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Disribution of Cobalt, Nickel, Manganese and Iron in the sediment from Al-Ashar and Al-Khandak canals connected with Shatt Al-Arab River, Basrah.

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ABSTRACT

Sediment samples were collected monthly during the period December, 1994 to November, 1995 from five stetions in Al-Ashar and Al-Khandak canals which areconnected with Shatt Al-Arab River in order to determine the ddistributin of Co, Ni, Mn and Fe in exchangeable and residual sediment phases.

The mean concentrations of co, Ni, Mn and Fe in the mean concentration of Co, Ni, Mn and Fe in the exchangable phase were 36.399, 23.491, 224.503 and 3499.476 µg/g dry weight, respectively; while the mea concentrations of theses elements in the residual sediment phase were 28.589 , 69. 204, 108.297 and 11509. 874 ug/g dry weight, respectively.

The concetrations of Co and Mn were higher in the exchengable phase than in the resdual phase of sediment, this may be attributed to the anthropogenic sources.

Organic matter contents and texture for sediment were also studied to illustrate the influence of theses characteristics on the concentrations of heavy element in sediment .

Introduction

In the water system the heavy elements were present partly in solution and partly adsorbed in organic or inorganic particulate matter.

In addition, certain amounts of elements exist in chelates and colloids. The amount of elements which adsorbed in particulate matter depended on the balance between gain by adsorption and loss by abrasion

(Morlarty & Hanson, 1988); this particulat matter may be lost to the sediments by settling in the less turbulent area (Phillips, 1977).

The concetrations of heavy elements in sediment were varied according to the rate of particle sedimentation ; the rate of heavy elements deposition; particle size and the presence or absence of organic matter in the sediment (Al-Khafaji, 1996).

Sediments are important hosts for pollutant heavy elements; therefore, it has been employed to monitor the pollution in aquatic environments (Salamons et al., 1987).

Many authors have reported data concerning the concentrations of heavy elements in sediment from open ocean areas, coastal areas, estuaries or rivers; and most of them found that the highest concentrations of most elements in sediment .

The present study is concerned with the determination of Co, Ni, Mn and Fe concentratios in exchangable and residual phases of sedoment from Al-Ashar and Al-Khandak canals connected with Shatt Al-Arab River to illustrate the influence of untreated municipal municipal sewage, wast water from industries and domestic sewage which discharge to Shatt Al-Arab River (Without even preliminary treatment through these canals.

Study Area:

Tigris and Euphrates rivers were confluenced to from Shatt Al-Arab River which ends in the Arabian Gulf. There were several hundreds canals on both sides of Shatt Al-Arab River , some pass through the center of Basrah city where untreated domestic sewage and industrial wastes are added (A-Aarajy, 1996). Previous studies showed that most of theses canals are highly polluted with organic matter)Saad & Antoine , 1982; A-AAsadi, 1983 ; Al-Awadi, 1983 A-Aarajy, 1996). One of the most polluted canals was A-Ashar canal, Fig (1), whose length is about (4) Km with a width from (10) m to (34) m and a depth from (1) m to (2.5) m Two stations (1 and 2) were selected in Al-Ashar canal (1.1 and 3.6) Km far from the connecting point with Shatt Al-Arab .

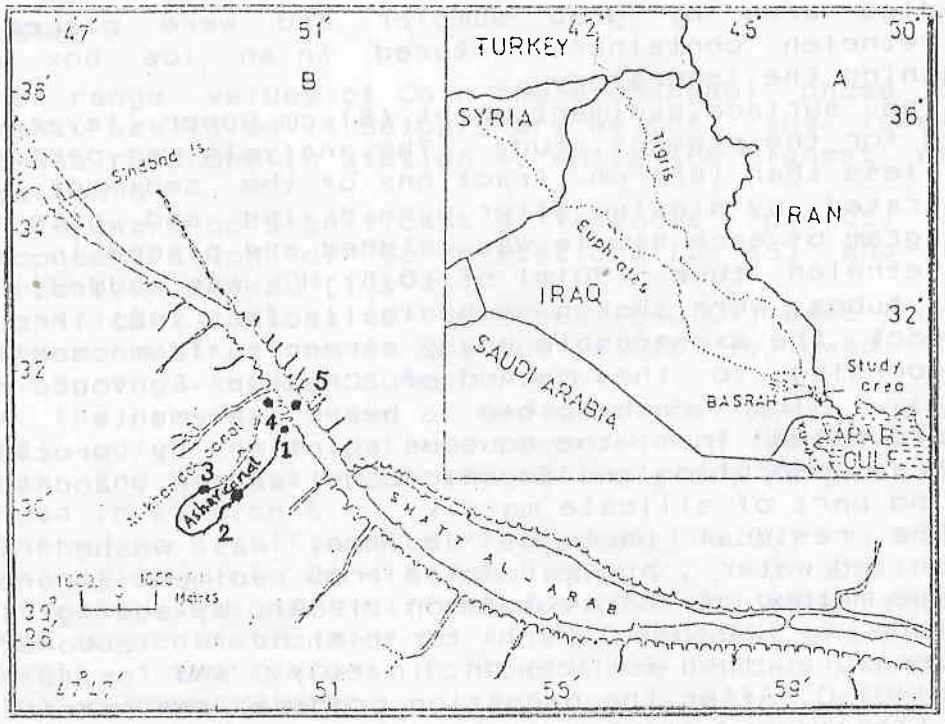

Fig.1. The sampling Stations

The other polluted canal was Al-Khandak canal, whose length is about (4.3) km with a width from (12)m to and a depth from (1)m . Two stations (3 and 4) were selected in this canal; (3.9 and 1.1) km far from the connecting point of this canal with Shatt al-Arab River.

In 1989 Al-Ashar canal has been connected with Al-Khandak canal a small canal whose length is about (300)m and a width about (12)m.

S.I.D: State Irrigation Directorate (Personal communication)

Material & Methods

The sediment samples were collected from the studied area by grab sampler and were placed in polyethelen containers, stored in an ice box upon reaching the laboratory .

The surface sediment about (5) cm upper layer was used for the present study . The analysis was performed on less than (65) um. fractions of the sediment were separated by sieving after oven drying and grinding. One gram of each sample was weighed and placed in (50) polyethelen tube. (30)ml of (0.5) HCL was added, and the tubes were shaken mechanically for (16) hr. to extract the exchangable heavy elements from sediment (Accoording to the method of Chester & Voutsinou, 1981). The exchangable heavy elements were incorporated from the aqueous solution by processes such as adsorption and organic complication , and there was no part of silicate matrix.

The residual part of sediment was washed with deionized water , and extracted from sediment according to the method of (Barak & Mason, 1989), by adding (15)ml mixture of HNO :HClO (4:1) for (48) hr in labboratory temperature, then for (1) hr. in (40) C and for (9) min in (140) C. After the digestion process, the extraction was fltered and diluted to (2) ml with deionized water. The residual heavy elements in sediment was found as part of silicate matrix, which are located mainly in the lattic structurees of the component minerals .

PYe-Unicam Flam Atomic Absorptions pectrophotometer (AAS) model SP9 was used to determine heavy elements concentrations in theses samples.

The sediment granules were separatedby using sedigraph ET-5000, the percentage of texture was calculated according to Folk's (1954) method.

The total organic carbon (TOC) was determined according to Ball's (1964) method.

Results & Discussion

The mean concentrations of studied elements in the exchangable phase of sediment are presented in Fig (2) and Tab (1), while those in the resdual phase sre presented in Fig (3) and Table (1).

1-Cobalt:

The range values of Coin the exchangabl phase of sediment was (5.04-74.68)ug/g dry weight, the lowest value was recorded in station 1, while the highest was in station 5.

There were no significant differences (p>0.05) in the concentration of Co in stations [3 &5] and in stations [1 & 2] and [1 & 4].

Significant seasonal differences (p<0.01) were found in the concentrations of Co, the values followed the order Spring >Autumn> Summer > Winter .

In the residual phase of sediment the lowest value (15.68) ug/g dry weight was recorded in station 4, Whereas the highest value (48.88) ug/g dry weight was recorded in station 5.

There no significant differences (P>0.05) in the concentration of Co in stations 2 , 3 and 4. Significant seasonal differences (P<0.01) were found in the concentrations of Co in the residdual phase of sediments, the values followedththe order Autumn >Spring >Summer >Winter.

2-Nickel:

In the exchangeable phase of sediments the lowest value (9.07) ug/g dry weight was recorded in stations 1, whereas the highest value (36.62) ug/gdry weightwas recorded in stattion 3. There were no significant differences (p>o.o5) were found in the concentration of Ni among all the studied stations > On the othe hand,

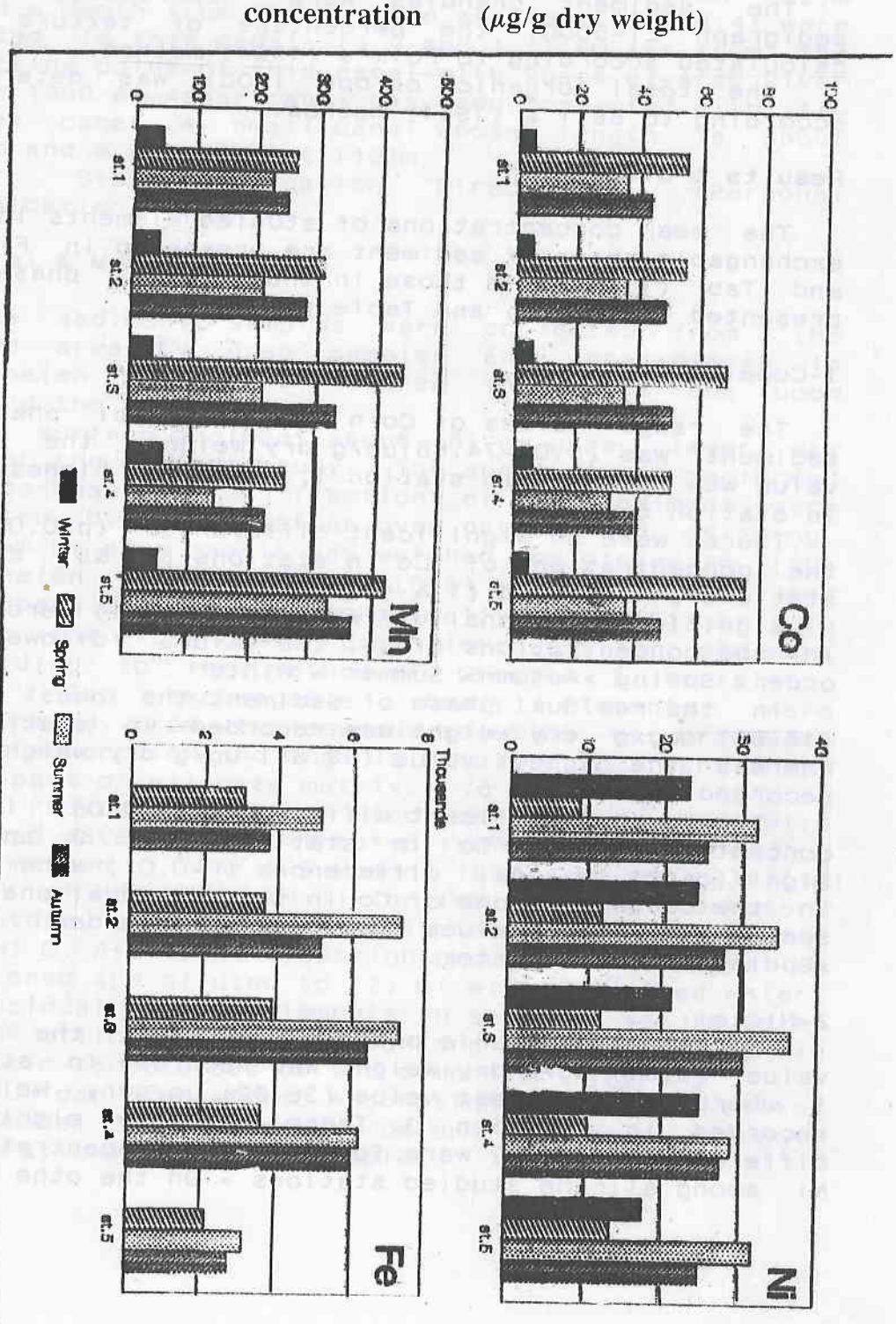

Fig (2): Mean concentrations of heavy elements in the exchangable phase of sediment in the studied stations.

Table (1): The mean concentrations of heavy elements (μg/g dry weight) in the studied area. (Mean $\pm$ SD)

Seasons	st.	Co		Ni		Mn		Fe	
		Exchangable phase	Residual phase	Exchangable phase	Residual phase	Exchangable phase	Residual phase	Exchangable phase	Residual phase
Winter	1	5.04 ± 1.4	17.62 ± 3.2	23.10 ± 13.57	105.58 ± 93.56	45.42 ± 4.2	99.71 ± 15.29	12.26 ± 9.4	7894.8±1649.56
	2	5.26 ± 0.27	18.85 ± 2.3	24.37 ± 8.25	113.71 ± 90.66	43.00 ± 6.98	107.08 ± 3.68	14.75 ± 0.7	8872.4±1182.99
	3	5.39 ± 1.01	16.13 ± 2.3	21.32 ± 11.66	114.11 ± 99.6	36.00 ± 6.8	101.00 ± 13.5	33.44 ± 18.2	8162.0±1352.5
	4	6.07 ± 1.8	15.68 ± 1.79	24.94 ± 2.7	100.88 ± 50.29	56.71 ± 3.3	111.46 ± 5.6	21.70 ± 2.1	8771.1±149.8
	5	5.24 ± 0.97	21.74 ± 1.4	17.71 ± 19.4	152.70 ± 114.4	52.41 ± 2.55	148.64 ± 3.13	6.05 ± 4.9	15288.1±291.17
	mean	5.40 ± 0.39	18.00 ± 2.44	22.29 ± 2.91	117.40 ± 20.51	46.71 ± 8.10	113.58 ± 20.17	17.64 ± 10.46	9797.7±3096.40
Spring	1	54.31 ± 0	34.81 ±1.7	9.07 ±0	13.94 ±1.06	260.72 ±40.47	72.28±6.46	3068.8±1245.4	6938.6±171.6
	2	54.31 ± 0	26.05 ±1.1	12.10 ±0	14.94 ±2.01	308.88 ±37.36	80.78±3.2	3644.1±798.9	7492.6±898.4
	3	67.89 ± 0	25.92 ±1.6	12.10 ±0	15.31 ±1.4	440.8 ±35.19	73.69±7.97	3872.0±842.1	7333.4±1307.2
	4	50.35 ± 3.3	24.66 ±1.7	10.59 ±1.7	13.43 ±0.2	253.39 ±5.1	87.02±3.1	3623.0±971.4	7550.6±974.5
	5	74.68 ± 0	48.19 ±2.6	13.61 ±1.7	25.40 ±2.49	420.92 ±10.5	125.70±3.09	2138.4±300.0	11879.4±369.4
	mean	60.31 ±10.4	31.92 ±9.9	11.49 ±1.7	16.60 ±4.97	336.94 ±88.6	87.89±21.95	3269.3±697.9	8238.9±2049.1
Summer	1	35.12 ±17.3	24.53 ±4.87	31.91 ±0	62.13 ±15.5	223.47 ±8.8	94.22±17.97	5161.5±1237.1	13736.2±442.5
	2	35.39 ±2.7	26.00 ±0.86	34.82 ±9.5	57.96 ±10.96	212.54 ±52.02	99.20±20.0	7359.2±2086.7	13578.3±758.5
	3	34.84 ±10.4	24.00 ±2.27	36.62 ±1.3	62.16 ±5.5	213.75 ±13.95	80.94±10.87	7348.1±823.8	10984.1±1071.7
	4	30.69 ±4.4	25.56 ±6.6	29.01 ±0	56.10 ±8.2	140.58 ±6.35	93.57±8.1	6267.5±1092.2	17068.5±948.5
	5	36.50 ±4.6	41.17 ±6.7	31.91 ±0	106.48 ±8.98	328.83 ±51.2	141.74±4.6	3161.4±24.198	24250.0±1365.0
	mean	34.51 ±2.2	28.25 ±7.27	32.85 ±2.9	68.97 ±21.14	223.83 ±67.42	101.93±23.25	5859.5±1760.6	15923.4±5131.4
Autumn	1	42.67 ±3.8	41.23 ±1.7	25.61 ±6.36	62.44 ±6.95	249.01 ±26.7	114.1±13.54	3760.1±1579.7	10558.2±2199.1
	2	47.85 ±0	31.47 ±1.57	27.92 ±5.06	67.71 ±4.4	280.90 ±15.55	129.36±8.7	5195.1±132.5	11992.0±1379.2
	3	50.25 ±5.0	28.40 ±3.08	30.48 ±2.65	71.83 ±3.08	331.67 ±16.9	112.51±5.59	6475.7±1803.0	9509.0±142.7
	4	38.28 ±0	30.93 ±1.8	27.63 ±1.67	69.15 ±14.95	223.17 ±28.04	127.72±6.8	6048.9±1299.9	10198.1±485.6
	5	47.85 ±0	48.88 ±2.4	25.03 ±3.7	98.14 ±8.2	367.92 ±7.86	165.24±12.4	2777.5±439.6	18140.41±386.8
	mean	45.38 ±4.8	36.18 ±8.6	27.33 ±2.16	73.85 ±14.0	290.53 ±59.24	129.79±21.25	4851.5±1555.8	12079.5±3507.3

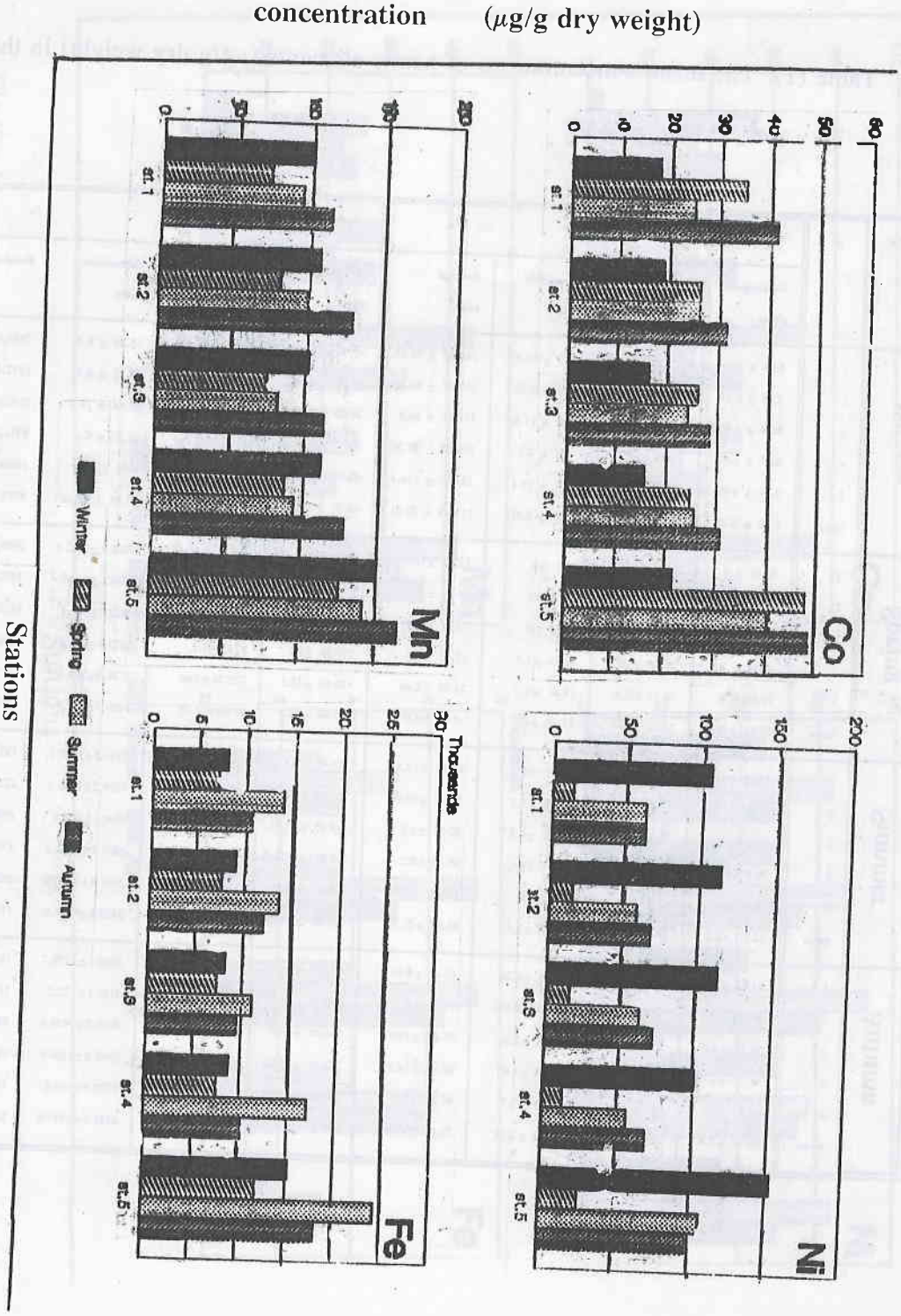

Fig (3): Mean concentrations of heavy elements in the residual phase of sediment in the studied stations.

significant seasonal differences ($p<0.01$) were found in the concentration of Ni in the exchangeable phase sediments in the order Summer >Autumn>Winter >Spring.

In the residual phase of sediment, the lowest value (13.43) ug/g dry weight was recorded in station 4, while the highest value (152.70) ug/g dry weight was recorded in station 5. There were no significant differences ($p>0.05$) were found in the concentration of Ni among the stations 1, 2, 3 and 4 or between the station 3 and 5 .

The highest values of Ni in the residual phase of sediments were recorded in Winter , whereas the lowest values were recorded in Spring . There were no significant differences ($p>0.05$) between the concentration of Ni in Summer and Autumn .

3-Managnese:

The highest value (440.80) ug/g dry weight and lowest value (36.00) ug/g dry weight of Mn in the exchangable phase of sediment were found in station 3 . Significant differences ($p<0.01$) were found in the mean concentrations of Mn in the exchangable phase of sediments among all the studied. There were also significant differences ($p<o.o1$) found in the concentration of Mn in the exchngable phase of sediment . The values follwed the order Spring >Autumn>Summer>Winter.

In the residual phase of sediment , the lowest value (72.27) ug/g dry weight was recorded in station 1, whereas the highest valu (165.24) ug/g weight was recorded in station 5 . There were no significant differences($p>0.05$) found between the mean concentration of Mnin station 2 &4 or 1 & 3.
Significant seasonal differences ($p<0.01$)were found in the mean concentration of Mn in the residual phase of seddiment . the values follwed the order Autumn >Winter >Summer >Spring.

4-Iron

A wide range in mean concentration of Fe in the exechangable phase of sediments were as (6.05-7359.16) ug/g dry weight.

The lowest value was recorded in station 5, while the highest value was recorded in station 2. There were no significant differences (p>0.05) found in the mean concentration of Fe among the stations 2,3 & 4. On the other hand, significant seasonal differences (p<0.01) were found in the mean concentration of Fe in the exchangeable phase of sediments. the values followed the order Summer >Autumn >Spring>Winter.

In the residual phase of sediments, The lowest value was (6938.60) ug/g dry weight was recorded in station 1, whereas the highest value was (24250.01) ug/g dry weight was recorded in station 5. There were no significant differences (p>0.05) found in the mean concetrations of Fe between the station 2 & 4. Whereas there were significant seasonal differences (P<0.01) found in the mean concentrations of Fein the residual phase of sediments, the values followed the order Summer>Autumn >Winter >Spring.

Organic matter contents and texture for surficial sediments from the studied stations were given in table (2).

The results showed that the lowest value of organic matter contents was found in station 5, while the highest value was found in each station 3. Present study agrees with the study of patterson (1983) who found an increase in heavy elements concentrations with the increase of total organic carbon in the sediments .

Sediments had a wide varity of particle size and in order to make a viable inter sediments comparsion heavy elements analyses were carried out on <65 um fraction.

It has been known for a long time that size of sediments particles is an important factor affecting the distribution of heavy element; therefore , one might expect that smaller particles , with their larger surface to volume ratio, have higher concentrations of heavy elements. However, there is no consistent increas in some elements concentrations with the decrease in particle size. This conclusion arees with Morriaty & Hanson's (1988) study, and this may be due may be due to loss by abrasion , the rate of heavy elements deposition or degradation (physical or biological), the rate of particle sedimentation may also affect final concentration of heavy elements found in sediments .

The results showed local and seasonal variation in the concentrations of studied heavy elements, this may be due to the natural structure of sediments in each station, this agrees with Al-Kafaji's, (1996) who found an increas in heavy element concentrations in sediments with an increas of clay and silt percentage in the sediments also he found a decrease in heavy elements concentration with an increase in sand percentage in the sediments.

There were considerable differences in the partitioning of heavy elements between the exchangable and residual phases of sediments, they were in a good agreement with Al-Muddafr et al. (1992) for the partitioning of the studied heavy elements in surficial sediments from Shatt Al-Arab River.

Comparing heavy elements concentrations of this study with those given in the literature for the same area and others of nearby environments, was given in table (3).

The slightly higher elements concentrations which were observed even in the part of the area suggest an anthropogenic input of elements to the studied area possibly from the aerial deposition and dust fallout, untreated municipal sewage, wastewater from industries and domestic sewage, which discharge to the studied area.

On aseasonal bases, the concentration of some heavy elements such as Fe & Ni increased in Summer, this was probably due to the high production of phytoplankton and high input of particulate matter from the watershed in Summer which causes alarg portion of elements to be bound to particles which gives a higher sedimentation rate in Summer.

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Table (2): Organic matter contents and texture for surficial sediments from the studied area.

St.	Local	% TOC	Texture			Description
			% sand	% silt	%clay	
1	Al-Ashar canal	15.608	35.500	13.424	51.077	Sandy-clay
2	Al-Ashar canal	12.920	45.440	16.520	38.040	Sandy-mud
3	Al-Khandak canal	22.278	13.117	18.854	68.029	Sandy-clay
4	Al-Khandak canal	11.178	26.614	17.032	56.355	Sandy-mud
5	Shatt Al-Arab river	8.340	3.969	21.577	74.456	clay

Table (3): Mean concentrations and range of heavy elements in sediment from the studied area together with those in the nearby areas (μg/g dry weight).

location	Co	Ni	Mn	Fe
(a) Khor Al-Zubair canal	3 (1-11)	94 (1-240)	389 (43-570)	31762 14810-44040
(b) NW coastal Arabian Gulf	2.01	10.05	50.81	2407.32
(c) Shatt Al-Arab River	17	655	740	6801
(d) Shatt Al-Arab	-	421	917	31800
(e) Shatt Al-Arab River	-	57	700	6200
(f) NW Arabian Gulf	-	547	1913	7696
(g) Shatt Al-Arab Estuary	16.1	85.9	392.1	4845.1
(h) Shatt Al-Arab Estuary	16 6.8-18.2	163.7 126.7-197.6	590 267-710	3774 1459-7945
(i) Studied Area	64.988	92.695	332.800	15009.350

(a): Al-Mussawy & Salman, 1989
(b): Al-Hashimi & Salman, 1985
(c): Abaychi & Douabul, 1985
(d): Al-Muddafr *et al.*, 1992
(e): Abaychi & Mustafa, 1988
(f): Abaychi & Douabul, 1986
(g): Al-Khafaji, 1996
(h): Al-Saad *et al.* (1997)
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توزيع عناصر الكوبلت ، النيكل ، المنغنيز و الحديد في رسوبيات قناتي العشار والخندق المرتبطتين بنهر شط العرب

سكينة مهلهل الحجاج
قسم علوم الحياة – كلية العلوم – جامعة البصرة

الخلاصـــة

جمعت عينات الرسوبيات بصورة شهرية اثناء الفترة الممتدة مـــن كـانون الاول 1994 ولغاية تشرين الثاني 1995 من خمس محطات تقع في قناتي العشـــار والخنـــدق المرتبطتين بنهر شط العرب، لغرض تحديد توزيع العناصر الثقيلـــة الكوبلـــت Co والنيكل Ni والمنغنيز Mn والحديد Fe في الطورين المتبادل والمتبقي من الرسوبيات.

لقد كان متوسط التركيز لـــ Fe, Mn, Ni, Co في الطور المتبادل 23.491, 36.399 3499.476, 224.503 مايكروغرام/غرام وزن جاف على التوالي ، بينما كـــان متوسـط التركيز لتلك العناصر في الطور المتبقي من الرســـوبيات 28.589 ,69.204 ,108.297 و 11509.874 مايكروغرام/ غرام وزن جاف على التوالي.

لقد اوضحت النتائج ارتفاع تراكيز الكوبلت Co والمنغنيز Mn في الطور المتبادل من الرسوبيات مقارنة مع الطور المتبقي منها، وهذا الارتفاع قد يعزى الى مصـــادر التلوث البشري المنشأ. كذلك تمت دراسة محتوى الرسوبيات من المـــواد العضويـــة وتركيب نسجة الرسوبيات لبيان تأثير تلك المحتويات على تراكيز العناصر الثقيلـــة في الرسوبيات.