Application of Geophysical Methods in Deep Metallic Ore Exploration

Hui XU, Shuyan He, Ye LI

Jiangsu Institute of Geological Explorat Ion Technology, Jiangsu 210008, China

1455065502@qq.com

Keywords: Geophys ical method, Deep prospect ing for metal ore, Appl icat ion

Abstract: In recent years, with the depletion of shallow metal mineral resources, the exploration of deep metal mineral resources has become an impor tant deve lopment direction and an important way to effectively deal with and solve the probl em of resource shortage. But deep metal ore prospect ing has always been the focus and difficulty of ore prospecting. In deep metal ore prospecting, the appl ication of geophys ical prospecting method can greatly improve the efficiency and quality of prospecting. Therefore, the applicat ion of geophysical methods and techniques should be paid more attention to in deep prospecting of metal ore.

1. Introduction

In recent years, with the rapid development of science and technology, geophysical exploration technology has al so made great progress, and has played a very important role in mineral resources exploration. In order to further improve the efficiency and quality of deep metal ore prospecting, this paper mainly a nalyzes and discusses the application ofgeophysical methods in deep metal ore prospecting.

Deep prospecting is not a simple increase of exploration depth. With the increasing burial depth of prospecting target body, the underground geological env ironment and structural complexity must be inferred according to relevant data. Traditional geological methods face great dfficulties n deep prospecting. In addition, the deep prospecting is a practical problem with strong exploration, and the deep prospecting of a specific mining area has a strong case and case na ture, so it is necessary to C losely combine the prospecting practice and constantly revise the understanding of metallogenic characteristics to obtain good prospecting results, And has the characteristics of comprehensive, deep prospecting is' the height of the multidiscipl inary integrated, including geology, mineral content, exploration techniques and related disciplines, must impl ement the combination of professional knowl edge, such as metal deep prospecting need joint appl ication of geological, geophysical, geochemical and other[1]. Technical means, finally still need drilling verification, etc., In this way, the deep prospecting effect of metal ore can be effectively improved.

2. Application of Geophysical Method in Deep Prospecting of Metal Ore

2.1 Excited Polarization Method

Excitation polarization method is the most common technique used in deep metal exploration. With the deve lopment of science and techno logy, excitation pol ar izat ion method has been improved and improved. The most important part of excitation polarization met hod is the excitation effect, through the observation and study of the excitation effect, we can understand the geoelectric characteristics of the mining area. After the geoelectric characteristics are understood, the pr imary conductor and the power supply electrode A and B are laid on the intermediate gradient device, and then the excited polarization method is used to sweep the surface. The advantage of this method is that it is easy to measure the large area, and. it is easy to observe the anomalies of various shapes and occurrences of geological bodies, and the obtained anomalies are more intui tive. However, good groundi ng conditions should be ensured for the power, supply, electrode before measurement, and the AB pole distance should be 1000 meters in the test area. In addition, it is

  DOI: 10.25236/edssr.2022.013

necessary to ensure the supply vol tage and current of the AB pole to ensure that the depth of the target layer can be observed. In order to ensure the quality of received data, 20 meters of MIN pole distance is selected; In order to reduce the polarization potential difference, MN electrode uses non-polarization electrode. At the same time, the interference of electromagnetic coupling should be avoided, and the power supply line should be arranged in the space zone 10m above the measuring line. The induced polarizat ion method can calculate the depth, thickness and electrical parameters of each layer. Combined with the situation of the mining area, the burying and extension of IP anomalies can be unders tood. The observation method adopts symmetric quadrupole sounding[2].

2.2 Gravity Survey Method

In recent years, the gravity explorat ion method has been well applied in studying the gravity anomaly on the surface of ore bodies and the structure of metal deposits. The gravi ty explorat ion me thod has become one of the methods to search for deep metal and concealed deposits. The buried depth of deep metal ore is. Generally between 700m and 2000m. It is possible to find the metal ore at this depth by applying the gravity explorat ion method. Through the gravity explorat ion, the gravity anomaly in the mining area can be observed and the abnormal scale can be reversed. Therefore, gravity exploration method can effectively detect. The gravity anomaly of deep metal ore. However, gravity exploration method also has, certain 1 imi tat ions. For metal mines with large topographic fluctuations and deep concealed deposits, observation errors will be generated due to the impact of topography. In this case, gravity exploration method needs to be used together with other exploration methods for comprehensive interpretation to improve the accuracy of interpretation results.

2.3 Seismic Explorat Ion Me Thod

Seismic exploration is mainly used to detect stratified strata and fault struc tures, but sel dom used in deep metal exploration. There is a large deve lopment space in deep metal exploration. In deep metal prospecting, seismic explorat ion method can effectively detect the second depth space metal ore exploration by virtue of its characteristics of better detection of stratified strata, which is irreplaceable advantage of other geophysical methods. The detect ion depth of seismic explorat ion method is affected by observation system, source energy, instrument and equipment, etc. When detecting large and super-large deep metal ore, the method of increas ing source energy and changing observation system can be adopted to achieve the purpose of detecting deep metal ore. The detection depth of sei smic exploration method can be up to 2000m,and the deep posit ion and space structure of forming area have a good understanding, and the concealed position of metal ore can be inferred, prov iding effective judgment for subsequent mining means. It can be seen that seismic explorat ion method has great deve lopment potential in the exploration of deep metal ore. At present, the technical means of seismic exploration is developing continuously, and there are seismic scatter ing method, 2D, 3D, VSP method based on reflect ion technology, sei smic tomography method and other means[3]. These detection methods br ing dynamic effect to reveal the location law of mineral distribution.

3. Application Example of Geophysical Method in Deep Prospecting of Metal Ore

3.1 Overview and Geological Background of the Mining Area

The cu-Ni ore body of a cu-Ni mining area occurs at the edge of syncline structural rock mass ex tending ne (Figure 1). Basic - ultrabasic complex belt for shearing section. at unit different surge of magma intrusion in issue emplacement intrusive complex form of double entry, can be further divided into three phases of invasion, has been found in norite first invasion period, gabbro, olive norite, olive gabbro, etc., has been found in peridotite, the second invasion per iod ChanHuiHui throws rocks, the third invas ion per iod exposed ChanHui throws pyroxenite[4]. The complex rock mass are controlled by deep fracture, and output space and fac ies different iation degree and the simi lar characteristics, origin, formation, in place of the. rock mass mi scel laneous, evolut ion and

minerali zat ion has the uniformity, especially in the west of the new di scovery of mixed with characteristics like the rhy thm of layered rock mass, limonite and peacock petrochemical and existence, and for the take copper nickel containing platinum palladium opened up a new direct ion. At present, the max imum explorat ion depth of the mine has reached 557m, and a large amount of disseminated nickel and copper sulfide can still be seen in the deep, which is a typical mineral occurrence area in the second depth space.

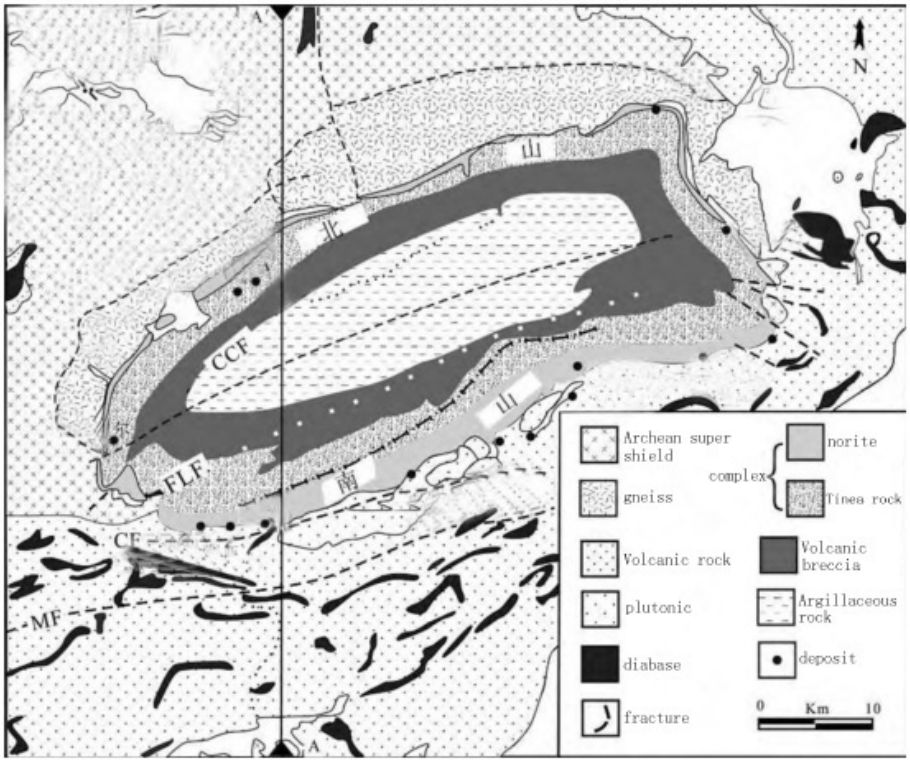

FIG. 1 Geological map of mining area

Fig.1 Geological Map of Mining Area

3.2 Application Effect of Geophysical Method in Deep Prospecting

After many, years of analysis and research, it is concluded that the distribution of cu-Ni mineralization is correlated with the intrusive complex. With the demand of mineral deve lopment in the mining area, it has become an urgent problem to carry out deep prospecting to expand the resource reserves of the mining area and find out the deep structure and floor depth of the basic-ultrabasic volcanic complex. For relying on the surface in shallow ground to implement regular clues to carry out the methods of geochemistry, geology, it is difficult to achieve prospecting has been in the area, is deep detecting depth, high precision of modern geophysical me thods, such as: high resolution sei smic exploration and high precision gravity survey method, comprehensive utilization of joint invers ion has become the important way of deep mining prospect ing.

To carry out high resolution reflection seismic exploration in the mining area: channel spac ing of 20m,gun spacing of 40m,receiving channel of 288, cover ing 72 times, vibroseis sweep frequency of 20-60Hz; Hi gh-frequency seismic explorat ion: channel spacing of 20m,gun spacing of 40m,receiving channel of 480,covering 120 times, vibroseis sweep frequency range of 30-90Hz;Carry out hi gh-precision gravity measurement: the distance between points is 20m,and the total accuracy of bouge anomaly is controlled at 50 (10)-* m /s). In the later period, through the data processing methods such as static correct ion, dynamic correction, stacking and migration of seismic data and the data process ing methods such as topography, height and bougue correction of gravity data, a better section result map was obtained.

(This magnetic anomaly profile has no map number and no map name. It is placed at the top of FIG. 2 for confusion, it can be made up.)

According to constraints such as the depth of different rock layers de termi ned by known

boreholes and seismic reflection interfaces and the extension interface of different rock boundaries on the surface,combined with geomagnetic anomaly profiles, the underground gravity and magnetic joint inversion model (a-A'section in Figure 1) was establ ished. The results are shown in Figure :2

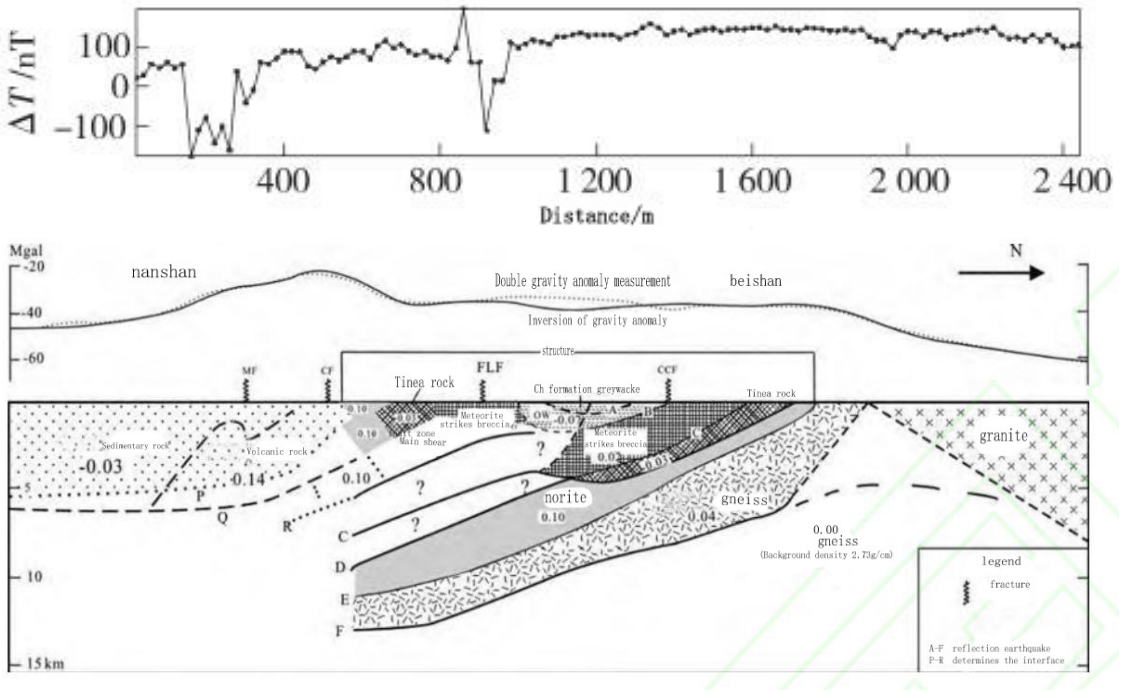

Fig.2 A-A' Section Seismic and Gravity and Magnetic Joint Inversion Sect Ion

By the picture visible, mining area showed obvious asymmetry characteristics of deep structure, at the same t ime from the northern reflect different li thology bottom reflection interface, the structure is relatively flat, less volatile overall south, show that beishan is from south sloping floor granite, gne iss, basic - ultrabasic complex rock and sed imentary rock. Careful observation can reveal the phenomenon of structural changes, that is, the sedimentary rock strata near the basic -ultrabasic complex are cut off by faults, and the rock strata of the floor strata continue to extend southward, extending to a depth of 5000m.

3.3 The Conclus Ion

The joint inversion results prov ide abundant informat ion of underground geological structure units, an the thickness of each layer below the surface of the mining area and the depth of the 1 floor interface are divided respectively, so as to basically find out the distribution and buried depth of deep structure in the mining area, and find out the favorable locat ion of orebody. 0n this basis, in-hole transient electromagnetic exploration (DHEM) (FIG.3) was carried out to verify the accuracy of joint inversion and inference combined wi th borehole data. Through data processing, the results show that the obvious low resistance anomaly zone is delineated at the depth of 1000m~ 1500m, indicating the existence of good conductor. After analysis, the abnormal part is considered as the ore bearing part, and drilling 1-6 to verify, the high grade ore body is found between 600m~280m underground, realizing the goal of deep prospecting[5].

The joint inversion results provide abundant informat ion of underground geological structure units, and the thickness of each layer below the surface of the mining area and the depth of the floor interface are divided respectively, so as to basically find out the distribution and buried depth of deep structure in the mining area, and find out the favorable location .of orebody. On this basis, carried out in the known drill hole in the transient electromagnetic method in. exploration well (DHEM), combined with drilling data joint inversion concluded that the accuracy of the auxiliary card and directly posit ioning depth of burial depth and burial site, realize effective combinat ion for deep mining of mineral resources, is of great significance to realize mining deep prospecting.

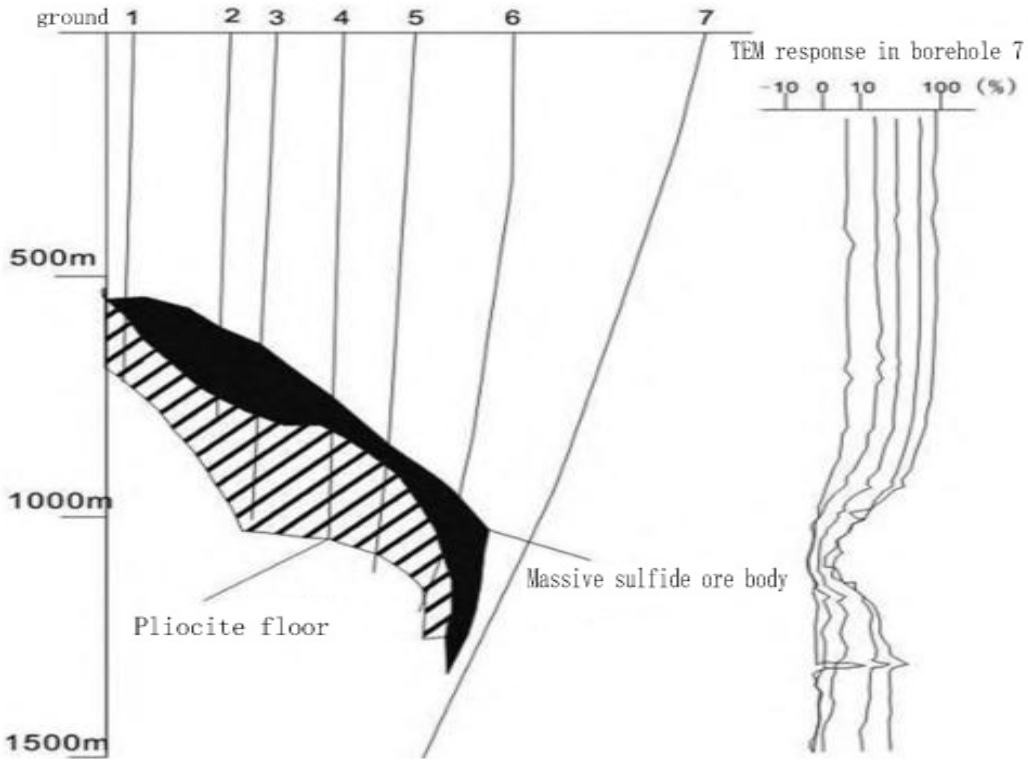

FIG. 3 DHEM measurement results and drilling validation diagram in Borehole 7

Fig.3 Dhem Measurement Results and Drilling Validation Diagram in Borehole 7

Of course, in the deep exploration of the devel opment and utilization of mineral resources, due to factors such as ore-controlling structure and .generation process all kinds of differences, face detection depth requirements more and more new forms and precision demand is higher and higher, must strengthen the improvement and development of new geophysical explorat ion instrument and equi pment, s trengthening the forward and invers ion theory and deep prospecting information extraction and processing techno logy research, Develop the sof tware system which has pertinence and practicability for deep prospecting. At the same time, only by in-depth study of different geological targets, targeted selection and development of large depth and high precision geophysical explorat ion methods, combined with geological and geochemical explorat ion me thods, streng then comprehens ive research and gradually achieve the most practical interpretation and inference effect, can the prospecting target be achieved[6].

4. Conclusion

At present, in the process of metal ore prospect ing, the applicat ion of geophysical method is becoming more and more popular, and, it will play a more and more important role. In deep metallic ore prospect ing work, therefore, the related technical personnel should fully understand the deep geophysical method in metallic ore prospecting work, the importance of cont inuous re inforcement learning, for all kinds of methods and techniques of the actual operation, there is a more fully understand and master, raise the level, improve efficiency and quality of metal deep prospecting work, To realize the sustainable and healthy development of metal ore prospecting.

References

[1] LIU Hongying, LIU Hongying, ZHANG Hongy ing. Application and Prospect of Geophysical method in deep prospecting of metallic ore. Progress in geophysics (in Chinese), vol.26, no.02, pp.701-708, 2019.

[2] zhang wenqing. Geophysical prospect ing methods commonly used in deep metal exploration.

China metal bulletin, vol.04, no.02, pp.37-43, 2016.

[3] LI Ruihai. Analysis of common geophysical prospect: ing methods and application effect in deep metal exploration. China new technology and new products, vol.23, no.03, pp.84-85, 2016.

[4] LIU Jianjun, WANG Jianjun. Applicat ion and prospect of Geophysical method in deep prospecting of metallic ore field. China Strategic Emerging Industries, no.44, pp.109-110, 2018.

[5] ZHANG Haijiang. Study on appl icat ion and prospect of geophysical method in deep prospecting of metallic ore. China Strategic Emerging Industries, no.44, pp.109-110, 2018.

[6] Zhou Linong. Appl ication of geophysical method in deep prospecting of metallic ore.Informatizat ion Construction, no.09, pp.347, 2019.