Using aerial time-domain electromagnetic surveys to quantify storage change in copper heap leach recovery

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Heap leach recovery is a commonly used mining practice that layers low-grade ore on surficial leach pads where an acidic solution, "lixiviant," can percolate and dissolve target metals along its flow path. Ore recovery and long-term reclamation outcomes are heavily dependent upon lixiviant flow efficiency. Prior studies have shown that flow behavior in leach pads is governed by structural design, variable hydrogeologic properties, and physiochemical reactions. These studies have used methods including both physical characterization and geophysical imaging. Electrical resistivity tomography (ERT) has been the primary geophysical tool applied to heap leach systems, delineating moisture distributions, perched zones, and preferential flow paths. However, time domain electromagnetic (TDEM) methods remain underutilized in heap leach monitoring despite having demonstrated success in more general hydrogeologic investigations.

This study evaluates the use of aerial TDEM surveys to quantify dewatering in a copper heap leach pad undergoing drainage through horizontal drains. Datasets spanning multiple years will be used to track temporal changes in subsurface conductivity as an indicator of evolving moisture content. This work demonstrates the potential of TDEM to identify and quantify storage change from features that induce preferential flow, seepage, and solute perching within heap leach stockpiles. The results position TDEM as a potential tool for monitoring heap leach performance, informing operational decisions, and optimizing ore recovery.

The data for this project were collected from a copper heap-leach facility in New Mexico using aerial TDEM surveys conducted in 2023 and 2025. The analysis of data will rely on SimPEG, an open-source python pack designed for geophysical data processing. For each survey year, we will identify zones of increased conductivity, calculate storage within a given volume, and then compare how calculated storage has changed with the development of the heap leach facility. Our hypothesis would be supported by establishing that out storage calculations for a given survey are supported by physical well and drainage data collected from site – this is independent of the extent to which storage change has occurred within the heap leach. The effectiveness of employing TDEM in such an investigation would be refuted if added ore levels or major structural changes within the heap leach disrupt direct comparison of 2023 and 2025 survey data. Ultimately, this work is an opportunity evaluate the application of a robust geophysical method to monitor and optimize the recovery of critical minerals.

Key Figure:

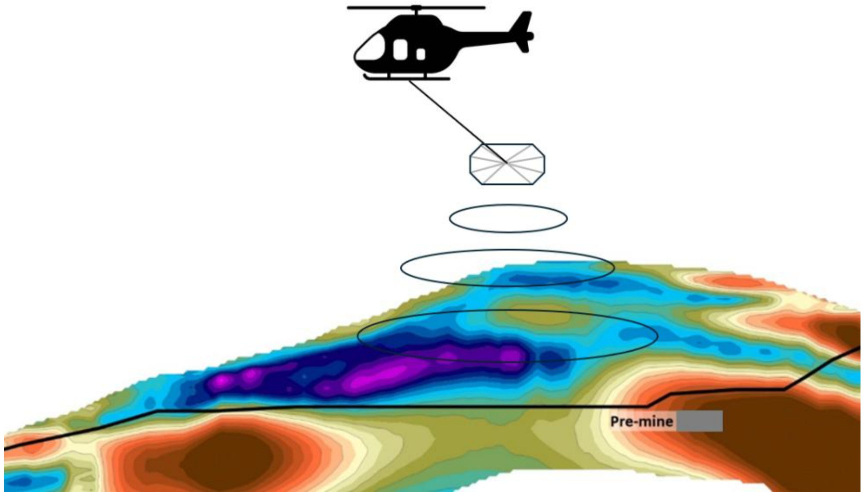

Figure 1: Illustrated graphic demonstrating the use and resultant data of an aerial TDEM survey. Conductivity data provided by Hydrogeophysics Inc. report discussing initial findings from the 2023 survey.

Milestones:

Start	End	Description
3/9/26	4/5/26	Process 2023 data and compare results with previous interpretation of the data as reported by Hydrogeophysics Inc.
4/6/26	5/9/26	Apply data processing procedure to 2025 data.
5/20/26	6/14/26	Compare results from 2023 and 2025 surveys and interpret storage change of the heap leach.
3/30/26	4/5/26	Compile data and prepare final report.