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STUDY OF THE MINERAL COMPOSITION OF SAND DUNES IN AL-DIWANIYAH PROVINCE, IRAQ

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Abstract

In order to study the mineral composition of sand dunes in Al-Diwaniyah province / Iraq, two locations were identified, the first location was in Al-Bdeir district and the second location was in the Al-Shanafiya district. The samples were taken from the study areas to a depth of (0-30) and after being transferred to the laboratory, they passed through a sieve with a hole diameter of 2 mm for the purpose of conducting chemical and physical analyzes. Also, the soil was separated into sand with a 50-micron sieve, clay and silt by sedimentation method, and then the sand and silt minerals were diagnosed by X-ray and their percentages were determined by a point-counting method. As for the separated clay, it was diagnosed by saturating the sample with magnesium, air drying, saturating with ethylene glycol, saturating with magnesium and heating to a temperature of 350 and 550 degrees Celsius. The results show the following: The results of the x-rays of the sand dunes separated by sand in Al-Bdeir district showed the presence of quartz (52.7%), calcite (18.3%), Dolomite (1.6%), Albit (26.1%), Antigurite (5.1), gypsum (0.2), magnetite (2.7), and kaolinite (3.0).), chlorite (1.0%), Ilite (2.3%), Palligorskite (3.2%), Vermiculite (3.2%), and silt separated. The proportions of Quartz minerals were 42.1% and Calcite (26.2%). Dolomite (6.6%), Albite (15.5%), gypsum (2.0%), magnetite (2.8%), Hematite (1.6%), orthoclase (2.3%), Kaolinite (3.8%), Chlorite (0.4%).and the Ilite ((9.2%) and the clay part contained the minerals Montmorillonite, Chlorite, Ilite and kaolinite. The sand is separated in the sand dunes in Al-Shanafiya district. The proportions of the minerals quartz (29.3), calcite ((21.2) and dolomite)) were 29.1. The Albite (22.7), Antigurite (5.9), gypsum (2.7), magnetite (2.8), kaolinite (3.6), chlorite (1.1), Ilite (3.0), Pallygorskite ((3.2), and Vermiculite (0.1).

Keywords: mineral composition, sand dunes, soil

Introduction

Sand dunes, in general, are deposits transferred to soil separations (sand, clay, silt) by wind, which are depolocationd when the energy factor decreases, whereas sand dunes in their general form consist of more than 98% of sand and the rest is clay and silt (Jasim, 2017). Its mineral composition of it is affected by several factors, the most important of which is the climate factor and the parent material. The presence or absence of a certain mineral gives an idea of how it was formed (Sulaiman, (2018). Sand dunes are classified according to their mineral composition into quartz dunes of which quartz is the main mineral. The presence of quartz gives a yellow colour to the dunes. As for the presence of iron oxides, their colour tends to be reddish-brown in the case of the presence of diamonds with a percentage of less than 1%, it tends to be white and contains silica ranging from 99-98% and in some cases the colour is the result of weathering of gypsum mineral or Calcite mineral (baroudi, 2016)As well as the presence of clay minerals, Montmorillonite, Chlorite, Pallykorskite and Kaolinite, and the proportions of minerals differ from one region to another. There are light minerals that have a specific weight of less than 2.89, including Quartz, Calcite, Dolomite, Gypsum, Halite, arconite and others, and heavy minerals with a specific weight of more than 2.89, such as mica, stable minerals (olefin) and super-stable (Rutile, Zircon, Tourmaline) and dark minerals (Hematite, magnetite, pyrite) (Al- kalil, 2020) Accordingly, it light minerals are prevalent, it indicates a high weathering condition, but if heavy minerals are prevalent, the weathering is low, and the proportions of minerals in sand dunes depend according to their distance or proximity to the source of deposition .Al-Qaisi et al., (2012) explained that the sand dunes in the sand joint contain quartz mainly with the presence of other minerals such as calcite, feldspar, rutile, hornblende, tourmaline and other minerals. into igneous and metamorphic rocks . Also, Jarallah and Issa (2012) found the presence of Quartz, Feldspar, Kaolinite, Mica and Chlorite minerals in sedimentary soils and by powder method.Al-Ghabban (2022) for sedimentary soils separated by sand found the presence of minerals quartz, Ilite, Chlorite, Mica, Kaolinite, Hematite and Magnetite. Based on what was mentioned, the current study aims to study the mineral composition of sand dunes in Al-Diwaniyah province/ Iraq

Materials and methods

Preliminary actions

The study area was chosen within the lands located in the Al-Diwaniyah province, which is part of the Iraqi sedimentary plain, where two locations were chosen.

• The first location is the sand dunes in Al-Bdeir district
• The second location is the sand dunes in Al-Shinafiya sub-district

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	Sand dunes (Al-Shanafia)	Sand Dunes (Al Badir)
EC . electrical conductivity	ds m^{-1}	2.64	2.06
pH		7.36	7.84
O.M . organic matter	%	0.002	0.003
Soluble calcium Ca+2	ppm	560	120
Soluble Magnesium Mg+2		252.7	234.0
dissolved sodium Na+		130	260
Soluble potassium K+		76	40
Cl- dissolved chlorine		290	604
Soluble sulfate SO4-2		596.32	125.0
Dissolved carbonate CO3-2		Nil	Nil
soluble bicarbonate HCO3-		30	24
Total carbonate	%	6	6.2

active carbons		ppm	Nil	Nil
gypsum		%	6.75	5.71
bulk density		$g.cm^3$	1.55	1.49
Soil Texture			sandy	sandy loam
Soil Separators	sand	$g.kg^{-1}$	996	801
	slit		3	82
	caly		1	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
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〗 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 ($SO4^{=}$)

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 (〖$CO3^{-2}$〗 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).

mineral analyzes

Separation and fragmentation

Separation of sand particles was conducted by Sieving Wet using a sieve with openings of 50 microns. Then the clay particles were separated from the silt by sedimentation method according to Stock's law, taking into account the temperature as mentioned in (Jackson, 1979).

Soil Separators

separated by sand and silt

The separated sand and silt were taken, then scattering slides were made for them using Canada balsam, and then the minerals were diagnosed and their percentages were determined by the point-counting method and according to the method proposed by the scientist Fleet (1926).

clay separated

To accurately diagnose clay minerals, it requires a separate process for the clay part by dismantling the sample with distilled water, separating the clay part and making a clay solution, and then conducted the necessary treatments to confirm the diagnosis of clay minerals according to the method of Theisen and Harward (1962).

The treatments include the following steps:

a. Saturation with magnesium using magnesium chloride MgCl2 and magnesium acetate Mg(OAc)2.

Deposition of the clays after saturation on two glass slides. One of the slides is left to dry in the air, and the second slide is saturated with ethylene glycol for 24 hours at a temperature of 60°C.

B. Potassium saturation with potassium chloride KCl and potassium acetate KOAc

The clays are depolocationd after saturation on two glass slides and then they are entered into the incineration furnace, one of them burns to a temperature of 350 C and the other is burned to a temperature of 550 C

Results and discussion

sand separated

Sand Dunes (Al Badir)

The results are shown in Figure 1 a representative of the X-ray diffraction of the sand separation in the sand dunes (Al-Budair) and the presence of minerals calcite, dolomite, albite, quartz, chlorite, kaolinite, Ilite, Pallygorskite, Antigurite, Magnetite. The highest percentage of dolomite mineral was (28.1%) due to the presence of a calcareous horizon under the sandy joints containing magnesium and because of the capillary property of water containing carbonate (magnesium carbonate), which leads to its deposition as a result of evaporation (Al-Qaisi et al., 2012) and the lowest percentage of gypsum mineral (% 0.2) It refers to the original sedimentary material containing salts, which is transported by wind and depolocationd when the energy factor of the transport factor decreases. As for chlorite, the rate of (1.0%) comes from igneous rocks, and it is difficult to distinguish small quantities of it, especially in the case of the presence of kaolinite and vermiculite minerals (Al-Sharifi, 2017). Calcite-containing water rises and precipitates due to evaporation (Muhs, 2003).The results also showed Albite (26.1%) as it is one of the feldspar minerals sourced from basalt rocks as well as from transport and sedimentation processes. Quartz (52.7%) is considered the main component of sand dunes (Saleh et al., 2012), where its presence is attributed to the parent material as well as to the processes of deposition from wind, and it is one of the minerals resistant to weathering. As for the Ilite, it reached a percentage of (2.3%), whose composition depends on the presence of potassium on the surface horizon and the continuous vital activity. The mineral Balikorskite appeared at an average of 2.8%, and it is one of the minerals rich in magnesium. The deposition of calcite in the surface layer leads to an increase in Mg/Ca. In this process, the mineral is formed, as the limestone crust in areas with dry and semi-dry climatic conditions, including the study area, which is accompanied by magnesium-rich clays. Including the Palligorskite Closon (1996).The results also showed the presence of antigorite mineral at a rate of (5.1%), and its presence is attributed to the above-basal and metamorphic source rocks. Magnetite mineral (2.7%), which is due to the nature of the mineral composition of the parent material and is also produced from minerals containing iron such as hornblende, Amphibole and Pyroxene, and its source is igneous and metamorphic rocks in northern Iraq and Turkey. Likewise, the percentage of Kaolinite minerals (3.0%) increases when the percentage of Carbonate minerals decreases and decreases with its increase. It needs washing conditions to form.As for Vermiculite (0.2%), it arises from the change of curite mineral through the effect of the chemical energy of the weathering factor and in a very small amount on the weak bonds of chlorite mineral. This process is known in dry and semi-arid areas as the chlorite-vermiculite process

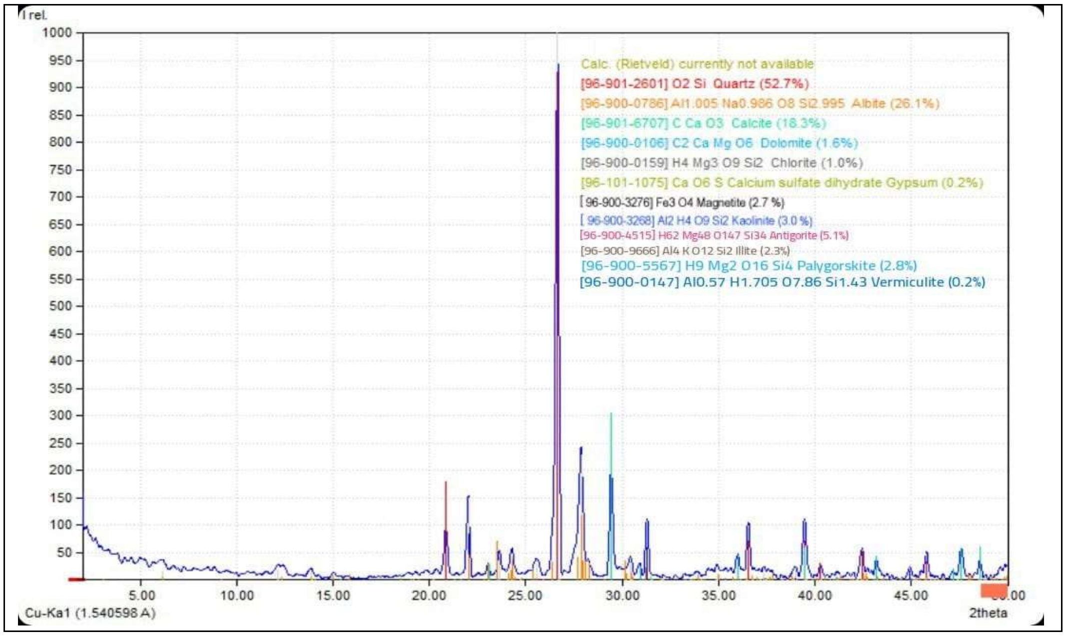


Figure (1) X- ray diffraction of sand dunes (Al Badir) in the sand separation

Sand dunes (Al-Shanafiya)

The results of Figure 2 representing the X-ray diffraction in the sand separation in the (Al-Shanafiya) sand dunes showed the presence of Calcite, Dolomite, Quartz, Albite, Chlorite, Kaolinite, Gypsum, Magnetite. The highest percentage of quartz mineral was 29.3%), which is the main component of sand, which is characterized by its light weight, where it travels for long distances and is depolocationd when the momentum of the transmission factor energy decreases. The lowest percentage of vermiculite is (0.1%) This mineral is formed from the change of Chlorite mineral through the effect of the chemical energy of the weathering factor on the weak bonds of chlorite mineral. The results also showed the presence of calcite mineral (21.2%), which indicates that these sands and what below represent a calcareous horizon, which is common in the study area and due to evaporation, Calcite deposits (Muhs, 2003) and their presence (Calcite and Gypsum) is due to the content of the original material on these minerals and their ratios reflect dry and semi-arid climatic conditions. As for kaolinite minerals (3.6% and chlorite (1.1%) where their percentage is low (Al-Qaisi et al., 2012) and their source is igneous rocks in Northern Iraq and is transmitted by wind or rivers or both, where the results showed the presence of iron oxides represented by magnetite (2.8%), a percentage of which indicates weak weathering and the activity of water and wind erosion processes that affect weathering. Basalt in addition to the transfer and sedimentation processes.It was also found that calcite mineral deposition in the surface layer leads to an increase of Mg/Ca with a percentage of 3.2%, which is one of the minerals rich in magnesium. By this process, the clay mineral is formed, as the lime crust in areas with dry and semi-dry climatic conditions, including the study area, is accompanied by magnesium-rich clays. Including

Pallygorskite, The results also showed the presence of the mineral Antigorite at an average of (5.9%), and its presence is attributed to the above-basal and Metamorphic source rocks. As for Dolomite, its percentage was (28.1%). The dominance is due to the presence of a calcareous horizon under the sandy separations containing magnesium, and because of the capillary property of water containing carbonates (magnesium carbonate), which leads to its deposition as a result of evaporation. The gypsum mineral is 2.7 (2%) Its presence depends on the salt-rich parent material, transport and sedimentation processes for these salts, as well as climatic conditions such as rain, temperature and wind. When comparing the percentages of minerals prevalent in the sand dunes in the Al-Budair and Al-Shanafiya locations of the sand separation, the results showed that there is a discrepancy in the predominance of minerals in these dunes. The Dolomite mineral was superior in the sand dunes of Al-Bdeir region, while the quartz mineral was superior in the sand dunes of the Al-Shanafiya region, and this is due to the nature of the original materials on the one hand, as well as the difference in the transport factor or the proximity of the groundwater, which causes the gathering of dolomite and calcite. The following mineral sequences were taken for the highest four percentages

- Quartz > Albite > Calcite > Antiquarite.(AL-Badir).
- Dolomite > Quartz > Albite >Calcite (Al-Shanafia).

The sand dunes of Al-Budair location excelled in the minerals quartz, Albite, and vermiculite, while the sand dunes in Al- Shanafiya region excelled in the rest of the minerals

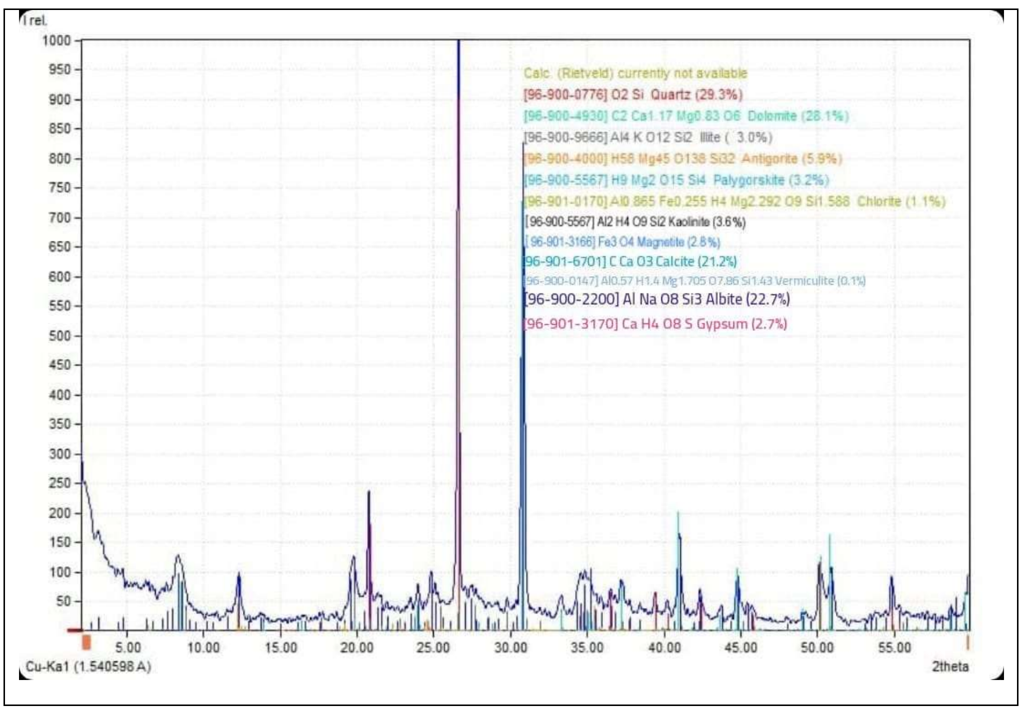


Figure (2) X- ray diffraction of sand dunes (Al-Shanafia) in the sand separation silt separated

Sand Dunes (Al Badir)

The results in Figure 3 shown the X-diffractions of the silt separation of the sand dunes (Al Badir) minerals calcite, dolomite, quartz, feldspar (Albite, orthoclase), iron oxides (Hematite, Magnetite), gypsum, as well as clay minerals (Chlorite, Kaolinite, Ilite).Quartz is dominant in it with a percentage (42.1%) and it is one of the minerals resistant to weathering, which is the main component of sand. The sediments are rich in quartz minerals. Its specific weight helps it to travel long distances and is depolocationd when the energy factor is reduced. It is one of the minerals that is characterized by high hardness and resistance to weathering processes. As for the percentage of Calcite mineral (26.2%), its presence depends on the source materials of the transported sediments, and these sands and what below represent a calcareous horizon. As well as Dolomite (1.9%) and its presence depend on the erosion of the source rocks of sediments rich in magnesium. The results also showed the presence of iron oxides, where the proportion of Magnetite ((2.8%) and hematite (1.6%)) It is due to the weakness of weathering processes as well as its presence in the original material, and its low proportions are due to being undeveloped sedimentary desert dunes and the activity of the wind and water erosion process that affects the activity of the weathering process (Al-Radi and Al-Baqer, 2018).The presence of clay minerals within the silt separated is due to the fact that their sizes are the same as that of the silt, where the percentage of chlorite minerals (0.4%), Kaolinite (3.8%) and Ilite (9.2%) are due to transport and sedimentation processes, and the percentage of Gypsum mineral (0.2%) is attributed to the processes of transporting and sedimentation. Transport and deposition of sulfate-containing salts, and due to evaporation, Gypsum is depolocationd. As for the Orthoclase mineral, it reached a rate of (3.3%), and it is a non-weathering mineral, as it is exposed to weathering during the transportation process from igneous and metamorphic rocks in northern Iraq. It is due to the activity of weathering processes and its intermediate component of weathering, as well as transport and deposition processes (Al-Ani, (2001). From the above results, we find the predominance of Quartz, Calcite, Ilite, and Dolomite over respectively.

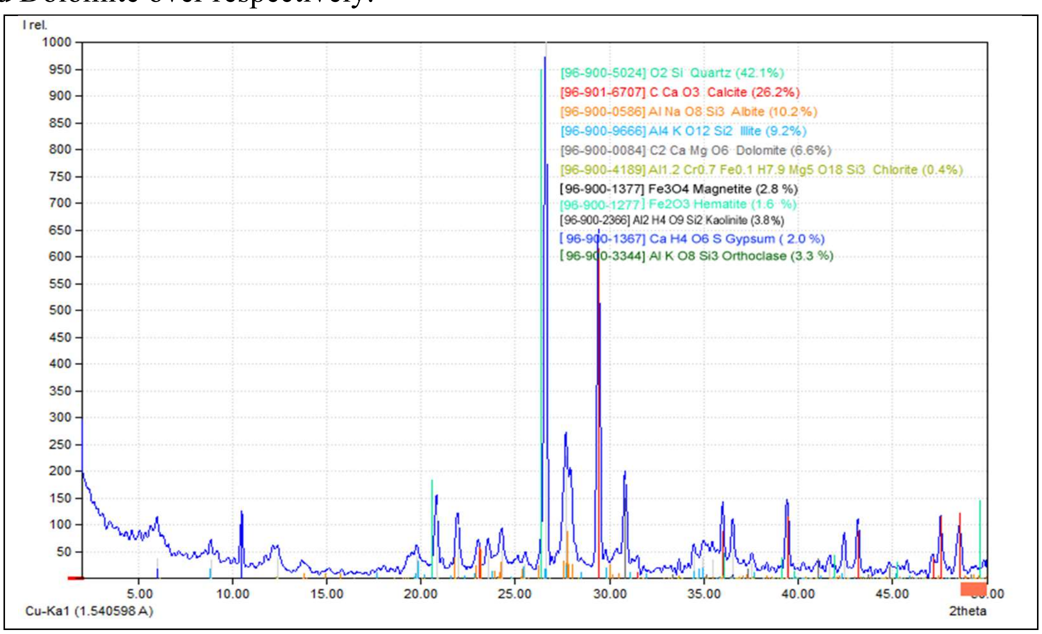


Figure (3) X- ray diffraction of the sand dunes - Al-Budair, silt separated

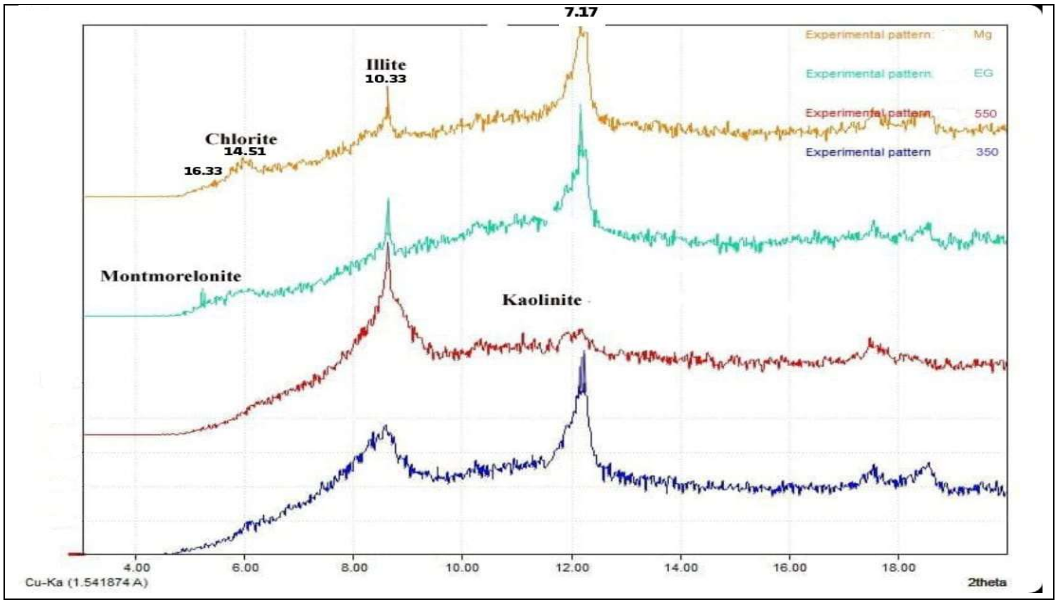
Sand dunes (Al-Shanafia)

Not mentioning any percentage of minerals because silt is not obtained or the presence of silt in a percentage that cannot be extracted from it. Sand dunes, as natural, contain sand at a rate of no less than 98%. In some cases, the percentage of silt and mud increases due to dust storms or during rainy seasons so that the alluvial or clay soil mix With sand and in the dry season, the wind blows on the dunes, where the mud and silt fly, and the sand remains Jasim (2017).When comparing the sand dunes in Al-Bdeir district with the sand dunes in Al-Shanafiya sub-district, we find that the sand dunes in Al-Shanafiya district excel in all mineral ratios due to the inability to extract the separated silt from the sand dunes in Al-Shanafiya sub-district due to their presence in very few percentages.

clay separated

sand dunes_al-Badir

The results showed in Figure (4) the X-ray diffraction of the clay separated in the sand dunes (Al-Badir). The diffraction diagnosis (16.33) of the mineral Montemoyllonite in the sample saturated with magnesium, air drying and saturation with ethylene glycol. I am from Mika.The X-ray diffraction also showed the presence of chlorite at the diffraction (14.51) in the coefficients of saturation with magnesium and air drying, and the metal was also diagnosed when the sample was treated with ethylene glycol and saturation with magnesium and heating to 350 ° C and it disappears when heating to 550 ° C. Mmectite minerals were affected by the chlorination phenomenon and its transformation towards swollen chlorite, and the second was the effect of the inner hydroxide layer of the original chlorite mineral during the transport and deposition process, which was reflected in the degree of fullness of the inner hydroxide layer, turning the mineral towards swollen chlorite. The diffraction (10.33) of Ilite metal was detected in the treatment of saturation with magnesium and air drying, as well as the character of the metal in the treatment of saturation with ethylene glycol and saturation with magnesium and heating to 350° C and 550° C. Its presence in all treatments indicates that it is of the heat-resistant type. The diffraction (7.17) due to the mineral Kaolinite was diagnosed in the treatment of saturation with magnesium and air drying, as well as the diagnosis of the mineral in the treatment of saturation with ethylene glycol and saturation with potassium and heating to 350 ° C and 550 ° C indicating the presence of chlorite (Al-Alwani and Al-Bayati, (2011).



Fig(4) X- ray diffraction of sand dunes (Al Badir) clay separated

Sand dunes (Al-Shanafia)

It is not possible to extract the clay separated from these dunes because it is in a very small percentage and therefore its minerals have not been diagnosed within this segregation.

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