

The exploration fairway for mineralised copper porphyries in the Stavely Arc of western Victoria

Exploring an old arc with new ideas

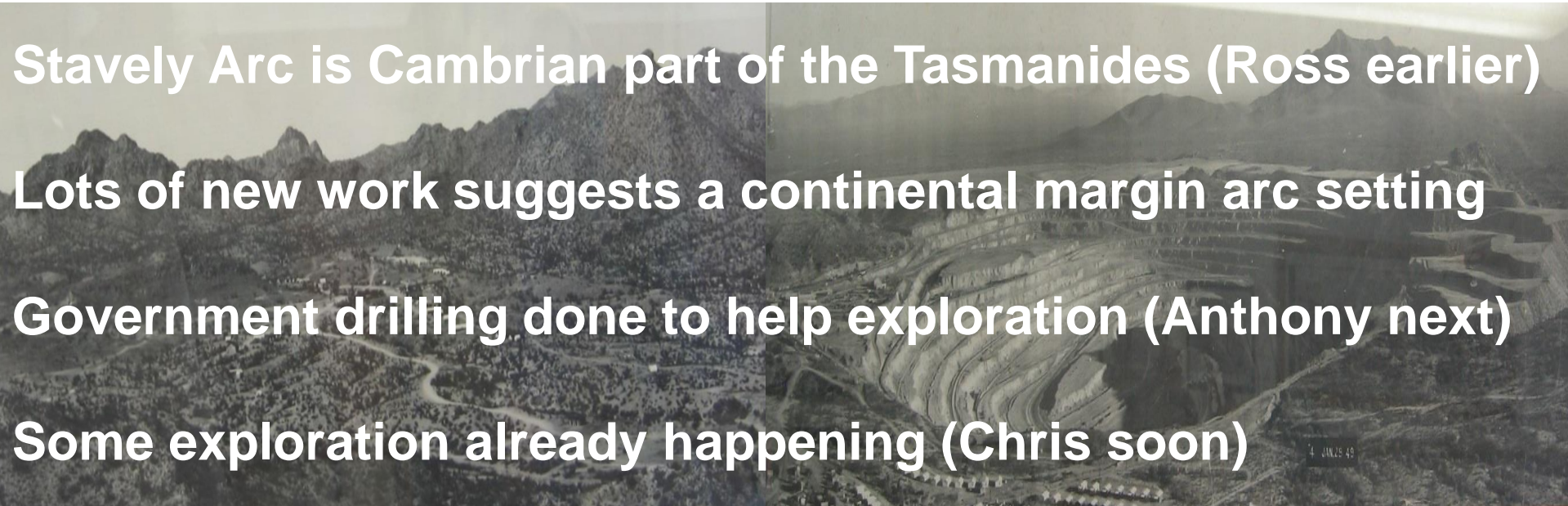
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20 minute talk in 3 parts

- **Why there is currently no mines**
- **Why there could be some really big mines**
- **What is happening to test the potential**



By way of introduction....



Ajo, Arizona. Mined for 70 years from 1916 to 1986 : Town of 18K now pop of 3K

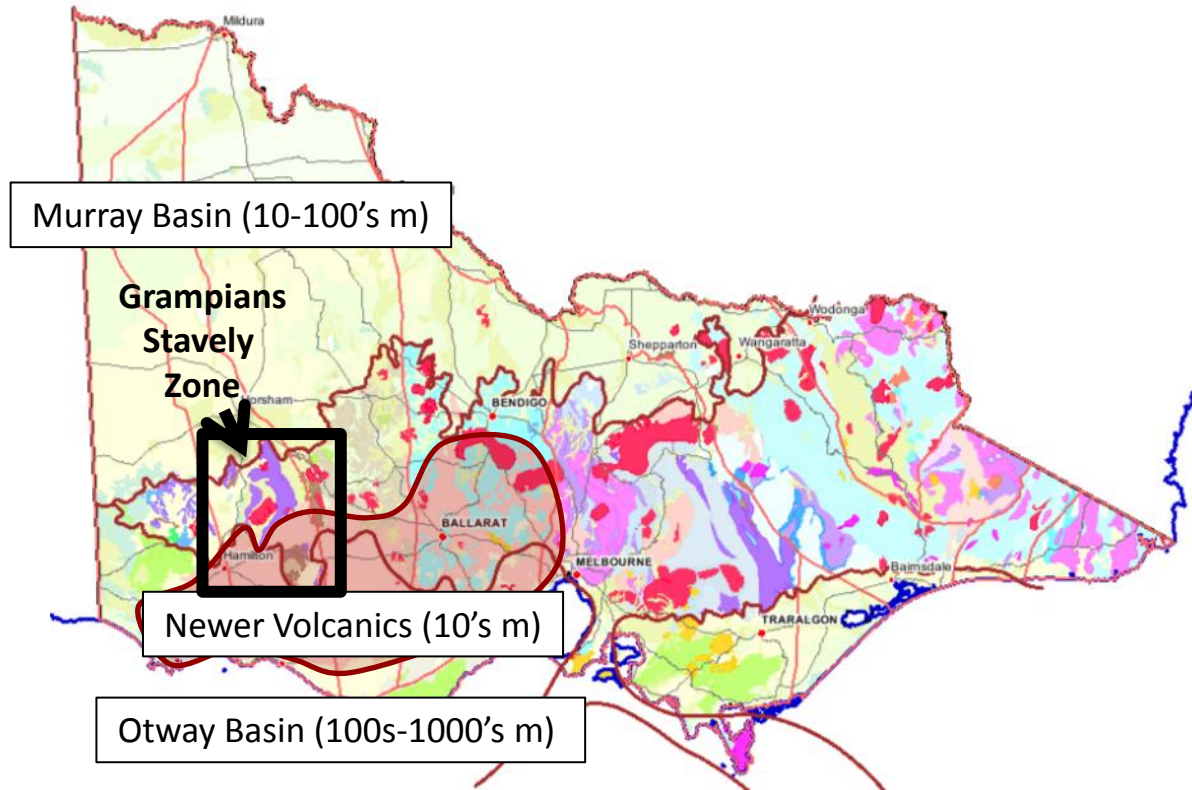
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Grampians Stavely Zone in Western Victoria

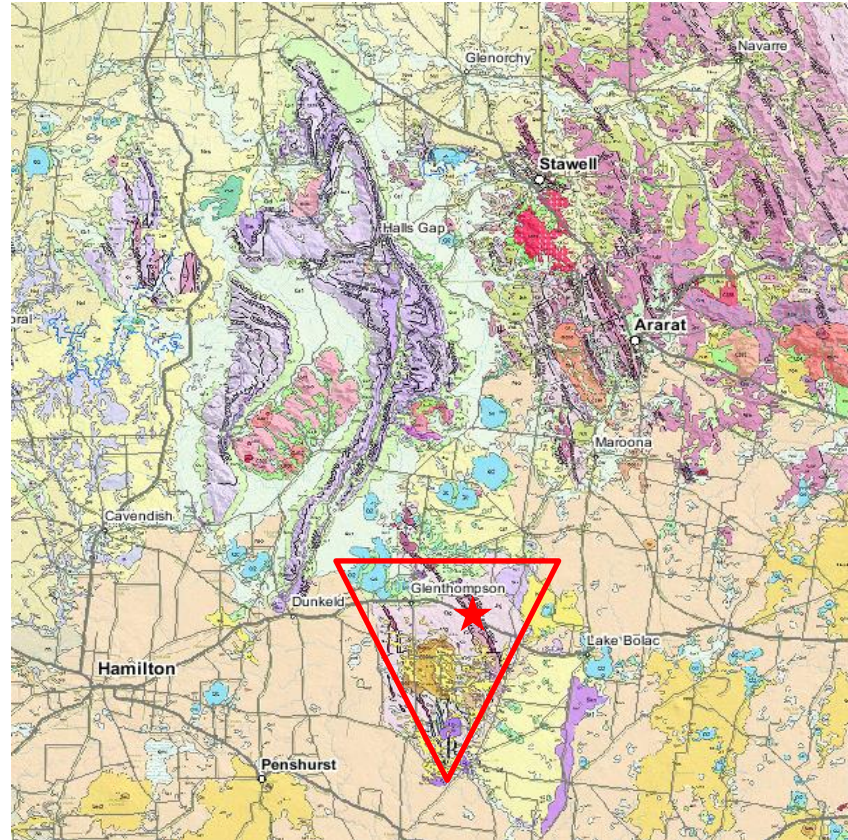
Cambrian bedrock of western Victoria with lots of cover.



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Grampians Stavely Zone in Western Victoria

2 small windows back into the Cambrian: narrow andesite belts amidst turbidites



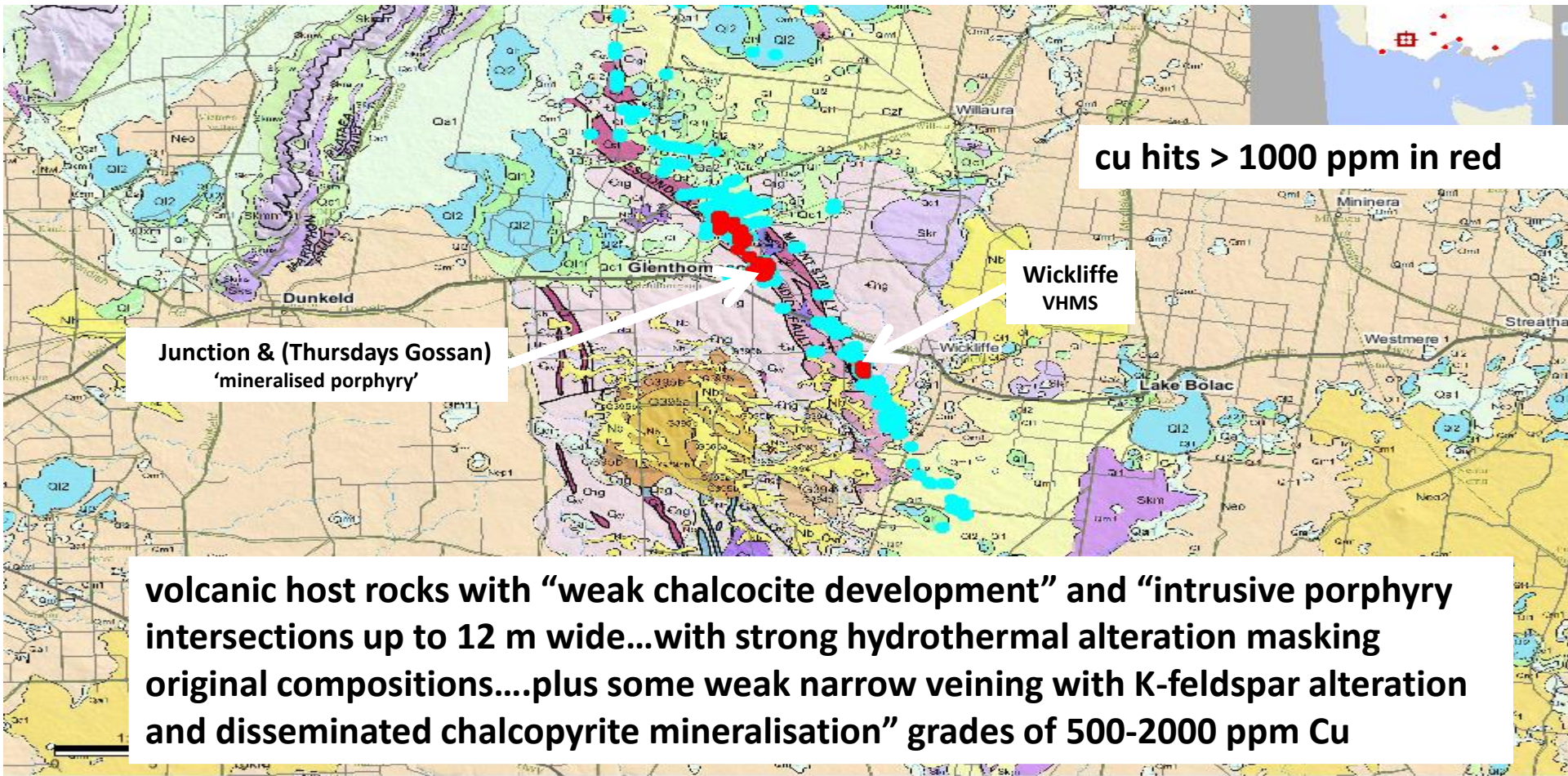
Mount Stavelly not Stavelly Mountain!



Deep weathering meant sampling by drilling



**First exploration by Pennzoil in early 1980s: shallow drilling
pretty much restricted to the andesite belt (750 holes)**



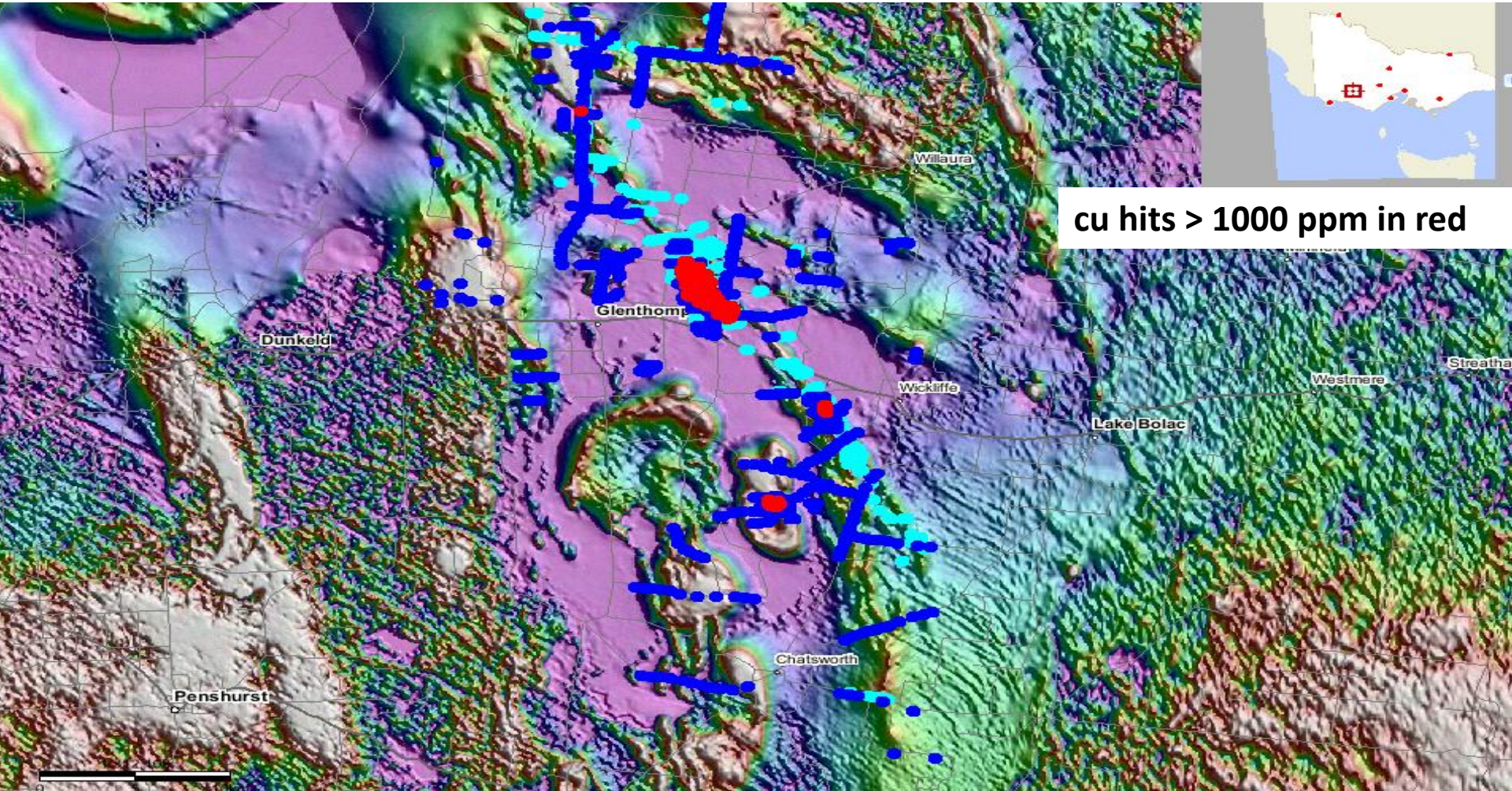
cu hits > 1000 ppm in red

**Junction & (Thursdays Gossan)
'mineralised porphyry'**

**Wickliffe
VHMS**

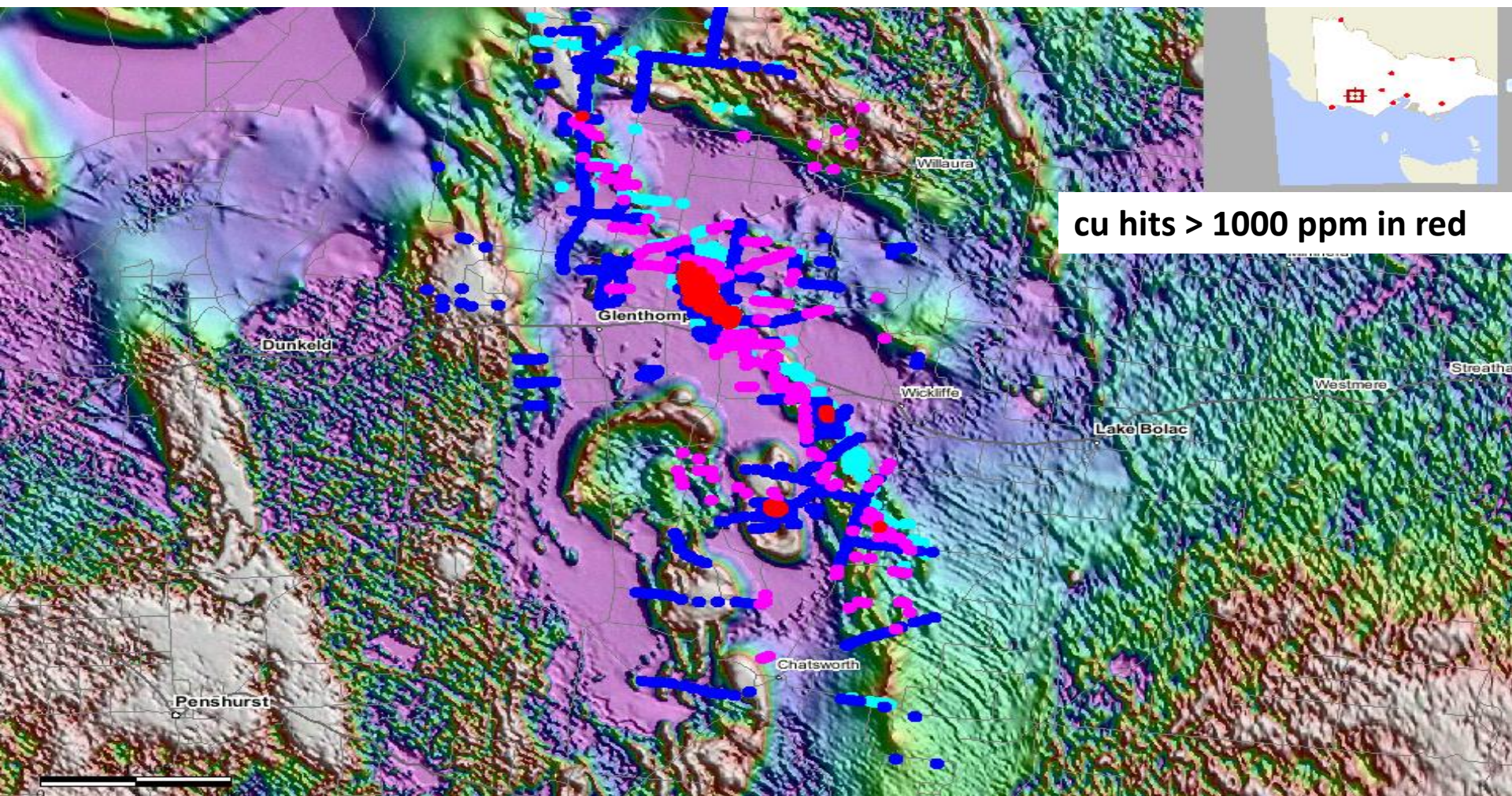
volcanic host rocks with "weak chalcocite development" and "intrusive porphyry intersections up to 12 m wide...with strong hydrothermal alteration masking original compositions....plus some weak narrow veining with K-feldspar alteration and disseminated chalcopyrite mineralisation" grades of 500-2000 ppm Cu

North Drilling early 1990s (dark blue) started to step out using recent magnetic data (800 holes)

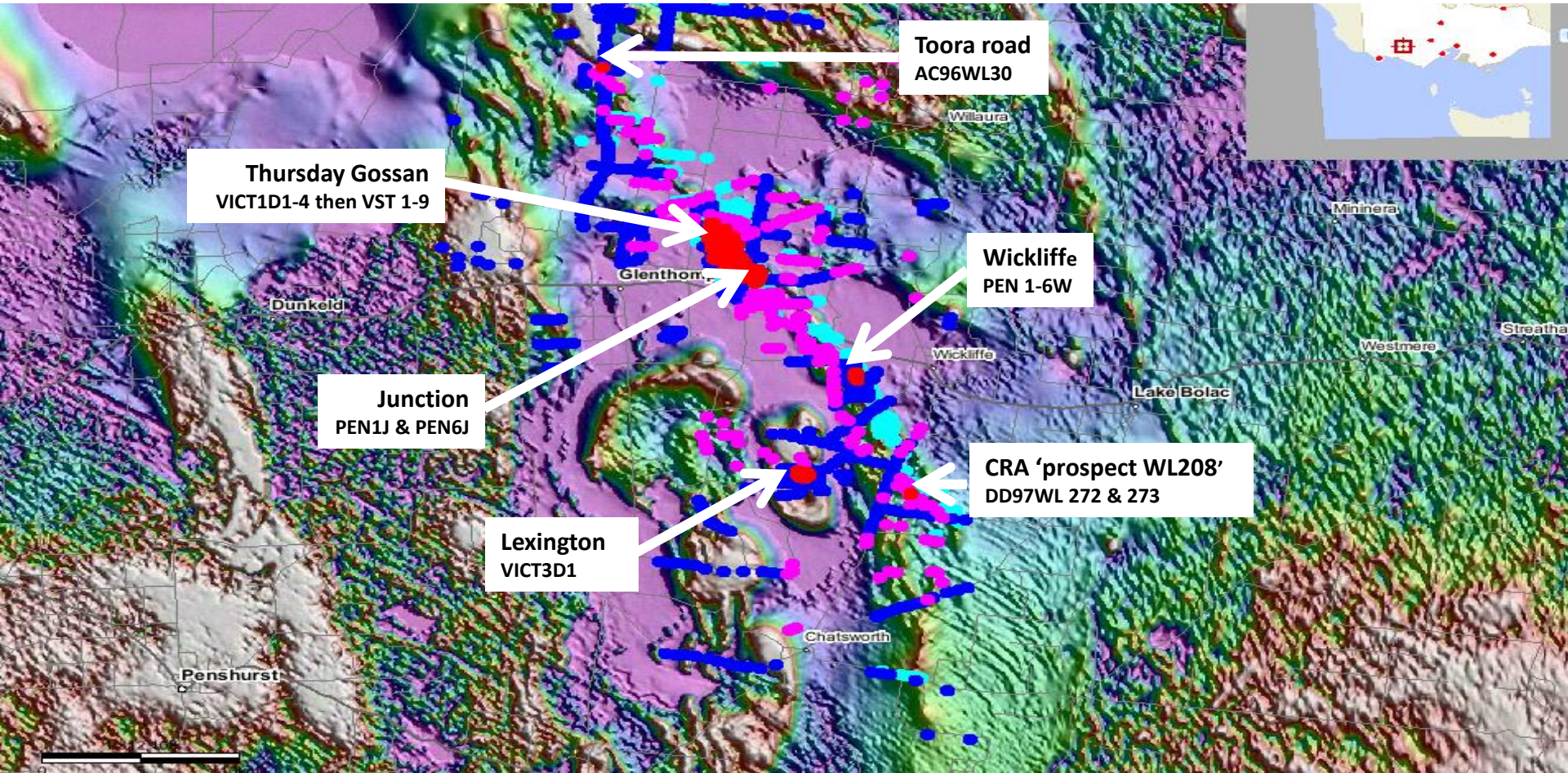


cu hits > 1000 ppm in red

CRA JV drilling mid 1990s (hot pink) in final tranche of exploration (290 holes)



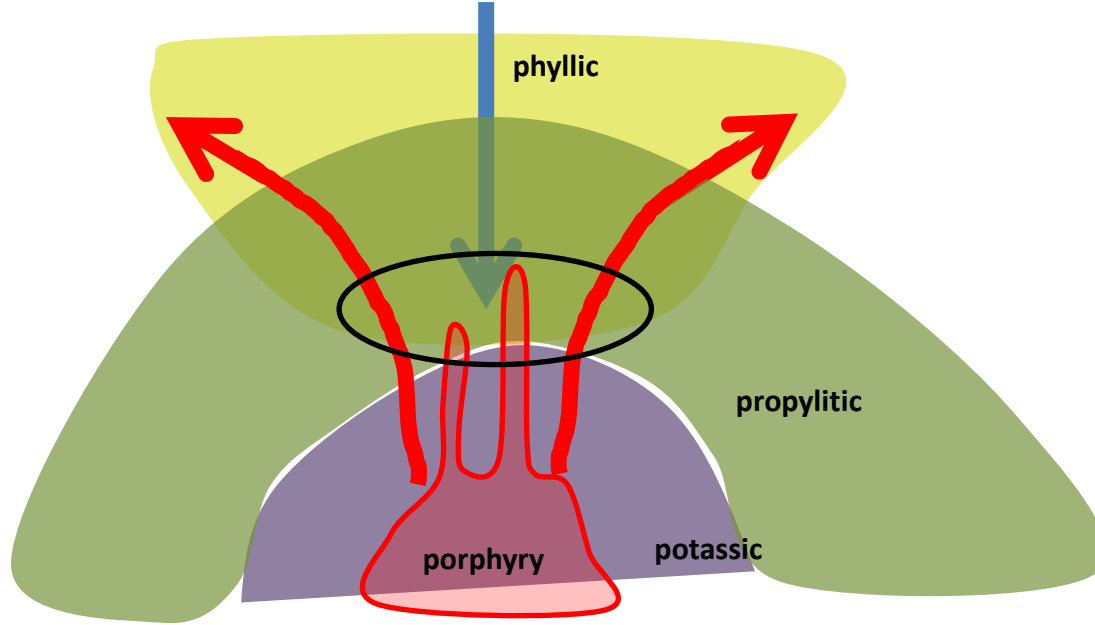
Total of 1850 shallow exploration aircore holes : all Cu anomalies running >0.1% named
About 20 follow up DDH holes all to less than 300 m with low grades of 0.2-0.3%



Porphyry zonation as vectors to mineralisation (mind your p's)

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1. Melt ascending towards surface starts to crystallise
2. Hot fluids and metals given off continue to rise and cool to create a potassic core surrounded by a much larger propylitic halo
3. As fluids cool and oxidise, they become acidic and eventually variably collapse back onto cooling system for phyllic overprint

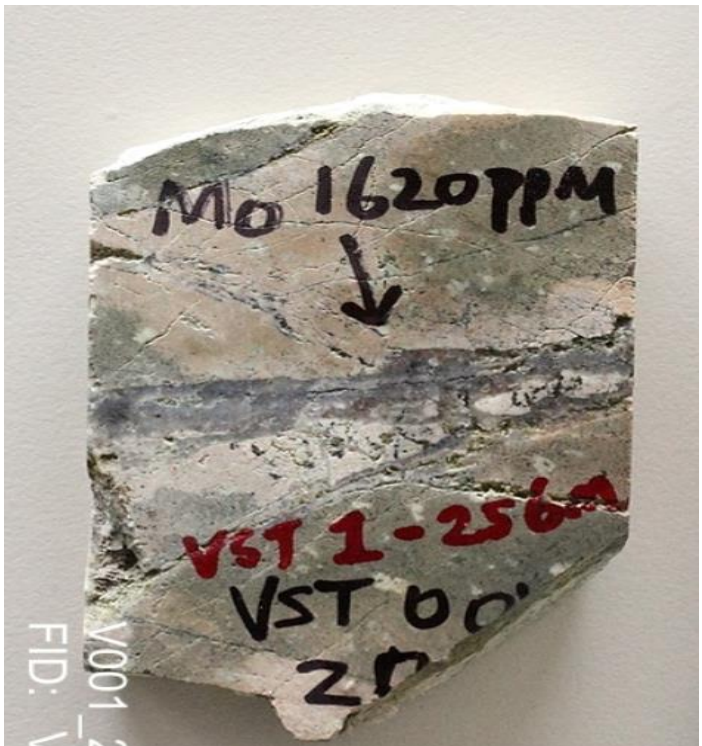


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Mineralisation seen in the diamond drilling generally propylitic grade porphyry dykes but some potassic (\pm phyllic) all about 0.2-0.3% Cu intruding less mineralised (or barren) volcanic host



VST 8 215 m
Junction volcanic host

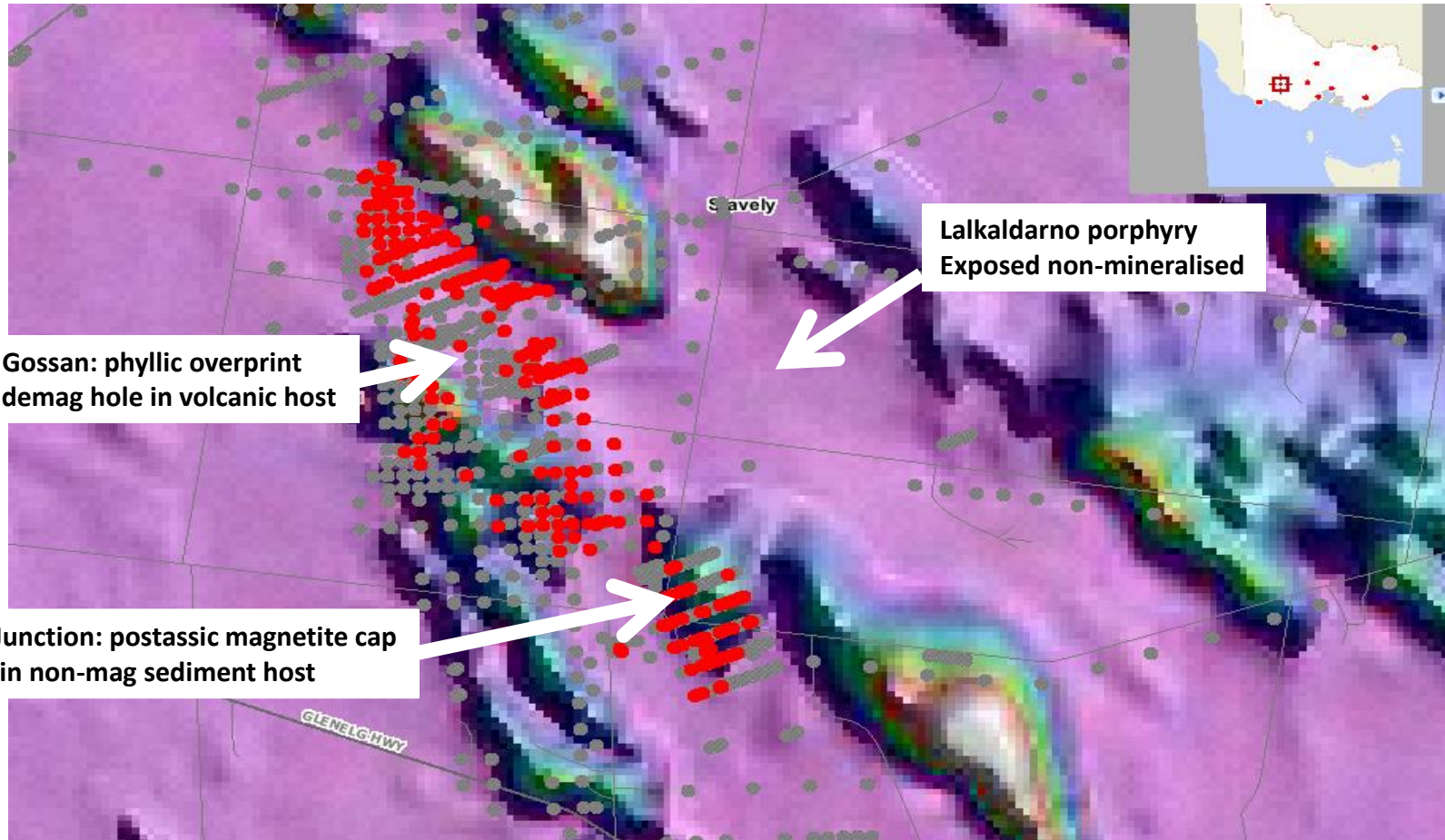


VST 1 256 m
Thursday Gossan andesite



VST 5 285 m
Junction sandstone host

Demagnetised, magnetic and barren porphyries all evident



S'avelly

Lalkaldarno porphyry
Exposed non-mineralised

Thursdays Gossan: phyllic overprint
leading to demag hole in volcanic host

Junction: postassic magnetite cap
in non-mag sediment host

GLENELG HWY

20 minute talk in 3 parts

Why there is currently no mining

- **No historical mine encouragement**
- **Lots of cover and deep weathering hinders exploration**
- **Limited diamond drilling to about 300 m generally intersecting propylitic grade dykes at only 0.2-0.3% Cu**
- **Why should anyone persevere and drill 300m +?**



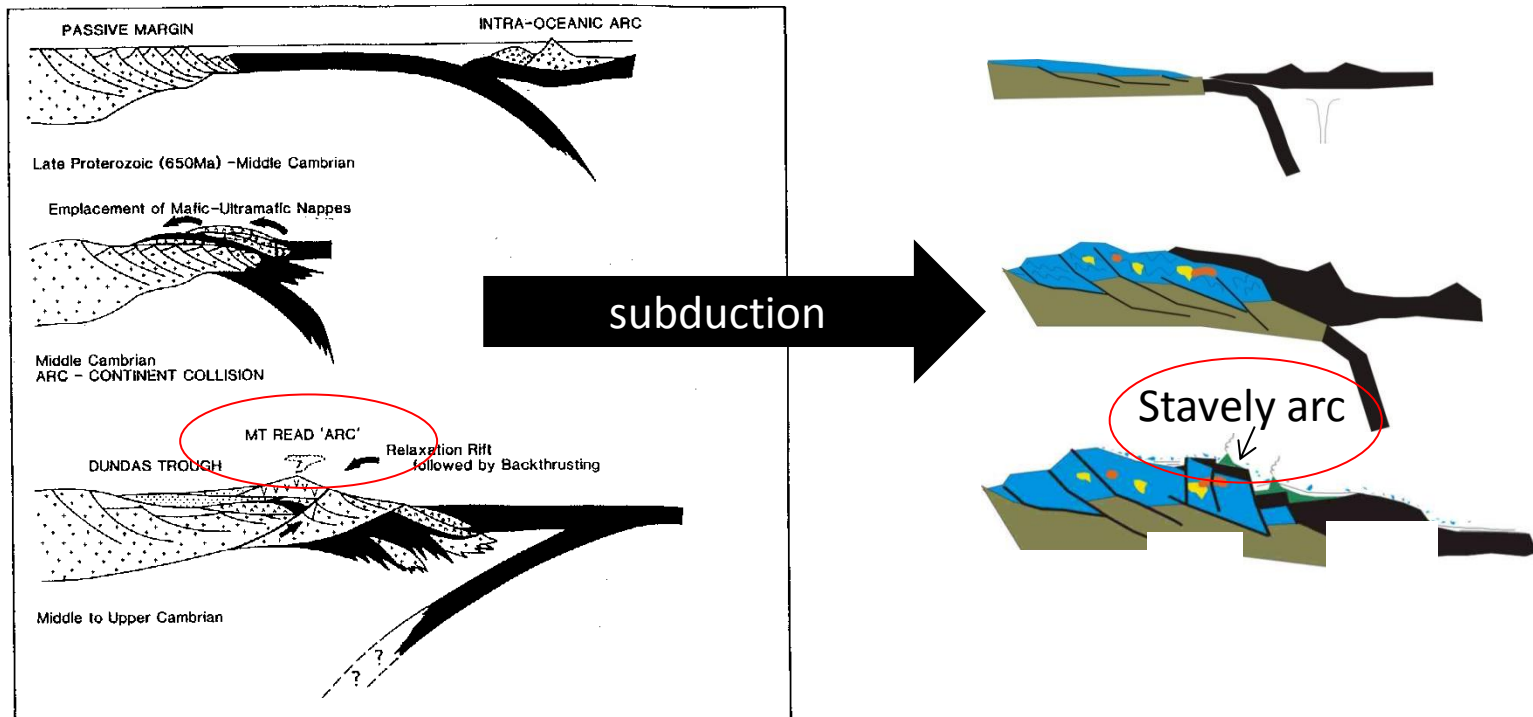
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Different models = different prospectivity: arc-continent collision

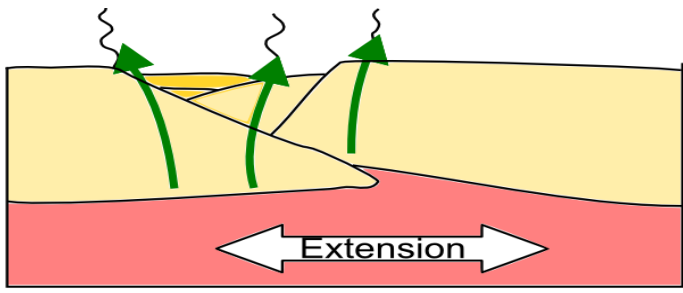
Berry and Crawford 1992 post-collisional rift template



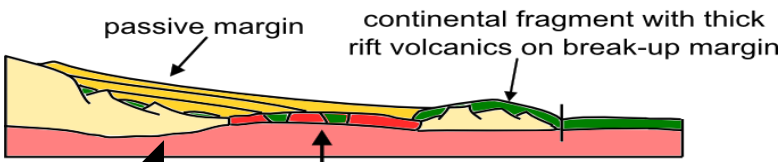
Berry & Crawford 1992

Change to subduction always west makes an Andean Margin

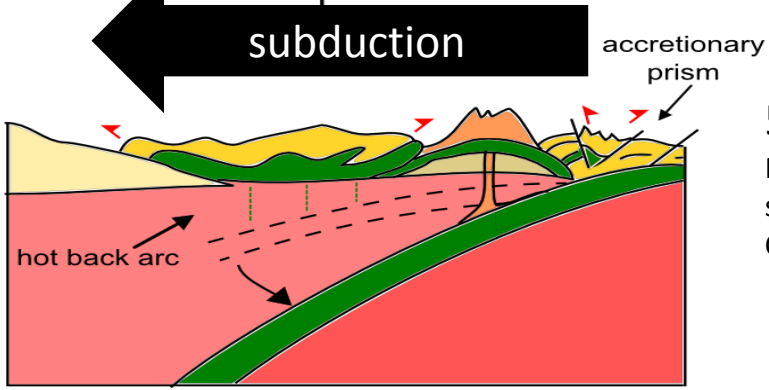
Foden et al., 2006 andean template



830-580 Ma
Continental break-up of Rodinia



580-520 Ma
Passive margin with outboard continental ribbon



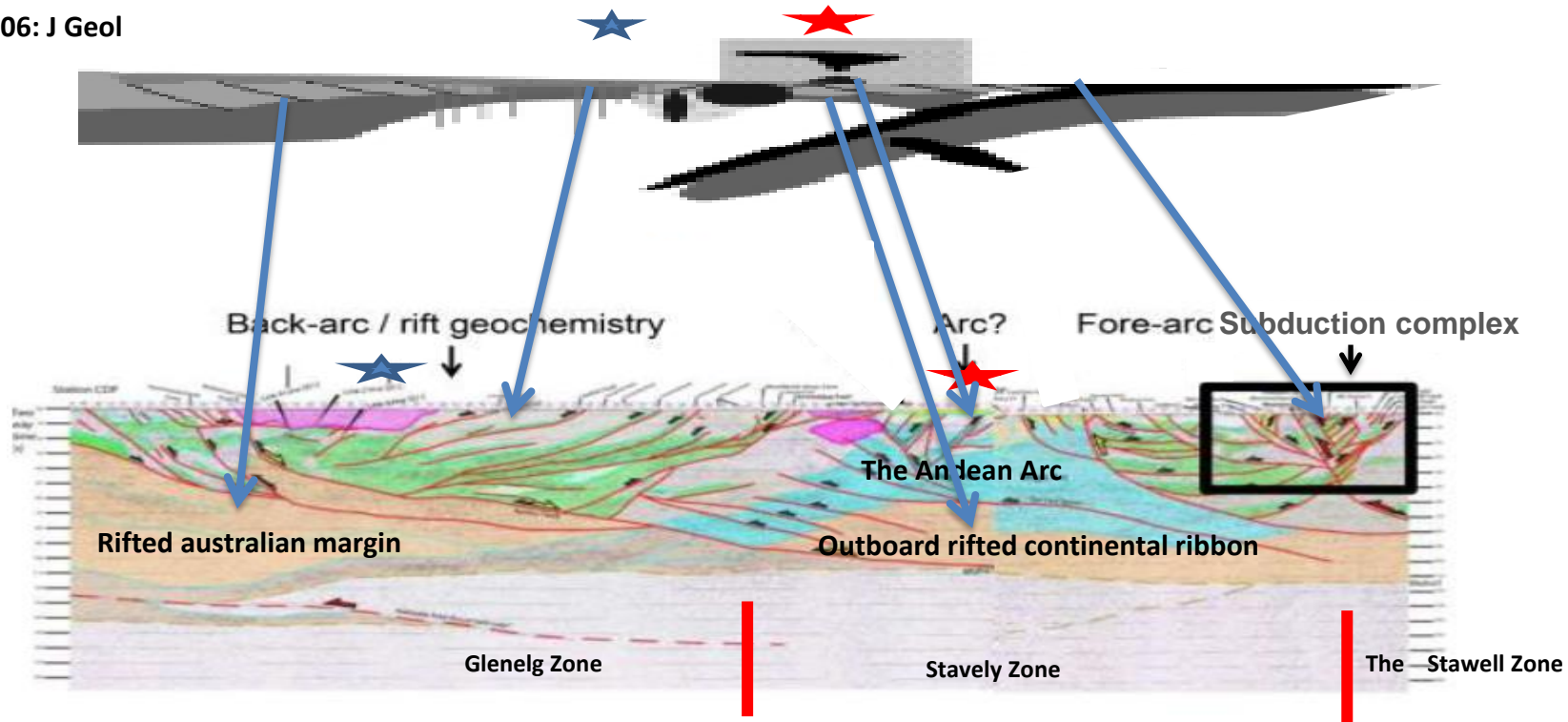
520-500 Ma
Passive margin overprinted by west-dipping subduction with early boninites maturing into Classic calc-alk arc thru the continental fragment

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The west dipping Andean margin subduction model based on early subduction-based boninites being found in Glenelg Zone (blue star) maturing to andesite arc (red star)

Kemp 2004: Lithos

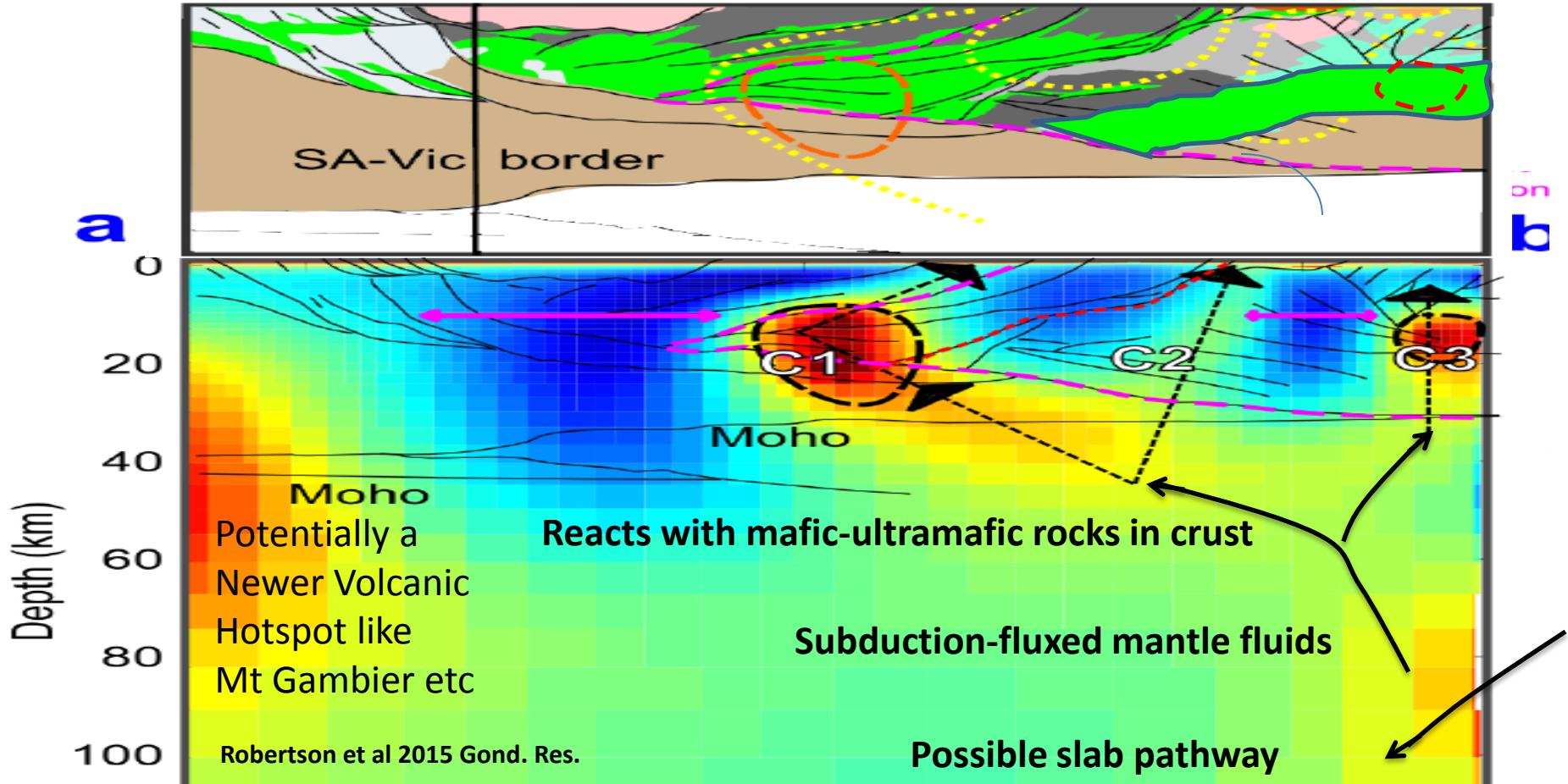
Foden et al 2006: J Geol



GSV et al
In prep

2011 deep crustal seismic interpretation being finalised and fully supports the cartoon model for Andean Subduction: Andean Margins can host big deposits

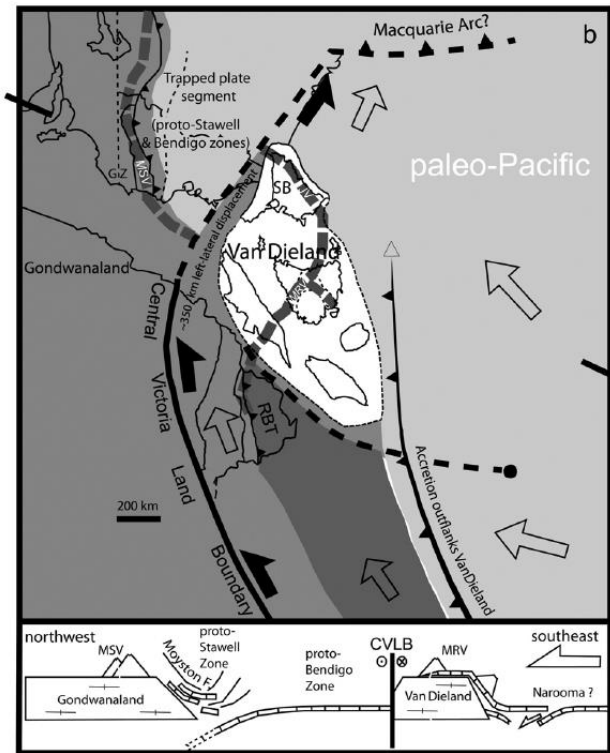
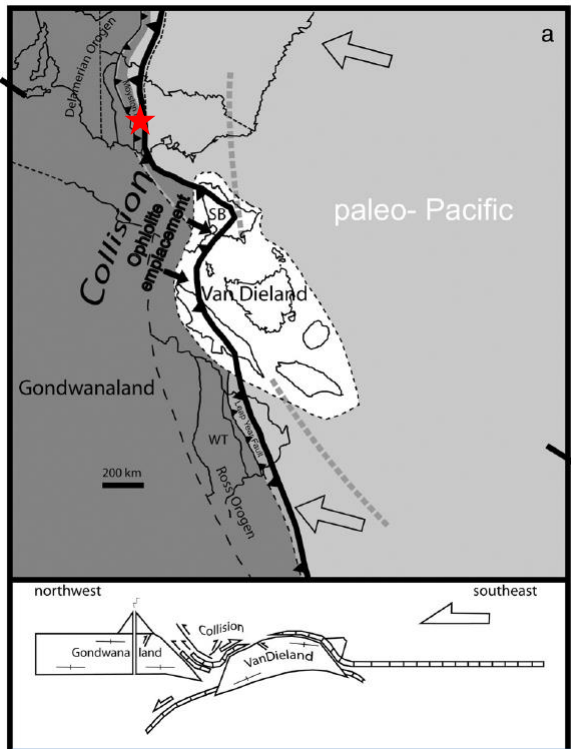
2012 MT along the seismic further supports the andean subduction model with fossil fluid pathways coming up from the mantle (off slab pathway) and into the crust?



Short lived subduction zone switched to more outboard location by external events

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Cayley 2010: Gond. Res.



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20 minute talk in 3 parts

Why there could be some really big mines

- **Previous exploration too shallow**
- **New geochemistry, seismic and MT support an Andean Subduction setting for the porphyries.**
- **Andean systems can generate big deposits because longevity of subduction allows concentration of metals during subduction process to be given up in tectonic switching events**

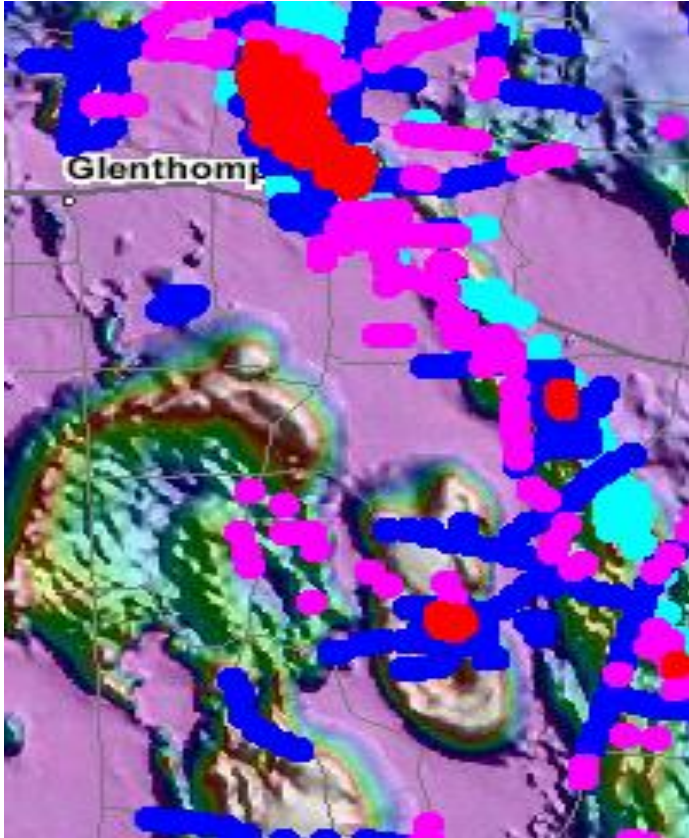


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Geochemistry of the porphyries: How do they relate to Mount Stavelys vs Bushy Creek



Mount Stavelys 500 Ma faulted on end

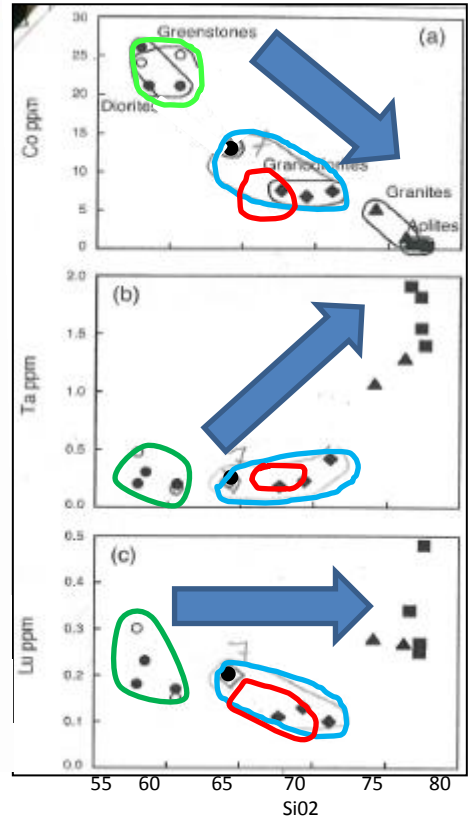
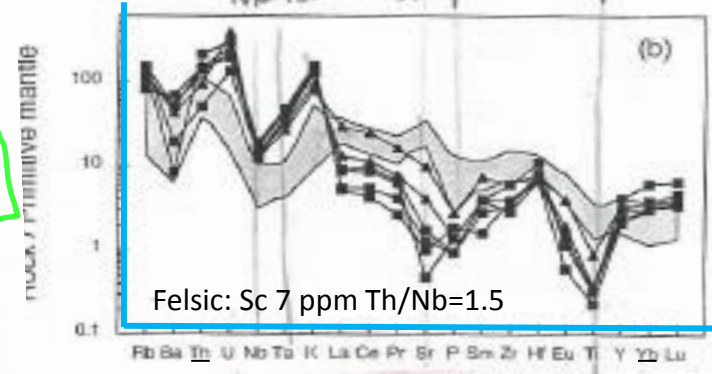
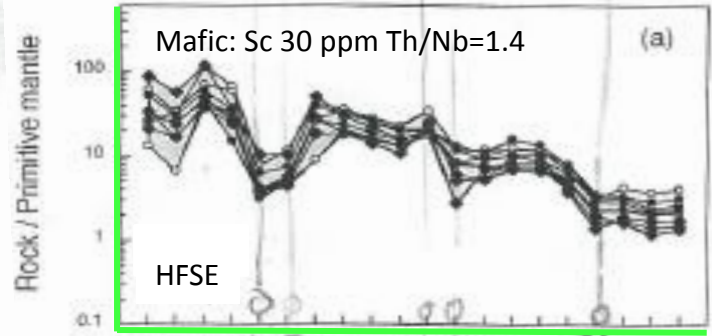
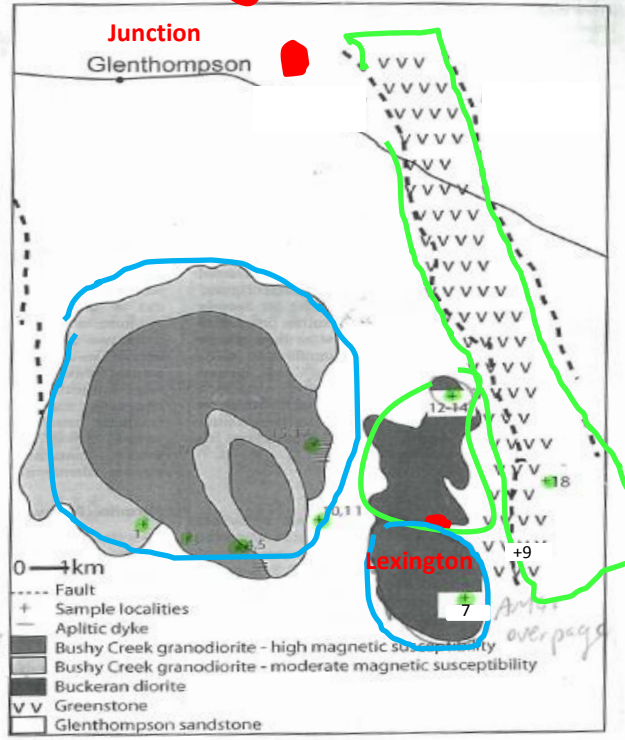
Bushy Creek Granite 495 Ma post tectonic

Geochemistry of the porphyries: How do they relate to Mount Stavelys vs Bushy Creek

Whelan et al AJES 2007

Thursday Gossan

Originogenesis of Bushy Creek magmas 977



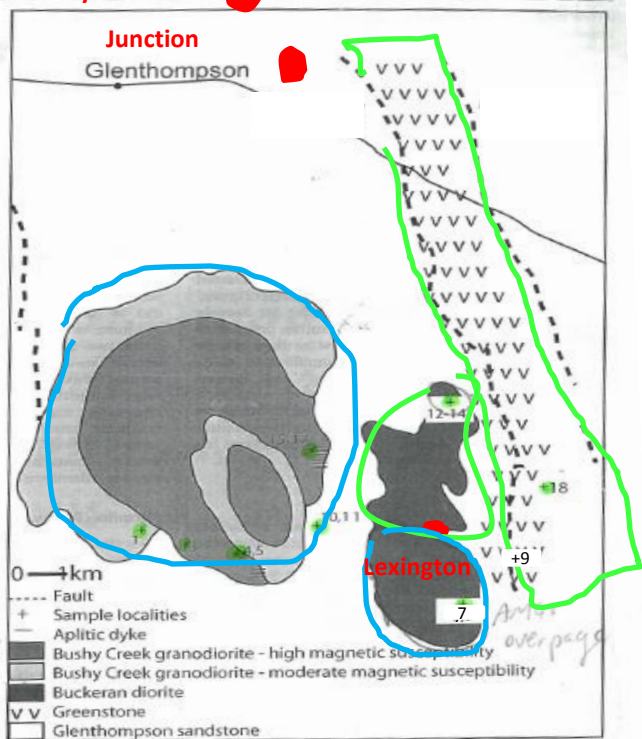
Porphyries as Bushy Creek expands the Fairway!

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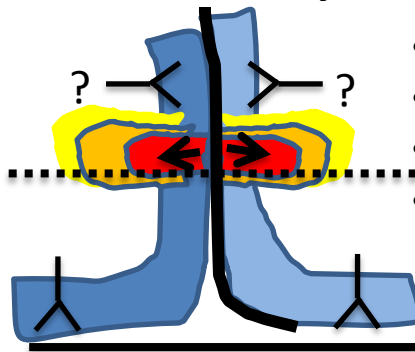
Whelan et al AJES 2007

Thursday Gossan

Genesis of Bushy Creek magmas 977

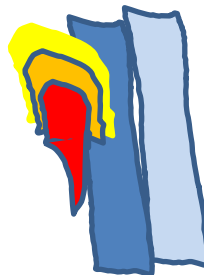


Part of Stavely Volcanics?



- Which is the upright 'head' end?
- Sliced/truncated by the faulting
- Core could be above erosion level
- Restricted to a few tightly held belts

Part of Bushy Creek?

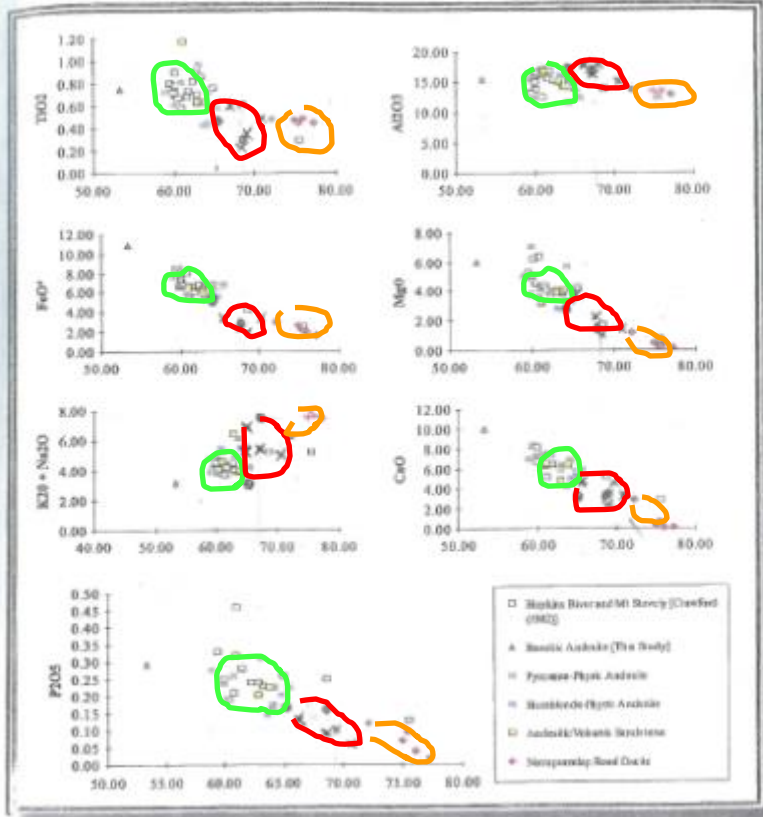


- Facing of stavelys irrelevant
- As easy to explore as modern andes
- Can by right across Stavely Zone
- Twenty fold increase in Fairway!

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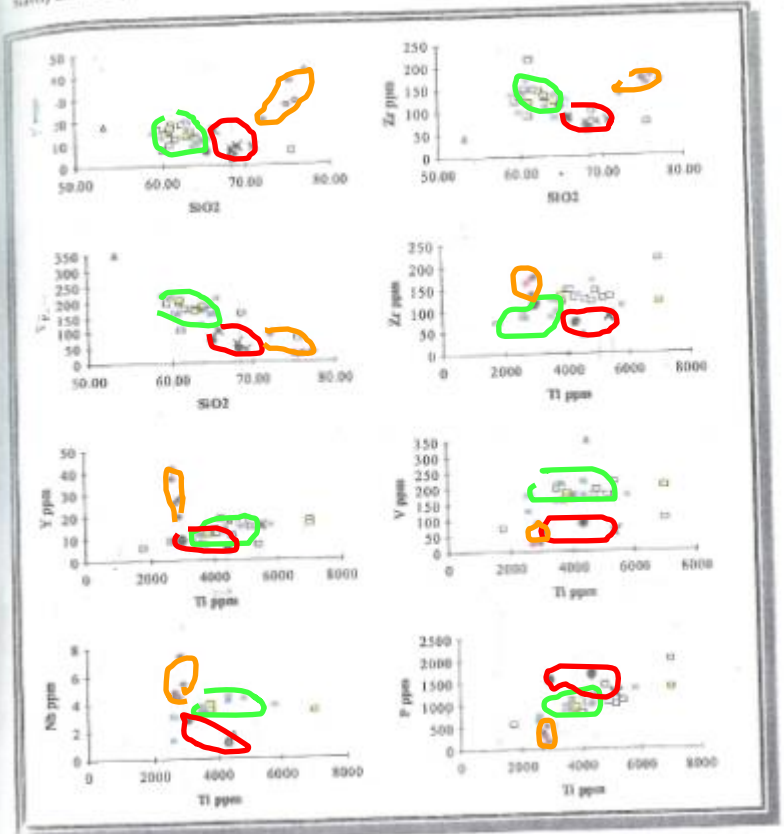
New Geochem suggest Bushy Creek suite and not Stavelays

Figure 9. Plots of major element oxides versus SiO_2 for VICTOR 2 prospect lithologies compared with data for Mt Stavelay and the Hopkins River from Crawford (1982). Also provided is the Lallaigandu Porphyry intrusive for comparison (from Crawford, 1982).



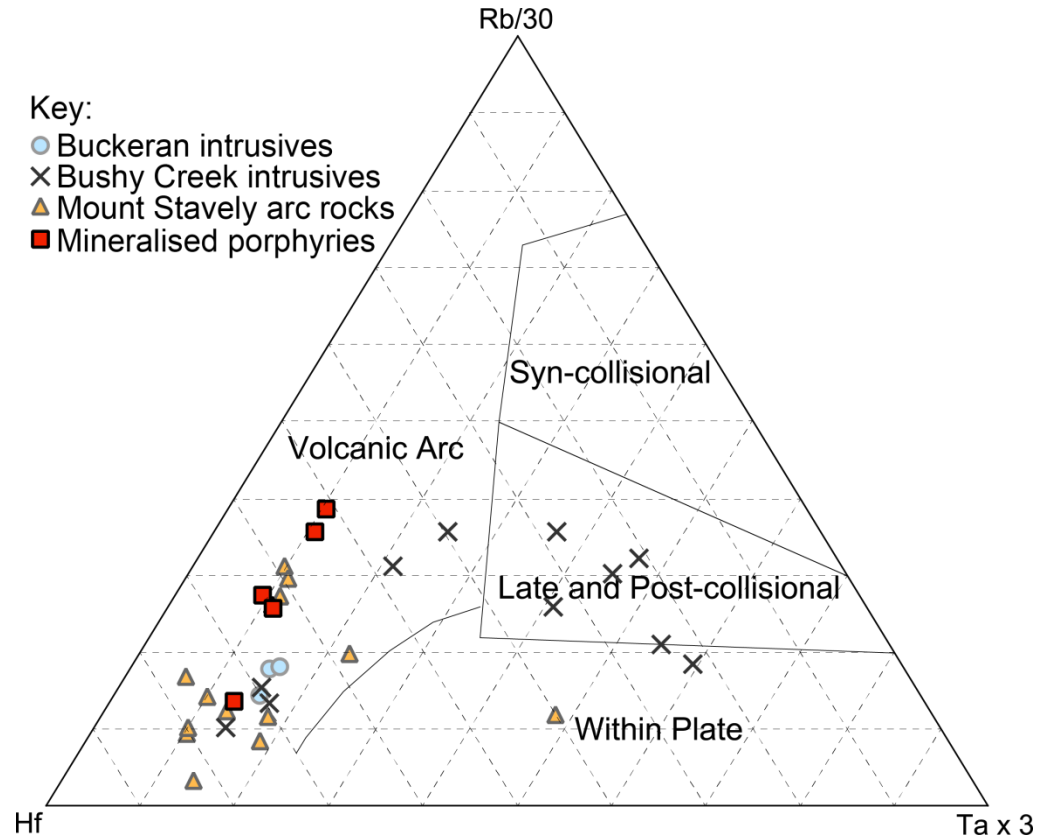
* VST 1, 2
x BC LP

Figure 10. Plots of minor elements versus SiO_2 and Ti for VICTOR 2 prospect lithologies compared with data for Mt Stavelay and the Hopkins River from Crawford (1982). Symbols are identical to those used in Figure 9.

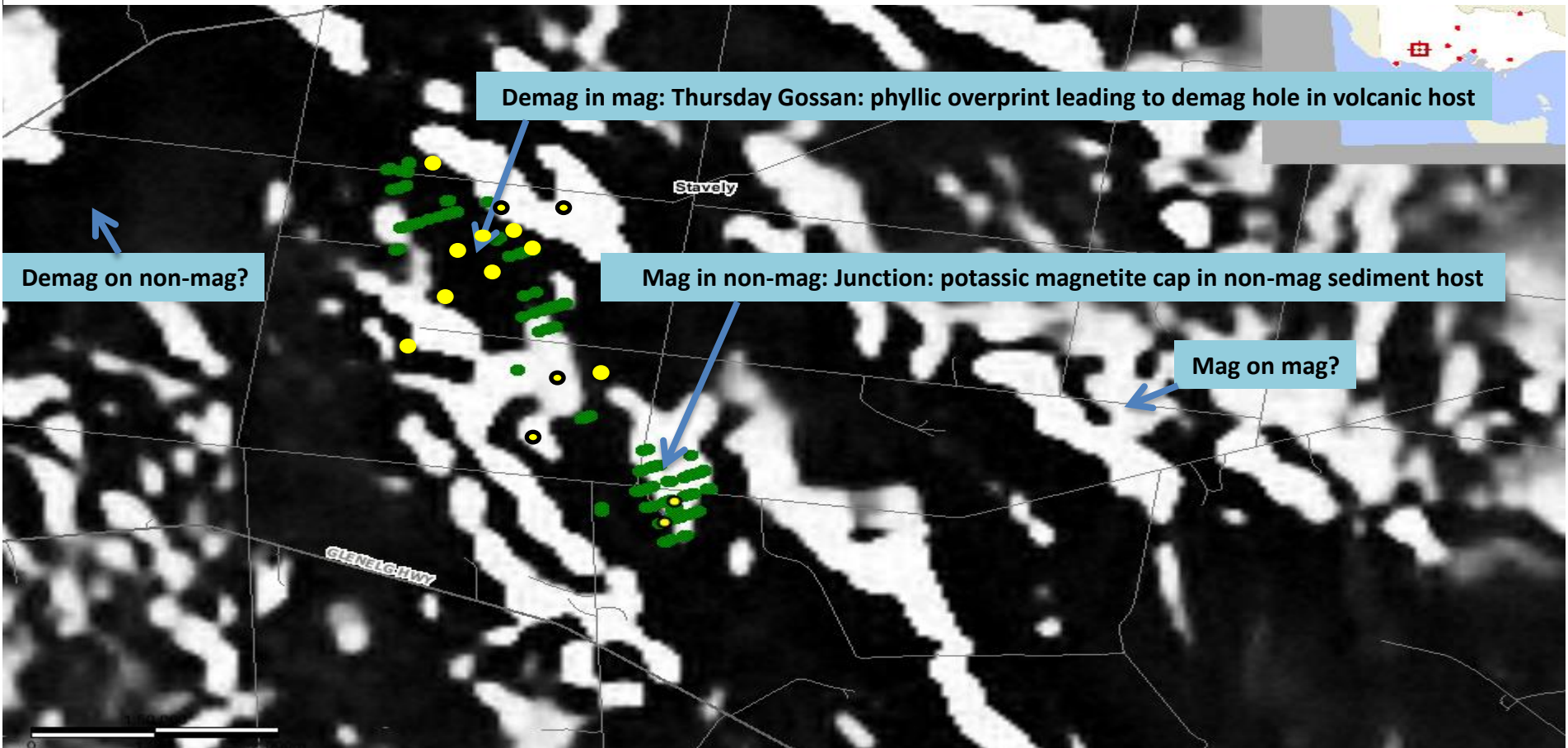


* VST 1, VST 2
x BC LP

Geochem discrimination diagrams show more complexity



Many Play types in the expanded Fairway: Only easy contrasts found to date



Demag in mag: Thursday Gossan: phyllic overprint leading to demag hole in volcanic host

Demag on non-mag?

Mag in non-mag: Junction: potassic magnetite cap in non-mag sediment host

Mag on mag?

Conclusions

- **Mineralised Porphyries relate to Bushy Creek Granite Suite and not Mt Stavelly Volcanics as previously thought.**
 - **porphyries can be right across the Grampians-Stavelly Zone**
 - **porphyries are upright for easy exploration vectoring**
- **Government has collected Seismic, MT and Stratigraphic Drilling to better define the boundaries to the Grampians Stavelly Zone Fairway**
- **Historic exploration drilling too shallow. Stavelly Minerals and Navarre Resources currently exploring with the deeper paradigm.**



The rocks can hide but they cant run!



Brief history of Stavelly Fairway

1983 Global explorer Pennzoil does large scale systematic exploration with many drill holes for massive sulphides but also finds porphyries

1986 basic geological map created by GSV

1998 Global explorer Geopeko/North in JV with CRA completes massive exploration program on the porphyries but fails to drill deep enough to test for economic grades

1999 update regional map by GA as part of National GeoScience mapping with first geochronology

1999 GSV summary report of exploration points out that only drilled into shallow levels of the system and that the most important point that the system proven to exist. Also lists the geophysical tool kit needed to find more porphyries

2006 New geological model published by Adelaide University demonstrates the geological setting is an Andean Margin

2007 Geochemical investigation by Melbourne University shows that the Stavelly Volcanics and the slightly younger Bushy Creek intrusions are separate yet related.

2010 Whilst doing west Vic seismic work which is consistent with the Andean model, GSV points out that Andean Margins can host world class porphyries and that this setting now applies to Stavelly Region

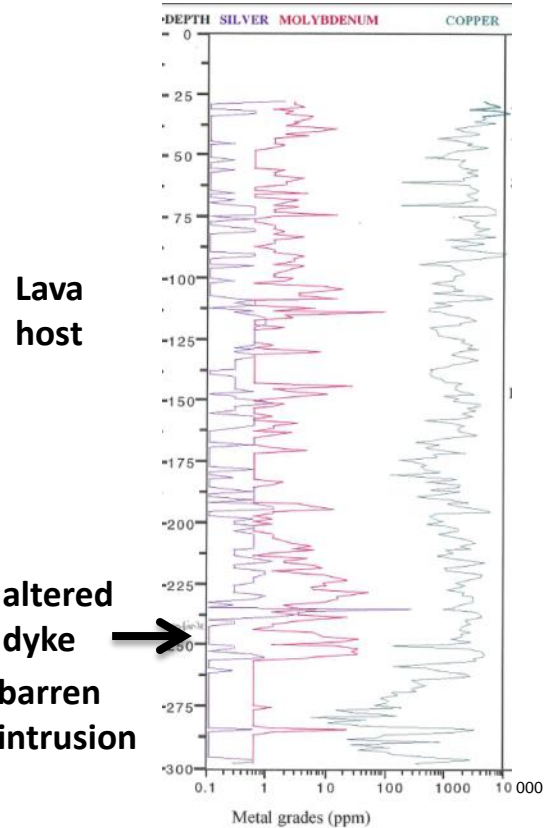
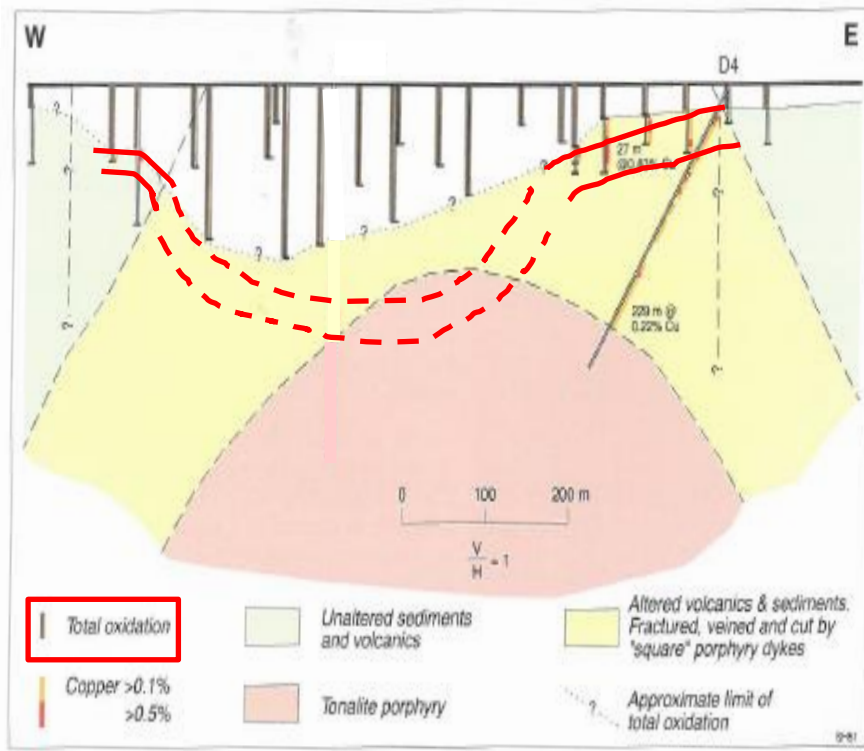
2012 Willaura Project begins and geochemistry analysis of historic porphyry drill core shows that porphyries are part of the Bushy Creek rocks (and not Stavelly volcanics) which means the mineralisation can be anywhere in the Stavelly Zone. Use of the previously established geophysical tool kits quickly finds at least 30 potential targets.

2012 + Exploration companies such as Stavelly Minerals and Mallee Mining start taking up ground so Moratorium imposed to allow a better value-creation process for land release, rather than the 'first-in' approach of the standard over-the-counter template for exploration.

2014 Stavelly Project began to better define the margins of the expanded Stavelly Fairway whilst the process for land release and Target is established.

Some of the Diamond hole explored margin of system

Spencer. Geophysical Signatures of base metal deposits GSV Report 119



DEPARTMENT OF STATE DEVELOPMENT BUSINESS AND INNOVATION



Lexington Prospect — *Positive signs for a discovery*

Sulphide in surface rocks



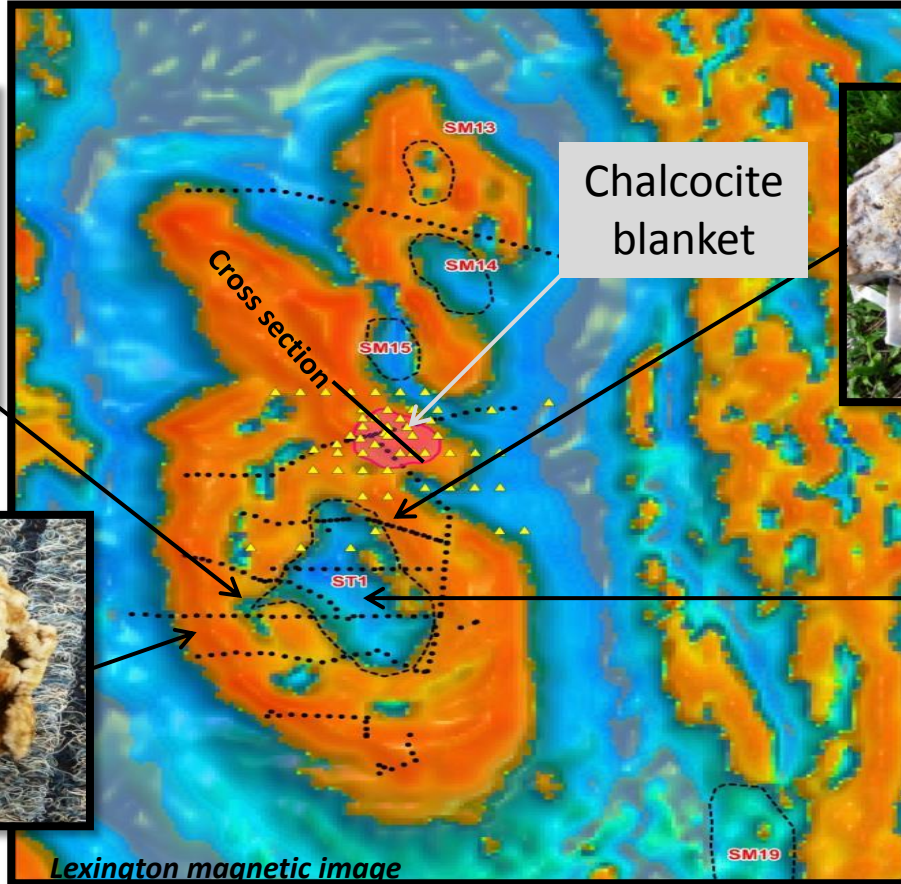
Epithermal quartz veining



Highly anomalous geochemistry & quartz veining



Chalcocite blanket

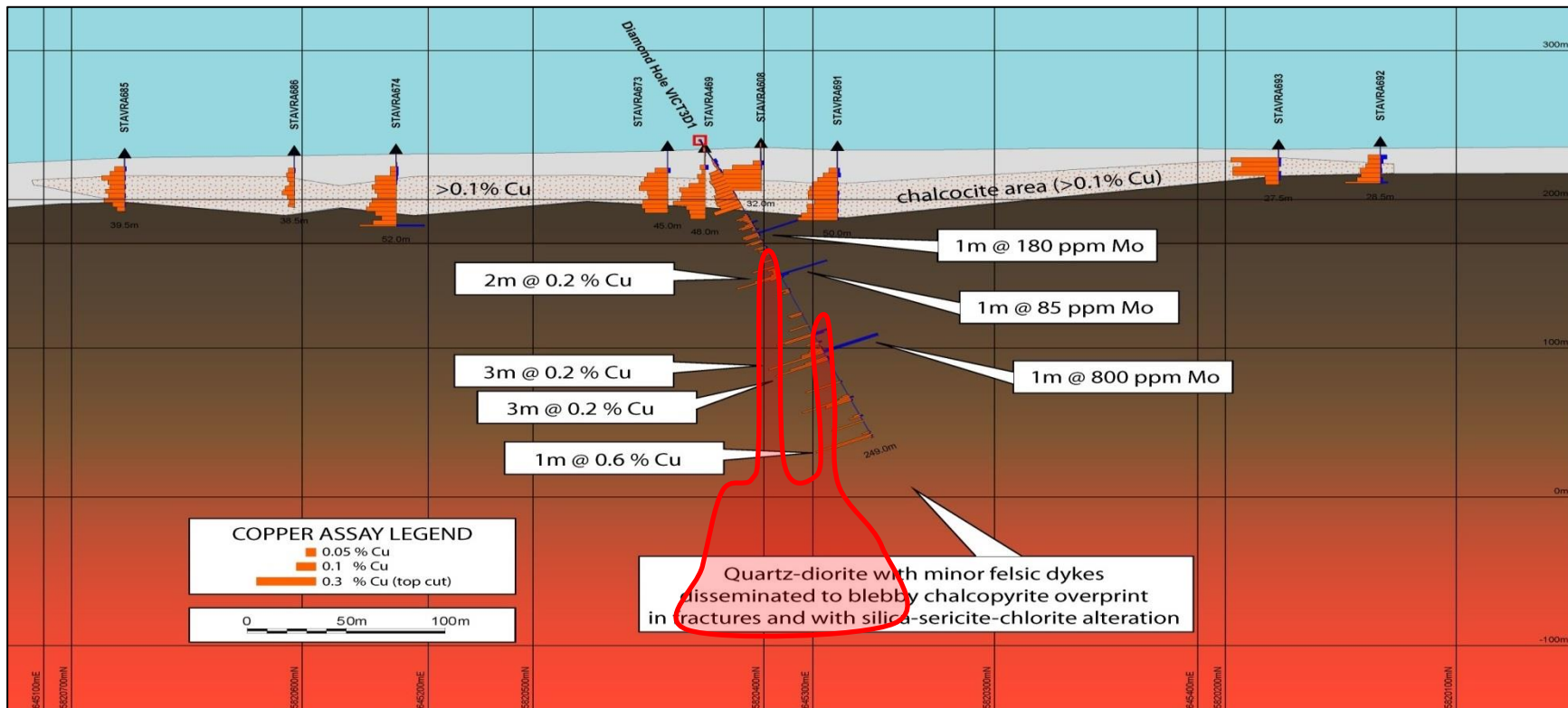


Granodiorite porphyry core



Lexington magnetic image

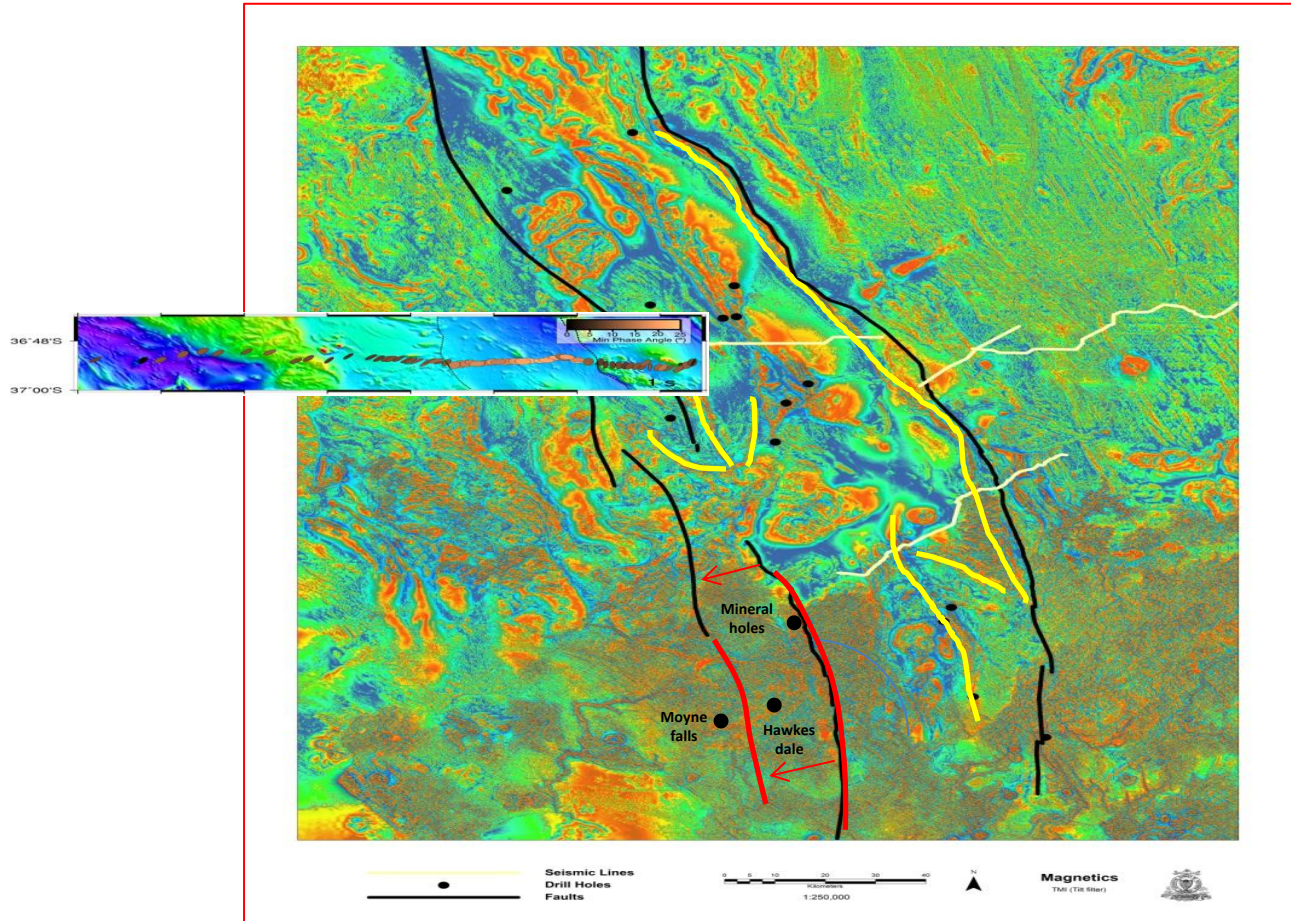
Lexington Prospect – Cross Section



Source of drill locations & assay data: open file reports provided in CLASSIFIED format to Victorian Mines Dept., February 1995

Stavelly Stratigraphic Drilling with GeoScience Australia

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