

Applying Geophysics to Mining Geology Problems

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ABSTRACT

Although geophysics is routinely applied to mineral exploration and has been responsible for most large mineral deposit discoveries in recent years, its use in mining is still limited. However, geophysics has two major advantages: First, in contrast to results from borehole drilling which are point or line measurements that only sample a small fraction of the rock, it is able to produce three-dimensional images of the sub-surface; Second, most geophysical measurements are in fact effectively volume averages of rock properties, and so are less affected by spatial variation than are the results from boreholes.

While the physical properties that geophysics is able to image might not always be directly relevant to a mining engineer, they are often correlated with properties of interest. A relatively small number of samples can be used to derive a relationship between the physical properties measured by geophysics and quantities relevant to mining. This allows full three-dimensional inferences to be made about the desired parameters.

These principles are illustrated using the examples of electrical and seismic properties. The conductivity of the ground, obtained using electromagnetics, can be used to infer information about groundwater amount and quality, as well as geology. Seismic velocity images obtained both using active sources and from passive seismics, where images are generated using seismic “noise”, are used to infer rock stress, and other geotechnical information.

Use of geophysics to improve the interpolation of ore-grade values or impurity content between grade holes, or to yield information about rock hardness, crushability and blastability to allow optimisation of blast-hole drilling for example, could potentially have significant financial implications.