VOL. 3, NO. 4, April 2013 ISSN 2225-7217
ARPN Journal of Science and Technology

http://www.ejournalofscience.org

Geomorphologic Study Of Umm Al Raşāş Island and Its Surrounding Channels, Shatt Al-Arab River, Southern Iraq

[1] Usama .Q. Alwhaely, [2] Badir N. Albadran, [3] Saher T. Al-Mulla
[1] Department of Marine Geology, Marine Science Center, University of Basra.
[2,3] Department of Geology, College of Science, University of Basra.

ABSTRACT

This study aims to analyze and monitor the geomorphological changes that have occurred on Um Al Rasas Island. This island is located in the Shatt Al-Arab River south of Basra city in southern part of Mesopotamian plain. Field surveys include measurement of water velocity and cross – sectional Profile. Satellite images of Landsat multi-spectral scanner (MSS) 1973, thematic mapper (TM) 1990, and enhanced thematic mapper plus (ETM+) 2002, 2004have been used monitoring the geomorphological changes. The study inferred that there are changes were take place in the total area of island; the increased area reaches 830m^2

Keywords: *Satellite Image, ETM, TM, MSS, Iran, Geomorphologic*

1. INTRODUCTION

The southward-flowing Shatt al-Arab River is formed by the confluence of the Tigris and Euphrates Rivers at Qurna, and is further fed by the Karun River at a junction 35km south of the city of Basra(Mohamed et al., 1999), where the Karun contributes about half of the Shatt al-Arab's final water and sediment discharges (Al-Mansouri, 1996).Currently, twenty-four islands are distributed along the Shatt al-Arab River. All except two are located to the south of Basra, where continuous exchanges between erosion and sedimentation are manifested in formation, erosion, and re-formation of spit islands. A significant proportion of these changes may be attributed to the impacts of human activities on water volume, water flow rates, and sediment volume (Al-Mulla, 2005).

Umm al Raşāş Island is 8.9 km long by 1 km wide, located 35km south of Basra. It is the three islands merged forming a spindle-shaped group that also includes Umm al Raşāş, Um Al-Khasasef, and Deba (Al-Mulla, 2005). This spindle form is a result of water currents diverging at the head of the island into eastern and western channels, with higher water velocity in the easternmost channel. The Umm al Raşāş Island located in mid channel of Shatt Al-Arab river, and this location results in dividing of river channel in two parts,(East-West). In the eastern part of channel ,the water flow velocity is more than western part ,because that the water current in ebb state in addition of the current that coming from Karun river that led to increasing of velocity of currents(Mohammad et al., 1999). As a result the lower part of Umm al Raşāş subjected to erosion. Another possibility is that the western channel in filled due to cessation of channel dredging during the Iran–Iraq war (First Gulf War) 1980–1988. Recently the depth of the west wards channel ranges between (2 -4) m .While the eastern channel is considered as navigational channel of Shatt al-Arab where the depths reached 15m. Karun River is added about half of discharge that contributed by Shatt al-Arab. As well as 18 million ton/year of sediments (Al-Mansoury, 1996) .In addition ,there are wrecks drowned about 5km south of Karun, led to results in deposition of amounts of sediments on the two sides of the channel ,therefore this led to narrowing the river in this reach. The area is crowded with private and commercial watercraft, including shipping associated with Iranian ports on the eastern bank, further narrowing the navigational lane available to Iraqi vessels. Therefore, any change to the gross morphology of the island group can pose a distinct navigational hazard and/or have profound economic consequences. This study is an attempt to characterize the present state of sedimentation patterns surrounding, and geomorphologic changes to, Umm al Raşāş Island.

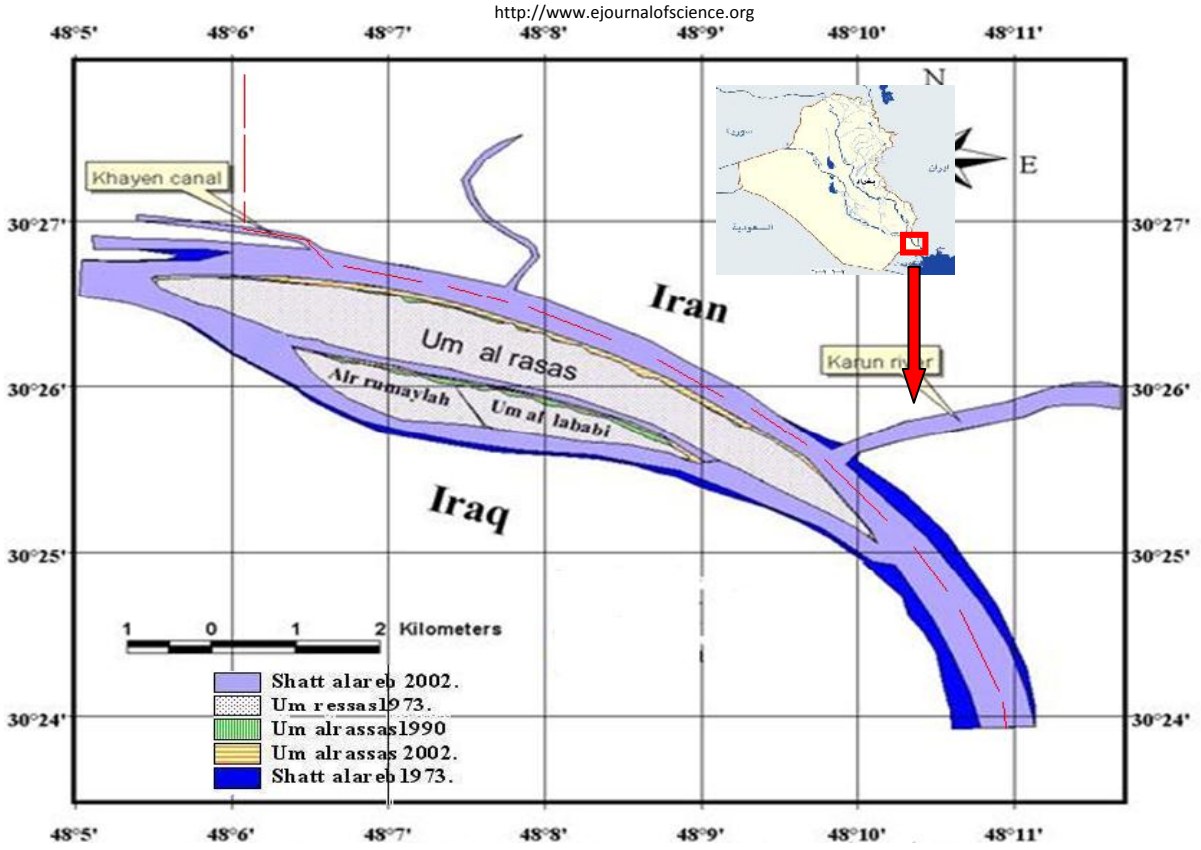

Fig 1A: Map of the Umm al Raşāş Island Group

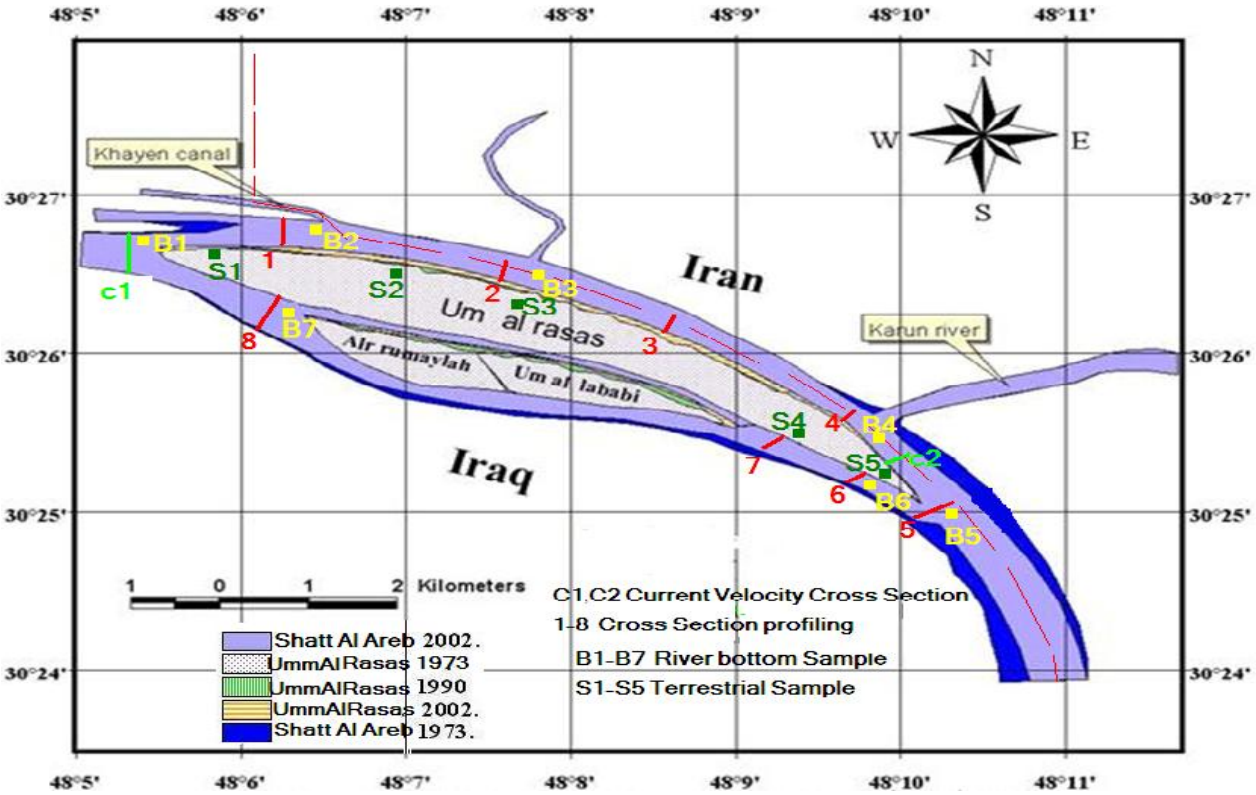

Fig 1B: Umm al Raşāş Island Group. Legend indicates changes to island widths since 1973. Red bars indicate transects for river bottom profiles and measurement of current velocity. Red numbers (S=terrestrial; B=channel bed) indicate sediment sample locations.

2. METHODOLOGY

Ten field trips were undertaken October 2007–2008 on board Mahar, a smaller search vessel belonging to the University of Basra Marine Science Center.

2.1 Satellite Imagery Analysis

The satellite images are provided synoptic view of wide coverage over the area of interest, and enabling the detection of regional geomorphological features. In this study, the satellite images of MSS multi spectral scanner , thematic mapper (TM) and enhanced thematic mapper for the years; 1973, 1990, and 2002 respectively are used . These images are downloaded from the website of Global land Cover Facility (GLCF) Earth Science Data Interface (ESDI). It is geographically corrected With the coordinate projection of Unirversal Transverse Merator(UTM). These images used to monitor the geomorphologic changes that occurred in Shatt Al-Arab Islands (Figure 1).

2.2 Current Velocity Measurement

Fig 2: Measuring water currents. Photo: [First Researcher]

Water velocity was measured across two transects. North of the island, on January 31, 2008, a current meter model CM2 was used to take measurements at surface, mid - water column, and one meter above the river bed (Figure 2), at each of three stations across transect 2 (Figure 1, number 2) Data from a second transect south of the confluence of the Karun and Shatt al-Arab Rivers (Figure 1, number 6) was available from Sedkhan (2009).

2.3 Bottom Profiling

A chart plotter echo sounder type Single beam model PS-10 was used to plot cross-sections of the river bottom along six additional transects (Figure 1, numbers 1, 3–5, and 7–8).The cross-sections that measured in this study, corrected to the bench marks that established by marine sciences center ,1998 .These bench marks referenced to mean sea level datum, that elevated by level instrument.

2.4 Sediment Analyses

Twelve sediment samples were collected. Five terrestrial samples were collected by hand from the ground surface of Umm al Raşāş Island (Figure 1, S1–S5). Seven river bottom samples were collected using a grab sampler, five from the bottom of the eastern navigational channel (Figure 1, B1–B5), and two from the western channel (Figure 1, B6–B7). All samples were kept in plastic sacks, transferred directly to the laboratory, and wet-sieved to calculate the percentage of sand. The wet fraction was then pipetted to measure the percentage of fine -grained sediments (silt and clay) (Folk, 1974).

3. RESULTS

3.1 Umm al Raşāş Island Morphology

The geomorphological development of Umm al Raşāş Island showed in Table 3 below.

Table 3: Change in length, width, above-water area, and above-water circumference of Umm al Raşāş Island.

Year	Length Km	Width (Max) Km	Area Km^2	Net Change Area	CircumferenceKm	Net Change Circumference
1973	8.30	0.85	5.87		16.65	
1990	8.50	0.95	6.42	+ 9.375	17.20	+3.3 %
2000	8.70	0.97	6.64	+ 3.43%	17.32	+ 0.70 %
2004	8.85	0.97	6.70	+ 0.90%	17.47	+ 0.87 %
Cumulative	+ .55	+ 0.12	+ 0.83	+13.7 %	+ 0.82	+ 7.8 %

3.2 Water Current Velocity

Water currents differ inside the cross section 1 that located north of Umm al Raşāş Island (Figure 1). The currents are generally slow at all depths, ranging from (0.01-0.2) m/sec at westward and Eastward, to (0.25-0.32)m/sec at mid (Figure 3). These results may be compared to those reported by Sedkhan (2009) from a second transect (Figure 1, 6),while the cross section 6 south of Umm al Raşāş Island, downstream from the Karun River's confluence with the Shatt al-Arab river ,the water currents was rapid that led to forming of turbulent currents that to western side (Figure 4).

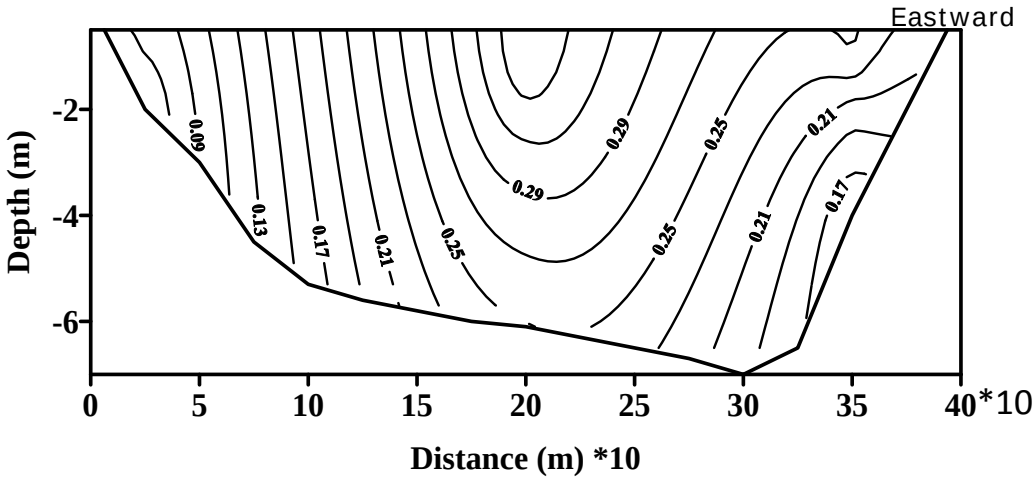

Fig 3: Water currents (m/sec) measured 21 JAN 2008 at cross section 6.

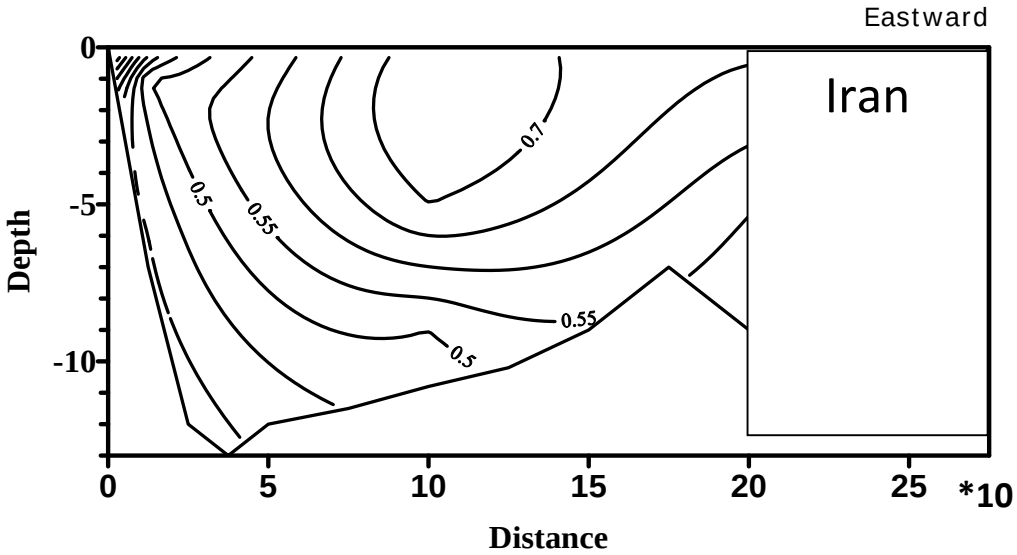

Fig 4: Water currents (m/sec) south the confluence of Shatt al-Arab and Karun Rivers. After Sedkhan (2009).

3.3 River Bed Morphology

The hydrographic survey showed highly variable channel bottom bed shape (Figure 5). Sections 2–5 are incomplete because, beginning north of the confluence of Shatt al-Arab and Karun Rivers, the eastern bank of the Shatt al-Arab River falls inside Iranian territory, precluding access.

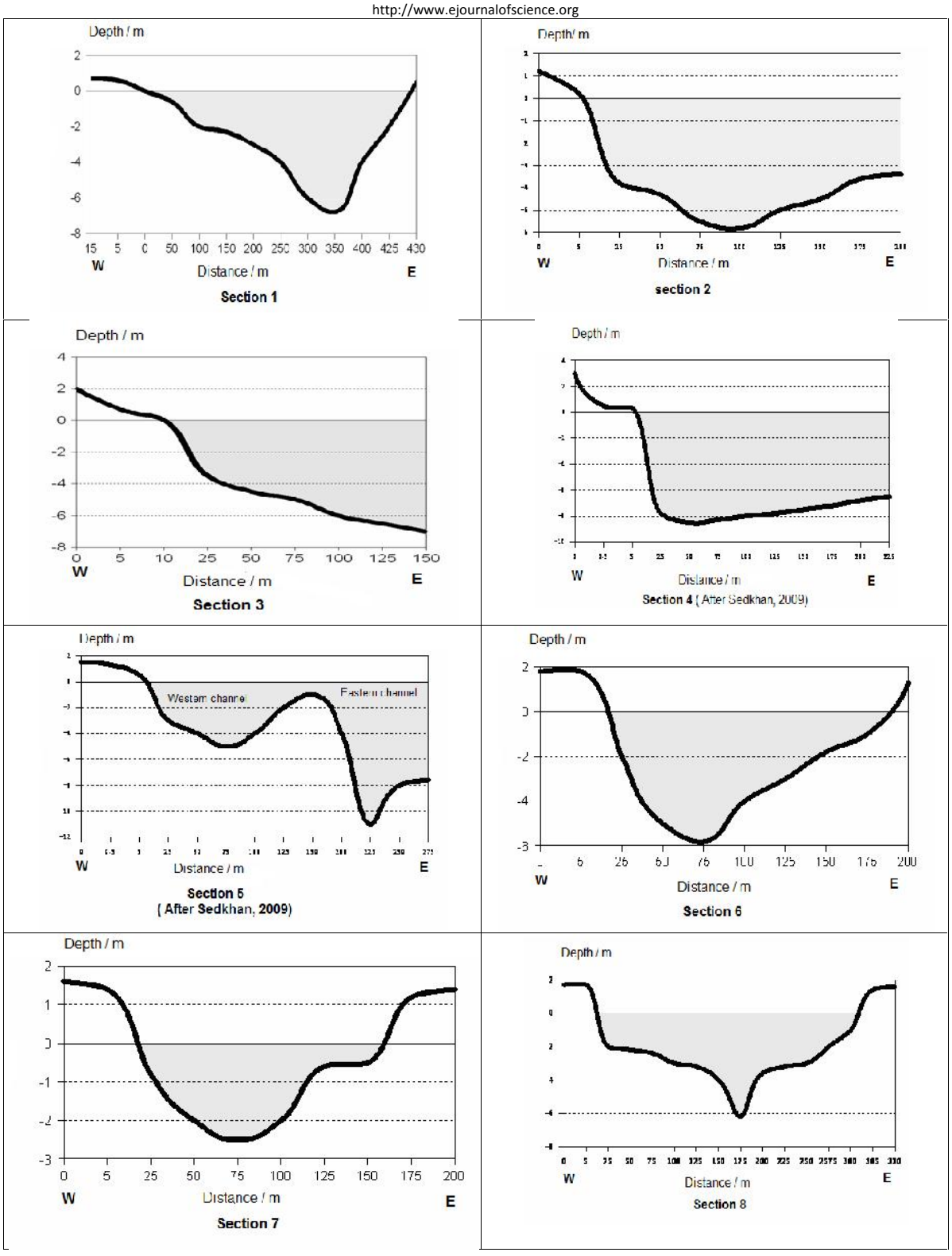

Fig 5: Cross -sections of channels around Um Al- Rasas Island. For transect locations, see Figure 1.

3.4 Sediments

3.4.1 Terrestrial Sediments

Sediments collected from the island are classified as silty (Folk 1974), being composed predominantly of silt (61%–69%), clay (28%–35%), and sand (3%–5%).Sediment statistical parameters (Folk and Ward 1957) are: mean size value ranges 6.7–6.9, poorly sorted, negatively skewed and platykurtic (Table 1).

Table 1: Grain - Size analysis and statistical parameters of Umm al Raşāş Island sediments

Sample	Clay %	Silt %	Sand %	Mean size	Sorting	Skewness	Kurtosis
1	35	61	4	6.96	1.86	–0.05	0.62
2	33	62	5	6.90	1.95	–0.07	0.66
3	30	66	4	6.90	2.00	–0.05	0.66
4	29	67	4	6.80	1.77	–0.01	0.54
5	28	69	3	6.70	1,76	–0.01	0.71

3.4.2 River Bed Sediments

The bed sediment samples collected from the eastern and western channels of Umm al Raşāş Island show a tendency of increasing clay content (Table 2).

Table 2: Grain - size analysis of channel bed sediments

Sample No.	Clay%	Silt%	Sand%
1	23	70	7
2	20	72	8
3	15	70	15
4	1	1	98
5	18	68	14
6	48	50	2
7	45	52	3

4. DISCUSSION

This region was a conflict area during the first Gulf War between 1980 and 1988. Many ships and boats were drowned in that area, which act as sediment traps due to the obstruction the water flow, and the dredging of the navigation channel of Shatt al-Arab River stopped during this time and up to now. All of these factors act together to change the geomorphologic appearance of the channel. There is a decrease in the width of Shatt Al Arab River South of Umm al Raşāş Island during the 30 years ago by about 300 meters.

Umm al Raşāş Island suffer from erosion and sedimentation from site to site, but generally speaking the northern part of this island is a subject to sedimentation whereas the southern part is subject to erosion. These sedimentation and erosion processes take place in general to the periphery of this island.

The shape of Umm al Raşāş Island is spindly, convex side is toward the northeast. This shape was formed by dividing of the currents into two sides (western, eastern) in the area. After gulf war (1980) the currents in the western channel of Umm al Raşāş Island are slow in comparison with the currents in the main channel to the east of Umm al Raşāş Island which forms the navigation channel of Shatt al-Arab. Mohammad et al. (1990) attributed this phenomenon to the meandering of Shatt al-Arab River in that area. In addition to that the eastern channel is highly active by the movement of ships especially the eastern bank of Shatt al-Arab River.

The texture of Umm al Raşāş Island sediment shows a tendency of increasing silt fraction toward the channel due to the nearby the Karun River, where the later supply almost the silty sediment. These factors lead to increase the eddy currents. The eddy currents wash the sediments in many times, taking the fine particles and leaving the coarse one, for that the percentage of sand fraction is high in sample 4, which belongs to the Karun bar (Sadkhan, 2009). Sadkhan (2009) defines the Karun Bar started from the confluence of Karun and Shatt al-Arab Rivers to 5 km south of Umm al-Rasas Island. The equivalence of the silt and clay fraction percentages in samples 6 and 7 could be related to the tide effects during the slack water in the channel between the islands to the west of Umm al Raşāş Island.

The geomorphologic changes in Umm al Raşāş Island are small compared with the navigation activity in the region. The erosion and sedimentation processes occur at the same time. Sections 1 and 2(Figure 5), section 3 shows the absence of erosion in the northern and central parts of eastern bank of the island. The southern part of the east bank of the island is being exposed to the erosion (section 4, Figure 5). Remarkable change in the bank of this island at this area was occurred (Figure 6).

Fig 6: Island bank in front of Karun River mouth. Left: The Island bank at 2005 (Al-Mulla, 2005).

Right: The Island bank during the field work of this study.

From the confluence of Shatt al-Arab and Karun Rivers downstream the scene will quickly turn from erosion to sedimentation and the formation of sand bar in the channel (section 5, Figure 5). The depth over this sand bar in that area is no more than one meter. The area behind the bar which means between the bar and the island becomes trap to the sediments and will be filled with time. Whereas, the erosion is high in front the bar due to the eddy currents formed from the interaction between the water of Shatt al-Arab and Karun River. To the western side of the island the water currents are slow (field observations), the deposition process takes place and the channel is significantly shallow (sections 6, and 7, Figure 5). Section 8(Figure 5) is near piles of temporal bridge constructed during the first Gulf War (1980). These piles act as a trap of sediments behind it and with time many small islands were formed in the mid-channel which narrows the channel. The region is active by shipping traffic due to the presence of Iranian and Iraqi ports as well as the main reason is the confluence of the Shatt al-Arab and Karun Rivers, which contributes with most revenues of Shatt al-Arab River sediment and water. The velocity of water current north of Umm Al Rasas Island is 0.3 to 0.35 m / sec (Figure 3). Increasing the velocity of water currents south of the Karun River to double (Figure 4) as well as the high amount of loaded sediment, which cause what is known as Karun sandy barrier.

The discharge of Karun River is high; its contribution in the total discharge of Shatt al-Arab River is about 66% (Al-Mansoury, 1996). The direction of Karun River currents is perpendicular on the water body of Shatt al-Arab River. The bathymetry of the area varies, it is about 6–7 meters in the eastern channel north of Umm al Raşāş Island, then increases to reach 10 meters to north of the confluence of Shatt al-Arab and Karun Rivers. At the confluence the depth is 15m. at a longitudinal depression in the bed of the river (Sedkhan, 2009), which could attributed to the scouring action generated from the eddies currents after the interaction of the currents of the two rivers during the ebb tides downstream Shatt al-Arab River. After that, the bathymetry of the Shatt reduces to about 10m.

Fig 7: The spit formed at the southern end of the island.

5. CONCLUSIONS

The Shatt al-Arab River represents the final, or perstrative phase of the Tigris-Euphrates-Karun watershed, where the water velocity is slow and sedimentation is the predominant influence on the local geomorphology of the river

ACKNOWLEDGEMENTS

The authors gratefully acknowledge Dr. Jennifer Pournelle, PhD, Research Assistant Professor, Environment and Sustainability Program, School of Earth, Ocean and Environment, University of South Carolina for reading the manuscript of the paper and for her encouraging comments.

REFERENCES

[1] Al-Mahdi, I. A. and Al-Asadi, S.afaa A., 2007. Some characteristics geomorphological diversion of Shatt Al- Arab. Basra Human Sciences Research Magazine, vol. 32, No. (1) part (b) pp.88–104.

[2] Al-Manssory, K. Y., 1996. Sediment transport in the lower reach of Shatt al-Arab. Unpubl. MSc. Thesis, University of Basrah (In Arabic).

[3] Al-Mulla, S. T., 2005. Geomorphologic studt of Shatt Al -Arab valley by application of remote sensing technique. Unpubl. PhD. Thesis, University of Basrah (In Arabic).

[4] Folk, R. L., 1974. Petrology of Sedimentary Rocks.Hemphill Pub. Co.Texas, USA.p.128

[5] Folk, R. L. and Ward, W.C., 1957. Brazos River bar study in the significance of grain size parameters. J. Sed. Pet., No.27, pp. 3–26.

[6] Mohamed, A. M., Albadran, B. and Hussein, N.A., 1999. Topographic survey of Shatt Al Arab river course from Al-Karma to the Arab Gulf. Internal report, Marine Science Center, University of Basra, pp 48.

[7] Sedkhan, M. T., 2009. Sedimentological, hydrographical and mineralogical study of Karun River area confluence with Shatt al-Arab River and adjacent area.Unpubl. MSc. Thesis, University of Basrah (In Arabic).