Advanced Engineering Days

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Investigating the Kavşut (Göksun-Kahramanmaraş) Cu-Pb-Zn deposit by using IP/Resistivity methods

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Cite this study: Yalçın, C., Canlı, H., Haznedaroğlu, K., & Akbulut, F. (2023). Investigating the Kavşut (Göksun-Kahramanmaraş) Cu-Pb-Zn deposit by using IP/Resistivity methods. Advanced Engineering Days, 7, 73-76

Keywords
Polymetallic
Cu-Pb-Zn
IP/Resistivity
Mining
Kavşut

Abstract

According to its tectonic structure, Türkiye has major orogenic belts. Important ore deposits are observed along the characteristic Tethys metallogenic belt. Cu-Zn-Pb (polymetallic) mineralizations are hosted in many areas along this tectonic belt. The polymetallic enrichment southeast of Kavşut (Göksun, Kahramanmaraş-Turkey) is also located in the Tethys metallogenic belt. The region is basement to the Goksun ophiolites. This complex is overlain by the Malatya Metamorphites with a tectonic contact. Within these units, mineralization is observed in the fracture-cracks and karstic gaps of carbonate rocks. IP/Resistivity studies were carried out to reveal the geometry and distribution of this mineralization underground. It was determined that sulphide mineralizations show high rechargeability character. Cross sections and two-dimensional level maps were prepared according to the electrical data obtained for planning and coordination. This visual information provides very important information for the mining operation in the region.

Introduction

Electrical methods, which started in the 1920s and have developed greatly in recent years, have shown to be a powerful asset in the exploration of metallic and non-metallic mineral deposits [1-2].

Electrical resistivity tomography is widely used for characterizing subsurface structures and overlaying geological settings [3-4]. The induced polarization (IP) can even detect information of small conductive rocks that have been extinct in the subsurface. Resistivity models resulting from both resistivity and IP studies can also identify the presence of sulfur in minerals, mineral deposits and soils [5].

For the exploration of sulfide mineral deposits (e.g., Cu-Pb-Zn), combined geophysical surveys such as electrical and electromagnetic surveys have been practiced [6-7]. Both Electrical resistivity and Induced Polarization (IP) are two significant geophysical techniques used to map the location of sulfide minerals [8-9].

Geological structures where sulfide minerals occur show low resistivity and high chargeability [10-11]. High chargeability and high resistivity anomalies have also been attributed to the presence of disseminated sulfides [12]. Successful applications have been made with these geophysical methods used in mineral exploration. Resistivity and induced polarization applications in Cu-Pb-Zn exploration have been applied in many studies by various authors [13-14].

The Tethyan Eurasian Metallogenic Belt [15], which extends from Western Europe to Anatolia and Iran, is one of the most important metal formation belts [16]. Göksun (Kahramanmaraş) region is also located in this belt and hosts important metallic deposits.

In this study, geophysical studies were carried out for the ore potential of the Cu-Pb-Zn deposit in the southeast of Kavşut (Göksun, Kahramanmaraş-Türkiye). This study is a regional scale and recommendation and includes the determination of whether the relevant area is suitable for polymetal (Cu-Pb-Zn) mineral formation and exploration, and if so, the determination of target areas for exploration and the selection of appropriate exploration methods. The literature was supported by observational geological data and then geophysical methods were applied.

Material and Method

The IP/Resistivity method is based on the principle that some rocks act like a capacitor and retain some of the current for a certain period of time after the electric current is cut off. The distribution of metallic mineral particles in rocks is the source of IP anomalies. Increasing the concentration of polarizable sulfide minerals increases the chargeability values. In other words, mineralization is directly related to chargeability values.

True chargeability; (M") is the ratio of the voltage after the current is cut off to the voltage measured during the current supply and is defined as mVolt/Volt. It varies between 0-1000 mv/v values.

In resistivity (electrical resistivity) method applications; electric current is sent into the ground through a stainless metal-steel electrode driven into the ground. With the help of two electrodes placed at two other points on the ground, the voltage difference in the ground is measured. The unit of the applied current is recorded in amperes (usually milliamperes) and the unit of the measured voltage in Volts (usually millivolts). Using the measured values and the geometric factor K (array factor) of the electrode array used, the apparent resistivity (in ohm-m) is calculated for this measurement location. The calculated value is assigned below the midpoint of the electrode array system.

In the study area, the AGI brand, 8-channel, 84-electrode resistivity and IP measurement device with 84 electrodes was used.

Dipole-Dipole Gradient method was applied and 24 profiles were made with 20-10-7 meters between the electrodes. This measurement was evaluated in EarthImager 2D evaluation program. In this study, the data of 3 profiles are presented. After the geophysical measurements, two-dimensional level maps were prepared to make the structure of the region more understandable.

Geology and Mineralization

The study area is located in the western part of the Eastern Taurus Mountains within the Taurus orogenic belt. In this region, allochthonous and autochthonous rock units represented by different ages and rocks are bound by tectonic contacts. Göksun ophiolitic rocks are observed at the base of the region and Malatya metamorphites are overlying it with tectonic contact [17-18]. These two units are cut by Esence granitoids [17]. Tertiary aged sediments cover all units with angular discordance.

Various anomalies were obtained in geochemical studies conducted in and around this region [19]. Tüfekçi and Dumanlılar [20] reported mineralization in alteration zones and karstic gaps. Ore paragenesis consists of chalcopyrite, sphalerite, galenite, pyrite, malachite and azurite respectively.

IP-Rezistivity Results

Resistivity and chargeability data were compiled and inverted to obtain a more realistic geologic representation. GPS elevation data of the profiles were used to correct the effects of topography in the inverse analysis. Chargeability and resistivity graphs were prepared for the inverse solutions of the profiles.

In the graphs, warm red-purple colors were used to represent high chargeability and resistivity values and cool colors such as green and blue were used to represent low values. In this study, the important targets are considered to be the areas showing high resistivity (karstic sinkholes).

Normal chargeability values were observed in most of the profiles measured in the field. Probable sulphide ores are thought to be the cause of the high chargeability values obtained.

1. Along the 1st profile, high resistivity inclusions are observed at 60 meters, 160 meters, 240 meters, 320 meters and 580 meters. High chargeability inclusions are observed at 60 meters, 280 meters, 380 meters, and 460 meters (Figure 1).
2. Along the 2nd profile, high resistivity inclusions are found to be more widespread at 160 meters and 220 meters. The main reason for this is the development of karstic gaps and fracture-crack system below this profile. In contrast, the chargeability is not as widespread as the high resistivity but in a narrower area at 270, 370 and 480 meters (Figure 2).

Two-dimensional level maps of different elevation values were prepared by evaluating the other profiles and the above profiles together. Of these maps, Figure 3 represents the 50-61 meter range.

Geophysical methods have an important role in mineral exploration. The preparation of visual cross-sections and maps for planning and coordination will provide a significant advantage.

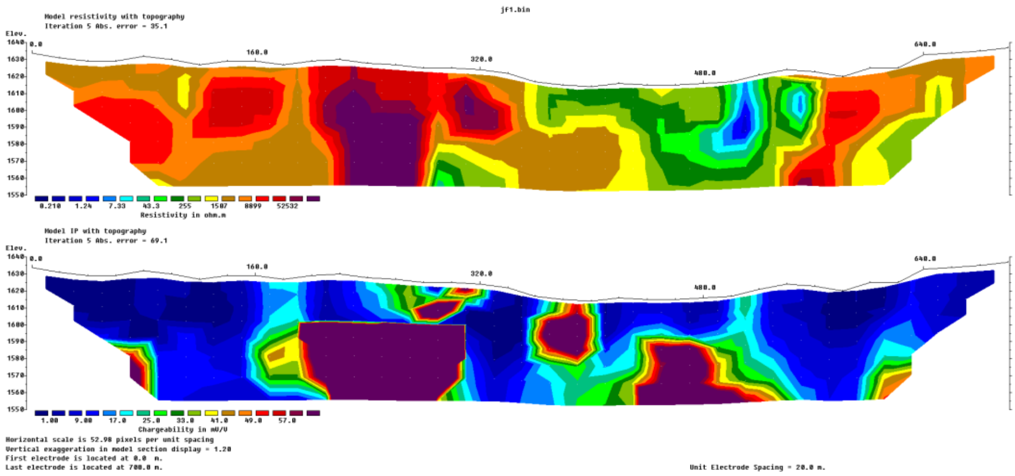

Figure 1. The inverted resistivity and IP sections of the 1st profile

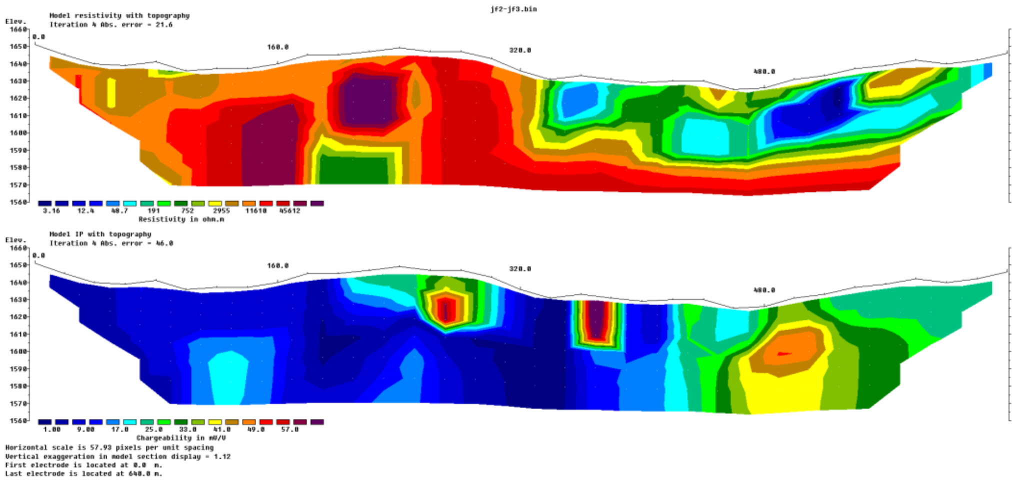

Figure 2. The inverted resistivity and IP sections of the 2nd profile

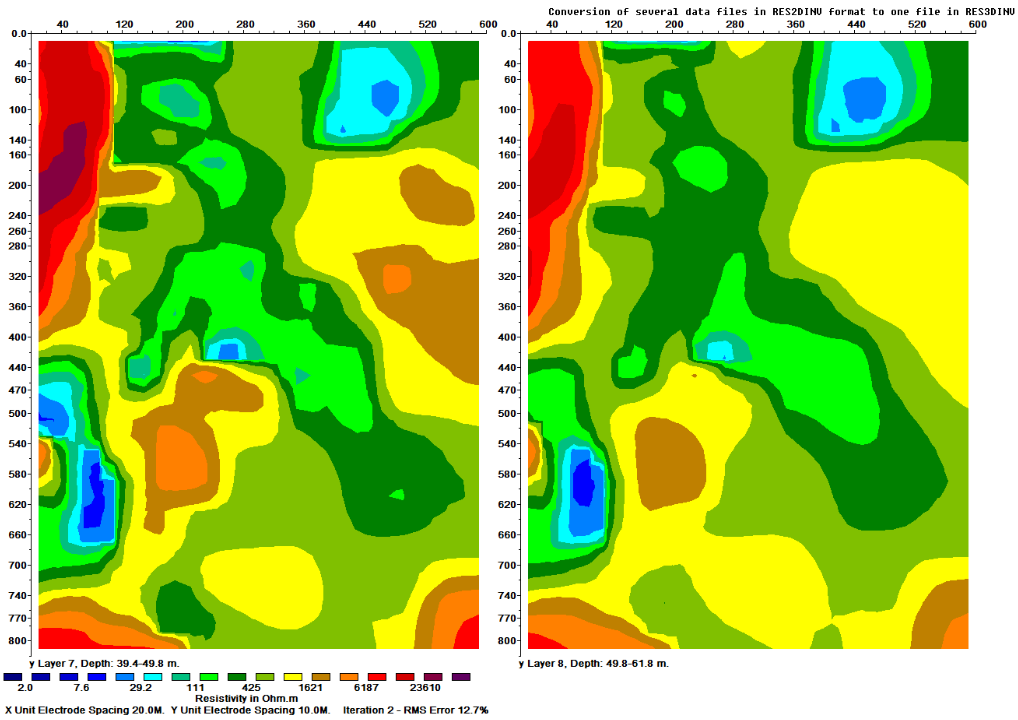

Figure 3. Two-dimensional level maps of 50-61 meter range

Conclusion

It is already known that the Cu-Pb-Zn mineralization produced in the mining area is located in fracture zones and karstic gaps. In this study, these zones were imaged and schematized underground. It is concluded that the IP/Resistivity method can be applied successfully in polymetallic mineralization.

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