

## **EFFECTS OF PARENT MATERIAL WEATHERING ON MINERALOGICAL AND CHEMICAL PROPERTIES OF SOME SOILS IN THE BAHARIYA OASIS, WESTERN DESERT, EGYPT**

**Hussein, M. A. M.**

**Soil & Water Dept. Fac. Of Agric., Al-Azhar University, Egypt**

### **ABSTRACT**

The clay mineralogy and trace elements analysis of 31 selected soil profiles was recorded using X-ray diffraction analysis and X-ray fluorescence analysis. Results indicate that smectite is the predominant clay mineral followed by kaolinite in the soil derived from Bahariya, El Hefhuf and Khoman Formation. Kaolinite is the predominant mineral in the soils derived from El Heiz, Qazzun and Radwan formation.

The origin of these clay minerals may be related almost entirely to parent rocks without significant transformation within the soil profiles studied.

The distribution of the trace elements in the studied soil profiles indicate that, zirconium (Zr) is the dominant element in all profiles studied and Formation. Barium (Ba) is the second dominant element followed by Zin (Zn) and chromium. (Cr).

Based on the soil properties and the American soil Taxonomy (2006) Baharia Oasis soils were classified at great soil group level into Torripsaments, Torriorthents, Haplosalids and Haplocalcids

### **INTRODUCTION**

**Geologic Setting:** the Bahariya Oasis is a topographic depression located in the heart of the Western Desert, 370 km southwest of Cairo and 190 km west of Samalut in the Nile Valley. This depression is one of the most important areas in the Western Desert, and it has attracted the attention of many geologists especially in the last four decades, with the beginning of the land reclamation and discovery of iron ore deposits. More detailed studies include works published by Said (1962), El Akkad and Issawi (1963). El Bassyouny (1972, 1978), Issawi (1972), Khalifa (1977), Soliman and El Badry (1980), Franks (1982), Dominik (1985), Khalifa and Abu El-Hassan (1993), Soliman and Khalifa (1993). Khalifa et al., (2002, 2003).

Ball and Beadnell (1903) further established the foundation of the Geology of the Bahariya Oasis, which starts with the Cenomanian rocks at the base. Stromer (1914) was the first to introduce the term Baharije-Stufe for the Cenomanian sandstones and Claystones in the floor and escarpments of the Bahariya depression. Later on, Said (1962) used the term Bahariya Formation instead of Baharije-Stufe. He mentioned that the Bahariya formation consists of sandstones with several intercalations of ferruginous layers, and termed the lowermost sandstone beds as the Dinosaur bed at Gabal El Dist. The base of the Bahariya Formation is unexposed, while its top shows an unconformable relationship with the overlying Upper Cenomanian El Heiz Formation (Khalifa and Abu El-Hassan, 1993) in most of the western and eastern escarpments. In the northern parts, it shows an unconformable contact with the overlying lower Middle Eocene Naqb Formation. The

minimum thickness of the Bahariya formation is 90 m in the central part of the oasis, while its maximum thickness is about 190 m at Gabal El Dist in the north.

The Bahariya formation reflects a complex depositional history that encompasses a wide range of sedimentary environments, including fluvial, beach, deltaic and shallowmarine (Soliman and Khalifa, 1993, Catuneanu *et al.* 2006). Fig. 1.

**Geomorphology:**

The Bahariya is a large oval-shaped depression located at the northern part of the Western Desert. Unlike other oases in the Western Desert, the Bahariya is surrounded by scarps from all directions and has a considerable karst products. The karst features of the Bahariya eastern and northeastern plateaux are represented by the following: (Soliman and Khalifa, 1993).

**Karst landforms: These include:**

- A. Conekarst and cockpits.
- B. Small-scale depressions and dolines.
- C. Large-scale depressions.

**Karst products; including:**

- A. Spheroidal weathering and corestones.
- B. Surficial duricrusts (terra rossa, silcrete, ferricrete and calcrete crusts).

## **MATERIALS AND METHODS**

31 soil profiles of a transect across the Baharia Oasis representing different parent materials, geomorphological features and wide range of land use periods Fig (2) the profiles were described and sampled according to conventional procedures outlined in the FAO guideline (1970). These soil profiles representing five Great Soil Groups belonging to Entisols and Aridisols

**Mineralogical Analysis**

Clay fraction (<2  $\mu$ ) were separated from soil samples after the pretreatment for the removal of organic matter, carbonates, gypsum and free iron oxides according to Kunze and Dixon (1986). The clay fractions were separated by the method of sedimentation and decantation .

**X-Ray Diffraction Analysis**

Oriented clay samples were prepared from the separated clay as Mg-saturated air-dried, Mg-saturated glycerol solvated, K-saturated air dried and K-saturated heated to 500°C for 2 hours. The criteria used for clay mineral identification are those mentioned by Brown (1961), Dixon and Weed, (1977) and Wilson.

X-ray diffraction technique, (XRD), was used to identify the unknown minerals using PHILIPS PW 3710/31 diffractometer with automatic sample changer PW 1775, (21 positions), scintillation counter, Cu-target tube and Ni filter at 40 kV and 30 mA. This instrument is connected to a computer system using X-40 diffraction program and ASTM cards for mineral identification.

Semi-quantitative determinations for identified minerals were then conducted by measuring the peak area as outlined by Norrish and Taylor (1962).

**Fig1**

*Hussein, M. A. M.*

**Fig2**

### **X-Ray Fluorescence Analysis**

For trace elements analysis, pressed powder pellets were prepared by filling an alumina cup, (diameter 4 cm, height 1.2 cm and weight 3 gm), with 9 gm of crystalline boric acid covered by 1 gm of the grounded sample, (-200 mesh grain size), and then pressed under 12 tons using semi-automatic hydraulic press model HERZOG HTP-40.

The X-ray fluorescence technique, (XRF), was used to determine the trace element contents using PHILIPS X'Unique-II spectrometer with automatic sample changer PW 15150, (30 positions). This instrument is connected to a computer system using X-40 program for spectrometry. The trace elements concentrations are calculated from the program's calibration curves which were set up according to international reference materials, (standards), as SARM-46, SARM-50 and Stream-1. The trace elements were measured by calibrating the system under the conditions of Rh-target tube, LiF-420 crystal, gas flow proportional counter, (GFPC), coarse collimators, vacuum, 30 kv and 40 mA for the determination of V, Cr, Co, Ni, Cu, Zn and Ga, 70 kv and 15 mA, for Rb, Sr, Y, Zr and Nb and 100 kv and 10 mA for the determination of Ba and Pb, (Viswanathan, 1989). The detection limit is the lowest concentration, and it is function of the level of background noise relative to an element signal, (Norrish and Chappell, 1967). The detection limit for the elements measured by XRF technique is estimated at 2 ppm for Rb, Nb, Ga, Co, Y and Sr and at 8 ppm for Pb and Cu and 5 ppm for other measured trace elements sedimentation times according to the temperature and viscosity at a standard depth.

## **RESULTS AND DISCUSSION**

Soils of Bahariya are developed under arid conditions where the chemical variation are expected to be at minimum. The physical weathering and the geogenetic processes are the obvious features in the formation of these soils. Soil parent materials are mainly residual, alluvial, terraces and aeolian. The parent material are the weathering product of the geological formation. The following is a general description of the different stratigraphic units and clay mineral association in the Bahariya Region (Table 1 )

### **Mineralogical composition of the clay fraction**

The results of the mineralogical analysis of the clay fraction separated from the soils derived from parent material surroundings of G. Ghorabi, G. Mysera, El-Hara, G. Tobog, G. Tibnia and El Qasr areas soil (profiles 1,2,3,4,5,12,17,19,21, 24 and 26) which derived from Bahariya, El-Hefhuf, Khoman formation, Table (2) , show that smectite is the dominant mineral followed by kaolinite.

The X-ray diffraction patterns of the clay fraction of the soils of G. Maysera, G. Mandisha, El-Harra, G. Hammad and El Heize area which derived from El Heiz, Qazzun and Radwan Formation. (Fig.3 and 4) and table (2) reveal that kaolinite is the predominate mineral. Minute and low amounts of illite was detected in El Fagga, Naab siwa and El Heiz soils. It is clear that no

significant mineralogical changes among the different layers of each studied soil profiles.

The mineralogical analysis of the soil clays reveal that all clay minerals, are found in the geological formation of Baharia Oases. Therefore, the variation in their mineralogy probably reflect the mineralogy of parent rock and alluvium from which they are found rather than pedagogic processes . This conclusion is confirmed by the similarity of the clay mineral assemblages of both soils and rocks. Trace elements distribution in the studied soil profiles:

**Table (1) Clay mineral assemblages and the different geological formations of the Bahariya Region ( Issaw , 2009).**

Formation	Description	Smec	Koal	Tillute	Qw
<b>Baharia form.</b>	Type section	Geble El Dist			
	Lithology	Fluviatile sandstone and siltstone and shale	++++	++	+ +
<b>El Heiz form.</b>	Type section	Eastern part of El-Tibniya promontory			
	Lithology	Dolomite sandstone, siliceous dolostone, sand clay, calcareous grit and ironstone		+++++	+
<b>El Helfhuf form.</b>	Type section	Geble El Hefhuf			
	Lithology	Dolostone with sandstone, sandy clay interbeds and phosphatic beds.	+++++	+++++	+
<b>Khoman form</b>	Type section	The scarp to the west of Ain kheman			
	Lithology	Chalky calciutite with calcite filling	+++	++	++ +
<b>Hamra from</b>	Type section	Geble Hamra, plateau northeast of Bahariya			
	Lithology	Reef limestone and conglomerates.	+++++	++	+
<b>Qazzum form</b>	Type section	Norht Bahariya plateau			
	Lithology	Lagoonal limestone, partly chalky and dolomitic		+++++	+
<b>The Radwan form</b>	Type section	Southern part of the Bahariya Oasis			
	Lithology	Ferruginous sandstone and Quartzitic.		+++++	+

**Table (2) Clay mineral composition of the clay fraction (< 2 μ) of the studied samples.**

Prof. No.	Depth cm	Classification	Smec	Koal	Ill	Quar
1	0-20	Torripsaments	+++++	++		+
	20-30	Almost flat	+++++	++		+
	30-60		+++++	++		+
	60-75		+++++	++	+	+
	75-95		+++++	++		+
	95-120		+++++	++		+
	120-160		+++++	++		+
	200m. south Ghorabi					
2	0-10	Torripsaments	++++	++		+
	10-30	Undulating	++++	++		+
	30-60		++++	++		+
	80-150		++++	+++		+
	5km. South G. Ghorabi					
3	0-15	Torripsaments	+++++	++		+
	15-35	Undulating	+++++	++		+
	35-60		+++++	++		+
	60-80		+++++	++		+
	80-100		+++++	++		+
	100-150		+++++	++		+
		2km North G. Mysera				+
4	0-20	Torriorthents	+++++	++		+
	20-55	Flat	+++++	++		+
	55-130		+++++	++		+
	East G. Fay El-Harra					
5	0-30	Torriorthents	+++	+++		+
	30-80	Flat	+++	+++		+
	80-150		+++	+++		+
	North Ain yhia					
6	0-15	Haplogypsids	++	++	+	+
	15-25	Almost flat	++	++		+
	25-80		++	++		+
	38-100		++	++		+
	south G Maysera					
7	0-25	Torrorthents	+	++++		
	25-55	Teraces	+	++++		
	85-150					
8	1km south G. Mandisha					
	0-10	Haplogypsids		+++++		
	10-35	Rolling		+++++		
	35-65			+++++		

Prof. No.	Depth cm	Classification	Smec	Koal	III	Quar
	65-85			+++++		
	85-150			+++++		
	East G. Fagy El Harra					
9	0-10 10-30	Torripsamments		+++++		
	30-80 80-100	Undulating		+++++		
	El-Harra					
10	0-15 15-50 50-90 90-14	Torripsaments Flat	+++ +++ +++ +++	+++ +++ +++ +++		
11	Ayun El Wadi					
	0-20 20-60 60-95 95-150	Torripsaments Flat	+++ +++ +++ +++	+++ +++ +++ +++		
12	500 m south G. Tobog					
	0-50 50-60 60-70 70-90 90-150	Torripsaments Rolling	+++++ +++++ +++++ +++++ +++++	+ + + + +		
13	Ain guffara					
	0-10 10-45 45-70 70-100	Torriorhents Undulating	++ ++ ++ ++	+++ +++ +++ +++	+ + + +	
14	El-Aguz					
	0-15 15-55 55-150	Torripsaments Undulating	+ + +	+++++ +++++ +++++		
15	Bawiti					
	0-20 20-50 50-140	Torripsaments Flat	+++ +++ +++	+++ +++ +++		
16	North G. Hammad					
	0-25 25-55 55-150	Torripsaments Undulating	+++ +++ +++	+++ +++ +++		
17	East G. Hammad					
	0-25 25-35 35-45 45-70 70-90 90-120	Haplogypsids Undulating	+++++ +++++ +++++ +++++ +++++ +++++			



Prof. No.	Depth cm	Classification	Smec	Koal	III	Quar
	120-150		+++++			
18	South G. Hammad					
	0-10 10-20 20-45 45-150	Haplogypsid Roiling	+++++ +++++ +++++ +++++			
19	El Tibnia					
	0-10 10-35 35-150	Haplogypsid	+++++ +++++ +++++			
20	El-Qasr					
	0-15 15-60 60-90 90-150	Torripsaments Undulating	+++ +++ +++ +++	+++ +++ +++ +++		
21	Tibnia-El Qsr					
	0-20 20-35 35-38 38-60 60-150	Torripsaments Flat	++++ ++++ ++++ ++++ ++++	++ ++ ++ ++ ++		
22	South NaQb Siwa					
	0-30 30-50 50-150	Torripsaments flat	+ + +	++ +++ +++	+ + +	+ + +
23	Ayn El Qsr					
	0-20 20-60 60-150	Torripsaments Undulating	+ +	+++ +++ +++		
24	200m. North G. Radwan					
	0-10 10-25 25-40 40-80 80-100 100-150	Torriorhents Undulating	+++ +++ +++ +++ +++ +++	+++ +++ +++ +++ +++ +++		
25	Khoman					
	0-20 20-40 40-55 55-75 75-95	Torripsaments Undulating	++ ++ ++ ++ ++	++ ++ ++ ++ ++		
26	Khoman					
	0-10 10-20 20-45 45-70	Torriorhents Undulating	++++ ++++ ++++ ++++	++ ++ ++ ++		
27	Khoman					

Prof. No.	Depth cm	Classification	Smec	Koal	Ill	Quar
	0-20	Torripsaments	++	++	++	
	20-50	Flat	++	++	++	
	50-150		++	++	++	
28	Ayun Aza El Heiz					
	0-20	Torriorthents	++	+++		
	20-60	Flat	++	+++		
	60-90		++	+++		
	90-110		++	+++		
29	El Ris El Heiz					
	0-20	Torriorthents	+++++			
	20-60	Undulating	+++++			
	60-90		+++++			
	90-150		+++++			
30	El Heiz					
	0-20	Torripsaments	+++++			
	20-60	Undulating	+++++			
	60-90		+++++			
	90-150		+++++			
31	Ain Table Lymoon El Haiz					
	0-20		+	+++	+	
	20-70		+	+++	+	
	70-150		+	+++	+	

**Trace elements distribution in the studied soil profiles:**

The distribution of the trace elements in some soils of Baharia Oasis are listed in Table ( 3 ) . the following is a brief distribution of the studied elements: Zirconium (Zr) is the dominant element in all the analytical samples. The lower value is detected in profile 11, while the highest value is detected in profile No. 26.

Barium (Ba) is the second dominant elements, Ba ranges from 241 (Prof. 6) ppm to 737 (prof. 21) In comparing the with data reported by Mason (1966) the barium values are higher than (580 ppm) for shale.

Zinc (Zn) range from (12 ppm) to (70 ppm) comparing with (Mason, 1966) data in shale (95ppm), in sandstone (16ppm) and in carbonate (20 ppm).

Chromium (Cr) concentration ranges from (17 ppm) to (77 ppm).

Copper (Cu) It range from (26 ppm ) to 142 ppm.

In general, trace element data for soils derived from shale, sandstone and carbonate are comparinting with data after Mason (1966) Table ( 4) and soliman (1989).

Fig3

*Hussein, M. A. M.*

Fig4



Cont 3

Elements ppm		Zr	Y	Sr	Rb	Nb	Cu	Ni	Co	Cr	Zn	Ga	Ba	Pb	Ta	Sc	V
Profile No.	Depth cm	Parent Materials: Sandstone															
6	0-15	239	10	796	26	11	27	9	106	34	21	9	281	20	2	3	27
	15-25	185	7	689	14	-	24	6	86	27	9	8	99	12	-	-	11
	25-80	126	6	245	22	2	27	7	92	33	8	-	272	7	-	4	13
	80-100	223	8	240	20	6	29	9	97	35	-	8	335	8	-	3	17
	<b>Average</b>	<b>193</b>	<b>7</b>	<b>567</b>	<b>20</b>	<b>6</b>	<b>26</b>	<b>7</b>	<b>95</b>	<b>32</b>	<b>12</b>	<b>8</b>	<b>240</b>	<b>11</b>	<b>2</b>	<b>3</b>	<b>17</b>
11	60-95	100	11	145	25	6	29	9	118	21	17	29	249	12	-	-	17
	90-150	86	6	140	21	4	31	8	101	34	23	-	254	5	2	5	12
	<b>Average</b>	<b>93</b>	<b>8</b>	<b>142</b>	<b>23</b>	<b>5</b>	<b>30</b>	<b>8</b>	<b>109</b>	<b>17</b>	<b>20</b>	<b>29</b>	<b>251</b>	<b>8</b>	<b>2</b>	<b>5</b>	<b>14</b>
14	0-15	410	20	139	46	24	33	22	318	57	57	-	640	13	9	-	75
	15-55	458	20	122	52	25	34	22	310	51	57	-	724	15	2	4	77
	55-150	411	16	112	44	22	29	20	378	45	45	14	757	18	3	3	63
	<b>Average</b>	<b>436</b>	<b>18</b>	<b>124</b>	<b>47</b>	<b>23</b>	<b>32</b>	<b>21</b>	<b>335</b>	<b>51</b>	<b>53</b>	<b>14</b>	<b>707</b>	<b>15</b>	<b>4</b>	<b>3</b>	<b>71</b>
21	0-20	648	31	154	37	42	29	18	237	52	31	2	690	20	-	-	112
	20-35	718	20	99	34	28	21	17	152	40	25	27	630	-	-	-	70
	38-60	717	24	114	38	37	38	14	211	48	29	-	891	-	7	-	93
	<b>Average</b>	<b>694</b>	<b>25</b>	<b>122</b>	<b>36</b>	<b>35</b>	<b>29</b>	<b>16</b>	<b>200</b>	<b>46</b>	<b>28</b>	<b>14</b>	<b>737</b>	<b>20</b>	<b>7</b>	<b>-</b>	<b>91</b>
24	10-25	670	13	180	20	19	28	9	143	34	25	14	835	6	-	8	41
	25-40	549	15	181	22	13	31	10	125	34	12	-	553	22	-	-	44
	<b>Average</b>	<b>609</b>	<b>14</b>	<b>180</b>	<b>21</b>	<b>16</b>	<b>29</b>	<b>3</b>	<b>134</b>	<b>38</b>	<b>18</b>	<b>14</b>	<b>694</b>	<b>14</b>	<b>-</b>	<b>8</b>	<b>42</b>

Table (4): Chemical composition of rocks

Element	Shales	Sandstones	Carbonates	Igneous Rocks
V	130	20	20	135
Cr	90	35	11	100
Co	19	0.3	0.1	25
Ni	68	2	20	75
Cu	45	-	4	55
Zn	95	16	20	70
Ga	19	12	4	15
Rb	140	60	3	90
Sr	300	20	610	375
Y	26	40	30	33
Zr	160	220	19	165
Nb	11	0	0.3	20
Ba	580	0	10	425
Th	12	1.7	1.7	9.6
U	3.7	0.45	2.2	2.7

REFERENCES

- ASTM (1981): Selected powder diffraction data for minerals. Joint Committee on powder diffractions standers 1601. Park Lan, Swarthmore, Pennsylvania 1981, USA.
- Brown, G. (1961): The x-ray identification and crystal structure of clay minerals. Mineral. Soc. Of Great Britain, Monograph, London, UK.

- Catuneanu, O., Khalifa, M.A., Wanas, H.A., 2006 Sequence stratigraphy and incised-valley systems of the Cenomanian Bahariya Formation, Western Desert, Egypt. *Sedimentary Geology* 190. 121-137.
- Dixon, J.B and Weed, S.O (1977): Minerals in soil environments, soil Sci. Amer. Modison, Wisconsin, USA.
- Dominik, W., 1985, Stratigraphie und Sedimentologie (Geochemie, Schwermineralanalyse) der Oberkreide von Bahariya und ihre Korrelation zum Dakhal Becken (Western Desert, Agypten). *Berliner Geowissenschaftliche Abhandlungen*, vol. 62, 173 pp.
- El Bassyouny, A.A. ,1978 . Structures of the northeastern plateau of the Bahariya Oasis, Western Desert, Egypt. *Minijbouw*. 57, 77-86.
- El Bassyouny, A.A., 1972. Geology of the area between Gara El Hamra of Ball-Qur Lyons and Ghard El Moharrik and its correlation with El harra area, Bahariya Oasis, Egypt. Unpublished M.Sc. Thesis, Cairo University, 180 pp.
- El-Gamal, E.A. (1985) Geological and clay mineralogical studies of upper cretaceous-lower tertiary succession in Abu-Tartur Area, Western Desert, Egypt. M.Sc., Thesis, Fac. Sci. Cairo Univ.
- El Akkad, S., Issawi, B., 1963. Geology and iron ore deposits of the Bahariya Oasis. *Geol. Surv. Of Egypt, Cairo . Paper No.18 , 301pp.*
- FOA (1990) :Guidelines for soil description . 3<sup>rd</sup> edition,FOA, Rome
- Franks, J.R., 1982. Stratigraphic modeling of the Upper Cretaceous Sediments of Bahariya Oases. In: *Processdings of the Sizth Egyptian General Petroloeuom Corporationh Seminar*, pp. 93-105.
- Issawi, B., 1972 Review of the Upper Creatous-Lower Tertiary stratigraphy in the central and northern Egypt.*American Association of Petroleum Geologists Bulletin* 56, 1448-1463.
- Issaw, B., Francis, M. , Youssef, E (2009) *The PHANEROZOIC Goelogy of Egypt, A Geodynamic Approach*, Ministry of Petroleum, Cairo,
- Issawi, B., 1977. Review of Upper Cretaceous-Lower Teriary stratigraphy in the central and northern Egypt. *American Assoiacation of Petroleum Geologists Bulletin* 56, 1448-1463.
- Khalifa, M.A., 1977. Geological and sedimentolgical studies of the El Hefhuf area. Bahariya Oases, Western Desert, Egypt. Unpublished M.S., Thesis, Cairo University, 181 pp.
- Khalifa, M.A. Abu El-Hassan, M.M. 1993. Lithofacices, diagenesis, cyclicity and depositional environment of the Upper Cenomanian El-Heiz Formation, Bahariya Oasis, Western Desert, Egypt.*Journal of the African Earth Sciences* 17, 555-570.
- Khalifa, M.A., Soliman, H.D, Abu El-Hassan, M.M., 2002. Lithonian Rocks, Bahariya Oasis, Western Desert, Egypt. In :*Proceedings of the Sizth Conference Geol. Arab World. Cairo University*, pp. 483-501.
- Khalifa, M.A. Wanas, H.A., Tsirambides, A., 2003. Depositional history of the clastic-carbonate facies (El Reis Formation) of the Limestone Hills, central part of the Bahariya Oasis, Western Desert, Egypt. In *proceedings of the Fifth International Conference of the Middle East. Ain Shams University*, pp. 355-366.

- Kunze, G.W. and Dixon, J.B. Bettany (1986): Pretreatment for Mineralogical analysis in methods of soil analysis, part 1, Klute (ed.), Americ. Agron. Inc., Soil Sci. Soc. Amer., Inc. Pub., Madison Wisconsin USA.
- Mason, B. (1966): Principles of geochemistry, 3rd ed., John Wiley and Sons, New York, p. 310.
- Norrisk and Chapell, B.W. (1967): X-ray fluorescence spectrography in: Zussman, J. (ed.), Physical Methods on Determinative Mineralogy, Academic Press, New York, pp. 161-214.
- Norrisk, K. and Taylor, R.M (1962): Quantitative analysis by X-ray diffraction. Clay miner. Bull., V.5, p. 98.
- Said, R., 1962, The Geology of Egypt. Elsevier, Amsterdam, 377 pp. Selley, R.C., 2000. Applied sedimentology, second ed. Academic press Orlando, Fl. 523. pp.
- Sherief, Y.S. (2008): Flash floods and their effects on the development in El-Qaá plain area in South Sinai, Egypt, a study in applied geomorphology using GIS and remote sensing. Ph. D. Thesis, der Johannes Gutenberg- Universität Mainz .
- Soil Survey Staff (2006): Key to soil taxonomy. Tenth ed. U.S. gov. Print. Office, Washington, DC.
- Soliman, FA (1989): Trace and rare earth elements geochemistry of some metavolcanic rocks in Wadi Zaghara, Wadi Saal area, Southern Sinai, Egypt, abstr. 2nd conf. Geol Sinai Develop, Suez Canal Univ., Ismailia, Egypt, Nov., 1989, p. 17-18.
- Soliman, H.E., Khalifa, M.A., 1993. Stratigraphy, facies and depositional environments of the lower cenomanian Bahariya formation, Bahariya Oasis, Western Desert, Egypt. Egyptian Journal of Geology, 37, 193-209.
- Soliman, S.M., El Badry, O.A. 1980. Petrology and tectonic framework of the Cretaceous, Bahariya Oasis, Egypt. Journal of Geology 24, 11-51.
- Wilson, M.J. (1987): X-ray powder diffraction methods, in determinative methods of clay mineralogy, Wilson, J. J. (ed.), Blackie and Son Ltd., New York .
- Wiswanathan, S., 1989, wavelength dispersive X-ray fluorescence spectrometry. Expel. Res. Atom. Min., 2, 247-268.



**تأثير تجويه مادة الأصل على الخواص المنرالوجية والكيمائية لبعض أراضي  
الواحات البحرية - الصحراء الغربية مصر  
محمد عبدالسلام محمد حسين  
قسم الأراضي والمياه - كلية الزراعة - جامعة الأزهر**

تم دراسة معادن الطين والعناصر الصغرى لعدد 31 قطاع تربة ممثلة لبعض الأراضي بالواحات البحرية وأظهرت النتائج أن معدن طين المونتموريللوننت هو السائد ثم معدن الكاولينيت في الأراضي الناتجة من تكوين البحرية - الهفوف - خمعان بينما يسود معدن الكاولينيت في الأراضي الناتجة من تكوين الحيز - الكازون - رضوان. وأظهرت الدراسة ارتباط معادن الطين بالتكوينات الجيولوجية الناتجة منها. أما العناصر الصغرى فكانت العناصر السائدة هي الزركنيوم والباريوم والزنك مع وجود ارتباط وثيق بين توزيع هذه العناصر والتكوينات الجيولوجية الناتجة منها وقد قسمت أراضي المنطقة تبعاً للتقسيم الأمريكي الحديث إلى المجموعات العظمى التالية:

Torripsaments, Torriorthents, Haplosalids, and Haplocalcids

**قام بتحكيم البحث**

**كلية الزراعة - جامعة المنصورة  
كلية الزراعة - جامعة الأزهر**

**أ.د / زكريا مسعد الصيرفي  
أ.د / حسن على احمد**