1 Introduction

Spectrum induced polarization method (SIP for short) is a kind of geophysical method, which is widely used in oil prospecting and mineral exploration. As it has a good effect with prospecting metallic sulphides, SIP method has a good prospect in the application of Uranium and polymetallic deposit explorations.

2 SIP Observation and Data Processing Techniques

2.1 The principle of observation

Spectrum induced polarization is developed from induced polarization method, both of which are based on prospecting the difference in polarizability between different rocks. When a direct current is send underground, the electrically charged particles in rocks are arranged by a particular direction, this kind of arrangement generates a secondary electric field added onto the primary field. Once the current stops, the primary field disappears immediately but the secondary one is declining gradually (figure 1). The SIP method considerate not only the charging and discharging process, but also its velocity to saturated condition. Indicated from the curves in figure 1, the charging processing cost time, even it’s very fast in several seconds, but different minerals and rocks have different saturated time. If sending transmit current of different charging time, which means current of different frequencies, at a certain frequency, some rocks may get saturated while some doesn’t. By detecting and describing the secondary field and recording saturated values, more electrical properties are shown for rock identification. Using SIP method, we can obtain four electrical parameters in total, such as resistivity ($\rho_s$), polarizability ($m_s$), timing constant ($\tau_s$) and frequency correlation coefficient ($C_s$). $\tau_s$ shows the time of rocks underground to get saturated, and $C_s$ is a parameter to describe the homogeneity of polarization minerals in rocks, while $\rho_s$ and $m_s$ are the same as traditional Time Domain IP.

2.2 The principle of data processing

Cole-cole model is the core of SIP data processing. In field exploration, the frequency domain curves of appearance complex resistivity is affected by IP and EM effects at the same time. Two or more ‘cole-cole’ model are used to fit the observed curves.

$$\rho_s(i\omega) = \rho_{so} \left[ 1 - m_1 \left( 1 - \frac{1}{1 + (i\omega\tau_s)^{c_1}} \right) \right] + m_2 \left( 1 - \frac{1}{1 + (i\omega\tau_2)^{c_2}} \right)$$

In the formula above, $\rho_{so}$ is appearance resistivity including IP effect when the frequency is 0Hz., $m_1$, $\tau_1$ and $c_1$ respectively mean the polarizability, time constant and frequency correlation coefficient of IP effect in rocks. And $m_2$, $\tau_2$ and $c_2$ are those parameters of EM effect.
The procedures of SIP data are as follows: ① elimination of ‘jumping point’ and ‘bad channel’; ② pole location correction; ③ extraction of appearance parameters; ④ separation of EM and IP effect; ⑤ do 2D resistivity and polarizability inversion. ⑥ draw the section contour map for further interpretation.

3 SIP Observation System and Advantages

SIP method is a geophysical exploration way which is usually used in reconnaissance geological survey. It is a sounding method mostly with dipole-dipole array. Now the instruments can be used on SIP survey only V8-system and GDP-32. Different frequencies of square current wave are send into rocks underground, and receivers detect the secondary electrical field by non-polarizable electodes. The measurement system in actual surveys is laid out as figure 2. It depends on the variation of receiving poles-transmitting poles distance to reach the destination of detecting the rock at different depth. There are several advantages than traditional IP, as its transmitting current is much lower, so it gets easier for transmitting. Also more...
electrical parameters are detected, which can provide plenty of characteristic of rocks, reduce the interpretation ambiguity.

4 Applying in No. 534 U-Mo Deposit

No. 534 deposit is a typical U-mo deposit. The molybdenum here are mostly located in the upper Jurassic stratum and rhyolite intrusions with the form of sulfides. Pyrite, lead and zinc mine also discovered at about 300m below. Uranium is discovered accompanying with molybdenum. An SIP profile is set above the mineral body and coincided with drilling profile, No.15 (figure 3).

5 Conclusion

SIP method is an effective method in mineral exploration. It also can be applied in uranium and multimetallic deposit as uranium often accompanying with other sulfide. In No.534 deposit, rocks rich of uranium and metallic mine shows a characteristic of ‘high resistivity and polarizability’.

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