Outline of the talk

- Electromagnetics
- Example from Northern Territory
  - Survey results from Tanami Desert
    - Ground TEM, Downhole EM and Hydrogeochemistry
    - Comparison with other geophysical data/responses
- Example from South Australia
    - TEM Survey results from Kalkaroo Mineral Prospect
    - Comparison with AEM and Aeromagnetic responses

Electromagnetic Methods

- Measure of electrical conductivity (σ)
  - How easily electrical current can pass through
- Conductivity is a complex function
  - Chemical or mineralogical composition
  - Porosity, connectivity
  - Pore fluid conductivity, degree of saturation
  - Temperature
- Wide range of approaches
  - GPR ➔ TEM/AEM/DHEM ➔ CSMT/AMT/MT/GDS

EM Case Study from Tanami Desert, Northern Territory

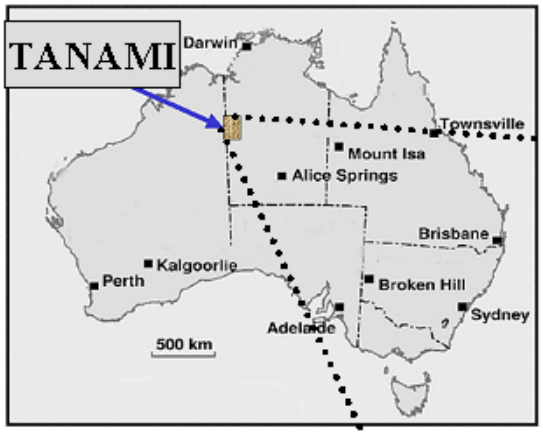
Palaeochannels are being identified as hidden sources of fresh water and path-finders of base metal deposits including gold.

Objectives

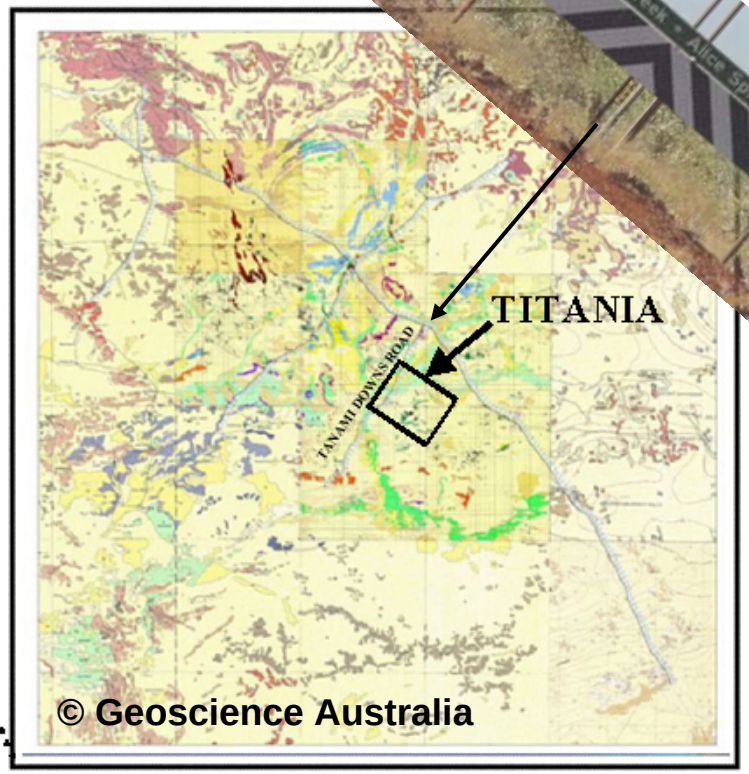
- Delineate the palaeochannel characteristics
- Study ground water properties
- Identify possible locations of mineralisation

Part of multi-disciplinary research project

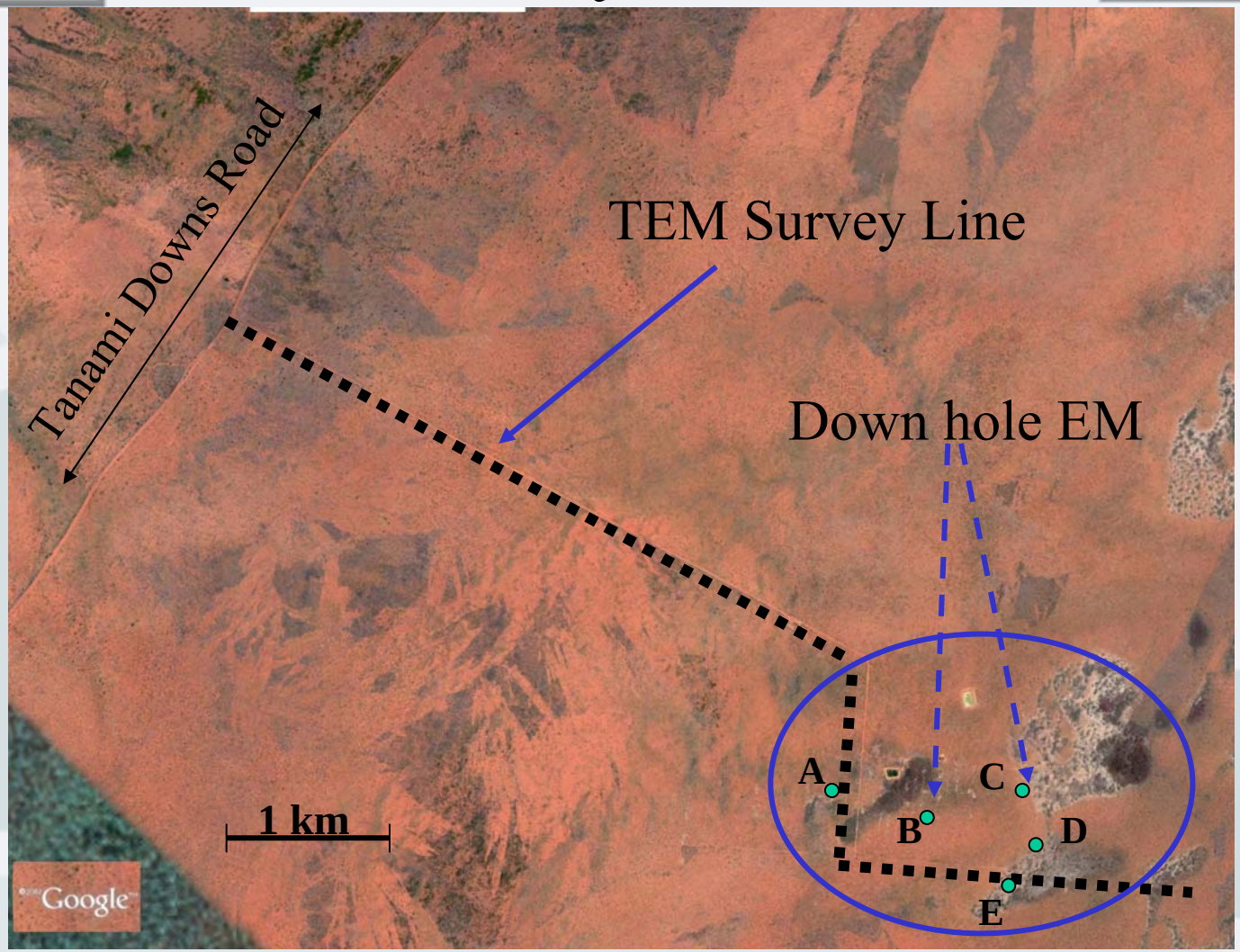
Survey Area


TANAMI
Darwin
Townsville
Mount Isa
Alice Springs
Brisbane
Kalgoorlie
Perth
Broken Hill
Sydney
Adelaide
500 km

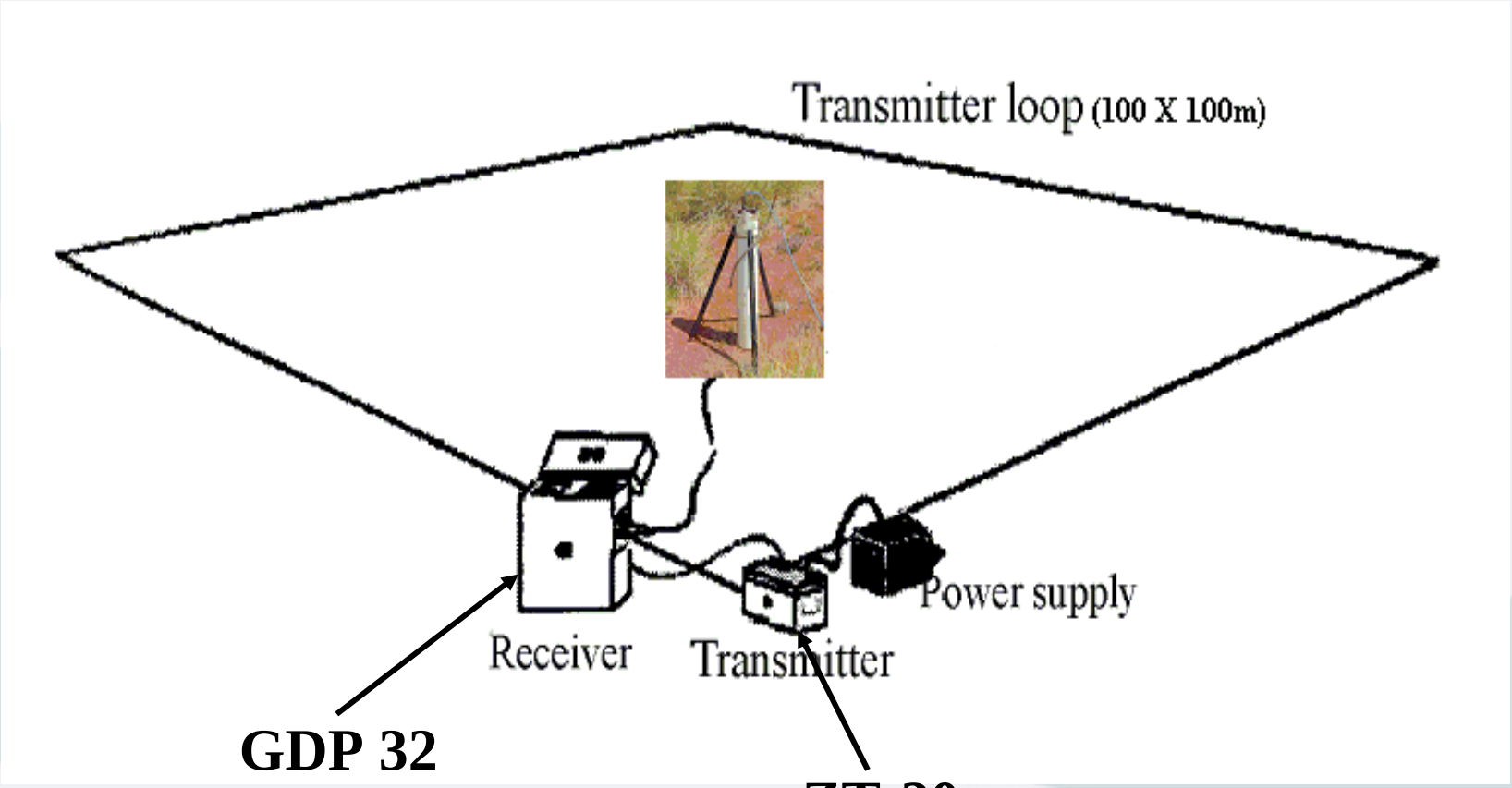

448 Halls Creek - Alice Springs 602


TITANIA
TANAMI DOWNS ROAD
© Geoscience Australia

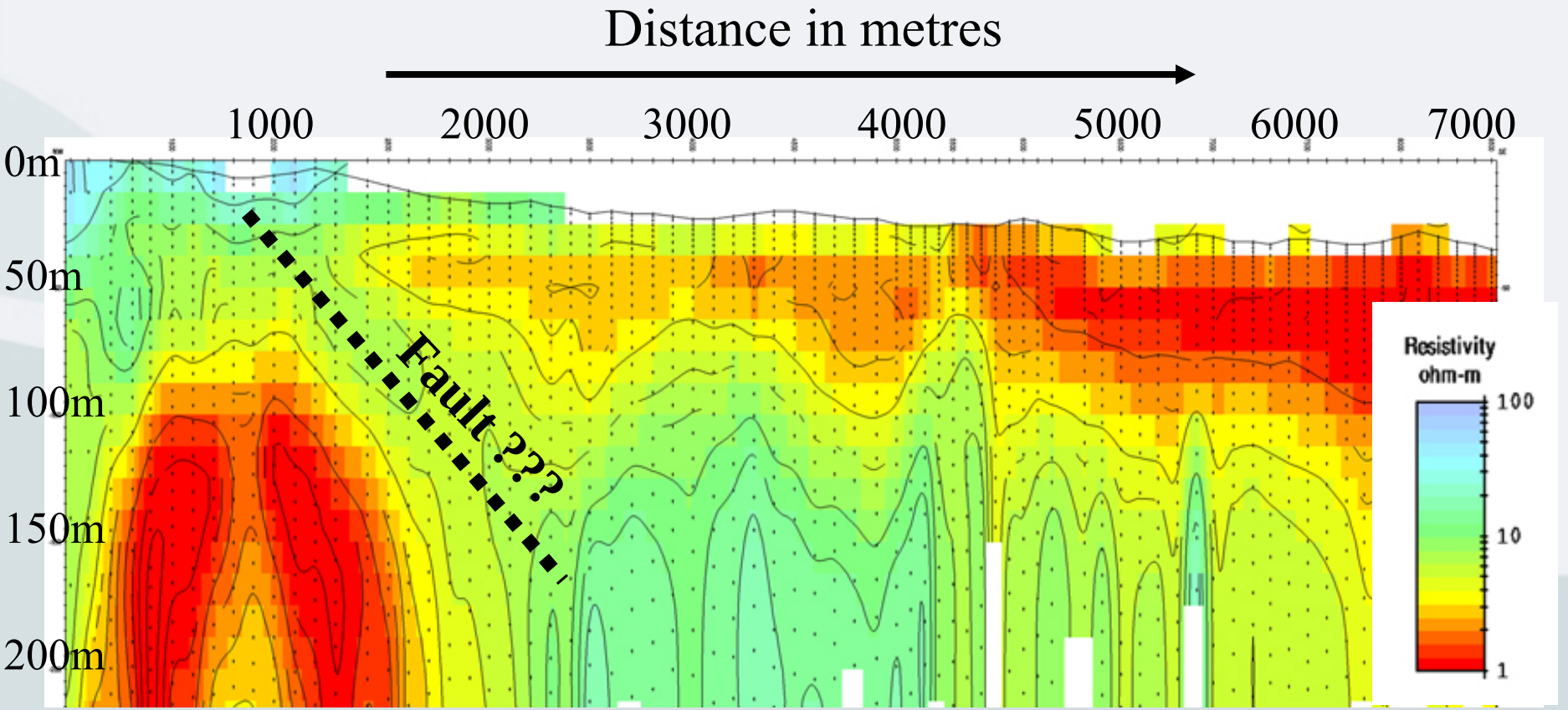
Survey Area


Tanami Downs Road
TEM Survey Line
Down hole EM
A
B
C
D
E
1 km
Google

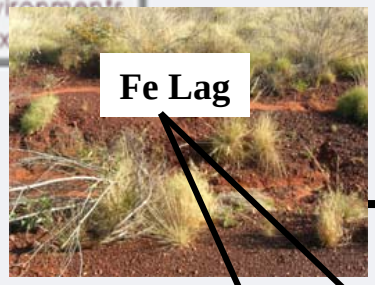
Ground TEM System

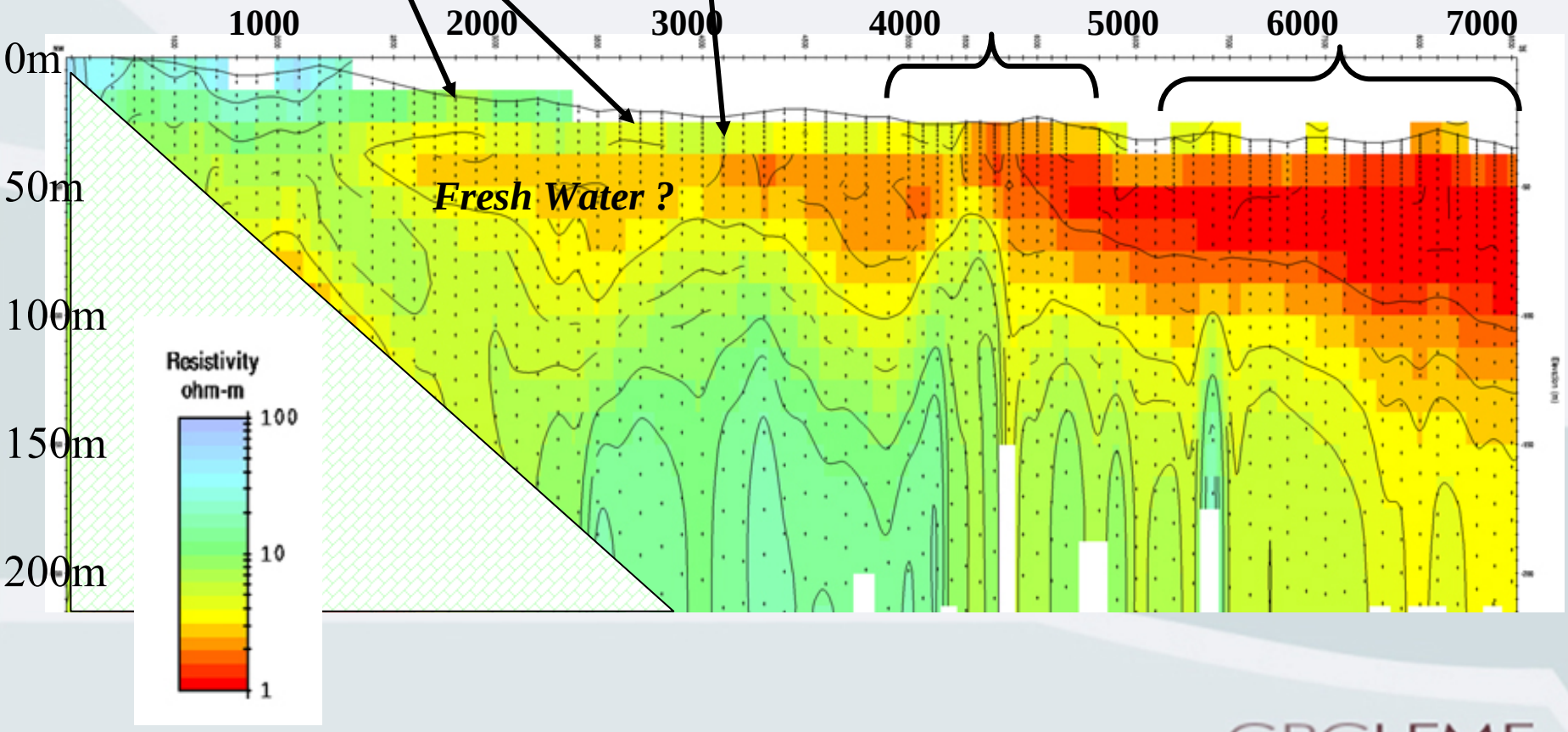


2-D depth-resistivity profile



2-D depth-resistivity profile



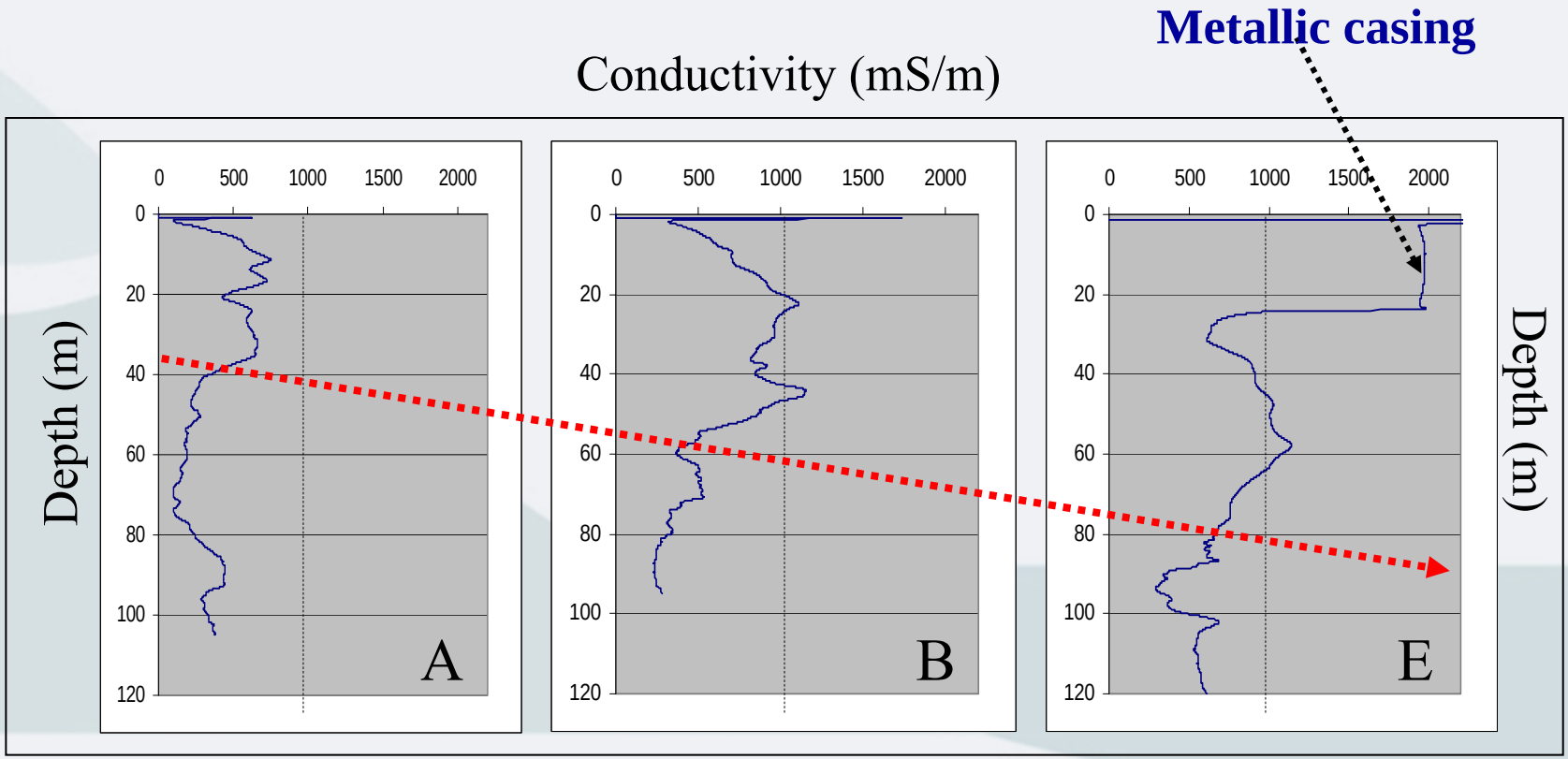


Down hole logging

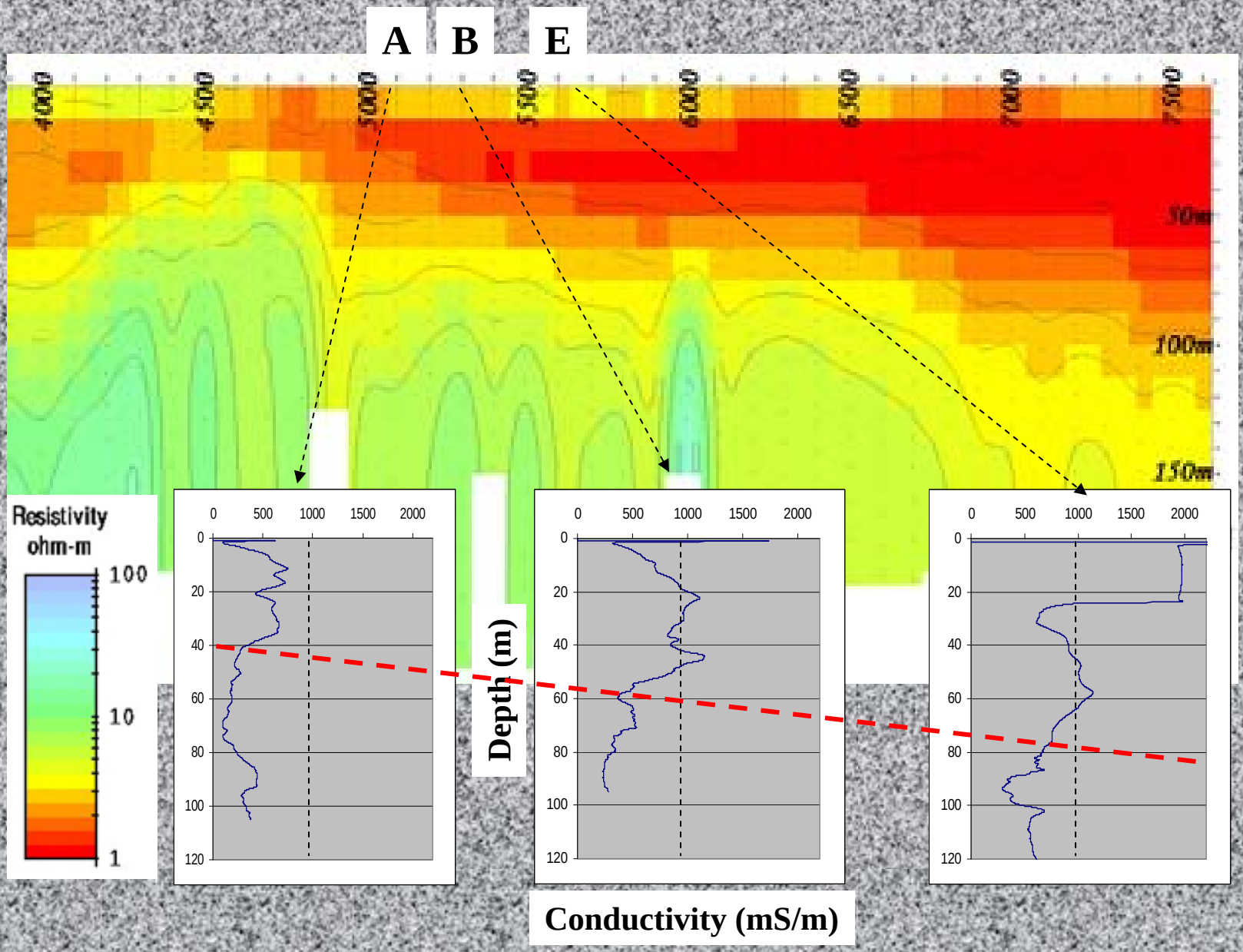
Six drill holes logged

- Metallic casing
- PVC casing
- A034 (HI-451) induction conductivity sonde

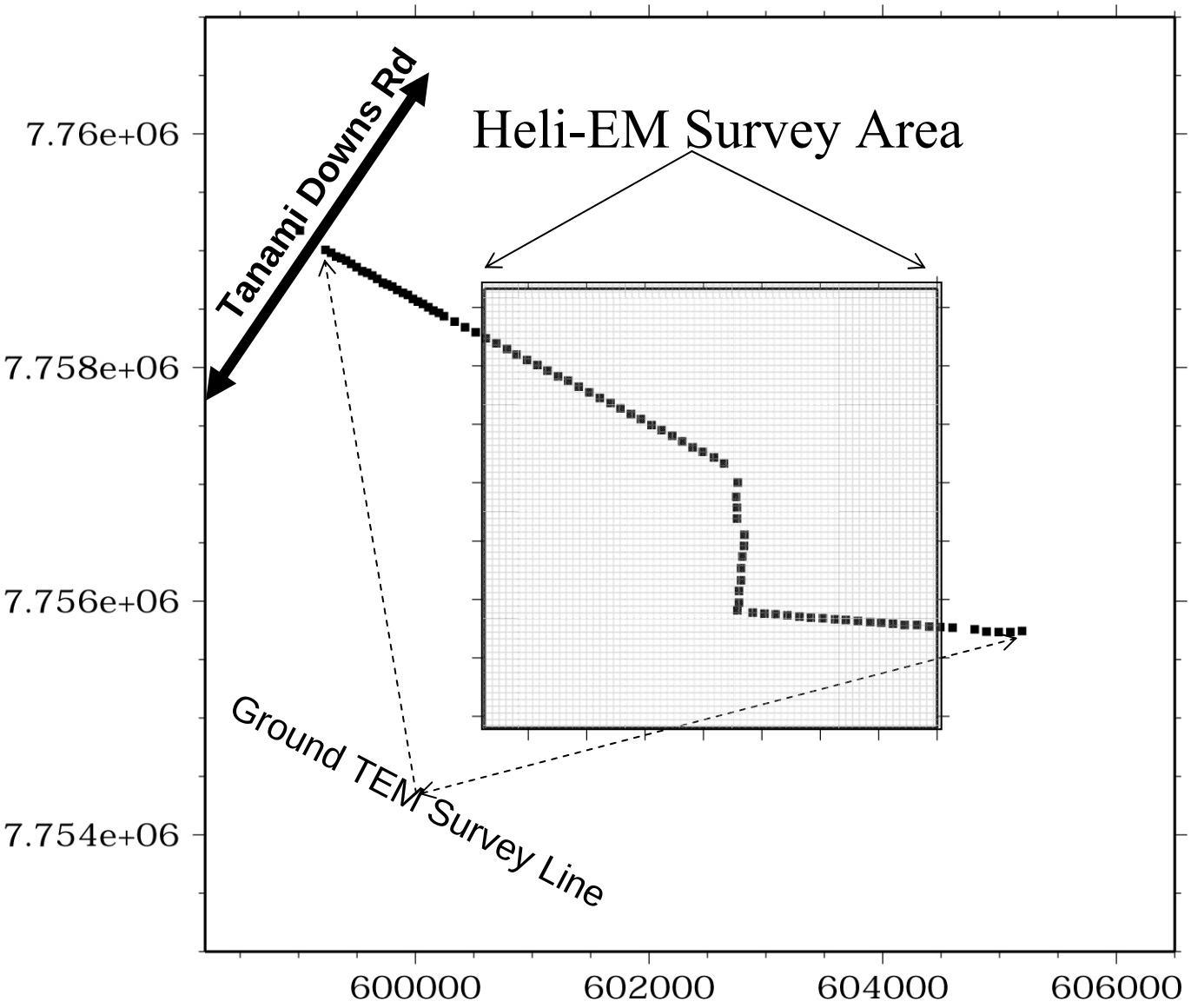
Down hole responses



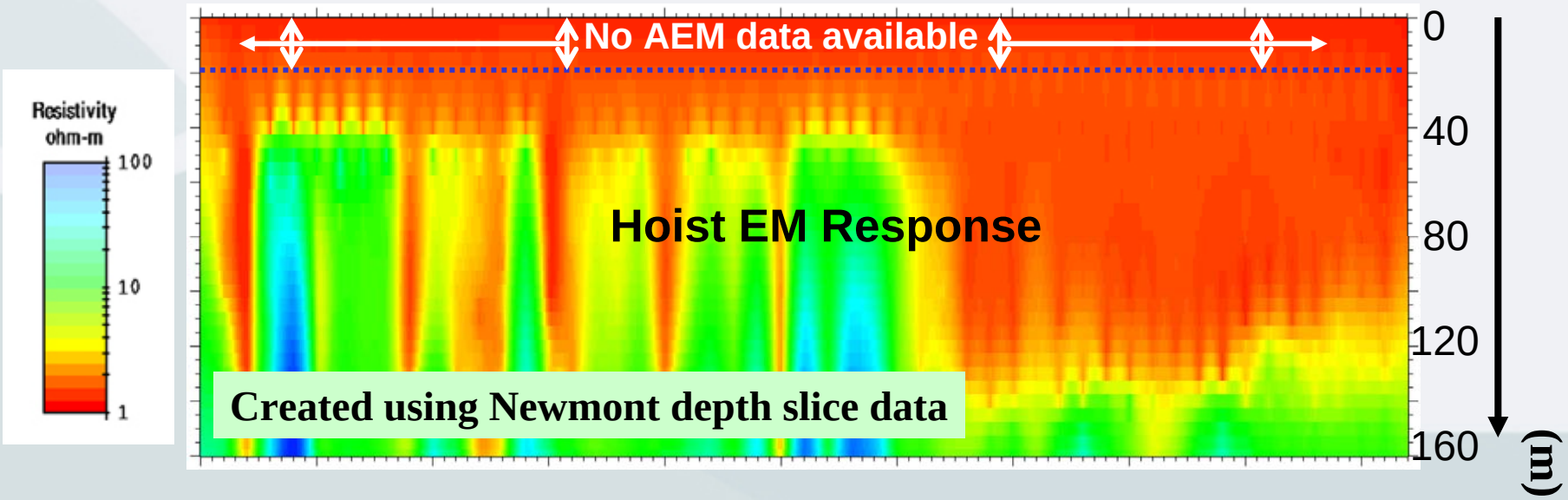
Ground and Down hole EM responses



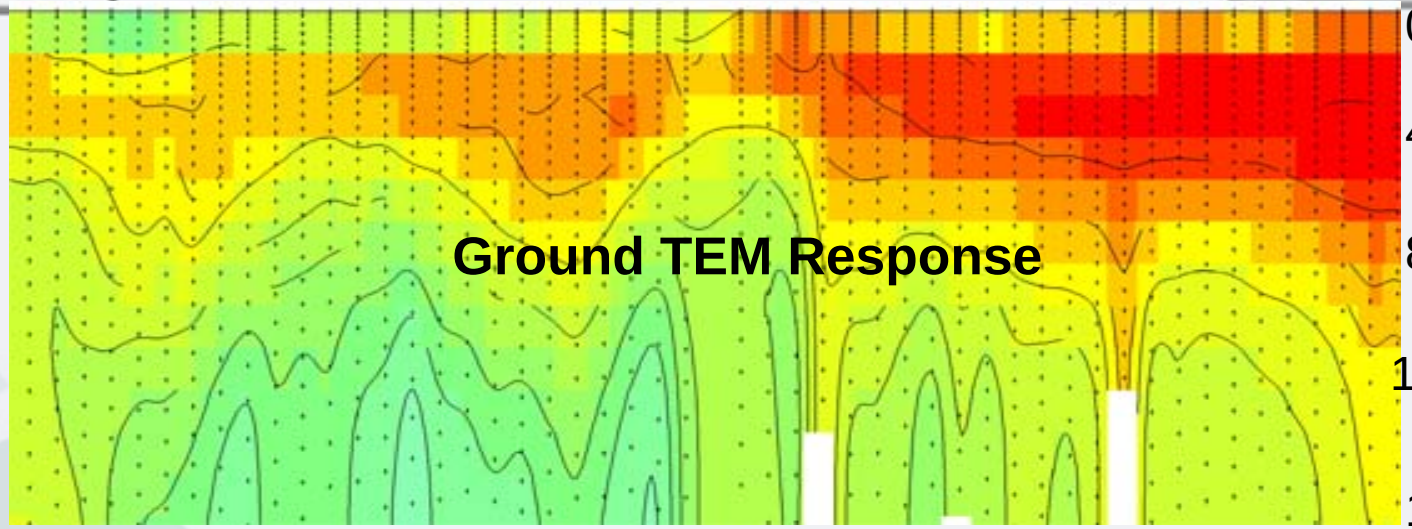
Titania HeliEM/GrndTEM Survey Map

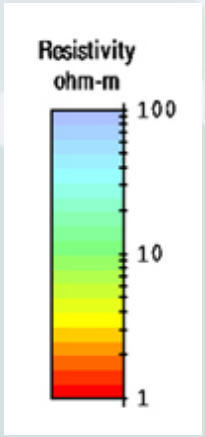


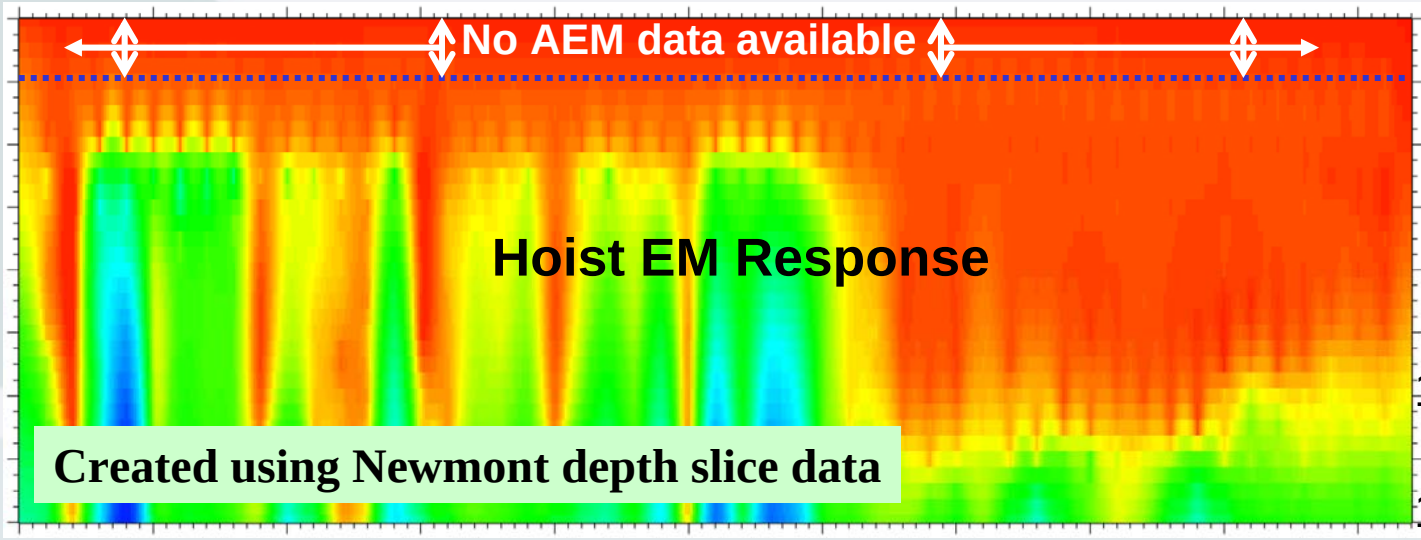
Heli-EM Responses along ground TEM Transect



Comparison of EM Responses



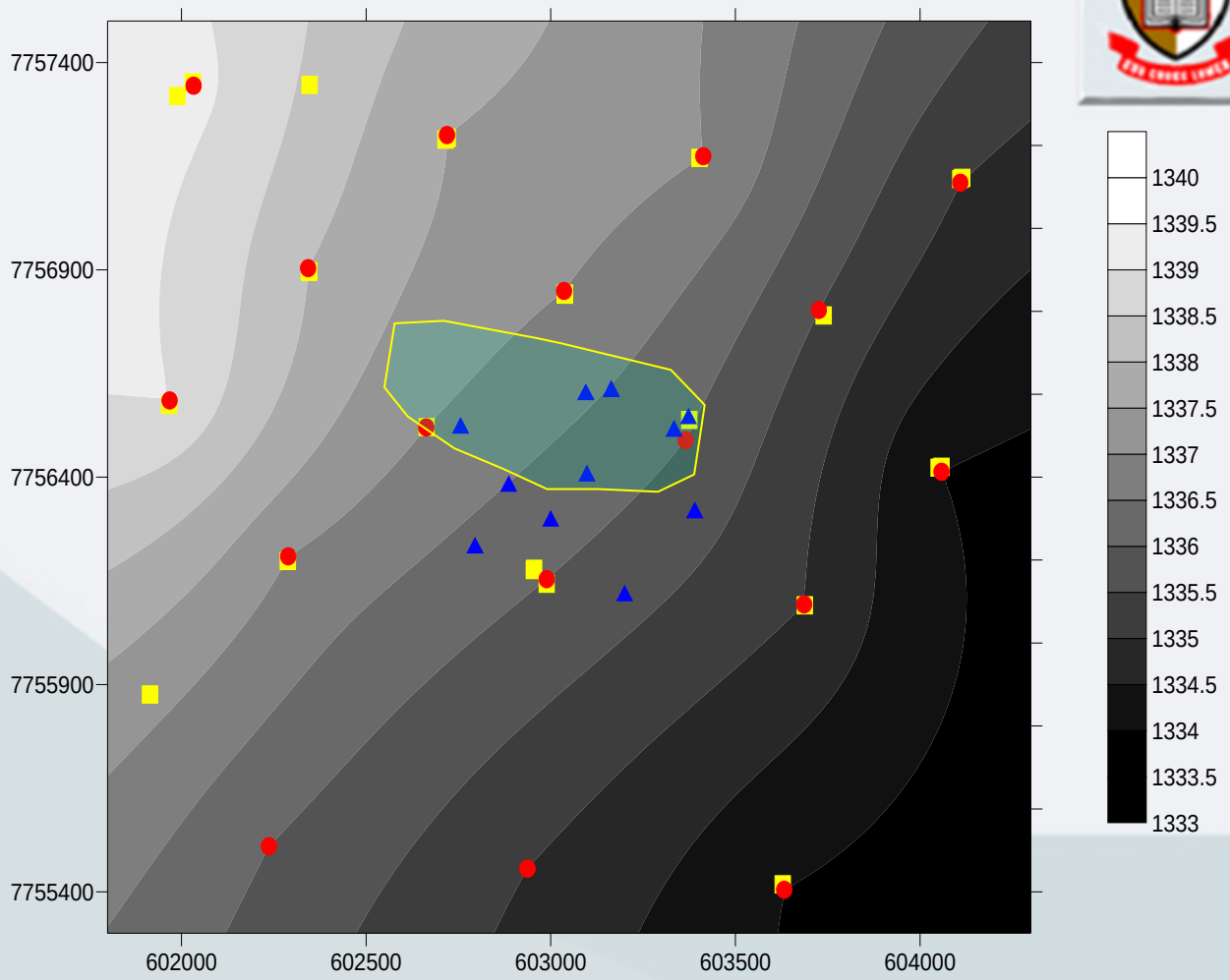




Groundwater Sampling

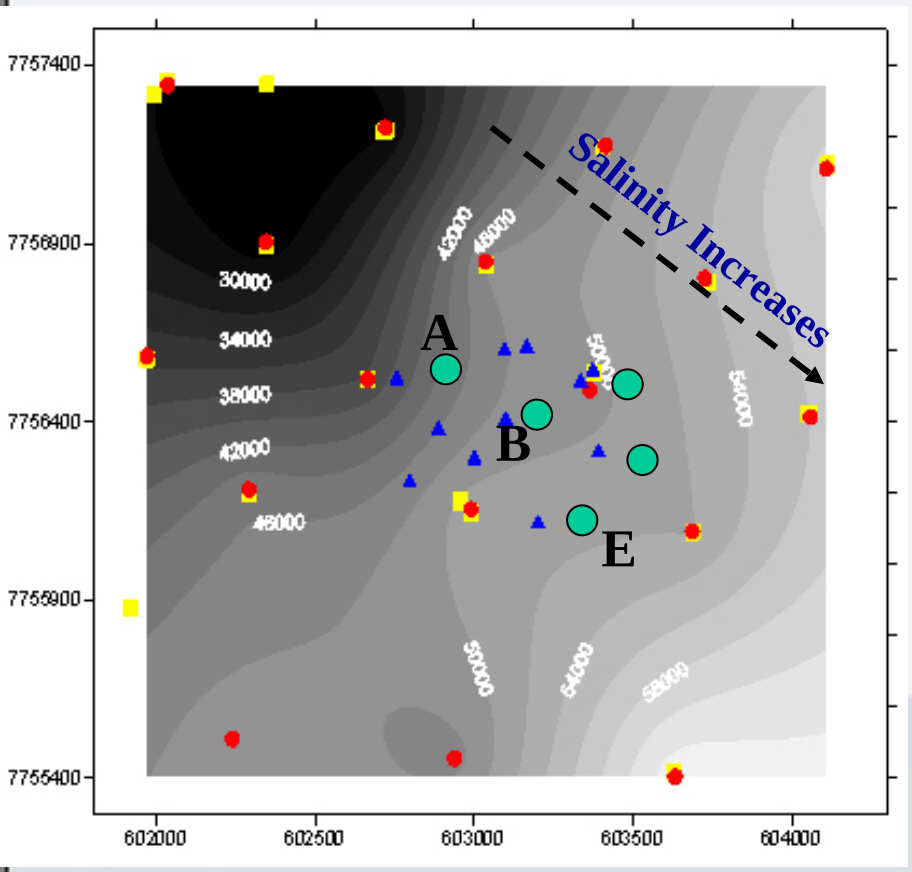
- Develop the hydrogeochemical framework
- Characterise mineralisation geochemistry
- Generate conceptual and numerical models

Titania

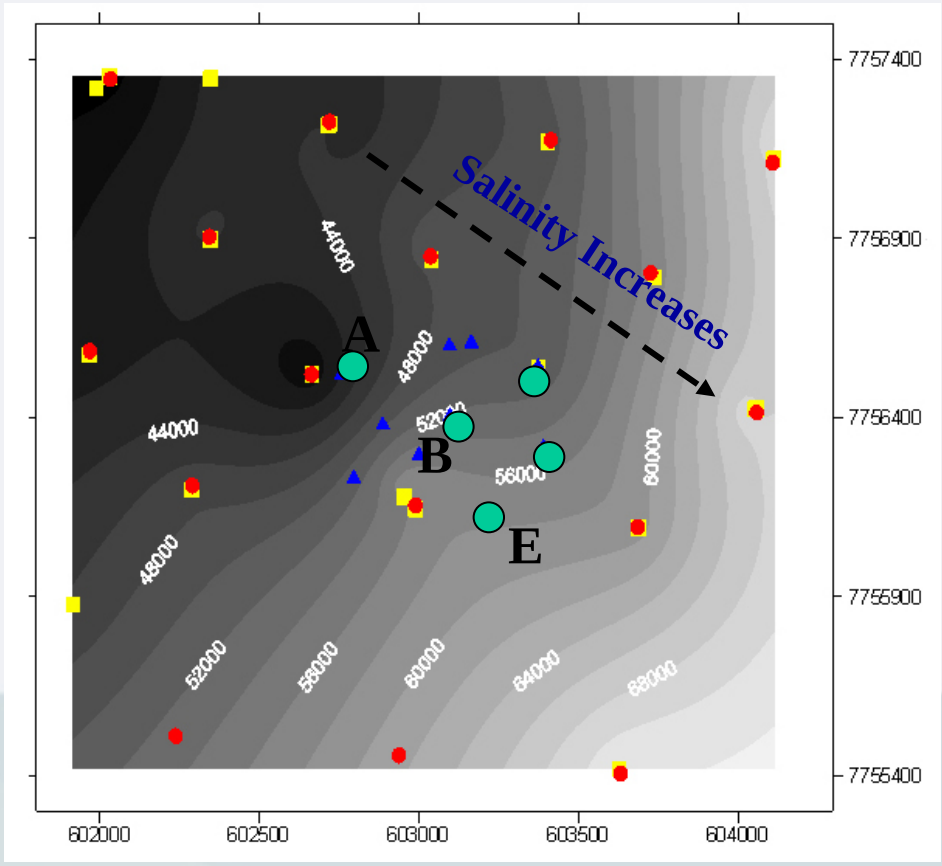


Titania water sample locations on topography
Shallow aquifer – red circles 17 samples
Deep aquifer – yellow squares 16 samples

Aquifer Conductivity contours

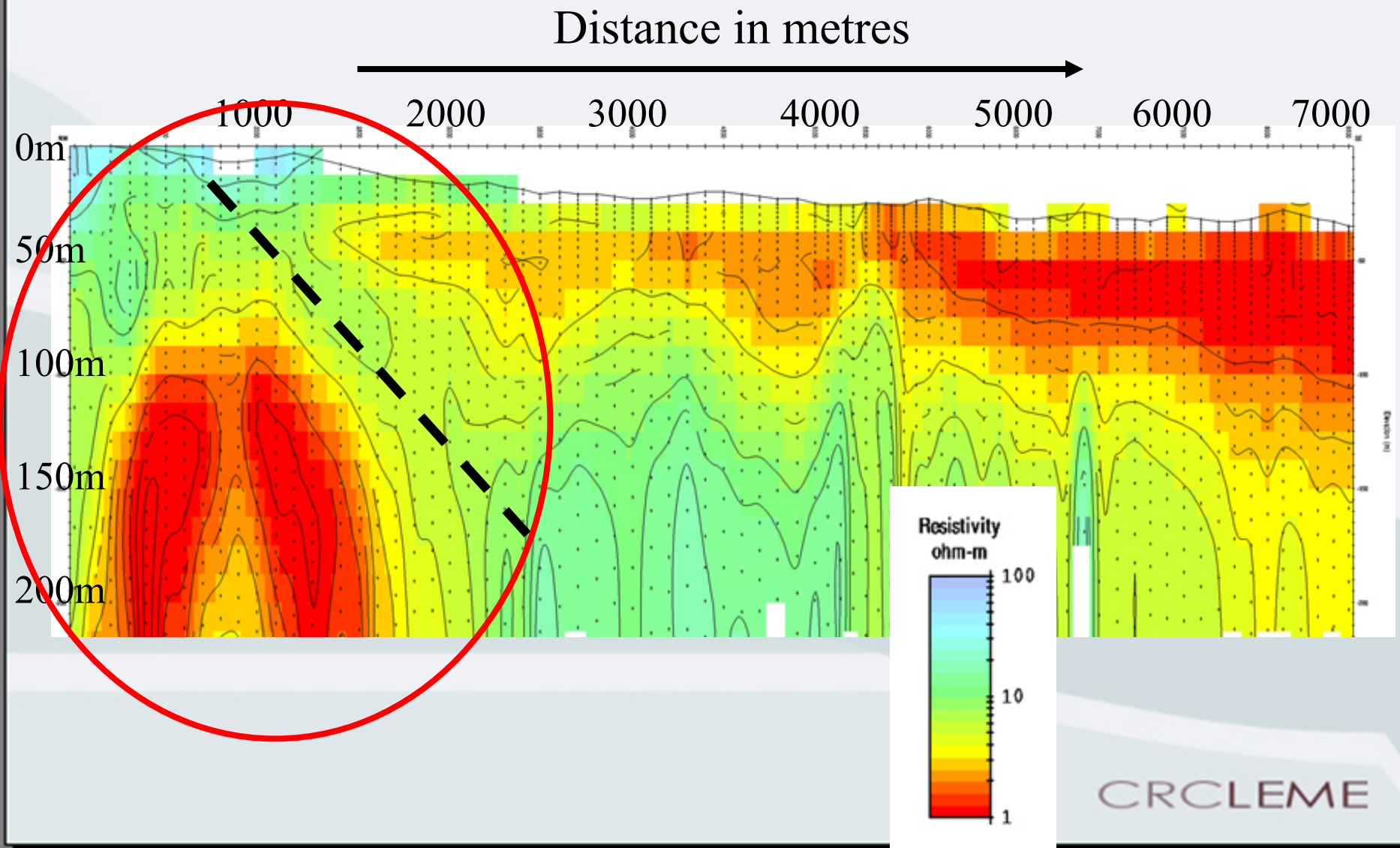


Shallow aquifer

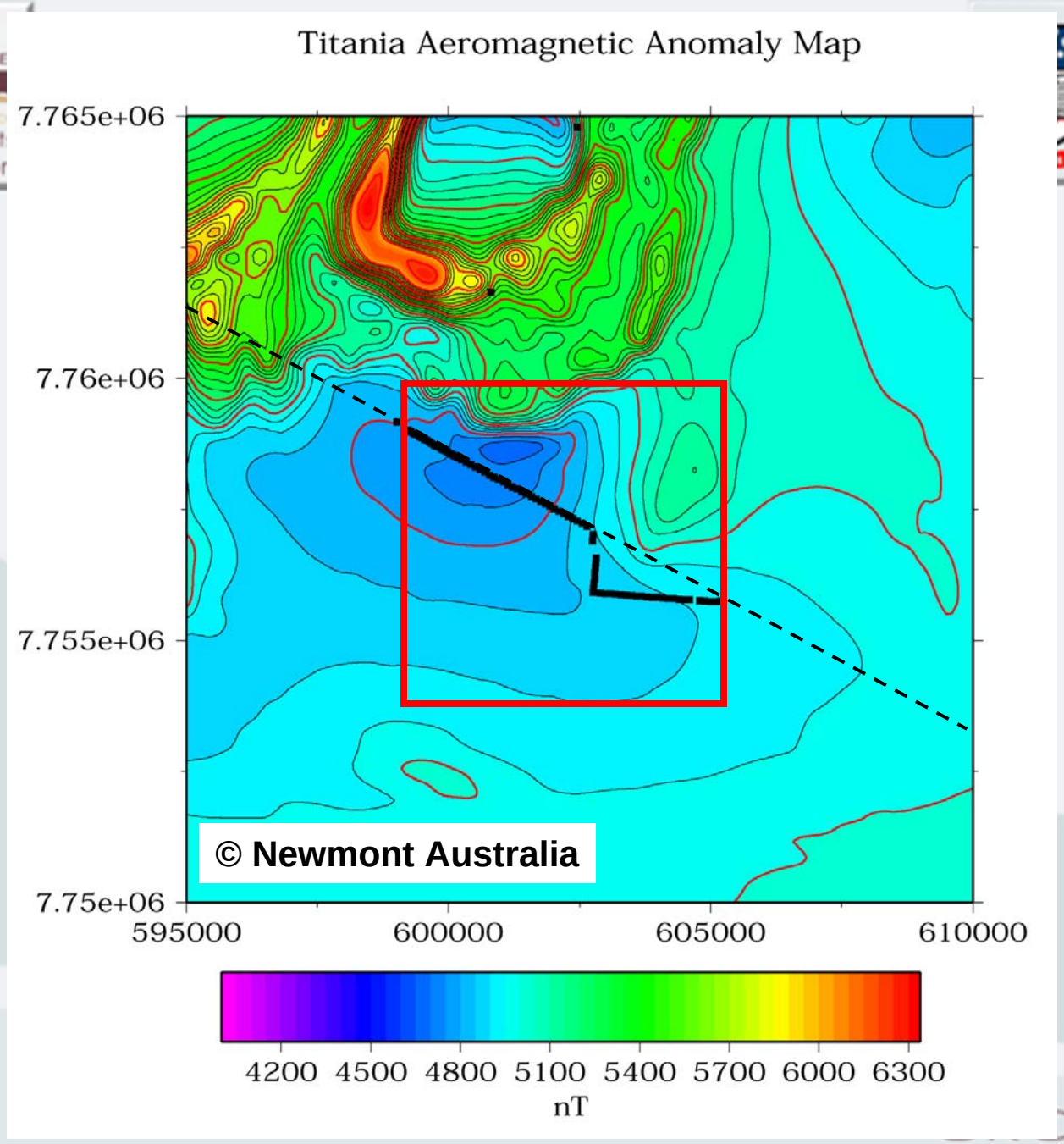


Deep aquifer

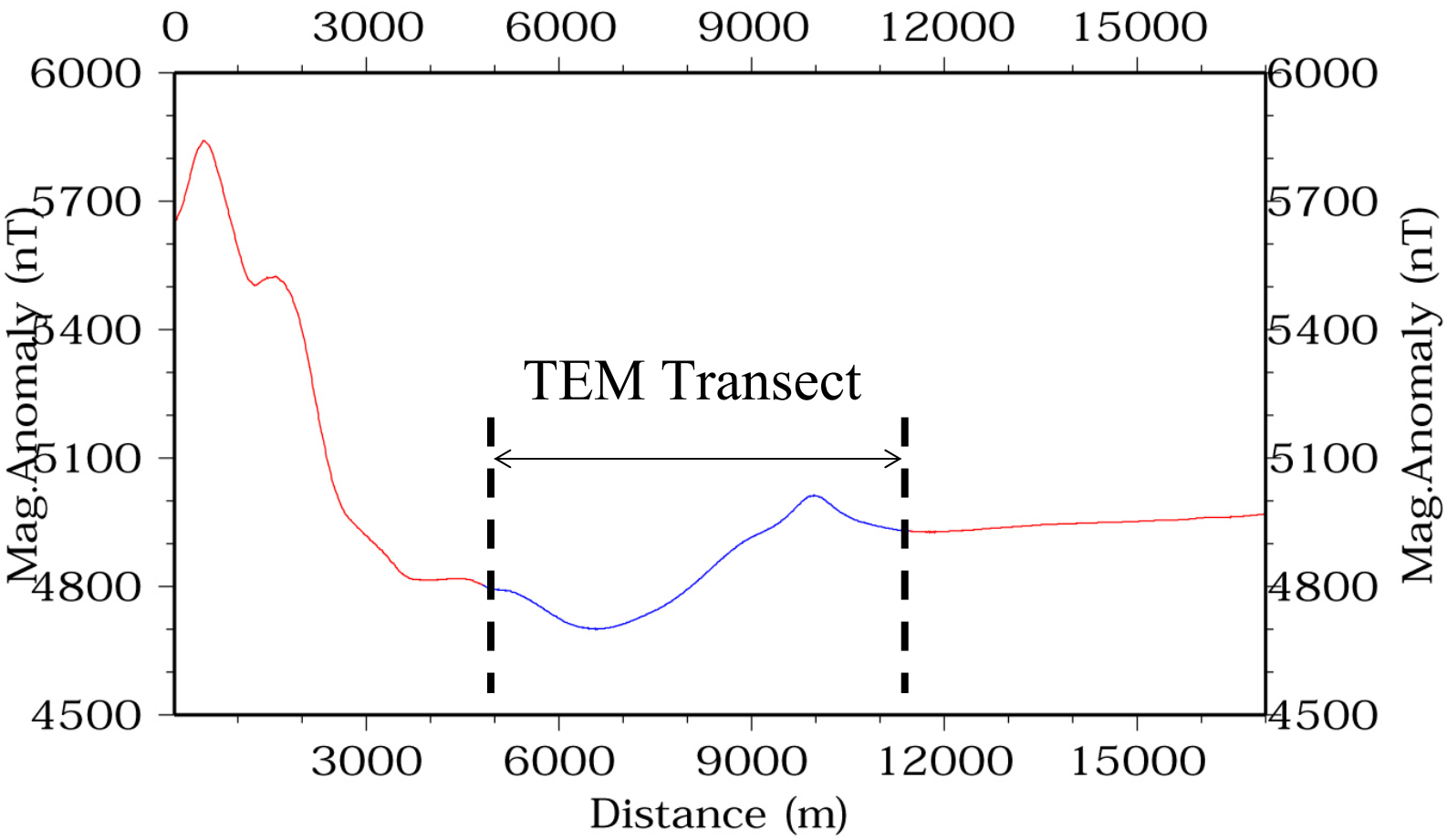
2-D depth-resistivity profile



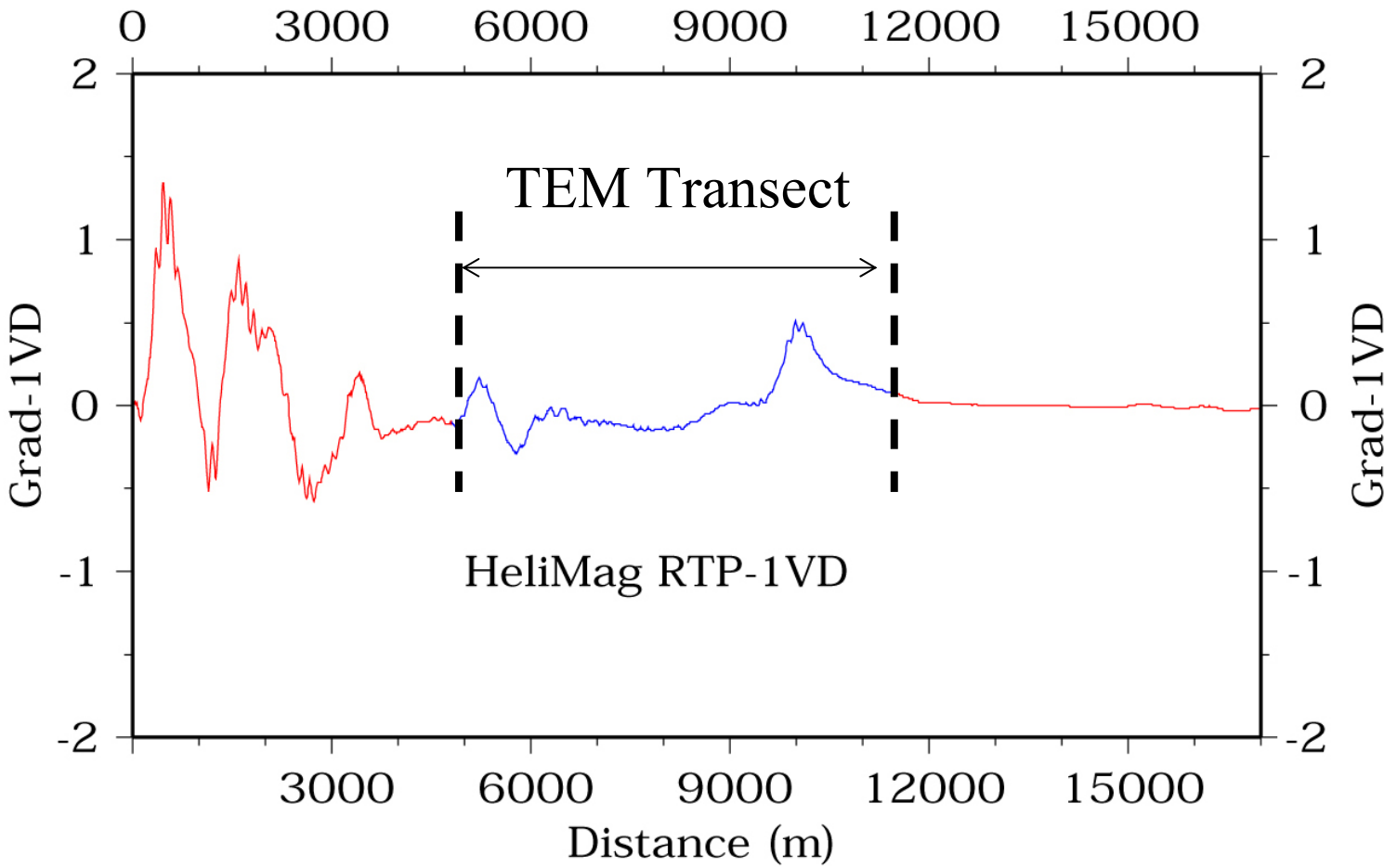
CRCLEME


Titania Aeromagnetic Anomaly Map
7.765e+06
7.76e+06
7.755e+06
7.75e+06
595000
600000
605000
610000
© Newmont Australia
4200 4500 4800 5100 5400 5700 6000 6300
nT

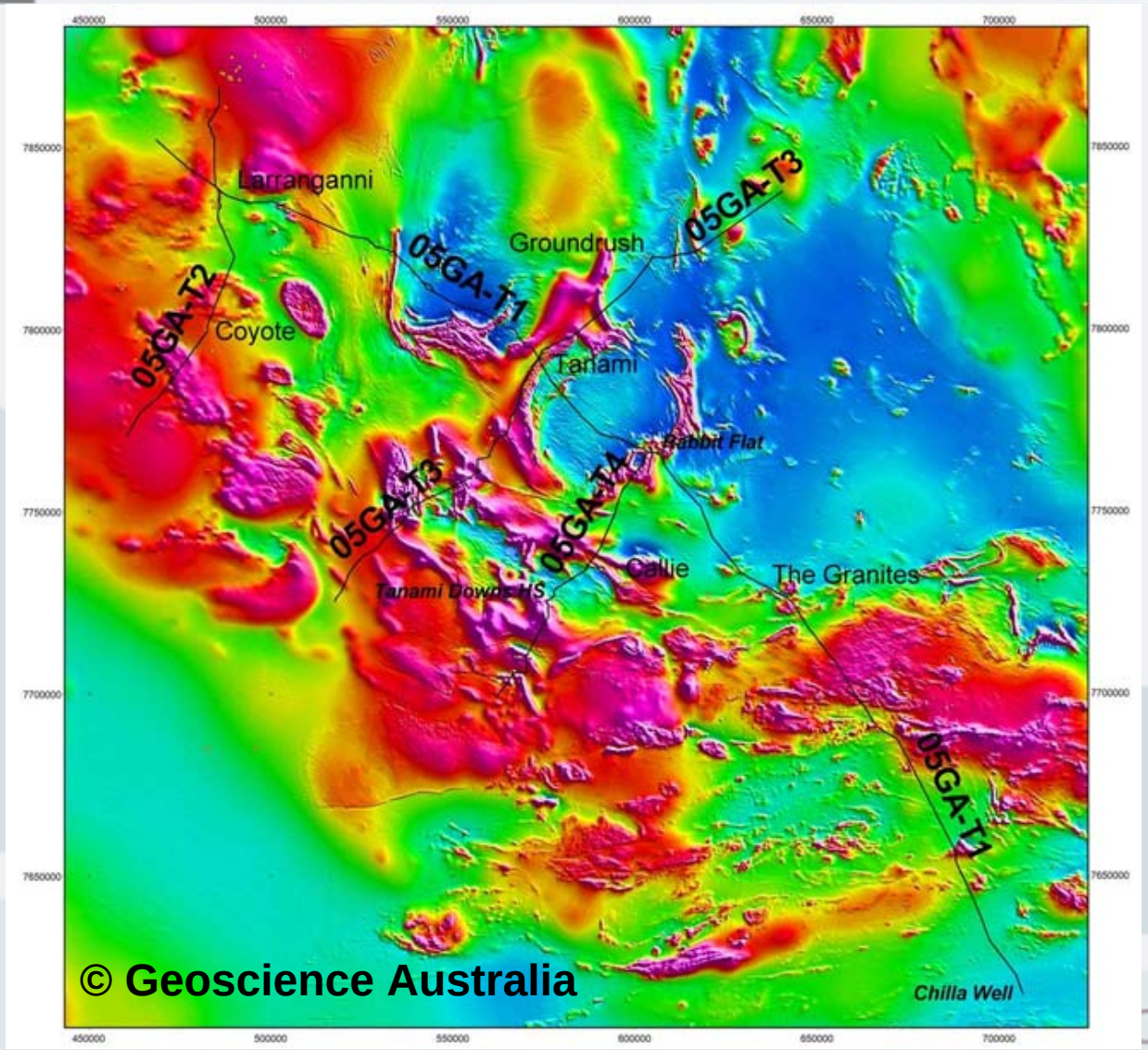
TMI along TEM Transect



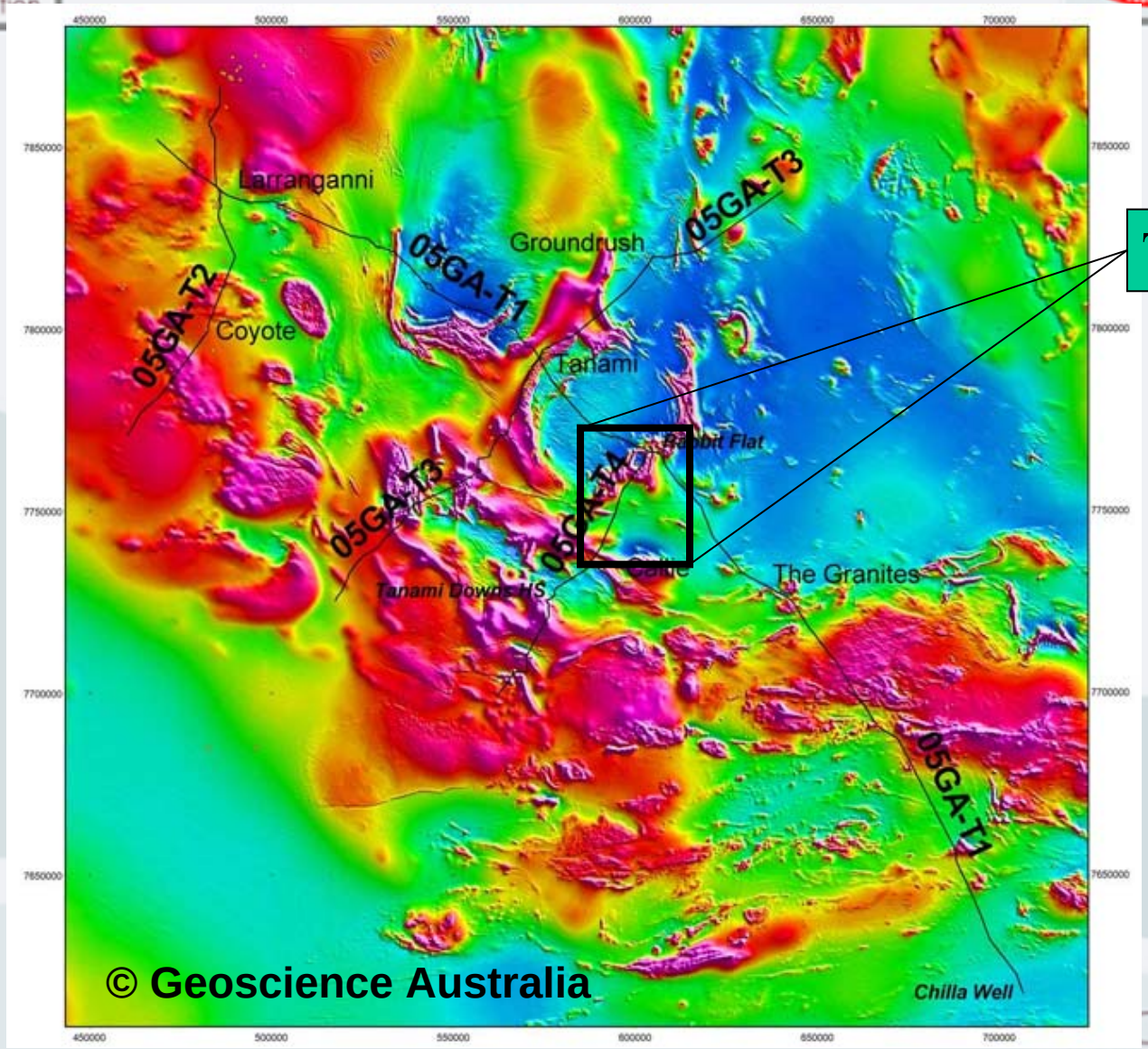
Mag 1-VD along TEM Transect



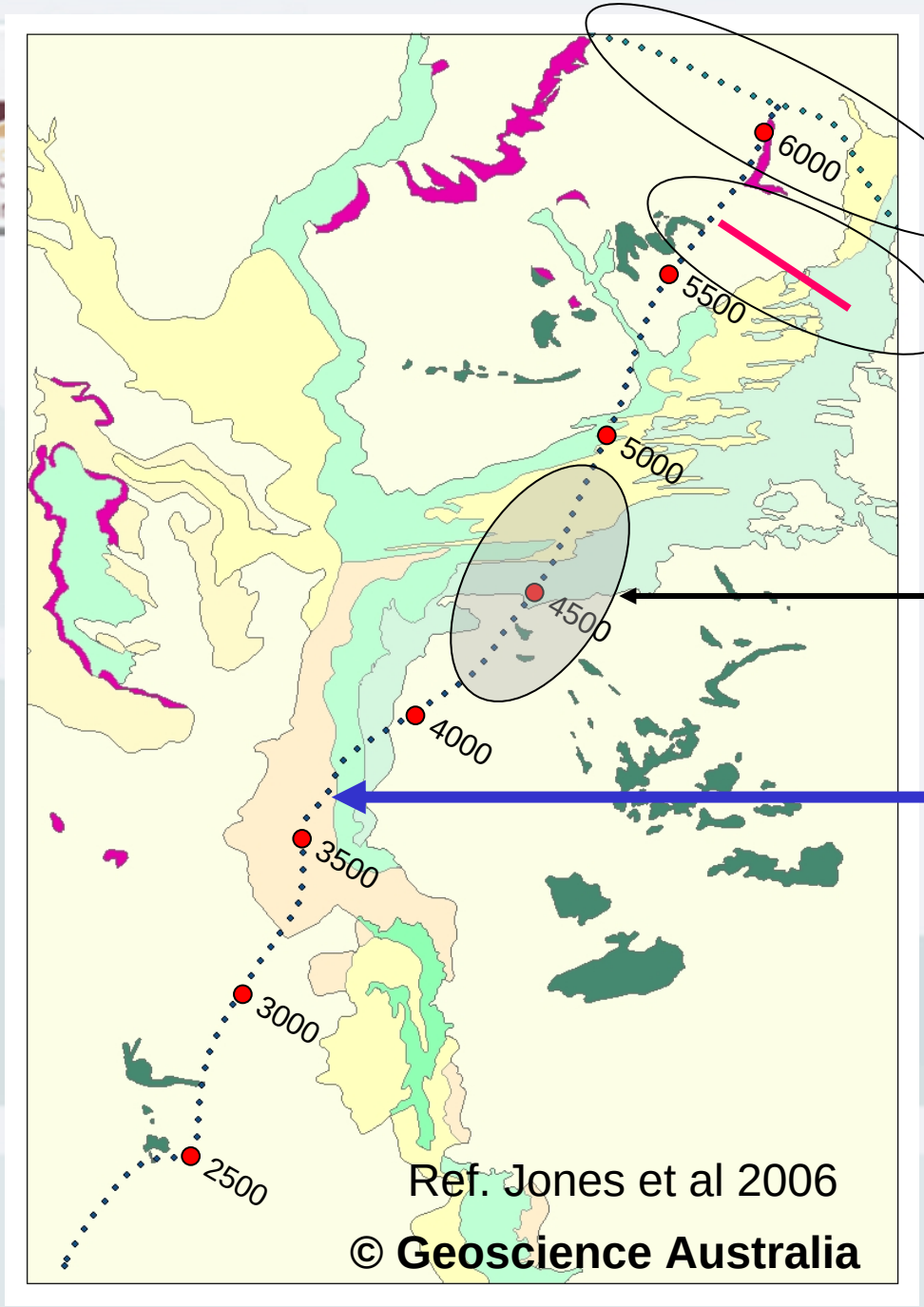
Seismic Transects



Seismic Transects



Titania



Seismic Transect T1

TEM Transect

Seismic Transect T4
Cutting palaeochannel

Seismic Transect T4

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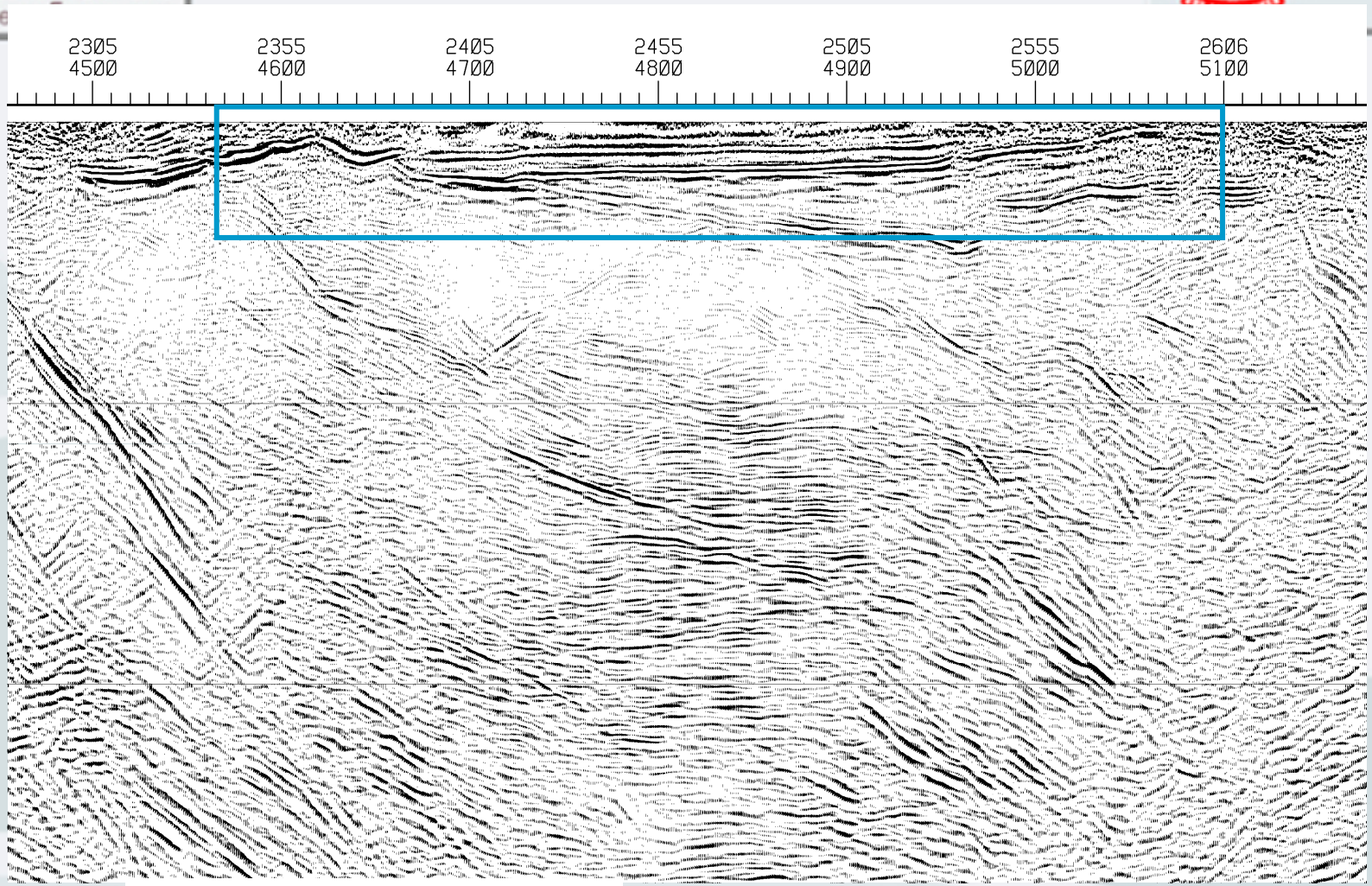
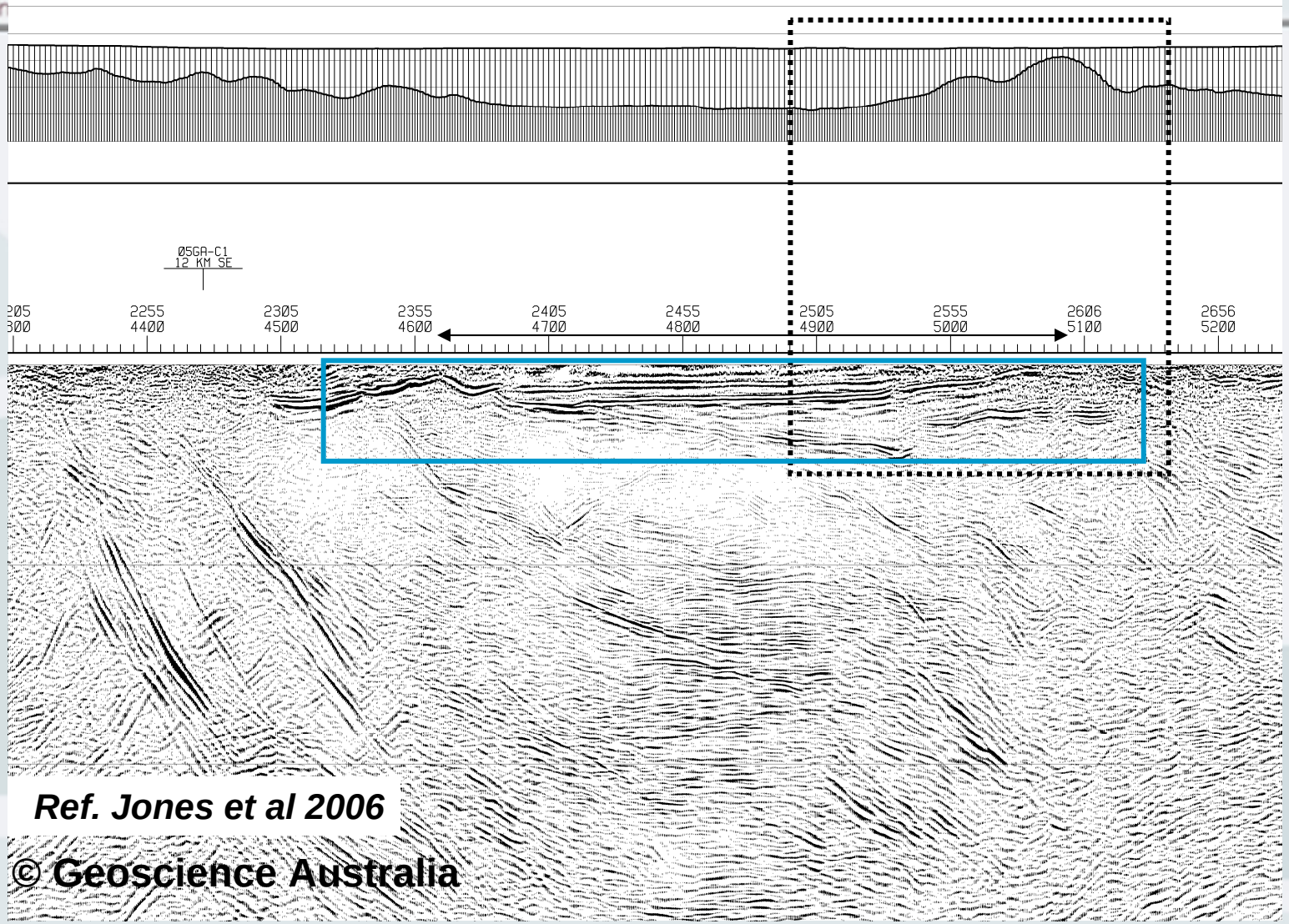
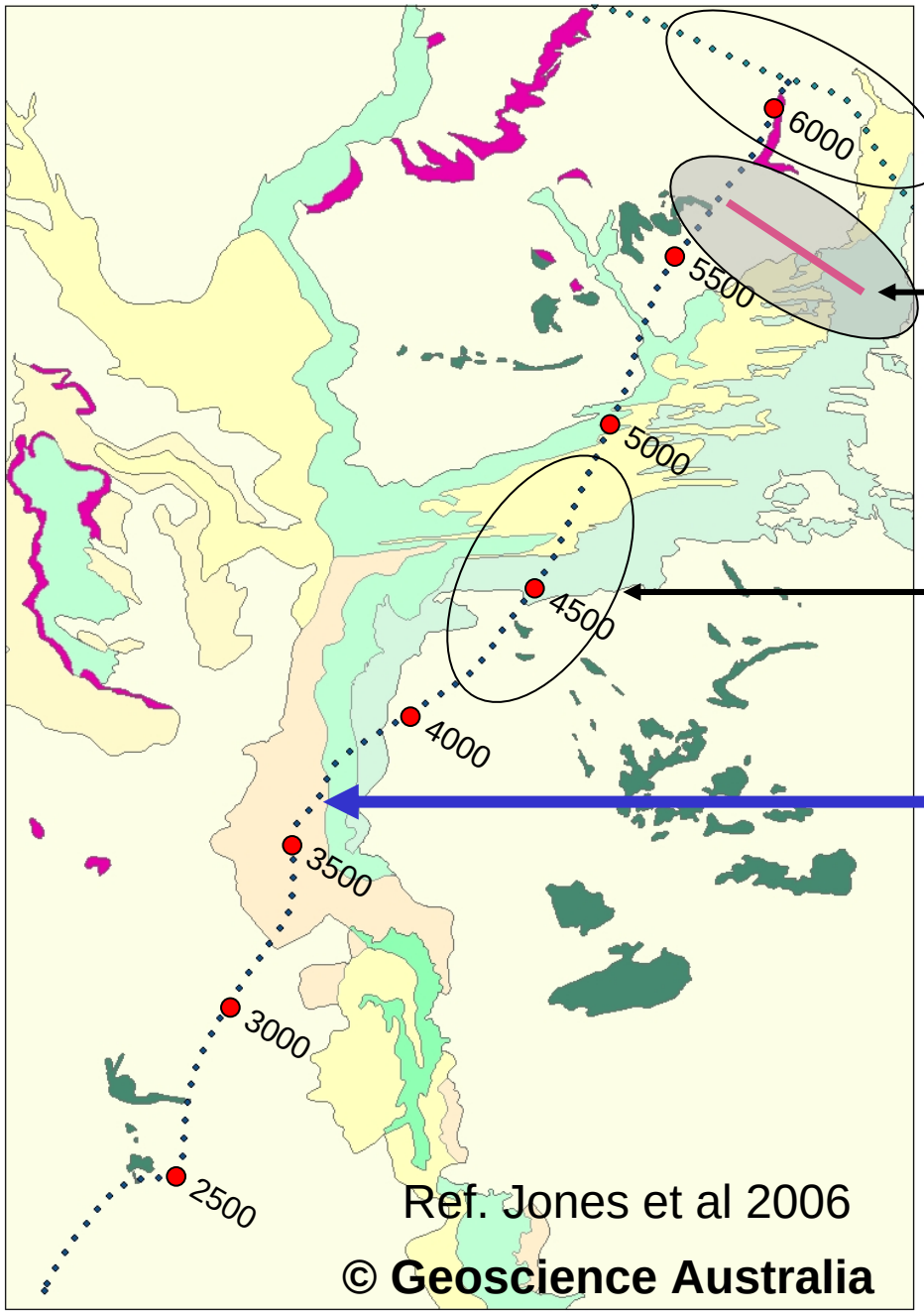
Across the Palaeochannel (T4)



Across the Palaeochannel (T4)



Ref. Jones et al 2006



Seismic Transect T1

TEM Transect

Seismic Transect T4
Cutting palaeochannel

Seismic Transect T4

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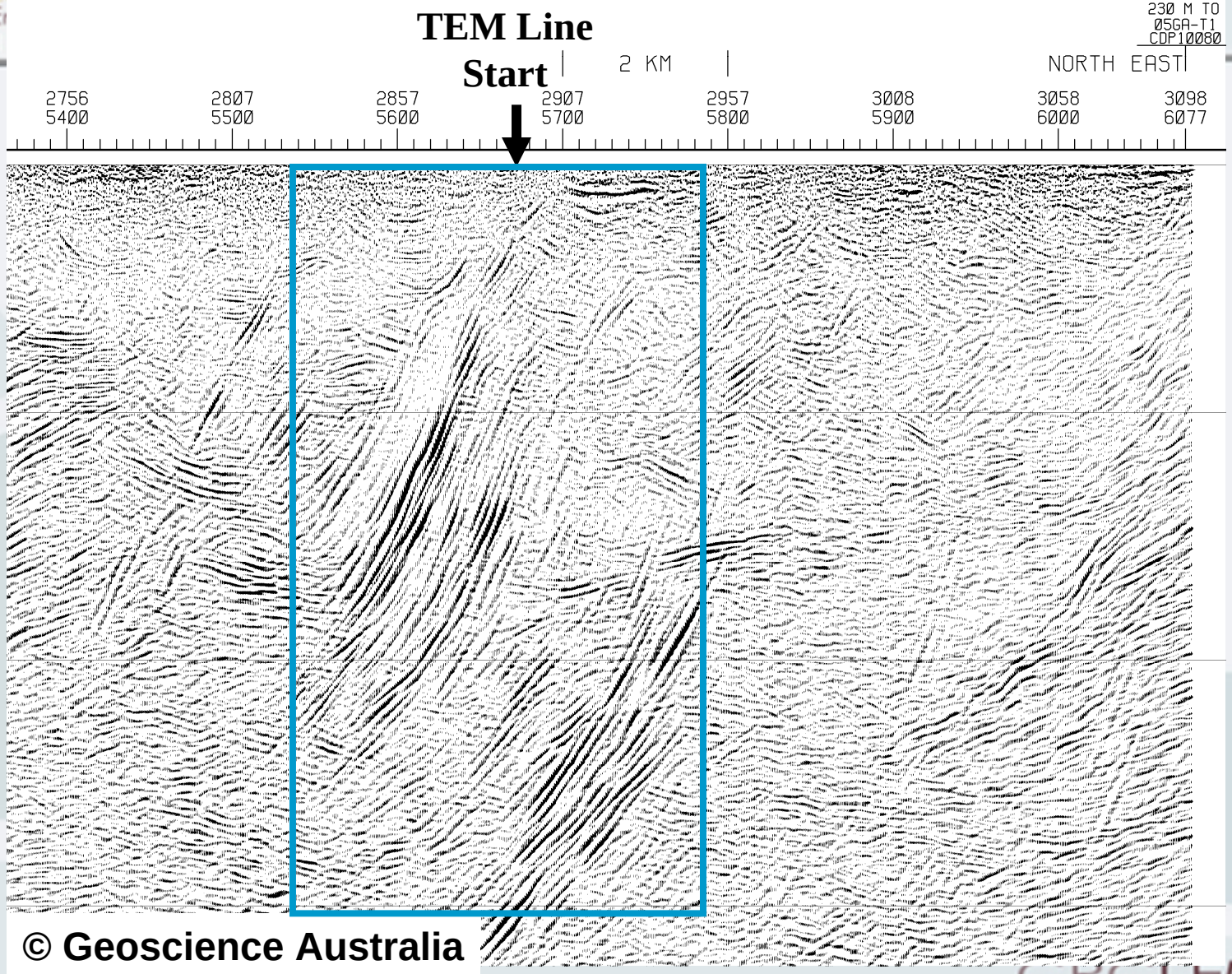
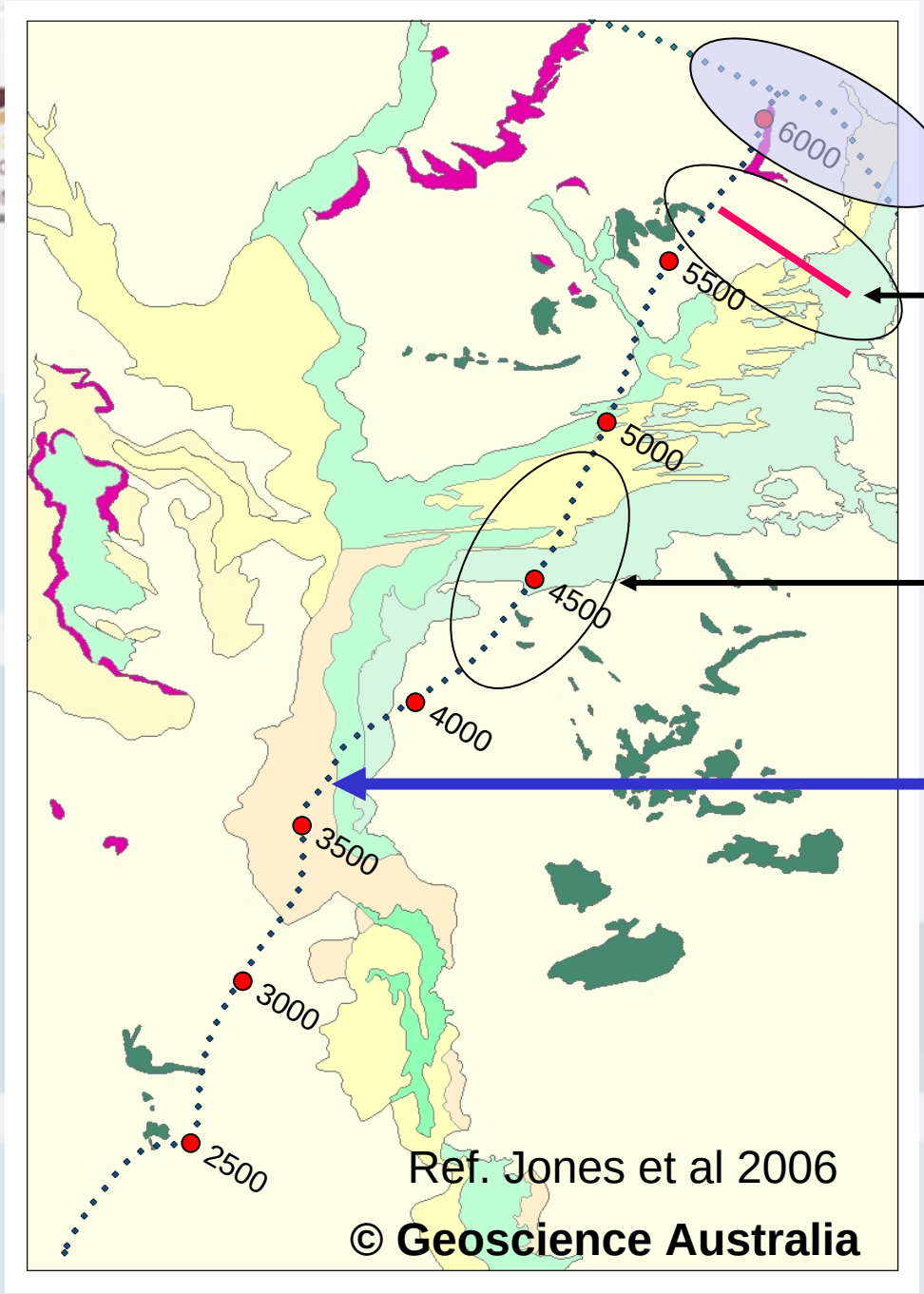
Seismic Reflection Data (Transect T4)





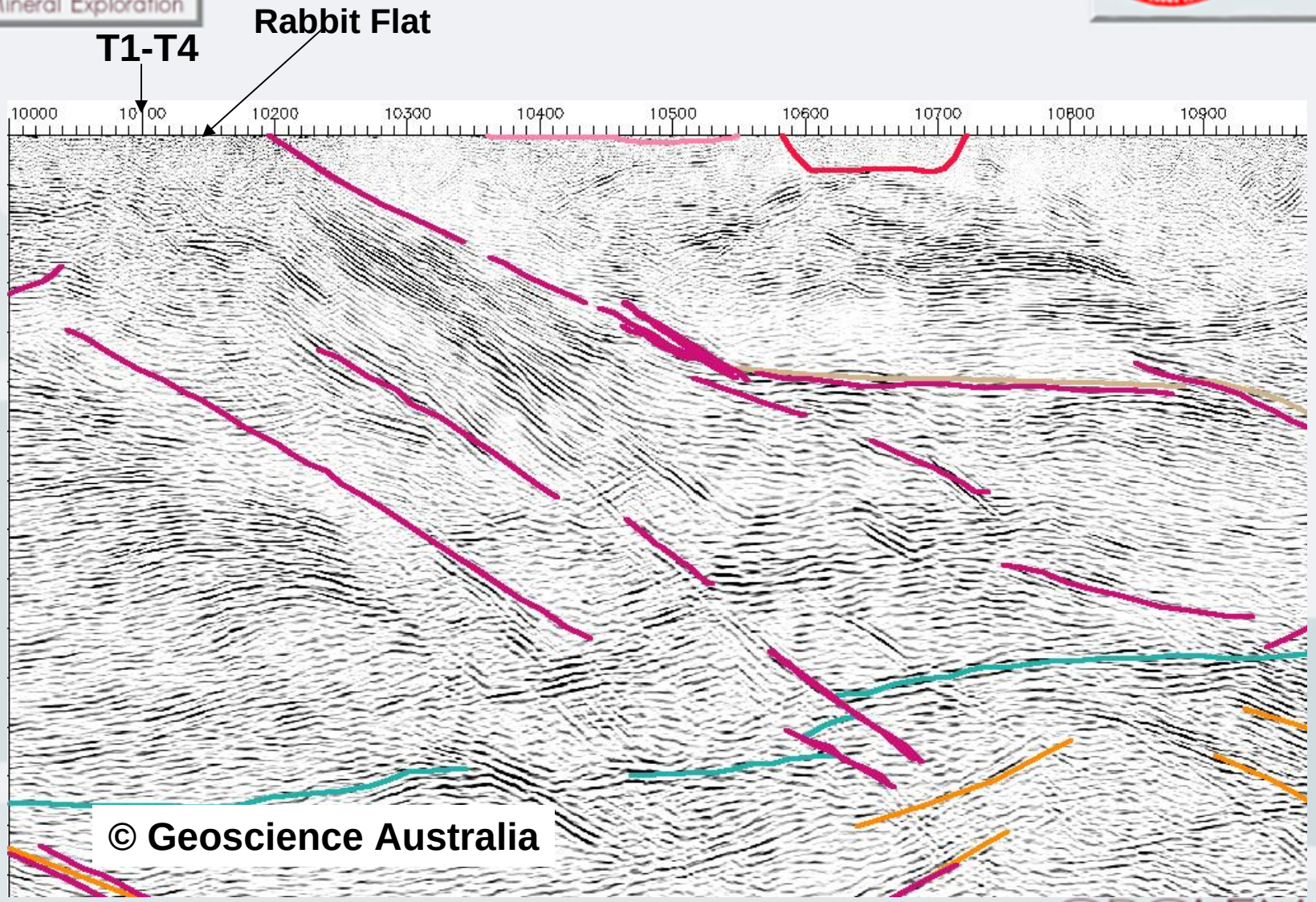
Seismic Transect T1

TEM Transect

Seismic Transect T4
Cutting palaeochannel

Seismic Transect T4

Seismic Transect T1



Summary

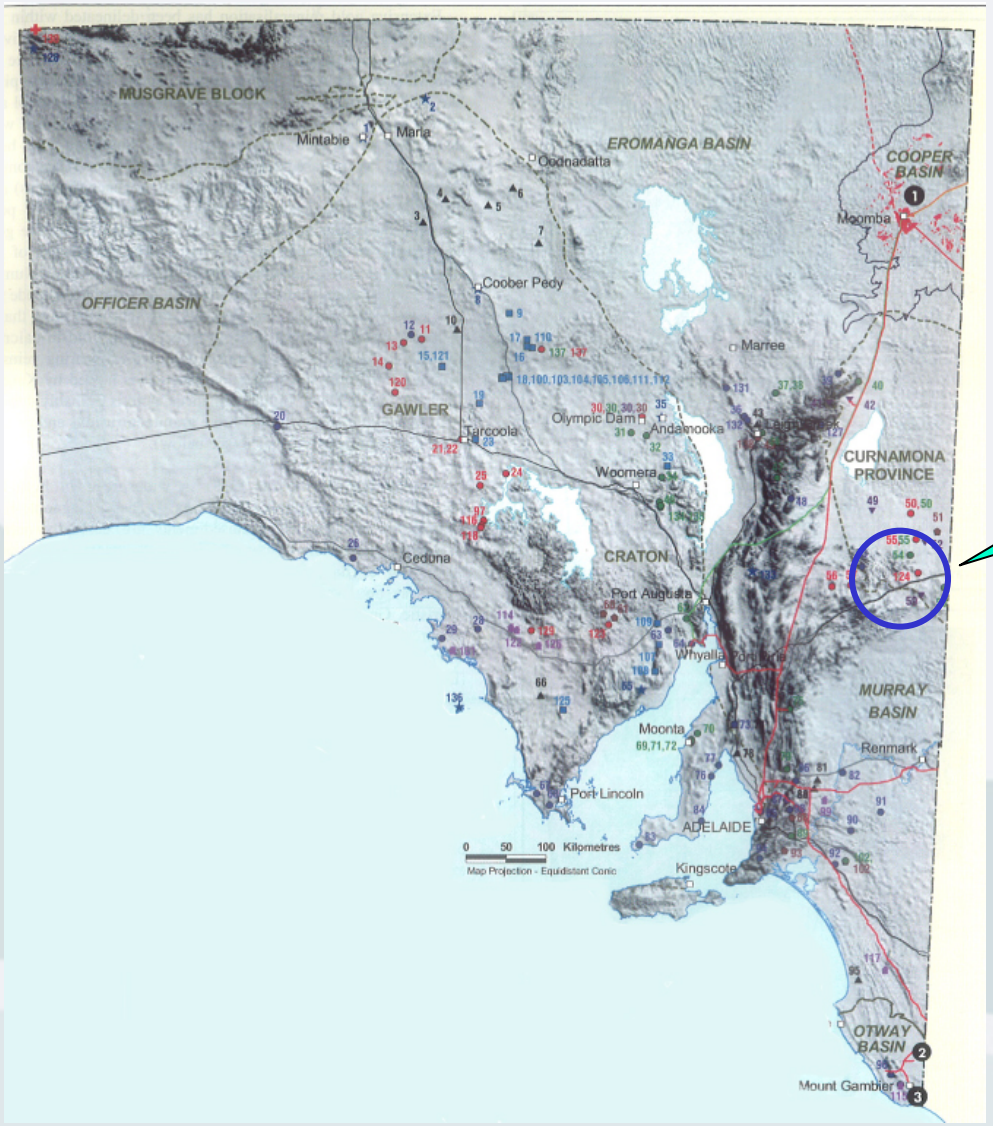
- Ground TEM survey is effective in delineating palaeochannel
  - Three sub-basins within the palaeochannel with varying conductivities are identified.
    - **Possible presence of fresh water !**
- Ground EM, downhole and Airborne responses are comparable
- Hydrogeochemical studies and vegetation observations support the results obtained from geophysical techniques.
- Identified the presence of a structural discontinuity close to the beginning of TEM transect.
  - **Highly conductive body - *Possible presence of graphitic shale***
  - Seismic & aeromagnetic results support the findings

EM Case Study from Kalkaroo Prospect, South Australia

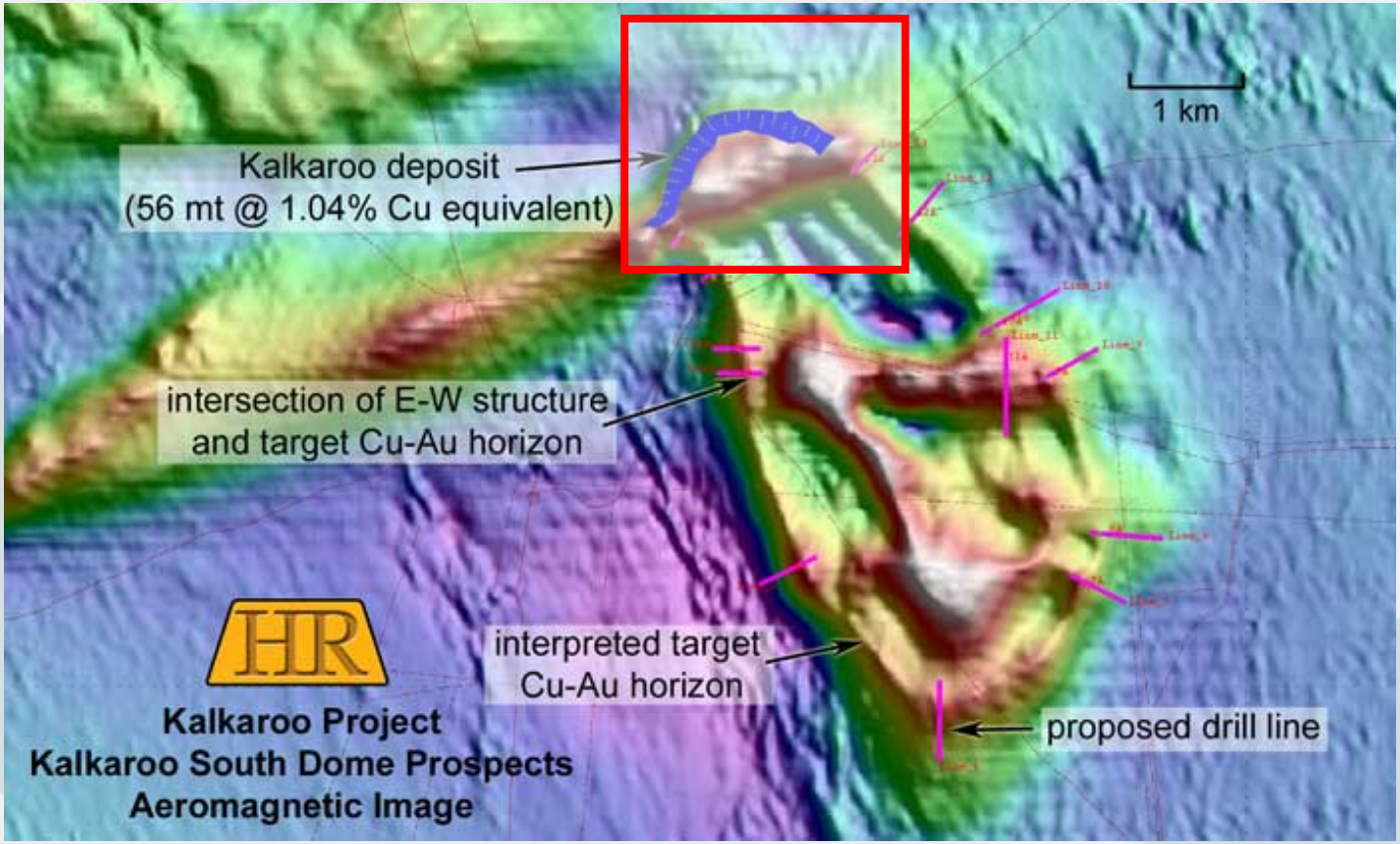
Curnamona MinEx Project – CRC LEME Funds

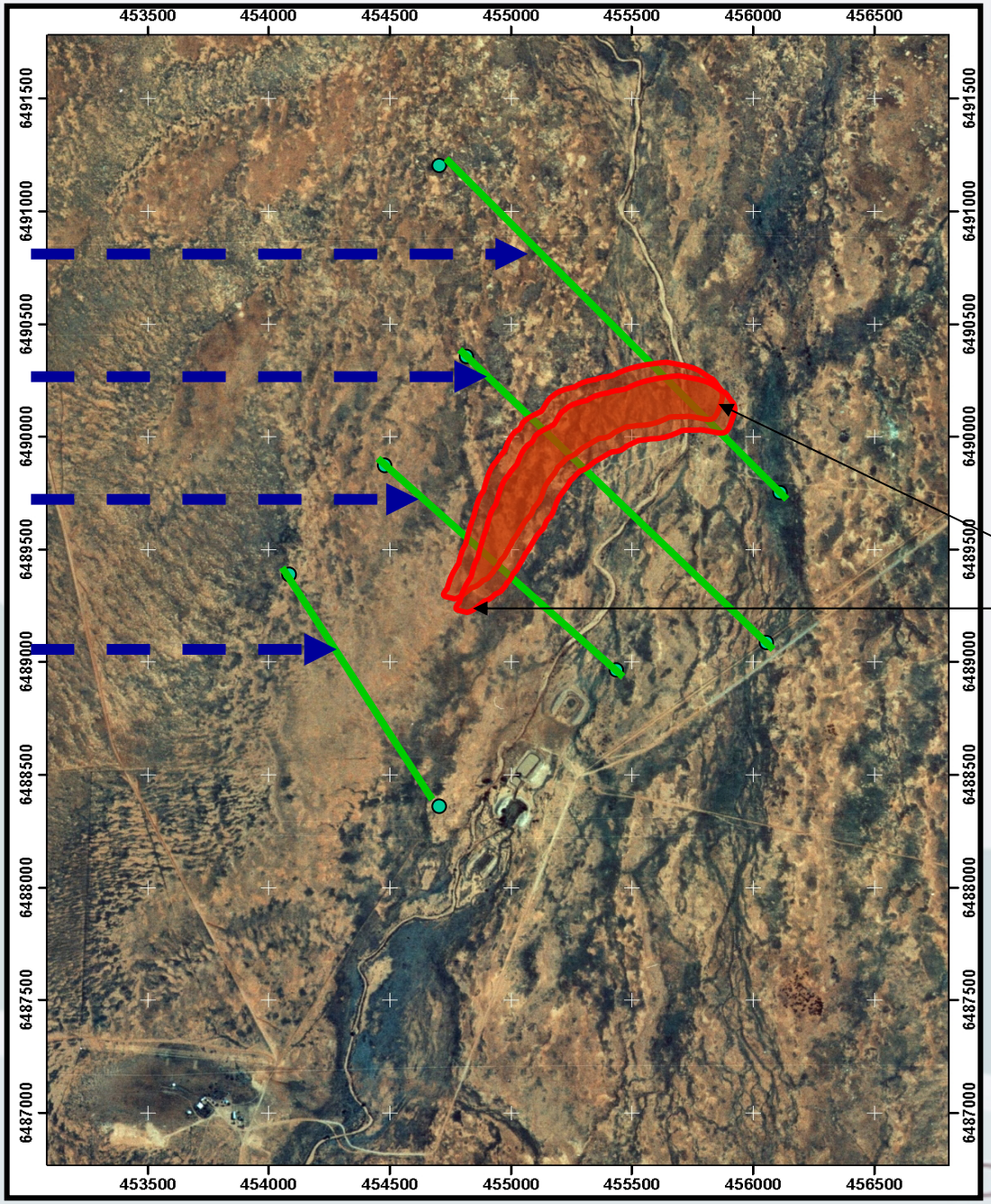
- **Objectives:**
  1. Understanding regolith processes
  2. Making geochemistry more effective
  3. **Geophysical mapping and modelling**
- Enhance the ability of Exploration in areas of Regolith Cover

TEM Survey Area



Kalkaroo Mineral Prospect





Line 1

Line 2

Line 3

Line 4

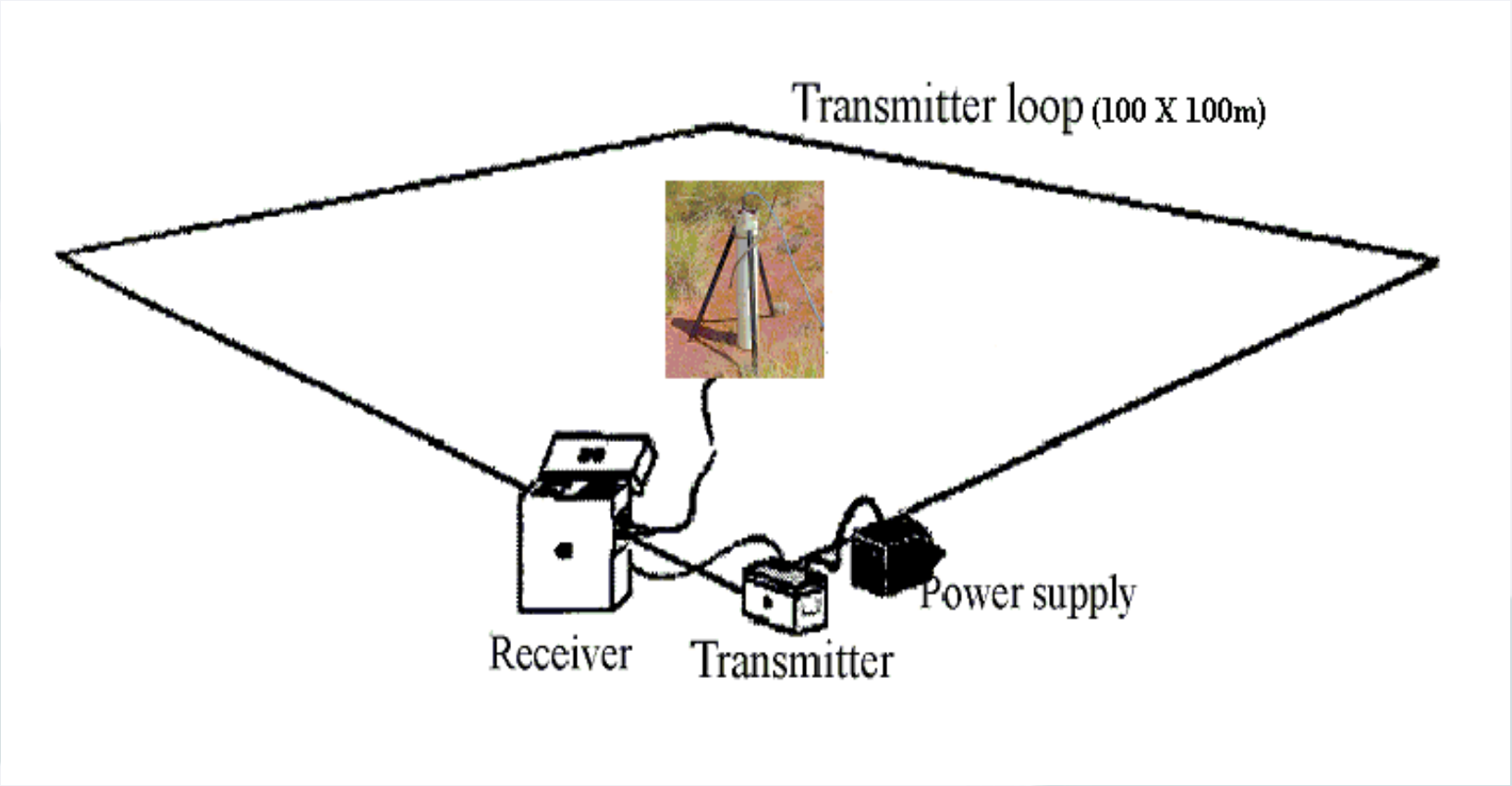
Drilling Area

CRCLEME

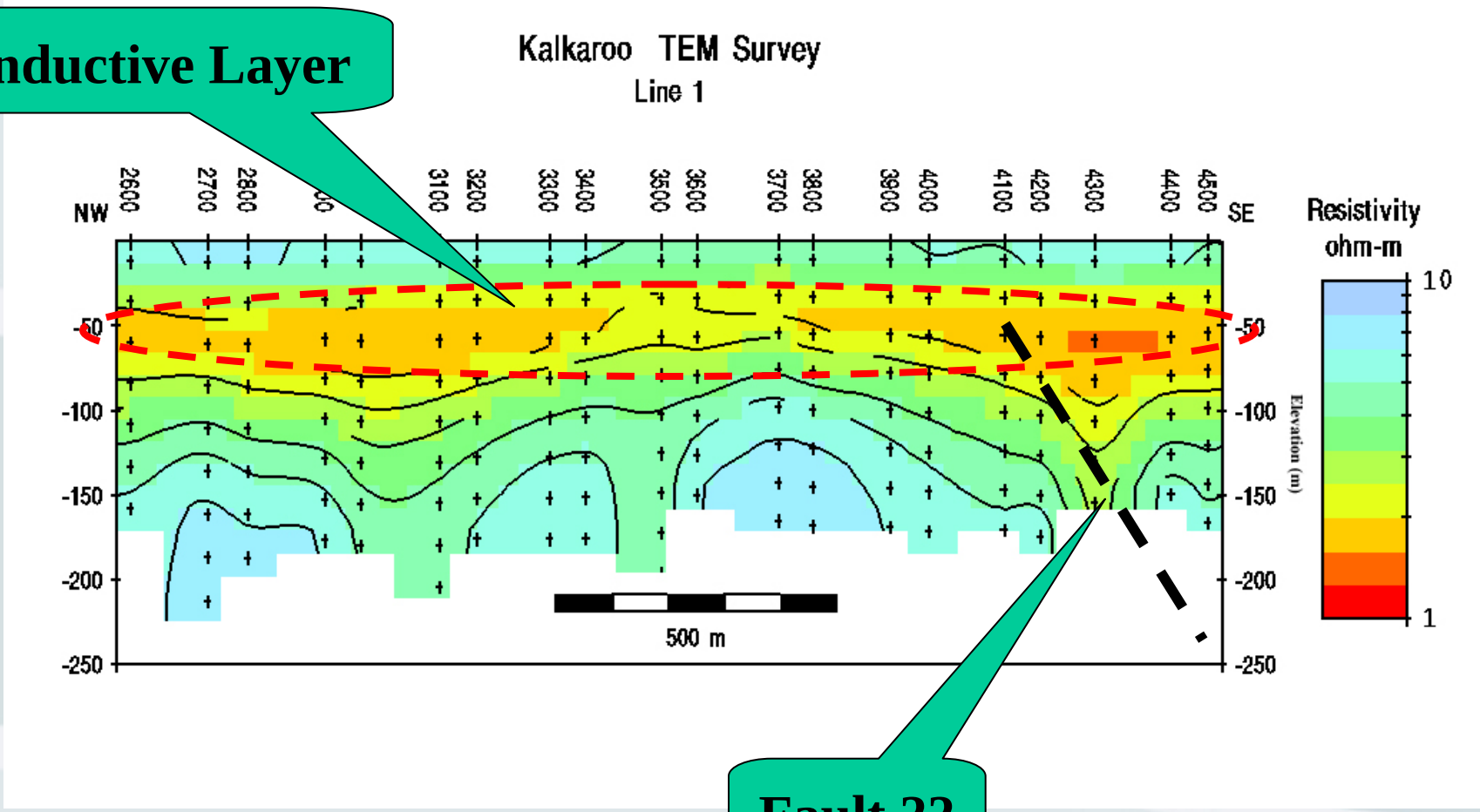
Cooperative Research Centre for Landscape Environments and Mineral Exploration

ADELAIDE UNIVERSITY AUSTRALIA

Ground TEM System



2-D Depth-Resistivity

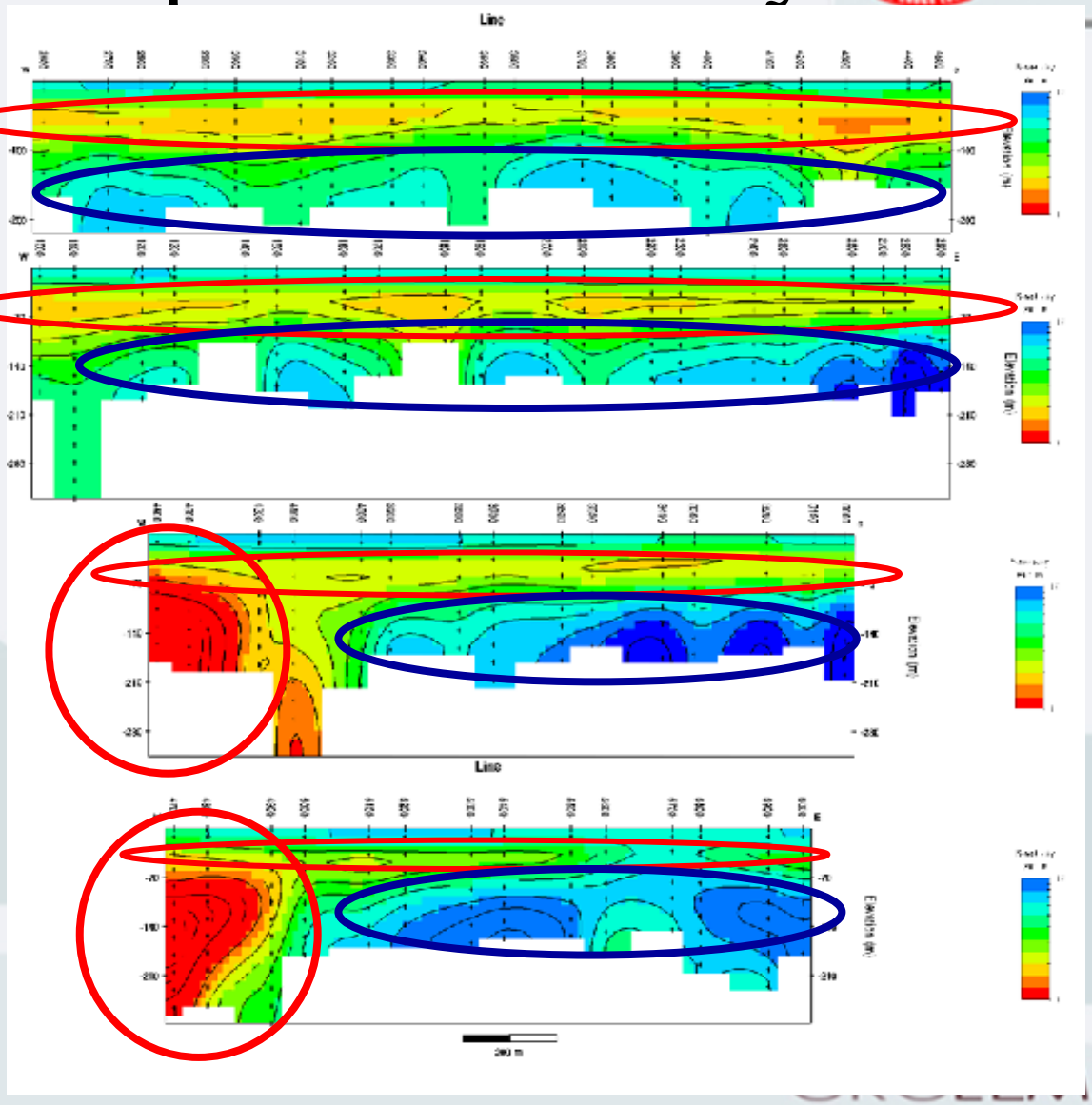


2-D Depth-Resistivity

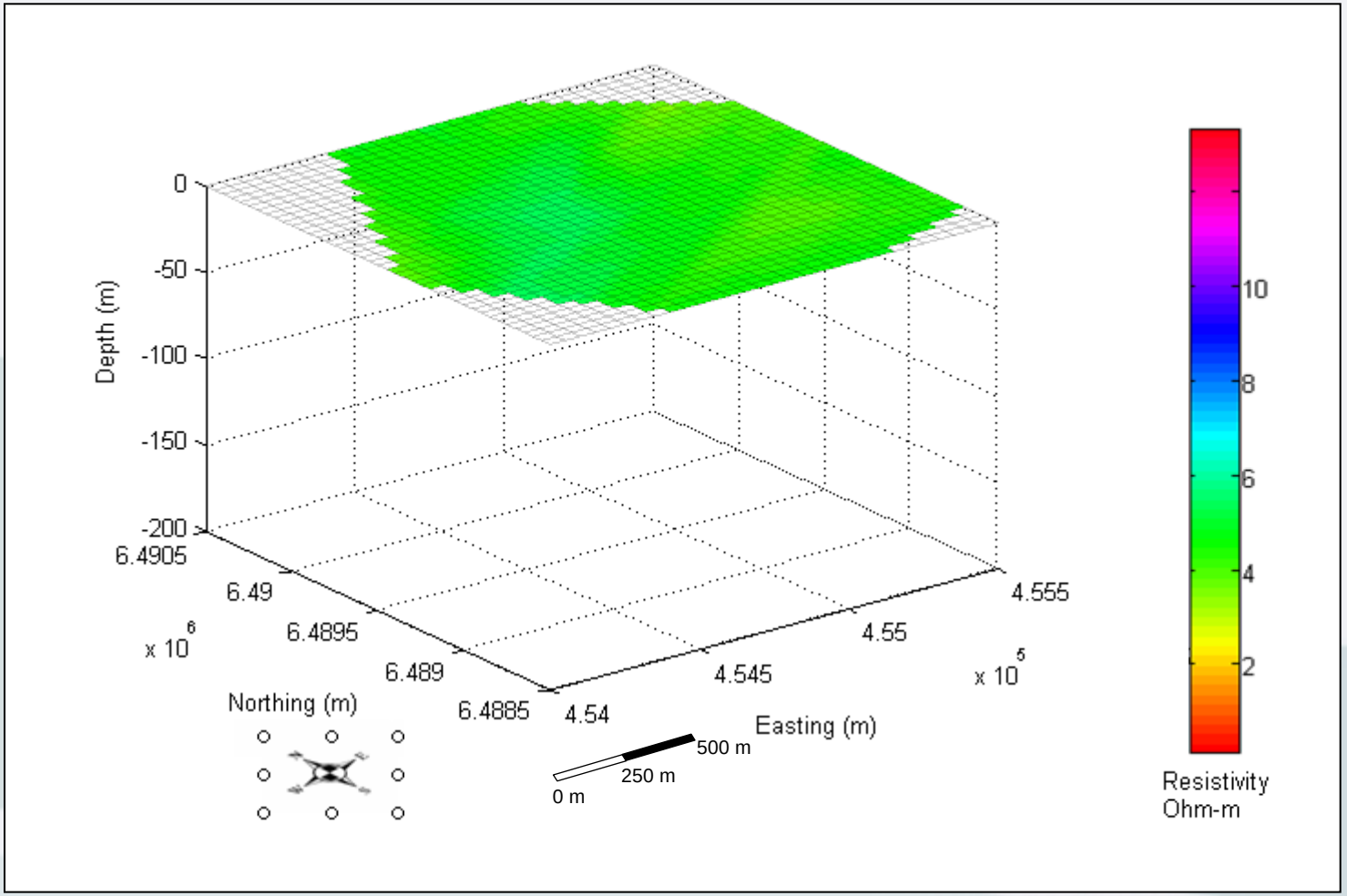
Conductive Layer

Conductive Body

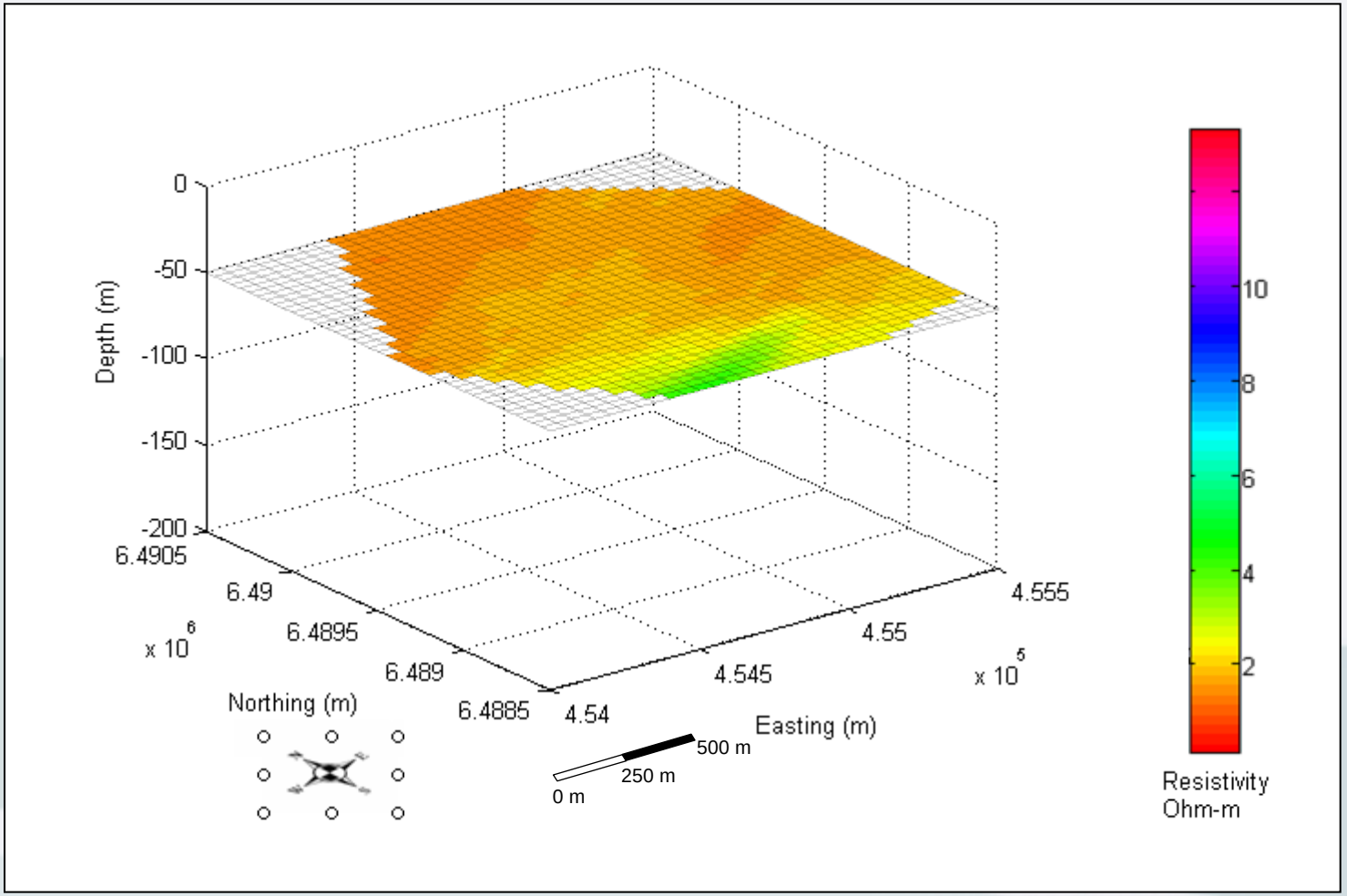
Resistive Basement



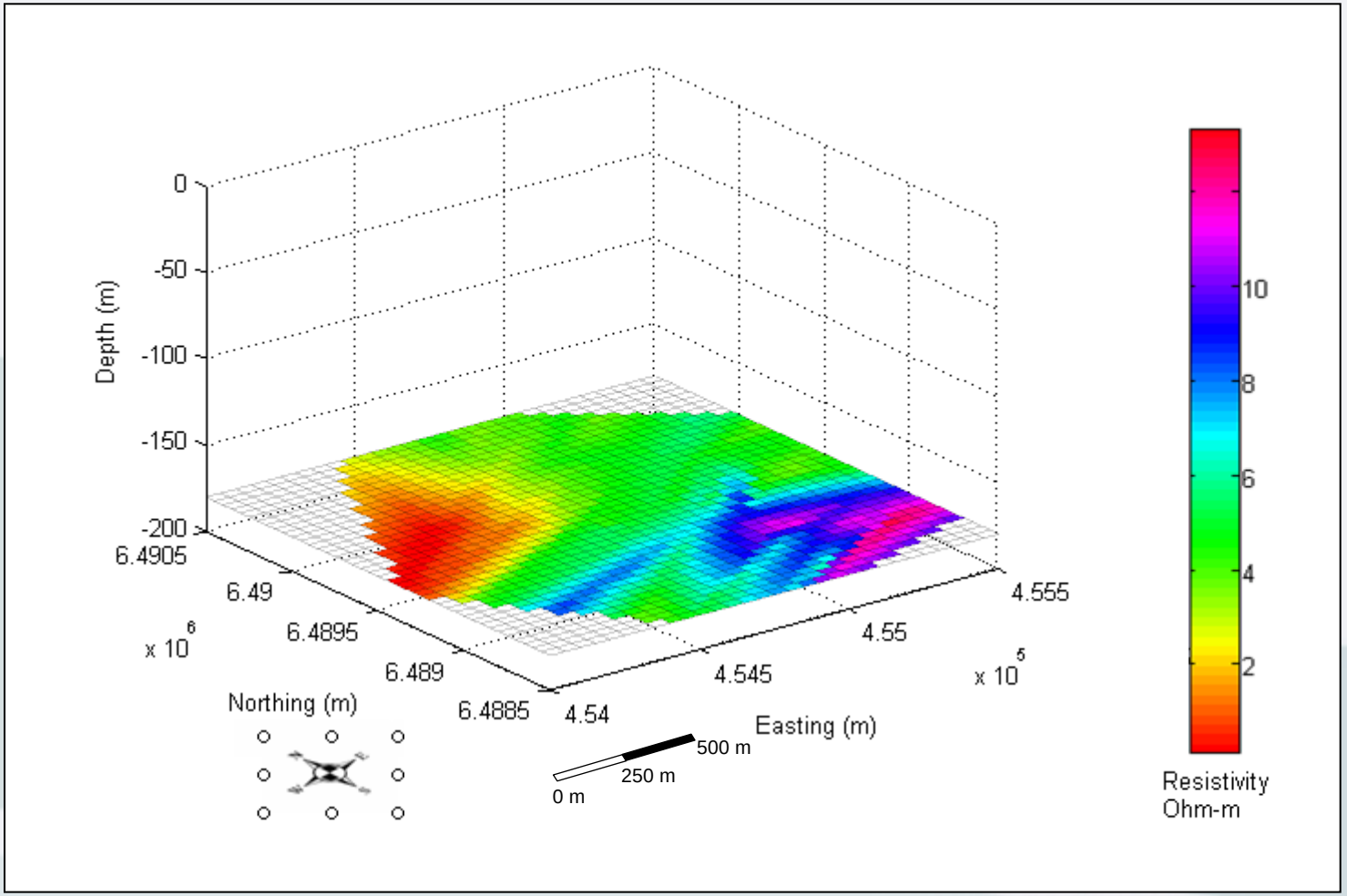
Depth Slice – 0 m



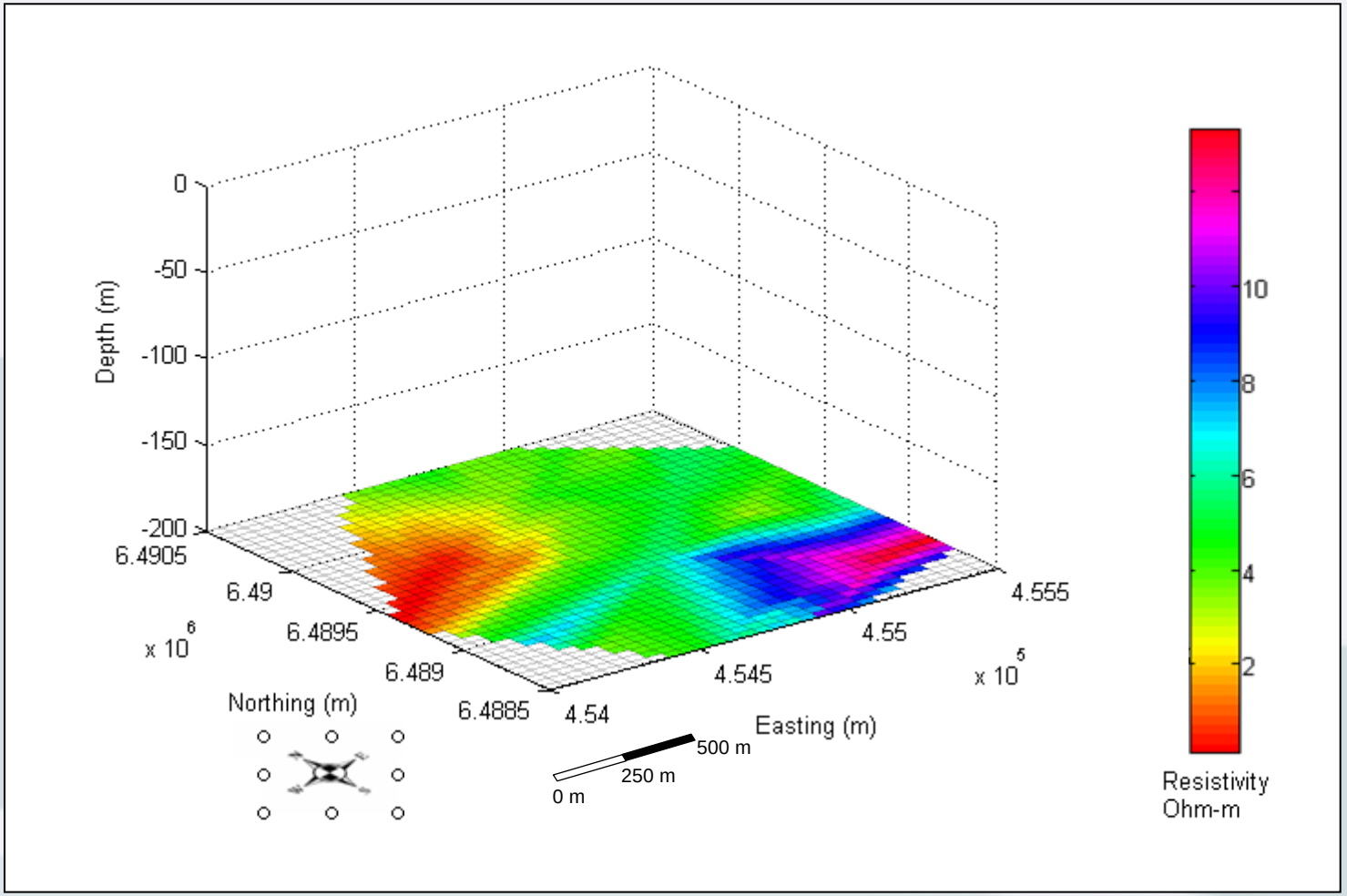
Depth Slice – 50 m



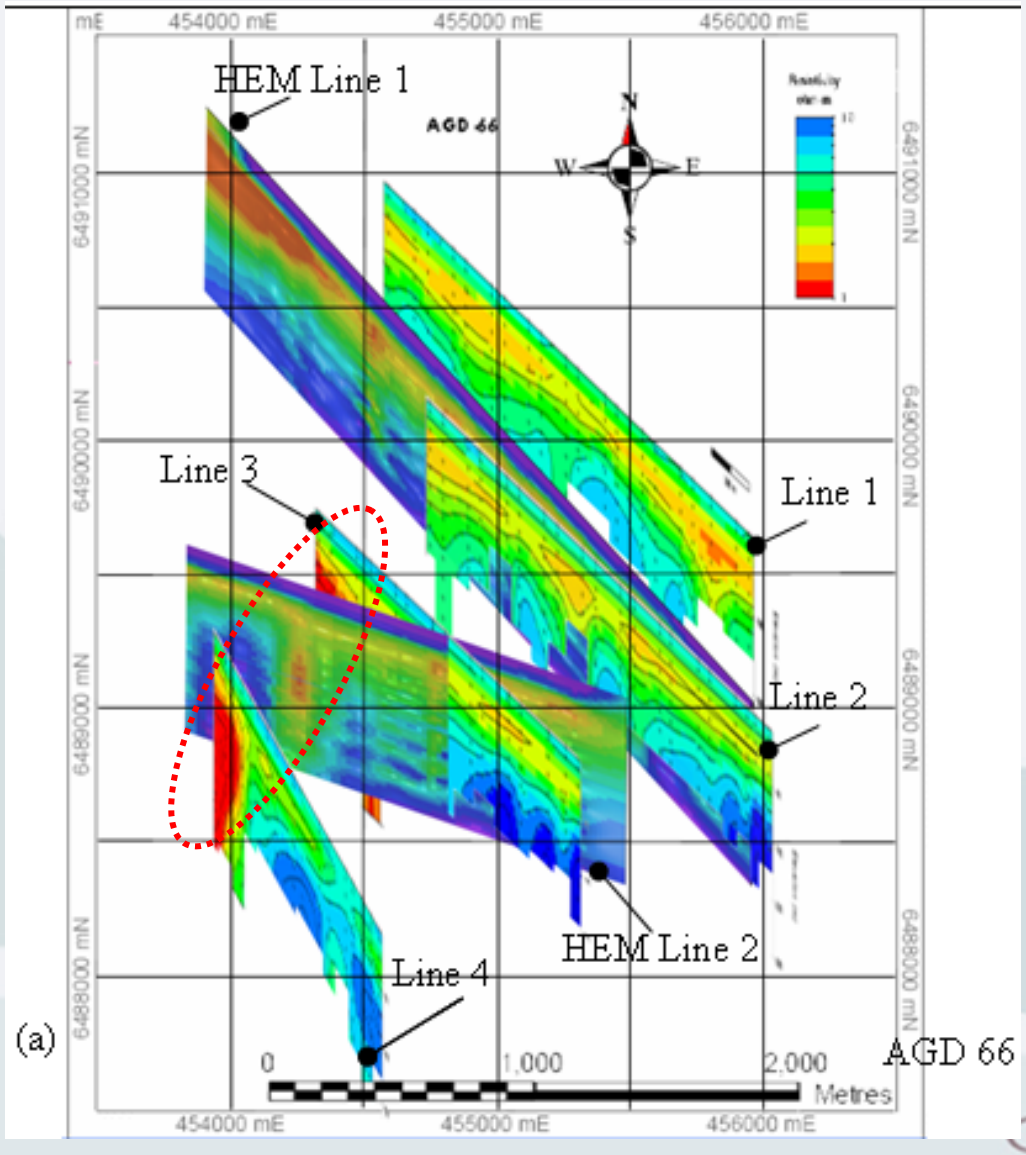
Depth Slice – 180 m



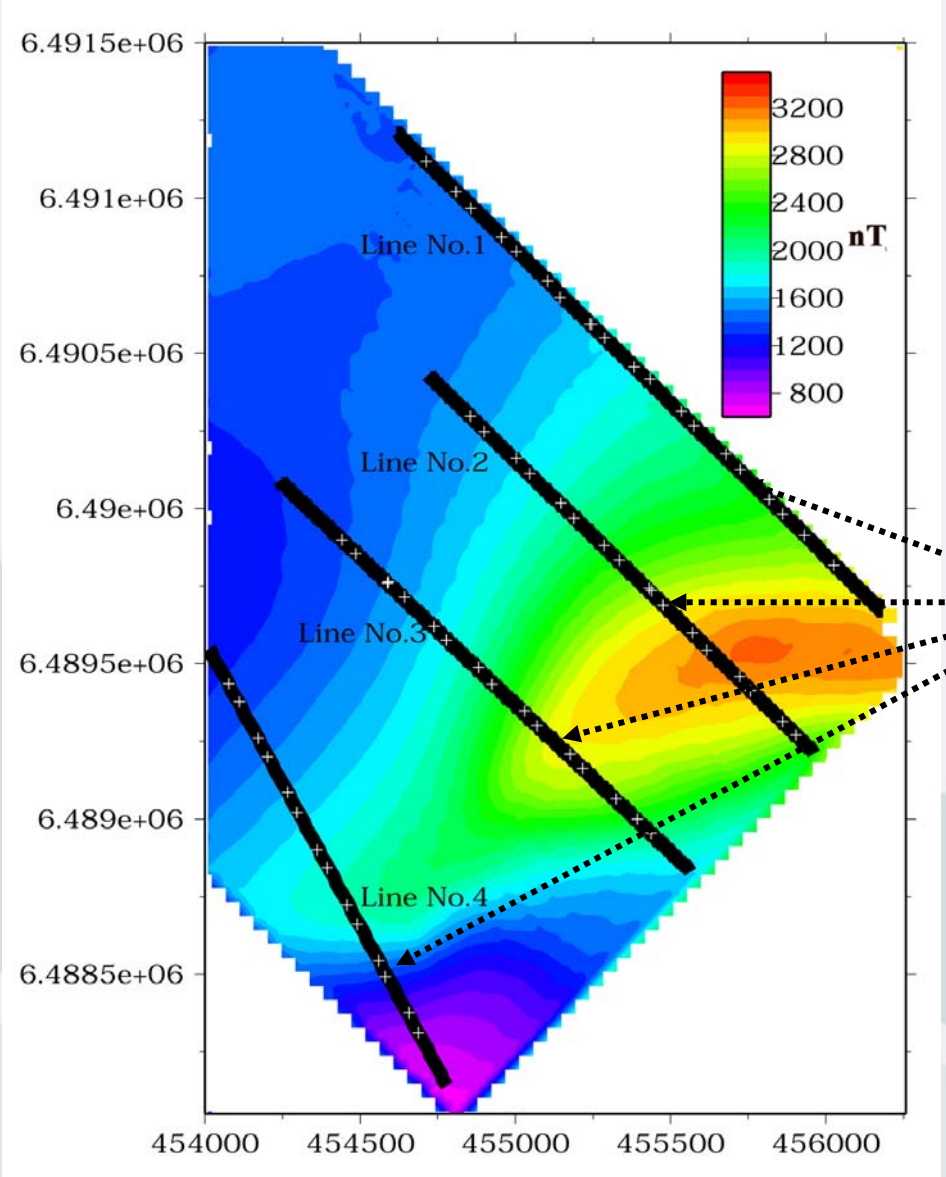
Depth Slice – 200 m



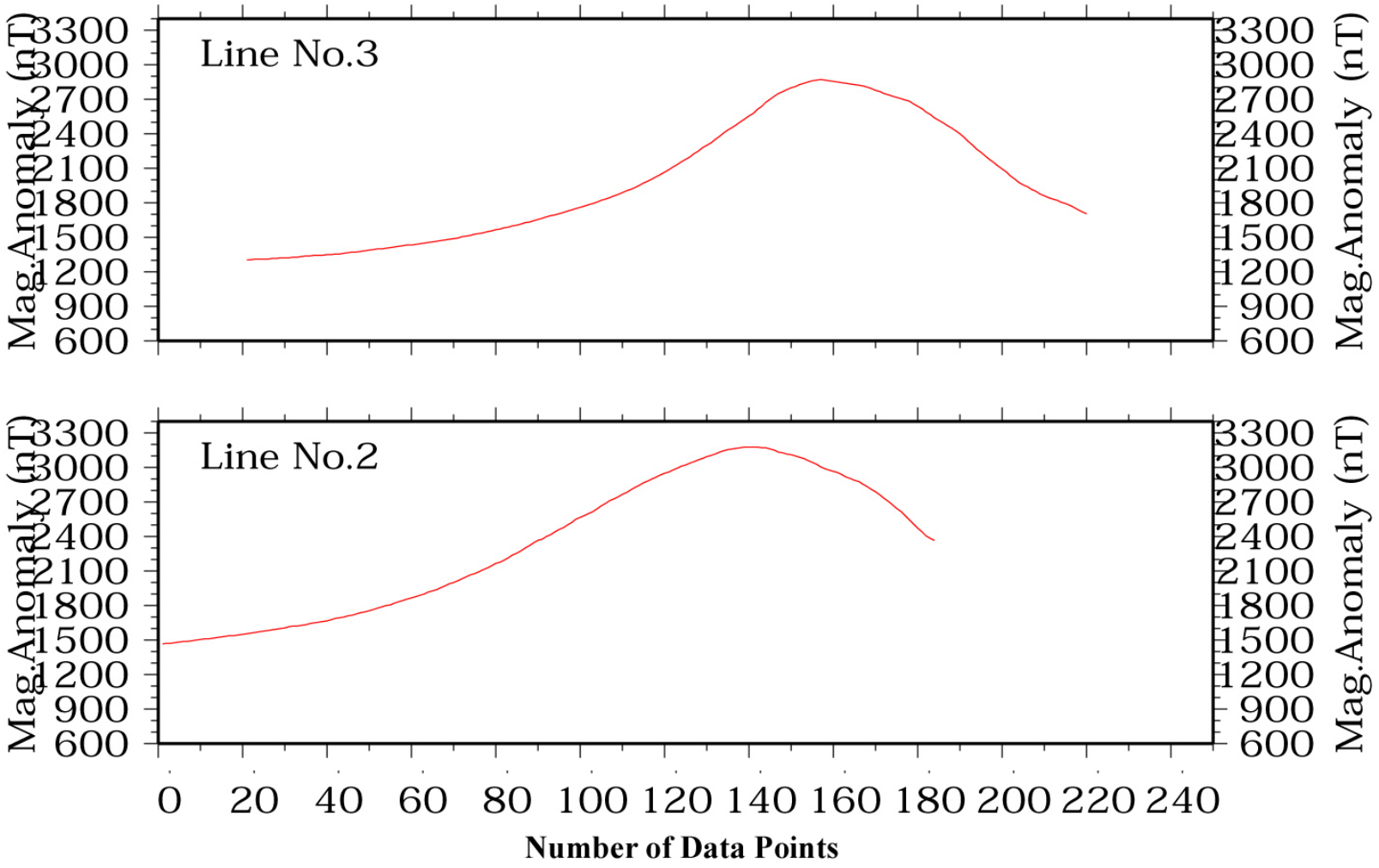
Comparison with Heli-EM



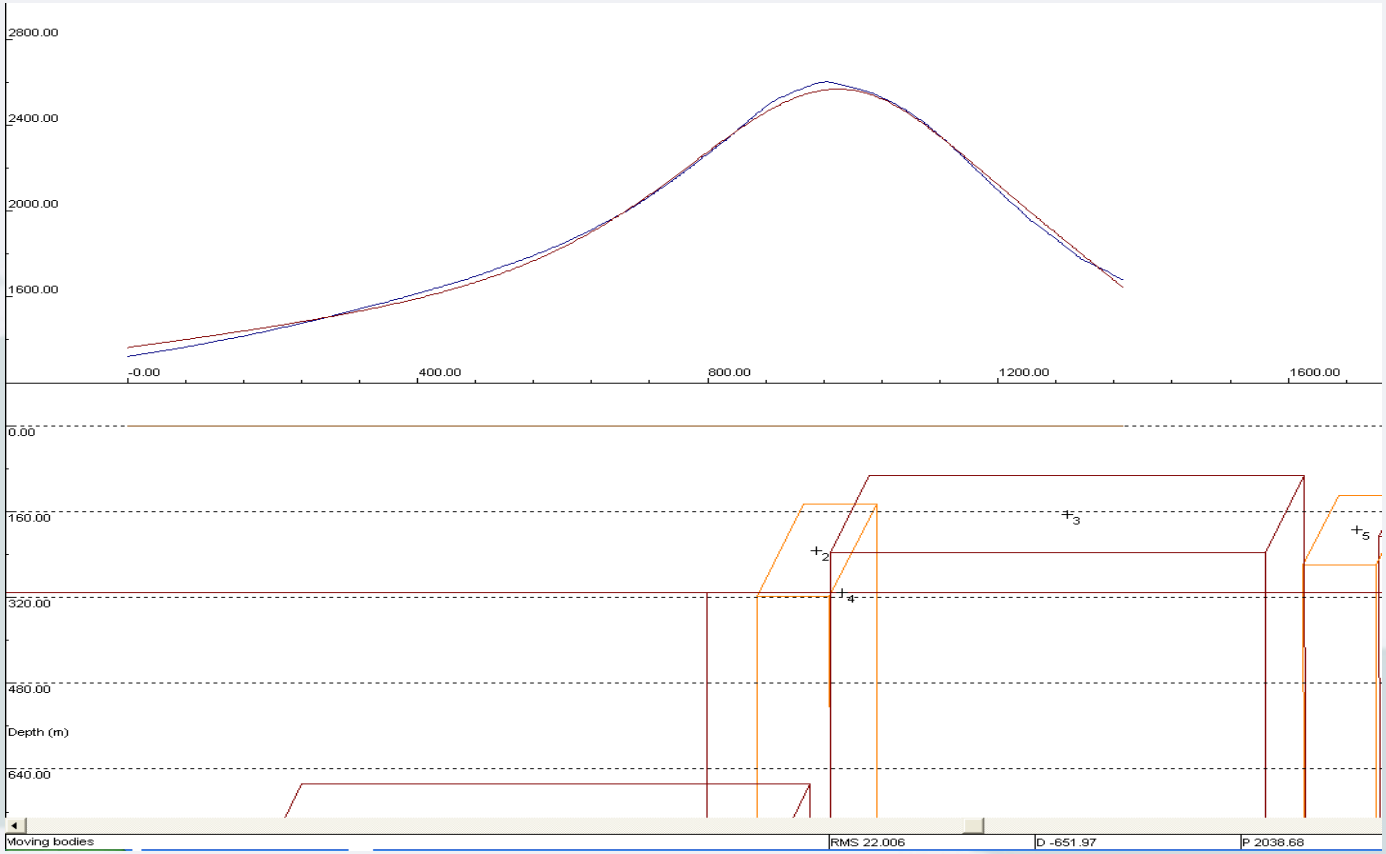
Aeromagnetic- TMI



TEM Lines


Line No.3
Line No.2
Mag.Anomaly (nT)
3300
3000
2700
2400
2100
1800
1500
1200
900
600
0
20
40
60
80
100
120
140
160
180
200
220
240
Number of Data Points

Magnetic data model responses



- Magnetic susceptibility (brown) = 0.15 SI units
- Magnetic susceptibility (orange) = 0.3 SI units

Summary

- Thick conductive layer-(30-80m depth) it is coincides with the Namba Formation
- Large conductive body (NW end of lines 3 &4) - graphitic pelite (Plumbago Formation).
- Indication of resistive basement
- Fault or a structural discontinuity.
- The modelling of aeromagnetic data indicates the presence of the magnetic basement at a depth of about 150 m.
- Ground EM results agree well with Heli-EM responses

Acknowledgements

THANKS TO:

- **CRC LEME**
- **Geoscience Australia, NTGS & GSWA**
- **Newmont Australia**
- **Tanami Team Members (from Adel Uni, ANU, GA)**
- **PIRSA**
- **Hevilah Resources**
- **Mike Hatch, David Baker & German exchange Students**
- **Zonge Engineering & Research Organisation**