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Exploration of bitumen (natural asphalt) using a combination of apparent resistivity method and exploration drilling in saleh-abad area, ilam province Iran

Payam Salimi, Asghar Teymoorian Motlagh and Kamran Rahimi Bisetooni

Department of Geophysics, Faculty of Islamic Azad University of Hamedan Branch, Iran.

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ABSTRACT

Bitumen is a hydrocarbon material that accumulates near the earth's surface in the form of asphalt springs or in other forms under the act of hydrostatic pressures of oil reservoirs, it will form bitumen mines after undergoing polymerization process. This mineral (organic) matter is in close relationship to oil reservoirs present in the area, i.e. when oil moves or migrates from one place to another place some part of it will be separated and will remain in the form of streaks, lenses and etc. In this work, the exploration of bitumen resources in Saleh-Abad area, Ilam is carried out using geoelectrical data that were gathered in two-dimensional form, exploration drilling data and also geological data. Today the best method for underground studies and mineral explorations is geophysical studies and drilling exploration wells meanwhile. One of the best data acquisition methods in the Geoelectricity is two-dimensional data acquisition or in other words electrical imaging in two dimensions. Tomography or electrical apparent resistivity tomography is a geophysical technique that investigates underground structures in two or three dimensions. The advantage of ERT method in comparison with other traditional and routine methods is that it investigates the changes of electrical apparent resistivity either laterally (constant spacing traversing or CST) or vertically (vertical electrical sounding, VES) in space. Geophysical data acquisition of the mentioned mine was done using dipole-dipole array in two profiles upon which some points were proposed for exploration drilling. Exploration drilling was done in powder method on the geophysical profiles in six 15-meter bores which proved the high precision of apparent resistivity method for bitumen exploration. Interpretation and modeling of two profiles was carried out using RES2DINV and modeling of drilling Logs was done using LOGPLOT that both had a good conformity with geological data and surface outcrops.

Introduction

Until a few decades ago, most of the studies of Geology and Mineral Prospecting methods under various categories such as economic geology, petrology, sedimentology and was limited. But with the advancement of science and the creation of new branches of science and the use of more advanced equipment and basic necessities as the Geophysical any mining projects are considered. Different ways depending on the mineral geophysical and geological conditions can provide valuable basic information about the location, size and grade of mineral deposits professionals are approximate. Geophysical methods can be used to study bituminous minerals include gravity, electromagnetism, and Geoelectrics (resistivity) due to regional geological geophysical methods were used to harvest Geoelectrics. One of the best types of two-dimensional impression of the area harvested Geoelectrics or in other words, is a two-dimensional electrical Illustration with different electrode arrays (Wenner, Schlumberger, dipole - dipole, pole-dipole,pole - pole, gradients, etc) could be performed. Studies have shown that the electrode array dipole - dipole regional heterogeneity in the study will yield the best results. The sensitivity of this array heterogeneity makes the best option for geophysical studies in the area is mining.

Electrical resistivity tomography (ERT)

Electrical Resistivity Tomography (ERT) is an advanced geophysics method used to determine the subsurface's resistivity distribution by making measurements on the ground surface. ERT data are rapidly collected with an automated multi-electrode resistivity meter. ERT profiles consist of a modeled cross-sectional (2-D) plot of resistivity (Ω·m) versus depth. ERT interpretations, supported by borehole data or alternate geophysical data, accurately represent the geometry and lithology and/or hydrology and/or petrology of subsurface geologic formations. ERT measures resistivity. Resistivity, measured in Ω·m, is the mathematical inverse of conductivity. It is a bulk physical property of materials that describes how difficult it is to pass an electrical current through the material. Resistivity measurements can be made with either an alternating current (AC) or a direct current (DC). As resistivity measurements are frequency dependant, care must be taken when comparing resistivity values collected using different techniques.

Clay materials, metallic oxides, and sulphide minerals are the only common sedimentary materials that can carry significant electrical current through the material itself. As such, the resistivity of most near surface sedimentary materials is

Tele:

E-mail addresses: p_salimi_903@yahoo.com

primarily controlled by the quantity and chemistry of the pore fluids within the material. Any particular material can have a broad range of resistivity responses that is dependant on the level of saturation, the concentration of ions, the presence of organic fluids (such as non aqueous phase liquids, NAPLs), faulting, jointing, weathering, etc. The general principals that ERT is based on have been in use by geophysicists for almost a century. Recent advances to field equipment and data processing procedures have made rapid 2D surveys routine and 3D surveys possible. Old-style 1D resistivity surveys are still common and are useful on many occasions, but encounter interpretation problems in areas of complex 2D or 3D geology.

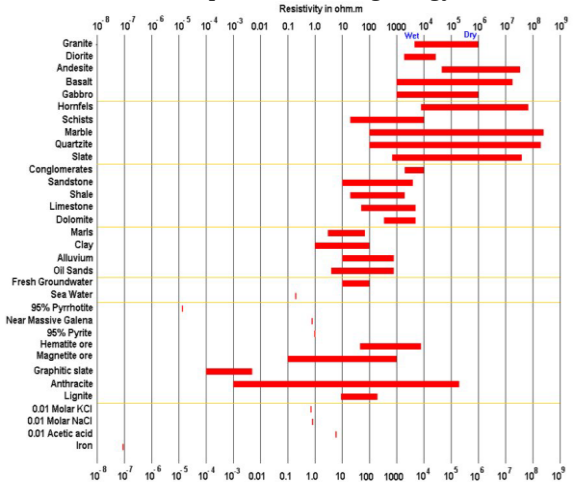


Figure 1. Ground resistivity material

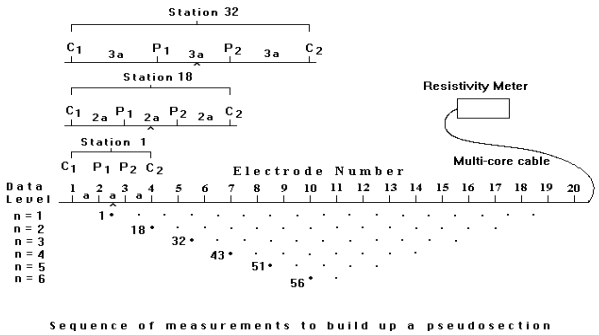


Figure 2. Navigation and placement of the electrodes in the two dimensional electrical tomography(array Wenner).

Figure3. Aerial map of bituminous mine and position profiles

Geographical location and geological mine

The construction division of Iran Ilam province construction in the area has been folded Zagros.Zagros magmatic activity areas due to lack of talent, as well as repeating the same sedimentary facies minerals is limited, which is why metal deposits in this area are rare. But this area because of the oil reserves of the utmost importance, as the largest oil fields are located in this area. In fact the oil fields of bituminous reserves have been created. Ilam oldest rock outcrops within the Sarvak Cretaceous is mainly composed of limestone. Other formations in the province can be Gurpi, Ilam, Pabdeh, Asmari, Gachsaran, Mishan, Aghajari and Bakhtiari province named constitute the bulk rock samples taken place

Sub-section profiles (1)

Inversion of electrical resistivity pseudo-sections of the 2D profiles (1) is illustrated in Figure 4.The vertical axis represents depth in sub-section shown along the horizontal axis shows the line profiles. The resistivity scale is shown in the following sub-sections. This profile was chosen over 130 meters in depth profiles of about 25 meters.

At the beginning of the profiles and about 15 meters high resistivity anomaly is an anomaly that is approximately 85 m profiles also contain a great extent, this is the surface area of the sample profiles has occurred. Given the depth and spread good set of anomalies over this region was proposed exploratory drilling of exploratory drilling results showed very good agreement with geophysical profiles. Layers of marl, gypsum, and limestone are also visible profiles traceable did well in the region. It should be noted that the sub-grade ore from yellow to red colors have been identified.

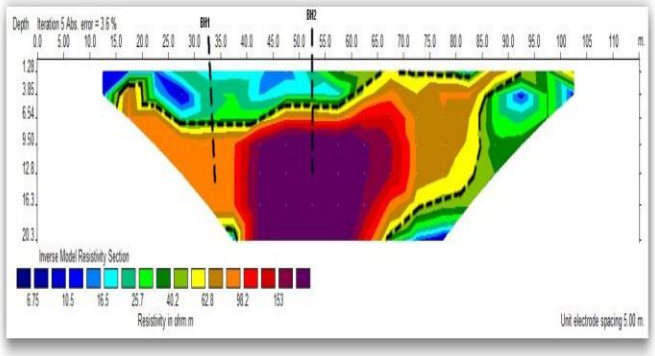


Figure 4. Electrical resistivity pseudo-section profiles (1)

Inversion of electrical resistivity pseudo-sections of the 2D profiles (2) is illustrated in Figure 5.The vertical axis represents depth in sub-section shown along the horizontal axis shows the line profiles.The resistivity scale is shown in the following sub-sections.This profile was chosen over 70 meters in depth profiles of about 12 meters. At the beginning of the profile to about 10 meters high resistivity anomaly is an area of the surface profile of the sample occurred.Given the depth profile and its position at the beginning of this anomaly is not known well exploration drilling in this area was proposed.As it is visible from a distance of 15 meters from the beginning of the profile to a distance of about 40 yards, two anomalies with high resistivity profiles are observed in more depth, which combine the form of a larger anomaly and.To ensure there bituminous region in a series of exploratory drilling was proposed. Based on this profile also took to the stage, geophysics and exploration drilling has confirmed the presence of water to form a thin layer in the profile is visible. Layers of marl, gypsum, and limestone are also visible profiles traceable did well in the region.It should be noted that the sub-grade ore from yellow to red colors have been identified.

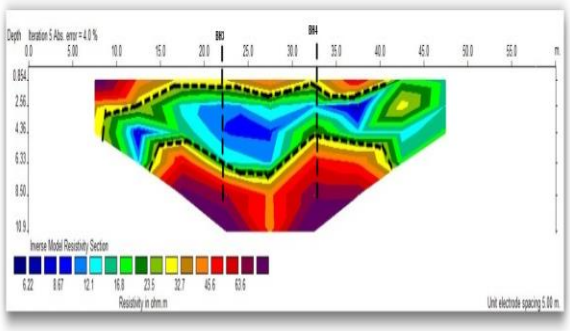
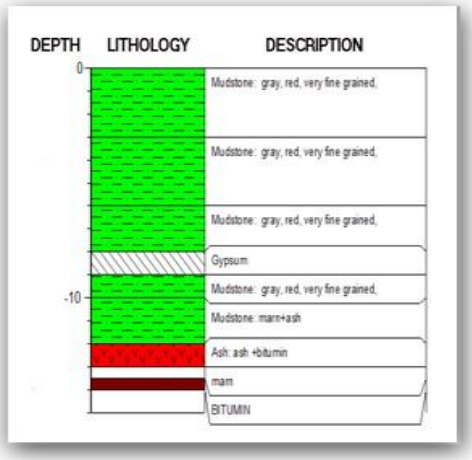
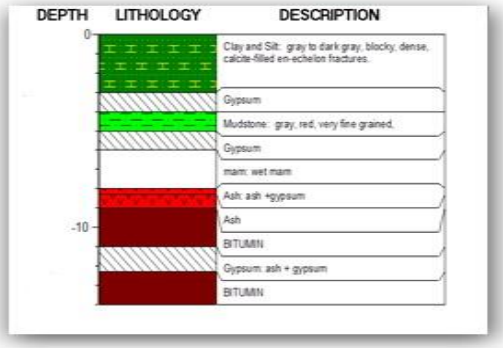


Figure 5. Electrical resistivity pseudo-section profiles (2)

In order to match geophysical studies and drilling holes, 6 holes (15 m) with a total of 90 meters in the first phase of drilling subsurface geophysical sections during excavation. Under the first four holes on geophysical profiles have been identified are listed.



F**igure 6. Boreholes BH1 and BH2**



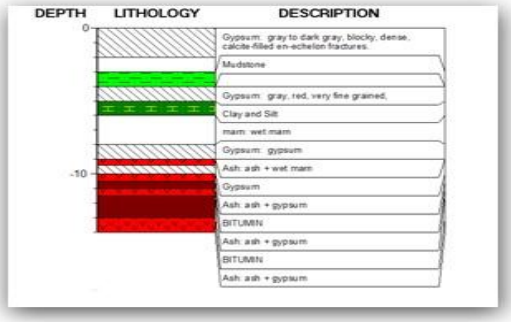


Figure 7. Boreholes BH3 and BH4

Conclusions and recommendations

1.The results obtained by the interpretation of electrical resistivity in the range of bituminous mine mentioned that using this method, combined with geophysical and exploration drilling, geological data and field visit could be used as a reliable method to explore bituminous.

2.There are juicy layers according to the geoelectric sections and exploratory drilling in the area was almost certain they should be considered when extracting.

3.Remember always set Conclusive bituminous mine exploration well drilling exploratory geophysical time series is needed.

Resources

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