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The vertical and horizontal distribution of the organic matter in selected areas of BasrahGovernorate / southern Iraq, for engineering purposes

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Abstract: *Organic matter occurrence in the soilcauses many problems for the engineering projects. In this study, seventeen locations have been chosen from Basrah soils with sampling frequency one sample per meter.*
For the experimental tests, Grain-size, Atterberg limits, and organic matter tests were performed on all the samples to evaluate the spatial distribution of the organic matter at selected areas in Basrah governorate. The results show that 62.3% of samples are classified as low plasticity clayey silt (CL), 27% as low plasticity silty clay (ML) and low plasticity organic soils (OL), 4.7% are classified as high plasticity clayey silt (CH) and 6% of study area soils are considered as poorly graded sand soils (SP). Organic matter percentages test showed that there is a large disparity of organic matter distribution in Basrah governorate, where the values vary from site to other and between the different meters for the same location.Organic matter valuesrange from 0.05 at the first-meter depth of Al- Zubair location to 3.5% in the fifth-meter depth of Al-Qurna location, while the percentages of the organic matter in many sites in the study area are exceeded 2%.

Keywords: *Organic matter, Basrah soils, classification of soils.Geotechnical properties.*

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I. Introduction

Organic soils are considered as one of the soil types that cause many problems for the engineering construction. The presence of organic matter in soil leads to a changein its physical and chemical properties, such as density, and water content. Many studies demonstrated that the amount of organic matter in the soil and the degree of decomposition had a significant effect on its geotechnical properties (Landva *et al*., 1983). The presence of organic matter in the soil is associated with low values of bearing capacity, specific gravity, and shear strength. On the other hand, higher values of compressibility, water content and significant secondary compression. An increased risk of inadmissible settlements and /or failer of foundations is often associated with low strength characteristics and high compressibility of the soil (Huang *et al*., 2009).

The soils that contain more than 2 % of organic matter are termed "organic soil" (Myslinska, 2010). The organic soils have a large void ratio that been formed due to the decomposition of organic matter in the soil. Therefore, this type of soils is unsuitable for the embankments and highway fills (U.S.D.I, 1965 in Mahmood, 1997). The organic matter in soils had a significant effect on foundations due to the high organic content that prevents cement from consolidation and high sulfate content which caused crashing of the concrete. In general, less than 0.5 % of the organic matter in the soil is unlikely to affect the engineering behavior, while 2 % to 3% of the organic matter seriously alters the strength and compressibility of the soil (Scott,1980).This study focuses on determining the percentages of organic matter content within the first five-meter depths of shallow bearing strata in Basra governorate soils, as well as their vertical and horizontal distribution.

II. Materials and Methodology

Soil sampling

In this study disturbed samples have been collected from seventeen locations within the first five-meter depths of Basrah governorate soils, as shown in Figure 1.1. Hand auger was used to drill five boreholes with five-meter depth and take a sample every one-meter depth. The rest of the samples were collected from different companies that deal with soil tests in Basrah governorates, such as Al-Emar, Fugro, RSK and Fao engineering tests by using mechanicaldrilling. Thecollected samples were packed and sealed in plastic bags and transported to the laboratory to undergo the geotechnical test.

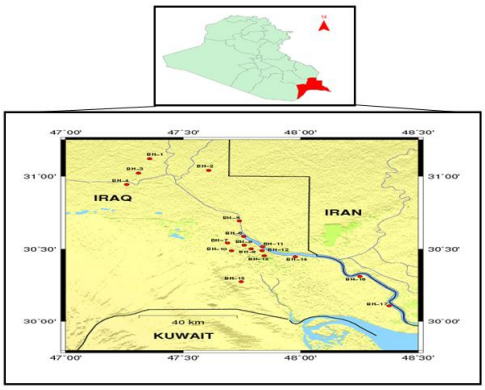


Figure 1.1: Location map of the study area.

The tests used in the study

To achieve the objects of the study, the tests are accomplished to determine the percentages of the organic matter and its classification in selected sites within Basrah soils. The grain size analysis test carried out according to ASTM D-421 and D-422 and Atterberg limits tests were done according to ASTM D- 4318-05. These two tests were used to classify the soils according to the Unified Soil Classification System (USCS). While the organic matter test was accomplished by using potassium dichromate methods according to BS 1377: Part 3: 1990toshow the vertical and horizontal distribution of the organic matter in the study area soils.

III. Results and Discussions

Grain size analysis test

The results show that the percentages of clay particles in the study area soils range from zero % at the fourth-meter depth of AL- Zuber town (BH-15) to 67.1% at the third-meter depth of Al- Tuwaisa site (BH-9), with average 40%.The results also demonstrated that the percentages of silt particles in the study area soils range from 1% at the fourth and fifth-meter depth of Al-Zubair town (BH-15) to 81.5% at the second-meter depth of*Abu Al-Khasib* (BH-14), with average 51 %. While the percentages of sand particles range from 0.1% at the fourth-meter depth of Siba oil field (BH-16) and the fifth-meter depth of AL- Mutiahasite (BH-12) to 90% at the first-meter depth of AL- Zuber town, with average 9, as shown in Figure1.2.

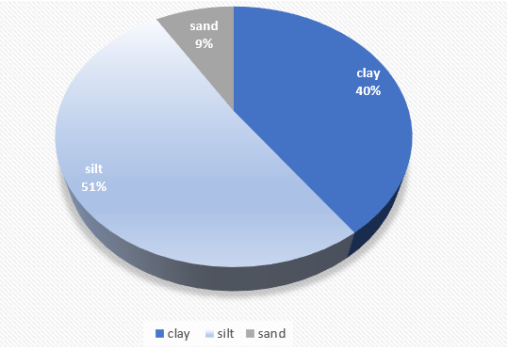


Figure 1.2: The results of grain size analysis test for studied soils.

Atterberg limits tests

The results of Atterberg limits tests show that the percentages of liquid limit in the study area soils range from 34% at the second-meter depths of AL-Hayyaniyah site to 54.8% at the third-meter depth of AL-Mutiahasite, with average 40.78%. Whereasthe percentages of plasticity index in the study area soils range from 8.2 at the fifth-meter depth of Al- Hartha site to 28.9% at the second-meter depth of AL- Mutiahasite, with average 16.74%. The test results also show that there are 62.3% of studied soils are classified as low plasticity silty clay soils (CL). While27% are classified as low plasticity clayey silt soils (ML) and organic soils(OL). The results also demonstrate that there are 4.7% of studied soils are classified as highplasticity silty clay (CH). For the coarse-grained soil samples, 6 % of the soil of Al-Zubair site is classified as poorly graded sand (SP) according to particle size analysis curve, as shown in Figure 1.3.

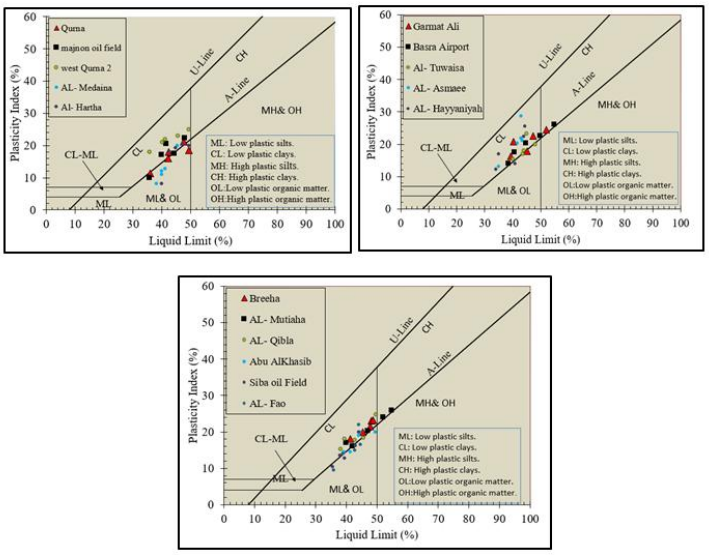


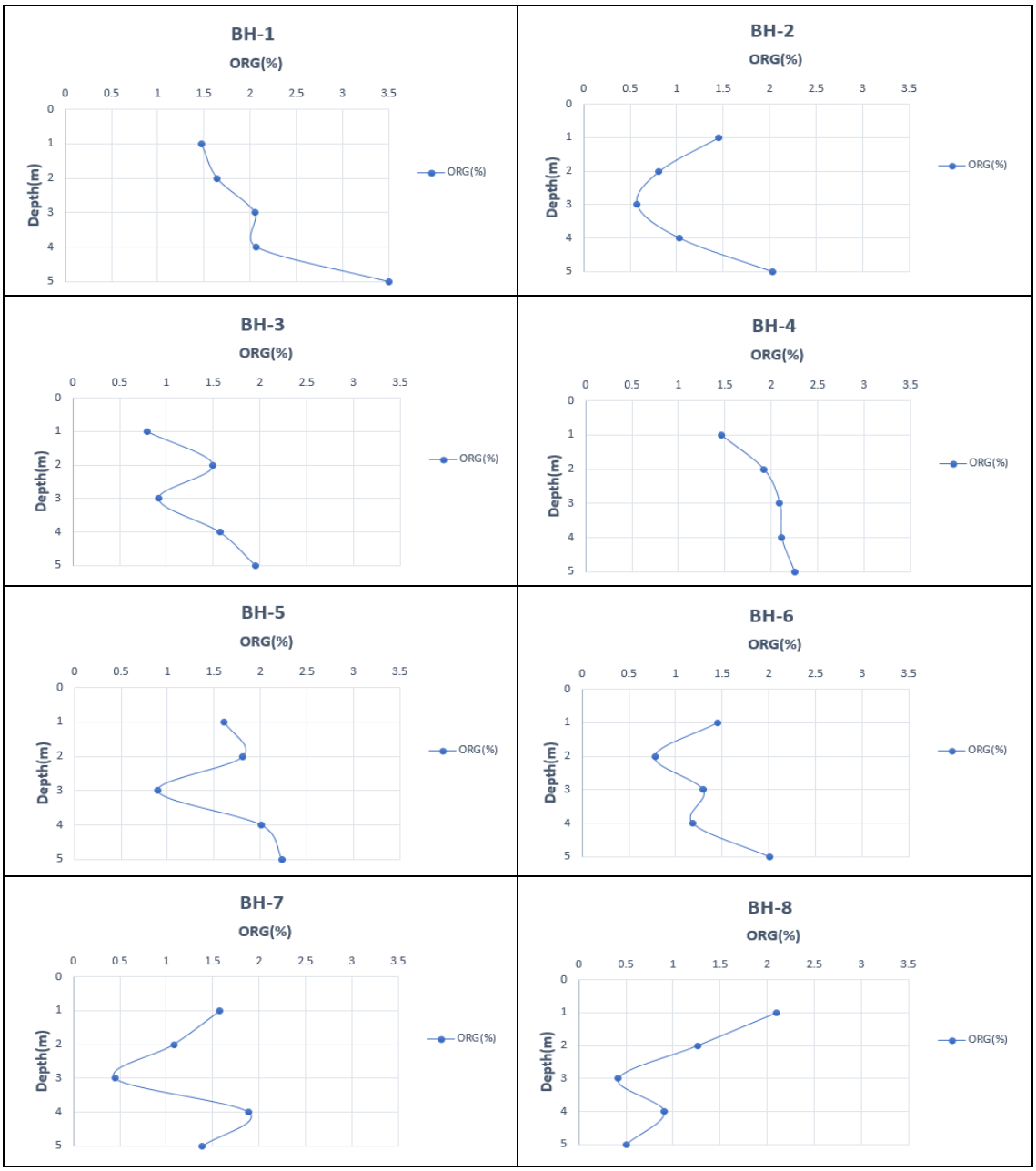
Figure 1.3: the plasticity chart for studied soils.

The vertical and horizontal distribution of the organic matter

For seventeen sites within the first five-meter depths, test results of the organic matter content are represented by vertical and horizontal distribution.

1.Vertical distribution of organic matterin the study area

Organic matter test results showed that there is a significant variation in the percentages of the organic matter from one location to another and between one meter to another at the same site. The results demonstrate that there is an increase in the percentages of the organic matter gradually down with depth in the soil of Al-Qurna site (BH-1) and Al- Medaina site (BH-4). Whereas, the rest of the studied soils are fluctuated between increasing and decreasing in the percentages of the organic matter with depth, as shown in Figure 1.4.



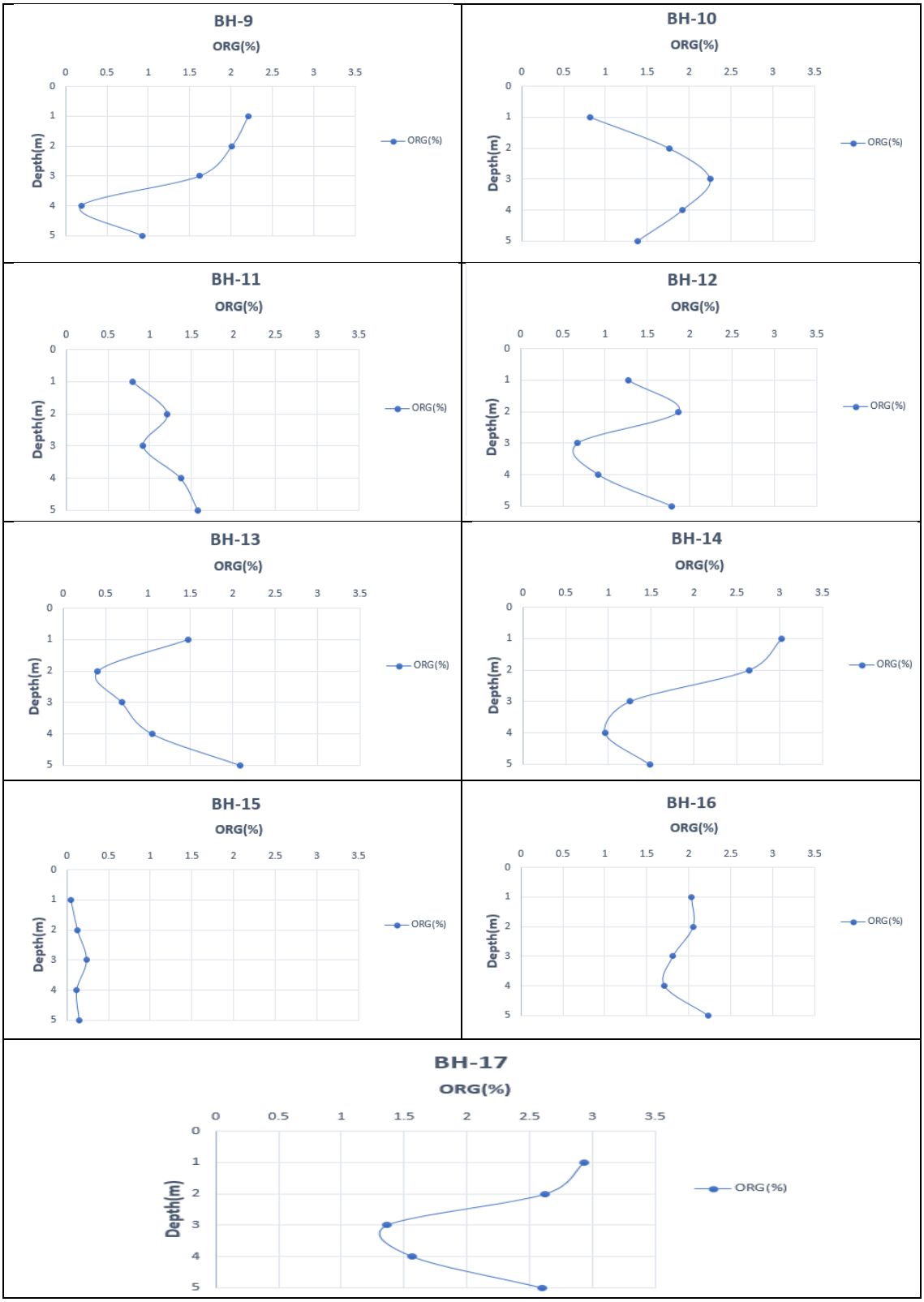


Figure 1.4: The vertical distribution of the organic matter for the studied soils.

There is a verity in the vertical distribution of the organic matter contents in the different site from the study area soils. These variations reflect the environmental condition contract to form organic matter in the soil. The variations in the organic matter percentages are caused by different factors such as depositional environments, grain size, organisms, leaching process, clay minerals and nature of soils. Carbon sediment and nutrient concentrations increase with decreasing grain size because total organic carbon adsorbs onto mineral

surfaces and has a high affinity for fine-grained sediment. The adsorption process helps to preserve the total organic carbon (Huon, 2000). Furthermore, the organic carbon decreases with depth due to the destruction caused by bacterial activity after burial (Al-Abaychi, 1995).

2.The horizontal distribution of the organic matter

The test results are represented utilizing mapping technique. In this study, Surfer software version 13 is used to map the distribution of the organic matter percentages in the study area soils. Figures 1.5,1.6,1.7,1.8 and1.9show the horizontal distribution of the organic matter percentages of 17 sites taken in this study at depths 1,2,3,4 and 5, respectively.

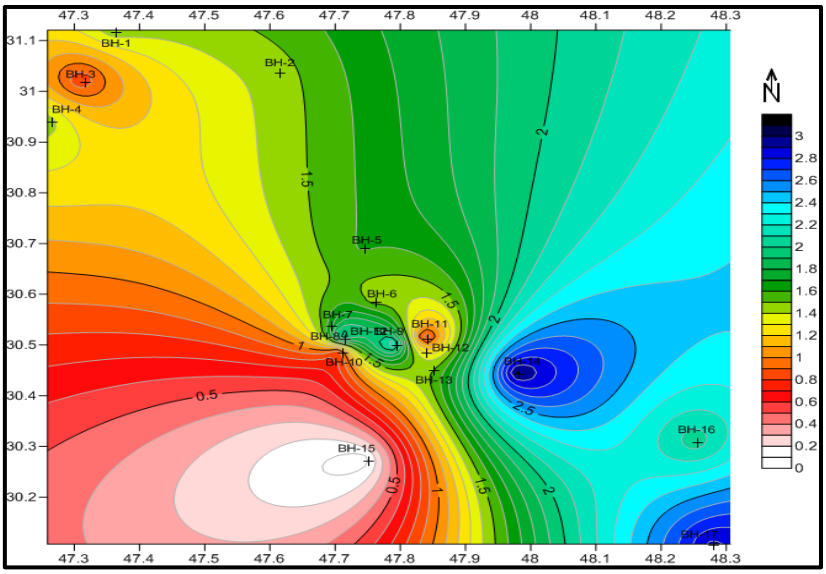


Figure 1.5: The horizontal distribution of the organic matter from the first-meter depth of the study area soils.

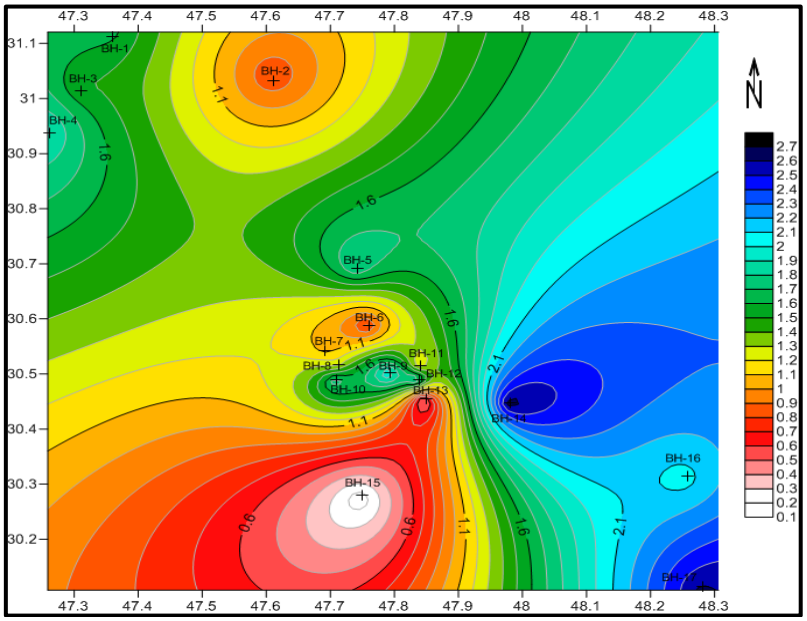


Figure 1.6: The horizontal distribution of the organic matter from the second-meter depth of the study area soils.

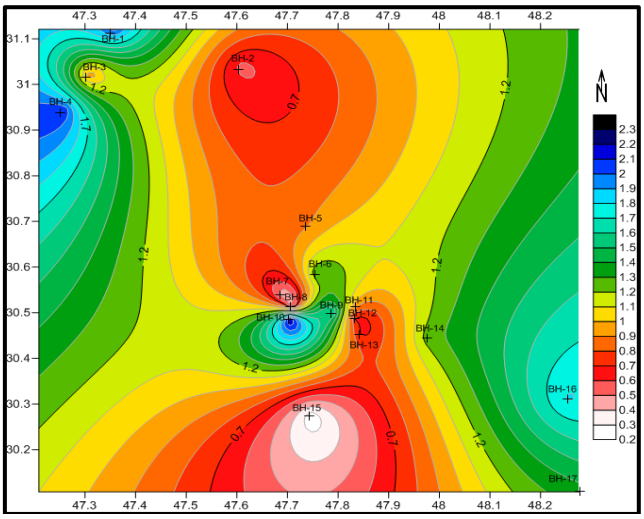


Figure 1.7: The horizontal distribution of the organic matter from the third- meter depth of the study area soils.

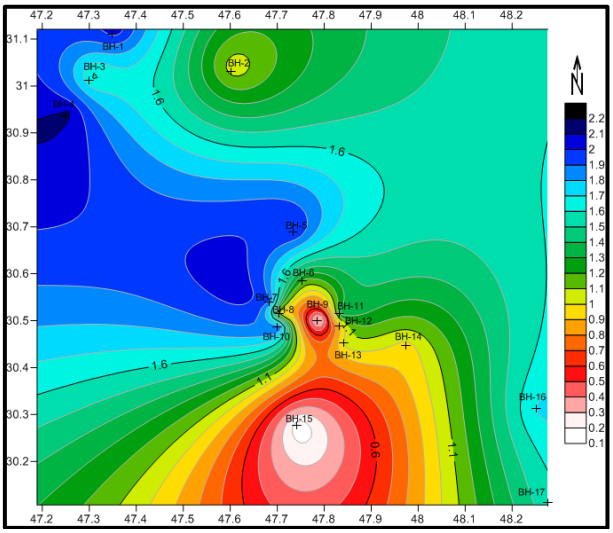


Figure 1.8: The horizontal distribution of the organic matter from the fourth-meter depth of the study area soils.

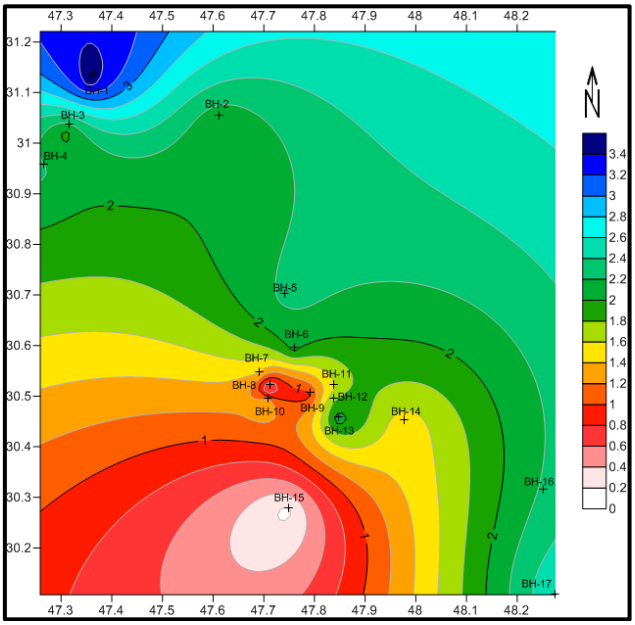


Figure 1.9: The horizontal distribution of the organic matter from the fifth- meter depth of the study area soils.

After representing the organic matter ratios, a significant variation was observed in the horizontal distribution of organic matter in the first five meters depth of Basrah governorate soils. The results show that the percentage of the organic matter in the first and second meters depths are increasing towards the eastern part of the study area soils, especially in the soil of Abu Al-Khasib site (BH-14) and Al-Fao site (BH-17). This is due to the presence of agricultural land near Shatt Al-Arab river which makes soils saturated with water and suitable for plants growth, whereas it seems that there is a gradual decrease in the percentages of the organic matter content to the west of Basra governorate because it is poor in agriculture land and it considers as Sabkha land as shown in Figure 1.5 and 1.6.

In the third-meter depth from the study area soils, the results show that the high percentages are recorded in the central area from Basra governorate, specifically in the soil of Hayyaniyah site (BH-10) as shown in Figure 1.7. This increase is due to the soil nature of this area, which is characterized by being very soft soils in addition to being saturated with water and thus helps to collect and retain organic matter in the small pore spaces between these small particles.

It is observed that there is a high variation at the fourth and fifth-meter depthsfrom the study area soils. In these depths, the effective percentages of the organic matter are observed in the northern areas from Basra governorate, which represented by Al- Medainasite (BH-4) and Al-Qurna site (BH-1) as shown in Figure 4.8, this variation is related to many factors as mentioned above, these factors control the organic matter distribution and movements through the voids.

IV. Conclusions

The study shows the following conclusions:

1. Most of the study area soils are classified as low plasticity silty clay (CL), and the other soils are classified as low plasticity clayey silt soils (ML) and organic soils (OL). besides, it is classified as high plasticity silty clay within some locations at specified depths. While,the soils of Al-Zubair Town are classified as poorly - graded sand soil with little fines.
2. A general fluctuation in the percentages of organic matter from one location to another and within different depths in the same location.
3. Organic matter gradually increases with depth in the locations of Al-Qurna and AL- Medaina , whereas the variations were evident between the increase and a decrease in other sites.
4. Organic matter is highly concentrated in silty clayey and clayey silt soils and it has a little concentration in sandy soils.
5. Many depths among the seventeen locations selected for a study show that there are several organic matter percentages that affecting on engineering soil behavior, due to the highorganic content more than 2%

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