Principle and application of array spread spectrum induced polarization instrument (SSIP) with depth of exploration great than 1000 m

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SUMMARY

Induced polarization method (IP) is the main exploration method for metal sulfide deposits and is also widely used in groundwater exploration and evaluation. However, the IP method has long been restricted by problems such as small exploration depth, low exploration efficiency, and the inability to distinguish graphitized formation and pyrite haloes, which cause interference IP anomalies. Although the emergence of spectral induced polarization (SIP) has solved the problem of distinguishing sources of IP anomalies to a certain extent, SIP is less efficient than traditional IP exploration and is more susceptible to electromagnetic interference. In view of the practical problems faced in the application of the IP method, we proposed the spread spectrum induced polarization (SSIP) method and developed related instruments. The SSIP method uses pseudo-random signals as the excitation field source, and then despreads the collected pseudo-random signals into amplitudes and phases of several controllable frequency points at the receiving end based on the idea of spread spectrum. The characteristics of the source of IP anomalies are distinguished through the amplitude and phase of multiple frequency points. The above method can greatly improve the exploration depth and anti-interference ability, and also includes the advantages of SIP. In terms of instruments, we have implemented synchronous real-time acquisition of massive SSIP receivers based on the wireless Internet of Things using ZigBee and GPS, thereby greatly improving exploration efficiency; based on the series and parallel technology of multiple controllable rectification sources, the transmitter also takes into account high voltage and sending large currents. The maximum output voltage using SSIP transmitter can reach 2000 – 5000 V, and the maximum output current can reach 6 - 30 A. Finally, through the case of deep prospecting breakthrough in Gaochun District, Nanjing City, Jiangsu Province, we prove that SSIP can achieve an exploration depth of greater than 1,000 m in strong electromagnetic interference areas under a power supply current of 3-6 amps.

Keywords: Spread spectrum induced polarization, ore deposit, mineral exploration, ZigBee