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PGC Geophysics

Geotechnical applications of ERI resistivity surveys - low cost and non-intrusive

Resistivity surveys are an excellent tool to detect variations in soil and rock resistivities and have the ability to detect features from shallow to great depth. In geotechnical applications, anomalous resistivities mainly originate from pore media eg. electrolytes or clay, not from the solid material, rocks and gravel, as they are comparably too resistive. Subsequently, in **geotechnical applications** the results **are measures of soil moisture and clay/weathering**.

Successful applications of resistivity surveys are:

- Mapping contamination in groundwater
- Mapping soil and groundwater salinity
- Mapping depth to consolidated rock
- Mapping vertical shear zones, alteration
- Locating cavities, voids, buried mine adits

Resistivity surveys use 4 electrodes: 2 for current injection and 2 for measuring voltages (Figure 1). By increasing their separation, the depth of investigation increases. By combining a multitude of readings, a **resistivity-depth profile is created**. Figure 2 presents a resistivity-depth profile, depicting a leachate (blue colour) leaking into a nearby pond.

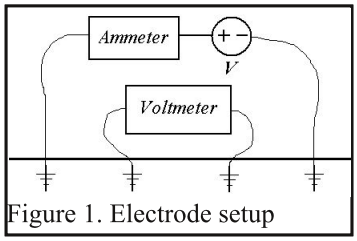

Figure 1. Electrode setup

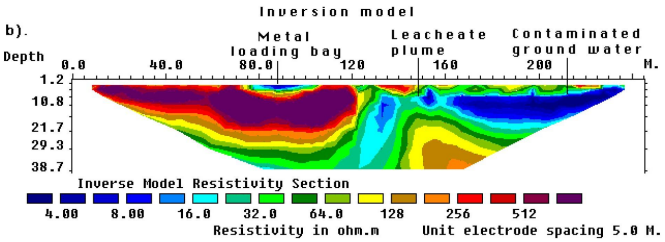

Figure 2. Resistivity-depth profile

Specialised resistivity surveys for detailed resolution eg. **E**lectric **R**esistivity **I**maging (**ERI**), consist of daisy-chained electrode arrays typically of 64 electrodes. The array autonomously measures numerous permutations of electrode pairs while the crew is preparing the next section (Figure 3).


Figure 3. PGC's Electric Resistivity Imaging (ERI) ABEM Terrameter LS2

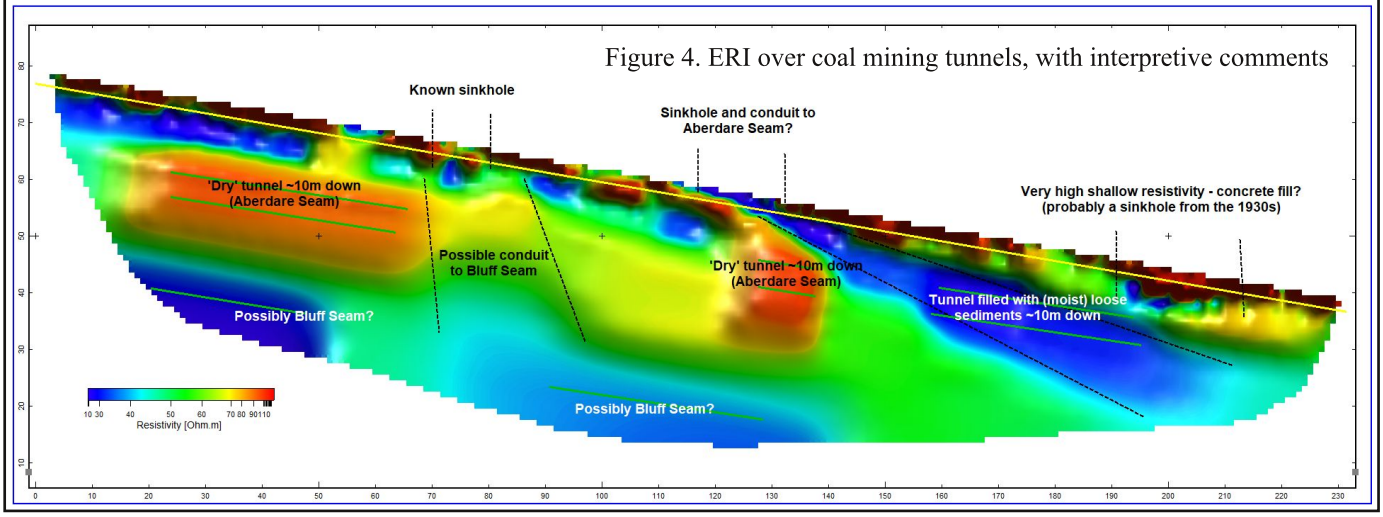

Figure 4. ERI over coal mining tunnels, with interpretive comments

Case Study 1 - Old coal mining tunnels (Ipswich)

There are numerous shallow mining tunnels in the old coal mining areas of east Ipswich, dating back to mining from 1880 – 1940. At this location, the main seam was the top Aberdare Seam as shallow as 10m. These tunnels cause sink-holes, subsidence and even failure. Figure 4 presents a section where resistive areas (red) are interpreted as 'dry' tunnels conductive areas (blue) are interpreted as fluid conduits. Existing and possibly evolving sinkholes are inferred.

Case Study 2 - landslide-prone slopes (Malaysia)

A common problem in Malaysia is local water accumulation on hill slopes that weaken stability and may trigger landslides.

Figure 5 shows the upper part of a hill slope above a recent landslide. The survey shows a prominent low resistivity zone, interpreted to be caused by water accumulation.

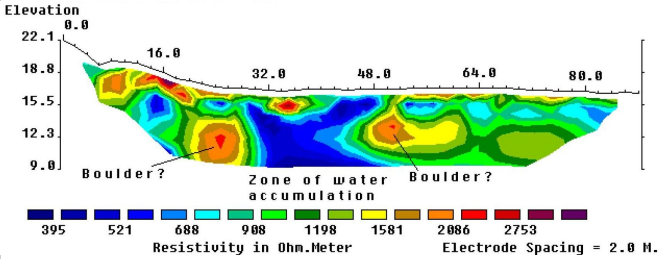

Figure 5. Landslide-prone slopes (Malaysia)

Case Study 3 - Time-lapse surveys

Time-lapse survey of percolation of irrigated water over 26 hours after the end of irrigation is shown in Figure 6. This figure shows the percentage difference to the initial measurement, t=0, clearly displaying the percolation of the irrigated water (low resistivity areas) over time.

PGC's conductivity mapper EM34 is a two-person instrument that measures the average conductivity of the sub-soil. Each person carries a coil, and they are connected by a cable of 10m, 20m or 40m length, setting the nominal depth senstivity. A typical production rate of a 20m cable and 20m station increment survey ~4km/day. Due to its low cost and high production rate, the EM34 is suitable to quickly scan larger areas to find locations to further investigate. For more information www.pgcgroup.com.au/download

PGC Geophysics offers competitive packages that combine the rapid EM34 to scan large areas and the ERI to provide detailed assessments.

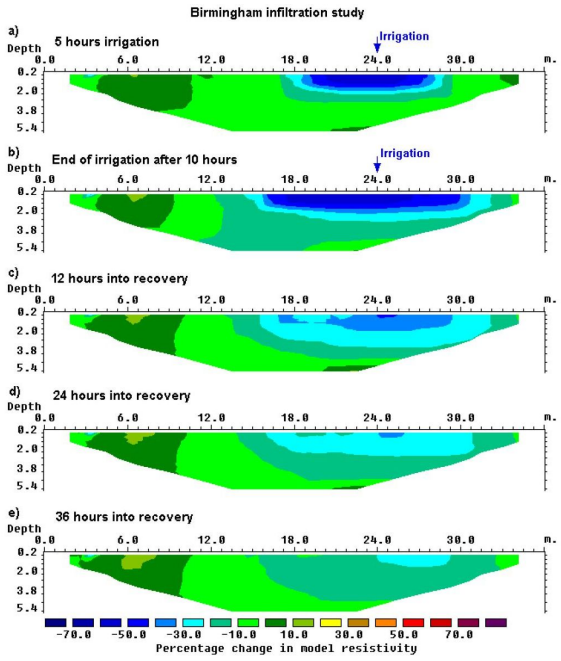

Figure 6. Time-lapse surveys

Case studies 2 and 3 are from Loke, M H, Tutorial: 2D and 3D electrical imaging surveys.

PGC Geophysics (PGC) specialises in electrical and electromagnetic surveys in the minerals, and near-surface engineering geophysics markets. PGC owns and operates an ABEM Terrameter LS2 and for smaller profile style investigations, an EM34.

PGC Geophysics offers near surface ERI in geotechnical applications as well as Res/IP for shallow minerals prospects:

- Contamination plumes, seepages
- Faults, shears, alterations
- Disseminated sulphides
- Depth of weathering
- Groundwater, salinity
- buried objects, tanks cavities

Ron Palmer PGC's principal consultant, offers 30 years experience in geophysics and exploration/project management. Ron and his crew are based in Brisbane and operates in all States and Territories as well as New Zealand.

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