Carrapateena: Discovery and Early Exploration

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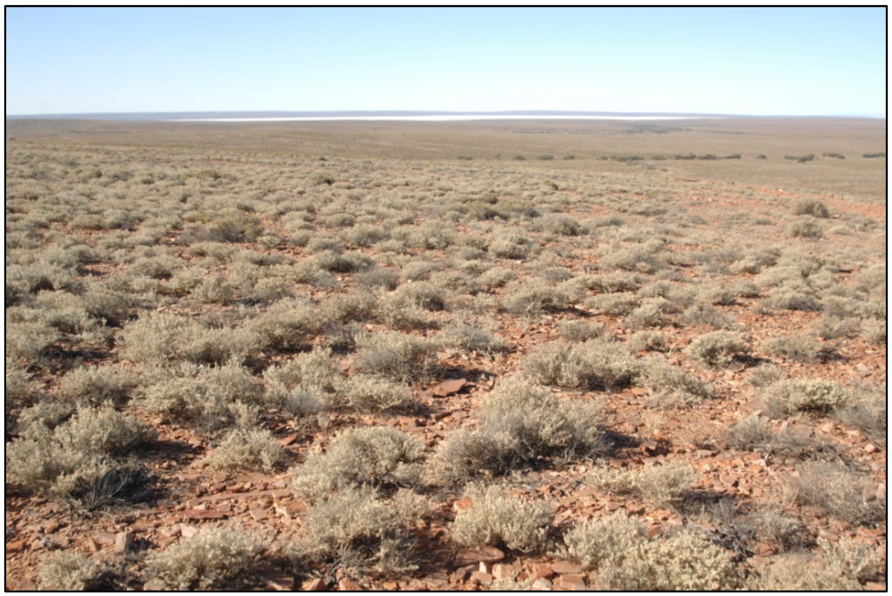
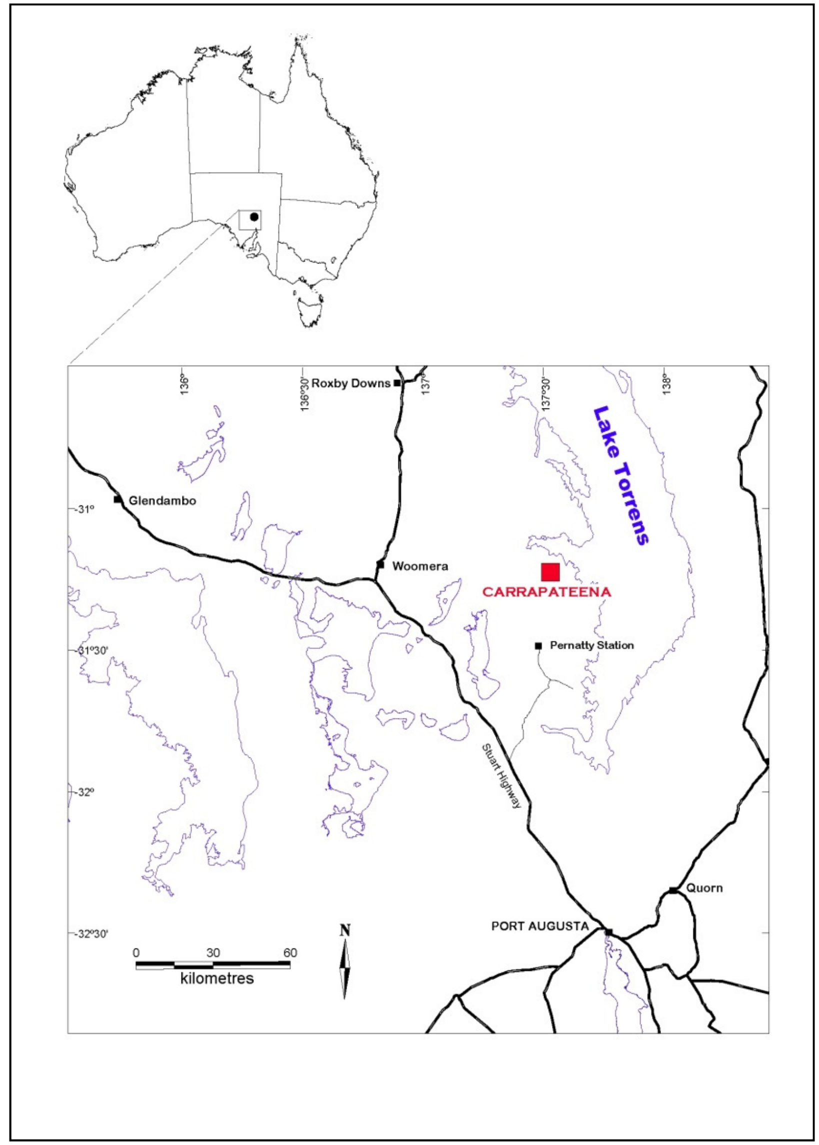
Outline of Presentation

- Location and Discovery
- Geological Setting
- Physical Properties
- Geophysical Surveys
  - Aeromagnetics
  - Gravity
  - IP/Resistivity/MT
  - Down hole IP/resistivity
  - EM
- Conclusions
- Acknowledgements

Location

Carrapateena iron-oxide copper-gold deposit lies 160km north of Port Augusta and 100km south-east of Olympic Dam, South Australia.





The project area is located on the Pernatty Station pastoral lease, within the Andamooka Ranges. Topography is dominated by gentle to moderately sloped hills, extensively covered by quartz sandstone. Vegetation comprises mainly salt bush, blue bush and shrubby eucalypts.

Carrapateena – Early History

- In the late 1970s and early 1980s, Carpentaria Exploration Co. Pty. Ltd. and its joint venture partners drilled several holes on gravity and/or aeromagnetic highs at a prospect named Salt Creek (now Khamsin), 100km southeast of Olympic Dam and immediately west of Carrapateena.
- Drill hole SASC-4 intersected hematite – sericite altered Donnington suite from 520 m to the end of the hole (1250m).

Since the discovery in **1975**, by WMC Resources Ltd., of the giant **Olympic Dam** iron-oxide copper-uranium-gold-silver deposit, the Gawler Craton has been subject to a great deal of exploration activity. In the **latter** part of the **1970s** and **early 1980s**, **Carpentaria Exploration Co. Pty. Ltd.** and its **joint venture partners** drilled several holes on gravity and/or aeromagnetic highs at a prospect named **Salt Creek**, 100 km southeast of Olympic Dam and immediately west of Carrapateena. Drillhole **SASC-4** was completed to **1250 m**, intersecting **hematite – sericite altered Donnington suite from 520 m to the end of the hole**, thus providing encouragement to later explorers in this area.

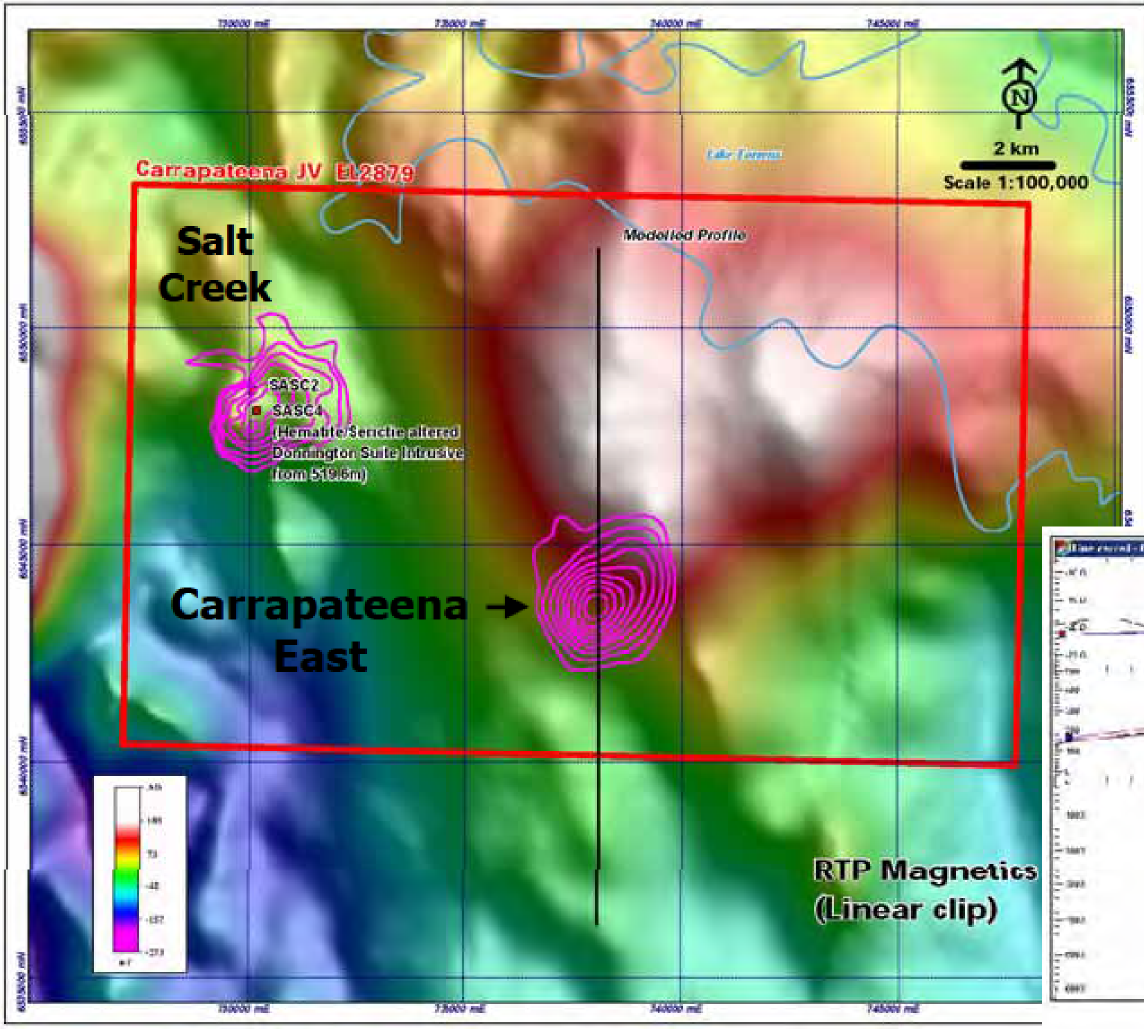
Carrapateena – Rudy Gomez (RMGS)

- RMG Services Pty. Ltd., is a South Australian, unlisted company incorporated in 1974. It’s principal, Rodolfo (Rudy) M. Gomez, previously studied Mechanical Engineering and Extractive Metallurgy.
- RMGS first applied for an Exploration License over Carrapateena to provide salt for a proposed petrochemical plant at Port Bonython. Mr Gomez’s interest in the Gawler Craton for IOCG deposits was fuelled by information searches in the PIRSA library.
- In 1996, RMGS applied for EL2879 (formerly EL2170), based on the belief that the Carrapateena Arm and the Torrens Hinge Zone make this area prospective for IOCG deposits.

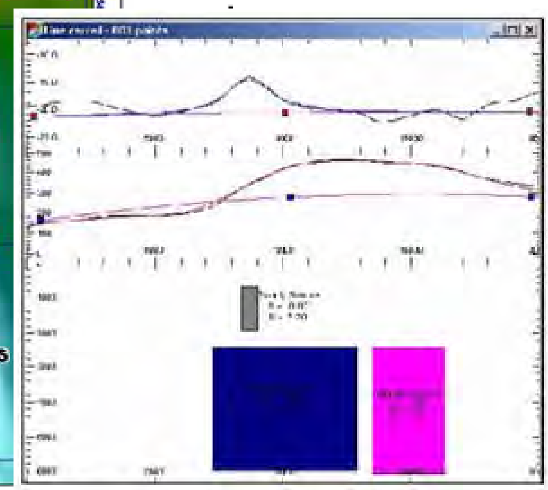
RMG Services Pty. Ltd., is an unlisted company incorporated in South Australia in **1974**. It's principal, **Rodolfo M. Gomez**, previously studied **Mechanical Engineering** and **Extractive Metallurgy** and has more than two decades of overseas experience in designing, engineering, construction, commissioning and operation of major mining operations.

RMGS first applied for an Exploration License in the southern part of Lake Torrens (SE of Carrapateena), to provide **salt for a proposed petrochemical plant at Port Bonython**. Mr Gomez's interest in the Gawler Craton for iron-oxide copper-gold deposits was fuelled by information searches in the PIRSA (Primary Industries and Resources South Australia) library. **In 1996, RMGS applied for EL2879** (formerly EL2170**), based on the belief that the Carrapateena Arm and the Torrens Hinge Zone make this area prospective for IOCG deposits** (Gomez, 2005).

Early Magnetic and Gravity Data



- Gravity bulls-eye at margin of moderately strong magnetic domain
- 2.0-2.5 mgal



Magnetics And Gravity Model

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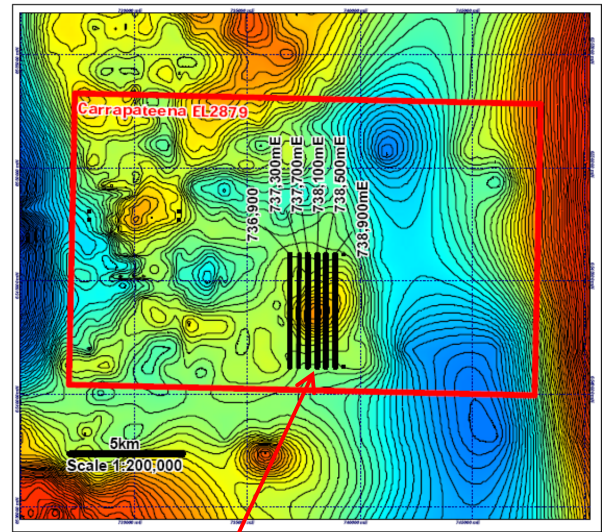
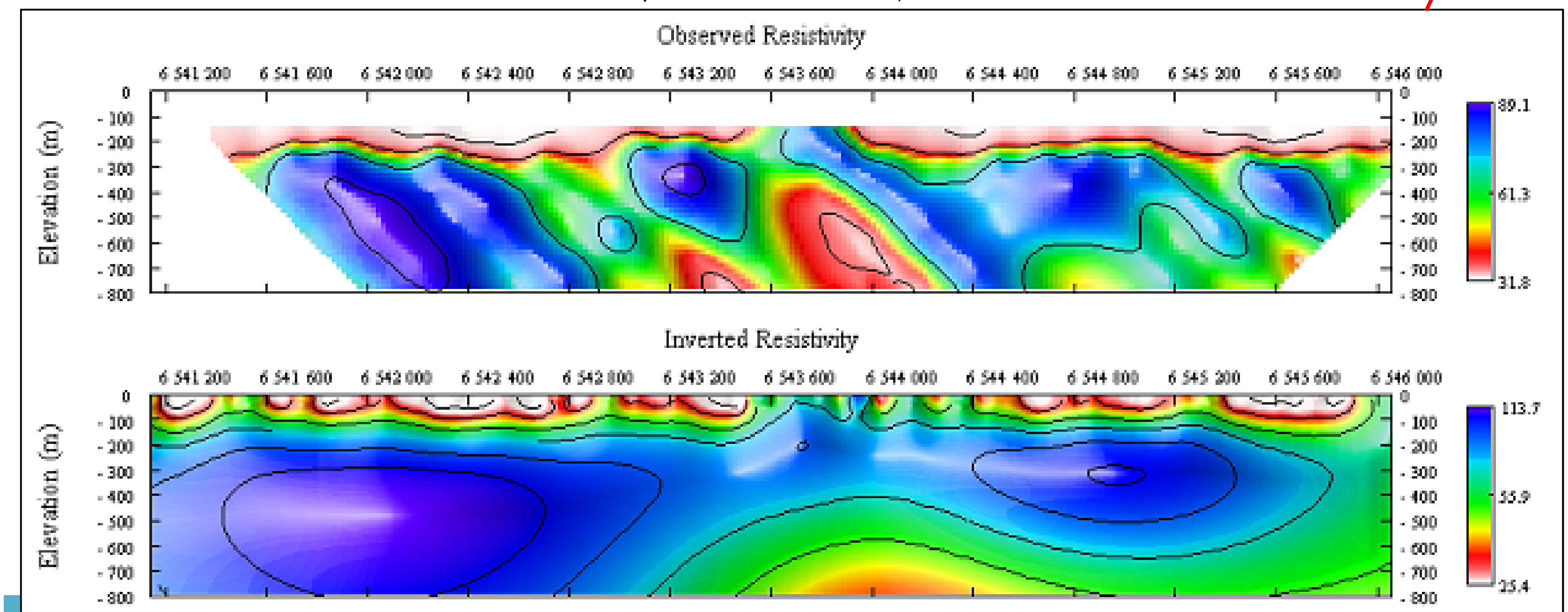
Regional aeromagnetic and gravity data, acquired by PIRSA, indicated an Olympic Dam – style potential field anomaly - Carrapateena. **Additional gravity** acquisition was carried out by a joint venture of **RMGS and General Gold Resources Ltd**., confirming the presence of a discrete gravity response.

2003 MIMDAS – Line 738100E



400m spaced, N-S lines, 5km along, using a pole – dipole array (200m dipole spacing). Transmitter frequency 25/512Hz.Current 14A. Chargeability time slice 2.5 – 4 seconds.

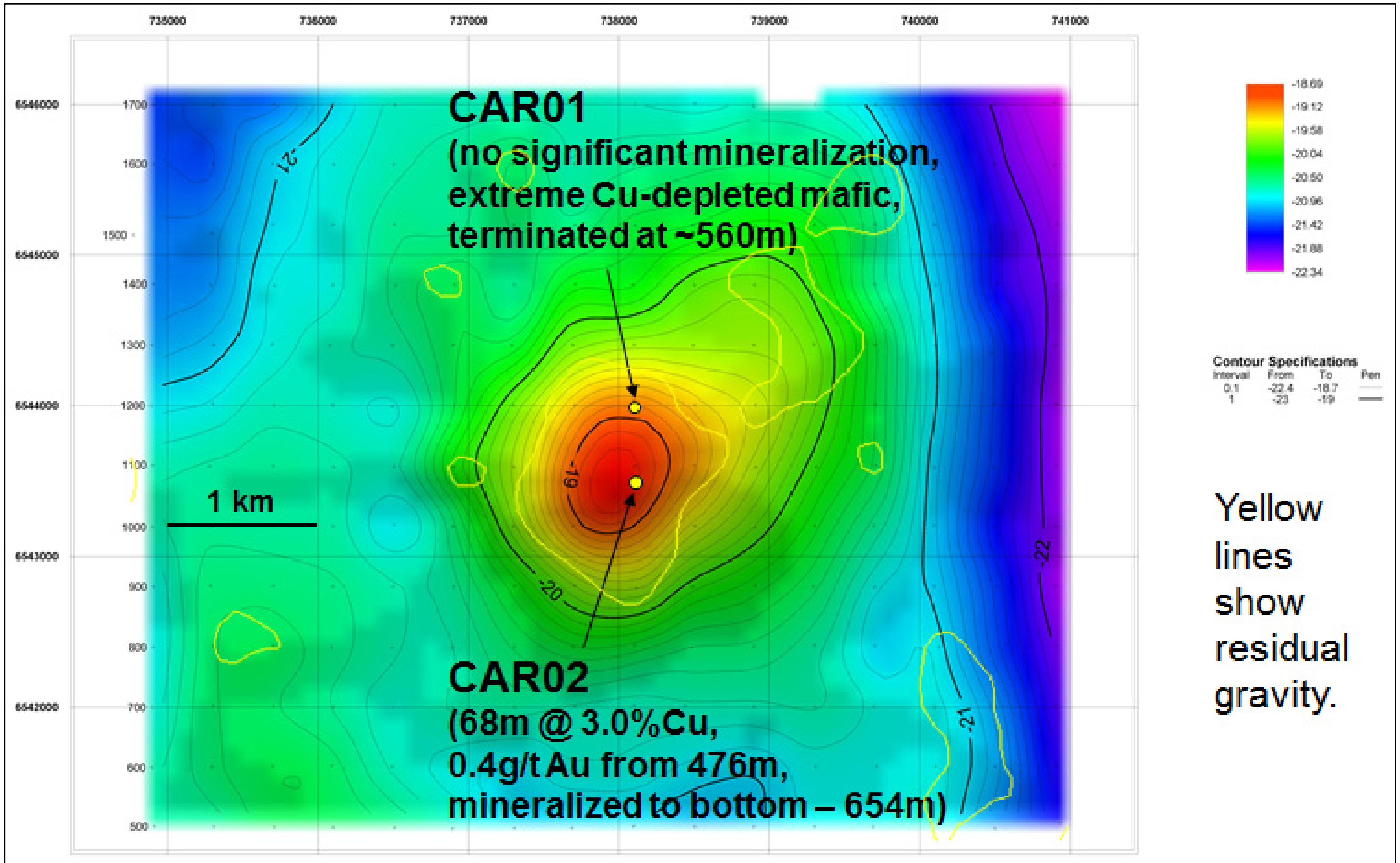
Hem breccia +/- sulphides



•In **2003 – 2004**, a joint venture between **MIM Exploration Pty. Ltd., Terramin Australia Ltd. and RMGS**, undertook further gravity surveying. MIM also completed **six 5 km long (north - south) lines** of induced polarisation **(IP)** and magnetotelluric **(MT)** surveying, using its then proprietary **MIMDAS** system. MIM and Terramin later withdrew from the joint venture and **RMGS was on its own again**.

•While the **IP data were ambiguous**, modelling of resistivity data over the peak of the gravity anomaly indicated the existence of **at least 150m of conductive (0.05 – 0.1S/m) overburden**, overlying a **several hundred metre thick layer of relatively resistive (>150ohm.m) material**, with the **underlying basement exhibiting variable, but significantly lower, resistivities**. In particular, a **deep conductive zone was interpreted to be coincident with or slightly north of the gravity response**. The Carrapateena discovery hole **(CAR002)** was targeted on these anomalies.

PACE – Part-funded Drilling



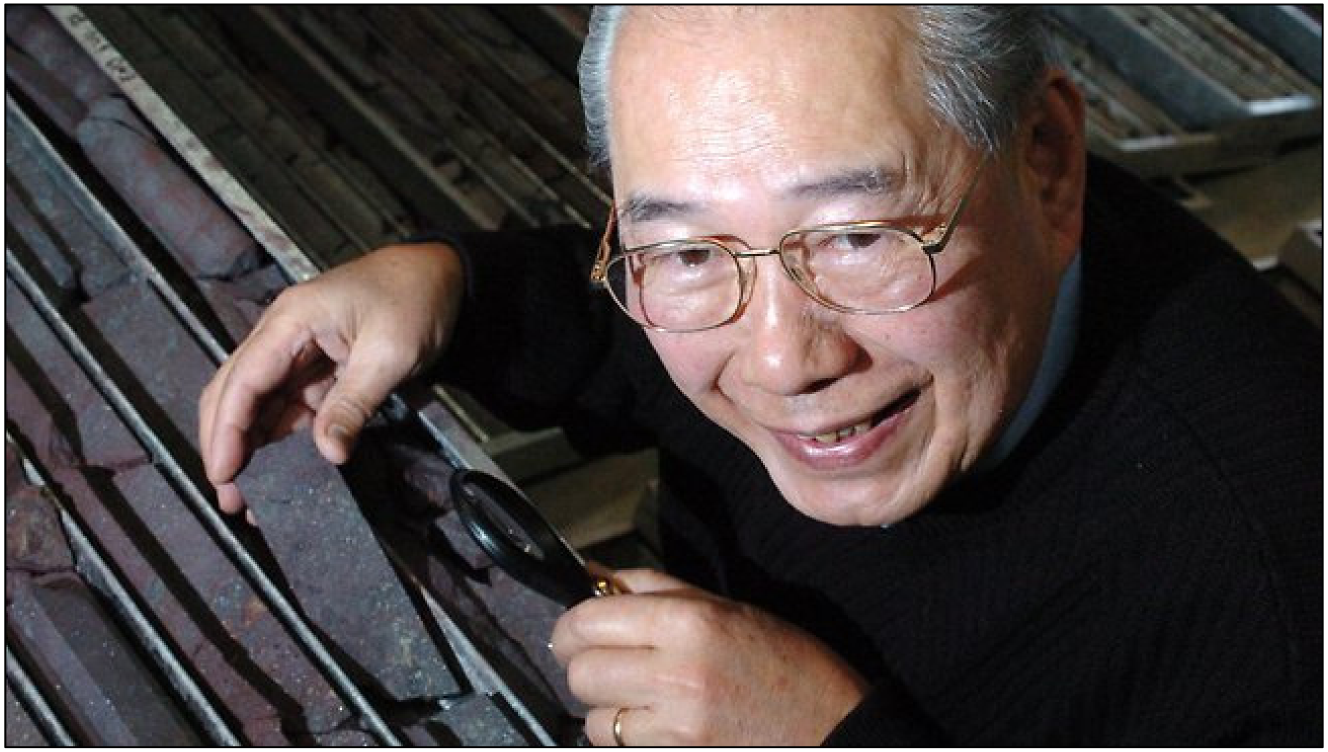
Yellow lines show residual gravity.

Carrapateena is located in the **G2 corridor** and within the Olympic Dam District. The project has benefited from **structural studies** undertaken by **Dr Rodney Boucher**, based on methods utilised by the **late Dr Tim O'Driscoll**. **Chris Anderson and Associates**, consultants to RMGS, played an integral role, **modelling and interpreting data** acquired by MIM and PIRSA, and **planning final drill hole locations**.

In February 2005, RMGS initially proposed four holes to be jointly funded with PIRSA, through their **PACE** program. This was later reduced to **two drill holes, one which would be targeted on the gravity anomaly and a second hole designed to test the MIMDAS conductivity anomaly**. These holes were drilled in **May-June 2005** and a new and exciting discovery in the Gawler Craton was announced soon after.

Discovery!

CAR002 - 178.2m @ 1.83% Cu, and 0.64g/t Au, from 476m, including 75m @ 2.89% Cu & 0.4g/t Au.



Source: Greg Adams, Adelaide Now

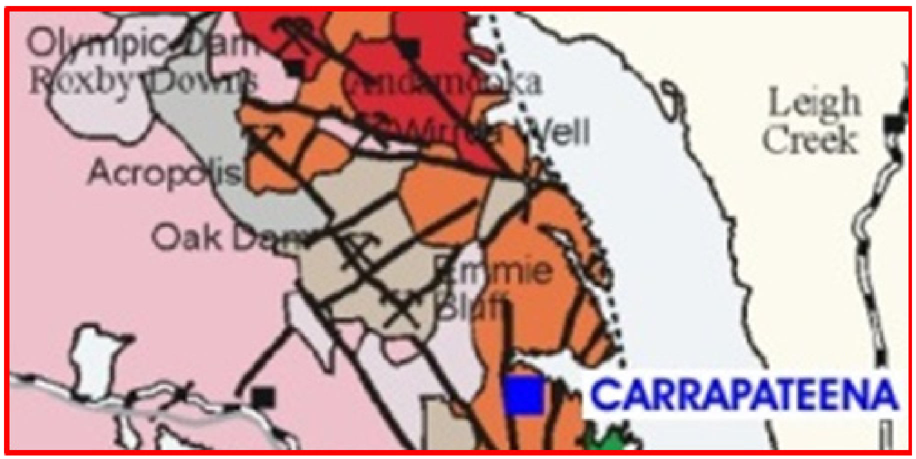
Beyond Discovery

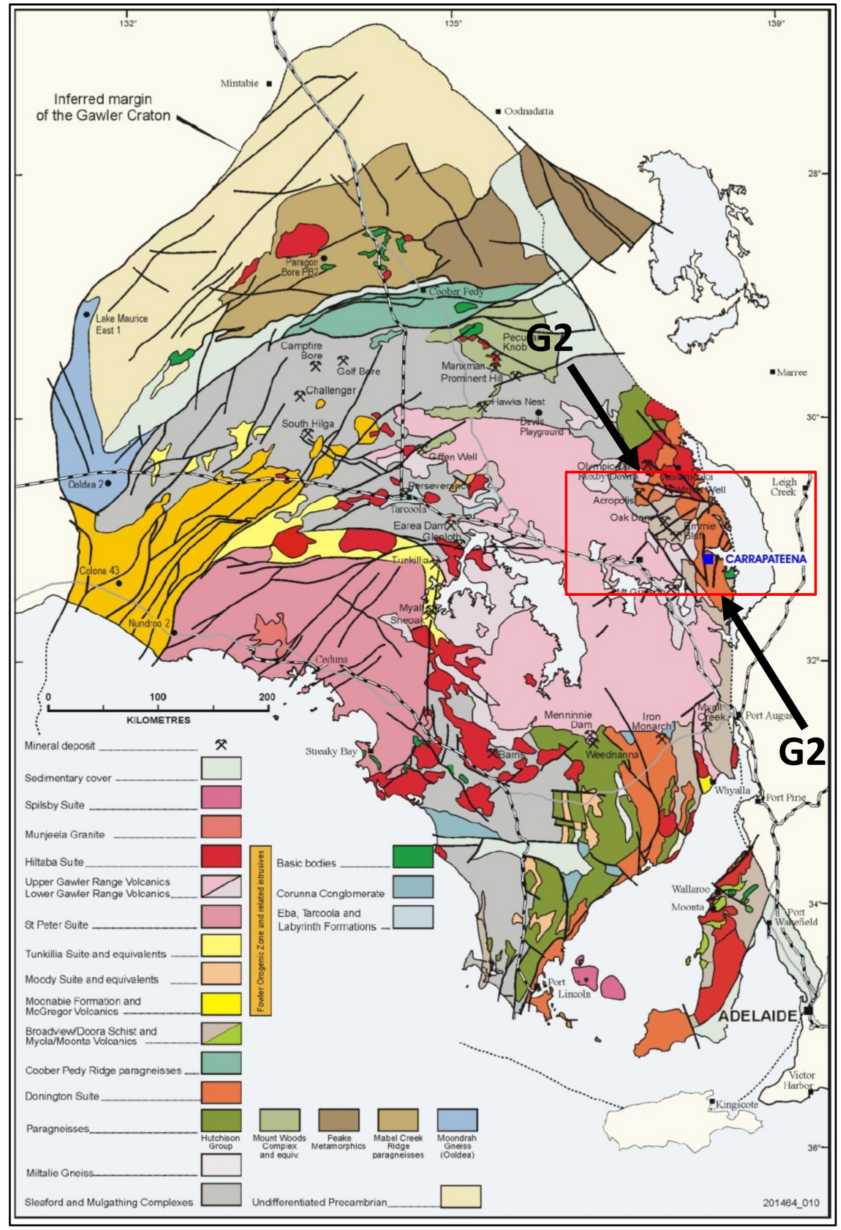
- In September 2005, Teck Australia Pty. Ltd. farmed into Carrapateena.
- Extensive exploration by Teck resulted in the drilling of CAR050, which intersected **905 m @ 2.1% Cu and 1 g/t Au.**
- Drilling of regional prospects by Teck identified hematitic breccias at Khamsin, and copper mineralised, chlorite, sericite and hematite altered granites and breccias at Fremantle Doctor.

- In April 2011, Oz Minerals purchased Carrapateena and subsequently released an inferred resource of **292Mt @ 1.29% Cu, 0.48 g/t Au, 207 ppm U_3O_8 and 5.4g/t Ag.** Further drilling at Khamsin and Fremantle Doctor has also identified significant copper mineralisation.

Geological Setting

Carrapateena is located on the eastern margin of the Gawler Craton, at the intersection of interpreted major NNE – and NW – trending structures.



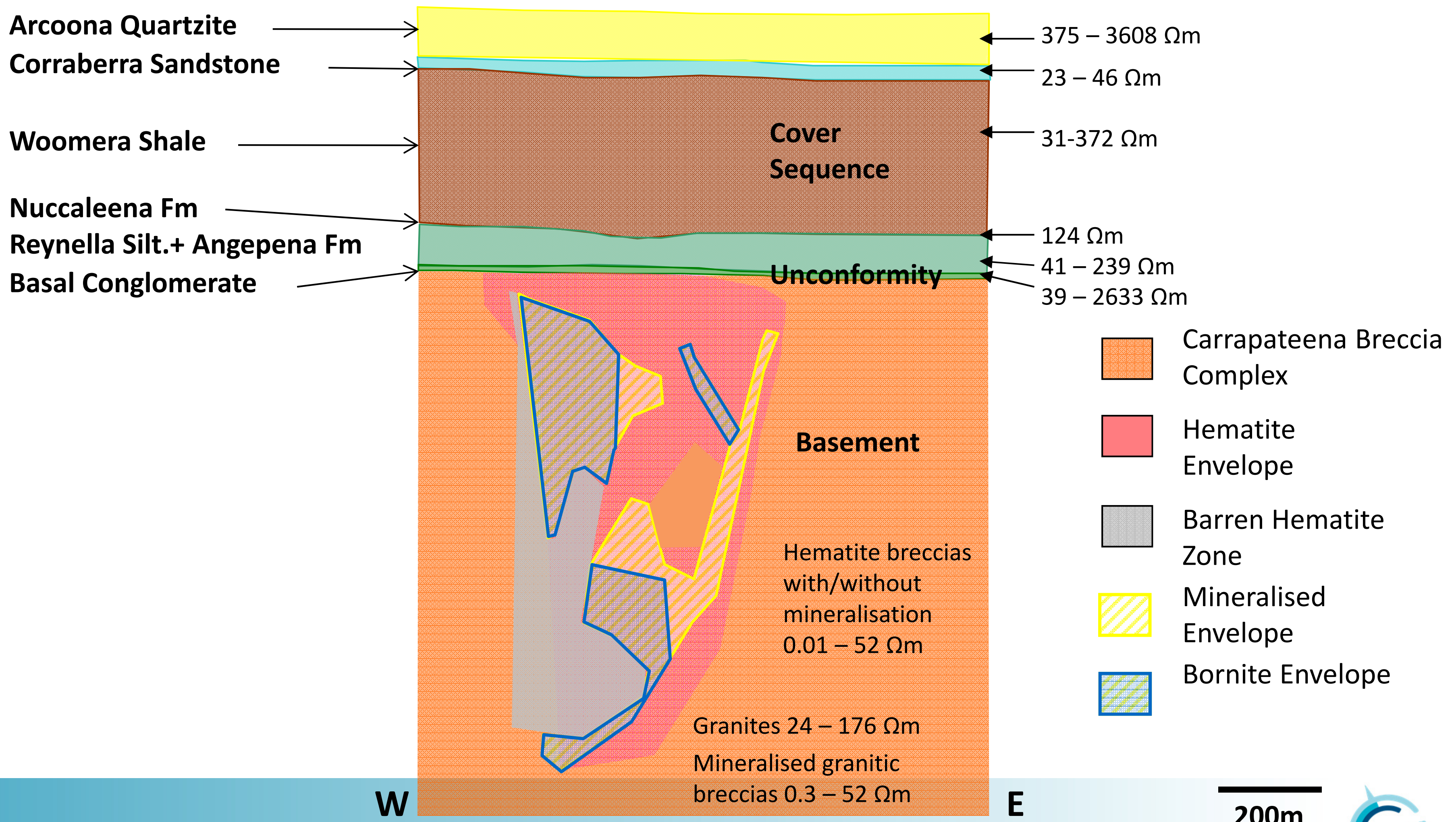


•The Carrapateena deposit is located within what is termed the 'Olympic Fe-Oxide Copper-Gold Province' in the eastern margin of the Gawler Craton. The Gawler Craton is a region of Archaean to Mesoproterozoic crystalline basement, underlying most of South Australia, which has not undergone substantial deformation in the past 1450 million years.

•The MesoProterozoic Eastern margin – bounded by Torrens Hinge Zone and covered by younger Proterozoic Stuart Shelf sediments and local Palaeozoic cover.

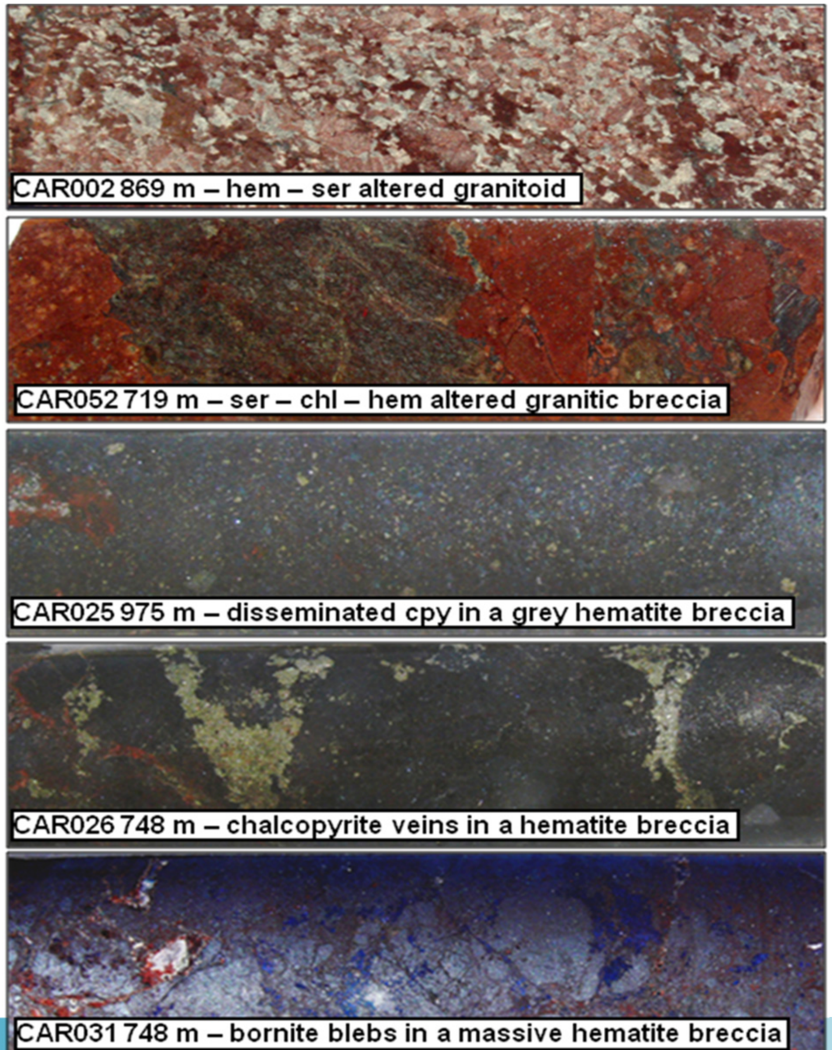
•Carrapateena is located at the intersection of interpreted major NNE and NW trending structures, analogous to structures thought to have played a role in focussing the mineralisation at Olympic Dam.

Schematic Geological Section (with resistivities annotated)



•Carrapateena lies under 470m of moderately conductive Stuart Shelf sediments, presenting significant technical challenges to exploration.
•The cover sequence consists of Wilpena Group sediments overlying Umberatana Group sediments.
•The Wilpena Group comprises the outcropping Arcoona Quartzite, Corraberra Sandstone and the Woomera Shale.
•The Umberatana Group sediments comprise variably gritty siltstones to sandstones, with minor interbeds of dolomite.
•The cover sequence unconformably overlies the basement, with the unconformity being marked by the basal conglomerate.
•Cu-Au-U-REE mineralisation hosted by the Carrapateena Breccia Complex and occurs in a hem-chl-ser mineralised sequence, of partly conglomeratic sediments, with clasts and fragments of granite, gneiss and vein quartz. These sediments are likely derived from hydrothermal activity re-sedimenting a brecciated host.
•The host rock is a variably foliated and/or sheared gneissic quartz granite and quartz diorite, which has been age dated at 1857 +/- 6 Ma, assigning it to the Donnington Suite.
•Basement rocks locally intruded by felsic and mafic dykes.

Drill Core Samples



- Alteration minerals – hematite, chlorite, sericite, locally abundant quartz & carbonate (siderite and/or ankerite).
- Secondary minerals – barite, monazite, anatase, magnetite, apatite, fluorite and zircon.
- 3 types of hematite.
- Copper sulphides – chalcopyrite and bornite, mainly disseminations, blebs and veinlets. Rare chalcocite.
- Pyrite is locally abundant.

•Three types of hematite are observed – fine – grained earthy red hematite; massive steely grey hematite, and coarse platy grey specular hematite. In my talk on Wednesday afternoon, I'll discuss how the electrical properties of hematite can vary depending on type.

•(Note: hem = hematite, ser = sericite, chl = chlorite, cpy = chalcopyrite).

Physical Properties

	Density (g/cc)	Magnetic Susceptibility (SI x 10^{-5})	Galvanic Resistivity (ohm.m)	Chargeability (ms)	EM Conductivity (S/m)
Cover	2.29-2.74	1-75	36–2,484	1-8	-
Basement	2.4–2.72	30-55	9–98	2-3	-
Basement (altered and/or mineralised)	2.7–4.37	45–11,251	1-176	1-188	0–345 (chalcopyrite vein)

Petrophysical characteristics of basement rocks are dominated by the presence of Fe-oxide. Separation of responses from the Fe-oxides, Fe-sulphides and Cu-sulphides is difficult.

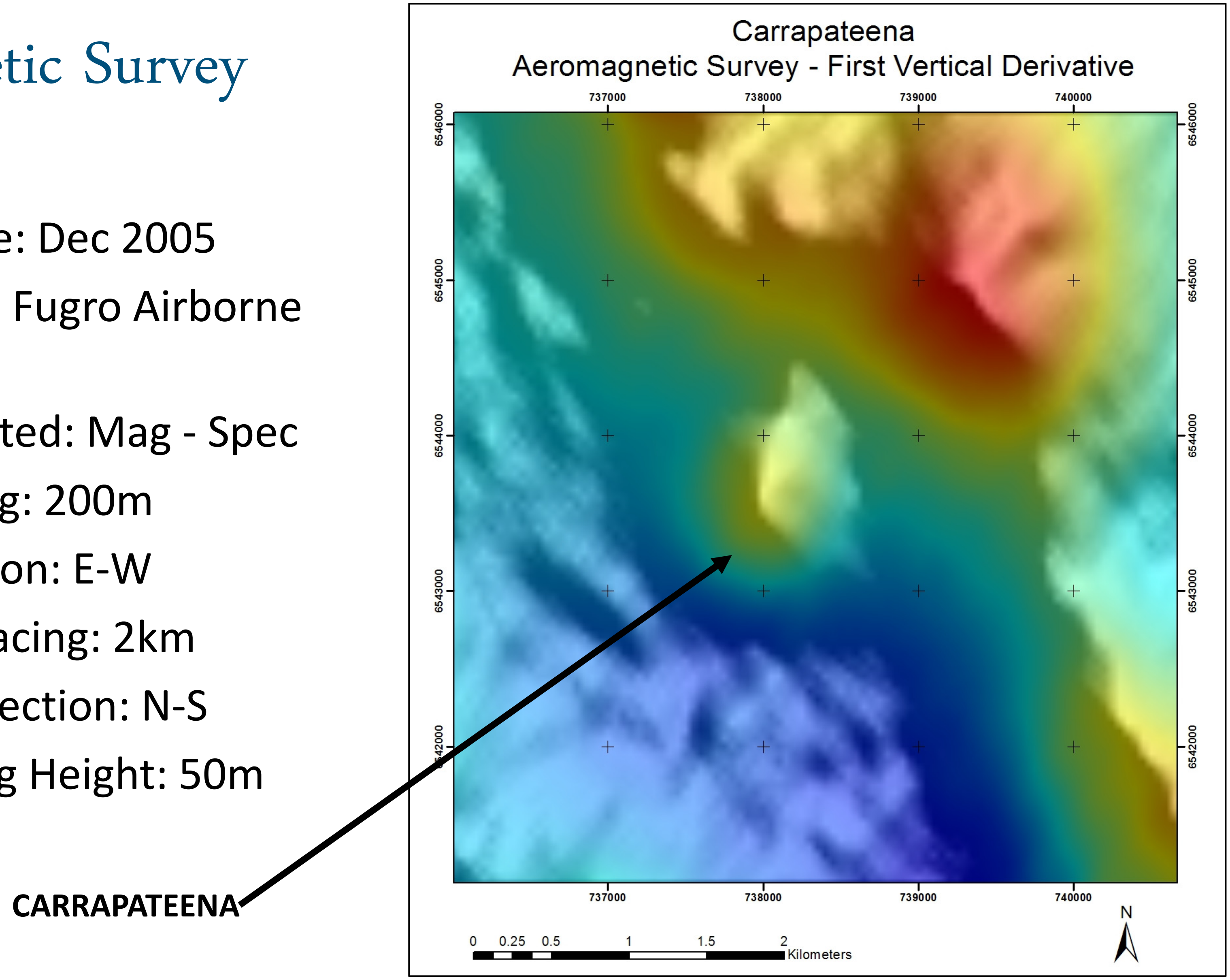
•72 samples.

•Cover Sequences – low densities, magnetic susceptibilities, chargeabilities and EM conductivities. High apparent porosities. Variable P-wave velocities. With the exception of the Arcoona Quartzite, which is highly resistive, rocks are weakly to moderately conductive, and show significant electrical anisotropy.

•Basement – Densities increase with increasing hematite and/or magnetite and/or sulphide content. Magnetic susceptibilities correlate with % magnetite. EM conductivities generally low, with rare exceptions. Lower galvanic resistivities and higher chargeabilities correspond to increasing sulphides +/- hematite +/- magnetite.

Aeromagnetic Survey

- Survey Date: Dec 2005
- Contractor: Fugro Airborne Surveys
- Data Collected: Mag - Spec
- Line Spacing: 200m
- Line Direction: E-W
- Tie Line Spacing: 2km
- Tie Line Direction: N-S
- Mean Flying Height: 50m

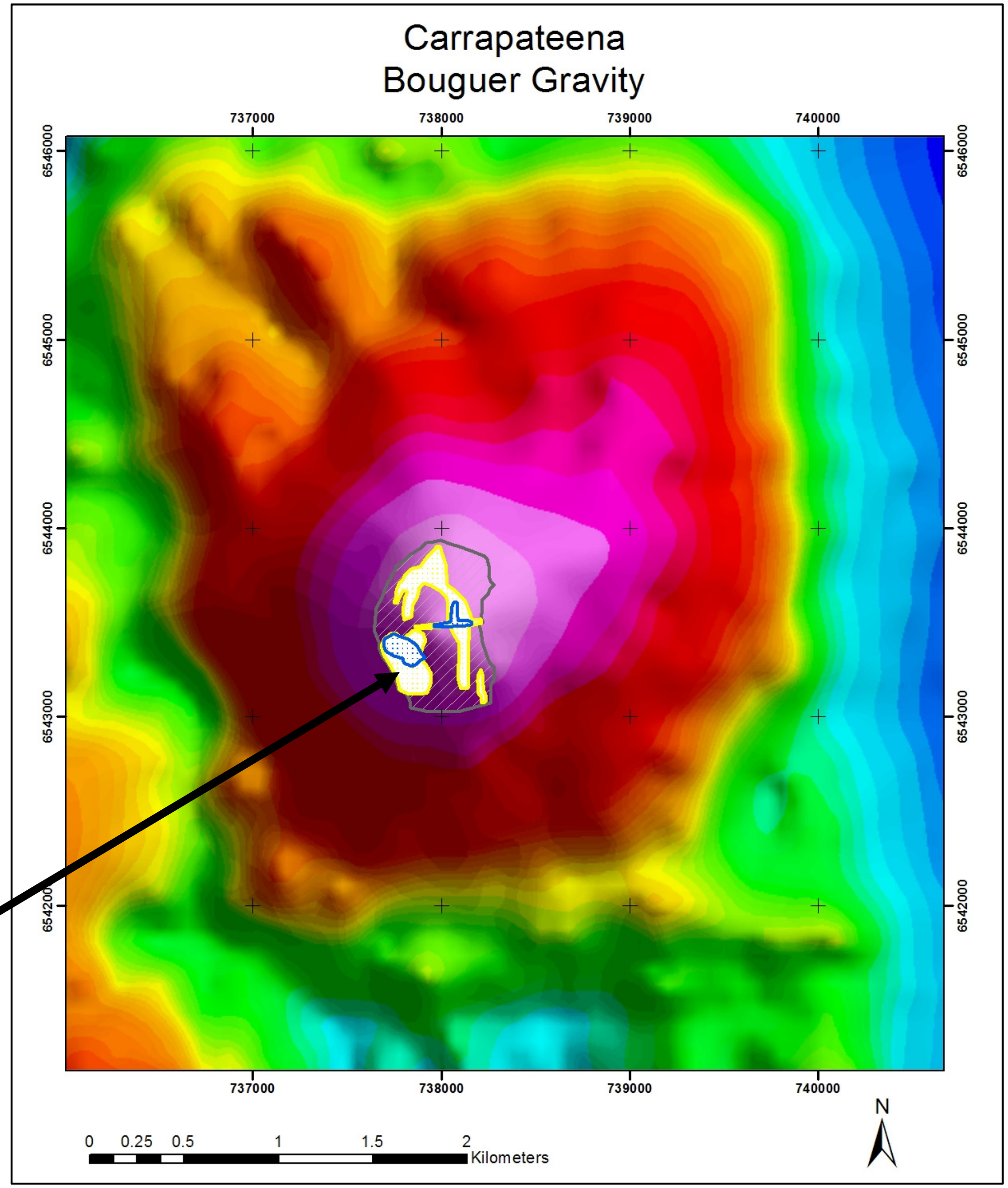


•Carrapateena lies on the SW margin of a broad magnetic anomaly of moderate amplitude and is associated with a weak, discrete, ellipsoidal magnetic response, being elongated in a north-south direction and having an approximate amplitude of **20nT.**

Gravity Surveys

- Three detailed gravity surveys:-

Date	Company	Surveyor	Station Spacing
1996	General Gold	Dynamic Satellite Surveys	500m x 500m
2003	MIM	MIM	400m x 400m
2006	Teck	Haines	200m x 200m



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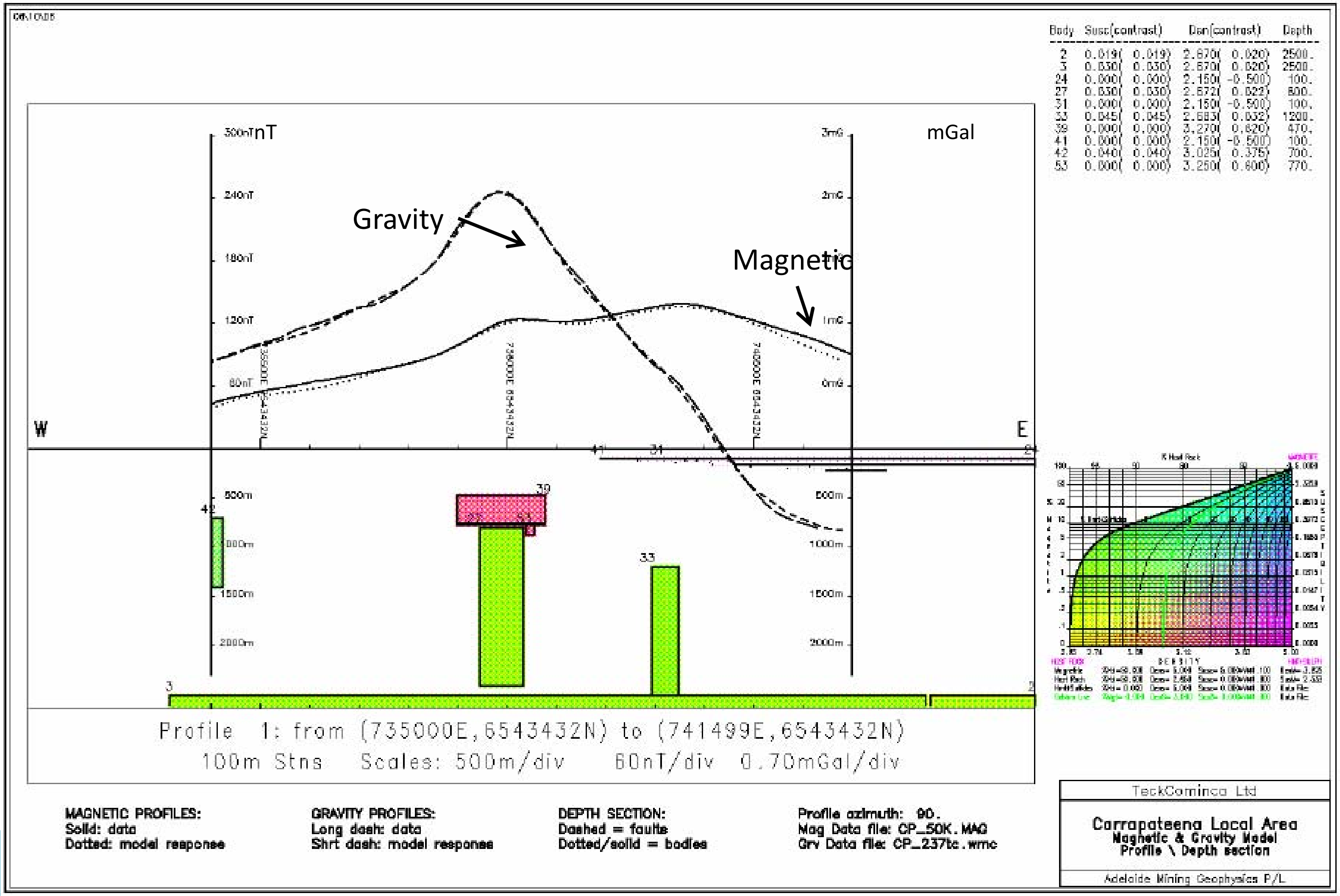
Hematite breccia (grey), chalcopyrite (yellow) and bornite (blue).

•Carrapateena is characterised by a weak (approximately 2.5mGal) bullseye gravity high, near-coincident with the observed magnetic response.

Forward Modelling – East-West Profile over Carrapateena

(Hanneson, 2006)



Body	Susc(contrast)		Den(contrast)		Depth
2	0.019(	0.019)	2.670(	0.020)	2500.
3	0.030(	0.030)	2.670(	0.020)	2500.
24	0.000(	0.000)	2.150(	-0.500)	100.
27	0.030(	0.030)	2.672(	0.022)	800.
31	0.000(	0.000)	2.150(	-0.500)	100.
33	0.045(	0.045)	2.683(	0.032)	1200.
39	0.000(	0.000)	3.270(	0.620)	470.
41	0.000(	0.000)	2.150(	-0.500)	100.
42	0.040(	0.040)	3.025(	0.375)	700.
53	0.000(	0.000)	3.250(	0.600)	770.

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•Explain phase diagram. Refer to Adelaide Conference 2003.

•Detailed forward modelling, by Jim Hanneson (Adelaide Mining Geophysics), undertaken during the early stages of exploration. Model suggests observed gravity and magnetic responses could be explained by a non-magnetic, vertical cylindrical body, with a diameter of 1km and average density of 3.27 g/cc, overlying a less dense and weakly magnetic body, having an average magnetite content of no more than a few percent.

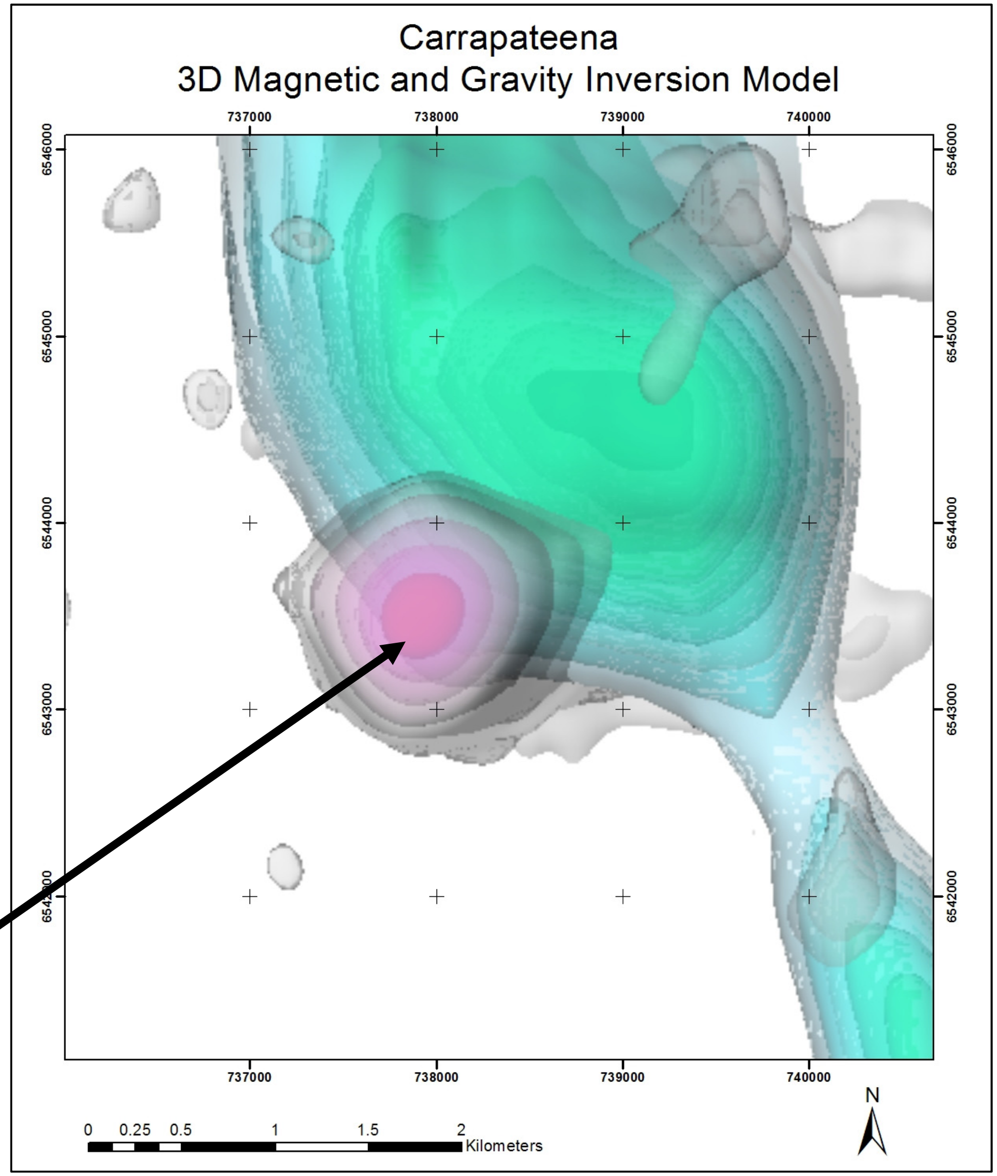
•The observed data can also be modelled using economically uninteresting mafic bodies – implications for exploration.

•When the Carrapateena model bodies are made shallower (simulating 350m of cover, like at Olympic Dam), the peak gravity response, increases from about 2.5 to 3.5 mGal, and the magnetic response increases from about 20nT to perhaps 30nT.

Inversion Modelling

- 3D gravity and magnetic inversion model, using high-pass filtered (10km) data.
- The gravity model was constrained for cover.
- Iso-surfaces of density contrast are pink – grey and % magnetite are blue – green.

CARRAPATEENA



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•Modelling done by Craig Beasley (Wave Geophysics).

•The gravity model was constrained by incorporating a reference model, comprising an overburden layer (450m thick, with a density contrast of -0.1g/cc), overlying a half-space. If the model was not constrained in this way, the dense bodies would come up to surface, which clearly wasn't geologically realistic.

•Drill holes, to depths >1500m, confirm that hematite dominates in the shallower part of the deposit, with increasing magnetite being observed at depth.

2006 High – Powered IP/Resistivity

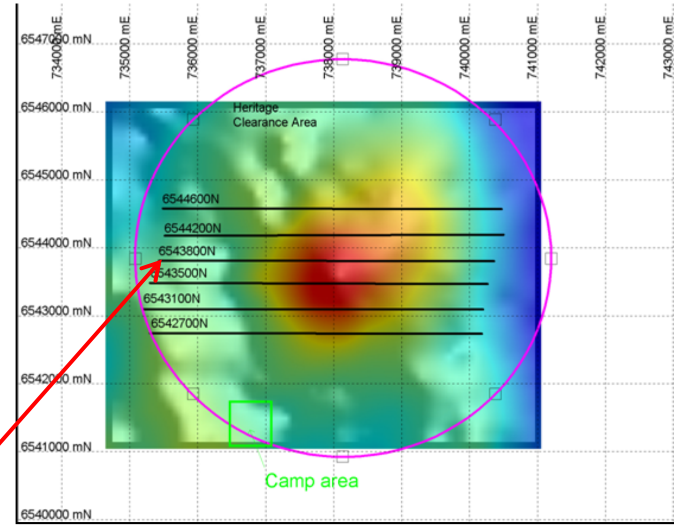
Configuration: Dipole – dipole
Transmitter dipole: 200m, 300m and 400m
Receiver dipole: 200m
Station interval: 100m
Number of receiver dipoles: 8+ (“n” levels)
Line Direction: East/West
Base frequency: 0.125 and 0.0625 Hz
Duty Cycle: 50%
On/off time: 2sec and 4sec on-off
Maximum transmit current: 68A
Receiver: Search Exploration Full Time Series (SSIP16)
Chargeability Integration: 590msec to 1200msec
Transmitter: Search Exploration 50kVA

•In 2006, Search Exploration carried out a 2D high-powered IP/resistivity survey, using proprietary technology. Data were collected on seven east-west lines, 300m to 400m apart, with readings being taken at 100m intervals. Line length varied from 3.9 to 5.1km, with a total of 40.7 line km of data collected. Maximum transmit current was 68A.

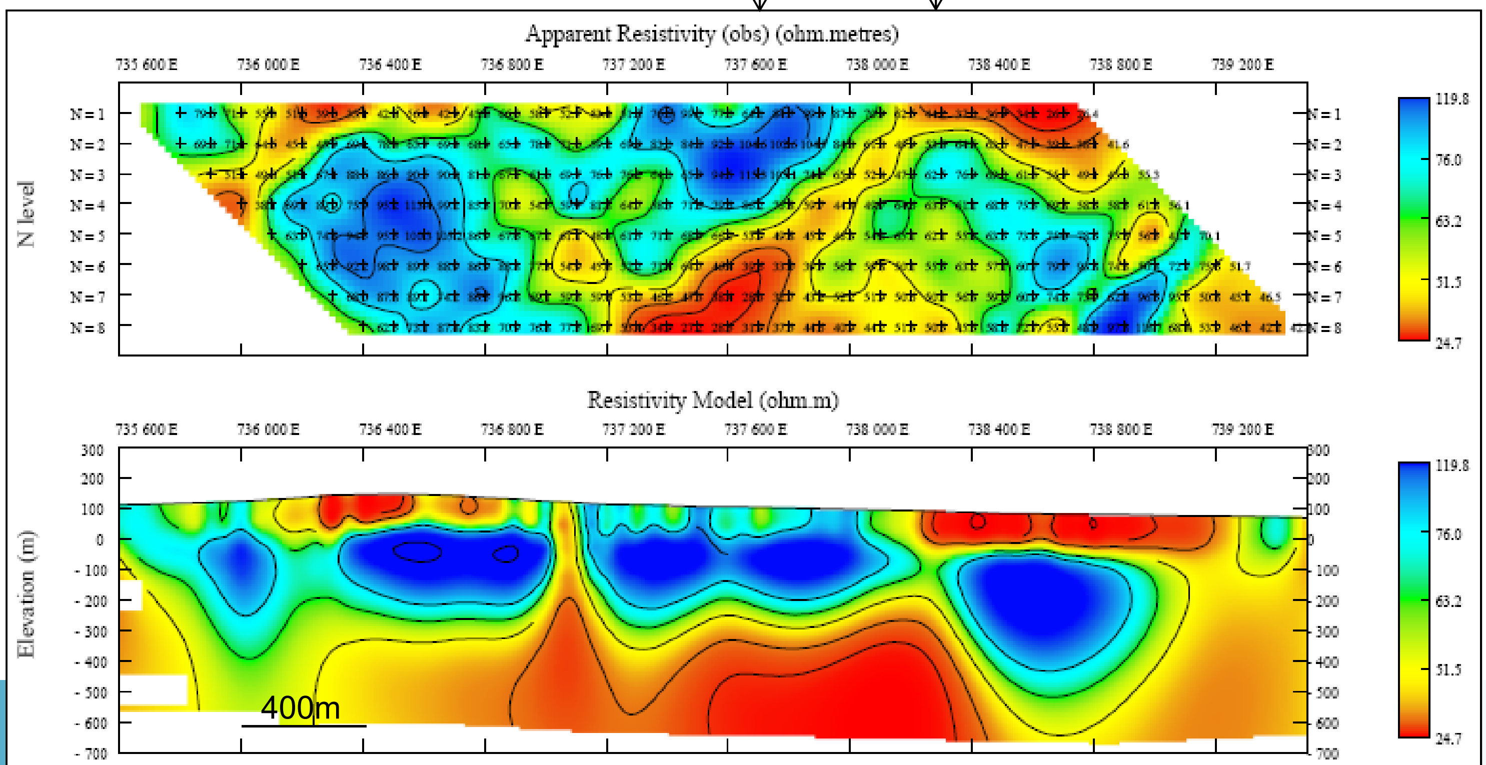
•Overall, data quality was quite good, however the data almost invariably showed an increase in chargeability with n-level. This was due to the data containing a significant amount of EM coupling at large n spacings. Some data were also negatively impacted by tellurics. These were minimised through sophisticated processing, shared collaboratively between John Paine (Scientific Computing and Applications) and David McInnes (Montana Geophysics).

2006 High-Powered IP – Resistivity – Line 6543800N

Inversion modelling (2D Zonge) shows a good correlation between the observed conductivity and gravity anomalies (hematite +/- sulphides).



Hem breccia +/- sulphides



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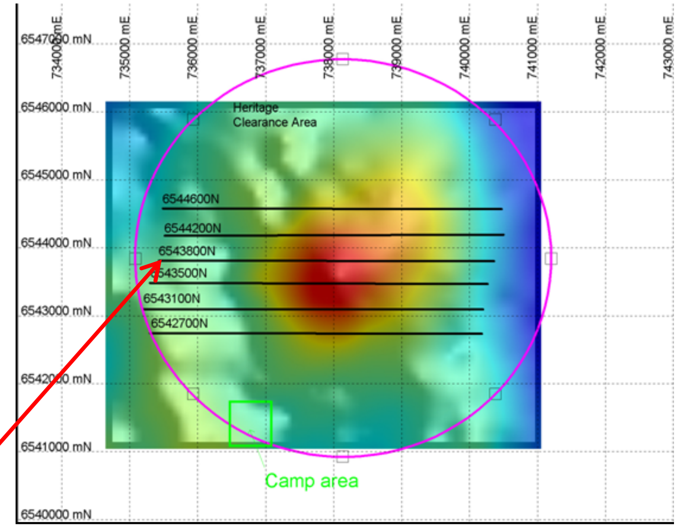
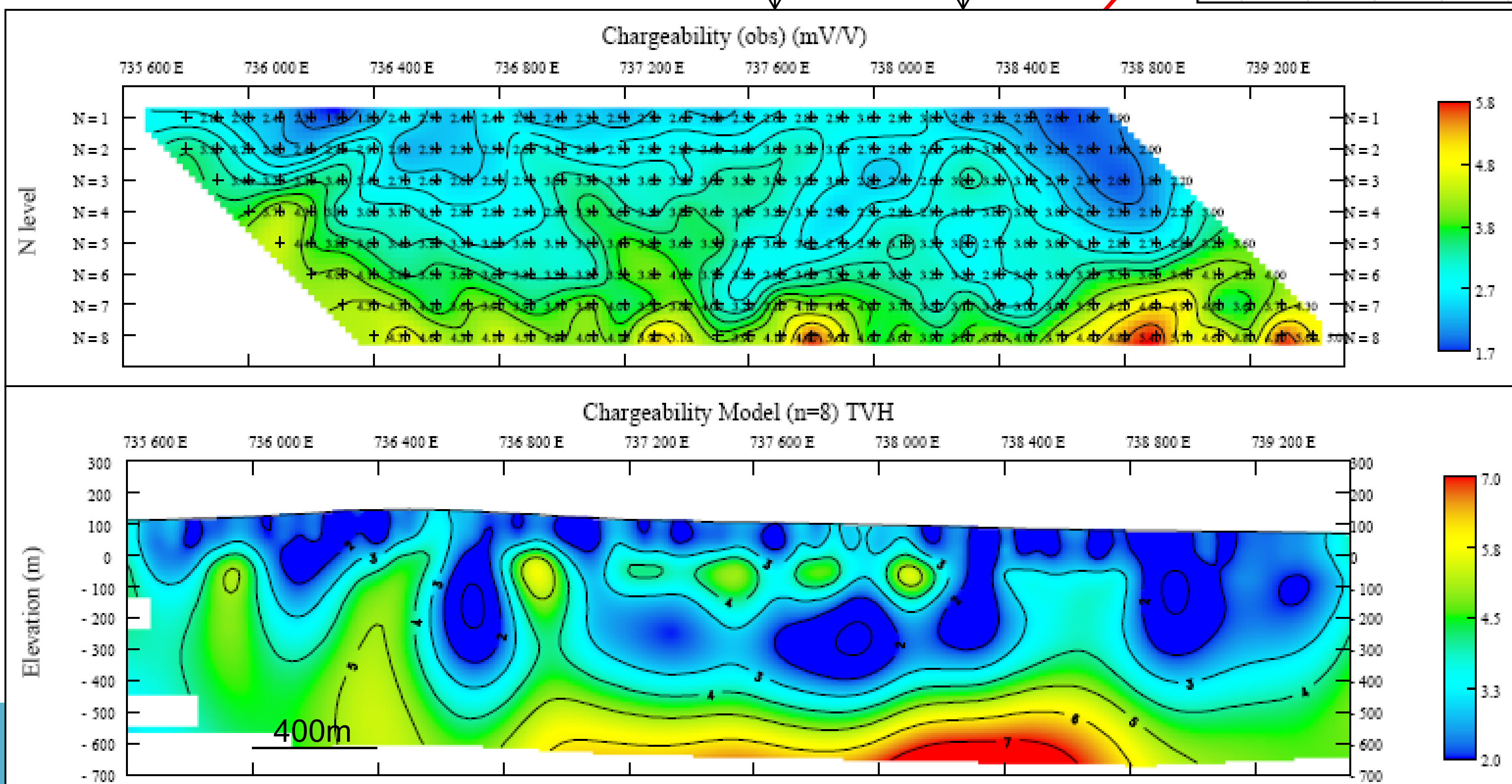
2006 High-Powered IP – Chargeability – Line 6543800N

Chargeability data were ambiguous at times. Interpretation was complicated by the presence of specular hematite, often not noted in geological logs.



Hem breccia +/- sulphides

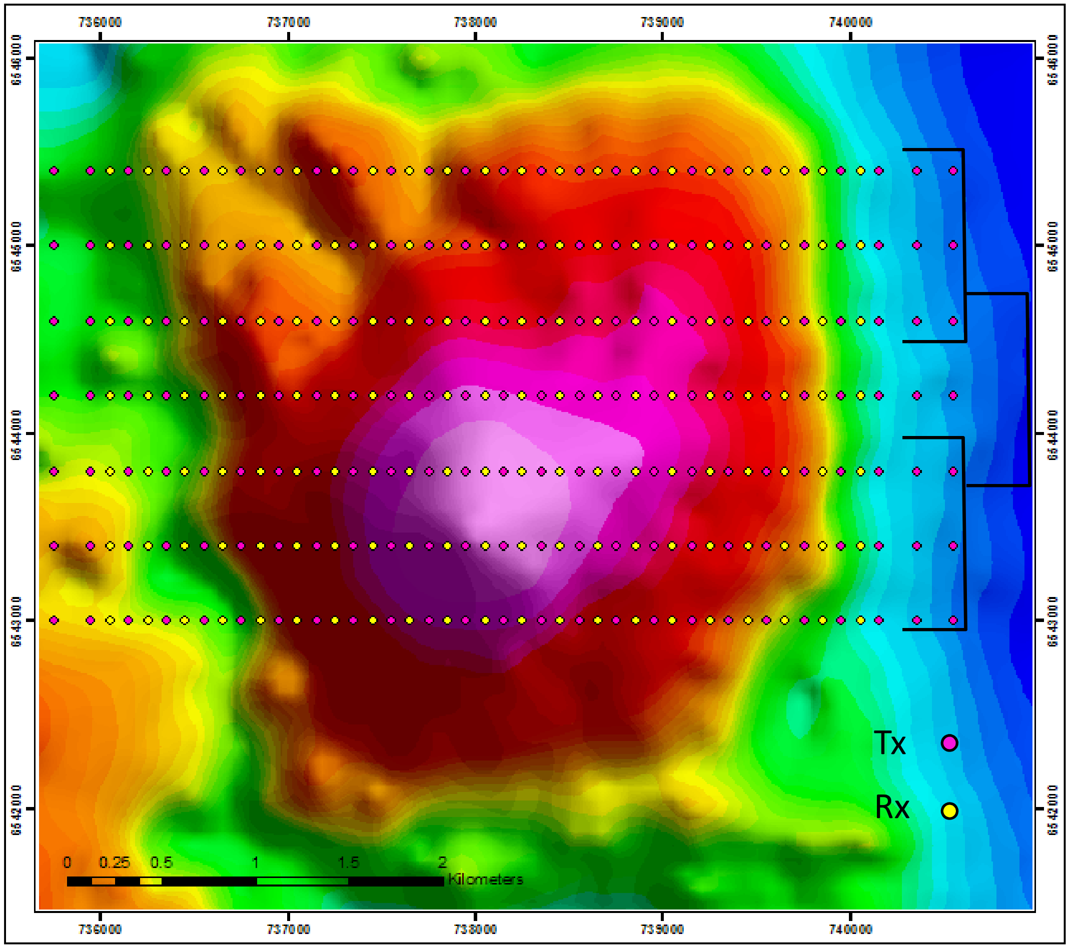


•Line locations shown on residual gravity.

•Specular hematite can exhibit an appreciable chargeability.

•On some drill sections there was a good correspondence between chargeability and drill results. On others, chargeability anomalies appeared to be shallower than expected (i.e. within the cover). May depend on whether or not the hematite +/- sulphide mineralisation is in contact with the unconformity, or significantly deeper (signal gets caught up in the cover).

2006 MIMDAS Survey Layout (3D Pole-dipole)



Grid North

Grid Middle

Grid South

Dipole length: 200 m
Tx freq.: 25/256, 25/512 Hz
Tx current: 3 – 8.5 A
Tx: Zonge GGT10 10 kVa
Duty cycle: 100%
Chargeability time slice:
21.5 – 2.5 s & 3.5 – 5.0 s
Sampling rate: 100 & 200 samples/second
Magnetometers: 2 pairs of BF-4

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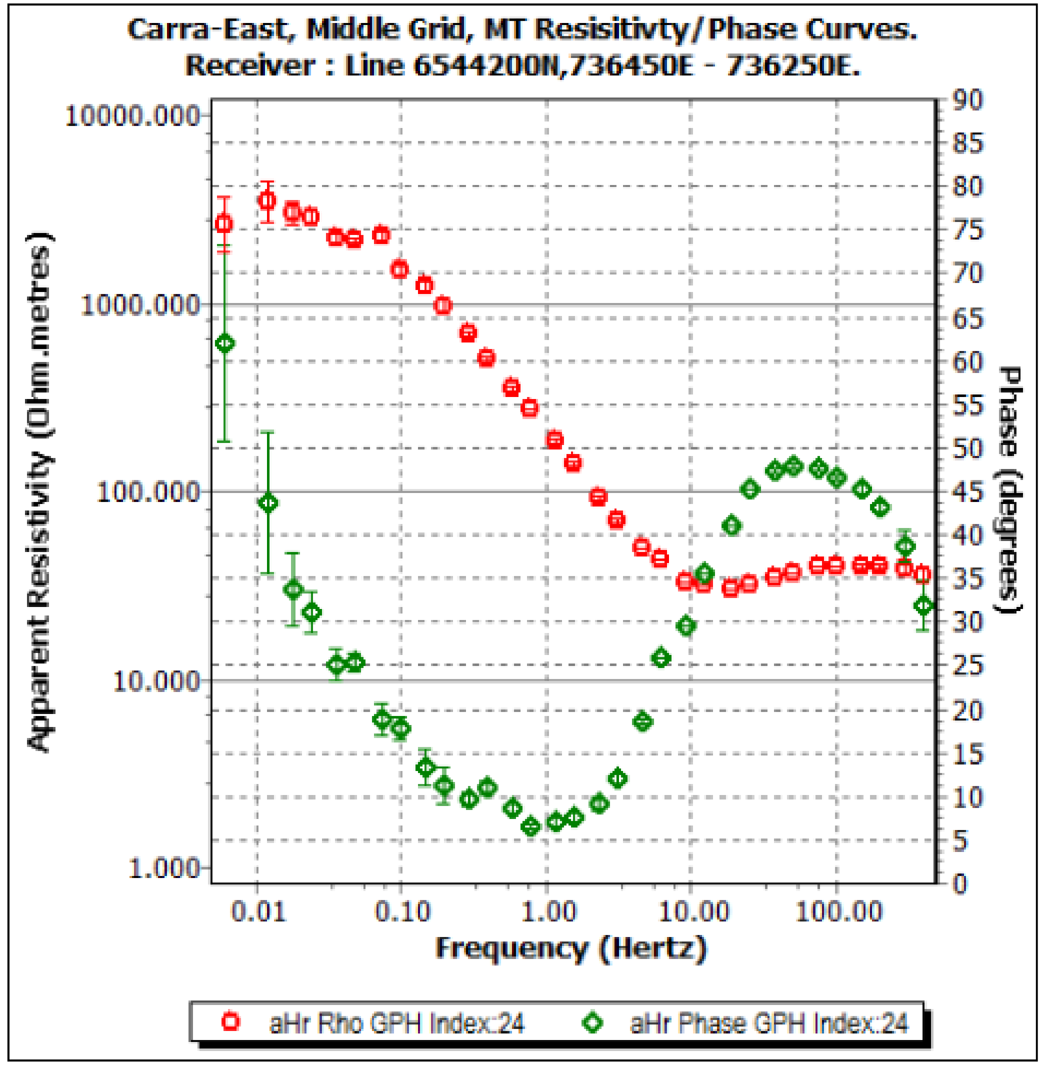
•2006, GRS’s proprietary MIMDAS system. “Ghost Line” 3D setup, comprising 3 overlapping grids, thereby also providing 7 collinear 2D lines of pole-dipole IP/resistivity/MT data. Each line was 4km long, being spaced 400m apart, with a receiver dipole length of 200m. Tx locations extended east ands west of the array by 500m.

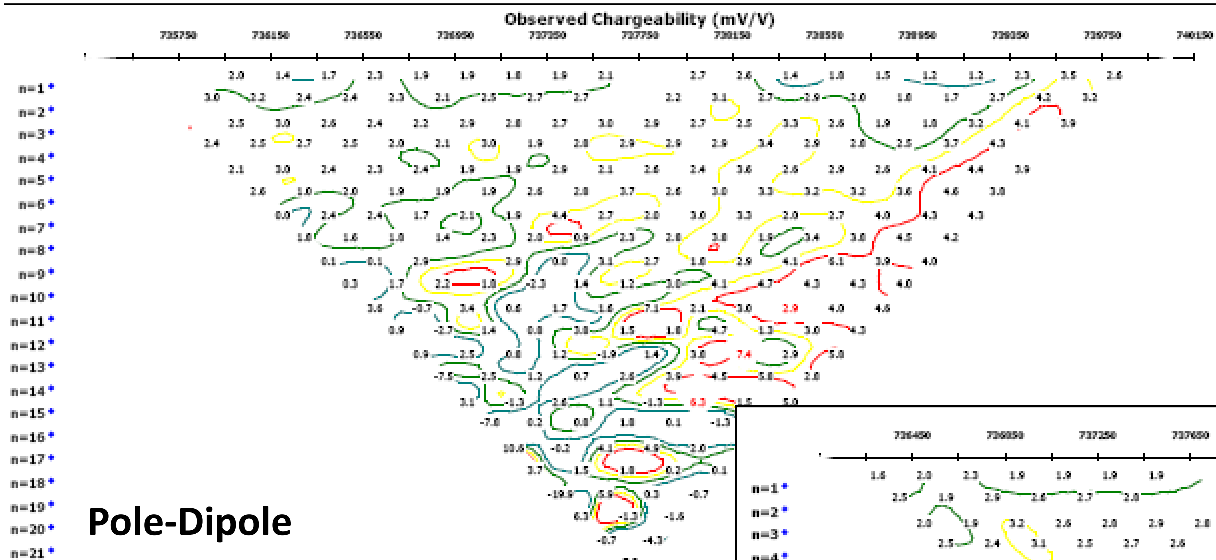
•Magnetometers - one used on line and the second for remote referencing

2006 MIMDAS MT Data Quality Example

- The MT data are characterised by clean impedance estimates for frequencies to below 0.1Hz.

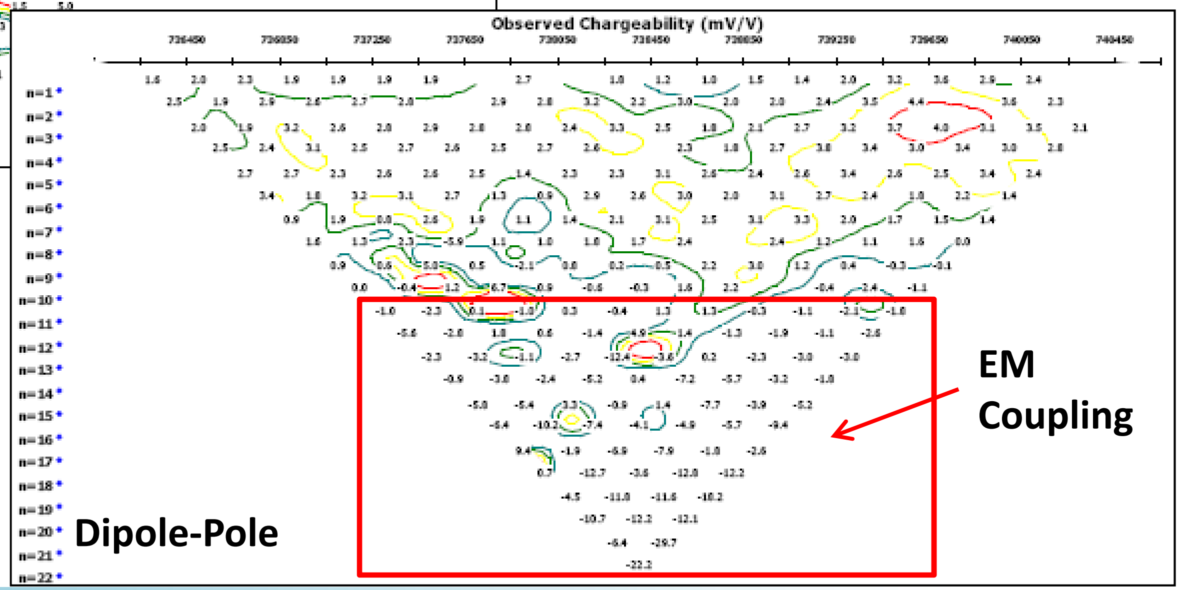


2006 MIMDAS IP Data Quality – Example Line 6543800N



- IP and resistivity data are generally of good quality.

However, dipole-pole data are dominated by negative EM coupling below n=10.



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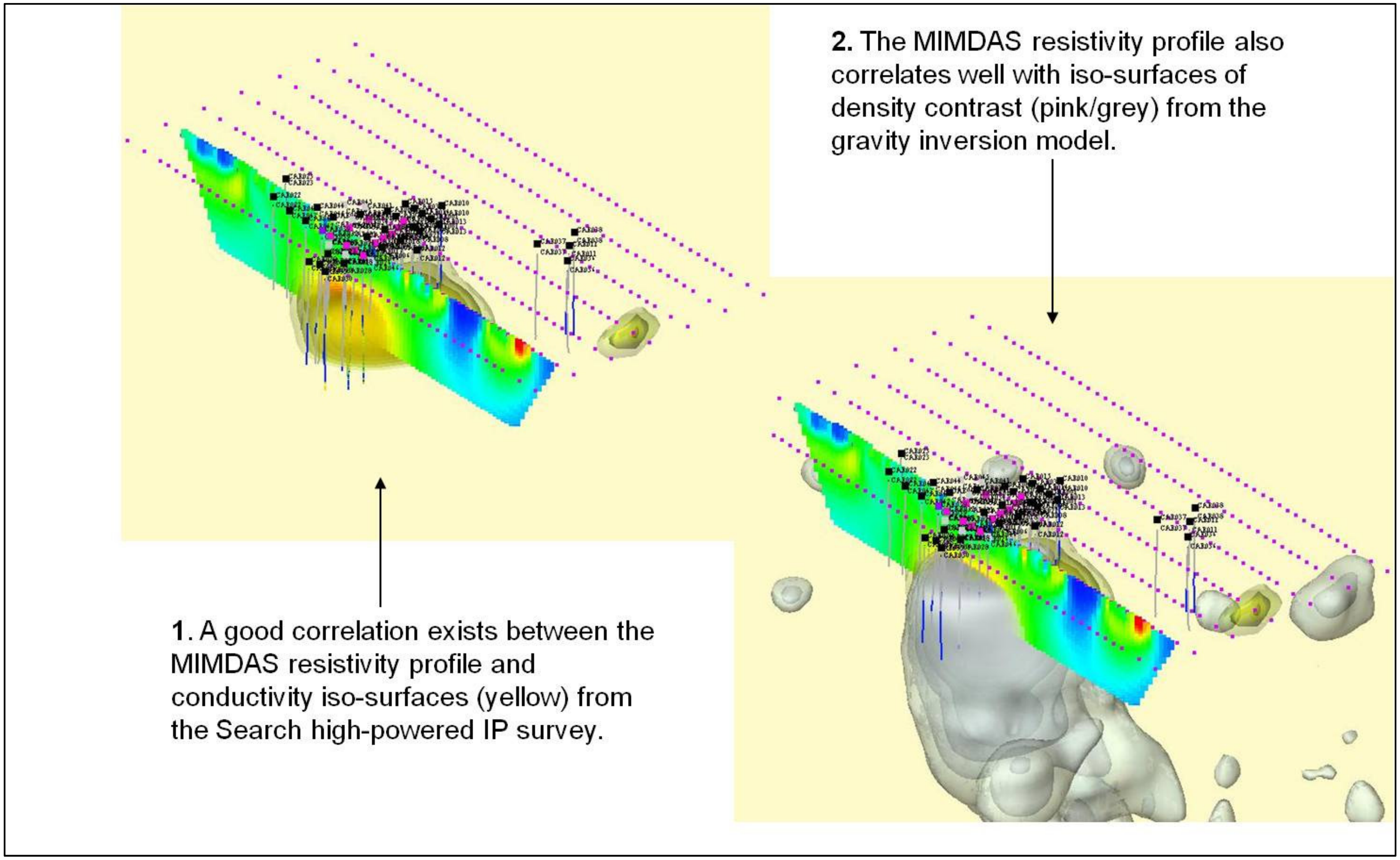
•The resistivity and IP data acquired were generally of good quality, although this was limited by the magnitude of IP signals, relative to the magnitude of residual EM coupling, at a location with significant low-frequency tellurics. Pole – dipole data contained less EM coupling than dipole – pole data, therefore, the latter was excluded from input into the inversion models.

This can be explained by the general increase in conductivity to the east of the grid which is possibly attributable to the presence of Lake Torrens and the presence of saline groundwater.

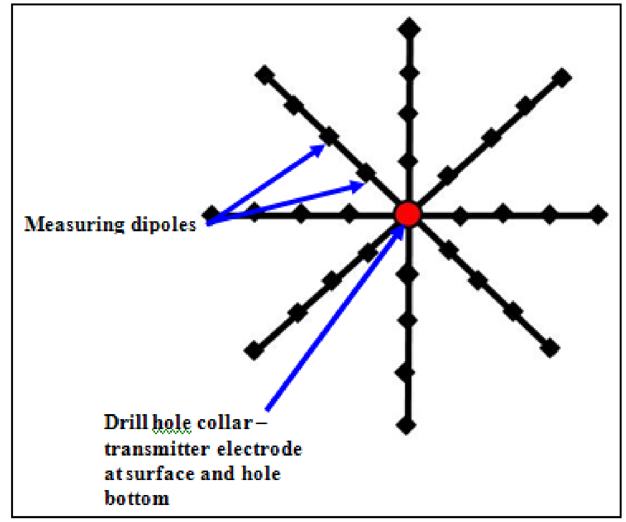
2D High-Powered IP/Resistivity Compared with MIMDAS – Line 6543400N



- Like the 2D high-powered IP/resistivity survey and the 2003 MIMDAS survey, a good correlation was observed between the conductive and gravity responses at Carrapateena. However, subtle chargeability anomalies have been negatively impacted by substantial EM coupling. Therefore, it was concluded that the resistivity and MT results would be a more reliable guide for targeting than the chargeability.

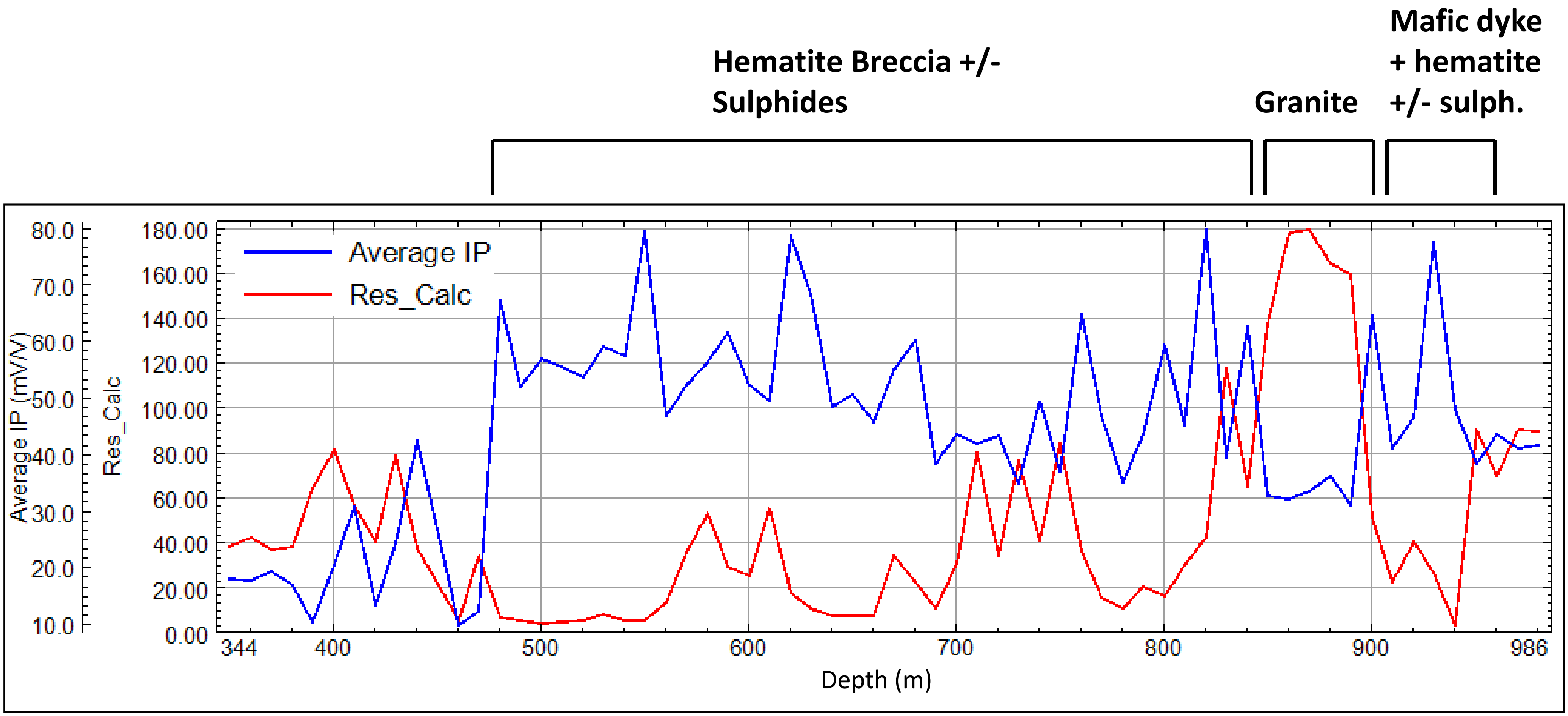
Down Hole IP/Resistivity Surveys

- 2006 – 2008 IP/resistivity surveys were undertaken by Search Exploration:-
  - *In-situ* measurements in 21 drill holes, using a collinear Wenner array, with a 3m electrode spacing;
  - Radial measurements in 6 drill holes, using three separate transmitting arrays, and
  - Cross – hole dipole – dipole surveys, using a 100m transmitter in one hole and a 50m receiver in the other.



Radial IP/resistivity measurements were also made in six drill holes in which a single transmitter electrode was placed near the bottom the hole and two other transmitting electrodes were placed about 1.5km from the drill hole and at the drill hole collar. This provided three separate transmitting arrays. Potential electrodes were then set up on eight radial lines around the transmitting drill hole. For each line there were five potential electrodes, 100m apart.

In-Situ IP/Resistivity – CAR002

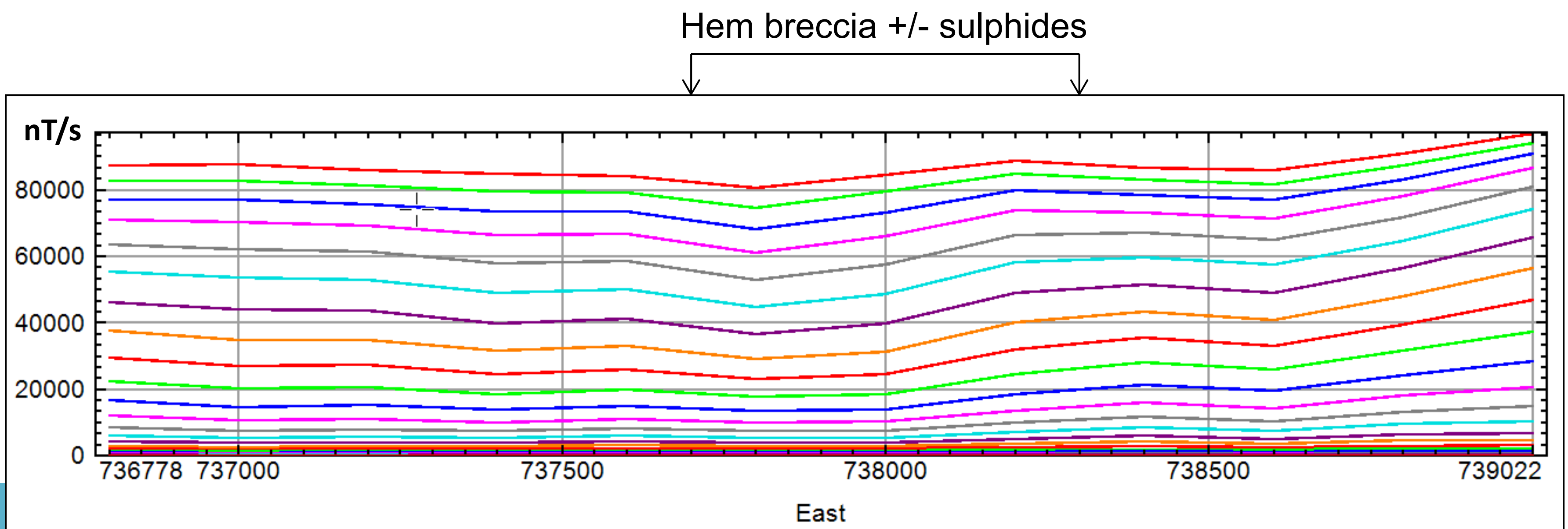


The in-situ IP/resistivity measurements were extremely useful in furthering the understanding of the electrical properties of the Carrapateena rocks. However, the radial DHRESIP does not appear to have worked in the way it was intended, presumably being a victim of 470m of moderately conductive cover and significant electrical anisotropy. Results from the cross-hole surveys were inconclusive and it may be worthwhile re-processing and re-modelling these data.

EM Surveys – Line 6543250N

System: Crone Pulse EM system
Time Base: 150 ms
Ramp Time: 1.50 ms
Channels: 42

Survey Type: Moving loop (in-loop), with abutting loops
Transmitter Loop Size: 200 m x 200 m
Current: 30 Amps
Receiver Coil Area: 4100 m^2



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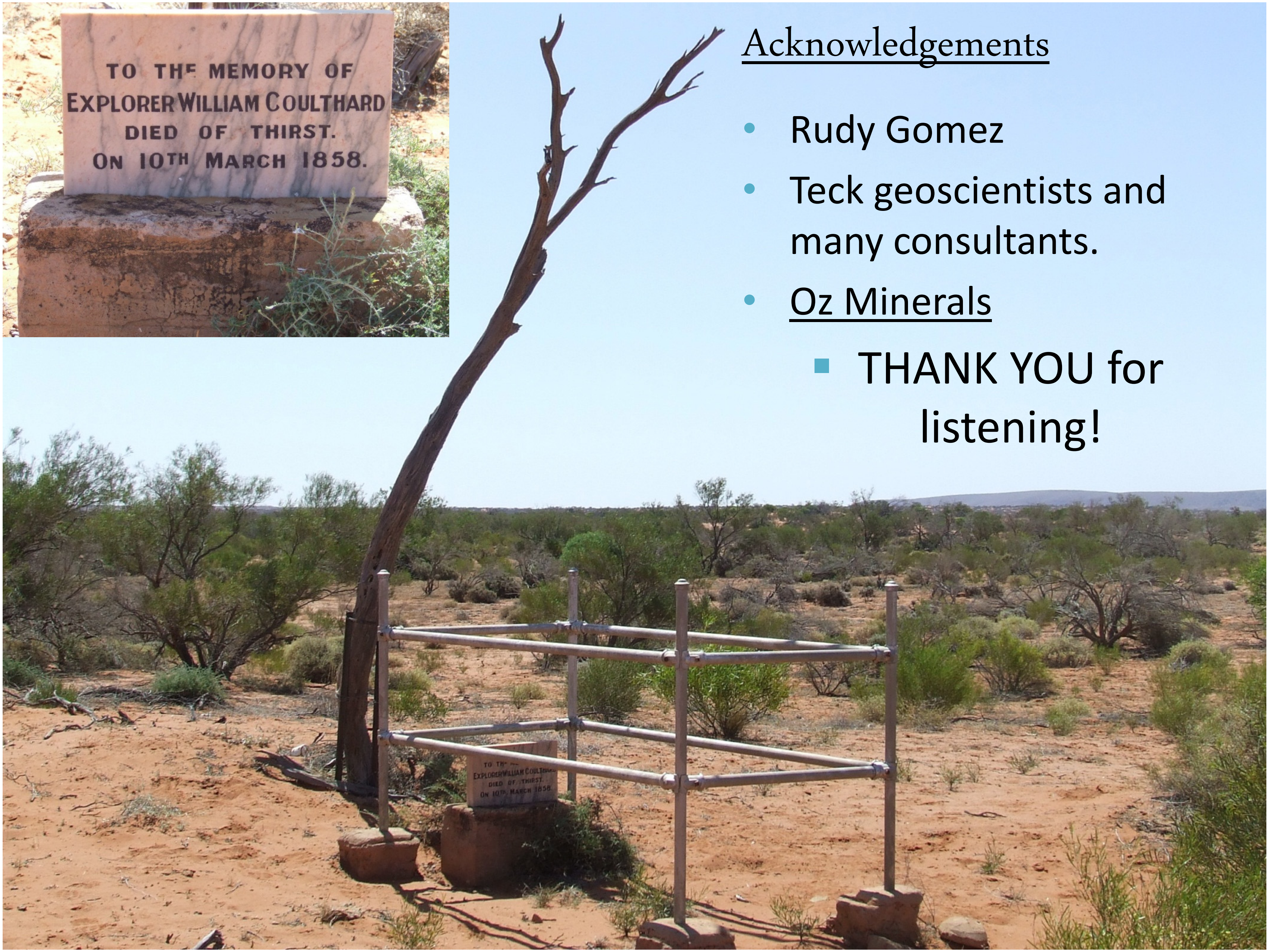
2007, Outer Rim Exploration Services conducted 3-component down hole EM surveys in four drill holes, and read one surface moving loop profile. The data were collected using a 42 channel Crone Pulse EM system, and receiver coil. A 600m x 600m transmitter loop, with a transmit current of 27A, was used for the down hole surveys, while the surface profile was read using a 200m x 200m in-loop configuration, with a transmit current of 30A.

Given the disseminated nature of the sulphide mineralisation observed to date, it was not surprising that there were no convincing responses that could be attributed to bedrock conductors away from the drill holes. Similarly, the surface profile did not yield a credible anomaly over the Carrapateena deposit.

Conclusions

- Carrapateena is associated with a weak, discrete, ellipsoidal magnetic response and near-coincident, weak, bullseye gravity high.
- Also characterised by a distinct conductivity anomaly.
- Chargeability data are somewhat ambiguous.
- EM surveys did not provide any responses attributable to bedrock conductors and are not recommended for Olympic Dam – style Fe-oxide Cu-Au deposits.
- Geophysical responses are dominated by the presence of Fe-oxides, especially hematite, with sulphides playing a lesser part.



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- Oz Minerals
  - THANK YOU for listening!

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•Permission from Oz Minerals Ltd. to present and publish this information is greatly appreciated.
•Photos taken on the SW edge of the leases.

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Questions?

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