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ORIGIN , UNIFORMITY AND DEVELOPMENT OF EL-SALHIYA AREA IN THE EASTERN DESERT OF EGYPT

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ABSTRACT: ***Six soil profiles were select representing the soils of El-Salhiya project . These soils were studied in order to evaluate their genesis , formation and development .***

Studied grain size distribution and statistical parameters indicate that these soils have mainly moderately to poorly sorted sediments with near symmetrical to fine skewed materials and leptokurtic to mesokurtic pattern . These parameters indicate that these soils are formed under water or both water and wind action.

With regard to the petrographic examination , data show that the light fraction are composed essentially of Quartz . The other associated minerals such as Feldspars are detected in small amounts . On the other hand , heavy minerals are dominated by opaque minerals . The non-opaque minerals are dominated by pyroboles (pyroxenes+amphiboles) and epidote . Zircon , rutile and tourmaline are presence in moderate amounts . Garnet , staurolite , kyanite and silimanite are found in less pronounced amounts.

Moreover , the results indicate that these soils are formed from heterogeneous materials either due to their multiorigin or due to a subsequent variation along the course of sedimentation . Therefore , they are pedologically considerd as weak developed and young .

Key words : ***Origin , Uniformity and heavy minerals .***

INTRODUCTION

One of the most stressing problems which face Egypt country is that preserving the food and shelter for the rapidly growing of population . The government of Egypt being aware of such problem , the horizontal agricultural expansion by reclaiming new lands and preserving the required irrigation water are the main track to resolve this problem .

Reclamation the desert lands which extending on the two sides (east and west) of the Nile delta and valley and preserve its required irrigation water are achieved the aim . The eastern desert of Egypt is stretch eastwards of the Nile valley and delta , occupies an area of about 223.000 Km. (21% of the total area of Egypt) .

One of the most important agricultural projects which laying in the eastern desert of Egypt is El-Salhiya project . This project located at north Ismailiya canal and Cairo-Ismailiya agricultural road , it is stretching on the eastwards from Ezbet El-Waburot to Ezbet El-Bakarsha and on the northwards to El-Salhiya village .

Generally , El-Salhiya project occupies an area of 23.000 Feddans and lies between longitudes 31^o 39$'$ and 32^o 00$'$ East and latitudes 30^o 20$'$ and 30^o 38$'$ North Fig. (1) .

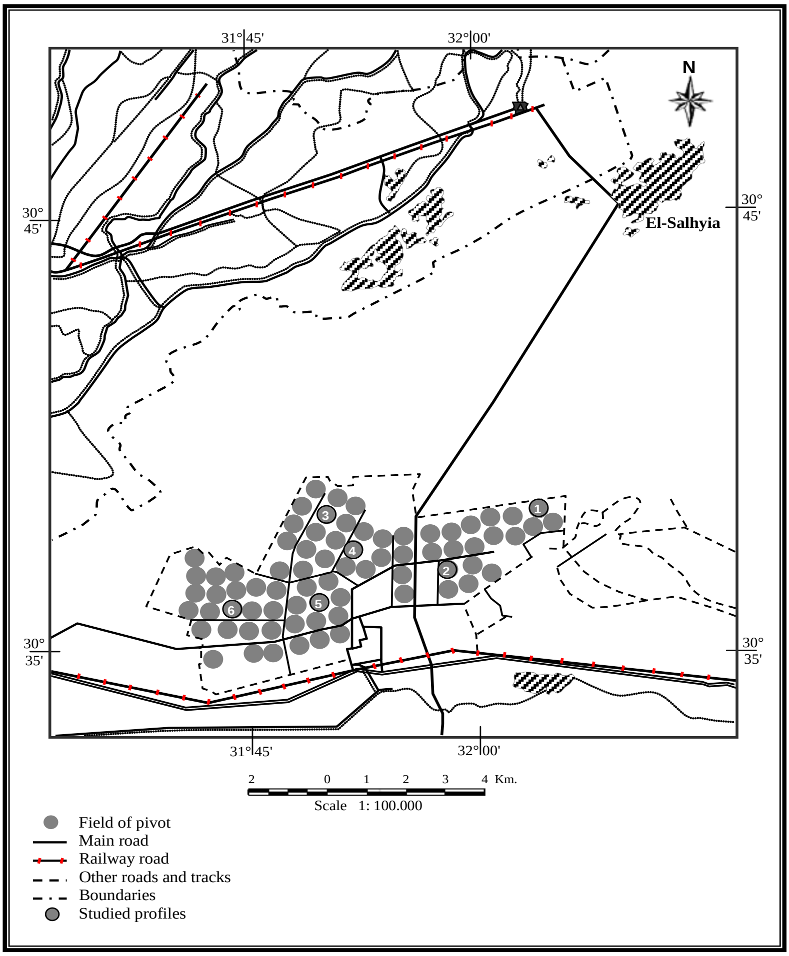

Fig. (1) : Location of the studied soil profiles .

Geology of the studied area :

Acoording to El-Fayoumy (1968) , the studied area essentially occupied by different rocks belonging to Quaternary formation which could be summarized in the following :

The surface deposits of Pleistocene and Holocene ages cover a great portion of the present origin , particularly the area north Ataqa – El-Mokattam plateau , the red sea coastal plain and the old water course . they comprise a variety of continental and epi-continental deposits including the following :

A – Aeolian deposits : Mainly of losses quartzitic sand dunes , hummocks and sheets in El-Khanka sand dunes .
B – Lacustrine deposits : mainly gypsum , alternating with sand and clay beds , dominating the isthmus depression and the inland drainage system .
C – Fluvio-marine deposits : Clay occasionally gypsifferous of ferroginous and /or capped with limestone or sand facies lie around El-Manzala and the red sea coastal plain particularly close to the delta of the old water sourse .
D – Fluviatile deposits : Coarse – textured materials with thin clay beds , doming the Nile terraces and deltaic plain .
E – Old deltaic deposits : Mainly loess of quartizitic sand and flinty pebbles .

Geomorphological features of the studied area :

According to El-Fayoumy (1968) and Abu Al-Izz (1971) , there are two main landforms in this region :

1 - Old deltaic plain : The old deltaic plain occupies much of the almost flat area between the cultivated land and the Suez canal zone . This plain extends presumably further eastwards into Sinai , but its nature was modified by dredging of the Suez canal . The surface slopes regionally from south to north at a rate of 1 m./Km. from an elevation of (+100 m.) to (+20 m.) over a distance of about 80 Km. . Their surface is mostly coverd by desert pavement and barren from natural vegetation except along the course of some drainage channel .

Under this geomorphic unit , two main terraces are distinguish :

1 – Middle terrace : Occupying the area south of El-Tumulate depression with an elevation of (+60 m.) and geographically known as the Tenth of Ramadan district . The component material was deposited under typical deltaic conditions and constitutes a mixture of sediments brought the Nile itself and sediments brought by old rivers dissecting the upland to south .

2 – The lower terrace : Occupying much of the area to the north of El-Tumulate depression with an elevation of (+ 40 m.) and the component materials were deposited under typical deltaic conditions and were

essentially brought by the Nile river from the middle terraces , then reworked into the deposits of the lower terraces .

2 - Wadi El-Tumulat depression : This depression is considered the oldest branch of the Nile and its course can still be followed , whereas the other branches disappeared . Generally , it is shallow elongated depression which extends in an east – west direction for a distance of about 50 Km. with an average width of about 5 Km. and a mean elevation not exceeding +7m. , its northern and southern sides are both surrounded by the old deltaic terraces of early Pleistocene periods .

The aim of the present work is to study the 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

Six soil profiles were selected for this study to represent the new reclaimed project in the eastern side of the Nile delta (El-Salhiya project)

The morphological description for the studied soils was done according to Soil Survey Staff (1993) , Table (1) .

The collected soil samples (total of 18 soil samples) were air-dried and sieved through 2 mm. sieve and subjected to the following analyses :

1 - Particle size distribution was mechanically conducted by sieving (Piper , 1950) . then , the data were statistically evaluated according to Folk and Ward (1957) .

2 - Separation of heavy and light minerals of the sand fraction (0.125 – 0.063mm.) after the ordinary pretreatments (Jackson , 1973) , these minerals has been proved to be the most suitable for the microscopic study (El-Hinnawi , 1966)

The separation of the aforementioned fraction into heavy (specific gravity $< 2.87 g/cm^3$) was conducted by means of the Bromoform . The light and heavy minerals were collected and washed with Alcohol and dried . Mounting of light and heavy fractions was undertaken according to the method of Brewer (1964) in which grains were permanently mounted by Canada Balsam .

The systematic identification of light and heavy minerals was carried out using the polarizing microscope principles of identification reported by Kerr (1959) and Milner (1962) .

The graduate mechanical stage for traverse counts was run as suggested by Krumbien and Pettijohn (1938) and Milner (1962) . An average of 500 grains were counted as a balance between accuracy and time involved . The percents of different groups of heavy and light minerals were calculated .

Table 1

RESULTS AND DISCUSSION

Folk and Ward (1957) were used the particle size distribution of the soil profiles as a criterium for determining their genesis and uniformity. In this connection , many investigators use cumulative curves characterizing sedimentary materials .

The results of the particle size distribution are plotted on phi curves . Seven accumulative percentages ($ø_5$, $ø_{16}$, $ø_{25}$, $ø_{50}$, $ø_{75}$, $ø_{84}$ and $ø_{95}$) are recorded graphically for each sample (Table 2) . Four statistical parameters (Mz , So , SKI and KG) are calculated using the formula of Folk and Ward (1957) and given in Table (3) . These values indicate that :

1 – According to the values of graphic mean Mz , most of the studied soil samples of the different profiles fall within the medium sand (1.72 ø – 1.93 ø) except those of the uppermost surface layers of profiles Nos. 2 , 3 and 4 which have Mz values indicating fine sand .

2 – The soil samples have moderately and poorly sorted sediments respectively . So values ranged from 0.68 ø to 0.92 ø and 1.18 ø to 1.48 ø , respectively . The poorly sorted sediments suggest that the soils are deposited mainly under water action , while moderately sorted sediments are transportated and deposited under the action of both water and wind.

3 – According to the values of inclusive graphic skewnes (SKI) , most of the studied samples fall within the range of near symmetry (0.01 ø to 0.13 ø) to fine skewed (0.17 ø to 0.27 ø) , respectively .

4 – Regarding the data of graphic Kurtosis (KG) the values ranged between 0.77 ø to 0.89 ø indicating platy Kurtic pattern, 1.12 ø to 1.36 ø (Leptokurtic) and 0.9 ø to 1.04 ø (mesokurtic) .

The platy kurtic pattern indicate that water is the main factor responsible for soil formation , while mesokurtic and leptokurtic pattern indicate the involvement of wind and water action in the formation of soils.

2. Mineralogy of the sand fraction :

2 . 1 . Mineralogy of the light minerals :

Examination of the light fraction (sp. gr. $< 2.85 \pm 0.02$) shows that it is composed almost intirely from quartz mineral which constitutes more than 92 % (Table 4) . Other associated light minerals are mainly plagioclase , orthoclase and microcline .

Quartz is present as single grains in different degree of roundness and extinction . It constitutes 92.19 % to 97.53 % of the light minerals . The lowest value is detected in the surface layer of profile No. 2 , while the highest value is in the top layer of profile No. 6 . Variations throughout the soil depth are not of pronounced magnitude . The dominance of quartz over other light minerals is related to its resistance to weathering during the process of soil formation and sedimentation .

Table 2

Table 3

Table 4

Feldspars are detected in all the studied soil samples and are composed essentially of plagioclase , orthoclase and microcline . The frequency distribution in the current soils varies from 0.57 % to 2.22 % orthoclase ,1.3% to 4.04 % plagioclase and 0.25 % to 1.2 % microcline .

The general order of abundance is plagioclase > orthoclase > microcline . The presence of feldspars indicates that the weathering effect was not enough to cause a complete alteration of these minerals .

2 . 2 . Heavy minerals :

Heavy minerals are those having high specific gravity > 2.85 . They are usually primary minerals having high occurrence in rocks may be essential or accessory . They usually constitute a small portion of the soil materials . However, their measuring data can be clear and understand genesis and development as well as the age of the soil .

Frequency distribution of the heavy minerals in the studied soil profiles are given in Table (5) . The description and interpretation of these minerals according to their aboundance in studied soils are in the following :

- Opaque minerals :

Opaque minerals such as hematite , ilmenite , lemonite , magnetite and pyrite are characterized by isotropy between cross nicol and are shaded in appearance in plane light , non peleochronic . They are generally subrounded to rounded .

Data in Table (5) show that opaque minerals ranged from 47.4% to 63.6%. The lowest content is detected in the surface layer of profile No. 3 , while the highest one is counted in the subsurface layer of profile No. 1

Depthwise distribution shows an increase with depth in profiles 3 , 4 and 6 and a decrease with depth in profile 2 and no specific pattern in profile Nos. 1 and 5 .

- Non – opaque minerals :

Table (5) reveals that the weatherable minerals of amphiboles , pyroxenes , Kyanite and epidote are the most abundant varieties . The ultrastable minerals of zircon , rutile and tourmaline are present in small amounts , while parametamorphic minerals (garnet , staurolite and silimanite) and the other minerals are in very small amounts . The description of these minerals is given in the following :

* Amphiboles

These minerals are represented mainly by hornblende with few amounts of actinolite and glaucophane . Amphiboles ranged from 20.3 % to 31.4 % . The lowestvalue is found in the subsurface layer of profile No. 5 , and the highest one is in deepest layer of profile No. 4 .

The vertical distribution of amphiboles shows an irregular pattern in all studied profiles except for profiles 3 and 4 which have an increase with depth. In profile No. 2 , there is a decrease distribution with depth .

Table 5

* Pyroxenes

These group are the second aboundant of non-opaque minerals . The most common of them is hyperthene , followed by augite and the lowest is diopside . Their presence in the current study ranges from 18.2 % to 32.1 % of the non-opaque minerals with an irregular distribution pattern with depth . The lowest value is present in the surface layer of profile No. 6 , whereas the highest one is associated with the subsurface layer of profile No. 1 .

These results may be attributed to the variation in parent materials , sedimentation regimes and environments of the studied soil materials .

* Epidote

Epidote content ranges from 9.0 % to 15.0 % of the non-opaque minerals . The highest and lowest values are found in the middle and deepest layers of profile No. 2 , respectively . There are no specific distribution pattern in the studied soil profiles representing the soils of El-Salhiya project .

- Parametamorphic minerals :

This group of minerals include the minerals of kyanite > garnet > silimanite > staurolite according to their frequency distribution in studied soils .

* Garnet

This mineral have values between 1.3 % and 10.0 % of the non-opaque minerals . The lowest content was in the subsurface layer of profile No. 1 and the highest one was in the deepest layer of the same profile .

* Staurolite

This mineral forms 0.5 % to 3.3 % of the non – opaque minerals . The lowest content is detected in the surface layer of profile No. 1 , while the highest content is associated with the subsurface layer of profile No. 2

It exhibits an irregular pattern of depthwise distribution in the studied profiles , except for profile No. 1 where it tends to increase with depth .

* Kyanite

This mineral have values between 3.6 % and 14.0 % of the non-opaque minerals . The lowest content is detected in the subsurface layer of profile No. 1 , while the highest content is recorded in the surface layer of profile No. 6 .

The distribution of kyanite haven't any specific pattern with depth , except for the soils of profiles Nos.3 and 4 where its content tends to increase with depth .

* Silimanite

This mineral constitutes 0.9 % to 5.0 % of the non-opaque minerals . The lowest content is detected in the deepest layer of profile No. 1 , while the highest content is associated with the surface layer of profile No. 6 .

- Ultrastable minerals :

This group are the most ultra-stable minerals including zircon , rutile and tourmaline .

* Zircon

This mineral ranges from 5.0 % to 11.7 % of the non – opaque minerals . The lowest contents is detected in the deepest layer of profile No. 4 , while the highest content is associated with the surface layer of profile No.1 . Zircon tends to decrease with depth . This reflects the multi-origin of parent material as well as well its multi-depositional regime .

* Rutile

This mineral forms 0.8 % to 4.5 % of the non – opaque minerals with an irregular distribution pattern with depth . Their lowest value is shown in the deepest layer of profile No. 5 , whereas the highest one is in the surface layer of profile No.4 .

The apparent discontinuity in the mineral distribution could be refer to multi-origin parent material as well as different depositional regimes of the studied soils .

* Tourmaline

This mineral is the second abundant ultrastable minerals and ranges from 2.0 % to 5.8 % of the non-opaque minerals . Its content shows an irregular distribution with depth .

- Other non-opaque minerals :

This group is represented by biotite , monazite , glauconite and ziosite minerals .

Biotite : This mineral ranged from 0.5 % to 2.8 % of the non-opaque minerals . The lowest value is recorded in the deepest layer of profile No. 5 , while the highest value is detected in the deepest layer of profile No. 2 .

Monazite : This mineral ranged from 0.1 % to 2.7 % of the non-opaque minerals with an irregular distribution pattern with depth . The lowest value is recorded in the top layer of profile No. 1 , while the highest value is detected in the top layer of profile No. 5 .

Glauconite : Constitutes 0.3 % to 3.7 % of the non-opaque minerals with an irregular distribution pattern with depth .

Ziosite : This mineral ranged from 0.7 % to 3.7 % of the non-opaque minerals . The lowest content is detected in the upper most surface layer of profile No. 1 , while the highest content is found in the deepest layer of profile No. 5 .

- Assessment of soil uniformity on basis of mineralogy of the sand fractions :

Mineral analysis is great importance in evaluating the origin uniformity , weathering and development of soil profile .

Variation in heavy mineral species and their frequency distribution in different soil layers help in studying soil genesis . Brewer (1964) and Mitchell (1975) mentioned that weathering would load to a decrease in distribution frequency of less resistant minerals .

Pyroxenes , amphiboles , epidote and garnet have little or no effect on the frequency of the more resistant minerals of zircone , rutile and tourmaline .

El-Demerdashe *et al.* (1979) , Hassona *et al.* (1995) , Hassona (1999) and Abdel Razik (2005) reported assessment of evaluating profile uniformity and development in some Egyptian soils using their mineralogy .

In the present investigation , uniformity of soils are assessed using different parameters . These include frequency distribution of index minerals (zircon , rutile and tourmaline) , and the ratios of zircon with each of rutile , tourmaline and both for the different layers within the soil profile .

Other parameters used to evaluate the soil profile uniformity are those related to resistant minerals. Their ratios are call " weathering ratios "

There are three weathering ratios as follows :

Wr_1 = Pyroxenes + Amphiboles / Zircon + Tourmaline

Wr_2 = Horblende / Zircon + Tourmaline

Wr_3 = Biotite / Zircon + Tourmaline

Data of the uniformity ratios for the resistant minerals and weathering ratios are given in Table (6) and Figures (2 and 3) . Data clear that the soil materials of El-Salhiya project are stratified and heterogeneous as reveald by the abrupt change in the distribution of the index minerals and various ratios of their layers .

This confirms the conclusion that the soils have discontinuity of their parent materials .

Also since the soils have rather high contents of pyroboles than zircon they still weak developed and are young from the pedological point of view .

Table 6

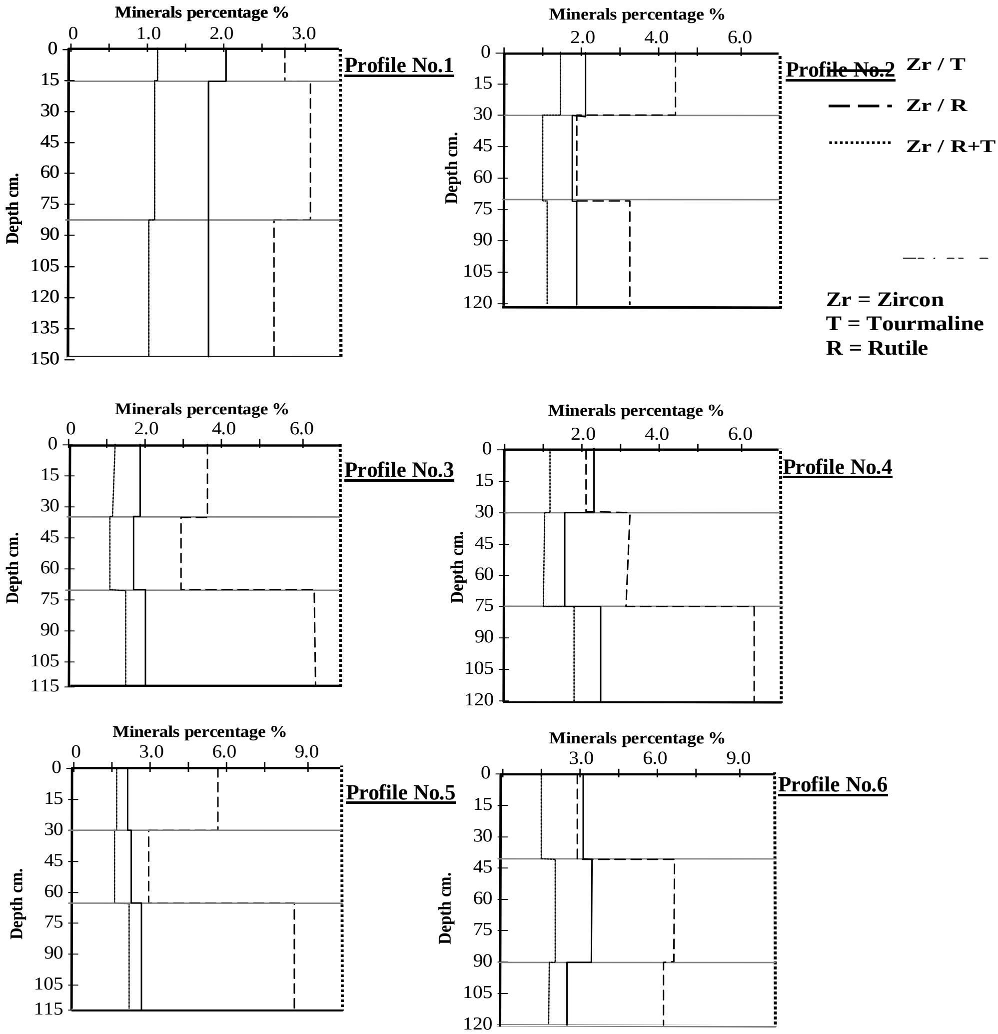

Fig . (2) : Depthwise distribution pattern of uniformity ratios in the studied soil profiles .

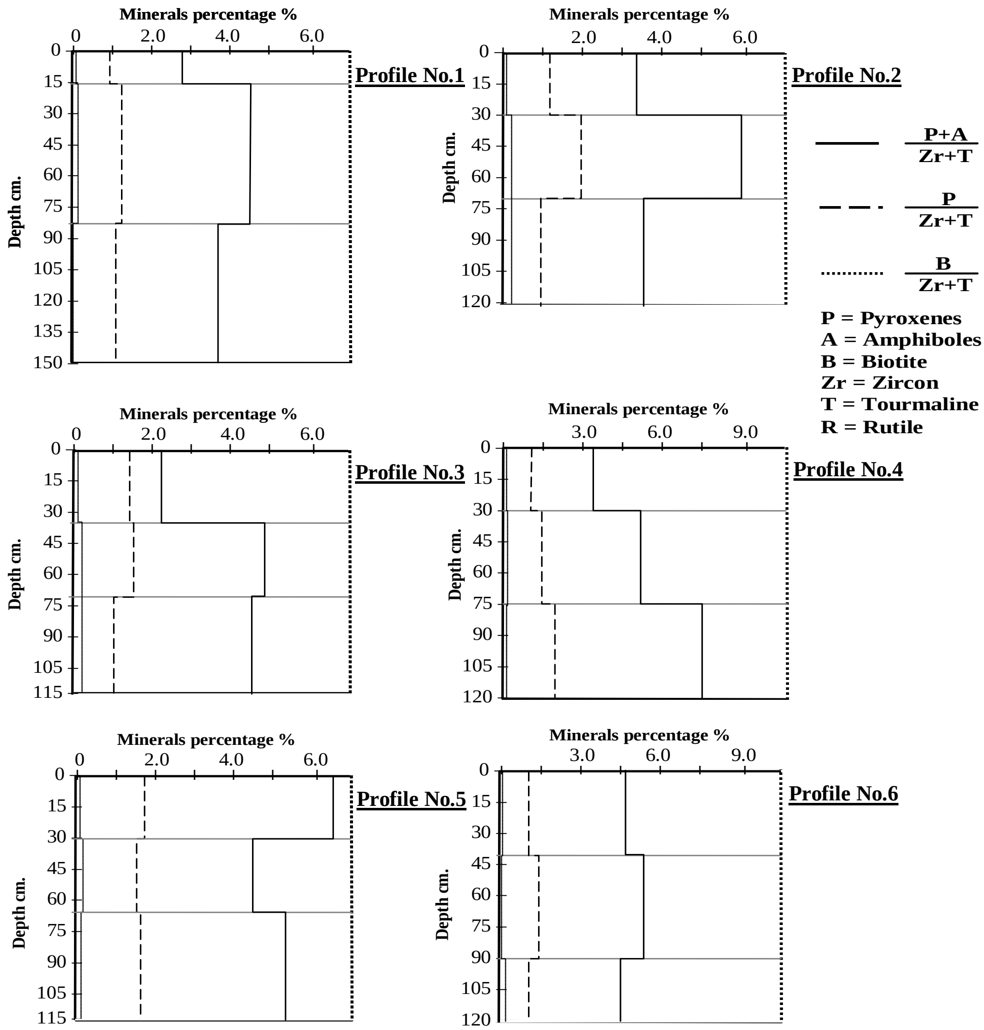

Fig . (3) : Depthwise distribution pattern of weathering ratios in the studied soil profiles .

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أصل و تجانس و مدى تطور أراضى الصالحية فى صحراء مصر الشرقية

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الملخص العربي

أجرى هذا البحث على أراضى مشروع الصالحية بغرض التعرف على أصل و تجانس و مدى تطور أراضى هذا المشروع ، و تبعا لذلك اختير عدد ستة قطاعات أرضية لتمثل أراضى المشروع .

و قد أوضحت دراسة التوزيع الحجمى لحبيبات التربة و قيم المتغيرات الأحصائية لها الى انها متوسطة الى فقيرة فى تجانسها و خشنة الأنجراف كما تشير قيم ال Sorting لهذه الأراضى .

و قد أستنتج من هذا ان هذه الأراضى قد تكونت تحت الظروف المائية أو المائية و الهوائية معا و أن الماء و الهواء هما العامل الرئيسى المسئول عن نقل و ترسيب هذه الأراضى

كذالك أوضح الفحص البتروجرافى للرمل الناعم الى أن المعادن الخفيفة تميزت بسيادة معدن الكوارتز مع وجود نسبة قليلة من معادن الفلسبارات – أما المعادن الغير معتمة فقد تميزت بسيادة معادن البيروبولز (بيروكسين + أمفيبول) و الكيانيت و الأبيدوت أما معادن الزركون و التورمالين و الروتيل فقد وجدت بكميات متوسطة . كذالك وجدت معادن الجارنت و الأشتروليت و الكيانيت و السليمنيت و لكن بكميات قليلة .

و بدراسة مدى تجانس و تطور القطاعات الأرضية تحت الدراسة أن هذه الأراضى غير متجانسة و يرجع هذا الى تعدد مواد الأصل المكونة لها أو أختلاف ظروف الترسيب كما ان هذه الأراضى ضعيفة التطور و حديثة من الوجهة البيدولوجية .