



Miners Need Deeper Maps

Running Australia's largest IP survey

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Mines & Wines
12th September 2013

Miners need deeper maps: scientists

Exploration in Australia is getting more difficult!

- “the easy find of mineral deposits have already been made and it is becoming increasingly difficult to find large new deposits that are economically viable”
-Phil McFadden, Theo Murphy Think Tank
- “..much of Australia’s wealth is derived from mining ore bodies that were discovered decades ago”
-Barry Drummond, UNCOVER
- “Although exploration expenditure is on the rise, exploration success is declining”
- Dr Hronsky, CET
- “Yet much of Australia remains underexplored because it lies under cover”
-Barry Drummond, UNCOVER

Update on UNCOVER – May 2013

This article follows previous updates on UNCOVER, the last of which was in Issue 162 of *Preview*.

Recapping: UNCOVER is an initiative of the Australian Academy of Sciences that sets out a new vision for exploration geoscience in Australia. UNCOVER grew out of earlier initiatives of the Academy, recognising that much of Australia’s wealth is derived from mining ore bodies that were discovered decades ago. As those deposits are mined out, Australia faces a serious decline in its mineral sector, and therefore its economy, if new deposits are not found. Yet much of Australia remains underexplored because it lies under cover.

UNCOVER has identified four science themes that would help focus the effort to stimulate new exploration in areas under cover. These four science themes

- Establishing a research network that encourages collaboration across sectors.

Until now, UNCOVER has been working in a development mode, with people from all sectors participating in a working group. They have now set up the process to shift UNCOVER to a more operational mode. In May, the first step was taken, with the Academy agreeing to a new management structure led by an Executive Committee. The Executive Committee will comprise representatives from the major stakeholders:

- The exploration industry
- Universities
- CSIRO
- The Geological Surveys
- The Geoscience Societies
- The Academy as the initiator of UNCOVER.

the geoscience community can take part by filling in a questionnaire that will be posted soon on the Academy website.

Second, the results of the survey will be used to tease out the nature of discussions of the four science themes at the UNCOVER Conference later in the year.

The conference was originally planned for November 2013, but November is fairly booked up with conferences. The UNCOVER community considers the conference sufficiently important that it has decided to bring it forward to October rather than push it out to 2014.

Details of the Conference will be advertised widely, as well as on the UNCOVER website. In summary, it will be held at a residential venue near a capital city for easy access, and will

Louise Dodson

The federal government has been pressed by a think tank of scientists to provide funding to ensure subsurface exploration for future resource discoveries.

“A few tens of millions of dollars of co-ordinated research and mapping could reveal hundreds of billions of dollars of potential new mines,” said one of the scientists and director of Western Mining Services, Jon Hronsky.

A report by the 2010 Theo Murphy High Flyers Think Tank at the Australian Academy of Science said what was needed to promote future exploration was to geologically map Australia’s subsurface.

“In order to maintain Australia’s economic wellbeing we need to do something that has never been done before. We need to map Australia’s subsurface to the depth of 500 metres,” said Phil McFadden, chairman of the think tank’s organising committee.

Federal Resources Minister Martin Ferguson, launching the report, *Searching the Deep Earth: The Future of Australian Resource Discovery and Utilisation*, said the funding bid would be considered as part of the government’s future budget processes.

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While more is being spent on exploration, less is being discovered by mining groups.

Photo: DAMIAN WHITE

potential sources of geothermal energy and improve earthquake pre- “Although exploration expendi- ing rock outcrops on the surface. But Dr Hronsky said the technol- ogy existed to look beneath the sur- of the next Olympic Dam. just about discovering osits, it’s also about find- nes that will last a hun- ton’s Olympic Dam min- South Australia, 500 kil- th of Adelaide, has the ium, fourth-largest cop- b-largest gold deposits in

Each year since 2002, the Australian Academy of Science has held a High Flyers Think Tank to bring together some of Australia’s brightest young minds to consider a topic of national importance.

To a large extent, Australia has a minerals economy. However, the easy finds of mineral deposits have already been made and it is becoming increasingly difficult to find large new deposits that are economically viable. This does not mean that Australia has run out of undiscovered giant ore deposits, rather that we need new approaches to understanding the crust we live on and to locating the deposits that do exist. This is particularly difficult in Australia because of deep and extensive coverage by the regolith.

The 2010 Think Tank, *Searching the Deep Earth: The Future of Australian Resource Discovery and Utilisation*, will examine the contemporary challenges facing Australian science in delivering a better understanding of crustal processes and mineral systems, and thereby in delivering more effective exploration strategies. This Think Tank represents a valuable opportunity for some of Australia’s leading early- and mid-career researchers to develop new understandings of our world and to identify new approaches that can be applied to this critical issue.

Think Tanks are generously supported by funds from the Theo Murphy (Australia) Fund, which is administered by the UK Royal Society. The Academy is pleased to have this funding available to enable some of Australia’s outstanding young scientists to engage in fresh thinking about an area of great importance to the nation and to develop networks that will sustain their careers into the future.

We need something new!

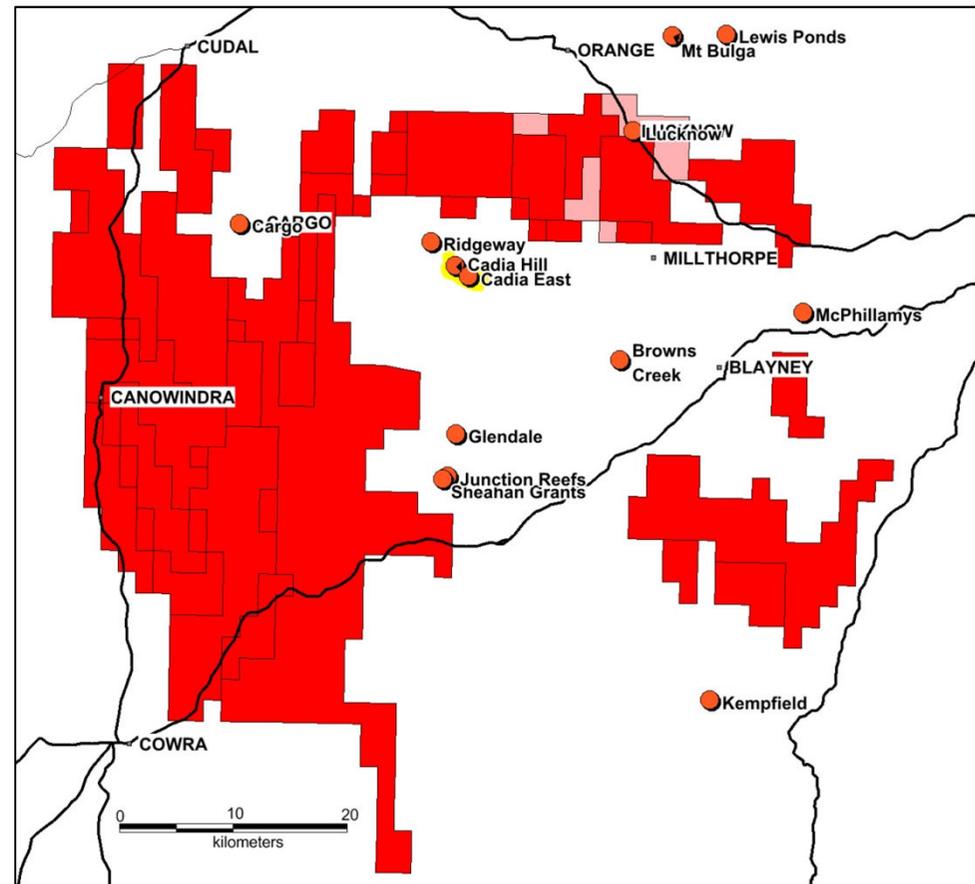
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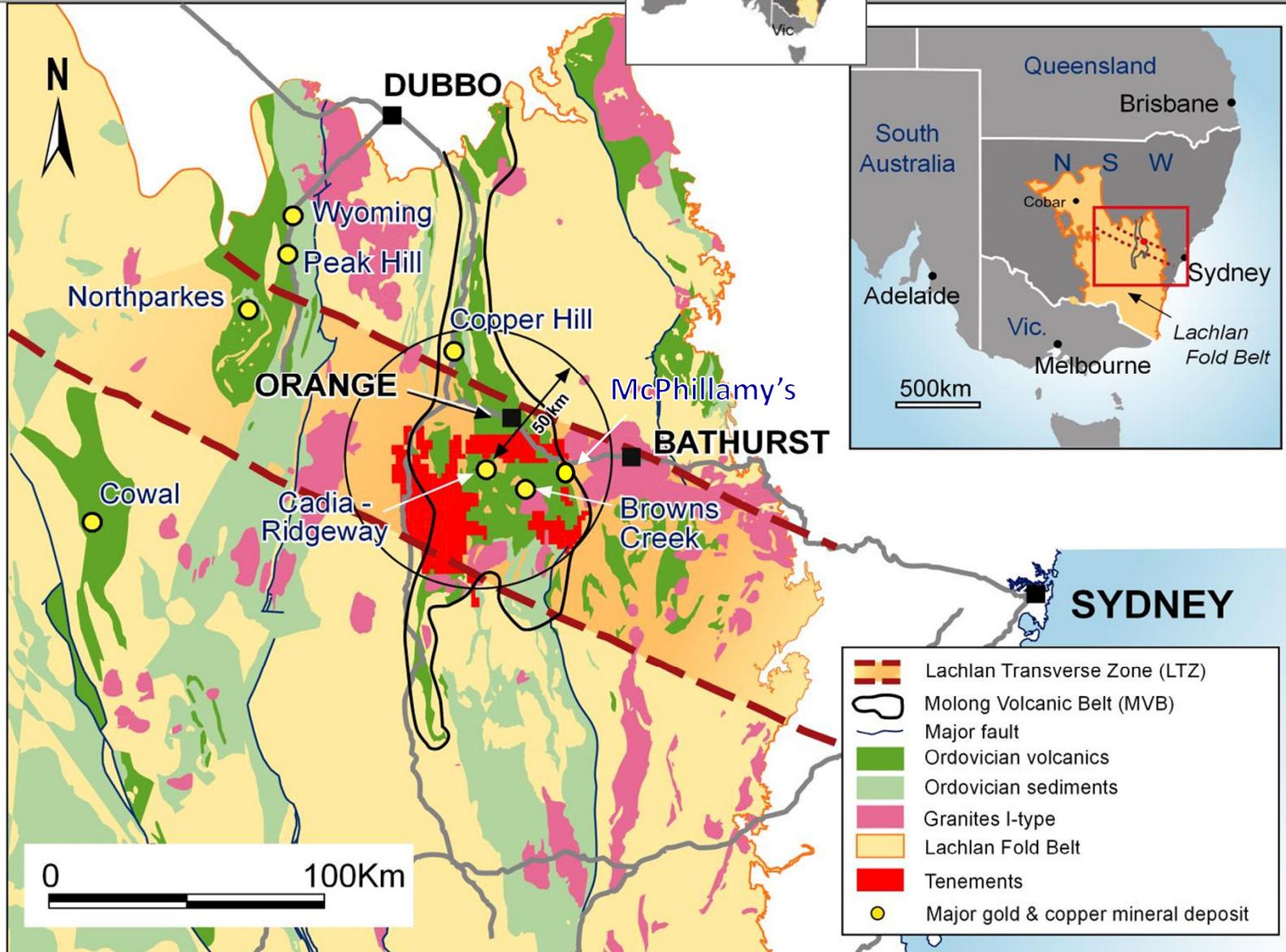
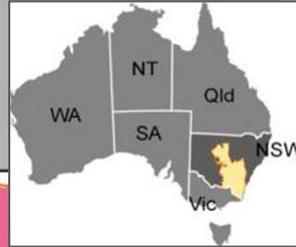


GCR is a private mineral exploration company that:

- Believes that there are further economic ore deposits in the Orange Region, but they will be more difficult to find due to cover or being “blind” at surface
- Aims to confirm the Orange Region as a globally significant porphyry Cu-Au province, and to use the next generation of technology to unlock it

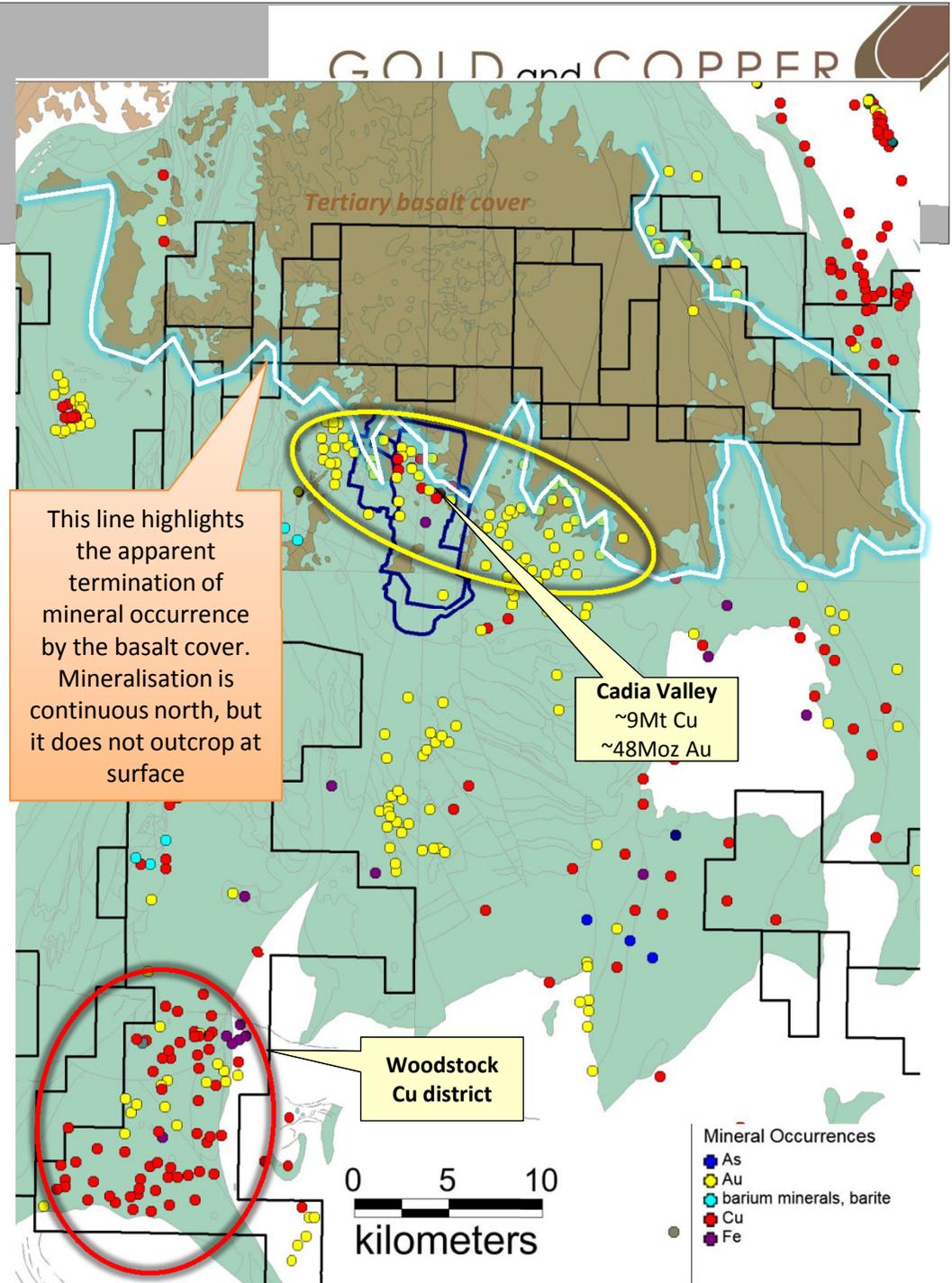


Project Location



WHY ARE WE HERE?

- Newcrest’s discovery of Ridgeway under 500m of cover and Cadia East under 1000m of cover was the catalyst for GCR to target porphyry systems under cover in the Orange region
- Need a technique to see through cover sequences, to eliminate wildcat drilling
- Super IP provides an extra layer of information to target drilling
 - e.g. Woodstock Copper district with abundant Cu “smoke”



IP Surveys

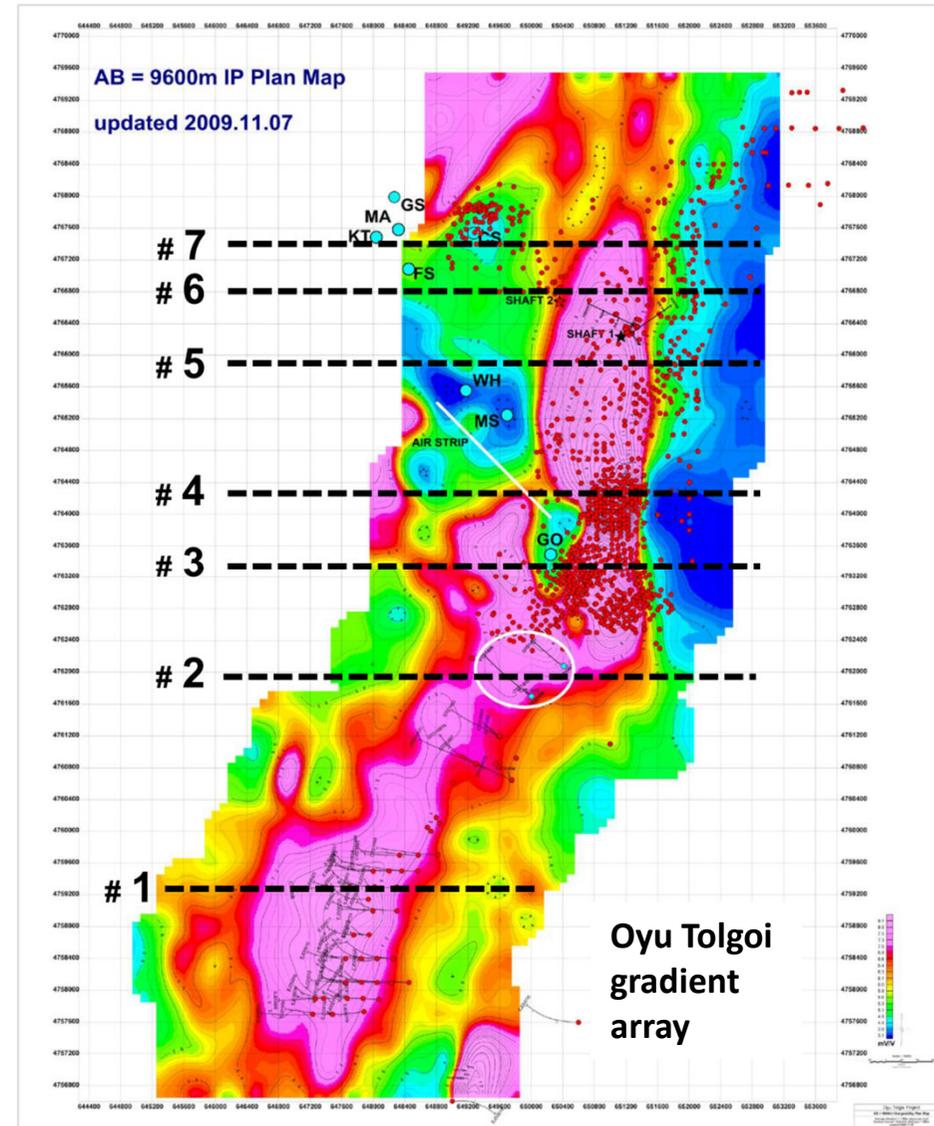
- IP surveys commonly used in minerals exploration industry to detect pyrite and other sulphides around porphyry ore bodies
- Proven method in Orange region:
 - Early IP survey crucial in focusing exploration across Ridgeway
 - IP survey detected pyrite halo above the ore zone
- GCR use the IP survey data to provide a target for follow up work
- Large-scale gradient array IP defines target which is then refined through mapping, sampling and analysis of historic information





SUPER IP

- **SUPER IP** – large-scale version of an IP survey, with electrode separation of >12km
- Super IP technology developed and validated at Oyu Tolgoi, where the large-scale gradient array IP (or Super IP) increased the extent of the known mineralisation under >2km of cover
- The similar rocks and district scale led GCR to believe Super IP was applicable across the Orange region





SUPER IP

But there is a big difference between the Gobi Desert...



...and the central west!



SUPER IP

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How do you run 12km+ of electric cable carrying 1000volts in a populated area?



Put it up on poles!







(c) Gold and Copper Resources Pty Ltd





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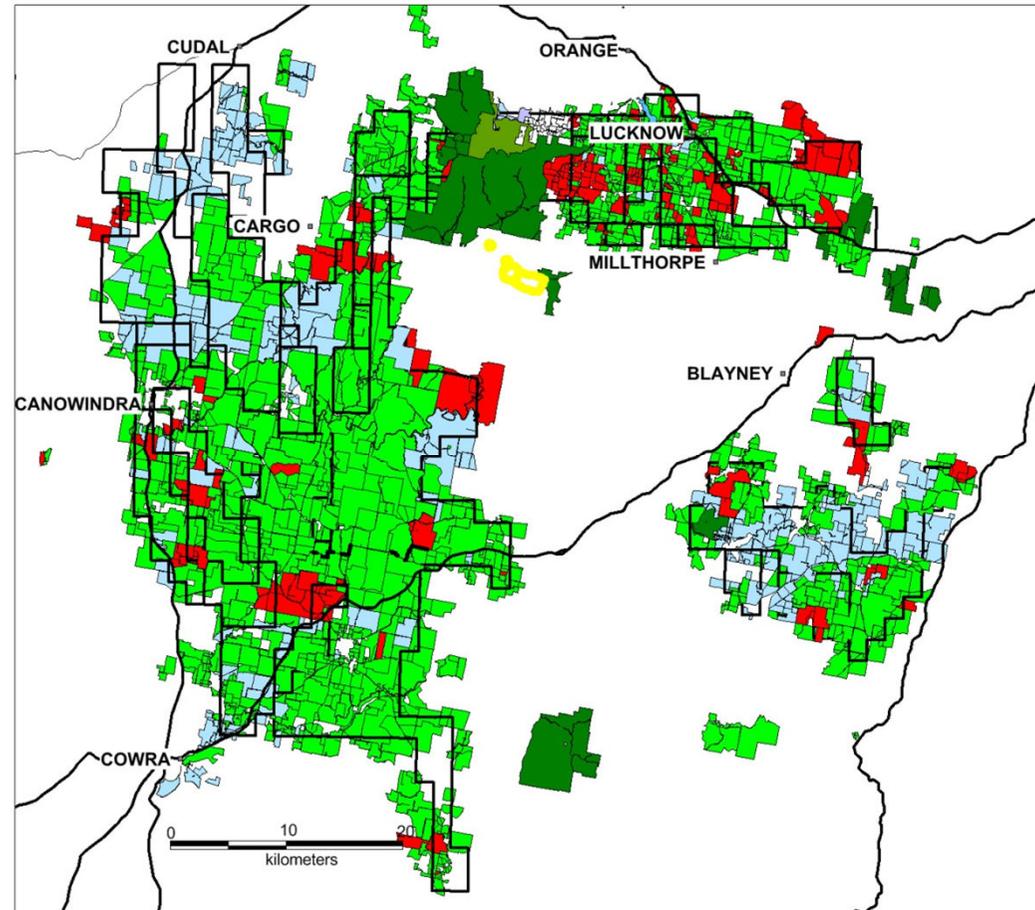
SUPER IP

- Poles are strung with low resistance “raisin” wire
- Raisin wire has $>1/3$ of the resistance of normal IP cable
- Doesn't need to be insulated, as minimum 5m off the ground
- Using raisin wire means that a high powered transmitter is not necessary to get the required amps into the ground



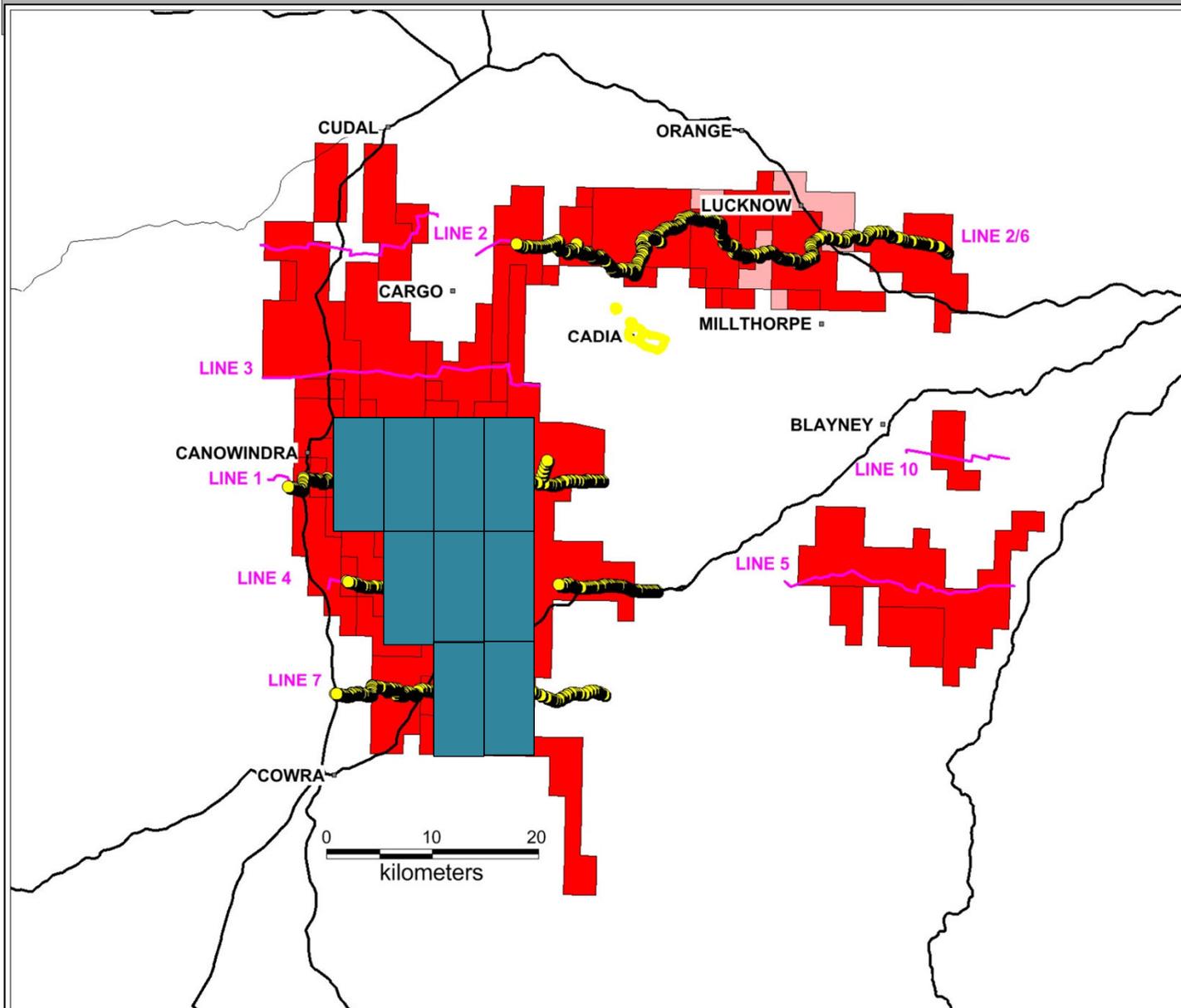
Land Access

- More than 2000 landowners in the survey area
- >1300 signed property agreements
- Low impact nature of survey has been key to success
- Large tenement package allows survey to be scheduled to fit around farming activities
- Gives landholders the chance to find out if anything of significance is below their property



Access July 2013		
■	Signed Agreement	(1329)
■	In negotiation	(222)
■	Will not sign on first approach	(184)

IP Survey



IP Survey Progress

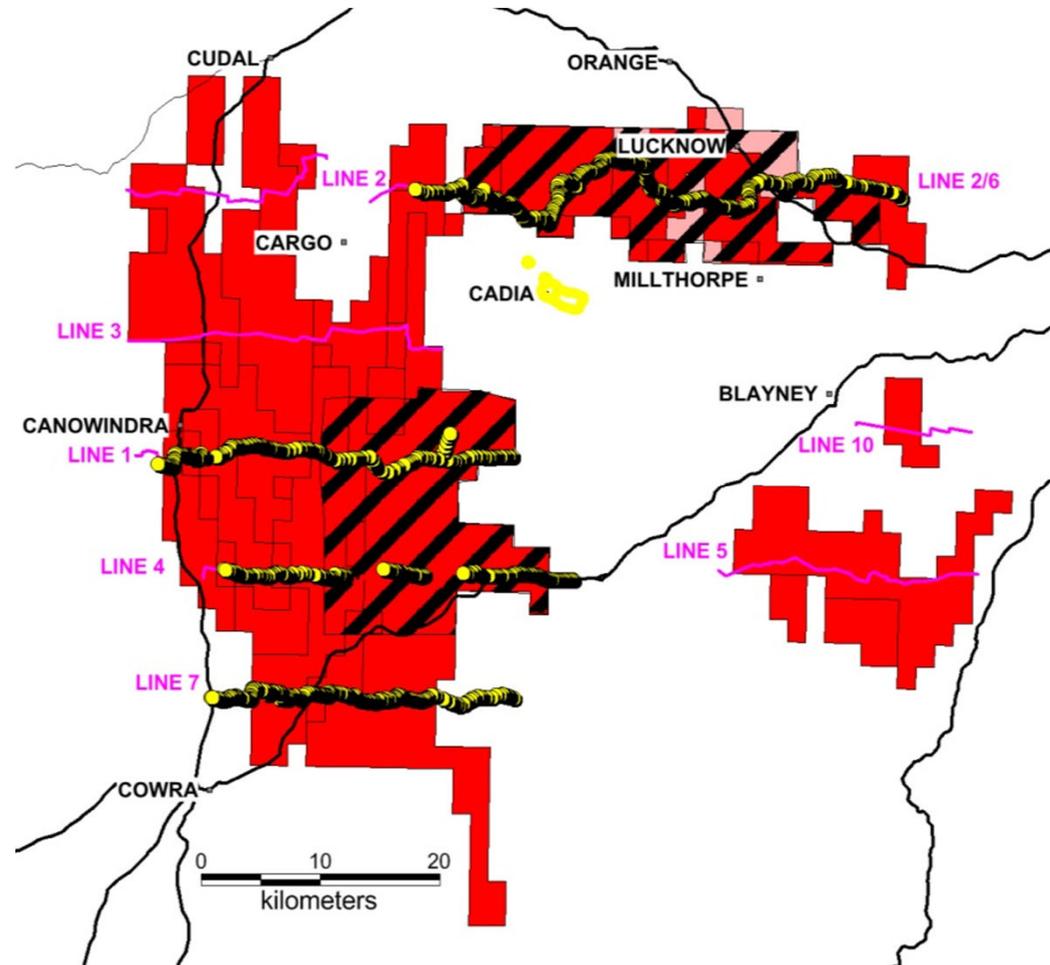
- Survey started in July 2011
- Began with Zeus Transmitter and Mongolian Field crew
 - Zeus returned to Mongolia in September 2011
- Continued with Search transmitter and crews from Fender Geophysics
- Surveying with the two transmitters allowed comparison of data – benchmarking
- Proved that get the same quality data without Zeus



Zeus team in the field near Mandurama, July 2011

IP Survey Progress

- 9 transmission lines planned
- >130km of transmission line built
- >500km² of IP survey completed so far
- When complete, more than 1,500km² will have been covered with IP



Chinaman's Hill

- Isolated, extremely high chargeability returned from survey >50 mv/v
- Correlates with mag anomaly
- **YOU BEAUTY!!**

- Field check of anomaly
- Send off sample for petrophysical testing
- Create 3D mag inversion model
- Initiate 3D IP survey to detail anomaly at depth

- **BUT**
- Field check revealed ultramafic in outcrop
- No geochemical anomalism
- Mag model matches IP model to 200m
- Petrophysical results showed ultramafic responsible for strong chargeability values
- Petrology revealed the presence of serpentinite and 2° magnetite (not hydrothermal) were the likely cause of the high chargeability as no sulphide or graphite were present!



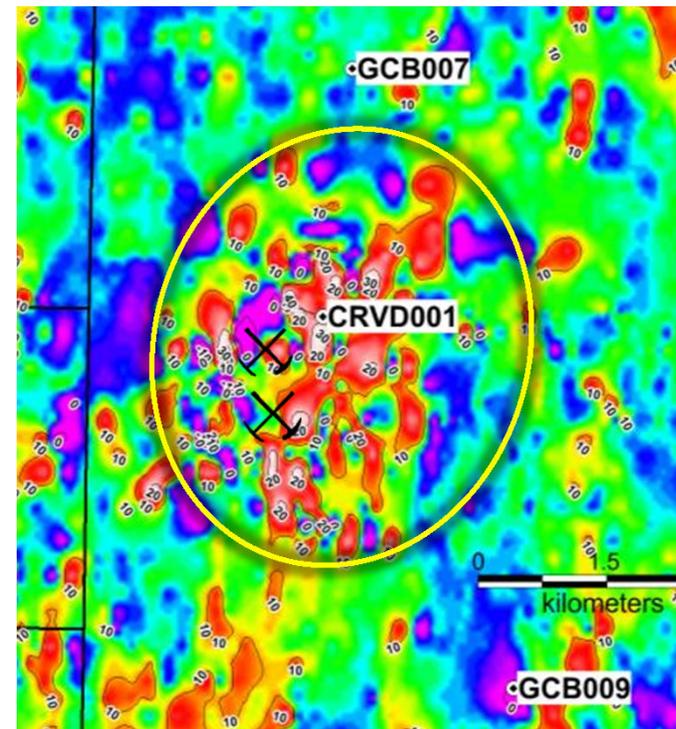
Throughout the survey there will be red herrings!

Corrivale

- Complex IP anomaly 2km x 3km in otherwise “ordinary” Walli Volcanics
- Numerous historic copper & barium occurrences including Fitzroy and Belubula copper mines
- Surveyed with Zeus & Search transmitters allowing reconciliation of data



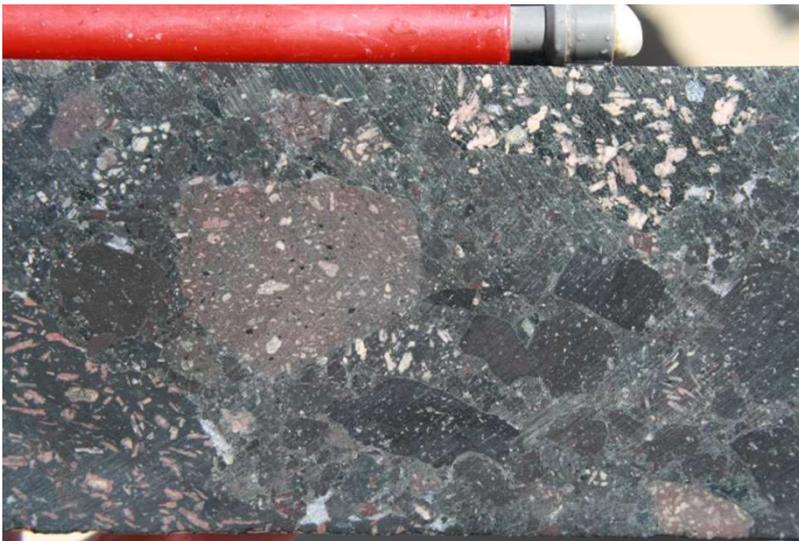
Quartz-carbonate veining with malachite and bornite at Fitzroy mine



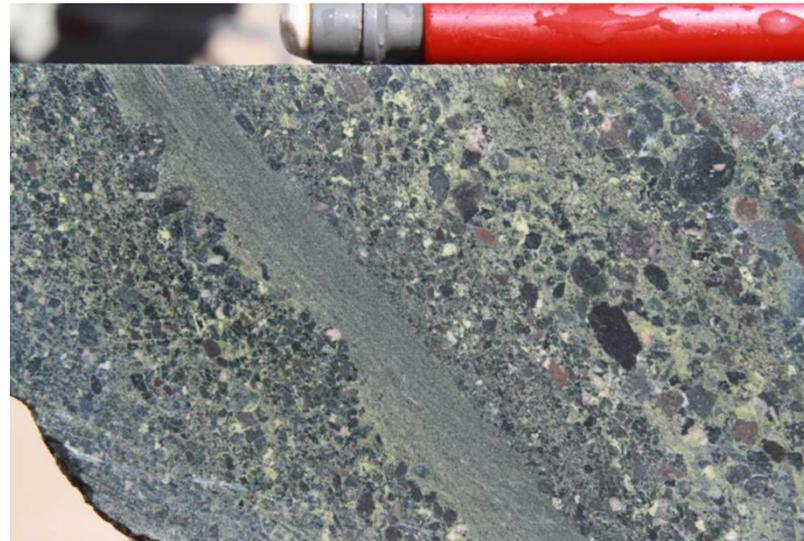
IP chargeability results across the Corrivale anomaly, with the locations of the historic Cu workings shown

Corrivale

- 750m drillhole completed into strongest part of GA anomaly
- Chalcopyrite and pyrite present in volcano-sedimentary units
- Drillhole provided evidence for a likely mineralised volcanic centre within the Walli Volcanics
- Petrophysical testing of core indicated sulphides were not the cause of the large chargeability anomaly
 - **Drilling did not adequately test the IP anomaly – importance of further IP surveys to detail anomaly shape**



*Volcanic breccia with variably altered clasts and fg chalcopyrite; 111m.
(photo courtesy G.Corbett)*



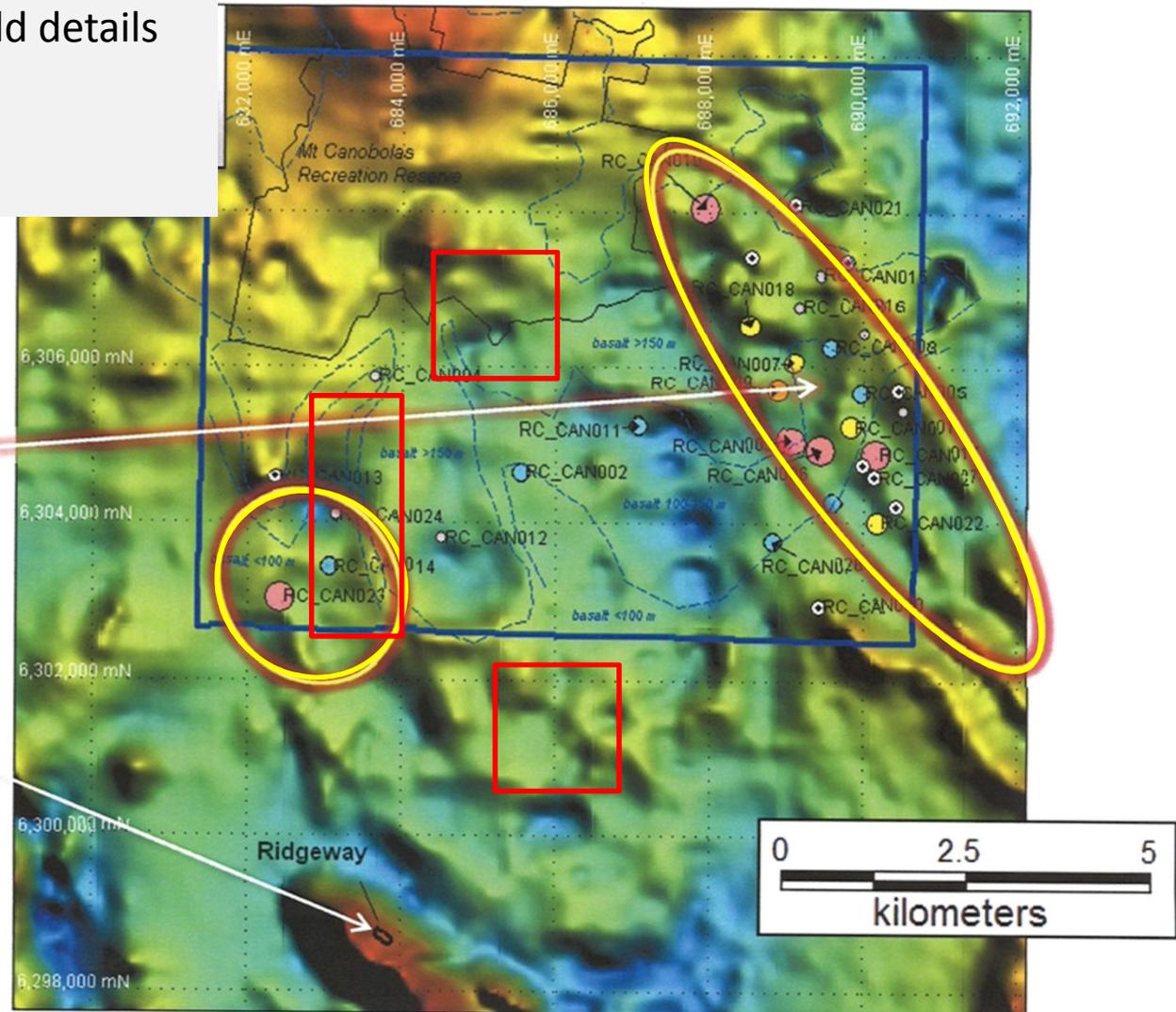
Epidote flooding in the matrix of a clastic rock, with magnetite altered clasts, 654m (photo courtesy G.Corbett)



Basalt Cover

Previous work by Paradigm Gold details areas of significant anomalism
- Drilling targeted on aeromag

GCR gradient array IP survey gives extra level of detail, and new data for drill targeting



Roxanne

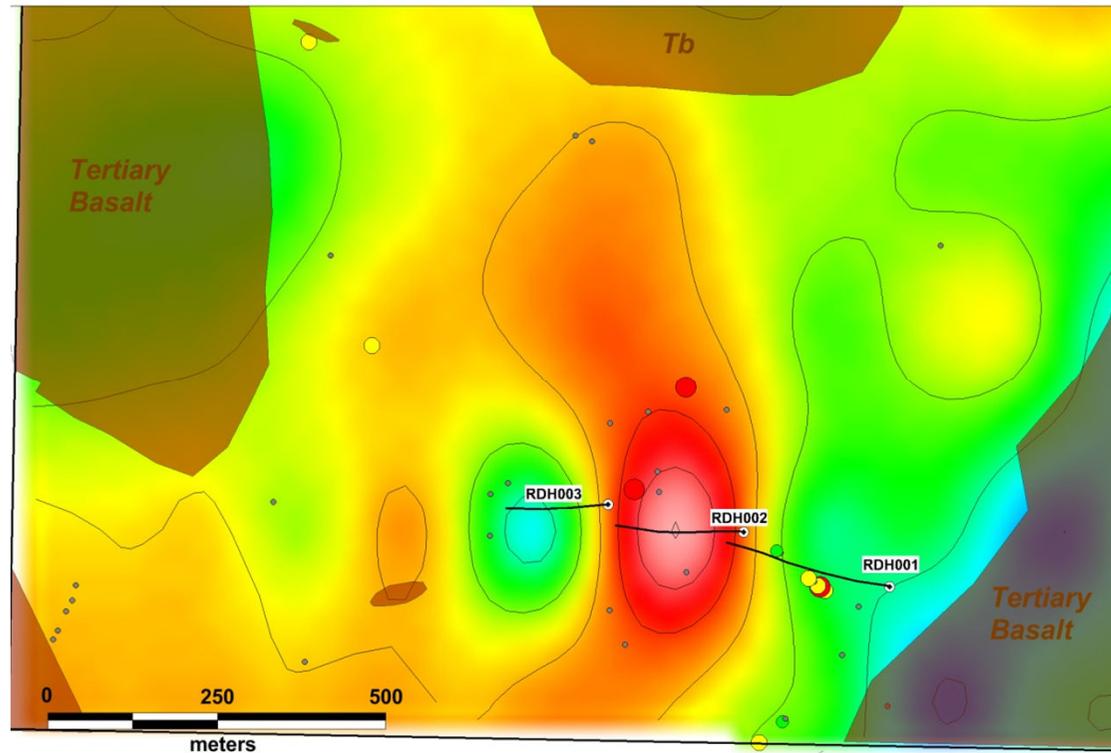
- Area previously mapped as under cover
- Strong chargeability + Resistivity target from gradient array IP survey
- Field traverses and petrology confirmed outcropping Ordovician – not Tertiary cover
- Anomalous Au+Cu+Mo from rock chip sampling on surface including quartz veining with epithermal textures
- Offset pole-dipole survey completed to model anomaly at depth



Right: Epithermal style quartz vein (D vein?); and top right: Fe/Mn fracture fill

Roxanne

- 3 shallow vector drill holes completed March 2013
- Provided geological information to focus in on porphyry at depth
- Drilling encountered porphyry-style alteration and sulphides in veins
- Each of the three initial holes intersected Forest Reef Volcanics and/or Weemalla Formation (same rocks that host mineralisation at Cadia Valley)



Roxanne

Summary of drilling results - RDH001



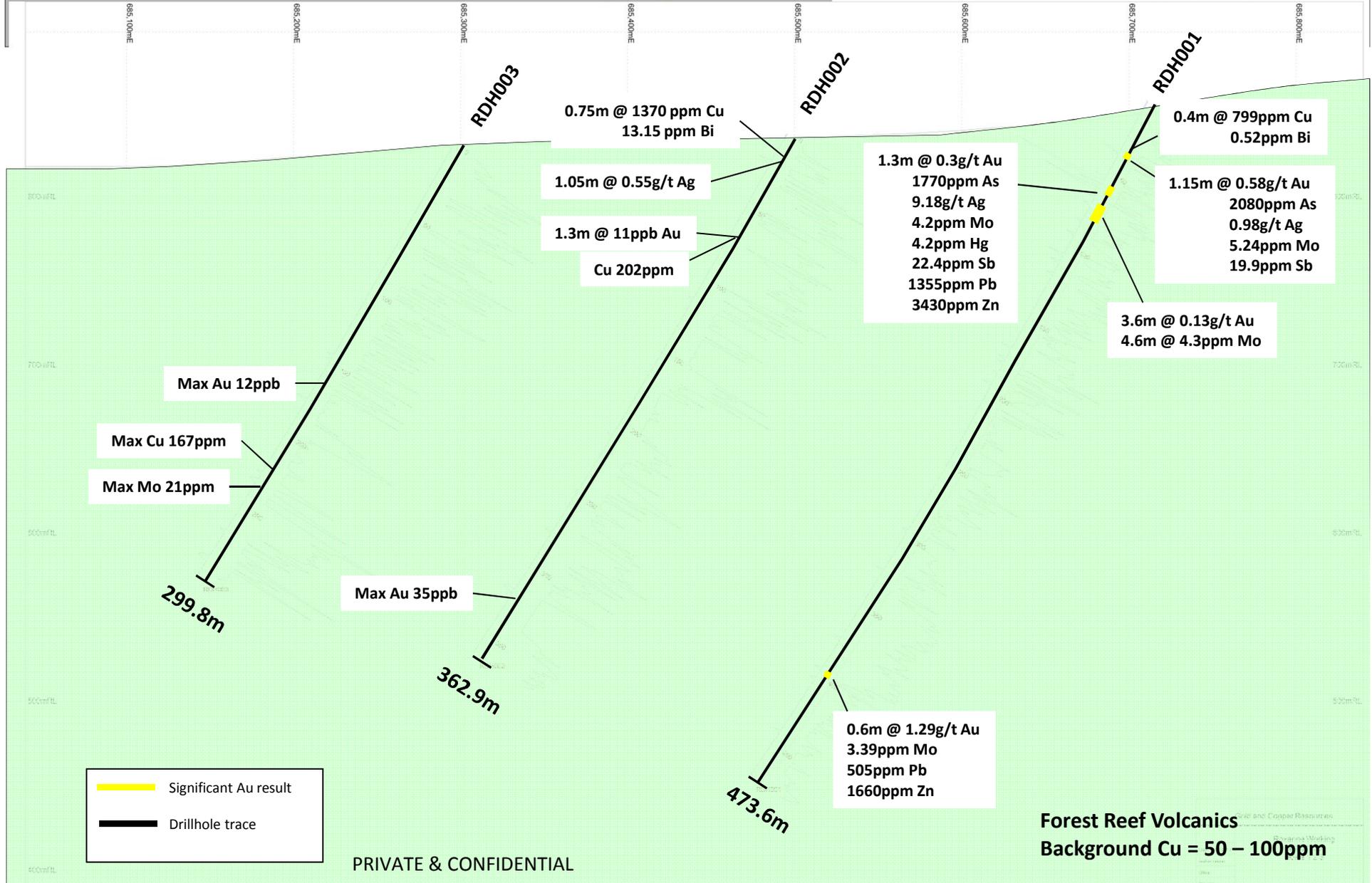
- Significant Results include:
 - **1.15 m @ 0.58 g/t Au** with anomalous arsenic (2080 ppm), silver (0.98 g/t), moly (5.24 ppm) and antimony (19.9 ppm) from 35.45 m
 - **1.3 m @ 0.3 g/t Au** with anomalous arsenic (1770 ppm), silver (9.18 g/t), moly (4.2 ppm), mercury (4.2 ppm), antimony (22.4 ppm), lead (1355 ppm) and zinc (3430 ppm) from 55 m
 - **3.6 m @ 0.13 g/t Au** from 62m with **4.6 m @ 4.3 ppm Mo** from 61 m
 - **0.6 m @ 1.29 g/t Au** with anomalous Mo (3.39 ppm), lead (505 ppm) and zinc (3430 ppm) from 396.8m
 - **Copper to 0.08%** from 34.7 m – 35.1 m
- Significant gold associated with altered dikes which are associated with anomalous As, Ag, Sb, Hg +/-Mo in disrupted Qtz-Carbonate veins
- Confirms high level porphyry environment



Drilling at RDH001

Roxanne

Multielement results

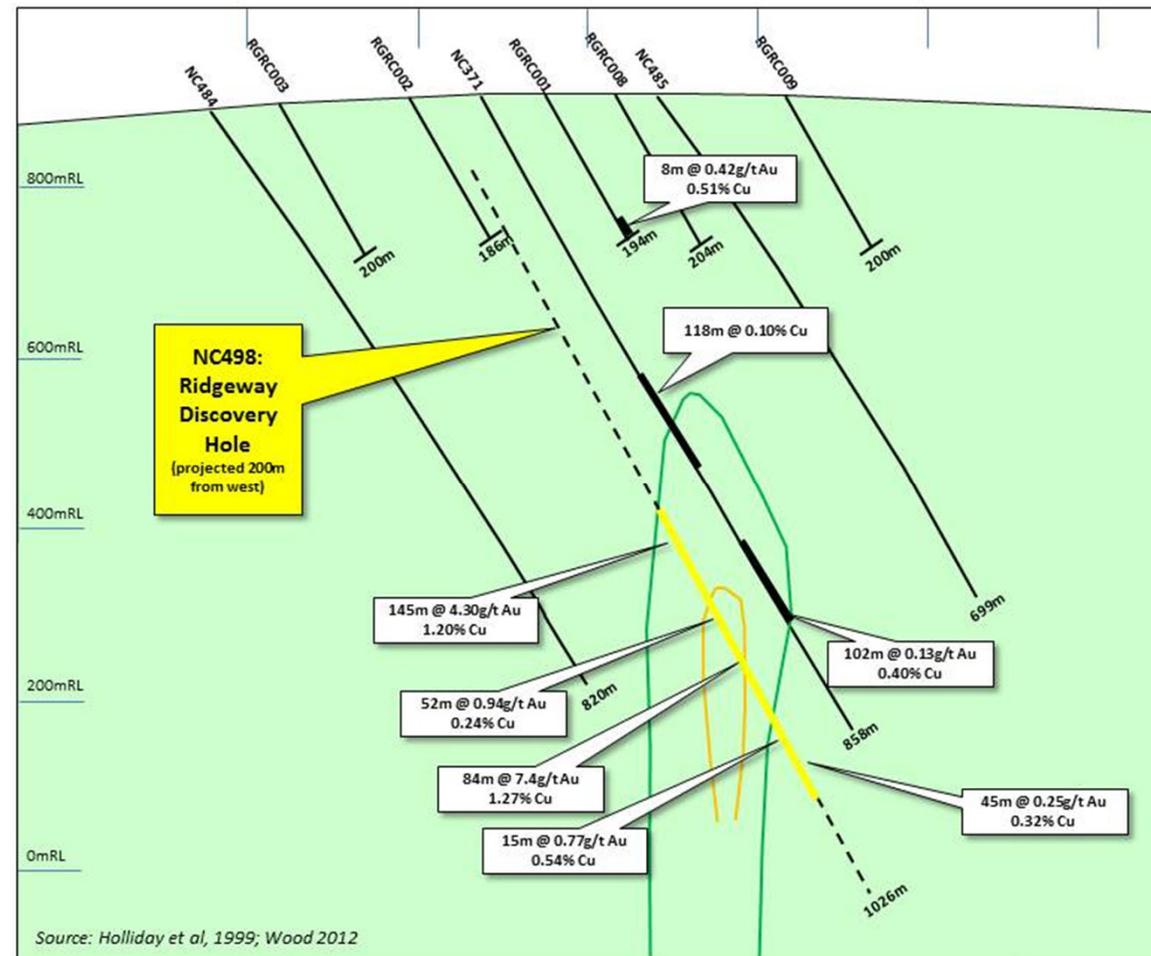


Roxanne vs Ridgeway

- a comparison in exploration strategy



- Early RC drilling into Ridgeway based on weak IP anomalism
- Early drilling did not intersect significant mineralisation, rather
 - The presence of alteration encouraged further drilling
- Subsequently grade was returned from what is now known to be part of the “outer halo” of the Ridgeway deposit.
- Consequently, GCR geologists who have worked on the various components of the Cadia Valley are encouraged by the results returned in the first vector holes (RDH001 – 003).



Above: Early drilling through Ridgeway orebody, after Wood, 2012

Challenges & Opportunities

- Large logistical challenge before “exploration” begins
- Long lead time for survey ≠ short license renewal periods
- EL period of grant doesn’t reflect changing exploration techniques
- Low impact, large scale exploration allowing effective targeting
- Only way to see through cover & barren sequences other than wildcat drilling



MINERS NEED DEEPER MAPS

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- Many politicians, researchers and industry “big wigs” are noting the need for deeper maps and new technologies to uncover the mines of tomorrow
- **Gold and Copper Resources are doing it!!**
- Discovery of Ridgeway under 500m of cover is proof that hidden mineralised systems are present in the area
- IP survey produces new data to target these hidden systems

Super IP + deep drilling of targets = new discoveries



A tale of two districts

- SuperIP at Oyu Tolgoi vs. conventional drilling at Cadia – long section at same scale

Cadia Valley 1.5 billion tonnes, current mining operation defined by drilling (20 years)

Oyu Tolgoi 6-8 billion tonnes, current unmined resource discovered using Super IP prior to drilling (6 years)

