

Metallogenesis of the Koonenberry Belt

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Geological Survey of NSW

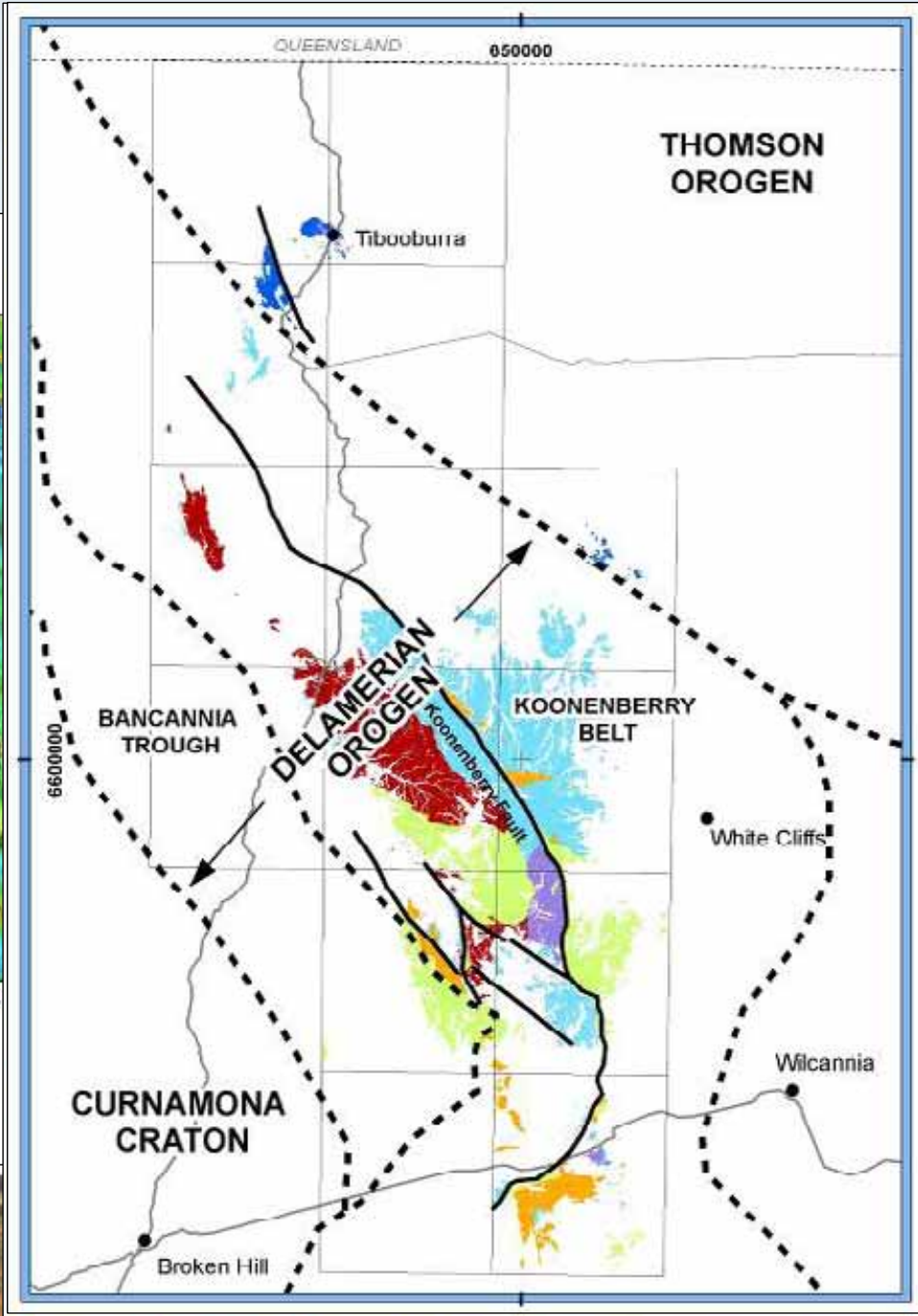
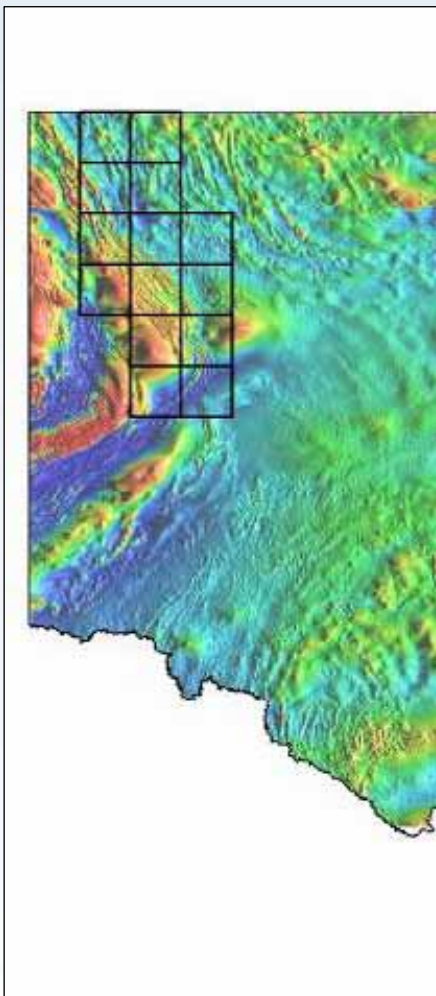


Talk outline

1. Location
2. Tectonic setting and mineralisation potential
3. Current status and products



Location



Legend

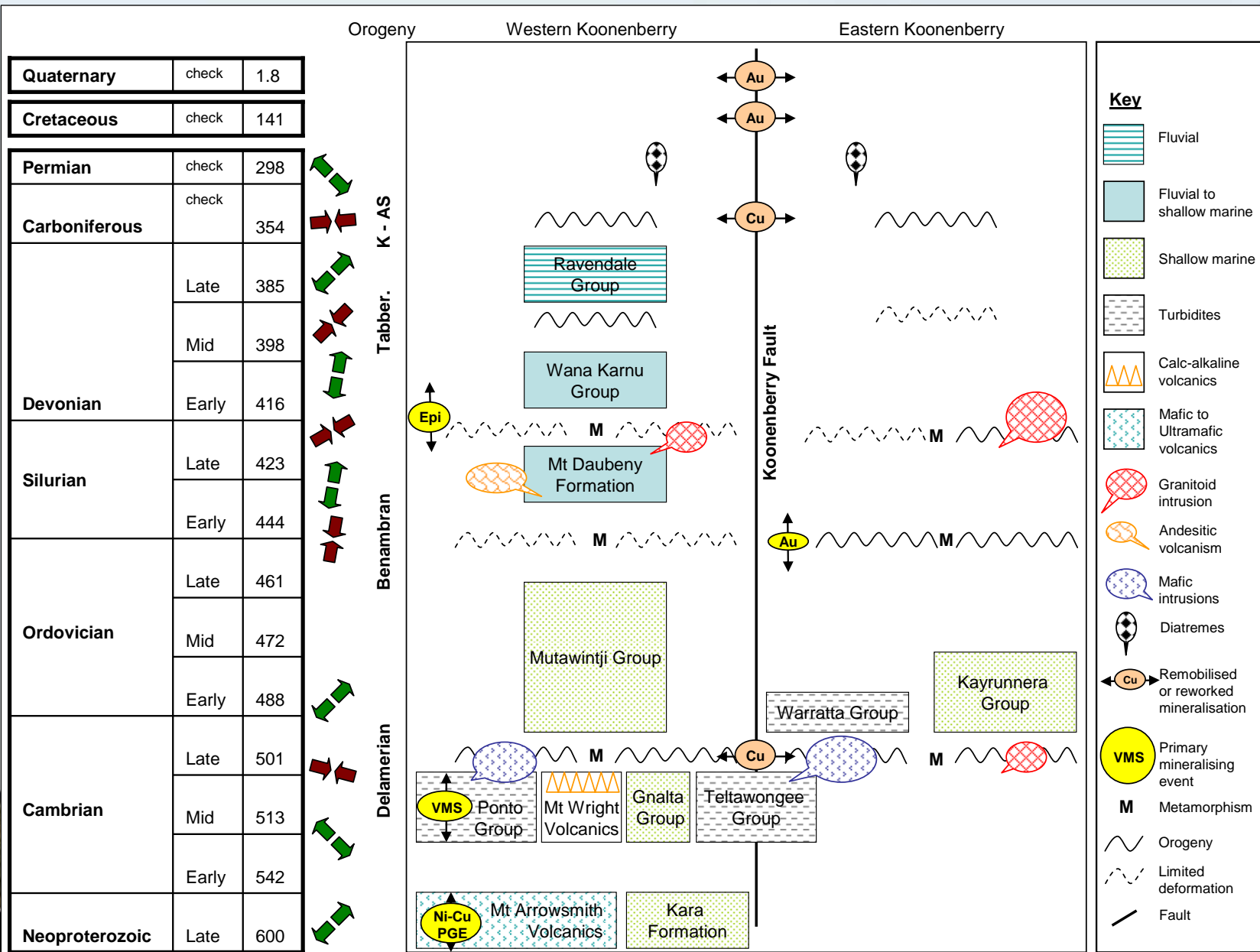
- Locality
- Main road
- - - NSW_Boundary
- 1:100 000 map sheet boundary
- Major faults
- - - Tectonic boundary

Geology by age

- Devonian
- Silurian
- Ordovician
- Cambro-Ordovician
- Late Cambrian
- Mid Cambrian
- Neoproterozoic

0 10 20 40 km
 Datum: GDA 1994
 Coords: MGA zone 54

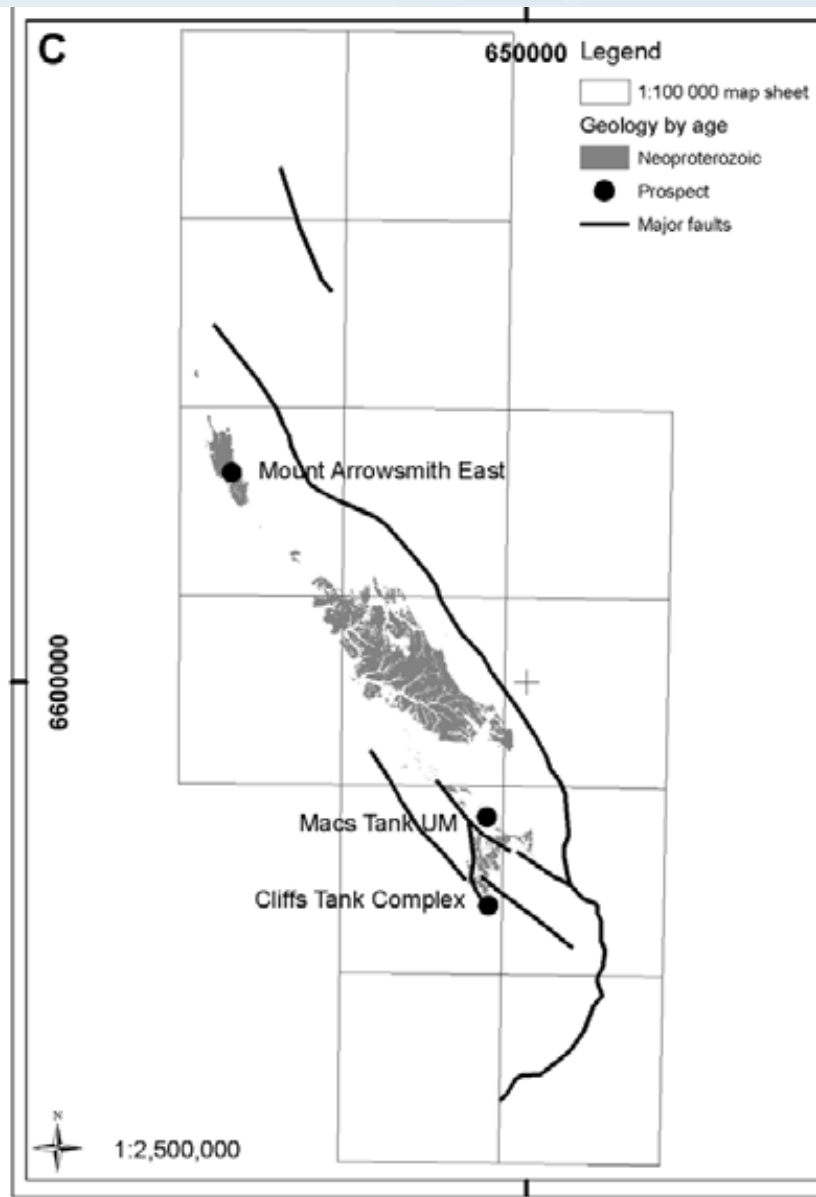
Tectonics and metallogeny



Neoproterozoic rifting

Quaternary	check	1.8	
Cretaceous	check	141	
Permian	check	298	K - AS
Carboniferous	check	354	
Devonian	Late	385	Tabber.
	Mid	398	
	Early	416	
Silurian	Late	423	Benambran
	Early	444	
Ordovician	Late	461	Benambran
	Mid	472	
	Early	488	
Cambrian	Late	501	Delamerian
	Mid	513	
	Early	542	
Neoproterozoic	Late	600	

- Intracontinental rifting
- Kara Formation
 - platform to slope
 - slates, exhalative
- Mount Arrowsmith
 - alkali basalts
 - 585 Ma
- Equivalents to the west of Bancannia Trough



Neoproterozoic – potential

- √ Orthomagmatic Ni-PGE-Cu
 - Mount Arrowsmith Volcanics
 - INCO (CVRD) have intersected anomalous Ni-Cu-Pt-Pd-Au in ultramafic intrusives near Mount Arrowsmith
 - Disseminated primary sulphides (py-ch-po –ex pent)
 - Further UM bodies identified from high resolution aeromagnetic surveys
 - Other ultramafic bodies in Koonenberry Belt have anomalous Ni and Cu
 - Cliffs Tank (recent drilling by Bondi Mining)
 - Macs Tank UM



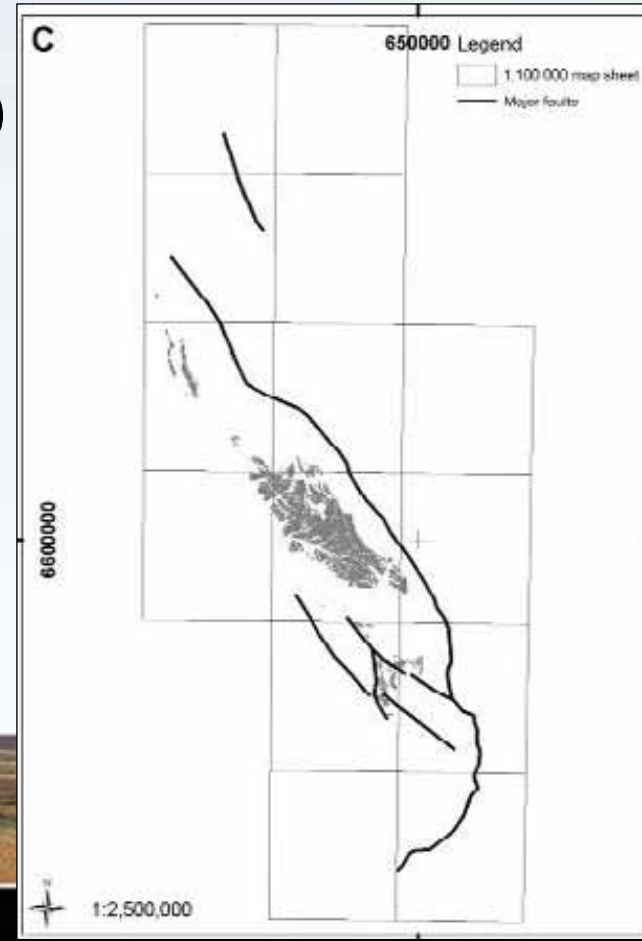
Neoproterozoic – potential

? Mississippi Valley-type Pb-Zn

- Limited holes in the Kara Formation
- Thick enough carbonate accumulations?
- PlatSearch recently intersected MVT mineralisation in Adelaidean units (equivalents to the Kara Formation) on the Mundi Mundi Plain?

? Stratiform sediment hosted Zn-Pb-Ag

- Limited holes in the Kara Formation
- Historical drilling hit 80m@ 8g/t Ag (incl. 3m@89g/t Ag, 1.5% Pb, 0.14% Zn)
- No follow up

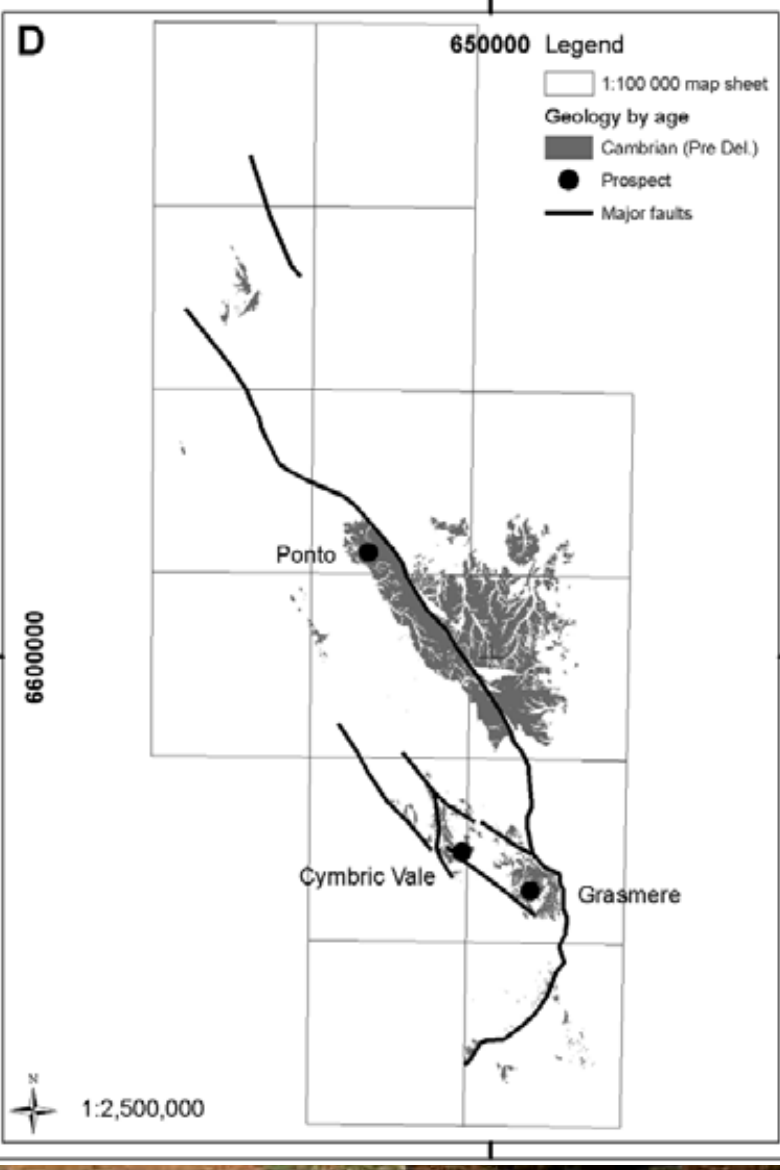


Cambrian

- Early Cambrian - pa extension
- Mid Cambrian - cal
- Ponto Group
 - distal continenta
 - tholeiitic submari
- Teltawongee Group
 - continental slope
- Gnalta Group
 - shelf sediments, v
 - Mount Wright Vo



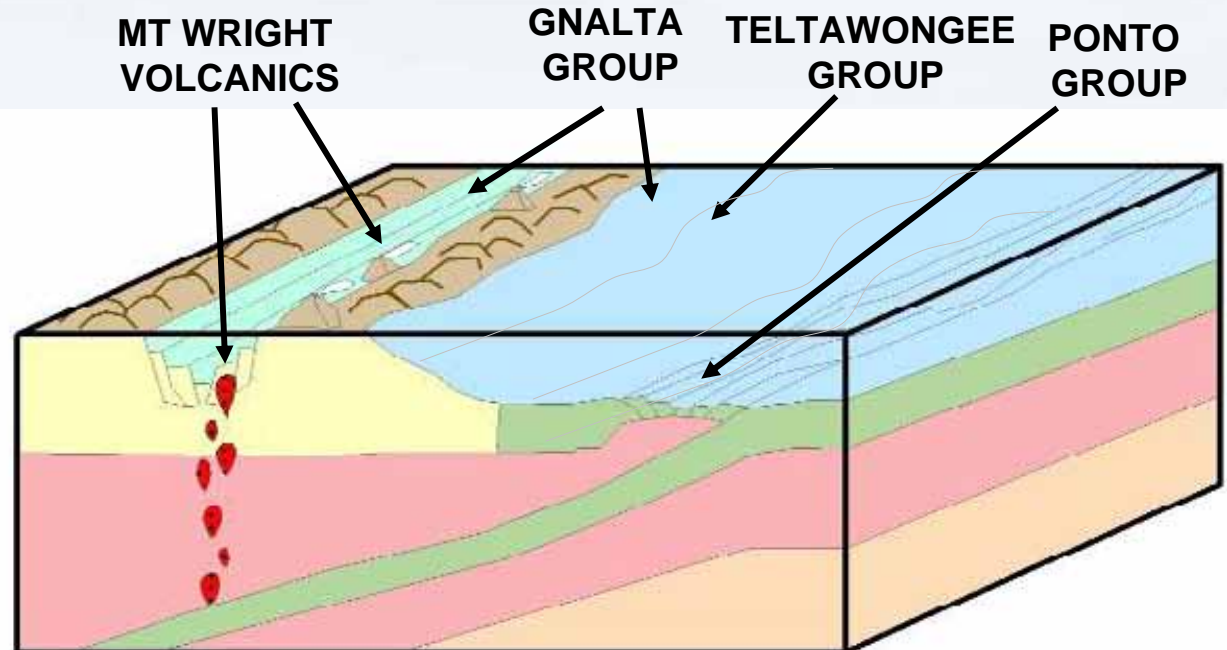
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Neoproterozoic	Early	542	Delamerian
	Late	600	



Cambrian

- Tectonic setting
 - Fore-arc to subduction zone with calc-alkaline Mount Wright Volcanics arc
 - Mount Wright Volcanics in Bancannia Trough
 - Tholeiitic basalts in Ponto - MORB

Quaternary	check	1.8	
Cretaceous	check	141	
Permian	check	298	
Carboniferous	check	354	K - AS
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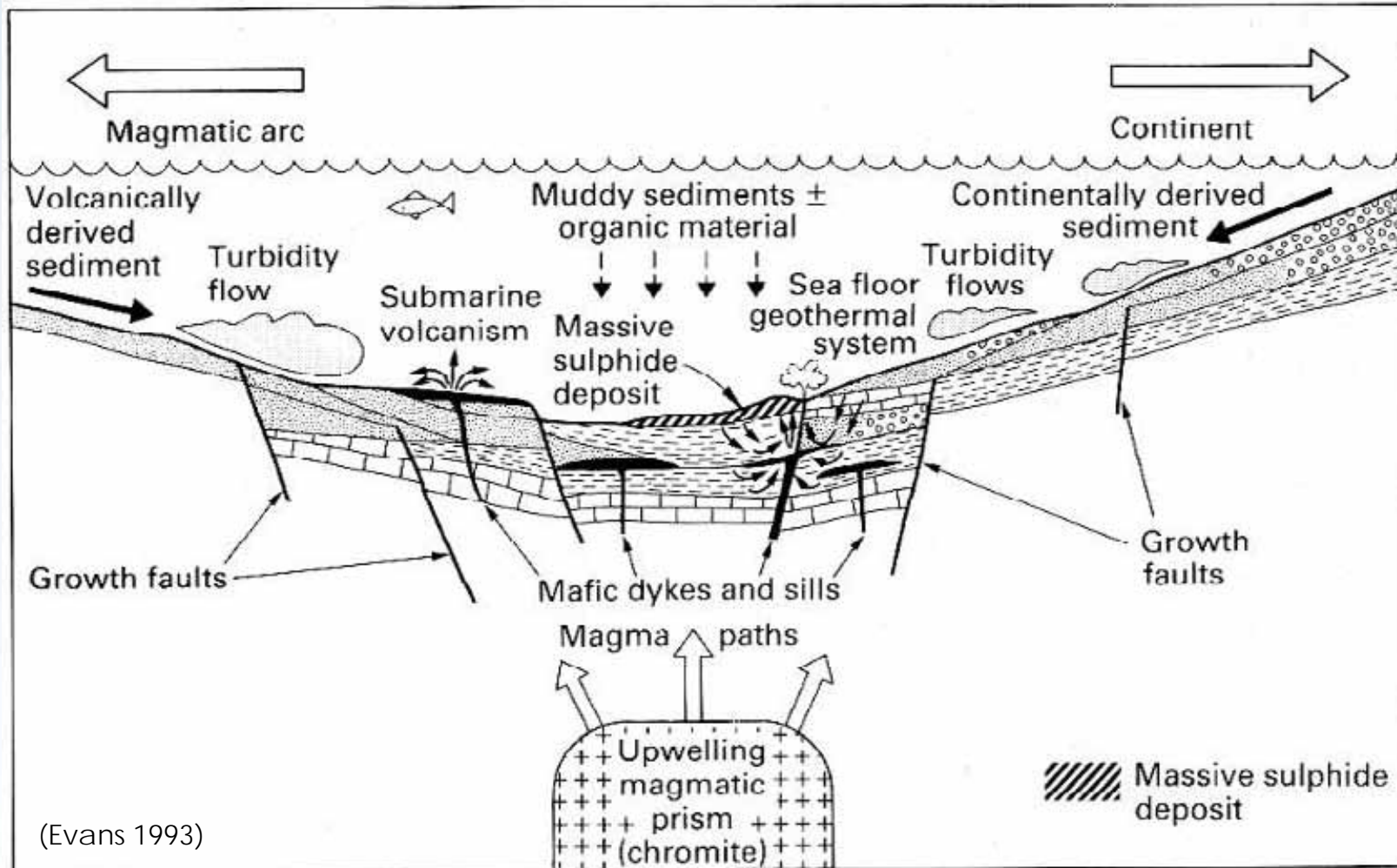
Cambrian - potential

√ Volcanic massive sulphide

- Grasmere
 - Besshi-style VMS
 - Ponto Group host
 - 584 000 tonnes @ 2.47% Cu, 0.94% Zn and 5.24 g/t Ag with elevated Pb, Co, Au (inferred) – Black Range Minerals
 - Two episodes of mineralisation
 - Stratiform banded fine and coarse-grained pyrite with bornite-sphalerite-chalcopyrite
 - Late quartz-carbonate-chalcopyrite veins

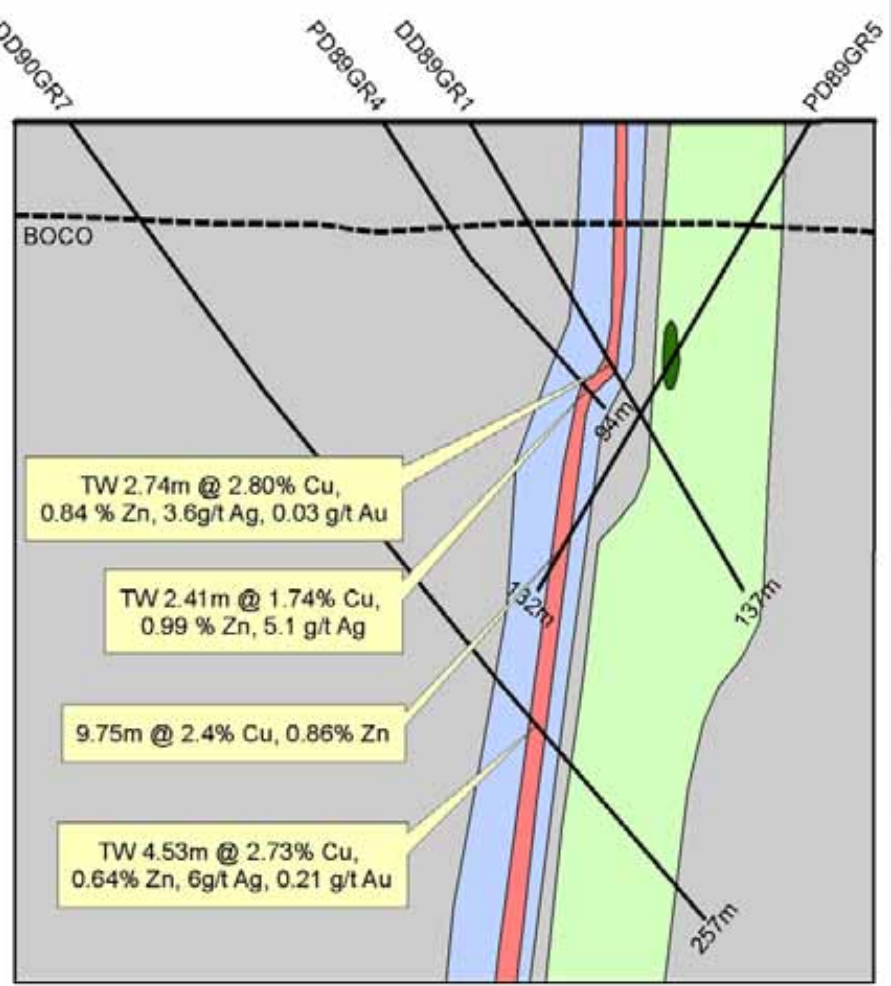


Grasmere



Grasmere - host

Looking northwest



Hanging wall deformed meta-sediments (low mag. sus.)

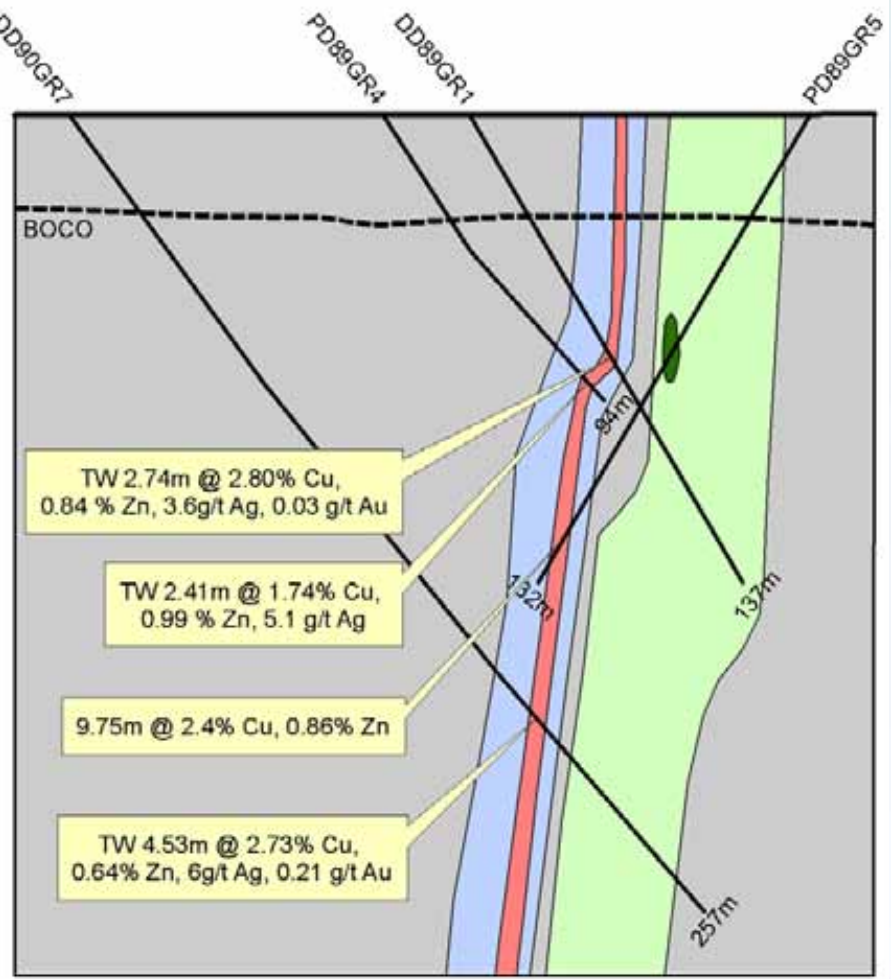


Footwall deformed ch-ep-py schist (ex-tuff) (high mag. sus.).



Grasmere – ore

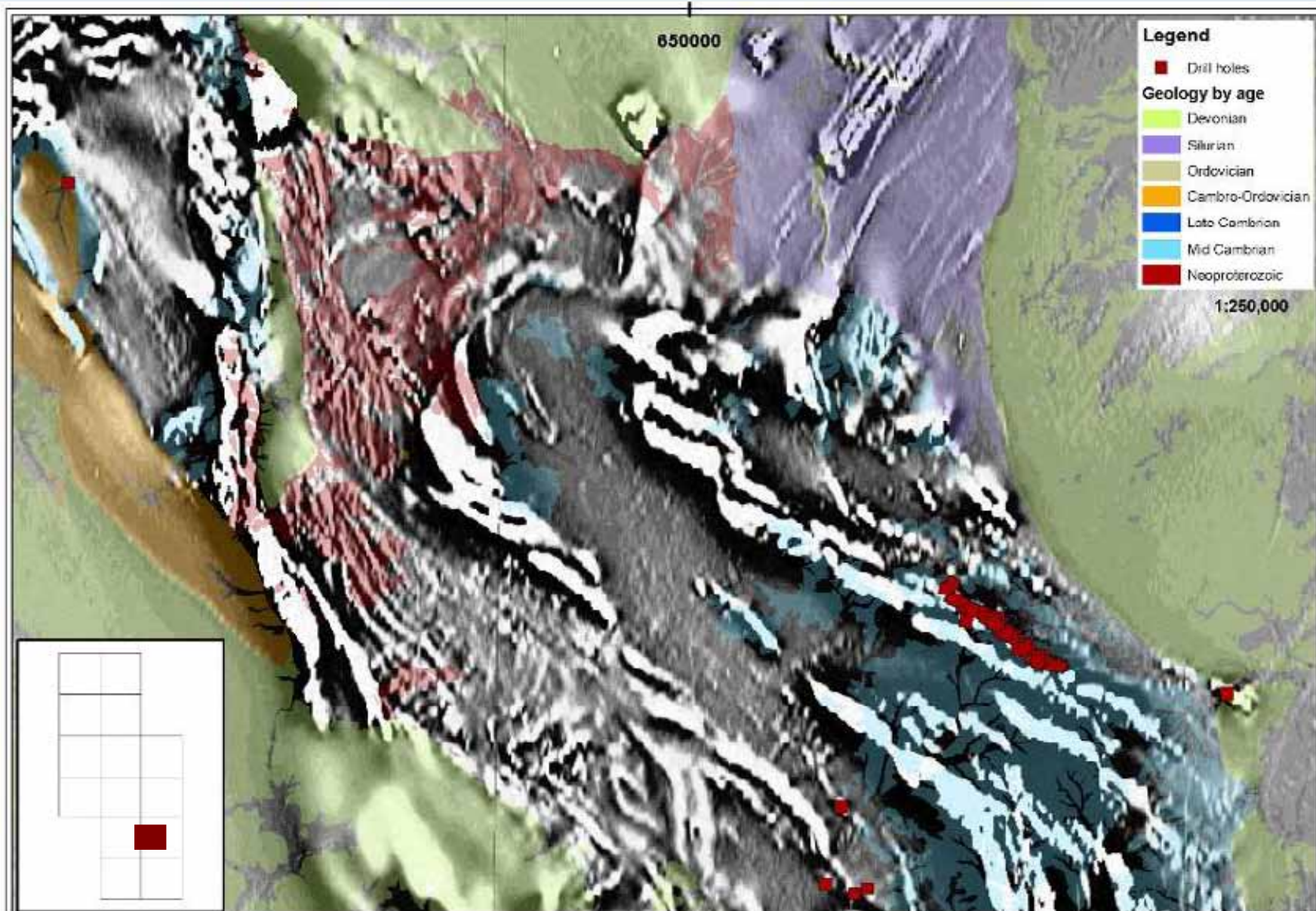
Looking northwest



Late q-c-ch veins

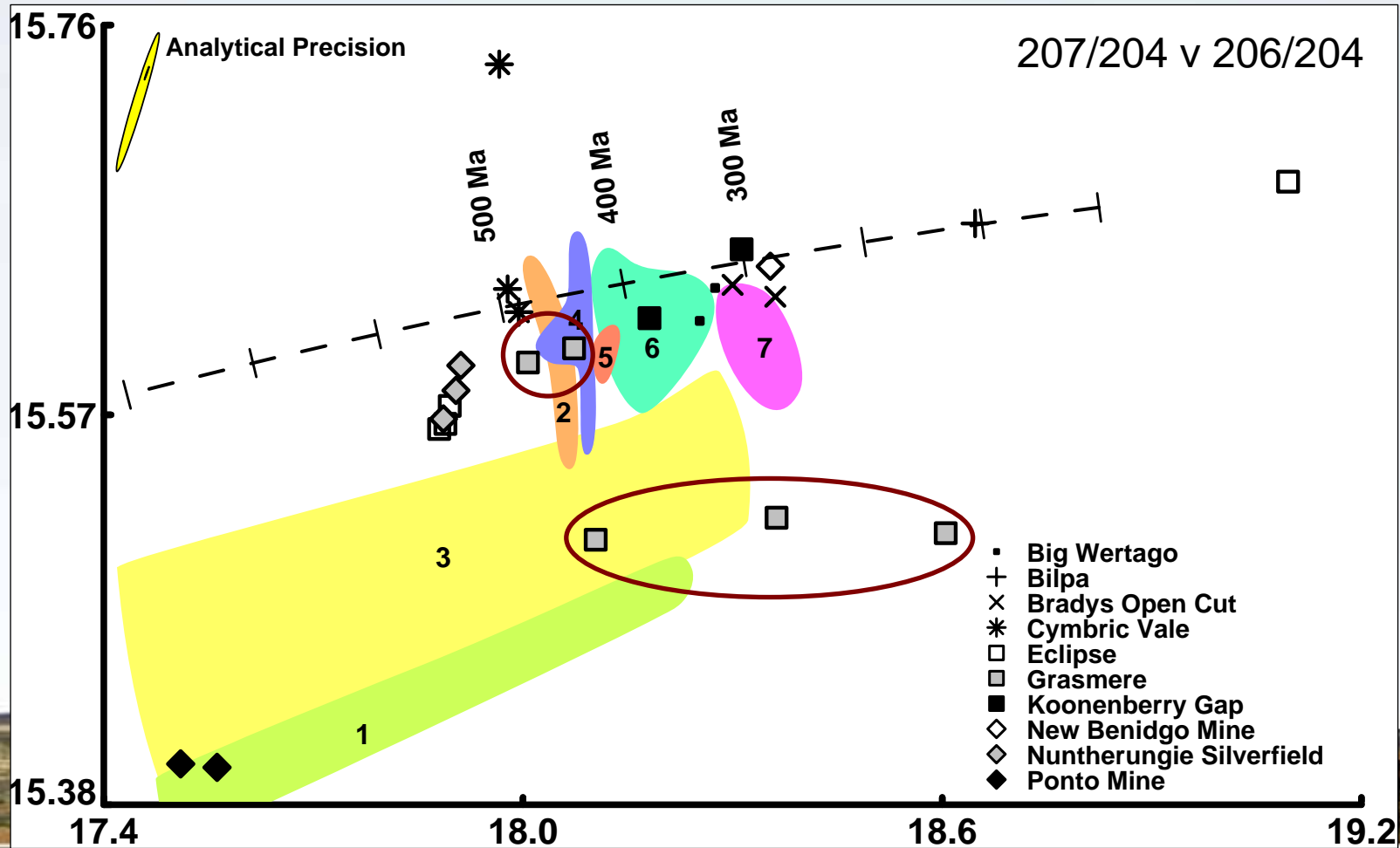


Grasmere



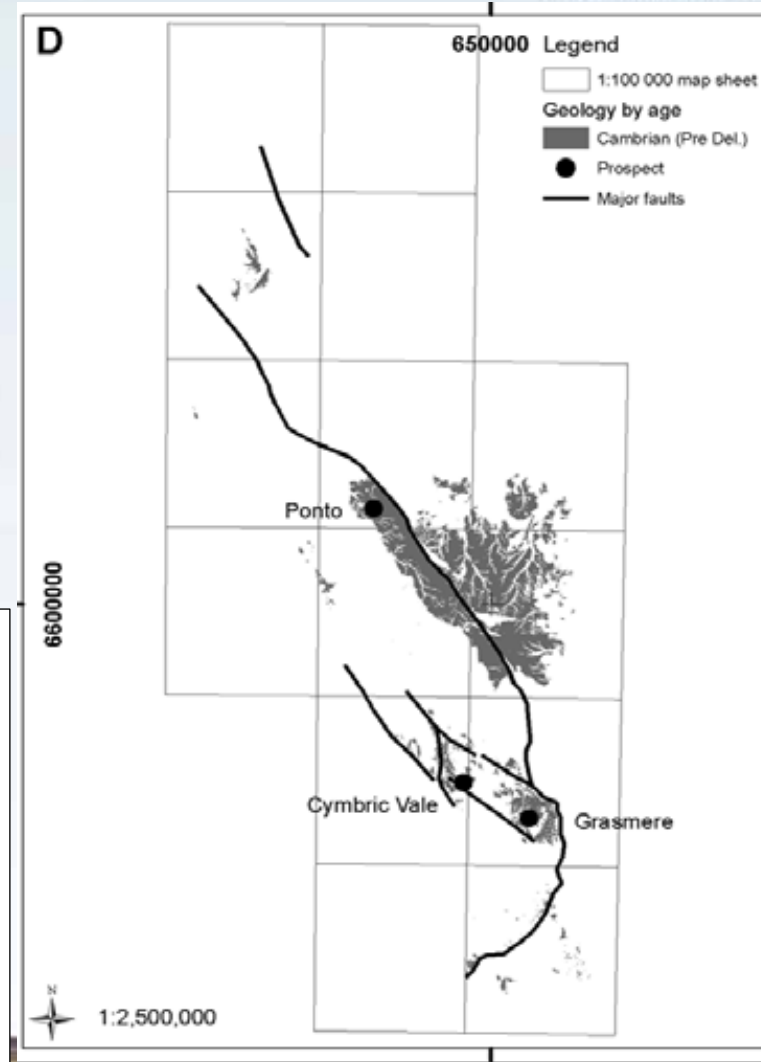
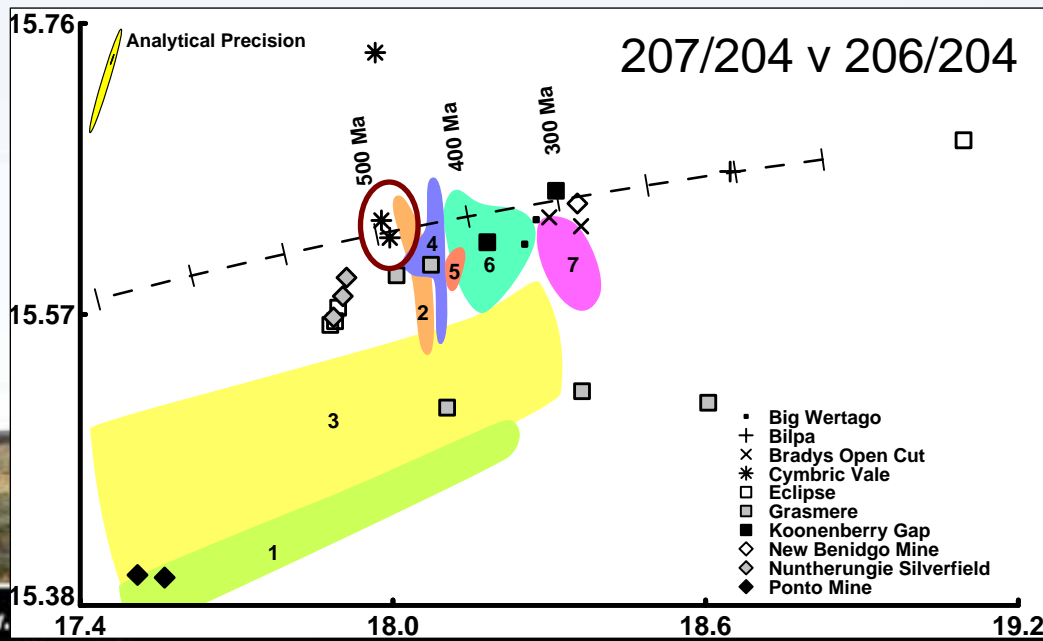
Grasmere

- Pb-isotopes plot
 - Besshi-style field
 - mantle source



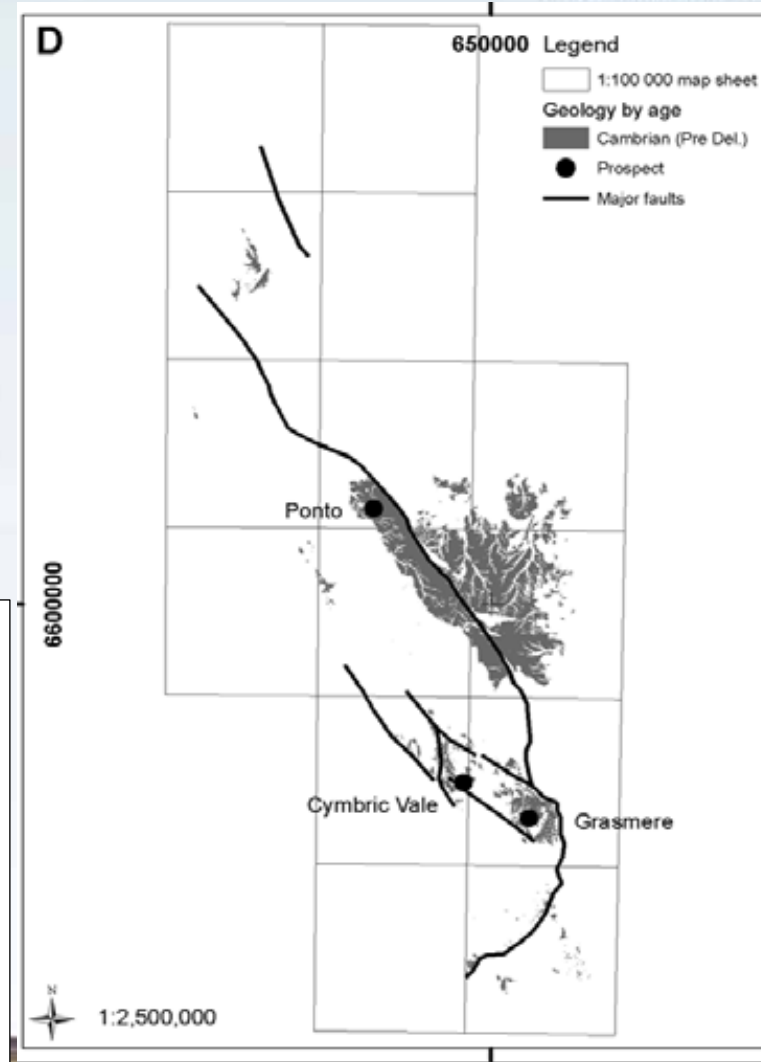
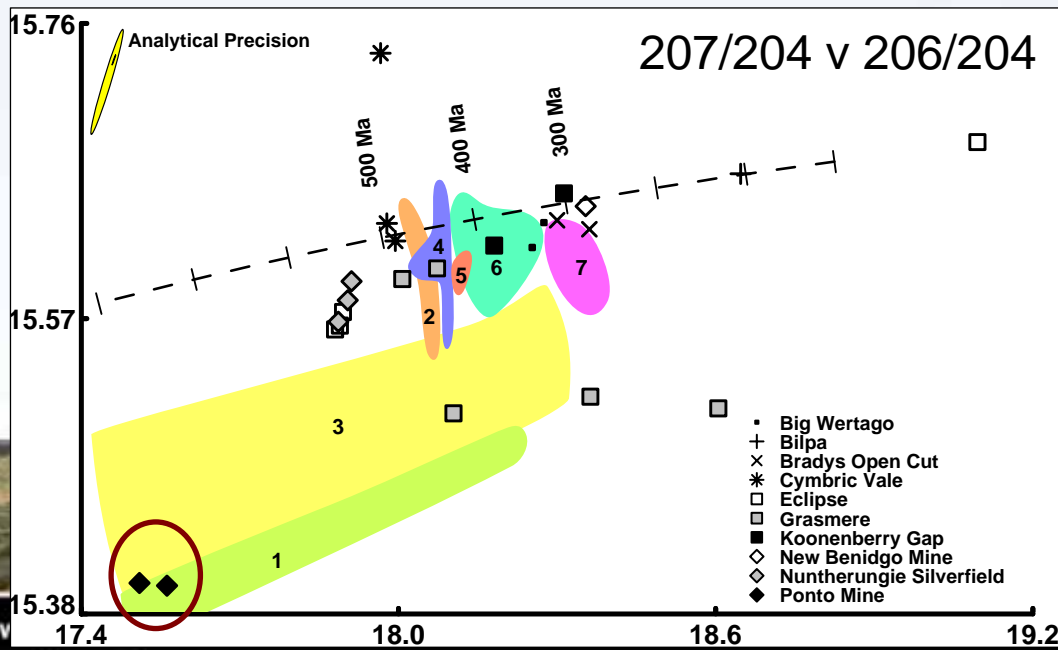
Other Cambrian VMS – Cymbric Vale

- Historic Cu workings
- Recent Bondi Mining drilling has confirmed mineralisation at depth
- Similar to Grasmere – but higher metamorphic grade
- Ponto Group (schist, tuffs, mafics)
- Pb-isotopes plot near Besshi field



Other Cambrian VMS – Ponto Mine

- 18.5% Cu mined from 40m shaft and drive in early 1900's
- 1980's drilling confirmed Cu at depth and along strike
- Ponto Group host (tuffs, schists, basalts) with Fe alteration
- Pb-isotopes suggest primitive mantle reservoir



Delamerian Orogeny

Quaternary	check	1.8	
Cretaceous	check	141	
Permian	check	298	↔
Carboniferous	check	354	↔
	Late	385	↔
	Mid	398	↔
Devonian	Early	416	↔
	Late	423	↔
Silurian	Early	444	↔
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Cambrian	Mid	513	↔
	Early	542	↔
Neoproterozoic	Late	600	↔

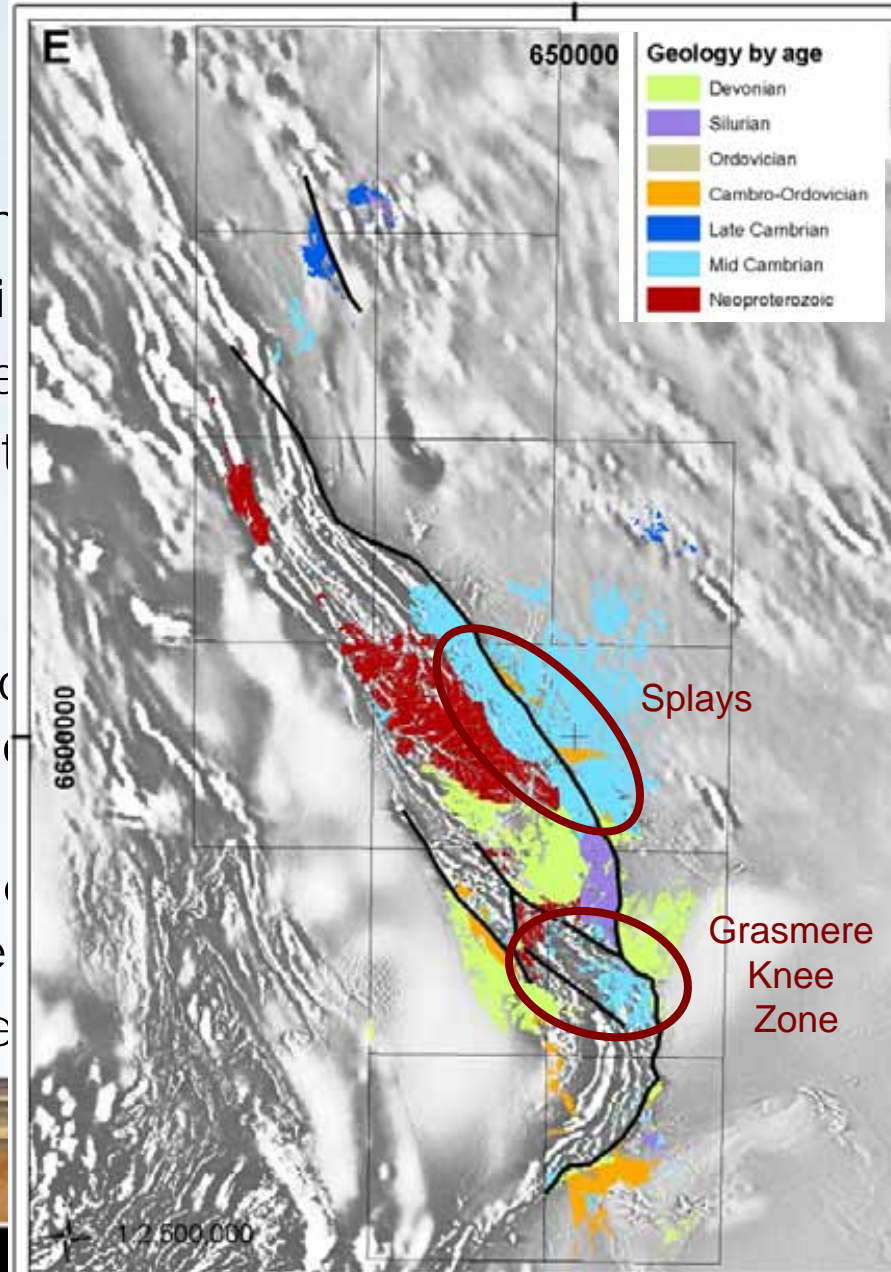
K - AS
 Tabber.
 Benambran
 Delamerian

Effects:

- Tight folding and
- Sinistral strike-sli
- Sub-vertical cle
- Low grade met

Potential:

- ✓ Remobilisation of mineral deposits (Knee Zone)
- ? Splays off Koon
- shallow marine
- (intrusion relate



Benambran Orogeny

Quaternary	check	1.8	
Cretaceous	check	141	
Permian	check	298	K - AS
Carboniferous	check	354	
Devonian	Late	385	Tabber.
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West of Koonenberry Fa

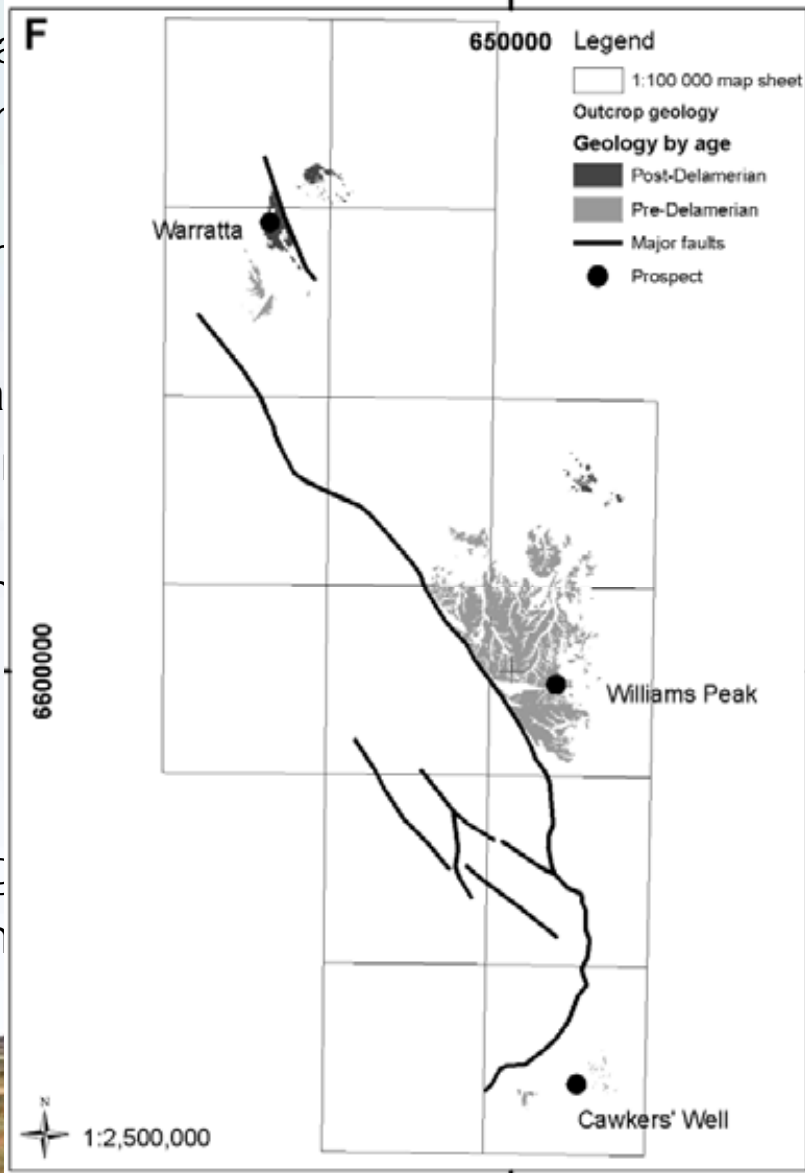
- West-vergent deformation
- West-dipping faults
- Cleavage development

East of Koonenberry Fa

- Greater deformation
- Koonenberry Fault
- East-vergent fold axis
- Steep west-dipping

Potential:

- √ Turbidite hosted orogenic
- east of the Koonenberry



Warratta Inlier – orogenic Au

- Historical production
 - Pioneer, Warratta, Phoenix, Rosemount, Elizabeth reefs
 - Average grade ~25 g/t Au
 - Ironically mining hampered by water table and by lack of fresh water
- Modern exploration
 - No drilling until 2006
 - Proto Resources drilling confirmed mineralisation continues at depth (e.g. 4m @ 4.39g/t Au from 88m)
 - Need to target undercover areas, structural traps



Warratta Inlier – orogenic Au

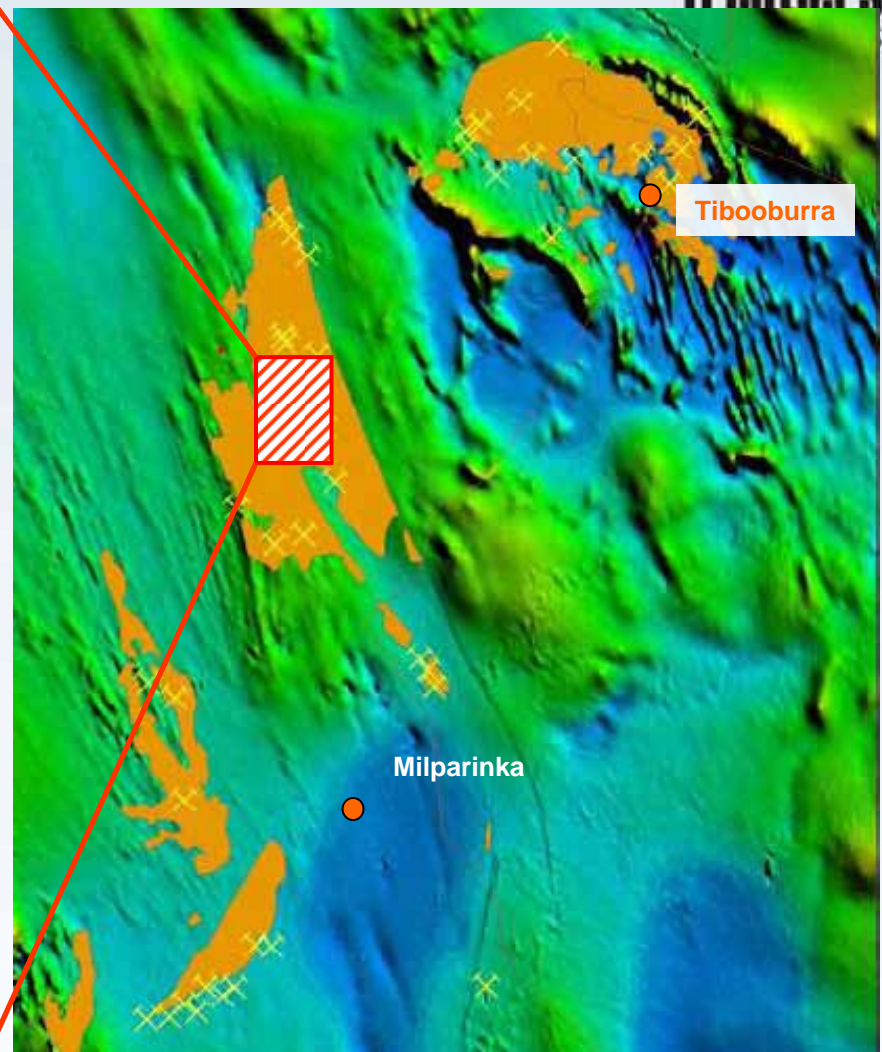
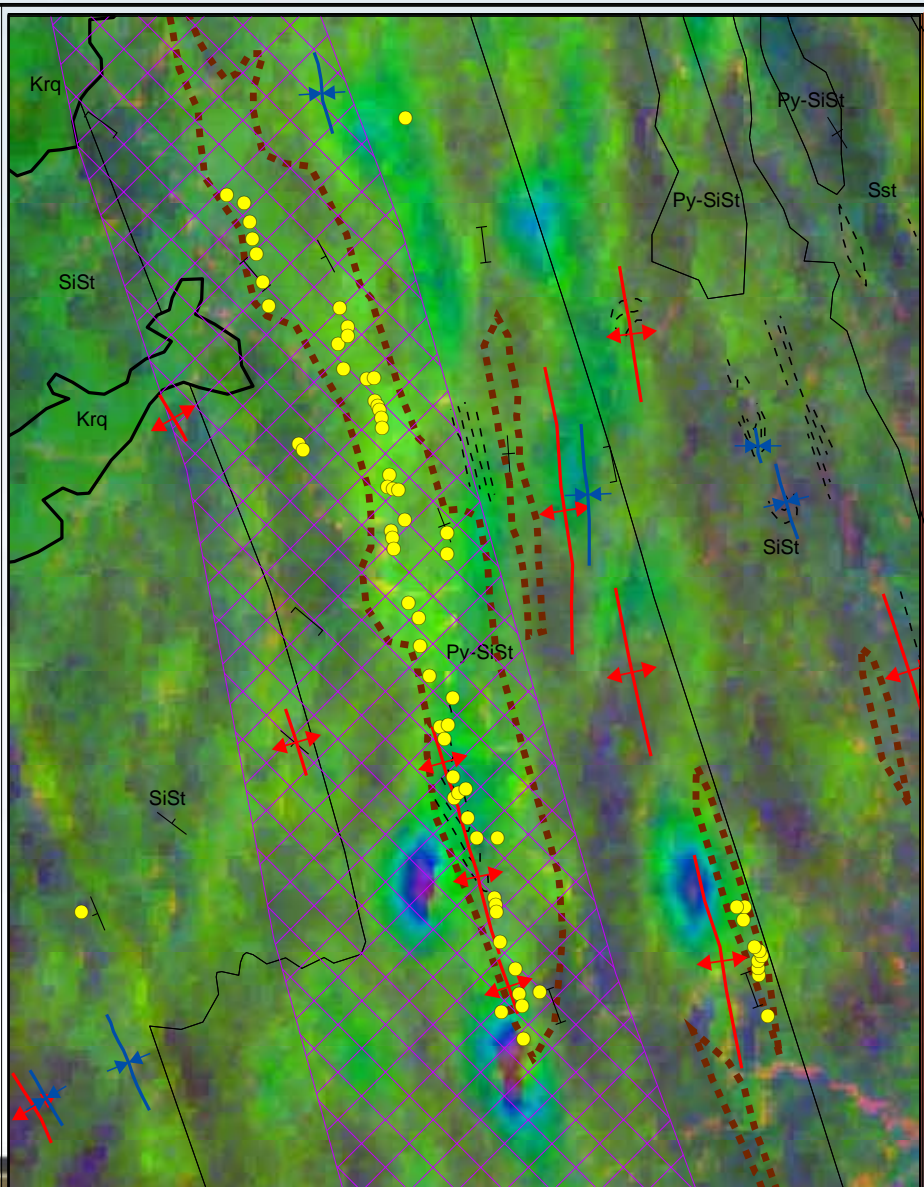
- Host:
 - post-Delamerian sediments
 - Jeffreys Flat Formation of Warratta Group
 - Turbidite sequence with pyritic siltstone, minor conglomerate and limestone
- Structure
 - East vergent
 - Shallow double-plunging, upright- to inclined, concertina-style flattened chevron folding
 - Steep reverse faults
 - Flat enveloping surface and metamorphic isograd



Warratta Inlier – orogenic Au

- Au mineralisation:
 - Quartz vein associated (bedding parallel, crack-seal, eastern limbs of anticlines)
 - pyrite and arsenopyrite main sulphide species
- Source:
 - Pb-isotopes – mixed dominant crustal and minor mantle
 - S-isotopes – magmatic
- Alteration:
 - strike-extensive carbonate-sericite ‘bleached’ zones
 - narrow halos of phengite-chlorite-pyrite-carbonate
 - dated at 440 Ma
- P-T conditions:
 - 300-350°C and 200-400 Mpa

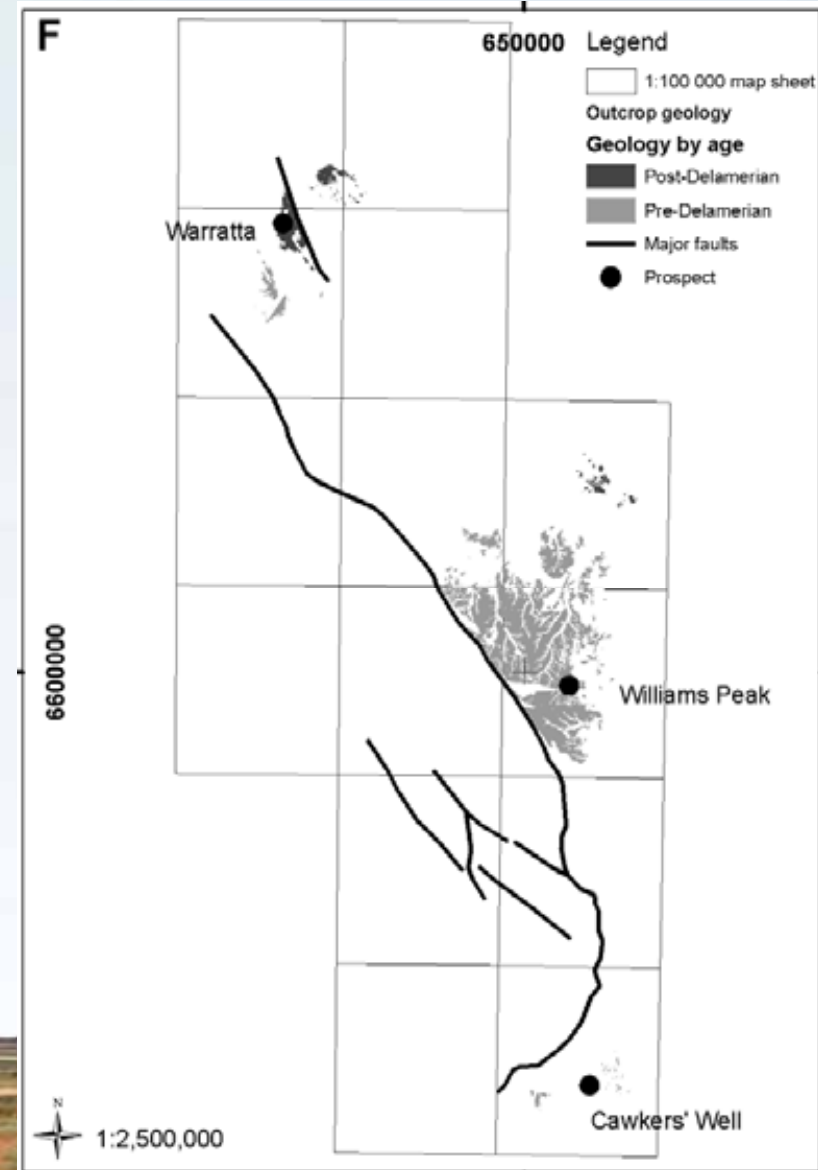




Outcrop

Other orogenic Au

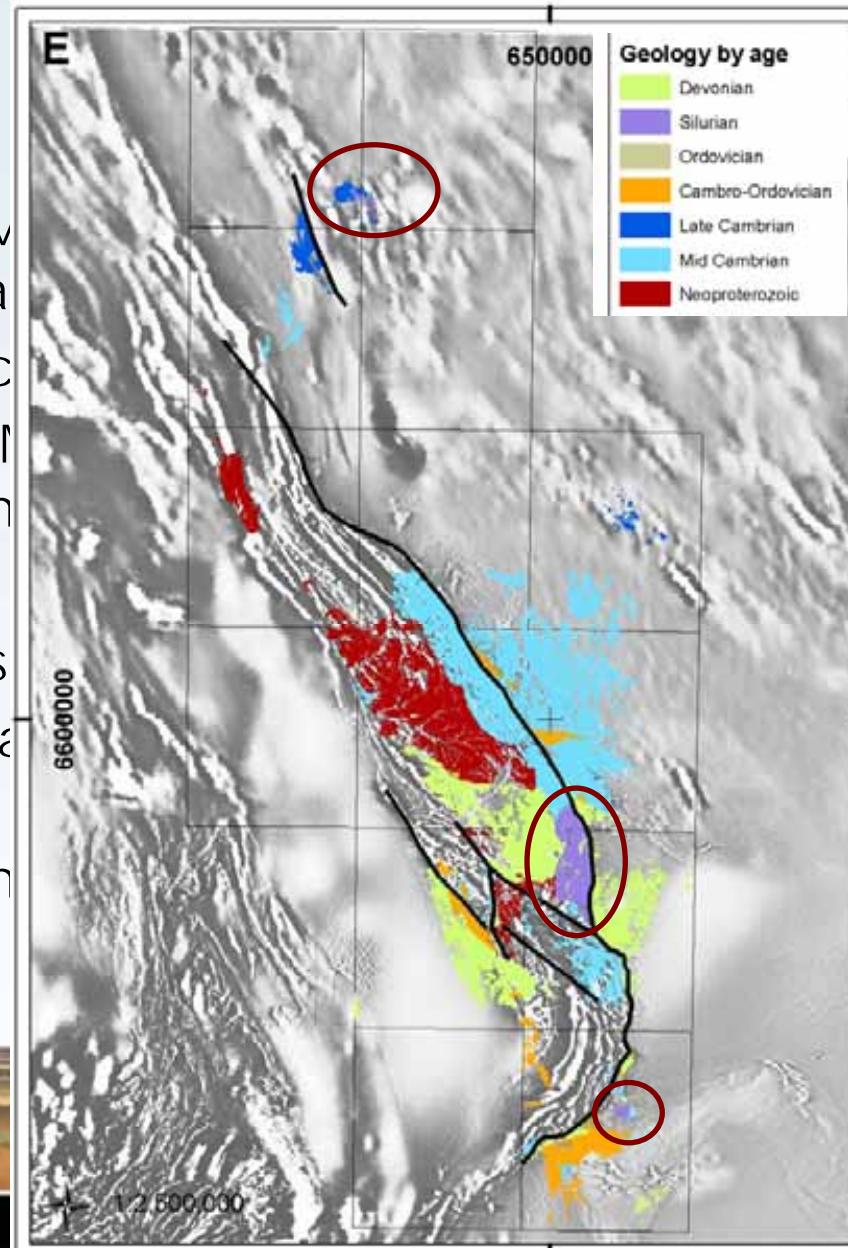
- Williams Peak
 - Recent greenfield exploration by Rockwell Resources
 - Soil Au-As anomaly corresponding to structure
 - Drilling intersected anomalous Au associated with quartz veining
- Cawker's Well
 - Rockwell Resources
 - Au intersected near historic workings
 - Quartz vein association



Late-Silurian extension

Effects:

- Opening of the Murrumbidgee and Churinga Basins
 - Andesitic volcanics
 - Sediments of the Murrumbidgee and Daubeny Formations
- Granite intrusions
 - Tibbooburra granite 421 Ma
 - Allambie granite



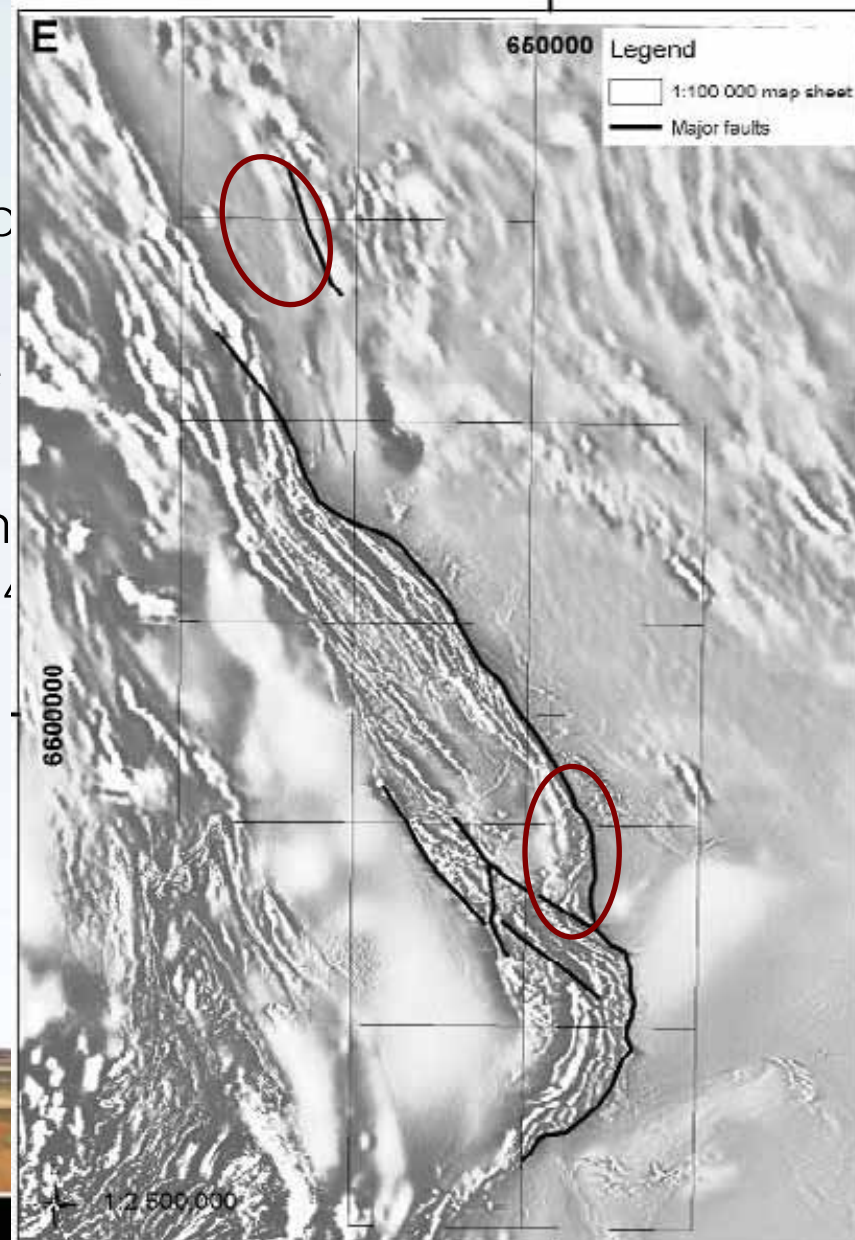
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Cambrian	Late	501	↔	
	Mid	513	↔	
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Neoproterozoic	Late	600	↔	



Early-Devonian

Effects:

- Dextral strike-slip
- Refolding in the
- Felsic volcanism
Daubeny Basin



Quaternary	check	1.8		
Cretaceous	check	141		
Permian	check	298	↗ ↘	K - AS
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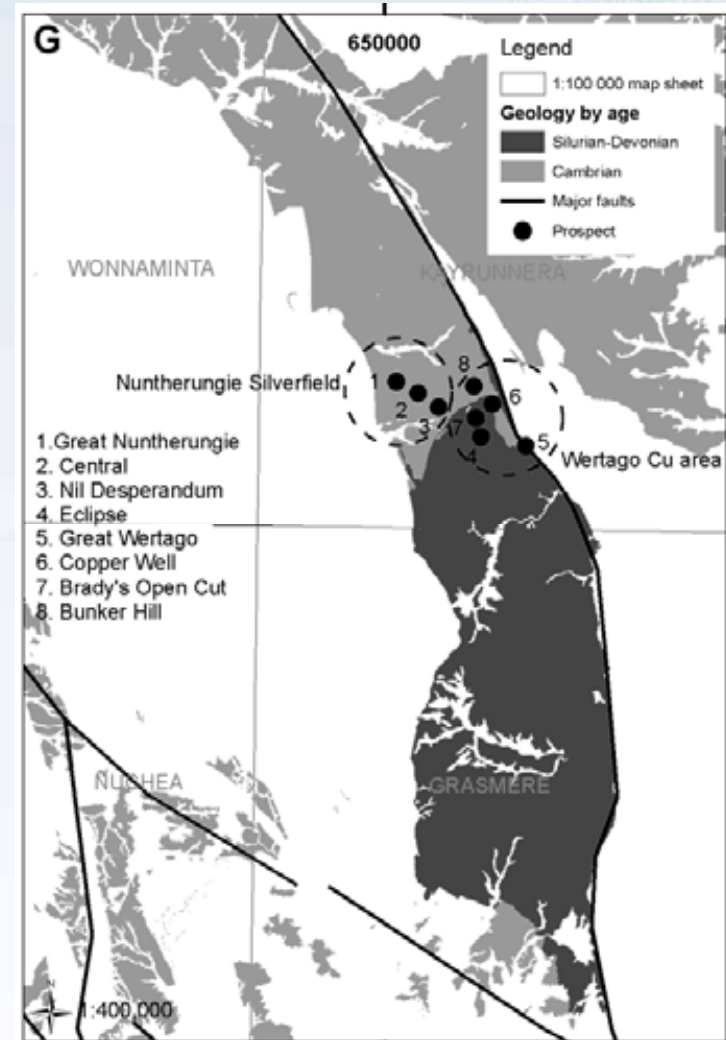
Nuntherungie – Wertago

- Ag-Pb-Cu

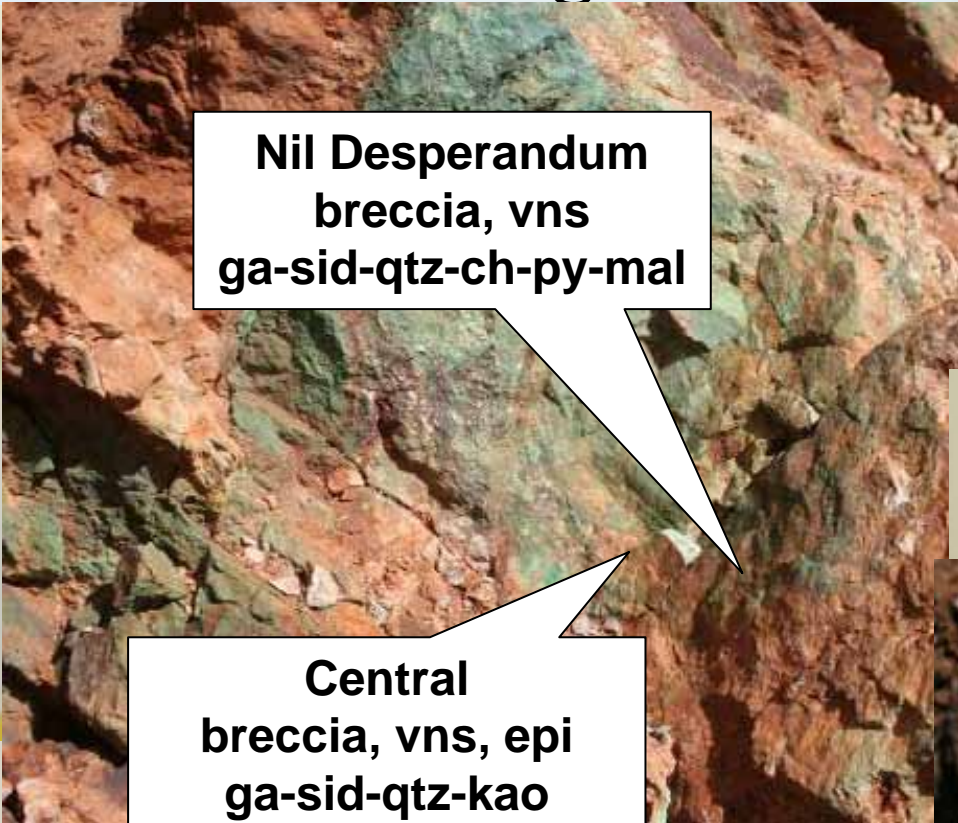
? Thackaringa-style veins

√ Epithermal low sulphidation event

√ Carboniferous remobilisation

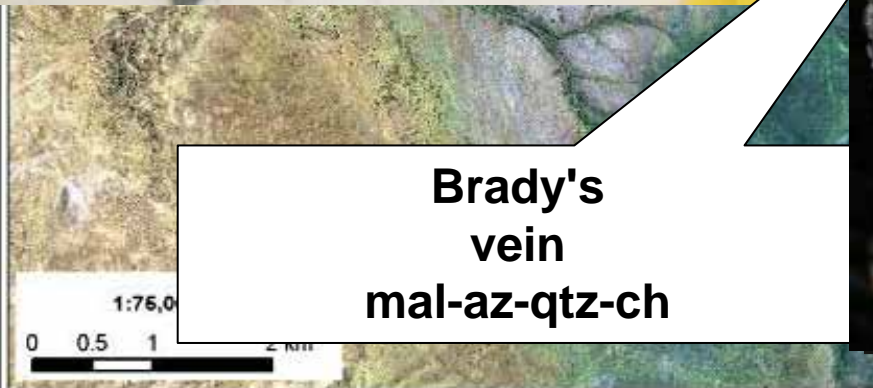


Nuntherungie – Wertago



**Nil Desperandum
breccia, vns
ga-sid-qtz-ch-py-mal**

**Central
breccia, vns, epi
ga-sid-qtz-kaol**



**Brady's
vein
mal-az-qtz-ch**

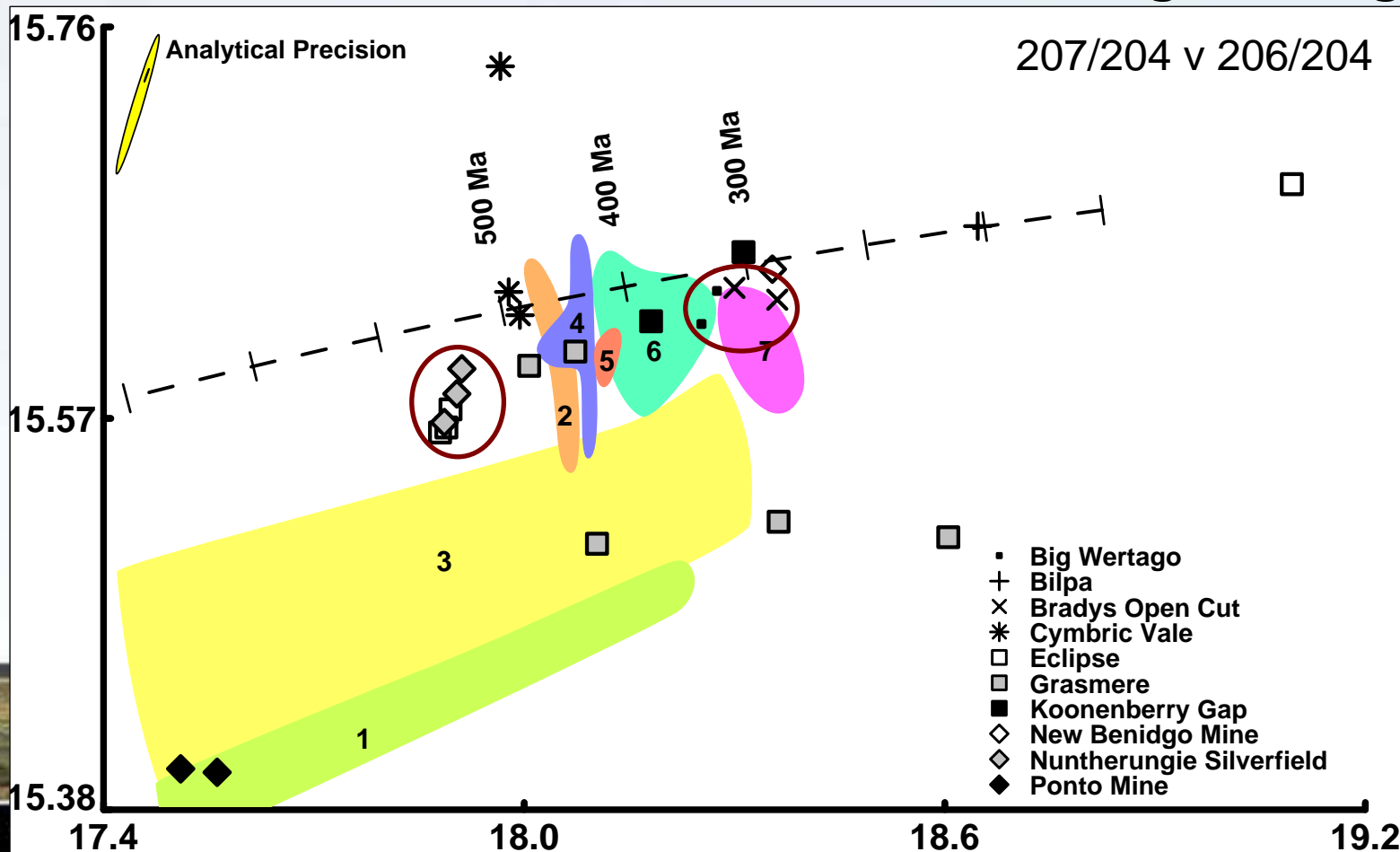


**Bunker Hill
vein, breccia, epi
mal-qtz-ch-py-po-ser-cal**



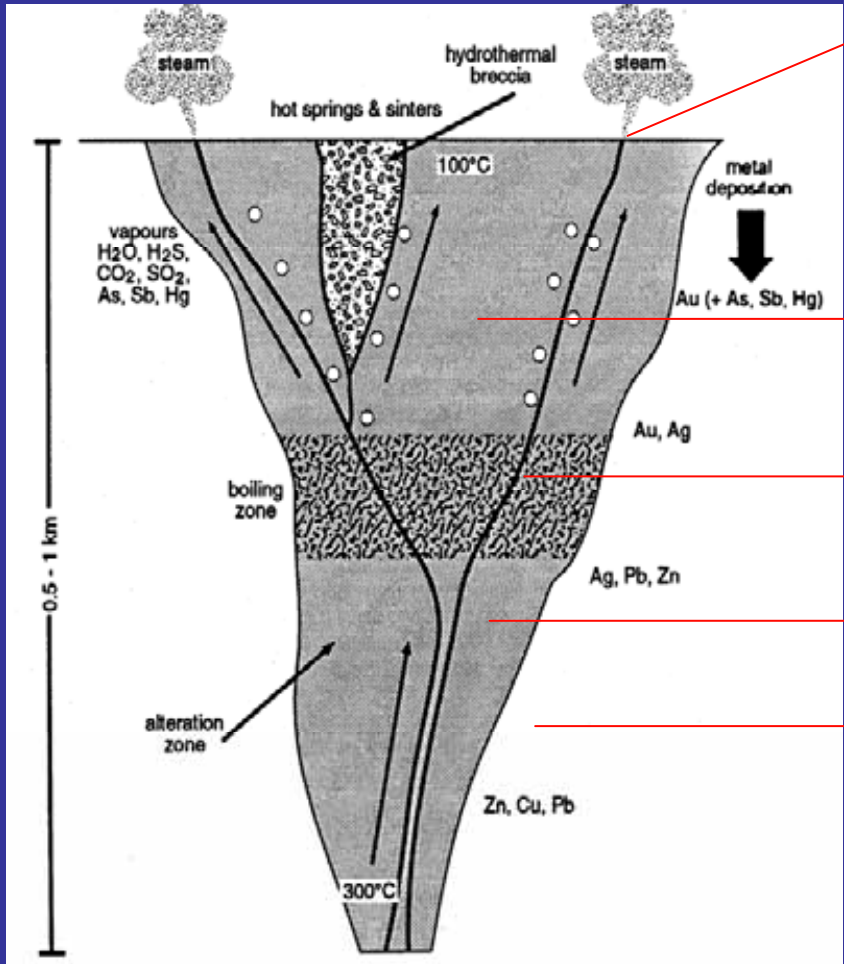
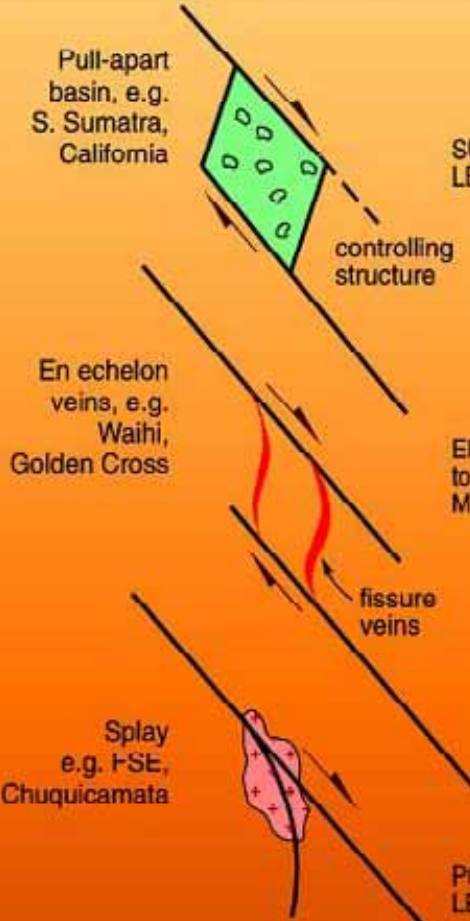
Nuntherungie - Wertago

- Pb-isotopes indicate
 - Similar results at Eclipse and Nuntherungie
 - Carboniferous remobilisation at Big Wertago



Nuntherungie - Wertago

Model for epithermal low-sulphidation system



silica sinter

steam-heated advanced argillic

potassic(adularia)

argillic/phyllitic

peripheral propylitic

Source: Ashley (2006)

Source: Corbett (2007)

Kanimblan-Alice Springs Orogeny

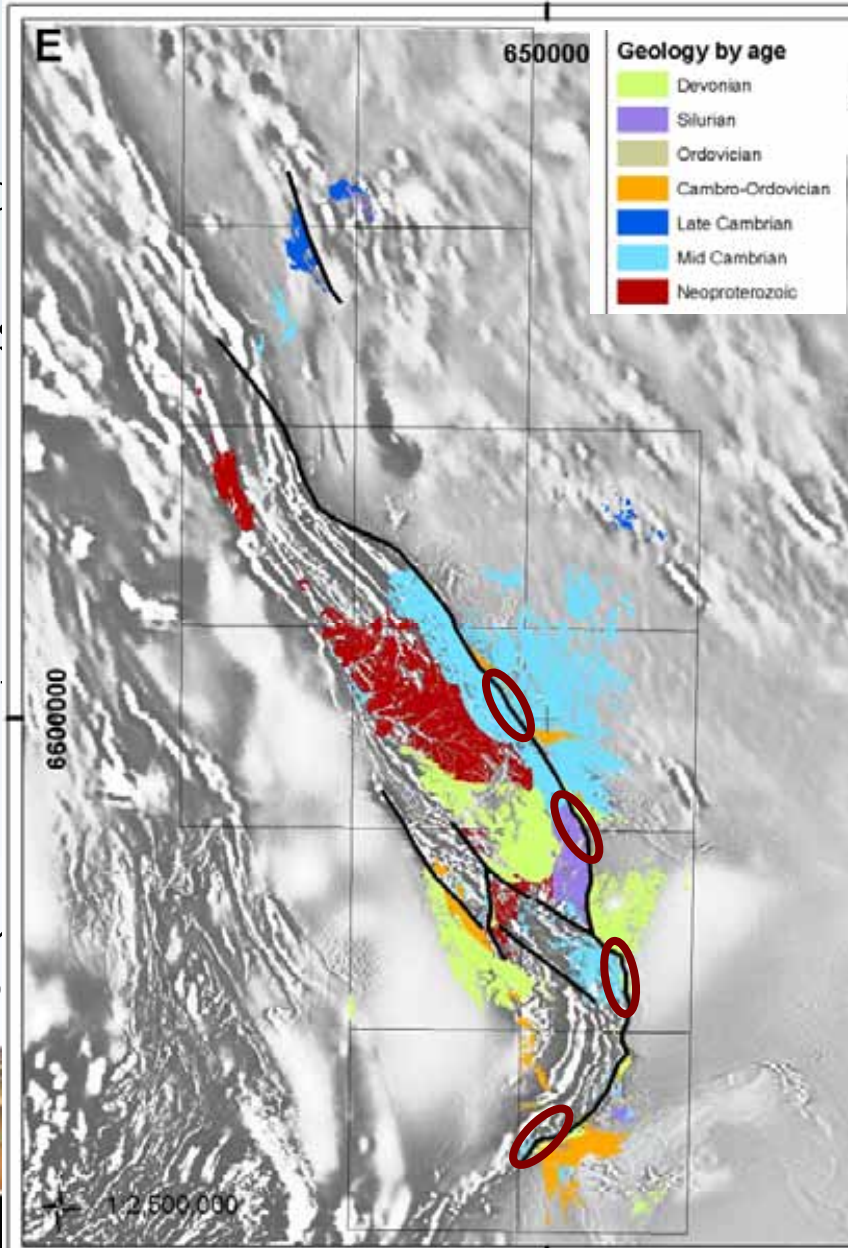
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Neoproterozoic	Late	600	

Effects:

- Shear zones and breccias
- Reactivated existing structures
- Fluid remobilisation

Potential:

- ✓ Remobilisation of deposit upgrade
- ✓ Au and Cu occur adjacent to Ko



Cretaceous

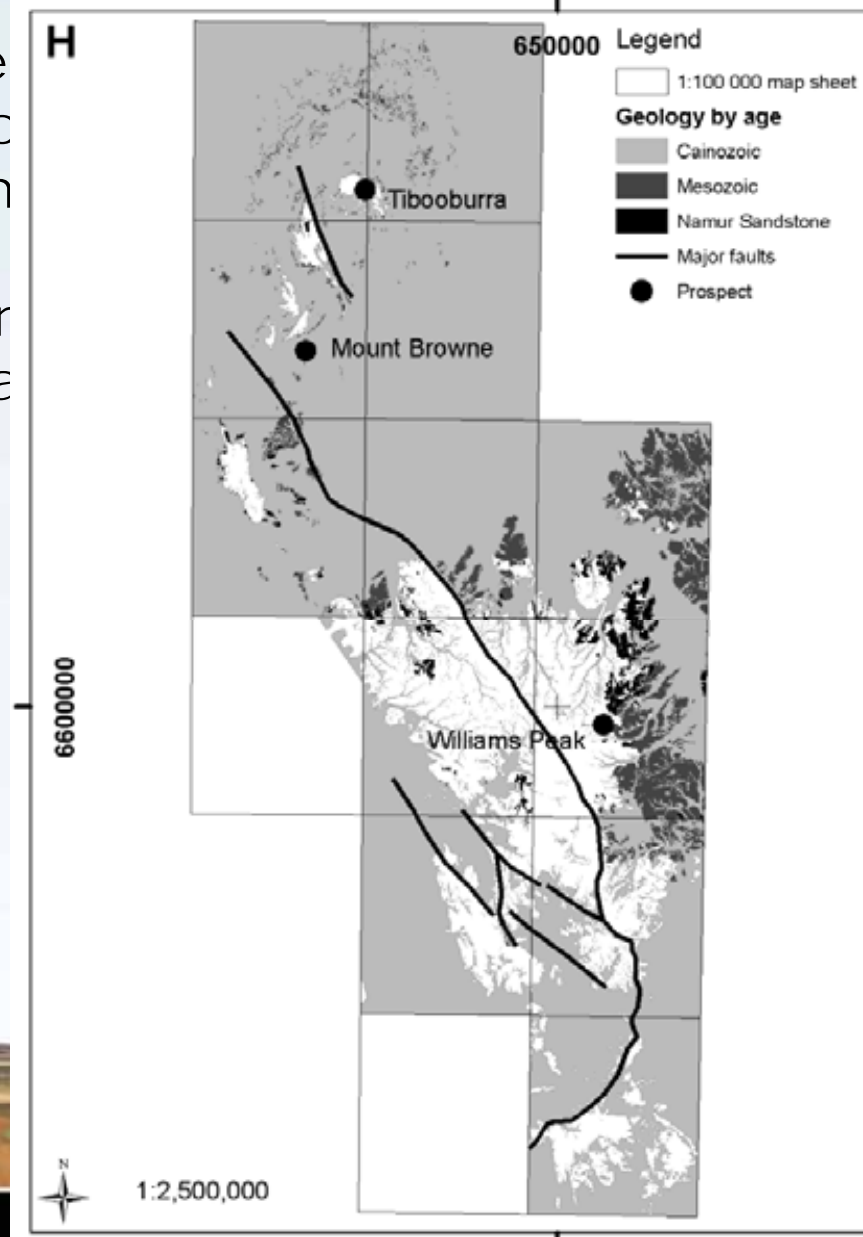
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K - AS
Tabber.

Benambran

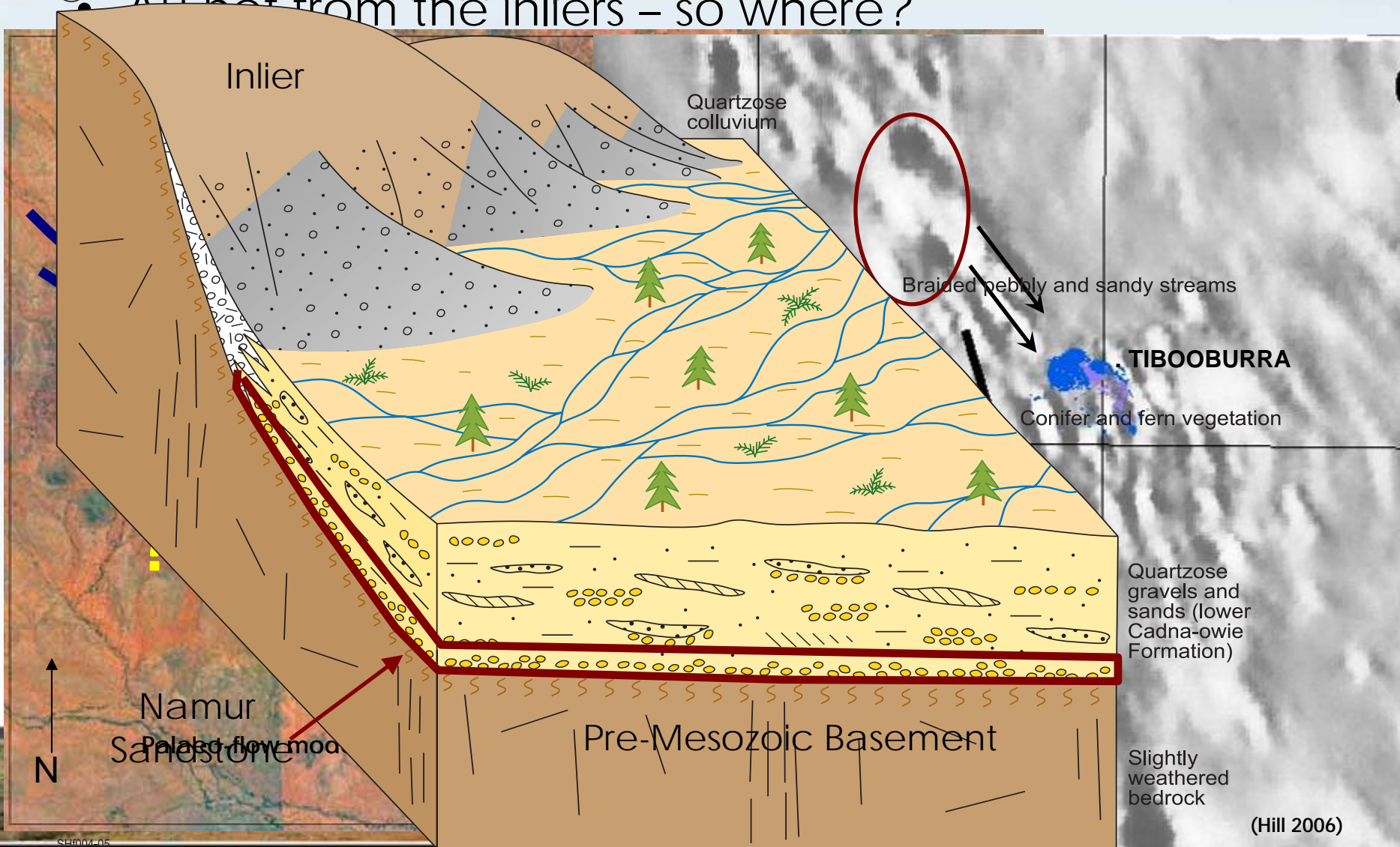
Delamerian

- Deposition of sea to marine environments in the Eromanga Basin
- Namur Sandstone unit of the Cretaceous
- Au nugget rich



Cretaceous

② Aspect from the inliers – so where? → North



Quartzose gravels and sands (lower Cadna-owie Formation)

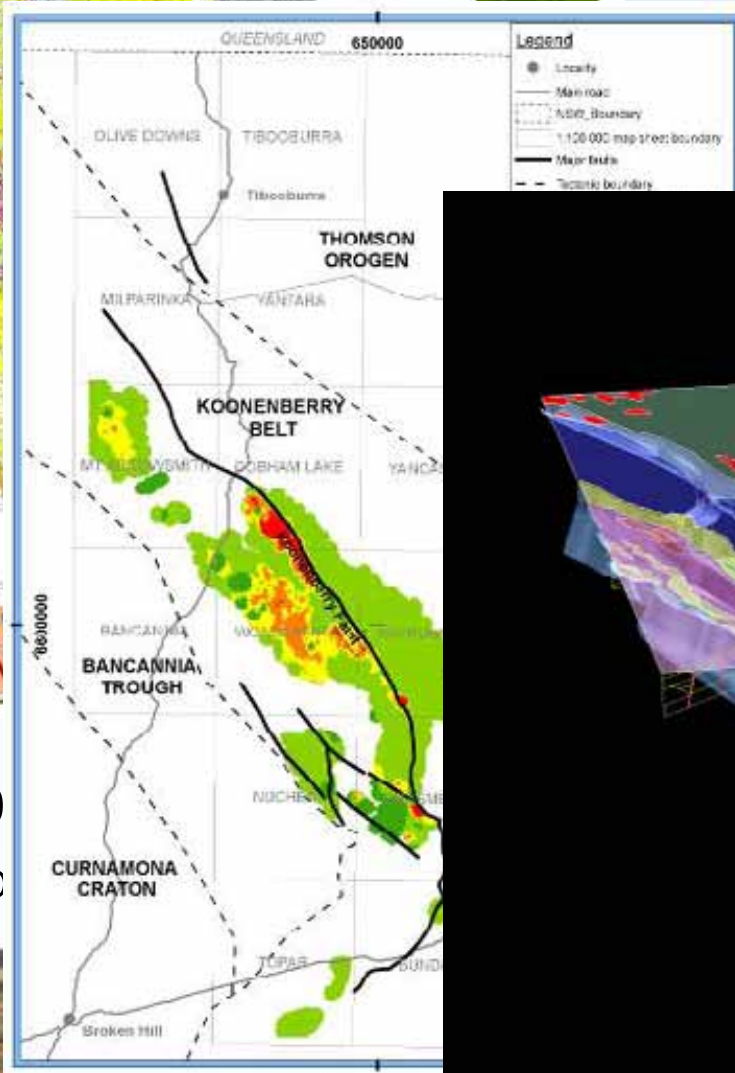
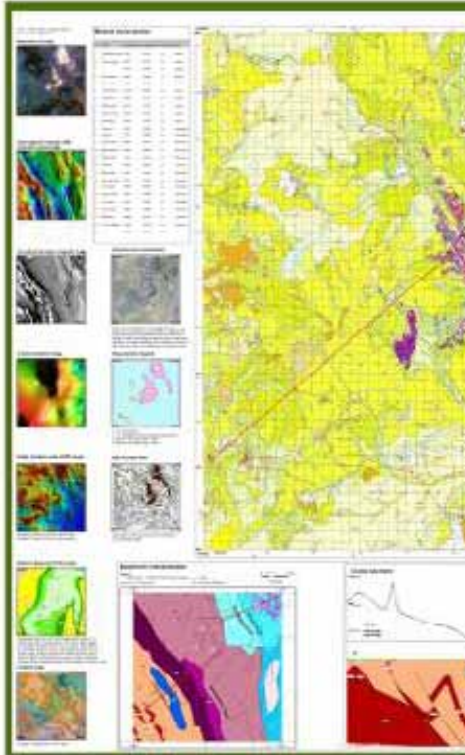
Slightly weathered bedrock

(Hill 2006)

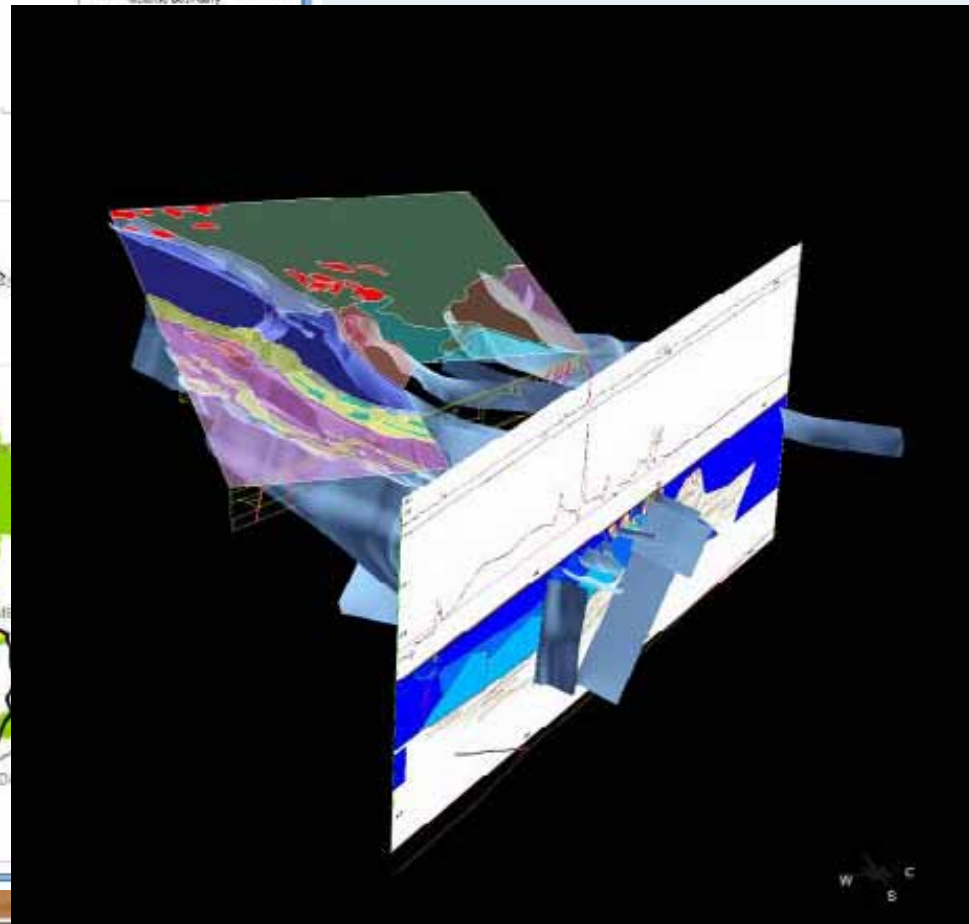
Summary of mineral potential

- The Koonenberry Belt is prospective for:
 - Orthomagmatic Ni-Cu-PGE
 - VMS Cu-Zn-Ag-Au
 - Turbidite hosted orogenic Au
 - Epithermal Ag-Pb-Cu
 - Plus multiple deformation events
 - structural complexity (e.g. lower order splays, traps)
 - remobilisation
 - potential for upgrading mineralisation
 - Plus reworked metals through complex landscape evolution
 - palaeo-placer Au
- **UNDEREXPLORED!**

How the Geological Survey can help



250k geophy. interp.)

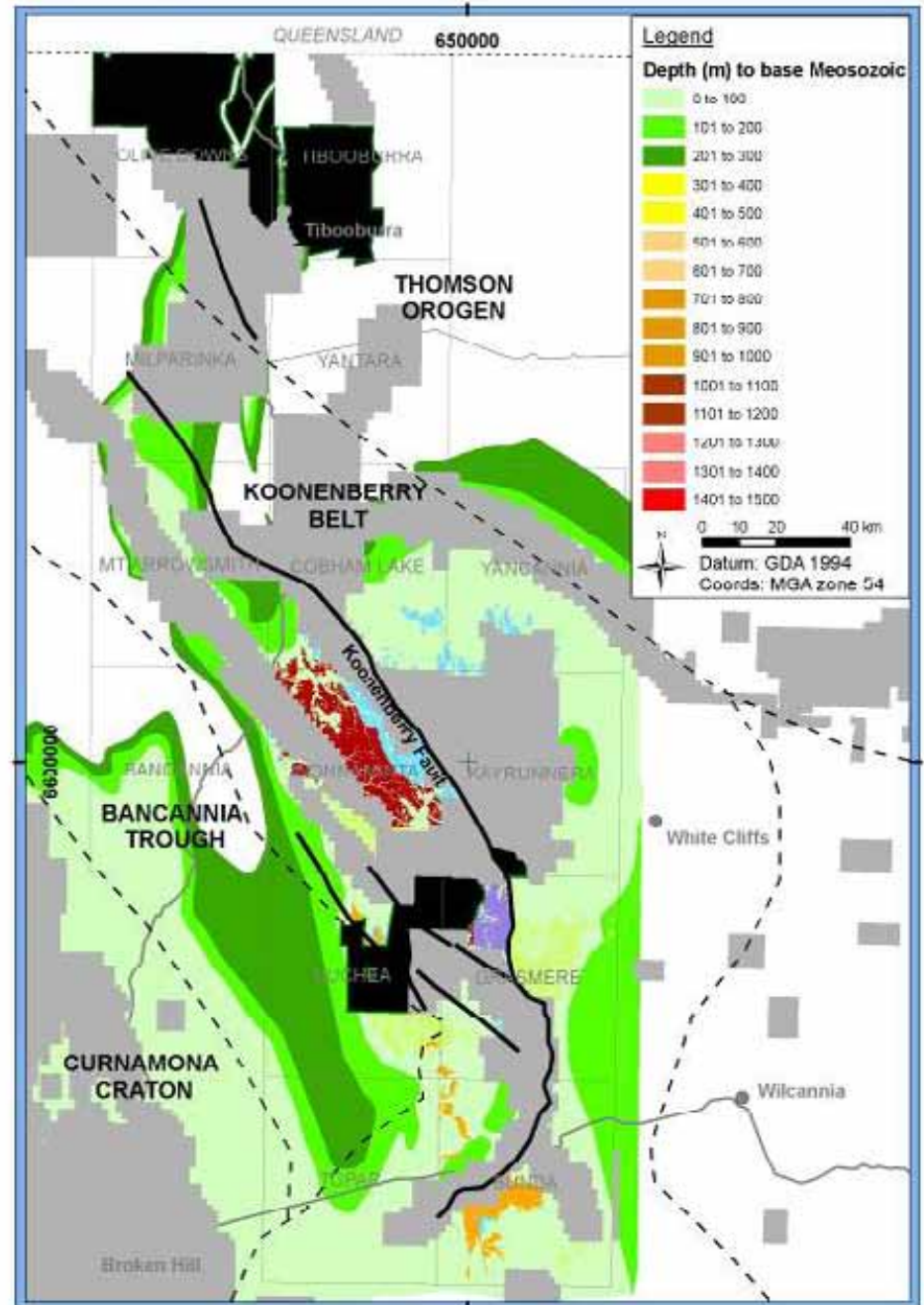
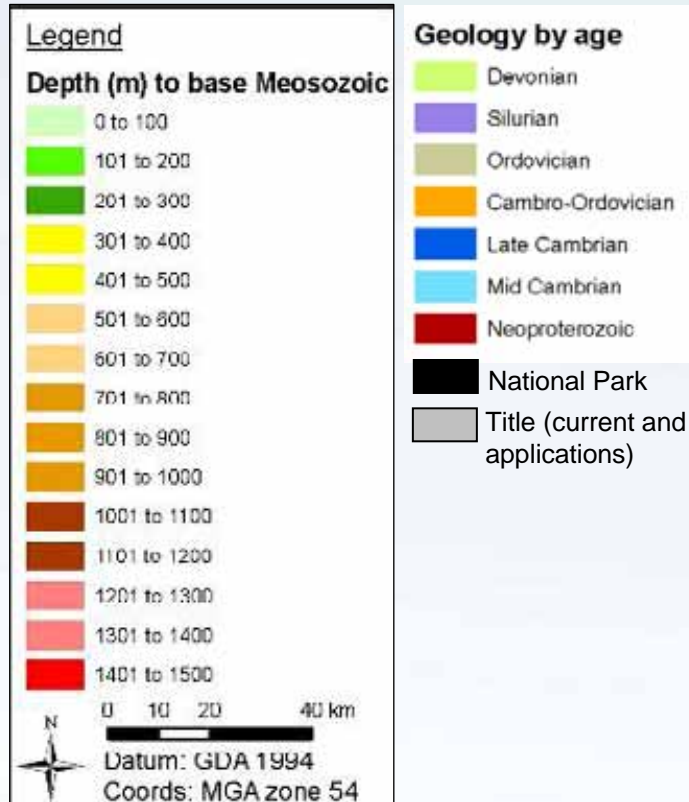


END OF FY 07/0
- DVD, exp



Available ground

- Still up for grabs (on 12/09/07)



Ta !

