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Research Article

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The Investigation of the Connection between the Historical Excavation Site and the Historical Fountain by Resistivity Imaging in Istanbul-Silivri Muratçeşme

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Abstract Geophysics, in the archaeological explorations, before the polling excavations; place, form, depth etc. in three dimensions. For this purpose, the properties of the wanted structure and the physical parameters that can be measured are determined. By taking these parameters into consideration, the method to be applied is selected. Thus, archaeological works can be directed and removed more quickly and at lower cost without deteriorating the remains. Here the aim of Geophysics; to help the use of time and economic factors in the most appropriate way by guiding the research program better. In this study; It was investigated whether there was a continuation of the fountain between the historical fountain and the area to be excavated at the Murat Çeşme locality in the Silivri district of Istanbul. It was estimated that there was no continuation of the fountain between the fountain and the possible excavation area. As a matter of fact, after the excavation, there was no connection between them.

Keywords Geophysics, Archeology, Resistivity, Imaging

1. Introduction

Various methods are used in order to obtain the final results in the researches on the Earth. Soundings, polling excavations and so on. it is possible to show them as an example. However, these methods are quite expensive and only provide information for that point. Geophysics is able to determine the changes in a wide range of signs very quickly and economically. So the geophysical devices are underground; changes in some physical properties such as conductivity, speed, density, magnetization, temperature are measured and results are obtained by evaluating the obtained symptoms. Here the aim of Geophysics; to help the use of time and economic factors in the most appropriate way by guiding the research program better.

Recent developments in the fields of electronics, computer hardware and software have led to significant developments in shallow geophysical surveys. High-quality data can be collected from the field with high-tech devices. The underground data can be modeled by performing reverse solution of the collected data with computers [1-3].

Griffiths and Barker [4] have made significant studies on the preparation of shallow 2-D electrical imaging maps. In fact, due to rapid developments in technology, 2-D and 3-B investigations have become more practical. This is due to improvements in multi-electrode resistivity studies and rapid computer reverse solution software [5]. In order to obtain the best results in these studies, land survey should be handled in a systematic order and all possible measurements should be made. Because the model obtained from the inverse solution of apparent resistivity measurements, affects the quality of the comments [6].

2. Aim of the Study

The study area can be seen in the Figure 1. An excavation was requested. However, since there is a protection decision for the historical fountain in the excavation area and the fountain is believed to continue underground in the direction of the area to be excavated, this request is negative. Due to the estimated connection, it was necessary to wait years for excavation. After years of correspondence, it was decided to investigate whether there is a connection between the historical fountain and possible excavation area with geophysical methods. Therefore, this study was conducted.

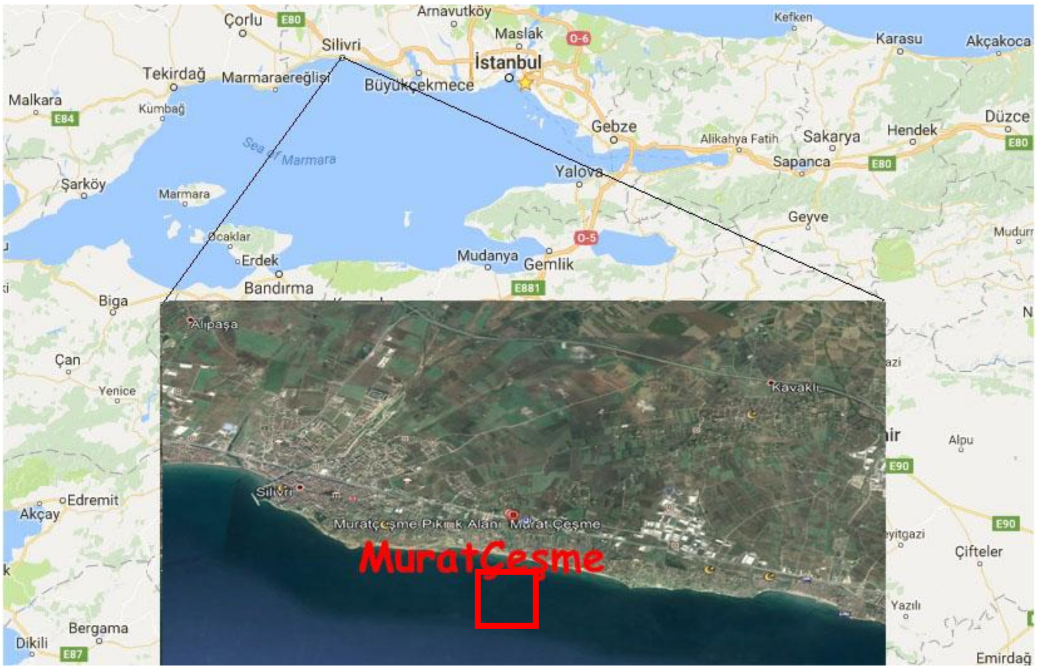

Figure 1: Location of the Study Area [7]

3. Material and Method

In this study, Electrical Resistivity Method (ERM) results are presented. In ERM, if the underground is to be displayed, then the work to be performed in this case is Electrical Tomography (ET) and the Ground Electrical Map (GEM) is created. With GEM, you can view underground spaces, graves, rooms, buried metal objects, etc. structures; It is possible to estimate the location, size and depth. Causes of differences in electrical resistance expected to be seen in archaeological remains; porosity, humidity, residual and burial and the resistance of the environment, loose and stiffness of soil, ion density, mineral and mineral admixtures of the stone and so on. With ERM,

1. The limits of the sites,
2. Place, depth and geometry of buried remains,
3. Location and dimensions of possible empty spaces (rooms, graves, etc.)
4. Old waterways etc. it is possible to determine.

ERM is widely used in geophysics. ET is one of the application forms of ERM. The main principle in ET is current flow with current electrodes and measurement of voltage difference between potential electrodes and them. The electrodes used are placed on the ground surface with different geometries. These different geometries are known as electrode arrays and the voltage difference is measured depending on the factor from geometry.

The apparent resistivity values are obtained by multiplying the measured voltage difference by a coefficient depending on the position of the electrodes and dividing the value by the current value depending on the Ohm law. In this study as electrode array; dipole-dipole and wenner alpha were used. Dipole-dipole (Figure 2) and wenner alpha (Figure 3) were performed using electrode arrays, and EEH was formed. Consequently, the geological structure and boundaries of the underground or the features listed above were determined by the interpretation of the graph or map.

The electrode arrays are selected according to the purpose of the study, the depth to be searched and the geometry of the wanted object. For a fixed electrode range (wenner alpha) in ET, measurements are taken at regular intervals along a profile (Figure 3). The taken measurements are combined along a line (profile) to obtain an electrical profile. Since the electrode range is kept constant, the resistivity curve represents the change in resistivity at the same depth along the profile. By increasing the electrode spacing (a), more information is obtained in each profile.

The aim of the search geophysics is to determine the shape (geometry) and the physical properties of the buried structures that cause the symptoms to be seen and cannot be seen from the surface. It is obvious that underground structures with different formal and physical characteristics will give symptoms in different sizes and appearance. Accordingly, in geophysics, the geometric shapes we create to define the underground structures with various geometry and physical properties are called models.

The aim of the process is to estimate the parameters of the underground model which causes us to measure this data from geophysical data. This process is called geophysical modeling. The process gives the solution of the current problem in geophysics. This kind of problem solution is done in geophysics in two ways as flat and reverse solution. In the flat solution (1-B), it is tried to determine the geophysics of this model by the geological model. In the inverse solution (2-B), it is tried to determine the parameters of the geological model based on the obtained geophysical sign.

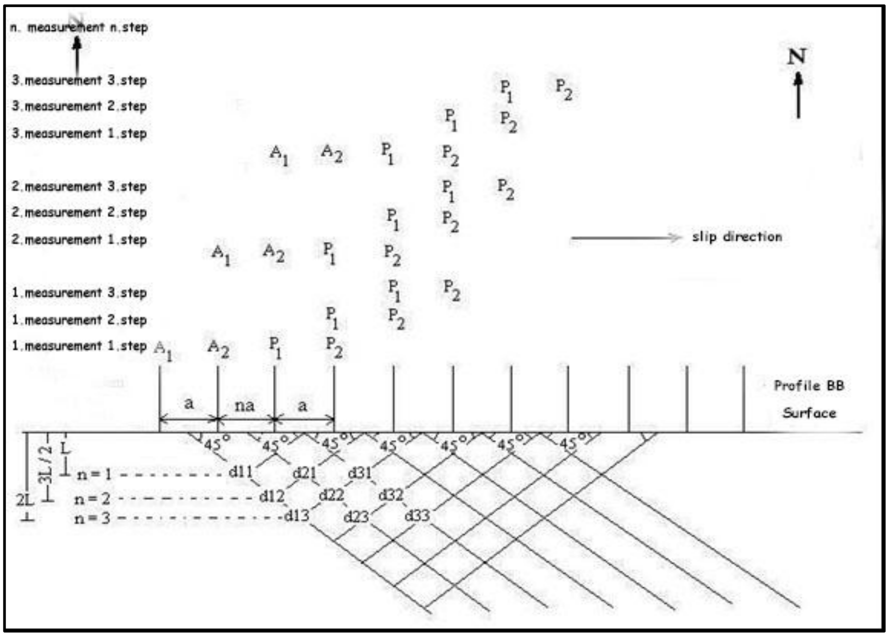

Figure 2: Dipole-dipole electrode alignment and their measurement steps (n, is the amount of shear)

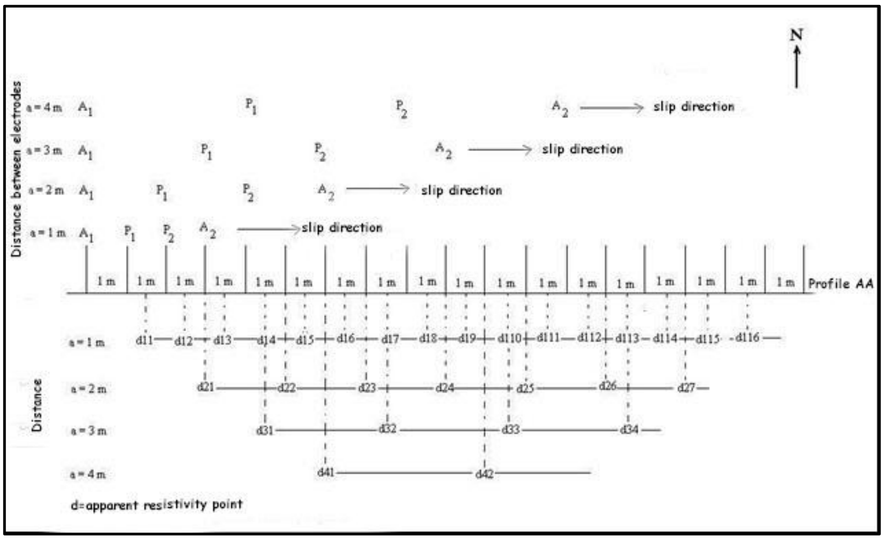

Figure 3: Wenner alpha electrode alignment and their measurement steps

4. Results

A photograph showing the examination area is given in Figure 4. This photo shows the possible excavation area and the location of the fountain. In order to determine whether there is an underground connection between the excavation area and the historical fountain, the locations of the measurements taken in different positions and directions and the layout plan (scale) where the directions of opening can be followed are given.

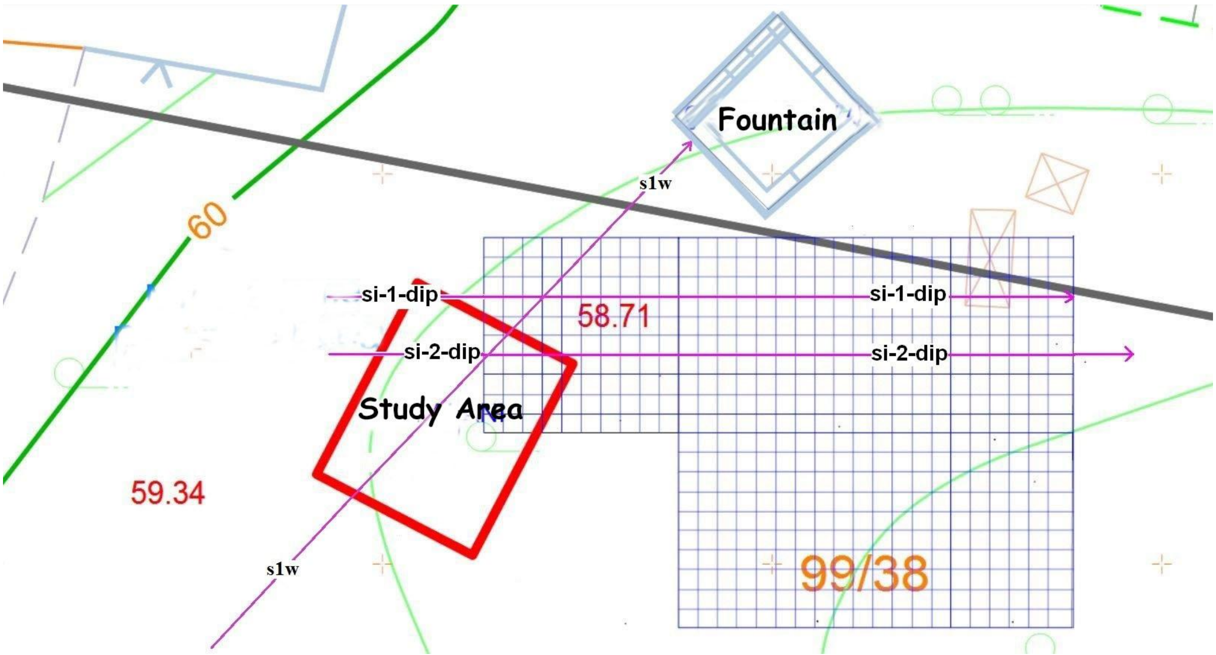

Figure 4: The location of the measurements in the study area and the directions of opening [7]

Si-1-dip and si-2-dip measurements were taken by using dipole-dipole electrode array and the obtained data were evaluated by using Res2dünv [8] program and the generated REEs are presented in Figure 5 and 6. The s1w measure values obtained by using the Wenner alpha electrode array were also evaluated by using Res2dınv [8] program and the generated YHR is given in Figure 7.

In the Si-1-dip profile, data was collected from a measuring distance of 30 m on the surface and approximately 5.00 m deep from the ground. The vertical and horizontal distance of this dimension profile to the fountain is 4m. The range of measurement points in the profile was chosen to be 1.00m and thus an underground map was created at 0.5m intervals. It is seen that the opening of the dimension profile is 0.00-08.00m. The conductive and insulating media continue to follow each other along the direction of opening without being similar to any geometric shape. In the Si-1-bottom profile, the insulating medium immediately observed at the head could not be displayed here. However, in this measurement profile, a high resistivity environment was observed immediately at the opening distances between 8.00-16.00m. But the continuation of this environment could not be seen in the si-1-bottom profile. It was determined that these high resistivity values originated from the rubble, etc., immediately on the surface. In addition, in both profiles taken in the same directions as the 3 m interval, no geometric structure or conductivity was observed in the direction of the possible excavation area.

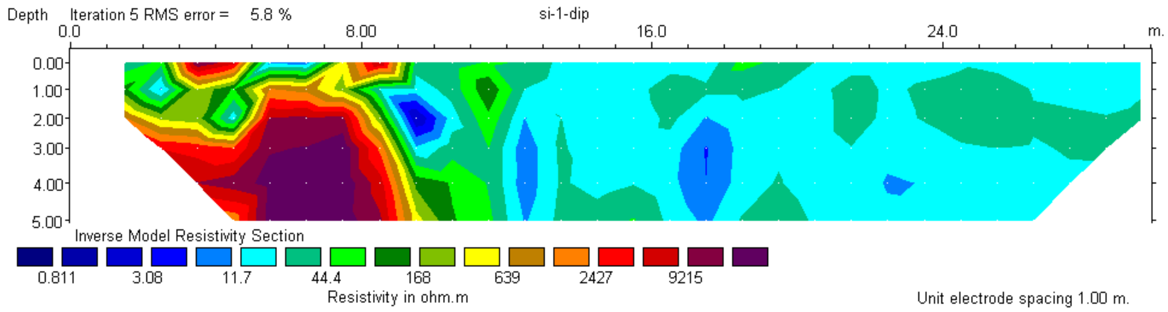

Figure 5: Electrical map for the Si-1-dip profile

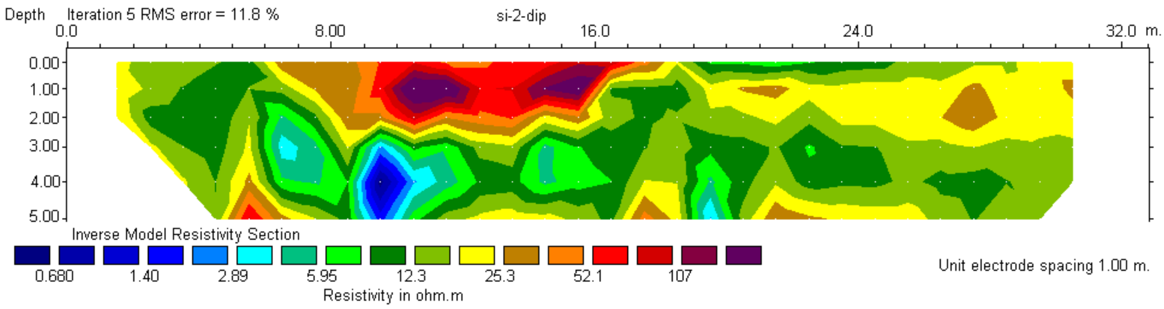

Figure 6: Electrical map for the Si-2-dip profile

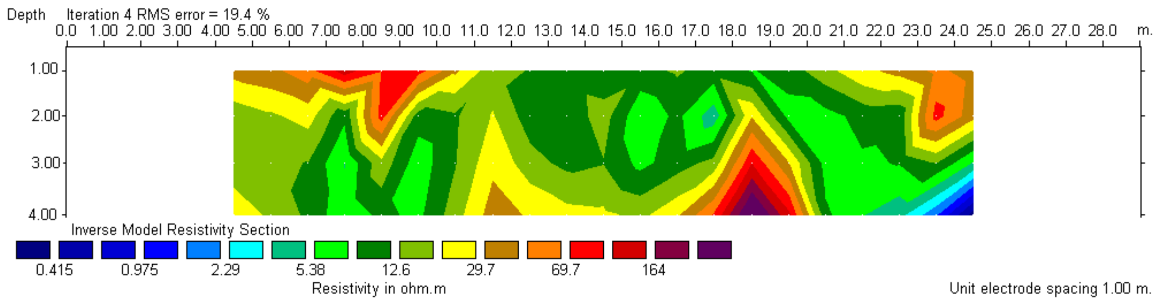

Figure 7: Electrical map for the S1wprofile

At the S1w measurement point, an opening of 26m was made on the surface and data was collected from 4m depth. Between 17 and 20m opening distance, starting from the depth of 2.5m and continued to be more than 4m deep. However, the S1w data did not show a linear conductivity which would indicate a high resistance geometric structure or water connection which might suggest that the historical fountain continued in this direction. Since the last section of this opening, which is 24 m and later on the fountain, was reached, a conductive medium from the fountain was found at a depth of about 3 and 4 m.

6. Conclusion and Discussion

In this study, the province of Istanbul in Turkey, Silivri district, Sinekli neighborhood, among the possible excavation area with fountains fountain located in the historic Murat was carried out to investigate whether the continued underground fountain.

Figure 8: An image of the excavation in the study area

In the data obtained, it has been reported that there is no regular, continuous, geometric shaped and continuous linear-conductive structure in which the water can be transported, which may suggest that the historical fountain continues in line with the possible excavation area, and there is no connection between the fountain and the excavation area (Figure 8).

The method used should be allowed to be excavated with high resolution HGH, which is based on the selected research depths and the findings obtained? long-term uncertainty has been eliminated in a short time. Thus, it is seen that with similar studies both time will be saved and the destruction of possible historical monuments can be prevented. In addition, it is shown that excavation costs and excavation times will decrease with similar studies.

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