Zinc Skarns of the Chillagoe District
NE Queensland
(A snap shot)

Mines and Wines 2015
Queanbeyan
Skarn Classifications
Major Metals, Host Rocks, Intrusive Source

✓ Zinc
✓ Calcic (limestone – prograde granulite garnets and cpx)
✓ Proximal
?
? Medial/Distal
Key Ingredients

- Fertile source intrusives (common Cu-Au-(Mo))
- Reactive host rocks
- Permeability - structures to focus mineralising fluids

*Characteristics of the Chillagoe district skarn deposits*
NQ deposits vs the “average” Zn skarn deposit

- Zn-rich skarn mineralisation typically: occurs in porphyry/skarn Cu-Au (± Mo) districts (± epithermal gold deposits – eg Fluorspar in Chillagoe district) ✓
- ...... is focussed along faults – commonly contacts between limestone and non-limestone ✓
- ...... post-dates an early phase of prograde grandite-cpx (Hd-Di-Jo) dominant alteration (± wollastonite, bustimite, ilvaite, magnetite & others) ✓
- ...... coincides with retrograde alteration of prograde species to any of amphibole, calcite, quartz, chlorite (and others) ✓
- ...... is more Cu-rich close to the fertile intrusive, increasing zinc proportion and decreasing skarn alteration transitional to limestone/marble replacement with distance from the intrusive ✓
- ...... has a tabular or pipe/chimney morphology ✓
- ...... is Zn – Pb rich with low Cu X (with a couple of notable exceptions)
The “Median” skarn

1.4 Mt @ 5.9% Zn, 2.8% Pb, 0.09% Cu, 58 g/t Ag
(n = 34: Source – Mosier, 1986)

Zn : Pb : Cu = 1 : 0.5 : 0.02

- Chillagoe skarns are within the ballpark of median size but are typically high Cu – low Pb and, in the case of King Vol and Mungana in particular, double median Zn grade
<table>
<thead>
<tr>
<th>Deposit</th>
<th>Category</th>
<th>Tonnes</th>
<th>Zn%</th>
<th>Pb%</th>
<th>Cu%</th>
<th>Ag g/t</th>
<th>Au g/t</th>
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<tbody>
<tr>
<td>King Vol (1)</td>
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<td>1,045,000</td>
<td>14.7</td>
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<td>1,943,000</td>
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<td>Production</td>
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<td>The “Median” skarn (7)</td>
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<td>1,400,000</td>
<td>5.9</td>
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Regional Setting

Palmerville Fault

Proterozoic rocks to the west, Palaeozoic rocks to the east

Chillagoe Formation: Siluro-Devonian
Limestone, siliciclastics, basalt, chert

Devonian-Carboniferous (Taberabberan Orogeny)

Kennedy Province granitoids and volcanics

High level porphyries

(Red Dome and Mungana: Au-Cu-(Mo) and Zn skarns)
Chillagoe District

Geology

Deposits & Prospects

The Mine Corridor Deposits

Porphyry-skarn Au-Cu:
Red Dome & Mungana (131Mt @ 0.21% Cu, 0.65g/t Au, 8.1 g/t Ag)

Zinc skarns:
Griffiths Hill (proximal)
Girofla (distal pipe/chimney)
Mungana (distal with porphyry overprint)

Redcap Group of Deposits

Queenslander/Morrisons (?distal)
Victoria (?medial)
Penzance (proximal)
Dunter (?distal pipe – 500m NW of Q’lander)

King Vol Cluster of Deposits

King Vol (distal)
Montevideo (distal)
Queen Grade (distal)
Tartana Copper (?porphyry source – Hodgkinson Formation)
Mine Corridor – Redcap

Imbricate thrust faulting has produced 12 repetitions of stratigraphy across 8km of stratigraphy with characteristic terminations of stratigraphy along strike.

Late brittle faulting – possible re-activation of ductile thrusts – conduits for mineralisation.
The Mine Corridor Deposits

• Griffiths Hill
  
  tabular skarn body along limestone-sandstone contact
  proximal Cu - Ag-(Au-Zn)
  transition through Cu + Zn to Zn-rich skarn

• Girofla
  
  bx pipe/chimney – early skarn + chaotic bx
  distal Pb – Zn – Ag – Cu

• Mungana
  
  tabular skarn body along limestone-sandstone contact
  distal Zn – Cu – Pb – Ag – Au skarn
  resurgent porphyry cut polymetallic skarn mineralisation – introduce
  Au – Cu mineralisation
Red Dome/Mungana Mine Corridor

- Current and historical Zn-rich skarn and Au-Cu skarn and porphyry-hosted resources
- Large Au-Cu skarn- and porphyry-hosted resources at Red Dome and Mungana
- Tabular fault-hosted Cu-Au skarn transitional to Cu-Zn to Zn skarn at Griffith’s Hill – metal zoning & PROXIMAL
- Pb-Zn-Ag-Cu skarn pipe/chimney at Girofla
- Zn-Cu-Pb-Ag-Au tabular skarn along faulted limestone-sandstone contact with porphyry stock overprint - ?DISTAL but cut by resurgent porphyry stock

Red Dome + Mungana Au-Cu resource: 131Mt @ 0.65 g/t Au, 0.21% Cu, 8.1 g/t Au
Mine Corridor Deposits and Targets

Historic Production

- **Red Dome**: approx. 15Mt @ 2.0g/t Au, 0.5%Cu, 15g/t Ag
- **Lady Jane**: 100,000t @ 5.8%Cu, 17%Pb, 250g/t Ag
- **Girofla**: 224,000t @ 2.5%Cu, 13%Pb, 250g/t Ag

Mungana Au Resource
- 48.7Mt @ 0.7g/t Au, 0.19%Cu, 13.3g/t Ag
  - (1.095Moz Au, 92Kt Cu, 20.8Moz Ag)

Red Dome & Griffiths Hill Au-Cu Resource
- 69.2Mt @ 0.63g/t Au, 0.24%Cu, 5.2g/t Ag
  - (1.4Moz Au, 163Kt Cu, 11.5Moz Ag)

Mineralising Porphyry
- Known Gold Mineralisation

**AuEQ=Au+1.96xCu + (0.0158xAg)**

KAGARA LTD
### Griffith’s Hill Cu and Zn Skarn Deposit

#### Historical Red Dome Pit

<table>
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<tr>
<th>Deposit</th>
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<th>Tonnes</th>
<th>Zn%</th>
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<th>Cu%</th>
<th>Au g/t</th>
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<tbody>
<tr>
<td>Griffiths Hill (Cu)</td>
<td>Inferred</td>
<td>1,011,000</td>
<td>0.4</td>
<td>0.0</td>
<td>3.1</td>
<td>0.6</td>
<td>61</td>
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<tr>
<td>Griffiths Hill (Zn)</td>
<td>Inferred</td>
<td>58,000</td>
<td>6.9</td>
<td>0.0</td>
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<tr>
<td><strong>Total</strong></td>
<td></td>
<td>1,069,000</td>
<td>0.8</td>
<td>0.0</td>
<td>2.9</td>
<td>0.6</td>
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Griffiths Hill Cu and Zn Skarn Deposit

- Griffiths Hill - discovered whilst conducting resource extension drilling at Red Dome

- Tabular body - Mineralisation developed in skarn along faulted marble – sandstone contact

- Proximal skarn deposit transitional from Cu-Au adjacent to porphyry to Cu-Zn to Zn-rich skarn approx 300m SE of porphyry

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<td>6.9</td>
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<td>0.3</td>
<td>0.0</td>
<td>12</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>1,069,000</td>
<td>0.8</td>
<td>0.0</td>
<td>2.9</td>
<td>0.6</td>
<td>58</td>
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</tbody>
</table>
Girofla Isometric

Hole 666:
432-477m: 45m @ 0.4% Cu, 8.3% Pb, 4.5% Zn, 125 g/t Ag

Including:
432-456m: 24m @ 0.5% Cu, 10.0% Pb, 4.5% Zn, 156 g/t Ag

And:
465-477m: 12m @ 0.4% Cu, 11.0% Pb, 6.4% Zn, 133 g/t Ag

Historical Production:
224,000t @ 2.5% Cu, 13% Pb, 250 g/t Ag

Pb-Zn-Ag (Cu) - breccia pipes (chimneys) in skarn and limestone with sulphide-bearing chloritic breccia halo

Typical of lower temperature mineralisation distal to high level felsic intrusive with Cu-Au potential

Targets:
1. Depth extension of Pb-Zn-Ag pipe
2. Tabular polymetallic body at depth
3. Au-Cu skarn and porphyry at depth
Mungana Au-Cu porphyry deposit and Zn-rich skarn deposit
Plan view approx 300m below surface (2000m RL)
MUNGANA 3850E XSECTION

Steep S-dipping tabular Zn-Cu-Pb sulphide body localized along the skarn-altered faulted contact between limestone and clastic sediments

Mineralisation replaces skarn and limestone/marble

Subsequent tectonic (and hydrothermal) brecciation common

Finger of porphyry cuts polymetallic body – possible remobilisation of earlier base metal sulphides and introduction of Au + Cu

Porphyry is focus of Au-Cu mineralisation

Interpretation: DISTAL Zn-rich skarn deposit cut by resurgent porphyry
Mungana: Bx’d skarn with massive sp matrix
Mungana: Bx’d sp in siderite matrix
The Redcap Deposits

• Queenslander/Morrisons (_DISTAL)
  Zn-rich skarn

• Victoria (Medial)
  Zn-rich transitional at depth to Cu-Au rich

• Penzance (Proximal)
  Cu-(Zn) rich core and peripheral Zn-(Cu) rich
Redcap Project

Fault-related Zn-rich and Cu-rich polymetallic skarn deposits:

• Queensland/Morrisons – tabular body of zinc-rich mineralisation – 1.6km strike

• Victoria, Queenslander, Morrisons, Penzance:

• Highest grade Zn+Pb intersection to date returned from Dunter Prospect – Hole 1203: 5m @ 31.63% Zn, 29.13% Pb, 302g/t Ag from 245.4m

• Recent mapping shows gossan and breccia may extend for further 500m NW of hole 1203 on Red Cap thrust

• Highly anomalous Zn-in-soils open to north-west and south-east

• IP geophysical surveying and further drilling planned
Redcap Project - Plan View

(1) Red Cap Project Combined Resources

<table>
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<th>Deposit</th>
<th>Category</th>
<th>Tonnes</th>
<th>Zn%</th>
<th>Pb%</th>
<th>Cu%</th>
<th>Au g/t</th>
<th>Ag g/t</th>
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<td>Victoria Main and Sth</td>
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<tr>
<td>Queenslander</td>
<td>Inferred</td>
<td>1,570,000</td>
<td>4.4</td>
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<td>Morrisons</td>
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(2) Victoria – Queenslander – Morrisons Higher Grade Zones*

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* Included in combined resource figures in (1)
Queenslander/Morrsions lodes combined contain an inferred: 3.5Mt @ 5% Zn, 0.6% Cu, 0.3% Pb, 0.1g/t Au, 17g/t Ag

High grade zones contain combined:
  - 1.45Mt @ 7% Zn, 0.7% Cu, 0.4% Pb, 0.1g/t Au, 28g/t Ag

Mineralisation hosted in magnetite-garnet-pyroxene-pyrrhotite skarn
Victoria comprises 2 base metal skarn lodes: Main Zone and South Zone

Combined zones contain an inferred:
- **3.44Mt @ 5.1% Zn, 1% Cu, 0.1g/t Au, 22g/t Ag**

High grade core contains:
- **950Kt @ 7.4% Zn, 1.6% Cu, 0.3g/t Au, 30g/t Ag**

Mineralisation hosted in magnetite-garnet-pyroxene-pyrrhotite skarn

Mineralisation remains open down dip and along strike

Zn-rich upper zone

Cu-Au rich at depth
Red Cap Project - Victoria Long Section

Combined zones: inferred 3.44Mt @ 5.1% Zn, 1% Cu, 0.1g/t Au, 22g/t Ag

High grade core: 950Kt @ 7.4% Zn, 1.6% Cu, 0.3g/t Au, 30g/t Ag

Zn-rich upper and to SE
Cu-Au rich at depth and to NW

Mineralisation hosted in magnetite-garnet-
pyroxene-pyrrhotite skarn

Recent high grade results in core of deposit:
3.7m @ 8.7% Zn, 2.1% Cu
3m @ 20.5% Zn, 2.9% Cu
5m @ 9.4% Zn, 0.9% Cu
Red Cap Project
Penzance Section 6000E

- Penzance lodes:
  - 228Kt @ 3.2% Cu, 1.3% Zn, 0.2g/t Au, 58g/t Ag
  - 85Kt @ 0.7% Cu, 6.2% Zn, 0.1 g/t Au, 19 g/t Ag

- Mineralisation hosted in garnet-pyroxene-pyrrhotite skarn along basalt-limestone contact
Redcap Deposits
Schematic Xsectional representation

Penzance
Queenslander/ Morrisons position
Victoria Main & Victoria South

What is down here?
King Vol area geology and deposits/prospects
King Vol Cross Section 5075N

Eastern Zone – high grade core approx 200m down-dip extent and ave true thickness approx
KVD117: 18.4m @ 13.2% Zn, 0.6% Cu
KVD118: 17.1m @ 24.4% Zn, 0.6% Cu
KVD100: 17.3m @ 29.7% Zn, 1.5% Cu
KVD100W1: 17.9m @ 30.9% Zn, 1.4% Cu

King Vol & Western Contact Zones
Zn – Pb rich (Zn : Pb : Cu = 1 : 0.35 : 0.1)

Eastern Replacement & Contact Zones
Zn – Cu rich (Zn : Pb : Cu = 1 : 0.02 : 0.05)

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<tr>
<th>Category</th>
<th>T</th>
<th>Zn</th>
<th>Pb</th>
<th>Cu</th>
<th>Ag</th>
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<td>Indicated</td>
<td>1,045,000</td>
<td>14.7</td>
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<td>Total</td>
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<td>0.8</td>
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King Vol Lsection

Intersections from current drilling:

KVD125: 2.4m @ 17.4% Zn
KVD129: 6.95m @ 13.8% Zn

Narrow tabular body – high grade core approx 100m strike extent open beyond 700m down dip
King Vol:
Vein of dark sp + gn replace skarn (down hole to left) and replace high fol’d limestone uphole.
Conclude

- Fertile Intrusive
- Reactive Rocks
- Early structures – focus high T fluids
- Late brittle structures/faults – focus mineralising fluids
- ?Resurgent porphyry – high grade
- Proximal or medial or distal to “the big one”
THANKYOUUSEALL