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Alteration and mineralisation settings in the Olympic Cu-Au province, Gawler Craton, South Australia

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Outline

- Where and what is the Olympic Cu-Au province?
- Key alteration types & relation to Cu-Au
- Event timing
- Metal contents of fluids (PIXE results)
- Crustal settings of Cu-Au hydrothermal systems

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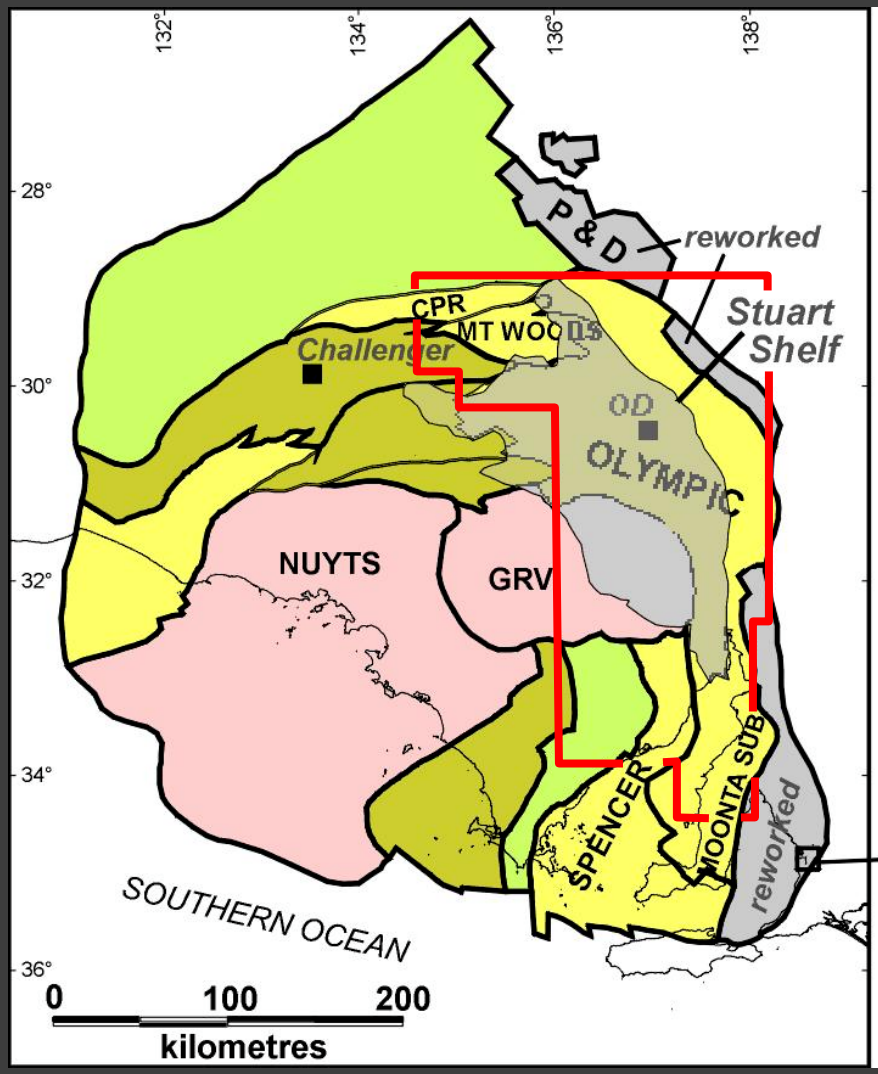
MINERALS & ENERGY RESOURCES
Government of South Australia

Where and what is the Olympic Cu-Au province?

Gawler Craton - Tectonic Domains



EARLY MESOPROT. & LATE PALAEOPROT.

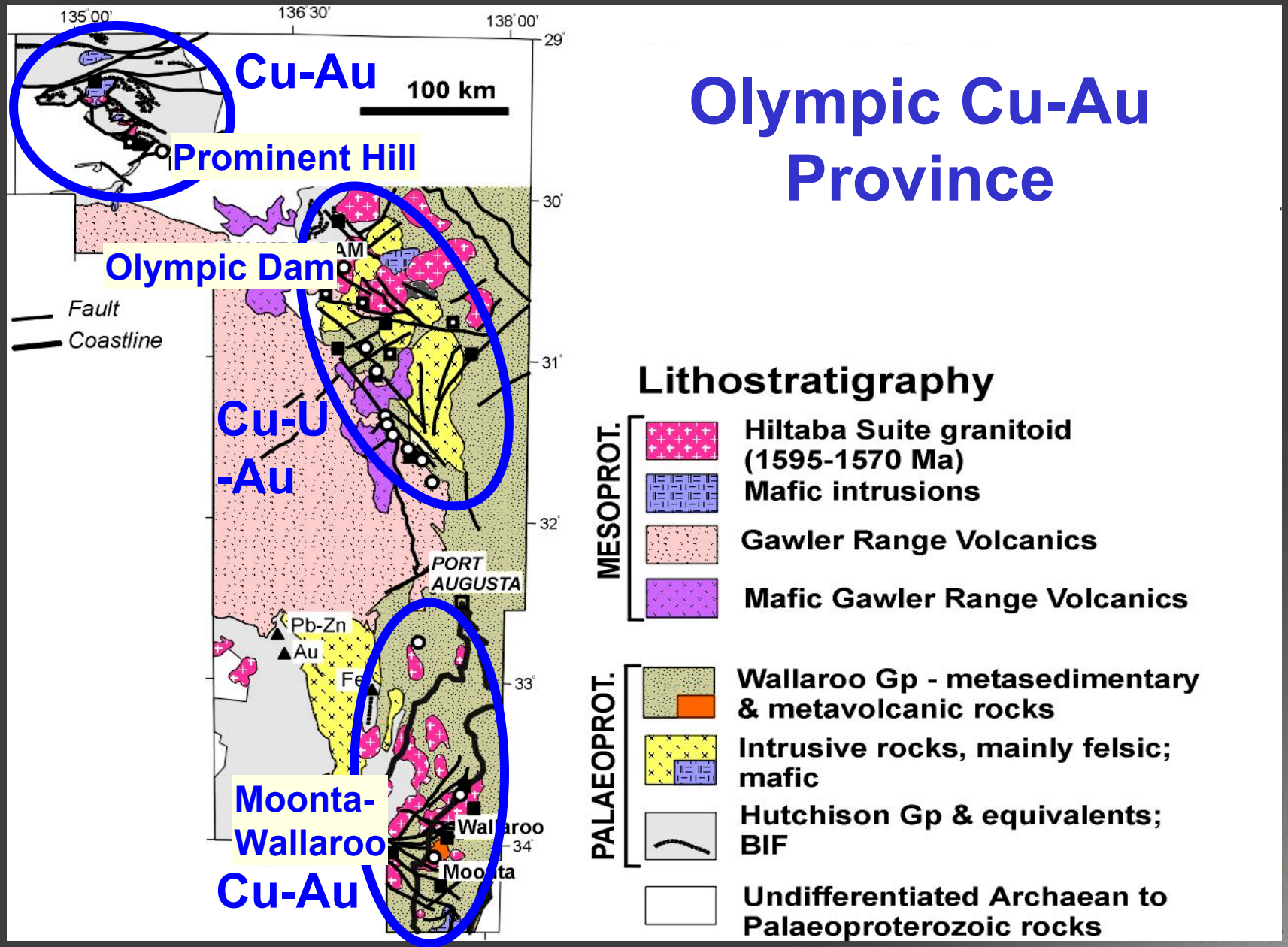
PALAEOPROTEROZOIC

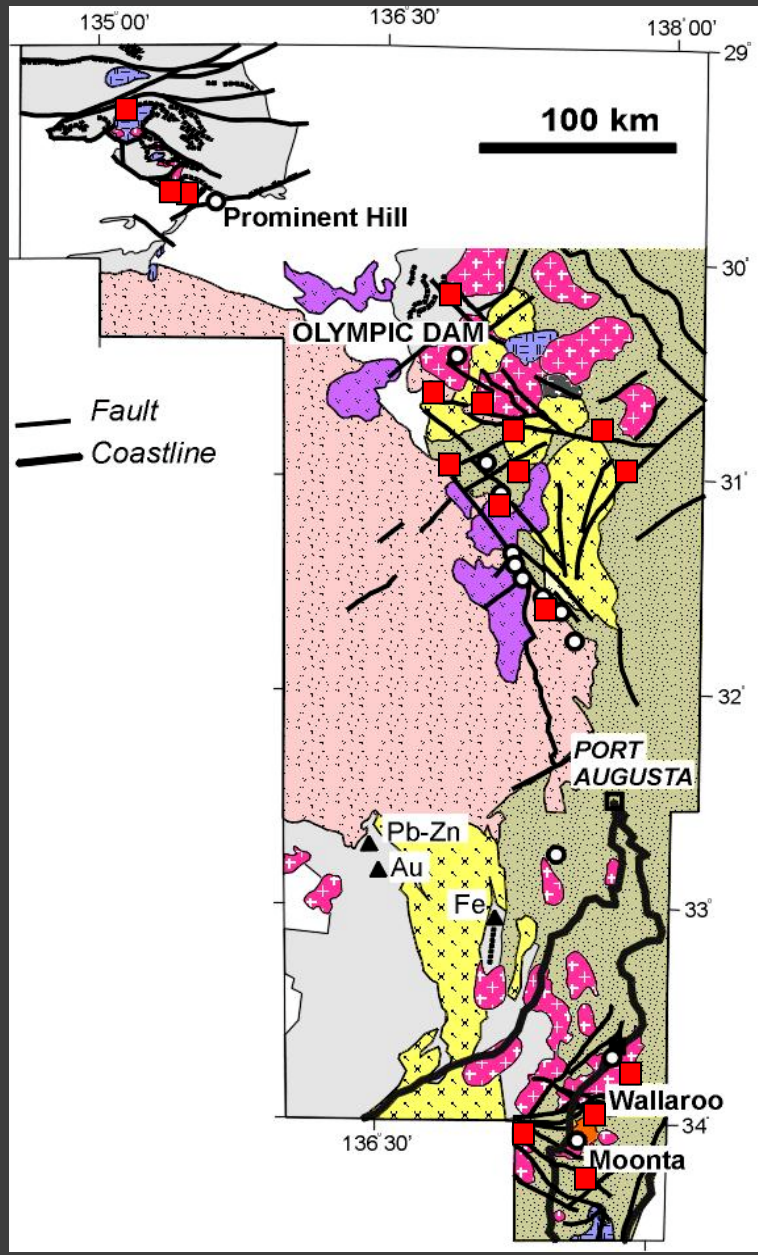
ARCHAEAN & PALAEOPROT.

ARCHAEAN

Based on Parker (1993), Teasdale (1997), Ferris et al. (2002)

Olympic Cu-Au Province





Alteration types

- CAM: calcsil - alk feld - mt
  MB: mt - bt ± Cu-Fe sulfides

Lithostratigraphy

MESOPROT.

- Hiltaba Suite granitoid (1595-1570 Ma)
- Mafic intrusions
- Gawler Range Volcanics
- Mafic Gawler Range Volcanics

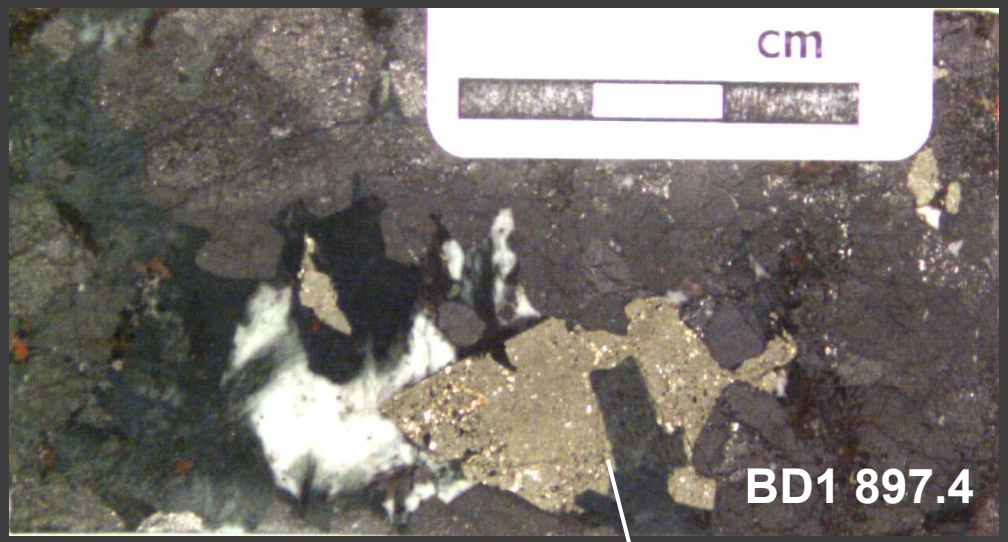
PALAEOPROT.

- Wallaroo Gp - metasedimentary & metavolcanic rocks
- Intrusive rocks, mainly felsic; mafic
- Hutchison Gp & equivalents; BIF

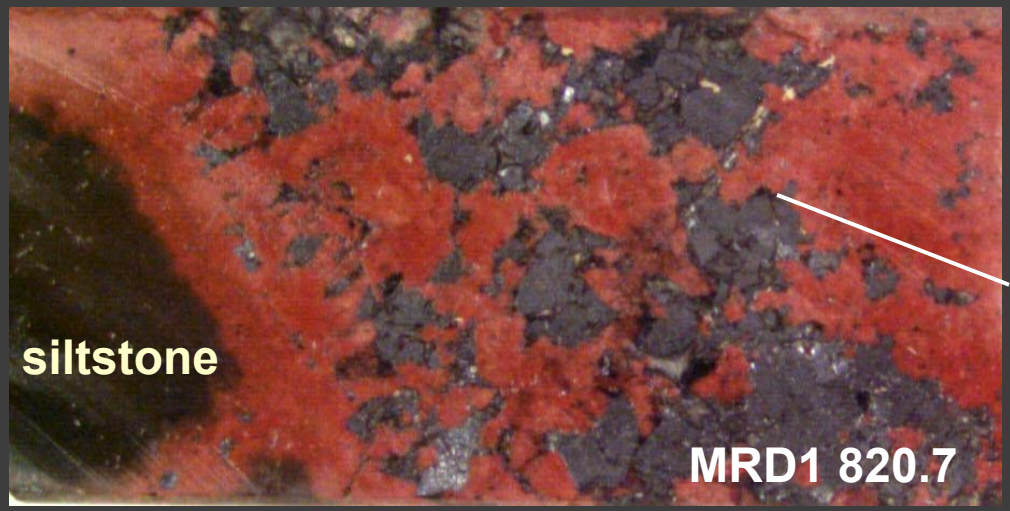
Undifferentiated Archaean to Palaeoproterozoic rocks

Stuart Shelf basement:

High-temp CAM assemblages



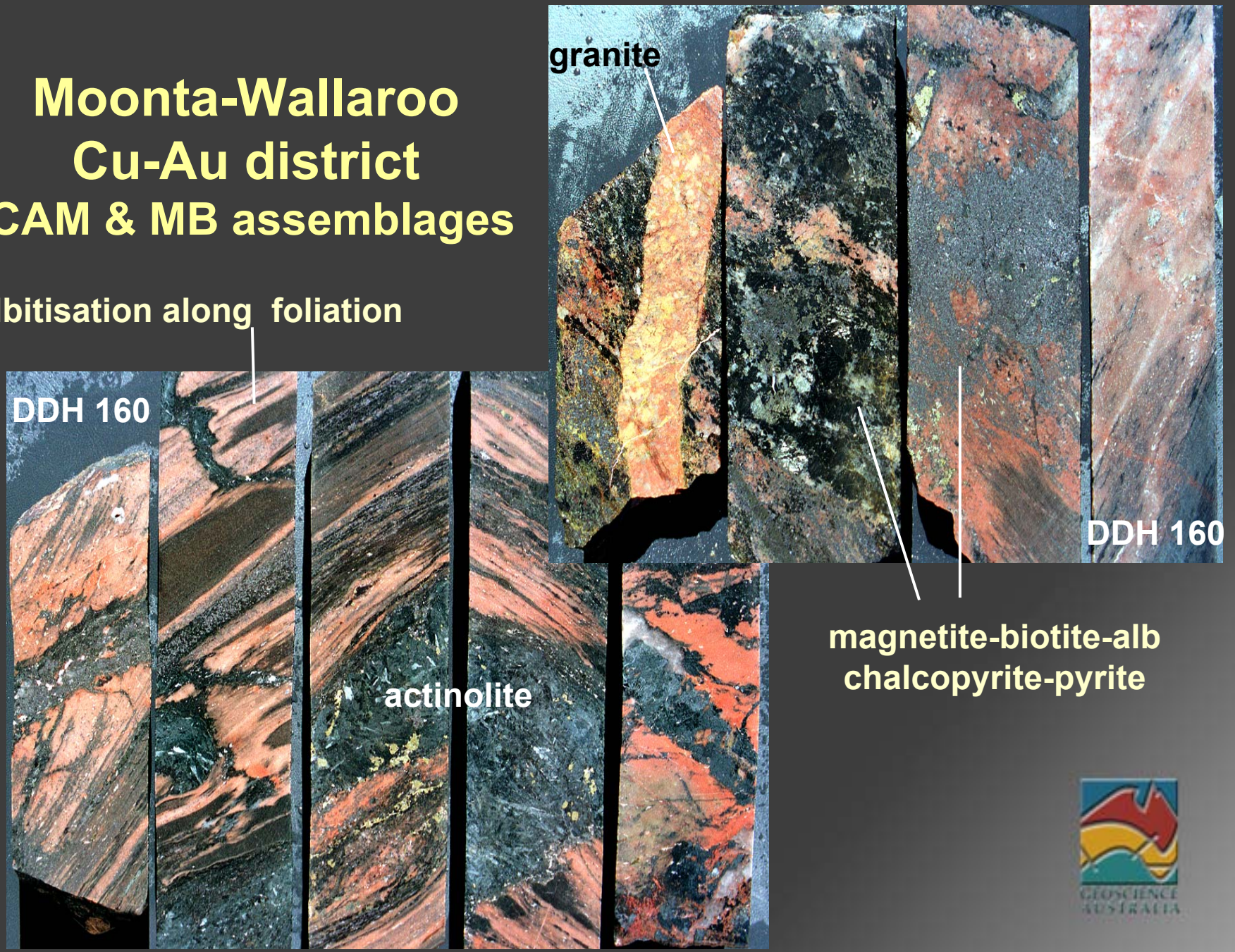
magnetite-act-Kfs-pyrite-dol

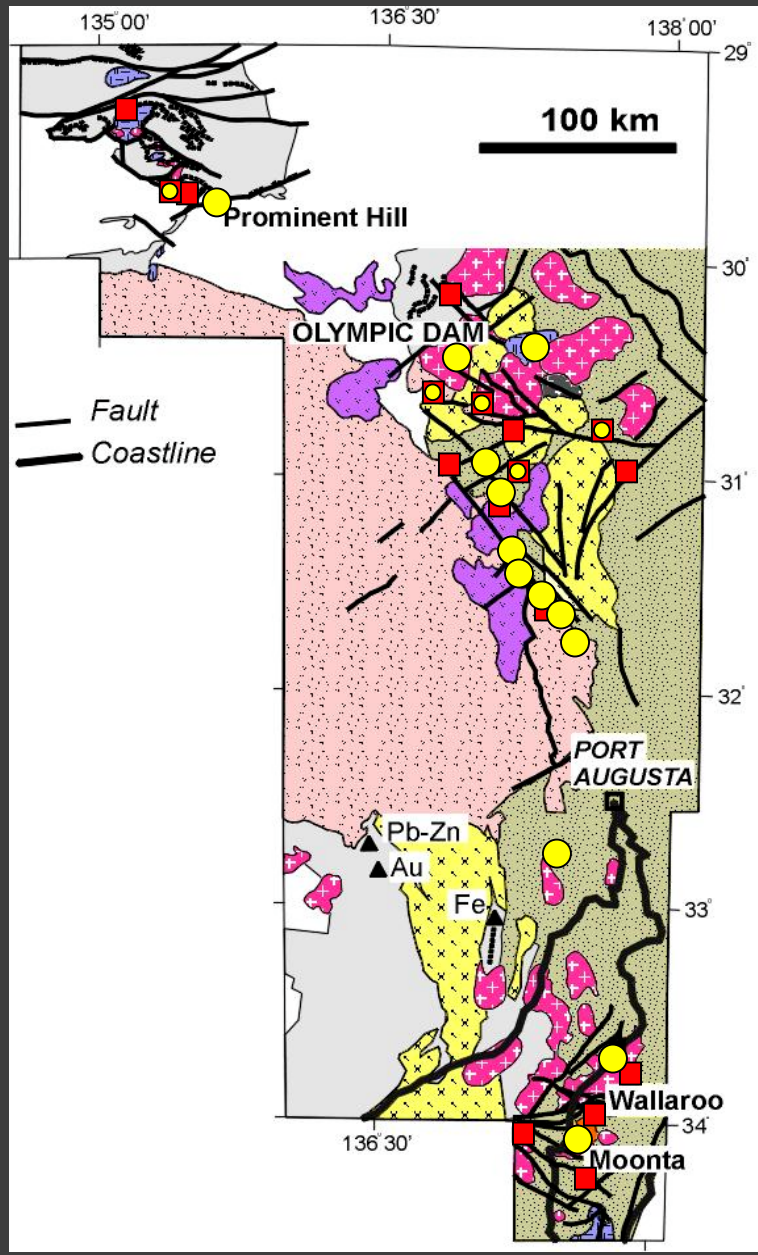


K-feldspar - magnetite-act-apatite-pyrite

Moonta-Wallaroo Cu-Au district

CAM & MB assemblages





Alteration types

- CAM: calcsil - alk feld - mt
  MB: mt - bt ± Cu-Au
- HSCC: hm - ser - chl - carb
  ± Cu-Au-U
- HSCC overprinting CAM / MB

MESOPROT.

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- Mafic Gawler Range Volcanics

PALAEOPROT.

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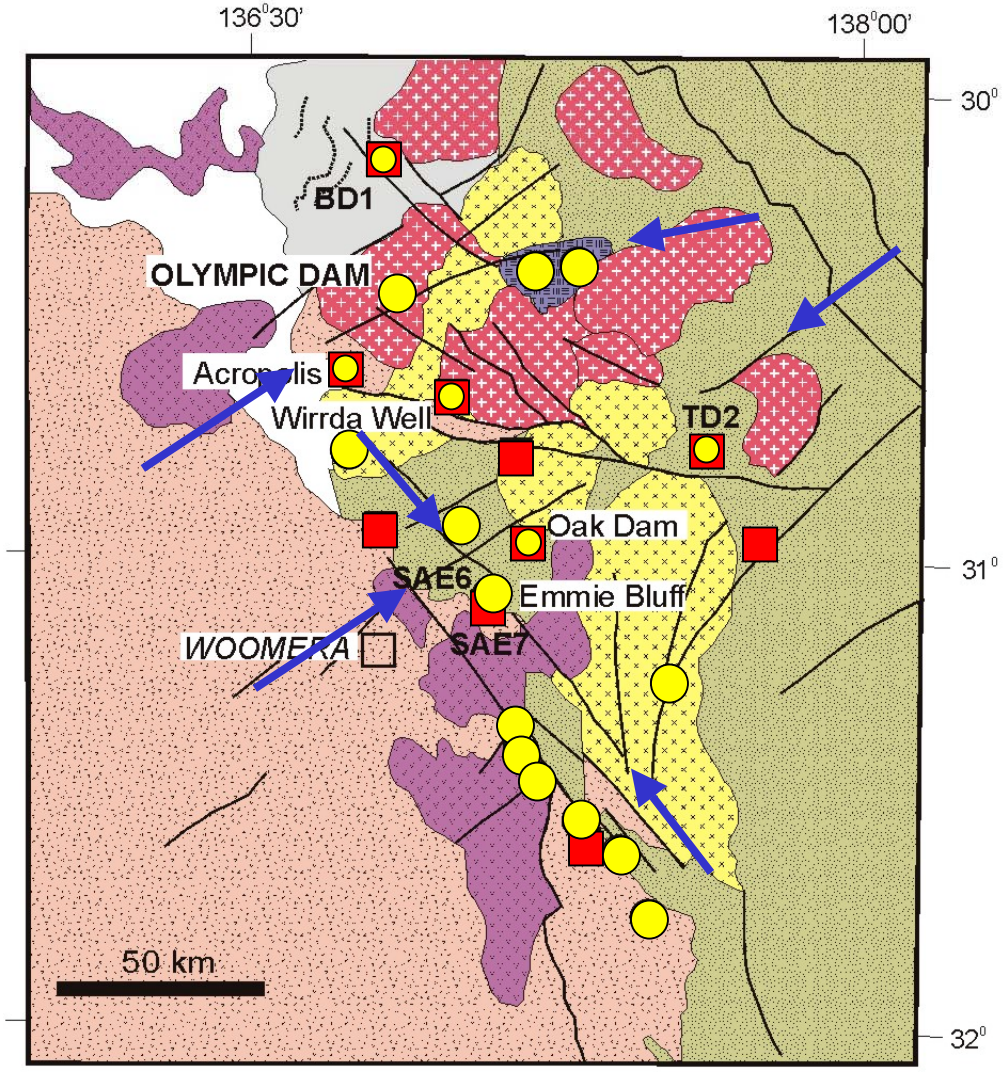
Unifying assemblages

Alteration / mineralisation	*'Footprint'*
CAM (calcsil-ALB-mt-ap) MB (mt-bt + Cu-Au) HSCC + Cu-Au-U (Prom. Hill)	*Mt Woods Inlier*
CAM (calcsil-KFS-mt-ap) HSCC + Cu-U-Au	*Stuart Shelf basement*
CAM (calcsil-ALB-mt) MB (mt-bt + Cu-Au) HSCC (hm-chl-qtz) + Cu-Au	*Moonta-Wallaroo*

Stuart Shelf basement: architecture



Alteration types

- CAM: calcsil - Kfs - mt ± Cu-Au
- HSCC: hm-ser-chl-carb ± Cu-Au-U
- HSCC over CAM

Lithostratigraphy (pre-Pandurra Fm)

MESOPROT.
- *Hiltaba Suite granitoid (1595-1570 Ma)*
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- *Gawler Range Volcanics - felsic*
- *Gawler Range Volcanics- mafic*

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- *Wallaroo Gp - metasedimentary & metavolcanic rocks*
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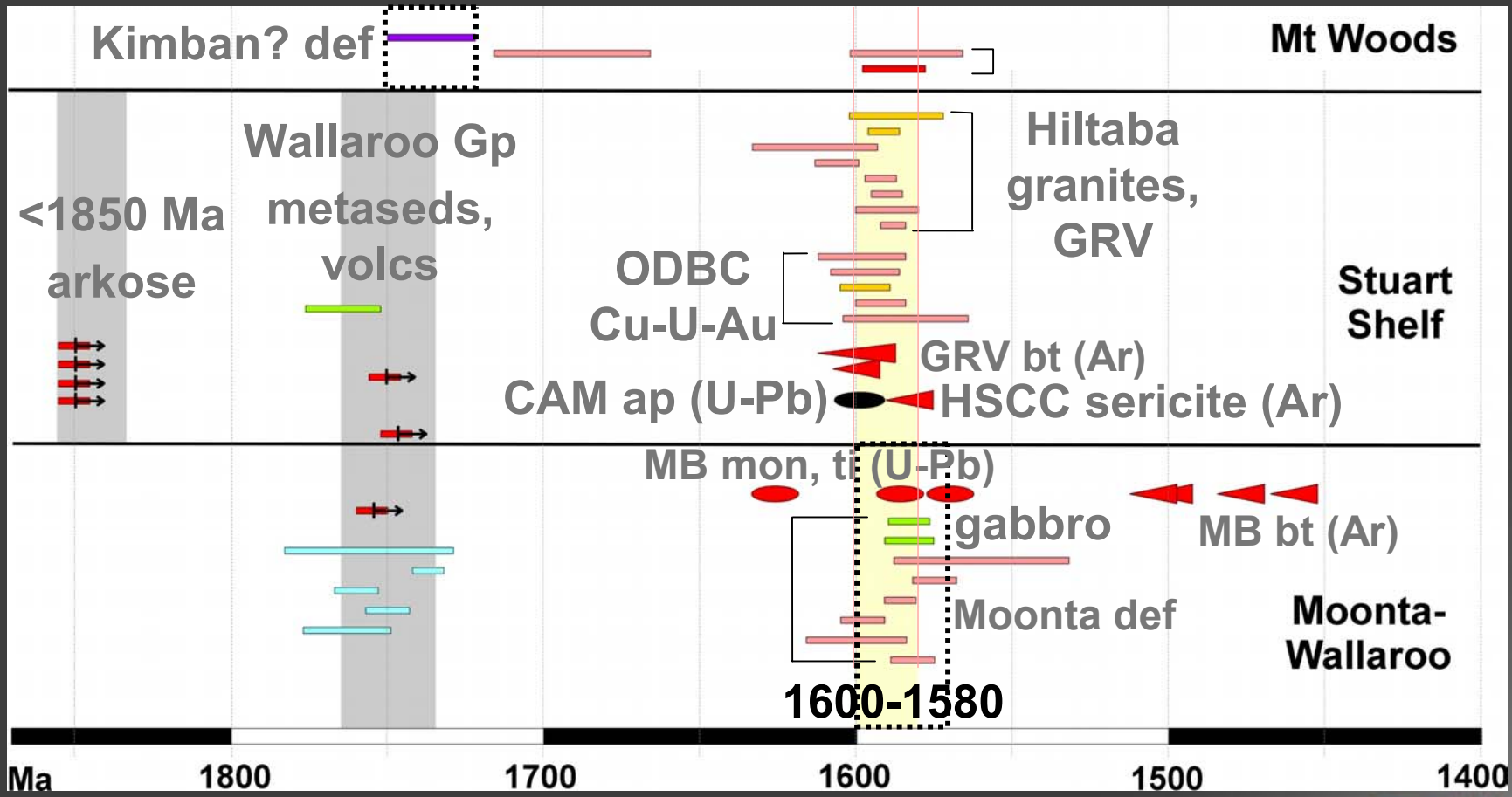
Timing of regional events and hydrothermal activity -

New U-Pb and Ar-Ar constraints

Olympic Cu-Au prov: event timing



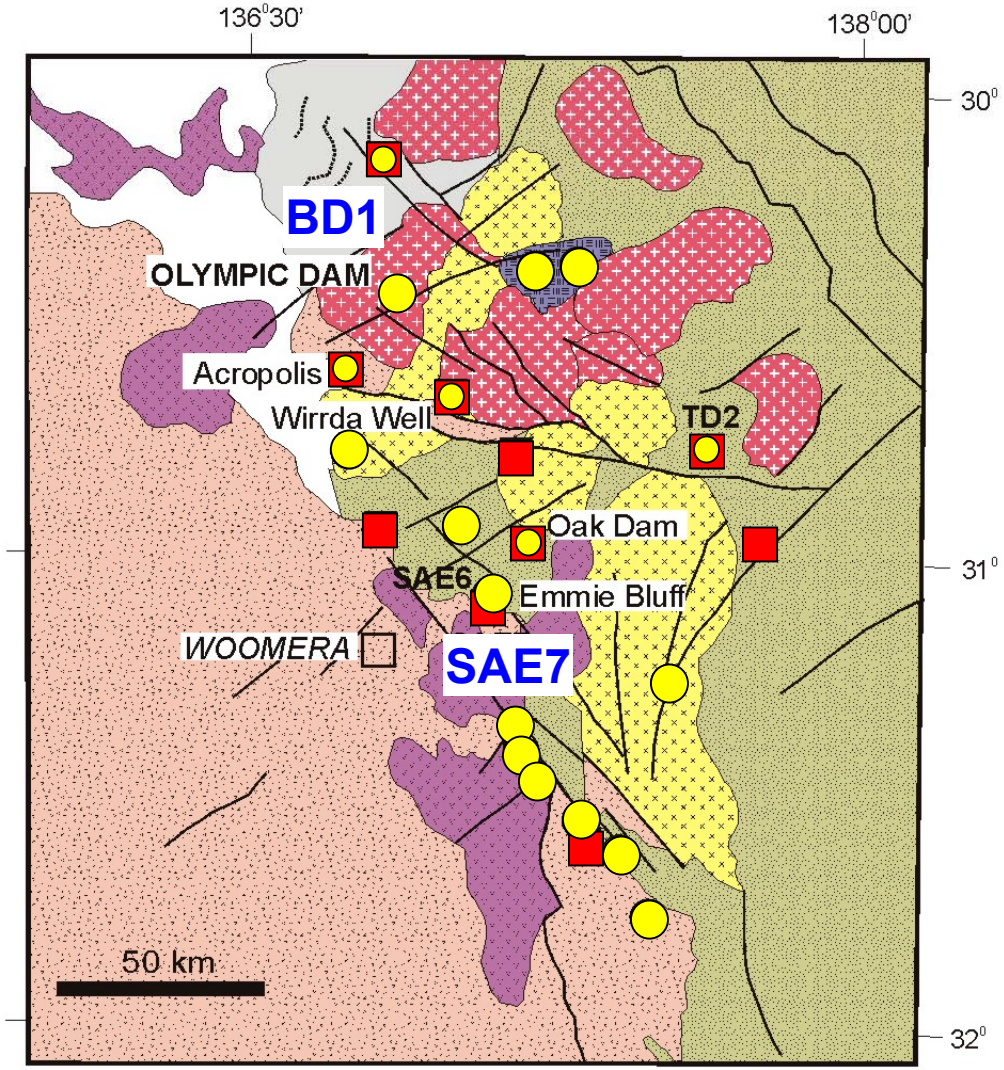
Time, Ma

(new GA-PIRSA results in red; other data from Fanning, Mortimer, Creaser, Johnson, Daly and others)

Metal contents of fluids
(Stuart Shelf basement)

- Brines assoc with CAM alt -
  hypersaline, 350-500^{o}C
- Fluids assoc with HSCC -
  lower salinity, <300^{o}C, surficial origin
- But which of 2 fluids carried Cu, Au, U?
- Targeted FI's in CAM & HSCC quartz

Stuart Shelf basement



Alteration types

- CAM: calcsil - Kfs - mt ± Cu-Au
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- HSCC over CAM

Lithostratigraphy (pre-Pandurra Fm)

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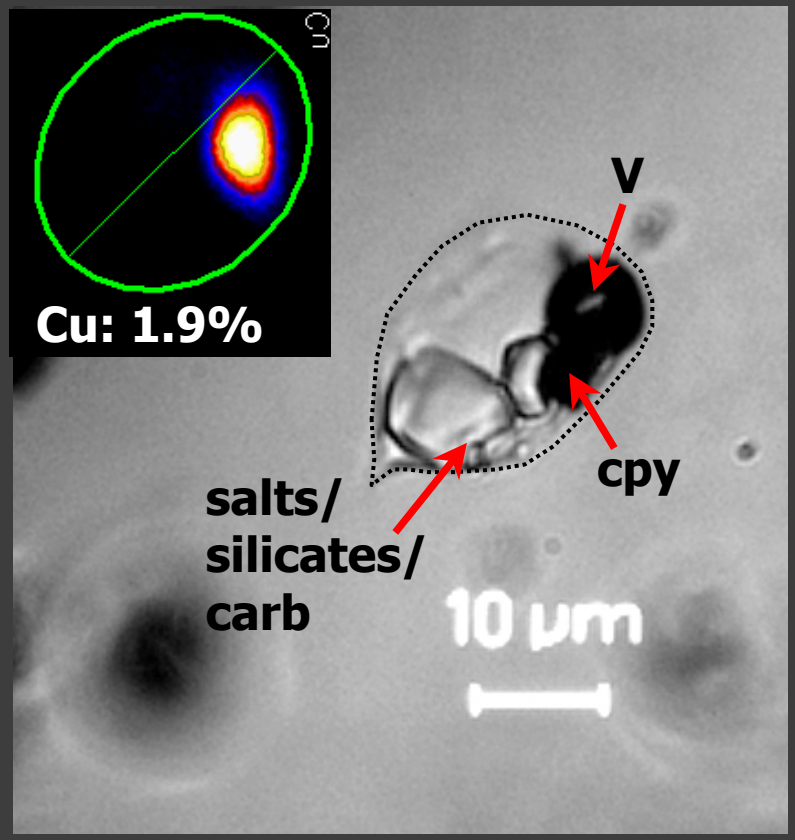
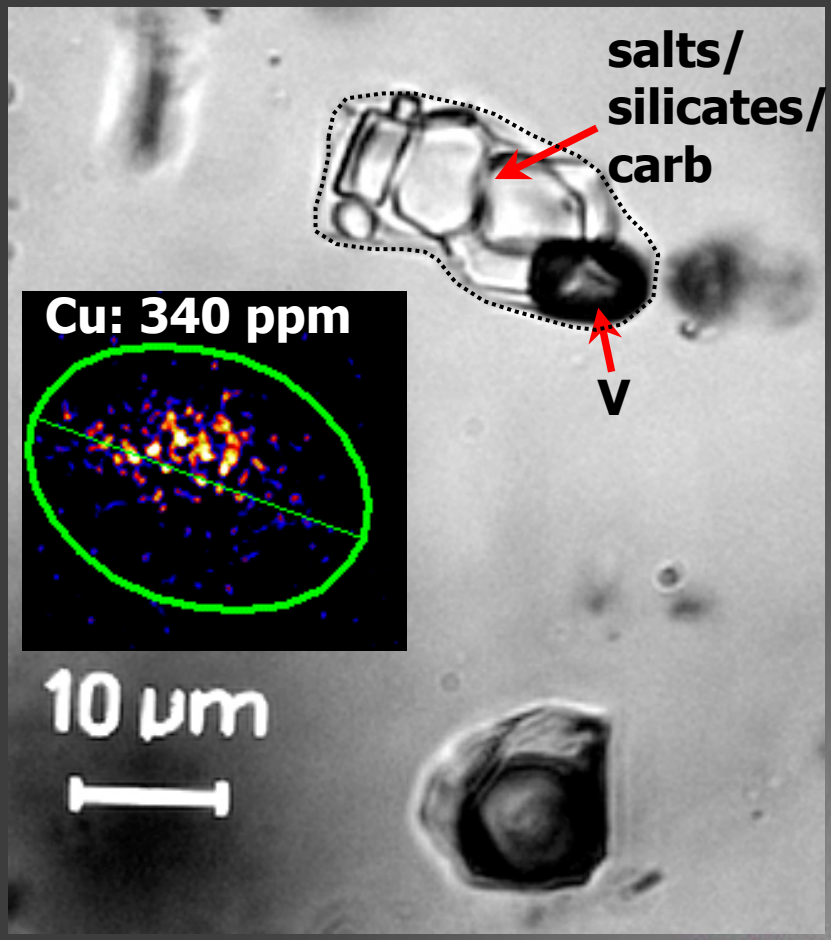
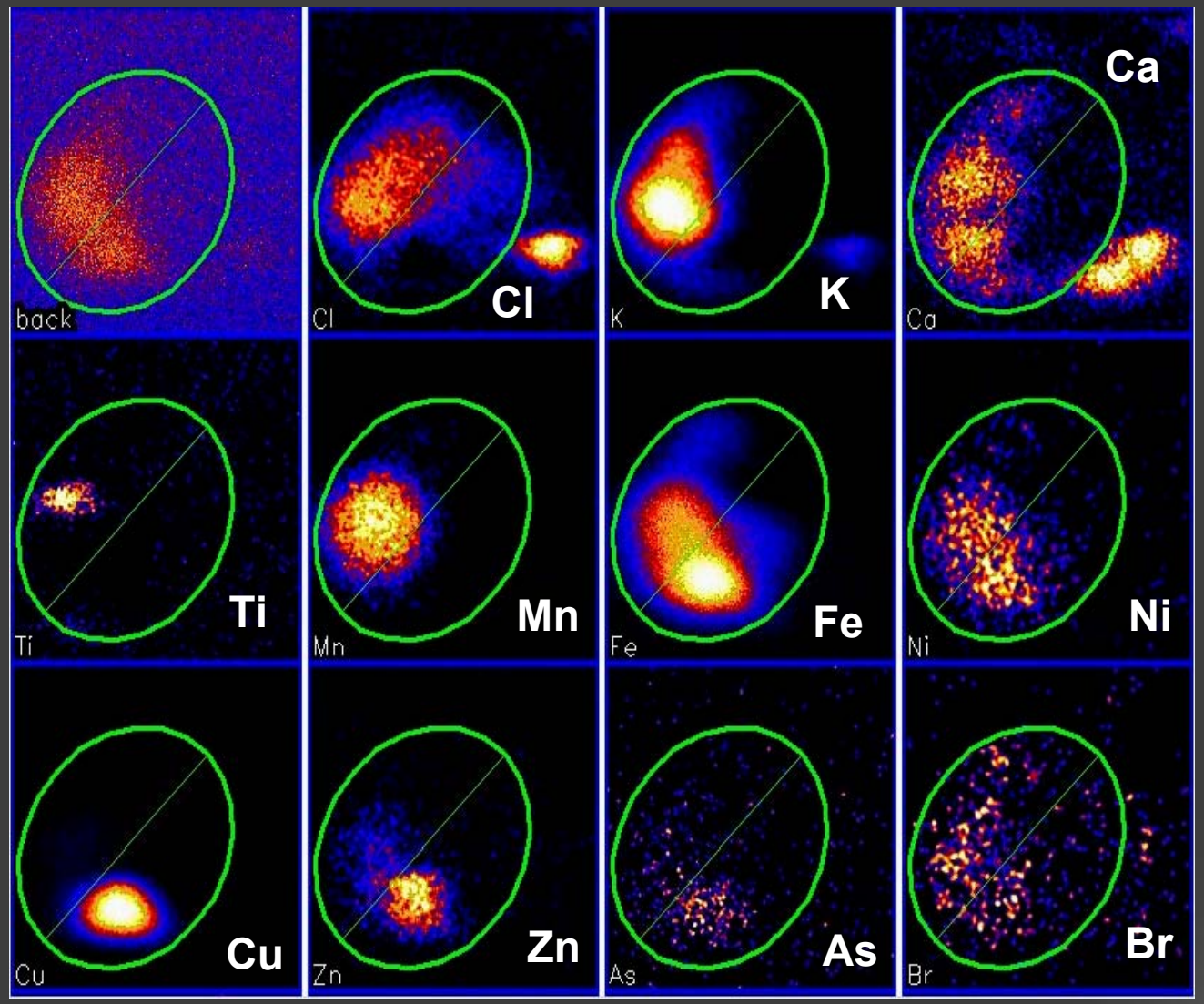
High-temp Cu-bearing brines

(drill hole BD1)

CAM alteration: magnetite-qtz-amp-Kfs-ap-py (trace cpy)







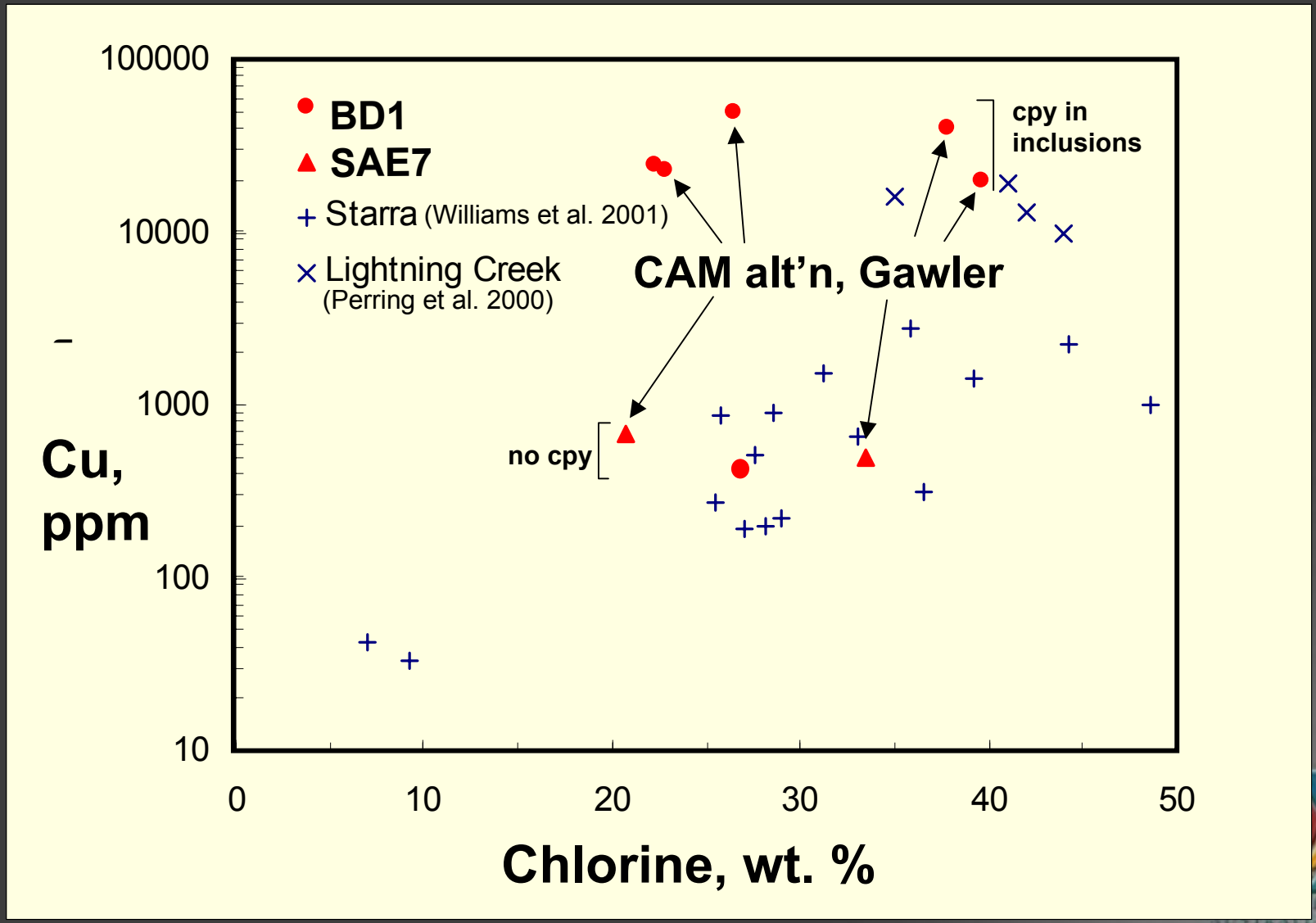
PIXE Analysis of a single fluid inclusion

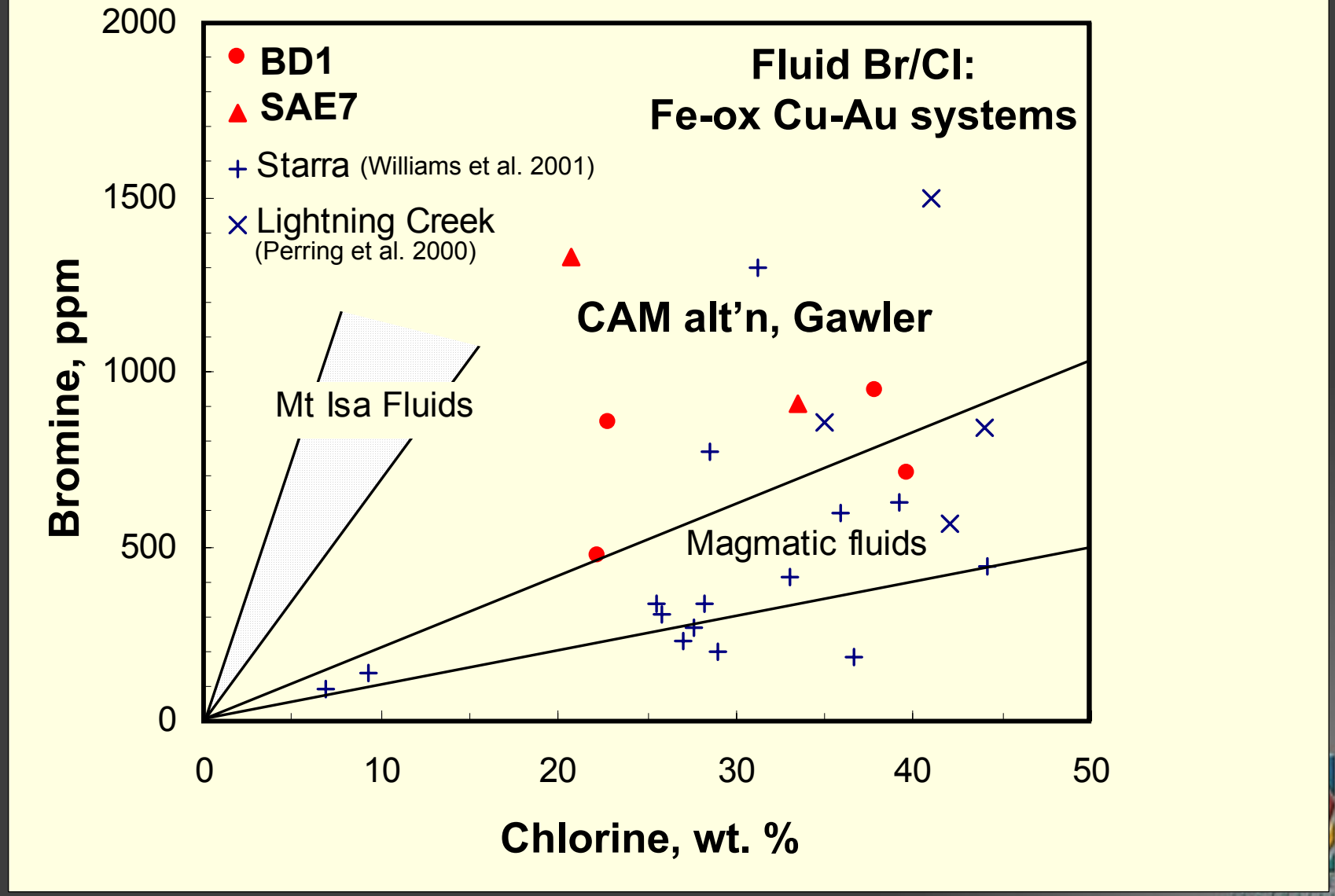
BD1 897.4

(images: CSIRO)

0.03 mm

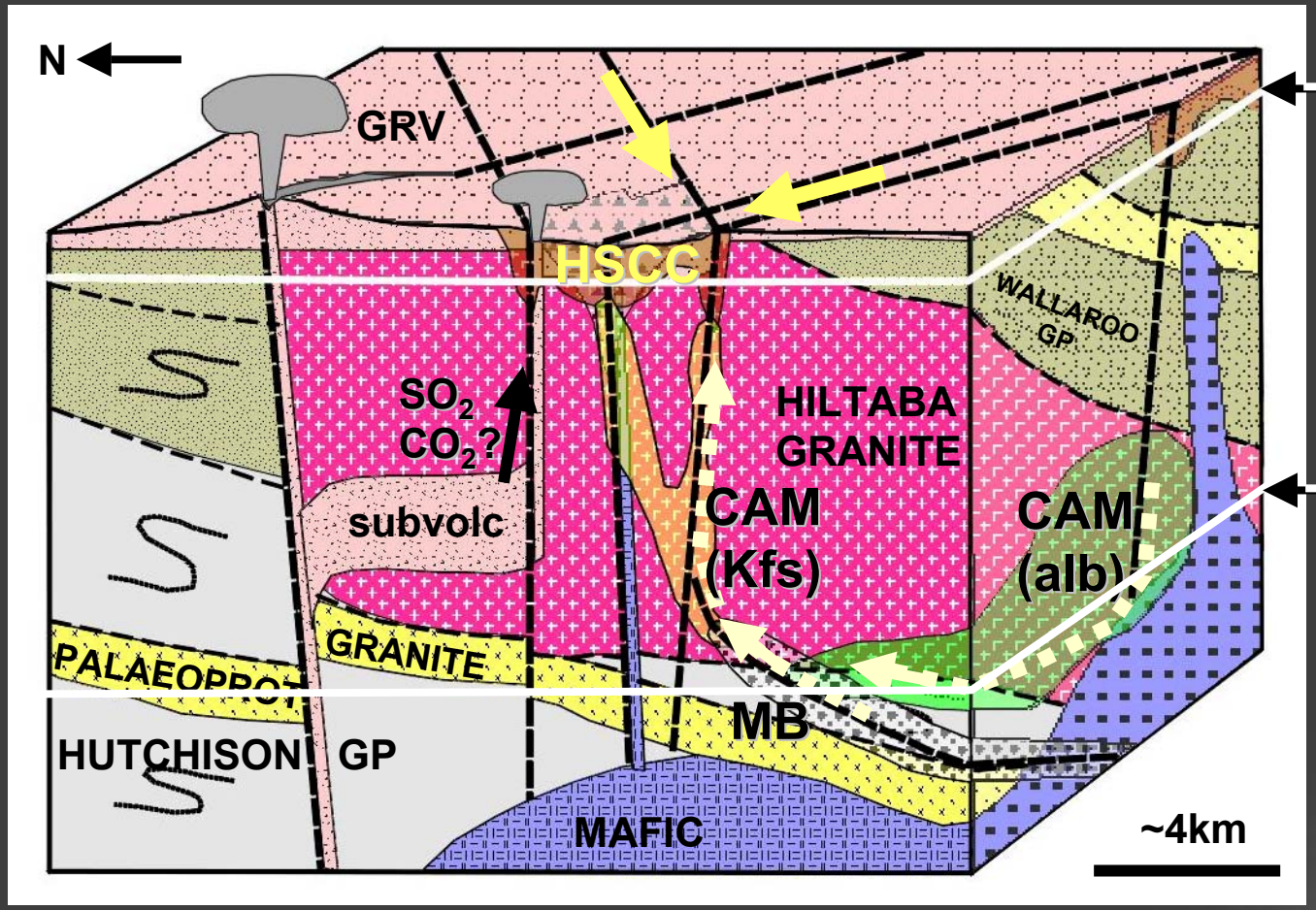
Copper in fluids: Fe-ox Cu-Au systems




Fluid Br/Cl:
Fe-ox Cu-Au systems
BD1
SAE7
Starra (Williams et al. 2001)
Lightning Creek
(Perring et al. 2000)
CAM alt'n, Gawler
Mt Isa Fluids
Magmatic fluids
Bromine, ppm
Chlorine, wt. %
2000
1500
1000
500
0
0
10
20
30
40
50

Implications of PIXE results

- Only minor copper was deposited in mt-rich CAM alt despite brines carrying >300-600 ppm Cu
- Brines too hot to saturate Cu-minerals?
- Efficient Cu deposition requires cooling and/or gradients in redox, pH, Cl, S
- Peripheral zones with HSCC + Cu-Au?
- Ongoing work - HSCC-related fluids



Central Olympic Cu-Au province: ~1590 Ma
Schematic Cu-Au ore-forming system
(view to ENE)

Conclusions

- Three regional ‘footprints’ of hydrothermal & magmatic systems in Olympic Cu-Au province
- High-T CAM alt and lower-T HSCC in each footprint
- Alteration & Cu-Au at 1580-1600 Ma in 3 regions
- Magnetite-related brines carry 300-600 ppm Cu
- But - efficient copper deposition requires a strong chemical or physical (T-P) gradient + sulfur
- Crustal levels of exposure differ in the 3 footprints