MODELLING AND SURVEY RESULTS OF IN-MINE ELECTROMAGNETICS FOR BRINE LAYER DETECTION

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Safe mine expansion has been a reoccurring issue for potash mines in Saskatchewan over the years. One of the key issues facing all mining operations is the potential for water in-flow; however, that threat is even greater for potash mines due to the solubility of halite and sylvite minerals[i]. The source of water in-flows are porous geological layers above the mine. In this project we are proposing, through computer modelling, the detection of these zones of water-bearing strata, specifically water bearing carbonates, using electromagnetic methods.

Normally, near mine carbonate layers are considered low-risk for having porous water-bearing characteristics. However, under certain conditions there is the potential for unsaturated water to have been introduced both into the carbonates above the mine and into the salt of the prairie evaporate formation itself. Anomalous areas of higher porosity have been identified in core samples and have been spatially tied to areas of absent overlying salt layers[ii]. Several geophysical techniques have been proposed to determine the presence of water-bearing anomalies near mine. The techniques that have been tested for this purpose in a mine environment include 3D resistivity[iii], frequency-domain electromagnetics[iv], and time-domain electromagnetics[v]. In these example cases, the geophysical methods proved effective in determining the presence of water-bearing anomalies in the Prairie Evaporite Formation.

This project sought to investigate the potential of using time-domain electromagnetics to determine the presence of water-bearing anomalies within the carbonates of the Dawson Bay Formation that lie above the Prairie Evaporite Formation. This project consisted of two principle components. One was computer modelling of time-domain electromagnetics in a full-space or mine environment performed in COMSOL Multiphysics, the other, as part of a Mitacs Accelerate internship that the student author participated in concert with Nutrien, under the joint supervision of Dr. Samuel Butler of the University of Saskatchewan and Randy Brehm of Nutrien, was an in-mine time-domain electromagnetics survey conducted in an area of suspected Dawson Bay water-bearing anomalies. The survey found a decisive conductive zone in the vicinity of the suspected carbonate anomaly. Subsequent computer modelling, both forward and inverse, has been performed to further constrain the location of this anomaly relative to the Prairie Evaporite salt.

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