Sci. J. Fac. Sci. Menoufia Univ, VoL.VI (1992)73-94.

IMPACT OF THE DEPOSITIONAL ENVIRONMENT ON THE HYDRAULIC PROPERTIES OF THE PLEISTOCENE AQUIFER IN EL-SADAT AREA AND ITS VICINTIES

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ABSTRACT

The range of porosity, permeability and hydraulic properties of the Pleistocene aquifer in El-Sadat area and its vicinities is quite large for a water-table aquifer. It also reflects the direct impact of the environment of deposition on the hydraulic properties of the environment of deposition on the hydraulic properties of the Pleistocene aquifer in this area.

This depositional environment greatly influenced the grain-size distribution within the sediments. This controlled the porosity, permeability and hydraulic properties of the aquifer.

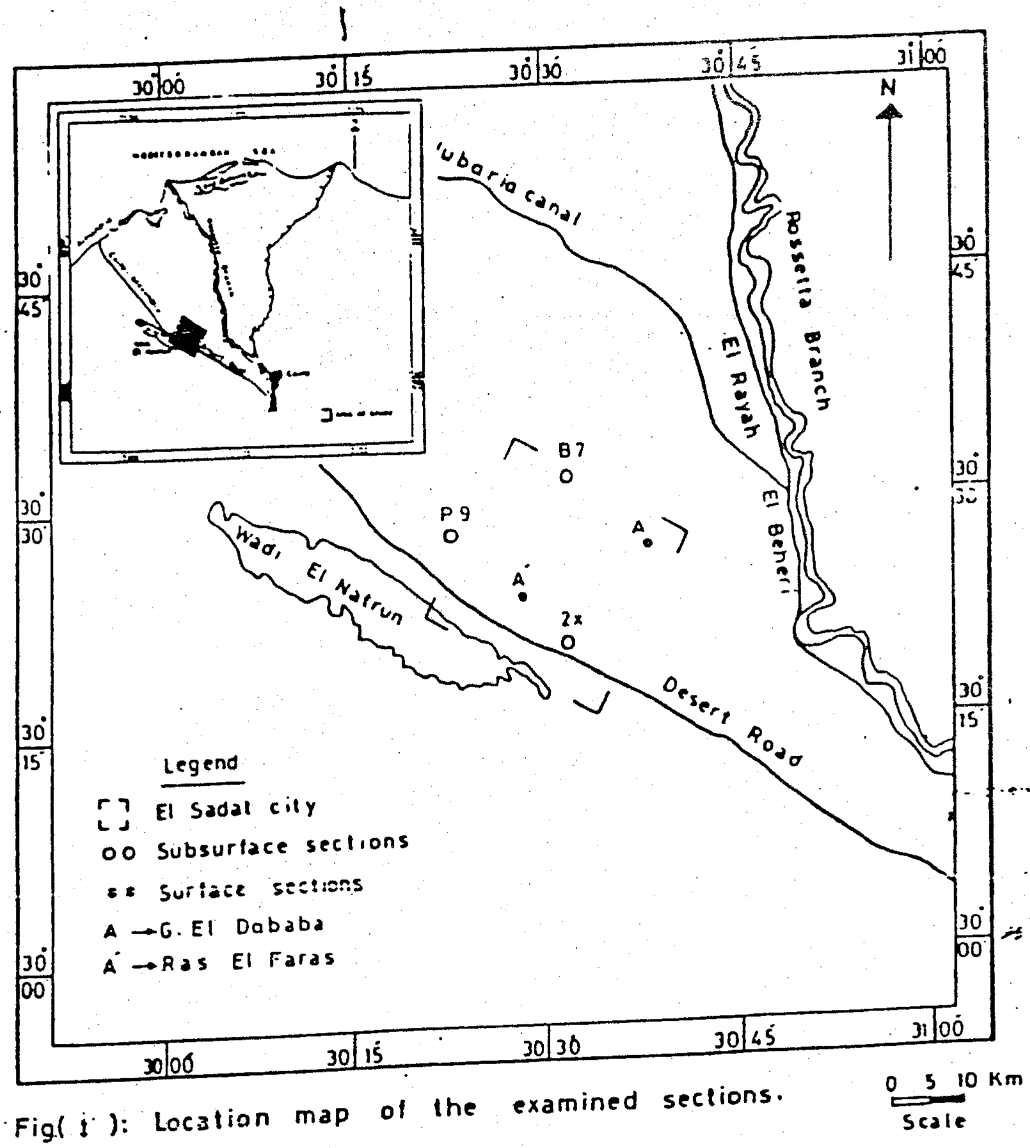
The porosity of the Pleistocene aquifer in the area varies between 34% and 46% and the permeability ranges from 0.001 m/day to 247.9 m/day. The aquifer transmissivity varies between 0.29 m2/ min. and 0.84 m2/min. and the storativity ranges from 2.0 x 10-2 to 8.1 x 10-2 .

Mechanical analysis, heavy mineral studies and X-ray diffraction analysis show that the Pleistocene sediments in El-Sadat area were depositied under beach and deltaic environments in presence of shallow marine agitation and turbidite.

Introduction

The area of El-Sadat city and its vicinities is bounded by long 30 19' 30" -30 40' 27" E, lat 30 34' 00" - 3 34' 00" N received special attention during the last few years due to its reasonable groundwater resources, lack of sharp relief and soil potentialitie. (Fig. 1).

The geology, geomorphology and subsurface geology of the area west



Fig(1): Location map of the examined sections.

of the Nile Delta in general were studied by several authors of whom; Shata (1953, 1955, 1957, 1959, 1961, 1978), Said (1962). Shata and El-Fayoumy (1967a - 1970b), Sanad (1973), Sallouma (1974), Attia (1975), El-Shazly et al. (1975, 1978) and Abdel Baki (1983). However there is no detailed geologic or hydrogeologic studies on El-Sadat area and its vicinities.

The present paper deals with investigations: grain size analysis, heavy mineral study and X-ray analysis in an a ttempt to throw some light on the depositional environment of these sediments and their impact on the hydraulic properties of the Pleistocene aquifer in the area.

GEOMORPHOLOGY

The area under study could be classified geomorphologically into the following physiographic units

A- The alluvial plains: [Shata and El Fayoumy (1967) (Fig. 2)] can be classified into:

1. Young alluvial plain.
2. Old alluvial plain.

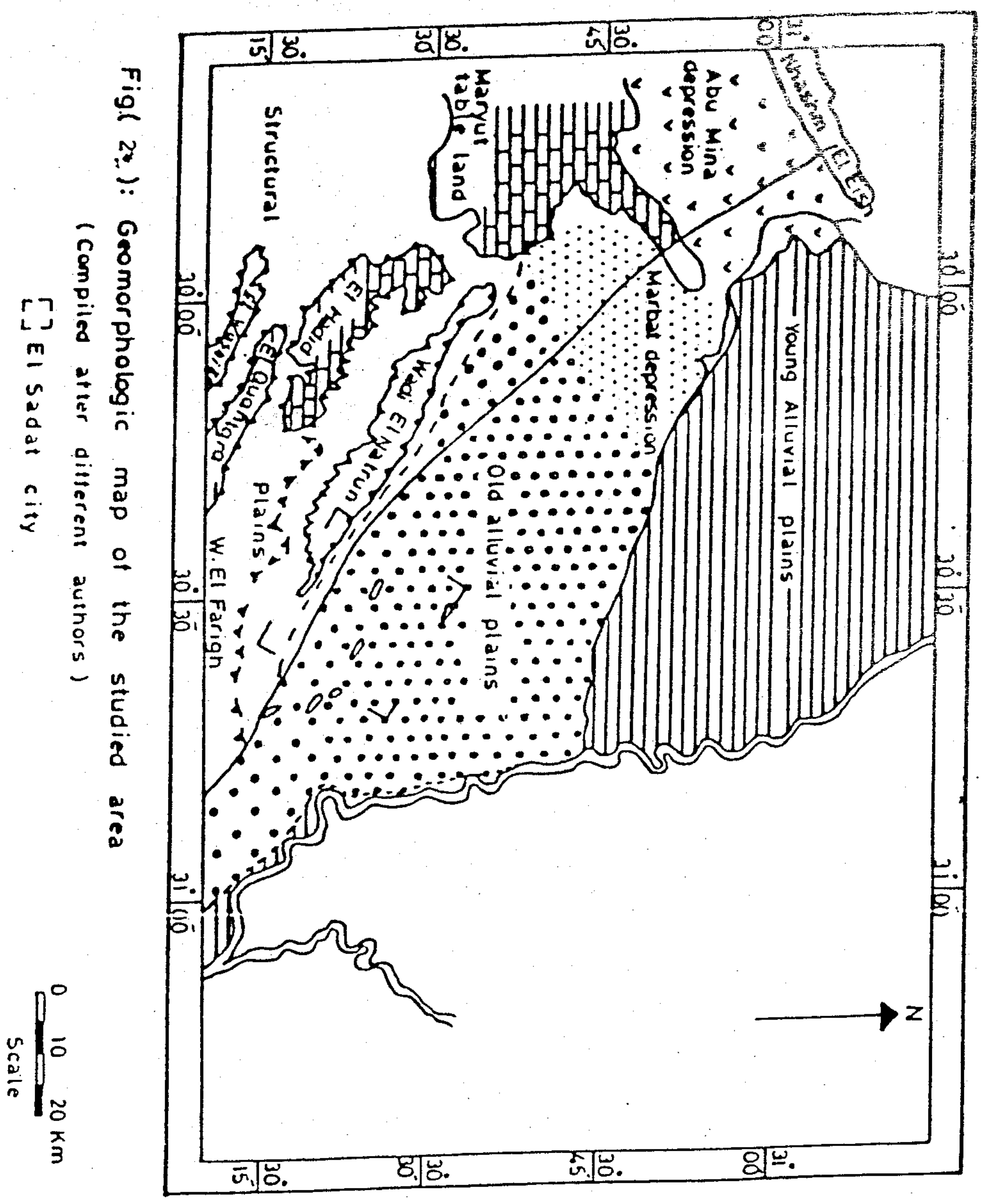
B- The tablelands:

1. Maryut tableland. lies west of the old alluvial plains. It has a maximum heigh of about 110 m. Two ridges are shown, the northern ridge is "Khash El Eish and the southern one is "Alam shaltut". Moreover two morphotectonic depressions exist which are from north to south, Abu Mina and El Marbat depressions.
2. El hadid tablelands which lie to the west of wadi El Na'run depression and mainly covered with a blanket of dark brown gravels with remains of silicified wood.

C- The structural plains:

1. Depression areas including Wadi El-Natrun, Wadi El-Farigh and Wadi El-Tarfaya (El-Fayoumy, 1964).
2. Structural ridges, as Gebel El Hadide ridge (+180) and El Qantra El Washika ridge (+ 180 m to + 190m). Most of these ridges are covered by a gravel blanket derived mainly from both sedimentary and igneous rocks which exist to the east

STRATIGRAPHY AND LITHOLOGY



Fig(2): Geomorphologic map of the studied area
(Compiled after different authors)
[ ] El Sadat city

The sedimentary rocks which outcrop in the area belong essentially to the Late Tertiary and Quaternary times . . Sedimentary succession attains a thickness of about 2.000 m over the basement rocks (Abd El Baki, 1983).

STRUCTURAL CONDITIONS

The structure of the area was studied by Shata (1953) and Shata et al. (1962a and 1962b).

The surface geologic structure is relatively simple. However, many complicated structures are detected by means of geophysical methods, Shata (1962). The area was affected by NW-SE clysmic producing a number of folds and faults, El Fayoumy (1964). The folds include Wadi El-Natrun anticline, Wadi El-Farigh anticline and Gebel El-Qantarea syncline. The faults are detected at the eastern and western sides of Wadi El-Natrun, however, other type of faults trending NE-SW are detected in the area between Abu Roash and Wadi El-Natrun (El Fayoumy 1964).

SAMPLES AND MATERIAL

Representative rock samples were collected from two surface sections at Gebel El-Dababa (10 samples) and Ras El-Faras (7 samples) and from newly drilled wells namely 2_x (40 samples), P_9 (28 samples) and P_7 (9 samples) Fig. 1.

A. Grain size analysis

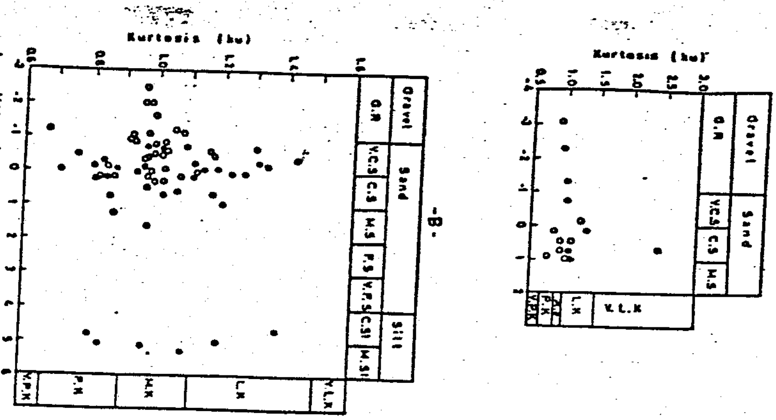
The main purpose of this analysis is to throw some light on the environment of deposition of these sediments, the agents of deposition and to deduce porosity, specific yield and permeability of the water bearing formation. To achieve this, grain-size analysis of 91 representative samples from El-Sadat area was carried out (Table.1).

From the data listed in Tables (1) and the graphs in Fig, 3, the following could be deduced :

1. Surface samples

Surface samples have a sorting coefficient ranging from 1.12 to 1.97 indicating poorly sorted sediments with some exceptions. The calculated skeweness ranges from +0.08 to -0.21 indicating near symmetrical to coarse skewed sediments with the exception of sample No. 4 from Gebel El-Dababa section which is fine skewed and sample No. 5 from Gebel El-Dababa section which is very coarse skewed.

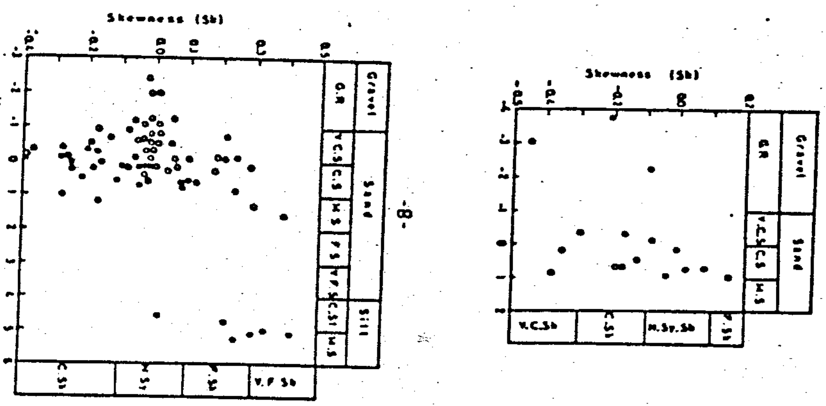
Kurtosis varies between 0.76 and 1.37 indicating platy to leptokurtic



Fig(5): Relationship between Mean size (Mz) in ø value and Kurtosis.

Legend

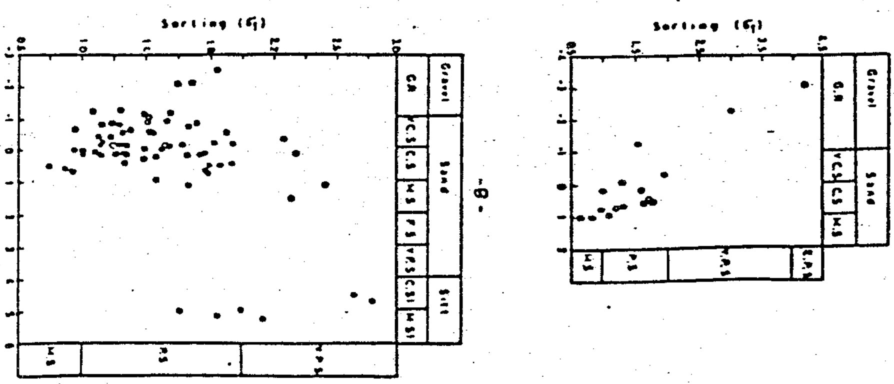
V.P.K : Very platykurtic
M.K : Mesokurtic
V.L.K : Very leptokurtic
P.K : Platykurtic
L.K : Leptokurtic



Fig(4): Relationship between Mean size (Mz) in ø value and Skewness.

Legend

V.C.Sk : Very coarse skewness
C.Sk : Coarse skewness
N.Sy.Sk : Near symmetrical skewness
F.Sk : Fine skewness
V.F.Sk : Very fine skewness



Fig(3): Relationship between Mean size (Mz) in ø value and Sorting.

Legend

M.S : Medium sorting
P.S : Poorly sorting
V.P.S : Very poorly sorting
E.P.S : Extremely poorly sorting

Table 1: Statistical parameters and data of grain size analysis.

section name	Sampl No	c (Q_1)	Q_5	Q_{16}	Q_{25}	Md Q_{50}	Q_{75}	Q_{84}	Q_{95}	M_z	σ_1	SK_1	K_G	G %	Sand %	Silt %	Clay %	Sediment type
Gabel El Dubaba	2	-4.55	-2.90	-1.35	-0.66	0.55	1.75	2.2	2.93	0.43	1.78	-.31	1.1	11.85	84.1	2.95	1.1	G.S
	4	-1.98	-1.38	-0.73	-0.25	0.85	1.50	1.8	2.55	0.92	0.67	0.5	1.0	0.4	99.4	0.2	-	S
	5	-1.75	-0.79	-0.55	-0.15	1.30	1.68	1.87	2.6	0.87	1.12	-.38	0.7	0.6	96.7	2.7	-	S
	6	-0.98	-0.10	0.30	0.50	0.85	1.35	1.6	2.15	0.69	1.23	-.19	0.9	0.9	96.7	2.4	-	S
	7	-5.20	-3.25	-1.45	-0.60	0.78	1.60	1.96	2.85	0.47	1.77	-.13	0.9	10.3	85.6	3.14	0.96	G.S
	8	-3.35	-2.55	-1.80	-1.45	-0.60	0.85	1.65	2.33	0.15	1.6	-.35	0.8	12.1	87.7	0.2	-	G.S
	9	-4.03	-2.58	-1.18	-0.40	0.68	1.64	2.08	2.9	0.53	1.65	-.17	1.1	8.51	87.3	3.33	0.83	S
	10	-3.90	-2.68	-1.50	-0.95	-0.10	0.65	1.05	2.2	-.18	1.38	-.08	1.2	10.4	87.4	2.2	-	G.S
Ras El Furas	2	-2.30	-0.93	-0.25	0.05	0.65	1.30	1.68	2.45	0.11	1.01	-.01	1.3	1.30	97.1	1.60	-	S
	3	-4.53	-3.22	-2.00	-1.45	-0.13	0.65	0.98	2.05	0.96	0.87	-.04	1.1	0.9	96.8	2.3	-	S
	4	-5.95	-4.20	-2.40	-1.70	-0.24	0.90	1.45	2.45	0.65	1.27	-.02	2.4	0.2	95.3	4.5	-	S
	5	-1.68	-1.25	-0.65	0.80	0.70	1.50	1.9	2.95	-.39	1.97	-.16	1.0	21.8	76.4	1.8	-	G.S
	6	-1.95	-1.25	0.36	0.00	0.92	1.35	1.6	2.45	-.38	1.54	-.21	1.0	16.4	82	1.6	-	G.S
	7	-2.10	-1.45	-0.80	-0.45	0.20	0.70	0.92	2.4	0.69	0.99	0.08	1.11	1.4	96.8	1.8	-	S

Table 1 cont.

Well N0.	Sample N0.	Depth (m)	c (Q_1)	Q_5	Q_{16}	Q_{25}	Md Q_{50}	Q_{75}	Q_{84}	Q_{95}	M_z	σ_1	SK_1	K_G	G %	Sand %	Silt %	Clay %	Sediment type
2_x	1	2	-3.80	-3.05	-2.38	-2.05	-1.35	-0.65	-0.23	0.52	-1.32	1.08	0.05	1.05	27	72.7	0.3	-	G.S
	2	6	-3.30	-2.44	-1.7	-1.33	-0.45	0.40	0.8	1.6	-0.45	1.24	-0.01	0.95	10.7	88.7	0.6	-	G.S
	3	10	-3.13	-2.35	-1.65	-1.28	-0.66	-0.10	0.22	0.98	-0.69	0.97	-0.04	1.16	9.8	90	0.1	-	S
	4	14	-2.52	-1.84	-1.18	-0.80	-0.05	1.1	1.45	2.2	0.11	1.27	0.06	0.87	3.5	95.1	1.2	-	S
	5	18	-4.55	-3.55	-2.6	-2.15	-1.18	-0.23	0.2	1	-1.19	1.39	-0.03	0.97	28.4	71	0.6	-	G.S
	6	22	-3.53	-2.75	-20	-1.64	-0.82	-0.08	0.3	0.98	-0.84	1.14	-0.03	0.98	15.9	83.7	0.4	-	G.S
	7	26	-3.40	-2.64	-1.90	-1.55	-0.53	0.5	0.8	1.6	-0.19	1.32	-0.01	0.85	14.5	83.6	1.75	-	G.S
	8	30	-2.80	-2.05	-1.33	-1	-0.18	0.65	1.05	2.05	-0.15	1.22	0.06	1.02	5.5	93	1.5	-	S
	9	34	-4.40	-3.48	-2.60	-2.17	-1.27	-0.43	-0.05	0.63	-1.31	1.26	-0.06	0.67	29.7	70.1	0.2	-	G.S
	10	38	-4.42	-3.43	-2.50	-2.05	-1.05	-0.1	0.33	1.3	-1.07	1.43	-0.01	0.99	26	72.6	1.3	-	G.S
	11	42	-5.2	-3.75	-2.50	-1.85	-0.6	0.4	0.8	1.9	-0.77	1.68	-0.13	1.03	22.2	76.7	1.1	-	G.S
	12	46	-2.85	-2.1	-1.40	-1.07	-0.34	0.6	1.18	2.3	-0.19	1.31	0.17	1.08	6	92.2	1.6	-	S
	13	50	-2.05	-1.45	-0.92	-0.68	-0.15	0.74	1.25	2.25	-0.06	1.10	0.29	1.07	1.2	97.1	1.7	-	S
	14	54	-2.15	-1.63	-1.14	-0.85	-0.2	0.9	1.48	2.5	0.05	1.28	0.29	0.97	1.7	95.9	2.3	-	S
	15	58	-2.75	-1.75	-0.80	-0.45	0.4	1.35	1.73	2.5	0.44	1.28	0.02	0.97	3.5	94.2	2.3	-	S
	16	62	-4.75	-3.65	-2.65	-2	-0.88	0.25	0.85	2	-0.85	1.73	0.01	1.02	25.2	73.2	1.6	-	G.s
	17	66	-4.35	-3.1	-1.88	-1.3	-0.17	0.9	1.38	2.4	-0.22	1.65	-0.06	1.02	14.9	82.9	2.2	-	G.s
	18	70	-6.05	-1.9	-3.77	-3.25	-2.05	-0.9	-0.33	0.72	-0.05	1.71	-0.01	0.98	51.6	48.1	0.2	-	G.S
	19	74	-3.75	-2.65	-1.58	-1.05	-0.3	1	1.43	2.45	-0.15	1.53	0.11-	1.02	10.6	86.5	2.7	-	G.S
	20	78	-5.95	-4.33	-2.6	-1.85	-0.35	0.75	1.2	2.2	-0.58	1.92	0.19	1.01	22.8	75	2.2	2.8	G.S
	21	82	-3.6	-2.5	-1.43	-0.9	0.0	0.85	1.3	2.33	-0.04	1.41	-0.04	1.13	9.3	89.2	1.5	1.7	S
	22	86	-2.85	-2	-1.2	-0.75	0.23	1.15	1.65	2.72	0.23	1.43	0.03	1.02	5.1	91.5	3.3	0.94	S
	23	90	-3.2	-2.25	-1.35	-0.9	0.05	0.97	1.6	1.55	0.1	1.31	-0.08	0.83	7.4	90.3	2.3	-	S
	24	92	-3.4	-2.25	-1.2	-0.65	0.63	2.8	4.8	5.53	1.24	2.55	0.03	0.92	7.2	71.1	18.9	-	S1.S1
	25	94	-2.40	-1.55	-0.65	-0.2	0.75	2.75	4.43	5.45	1.51	2.33	0.39	0.97	2.3	75.4	20.5	-	S1.S1
	26	96	-4.40	-3.16	-1.95	-1.4	0.0	1.4	2.45	5.15	0.17	2.36	0.18	1.22	15.1	71.8	12.1	-	G.S
	27	98	-3.15	-2.18	-1.25	-0.8	0.17	1.23	1.72	2.72	0.21	1.48	0.04	0.99	6.8	89.8	3.4	-	S
	28	102	-3.48	-2.49	-1.55	-1.08	0.0	1	1.9	2.9	0.12	1.65	0.07	1.02	9.7	87.7	2.5	-	S
	29	106	-3.70	-2.9	-2.13	-1.75	-0.95	-0.1	0.3	1.08	-0.93	1.21	0.02	0.99	19.1	80.1	0.2	-	G.S
	30	110	-3.00	-2.05	-1.20	-0.8	0.13	0.9	1.25	2	0.06	1.23	-0.02	0.98	5.5	93.9	0.6	-	S
	31	114	-3.94	-2.95	-2.07	-1.64	-0.68	0.2	0.55	1.44	-0.73	1.32	-0.05	0.98	17.7	81.3	1	-	G.S
	32	118	-3.50	-2.68	-1.87	-1.44	-0.6	0.3	0.69	1.49	-0.59	1.27	0.01	0.97	13.8	85.9	0.3	-	G.S
	33	122	-4.05	-3.05	-2.08	-1.64	-0.6	0.33	0.75	1.8	-0.64	1.44	-0.03	0.99	17.8	81.7	0.4	-	G.S
	34	126	-3.8	-2.82	-1.9	-1.47	-0.53	0.33	0.8	2.38	-0.54	1.46	0.05	1.17	14.9	84	1.1	-	G.S
	35	130	-4.8	-3.75	-2.73	-2.25	-1.2	0.0	0.43	1.32	-1.17	1.56	0.01	0.92	30.6	68.9	0.5	-	G.S
	36	134	-5.15	-3.85	-2.65	-2.1	-0.86	0.15	0.49	1.18	-1	1.55	-0.17	0.92	26.7	73	0.2	-	G.S
	37	138	-5.9	-4.75	-3.73	-3.2	-2.13	-1	-0.43	-0.43	-2.09	1.61	0.01	0.96	53.3	46.6	0.1	-	G.S
	38	142	-7.00	-5.68	-4.4	-3.85	-2.52	-1.25	-0.65	0.4	-2.52	1.86	-0.02	0.96	61.4	38.4	0.0	-	G.S
	39	146	-4.9	-3.5	-2.44	-1.95	-0.85	0.15	0.5	1.2	-0.93	1.45	-0.10	0.92	23.6	76.3	1	-	G.S
	40	150	-4.55	-3.5	-2.48	-2	-0.95	0.05	0.43	1.13	-1	1.43	0.08	0.93	25.1	74.9	0.0	-	G.S

Table 1 cont.

Well NO.	Sampl No	Depth (m)	c (Q_1)	Q_5	Q_{16}	Q_{25}	Md Q_{50}	Q_{75}	Q_{84}	Q_{95}	M_z	σ_1	SK_1	K_G	G %	Sand %	Silt %	Clay %	Sediment type
P_9	1	12	-3.50	-2.45	-1.47	-1	-0.2	0.4	0.7	1.4	-0.32	1.13	-0.17	1.13	9.2	90.3	0.5	-	S
	2	13	-2.65	-1.7	-0.92	-0.58	0.14	0.75	1.08	1.92	0.1	1.06	-0.04	1.13	3.4	95.8	0.8	-	S
	3	14	-2.38	-1.68	-1	-0.65	0.1	0.73	1.02	1.92	0.04	1.05	-0.04	1.07	3.6	94.8	0.8	-	S
	4	15	-4.12	-2.8	-1.55	-0.95	-0.2	0.4	0.7	1.5	-0.35	1.21	-0.2	1.31	11.1	88.7	0.2	-	G.S
	5	16	-2.4	-1.6	-0.85	-0.47	0.22	0.75	1	1.97	0.12	1	-0.09	1.19	2.4	96.2	1.3	-	S
	6	17	-3.15	-2.5	-1.85	-1.6	-0.93	-0.2	0.39	1.95	-0.8	1.24	0.23	1.3	13.1	85	1.9	-	G.S
	7	18	-4.05	-2.9	-1.76	-1.2	-0.05	1.13	1.43	2.08	-0.13	1.55	-0.11	0.88	13.7	85	1.2	-	G.S
	8	19	-3.63	-2.47	-1.35	-0.85	0.05	0.55	0.8	1.43	-0.17	1.13	-0.28	1.14	8.5	91.4	0.1	-	S
	9	20	-4.6	-3.15	-1.75	-1.1	0.65	1.9	2.3	3.02	0.4	1.95	-0.21	0.84	13.7	81.1	5.2	-	G.S
	10	21	-3.55	-2.47	-1.45	-0.98	0.65	2	2.39	3.08	0.53	1.8	-0.11	0.76	9.1	84.9	5.9	-	S
	11	22	-2.15	-1.55	-1.02	-0.5	0.83	2	2.5	3.18	0.75	1.79	0.09	1.03	1.69	90.3	4.89	3.12	S
	12	23	-3	-2.18	-1.33	-0.85	0.55	1.75	2.35	3.2	0.5	1.87	0.1	1.06	6.81	85.4	4.4	3.28	S
	13	24	-2.65	-1.95	-1.23	-0.72	0.88	1.2	2.43	3.07	0.68	1.78	-0.05	0.86	4.39	89.36	3.65	2.6	S
	14	25	-2.9	-1.83	-0.63	0.15	1.3	2.13	2.48	3.07	1.08	1.67	-0.16	1.19	4.09	89.01	4.8	2.1	S
	15	26	-2.85	-1.8	0.68	0.05	1.23	2	2.32	2.96	0.96	1.47	-0.27	1.02	3.89	92.06	2.44	1.6	S
	16	27	-3.4	-4.12	-2.4	-1.6	0.2	1.45	1.98	3	0.12	1.77	-0.02	0.85	11.47	84.49	1.61	2.42	G.S
	17	28	-2.4	-1.91	-1.43	-1.2	-0.45	0.75	1.22	1.95	-0.22	1.25	0.25	0.81	3.7	95.7	0.6	-	S
	18	29	-3.85	-3.05	-2.28	-1.92	-1.13	0.05	1.03	1.6	-0.79	1.53	0.24	0.97	23.1	76.8	-	-	G.S
	19	30	-2.55	-2	-1.45	-1.2	-0.34	1.15	1.45	2.05	-0.11	1.34	0.21	0.71	4.9	95.5	0.1	-	S
	20	31	-3.15	-2	-0.95	-0.55	0.13	0.58	0.8	1.4	-0.01	0.96	-0.25	1.23	5.1	94.6	0.1	-	S
	21	32	0.45	3.03	3.3	3.75	4.5	6.15	7.03	7.95	5.01	1.63	0.42	0.84	0.0	4.59	69.17	26.23	Cl.Sl
	22	33	0.55	1.6	3.4	3.65	4.4	6.1	7.1	8.8	4.9	2.02	0.34	1.2	0.0	7.88	66.12	25.98	Cl.Sl
	23	34	-1.53	-0.9	2.2	3.25	4.4	6.2	7.1	9.02	4.56	2.73	0.02	1.38	0.2	20.82	51.77	27.18	S.Cl
	24	35	-0.65	1.8	3.4	3.85	4.8	6.6	7.5	9.13	5.23	2.14	0.25	1.09	0.0	9.86	59.36	30.75	Cl.S
	25	36	-0.25	2.28	3.43	3.78	4.6	6.32	7.15	8.3	5.06	1.84	0.3	0.97	0.0	7.24	64.44	28.3	Cl.S
	26	39	-0.70	0.5	1.95	2.33	4.13	6.7	8.05	9.15	4.751	2.84	0.22	0.81	0.0	40.72	28.92	30.35	S.Cl
	27	40	-1.40	-0.85	-0.23	0.05	0.52	0.97	1.45	2.36	0.58	0.91	0.13	1.43	0.1	98.6	1.3	-	S
	28	41	-1.40	-0.85	-0.25	0.03	0.58	1.15	1.58	2.35	0.64	0.94	0.09	1.17	0.1	98.6	1.3	-	S
B_7	1	4	-1.65	-0.9	0.0	0.15	0.5	0.95	1.25	1.9	0.52	0.79	0.02	1.43	0.5	98.9	0.6	-	S
	2	8	-4.1	-2.95	-1.82	-1.25	0.3	1.4	1.9	2.38	0.13	1.74	-0.18	0.82	13.8	85.8	0.4	-	G.S
	3	14	-7.6	-5.15	-2.95	-1.75	0.15	1.1	1.59	2.49	-0.37	2.27	-0.37	1.09	22.7	75.4	1.9	-	G.S
	4	20	-6.4	-4.25	-2.2	-1.2	0.15	0.75	1.2	2.12	-0.28	1.82	-0.38	1.34	17.7	81.4	0.9	-	G.S
	5	22	-3.65	-2.62	-1.65	-1.2	0.2	1	1.4	2.45	-0.02	1.53	-0.16	0.94	11.3	85.3	3.4	-	G.S
	6	26	-5.40	-3.83	-2.35	-1.65	0.13	1.05	1.59	2.48	-0.21	1.94	-0.26	0.96	20.2	78.2	1.6	-	G.S
	7	32	-4.40	-2.98	-1.65	-1	-0.32	0.15	0.5	1.03	-0.49	1.15	-0.28	1.43	12.3	87.7	0.0	-	G.S
	8	36	-3.70	-2.33	-1.05	-0.55	0.3	0.9	1.12	1.9	0.12	1.19	-0.25	1.2	7.5	91.8	0.7	-	S
	9	40	-4.10	-2.55	-1.15	-0.65	0.22	0.85	1.2	2.1	0.09	1.29	-0.18	1.27	7.8	89.6	2.6	-	S

Legend:

G:Gravel S:sand Si:Silt Cl:Clay G.S :Gravelly sand
S.G:Sandy gravel Sl.S :Silty sand Sl.G.S :Silty gravelly sand Sl.G.S :Silty gravelly sand Cl.Sl:Clayey silt S.Cl, Sl:Sandy clayey silt

except sample No. 4 from Ras El-Faras section which is very leptokurtic.

The calculated percentage of gravel, sand, silt and clay components show that samples of Gebel El-Dababa and Ras El-Faras sections lie in sand and gravel categories.

2. Subsurface samples

Histograms of well 2_x, P_9 and B_7 samples show that the frequency distribution of grains ranges from unimodal to bimodal

The samples have a sorting coefficient ranging from 1 to 2.84 indicating poorly to very poorly sorted sediments except Sample No. 3 at 10 m depth (well 2_x), samples No. 20, 27 and 28 at 31, 42 and 41 m depth respectively (well P_9) and sample No. 1 at 4 m depth (well B_7) which are moderately sorted.

The calculated skeweness ranges from + 0.3 to -0.28 indicating fine to coarse skewed except sample No. 25 at 94 m depth (well 2_x) and Samples NO. 21 and 22 at 32 and 33 m depth respectively (well P_9). These samples are very fine skewed. Sample No. 1 at 4 m depth (well B_7) gives near symmetrical skewed, samples No. 3 and 4 at 14 and 20 depth respectively (well B_7) give very coarse skewed indicating variable environmental depositional conditions.

Kurtosis varies between 0.67 and 1.43 (platy to leptokurtic).

The calculated percentage of gravel, sand and clay components shows that samples from well 2_x lie in gravely-sand, sandy-gravel and silty-sand categories while samples from well p, lie in sand ,gravely-sand and silt categories. Samples from well B_7 lie mostly in gravely-sand category.

The calculated discriminant functions of the studied samples (surface and subsurface samples) suggest that these samples were mainly deposited under beach and deltaic environments.Shallow agitated marine and turbidit have some effect on the deposition of these samples (Table3).Discrimintation of sedimentary environments using bivariate plots of statistical grain-size parameters of Folk and Ward (1957) might be valuable for revealing the environmental conditions of sedimentation.

1. The mean size(Mz) versus Inclusive Graphic Standard Deviation(σ_1):The examined surface and subsurface samples are very coarse and coarse sand size with some exceptions of gravel and coarse silt size. The samples in general are almost poorly sorted. This may indicate that the sands examined are possibly fluviatile immature sediments . The plotting points of the examined samples (surface and well subsurface),suggesting the

similarity of environmental conditions of deposition of both subsurface and surface samples (Figs.4a and 4b).

2. Mean size (Mz)versus Skewness (SK_1):The relationship between Mz and SK_1 is used to differentiate between beach and aeolian sands .The scatter diagram (Figs . 4a and 4b) suggests a possible heterogeneous origin.These samples might be of beach and fluviatile origin.(Mason and Folk, 1958; Friedman,1961 and Meola and Weiser, 1968).

3- Mean size (Mz) Versus Kurtosis (Kg)

The samples in general appear mesokurtic to platykurtic with some exception of leptokurtic and very leptokurtic.This may suggest a beach environment (Fig.5a and 5b).

The resulting C-M pattern (Passega and Pyramjee,1969) of surface and well samples (Figs. 6 and 7) show that the examined samples are scattered in a relatively vast area away from line C-M.The samples in general almost lie in (1) type of the basic C-M diagram with a few exception of well samples which lie in (III) type.Consequently, it could be concluded that the examined sediments are mixtures of suspension sediments and rolled coarse grained sediments.

B.Mineral analyses

A mineral analysis of the Quaternary sediments was carried out by means of X-ray diffraction and heavy minerals in central labratory of faculty of science Menoufia University.

1. X-ray diffraction analysis

a. Non-clay minerals

The objective of this study is to determine the mineral content of the samples and their effect on the depositional environment and post-depositional conditions of the water-bearing rocks. To achieve this, quantitative determination of the minerals: quartz, gypsum, calcite, goethite, glauconite, kaolinite, halite, anhydrite, orthoclase, rhodochrosite and dolomite in about 12 samples collected from two surface section was carried out by means of X-ray diffraction analysis using the internal standard method (CaF_2 was used as internal standard) (Table 3 and4).

b. Clay minerals

Samples used for clay minerals identification were collected from two wells namely P_9 and 2_X. The results obtained indicate the presence of kaolinite and occasionally illite (Table 4).

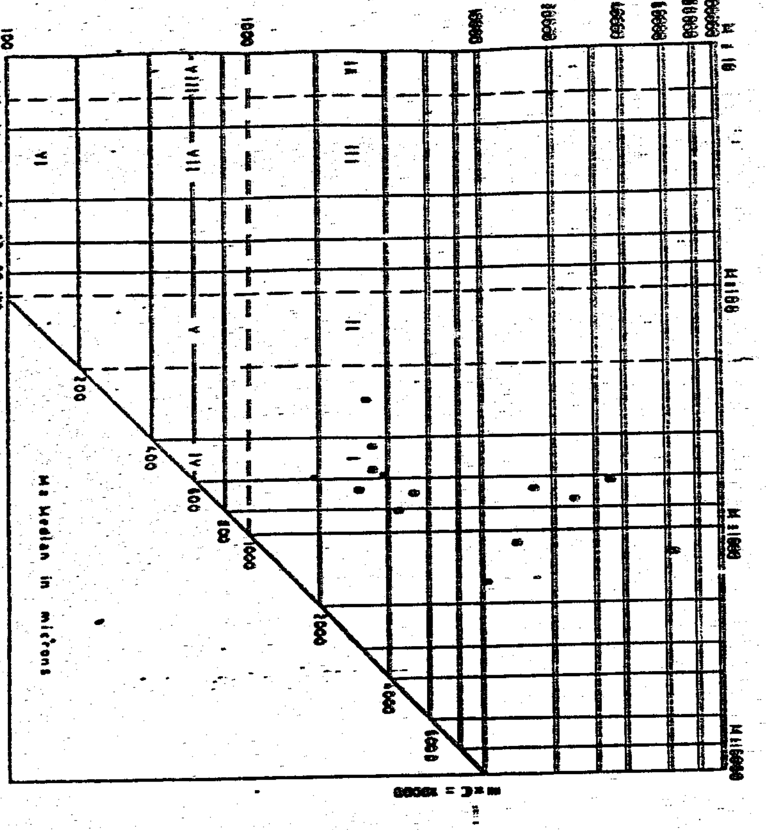


Fig.(6): C-M diagram of the surface samples.

Legend

Samples of Gebel El Dabaa section

Samples of Ras El Faras section

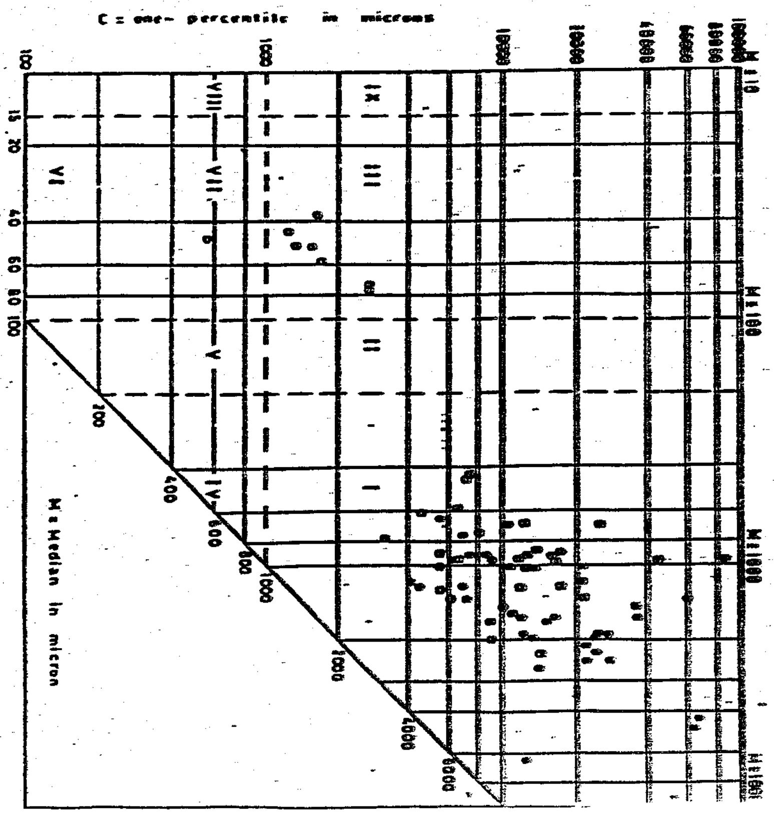


Fig.(7): C-M diagram of the well samples.

Legend

Samples of well No. Z1

Samples of well No. P3

Samples of well No. B7

Table (2): Quantitative X-ray mineralogy Gabal El-Dabba Section.

Sample No.	Qz	Gy	Ca	Ge	Gl	Ka	Ha	An	Or	Rh	Do	Others
1		30 M-S	21 M-S			1 T	T	1 VW	3 T	3		
2	20 M-S					1 T			1			
3	21 M-S		7 W			1 T						
4	21 M-S	10 W	1 T			1 T						
5	30 M-S	8 W			1 T	2 T						
6	20 M-S	1 T 1 T				2 T	2 T					
7	20 M-S	6 W-VW			20 M-S	4 VW	1 T		1 T			
8	21 M-S	13 M 1 T	5 VW					1 T		1 T	1 T	1 T
9	21 M-S	13 M 1 T	13 M				2 T	1 T				

Table (3): Quantitative x-ray mineralogy of Ras El-Faras section

Sample No.	Qz	Gy	Ca	Ge	Gl	Ka	Ha	An	Or	Rh	Do	Others
1	21 M-S	1 T	1			1 T					1 T	
2	21 M-S	17 M	1 T	3 VW		5 VW		1 T				
3	29 M-S	9 W	1 T	1 T	1 T	3 VW	1 T					

Abbreviations

Qz = Quartz
Ge = Geothite
Ha = Halite
Rh = Rhodochrosite
Gy = Gypsum
Gl = Glauconite
An = Anhydrite
Do = Dolomite
Ca = Calcite
Ka = Kaolinite
Or = Orthoclase

VS = 30 - 70 %
M = 12 - 15 %
VW = 3 - 4%
S = 25 - 30%
W = 7 - 10%
T = 3%

Table (4): Identified caly minerals from P9 and 2x, El-sadat area.

Well No	Sample No.	Depth (m)	Untreated		Glycolated		Heated		Mineral
			dA°	I/Io	dA°	I/Io	dA°	I/Io	
	1	27	8.35	100	7.26	100	-	-	Kaolinite
			5.95	40	5.25	45	-	-	
			3.60	48	3.56	87	-	-	
	2	32	7.49	100	7.45	100	-	-	
			5.44	61	5.95	60	-	-	Kaolinite
			3.59	43	3.66	43	-	-	
	3	33	7.03	90	7.30	100	-	-	
			5.61	62	5.47	68	-	-	Kaolinite
			3.53	96	3.51	44	-	-	
			3.34	100	3.33	60	3.33	91	
	4	94	7.44	100	7.59	100	-	-	
			5.01	41	5.79	38	-	-	Kaolinite
			3.60	40	3.60	63	-	-	
			3.38	42	3.33	41	3.33	76	
P9	5	35	7.23	100	7.44	94	-	-	
			5.72	54	5.37	78	-	-	Kaolinite
			37.75	30	3.60	44	-	-	
	6	36	7.26	100	7.69	81	-	-	Kaolinite
			5.47	29	5.25	69	-	-	
			3.56	56	3.48	53	-	-	
			3.31	53	3.94	53	3.34	93	
	7	37	7.32	100	7.32	63	-	-	
			9.34	23	5.57	44	-	-	Kaolinite
			3.58	30	-	-	-	-	
	8	38	7.32	100	8.27	71	-	-	
			5.68	23	5.71	64	-	-	
			4.55	41	4.77	54	4.85	53	Kaolinite
			3.58	18	-	-	-	-	
			3.33	26	3.33	64	3.49	60	
	9	39	7.43	100	8.93	42	-	-	
			5.54	26	5.37	75	-	-	
			4.55	24	4.42	58	4.31	53	
			3.60	35	-	-	-	-	
			3.38	29	3.34	100	3.34	90	
2x	10	94	9.51	58	9.58	50	9.49	109	Illite
			7.32	100	7.03	79	-	-	Kaolinite
			5.41	35	5.04	67	-	-	
			3.62	42	3.80	58	-	-	
			3.14	75	3.31	71	3.33	47	

Kaolinite is the most dominant clay mineral in the samples.The presence of kaolinite may indicate a derivation from eroded,pre-existing kaolinite-bearing sediments.

Illite was only recorded in one sample collected from well 2_x (sample No. 10).

The clay mineral distribution shows that kaolinite is the dominant clay mineral. It is known that kaolinite can be produced from Al-silicate rocks under suitable environmental conditions. Mineralogical studies reveal that kaolinite is not restricted to a particular lithofacies(Table 6). Its abundant occurance through the sections and wells studied reflect the intensity of weathering and leaching conditions aided by pronounced relief in the source areas. Illite could have been either detrital in origin or a product of diagenetic alteration or both. The study reveals that some illite is a product of alteration of kaolinite which is the only detected clay mineral in surface samples. This may indicate that part of the sediments may have been derived from a nearly source. The presence of quartz,calcite,kaolinite,orthoclase and dolomite in the surface sediments together with the observed textural immatureurity of some of the sediments confirm the existance of this nearly source.

2. Heavy minerals

About 8 samples from well 2_x, 6 samples from well P_9, 5 samples from well B_7, 6 samples from Gebel El-Dabba section and 3 samples from Ras El-faras section were analyzed for their heavy mineral content. The selected samples.were screened through a standard set of sieves with mesh openings 0.5, 0.25, 0.125 and 0.063 mm. The dominant heavy minerals in the examined samples are opaque minerals, however, the non-opaque minerals;staurolite, zircon, pyroxenes, amphiboles, garnet,rutile, tourmaline,epidotes and biotite, rare amounts of kyanite and apatite were also identified.The percentage of opaque minerals varies at depth and surface sections. This may indicate an oscillation in the depositional conditions.

EFFECT OF GEOLOGY ON THE HYDROLOGY OF THE PLEISTOCENE AQUIFER

An attempt has been conducted to calculate the porosity, specific yield and permeability using the mechanical analysis data of samples collected from wells 2_x , P_9 and B_7 at different depths (Table 5)

The porosity ranges from 34% to 40% (well 2_x), from 34% to 46% (

Table (5): Porosity, specific yield and permeability of the studied samples

Well No	Sample No	Depth (m)	Porosity %	Specific yield	permeability m/day
2_x	1	2	34	0.18	187.8
	2	6	35	0.16	44.9
	3	10	35	0.16	104.1
	4	114	35	0.15	19.1
	5	18	34	0.18	98.3
	6	22	35	0.17	92.6
	7	26	35	0.17	44.9
	8	30	36	0.15	27.5
	9	34	35	0.18	142.9
	10	38	35	0.18	87
	11	42	36	0.18	37.5
	12	46	35	0.16	21.8
	13	50	40	0.15	24.6
	14	54	36	0.15	14.4
	15	58	35	0.15	12.2
	16	62	35	0.17	34
	17	66	35	0.16	19.1
	18	70	35	0.20	179.9
	19	74	35	0.16	19.1
	20	78	35	0.17	24.6
	21	82	35	0.15	19.1
	22	86	35	0.15	12.2
	23	90	36	0.16	10.3
	24	92	37	0.16	0.23
	25	94	36	0.15	0.19
	26	96	36	0.17	0.53
2_x	27	98	35	0.16	10.3
	28	102	35	0.15	6.9
	29	106	35	0.17	104.1
	30	110	35	0.15	24.6
	31	114	35	0.16	71.5
	32	118	34	0.16	53.1
	33	122	35	0.16	44.9
	34	126	35	0.17	14.4
	35	130	34	0.18	76.5
	36	134	35	0.18	76.5
	37	138	35	0.20	195.8
	38	142	34	0.21	247.9
	39	146	36	0.17	71.5
	40	150	35	0.17	81.7

Well No	Sample No	Depth (m)	Porosity %	Specific yield	Permeability m/day
P_9	1	12	35	0.16	61.9
	2	13	35	0.15	24.6
	3	14	34	0.15	27.5
	4	15	35	0.15	61.9
	5	16	35	0.15	30.7
	6	17	35	0.16	41.1
	7	18	35	0.16	21.8
	8	19	35	0.16	53.1
	9	20	35	0.15	4.7
	10	21	40	0.15	4.3
	11	22	37	0.15	4.2
	12	23	34	0.16	5.4
	13	24	36	0.15	5.4
	14	25	36	0.15	4.4
	15	26	38	0.14	5.4
	16	27	35	0.16	7.2
	17	28	34	0.15	24.8
	18	29	35	0.18	27.5
	19	30	35	0.15	17.9
	20	31	35	0.15	57.5
	21	32	46	0.08	0.007
	22	33	45	0.09	0.005
	23	34	44	0.08	0.002
	24	35	45	0.07	0.002
	25	36	46	0.07	0.005
	26	39	42	0.09	0.001
	27	40	36	0.15	14.4
	28	41	36	0.15	14.4
B_7	1	4	36	0.15	24.6
	2	8	35	0.16	8.5
	3	14	35	0.17	12.2
	4	20	34	0.16	26.03
	5	22	35	0.16	19.1
	6	26	35	0.17	12.2
	7	32	35	0.16	73.9
	8	36	35	0.16	27.5
	9	40	35	0.15	24.6

well P_9) and from 34% to 36% (well B_7) except samples No. 21, 22, 23, 24, 25, and 26 at depths of 32, 33, 34, 35, 36 and 39 m respctively from well No. P_9 where the value increases to about 46% due to an increase in silt and clay content in these samples.

The specific yield ranges from 0.14 to 0.21 (well 2_x and P_9) and from 0.15 to 0.17 (well B_7) with the exception of samples 21, 22, 23, 24, 25 and 26 from well P_9 where the value decreases to about 0.07. According to Freeze and Cherry (1978), these values indicate that the Quaternary aquifer at El-Sadat area lies under water table conditions.

The permeability as determined according to Allen Hazen formula ranges from 0.19 m/day to 98.3 m/day (well 2_x , P_9 and B_7). In samples No. 21 to 26 (well P_9) the value decreases to about 0.001 m/day. This may be attributed to an increase in the silt and clay content in these samples, while in samples 1, 3, 9, 18, 29, 37 and 38 at depths 2, 10, 34, 70, 106, 136 and 142 m (well 2_x) the value increases to about 247.9 m/day, indicating the dominance of coarse sand and gravel at these areas (Table5,).

The hydraulic parameters of Pleistocene aquifer as concluded from pumping test data (Fig.8) indicate that the transmissivity of the aquifer has reliable values and is nearly uniform all over the area under study. It varies between 0.29 m^2/min. and 0.84 m^2/min. The wide variation of storativity and hydraulic conductivity values is attributed to the depositional condition of the aquifer materials and the existence of intercalated impermeable clay lenses through the water bearing formation. These factores directly affect porosity, permeability, hydraulic conductivity and tranmissivity of the Quaternary aquifer at El-Sadat area.

CONCLUSION

From the above discussion it can be concluded that the Pleistocene sediments of El-Sadat area and its vicinities vary from gravely sand to sand that were mainly deposited under beach and deltaic environments in which the shallow marine agitation and turbidities prevailed. The mechanism of depostion reveal that the sediments were transported by mixtures of suspension and rolling.

X-ray diffraction analysis indicates the presence of quartz, gypsum, calcite, goethite, glayconite, kaolinite, halite, anhydrite, orthoclase, rhodochrosite and dolomite in a decreasing order of abundance. The clay minerals identified are mainly kaolinite. The illite mineral is detected in one sample indicating that the illite is derived from kaolinite through diagenetic

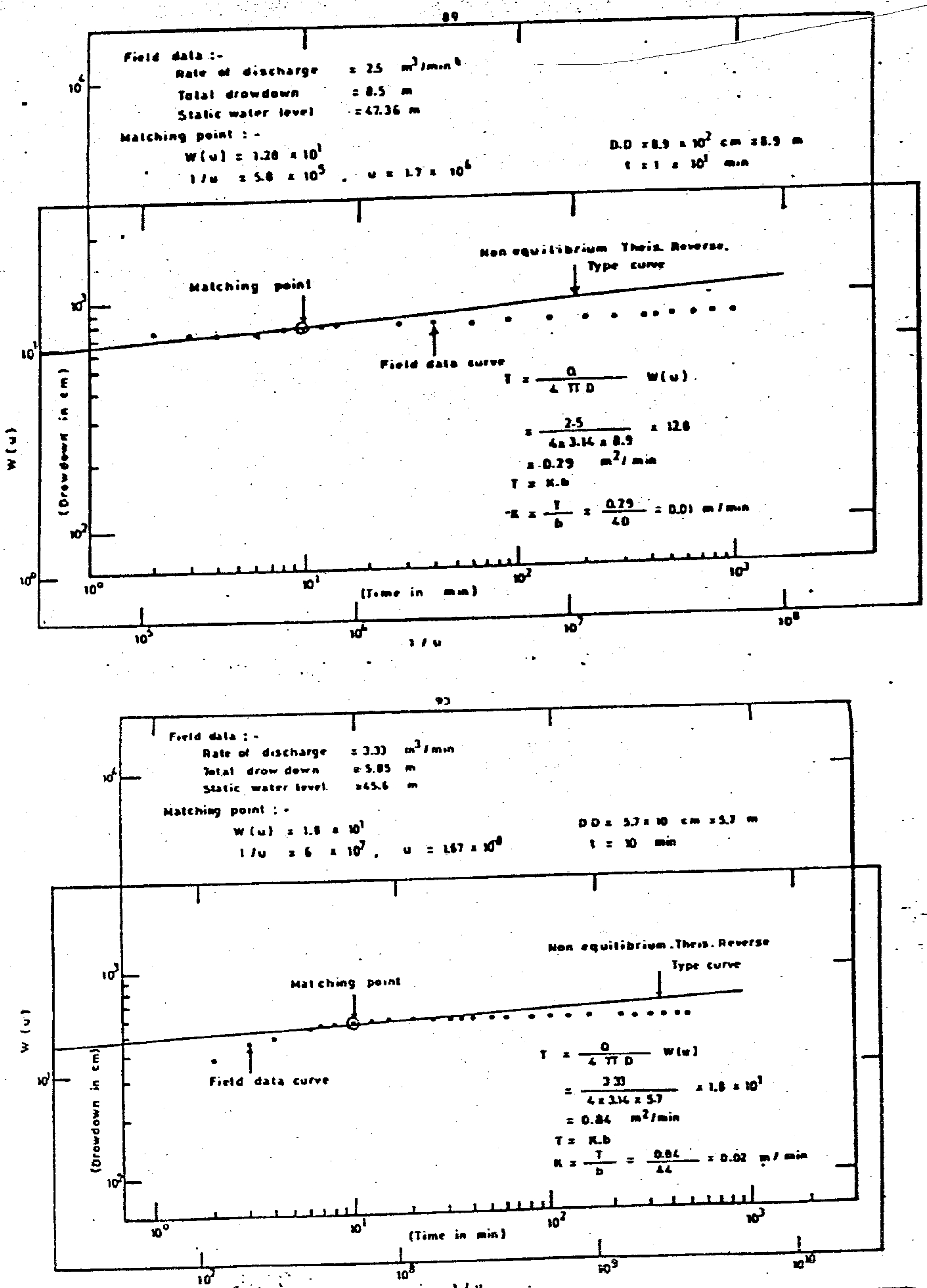


Fig.(8) ;Pumping test data for some wells.

processes. The great abundance of kaolinite may be due to the nearly absence of calcareous sediments (Millot 1970).

Heavy mineral study indicates the presence of opaque and non-opaque minerals, mainly staurolite, zircon, pyroxene, amphibole, garnet, rutile, tourmaline, epidotes and biotite. Rare amounts of kyanite and apatite were also identified. This may indicate a derivation of pre-existing igneous metamorphic and resedimented rocks.

The porosity of the Pleistocene aquifer varies between 34% and 46% while the permeability ranges from 0.001 m/day to 147.9 m/day. The aquifer's transmissivity varies between 0.29m^2/min, and 0.84 m^2/min, and its storativity ranges from 2.0 x 10^{-2} to 8.1x 10^{-2}.

The calculated values of porosity, permeability and hydraulic properties of the Pleistocene aquifer at El-Sadat area suggest that it lies under a water table aquifer condition. These values also reveal that there is a direct impact of the environment of deposition on the hydraulic properties of the Pleistocene aquifer in the studied area.

Acknowledgment

The author is grateful to Prof. Dr. M. Sh. Diab for his constructive discussions, support and encouragement during the writing of this paper, thanks also to A. G. Shedid for his help in sampling.

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أثر بيئة الترسيب على الخواص الهيدروليكية لخزان البليستوسين فى منطقة السادات وما حولها

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وجد أن لبيئة الترسيب أثر كبير على توزيع حجم الحبيبات خلال الرواسب وبالتالى فإن المسامية والنفاذية والخواص الهيدروليكية لخزان البليستوسين سوف يتأثر بهذا التوزيع .

وقد وجد أن مسامية خزان البليستوسين فى منطقة الدراسة تتراوح بين ٣٤ ٪ ، ٤٦ ٪ . أما النفاذية فانها تتراوح بين ٠٠١ر٠ م / يوم إلى ٩ر٢٤٧ م / يوم .

وقد أثبتت دراسة الرواسب من الناحية الميكانيكية ، دراسة المعادن الثقيلة والأشعة السينية أن رواسب البليستوسين فى منطقة السادات ترسبت تحت تأثير بيئات شاطئية دلتيه فى وجود بيئة بحرية ضحله وتيارات قاعية .