Studying and diagnosing the heavy and light sand minerals for some of the soils in southern and northern Iraq

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Abstract

A study and diagnosis of heavy and light sand minerals were conducted for some soils in southern and northern Iraq, as the soils in southern Iraq from Maysan Governorate were represented in four regions and included soils (Ali Al-Gharbi, Al-Batira, Al-Maymouna, Al-Tayyib). And four areas of the soils of northern Iraq from the governorate of Erbil and included soils (Shaqlawa, Salah El-Din area, Kori, and Harir), as the surface depths (0-30) cm were chosen for all the soils studied. The results showed the predominance of quartz minerals in all soils of the study within the light part of light sand minerals and attributed the dominance to their resistance to weathering in addition to being inherited from the original material while the dominance of the opaque minerals and all the studied soils appeared within the heavy fraction of sand minerals, the sovereignty was attributed to the nature of the sediments, their source, and the severity of the weathering process that affected them. The results also showed the similarity in the mineral composition with the difference in the proportions of their distribution. This difference in the relative distribution is due to the effect of sedimentation processes. Which is a reflection of the variation in the physiographic sites and its effect on the mineral content of the sediments, and because the soil samples are located within the flood plains that were formed by floods occurring in the river basins, which reflected the difference in the relative distribution of sand minerals for the soils of Erbil Governorate, as they are outside the range of riverine operations which is attributed to the nature of the topography and geography of the land in northern Iraq that differs from its south.

Keyword: Mineralogical Properties of Sand, Sedimentary environments, Heavy Minerals, Light Minerals.

1. Introduction

The group of silicate minerals occupies an important place among other groups of minerals, as we find that they constitute 25% of the known minerals and 40% of the common minerals and all the minerals that make up igneous rocks, which constitute more than 90% of the earth's crust \[1\]. \[2\], mentioned that sand minerals are one of the natural sources spread in the earth's crust, which are products of rock weathering processes of various sources, they are metamorphic, sedimentary, and igneous, which differ in their mineral content from quartz minerals and feldspar and others. Although heavy sand minerals are present in small quantities, they are resistant to weathering and erosion processes, and thus they represent the rocky origin material. Even after many cycles of erosion and sedimentation, light sand minerals lack this quality \[3\].

Said \[4\], that sand minerals are divided into two types: primary minerals, which are the result of the physical breakdown of the original rocks, that is, they are inherited from the original rock, there are many of them, and among the most prevalent in the quartz sand is SO\textsubscript{2} and Al\textsubscript{2}Si\textsubscript{3}O\textsubscript{8} and secondary minerals, which are the result of chemical weathering the primary minerals, which are important for many chemical reactions prevalent in sand, among the most widespread are silicates, CaCO\textsubscript{3}, dolomite CaMg(CO\textsubscript{3})\textsubscript{2}, gypsum CaSO\textsubscript{4}.2H\textsubscript{2}O, iron oxides Fe\textsubscript{2}O\textsubscript{3}, FeO, and aluminum Al\textsubscript{2}O\textsubscript{3}.

As for the organic components, they include all living organisms that live in the sand and its remnants, and when it falls Organic materials or they are added to sand, they have many changes as a result of microorganisms converting them into simple materials or other complex materials. Although the percentage of organic matter is small, it plays a large and important role in the physical and chemical properties of sand. \[5\], confirmed that the study and diagnosis of primary minerals is of great importance, especially quartz, which is one of the primary minerals used in the study of soil development and emergence, and quantitatively in Iraqi lands. Also, the percentage of quartz in the fine sand joint is one of the criteria used in determining the homogeneity of the source material for soil. Light and heavy sand minerals are of great importance in
determining the nature of weathering that the soil is subjected to in terms of its severity and origin and determining any factor of soil formation, as it had a significant impact on the formation of different soils [1]. Heavy metals are of great importance to know the source of rocks, the history of transport and give an idea of the most important processes and sedimentation environments. The morphological characteristics and color of heavy metals have been used to determine the location of the source of rocks. The pattern of mineral distribution and groupings can also help in understanding the transport and direction of dispersion.

In view of the importance of studying the heavy and light sand minerals to know the nature of the weathering that the soil is exposed to and the role that heavy metals play in understanding the origin of the soil and the origin of its source and understanding the processes and environments of its deposition, so our current study aimed to study the light and heavy sand minerals and their percentages and the effect of the physiographic location on the content of their presence in the study soils.

2. Materials and methods of work field procedures

The study sites were selected within the lands located in the governorates of Maysan, which is located in southern Iraq, and Erbil, which is located in northern Iraq, as four different sites were chosen from the governorate of Maysan represented by Soils (Ali Al-Gharbi, Al-Batira, Al-Maymouna, and Al-Tayyib), and four different sites in Erbil governorate represented by Soils (Shaqlawa, Salah El-Din Resort, Kori, and Harir). Select samples of surface soils and depth (0-30) cm, and soil for all the study sites.

2.1. Laboratory procedures:

2.1.1. Preparing soil samples for mineral analyzes:

After the soil samples were obtained, they were transported to the laboratory, air dried, and their orbits were split by hand and with a polyethylene hammer in order to preserve the morphology of the minerals in them. They were passed through a sieve with holes (2mm) in diameter and kept in plastic boxes. After the sand was separated from the clay and silts by a wet sieving method, with a sieve with a diameter of 50 micrometer holes. The sand separator is taken after washing it well with distilled water to get rid of clays sticking to the particles, and it was dried by a drying oven at a temperature of 60 degrees Celsius. The sand granules were washed with acetone to ensure washing of the granules, after that a weight of 5 g was taken from the sandy fraction for the purpose of separating the light metals from the heavy metals of the sand separator using bromoform liquid CHBr3 of a specific weight of 2.89 and according to the method suggested by [6,7]. weighs the light fraction and heavy fraction accurately to find out the ratio of heavy to light metals.

After that, the sand separated (light and heavy metals) was sprayed after it was air-dried on a slide and fixed with canda balsam with a refractive index of 1.54. Minerals were diagnosed using a polarized optical microscope and their percentages were determined using the point counter method, according to the method proposed by [8] , and described in [9].

3. The Results and discussion

The results of Table 1 showed the weight percentages of heavy and light sand minerals, as the percentages of light sand minerals within the soil samples located in Maysan ranged between (95.0 - 95.6)%, while the percentages of heavy sand minerals ranged between (3.8 - 5.0)%. While the percentages of light sand minerals within the samples of soils located in Erbil ranged between (95.4 - 97.0)%, while the percentages of heavy sand minerals ranged between (3.0 - 4.6)%.

Table 1. The percentages of light and heavy sand minerals for the soils under study.

| Heavy Metals Percentage% | Heavy metal weight (grams) | percentage For light metals% | Light metal fraction weight (grams) | Model Weight (grams) | Sample numbers |
|--------------------------|---------------------------|------------------------------|-----------------------------------|---------------------|----------------|
| 5.0                      | 0.25                      | 95.0                         | 4.75                              | 5                   | Ali Al-Gharbi  |
| 4.0                      | 0.20                      | 96.0                         | 4.80                              | 5                   | Maymona        |
| 4.4                      | 0.22                      | 95.6                         | 4.78                              | 5                   | Al-Tayyib      |
| 3.8                      | 0.19                      | 96.2                         | 4.81                              | 5                   | Btaria         |
| 4.2                      | 0.21                      | 95.8                         | 4.79                              | 5                   | Kori           |
| 4.6                      | 0.23                      | 95.4                         | 4.77                              | 5                   | Salah El-Din   |
| 3.2                      | 0.16                      | 96.8                         | 4.84                              | 5                   | Shaqlawa       |
| 3.0                      | 0.15                      | 97.0                         | 4.85                              | 5                   | Harir          |

The low percentages of heavy metals compared to the light metals of the fine sand separator are due to the weathering occurring in them in the places of their transport and during transport or after deposition, and may be attributed to the nature of the mineral composition of the source materials for sediments.
The difference in the mineral distribution of opague minerals is due to the large difference in their ratios due to the effect of deposition processes, which is a reflection of the state of variation in the physiographic sites and their effect on the mineral content of sediments and the lack of activity of weathering processes [10]. The results of Table 2 and 3 show the content of light and heavy sand minerals for the soils under study. The results showed the predominance of quartz minerals SiO2 in all soils of the study, as it ranged between (17.1 - 28.8) % and a rate of 15.3%, as the highest value appeared in Ali Al-Gharbi soil and the lowest value in Kori soil, the quartz monocrystalline person based on its linear or straight extinction. As the linear extinction indicates the fiery origin of [1].

The metal appeared in the form of a single crystal within the Salah El-Din area, Plate 1, and a granular shape appeared indicating that the metal grains were not exposed to the phenomena of polishing and roundness due to the transport operations from the source, which is attributed to its light weight as it is carried by the tanker water and for long distances [11]. As for the multi-crystallized quartz within the Salah El-Din region with a transformed origin, Plate 1, the percentage ranged between (1.8 - 4.6) % and an average of 3.2%, as the highest value appeared in Kori soil and the lowest value was in auspicious soil. The grain of the mineral appeared in the form of Composite Quartz, which consisted of two or more crystalline units with different optical orientation, with a wavy extinction, as it reflected the transformed origin of those crystals, and an angular shape to a quasi-circular Angular-Sub a rounded according to [12]. The high percentages are due to the influence of the nature of the original material, which is the main component of sand separator, as well as its high resistance to maximum weathering [13]. It may be subject to decomposition under severe weathering conditions, especially when its grains are very small. In addition, quartz needs special conditions of temperature, pressure, and time, which are not easily available in soils [14].

The results of Table 2 and 3 showed Carbonate Rock Fragment in the study soils, which ranked second in terms of sovereignty, and their ratios ranged between (26.6 - 42.4)% and an average of 34.5%, as the highest value appeared in Curie soil, while the lowest value appeared in soil. Auspicious. The mineral appeared under the polarized optical microscope plate 1(A) piece of sedimentary carbonate rocks Calcite CaCO3 Plate 1(A) within the Shaqlawa area and rock pieces of modern Aragonite shells CaCO3 within the auspicious area of plate 1(B) and a piece of carbonate rocks appeared, which is a fossilized structure of ancient living organisms within.

The Harir of area Plate 1(C) and the carbonate rock pieces appeared under the microscope in its circular shape to semi-circular Arounded-Subarounded, and the size of its grains is very rough to smooth, and the reason is that these carbonate rock pieces are an important source of carbonate minerals in the soil, and the melting and re-sedimentation processes effect Of those rocks in the formation of new forms of carbonate minerals later in those soils [15]. As [16] mentioned, there are different forms of calcite, commonly following Aragonite. Some soft animals also excrete calcium carbonate as Aragonite in their shells, and this decomposes on the surface of the shell to give calcite. Aragonite is less stable and less widespread than calcite, as Aragonite precipitates from calcic carbonate solutions when it is hot, while calcite precipitates from cold solutions. In many shells, the pearly layer is made of Aragonite. In terms of sovereignty, it was followed by the salts of Evaporates in Table 2 and 3 and ranged between (1.4 - 9.6) %, with an average of 5.5%, as the highest value appeared in Ali Al-Gharbi soil and the lowest value in Salah El-Din soil. The optical properties showed that the metallic mineral within this group (Gypsum CaSO4,2H2O and Anhydrite CaSO4) Fig. 1, depending on the optical properties adopted by [17].

Appeared white, gray, or colorless and may appear yellow, red, or brown due to the presence of impurities. Vitreous luster. It has a colorless abrasive, and has an oyster crushed for anhydrite, with a specific weight of 3, while the gypsum has an uneven crumble, and a specific weight of 2.3. Gypsum is formed as a result of hydration of anhydrite, which can be differentiated from gypsum of relatively high hardness [18]. Anhydrite is distinguished from calcite by its specific weight (2.89-2.98) and from gypsum with its hardness (3-3.5), and the mineral easily decomposes as a result of moisture absorption and turns into gypsum metal, and this process is accompanied by an increase in volume, and gypsum can be distinguished from anhydrates by containing a quantity of water and its solubility in acid Hydrochloric, and gypsum is found in sedimentary rocks, while anhydrite is found in most places where gypsum is present, where they are always associated [16].

Tables 2 and 3 also showed Chert Rock Fragment, which ranked fourth in terms of sovereignty, and ranged between (7.1-8.8) % at a rate of 7.95%. As the highest value appeared in Kori soil and the lowest value in Harir soil, and it showed optical properties. This mineral within the al-Tayyib area has a fig. 1 , between very coarse to fine and angular in shape, and these rock pieces are of little importance in soil chemical properties [19,20]. And then the rock pieces, which include the clay pieces of Mudstone Rock Fragment, Table 1 and 2, and ranged between (3.6 - 7.8) %, with an average of 5.7%, as the highest value appeared in Sala Al-Din soil and the lowest value in Al-Tayyib soil, Fig. 1 within the auspicious area.

The results of Table 2 and 3 also showed the feldspar minerals, which included orthoclase, microcline and plagioclase, and ranged between ((2.5 - 4.2), (1.7 - 2.6), (2.3 - 3.8)), respectively, and an average of (3.35, 2.15, 3.05)% on The sequence, as the highest value of the Microcline mineral appeared in the Kori of soil and the lowest value in the Harir of soil, while the highest value of the Plagioclase mineral appeared in the soil with a frequency and the lowest value in the auspicious soil, and the optical properties were shown For Feldspar minerals, fig. 1 of Orthoclase KalSi3O8, within a region of Kori with a high degree of decomposition, and Microcline.
Table 2. The percentages of light metals and heavy metals group for soils located in Maysan Governorate

| Light Components | Btiara | Maymona | Al-Tayyib | Ali Al-Gharbi |
|------------------|--------|---------|-----------|--------------|
| Mon crystalline Quartz | 28.4   | 31.3    | 28.8      | 23.4         |
| Polycrystalline Quartz | 2.3    | 1.8     | 2.6       | 3.5          |
| Alkaline Feldspar (Orthoclase) | 4.2    | 3.4     | 3.5       | 3.6          |
| Alkaline Feldspar (Microcline) | 2.6    | 1.9     | 2.1       | 1.8          |
| Plagioclase Feldspar | 3.8    | 2.3     | 2.8       | 2.5          |
| Carbonate Rock Fragments | 31.1   | 26.6    | 32.7      | 29.2         |
| Chert Rock Fragments | 7.3    | 8.6     | 7.8       | 8.5          |
| Igneous Rock Fragments | 2.8    | 2.9     | 2.8       | 2.6          |
| Metamorphic Rock Fragments | 1.7    | 2.3     | 1.5       | 2.8          |
| Mudstone Rock Fragments | 4.2    | 5.3     | 3.6       | 7.5          |
| Evaporates (Gypsum + Anhydrite) | 7.3    | 9.6     | 8.6       | 9.6          |
| Coated Grain by Clay | 2.6    | 2.8     | 2.7       | 3.5          |
| Others | 1.5    | 1.2     | 0.6       | 1.5          |

| Heavy Minerals | Btiara | Maymona | Al-Tayyib | Ali Al-Gharbi |
|----------------|--------|---------|-----------|--------------|
| Opaque's | 37.7   | 43.1    | 38.4      | 44.0         |
| Chlorite | 9.5    | 9.3     | 7.5       | 8.6          |
| Zircon | 5.3    | 5.2     | 6.6       | 5.9          |
| Garnet | 4.2    | 5.8     | 4.8       | 4.5          |
| Orthopyroxene Group | 2.5    | 1.5     | 2.8       | 3.9          |
| Monopyroxene Group | 4.8    | 4.5     | 3.0       | 2.6          |
| Amphibole Group | 3.7    | 3.8     | 4.7       | 4.3          |
| Tourmaline | 4.5    | 3.5     | 4.6       | 3.7          |
| Epidote Group | 5.3    | 5.3     | 5.7       | 6.1          |
| Rutile | 3.2    | 4.6     | 4.5       | 3.1          |
| Kyanite | 2.4    | 1.5     | 2.7       | 2.1          |
| Staurolite | 3.4    | 3.1     | 3.3       | 3.1          |
| Biotite | 4.8    | 2.8     | 3.5       | 4.8          |
| Muscovite | 7.8    | 5.8     | 6.4       | 5.8          |
| Others | 0.9    | 1.2     | 1.5       | 1.5          |

KalSi$_2$O$_8$ within the region of Ali Al-Gharbi, with intertwined twinning, as it appeared in its hazy and eroded form, edges and lacks Subhedral, with a specific weight of 2.6, uneven, scratched colorless, with a glass luster to Pearly, while the plagioclase NaAlSi$_3$O$_8$ appeared within the Batira of region, with a specific weight of 2.7, its scratch was colorless, with a glass luster, uneven, and appeared under the microscope in its angular to quasi-angular shape and characterized by multiple twinning that distinguishes it from the base feldspar, with The mineral has been subjected to an irregular liner transformation, [21].

Whereas the percentages of Metamorphic Rock Fragment ranged between (1.5 - 5.5) % and an average of 3.5%, as the highest value appeared in Salah El-Din soil and the lowest value was in al-Tayyib of soil, as the foliated tissue appeared due to pressure. It is the schist rock within the Harir of region Plate 1. Whereas, the Igneous Rock Fragment ranged between (2.6 - 6.7)% at a rate of 4.65%, as the highest value appeared in Harir soil and the lowest value in the Western soil in Plate 1, as several minerals appeared with the mineral, including quartz and feldspar within the area of al-Tayyib, fig. 1.

Then came the coated grain by clay granules and ranged between (2.2 - 3.9)% as a rate of 3.05%, as the highest value appeared in Sala El-Din soil and the lowest value in Kori soil. While the other minerals appeared in their few percentages and ranged between (0.6 - 1.8) %, on average, 1.2%, and this group includes some diagnosed minerals Biotite, muscovite, and Chlorite, which represent weathered minerals or of late origin [11].
Figure 1. Photographs of some heavy metals from the soils under study with polarized light microscopy
The results of Table 2 and 3 show the percentages of heavy sand minerals. The proportions of opaque's ranged from high levels of heavy metals. It ranged between (43.3 - 48.8) %, at a rate of 46.05%, the highest value appeared in Shaqlawa soil, and the lowest value appeared in Kori soil, the optical properties of Plate 2 showed that this group included the minerals of Fe3O4, the magnetite iron oxides in the Ali Al-Gharbi of region, which appeared in a dark black color. Metallic luster, with irregular shapes, under crushed oysters, with a specific weight of 5.2, with a black mark, [22].

In terms of dominance, chlorite minerals were followed by and ranged between (7.5 - 9.5)% as an average of 8.5%, as the highest value appeared in the soil of Al-Tayyib and the lowest value in the batira soil, and the mineral appeared under the polarized optical microscope within the Kori of region, fig. 2, with a laminar shape, in a false hexagonal form. , And green in different shades , It can rarely be yellow or pinkish-red , with a glassy or pearly luster. The source of chlorite, which is considered one of the lamellar minerals, is the transformation of Biotite, Amphibole, and pyroxene minerals, or primary minerals from metamorphic rocks in Iraq and Turkey, or it is found in igneous rocks derived from the Hydrothermal variants [22]. As the chlorite group arises from the deposition of the Brucite layer between the inner layers of the mineral montmorillonite, this state is known as natural chlorination [24].

While the results showed Zircon minerals, which are considered to be weather-resistant minerals, and their percentages ranged between (2.6 - 6.6), an average of 4.6%, as the highest value appeared in the soil of Al-Tayyib and the lowest value in Salah El-Din soil, and microscopic examinations within the Salah El-Din area showed, Plate 2, that Zircon is colorless, sometimes in shadows of deep blue or purple layers, with a diamond luster. Among the minerals diagnosed are the minerals of Garnite, and the percentage ranged between (3.7 - 5.8)% as a rate of 4.75%, as the highest value appeared in the Maymona of soil and the lowest value in Shaqlawa soil, and the mineral is characterized by its colorlessness, some of which are full-face, with complete extinction. Glitter of glass within the area of the perfume, fig. 2. As for the Pyroxene mineral group, which represents one of the sources of magnesium ions in the soil, its percentages ranged between (1.5 - 4.9)%, as an average of 3.2%, as the highest value appeared in Salah El-Din soil and the lowest value was in Maymona soil, and microscopic examinations showed fig. 2 within the Maymona of region , It is distinguished by its pale green color, and its rectangular prismatic grains, whether they are Orthopyroxene or Mono pyroxene, have varied in their relative distribution due to the nature of the mineral composition of the original material [25].

Amphibole minerals were identified within heavy metals and ranged between (3.7 - 7.8) % as an average of 5.75%, as the highest value appeared in Kori soil and the lowest value in batira soil, and if they found it indicates that , the area of origin is characterized by the speed of transport and the intensity of erosion and that the physical weathering of rocks is more An effect of chemical weathering [11]. and among the most important minerals diagnosed within this group is the Hornblende mineral within the Ali Al-Gharbi of region fig. 2. As the mineral was distinguished by its light green to green-brown color, it has a glassy luster, and the edges appear serrated as a result of mechanical corrosion during transportation. Hornblende refers to metamorphic rocks and gneiss [26].

The results also showed the presence of tourmaline and ranged between (1.6 - 4.6)% as an average of 3.1%, as the highest value appeared in the soil of al-Tayyib and the lowest value in Salah El-Din soil, and the metal appeared in its light brown color and circular shape, within the Petra area, fig. 2. As for the Epidote, it ranged between (4.4 - 6.1%), with an average of 5.25%, as the highest value appeared in Ali Al-Gharbi soil and the lowest value in Kori soil. The mineral is distinguished by fig. 2 within the Shaqlawa of region , with its greenish yellow color, and sometimes its pale coffee color. As for the rutile metal TiO2, its percentage ranged between (1.2 - 4.6) % at an average of 2.9%, as the highest value appeared in auspicious soil and less in Salah Al-Din soil, and the mineral is microscopically distinguished within the Al-Tayyib region, fig. 2, with its dark red, reddish brown or black color, the scratched Light brown, diamond luster, 4.5 specific weight. It is considered a very stable mineral in most geological environments and even at high pressures and temperatures of the Earth's interior [27].

Table 3. The percentages of light metals and heavy metals group for soils located in Erbil Governorate.

| Light Components | Light Components Samples Number |
|------------------|---------------------------------|
|                   | Kori  | Harir | Shaqlawa | Salah El-Din |
| Monocristalline Quartz | 17.1  | 22.5  | 21.2     | 18.7         |
| Polycristalline Quartz | 4.6   | 2.7   | 2.8      | 3.2          |
| Alkali Feldspar (Orthoclase) | 2.5   | 3.6   | 3.9      | 3.5          |
The results showed the presence of the mineral stearate, and its percentage ranged between (2.4 - 3.7) %, with a rate of 3.05%, as the highest value appeared in Shaqlawa soil and the lowest value in Maymona soil, and microscopic examinations showed the mineral with a yellowish to golden color, with a semi-glass luster, within the Salah El-Din region plate 2. Whereas, the percentage of kainite ranged between (1.5 - 2.9)% as a rate of 2.2%, as the highest value appeared in the soil of the good and the lowest value in the Maymona of soil, and it was microscopically distinguished for being colorless, with the presence of fissures, with elongation and high clearance of the mineral within the Curie region, fig. 2.

As for the group of Mica, it was diagnosed within the heavy metals diagnosed in the soils of the study, as the metal Biotite K(Mg, Fe)3(OH)2 was identified, and its percentage ranged between (2.8 - 5.5)% as an average of 4.15%, as the highest value appeared in Soil is Harir and of less value in Maymona soil, and the mineral appeared under a light microscope with its dark green or brown to black color, flexible, and sheet-shaped, glassy to pearly, weighing 3.2, its colorless scratch within the auspicious area, fig. 2, it is found in all types of igneous, metamorphic and sedimentary rocks [16]. As for muscovite, KAl2[(OH,F)2AlSi3O10, which is located within minerals.

The mica ranged between (2.6 - 7.8)% with an average of 5.2%, as the highest value appeared in Batira soil and the lowest value in Shaqlawa soil, and the mineral was distinguished by its light green color, flexible, its specific weight 2.8, its scratch is white, Fig.2 within the Harir region . Its low percentage compared to quartz is due to its weak resistance to weathering, as it weathered with Smectite minerals under arid and semi-arid conditions [10]. There is another group of minerals, which include all secondary minerals resulting from weathering or diagenetical emergence, and ranged between (0.6 - 1.5)% as a rate of 1.05%, as the highest value appeared in the soils of Shaqlawa, Kori, Ali Al Gharbi, Al-Tayyib, and the lowest value in the soils of Salah El-Din and Harir.
Figure 2. Photographs of some heavy metals from the soils under study with polarized light microscopy.
The results showed the similarity in the mineral composition in terms of the predominance of quartz in all soils of the study. The dominance is attributed to its resistance to weathering due to its chemical bonds as well as its inheritance from the original material. Given the previous considerations, it may be assumed that a part of the quartz has been added to the soil by wind transport operations. Erosion and sedimentation processes may participate in the availability of quartz in the soil in some conditions of [14], and it was followed in terms of dominance by the minerals of the carbonate rock cut, the salts of Evaporates, the pieces of rock (flint), the clay pieces, the feldspar, the granules covered with clay, the rock pieces Igneous, metamorphic rock pieces and other minerals for both soil sites in Erbil and Maysan. Whereas, heavy metals showed dominance over opaque minerals, due to the nature of the deposits, their source and the severity of the weathering they were exposed to, as well as the original material rich in them. As for the difference in its relative distribution in all soils of the sites in southern Iraq (Maysan) and northern Iraq (Erbil), it is due to the effect of sedimentation processes, which are a reflection of the state of variation in the physiographic sites and their effect on the mineral content of sediments, and because the soil samples are located within the floodplains that were formed. Due to the floods occurring in the river basins, which reflected the difference in the relative distribution of sand minerals for the soils of Erbil Governorate, as they are outside the scope of riverine operations, which is due to the nature of the topography and geography of the land in northern Iraq that differs from its south, and to the difference in the type of sedimentary environments for both regions, which was reflected Variation and difference in the distribution of percentages of sand minerals, as the greater part of Maysan Governorate is a flat surface as it is located within the Mosaic sedimentary plain area [28], while the surface of Erbil Governorate consists of high and low mountains and is characterized by the presence of mountain ranges in it that are an extension of mountain ranges Taurus and Zakros [29].

Conclusions

1- The similarity in the mineral composition of heavy and light sand minerals with the predominance of light sand minerals over heavy sand minerals in all the studied soils. With the predominance of quartz minerals within the light part of the sand and the predominance of opaque minerals within the heavy fraction in all studied soils the nature of sediments, their source, and the severity of the weathering process that affected them.

2- The apparent variation in the relative distribution of heavy and light sand minerals in the study soils, which is due to the difference in sedimentation processes, which reflects the state of variation in the physiographic sites and their effect on the mineral content of sediments.

Recommendations

In view of the importance of light sand minerals, and in particular heavy metals, in understanding the history of transport, the type of processes, the sedimentation environments, and knowledge of the source material, we recommend expanding the studies related to the mineral composition of sand separators because of their importance in determining the source and origin of these soils, and determining their properties depending on the pattern of distribution of heavy and light metals.

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