GEOLOGICAL STUDIES OF THE QUATERNARY SEDIMENTS OF EAST DELTA REGION

THESIS

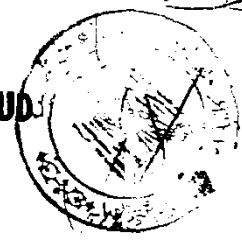
Submitted for the M. Sc. Degree

GEOLOGY

By

ABDEL-MONEIM AHMED MAHMOUD

B. Sc.



To

Department of Geology

Faculty of Science

Ain Shams University

1985

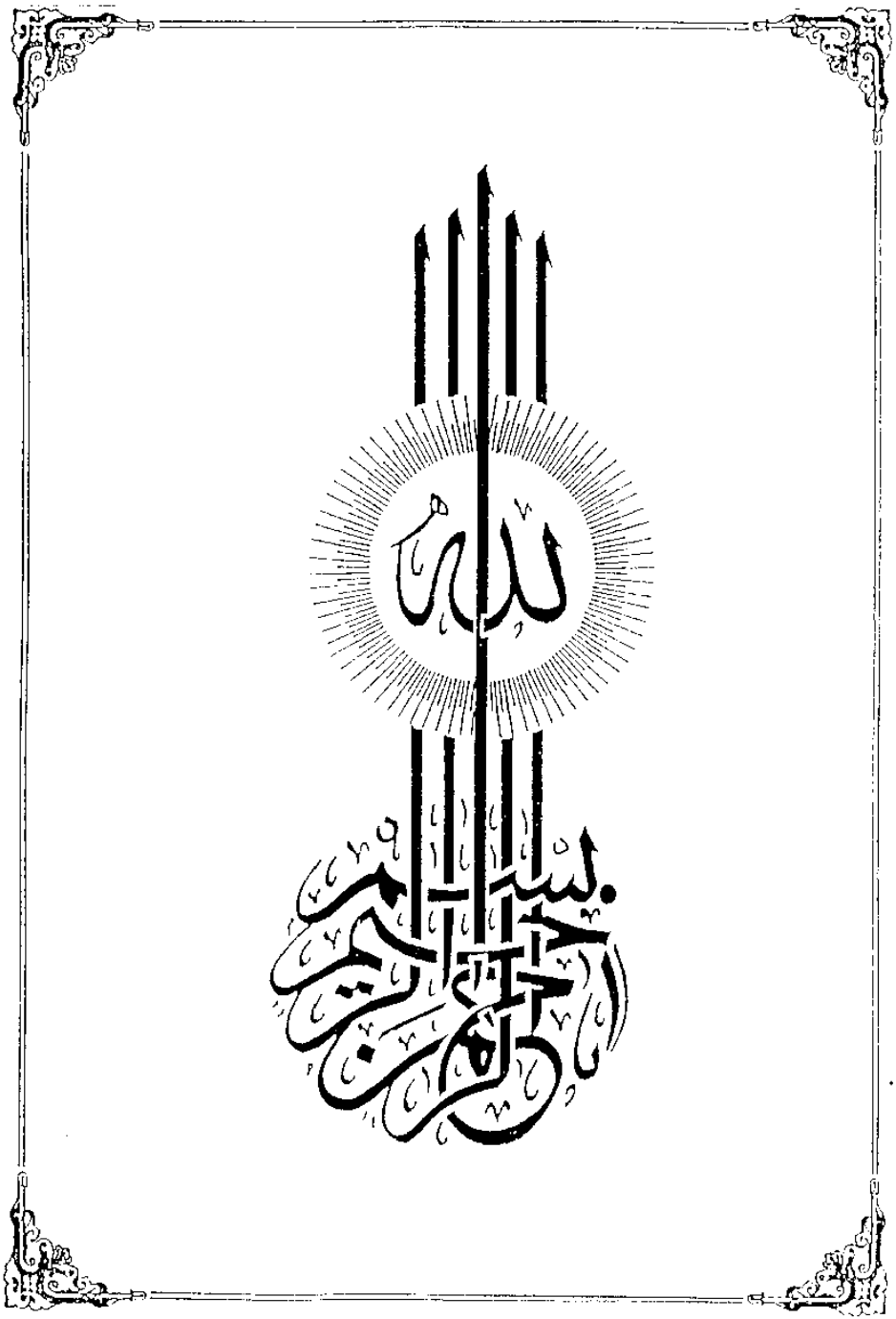
ACKNOWLEDGEMENTS

The author wishes to express his deep gratitude to Prof. Dr. M.E. Hilmy for his encouragement and generous advice in the preparation of the thesis. I also acknowledge the guidance and help of Prof. Dr. Samir A. Hussein, Geology Department, Ain Shams University and Prof. Dr. Zahid Hassan, Anthropology Department, Washington State University.

I am also grateful to Dr. Ahmed Youssef, Associate Professor, Geology Department, Ain Shams University, and Dr. Nazih Daad, Natural History Department, Geology section, Faculty of Education, Ain Shams University for their help and advice.

I am also grateful to Prof. Dr. M. El Amin Dessouki, Head of the Geology Department, for the use of departmental facilities and to Prof. Dr. Amin Dowidar, Head of the Natural History Department, Faculty of Education, Ain Shams University for his support.

I am also immeasurably indebted to my family and especially my mother to whom I dedicate this work.



NOTE

The present thesis is submitted from Abdel-Moneim Ahmed Mahmoud to Ain Shams University in partial fulfilment of the requirements for the degree of Master of Science in Geology.

Besides the research work materialized in this thesis, the candidate has attended nine graduate courses for one year in the following topics :

- Geologic laboratory techniques.
- Photogeology.
- Sedimentary rocks.
- Sedimentation.
- Geotectonics.
- Crystallography.
- Mineralogy.
- Geochemistry.
- Lithostratigraphy.
- English Language.

He has successfully passed the final examinations of these courses in September 1981.

Prof. Dr. M. El Amin Bassioni

Head, Department of Geology

ABSTRACT

Investigations of East Delta Quaternary deposits reveals a sequence of Upper Pleistocene fanglomerates, older Nile and younger Nile sediments. The older Nile sediments are braided stream deposits of regime dominated by contributions from local tributaries and equatorial sources. The younger Nile sediments are mostly related to a meandering river dominated by contributions from Ethiopian sources.

Intercalations of sheet-wash and wadi deposits denote occurrence of episodes of semiarid climate during the Pleistocene and Holocene.

Several lithostratigraphic units were identified on the basis of field relations and lithologic features.

Granulometric analysis showed differences related to environmental conditions. Heavy mineral analysis and examination of lithoclasts reflected difference in the source area. The results of sphericity and roundness were of limited differential value.

	Page
CHAPTER V : HEAVY MINERAL ANALYSIS	191
- Method and Technique	193
- Results and Discussion	194
- Mineralogy of the Light Fraction	203
- Mineralogy of the Heavy Fraction	205
Opaque heavy minerals.	205
Non-opaque heavy minerals.	208
- Source Rock.	224
SUMMARY AND CONCLUSIONS.	227
REFERENCES	234
ARABIC SUMMARY	

LIST OF FIGURES

Fig. No.		Page
1-	Location map of measured sections	23
2-	Location map showing El Ismailia Canal environs and index of the geological maps.	26
3-	Photograph of Basal Pleistocene at Cairo-Suez Road.	34
4-	Photograph of Basal Pleistocene at Almaza section	34
5-	Photograph of the Belbeis Formation at Belbeis locality	38
6-	Photograph of the Belbeis Formation at Abbassa locality	38
7-	Photograph of the Lower Pleistocene section at Abu Rabak.	42
8-	Photograph of the Ridamyia Member at the Abbassia section	42
9-	Photographs of the Abu Zabaal Member at the Abu Zabaal / Belbeis section	43
10-	Columnar sections of formations discussed in the text	46
11-	Geologic section in the Zeiton area	49
12-	Geologic sections of the Manshat Abu Omar Formation	51
13-	The Graeco-Roman deposits at geologic section (C)	54
14-	The Graeco-Roman deposits at geologic section (D)	54
15-	Composite lithostratigraphic section and sedimentological phases.	56
16-	Nomenclature of size-mixture samples (Folk, 1954)	69
17-	Nomenclature of size-mixture samples (USA Soil Survey Staff, 1962).	70
18-	Histograms of the Dabyet El-Kusumi Formation.	72
19-	Histograms of the Belbeis Formation	73
20-	Histograms of Abu Zabaal Formation.	75
21-	Histogram of Debet El Raml Formation.	75
22-	Histograms of Sufaniia Formation	75
23-	Histograms of Abu Qweir Formation	76
24-	Histograms of Zeiton Formation.	76
25-	Histograms of Manshat Abu Omar Formation.	76
26-	Histograms of the Graeco-Roman deposits	77
27-	Histograms of the sheetwash and wadi deposits.	78
28-	The cumulative curves of the Dabyet El Kusumi Formation	79

Fig. No. Page

29- The cumulative curves of the Bastet El Nasumi Formation . 80
30- The cumulative curves of the Bastet El Nasumi Formation . 82
31- The cumulative curves of the Belbeis Formation. 83
32- The cumulative curves of the Belbeis Formation. 84
33- The cumulative curves of Abu Zabaal Formation 85
34- The cumulative curves of Debet El Raml Formation. 86
35- The cumulative curves of Qafaria Formation. 87
36- The cumulative curves of Abu Sweir Formation. 89
37- The cumulative curves of Zeiton Formation 90
38- The cumulative curves of Manshat Abu Omar Formation . . . 92
39- The cumulative curves of the Graeco-Roman deposits. . . . 93
40- The cumulative curves of sheet-wash and wadi deposits . . 94
41- Diagram plot of mean size versus inclusive standard deviation after Friedman (1961), and Wicle & Weiser (1968) . 121
42- Diagram plot of standard deviation versus median after Stewart (1958), and Wicle & Weiser (1968) 122
43- Diagram plot of mean size versus skewness, after Stewart (1958) and Wicle & Friedman (1961). 123
44- Diagram plot of skewness versus standard deviation, Friedman (1967) 125
45- The "CM" pattern of the studied sediments 127
46- Photomicrograph of chert pebble (Cross Nicol' 138
47- Photomicrograph of igneous pebble (Rhyodacite) (Cross Nicols) 139
48- Photomicrograph of the same sample (Rhyodacite) (Cross Nicols) 139
49- Photomicrograph of the same sample (Rhyodacite) (Cross Nicols) 139
50- Photomicrograph of igneous pebble (andesite) (Cross Nicols) 140
51- Photomicrograph of igneous pebble mainly porophyritic quartz andesite 142
52- Photomicrograph of igneous pebble mainly porphyritic biotite andesite (Cross Nicols) 143

Fig. No. Page

53- Photomicrograph of igneous pebble mainly quartz andesite (Cross Nicols). 140
54- Photomicrograph of metamorphic rock fragment (quartzite) (Cross Nicols). 142
55- Photomicrograph of metamorphic rock fragment (quartzite) (Cross Nicols). 143
56- Photomicrograph of metamorphic rock fragment pebble (quartz phyllite) (Cross Nicols). 145
57- Pomeroy diagram showing quartz varieties (Cross Nicols) . 149
58- Photomicrograph of sandstone sample (a,b) (Cross Nicols). 152
59- Photomicrograph of sandstone sample (Quartzose wacke) (Cross Nicols). 154
60- Photomicrograph of sandstone sample with composite quartz grains (Cross Nicols) 156
61- Photomicrograph of sandstone sample with altered feldspar (Cross Nicols). 159
62- Photomicrograph of sandstone sample with altered feldspar and composite quartz grain (Cross Nicols) 161
63- Photomicrograph of sandstone sample with ore fragment (Cross Nicols). 163
64- Photomicrograph of sedimentary rock fragment pebble (Cross Nicols). 165
65- Photomicrograph of sandstone sample with calcareous matrix (Cross Nicols). 167
66- Photomicrograph of sandstone sample showing reworked carbonate grains (Cross Nicols) 169
67- Photomicrograph of sandstone sample with coarse fractured quartz grains and calcareous matrix (Cross Nicols). . . . 171
68- Photomicrograph of sandstone sample with microcrystalline calcite cement (Cross Nicols) 173
69- Classification of sandstone fragment, Petrijohn (1957). . 180
70- Classification of sandstone fragment, Okada (1971). . . . 182
71- Shape analysis of fragile quartz granule, Zingg (1935). . . 176
72- Shape analysis of thick White granule, Zingg (1935). . 177

Fig. No.		Page
73-	Shape analysis of the younger Nile gravels, Zingg (1935)	173
74-	Shape analysis of the sheet-wash and wadi gravels, Zingg (1935)	175
75-	Histograms of shapes of different types of the fanglomerate pebbles	180
76-	Histograms of shapes of different types of the older Nile pebbles	180
77-	Histograms of shapes of different types of the younger Nile pebbles	180
78-	Histograms of shapes of different types of the sheet-wash and wadi gravels	180
79-	Sphericity-form for particle shapes of the fanglomerate gravels	183
80-	Sphericity-form for particle shapes of the older Nile gravels	186
81	Sphericity form for particle shapes of the younger Nile gravels	187
82-	Sphericity-form for particle shapes of the sheet-wash and wadi gravels	188
83-	Average percentages of the heavy minerals of the different sediments	197
84-	Average proportions of pyroxenes, epidotes and amphiboles in the Quaternary Nile sediments in a ternary diagram.	198
85-	A plot of the pyroxene index against the frequency of pyroxenes relative to the total frequency of amphiboles, pyroxenes and epidotes	201
86-	The average frequency distribution of heavy and light minerals in the studied sections	204
87-	The average percentage of opaque and non-opaque heavy fractions for the studied sections at East-Delta region.	206
88-	Photomicrograph of elongated epidote (Plane Polarised)	211
89-	Photomicrograph of composite epidote grain (Plane polarised)	211
90-	Photomicrograph of composite epidote grain (Plane polarised)	211

Fig. No. Page

91- Photomicrograph of fragmental epidote (Plane Polarized)... 211
92- Photomicrograph of cleavable hornblende (Plane Polarized) 213
93- Photomicrograph of cleavable hornblende (Plane Polarized) 213
94- Photomicrograph of fragmental hornblende (Plane Polarized) 213
95- Photomicrograph of fragmental hornblende (Plane Polarized) 213
96- Photomicrograph of Elongated cleavable augite (Plane Polarized) 215
97- Photomicrograph of elongated augite (Plane Polarized). . . 215
98- Photomicrograph of hypersthene with iron oxides and zircon inclusions (Plane Polarized) 215
99- Photomicrograph of Metamict zircon (Plane Polarized) . . . 217
100- Photomicrograph of Euhedral zicon (Plane Polarized). . . . 217
101- Photomicrograph of well rounded zircon (Plane Polarized) . 217
102- Photomicrograph of shaded zircon (Plane Polarized). . . . 217
103- Photomicrograph of garnet showing outgrowth (Plane Polarized) 220
104- Photomicrograph of garnet with iron oxides inclusions (Plane Polarized). 220
105- Photomicrograph of well rounded tourmaline(Plane Polarized) 220
106- Photomicrograph of well rounded tourmaline(Plane Polarized) 220
107- Photomicrograph of well rounded rutile (Plane Polarized) . 220
108- Photomicrograph of elongated rutile (Plane Polarized). . . 220
109- Photomicrograph of kyanite with traces of cleavage (Plane Polarized) 222
110- Photomicrograph of kyanite with traces of cleavage (Plane Polarized) 222
111- Photomicrograph of kyanite with traces of cleavage (Plane Polarized) 222
112- Photomicrograph of staurolite (Plane Polarized). 223
113- Photomicrograph of well rounded staurolite(Plane Polarized) 223
114- Photomicrograph of elongated biotite (Plane Polarized) . . 223

List of Tables

Table No.		Page
1-	East Delta rock units as described by different authors.	21
2	A data sheet for hydrometer silt-clay analysis	66
3-	Size analysis data of nine mixture samples	87
4-	The phi percentile for the sandy fraction of the analysed sediments from the East-Delta region	96
5-	Phi percentiles for the sandy fraction of the analysed sheet-wash and wadi deposits from the East-Delta region.	98
6-	The scale suggested by Folk and Ward (1957) for describing the calculated "M_z" values	99
7-	The scale suggested by Folk and Ward (1957) for describing the "σ_1".	100
8-	The scale suggested by Folk and Ward (1957) for describing "SK_1".	101
9-	The scale suggested by Folk and Ward (1957) for describing "K_g"	104
10-	The calculated "M_z" values of fanglomerate sediments in the studied area	101
11-	The calculated "M_z" values of the older Nile sediments in the studied area.	103
12-	The calculated "M_z" values of the younger Nile sediments in the studied area.	104
13-	The calculated "M_z" values of the sheet-wash and wadi deposits in the studied area	105
14-	The calculated "σ_1" values of the fanglomerate sediments in the studied area.	107
15-	The calculated "σ_1" values of the older Nile sediments in the studied area.	108
16-	The calculated "σ_1" values of the younger Nile sediments in the studied area.	109
17-	The calculated "σ_1" values of the sheet-wash and wadi deposits in the studied area.	111
18-	The calculated "SK_1" values of the fanglomerate phase in the studied area	112

Table No. Page

19- The calculated "SK_I" values of the older Nile sediments in the studied area. 111

20- The calculated "SK_I" values of the younger Nile sediments in the studied area. 112

21- The calculated "SK_I" values of the sheet-wash and wadi deposits in the studied area 114

22- The calculated "K_G" values of the fanglomerate sediments in the studied area. 115

23- The calculated "K_G" values of the older Nile sediments in the studied area. 116

24- The calculated "K_G" values of the younger Nile sediments in the studied area. 117

25- The calculated "K_G" values of the sheet-wash and wadi deposits in the studied area 118

26- The average percentage of quartz, chert and rock fragments in the studied sediments 136

27- Percentage of roundness of quartz grains 146

28- Frequency distribution of different types of Quartz. . . 148

29- Modal analysis of sandstone samples. 161

30- Classification of sandstones according to different authors. 163

31- Average percentage of roundness of gravels of the studied sediments. 167

32- The relationship between the average grain-size and roundness of the fanglomerate pebbles from the area studied . 168

33- The relationship between the average grain size and roundness of the older Nile pebbles from the area studied . . 169

34- The relationship between the average grain size and roundness of the younger Nile pebbles from the area studied . 169

35- The relationship between the average grain size and roundness of the sheet-wash and wadi gravels from the area studied. 170

36- The relationship between roundness and composition of the fanglomerate gravels 171

Table No.		Page
37-	The relationship between roundness and composition of the older Nile gravels	17
38-	The relationship between roundness and composition of the younger Nile gravels	17
39-	The relationship between roundness and composition of the sheet-wash and wadi gravels.	17
40-	Average shape class percentages of the fanglomerate pebbles	17
41-	Average shape class percentages of the older Nile pebbles.	17
42-	Average shape class percentages of the younger Nile pebbles	17
43-	Average shape class percentages of the sheet-wash and wadi gravels.	17
44-	Different from percentages, and form ratios of the fanglomerate gravels	18
45-	Different form percentages and form ratios of the older Nile gravels	18
46-	Different form percentages and form ratios of the younger Nile gravels	18
47-	Different form percentages and form ratios of the sheet-wash and wadi gravels.	18
48-	Average distribution of heavy minerals for the analyzed sediments.	19
49-	Average mineralogical indices of the studied sediments	19
50-	Mineralogic indices of the sediments of the major tributaries of the Nile, Hassan (1976b).	20
51-	The average frequency distribution of heavy and light minerals in the studied sections	21
52-	The average frequency distribution of opaque and non-opaque minerals in the studied sections	21
53-	The average percentage of stable heavy minerals for the studied sediments.	21

INTRODUCTION