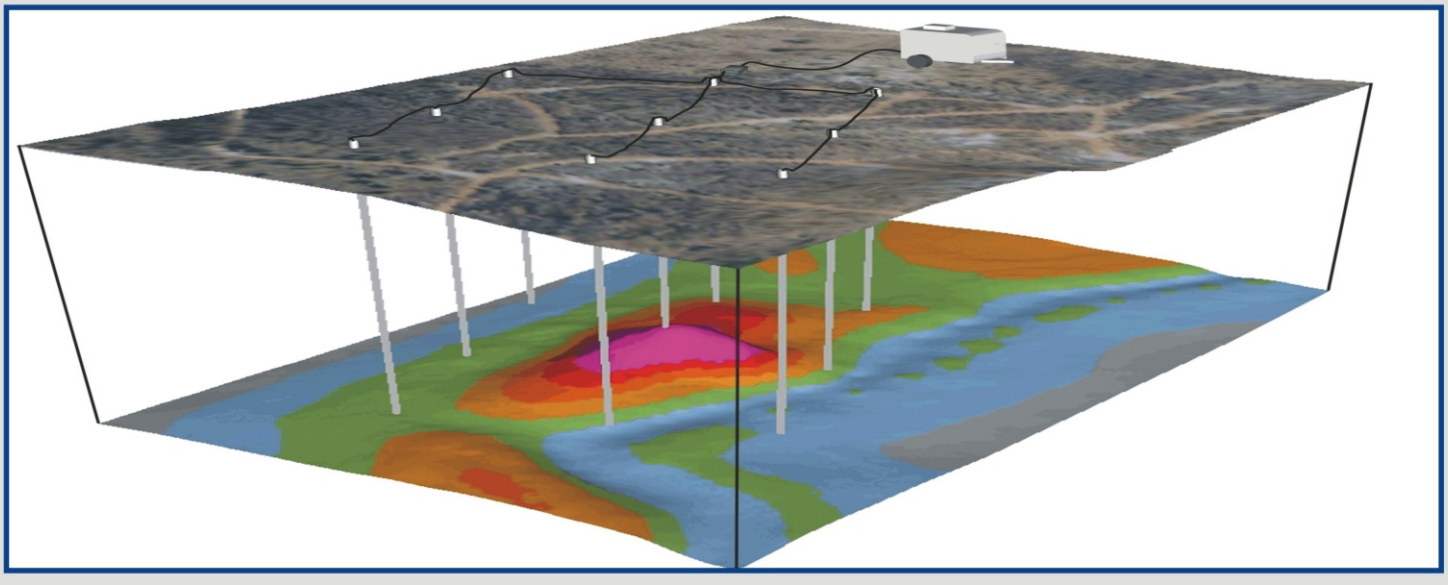
Heap Leach Characterization for Enhanced Metal Recovery



In 2008 hydroGEOPHYSICS, Inc. (HGI) was contracted by Newmont Mining Corporation to complete a geophysical characterization study of a mature heap leach stack at the Gold Quarry mine in Nevada. Newmont sought to enhance mineral recovery using the HydroJex™ technology to inject lixiviant into the heap to stimulate possible orphaned gold due to incomplete wetting during the leaching process. The HydroJex™ process stimulates the heap by opening up plugged pathways and creating new flow paths while delivering a customized lixiviant to the pay zones. It is believed that the pressurized delivery of the lixiviant, at different depths, develops new fluid flow pathways within the heap enhancing mineral recovery. Newmont had two main challenges in completing the project: 1. determining where to inject the lixiviant to reach dry zones where valuable gold inventory may exist; and 2. how to monitor the injected lixiviant to assess the effectiveness of the injection process to achieve maximum gold recovery.

To solve the two challenges, HGI's High Resolution Resistivity™ (HRR™) geophysical surveying method was selected for the heap characterization and for monitoring, in real time, the spatial changes during the fluid injection. The HRR™ method is well suited to accomplish the project goals, has a successful track record for over 20+ years, increases cost effectiveness, and enhances resolution of the hydro geological processes.

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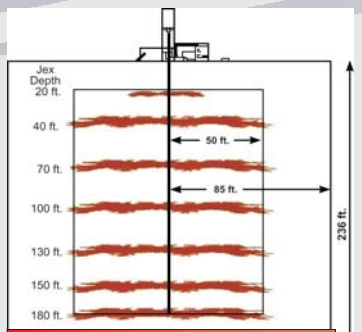
Enhanced Metal Recovery

The objective of the HRR™ characterization survey was to reduce the cost for Hydro-Jex™ well field construction and enhance mineral recovery by optimizing the placement of individual wells. Two-dimensional (2D) and three-dimensional (3D) resistivity maps provided information on the relative moisture distribution within the heap were used by Newmont and HGI to preferentially locate several of the planned Hydro-Jex™ wells.

HydroJex™ Injection

Following the heap leach stack characterization and well implementation HGI installed its versatile 30 channel monitoring system to monitor each Hydro-Jex™ injection to map the zone of influence and to insure the injection stayed within the main body of the heap. The HRR™ monitoring system consists of a network of electrodes composed of steel well casings used for the Hydro-Jex™ injections and an array of surface electrodes wired to a trailer mounted 30 channel resistivity data acquisition system. Once the system is in place transfer resistance measurements were made at discrete, closely spaced time intervals to obtain an electrical time series representing the hydrodynamic behavior of the heap before, during, and after each injection.

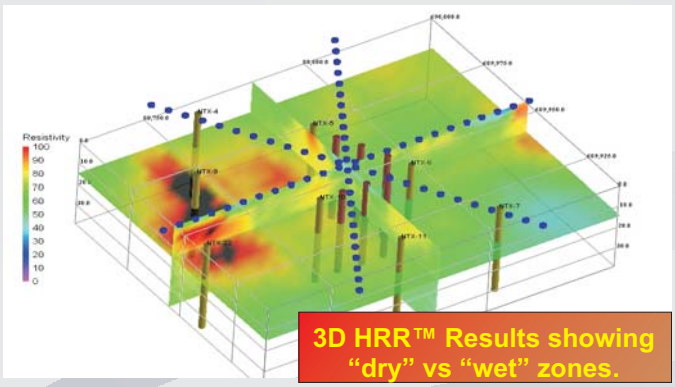


Zones Re-Leached during HydroJex™ Process

By combining the processes of HRR™ characterization, monitoring, and Hydro-Jex™ lixiviant injection the Newmont test project results were impressive. Improved fluid flow and adequate wetting of dry unleached areas released an additional estimated 25000+ ounces of gold for a heap that was previously considered depleted of impregnated ore and ready for closure. Additionally, the improved fluid flow through the heap reduced pumping and maintenance costs and allowed for early closure following the HRR characterization, and Hydro-Jex™ injection process.

*Metal Recovery Solutions, LLC is the sole commercial provider by Newmont USA to utilize the Hydro-Jex™ technology.

The HRR™ method is an enhanced galvanic resistivity method developed specifically for imaging subsurface variations in geology, pore space water content, and pore water chemistry. As with all galvanic resistivity methods, electric current is injected at known points on the surface



3D HRR™ Results showing "dry" vs "wet" zones.

or within the subsurface of the earth. The resulting electric potential field is measured at known locations relative to current injection points, usually along linear 2D traverses. Use of a 3D network of electrodes and borehole to borehole configurations are becoming more common.

HRR™ exhibits superior signal-to-noise characteristics, increased depth of investigation, and enhanced spatial resolution. A pole-pole array is most often used for HRR™ data acquisition. In some cases, logistical challenges require the use of either the dipole-dipole or pole-dipole array. In all cases, HRR™ data sets are well suited for 2D or 3D inverse modeling.

HRR™ data are acquired using a modern, multi-channel computer controlled digital data acquisition system. HGI employs commercial instrumentation for most subsurface characterization projects. A trailer mounted large channel system designed and built by HGI is used to acquire time lapse resistivity monitoring data. The system is configurable for 2D and 3D characterization surveys and RTK GPS surveys are completed to obtain necessary precision for electrode position and elevation data for all HRR™ surveys.

*HRR™ is a trademark of hydroGEOPHYSICS, Inc. of Tucson, AZ

Contact Us:

HGI is an innovative, solutions oriented geophysical consulting and service provider with offices in Tucson, Arizona and Richland, Washington. We specialize in the application of geophysical methods to the characterization and monitoring of the hydro geologic process associated with mining, water resources, and waste sites such as landfills, contaminated disposal areas, and subsurface contaminate plumes.

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