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CLAY MINERALS OF SOME SOIL SUBGROUP ALONG THE WESTERN SIDE OF SINAI PENINSULA BETWEEN EL- KANTARA SHARK AND SUEZ CITIES

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ABSTRACT: Sixteen pedons were selected to represent the soils east of the Bitter lakes between El-Kantara Shark and Suez cities along the western part of Sinai peninsula in Egypt. According to the soil *Taxonomy (1998)*, the studied soils are classified as *Typic Haplocalcids*, *Gypsic Haplosalids*, *Typic Torriorthents* and *Typic Torripsamments*. *The clay* fraction was separated from some soil samples representing the taxonomic units for mineralogical analysis. The data reveal that smectite (montmorillonite) is the predominant clay mineral in all the studied taxonomic units followed by kaolinite. Illite, vermiculite, interstratified minerals and palygorskite were also detected in small amounts. The identified accessory minerals, dominantly quartz and feldspars. Calcite, dolomite and apatite, are detected in traceable amounts.

INTRODUCTION

The work aimed to study the mineralogical composition of the clay fraction of the soils east of the "Bitter lakes" between El-kantara Shark and Suez cities.

Geological information given by El-Shazly *et al.*, 1974 revealed that the Quaternary deposits in the studied area consist of: 1) sand dunes in the north west of Sinai, originated from the beaches which were successively elevated by deposition of sand and undergone a cycle of emergence and submergence since the beginning of the Pleistocene period (Ball, 1952). Most of the dunes in the area are now stabilized by desert bruch and salts especially gypsum and calcium carbonate and, 2) the alluvial deposits have been divided according to their lithology into; sands/limes/shalky/clayey/ dolmitic or undifferentiated, deposite.

Geomorphology information given by Dames and Moore, (1985) indicated that the main geomorphic units covering the area under study could by distinguished as follows: 1) Coastal plain which extended from the Gulf of Suez on the south to near El-Kantara Shark on the north. The topography of this unit is generally of low relief and is characterized by hilly masses, sand plains, few short drainage lines and few Plionece terraces. It is occupied by a number of lakes "Bitter lakes" and "El-Timsah lake". The surface of this unit is essentially under-lain by yellow gypsiferous marls belonging to the Miocene times and is covered by a variety of unconsolidated deposits belonging to Quaternary period, aeolian sand as well as lagoonal clay deposits. 2) The interior sand dune plain unit in the eastern side of the studied area. The surface is strongly undulating and dominated by aeolian sand deposits in form of dunes, hummocks, sheets and ripple marks belonging to the late Palealithic time. 3) Alluvial fan: this geomorphic unit is bound from the east by Umm khoshied calcareous plateau and from the west by the Suez canal and the Bitter lakes depression. In this district the land surface is sloping from the east towards the west at a rate of about 0.8%. From the topographic point of view, this district is divided into two main drainage lines (El-Gali and Umm Khoshaid) sloping from east to west. The surface of the alluvial fan consists of sand, gravel with various sizes of boulders and cobbels made up of limestone, sandstone and other types of crystalline rocks. 4) Hammada plain this plain occupies a portion of the Isthmus of Suez continuing southward into the main rift valley basin of the Gulf of Suez. The origin of that plain is associated with past Eocene faluting of the region. The landscape was excessively modified during the late Tertiary and the Quaternary. The surface is moderately to roughly undulating.

X-ray information given by Abdel-Salam, (1966); Abdel-Hady, (1981); Farag, (1981), Abdel-Reheim, (1982); Nasr, (1988); Hassona, (1989) and El-Kafrawy, (1998) revealed that the clay fraction of soils on the east of Bitter lakes soils was mainly domina by smectite (montmorillonite) followed by kaolinite. Interstratified minerals vermiculite, illite. chlorite and palygorskite are also detected but in few amounts. Concerning the accessory minerals, quartz and/or feldspars are the most abundant ones, while gypsum is detected in trace amounts. The present investigation is a continuation of the study of the mineralogy of the clay fraction of some soil subgroups in the western side of Sinai peninsula adjacent to Bitter and El-Timsah lakes which is subjected to land reclamation and intensive agricultural utilization to the present time

MATERIALS AND METHODS

The area under study lies between longitudes 32° 17' and 33° 20' East and latitudes 30° 10' and 30° 48' North and occupied about 350.000 feddans. The landsat image TM5 bands 2, 3, 7 was used for the purpose of delineation of the geomorphic units. The image was covering path 176 and 39 acquired in 1994. The physiographic approach used for the interpretation (Goosen, 1967) depends on slope, vegetation, parent materials, parent rocks, drainage patterns, etc.

Sixteen soil profiles were chosen to represent the different physiographic units (Fig. 1).

The pre-treatment of soil samples for mineralogical analysis was applied according to Jackson, (1965). Destruction of carbonates and removal of divalent cations were carried out by treating the samples with sodium acetate buffered at pH5. The organic matter and manganese oxides were removed by digesting the samples in hydrogen peroxide (30%), free iron oxides were removed according to Mehra and Jackson, (1960).

The clay fractions were separated by sedimentation under gravity.

Identification of the clay minerals in the pre-treated clay samples was carried out by X-ray diffraction technique using a philips p-w (1060\100) X-ray diffractometer with Cu-K α radiation and iron filter.

Three treatments of each sample were examined; namely, Mg-saturated, air dried; Mg-saturated, glycerol solvated (Mg-g) and k-saturated, heated at 550°C for 4 hours (k-H). The x-ray diffractograms were interpreted in terms of component minerals and their relative abundance. The inter-stratified minerals were identified using the diagnostic criteria published by Whittig and Jackson, (1955) and Dixon *et al.*, (1977).

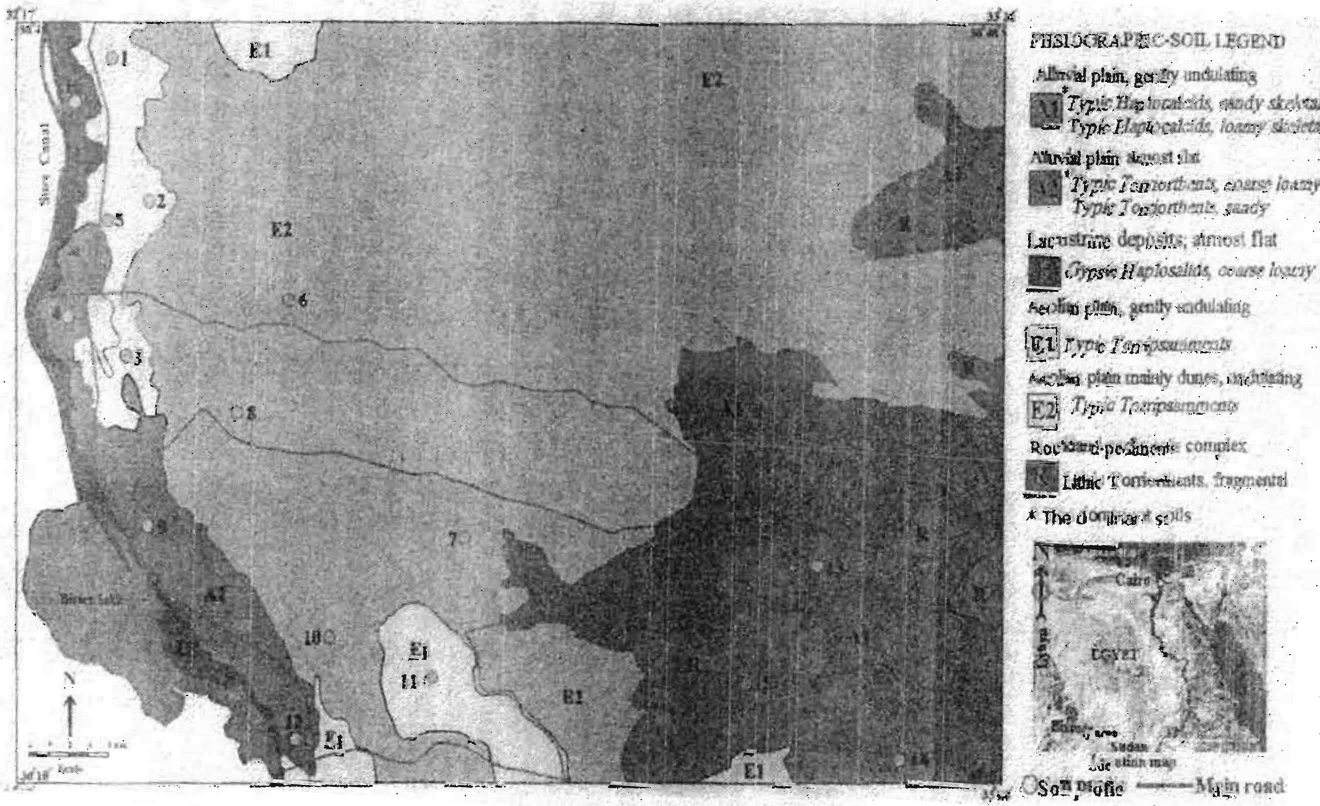

Fig. (1): Physiographic soil map of the studied area

The peak area is employed for a semi-quantitative determination of clay minerals as recommended by Gjems, (1967).

RESULTS AND DISCUSSION

On the basis of morphological characteristics and the soil analytical data, Tables (1 and 2), the investigated soils were classified to subgroup level according to the U.S. soil Taxonomy, (1998). Members of the *Aridisols* and *Entisols* orders are identified in the studied areas. Table (3) suggests placing of the studied soils to subgroups of those orders.

1- Order *"Aridisols"*:

The soils of this order are soils that do not have available water to mesophytic plants for long periods.

The soils are characterized by a torric moisture regeime because the control section in most year is dry in all parts for more than half the time and the soil temperature at a depth of 50 cm is above 50°C; they have an ochric or anthropic epiedon, and one or more of the following with the upper boundry within 100cm of the surface; calcic, gypsic and salic horizon.

In the investigation, the soils are placed in the subgroups *Typic Haplocalcids*, (profiles 13 and 14) and *Gypsic Haplosalids* (profile 16).

2. Order *"Entisols"*:

Three soil profiles (12, 4 and 9) are mineral soil devoid of any observable signs of soils development, and do not have any diagnostic horizons that can be identified with in the described depth.

These soils are usually dry in all parts of the year, do not have cracks or lithic and/or paralithic contact within 50 cm of the soil surface. Also, they have coarse to medium texture, clay content less than 35% of the whole soil with no one soil mineral predominating, torric moisture regime and an average annual soil temperature between 27.3 and 15.5°C.

Accordingly, these soils could be placed into the order *Entisols* and Suborder of Orthents great group *Torriorthents* and Subgroup *Typic Torriorthents*.

On the other hand, the other soil profiles (1,2,3,5,6,7,8,10 and 11) are mineral soils without any observable signs of soil development and diagnostic horizon. They have below a depth of 25 cm a sandy texture in all layers to a depth of 1 m., have torric moisture regime and the soil temperature regime is thermic. These soils are not saturated with

Table (1): Particle size distribution, texture class, $CaCO_3$, OM% and gypsum contents of the studied soil profiles.

Profile No.	*Depth, cm*	*Particle size distribution %*				*$CaCO_3$ %*	*Gypsum %*	*O.M. %*	*Texture class*
		C. Sand	**F. sand**	**Silt**	***Clay %***				
				Typic Haplocalcids					
13	0-25	76.45	11.40	2.84	9.67	14.72	0.03	0.09	SL
	25-50	72.25	11.59	6.36	9.80	8.59	0.04	0.10	SL
	50-150	82.82	10.65	2.26	4.27	12.27	0.03	0.08	S
14	0-25	57.55	28.50	8.80	5.15	14.31	0.50	0.06	LS
	25-50	72.13	12.25	5.75	9.92	17.99	1.40	0.13	LS
				Gypsic Haplosalids					
16	0-40	63.90	22.78	8.78	4.54	0.88	5.35	0.07	LS
	40-90	64.0	19.28	12.22	4.50	1.84	6.29	0.13	LS
	90-150	65.05	25.13	6.42	3.22	0.70	7.65	0.03	S
				Typic Torriorthents					
4	0-25	75.55	20.43	2.98	1.04	1.64	0.08	0.01	S
	25-60	80.0	15.80	3.50	0.70	1.84	0.07	0.03	S
	60-150	70.05	19.69	3.83	6.43	1.64	0.05	0.02	S
9	0-40	80.15	6.50	6.65	6.70	1.23	0.62	1.40	LS
	40-80	55.58	32.59	7.70	4.15	2.45	1.50	1.23	LS
	80-150	75.45	10.95	3.89	9.76	1.84	1.82	0.99	SL
12	0-30	77.50	8.59	5.70	8.21	3.68	0.03	0.09	SL
	30-70	71.95	13.29	6.36	8.50	4.50	0.02	0.22	SL
	70-150	63.58	17.05	10.12	9.25	3.68	0.04	0.12	SL
				Typic Torripsamments					
1	0-40	72.99	17.63	6.53	2.85	0.82	0.04	0.10	S
	40-80	63.30	21.00	4.92	11.78	1.64	0.06	0.08	SL
	80-150	68.61	14.40	6.03	10.88	2.66	0.06	0.16	SL
2	0-25	60.45	31.49	7.02	1.05	0.82	0.12	0.03	S
	25-60	74.55	18.0	5.48	1.97	1.84	0.07	0.02	S

Table (1): Cont.

Profile No.	*Depth, cm*	*Particle size distribution %*			*Clay %*	*CaCO₃ %*	*Gypsum %*	*O.M. %*	*Texture class*
		C. Sand	F. sand	Silt					
3	0-30	76.10	18.38	1.13	4.39	0.37	0.09	0.04	S
	30-50	83.85	10.19	3.34	2.62	2.86	0.05	0.03	S
	50-150	75.35	13.43	8.28	3.14	3.69	0.06	0.05	LS
5	0-25	64.64	21.15	6.32	7.85	1.64	0.04	0.90	LS
	25-50	74.55	16.81	3.34	5.30	1.23	0.04	0.22	LS
	50-150	81.60	8.21	1.65	8.54	1.02	0.06	0.08	LS
6	0-30	84.15	11.53	3.40	0.92	1.43	0.06	0.04	S
	30-70	82.55	12.66	7.08	0.71	1.23	0.02	0.03	S
	70-150	83.90	8.41	3.61	4.08	0.82	0.02	0.02	S
7	0-25	84.51	9.29	3.40	2.80	1.23	0.03	0.08	S
	25-55	77.32	8.70	3.76	10.22	1.23	0.04	0.06	SL
	55-150	78.58	7.68	3.98	9.76	1.64	0.01	0.02	SL
8	0-40	58.11	34.07	1.65	6.17	1.23	0.01	0.02	S
	40-90	79.10	13.78	5.71	1.40	0.40	0.02	0.03	S
	90-150	74.55	19.98	1.31	4.17	0.82	0.02	0.03	S
10	0-20	75.25	18.91	3.40	2.44	5.31	0.03	0.06	S
	20-50	81.60	16.91	0.70	0.79	6.95	0.01	0.04	S
	50-150	85.0	9.94	3.40	1.66	4.09	0.01	0.02	S
11	0-15	71.99	18.63	3.50	5.88	10.63	0.01	0.06	LS
	15-60	81.60	11.98	1.25	5.17	8.18	0.01	0.03	LS
	60-150	76.80	16.8	5.72	1.40	5.31	0.01	0.07	S

Table (2): Chemical composition of the soil saturation extract of the studied soil profiles.

Profile No.	*Depth, cm*	*pH*	*EC dSm^{-1}*	Soluble cations me/l				Anions m.e/l		
				Ca^{+2}	Mg^{+2}	Na^{+}	K^{+}	HCO_3^{-}	Cl^{-}	SO_4^{-2}
Typic Haplocalcids										
13	0-25	7.85	2.39	7.92	1.09	15.75	0.12	2.5	11.5	10.88
	25-50	7.78	6.16	29.70	1.86	30.60	0.22	1.5	45.0	15.88
	50-150	7.78	3.26	39.60	5.54	17.82	0.19	1.5	45.0	16.65
14	0-25	8.25	1.57	5.94	1.20	7.65	0.35	2.5	5.0	12.14
	25-50	7.89	3.83	9.90	0.92	27.45	0.55	2.0	16.0	20.82
Gypsic Haplosalids										
16	0-40	7.5	21.90	51.0	35.70	252.45	3.82	15.93	204.0	123.04
	40-90	7.5	32.33	32.33	25.50	332.92	7.65	23.90	357.0	138.17
	90-150	7.6	24.71	34.71	20.40	240.97	5.61	7.96	255.0	39.72
Typic Torriorthents										
4	0-25	8.20	0.82	1.98	1.62	4.25	0.23	1.50	3.50	3.08
	25-60	7.98	1.71	2.97	2.44	2.30	0.32	2.0	6.5	10.03
	60-150	7.94	1.98	7.92	4.70	5.95	0.43	1.5	10.0	7.5
9	0-40	7.59	3.69	27.72	1.14	7.20	0.08	3.0	7.50	25.64
	40-80	7.61	2.74	20.75	2.44	4.25	0.32	1.0	1.50	25.26
	80-120	7.74	2.60	15.75	4.75	6.15	0.40	2.0	2.0	23.05
12	0-30	8.11	3.01	15.85	8.79	6.30	0.45	2.0	6.0	23.39
	30-70	8.25	3.08	12.86	9.68	8.55	0.43	1.5	3.0	27.02
	70-150	7.83	3.42	22.77	6.09	6.55	0.46	2.0	11.5	22.37
Typic Torripsamments										
1	0-40	8.07	1.64	1.98	0.72	3.57	0.25	2.00	4.50	10.02
	40-80	8.46	0.82	0.99	0.18	6.45	0.90	1.00	3.50	3.94
	80-150	8.43	0.61	0.49	0.41	5.20	0.16	2.00	2.50	1.76
2	0-25	7.91	0.82	0.49	0.41	6.75	0.25	1.50	4.50	1.90
	25-60	7.95	1.02	2.97	1.53	6.12	0.22	2.00	3.50	5.34

Table (2): Cont.

Profile No.	*Depth, cm*	*pH*	*EC dSm^{-1}*	*Soluble cations me/L*				*Anions me/l*		
				Ca^{+2}	Mg^{+2}	Na^{+}	K^{+}	HCO_3^{-}	Cl^{-}	SO_4^{-2}
3	0-30	8.41	1.09	0.99	0.81	8.65	0.10	1.50	3.00	6.05
	30-50	8.70	1.09	1.98	0.72	7.55	0.10	2.00	4.50	3.85
	50-100	8.42	0.68	1.98	0.72	4.80	0.14	4.00	2.00	1.64
5	0-25	8.00	2.39	2.97	2.44	18.86	0.50	2.00	19.50	3.27
	25-50	8.38	2.05	1.98	0.72	17.60	0.45	2.50	15.00	3.25
	50-100	7.93	1.78	0.99	0.81	15.35	0.13	2.50	1.00	13.78
6	0-30	8.19	0.75	1.48	0.32	4.65	1.40	2.50	0.30	5.05
	30-70	8.35	1.43	2.96	0.26	11.85	0.13	2.00	6.50	6.70
	70-150	8.01	1.23	1.98	0.72	8.85	0.13	1.50	6.50	3.68
7	0-25	7.87	1.73	1.98	1.62	14.20	0.15	2.50	2.00	13.45
	25-55	7.76	4.11	14.85	5.89	20.45	0.25	2.00	9.00	30.44
	55-100	7.84	6.16	15.84	4.89	42.12	0.28	2.00	22.50	38.63
8	0-40	7.98	0.54	0.99	0.81	3.50	0.15	2.50	0.30	5.05
	40-90	7.92	0.82	1.98	0.72	5.23	0.17	2.00	6.50	6.70
	90-150	7.86	0.95	1.98	0.72	6.30	0.12	1.50	6.50	3.68
10	0-20	7.98	1.02	0.99	0.81	7.65	0.30	2.00	2.00	5.57
	20-50	8.0	1.16	1.48	0.77	9.20	0.23	3.00	1.50	7.18
	50-150	7.75	5.06	4.95	4.06	40.62	0.50	2.00	23.50	24.63
11	0-15	7.85	1.02	3.96	0.54	5.30	0.30	2.00	3.50	4.60
	15-60	7.96	0.60	1.98	0.72	3.15	0.17	2.50	2.50	1.02
	60-100	8.21	0.68	1.98	0.72	3.75	1.78	2.00	3.00	1.62

Table (3): Soil classification of the studied soil profiles.

Orders	***Suborder***	***Great group***	***Subgroup*** •	***Family***	***Representative profiles***
Aridisols	*Calcids*	*Haplocalcids*	*Typic Haplocalcids*	Sandy skeletal, mixed, hyperthermic	13
	Salids	*Haplosalids*	*Gypsic Haplosalids*	Loamy skeletal, mixed, hyperthermic	14
				Coarse loam, mixed, hyperthermic	16
Entisols	*Orthents*	*Torriorthents*	*Typic Torriorthents*	Sandy skeletal, mixed, hyperthermic	4,9
				Coarse loam, mixed, hyperthermic	12
	Psamments	*Torripsamment*	*Typic Torripsamments*	Fragment	15
				Sandy, mixed, hyperthermic	1,2,3,5,6,7,8,10,11

• = According to *US Soil Taxonomy (1998).*

water and do not have characteristics associated with wetness, do not have a lithic contact within 50 cm of soil surface, and have no one kind of soil mineral predominating.

Therefore, these soils can be classified to the order *Entisols*, subgroup *Psamments*, great group *Torripsamments*.

Mineralogical analysis of the clay fraction:

X-ray analysis:

Interpretation of the x-ray diffraction patterns was based on the presence of diffraction peaks characteristic for each of the crystalline species present in sample. The intensity and sharpness of the peaks are affected by many factors i.e., the content and fineness of crystals, crystal imperfection, degree of disordering, presence of amorphous coating on the mineral grains, chemical composition, and parallel orientation of the clay crystals.

The diagnostic criteria used for identification of clay and accessory minerals, are those reported by Brown, (1961) ; Patterson, (1963) ; Jackson (1969) and El-Attar and Jackson, (1973). These criteria could be summarized in the following:

1) Smectite exhibits a basal reflection (001) at about 14.0-14.5A° for Mg-saturated sample which expands to 17.8 A° upon glycerol solvation and then collapse further to 10.0 A° after heating at 550°C for four hours.
2) Kaolinite, gives a strong specing at 7.13A° and 3.57 A° in the Mg-saturated samples which remain constatnt in the other treatments and disappear upon heating at 550°C for four hours.
3) Hydrous mica (illite), gives a diffraction peaks at 9.96-10.28 A° in the Mg-saturated sample and remains constant in the other treatments.
4) Palygorskite is distinguished by the spacings of 10.40-10.53 A°, 6.4-6.48, 4.45-4.55, 3.2-3.25 and 2.56-2.58 A° in all treatments.
5) Interstratified clay minerals, are characterized by the presence of small peaks around 20 A° in the air-dried sample, it is evidenced also by tailing of the 10 A° towards the 14 A° and 19 A° peaks.
6) Vermiculite is confirmed by the presence of the 14 A° peak which is contracted to 10 A° in K-saturated and heated at 550°C treatment.
7) Quartz gives basal reflections at 3.33 – 3.42 A° and 4.26 – 4.43 A° peaks.

8) Feldspars, calcite, dolomite and apatite are identified by their characteristic diffraction peaks at 3.1 – 3.25, 3.03, 3.89 and 3.81 A°, respectively.

For further differentiation, a semi-quantitative estimation of minerals is performed on basis of the relative frequencies indicated by the peak area (Jackson, 1965).

Out of the studied profiles in the whole area, only ten soil samples were chosen for clay separation and identification. These samples represent the soil subgroups: *Typic Haplocalcids*, *Gypsic Haplosalids*, *Typic Torriorthents* and *Typic Torripsamments*.

To substantiate the mineralogical composition of the clay fraction in the studied soils it is convenient to present the discussion under the following subheadings.

1- Clay mineralogy of the *Typic Haplocalcids*:

Soils of this taxonomic unit are represented by the 25-50 and 50 – 100 cm layers of profile 13. X-ray diffractograms of those layers are depicted in Figs. (2 and 3).

Interpretation of their diffractograms on a semi-quantitative basis leads to the clay minerals assemblage and proportion presented in Table (4) The data show that smectite (montmorillonite) predominates the clay minerals, suite in both layers which has dominant any units. Kaolinite minerals come next in abundance as it is found in common amounts in the subsurface layers while it is detected in moderate amounts, in the deepest layer. Illite is detected in traceable amounts in the subsurface and deepest layers, while playgorskite is found in trace amounts in the deepest layer and disappears entirely in the 25-50 cm layer depth.

Vermiculite constitutes moderate amount in the subsurface layer while being entirely absent in the deepest layer. Interstratified clay minerals are detected in traceable amounts in both profile layers.

The identified accessory minerals are mainly dominated by quartz followed by feldspars while calcite is found in the 50-100 cm depth and is absent in the subsurface layer and constitutes few amounts in the deepest layer.

2-Clay minerals of the *Gypsic Haplosalids*:

Soils of this subgroup are represented by profile 16. The x-ray diffractograms of the clay fraction separated from this profile are depicted in Figs. (4 and 5). The data in Table 4

Table (4): Semi-quantitative estimation of clay mineralogical composition of the clay fraction (<0.002mm) separated from layers of the studied soil profiles

Profile No.	Depth cm.	*Clay minerals*						*Accessory minerals*				
		Interstratified minerals	Montmorillonite	Kaolinite	Illite	Palygorskite	Vermiculite	Quartz	Feldspars	Calcite	Dolomite	Apatite
Typic Haplocalcids												
13	25-50	-	Dom	Com.	Tr	-	Mod	Few	Few	-	-	-
	50-100	-	Dom	Med.	Tr	Tr	-	Few	Tr	Tr	-	-
Gypsic Haplosalids												
16	40-80	Tr.	Com.	Com.	Few	Tr.	Com.	Few	Tr.	Tr.	-	-
	80-150	Tr.	Dom.	Few	Tr.	-	-	Few	Tr.	Tr.	Tr.	-
Typic Torriorthents												
12	30-70	-	Com.	Mod.	Tr.	-	Mod.	Mod.	Few	Tr.	Tr.	Tr.
	70-120	-	Mod.	Mod.	Few	Tr.	Mod.	Few	Few	-	Tr.	-
Typic Torripsamments												
7	25-55	-	Dom.	Few	Tr.	Tr.	-	Few	Tr.	-	Few	Tr.
	55-100	-	Dom.	Few	Tr.	-	Few	Few	Few	Tr.	Tr.	-
8	0-40	-	Dom.	Mod.	Few	-	Tr.	Few	Tr.	-	Tr.	-
	90-150	-	Dom.	Few	Tr.	Tr.	-	Few	Tr.	-	Tr.	Few

Note:

- = Absent | Mod = Moderate 15 – 25% | Tr = trace <5%

Com = Common 25 – 40% | Few = 5 – 15% | Dom = Dominant > 40%

reveal that the clay minerals of the soils of *Gypsic Haplosalids* are smectite characterized by an abundance of (montmorillonite) minerals followed by kaolinite which is detected in common amounts in the 40-80 cm layer and decrease in few amounts in the deepest layer.

Illite is found in few amounts and decreases with depth to reach tractable amounts.

Vermiculite and playgorskite minerals are detected in common and trace amounts in the subsurface layers, respectively.

The identified accessory minerals are mainly dominated by quartz followed by feldspars and calcite, while dolomite is found in the deepest layers and is absent in the subsurface layer.

3-Clay mineralogy of the *Typic Torriorthents*:

As the clay fractions composes considerable amount of the particle size distribution, this toxonomic unit is represented by profile 12. X-ray diffractograms of the clay fraction are interpreted in Table (4) and illustrated in Figs. (6 and 7).

Examination of the table reveals that, the clay fraction of the *Typic Torriorthents* soils dominated by smectite (montmorillonite) followed by kaolimite minerals. Illite is found in trace amount in the subsurface layer and increases to few amounts in the deepest layer. Vermiculite is found in moderate amounts in both profile layers, while palygorskite is detected in trace amounts in the deepest layer and disappears in the surface layer.

The identified accessory minerals are dominated by quartz followed by feldspars and dolomite, while calcite and apatite are found in tracable amounts in the 30-70 cm layer and disappears in the 70-120 cm depth.

4- Clay mineraology of the *Typic Torripsamments*:

Soils of this taxonomic unit are represented by profiles 7 and 8. X-ray diffractograms of these profiles are depicted in Figs. (8 and 11). The data in Table (1) show that the clay minerals assemblage consists of smectite (montmorillonite), as the major constituent, followed by kaolinite mineras, their proportions are dominant and few respectively.

Illite is found in trace amounts in all layers except in the subsurface layer of profile No. 8 where it constitutes few amounts

Vermiculite is detected in trace amounts in 55-100 cm layer of profile 7 and in 0-40 cm layer of profile 8, while it is absent in the other layers.

Palygorskite is found in trace amounts in the subsurface layer of profile 7 and 90-150 cm layer of profile 8.

As to accessory minerals, quartz is the first dominant mineral followed by feldspars and dolomite. Calcite and apatite minerals are found in traceable and few amounts in the 25-55 cm layer of profile 7 and 90-150 cm layer of profile 8, respectively.

Genesis of the clay minerals:

The formation of clay minerals in soils and the type of clay minerals present depend on a number of factors such as parent material, climate, relief, intensity of weathering, efficiency of drainage systems, level of water table, pH value and time Mackenzie (1967).

From the above mentioned presentation on the clay minerals present in the different taxonomic units in the studied area, it can concluded that:

(1) The clay minerals suite is a mixture of clay minerals, dominated by smectite (montmorillnite). This is confirmed by the previaled aridity and low content of vermiculite occurring as a transitional stage between non-expanding mineral illite and the fully expanding smectite, little contribution of degradational process on the formation of smectite is expected.

(2) Kaolinite mineral takes the second place in the clay fraction, its presence confirms the inheritance from parent materials during the drastic leaching of soils in the past humid climate.

(3) The presence of illite (Hydrous mica) is explained on the premise that Mg-affected conditions stimulate its formation either through diagnenesis or neogenesis.

(4) The presence of palygorskite mineral may be due to the soils high content of $CaCO_3$ and soluble salts in soils. These conditions favor palygorskite formation. Similar results were reported about the presence of palygorskite in the soils east of the Bitter lakes (E-l Aarby *et al*., 1989).

(5) The presence of interstratified clay minerals in soil samples may be due to pedogenic formation and transformation processes. Mackenzie (1967) stated that some transformation of mica to illite and dioctahedral smectite may take place.

(6) The presence of quartz and feldspars may be due to physical weathering of quartz and feldspars minerals of the sand and silt fractions under the prevaility of arid condition.

(7) The presence of calcite, dolomite and apatite indicates a contribution of calcareous parent materials (calcareous sandstone and/or limestone) to soil formation.

(8) The variation in mineralogical composition of the clay fraction in the study area, are mainly ascribed to the multi-origin of sediments (multi-parent materials).

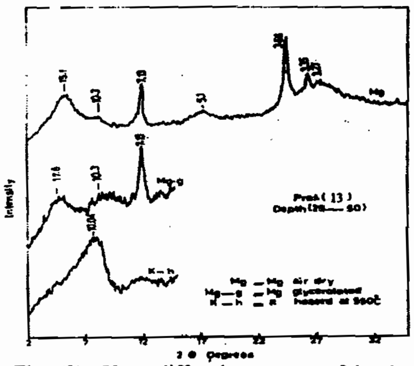

Fig. (2): X-ray diffraction patterns of the clay fraction separated from (25-50 cm depth) of profile 13, (*Typic Haplocalcids*).

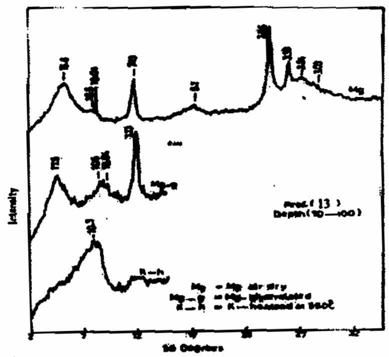

Fig. (3): X-ray diffraction patterns of the clay fraction separated from (50-100 cm depth) of profile 13, (*Typic Haplocalcids*).

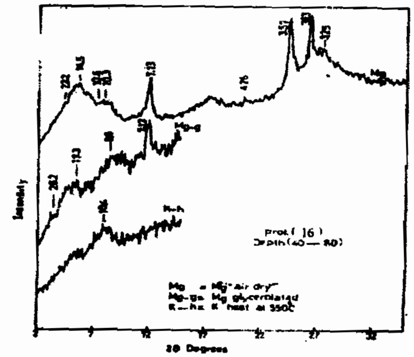

Fig. (4): X-ray diffraction patterns of the clay fraction separated from (40-80 cm depth) of profile 16, (*Gypsic Haplosalids*).

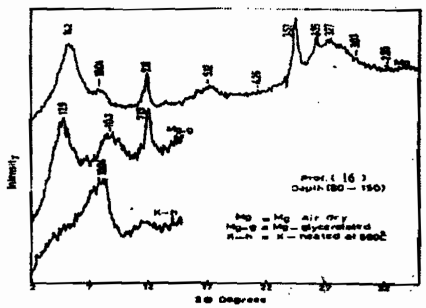

Fig. (5): X-ray diffraction patterns of the clay fraction separated from (80-150 cm depth) of profile 16, (*Gypsic Haplosalids*).

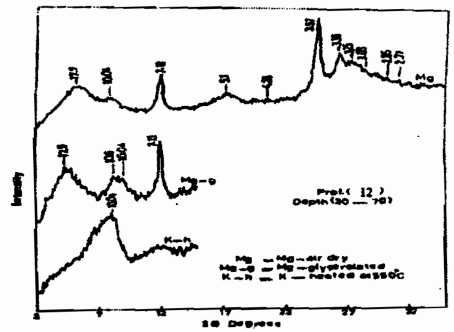

Fig. (6): X-ray diffraction patterns of the clay fraction separated from (30-70 cm depth) of profile 12, (*Typic Torriorthents*).

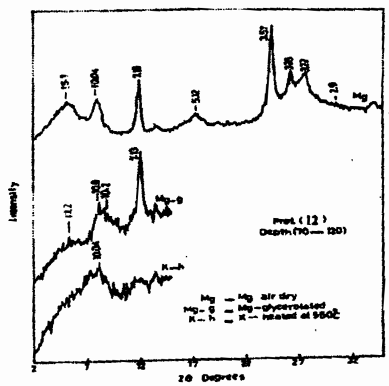

Fig. (7): X-ray diffraction patterns of the clay fraction separated from (70-120 cm depth) of profile 12, (*Typic Torriorthents*).

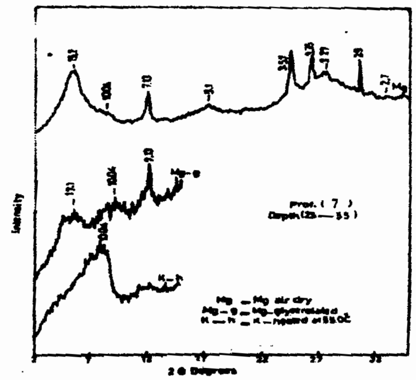

Fig. (8): X-ray diffraction patterns of the clay fraction separated from (25-55 cm depth) of profile 7, (*Typic Torripsamments*).

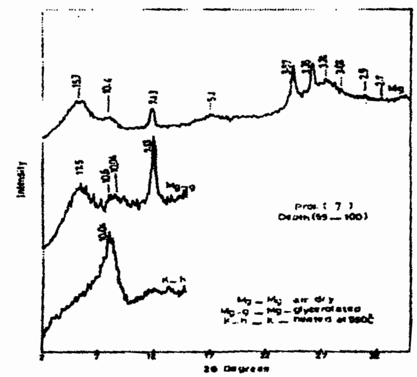

Fig. (9): X-ray diffraction patterns of the clay fraction separated from (55-100 cm depth) of profile 7, (*Typic Torripsamments*).

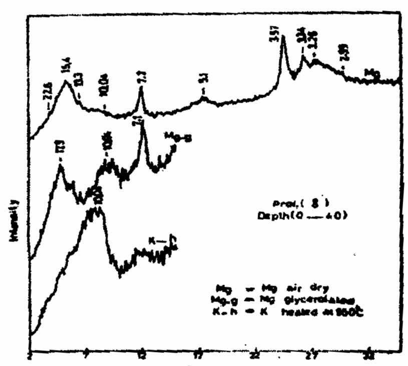

Fig. (10): X-ray diffraction patterns of the clay fraction separated from (0-40 cm depth) of profile 8, (*Typic Torripsamments*).

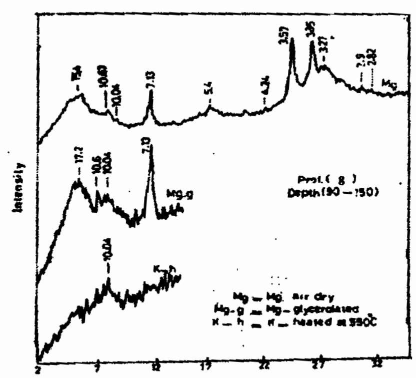

Fig. (11): X-ray diffraction patterns of the clay fraction separated from (90-150 cm depth) of profile 8, (*Typic Torripsamments*).

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معادن الطين فى بعض تحت مجموعات الأراضى الواقعة على طول الجانب الغربى لشبه جزيرة سيناء بين مدينتى القنطرة شرق والسويس

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اختير سته عشر قطاعاً أرضياً تمثل الوحدات التقسيمية للأراضى الواقعة شرق البحيرات المرة ما بين مدينتى القنطرة شرق حتى مدينة السويس على امتداد الجانب الغربى لشبه جزيرة سيناء وقد أمكن تحديد تحت المجموعات المختلفة لهذه الأراضى.

Typic Haplocalcids , Gypsic Haplosalids , Typic Torriorthents , Typic Torripsamments

وقد درست معادن الطين في عينات هذه الأراضى وقد أوضحت نتائج الدراسة سيادة معدن السمكتيت (المونتموريللونيت) فى كل الوحدات التقسيمية المدروسة ، يليه الكاؤولينيت – وقد وجدت معادن طين الألَيت والفيرميكوليت والمعادن المستطبقة وكذلك الباليجورسكيت بكميات قليلة وقد تميزت المعادن المصاحبة بسيادة معدن الكوارتز والفلسبارات مع وجود كميات بسيطة من معادن الكربونات وتشمل معادن الكالسيت والدولوميت وكذا الأباتيت.