- Soluble Ca^{+2} and Mg^{+2}

It was estimated by titration with (Na2 - EDTA) (N 0.01) according to[17].

- Soluble Na^{+} and K^{+}

It was estimated using a flame photometer, Biotech model AFB100, according to[17].

Identification of clay minerals using X-ray diffraction:

Clay minerals were identified using X-ray diffraction using a Philips X-Ray Diffraction device according to what was mentioned in Jackson (1979), in the laboratories of the College of Science, University of Baghdad, Department of Earth Sciences, and laboratories of the Department of Science and Technology, integrated with the Ministry of Higher Education and Scientific Research.

Identification of salt phases:

It was determined using the following equation:

$$\text{Salt Phase} = \frac{[Cl^{-}]}{[SO4^{-2}]}$$

If the ratio is greater than 1, the dominant salt phase is the chloride phase, and if less than 1, the su sulphide phase dominates.

Salinity standards:

Salinity standards in soils (SAR, ESR, TDS, and ESP) were determined according to what was mentioned in (35 ,17).

Results and discussion

- Particle size distribution

The results showed in Table (1) the size distribution values of the soil separate under study, which indicates that there is a variation in the size distribution of the separate values and the nature of their distribution. The results indicate that the clay separates in the study soils ranged between (168-508)

g.kg^{-1}, which is considered the most effective and influential component in the formation and transformation of the chloritization phenomenon under study. As for the percentage of silt separate, it ranged between (260-400) g.kg^{-1}, and the sand separate ranged between (92-532) g.kg^{-1}, and this reflects the nature of the locational factors specific to the samples under study in terms of the erosion, sedimentation, and transport processes to which the area is exposed due to the prevailing climate conditions of the study area and the resulting variation in soil texture for the selected sites. The presence of four types of texture was identified. Sandy Loam texture was texture for each of Samples No. 1 and 5, Loam texture for Samples No. 2 and 6, while Sample No. 3 texture was Clay and Sample No. 4 Silt Clay. The identification of these textures in the project area is due to the activity of transport and sedimentation processes, as it is a newly formed, undeveloped sedimentary soil characterized by the characteristic of stratigraphy transferred from one region to another due to various transport factors. In some areas, they may be affected by the effectiveness and activity of water movement during the seasons of the year, which causes the region to have water sedimentation environments accompanied by weak and slow-moving water currents, which has contributed, to the accumulation of clay separates in the surface horizons. This is reflected in the specific surface area of soil particles and thus affects the soil properties as a whole.

- Soil pH

The degree of soil reaction is a clear reflection of the nature of the original soil-forming materials from which those soils were derived. It is also considered a reflection of the nature of the physicochemical reactions taking place in the soil from the process of adsorption, oxidation, reduction, precipitation, and dissolution, and the nature of the exchange complex, the nature of the mineral and organic colloids presents in the horizons of those soils, and the nature of the pedogenic changes to which these soil horizons are exposed as a result of washing operations or the rise of groundwater by capillary action. It also depends on the values of the dominant carbonate minerals, which have a high regulatory capacity and which work to increase the soil resistance to any change in the degree of its reaction. it can be found that the pH values of the study soil samples ranged between (7.77-7.98) for the surface horizons, as they range from neutral to slightly alkali soil. In addition to the presence of carbonate minerals that work to regulate the buffering capacity of the soil. The reason may also be attributed to the accumulation of some natural plants after their decomposition, as they will affect the pH values. These results were consistent with [8,19,20].

- Electrical conductivity EC

The results of Table (1) showed the electrical conductivity values for the soil samples under study, which is a quantitative scale to express the salt content of the soil. As the EC values were recorded between (0.4 - 164.1) dS.m^{-1}. These results were consistent in terms of the nature of the soil samples under study, being Salty, Shura, Sabkha soil, as the conditions of the region were characterized by complete drought. Accordingly, most of the values exceeded the limits of 50 dS.m^{-1} for soil samples (2, 3, 6), so they are considered highly saline soils in which chlorides, sodium sulfates, magnesium, and calcium salts predominate. However, the areas (A, 4, 5) under study, they were lower salinity. Here, the method of irrigation using systems or irregular irrigation was adopted, using different types

of water, such as well water, drainage water, or wastewater. This is consistent with [20,21], which led to the deterioration of these soils and their transformation from fertile soils to saline soils that are not suitable for agriculture. These results reflect the long-term state of drought that the region under study is exposed to, which will lead to salt accumulations that later develop into salt minerals or evaporite minerals, which in their characteristics reflect the chemical and fertility properties of the soil. These results are consistent with [22,23].

- Cation Exchange Capacity

The CEC characteristic is an indicator of the mineral content in the soil, the values of which show a clear variation depending on the nature of the soil in terms of its content of carbonate minerals, the percentage of clay separate, the percentage of organic matter, the degree of its decomposition, the nature of the decomposition products, as well as the soil content of free iron oxides and gypsum minerals. The CEC of the soil samples under study ranged between (18.25-28.92) Cmol.kg^{-1} as the variation occurring is attributed to the difference in soil texture, difference in composition, and prevailing mineral content, as well as the role of carbonate minerals that contribute effectively to binding clay particles. Consequently, it blocks a large portion of the negative charge sites, and the soil content of organic matter decreases, which greatly affects the CEC values. This is in line with [8,24,40]. Furthermore, the CEC values of the soil samples were consistent with the soil content of sand, clay separates, and carbonate minerals, the content of organic matter, and the soil content of clay minerals quantitatively and qualitatively in terms of the dominance of certain clay minerals with high or low CEC, which directly reflects on the CEC values of the soil [25,26,39].

- Organic matter content

The results of Table (1) showed the amount of organic matter in the soil samples under study, as the organic matter content values ranged between (5.3-8.9) g.kg^{-1}. The results evident that there is a noticeable decrease in the amount of organic matter in the study soil samples, which may be attributed to the area being exposed to continuous wind erosion, which reduces the presence of vegetation, resulting in a decrease in the organic matter content. The decrease in the soil content of organic matter may be attributed to its weak development due to surrounding environmental factors that did not help the activity of pedogenic processes. As well as the prevailing drought conditions in the study area, which have a role in increasing the occurrence of oxidation and decomposition processes due to high temperatures with the decrease in moisture content through wind erosion processes and decreased vegetation negatively affected the organic matter content in the soils under study.

- Carbonate minerals

One of the most important manifestations of the active pedogenic processes in arid and semi-arid areas, including the study area, is the dominance of the process of accumulation and deposition of carbonate minerals in varying quantities. The results in Table (1) showed the values of carbonate minerals, which ranged between (312-399) g.kg^{-1}.

Table (1) Some physical and chemical properties of soil

Characteristic	Unit	Sample number/samples at depth 0-30 cm					
		1	2	3	4	5	6
ECe	dSm^{-1}	61.39	144.54	156.56	4.00	31.39	164.1
pH		7.82	7.81	7.93	7.77	7.83	7.98
Available nitrogen	$Mg.kg^{-1}$	23	24	26	15	16	28
Available phosphorus		7.82	7.66	7.31	6.33	6.15	8.91
Available potassium		192.13	191.02	198.32	115.28	178.35	20.10
Organic matter	$g. Kg^{-1}$	8.3	7.2	7.9	6.2	5.3	8.9
Carbonate minerals	$g. Kg^{-1}$	397	391	399	312	368	394
Soluble calcium	$Meq L^{-1}$	291.9	760.0	876.0	21.84	134.66	911.2
Soluble magnesium		276.6	620.0	622.0	16.43	120.04	676.0
Soluble sodium		37.8	48.02	56.0	7.89	47.36	58.02
Soluble potassium		3.96	6.00	8.02	2.00	3.46	5.0
Soluble bicarbonate		3.00	3.4	3.2	3.00	3.8	4.8
Soluble chlorine		344.5	439.2	478.4	29.94	180.4	360.42
Soluble sulfates		266.4	1002.8	1094.0	16.16	129.76	1275.78
Soluble carbonate		Nill	Nill	Nill	Nill	Nill	Nill
Exchangeable calcium		57	288	358	7	21	308
Exchangeable magnesium		34	196	205	5	16	221
Exchangeable sodium		4.49	19.01	17.97	2.15	6.28	28.62
CEC	$Cmol.kg^{-1}$	19.17	23.16	28.92	27.12	18.25	22.83
Particle size analysis		Texture					
Sand	$g.kg^{-1}$	Sandy loam	Loam	Clay	Silt clay	Sandy loam	Loam
		532	392	232	92	552	432
Clay		168	208	508	508	168	168
Silt		300	400	260	400	280	400

The reason for the presence of limestone carbonate minerals is due to the nature of the parent materials that are derived from limestone, as it can find a large accumulation of carbonate minerals

of various sizes and shapes in the surface layer of the soil, which is located at a depth of (30) cm. It is observed that there is an accumulation of calcium carbonate at the surface due to the accumulation of carbonate minerals in it due to the successive cycles of wetting and drying that the study area suffers from. This indicates that most of the carbonates in the soil under study were transported by water and appear in the form of fine particles that are re-deposited with other soil components [27], is in line with [6], who confirmed that the relative distribution of carbonate minerals in newly formed sedimentary soils depends on their distribution and behavior in line with sedimentation and transport factors

- Positive and negative ions

Positive ions: Table (1) shows the values of dissolved positive ions in the study soil samples, as the values of dissolved calcium ions ranged between (21.84-911.2) Meq L^{-1}, this variation reflects the content of carbonate minerals in the soil samples under study and the extent of the ability of these minerals to dissolve and preparation of calcium ions in the surface layers of those soils. As for magnesium ions, the values ranged between (16.34-676) Meq L^{-1}. The existing variation is due to the nature of the minerals carrying magnesium ions and the ability of these minerals to dissolve in the soil solution as a result of their exposure to various factors, which affects their solubility and thus the preparation of dissolved magnesium ions as a result of the balance or equilibrium occurring between the carbonate minerals that control the process of dissolution and precipitation of these ions, such as the minerals calcite $CaCO_3$ and dolomite $CaMg(CO_3)_2$ [28]. The presence of calcite and calcite minerals carrying magnesium ions, which is called Mg-berscalcit, since this mineral is one of the dominant minerals in Iraqi soils at the expense of dolomite mineral $CaMg(CO_3)_2$ due to the ability of this mineral to secondary precipitation when the concentration of magnesium ions in the soil solution increases. Dissolved sodium ions also recorded values that ranged between (7.89-58.02) Meq L^{-1}, and potassium ions recorded values that ranged between (5-8.2) Meq L^{-1}, as the soil content of these ions is affected by the nature of the dynamic equilibrium between these ions in the soil solution in the samples under study and the process of sedimentation and dissolution as a result of successive cycles of wetting and drying and the rise of groundwater by capillary action and pedogenic factors. Through the results, it is clear that the positive dissolved ions in the study soil samples took the following sequence in terms of dominance: -

Calcium > Magnesium > Sodium > Potassium

The soil samples under study were located in arid or semi-arid areas where the lack of rain and washing contributed to the accumulation of these ions in the surface layers of the soil compared to the subsurface layers. Moreover, the nature of these dissolved and released ions depends on the type of the parent materials and the severity of weathering, transport, and deposition that the region is exposed to over time, which affects the nature of the prevailing minerals, which is one of the most important sources that produce these ions [26,29]. It also depends on the density and spread of vegetation

cover, the percentage of presence of organic matter and the degree of its decomposition, the nature of the decomposition products in terms of humic acids represented by humic acid and fulvic acid, and the nature of the formation of humic complexes that are characterized by being insoluble with basic ions, especially single ions, which works to reduce their presence in the soil solution. On the other hand, Fulvic acid forms completely soluble complexes with binary and single basic ions, which limits its presence in a dissolved ionic form in the soil solution. This agrees with [14].

Negative ions: The results showed in Table (1) the concentrations of negative ions dissolved in the soil solution in the samples under study, as the concentrations of bicarbonate ions were between (3.0-4.8) Meq L^{-1}. While no concentration of carbonate ions was recorded because the pH ranged between (7.77-7.98) there is no presence of carbonate ions in such a medium and calcium ions are abundant, which leads to the possibility of its precipitation in the form of carbonate minerals. Similarly, the carbonate ion is present in soils with high levels of pH, which reach 10.33, and this is not present in the soil samples under study due to the buffering capacity as well as the effect of wetting and drying cycles on the mechanism of converting this ion to bicarbonate [30]. The values of the dissolved chlorine ion range between (29.94-478.4) Meq L^{-1}. As for sulfate ions, their values ranged between (16.16-1257.78) Meq L^{-1}, as it is known that ions having negative charges are washed out and expelled from the surface of the exchange complex towards the subsurface horizons as a result of the fact that the negative charges carried by these ions are incompatible with the charges of exchange surfaces and between various soil components having the same charges. It can be observed that there is a clear variation in the concentration of negative charges in the soil samples under study, as they vary between high charge values in the saline soils that include the Shura and Sabkha soils, where chloride and sulfate salt phases prevail. As well as due to the decrease in precipitation and washing operations in the study area and the rise in groundwater levels by the capillary action with the dissolved salts it carries. In addition to the rise in summer temperatures, which may exceed 50°C, and the increase in evaporation processes, which work to increase the concentrations of salts and their dissolved ions in the soil samples under study in general and the surface horizons in particular. Sulfate ions have recorded a noticeable increase in the soil samples under study, in varying proportions, and the increase was according to the prevailing salt phase formulas in the study area.

Table (2) Salinity standards and predominant salt phases in the study soils

Sample Number	SAR	ESR	TDS mg.L^{-1}	ESP %	Prevailing salt phase
1	1.59	0.05	39289.6	53.44	Chloride
2	1.30	0.04	92505.6	82.08	Sulfur
3	1.44	0.05	100838.4	66.26	Sulfur
4	1.28	0.14	3200	7.43	Chloride
5	2.97	0.18	20089.6	34.41	Chloride
6	1.46	0.05	1050240	125.36	Sulfur

The results in Table 2 indicated the predominance of the chloride phase for each of the samples (1, 4, 5) and the sulphide phase for each of the samples (2, 3, 6), which are characterized by being salts with a high ability to dissolve, which may have contributed to increasing their concentrations in the equilibrium medium. In addition to the decrease in the activity of washing operations due to the lack of precipitation, which is less than (50-100) mm/year, that contributed to their remaining in the surface layers of the soil. Sulfate ions from the ions that are affected by the oxidation and reduction conditions prevailing in the region are known to contribute to determining the soil content of this ion and thus is reflected in the salt phase and then in the prevailing mineral composition of these soils under study [31,32,41].

- Salinity standards

The results in Table 2 showed some salinity standards used to express the extent of soil salinity. Sample No. (4) was used as a comparison sample. The sodium adsorption ratio (SAR) ranged between (1.30-2.97), and the exchangeable sodium ratio (ESR) values ranged from (0.05-018), and the total dissolved solids (TDS) ranged between (3200-1050240) $mg.L^{-1}$. However, the exchangeable sodium percentage (ESP) ranged between (7.43-125.36)%.

- Salt phases

The results in Table 2 showed the predominant salt phases in the soils under study. Both the chloride and sulphide salt phases prevailed in varying proportions in the soil, and they naturally represent the common salt phases in the soils of the arid and semi-arid regions of the world, depending on the type and quantity of salts prevailing in them.

- X-ray diffraction XRD examinations of clay separates

Figure (Model 1) shows the results of X-ray diffraction tests of the clay separates of the soil samples under study for the surface horizons (0-30) cm. The results showed the presence of diffraction 14.47 A^0 in the magnesium saturation and air-dried treatment and its transformation to the basal distance 17.49 A^0 in the treatment of saturation with ethylene glycol and the basal distance returned by changing to 14.37 A^0 within the potassium saturation treatment heated to a temperature of 550 °C which indicates the presence of smectite mineral. Just as the increase in diffraction intensity to diffraction 10.02 A^0 at the expense of diffraction intensity 14.37 A^0 in the ethylene glycol saturation treatment indicates that the smectite mineral within the examination sample is inherited from mica minerals, and the evidence is the presence of diffraction 4.99 A^0 for the second diffraction of the mica mineral. The appearance of diffraction 14.32 A^0 in the saturation treatment with potassium and heated to 550 °C, confirms the presence of the Real chlorite mineral, which is resistant to heat. This is supported by the presence of diffraction 4.75 A^0, which represents the third diffraction of the

chlorite mineral, which indicates that the development of the chloritization phenomenon in the study area was due to the presence of chlorite mineral inherited from the parent material and not pedogenic in the region. This is consistent with the findings of [8] regarding the presence of the heat-resistant Real chlorite inherited from the parent material in the soil of Wasit Governorate in Iraq. The presence of diffraction 10.49 A^0 in the magnesium-saturated and air-dried treatment and its remaining constant in all treatments indicates the presence of mica mineral. Also, the diffraction 4.99 A^0 of the second diffraction of mica mineral with weak intensity in all treatments confirms that the mica mineral present is of the Tri-Octahedra mica type, which is known as the biotite mineral within the series of mica transformations. Besides, the appearance of diffraction 7.12 A^0 within the magnesium-saturated and air-dried treatment and continuously within the treatments until the potassium saturation treatment, heated to a temperature of 350°C, and then its disappearance within the potassium saturation treatment, heated to a temperature of 550°C, represents the first diffraction of the kaolinite mineral in the examination model.

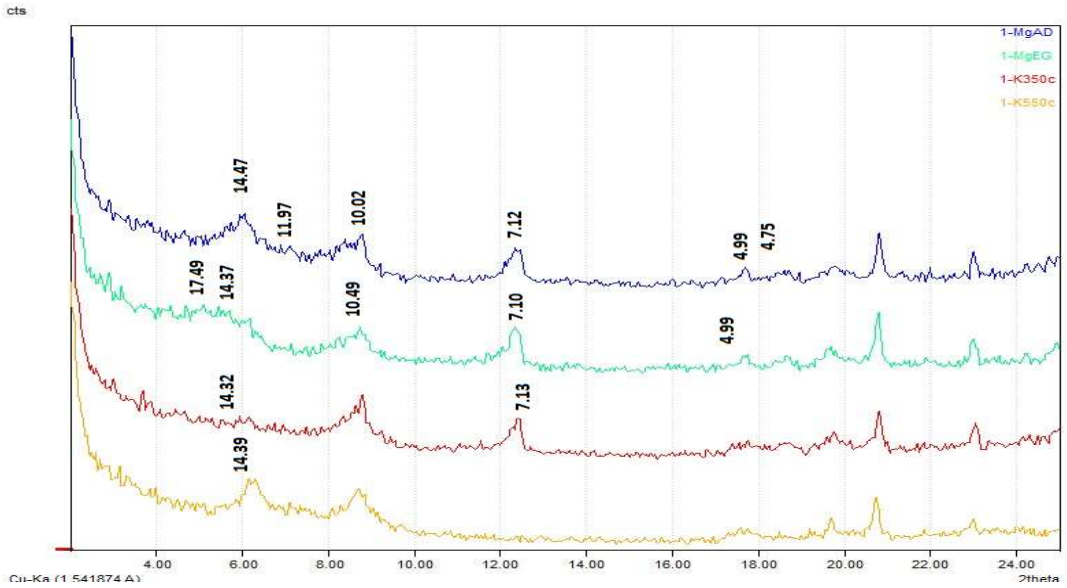

Figure sample 1

Figure (Model 2) shows X-ray diffraction, which showed diffraction 14.19 A^0 within the air-dried magnesium saturation treatment, which goes back to the first diffraction of the smectite mineral, then there is a widening of the basal distance within the ethylene glycol saturation treatment to reach 15.85 A^0, then it decreases again to 14.19 A^0 in all treatments, which indicates the presence of the

real chlorite mineral in the examination sample, which it leads to the formation of the chloritization phenomenon in the study areas. The presence of diffraction 11.87 A^0 indicates the presence of the interstratified mineral (mica-smectite), while the appearance of diffraction 10.49 A^0 under the magnesium saturation and air-dried treatment confirms the presence of mica mineral in the sample. Moreover, the appearance of diffraction 5.10 A^0, which represents the second diffraction of mica mineral, with an intensity that is almost weak confirms the presence of mica in Tri-octahedral minerals (biotite). The diffraction represents 7.60 A^0 and its resistance to the treatment of saturation with potassium and heated to a temperature of 550 °C confirmed the presence of kaolinite. The appearance of the two diffractions (5.10 and 4.76) A^0 is the second diffraction for mica and chlorite, respectively.

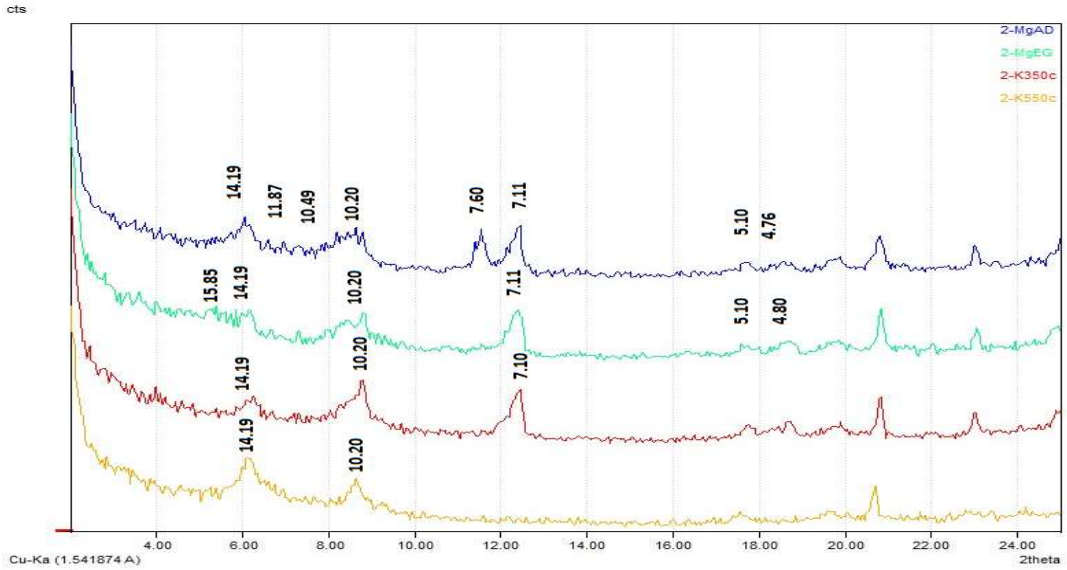

Figure sample 2

As for the results of the model in (Figure 3), the diffraction 14.29 A^0 also appeared, then expanded with the basal distance to 16.13 A^0, then returned to 14.29 A^0 when treatment saturated with potassium and heated to a temperature of 550 °C, which confirms the presence of the Real chlorite mineral, that confirms the cause of the chloritization phenomenon in the study area, which is inherited from the parent material of the soil. The appearance of diffraction 10.49 A^0 within the magnesium saturation treatment confirms the presence of mica mineral, which confirms the appearance of diffraction 5.02 A^0, the second diffraction of mica with weak intensity, which indicates its presence in the form of the biotite mineral within the series of transformations of mica mineral. Furthermore, the appearance of diffraction 7.11 A^0 indicates the presence of kaolinite mineral within the examination sample, which reflects its characteristics on the characteristics of the soil. The results of examining the model (Figure 4) revealed the appearance of diffraction 14.45 A^0 at the treatment of saturation with magnesium and air drying. Then the basal distance expanded within the treatment of saturation with ethylene glycol to reach 16.28 A^0 d-Spacing, it returned to

diffraction 14.45 A^0 within the treatment of saturation with potassium and heated to a temperature of 550 °C. ° which indicates the presence of smectite. The appearance of diffraction 11.64 A^0 indicates the presence of the interstratified mineral (mica-smectite) within the examination sample. Just as the appearance of diffraction 10.08 A^0 indicates the presence of mica mineral in the examination sample, which confirms this, the appearance of diffraction 5.10 A^0, the second diffraction of mica mineral, and the appearance of diffraction 4.73 A^0, the second diffraction of the mineral smectite, or perhaps it is of the metamorphic mineral chlorite.

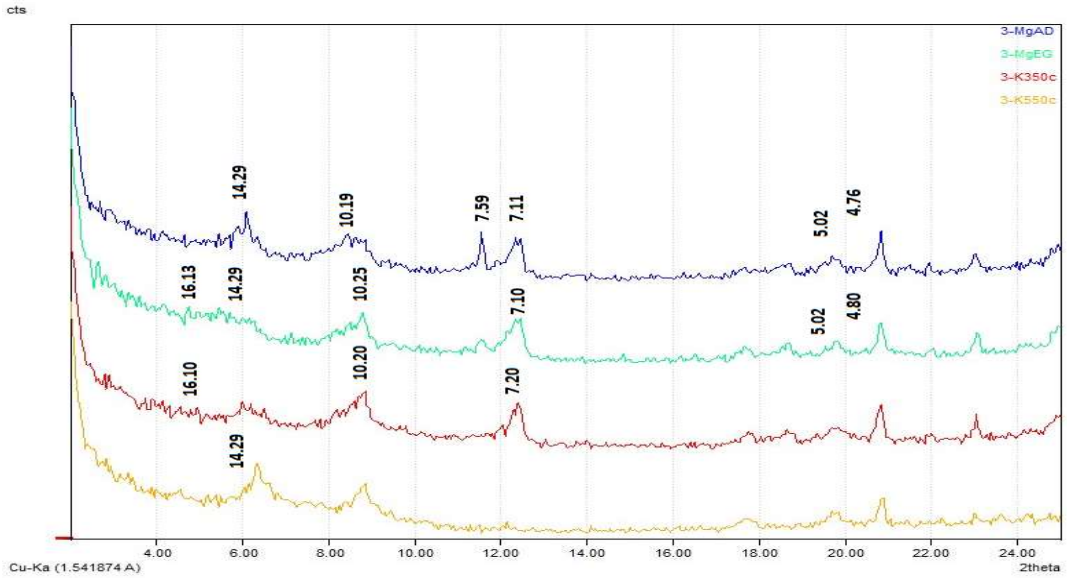

Figure sample 3

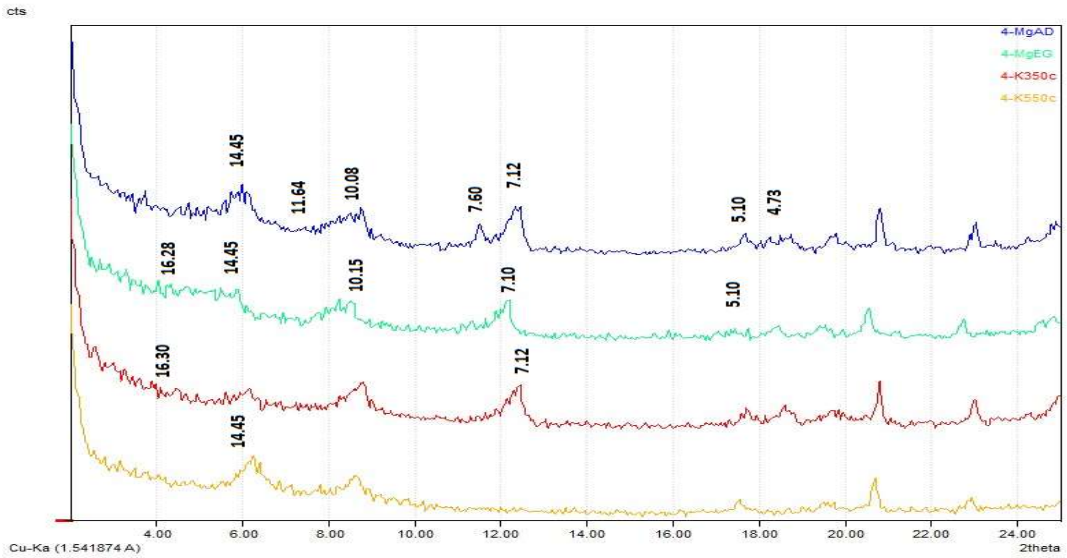

Figure sample 4

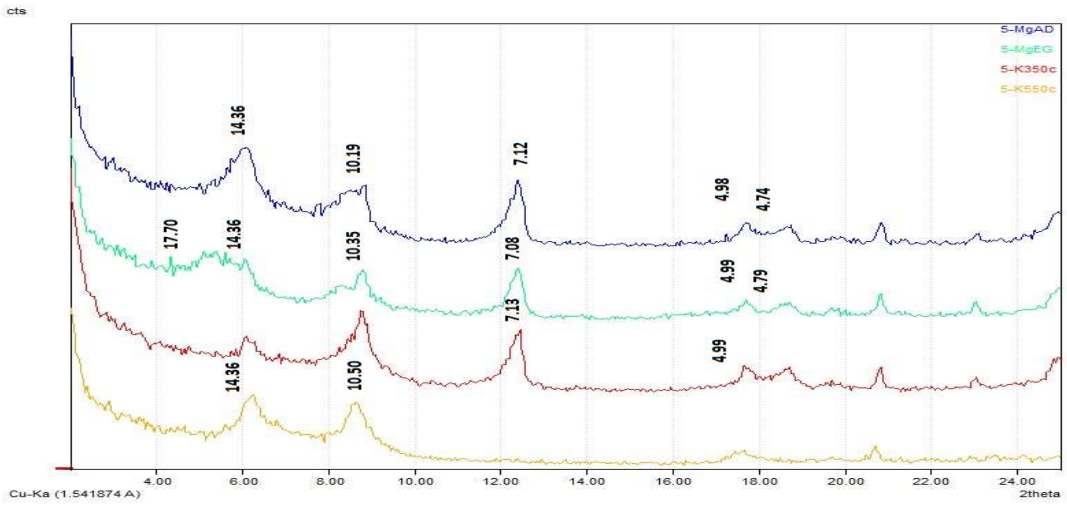

Figure sample 5

However, the results in (Figure 5) showed the appearance of diffraction 14.36 A^0 within the air-dried

magnesium saturation treatment, then the basal distance widened to 17.70 A^0 in the ethylene glycol saturation treatment to reach 14.36 A^0 in the potassium saturation treatment heated to a temperature of 550°C, which indicates the presence of a Smectite. Whereas the appearance of diffraction 10.19 A^0 in the saturation treatment with magnesium confirms the presence of mica mineral. This is confirmed by the presence of diffraction 4.98 A^0 and the second diffraction of mica mineral, just as the appearance of diffraction 7.12 A^0 indicates the presence of kaolinite mineral in the examination sample.

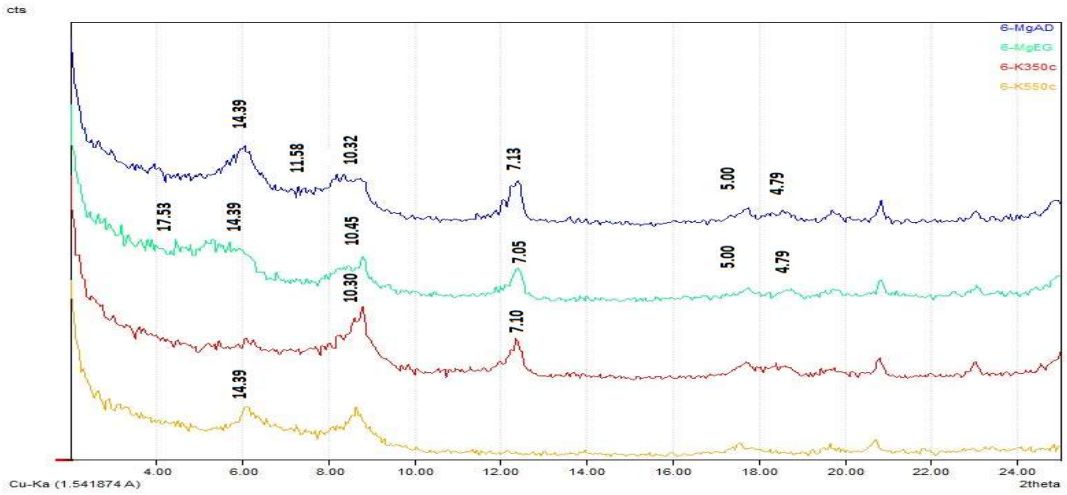

Figure sample 6

As for the results in (Figure 6), they showed the appearance of diffraction 14.39 A^0, which expanded to the basal distance 17.53 A^0 in the ethylene glycol saturation treatment, to reappear as diffraction 14.39 A^0 in all other treatments, which confirms the presence of the mineral smectite, and the appearance of diffraction 11.79 A^0 indicates the presence of (Mica-smectite) and the appearance of diffraction 7.13 A^0 indicates the presence of the mineral kaolinite. However, the appearance of diffraction 7.13 A^0 indicates the presence of the mineral kaolinite, and the appearance of diffraction 5.00 A^0 is the second diffraction for mica and 4.79 A^0 is the second diffraction for smectite.

Conclusions and recommendations

1- The phenomenon of Chloritization Phenomenon was identified after its formation due to the presence of the Real chlorite mineral, which comes from the parent material inherited from rocks containing a high percentage of the mineral chlorite.

2- The chloride phase and sulphide phase were identified for the predominant salt phases in the study soils.

3- The type of clay mineral that prevailed had an effective role in the soil properties under study and influenced the qualities and characteristics of the mineral chlorite, which affects the specific surface area and the cation exchange capacity of the soil.

Recommendation

The study recommends that further research must be conducted to identify the causes of the Chloritization phenomenon, which has begun to worsen widely in large areas of the soil to find treatments that can be followed to reduce the occurrence of this phenomenon.

References

1. Hossain, M.S.2019. Present scenario of global salt-affected soils, its management, and importance of salinity research.Int.Res.J.Biol.Sci, I,pp-3.
2. Mahmoud, M. A. 2018. Evaluation of potassium availability in saline soils based on ion exchange equations and thermodynamic criteria. Master's thesis. College of Agricultural Engineering Sciences. University of Baghdad.
3. Adhafa, A. K. H. 2005. Salt balance in soils irrigated with salty water under conditions of intensive agriculture. PhD thesis. faculty of Agriculture. Baghdad University.
4. Nasir R. S. 2021. Determining the ranges of some salt and vegetation spectral indices for some soils of the Iraqi alluvial plain. message Master's degree, Faculty of Agricultural Engineering Sciences. Baghdad University.
5. Al-Hazzaa, S.H.2018.types of clay minerals in the shale units of the Kayista and Ura Formations of northern Iraq: their use in interpreting the depositional environment; Iraq Journal of Agricultural Sciences,49(4):601-610 .https://jcoagri.uobaghdad.edu. iq/index.php/intro/article/view/ 68/45.
6. Al-Shammari, A.H.D .2020. The effect of sedimentation sources on the content and properties of clay separates and mineral composition of some soils in Wasit and Maysan governorates. PhD thesis, Faculty of Agricultural Engineering Sciences, Department of Soil and Water Resources Sciences. Baghdad University, Iraq.
7. Suleiman, H. S., O. A. Razzaq, and R. Kabba. 2020. Study of the mineral composition of some soils of the Syrian Jazira. Arab Journal of Science and Research Publishing. Journal of Agricultural, Environmental and Veterinary Sciences. 4 (4): (26-52).807-818.
8. Al -Shamary, S .H. K., Al Maamouri, A.D.S. and Dwenee, S. J. H . 2022.Effects of climatic variation on weathering intensity for the mineral composition in some Iraqi soils: Caspian Journal of Environmental Sciences, Vol. 20 No. 5 pp. 991-1001 DOI: 10.22124/ CJES.2022.6053
9. Al-Shamari, A.H., . Essa, S.K. (2020). Study of the contribution of clay, silt, sand, organic matter, free iron oxides, and calcium carbonate in CEC to some of wasit and maysan soils. Indian J, Eco. 47(9): 54-65.

10. AL-Khalil, S., & Essa, S.K., (2020). Effect of sedimentary source on the properties of sphericity and roundness of feldspar minerals in *soils of the alluvial plain. Indian J. Eco*. 47(9): 30-42.
11. Issa, Salman Khalaf. 2022. Soil minerals. Department of Soil Sciences and Water Resources. College of Agricultural Engineering Sciences. Baghdad University. Ministry of Higher Education and Scientific Research. Dar Al-Kutub 1909.
12. Mahmoud, Ola Mahmoud. 2023. The effect of irrigation patterns on some properties of clay minerals for the soil of rice farms in the provinces of Diwaniyah and Najaf Al-Ashraf. Master's thesis. College of Agricultural Engineering Sciences. Baghdad University.
13. Goran, A.H.A .2023.Investigate the Occurrence of Chloritization phenomenon in Some Soils Kurdistan Region. B.Sc. University- Erbil.
14. Al-Watifi. Abbas Saber Sarwan. 2012. The effect of montmorillonite to chlorite on the physicochemical properties of some Iraqi soils. PhD thesis. Zaraha College. Baghdad University.
15. Al-Jaff, B.O, and S.K.Essa.2020.The effect of vegetation on mica changes in the rhizosphere.Iraq Journal of Agricultural,51(1):493-499. . https://jcoagri.uobaghdad.edu.i . q/index.php/intro/article/view/ 948/712.
16. Al-Taee, Z. A.H and A. B. D.S. AL –Maamouri . 2020. Study of the mineral composition of some Iraqi soils and its effect on zinc adsorption. Plant Archives Vol.20 No 769-776.
17. Richards, L.A.1954. Identification and improvement of saline and alkali soils. USDA Handbook No.60.Indian Edn. Prinlar for Oxford and IBH Publishing Co. New Delhi, India.
18. Page, A.L., R.H. Miller and D.R. Kenney. 1982. Methods of soil analysis. Part 2. Chemical and Biological Properties. Amer. Soc. Agron. Inc. Publisher, Madison , Wisconsin.
19. Al-Jubouri' D. A. R. A. 2016. Study of different quantitative criteria for contamination with cadmium, lead, zinc, and nickel elements of soil and roadside plants in Baghdad Governorate. PhD thesis. faculty of Agriculture. Baghdad University.
20. Al-Ukaili, A. M. R. 2021. The effect of topographical climatic succession on the characteristics of some Iraqi soils. Master Thesis. College of Agricultural Engineering Sciences. Baghdad University.
21. Al-Mashhadani, A. N. I. 2011. Study of the mineralogical and micromorphological characteristics of sabkha and Shura soils in some areas of central Iraq. Master Thesis. faculty of Agriculture. Baghdad University.
22. Odthar,S.H and A.B.D.S.Al-Maamouri.2022.Identification of Oil Pollutants in Marshes Soil of Southern Iraq.Indian Journal of Ecology.2022:49 Special Issue(19) :482-490.
23. Maktouf, E. A. 2024. Study of the salt and mineral characteristics and halophytes of Shura soil in some areas of central and southern Iraq. PhD thesis. College of Agricultural Engineering Sciences. Baghdad University.
24. Al-Mamouri, A. B.D. S. 2012. The role of sedimentation speed, the ratio of calcium to magnesium, and the ionic strength of the soil equilibrium medium in the characteristics of carbonate

minerals and their efficiency in adsorption and precipitation of zinc. PhD thesis. faculty of Agriculture. Baghdad University.
25. Al-Shammari, A.H. D. 2020. The effect of sedimentation sources on the content and properties of clay separates and the mineral composition of some soils of Wasit and Maysan governorates. PhD thesis. College of Agricultural Engineering Sciences. Department of Soil Sciences and Water Resources. Baghdad University.
26. Al-Shahmani, L. S. S. D. 2020. Variation in the distribution of minerals in Al-Gharraf River sediments in Wasit and Dhi Qar governorates. PhD thesis. College of Agricultural Engineering Sciences. Baghdad University.
27. Al-Ali, J. T., A.H. Dhiab, and Q. M. Al-Saadi. 2015. Determining areas of desertification using remote sensing technology and geographic information systems in Muthanna Governorate, according to some physical and chemical characteristics of the soil. Kufa Journal of Agricultural Sciences. 7(1):215-219.
28. Nafawaah, S.M.2017.Study of minerals that controlled calcium, magnesium, and iron soluble and their relationships with soil conservation using solubility diagrams.The Iraqi Journal of Agricultural Sciences -1715-1726(6)48.
29. Al-Shammari, S. H. K. 2022. Study of the mineral composition, organic matter, and properties of some Iraqi soils under different climatic conditions. PhD thesis. College of Agricultural Engineering Sciences. Baghdad University.
30. Mohammadani, A. M.2008. Study of the effect of removing carbonate minerals and iron oxides on the adsorption and release of potassium from clay separate in some soils of northern Iraq. PhD thesis. College of Agriculture and Forestry. University of Al Mosul.
31. Al-Sultan, M. A. 2020. Identifying and determining the environmental impact of oil pollutants in the soil of Al-Hammar Marsh. Research submitted to the Ministry of Science and Technology.
32. Aadhar, S. H. 2021. The effect of oil pollutants in the marshes north of Basra on some chemical properties and the accumulation of some heavy elements in soil, water, and plants. Master Thesis. College of Agricultural Engineering Sciences. Baghdad University.
33. Day, P. R. 1965. Particle fractionation and particle-size analysis. In Black, C. A. et al. (eds.) Methods of soil analysis, Agron. Mono. No. 9: 545-567. Am. Soc. Agron. Madison, W I. USA.
34. Al-Shamary,S.H.K. 2022. Study The mineralogical Composition ,Organic matter and properites of Some Iraqi Soils under different climatic conditione. PhD thesis. faculty of Agriculture. Baghdad University.
35. Odeh ,M.and S.Shamsham.2008.Soil Fertility and Nutrition .Practical Part..Al-Baath University Publication .Faculty of Agriculural Engineering .Directorate of University Books and Publication.

36-AShref, A.M., A. B .D. S. Al-Maamouri., M.F. Khudhair .2024. Effect of Clay minerals,Calcite,And Organig Matter on Adsorption and desorption of Cadmium and Lead.Iraqi Journal of gricicultural Sciences.55(5):1657-1666.

37- Al-Mamoori,I.H and S.K.Essa.2024.Mineral Composition of Fine Sand Sediments in Euphrates River Deposits in Som Iraqi Soils North and South of Hindiya Dam.Frontiers in Health Informatics.13(3):3240-3228.

38-Makttoof,A.E and S.M.Nafawa.2024.Study of Salt Phases and Groundwater Chemically in Some Iraqi Soils.5Th Inernational Confrernce of Modern Technologies in Agricuitural Sciences.IOP Conf . Series:Earth and Environmental Science1371-082004.

39-Hameed,I.A., and H.A.J.A.Rahman and A.Anmar.2022. The effect of the Sediments of the Hilla river on the Characteistics pf the adjacent Soils (Babylon Governorate).International Journal of Applid Sciences and Technology 4(3):407-425.

40-Sharqi,S.Th and H.A.J.Almashhadani.2023.Pedogenic distribution of Iron in the Soils of Hit District.Bulgarian Journal of Agricultural Science Vol.28,No(SpecialIssue)pp,165-172.

41- Al-Shubaily,I.J and K.A.Wheib.2022.Study of the effect of plant mass on some Chemical properties of Soils in different areas of the great Musayyib project . Iraqi Journal of gricicultural Sciences .1(22):38:46.