Developing a tectonic framework for the Mary Kathleen Belt/Domain - implications for exploration -

Ioan Sanislav, Joshua Spence, Paul Dirks, Carl Spandler, Yanbo Cheng, Truong Le
and the GSQ team

EGRU
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Cairns
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Main points

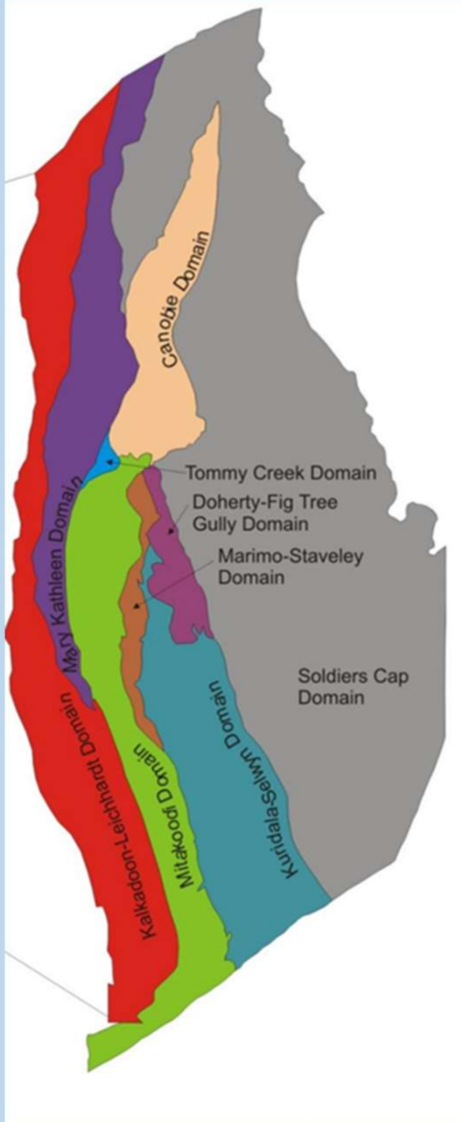
- MKD is not an extensional belt
- MKD was metamorphosed, deformed and intruded by plutons during **the Wonga Orogeny (1800-1680 Ma)**
- Sedimentation was diachronous along the belt – stratigraphy is not continuous
- Metamorphism, deformation and plutonism was diachronous across the belt
- Mineralization is related to Isan overprinting

Summary:

- Introduction to JCU-GSQ project
- Mineralization characteristics
- Preliminary results
  - A new tectonic framework for MKD
  - Implications for exploration
- Conclusions

The EGRU-GSQ project objectives :

1. **Establish the extent, character and timing of the dominant magmatic epochs in the Mary Kathleen Domain of the Mt Isa Inlier**
2. **Develop an understanding of the tectono-magmatic history of the Mary Kathleen Domain and its links to metallogenesis**
3. **Explore the applicability of magma fertility concepts as a tool for exploration for a variety of deposit types**
4. **Develop new concepts that can be used for exploration in the Mary Kathleen Domain**



Simplified geology of the EFB

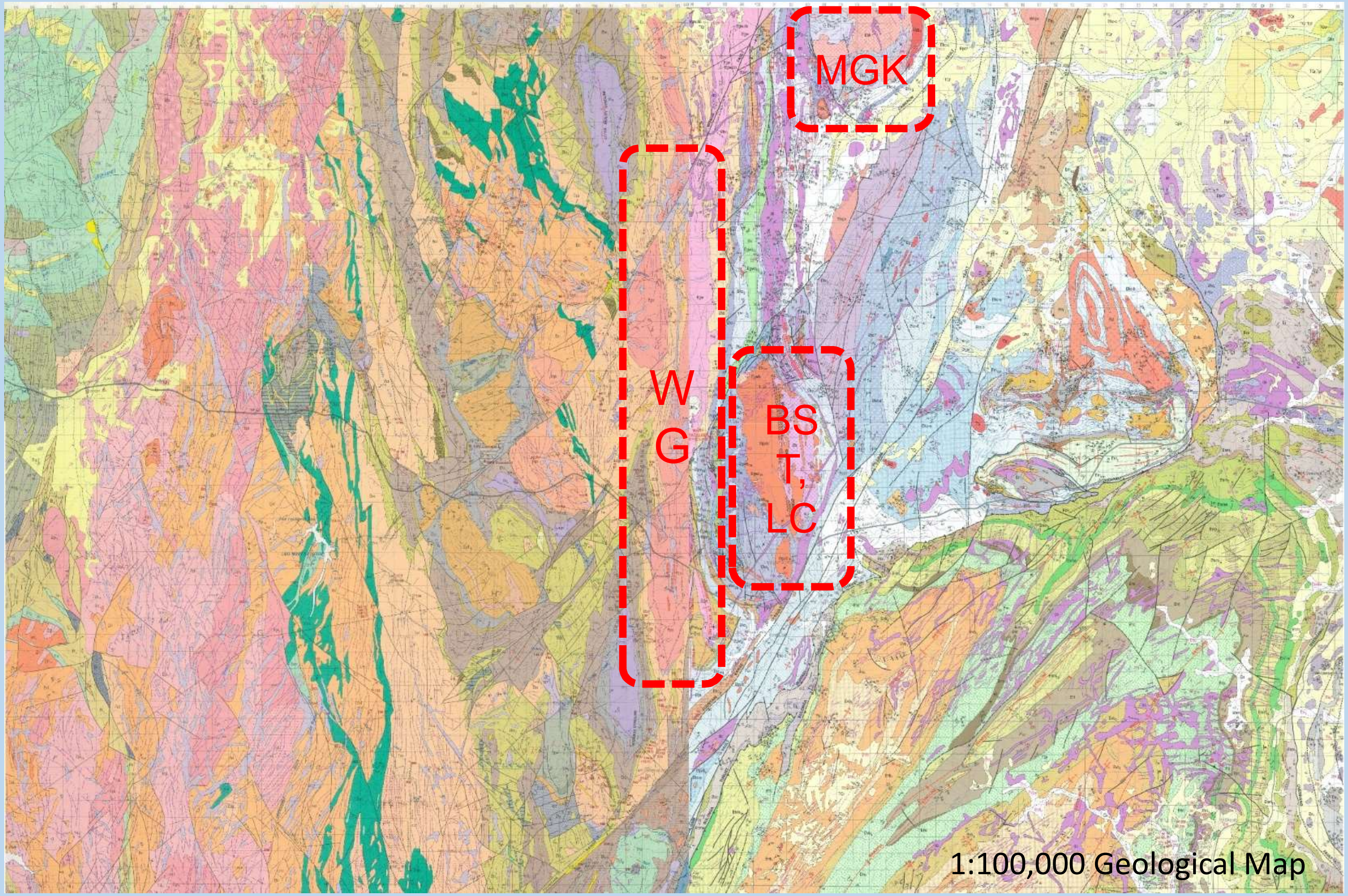
EGRU

EGRU team working on the MKD project

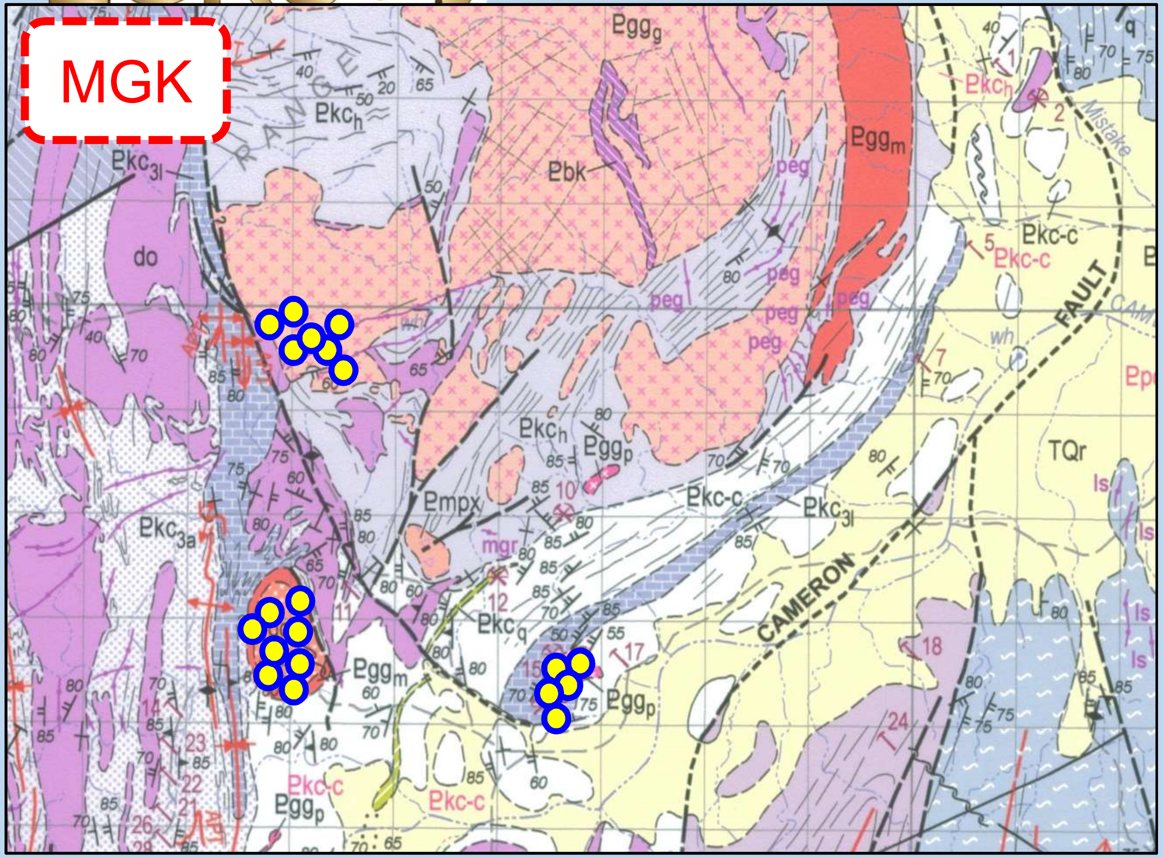
JCU Team	Project
Dr. Yanbo Cheng (postdoctoral researcher)	Magmatic evolution of MKD and implications for metallogenesis
Truong Le (Phd student)	Tick Hill deposit – deposit model, genesis and setting
Joshua Spence (PhD student)	Structure and intrusive history
Chinelle Smits (MSc student)	Fluid sources and fluid inclusion database
Alex Edgar (Honours student)	Scapolite around Elaine Dorothy
Travis Mackay (Honours student)	Pilgrim and Fountain Range Faults

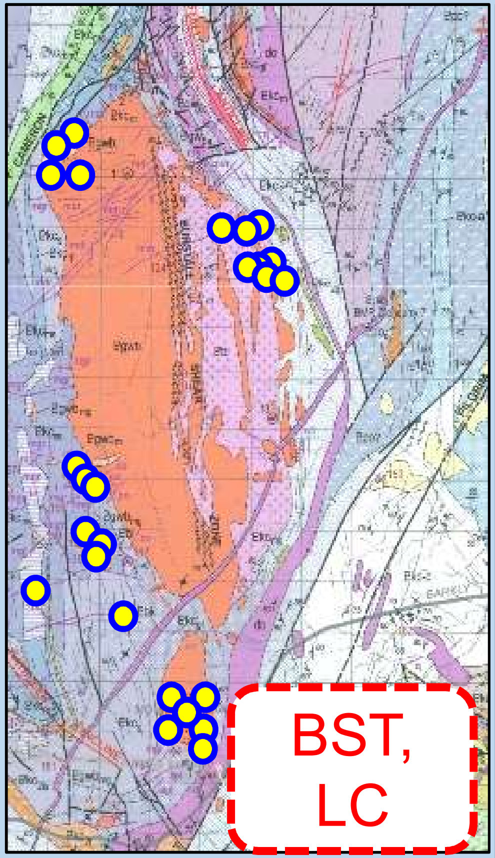
EGRU students working on related projects

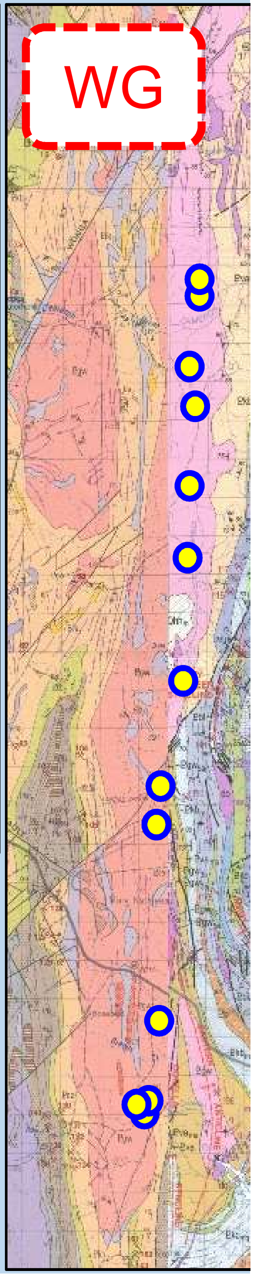
JCU Team	Project
Alex Brown (PhD student)	Tommy Creek block
Pieter Creus (PhD student)	Dugald River deposit
Keanu Stinson (Honours student)	Stara deposits
Grace Manestar (Honours student)	Peak metamorphism fluids



Mapping and sampling areas from 2018







Mt Godkin (MGK) granitoids: 20 samples

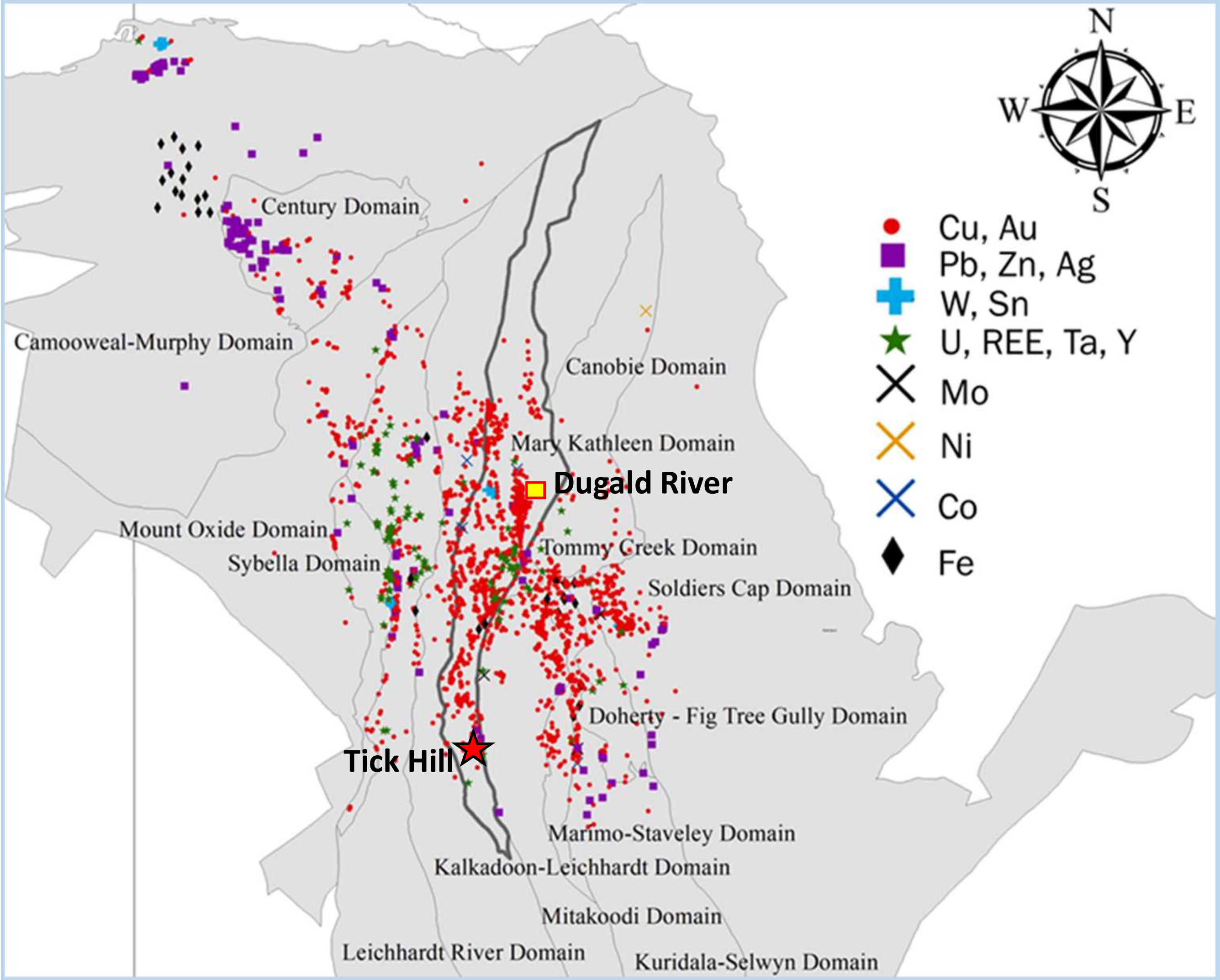
Burstal (BST) granitoids: 13 samples

Burstal mafic / felsic dykes: 6 samples

Lunck Creek (LC) gabbro: 8 samples

Wonga (WG) granitoids: 12 samples

Mineralization characteristics



Cu-Au:

- ***Mount Colin, Trekelano, Duchess, Overlander,*** **Elaine Dorothy,**

U-REE:

- ***Mary Kathleen***

Au only:

- ***Tick Hill***

Pb-Zn-Ag:

- ***Dugald River***

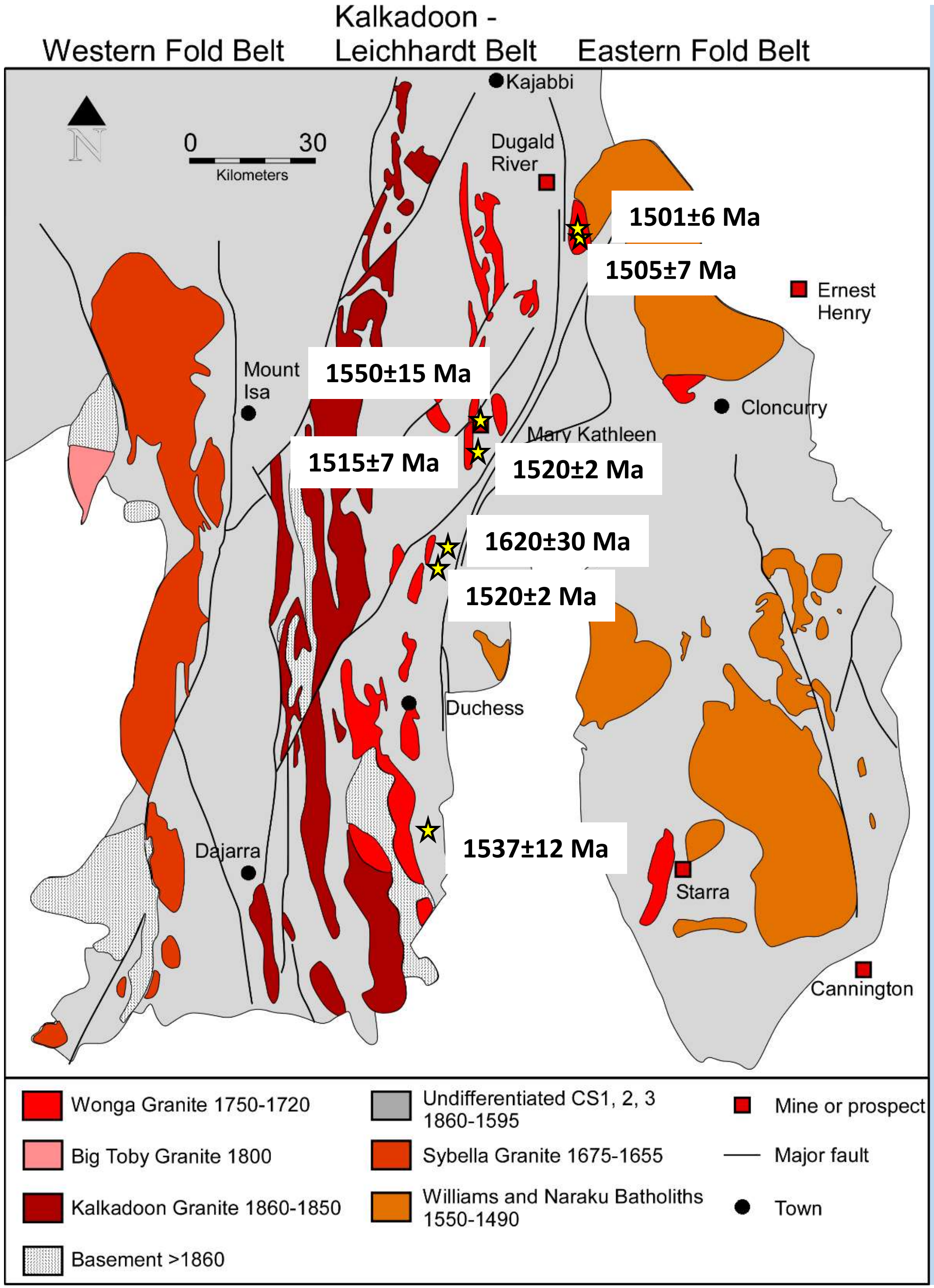
Cu-Au

- **Little Eva, Lady Clayre**

Distribution of mineral occurrences in the Mt Isa Inlier

Characteristics	Metamorphism	Deformation	Intrusive events	Scale
Economic Cu-Au±U±Ag (REE, Co, Mo etc)	Peak metamorphism/ Retrograde stage	D_2 /D_3 or later	~1590 Ma pegmatites/ 1550-1490 Ma plutons	Local
Sodic and/or sodic-calcic alteration	Peak metamorphism	D_2	~1590 Ma pegmatites	Regional
Fe-oxides, biotite, K-feldspar, apatite	Retrograde stage (upper greenschist facies)	D_3 or later	1550-1490 Ma plutons	Local
Strong structural control (brittle-ductile shears)	Retrograde stage (upper greenschist facies)	D_3 or later	1550-1490 Ma plutons	Local/Regional
Temporal association with A or I type plutons	Locally high grade (contact)/Retrograde stage	D_3 or later	1550-1490 Ma plutons	Regional

General characteristics of Cu-Au deposits in the EFB



Zircon ages

1505 and 1501 Ma – Dipvale granite

1620 Ma - rhyolite from Corella FM

1520 Ma - rhyolite from Corella FM

1537 Ma - pegmatite at Tick Hill

Uraninite:

1550 Ma – MK mineralization age

Titanite age

1520 Ma - Elaine Dorothy hydrothermal

Monazite age

1515 Ma - Deformation/metamorphism age

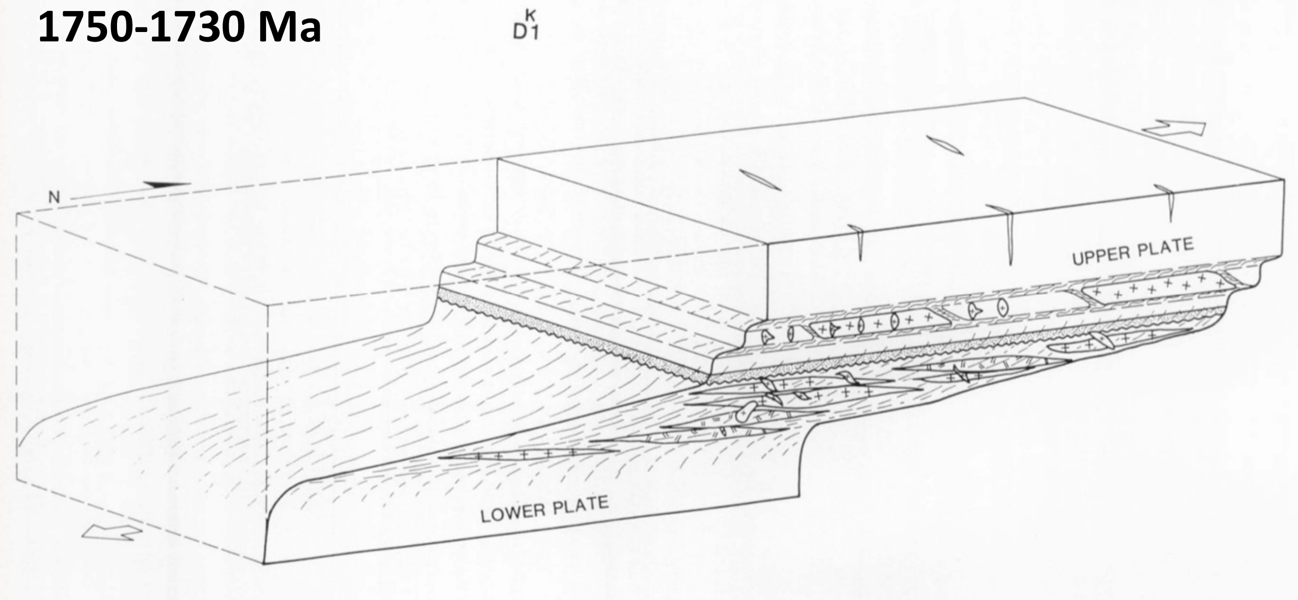
Igneous provinces in Mt Isa

Preliminary results

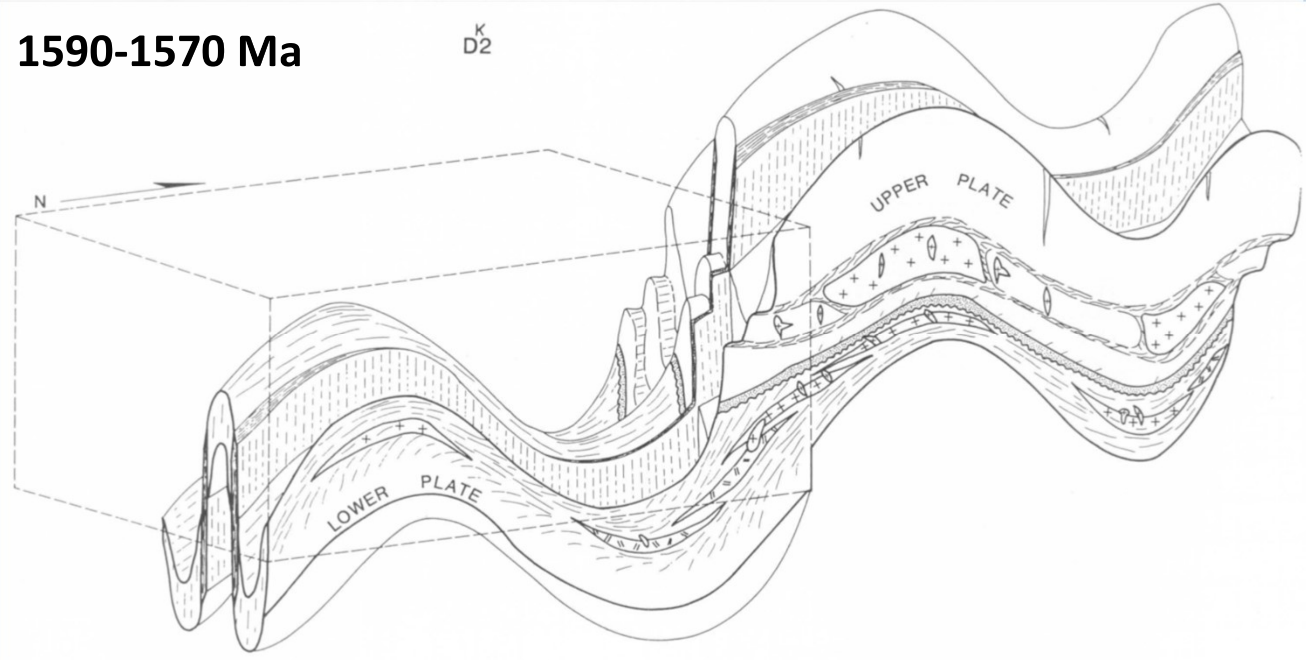
- **A new tectonic framework for MKD**
- **Implications for exploration**

The extensional belt model

1750-1730 Ma



1590-1570 Ma



Holcombe at al., 1991
Oliver et al., 1991
Holcombe et al., 1992
Pearson et al .,1992

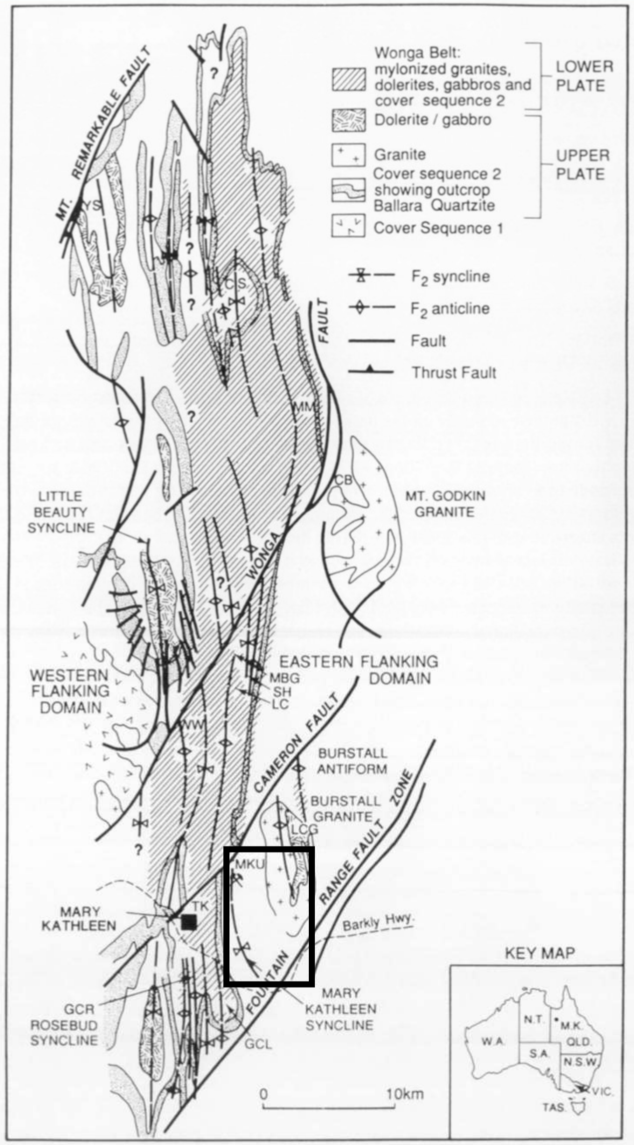


Fig. 1. General geology of the Mary Kathleen Fold Belt showing major structural elements and localities mentioned in the text. BG: Burstall Granite; CB: Copper Blonde mine; CS: 'Circular Structure'; GCL: Greens Creek, Lake Corella; GCR: Greens Creek, Rosebud; JS: Jubilee Springs; LBS: Little Beauty Syncline; LC: Lime Creek; LCG: Lunch Creek Gabbro; MBC: Middle Breakfast Creek; MGG: Mount Godkin Granite; MKS: Mary Kathleen Syncline; MKU: Mary Kathleen U-REE mine (abandoned); MM: Mount Maggie; RD: Rosebud Dam; RS: Rosebud Syncline; SH: 'Schist Hill'; TK: 'The Knob'; WC: Winston Churchill; WW: Wonga Waterhole; YS: Prospector 'Yamamilla' Syncline.

Holcombe et al., 1992

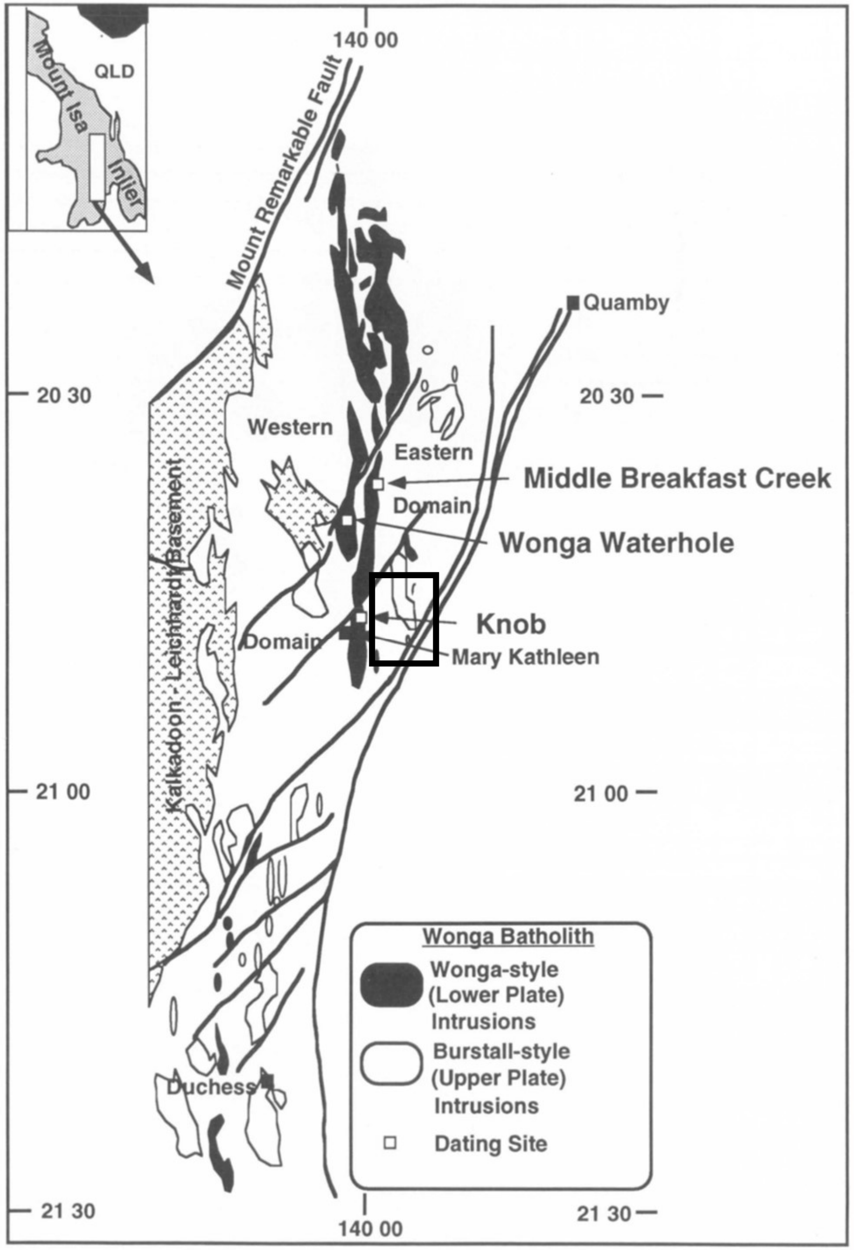
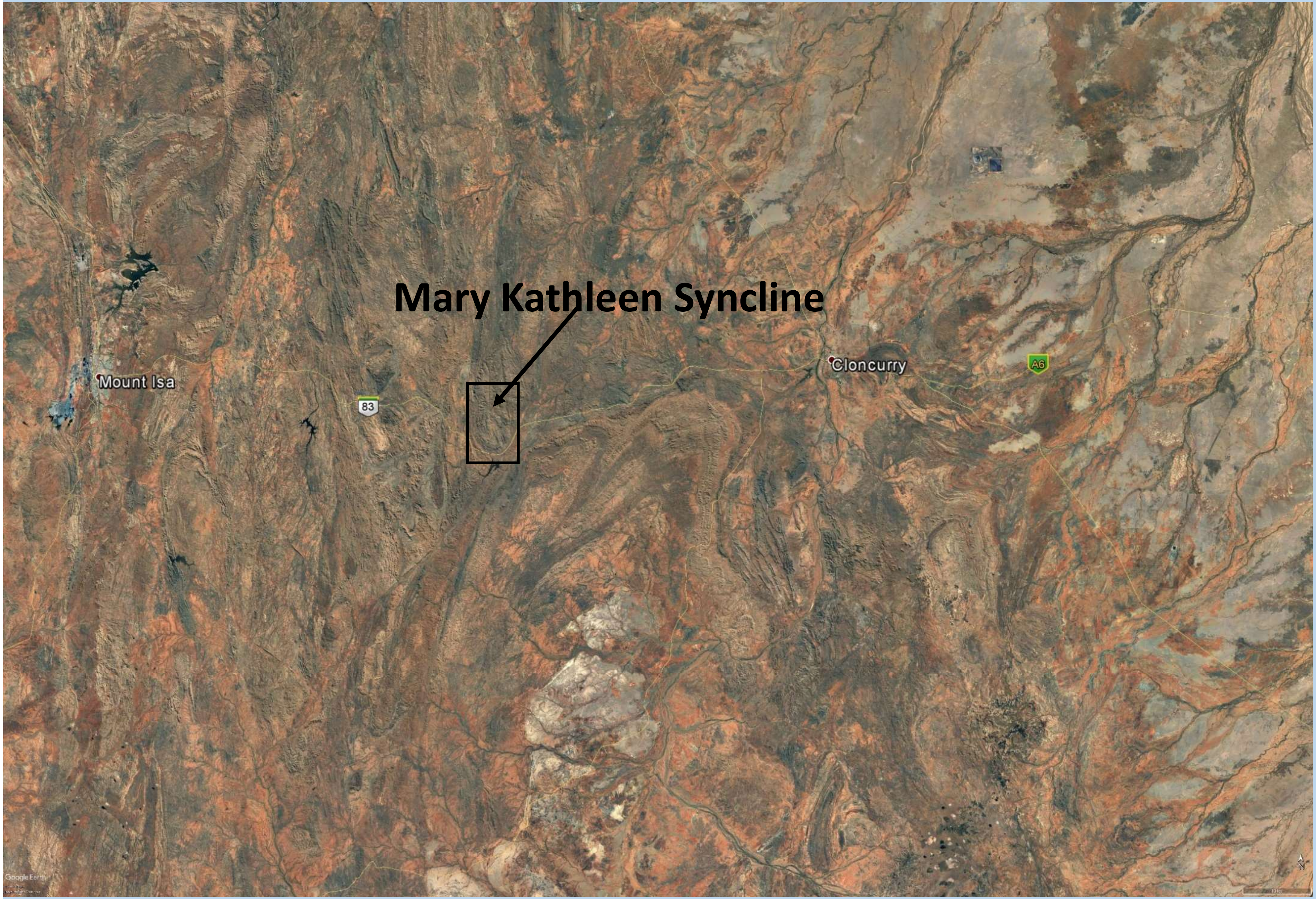
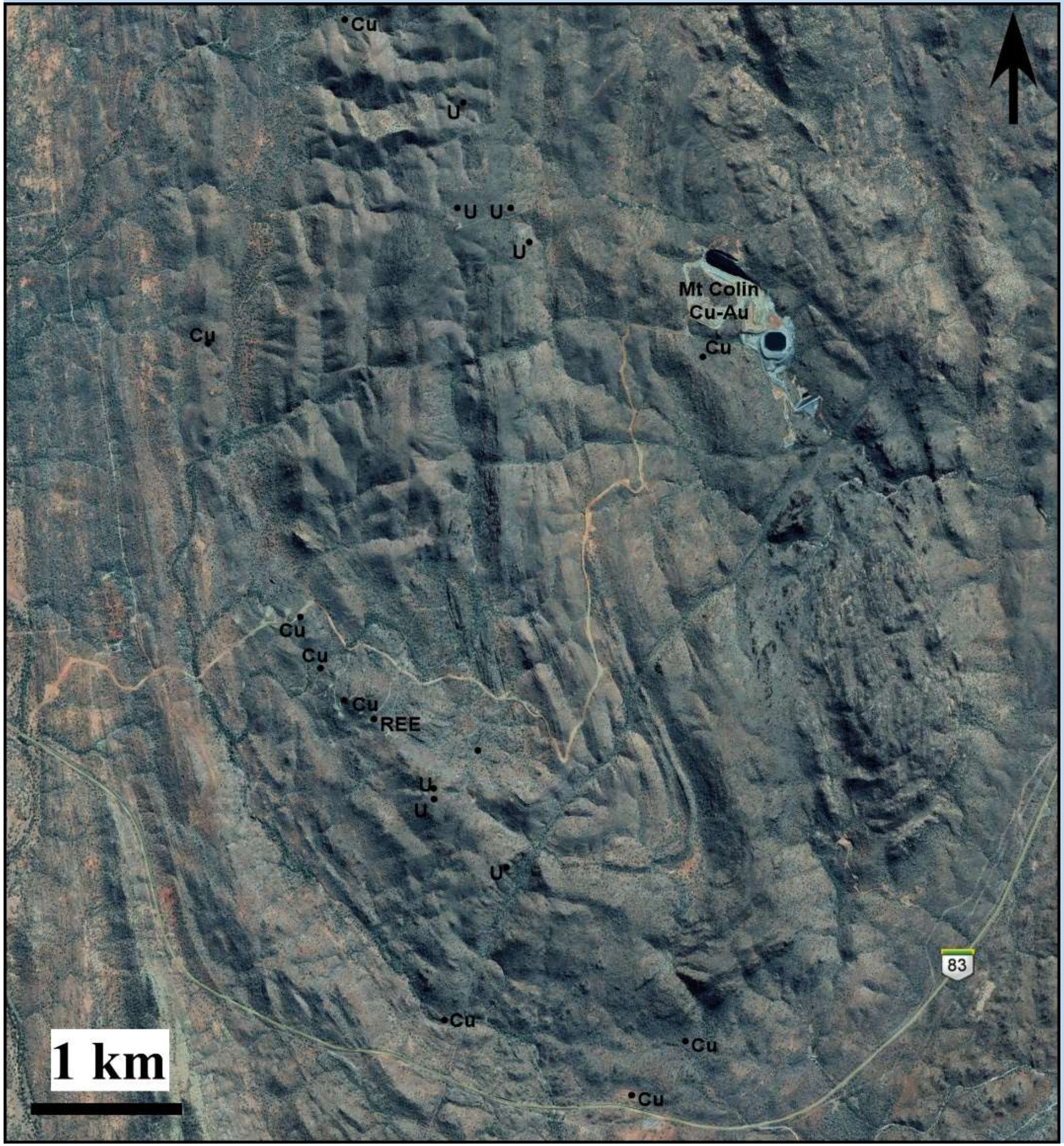


Fig.1. Locality map showing the Mount Isa Inlier, Mary Kathleen Fold Belt, and distribution of the Wonga Batholith.

Pearson et al., 1992


Mary Kathleen Syncline
Mount Isa
83
Cloncurry
A6
Google Earth


Cu
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Mt Colin
Cu-Au
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REE
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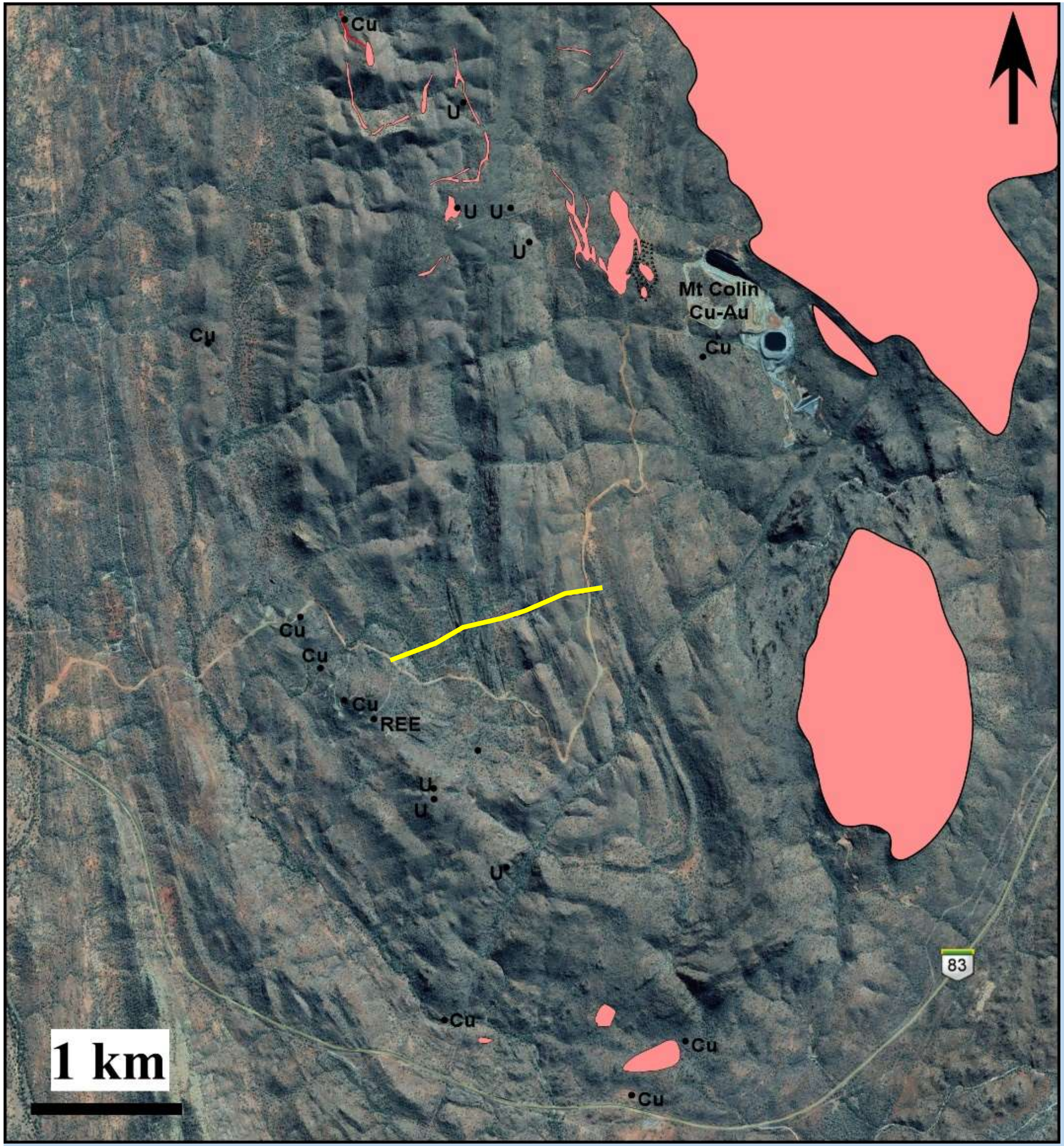
1 km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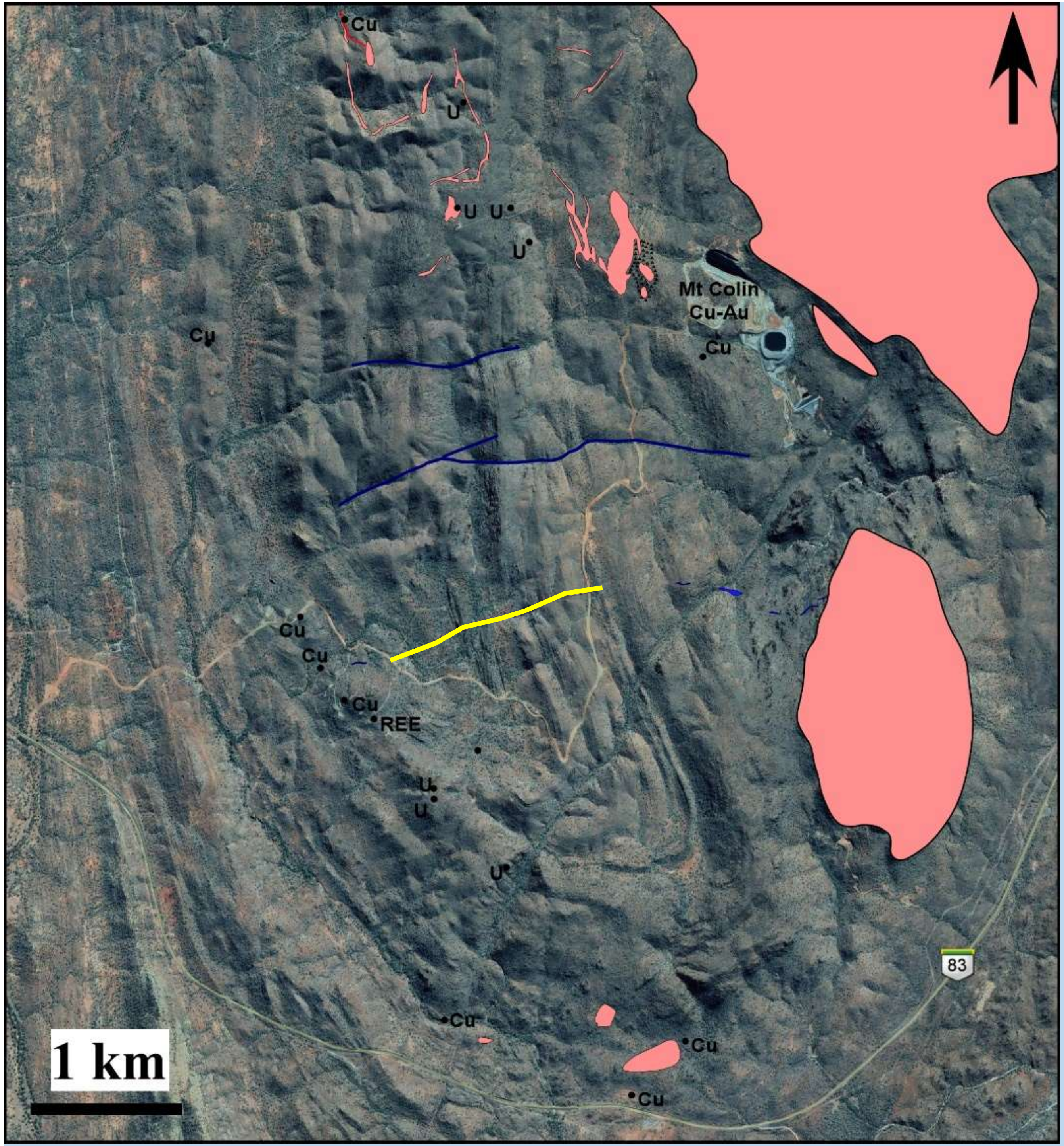
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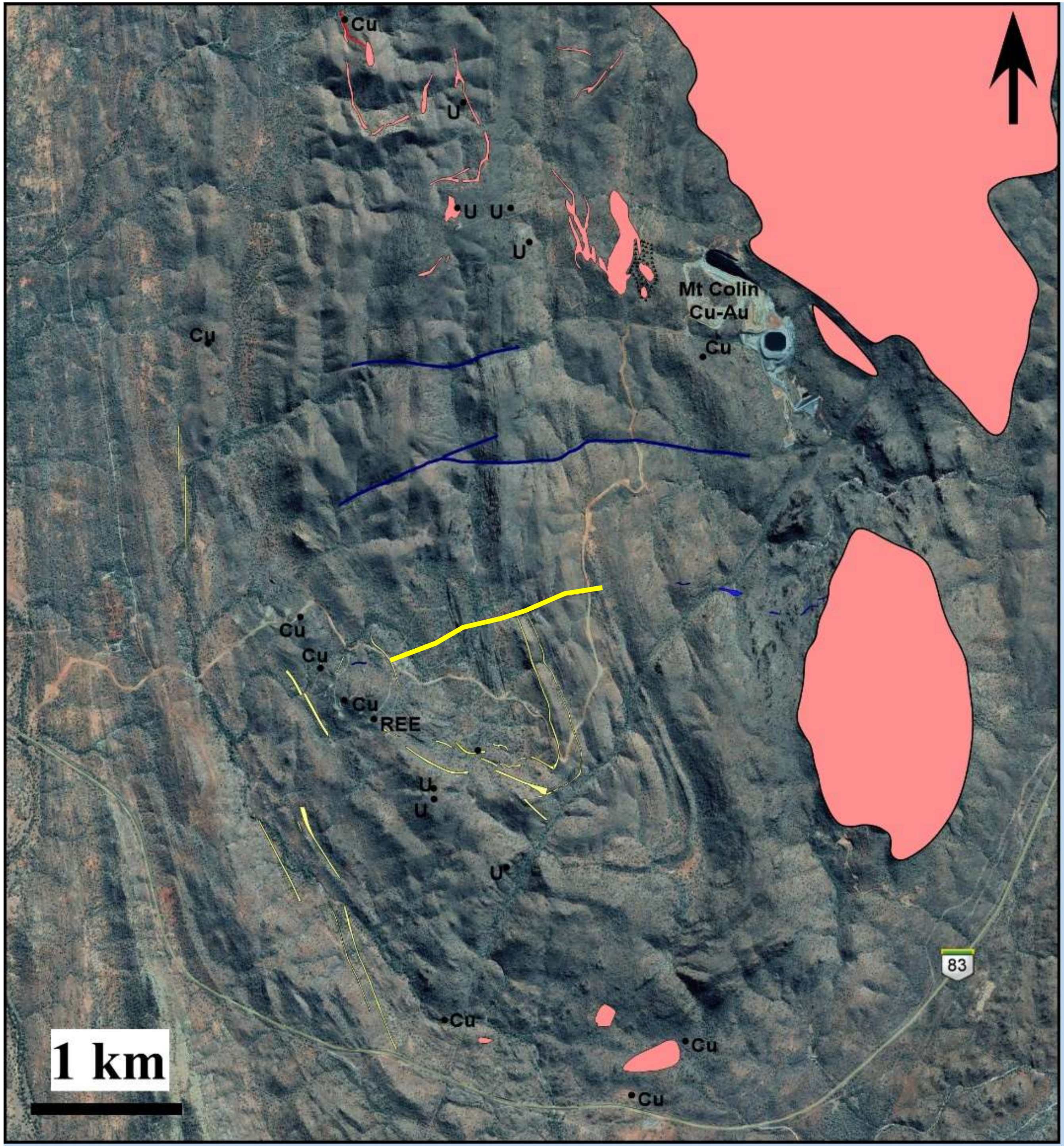
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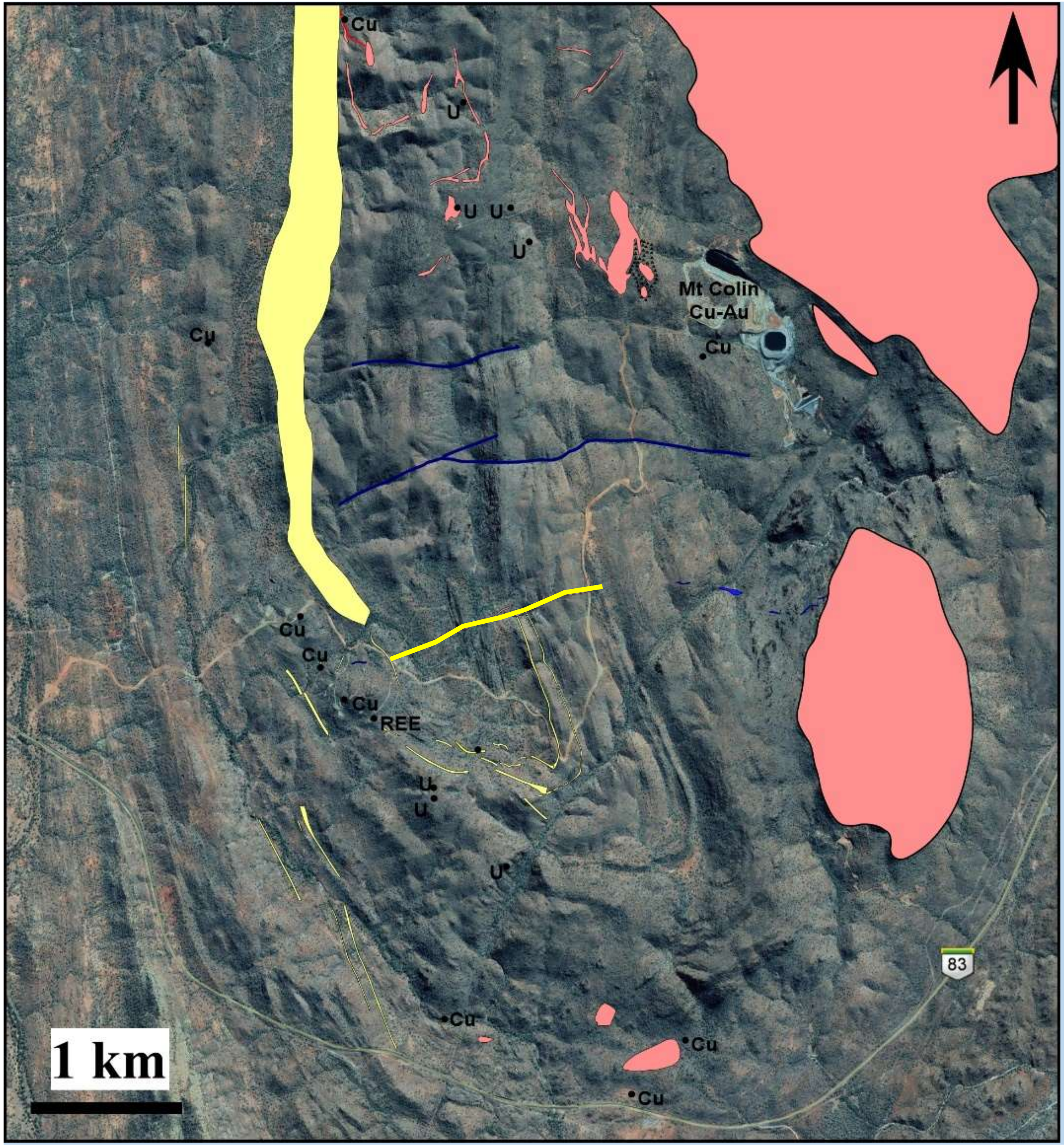

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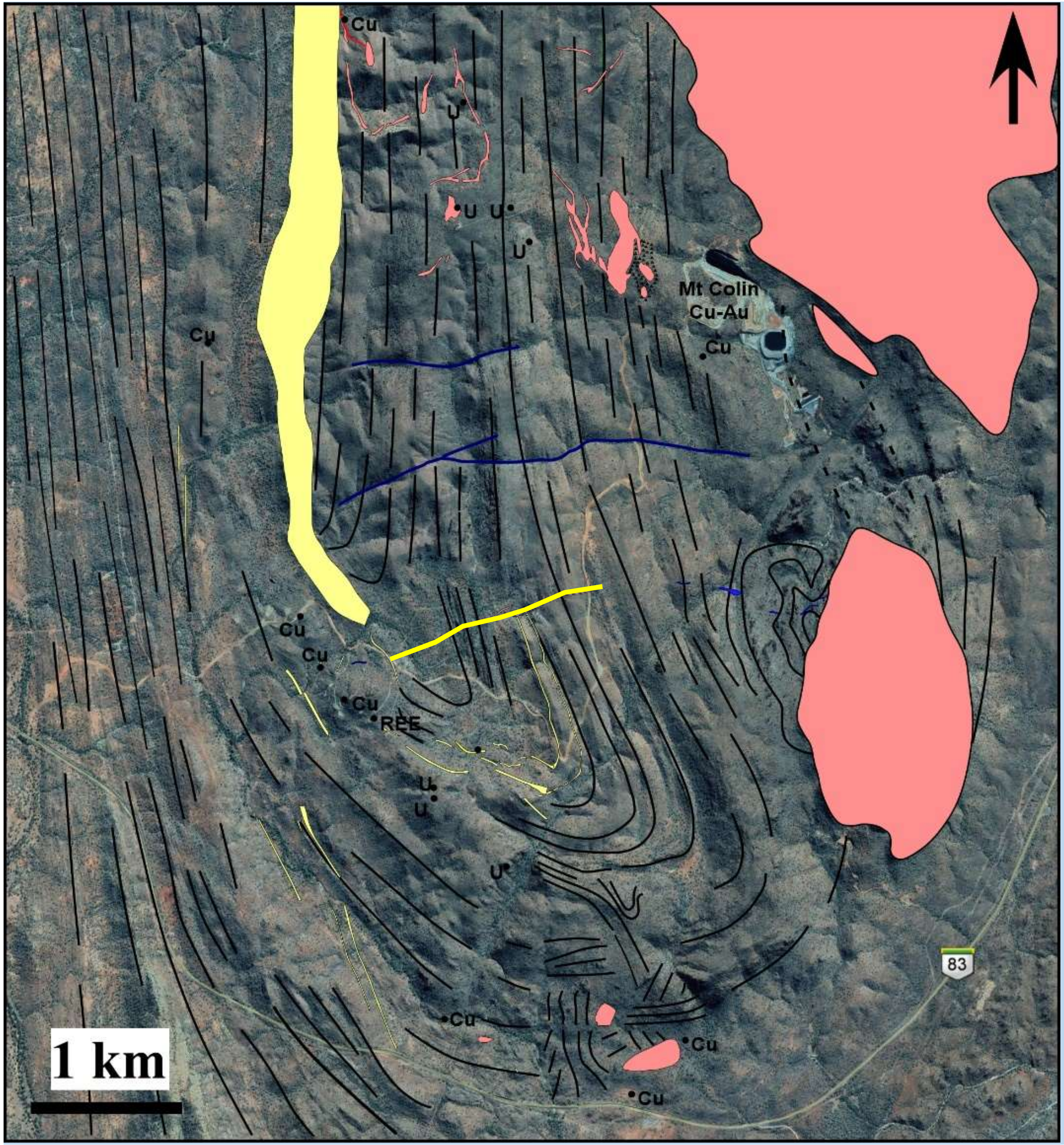

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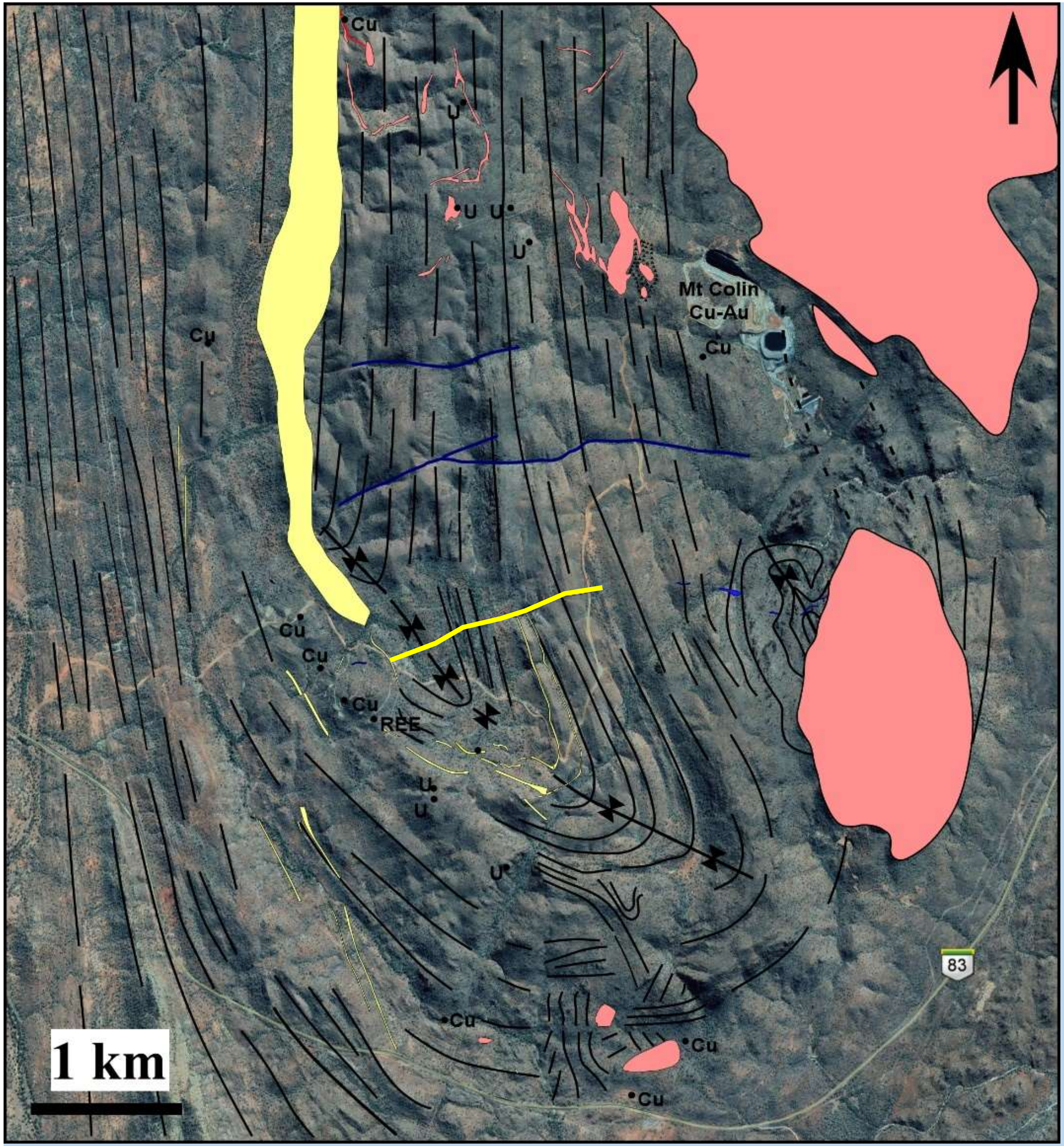
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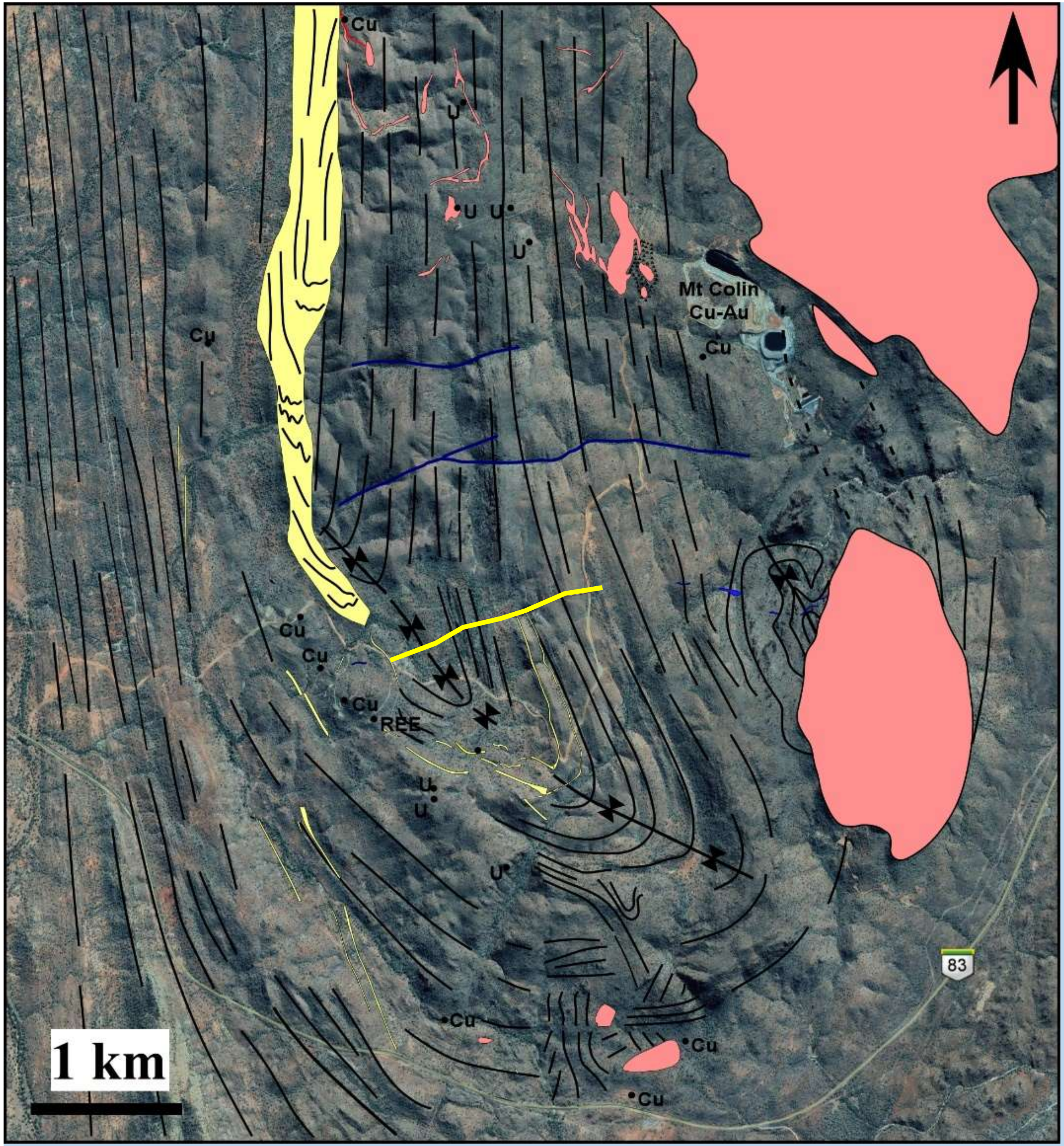

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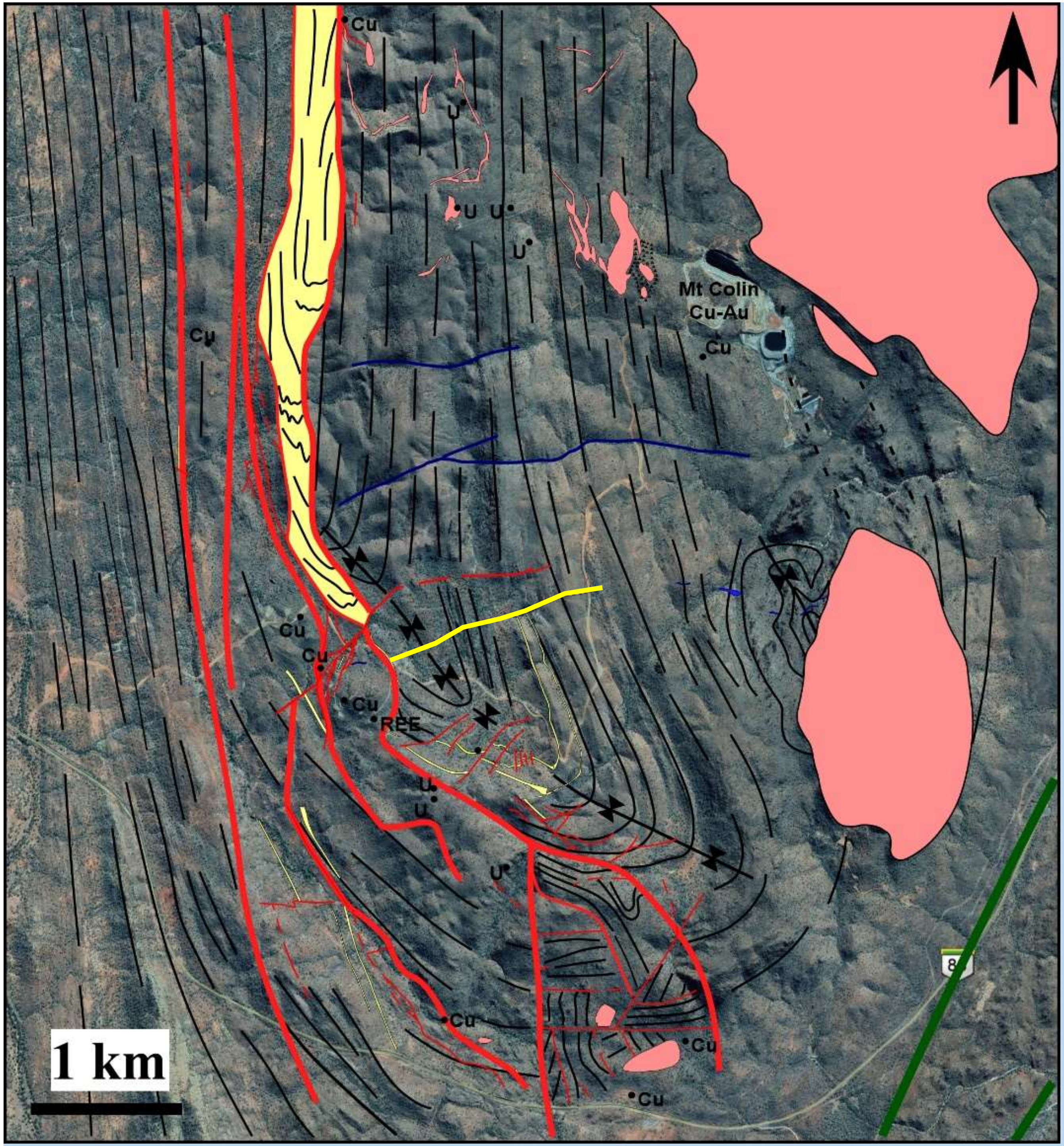
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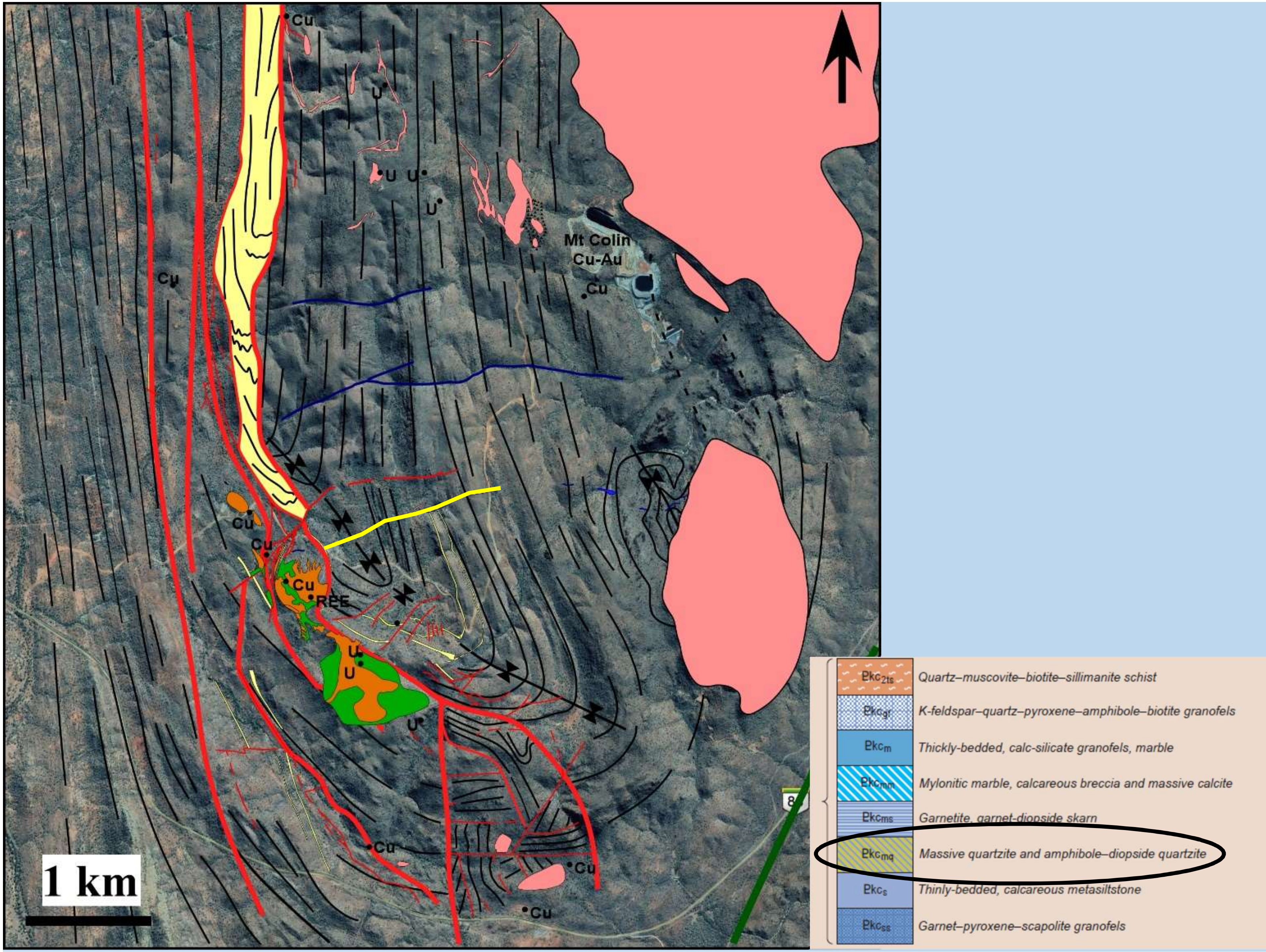
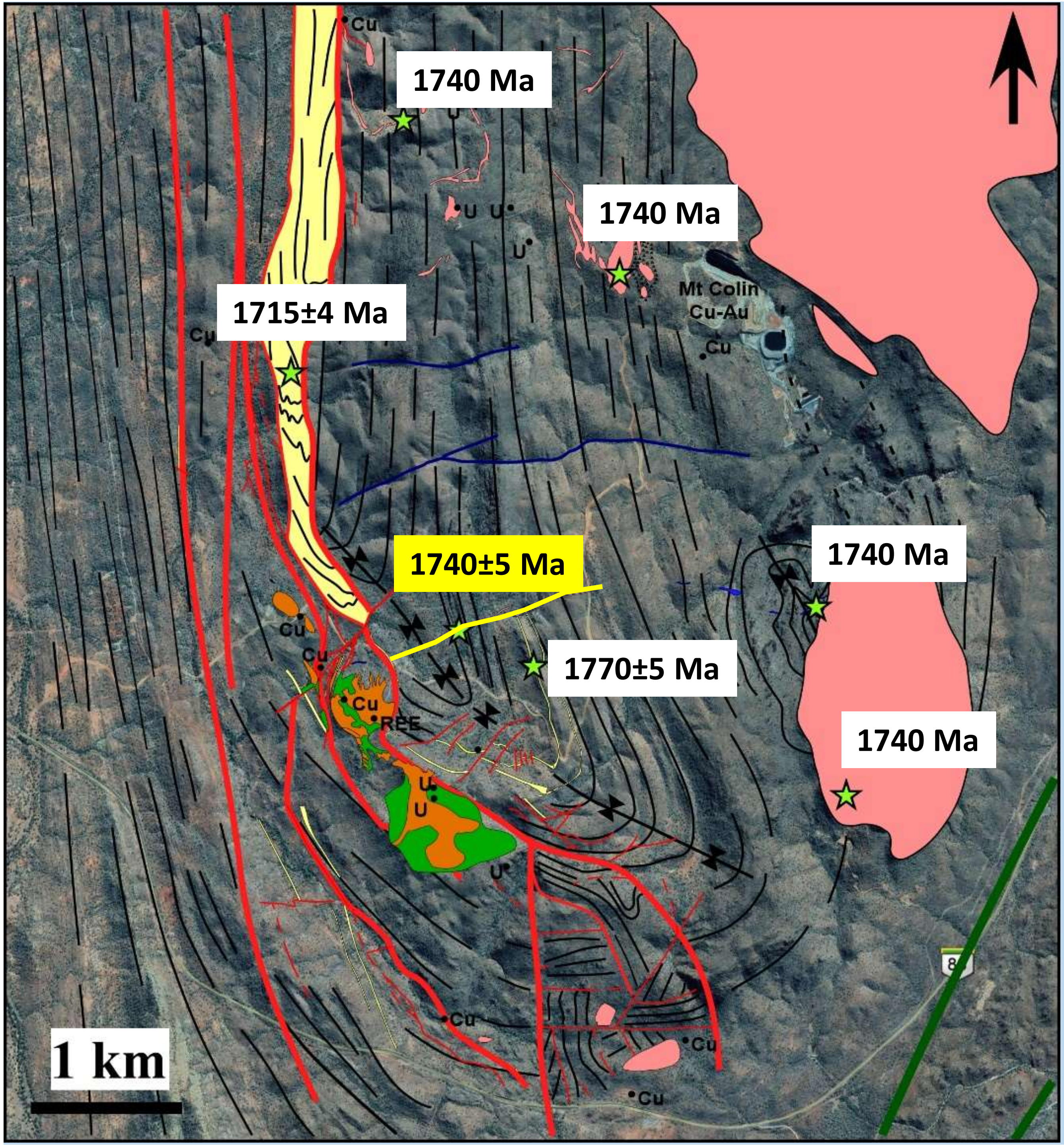
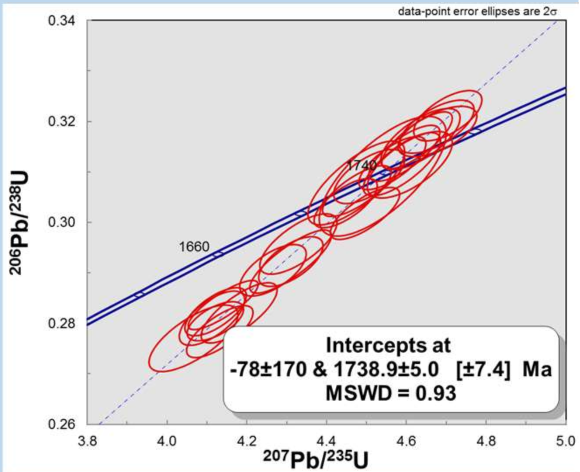
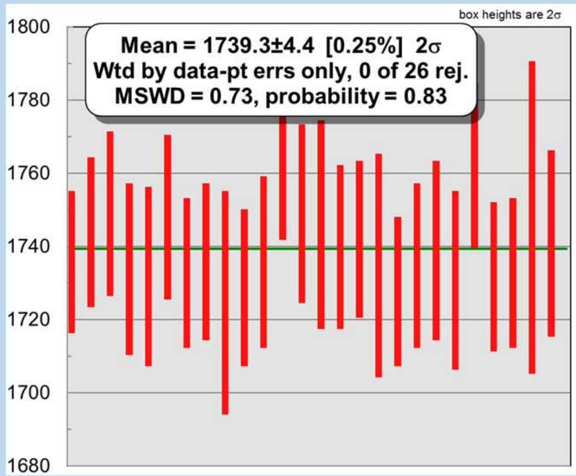


Mt Colin
Cu-Au
Cu
U
REE
1 km
Ꝑkc2ts
Quartz–muscovite–biotite–sillimanite schist
Ꝑkcgr
K-feldspar–quartz–pyroxene–amphibole–biotite granofels
Ꝑkcm
Thickly-bedded, calc-silicate granofels, marble
Ꝑkcmm
Mylonitic marble, calcareous breccia and massive calcite
Ꝑkcms
Garnetite, garnet-diopside skarn
Ꝑkcmq
Massive quartzite and amphibole–diopside quartzite
Ꝑkcs
Thinly-bedded, calcareous metasiltstone
Ꝑkcss
Garnet–pyroxene–scapolite granofels

Zircon ages



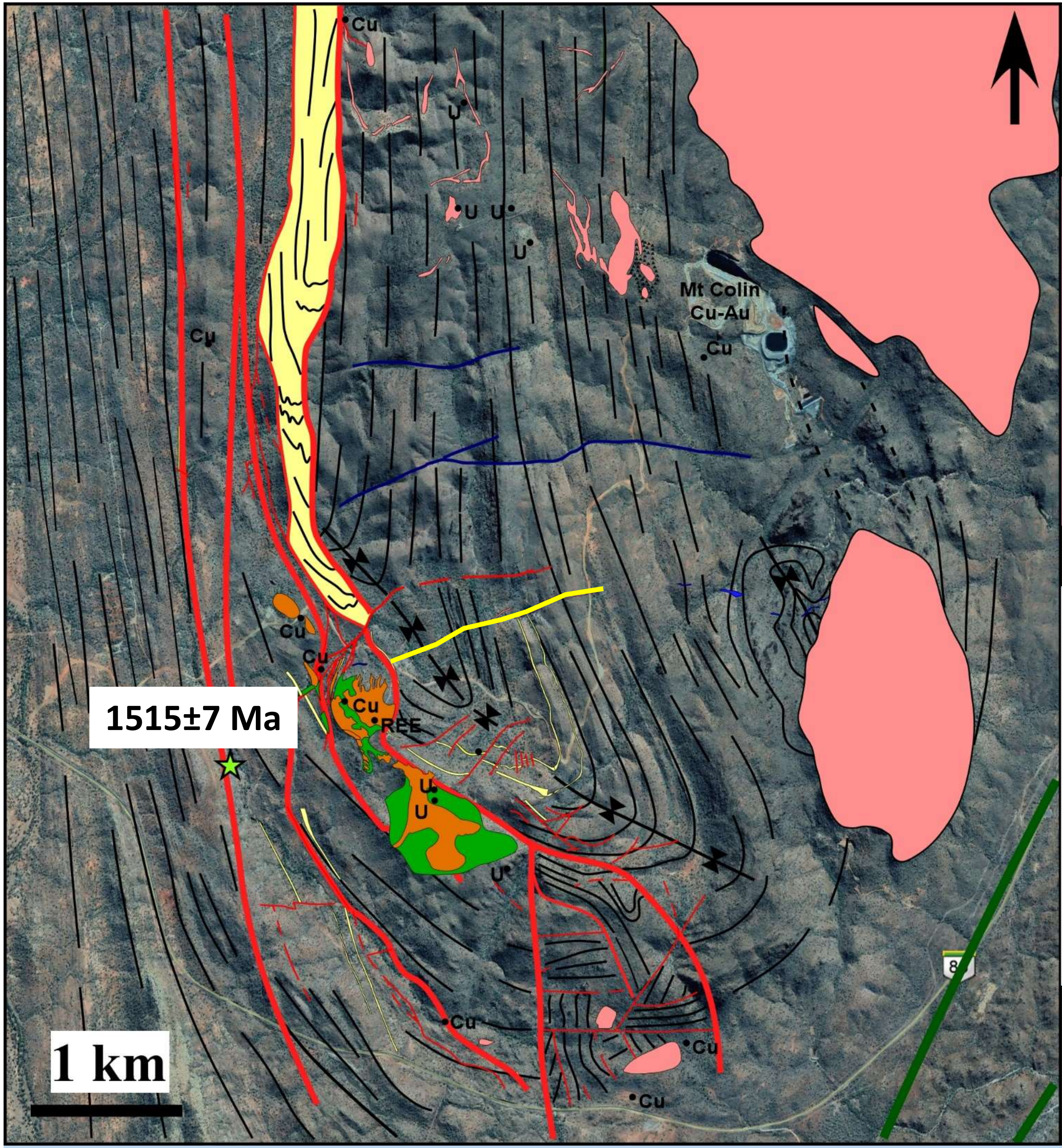


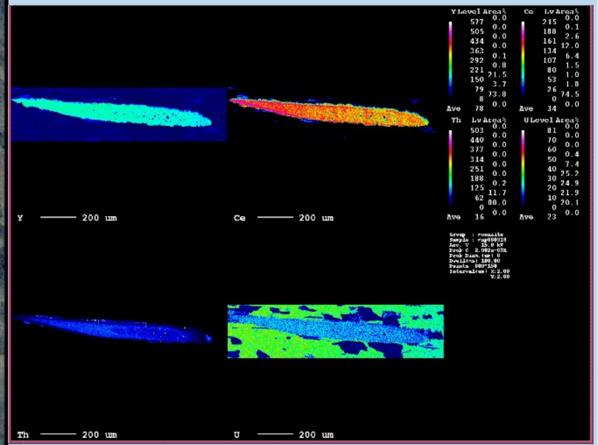


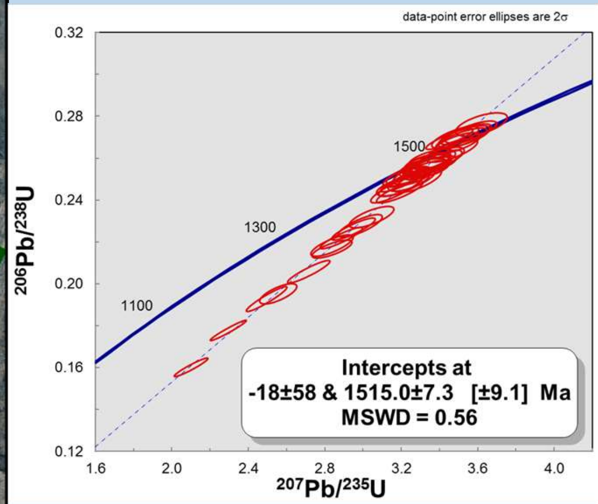
1770 Ma – 70/130 grains

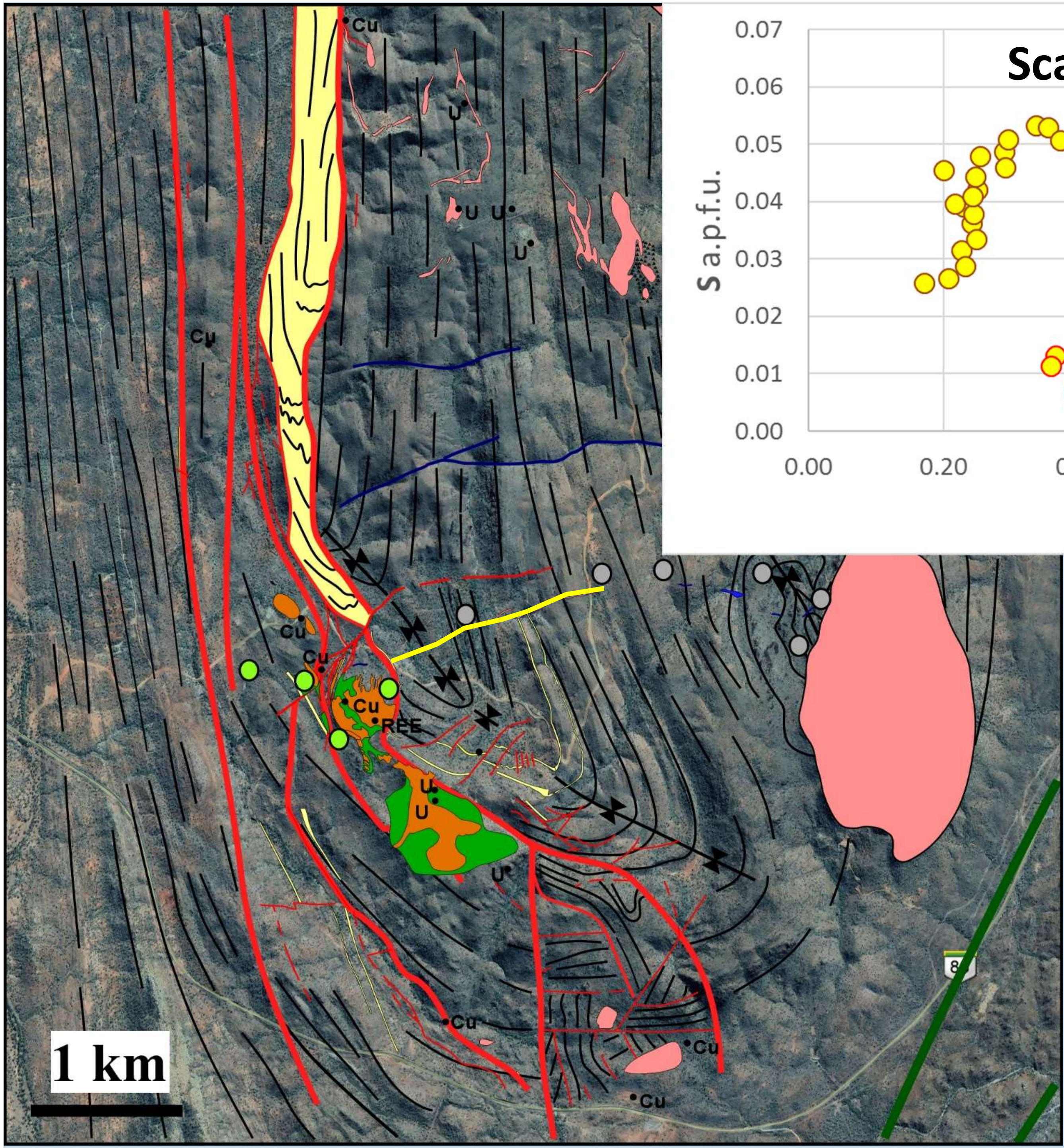
1715 Ma – 12/104 grains

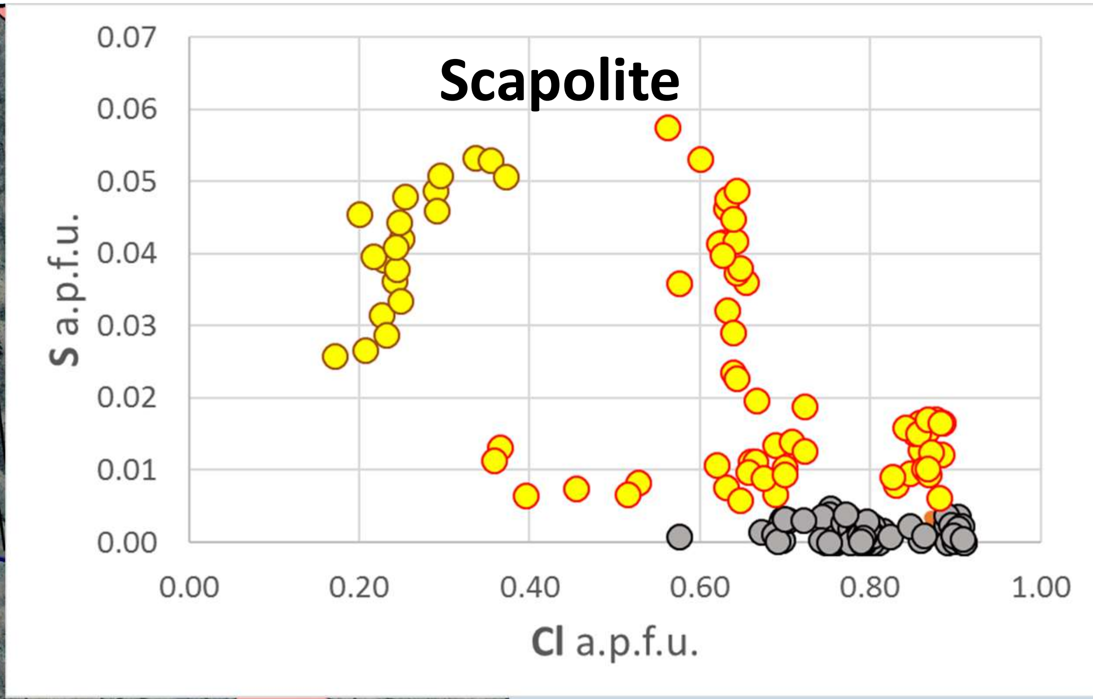
Monazite ages



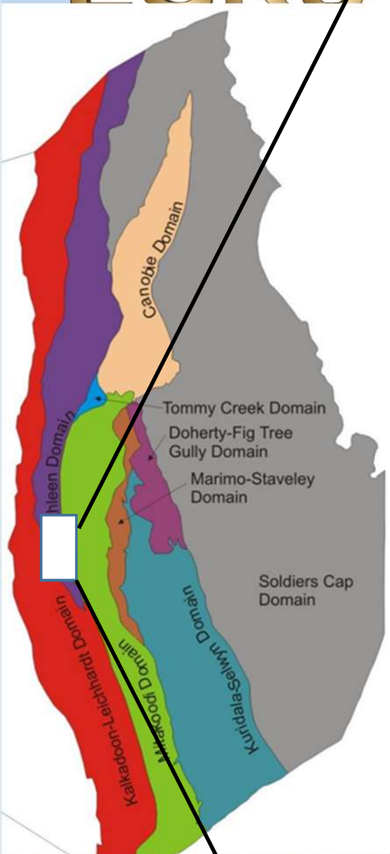


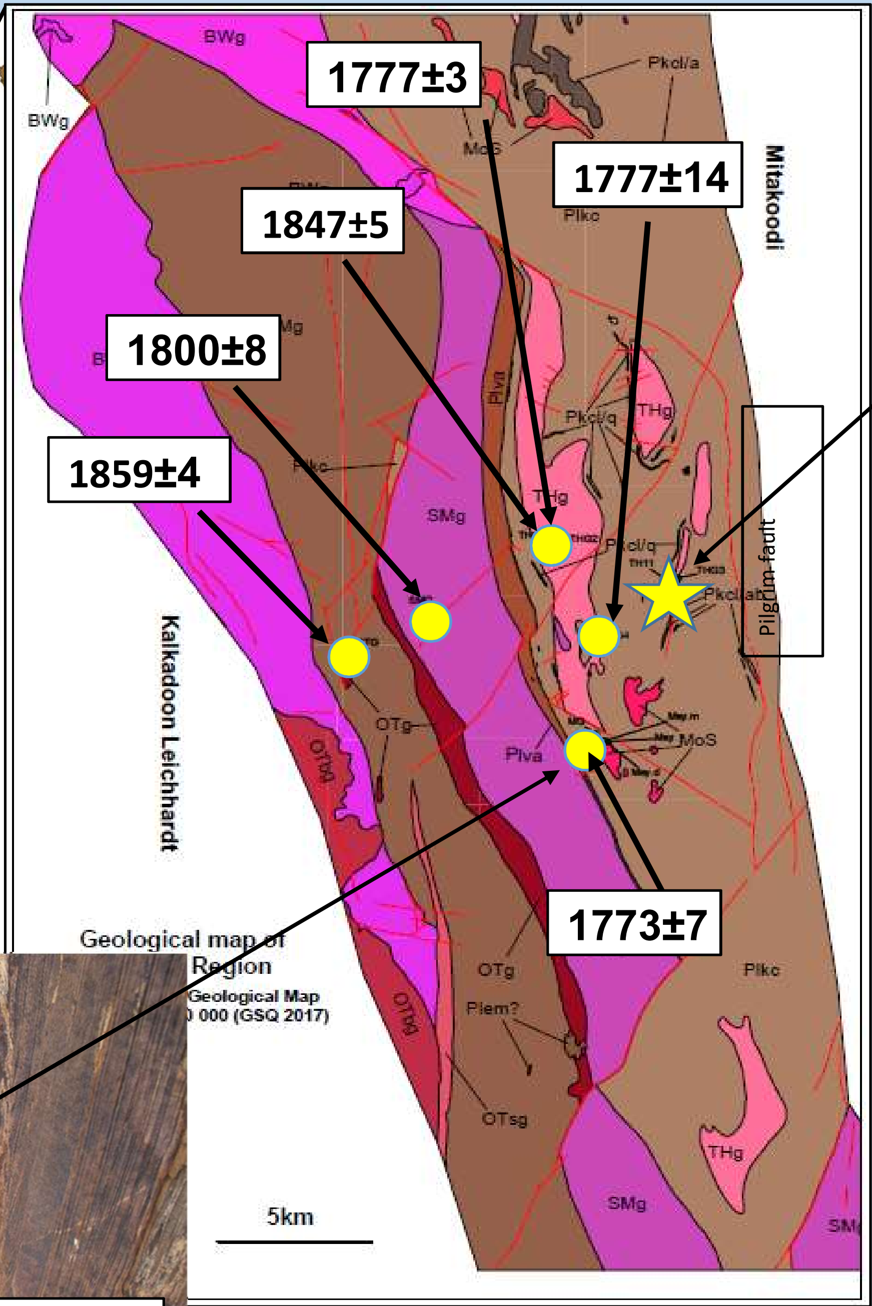


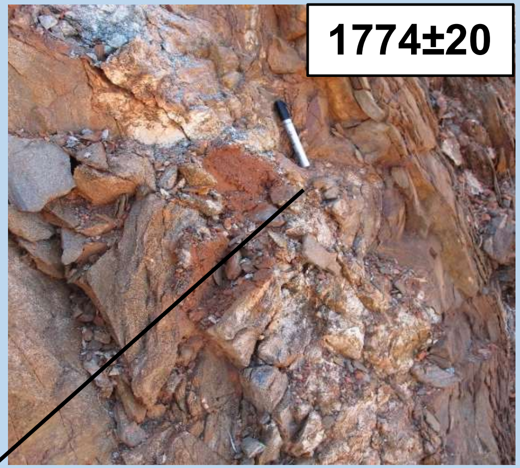


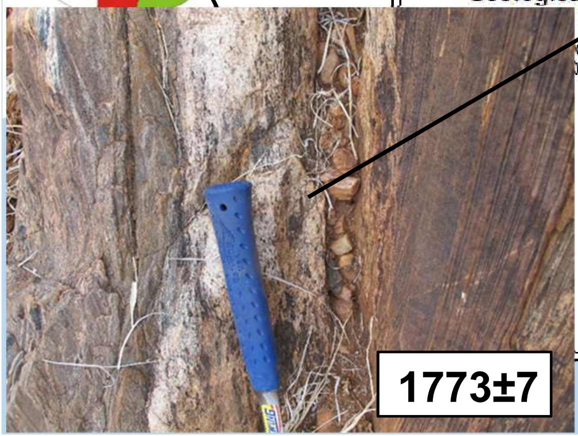


Scapolite geochemistry







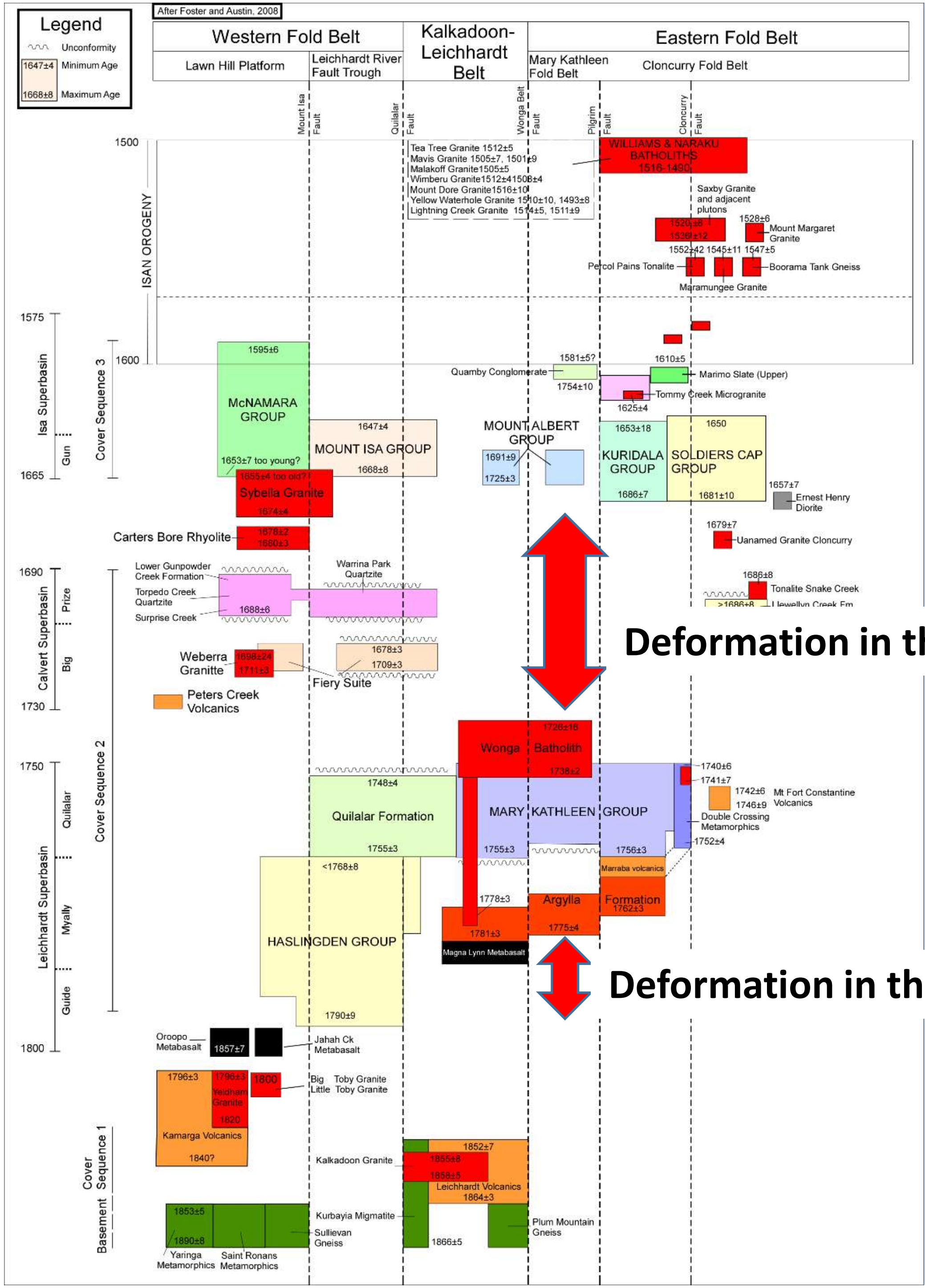


Implications:

- **Stratigraphy is older**
- **No Argylla and Corella Fm**
- **Deformation is old > 1760 Ma**

Mineralization:

- **Look for Isan overprinting**



Deformation in the MK area

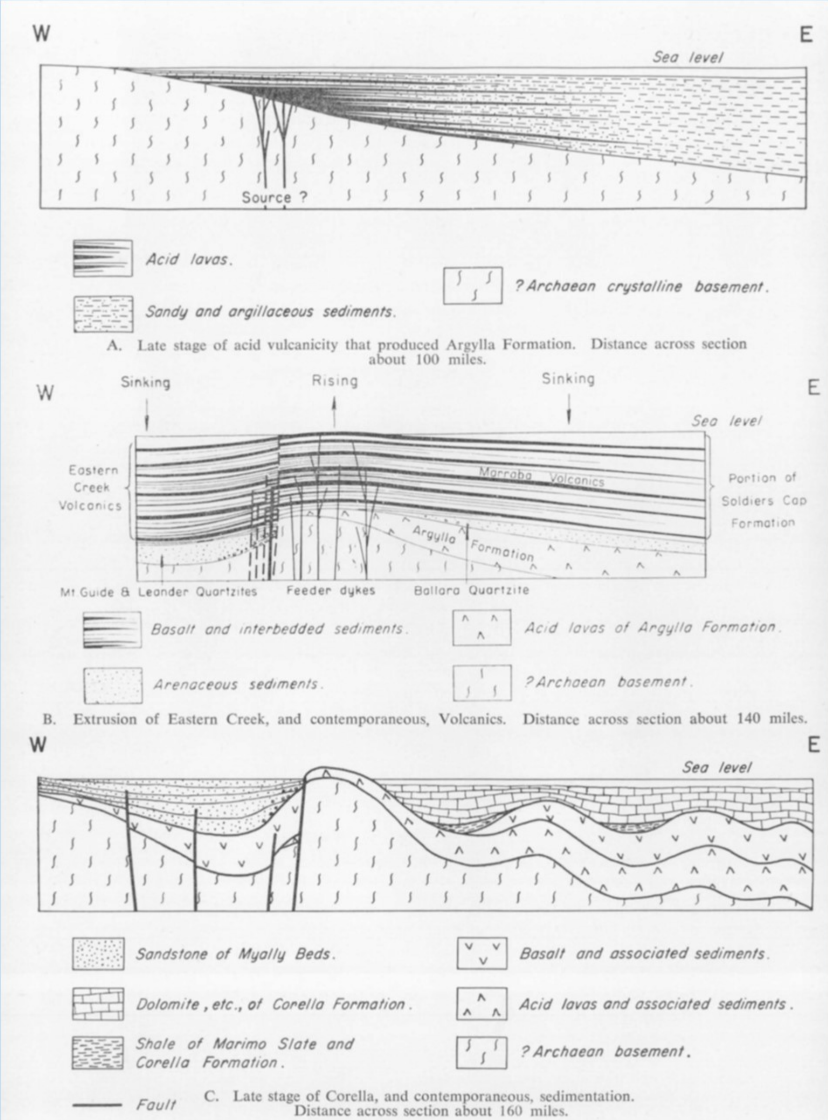
Deformation in the Tick Hill area

Simplified stratigraphy of Mt Isa Inlier

Conclusions

- **MKD is highly prospective for large Cu-Au**
- **There are no large Williams age intrusions – possibly small ones**
- **The upright folding is not Isan**
- **MKD is cut by Isan shear zones – many of which do not appear on published maps**
- **These Isan age shears should be primary targets for mineralization**

Thanks to GSQ for funding this project

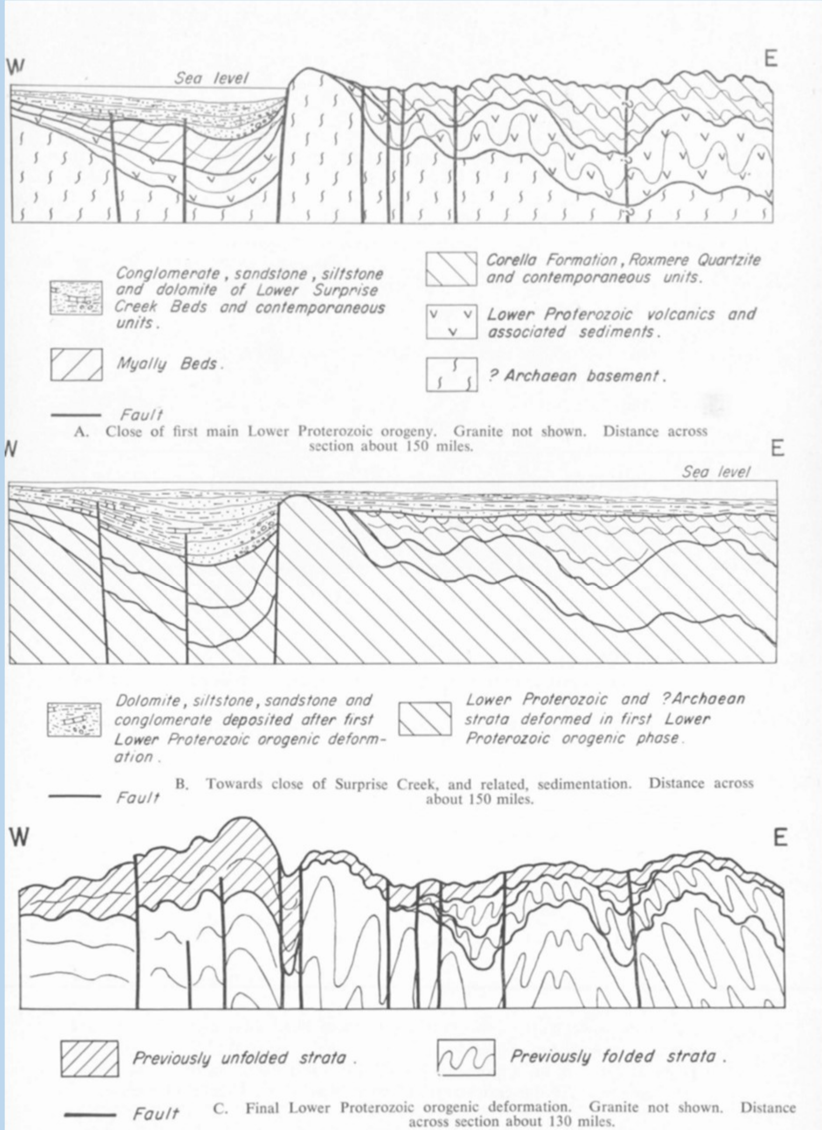


A. Late stage of acid vulcanicity that produced Argylla Formation. Distance across section about 100 miles.

B. Extrusion of Eastern Creek, and contemporaneous, Volcanics. Distance across section about 140 miles.

C. Late stage of Corella, and contemporaneous, sedimentation. Distance across section about 160 miles.

Fig. 6. Schematic sections showing development of Lower Proterozoic orogenic belt. Continued in Figure 7.



A. Close of first main Lower Proterozoic orogeny. Granite not shown. Distance across section about 150 miles.

B. Towards close of Surprise Creek, and related, sedimentation. Distance across about 150 miles.

C. Final Lower Proterozoic orogenic deformation. Granite not shown. Distance across section about 130 miles.

Fig. 7. Schematic sections showing development of Lower Proterozoic orogenic belt. Continued from Figure 6.

Carter, 1961