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MARSH BULLETIN

Amaricf_Basra office@yahoo.com
abdulalwan@yahoo.com
.marshbulletin@yahoo.com

Concentrations of trace metals in sediment of the southern part of Al- Hammar marsh ,Iraq .

Sámi T. Al-Yaseri

Dept. Chem.. and Mar. Poll. , Marine Science Centre, Basra University

Abstract

The determination of trace metals (Cd , Pb , Mn ,Zn ,Cu , Ni and Fe) in three locations Al-Mushab , Al-Nagarh and Al-Bourgah , of southern part of Al-Hammar marsh in 2009 during both the dry period (March , April and May) and the wet period (September , October and November) , were achieved by means of Flame Absorption Spectrophotometer were determined in sediment samples . The result showed that the Al-Mushab as the most contaminated site with Zn and Pb, Al-Nagarh as the lowest contaminated with all metals while Al-Bourgah as the most contaminated with Cd , Co, Cu, and Ni .The concentrations of trace metals are effected by chemical and physical parameters .The contamination with trace metals may determined to the health of the aquatic ecosystem and the rural communities that utilize the marsh water for domestic purposes without any treatment .The sediment pollution with heavy metals through to be due to different sources such as urban wastes , industrial effluents , land washout and boats activities .

Key words: trace metals, water ,sediment, farmland , Al-Hammar marsh .

1- Introduction

The marshes (aquatic environment) is the most important zone of the ecosystem as far as human activities are concerned, as it contains the main source of living river resources (Richardson and Hussain, 2006). The aquatic environment is the most sensitive, as it receives large amounts of contaminants introduced by domestic, industrial and agricultural activities, directly or via rivers or through anthropogenic activities such as, sewage, sludge, disposal application of pesticides and in organic fertilizers as well as atmospheric deposition . In recent times the trace metals in excess and has become a problem, this situation has arisen as a result of the rapid growth of population (Ali and Abdel-Satar 2005; Usero *et al.*,2005) .

The comparison of metal contamination in different aquatic environments is possibly analysis of sediment (Tankere-Muller *et al.*, 2006). Many of the organisms which live in, and feed from, aquatic systems are of ecological and economical value. Often the primary cause of toxification by organic and inorganic contaminants associated with the aquatic environment is consumption of fish or shellfish , rather than drinking of water (Morrisey *et al.*, 2003) Health risks associated with consumption of contaminated fish may be 20 to 40 times higher than those resulting from exposure to the same chemicals through drinking water (Morrisey *et al.*, 2003). Water bodies contaminated by heavy metals may lead to bioaccumulation in the food chain of an aquatic environment .Normally ,such contaminants are transported from its sources through river system and deposited downstream .Since most of pollutants could be mixed and became suspended solid and bottom sediment through sedimentation, (Morrisey *et al.*, 2003) therefore marshes is a potential sink for these pollutants for a long period of time . The presence of heavy metals in sediments can lead to great environmental problem when the contaminated sediments re suspended and such metals are up taken by filter feeder mollusk . Sediments are important sink for various pollutants like pesticides and heavy metals (Voigt , 1999).

There are no potable water supplies in of these catchments areas, hence dependence on water source mainly from ground–and surface waters for domestic ,irrigation and livestock activities. Obviously, the chemical status of the marshes would have its influence on the receiving land (Richardson and Hussain, 2006).

Trace metals have been referred to as common pollutants, which are widely distributed in environment with source mainly from the weathering of minerals

and soil (Klavins *et al*., 2000) . sediment can also provide a deeper insight into the long- term pollution state of the water–body. Sediment has been described as a ready sink or reservoir of pollutants including trace metals where they concentrate according to the level of pollution (Becker *et al*., 2001; Onyari *et al*., 2003). Analysis of sediment being a useful method of study environment pollution of trace metals and has been used in numerous investigation in aquatic environment (Hart,1982). There are many studies focusing on this topic Al-Imarah and Al- Khafaji (1998) established the effect of industrial effluent upon the levels of trace metals in water and sediment of the ShattAl-Arab river. Abaychi and Dou-Abul (1986) studied the geochemical fractionation of Cd. Cr, Cu, Fe, Mn, Ni, Pb, V and Zn in the sediment from the northern part of Shatt Al-Arab river and KhorAl-Zubair. Abaychi and Dou-Abul (1985) study Cd,Co,Cr,Cu,Fe,Mn,Ni,Pb, Vand Zn in the northern part of Shatt Al-Arab river. There are many investigations on the marshes environment a study of (Richardson and Hussain,2006), the study of (Al-Imarah *et al*., 2006), the study of (Al-Imarah *et al*., 2007), the study of (DouAbul *et al*., 2007), the study of (Albadran and Hassen 2003).

Aim and Purpose of the research

This study would provide an understanding about the trace metals in sediment, the early identification of in organic contaminants such as trace metals, which are all toxic above a specific threshold of bioavailability level is essential to avoid damage to aquatic environment.

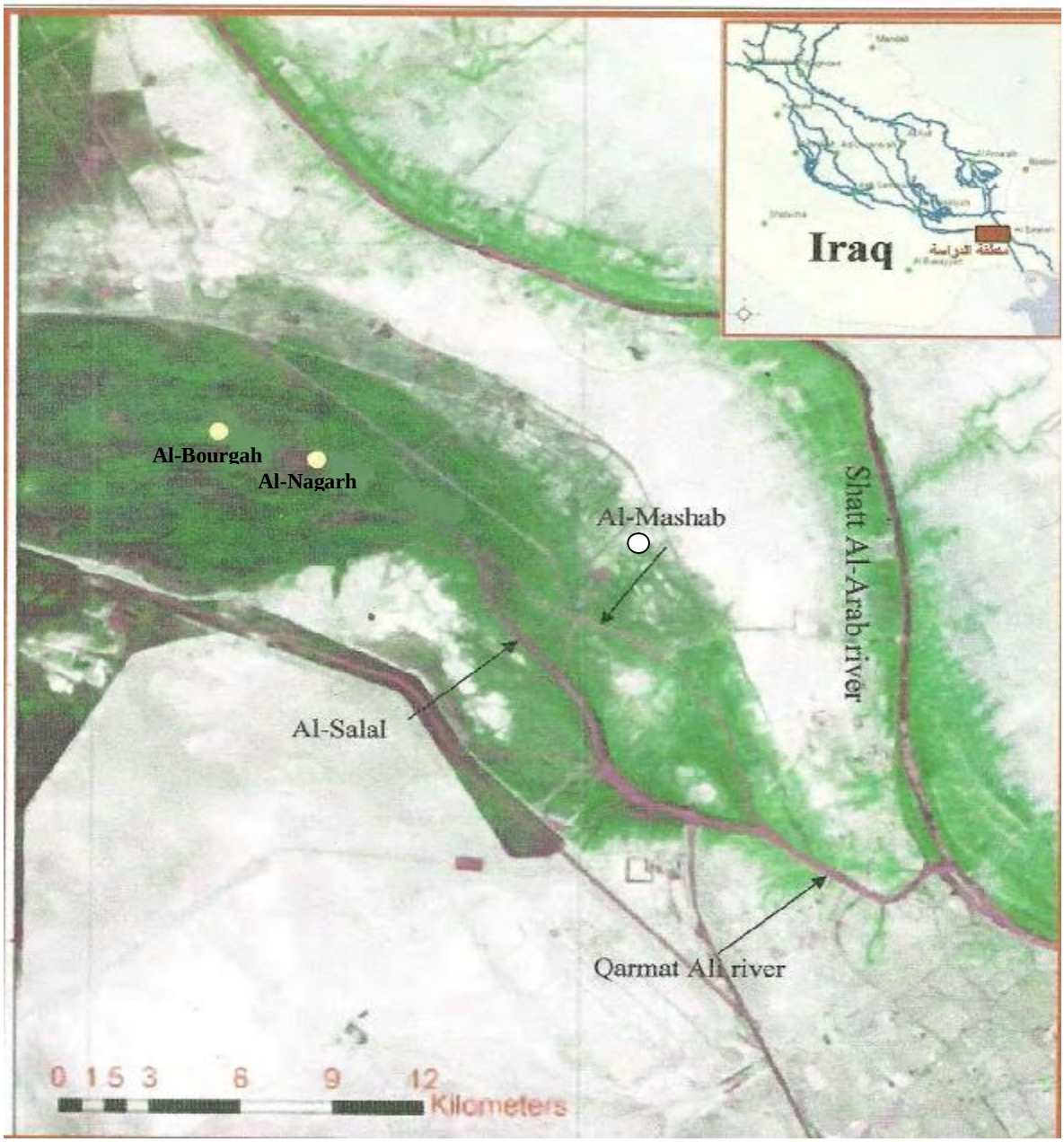

Fig. 1: Study area.

2- Description of study area

Iraq have many aquatic environments located in the southern and northern such as rivers , marshes and lacks . Marshes concerning as the largest ecosystem in the middle east and in west Asia (UNEP,2001). It is located within the east southern of Iraq between latitude 45º 30¯25¯ and altitude 48º 46¯13¯). It is regarded as a shallow water pond its depth ranged between 2-7 meter , its surveying is 8000-30000 Km^2 because of the seasonal variations in the water of Tigris and Euphrates (Figure 1).

3-Materials and methods

Sediment samples were collected from the southern part of Alhammar marsh during 2009 (Fig1) three stations Al-Nagara , Al-Masahab and Al – Burga were selected in this area sites in the dry period (March, April and May) and the wet period (September, October and November). A van veen grab sampler were used to collect samples . A sample of the surface 5 cm was kept for trace metals were stored in cooler for transport to the laboratory at the university of Basrah .Trace metals analysis was performed on the <63 µm fraction of the sediment which has been separated by sieving and grinding. Samples was done to the following procedure described by ROPME (1983), using Flame Atomic Absorption Spectrophotometer . the temperature of water measured by simple thermometer, pH values measured by pH meter by using Buffer Solutions 4,7,9. Cl, Mg, and Ca ions measured by using procedure described by Lind (1979). SO_4 and HO_3 and Salinity measured by using procedure described by APHA (1995).

4-Result and discussion

Analysis on the presence of heavy metals was performed in sediment sampled in 3 places (Table 1, 2 and 3) shows that the southern part of the study area is a source point of pollution with trace metals. The mean concentrations of Cd in sediment varied between 3.51 and 3.80 µg/gd.w, in dry period, 2.61and 4.21 µg/g d.w in wet period . The higher level of Cd in this study obtained might be due to contribution from other sources such as agriculture run off where fertilizer are used (Al-Saad *et al*., 2007) . Trace metals enter the aquatic environment of southern Iraq from both natural and anthropogenic sources (Al-Saad *eta*l.,2007).

The levels of Pb obtained in sediment 31.92 and 48.22 µg/g d.w, 54.76 and 71.42 µg/g d.w, hence the sediment could be an influential factor on the level of Pb in marsh water with other enhancing factors such as the current flow, degrees of

temperatures and pH since water acidity is known to influence the solubility and availability of metals . The range for Pb in river water for domestic use in 0 to 0.01 mg/l (DWAF, 1996a).

The values of trace metals obtained in this study exceed the allowable level hence making the water unsuitable for domestic use. The use of the marsh water for drinking purposes by man and animals could lead to accumulation of the metal with resultant ill- health effects .Levels obtained in this study were higher than these ranges, hence the water could still be used for irrigation and livestock watering purposes as far as this parameter is concerned. Chronic exposure to Pb has been linked to growth retardation .

Table(1) Levels of trace metals * (µg/g ±SD) in sediment samples Al-Mushab station .

	Sampling dates	
Metals	dry period	wet period
Cd	3.51 ±0.09	4.11 ±0.1
Pb	48.22 ±0.3	71.42 ±0.82
Co	213.64 ±1.2	102.24 ±0.48
Zn	433.27 ±3.4	509.23 ±4.98
Cu	16.50 ±0.02	17.87 ±0.05
Ni	114.92 ± 0.72	146.70 ±0.94

* Values are mean of triplicate analysis.

Table(2) Levels of trace metals * (µg/g ±SD) in sediment samples Al-Nagarh station.

Metals	Sampling dates	
	dry period	wet period
Cd	3.57 ±0.02	2.61 ±0.01
Pb	44.82 ±0.28	54.76 ±0.31
Co	145.17 ±0.61	131.90 ±0.57
Zn	420.11 ±6.40	422.40 ±3.7
Cu	20.18 ±0.03	12.67 ±0.01
Ni	122.90 ±0.49	120.40 ±0.62

* Values are mean of triplicate analysis.

Table(3) Levels of trace metals* (µg/g ±SD) in sediment samples Al-Bourgah station.

Metals	Sampling dates	
	dry period	wet period
Cd	3.80 ±0.01	4.21 ±0.10
Pb	31.92 ±0.07	59.12 ±0.28
Co	311.28 ±1076	216.70 ±1.98
Zn	408.14 ±3.30	478.15 ±3.85
Cu	22.72 ±0.02	20.63 ±0.01
Ni	130.75 ±0.65	161.89 ±0.62

* Values are mean of triplicate analysis.

Table (4) Some chemical and physical parameters of water samples Al-Mushab station.

Sampling dates	Inorganic mg/l						pH	A.TC^0	W.T C^0
	Cl^-	SO_4^{--}	$^-HCO3^-$	Ca^{+2}	Mg^{+2}	Sal‰			
March ,April and May 2009	1498.5	934.37	242.30	238	206.6	3.2	8.1	23.07	20
September, October and November 2009	2023.3	1639.5	281.12	233	210.2	4.97	7.3	30.1	23.57

* Values are mean of three determinations.

Table(5) Some chemical and physical parameters of water samples Al-Nagarh station .

Sampling dates	Inorganic mg/l						pH	A.T C^0	W.T C^0
	Cl^-	SO_4^{--}	$HCO3^-$	Ca^{+2}	Mg^{+2}	Sal‰			
March ,April and May 2009	1903	1118.8	232.3	262	273.6	4.0	8.1	23.075	20
September, October and November 2009	2021	1767.8	282.3	234	216.1	5.0	7.3	30.25	23.57

* Values are mean of three determinations.

Table(6) Some chemical and physical parameters of water samples Al-Bourgah station.

Sampling dates	Inorganic mg/l								
	Cl^-	SO_4^{--}	$HCO3^-$	Ca^{+2}	Mg^{+2}	Sal‰	pH	$A.TC^0$	$W.TC^0$
March ,April and May 2009	1826.3	1055.3	251.35	265	292.1	4.3	8.12	23.075	20
September , October and November 2009	2025	1893.5	289.7	251.6	224.8	5.05	7.3	30.25	23.57

* Values are mean of three determinations.

in children (Schwartz *et al*., 1986). Pb toxicity studies conducted on female mouse revealed mostly miscarriages, premature delivery and infant mortality (Taupeau *et al.*, 2001).

Concentration of Co in sediment , it varied from 145.17 to 311.28 µg/g d.w in dry period ,102.23 to 216.70 µg/g d.w in wet period . Cobalt is regarded as an essential element and forms part of Vitamin B_{12} required for red-blood cell synthesis . There is a wide margin of safety between toxic concentrations and nutritional requirement levels of Co . However, adverse chronic effects of Co ingestion at concentration > 2mg /l may occur (DWAF, 1996d). The range obtained in this study exceeds this amount Elemental Co is not found in nature but exists variously as sulphide ores and in association with As, Fe, Ni and Cu . Other possible sources in the river water include wastes from some metal alloys (Abaychi and Dou-Abul 1985).

Levels of Zn in sediment ranged between 408.14 and 433.27 µg/g d.w in dry period and 422.40 to 509.23 µg/g d.w . The Zn in water for domestic use is 3.0 mg /l (DWAF1996a) ; hence no detrimental effect from domestic water usage at the level obtained in this study are expected . Irrigation and livestock watering (DWAF1996c) are 0.002 mg/l ,0 to 1.0 mg/l and 0 to 1.0 mg/l and 0 to 20 mg/l respectively. Since the range obtained was much lower than the TWQR values .

Levels of Cu in sediment ranged from 16.50 to 22.72 µg/g d.w in dry period and 12.67 to 20.63 µg/g d.w in wet period . The Cu in water for domestic use is 0 to

1.0 mg/l (DWAF 1996a) . The range obtained was higher than the set value, the reason may be due to the decreasing of water column and its results the increasing of sedimentation . The levels of Cu for irrigation and livestock watering are 0 to 0.2 mg/l and 0 to 5.0 mg/l respectively .

Levels of Ni in sediment ranged from 114.92 and 130.75 µg/g d.w and 120 to 161.89 µg/g d.w . More attention has been focused on the toxicity of Ni in low concentrations, such as the fact that Ni can cause allergic (McKenzie and Smythe, 1998). The typical concentration of Ni in unpolluted surface water are given as 5.0×10^{-4} mg/l (DWAF,1996d). The range obtained in this study was much higher, indicating that the waters contaminated. All Ni compounds except for metallic Ni have been classified as carcinogenic to humans (IARC, 1990).

Some physical parameters determined in the stations of marsh water are presented in (Table 4 ,5,and 6) . The mean of pH of the marsh water ranged between 7.3 and 8.12 Water acidity is known to influence the solubility hence the values of pH denoted that the water in alkaline state and this due to HCO_3 (Hussein *et al.*,2001). The inorganic compounds plays important role in water retention ,aggregation and soil structure . It is a measure of soil fertility and could also affect the mobility of metals from soil to plants ,(Radojevic and Bashkin, 1999). The degrees of temperature effected on the metabolism of watery plants and then effected on the biogeochemical cycle of trace metals (weiner, 2000) .The decreasing of pH values effected on the sediment and cause (Phytotoxic) because of the element (Mn and Al) and decreased CO_2 and then HCO_3 and also decreased the nutrients like Mg and Ca (Gambrel and Patrick, 1998) The salinity effected also on the biogeochemical cycle (Wetzel, 2001). Iron and Mangaes oxided may be converted to Carbonates or Sulphides, leading to a decrease in adsorption capacity of sediment, the concentrations of trace metals are effected by chemical and physical parameters (Wetzel,2001).

5-Conclusions

The study revealed that the elevated levels of Cd and Pb were detected in the sediment ,which could be directly detrimental to the health of the aquatic ecosystem and indirectly to organism since the river water is used to irrigate a nearby farmland . zooplankton , fish and other organisms then to the people in food web , hence continual assessment is highly essential .

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تراكيز العناصر النزرة في رواسب الجزء الجنوبي من هور الحمار ، العراق.

سامي طالب لفته الياسري

قسم الكيمياء البيئية البحرية . مركز علوم البحار، جامعة البصرة

الخلاصة

قيست تراكيز سبعة من العناصر النزرة (الكادميوم ، الرصاص ، ألمنغنيز، الخارصين ، النحاس ، النيكل ، الحديد) في رواسب ماخوذة من مناطق منتخبة من الجزء الجنوبي من هور الحمار من مواقع ثلاثة(المسحب ،النكارة ، البركة) خلال فتر ة الجفاف في شهر(آذار ، نيسان ، مايس) وفترة ارتفاع منسوب المياه وعودتها في الأشهر (ايلول ، تشرين الأول ، تشرين الثاني) من عام 2009 .

أشارت النتائج بان منطقة المسحب هي من أكثر المناطق الملوثة بالخارصين والرصاص . منطقة النكارة هي اقل المناطق الملوثة بجميع العناصر النزرة المقيسة ، البركة هي من أكثر المناطق الملوثة بالكادميوم ،الكوبلت ،النحاس والنيكل . والتي تؤثر على الصحة والنظام البيئي والمجمعات الريفية بسبب اعتمادهم على مياه الاهوار الغير معالجة في الاغراض المنزلية والري والتي تؤدي إلى التأثيرفي الحيوانات وبالتالي السكان المحليون . ان وجود هذه العناصر في الرواسب المأخوذة من المواقع الثلاثة شخصت على اساس المستويات المختلفة من مصادر التلوث بالنشاطات البشرية المختلفة ، كالفضلات المنزلية والمنسكبات الصناعنية والانجرافات ومن تشاطات القوارب المعتمدة على الوقود السائل .

كلمات مفتاحية : العناصر النزرة، الماء، الرواسب، هور الحمار.

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Amaricf_Basra office@yahoo.com
abdulalwan@yahoo.com
.marshbulletin@yahoo.com

Application of remote Sensing Techniques to Map the Paleochannels of Shatt Al-Arab and Khor Al-Zubair, Southern Iraq

S.T. Almulla, B.N. Albadran and A.K.A. Al-Ali
Geology Department, College of Science, University of Basrah

Abstract

The study area covers the eastern and western part of Shatt Al-Arab River to Khor Al-Zubair channel and the north western coast of the Arabian Gulf. The application of remote sensing techniques on the satellite image Landsat 7 ETM+ (2003) indicates many local and regional interesting observations, which explain many geomorphological features in this area. This geomorphological analysis show five paleochannels; two of them located to the west and the other three to the east of the actual channel of Shatt Al-Arab River, respectively. The image processing reveals also that there are many extinct paleo irrigation systems connected to that five paleochannels and ending to the northern coast of the Arabian Gulf. The isopach maps of equal elevations provide the presence of levee's less than 3m in height. These levee's match with the actual meandering in the Shatt Al-Arab River. This could explain the paleo irrigation of the southern part of Shatt Al-Arab River and Behmashir River channels. Two paleo river lines are also distinguished around the actual channel of Khor Al-Zubair. These observations could be related to the tectonic settings of this area.

1- Introduction

The river channel is a subject to many variations, starting from its tributaries to the last stage of estuary due to hydrological, geological, meteorological and land use factors. For that the migration of river channel with time is an important mechanism which changes the geomorphology of the river. River channel migration phenomenon is well known in the low relief area of the delta plain, especially in the area which covered by unconsolidated sediments. In the Perstrative phase the river bank is low which suffered from the flooding period.

The study area is characterized by low relief (Almulla, 2005), where the maximum elevation is no more than 3 m. above sea level, and the surface is extended horizontally around Shatt Al-Arab and Behmashir Rivers to the inland sabkha. This area covers by Quaternary sediments, and is a subject to sea level fluctuation and meteorological variation which entrain a local contrast in the lithofacies and geomorphological features , (Jassim and Goff, 2006).

This study deals with the paleogeographic map of irrigation channels and their migration with time by application of remote sensing techniques.

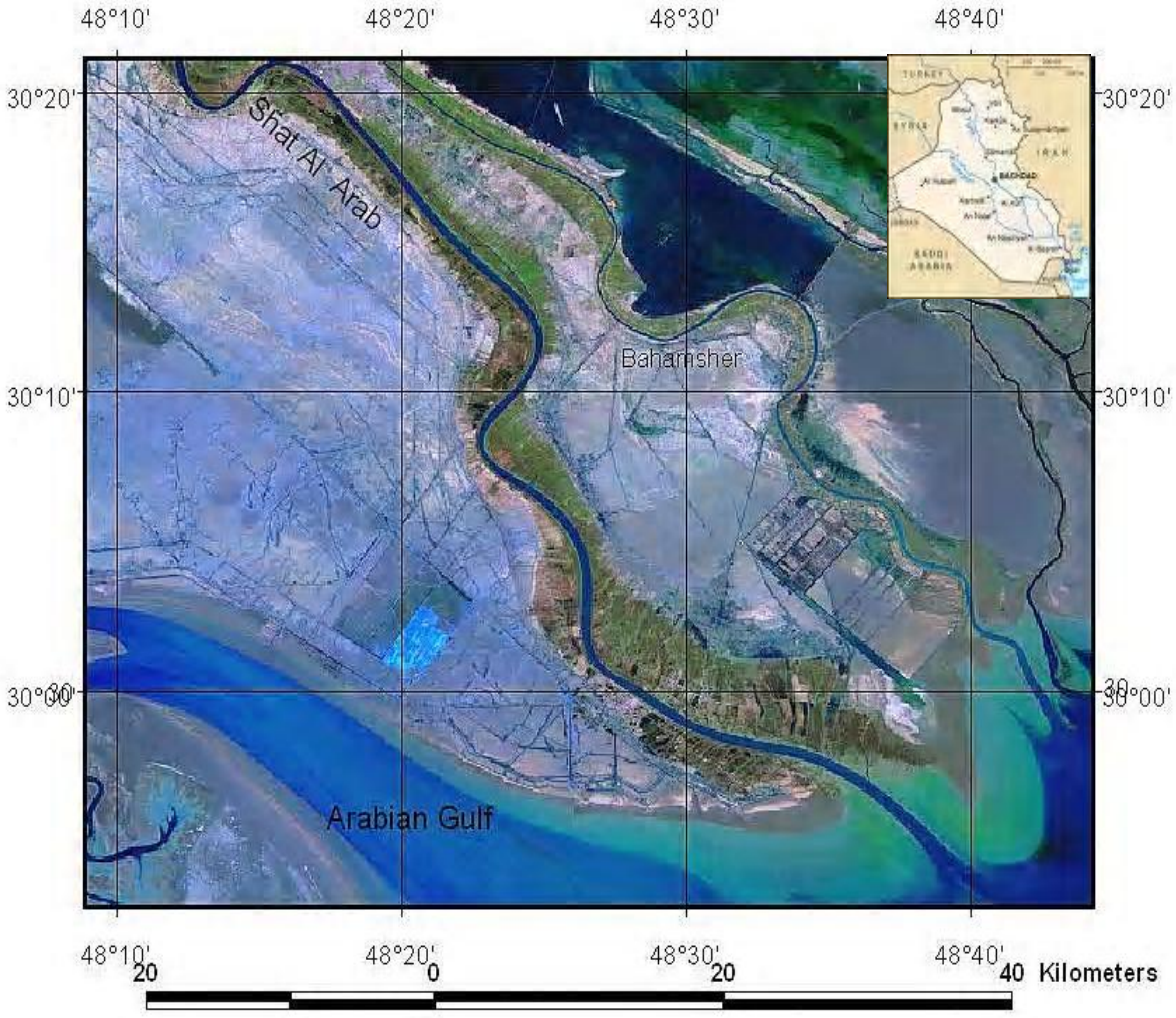


Fig (1) Landsat Image (ETM + , 2002) , showing the study area.

2-**Methods:**

The study area is located between the longitudinal 47° 38' and 48° 57' E, and latitude 29° 44' and 30° 49' N, (Fig. 1). Landsat image (ETM+) (2004) of all spectral bands within the visible to infrared used for this purpose. Erdas imagine 8.4 program was applied to made a several image possessing such as, geometric correction, subset images, spatial and radiometric enhancement and layer stack. Finally, the program Arcview GIS 3.2 was also applied to produce the maps of different scales and coordinates for the study area. Aerial photographs of scale (1: 33,000) (1960) was also employed to match the observations with topographic maps of 1: 100000. f Digital maps

of three dimension views in geomorphic details; accurate and easy interpretation has been obtained.

3-Results and discussion:

Edge enhancement and convolution techniques help to specify the course of extinct paleochannels of Tigris River in the sabkha region between actual position of Shatt Al-Arab River and Khor Al-Zubair (Fig. 2 and 3). In these figures, there are two extinct paleochannels located to the west of actual channel of Shatt Al-Arab. Historical evidences suggest that these two channels represent old migrated channels of Tigris River before it reaches the Arabian Gulf at that time (Lees and Falcon, 1952 and Hansman, 1978). The sharpness techniques with the other assist to reveal the old flood plain of these channels, and indicate the presence of paleo irrigation systems around the channels, which could be used for cultivation and soil reclamation in the southern part of the delta (Al-Mulla, 1999). In the east of Shatt Al-Arab River, the Landsat image reveals also two extinct channels (Fig.4) which could belong to the Karun and Behmashir Rivers before they reached the Arabian Gulf. This continuous migration of channels could submit to geological factors (Al-Sakini, 1993).

Satellite image and large scale aerial photographs reveal two extinct paleo river lines in the tidal flat of Khor Al-Zubair to the west of the study area (Fig. 5. 6). These rivers could participate in reshaping the geomorphologic and sedimentologic features of the area. One of these paleo rivers appears as a relic of clear relief connected to the north eastern part of Khor Al-Zubair, which called Khor Hardan . The other one could be active in the past and responsible for refiguring the north western part of Khor Al-Zubair, which could belong to the ancient Euphrates River. The trace of this river is parallel to the west of river basin and crossing the actual channel of Khor Al-Zubair to the south of Khor Al-Zubair port and finally disappeared under the tidal flat of the Khor to the east.

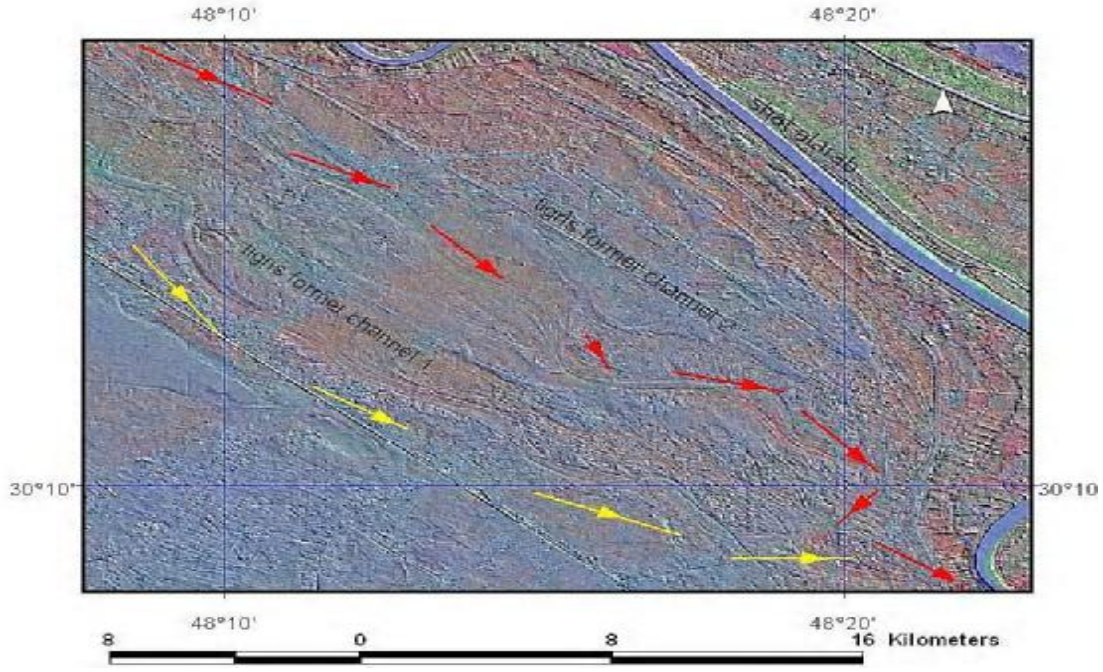


Fig (2) Ancient Tigris channels with their tributaries western shat alarab active channel

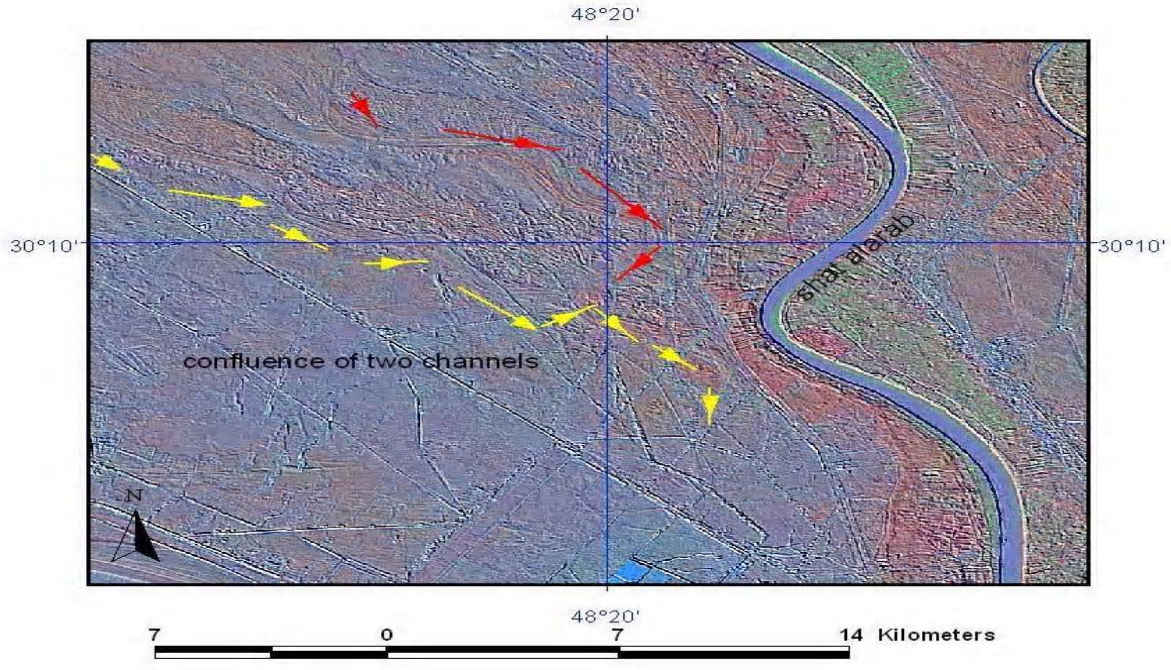
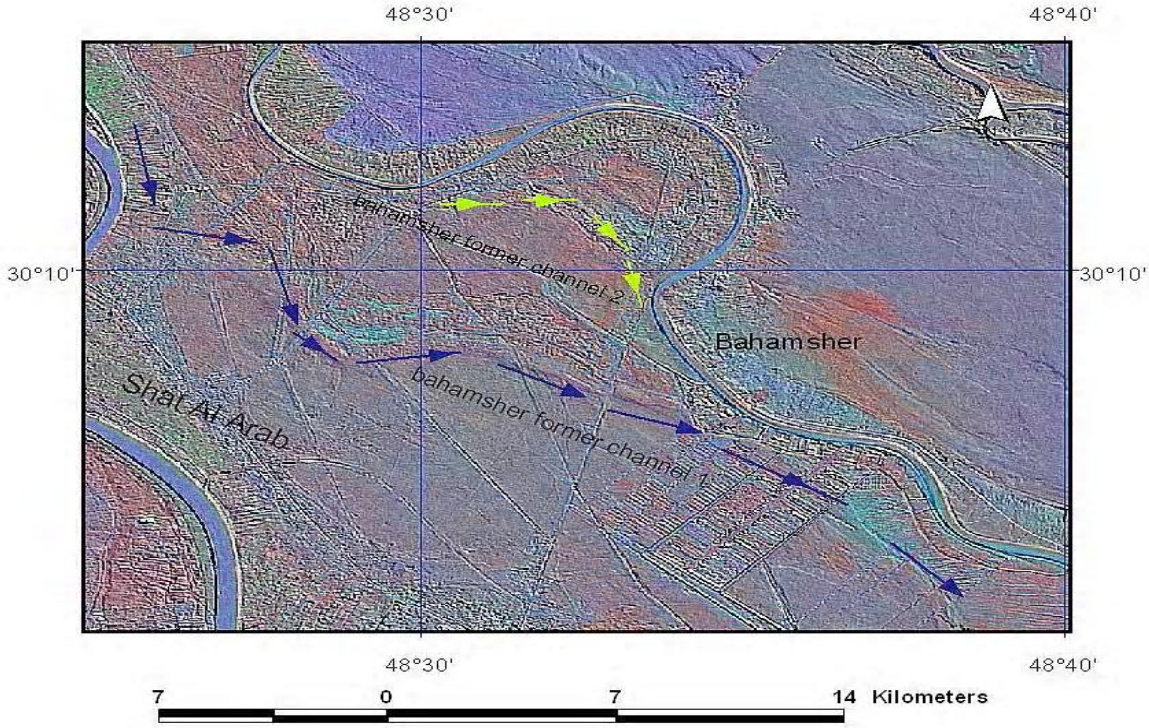


Fig (3) Ancient Tigris channels and their confluence western shat alarab active channel



(4) Ancient Bahmshir channels eastern shat alarab active channel

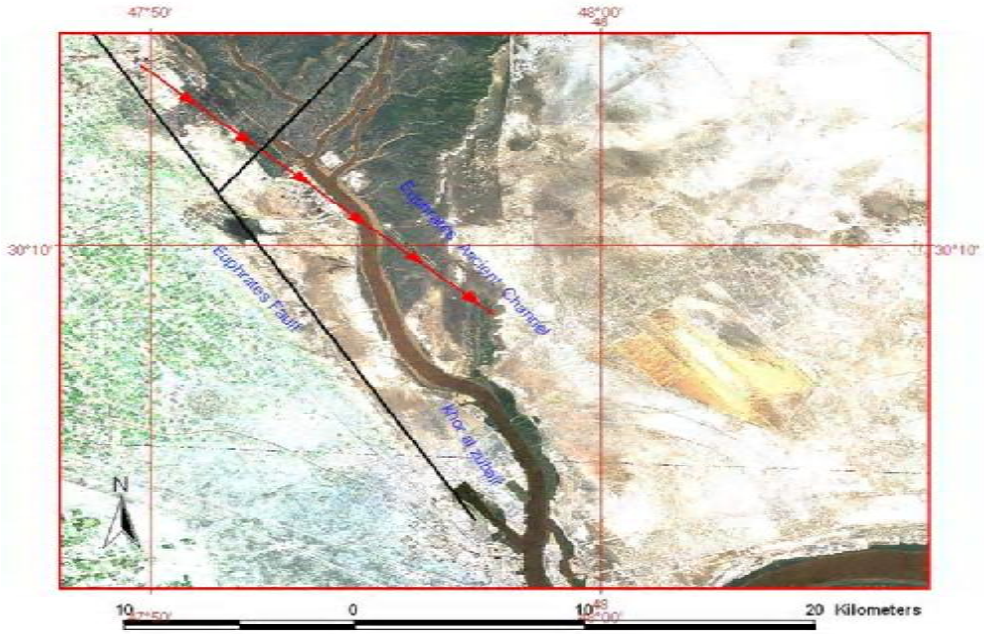


Fig (5) Ancient Channels of Euphrates and Abo al kasib in tidal drainage system of khor Alzubair

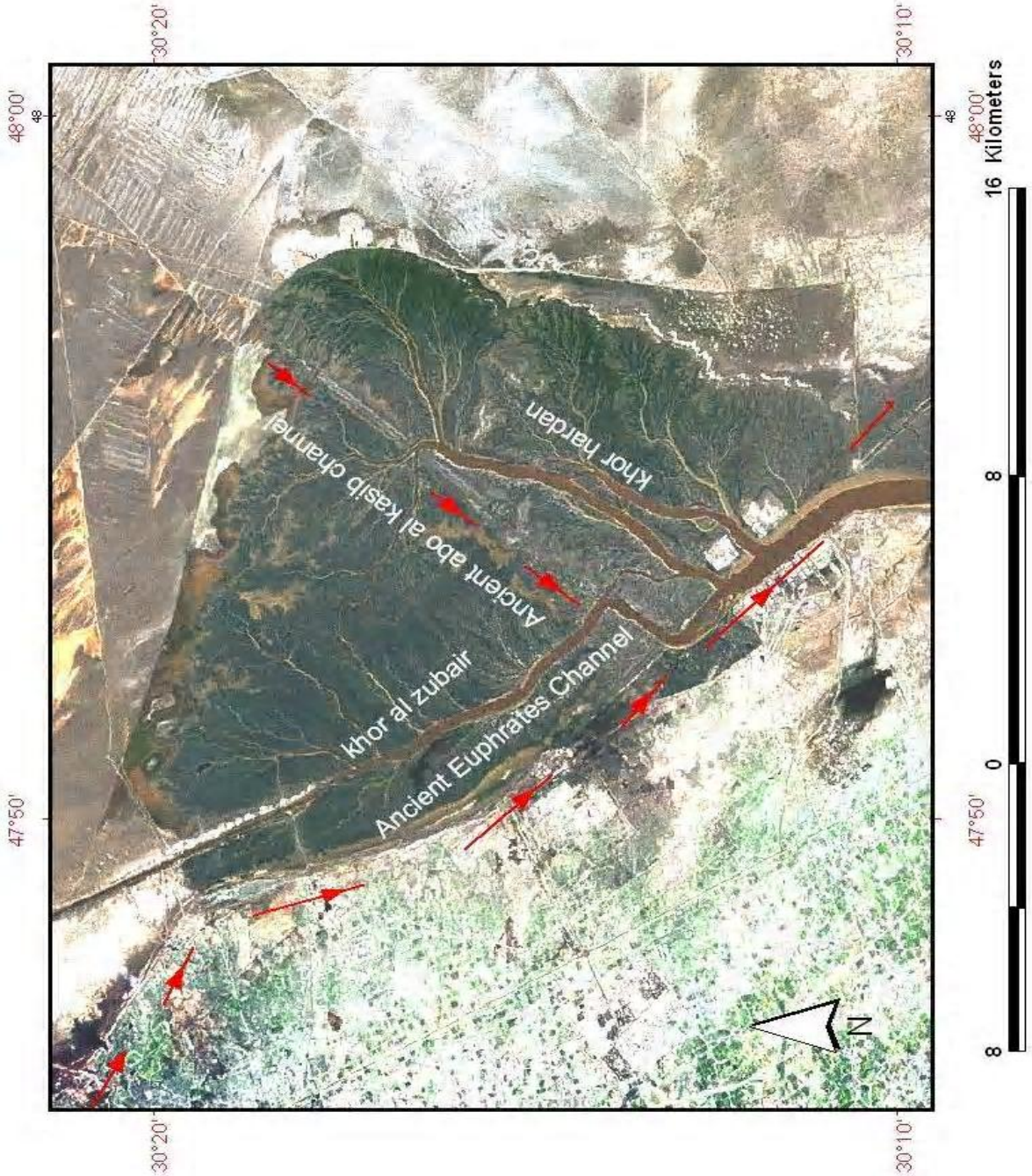


Fig (6) Ancient Euphrates Channel in tidal drainage system of khor Alzubair

4- Conclusions:

Satellite images processing was assisted to delineate the paleogeographical map of the irrigation system in the southern part of Mesopotamian plain . Four extinct channels appeared on both sides of shatt Al-Arab River and two others near Khor Al- Zubair channel. These extinct channels could relate to the river migration in that area which could evolve to the tectonic settings .

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تطبيق تقنيات التحسس النائي للكشف عن القنوات القديمة لشط العرب وخور الزبير، جنوب العراق

سحر طارق الملا و بدر نعمة البدران و علي خالد العلي
قسم علم الارض- كلية العلوم-جامعة البصرة ، العراق

الخلاصة

تغطي منطقة الدراسة الجزء الشرقي والغربي لنهر شط العرب والى قناة خور الزبير وبضمنها الاجزاء الشمالية الغربية لسواحل الخليج العربي. طبقت تقنيات التحسس النائي على المرئية Landsat 7 ETM+ (2004) الفضائية والتي أظهرت وجود بعض المظاهر الموقعية والاقليمية والتي تفسر الطبيعة الجيومورفولوجية للمنطقة. أظهر التحليل الجيومورفولوجي عن وجود اربعة قنوات قديمة مندثرة. تقع اثنان منها الى الشرق واثنان الى الغرب من القناة الحالية لشط العرب. كما أظهر تحليل الصور الفضائية عن وجود أنظمة اروائية قديمة مندثرة متصلة بهذه القنوات وتنتهي عند السواحل الشمالية للخليج العربي. أعطت خرائط تساوي الارتفاع عن وجود مرتفعات جانبية للانهر لا يتجاوز ارتفاعها عن 3 متر عن مستوى سطح البحر، تطابقت هذه المرتفعات مع الانحناءات الحالية لشط العرب. أن هذه المعطيات يمكنها ان تفسر النظام الاروائي القديم للجزء الجنوبي من شط العرب وقناة بهمشير. كذلك تم تمييز قناتين حول القناة الحالية لخور الزبير. يمكن ان تعزى هذه المشاهدات الى الوضع التكتوني للمنطقة.