4.RESULTS AND DISCUSSION

4.1. Properties of the studied soils:

4.1.1. Particle size distribution:

Table (6) shows the values of particle size distribution of soil samples collected from the studied 19 profiles dug in the chosen 5 traverse lines. The studied soils vary in their values of particle size distribution and texture classes range between sand and clay, but sandy texture is predominated in most samples.

Soils of traverse no. 1, which represented by profiles no. 1, 2,3 and 4, have a sandy texture in all layers. Clay content is ranged between 0.70 and 9.09% and decreases by depth in profiles no. 1 and 2, while, it increases with depth in the other two profiles. Silt percentage is ranged between 0.51 and 3.87% and decreases by depth in profiles no. 1,2 (except the layer of 60- 80 cm) and 3, while, the opposite is true in profile no. 4. Sand is the dominant fraction, especially medium and fine sand, and varies between 89.20 and 98.60% The higher sand content is found in profiles no. 1 and 4, in OM EL-Reda and Rosetta locations, respectively while the lower is found in profiles no. 2 and 3 in EL-Mattar and Gamassa , respectively.

Traverse no 2, which represented by soil profiles no. 5, 6,7,8,9 and 10 is characterized by a different texture classes. For example, texture is sand in all layers of profile no. 6, while profiles no. 5 and 7 are characterized by sandy texture in their surface layers and loamy sand texture in the subsurface ones. On the other hand, profiles no. 8 and 10 have sandy loam texture, while

Table (6) : Particle size distribution and organic matter , CaCO3 and gypsum contents in the studied profiles .

Trav. No.	Location	Profile No.	Samp. Depth (cm)	Gravel %	V.C. Sand %	C. Sand %	M. Sand %	F. Sand %	V.F. Sand %	Total Sand %	Silt %	Clay %	Texture Class	O.M. %	CaCO3 %	Gypsum %
1	Om EL-Reda	1	0-30	0.00	0.02	1.32	29.70	57.00	8.40	96.44	1.01	2.55	Sand	0.49	0.52	0.00
			30-50	0.00	0.00	1.06	28.85	58.58	8.49	96.98	0.51	2.51	Sand	0.13	0.31	0.00
			50-80	0.00	0.00	1.24	27.83	60.98	7.42	97.47	0.51	2.02	Sand	0.14	0.41	0.00
	EL-Mattar	2	0-30	0.00	0.17	0.66	19.47	66.35	7.78	94.43	1.51	4.06	Sand	0.49	0.52	0.00
			30-60	0.00	0.03	0.67	22.78	63.51	7.99	94.98	1.01	4.01	Sand	0.17	0.62	0.00
			60-80	0.00	0.03	0.68	20.68	63.66	9.31	94.36	2.05	3.59	Sand	0.14	0.63	0.00
	Gamassa	3	0-20	0.00	0.22	1.50	33.31	47.34	7.00	98.37	3.87	6.76	Sand	0.43	1.15	0.00
			20-40	0.00	0.18	1.35	33.46	45.62	8.72	89.33	2.64	8.03	Sand	0.19	1.00	0.00
			40-65	0.00	0.08	1.30	31.15	46.12	10.55	89.20	1.71	9.09	Sand	0.11	0.83	0.00
	Rosatta	4	0-20	0.00	1.25	1.94	17.02	50.16	28.23	98.60	0.70	0.70	Sand	0.12	1.00	0.00
			20-50	0.00	1.33	2.14	18.08	50.07	25.18	96.80	1.09	2.11	Sand	0.05	0.68	0.00
			50-80	0.00	2.16	4.18	20.05	47.64	21.21	95.24	3.14	1.62	Sand	0.03	0.43	0.00
2	EL-Nubaria	5	0-35	0.00	7.09	28.30	19.52	23.22	15.54	93.67	3.90	2.43	Sand	0.09	5.16	0.00
			35-75	0.00	4.90	21.14	19.42	22.62	16.78	94.86	8.79	6.35	L.Sand	0.06	8.05	0.00
			75-120	0.00	3.83	21.37	19.41	22.99	12.77	80.37	11.49	8.14	L.Sand	0.10	8.25	0.00
			120-150	0.00	3.51	20.74	21.94	26.23	12.75	85.17	7.41	7.42	L.Sand	0.50	5.16	0.00
	EL-Nubaria	6	0-30	0.08	3.50	28.24	27.02	18.40	18.39	95.55	3.06	1.39	Sand	0.43	8.00	0.17
			30-80	0.83	3.10	29.90	28.80	17.30	17.34	96.44	2.60	0.88	Sand	0.35	8.04	0.00
			80-150	1.15	1.42	16.68	30.50	21.80	23.31	93.71	3.92	2.37	Sand	0.28	10.16	0.00
	EL-Nubaria	7	0-30	1.04	5.52	30.08	23.70	16.00	14.18	89.48	6.89	3.63	Sand	0.96	8.10	0.00
			30-70	1.66	9.82	27.44	18.08	12.54	13.60	81.48	12.31	6.21	L.Sand	0.41	8.18	0.00
			70-120	1.92	6.74	30.06	20.24	14.64	11.93	83.79	10.12	6.09	L.Sand	0.80	10.93	0.00
	EL-Nubaria	8	0-40	1.45	1.20	6.55	18.44	12.91	35.40	74.50	10.00	15.50	S.Loam	0.44	23.99	0.22
			40-60	1.70	1.12	4.48	11.64	10.07	21.15	48.46	24.22	27.32	S.C.L.	0.23	34.65	0.26
			60-80	1.32	1.54	5.77	13.20	11.53	19.22	51.26	22.14	26.60	S.C.L.	0.14	42.01	0.26
			80-150	1.90	9.18	8.98	12.61	8.98	9.95	49.26	27.25	23.49	S.C.L.	0.11	50.37	0.29
	EL-Nubaria	9	0-40	1.63	3.14	8.72	21.20	17.45	32.44	83.03	7.25	9.72	L.Sand	0.32	27.66	0.31
			40-70	1.63	2.40	4.44	9.96	14.41	17.17	48.38	33.62	18.00	Loam	0.08	46.07	0.32
			70-150	1.89	1.20	4.15	11.06	19.74	14.30	50.45	22.84	26.71	S.C.L.	0.03	34.73	0.32
	EL-Nubaria	10	0-30	1.90	1.36	7.51	16.38	14.53	30.57	70.35	12.10	17.55	S.Loam	0.41	27.85	0.32
			30-50	2.86	2.56	5.86	8.91	12.20	23.57	53.20	20.30	26.50	S.C.L.	0.11	44.08	0.36
			50-150	2.97	0.79	2.61	7.11	17.15	17.07	44.73	28.54	26.73	Loam	0.05	35.21	1.87

L = Loam S. = Sand S.L. = Sandy loam

G.= Gravelly S.G. = Slightly gravelly S.C.L. = Sandy clay loam

Table (6) : Cont.

Trav. No.	Location	Profile No.	Samp. Depth (cm)	Gravel %	V.C. Sand %	C. Sand %	M. Sand %	F. Sand %	V.F. Sand %	Total Sand %	Silt %	Clay %	Texture Class	O.M. %	CaCO3 %	Gypsum %
3	EL-Shbab	11	0-40	0.00	13.83	28.02	24.76	21.15	4.70	92.46	1.70	5.84	Sand	0.41	1.51	0.00
			40-80	0.00	5.01	26.78	30.28	25.66	5.33	93.06	0.40	6.54	Sand	0.21	1.23	0.00
			80-110	0.00	6.43	21.47	22.33	24.03	7.14	81.40	11.10	7.50	L.Sand	0.09	2.78	0.00
			110-150	0.00	16.79	29.15	23.82	20.22	4.18	94.16	1.81	4.03	Sand	0.05	1.28	0.00
	EL-Shbab	12	0-22	0.00	1.70	23.49	31.82	16.34	5.41	78.76	6.74	14.50	S.Loam	0.77	1.65	0.00
			22-40	0.00	0.86	23.52	47.14	20.82	5.16	97.50	1.00	1.50	Sand	0.11	0.41	0.00
			40-150	0.00	0.26	18.35	50.17	23.27	5.13	97.18	1.57	1.25	Sand	0.13	0.62	0.00
	Belbeis	13	0-45	0.00	6.81	57.40	7.44	4.52	17.36	93.53	1.30	5.17	Sand	0.74	0.63	0.00
			45-80	0.00	5.36	17.54	40.56	27.09	6.45	97.00	0.83	2.17	Sand	0.25	0.25	0.00
			80-150	0.00	1.93	6.88	53.52	30.14	5.91	98.38	0.66	0.96	Sand	0.12	0.12	0.00
4	EL-Saff	14	0-40	6.51	4.11	10.01	17.56	34.76	17.92	84.35	12.75	2.90	S.G.L.S	0.11	13.83	2.88
			40-70	1.83	2.39	9.77	21.26	40.37	16.03	89.80	6.44	3.76	Sand	0.12	13.00	2.65
			70-100	33.06	25.85	21.74	16.03	19.27	10.18	93.11	2.28	4.61	G.Sand	0.14	11.14	1.01
			100-150	18.00	12.90	17.84	18.05	26.22	11.99	87.00	6.50	6.50	G.L.S.	0.06	14.44	0.00
	EL-Aiyat	15	0-20	0.51	0.20	4.68	32.82	28.68	19.65	86.03	7.81	6.16	L.Sand	0.41	8.86	0.08
			20-50	0.73	0.06	3.30	34.50	31.72	18.72	88.30	6.02	5.68	Sand	0.22	8.42	0.47
			50-70	0.96	0.08	6.50	26.60	25.76	23.65	83.31	7.21	9.48	L.Sand	0.13	12.18	0.15
	Kom-Oshim	16	0-20	0.00	0.35	9.30	32.93	18.42	15.96	76.42	13.48	10.10	S.Loam	0.25	5.88	0.00
			20-27	0.08	0.04	2.13	10.96	13.40	27.50	54.03	34.48	11.49	S.Loam	0.10	9.29	0.00
			27-40	0.09	0.39	5.09	30.11	22.04	16.08	73.70	17.70	8.60	S.Loam	0.08	4.13	0.00
			40-50	0.00	0.03	0.45	9.33	20.14	30.78	60.73	28.52	10.75	S.Loam	0.10	7.63	0.00
			50-80	1.15	1.05	0.97	9.38	8.86	23.75	44.01	44.06	11.93	Loam	0.09	15.48	0.00
			80-150	0.00	0.65	0.44	5.48	8.53	24.73	39.73	40.83	19.44	Loam	0.12	18.81	0.00
5	Wadi EL-Khrait	17	0-20	15.61	10.84	19.28	16.57	12.93	7.08	67.00	14.88	18.12	G.S.L.	0.35	3.42	0.00
			20-36	9.98	20.25	28.11	17.33	7.91	4.70	78.30	9.38	12.32	S.G.S.L	0.28	3.21	0.00
			36-71	5.59	10.07	31.01	27.64	10.64	3.64	82.99	9.04	7.97	S.G.L.S	0.09	3.52	0.00
	Kom-Ombo (east)	18	0-25	1.04	1.05	12.56	21.17	19.19	7.00	61.42	14.04	20.54	S.C.L.	1.16	10.77	0.00
			25-33	0.31	0.77	6.83	24.79	22.89	5.06	60.33	16.36	23.31	S.C.L.	0.57	9.21	0.00
			33-39	0.21	0.38	3.22	9.73	7.44	4.54	25.31	24.39	50.30	Clay	0.59	10.15	0.00
			39-65	0.63	0.76	6.74	13.68	17.85	8.67	47.70	21.91	30.39	S.C.L.	0.56	7.87	0.00
			65-110	0.30	1.02	25.03	55.70	9.70	0.64	92.08	2.48	5.44	Sand	0.17	1.97	0.00
	Kom-Ombo (west)	19	0-15	300	12.63	16.78	16.98	21.92	28.38	96.69	1.66	1.65	S.G.S.	0.28	2.36	0.00
			15-50	18.00	12.62	17.41	18.62	18.65	28.56	95.86	1.57	2.57	G.Sand	0.19	1.23	0.00
			50-90	15.09	19.14	17.88	17.31	15.82	25.16	94.51	2.20	3.29	G.Sand	0.03	0.43	0.00

the sandy clay loam texture is found in the subsurface ones, except the layer 50-150 cm depth in profile no. 10 which has a loamy texture. Texture class in soil samples of profile no 9 varies from layer to another. Generally, the soil texture class of their profiles tends to be heavier in the subsurface soil layers than the surface ones.

Zaghloul (1973) found in his study on the soils west EL-Nubaria that the different distributions of particle sizes with increasing depth are mostly associated with coarse and fine sands which decrease with depth. He added that the irrigation water partially dissolves some of $CaCO_3$ particles and decrease their diameter, thus it may be shifted towards finer range of particles, the same conclusion is found by *Mohamed (1992)*

The lowest clay content is found in the layer of 30-80 cm in profile no 6, while the highest one is found in the layer of 40-60 cm of profile no. 8 and tends to increase with depth. Silt content varies between 2.68 and 33. 62% in the layer of 30-80 Cm in profile no. 6 and the layer of 40-70 cm in profile no. 9, respectively, and tends to increase with depth, also. On the other hand, sand is the major constituent in all soil layers and coarse sand the dominant fraction in profiles no. 5 and 6, while fine sand is dominance in profiles no. 7, 8, 9, and 10. These variations in soil particle size distribution can be attributed to the differences in soil utilization periods. In this concern, *Hanna (1969)* found that clay content of the Western desert soil increases with land utilization and stated that, neither the natural rainfall nor the amount of irrigation water added to the soils were sufficient to cause the transportation of finer fractions to the subsoil.

Soils of the traverse no. 3 have a sandy texture class except the third layer (80-110 cm) of profile no 11 and surface layer of profile no. 12 which have loamy sand and sandy loam texture, respectively.

This loamy sand texture is due to the migration of fine fractions, specially calcium carbonate (Table 6) and amorphous materials (Table 9) in the case of profile no. 11 and to the addition of clay by farmers in the case of profile no. 12. Clay content ranges between 0.96 and 14.50% and tends to decrease with depth, especially in profiles no. 12 and 13. Silt content follows the same trend of clay.

Texture class of the soils of traverse no. 4, which represents by profiles no. 14, 15 and 16, varies from gravely sand and loam. Soils of this traverse tend to be finer from east to west, where profile no. 14 has a gravely sandy or sandy texture, profile no. 15 has sandy or loamy sand texture, while the textur of profile no. 16 . sandy loan or loamy texture. The texture class of soils EL-Saff, which represented by profile no. 14 varies from one layer to another. According to *FAO (1964)* the landscape is clearly sloping and the gullies from the high limestone plateau gives the land type a typical fluvial erosion pattern with gravely or cobbly wadies and wash deposits. Soils of EL-Aiyat (profile no. 15) have a few contents of gravels with a sandy texture, which assure that the origin of these soils is the river terraces deposits, where the younger deposits being predominantly sandy, *FAO (1964)*.Soil of Kom Oshim, which represented by profile no. 16, have sandy loam texture class in the upper 4 layers and loamy one in the deepest two layers. This indicates that these soils are more or less loamy alluvial deposits . This deposits are described as a complex because the alluvial deposits occur frequently in association with tertiary shales, clay and marls, *FAO (1964)* and *Hanna and Labib (1977)*. Generally, clay content tends to increase with depth in the profiles of this traverse. Silt content has the same trend of clay concerning profile no. 16, while profiles no.14 and 15 show an opposite trend.

Soils of the fifth traverse have texture classes vary between gravely sand and clay. The gravel content in the soils of Wadi EL-Khrait (profile no 17) varies between 5.59 and 15.61%, and tends to decrease with depth, while clay and silt vary from 7.97 to 18.12% and from 9.04 to 14.88%, respectively, and tend to decrease also with depth. Generally, the soils of Wadi El-Khrait (Profile no. 17) tend to be coarser with depth and appear to be well stratified. According to *FAO (1964)* and *Fanous (1984)* Wadi El-Khrait is a dry river bed and was eroded during the pluvial periods and still functioning as a drainage channel after rain, its soils are sandy and well stratified. It is filled up with coarse sand gravel with sloping surface. The soils of Kom Ombo plain were represented by profile no. 18 in the east of River Nile and profile no. 19 in the west. Profile no. 18 has a low gravel content and its clay content varies between 5.44 and 50.30%, while silt content varies from 2.48 to 24.39%. Silt and clay contents tend to increase with depth up to the layer of 33-39 cm, then they decrease up to 110 cm depth. The total sand content is high up and down the 33-39 cm soil layer. This finding opposites the trends of clay and silt contents. The soils of west River Nile (profile no. 19) have a gravel content higher than the east. Clay and silt contents in profile no. 19 are ranged from 1.65 to 3.29% and from 1.66 to 2.20%, respectively, and tend to increase with depth. These finding show that the soils eastern River Nile in Kom Ombo are finer than the western ones, which is generally rolling with the differences in altitude of 1.5 or 3m, *FAO (1964)*.

4.1.2. Calcium carbonate:

Data of Table (6) show that the soils of traverse no 1 have, in general, the lowest calcium carbonate content, which ranges between 0.31 (profile no. 1) and 1.51% (profile no. 3). $CaCO_3$ content tends to decrease with depth, and surface layers of all profiles (except profile no. 2) contain the higher $CaCO_3$. These results may be attributed to the shallow water table which helps in dissolving salts. Soluble salts rise toward soil then they accumulate as carbonate salts (especially $CaCO_3$) under dry conditions, *Fitzpatrick (1986)*.

Soils of traverse no. 2 contain the highest $CaCO_3$ content which varies between 5.16 and 50.37%. The soils under investigation of traverse no 2 are, generally, identify two geomorphic units: The first one is an old deltaic plain, which represented by profiles no. 5,6 and 7, where $CaCO_3$ is less than 11% and where aeolian sand and fluviatile sheets are presented within this plain. The second one, i.e., Abu Mina Basin is represented by profiles no. 8,9 and 10 and its $CaCO_3$ contents range between 23.99 and 50.37%. In this geomorphic unit,calcareous rocks (Lybian blateau) formed the table land and the soil materials were derived by alluviation processes, *Shata et al., (1977)*. This finding agrees with those of *Labib and Khalil (1977)* who indicated that, distribution of calcium carbonate in the same area of western desert is related to the geomorphic units. Depth wise $CaCO_3$ tends to increase due to dissolution and leaching, *Shata et al., (1977)*.

According to the US Soil Taxonomy *(USDA, 1975)*, horizons that contain a secondary carbonate layer (15 cm thick or more) have a carbonate content equivalent to I ≥ 15% $CaCO_3$ and a calcium carbonate equivalent at least 5% greater than the C horizon identify a "Calcic horizon". So it can be concluded that the layers of 40-70 cm (profile no. 9) and 30-50 cm (profile no. 10) represent a like calcic layer. According to *Shata et al., (1977)*, the lime concretions as well as the calcic horizon were formed in this area by dissolution and leaching of the country rocks followed by the concentration of calcareous materials in the form of concretions. This phenomenon is considered as a criterion for the prevalence of wet climatic conditions and it reflects a stage of the pedogenic development of soil profile. *Gewaifel et al., (1979)* showed that soils of north western desert of Egypt have almost two layers. The upper layer is generally weakly developed, recently formed and reflects the arid conditions of Holocene, while the lower one is older, relatively more developed, have a calcic horizon and reflects the more humid condition during the pleistocene. They concluded that, there is a mutual relation between geomorphic aspects and pedological characteristics. The wind-blown sand shows no diagnostic horizons, while the soils of Abu Mina valley have calcic horizon in the upper layers due to humid micro-climate which results in calcification process.

$CaCO_3$ content in the soils of traverse no. 3 is ranged between 0.12 and 2.78%. $CaCO_3$ appears here as a contamination during soils constitution. It tends to decrease with depth in profiles no 12 and 13, while it has an opposite trend in profile no. 11.

Concerning traverse no. 4, $CaCO_3$ content is higher than that of traverse no. 3 and ranges between 4.13 and 18.01 %. The distribution of $CaCO_3$ shows, in general, that it decreases with increasing soil depth. El-Saff soils which represented by profile no. 14, dug east of Nile River, are affected by the presence of high limestone plateau, therefor they contain a higher $CaCO_3$ content. On the other hand, El-Aiyat soils are affected by hills of middle Eocene limestone, so, they have a relatively low $CaCO_3$ content. On the contrary, soil of Kom Oshim is formed from alluvial deposits associated with marls *(FAO, 1964)*.

The soils of traverse no 5, have 0.43 and 10.77% $CaCO_3$ content and the soils of east Kom-Ombo contain the higher $CaCO_3$ than the west ones. This may be due to the presence of Cretaceous limestone forming a hilly to mountainous country on the east side of River Nile. $CaCO_3$ content of Wadi El-Khrait soils, east of River Nile, (profile no 17) tends to be homogenous throughout the soil profile, while it tends to decrease with depth in profiles no. 18 and 19.

4.1.3. Gypsum content:

Data of Table (6) show that gypsum is absent in soil profiles, while it ranges between 0.15 and 2.88% in the others. It tends to increase from east to west in soils of traverse no. 2, while it appears an opposite trend in soils of traverse no. 4.

4.1.4. Organic matter content:

Data of Table (6) represent the contents of organic matter in different soils of the chosen traverses. It varies between 0.03 and 1.16%.

In general, it can be noticed that the studied sandy soils contain low amount of organic matter. This finding is expected due to that,these soils are newly reclaimed or very recently utilized. Also the climatic conditions cause a very fast decomposition of plant residues or add organic manures. The relatively high organic matter contents in some locations are a result of the long period of land utilization as in the cases of traverses no. 2 and 5.

4.1.5. Soil salinity:

Accumulation of soluble salts occurs in a significant proportions in the soils of arid and semiarid regions due to such reasons as: the annual precipitation is insufficient for leaching process, the water-table exists at a shallow depth and soil moisture with its dissolved salts go up to the surface by capillarity and flooding the land by sea water *(Fitzpatrick, 1986)*.

Data of Table (7) represent the values of electric conductivity (EC) of saturated soil paste extract. It can be noticed the great variation in EC values according to the location of each traverse, climatic conditions and stage of land utilization.

Soils of traverse no. 1 show that the grade of soil salinity vary between non-saline (< 2 mmhos/cm), in deeper soil layer of profile no. 2, and very strongly saline (> 16 mmhos/cm), in the upper soil layers of profile no. 3. Soils represented by profiles no. 1,2 and 4 are slightly or moderately saline in different layers. Soils samples collected from surface (0-20 cm) and subsurface (20-40 cm) of profile no. 3 show that soils in this location are very strongly saline (Ec are 27.76 and 18.07 mmhos/m, in surface and subsurface soil layers, respectively). Depthwise, distribution of soluble salts shows a

Table (7) : Chemical analysis of saturated soil extract, cation exchange capacity and exchangeable cations in the studied profiles.

Trav. No.	Location	Profile No.	Samp. Depth (cm)	pH	EC mmhos /cm	Soluble ions (me / l) Anions CO3	HCO3	Cl	SO4	Cations Ca	Mg	Na	K	CEC me/100g	Exch. cation me/100g. Ca	Mg	Na	K	ESP %
1	Om EL-Reda	1	0-30	8.5	3.42	0.0	2.80	22.54	7.96	4.36	5.94	22.00	1.00	3.91	2.01	1.06	0.71	0.12	18.16
			30-50	8.5	5.31	0.0	2.80	40.18	9.54	6.00	8.42	36.00	2.10	2.60	1.04	0.98	0.51	0.14	19.03
			50-80	8.5	8.66	0.0	2.10	35.77	49.05	6.54	38.78	38.50	3.10	2.23	0.97	0.74	0.33	0.17	14.80
			W.T	8.2	5.04	Tr.	3.18	27.10	19.42	5.10	14.42	25.95	4.23						
	EL-Mattar	2	0-30	8.1	3.64	0.0	2.80	19.11	14.48	9.81	9.76	16.20	0.62	4.82	3.08	1.00	0.59	0.11	12.42
			30-60	8.4	1.69	0.0	1.40	9.80	4.71	4.36	4.40	6.00	0.35	3.51	1.78	1.11	0.52	0.09	14.81
			60-80	8.6	0.81	0.0	1.40	3.43	3.15	2.18	1.94	3.50	0.36	3.33	1.85	0.82	0.51	0.15	15.32
			W.T	8.3	0.63	Tr.	1.35	2.64	2.29	1.73	1.18	2.76	0.61						
	Gamassa	3	0-20	7.9	27.76	0.0	7.41	208.00	66.19	41.33	80.06	158.50	1.71	6.11	3.02	1.67	1.23	0.17	20.13
			20-40	8.1	18.07	0.0	4.85	37.10	142.14	8.26	12.26	163.00	0.57	6.28	3.11	1.60	1.39	0.17	22.13
			40-65	9.0	6.04	0.0	5.42	31.35	36.48	3.42	6.56	62.70	0.57	7.39	3.20	2.62	1.42	0.13	19.22
			W.T	8.6	6.53	Tr.	5.00	47.00	9.24	2.51	13.22	44.65	0.94						
	Rosatta	4	0-20	8.9	5.16	0.0	8.50	40.80	2.16	1.28	3.00	46.33	0.85	2.85	1.22	1.00	0.49	0.12	17.19
			20-50	9.0	4.17	0.0	7.65	31.03	2.13	1.28	3.40	35.28	0.85	3.15	1.43	1.03	0.51	0.17	16.19
			50-80	9.1	3.78	0.0	5.53	30.60	0.86	1.28	2.98	31.80	0.85	3.43	1.81	0.80	0.53	0.27	15.45
			W.T	8.7	3.56	Tr.	8.40	29.50	0.70	0.64	6.16	30.00	1.80						
2	EL-Nubaria	5	0-35	8.2	0.95	0.0	4.90	4.41	0.46	3.24	1.35	4.60	0.58	4.12	2.65	0.89	0.42	0.15	10.19
			35-75	8.4	0.73	0.0	2.80	2.45	2.05	2.70	0.87	3.85	0.68	5.83	3.83	1.24	0.47	0.26	8.06
			75-120	8.5	1.00	0.0	2.80	4.90	2.09	2.70	1.38	4.85	0.86	8.54	6.12	1.39	0.72	0.31	8.43
			120-150	9.0	2.10	0.0	2.80	15.19	3.96	2.16	1.41	18.00	0.83	6.63	4.70	0.68	1.08	0.17	16.29
	EL-Nubaria	6	0-30	8.1	2.59	0.0	10.60	7.46	8.94	9.61	8.72	6.87	1.80	2.31	1.18	0.73	0.29	0.10	12.55
			30-80	8.2	2.47	0.0	9.74	5.56	9.55	8.40	7.22	7.91	1.32	2.20	1.06	0.70	0.31	0.11	14.09
			80-150	8.2	2.21	0.0	9.68	5.51	6.03	8.26	5.31	6.48	1.17	2.00	1.00	0.66	0.27	0.05	13.50
	EL-Nubaria	7	0-30	8.6	6.83	0.0	27.81	14.88	24.63	11.21	16.24	37.24	2.63	3.62	1.36	1.62	0.69	0.13	19.06
			30-70	8.7	6.17	0.0	19.63	14.80	25.77	11.01	13.32	33.65	2.22	3.95	1.49	1.55	0.72	0.17	18.22
			70-120	8.7	5.69	Tr.	16.84	7.49	32.09	10.71	11.57	31.94	2.20	3.77	1.49	1.36	0.78	0.12	20.69
	EL-Nubaria	8	0-40	8.3	3.02	0.0	2.51	5.88	22.59	20.37	2.28	7.92	0.33	7.17	3.23	2.34	1.00	0.58	13.94
			40-60	8.4	0.88	0.0	1.59	1.59	5.93	2.58	0.74	5.25	0.54	8.23	3.29	2.92	1.15	0.93	13.82
			60-80	8.4	0.89	0.0	1.85	2.69	4.67	2.27	1.24	5.05	0.65	9.39	3.97	3.58	1.25	0.63	13.31
			80-150	8.5	0.63	0.0	1.52	2.07	2.80	0.74	0.33	4.09	0.43	7.96	1.98	4.37	1.08	0.59	13.57
	EL-Nubaria	9	0-40	7.6	1.16	0.0	1.81	2.47	8.32	5.78	3.64	2.71	0.47	5.83	2.74	1.84	0.82	0.42	14.07
			40-70	7.8	0.62	0.0	1.08	1.54	3.93	2.84	1.53	1.96	0.22	9.84	6.42	2.43	0.63	0.34	6.40
			70-150	7.8	0.53	0.0	1.61	1.79	2.15	2.42	0.39	2.38	0.36	9.66	4.82	2.07	1.33	0.56	13.77
	EL-Nubaria	10	0-30	7.6	0.66	0.0	2.02	1.56	2.92	3.06	0.72	2.53	0.19	10.47	4.49	3.39	1.53	1.03	14.61
			30-50	7.8	0.62	0.0	1.81	1.81	2.58	2.44	0.39	3.08	0.29	11.08	3.77	6.04	0.96	0.59	8.74
			50-150	7.8	3.08	0.0	0.69	0.86	29.55	23.28	1.40	6.11	0.31	10.59	7.09	1.13	1.58	0.58	14.16

W.T = Water table .　　　　Tr. = Trace .

Table (7) : Cont.

Trav. No.	Location	Profile No.	Samp. Depth (cm)	pH	EC mmhos /cm	Soluble ions (me/l) Anions CO3	HCO3	Cl	SO4	Cations Ca	Mg	Na	K	CEC me/100g	Exch. cation me/100 g Ca	Mg	Na	K	ESP %
3	EL-Shbab	11	0-40	7.6	3.01	0.0	0.92	17.33	11.62	4.61	1.50	22.58	1.01	5.05	2.37	1.53	0.75	0.32	14.85
			40-80	8.0	1.60	0.0	1.67	7.77	6.65	2.32	1.50	11.63	0.63	5.26	2.80	1.39	0.79	0.25	15.02
			80-110	8.6	1.26	0.0	3.76	3.59	5.00	2.01	30.34	39.81	0.27	6.32	2.75	1.24	1.74	0.47	27.53
			110-150	8.8	1.18	0.0	4.82	3.60	3.24	0.36	1.26	9.93	0.11	4.19	1.54	0.95	1.25	0.42	29.83
	EL-Shbab	12	0-22	8.4	1.90	0.0	4.98	8.33	6.49	1.09	2.52	14.70	0.32	9.92	7.10	0.93	1.47	0.31	14.82
			22-40	9.1	0.92	Tr.	3.50	2.94	2.40	1.64	0.42	6.40	0.38	2.36	1.54	0.39	0.30	0.06	16.10
			40-150	9.2	0.80	Tr.	3.20	3.43	0.73	1.64	0.94	5.10	0.60	1.87	1.04	0.37	0.35	0.08	18.71
	Belbeis	13	0-45	7.7	2.95	0.0	1.25	15.62	11.63	7.31	9.14	11.88	0.17	4.61	2.59	0.86	0.67	0.38	14.53
			45-80	7.8	1.43	0.0	1.29	7.86	4.76	2.90	3.94	6.72	0.35	3.23	2.11	0.47	0.46	0.16	14.24
			80-150	7.9	0.96	0.0	1.29	5.61	2.60	2.73	2.97	3.45	0.43	3.05	1.84	0.61	0.43	0.09	14.10
4	EL-Saff	14	0-40	7.5	87.42	0.0	2.80	883.20	91.13	365.19	125.69	475.00	11.25	4.81	2.48	1.37	0.67	0.29	13.93
			40-70	7.7	58.28	0.0	2.10	511.60	110.40	189.81	72.27	355.00	7.10	4.60	2.53	1.27	0.68	0.11	14.78
			70-100	7.9	50.76	0.0	2.10	445.44	88.81	124.32	62.88	345.00	4.15	3.62	2.09	0.82	0.49	0.21	13.54
			100-150	8.2	5.90	0.0	2.80	7.35	49.32	17.76	8.74	32.00	0.97	4.57	3.00	0.65	0.56	0.33	12.25
	EL-Nubaria	15	0-20	8.1	2.25	0.0	3.35	11.42	7.72	11.55	1.89	8.53	0.52	4.53	2.14	1.62	0.46	0.30	10.15
			20-50	8.2	2.98	0.0	2.01	9.83	14.93	11.70	3.38	11.36	0.33	4.80	1.97	1.33	0.49	0.21	12.25
			50-70	8.0	3.18	0.0	2.20	10.80	10.57	15.40	3.80	11.87	0.50	4.46	2.11	1.49	0.53	0.31	11.88
			W.T	7.4	3.83	0.0	5.81	23.80	7.78	16.90	8.70	10.87	0.92						
	Kom-Oshim	16	0-20	8.4	1.57	0.0	2.85	3.49	9.85	2.70	2.46	10.27	0.60	10.20	8.05	0.72	0.99	0.42	9.71
			20-27	8.5	1.91	0.0	2.39	7.24	9.74	1.86	1.65	15.12	0.74	17.02	13.10	1.02	1.89	0.91	11.10
			27-40	8.5	1.45	0.0	2.99	6.28	5.03	2.33	0.97	10.47	0.53	9.67	7.58	0.66	1.20	0.21	12.41
			40-50	8.3	1.83	0.0	2.42	7.35	8.69	1.89	2.86	13.03	0.68	12.53	9.77	0.75	1.39	0.60	11.09
			50-80	8.4	1.98	0.0	1.65	7.52	10.30	2.57	1.69	14.40	0.81	15.62	12.57	1.14	1.20	0.61	8.26
			80-150	8.6	2.19	0.0	2.88	6.84	13.64	2.24	0.41	19.31	0.60	14.83	11.48	1.15	1.62	0.58	10.92
5	Wadi EL-Khrait	17	0-20	7.8	10.09	0.0	2.83	27.92	82.77	60.56	22.67	28.78	1.51	11.92	6.26	3.52	1.61	0.51	13.51
			20-36	8.3	1.02	0.0	2.82	6.91	8.59	7.14	2.72	8.06	0.40	8.06	4.94	2.09	0.80	0.22	9.93
			36-71	8.4	1.10	0.0	2.11	3.94	4.34	3.84	2.38	3.82	0.35	5.53	3.36	1.48	0.54	0.15	9.76
			W.T	8.3	0.80	Tr.	1.78	2.93	3.94	3.01	1.18	3.09	0.57						
	Kom-Ombo (east)	18	0-25	7.8	4.67	Tr.	5.71	24.97	17.90	13.33	8.19	23.85	3.21	16.62	8.84	4.41	1.86	1.49	11.19
			25-33	7.9	2.19	0.0	2.16	11.10	8.42	5.61	3.41	12.05	0.61	18.95	13.23	3.69	1.45	0.56	7.65
			33-39	8.1	1.63	0.0	2.22	7.77	6.22	4.04	3.04	8.88	0.25	39.11	29.29	6.95	2.16	0.67	5.52
			39-65	8.1	2.06	0.0	2.16	10.89	9.28	5.61	3.94	11.64	0.34	23.17	16.77	4.56	1.48	0.34	6.39
			65-110	8.2	1.54	0.0	2.11	8.36	3.94	4.37	2.06	7.92	0.25	4.11	2.40	0.91	0.71	0.08	17.27
			W.T	7.6	4.22	0.0	1.78	21.09	10.96	12.64	7.56	19.51	2.12						
	Kom-Ombo (west)	19	0-15	8.1	0.87	0.0	0.85	5.80	2.02	2.27	1.12	5.25	0.03	2.94	1.41	0.87	0.43	0.22	17.63
			15-50	8.0	1.13	0.0	0.96	9.80	0.60	2.01	1.24	7.92	0.19	3.13	1.50	0.95	0.45	0.19	14.38
			50-90	7.9	3.40	0.0	1.67	29.50	2.74	9.61	1.50	22.58	0.22	3.29	1.63	0.88	0.49	0.27	14.89

tendency to decrease in all profiles of traverse no. 1, except profile no. 1 which shows an opposite trend. Generally, the salinity in this location is related to shallow water table (65-80 cm), which helps the dissolved salts to drown toward soil surface by capillarity and accumulate on it as the moisture evaporated These results are in good agreement with *Richard's (1954)* and *Fitzpatrick (1986)*. Soils of Gamassa which represented by profile no. 3, have higher contents of soluble salts due to the very shallow depth of water table, its location near the coastal plain, the flat and level topography which forms wide plains (Coastal barrier plains) and the seepage from the near by sea, *FAO (1964).Zein El-Abedine et al. (1967)* and *El-Kattib (1978)*, found that approaching Burullus lake, the elevation of the land decreases, the ground-water level approaches to soil surface and the ground-water becomes more saline due to the contamination with sea water. According to *El-Gabaly et al. (1969)* and *Ibrahim (1990)* the ground water in the Northern Nile Delta is affected by water intrusion from the sea and the low-lying area are often flooded and forming swamps and marshes.

Soils of traverse no. 2 show grades of salinity between non-saline and moderately saline. Profiles no. 5,8, 9 and 10 have non-saline grades, except soil layers of 120-150 cm depth in profile no.5, 0-40 cm in profile no. 8 and 50-150 cm in profile no. 10. These layers and all layers of profile no. 6 are slightly saline. On the other hand, all layers of profile no. 7 are moderately saline. Depthwise distribution of soluble salts shows two patterns. The first is the decrease with depth and accumulation in the surface layer, Which indicates the presence of secondary salinization (profiles no. 6,7,8 and 9). This finding is in full agreement with *Reda (1975)*, who attributed it to capillary effect and arid climate conditions. The second pattern is an increase of soil salinity with depth in profiles no. 5 and 10. This trend may be attributed to the heavy irrigation and leaching effects.

Soils of traverse no. 3 show a salinity grades vary from non-saline to slightly saline. Salinity tends to decrease with depth in all profiles and salts tend to accumulate in the surface layer in this traverse. This finding may be attributed to low precipitation in this location and relatively hot and dry conditions.

Soil salinity in the profiles represented traverse no. 4 varies between non-saline and very strongly saline grade. Salinity tends to decrease from east to west Nile. Profile no. 14 which dug in El-Saff area shows a very strongly saline level up to 100 cm depth and the deeper layer (100-150 cm) is moderately saline. As the area of profile no. 14 was rolling and its position was deeper, the upper most surface layer of the surround areas were transported and accumulated in the upper 100 cm during the leveling processes. According to *FAO (1964)* the parent material of these soils are very bad permeable and the denuded soils are usually highly saline and may even be alkali. These salinity in combination with the poorly permeability of the subsoils, is discouraging for the development of irrigated agriculture, where the deeper layer has higher content of clay originate from the high lime content of the original rock or from the weathered particle of shales. Soils of profile no. 15 are slightly saline and salinity increase with depth. Heavy irrigation rates and poor drainage practices in the area of this profile cause a rising of water table and increase salinity in the deeper layers and ground water. Soils of profile no. 16, which represent Kom Oshim area, are non-saline in all layers except the deeper one (slightly saline).

Soil salinity in the area of traverse no. 5 varies between non-saline and slightly saline, except the surface layer of profile no. 17 (strongly saline) and profile no. 18 (moderately saline). Salinity of these two surface layers may be attributed to the shallow water table and its salinity level, especially in profile no. 18. So, salinity in profiles no. 17 and 18 tends to decrease with depth, while profile 19 shows an opposite trend and, in general, soil salinity tends to decrease from east to west Nile.

Generally, the obtained results show that soil salinity is mainly affected by the level and salinity of ground water, climatic conditions and the different land utilization practices, *Omar (1982)*.

4.1.6. Soil reaction:

Data in Table (7) represent pH values of different studied profiles. These values vary between 7.5 and 9.2.

Richard (1954) and *Fitzpatrick (1986)* stated that, non saline-non alkali soils have the electric conductivity of their saturation extracts less than 4 mmhos/cm at 25°C, the reaction of the samples ranges from slightly acid to slightly alkaline and their exchangeable-sodium-percentage is less than 15. Saline soils have the electric conductivity of the saturation extracts excess than 4.0 mmhos/cm at 25°C, but the exchangeable-sodium-percentage is less than 15 and the pH value less than 8.5. Non-saline alkali soils have the electric conductivity of the saturation extract is less than 4.0 mmhos/cm at 25 °C, exchangeable-sodium-percentage is greater than 15 and the pH reading usually between 8.5 and 10. Saline-alkali soils have the electric conductivity of the saturation extract is greater than 4 mmhos/cm at 25°C, the exchangeable-sodium-percentage is greater than 15 and the pH readings are seldom higher than 8.5.

Data in Table (7) show that soils of profile no. 1 (except layers of 0-30 and 50-80 cm), profile no. 3 and profile no. 4 (except layer of 50-80 cm) are considered saline-alkali soils, while soil of profile no. 2 (except layer 60-80 cm) is non-saline non-alkali soil. On the other hand, all exception layers are considered alkali soils.

Data of traverse no. 2 show that soils of profile no. 5 (except, layer of 120-150 cm is alkali soil), 6,8,9 and 10 are considered non-saline non-alkali soil, while soils of profile no. 7 are saline-alkali soils.

With regard to soil of traverse no. 3, soil of profile no. 13 and layers of 0-40 cm and 40-80 cm of profile 11 and 0-22 cm of profile no. 12 are non-saline non-alkali, while another layers in profiles of traverse no. 3 reveal non-saline alkali reaction.

Soils of traverse no. 4 tend to be non-saline non-alkali except all layers of profile no. 14 that have saline reaction.

Soils of traverse no. 5 show non-saline and non-alkali reaction, except the surface layers of profiles no. 17 and 18, which show saline non-alkali reactions.

4.1.7 Soluble cationsand anions:

Data of Table (7) represent soluble cations and anions in different layers of the studied profiles.

In general, sodium is the dominant cation in soil samples collected from the profiles of traverse no. 1, followed by magnesium, calcium and potassium (except few cases). Similar results were found by *Ghaith (1961) and Ibrahim (1990)* who stated that the soils of northern part of Nile Delta are rich in their content of sodium and magnesium salts.

Chloride is the dominant anion in profile no. 1 (except the layer of 50-80 cm), profile no. 2 and profile no. 4, while sulfate is the dominant anion in profile no. 3 (except the surface layer) and layer of 50-80 cm in profile no. 1. On the other hand, bicarbonate is the lowest soluble anion, except profile no. 4. The values of soluble cations and anions in either water table or saturated soil extracts follow the same trend.

Soils of traverse no. 2 have different distribution patterns of soluble cations. For examples and except few cases, the distribution pattern Na>Ca>Mg>K is found profiles no. 5 and 8, while the distribution pattern Ca>Mg>Na>K can be noticed in profiles no. 6, 9 and 10. On the contrary, the distribution pattern Na>Mg>Ca>K is found in profile no. 7.

Concerning the status of different soluble anions, it can be said, in general, sulfate is the dominant one in more soil samples, except that of profile no. 1 where chloride and bicarbonate are approximately equal and higher than sulphate. In this traverse it can be noticed the presence of sulfate and bicarbonate ions in relatively high amounts due to the soil contents of gypsum and calcium carbonate.

The distribution of soluble cations in soil samples represent traverse no. 3 show the dominance of Na in all soil samples followed either by Mg or Ca. K in all profiles occupies the lowest content.

Concerning anions contents, it can be said that Cl^- content is higher than $SO_4{}^{2-}$, while $HCO_3{}^-$ content is the lower one.

The differences between ions content in both traverses no. 2 and 3 can be attributed to locations of these traverses. The first traverse represents Nubaria region which locates in Western Desert of Egypt, while the second traverse locates in the Eastern Desert. So, the high contents on Ca^{2+} $SO_4{}^{2-}$ and $HCO_3{}^-$ in the 2ed traverse is attributed to the origin of this area *(Shata et al., 1977)* and to the amount of $CaCO_3$. While the 3 ed traverse is affected by the eastern lakes and Suez Canal, so Na^+ and Cl^- ions are dominated.

Concerning the distribution of soluble cations in soil samples taken from traverse no. 4, it can be noticed that sodium is the predominant cation in all layers of profiles no. 14 and 16 follows by calcium and/or magnesium. While, soil samples of profile no. 15 show that calcium is the predominant cation, in all layers, followed by sodium, magnesium and potassium, respectively. The distribution of soluble anions show that chloride is the dominant anion followed by sulfate in profile no. 14 (except soil layer of 100-

150 cm). While, sulfate in the dominant anion in most layers of profiles no. 15 and 16.

It must be mentioned here that the soil content of $CaCO_3$ is positively affected the amount of SO_4^{2-}.

Data of Table (7) show, in general, that sodium is the predominant cation followed by Ca, Mg and K in all layers of the profiles represent traverse no. 5. Distribution of soluble anions shows that SO_4 the dominant anion in profile no. 17 followed by chloride and bicarbonate, while chloride is the dominant one in profiles no. 18 and 19 (except layer 15-50 cm).

From the above mentioned discussions it can be concluded that, the status and distributions of different ions in the studied sandy soils are largely affected by the origin of soil, parent material, method of transportation, stage of utilization, location, climatic conditions ..... etc.

4.1.8. Cation exchange capacity (CEC):

Data of Table (7) represent the values of cation exchange capacity in the studied soil samples. CEC varies between 1.87 and 39.11 me/100g. Generally, values of CEC appear relatively low, attributed to the dominance of coarse texture materials and relatively low content of organic matter. Data show that higher CEC value (39.11 me/100g) is found in layer of 33-39 cm (profile no. 18) which related to higher clay content (50.30%), lower sand content (25.31%), and relatively high content of organic matter (0.59%) and calcium carbonate (10.15 %). On the other hand, the least CEC value (1.87 me/100g) is found in layer of 40-150 cm (profile no. 12), which has 1.25%

Table (8) :Correlation coefficients (r) between cation exchange capacity and some soil variables .

Soil variables	r
Sand	- 0.825**
Silt	0.679**
Clay	0.852**
Organic matter	0.250*
Calcium carbonate	0.259*

* = Significant at 5 % level .

** = Significant at 1 % level .

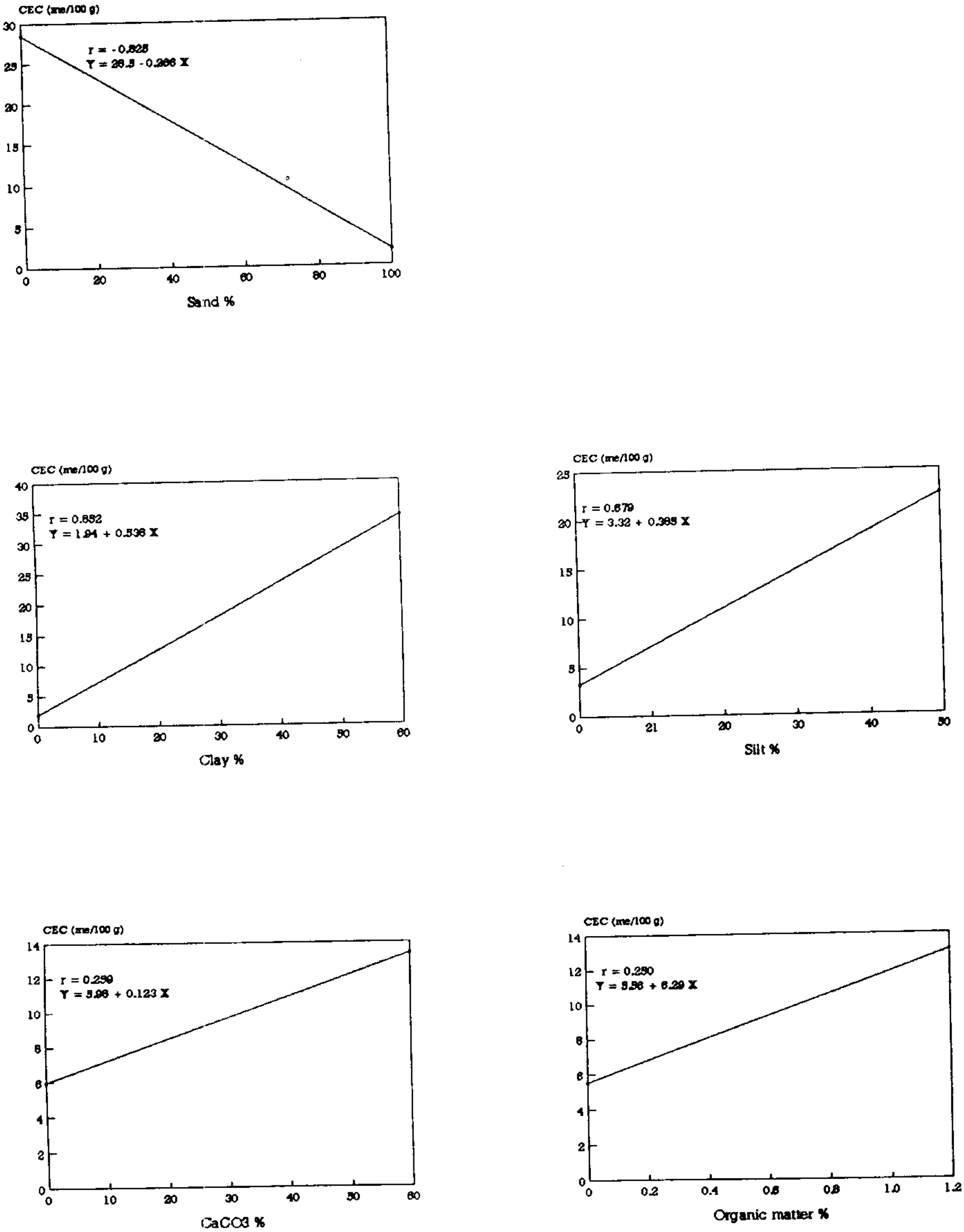


Fig. (3) : The linear relationships and regressions equations for the relation between CEC and some soil properties .

clay content, 97.18% sand, 0.62% $CaCO_3$ and 0.13% organic matter, which approved with *Hamra (1982), Al-Sharif (1987)* and *Hassona (1989)*.

Correlation coefficients and regression equations between cation exchange capacity and some soil variables are presented in Table (8) and illustrated in Fig.(3). It can be noticed that clay, silt, organic matter and calcium carbonate contents are significantly and positively correlated with the value of CEC (r=0.852**, 0.679**, 0.250* and 0.259*, respectively). While, CEC is negatively and significantly correlated with sand content (r= - 0.825**).

4.1.9. Exchangeable cations:

Data of Table (7) show, in general, that calcium is the predominant exchangeable cation follows by magnesium, sodium and potassium, But this finding is not exist in some layers of profiles no. 7, 8 and 10, where magnesium is the predominant exchangeable cation follows by Ca^{2+}, Na^+ and K^+. On the other hand, the order: Ca>Na>Mg>K is found in the deepest two layers of profile no. 11, upper layers of profile no. 16. These variation can be attributed to the nature of ion as manifested by valence, size and polarizability and polarizing power. The bonding strength increase with valence and the less hydrated the ion the more tightly it is held, *Bear (1964)*. So, Ca^{2+} is the predominant cations, in the other hand, another cations such as Mg^{2+} tend to predominant may be due to its concentration (profile no. 7) and valence. Increasing exchangeable sodium than exchangeable magnesium is due to concentration, which approved with Bear (1964). Data of exchangeable cation agree with *Al-Sharif (1987)* and *Mohamed (1992)*.

4.1.10. Amorphous inorganic materials:

The mineral components of clay fraction oc crystalline form. The principal forms of amorphou oxides, or more usually, the hydrous oxides of Amorphous inorganic materials are usually p inheritance of the parent materials from which soils we a result of chemical degradation of minerals, *Rich and Thomas, (1960)*.

Distributions and contents of amorphous inorganic materials in the studied soil samples and profiles are presented in Table (9).

Amorphous silica is the dominant constituent of the amorphous inorganic materials in the soil of traverse no. 1 (except the upper two layers of profile no. 1). Silica content ranges from 0.19 to 0.84%. On the other hand, alumina is the least content among amorphous constituents, where its content ranges from 0.04 to 0.55%, while amorphous iron content lies between silica and alumina. Total amorphous inorganic materials tend to decrease with depth in profiles no. 1 and 2 while the opposite trend is true in profiles no. 3 and 4, which reveal the same distribution of clay content.

The SiO_2/AL_2O_3 molar ratio ranges from 1.85 to 13.15andit increases from east to west. According to *Jackson (1956)* the "sesquioxidic allophane" and "halloysitic allophane" have SiO_2/Al_2O_3 molar ratios of 0.8-1.4 and 1.5-2.3, respectively. *Briner and Jackson (1969)* found that the amorphous aluminosilicates with SiO_2/Al_2O_3 molar ratios of 2.4 or more may appropriately be termed "siliceous allophane". So, the values of SiO_2/Al_2O_3 molar ratio show that profiles no. 1 (except layer of 30-50 cm) and 2 have

Table (9) : The contents of amorphous inorganic oxides in the studied soil profiles .

Trav. No.	Location	Profile No.	Samp. Depth (cm)	SiO2 %	Al2O3 %	Fe2O3 %	Total %	Molar ratio
1	Om EL-Reda	1	0-30	0.34	0.31	0.36	1.01	1.85
			30-50	0.19	0.12	0.26	0.57	2.69
			50-80	0.20	0.17	0.18	0.55	2.00
	EL-Mattar	2	0-30	0.67	0.55	0.57	1.79	2.07
			30-60	0.29	0.26	0.29	0.84	1.90
			60-80	0.46	0.36	0.36	1.16	2.29
	Gamassa	3	0-20	0.69	0.19	0.30	1.18	6.16
			20-40	0.75	0.19	0.25	1.19	6.70
			40-65	0.84	0.21	0.24	1.30	6.79
	Rosatta	4	0-20	0.31	0.04	0.21	0.56	13.15
			20-50	0.36	0.09	0.35	0.80	6.79
			50-80	0.52	0.12	0.49	1.13	7.35
2	EL-Nubaria	5	0-35	0.37	0.18	0.36	0.91	3.50
			35-75	1.01	0.22	0.68	1.91	7.79
			75-120	1.07	0.45	0.38	1.90	4.04
			120-150	0.92	0.21	0.53	1.66	7.43
	EL-Nubaria	6	0-30	0.29	0.09	0.44	0.82	5.46
			30-80	0.28	0.09	0.46	0.83	5.28
			80-150	0.35	0.17	0.44	0.96	3.50
	EL-Nubaria	7	0-30	0.75	0.21	0.55	1.51	6.06
			30-70	1.23	0.32	0.97	2.52	6.52
			70-120	1.23	0.33	0.84	2.40	6.33
	EL-Nubaria	8	0-40	0.30	0.08	0.29	0.67	6.36
			40-60	0.72	0.13	0.37	1.22	9.40
			60-80	0.41	0.18	0.29	0.88	3.87
			80-150	0.22	0.06	0.22	0.50	6.23
	EL-Nubaria	9	0-40	0.48	0.07	0.32	0.87	11.64
			40-70	0.77	0.12	0.56	1.45	10.89
			70-150	1.08	0.17	0.87	2.12	10.77
	EL-Nubaria	10	0-30	0.74	0.15	0.24	1.13	8.37
			30-50	0.83	0.16	0.41	1.40	8.81
			50-150	0.98	0.18	0.53	1.69	9.23

Table (9) : Cont.

Trav. No.	Location	Profile No.	Depth (cm)	SiO2 %	Al2O3 %	Fe2O3 %	Total %	Molar ratio
3	EL-Shbab	11	0-40	0.86	0.11	0.53	1.50	13.27
			40-80	0.94	0.12	0.59	1.64	13.29
			80-110	1.96	0.22	0.84	3.02	14.98
			110-150	0.81	0.13	0.64	1.58	10.57
	EL-Shbab	12	0-22	2.00	1.67	0.52	4.19	2.04
			22-40	0.25	0.20	0.11	0.56	2.12
			40-150	0.20	0.15	0.13	0.48	2.26
	Belbeis	13	0-45	3.52	0.16	0.61	4.29	37.44
			45-80	1.96	0.11	0.47	2.54	30.23
			80-150	1.25	0.09	0.27	1.61	23.57
4	EL-Saff	14	0-40	0.38	0.09	0.46	0.93	7.16
			40-70	0.55	0.12	0.48	1.15	7.77
			70-100	0.67	0.08	0.37	1.12	14.22
			100-150	0.77	0.15	0.61	1.53	8.70
	EL-Aiyat	15	0-20	0.70	0.17	0.52	1.39	6.99
			20-50	0.58	0.17	0.44	1.19	5.79
			50-70	0.64	0.15	0.81	1.60	7.25
	Kom-Oshim	16	0-20	1.11	0.26	1.37	2.74	7.25
			20-27	1.34	0.42	1.30	3.06	5.41
			27-40	0.83	0.20	0.64	1.67	7.04
			40-50	1.08	0.33	0.65	2.06	5.55
			50-80	1.07	0.48	0.64	2.19	3.78
			80-150	2.36	0.21	0.81	3.38	19.07
5	Wadi EL-Khrait	17	0-20	2.03	0.59	3.70	6.32	5.84
			20-36	1.57	0.26	2.30	4.13	10.25
			36-71	0.89	0.20	1.48	2.57	7.55
	Kom-Ombo (east)	18	0-25	2.51	0.34	1.47	4.32	12.52
			25-33	3.21	0.54	1.25	5.00	10.08
			33-39	4.62	1.15	1.55	7.32	6.82
			39-65	3.64	0.58	0.51	4.73	10.66
			65-110	0.29	0.21	0.37	0.87	2.34
	Kom-Ombo (west)	19	0-15	0.14	0.11	0.54	0.79	2.15
			15-50	0.15	0.13	0.70	0.98	1.95
			50-90	0.15	0.12	0.80	1.07	2.12

halloysitic allophane, while, profiles and layers of traverse 1 have siliceous allophane.

The percentages of total amorphous inorganic materials in traverse no. 2 range between 0.47 and 2.52% and tend to increase with depth. Amorphous silica is the predominant constituent of amorphous materials (except profile no. 6) and ranges between 0.22 and 1.23%, and it also increases with depth. The contents of amorphous iron and allumina range from 0.22 to 0.97% and 0.06 to 0.45% respectively and they also increase with depth except few cases. Generally, total amorphous material show the same distribution of clay content. Least content of amorphous material found in profile no. 6, which have lower clay and silt contents. The SiO_2/Al_2O_3 molar ratio ranges from 3.50 to 11.64, which reveals that the soils have siliceous allophane. Data show some homogeneity in profiles no. 6 and 10.

Amorphous inorganic materials in traverse no. 3 range between 0.48 and 4.29% and tend to decrease with depth except profile no. 11, which shows the opposite trend. Generally, clay content is main factor which related to higher content of amorphous materials. While, lower content of amorphous inorganic materials (0.48%) is related to higher pH value (pH 9.2) in layer of 40-150 cm (profile no. 12). The SiO_2/Al_2O_3 molar ratio varies between 2.04 and 37.44, which reveals that soils of profile no. 11 and 13 have siliceous allophane, while profile no. 12 has halloysitic allophane.

Total amorphous inorganic materials of soils of traverse no. 4 vary between 0.93 and 3.38% and it tends to increase with depth in profile no. 14, while profile no. 15 shows the opposite trend. Contents of amorphous silica, alumina and iron vary from 0.38 to 2.36%, 0.08 to 048% and 0.37 to 1.37% respectively. Profile no. 16 contains higher content of amorphous materials has higher clay content. The SiO_2/Al_2O_3 molar ratios range between 3.78 and 19.07, which reveal that soil have siliceous allophane.

Soils of traverse no. 5 show that total amorphous inorganic materials vary between 0.79 and 7.32% and, generally, tend to increase with depth (except profile no. 17). Contents of amorphous silica, alumina and iron vary from 0.14 to 4.62%, 0.11 to 1.15% and 0.37 to 3.70%, respectively. Profile no. 18 contain higher amounts of amorphous materials has higher clay content also. The SiO_2/Al_2O_3 molar ratios range between 1.95 and 12.52, which reveal that the soils of profiles no. 17 and 18 have siliceous allophane, while profile no. 19 has halloysitic allophane.

Finally, data of Table (9) show that amorphous inorganic materials is low due to decrease clay content highness pH values, which agree with *Heakal (1968)* and *Naga and Heakal (1972)*. Higher content of amorphous materials is related to higher clay content in layer of 33-39 cm (profile no. 18), while lower one is related to higher pH value in layer of 40-150 cm (profile no. 12). According to *Hassona (1989)*, the variation of amorphous material content are apparently associated with the high clay content or may be attributed to the dominantly igneous and metamorphic origin of parent materials. The SiO_2 /Al_2O_3 molar ratios show that siliceous materials are predominant constituent. Distribution of amorphous material reveal the soils appear as the multi-origin.

4.1.11 Trace elements:

The level of trace elements or micronutrients could be used as a guide for substantiating the nature of parent materials, together with pedogenic aspects which lead to the prediction of soil genesis and formation, *Hassona (1979)* and *Abd EL-Hamid (1981)*.Chemically extractable levels of micro-nutrients could be considered as a reliable guide for the assessment of their availability. *Lindsay and Norvell (1978)* pointed out that, a DTPA soil extract was developed to identify near-neutral and calcareous soils with insufficient available Fe, Mn, Zn or Cu for maximum yield crops. Soil samples collected from the studied soil profiles were examined to obtain more information about the levels of Fe, Mn, Zn, Cu and B.

a) Iron:

Data of Table (10) reveal that total iron content in the studied profiles varies between 3000 and 26000 ppm. It tends to decrease with depth in soils of traverses no. 1 (except profile no. 4) and 3 (except profile no. 11) . While, soils of traverses no. 2 (except profiles no. 6 and 8) and 4 show an opposite trend. Generally, soils of traverse no. 5 have higher contents of total iron .

The correlation coefficients between total iron content and some soil constituents are presented in Table (11) and illustrated in Fig.(4)5 It is obvious that total Fe content is positively and significantly correlated with clay and silt contents, which agree with the findings of *Katyal and Sharma (1990)* and *Rahim(1993)*. However, organic matter and $CaCO_3$ contents exhibit positive and insignificant correlations with Fe content, *Hassona(1989)*.

Table (10) : The total and chemically extractable contentes of some trace elements in the studied soils .

Trav. No.	Location	Profile No.	Samp. Depth (cm)	Total of trace elements (ppm)					DTPA-extractable (ppm)				Soluble B (ppm)
				Fe	Mn	Zn	Cu	B	Fe	Mn	Zn	Cu	
1	Om EL-Reda	1	0-30	15000	399	43	68	24.6	6.40	8.00	0.24	0.24	0.80
			30-50	12000	285	15	12	24.9	2.40	12.00	0.12	0.16	0.80
			50-80	10000	326	17	8	11.0	3.80	14.00	0.12	0.14	0.60
	EL-Mattar	2	0-30	9200	240	21	10	12.2	6.80	10.00	0.40	0.76	0.70
			30-60	8800	231	18	6	11.8	3.60	5.00	0.16	0.26	0.70
			60-80	4800	246	16	6	17.8	2.80	6.00	0.12	0.20	0.80
	Gamassa	3	0-20	19800	160	210	41	9.6	6.90	5.30	0.35	0.53	0.61
			20-40	18600	153	180	41	9.1	6.20	4.20	0.19	0.24	0.60
			40-65	18000	141	180	33	6.7	5.70	1.60	0.16	0.20	0.58
	Rosatta	4	0-20	5100	115	38	9	9.4	4.80	3.20	0.43	0.44	0.74
			20-50	5900	96	51	9	9.0	5.10	1.90	0.11	0.31	0.72
			50-80	6300	121	59	14	6.6	5.30	0.70	0.07	0.20	0.52
2	EL-Nubaria	5	0-35	7500	185	237	8	4.2	0.80	1.60	0.14	0.10	0.40
			35-75	10000	177	105	9	3.4	0.20	1.60	0.12	0.08	0.30
			75-120	9600	133	36	8	2.1	0.20	1.20	0.12	0.06	0.20
			120-150	9600	138	18	10	4.6	0.80	1.80	0.16	0.06	0.50
	EL-Nubaria	6	0-30	4600	71	44	10	2.5	2.40	2.80	0.42	0.53	0.50
			30-80	3900	62	17	8	1.6	1.60	0.60	0.19	0.07	0.19
			80-150	5800	74	59	12	5.3	2.30	0.70	0.66	0.51	0.46
	EL-Nubaria	7	0-30	7350	86	63	11	3.6	0.70	0.60	0.11	0.08	0.62
			30-70	9010	179	85	30	5.9	0.90	1.10	0.43	0.14	0.59
			70-120	8800	155	80	26	7.4	0.90	0.90	0.36	0.12	0.61
	EL-Nubaria	8	0-40	13000	105	153	35	3.6	2.10	1.70	0.96	0.87	0.36
			40-60	13800	112	168	32	4.5	1.50	0.90	0.87	0.66	0.31
			60-80	11100	70	139	18	3.7	1.40	0.70	0.69	0.53	0.22
			80-150	10900	60	115	16	4.8	0.90	0.70	0.73	0.80	0.20
	EL-Nubaria	9	0-40	9400	85	97	17	2.6	2.40	2.60	0.89	0.66	0.41
			40-70	10000	92	115	19	1.9	1.30	0.90	0.63	0.53	0.24
			70-150	11200	80	140	21	1.7	1.20	0.80	0.81	0.51	0.06
	EL-Nubaria	10	0-30	11800	96	122	27	1.6	1.50	0.90	0.97	0.88	0.53
			30-50	12600	110	157	30	2.1	1.30	0.60	0.63	0.47	0.43
			50-150	12700	125	173	28	1.5	1.20	0.40	0.95	0.42	0.41

Table (10) : Cont.

Trav. No.	Location	Profile No.	Depth (cm)	Total of trace elements (ppm)					DTPA-extractable (ppm)				Soluble B (ppm)
				Fe	Mn	Zn	Cu	B	Fe	Mn	Zn	Cu	
3	EL-Shbab	11	0-40	4800	100	47	9	2.1	0.90	1.30	0.58	0.53	0.64
			40-80	4100	85	43	6	2.0	0.80	0.40	0.33	0.21	0.53
			80-110	9600	130	59	11	1.8	0.80	0.40	0.18	0.06	0.26
			110-150	3500	61	65	5	2.9	0.30	0.20	0.05	0.01	0.33
	EL-Shbab	12	0-22	13000	277	27	26	9.4	4.80	8.20	0.50	0.76	0.60
			22-40	3600	87	9	10	6.6	0.40	1.60	0.08	0.04	0.50
			40-150	3000	69	7	80	11.9	0.20	1.40	0.08	0.02	0.70
	Belbeis	13	0-45	4370	92	39	13	3.2	2.50	0.90	0.33	0.52	0.85
			45-80	3740	86	31	11	3.4	2.30	0.50	0.18	0.43	0.71
			80-150	3700	74	33	7	2.5	0.90	0.60	0.21	0.19	0.36
4	EL-Saff	14	0-40	9300	214	29	14	3.1	1.00	1.80	0.32	0.18	0.30
			40-70	9400	223	24	13	2.1	0.80	2.00	0.18	0.10	0.20
			70-100	9800	152	17	13	3.4	0.60	2.40	0.24	0.18	0.30
			100-150	15000	213	38	16	2.7	0.80	2.2	0.16	0.10	0.20
	EL-Aiyat	15	0-20	8650	200	42	16	3.0	3.00	2.80	0.41	0.75	0.51
			20-50	8710	165	33	13	1.7	3.10	2.60	0.33	0.21	0.18
			50-70	9400	212	64	21	4.7	4.80	2.80	0.74	0.68	0.29
	Kom-Oshim	16	0-20	11100	449	29	40	4.1	1.60	4.20	0.56	0.36	0.40
			20-27	14500	250	43	20	2.7	0.20	2.40	0.20	0.20	0.30
			27-40	9000	205	27	12	2.6	0.60	2.40	0.26	0.22	0.20
			40-50	9900	165	30	12	4.5	0.20	1.60	0.20	0.20	0.40
			50-80	8700	194	25	13	3.0	1.80	1.60	0.62	0.36	0.30
			80-150	16000	222	44	23	3.2	1.60	1.40	0.32	0.20	0.30
5	Wadi EL-Khrait	17	0-20	26000	526	59	27	2.7	1.60	7.00	0.20	0.22	0.20
			20-36	18000	423	50	18	3.6	1.60	5.20	0.26	0.28	0.40
			36-71	18000	468	41	18	3.4	0.60	4.00	0.24	0.18	0.30
	Kom-Ombo (east)	18	0-25	15000	322	46	22	3.9	2.60	1.04	0.40	0.48	0.50
			25-33	18000	304	156	32	2.7	4.20	6.00	0.54	1.06	0.30
			33-39	21000	263	76	43	3.3	7.00	5.60	0.98	2.54	0.40
			39-65	22000	351	72	40	2.2	4.20	4.60	0.60	1.20	0.20
			65-110	3000	174	28	8	2.9	1.80	2.80	0.26	0.38	0.30
	Kom-Ombo (west)	19	0-15	6300	320	21	22	1.3	2.40	3.60	0.87	0.40	0.21
			15-50	4160	292	14	24	1.4	2.90	4.70	0.94	0.32	0.26
			50-90	7190	346	35	24	1.6	3.50	6.10	1.06	0.06	0.47

Table (11):Correlation coefficients (r) the between the total trace elements and some soil variables .

Soil variables	r				
	Fe	Mn	Zn	Cu	B
Sand	-0.554**	-0.074	-0.380**	-0.270*	0.333**
Silt	0.414**	0.046	0.260*	0.163	-0.333**
Clay	0.619**	0.094	0.452**	0.345**	-0.276*
Organic matter	0.187	0.128	-0.023	0.201	0.049
Calcium carbonat	0.179	-0.328**	0.490**	0.091	-0.318**
Tourmaline					0.869**

Table (12):Correlation coefficients (r) between chemically extractable trace elements and soil variables.

Soil variables	r				
	Fe	Mn	Zn	Cu	B
Sand	0.097	0.123	-0.478**	-0.530**	0.463**
Silt	-0.245*	-0.201	0.344**	0.283*	-0.481**
Clay	0.087	-0.014	0.549**	0.720**	-0.366**
Organic matter	0.238	0.275*	0.113	0.367**	0.315**
Calcium carbonat	-0.280*	-0.352**	0.552**	0.281*	-0.439**
Total element	0.306*	0.672**	0.309*	0.279*	0.681**
Tourmaline					0.625**

* = Significant at 5 % level

* * = Significant at 1 % level

Table (13) : Weighted mean , Trend and Specific range of some trace elements in the studied soil profiles .

Trav. No.	Location	Profile No.	Fe			Mn			Zn			Cu			B		
			W	T	R	W	T	R	W	T	R	W	T	R	W	T	R
1	Om EL-Reda	1	12375.0	-0.175	0.404	343.1	-0.140	0.332	26.3	-0.388	0.989	31.5	-0.537	1.905	19.6	-0.203	0.709
	EL-Mattar	2	7950.0	-0.136	0.553	238.1	-0.008	0.063	18.6	-0.114	0.269	7.5	-0.250	0.533	13.5	0.096	0.444
	Gamassa	3	18738.5	-0.054	0.096	150.5	-0.059	0.126	189.2	-0.099	0.159	37.9	-0.075	0.211	8.3	-0.135	0.349
	Rosatta	4	5850.0	0.128	0.205	110.1	-0.043	0.227	50.8	0.252	0.413	10.9	0.174	0.459	8.2	-0.128	0.341
2	EL-Nubaria	5	9216.7	0.186	0.271	157.9	-0.146	0.329	97.7	-0.588	2.242	8.7	0.080	0.230	3.4	-0.190	0.735
	EL-Nubaria	6	4959.3	0.072	0.397	69.4	-0.023	0.173	42.0	-0.045	1.000	10.3	0.029	0.388	3.5	0.286	1.057
	EL-Nubaria	7	8507.5	0.136	0.195	145.8	0.410	0.638	77.4	0.186	0.284	23.6	0.534	0.805	6.0	0.400	0.633
	EL-Nubaria	8	11873.3	-0.087	0.244	80.3	-0.235	0.648	135.4	-0.115	0.391	23.6	-0.329	0.809	4.3	0.163	0.279
	EL-Nubaria	8	10480.0	0.103	0.172	83.7	-0.015	0.143	123.5	0.215	0.348	19.5	0.128	0.205	2.0	-0.231	0.450
	EL-Nubaria	10	12506.7	0.057	0.072	117.2	0.181	0.247	160.7	0.241	0.317	28.1	0.039	0.107	1.6	0.000	0.375
3	El-Shbab	11	5226.7	0.082	1.167	91.6	-0.084	0.753	53.1	0.115	0.414	7.5	-0.167	0.800	2.2	0.045	0.500
	El-Shbab	12	4418.7	-0.660	2.263	101.7	-0.633	2.045	10.2	-0.622	1.960	63.7	0.592	1.099	10.9	0.138	0.486
	El-Shbab	13	3910.3	-0.105	0.171	82.2	-0.107	0.219	34.3	-0.121	0.233	9.7	-0.254	0.619	2.9	-0.094	0.310
4	El-Saff	14	11320.0	0.178	0.504	203.1	-0.051	0.350	28.6	-0.014	0.734	14.3	0.021	0.210	2.8	-0.097	0.464
	El-Aiyat	15	8890.0	0.027	0.084	188.4	-0.058	0.250	44.4	0.054	0.698	16.1	0.006	0.497	2.9	-0.033	1.034
	Kom-Oshim	16	12803.0	0.133	0.547	242.7	-0.459	1.170	35.7	0.188	0.532	21.4	-0.465	1.308	3.3	-0.195	0.576
5	El-Khrait	17	20253.5	-0.221	0.395	474.2	-0.098	0.217	48.1	-0.185	0.374	20.5	-0.241	0.446	3.3	0.182	0.273
	Kom-Ombo,E	18	12290.9	-0.181	1.546	263.8	-0.181	0.671	54.4	0.154	2.353	22.4	0.018	1.563	3.0	-0.231	0.567
	Kom-Ombo,W	19	5863.3	-0.069	0.517	320.7	0.002	0.168	24.5	0.143	0.857	23.7	0.072	0.084	1.5	0.133	0.200

In contrast, Fe is negatively and significantly correlated with sand content, *Rabie et al (1989)*.

Concerning the relationship between the distribution of trace elements and locality of the studied soil profiles, the weighted mean(W), trend (T) and specific range (R) are calculated according to *Oertel and Giles (1963)*. The weighted mean concentration for each profile is obtained by multiplying the concentration of each sample horizon of the solum by the thickness of horizon or layer and then dividing the sum of these products by the total thickness of profile.

Measure of the change in element concentration with depth is provided by the trend (T)

$T = (W - S) / W$ when $W > S$

$T = (W - S) / S$ when $W < S$

where: W = Weighted mean

S = The element concentration in the surface layer

All values for T lie in the range from -1 to +1. The T values are symmetrical when T is small. This symmetry is distorted when T is large because a value of +1 is possible but a value of -1 is impossible.

A small value for T does not necessarily imply a small range in concentration throughout the profile. Definite information on this feature is therefore provided by the specific range (R), defined by

$$R = (H - L) / W$$

where, H and L are the highest and lowest observations in the solum, and W is the weighted mean.

While the weighted mean concentration for a trace element in soil profile is probably determined as much by pedogenic processes as by the original concentration in the parent material, *Oertiel (1961)*, the trend (T) and specific range (R) are obviously determined by pedogenic processes alone, except where the parent material is markedly heterogeneous in trace element content.

The statistical measures, weighted mean, trend and specific range of iron are found in Table (13). The computed weighted mean in the soils of traverse no. 1 decreases on passing from east to west in profiles no. 1 and 2 and the same tendency is found in profiles no. 3 and 4. Likewise, T values show that Fe distribution in profile no. 3 is more symmetrical than other profiles and increasing the symmetrically toward west. Moreover, the specific range indicates that the soil's materials are heterogeneous.

The iron weighted mean of soils of traverse no. 2. shows no particular pattern. The computed trend indicates a more symmetrical distribution of Fe in profiles no. 6, 8 and 10 than other profiles. The specific range indicates that the soil's materials are heterogeneous.

The soils of traverse no. 3 show that W values of Fe tend to decrease from east to west . T values indicate that total Fe distribution is more symmetrical in profile no. 11 than others profiles. Furthermore, the data of R show that the soils of traverse no. 3 are heterogeneous in respect of total Fe content.

With regard to the soils of traverse no. 4, the weighted mean of total Fe shows no particular pattern. The computed trend indicates that Fe distribution in profile no. 15 is more symmetrical than another representative profiles. Moreover, the specific range shows that the soils of traverse no. 4 are heterogeneous in respect of total iron content.

The weighted mean in soils of traverse no. 5 shows that the soils contain higher amounts of total iron and have the same trend in soils of traverse no. 3. The computed trend indicates an increase of total Fe symmetrical distribution toward west. Furthermore, the specific range indicates that the soil materials are heterogeneous.

Data of Table (10) reveal that the amounts of DTPA- extractable iron in the studied soil samples between 0.2 and 7.0 ppm according to sampling depth, location of each traverse and total content of the element. Generally, the soils of traverse no. 1 contain higher amounts of available iron. This finding may be due to the exist of water table at a shallow depth which decreases the rate of oxygen diffusion and lead to increase availability of iron, *Sharma and Swarup (1988)*, *Rajkumar et al. (1990)* found that the soils developed from ferriginous sand stone and shale had a higher content of available Fe than soils developed from granite or basalt. Generally, the concentrations of DTPA-extractable forms reflect the differences in pedogenic and management processes. Surface layer of most profiles has a higher content of available iron, this finding may be attributed to the low pH values of these layers and the additions of mineral fertilizers.

The correlation coefficients between available iron and some soil variables are presented in Table (12) and illustrated in Fig .(5). It is obvious that chemically extractable iron is positively and significantly correlated with total iron content (r = 0.306*), the obtained data are in close agreement with *Rahim (1993),* while it significantly and negatively correlates with silt and $CaCO_3$ contents (r =-0.245* and -0.280*, respectively), which agrees with *Katyal and Sharma (1990).* On the other hand, the contents of sand, clay and organic matter are positively and insignificantly correlated with available iron.

Lindsay and Norvell (1978), divided The critical levels of DTPA-extractable iron for sensitive crops to three values: a) <2.5 ppm, consider deficient level. b) 2.5 - 4.5 ppm, reveal to marginal level and c) > 4.5 ppm, appear adequate level. According to these limits the available iron content at surface layer of different traverses could be evaluated as follows:

Available iron content in the profiles of traverse no. 1 and profile no. 12 of traverse no. 3 are considered as adequate level, while profile no. 13 of traverse no. 3, profile no. 15 of traverse no. 4 and profile no. 18 of traverse no. 5 are considered as marginal level . On the other hand, available iron in all profiles of traverse no. 2, profile no. 11 of traverse no. 3, profiles no. 14 and 16 of traverse no. 4 and profiles 17 and 19 of traverse no. 5 are considered as deficient level.

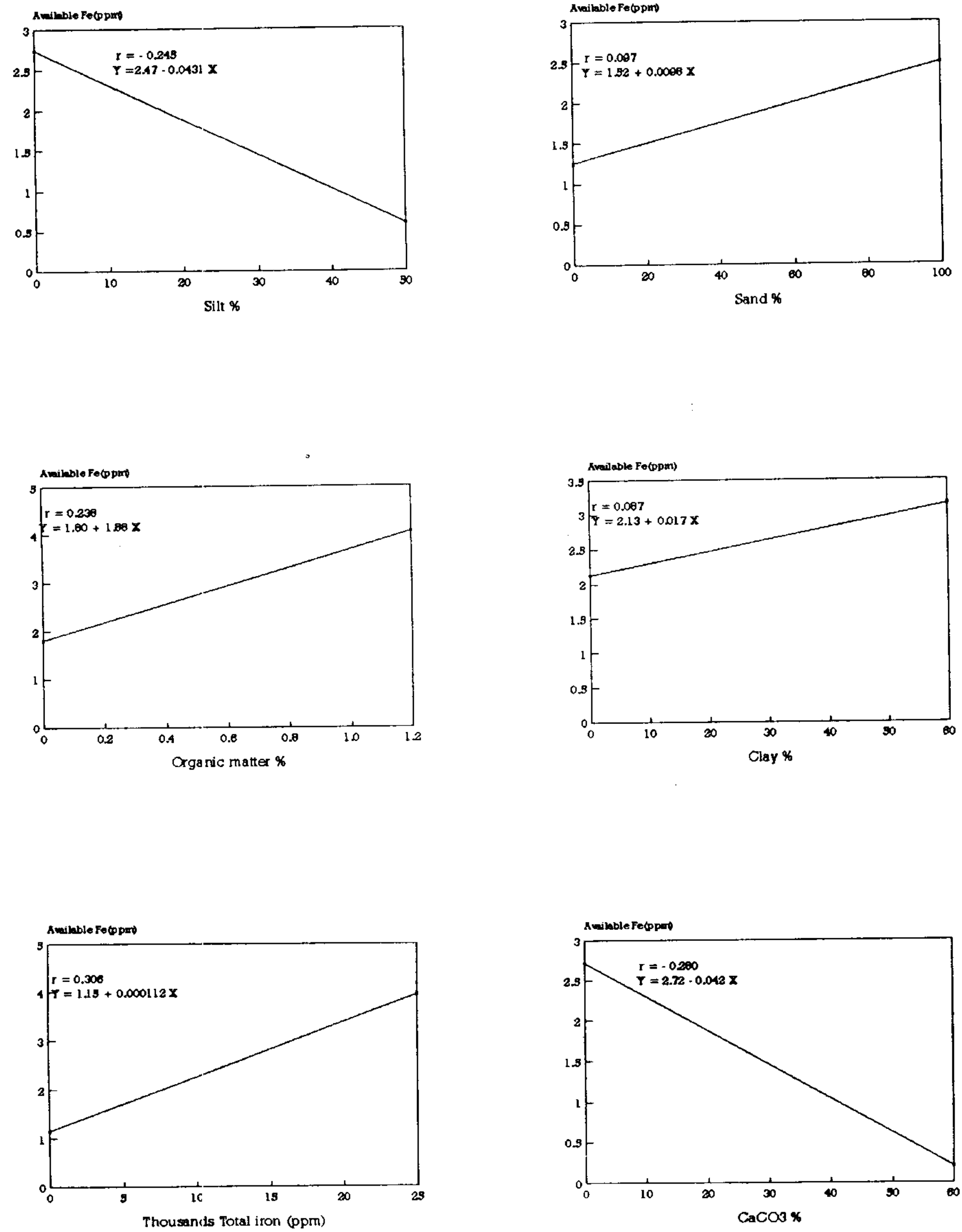


Fig. (5) : The linear relationships and regressions equations between available iron content and some soil constituents .

Generally, the availability of iron decreases as the soils become aridic and as pH and or $CaCO_3$ increase, *Katyal and Sharma (1990)*

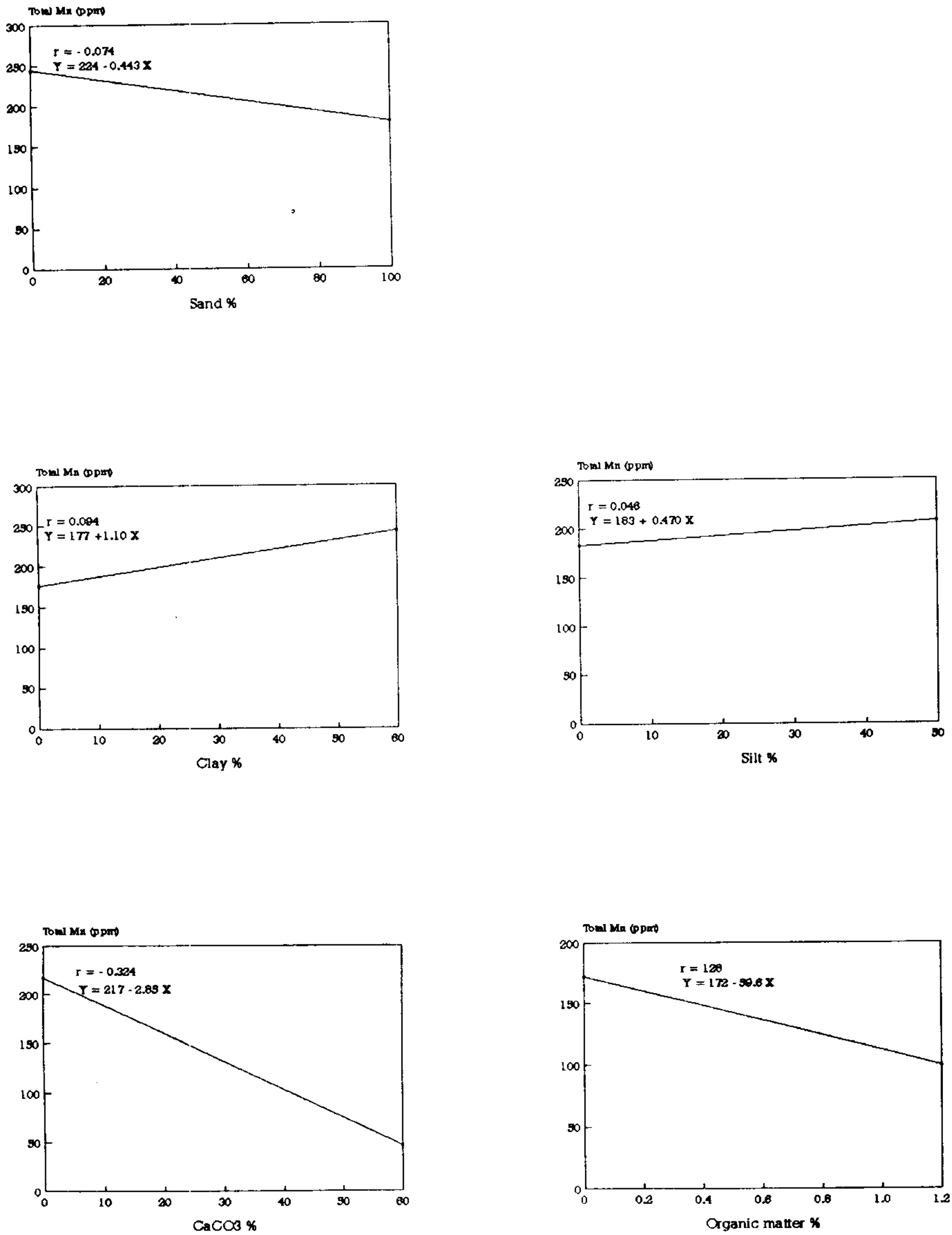
b) Manganese:

Data of Table (10) reveal that total manganese in the studied profiles varies between 60 and 526 ppm. It tends to decrease with depth in soils of profiles no. 1, 3 (traverse no. 1), 5 (traverse no. 2), 12, 13 (traverse no. 3), 16 (traverse no. 4) and 17 (traverse no. 5) . While soils of profiles no. 7 and 10 (traverse no. 2) show an opposite trend. On the other hand, other studied profiles have irregular trend.

The correlation coefficients between total manganese content and some soil constituents are presented in Table (11) and illustrated in Fig. (6). It is obvious that total manganese is negatively and significantly correlated with $CaCO_3$,which agree with the findings of *Ismail (1968 a)*. However, sand, silt, clay and organic matter exhibit insignificant correlations with total Mn content. *Hassona (1989)*.

The statistical measures, weighted mean, trend and specific range of Mn are found in Table (13). The computed weighted mean in the soils of traverse no. 1 decreases on passing from east to west and contains higher amounts of total Mn. Likewise, T values show that Mn distribution in profile no. 2 is more symmetrical than other profiles. Moreover, the specific range indicates that the soil's materials are heterogeneous.

The weighted mean (Mn) of soils of traverse no. 2 shows no particular pattern, except a tendency to increase on passing from east to west in profiles



Fif. (6) : The linear relationships and regressions equations between total manganese content and some soil constituents .

no. 8,9 and 10. The computed trend indicates more symmetrical distribution in profiles no. 6 and 9. The specific range indicates that the soil's materials are heterogeneous except soils of profiles 7 and 8 tend to be homogeneous in respect of total Mn content.

The soils of traverse no. 3 show that W values of total Mn reveal no particular pattern. T values indicate that total Mn distribution is more symmetrical in profile no. 11 than other profiles. Furthermore, data of R show that the soils of traverse no. 3 are heterogeneous.

With regard to the soils of traverse no. 4, W values of total Mn show no particular pattern. T values indicate that Mn distribution in profiles no. 14 and 15 are more symmetrical. Moreover, R values show that the soils of traverse no. 4 are heterogeneous in respect of total Mn content.

The weighted mean in soils of traverse no. 5 shows that total Mn shows no particular pattern. The computed trend indicates an increase of total Mn distribution in profile no. 19. Furthermore, the specific range indicates that the soil materials are heterogeneous.

Data of Table (10) reveal that the amounts of DTPA- extractable Mn in the studied soil samples, varies between 0.2 and 14.4 ppm according to sampling depth, location of each traverse and total content of the element. Generally, the soils of traverse no. 1 exhibit the higher contents of chemically extractable manganese due to the exist of shallow water table, similar results were found by *Sharma and Swarup (1988)*. According to *Rajkumar et al. (1990)* the soils developed from ferriginous sandstone and shale had larger content of available manganese than soils developed from granite or basalt. Generally, the concentration of DTPA - extractable forms reflect the differences in pedogenic and management processes. Surface layer of most profiles has a higher content of available Mn, this finding may be due to the low pH values of these layers and the addition of mineral fertilizers.

The correlation coefficients between available Mn and soil variables are presented in Table (12) and illustrated in Fig . (7). It is obvious that chemically extractable Mn is positively and significantly correlated with organic matter and total Mn, *Katyal and Sharma (1990)* and *Rahim (1993)*. While, it significantly and negatively correlates with $CaCO_3$ content which aggress with *Katyal and Sharma (1990)*. On the other hand, the contents of sand, silt and clay are insignificantly correlated with available Mn.

Lindsay and Norvell (1978) divided the critical levels of DTPA-extractable manganese to two levels: a (< 1.00 ppm considered deficient; b) > 1.0 ppm appear adequate level. According to these limits the available manganese content at surface layer of diffrent profiles could be evaluated as follows:-

All profiles under investigation exhibit as adequate level except profiles no. 7 and 10 of traverse no. 2 and profile no. 13 of traverse no. 3 were considered a deficient levels.

c) Zinc:

Data of Table (10) reveal that total zinc content in the studied profiles varies between 7 and 237 ppm. It tends to decrease with depth in soils of profiles no. 1,2,3 (traverse no. 1) 5 (traverse no. 2), 12 (traverse no. 3), 16

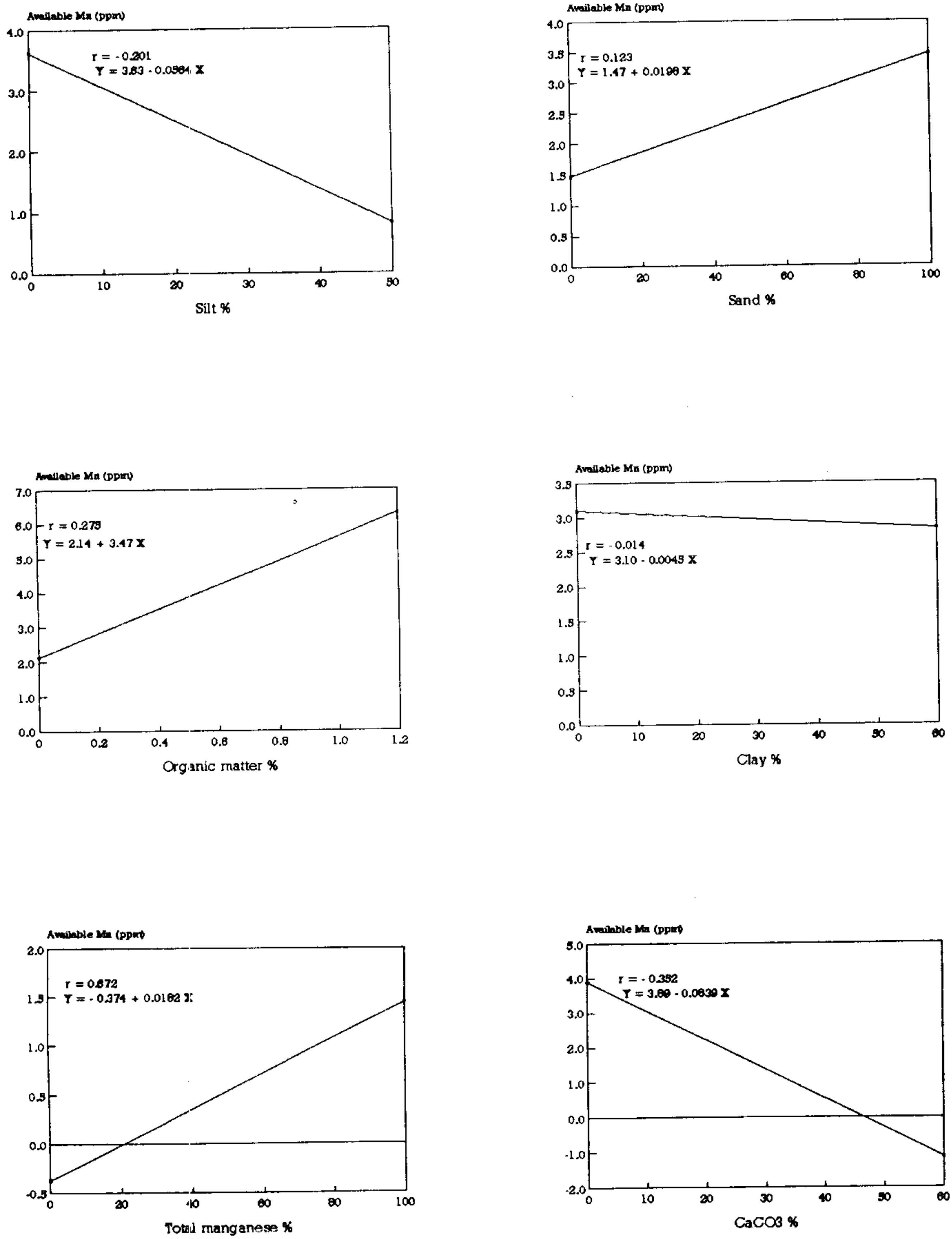


Fig. (7) : The linear relationships and regressions equations between available manganese contents and some soil constituents.

(traverse no. 4) and 17 (traverse no. 5). While, soils of profiles no. 4 (traverse no. 1), 7, 9,10(traverse no. 2), 18 and 19 (traverse no. 5) show an opposite trend. Generally, soils of traverse no. 2 have higher content of total Zinc, especially profiles no. 8,9 and 10 which affected by Lybian blateau which have calcareous rocks as main parent rocks.

The correlation coefficient between total zinc content and some soil constituents are presented in Table (11) and illustrated in Fig. (8). It is obvious that total Zn content is positively and significantly correlated with $CaCO_3$, clay and silt which agree with the findings of *Abd EL- Hamid (1981), Katyal and Sharma (1990) and Rahim (1993).* While, sand exhibits negatively and significantly correlation with Zn content, *Rabie et al. (1989).*

Concerning the relationship between the distribution of trace elements and locality of the studied soil profiles, the weighted mean, trend and specific range of zinc are found in table (13).

The weighted mean in the soils of traverse no. 1 decreases on passing from east to west in profiles no. 1 and 2 and the same tendency is found in profiles no. 3 and 4. Likewise, T values show that Zn distribution in profile no. 3 is more symmetrical than other profiles and increasing the symmetry toward west. Moreover, the specific range indicate that the soils material are heterogeneous.

The weighted mean of Mn in soils of traverse no. 2 shows no particular pattern. The computed trend indicates a more symmetrical distribution of zinc

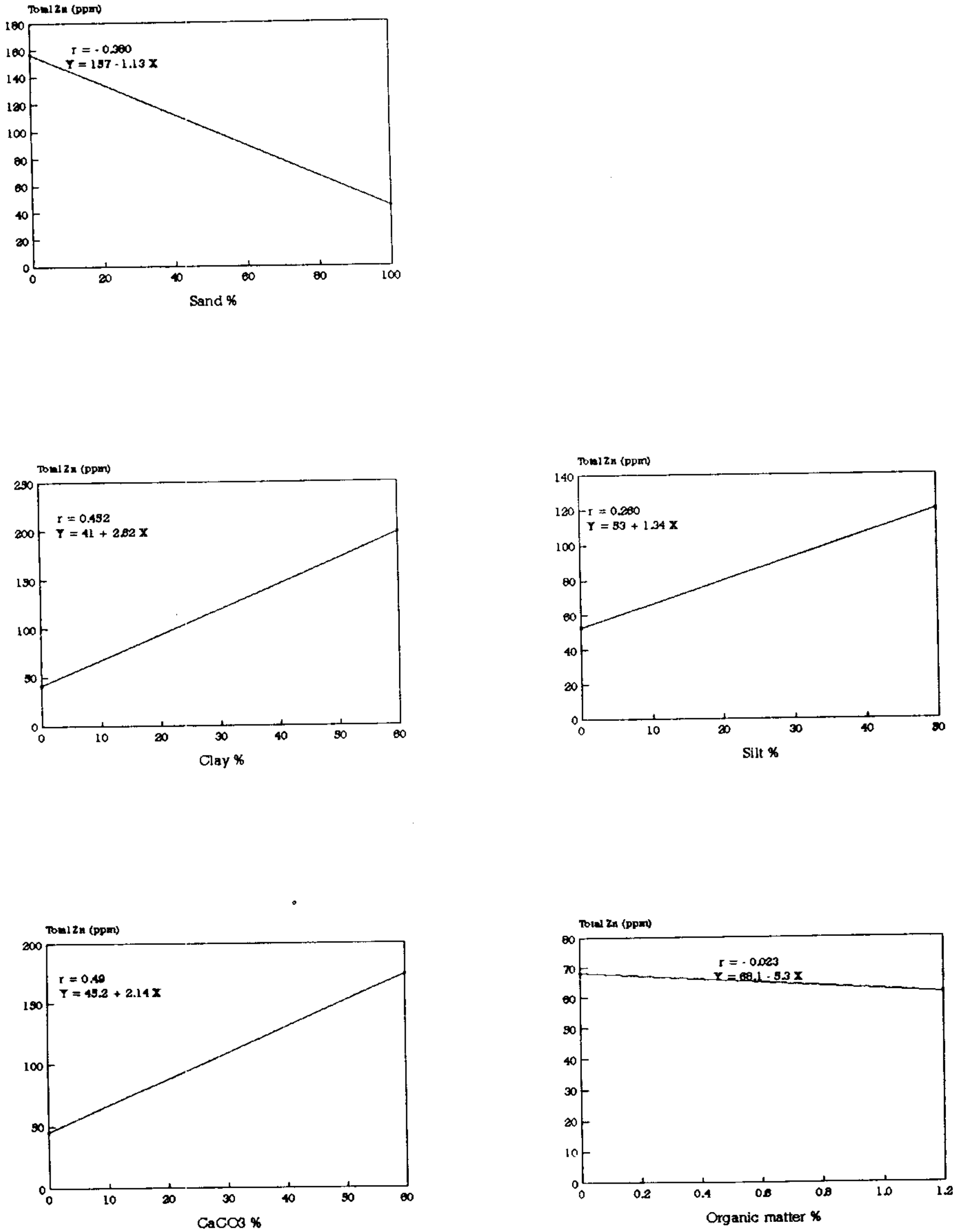


Fig. (8) : The linear relationships and regressions equations between total zinc content and some soil constituents .

in profile no. 6 than other profiles. The specific range indicates that the soils materials are heterogeneous.

The soils of traverse no. 3 show that W values of Zn show no particular pattern. T values indicate that total Zn distribution is symmetrical in profiles no. 11 and 13. Furthermore, data of R show that the soils of traverse no. 3 are heterogeneous in respect of total Zn content.

With regard to the soils of traverse no. 4, the weighted mean of total Zn shows no particular pattern. The computed trend indicates that Zn distribution in profile no. 14 is more symmetrical of all the representative profiles. Moreover, the specific range shows that the soil of traverse no. 4 are heterogeneous in respect of total iron content.

The weighted mean in soils of traverse no. 5 shows that total Zn has no. particular pattern . The computed trend indicates that total Zn distribution is symmetrical in all profiles. Furthermore, the specific range indicates that the soils materials are heterogeneous.

Data of Table (10) reveal that the amount of DTPA-extractable zinc in the studied soil samples, varies between 0.05 and 1.06 ppm, according to sampling depth, location of each traverse and total content of the element.

The correlation coefficients between available zinc and some soil variables are presented in Table (12) and illustrated in Fig. (9). It is obvious that chemically extractable Zn is positively and significantly correlated with

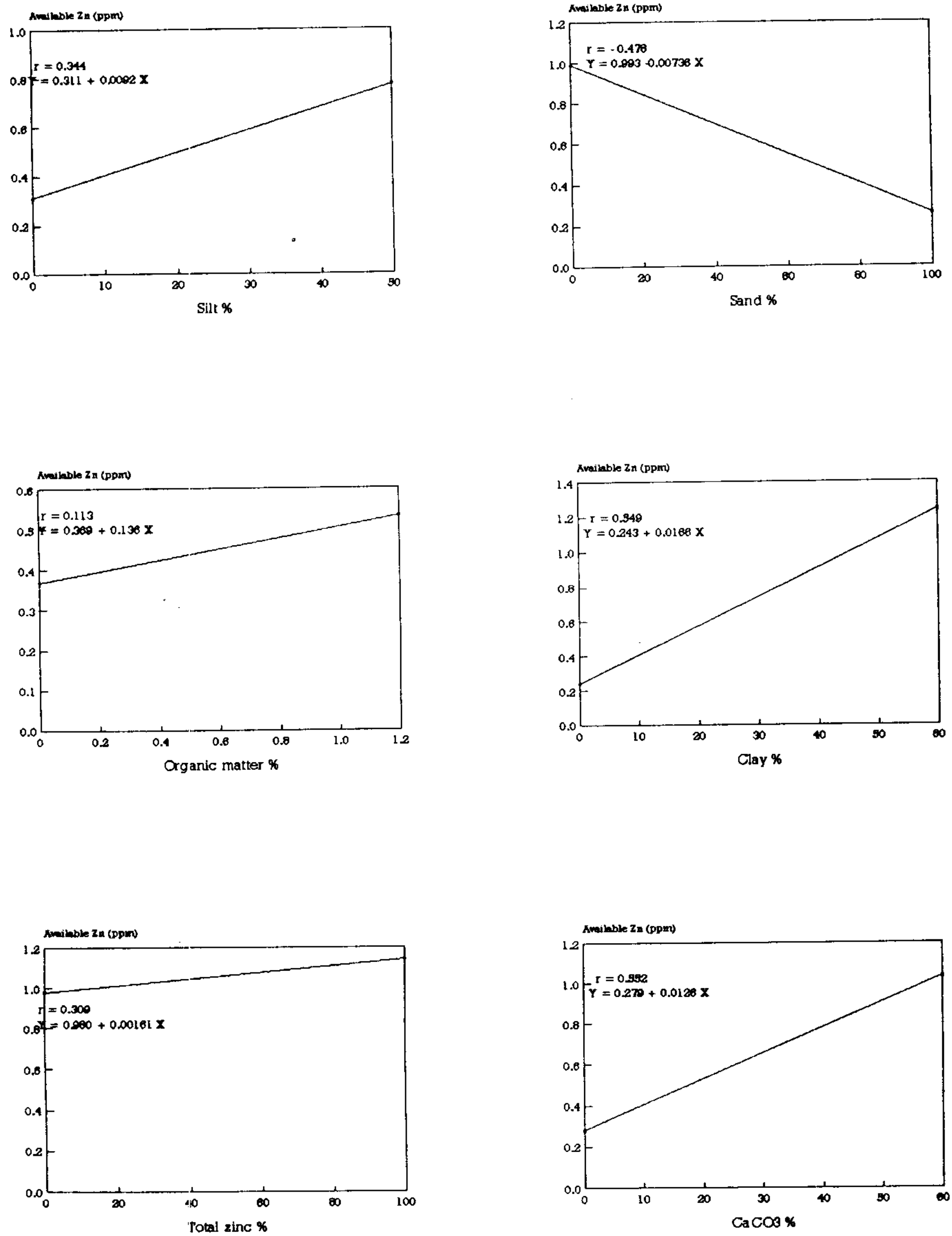


Fig. (9) : The linear relationships and regressions equations between available zinc and some soil constituents .

silt, clay, $CaCO_3$ and total zinc, while, available zinc is negatively and significantly correlated with sand.

Lindsay and Norvell (1978) divided the critical level of DTPA-extractable zinc for sensitive crops to three levels: a) < 0.5 ppm considered deficient level, b) 0.5-1.0 ppm reveal to marginal level and c) >1.0 ppm appear adequate level. According to these limits the available Zinc content at surface layer of different traverses could be evaluated as follows:-

Available Zn contents in the profiles of traverse no. 1, profiles no. 5, 6 and 7 of traverse no. 2, profile no. 13 of traverse no. 3, profiles no. 14 and 15 of traverse no. 4 and profiles no. 17 and 18 of traverse no. 5 are considered a deficient level, while, profiles no. 9 and 10 of traverse no. 2, profiles no. 11 and 12 of traverse no. 3, profile no. 16 of traverse no. 4 and profile no. 19 of traverse no. 5 are considered a marginal level.

d) Copper:

Data of Table (10) reveal that total copper content in the studied profiles varies between 5 and 86 ppm. It tends to decrease with depth in all profiles, except profiles no. 4 (traverse no. 1), 5.7,9,10 (traverse no. 2) and 19 (traverse no. 5) show the opposite trend.

The correlation coefficients between total copper and some soil constituents are presented in Table (11) and illustrated in Fig. (10). It is obvious that total Cu content is positively and significantly correlated with clay, which agree with the findings of *Katyal and Sharma (1990) and Rahim*

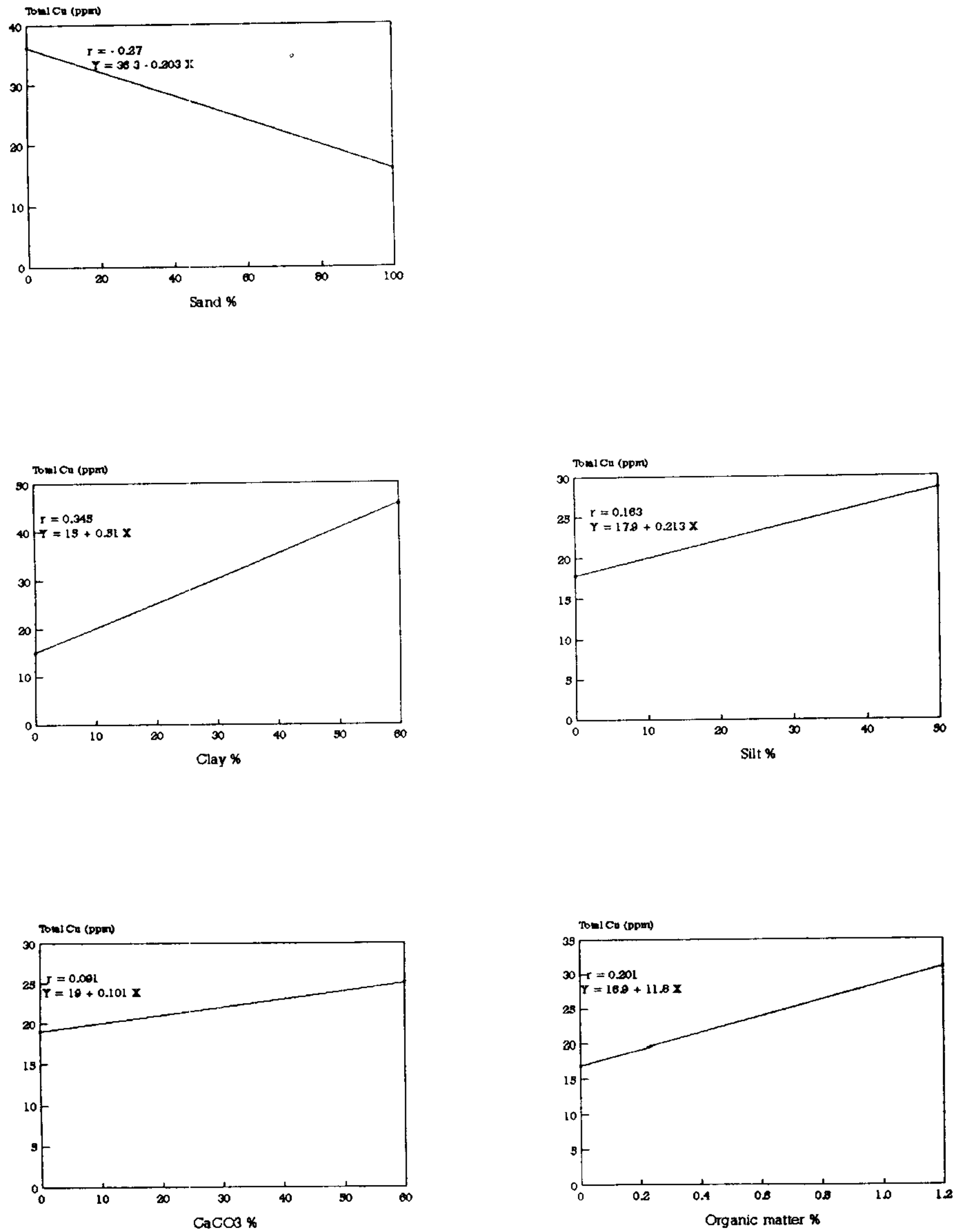


Fig. (10) : The linear relationships and regressions equations between total copper and some soil constituents .

(1993). However, sand contents exhibit positive and significant correlations with total Cu content, *Rabie et al., (1989)*.

Concerning the relationship between the distribution of trace elements and locality of the studied soil profiles, the weighted mean (W),trend (T) and specific range (R) are calculated according to *Oertel and Giles (1963)*, Table (13). The computed weighted mean in the soils of traverse no. 1 decrease on passing from east to west in profiles no. 1 and 2 and the same tendency is found in profiles no. 3 and 4. Likewise, T values show that Cu distribution in profile no. 3 is more symmetrical than other profiles. Moreover, the specific range indicates that the soil's materials are heterogeneous.

The weighted mean of Cu in soils of traverse no. 2 shows no particular pattern. The computed trend indicates a more symmetrical distribution of Cu in profiles no. 5,6 and 10 than other profiles. The specific range indicates that the soil's materials are heterogeneous, except profiles no. 7 and 8 are homogenous in respect of total copper content.

The soils of traverse no. 3 show that W of Cu tend to irregular pattern. T values indicate that total Cu distribution is more symmetrical in profile no. 11 than other profiles. Furthermore, data of R show that the soils of traverse no. 3 are heterogeneous in respect of total copper content.

With regard to the soils of traverse no. 4, the weighted mean of total copper tends to increase from east to west. the computed trend, indicates that Cu distribution in profile no. 15 is more symmetrical. Moreover, the specific range shows that the soils of traverse no. 4 are heterogeneous.

The weighted mean in soils of traverse no. 5 shows that the same trend in the soils of traverse no. 4. The computed trend indicates that total copper is symmetrical distribution towards west. Furthermore, the specific range indicates that the soil materials are heterogeneous.

Data of Table (10) reveal the amounts of DTPA- extractable Cu in the studied soil samples, varies between 0.01 and 2.54 ppm according to sampling depth, location of each traverse and total amount of the element. Generally, the soils of traverse no. 5 contain high amounts of available copper especially profile no. 18, which has higher clay contents. Generally , the concentration of DTPA-extractable forms reflect the difference in pedogenic and management processes. Surface layer of most profiles has a higher content of available Cu, this finding may be attributed to the low values of these layers and the addition of mineral fertilizers.

The correlation coefficients between available copper and some soil variables are presented in Table (12) and illustrated in Fig. (11). It is obvious that chemically extractable copper is positively and significantly correlated with silt, clay, organic matter, calcium carbonate and total copper. *El-Gundy (1988)* found that $CaCO_3$, clay and silt contents are significantly and positively correlated with DTPA-extractable copper. *Katyal and Sharma (1990)* stated that DTPA-Cu increased with increasing organic matter, clay and total Cu contents. *Rahim (1993)* showed that chemically extractable copper (DTPA-Cu) is positively and significantly correlated with total copper. In contrast, DTPA-extractable copper is negatively and significantly correlated with sand content .

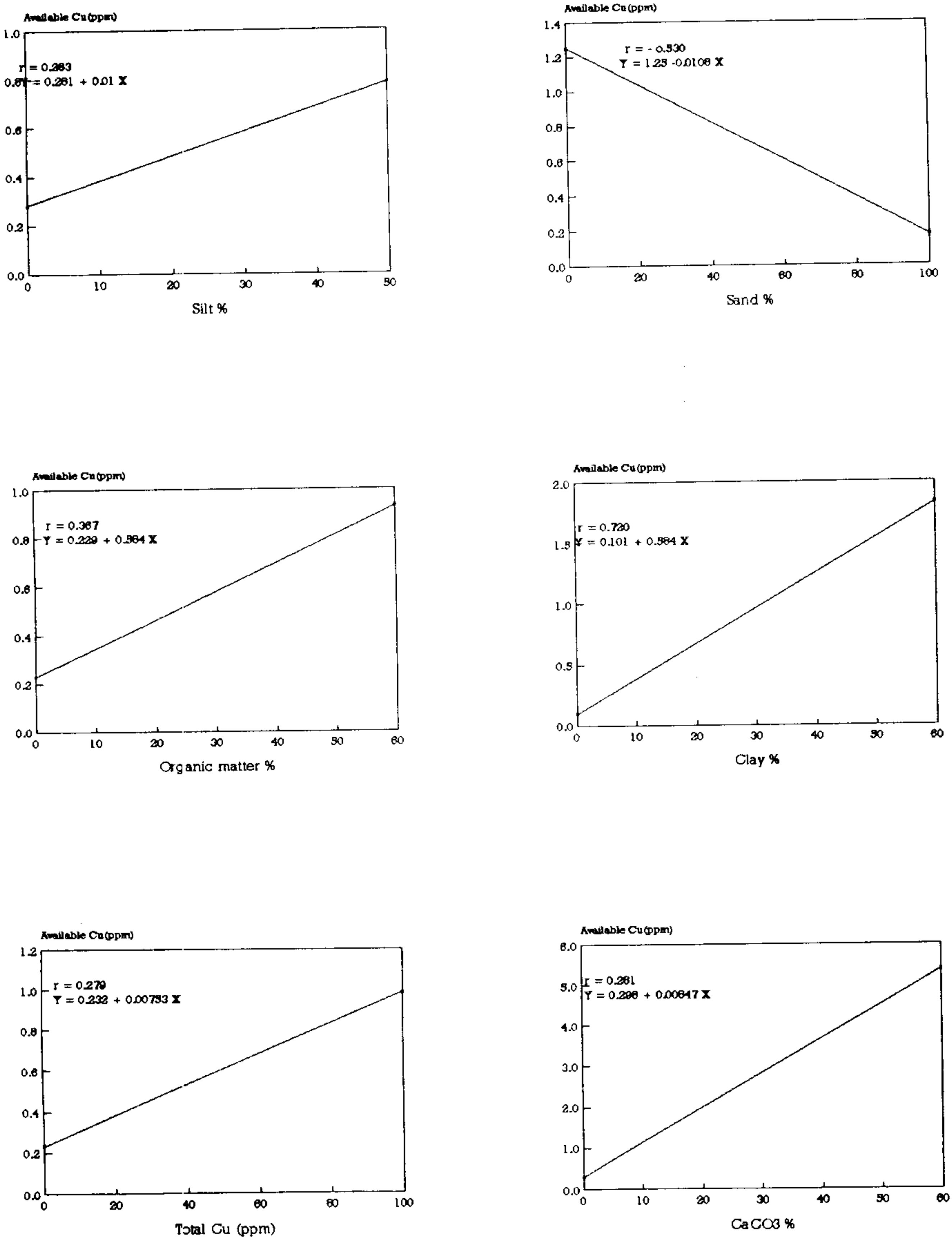


Fig. (11) : The linear relationships and regressions equations between available copper and some soil constituents .

*Lindsay and Norvell (1978)*divided the critical levels of DTPA-extractable copper for sensitive crops to two levels: a) <0.2 ppm consider deficient and b) > 0.2 ppm appear adequate level. Surface layer of all profiles under studding contain adequate levels of available copper, except profiles no. 5 and 7 of traverse no. 2 and profile no. 14 of traverse no. 4 exhibit deficient levels.

e) Boron:

Data of Table (10) reveal that boron content in the studied profiles varies between 1.3 and 24.9 ppm. It tends to decrease with depth in profiles no. 1, 2, 3 (traverse no. 1), 5,9 (traverse no. 2), 11 (traverse no. 3) and 18 (traverse no. 5). While, soils of profiles no. 7,8 (traverse no. 2), 17 and 19 (traverse no. 5) show an opposite trend. Generally, soils of traverse no. 1 have higher contents of boron may be due to marine effect in this traverse or high content of tourmaline mineral, *Mitchell (1964)*.

The correlation coefficients between total boron content and some soil constituents are presented in Table (11) and illustrated in Fig. (12)
B content is positively and significantly correlated with sand and tourmaline content. *Hassona (1989)* found that total boron is positively and significantly correlated with sand in the soils derived on coastal plain. *Abdel-Aal et al., (1990)* in a study on the soils of some oases in the western desert found a highly significant correlation between total B and tourmaline mineral content. Data show that total boron content is negatively and significantly correlated with silt, clay and calcium carbonate contents.

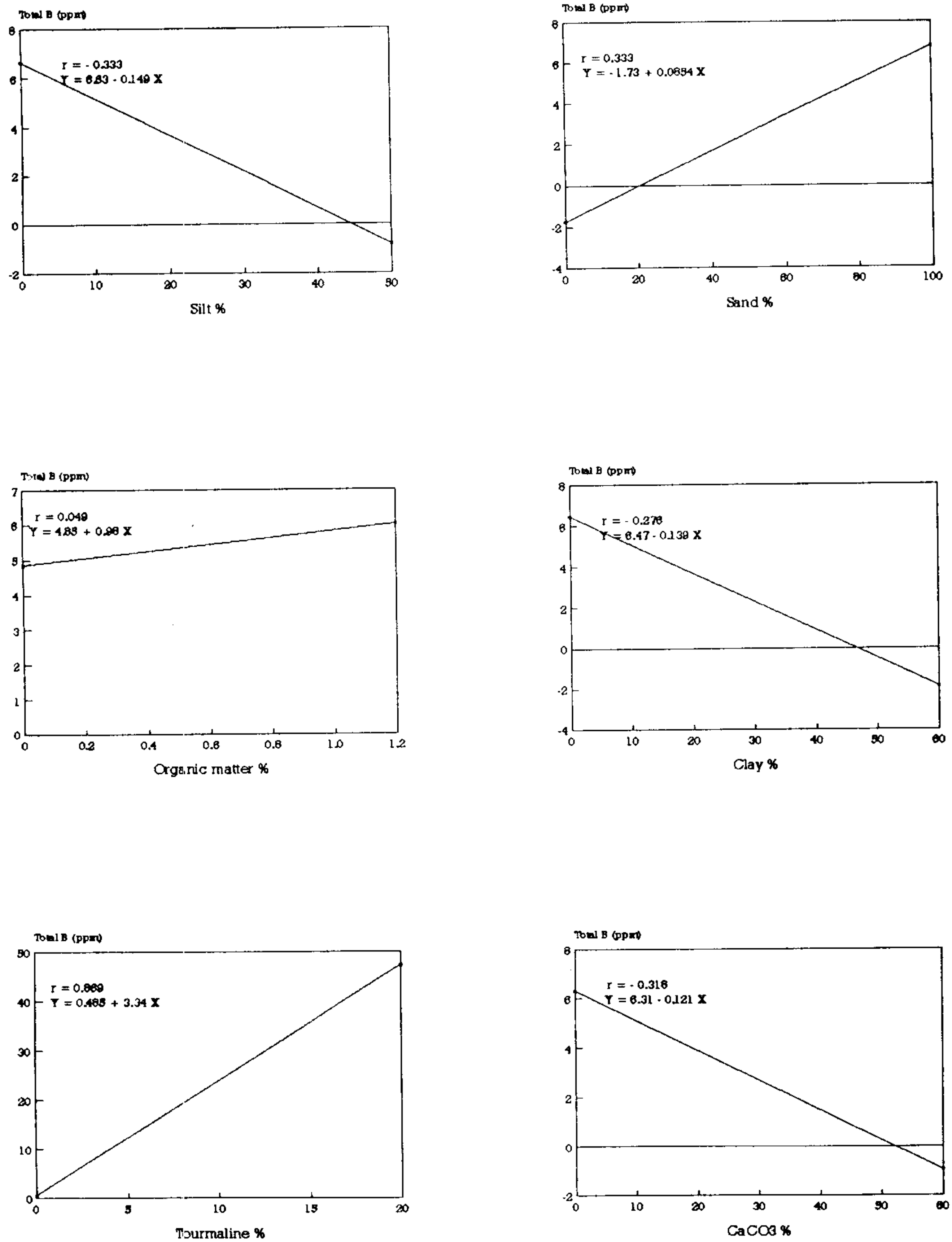


Fig. (12) : The linear relationships and regressions equations between total boron and some soil constituents .

Concerning the relationship between the distribution of total boron and locations of the studied soil profiles, Table (13), contains the weighted mean (W), trend (T) and specific range (R). The computed weighted means in the soils of traverse no. 1 decrease on passing from east to west. Likewise, T values show that B distribution in profile no. 2 is more symmetrical than the other profiles. Moreover, the specific range indicates that the soil's materials are heterogeneous, in spite of, homogeneity between profiles no 3 and respect of total boron content.

Weighted means of total boron in soils of traverse no. 2 increase on passing from east to west in profiles no. 5, 6 and 7 and the same tendency is found in profiles no. 8, 9 and 10 .The computed trend indicates a more symmetrical distribution of total boron in profile no. 10 than other profiles. The specific range indicates that the soil's materials are heterogeneous.

The soils of traverse no. 3 show that W values of total-B exhibit no particular pattern. T values indicate the that total boron distribution is more symmetrical in profile no. 11 than the other profiles. Furthermore, the data of R show that the soils of traverse no. 3 are heterogeneous in respect of total boron content.

With regard to the soils of traverse no. 4, the weighted mean of total boron tends to increase from east to west. T values indicate that the total boron distribution is more symmetrical in profile no. 15 Furthermore, the specific range indicates that the soil's materials are heterogeneous in respect of total boron content.

The weighted mean in soils of traverse no. 5 decreases on passing from east to west. The computed trend indicates that boron distribution is symmetrical in all profiles. Furthermore, the specific range indicates that the soil materials are heterogeneous.

Data of Table (10) reveal that the amount of hot-water soluble boron in the studied samples, varies between 0.6 and 0.85 ppm according to sampling depth, location of each traverse and total content of the element. Generally, the soils of traverse no. 1 contain higher amounts of available boron. This finding may be due to marine effect, which, show the relatively large content of boron in sea water, *Mitchell (1964)*.

The correlation coefficients between available boron and some soil variables are presented in Table (12) and illustrated in Fig.(3).Data indicate that extractable boron is positively and significantly correlated with sand, organic matter, total boron and tourmaline content, while, it negatively and significantly correlated with silt, clay and $CaCO_3$ contents.

Available boron, in the studied profiles, is less than 1.00 ppm. According to *Walsh and Beaton (1973)*, soils that may supply sufficient support normal plant growth.

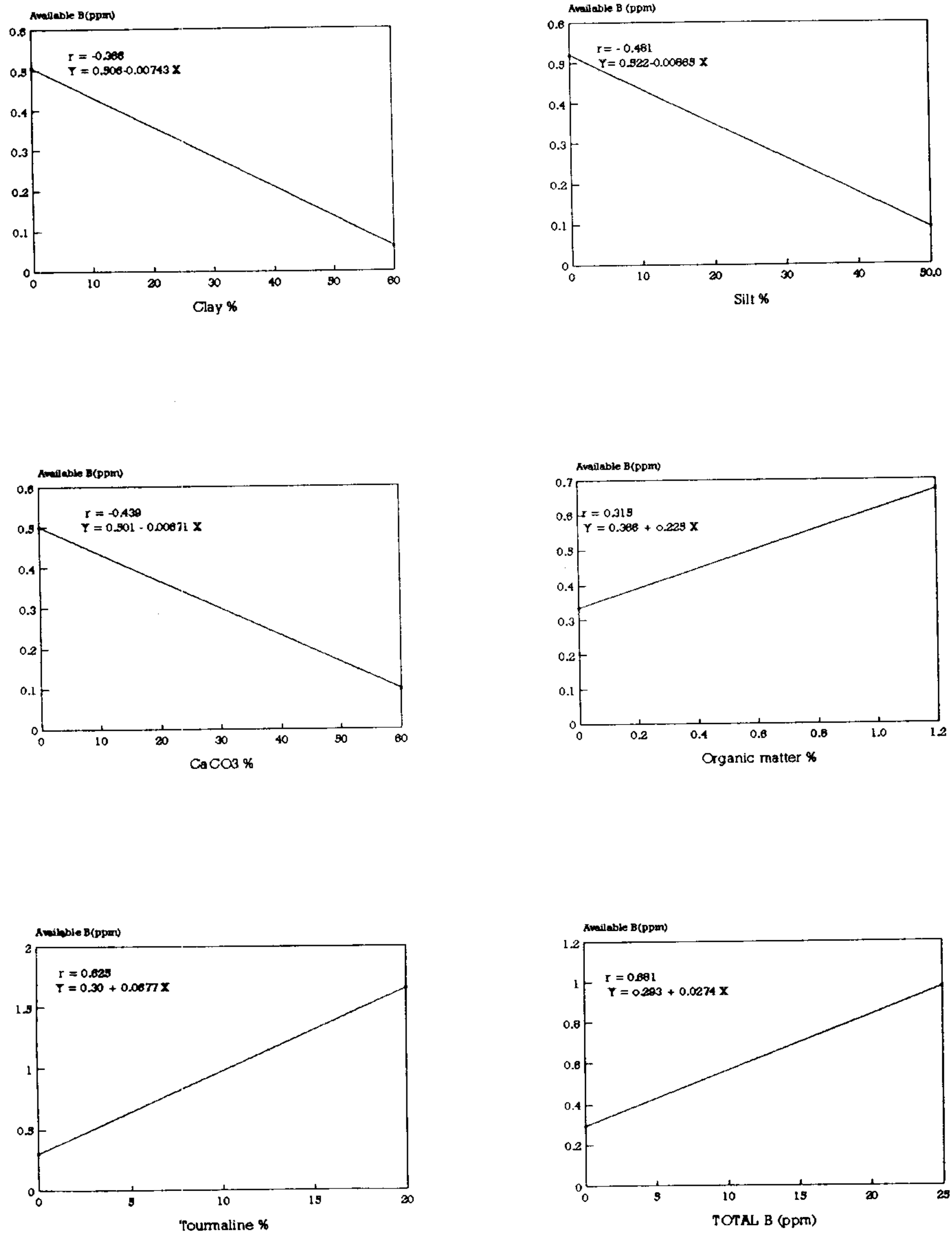


Fig. (13) : The linear relationships and regressions equations between available boron and some soil constituents .

4.2. Mineralogical properties of the studied sandy soils:

4.2.1. Grain size parameters:

Data of statistical size parameter of the studied sandy soils. (according to *Folk and Ward, 1957* and *Sahu, 1964*) are presented in Tables (14&15) and illustrated in Figures (14 to 32).

Soil of traverse no. 1:

Data presented in Tables (14&15) and illustrated in cumulative curves (Fig. 14 to 17) represent the different profiles of traverse no. 1. The values of mean size (M_Z) range between 2.40 and 2.80 ϕ corresponding to fine sand. The sorting (σ_I) values of the grain size range between 0.5981 and 1.6977 ϕ, and lie in the range between moderately well sorted and poorly sorted sediments. According to *Folk and Ward (1957)* and *Folk (1961)*, these values indicate to three clustering, the first one represents profile no. 1 (except layer of 0-30 cm) and layer of 30-60 cm of profile no. 2, which are moderately well sorted. The second one, represents layer of 0-30 cm (profile no. 1), layer of 0-30 cm (profile no. 2) and profile no. 4 (except layer of 50-80 cm) which are moderately sorted. According to *Inman (1952)*, moderately well sorted and moderately sorted sediments indicate that wind and water are the main factors in transportation and deposition of sediments. The third clustering, represents the layer of 60-80 cm (profile no. 2), profile no. 3 and the layer of 50-80 cm (profile no. 4), which are poorly sorted. The poorly sorted sediments indicate that water is the main factor in their transportation and deposition *(Inman, 1952)*.The values of skewness indicate that profiles 1(except layer of 50-80 cm) and 2 (except layer of 60-80 cm) are positively skewed, which indicates that these soils have a tail of finess. While, the layer of 60-80 cm(profile no. 2) and all layers of profile no. 3 are very positively skewed which indicates

Table (14) : The statistical size parameters of the studied sandy soils.

[according to Folk and Ward (1957) and Sahu (1964)] .

Trav. No.	Location	Profile No.	Samp. Depth (cm)	Folk and Ward (1957)				Sahu (1964)			
				Mz	OI	SKI	KG	Y1	Y2	Y3	Y4
1	Om EL-Reda	1	0-30	2.40	0.7136	0.1250	1.2295	-3.1122	96.0417	-4.3290	8.8753
			30-50	2.42	0.6458	0.1109	1.3871	-3.0044	92.9639	-3.4339	9.6660
			50-80	2.47	0.5981	0.0583	1.0502	-4.3422	82.6568	-2.6640	7.5888
	EL-Mattar	2	0-30	2.48	0.7723	0.1971	1.7486	-1.6083	113.8867	-5.3981	12.1307
			30-60	2.43	0.6587	0.1518	1.3388	-3.2131	94.0713	-3.7868	9.6861
			60-80	2.50	1.0045	0.3172	2.3822	1.5706	155.2585	-9.5645	16.1410
	Gamassa	3	0-20	2.53	1.6826	0.5975	3.4016	10.7991	299.3953	-26.8397	19.0451
			20-40	2.63	1.6826	0.5975	3.4016	10.4423	300.9606	-26.8112	19.1172
			40-65	2.73	1.6977	0.5988	3.1297	9.4250	300.8760	-27.2497	17.7306
	Rosatta	4	0-20	2.80	0.8189	-0.2036	0.9687	-4.0717	102.1325	-4.0331	6.7552
			20-50	2.77	0.8992	-0.0977	0.9563	-3.7128	112.4189	-5.7695	6.6757
			50-80	2.67	1.0053	-0.0692	1.1954	-1.9228	129.0672	-7.6956	7.8047
2	EL-Nubaria	5	0-35	1.92	1.6814	0.0980	1.0075	6.5444	236.2383	-24.6501	6.2382
			35-75	2.47	2.4000	0.2955	1.5605	16.7479	451.3749	-51.1271	9.7095
			75-120	2.90	2.6777	0.3779	1.5763	20.3101	552.5467	-64.3162	10.1134
			120-150	2.32	2.2519	0.3433	1.7697	15.2856	408.4966	-45.3588	11.3079
	EL-Nubaria	6	0-30	2.00	1.3061	0.2071	0.7128	0.9651	160.3399	-15.3530	5.9223
			30-80	1.79	1.3409	0.2487	0.6949	1.2710	166.3440	-16.3728	6.0490
			80-150	2.30	1.4977	0.4919	0.9088	1.9015	209.1185	-21.3755	8.8671
	EL-Nubaria	7	0-30	1.98	1.9514	0.4315	1.2295	6.2488	311.7782	-34.8470	9.3063
			30-70	2.40	2.7121	0.4935	1.2967	21.6701	553.8219	-66.1049	8.9526
			70-120	2.10	2.3333	0.4568	1.2436	15.5782	421.8954	-49.2706	9.6822
	EL-Nubaria	8	0-40	4.77	3.3098	0.4540	1.7463	28.0147	833.2207	-96.7453	11.3257
			40-60	5.70	3.2000	0.1406	0.6651	19.3348	776.9387	-88.7368	4.4526
			60-80	5.27	3.5303	0.3634	0.6272	28.5162	919.6119	-109.4561	4.5458
			80-150	4.87	3.8818	0.2352	0.6499	39.9230	1082.8993	-131.7359	2.4642
	EL-Nubaria	9	0-40	3.03	2.2848	0.4908	1.7463	12.9248	431.6521	-41.9648	12.6291
			40-70	5.20	3.3303	0.3006	0.8116	24.3923	830.6319	-86.0186	5.6015
			70-150	5.37	3.5053	0.4047	0.6468	27.4836	910.7296	-95.7704	5.0706
	EL-Nubaria	10	0-30	4.87	3.4902	0.4315	0.9531	29.7750	905.5800	-107.8531	6.5327
			30-50	5.43	3.6462	0.3920	0.7073	31.2136	978.7408	-116.8032	4.9424
			50-150	5.93	3.4152	0.2547	0.6831	23.6019	876.4816	-101.7000	4.9082

Table (14) : Cont.

Trav. No.	Location	Profile No.	Samp. Depth (cm)	Folk and Ward (1957)				Sahu (1964)			
				Mz	OI	SKI	KG	Y1	Y2	Y3	Y4
3	EL-Shbab	11	0-40	1.53	2.1492	0.3257	2.0276	17.2716	370.8834	-41.5248	12.1666
			40-80	1.80	2.0341	0.3772	2.1175	14.6990	346.0670	437.4772	13.3779
			80-110	2.63	2.6500	0.4012	1.6230	14.7841	432.6638	-48.3570	11.0163
			110-150	1.37	1.8212	0.3060	1.6849	11.9967	276.1089	-30.0819	10.6295
	EL-Shbab	12	0-22	3.77	3.6008	0.7200	1.9374	39.0689	959.8716	-115.9423	12.5962
			22-40	1.67	0.9197	0.4319	1.0587	0.2365	109.1290	-8.9969	9.3750
			40-150	1.80	0.9121	0.3716	1.0870	-0.7322	109.6823	-8.5414	9.2183
	Belbeis	13	0-45	1.52	2.2110	0.7764	1.3760	15.3396	384.5324	-46.1245	9.4429
			45-80	1.73	1.0883	0.0273	1.2978	2.1935	129.4155	-9.9534	14.6925
			80-150	1.92	3.7133	0.0947	1.1864	47.6767	959.7592	-120.6528	2.7453
4	EL-Saff	14	0-40	2.77	1.8860	0.1631	1.4857	7.5659	307.5323	-31.0975	9.5265
			40-70	2.53	1.9364	0.2341	2.0492	10.7423	327.8390	-33.1731	12.7361
			70-100	1.37	2.1197	0.3334	1.2219	14.8518	345.3301	-40.5432	7.8895
			100-150	2.02	2.4076	0.2549	1.6311	19.7929	447.3006	-51.3723	9.4703
	EL-Aiyat	15	0-20	2.73	1.9780	0.4668	1.7623	9.2549	340.8832	-35.6957	12.8629
			20-50	257	3.7555	0.5460	1.9527	47.9612	1012.7999	-125.3732	10.1826
			50-70	3.07	2.3242	0.3983	1.8345	13.9208	444.1681	-48.3078	12.4289
	Kom-Oshim	16	0-20	3.43	2.7568	0.5400	1.4896	19.4027	590.4156	-68.1721	10.9313
			20-27	4.85	2.7386	0.3742	1.1177	13.1513	596.1887	-66.0972	8.9117
			27-40	3.62	2.6011	0.5475	1.3661	14.8350	536.4257	-60.8527	10.8015
			40-50	4.57	2.5030	0.4838	1.2588	9.7920	515.2569	-55.8886	10.6920
			50-80	5.22	2.6784	0.3170	1.0075	10.3997	577.4777	-62.8602	8.3417
			80-150	6.02	2.9087	0.2227	0.7976	11.8489	668.9568	-73.4524	6.6546
5	Wadi EL-Khrait	17	0-20	3.82	3.9246	0.5786	0.8054	44.6780	1097.2606	-136.6350	4.7069
			20-36	2.52	3.3587	0.6918	1.4146	35.7250	819.4071	-101.4234	9.4132
			36-71	2.02	2.5322	0.5983	2.2086	22.1559	504.6487	-58.4167	14.5908
	Kom-Ombo (east)	18	0-25	4.55	3.6958	0.5728	0.7198	35.3652	992.2481	-121.1278	5.4442
			25-33	4.72	3.7008	0.6868	0.6660	34.4912	998.5892	-121.9640	6.0347
			33-39	7.43	3.8636	-0.4888	0.5560	31.4762	1098.6084	-126.2324	-1.0030
			39-65	5.68	3.7686	0.2223	0.6119	33.9665	1041.5799	-124.4029	3.0846
			65-110	1.50	1.6379	0.5012	4.3545	17.0779	289.1539	-25.2822	26.4240
	Kom-Ombo (west)	19	0-15	2.12	1.5391	-0.1637	0.7131	3.7611	199.0682	-19.2816	2.2471
			15-50	2.17	1.5992	-0.1911	0.5980	3.9793	209.6177	-20.8210	2.4136
			50-90	1.93	1.7826	0.0095	0.7066	7.0532	252.2620	-27.2999	3.9157

ıble (15) : The values of mean size , sorting , sleweness and kurtosis of studied sandy soils.

ɾav. No.	Location	Profile No.	Samp. Depth (cm)	Mean size (Mz)	Sorting (01)	Skeweness (SK)	Kurtosis (KG)
1	Om EL-Reda	1	0-30	Fine sand	Moderately sorted	Positively skewed	Leptokurtic
			30-50	Fine sand	Moderately well sorted	Positively skewed	Leptokurtic
			50-80	Fine sand	Moderately well sorted	Nearly symmetrical	Mesokurtic
	EL-Mattar	2	0-30	Fine sand	Moderately sorted	Positively skewed	Very leptokurtic
			30-60	Fine sand	Moderately sorted	Positively skewed	Leptokurtic
			60-80	Fine sand	Poorly sorted	Very positively skewed	Very leptokurtic
	Gamassa	3	0-20	Fine sand	Poorly sorted	Very positively skewed	Extremely leptokurtic
			20-40	Fine sand	Poorly sorted	Very positively skewed	Extremely leptokurtic
			40-65	Fine sand	Poorly sorted	Very positively skewed	Extremely leptokurtic
	Rosatta	4	0-20	Fine sand	Moderately sorted	Negatively skewed	Mesokurtic
			20-50	Fine sand	Moderately sorted	Nearly symmetrical	Mesokurtic
			50-80	Fine sand	Poorly sorted	Nearly symmetrical	Leptokurtic
2	EL-Nubaria	5	0-35	Medium sand	Poorly sorted	Nearly symmetrical	Mesokurtic
			35-75	Fine sand	Very poorly sorted	Positevely skewed	Very leptokurtic
			75-120	Fine sand	Very poorly sorted	Very positevely skewed	Very leptokurtic
			120-150	Fine sand	Very poorly sorted	Very positevely skewed	Very leptokurtic
	EL-Nubaria	6	0-30	Fine sand	Poorly sorted	Positevely skewed	Platykurtic
			30-80	Medium sand	Poorly sorted	Positevely skewed	Platylurtic
			80-150	Fine sand	Poorly sorted	Very positevely skewed	Mesokurtic
	EL-Nubaria	7	0-30	Medium sand	Poorly sorted	Very positevely skewed	Leptokurtic
			30-70	Fine sand	Very poorly sorted	Very positevely skewed	Leptokurtic
			70-120	Fine sand	Very poorly sorted	Very positevely skewed	Leptokurtic
	EL-Nubaria	8	0-40	Coarse silt	Very poorly sorted	Very positevely skewed	Very leptokurtic
			40-60	Medium silt	Very poorly sorted	Positevely skewed	Very platykurtic
			60-80	Medium silt	Very poorly sorted	Very positevely skewed	Very platykurtic
			80-150	Coarse silt	Very poorly sorted	Positevely skewed	Very platykurtic
	EL-Nubaria	9	0-40	V.fine sand	Very poorly sorted	Very positevely skewed	Very leptokurtic
			40-70	Medium silt	Very poorly sorted	Very positevely skewed	Platykurtic
			70-150	Medium silt	Very poorly sorted	Very positevely skewed	Very platykurtic
	EL-Nubaria	10	0-30	Coarse silt	Very poorly sorted	Very positevely skewed	Mesokurtic
			30-50	Medium silt	Very poorly sorted	Very positevely skewed	Platykurtic
			50-150	Medium silt	Very poorly sorted	Positevely skewed	Platykurtic

ıle (15) : Cont.

ıv.).	Location	Profile No.	Samp. Depth (cm)	Mean size (Mz)	Sorting (01)	Skeweness (SK1)	Kurtosis (KG)
3	EL-Shbab	11	0-40	Medium sand	Very poorly sorted	Very positevely skewed	Very leptokurtic
			40-80	Medium sand	Very poorly sorted	Very positevely skewed	Very leptokurtic
			80-110	Fine sand	Very poorly sorted	Very positevely skewed	Very leptokurtic
			110-150	Medium sand	Poorly sorted	Very positevely skewed	Very leptokurtic
	EL-Shbab	12	0-22	V.fine sand	Very poorly sorted	Very positevely skewed	Very leptokurtic
			22-40	Medium sand	Moderately sorted	Very positevely skewed	Mesokurtic
			40-150	Medium sand	Moderately sorted	Very positevely skewed	Mesokurtic
	Belbeis	13	0-45	Medium sand	Very poorly sorted	Very positevely skewed	Leptokurtic
			45-80	Medium sand	Poorly sorted	Nearly symmetrical	Leptokurtic
			80-15	Medium sand	Very poorly sorted	Nearly symmetrical	Leptokurtic
4	EL-Saff	14	0-40	Fine sand	Poorly sorted	Positevely skewed	Leptokurtic
			40-70	Fine sand	Poorly sorted	Positevely skewed	Very leptokurtic
			70-100	Medium sand	Very poorly sorted	Very positevely skewed	Leptokurtic
			100-150	Fine sand	Very poorly sorted	Positevely skewed	Very leptokurtic
	EL-Aiyat	15	0-20	Fine sand	Poorly sorted	Very positevely skewed	Very leptokurtic
			20-50	Fine sand	Very poorly sorted	Very positevely skewed	Very leplokurtic
			50-70	V.fine sand	Very poorly sorted	Very positevely skewed	Very leptokurtic
	Kom-Oshim	16	0-20	V.fine sand	Very poorly sorted	Very positevely skewed	Leptolurtic
			20-27	Coarse silt	Very poorly sorted	Very positevely skewed	Leptokurtic
			27-40	V.fine sand	Very poorly sorted	Very positevely skewed	Leptokurtic
			40-50	Coarse silt	Very poorly sorted	Very positevely skewed	Leptokurtic
			50-80	Medium silt	Very poorly sorted	Very positevely skewed	Mesokurtic
			80-150	Fine silt	Very poorly sorted	Positevely skewed	Platykurtic
5	Wadi EL-Khrait	17	0-20	V.fine sand	Very poorly sorted	Very positevely skewed	Platykurtic
			20-36	Fine sand	Very poorly sorted	Very positevely skewed	Leptokurtic
			36-71	Fine sand	Very poorly sorted	Very positevely skewed	Very leptokurtic
	Kom-Ombo (east)	18	0-25	Coarse silt	Very poorly sorted	Very positevely skewed	Platykurtic
			25-33	Coarse silt	Very poorly sorted	Very positevely skewed	Very platykurtic
			33-39	V.fine silt	Very poorly sorted	Very negatively skewed	Very platykurtic
			39-65	Medium silt	Very poorly sorted	Positevely skewed	Very platykurtic
			65-110	Medium sand	Poorly sorted	Very positevely skewed	Extremely leptokurtic
	Kom-Ombo (west)	19	0-15	Fine sand	Poorly sorted	Negatively skewed	Platykurtic
			15-50	Fine sand	Poorly sorted	Negatively skewed	Very platykurtic
			50-90	Medium sand	Poorly sorted	Nearly symmetrical	Very platykurtic

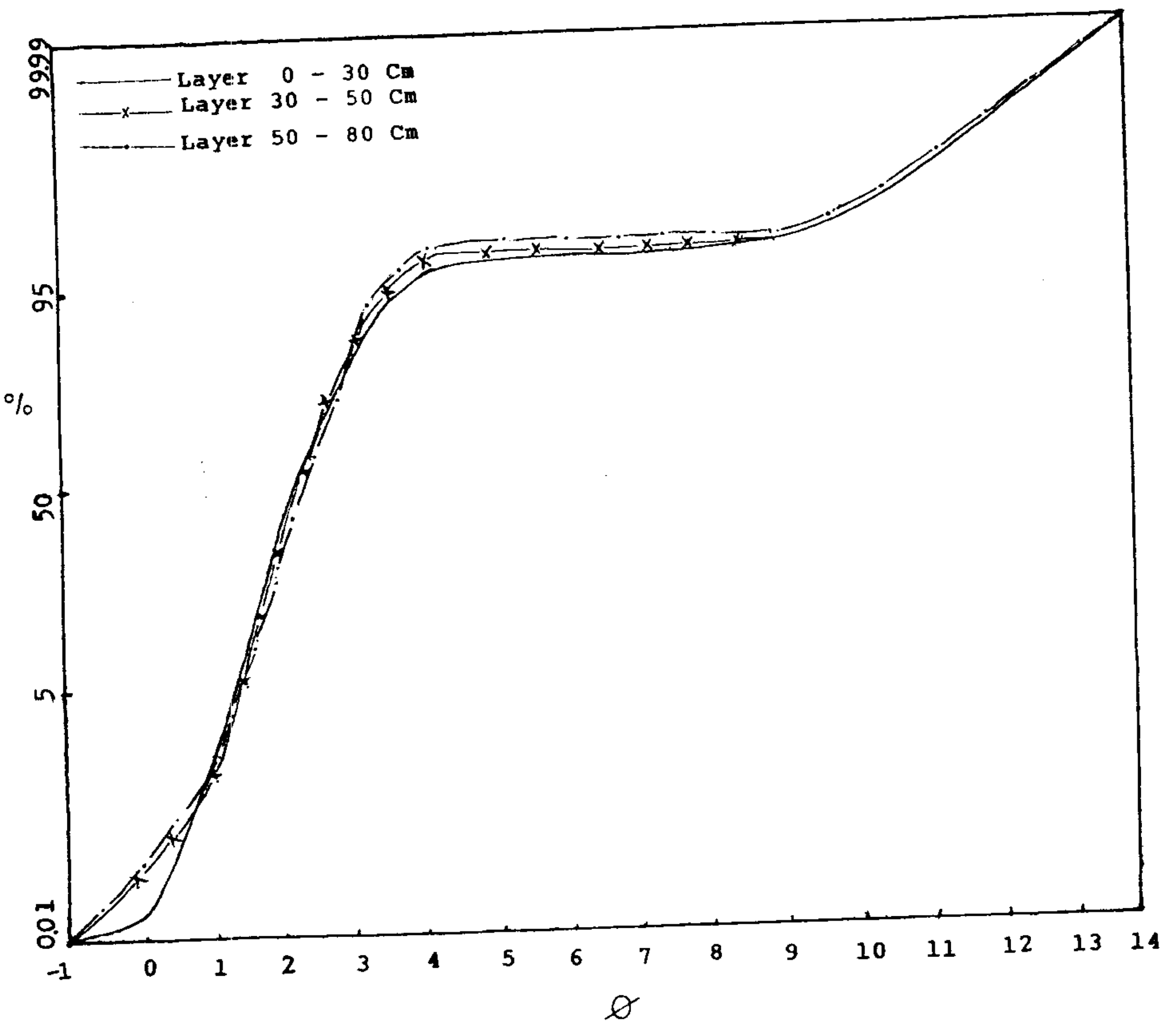


Fig. (14) : Cumulative frequency curve of different soil layers of profile no. 1 (Traverse no. 1) .

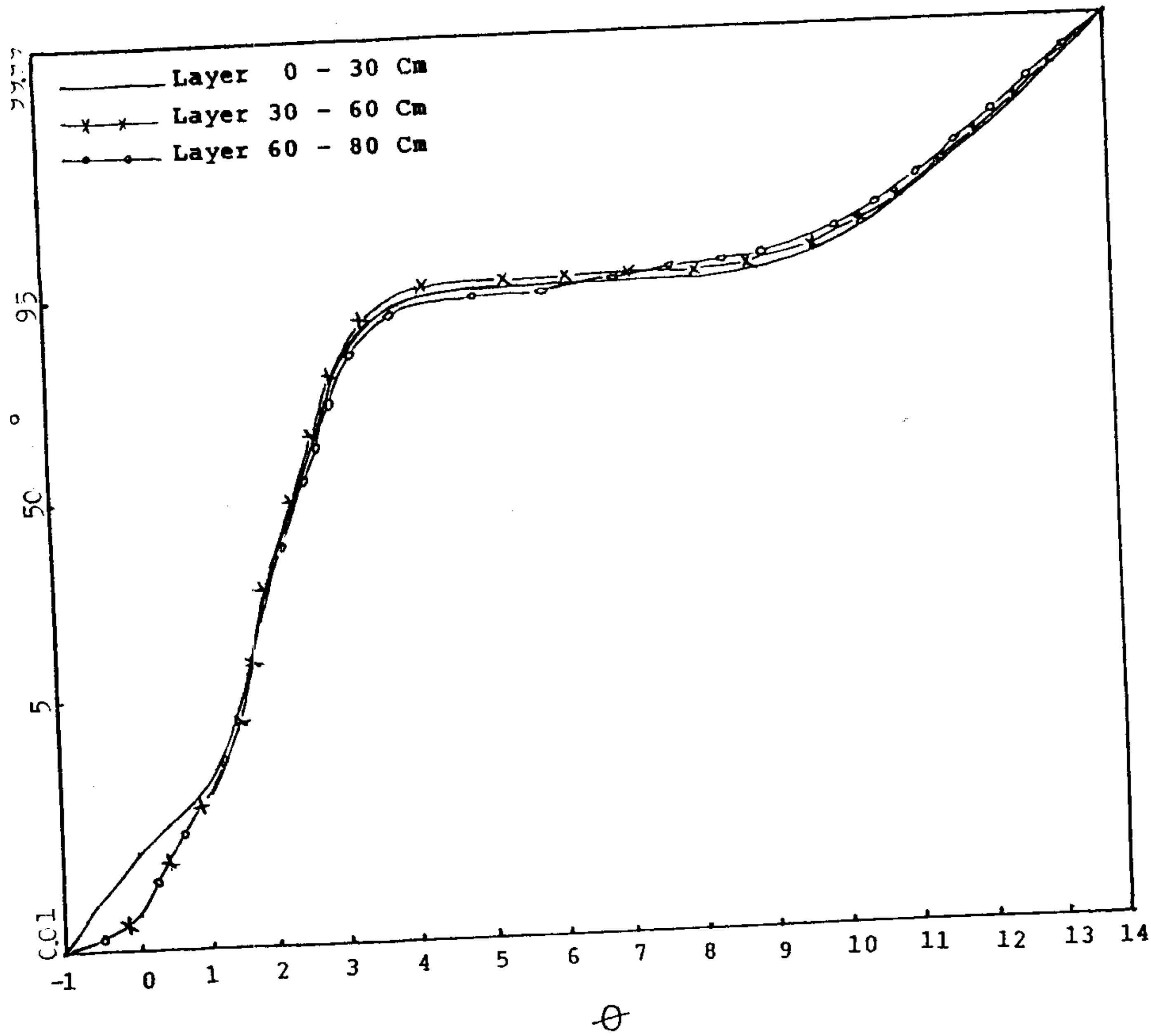


Fig. (15) : Cumulative frequency curve of different soil layers of profile no. 2 (Traverse no. 1) .

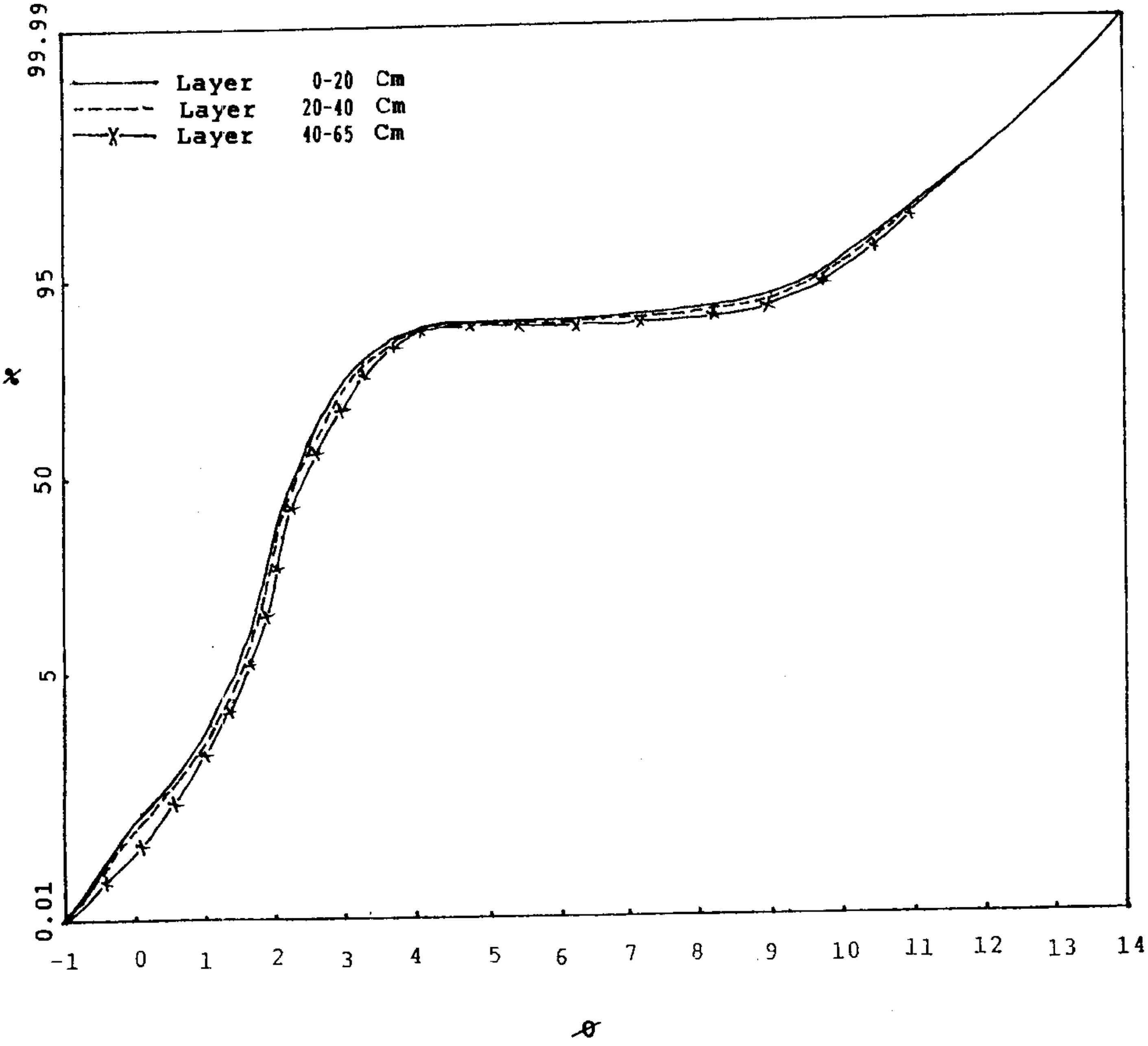


Fig. (16) : Cumulative frequency curve of different soil layers of profile no. 3 (Traverse no. 1) .

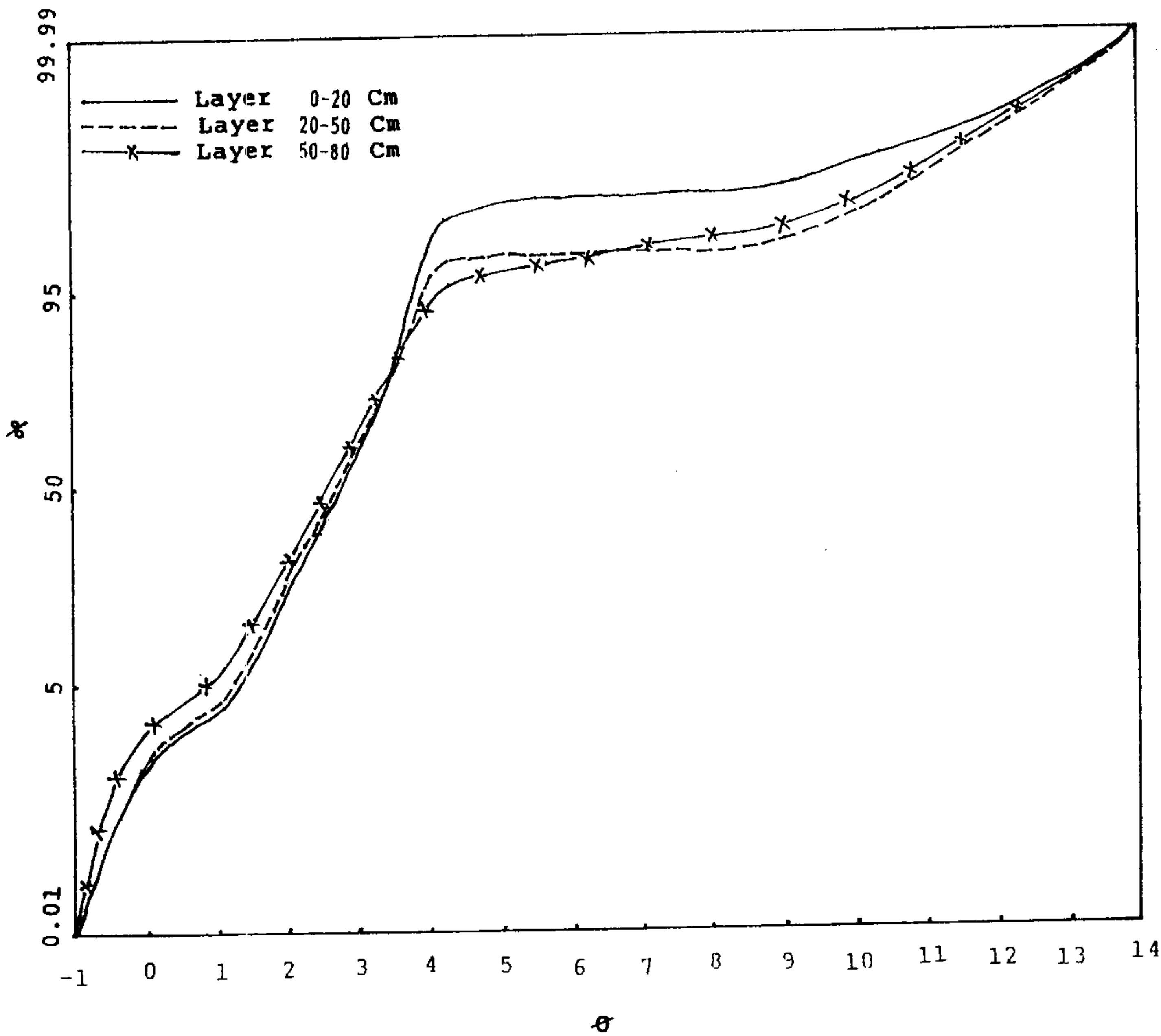


Fig. (17) : Cumulative frequency curve of different soil layers of profile no. 4 (Traverse no. 1) .

that these soils layers have a tail of fine grains. The model of nearly symmetrical skewed is represented by the layer of 50-80 cm (profile no. 1) and profile no. 4 (except layer of 0-20 cm), this indicates that the curves are obtained from a homogeneous distribution. On the other hand, the layer of 0-20 cm (profile no. 4) is negatively skewed, which indicates to a "tail" of coarse grains. The kurtosis values show that the soils represented by profile no. 1 (except layer of 50-80 cm), the layer of 30-60 cm (profile no. 2) and the layer of 50-80 cm (profile no. 4) have leptokurtic values. The soils represented by profile no. 2 (except layer of 30-60 cm) have a very leptokurtic values. All layers of profile no. 3 are extremely leptokurtic. Such values of kurtosis (leptokurtic, very leptokurtic and extremely leptokurtic) indicate to a very high energy environment and very low modification of grain size. The layer of 50-80 cm (profile no. 1) and profile no. 4 (except the layer of 50-80 cm) have mesokurtic values, which indicate to a very low energy and very high modification of grain size.

According to *Sahu (1964)*, every environment of deposition has its characteristic energy conditions and energy fluctuations through space and time. The preservation of these fluctuations is subjected to the availability of sufficient amounts of source materials of all sizes. Therefore, size distribution indicates to the properties of the deposition environment. The following discriminate function can be used for the classification purpose by using the previously calculated statistical measurements according to the method of *Folk and Ward (1957)*.

1. To distinguish between the aeolian and littoral (beach) environments, the following equation is used:

$$Y_1 = -3.5688\, M_Z + 3.7016\, \sigma_2 - \sigma^2{}_1 - 2.0766\, SK_1 + 3.1135\, K_G$$

Y_1 of less than (-2.7411) represents the aeolian depositions, whereas those greater than (-2.7411) represents beach environments.

2. To distinguish between beach and shallow agitated marine environments, the following equation is used:

$$Y_2 = 15.6534\, M_Z + 65.7091\, \sigma^2{}_1 + 18.1071\, SK_1 + 18.5043\, K_G$$

Y2 of less than 65.3650 indicates to a beach deposition, while the values greater than 65.3650 indicate to shallow agitated water depositions.

3. To distinguish between shallow marine and fluvial processes, the following equation is used:

$$Y_3 = 0.2852\, M_Z - 8.7604\, \sigma^2{}_1 - 4.8932\, SK_1 + 0.0482\, K_G$$

Y_3 of less than - 7.4190 indicates to a fluvial (deltaic) deposits and those greater than - 7.4190 indicates to a shallow marine deposits.

4. To distinguish between fluvial (deltaic) and turbidity current depositions the following equation is used:-

$$Y_4 = 0.7215\, M_Z - 0.4030\, \sigma^2{}_1 + 6.7322\, SK_1 + 5.2927\, K_G.$$

Values of Y_4 less than 9.8433 indicate to a turbidity current deposition and those greater than 9.8433 indicate to a fluvial (deltaic) deposition.

The standard deviation of the discriminate function are progressively increased in the sequence: aeolian < beach < shallow agitated marine < fluvial (deltaic) < turbidity current deposits.

According to the limits of *Sahu (1964)*, data of Table (14) show that the soils of profiles no. 1 and 4 (except layer 50-80 cm) and so the layer of 30-60 cm (profile no. 2) represent aeolian deposits. While the other layers and profiles have a fluvial (deltaic) ones.

Soils of traverse no. 2:

Data presented in Tables (14&15) and illustrated in cumulative curves (Fig. 18 to 23) represent the different profiles of traverse no. 2. The values of mean size (M_Z) vary between 1.92 and 5.93 ϕ corresponding to medium sand and medium silt contents, generally, mean size values tend to be finer from east to west. The sorting values show that the sediments constitution fall in the poorly sorted and very poorly sorted classes. In this accord; surface layer of profiles no. 5 and 7 and all layers of profile no. 6 constitute poorly sorted sediments. Subsurface layers of profiles no. 5 and 7 and all layers of profiles no. 8,9 and 10 have very poorly sediments. These values of sorting indicate that water is the main agent of transportation and deposition, *Inman (1952)*. Data manifest that the changes in sorting values through profiles no. 5.7 and 9 are strictly confined to the surface layer. The values of skewness indicate that all layers within the profiles under consideration are positively skewed and very positively skewed , which indicates that these soils have a tail of fine grains, except surface layer of profile no. 5 which has a skewness value of 0.098, i.e., near symmetrical. The kurtosis values show that the soil represented by profile no. 8 (except layer of 0-40 cm) and layer of 70-150 cm of profile no. 9 have very platykurtic values. The soil represented by profiles no. 6 (except layer of 80-150 cm) and 10 (except layer of 0-30 cm) and the layer of 40-70 cm profile no. 9 have a platykurtic values. The soil layers of 0-35 cm, 80-150 cm and 0-30 cm of profiles no. 5,6 and 10, respectively,

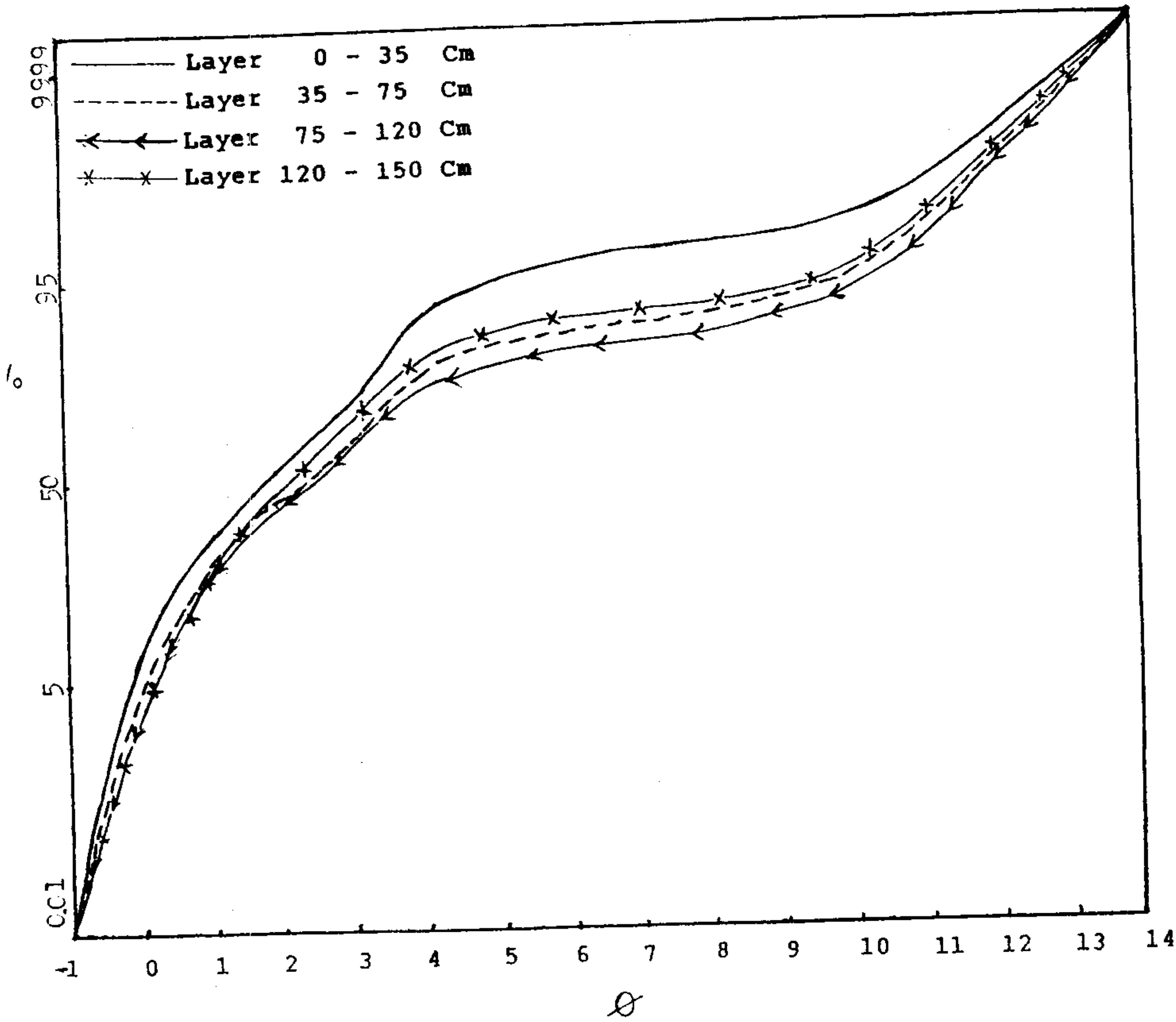


Fig. (18) : Cumulative frequency curve of different soil layers of profile no. 5 (Traverse no. 2) .

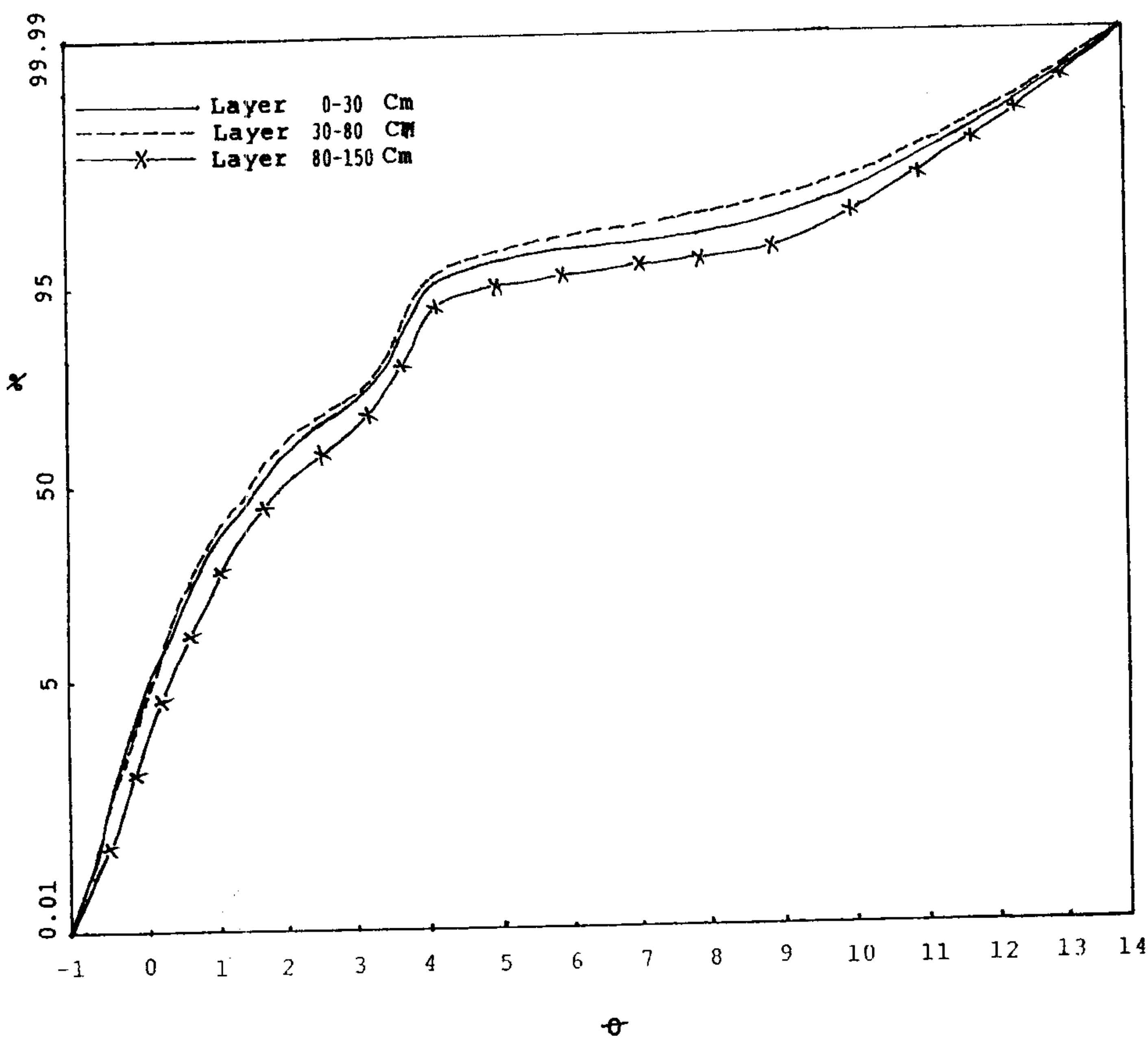


Fig. (19) : Cumulative frequency curve of different soil layers of profile no. 6 (Traverse no. 2) .

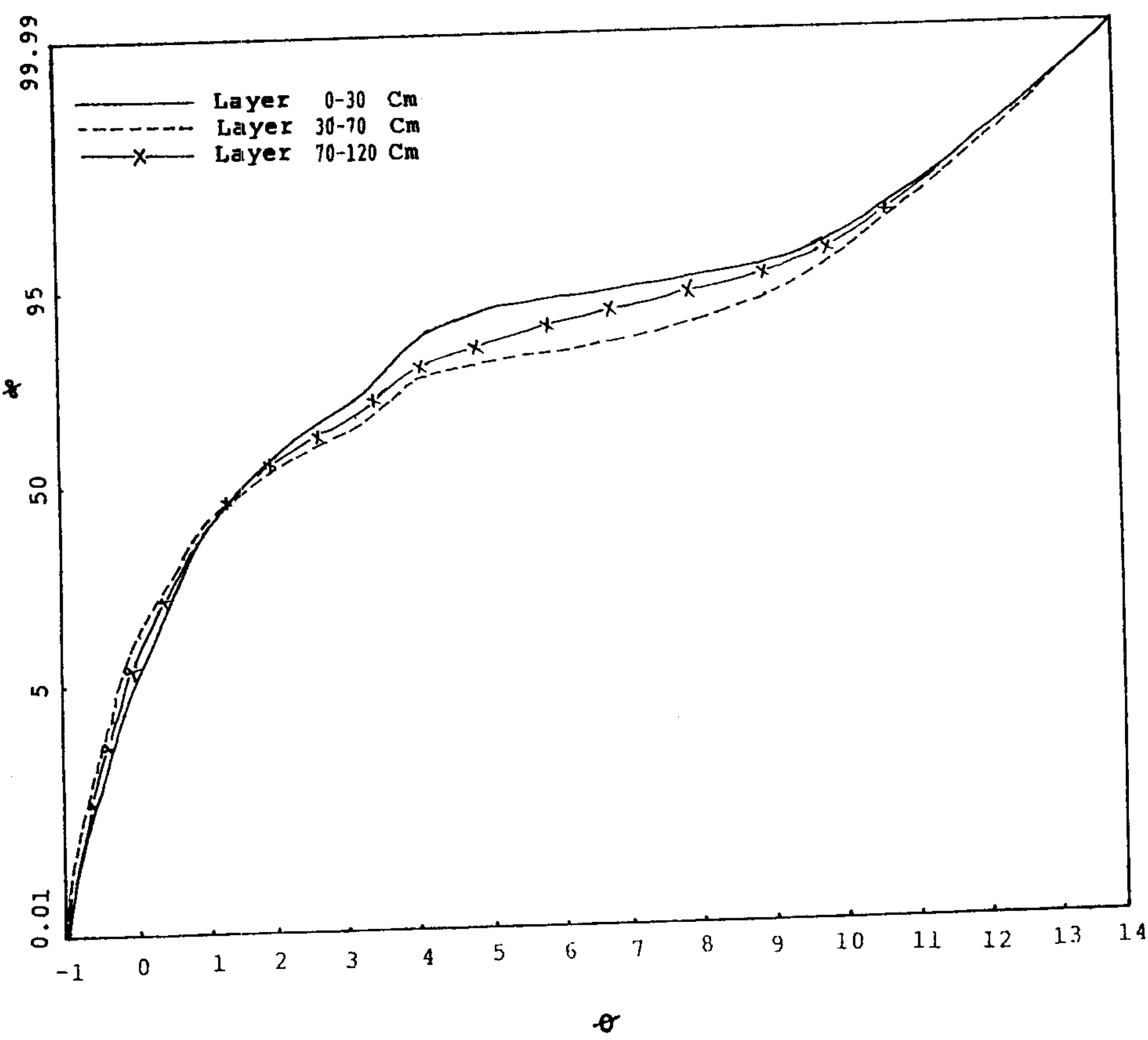


Fig. (20) : Cumulative frequency curve of different soil layers of profile no. 7 (Traverse no. 2) .

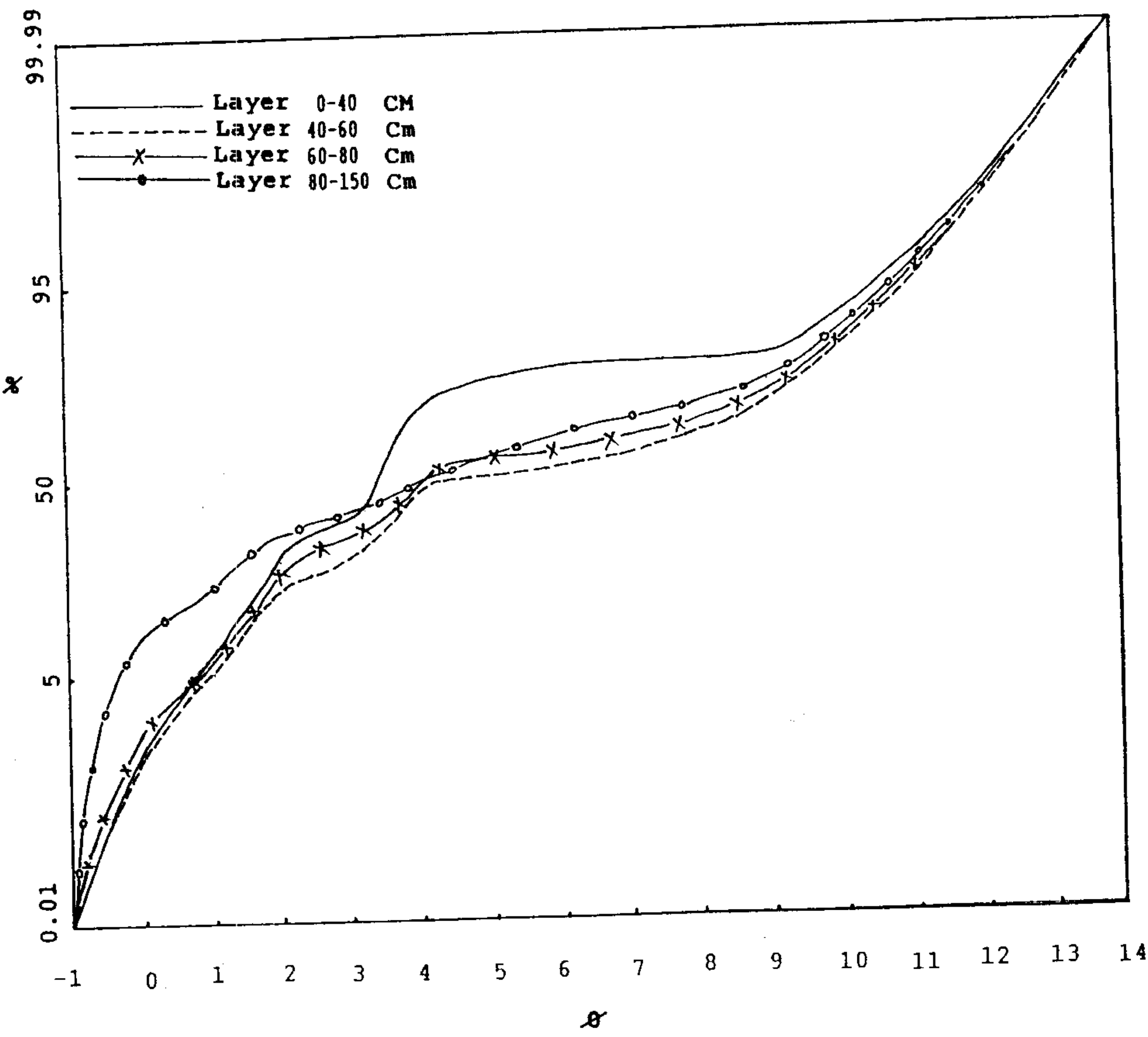


Fig. (21) : Cumulative frequency curve of different soil layers of profile no. 8 (Traverse no. 2) .

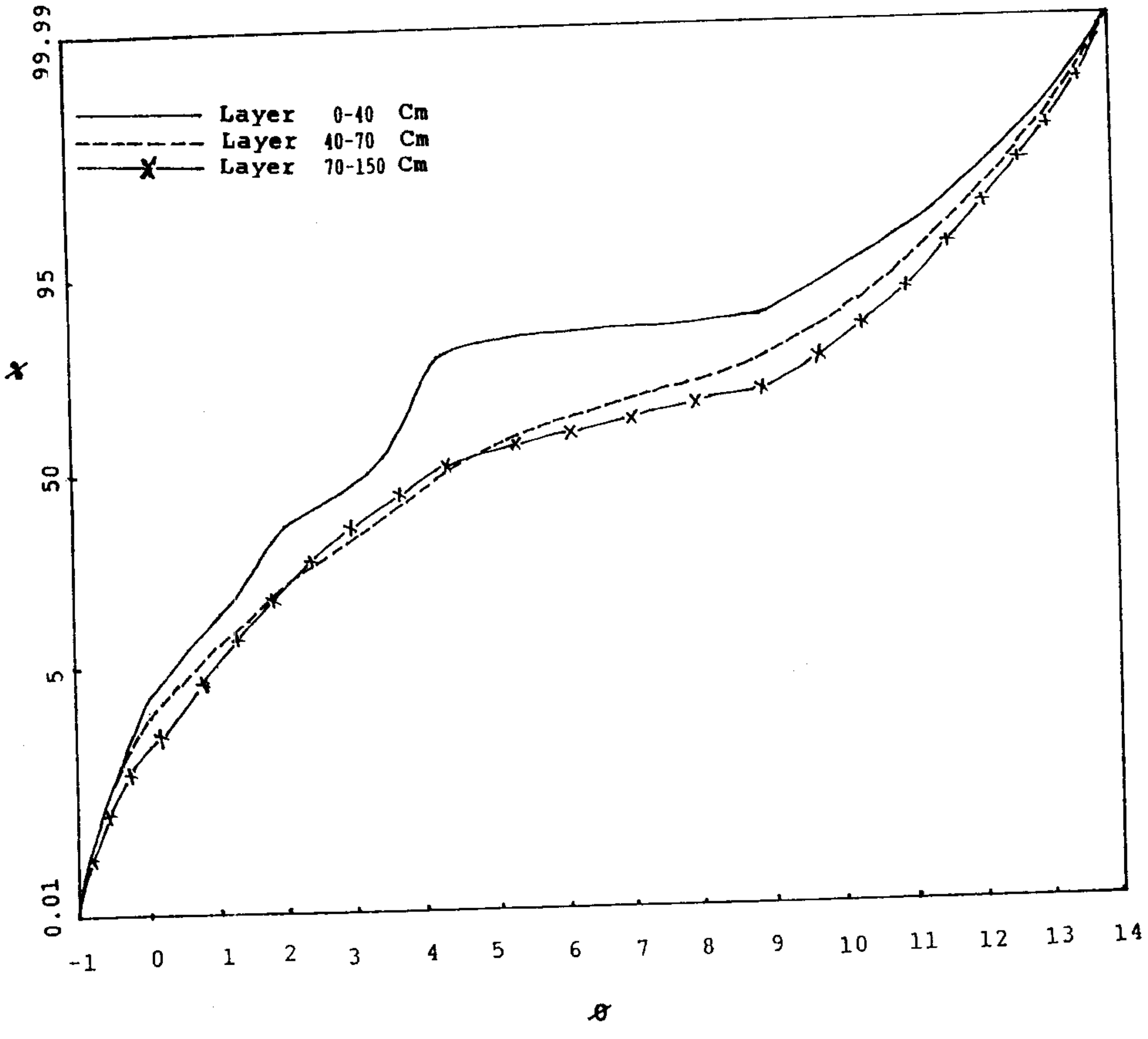


Fig. (22) : Cumulative frequency curve of different soil layers of profile no. 9 (Traverse no. 2) .

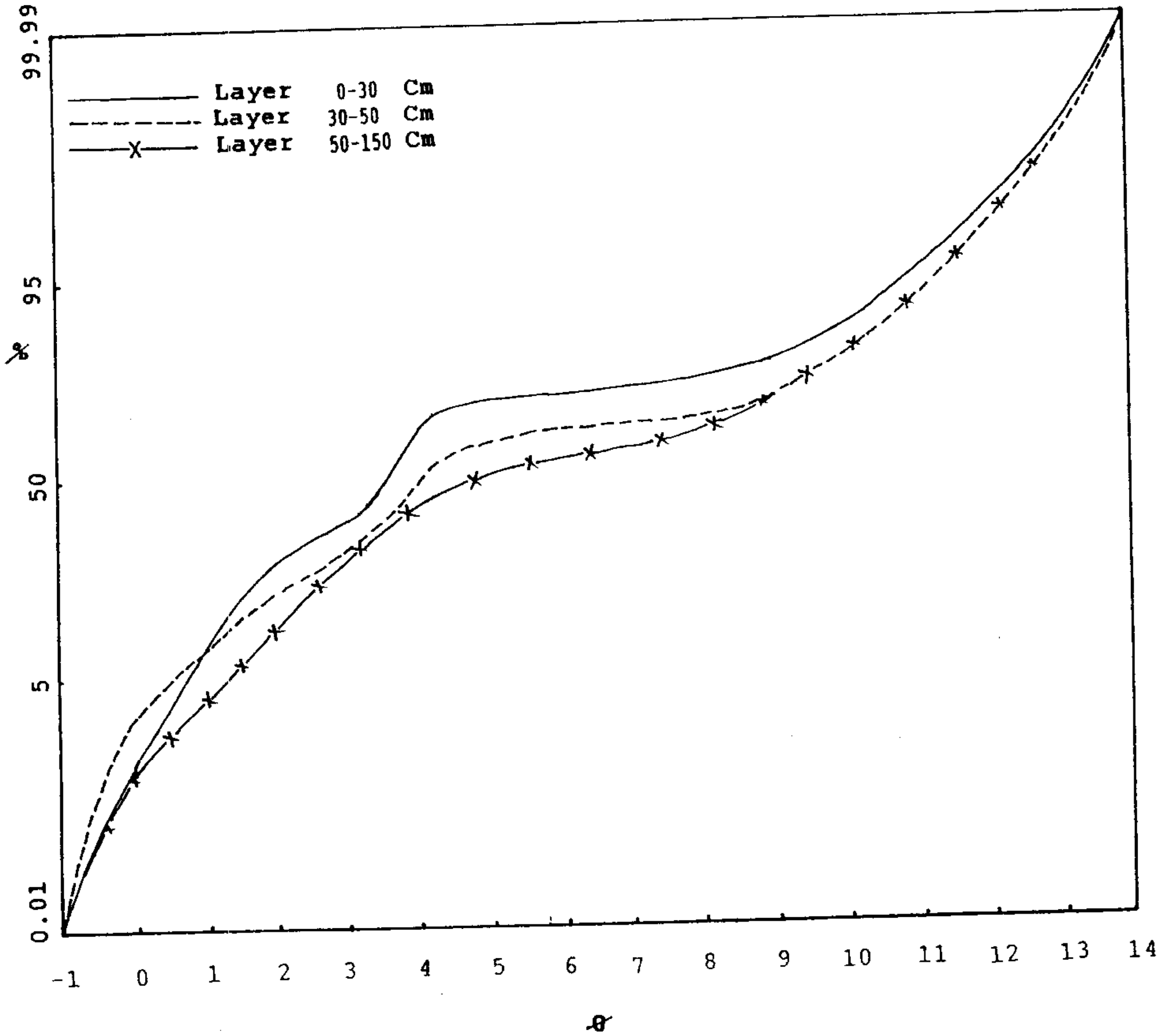


Fig. (23) : Cumulative frequency curve of different soil layers of profile no. 10 (Traverse no. 2).

5,6 and 10, respectively, have a mesokurtic values. Such values of mesokurtic, platykurtic and very platykurtic indicate a very low energy environment and very high modification of grain size. The soils of profile no. 7 have leptokurtic values. On the other hand, the soils of profile no. 5 (except layer 0-35 cm), the soil layer of 0-40 cm of profile no. 8 and the soil layer of 0-40 cm of profile no. 9 have a very leptokurtic values. Such values of leptokurtic and very leptokurtic indicate to very high energy environment and very low modification of grain size.

According to limits of *Sahu (1964)* and data of Table (14) the soils of all profiles of traverse no. 2 represent a fluvial (deltaic) deposits, which assure the geomorphic unit as old deltaic plain.

Soils of traverse no. 3:

Data presented in Tables (14& 15) and illustrated in cumulative curves (Fig. 24 to 26) represent the different profiles of traverse no. 3. The values of mean size (M_Z) range between 1.37 and 3.77ϕ corresponding to medium sand and very fine sand, respectively. Generally, medium sand is a predominant mean size in this traverse, while mean size was very fine in the layer of 0-22 cm of profile no. 12 due to addition of clay to improvement the soil texture by farmer, on the other hand, the layer of 80-110 cm of profile no. 11 has mean size as a fine sand may be due to migration fine fraction from upper layers. The sorting (σ_1) values of the sediments are very poorly sorted except the layers of 110-150 cm and 45-80 cm of profiles no. 11 and 13, respectively have a poorly sorted values, and soils of profile no. 12 (except layer 0-22 cm) have a moderately sorted values. According to *Inman (1952)*, the values of sorted sediments indicate that water is the main agent of transportation and

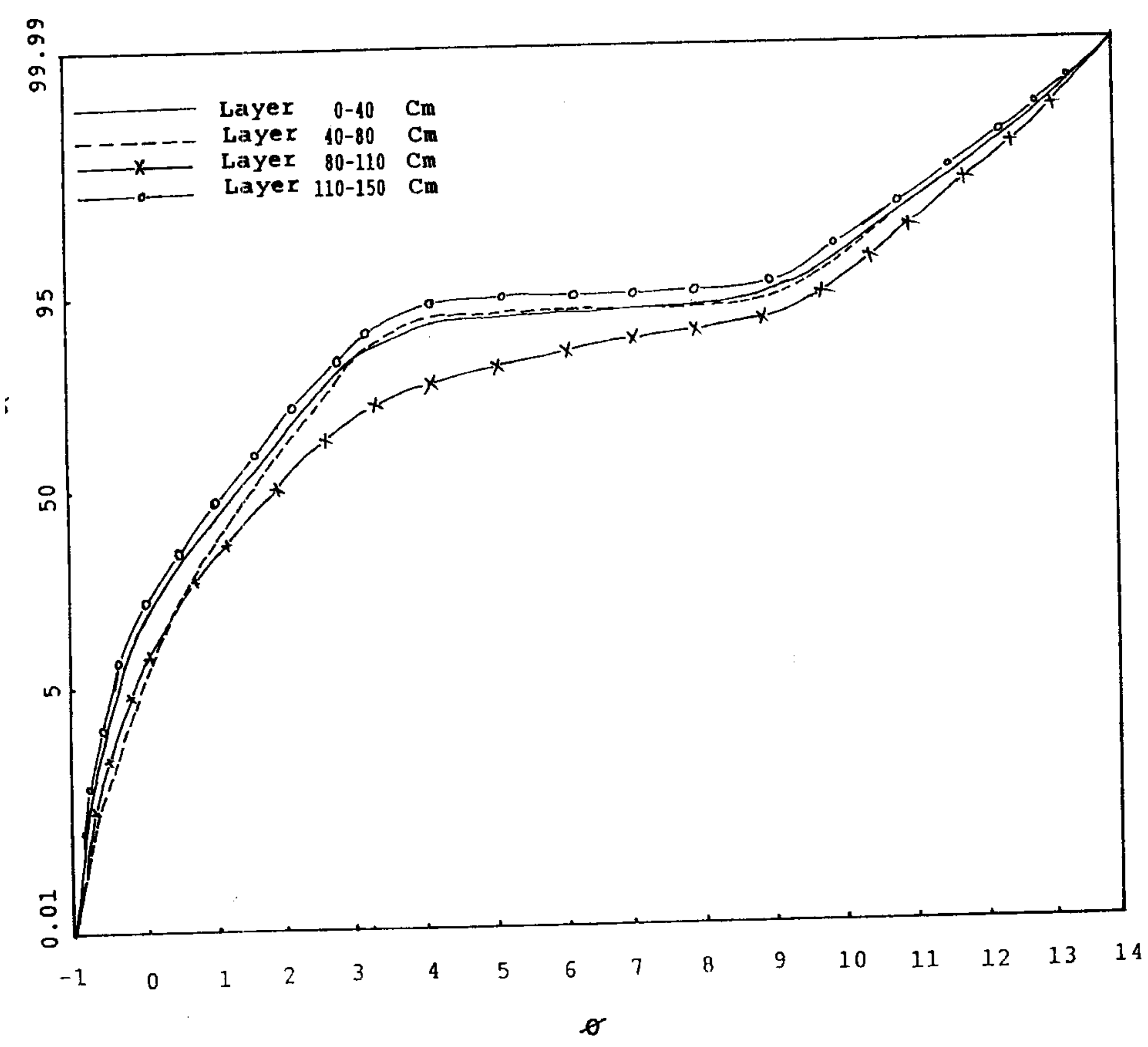


Fig. (24) : Cumulative frequency curve of different soil layers of profile no. 11 (Traverse no. 3).

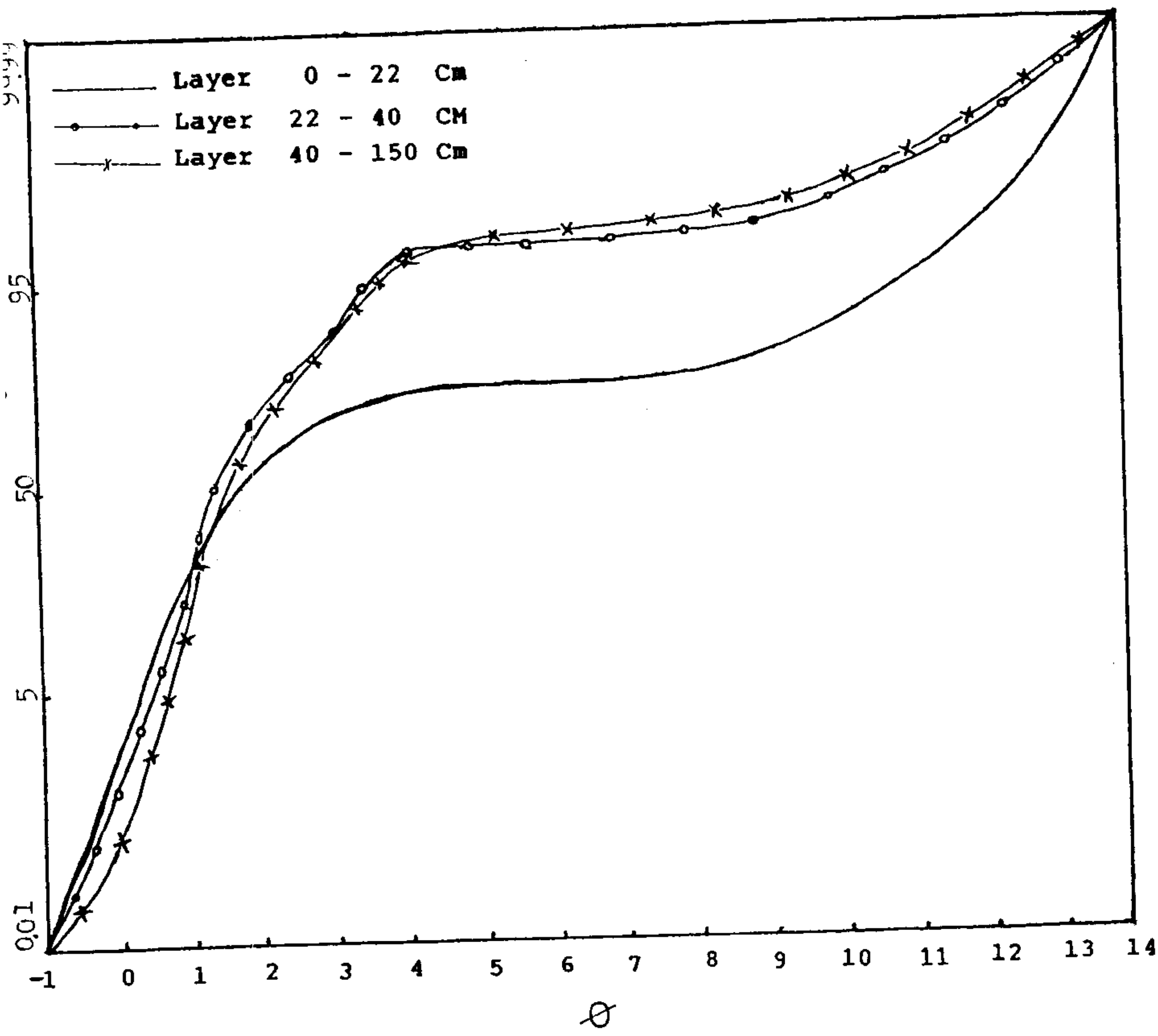


Fig. (25) : Cumulative frequency curve of different soil layers of profile no. 12 (Traverse no. 3).

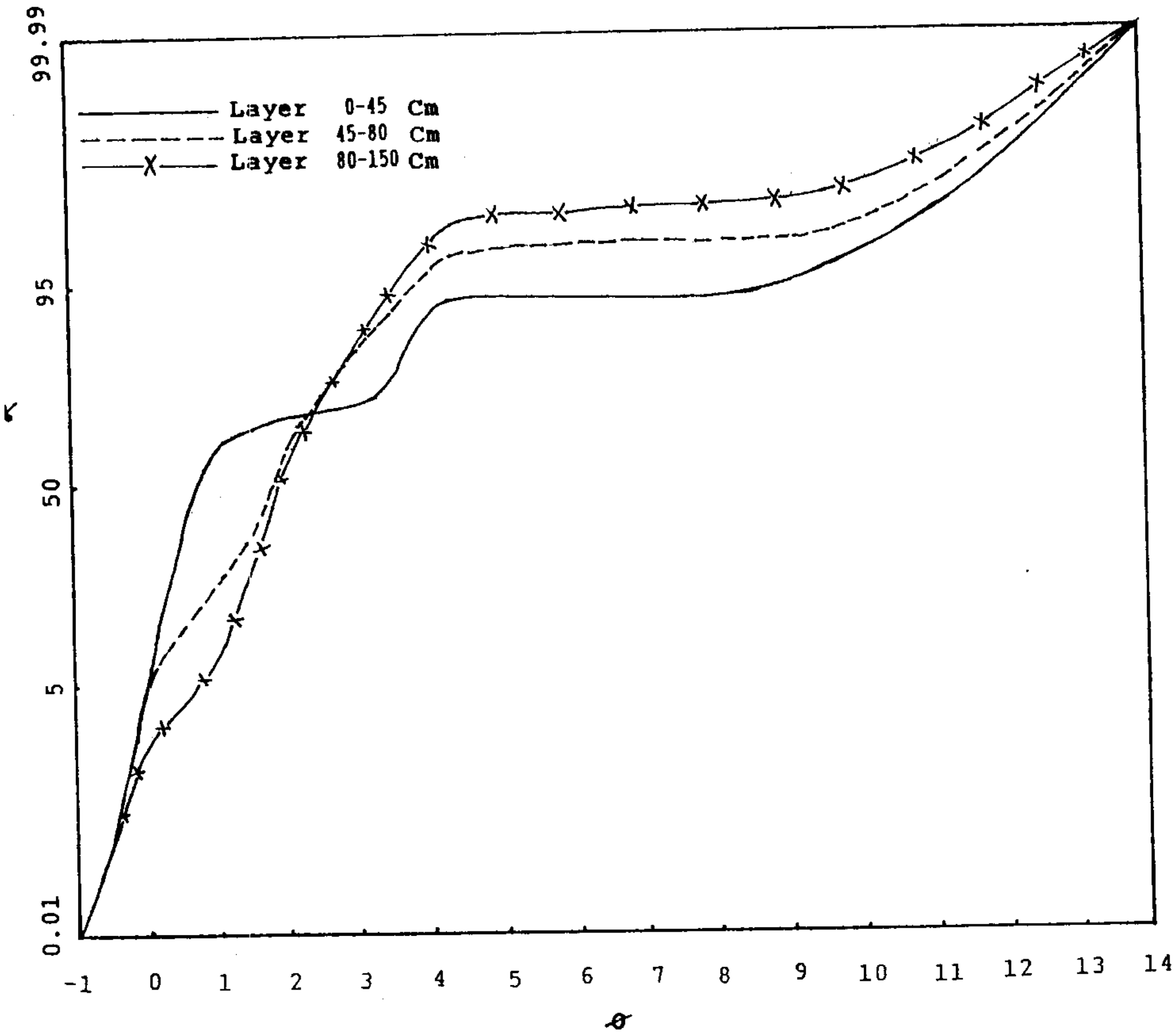


Fig. (26) : Cumulative frequency curve of different soil layers of profile no. 13 (Traverse no. 3).

deposition of sediments, except subsurface layers of profile no. 12 which are mainly transported and deposited by wind and water actions. The values of skewness indicate that profiles no. 11 and 12 and so surface layer of profile no. 13 are very positively skewed, while it is nearly symmetrical in soils of subsurface layers of profile no. 13, which indicate that the soils of traverse no. 3 have a tail of fine grains. The kurtosis values show that the soil represented by profile no. 11 and surface layer of profile no. 12 have very leptokurtic values. The soil represented by profile no. 12 (except layer 0-22 cm) has a mesokurtic values, while profile no. 13 has a leptokurtic values. Such values of kurtosis indicate to very high energy environment and very low modification of grain size except subsurface layers of profile no. 12, where kurtosis values indicate to very low energy environment and very high modification of grain size.

According to limits of *Sahu (1964)* and data of Table (14), the soils of traverse no. 3 represent fluvial (deltaic) deposition, this result assure the geomorphic unit, i.e., old deltaic plain.

Soils of traverse no. 4:

Data presented in Tables (14&15) and illustrated in cumulative curves (Fig. 27 to 29) represent the different profiles of traverse no. 4. The values of mean size (M_Z) range between 1.37 and 6.02ϕ corresponding to fine sand in profiles no. 14 (except layer of 70-100 cm has medium sand) and 15 (except layer of 50-70 cm has very fine sand). While, it varies from very fine sand in the surface layer to fine silt in the deeper one of profile no. 16. The sorting values of the grain size range between 1.8860 and 3.7555ϕ and lie in the range between poorly sorted and very poorly sorted sediments. The highest

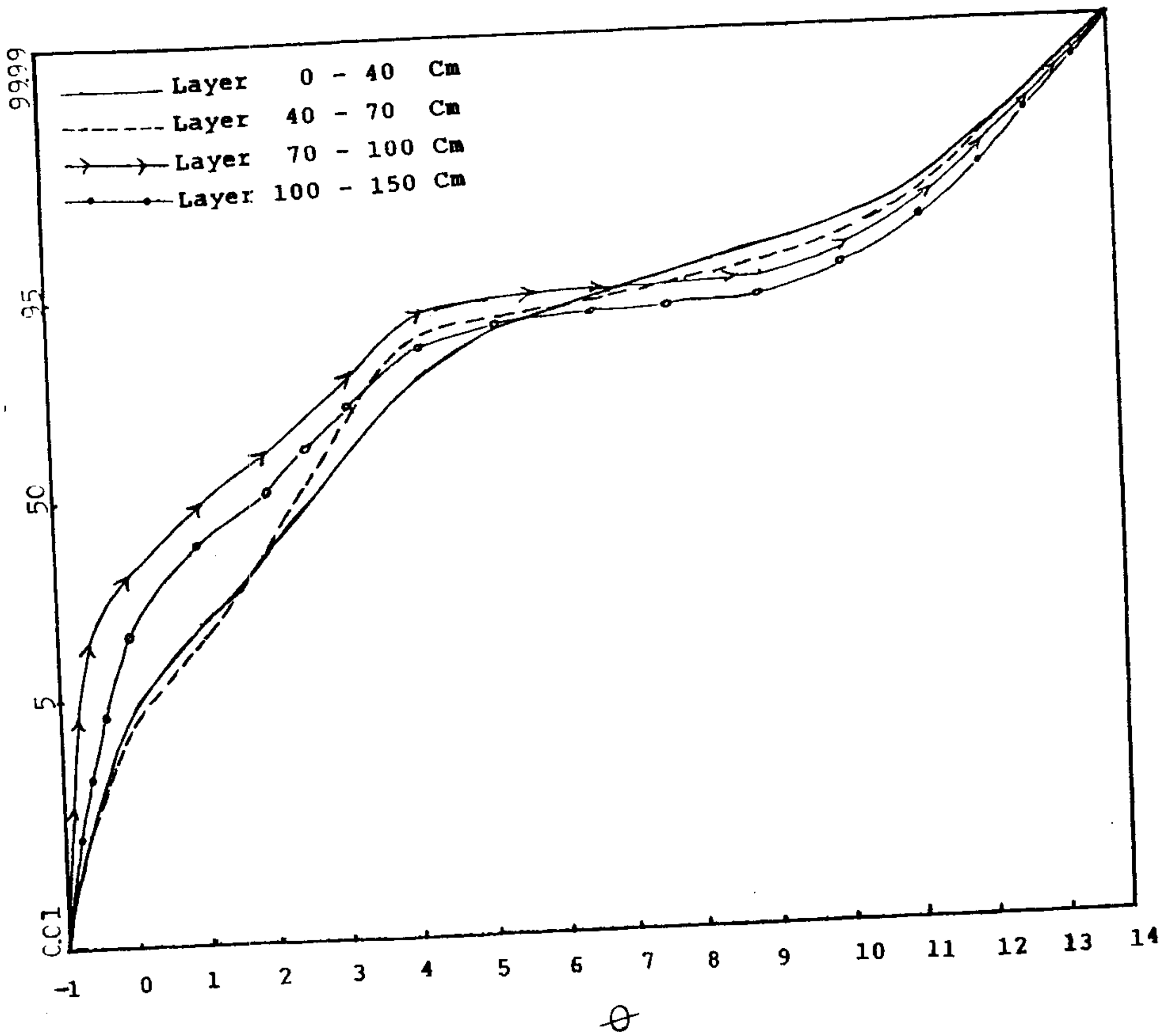


Fig. (27) : Cumulative frequence curve of different soil layers of profile no. 14 (Traverse no. 4).

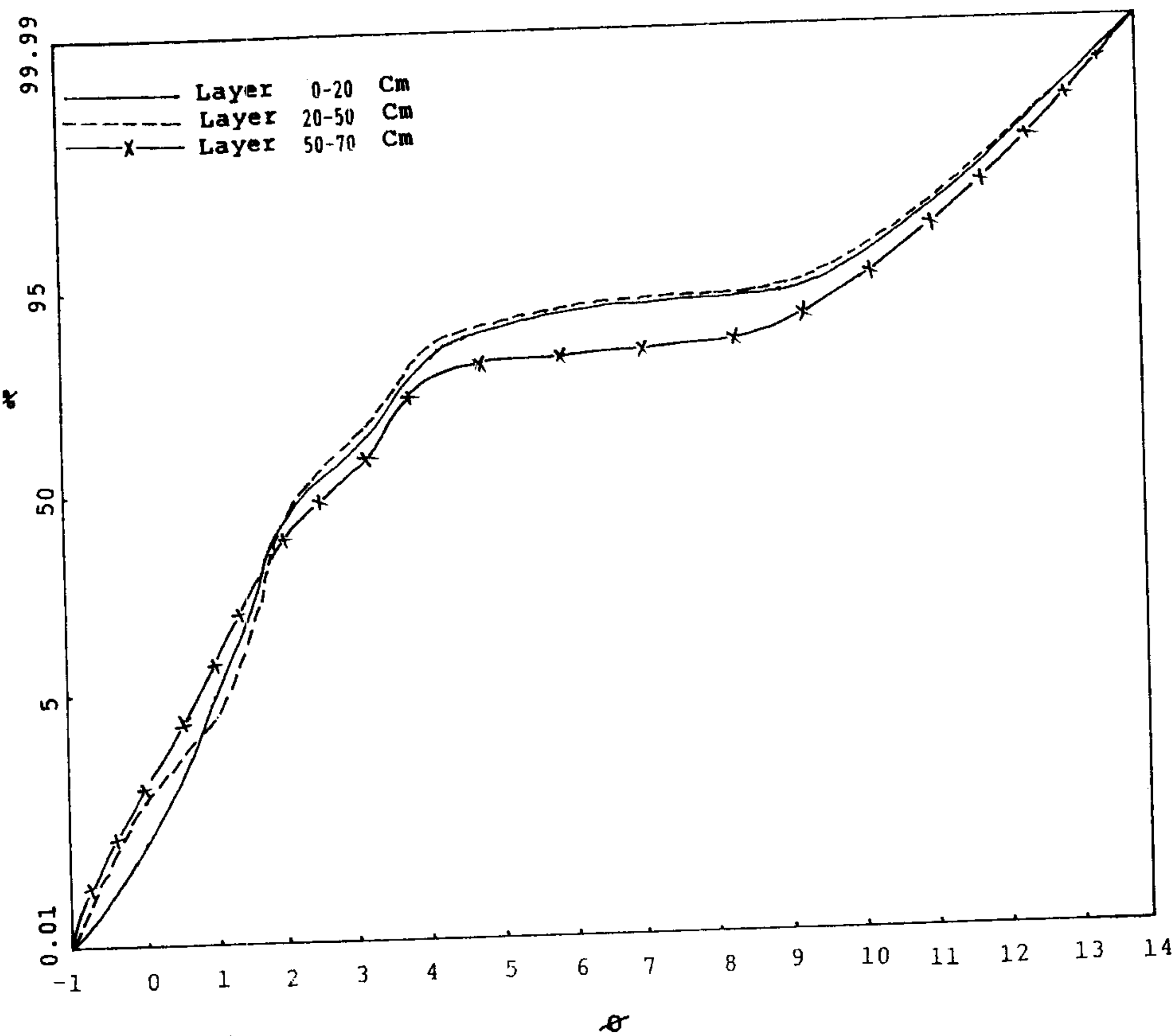


Fig. (28) : Cumulative frequence curve of different soil layers of profile no. 15 (Traverse no. 4).

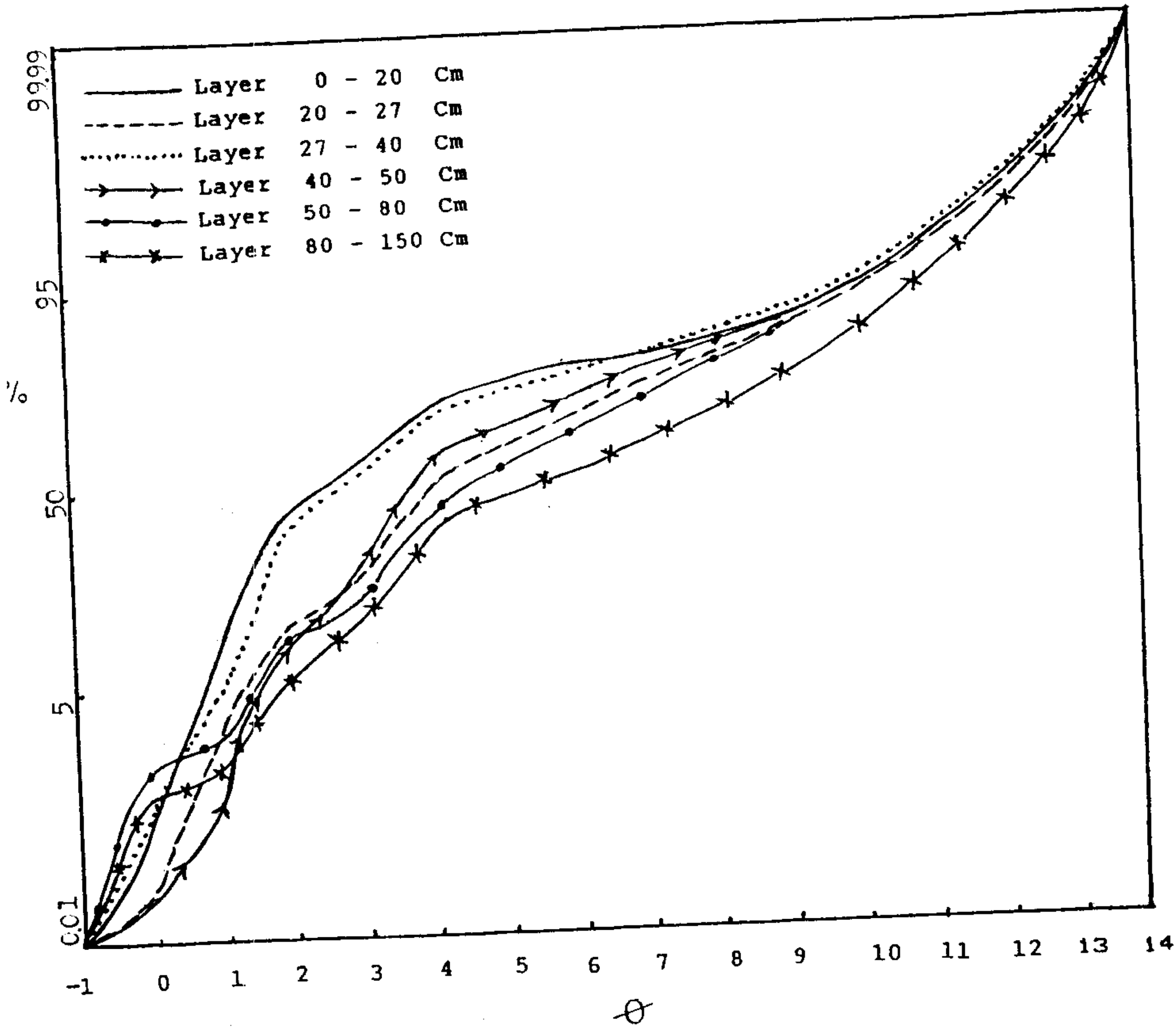


Fig. (29) : Cumulative frequence curve of different soil layers of profile no. 16 (Traverse no. 4).

two layers of profile no. 14 and surface layer of profile no. 15 show poorly sorted values. The soils of the deepest layer of profiles no. 14 and 15 and all soil layers of profile no. 16 have very poorly sorted values. According to *Inman (1952)*, poorly and very poorly sorted sediments indicate that water is the main agent in transportation and deposition of sediments. The values, of skewness range between positively and very positively skewed , which show that the samples have a tail of fine grains. The kurtosis values show that the soils represented by profiles of traverse no. 4 have leptokurtic and very leptokurtic values. Such values of Kurtosis indicate to a very high energy environment and very low modification of grain size except the layer of 80-150 cm of profile no. 16 has a platykurtic limit.

According to limits of *Sahu (1964)* and data of Table (14), the soils of traverse no. 4 represent fluvial (deltaic) depositions.

Soils of traverse no. 5:

Data presented in Tables (14&15) and illustrated. in cumulative curves (Fig. 30 to 32) represent the different profiles of traverse no. 5 the values of mean size (M_Z) range between 1.50 and 7.43ϕ and lie in the range medium sand and very fine silt. Soils of profiles no. 17 (except layer 0-20 cm) and 19 (except layer 50-90 cm) have a mean size corresponding to fine sand. Soils of profile no. 18 have a mean size as a coarse silt in upper two surface layers while the followed layers have a mean size corresponding to very fine silt, medium silt and medium sand, respectively. Layer 0- 20 cm of profile no. 17 and layer 50-90 cm of profile no. 19 have mean size corresponding to very fine sand and medium sand, respectively. Generally, the mean size (M_Z) tends to be coarser with depth. The sorting σ_1 values of grain size range between

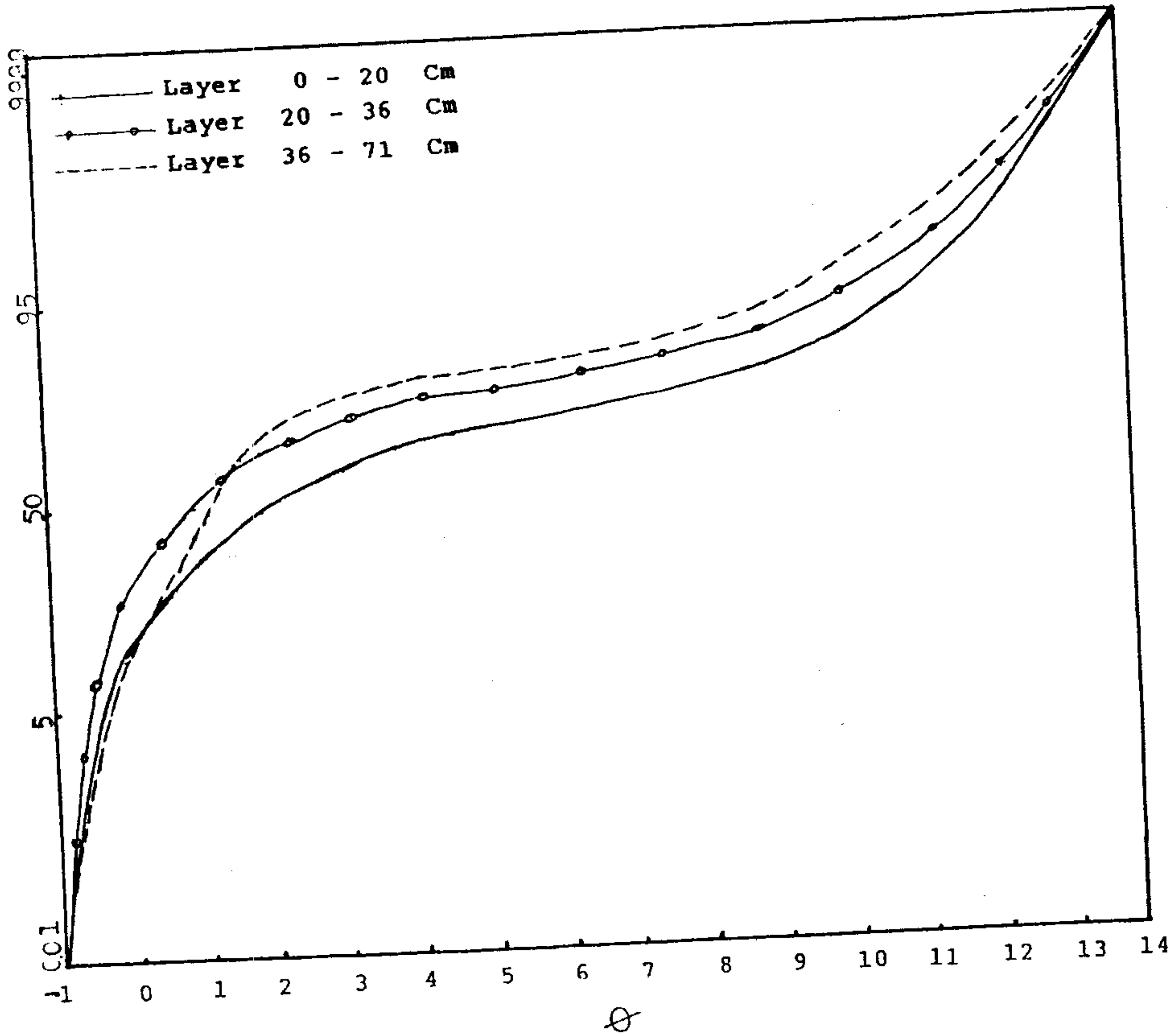


Fig. (30) : Cumulative frequence curve of different soil layers of profile no. 17 (Traverse no. 5).

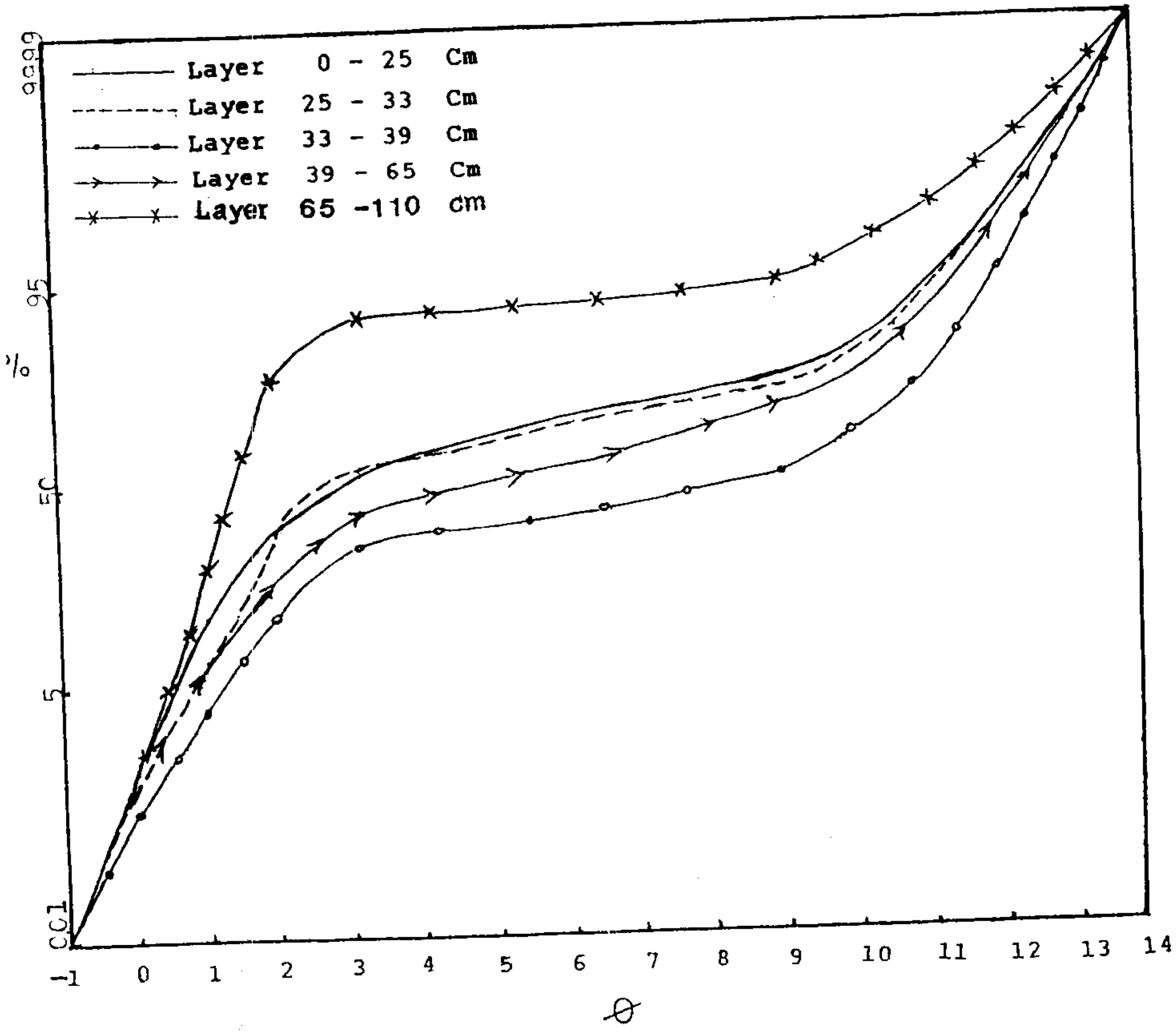


Fig. (31) : Cumulative frequence curve of different soil layers of profile no. 18 (Traverse no. 5).

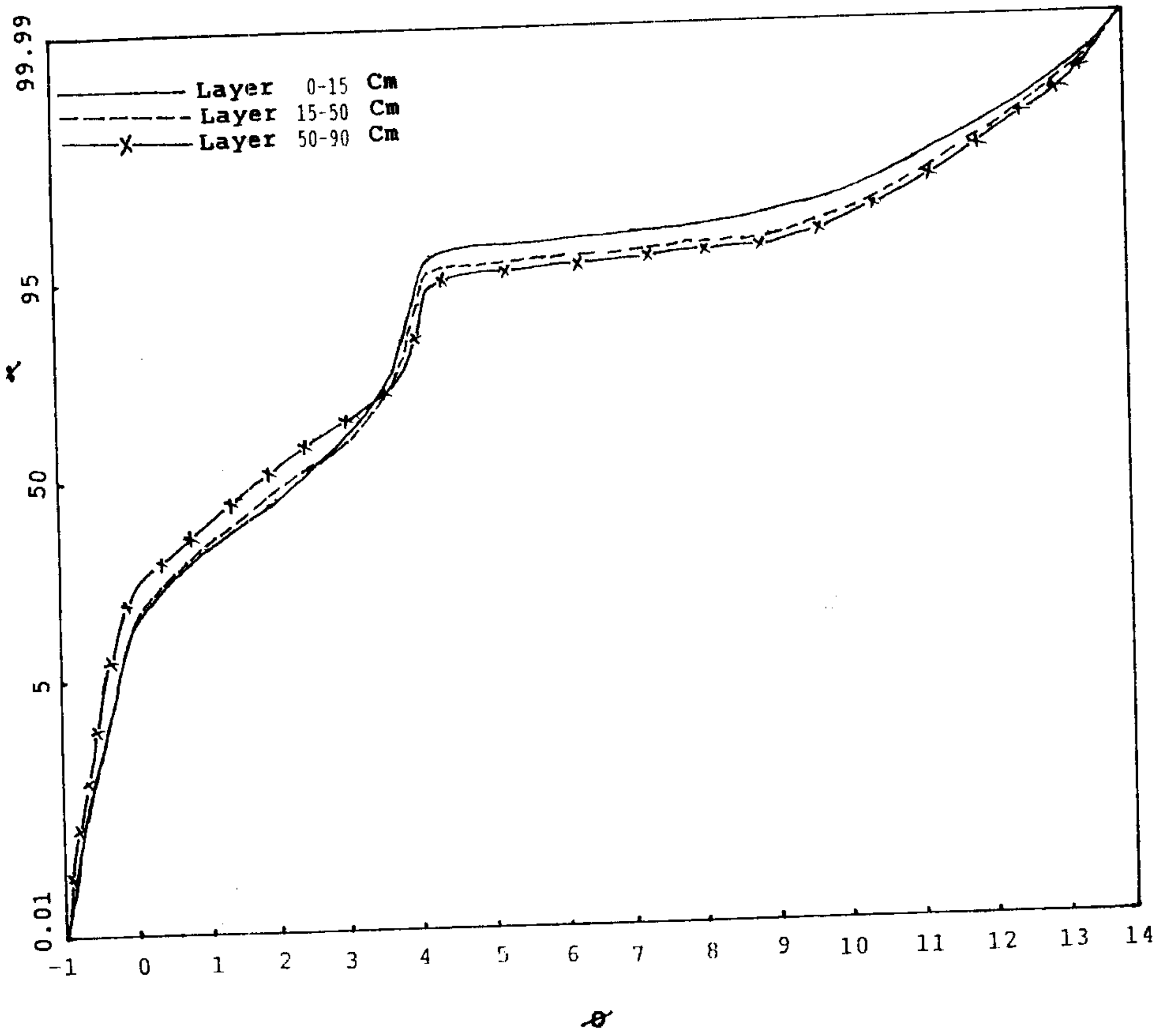


Fig. (32) : Cumulative frequence curve of fifferent soil layers of profile no. 19 (Traverse no. 5).

1.5391 and 3.9246 ϕ and lie in the range between poorly sorted and very poorly sorted.

According to *Inman (1952)*, poorly and very poorly sorted sediments indicate that water is the main factor in transportation and deposition of sediments. The values of skeweness indicate that profiles no. 17 and 18 (except layer 33-39 cm) are positively and very positively skewed, which indicate that these soils have a tail of finess. While, the layer of 33-39 cm of profile no. 18 and profile no. 19 (except layer 50-90 cm) are negatively and very negatively skewed, which indicate to a tail of coarse grains. The layer of 50-90 cm of profile no. 19 shows a nearly symmetrical skewed, this indicates that the curve is obtained from a homogeneous distribution. The kurtosis values show that the soil represented by profile no. 17 (except layer 0-20 cm) and layer of 65-110 cm of profile no. 18 have leptokurtic, very leptokurtic and extremely leptokurtic values. Such values of kurtosis indicate to very high energy environment and very low modification of grain size. While, another profiles and layers have platykurtic and very platykurtic values. Such values of kurtosis indicate to very low energy environment and very high modification of grain size.

According to *Sahu (1964)* and data of Table (14), the soils of traverse no. 5 are deposited under aqueous environments. The parent material of these soils seemed to have mainly deposited under fluvial (deltaic) conditions.

Concerning the soils of traverse no. 3, opaque minerals contents vary from 38.10 to 61.71% of the total heavy minerals content. They decrease also with depth in profiles no. 11 and 12, while the opposite trend is noticed in profile no. 13.

With regard to the soils of traverse no. 4, opaques constitute from 27.36 to 56.95% the total heavy mineral content. They increase with depth in profile no. 14 till 70 cm depth, then they decrease downwards, while they decrease with depth in profile no. 15. On the other hand, no clear trend is noticed concerning profile no. 16.

Concerning the soils of traverse no. 5, opaque minerals constitute from 13.63 to 66.27% of the total heavy minerals content and tend to decrease with depth.

Generally, soil profiles affected by shallow ground water have a lower content of opaque minerals than the unaffected ones. This may be due to the reduction effect of iron oxides which causes a decomposition of these minerals *(Sharma and Swarup, 1988).Rahim (1993)* stated that the saline environment and high water table, gley zones were developed due to the reduction in iron and manganese components under water logging condition.

Amphiboles:

These minerals are represented by hornblende, actinolite and tremolite. Data of Table (16) show that the total amphiboles vary between 1.44 and 32.83% of the total heavy minerals content in the studied soil samples.

Amphiboles content in the soils traverse no. 1 range between 12.17 and 20.56% of total heavy minerals content and tend to increase with depth, except the layers of 20-40 cm and 20-50 cm depth of profiles no. 3 and 4, respectively. Among of this group of minerals, hornblende is predominant and constitutes 8.28-12.96% of the total heavy mineral content, while tremolite is the lowest one constituent, and its contents vary between 0.21 and 3.03%. On the other hand, actinolite constitutes 2.61-8.27% of the total heavy minerals content.

Amphiboles constitute 2.76-14.10% of the total heavy minerals content in the soils of traverse no. 2. They tend to increase with depth in all profiles, except profile no. 5 shows an opposite trend. Generally, hornblende is a dominant constituent, followed by actinolite, while tremolite is the lowest one.

Concerning the soils of traverse no. 3, amphiboles content constitute 7.26-21.78% of the total heavy minerals and tend to increase with depth except profile no. 13 shows an opposite trend. Generally hornblende is the predominant constituent, follows by actinolite, while tremolite is the lowest ones.

In soils of traverse no. 4 amphiboles vary from 5.04 to 20.00% of the total heavy minerals content and tend to increase with depth in soils of profiles no. 14 (except layer 40-70 cm) and 15, while profile no. 16 shows an irregular trend. In this traverse predominant amphibole mineral changes between hornblende and actinolite, while tremolite is the lowest one constitutes.

Amphiboles content of soils of traverse no. 5 range between 1.44 to 32.83% of the total heavy minerals content and tend to increase with depth. Distribution of amphibole minerals shows the same trend in traverses no. 1,2 and 3.

Pyroxenes:

Pyroxenes are mainly represented by augite, hypersthene, diopside and enstatite.

Data of Table (16) reveal that total pyroxenes minerals, in the soils of traverse no. 1, vary between 8.64 and 14.90% of the total heavy minerals content. Generally augite is the predominant constituent, follows by hypersthene, enstatite and diopside, respectively.

Pyroxenes contents, in the soils of traverse no. 2, range between 4.10 and 13.02% of the total heavy minerals contents and tend to increase with depth except profiles no. 5 and 9 which show an opposite trend. Generally, augite is the predominant constituent.

Concerning the soils of traverse no. 3, pyroxenes constitute 6.60-20.19% of the total heavy minerals contents and tend to increase with depth, except profile no. 13 show an opposite trend.

In soils of traverse no. 4, pyroxenes vary from 6.90 to 17.50% of the total heavy minerals contents and tend to increase with depth, except profile no. 16 has an opposite trend. Augite is the predominant pyroxene mineral in profiles no. 14 and 16 (except layer 80-150 cm), while hypersthene is the dominant ones in profile no. 15 (except layer 0-20 cm, where diopside is a dominant).

With regard to the soils of traverse no. 5, the pyroxenes minerals vary between 1.88 and 22.02% of the total heavy minerals content and tend to increase with depth. Generally, augite is the predominant mineral.

Generally, soils affected by ground water have contents of amphiboles and pyroxenes minerals higher than the unaffected ones, may be attributed to the reduction effect in soils which affected by ground water causing decrease the opaque minerals content which represent the dominant constituent.

Zircon:

Zircon content, Table (16), varies between 0.23 and 12.40% of the total heavy minerals content and tends to decrease with depth except profiles no. 2,3 and 4 of traverse no. 1, profile no. 16 of traverse no. 4 and profiles no. 18 and 19 of traverse no. 5. On the other hand, zircon is homogenous in profile no. 12 of traverse no. 3. Soils of traverse no. 2 have higher zircon content.

Rutile:

Data of Table (16) reveal that rutile is absent in most soil profiles of traverse no. 1, while it ranges between 0.20 and 5.89% of the total heavy minerals content. Soils of traverse no. 2 record higher content of rutile.

Tourmaline:

Tourmaline varies between 0.31 and 8.87% of the total heavy minerals content, Table (61), and tend to increase with depth except profile no. 2 of traverse no. 1, profiles no. 5, 6, 8 and 10 of traverse no. 2, profiles no. 14 and 16 of traverse no. 4 and profiles no. 18 and 19 of traverse no. 5 all have an opposite trend. Soils of traverse no. 1 have higher content of tourmaline.

Garnet:

Garnet, in Table (16), is absent in profiles no. 7 and 19 of traverses no. 2 and 5, respectively and some layers. It ranges from 0.21 to 4.50% of the total heavy minerals content. Soils of traverse no. 3 show higher garnet content.

Staurolite:

Data of Table (16) reveal that Staurolite is absent in most layers of profiles no. 7 (traverse no. 2) and 15 (traverse no. 4). It varies between 0.21 and 7.20% of the total heavy minerals contents. Soils of traverse no. 1 record higher staurolite content. Staurolite content tends to decrease with depth except profiles no. 1,4 (traverse no. 1), 8,10 (traverse no. 2), 12 (traverse no. 3), 15 (traverse no. 4) and 17 (traverse no. 5). On the other hand, profile no. 11 (traverse no. 3) show an irregular trend.

Sillimanite:

Sillimanite content (Table, 16) is absent in profiles no. 5 and 9 of traverse no. 2, 11 and 13 of traverse no. 3 most layers of all profiles of traverse no. 4 and most layers of profile no. 18 of traverse no. 5 and varies between 0.20 and 2.16% of the total heavy minerals content. Soils of traverse no. 1 have higher content of sillimanite.

Spinel:

Data of Table (16) show that spinel is absent in profiles no. 6, 7,9 and 10 (except layer of 50-150 cm) of traverse no. 2, profile no. 11 of traverse no. 3, profile no. 15 and two upper layers of profile no. 16 of traverse no. 4 and profile no. 19 of traverse no. 5 and ranges from 0.19 to 2.13% of the total heavy minerals content. Distribution of spinel tend to be homogenous through all profiles of traverse no. 3 with depth, while decrease with depth in another profiles except profiles no. 3 and 4 of traverse no. 1 which have homogenous distribution.

Epidote group:

Epidote group is mainly represented by epidote (pistacite) and zoisite. Epidote, in Table (16), varies between 0.66 and 17.47% of the total heavy minerals content . While, zoisite. is absent in profiles no. 8, 9 and 10 most layers of profiles no. 5 and 6 of traverse no. 2, profile no.11 and deepest layer of profile no. 13 of traverse no. 3, profile no. 14 and some layers of profile no. 16 of traverse no. 4 and all profiles of traverse no. 5. Zoisite constitute 0.21-2.50% of the total heavy minerals content. Soils of traverse no. 4 have higher contents of epidote (pistacite), while soils of traverse no. 1 have higher ones of zoisite. Generally, epidote (pistacite) tends to increase with depth,except profiles no. 6 and 8 of traverse no. 2 and profile no. 19 of traverse no. 5 show an opposite trend. Zoisite content, also, tends to increase with depth,except profile no. 12 of traverse no. 3 reveals an opposite trend.

Kyanite:

Table (16) shows that kyanite varies between 0.30 and 10.08% of the total heavy minerals content. Kyanite content tends to decrease with depth except profiles no. 2 and 4 of traverse no. 1, profiles no. 7 and 9 of traverse no. 2, profile no. 15 of traverse no. 3, profiles no. 15 and 16 of traverse no. 4 and profiles no. 17 and 18 of traverse no. 5 have an opposite trend. Generally traverse no. 5 (except profile no. 19) has higher contents of kyanite follows by traverse no. 4.

Biotite:

Data of Table (16) show that biotite ranges from 2.16 to 7.20% of the total heavy minerals contents. Generally, soils of traverse no. 5 has higher contents of biotite. It tends to decrease with depth except profiles no. 1 and 3 of traverse no. 1, profile no. 7 of traverse no. 2, profiles no. 14 and 15 of traverse no. 4 and profiles no. 18 and 19 of traverse no. 5. On the other hand, soils of profile no. 16 have irregular trend.

Muscovite:

Data of Table (16) show that muscovite is absent in some layers of profiles no. 6 and 8 and most layers of profiles no. 9 and 10 of traverse no. 2, profiles no. 11 and 13 of traverse no. 3 and profile no. 19 of traverse no. 5. It varies between 0.21 and 6.07% of the total heavy minerals content. Soils of traverse no. 4 have higher content of muscovite. It tends to decrease with depth in profiles no. 1 and 4 of traverse no. 1, profile no. 15 of traverse no. 4 and profiles no. 17 and 18 of traverse no. 5, while profiles no. 2 and 3 of traverse no. 1, profiles no. 5, 6 and 7 of traverse no. 2, profile no. 12 of traverse no. 3 and profiles no. 14 and 16 of traverse no. 4 show an opposite trend.

Apatite:

Apatite is absent in soils of traverse no. 2 except two deepest layers of profile no. 5, profile no. 19 of traverse no. 5 and some layers of traverses no. 3, 4 and 5. It varies between 0.21 and 1.80% of the total heavy mineral contents. Soils of traverse no. 1 have higher content, Table (16).

Monazite:

Data of Table (16) show that monazite is absent in some layers of traverses no 2 sand 4, profiles no.11 and 18 of traverse no. 3, most layers of profile no. 17 and all layers of profile no. 19. It varies between 0.19 and 3.46% of total heavy minerals content. Soils of traverse no. 1 have higher contents of monazite, which tends to increase with depth.

Dolomite:

Dolomite in Table (16) is absent in profile no. 4 of traverse no. 1, profiles no 11 and 13 of traverse no. 3 and profile no. 19 of traverse no. 5. It varies between 0.31 and 4.44% of the total heavy minerals content. Soils of traverse no. 4 have higher content. Dolomite tends to increase with depth in soils of profiles no. 1 and 2 of traverse no. 1, profiles no. 5, 6, 7 and 10 of traverse no. 2 and profile no. 17 of traverse no. 5, while it decreases with depth in profile no. 10 of traverse no. 2, profile no. 12 of traverse no. 3, profile no. 14 traverse no. 4 and profile no. 18 of traverse no. 5. On the other hand, dolomite shows the same trend through all layers of profile no. 8 of traverse no. 2.

Sphene:

Data of Table (16) show that sphene is absent in some profiles and layers of traverse no. 2 and 3 and ranges from 0.21 to 4.60% of the total heavy minerals content. Soils of traverse no. 1 have higher content, follows by soils of traverse no. 5.

Glauconite:

Glauconite is absent in some layers of traverses no. 2, 4 and 5 and profile no. 14 of traverse no. 4, and varies between 0.21 and 5.18% of total heavy minerals content. Soil of traverse no. 1 have higher contents. It shows homogenous distribution in profile no. 10 of traverse no. 2 and profile no.11 of traverse no. 3, Table (16).

Andalusite:

Data of Table (16) show that andalusite is absent in most studied profiles and varies between 0.30 and 9.60% of the total heavy mineral content. It appears an important constituent in soils of profile no. 19 of traverse no. 5, and increases with depth.

4.2.2.2. Mineralogy of light minerals:

Light minerals have a specific gravity less than 2.85 g/cm3. In general , light minerals are composed of quartz and feldspars.

Quartz:

Quartz is the most prolific constituent of detrital sediments, especially of the arenaceous and argillaceous types. Its detailed study in the light portion of the sediment is of great consequence, particularly when inclusion are

Table (17) : Frequency distribution of primary light minerals in the sand fraction (0.063 - 0.250 mm)

Trav. No.	Location	Profile No.	Depth (cm)	Normal Quartz	Abnormal Quartz	Feldspars Ortho-clase	Plagi-oclase	Micro-cline	Total
1	Om EL-Reda	1	0-30	45.24	53.60	0.00	0.58	0.58	1.16
			30-50	52.36	47.43	0.00	0.21	0.00	0.21
			50-80	57.60	41.11	0.00	0.43	0.86	1.29
	EL-Mattar	2	0-30	57.05	42.53	0.00	0.21	0.21	0.42
			30-60	50.00	49.28	0.00	0.18	0.54	0.72
			60-80	47.99	50.67	0.00	0.45	0.89	1.34
	Gamassa	3	0-20	52.81	41.58	0.33	3.63	1.65	5.61
			20-40	52.12	41.04	0.65	4.23	1.95	6.83
			40-65	54.46	39.93	0.00	3.63	1.98	5.61
	Rosatta	4	0-20	53.04	42.12	0.00	3.33	1.52	4.85
			20-50	54.01	42.59	0.00	2.47	0.93	2.41
			50-80	54.29	43.87	0.00	1.84	0.00	1.84
2	EL-Nubaria	5	0-35	73.13	23.17	0.24	1.22	0.24	1.70
			35-75	53.69	44.02	1.02	1.02	0.25	2.29
			75-120	55.92	42.91	0.39	0.85	0.19	1.43
			120-150	61.64	37.25	0.22	0.67	0.22	1.11
	EL-Nubaria	6	0-30	90.69	8.71	0.00	0.30	0.30	0.60
			30-80	65.80	33.91	0.00	0.29	0.00	0.29
			80-150	83.07	16.61	0.00	0.32	0.00	0.32
	EL-Nubaria	7	0-30	76.79	22.88	0.00	0.33	0.00	0.33
			30-70	84.64	15.05	0.00	0.31	0.00	0.31
			70-120	78.33	20.43	0.00	0.31	0.93	1.24
	EL-Nubaria	8	0-40	71.48	22.62	1.97	2.95	0.98	5.90
			40-60	71.80	23.27	1.97	2.30	0.66	4.93
			60-80	72.79	24.59	0.98	1.64	0.00	2.62
			80-150	73.44	24.92	0.33	1.31	0.00	1.64
	EL-Nubaria	9	0-40	71.80	23.93	1.32	2.62	0.33	4.27
			40-70	72.13	25.57	0.66	1.64	0.00	2.30
			70-150	72.79	26.23	0.00	0.98	0.00	0.98
	EL-Nubaria	10	0-30	72.12	22.12	1.92	2.88	0.96	5.76
			30-50	72.44	23.08	1.60	2.24	0.64	4.48
			50-150	74.04	24.36	0.00	1.60	0.00	1.60

Table (17) : Cont.

Trav. No.	Location	Profile No.	Depth (cm)	Normal Quartz	Abnormal Quartz	Feldspars Ortho-clase	Plagi-oclase	Micro-cline	Total
3	EL-Shbab	11	0-40	83.28	9.97	0.00	1.93	4.82	6.75
			40-80	84.08	9.87	0.00	1.27	4.78	6.05
			80-110	84.61	11.22	0.00	0.64	3.53	4.17
			110-150	84.84	11.93	0.00	1.29	1.94	3.23
	EL-Shbab	12	0-22	62.28	36.85	0.22	0.43	0.22	0.87
			22-40	71.65	28.16	0.00	0.00	0.19	0.19
			40-150	68.36	31.64	0.00	0.00	0.00	0.00
	Belbeis	13	0-45	84.19	12.26	1.61	0.65	1.29	3.55
			45-80	84.84	12.90	1.29	0.00	0.97	2.26
			80-150	85.48	13.55	0.65	0.00	0.32	0.97
4	EL-Saff	14	0-40	67.61	31.97	0.21	0.21	0.00	0.42
			40-70	66.67	31.91	0.41	0.61	0.41	1.43
			70-100	61.77	36.36	0.93	0.47	0.47	1.87
			100-150	59.47	36.83	1.44	1.85	0.41	3.69
	EL-Nubaria	15	0-20	63.00	33.00	0.00	3.00	1.00	4.00
			20-50	74.71	24.41	0.00	0.88	0.00	0.88
			50-70	81.19	18.15	0.00	0.66	0.00	0.66
	Kom-Oshim	16	0-20	79.76	20.24	0.00	0.00	0.00	0.00
			20-27	80.31	18.70	0.39	0.59	0.00	0.98
			27-40	81.50	17.69	0.80	0.00	0.00	0.80
			40-50	80.66	18.18	0.58	0.39	0.19	1.16
			50-80	79.88	20.12	0.00	0.00	0.00	0.00
			80-150	83.42	16.05	0.35	0.18	0.00	0.53
5	Wadi EL-Khrait	17	0-20	53.42	41.32	0.79	3.42	1.05	5.26
			20-36	51.48	45.81	0.25	2.46	0.00	2.71
			36-71	45.77	48.83	1.64	3.29	0.47	5.40
	Kom-Ombo (east)	18	0-25	78.15	21.23	0.00	0.31	0.31	0.62
			25-33	63.95	32.92	0.31	1.88	0.94	3.13
			33-39	62.47	33.71	0.22	1.80	1.80	3.82
			39-65	64.92	32.83	0.65	1.50	0.19	2.34
			65-110	66.75	32.75	0.00	0.50	0.00	0.50
	Kom-Ombo (west)	19	0-15	57.55	37.51	0.31	1.23	3.40	4.94
			15-50	56.28	40.06	0.63	0.94	2.19	3.66
			50-90	56.17	40.90	0.00	0.00	2.93	2.93

present, these are, by their nature and abundance frequently valuable indices of provenance *(Pettijohn, 1984)*.

Data given in Table (17) represent the frequency distribution of light minerals.

Normal quartz in soils of traverse no. 1 varies between 45.24. and 57.60% of the total light minerals contents and tends to increase with depth in profiles no. 1, 3 and 4, while profile no. 2 shows an opposite trend. Abnormal quartz ranges from 39.93 to 53.60% and tends to decrease with depth in profiles no. 1 and 3, while profiles no. 2 and 4 show an opposite trend.

Soils of traverse no. 2 have normal quartz ranges from 53.69 to 90.69% and abnormal quartz between 8.71 and 44.02% of the light minerals content. Normal quartz tends increase with depth in profiles no. 7, 8, 9 and 10, while profiles no. 5 and 6 reveal an opposite trend. Abnormal quartz tends to increase with depth in profiles no. 5,6,8,9 and 10, while profile no. 7 has an opposite trend.

With regard to soil traverse no. 3, normal quartz varies between 62.28 and 85.48% of the total light minerals and tends to increase with depth. On the other hand, abnormal quartz ranges from 9.87 and 36.85% of the light minerals and tends to increase with depth in profiles no 11 and 13, while the opposite trend is found in profile no. 12

Data of normal quartz in soils of traverse no. 4 varies between 59.47 and 83.42% of the total light minerals and tends to increase with depth in profiles no. 15 and 16, while the opposite trend is found in profile no. 14. Abnormal quartz changes between 16.05 and 36.83% of the total light minerals and tends to decrease with depth in profiles no. 14 and 16, while profile no. 15 shows an opposite trend.

Soils of traverse no. 5 have normal quartz differs from 45.77 to 78.15% of the light minerals and tends to decrease with depth. Abnormal quartz changes from 21.23 to 48.83% of the total light minerals and tends to increase with depth.

Finally, soils of traverses no. 1 and 5 have highest contents of abnormal quartz, which are situated in the northern and southern Egypt, respectively. According to *Pettijohn (1984)*, the extinction of quartz varies from sharp to wavy. Quartz which has been subjected to considerable pressure shows "strain shadows" or "undulatory extinction" observable under crossed nicols. In general, therefore, quartz of metamorphic rocks (abnormal quartz) was presumed to show a marked wavy extinction whereas the igneous rocks was not. Last sentence reveals that the studied soils have multi-origin, on the other hand, soils of northern and southern Egypt have higher contents of quartz of metamorphic rocks and so in El-Saff region (profile no. 14).

Feldspars:

Feldspars are represented by orthoclase, plagioclase and microcline. Data of Table (17) show that feldspars are absent in layer of 40-150 cm of profile no. 12 and layers of 0-20 cm and 50-80 cm depth of profile no. 16 and varies between 0.19 and 6.83% of the total light minerals contents. Soils of profile no.11 have higher content of feldspars, follow by soils of profile no. 3.

Plagioclase and microcline are dominant constituent, while orthoclase is the lowest one.

The presence of feldspars could be taken as indication of weathering prevailed during soil formation and evolution which is not so drastic to cause a complete decay of these minerals susceptible to weathering, Hassona (1989). Generally, soils of traverse no. 5 have higher contents of feldspars minerals, which may be attributed to the soils are affected by more aridity and addition of sediments by the River Nile in soils of Kom Ombo plain or the accumulation of wadi deposits in Wadi El-Khrait.

4.2.2.3. Uniformity, maturity and source rocks of soil materials:

The stability of minerals means its resistance to alteration, solution and chemical decomposition. All minerals are not equally immune to solute and decay. So, if heavy minerals are newly derived from crystalline rocks, they are little worn. If, however, the heavy minerals are derived from early sediments, the less stable species tend to absent and the more stable survivors show notable rounding, *Pettijohn (1984).*

Data presented in Tables (16 and 18) and illustrated in Figures (33 to 36) show the distribution of most resistant minerals and the weathering ratios in the studied soils.

Soils of traverse no. 1, which represented by profiles no. 1,2,3 and 4 show that the distributions of zircon rutile, tourmaline, zircon/rutile and zircon/tourmaline + rutile are of more or less uniformity and reveal some homogeneity. The Wr_1, Wr_2 and Wr_3 ratios indicate that the studied soils are

Table (19): Semi-quantitative estimation of the minerlogical composition of the clay fraction (< 0.002 mm) separated from three studied soil profiles .

Trav. No.	Location	Profile No.	Depth (cm)	Interst-ratified %	Montmor-illonite %	Chlorite %	Vermicu-lite %	Sepiol-ite %	Palygor-skite %	Hydrous mica %	Kaolin-ite %	Accessory minerals Quartz %	Calcite %	Plagioclase %	Orthoclase %	Apatite %
3	El-Shbab	12	0-22	Mod.	Few	Tr.	Few	Few	--	Few	Few	Mod.	Med.	Few	--	--
4	Kom Oshim	16	0-20	Com.	Mod.	Tr.	--	Few	--	Tr.	Few	Few	Tr.	Tr.	Tr.	Mod.
5	Kom Ombo (east)	18	0-25	Mod.	Mod.	Tr.	Tr.	Few	Tr.	Tr.	Few	Few	Tr.	Tr.	--	Few
			25-33	Tr.	Mod.	Tr.	Few	Few	Tr.	Tr.	Few	Mod.	Tr.	Tr.	--	Few
			33-39	Com.	Tr.	Tr.	Few	Few	Tr.	Tr.	Few	Few	Mod.	Tr.	--	Few
			39-65	Tr.	Few	Tr.	Few	Tr.	Tr.	Tr.	Few	Mod.	Tr.	Tr.	--	Com.

Dom. = Dominant > 40 % Com. = Common 25-40 %

Mod. = Moderate 15-25 % Few = 5-15 %

Tr. = Trace < 5 % -- = Absent .

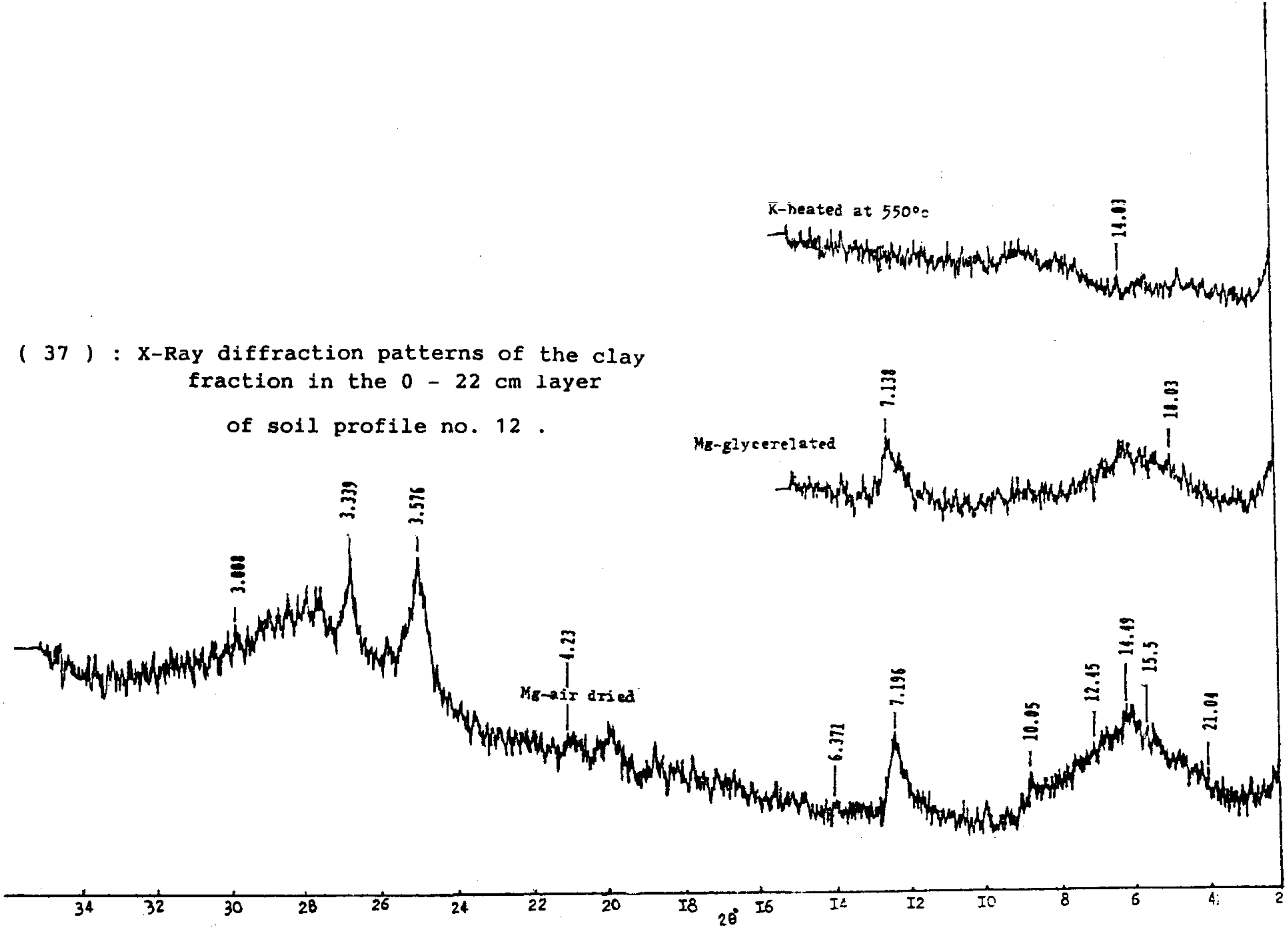
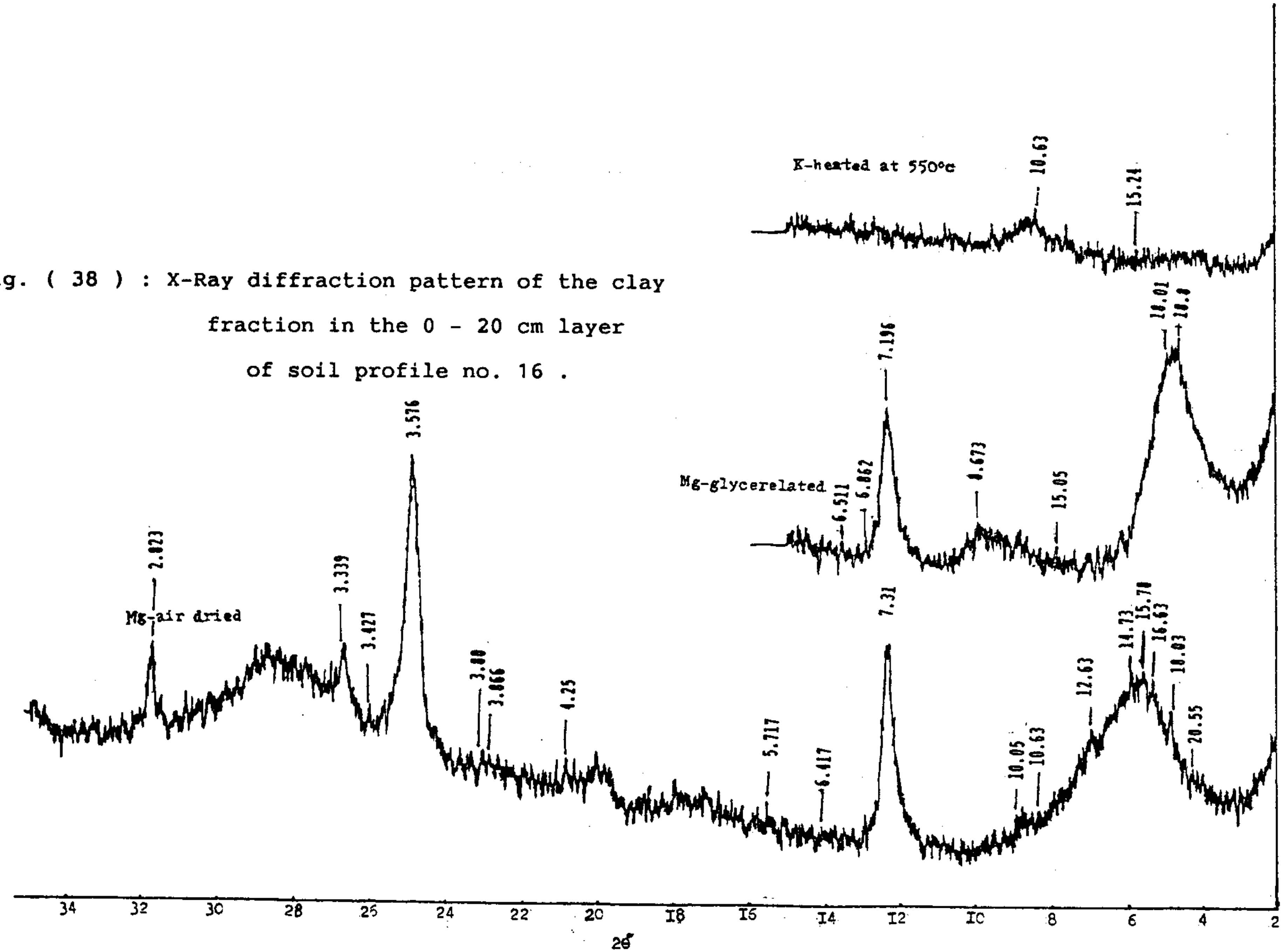


Fig. (37) : X-Ray diffraction patterns of the clay fraction in the 0 - 22 cm layer of soil profile no. 12 .

Fig. (38) : X-Ray diffraction pattern of the clay fraction in the 0 - 20 cm layer of soil profile no. 16 .



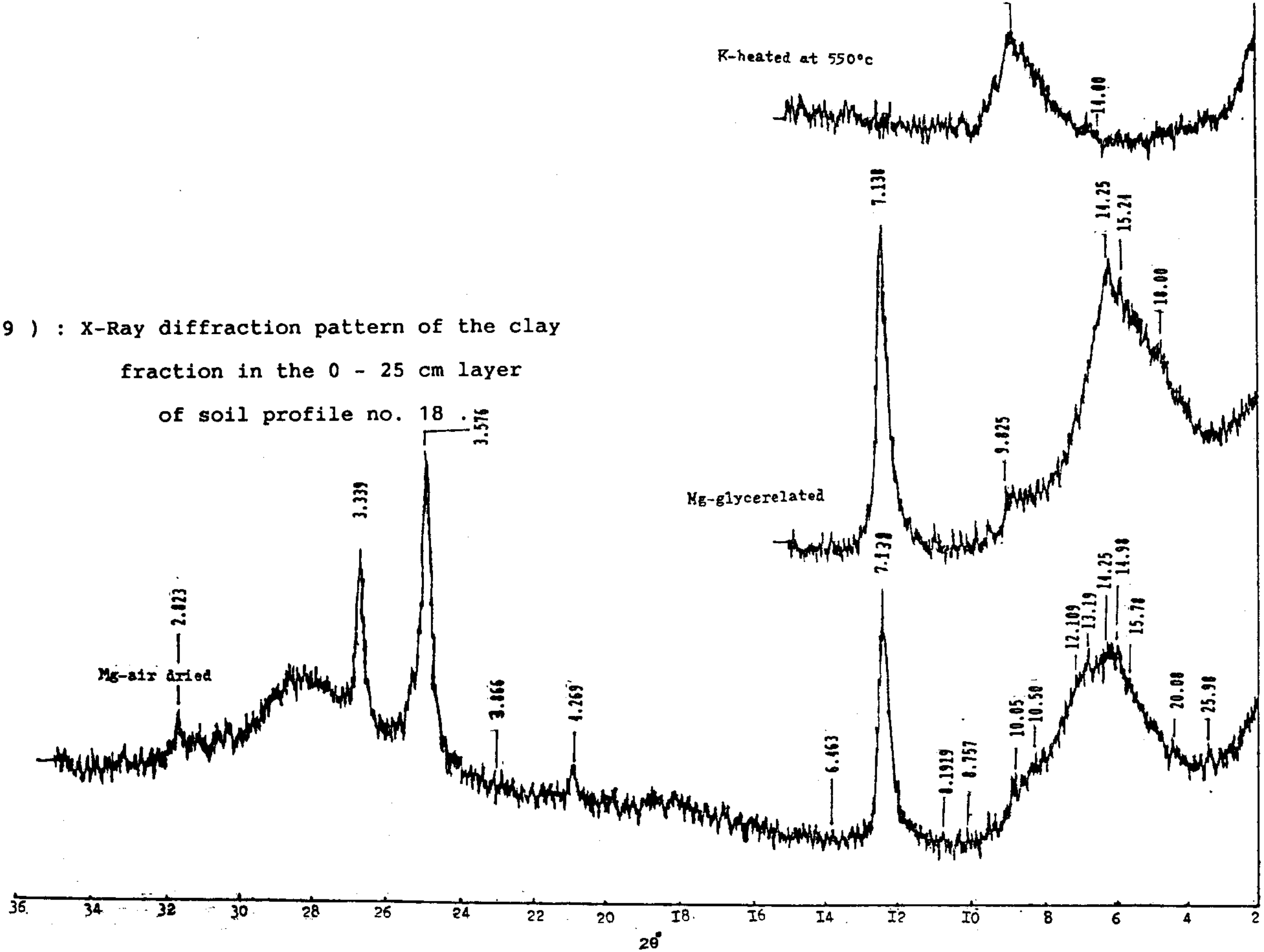


Fig. (39) : X-Ray diffraction pattern of the clay fraction in the 0 - 25 cm layer of soil profile no. 18 .

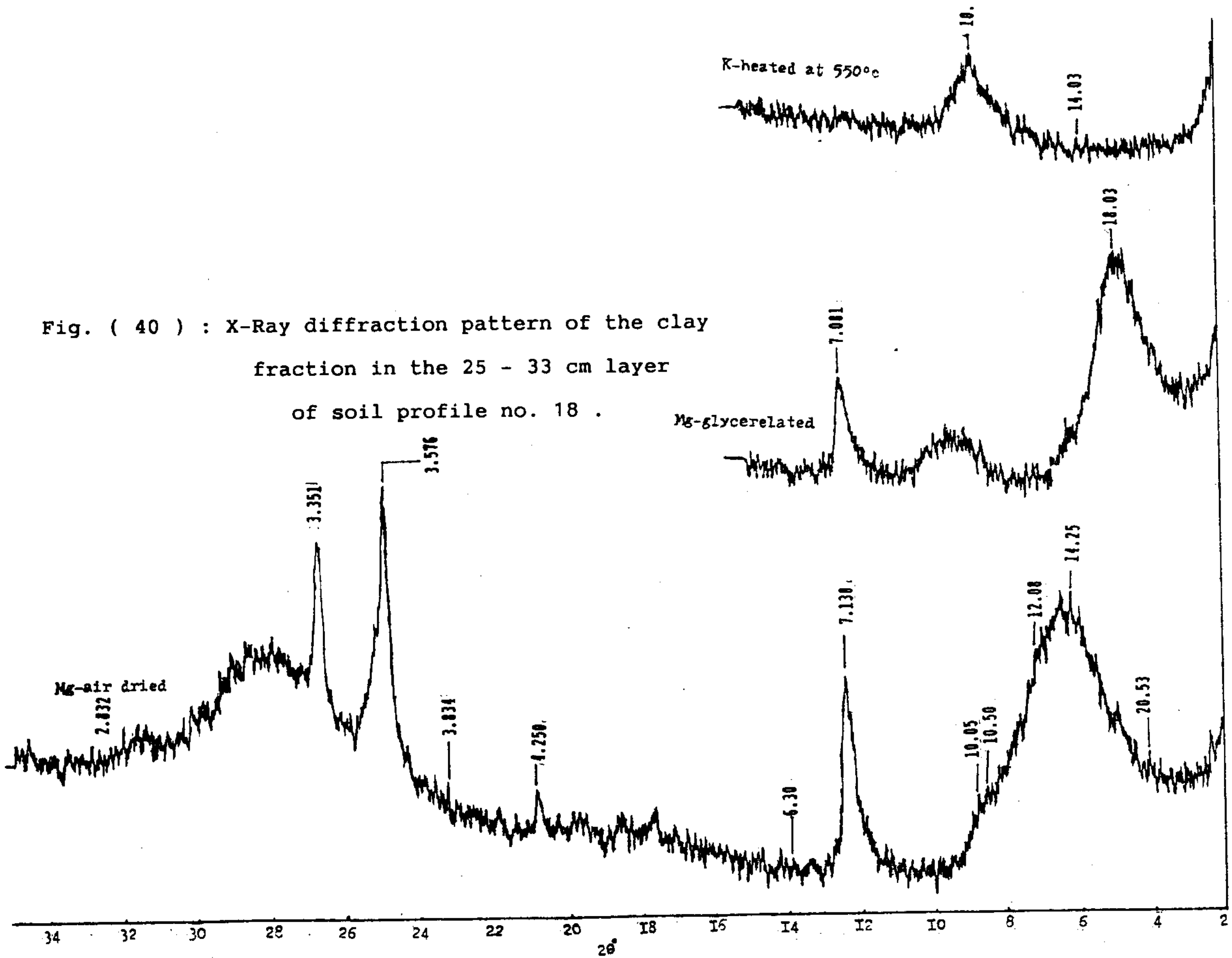


Fig. (40) : X-Ray diffraction pattern of the clay fraction in the 25 - 33 cm layer of soil profile no. 18 .

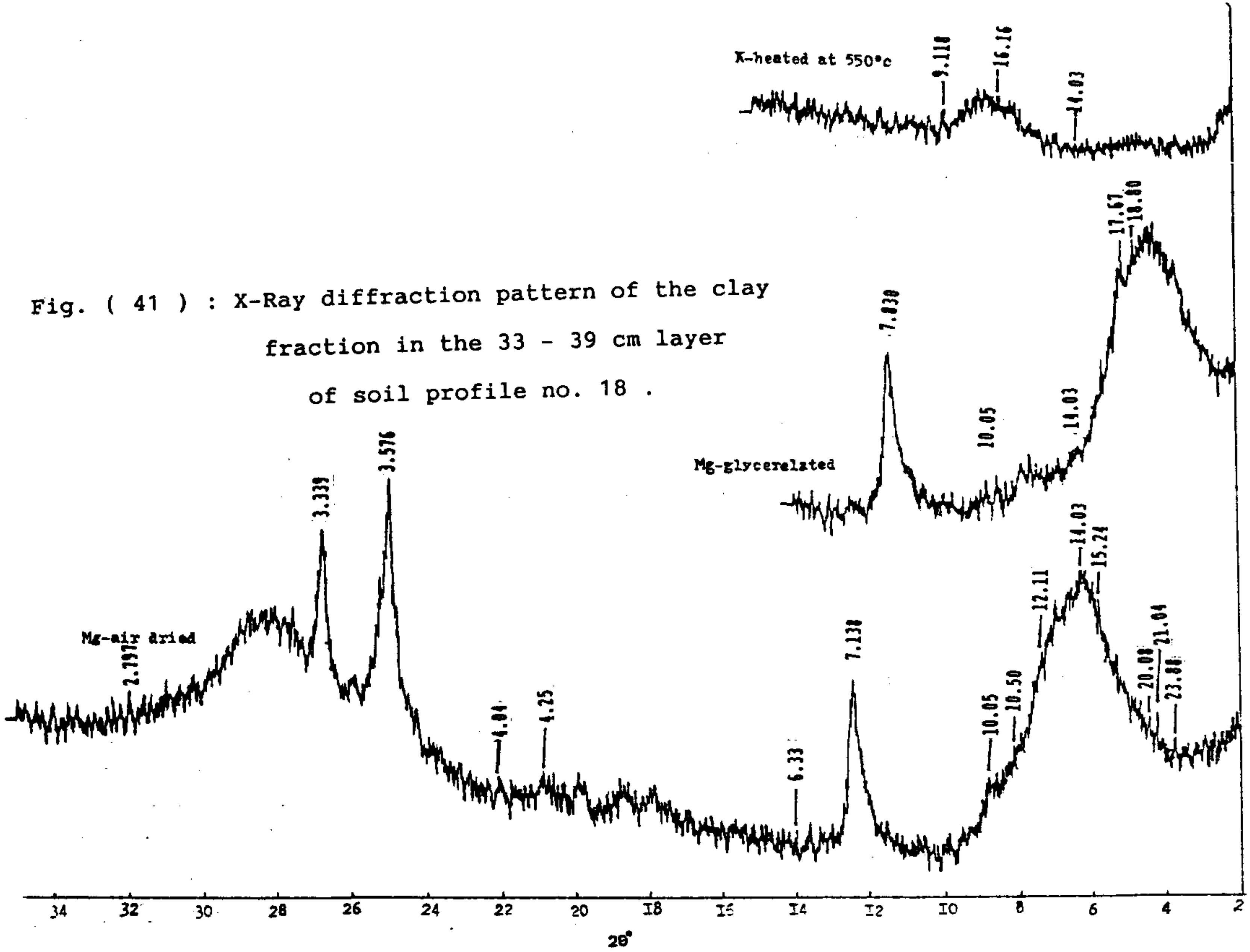


Fig. (41) : X-Ray diffraction pattern of the clay fraction in the 33 - 39 cm layer of soil profile no. 18 .

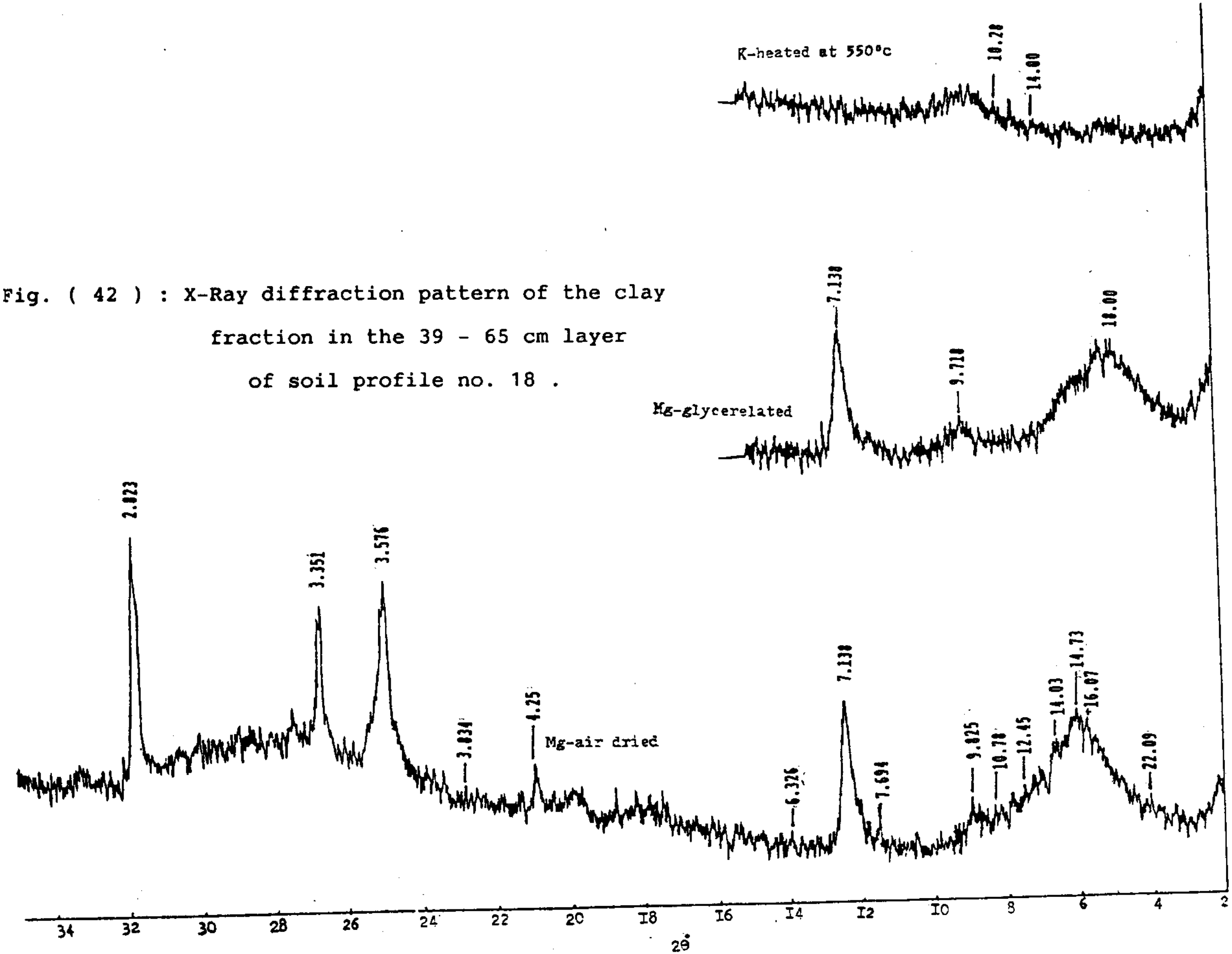


Fig. (42) : X-Ray diffraction pattern of the clay fraction in the 39 - 65 cm layer of soil profile no. 18 .

Quartz is found in moderate amounts in the layer of 25-33 cm and 39-65 cm, while it found in few amounts in the layers of 0-25 cm and 33-39 cm. Calcite and plagioclase are found in traceable amounts, except the layer of 33-39 cm depth (moderate). Apatite is detected in few amounts in all layers of profile no. 18, except the layer of 39-65 cm depth (common amounts are detected).

In general, data of Table (19) reveal that the clay fraction found in the studied layers is attributed mainly to the alluvial materials transported by Nile water during some era in the paste. *El-Gabaly and Khadr (1962)* found that clay minerals in of the soils middle and northern part of Delta soils are montmorillonite followed by kaolinite and very low content of hydrous mica. *El-Demerdashe et al (1971)* concluded that, alluvial soils in Egypt are dominated by montmorillonite mineral particularly in the fine fraction, while kaolinite and illite clay minerals are the second predominant. *El-Toukhy (1977)* reported that the alluvial soils of El-Fayoum, Kafr El-Sheikh, Giza and El-Tal El-Kebir are characterized by the dominance of smectite. *El-Badawy (1978)* mentioned that the coarse clay fraction of Nile sediments in some alluvial soils in Egypr contains montmorillonite, Kaolinite, illite, quartz, chlorite and feldspar. He also found that the fine clay fraction is dominated by montmorillonite, and contains kaolinite and illite and trace of chlorite. The trace amounts of palygorskite found in profile no. 18, its predict, due to the relatively high of carbonate content, which varies between 7.87 and 10.77% and a tendency to salinity environment. *Ghanim (1971)* found, in Maryuit area, that palygorskite was higher in the saline calcareous profiles as compared with the relatively no-saline ones. So, calcareous and saline environments may encourage palygorskite formation. *Verzilin (1972)* illustrated that playgorskite formations in the arid climate require marine basin which supply both silica and magnesium. *Paquet and Millot (1972)* found, under the Mediterranean climate, that palygorskite appears to be formed in arid plain of less than 300 mm annual rainfall and to be transformed into montmorillonite under the wetter conditions. Generally, clay minerals assemblage of these calcareous soils is dominated by palygorskite, kaolinite and illite and interstratified minerals as major admixture, while chlorite and vermiculite are found in very low amount.

The presence of interstratified minerals, in the studied samples as a dominant constituents, sheds on the formation of soil under water action in a pre-wet climatic conditions. These minerals are considered as transitional stages of clay minerals which stimulate by chemical weathering provided by water effect. This does not preclude the possible transformation of soil minerals under water action during formation processes, however, the prevailing aridity dose not verify this suggestion, *El-Gundy (1988)*.

The presence of quartz and feldspars as major constituents of accessory minerals is a true reflection of physical weathering of sandstone, quartz persists due to its high stability, *El-Gundy (1988) and Hassona (1989)*.

4.3. Evaluation of land characteristics:

The system developed by *Sys and Verheye (1978)* was used in evaluating the studied sandy soils. They regrouped their criteria in such a way that, the land classification can be done according to the FAO framework, and they used a specific guide lines for the definition of the orders (S and N) and classes (S_1,S_2,S_3,N_1 and N_2).

The characteristics influencing the land suitability with regard to its irrigation capability, can be regrouped according to the sub-classes of the FAO-framework as follows:

-t: Topographic limitation.

-w: Wetness limitation, mainly based on drainage conditions.

-s: Limitations with regard to physical soil conditions.

s1: Texture including stoniness

s2: Soil depth

s3: Calcium carbonate status

s4: Gypsum status

-n: Salinity and alkalinity limitations

Five levels of evaluation were used as follows:

Symbol	Intensity of limitation	Rating
-	no	95-100
1	slightly	85-95
2	moderate	60-85
3	severe	45-60
4	very severe	-45

Based on the number and intensity of the limitations, definitions of suitability orders and classes suggested. A suitability indices for irrigation (Ci) is calculated and integrated in the definition:

$$C_i = L \cdot \frac{w}{100} \cdot \frac{s1}{100} \cdot \frac{s2}{100} \cdot \frac{s3}{100} \cdot \frac{s4}{100} \cdot \frac{n}{100}$$

Order S: Suitable land for irrigation, land units with only moderate, slightly or no limitations and no more than one severe limitation and Ci is more than 25.

-Class S1 : Ci = + 75

-Class S2 : Ci = 50-75

-Class S3 : Ci = 25-50

Order N: Not suitable; land units with one or more severe limitation that exclude the use of land or with one or more severe limitation, and Ci is less that 25.

-Class N1: land units with severe or very severe limitations that can be corrected.

-Class N2: land units with severe or very severe limitations that can not be corrected.

According to the land evaluation system proposed by *Sys and Verheye (1978)*, data of Table (20) show the following:

The soils of traverse no. 1 have the order N and class N_1, concerning the characteristic of the studied profiles.

Table (20) : Paramater index and overall soil rating index for evaluating the studied sandy soils according to Sys and Verheye (1978) .

Trav. No.	Profile No.	Topogr-aphy (t)	Wetness (w)	Texture (s1)	Depth (s2)	CaCO3 (s3)	Gypsum (s4)	Salinity (n)	Rating Ci	Symbole	Intensity of limitation	Order	Class
1	1	100	55	30.00	90	85	90	86.88	9.87	4	Very Severe	N	N1
	2	95	80	30.00	90	85	90	94.50	14.83	4	Very Severe	N	N1
	3	100	55	30.00	75	85	90	78.85	7.46	4	Very Severe	N	N1
	4	100	55	30.00	90	85	90	86.88	9.87	4	Very Severe	N	N1
2	5	100	95	61.46	100	95	90	94.80	47.32	3	Severe	S	S3
	6	95	95	30.00	100	95	90	96.00	22.22	4	Very Severe	N	N1
	7	95	90	48.75	100	95	90	85.00	30.29	4	Very Severe	S	S3
	8	95	95	88.33	100	90	90	96.00	61.99	2	Moderate	S	S2
	9	95	95	80.42	100	90	90	96.80	56.91	3	Severe	S	S2
	10	95	95	87.08	100	90	100	96.00	67.90	2	Moderate	S	S2
3	11	100	95	36.25	100	95	90	91.60	26.97	4	Very Severe	S	S3
	12	100	95	38.25	100	85	90	90.88	25.26	4	Very Severe	S	S3
	13	100	95	30.00	100	85	90	96.00	20.93	4	Very Severe	N	N1
4	14	85	95	37.92	100	100	100	80.00	27.14	4	Very Severe	S	S3
	15	95	55	44.29	75	95	90	96.00	14.25	4	Very Severe	N	N1
	16	95	95	83.75	100	100	90	96.00	65.30	2	Moderate	S	S2
5	17	85	80	60.07	75	95	90	92.90	24.50	4	Very Severe	N	N1
	18	85	50	67.86	90	95	90	96.09	21.33	4	Very Severe	N	N1
	19	85	90	25.83	90	95	90	96.00	14.60	4	VEry Severe	N	N2

The soils of traverse no. 2 have the order S in all profiles and class S_2 in profiles no. 8, 9 and 10, while the profiles no. 5 and 7 have class S_3. On the other trend, the soils of profile no. 6 have the order N and class N_1.

The soils of traverse no. 3 have the order S and class S_3 in profiles no.11 and 12, while profile no. 13 has the order N and class N_1.

The soils of traverse No. 4 have the order S in profiles no. 14 and 16, and classes S_3 and S_2, respectively. While the profile no. 15 has the order N and class N_1.

The soils of traverse no. 5 have the order N and class N_1 except profile no. 19 which has the class N_2.

So, it can be said, in general, that the studied sandy soils can be evaluated according the following descending order::-

Traverse no. 2 (higher degree) > Traverse no. 4 > Traverse no. 3 > Traverse no. 5 > traverse no. 1 (Lower one)

SUMMARY AND CONCLUSIONS

Five traverses were chosen to represent some scattering newly reclaimed sandy soils in Egypt. These traverses were studied, to get more information about these soils. Nineteen soil profiles were dug in these traverses and morphologically described. Chemical and mineralogical properties of soil samples, collected from these profiles were determined. The obtained results could be summarized as follows:-

Soil texture: sandy in soil profiles dug in traverse no. 1 (North Delta), sandy to loamy in soil profiles of traverse no. 2 (El-Nubaria), sandy loam in soil profiles of traverse no. 3 (Belbeis - El-Shbab project), gravely sand to loamy in soil profiles of traverse no. 4 (El-Saff-Kom Oshim) and gravely sand to clay in soil profiles of traverse no. 5 (Wadi El-Khrail-West Kom-Ombo).

$CaCO_3$ content: varied widely in the studied soils and ranged from 0.21 to 50.37%, and increased with depth. Soils of traverse no. 2 contained the higher $CaCO_3$, while traverse no. 1 contained the lower one.

- Gypsum content: ranged between nil and 2.88% and reached its maximum in some profiles of traverses no. 2 and 4.

- Organic matter content: was low in all profiles but its higher value was found in the surface layers.

- Soil salinity (EC): ranged between 0.53 and 87.42 mmhos/cm 25°C. The soils affected by shallow water table and middle Eocine formation contained the highest soluble salts. Soluble salts were accumulated in the surface soil layers. On the other hand, the high salinity in Gamassa soil was related with seepage from the sea. Soil salinity increased with increasing salinity of ground water and tended to increase with increasing the fine fraction(clay content).

- Soluble cations and anions: sodium was the dominant cation, followed by calcium or magnesium according to the location of each traverse, while, potassium content was always the lowest.

- Chloride was the predominant anion, except most soils of traverse no. 2, where sulfate was the predominant anion.

- Soil reaction (pH): ranged between 7.5 and 9.2 according to $CaCO_3$ content and ESP values.

- Cation exchange capacity: varied between 1.87 and 39.11 me/100g soil. It significantly and positively correlated with clay, silt, organic matter and total carbonate contents, while it negatively correlated with sand content.

- Exchangeable cations: in general, exchangeable calcium was predominant followed by magnesium or sodium, while potassium was the least exchangeable one.

- Total amorphous materials contents: ranged between 0.48 and 7.32%. The soils of traverse no. 5 contained higher amorphous materials. Amorphous silica varied from 0.14 to 4.62% and its higher content was associated with the higher content of clay. Amorphous alumina varied between 0.04 and 1.67% and its higher content was related to clay content. Amorphous iron varied from 0.11 to 3.70%. SiO_2/AL_2O_3 molar ratio indicated the presence of sesquioxidic allophane, halloysitic allophane and predominated siliceous allophane.

- Trace elements in soils:

1- Total iron content ranged from 3000 to 26000 ppm and the soils of traverse no. 5 contained the higher total iron, total Fe was significantly and positively correlated with silt and clay contents and the opposite was true concerning sand content. Available iron was adequate to marginal in traverse no. 1 and most profiles of traverse no. 3, while traverse no. 2 exhibited a deficient level. Soils of traverses no. 4 and 5 have available iron between marginal and deficient levels. Available Fe was significantly and positively correlated with total iron but it significantly and negatively correlated with silt and total carbonate contents.

2- Total manganese content varied from 60-526 ppm and soils of traverse no. 5 contained higher Mn. Manganese content was significantly and negatively correlated with cacao3 content, while it insignificantly and positively correlated with silt, clay and organic matter contents. On the other hand, Mn content was insignificant, and negatively correlated with sand fraction contents. Available Mn exhibited adequate levels in most profiles, except some profiles in traverses no. 2 and 3 which exhibited deficient level. Available Mn significantly and positively correlated with organic matter and total Mn contents, but it significantly and negatively correlated with $CaCO_3$ content.

3. Total zinc content varied widely between 7 and 237 ppm and the soils of traverse no. 2 had a higher Zinc content. Zinc content was significantly and positively correlated with silt, clay and $CaCO_3$ contents, while it significantly and negatively correlated with sand fraction content. Available zinc exhibited deficient (traverse no. 1) to marginal levels in all traverses. It was significantly and positively correlated with silt, clay, $CaCO_3$ and total zinc contents, but it was significantly and negatively correlated with sand content.

4. Total copper content differed from 5 to 68 ppm. It significantly and positively correlated with clay, while it insignificantly and negatively correlated with sand. Available copper exhibited adequate limits in traverses no. 1, 3 and 5, while traverses no. 2 and 4 contained available copper between adequate to deficient levels. It was significantly and positively correlated with silt, clay, organic matter, $CaCO_3$ and total copper contents, but it significantly and negatively correlated with sand content.

5- Boron content varied between 1.30 and 24.90 ppm and the highest B content was found in the soils of traverse no. 1. Total boron was significantly and positively correlated with sand and tourmaline contents, while it significantly and negatively correlated with silt, clay and $CaCO_3$ contents. Available boron was not sufficient for normal plant growth. Available boron was significant and positively correlated with, sand, organic matter, total and tourmaline, but significant and negatively correlated with silt, clay and total carbonate.

The obtained results showed also that, available Fe and Mn were higher in the soils of shallow water table due to the reduction process. On the other hand soils of traverse no.1 had higher boron content affected by sea water.

The statistical measures; weight mean, trend and specific range of total micro nutrients showed that the content of each element varied according to sampling depth, location of each traverse and parent material. Generally, the computed trends of total micronutrints tended to be symmetrical distribution through the studied profiles. The values of specific range indicated also that the parent materials are heterogeneous.

-Grain size parameters.

The values of grain size parameters showed that, the mean size was fine sand in traverse no.1, medium sand to medium silt in traverse no.2, medium sand to very fine sand in traverse no. 3, medium sand to fine silt in traverse no. 4 and medium sand to very fine silt in traverse no. 5.

Sorting values indicated that the sediments falling between moderately well sorted and poorly sorted in traverse no. 1, from poorly sorted to very poorly sorted in traverses no. 2,4 and 5 and from moderately sorted to very poorly sorted in traverse no. 3. So, water was the main factor of transportation and deposition in the studied traverses except profiles no. 1 and 2 in traverse no. 1 and profile no. 12 in traverse no. 3, where water and wind were the factors of transportation and deposition.

- The studied soils had a non-normal distribution of skewed values, which indicated to more than one model and the positive and very positive skewed were dominated.

The kurtosis values showed that soils of traverses no. 1, 3 and 4 were dominated by leptokurtic to extremely leptokurtic, which indicated to a very high energy of deposition environment and very low modification of grain size, while soils of traverse no. 5 exhibited the domination KG values between mesokurtic to very platykurtic, which indicated to a very low energy of deposition environment and very high modification of grain size. On the other hand, soils of traverse no. 2 lied between these two groups.

- Mineralogy of the sand fraction:-
- Distribution of heavy minerals showed that opaques, amphiboles and pyroxenes were the dominated minerals. The soils of traverse no. 1 was distinguished by higher contents of tourmaline, apatite, sphene and glauconite, while rutile tends to be absent. The soils of traverse no. 2 contained higher amounts of opaques and zircon. In traverse no. 3, distinguished by pyroxenes, while epidote in traverse no. 4 and amphiboles

in traverse no. 5. Generally, it was found that the soils affected by ground water contained the lower amounts of opaque minerals.

- Distribution of light minerals showed that quartz was the dominated minerals, while feldspars took the opposite trend. The soils of traverse no. 1 had higher content of abnormal quartz followed by traverse no. 5.
- The distribution of heavy minerals (specially, ultrastable minerals i.e., zircon, rutile and tourmaline) and ratios of zircon/rutile, zircon/tourmaline and zircon/rutile + tourmaline, indicated that traverse no. 1 exhibited some homogeneity, while, other traverses were heterogeneous. Weathering ratios and distribution of heavy and light minerals indicated that the soils under investigation are recent and young.
- Source rocks of the studied soils were distinguished as follows:- Soils of traverse no. 1 varied between metamorphic rocks and acidic igneous ones, while metamorphic rocks was the main constituent in soils of traverse no. 2. On the other hand, basic igneous rocks were dominated in the soils of traverse no. 3. Soils of traverses no. 4 and 5 contained higher amounts of acid igneous rocks. Generally, it can be said that, the source of rocks in the studied soils are multi-origin.

- Mineralogy of the clay fraction:-

Distinctive minerals of the clay fraction were interstratified minerals, montmorillonite, chlorite, vermiculite, sipiolite, palygorskite, hydrous mica and kaolinite; while accessory ones were quartz, calcite, plagioclase, orthoclase and apatite. The source of clay in these layers was mainly due to alluvial materials transported by Nile water during some era in the past. On the other hand, carbonate content encouraged palygorskite formations.

- Land evaluation:

Soils of traverses no. 1,3,5 and 4 (except profile no. 16) were of relative limitation "very severe" and the same limitation was found in profiles no. 6 and 7 of traverse no. 2. While, soils of profiles no. 5 and 9 of traverse no. 2 were of relative limitation as "severe". On the other hand, the soils of profiles no. 8 and 10 of traverse no. 2 and profile no. 16 of traverse no. 4 were of relative limitation as "moderate".

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APPENDIX

Morphological description of the studied soil profiles.

Profile No. 1
=============

Location	: Om El-Reda El-Gdeda village , Damitta Governorate.
Topography	: Plain .
Elevation	: About 1.5 m.a.s.l.
Land use	: Maize.
Slope	: Almost flat.
Water Table	: 80 cm.

Depth (cm.)	Description
0 - 30	White (10YR 8/2) dry and light gray (10YR 7/2) moist , sand single grains , non-sticky ; non-plastic ; loose , few fine and medium roots ; slightly calcareous , diffuse smooth boundary .
30 - 50	Light gray (10YR 7/2) dry and pale brown (10YR 6/3) moist , sand , single grains , non-sticky ; non-plastic ; loose , slightly calcareous , diffuse smooth boundary .
50 - 80	Light gray (10YR 7/2) dry and pale brown (10YR 6/3) moist , sand , single grains ; non-sticky ; nom-plastic ; loose , slightly calcareous .

Profile No. 2

Location	:	About 7 Km west of Kafr El-Batekh village . El-Mattar , Damitta Governorate.
Topography	:	Plain .
Elevation	:	About 2.0 m.a.s.l.
Land use	:	Maize.
Slope	:	Gently sloping .
Water Table	:	80 cm.

Depth (cm.)	Description
0 - 30	Light yellowish browen (10YR 6/4) dry and yellowish brown (10YR 5/6) moist , sand , single grains ; non-sticky ; loose , few fine and medium roots , slightly calcareous , diffuse smooth boundary
30 - 60	Light yellowish brown (10YR 6/4) dry and yellowish brown (10YR 5/6) moist , sand , single grains ; non-sticky ; non-plastic ; loose , very few fine roots , slightly calcareous , diffuse smooth boundary .
60 -80	Light yellowish brown (10YR 6/4) dry and yellowish brown (10YR 5/6) moist , sand , single grains ; non-sticky ; non-plastic ; loose ; very few fine roots , slightly calcareous .

Profile No. 3
=============

Location : About 2 Km south west Gamassa .
Topography : Plain .
Elevation : About 0.5 m.a.s.l.
Land use : Vegetables .
Slope : Almost flat.
Water Table : 65 cm.

Depth (cm.)	Description
0 - 20	Brown (10YR 5/3) dry and brown (10YR 4/3) moist, sand , single grains , non-sticky ; non-plastic; loose , few fine roots ; slightly calcareous , diffuse smooth boundary .
20 - 40	Brown (10YR 5/3) dry and brown (10YR 4/3) moist, sand , single grains , non-sticky ; non-plastic; loose , slightly calcareous , diffuse smooth boundary .
40 - 65	Dark yellowish brown (10YR 4/4) dry and dark yellowish brown (10YR 3/4) moist , sand ,single grains , non-sticky ; non-plastic ; loose , slightly calcareous .

Profile No. 4
=============

Location : About 1 Km south - east of Rosetta .
Topography : Plain .
Elevation : About 0.7 m.a.s.l.
Land use : Clover.
Slope : Almost flat.
Water Table : 80 cm.

Depth (cm.)	Description
0 - 20	Yellowish brown (10YR 5/4) dry and dark yellowish brown (10YR 4/4) moist , sand , single grains , non-sticky ; non-plstic ; loose , few fine roots ; slightly calcareous ; clear smooth boundary .
20 - 50	Dark yellowish brown (10YR 4/4) dry and dark yellowish brown (10YR 3/4) moist , sand , single grain , non-sticky ; non-plstic , loose, slightly calcareous ; clear smooth boundary .
50 - 80	Dark brown (10YR 3/3) dry and very dark brown (10YR 2/2) moist , sand , single grains , non-sticky ; non-plastic ; loose , slightly calcareous .

Profile No. 5
=============

Location : El-Sheeck El-Shaarawy village , EL-Nubaria , about 25 Km east Km 85 Alex. - Cairo desert road .
Topography : Almost flat .
Elevation : About 9.0 m.a.s.l.
Land use : Corn .
Slope : Almost flat.
Water Table : Deeper than 150 cm .

Depth (cm.)	Description
0 - 35	Very pale brown (10YR 8/4) dry and yellow (10YR 7/6) moist , sand , single grains ; non-sticky ; non-plastic ; loose , few fine and medium roots; common lime concretion , stongly calcareous , clear smooth boundary .
35 - 75	Yellow (10YR 8/4) dry and yellow (10YR 7/8) moist , loamy sand , single grains ; non-sticky; non-plastic ; loose , common lime concretions , strongly , diffuse smooth boundary .
75 - 120	Yellow (10YR 8/6) dry and yellow (10YR 7/8) moist , loamy sand , single grains ; non-sticky; non-plastic ; loose ; very few lime concretions; common lime segregation ; strongly calcareous , diffuse smooth boundary .
120 - 150	Yellow (10YR 8/6) dry and Yellow (10YR 7/8) moist , loamy sand , single grains , non-sticky; non-plastic ; loose , very few lime segregation; strongly calcareous .

Profile No. 6
==============

Location : About 8 Km east of Alex. - Cairo desert road (at the point of Km 85) .
Topography : Almost flat
Elevation : About 10.0 m.a.s.l.
Land use : Corn .
Slope : Gently sloping
Water Table : Deeoer than 150 cm

Depth (cm.)	Description
0 - 30	Light yellowish brown (10YR 6/4) dry and yellowish brown (10YR 5/4) moist , sand , single grains ; non-sticky ; non-plastic ; loose ; few fine roots , common lime concretion ; few shells , strongly calcareous ; clear smooth boundary .
30 - 80	Brownish yellow (10YR 6/6) dry and yellowish brown (10YR 5/6) moist , sand , single grains ; non-sticky ; non-plastic ; loose , common lime concretion ; few shells ; strongly calcareous , diffuse smooth boundary .
80 - 150	Brownish yellow (10YR 6/6) dry and yellowish brown (10YR 5/6) moist , sand single grains ; non-sticky ; non-plastic ; loose , common lime concretion ; few shells ; strongly calcareous .

Profile No. 7

Location	: About 3 Km west of Alex. - Cairo desert road (at the point of Km 85) .
Topography	: Plain .
Elevation	: About 15.0 m.a.s.l.
Land use	: Tomato .
Slope	: Gently sloping .
Water Table	: Deeper than 120 cm .

Depth (cm.)	Description
0 - 30	Light yellowish brown (10YR 6/4) dry and yellowish brown (10YR 5/4) moist , sand , single grains ; non-sticky ; non-plastic ; loose , few fine and coarse roots , common lime concretion ; few shells ; strongly calcareous , clear smooth boundary .
30 - 70	Very pale brown (10YR 7/3) dry and light yellowish brown (10YR 6/4) moist , loamy sand, massive ; non-sticky ; non-plastic ; very friable , few fine roots , few lime concretion and common lime segregations ; few shells ; strongly calcareous , diffuse smooth boundary .
70 - 120	Very pale brown (10YR 7/3) dry and light yellowish brown (10YR 6/4) moist , loamy sand, massive ; slightly sticky ; slightly plastic ; very friable , few soft lime concration and common segregation ; few shells ; strongly calcareous .

Profile No. 8

Location	: About 20 Km west Alex. - Cairo desert rood (at the point of Km 85)
Topography	: Plain .
Elevation	: About 17.0 m.a.s.l.
Land use	: Wheat .
Slope	: Gently sloping .
Water Table	: Deeper than 150 cm .

Depth (cm.)	Description
0 - 40	Brownish yellow (10YR 6/8) dry and yellowish brown (10YR 5/8) moist , sandy loam , very few gravels , massive ; non-sticky ; non-plastic ; very friable , few fine roots , few lime concretion and common lime segregation ; strongly calcareous , gradual smooth boundary .
40 - 60	Brownish yellow (10YR 6/8) dry and yellowish brown (10YR 5/8) moist , sandy clay loam , massive ; slightly plastic ; very friable , few lime concretion ; and common soft lime segregation ; strongly calcareous , clear smooth boundary .
60 - 80	Very pale brown (10YR 7/4) dry and yellowish brown (10YR 5/6) moist , sandy clay loam , very few gravels , weak medium subangular blocky structure ; slightly sticky ; slightly plastic; very friable ; many soft lime segregation and common lime concretion ; strongly calcareous , gradual smooth boundary .
80 - 150	Reddish yellow (7.5YR 6/6) dry and strong brown (7.5YR 5/6) moist , sandy clay loam , very few gravels , weak medium subangular blocky structure , slightly sticky ; slightly plastic; very friable , many soft lime segregation and common lime concretion ; stronly calcareous .

Profile No. 9

Location	: About 26 Km west of Alex. - Cairo desert road (at the point of Km 85)
Topography	: Plain .
Elevation	: About 23.0 m.a.s.l.
Land use	: Vegetables .
Slope	: Gently sloping .
Water Table	: Deeber than 150 .

Depth (cm.)	Description
0 - 40	Brownish yellow (10YR 6/8) dry and yellowish brown (10YR 5/8) moist , loamy sand ; very few gravels , massive , non-sticky ; non-plastic ; very friable , few fine roots , few lime concretion and common lime segregation ; strongly calcareous , clear smooth boundary .
40 - 70	Brownish yellow (10YR 6/8) dry and yellowish brown (10YR 5/8) moist , loam , very few gravels , weak medium subangular blocky structure , slightly sticky ; slightly plastic; very friable , few soft lime segregation and common lime concretion ; strongly calcareous , clear smooth boundary .
70 - 150	Reddish yellow (7.5YR 6/6) dry and strong brown (7.5YR 5/6) moist , sandy clay loam , very few gravels , weak medium subangular blocky structure , slightly sticky ; slightly plastic; very friable , many soft lime segregation and common lime concretion , strongly calcareous .

Profile No. 10
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Location : About 31 Km west of Alex. - Cairo desert road (at the point of km 85)

Topography : Plain .

Elevation : About 30.0 m.a.s.l.

Land use : Grapes .

Slope : Gently sloping .

Water Table : Deeper than 150 cm .

Depth (cm.)	Description
0 - 30	brownish yellow (10YR 6/7) dry and yellowish brown (10YR 5/8) moisyt , sandy loam ,very few gravels , massive ,non-sticky ; non-plastic ; very friable , few fine concretion and common lime segregation ; strongly calcareous , clear smooth boundary .
30 - 50	Brownish yellow (10YR 6/8) dry and yellowish brown (10YR 5/8) moist , slightly gravelly sandy clay loam , weak medium subangular blocky structure , slightly sticky ; slightly plastic; very friable , few soft lime segregation and common lime conceretion ; strongly calcareous , clear smooth boundary .
50 - 150	Reddish yellow (7.5YR 6/6) dry and strong brown (7.5YR 5/6) moist , slightly gravelly loam , weak medium subangular blocky structure , slightly sticky ; slightly plastic ; very friable , many soft lime segregation and common lime conceration ; strongly calcareous .

Profile No. 11
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Location : About 0.5 Km west Cairo - Ismailia road (at the point of Km 85) El-Shbab project .

Topography : Plain .

Elevation : About 16.0 m.a.s.l.

Land use : Tomato .

Slope : Almost flat.

Water Table : Deeper than 150 cm .

Depth (cm.)	Description
0 - 40	Light yellowish brown (10YR 6/4) dry and yellowish brown (10YR 5/4) moist , sand , single grains , non-sticky ; non-plastic ; loose , few fine roats , slightly calcareous , diffuse smooth boundary .
40 - 80	Very pale brown (10YR 7/4) dry and light yellowish brown (10YR 6/4) moist , sand , single grains , non-sticky ; non-plastic ; loose ; slightly calcareous , clear smooth boundary .
80 - 110	Pale brown (10YR 6/3) dry and brown (10YR 5/3) moist , loamy sand , massive , non-sticky ; non-plastic ; very friable , slightly calcareous , clear smooth boundary .
110 - 150	Light yellowish brown (10YR 6/4) dry and yellowish brown (10YR 5/4) moist , sand , single grains , non-sticky ; non-plastic ; loose , slightly calcareous .

Profile No. 12
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Location : About 10 Km west Km 85 , El-Shbab project .
Topography : Plain .
Elevation : About 8.0 m.a.s.l.
Land use : Clover .
Slope : Almost flat.
Water Table : Deeper than 150 cm .

Depth (cm.)	Description
0 - 22	Brown (10YR 5/3) dry and dark yellowish brown (10YR 4/4) moist , sand loam , massive ; non-sticky ; non-plastic ; soft ,common fine roots, calcareous , clear smooth boundary .
22 - 40	Very pale brown (10 YR 8/4) dry and yellow (10YR 7/6) moist , sand , single grains , non-sticky ; non-plastic ; loose ,non-calcareous , fiffuse smooth boundary .
40 - 150	Very pale brown (10YR 8/4) dry and yellow (10YR 7/6) moist , sand , single , grains , non-sticky ; non-plastic ; loose ,slightly calcareous .

Profile No. 13

Location : About 3.5 Km east Belbeis .
Topography : Plain .
Elevation : About 6.0 m.a.s.l.
Land use : Sesame .
Slope : Almost flat.
Water Table : Deeper than 150 cm .

Depth (cm.)	Description
0 - 45	Light yellowish brown (10YR 6/4) dry and yellowish brown (10YR 5/4) moist , sand , single grains ; non-sticky ; non-plastic ; loose , few fine and coarse roots , slightly calcareous , diffuse smooth boundary .
45 - 80	Light yellowish brown (10YR 6/4) dry and yellowish brown (10YR 5/4) moist , sand , single grains , non-sticky ; non-plastic ; loose , very few fine roots ,slightly calcareous , gradual smooth boundary .
80 - 150	Pale brown (10YR 6/3) dry and brown (10YR 5/3) moist , sand , single grains , non-sticky ; non-plastic ; loose , slightly calcareous .

Profile No. 14

Location : About 5 Km east Ghamaza El-Kobra Village (at Km 19) El-Saff , El-Giza Governorate .
Topography : Concave .
Topography surrounding country : hilly .
Elevation : About 66.0 m.a.s.l.
Land use : Cucumber .
Slope : Sloping to east .
Water Table : Deeper than 150 cm .

Depth (cm.)	Description
0 - 40	Very pale brown (10YR 8/4) dry and yellow (10YR 7/6) moist , slightly gravelly loame sand , single grains , non-sticky ; non-plastic ; loose , few gravel , common lime segregation ; few lime conceretion ; strongle calcareous , very few fine roots , few gypsum crystals , clear smooth boundary .
40 - 70	Very pale brown (10YR 8/4) dry and yellow (10YR 7/6) moist , sand , single grains , non-sticky; non-plastic ; loose , strongle calcareous , few gypsum crystals , abrupt smooth boundary .
70 - 100	Very pale brown (10YR 8/4) dry and yellow (10YR 7/6) moist , gravelly sand , single grains , non-sticky ; non-plastic ; loose , rounded to angular very frequent gravel , common lime concretion and segregatin ; strongly calcareous very few gypsum crystals , clear smooth boundary .
100 - 150	Very pale brown (10YR 8/4) dry and yellow (10YR 7/6) moist , gravelly loamy sand , massive , non-sticky ; non-plastic ; soft , rounded and flat frequent gravel , common lime concretion , strongly calcareous .

Profile No. 15

Location : About 5 Km west El-Aiyat (Beedf) , El-Giza Governorate.

Topography : Plain .

Topography surrounding country : hilly .

Elevation : About 30.0 m.a.s.l.

Land use : Graps .

Slope : Gently sloping .

Water Table : 70 cm .

Depth (cm.)	Description
0 - 20	Yellowish brown (10YR 5/4) dry and yellowish brown (10YR 5/6) moist , loamy sand ,single grains , non-sticky ; non-plastic ; few fine and coarse roots , many lime concretion ; strongle calcareous ,very few small gypsum crystals , clear smooth boundary .
20 - 50	Very pale brown (10YR 7/4) dry and light yellowish brown (10YR 6/4) moist , sand , single grains , non-sticky ; non0plastic ; loose , few fine roots , few lime concrestion and many lime segregation ; strongly ca-careous few small gypsum crestals , clear smooth boundary .
50 - 70	Very pale brown (10YR 7/4) dry and light yellowish brown (10YR 6/4) moist , loamy sand , single grains , non-sticky ; non-plastic ; loose , many lime concretion ; strongly calcareous , very vew small gypsum crestals .

Profile No. 16
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Location : Kom Osheem , Cairo El-Fayoum road (at Km 67 point .
Topography : Undulating .
Elevation : About zero m.a.s.l.
Land use : Clover .
Slope : Almost flat.
Water Table : Deeper than 150 cm .

Depth (cm.)	Description
0 - 20	Pale yellow (2.5Y 7/4) dry and yellow (2.5Y 7/6) moist , sandy loam , single grains , non-sticky ; non-plastic ; loose , few fine and medium roots , strongly calcareous , gradual smooth boundary .
20 - 27	White (2.5Y 8/2) dry and pale yellow (2.5Y 8/4) moist , sandy loam , coarse subangular blocky ; non-sticky ; non-plastic ; very friable ; slightly hard , many coarse roots , many lime segregation ; strongle calcareous , gradual smooth boundary .
27 - 40	Pale yellow (2.5Y 7/4) dry and yellow (2.5Y 7/5) moist , sandy loam , massive , non-sticky; non-plastic ; soft , few coarse roots , many lime segregation ; strongly calcareous , diffuse smooth boundary .
40 - 50	Pale yellow (2.5Y 7/4) dry and yellow (2.5Y 7/5) moist , sandy loam , structureless , non-sticky ; non-plastic ; very friable ; slightly hard , few fine roots , many lime segregation ; strongly calcareous , clear smooth boundary .
50 - 80	Pale yellow (2.5Y 7/4) dry and yellow (2.5Y 7/5) moist , loam , structureless , slightly sticky ; slightly plastic ; very friable ; soft many lime segregation ; strongly calcareous , very few gravel , gradual smooth boundary .
80 - 150	Pale yellow (2.5Y 7/4) dry and yellow (2.5Y 7/5) moist , loam , coarse subangular blocky , slightly sticky ; slightly plastic ; friable ; hard , many lime concretion and segregation ; strongly calcareous .

Profile No. 17

Location	: 8.8 Km from Aniba - Khrait road (at Km 6 point) Wadi El-Khrait , Kom Ombo , Aswan Governorate .
Topography	: Undulating .
Elevation	: About 200 m.a.s.l.
Land use	: Watermelon .
Slope	: Slopping to west
Water Table	: 71 cm.

Depth (cm.)	Description
0 - 20	Dark brown (7.5YR 4/4) dry and dark brown (7.5YR 3/4) moist , gravelly sandy loam , single grains , non-sticky ; non-plastic ; loose , frequent gravel , very few fine roots , calcareous , gradual smooth boundary .
20 - 36	Bright brown (7.5YR 5/6) dry and bright brown (7.5YR 5/8) moist , slightly gravelly sandy loam , single grains , non-sticky ; non-plastic loose ; few gravel , calcareous , diffuse smooth boundary .
36 - 71	Dull brown (7.5YR 5/4) dry and bright brown (7.5YR 5/6) moist , slightly gravelly loamy sand , single grains , non-sticky ; non-plastic loose , few gravel , few lime segregation ; calcareous , few distinct clear yellow mottles.

Profile No. 18

Location : About 1.7 Km east of aswan - Idfo road (at Km 51 point) Kom Ombo , Aswan Governorate .

Topography : Plain .

Topography of surrouding country : Undulating .

Elevation : About 98 m.a.s.l.

Land use : Tomato .

Slope : Slopping .

Water Table : 110 cm.

Depth (cm.)	Description
0 - 25	Brown (7.5YR 5/4) dry and dark brown (7.5YR 4/4) moist , sandy clay loam , structureless , non-sticky ; non-plastic ; very friable , very few gravels , frequent fine and medium roots , common lime concretion and few lime segregation strongly calcareous , clear smooth boundary .
25 - 33	Brown (7.5YR 5/3) dry and dark brown (7.5YR 4/4) moist , sandy clay loam , structureless , non-sticky ; non-plastic ; very friable , common lime concretion and segregation ; strongly calcareous , few fine roots , clear smooth boundary .
33 - 39	Dark brown (7.5YR 4/2) dry and dark brown (7.5YR 4/4) moist , clay , moderate thick subangular blocky , slightly sticky ; slightly plastic ; hard , common lime concretion and segregation ; strongly calcareous , clear wavy boundary .
39 - 65	Light brown (7.5YR 6/4) dry and brown (7.5YR 5/4) moist , sandy clay loam , weak fine subangular blocky , slightly sticky ; slightly plastic ; soft , very few gravels , few lime concretion and segregation ; strongly calcareous , abrupt smooth boundary .
65 - 110	Light brown (7.5YR 6/4) dry and brown (7.5YR 5/4) moist , sand , single grains , non-sticky; non-plastic ; loose , slightly calcareous .