

HEAP LEACHING CHALLENGES: GEOPHYSICAL SOLUTIONS

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Heap (or dump) leaching is a process used to extract precious metals, copper, zinc, gold, uranium, and other compounds from the ore using a series of chemical reactions that absorb specific minerals and re-separate them after their extraction from other earth materials. In the heap leaching mining process, the ore is placed on a liner (film), then the chemicals are added via drip systems, and, finally, the enriched solution is extracted to obtain the metals. Heap leaching is widely used in modern large-scale mining operations as it produces the desired concentrates at a lower cost compared to conventional processing methods such as flotation, agitation, and vat leaching. Additionally, dump leaching is an essential part of most copper mining operations and determines the quality grade of the produced material along with other factors.

There are two problems with this technology that can be fixed with the proposed geophysical approaches. First, the liner can degrade and the solution leaks out from the heap which creates environmental problems in addition to the direct loss of the metals. Second, as the heap is not uniform, the solution consisting of the acids is flowing in the heap through the most permeable routes. Thus, the routes form the irregular 3-dimensional net of channels, where the ore is treated, while the ore outside those routes is still rich with metals. Due to this fact, a heap must be continuously stirred and this operation is quite expensive. However, it is possible to explore (image) a heap prior to the stirring, to avoid unnecessary treatment and optimize the pouring process, saving acids, and decreasing the environmental risks.

The authors are going to demonstrate their works for solving the above-mentioned problems with 2D and 3D electric resistivity tomography (ERT) and frequency-domain electromagnetic induction (FEMI) sounding. This solution is based on using the easy-to-operate FEMI device AEMP-14 and ERT devices Siber-64K15 and Siber-48K12 and is quick and cost-effective.

Examples of both research and industrial applications will be given together with an evaluation of the economic impact of the geophysical technologies implementation for heap leaching mining.