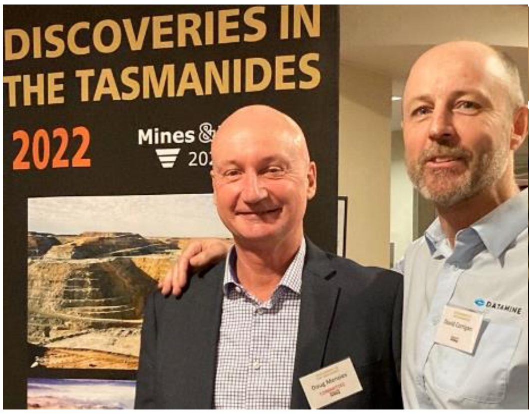
Mines & Wines

DISCOVERIES IN THE TASMANIDES

Pictures from 2022



Gold Sponsor	Silver Sponsor	Silver Sponsor	Silver Sponsor
NEWCREST MINING LIMITED	Evolution MINING	ALKANE RESOURCES LTD	Newmont.
Newcrest Mining	Evolution Mining	Alkane	Newmont Mining
www.newcrest.com.au	evolutionmining.com.au	alkane.com.au	www.newmont.com


SMEDG
1972 - 2022


SMEDG
1972
Sydney Mineral Exploration Discussion Group


SMEDG
1972 - 2022


SMEDG
GOLDEN JUBILEE
1972 - 2022







Ice Breaker Sponsor

Hetherington

hetherington.net.au

Core Grade Guessing Competition

MIME

Roland Kite | LinkedIn

Name Tags Sponsor

Durock Drilling

durockdrilling.com.au


Melinda Deacon
COMMITTEE


Paul Gow


RESTROOMS


geoscientists
together
AUSTRALIAN
August 2022
Club, Sydney


SMEDG
1972 - 2022
Golden Jubilee


Ian Chalmers
Tony Crawford


SMEDG
1972 - 2022
Sydney Mineral Exploration Discussion Group
bringing
geoscientists
SMEDG
1972 - 2022
Golden Jubilee
Conference and Dinner


AUSTRALIAN INSTITUTE OF GEOSCIENTISTS
Supporting Geoscientists
SMEDG
Golden Jubilee
Conference and Dinner


Mines & Wines
Peel Mining Limited
EXPLORER OF 2022
AUSTRALIAN INSTITUTE OF GEOSCIENTISTS
SMEDG


ALS Global


Ophir Drilling
OPHIR DRILLING
SAFE, COMPETITIVE AND EFFICIENT DRILLING SOLUTIONS


OLYMPUS
Olympus
EVIDENT
OLYMPUS


GNOMIC
Gnomic


ULTRAMAG GEOPHYSICS
Ultramag


CORESAFE™
OUR CORE VALUES

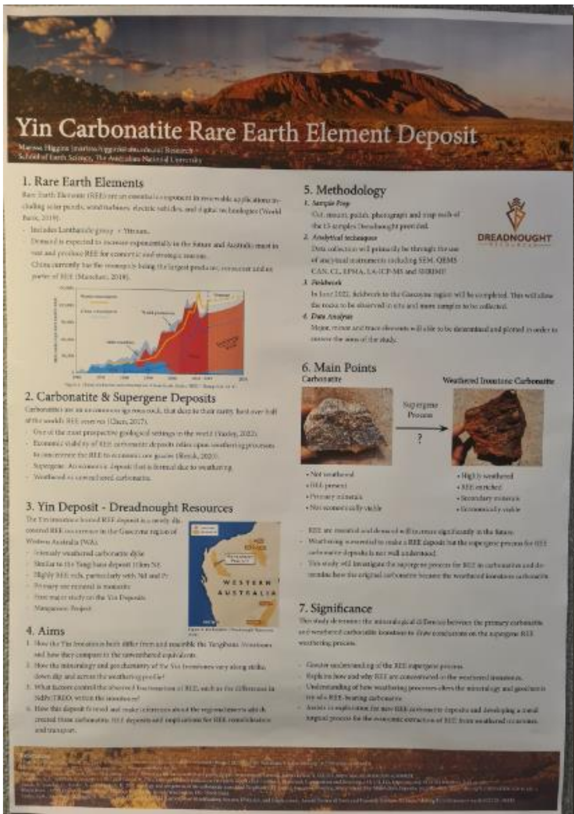

ULTRAMAG

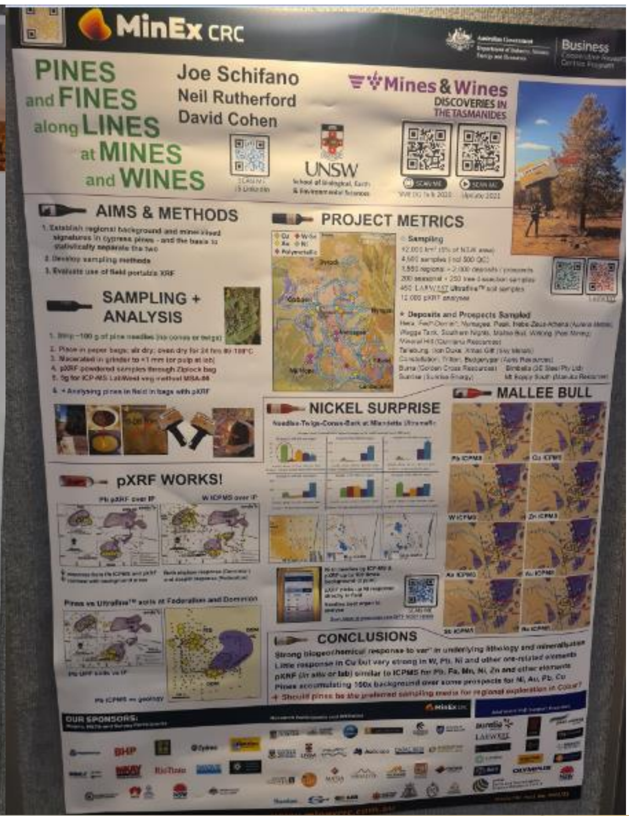

aerometrex

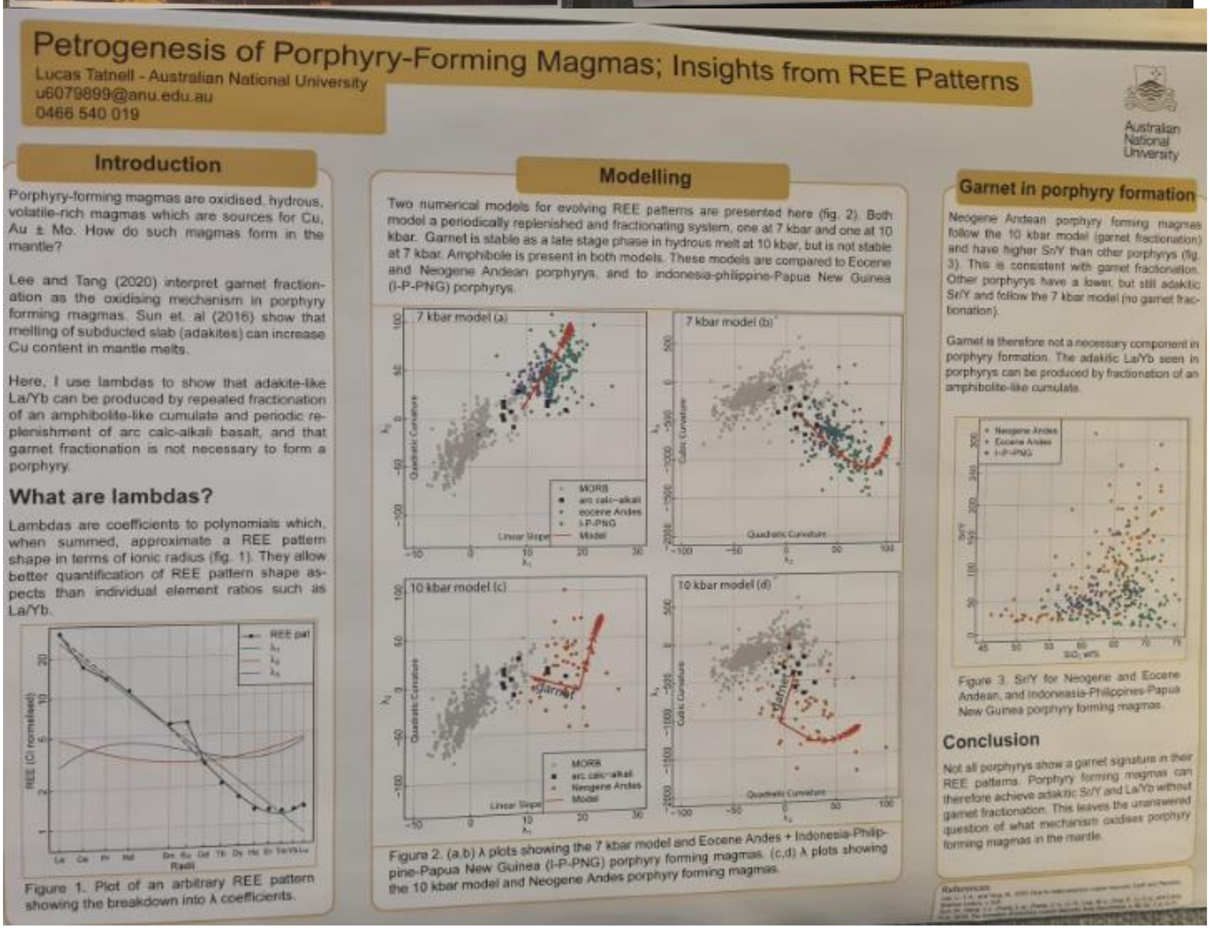

Fender
GEOPHYSICS
Fender Geophysics
HETERODYNE
Geophysics


We
Are

Student Poster Session







The Porphyry-Forming Potential of Adakite Melts

Timothy S. J. Leong | The Australian National University

INTRODUCTION

Porphyry copper deposits (PCDs) are responsible for ~70% of Cu and ~25% of Au production worldwide[1]. Spatial relationships have been found linking mineralization in porphyry-epithermal deposits to adakites, suggesting that adakite magmas play an important role in the genesis of PCDs[2].

Adakites are intermediate-felsic rocks derived from the partial melting of subducting young oceanic lithosphere in the garnet stability field[3]. They have been typically characterized by high (<20) Sr/Y and La/Yb ratios.

An issue with this definition is that high Sr/Y and La/Yb ratios can be generated by the fractionation of phases like amphibole outside of the garnet stability field - making it difficult to identify true slab melts[4].

Additionally, adakites have typically been analysed using whole-rock compositions[5]. However, analytical compositions of adakites can differ substantially from original melt compositions due to volatile loss and incorporation of xenocrysts in bulk analyses.

This study is the first to assess the ore-forming potential of adakites through melt inclusion analysis, and provide a more coherent tool to identify adakite slab melts than just Sr/Y and La/Yb ratios.

SITE LOCALITY

Samples were obtained from dredges of volcanic seamounts around the Southern New Hebrides Arc, an active subduction zone that hosts a wide variety of magmatic suites, with boninites, tholeites and adakites reported[6].

METHODS

Melt inclusions (MIs) are small pockets of magma trapped during crystal growth and isolated, thereby preserving the composition of the magma during its ascent without contamination from foreign material[7]. The pre-eruptive entrapment of MIs also preserves volatiles, which lets us to quantify water, sulfur and chlorine concentrations.

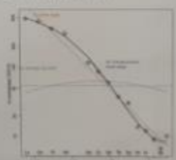
MI major and minor element compositions were analysed with the JEOL 8530F EMPA at the Centre for Advanced Microscopy, ANU. Trace element compositions were analyzed with the LA-ICP-MS at the Research School for Earth Sciences in ANU.

Rare Earth Element (REE) patterns are typically plotted as chondrite-normalized curves, where fractionation processes are inferred by shape and curvature. However, discriminating between garnet and amphibole fractionation this way is difficult.

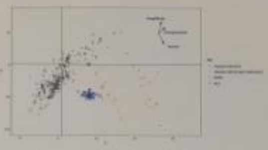
Instead, the REE curve can be approximated as a polynomial curve with the equation:

$$\ln([REE]/[REE]_{c}) = \lambda_0 + \lambda_1 f_1^{orth} + \lambda_2 f_2^{orth} + \ldots$$

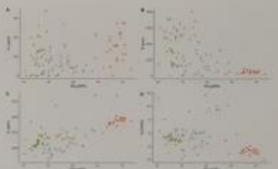
Both amphibole and garnet fractionation produces curves with steep slopes (high λ_1), but garnet produces curves with more curvature from the slope (negative λ_2) whereas amphibole leads to straight slopes (positive λ_2).



RESULTS



The MIs of this study show clear evidence of being slab melts. They had high Sr/Y and La/Yb ratios, and two-pyroxene geothermometry produced temperature estimates of 900-1000°C±20°C at pressures of 9.2±1.4 kbar, well above the ~840°C required for slab melting. Their REE trends showed strong evidence of garnet fractionation at source. For comparison, the λ values of Hawaiian melts with 1. Garnet presence in residue and 2. Garnet fractionation at source are displayed above.



Adakite MIs exhibit key indicators of melt fertility:

1. Highly oxidized (+1.9 to +3.2 ΔFMQ) compared to ocean floor basalts (~+0.1 ΔFMQ) due to their slab melt origin from the incorporation of terrigenous sediments during melting[9].
2. High sulfur (600-4000ppm) - more S-rich than typical arc magmas (900-2500 ppm). Likely due to their high oxidation state allowing for melting and mobilization of sulfides[10].
3. High water concentrations (typically 2-7wt%), which promotes large-scale exsolution of fluids essential for PCD formation[11].
4. High chlorine concentrations (1000-3000ppm). Chlorine is an important ligand in the complexing of Cu.
5. High Cu concentrations in melt.

CONCLUSIONS

This study shows clear evidence for the empirical link between PCDs and adakite melts. Adakite melts may play an important role in PCD formation due to their oxidized, sulfur-rich and water-rich nature. The slab melt origin of adakites is directly responsible for these characteristics, as it is the incorporation of oxidized terrigenous sediments during partial melting of the slab that oxidizes the melt sufficiently to mobilize copper-rich sulfides.

Consequently, this study reinforces the idea that adakite signatures can be a powerful tool in PCD exploration. It is important to recognise that current use of Sr/Y and La/Yb ratios is insufficient to properly identify adakites. Instead, this study shows that the polynomial fitting of REE patterns can be used as a more robust tool to identify adakites by the activity of garnet during melting.

If the models of adakites as slab melts hold up with orthogonal polynomial fitting, geobarometry and geothermometry, the relationship between adakites and PCDs should be explored through further melt inclusion studies of adakites and of parental PCD magmas. If this study's findings of adakites being highly oxidized, sulfur-rich, and water-rich is repeated in other studies, a conclusive link can be drawn between adakite melts and PCD formation.

ACKNOWLEDGEMENTS

Prof. John A. Mavrogenes, Prof. Richard J. Arculus for supervising this project.

The Centre for Advanced Microscopy, Australian National University, a facility that is funded by the University and the Federal Government through NCRIS.

REFERENCES

1. SILLITOE R. H. 2010. Economic Geology, vol. 105, no. 1, pp. 3-41.
2. THIEBLEMONT D., STEIN G. & LESCUYER J. L. 1997. Comptes Rendus De L Academie Des Sciences Serie II Fascicule a-Sciences De La Terre Et Des Planetes, vol. 325, no. 2, pp. 103-109.
3. DEFANT M. J. & DRUMMOND M. S. 1990. Nature, vol. 347, no. 6294, pp. 662-665.
4. LOUCKS R. R. 2014. Australian Journal of Earth Sciences, vol. 61, no. 1, pp. 5-16.
5. TOLSTYKH M. L., NAUMOV V. B. & YARMOLYUK V. V. 2017. Petrology, vol. 25, no. 3, pp. 304-317.
6. MONZIER M., et al. 1993. Journal of Volcanology and Geothermal Research, vol. 57, no. 3-4, pp. 193-217.
7. RUTH D. C. S., et al. 2018. Nature Communications, vol. 9, no. 1.
8. O'NEILL H. S. C. 2016. Journal of Petrology, vol. 57, no. 8, pp. 1463-1508.
9. MUNGALL J. E. 2002. Geology, vol. 30, no. 10, pp. 915-918.
10. NILSSON K. & PEACH C. L. 1993. Geochimica et Cosmochimica Acta, vol. 57, no. 15, pp. 3807-3813.
11. CHIARADIA M. 2018. Frontiers in Earth Science, vol. 6.

BOWDENS SILVER

UNSW SYDNEY

AUSTRALIAN INSTITUTE OF GEOSCIENTISTS

Structural controls and evolution of gold mineralisation at Tuena, NSW

Christopher Standard, Dr Ian Graham, Prof. Martin Van Kranendonk

AMEC

1. Introduction

There have recently been significant new discoveries of gold within the Hill End Trough, a structurally complex region well-known for its multiple regional-scale folding events. Tuena is part of this belt, containing several historic gold sites and is prospective to host orogenic gold mineralisation.

Fig 1. Tuena Project location in the Lachlan Orogen (Silver Mines Pty LTD, 2020)

This project is an explorational study aiming to understand the deformation history, structural controls and vein styles that resulted in mineralisation at Tuena. The results aim to modify the exploration model for Tuena and the Hill End Trough.

2. Methods

All data used in this project has been collected from field mapping and RC drilling within the EL8526 study area.

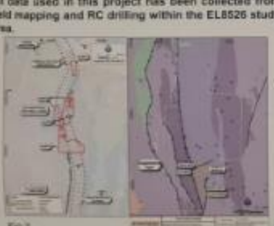


Fig 2.
a) Bowdens Exploration Leases relative to regional structures (left) (Silver Mines Pty LTD, 2020). b) Geological Survey across EL8526 (right) (Klein, 2020)

3. Back Creek Adit

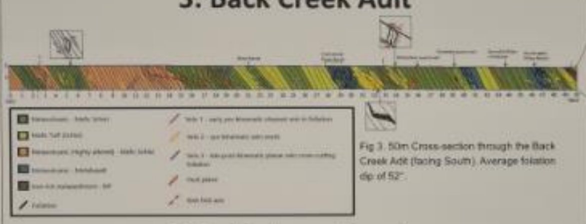


Fig 3. 50m Cross-section through the Back Creek Adit (facing South). Average foliation dip of 52°.

4. Preliminary Results

A generalized paragenesis of hydrothermal veining and deformation is summarised below:

- **S1** Goulburn basin (Siluro-Devonian) Extensional faults (reactivated to thrusts)
- **V1** Early pre-kinematic veining event. Highly sheared veins deformed into the regional foliation. Associated with early silica alteration
- **S2** Large-scale N-S structures and development of the regional foliation, likely related to the Tabberaberan Orogen (Devonian)
- **V2** Syn-kinematic vein event. Deformed veins, displaying shearing and folding.
- **S3** Reactivation of structures and kink folding, likely related to the Kanimblan Orogen (Carboniferous)
- **S4** Pervasive alteration event (undeformed chlorite, illite/muscovite assemblages)
- **V3** Post-kinematic vein event. Late, planar, carbonate dominant, thin veins and veinlets

Fig 4. a) Orientation of regional foliation at Tuena (left). b) Orientation of vein styles: v1 purple, v3 black (centre). c) Orientation of faults in the Back Creek Adit and average fault lineation (right).

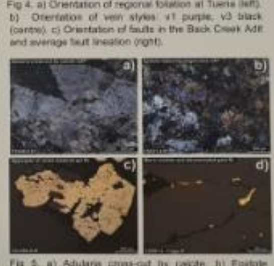


Fig 5. a) Adularia cross-cut by calcite. b) Epidote replacing plagioclase in metabasalt. c) Aggregate of caries textured pyrite. d) Microveinlets and disseminated gold

Fig 6. a) Inside the Back Creek Adit. b) Fault cutting kinked foliation (facing South). c) near-vertical foliation in outcrop (facing North). d) Veining at 32m in the Back Creek Adit (facing North)

5. Geochemistry

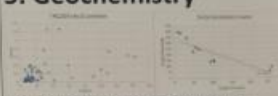


Fig 7. a) TRC20010 drill hole As-S correlation. b) Sr-Ca correlation in Back Creek Adit vein samples.

References

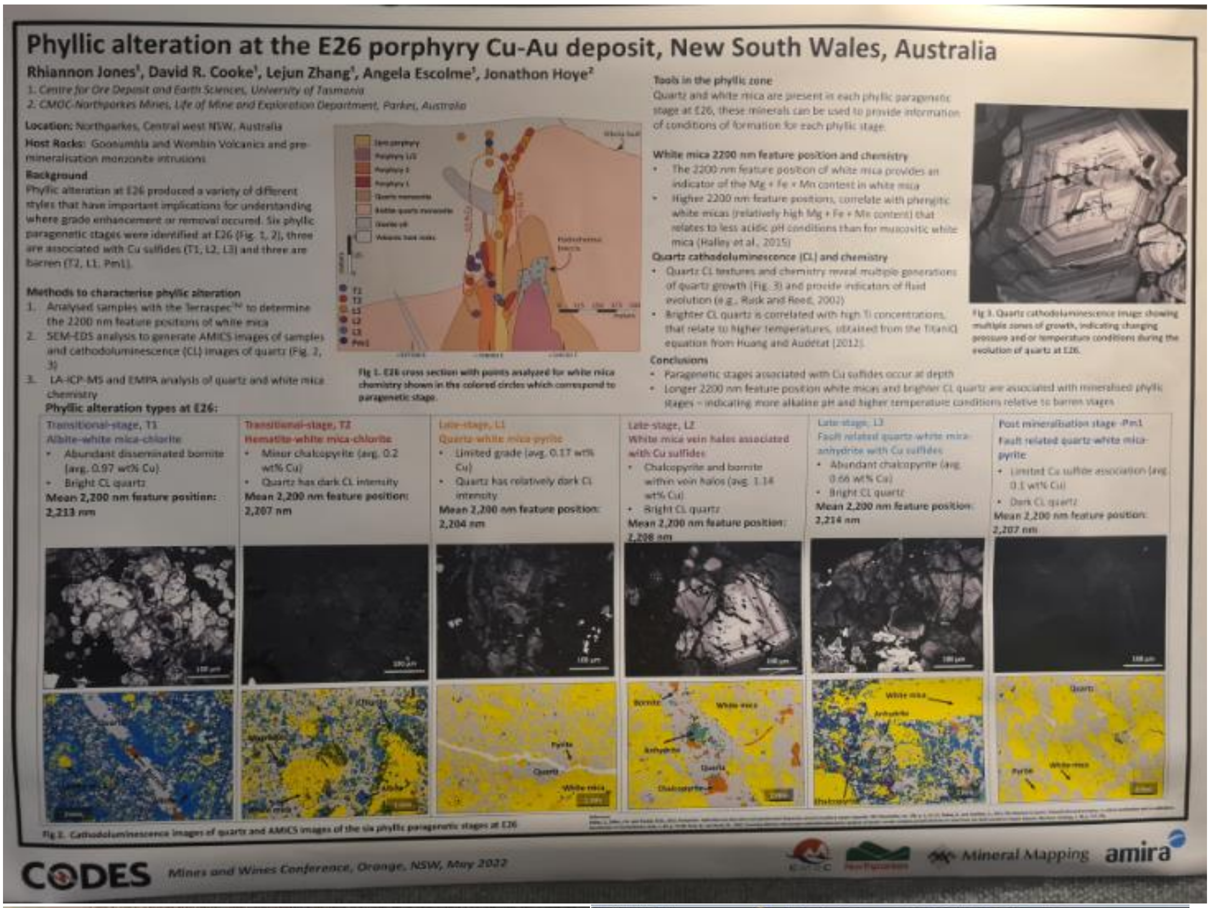
Klein, T., 2020. Tuena Project Annual Report 2020 [Company Annual Report]. (Bowdens Silver LTD., Mudgee, NSW, 27 March 2020), pp.1-20.

Silver Mines Pty LTD., 2020. Tuena Gold Project: Project area expanded and new gold targets defined [ASX announcement]. (Silver Mines LTD., Sydney, Australia, 18 May 2020), pp.1-12.

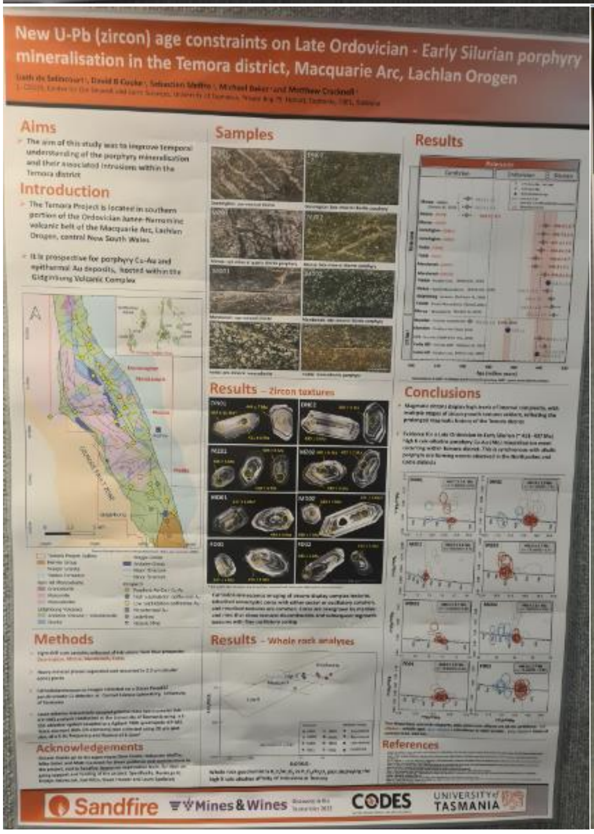
School of Biological Earth and Environmental Science, UNSW, Sydney

Acknowledgements:
- This project would not be possible without the funding and ongoing support of Bowdens Silver Pty LTD. A special thank you to Tom Klein.
- AIG 2021 Honours Bursary funding.
- AMEC Mines & Wines Geoscience Student Scholarship

Mines & Wines



Phyllic alteration at the E26 porphyry Cu-Au deposit, New South Wales, Australia
Rhiannon Jones[1], David R. Cooke[1], Lejun Zhang[1], Angela Escolme[1], Jonathon Hoye[2]
1. Centre for Ore Deposit and Earth Sciences, University of Tasmania
2. CMOC-Northparkes Mines, Life of Mine and Exploration Department, Parkes, Australia
Location: Northparkes, Central west NSW, Australia
Host Rocks: Goonumbla and Wombin Volcanics and pre-mineralisation monzonite intrusions
Background
Phyllic alteration at E26 produced a variety of different styles that have important implications for understanding where grade enhancement or removal occured. Six phyllic paragenetic stages were identified at E26 (Fig. 1, 2), three are associated with Cu sulfides (T1, L2, L3) and three are barren (T2, L1, Pm1).
Methods to characterise phyllic alteration
1. Analysed samples with the Terraspec™ to determine the 2200 nm feature positions of white mica
2. SEM-EDS analysis to generate AMICS images of samples and cathodoluminescence (CL) images of quartz (Fig. 2, 3)
3. LA-ICP-MS and EMPA analysis of quartz and white mica chemistry
T1
T2
L1
L2
L3
Pm1
Fig 1. E26 cross section with points analyzed for white mica chemistry shown in the colored circles which correspond to paragenetic stage.
Tools in the phyllic zone
Quartz and white mica are present in each phyllic paragenetic stage at E26, these minerals can be used to provide information of conditions of formation for each phyllic stage.
White mica 2200 nm feature position and chemistry
The 2200 nm feature position of white mica provides an indicator of the Mg + Fe + Mn content in white mica
Higher 2200 nm feature positions, correlate with phengitic white micas (relatively high Mg + Fe + Mn content) that relates to less acidic pH conditions than for muscovitic white mica (Halley et al., 2015)
Quartz cathodoluminescence (CL) and chemistry
Quartz CL textures and chemistry reveal multiple generations of quartz growth (Fig. 3) and provide indicators of fluid evolution (e.g., Rusk and Reed, 2002)
Brighter CL quartz is correlated with high Ti concentrations, that relate to higher temperatures, obtained from the TitaniQ equation from Huang and Audétat (2012).
Fig 3. Quartz cathodoluminescence image showing multiple zones of growth, indicating changing pressure and or temperature conditions during the evolution of quartz at E26.
Conclusions
Paragenetic stages associated with Cu sulfides occur at depth
Longer 2200 nm feature position white micas and brighter CL quartz are associated with mineralised phyllic stages – indicating more alkaline pH and higher temperature conditions relative to barren stages
Phyllic alteration types at E26:
Transitional-stage, T1
Albite-white mica-chlorite
Abundant disseminated bornite (avg. 0.97 wt% Cu)
Bright CL quartz
Mean 2,200 nm feature position: 2,213 nm
Transitional-stage, T2
Hematite-white mica-chlorite
Minor chalcopyrite (avg. 0.2 wt% Cu)
Quartz has dark CL intensity
Mean 2,200 nm feature position: 2,207 nm
Late-stage, L1
Quartz-white mica-pyrite
Limited grade (avg. 0.17 wt% Cu)
Quartz has relatively dark CL intensity
Mean 2,200 nm feature position: 2,204 nm
Late-stage, L2
White mica vein halos associated with Cu sulfides
Chalcopyrite and bornite within vein halos (avg. 1.14 wt% Cu)
Bright CL quartz
Mean 2,200 nm feature position: 2,208 nm
Late-stage, L3
Fault related quartz-white mica-anhydrite with Cu sulfides
Abundant chalcopyrite (avg. 0.66 wt% Cu)
Bright CL quartz
Mean 2,200 nm feature position: 2,214 nm
Post mineralisation stage -Pm1
Fault related quartz-white mica-pyrite
Limited Cu sulfide association (avg. 0.1 wt% Cu)
Dark CL quartz
Mean 2,200 nm feature position: 2,207 nm
Bornite
White mica
Anhydrite
Quartz
Chalcopyrite
Pyrite
Fig 2. Cathodoluminescence images of quartz and AMICS images of the six phyllic paragenetic stages at E26
CODES
Mines and Wines Conference, Orange, NSW, May 2022
Mineral Mapping
amira



New U-Pb (zircon) age constraints on Late Ordovician - Early Silurian porphyry mineralisation in the Temora district, Macquarie Arc, Lachlan Orogen
Aims
The aim of this study was to improve temporal understanding of the porphyry mineralisation and their associated intrusions within the Temora district
Introduction
The Temora Project is located in southern portion of the Ordovician Junee-Narromine volcanic belt of the Macquarie Arc, Lachlan Orogen, central New South Wales
It is prospective for porphyry Cu-Au and epithermal Au deposits, hosted within the Gidginbung Volcanic Complex
Samples
Results
Results – Zircon textures
Conclusions
Methods
Results – Whole rock analyses
References
Acknowledgements
Sandfire
Mines&Wines
CODES
UNIVERSITY of TASMANIA

Australian National University
EXTRACTION OF RARE EARTH ELEMENTS FROM EUDIALYTE
Claudia Tomkins
Research School of Earth Sciences, The Australian National University, Canberra, Australia
INTRODUCTION
REEs are essential for many technological, industrial, low-carbon, agricultural, medical and military applications [1]
Eudialyte, a Na-Ca-rich zirconosilicate [2], is a potential source of REEs, containing ~0.5-10 wt.% TREO [3]
However, no proven method for extraction on an industrial scale exists
Due to acid decomposition causing formation of non-filterable silica by-products [4]
Toongi, a peralkaline deposit outside of Dubbo in NSW, contains eudialyte [5]
If "extraction code" is cracked, could present a source of REEs for Australia
METHODOLOGY
Sodium species used for carbonation (Na_2CO_3), sulfidation (Na_2SO_4), & chlorination (NaCl)
Atmospheric pressure heating experiments conducted in box furnaces, high-pressure heating in cold-seal hydrothermal vessols
Analysis via SEM, QEMSCAN, LA-ICP-MS, & Raman spectroscopy
ILIMAUSSAQ, GREENLAND
KHIBINY, RUSSIA
AIM
To evaluate the potential of natural processes – oxidation, carbonation, sulfidation & chlorination – as methods for REE extraction
ATMOSPHERIC PRESSURE
HIGH PRESSURE
CONCLUSIONS
Sulfidation & carbonation found to be most effective
Atmospheric pressure carbonation & sulfidation produced significant alteration rims around eudialyte fragments
REE-rich (up to 75 wt% TREO) silicate minerals crystallised
Most promising results produced by high pressure sulfidation
Silicate mineral phases containing up to 49 wt% TREO achieved, with precipitates forming along edges of altered eudialyte grains

Sponsors and Exhibitors M&W 2022

Gold Sponsor
Newcrest Mining
www.newcrest.com.au

Silver Sponsor
Evolution Mining
evolutionmining.com.au

Silver Sponsor
Alkane
alkane.com.au

Silver Sponsor
Newmont Mining
www.newmont.com

Bronze Sponsor
ALS Global
alsglobal.com

Bronze Sponsor
Regis Resources
regisresources.com.au

Bronze Sponsor
SGS
sgs.com.au

Bronze Sponsor
Godolphin Resources
godolphinresources.com.au

Bronze Sponsor
CMOC – Northparkes
northparkes.com

Dinner Sponsor
Titeline Drilling
titelinedrilling.com.au

Field Trip Sponsor
Sandfire Resources
sandfire.com.au

Student Posters Sponsor
SMEDG
smedg.org.au

Student Posters Sponsor
AMEC
amec.org.au

Ice Breaker Sponsor
Hetherington
hetherington.net.au

Core Grade Guessing Competition
MIME
Roland Kite | LinkedIn

Name Tags Sponsor
Durock Drilling
durockdrilling.com.au

Booth Holder
SciAps
https://sciaps.com/

Booth Holder
Aerometrex
https://aerometrex.com.au/

Booth Holder
AIG
https://www.aig.org.au/

Booth Holder
ALS
https://www.alsglobal.com

Booth Holder

AMETS

https://amets.com.au

Booth Holder

Dynamics G-EX

www.dynamicsgex.com.au/

Booth Holder

Fender Geophysics

fendergeophysics.com.au/

Booth Holder

Gnomic

www.gnomic.com.au

Booth Holder

Umwelt

www.umwelt.com.au

Booth Holder

Max Geo

www.maxgeo.com

Booth Holder

Micromine

Micromine

Booth Holder

NSW GOVERNMENT

regional.nsw.gov.au/meg

Booth Holder

Westernex

westernex.com.au

Booth Holder

Ophir Drilling

ophirdrilling.com.au

Mines & Wines