

ASEG 3D IP Workshop

North Parkes 3D IP Survey

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North Parkes 3D IP Survey

Deep drilling proximal to current mining operations discovered the GRP314 mineralisation beneath Altona Thrust.

Overall a large low grade system but high grade mineralisation intersected in discrete patches.

Chalcopyrite-bornite are the only sulphides present, so Induced Polarisation has the potential of directly mapping mineralisation.

North Parkes 3D IP Survey

Concept of running a true 3D survey using transmitter and receiver electrodes in boreholes and at surface.

Support from NPM

Involve Stephen Collins (Arctan) and Alex Copeland (Search Exploration)

Technical and operational issues identified and addressed.

Drillholes were dipped in two campaigns and enough were open to sufficient depth to proceed with a trial survey.

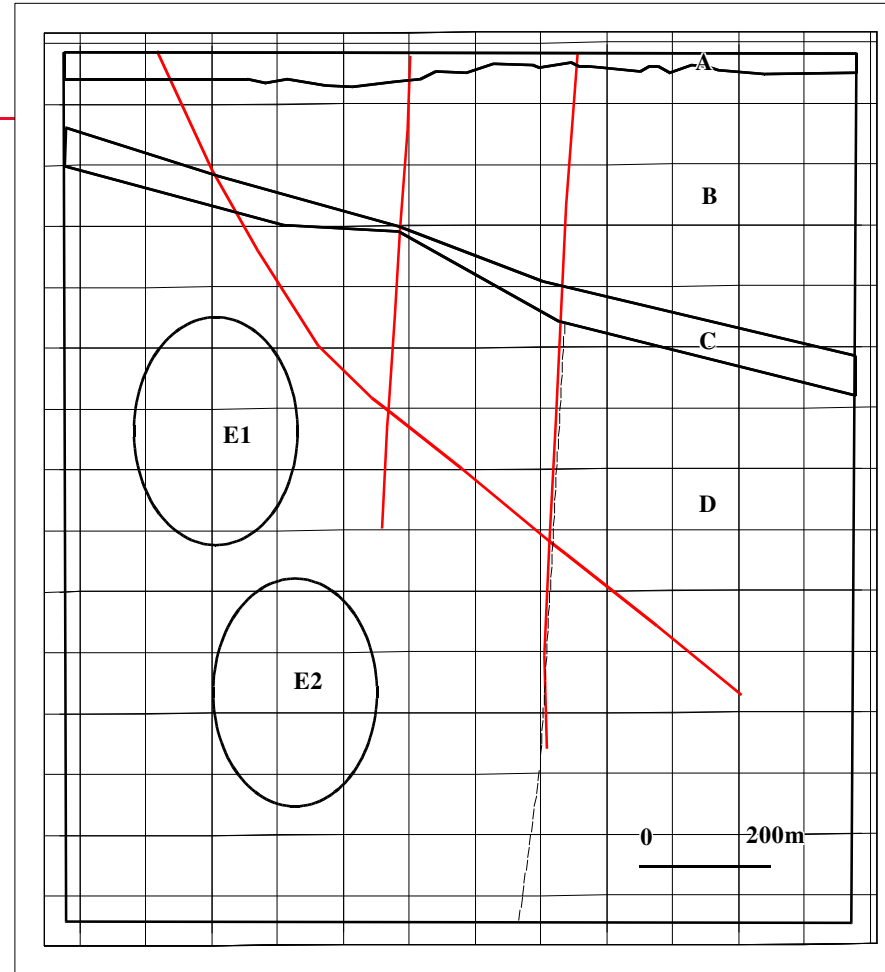
Forward Modelling Exercise

Principal aim to establish whether off hole targets might be detectable in the GRP314 environment.

Two vertical holes and one inclined hole pass close to highly chargeable bodies of high grade mineralisation.

Models ran with Tx electrodes in western vertical hole – Rx electrodes in other holes and on surface. Dipole TX and Rx dipoles used throughout.

Downhole / Crosshole IP Forward Model

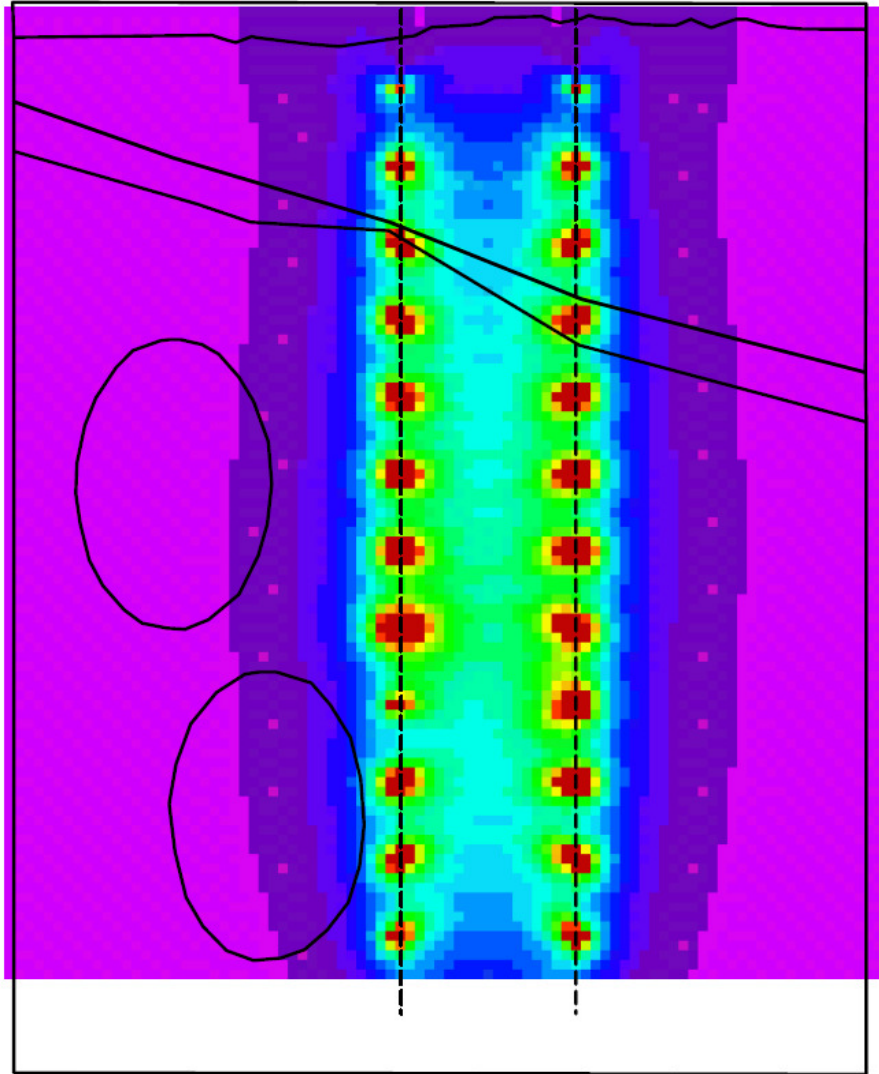


A	Overburden & Weathering	5ohmm 0mrads
B	Upper Plate	2000ohmm 5mrads
C	Fault Zone	100ohmm 10mrads
D	Lower Plate	5000ohmm 10mrads
E	Targets	5000ohmm 50mrads

Model Sensitivity – Homogeneous Earth, 2 Vertical deep Holes

‘Absolute’ Model Sensitivity for 100m spaced electrodes down two vertical drillholes (deeper than both targets) in a uniformly resistive 5000ohmm environment.

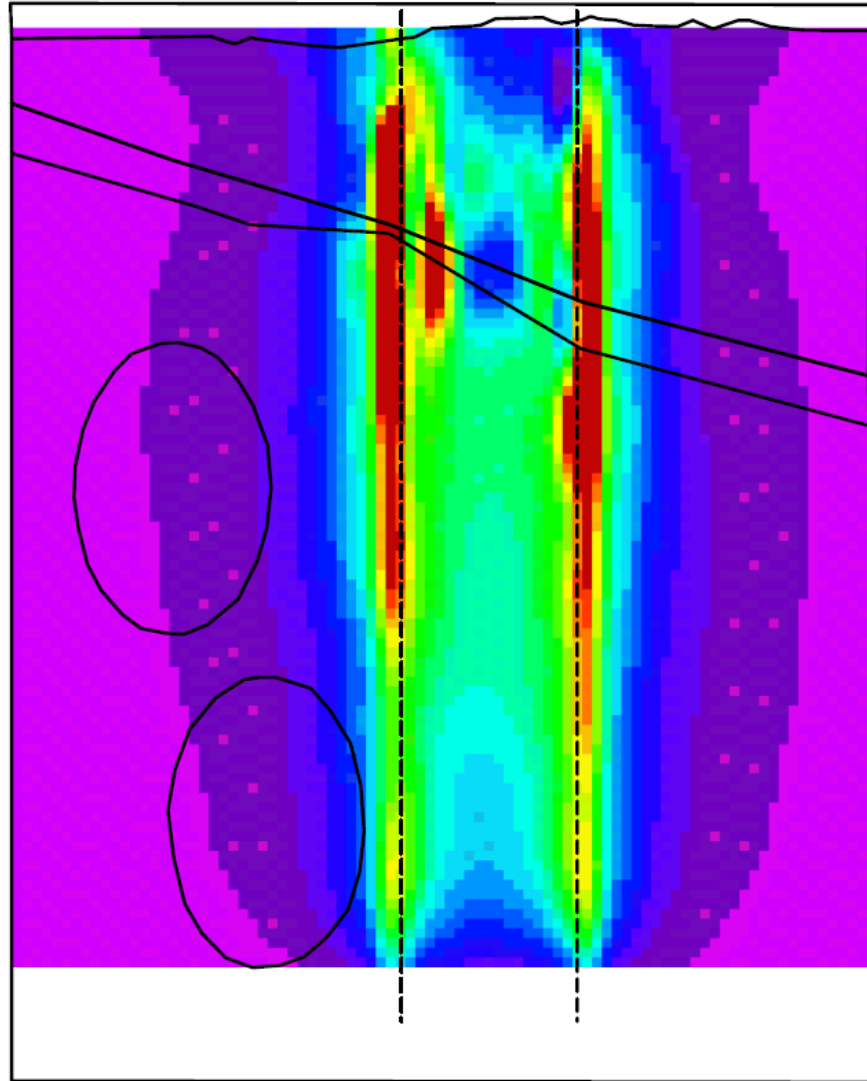
Area between drillholes (250m apart) is well resolved – but sensitivity drops off quickly outbound from the drillholes, and the model is largely insensitive to sources at >200m beyond the drillholes.



Model Sensitivity – Actual Model Section, 2 Vertical deep Holes

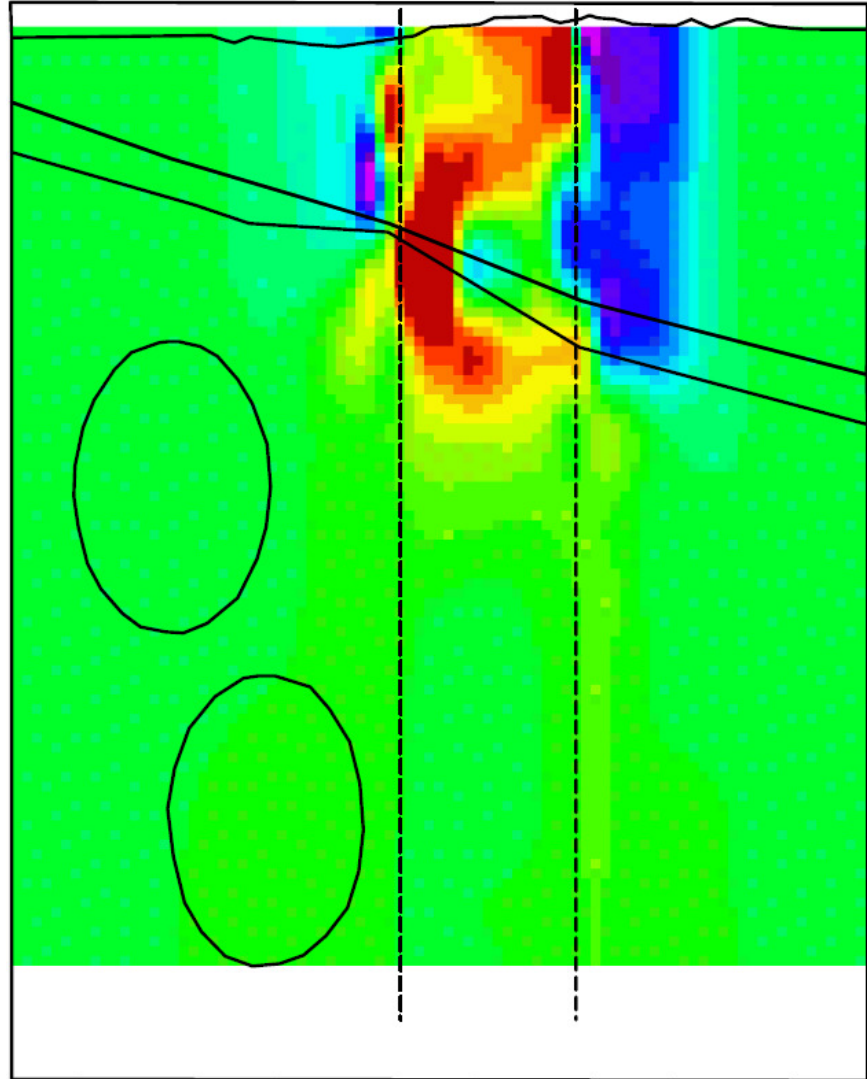
‘Relative’ Model Sensitivity for 100m spaced electrodes down two vertical drillholes for actual inverted resistivity model.

More complex but essentially very similar to homogeneous earth case suggesting the uniform half space sensitivity model may be a good guide to determine ideal electrode locations in the absence of real data.



Inverted Resistivity Section, 2 Vertical deep Holes

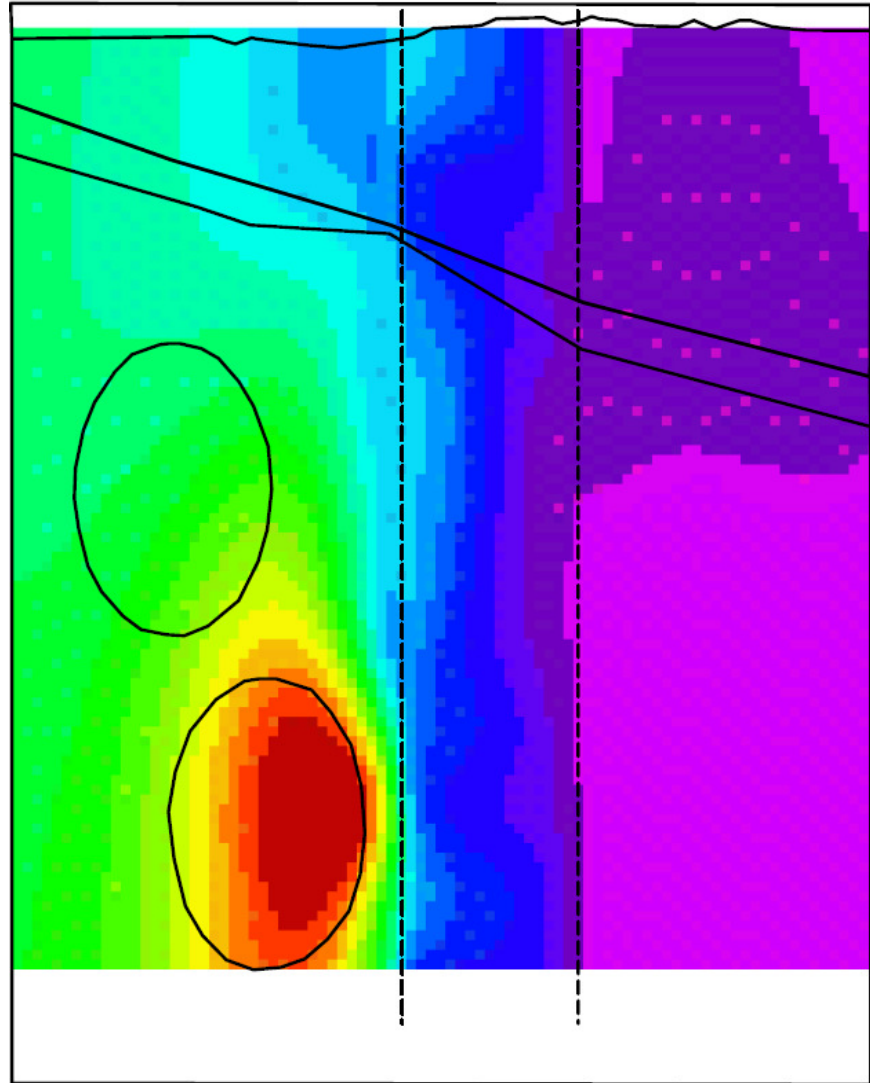
Looks nothing like the real section because we have only electrodes down the two drillholes and most of the resistivity variations are in the near surface.



Inverted Chargeability Section, 2 Vertical deep Holes

The nearest target is well resolved (closest part is only 50m from the drillhole) – the second body at 150m distance is not seen.

This is in good agreement with the model sensitivities determined beforehand by both methods.

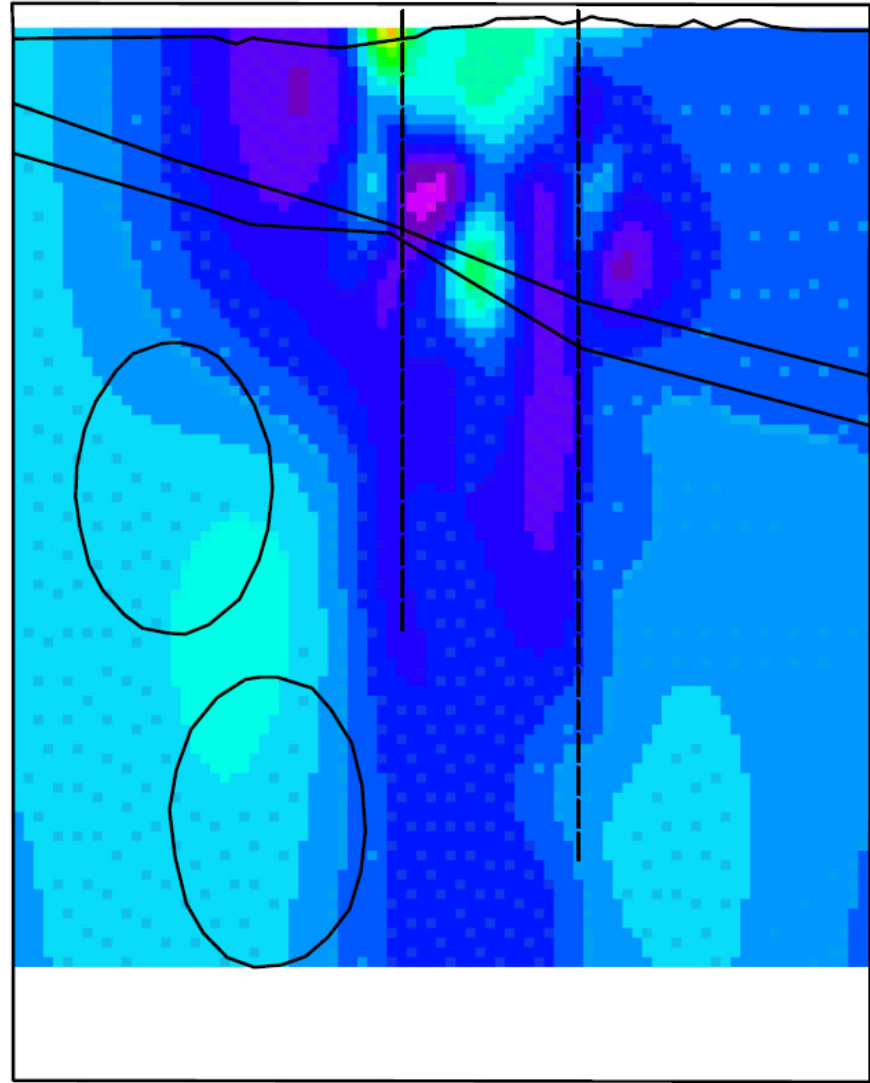
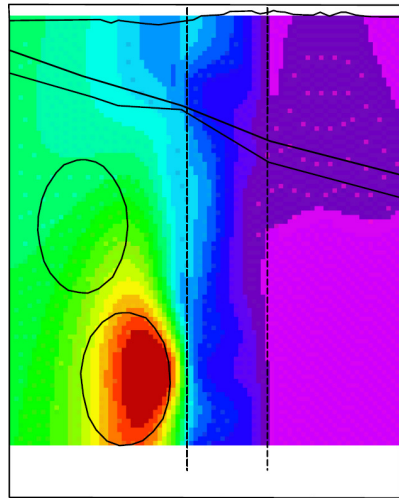


Now – what about drillholes that do not go beyond the target

Inverted Chargeability Section, 2 Vertical deep Holes

With both targets now 150m away from the nearest electrode, neither is detected. This is in good agreement with the model sensitivities.

Curious artefacts in upper part of section

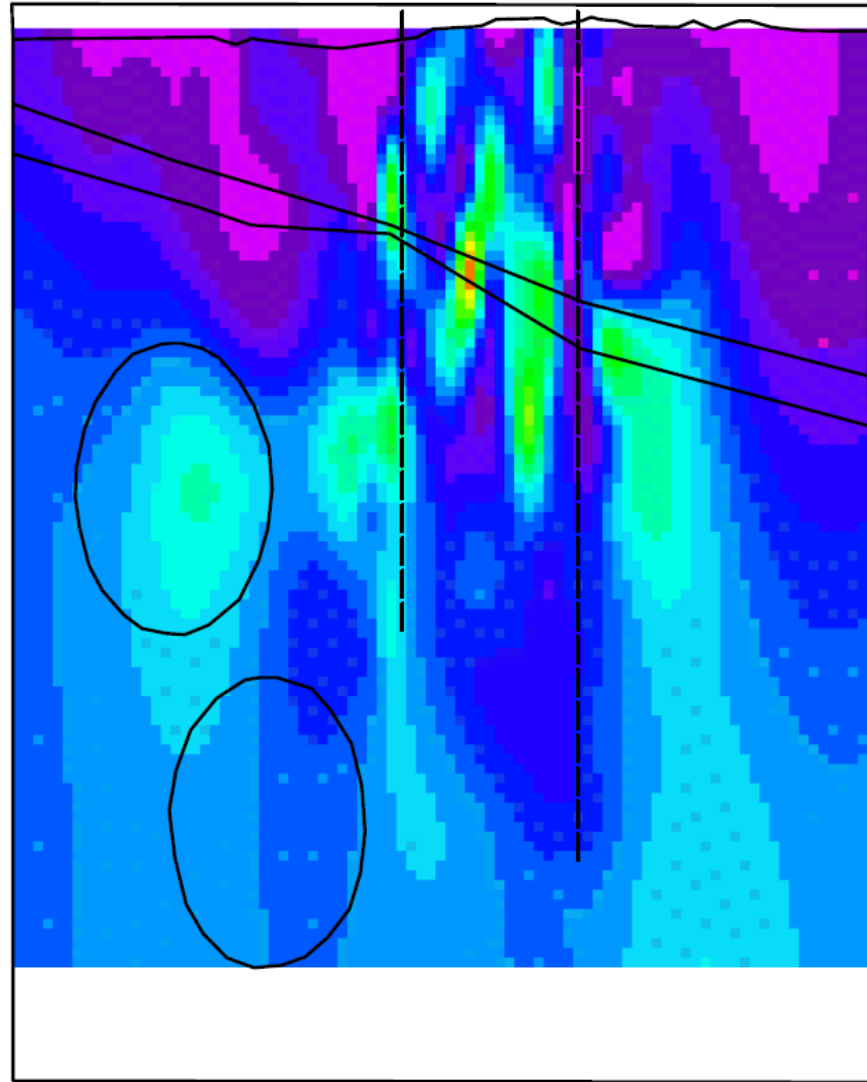
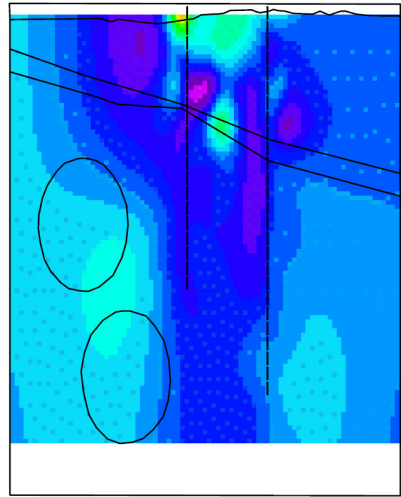
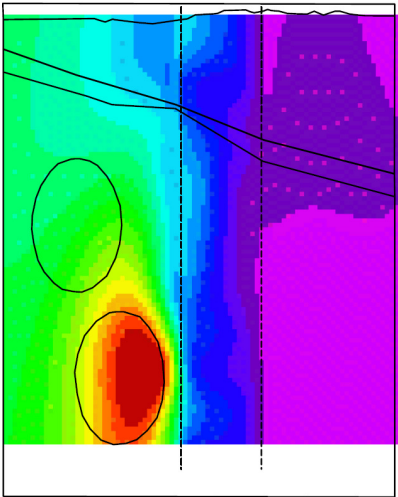


Now – what about adding in some surface electrodes

Inverted Chargeability Section, 2 Vertical deep Holes + surface Electrodes

The addition of the surface electrodes has helped delineate the shallower target.

Also interesting is that despite the poor looking resistivity section, the IP character of the section is quite well reproduced.



Conclusions

The model study has demonstrated that off-hole targets may be detected using electrodes placed in boreholes and at surface.

The potential exists therefore to extend the volume of investigation of a drillhole to a cylinder of 200m diameter.

The sensitivity to off-hole targets is assisted by adding electrodes to the overall array. Placing electrodes beyond the depth of the target will have a large positive effect, but placing electrodes at surface is also beneficial. The ideal set up would be to have an even distribution of electrodes within and somewhat beyond the volume of interest (assuming relatively uniform half space).

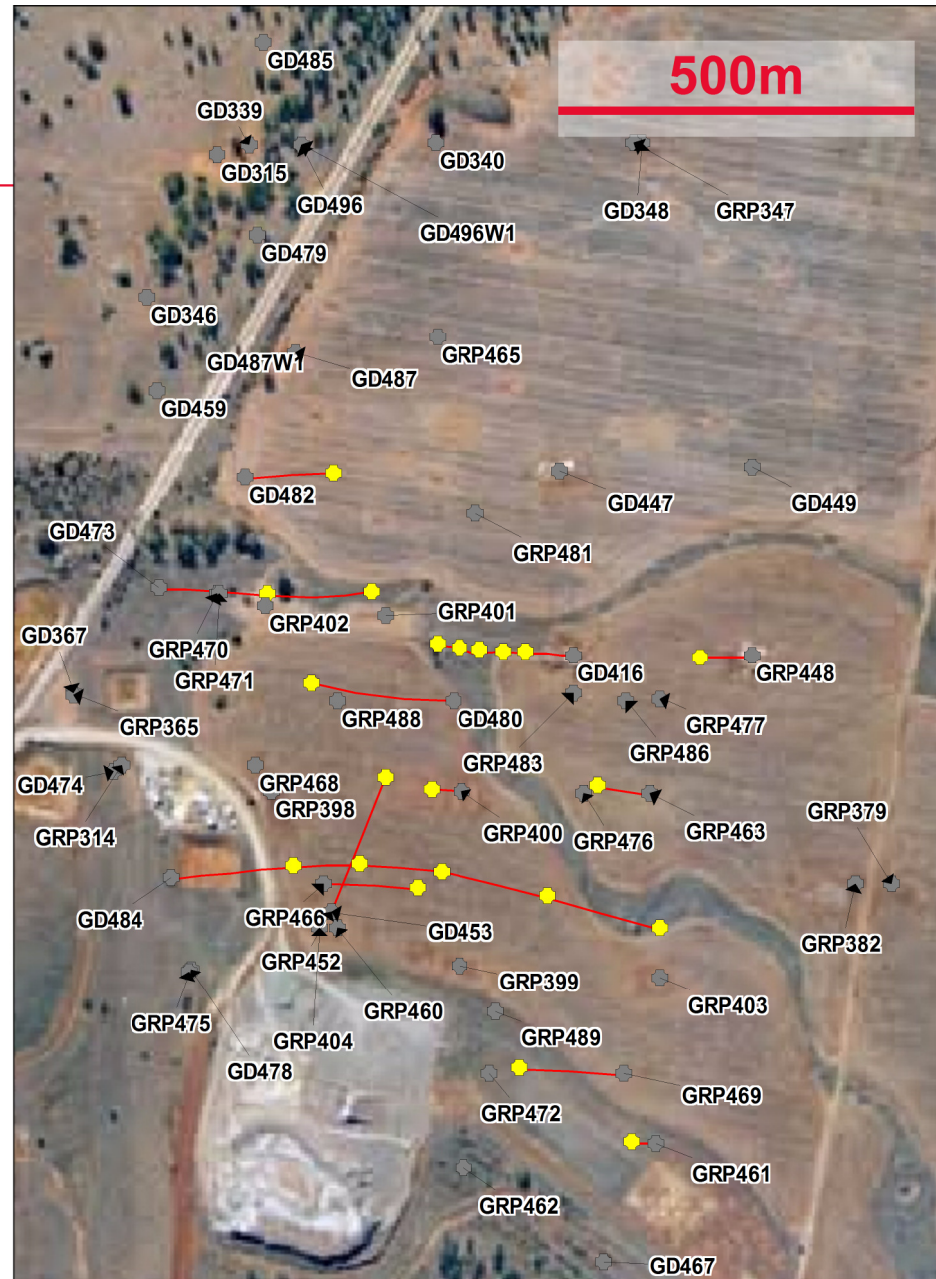
Model Sensitivity analysis is a useful means of determining the validity of a model result, and in designing a galvanic resistivity / IP survey.

GRP314 Location



GRP314 Down-hole Set-up

- Selection of drillholes were dipped – many are blocked at the Altona Fault.
- Two holes open to significant depths (+600m below surface)
- 21 downhole electrodes were placed in 11 drillholes at discrete 100m RL levels
- Minimum electrode depth 200m maximum depth 700m

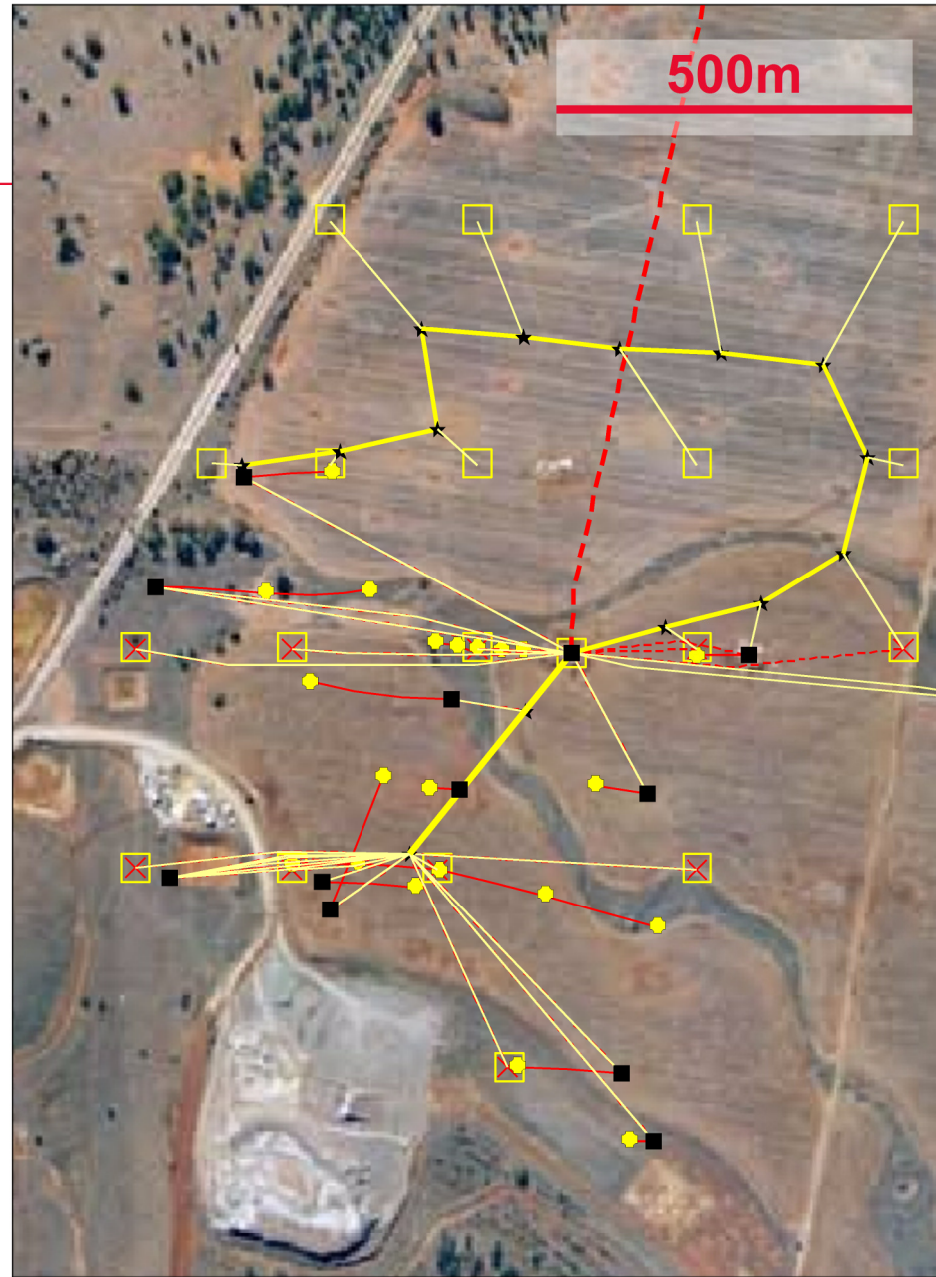


GRP314 Surface Set-up

20 Surface Electrode locations determined by best fit to legal list of downhole electrode positions

All up there are 41 Rx Electrodes and 31 Tx Electrodes

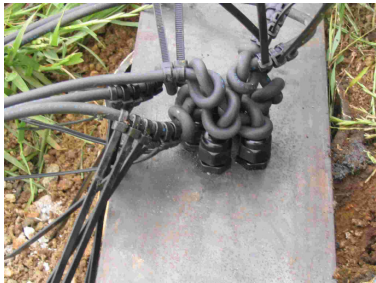
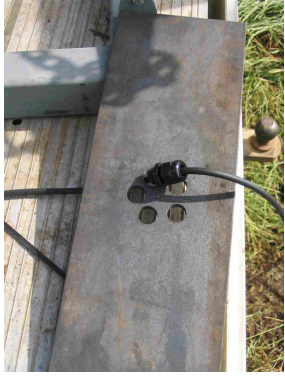
For each Tx electrode all Rx electrodes were read – in total ~1000 data points.



Connecting the Downhole Electrode



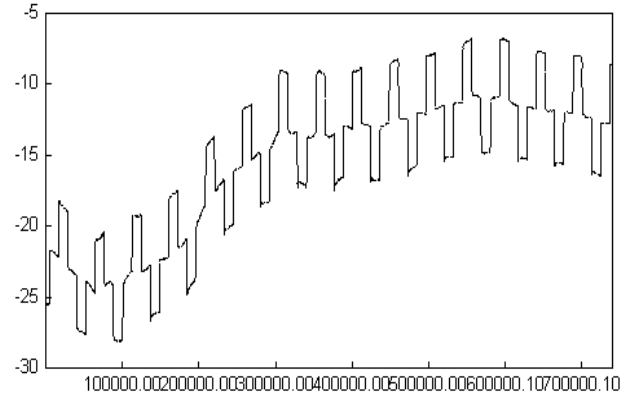
Lowering the Downhole Electrodes



Transmitter Set-up



IP Full Time Series Receiver & Processing Routines



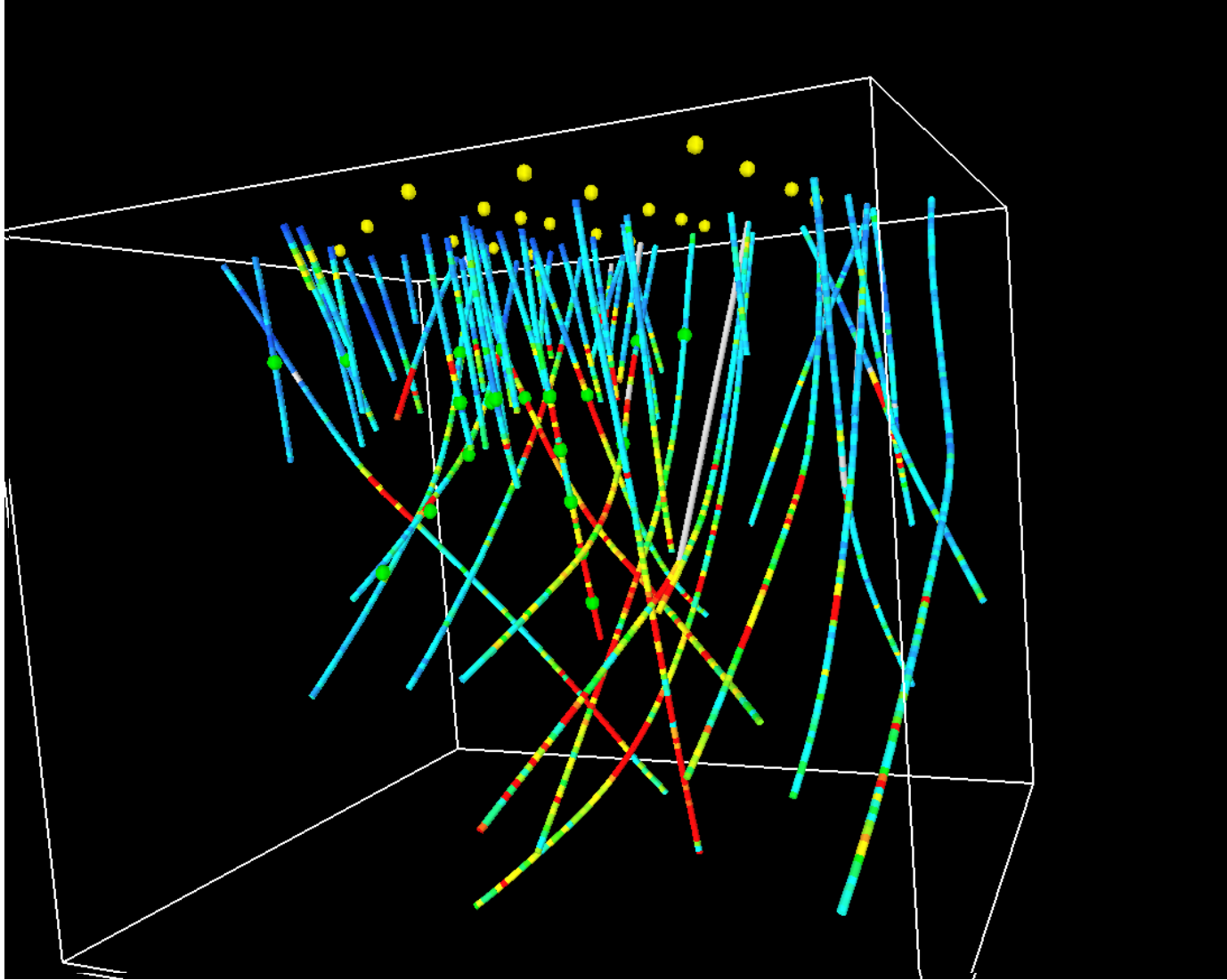
Time Series IP for Data52

Database Time Series File Reset Recalculate Store Data Help

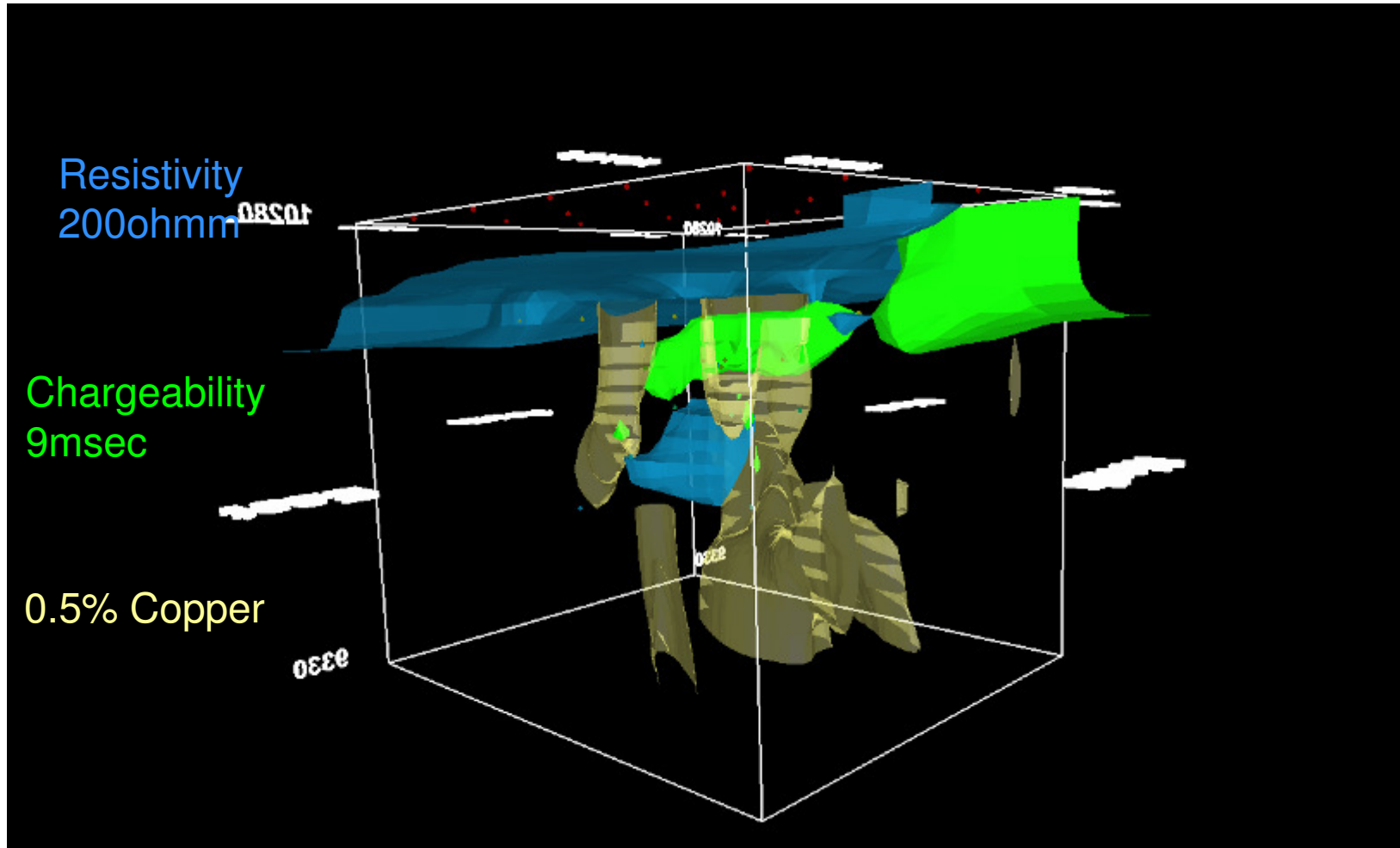
The software interface includes several plots and control panels:

- Top Plot:** A zoomed-in view of the time series signal, showing a step-like pattern with noise. The x-axis ranges from 50 to 200, and the y-axis from -25 to 0.
- Bottom Left Plot:** A plot of the signal's amplitude over time, with the x-axis ranging from 18.0 to 21.5 and the y-axis from -0.5 to 0.5.
- Bottom Right Plot:** A plot showing the signal's behavior over a range of 0.5 to 4.0, with the y-axis from -120 to 120.
- Control Panel:** A series of input fields and buttons for data processing. The fields contain values: -0.230, -0.321, 0.080, Upd, 6.228, 3.9456, 13.52, 26.012, 5.665, EMC.
- Repeat Data Section:** A section with checkboxes and numerical values for repeating data processing. The 'Use Repeat' checkbox is checked. Values include 3.87, 13.25, 24.183, 2.568, 0.018, 0.0000, and buttons for Cancel and Done.

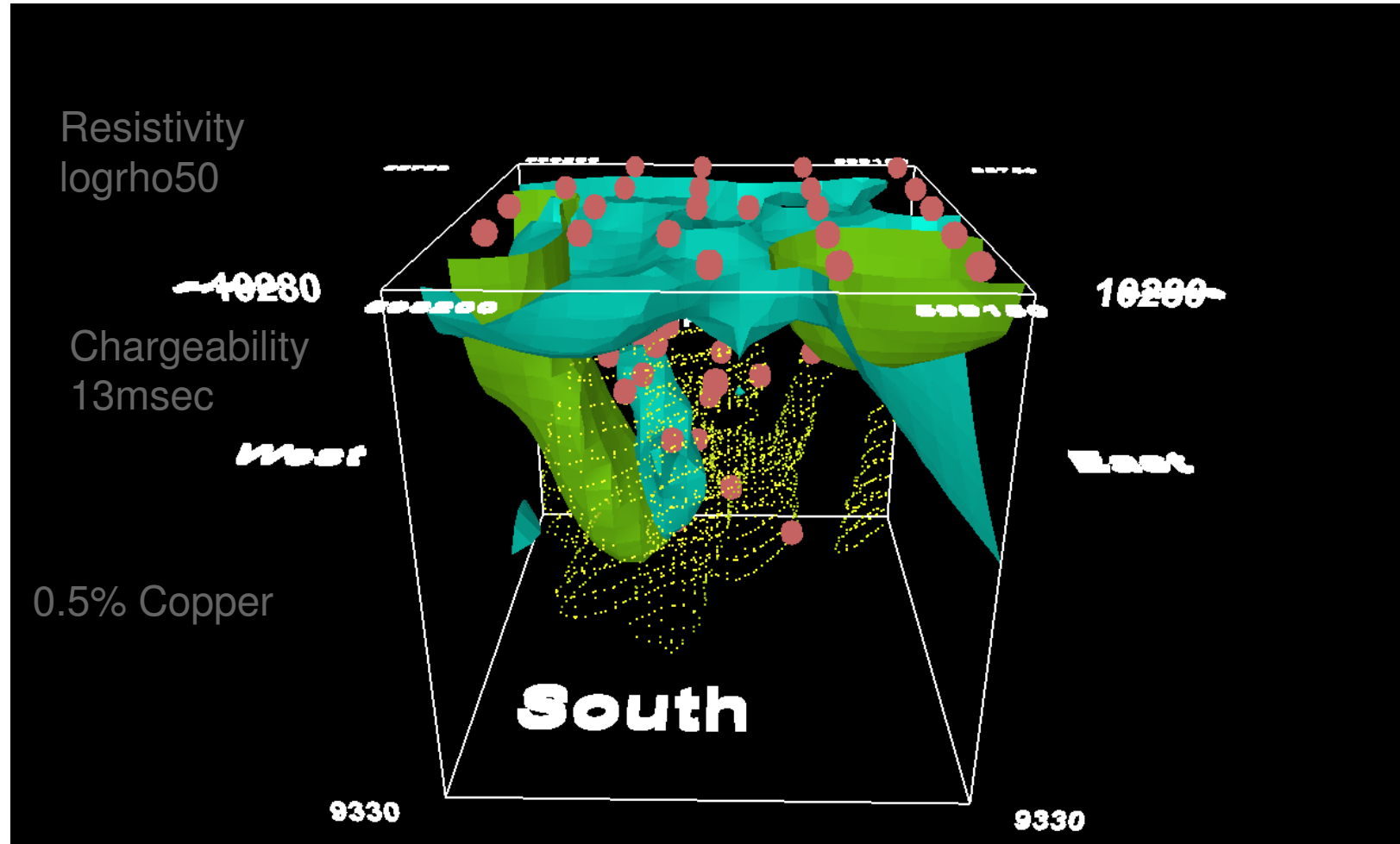
3D View from NE of Electrode Array and Drilling



Loke 3D Model – View from NE



UBC 3D Model – view from South



Conclusions

- Still a Bleeding Edge Technology – worth experimenting with in special cases
- To a first order approximation – the models generated using different codes agree – suggests either code is OK to use.
- Handling 3D inversion software requires skill and experience – a rare commodity.
- Results are not ‘convincing’- it may be some time before the industry takes on this approach (or a variant of it).
- Significant unknowns e.g. How sensitive is a downhole electrode to its immediate environment – especially in terms of chargeability?