

A photograph of a dark, porous rock sample, likely a zinc skarn, with a metal tool for scale. The rock is dark brown to black with numerous small, dark, circular pores. The tool is a metal piece with two holes and the word "Caudex" and the number "10" visible on it.

**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 grandite 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 (\pm Mo) districts (\pm 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 (\pm 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**

Deposit	Category	Tonnes	Zn%	Pb%	Cu%	Ag g/t	Au g/t
King Vol (1)	Indicated	1,045,000	14.7	0.7	0.9	37	0.0
	Inferred	1,943,000	10.4	0.5	0.7	26	0.0
Montevideo (2)	Inferred	720,000	7.7	0.2	0.0	7	0.0
Queenslander (1)	Inferred	1,570,000	4.4	0.2	0.5	12	0.0
Morrison's (1)	Inferred	1,930,000	5.4	0.3	0.6	21	0.1
Victoria (2)	Inferred	3,440,000	5.1	0.0	1.0	22	0.1
Inc Victoria – high grade (3)	Inferred	948,000	7.3	0.0	1.6	30	0.3
Penzance Zn (1)	Inferred	85,000	6.2	0.2	0.7	19	0.1
Penzance Cu (1)	Inferred	228,000	1.3	0.0	3.2	58	0.2
Griffiths Hill Zn (2)	Inferred	58,000	6.9	0.0	0.3	12	0.0
Griffiths Hill Cu (2)	Inferred	1,011,000	0.4	0.0	3.1	61	0.6
Total Zn Resources (6)		10,791,000	7.1	0.3	0.7	21	0.1
Mungana (4)	Probable	1,130,000	10.2	0.8	1.7	122	1.04
	Indicated	230,000	13.3	5.1	2.5	173	1.21
	Inferred	180,000	16.8	0.0	1.7	108	0.7
2009 FYr production	Production	156,625	15.9	1.6	2.1	?122	?1.04
Total Mungana		1,540,000	11.84	1.37	1.85	127	1.03
Mt Garnet (pre-mining) (5)	Proven in-pit	646,000	6.3		0.5	20	
Mt Garnet U/ground (4)	Production	71,000	9.5		0.5	?15	
	Probable	827,000	7.5		0.3	15	
	Indicated	544,000	6.7	0.1	0.4	18	
	Inferred	136,000	8.6	0.4	0.4	49	
Total Mt Garnet (8)		1,264,000	8.35		0.45	19	
The “Median” skarn (7)		1,400,000	5.9	2.8	0.09	58	

Regional Setting

Palmerville Fault

Proterozoic rocks to the west
Palaeozoic rocks to the east

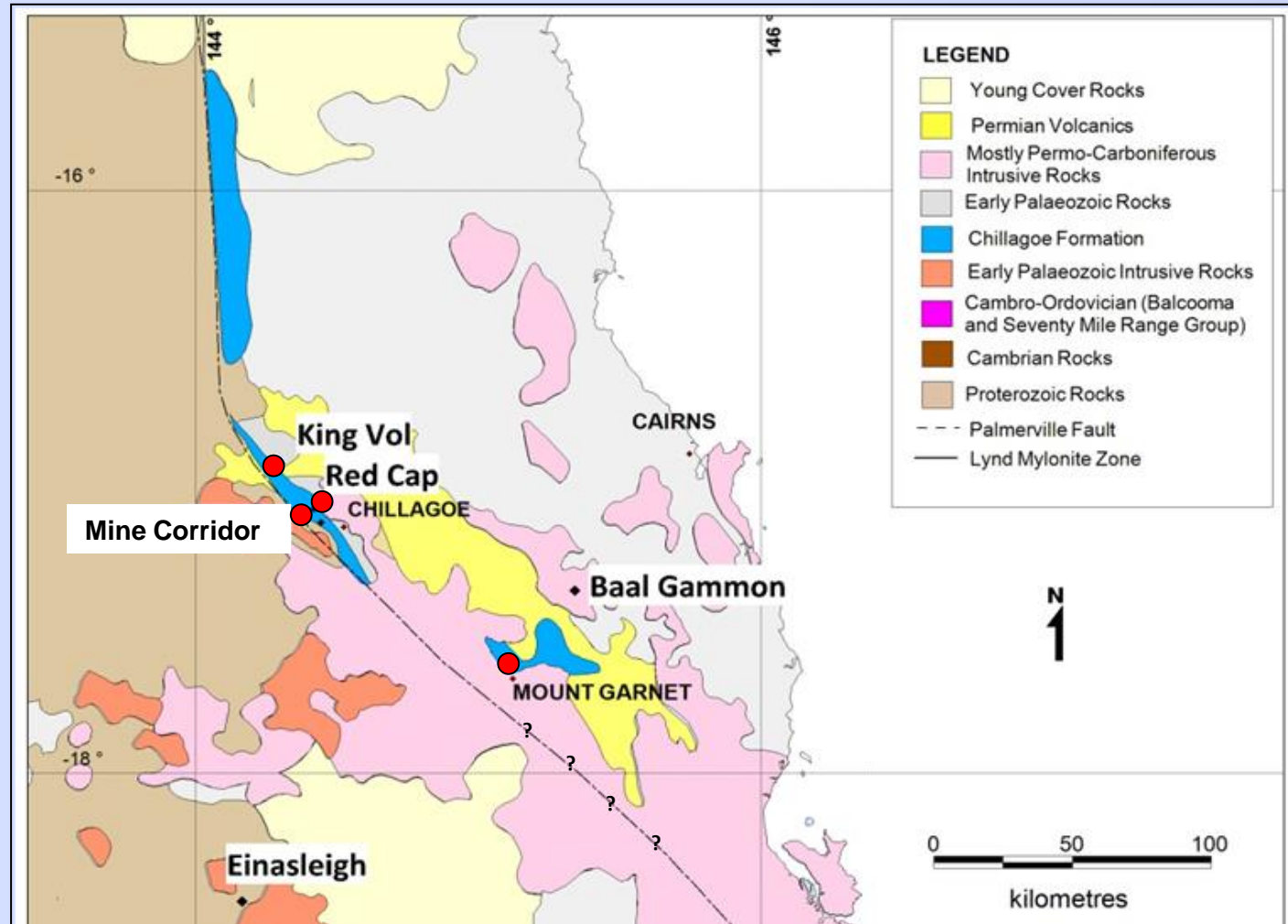
Chillagoe Formation:
Siluro-Devonian
Limestone, siliciclastics,
basalt, chert

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:

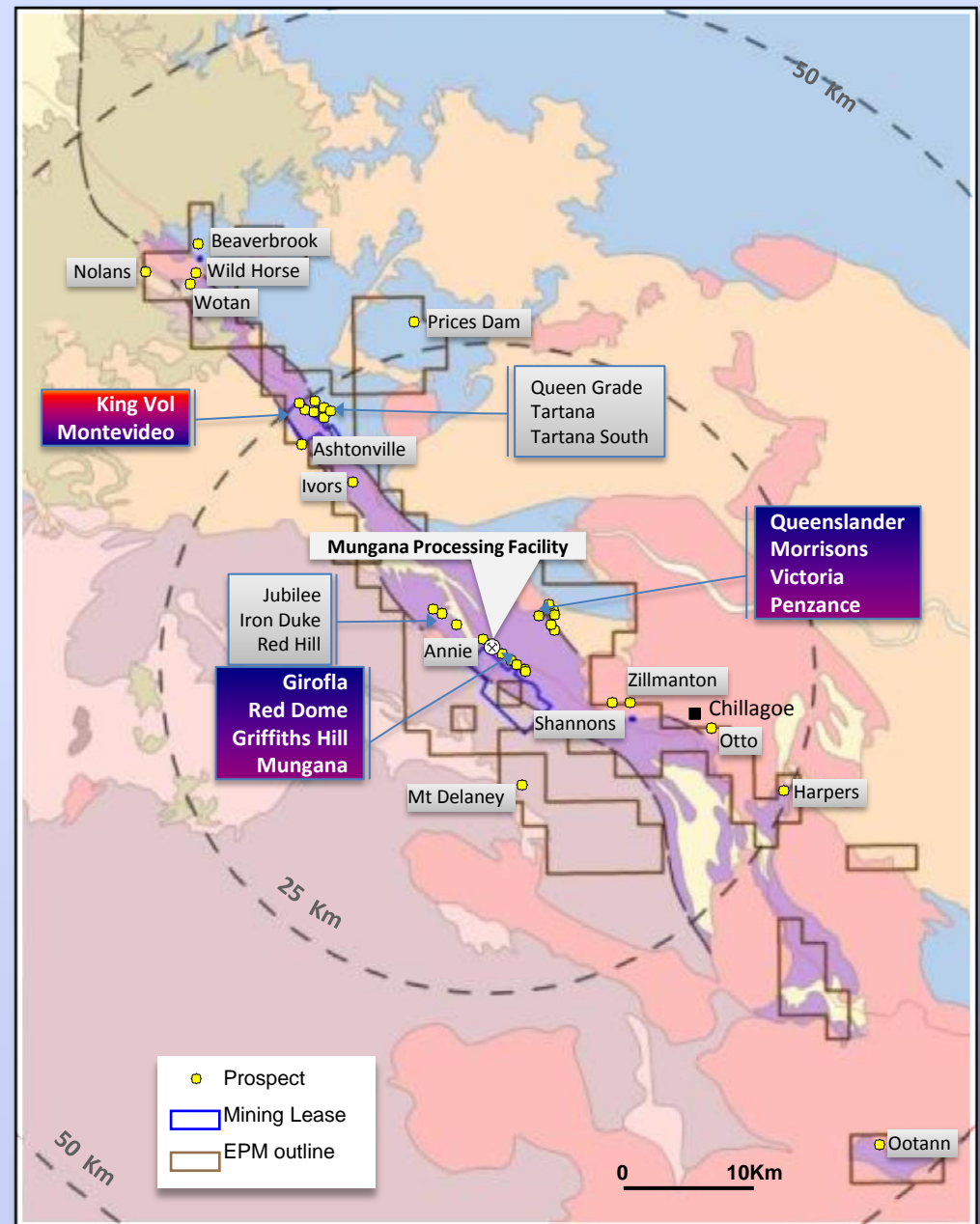
Griffiths Hill (proximal)
Girofla (distal pipe/chimney)
Mungana (distal with porphyry overprint)

Redcap Group of Deposits

Queenslander/Morrison's (?distal)
Victoria (?medial)
Penzance (proximal)
Dunter (?distal pipe – 500m NW of Q'lander)

King Vol Cluster of Deposits

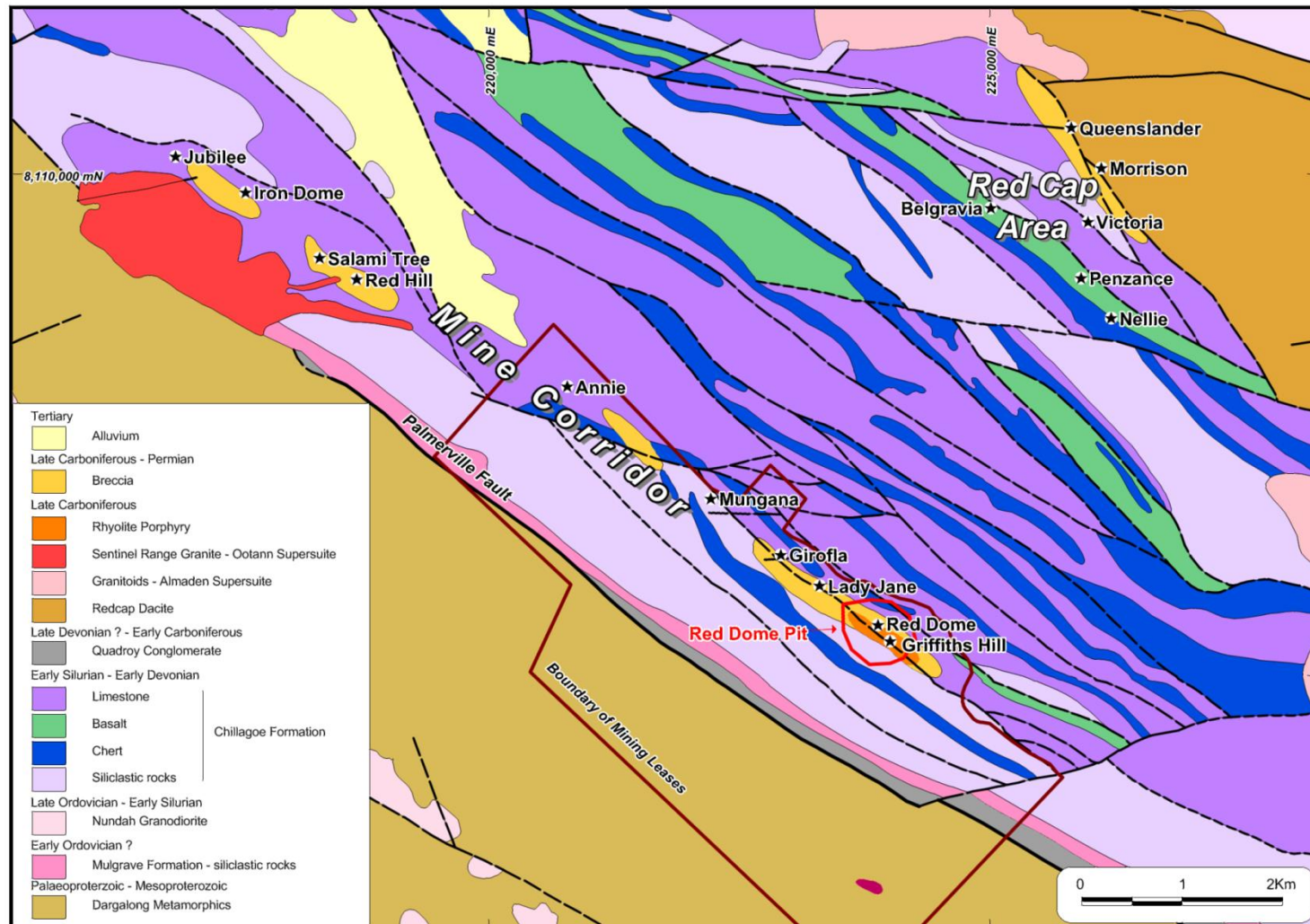
King Vol (distal)
Montevideo (distal)
Queen Grade (distal)
Tartana Copper (?porphyry source –
Hodgkinson Formation)



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



MINE CORRIDOR - SIMPLIFIED GEOLOGY

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**

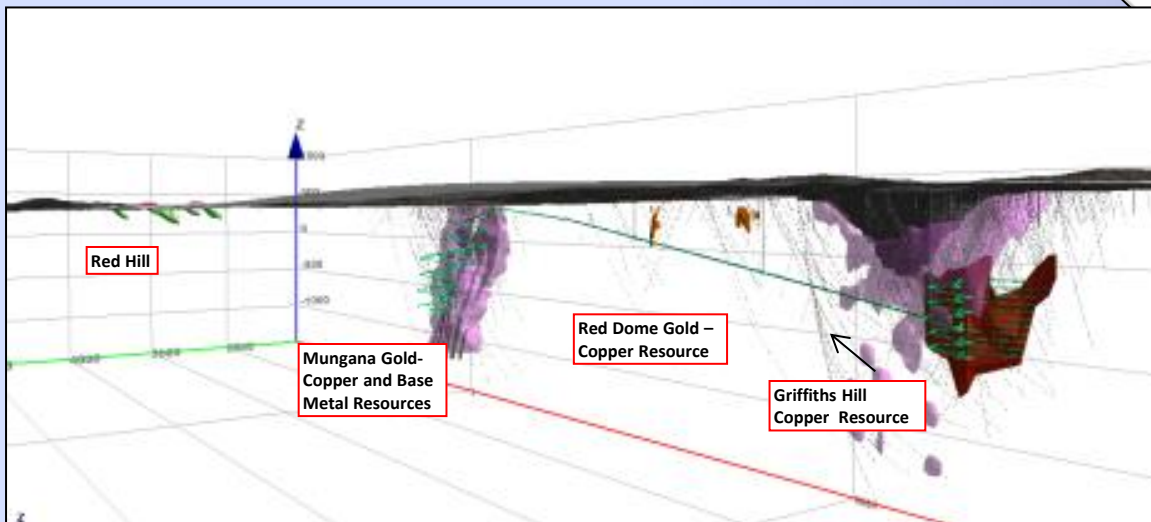
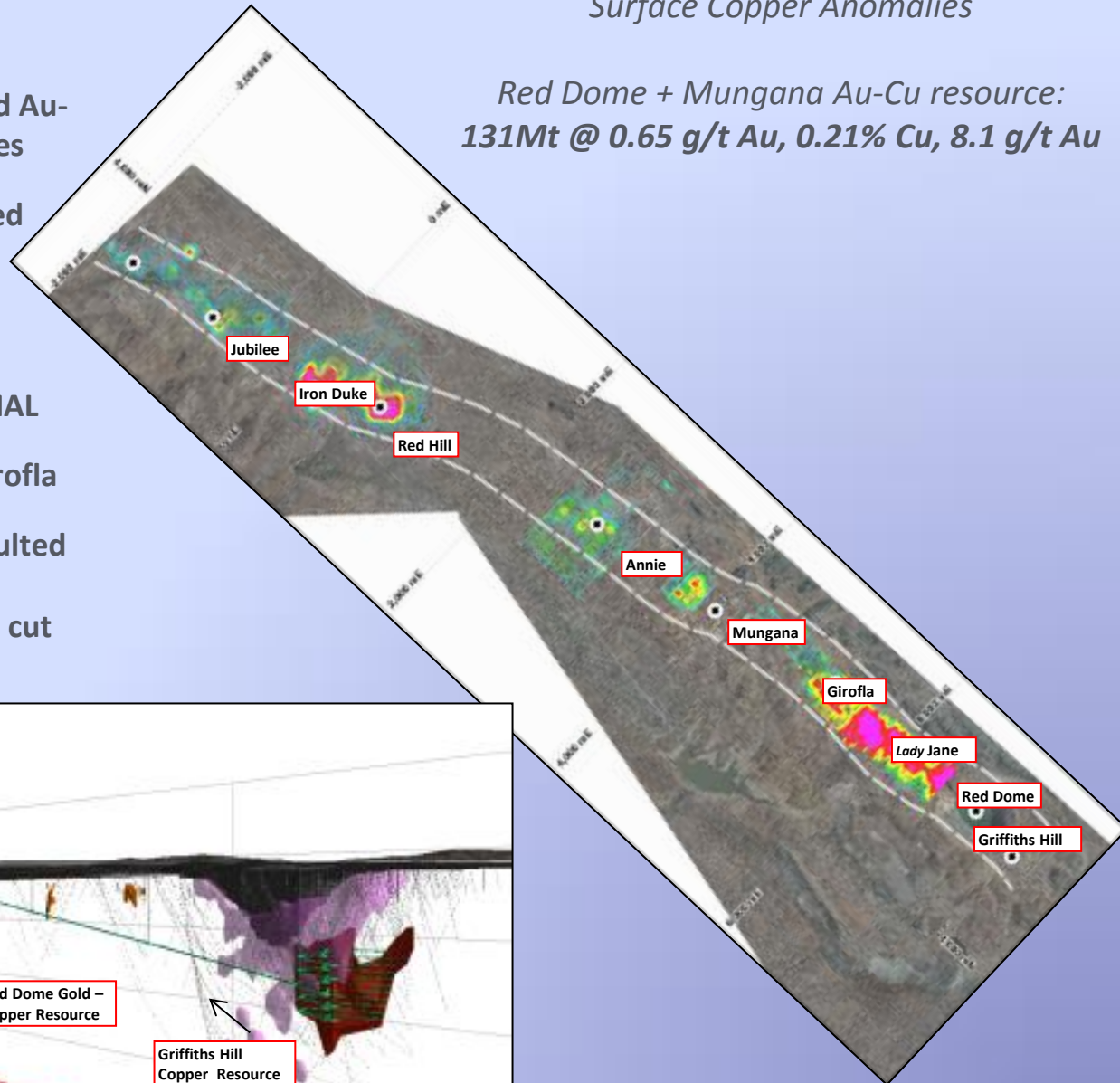
- tabular skarn body along limestone-sandstone contact
 - distal Zn – Cu – Pb – Ag – Au skarn
 - resurgent porphyry cut polymetallic skarn mineralisation – introduce Au – Cu mineralisation

Red Dome/Mungana Mine Corridor

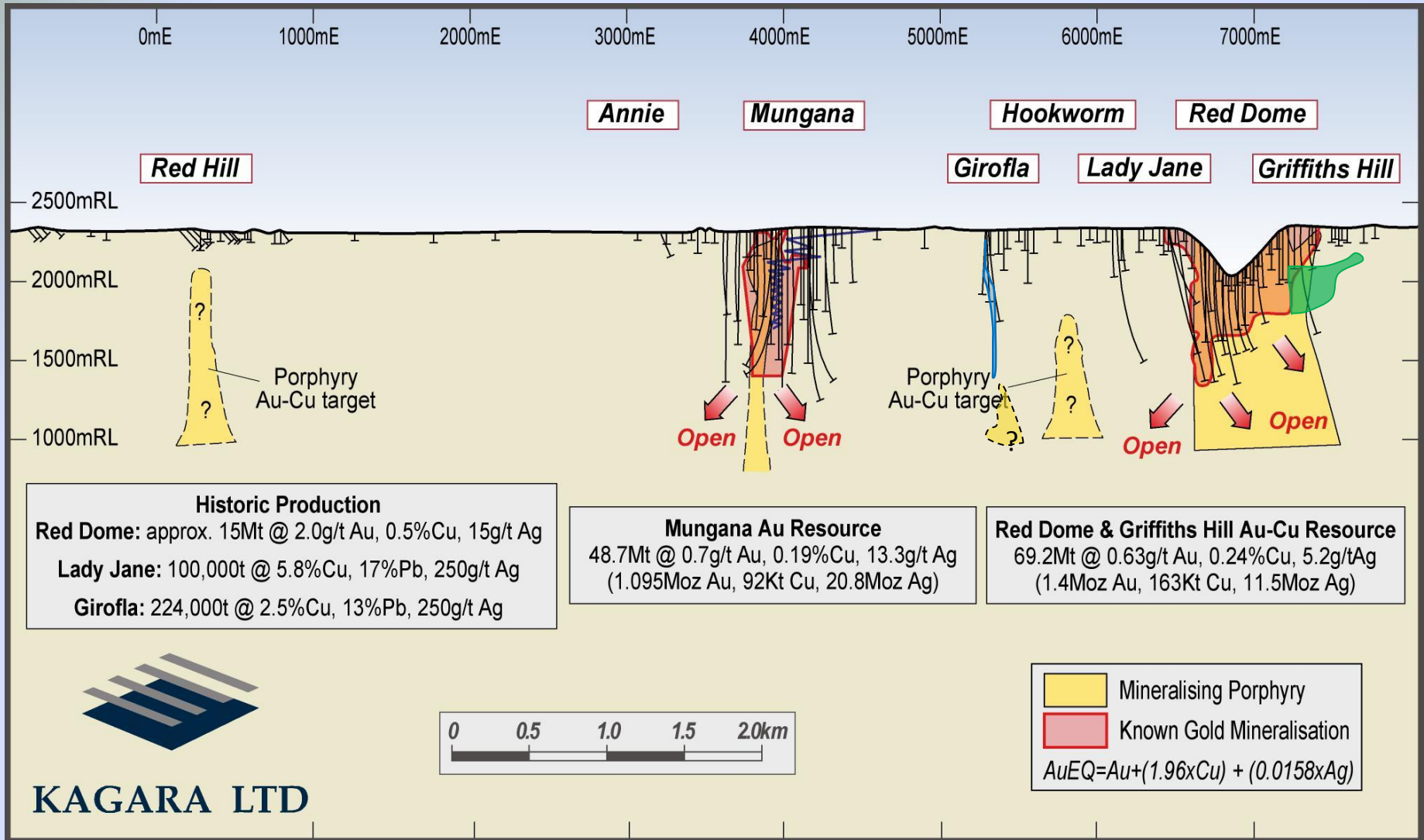
10 km long Mine Corridor
Surface Copper Anomalies

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

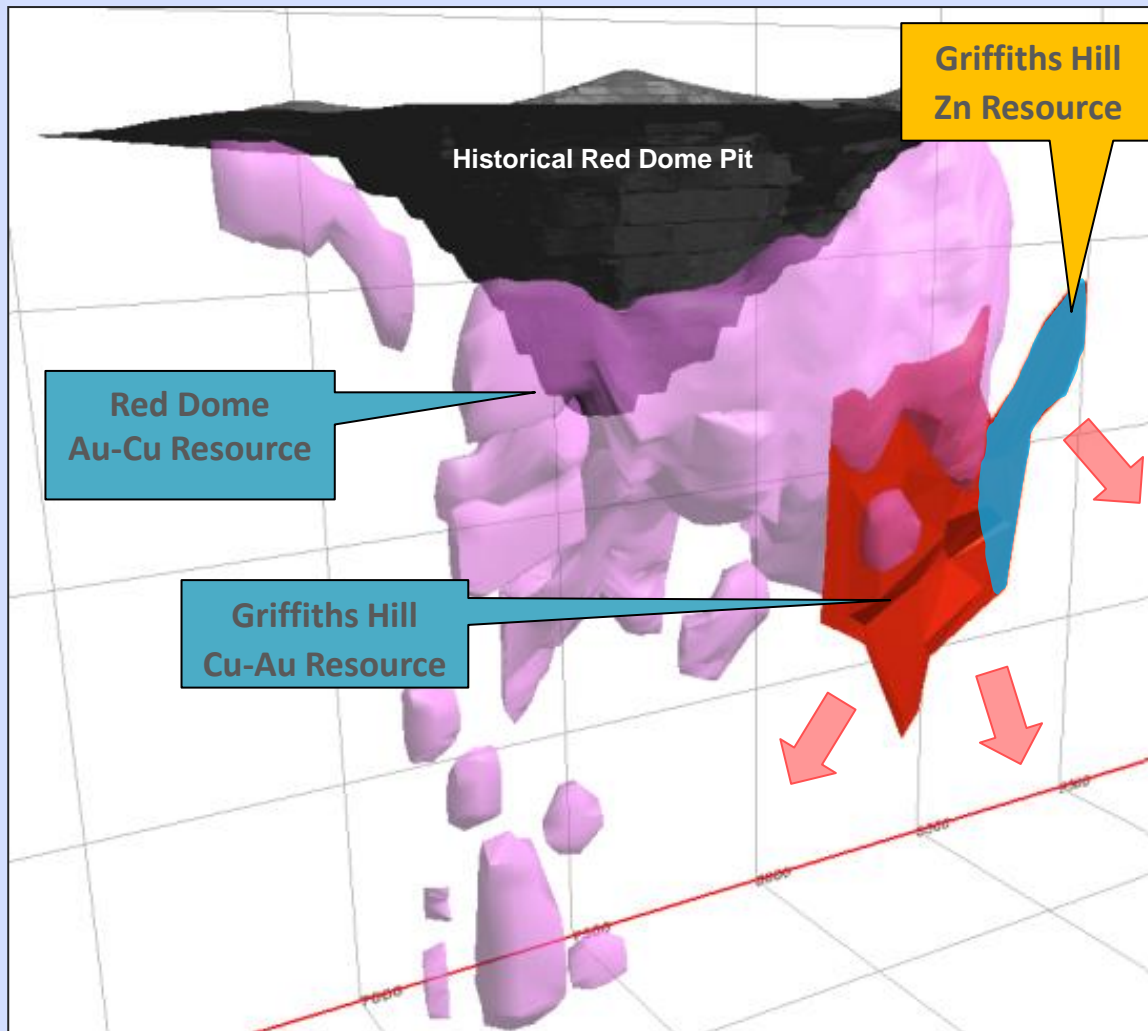
- Current and historical Zn-rich skarn and Au-Cu skarn and porphyry-hosted resources
- Large Au-Cu skarn- and porphyry-hosted resources at Red Dome and Mungana
- Tabular fault-hosted Cu-Au skarn transitional to Cu-Zn to Zn skarn at Griffith's Hill – metal zoning & PROXIMAL
- Pb-Zn-Ag-Cu skarn pipe/chimney 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



Mine Corridor Deposits and Targets



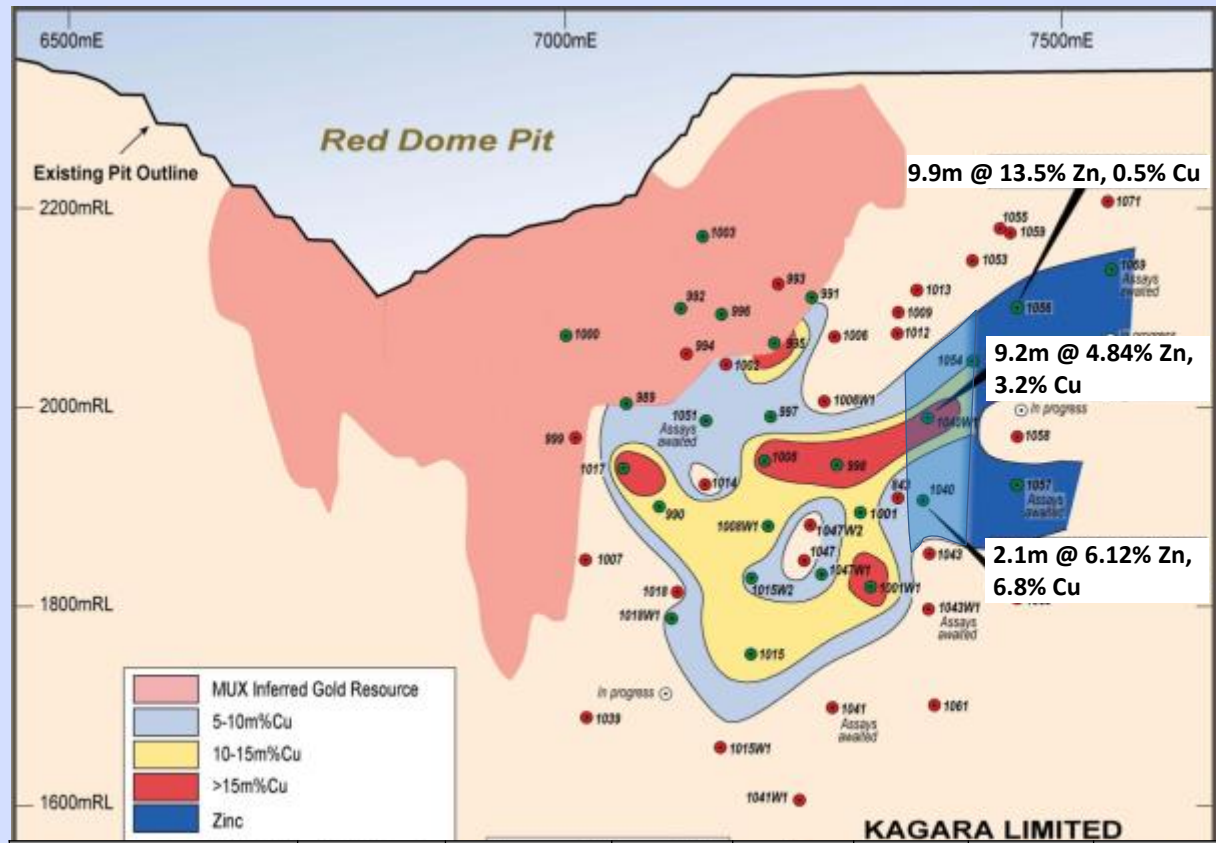
Griffith's Hill Cu and Zn Skarn Deposit



Deposit	Category	Tonnes	Zn%	Pb%	Cu%	Au g/t	Ag g/t
Griffiths Hill (Cu)	Inferred	1,011,000	0.4	0.0	3.1	0.6	61
Griffiths Hill (Zn)	Inferred	58,000	6.9	0.0	0.3	0.0	12
Total		1,069,000	0.8	0.0	2.9	0.6	58

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



Deposit	Category	Tonnes	Zn%	Pb%	Cu%	Au g/t	Ag g/t
Griffiths Hill (Cu)	Inferred	1,011,000	0.4	0.0	3.1	0.6	61
Griffiths Hill (Zn)	Inferred	58,000	6.9	0.0	0.3	0.0	12
Total		1,069,000	0.8	0.0	2.9	0.6	58

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:

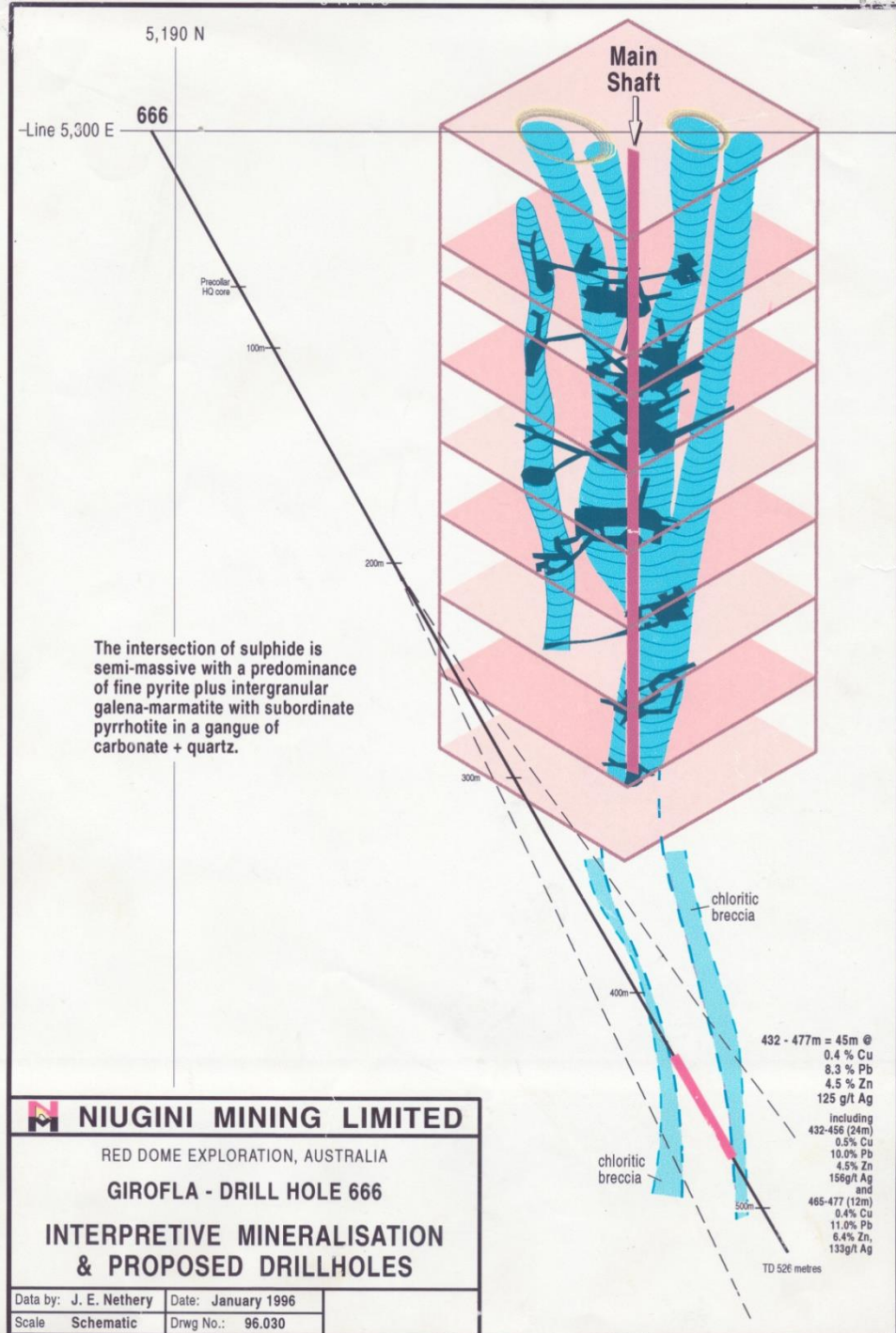
224,000t @ 2.5% Cu, 13% Pb, 250 g/t Ag

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



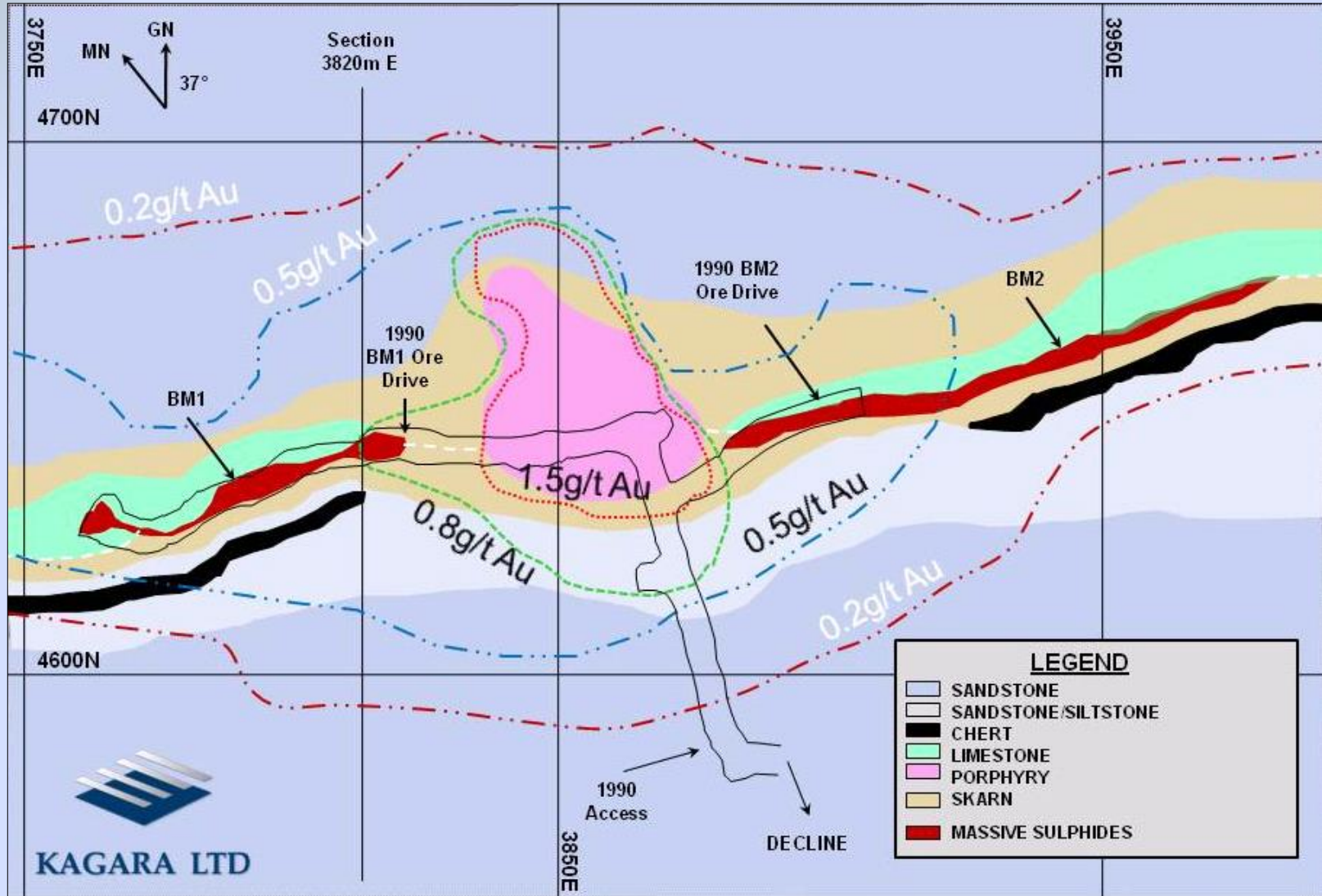




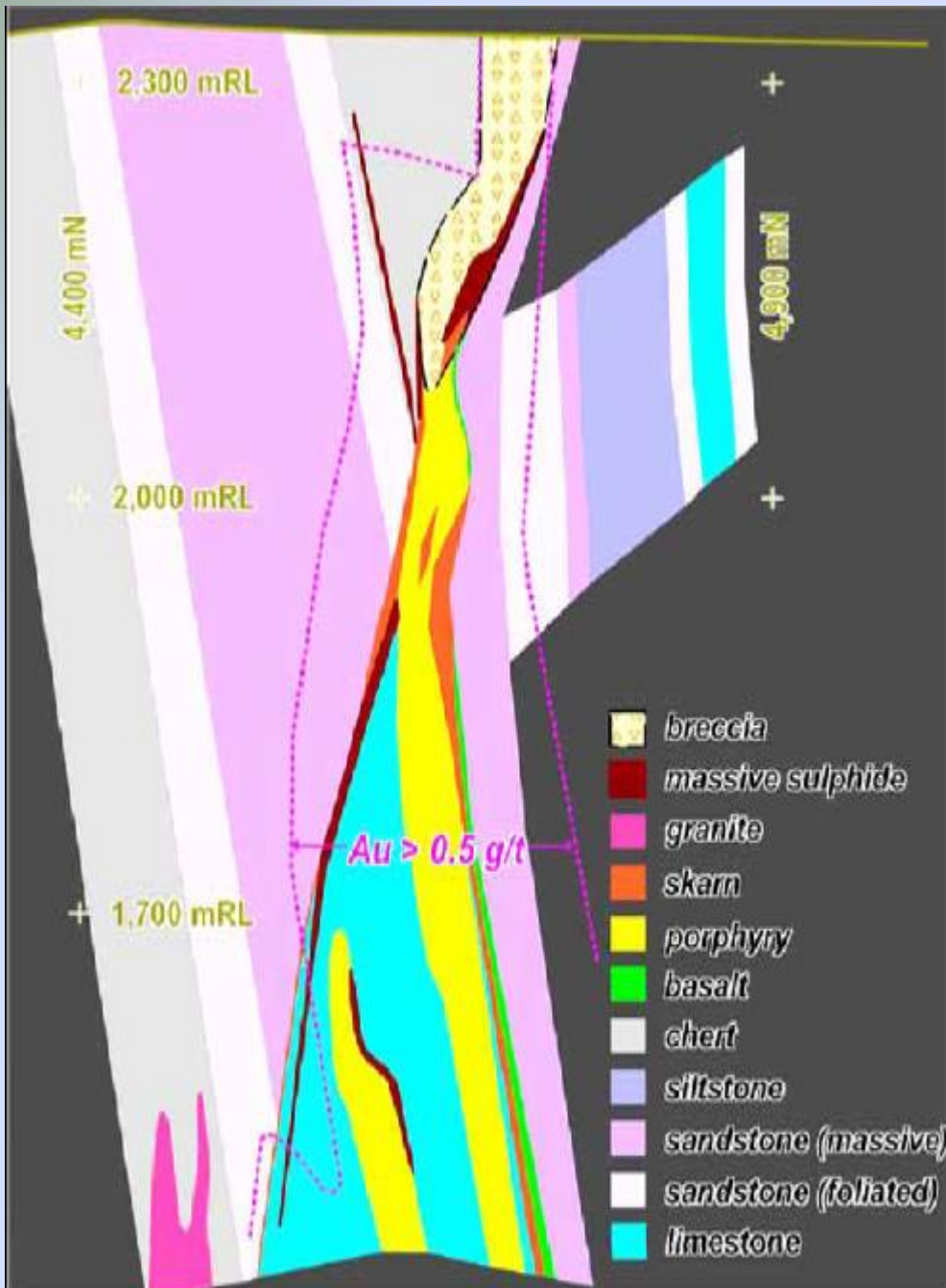


Mungana Au-Cu porphyry deposit and Zn-rich skarn deposit

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



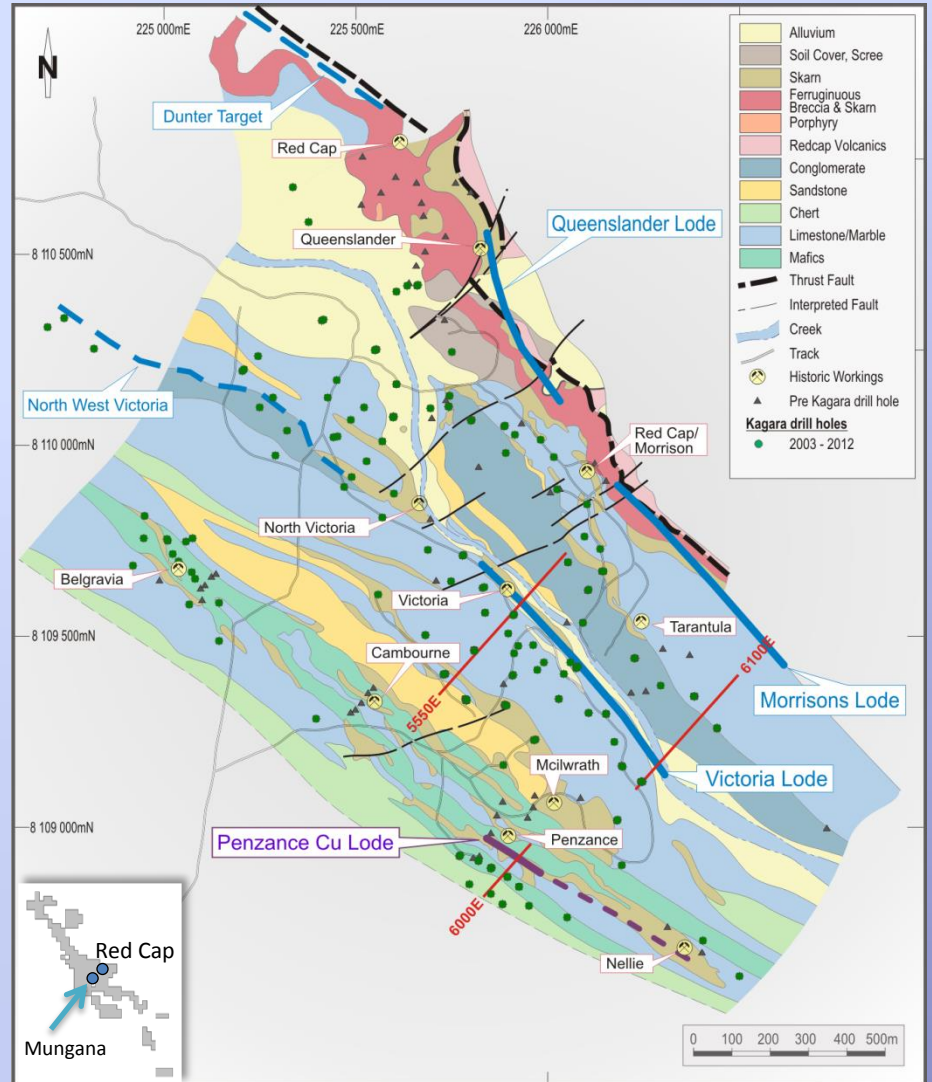
The Redcap Deposits

- **Queenslander/Morrison's (?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

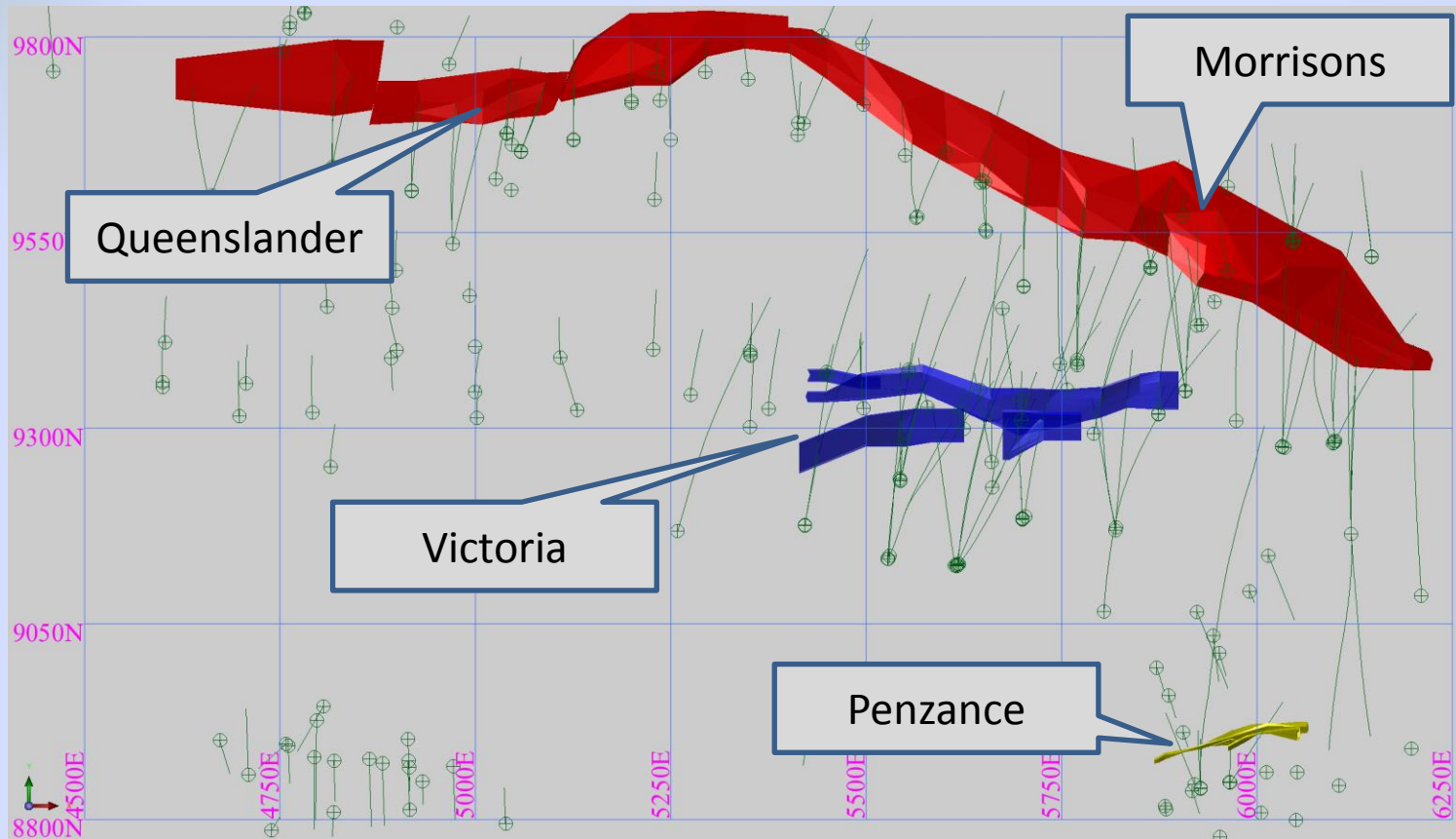
Redcap Project

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

- Queenslander/Morrison's – tabular body of zinc-rich mineralisation – 1.6km strike
- Victoria, Queenslander, Morrison's, 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

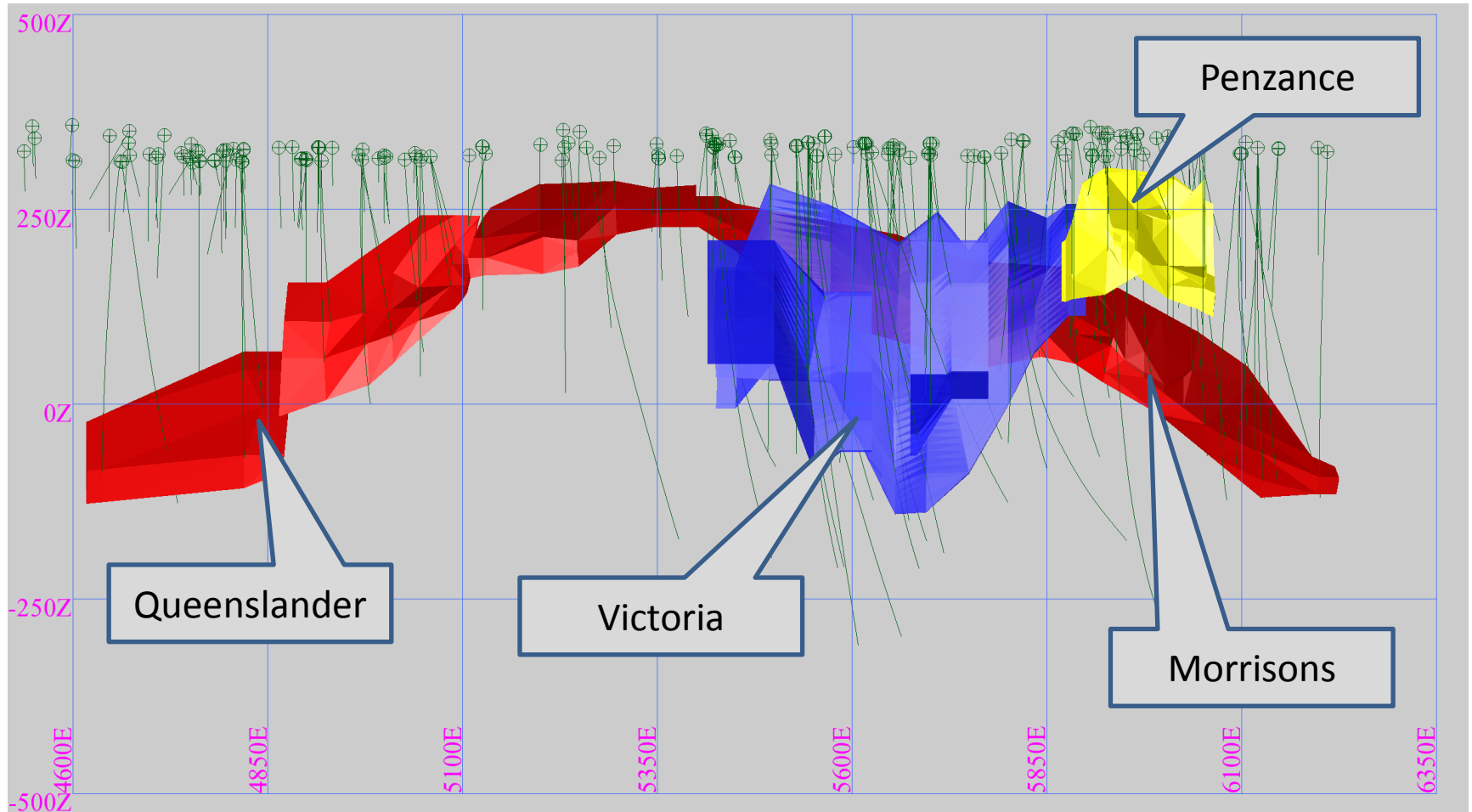
Deposit	Category	Tonnes	Zn%	Pb%	Cu%	Au g/t	Ag g/t
Penzance (Cu)	Inferred	228,000	1.3	0.0	3.2	0.2	58
Penzance (Zn)	Inferred	84,000	6.2	0.2	0.7	0.1	19
Victoria Main and Sth	Inferred	3,440,000	5.1	0.0	1.0	0.1	22
Queenslander	Inferred	1,570,000	4.4	0.2	0.5	0.0	12
Morrisons	Inferred	1,930,000	5.4	0.3	0.6	0.1	21
Total		7,253,000	4.9	0.1	0.9	0.1	21

(2) Victoria – Queenslandler – Morrisons Higher Grade Zones*

Deposit	Category	Tonnes	Zn%	Pb%	Cu%	Au g/t	Ag g/t
Victoria	Inferred	950,000	7.4	0.0	1.6	0.3	30
Queenslander	Inferred	620,000	6.1	0.1	0.7	0.0	13
Morrisons	Inferred	830,000	7.6	0.6	0.7	0.1	39
Total		2,400,000	7.1	0.2	1.1	0.2	29

* Included in combined resource figures in (1)

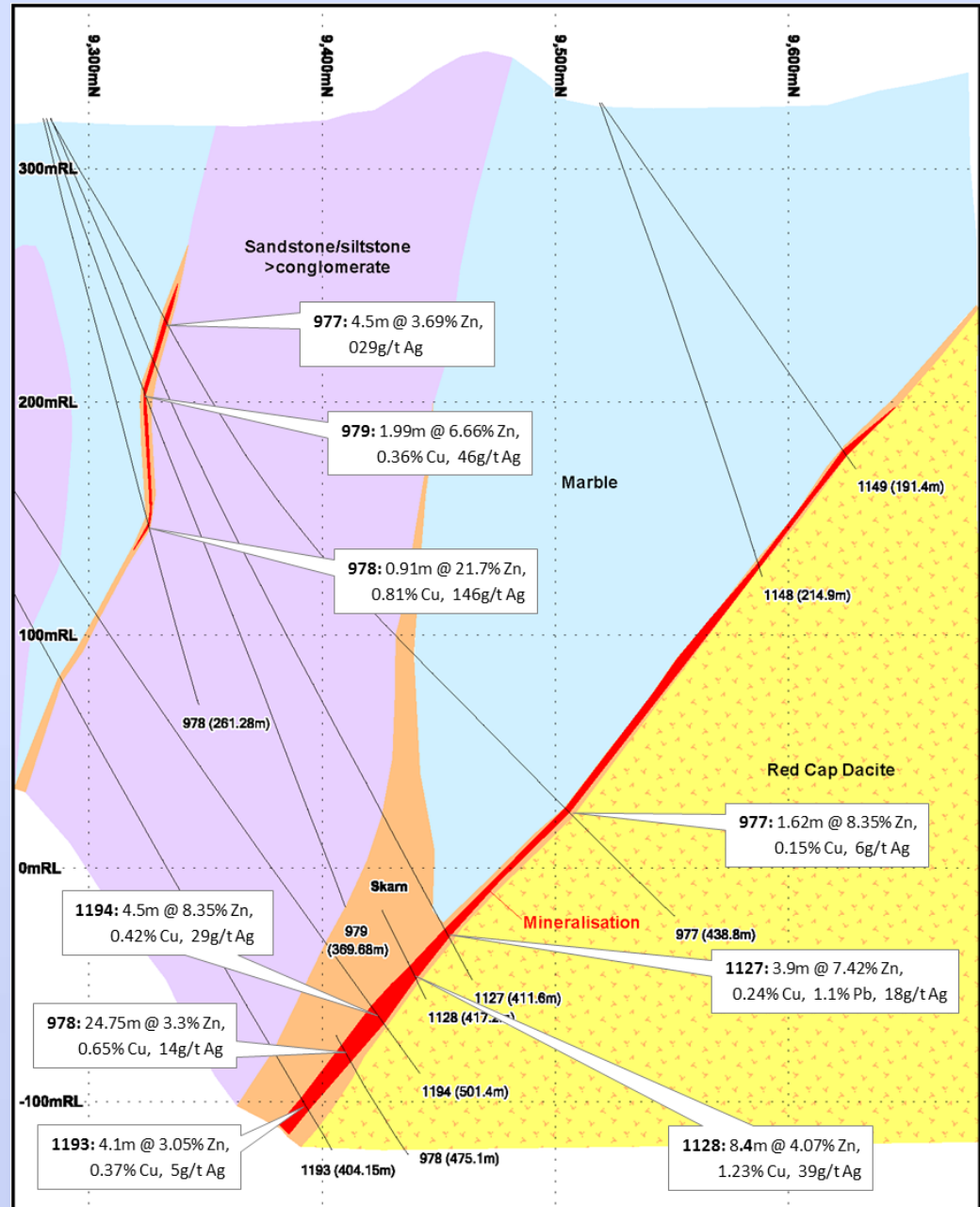
Red Cap Project – Long Section View



Red Cap Project

Morrison's Section 6100E

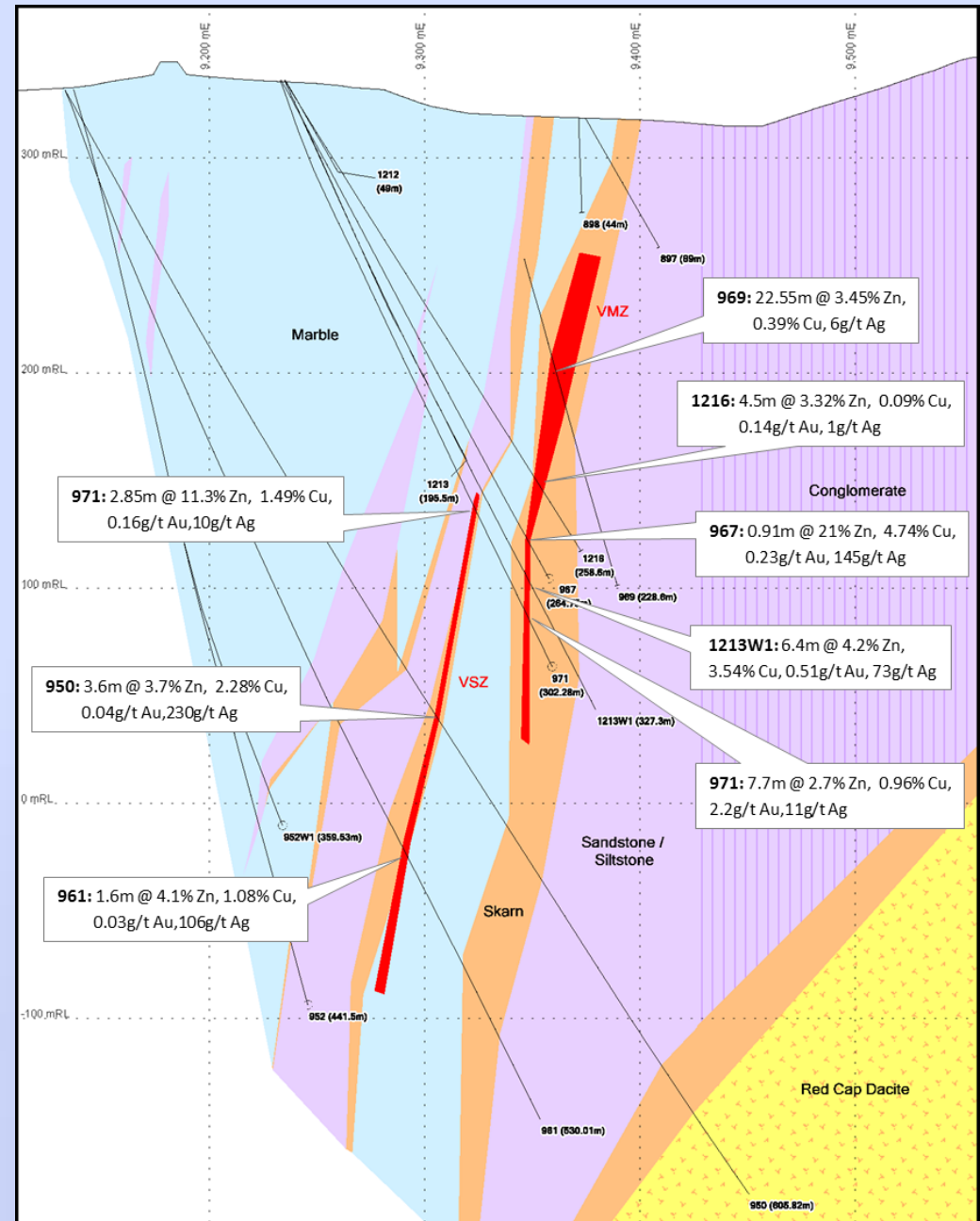
- Queenslander/Morrison's lodes combined contain an inferred: 3.5Mt @ 5% Zn, 0.6% Cu, 0.3% Pb, 0.1g/t Au, 17g/t Ag
- High grade zones contain combined:
 - **1.45Mt @ 7% Zn, 0.7% Cu, 0.4% Pb, 0.1g/t Au, 28g/t Ag**
- Mineralisation hosted in magnetite-garnet-pyroxene-pyrrhotite skarn



Red Cap Project

Victoria Section 5550E

- 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

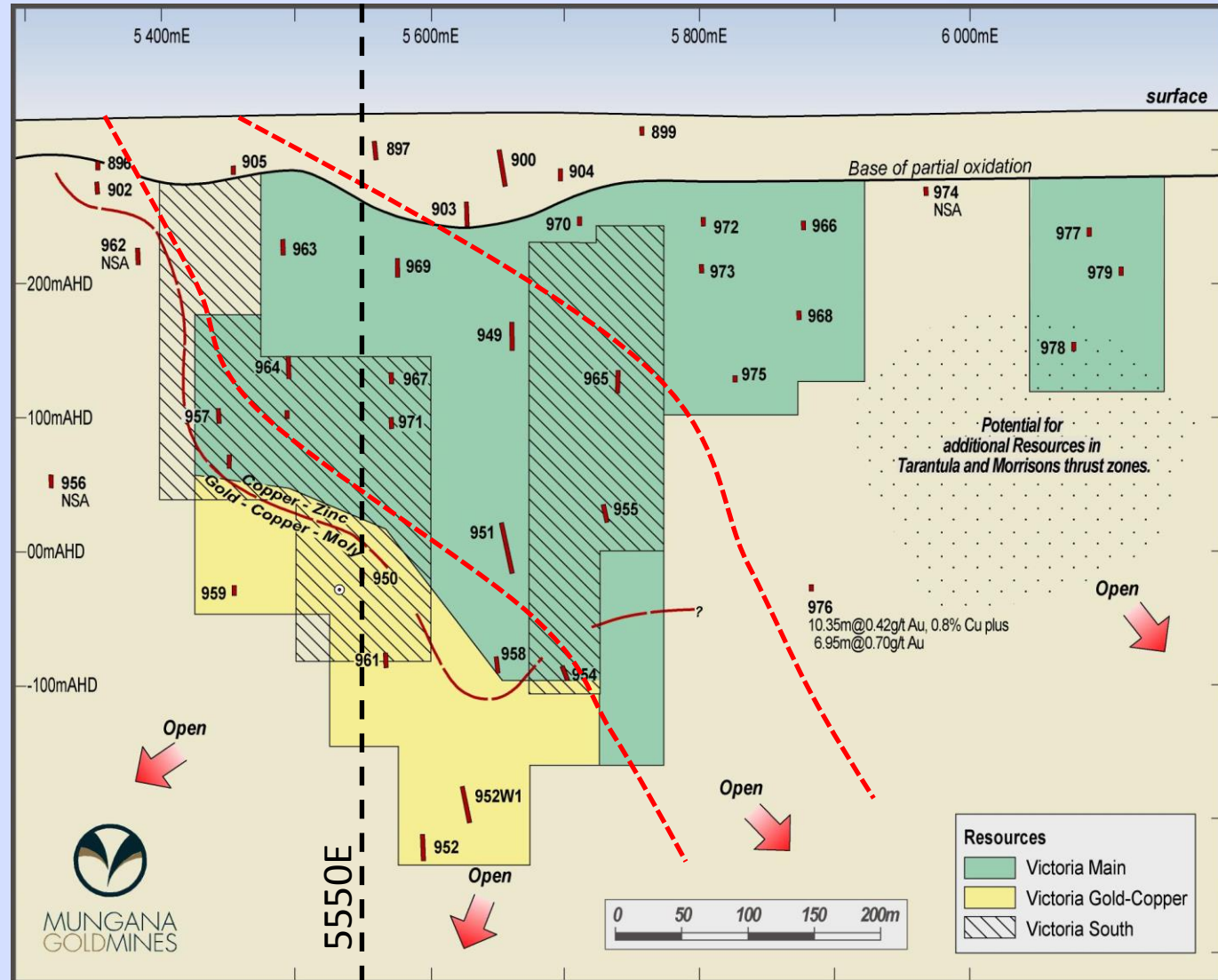
Combined zones:
inferred 3.44Mt @
5.1% Zn, 1% Cu, 0.1g/t Au,
22g/t Ag

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

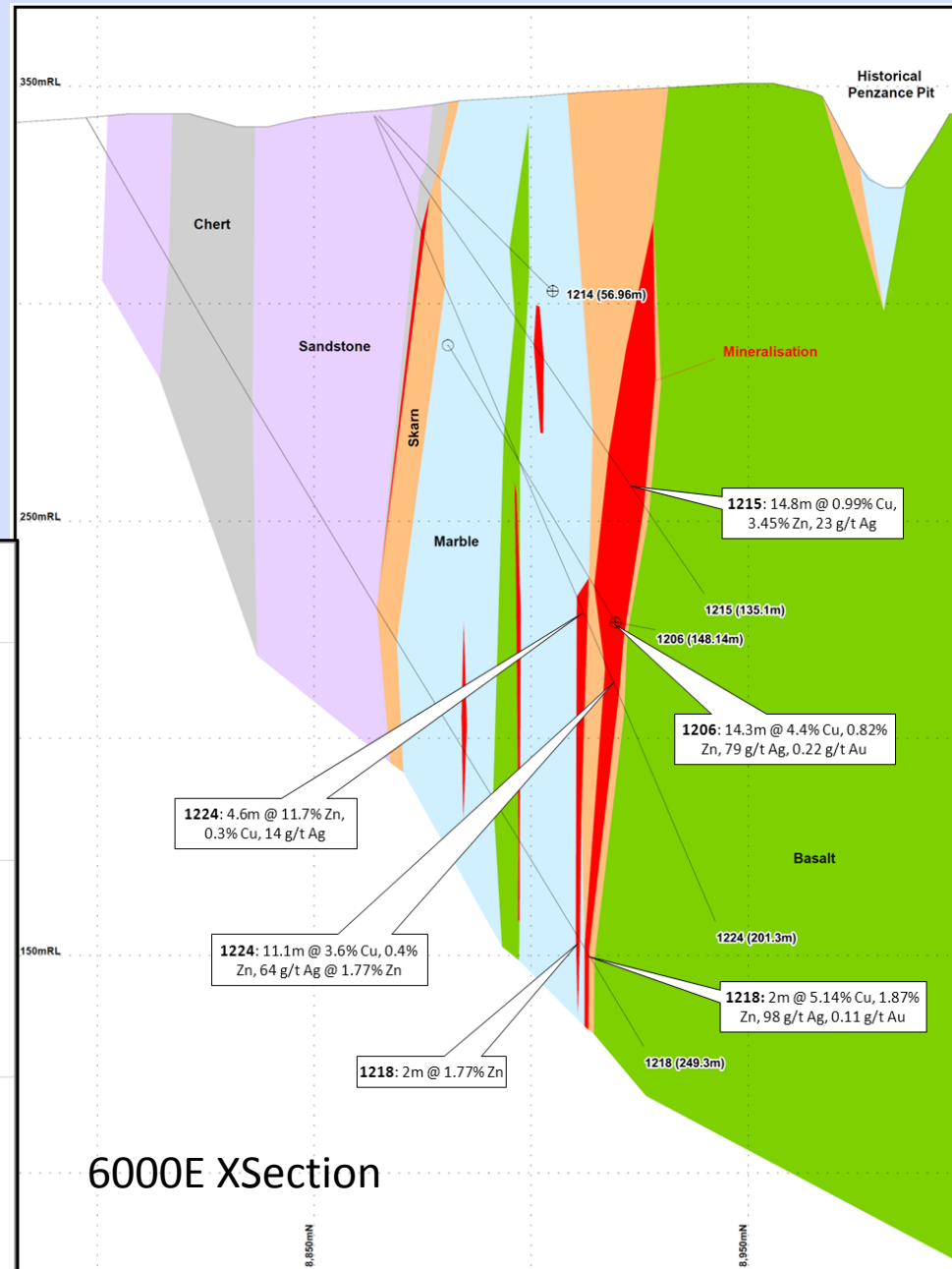
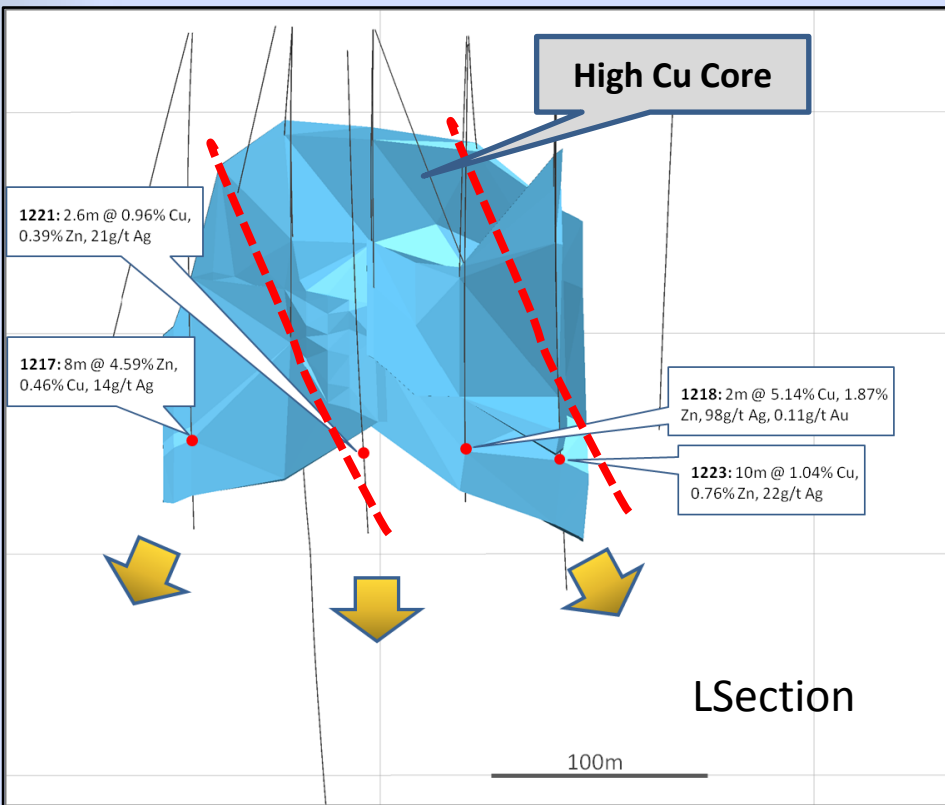
Recent high grade
results in core of deposit:
3.7m @ 8.7% Zn, 2.1% Cu
3m @ 20.5% Zn, 2.9% Cu
5m @ 9.4% Zn, 0.9% Cu



Red Cap Project

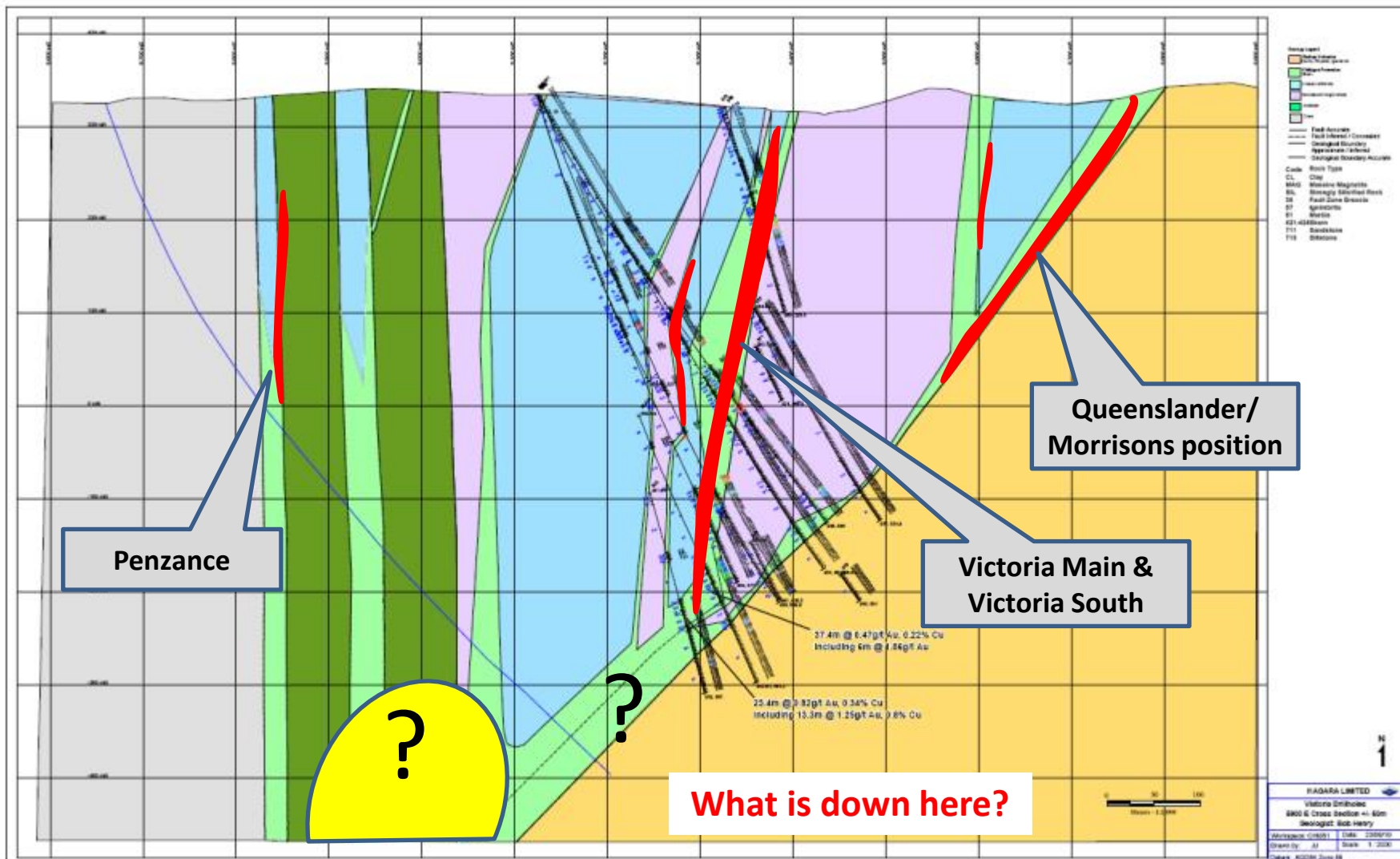
Penzance Section 6000E

- 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

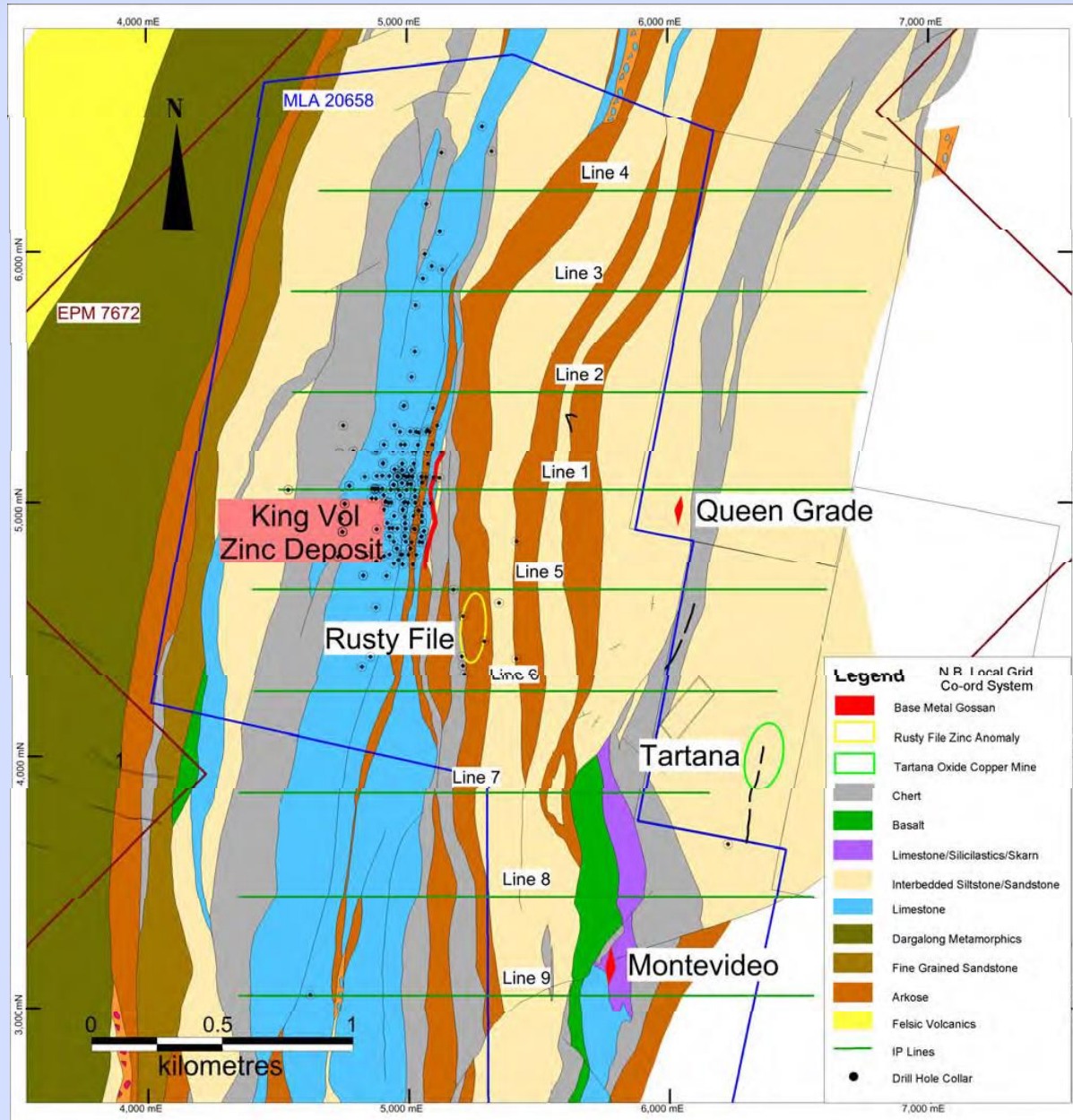


Redcap Deposits

Schematic Xsectional representation



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

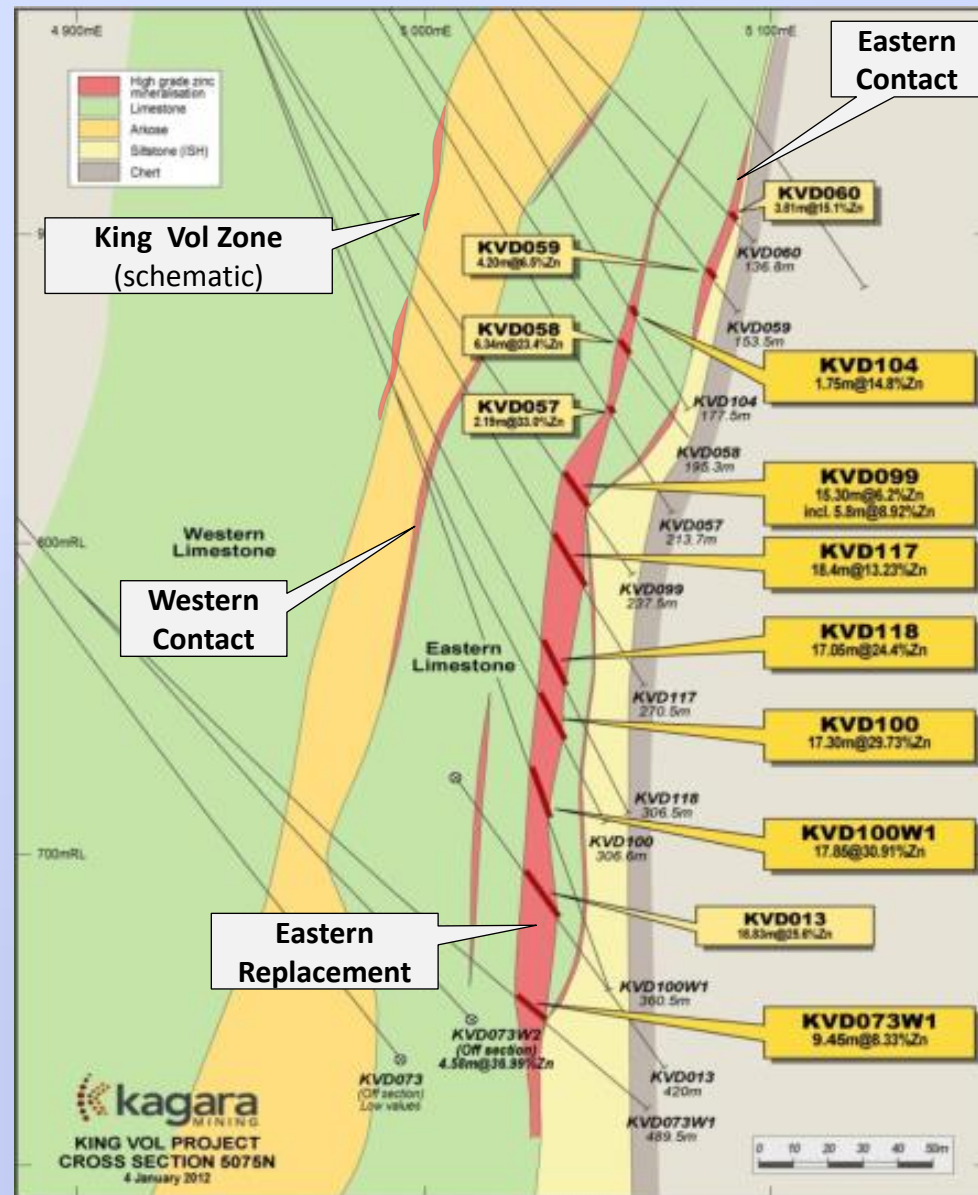
King Vol & Western Contact Zones

Zn – Pb rich (Zn : Pb : Cu = 1 : 0.35 : 0.1)

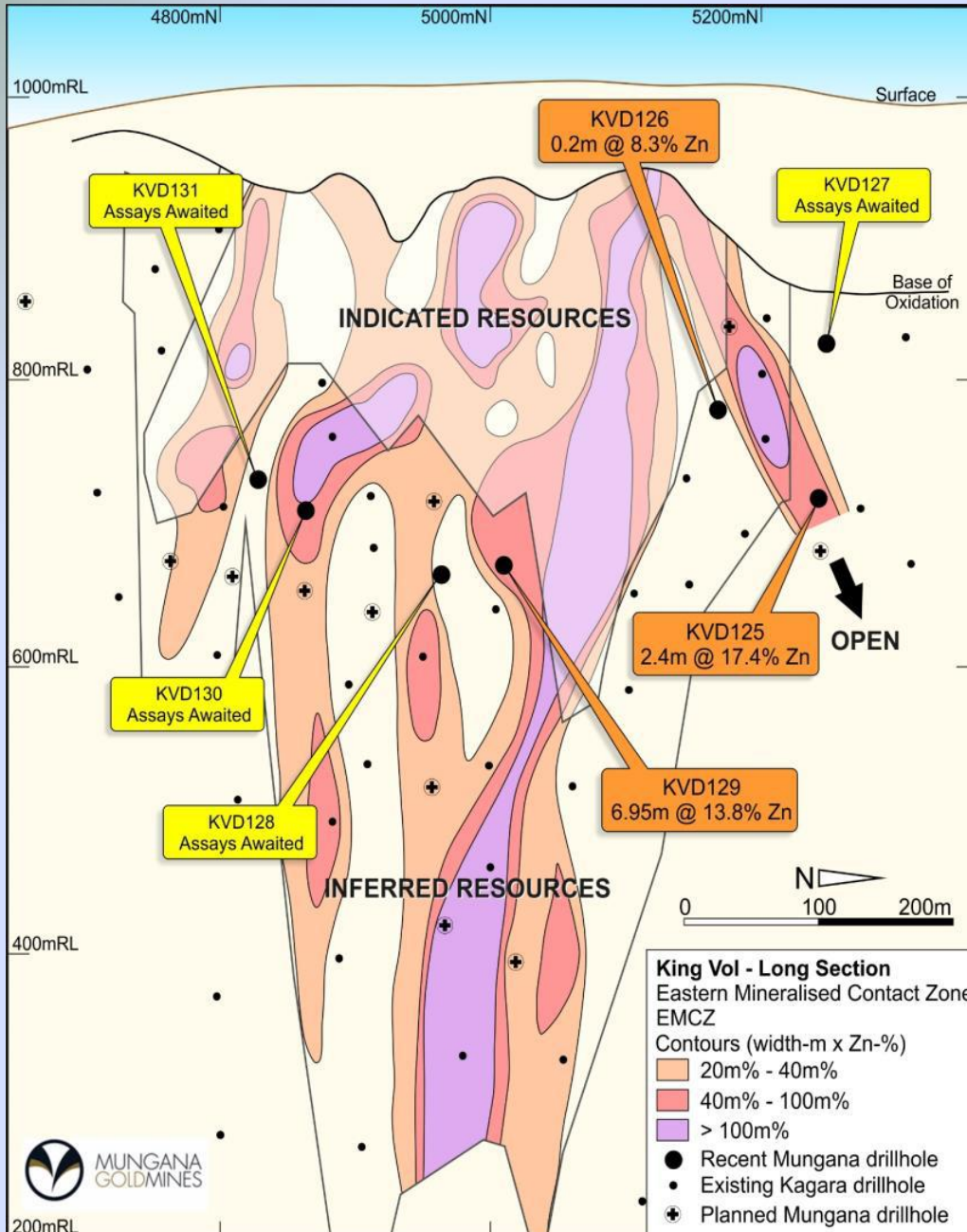
Eastern Replacement & Contact Zones

Zn – Cu rich (Zn : Pb : Cu = 1 : 0.02 : 0.05)

Category	T	Zn	Pb	Cu	Ag
Indicated	1,045,000	14.7	0.7	0.9	37
Inferred	1,943,000	10.4	0.5	0.7	26
Total	2,988,000	11.9	0.6	0.8	30



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”

THANKYOUSEALL