

A geological framework for the northern Molong Volcanic Belt, Lachlan Orogen, NSW

Implications for regional correlations and alkalic porphyry Au-Cu metallogensis



Peter Duerden

Overview

1. Background

2. Northern Molong Volcanic Belt

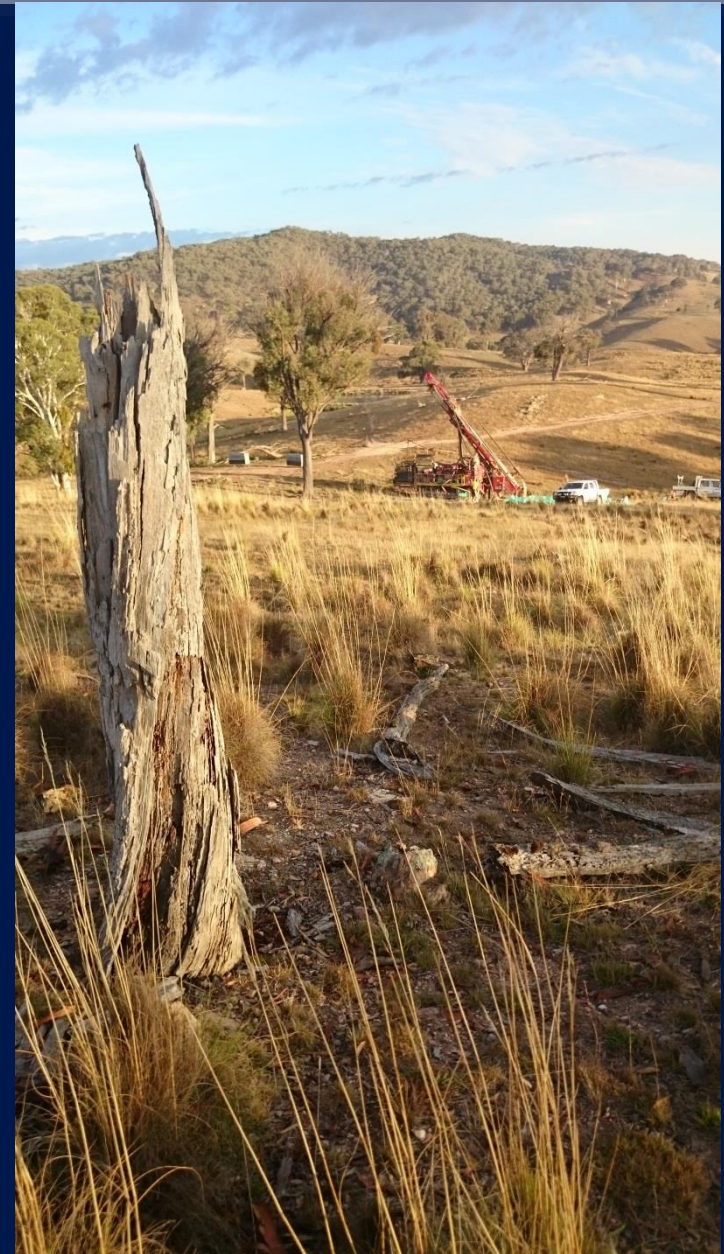
Establishing a Geological Framework

Regional Correlations

3. Exploration Implications

Kaiser Project exploration status

4. Conclusions



**Alkalic Porphyry Au - Cu
(Intrusion-Centred)**
e.g. Ridgeway

- Kaiser Project**
- Bodangora Project**
- Finns Crossing Project**
- Cudal Project**
- Peak Hill Project**

Subseafloor hybrid Au ± Cu
e.g. McPhillamys

- Elsinora Project**
- Rockley Project**
- Wellington Project**

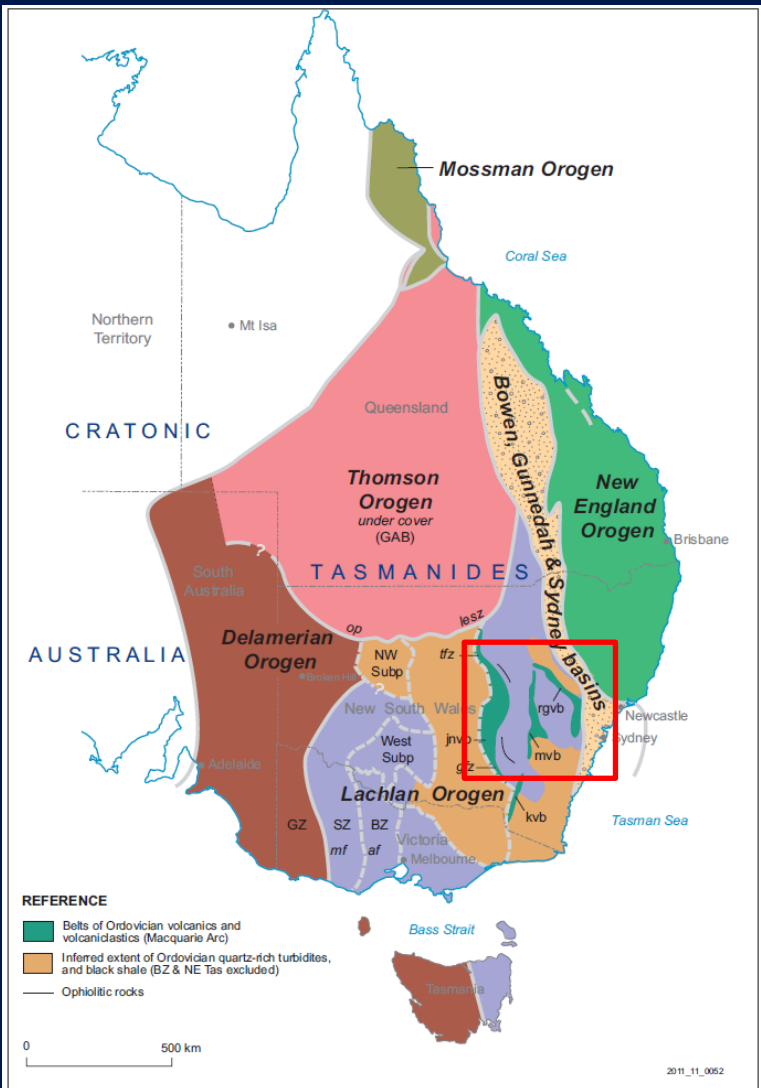
Orogenic Au
e.g. Caloma

- Tomingley Project**

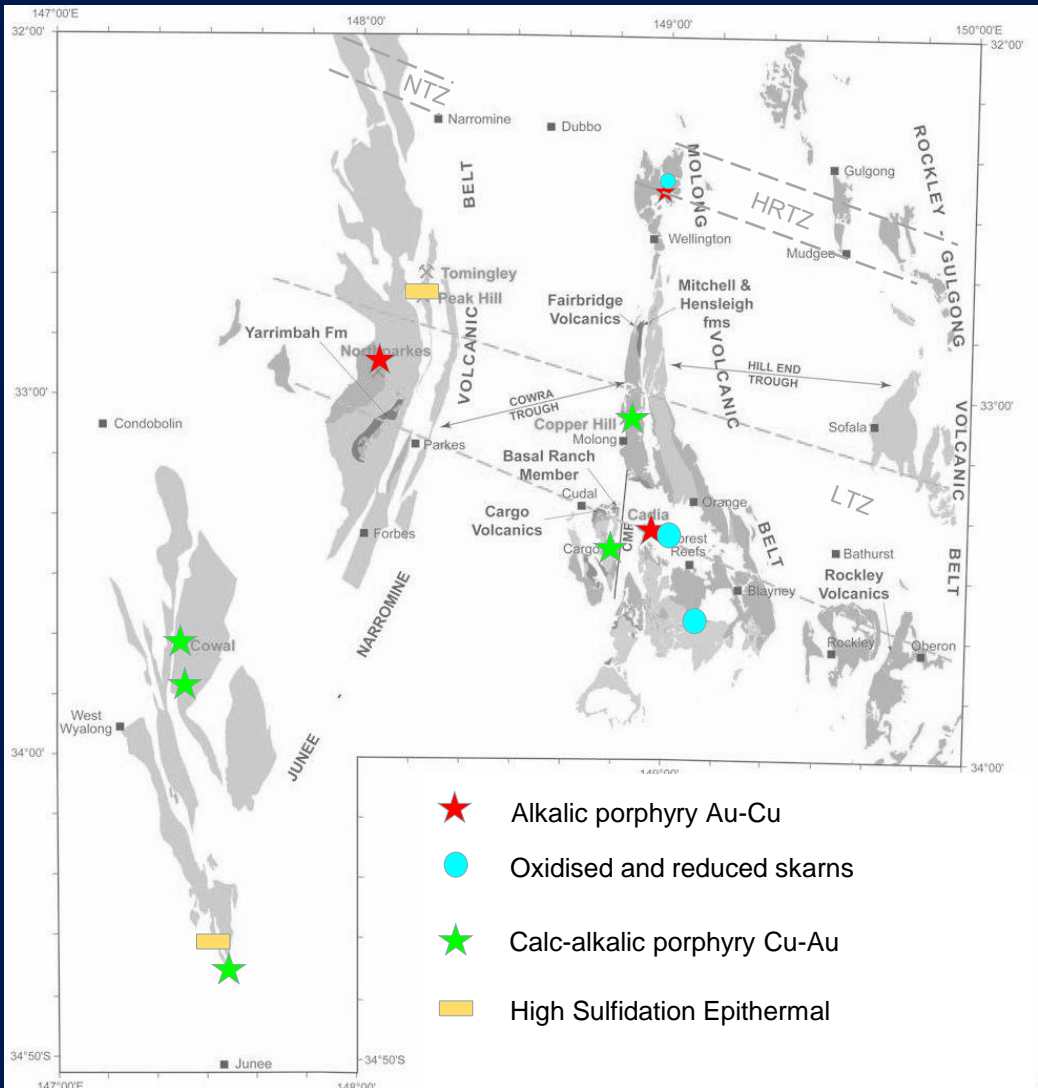


Background

Macquarie Arc Regional



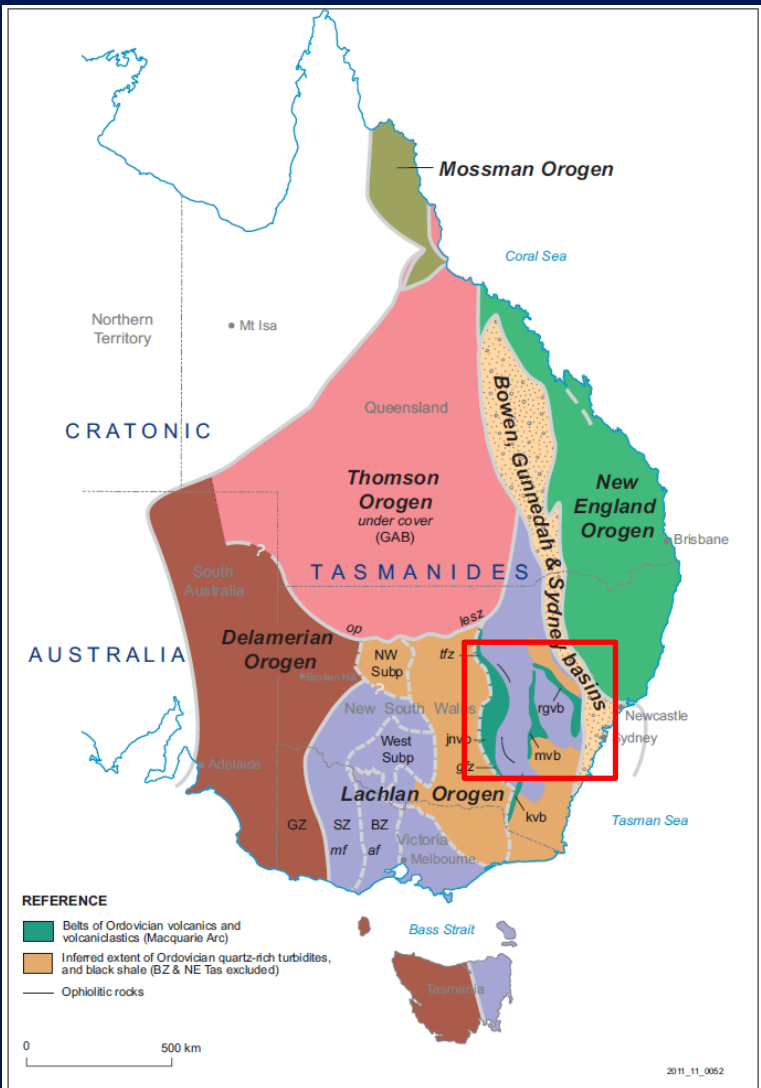
Glen et al 2012



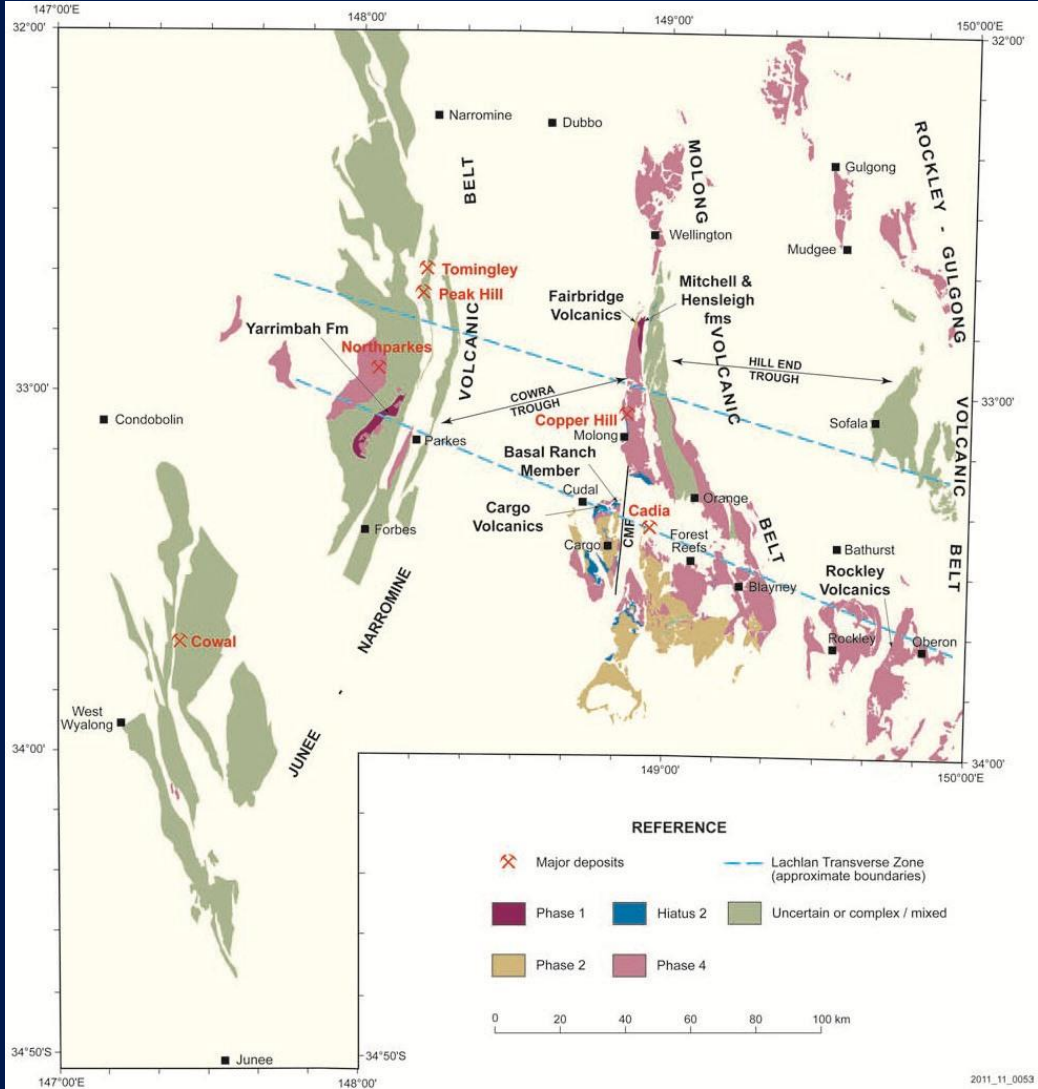
Glen et al 2012

Background

Macquarie Arc Regional

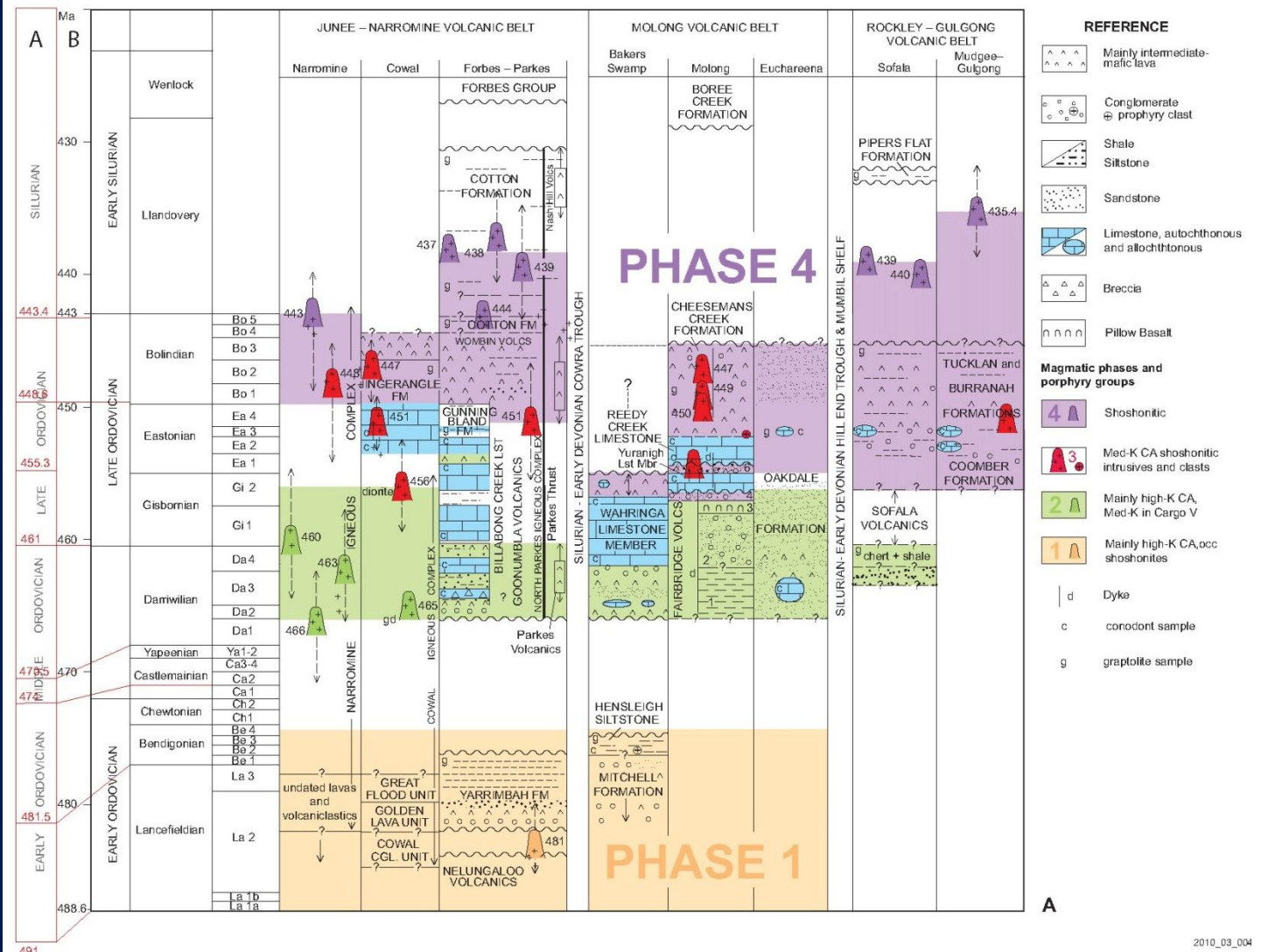


Glen et al 2012



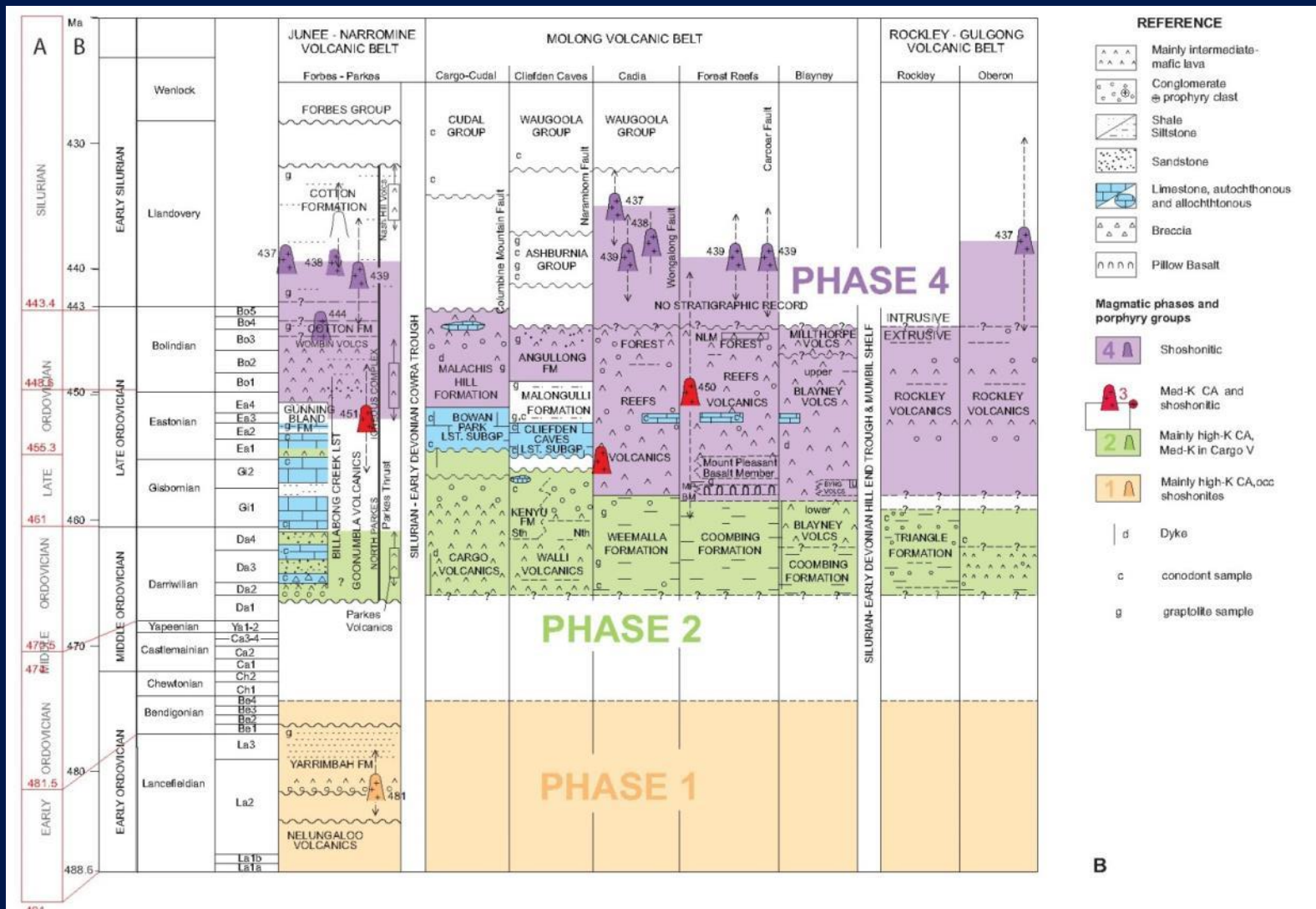
Glen et al 2012

Northern portion of Arc (central MVB)



Glen et al. (2012)

Southern portion of Arc



491

2010_03_0246

Northern Molong Volcanic Belt

Establishing a Geological Framework



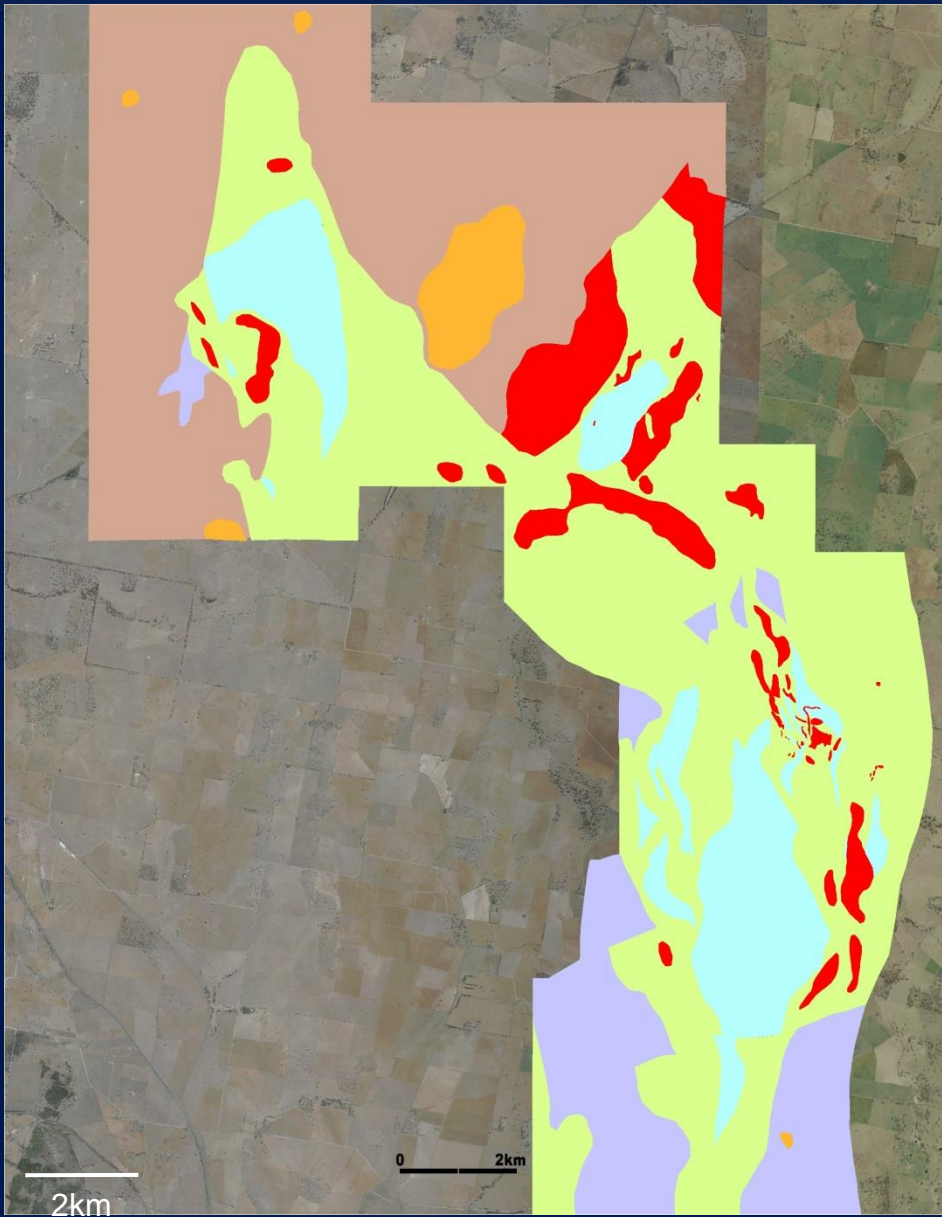


SPIRT Ordovician Project (1998-2000)
Regional synthesis correlation work by
CODES – GSNSW - Industry Teams
(inc. Alkane)

Didn't include the northern MVB



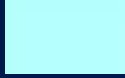
Originally mapped as widespread areas
of Oakdale Formation

**'Basalt, basaltic andesite, latite lava and
intrusions, volcanoclastic breccia,
conglomerate, sandstone and siltstone, minor
allochthonous limestone'**



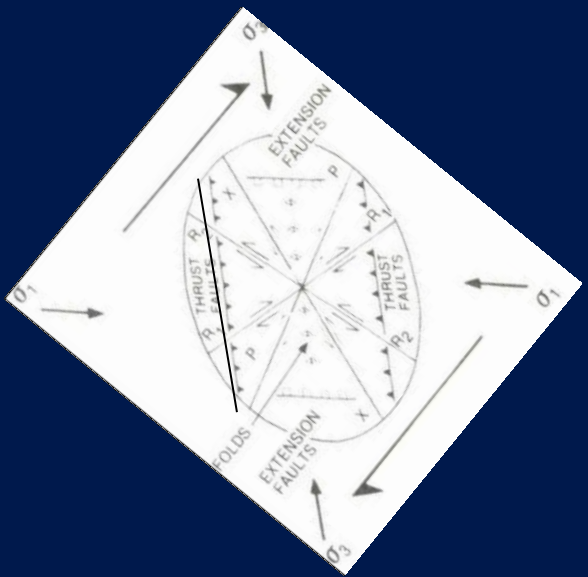
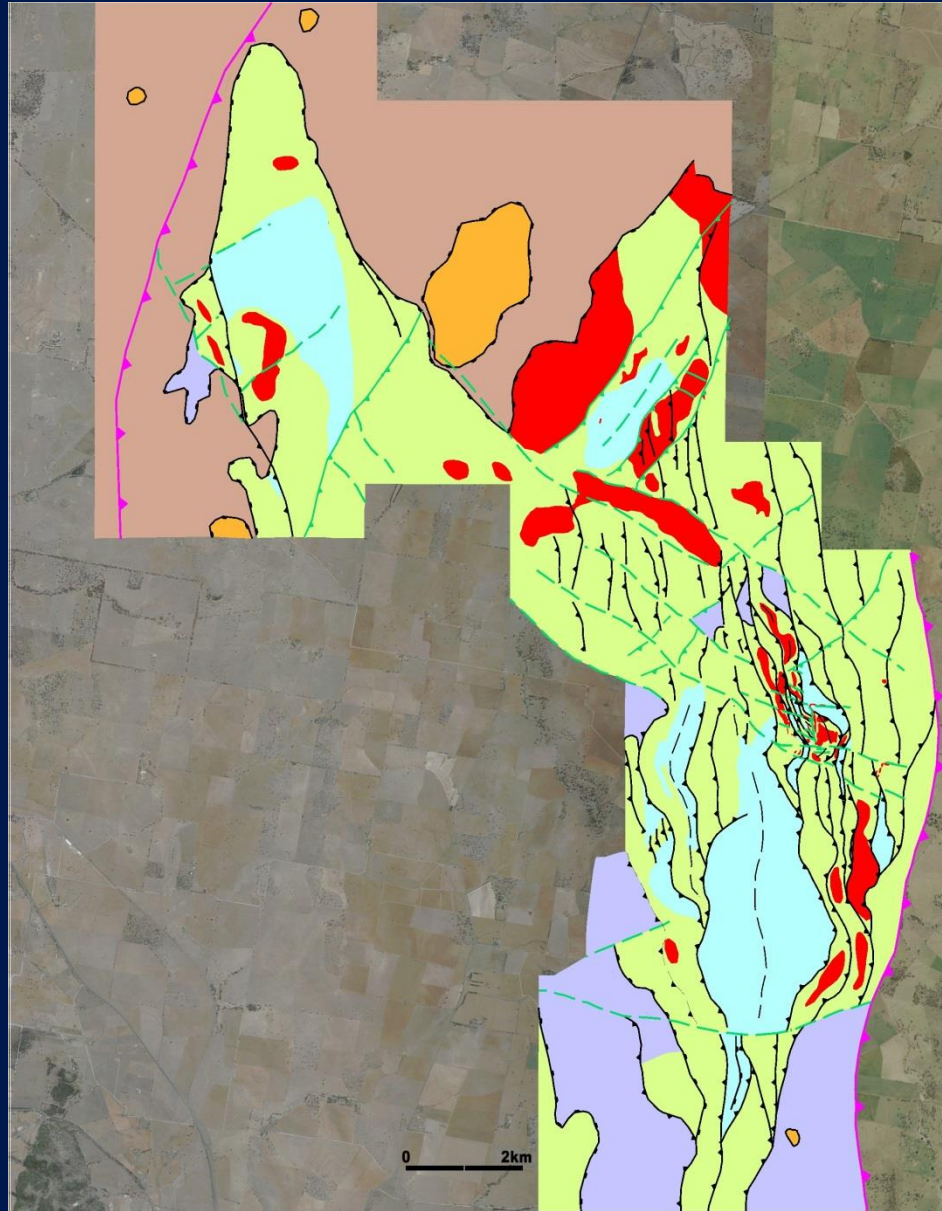
-  Tertiary basalt
- *unconformity*
-  Gunnedah Basin
- *unconformity / faults*
-  Mumbil Group
- *Unconformity / faults*
- Silurian**
-  Alkalic Intrusives
- Ordovician**
-  Kaiser Volcanics
Basaltic-andesitic volcanics, polymict breccias
-  Bodangora Formation
Fine g. volcanoclastics, upper contact marked by basaltic volcanics, carbonate



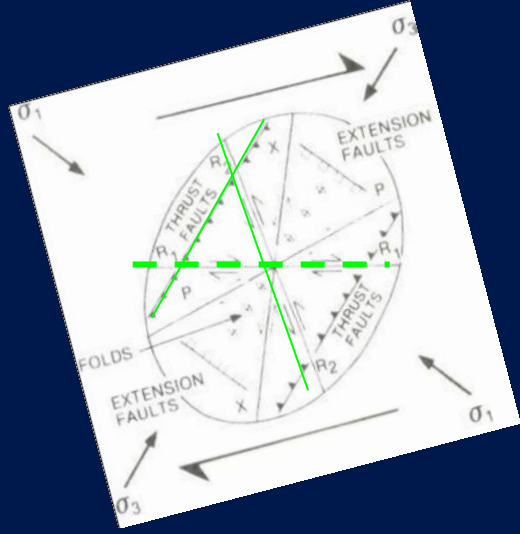
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Fine g. volcanoclastics, upper contact marked by basaltic volcanics, carbonate
- Silurian*
- Ordovician*

Northern MVB

Geological Framework



D_1

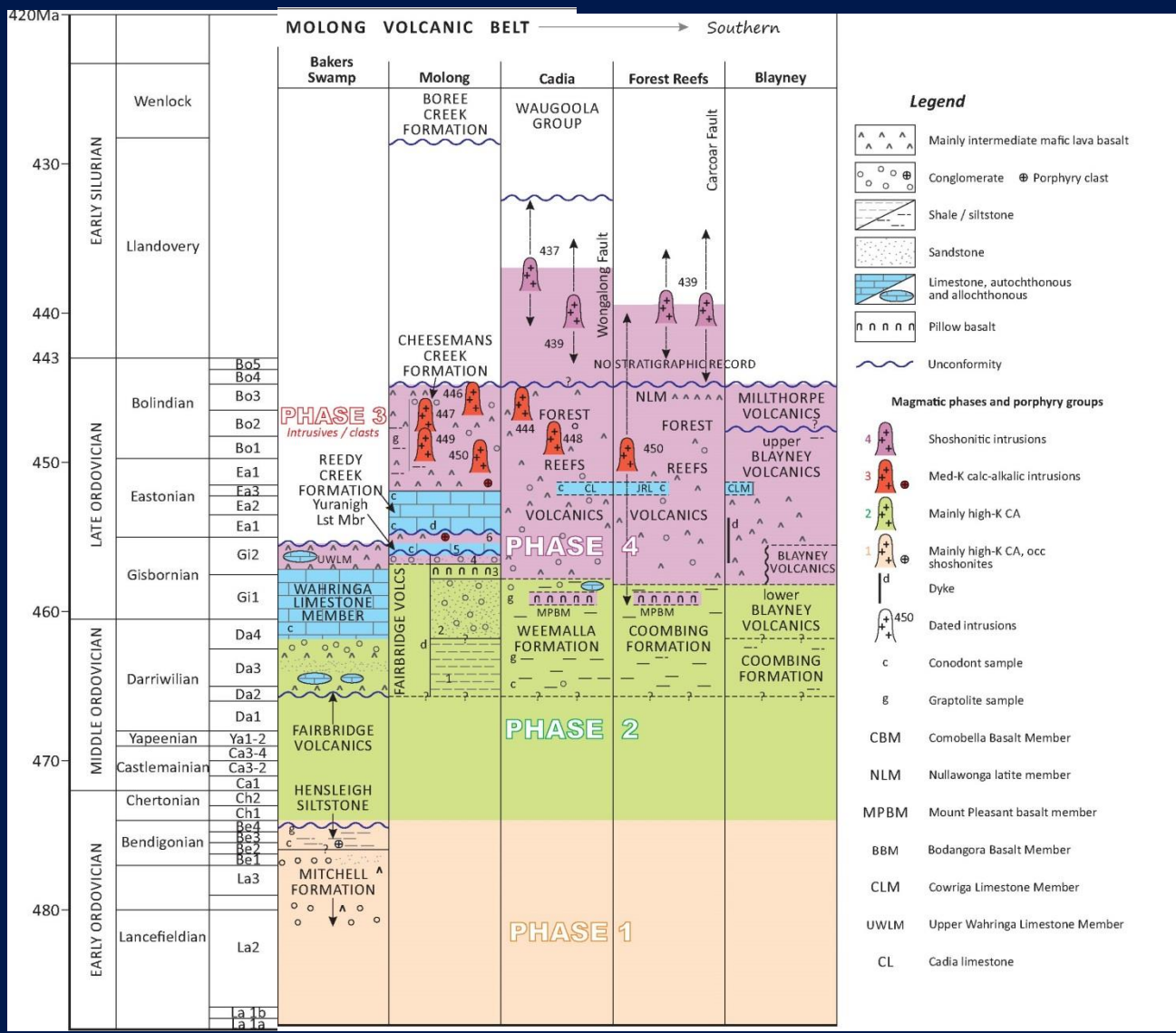


D_2

Northern Molong Volcanic Belt

Regional Correlations



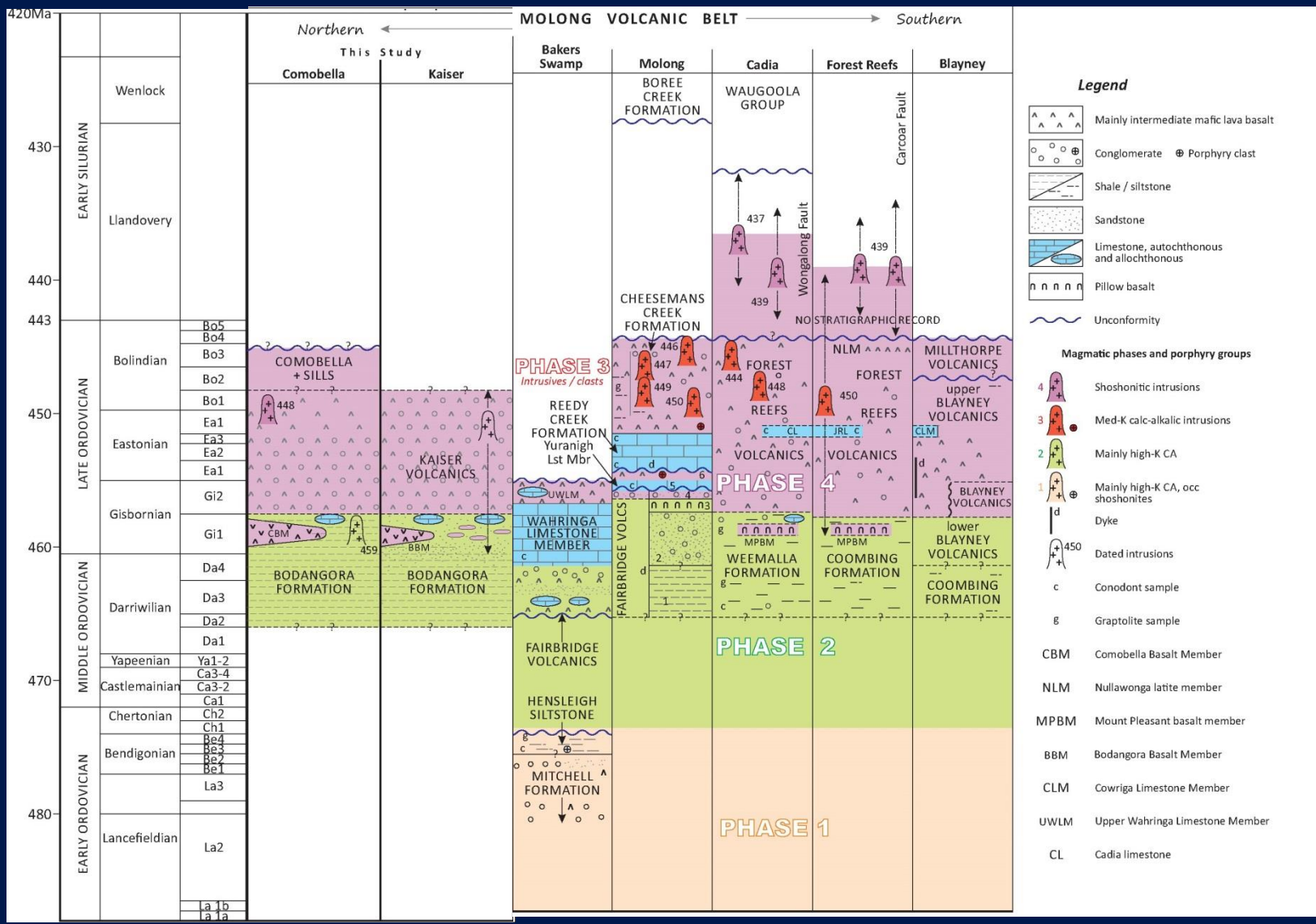


New stratigraphic position for MPBM = new timing of the onset of shoshonitic magmatism in Cadia district e.g. Harris et al (2014)

Association of MPBM with Gisbornian carbonates = key stratigraphic marker at transition from turbiditic (distal) to volcanic-derived sedimentation (proximal)

in the
Cadia District
and
Northern MVB District

Modified from Percival and Glen (2007). Position of MPBM and gisbornian limestones from Harris et al. (2014)

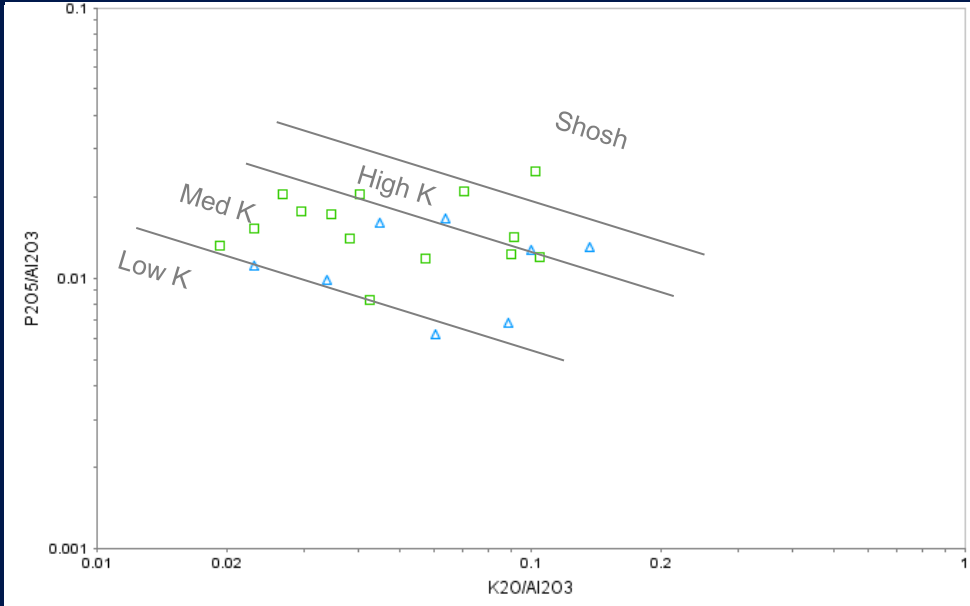
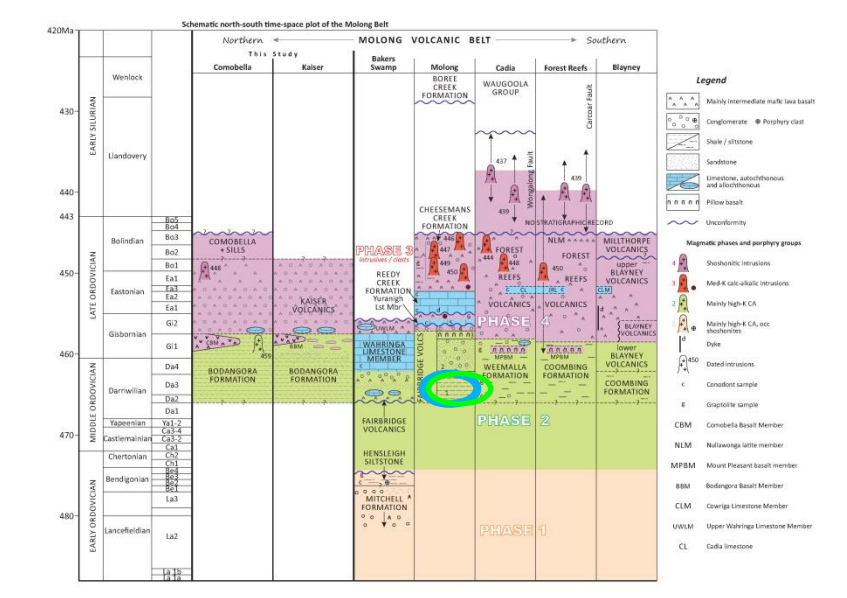


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Volcanics

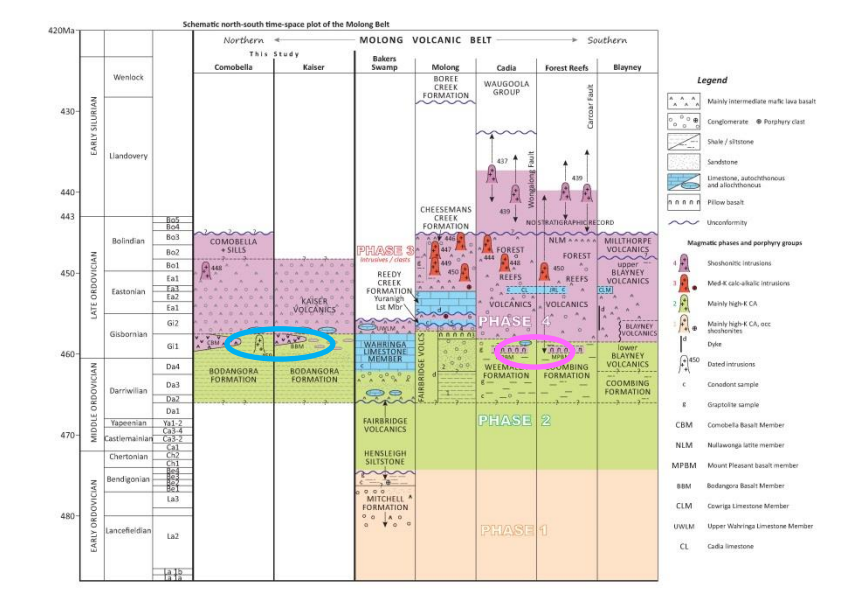
Mid Ordovician

Basal sequence volcanics



Lower Fairbridge Volcanics basal eastern

Lower Fairbridge Volcanics basal southern

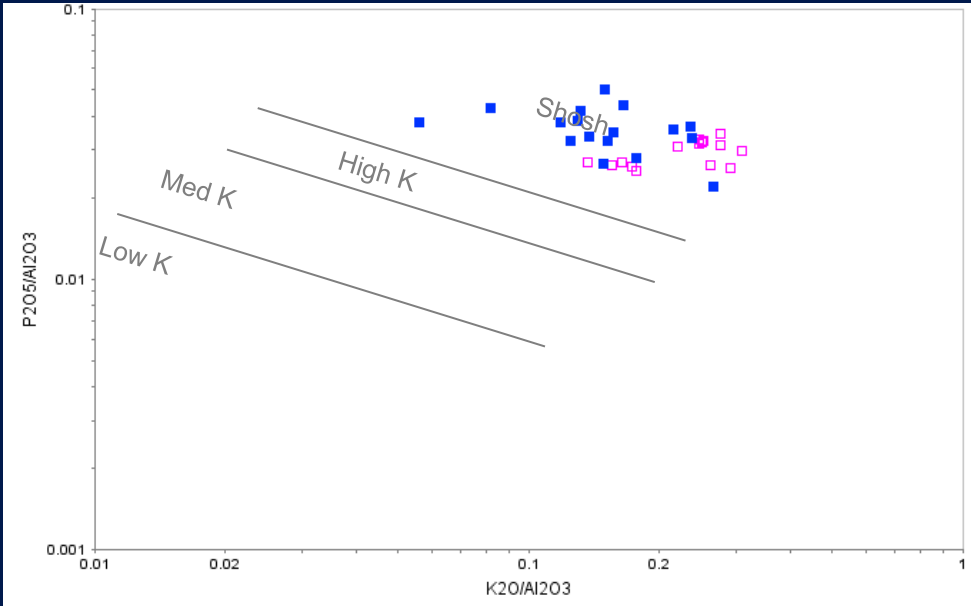


Volcanics

Late Ordovician

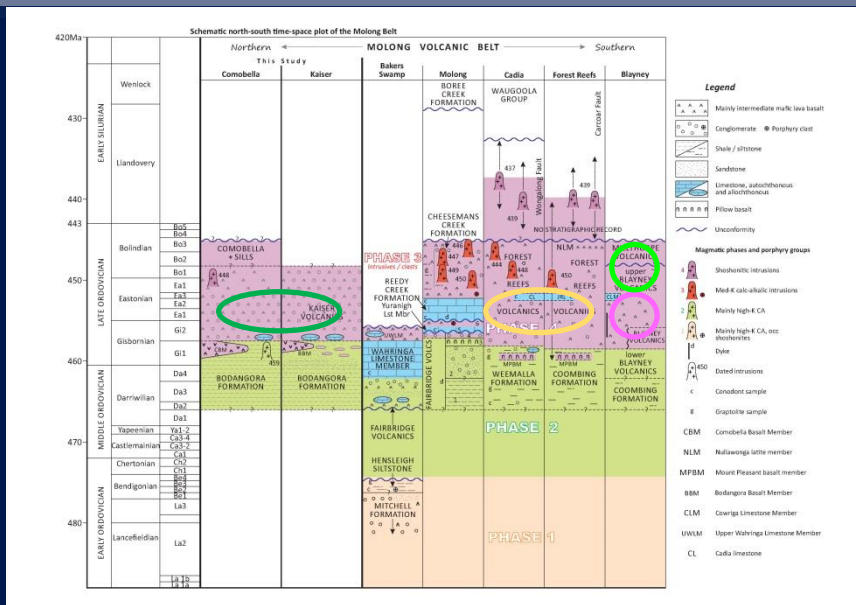
Onset of shoshonitic magmatism

Pre Gisbornian Limestones



Mt Pleasant Basalt Member

Bodangora Basalt Member
(within Bodangora Fm, informal names)

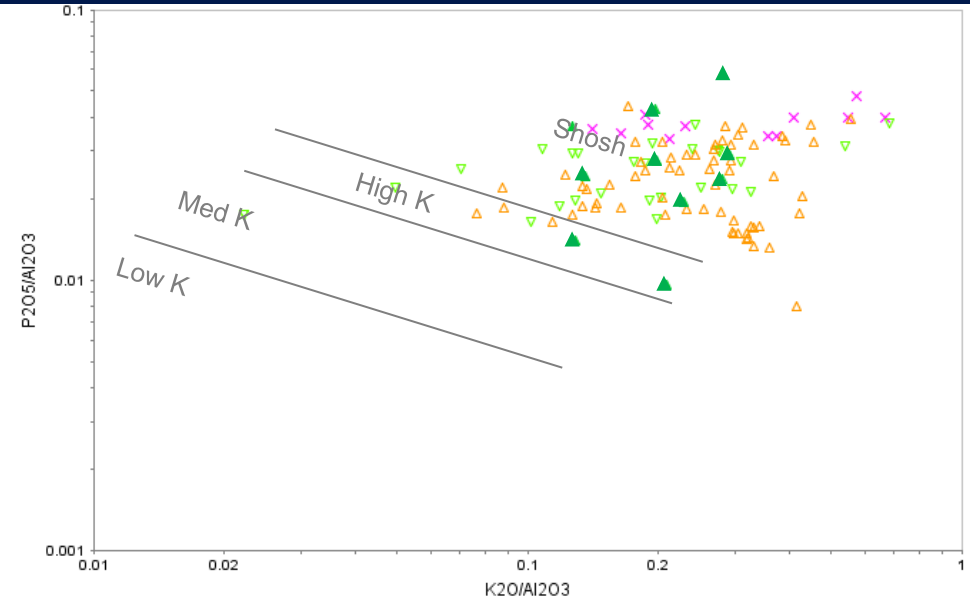


Volcanics

Late Ordovician

Ongoing shoshonitic magmatism

Post Gisbornian Limestones

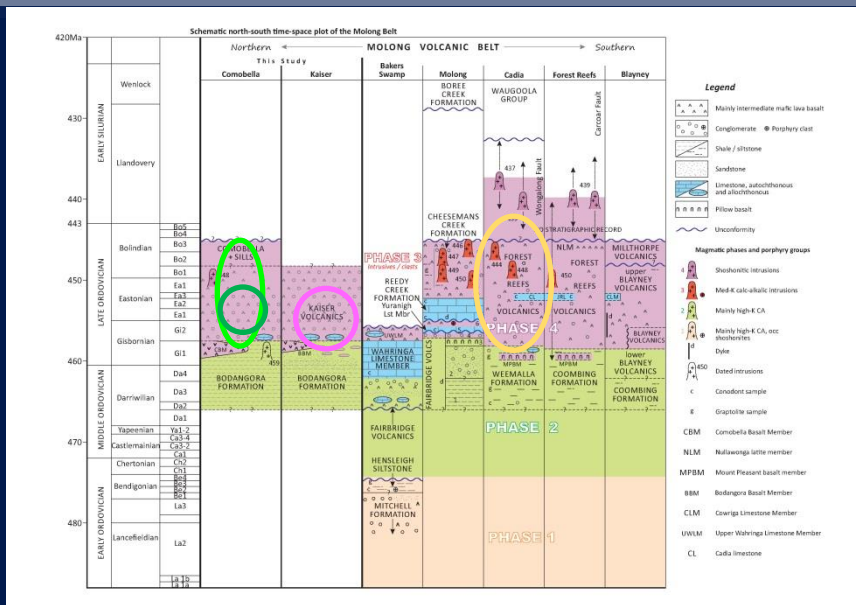


Forest Reefs Volcanics

Upper Blayney Volcanics

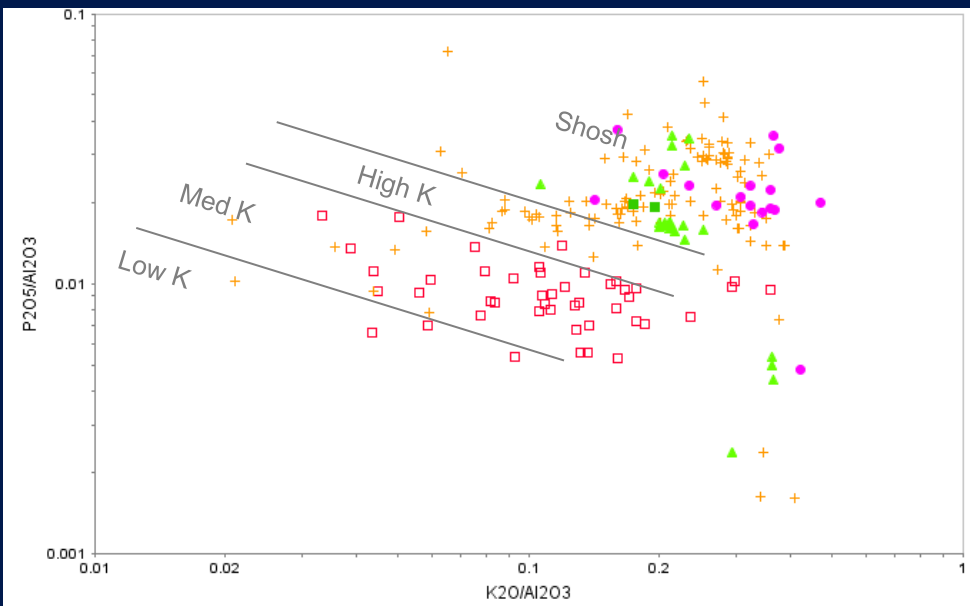
Millthorpe Volcanics

Kaiser Volcanics



Intrusions

Late Ordovician →



- Cadia Intrusive Complex
- Kaiser Intrusive Complex
- Comabella Intrusive Complex
- Finns Crossing Intrusive Complex
- Copper Hill Intrusive Suite

Northern Molong Volcanic Belt

Exploration Implications

Kaiser Project



Kaiser Mine – 0.4Mt @ 1% Cu, 1 g/t Au (Inferred Res)

Previously described as a Orogenic or Porphyry – Hybrid system

Brownfields exploration setting

15km drilling = mostly into the Kaiser Intrusive Complex and Kaiser Mine Prospect

1960s - **Pacific Copper Mines Ltd** – Placer JV

1980s - **Homestake Australia Ltd** – Terrex Resources

- **Compass Resources** - Terrex Resources–
Ajax Joinery – Cluff Resources Pacific Ltd JVs

1990s - **CRAE (Rio Tinto)** - Terrex Resources- Compass Resources - Ajax Joinery

2000s - **Newcrest** – Compass Resources – Ajax Joinery

- **Paradigm Gold** – Ajax Joinery JV

- **Great Western Minerals Ltd** – Ajax Joinery JV

- **Somerset Minerals Pty Ltd** – Ajax Joinery JV

2014 - **Alkane Resources Ltd**



Kaiser Project

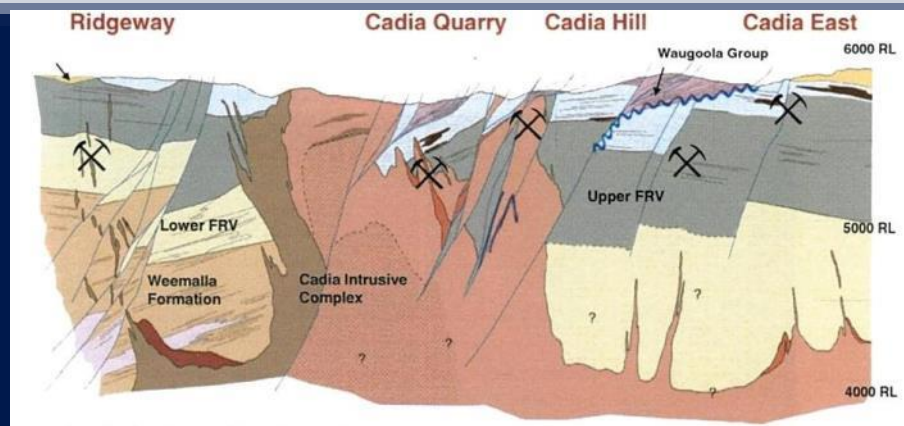
Exploration targeting criteria

Margins of multiphase alkalic intrusive complexes

i.e Intrusion-centred porphyries (Pencil Porphyries) vs Intrusion-hosted porphyries

Pipe geometry = focussed hydrology = high-grades

e.g. Ridgeway , Cadia East, E26N, E48, E22, E27, E37



Newcrest Mining Ltd

Reduced – Oxidised stratigraphic contact

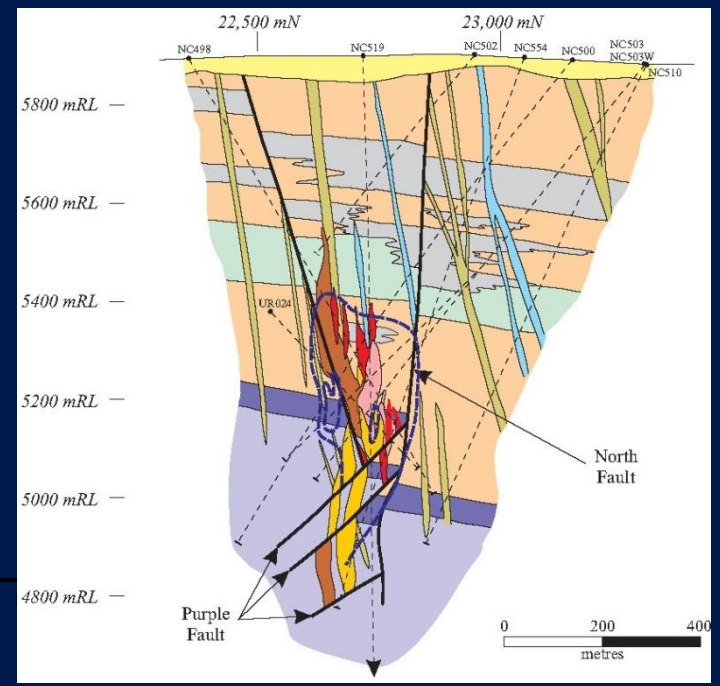
Correlate to Ridgeway blowout position at Weemala Fm – FRV position

Alteration vectors

Alteration mapping using lithogeochemistry, petrography, Hylogger spectral

Structural offsets of known Mineralisation

Wrench fault systems (D₂)



Ridgeway Section

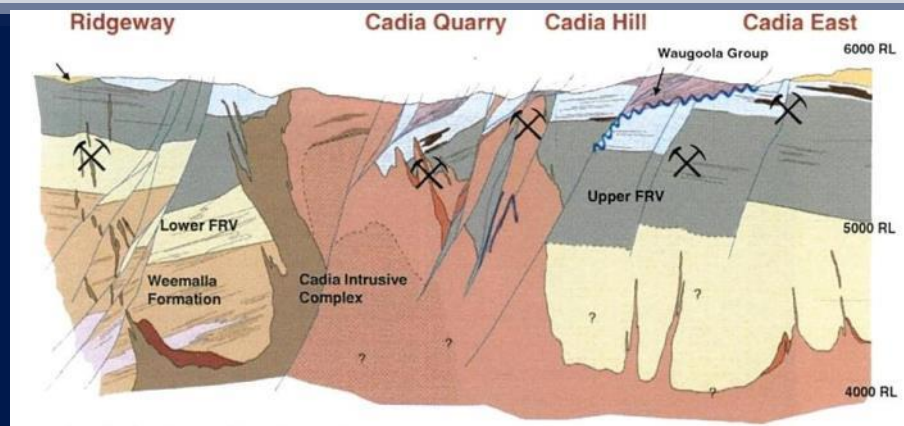
Newcrest Mining Ltd

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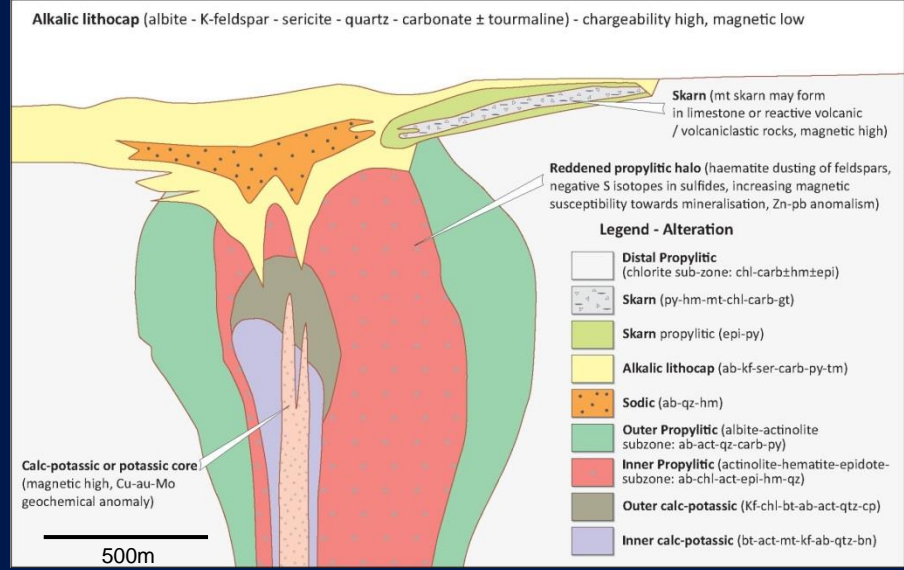
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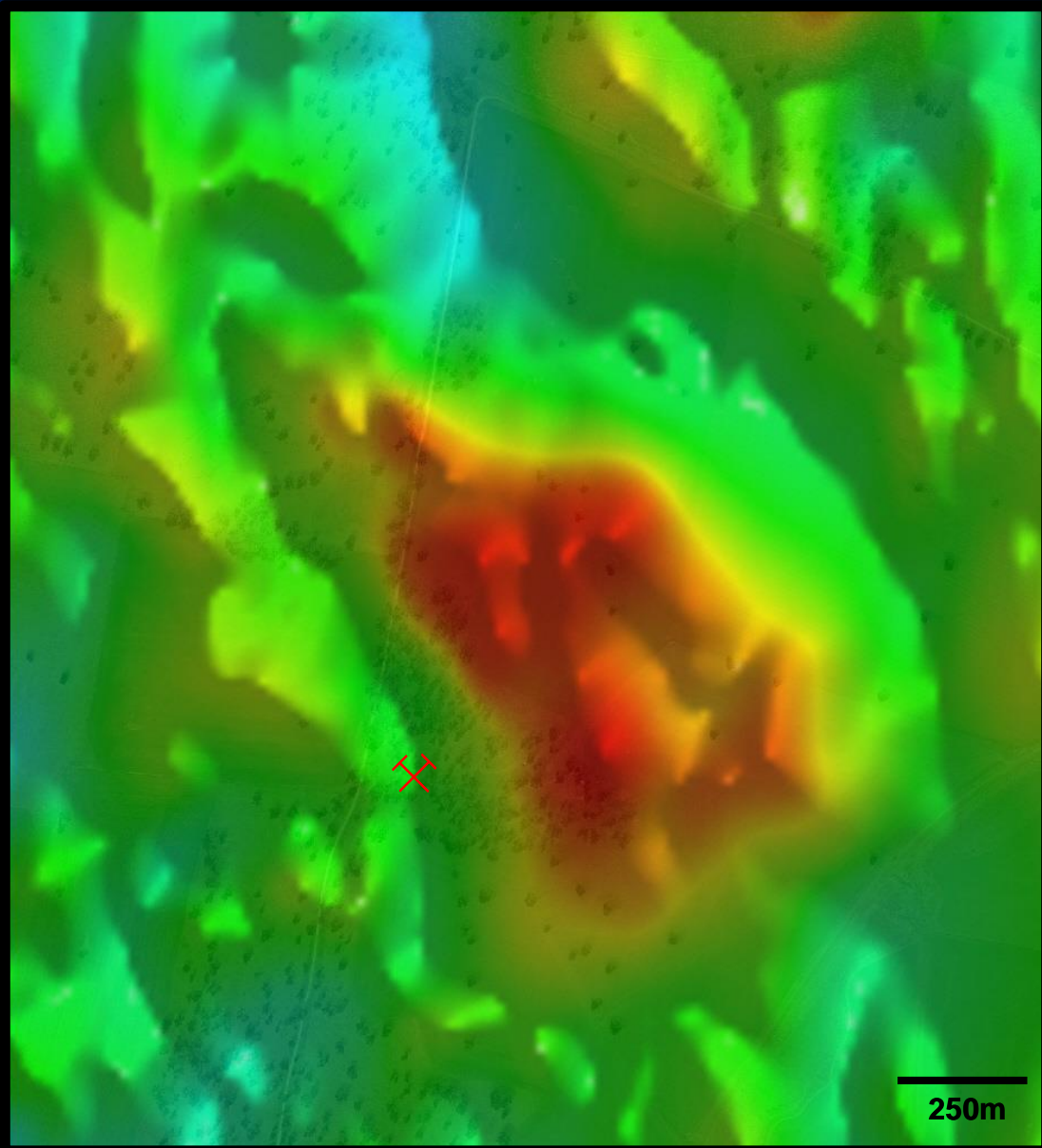
Alteration mapping using litho-geochemistry, petrography, Hylogger spectral

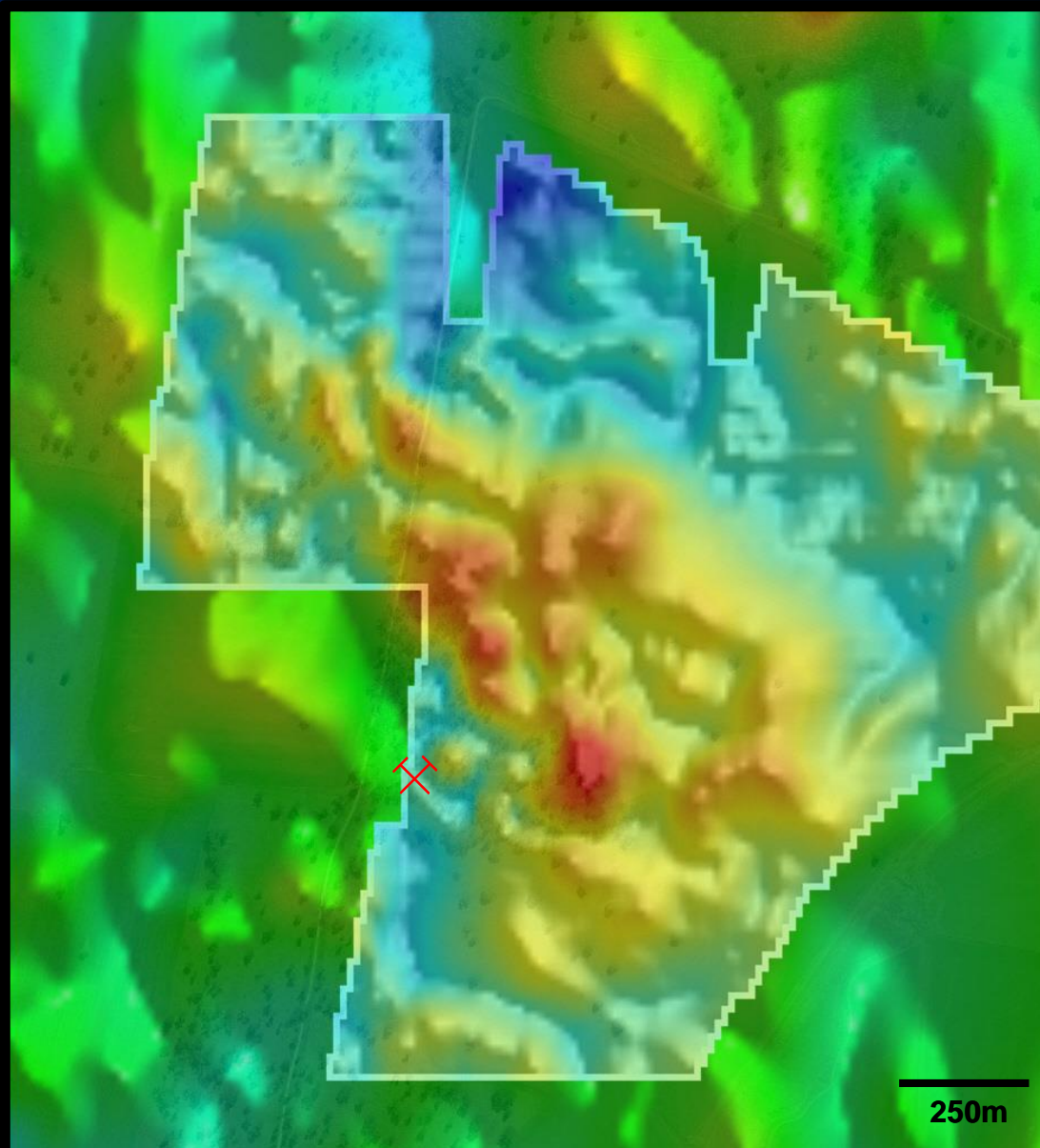
Structural offsets of known Mineralisation

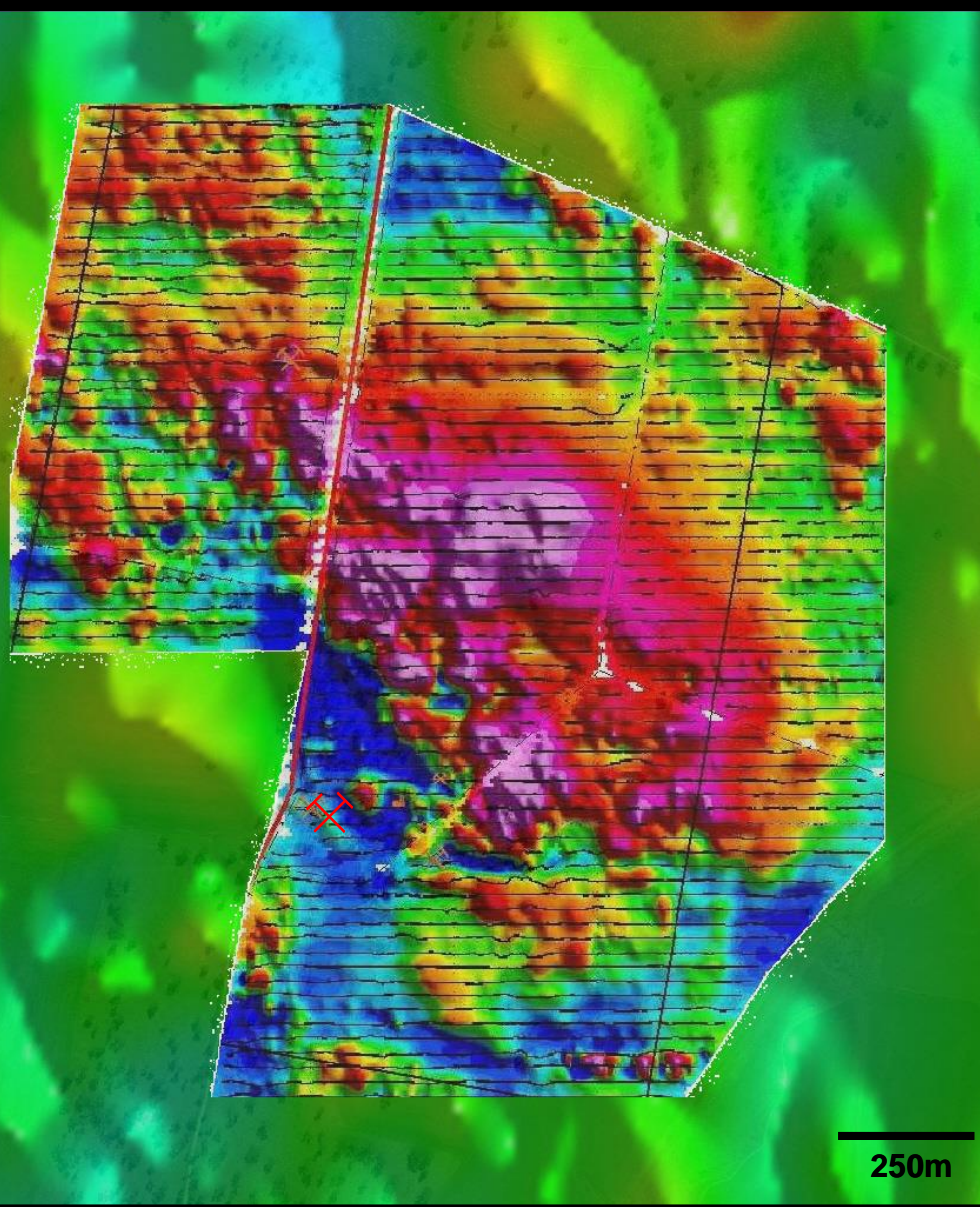
Wrench fault systems (D₂)

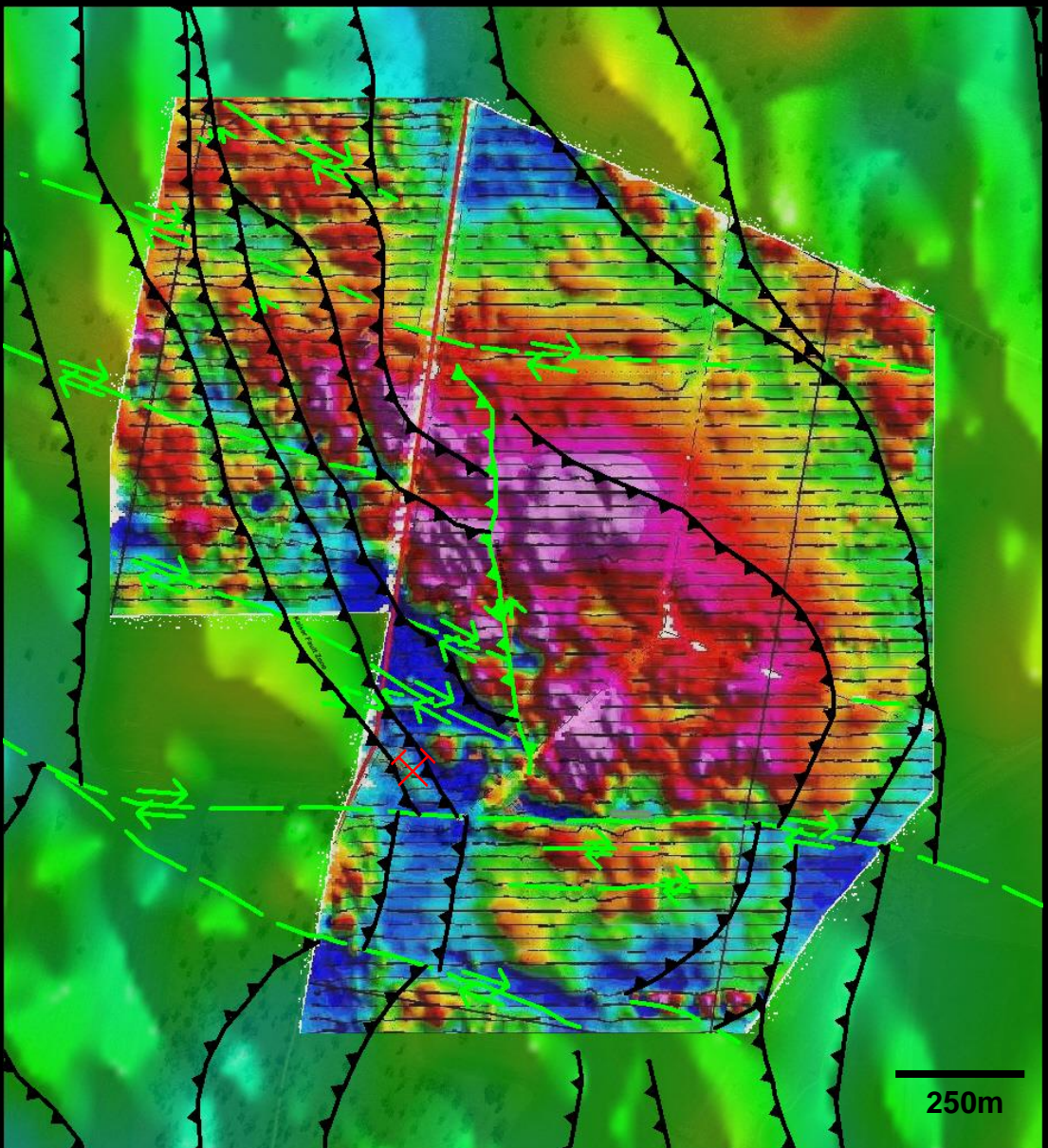


Holliday and Cooke 2007

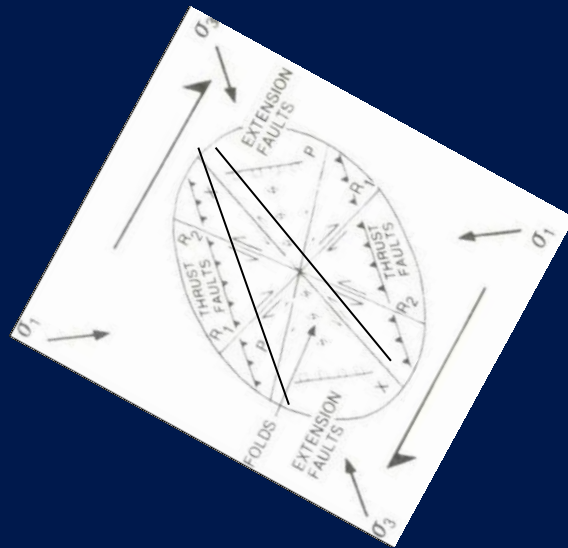




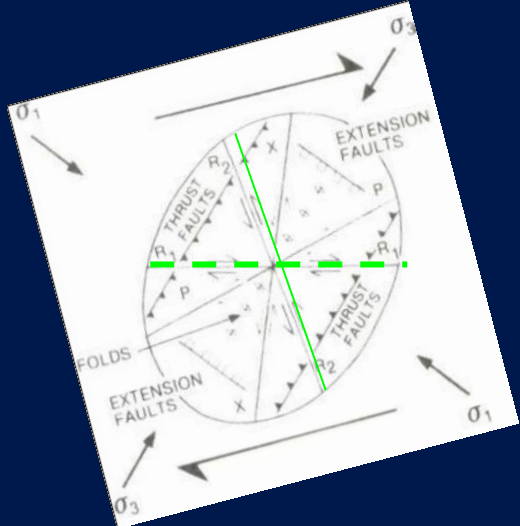




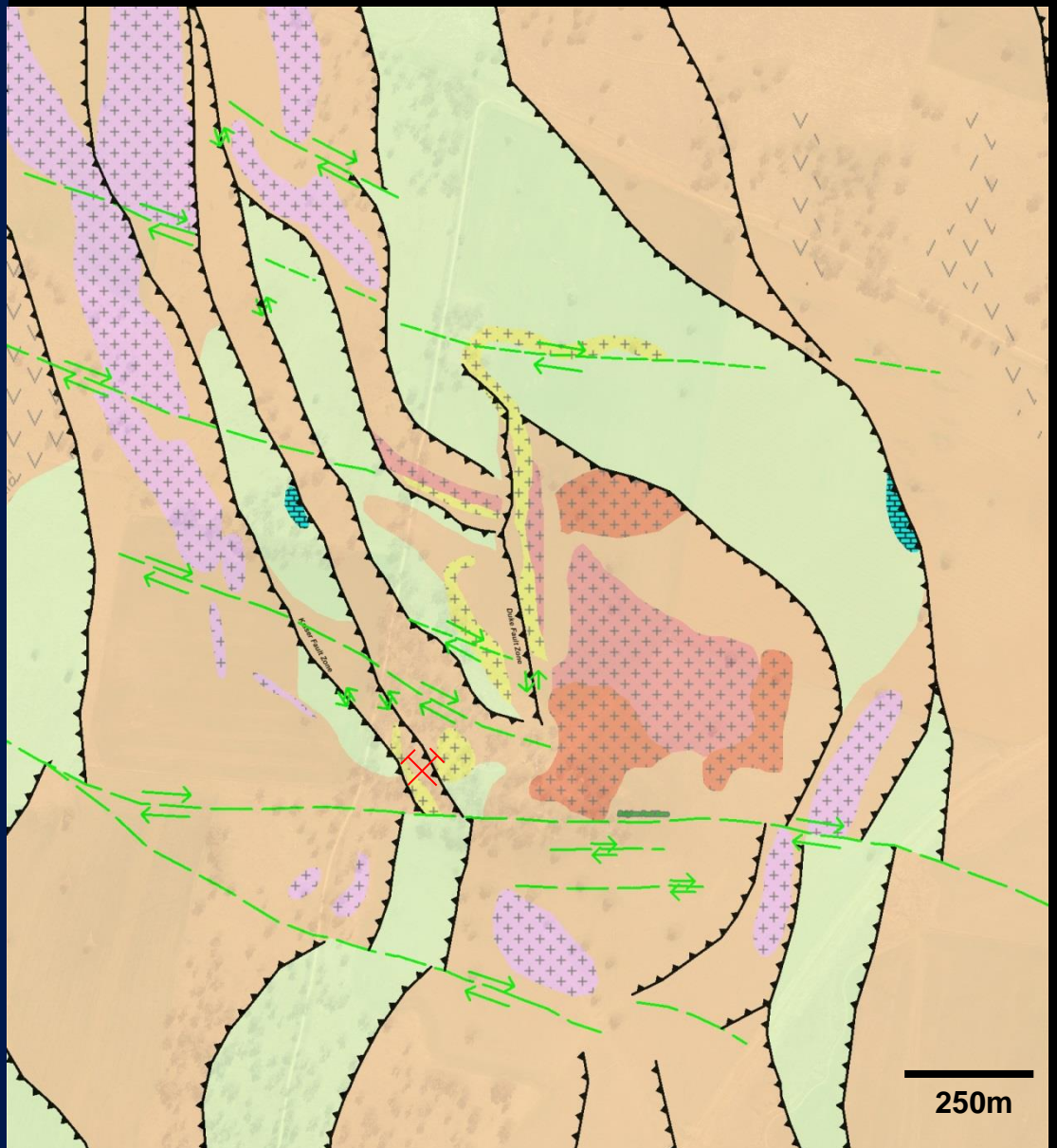
Dubbo 100k Sheet (2000)



D_1

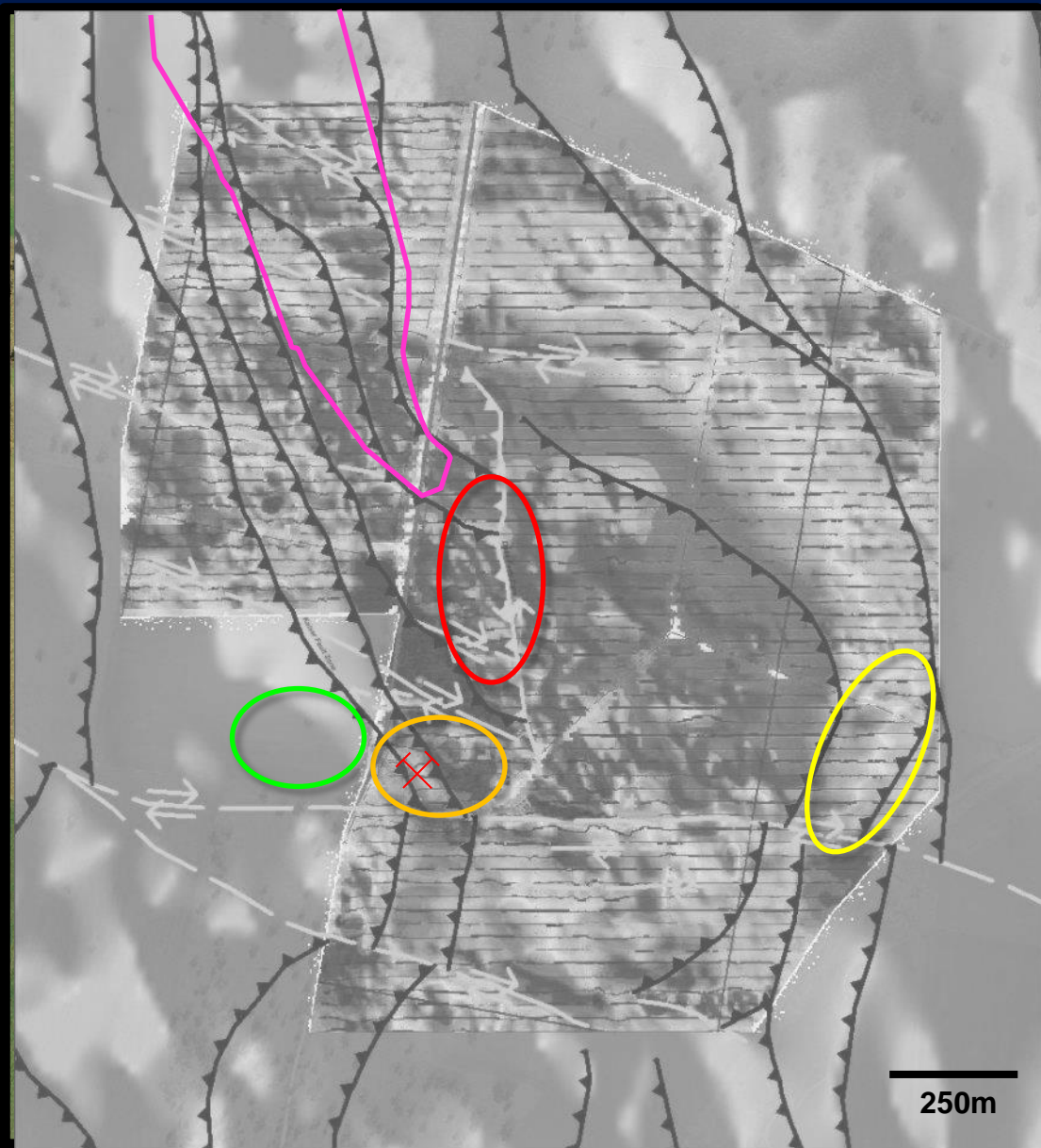


D_2



- Kaiser Intrusive Complex**
- Probable hyd. altered monzodiorite phase (progenitor)
 - hyd. altered monzodiorite phase (progenitor)
 - Monzonite-Monzodiorite
 - Diorite porphyry

- Late Ordovician Cabonne Group**
- Kaiser Volcanics
Basaltic-andesitic polymict Breccias (proximal)
 - Bodangora Formation
Basaltic volcanoclastics, Py-phyric basalt, hbl-d-phyric Basalt (distal)



Duke Prospect

D₂ dextral WNW faulting of Kaiser-Duke porphyry system

Kaiser Prospect

Inferred Resource 0.4Mt @ 1% Cu, 1 g/t Au
Open at depth >80m

Belgium Prospect

Strongly chargeable IP feature coincident with KIC southeastern margin

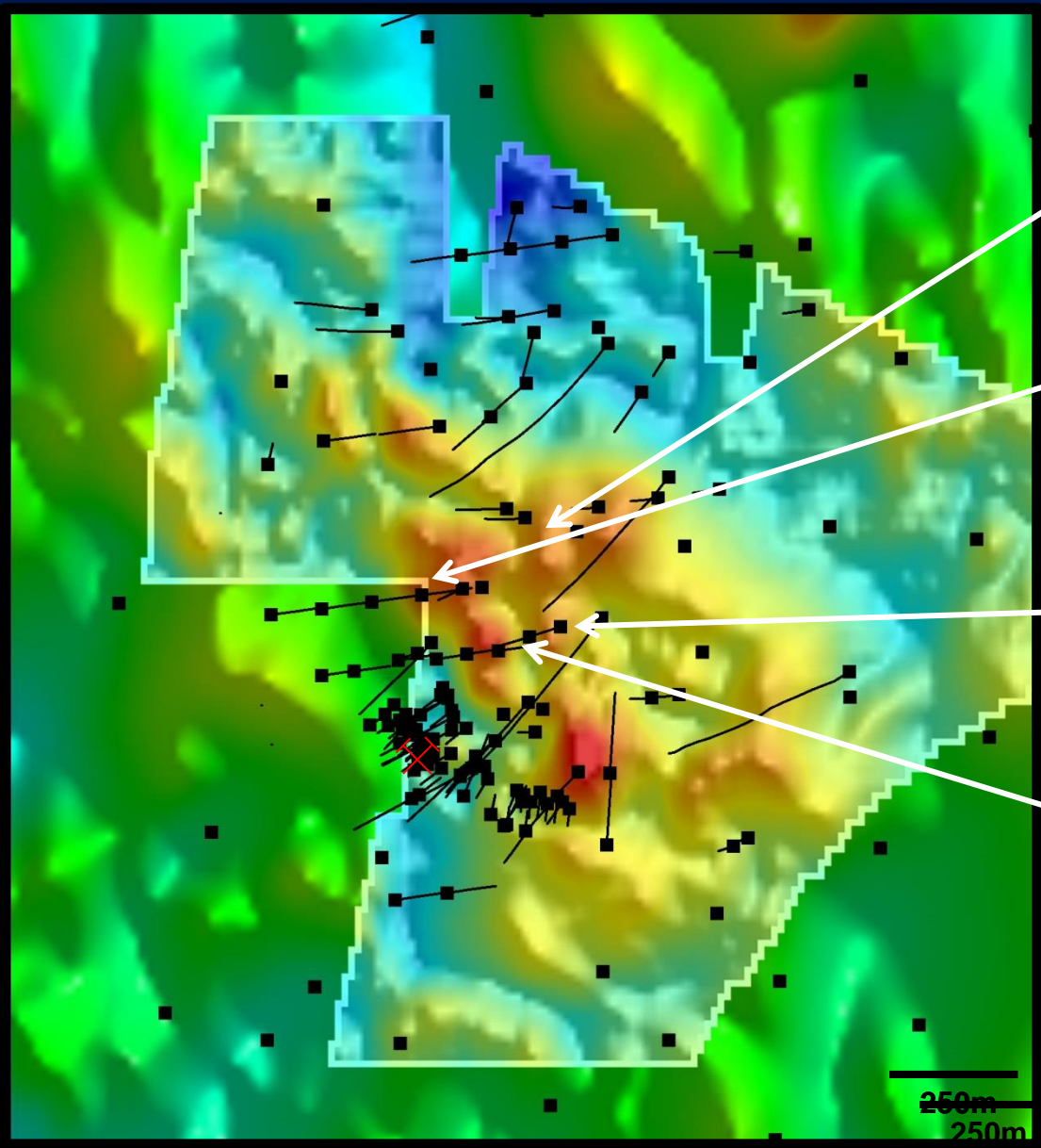
McGregor Prospect

D₂ sinistral NNW faulting/thrusting of Kaiser porphyry system

Duke-Driell Creek Corridor

Largely concealed zone
Extensive alkalic lithocap alteration zone at Driell Crk

HISTORICAL DRILLING TESTING THE DUKE TARGET



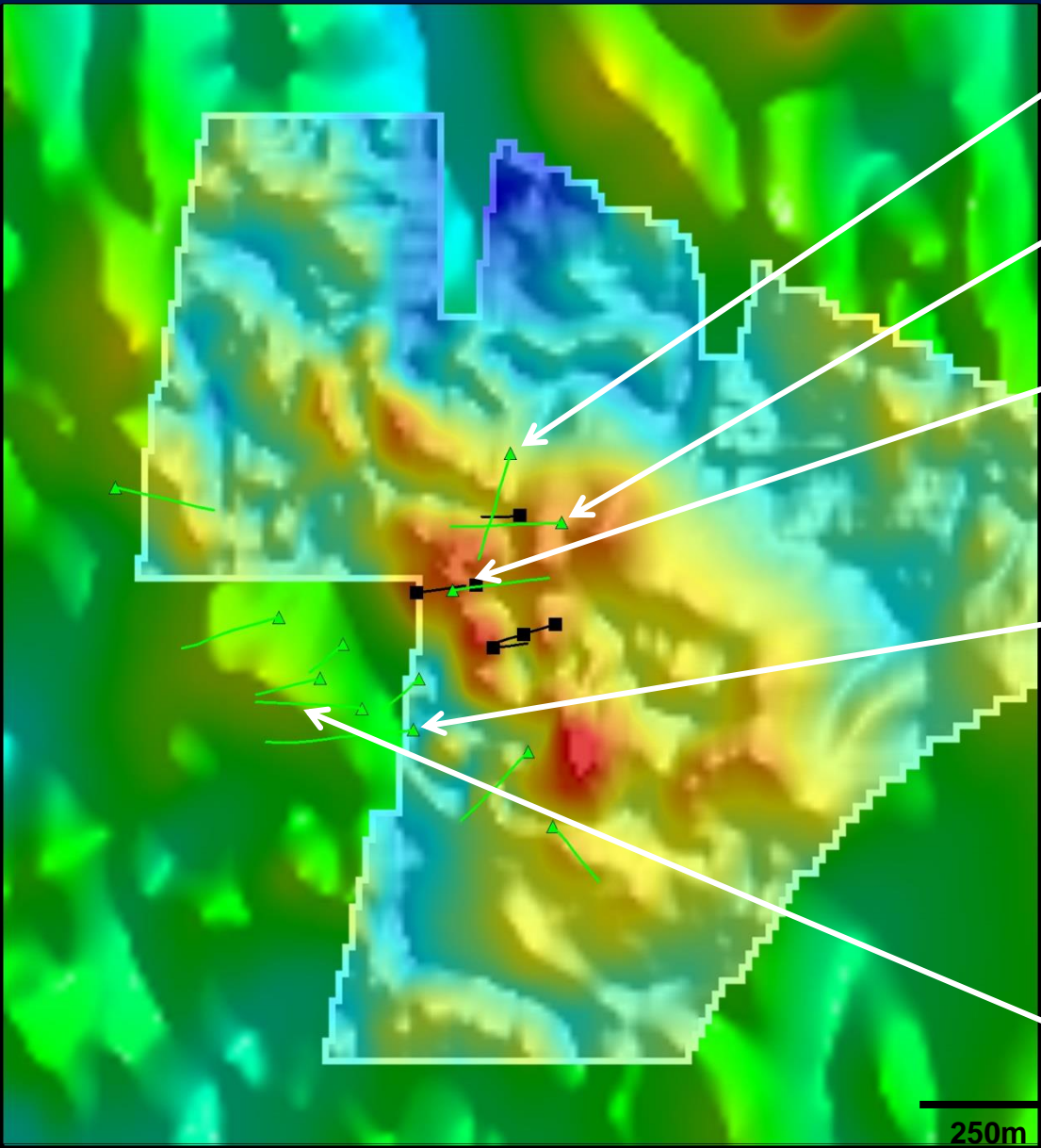
60m @ 0.13g/t Au, 0.27% Cu
(collared in mins) (PD94CK46)

20m @ 0.34g/t Au, 0.25% Cu
(mins at EOH) (RC93CK36)

113m @ 0.40g/t Au, 0.15% Cu
(collared in mins) (KSP001)

76m @ 0.49g/t Au, 0.18% Cu
(collared in mins) (KSP002)

250m
250m



79m @ 0.37% Cu, 0.22g/t Au
(KSRC011)

78m @ 0.45% Cu, 0.30g/t Au
(KSRC010)

12m @ 0.82g/t Au, 0.20% Cu
(collared in mins) (KSRC009)
285m @ 0.26g/t Au, 0.14% Cu

60m @ 0.81g/t Au, 0.91% Cu
(KSRC001)

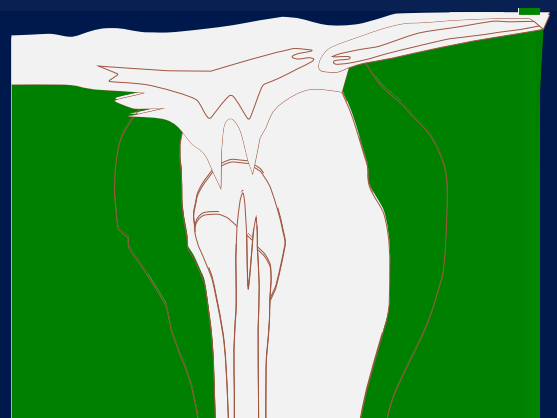
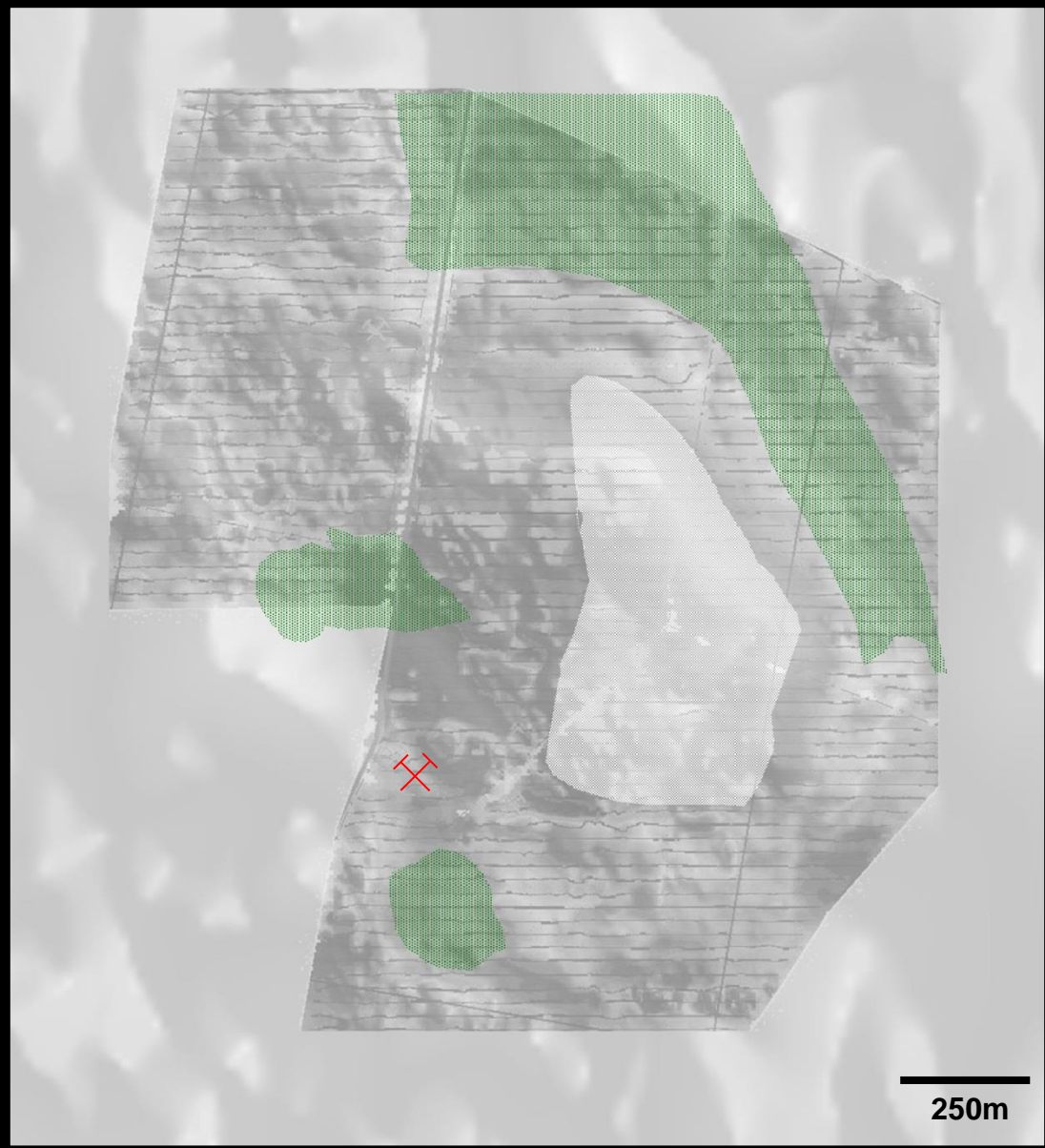
re-drilled Kaiser Mine mins on way to testing
McGregor target (met test work suggested assay
under reporting, results suggest ~50% under-
reporting in 1970s work)

8m @ 1.06% Cu, 0.34g/t Au
(KSRC003)

250m

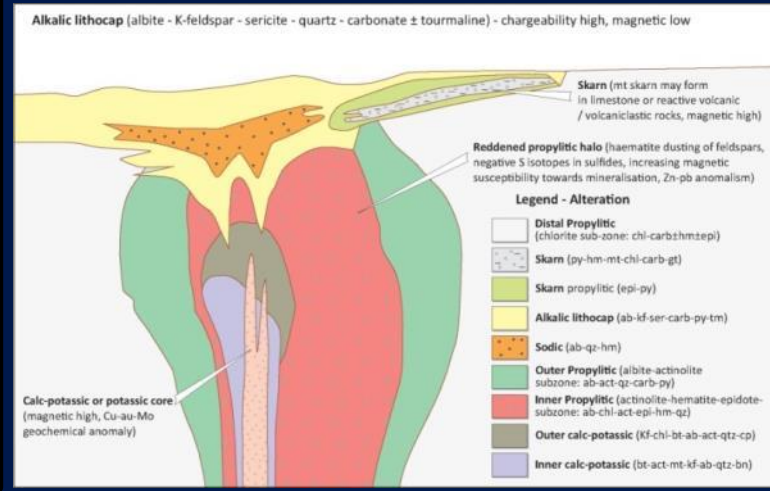
Kaiser Project

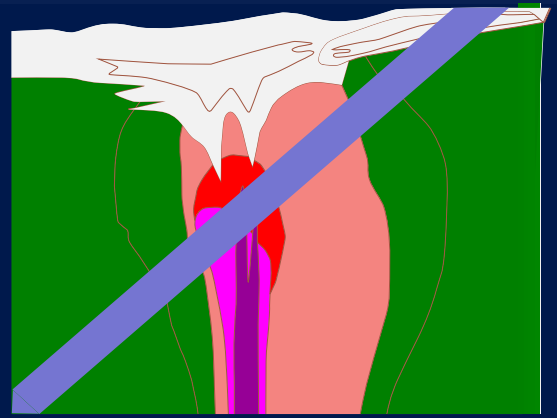
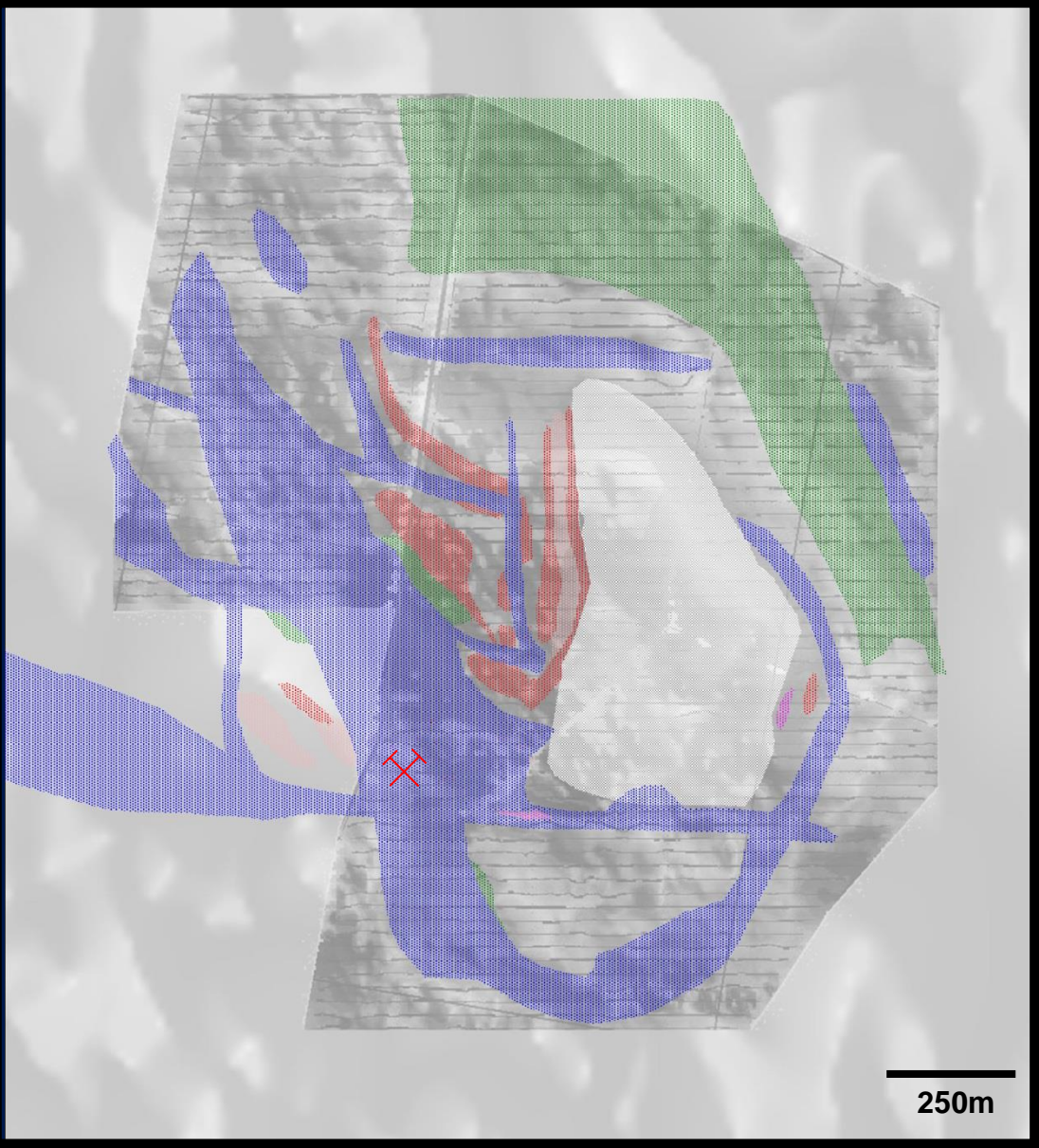
Alteration Mapping (current)




Modified from Holliday and Cooke 2007

- Distal Propylitic (chlorite subzone)
- Outer Propylitic (albite-actinolite subzone)





Modified from Holliday and Cooke 2007

-  Distal Propylitic (chlorite subzone)
-  Outer Propylitic (albite-actinolite subzone)
-  Inner Propylitic (actinolite-hematite-epidote subzone)
-  Outer calc-potassic (kf-chl-bt-ab-act-qtz-cp)
-  Inner calc-potassic (bt-act-mt-kf-ab-qtz-bn)
-  Late stage phyllic (fault controlled) (sericite-pyrite)

Kaiser Project

Encouraging geological setting / stratigraphic position

hosted at margin of major multiphase alkalic intrusive complex
 Intrusion 'centred' alkalic porphyry system
 Bodangora Fm – Kaiser Volcanics contact

Encouraging alteration setting

mins associated with outer calc-potassic assemblage (lithogeochem)

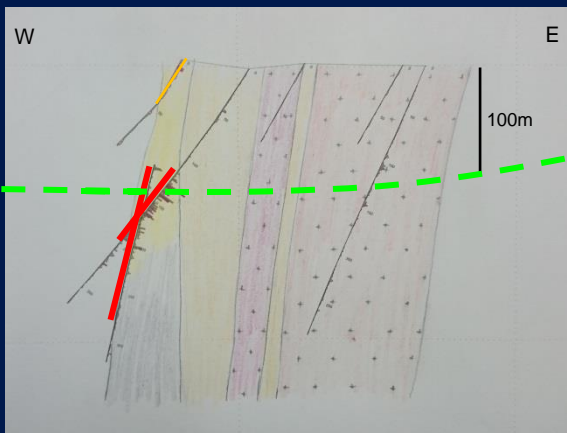
Encouraging mineralisation

Ridgeway near-miss intersection (~100m)
 102m @ 0.40% Cu, 0.13g/t Au

78m @ 0.45% Cu, 0.30g/t Au (Duke)

60m @ 0.27% Cu,
 0.13g/t Au
 (PD94CK46-1994)

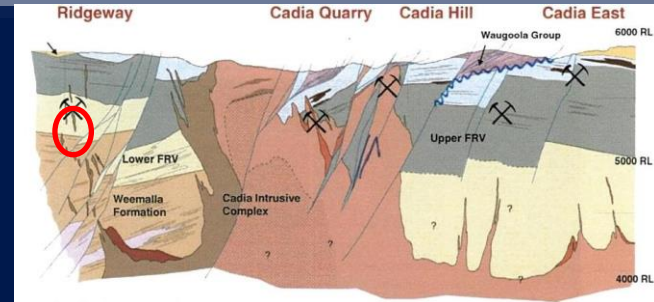
78m @ 0.45% Cu,
 0.30g/t Au
 (KSRC010-2014)



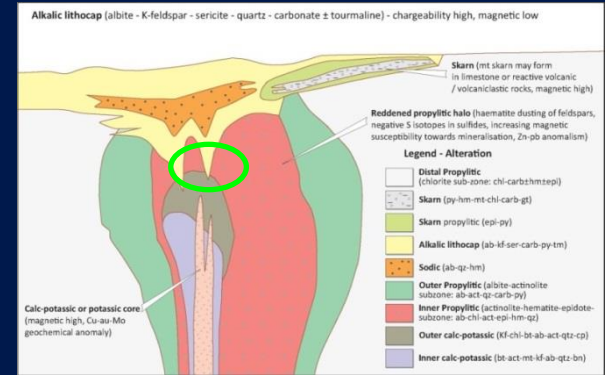
Duke Prospect

100m vert.depth

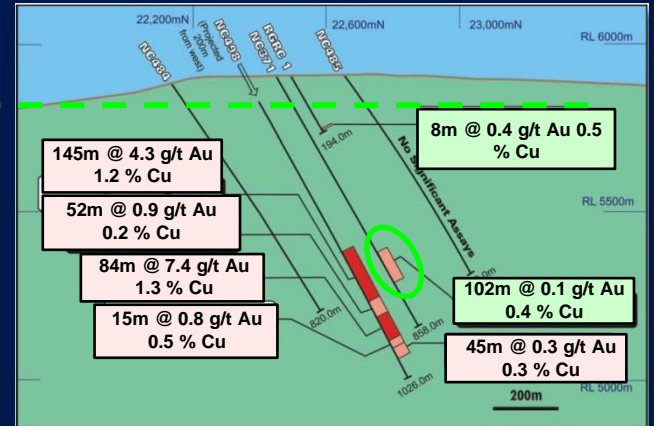
Kaiser – Duke Summary



Cadia District schematic section (Newcrest Mining Ltd)



Holliday and Cooke (2007)



Ridgeway discovery sequence schematic section (Wood 2012)

Conclusions

Northern Molong Volcanic Belt

Geological framework - extensive areas of Oakdale Formation - Bodangora Formation, Kaiser Volcanics (informal terms)

Defined key stratigraphic, facies architecture correlations with Cadia district – lithogeochemical support

Identified controls on mineralisation e.g. Bodangora Fm-Kaiser Volcanics contact

Multiple high priority targets at Kaiser-Duke, Belgium, Driell Creek Corridor

Implications for regional target selection

Kaiser Project

Applied geological framework to Kaiser brownfields interp.

Identified dismembered Kaiser - Duke alkalic porphyry system at W margin of KIC

Successful targeting e.g. 78m @ 0.45% Cu, 0.30g/t Au (KSRC010)



Questions?

