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Mineralogical Evaluation of Some Soils Representing The Geomorphic Units in The Northwestern Coast of Egypt

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FIFTEEN soil samples from successive strata were collected for five soil profiles representing assimilated four geomorphology units in the northwestern coast of Egypt. For mineralogical structure, the soil samples were studied microscopically and X-ray diffraction was done. The polarized microscopic examination of the sand fraction between 0.125 and 0.063 mm showed that. Light minerals were dominated by quartz then by feldspar minerals. The presence of feldspars indicates that the soils are young from the pedological view point. Heavy minerals were the dominion of the total opaque minerals. The predominant minerals in non-opaque minerals were: Pyroxene minerals, Parametamorphic minerals. High-resistance mineral for weathering was predominant with zircon mineral. Distributions of the resistant minerals indicate that the soils are generally of multi-origin and/or multi-depositional regime and are thus young. X-ray diffraction of clay minerals showed the predominance of kaolinite, followed by montmorillonite, then mica trioctahedral, halloysite, -vermiculite, palygroskite, -regularly interstratified minerals -(vermiculite + mica), talc mineral and regularly interstratified minerals (montmorillonite + mica or chlorite + vermiculite), regularly interstratified minerals (chlorite + montmorillonite or saponite) chlorite, mica dioctahedral. The accessory minerals were dominated by quartz mineral. The study showed that the variable content of clay minerals in the geomorphic units in the study soil is essentially inherited from the parent materials, with some modification during the spatial deposition system and a slight change if there is any effect of the weathering factors on the studied soils.

Keywords: Heavy and light minerals, X-ray, Clay and Accessory minerals.

Introduction

The aim of this research is to mineralogical evaluation of some soils representing the geomorphic units in the Northwestern coast of Egypt. Identification of origin and genesis as well as the mineral composition of the soil and the composition of minerals and the modifications clay during the weathering operations which occurred as a result of environmental conditions by using the accessible and easy minerals in the sand and possible presence in the clay and the extent of impact of clay minerals creep and enter salt water rich in salts, especially magnesium in the formation of clay minerals. Soil minerals, especially clay minerals, play an important role in soil fertility, the extent to which they retain both plant nutrients and the availability of easy water for plant food. The mineral structure of the clay and its transformations as a result of the weathering processes under the prevailing environmental conditions is a determining factor in the exploitation of these soils for the expected agricultural expansion.

The western coastal soils of Egypt are developed in sediments that have been transported from interior uplands by fresh water streams and consequently deposited a littoral zone extending about 500 Km. length. The various soils along this coastal littoral have been pedologically studied through reconnaissance; semi-detailed and detailed soil surveys during the last 50 Years by the Desert Institute and the Desert Research Center of Egypt and classified according to FAO (2002) and Hegazi et al. (2009) and its

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Supplement USDA (2014) the 7th. Approximation and its modification into the two orders; Entisols and Aridisols, of which soils related to the order Aridisols, are the more concerned herein.

The Mediterranean saltwater tides and intrusion have created a chemical environment that differs from that of the surface area (Giambastiani et al. 2007; White and David 2017). The abundance of Mg++, Ca++ and Na+ with some other ions in the encroaching sea water may contribute to digenetic changes in soil clay minerals and may also affect other soil minerals susceptible to weathering and clay minerals formation or alteration (Hy et al. 2013). From the geological point of view the northwestern coast of Egypt was studied in details by many authors, among them El-Bastwasy (2008) and Ibrahim (2015). From the stratigraphic point of view, the northwestern coast of Egypt is covered with sedimentary rocks, ranging in age the cluster nary to the tertiary epochs. The strata from the Sea coast to the Libyan plateau are formed of a calcareous formation of Pliocene and Pleistocene ages but covered by recent Aeolian fluvial sediments (Rodrıguez-Lopez et al. 2014).

This paper presents the results of mineralogical investigations of 5 soil profiles representing the western coastal littoral and considers the possible effects of seawater encroachment and intrusion on the clay mineral assemblage.

Materials and Methods

Fifteen soil samples were collected from five soil profiles representing the soils of four geomorphological units; namely the coastal plain, windblown formation, the tableland and the piedmont -like plain by DRC (2003), of Burg El-Arab (The coastal plain), Ras El-Dabaa (windblown formation), Mersa Matruh and El-Sallum (The Tableland) and Sidi Barani (The piedmont –like plain) the western Mediterranean coast of Egypt, Figs. (1 & 2) Hegazi et al. (2009).

The soil samples of the studied profiles were subjected to the following analyses: Soil reaction (pH) was determined in the soil paste using a pH meter, 3320 Jenway, total soil salinity (ECe) was measured in the soil saturation extract using a conductance meter YSI model (35) and soluble cations and anions were determined. Cation exchange capacity (CEC) was determined using the method described by Dawid and Dorota (2014), organic matter content was determined as recommended by Brian (2002) and De Vos et al. (2007), $CaCO_3$ content was determined using Collin's calcimeter (Elfaki et al. 2016) and Particle size distribution by the pipette method (Syvitski and James 2007).

Separation of the sand fraction and pretreatments for sand mineralogy. Very fine sand fraction (0.063- 0.125 mm diameter) was separated from the soil samples by decantation and sieving through. After the essential pretreatments for removal of total carbonates and organic matter (Kettler et al., 2001), the separated sand fraction was further separated into heavy and light minerals using bromoform (SG 2.85 $\pm$ 0.02), (Biswas and Mukherjee, 2006). The separated minerals were washed repeatedly with ethanol then mounted on glass slides using gum tragacanth and Canada balsam (RI 1.54), (Karmakar, 2014). Mineralogical identification of the sand minerals. Identification of the mounted sand minerals was carried out by the polarizing microscope with a graduated mechanical stage for traverse counts; approximately 500 grains in each slide were examined to minimize the absolute error Hughes, et al. (2000) and Gunter (2004). The principles applied for identification through optical properties of minerals are those given by Mange and Wright (2007) and Limonta (2014). Percentages of light and heavy minerals were counted without taking opaques, anhydrates and carbonates into account (Cascalho et al. 2016). Opaque minerals were investigated individually using the ore microscope (reflection system) following the mineral description given by Bowles et al. (2011). Separation of the clay fraction (less than 2 μ) was carried out after the essential pretreatments, *i.e.,* the removal of soluble salts, carbonates, organic matter and iron and manganese oxides (Soukup et al 2008). Identification of different clay and non- clay minerals was carried out following the criteria established by Al-Ani and Sarapää (2008).

Results and Discussion

Soil properties

Results showed that soil texture of the studied profiles ranges between loamy sand and light clay except the subsurface layer of profile 3 in the soils of Marsa Matruh which is sandy texture Table 1. It is also even dent that profiles 1 and 2 have uniform textural class, while other profiles have variable textural in their subsequent layers. Organic matter (OM) content is quite low being in the range of 0.2 to 1.4 g/100g. Total $CaCO_3$ varied considerably from one profile to another and even within subsequent layer in each profile. It ranged from as low as 16.6 and up to 73.8 g/100g.The distribution pattern of $CaCO_3$ tends to increase with soil profile, depth, except for the soils of profiles 4 and 5 which did not portray any specific pattern with depth.

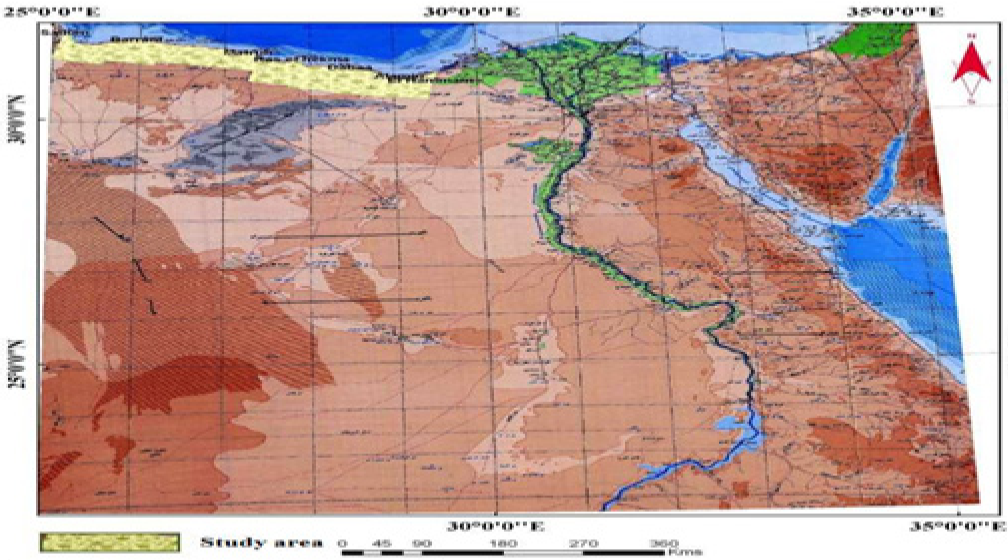

Fig. 1. Location of the Northwestern Coastal Zone (NWCZ) of Egypt

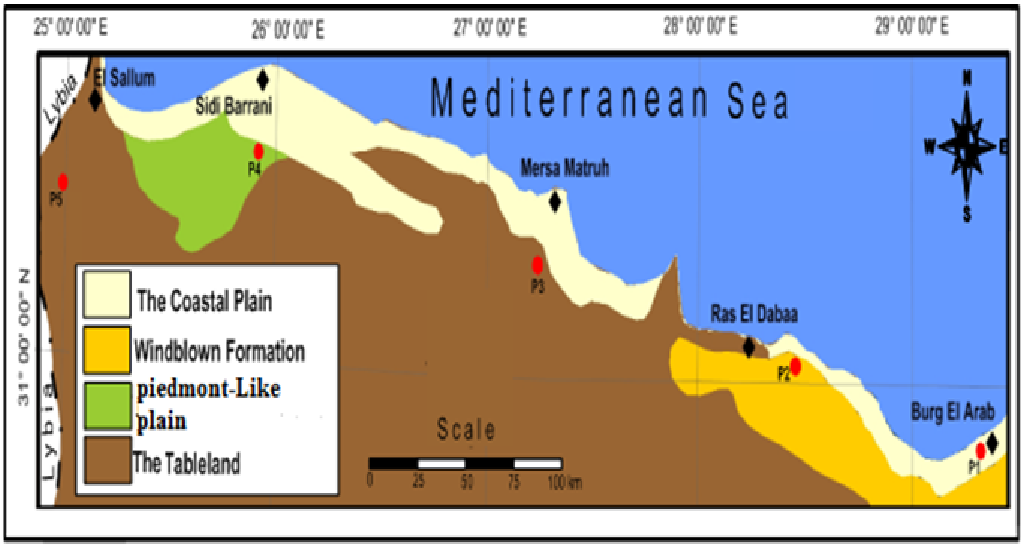

Fig. 2. Geomorphological unites map of the Northwestern Coastal Zone (NWCZ) of Egypt [After Hegazi, et al. (2009)]

Table 2 reveals that soil reaction is generally slightly to strongly alkaline where pH values varied between 7.4 and 8.6.Soil salinity varies widely from 0.4 to 25.8 dS/m (nonsaline to strongly saline). The lowest content characterised the deepest layer of profile 5 in Sidi Barani soils whereas the highest is associated with the subsurface layer of profile 1 in Burg El-Arab soils. Soluble cations follow two orders, either dominated by Na+ followed by Ca++ and/ or Mg++ or dominated by Ca++ followed by Na+ and Mg++. Soluble anions are generally dominated by Cl- followed by SO4= and /or HCO3-, while soluble CO3= is the integrant. Cation exchange capacity (CEC) values vary from one profile to another and even within each profile; it is values range from 5.1 to 28.9 $CmoL_c kg^{-1}$ soil.

Mineralogy of the sand fraction in soil samples

Light minerals

Table 3 and Fig. 3 show the frequency distribution of light minerals of studied soil profiles as well as their distribution the entire depth of each profile. Data reveal that light fraction was almost entirely composed of quartz which constituted more than 97.3 % in all the studied soil profiles. Quartz constitutes 97.3 to 99.3 % and the lowest value is detected in the coastal plain soils (profile 1), while the highest value characterized the Tableland soils (profile 4). Feldspar minerals are recorded in all the studied soil profiles. They are composed essentially of three member 5 namely; orthoclase, plagioclase and microcline.

TABLE 1. Organic matter, total $CaCO_3$ contents, particle size distributions and texture classes of the studied soils

Profile No.	Location	Geomorphologic units	Depth, Cm.	Organic matter (%)	Total $CaCO_3$ (%)	Particle size distribution g/100g Coarse sand	Fine sand	Silt	Clay	*Texture Classes
1	Burg El-Arab	The coastal plain	0-25	1.4	40.7	15.6	26.6	13.3	44.5	LCl
			25-65	0.3	43.9	18.1	28.7	16.4	36.8	LCl
			65-120	0.3	49.1	11.2	19.9	29.5	39.4	LCl
2	Ras El-Dabaa	Windblown formation	0-25	0.6	66.9	24.5	41.7	15.0	18.8	SaClLo
			25-70	0.4	68.1	30.1	44.3	7.4	18.2	SaClLo
			70-150	0.3	73.8	38.2	35.0	6.1	20.7	SaClLo
3	Mersa Matruh	The Tableland	0-40	0.7	16.6	54.5	15.9	11.9	17.7	SaClLo
			40-75	0.4	30.1	15.2	76.9	2.8	5.1	Sa
			75-150	0.2	32.8	13.5	51.1	18.5	16.9	SaClLo
4	El-Sallum		0-10	1.0	29.7	25.5	55.9	3.7	14.9	SaLo
			10-70	0.4	33.3	36.3	44.9	5.6	13.2	SaLo
			70-150	0.3	27.6	46.8	38.5	2.9	11.8	LoSa
5	Sidi Barani	The piedmont –like plain	0-25	0.8	19.3	14.9	71.1	4.9	9.1	LoSa
			25-55	0.5	37.1	7.1	65.6	12.3	15.0	SaLo
			55-80	0.2	25.9	5.4	59.8	16.5	18.3	SaClLo

Note: * Texture classes of the ISSS (International Soil Science Society) / triangle, LCl= Light clay, Sa = Sand, LoSa= Loamy sand, SaLo =Sandy loam and SaClLo = Sandy clay loam.

TABLE 2. reveals that soil reaction is generally slightly to strongly

Profile No.	Location	Geomorphologic units	Depth, Cm.	pH (soil paste)	EC dS/m	Cations ($mmol_c L^{-1}$) Na^+	K^+	Ca^{2+}	Mg^{2+}	Anions ($mmol_c L^{-1}$) CO_3^{2-}	HCO_3^-	Cl^-	SO_4^{2-}	CEC $Cmol_c Kg^{-1}$ soil
1	Burg El-Arab	The coastal plain	0-25	8.4	18.2	80.4	11.6	66.9	23.1	0.0	6.0	140.1	35.9	28.9
			25-65	8.5	25.8	200.0	5.9	41.1	11.0	0.0	6.7	210.0	41.3	21.3
			65-120	8.6	18.8	143.1	6.0	18.7	20.2	0.0	7.7	147.1	33.2	16.3
2	Ras El-Dabaa	Windblown formation	0-25	7.9	3.6	19.3	1.0	10.3	5.4	0.0	2.0	29.3	4.7	11.1
			25-70	7.6	1.0	1.7	0.8	5.6	1.9	0.0	0.8	6.5	2.7	10.3
			70-150	7.5	0.8	4.0	0.2	2.7	1.1	0.0	0.6	5.0	2.4	10.9
3	Mersa Matruh	The Tableland	0-40	7.6	1.6	9.0	0.6	4.4	2.0	0.0	0.9	13.5	1.6	7.1
			40-75	7.4	2.8	16.6	1.1	7.0	3.3	0.0	0.6	23.4	4.0	5.1
			75-150	7.5	3.1	18.2	0.7	9.9	2.2	0.0	1.0	24.4	5.6	11.2
4	El-Sallum		0-10	8.2	6.7	32.9	0.6	25.9	7.6	0.0	3.9	51.8	11.3	9.2
			10-70	7.8	7.4	36.2	1.7	31.6	4.5	0.0	1.8	59.9	12.3	8.6
			70-150	7.9	4.1	20.7	2.0	14.4	3.9	0.0	5.4	31.1	4.5	6.7
5	Sidi Barani	The piedmont -like plain	0-25	7.8	1.9	9.3	0.4	7.3	2.0	0.0	0.8	15.3	2.9	6.7
			25-55	7.6	1.4	7.3	0.3	5.1	1.3	0.0	0.6	10.8	2.6	8.0
			55-80	7.7	0.4	1.7	0.1	1.6	0.6	0.0	0.5	2.9	0.6	9.1

TABLE 3. Frequency distribution of the light minerals (0.125-0.063 mm) in the sand fraction of the studied soils

Profile No.	Location	Geomorphologic units	Depth, Cm.	Quartz %	Feldspars %			Total feldspars %	Others %
					Orthoclase	Plagioclase	Microcline		
1	Burg El-Arab	The coastal plain	0-25	98.10	1.00	0.40	0.20	1.60	0.30
			25-65	97.30	1.60	1.00	0.10	2.70	0.00
			65-120	99.00	0.20	0.40	0.00	0.60	0.40
2	Ras El-Dabaa	Windblown formation	0-25	99.20	0.40	0.20	0.00	0.60	0.20
			25-70	98.00	0.80	0.30	0.00	1.10	0.90
			70-150	97.60	1.30	0.30	0.00	1.60	0.80
3	Mersa Matruh	The Tableland	0-40	98.50	0.30	0.50	0.10	0.90	0.60
			40-75	97.80	1.40	0.60	0.20	2.20	0.00
			75-150	98.80	0.10	0.60	0.00	0.70	0.50
4	El-Sallum		0-10	98.00	0.70	0.40	0.10	1.20	0.80
			10-70	99.30	0.30	0.10	0.10	0.50	0.20
			70-150	98.90	0.60	0.50	0.00	1.10	0.00
5	Sidi Barani	The piedmont -like plain	0-25	97.80	1.00	1.20	0.00	2.20	0.00
			25-55	98.10	0.40	0.80	0.00	1.20	0.70
			55-80	97.90	0.50	0.40	0.10	1.00	1.10

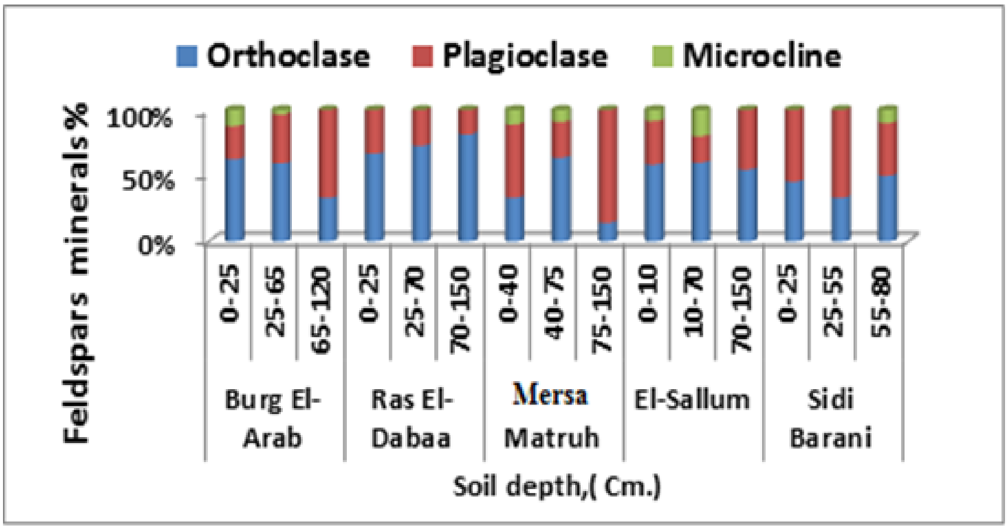

Fig. 3. Distributions of Feldspars minerals with depth in the studied soils

With regard to the distribution of total feldspars, their constant varies from 0.5 to 2.7 % in the investigated soils. The highest value is associated with profile 1 (The coastal plain), while the lowest value is detected in the soil of profile 4 (The Tableland). The members of feldspars could be arranged en the order orthoclase > plagioclase > microcline. The high amount of quartz, compared with other light minerals, may reflect the resistance of quartz to weathering or indicate that the soil materials are drived from rock enriched in quartz.

Feldspars content as such or as individual members shows apparent variability. This is a true reflection of their susceptibility to weathering which modified of alters the initial feldspars content originated from the parent materials. The variability encountered in the content of individual members of feldspars group could be explained on basis of the relative resistibility of such minerals to different weathering processes.

Heavy minerals

Table 4 and Fig. 4 show frequency of heavy minerals of the studied soils as well as their distribution throughout the entire depth of each profile. Heavy minerals are generally studied in terms of two groups: opaques and non-opaques minerals.

Opaque minerals

Opaques from a considerable part of the heavy minerals in all the sample studied. They were counted as opaques because it is not possible to identify their individual. Their values vary from 48.05 % in the soils of windblown formation (profile 2) to 57.15 % in the Tableland (profile 3). Concerning the pattern of opaque minerals distribution with depth, no specific trend in profiles 1, 2 and 5 could be observed, while in the rest soil profiles opaques tend to decrease throughout the entire profile depths.

Non-opaque minerals

Table 4 shows that, the non-opaque minerals were detected as pyroboles (pyroxenes + Amphiboles), zircon, epidote, tourmaline, garnite, staurolite, rutile, kyanite and biotite in different frequency amounts.

The distributions of the non-opaque minerals are presented under the following subheading:

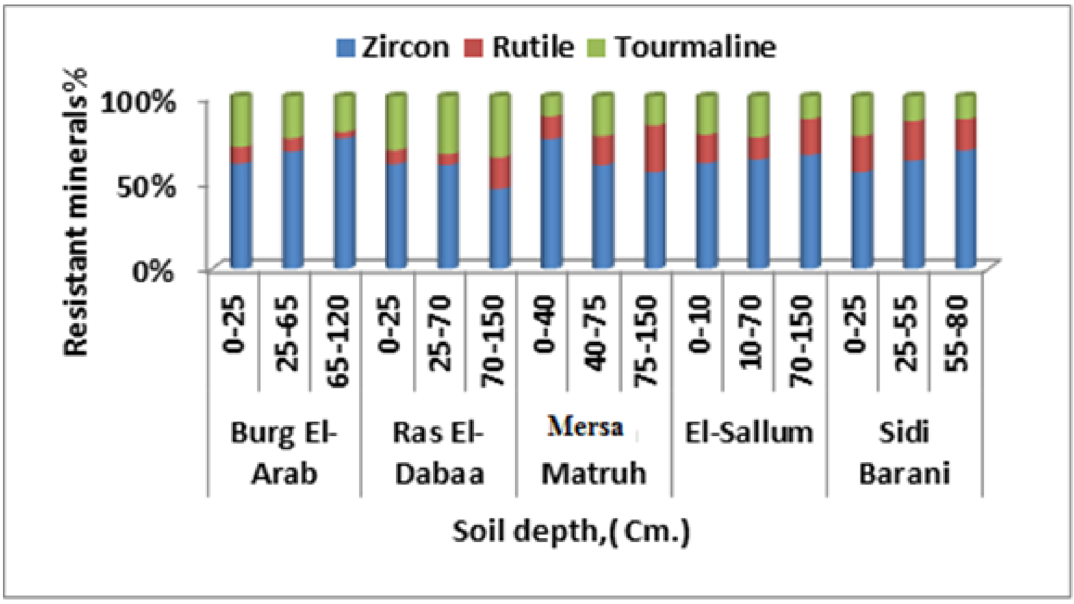

Fig. 4. Distributions of resistant minerals with depth in the studied soils

TABLE 4. Frequency distribution of the main groups of heavy minerals (0.125-0.063 mm) and their individual members in the sand fraction of studied soils

Profile No.	Location	Geomorphologic units	Depth, Cm.	Total Opaques %	Total non-Opaques %	Percent of non-Opaque Heavy minerals groups													
						Pyroboles %					Parametamorphic %				Resistant minerals %				
						Pyroxenes				Amphiboles									
						Augite	Diopside	Hyperthene	Total	Hornblende	Epidote	Kyanite	Garnet	Staurolite	Zircon	Rutile	Tourmaline	Biotite	Others
1	Burg El-Arab	The coastal plain	0-25	49.70	50.30	15.9	1.3	4.2	21.4	6.8	12.1	2.7	2.7	5.1	26.0	4.1	12.5	2.6	4.0
			25-65	48.45	51.55	9.9	1.9	5.8	17.6	5.4	17.9	2.4	2.8	7.2	25.0	2.8	8.9	1.1	8.9
			65-120	49.49	50.60	14.0	2.9	7.0	23.9	7.9	20.3	8.9	4.1	4.3	21.0	1.0	5.7	2.3	0.6
2	Ras El-Dabaa	Windblown formation	0-25	48.05	51.95	11.1	2.8	1.0	14.9	7.6	6.8	4.2	5.5	10.6	25.0	3.3	12.8	2.8	6.5
			25-70	49.35	50.65	14.0	2.3	2.6	18.9	4.9	6.3	3.6	7.3	13.0	24.0	2.5	13.3	4.5	1.7
			70-150	48.40	51.60	11.6	4.9	5.6	22.1	7.2	4.5	3.4	9.1	4.9	13.0	5.1	9.9	3.6	17.2
3	Mersa Matruh	The Tableland	0-40	57.15	42.85	7.2	7.8	17.9	32.9	8.9	14.1	0.6	13.4	1.6	28.0	4.9	4.3	0.4	0.9
			40-75	54.35	45.65	4.1	3.9	6.8	14.8	7.4	7.9	2.2	13.7	2.8	18.0	5.0	6.9	0.8	10.5
			75-150	51.80	48.20	8.3	4.1	4.6	17.0	7.3	10.2	4.7	10.9	2.3	22.0	10.7	6.6	0.9	7.4
4	El-Sallum		0-10	50-70	49.30	7.4	6.2	8.1	21.7	7.5	9.7	4.4	8.4	7.0	18.2	4.9	6.6	1.0	10.6
			10-70	51.00	49.00	6.3	2.7	6.3	15.8	4.3	8.3	7.5	3.1	4.8	33.4	6.8	12.5	0.8	3.2
			70-150	49.80	50.20	6.4	7.3	8.4	22.11	3.9	7.8	3.6	3.2	3.9	32.6	10.3	6.4	0.7	5.5
5	Sidi Barani	The piedmont-like plain	0-25	50.85	49.15	8.4	3.8	8.7	20.9	6.3	11.5	1.0	8.7	2.7	23.1	8.6	9.5	0.8	6.9
			25-55	49.00	51.00	7.0	4.1	7.3	18.4	5.8	10.8	1.0	11.3	4.1	26.7	9.8	6.1	0.2	5.8
			55-80	48.90	51.10	7.1	5.8	8.6	21.5	5.2	12.6	2.1	7.5	3.2	30.5	8.1	5.8	1.3	2.2

A) Pyroboles minerals

These include both pyroxene and amphibole groups. Pyroxenes are shown to be more abundant. It is mainly represented by augite, diopside and hyperthene of which augite is the most abundant. Total pyroxenes content ranged from 14.8 % in the soils of the Tableland (profile 3), to 32.9 % in the same geomorphology unit of same profile. With regard to amphiboles, hornblende is the common member and constitutes 3.9 to 8.9 %. The lowest and highest values are detected in the soils of Tableland (profiles 4 and 3) respectively. The wide variations encountered of pyroboles minerals may be rendered to the nature of parent material, its discontinuity as well as sedimentation regime with little, if any contribution of soil formation process. Also, pyroboles minerals are easily weathered and destroyed their presence in high percentages can be taken as an indication of recent depositions.

B) Parametamorphic minerals

This group of minerals includes epidote, kyanite, garnet and staurolite minerals. Epidote content ranged between 4.5 to 20.30 % of the non-opaques. Reaching its minimum in the windblown formation soils, while the maximum content characterized coastal plain soils. Kyanite constitutes 0.6 to 8.9 % of the non-opaques. The lowest content was detected in the Tableland, whereas the highest content was found in the coastal plain soils. Garnet mineral varied from 2.7 % in the coastal plain soils to 13.7 % of the Tableland soils with no distinct depthwise distribution along profiles except for profiles 1 and 2 where garnet tends to increase with depth. Staurolite mineral constitutes 1.6 to 13.0 % of the non-opaque minerals and the lowest content was in the Tableland soils while, highest content was in the windblown formation soils.

C) Resistant minerals

These minerals constitute the most ultra-stable group among the minerals. They include zircon, rutile and tourmaline. Zircon has a frequency ranging between 13.0 % in the soils of windblown formation (profile 2) and 33.4 % in the Tableland soils (profile 4). The vertical distribution of zircon indicted discontinuity of zircon contents with depth. This reflects the multi origin of parent material and/ or their multi- depositional course. Rutile content ranges from 1.0 % in the soils of coastal plain (profile 1) to 10.70 % in the Tableland soils (profile 3). The apparent discontinuity in the mineral distribution could be explained on the premise that the studied soils have multi- origin. Tourmaline content ranges widely between 4.3 and 13.3 % of the non-opaque minerals and its depthwise distribution is irregular with a relative increase in the deepest layers of the soils representing piedmont like-plains (profile 5). Biotite mineral is seemingly rare minerals among the heavy minerals since its constituting 0.2 to 4.50 % of the non-opaque minerals with an irregular distribution with depth.

In short, the data of frequency distribution of the resistant mineral lead to the conclusion that the soils constituting each profile are heterogeneous either due to their multi origin or to subsequent variations along the course of sedimentation. Therefore, the soils ore considered young from the pedological viewpoint.

-Mineralogy of the clay fraction in soil samples

- X-Ray diffraction analysis

The studied soils were prepared as uniform unconsolidated calcareous materials representing a thickness of the solum that could not be determined with certainty, Soil Survey Staff (2004). In order to find out if those groups of calcareous soils from Burg El-Arab to El-Sallum have a typical mineralogical composition or not, it was found necessary to study the X-ray diffraction patterns of the soil samples.

Coastal plain soils

Data depicted in Fig. 5 and illustrated in Table 5 show that the identified clay mineral of X-ray diffractogames, reveal the predominance of kaolinite followed by palygroskite while regularly interstratified (chlorite + montmorillonite or saponite), montmorillonite, trioctahedral mica), regularly interstratified (vermiculite+mica), vermiculite, chlorite, halloysite and talc were detected in moderate amounts. Regularly interstratified (montmorillonite + mica or chlorite + vermiculite) and Dioctahedral mica were absent.

The identified accessory mineral, are mainly dominated by quartz in commons amount in the surface layer and decrease in few amounts in the deepest layer. The gibbsite mineral is found only in the deepest layer of the same profile.

Windblown formation soils

Fig. 6 and Table 5 showed that kaolinite is the predominant clay mineral followed by trioctahedral mica, Dioctahedral mica, montmorillonite, regularly interstratified (chlorite +montmorillonite or saponite), regularly interstratified (montmorillonite + mica or chlorite +vermiculite), palygroskite, regularly interstratified (vermiculite + mica), vermiculite and halloysite minerals were detected in moderate amounts.

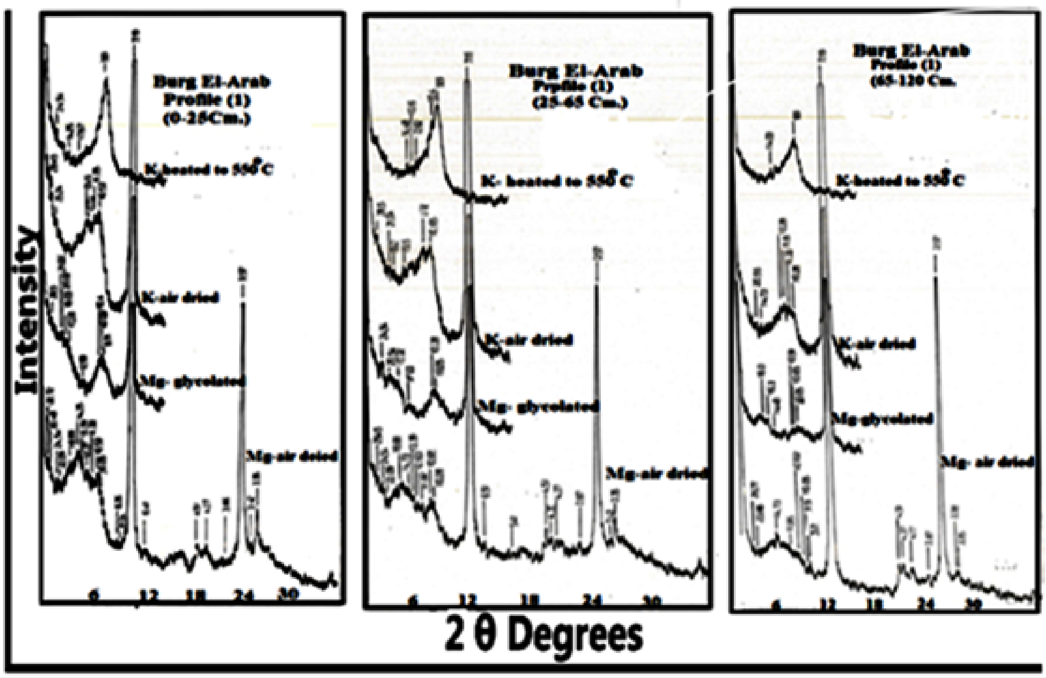

Fig. 5. X-Ray Diffractogrames of the clay fraction of the studied soils in the coastal plain (Burg El-Arab)

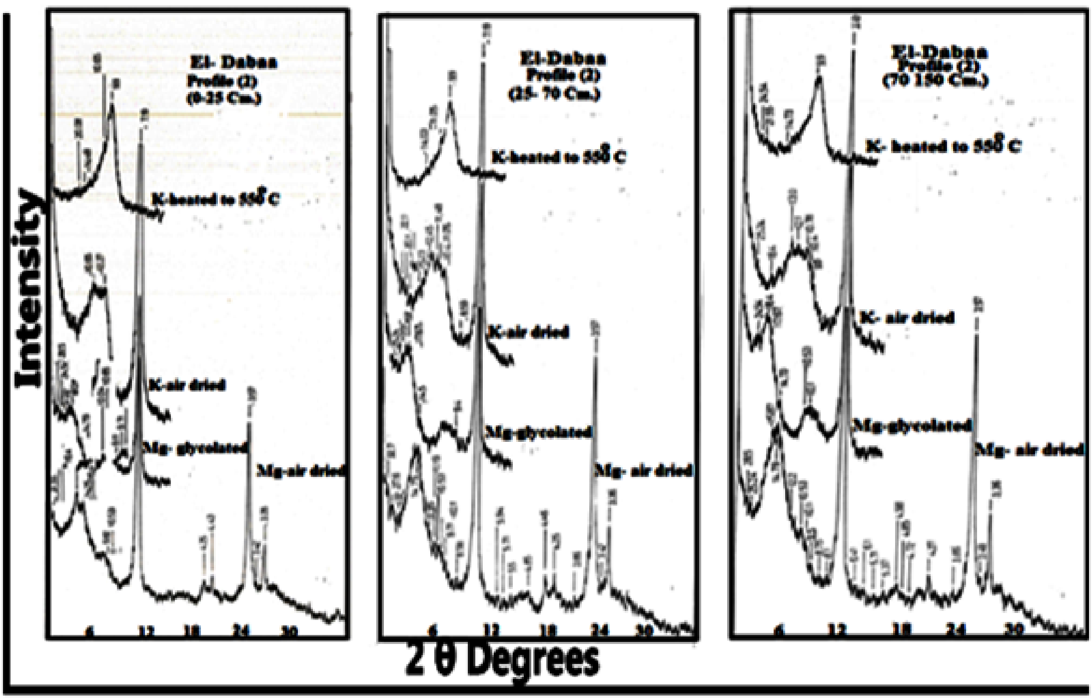

Fig. 6. X-Ray Diffractogrames of the clay fraction of the studied soils in the Windblown formaton (Ras El-Dabaa)

Table 5. Mineralogy of the clay fraction of some the northwestern coast

				Minerals																
				Clay minerals												Accessory minerals				
Profile No.	Location	Geomorphologic units	Depth, Cm.	R.In.Ch. +Mont. or Sab.	R.In.V. +mica	R. In. mont.+ mica;or Ch. Verm.	Vermiculite	Mont.	Chlorite	Halloysite	Trioctahedral mica	Dioctahedral mica	Palygroskite	Talc	Kaolinite	Amphiboles	Feldspars	Quartz	Goethite	Gibbsite
1	Burg El-Arab	The coastal plain	0-25	**	**	–	**	**	**	**	**	–	***	–	****	–	–	****	–	–
			25-65	**	**	–	**	**	**	**	**	–	**	–	****	–	–	–	–	–
			65-120	**	–	–	–	**	–	–	**	–	**	**	*****	–	–	**	–	**
2	Ras El-Dabaa	Windblown formation	0-25	**	–	–	**	**	–	–	**	**	–	–	*****	–	–	***	–	–
			25-70	**	–	**	–	–	–	**	**	**	**	–	****	**	–	***	–	–
			70-150	–	**	**	–	***	–	–	**	**	**	–	****	**	**	****	–	–
3	Mersa Matruh	The Tableland	0-40	–	**	–	–	**	–	**	**	–	**	***	****	–	–	–	–	–
			40-75	–	–	***	**	**	–	**	**	–	**	–	*****	–	–	**	–	–
			75-150	–	****	–	**	**	–	–	**	–	–	**	****	–	–	**	–	–
4	El-Sallum		0-10	–	**	**	**	**	–	**	**	–	–	**	***	–	**	**	**	**
			10-70	–	**	**	–	**	–	**	**	**	**	**	****	**	–	**	–	–
			70-150	–	**	**	**	**	–	**	**	–	**	**	***	–	–	–	**	**
5	S i d i Barani	The piedmont-like plain	0-25	–	**	–	–	***	–	–	**	***	***	–	****	–	***	****	–	–
			25-55	**	–	–	***	**	**	–	**	–	–	**	***	–	**	**	–	–
			55-80	**	–	–	–	**	–	**	**	–	–	–	*****	**	**	**	–	**

None - ; Traces *< 5 %, Few ** 5-15 %; Moderate ***15- 25%; Common **** 25-40 % and Dominant ***** >40 %., R. In.Ch. + Mont. or Sab. = regularly interstratified chlorite + montmorillonite or saponite, R. In. V. + mica = regularly interstratified vermiculite + mica, R. In. Mont. + mica; or Ch. + Verm. = Regularly interstratified montmorillonite + mica; or chlorite + vermiculite and Mont. = Montmorillonite.

The identified accessory mineral are mainly dominated by quartz mineral in all layers of profile 2 but the amphiboles mineral is only detected in two layers as few amounts, in the surface layer and subsurface layers but the feldspar minerals were existed only in the deepest layer of the same profile.

Tableland soils

Soils of Tableland geomorphic unit are represented by profiles 3 and 4. X-ray diffractogames of these profiles are depicted in Figs. (7 and 8). The data in Table (5) shows that the clay minerals assemblage consists of kaolinite as the major constituent followed by montmorillonite, halloysite, talc, palygroskite and trioctahedral mica, their frequencies common and moderate, respectively.

Vermiculite, regularly interstratified chlorite + montmorillonite and chlorite are found in moderate amounts in some profiles layers. As for accessory minerals, quartz is the first dominant minerals followed by feldspars, while goethite and gibbsite minerals are found in moderate amounts in the surface and deepest layers of profile 5.

The Piedmont-like plain soils

X-ray diffraction pattern of the clay fraction separated of from the piedmont like plains soils (profile 5) are shown in Fig. 9 and Table 5. Identified clay minerals are characterized kaolinite by an abundance amount of followed by montmorillonite and trioctahedral mica, while regularly interstratified (chlorite + montmorillonite or saponite), vermiculite, Dioctahedral mica, palygroskite, regularly interstratified (vermiculite + mica), chlorite, halloysite and talc were detected in common amounted in some profile layers.

The identified accessory mineral one mainly dominated by quartz and feldspars. Amphiboles and gibbsite are also found in moderate amounts in the deepest layer of the same profile.

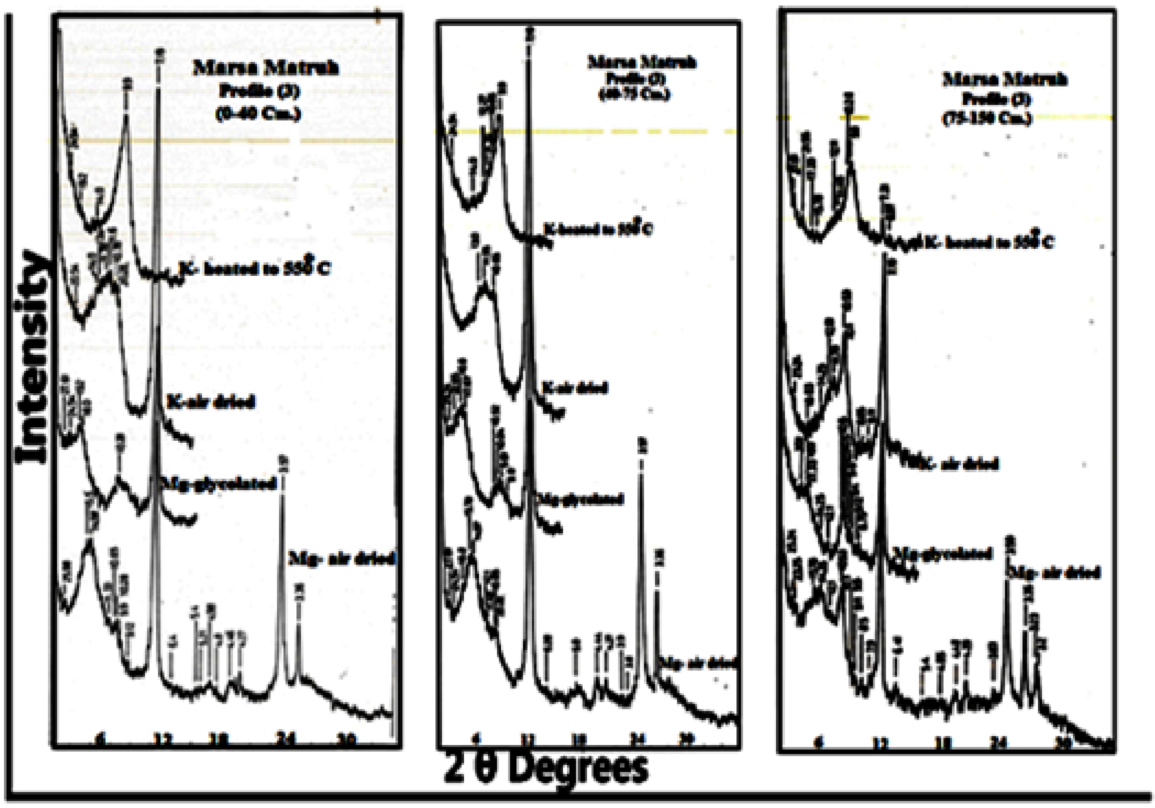

Fig. 7. X-Ray Diffractogrames of the clay fraction in the Tableland soils (Mersa Matruh)

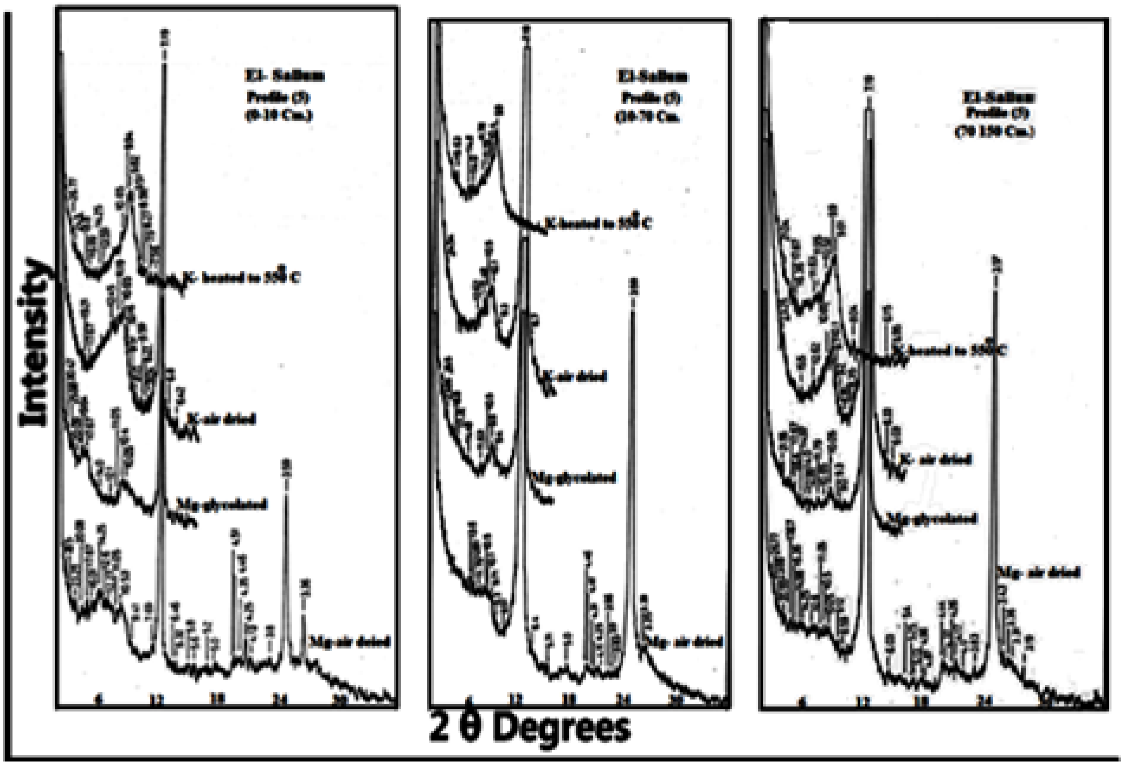

Fig. 8. X-Ray Diffractogrames of the clay fraction in the Tableland (El- Sallum)

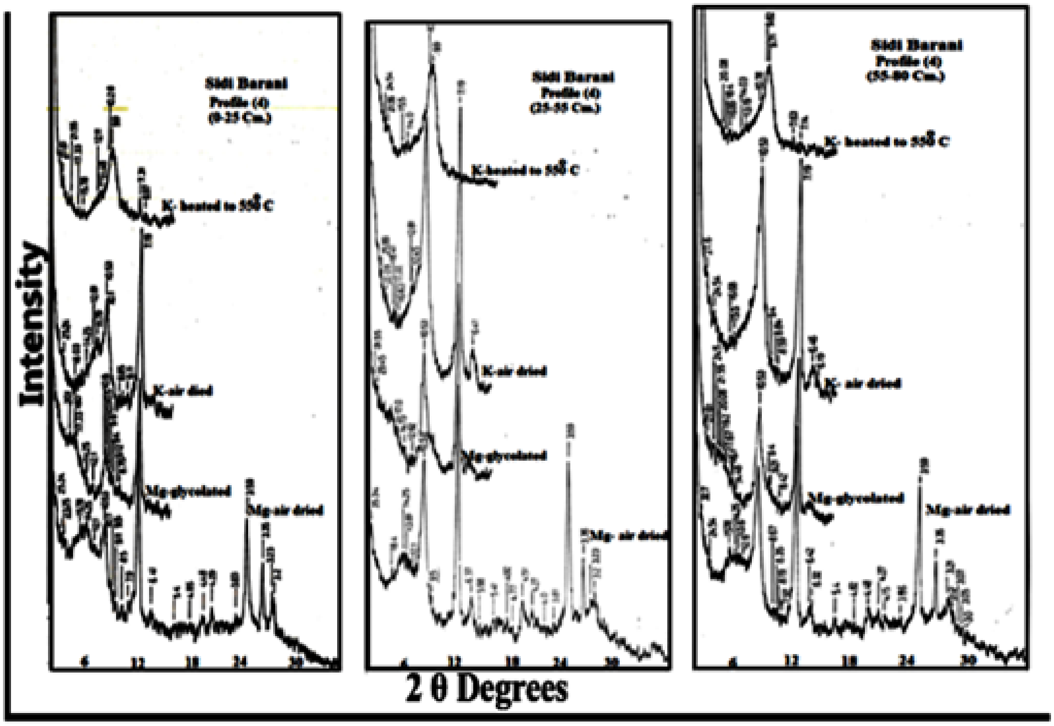

Fig. 9. X-Ray Diffractogrames of the Clay Fraction in the Piedmont like-plains (Sidi Barani)

Conclusion

The obtained mineralogical composition indicates that the soils of the northwestern coast of Egypt though derived from different parent material sediments. Namely limestone, shapes and marls of the Libyan plateau, yet their clay minerals suite is dominated by kaolinite followed by montmorillonite and /or Interstratified minerals. These minerals are almost inherited from the parent material with minimal mineralogical changes resulting from pedogenesis as indicated by the presence of weather able minerals such as feldspars. The kaolinite is perhaps a product of more intensive weathering regime and many have gone through on or more cycles of erosion and sedimentation before deposition in its present pedogenic environments. Montmorillonite coincides with lithology of the parent sediments as well as the enrichment in alkalines and alkaline earth. According palygorskite in most likely to be inherited from the calcareous parent material and could be related of Libyan plateau which is transported by several marine currents (alluvial) to coastal zone.

References

Al-Ani, T. and Sarapää, O. (2008) Clay and clay mineralogy. Physical – Chemical properties and industrial uses, Geol. Tutkim. Geol. Forsk. Geol. Sur. of Finland. (Kokoteksti). *Anal Grochem.,* State Univ., Gent, Belgium**.**

ASTM, D4972-01 (2006) Standard test method for pH of soils. *Annual Book of ASTM stan-dards.* Amer. Soc. for Tes. and Mate., p. 963-965.

Biswas, T. D. and Mukherjee, S. K. (2006) *Text Book of Soil Science.* Six. rep. Tata McGraw-Hill Publ. Comp. Ltd., New Delhi, India.

Bowles, J. F. W., Howie, R.A., Vaughan, D. J. and Zussman, J. (2011) Rock-forming minerals: non-silicates: oxides, hydroxides and sulphides. Geol. Soc. V. 5A, sec. ed., London, U.K.

Brian, A. Sch. (2002) Methods of the determination of. Nati. Exp. R. L. Eco. Ris. Ass. Sup. C. Office of Rese. and Deve.US. Envir. Prot. total organic carbon (TOC) in soils and sediments. *Ph. D Thesis* of. Envir. Prote. Agen. Envir.l Sci. Div. Agen.

Cascalho, J., Cota, P., Dawsan,S., Milne, F. and Rocha, A. (2016) Heavy mineral assemblages of the Storegga tsunami deposit. *Sedim. Geol.,* **334**, 21-33.

Dawid, J. and Dorota, K. (2014) A comparison of methods for the determination of cation exchange capacity of soils. *Ecol. Chem. Eng.* S., **21** (3), 487-498.

De Vos, B., Lettens, S., Muys, B. and Deckers, J. A. (2007) Walkley- Black analysis of forest soil organic carbon: recovery, limitations and uncertainty. Soil Use Manage.

DRC (2003) The development of the northern coast, land resources of Sedi Abd El Rahman, western Desert, Egypt, Inte. Rep., Ara.ed. Agri. and Rec. Min. D.R.C., W.R. and D. S. D., Eg.

El-Bastwasy, M.A. (2008) The Use of Remote Sensing and GIS for Catchments Delineation in Northwestern Coast of Egypt: An Assessment of water Resources and Soil Potential., *Egypt J Remote Sensing Space Sci,* pp. 3-16.

Elfaki, J. T.,, Gafer, M.O., Sulieman, M.M., Ali, M.E. (2016) Assessment of Calcimetric and titrimetric methods for calcium carbonate estimation of five soil types in central Sudan. *J. of Geo. and Env. Prot.* 4, 120-127. Pub. Online J. in Sci. Res. http://dx.doi.org/10.4236/gep.2016.41014H.

FAO (2002) Land resources information systems in the Near East. for Mineralogical Analyses. S. Sci. Soc. of Ame. 677 S. Segoe Road, Madison, WI 53711, Part 5. SSSA Book Ser., No. 5, USA.

Giambastiani, BMS., Antonellini, M., Oude Essink, GP. and Stuurman, RJ.(2007) Saltwater intrusion in the unconfined coastal aquifer of Heavy mineral assemblages of the Storegga tsunami deposit. *Sedim. Geol.,* **334**, 21-33.

Gunter, M.E.(2004).The polarized light microscope: Should we teach the use of a 19th century instrument in the 21stcentury?, *J. of Geo. Edu.*V.52,p.34-44.

Hegazi, A. M. , Elwan, A. A., Abddel-Mogith, S. M, Wassif, M. A., El- Demerdashe S., Afifi, M.Y. and Moawad, M. (2009). Assessment and mapping of desertification sensitivity in the Northwestern coastal zone, Egypt. *Egyptian J. Desert Res*., **59**, 1-96.

Hughes, M.G., Keene, J.B., Joseph, R.G. (2000). Hydraulic sorting of heavy mineral grains by swash on a medium sand beach. *J. of Sedi. Res.* V.70, No.5, 994 –1004.

Hy, Y., Ray, JR. and Jun Ys. (2013) Na^+, Ca^{2+}, and Mg^{2+} in brines affect supercritical CO2-brine-biotite interactions: ion exchange, biotite dissolution, and Illite precipitation. *Environ Sci. Technol.* **2**,47 (1):191-7. doi: 10.1021/es301273g.

Ibrahim D. (2015) Bedouin society strategies facing drought in Northwest coastal Zone of Egypt: a case study of Wadi Naghamish. *Thesis Ph. D.* Agro Paris

Tech, Specialization: Agronomic and ecological sciences. Inst., Sci., the Tec., P., Ins., of Tec.

Karmakar, R. M. (2014) Sand mineralogy of soils of Assam soils developed on different land forms in North Bank Plain Zone of Assam. II. Sand mineralogy**.** Agropedology, Dep. of S. Sci. Fac. of Agri., Assam, Agri. Uni., Jorhat, (01), 64-69. India.

Kettler, T.A., Doran, J.W. and Gilbert, T.L (2001) Soil particle size: simplified method for soil particle-size determination to accompany soil-quality analysis, *S. Sci. Soc. Amer. J.*, **65**, 849-852.

Limonta, M. (2014) Heavy minerals: a key to unravel orogenic processes. Labo. for Prov. Stu. Dep. of Earth and Environ. Sci. Uni. Milano-Bicocca, Italy.

Mange, M.A. and Wright, D.T. (2007) Heavy Minerals in Use. *Developments in Sedimentology Series,* **58.** Elsev., Amste., pp. 345–391.

Rodrıguez-Lopez, J. P., Clemmensen L., B., Lancaster N., Mountney, N.P. and Veiga, G. D. (2014) Archean to Recent aeolian sand systems and their sedimentary record: Current understanding and future prospects. In. *Ass. of Sed. Sedimentology.*p.1-43.

Soil Survey Staff. (2004) Soil Survey Field and Laboratory Methods Manual. Soil Survey Investigations Report No. 51, Ver. 1.0. R. Burt (Ed.). U.S. Depa. of Agri., Nat. Res. Cons. Ser.

Soukup, D. A., Buck, B. J., and Harris, W. (2008) Preparing Soils for mineralogical analyses. S. Sci. Soc. of Ame. 677 S. Segoe Road, madison, W153711, part 5 SSSA b. USA.

Syvitski and James, P. M. (2007) Principles, methods and application of Particle Size Analysis. Cam. Univ.

USDA, Keys to Soil Taxonomy. (2014) Uni. Sta., Dept. of Agri.,12 th. ed. USA.

White, E., and David, K., (2017) Restore or retreat? Saltwater intrusion and water management in coastal wetlands. *Eco. Hea. and Sus.* **3** (1).

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التقييم المعدنى لبعض الأراضى الممثله للوحدات الجيومورفولوجيه بالساحل الشمالى الغربى - مصر

نبيل محمد عبداللطيف بهنساوى
- قسم كيمياء وطبيعة ألأراضى- مركز بحوث الصحراء- مصر

تم جمع خمس عشرة عينة تربة من الطبقات المتعاقبة لخمس قطاعات أرضيه تمثل أربع وحدات جيومورفولوجية لبعض أراضى الساحل الشمالى الغربى بمصر . ولمعرفة التركيب المنرالوجى فحصت عينات التربه ميكروسكوبياً وتم عمل حيود الأشعة السينية. وقد أظهر الفحص الميكروسكوبى المستقطب على الجزء الرملى المحصور بين (0,125 و 0,063 مم) أن: المعادن الخفيفة كان يسود بها معدن الكوارتز ثم معادن الفلسبارات. والتى يشير تواجدها إلى أن هذه الأراضى حديثة من الوجهة البيدولوجية. المعادن الثقيلة كانت السيادة بها للمعادن المعتمة الكليه بينما المعادن الغير معتمة فقد تميزت بسيادة : معادن البيروكسينات ثم الباراميتامورفك والمعادن عالية المقاومة للتجوية كانت السيادة لمعدن الزيركون. وقد أوضحت نتائج توزيع المعادن المقاومة للتجوية إلى أن ألأراضى المدروسة غير متجانسة ويرجع ذلك إلى تعدد مواد الأصل المكونة لها أو اختلاف ظروف الترسيب. وقد أظهرت حيود الأشعة السينية لمعادن الطين سيادة معدن الكاؤلينيت يليه معدن المونتموريلونيت ثم معدن الميكا تراى أوكتاهيدرا ثم معدن الهالوسيت ثم معدن الفيرميكيوليت ثم معدن الباليجورسكيت ثم المعادن المستطبقة (الفيرميكيوليت + الميكا) ثم معدن التلك ثم المعادن المستطبقه (المونتموريلونيت + الميكا أو الكلورايت + الفيرميكيوليت) ثم المعادن المستطبقة (الكلورايت + المونتموريلونيت أو السابونيت) ثم الكلورايت ثم الميكا داى أوكتاهيدرا. أما المعادن المصاحبة فكانت السيادة لمعدن الكوارتز. وقد تم تفسير تواجد معادن الطين على مادة ألأصل ونظام وبيئة الترسيب وقد نوقشت كذلك نشأة معادن الطين وبتركيز خاص بظروف الغمر والابتلال التى كانت سائده قبل ظروف الجفاف الحالية.