FEM and GPR to Map Paleochannels

Introduction

The scope of the survey was to map the location of paleochannels around an open cut mine. A combination of Frequency Electromagnetics (FEM) and Ground Penetrating Radar (GPR) were proposed for this task.

Survey Specifications

Geonics EM34-3 Ground Conductivity Meter

The EM34-3 Ground Conductivity Meter measures the bulk conductivity of the subsurface, i.e. the cumulative response from 0m depth to the maximum depth of exploration (DoE). The system can be operated in two dipole modes, horizontal (as shown) and vertical. The horizontal dipole mode has a maximum DoE of approximately 75% of the inter-coil spacing, whereas the vertical dipole mode has a maximum DoE of 150% of the inter-coil spacing. The EM34-3 uses three inter-coil spacings - 10, 20 and 40m. With two dipole modes possible for each inter-coil spacing, the EM34-3 gives up to six measurements of bulk conductivity with various maximum DoE's ranging from 7.5m to 60m.

The EM34-3 is a proven tool for groundwater prospecting. Paleochannels are often associated with an increase or decrease in ground conductivity relative to surrounding material.

Aside from plotting the map location of conductive targets, high quality EM34 datasets can be used to generate 2D profiles of conductivity with depth. This is achieved using a process called inversion which is performed using specialized software.

Ground Penetrating Radar

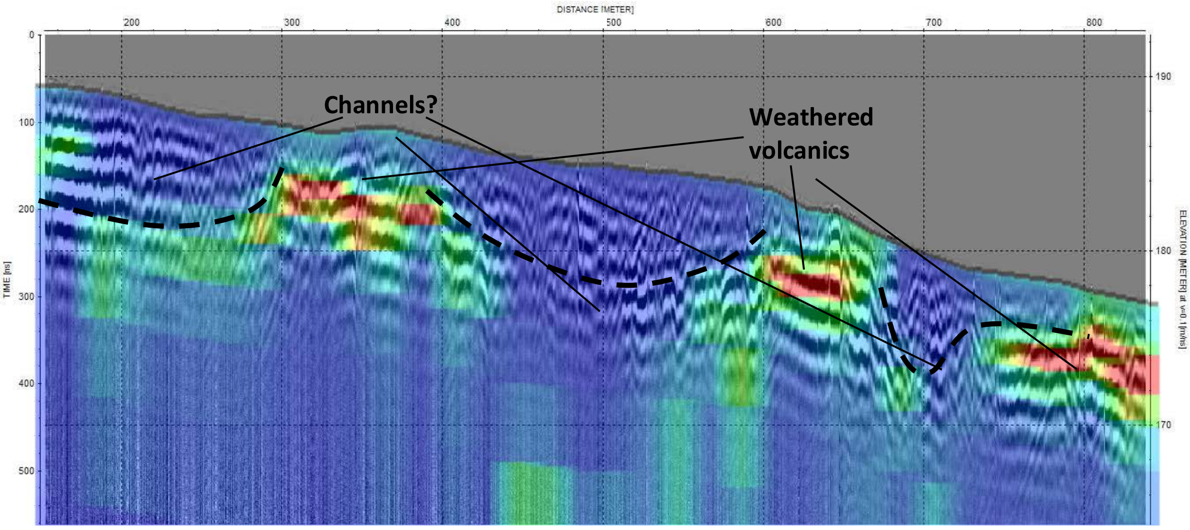
Ground Penetrating Radar (GPR) is a well-recognised tool for accurately mapping the depth and extent of paleochannels, with the added benefit that data acquisition is extremely rapid.

The 25MHz antenna was used with DGPS for positional control and a Quad bike for towing.

In contrast to the EM34-3, GPR is most successful in electrically resistive environments such as sandy soils where signal penetration is good. It was thought that GPR could compliment the EM34-3 dataset well because GPR might achieve very good penetration through the uncontaminated aquifers.

Data Processing

The GPR data was processed and EM data inverted, both using specialist software. Both datasets were corrected for topography. The EM models were then overlaid onto the GPR profile for a joint interpretation.



Summary

The combination of techniques reduces ambiguity and aids in interpretation. The interpreting Geophysicist understands the strengths and weaknesses of both techniques, leading to a much more accurate interpretation than with either technique alone.

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