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\*\*\*

2005 ( 4-6 2-4 0-2)  
2004

Igeo

263.47

1-

14443.29

1679.26

36.61

149.28

24.52

.(Audry *et al.*, 2004 and MacKenzie and Pulford, 2002)  
%97

.(Kabata- Pendias and Pendias, 2001)

.(1985 Al-Saad *et al.*, 1996)

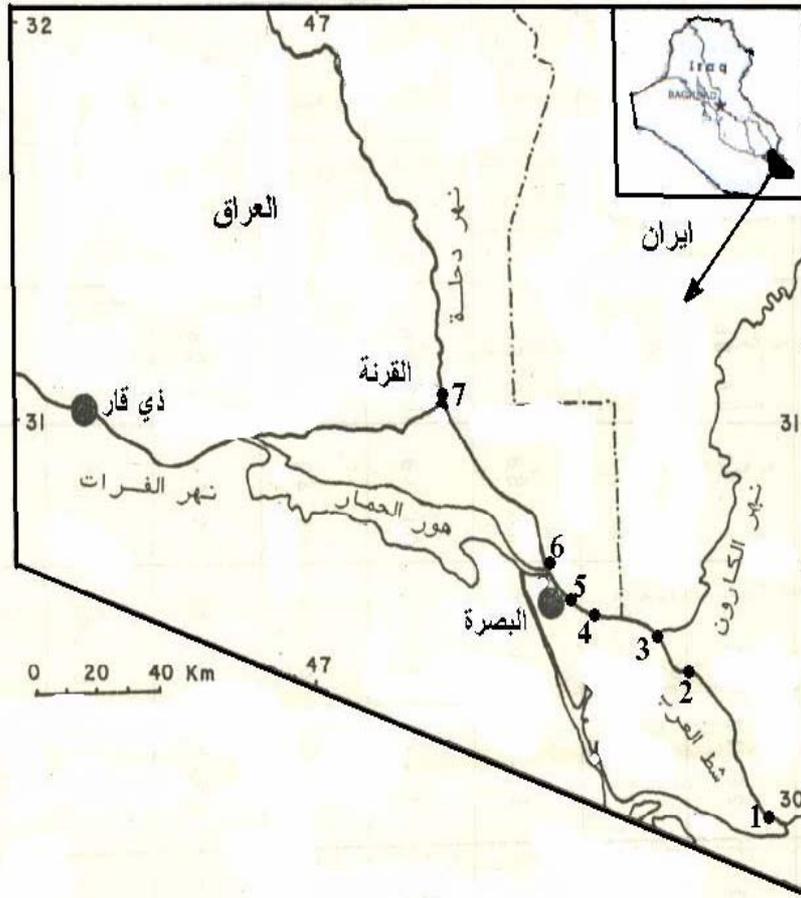
)  
Draver, 1988)

(  
.( Faure, 1998

.(Singh *et al.*, 2005)

-:

- ( ) -1      ( ) -2      ( ) -3      ( ) -4      ( ) -5      ( ) -6      ( ) -7      .1



شكل ( 1 ) خارطة تبين مواقع جمع العينات.

( 10-0) ( 20-25 10 ) cores sample  
3 1

( )  
( ) 13/10/2004 ( ) 27/7/2004 ( ) 17 /4/2004  
( ) 13/1/2005

2

( 6-4 4-2 2-0)

HClO<sub>3</sub>: HNO<sub>3</sub>: HF

( : : )  
3 30 Teflon Tessier *et al.* (1979)

.Philips (spq)

(nthropogenic)

*Audry et al.* (2004)

: Müller (1979)

$I_{geo} = \log_2$  (concentration of the element in sediments/ conce. Of element in earth crust X 1.5)

: (Nakanishi *et al.*, 2004)  $I_{geo}$

---

	Igeo
-	<0
-	1-2
-	2-3
	3-4
-	4-5
	>5

( )

( )

.(2\* 4\*3\*7)

.(F) Analysis of Variance

(Revised L. S. D. test)

.(1980 )

:

195.36

.(1 )<sup>1-</sup> . 39.40±263.47 350.76

275.14 260.85 273.02 260.39 252.97 255.28 266.63

1-

Iraqi Ministries of Environment, Water Resources, )  
(Municipalities and Public Works, 2006

Kabata – Pendas & Pendas (2001)  
(silty clay loam)  
(nonexchangeable forms)

30.76 19.61

(1 )<sup>1-</sup> . 2.03 ± 24.52 <sup>1-</sup> .

-:

. < < < < < <

.Lacal *et al.* (2003)

Vandecasteele *et al.* (2002)

.(Fergusson, 1990)<sup>1-</sup> . 0.35

4

(2005)

.<sup>1-</sup> . 6.39

24.88

( 1 )<sup>1-</sup> . 6.34± 36.61 55.35

Al-khafaji (2001) .

.<sup>1-</sup> . 29.25

.(Audry *et al.*, 2004) %45

-:

. < < < < < <

(1)

(<sup>1-</sup> . 40.57)

.(<sup>1-</sup> . 37.72) (<sup>1-</sup> . 40.16)

.(<sup>1-</sup> . 32.36)

( )

.(Huang&Lin, 2003 Singh *et al.*, 1988 Sakai *et al.*, 1986)

.(2001)

(1)

<sup>1-</sup> . 28.55 ± 49.28 97.20 262.61

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235.4 (Al-Muddafar *et al.*, 1992) <sup>1-</sup> . 135  
 .(2005 ) <sup>1-</sup> .

.(Pagnanelli *et al.*, 2004)

0.05

<sup>1-</sup> . 138.15  
 . <sup>1-</sup> . 161.82

2001 1991 )  
 (2005 Al-Khafaji, 2002

%20 Audry *et al.* (2004)  
 Garonne Lot  
 . %1

2431.91 634.36  
 .(1 ) <sup>1-</sup> . 370.59 ± 1679.26

<sup>1-</sup> . 2000 350  
 .(Kabata-Pendias & Penndias, 2001)

.<sup>1-</sup> . 917 Al-Muddafar *et al.* (1992)

(Sakai *et al.*, 1986 Geesey *et al.*, 1984)

5667.12

(1 )<sup>1-</sup> . 4504.76 ± 14443.29 23808.20

(2005)

(1 )

(<sup>1-</sup> . 16503.20)

(<sup>1-</sup> . 14506.90)

(<sup>1-</sup> . 16468.50)

(<sup>1-</sup> . 12964.50)

( )

Huang&Lin (2003)

(1 )

Iraqi Ministries of )  
 Environment, Water Resources, Municipalities and Public  
 .(Works, 2006 and Audry *et al.*, 2004

(1 )

)

6 .(Williamson *et al.*, 1995 1991

.

:

Index geoaccumulation)

Müller (1979)

((Igeo)

(2) 0.06± 8.03

8.45 8.16

.(very strongly polluted)

---

Huang & Lin (2003)

5

Lot

Audry *et al.* (2004)

5

Igeo

(Igeo)

.Müller (1979)

(1-1)

(1)

الموقع	العمق سم	الموسم	الرصاص	الكاديوم	النحاس	الزنك	المنغنيز	الحديد
الفاو	2-0	الربيع	314.03	24.11	37.46	148.07	741.55	7934.165
		الصيف	253.32	27.15	49.72	169.92	1435.35	11275.93
		الخريف	251.2	25.69	35.66	127.66	1842.27	14197.47
		الشتاء	276.88	28.4	28.38	113.36	2139.93	19164.77
	4-2	الربيع	317.01	25.61	34.75	148.3	1744.79	8062.43
		الصيف	254.37	25.43	48.04	199.64	1510.46	11392.24
		الخريف	229.64	22.65	25.21	112.76	1915.4	15093.81
		الشتاء	257.6	24.55	29.84	102.53	2331.16	16659.53
	6-4	الربيع	294.61	26.93	34.79	153.4	1433.75	7598.03
		الصيف	236.07	23.97	33.53	137.72	1551.04	13027.79
		الخريف	226.84	23.15	30.74	128.1	1634.98	13975.26
		الشتاء	287.94	26.07	30.47	150.21	1711.27	20323.7
	المعدل		266.63	25.31	34.88	140.97	1666	13225.43
السيبية	2-0	الربيع	304.41	24.43	38.36	154.66	634.36	7750.55
		الصيف	223.87	23.62	44.69	169.13	1625.47	13951.7
		الخريف	234.07	22.11	33.69	121.23	1417.68	14481.1
		الشتاء	268.77	26.82	34.68	175.43	1967.31	18907.1
	4-2	الربيع	326.93	26.56	36.19	200.2	698.46	7284.13
		الصيف	206.23	24.43	39.08	184.22	2006.02	14452.1
		الخريف	238.52	24.43	32.04	116.03	1547.92	12948.1
		الشتاء	241.17	23.17	33.38	134.65	1837.51	17472.3
	6-4	الربيع	306.38	23.63	35.43	164.17	914.4	5667.12
		الصيف	195.89	24.43	35.78	152.74	1586.02	14486.4
		الخريف	233.31	23.58	32.13	141.65	1316.88	13921.7
		الشتاء	283.81	27.98	33.2	153.93	1958.71	17620.5
	المعدل		255.28	24.6	35.72	155.67	1459.23	13245.2

## تكملة جدول (1)

الموقع	العمق سم	الموسم	الرصاص	الكاديوم	النحاس	الزنك	المنغنيز	الحديد
مصب الكارون	2-0	الربيع	303.68	24.93	34.44	161.68	1586.33	7596.56
		الصيف	213.79	25.55	32.24	122.53	1679.53	13033.5
		الخريف	228.8	23.96	32.92	109.59	1739.86	14446.8
		الشتاء	292	28.66	27.84	134.81	1830.76	16416.2
	4-2	الربيع	350.76	26.08	39.15	183.69	1048.83	7584.85
		الصيف	199.29	23.87	33.41	152.61	1835.86	12301.1
		الخريف	251.52	22.79	34.48	97.2	1778.65	15046.6
		الشتاء	195.36	24.35	27.5	137.69	1779.99	15027.9
	6-4	الربيع	318.71	26.53	30.35	165.65	1746.71	10423.2
		الصيف	195.63	24.5	31.02	114.4	1617.43	12579.6
		الخريف	245.05	23.69	29.11	152.87	1983.74	13034.1
		الشتاء	241.04	30.76	35.9	125.06	1531.23	18083.2
	المعدل	252.97	25.47	32.36	138.15	1679.91	12964.5	
ميناء ابوفلوس	2-0	الربيع	324.13	24.12	36.44	137.79	782.92	7224.19
		الصيف	249.03	23.99	38.25	183.3	1442.43	13532.4
		الخريف	250.94	22.49	39.06	117.59	1795.94	20673.8
		الشتاء	196.52	23.03	28.49	143.84	1537.14	20181.8
	4-2	الربيع	325.19	25.83	38.21	149.35	1914.97	8758.22
		الصيف	210.2	23.32	35.18	139.81	2064.9	12350
		الخريف	229.5	22.12	33.03	154.7	2027.89	13846.6
		الشتاء	275.54	26.58	29.65	127.65	1728.7	21240.1
	6-4	الربيع	321.4	23.11	37.43	147.05	1786.18	8336.32
		الصيف	216.82	23.98	36.74	142.59	1618.21	12099.6
		الخريف	260.14	21.28	35.76	138.08	1597.88	13276.3
		الشتاء	265.26	27.42	29.59	147.66	1770.96	18751.8
	المعدل	260.39	23.94	34.82	144.12	1672.34	14189.3	

## تكملة جدول (1)

الموقع	العمق سم	الموسم	الرصاص	الكاديوم	النحاس	الزنك	المنغنيز	الحديد
العشار	2-0	الربيع	318.25	24.5	40.34	159.31	1814.14	8135.91
		الصيف	248.97	23.96	47.35	157.54	2176.51	14818.6
		الخريف	229.3	19.61	37.13	126.38	1908.22	10379.3
		الشتاء	279.48	22.8	36.63	135.8	1668.75	20340.9
	4-2	الربيع	313.34	23.01	35.41	155.93	1276.81	8051.74
		الصيف	249.69	22.56	48.9	262.61	1873.66	21211.8
		الخريف	235.04	20.93	43.2	134.41	2166.79	14612.2
		الشتاء	286.47	27.4	33.43	150.6	1940.37	20028.3
	6-4	الربيع	325.11	25.82	36.61	157.07	1346.36	13606.3
		الصيف	275.47	24.03	55.35	213.96	1847.58	8830.3
		الخريف	252.49	22.81	35.81	134.55	1734.32	14795.8
		الشتاء	262.68	28.38	31.75	153.78	1822.9	19271.7
	المعدل	273.02	23.82	40.16	161.82	1798.03	14506.9	
السندباد	0-2	الربيع	315.96	25.09	39.44	153.92	1798.78	13236.1
		الصيف	217.01	20.96	42.36	182	1709.67	16133
		الخريف	222.34	21.32	31.15	118.03	1642.95	14261.6
		الشتاء	252.62	23.35	31.05	126.33	1994.78	18436.4
	4-2	الربيع	306.41	27.58	42.87	160.51	1587.54	15901.6
		الصيف	266.73	23.24	42.66	249.56	1833.14	22289.5
		الخريف	235.51	23.03	33.58	103.47	1104	22211.6
		الشتاء	261.14	23.98	24.88	126.39	2027.35	15384.1
	6-4	الربيع	285.45	23.56	40.48	143.01	1853.3	8532.48
		الصيف	257.16	23.12	54.43	172.12	1743.74	18975.1
		الخريف	260.91	21.55	38.96	136.29	1719.89	14131.2
		الشتاء	248.94	25.48	30.79	175.26	2241.34	18129.2
	المعدل	260.85	23.52	37.72	153.91	1771.37	16468.5	

## تكملة جدول (1)

الموقع	العمق سم	الموسم	الرصاص	الكاديوم	النحاس	الزنك	المنغنيز	الحديد
القرنة	0-2	الربيع	312.03	24.28	42.17	157.6	2431.91	11843.3
		الصيف	198.42	22.54	33.97	126.3	1793.11	18657.5
		الخريف	249.33	23.6	36.75	127.57	2080.13	10448.7
		الشتاء	290.21	28.11	34.33	141.67	1494.72	22230.3
	4-2	الربيع	314.4	24.56	43.1	163.84	1672.76	8607.96
		الصيف	210.34	23.23	50.86	184.3	1481.32	18844.7
		الخريف	331.72	25.35	40.25	138.87	1813.58	17594.4
		الشتاء	291.68	27.66	36.13	148.1	2102.22	23338.7
	6-4	الربيع	311.18	24.8	47.85	175.26	962.11	9894.28
		الصيف	247.42	25.22	49.21	160.13	1893.01	18152.1
		الخريف	253.34	23.45	38.92	121.11	701.84	14618.5
		الشتاء	291.67	26.8	33.29	158.66	2068.81	23808.2
	المعدل		275.14	24.97	40.57	150.28	1707.96	16503.2
	المعدل العام		263.47	24.52	36.61	149.28	1679.26	14443.29
RSD	للمواقع		19.11	1.65	4.45	20.48	308.14	2313.00
	للمواسم		29.52	0.32	5.43	13.30	245.34	3176.73
	للاعماق		NS	NS	NS	10.73	NS	NS

جدول (2): دليل التجمع الجيو كيميائي للعناصر النزرة في راسب شط العرب (Igeo).

Fe	Mn	Cu	Zn	Cd	Pb	
-3.00	0.06	-0.83	0.15	5.79	8.30	المعدل العام
-3.64	-1.01	-1.15	-0.05	5.68	8.16	ادنى قيمة
-2.15	0.93	-0.50	0.49	5.94	8.45	اعلى قيمة
0.36	0.56	0.14	0.12	0.07	0.06	الانحراف المعياري

- 
- :
- .2001
- .393-379 :16 .1990
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## THE GEOCHEMICAL DISTRIBUTION OF TRACE METALS IN SHATT AL-ARAB RIVER SEDIMENTS

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### ABSTRACT

The geochemical distribution and fractionation of trace metals (Pb, Cd, Cu, Zn, Mn and Fe) in Shatt Al-Arab water and sediments River has been investigated. Seven sampling stations were chosen, from Qurna to Al-Faw during Spring 2004 to winter 2005. The water samples were collected from near the river bed, whereas sediments samples from the river bed by using hand – push corer to get undisturbed samples along the vertical variation (0-2, 2-4, 4-6cm). Total concentrations of above metals were determined in water and sediments samples. The results showed that the concentration of Pb, Cd, Zn, Cu, Mn, and Fe in sediment samples were 263.47, 24.52, 149.28, 36.61, 1679.26, and 14443.29 mg.kg<sup>-1</sup> respectively. Pb and Cd concentrations were found to be much higher than normal background values. Moreover seasonal and location variation in metals concentration were recorded. The significant variation in the Pb and Cd concentration in sediments is documented during winter and spring seasons, i.e. season of high discharge, whereas, the Cu and Zn concentration increases during the summer, which may be effected by the anthropogenic factor. According to the geoaccumulation index (Igeo), the sediments of Shatt Al-Arab River are polluted at very high risk by Pb and Cd, and unpolluted by Cu, Zn, Mn and Fe.