Near-Surface Geophysics across the Mining Value Chain

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INTRODUCTION

The important contributions of geophysics to mineral exploration have been well documented and need no introduction. However, across the rest of the mining value chain, the use of geophysics is less well documented. In Australia, mining companies increasingly use non-invasive survey methods for hydrogeological studies, environmental site investigations, ore-body characterization, and geotechnical assessments.

In this contribution, I will present an overview of the use of modern geophysical tools and approaches for a range of the above applications, conducted in recent years at project and mine sites in Australia. The case studies cover a broad range of stages in the value mining value chain, from greenfield and brownfield projects, to construction, operation, and closure.

CASE STUDIES

A groundwater exploration project in a greenfield setting used structural interpretation of large-scale open-file airborne magnetic data with complementary GIS layers to target fractured bedrock aquifers and areas for follow-up ground-based investigations.

A brownfield groundwater study focusing on depth of regolith used a large-scale passive seismic survey (4,000+ stations) and profiling TEM data in combination with a suite of airborne geophysical survey results to inform and constrain hydrogeological models.

At the planned construction site of two future tailings storage facilities (TSFs), high-resolution profiling TEM surveys provided depth-to-bedrock information that filled gaps in drilling coverage and improved the hydrological understanding of the sites and siting of environmental monitoring bores.

At operational mine sites, recent projects have included a) an airborne EM supported assessment of near-surface stratigraphy and surface water – groundwater interactions for a creek diversion study, b) a study of managed aquifer recharge (MAR) potential of a near-mine detrital sequence using a high-resolution TEM survey with backpack-carried profiling equipment, and c) an assessment of the occurrence of clay pods below the floor of an open-pit mine using a vehicle-towed profiling TEM system.

At a legacy mine closure site, data from a frequency domain electromagnetic survey was used to map the distribution of potential seepage, illustrating the lateral migration away from drainage channels, resulting in improved targeting of samples ad monitoring bores/

CONCLUSION

The above examples from mine development, construction, operational, and closure projects across Australia illustrate the potential uses and benefits of state-of-the-art geophysical tools and approaches, including better informed operational decision making, de-risking of sampling and drilling programs, and improved environmental stewardship.