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….

Stavely Arc is Cambrian part of the Tasmanides (Ross earlier)

Lots of new work suggests a continental margin arc setting

Government drilling done to help exploration (Anthony next)

Some exploration already happening (Chris soon)

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

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Grampians Stavely Zone in Western Victoria

Cambrian bedrock of western Victoria with lots of cover.
2 small windows back into the Cambrian: narrow andesite belts amidst turbdites
Mount Stavely not Stavely 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)

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)

cu hits > 1000 ppm in red
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)

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
Mineralisation seen in the diamond drilling generally propylitic grade porphyry dykes but some potassic (±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

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

Junction: postassic magnetite cap in non-mag sediment host

Lalkaldarno porphyry Exposed non-mineralised
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 +?
20 minute talk in 3 parts

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Different models = different prospectivity: arc-continent collision

Berry and Crawford 1992 post-collisional rift template
Change to subduction always west makes an Andean Margin

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

Foden et al., 2006 andean template
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?

Potentially a Newer Volcanic Hotspot like Mt Gambier etc

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

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
20 minute talk in 3 parts

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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 Junction

Mafic: Sc 30 ppm Th/Nb=1.4

Felsic: Sc 7 ppm Th/Nb=1.5
Porphyries as Bushy Creek expands the Fairway!

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!

Whelan et al AJES 2007
New Geochem suggest Bushy Creek suite and not Stavelys
Geochem discrimination diagrams show more complexity

Key:
- Buckeran intrusives
- Bushy Creek intrusives
- Mount Stavely arc rocks
- Mineralised porphyries

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

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

Mag on mag?

Demag on non-mag?
Conclusions

- Mineralised Porphyries relate to Bushy Creek Granite Suite and not Mt Stavely Volcanics as previously thought. Porphyries can be right across the Grampians-Stavely Zone. Porphyries are upright for easy exploration vectoring.

- Government has collected Seismic, MT and Stratigraphic Drilling to better define the boundaries to the Grampians Stavely Zone Fairway.

- Historic exploration drilling too shallow. Stavely Minerals and Navarre Resources currently exploring with the deeper paradigm.
The rocks can hide but they can't run!
Brief history of Stavely 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 Stavely 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 Stavely 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 Stavely volcanics) which means the mineralisation can be anywhere in the Stavely Zone. Use of the previously established geophysical tool kits quickly finds at least 30 potential targets.
2012 + Exploration companies such as Stavely 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 Stavely Project began to better define the margins of the expanded Stavely 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

Lava host

altered dyke barren intrusion
Lexington Prospect – Positive signs for a discovery

- Sulphide in surface rocks
- Epithermal quartz veining
- Highly anomalous geochemistry & quartz veining
- Granodiorite porphyry core
- Chalcocite blanket

Lexington magnetic image

NAVARRE MINERALS
Lexington Prospect – Cross Section

Source of drill locations & assay data: open file reports provided by Navarre Minerals Corporation to Victorian Mines Dept., February 1995
Stavely Stratigraphic Drilling with GeoScience Australia