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Levels of Mercury in Ground Water at Basrah, South of Iraq.

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Abstract:

During Gulf War I and Π, the area of Southern Iraq has been effected by explosion of projectiles which are made of different heavy metals such as mercury or radioactive materials like depleted uranium (DU). By rain and dust the flying materials will settle down to accumulate in the soil then the ground water which is used for irrigation and agriculture. The level of Hg have been estimated in water from wells cover areas at Southern Iraq streaches from Southern Rumailah to Burjisiah, Zubair, Safwan and Umm Qaser. The salinity of well water increases from West to East. Mean concentration for dissolved inorganic mercury related directly to salinity. Values recorded were less than 1 µg/l for EC of 2 mS/cm and higher value was around 7.7 µg/l for EC of 5.7 mS/cm. Values in particulate phase were ranged from zero for deep wells and higher Value of 7.4 µg/l for shallow wells while no mercury was found in surface water from Shatt Al-Arab river. The world wide values were 1 ng/l for unpolluted water and reaches 300 ng/l for polluted water. The higher mercury concentration in the wells in Southern Iraq could be arises from accumulation with time after probable exposure to mercury due to weapon explosion or probale emission within the radioactive chain in the area.

Keywards: Mercury, Ground water, Southern Iraq, Salinity, Basrah

Introduction:

Cadmium, lead and mercury are the most toxic metals which affect the environmental systems. Sources of these metals in aquatic environment are originated from natural processes and manmade activities mostly due to rapidly developed industrialization and urbanization [1].

Mercury is a persitent and bioaccumlative metal in the whole environment [2]. It exists both in organic and inorganic forms at various levels, and is ubiquitous. The concentrations of mercury vapour in the atmosphere as well as in drinking water so as low that they do not contribute significantly to human intake of mercury.

The natural level of mercury in water is 10 ng/l [3]. The advised upper limit of mercury in drinking water is 1 ng/l [4], while maximum allowable is 2 ng/l [5]. Anjaneyulu et al.[6] have determined mercury spectrophotometrically after extracting its ternary complex with 4(2- Pyridylazo) resorcinol- CDPAC in pH range of 7-8, while Perez-Ruiz et al.[7] have determined mercury spectrofluorometrically after extraction of its ternary complex.

The use of phenanthroline and eosin as a ternary system for the determination of trace amounts of mercury was reported spectrophotometrically in which inorganic mercury was determined in presnce of other trace metas. In this study the method of Mudakavi [8] has been used fluorometrically to estimate the levels of mercury in grundwater from wells at Southern Iraq.

Study Area:

The area of South- Westem Iraq represented by wadi Albatin which lies upon Dibdibba or Upper Fars formation.It belong to miocene which formed of sand and graval.The texture of soil formed as an average of 74.6 % sand with low amounts of mud 15.9 % and clay 8.9 %.This formation is characteerized as
permeable membrane Which allows pentration of rainwater and preserves it to form the groundwater, the major source of water in the area which makes it suitable for agriculture and irrigation.

As long as main source of groundwatar in the area is from atmospheric origin, therefor, its watar will be close to the surface [9].

Consequently the area is characterized by shallow groundwatar in depth of 1.5m at Eastern and Northem secteors (near Khor Al-Zubair and Hor Al-Hammar respectively)and increase in depth towards and west up to 14-60m at Zubair and Burgisiya and it may reach 100m deeper to the wast [10]. The groundwater of this area is present in tow layers; the upper one is fresh while the lower is brackish.The salinity of the upper layer increases from Safwan to Zubair [11].

The study area represents a part from southern Iraq which located on the top of North – West Arabian Gulf contributes to the altitude 30° 00′-30° 30′ and altitude 47° 30′-48° 00′ (fig.1). Its groundwater resource is fed from Didbibba formation , (fig. 2) [9].

The quality of groundwater in southern Iraq differs from one well to the second in the same area depending on the quantity of fed water and / or increase irrigation.

Experimental:

Water samples were collected from groundwater wells along an agricultural fields which cover southern Rumala, Burgisia, Zubair, Safwan, and Umm Qaser for the period July – Oct. 1998 (fig. 1) the study was consisted of two categories, soft to the west and hard to the east. The depth of wells rage from shallow (5-10 m) close to Khor Al- Zubair (wells No. 18, 20-22) and deep (17-21 m) faraway from waterways (wells no. 1-17, 19). All sampled wells were in a contineous use for irrigation, each water sample was taken after on pumping hour by using a
plastic bottle which previously cleaned in acid and disttiled water. Few drops of nitric acid were added immediately to each sample in order to prevent the mercury fixing itself to the polyethylene.

For each well conductivity of water was measured immediately by using portable conductivity meter. In the lab, water samples were analyzed for mercury by adopting procedure given by Mudakavi (8) in which the procedure depends upon formation of ternary system between mercury, 1,10- phenanthroline and eosin at pH 4.5 in presence f EDTA and gelatine. To each sample container a certain amount of EDTA, pH 4.4 buffer, 1, 10- phenanthroline and gelatine solutions were added. After well mixing of the contents a certain amounts of eosin solution was added, then the whole mixture was dilluted by dionized water to a fixed volume. The ternary solution developed from eosin orange coler to light pink.

The measurements were perfomed on a shimadzu RF 540 spectrofluorometer fitted with data station in which excitation and emission wavelengths were 555 nm. These wave lengths were comparable to the absorption of the reagem (550 nm) and the same ternary system (552 nm).

Stndard mercury chloride solution was used for calibration curve. Water used through out this work was deionized and gelatine solution was prepared fresh daily.

Results and Discussion:

In this study mercury has been determined spectrofluormetrically as a ternary system in which the reaction between mercury, 1, 10-phenanthroline and eosin proceeded immediately after mixing of the reagents. Gelatine is used to solubilize any expected preciptation while the addition of EDTA solution to the studied smples to suppress the interference of foreign metal ions. Measurements
of mercury for all sampes, as well as standard samples, were poroceeded at PH 4.5. The excitation and emission wave lengths were nearly the same at 555 nm.

The concentrations of mercury in groundwater from wells at Southern Iraq are listed in Table (1) together with electrical conductivity and chlorinity. Salinity of samples as expressed in electrical conductivity revealed that ground water wells regarded as being brackish saline water (12). Chloride in studied ground water samples showed high consistent trend of variation. It occurs in all samples but with relatively low values around locations faraway from coastal

Table (1). Electrical conductivity (m S/ cm), chlorinity (ppm) and levels of mercury (ug/l) in ground water from southern Iraqi wells.

Well No.	EC	Chlorinity	Mercury		
			Total	Dissolved	Particulate
1	2	496	0.294	0.294	ND
2	1.8	744	5.040	0.887	4.153
3	1.8	2091	-	-	-
4	1.8	2942	ND	ND	ND
5	5.7	2587	7.716	7.716	ND
6	4.9	3190	2.062	0.294	1.778
7a	4.9	850	1.46	1.46	ND
b	4.2	-	2.1	1.5	0.6
C	5.5	-	ND	ND	ND
8a	6.4	2836	5.935	5.935	ND
B	5.9	2658	3.559	3.559	0.694
C	3.7	1524	0.887	0.887	0.887
9	6.3	2836	3.559	3.559	2.966
10	6.2	-	4.153	4.153	2.372
11	5.4	3935	3.559	3.559	ND
12	2.85	1063	-	-	-
13	2.67	850	1.778	1.77	0.887
14	-	-	-	-	-
15	4.0	2841	-	-	-
16	8.23	3261	7.122	7.122	ND
17	2.6	1772	5.341	5.341	ND
18	4.1	2259	1.778	1.778	7.419
19	6.33	3270	5.341	5.341	ND
20	6.15	2375	4.153	4.153	4.747
21	6.90	2658	4.450	4.450	0.887
22	5.73	-	2.611	2.611	0.404
Shatt Al-Arab	1.2	600	ND	ND	ND

Water of Khor Al- Zubair in which values less than 1000 ug/l were reported, while being higher toward Al- Zubair as high as 3000 ug/l. No account was taken of pH, temperature and the water level as no correlation was found between these parameters and distribution of mercury.

The data in table (1) shows that some samples are fairly enriched in mercury. Values of mercury reported represent, according to methodology used, the total and the dissolved mercury. Dissolved mercury showed higher values in saline water than in

fresh water. Values recorded were less than I ug/l for electrical conductvity of 2 mS/cm and higher values to 7.7 ug/1 for electrical conductivity of 5.7 mS/cm.

This finding is in good agreement with observation of Mikac et al., (13). Levels of mercury estimated unpolluted sea water is in the range 0.1-1ug/1 (14). Mercury concentration in the range up to 1-95 ng/1 was reported in Gulf of Thiland (1). In surface coastal water of India from the Arabian Sea values of mercury were ranged between 30-130 ng/1(15). While values up to 310 ng/1 of mercury were recorded in contaminated river in Australia (16).

Maximum levels of mercury detected in river / lake of Louisiana were 2-3 ug/1 (17), while in Spain mean value ranged between 0.3-6.1 ug/1 (18).

Total mercury is represented by dissolved and particulate phases. Differences in measured mercury before and after samples indicated that a certain amounts of mercury is present as particulate matter in which mercury have a storage tendency to be associated with suspended matter. The particulate mercury will be released in saline watar to increase dissolved mercury which is enhanced by the presence of chloride to form dissolved chloride (13).

The correlation coefficients revealed the connection between mercury and measured parameters. Regreesion coefficient fairly positive between mercury and electric conductivity (r=0.678). On the other hand, the coefficient was moderately positive between dissolved mercury and chlorinity (r=0.433) while particulate mercury showed no correlation to chlorinity (r=0.190).

Differences in depth and composition of the wells associated mainly to the distance between the surface water of Khor Al-Zubair and any sampling place (19). Wells at longer distance from Khor Al- Zubair are expected to rainy fed related to Dibdibba formation which is represented as fresh water (9)

Development of extended agricultural zones in semi-arid area, like southern Iraq is restricted by the quality of the available water resources. Quality of groundwater depends upon major factors represented by the geological characterization of the area and sources of water in the absence of other factors like proximity to an industrial estate. The main problem is high salinity in underground and even surface water and the presence of certain trace elements in amounts that turn out to be toxic for inhabitants especially in densely populated and agricultural development areas. This is the case for Zubair and Safwan which revealed problems of salinity as well as presence of toxic mercury in ground water wells (20).

Conclusion:

pollution by mercury as an accumulative metal in groundwater of southern Iraq could be arises from atmospheric fall down by rain or dust due to the effects of weapon explosion for a long period or existence of natural mercury within petroleum products and connection with radioactive materials that are naturally abandoned in petroleum fields, in which mercury is a metal included in the radioactive decay chain.

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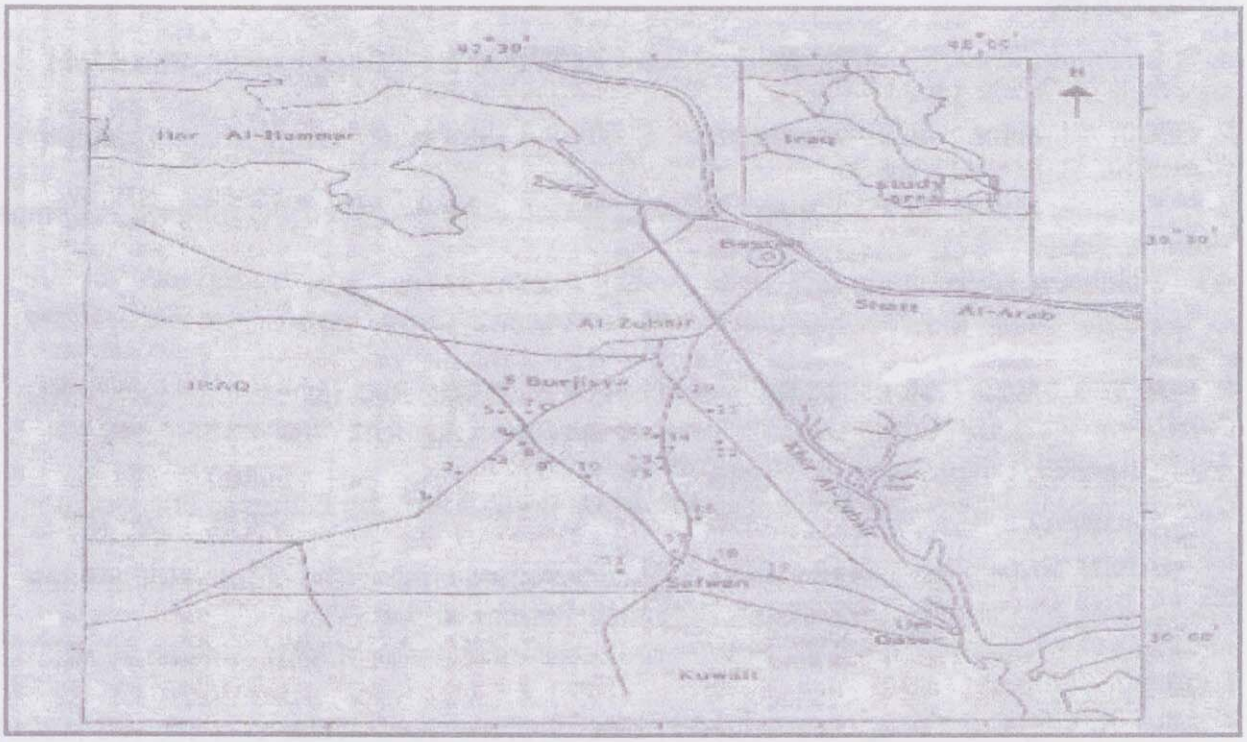
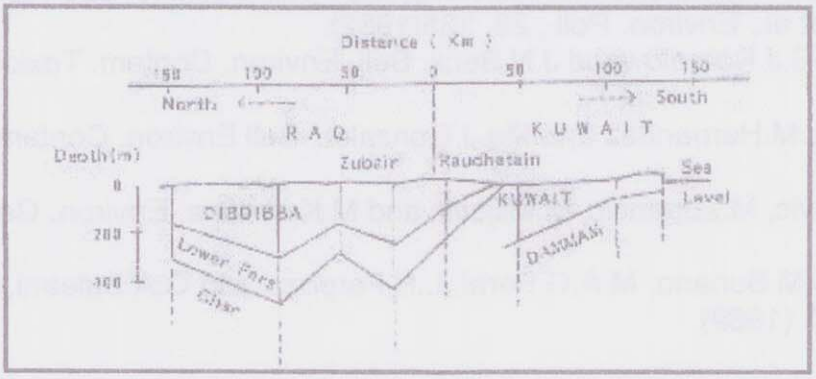
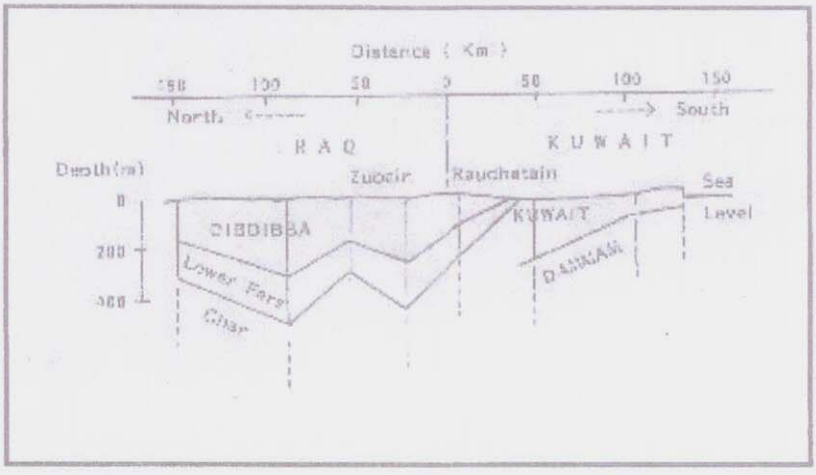


Fig.1. Location map for southern Iraq showing positions of sampling stations





مستويات الزئبق في المياه الجوفية في البصرة جنوب العراق

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الخلاصة:

خلال حربي الخليج الأولى والثانية تأثرت مناطق جنوب العراق لانفجار كميات كبيرة من المقذوفات المصنعة من مواد مختلفة منها المعادن الثقيلة مثل الزئبق أو المواد المشعة مثل اليورانيوم المستنزف. وبفعل الأمطار والأتربة يتساقط المتطاير من هذه المواد ليتراكم في التربة ومنها الى المياه الجوفية والتي تستخدم للزراعة والري . تم تقدير مستوى الزئبق في مياه آبار تغطي مناطق في جنوب العراق تمتد من الرميلة الجنوبية الى البرجسية والزبير وسفوان و ام قصر . تتغير ملوحة هذه الآبار حيث تزداد من الغرب باتجاه الشرق، وكان معدل تركيز الزئبق اللاعضوي فيها بجزئه الذائب يتناسب طرديا" مع الملوحة. فقد سجلت قيم بحدود اقل من 1 مايكروغرام/ لتر لتوصيلية بحدود 5.7 مللي مو/سم . وتراوحت قيم الجزء العالق للزئبق في المياه الجوفية بين قيم غير محسوسة للآبار العميقة واعلى قيمة بحدود 7.4 مايكروغرام/لتر لآبار ضحلة، في حين لم تسجل أي قيمة للزئبق في المياه السطحية لشط العرب ، وان القيم المسجلة عالميا" بحدود 1 نانوغرام/لتر في المياه غير الملوثة وتصل الى 300 نانوغرام/لتر للمياه الملوثة . أن ارتفاع تراكيز الزئبق في المياه الجوفية لجنوب العراق يعزى الى التراكم مع مرور الزمن بعد تعرض المنطقة الى احتمالية التلوث بالزئبق نتيجة لأنفجار الذخيرة او احتمالية انبعاثها ضمن سلسلة المواد المشعة في المنطقة.

مفاتيح دالة: زئبق، مياه جوفية، جنوب العراق، ملوحة، البصرة.