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 Calc-alkalic porphyry Cu-Au

High Sulfidation Epithermal

Glen et al 2012

Glen et al 2012
Background

Macquarie Arc Regional

Glen et al 2012

Glen et al 2012
Background

Macquarie Arc Time – Space Synthesis

Northern portion of Arc (central MVB)

Glen et al. (2012)
Southern portion of Arc

Background

Macquarie Arc Time – Space Synthesis

Glen et al. (2012)
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, volcaniclastic breccia, conglomerate, sandstone and siltstone, minor allochthonous limestone’
Northern MVB

Geological Framework

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

**Northern MVB**

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*Dubbo 100k Sheet (2000)*
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 limests from Harris et al. (2014)
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NMVB Correlations

Igneous Geochemistry

Volcanics

Mid Ordovician

Basal sequence volcanics

Lower Fairbridge Volcanics
basal eastern

Lower Fairbridge Volcanics
basal southern
Igneous Geochemistry

**NMVB Correlations**

**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
**NMVB Correlations**

**Igneous Geochemistry**

**Intrusions**

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

Late Ordovician →
Northern Molong Volcanic Belt

Exploration Implications

Kaiser Project
**Kaiser Project**

**Background**

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

<table>
<thead>
<tr>
<th>Year</th>
<th>Company</th>
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<tbody>
<tr>
<td>1960s</td>
<td>Pacific Copper Mines Ltd – Placer JV</td>
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<tr>
<td>1980s</td>
<td>Homestake Australia Ltd – Terrex Resources</td>
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<td></td>
<td>Compass Resources - Terrex Resources – Ajax Joinery – Cluff Resources Pacific Ltd JVs</td>
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<td>1990s</td>
<td>CRAE (Rio Tinto) - Terrex Resources- Compass Resources - Ajax Joinery</td>
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<td>2000s</td>
<td>Newcrest – Compass Resources – Ajax Joinery</td>
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<tr>
<td></td>
<td>Paradigm Gold – Ajax Joinery JV</td>
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<td></td>
<td>Great Western Minerals Ltd – Ajax Joinery JV</td>
</tr>
<tr>
<td></td>
<td>Somerset Minerals Pty Ltd – Ajax Joinery JV</td>
</tr>
<tr>
<td>2014</td>
<td>Alkane Resources Ltd</td>
</tr>
</tbody>
</table>

250m
**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

**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)
Exploration targeting criteria

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Kaiser Project

Geological Framework

Dubbo 100k Sheet (2000)
Kaiser Project

Geological Framework

Dubbo 100k Sheet (2000)
**Kaiser Project**

**Geological Framework**

250m

D1

D2

Dubbo 100k Sheet (2000)
**Kaiser Project**

**Exploration Datasets**

- **Geology**
  - **Geological Framework**
  - **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 volcaniclastics, Py-phyric basalt, hbld-phyric Basalt (distal)

250m

Dubbo 100k Sheet (2000)
Kaiser Project

Priority Targets

**Duke Prospect**
D$_2$ 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**
D$_2$ sinistral NNW faulting/thrusting of Kaiser porphyry system

**Duke-Driell Creek Corridor**
Largely concealed zone
Extensive alkalic lithocap alteration zone at Driell Crk
Kaiser Project

Historical drilling results

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)
Kaiser Project

Alkane’s 2014 drilling results

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

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)
Kaiser Project

Alteration Mapping (current)

Modified from Holliday and Cooke 2007

Distal Propylitic
(chlorite subzone)

Outer Propylitic
(albite-actinolite subzone)
Late stage phyllic (fault controlled) sericite-pyrite

Exploration Datasets - Geology Alteration Mapping (current)

Kaiser Project

Outer Propylitic (albite-actinolite subzone)

Distal Propylitic (chlorite 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)

Modified from Holliday and Cooke 2007
**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)

100m vert. depth

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?