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ORIGIN , MODE OF FORMATIOM AND UNIFORMITY OF THE COASTAL PLAIN SOILS IN SINAI PENINSULA

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ABSTRACT : Seven profiles were selected to represent the different geomorphic units in the northern Coastal belt of Sinai peninsula , in order to evaluate their soil genesis , formation and the degree of homogeneity .

Applying the particles size distribution and their parameters , data clarified that , these soils are moderately to poorly sorted , fine to near symmetrical skewed and meso to leptokurtic , this is indicating that , water and wind are considered the main factors responsible for the formation of such soils .

With regard to the mineralogical composition of the sand fraction in these soils , data indicate that , light minerals are composed mainly of Quartz (> 95 %) with few amounts of Feldspars . Heavy minerals , on the other hand , are dominated by Opaques minerals besides Pyroxenes and Amphiboles , Zircon , Epidote , Rutile , Tourmaline , Garnet , Staurolite and relatively moderate amounts of Kyanite . Generally , Pyroboles minerals constitute mostly of the non-Opaque minerals . The trend of heavy minerals distribution as function of profile depth , indicated that differences within the respective layers of soil profiles are mainly sedimentary relicts . The ratio of resistant minerals (Zr / T , Zr / R and Zr / T + R) with the soil profile , furtherly confirms the heterogenity of parent materials forming these soils .

Key word : Coastal soils , Origin , Sorted and skewed , Light and heavy minerals , Uniformity and weathering ratios .

INTRODUCTION

Agricultural expansion usually involves both reclaimation of barren area beside preserving the require irrigation water. The Coastal plain belt of Sinai Peninsula is one of the promising regions in conection with the hopeful agricultural development in Egypt; El-Shiekh Gaber canal (The part of El-Salam canal in eastern region of Suez canal) is one of the main irrigation project in this area of Sinai . This canal was designed to irrigate about 400.000 Feddans in this region as follow :

1 - El-Tina plain area (50.000 Feddans) .
2 - South El-Quantara area (75.000 Feddans) .
3 - Rabaa area (70.000 Feddans)
4 - Beir El-Abd area (70.000 Feddans) .
5 - El-Serou & El-Quarier area (135.000 Feddans) .

All of these areas representing mainly the studied area (the northern coastal plain soils of Sinai Peninsula) in Egypt , The area characterized by wide variations in their origin , properties and the suitability for agriculture .

Location :

The studied area is located in the northern part of Sinai Peninsula , it extends from Port Said to Rafah on the Mediterranean sea coast from the north , and from El-Quantara sharq to wadi El-Azariq from the south ; This area lies between longitudes 32° 30' and 34° 25' East , and latitudes 30° 50' and 31° 20' North , (Fig . 1) ; It is extending nearly to the Mediterranean Coast , includs El-Tina plain , the sandy coastal plain and both wadi El.Arish and wadi El.Azariq .

Geology :

The geology of Sinai Peninsula has been studied by several geologists among them Ball (1939) , Shokri (1953) , Said (1962) , El.Shazly *et. al.* (1974) and Henry and Chorowieze (1986) . In formation given by the above mentioned authors revealed that , the studied area is occupied by different type of rock varing between the Cenzoic to Mesozoic eras , which occupy the southern portion of Sinai Peninsula and constitue of limestone with marl intercalations sand limestone .

Cenozoic formation occupy the northern portion of Sinai Peninsula " Gabal Maghara " . It is mainly composed of shale intercalated with marl and fossiliferous limestone with sandstone .

Geomorphology :

According to Dams and Moor (1985) , Fig .(1) the geomorphological features of the studied area are classified into three main geomorphic units , namely :

1 - Northern Coastal plain .
2 - Morphotectonic depression (El-Tina plain) .
3 - Wadis (El-Arish and El-Azariq) .

1- *Northern Coastal plain*

This unit is the bigest geomorphic unit in the study area and including coastal beach , mobile elevated sand dunes and sandy plain as landscape units , texture of these soils are ranged from sandy loam to sand . This plain constitutes flat to slightly undulating strip of stretches adjacent to the Mediterranean shore line , this unit represented by profiles No. 2 , 3 and 4 .

2- *Morphotectonic depression*

It includs El-Tina plain in the northern west portion of Sinai , the soil in this unit are characterized by an almost flat or flat surface with low-lying terrain , soil parent material constitutes is a mixture of Nile alluvial and lacustrine deposits sometimes contaminated with aeolian sand sediments , this unit represented by profile No. 1 .

3- *Wadis*

Wadi El-Arish basin is one of the most important geomorphical phenomena in Sinai , it occupies the north eastern coastal portion , the wadi channel is surrounded by three conspicuous terraces ; Parent material is mostly dominated by the calcareous sediments of alluvial origin with variable contribution of aeolian deposits , this wadi represented by profiles No. 5 and 6 .

Wadi El-Azariq is one of the downstream tributaries which come from the east and has the same origin as wadi El-Arish , this wadi represented by profile No. 7 .

The current study concerns with morphological and mineralogical properties , genesis and soil formation of these soils to elucidate its mode of formation , identify minerals within sand subfraction and their relation to soil development as a degree of uniformity of parent material .

MATERIALS AND METHODS

Twenty four soil samples were collected from seven soil profiles Fig. (1), representing the main geomorphic units in the studied area, the collected samples were mechanically analysed using the pipette method Piper (1950) to get the non clay fractions, the sand fractions were determined using dry seving method. Then, the data was statistically evaluated according to Folk and Ward (1957), Passega (1964) and Passega and Byramjee (1969).

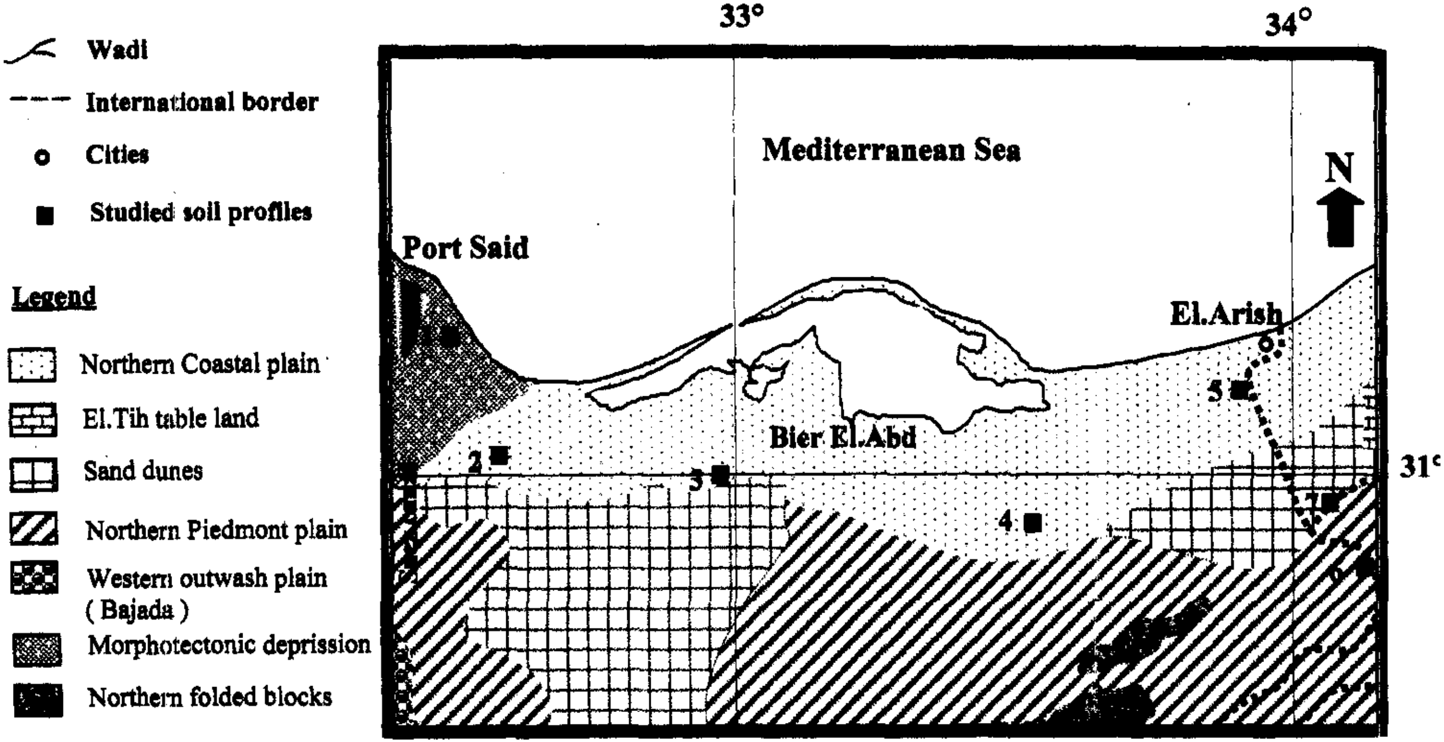
The mineralogical studies of the sand fraction were carried out as follow ; after the ordinary treatment (Jackson , 1967) , the sand subfraction (0.125 - 0.063 mm.) was separated from each sample by dry sieving methods . Separation of light and heavy minerals was carried out following the procedure described by Brewer (1964). Mounting of the minerals was undertaken according to the method outlined by Brewer (1964), systematic identification of the light and heavy minerals was done using the optical properties as given by Milner(1962).

RESULTS AND DISCUSSION

The morphological characteristics of the studied soil profiles are given in Table (1).

As shown in this table, soils of El.Tina plain (profile 1) has dry colours ranged from grey (10 YR 5/1) to dark grey (10 YR 4/1), the moist colours were ranged from dark grey (10 YR 4/1) to very dark grey (10 YR 3/1), the texture is clay throughout the entire depth , the structure is less developed (weak medium subangular blocky and weak medium angular blocky), the consistence is firm, very sticky and very plastic , mottles in subsurface layers as one of the morphological features and these soils are slightly calcareous .

Soils of the Northern Coastal plain (profiles 2 , 3 and 4) has dry colours ranged from yellow (10 YR 7/6) to yellowish brown (10 YR 5/4), the moist colours vary from brownish yellowish (10 YR 6/6) to dark yellowish brown (10 YR 4/4), the texture is sand, these soils are structureless (single grains), the consistence was loose, non sticky and non plastic, lime seggrigations , broken marine shells and and some roots as morphological



Scale : 1 : 1.500.000

Fig . (1) : Geomorphic units and location of the studied soil profiles in the Northern Sinai Peninsula

Table (1) : Morphological description of the studied soil profiles .

Geomorphic unit	Profile No.	Depth cm.	Colour		Texture	Structure	Consistence	Morpho. features	Calcareous
			Dry	Moist					
El.Tina plain	1	0 – 10	10YR 4/1	10YR 3/1	Clay	W.M.sab.	F.,VS.,VP.	Non.	Sl.calcar.
		10 – 40	10YR 4/1	10YR 3/1	Clay	W.M.ab.	F.,VS.,VP.	Mottles	Sl.calcar.
		40 – 110	10YR 5/1	10YR 4/1	Clay	W.M.ab.	F.,VS.,VP.	Mottles	Sl.calcar.
Northern Coastal plain	2	0 – 20	10YR 7/6	10YR 6/6	Sand	S. grains	L. , Ns.,Np.	Lime seg.	Mo.calcar.
		20 – 75	10YR 6/4	10YR 5/4	Sand	S. grains	L. , Ns.,Np.	B.M.shells	Mo.calcar.
		75 – 135	10YR 6/4	10YR 5/4	Sand	S. grains	L. , Ns.,Np.	Non.	Sl.calcar.
	3	0 – 10	10YR 7/6	10YR 6/6	Sand	S. grains	L. , Ns.,Np.	Non.	Non calcar.
		10 – 35	10YR 6/4	10YR 5/4	Sand	S. grains	L. , Ns.,Np.	Non.	Non calcar.
		35 – 80	10YR 5/4	10YR 4/4	Sand	S. grains	L. , Ns.,Np.	Non.	Sl. calcar.
		80 – 165	10YR 5/4	10YR 4/4	Sand	S. grains	L. , Ns.,Np.	F. roots	Sl. calcar.
	4	0 – 25	10YR 5/4	10YR 4/4	Sand	S. grains	L. , Ns.,Np.	B.M. shells	Sl. calcar.
		25 – 85	10YR 5/4	10YR 4/4	Sand	S. grains	L. , Ns.,Np.	Non.	Sl. calcar.
		85 – 180	10YR 6/4	10YR 5/4	Sand	S. grains	L. , Ns.,Np.	$CaCO_3$ seg.	Mo. calcar.

Table (1) : Cont .

Geomorphic unit	Profile No.	Depth cm.	Colour		Texture	Structure	Consistence	Morpho. features	Calcareous
			Dry	Moist					
Wadi El.Arish	5	0 – 25	10YR 7/6	10YR 6/6	Sand	S.grains	L. , Ns.,Np.	B.M. shells	Mo.calcar.
		25 – 70	10YR 5/4	10YR 4/4	S. loam	Massive	S.,Sl.s.,Sl.,p.	$CaCO_3$ seg.	H.calcar.
		70 – 120	10YR 5/4	10YR 4/4	L. sand	Massive	S.,Sl.s.,Sl.,p.	Non.	Mo.calcar.
		120 – 180	10YR 5/4	10YR 4/4	L. sand	Massive	S.,Sl.s.,Sl.,p.	F. roots	Sl. calcar.
	6	0 – 15	10YR 5/4	10YR 4/4	L. sand	Massive	S.,Sl.s.,Sl.p.	F. roots	Mo.calcar.
		15 – 55	10YR 6/4	10YR 5/4	L. sand	Massive	S.,Sl.s.,Sl.p.	$CaCO_3$ seg.	H.calcar.
		55 – 95	10YR 4/4	10YR 3/4	S.C.L.	W.a.b.	f. ,Mo.s,Mo.p	Non.	Sl.calcar.
		95 – 160	10YR 5/4	10YR4/4	L. sand	Massive	S.,Sl.s.,Sl.p.	Non.	Sl.calcar.
Wadi El.Azariq	7	0 – 20	10YR 5/4	10YR 4/4	S. loam	Massive	S.,Sl.s.,Sl.p.	F. roots	V.H. calcar.
		20 – 80	10YR 4/4	10YR 3/4	S.C.L.	W. a. b.	f. ,Mo.s,Mo.p	$CaCO_3$ seg.	V.H. calcar.
		80 – 160	10YR 5/4	10YR 4/4	L. sand	Massive	S.,Sl.s.,Sl.p.	Non.	Mo. calcar.

W.M.ab. = Weak medium angular blocky F. = Firm VS. = Very sticky VP. = Very plastic Sl. = Slightly
Mo. = Moderately H. = Highly S.grains = Single grains L. =Loose Ns. = Non sticky Np. = Non plastic
F. = Fine B. M. = Broken marine seg. = seggrigations S. = Soft L.sand = Loamy sand S.loam = Sandy loam
S.C.L. = Sandy clay loam f. = friable W.a.b. = Weak angular blocky V.H. = Very High calcar. = calcareous

features and these soils are non to moderately calcareous .

Soils of wadis (profiles 5 and 6) has dry colours ranged from yellow (10 YR 7/6) to dark yellowish brown (10 YR 4/4), the moist colours are ranged from brownish yellowish (10 YR 6/6) to very dark yellowish brown (10 YR 3/4) , the texture was varies from sand to sandy clay loam , the structures are ranged from structureless (single grains) to weak angular blocky , the consistence are varies from loose to friable , non sticky to moderately sticky and non plastic to moderately plastic , lime segregations , broken marine shells and some roots as morphological features and the soils are slightly to very high calcareous .

The particle size distribution pattern of the soil profiles are used as a criterium for determining the genesis of these profiles and their uniformity .

In this connection , use of a cumulative curves in characterizing sedimentary materials which has been proposed by many investigators . Four statistical parameters (Mz , $\sigma 1$, SK and KG) are calculated using the formula of Folk and Ward (1957) .

Data in Tables (2) and (3) , indicate that :

1 – As to the graphic mean Mz , most of the samples of the different profiles fall within the medium and fine sand (1.67 – 2.47 Ø) .

2 – All soil samples are poorly to moderately sorted (0.62 – 2.03 Ø)

The poorly sorted nature of the sediments suggests that the soils are mainly deposited by water action , while moderately sorted sediments suggests two means of transportation and deposition , i.e. , water and wind actions.

3 – As to inclusive graphic Skewness (SK) or symmetry , most of the samples fall within the range of fine skewed (0.30 – 0.10 Ø) ;

Exceptions are , the surface and deepest layers of profile 6 and the deepest layer of profile 7 , which falls within the range of near symmetrical (-0.5 – 0.08 Ø) .

4 – Regarding the values of graphic Kurtosis (KG) parameters , the soils range between 0.44 Ø (Mesokurtic) to 0.63 Ø (Leptokurtic) , using the scale given by Folk and Ward (1957) .

Taking into consideration , that Mesokurtic and Leptokurtic values , indicate the involvement of wind and water actions are the main factors responsible for soil formation .

The C-M pattern of the studied soil profiles is also used as a tool for indicating the mechanism of transportation and the hydrodynamic condition of sedimentation as suggested by Passega (1964) and Passega and Byramjee (1969). Data of C-M pattern , Table (3) and Fig . (3) show that the sediment of the studied area are transported by rolling & suspension .

Forthermore , the available data of the statistical size parameters reveal that the studied soil profiles are non-uniform of parent materials , however , the stratified conditions observed in these profiles are mostly attributed to depositional variations and / or the depositional regime .

Mineralogy of the sand fraction :

A – *Light minerals*

With regard to the role of the mineralogical composition of the sand fraction in order to evaluate the soil genesis and uniformity of these soils , light minerals are composed mainly of Quartz (< 95 %) for all the examined samples Table (4) , most of the Quartz grains which separated from El.Tina plain and wadis soils are simple type (mono-crystalline) and show straight to slightly undulose extension (Folk , 1968). Such these grains are thought to be derived from the disintigration of the igneous and metamorphic rocks ; The dominancy of Quartz over other members of the light minerals is mostly related to its resistance to weathering and the disentegration during the multicyclic processes of sedimentation .

Considering , Feldspars , it is evident that , these minerals constitutes are about 2.6 to 5.3 % of the light fraction , the members of Feldspars could be arranged in the order of their abundance as Orthoclase , Plagioclase and Microcline .

The presence of Feldspars could be taken as an indication that weathering prevailing during soil formation was not so drastic to cause a complete decay of these minerals susceptible to weathering

B – *Heavy minerals*

Considering the heavy minerals , data in Table (5) show that , the detected minerals of the heavy minerals are dominated by Pyroboles (Pyroxenes and Amphiboles) which form the main constituent of such fraction .

Table (2) : Ø values read from the cumulative frequency curves of the studied soil profiles .

Geomorphic unit	Profile No.	Depth cm.	Ø1	Ø5	Ø16	Ø25	Ø50	Ø75	Ø84	Ø95
Morphotectonic depression (El.Tina plain)	1	0 - 10	-0.95	-0.20	1.00	1.45	2.10	3.00	3.80	4.60
		10 - 40	-0.80	-0.10	1.10	1.90	2.30	3.30	3.90	4.75
		40 - 110	-0.70	-0.30	1.20	1.45	2.15	3.40	3.95	4.80
Northern Coastal plain	2	0 - 20	-0.10	1.00	1.20	1.50	2.00	2.10	2.65	3.35
		20 - 75	-0.10	0.90	1.25	1.45	1.95	2.30	2.90	3.50
		75 - 150	-0.60	0.20	0.65	1.25	2.15	2.65	2.90	3.75
	3	0 - 10	0.65	1.10	1.30	1.45	1.70	2.00	2.40	3.35
		10 - 35	-0.80	0.15	0.70	1.00	1.65	2.10	2.85	3.75
		35 - 80	-0.15	1.10	1.40	1.65	1.90	2.15	2.60	3.20
		80 - 165	-0.30	0.95	1.10	1.35	1.80	2.20	2.55	3.00
	4	0 - 25	-0.80	0.85	1.20	1.55	2.00	2.10	2.70	3.00
		25 - 85	-0.90	0.20	0.80	1.20	1.30	2.50	2.90	3.60
		85 - 180	-1.10	0.30	1.00	1.34	1.85	2.50	3.00	3.70
Wadi ELArish	5	0 - 25	-1.00	-0.50	0.10	0.70	1.60	2.80	3.40	4.40
		25 - 70	-1.10	-0.50	0.30	0.60	1.80	3.00	3.30	4.60
		70 - 120	-0.90	-0.40	0.20	0.60	1.80	3.00	3.60	4.50
		120 - 180	-0.75	-0.35	0.10	0.50	1.70	3.10	3.60	4.70
	6	0 - 15	-0.65	0.70	1.20	1.40	2.30	2.90	3.30	4.00
		15 - 55	-0.35	1.00	1.30	1.60	2.50	3.00	3.60	4.40
		55 - 95	-1.00	0.20	0.60	1.50	2.40	3.10	3.60	3.80
		95 - 160	-1.00	-0.30	0.70	1.35	2.20	2.70	3.20	3.50
Wadi ELAzariq	7	0 - 25	-0.20	1.00	1.70	2.00	2.30	3.00	3.20	3.70
		25 - 80	-0.50	0.50	1.40	1.60	2.00	2.80	3.20	3.90
		80 - 160	-0.10	-0.20	0.80	1.30	2.20	2.60	2.90	4.00

Table (3) : Statistical parameters , one percentile , median size values and mechanism of transportation of the studied soil profiles .

Geomorphic unit	Profile No.	Depth cm.	Mz ϕ	σI ϕ	SK1 ϕ	KG ϕ	One percentile in mm.	Median in mm.	Mechanism of transportation
Morphotectonic depression (El.Tina plain)	1	0 - 10	2.30	1.42	0.13	0.56	1.927	0.235	O - P
		10 - 40	2.43	1.43	0.11	0.53	1.737	0.204	O - P
		40 - 110	2.44	1.46	0.17	0.51	1.621	0.226	O - P
Northern Coastal plain	2	0 - 20	1.95	0.73	0.02	0.62	1.100	0.250	O - P
		20 - 75	2.03	2.03	0.17	0.56	1.100	0.263	O - P
		75 - 150	1.92	1.90	0.22	0.51	1.513	0.226	O - P
	3	0 - 10	1.8	0.62	0.30	0.63	0.637	0.310	O - P
		10 - 35	1.73	1.08	0.14	0.57	1.737	0.320	O - P
		35 - 80	1.97	0.62	0.20	0.63	1.110	0.270	O - P
		80 - 165	1.81	0.67	0.10	0.50	1.230	0.288	O - P
	4	0 - 25	1.97	0.70	-0.06	0.61	1.800	0.250	O - P
		25 - 85	1.67	1.04	0.44	0.52	1.800	0.400	O - P
		85 - 180	1.95	1.02	0.12	0.55	2.140	0.278	O - P
Wadi El.Arish	5	0 - 25	1.70	1.57	0.11	0.48	2.000	0.333	O - P
		25 - 70	1.80	1.52	0.05	0.46	2.000	0.285	O - P
		70 - 120	1.87	1.59	0.08	0.46	1.900	0.285	O - P
		120 - 180	1.80	1.64	0.13	0.44	1.700	0.312	O - P
	6	0 - 15	2.27	1.00	-0.01	0.47	1.600	0.200	O - P
		15 - 55	2.47	1.10	0.03	0.50	1.300	0.200	O - P
		55 - 95	2.20	1.36	0.05	0.50	2.000	0.200	O - P
		95 - 160	1.90	1.20	-0.25	0.53	2.000	0.200	O - P
Wadi El.Azariq	7	0 - 25	2.40	0.78	0.08	0.53	1.200	0.200	O - P
		25 - 80	2.20	1.00	0.22	0.53	1.400	0.250	O - P
		80 - 160	1.97	1.16	-0.24	0.57	1.100	0.200	O - P

O - P = Rolling & suspension

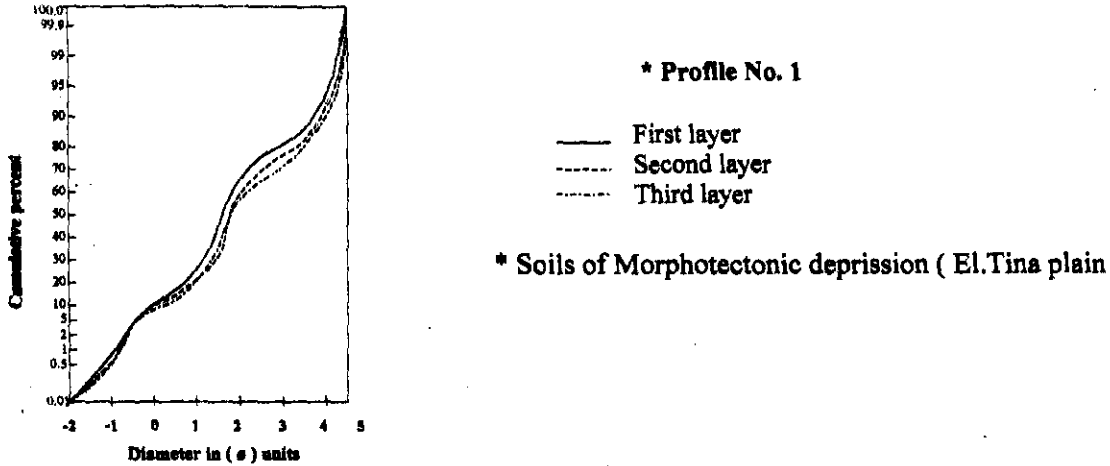
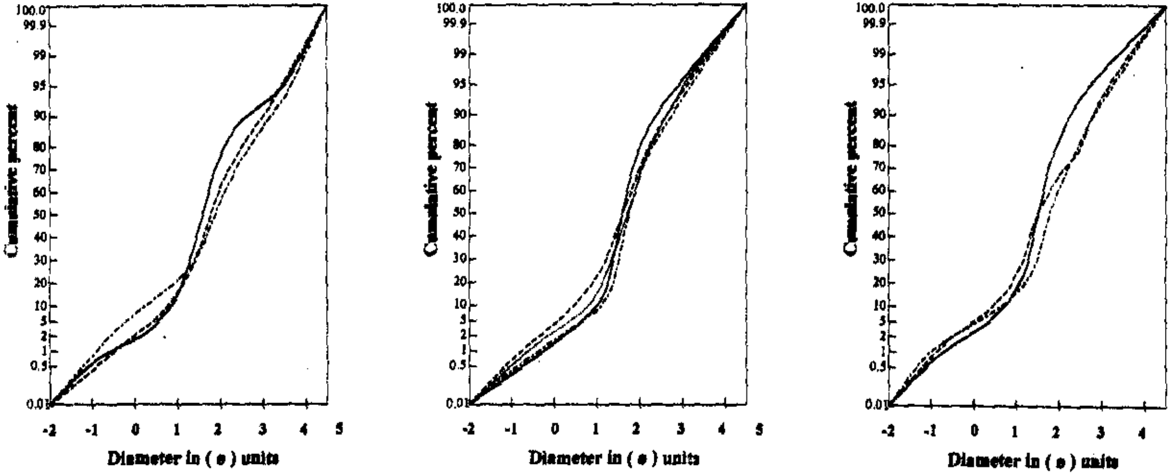


Fig . (2) : Cumulative frequency curves of the studied soil profiles .

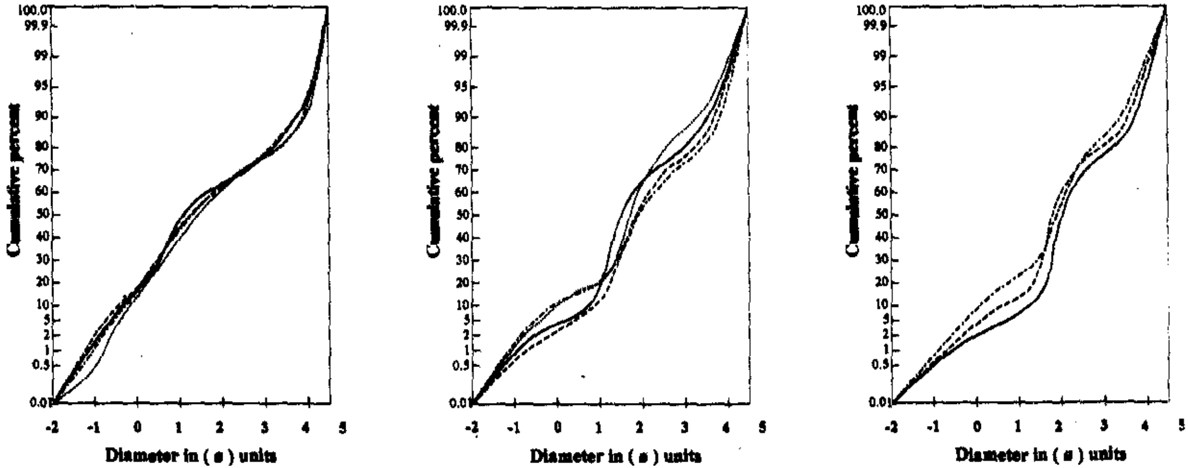


* Profile No. 2 * Profile No. 3 * Profile No. 4

* Soils of the Northern Coastal plain

First layer
Second layer
Third layer
Fourth layer

Cont . **Fig . (2) : Cumulative frequency curves of the studied soil profiles .**



* Profile No. 5   * Profile No. 6   ** Profile No. 7

* Profiles No. 5 and 6 Wadi El.Arish
** Profiles No. 7 Wadi El.Azariq
Soils of Wadis

—— First layer
------ Second layer
-·-·-·- Third layer
········ Fourth layer

Cont . **Fig . (2) : Cumulative frequency curves of the studied soil profiles .**

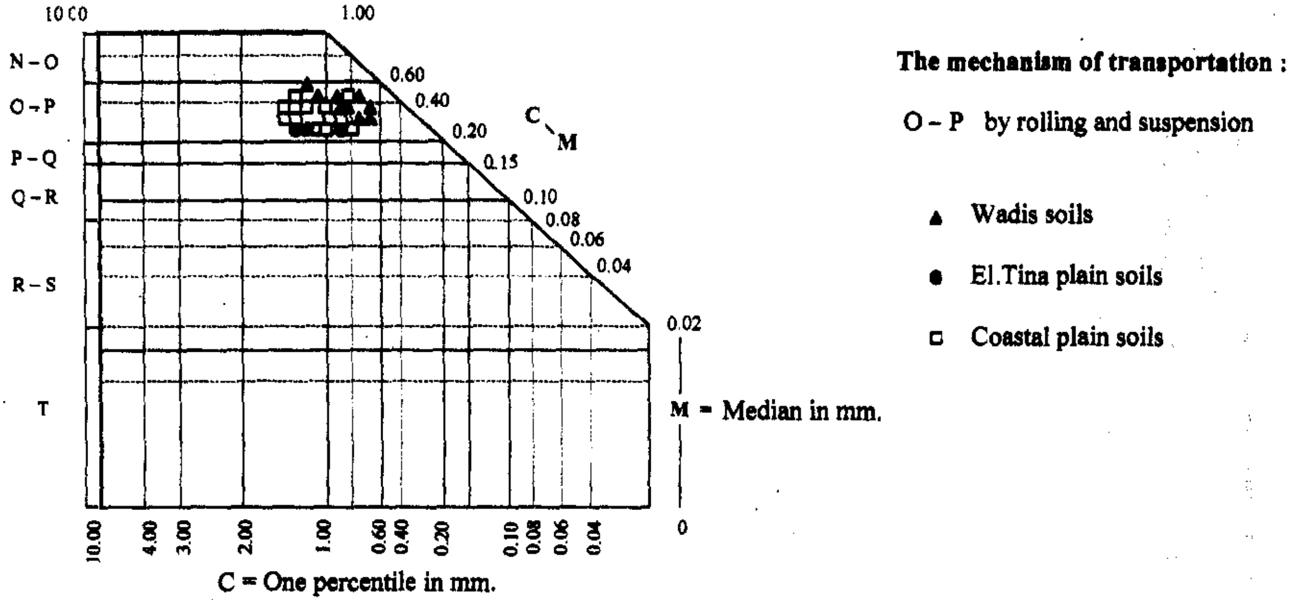


Fig . (3) : C – M Pattern diagram of the studied soil profiles .

Other minerals are detected as Opaques , Epidotes , Zircon , Garnet , Rutile , Tourmaline , Biotite , Staurolite , Silimanite , Kyanite and Gloucophane in different frequency amounts . The optical examination of such minerals reveal that Pyroxenes minerals constitute , most of the non-Opaque minerals . The most common minerals encountered in this group are Augite , Diopside and Hyperthene ; The values of Pyroxenes are ranged from 19.2 to 33.8 % , the highest value is detected in the northern coastal plain soils (profile 2) , while the lowest one is found in the soils of wadi El.Arish (profile 5) .

Amphiboles minerals are represented by Hornblend , Actinolite and Gloucophane which was the second important portion of the heavy residue after Pyroxene ; Their values varied widely from one geomorphic unit to other with ranges between 11.1 % and 26.1 % with an irregular distribution pattern with depth .

Zircon , Rutile and Tourmaline minerals are detected in all the studied soil samples without any specific trend either within the fraction or throughout the respective layers of the soil profiles . Regarding , the variability of their distribution in the studied geomorphic unit , Zircon varies from 2.3 % to 8.5 % , the lowest value is found in the soils of northern coastal plain , while the highest value is detected in the soils of wadi El.Arish . Rutile mineral is presented in a variable amounts , ranges between 1.7 % and 4.0 % . The highest percent characterizes the surface layer of profile 5 (wadi El.Arish) , whereas the lowest one is exhibited in the 40 – 110 cm. layer of the soils of El.Tina plain (profile 1) .

Tourmaline mineral displays to some extent , the same trend catching the Zircon and Rutile minerals , where its highest value is found in El.Tina plain soils (profile 1) , while the lowest frequency content is this of the northern coastal plain soils (profile 4) . The other accessory minerals ; Epidote , Garnet , Biotite , Kyanite , Staurolite , Silimanite , Monazite and Gloucophane are presented in varied frequencies from one geomorphic unit to another . The trend of their distribution as of depth is not obvious , however , it is mostly irregular .

From the former discussion , it can be concluded that Pyroboles (Pyroxenes + Amphiboles) and Opaques are the most aboundant minerals , Zircon , Rutile , Tourmaline , Garnite and Epidote are presented in moderate amounts , while the remaining minerals are found in less pronounced amounts .

The variations of the mineralogical composition already observed in Table (5) in the studied geomorphic units could be attributed to the sedimentation regime and the effect of sorting distribution .

Uniformity and Weathering ratios :

To evaluate the weathering stage and uniformity of profile parent materials , certain minerals as Pyroboles , Zircon Tormaline and Rutile are used to achieve this purpose .

Pyroboles are considered as an assessable minerals to weathering , while Zircon and some extent Tourmaline and Rutile as resistant . So the presence of assessable minerals in high precentages can be taken as an indication of the immature conditions or recent deposits . This care is in harmony when resistant minerals is existed in low levels .

Generally , soils of the areas under consideration are relatively recent from the view point of pedogenesis ; Moreover , the narrow limits in heavy mineral frequency is mainly ascribe geogenesis . To elucidate the homogeneity or heterogenity of the soil parent material , resistant minerals as well as their ratios are employed (Zr / R , Zr / T and Zr / T+R) .

Application of the former ratios for each soil profile , Table (6) and Fig . (4) , indicate that most of these profiles in the areas undertaken are of multi-origin or formed due to a multi-depositional regimes . Exceptional being few soil profiles representing the soils of northern coastal plain which have a relatively apparent hemogeneity with only slight differenes rander mainly in their surface layer due either to the contamination of more than one parent material or to the sedimentation processes .

In conclusion , it is quite clear that soil profiles have quite defferent features due to lithologic discontinaity ; The latter is indicated by the distribution of minerals within successive layers

Table (4) : Frequency distribution of light minerals in the sand fraction (0.125 - 0.063 mm.) of the studied soil profiles .

Geomorphic units	Profile No.	Depth cm.	% Quartz	% Feldspars			
				Orthoclase	Plagioclase	Microcline	Total
Morphotectonic depression (El.Tina plain)	1	0 - 10	95.0	2.4	2.2	0.4	5.0
		10 - 40	95.2	2.3	2.0	0.5	4.8
		40 - 110	94.7	2.7	2.1	0.5	5.3
Northern Coastal plain	2	0 - 20	96.3	1.6	1.2	0.9	3.7
		20 - 75	96.4	1.7	0.9	1.0	3.6
		75 - 150	97.4	1.1	0.7	0.8	2.6
	3	0 - 10	95.5	2.3	1.2	1.0	4.5
		10 - 35	96.0	2.0	0.8	1.2	4.0
		35 - 80	96.4	1.6	0.9	1.1	3.6
		80 - 165	95.5	2.0	1.4	1.1	4.5
	4	0 - 25	95.7	2.0	1.0	1.3	4.3
		25 - 85	96.0	1.4	1.6	1.0	4.0
		85 - 180	96.4	1.5	1.1	1.0	3.6
Wadi El-Arish	5	0 - 25	97.0	1.0	1.2	0.8	3.0
		25 - 70	96.5	1.5	1.0	1.0	3.5
		70 - 120	95.8	2.1	1.0	1.1	4.2
		120 - 180	95.7	1.9	1.5	0.9	4.3
	6	0 - 15	97.0	1.3	0.7	1.0	3.0
		15 - 55	97.0	1.1	1.2	0.7	3.0
		55 - 95	96.2	1.9	1.0	0.9	3.8
		95 - 160	96.0	2.0	0.9	1.1	4.0
wadi El.Azariq	7	0 - 20	95.6	2.0	1.5	0.9	4.4
		20 - 80	95.8	2.3	1.0	0.9	4.2
		80 - 160	96.0	2.1	0.9	1.0	4.0

Table (5) : Frequency distribution of heavy minerals of the sand fraction (0.125 - 0.063 mm.) of the studied soil profiles .

Geomorphic unit	Profile No.	Depth cm.	Opaque minerals %	Non opaque minerals %							
				Pyroboles							
				Pyroxenes				Amphiboles			
				Augite	Hyperthene	Diopside	Total	Hornblend	Glauconite	Actinolite	Total
Morphotectonic depression (ELTina plain)	1	0 - 10	37.2	14.8	3.1	6.5	24.4	8.4	1.8	2.1	12.3
		10 - 40	35.5	14.0	2.4	4.2	20.6	7.3	1.8	2.0	11.1
		40 - 110	36.4	12.8	3.0	4.5	20.3	9.2	1.6	3.0	12.0
		Mean	**36.4**	**13.7**	**2.8**	**5.1**	**21.8**	**8.3**	**1.7**	**2.4**	**11.8**
Northern Coastal plain	2	0 - 20	27.1	18.3	6.0	9.5	33.8	9.6	2.1	2.7	14.4
		20 - 75	28.4	16.5	5.6	9.0	31.1	10.2	3.6	3.2	15.3
		75 - 135	24.7	17.3	5.8	8.8	31.9	9.8	3.2	3.0	16.0
		Mean	**26.7**	**17.4**	**5.8**	**9.1**	**32.3**	**9.9**	**3.0**	**3.0**	**15.2**
	3	0 - 10	27.5	17.0	5.2	8.4	30.6	10.5	3.6	2.7	16.2
		10 - 35	25.0	17.1	5.0	9.4	31.5	9.8	3.6	3.0	16.4
		35 - 80	25.1	17.4	6.0	8.8	32.2	12.0	3.8	2.9	16.4
		80 - 165	24.8	16.6	5.8	8.2	31.6	11.6	5.0	3.4	15.9
		Mean	**25.6**	**17.0**	**5.5**	**8.7**	**31.5**	**11.0**	**4.0**	**3.0**	**16.2**
	4	0 - 25	23.3	17.4	5.8	7.3	30.5	11.6	2.9	4.4	18.9
		25 - 85	22.0	15.2	4.7	11.0	30.9	13.2	3.8	3.6	20.6
		85 - 180	22.7	10.7	3.5	10.7	24.9	10.7	5.3	3.5	19.5
		Mean	**22.7**	**14.4**	**4.6**	**9.7**	**28.8**	**11.8**	**4.0**	**3.8**	**19.7**
Wadi ELArish	5	0 - 25	20.1	14.7	4.0	8.0	26.7	13.1	6.7	2.7	22.5
		25 - 70	17.5	12.6	6.4	12.9	31.9	11.6	5.3	2.6	19.5
		70 - 120	23.7	8.9	4.4	5.9	19.2	14.9	8.3	2.9	26.1
		120 - 180	20.7	9.0	6.4	10.1	25.5	11.6	6.4	3.6	21.6
		Mean	**20.5**	**11.3**	**5.3**	**9.2**	**25.8**	**12.8**	**6.7**	**2.9**	**22.4**
	6	0 - 15	21.9	11.0	4.1	9.6	24.6	12.3	8.2	4.1	24.6
		15 - 55	21.3	8.8	6.3	10.0	25.1	11.3	6.0	3.5	20.8
		55 - 95	20.8	7.8	5.2	9.1	22.1	14.3	7.8	3.9	26.0
		95 - 160	22.0	11.0	5.5	6.9	23.4	13.2	4.1	6.3	23.7
		Mean	**21.5**	**9.7**	**5.3**	**8.9**	**23.9**	**12.8**	**6.5**	**4.5**	**23.8**
Wadi ELAzariq	7	0 - 20	23.3	8.7	5.8	7.3	21.8	14.5	4.4	6.4	25.3
		20 - 80	21.6	9.3	4.8	6.4	20.5	15.2	5.6	5.2	26.0
		80 - 160	22.6	8.8	6.2	8.0	23.0	14.8	5.8	5.1	25.7
		Mean	**22.5**	**8.9**	**5.6**	**7.2**	**21.7**	**14.8**	**5.3**	**5.6**	**25.6**

Table (5) : cont .

Profile No.	Depth cm.	Non opaque minerals %												
		Parametamorphic				Ubibuitous Ultrastable minerals			Biotite	Epidote	Monazite	Glaucophane	others	Index figure
		Garnet	Saturolite	Kyanite	Silmanite	Zircon	Rutile	Tourmaline						
1	0 - 10	2.0	2.3	1.2	1.0	5.2	2.0	2.5	1.5	6.3	0.6	1.4	0.1	4.4
	10 - 40	3.2	2.0	1.0	2.4	6.6	2.5	3.0	2.1	6.8	1.0	2.0	0.2	4.8
	40 - 110	3.6	2.2	0.8	1.6	6.8	1.7	2.4	2.5	6.0	1.2	2.5	0.0	12.1
	Mean	**2.9**	**2.2**	**1.0**	**1.7**	**6.2**	**2.1**	**2.6**	**2.0**	**6.4**	**1.0**	**2.0**	**0.1**	**7.1**
2	0 - 20	2.4	1.6	1.2	1.7	2.4	2.6	1.5	2.7	7.1	1.3	0.1	0.1	10.5
	20 - 75	3.1	2.2	1.0	1.1	3.0	2.4	2.0	1.2	8.1	1.0	0.1	0.0	8.8
	75 - 135	3.0	2.3	1.4	1.3	3.0	2.8	1.9	2.0	7.4	1.2	0.0	1.1	10.4
	Mean	**2.8**	**2.0**	**1.2**	**1.4**	**2.8**	**2.6**	**1.8**	**2.0**	**7.5**	**1.2**	**0.1**	**0.4**	**9.9**
3	0 - 10	3.3	1.9	1.0	1.2	3.2	3.8	1.8	1.2	6.4	0.9	0.0	1.0	18.8
	10 - 35	3.8	2.6	0.9	1.5	4.5	3.0	2.0	2.0	4.2	1.0	0.2	1.4	22.4
	35 - 80	3.6	2.6	1.4	1.4	4.2	3.5	2.3	1.5	4.6	0.6	0.0	0.6	16.4
	80 - 165	3.5	2.5	1.6	1.3	5.2	3.6	2.8	1.3	4.4	0.8	0.0	0.7	12.5
	Mean	**3.6**	**2.4**	**1.2**	**1.4**	**4.3**	**3.5**	**2.2**	**1.5**	**4.9**	**0.8**	**0.1**	**0.9**	**17.5**
4	0 - 25	2.9	1.4	1.4	2.0	2.3	2.3	1.2	2.9	7.0	1.2	0.0	2.6	10.5
	25 - 85	2.7	2.5	1.1	1.4	4.7	2.5	1.4	0.6	6.3	0.8	0.4	2.0	8.8
	85 - 180	3.5	2.4	1.9	1.3	6.7	3.5	1.9	2.1	6.7	0.0	0.6	3.0	10.4
	Mean	**3.0**	**2.1**	**1.5**	**1.6**	**4.6**	**2.8**	**1.5**	**1.9**	**6.7**	**0.7**	**0.3**	**2.5**	**9.9**
5	0 - 25	3.2	2.7	0.8	1.3	6.7	4.0	2.7	1.1	5.3	0.8	0.0	2.1	5.8
	25 - 70	4.4	2.9	0.9	1.2	8.5	2.9	2.0	0.9	3.8	0.9	0.1	2.4	4.2
	70 - 120	3.6	2.9	1.5	1.2	8.3	2.9	2.1	1.2	4.4	0.6	0.0	2.2	3.9
	120 - 180	3.6	2.5	1.8	1.3	8.3	3.9	2.3	1.3	4.4	0.5	0.0	2.0	6.2
	Mean	**3.7**	**2.7**	**1.3**	**1.3**	**8.0**	**3.4**	**2.3**	**1.1**	**4.5**	**0.7**	**0.0**	**2.2**	**5.0**
6	0 - 15	2.7	2.5	1.1	1.4	6.8	3.8	2.2	1.9	3.6	0.5	0.0	2.5	4.5
	15 - 55	3.8	3.3	1.8	2.5	6.3	3.8	2.3	1.3	2.5	0.5	1.8	2.9	3.8
	55 - 95	3.9	2.6	1.3	1.8	6.5	3.9	2.3	1.8	3.1	0.8	0.2	2.9	3.0
	95 - 160	3.6	2.8	1.1	1.9	8.0	3.3	1.9	1.4	4.1	0.6	0.1	2.1	3.5
	Mean	**3.5**	**2.8**	**1.3**	**1.9**	**6.9**	**3.7**	**2.2**	**1.6**	**3.3**	**0.6**	**0.5**	**2.6**	**3.7**
7	0 - 20	4.3	2.9	1.2	1.4	5.8	3.5	2.0	1.5	4.4	0.6	0.1	1.9	2.9
	20 - 80	4.1	2.5	1.4	1.6	5.5	3.2	2.2	1.8	3.5	0.6	0.0	5.5	3.5
	80 - 160	3.7	3.0	1.3	1.5	5.6	3.7	1.9	1.6	3.8	0.5	0.0	2.1	5.4
	Mean	**4.0**	**2.8**	**1.3**	**1.5**	**5.6**	**3.5**	**2.0**	**1.6**	**3.9**	**0.6**	**0.0**	**3.2**	**3.9**

Table (6) : Uniformity and Weathering ratio of the studied soil profiles .

Geomorphic unit	Profile No.	Depth cm.	Uniformity ratios			Weathering ratios		
			Zr / T	Zr / R	Zr / R+T	* P+A / Zr+T	** H / Zr+T	*** B / Zr+T
Morphotectonic deprission (El.Tina plain)	1	0 - 10	2.10	2.60	1.15	4.76	1.09	0.19
		10 - 40	2.20	2.64	1.20	3.30	0.76	0.21
		40 - 110	2.80	4.00	1.65	3.50	1.00	0.27
Northern Coastal plain	2	0 - 20	1.60	0.92	0.59	12.36	2.46	0.69
		20 - 75	1.50	1.25	0.68	9.28	2.04	0.24
		75 - 150	1.58	1.07	0.64	9.77	2.00	0.41
	3	0 - 10	1.77	0.84	0.57	9.36	2.10	0.24
		10 - 35	2.25	1.50	0.90	7.37	1.51	0.31
		35 - 80	1.83	1.20	0.72	7.48	1.85	0.26
		80 - 165	1.86	1.44	0.81	5.94	1.45	0.16
	4	0 - 25	1.92	1.00	0.66	14.11	3.31	0.83
		25 - 85	3.36	1.88	1.21	8.44	2.16	0.10
		85 - 180	3.53	1.91	1.24	5.16	1.24	0.24
Wadi ElArish	5	0 - 25	2.48	1.68	1.00	5.53	1.39	0.12
		25 - 70	4.25	2.93	1.73	4.90	1.10	0.10
		70 - 120	3.95	2.86	1.66	4.36	1.43	0.11
		120 - 180	3.61	2.86	1.34	4.44	1.09	0.12
	6	0 - 15	3.09	1.79	1.13	5.47	1.37	0.21
		15 - 55	2.74	1.66	1.03	5.34	1.31	0.15
		55 - 95	2.83	1.67	1.05	5.47	1.32	0.20
		95 - 160	4.21	2.42	1.54	4.76	1.33	0.14
Wadi El.Azariq	7	0 - 20	2.90	1.66	1.05	6.04	1.86	0.19
		20 - 80	2.50	1.72	1.02	6.04	1.97	0.23
		80 - 160	2.94	1.51	1.00	6.76	2.06	0.21

Zr = Zircon **T = Tourmaline** **R = Rutile** * Wr1
P = Pyroxenes **A = Amphiboles** **B = Biotite** ** Wr2
H = Hornblend *** Wr3

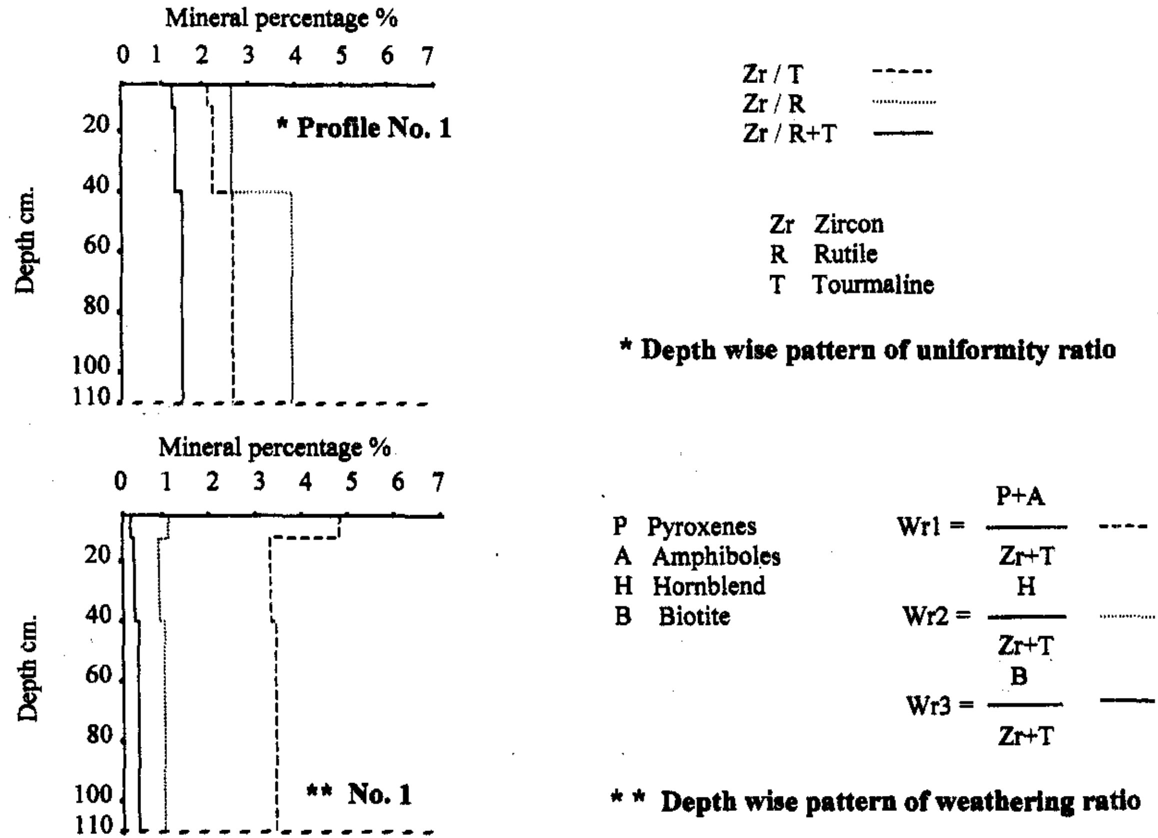
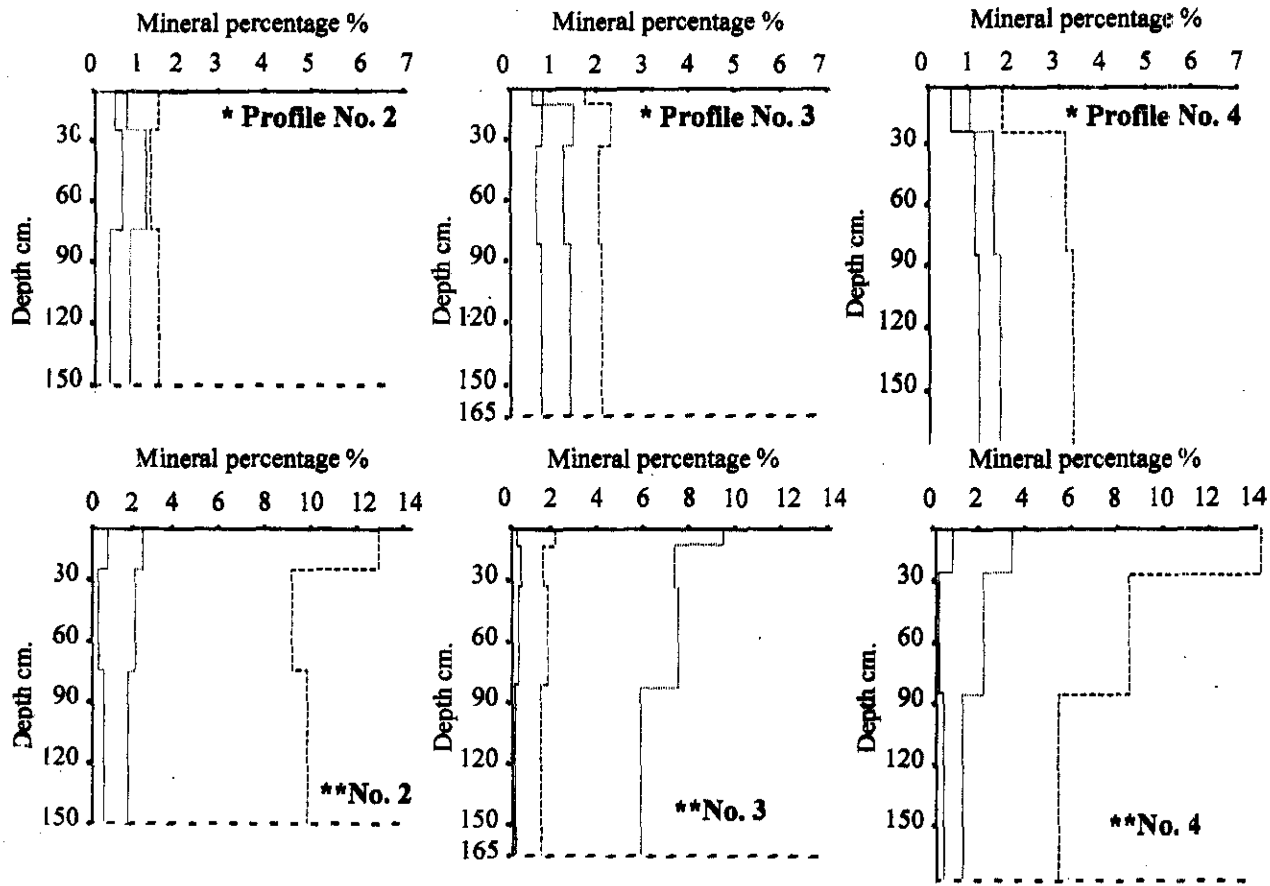
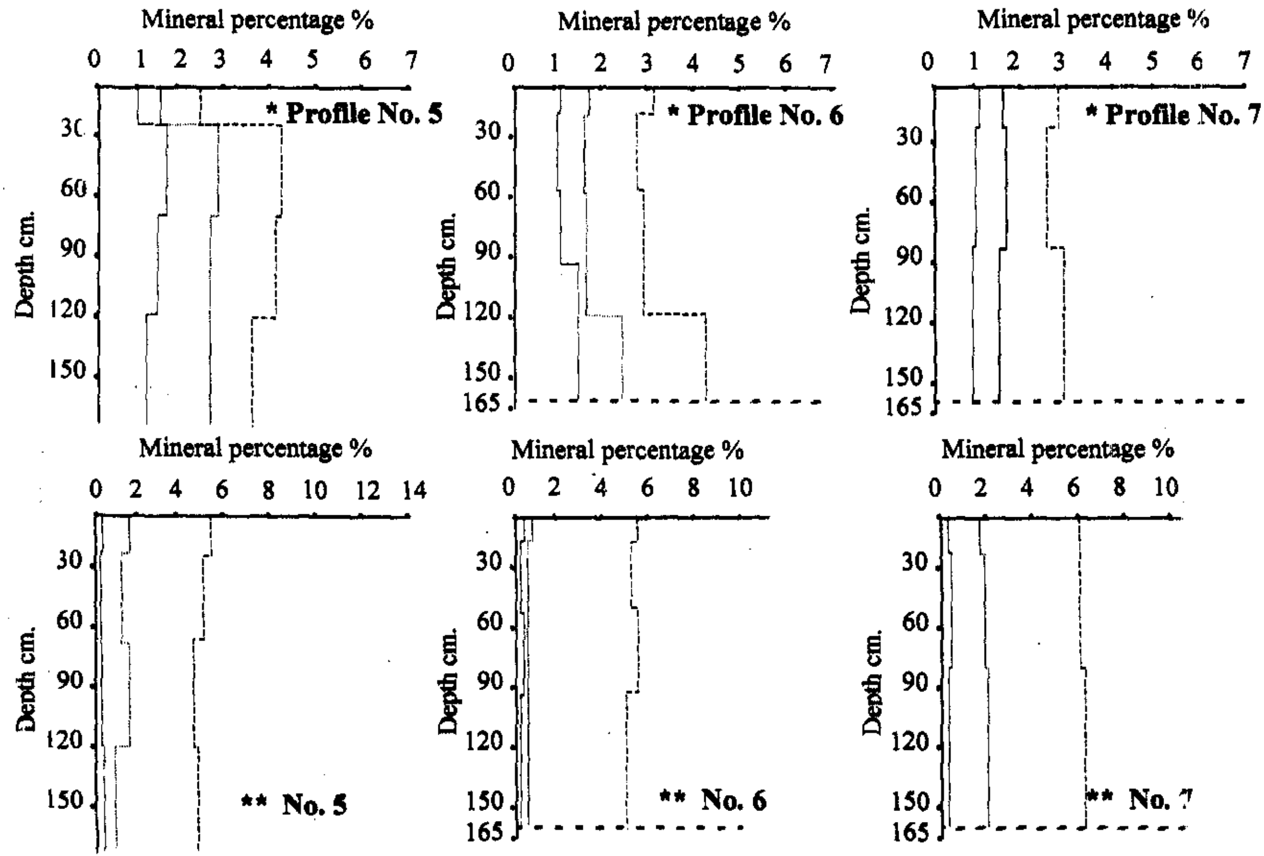


Fig . (4) : Depth wise patterns of uniformity and weathering ratios of the studied soil profiles (El.Tina plain soils)



Cont . Fig . (4) : (Northern Coastal plain soils)



Cont . **Fig . (4) : (Wadis soils)** of profiles , this difference in distribution is attributed to either heterogenity of parent material prior to inception to weathering .

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دراسة أصل و طبيعة تكوين و مدى تجانس أراضى السهل الساحلى فى سيناء

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أجريت هذه الدراسة على أراضى السهل الساحلى الشمالى بسيناء بغرض التعرف على نشأتها و كذلك مدى التجانس للقطاعات الأرضية و قد أخذت ٧ قطاعات أرضية ممثلة للوحدات الجيومورفولوجية السائدة فى الساحل الشمالى لسيناء و قد أوضحت الدراسة الأحصائية للتوزيع الحجمى للحبيبات أن هذه الأراضى غير متجانسة أو فقيرة التجانس حيث نقلت كمادة معلقة و رسبت فى وسط مائى أو بالتدحرج بواسطة الهواء ، و يمتاز بعضها برواسب ناعمة ذات أصل نهرى (سهل الطينة و أراضى الأودية) و لكن هذه ذات طبيعة غير متجانسة .

و قد تبين من الدراسة البتروجرافية أ ن المعادن الخفيفة تتكون أساسا من الكوارتز مع كميات من الفلسبارات ، بينما المعادن الثقيلة فيسود بها معادن البيروكسينات و الأمفيبولات و المعادن المعتمة و الأبيدوت ، أما معادن الزيركون و الجارنت و التورمالين و الروتيل فقد وجدت بكميات متوسطة ، و تتواجد بقية المعادن بكميات قليلة نسبيا .