IOSR Journal of Applied Geology and Geophysics (IOSR-JAGG)
e-ISSN: 2321–0990, p-ISSN: 2321–0982.Volume 6, Issue 4 Ver. III (Jul. – Aug. 2018), PP 01-17
www.iosrjournals.org

Distribution and Geo-Chemical Assessment of the Bottom-Sediments, Northern Part of Damietta-Branch, River Nile, Egypt

Farouk M. El-Fawal(1)*, Ahmed E. El-Rayes(2), Shams El-DinShahin(1), Salma M. Abdel-Nabi(1)

[1] *Geology Department, Faculty of Science, Port Said University, Port Said 42522, Egypt*
[2] *Geology Department, Faculty of Science, Suez Canal University, Ismailia 41522, Egypt*
Corresponding Author: Farouk M. El-Fawal

Abstract: *Detailed sedimentary textural and chemical studies were made for 47 samples, collected from 25 sampling profile across the northern part of Damietta Branch, River Nile, Egypt to arrive the nature of the bottom-sediments and their chemical status. The regional distribution of the textural composition of the examined sediments was found essentially consisting of silt>clay in the southern parts, muddy at the middle, and clay>silt toward the northern parts. The general textural distribution of the bottom-sediments reflects the general hydrodynamic depositional regime prevailing within the river branch. The geochemistry of the bottom-sediments provides an assemblage of cations and anions reflecting the multi-variant status of the geochemical-environment around the river-branch. The present trace elements (Cu, Cd, Pb, Zn, Cr, and Co) display variable concentrations enclosed in the bottom-sediments, proving unwise treatments with the river-branch. Vital environmental awareness and necessary rehabilitation are required.*

Keywords: *bottom-sediments, chemistry, Damietta-branch, textures.*

Date of Submission: 28-07-2018 Date of acceptance: 10-08-2018

I. Introduction

River Nile has long been acted as the main source of life-water necessary for millions of Egyptians. Therefore, the Nile water was dealt since the Pharaonic times with much care, and so many instructions and constructions were established to control and adjust the water quantity and quality. The river distributaries of any given river-system are commonly the final terminations of that drainage net[1]. They represent the remote receivers that keep all wastes and pollutants derived into the drainage net both within bottom-sediments and water body. Recently, the uncontrolled discharge of undesired waste disposalscommonly poured into the River Nile in huge quantities, especially along the areas of heavy-population, factories and power stations, constitutes a direct threat on the water and bottom sediments qualities [2]. The behavior and fluxes of Cu and Pb in the River Nile were examined [3] and found that about 110 tones Cu and 50 tones Pb are transported annually through the River Nile to the Mediterranean water, constituting more than 50% of both metals reaching the basin from sources. Another[4] found that thetotal of Cr, Ni, Pb and Cd in the < 2 µm fraction sediments of the River Nile is varying in the range 169–5618, 62–124, 14–327 and 0.09–11.80 ppm, respectively. The geochemical distribution of metal into the different sedimentary phases showed that the sediments of the two branches of the Nile Delta are highly polluted with Cr, Pb and Cd relative to those of the River Nile valley. The suspended matter is mainly composed of clay and silt which constitute about 90% whereas sand content is very low [5]. Clay minerals include smectite, and mica with subordinate chlorite, and kaolinite. Quartz, plagioclase, alkali feldspar and traces of calcite and dolomite constitute the remaining of the mud fraction. The Rosetta Branch is impacted by several industrial companies surrounding areas that potentially affect and deteriorate the branch's sediment and water quality [6]. The heavy metals in the northern Lakes include [7]Fe, Zn, Cu, Cd and Pb. The sediments of Lake Manzala (the nearest to the Damietta River Nile branch) are the greatest in most of the studied metals. Fe, Cd and Pb of this lake recorded levels above the international permissible limits in water. Cd in sediment samples was recorded having high values more than those of the sediment quality guidelines. Egypt is the most populous [8], agricultural and industrial country in the River Nile Basin. Therefore, most sewage release to the river takes place in Lower Egypt, and the Nile pollutants are derived from sources such as industrial wastewater, oil pollution, municipal wastewater, agricultural drainage. [9] The River Nile sediments are the major source of persistent bio-accumulative toxic chemicals which may threat the ecological and human health, even after contaminants are no longer released from sources. The order of total metal concentrations in sediment samples was found to be Fe > Zn > Ni > Cu ≥ Cr >Pb> Cd. [10]. The bottom sediments of Rosetta Branch are composed of silt, sandy silt, mud and silty sand. The authors concluded that the heavy metals enrichment is attributed to the pollutants derived from domestic and agricultural drainage and by several industrial companies.

The present study is concerned with the northern part of Damietta Branch as a major River Nile distributary in the northern parts of Egypt. Along this branch, cities of huge populations and crowded villages drain their wastes into the river branch. Thousands of cultivated acresusually discharge their returnedirrigation water into the river branch. Many industrial factories and power plants established along the river branch sides discharge their industrial wastes into the river branchwater.

The present work aims to detail the regional distribution of the bottom-sediment texture along the study area, and then discuss the geochemical status of such sediments. Assessment of the overall geochemical evolution of the branch's bottom sediments will be presented.

II. Study area

The study area focuses on the northern part of the major Damietta distributary flowing over the northern parts ofEgypt (Fig.1). The area extends between Latitudes 31' 00^o&31' 20^{o}N and longitudes31' 30^o& 31' 50^{o}E. The river course in the study area displays so many meanders, the most acute of which lies at Sherbin (Dakahliya) and City of Damietta. The examined segment has a total length of 102 km, passing through a big number of villages and cities. It extends from the southern reaches of El-Mansoura City, El-Dakahliya Governorate, to the northeastern-most inlet of Ras El-Barr, Damietta Governorate, when the distributary debouches into the Mediterranean Sea (Fig. 1).

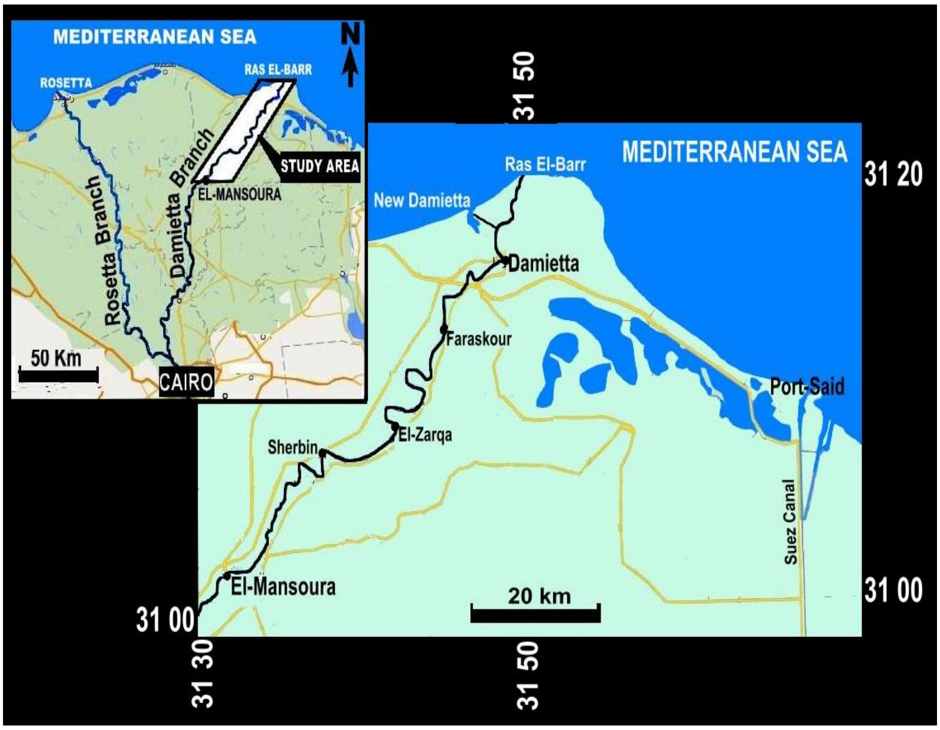

Fig. (1): Location map of the examined sector of the Damietta Distributary along the Nile Delta.

III. Materials and Techniques

The different aims of this work were accomplished through a series of field and laboratory techniques as of the following schemes:

3.1 Field Work

3.1.1. Sampling Period

The field work was carried out during the time interval from the 30th of October, 2015 to the 30th of November, 2015. The sampling period was done after annual seasonal-charge usually done by the Ministry of Irrigation along the River Nile course in Egypt, little after the main annual period of the river flood (Mid-August). During this period, the best healthy state of the running-water and the bottom-sediments will be achieved, where much of the suspended and settled contaminants are being removed away into the Mediterranean Sea. During this period, six successive one-day field trips were carried-out, along the northern parts of Damietta river branch to sample the running-water and the bottom-sediments.

3.1.2. Selection of the Sampling Profiles along the Damietta Branch

The examined segment of the Damietta Branch (102 km) was subdivided into twenty-nine (29) sampling profiles along El-Dakahliya and Damietta Governorates (Fig. 2). The sampling profiles were chosen along an almost equal distance of about 3.5 km, as far as the river permits, each profile extends from the eastern bank to the western bank. A special interest was paid to collect samples from the areas with specific establishments and those having environmental impacts. Table (1) provides the numbers, locations and names of the sampling profiles as well as the numbers of the collected sediment-samples.

3.1.3. Sampling of the Bottom-Sediments:

Two bottom-sediment samples were usually collected at 10 - 25 m away from the natural eastern and western banks of the river branch. For the shallow-bottom sediments, collection of the samples was accomplished using a steel auger, fitted with eight-meter long connections; each is one-meter-long, available in the Central-Lab, Faculty of Science, Port-Said University. For the relatively deep-bottom sediments, a jaws-auger, fitted with 100m steel wire is used, kindly provided from the Authority of El-Gamil Protectorate, Port-Said. The extracted sediment sample is then put in a plastic bag, numbered andlabeled. The collected samples were then saved in ice-boxes waiting for the textural and chemical analyses.

3.2 Analytical Techniques

The analytical techniques done for the examined bottom-sediments include two main groups:

3.2.1. Textural analyses

The textural analyses were applied upon **47** bottom-sediment samples collected from **25** sampling profiles (Table 1). In this concern, at the Profiles 20 and 21 locating around Damietta: El-Hawiss (Fig. 2), the river-bottom is artificially mantled for a long distance from the banks by limestone blocks, therefore no samples were collected from this area. Moreover, at the profiles 24 & 29, the river bottom was too deep to be reached by the used auger; hence, no samples were collected from these profiles. The textural analyses encompass determination of the bulk textural composition of the sediments, calculated as the total percentage composition of carbonate cements, gravels, sands, silts and clays. These analyses were made according to the different techniques given [11] [12]. In addition, grain size analysis was made for the sand-rich sediments to emphasize their particle size characteristics and grain size parameters [13].

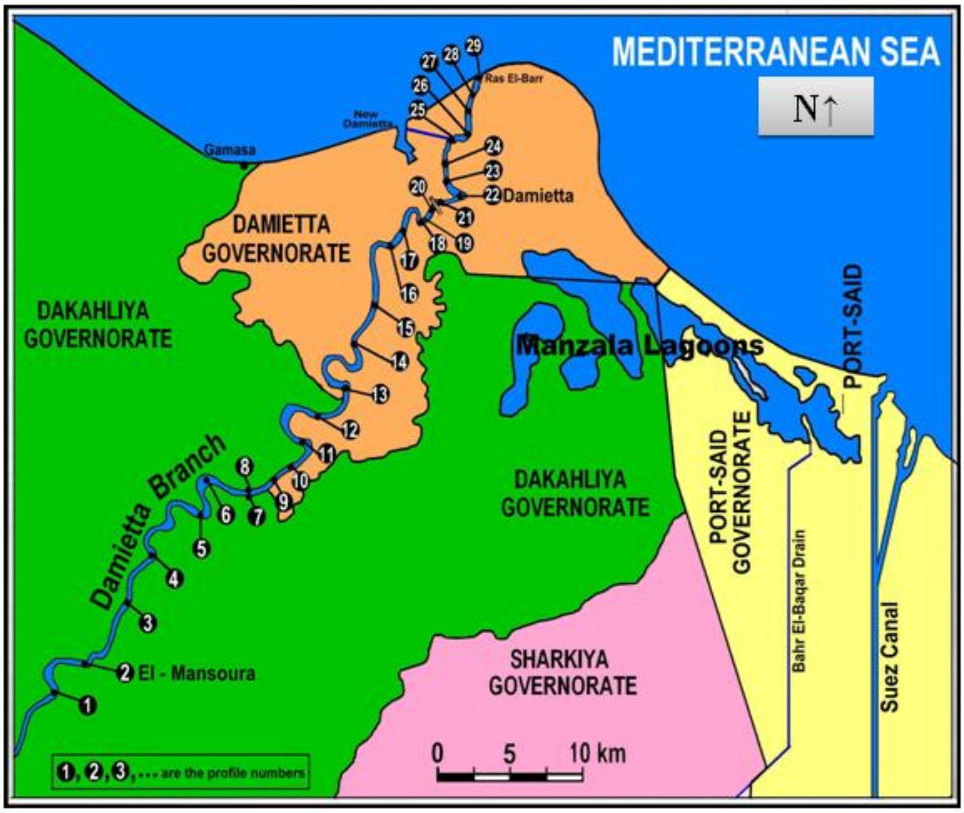

Fig. (2): The distribution and numbers of the examined profilesalong the Damietta Branch, River Nile.

3.2.2. The Chemical Analyses

The chemical analyses were applied upon only **32** bottom-sediment samples collected only from **16** sampling profiles (Table 1). The chemical analyses of the bottom sediments include three processes:

(1) The process of dissolution and extraction of the chemical elements from the sediments.

(2) The process of determining the total water hardness of the extracted solute in order to determine the contents of $CaCO_3$, Ca, $MgCO_3$, and Mg [14]. The results are given in Table (3).

(3) The process of determining the other major cations and anionsas well as the heavy metals as follows:

a- Potassium (K) and sodium (Na) using the flame photometer type 410e, model 850 CORING UK.

b- Carbonates (CO_3) and bicarbonates (HCO_3) according to the technique of Eaton [14].

c- Chloride (Cl) according to the technique of Eaton [14].

d- Sulphates (SO_4) according to the technique of Eaton [14], using Spectrophotometer, instrument type: NANOCOLOUR, model NUV 0741 MACHEREY-NAGEL MN GERMANY.

e- Trace elements (Cu, Cd, Pb, Zn, Cr, and Co) using digital atomic absorption instrument model AVANTA-E, GBC AUSTRALIA.The results of cations and anions as well as trace elements are given in Tables (3, 4, & 5).

IV. Results

4.1 The Bottom-Sediments Textural Characteristics and Regional Distribution

4.1.1. The Bulk Textural Composition:

The textural composition of the bottom sediments in the study area was emphasized according to the techniques mentioned above and was represented in ternary diagram (Fig. 3) [12] to attain the precise composition and nomenclature of the clastic mixture obtained in each profile. Moreover, the regional distribution of the clastic composition of the examined bottom-sediments is illustrated in Fig. (4).

Table (1): The numbers and locations of the texturally and chemically examined Bottom-sediment samples, northern Damietta Branch, River Nile.

Profile Nos.	Samples		Profile Name	Bottom-Sediment Sample Nos.	
	Texturally Analyzed	Chemically Analyzed			
1	√	√	MitBadrKhamis – El-Mansoura	**S-1a**	**S-1b**
2	√	√	El-Mansoura: (Talkha Electric Power Station	**S-2a**	**S-2b**
3	√	√	El-Khiyariya - Sheremsah	**S-3a**	**S-3b**
4	√	√	El-Baramon – El-Tawila	**S-4a**	**S-4b**
5	√	√	Izbet El-Qabbani – Taranis El-Bahr	**S-5a**	**S-5b**
6	√	√	Sherbin	**S-6a**	**S-6b**
7	√	√	Bosat Karim El-Din	**S-7a**	**S-7b**
8	√	X	Bosat Karim El-Din Drinking Water Station	**S-8**	
9	√	√	Sheremsah – El-Sheikh Attia	**S-9a**	**S-9b**
10	√	√	El-Zaatra – El-Ahmadi	**S-10a**	**S-10b**
11	√	√	El-Zarqa	**S-11a**	**S-11b**
12	√	√	El-Serw – Ras El-Khaleeg	**S-12a**	**S-12b**
13	√	√	El-Berashiya – El-Sawalem	**S-13a**	**S-13b**
14	√	X	Kafr El-Arab – Mit Abu Ghaleb	**S-14a**	**S-14b**
15	√	√	Faraskour	**S-15a**	**S-15b**
16	√	√	Al-Horani – El-Tawfiqiya	**S-16a**	**S-16b**
17	√	X	El-Bostan Drinking Water Station	**S-17**	
18	√	√	El-Adliya – Taranis El-Arab	**S-18a**	**S-18b**
19	√	X	Ezab El-Nahda Drinking Water Station (El-Adliya)	**S-19**	
22	√	X	DAMIETTA: (El- Sa'a Square)	**S-22a**	**S-22b**
23	√	√	DAMIETTA: (Al-Senaniya)	**S-23a**	**S-23b**
25	√	X	DAMIETTA: (Navigation Canal)	**S-25a**	**S-25b**
26	√	X	DAMIETTA: (Ezbet-El-Ratama–El-Gerbi	**S-26a**	**S-26b**
27	√	X	DAMIETTA: (El-Sheikh Dorgham–El-Gerbi)	**S-27a**	**S-27b**
28	√	X	DAMIETTA: (Ezbet El-Borg– El-Gerbi	**S-28a**	**S28-b**
25	**47**	**32**	**Total**		

4.1.1.1. Carbonate Cement: The preliminary investigation done for the collected sediments has proven that the bottom sediments of the examined river branch contain very traces of carbonate cement when tested with the dilute (10%) HCl. The amounts of carbonates were found ranging between 0.096 % and 0.003%. Therefore, it is planned herein to remove the carbonate traces (if present) from the examined sediments regardless of their amounts.

4.1.1.2. Gravel % Content**:** The bottom-sediments of the examined part of the Damietta branch, when analyzed for their gravel % content, were found free of any gravelly materials. They entirely fall in the size category of less than -1Φ (2mm).

4.1.1.3. Sand % Content**:** Generally, the sands are of small amounts relative to the collected bulk samples. The sands are generally of medium to very fine in grain size, rather sorted and generally sub-angular to rounded. The sands include some external contaminations of fire-bricks; carbonaceous fragments and minute debris of fresh-water pelecypods and gastropods. The total sand % content is given in Table (2) andis illustrated as ternary diagram [12]together with silt and clay contents (Fig. 3), and in (Fig. 4) as regional distribution of the clastic mixture. Investigation of the data shows that:

(a) The examined clastic-mixture composition displays scarce contents in sand-sized detrital.The sandcontents range between 0.12 % and 8.82% as indicated in 80.85% of the examined samples (Table: 2). However, the clear rarity in the sand content is recorded in the profiles of the Drinking Water Stations (Profiles: 8, 19, & 17) where contents of0.12%, 0.20% and 1.02% are recorded. These poor contents could be attributed to the effective role of the sand-sheltered zones of the in-take sites of these stations.

(b) The rather increase in sand% (13.0-16.0%) seen in the northernmost areas toward the Mediterranean Sea coastal zone (Fig. 4B), may be attributed to the action of beach marine wave-drift capable of removing fine detrital seaward, hence enriching the depositing sands beach-ward.Generally, the situation of the study area at the northernmost distal part of Damietta branchmay explain the clear poverty in sand %. In other words, most of the sands derived by the River Nile were laid-down within the flood-plains and water courses all along the Nile Valley behind. Thus, the northern distal terminations received scanty of sands, although noticeable silt and clay % contents were received instead.

4.2.1 Silt % Content**:** The silt-sized detrital constitute 29.79% of the examined bottom sediments (Fig.3), especially frequent in the southern profile (No. 1-7, Fig. 4A), locating in the Dakahliya Governorate.

4.2.1 Clay % Content:The clay-sized detrital constitute 12.77% of the examined bottom sediments (Fig. 3), especially frequent in the northern profile (No. 22-25, Fig. 4B), locating in the Damietta Governorate.

4.2.1 Mud % Content: The mud-sized detrital are the prominent clastic-type in the examined bottom-sediments. The mud constitutes 44.67% of the examined bottom sediments (Fig. 3), representing the middle parts of the study area, (profiles Nos.: 8 – 19).

4.2.1 Sandy Clay % Content: Thisis some dominant clastic facies, having rather rich sand proportions (13.0 - 16.0%), only recorded along the northernmost profiles near the mouth-inlet of the river branch into the Mediterranean Sea (profiles Nos.: 26, 27, & 28). These faciesconstitute only 12.77% of the examined bottom sediments.

Generally, the regional distribution of the clastic mixture of the examined bottom-sediments provides the following:

(1) The distribution of the clastic-mixture of (Figs. 4A&4B) reflects the nature of the hydrodynamic depositional regime within the river branch. This hydrodynamic regime

Table (2): Sand-Silt-Clay % composition of the bottom-sediments, Northern Damietta Branch, River Nile: (a: eastern bank, b: western bank)

Profile Nos.	Profile name	Sample Nos.	% Textural Contents		
			Sand%	Silt %	Clay %
1	MitBadrKhamis – El-Mansoura	S-1a	06.80	80.70	12.50
		S-1b	05.34	84.37	10.29
2	El-Mansoura: (Talkha Electric Power Station	S-2a	04.04	85.96	10.00
		S-2b	03.22	87.50	09.28
3	El-Khiyariya - Sheremsah	S-3a	08.32	74.68	17.00
		S-3b	04.05	73.95	22.00
4	El-Baramon – El-Tawila	S-4a	02.72	87.28	10.00
		S-4b	07.54	69.46	23.00
5	Ezbet El-Qabbani - Taranis El-Bahr	S-5a	03.82	83.68	12.50
		S-5b	07.04	74.26	18.70
6	Sherbin	S-6a	08.94	66.06	25.00
		S-6b	04.33	72.45	23.22

7	Bosat Karim El-Din	S-7a	07.06	65.94	27.00
		S-7b	02.00	74.02	23.98
8	Bosat Karim El-Din Drinking Water Station	S-8	00.12	63.88	36.00
9	Sheremsah – El-Sheikh Attia	S-9a	06.65	60.35	33.00
		S-9b	04.77	48.22	47.01
10	El-Zaatra – El-Ahmadi	S-10a	07.78	52.22	40.00
		S-10b	05.66	50.50	43.84
11	El-Zarqa	S-11a	06.57	44.94	48.50
		S-11b	03.82	40.24	55.96
12	El-Serw – Ras El-Khaleeg	S-12a	06.44	44.39	49.17
		S-12b	03.66	41.12	55.22
13	El-Berashiya – El-Sawalem	S-13a	08.23	45.11	46.66
		S-13b	05.11	42.16	52.73
14	Kafr El-Arab – Mit Abu Ghaleb	S-14a	04.78	46.22	49.00
		S-14b	06.88	49.30	43.82
15	Faraskour	S-15a	08.82	36.18	55.00
		S-15b	05.22	33.70	61.08
16	Al-Horani – El-Tawfiqiya	S-16a	07.18	35.01	57.81
		S-16b	04.91	40.08	55.01
17	El-Bostan Drinking Water Station	S-17	00.20	34.80	65.00
18	El-Adliya – Taranis El-Arab	S-18a	07.74	32.26	60.00
		S-18b	06.23	32.00	61.77
19	Ezab El-Nahda Drinking Water Station	S-19	01.02	47.23	51.75
22	DAMIETTA: (El-Sa'a Square)	S-22a	06.39	18.61	75.00
		S-22b	03.51	27.89	71.60
23	DAMIETTA: (Al-Senaniya)	S-23a	04.22	17.68	78.10
		S-23b	02.22	16.55	81.23
25	DAMIETTA: (Navigation Canal)	S-25a	04.28	13.42	82.30
		S-25b	05.15	17.11	77.74
26	DAMIETTA: (Ezbet El-Ratama – El-Gerbi)	S-26a	13.18	17.21	69.61
		S-26b	16.22	15.31	68.47
27	DAMIETTA; (El-Sheikh Dorgham – El-Gerbi	S-27a	13.11	13.67	73.22
		S-27b	18.78	15.22	66.00
28	DAMIETTA: (Ezbet El-Borg – El-Gerbi)	S28-a	14.10	14.28	71.62
		S-28b	16.22	13.01	70.77

Characterized by an effective natural selective-sorting that played a steady natural size fractionation, accompanied by a natural dispersal of fine clastics (silts and clays) all along the river distributary. While the course argillaceous fraction (silts) was accumulated at the southern reaches of the study area (Fig. 4A), a remarkable gradual size-fractionation was undertaken kilometer-by-kilometer northwards. By the middle parts, the clastic mixture composition was gradually enriched in finer clay fraction, thus changed into a mud (silt+clay) composition for a long distance (Figs. 4A&4B). Finally, the long-lasted natural size-fractionation along the river branch, led the silt fraction to give-way to the clay fraction to dominate toward the northern parts (Fig. 4B).

(2) The rather sand-rich bottom sediments, locating near to the mouth of the river branch into the Mediterranean Sea, reflect the role of beach wave drift action capable of removing significant contents of silts and clays seaward, while leaving the sands to accumulate beach-ward.

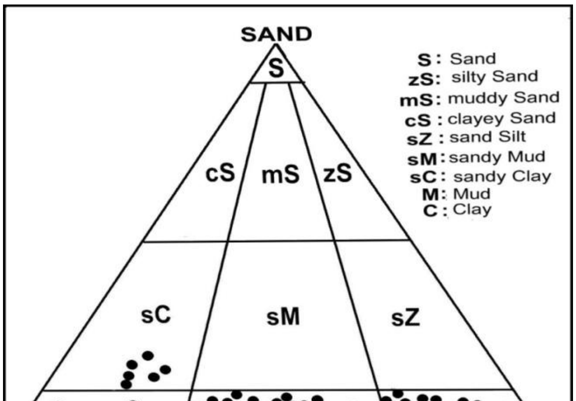

Fig. (3): The clastic-mixture composition of the bottom sediments, Damietta Branch, River Nile plotted on the Ternary Diagram [12]

4.2 Geochemistry of the Bottom-Sediments

A number of thirty-two (32) bottom-sediment samples were collected from sixteen (16) profiles were chemically analyzed to estimate their chemical contents of the major cations (Ca, Mg, Na, and K), major anions (CO_3, HCO_3, SO_4, and Cl), and some heavy metals (Cu, Cd, Pb, Zn, Cr, and Co). The data obtained are given in Tables (3, 4, &5).

4.2.1 octal $CaCO_3$, $MgCO_3$, Ca, and Mg

The total $CaCO_3$, $MgCO_3$, Ca, and Mg contents are herein calculated according to the technique of Eaton [14]. First, the total water hardness of the extracted solute from each bottom-sediment is determined. Second, the solute extracted from each sediment sample was titrated with EDITA Solution, and the volume at the end point is multiplied by 40 to calculate the total concentration of $CaCO_3$ mg/l. The total Calcium (Ca) concentration is then calculated by multiplying the total ($CaCO_3$) concentration by (0.4). The total concentration of the ($MgCO_3$) is calculated [14] as follows:

The total concentration of ($MgCO_3$) = [The Total Water Hardness – The total concentration of ($CaCO_3$)].

The total Magnesium (Mg) concentration is then calculated by multiplying the total ($MgCO_3$)content by (3/4). The obtained results of the total water hardness, $CaCO_3$, Ca, $MgCO_3$, and Mgare tabulated in Table (3).

4.2.2. The Major Cations

Calcium (Ca), Magnesium (Mg), Potassium (K), and Sodium (Na) are the major cations analyzed herein to investigate their relative abundance and distribution in the bottom-sediment of northern part of the Damietta Branch, River Nile. Two bottom-sediment samples were collected from16 sampling profile (32 samples). The average concentrations of encountered cations are given in Table (4). The following is a brief of the encountered major cations and their distribution along the examined river branch.

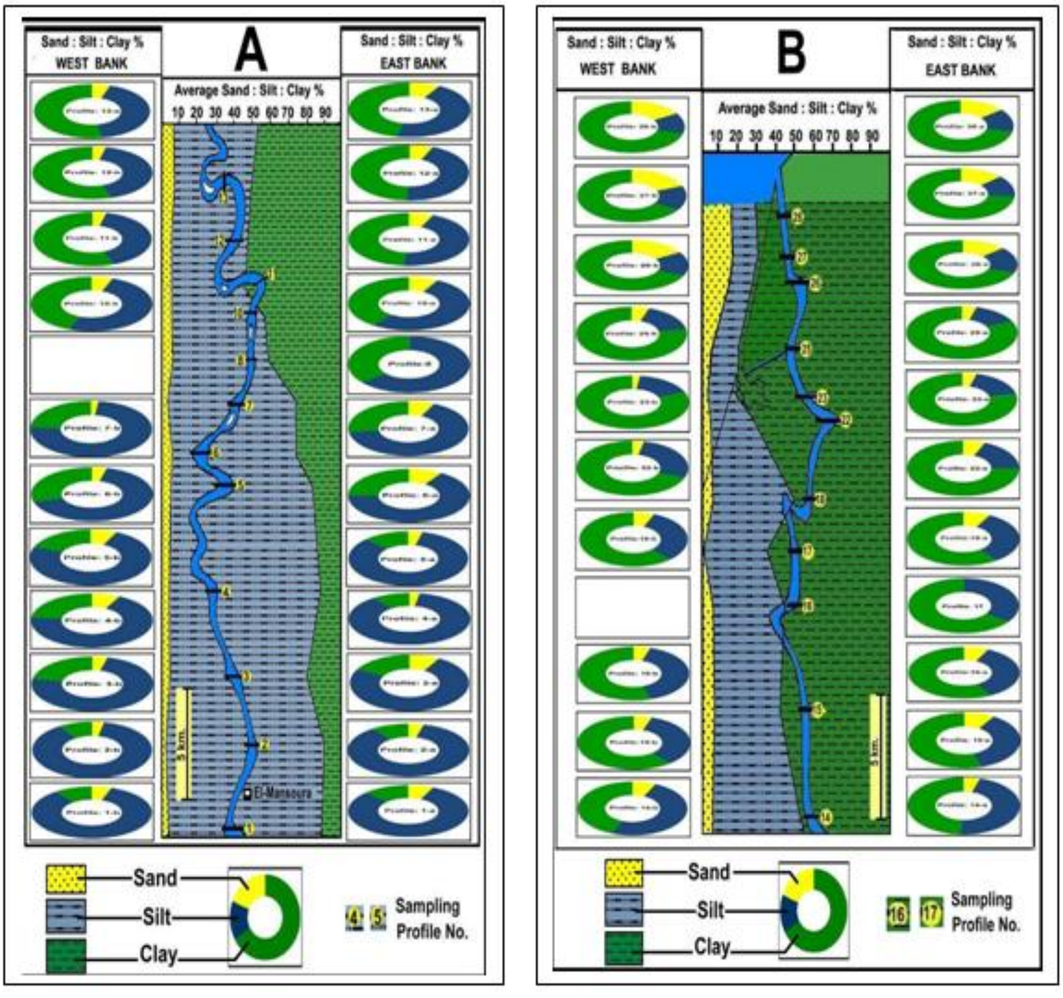

Fig. (4): The regional distribution of the Sand-Silt-Clay % contents along the examined part of Damietta Branch, River Nile. (A): Profiles Nos. 1 – 13, (B): Profiles Nos.14 – 28.

4.2.2.1. Calcium (Ca)

The average sediment calcium concentrations display much rich contents in the southern parts than in the north (Table: 3; Plate-1A). Concentrations around 375, 350 and 300 mg/l were recorded at the southern profiles Nos. 2, 5, and 9, whereas the northern one's range between >50 to 250 mg/l(Plate-1A). This local enrichment of Ca-concentration could be partly attributed to the high content of the clay minerals in the bottom-sediments. In addition, the fine-grained sediments act as good reservoirs able to capture Ca-sourcesfrom the returned flows-irrigation water enriched with fertilizers and pesticides products. It is of worth mentioning that the clays of the River Nilehave long been reported as Ca-rich clay minerals such as montmorillonite, illite and their mixed-layers [15] [16] [17] [18] [19] [10]. These minerals, on the processes of cation exchange, yield significant Ca- contents that are kept into the sediments. In this respect, it is clearly noticed that the profiles Nos. 2, 5, 9, and 12, displaying the highest Ca-contents (Plate-1A), compared to the lowest sodium-concentrations (Plate-1D).This explains the role of Ca-Na cation exchange process taken place along the surfaces of clay minerals. In such process, the Na-cations adhering into the clay minerals are replaced by the Ca-cations; hence increase the Ca-concentrations in the bottom sediments on the expense of the sodium. On the other hand, the role of the Ca-rich marine water of the Mediterranean Sea cannot be denied in the local enrichment of Ca-concentrations in northward profiles as recorded in profile No. 23 (Damietta: El Senaniya).

Table (3): Total water hardness, CaCO3, MgCO3, and other cation contents in the examined sediments (Values in mg/l).

Profile No.	PROFILE NAME	Total Hardness	$CaCO_3$	$MgCO_3$	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)
1	MitBadrKhamis - El Mansoura	380.19	318.15	62.04	127.26	46.53	63.81	18.42
2	El-Mansoura: Talkha Electric Power Station	1010.74	930.00	80.74	372.00	60.56	49.40	19.00
3	Al Khiyariya – Sheremsah	663.58	582.53	81.06	233.01	60.80	40.85	6.15
4	El Baramoon – El Tawila	874.16	772.88	101.29	309.15	75.97	37.27	13.50
5	Ezbet El-Qabbani - Taranis El Bahr	957.27	881.85	75.42	352.74	56.57	33.06	14.67
6	Sherbin	459.47	399.40	60.60	159.76	45.05	68.122	88.70
7	Bosat Karim El Din	752.03	673.25	78.78	269.30	59.09	93.52	18.11
9	Sheremsah - El Sheikh Attia	815.70	748.08	67.62	299.23	50.72	23.55	7.63
10	EL-Zaatra – El Ahmadi	722.98	644.38	78.60	257.75	58.95	138.6	22.35
11	El Zarqa	586.83	478.93	107.90	191.57	80.93	222.92	19.51
12	El Srew - Ras El Khaleeg	602.20	555.00	47.20	222.00	35.40	24.6	9.60
13	El Berashiya - El Sawalem	453.41	420.13	33.29	168.05	24.97	34.53	11.77
15	Faraskour	164.47	113.60	50.97	45.44	38.23	47.6	8.65
16	El Horani - El Tawfiqiya	338.00	291.78	46.58	116.71	34.94	41.00	15.3
18	El Adliya - Tranis El Arab	310.35	278.56	31.78	111.43	23.84	20.87	11.03
23	Damietta (El Senaniya)	1017.12	676.00	341.12	270.40	255.84	1531.8	104.9

4.2.22. Magnesium (Ca)

The average sediment magnesium contents along the examined profiles record levels of ≥ 50 mg/l in the southern profiles Nos. 1 – 11 (Table: 3; Plate-1B), whereas the northern profiles Nos. 12–18 show lesser concentrations around 25 to 30 mg/l. A sudden increase in Mg-concentration is recorded at the northern-most profile No. 23 (Damietta: El-Senaniya) toward the Mediterranean Sea, possibly due to mixing of fresh river water withsaline sea water. In general, the behavior of the Mg-concentration trend is by far similar to that of the Ca-concentration (Plate-1B) suggesting the possible similar sources.

4.2.2.3. Potassium (K)

The average sediment K-concentrations display low contents, ranging between 23 and 6.16 mg/l (Plate-1C). However, two prominent K-concentrations are recorded at the profile No. 6 (Sherbin) of 88.70 mg/l, and at profile No. 23 (Damietta, El-Senaniya) of 104.9 mg/l. The abnormal increase in the K-concentration toward the northern profiles is attributed to the nearness to the northern shallow salt-water marshes and salt lakes as well as to the saline-water encroachment into the river branch from the Mediterranean Sea. The high k-concentration at the southern profile of Sherbin (No. 6) is attributed to the returned flows-irrigation water rich in K-residuals derived from the wide usage of K-rich fertilizers and pesticides along the surrounding cultivated fields. In addition, local sewage-water discharges, possibly rich in K-salts, are recorded aroundthe banks of the river branch at the Sherbin City (profile-6).

4.2.2.4 Sodium (Na)

The average sediment Na-contents displays little variations, less than 100 mg/l (Plate-1D). Like K-concentration (Plate-1C), an abnormal increase in average sediment Na-content is recorded toward the northern profilesprofile No. 23 (Damietta-El-Senaniya)and local concentration of 222.92 mg/l at the southern profile No. 11 (El-Zarqa). This assumes that both sediment-Na and sediment-K could have similar sources in the study area. However, the noticeable low sodium contents, recorded in bottom-sediments (profiles Nos. 2, 5, 9 and 12, Plate-1 C & D), could be explained in terms of the process of cation-exchange between Na and Ca as previously explained (See 3.2.2.1).

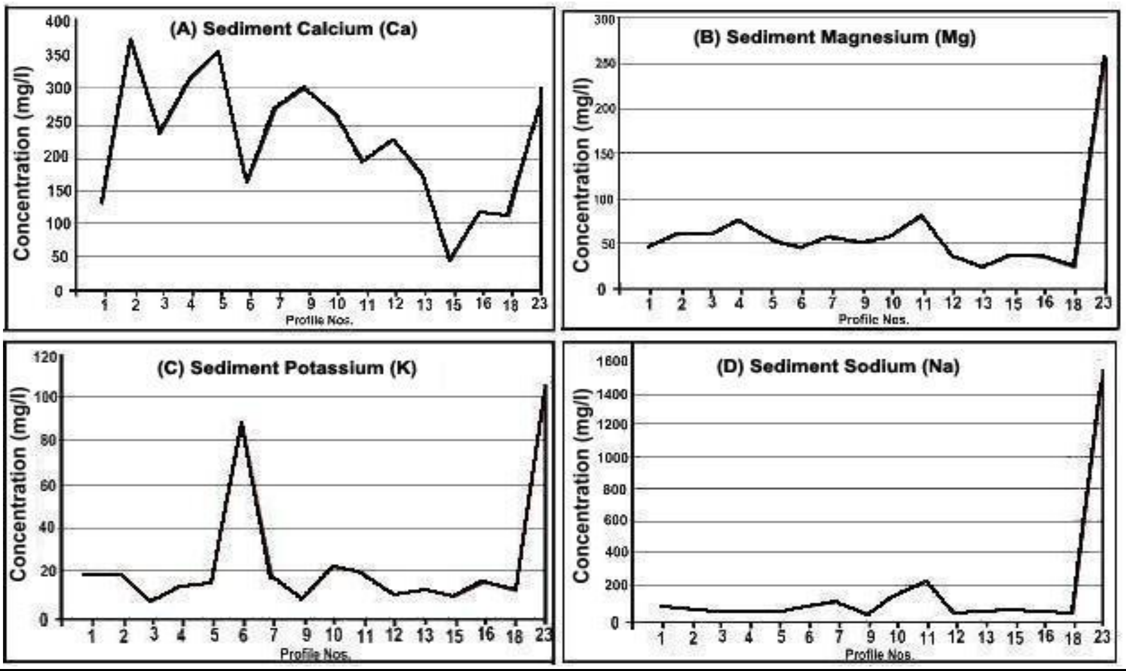

PLATE-1: The aerial distribution of the average contents of sediment's cations (A: Calcium, B: Magnesium, C: Potassium, and D: Sodium).

4.2.3. The Major Anions

Sulphates (SO_4), chloride (Cl), carbonates (CO_3) and bicarbonates (HCO_3) are the major anions analyzed herein to investigate their relative abundance and distribution in the bottom-sediment of northern part of the Damietta Branch, River Nile. Two bottom-sediment samples (total of 32 samples) were collected from 16 sampling profile. The average concentrations of encountered anions are given in Table (4). The following is a brief of the encountered major anions and their distribution along the examined river branch.

Table: (4): Average concentrations of the major anions in the bottom-sediment samplesalong the examined profiles (Values in mg/l).

Profile No.	Profile Name	Sulphates (SO4)	Chloride (Cl)	Carbonates (CO3)	Bicarbonates (HCO3)
1	MitBadrKhamis -El Mansoura	266.00	16.00	120.00	146.40
2	Talkha Electric Power Station	332.00	16.00	116.00	141.52
3	Al Khiyariya – Sheremsah	348.00	34.00	168.00	204.96
4	El Baramoon – El Tawila	328.50	20.00	150.00	183.00
5	Ezbet El-Qabbani-Taranis El Bahr	365.00	16.00	116.00	141.54
6	Sherbin	302.00	56.00	160.00	195.2
7	Bosat Karim El Din	321.00	16.00	180.00	219.6
9	Sheremsah - El Sheikh Attia	410.00	72.00	160.00	195.2
10	EL Zaatra - El Ahmadi	415.00	100.00	112.00	136.64
11	El Zarqa	384.00	48.00	140.00	170.8
12	El Srew - Ras El Khaleeg	275.00	12.00	160.00	195.2
13	El Berashiya - El Sawalem	287.00	20.00	132.00	161.04
15	Faraskour	320.00	24.00	208.00	253.76

16	El Horani - El Tawfiqiya	215.00	12.00	128.00	156.16
18	El Adliya - Tranis El Arab	236.00	12.00	144.00	175.68
23	Damietta (El Senaniya)	1620.00	120.00	148.00	180.56

4.2.3.1 Sulphates (SO_4)

The average sediment-sulphate usually displays significant high concentrations. More than 94% of average contents are more than 200 mg/l (Table: 4; Plate-2 A)without significant variations in between the profiles. An abnormalSO4-concentration of 1600 mg/l is recorded toward the northern profile No. 23 (Damietta, El-Senaniya) due to the influence of supratidal shallow marine areas rich in sulphates, and to the salt-water encroachment into the river branch from the Mediterranean Sea. In fact, the environmental role of excessive sewage water (especially domestic-sewage) discharge, and the agricultural water-discharge rich in waste fertilizers and pesticides all along the river branch could be of the strong reasons of such SO4 high content.

The high sulphate content in the sediments can produce sulphuric acid (H_2SO_4) and sulphurous acid (H_2SO_3) which lowers the pH of surrounding soil and freshwater bodies, resulting in substantial damage to the environment [20] and can cause serious vascular damage in human veins, heart and kidneys[21]. Moreover, the clay-rich nature of the bottom-sediments enables long storage and preservation (i.e.: act as permanent pollutant source), increasing the complexity of the problem.

4.2.3.2 Chloride (Cl)

The average sediment Cl-concentrations display no regular variation trend with rapid fluctuations varying between 12.0 mg/l and 100 mg/l (Table: 4; Plate-2B). An observable Cl-concentration of 120 mg/l is recorded at the northern profile No. 23 (Damietta: El-Senaniya). The average sediment-Cl-content assumes that most of the chloride salts are due to exogenetic sources, admixed into the clay-rich substrate, or partially related to the decomposition of the Cl-rich clay minerals in the bottom substrate itself.

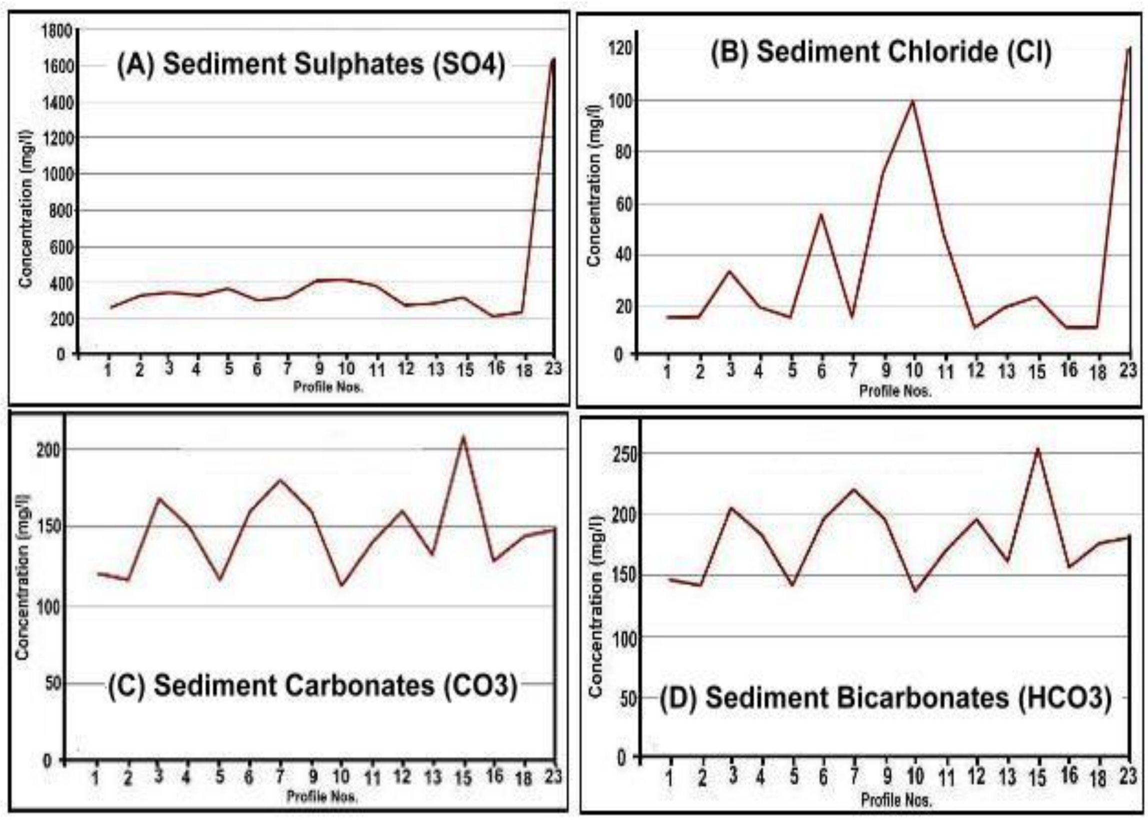

PLATE-2: The aerial distribution of the average sediment anions (A: Sulphates, B: Chloride, C: Carbonates, and D: Bicarbonates).

4.2.3.2 The Carbonates $(CO_3)^{-2}$& Bicarbonates $(HCO_3)^{-1}$:

The average sediment carbonate and bicarbonate concentrations display very similar behavior (Plate-2 C & D), assuming the same possible sources. In general, the average concentration of bicarbonates slightly exceeds that of carbonates. The minimum average CO_3concentration is recorded as 112 mg/l (profile No. 10: EL Zaatra-El Ahmadi) while the maximum average CO_3concentration is recorded as 208 mg/l (profile No. 15:

Faraskour). Between these two values the average concentrations show strong fluctuations (Plate-C). The average sediment-bicarbonate concentrations display almost identical behavior as for carbonates. The minimum average sediment HCO_3concentration of 136.64 mg/l is recorded at profile No. 10 (El-Zaatra-El-Ahmadi), whereas the maximum sediment HCO_3concentration of 253.76 mg/l is recorded at profile No. 15 (Faraskour), the same as encountered for the average sediment CO_3^-concentrations (Plate-2 C & D). This close resemblance of regional variations of both carbonates and bicarbonates over weight their derivation due to similar sources.

Possibly, this observable increase in sediment CO_3/HCO_3concentrations could be related to the differential absorption of CO_2 from the nearby-vegetation cover on both banks, or/and decomposition of carbonate-rich clays (smectite). However, field observationscould partially explain such high average CO_3/HCO_3contents. It was noticed that the profiles No. 3 (El-Khyariya-Sheremsah), No. 7 (Bosat Karim El-Din), No. 12 (El-Serw-Ras El-Khaleeg), and No. 15 (Faraskour) having highCO_3/HCO_3contents, are characterized by artificial banks mantled by limestone blocks for long distances toward the rivercentralparts (See for example Figs.13A & B). These CO_3-rich artificial surfaces supplied the river water with the carbonates by dissolution, hence accumulated in the bottom-sediments by successive sedimentation.

Fig. (5): Limestone blocks mantle the river side-banks and bottom. Ras El-Khaleeg (profile-12)and B) Bosat Kareem El-Din Drinking Water Station (profile-7).

4.2.4 Trace Elements

Copper (Cu), cadmium (Cd), Lead (Pb), Zinc (Zn), Chromium (Cr), and cobalt (Co) are the trace elements analyzed herein to investigate their relative abundance and distribution in the bottom-sediment of northern part of the Damietta Branch, River Nile. Two bottom-sediment samples (total of 32 samples) were collected from 16 sampling profile. The average concentrations of encountered trace elements are given in Table(5).

4.2.4.1. Copper (Cu)

The average sediment copper concentrations along the examined profiles display wide variations.Observed increase at the southern parts (Table: 5; Plate-A) of 0.06 mg/l the profile No. 1(El-Mansoura-Mit-BadrKhamis), together with moderate average Cu-content of 0.02 mg/l the profiles Nos. 11, (El-Zarqa), 15 (Faraskour), 16 (El-Horani – Damietta Power Plant Station), and 23 (Damietta El-Senaniya). These local increments are all recorded around the majorcities with heavy traffic and industrial wastes that yield Cuvapor, solid and liquid residuals, finally dissolved in the river water, and then admixed into the bottom-sediments.The minimum Cu-concentrations, on the other hand, are recorded at profiles No. 7 (BosatKarim El Din), and 13 (El-Berashiya – El Sawalem) where the purification influence of the drinking water stations is observed. Cu is immobile element mostly adsorbed by bottom sediments and hardly moved to water (Plate-3A & B).

4.2.4.2. Cadmium (Cd)

The average sediment cadmium concentrations along the examined profiles display relatively higher concentrations than those encountered for the water Cd-concentrations[2]. The sediment Cd concentrations record up to 0.0040 mg/l (Table-4; Plate-3B). The river branch bottom sediments received much of the dissolved Cd in branch water due to different resources of which:

(i) The long exposure to fuel combustion, especially that the examined river branch cut-through big cities having very heavy traffics of different kinds (e.g.: El-Mansoura, Sherbin, Faraskour, Damietta, Ras-El Barr).

(ii) The extensive and unwise use of phosphate fertilizers and other animal-dung fertilizers in the cultivated lands around the examined river branch

(iii) The massive municipal solid wastes distributed along the river banks that commonly yield dangerous secondary product leached by time into the surrounding soil and the water river course.

Table (5): The average concentrations of the trace elements of the bottom-sediment samples along the examined profiles.

Profile No.	Profile Name	The Average Concentration of the Bottom-Sediment trace Elements (mg/l)					
		Copper (Cu)	Cadmium (Cd)	Lead (Pb)	Zinc (Zn)	Chromium (Cr)	Cobalt (Co)
1	MitBadrKhamis -El Mansoura	0.06	0.002	0.070	0.50	9.07	11.32
2	Talkha electric power station	0.01	0.001	0.060	1.12	8.39	13.55
3	Al Khiyariya – Sheremsah	0.01	0.0005	0.009	0.30	12.08	6.27
4	El Baramoon – El Tawila	0.01	0.001	0.008	0.35	9.11	7.89
5	Ezbet El-Qabbani - Taranis El Bahr	0.01	0.001	0.040	0.50	13.58	3.76
6	Sherbin	0.01	BDL	0.010	0.40	10.82	8.96
7	Bosatkarim El Din	BDL	BDL	0.007	1.01	13.38	12.43
9	Sheremsah – El- Sheikh Attia	0.01	0.001	0.020	0.40	12.02	7.64
10	EL Zaatra – El- Ahmadi	0.01	BDL	0.100	1.02	10.91	6.11
11	El Zarqa	0.02	0.004	0.070	0.80	11.7	2.98
12	El Srew - Ras El- Khaleeg	0.01	0.001	0.080	0.30	14.86	6061
13	El Berashiya – El- Sawalem	BDL	0.001	0.040	0.60	8.21	10.74
15	Faraskour	0.02	0.001	0.008	0.05	11.55	8.12
16	El Horani – El- Tawfiqiya	0.02	0.001	0.040	0.20	16.5	4.61
17	El Adliya - Tranis El- Arab	0.01	0.001	0.008	0.30	11.75	12.31
23	Damietta:(El-Senaniya)	0.02	0.002	0.200	0.30	2.32	6.03

BDL: Below Detection Limit

The long leaching and continuous water removal of the Cd-contaminants yielded due to the above-mentioned factors through the long northward trip of the river branch resulted in the obvious presence of localized Cd-concentrations at the northern territories of Damietta Governorate. In this concern [22] [23] the long exposure to fossil fuel combustion, phosphate fertilizers, municipal solid waste and from boat paints in the River Nile result in cadmium environmental hazards for human beings. [24] most plants bio-accumulate Cd as a metal toxin, and when manufactured to form organic fertilizers, after animal-dung, yield a product containing high amounts (up to 0.5mg/kg fertilizer) of metal toxins that can contain amounts of cadmium. Furthermore, Cd is adsorbed on clay sediments as immobile element, thatbecomesricher by time and act as a secondary Cd-source for the river water.

4.2.4.3. Lead (Pb)

The average sediment-lead concentrations display rich contents (Table-5; Plate-3C). The sediment Pb-concentrations reaches values of 0.20 mg/l the area of Damietta: El-Senaniya(profile No. 23). Lesseraverage sediment Pb-concentrationsare recorded ranging between 0.04 mg/l to0.10 mg/l at the middle parts of the examined area; however, they are still higher than those encountered in the river-branch water[2]. This signifies that the present

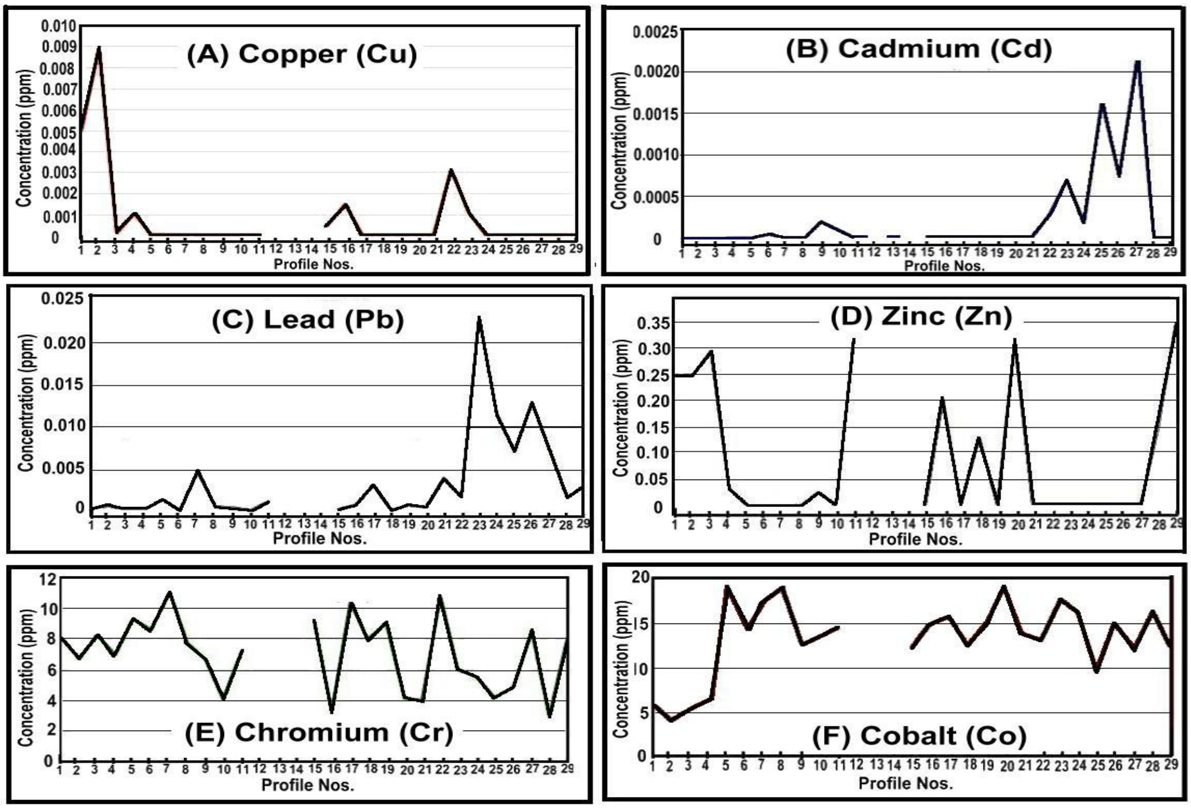

PLATE-3: The aerial distribution of the average sediment Trace Elements: (A) Copper, (B): Cadmium, (C) Lead, (D): Zinc, (E): Chromium and (F): Cobalt.

bottom sediments and the surrounding soil banks act as a capturing reservoir for the Pb-pollutants, continuously feeding the river water by contaminants. This means that the river bottom-sediments will act -by time- as a permanent source for the Pb-pollutants as a long as the Pb-sources still active with unwise treatments. Generally, the sources of lead could be within the smelting lead, contaminated air due to the wide combustion of gasoline within the big cities [25], the wastes of widely used lead-pole batteries that are removed into the river water or its connecting canals [25], and the dissolved lead within lead-pipes in water connections due to long usage[26]. The drink of such water, over time, cause health problems due to the toxicity of the dissolved lead [27].

4.2.4.4 Zinc (Zn)

The average sediment zinc concentrations along the examined display wide variation form a place to another (Table: 5; Plate-3D). They range between 0.05 mg/l (Faraskour, profile No. 15) and 1.12 mg/l (El-Mansoura-Talkha Electric Power Station, profile No. 2). However, similar high Zn-concentrations are recorded in the middle parts of the examined area (e.g.: 1.01 mg/l Bosat Karim El Din, profile No 7 and 1.02 mg/l EL-Zaatra - El Ahmadi profile No 10). This differential enrichment of Zn-concentrations in these areas could be related to the wide usage and the successive accumulation of chemical fertilizers and pesticides in the cultivated fields covering vast areas around the river branch in such areas. The returned flows-irrigation water in these areas through many drainage canals accumulated such metals in the river substrate.

4.2.4.5 Chromium (Cr)

The average sediment Chromiumconcentrations along the examined display high concentrations of 12.0 to 16.5 mg/l are recorded in the profiles No.; 3, 5, 7, 12, and 16 (Table 3; Plate-3E). No doubt that the wastes arrived to the river-water from the many sources carry much of Cr-pollutants. Such sources could be due to the continuous removals from factories and workshops ofdyes, paints, and leather tanning compounds. These compounds are often removed into soil andgroundwaterat abandoned industrial sites. When these pollutants reach to the river water, they are readily accumulated and stored within the bottom-sediments and act as permanent pollution sources.

4.2.4.6 Cobalt (Co)

The average sediment cobalt concentrations along the examined profiles display non-rhythmic behavior (Table 3; Plate-3F). However, the Co-concentrations in the river-water [2]are higher than those recorded in the bottom-sediments indicating the high mobility of cobalt. The lesser concentrations in the bottom-sediments could be related to the relative high solubility of cobalt salts that ensure long stay as soluble material within the river water before deposited in the bottom sediments.The Co-salts are commonly long-dominate the surface water due to their relative high solubility [28].

4.3 ENVIRONMENTAL IMPACTS OF BOTTOM SEDIMENTS GEOCHEMISTRY

The foregoing sediment-chemical studies made for the northern part of the Damietta branch, River Nile have declared some important aspects that can be summarized in the following:

1) The bottom-sediments are characterized by the dominance of the fine detrital, especially silts in the southern part and clays in the northern part. These muddy sediments are ready and have good capability to preserve the pollutant materials for long times. Therefore, they act as unsafe permanent source from which dangerous pollutants can emanate into the river water. This danger is expected herein because of the unsafe environmental status around the river branch. The river branch is heavily surrounded by so many environmentally unsafe factories, local workshops, and primitive shops whose industrial-wastes are directly pass into the branch water. Additional serious pollutant source is derived from the returned flows-irrigationwater discharged from the wide cultivated fields (millions of acres). This water usually contains different types of chemical pollutants due to the wide usage multi-types of chemical fertilizers, nutrients, and pesticides. These pollutants are long-captured within the muddy substrate, and then continuously leaked for long time into the river water.

2) The nature of the chemical cations encountered in the examined bottom-sedimentsshow wide variation in their composition and contents. While rich in calcium and magnesium contents, they are reasonable for potassium and sodium. As a general remark, the cations display local enrichment in the southern parts, then decreasing northward before exhibiting sudden and abnormal increase just before the coastal zone of the Mediterranean Sea. This behavior is attributed to the uncontrolled usage of the chemical fertilizers and pesticides in cultivating millions of acres situated to the southern parts of the river branch, especially within El-Dakahliya Governorate. The sudden increase in the sediment-cations near to the coastal area of the Mediterranean Sea is related to the many sources of these cations derived from the coastal marches, lakes, pond and tidal flats, commonly rich in such cations. Normally, the presence of such cations in the river branch bottom-sediments may represent a permanent pollution reservoir, releasing pollutants to the running water of the branch that threat living plants, animals and human beings. Serious health problems may result in the release of some cations into the running water. For example; abundance of calcium and sodium may influence the salinity of the surrounding soils due to the ion-exchange. Excessive magnesium is associated with magnesium toxicity [29]. Deficiency of potassium (as recorded herein) may result in its deficiency in the plasma, causing increased gastrin-testinal loss (vomiting, diarrhea), and increased renal loss [31]. Deficiency of sodium (as recorded herein)lower systolic blood pressure may lead to hypertension[32], leading to the death [33].

3) The sediment-anions show that the sulphates, carbonates and bicarbonates are abundantly present. Chloride displays abnormal increase in the southern parts of the examined area. Generally, the anion contents display strongly fluctuating concentration trends, reflecting multiple various internal and external sources. The release of such anions in the running river branch water may cause environmental and human complexities. For example; Sulphur can cause serious vascular damage in veins of the brains, the heart and the kidneys [21]. These tests have also indicated that certain forms of Sulphur can cause vital damage and congenital effects. Mothers can even carry Sulphur poisoning over to their children through mother milk. Finally, Sulphur can damage the internal enzyme systems of animals.Reduction in blood chloride leads to cerebral dehydration and can affect oxygen transport [34]. Because it is denser than air, it tends to accumulate at the bottom of poorly ventilated spaces. The toxicity of chlorine comes from its oxidizing power. Carbonates and bicarbonates strongly influence metabolism and pH–blood of the animals and humans.

4) The bottom-sediment trace element assemblage encountered indicates that the river branch receives substantial amounts of industrial and agricultural wastes rich in the encountered trace elements. These elements are successively accumulated in the branch bottom-sediments, forming by time, renewable source for such elements, especially lead, chromium and cobalt whose contents exceed the allowed safe limits in the bottom-sediments. The heavily gasoline and other fuel polluted air around big cities, the unwise usage of chemical fertilizers and pesticides in agriculture and the massive municipal solid represent major sources

of the encountered trace elements when leached into the river branch. Moreover, the industrial wastes derived from the many multi-purpose factories (steel production, cement, metal-smelting, wood-painting, etc.), power plants, old-workshops many distributed along the river-banks could be additional common source of such elements when their wastes removed into the river. Serious health circumstances result due to the exposure to such trace elements. Excessive copper result in poisoning, while its deficiency can lead to anemia, heart and circulation problems, bone abnormalities and complications in the functioning of the nervous and immune systems, the lungs, thyroid, pancreas and kidneys[35]. Cadmium is environmentally hazardous for human beings and bio-inorganic toxic element [22]; [23]. The most dangerous form of exposure to cadmium is inhalation of fine dust and fumes, or ingestion of highly soluble cadmium compounds [22]. Lead is a highly poisonous, affecting every organ and system in the human body [36]. Lead is rapidly absorbed into the blood-stream [37]. It accumulates in soft tissues and bones, damaging the nervous system andcausing brain and blood disorders [38]. Lead reduces fertility in males, miscarriage for pregnant women [39] [25]. Exposure to combustion of gasoline has been linked with increases in violence and crimes. Lead accumulates in soils, where it remains for hundreds to thousands of years. It can take the place of other metals within plants and retard photosynthesis and preventing their growth or killing them. Contamination of soils and plants then affects micro-organisms and animals. Zinc in the present study is generally of low concentrations. Zinc deficiency is associated with children growth retardation, delayed sexual maturation, infection susceptibility, and diarrhea [40]. Zinc deficiency is usually associated with chronic liver and chronic renal disease, sickle cell disease, diabetes and malignancy, [41]. The acute toxicity of $Cr^{6+}$is due to its strong oxidational properties, when it reaches the blood stream; it damages the kidneys, the liver and blood cells through oxidation reactions [42]. Hexavalent chromium is generally environmentally dangerous, occurring in dyes, paints, and leather tanning compounds [43]. Cobalt is a constituent of tobacco smoke [44]. Breathing of cobalt in too high concentrations through air lung, asthma and pneumonia occurs [45]. Moreover, cobalt dust may cause an asthma-like disease [28]. Exposure to cobalt may cause weight loss, dermatitis, and respiratory hypersensitivity. As for carcinogenicity, the International Agency for Research on Cancer (IARC) has listed Cobalt and Cobalt compounds within group 2B (carcinogenic to humans) in category A3 (carcinogenic to experimental animal).

V. Recommendations

The present study is concerning with the most important source of life of millions of Egyptians. The study proved the presence of some dangerous criteria and scientific facts influencing the health and quality of the Damietta branch bottom-sediments. Therefore, it is assumed here to state some recommendations that may act to improve the health status of the concerned sediments:

5.1. People (Public Population,)

General populations should stop the bad habits and prevent sources of pollution derived from throwing rubbish materials, washing animals, releasing domestic sewage water, releasing solid municipal wastes, releasing industrial materials from primitive factories and local work-shops.

5.2. Media

News-papers, magazines, TV-programs and broadcasting-programs must focus their efforts to change the unsafe traditions and habits of publics. Media must propose the safe and right treatment with the river branch to the public in different places at any civil standard. Media must propose the safe alternatives to the people to treat with the river. The suspected diseases and health damages that may take place must be continuously announced in different media.

5.3. Ministry of Irrigation

The Ministry of Irrigation must apply the different laws ensuring the right treatment with the river. The different factories, power plants and local industries must have held pre-chemical treatment to their wastes before releasing into the river to prevent settling of pollutants into the bottom-sediments. Drainage canals carrying wastes must be widened, cleaned and directed to safe reservoirs far from the river.

5.4. Ministry of Health

The Ministry of Health must prepare the medicines, vaccines and equipment necessary for treating with suspected diseases take place by various pollutants recorded. Medical-trips must visit villages and cities to let the public aware with health-circumstances due to bad treatment with river.

References

[1]. Collinson, J.D. (1986): Alluvial sediments. In: Reading, H.G.ed. Sedimentary Environments and Facies. Black well sci. Pub., 20-62
[2]. Abdel-Nabi, S. M. (2018): The geoenvironmental assessment of the bottom-sediment and water of the northern part of the Damietta Branch, River Nile – Egypt. M. Sc. Thesis, Geol. Dept., Fac. Sci., Port-Said University, 171p.
[3]. Abdel-Moati, A. R. (1990): Behavior and fluxes of copper and lead in the Nile River Estuary. Estuarine: Coastal and shelf science, Vol.30, PP 153-165.
[4]. El-Sokkary, I.H. and Muller,G.(1990): Assessment of Chromium , Nickel, Lead and Cadmium sediments of the River Nile, Egypt. Sci. total envir., STNDL Vol.97/98, PP 455-463.
[5]. Abbas, M. M. & Hans, K. (1996): Seasonal variation and mineralogical of suspended sediments in the River Nile between Esna and Nag Hammadi barrages, Egypt. Egypt J.Geol, Vol.40(1), PP 67-86.
[6]. Donia, N.; El-Azizy, I. &Khalifa, A. (2003): Industrial pollution control of Rosetta branch, Nile River, Egypt. 7th. Inter. waterTech. Conf., Egypt. PP 235-247.
[7]. and their effect on oreochromisniloticus in the northern delta lakes, Egypt .Central lab for Aquaculture Research, Agricultural Research Center, Limnology Dept.
[8]. [8] El-Shiekh, M.(2009): The Nile pollutants and their effect on life food and water quality . Springer-Verlag, Netherlands, MonographiaeBiologicae, Vol.89, PP 395-405.
[9]. Lasheen, M. R. & Ammar, N. S. (2009): Speciation of some heavy metals in River Nile sediments, Cairo, Egypt.Environmentalist (2009) Vol.29 pp 8-16.
[10]. Wahid, A. &Shaheen, Sh. (2010): Sedimentological and geochemical studies of bottom sediments in Rosetta Branch of the River Nile, Egypt. Sedimentology of Egypt, Vol.18, PP 29-44.
[11]. Carver, R. E. (1971): Procedures in sedimentary petrology. John Wiley & Sons Inc., 672p.
[12]. Folk, R. L., 1980: Petrology of Sedimentary Rocks. Hemphill Pub. Co., Austin, Texas, 182. (12)
[13]. Folk, R. and Ward, W. (1957): Brazose River Bar. A study in the significance of grain size parameters. J. Sed. Pet. Vol. 1, pp3 – 26.
[14]. Eaton, A. D.; Clesceri, L. S.; Rice, E. W. & Greenberg, A. H. (2013): Standard methods for the examination of water and wastewater (22nd edit.). American Public Health Association (AHPA). 1123p.
[15]. El-Sherbini, M. I. (1973): Grain size, mineralogy and petrographical studies on the subsurface sediments of Sidisalim Well No. 1, Nile Delta. M.Sc. Thesis, Fac. Sci., Mansoura Univ., 170p.
[16]. Zaghloul, Z.M.; Taha,. and Gheith, A.M.. (1977): On the Quaternary-Neogene cyclic sedimentation in the Nile Delta area.Proc. IV Colloquim on the Geology of the Agean Region, Inst. Geol. Min. Res., Athens (Greece), Vol. II, pp 779-803.
[17]. Zaghloul, Z.M.; Gheith, A.M.; Abdel-Daiem, A. and El-Asmar, H. (1989): The pattern of sedimentation of the Quaternary Nile Delta, Egypt. Bull. Fac. Sci. Mansoura Univ. Vol. 16, pp 393-413.
[18]. Geith, A. (1976): Geological studies on the subsurface sediments of Kafr El-Sheikh Well No. 1, Nile Delta. M. Sc. Thesis, fac. Sci., Mansoura Univ., 181p.
[19]. El-Fawal, F. (1979): Sedimentological studies on the Northern parts of the Nile Delta subsurface section, Egypt. M.Sc. Thesis, Fac. Sci. Mansoura Univ., 256p
[20]. Lippard, S. J. & Berg, J. M. (1994): Principles of Bioinorganic Chemistry University Science Books.
[21]. Greshman, C. &Lawrey, E. (2016): Hydrogen Sulphide toxicity. Medscape article, 815139.
[22]. Morrow, H. (2010): Cadmium and Cadmium Alloys". Kirk-Othmer Encyclopedia of Chemical Technology. John Wiley & Sons. pp. 1–36.
[23]. Tellez-Plaza, M; Jones, M. R.; Dominguez-Lucas, A; Guallar, E. &Navas-Acien, A. (2013): Cadmium Exposure and Clinical Cardiovascular Disease: A Systematic Review". Current Atherosclerosis Reports. 15
[24]. Rzymski, P.; Rzymski, P.; Tomczyk, K.; Niedzielski, P.; Jakubowski, K.; Poniedziałek, B.&Opala, T. (2014): Metal status in human endometrium: Relation to cigarette smoking and histological lesions. Environmental Research. 132: 328–33.
[25]. ATSDR (Agency for Toxic Substances and Disease Registry), (2017):"Information for the Community: Lead Toxicity" (MP4 webcast, 82 MB). Retrieved 11 February 2017.
[26]. Moore, M. R. (1977). "Lead in drinking water in soft water areas—health hazards". Science of the Total Environment, 7 (2): 109–15.
[27]. Wiberg, E.; Wiberg, N. &Holleman, A. F. (2001): Inorganic Chemistry. Academic Press.
[28]. Basketter, D.A.; Angelini, G.; Ingber, A.; Kern, P.S.&Menné, T.(2003): Nickel, chromium and cobalt in consumer products: revisiting safe levels in the new millennium. Contact Dermatitis. 49 (1): 1–7.
[29]. James M.F. (2010): Magnesium in obstetrics. Best Pract Res ClinObstetGynaecol. 24 (3): 327–337.
[30]. Euser, A. G. &Cipolla, M. J. (2009): Magnesium Sulfate for the Treatment of Eclampsia: A Brief Review. Stroke. 40 (4):pp 1169–1175.
[31]. Slonim, A. D.; Pollack, M. M. (2006): Potassium. Pediatric critical care medicine. Lippincott Williams & Wilkins. p. 812.
[32]. Geleijnse, J. M.; Kok, F. J. &Grobbee, D. E. (2004): Impact of dietary and lifestyle factors on the prevalence of hypertension in Western populations. European J. of Public Health. 14 (3): 235–239.
[33]. Lawes, C. M.; Vander H., S. & Rodgers, A. (2008): International Society of Hypertension. Global burden of blood-pressure-related disease, Lancet, 371: 1513–1518.
[34]. Lavie C.J.; Crocker E.F.; Key K.J. & Ferguson T.G. (1986). Marked hypochloremic metabolic alkalosis with severe compensatory hypoventilation. South Med. J. 79 (10): 1296–9.
[35]. Adelstein, S. J. &Vallee, B. L. (1961): Copper metabolism in man". New England J. of Medicine. 265 (18): 892–897
[36]. ESFA (European Food Safety Authority), (2006): Tolerable Upper Intake Levels For Vitamins And Minerals (PDF).
[37]. OSHA (Occupational Safety and Health Administration), (2017): Substance data sheet for occupational exposure to lead. www.osha.gov. Retrieved 1, 2017.
[38]. Rudolph, A. M.; Rudolph, C. D. &Hostetter, M. K. (2003). Lead. Rudolph's Pediatrics (21st ed.). McGraw-Hill Professional, p. 369.
[39]. Dart, R. C.; Hurlbut, K. M.; Boyer-Hassen, L. V. (2004). "Lead". In Dart, R. C. Medical Toxicology (3rd ed.). Lippincott Williams & Wilkins. p. 1426. (11)
[40]. Berdanier, Carolyn D.; Dwyer, Johanna T.; Feldman, Elaine B. (2007). Handbook of Nutrition and Food. Boca Raton, Florida: CRC Press. ISBN 0-8493-9218-7.
[41]. Broadley, M. R.; White, P. J.; Hammond, J. P.; Zelko I.& Lux, A. (2007): Zinc in plants". New Phytologist. 173 (4): 677–702.
[42]. Dayan, A. D.& Paine, A. J. (2001): Mechanisms of chromium toxicity, carcinogenicity and allergenicity: Review of the literature from 1985 to 2000". Human & Experimental Toxicology. 20 (9): 439–451.
[43]. Baselt, R.C. (2008): Disposition of Toxic Drugs and Chemicals in Man (8th Ed.). Foster City: Biomedical Publications. pp. 305–307.

[44]. Talhout, R.; Schulz, T.; Florek, E.; Van B., Jan; W., Piet; O.(2011). Hazardous Compounds in Tobacco Smoke. Internat.J. of Environ.Research& Public Health. 8 (12):613–628.
[45]. Barceloux, D. G.&Barceloux, D. (1999): Zinc". Clinical Toxicology. 37 (2): pp 279–292.

IOSR Journal of Applied Geology and Geophysics (IOSR-JAGG) is UGC approved Journal with Sl. No. 5021, Journal no. 49115.

Farouk M. El-Fawal "Distribution and Geo-Chemical Assessment of the Bottom-Sediments, Northern Part of Damietta-Branch, River Nile, Egypt." IOSR Journal of Applied Geology and Geophysics (IOSR-JAGG) 6.4 (2018): 01-17.