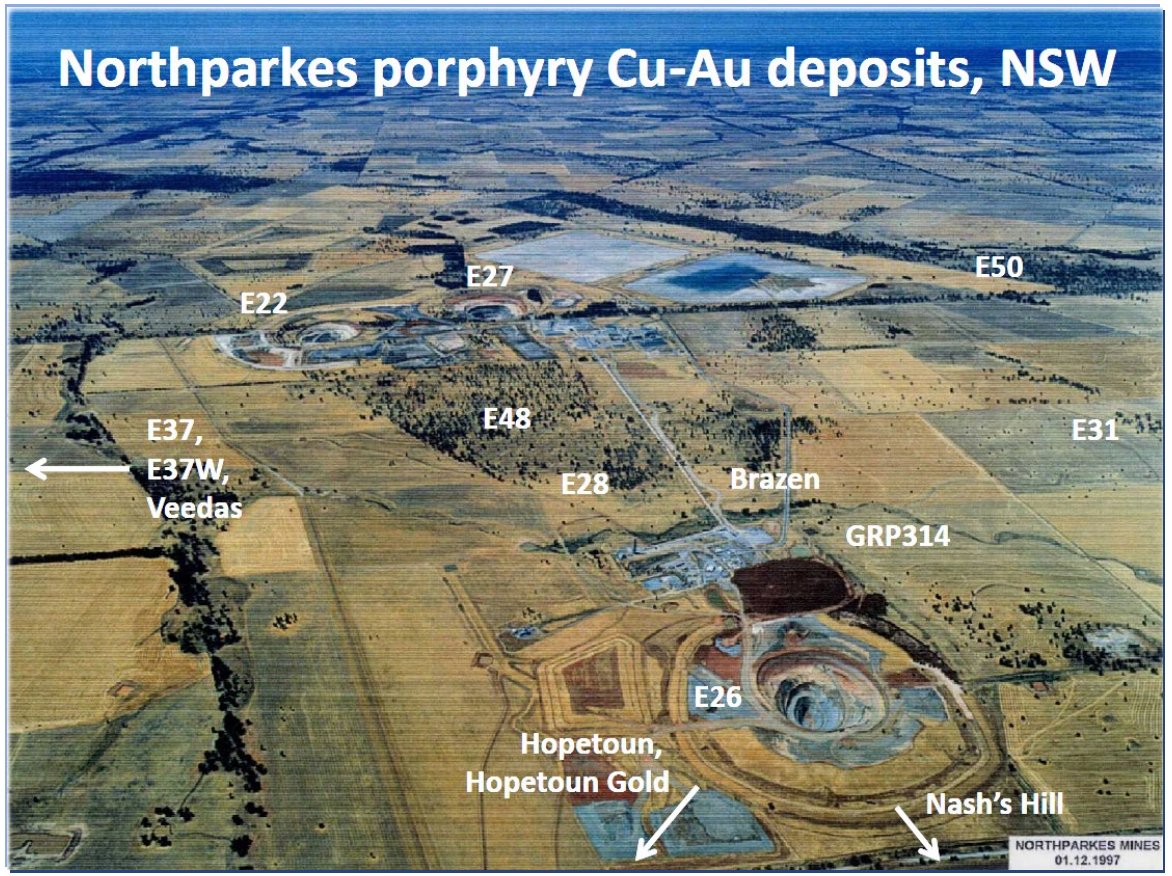
# GEOPHYSICAL RESPONSE OF ALTERATION AND MINERALISATION AT THE CADIA AND NORTH PARKES PORPHYRY DISTRICTS, NSW, AUSTRALIA


Terry Hoschke
Anthony Harris
Jonathon Hoye

# Talk Outline

## Location

## Regional Geophysics

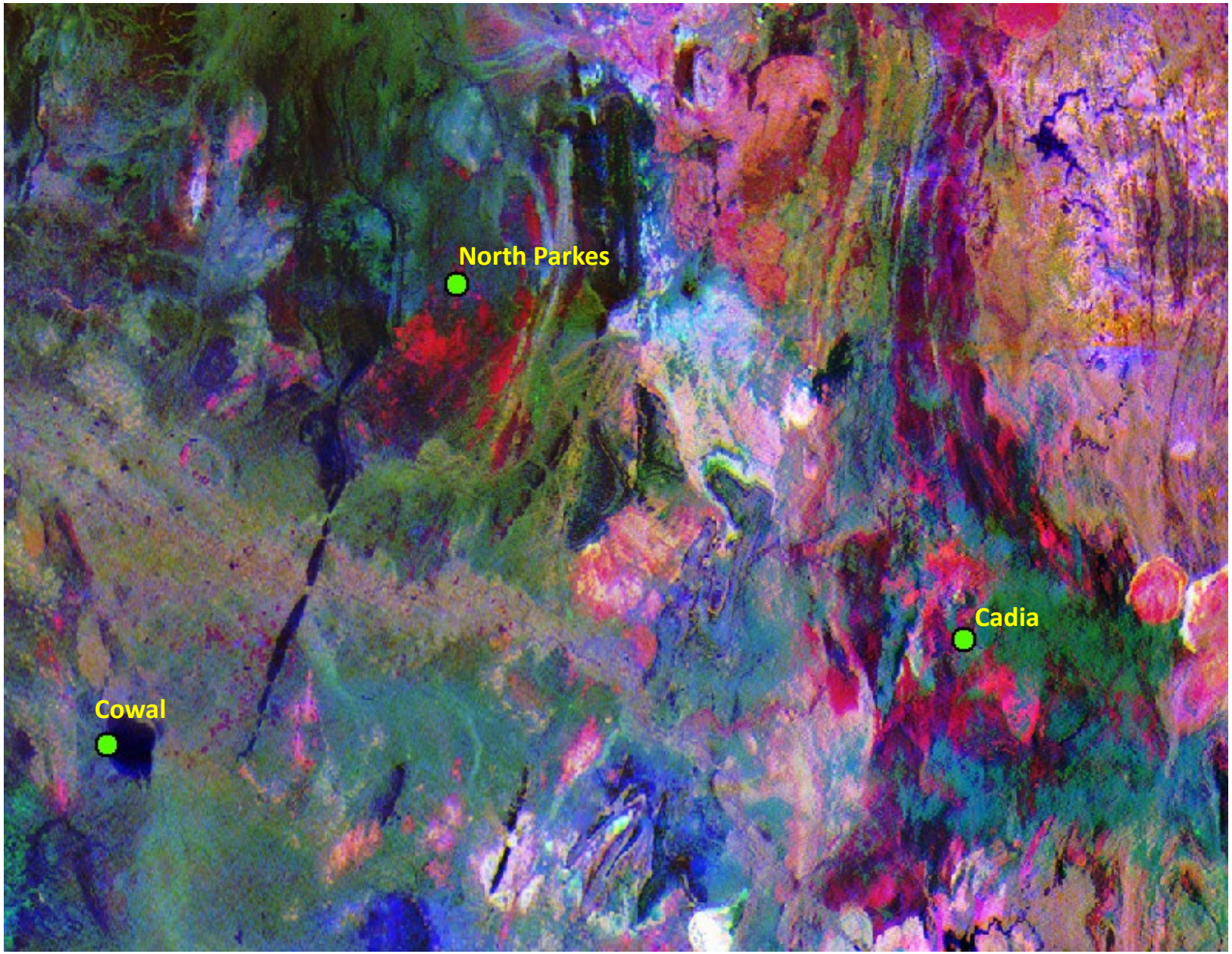
## Cadia

- Discovery History
- Geology
- District Gravity
- Magnetics
- Cadia Hill
- Ridgeway
- Cadia East

## North Parkes

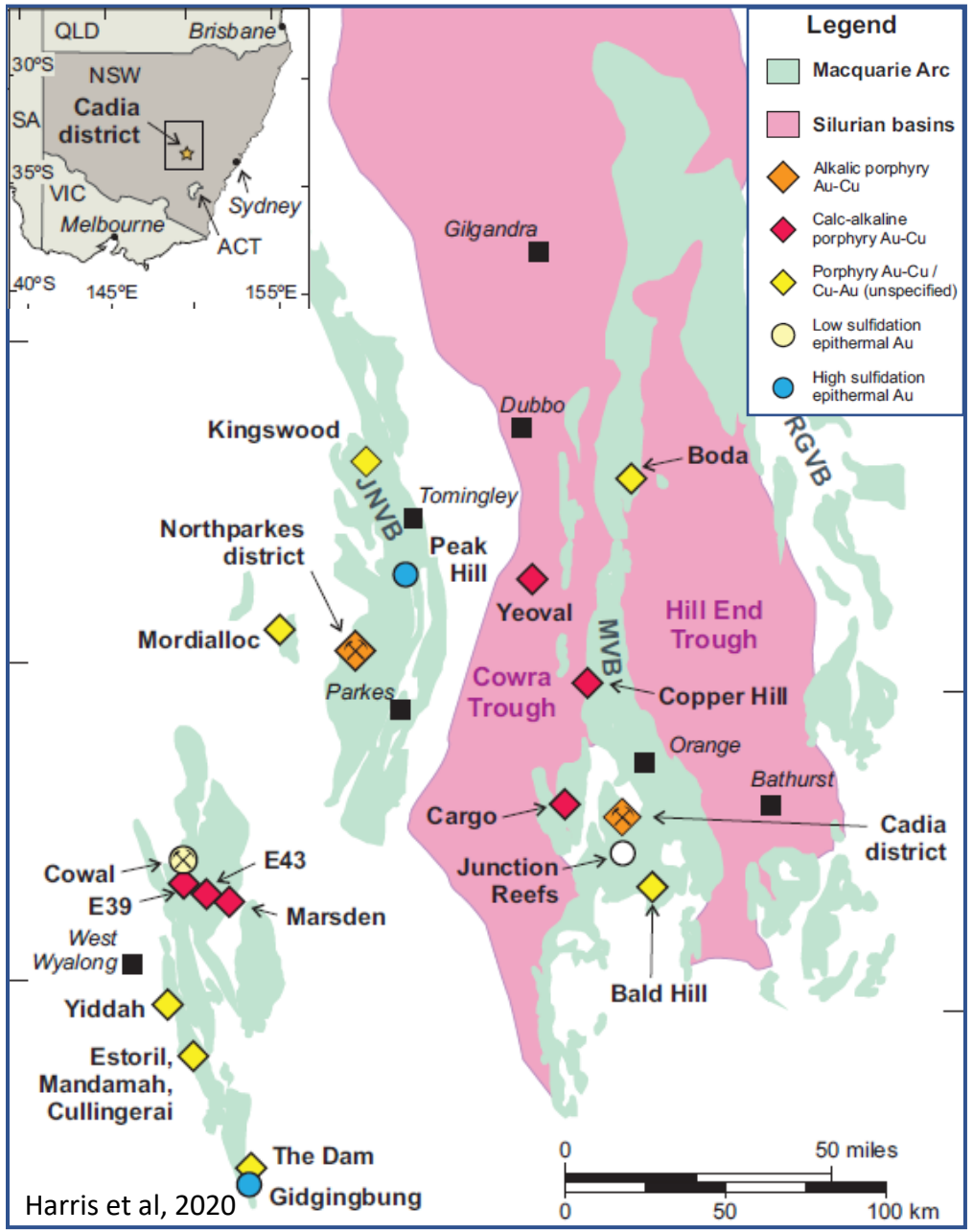
- Discovery History
- Geology
- District Gravity
- Magnetics
- E22, E26, E48

## Conclusion

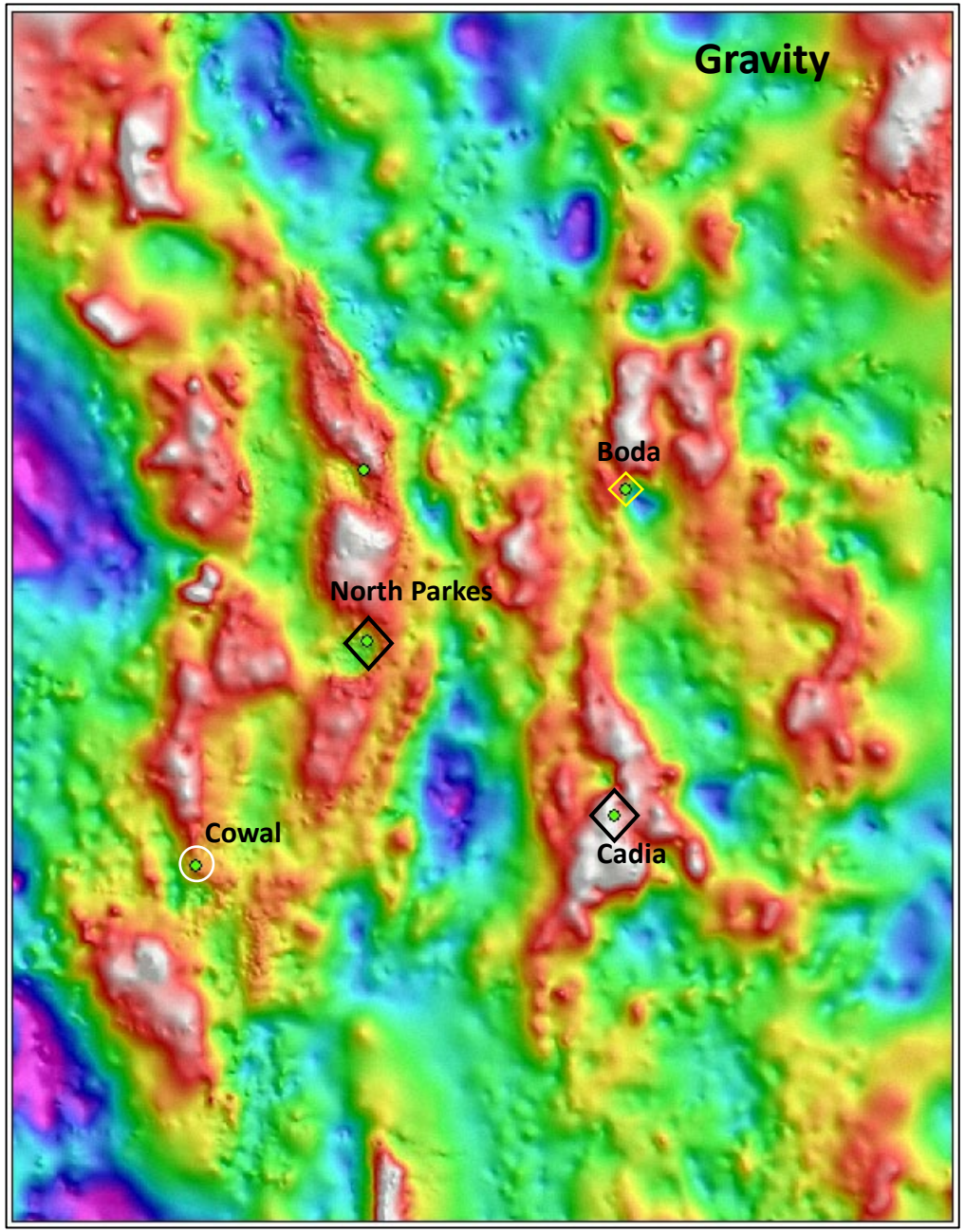



Radiometrics K-red, Th-green, U-blue

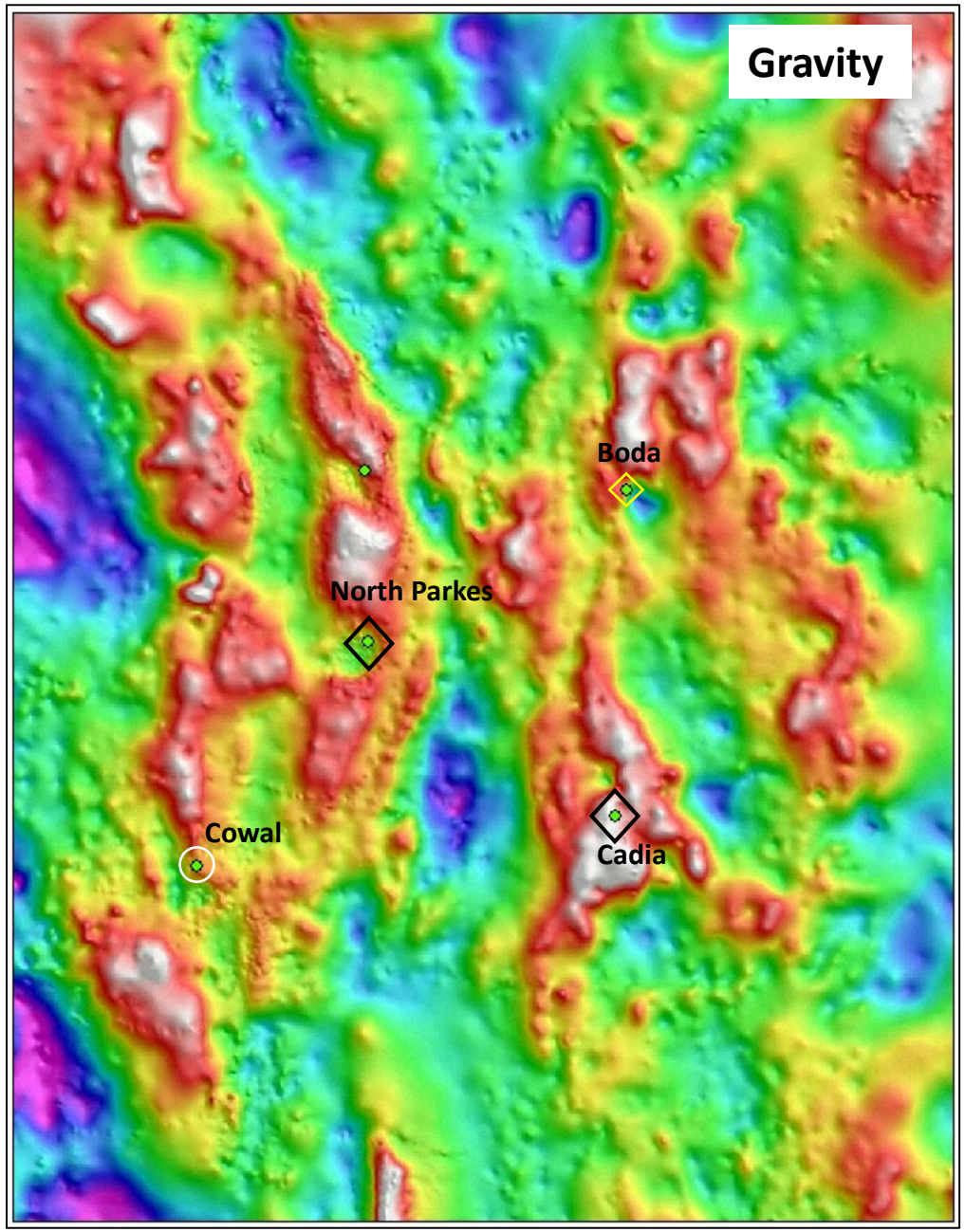
# Lachlan Fold Belt – Deposit Location

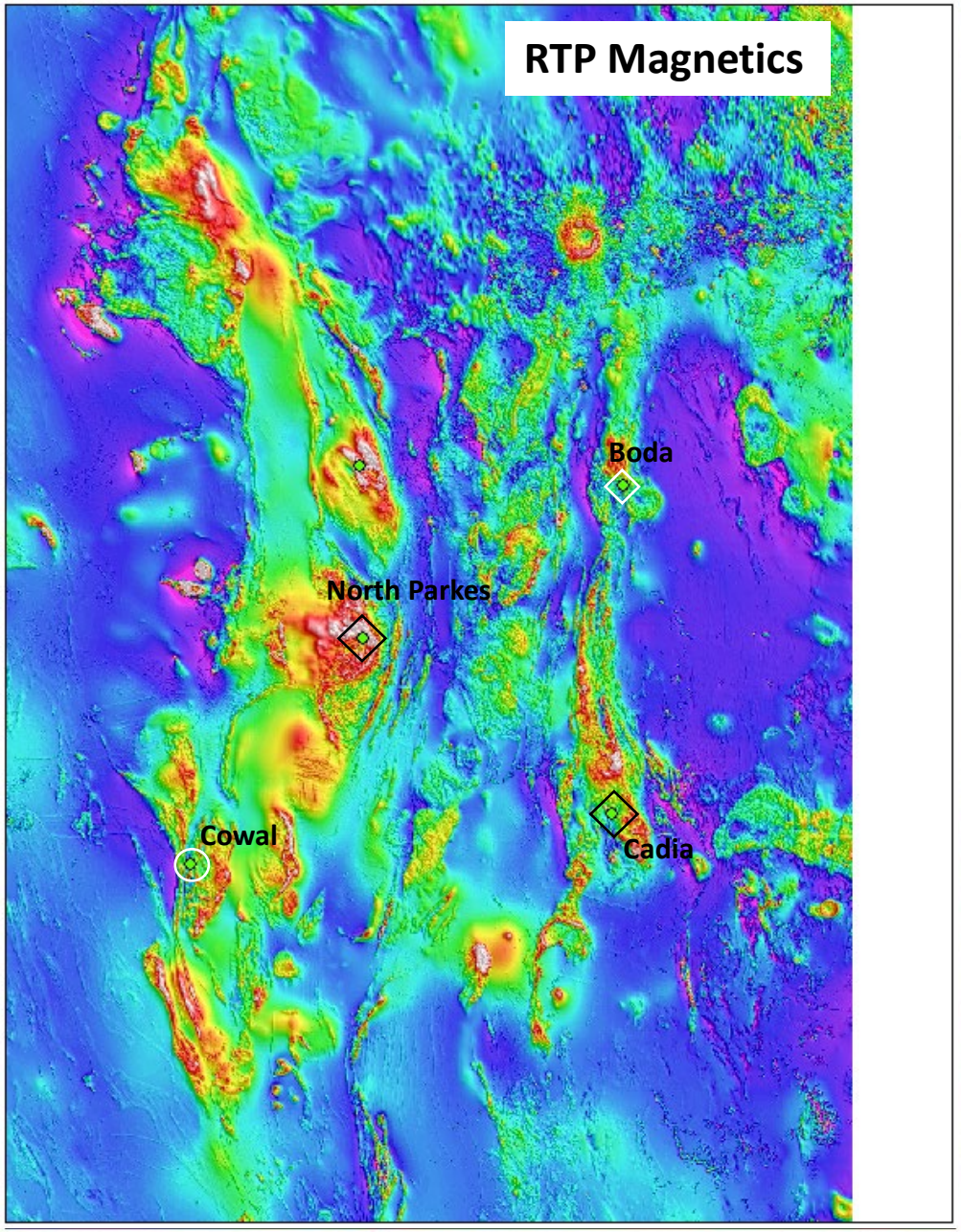



Harris et al, 2020



# Lachlan Fold Belt – Regional Geophysics



# Cadia Discovery History

**1850s**

minor Au production from Cadia Quarry

**early 1900s:**

Fe production from Big Cadia skarn

**1960-80s:**

evaluation of bulk tonnage skarn potential

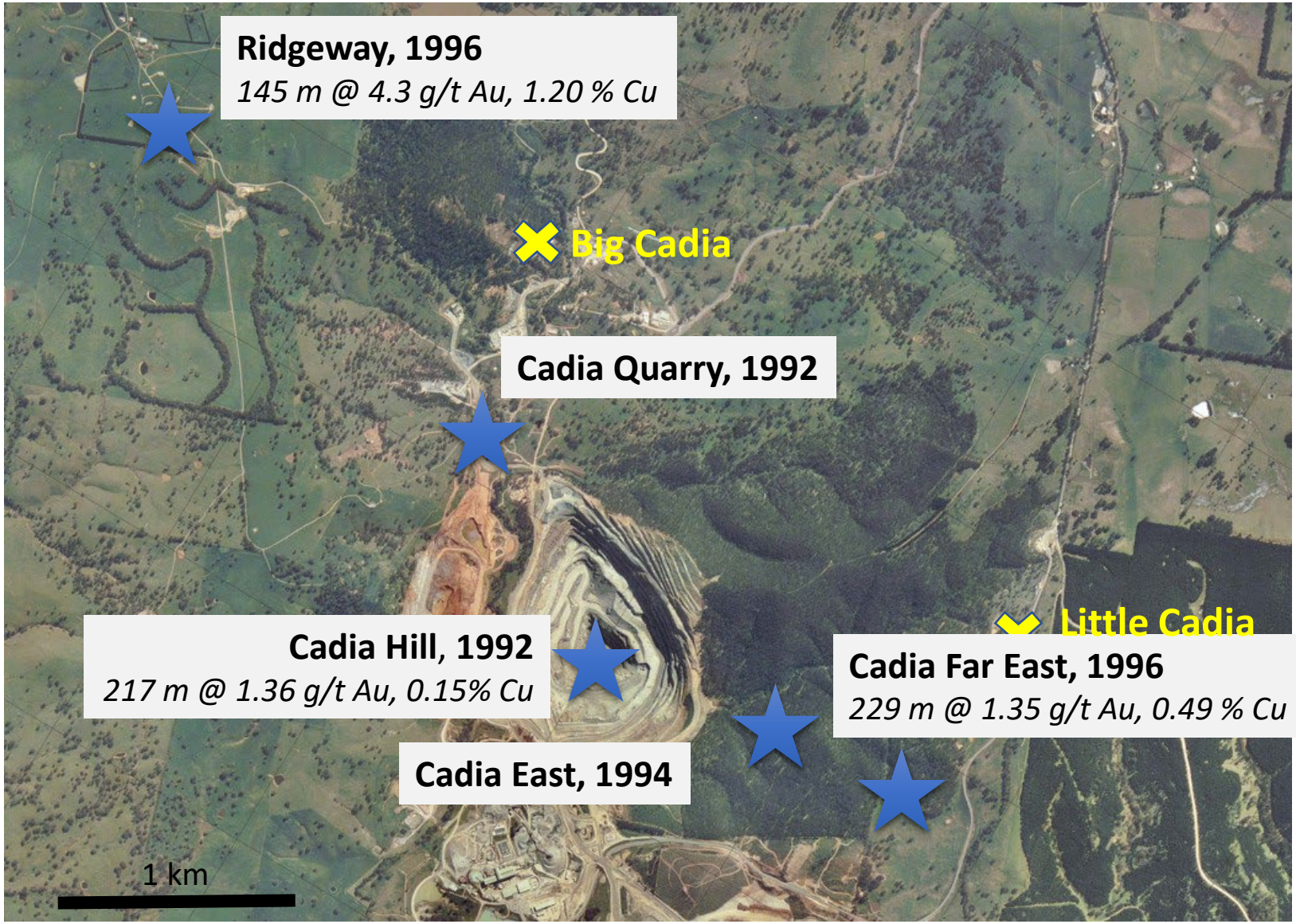
**1990:**

Cadia Hill drilled (96m @ 0.6 g/t Au)

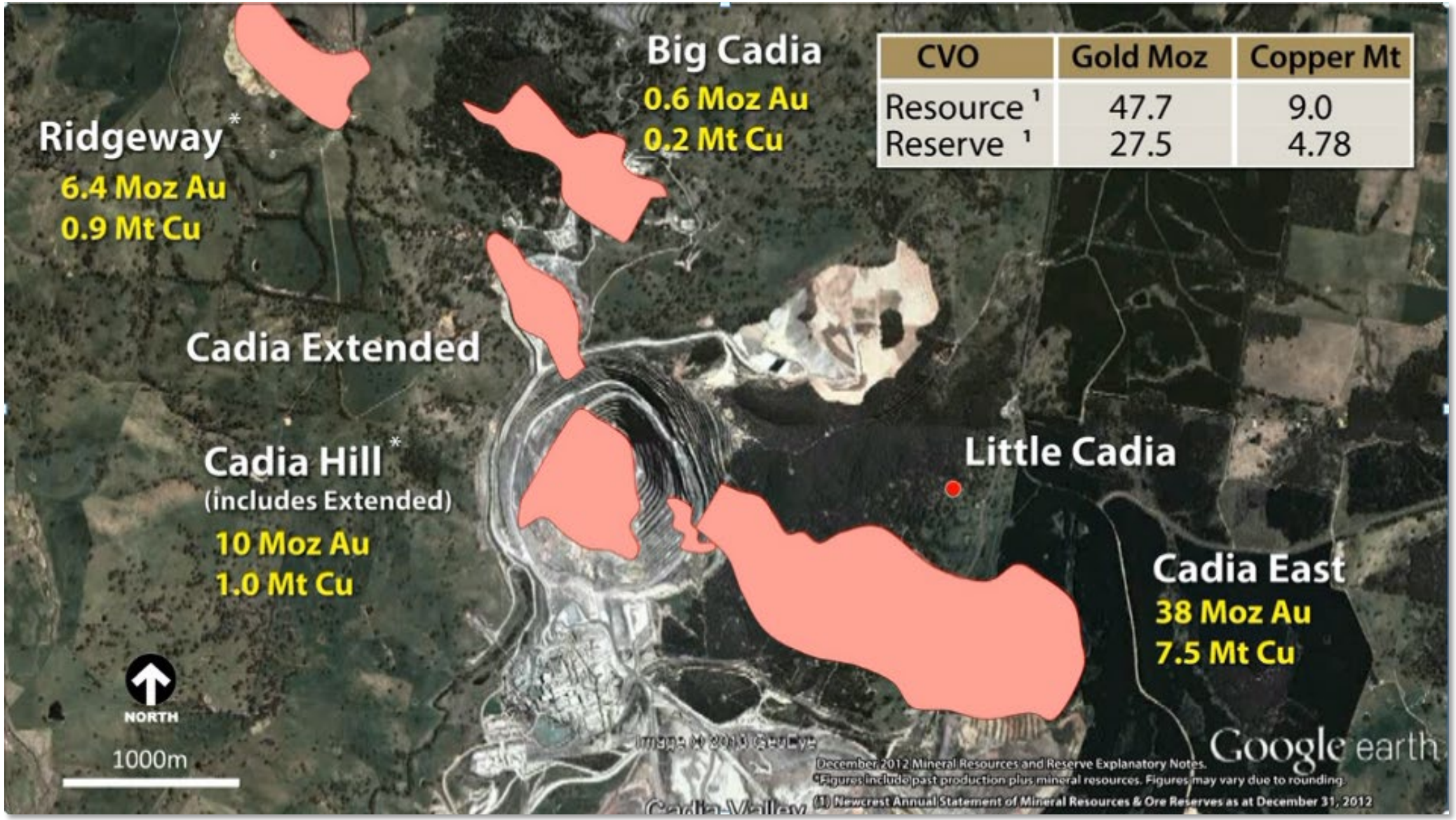
porphyry-potential not recognized

**1991:**

Newcrest purchases Cadia

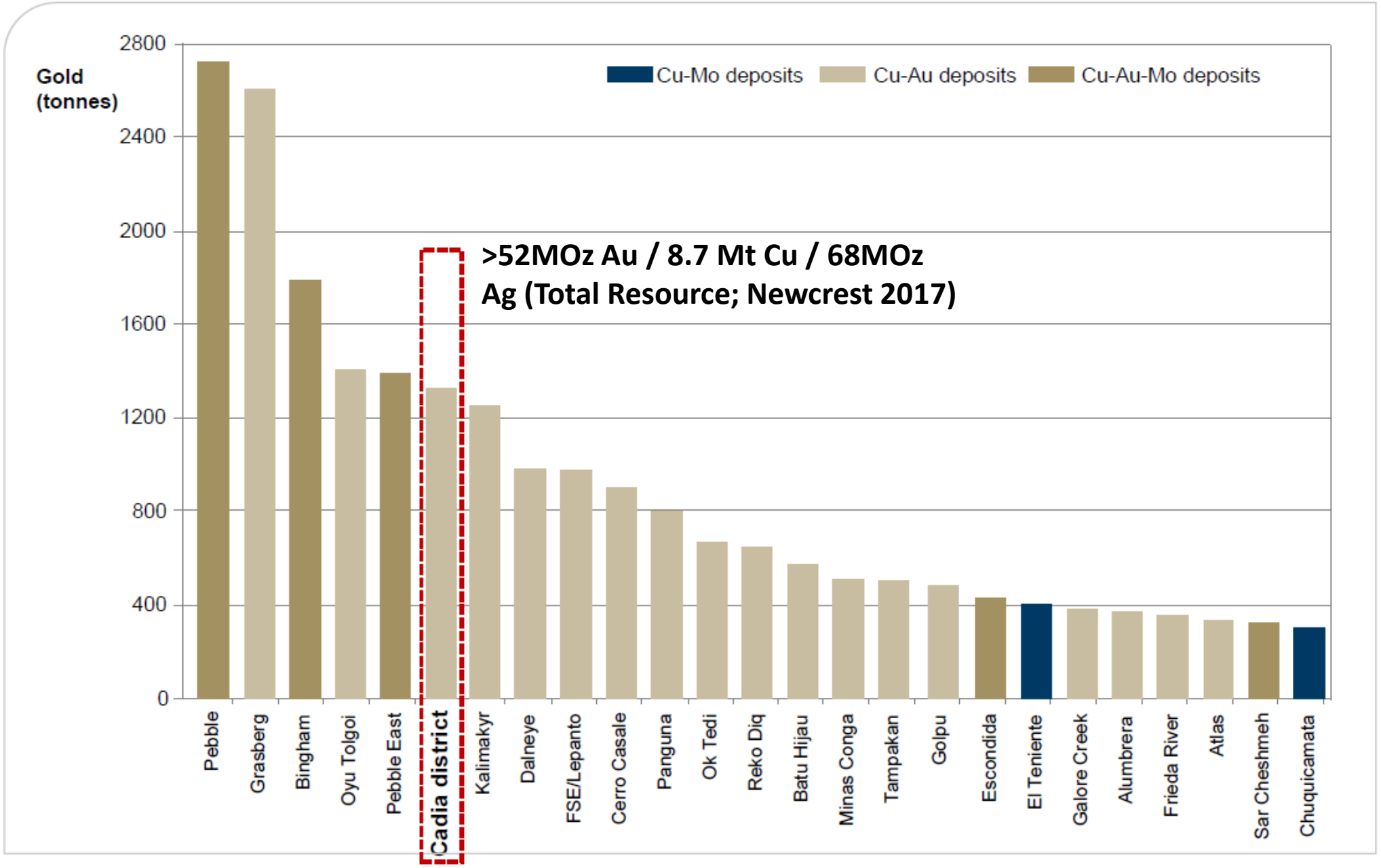


# Cadia Resources



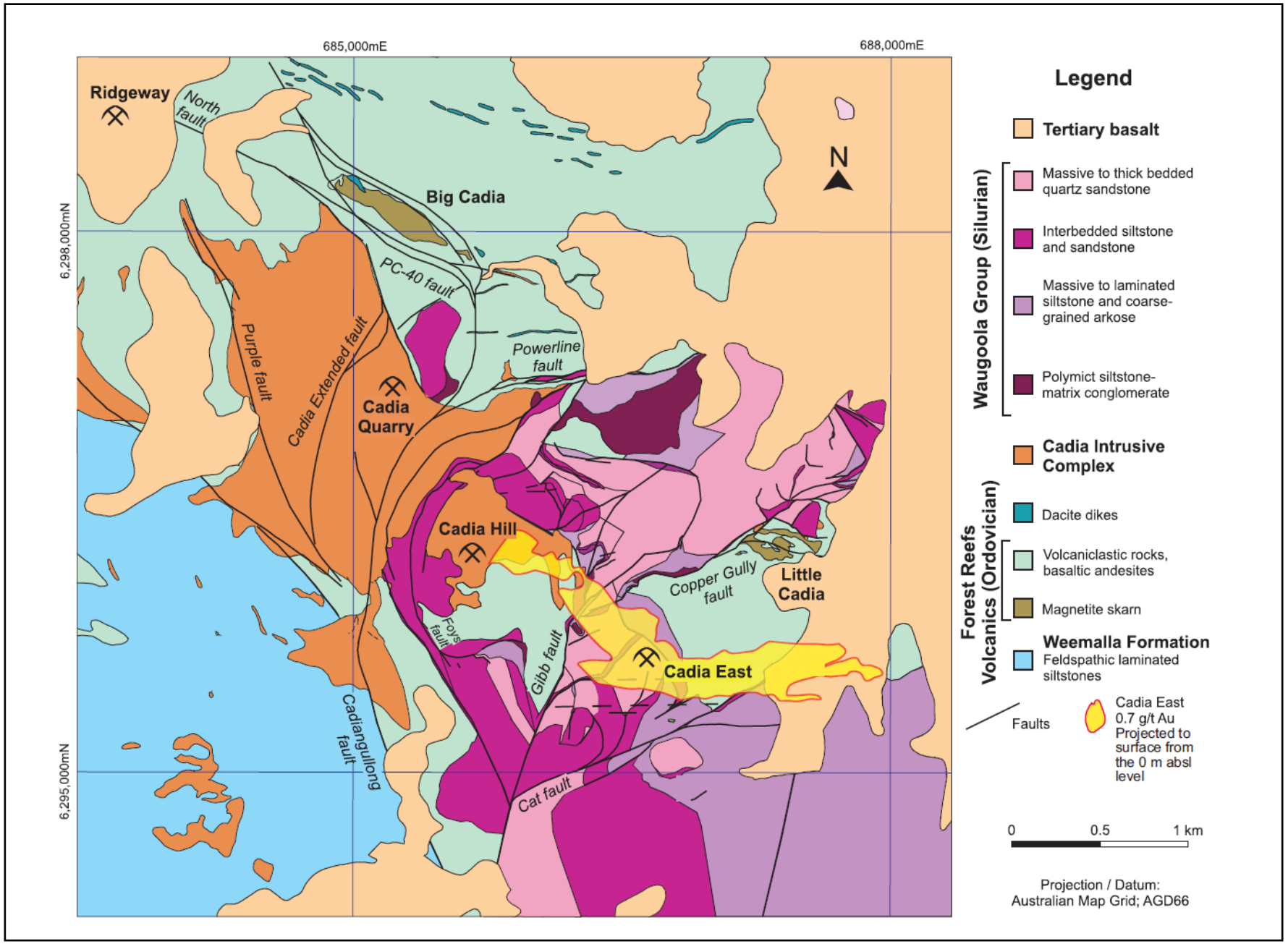

| CVO | Gold Moz | Copper Mt |
|---|---|---|
| Resource [1] | 47.7 | 9.0 |
| Reserve [1] | 27.5 | 4.78 |

# Size of Giant Porphyry Deposits



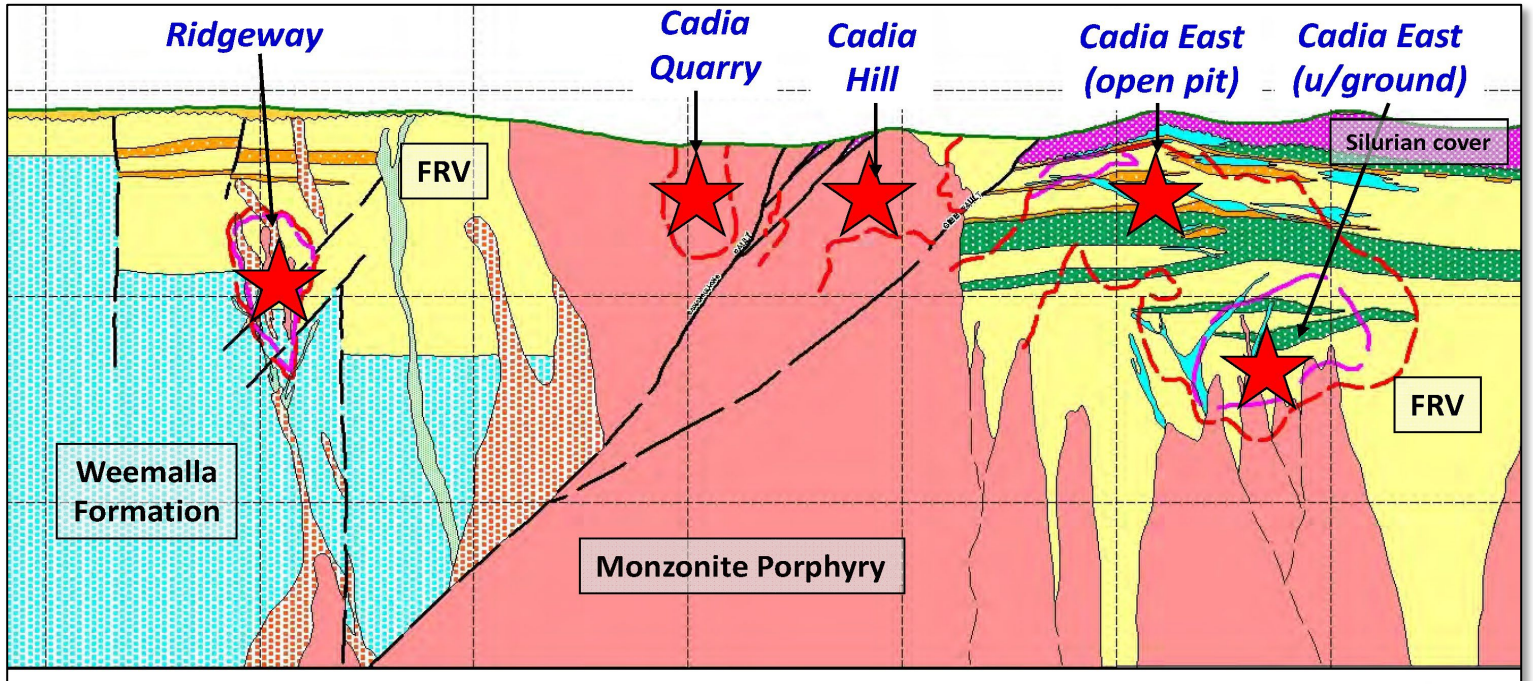

*Source: Modified from USGS porphyry ore deposit database.*

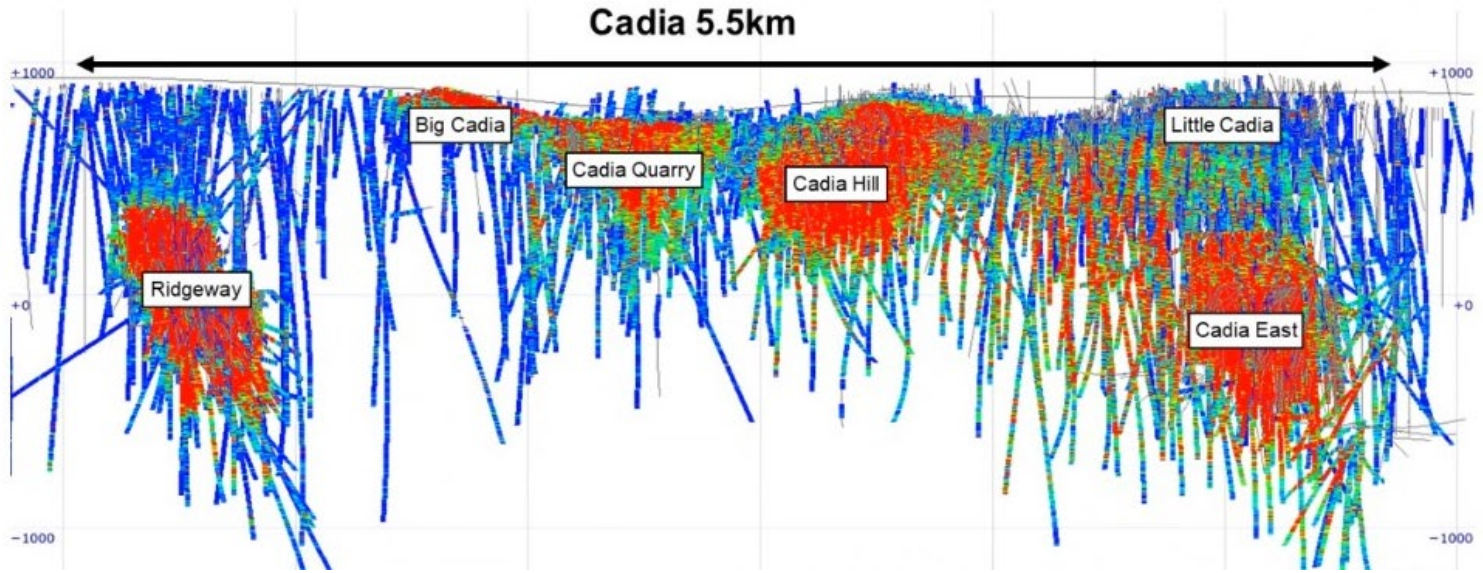
# Cadia Geology

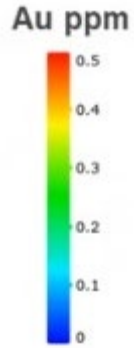



Harris et al, 2020

# Cadia Geological Cross Section



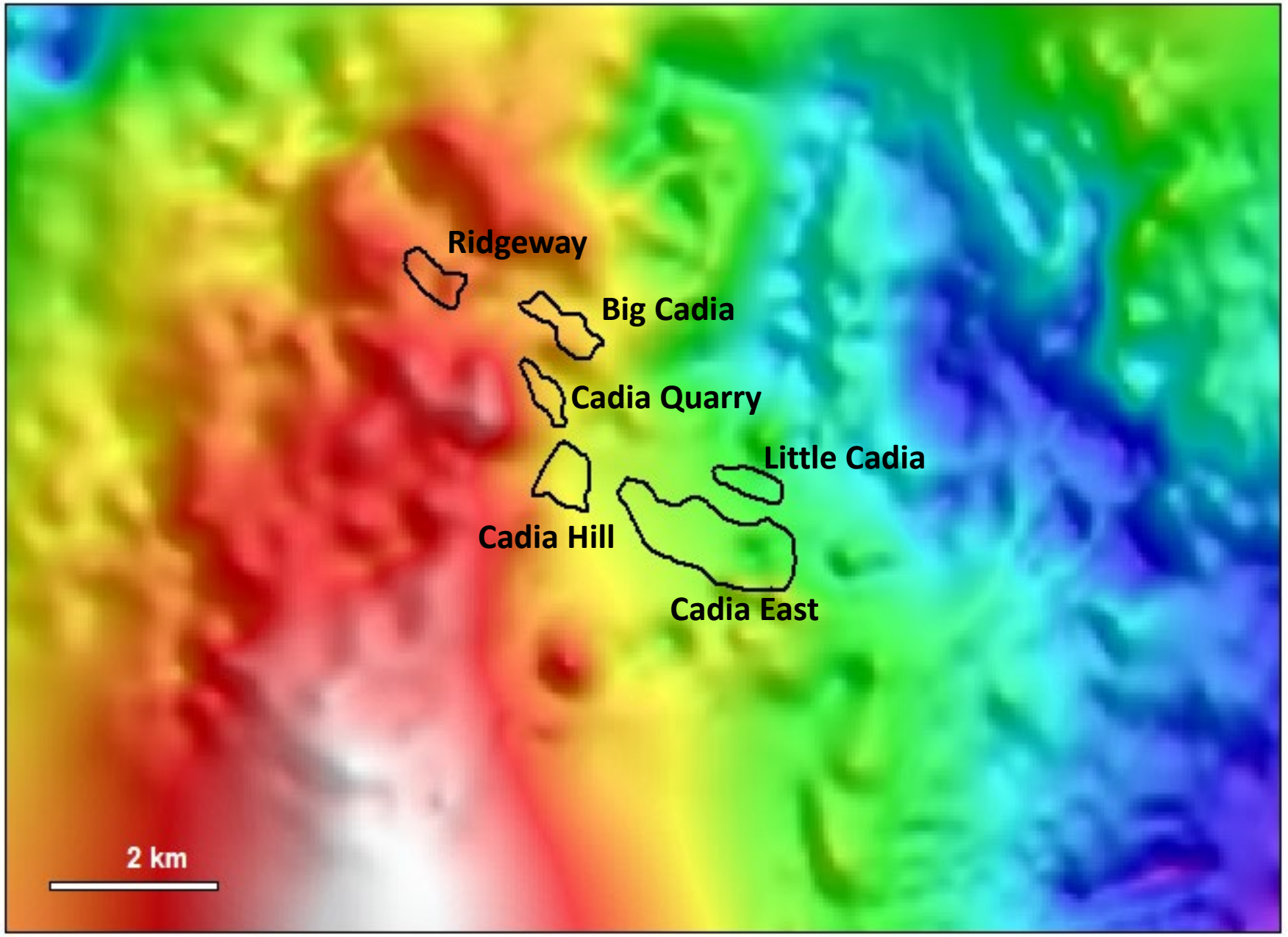




**Two main porphyry groups:**

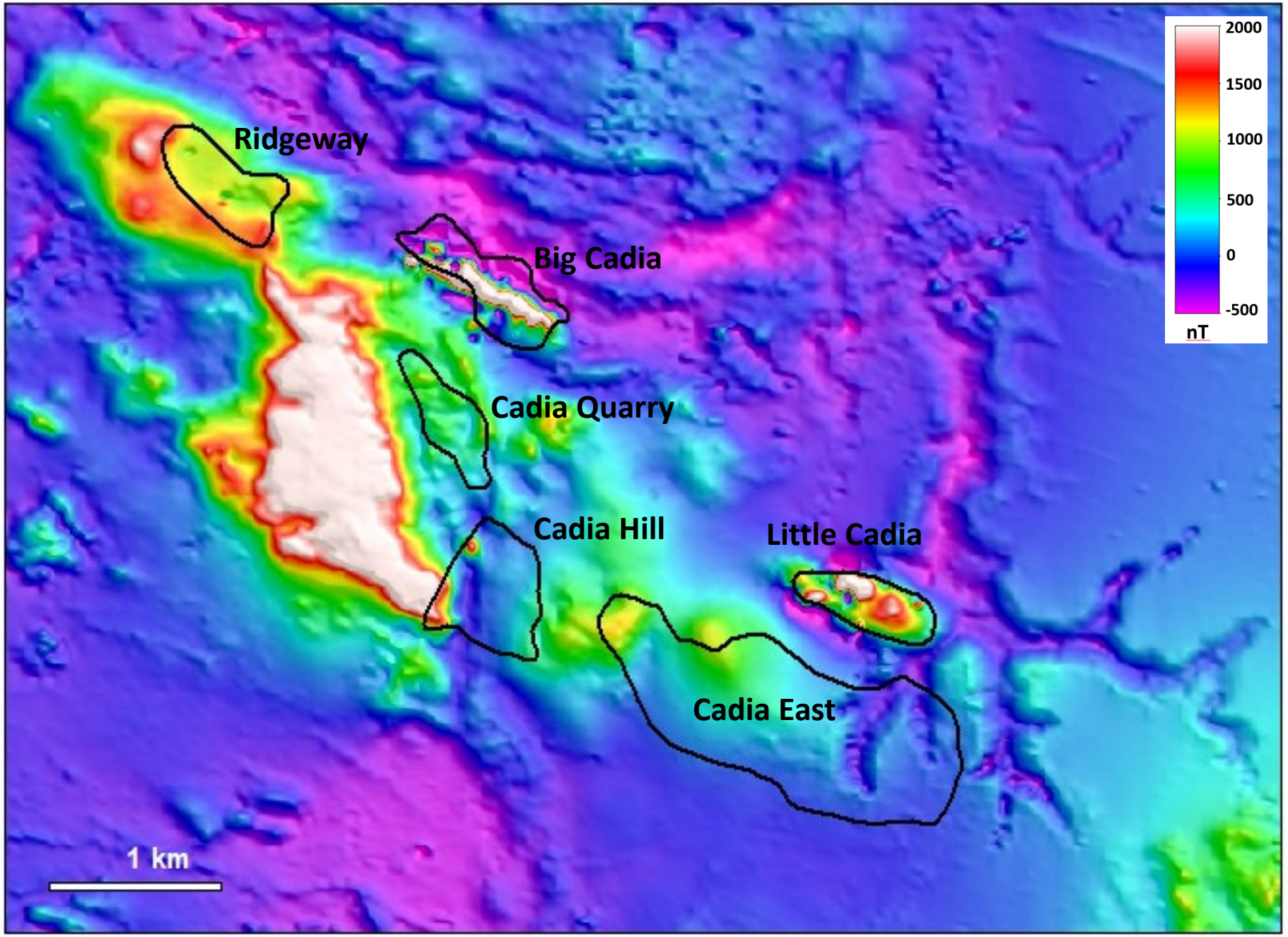
***Intrusion-centred***
*hosted outside main intrusive/magnetic complexes, high-grade,* pipe-shaped (Ridgeway) and elongate dyke (Cadia East) porphyry geometries

***Intrusion-hosted***
*hosted inside main intrusive/magnetic complexes,* lower grade, sheeted veins (Cadia Hill)

# Cadia Gravity 1994, 1995 500m spacing

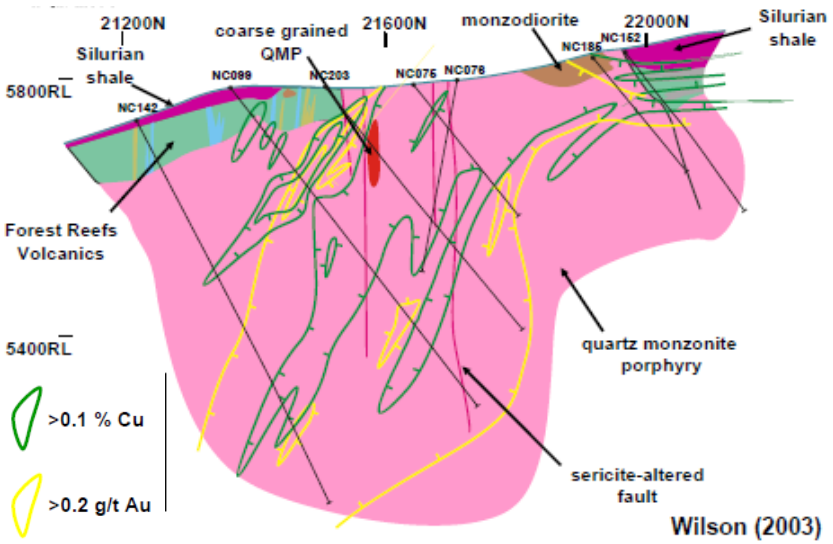


# Cadia Magnetics 1996 (50m line spacing)

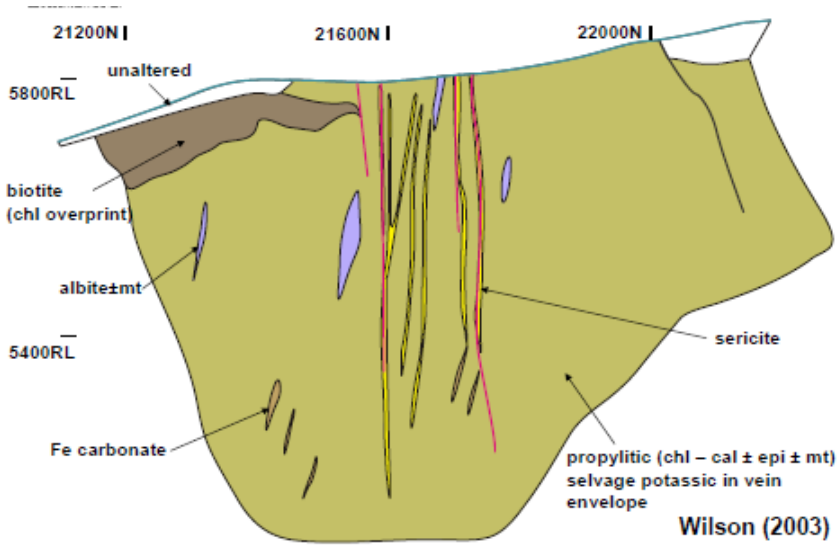


# Cadia Hill Section 14020E

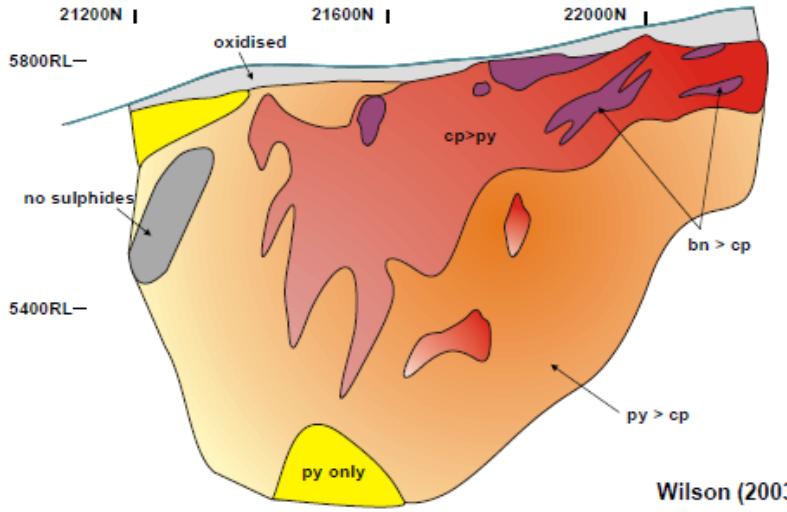
## Geology



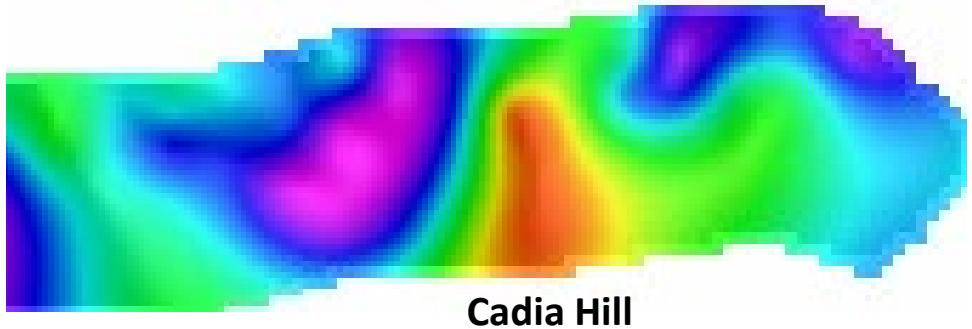

## Alteration



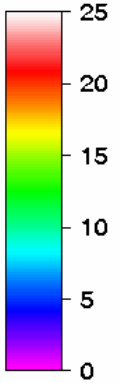

## Sulphide Zonation



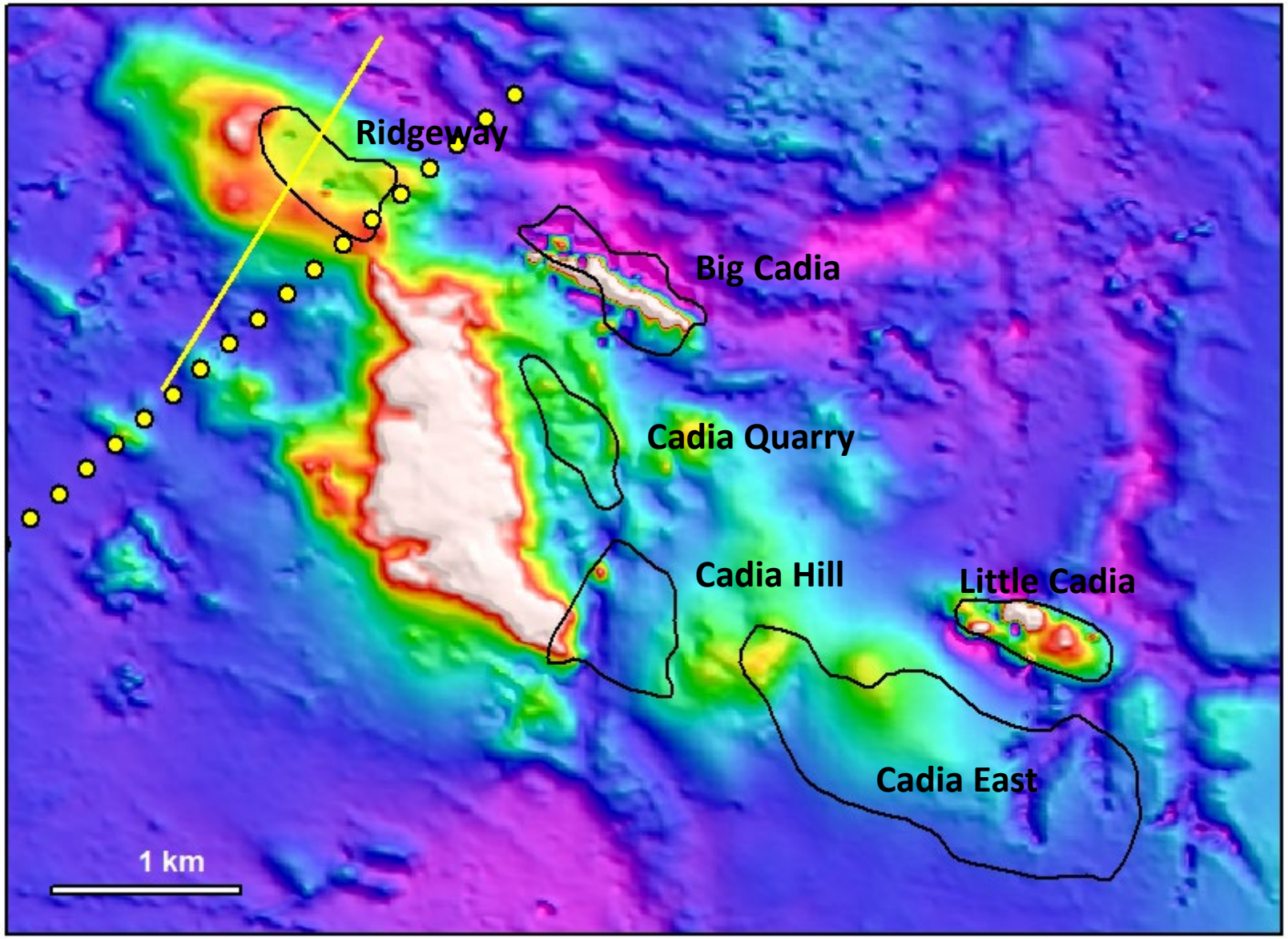

## 2D IP Inversion Line 13900E



Cadia Hill

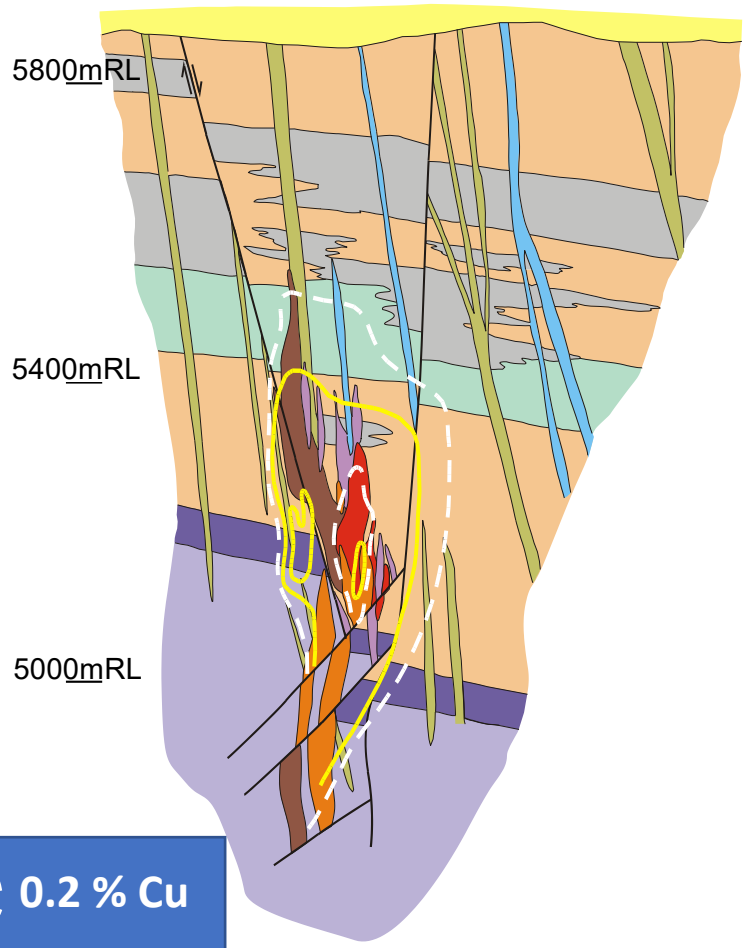


# Ridgeway IP Line Location



# Ridgeway Section 1050E

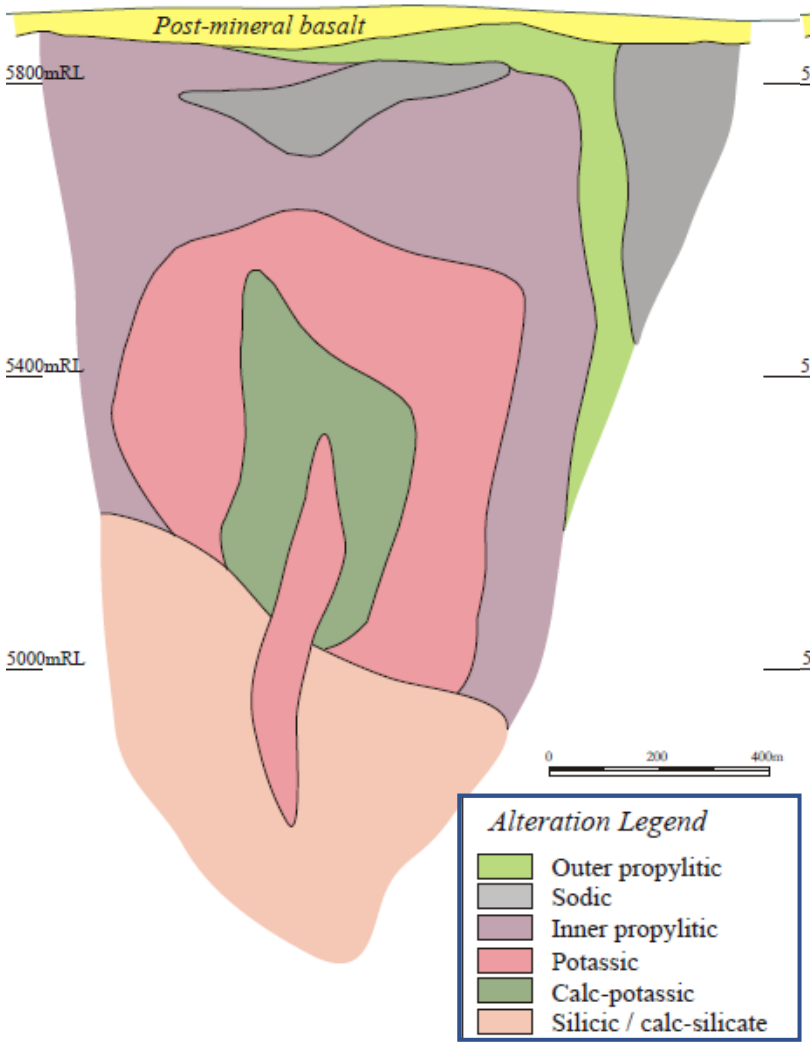
## Geology



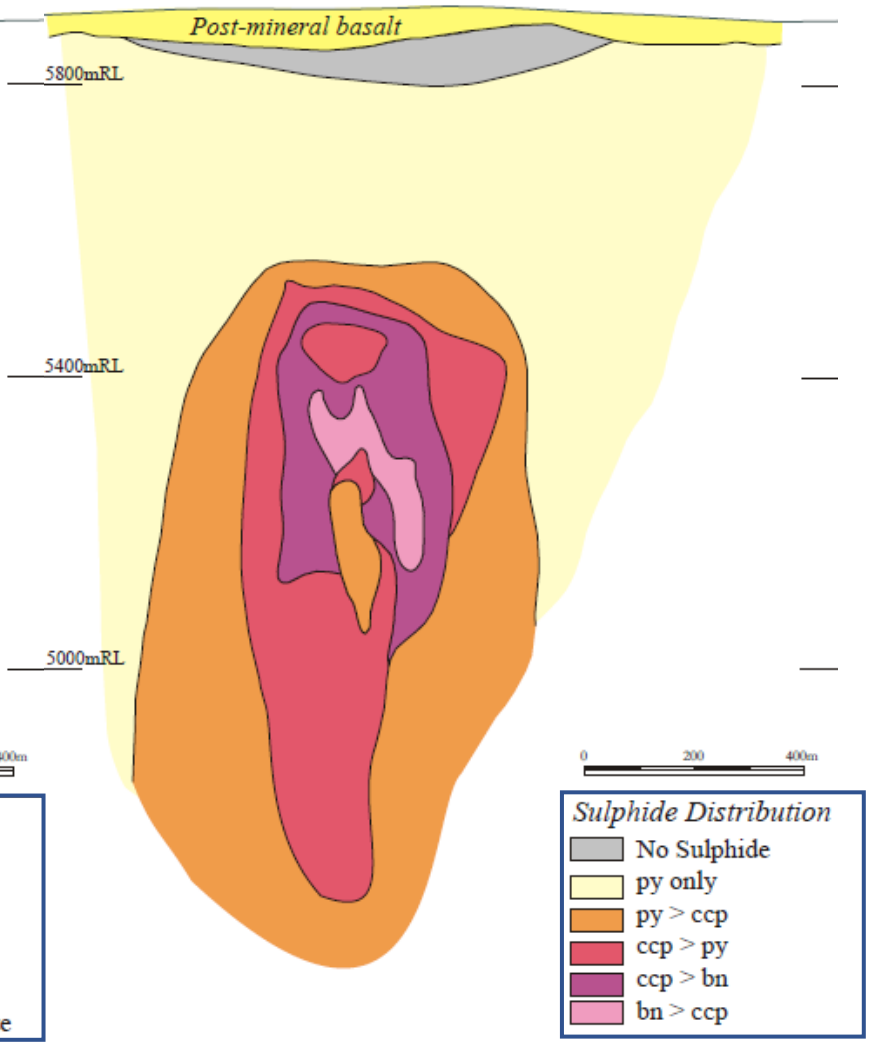

0.2 % Cu

0.2 g/t Au

## Alteration

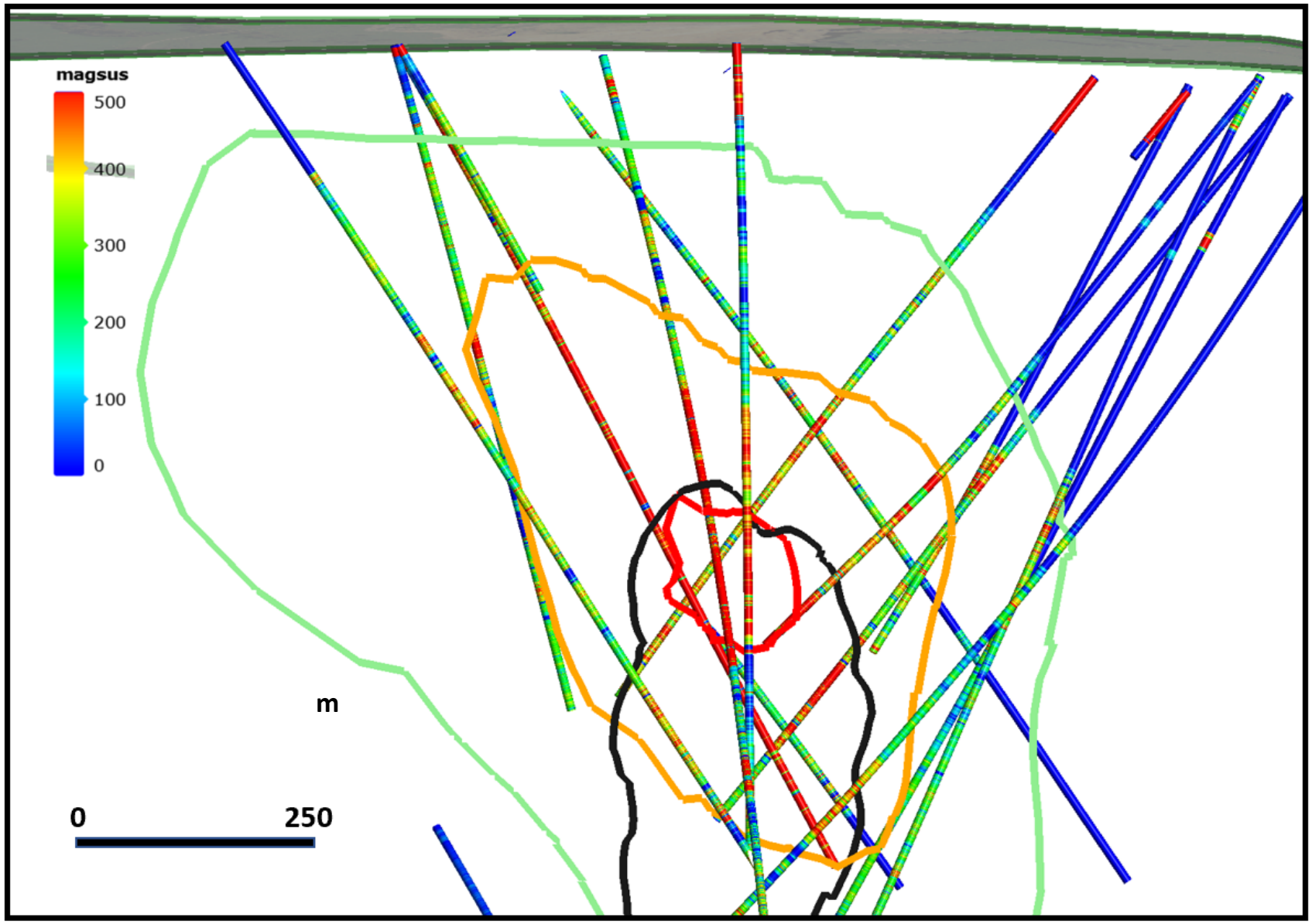



## Sulphide Zonation



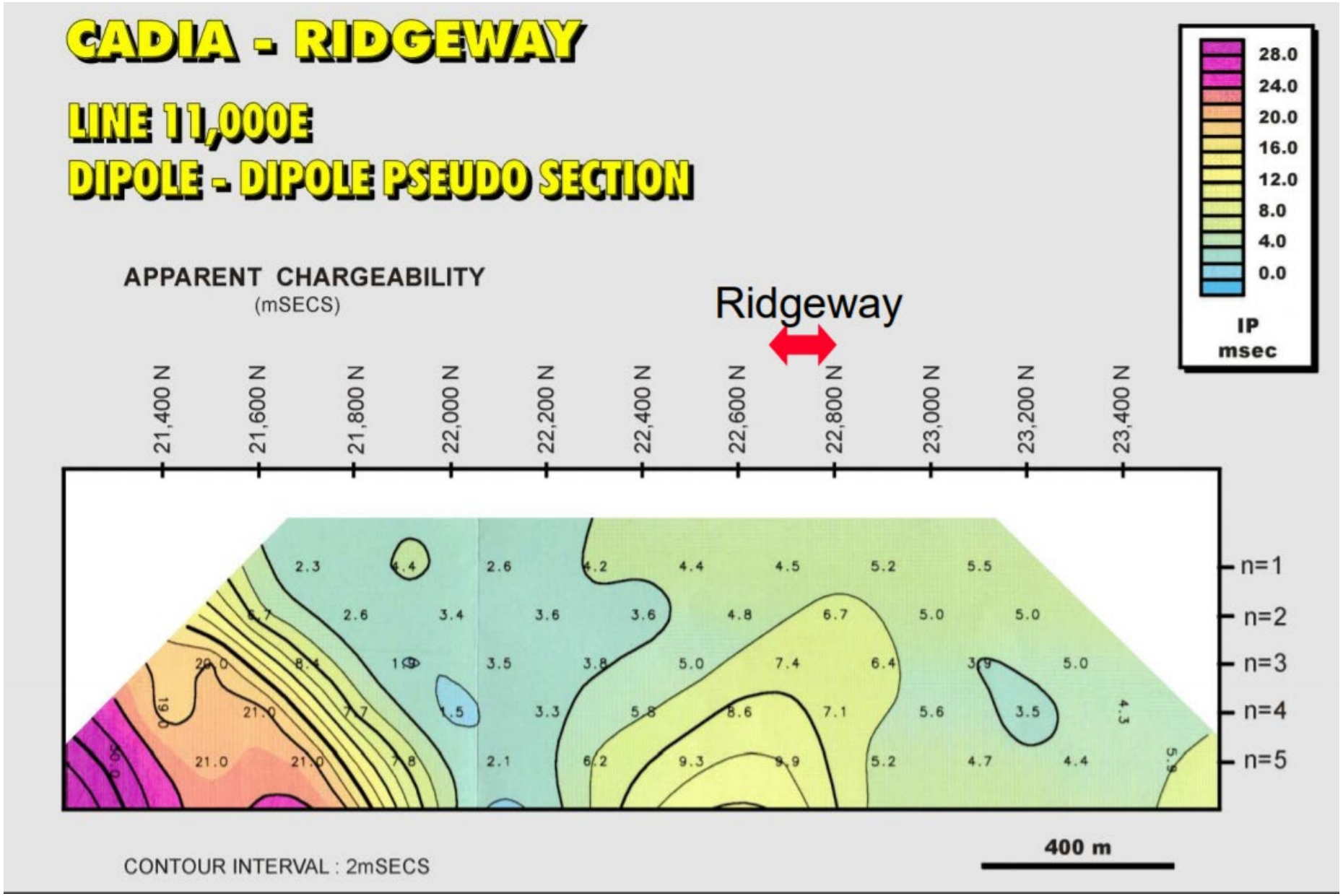

After Wilson (2003)

# Ridgeway Magnetic Susceptibility

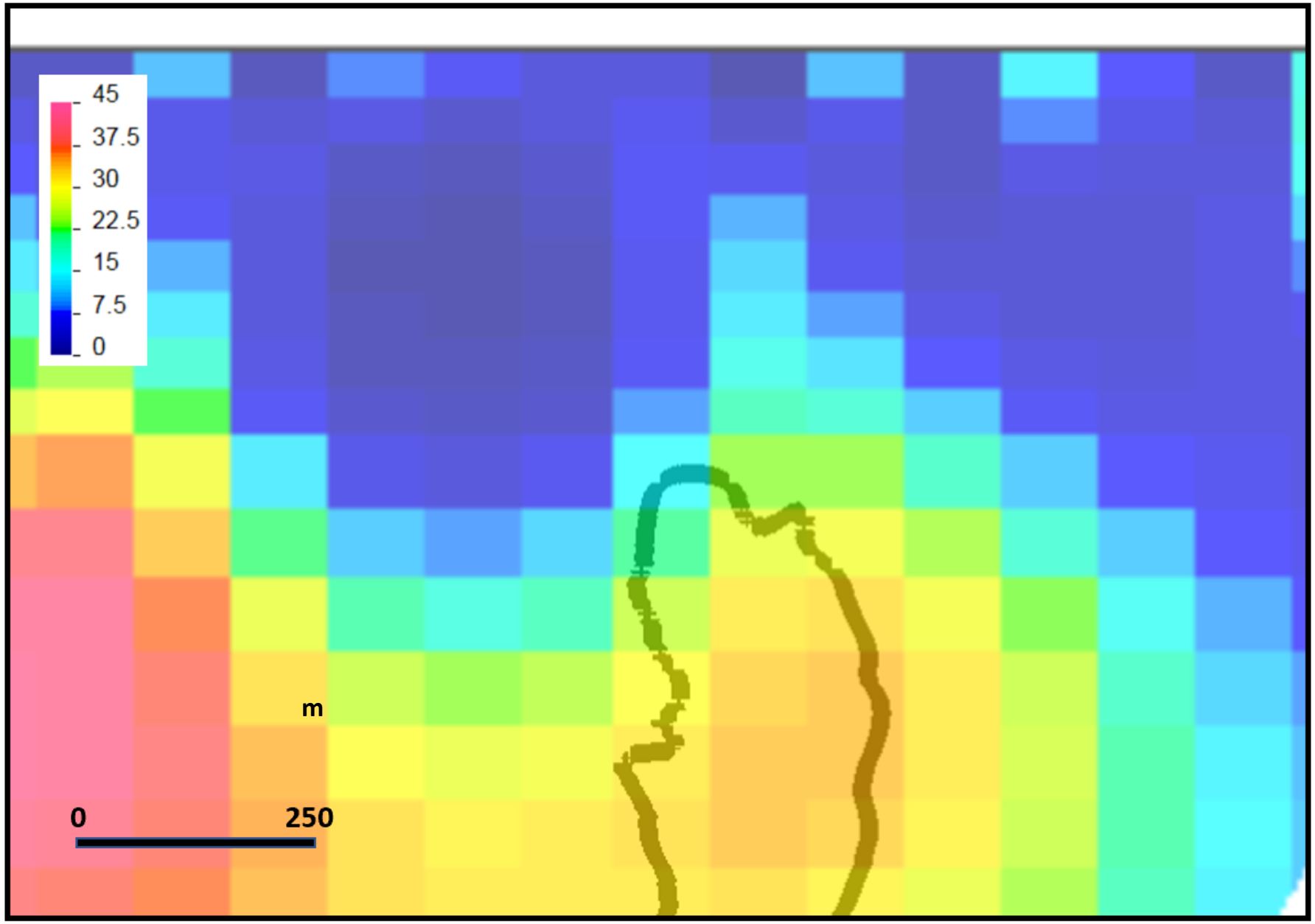



Units are $10^{-3}$ cgs. Ridgeway mag sus 0.05 to 0.3 SI (Close, 2000)

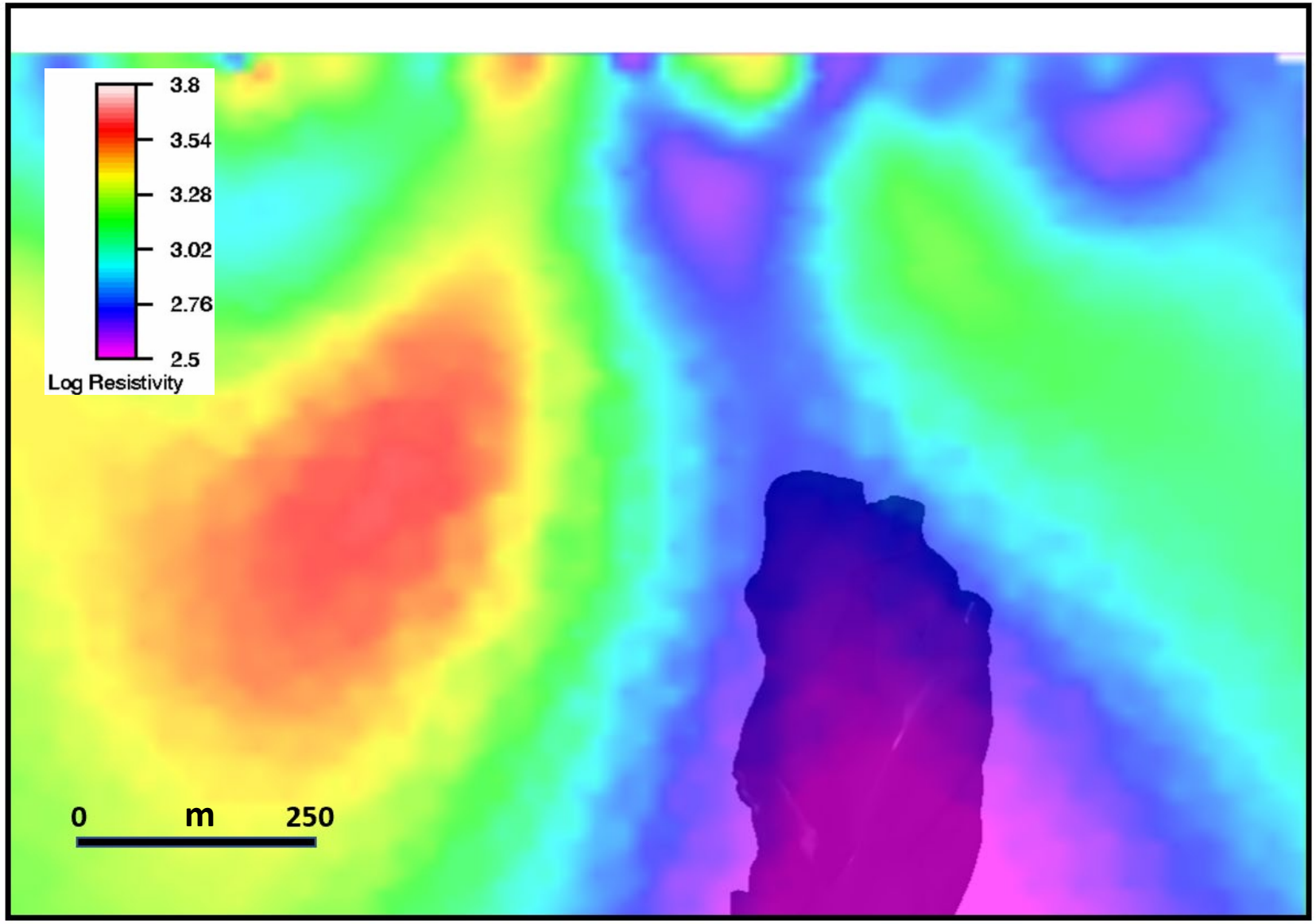
# Ridgeway 1995 IP (200m dipole-dipole)



# Ridgeway 11000E 2DIP Inversion

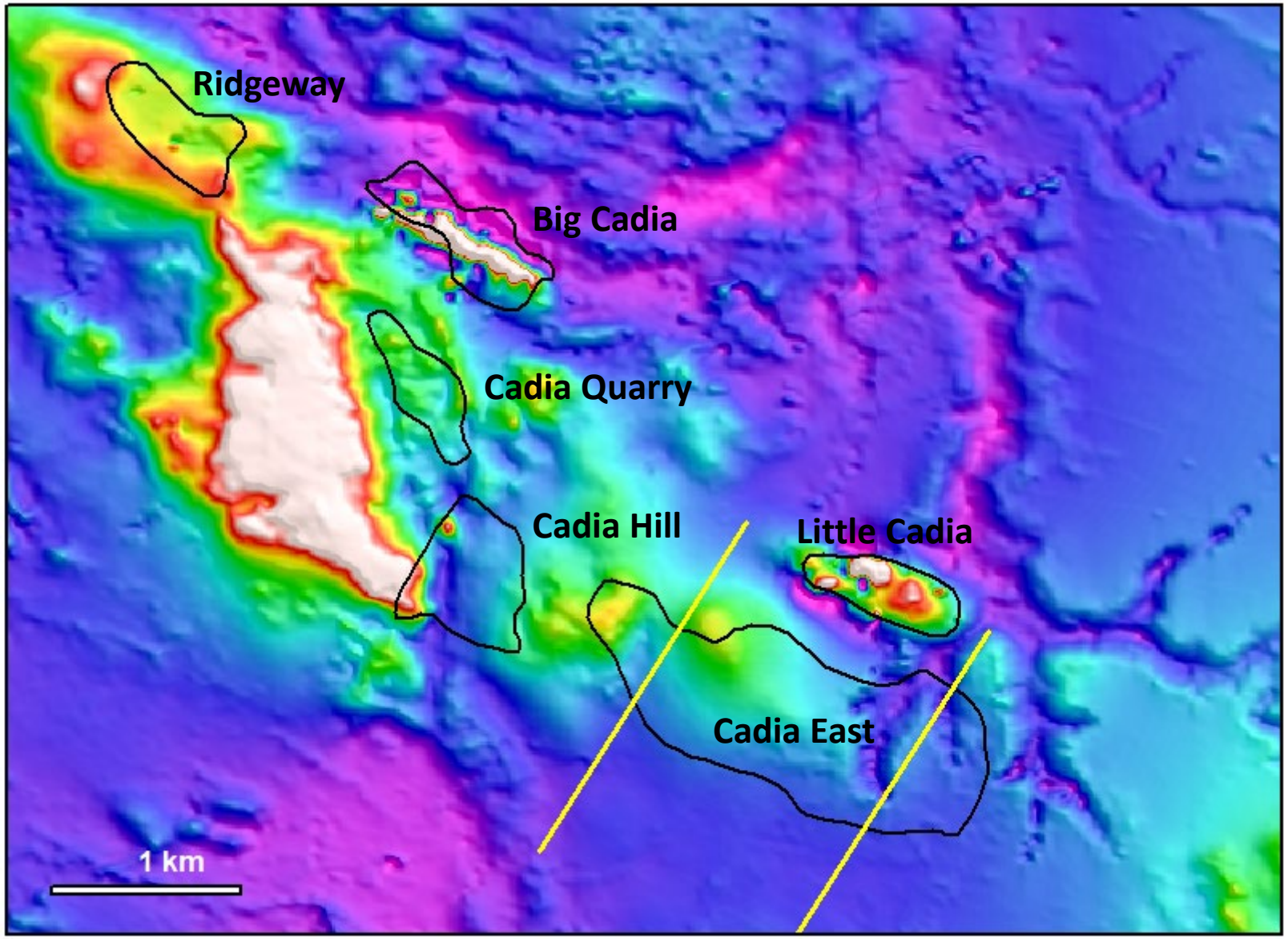


# Ridgeway Resistivity Inversion




There is a clear conductive zone associated with mineralization (<~200 ohm-m). This is consistent with Close(2001) obtaining measurements of 10-100 ohm-m from in situ and laboratory measurements. The conductive zone is flanked by highly resistive zones (>~2000 ohm-m) due to feldspar alteration

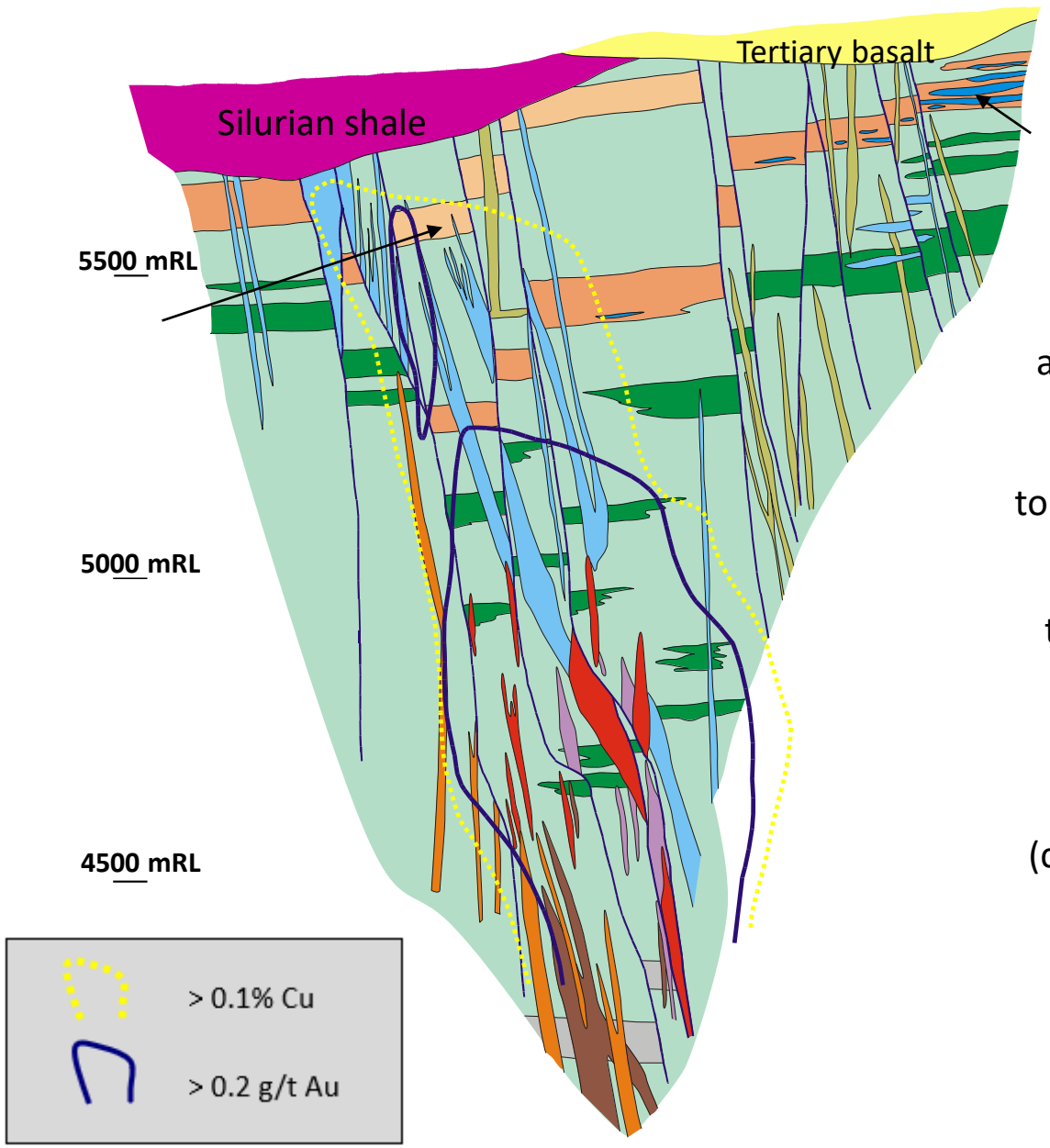
# Cadia East Section Locations



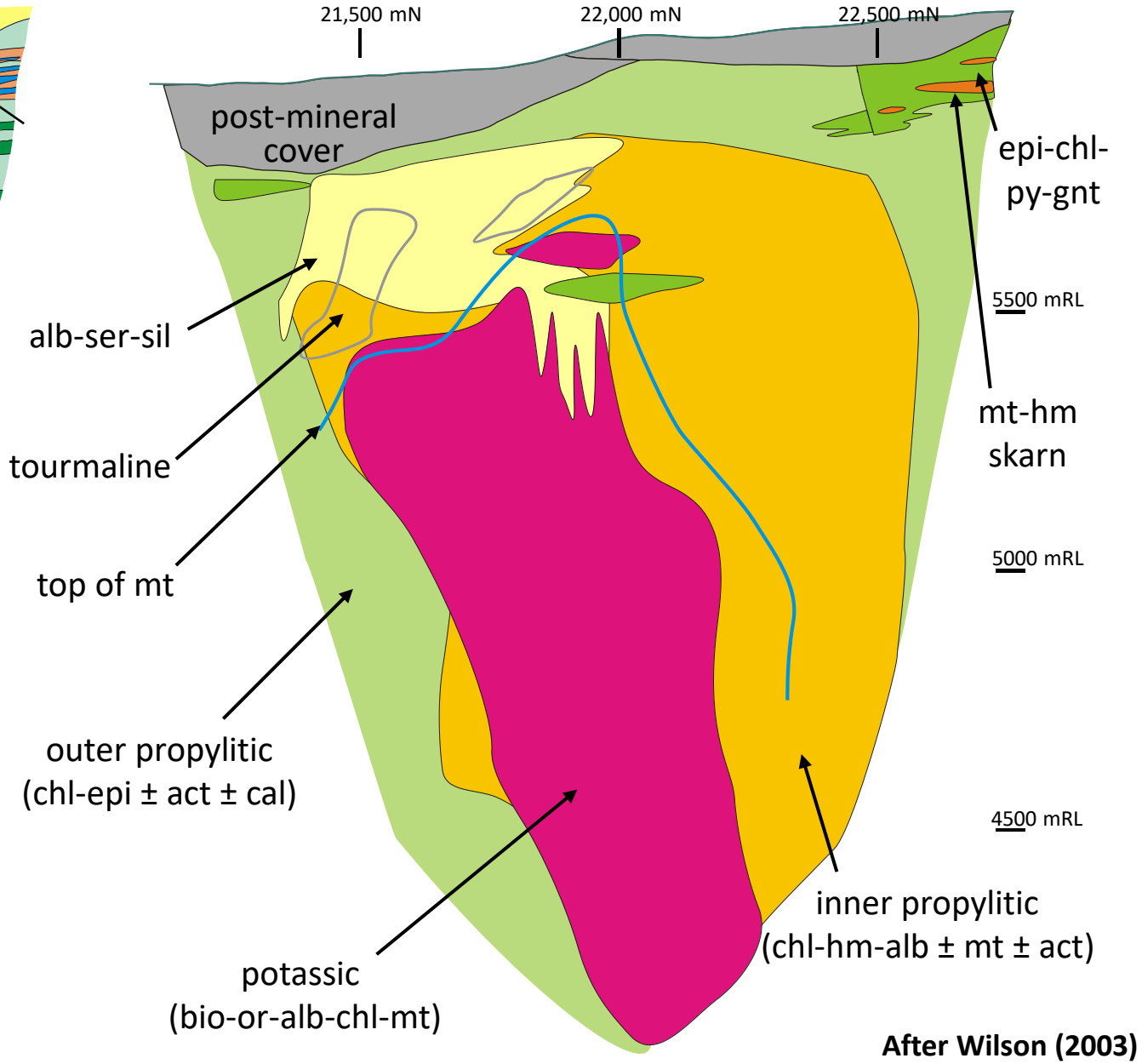

Cadia East - Orebody dimensions of 2000m by 600m by 1500m depth

# Cadia East Line15820E

## Geology

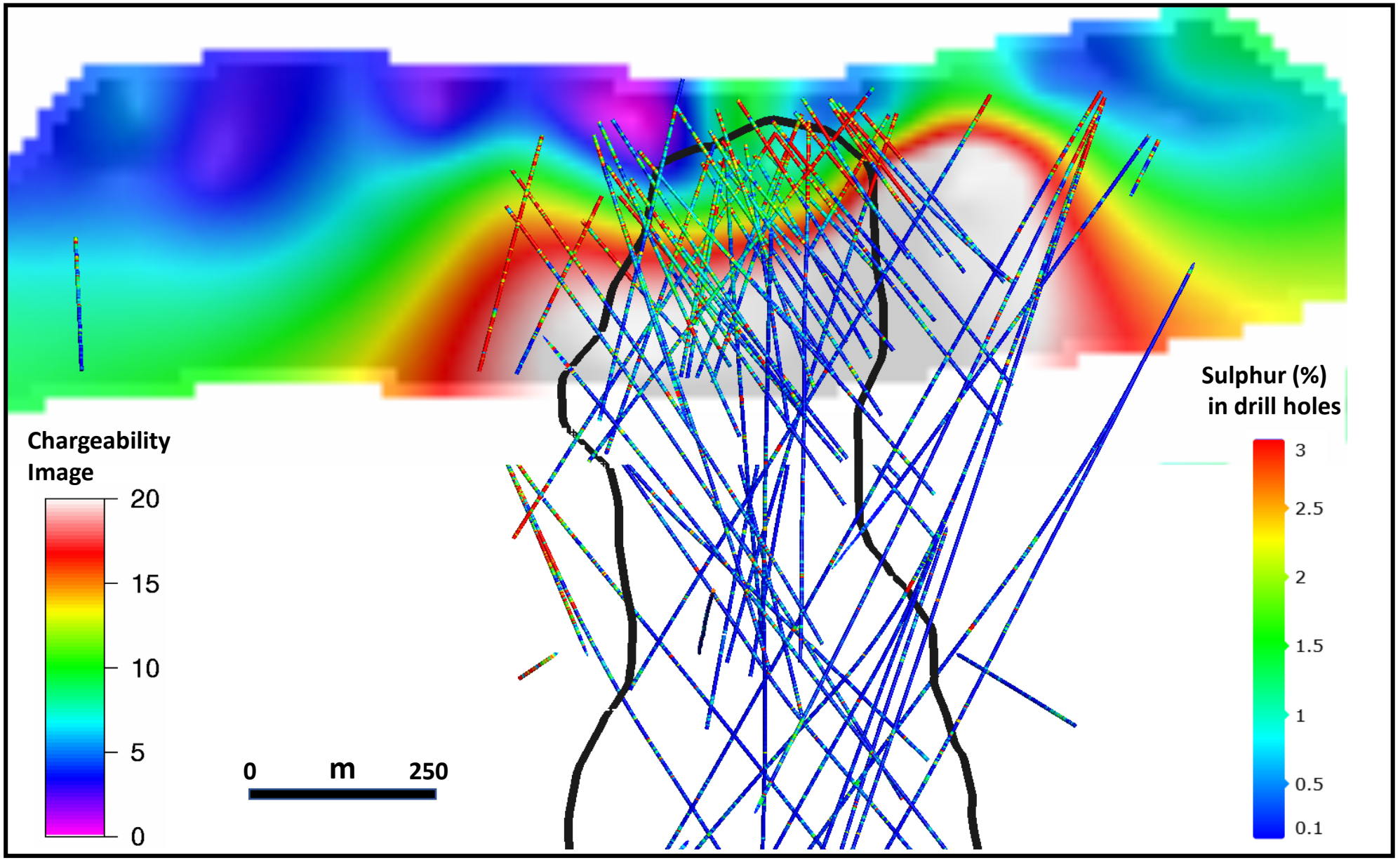


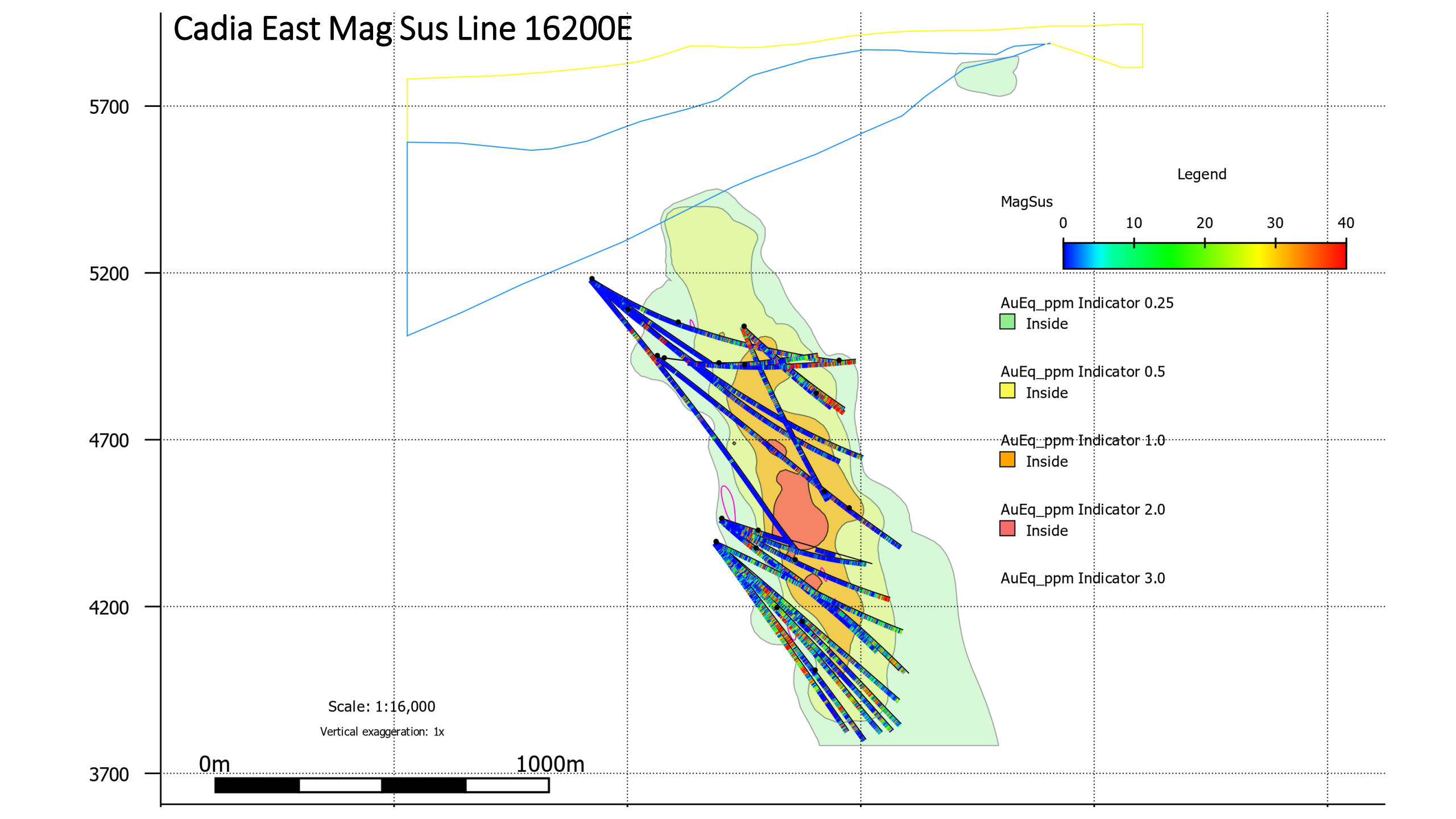

## Alteration



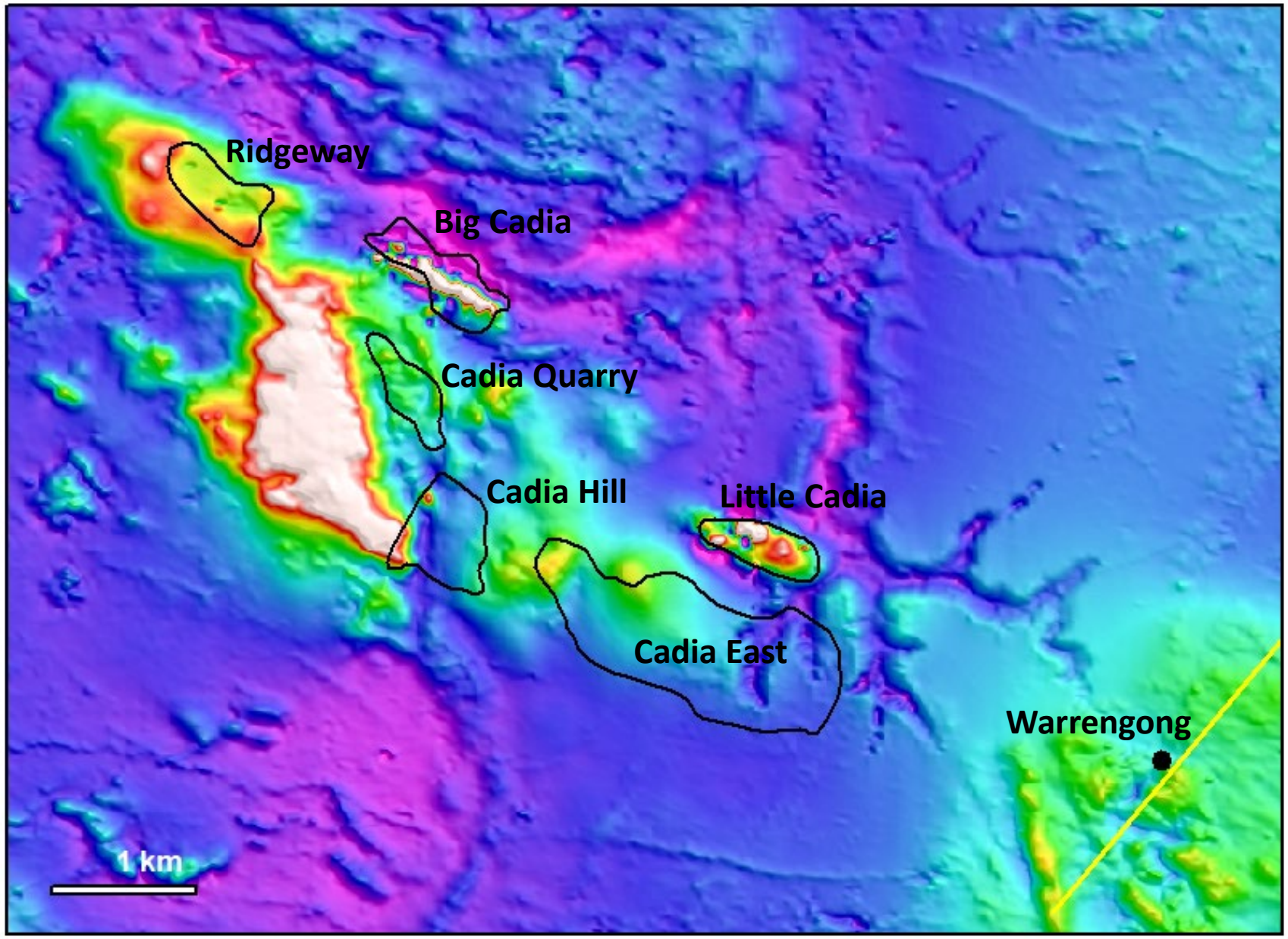

**After Wilson (2003)**

# Cadia East IP Inversion with S Assays

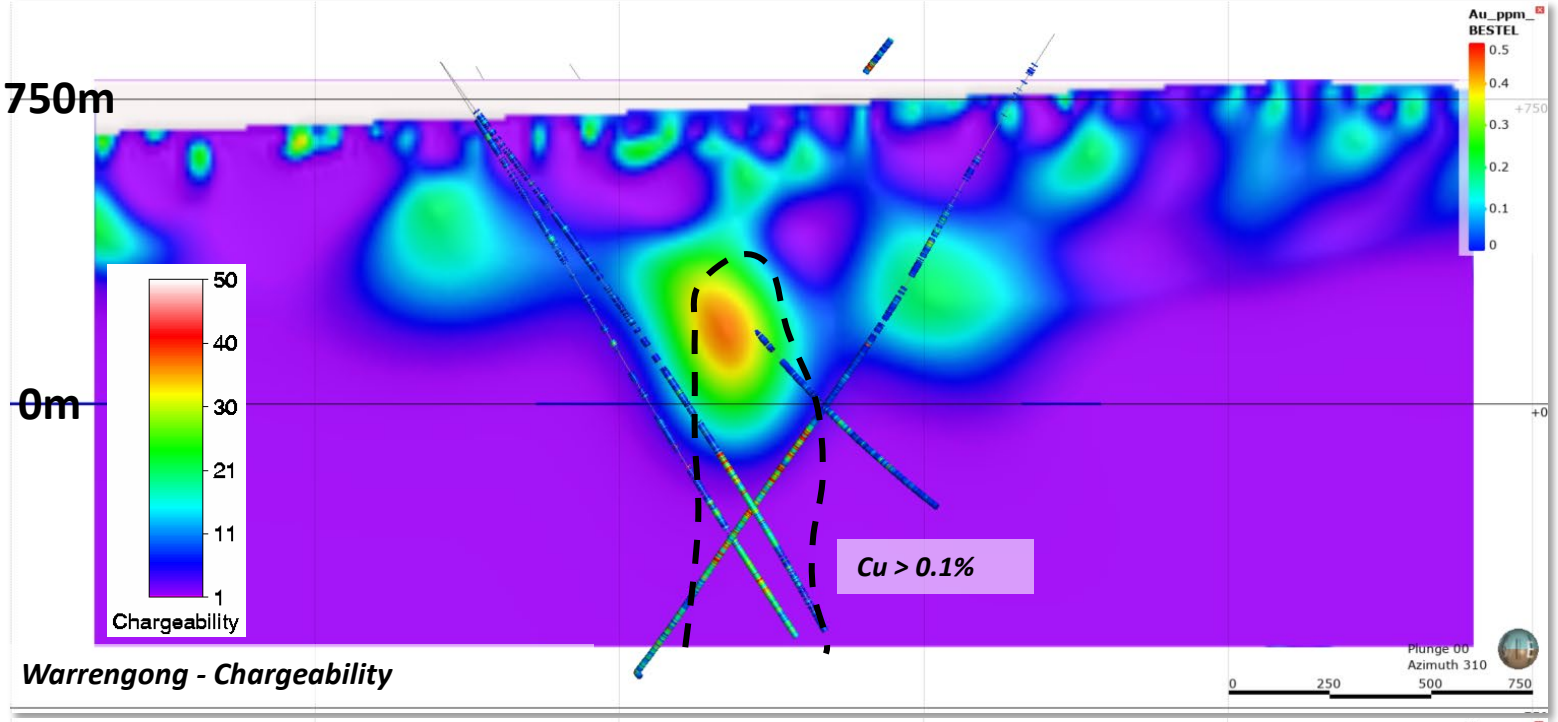



Cadia East Mag Sus Line 16200E
5700
5200
4700
4200
3700
Legend
MagSus
0
10
20
30
40
AuEq_ppm Indicator 0.25
Inside
AuEq_ppm Indicator 0.5
Inside
AuEq_ppm Indicator 1.0
Inside
AuEq_ppm Indicator 2.0
Inside
AuEq_ppm Indicator 3.0
Scale: 1:16,000
Vertical exaggeration: 1x
0m
1000m

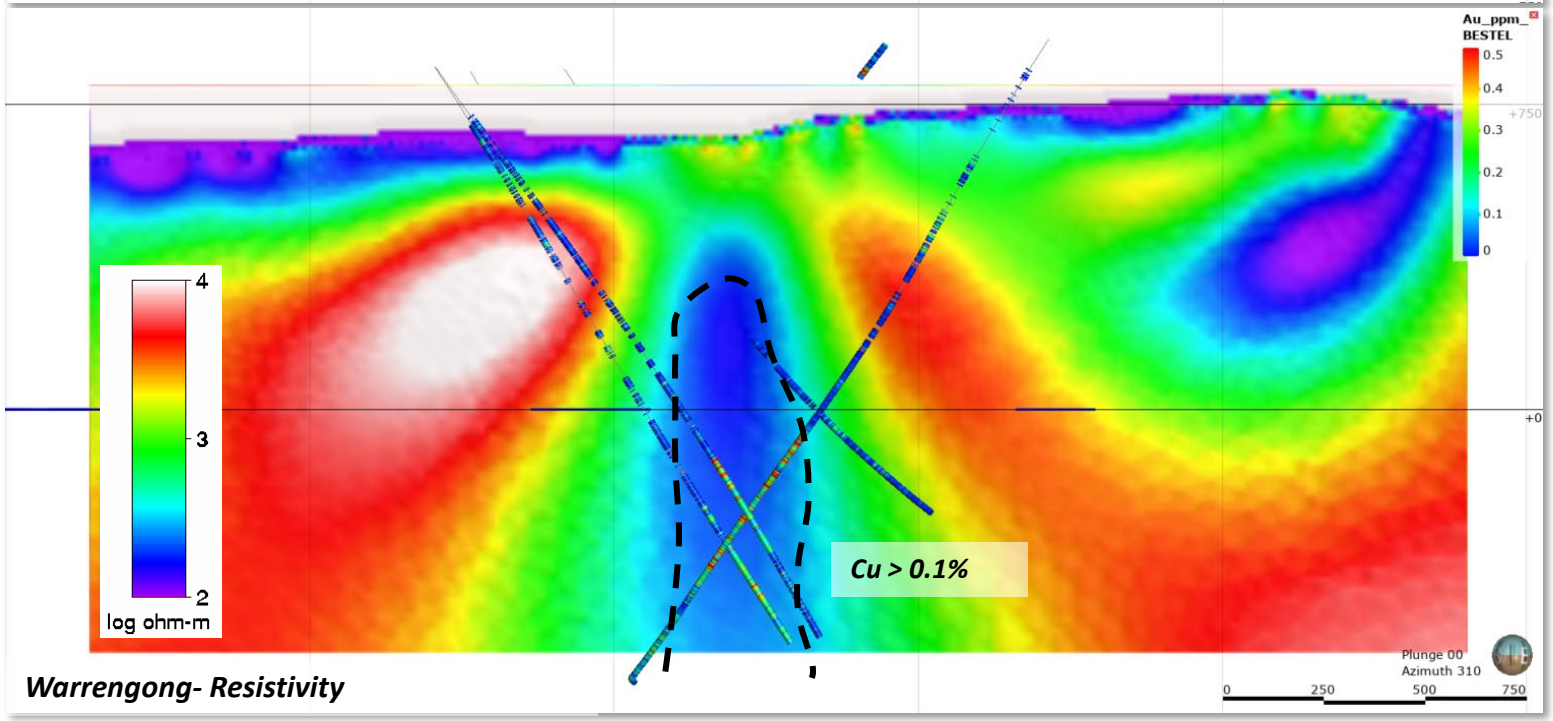
# Warrengong IP Line Location



# Warrengong IP/MT Survey




*Warrengong - Chargeability*




*Warrengong- Resistivity*

**Sheeted qz-cp veins in monzonite**

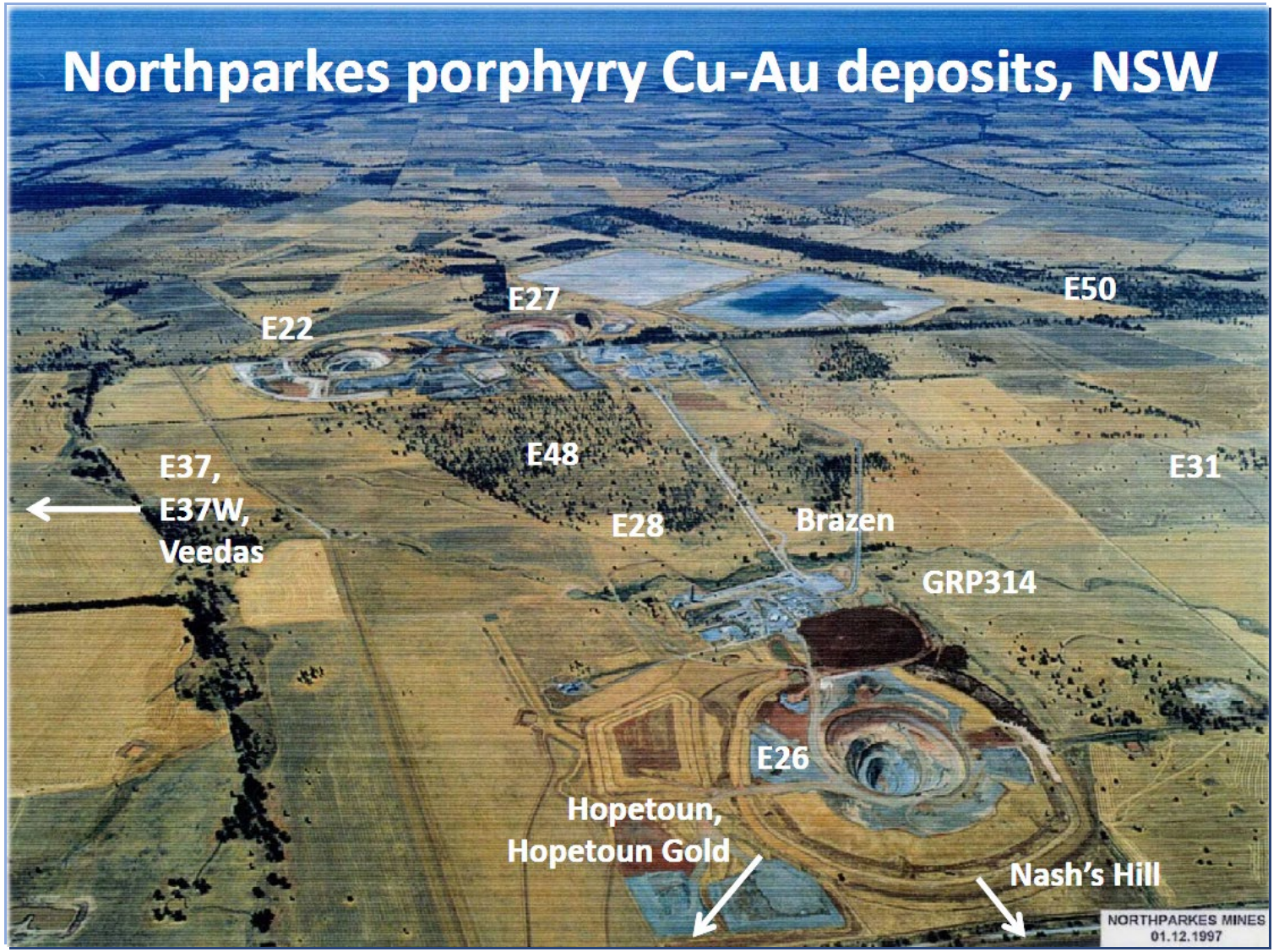
**Large low grade and deep**
**>1400m strike and 250m width**

**Moderate IP chargeability anomaly maps sodic and propylitic zones (pyrite)**

**Resistive shoulders map feldspar (sodic) alteration**

**Conductive zone corresponds with mineralisation**

# North Parkes - Discovery History




1972 Geopeko commenced exploration for VHMS deposits in the submarine volcanics of the Goonumbla Volcanic Complex

1973 E7 lead-zinc skarn discovered

1974 airborne survey

1975 one km spaced regional auger-core drill traverses along public roads commenced

1976 alteration associated with E22 was intersected on Adavale Lane

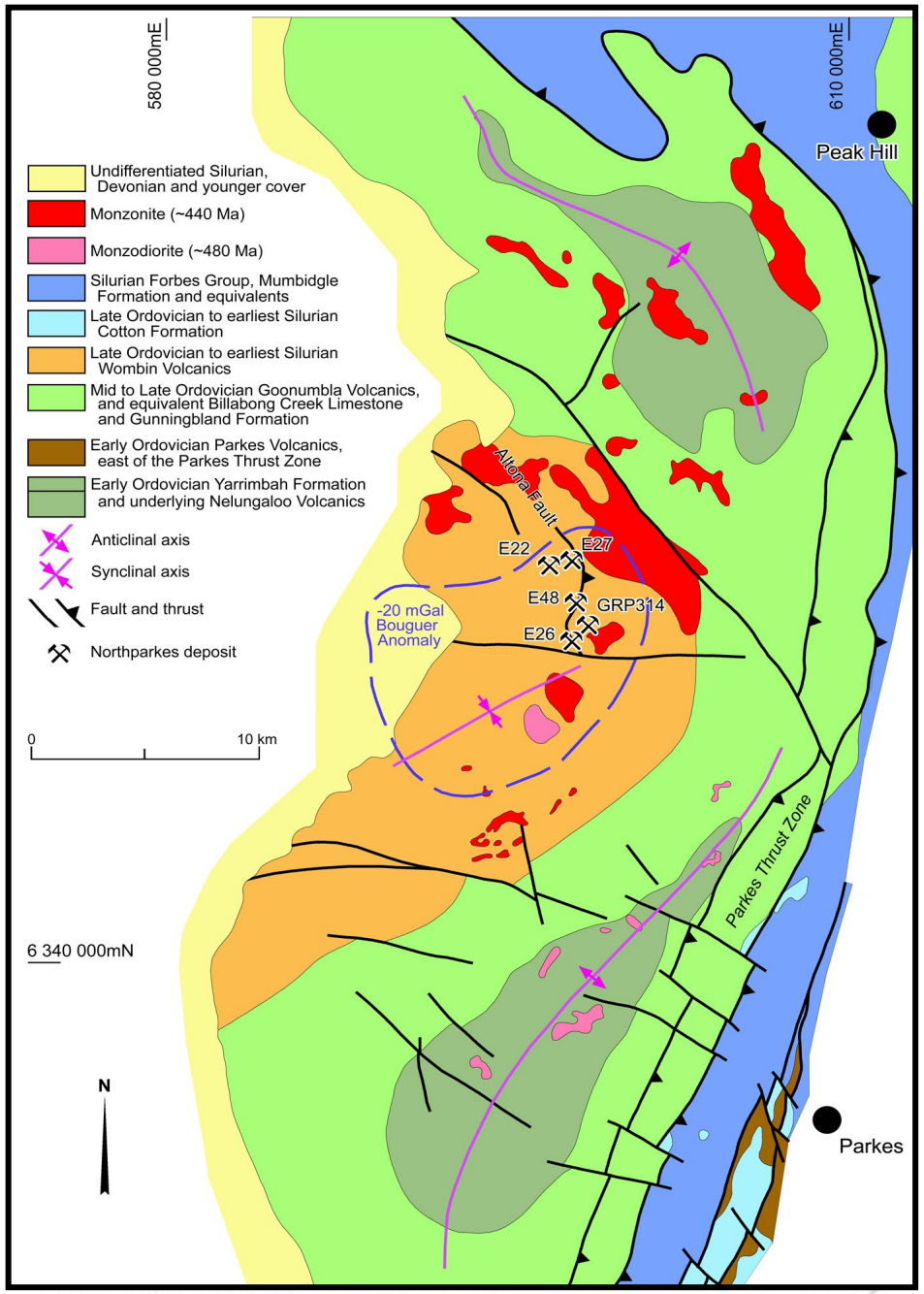
1977 after follow up RAB, diamond drilling intersected 229m at 0.61% Cu 0.67 g/t Au at E22.

1978 The nearby E27 deposit was discovered

1980 Further exploration with RAB and mapping located E26. First diamond hole intersected 441m at 0.67% Cu

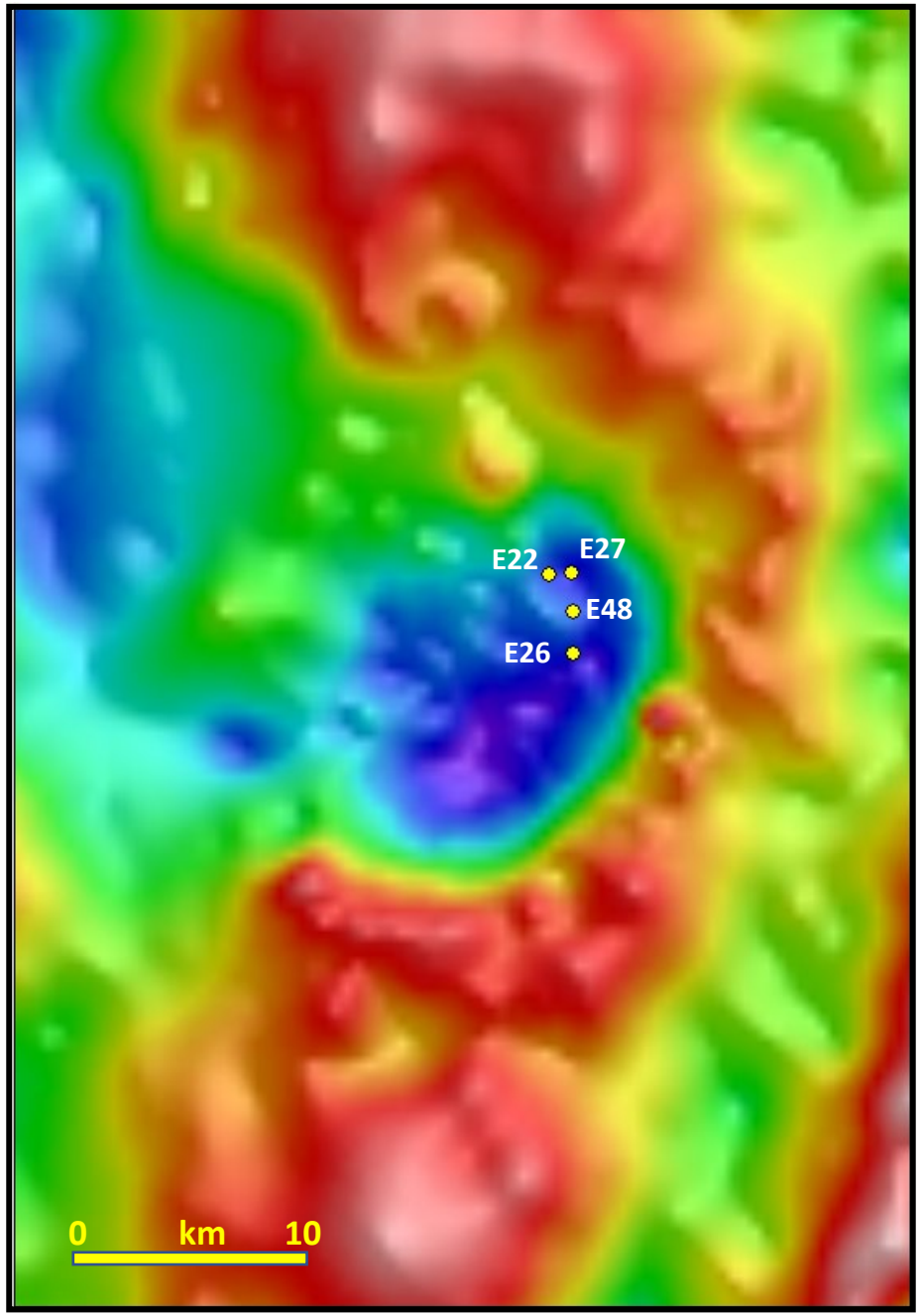
1993 E48 was discovered after testing a magnetic anomaly. First RC hole intersected 83m at 0.95 % Cu and 0.15 g/t Au

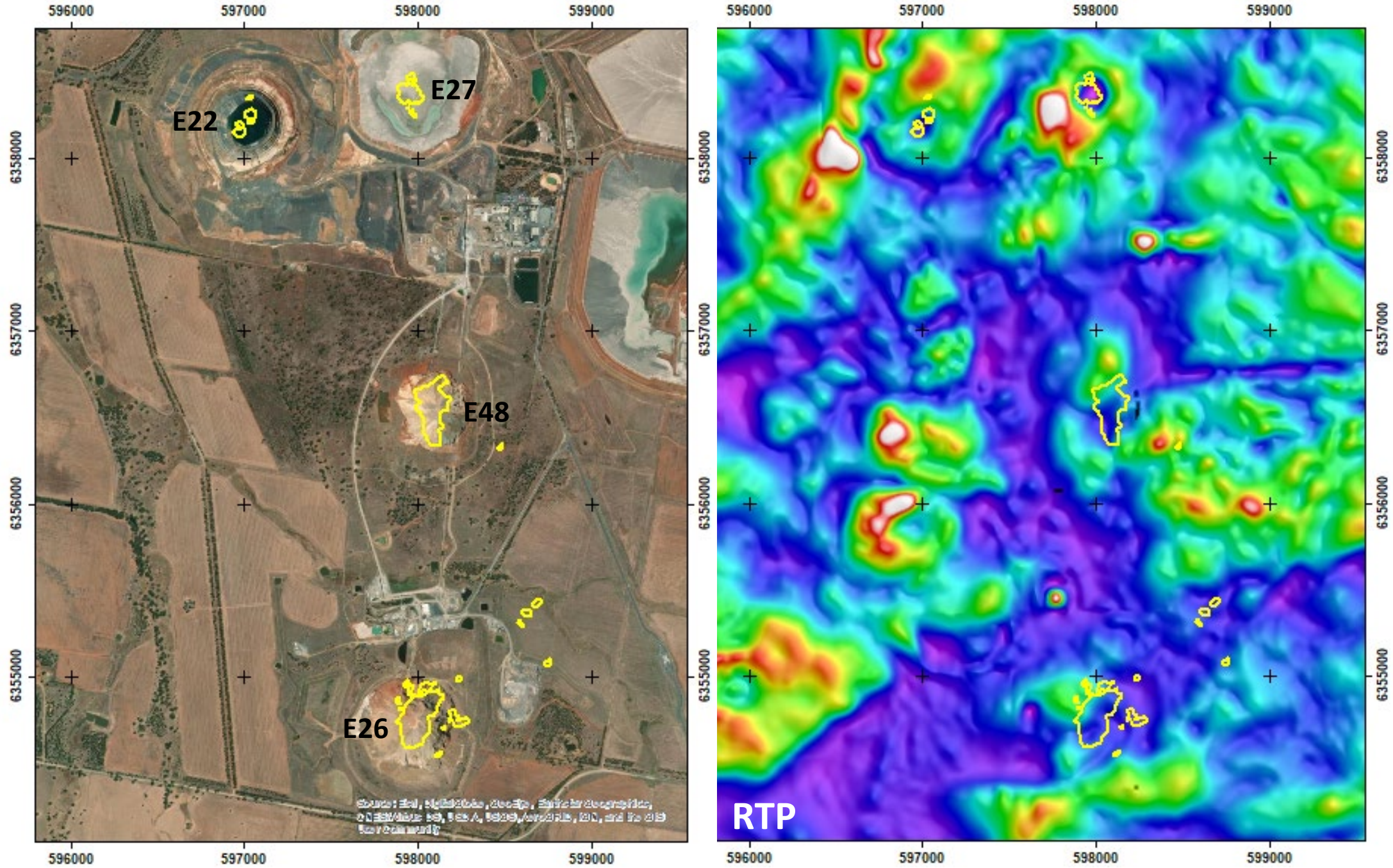
# North Parkes Geology And Regional Gravity




From http://www.portergeo.com.au/database/mineinfo.asp?mineid=mn232

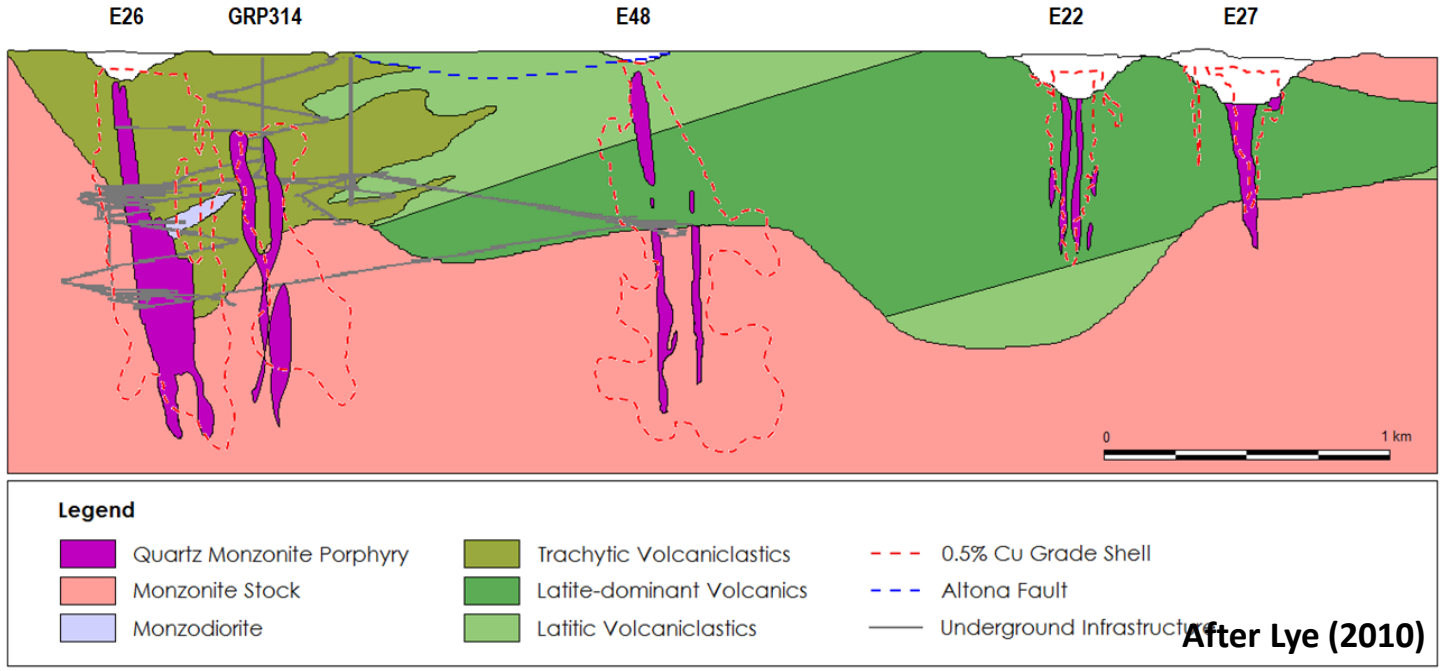
Geological setting of the Goonumbla Volcanic Complex, Macquarie Arc, Central Western New South Wales. After Pacey *et al.* (2019), Owens *et al.* (2017), Simpson *et al.* (2005), Lickfold *et al.* (2003), Raymond *et al.* (1995)



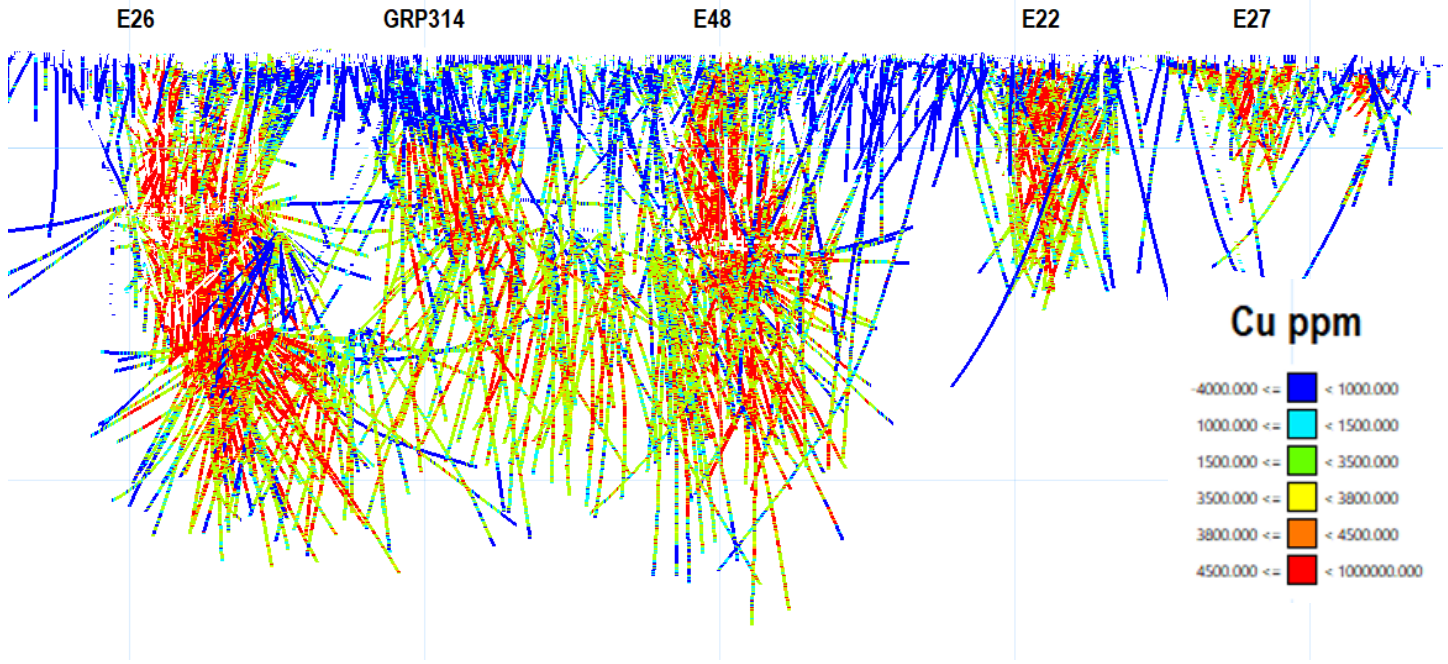



Yellow: 1% Cu outline

# North Parkes – Simplified Geological Long Section




After Lye (2010)

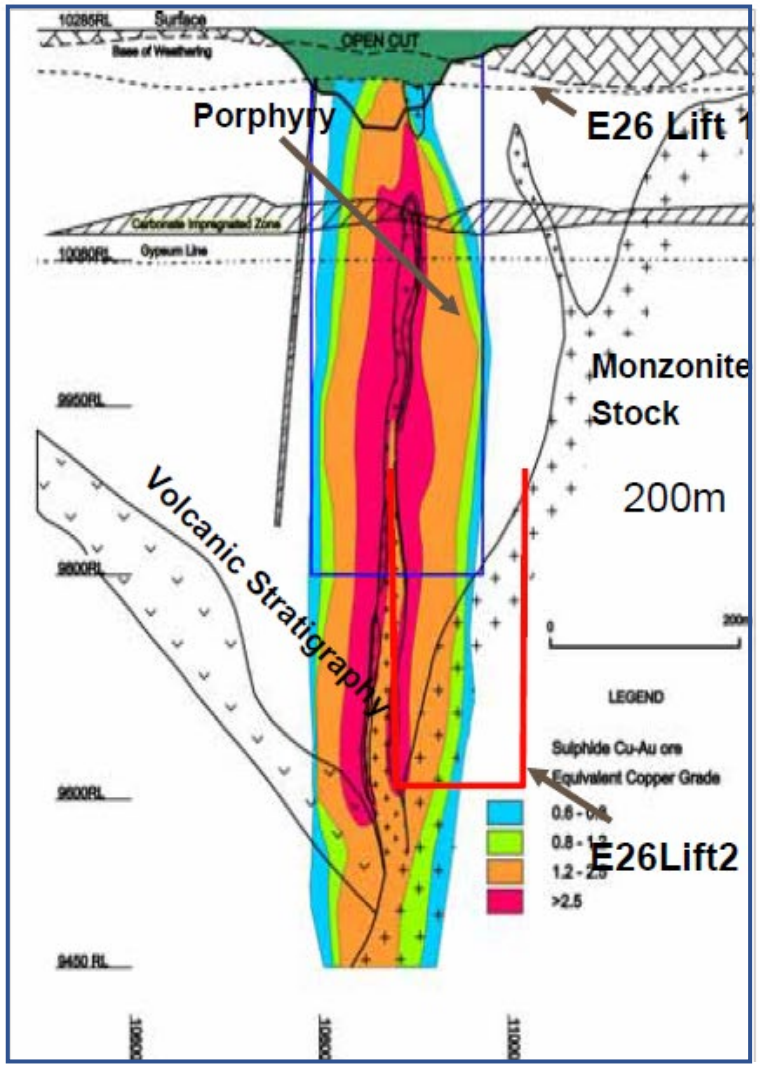



| Deposit | Mt | Cu (%) | Au (g/t) | Reference |
|---|---|---|---|---|
| E26 # | 61.0 | 1.25 | 0.42 | Butcher et al. (2011) |
| E48 # | 63.4 | 0.85 | 0.34 | Butcher et al. (2011) |
| E22 * | 29.8 | 0.76 | 0.72 | North Ltd. (1992) |
| E27 * | 28.1 | 0.74 | 0.96 | North Ltd. (1992) |

**Total MineralEndowment**
**~4.5Mt Cu, 5.4 MozAu (>24Moz *Au(eq.)*)**

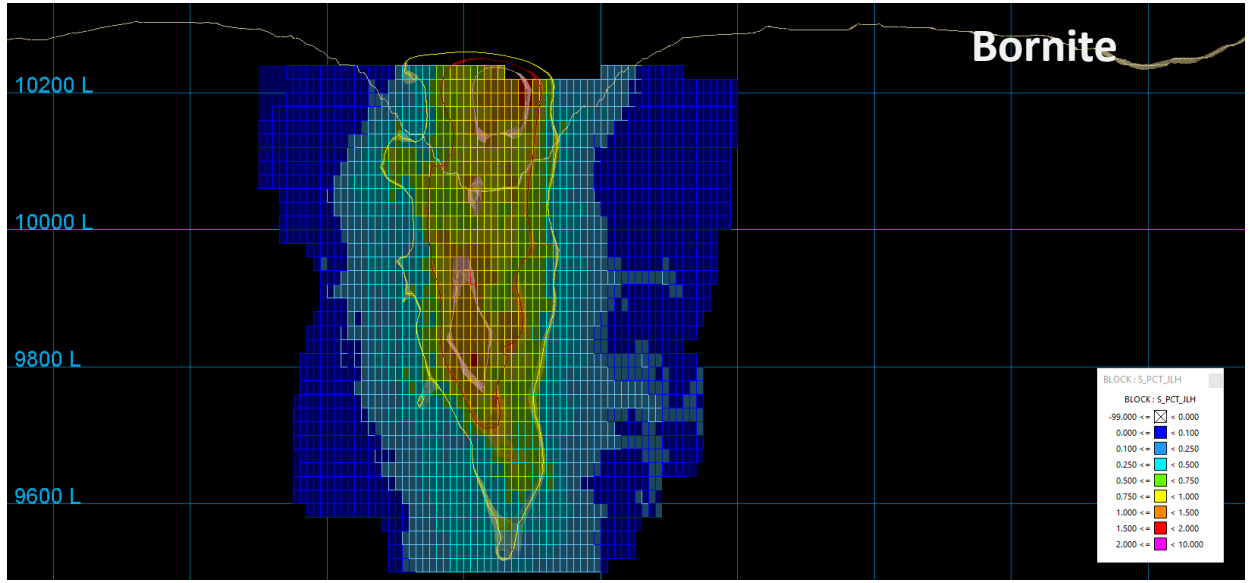
# North Parkes Deposit Characteristics

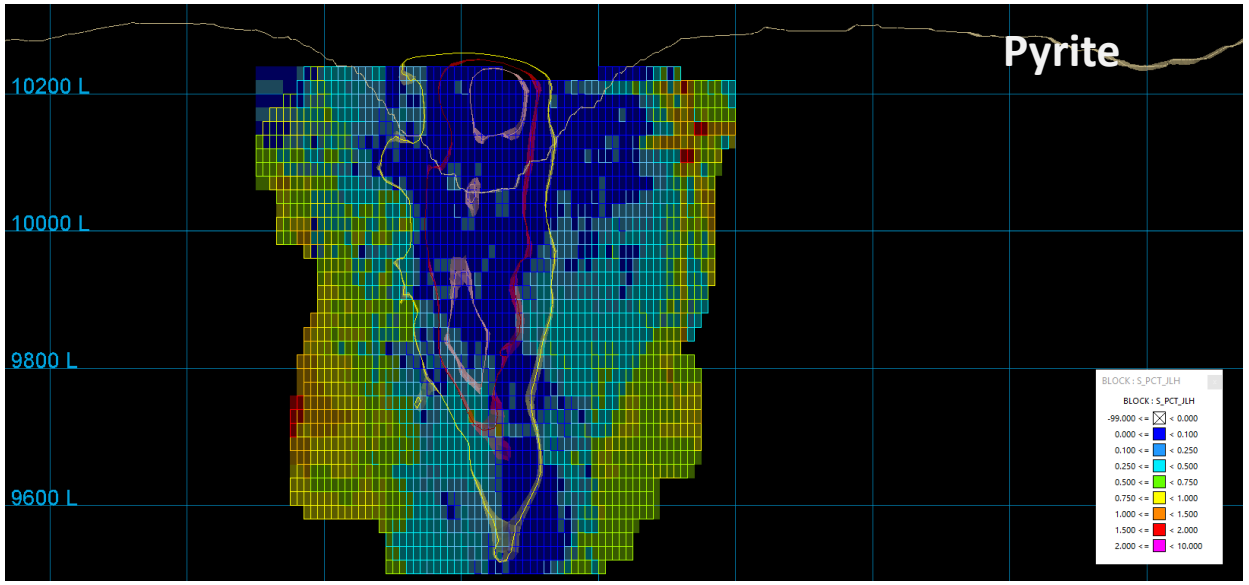
- Pipe-shaped porphyry systems
- Vertically extensive : E26 > 1200m deep
- Mineralisation concentrically zoned around the porphyry
  - Higher grades in or around the porphyry, declining outwards
  - Bornite cores → chalcopyrite → distal pyrite
- Similarly zoned alteration
  - K feldspar → Biotite magnetite → distal sericite chlorite
  - Late phyllic overprint

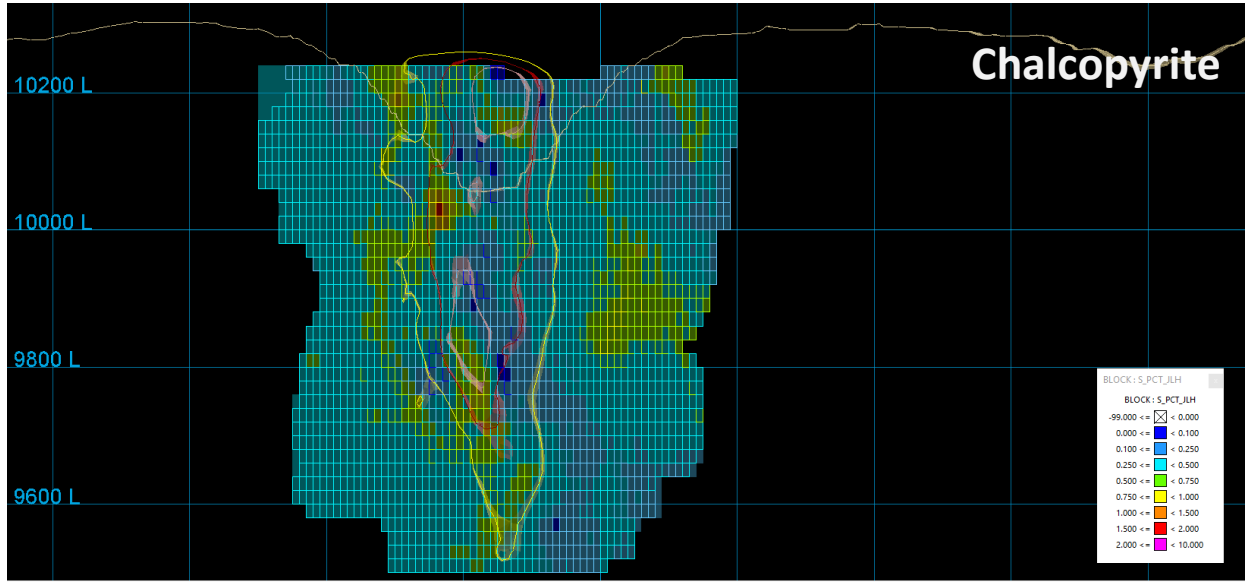


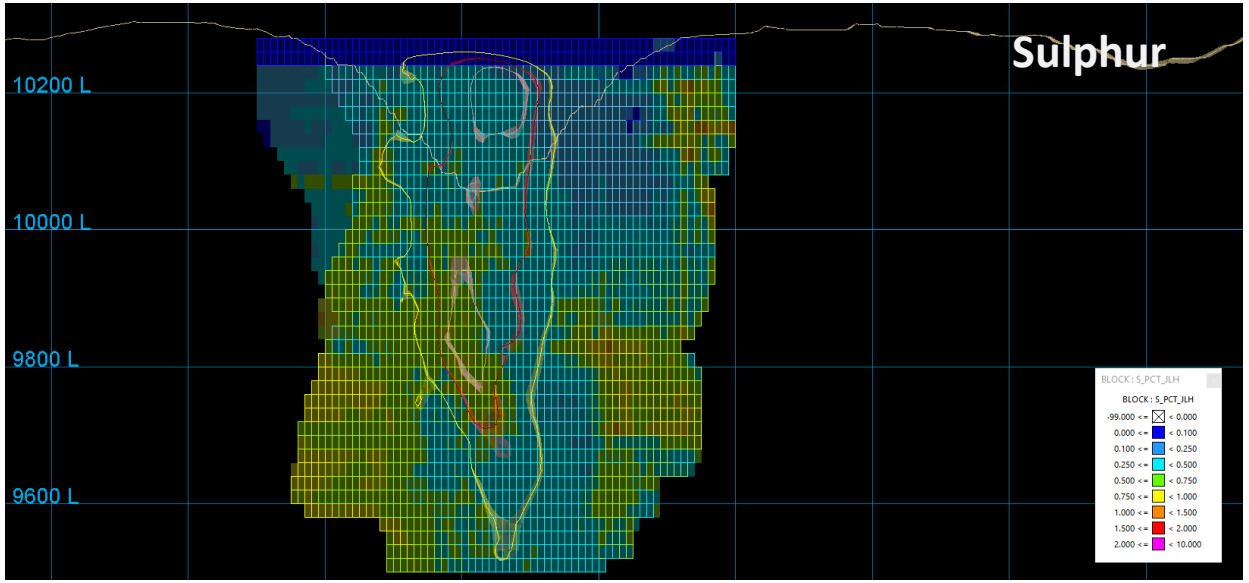

After Lye (2010)

# North Parkes E22

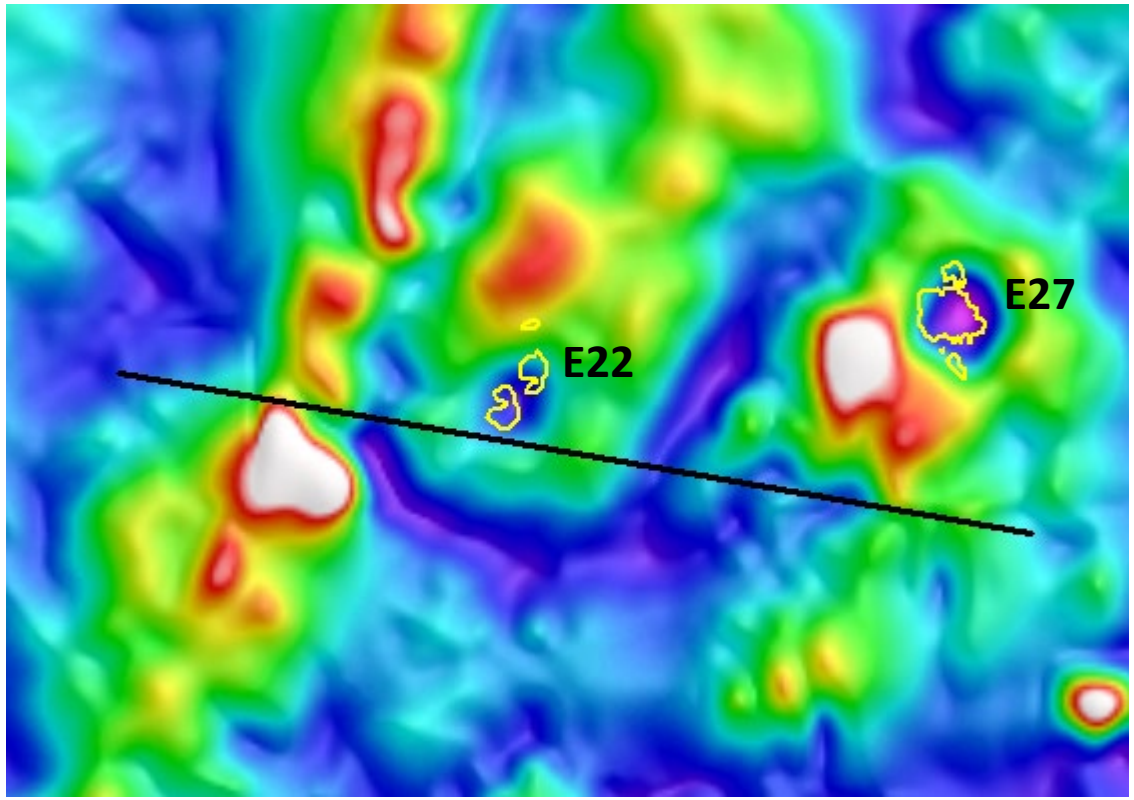


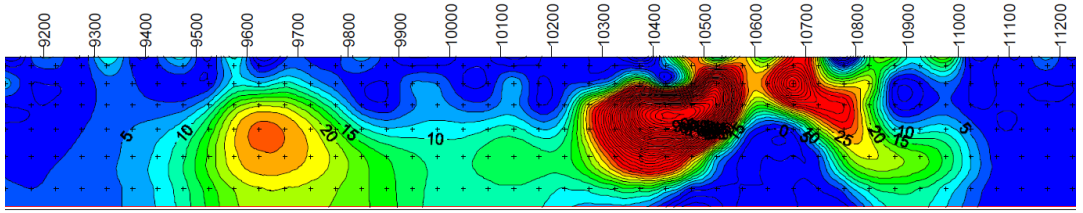



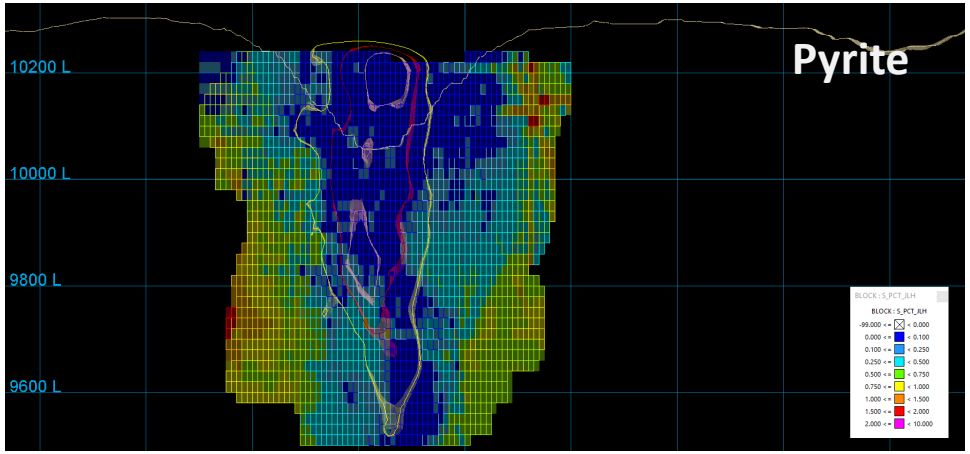



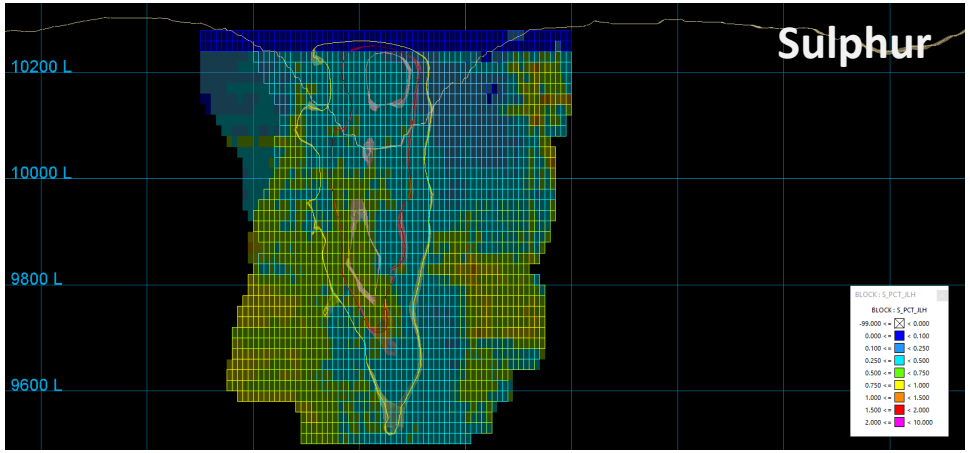



# North Parkes E22

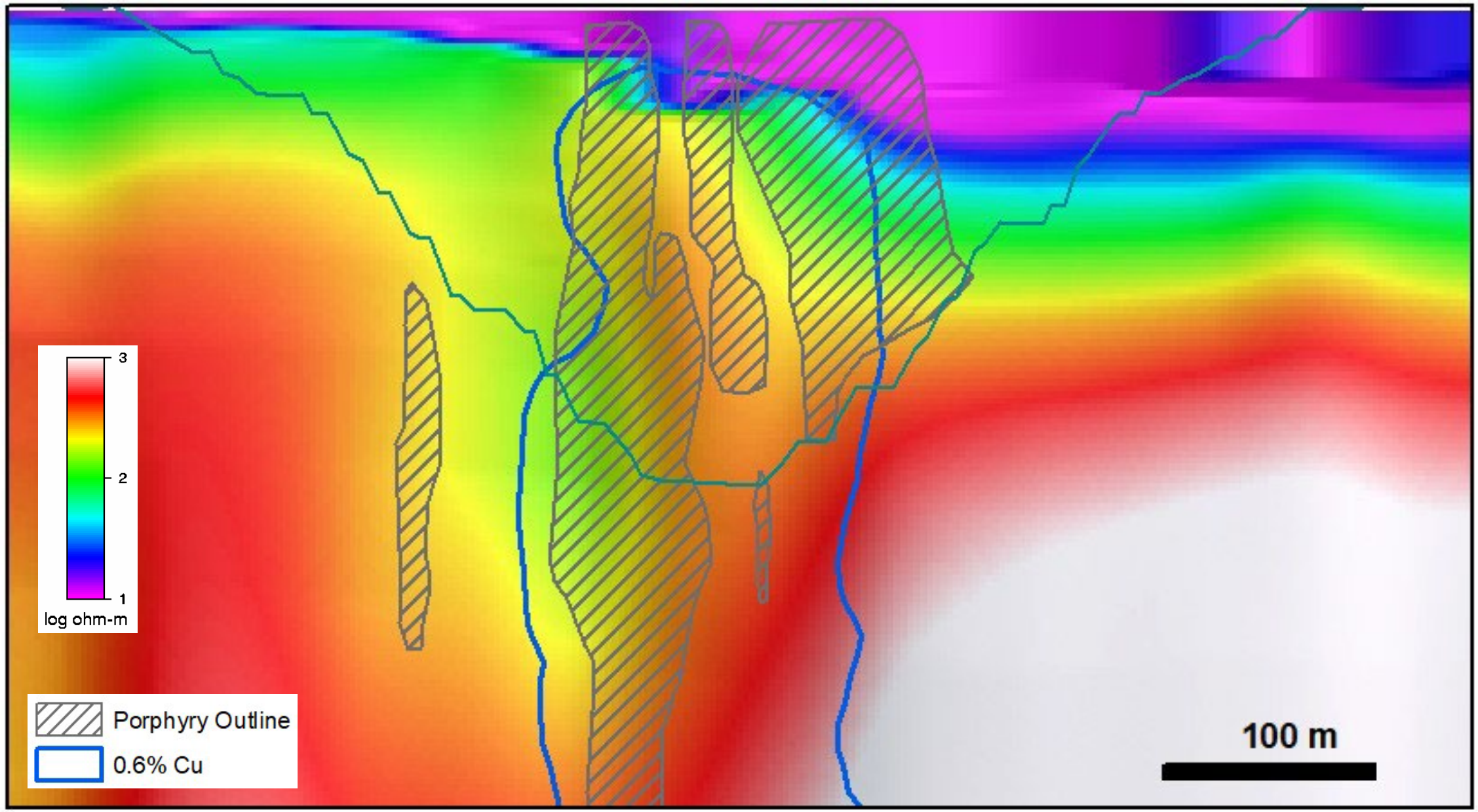


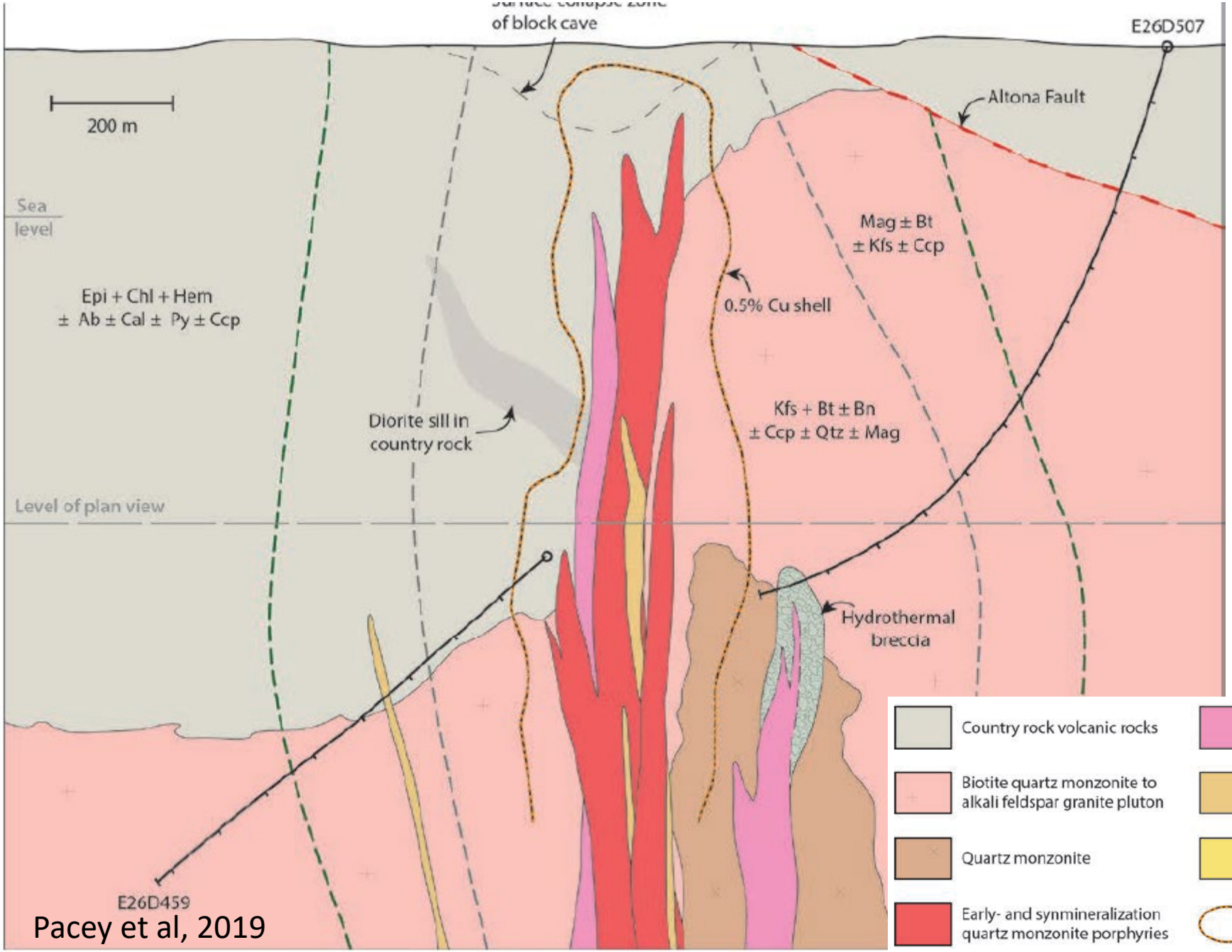



# North Parkes E22 - CSAMT



# North Parkes E26

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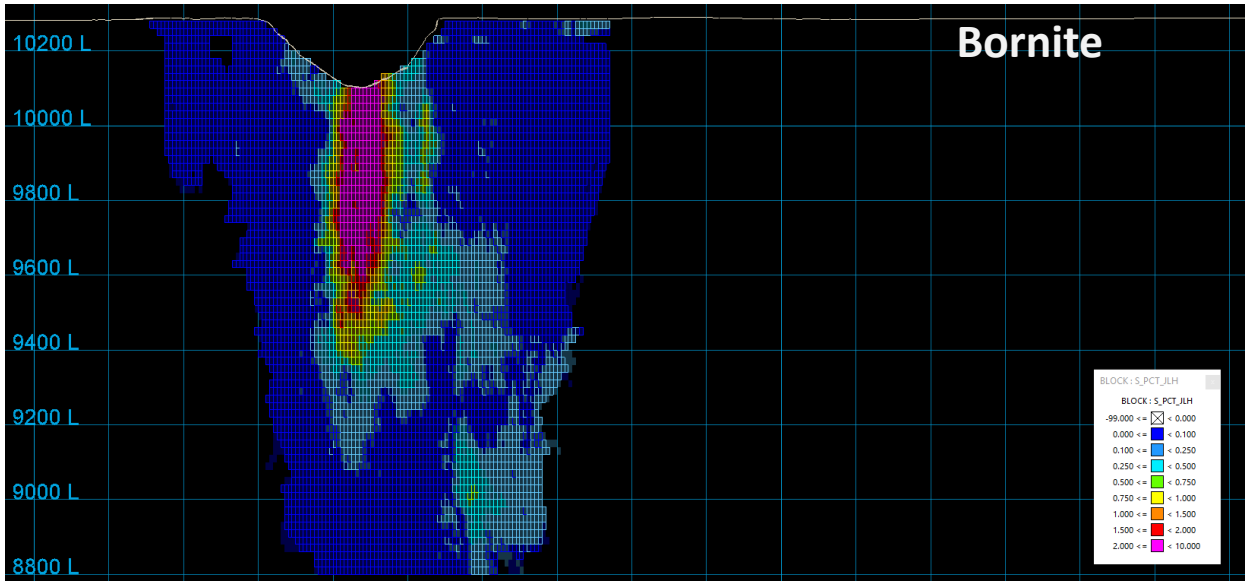
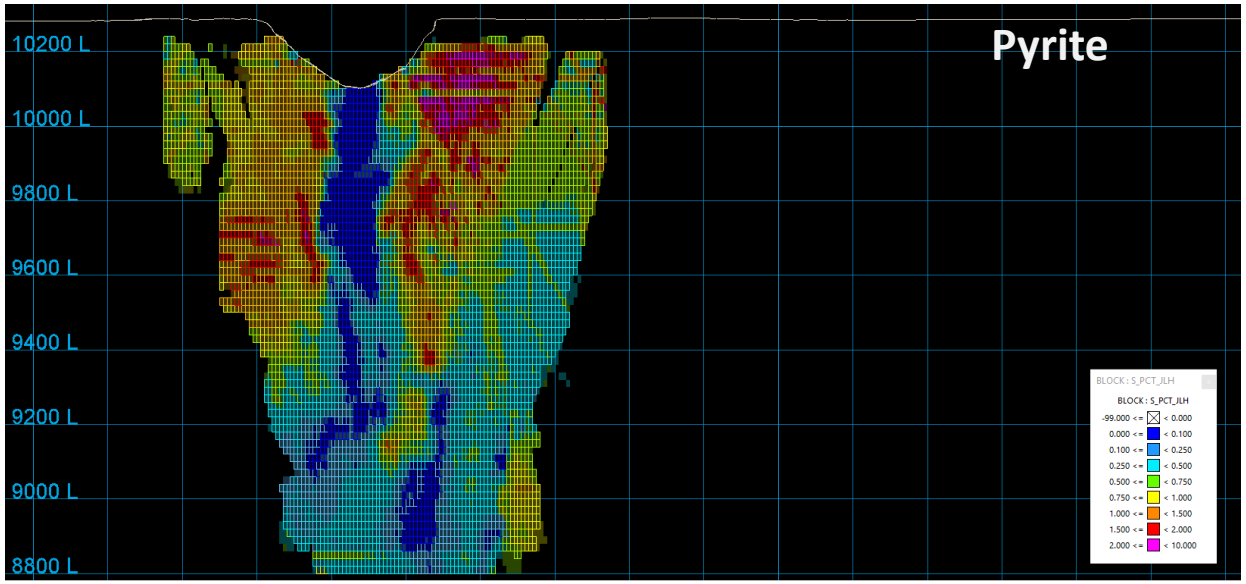
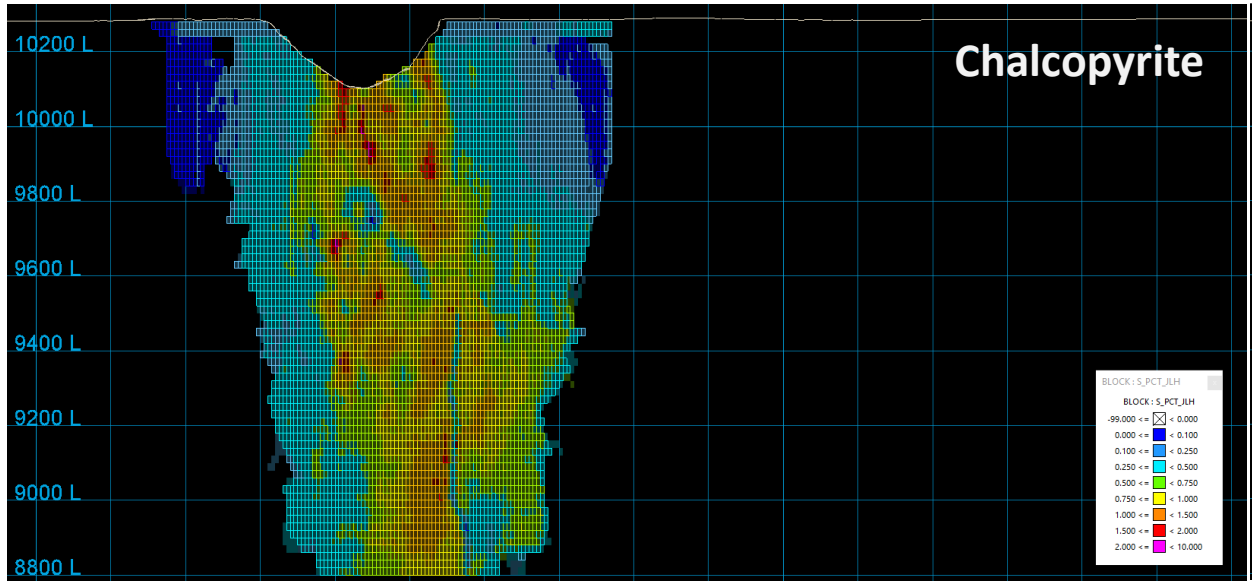
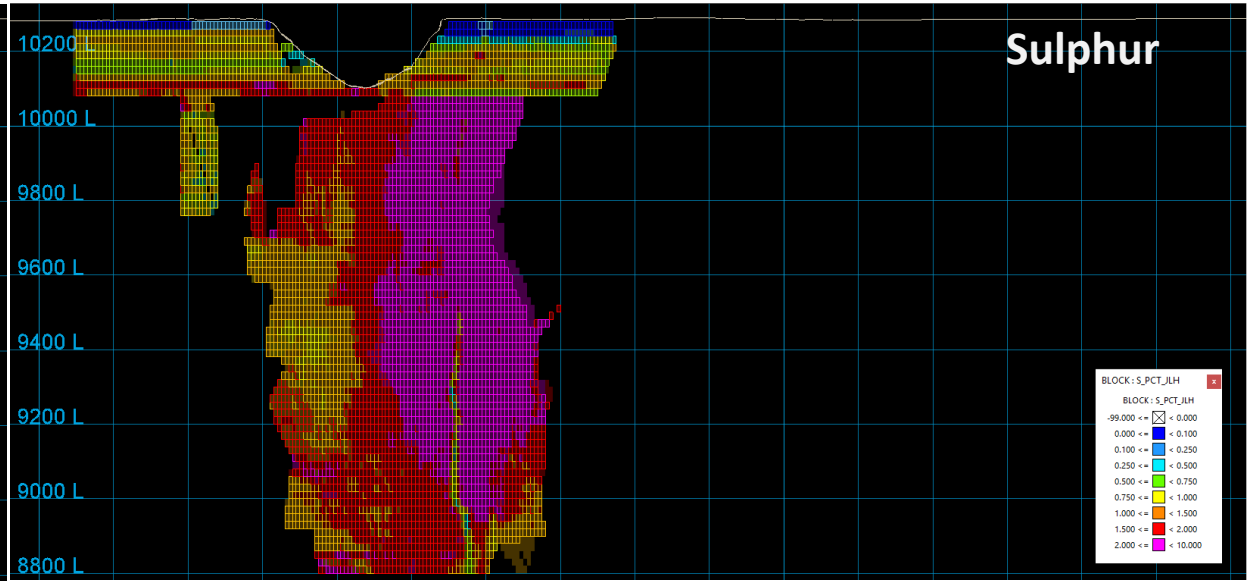
# North Parkes E26

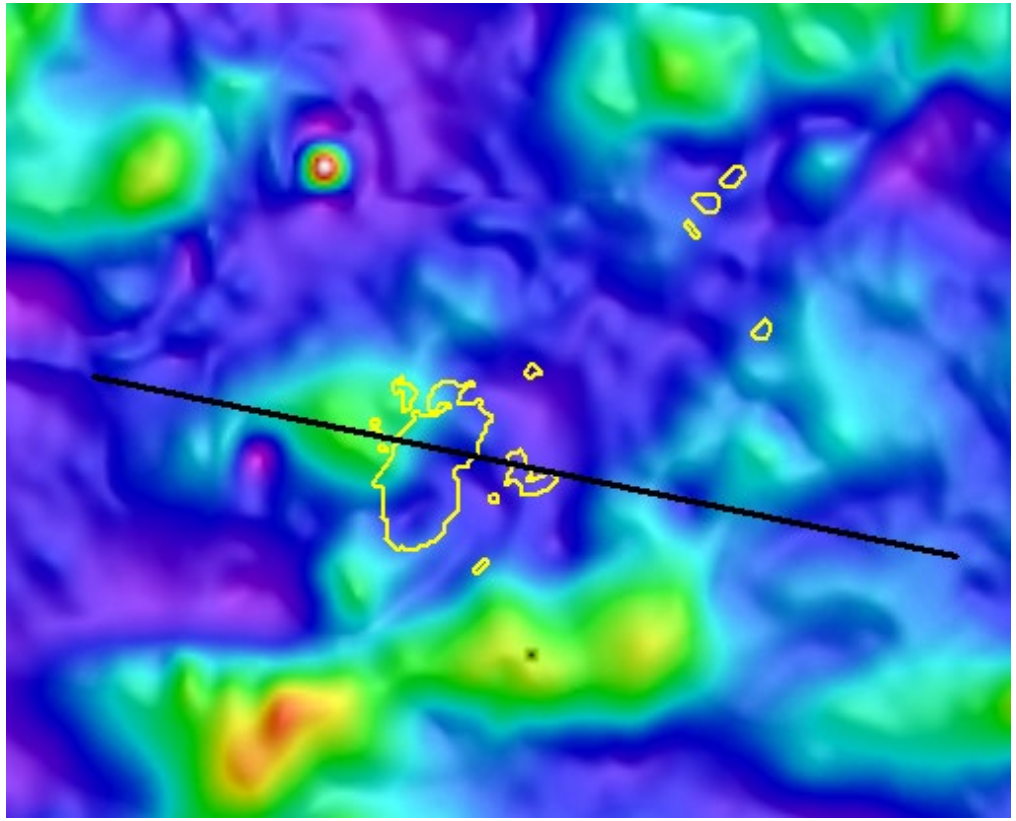


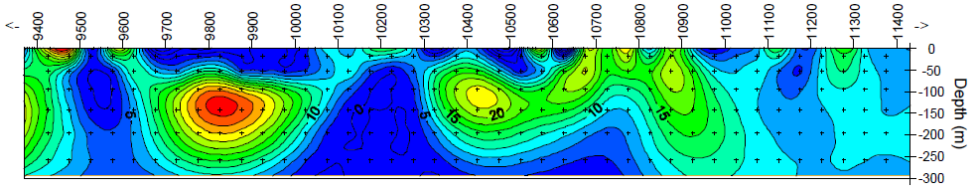



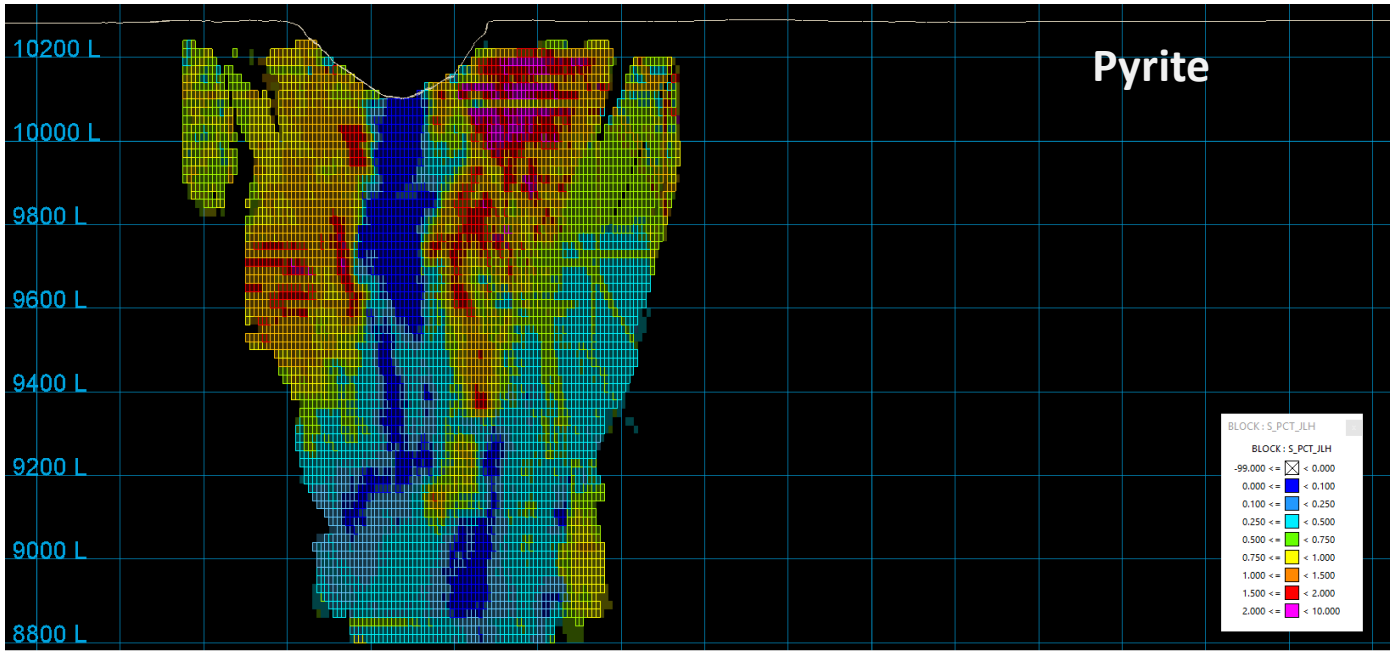



# North Parkes E26

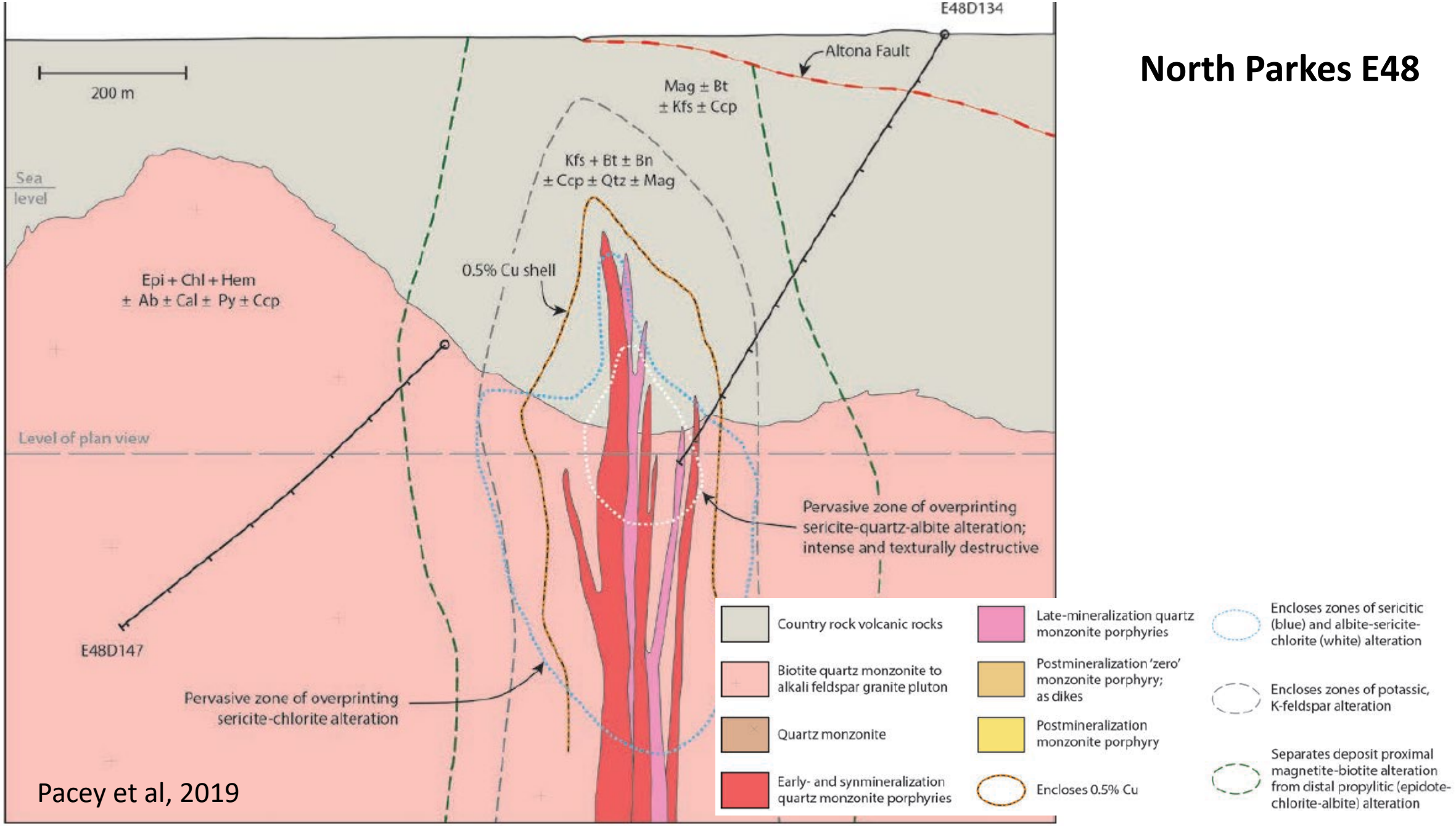


## Inverted Chargeability



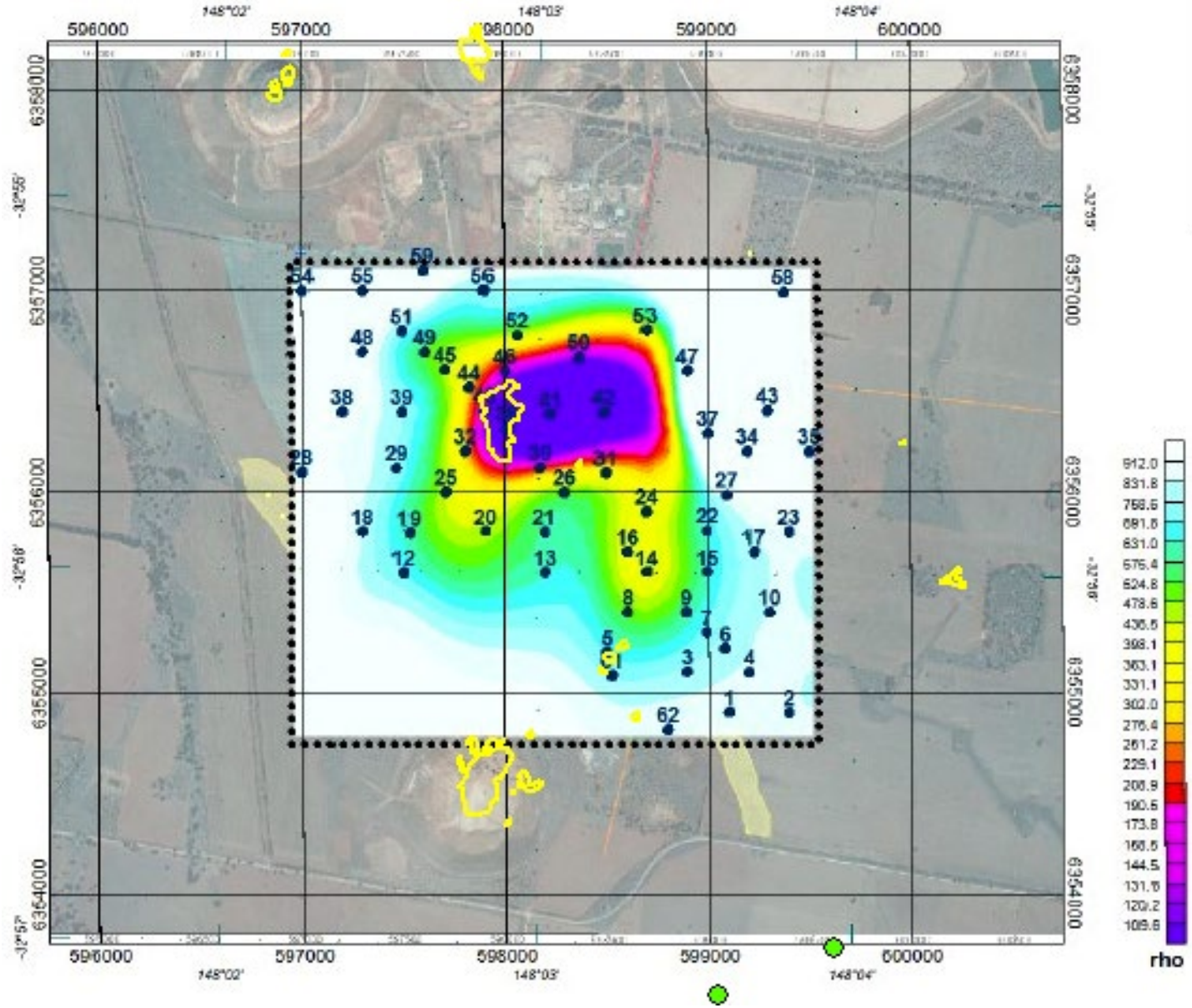



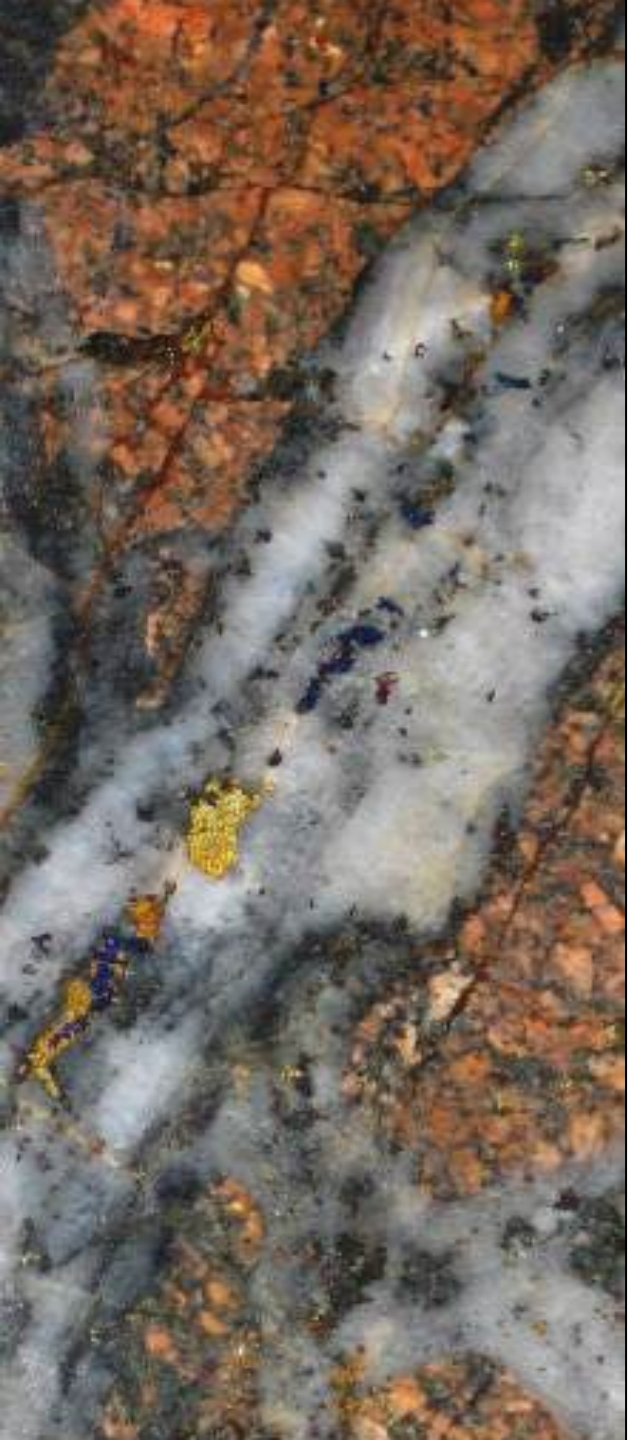
# North Parkes E48




Pacey et al, 2019

# MT3D {db3d} at elevation 100m (~200m depth)





# Conclusion

**Ore Zone – difficult to directly detect**
**Low sulphide**
**Resistive**
**Non magnetic**
**Ridgeway is the exception**

**Magnetite halo – E22, E27, E48, Ridgeway, Cadia East**

**Pyrite Halo. Pyrite may also be associated with late phyllic or sodic alteration.**

**Generally resistive alteration. May have weakly conductive sulphide veining or late phyllic alteration**

**We would like to thank Newcrest Mining Limited and CMOC for permission to present this.**