Ann. For. Res. 66(1): 522-532, 2023
ISSN: 18448135, 20652445

ANNALS OF FOREST RESEARCH
www.e-afr.org

STUDY OF HEAVY AND LIGHT MINERALS IN SEPARATED SAND FOR SOME SOILS OF AL-DIWANIYAH PROVINCE, IRAQ

Maher Nazim Karim Al-Fatlawy and Raid Shaalan Jarallah
Al-Qadisiyah University, College of Agriculture, Iraq
Email: raid.jarallah@qu.edu.iq , maherrr608@gmail.com

Abstract

With the aim of studying heavy, light and light minerals of sand separated for some soils of Al-Diwaniyah province Where three locations were selected, the first location was in Al-Nouriah area, the second location was in Al-Shanafiya area, and the third location was in Al-Bdeir area. The light sand minerals were separated from the heavy metals and their percentage was determined by point counting. The results showed the following: The results showed the presence of heavy sand minerals in all the study soils represented, in the limestone soils, the percentage of opaque minerals was (37.8), chlorite (9.6%), orthopyroxene (2.0%), clenopyroxene (4.7%), hornblende (7.3%), clacovan (0.3%) and biotite ((4.9%), muscovite (4.4%), zircon ((5.7%), tourmaline (4.4%) and rutile (2.6%), karanite (5.1%) and epidot (6.5%), while the gypsum soil was the percentage of opaque minerals (36.6%), chlorite (3.9%), orthopyroxene (2.1%), clenopyroxene (1.8%), hornblende (3.5%), and glacophan (0.9%).), biotite (2.4%), muscovite (6.6%), zircon (5.2%), and tourmaline (4.4%).The percentage of opaque minerals was rutile (3.3%), karanite (4.4%), epidot (6.4%), sand dunes were opaque minerals (32.6%), chlorite (7.9%), orthopyroxene (3.0%), clenopyroxene (2.7%), hornblende (4.5%), and glacovan (1.2%) and biotite (5.7%), muscovite (4.3%), zircon (9.2%), tourmaline (7.4%), rutile (4.3%), carnitate (4.4%), and epidote (6.4%).The results showed the light sand minerals for the study soils, and their percentages in the limestone soils were for monocrystalline quartz (42.2%), polycrystalline quartz (2.7%), microcline (2.5%), orthoclase (2.3%), plagioclase (2.5%), carbonate rock pieces (33.7%), and flint stone. (5.5%) and igneous rocks (2.2%) Clay rocks (6.7%), gypsum (5.2%), metamorphic rocks (1.8%), clay-coated particles (1.6%), and other minerals (0.9%). As for gypsum soil, the percentage of mono-crystalline (29.6%) and polycrystalline quartz (2.2%) micro-cleans (3.3%), orthoclase (4.5%), plagioclase (3.4%), and carbonaceous rocks (29.3%). Flints (5.2%), igneous rocks (2.3%), clay rocks (3.1%), gypsum (11.6%), metamorphic rocks (3.5%), clay-coated granules (2.1%) and other minerals (0.9%). Monocrystalline quartz (46.6%) and polycrystalline quartz ((2.2% .) Microcline (3.3%), orthoclase (4.5%), plagioclase (3.4%), Carbonite (19.3%) and Flint (5.2%)igneous rocks(2.3%), clay rocks (3.1%), gypsum (3.6%), metamorphic rocks (3.5%), clay-coated particles (2.1%) and other minerals (0.9%).

Keywords: heavy mineral, light mineral, soils

Introduction

The mineral composition of the soil in general is affected by several factors, the most important of which is the climate factor and the material (Sulaiman, (2018). Sand minerals are minerals resulting from the weathering of igneous, metamorphic and sedimentary rocks. There are heavy sand minerals whose specific weight is higher than 2.89. These include opaque, mica, and semistable (amphibole, Alvin, and pyroxene) and superstable (rutile, tourmaline, and zircon minerals). As for the light minerals, their specific weight is less than 2.89, and they include quartz, feldspar and rock pieces. Sand minerals express the state of weathering, as light minerals dominate, weathering is high and vice versa for heavy minerals.The soils of Al-Diwaniyah province are the sedimentary soils of central and southern Iraq affected by the sediments of the Euphrates River. As the sedimentary soils are soils rich in pyroxene, amphibole and biotite minerals, with the presence of zircon and tourmaline, but in a smaller amount in the separated heavy sand, and in the light sand separated quartz, feldspar, gyrate and muscovite, because the rocks from which these soils were formed are metamorphic rocks and acid igneous rocks. Also (Al-Ghabban, 2022) in their study of Al-Diwaniyah soils showed the presence of quartz, feldspar and rock pieces for light minerals, while for heavy minerals the presence of dark minerals, mica, amphiboles, pyroxene, zircon, rutile and tourmaline. Another study showed (Al-Tawash et al., 2012. Sedimentary soil in central Iraq and the main source of its deposits is the Euphrates River. The presence of amphibole, pyroxene, carnit and other heavy metals, as for the light minerals quartz and feldspar. Al-Gabban and Raid, (2022) also found, in their study of the sedimentary soils affected by the sediments of the Euphrates River, the presence of dark minerals, chlorite, biotite, hornblende, muscovite, tourmaline, rutile, carnites, epidot and citrulite. As for the light minerals, they showed the presence of monocrystalline and polycrystalline quartz, microcline, orthoclase, plagioclase, gypsum, igneous and metamorphic rocks. They also indicated the mineral composition in the Iraqi sedimentary soils, the presence of heavy sand minerals pyroxene, amphibole, rutile, zircon and tourmaline, while the light sand minerals quartz, calcite, biotite, gypsum and muscovite. Bennett (Hebron, 2020). In this study, an increase in the proportions of light metals compared to heavy metals. The sedimentation process is the last process that occurs after water or wind erosion when the energy of the carrier factor decreases and based on what was mentioned above, it aimed to study the heavy and light minerals of sand separated for some soils of the Diwaniyah portfolio in Iraq.

Materials and methods

Preliminary actions

Three locations were chosen within the lands located in Al-Diwaniyah province, which is part of the Iraqi alluvial plain

- The first location is calcareous soil in Al-Nouriah area
- The second location is gypsum soil in Al-Shanafiya area
- The third location of the sand dunes in Al-Budair area

field procedures

The samples were taken from the study locations to a depth of 0-30 cm and were collected in nylon bags and transported to the laboratory and air dried, then ground with a wooden hammer and passed on a sieve with a diameter of 2 mm for the purpose of conducting the required chemical and physical analyzes as well as preparing them for metallurgical examinations.

Table (1) Some chemical and physical properties of sand dunes

studied trait		unit	gypsum soil	calcareous soil	
EC . electrical conductivity		ds m^{-1}	1.89	1.41	2.06
pH			7.65	7.91	7.84
O.M . organic matter		%	0.12	0.42	0.003
Soluble calcium Ca+2		ppm	400	110	120
Soluble Magnesium Mg+2			678.6	304.2	234.0
dissolved sodium Na+			70	188	260
Soluble potassium K+			56	30	40
Cl- dissolved chlorine			142	2800	604
Soluble sulfate SO4-2			525.53	304.2	125.0
Dissolved carbonate CO3-2			Nil	Nil	Nil
soluble bicarbonate HCO3-			30	32	24
total carbonate		%	3.4	5.5	6.2
active carbons		ppm	Nil	Nil	Nil
gypsum		%	40.59	1.23	5.71
bulk density		g.cm^{-3}	1.31	1.42	1.49
Soil Texture			Sandy loam	Clay loam	sandy loam
Soil Separators	sand	g.kg^{-1}	681	326	801
	slit		142	203	82
	caly		177	471	117

physical analyzes

Volumetric analysis of soil separations

Estimate the relative analysis of the sand separated by hydrometer method as mentioned in (Black, 1965).

bulk density

Density was estimated by (Core sample) method in (Black 1965).

chemical analyzes

Electrical conductivity (EC

It was estimated by the Wet Digestion method, according to Walkely and Black method mentioned in (Jackson, 1958).

Soil reaction (pH)

The degree of soil reaction in a soil suspension: water (1:1) was measured using a pH-meter as mentioned in (Page et al., 1982).

Electrical conductivity (EC)

The electrical conductivity was measured in a soil-water suspension (1:1) using an EC-meter according to what was mentioned in (Page et al., 1982).

positive ion exchange capacity (CEC)

The exchange capacity of positive ions was measured using ammonium acetate and sodium acetate according to what was mentioned in (Black, 1965).

carbonate minerals

The carbonate minerals were estimated by titration with 1N of HCL with 1N of NaOH according to (Page et al., 1982).

Organic matter

The organic matter was estimated by wet oxidation method by potassium dichromate according to Walkly and Black method mentioned in (Black 1965).

gypsum

The gypsum was determined by acetone precipitation, according to what was mentioned in the Richards method (1954).

Dissolved positive and negative ions

Calcium (Ca^{+2}) Calcium was determined by sintering with Fresenite (EDTA) - 〖Na〗_2) using the ammonium perberate reagent according to the Lanyon and Heald method mentioned in (Page et al., 1982).

Magnesium (Mg^{+2})

It was estimated by estimating calcium and magnesium together by smearing it with fersnet using Erichrome Black T reagent, then subtracting calcium from the total calcium and magnesium according to the method of Lanyon and Heald mentioned in (Page et al., 1982).

Sodium (Na^+)

It was estimated using the Flamephotometer (Jackson, 1958 .).

Potassium (K^+)

It was estimated in a soil extract: water (1:1) using a flame photometer according to the method suggested by Knudesn et al. mentioned in (Page et al., 1982).

Sulfate ($SO_4^=$)

The sulfate was determined by precipitation method in the form of barium sulfate contained (Black, 1965).

Chlorine(〖Cl〗^-)

It was determined by grinding with silver nitrate (〖AgNO〗_3) at a concentration of (0.01N) in the presence of potassium chromate according to the method mentioned in (Jackson, 1958).

Carbonates and bicarbonates (〖CO〗_3^(-2)) and (HCO3-)

The bicarbonate carbonates were determined by scaling method with sulfuric acid (〖H_2SO〗_4) at a concentration of (0.01N) in the presence of orange methylation index according to the method mentioned in (Jackson, 1958).

active carbons

It was estimated using 0.2 M ammonium oxalate and skewing with 0.2 M potassium permanganate according to (Carter, 1981).

Total carbonate

Total carbonate was determined by calcimeter method using 3N of hydrochloric acid described in Hesse (1971).

Separation and fragmentation

The separation of sand particles was carried out by wet sifting method using a sieve with a diameter of 50 microns, then the clay particles were separated from the silt by following the sedimentation method according to Stock's law, taking into account the temperature as mentioned in (Jackson, (1979).

Separation and characterization of heavy and light sand minerals

A weight of 20 g was taken from the model and then it is ensured that the model is dismantled and that the granules do not stick to each other by mixing the model, stirring it and knocking it with a light wooden cylinder, and then the model was mixed with distilled water to ensure the process of dismantling the granules well and then drying it in the drying oven

Then the sample is washed on a sieve with a size of 63 microns for sand for the purpose of getting rid of the mud and silt, then the model is taken and washed well with water in order to get rid of the mud stuck to the granules, and then the sand granules are washed by acetone to ensure the washing of the granules.A weight of 15 g is taken to carry out the sifting process by means of sieves in order to isolate the sand (fine, very fine) that will be used to separate heavy metals from light metals. A weight of 5 g is taken from the fine and fine sandy part for the purpose of carrying out the process of separating heavy metals from light metals by heavy liquid bromofrom using a separating funnel and according to the method proposed by Flok (1974) and Carver (1971) Then scattering slides are made using Canada balsam, after which the minerals are diagnosed and their percentages determined by the dot-counting method and according to the method proposed by the scientist Fleet (1926).

Results and discussion

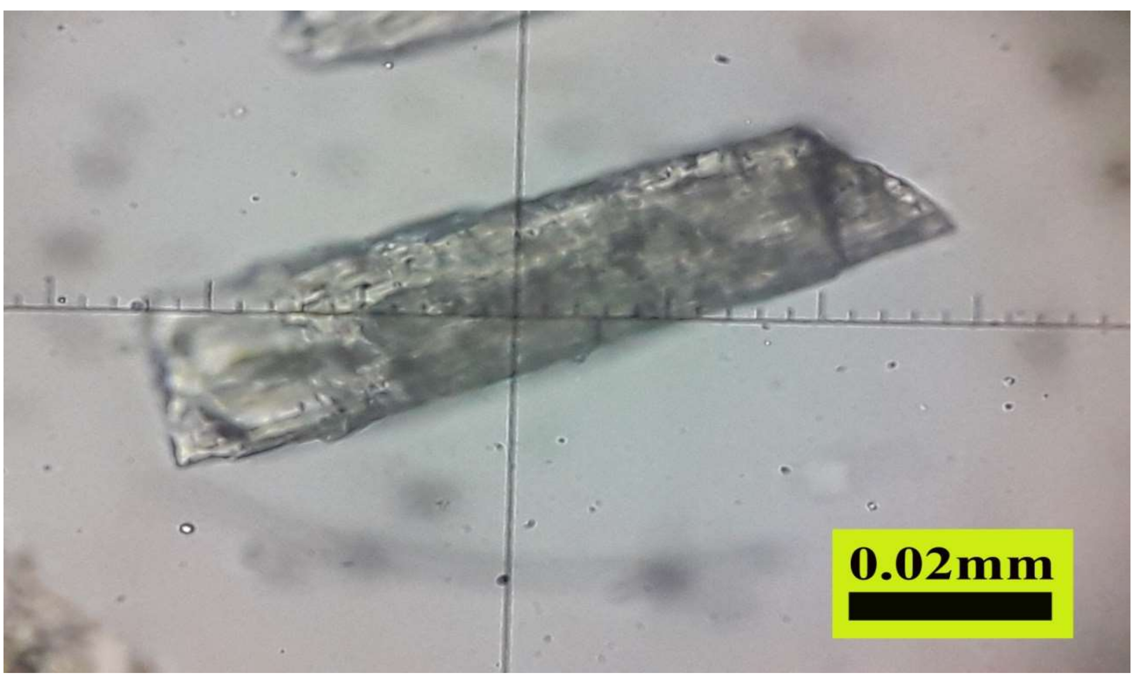
Heavy and light sand minerals in study soils

heavy metals

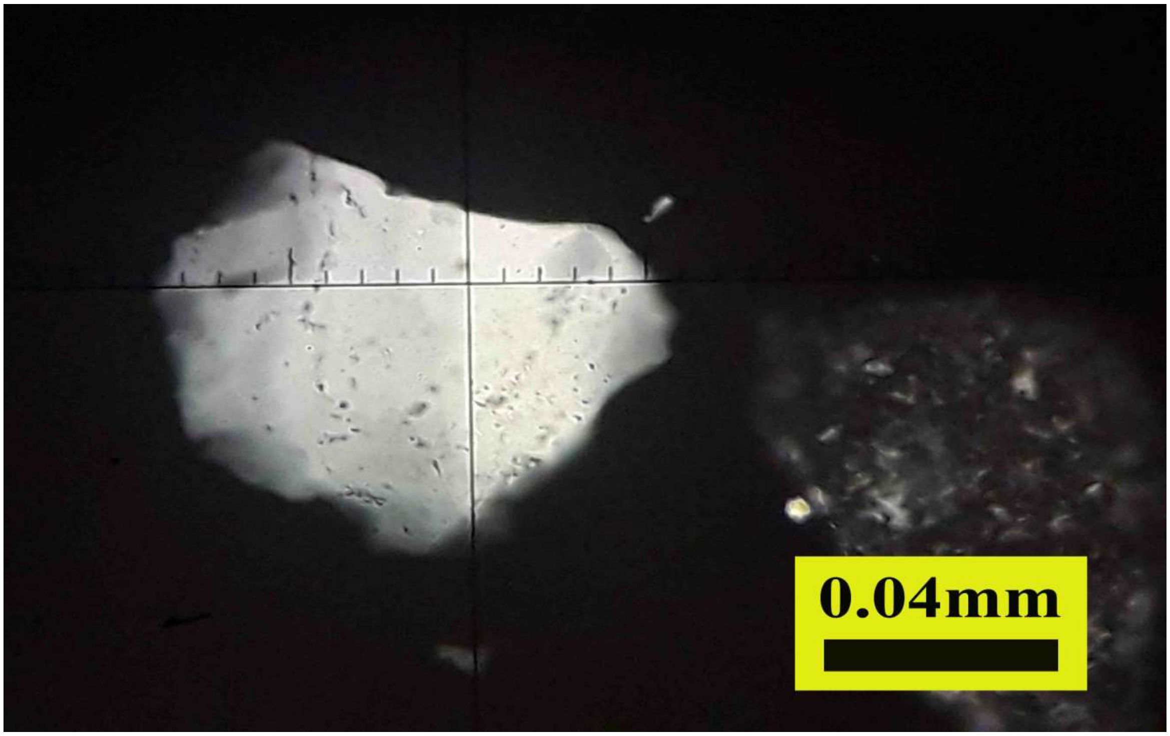
The results in Table 2 showed the percentages of heavy metals separated by sand in the study soils. The lime soil contains opaque minerals with a percentage of (37.8%), chlorite (9.6%), orthopyroxene (2.0%), and clenopyroxine (4.7%).Marble neblende (7.3%), claucofan (0.3%), biotite (4.9%), muscovite (4.4% Fig. 2), zircon ((5.7%), tourmaline (4.4%), tarantula (2.6%), carnet (5.1%), and epidot (6.5%) and sterolite (1.4%), kyanite (1.5%), silcite (1.2% Fig. 1), and other minerals (0.6%), while the percentage of opaque minerals was gypsum (36.6%), chlorite (3.9%), orthopyroxene (2.1%), and clenopyroxine (1.8%).), hornblende (3.5%), glacophan (0.9%), biotite (2.4%), muscovite (6.6%).Zircon (5.2%), tourmaline 4.4%, tarteel (3.3%), carnet (4.4%), epidote (6.4%), citrulite (1.5%), kyanite (1.3%), silcite and other minerals (1.3%). dark metals (32.6%)Chlorite (7.9%), orthopyroxene (3.0%), clinopyroxene (2.7%), horde neblend (4.5%), clacovan (1.3%), biotite (5.7%), muscovite (4.3%), zircon (9.2% picture) (3), tourmaline (7.4%) Waltarel (4.3%) Carnites (4.4%), epoid (6.4%), citrulite (2.0%), kyanite (2.2%), silcite (1.5% Fig. 1), and other minerals 0.6%.There is a discrepancy in the percentages of heavy metals for the study soils, where the lime soil excelled in the percentage of opaque minerals, chlorite, clenopyroxine, hornblende, carnitate and epidot While gypsum soil excelled in the minerals muscovite, sterolite, silicite and other minerals, sand dunes excelled in the minerals ortho pyroxene, biotite and zircon.Tourmaline and rutile differ in their percentage due to the original material, igneous, metamorphic and sedimentary rocks, as well as the transport factor.

Table (2) Heavy metals for study soils in sand

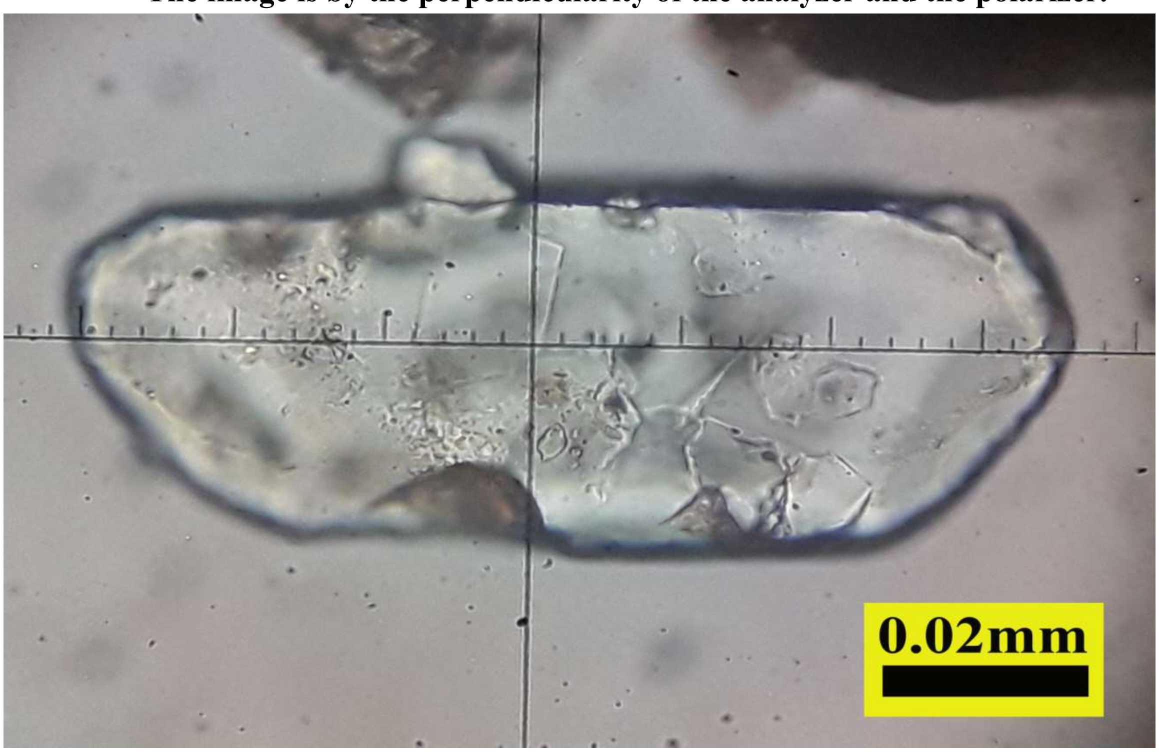
heavy metals		calcareous soil	desert lime	Sand dunes
Opaques		37.8	28.5	32.6
Chlorite		9.6	5.5	7.9
Pyroxene Group	Orthopyroxene	2.0	2.4	3.0
	Clinopyroxene	4.7	3.4	2.7
Amphibole Group	Hornblende	7.3	4.6	4.5
	Glaucophane	0.3	1.2	1.2
Mica Group	Biotite	4.9	5.7	5.7
	Muscovite	4.4	7.4	4.3
Zircon		5.7	12.4	9.2
Tourmaline		4.4	9.7	7.4
Rutile		2.6	6.7	4.3
Garnet		5.1	4.6	4.4
Epidote		6.5	3.8	6.4
Staurolite		1.4	1.5	2.0
Kyanite		1.5	1.3	2.2
Celestite		1.2	-	1.5
Others		0.6	1.3	0.6



Picture (1) A prismatic granule with elongation of celestite mineral decomposing in gypsum soil using polarized light.



Picture (2) A lamellar granule of muscovite from the mica group of limestone minerals. The image is by the perpendicularity of the analyzer and the polarizer.



Picture (3) A prismatic granule with high clarity and is colorless for zircon mineral for sand dunes using polarized light

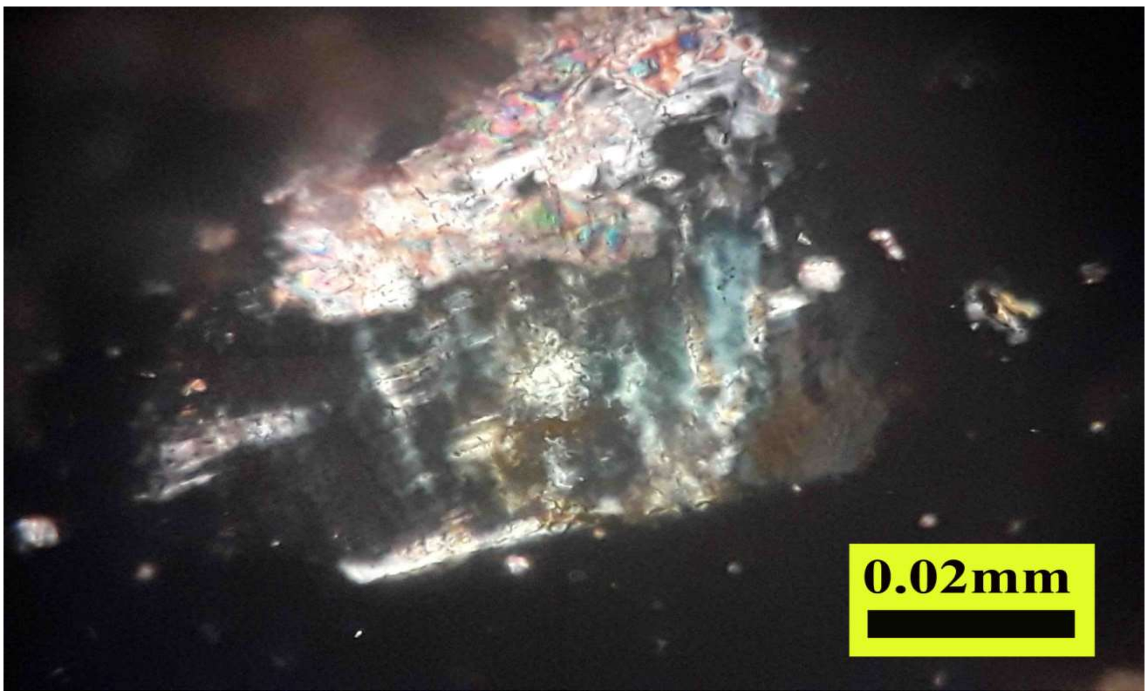
light metal

The results of Table 3 showed the percentages of light minerals separated by sand in the study soils.In calcareous soils, the proportion of monocrystalline quartz was 42.2%, polycrystalline quartz (2.7%), microcrystalline quartz (2.5% Fig. 4), orthoclase (2.3%), and plagioclase (2.5%).Carbon blocks (33.7%), limestone (5.5%), clay pieces (6.7%), gypsum (5.2%), and igneous rock pieces (1.8%).The metamorphic rock pieces (2.2%) and the clay-coated particles (1.6%) and other minerals (0.9%). As for the gypsum soil, the percentage of monocrystalline quartz was 29.6% Fig. (5), polycrystalline quartz (2.2%), microcrystalline (3.3%), and orthoclase. 4.5%, plagioclase (3.4%), carbonate rocks (29.3%), limestone (5.2%) Clay pieces (3.1%), gypsum (11.6 percent), igneous pieces (2.3%), metamorphic pieces (3.5%), and clay-coated particles (2.1%) and other minerals (0.9%). The percentages in sand dunes were monocrystalline quartz (46.6%), polycrystalline quartz (2.2%), microcrystalline (3.3%), orthoclase (4.5%), plagioclase (3.4%), carbonate rock pieces (19.3%) and gerite (5.2%).) and clay rock pieces ((3.1%Gypsum (3.6%), igneous rock pieces (2.3%), metamorphic rock pieces (3.5%) (2.1%), and other minerals (0.9%).The results showed a variation in the proportions of light minerals. The lime soil outperformed the polycrystalline quartz minerals, carbonate rock pieces, limestone and clay rock pieces. As for the gypsum soil, it outperformed the gypsum mineral than the study soil, and it outperformed the calcareous soil in the minerals of orthoclase, microclays, plagioclase, igneous and metamorphic rocks and clay-coated granules. While sand dunes excel in monocrystalline quartz minerals.Its proportions were equal with gypsum soils in polycrystalline quartz, feldspar, limestone, clay rock pieces, igneous and metamorphic rock pieces, and clay-coated granules. As for polycrystalline quartz and other minerals, they were equal in all study soils. This is due to the original material and its carrier factor.

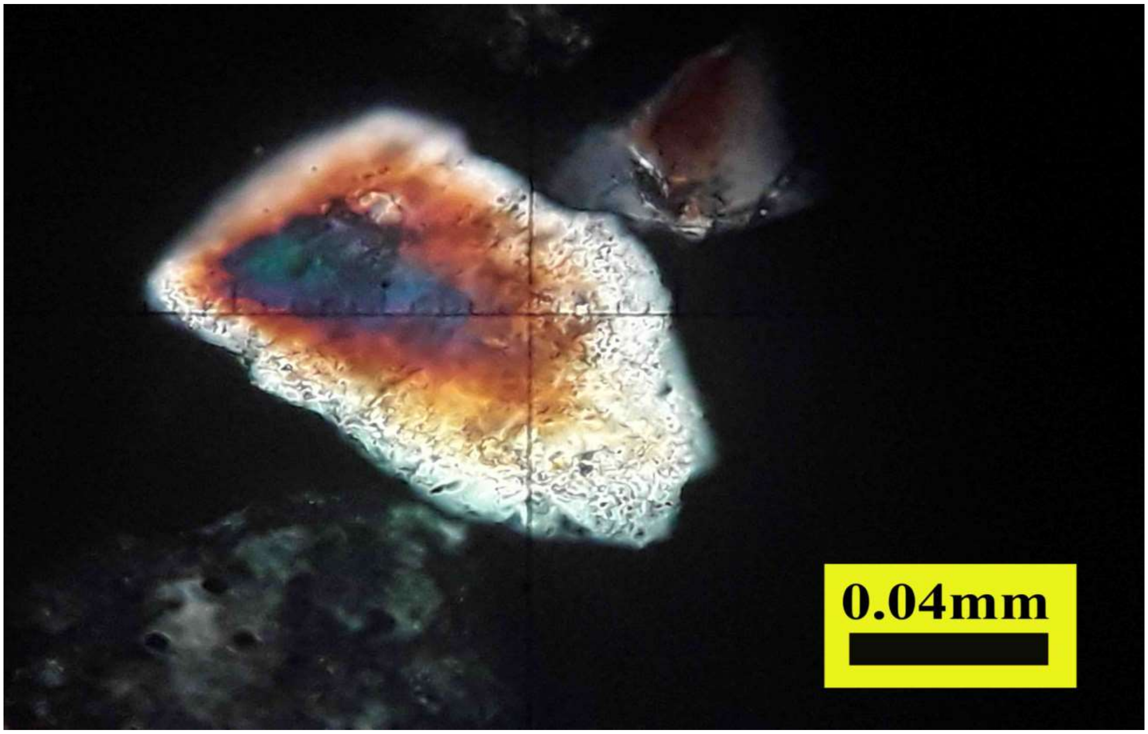
Table (3) light minerals for study soils

light metal		**calcareous soil**	**gypsum soil**	**Sand dunes**
Quartz	Monocrystalline Quartz	42.2	29.6	46.6
	Polycrystalline Quartz	2.7	2.2	2.2
Feldspars	Potash Feldspar Microcline	2.5	3.3	3.3
	Potash Feldspar Orthoclase	2.3	4.5	4.5
	Plagioclase Feldspar	2.5	3.4	3.4

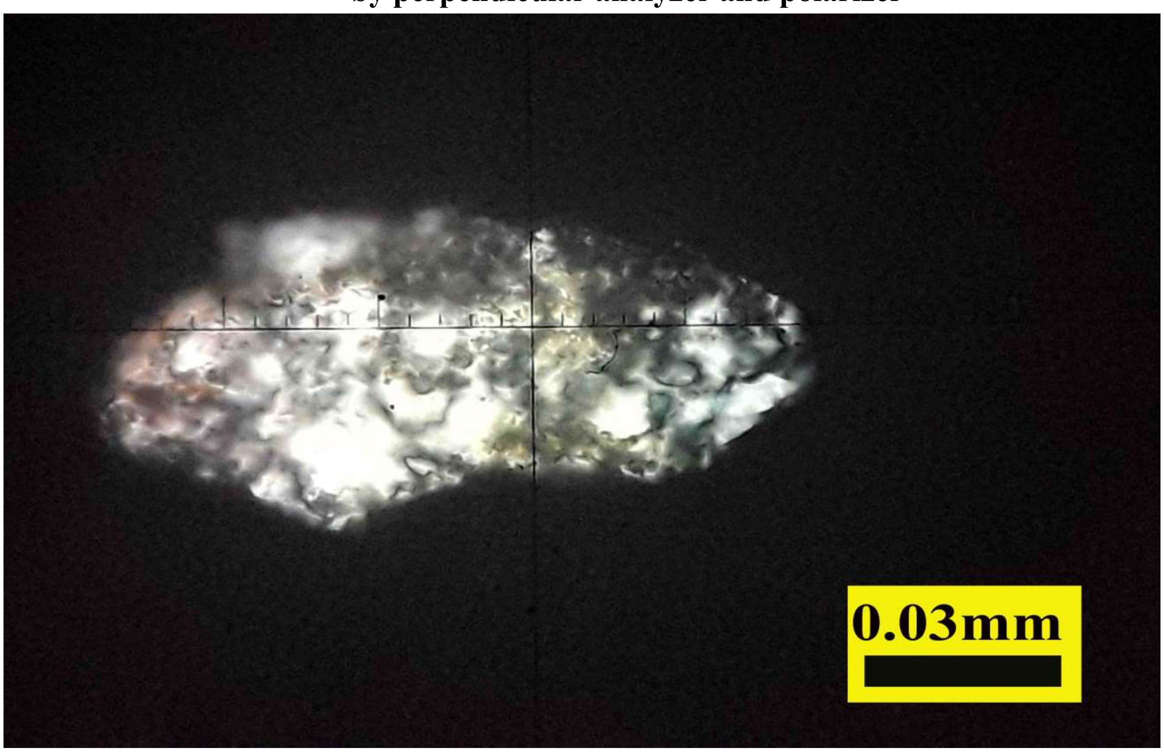
Rock Fragments	Carbonate Rock Fragments	33.7	29.3	19.3
	Chert Rock Fragments	5.5	5.2	5.2
	Mudstone Rock Fragments	6.7	3.1	3.1
	Evaporites (Gypsum)	5.2	11.6	3.6
	Igneous Rock fragment	1.8	2.3	2.3
	Metamorphic Rock Fragments	2.2	3.5	3.5
Coated Grains by Clay		1.6	2.1	2.1
Others		0.9	0.9	0.9



Picture (4) Interlocking twinned granule of micro-clean from the potassium feldspar group of limestone soil. Image by perpendicular analyzer and polarizer



Picture (5) Angled-edged granule of monocrystalline quartz mineral for gypsum soil. Image by perpendicular analyzer and polarizer



Picture ((6) angle granules of a piece of silicate limestone of a sand dune image by perpendicular analyzer and polarizer

References

-Al-Tawash, Balsam et al. 2012. Study of late Quaternary sediments using volumetric analysis and heavy metals in Bahr al-Najaf depression in central Iraq. Iraqi Journal of Geology and Mining. folder 8. Number 2. p. 18 - 1.

Al-Ghabban, Haider Jaafar, 2022. Study of the mineral composition and iron oxides of sedimentary soils of the Tigris and Euphrates rivers. Master Thesis. faculty of Agriculture. Al-Qadisiyah University.

Alkhalil, Shireen Muzaffar Ali. 2020. The effect of the sedimentation source on the variation in the characteristics and distribution of feldspar minerals in some soils in Wasit and Maysan governorates. PhD thesis. faculty of Agriculture. Baghdad University.

Suleiman, Hussein Suleiman. 2018. Mineral composition in northeastern Syria and its effect on some physical and chemical properties of soil. Master Thesis. university of Damascus. Syria.

• **Al- Gabban, H. J. and Raid. S. J.** 2022. Study of heavy and light minrals and free iron oxides in sand fraction for tigris and Euphrates rivers/Iraq. Publication in jundishapur journal of microbiology.

• **Black, C. A. 1965.** Methods of soil analysis. Part I and II, Amer. Soc. Agron. Inc. Publisher Medison Wisconsin USA.

• **Carter, M. R. 1981.** Association of total $CaCO_3$ and active $CaCO_3$ with growth of five tree species on chernozermic soils. Cand. J. of Soil Sci. 61:173–175.

• **Carver, R. E. (edits). 1971.** Procedures in sedimentary petrology. John wiley and sons. 653P.

• **Fleet, W. F. 1926.** Petrology notes on the red sandstone of the west midlands. Geol. Mag. V. 63. P. 505 – 516.

• **Folk, R. 1974.** Petrology of sedimentary rocks. Hamphill. Texas.

• **Hesse, P. R. 1971.** A text book of soil chemical analysis. John Murray. LTD. London. British.

• **Jackson, M. L. 1958.** Soil chemical analysis. Prentice-Hall Inc. Englewood ciffs.

• **Jackson, M. L.1979.**Soil chemical analysis: Advanced course.2nd ed. Madison, WI: Jackson, M. L. Univ. of Wisconsin.895p.

• **Page, A. L.; R. H. Miller. And D. R. Kenney. 1982.** Methods of soil analysis Part (2). 22n ed. Agronomy 9Am. Soc. Agron. Madison Wisconsin.

• **Richards, L. A. 1954.** Diagnosis and improvement of saline and alkaline soils. USDA. Washington. DC.