

Some geotechnical soil properties of western bank of Khor Al-Zubair channel coast at Khor Al-Zubair Port location, southern Basrah, Iraq

W.R. Muttashar

Marine Geology Dept., Marine Science Center

e-mail: wrmgeo@mscbasra.com

(Received: 23 November 2009 - Accepted: 31 May 2010)

Abstract - Five Offshore Boreholes have been drilled by the National Construction Center at Basrah with cooperation the Marine Science Center/Basrah University, together with three Onshore Boreholes at the western bank of Khor Al-Zubair channel during July 2009. The drilling machine of Auger type has been used for drilling. Representative soil samples were taken at appropriate intervals ranged between 0.5 and 2.0 meters depth or where the stratum has been changed. Onshore boring depths ranged from 19.0 – 20.5 m, from natural ground surface, while, the offshore borings were from 7-16 m from the bed level. The depths of drilling reached the bedrock which is hard enough to require N-value of more than 50 blows. Standard Penetration Test (SPT) has been carried out for each 2m depths. Grain size analysis, moisture content, Atterberg limits of these soils were also determined. The results show that there are two main strata making up the coast bank of the navigational channel of Khor Al-Zubair. First is Marly silty Clay or fat clay soil which has of a thickness 18 m, and gradually changes from very soft- m.stiff to stiff-v.stiff which belongs to the Hammar deposits. The second is Silty Sand layer which has two types of sandy soil, these are: (1) borrowed Back filled layer as surficial compaction soil with of a thickness 2.0 m, and (2) are interacted lenses stratum between the gray stiff silty clay and the hard brown silty clay in the near and onshore Boreholes which belongs to the Dibdiba formation.

Keywords: Soils, SPT, Banks, Khor Al-Zubair, Basrah.

Introduction

The investigated area is a part of the western bank of Khor Al-Zubair coast, (Figure 1). The banks of Khor Al Zubair channel are extended along to about 40 Km. Structural setting of Khor Al Zubair tongue indicates a neo tectonic existence responsible of the formation of a fault structure of Khor Al-Zubair zone, which represented an extension of the ancient Euphrates river course (Al-Mosawi, 1991). The uplift of the neighboring areas of Khor Al-Zubair and the subsidence of others led then to the propagation of the sea level and disconnecting of the Euphrates course. Subsequently, Khor Al-Zubair channel became a natural extension of the marine water inside the land. It is recently considered as an elongated lagoon environment (Al Mosawi, 1993; Wasil, 2003). Sediments of Khor Al Zubair banks mostly belong to both Tertiary and Quaternary ages. They involve floodplain, Deltaic and wind deposits as sandy Dibdiba formation deposits. Also, the

presence over of the lacustrine, estuarine and marine deposits belonging to the fine-grain of the Hammar formation deposits. Hammar formation deposits are widely spreading over this region which is considered as lacustrine soils (silts and clays), where their deposition mode is very uniform and consistent. Therefore, their engineering properties are often poor (Coduto, 2007). Many previous studies assessed the engineering properties of the surficial fine-grained sediments in this region, and their improvement methods (Al-Tai, 2005). In spite of this mode of deposition, they may be more predicable than other erratic soils of flood plain soils (Coduto, 2007).

Khor Al-Zubair tongue recently became a navigational channel with a length of 40Km, width of 600-800 m, and a depth of up to 22m. It has a semidiurnal tidal rhythm with amplitude of range within 5m. Khor Al-Zubair area contains a group of important Iraqi ports. The northern part of the channel includes Khor Al-Zubair (KAZ) Port on the western bank, where the investigation was carried out. KAZ port needed rehabilitation after the wars which hold in the region since its construction in 1978, where it was subjected to great deform and neglect. Also, it does appear necessary to modernize the port. Many geotechnical investigation in the world involved rehabilitation and remediation projects, including land sliding failure, embankment stability, slope stabilization, subgrade, replacement of old foundation systems (Mayne, 2001). So that, it requires a site investigation and most important of which is soil properties. This study is aimed at investigating the site soil properties of the western bank of Khor Al-zubair Channel which located within the zone of KAZ port, as part of the program of remediation and rebuilding of Khor Al Zubair port.

Materials and Methods

Five Boreholes were drilled offshore up to a depth of 7-16m by the National Construction Center at Basrah in cooperation with the Marine Science Center, Basrah University on July 2009, in addition, three Boreholes were drilled onshore up to a depth of 19-20.5m from the ground surface using an Auger drilling machine, (Figure 1).

The drilling machine (Auger type) has been used to drill the boreholes which consist of segments of rods encircled by a helical blade, over the whole length, which conveys the soil from the bottom of the hole to the surface. Representative soil samples were taken at appropriate intervals ranged between 0.5 and 2.0 m deep and also if the stratum has been changed. The depths of drilling reached the bedrock which is hard enough to require N-value of more than 50 blows. Standard Penetration Test (SPT) has been carried out for each 2m depths according to ASTM Std. 1586. Samples were obtained from the boreholes by driving into the subsoil Standard Split Spoon Sampler, (S.S Samples). In the same time the most disturbed samples were recovered by S.S. sampler. SPT test is one of the most popular tools for geotechnical characterization data in the world (Zekkos *et al.*, 2004), where 80-90 percent of the estimated geotechnical investigations consist of SPTs (Thorner, 2001).

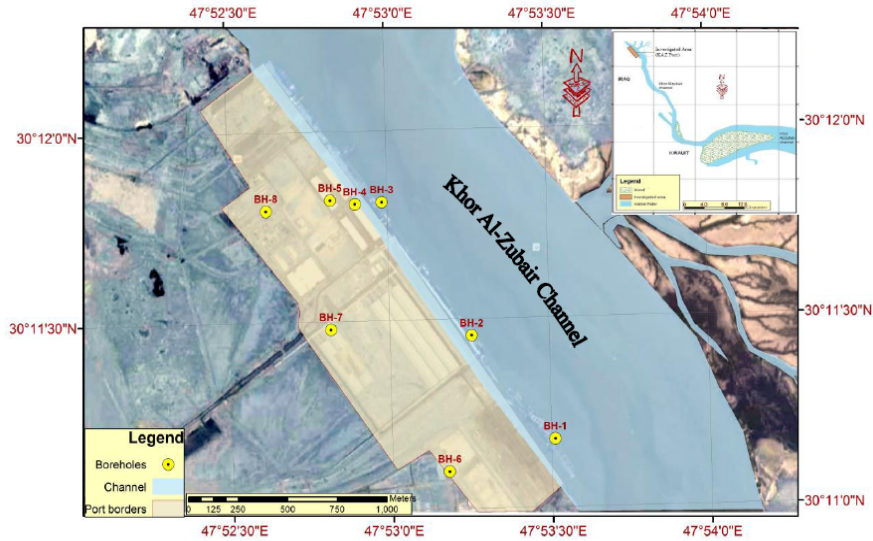


Figure 1. Map showing study area, Khor Al-Zubair region.

The depths at which N-Values have been obtained were observed on the sections (Figures 2, 3, 4, and 5) at each of the boreholes.

According to ASTM D1586 standards, soil samples were prepared and analyzed. Classification tests were carried out these includes the visual classification to identify samples, and the grain size analysis, Atterberg limits and moisture contents; as well as the specific gravity.

All depths were referenced to the chart datum Main Lowest Low water (MLLW), which was plotted with a blue line in the sections Figures.

Results and Discussion

The subsoil section (sections A, B, C and D) in Figs. (2-7) were having the following features:

The first soil layer which exposed only in the onshore Boreholes consists of medium to very dense brown silty sand (SM) slightly gypseous or well graded sand with silt (SW-SM). This layer extends to about 2.0 m depth. This layer is borrowed backed filled brought to the port and subjected to compaction to form reinforcement layer of constructions foundations.

The second soil layer consists of soft to medium stiff gray lean clay, silty clay (CL), or fat clay (CH), which extends to about 14.0-17.0 m depth. Whereas a soil layer consists of medium stiff to stiff gray lean clay, (CL) or fat Clay (CH) at BH-04, BH-05 locations extends to about 15.0 m deep, while the consistency of this layer increase to stiff - very stiff at BH-01 and BH-02 locations which extends to a depth of about 23.0 m depth. It belongs to the Al-Hammar formation deposits.

The third soil layer consists of very soft to soft gray or brown marly, lean clay (CL) or fat clay (CH) at sites BH-01, BH-02, BH-03. This layer extends from the existing bed level (E.B.L) down to a depth ranging between 9.0 -22.0 m below the existing ground surface (E.G.S.). This layer belongs to the Al-Hammar formation deposits.

The next soil layer consists of stiff gray silty clay, sandy lean clay (CL) or organic Clay (OL), and extends to a depth of about 18.0 – 19.0 m depth.

Followed by very dense gray silty sand (SM) layer at BH-06, a BH-07 location which extends to a depth of about 21.0 m. At BH-08 location a layer of dense to very dense gray and brown silty sand with gravel (SM) appears at a depth of 15.0 m depth and extends to a depth of about 19.0 m. It consists of hard gray or brown lean clay (CL), fat clay (CH) or clayey silt (ML) at sites BH-01, BH-02, BH-3. This layer extends from the above layers down to the end of boring (E.O.B) at the boreholes locations, while the layer of dense to very dense gray silty sand (SM) was found at a depth ranging between 15.0 and 17.0 m at BH-04, BH-05. This layer represents the Dibdiba formation deposits.

Finally a layer of hard brown fat clay (CH) or lean clay, sandy lean Clay (CL), or elastic silt (MH) was followed which extends from the above layer down to the end of boring (E.O.B).

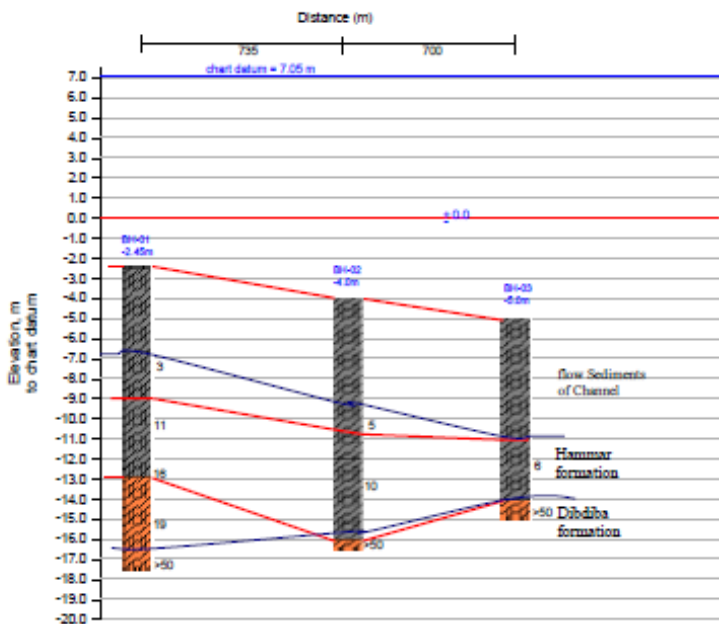


Figure 2. Section (A) offshore Boreholes.

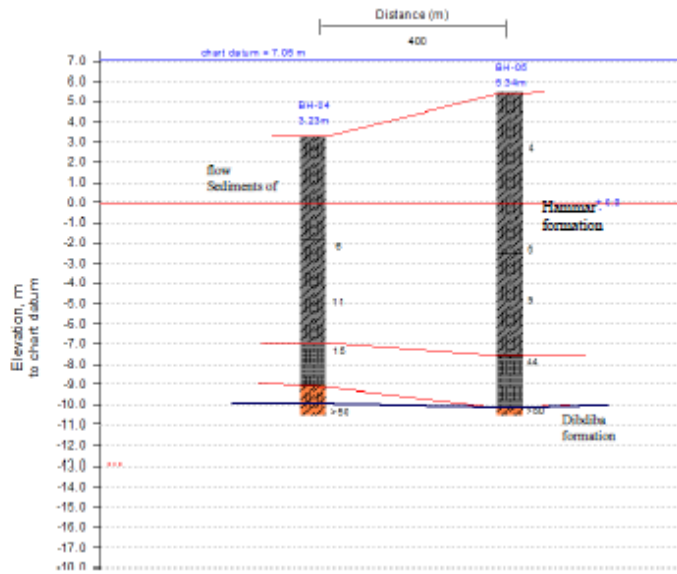


Figure 3. Section (B) nearshore Boreholes.

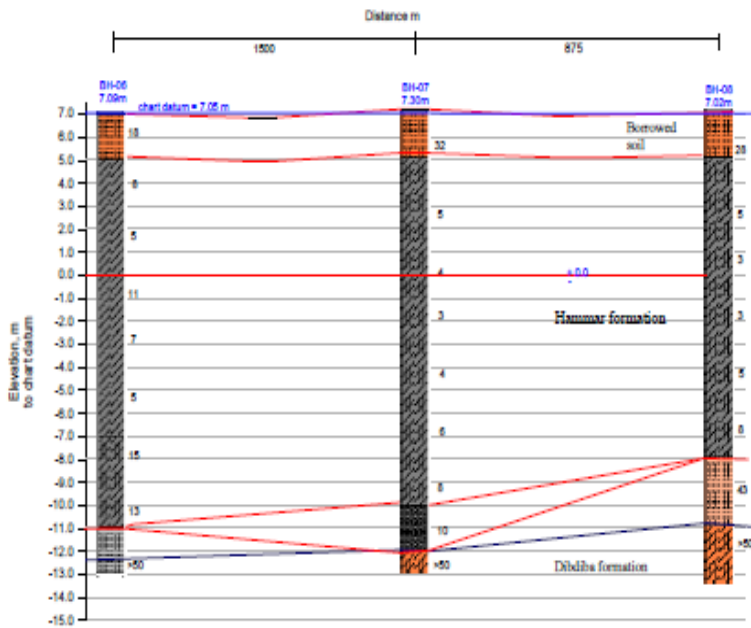


Figure 4. Section (C) onshore Boreholes (BH-6, BH-7, BH-8).

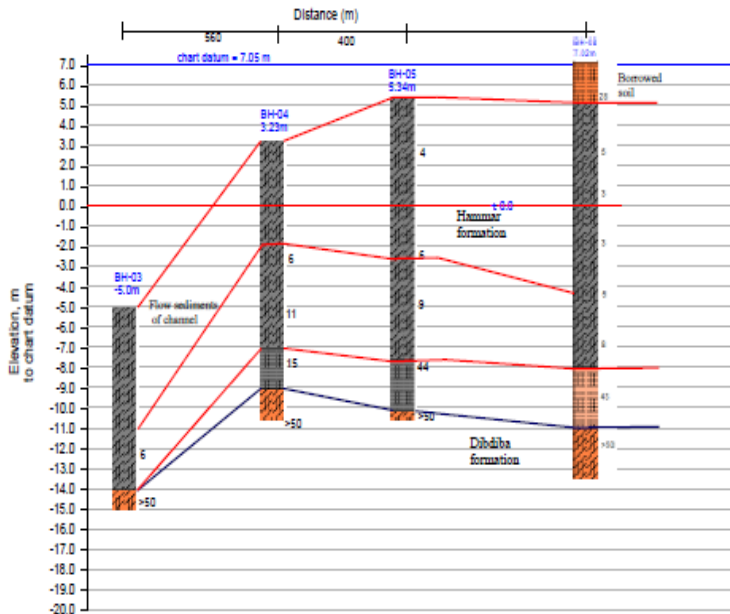


Figure 5. Section (D) BHs (BH-03, BH-04, BH-05, BH-8).

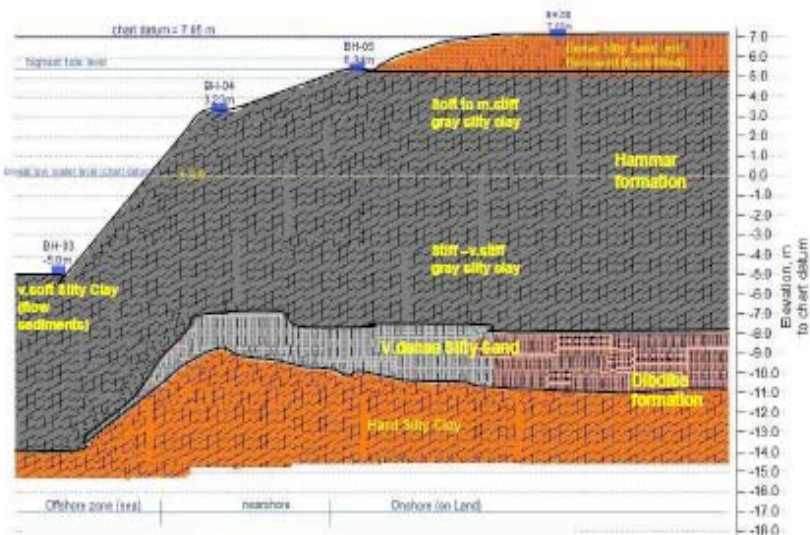


Figure 6. A diagram showing a model profile of western bank of Khor Al-Zubair channel coast.

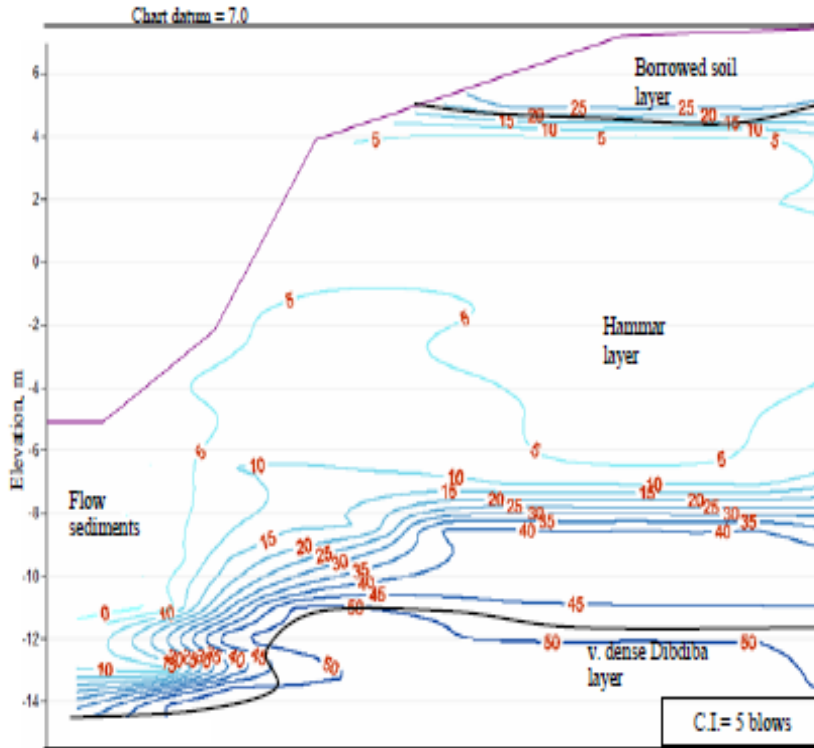


Figure 7. Contour lines of N-values (SPT) with the elevation of the main layers forming the western bank of Khor Al-Zubair channel coast.

It can be summarized that there are two main strata making up the coast bank of the navigational channel of Khor Al-Zubair, these are;

Marly silty Clay or fat clay soil which has a thickness of 18 m, and gradually changes from very soft- m.stiff Al-Hammar deposits to stiff-v.stiff. Figure (7) shows the contour lines of the N-values (SPT) of the main strata forming the western bank of Khor Al-Zubair coast. It appears as hard brown silty clay underlies dense sandy soil at the end of Boreholes (EOB). Table (1) shows the main layers and their classification properties.

Silty Sand soil which has two types of sandy soil are (1) borrowed back filled soil as surficial compacted soil with a thickness of 2.0 m, and (2) are interacted lenses between gray stiff silty clay and hard brown silty clay in the near and onshore Boreholes which belongs to the Dibdiba formation. A Model profile is drawn to the western bank of Khor Al-Zubair channel coast, (Figure 6).

Table 1. The main layers and their physical properties of the western side at the Site of Khor Al-Zubair port.

Symbol	Description of layer	Thickness, m	Grain Size			Atterberg		G _s	Remarks
			% clay	% silt	% sand	%LL	%PI		
	M dense to v dense brown Silty Sand (SM) or (SW-SM). its borrowed Banked fill	2.0	8-10	90-92	-	-	2.65	its appear in onshore BHs only	
	V. soft to soft gray marly silty clay (CL) or fat Clay (CH)	3.0	56-68	33-41	0-3	50-65	25-29	2.72	its mostly appear at offshore BHs.
	Soft-stiff gray Silty Clay (CL) or fat Clay (CH)	12.0 - 16.0	51-63	37-43	1-6	40-48	16-24	2.72	mostly of Boreholes
	Stiff- v. stiff gray Silty Clay (CL) or fat Clay (CH)	2.0 - 4.0	43-58	27-37	15-30	55	30	2.72	mostly of Boreholes
	V. dense gray Silty Sand (SM)	1.0 - 1.5	29-40	60-71	-	-	2.66	its appear as lenses at (5, 7, 8)	
	V. dense brown Silty Sand (SM)	4.0	15 - 40	60-85	-	-	2.67	In all	
	Hard brown fat Clay (CH) or elastic Silt (MH)	at E.O.D	33-44	36-42	18-25	-	-	2.71	All of Boreholes

Conclusions

There are two main strata making up the coast bank of the navigational channel of Khor Al-Zubair; the first is Marly Silty Clay which is 18m thick, changes from very soft-m.stiff to stiff-v.stiff and belongs to the Al-Hammar deposits. The second layer is Silty Sand soil which looms interacting with Silty clay layers in the near and onshore Boreholes and belongs to the Dibdiba formation, it also has more than 50 N-values at BOD depths in some Boreholes.

Acknowledgments

This work was funded by Marine Geology Dept., Marine Science Centre, Basrah University Iraq.

References

- Al-Tai, M.A. 2005. rovement of selected parts of Basrah Governorate Soil using polymer resins, Ph.D. thesis, Science College/Basrahuniversity, Iraq.
- Al-Mosawi, S.N. 1991. Khor Al-Zubair classification and possibility to detection dimensions during stages of different tectonic development. Third symposium about marine natural of Khor Al-Zubair, Marine Sciences Center/Basra University.
- ASTM D1586 1999. Standard test method for penetration test and Split-Barrel Sampling of Soils.
- ASTM D 4318 1999. Liquid Limit, and plasticity index of soils.
- ASTM D 2216 1999. Standard Test Method for laboratory Determination of water (moisture) content of Soil and Rock by Mass.
- ASTM D 422 2002. Standard Test Method for particle-Size Analysis of Soils.
- Coduto, D.P. 2007. Geotechnical engineering, "principles and practice". Civil Engineering department, California state polytechnic university, Pomona. Pearson prentice Hall, 39p.
- Mayne, P.W., Barry R.C. and Jason, D. 2001. Manual on subsurface investigations, National Highway Institute Publication No. FHWA NH1-01-031 Federal Highway Administration, Washington, DC.
- Thorner, R.H. 2001. Engineering Geology Field Manual S2, U.S. Department of the Interior Bureau of Reclamation, p72
- Wasil, S.A. 2003. Sedimentological and mineralogical study of rocky Island in Khor Al-Zubair area north-west of the Arabian Gulf. M.Sc. thesis, Basrah University, Iraq. p17, (In Arabic).
- Zekkos, D.P., Bray, J.D. and Der Kiureghian, A. 2004. Reliability of shallow foundation deign using the standard penetration test, proceedings ISC-2 on Geotechnical and Geophysical Site characterization, Viana da Fonseca & Mayne(eds.). Millpress, Rotterdam, ISBN 90 5966 0 09 9. 1575-1582 p.

بعض الخصائص الجيوتكنيكية للضفة الغربية لساحل قناة خور الزبير عند موقع ميناء خور الزبير جنوب البصرة، العراق

وسام رزاق مطشر

مركز علوم البحار، جامعة البصرة، البصرة - العراق

المستخلص - تم حفر خمس حفر بحرية وثلاث اخر على الارض في جزء من الضفة الغربية لساحل خور الزبير خلال فترة شهر تموز 2009، بالتعاون بين المركز الانشائي في البصرة مع مركز علوم البحار في جامعة البصرة. استخدمت آلة الحفر من نوع الاوكر التابعة للمركز الانشائي الوطني في البصرة، حيث تم اخذ النماذج بين عمق 0.5 - 2.0 متر او عند حصول تغير في الطبقة. تراوحت اعماق الحفر الارضية بين (19-20.5) متر من مستوى سطح الارض الطبيعي، بينما تراوحت الحفر البحرية بين 7-16 متر من مستوى القاع. جميع اعماق الحفر وصلت الى الطبقة الصخرية ذات قيم N عالية أكبر من 50 ضربة. فحص الاختراق القياسي نفذ لكل 2 متر تقريبا لمعظم الحفر. تم التوصل الى ان اهم الطبقات الرئيسية التي يمكن تصنيفها والمكونة لضفة ساحل خور الزبير هي: (1) طبقة الطين الغريني المارلي التي يتجاوز سمكها 18 متر، والتي تتدرج قواميتها من طري جدا - طري الى قوي - قوي جدا وهي تمثل ترسبات تكوين الحمار. كما انها تظهر كطبقة بنية صلبة بعد الطبقة الرملية النحيفة، وتستمر الى نهاية الحفر. (2) طبقة الرمل الغريني والمكونة من نوعين رئيسيين هما: الطبقة الاولى: الطبقة الاملائية السطحية المضافة والمعرضة لعمليات الحدل وهي طبقة كثيفة بسمك 2 متر. الطبقة الثانية: والتي تظهر متداخلة بين الطبقة الطينية القوية والطبقة الطينية الصلبة في الحفر الارضية، وهذه الطبقة تمثل ترسبات تكوين الدبديبة.