



MOUNT ISA  
MINES



THE UNIVERSITY  
of ADELAIDE



# Trace Element Variation in the Mount Isa Cu-Pb-Zn system

Brad Cave  
Richard Lilly

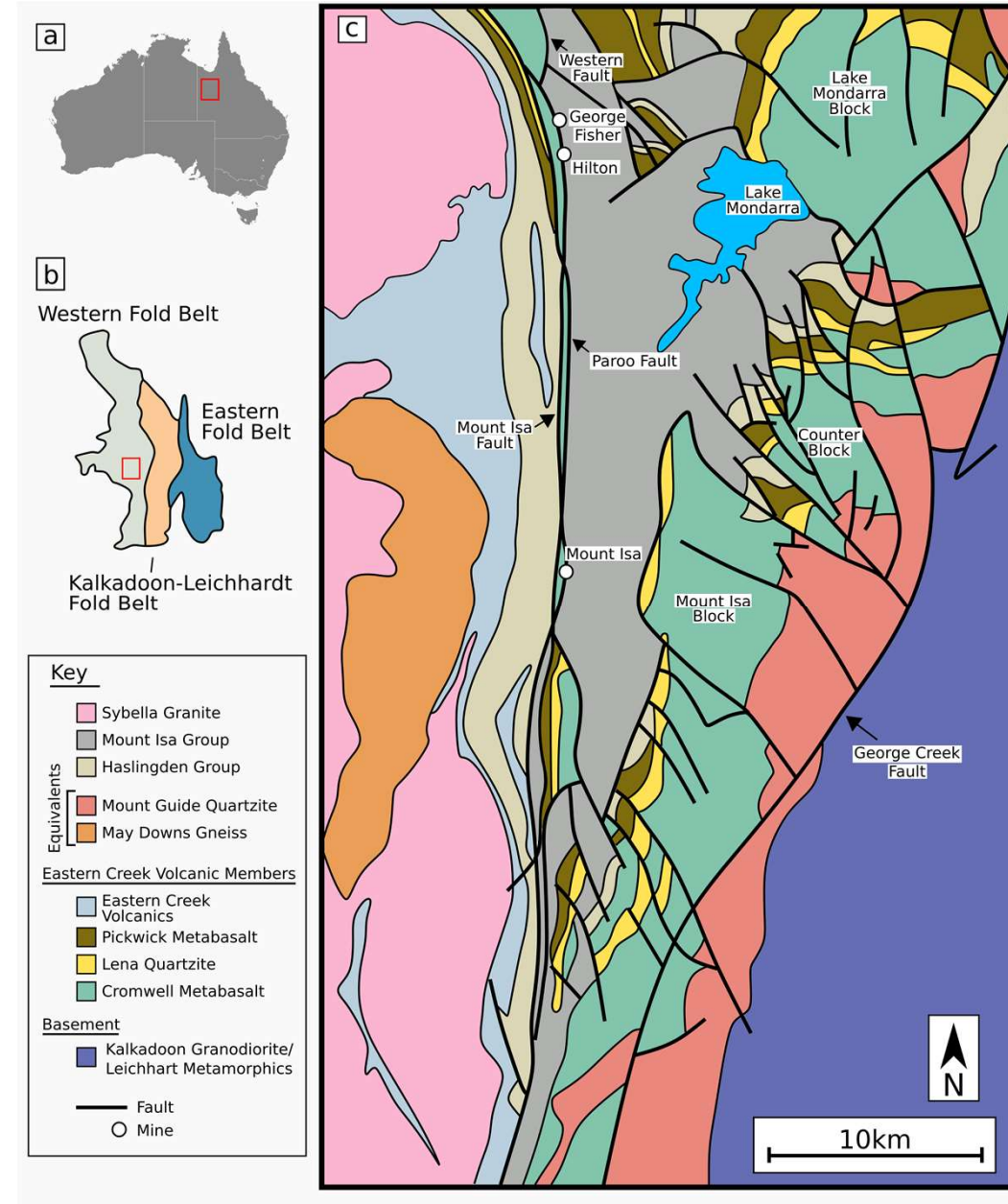
Mount Isa Research for Geology and Exploration

**MIRGE**



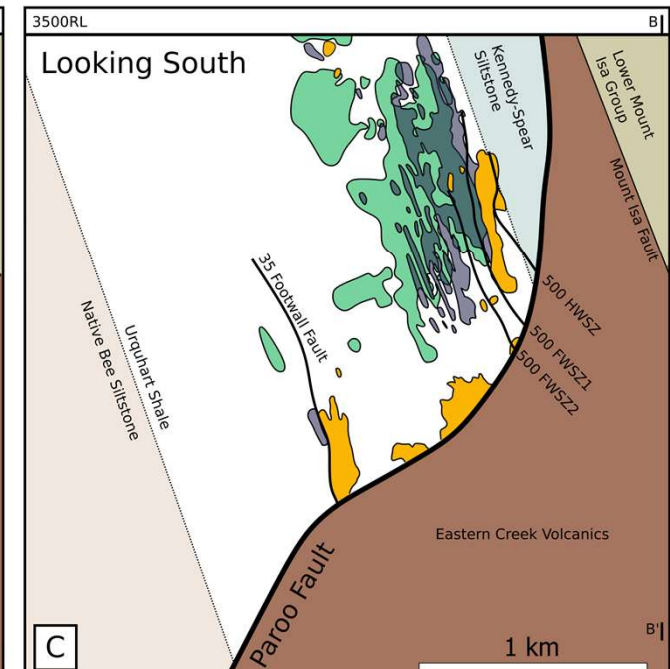
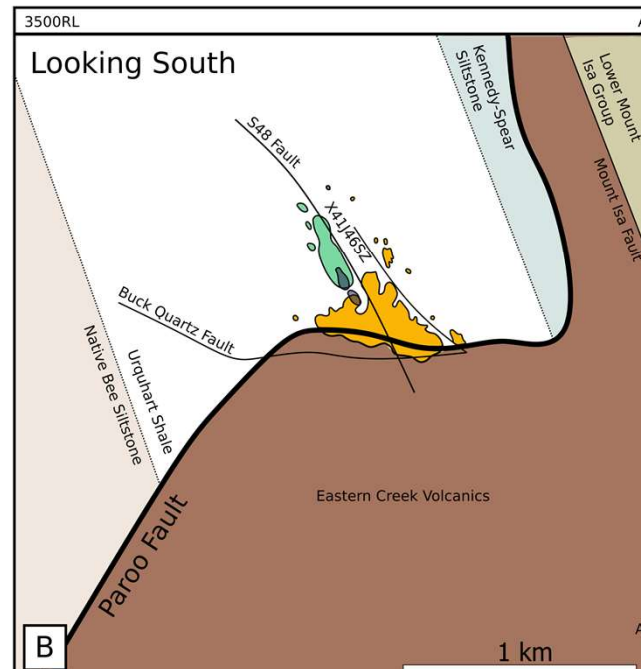
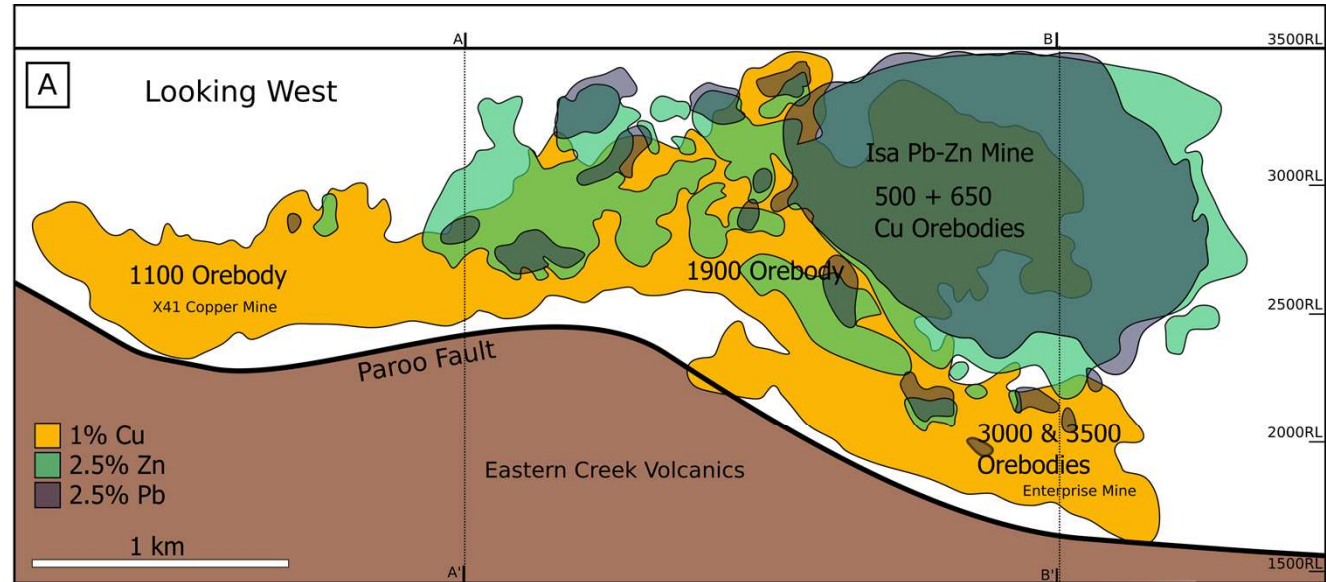
# Introduction

- Western Succession of the Mount Isa Inlier
- Isan Orogeny
  - D1 – (N-S compression at ~1610 Ma)
  - D2 – (E-W compression at ~1575 Ma)
  - D3 – (NE-SW transpression at ~1510 Ma)
- Mount Isa Group
  - Siltstone, shale, dolomite, sandstone, conglomerate, meta-sediments



# Deposit Geology

- Ore hosted in Urquhart Shale and Kennedy-Spear Siltstones
- Chalcopyrite infill predominantly hosted in a silica-dolomite breccia
- Sphalerite and galena infill and replacement located proximal to silica-dolomite; hosted in shale and brecciated shales.
- Ore zones outwards from the Paroo Fault: Cu → Pb → Zn





# The Isa Debate

- **Syn-sedimentary Cu-Pb-Zn**

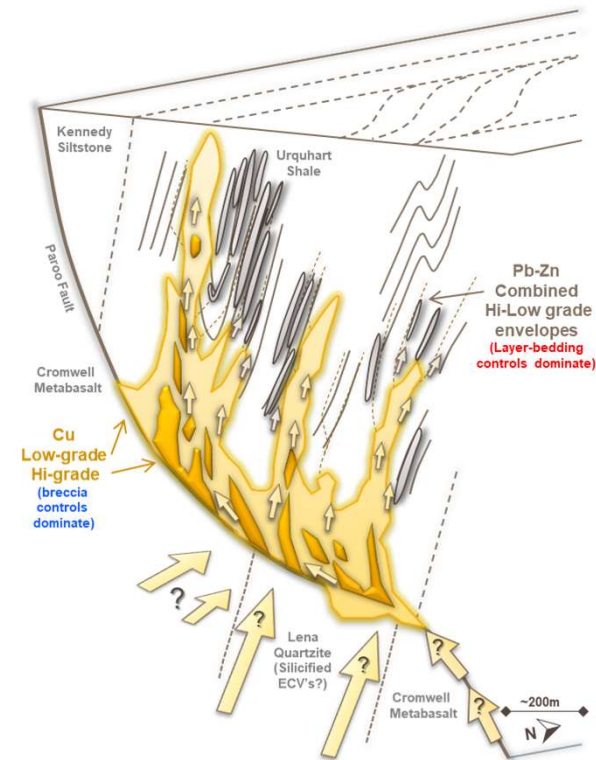
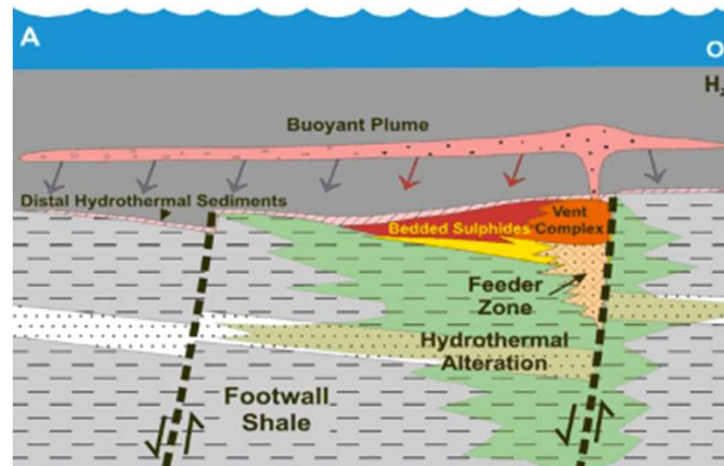
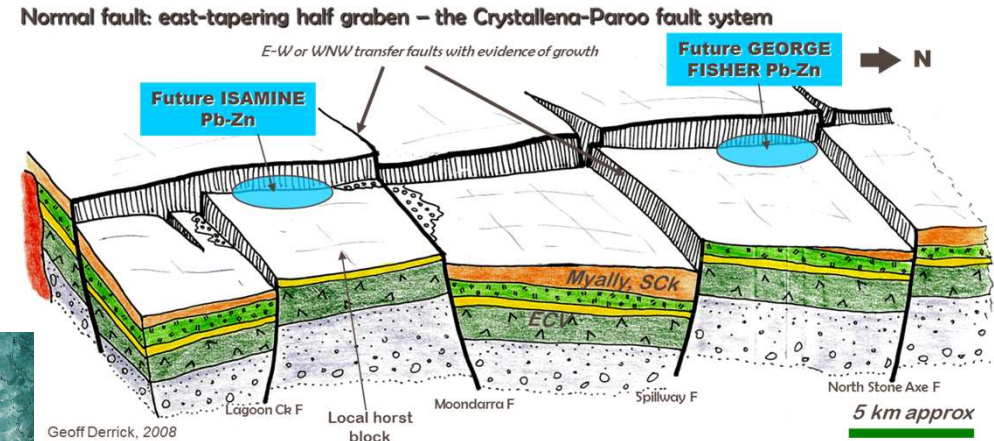
- *Finlow-Bates & Stumpfl (1980); McGoldrick and Keays (1990)*

- **Syn-sedimentary Pb-Zn overprinted by epigenetic Cu**

- *Gulson et al (1983); Smith et al (1978); Carr et al (2004); Gregory et al (2008)*

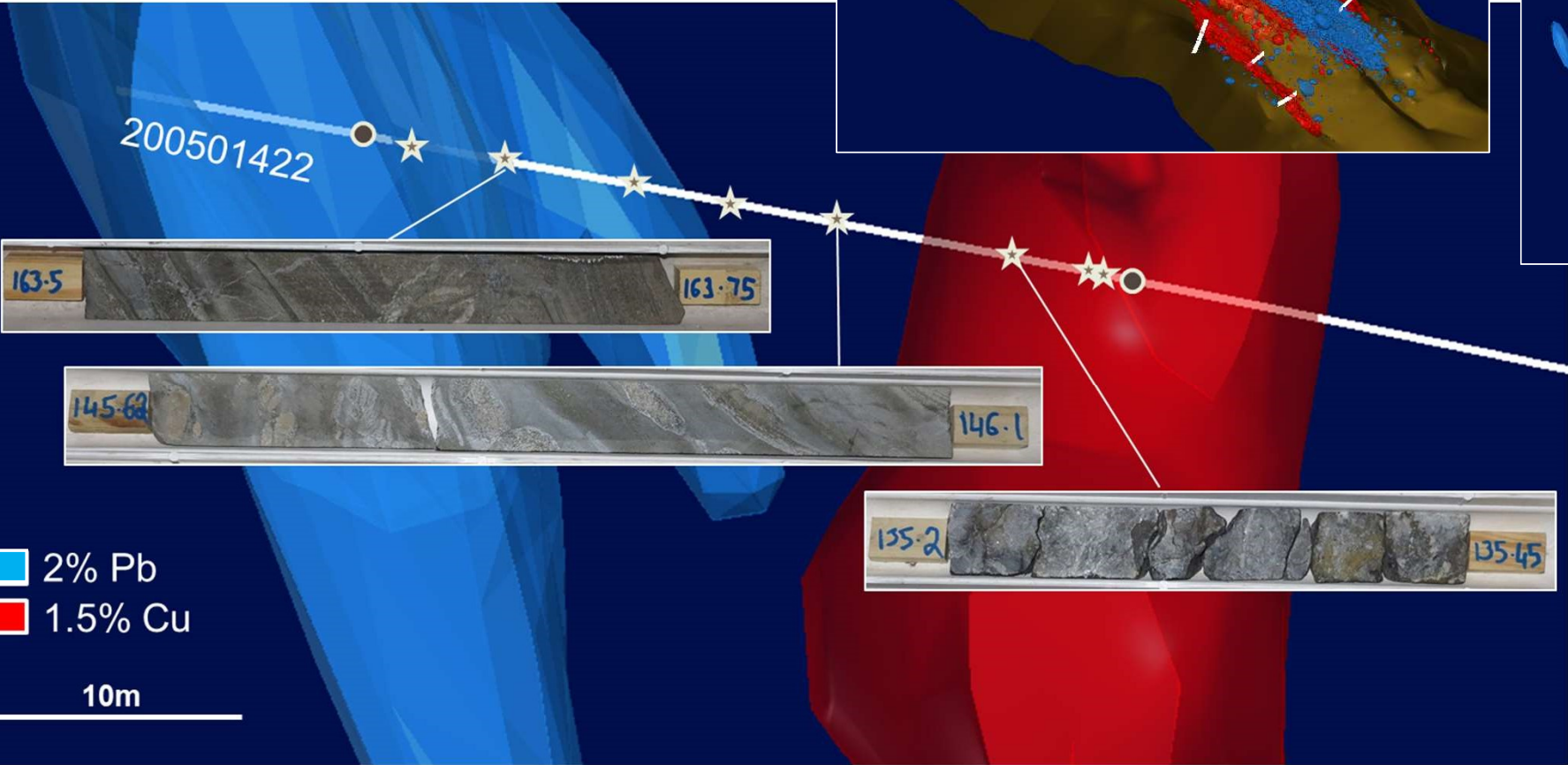
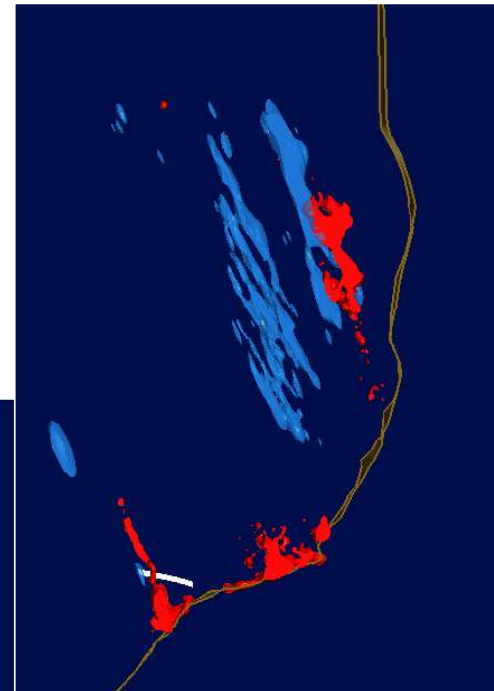
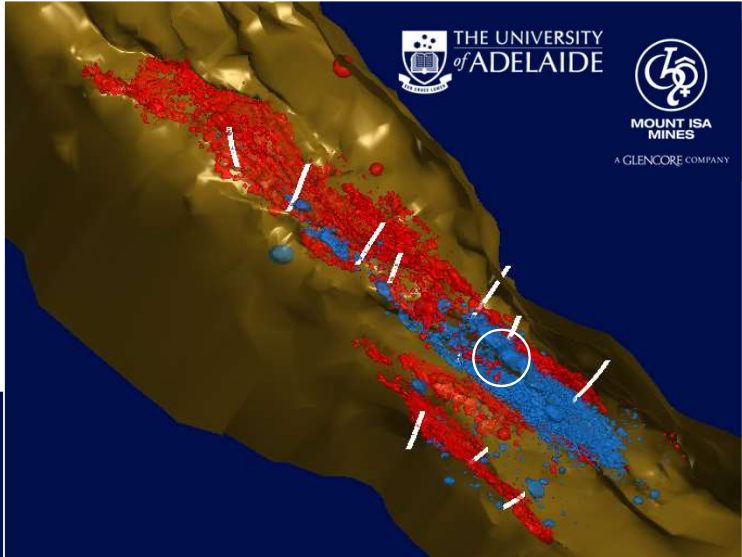
- **Epigenetic Cu-Pb-Zn**

- *Grondijs and Schouten (1937); Perkins (1997); Davis (2004); Taylor and Lilly (2016)*



# Logging + Sampling

- 8 different sections intersecting Cu and Pb-Zn mineralization logged and sampled



■ 2% Pb  
■ 1.5% Cu

10m

- Sampled across each hole for petrography and LA-ICP-MS trace element work.

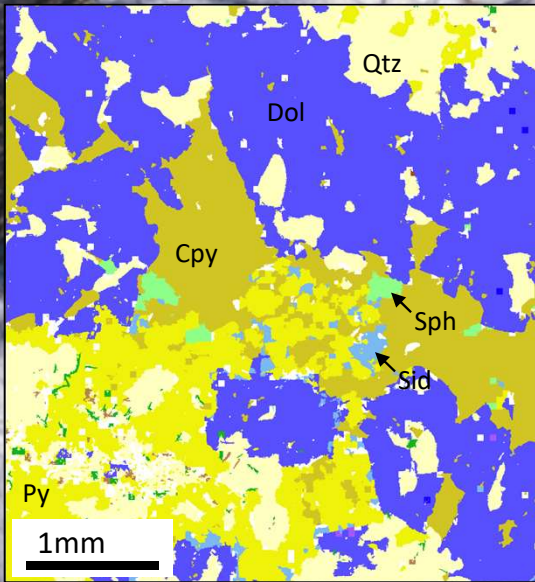
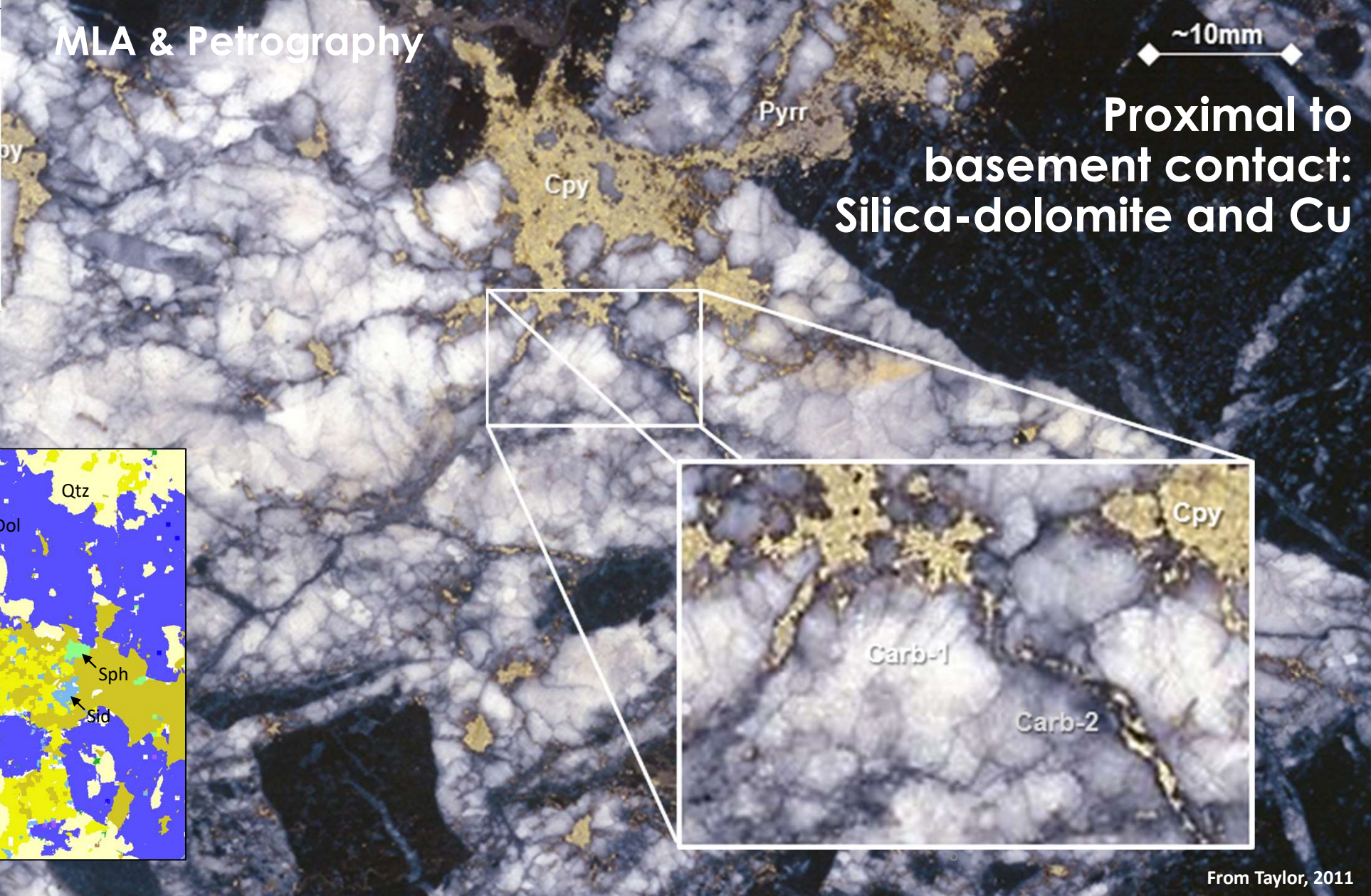
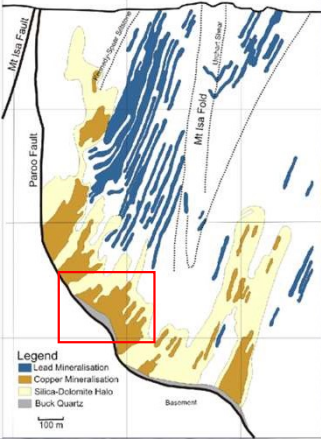




# MLA & Petrography

~10mm

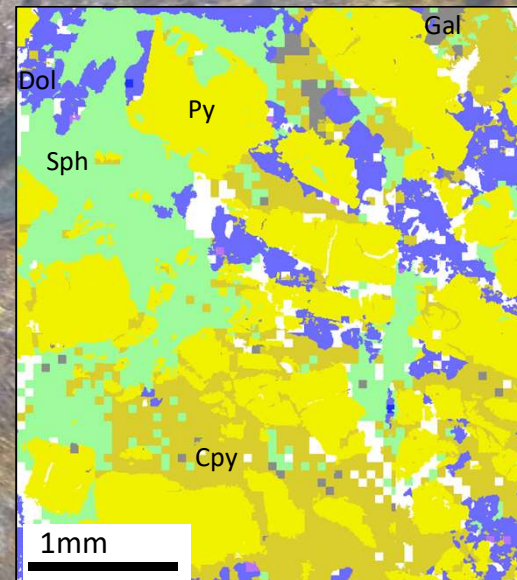
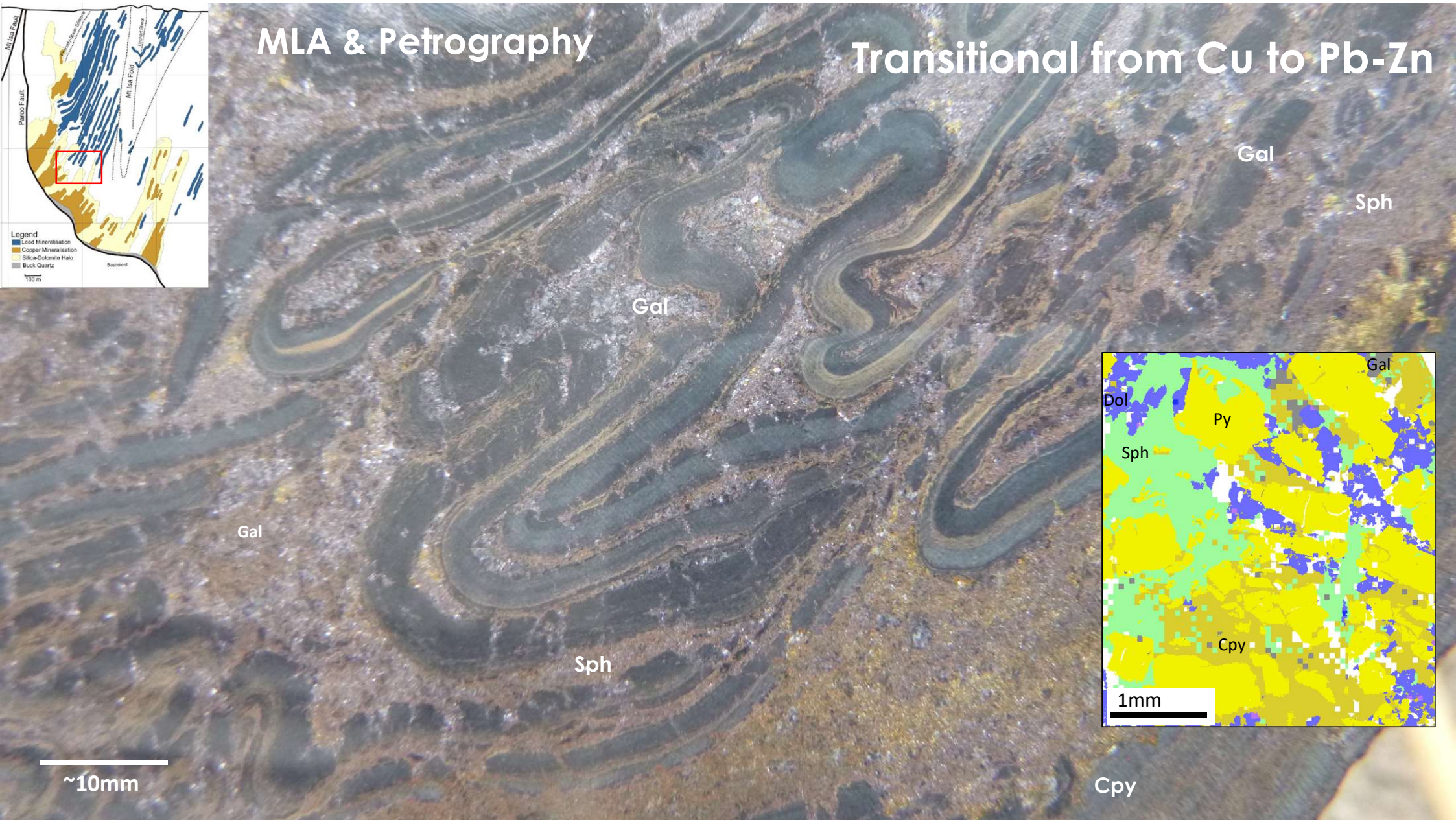
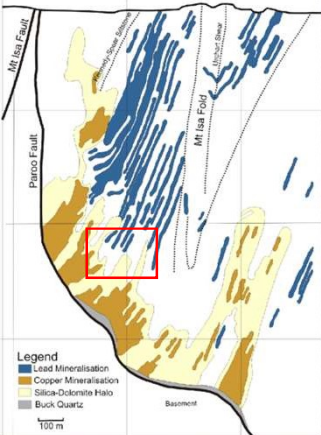
Proximal to basement contact:  
Silica-dolomite and Cu





# MLA & Petrography

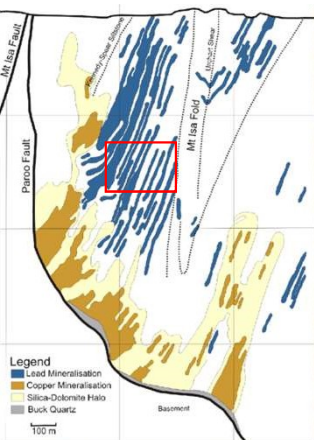
# Transitional from Cu to Pb-Zn





# MLA & Petrography

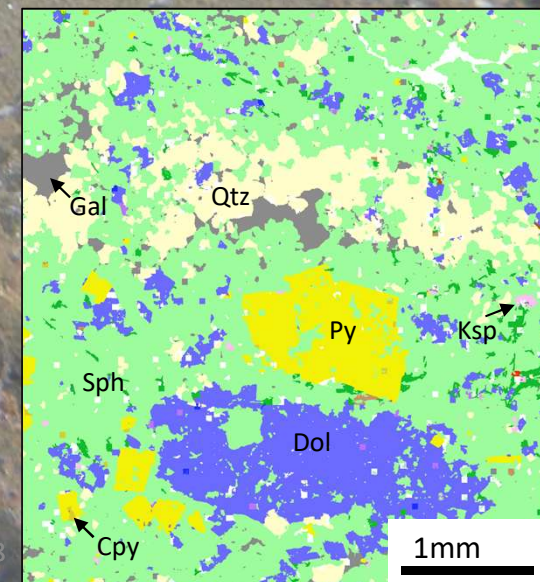
# Distal to Basement contact: Pb-Zn ores



Gal

Sph

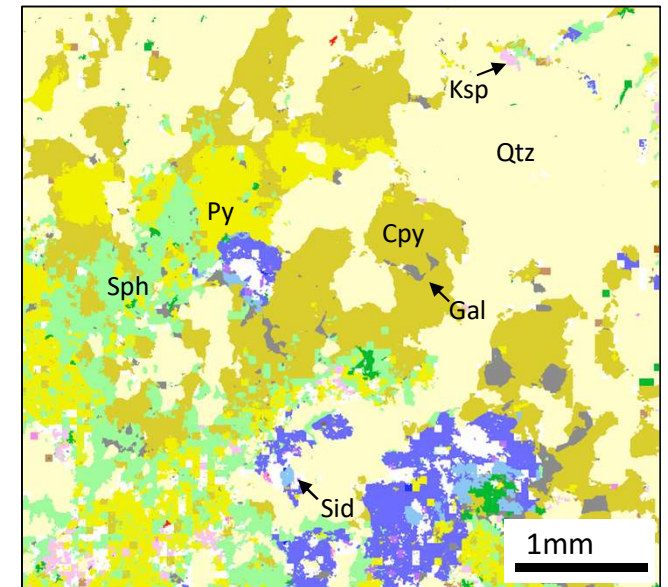
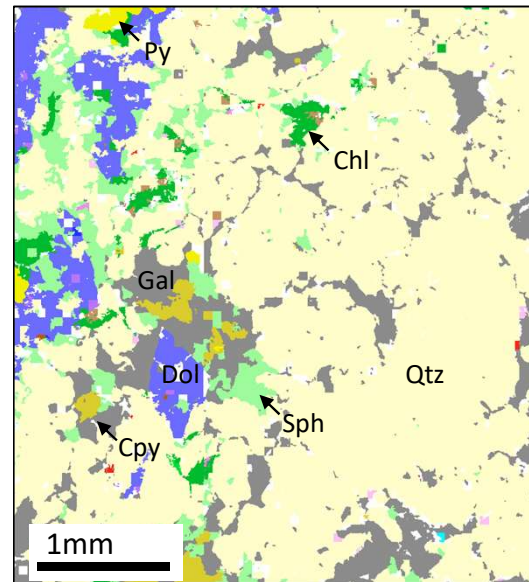
~10mm





# MLA & Petrography

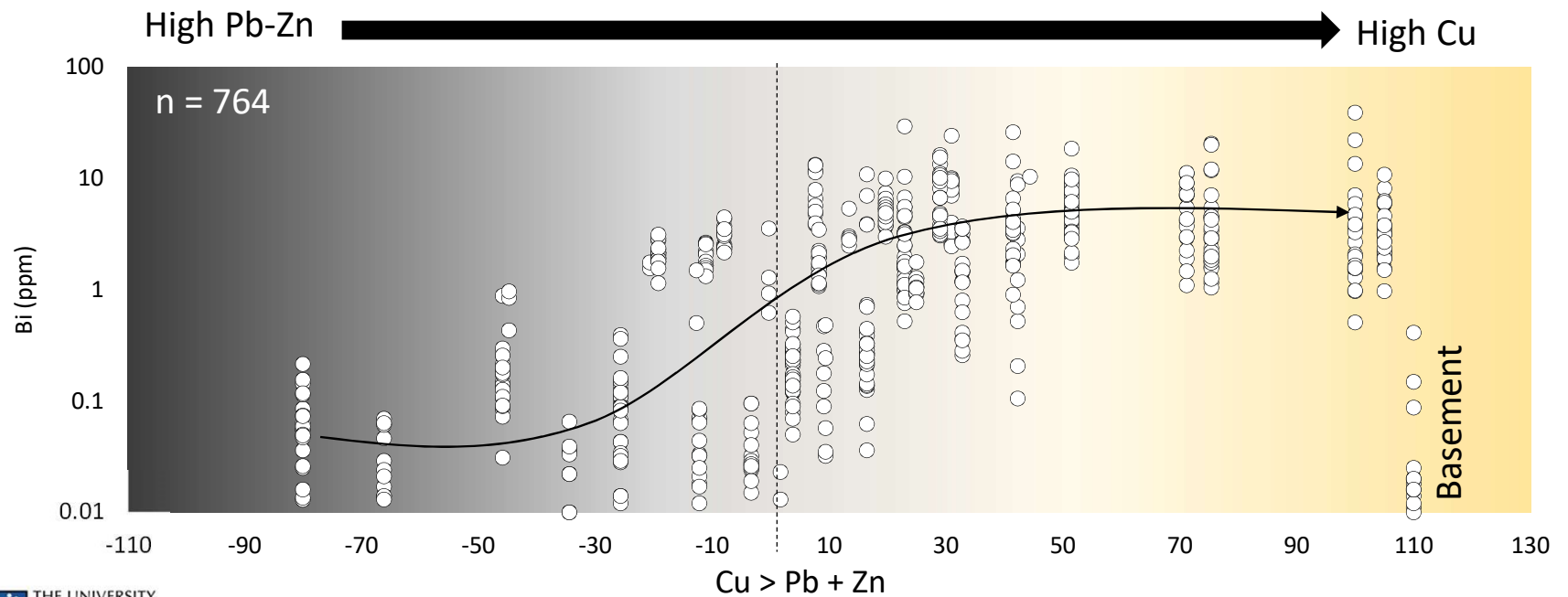
- Chalcopyrite, galena and sphalerite postdate coarse-grained pyrite, and form around dolomite and quartz.
- No evidence of chalcopyrite postdating sphalerite or galena.
- Low grade chalcopyrite exists within sphalerite and galena. Low grade galena and sphalerite exists within chalcopyrite.





# Trace Elements in Chalcopyrite

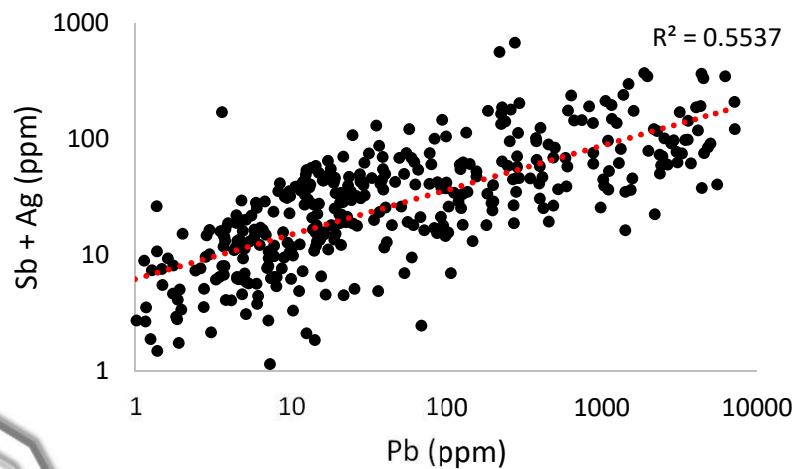
- Contained measurable amounts of Al, Co, Ni, Zn, Ga, Ge, As, Se, Ag, Cd, In, Sn, Sb, Te, Tl, Pb and Bi.
- Bi showed a systematic change from Pb + Zn → Cu mineralization.



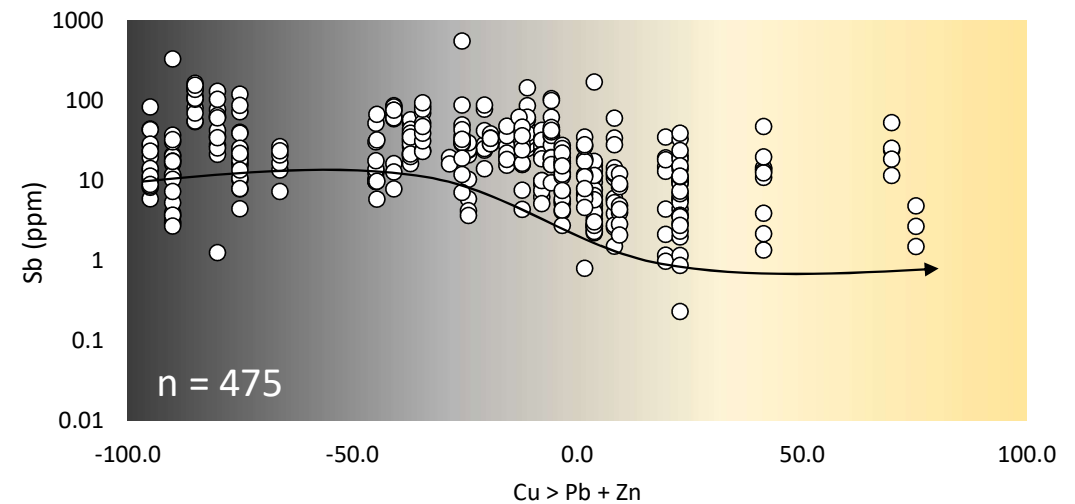


# Trace Elements in Sphalerite

- Measurable concentrations of Al, Mn, Co, Ni, Cu, Ga, Ge, Ag, Cd, In, Sn, Sb, Tl, Pb, and Bi
- Decrease in Sb, Pb and Ag towards Cu mineralization.
- Sb, Pb & Ag exist as micro-inclusions of Sb-Pb-Ag bearing minerals.



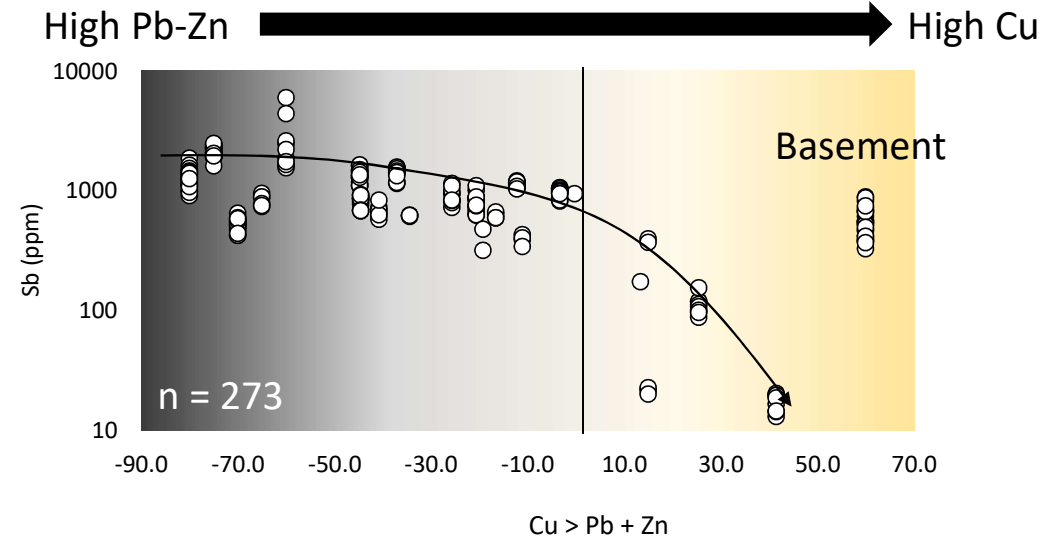
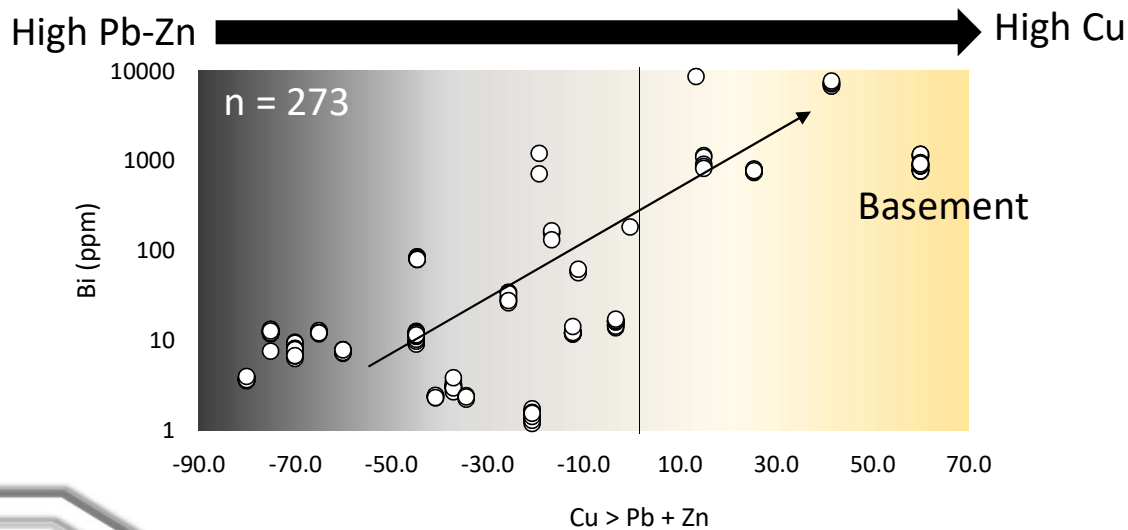
High Pb-Zn  High Cu





# Trace Elements in Galena

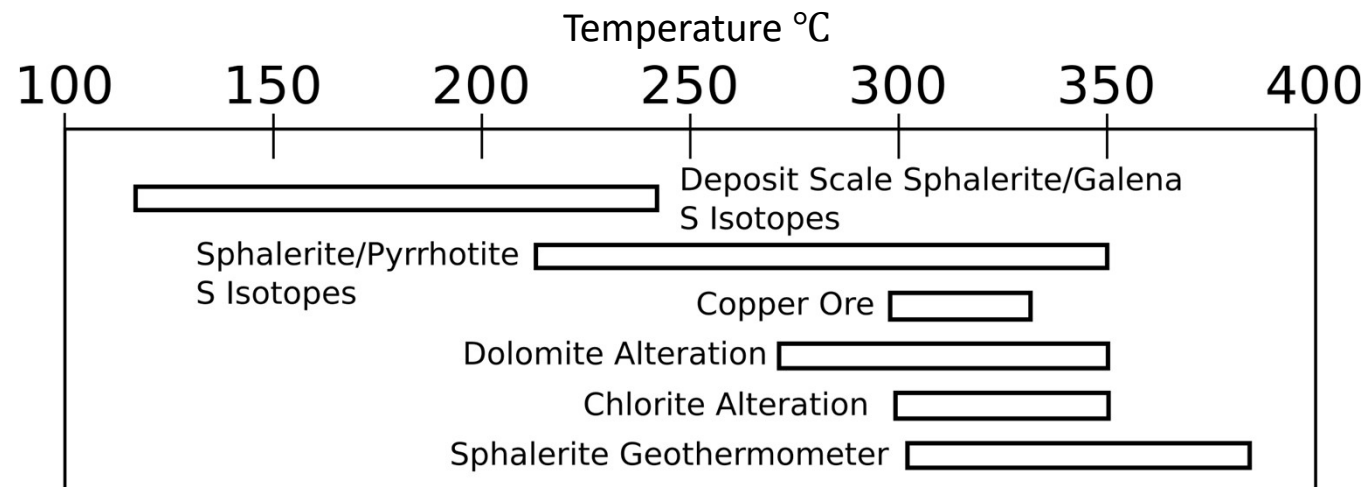
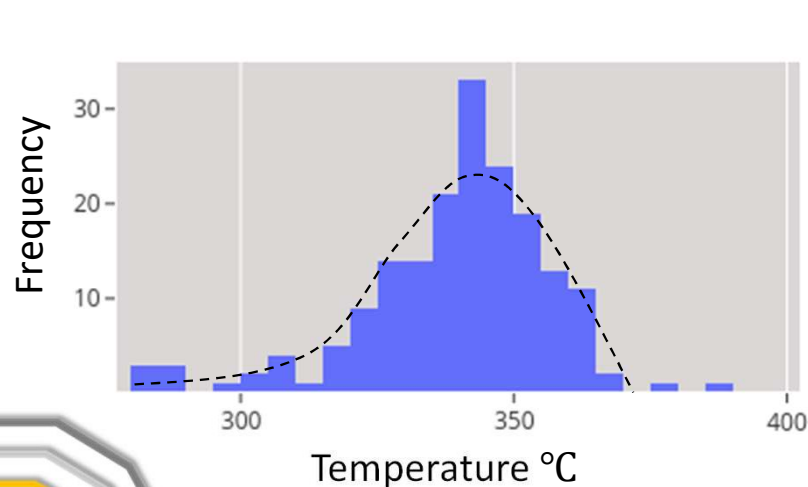
- Measurable concentrations of Fe, Co, Ni, Cu, Ga, Ge, As, Se, Ag, Cd, In, Sn, Sb, Te, Tl, Bi
- Systematic changes occur in Se, Te, Cd, Bi and Sb
- Bi and Sb trends are noteworthy. May be used together to track fluids.



# GGIMFis Geothermometer



- The concentration of Gallium, Germanium, Indium, Manganese, and Iron in sphalerite are controlled by fluid temperature (Frenzel et al, 2016).
- This lead to the development of the GGIMF in sphalerite geothermometer.
  - **Sphalerite from Mount Isa produced an estimated formation temperature of 341.9°C ( $2\sigma = 37.5^\circ\text{C}$ ).**
- This agrees with the estimated formation temperature of Copper Ore, dolomite alteration, chlorite alteration and the S isotopic equilibrium between sphalerite and pyrrhotite.





# Conclusions to Date:



- All petrography, paragenetic and textural analysis continues to suggest coeval Cu-Pb-Zn mineralization.
- Sb and Bi in galena may be used to trace fluid pathways.
- The GGIMFis geothermometer indicates that Zn was hot (> 300°C) upon placement.
- 2019 fieldwork will apply techniques to George Fisher system

*Thank you to the geology teams at  
**MICO, MIM RD** and **GFM** for  
continued assistance with fieldwork*

Mount Isa Research for Geology and Exploration

# MIRGE



P49 (Hilton) 12L – H558 - 08  
Proximal to basement  
contact: coeval Cu-Pb-Zn

Pyrr

Sph

Gal

Cpy

~10mm

