Electrical Geophysics for Deep Tunnel Detection at a 
Gold Mine Remediation Site
Nicole Pendrigh and Phil Sirles (Zonge), Doug LaBrecque (MPT3), and Paul Ivancie (Amec)

Surface and crosshole geophysical investigations, including time-domain dipole-dipole resistivity and frequency domain Mise-a-la-Masse (MALM) surveys, were conducted on the Captain Jack Project, an EPA Superfund remediation site which includes the Big Five tunnel. The Mise-a-la-Masse survey used the main access tunnel as a transmitting electrode and recorded data on the surface above the tunnel using a pole-dipole configuration. The objectives of the surface geophysical investigation are two-fold: 1) Geologically characterize the host-rock and region in which the mineralized fault zone and associated mine tunnel system lies; and, 2) Determine the location of the mineralized zone and the associated tunnels, if possible.

Time-domain resistivity results indicate a high resistivity background with lower resistivity fluid conduits, but were unable to image deep enough to detect the mine tunnel. The MALM showed potential to optimize the placement of drill holes meant to intersect the geologic structure associated with the mine, or intersect the tunnel itself. Two holes were drilled based off of preliminary MALM results. The holes were less than 30 ft apart and failed to intersect the tunnel; thus, crosshole ERT was acquired between the borings. Based on the crosshole ERT results, a third boring was drilled on the ERT anomaly and intersected the tunnel. It was determined the initial borehole missed the tunnel by less than 5 feet laterally.

A second location was drilled further along the fault trend. The tunnel was expected to be at a depth of approximately 450 ft. During drilling a large void was encountered at approximately 350 feet, and extended several hundred feet downward. This boring was likely drilled into a previously unknown shaft or winze system.

Using the mine tunnel as a transmitting electrode it appears the MALM survey technique was able to image its approximate position 2000 ft into the mountain side, at depths of up to 500 ft. The effectiveness of using the tunnels as electrical transmitters may be dependent on seasonal variations in water levels. Given good seasonal conditions and continuity of cultural features (e.g., rails) and water, the MALM ‘in-tunnel electrode’ techniques can be used as a tool for tunnel location.