

Resistivity profiling or imaging is a method for investigating the subsurface by measuring the capacity of earth materials to pass electrical current. On land or overwater, this technique is effective in detecting boundaries between materials that have contrasting electrical resistivities. Clays and water saturated materials are generally electrically conductive and contrast sharply with more electrically resistive materials such as gravels, glacial till, bedrock, or frozen ground.

Resistivity exploration can be carried out to depths that range from a few metres to several hundred metres under favourable conditions. Historically, recording of resistivity information was carried out using only four electrodes and one of the standard geometric arrays. The advantage of resistivity imaging is that by exploiting the ability to redundantly sample very large numbers of electrode combinations, a detailed resistivity image of the subsurface is developed. Instead of simple layering information, resistivity imaging can resolve small and irregular anomalies even in areas of complex subsurface geometry.

The method is based on generation of an artificial electric field in the earth by introduction of current through metal electrodes. Utilising one of a large variety of standard array configurations, a voltage is measured across two electrodes. This voltage, together with the current value and a constant based on the array geometry, yields an apparent resistivity reading of the underlying geological layering.

In field operation, the metal electrodes are inserted into the ground at the required separation along the section to be profiled. Wider electrode spacings result in deeper penetration. Intelligent nodes are then connected to the electrodes that allow each to be in either standby, current or potential measuring modes. These nodes are controlled by an

automatic multi-electrode switching system that steps through the programmed combination of electrodes. A number of companies offer this instrumentation, some of which include the capability to measure the induced polarisation effect as well.

The data processing is carried out using a package such as RES2DINV. This package uses a finite difference modeling approach to calculate the resistivity values that best fit the observed data. An iterative least-squares method progressively increases the fit for each run of the forward code. The resulting profile is the best estimate of the true resistivity section and is displayed in colour contour format in ohm-metres for interpretation.

Utilising multiple surface electrodes and a multi-electrode switching system that automatically selects electrode arrangements, surveys can be carried out rapidly and accurately.

Applications

- Groundwater exploration
- Monitoring landfill leachate plumes
- Saline intrusion
- Mineral prospecting
- Industrial minerals exploration
- Subsurface void detection
- Permafrost investigations
- Placer exploration
- Geologic mapping

