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Molybdenum mines prospecting using new developed MTEM system

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A new electromagnetic observation system for multichannel transient electromagnetic (M-TEM) method was researched by University of Edinburgh. Ziolkowski et al. [1] used the developed MTEM method for geophysical prospecting over gas reservoir and oil-gas field. The system uses seismic data processing method to obtain earth impulse response from the transmitted waveform and the received signal, and uses pseudo-seismic method for interpretation.

With the support of major national scientific researches and equipment development projects in China, a new multi-channel transient electromagnetic (M-TEM) system was developed by the Institute of Geology and Geophysics, Chinese Academy of Sciences. The transmitter system includes generator, uncontrolled rectifier bridges, pulse width modulated DC/DC full-bridge converter, H Inverter Bridge and pattern generator, which can generate pulse random binary signals (PRBS) waveform. The dynamic range of MTEM electromagnetic data acquisition station is 160dB, minimum detectable voltage is 50nV, synchronization precision is 5μs, and the sampling rate is 16Ksps. Its advantages include; low power consumption, small size and light weight. The acquisition station data transfer is based on TCP/IP protocol.

An integrated geophysical data acquisition and processing using the developed MTEM system was carried out at Cao-si-yao molybdenum mines, Inner-Mongolia, China. The summary of the integrated results is given as: the ore body of Cao-si-yao molybdenum mines is 1900m long in east-west direction and 1400m wide in north-south direction, while the single drilling maximum ore body thickness is more than 900m. This reserve estimate indicates that about 200 million ton of molybdenum metal can be obtained from this ore area and that Cao-si-yao molybdenum mine will become the world's second largest molybdenum mine.

In July 2015, we conducted a field test with the developed MTEM system using an electric dipole to transmit 12 order PRBS electric current code type, whose element frequency is 512Hz, into the earth repeatedly in 30 cycles. Since there were only 10 receivers available for the study, the 10 receivers with three channels for each were used to collect data from 30 stations simultaneously. The electrode spacing used was 40m, the profile length was 4800m, the length of transmit dipole was 300m, and the maximum current was 15A. Similarly, like seismic survey, M-TEM data were recorded at different offsets by moving the transmitter dipole at an interval of 300m towards the receiver units while keeping the receivers stationary. Hence, we were able to obtain the earth impulse response at different offsets.

Although 50Hz electromagnetic interference was observed over the study area, good earth impulse response curve was still obtained along the offset. This shows that the performance of the instrument is stable. The peak time of the collected data were extracted and used to calculate the subsurface apparent resistivity value. The obtained 2D inversion result showed a resistivity structure that was consistent with known geological data.

References:

[1] Ziolkowski A et al. (2007) Geophysics 72(4):192-209.