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Geoelectrical Investigation of the Reservoir Aquifer Potential in RONIZ Plain, South East of Fars, Iran

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Abstract— Water is one of the most valuable natural resources. This source provides about 40 percent of the power plantand finally we can say is very important for health and the economy. This water is the largest availablewater source and since has been stored in the basement, called groundwater. In developing countries Groundwater is one of the key issues for water supply in urban and rural areas. Therefore, fundamental studies and subsurface geophysical exploration was done in Roniz plain by using geoelectrical methods (electrical resistivity).Measurement involving vertical electrical sounding (VES) using Schlumberger array was taken along ninety seven (97) traverses using the PASI-Earth (16GL-N) Resistivity meter a maximum distance of 600m current electrode spread was adopted for this survey.The results of investigationsindicatefine grained layers in the first stages, with resistivity of 187 ohm-m to 200 ohm-m and thickness of about 20 meters to 60 meters, which are called dry sediments (surface soil).The second geoelectric layer has a resistivity of 340 ohm-m and an average thickness variable from 10 to 15 meters which represents marly Sandstone layer. Identification of this section in the parts of the study area, due to the expansion of clay, showed how dangerous the region is for structural engineering.The third geoelectric layer has a resistivity of 20 ohm-m to 41 ohm-m and an average thickness variable from 20 to 30 meters which represents marl stone.The fourth geoelectric layer has an electrical resistivity of 0.4 ohm-m to 6 ohm-m and an average thickness variable from 6 to 8 meters which represents limy aquifer. Aquifer depth is an average of about 150 to 200 meters.The fifth geoelectric layer has an electrical resistivity of 1000 ohm-m to 6200 ohm-m which represents basement limestone.

Index Terms— Geoelectric section, Schlumberger array, subsurface investigation, groundwater, aquifer, electrical resistivity.

1 Introduction

Water as a source of life, has occupied more than 70 percent of the Earth's surface (Deming 1975). It should be noted that groundwater have been considered as part of the water (Bouwer, 1978).Many countries in the world require groundwater extracted from weathered/fractured zones through water wells/boreholes (Clark, 1985; Olasehinde et al., 1998).The main objective of this study was to determine areas with high potential and groundwater resources based on geophysical surveys and using Geoelectric Methods or Vertical Electrical Sounding (VES).This procedure is based on the difference between the electrical conductivity of the subsurface caused by the distribution of electric potential.The effectiveness depends on the size, shape, position and the electrical resistivity of the subsurface layers.The electrical resistivity depends on the mineralogy of the rocks and the fluids in the pore spaces of the rocks. (William, 1997). Electrical methods use direct current or low frequency alternating current for subsurface investigation (Brooke and Kearey, 1984).These studies (Regardless of the electrode array) include determining the current and the potential electrode spacing and are used to delineate the apparent resistivity at thee certain depths.After that, if explored at depths greater than current supply is continued, measuring the potential difference between the electrodes potential is performed without change (Zohdy et.al, 1980).In homogeneous layer the depth of current penetration will increased with increasing distance of current electrodes.It should be noted that vertical sounding was carried out to study the relationship between horizontal and nearly horizontal layers.In fact, this determined horizontal zones of porous layers.The purpose of this study is to determine the subsurface lithology which will help us delineate the depth to which boreholes can be obtain potable water and thus determining the depth to each layer.

2 Location of the Study Area

The study area is located in southeast of Fars province, west of the Estahban and 160km southeast of Shiraz. The area lies on longitudes 53°, 30′E - 54°, 15′E and latitudes 29°, 00′N - 29°, 39′N (Figure 1).The topographic Height of the area is variable from 1600 to 2300meters above sea level and Regional climate is warm and dry.

3 Methodology

Five scrolling and more than 97 vertical electrical sounding (VES) have been done in different parts of the plain (Figure 2).The electrode spacing (AB/2) was 250 to 300m and PASI-Earth (16GL-N) Resistivity meter, direct current sources and four electrodes were used for the survey.The VES survey was carried out using the Schlumberger array.The IPI2WIN (2008) software was usedfor interpretation and computer modeling of the VESdata.The coordinates of each VES station were determined along with their respective elevation above sea level using the Garmin GPS device..

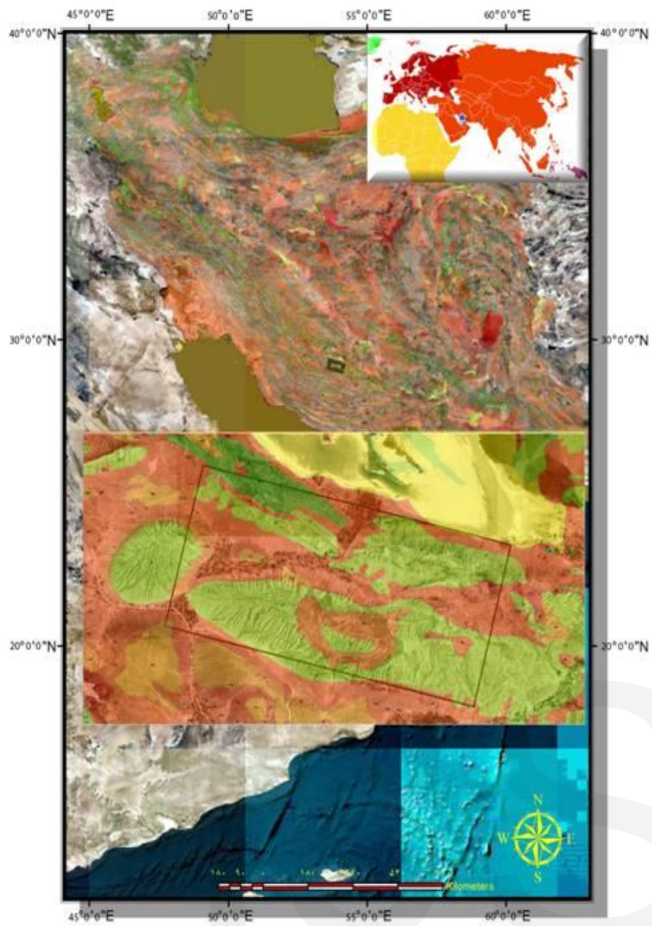

Fig. 1. The location of study area on geological map

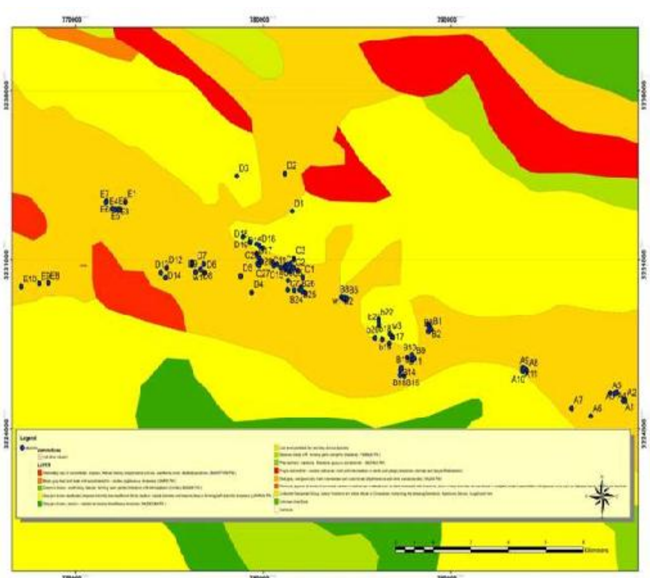
Fig. 2. The location of 97 vertical electrical sounding (VES) on the geological map of the studied area

3.1 Results and Discussions

The results of VES indicate that up to five layers are inclined.Also the model of resistivity and thickness of each layer to be obtained.Then, three different Geoelectric sections were measured based on five different surveysusing the values of a 2D-layered model. Different geoelectric layers were identified such as geological layers.Finally, this information has been confirmed by wells data in the vicinity of the study area.

3.2 Geo-Electric Sections

The section shows five Geoelectric layers in the study area including

1. The topsoil (dry alluvial)
2. Marly Sandstone
3. Marl stone
4. Limy aquifer and
5. The partially weathered/fractured/fresh basement(See figure 3).

For example, Section and sub-Section scrolling (A) is explained.In apparent Resistivity graph, the fault is visible passing through the station A5. Since the changes on both sides of the fifth station are relatively uniform, the station was located on the crashed zone and the fault crossing the basement.The Warm color spectrum (red) and the cool colors spectrum (blue) show a high resistivity to a low resistivity, respectively. So in these places water can be investigated after studying the actual resistivity.According to the apparent resistivity graph, from the depth of100 meters down the resistivity decreases in all stations. In the fifth station from shallower (about 40 meters), this reduction in resistivity can be seen, and then at a depth of 130 meters resistivity is increased again. Thus, according to the actual resistivity graph, this part of the plain floor is made of limestone.

However, although can confidently said that the A6 and A7 stations also have limestone floors, but because they have less crushing than A5 stations, water was not able to penetrate into the depths. So surface water have penetrated to the upper fractures. While at fifth Station due to the large crunch, the water has penetrated the lower part (to depths of over 250 m) that is called karstification.

3.3 Resistivity Maps

In Roniz plain, the depth to the surface was calculated for all soundings. Then these values employed to construct a depth map with suitable contour interval as shown in Figure 5.In general, the bedrock (limestone) located at depth of 100 to 150 meters.So depths of 10 to 300 meters were considered for these explores.On the other hand, greater depths up to 300 meters in some areas wereinvestigated due to the graben faults.The resistivity distribution map of fractured basement shows significant variation in the resistivity values and so that the resistivity increases to the West. This indicates that, the basement may have lateral facies changes and/or variation in water saturation or moisture content.

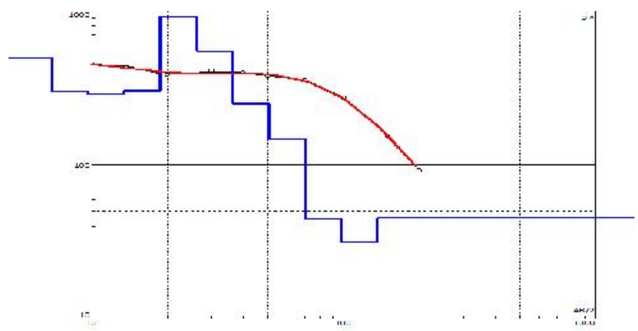

Fig. 3. Deep and true resistance of layer in the interpretation of sounding curve D9

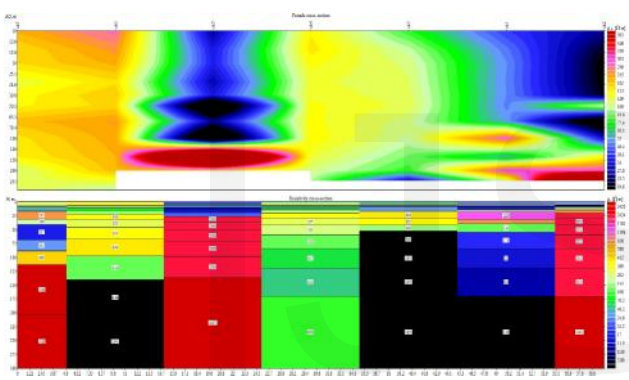

Fig. 4. The modeled curve for VES (Section and sub- section)

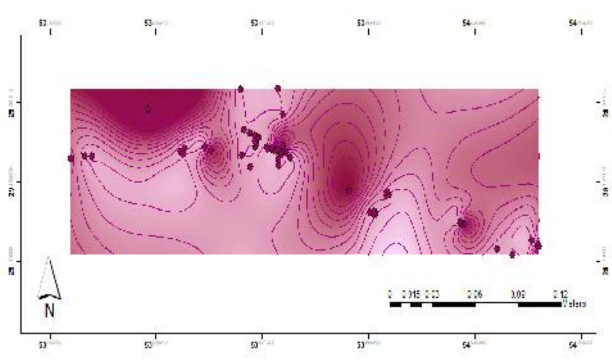

Fig. 5. The Resistivity map in depth of 250 meters

4 Conclusion

The results of five surveys show different Lithology of the rocks in the study area based on the depth of each one.So using geologic interpretation of the VES we can say that the lower layers are composed of clay and marly sandstone with different grain sizes and above basement the hydro geologic unit (aquifer) is exist.During these five-surveys, thick alluvial deposits of clay and sand constitute topsoil. Under this layer, marly sandstone, which was proved in field observations.Lower weathering layer thickness is relatively high. These layers are made of clay and clay minerals, while in some places the underlying rock is fractured.

Based on these results, it can be said that some of the possible causes of decreased volume of water in West Plains include:

1. Reducing the amount of fractures that conduct water from the East to the West as a channel.
2. Topographic slope of the field towards the East.
3. The marly layer in the western and southeastern parts of field caused to Accumulation of water in this aquifer.

So it can be concluded that the aquifer in this area is located in the north-eastern parts of Roniz plain and the main underground water reservoirs have focused on 150 to 200 meters deep.

References

[1] Brooks, M., Kearey, P. (1984). An Introduction to Geophysical exploration. First Edition: 99104, 183-196.

[2] Clark, L., 1985. Groundwater abstraction from basement complex areas of Africa. Quart. J. Eng. Geol., 18: 25-34.

[3] Deming, H.G., 1975. Water, the Foundation of the Opportunuty. Oxford University Press, New York.

[4] William, L., 1997. Fundamentals of Geophysics.Cambridge University Press, Cambridge, U.K.,pp: 208.

[5] Zohdy, A.A.R, Eaton, G.P., Mabel, D.R. (1980). Application of Surface Geophysics to Ground Water Investigation of U.S.A. Geological Survey. U.S. Government Printing Office, Washington.