Determining the Feasibility of a Real Time Geophysical Magnetic and Electric Measurement System for Monitoring Strain Underground

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Abstract

The piezoelectric, electrokinetic, and seismoelectric effects result in measureable electric and magnetic geophysical responses in rockmass under stress. The implementation of real time monitoring of these signals has the potential to significantly improve deep mine safety by mapping the evolution of strain underground and indicating potential areas susceptible to failure. Electric, magnetic and seismic data were collected during a four day period at Coleman Mine, Sudbury, Ontario, in a small area along two drifts on the 3425 level. Algorithms were applied to this data to remove known signals, leaving only noise due to mine operation and potential signals due to strain. The processed datasets were only analyzed individually due to time stamping inconsistencies that could not be resolved. Individual analysis concluded that no signals due to strain were evident in the magnetic and electric datasets due to the low 200 and 500 Hz data acquisition frequencies, and signal interference from other geophysical experiments in the area. Analysis of the Coleman Mine data led to a proposed three-part experiment aimed to identify signals related to strain in a mine environment. The experiment will acquire magnetic data at 32 kHz, and electric data at 8 kHz to increase the likelihood of recording short strain related impulses. One above ground experiment will monitor the signals associated with strain when a rock is stressed by an air driven system; a second experiment in a low noise environment will identify atmospheric, instrumental, and manmade electromagnetic noise, and how to effectively mitigate or remove these undesired signals. Finally, a highly regulated, passive acquisition, underground test will be carried out with optimal data acquisition frequencies, and with a base station located at the low noise field test site to remove atmospheric noise. Successful identification of signals due to strain through this experiment could potentially prove the feasibility of a real-time underground geophysical monitoring system to improve safety.