

Geoelectromagnetic Methods of Coal Mine Groundwater Monitoring

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Abstract The Real-Time Monitoring and Pre-Warning System of Inundation in Underground Coal Mine has been developing at China University of Mining and Technology through China National Science and Technology Supporting Program funding in 2013. The precision geoelectromagnetic methods involved in monitoring groundwater have been improved and developed by theoretical analysis, physical model experiments, numerical simulations and field tests. The law of electromagnetic fields produced by small multi-turn coil has been studied. New apparent resistivity algorithm for small multi-turn coil TEM is proposed. It is a long-term problem for TEM in underground mine that readings are too low to mislead their interpretation and limit their applications. Some configurations of Controlled Source Electromagnetic Method (CSEM) to reduce the effect of primary fields and enhance the secondary fields due to eddy current diffused in good conductor have been tested. In order to explore the geological structures in coal floor, the electromagnetic characteristics introduced by the large loop along the workforce have been modeled. The results help us to optimize the arrangement of magneto-sensors for monitoring the floor destruction in order to prevent confined water inrush. To improve the resolution of radio imaging method (RIM) and overcome its difficulties in recognition of geological structures adjacent or perpendicular to roadway, we construct the electromagnetic fields in coal seam by time and frequency domain finite difference methods. The phases could supply more information about the structures than the amplitudes, so get higher resolution. This leads to develop new instruments for RIM to measure the phase and amplitude of radio wave simultaneously. For the exploration of multi-level mined voids, the electrical source CSEM is developed. It has higher resolution and deeper depth than those of the fixed large loop TEM. All results are helpful to set up the monitoring and pre-warning system for inundation in underground coal mine.

Keywords real-time monitoring, small multi-turn coil, CSEM, RIM