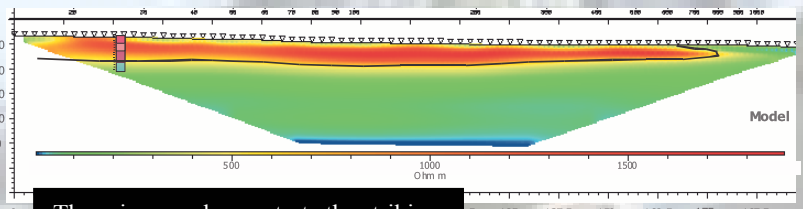
Geotechnical Case Study: Basalt Thickness

The ABEM SAS1000 Terrameter was used in this project

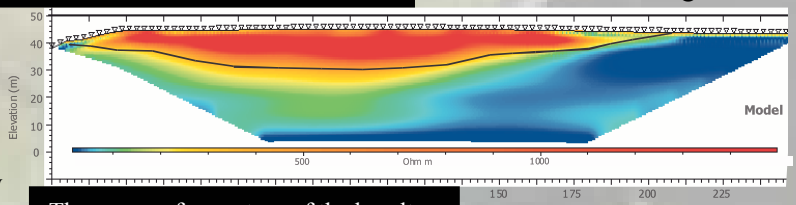
Subsurface Imaging were contracted to undertake geophysical surveys to map the extent and depth of lava flows in the central Auckland area to aid in the planning of a new highway. These surveys were undertaken using non-destructive, low impact methods. This meant environmental disturbance was kept to a minimum.



These images demonstrate the striking effectiveness of the resistivity imaging method applied to imaging thickness and lateral extent of igneous geology. This method is similarly effective when applied to other geological materials as well.

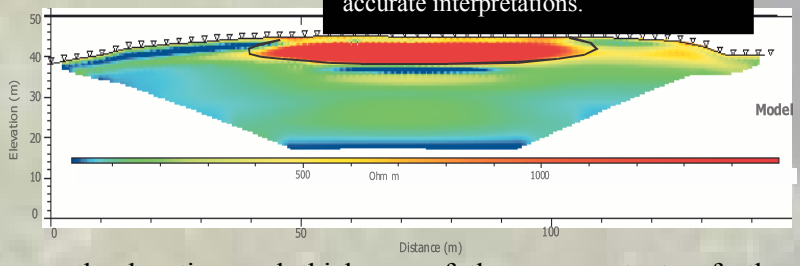
The geophysical methods chosen use physical property contrasts between basalt and the underlying sediments to map the location and thickness of the basalt. Basalt is magnetic and also resistive to electrical currents. This allows it to be mapped using ground magnetics surveys, ground penetrating radar, direct current (DC) resistivity soundings and 2D imaging surveys. This case study highlights the resistivity imaging results and interpretations.

Ground magnetics surveys measure the magnetic field arising from the basalt. The magnetic field intensity increases when readings are taken over the basalt. This allows accurate determination of the edge of the lava flow by recording the change in magnetic intensity across the flow edge.



The near surface nature of the basalt and the resistive contrast between it and the underlying sediments facilitates excellent data and very accurate interpretations.

Ground Penetrating Radar (GPR) was also used to map the flow edge in areas where access was restricted or where cultural features such as pipes, parked cars etc existed.



Resistivity imaging was used to map the thickness and lateral extent of the basalt flows. A 2D

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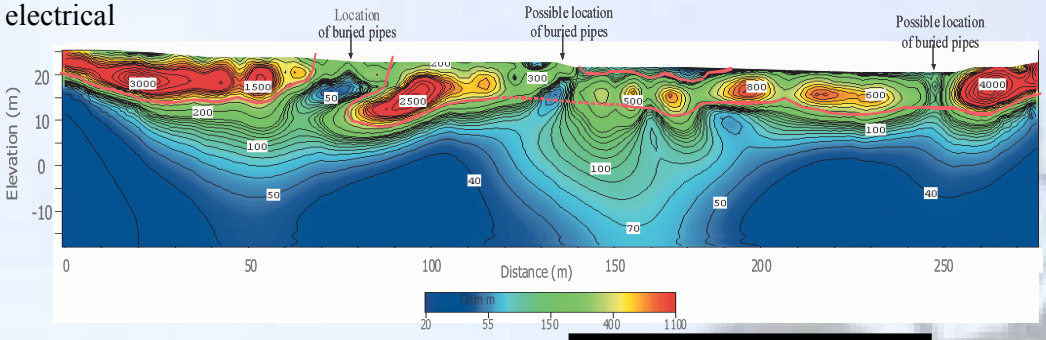
resistivity imaging survey maps both horizontal and depth changes in the electrical resistance of the rock, whereas resistivity soundings provide only depth information at a single point. The resistance of a rock to electric current is dependent on a number of factors. Typically the resistivity contrast between basalt and the sediments underneath is on the order of 10:1 to 100:1, with basalt being more resistive. This large contrast means it is straightforward to interpret electrical image sections. High resistivity areas indicate basalt, and low resistivity areas indicate sediment.



This detailed resistivity image shows not only precise basalt locations and thicknesses, but also possible underground metal pipes as indicated.

Seventeen resistivity images were performed both parallel to the flow edge and in some cases at right angles to it. This allowed both the thickness and lateral extent of the flow to be determined. The resistivity method was able to determine the basalt thickness to a high degree of correlation with drill hole information. In most cases basalt thickness was between 5m and 10m reaching a maximum of 17m.

Resistivity imaging data can be collected rapidly and in a variety of different environments

Geophysical surveys show the location of the edge of the lava flows and of their thickness. The methods chosen were ground magnetics, ground penetrating radar and resistivity imaging. These methods caused minimal environmental impact and provided a greater data coverage than is possible from drilling alone. In particular, the resistivty imaging method was very effective at mapping basalt thickness and extent across the flows.

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