Principle and Case Study of Distinguishing Ore and Non-ore Induced Polarization Anomalies Based on Spread Spectrum Induced Polarization

R. Chen[1], H. Yao[1], R. Shen[1], L. He[2], L. Yang[3], H. Hu[3], and F. Ullah[3]
[1]School of Geosciences and Info-Physics, Central South University, chrujun12358@gmail.com
[2]Key Laboratory of Mineral Resources, Institute of Geology and Geophysics, Chinese Academy of Science, mofoo@263.net
[3]Institute of Geochemical Exploration and Marine Geological Survey, Jiangsu Geological Bureau, 584945583@qq.com

SUMMARY

Spectral induced polarization (SIP) measurements of artificially synthesized ore samples and ore outcrops, as well as some cases of SIP exploration, indicate that the time constant of Cole-Cole model parameters in SIP can be used to distinguish between ore and non-ore induced polarization (IP) anomalies. However, due to the fact that SIP is usually observed in the frequency band range of 0.125-1024 Hz, the exploration efficiency of SIP is very low, and the SIP time constant of some large-scale massive sulfide deposits exceeds 1000 seconds. The traditional SIP observation frequency band cannot meet the needs of distinguishing between ore and non-ore IP anomalies. In order to overcome the above challenges, we propose and implement a distinguishing technology between ore and non-ore IP anomalies based on spread spectrum induced polarization (SSIP). This technology first measures and analyzes the SIP response of deposit types and typical rock and ore specimens in the exploration area. By measuring the SIP response of typical rock and ore specimens, the optimal frequency band for distinguishing between ore and non-ore IP anomalies is determined. Secondly, we conducted deep SSIP measurements in the exploration area using the best frequency band determined based on the SIP measurements of the rock and ore samples mentioned above. Due to the exploration method of SSIP being similar to seismic exploration, SIP signal acquisition can be carried out simultaneously on one or more survey lines, greatly improving work efficiency and exploration accuracy. Then, we conducted 2D/3D complex resistivity inversion based on the IP data obtained from various frequency points of SSIP. Finally, based on the inversion results and SIP response of typical rock and ore samples in the work area, we provide an interpretation for the lithology, mineralization area, and differentiation between ore and non-ore IP anomalies in the measurement area. Based on the above method, we have realized the differentiation of ore and non-ore IP anomalies and major ore prospecting breakthroughs in several deposits, such as the Guchenghu copper-lead-zinc polymetallic deposit in Nanjing, Jiangsu Province, the Qiushuwan porphyry copper-gold deposit in Zhenping, Henan Province, the VMS copper-lead-zinc polymetallic deposit in Baiyinchang, Gansu Province, and the Zhaxikang lead-zinc deposit in Tibet, proving the effectiveness of the above method and its universality in the exploration of different deposits.

Keywords: Spread spectrum induced polarization, ore deposit, mineral exploration, ore and non-ore IP anomalies, IP