*Int. J. Agricult. Stat. Sci.* Vol. 17, Supplement 1, pp. 1815-1824, 2021 www.connectjournals.com/ijass
**DocID**: https://connectjournals.com/03899.2021.17.1815 ISSN : 0973-1903, e-ISSN : 0976-3392

**ORIGINAL ARTICLE**

# STUDY OF THE NATURE OF THE MINERAL COMPOSITION OF SAND SEPARATED IN THE DRIED MARSH SOILS IN SOUTHERN IRAQ

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**Abstract:** This study was conducted in some dried marsh soils in Basra province, Thi Qar and Maysan in southern Iraq, for the purpose of knowing the minerals separated by sand within the studied area. The six pedons locations have been selected and these locations are Al-Shafi, Al-Mashab, Al-Jabayish, Al-Hammar, Aleazim and Al-Musharreh. Its coordinates were determined using a GPS device, the study pedestals were characterized and soil samples were obtained from each horizon for laboratory analysis. The results showed that the dominance of heavy sand separated minerals was for the opaque minerals. For all pedons, their vertical distribution showed an irregular distribution with depth within all soil horizons. As for the light minerals, the two minerals Carbonate Rock Fragments and Monocrystalline Quartz were dominant and it was a state of exchange in the dominance of these two minerals between the different horizons and pedons.

***Key words***: Dried marsh soils, Heavy metals, Light minerals, Pedons.

**Cite this article**

Baida Hamid Jabr, Mohamed Malik Yassin and Salah Mahdi Sultan (2021). Study of the nature of the mineral composition of sand separated in the dried marsh soils in southern Iraq. *International Journal of Agricultural and Statistical Sciences.* DocID: https://connectjournals.com/03899.2021.17.1815

## 1. Introduction

The southern part of the Alluvial plain in Iraq is characterized by the presence of marshes. The marshes occupy a large proportion of the area of this part of the sedimentary plain and represents the area between Maysan province in the north, Basra in the south and east and Suq Al-Shuyoukh in the west. The area of the marshes is about 20,000 km$^2$. The environment of the marshes has undergone a rapid environmental change during the past two decades and in a short time. Almost 94% of the water in these water bodies was lost. That is, it is wetlands that have been subjected to rapid drying that can significantly affect the mineral properties of the sediments and over time. The study of mineral composition is of great importance because of its role as an indicator of soil formation and development. Al-Bayati *et al.* (2012) noticed when they studied the marshes soil after choosing three paths: Al-Amarah, Al-Nasiriyah and Al-Samawah that the marshes of the Al-Amarah and Al-Nasiriyah tracks (deposits of the Tigris River) have a higher content of Epidote mineral compared to the marshes of the Samawa path (the sediments of the Euphrates River), which showed higher percentages of Pyroxene, Garnit, Tourmaline and Rutile. As for the study of light minerals, it showed the predominance of minerals in the following sequence of study criteria: Quartz > Chert > Muscovite > Chlorite > Biotte > Feldspar. Jassim and Goff (2006) showed that the most important minerals found in the soil of Hammar Marsh in the eastern and northern parts and according to their sequence, are Carbonate, Quartz, Feldspar, Chert and Chlorite. Given the importance of marsh soils and the limited studies of heavy and light minerals, this study came to identify these minerals in the sand separated of the dried marsh soils in southern Iraq.

## 2. Materials and Methods

The six pedons were selected representing three paths covering most of the marshes in southern Iraq, namely:

***Author for correspondence*** ***Received** April 17, 2021* ***Revised** July 08, 2021* ***Accepted** July 29, 2021*

1- The first path is towards Basra and includes the marshes of Al-Dair, Al-Shafi and Al-Mashab.

2- The second path is towards Thi Qar and includes the marshes of Al-Jbayish, Al-Fahd and Al-Hamar.

3- The third path is in the direction of Maysan and includes the marshes of Al-Azeem and Al-Musharrah.

The mineral group chlorite comes in second in terms of dominance in most of the pedon soils of the study (Table 3), except for the (A) horizon of pedon 1 (Basra - Shafi 1) and the horizon C1 of Baidun 3 (Thi Qar - Al-Jbayish). The percentages of chlorite minerals ranged between (6.60 - 9.90), as the highest value appeared on the C1 horizon in pedon 6 (Maysan - Al-Musharrah). While the lowest value appeared on the horizon C1 in pedon 3 (Thi Qar - Al-Chabaish). Chlorite minerals are lamellar minerals and the mineral appears in image 1 (B image 2 A, B) in a false hexagonal shape, green in various degrees or brown and with a glassy or pearly luster or its particles may contain iron oxide spots and its source comes from the decomposition of silicate minerals containing magnesium, iron and aluminium elements such as Biotite and Pyroxene minerals, or primary minerals from metamorphic rocks in Iraq and Turkey. As well as its three types represented by real, sedimentary and puffy chlorite and it is created as a result of the deposition of the brucite layer within the inner layers of the mineral montmorillonite, forming what is called the phenomenon of chlorozation. The tests showed the presence of a group of mica minerals within the heavy minerals (Table 2), which included the minerals Muscovite, with a percentage ranging between (3.10-7.60) and biotite in percentages (4.40-6.70). The results show that the proportions of Muscovite minerals were excelled on those of biotite minerals in the study soils tests due to their high resistance to weathering compared to biotite minerals. Biotite appeared brown in color (Fig. 2C) under the microscope, while Muscovite appeared in light green color in different degrees (Fig. 2D). Fig. 1 shows the geographical locations of these marshes selected for study. After determining the required locations for the study, the soil section was excavated and its morphology was described. Soil samples representing each horizon were taken. The soil samples were pneumatically dried and broken up manually and with a wooden hammer in order to preserve the morphology of the minerals in them. They were passed through a sieve whose holes diameter (2 mm) and kept in plastic boxes. Analysis of the separation of heavy metals from light metals for parts separated by sand was conducted by Bromoform ($CHBr_3$) liquid for each separated, then the heavy and light metals were diagnosed and estimated using the polarized microscope and through the following traits: Color, Form, Cleavages, Cracks, Refractive index, Inclusions, Relief, Interference figure according to Milner (1962).

## 3. Results and Discussion

### 3.1 Heavy metal for sand separation

The process of separating heavy metals by means

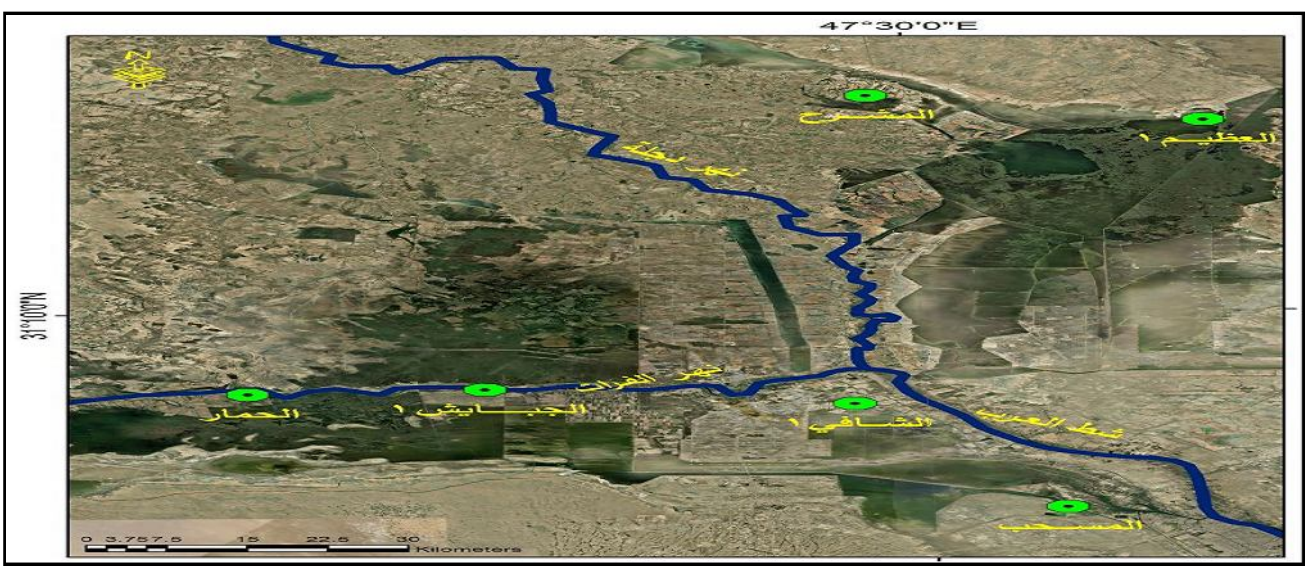


**Fig. 1:** The image representing the study sites

of a liquid (Bromoform) for the soil of the study showed that the group of heavy metals occupies a small part of the separated sand compared to light metals, where their percentages ranged between 3.4-5.4% (Table 1) and the highest value in the C2 horizon was for pedon 1 (Basra - Al-Shafi 1), while it showed the lowest value on the horizon A to appear 3 (Thi Qar- Al-Chaibayish). The decrease in the proportions of heavy metals is a result of the weathering that occurs in the places where they are transported, during transport, or after their deposition, as Al-Ani (2006) indicated, or it may be due to the content of these minerals originally in the soil origin materials, or it may be due to their deposition in the location closest to the source of sedimentation geographically. The results shown in Table 1 show the values of heavy metals as a percentage in the sand separation and their distribution with depth. Heavy sand minerals included a large number of minerals represented primarily by the group of opaque minerals (Opaque Minerals).

Amphiboles, Pyroxene, Epidote and lamellar minerals are represented by Muscovite, Biotite, Chlorite, as well as Staurolite, Kyanite, Celestite. It also appears in Table 2 that the dominance of opaque minerals (Opaque Minerals) for all pedons of the study soils, as their ratios ranged between 35.50 - 046.7 and the highest value in the C2 horizon was for pedon 6 (Maysan - Al-Mushatrah). While the lowest value appeared on horizon A for pedon 2 (Basra / Al-Mashab 1) and the horizon C2 for pedon 3 (ThiQar - Jibayish 1) and its vertical distribution showed an irregular distribution with depth within all soil horizons. The reason for the dominance of the opaque minerals group (Opaque Minerals) is due to the role of the original material rich in oxides [Al-Rawi (2003)]. Kerr (1959) showed that opaque minerals are found in metamorphic rocks and re-depositioned sedimentary rocks. The optical and microscopic properties shown in Fig. 1 that this group included iron oxides machnite, which appeared in opaque black color, metallic luster, irregular shapes, as well as chromate oxide with black color, angular semi-round shape. The mineral group chlorite comes in second in terms of dominance in most of the pedon soils of the study (Table 2), except for the (A) horizon of pedon 1 (Basra - Shafi 1) and the horizon C1 of pedon 3 (Thi Qar - Al-Jbayish). The percentages of chlorite minerals ranged between (6.60 - 9.90), as the highest value appeared in the C1 horizon in pedon 6 (Maysan - Al-Musharrah), while the lowest value appeared in the C1 horizon in pedon 3 (Thi Qar - Al-Jbayish). Chlorite minerals are lamellar minerals and the mineral appears in the form Figs. 1 & 2 in a false hexagonal shape, green in various degrees or brown and with a glassy or pearly luster, or its particles may contain iron oxide spots.

**Table 1:** Percentages of heavy and light sand minerals.

| Pedon number | Location | Depth | horizon (cm) | Heavy minerals Percentage(%) | Percentage of light minerals (%) |
|---|---|---|---|---|---|
| P1 | Basra / Al-Shafi 1 | A | 28-0 | 4.60 | 95.40 |
| | | $C_1$ | 71-28 | 5.40 | 94.60 |
| | | $C_2$ | 113 + | 4.00 | 96.00 |
| P2 | Basra / Al-Mashab 1 | A | 21-0 | 4.40 | 95.60 |
| | | $C_1$ | 90 + | 3.80 | 96.20 |
| P3 | Thi Qar/ Al Jabayish 1 | A | 20 - 0 | 3.40 | 96.60 |
| | | $C_1$ | 35 - 20 | 5.20 | 94.80 |
| | | $C_2$ | 81 - 35 | 3.60 | 96.40 |
| | | $C_3$ | 116+ | 5.20 | 94.80 |
| P4 | Thi Qar/ Alhimar1 | A | 22 - 0 | 3.80 | 96.20 |
| | | $C_1$ | 46 + | 4.80 | 95.20 |
| | | $C_2$ | 99+ | 5.00 | 95.00 |
| P5 | Maysan / Aleazim 1 | A | 28 - 0 | 4.40 | 95.60 |
| | | Cl | 71 + | 5.00 | 95.00 |
| P6 | Maysan / almashrah | A | 18 - 0 | 4.00 | 96.00 |
| | | $C_1$ | 57 - 18 | 3.60 | 96.40 |
| | | $C_2$ | 100 + | 4.20 | 95.80 |

**Table 2:** Percentages of heavy minerals in the sand separation of the horizons of Pedon for study soils.

| Pedon number | Location | Horizon (cm) | Depth(cm) | Opaques minerals | Chlorite | Muscovite | Biotite | Zircon | Tourmaline | Garnet | Rutile | Amphibole (Hornblende) | Pyroxenes | Epidote | Staurolite | Kyanite | Celestite | others |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P1 | Basra / Al-Shafi1 | A | 28-0 | 36.40 | 7.60 | 7.60 | 5.20 | 9.40 | 3.50 | 3.80 | 3.60 | 6.70 | 4.50 | 3.70 | 2.40 | 2.90 | 1.30 | 1.20 |
| | | $C_1$ | 71-28 | 37.70 | 8.70 | 6.30 | 5.70 | 6.40 | 4.70 | 4.80 | 2.30 | 5.60 | 4.50 | 6.70 | 2.30 | 1.80 | 0.00 | 1.60 |
| | | $C_2$ | 113+ | 38.50 | 9.60 | 5.90 | 6.20 | 6.50 | 3.70 | 3.60 | 3.10 | 4.60 | 5.20 | 5.40 | 1.70 | 2.40 | 2.30 | 1.30 |
| P2 | Basra / Al-Masha 1 | A | 21-0 | 35.50 | 8.10 | 7.10 | 5.10 | 5.70 | 2.40 | 4.30 | 2.50 | 6.40 | 4.60 | 6.80 | 2.30 | 3.20 | 4.70 | 1.30 |
| | | $C_1$ | 90 + | 42.60 | 7.70 | 4.20 | 5.90 | 5.10 | 4.70 | 4.80 | 2.10 | 5.50 | 4.10 | 5.30 | 1.40 | 1.60 | 3.50 | 1.50 |
| P3 | Thi Qar/ Al Jabayish1 | A | 20 - 0 | 35.50 | 8.60 | 5.40 | 6.70 | 4.60 | 3.70 | 3.60 | 2.60 | 5.30 | 4.10 | 7.40 | 2.80 | 2.60 | 4.80 | 2.30 |
| | | $C_1$ | 35 - 20 | 42.40 | 6.60 | 6.80 | 5.40 | 7.50 | 2.50 | 4.70 | 1.40 | 4.90 | 5.30 | 5.70 | 1.90 | 2.30 | 1.10 | 1.60 |
| | | $C_2$ | 81 - 35 | 35.50 | 8.90 | 7.50 | 4.70 | 4.60 | 4.70 | 4.80 | 2.10 | 5.50 | 4.40 | 6.60 | 1.50 | 1.90 | 5.70 | 1.60 |
| | | $C_3$ | 116+ | 38.30 | 7.70 | 5.90 | 5.30 | 5.70 | 4.80 | 5.20 | 3.20 | 5.20 | 5.10 | 5.70 | 2.40 | 1.20 | 2.80 | 1.50 |
| P4 | ThiQar/ Alhima1 | A | 22 - 0 | 35.70 | 8.60 | 7.30 | 5.20 | 5.60 | 4.50 | 4.40 | 5.90 | 4.50 | 4.40 | 6.50 | 1.40 | 2.30 | 2.10 | 1.60 |
| | | $C_1$ | 46 - 22 | 40.20 | 6.70 | 3.80 | 4.40 | 5.50 | 4.00 | 3.20 | 5.50 | 5.50 | 4.30 | 5.50 | 1.60 | 2.10 | 4.60 | 1.10 |
| | | $C_2$ | 99 + | 38.60 | 7.70 | 6.40 | 5.20 | 6.10 | 2.60 | 4.50 | 2.50 | 6.50 | 4.70 | 6.30 | 1.60 | 2.80 | 3.30 | 1.20 |
| P5 | Maysan / Aleazim1 | A | 28 - 0 | 36.80 | 9.40 | 6.40 | 5.50 | 9.10 | 2.80 | 4.20 | 3.30 | 4.70 | 2.90 | 6.50 | 1.80 | 2.40 | 3.30 | 0.90 |
| | | C1 | 71 + | 37.60 | 8.90 | 7.10 | 6.20 | 5.20 | 4.80 | 4.70 | 4.40 | 5.50 | 3.70 | 4.40 | 1.60 | 2.40 | 2.90 | 0.60 |
| P6 | Maysan / almashrah | A | 18 - 0 | 37.90 | 7.50 | 6.30 | 5.20 | 5.10 | 3.30 | 3.30 | 6.20 | 4.60 | 5.70 | 6.20 | 2.40 | 2.00 | 3.10 | 1.20 |
| | | $C_1$ | 57 - 18 | 44.50 | 9.90 | 3.10 | 5.40 | 4.30 | 3.80 | 2.90 | 4.20 | 5.70 | 3.30 | 4.70 | 1.90 | 1.20 | 2.50 | 1.60 |
| | | $C_2$ | 100 + | 46.70 | 8.50 | 3.70 | 6.30 | 4.50 | 3.70 | 2.70 | 4.20 | 4.90 | 2.50 | 3.60 | 2.60 | 1.60 | 3.30 | 1.20 |

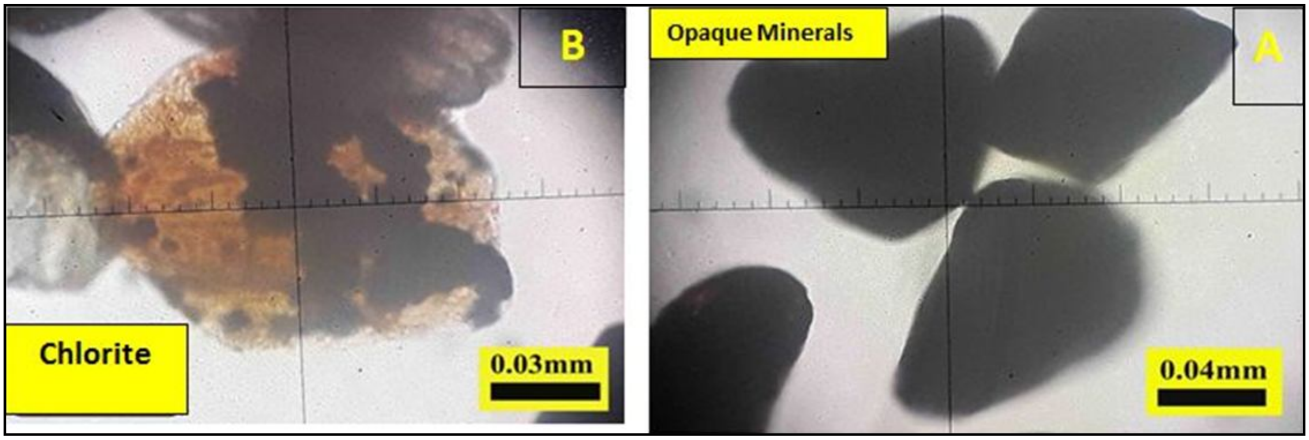


**Fig. 1:** Some heavy Minerals in the study pedons soils

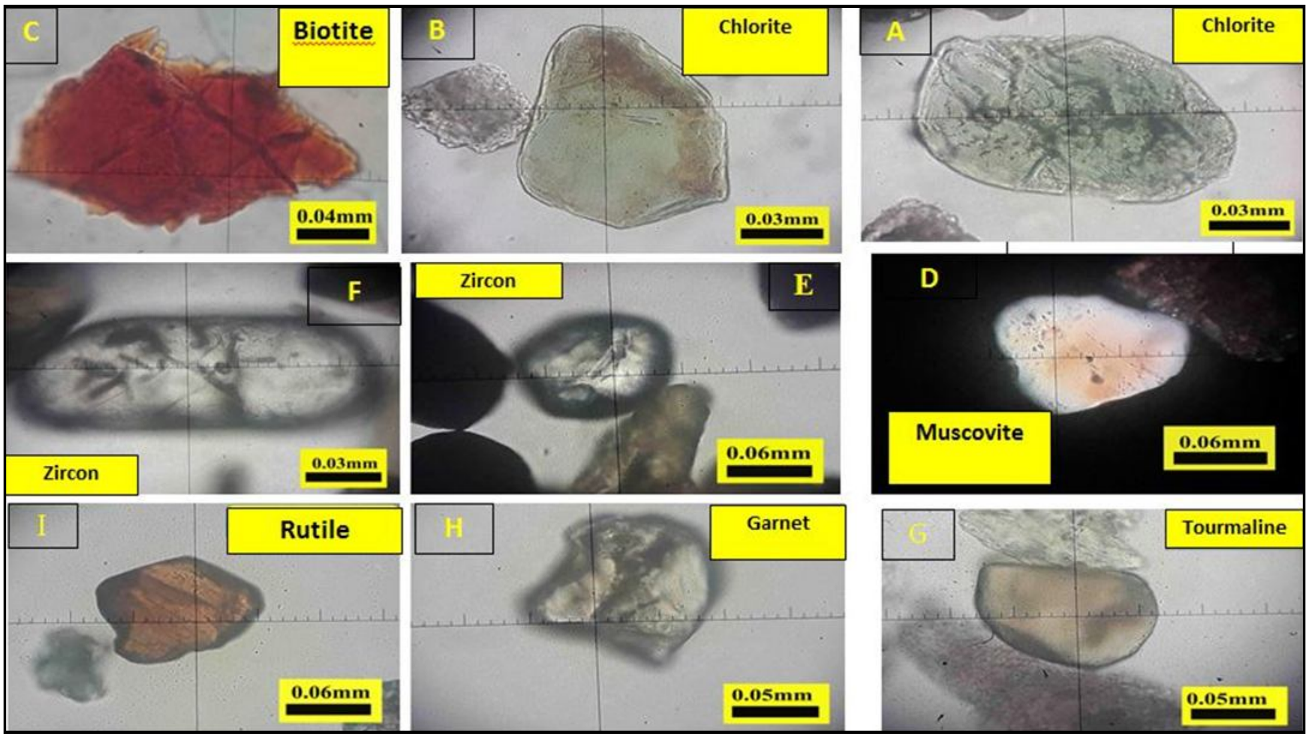


**Fig. 2:** Some heavy Minerals in the soil of the study pedons

Its source comes from the decomposition of silicate minerals containing magnesium, iron and aluminium elements such as Biotite and Pyroxene minerals, or primary minerals from metamorphic rocks in Iraq and Turkey , as well as its three types represented by real, sedimentary and bloated chlorite. The so-called phenomenon of chlorosis [Al-Watifi *et al.* (2015)] and the vertical distribution of these minerals with depth was not homogeneous (Table 2). The tests showed the presence of a group of mica minerals within the heavy minerals (Table 2), which included the minerals Muscovite, with a percentage ranging between (3.10 - 7.60) and biotite in percentages (4.40 - 6.70). The results show that the proportions of Muscovite minerals were excelled on those of biotite minerals in the study soils examination due to their high resistance to weathering compared to biotite minerals. The mineral biotite appeared in its brown color (Fig. 2C) under the microscope, while Muscovite appeared in light green color and in different degrees (Fig. 2D). As for the heavy metals resistant to weathering, Zircon, Tourmaline, Garnet and Rutile, their percentages ranged between 4.30-9.40%, 2.40-4.80%, 2.70-5.20% and 1.40-6.20%, respectively (Table 2). As the optical tests showed that zircon was colorless and sometimes contains blue or violet shades in the form of layers and has a diamond luster its prismatic grains are more common, its hardness is 7.5 and its specific weight is 4.68 [Kerr (1959)]. Its specific weight and its chemical structure are among the factors that help in the formation

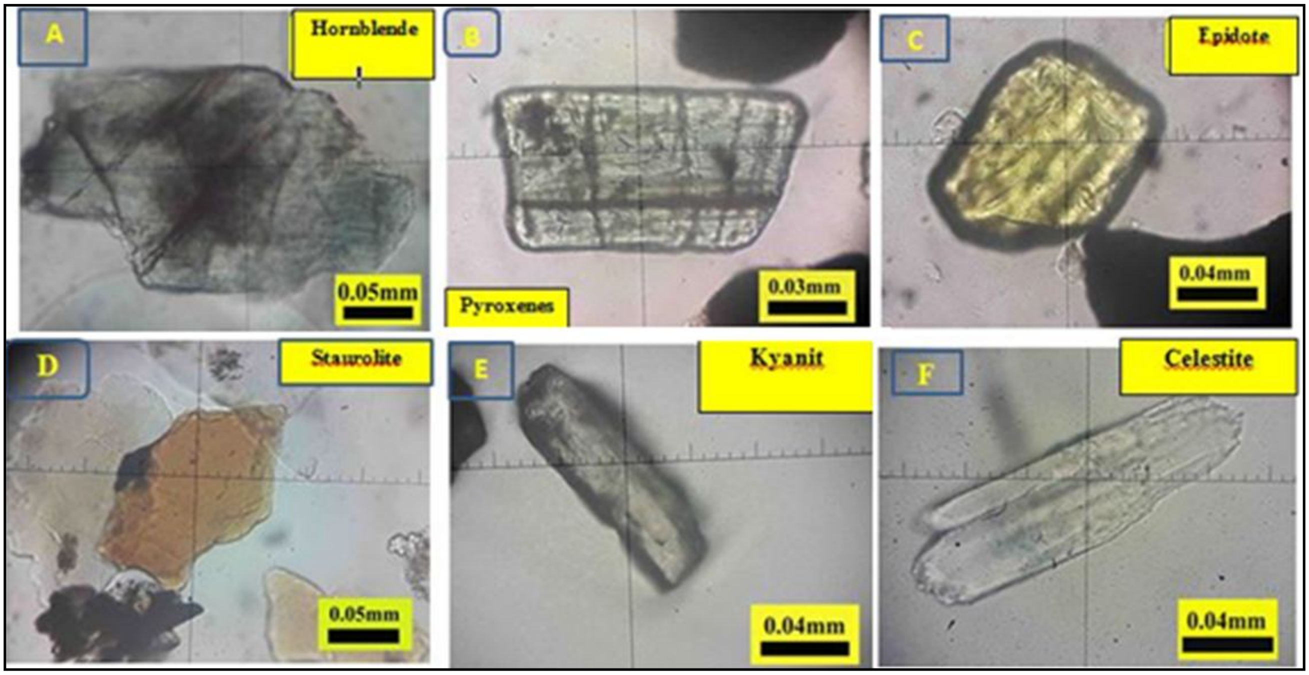


**Fig. 3:** Some heavy minerals in the soil of the study pedons

of the mineral in the form of small, round grains of transported sediments. As for the mineral Tourmaline, it appeared in its light brown to honey color with a vitreous luster and a circular shape, its hardness 7.5-7 and its specific gravity 3.2-3. Garnet is distinguished through microscopy tests. It is colorless with a vitreous luster, its hardness is 7-6 and its specific gravity is 3.5-3.3. It is considered one of the chemically stable minerals even at high pressures and underground temperatures. Also, rutile is characterized microscopically (I) by its dark red color, clear cracking, its hardness 6.5-6 and its specific gravity 4.21 [Herald (2010)].

As for the group of Amphibole and Pyroxenes, which are unstable heavy metals, they are less stable, with a percentage of 4.50-6.70 and 2.50-5.70%, respectively. Among the most important minerals identified for the amphibole group is Hornblende, which is found in igneous rocks and metamorphic and medium-metamorphic rocks, especially [Al-Jubouri (1989)]. Al-Jubouri (2014) also showed that its presence indicates the weakness of chemical weathering and the prevalence of mechanical weathering. The optical and morphological properties of Hornblende mineral were revealed under the polarized microscope and shown in Fig. 3A, as it was distinguished by its transparent color from light green to brownish green, its vitreous luster and its hardness. It is 6-5, its specific gravity is 3.4-3 and it has a rectangular prismatic shape [Kerr (1959)]. While the microscopic examinations showed a group of pyroxene minerals (Fig. 3B) with a pale green color and rectangular prismatic grains, whether they were pyroxene (Mono Ortho) [Jassim and Goff (2006)].

As for epidote, it is a heavy metal with medium resistance to weathering. It is found in igneous and metamorphic rocks. It is also produced from the decomposition of feldspar, amphibole, pyroxenes and biotite under severe weathering conditions [Al-Watifi *et al.* (2015)]. Its percentage ranged between 03.6-07.4% (Table 2). The mineral was characterized microscopically in Fig. 3C by its greenish-yellow color and sometimes by pale coffee colors, it has a glassy luster, its hardness is 7-6 and its specific weight. The results in Table 2 showed that among the minerals diagnosed within the heavy metal group of the studied pedon soil is staurolite, the percentage ranged between 1.4-2.8%. It is distinguished by its angular shape, its yellowish-golden color and its semi-vitreous luster. Also, the mineral Kyanit appeared and its percentage ranged between 1.20-3.20% and it appeared under the microscope as a colorless image (Fig. 3) with clear cracks. Heavy metals also included celestite, its percentage reached 00.0-5.70%. Through microscopic examinations, it was found that the mineral is colorless Photo (Fig. 3F). There is another group of minerals, which include secondary minerals resulting from weathering and their percentage ranged between 0.60-2.30% (Table 2).

**Table 3:** Percentages of light minerals in the sand separation for the horizons of Pedon for study soils.

| Pedon number | Location | horizon (cm) | Depth(cm) | Carbonate Rock Fragments | Monocrystalline Quartz | Polycrystalline Quartz | Chert Rock Fragments | Igneous Rock fragment | Metamorphic Rock Fragments | Mudstone Rock Fragments | Potash Feldspar Microcline | Potash Feldspar Orthoclase | Plagioclase Feldspar | Evaporites (Gypsum) | Coated Grains by Clay | Others |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P1 | Basra / Al-Shafi | A | 28-0 | 30.30 | 35.20 | 2.70 | 6.30 | 3.90 | 2.20 | 6.80 | 3.800 | 1.30 | 3.50 | 1.30 | 2.60 | 0.30 |
| | | $C_1$ | 71- 28 | 34.40 | 32.40 | 1.700 | 5.60 | 1.70 | 2.500 | 6.40 | 4.500 | 2.300 | 2.80 | 2.10 | 3.30 | 0.30 |
| | | $C_2$ | 113+ | 37.40 | 30.50 | 2.30 | 4.00 | 2.40 | 1.60 | 5.40 | 3.30 | 1.60 | 1.30 | 6.20 | 3.50 | 0.50 |
| P2 | Basra / Al-Masha | A | 21-0 | 35.30 | 34.50 | 1.50 | 3.40 | 1.70 | 2.10 | 4.60 | 10.5 | 4.80 | 1.60 | 5.20 | 2.80 | 1.00 |
| | | $C_1$ | 90 + | 36.80 | 33.10 | 2.50 | 3.40 | 2.40 | 1.60 | 5.40 | 2.20 | 3.20 | 1.60 | 3.50 | 3.10 | 1.30 |
| P3 | ThiQar/ Al Jabayish | A | 20 - 0 | 29.10 | 32.10 | 2.70 | 5.40 | 2.70 | 3.40 | 6.20 | 1.40 | 4.40 | 2.60 | 6.30 | 3.40 | 0.30 |
| | | $C_1$ | 35 - 20 | 28.30 | 32.10 | 4.50 | 5.70 | 3.30 | 3.50 | 5.70 | 2.20 | 3.70 | 2.90 | 5.20 | 2.40 | 0.50 |
| | | $C_2$ | 81 - 35 | 33.40 | 34.40 | 2.90 | 3.10 | 2.40 | 2.90 | 5.30 | 1.50 | 4.20 | 3.70 | 3.10 | 2.70 | 0.40 |
| | | $C_3$ | 116+ | 28.40 | 32.30 | 1.60 | 4.80 | 3.90 | 3.30 | 5.50 | 1.80 | 3.10 | 3.40 | 7.20 | 3.60 | 1.10 |
| P4 | ThiQar/ Alhima | A | 22 - 0 | 30.20 | 33.70 | 2.90 | 5.30 | 3.70 | 2.40 | 4.90 | 1.70 | 3.40 | 2.10 | 5.30 | 3.10 | 1.20 |
| | | $C_1$ | 46 - 22 | 31.10 | 30.70 | 2.50 | 5.40 | 2.60 | 3.20 | 5.30 | 2.00 | 2.80 | 2.30 | 8.20 | 3.50 | 0.40 |
| | | $C_2$ | 99 + | 33.40 | 27.40 | 2.70 | 8.00 | 3.90 | 3.40 | 5.30 | 2.10 | 2.50 | 3.60 | 3.70 | 2.80 | 1.20 |
| P5 | Maysan / Aleazim | A | 28 - 0 | 35.10 | 35.40 | 2.60 | 4.20 | 3.40 | 1.80 | 5.50 | 1.40 | 3.30 | 2.90 | 1.10 | 2.20 | 1.10 |
| | | Cl | 71 + | 33.40 | 35.40 | 1.50 | 4.30 | 3.90 | 3.30 | 4.70 | 1.60 | 2.10 | 3.20 | 3.00 | 3.20 | 0.40 |
| P6 | Maysan / almashrah | A | 18 - 0 | 35.30 | 30.10 | 3.70 | 6.50 | 4.30 | 3.70 | 3.30 | 1.70 | 3.20 | 3.10 | 4.10 | 3.70 | 1.20 |
| | | $C_1$ | 57 - 18 | 31.40 | 27.90 | 2.40 | 6.40 | 4.60 | 2.40 | 5.40 | 2.10 | 4.90 | 2.20 | 7.10 | 2.40 | 0.70 |
| | | $C_2$ | 100 + | 33.10 | 33.30 | 2.40 | 6.70 | 2.30 | 3.40 | 5.30 | 1.90 | 3.90 | 3.40 | 2.90 | 2.50 | 0.90 |

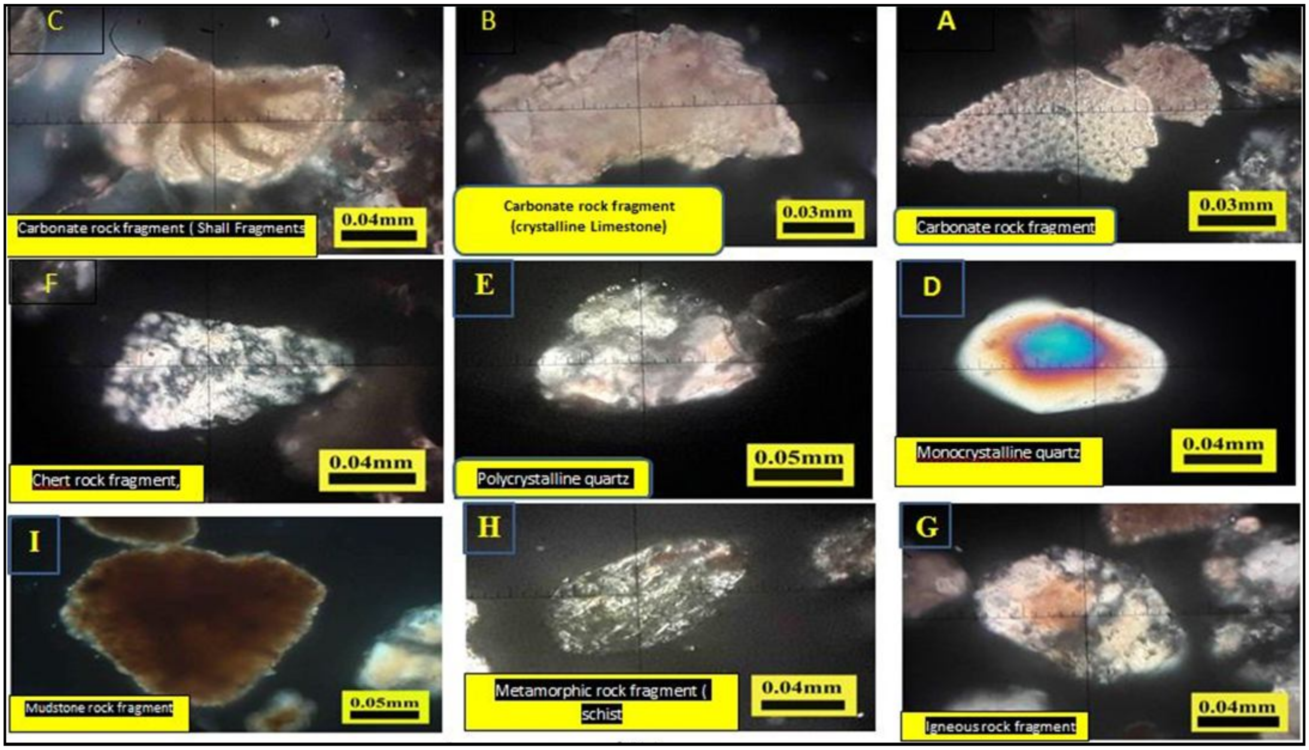


**Fig. 4:** Some of the light minerals in the studied pedons soils.

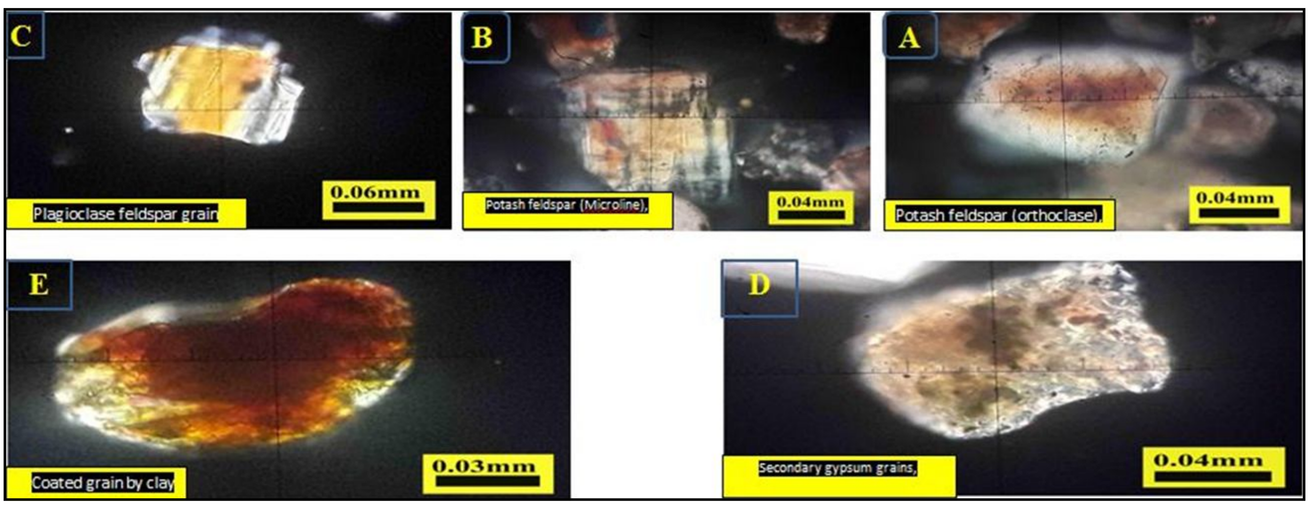


**Fig. 5:** Optical properties of the microcline metal

### 3.2 Light minerals for sand separation

The results showed that the light minerals separated by sand in the study soils include quartz with the quality of monocrystalline and polycrystalline and feldspar of its basic types, plagioques and rock pieces, including carbonate rock fragments, flint, igneous rocks, metamorphic rocks, clay rocks, evaporated salts, clay-enclosed grains and other minerals. The results in Table 3 show that the dominance was for the minerals Carbonate Rock (Fragments) and Quartz (monocrystalline), as there was a state of exchange in the dominance of these two minerals between the different horizons and pedons. The results showed that the carbonate rock fragments constituted percentages ranging between 28.3-37.4%. These rocks are of importance as an important source of carbonate minerals in the study soils. The optical properties of these minerals (Figs. 4A, 4B, 4C) showed that their crystals are circular to semi-circular and that the size of their grains ranged from very coarse to fine, where they appear to be affected by rapid mechanical erosion more than the processes of dissolution and chemical decomposition. As for quartz, it was diagnosed in its two types, monocrystalline, with rates ranging between 27.40-35.40% and polycrystalline, with rates ranging between 1.50-4.50%. The high content of quartz minerals in the study soils, in general, is due to its high resistance to weathering due to the nature of its chemical bonds and its high hardness, its lack of cracks within the crystal structure and its lightweight, which is easy to carry to long distances without being affected by weathering processes and it is considered the most stable mineral. Monocrystalline quartz was identified as a single crystal (Fig. 4D) and its grains were characterized by being coarse-smooth, angular in shape. As for polycrystalline quartz, Tire (Fig. 4), which is characterized by its composition of two or more crystal units, it appeared in an angular to semi-circular shape. The results also showed that the rock fragments (Chert Rock Fragments) formed percentages ranging between 3.10-08.0% (Table 3). Fig. 4F shows the optical properties of this mineral, as the size of its grains ranged from very coarse to fine and angular in shape. It is one of the minerals resistant to weathering, so its percentages are high in the study soils, but it has no effect on the chemical properties of the soils [Jissam and Goff (2006)]. As for the Igneous Rock Fragment, its ratios ranged between 1.70 - 4.60%. Its grains are volcanic rock fragments of angular shape and their sizes varied between medium to soft and they are of two types, light and dark in color Tour (Fig. 4G). Image (Fig. 6H) showed the presence of metamorphic rock. This type of rock of sedimentary or igneous origin was subjected to pressure and heat factors, which led to changing its physical and chemical properties and the formation of minerals with a very coarse texture.

The percentages for this group ranged between (1.6 - 3.7)% (Table 3). The results also showed that the Mudstone Rock Fragments constituted percentages that ranged between (3.3 - 6.8)%, Clay rock pieces are among the most common sedimentary rocks and appeared in several types, including (Siltstone, Mudstone, Clay stone, Clay Shale) (Fig. 4I). The group of feldspar minerals has been diagnosed with its two types, basic feldspar, plagioclase and Table 3 percentages of the basic feldspar mineral (Feldspar Microcline), where it ranged between 1.30-4.90%, while the percentages of Plagioclase Feldspar were between 1.30-3.70%. Through microscopic tests, it was found that the orthoclase mineral (Fig. 5A) is distinguished by its clear, corroded, blunted edges and imperfect faces. The results of Table 3 showed that the percentages of Feldspar Microcline metal ranged between 1.40-3.70%. The optical properties of the microcline metal showed through the sound of Fig. 5 that the mineral was glassy and sometimes foggy, with black spots on the surface. (Strracure Quadrille) and this is what distinguishes it from the mineral orthoclase [Issa (2001)]. As for the plagioclase mineral, it showed the optical properties in Fig. 5C that the mineral is in a glassy color or white and sometimes gray and can interfere with pale yellow or white stripes, it has a glassy or pearly luster, transparent to semi-transparent, a cortical wire with different plates, cracking is clear in both directions, one of them is less clearly from the other [Al-Fatlawi (2002, 2016)].

## 4. Conclusion

The results of a study of the nature of the mineral composition of sand separated showed that heavy metals occupy a small part of the sand separated compared to light minerals, as their percentage ranged between 5.4-3.4%. The results showed that the dominance of the heavy sand separated minerals was for the opaque minerals for all the pedons and the vertical distribution of them showed an irregular distribution with depth within the horizons of all soils.

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