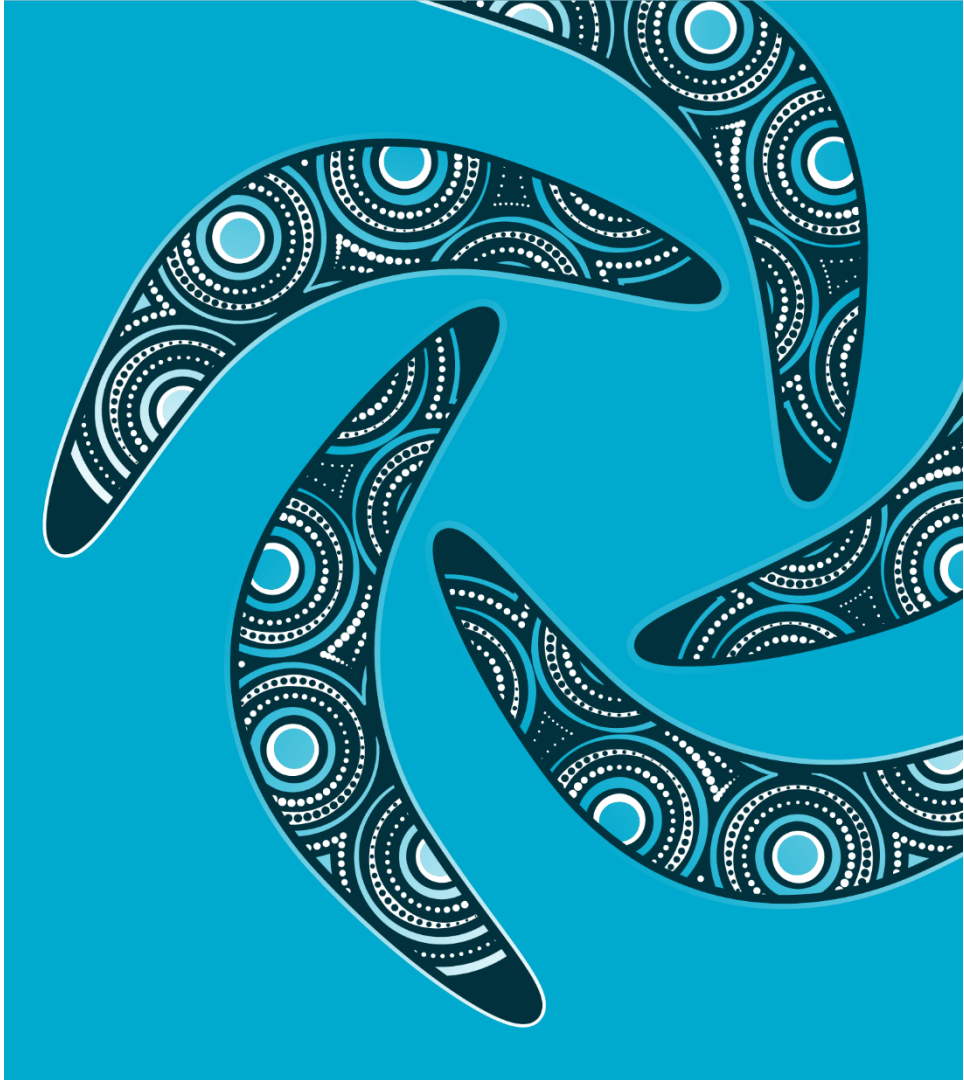
Australia's National Science Agency

First insights into the sediment-hosted copper mineral system of the Birrindudu Basin, NT

Susanne Schmid & Raphael Baumgartner

In collaboration with the Northern Territory Geological Survey

I would like to begin by acknowledging the Arrernte people as the Traditional Owners of the land that we're meeting on today, and pay my respect to their Elders past and present.



Project Aims

Aims to develop a robust sedimentological, stratigraphic and sequence stratigraphic framework and mineral potential

- Module – Facies Analysis
  - Several drillholes logged, published through NTGS 2023
- Module – Sequence Stratigraphy
  - Sequence stratigraphic correlation
  - Subsidence history
  - Palaeogeographic maps
- Module – Mineral Potential
  - Identification of source/host rocks Cu, Zn
  - Copper sulphide characterisation and timing
  - Mineral systems analysis

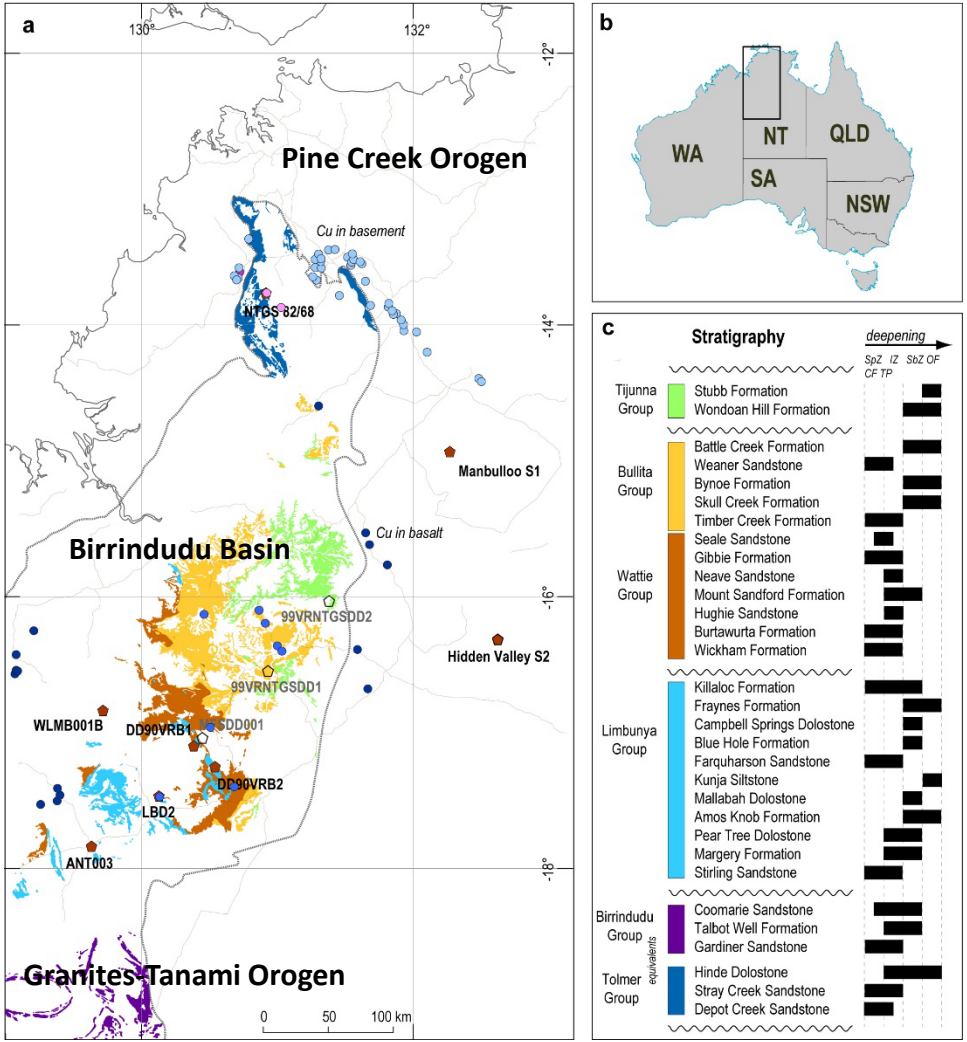
Birrindudu Basin

Birrindudu Basin

- Palaeoproterozoic to Mesoproterozoic basin
- equivalent to McArthur Basin
- unmetamorphosed
- underlain by NAC

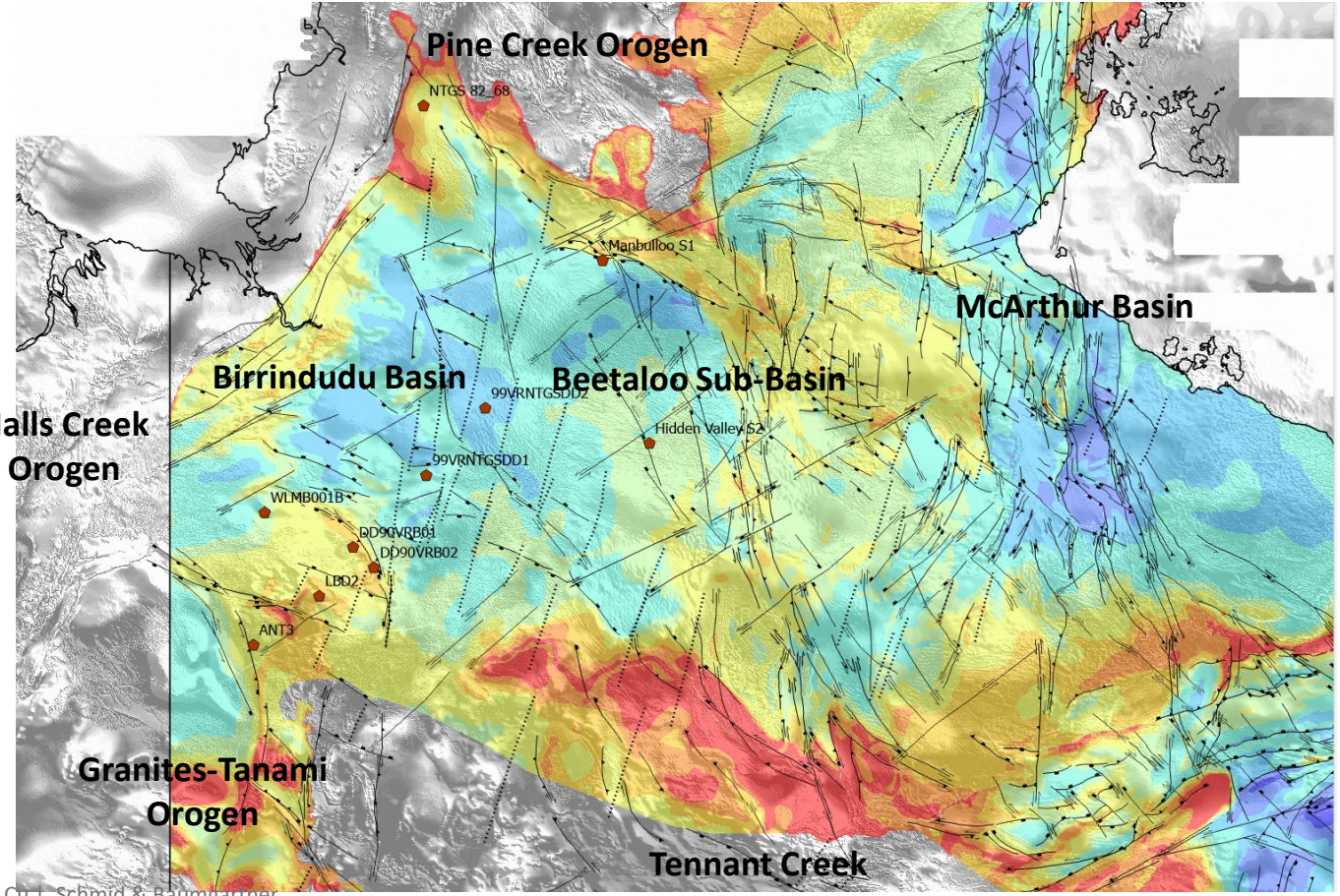
NAC - North Australian Craton

- Archean – rare
- Palaeoproterozoic orogenic belts
  - Halls Creek Orogen
  - Granites-Tanami Orogen
  - Pine Creek Orogen



Birrindudu Basin

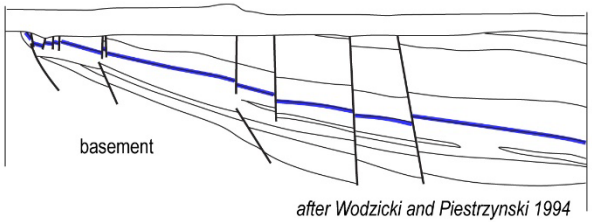
present-day sediment thickness Palaeo/Meso-proterozoic basins



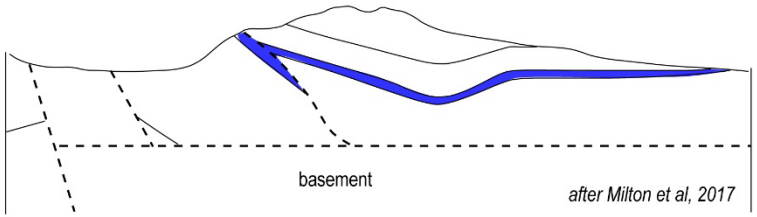
Sed-Cu Deposits

Timing of copper mineralisation hosted in sedimentary successions can occur throughout the basin evolution

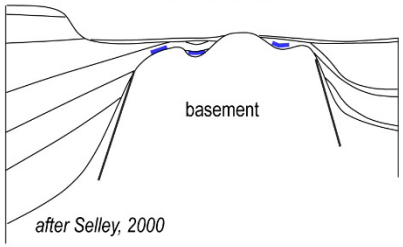
Lubin-Sieroszowice, Poland



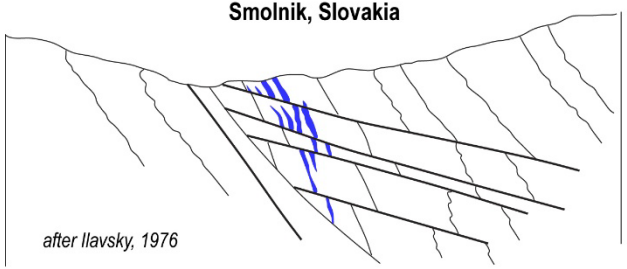
Coppercap Mountain, Canada



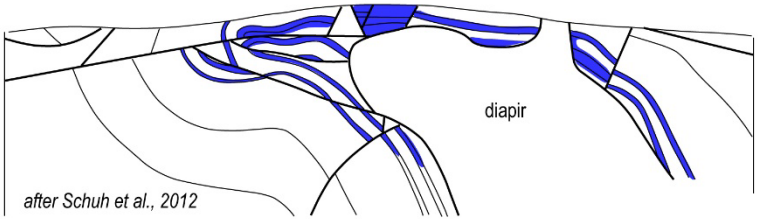
Mt Gunson, Australia



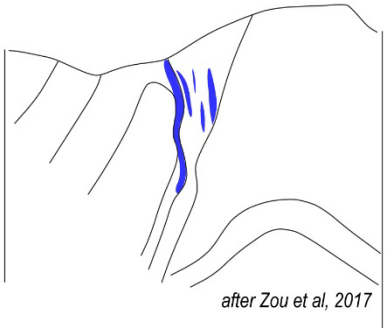
Smolnik, Slovakia



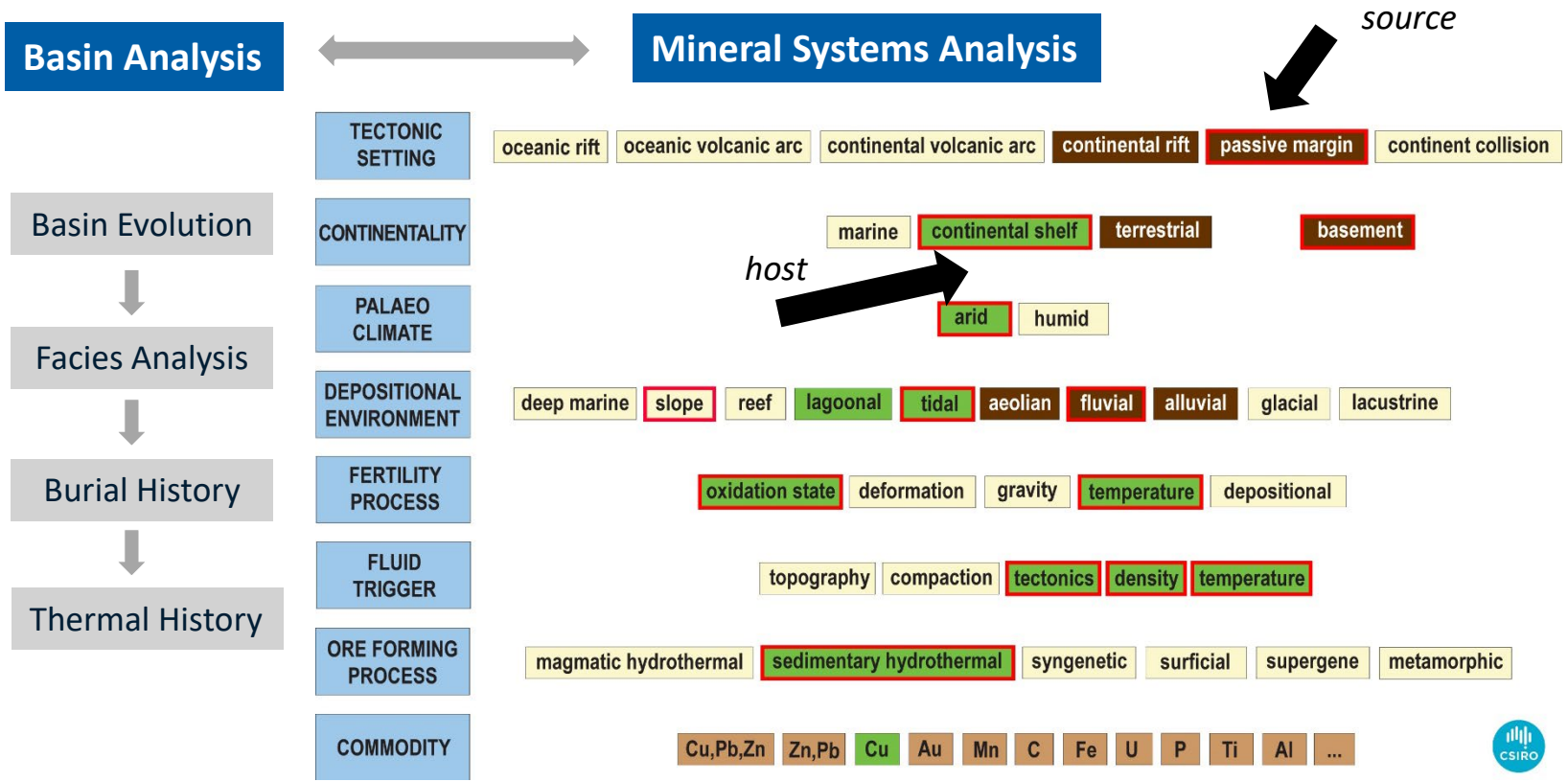
Kwatebala, DRC



Jinman, China



Sed-Cu Mineral Systems



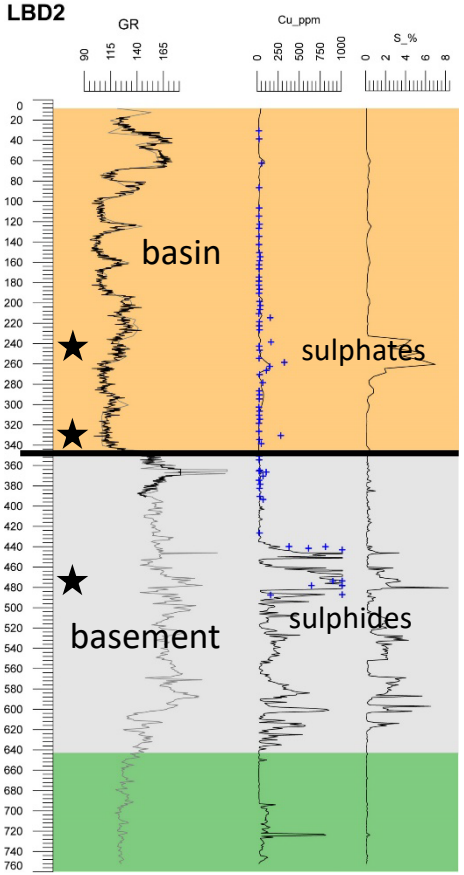
Sed-Cu Mineral Systems

Selected components discussed:

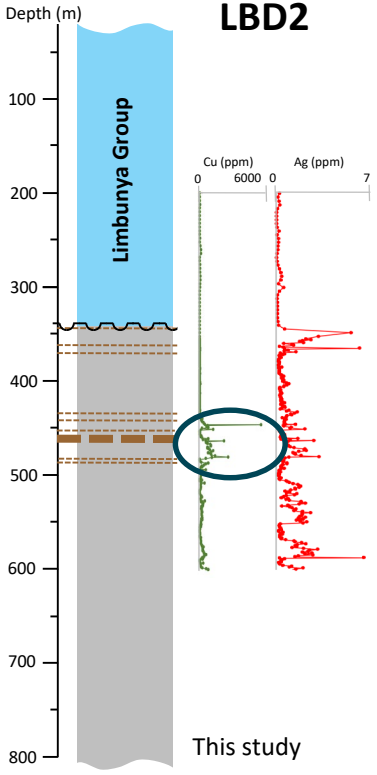
- Source rocks and fertility process
- Alteration
- Mineralisation
- Mapping distribution of host rocks

Sed-Cu Mineral Systems

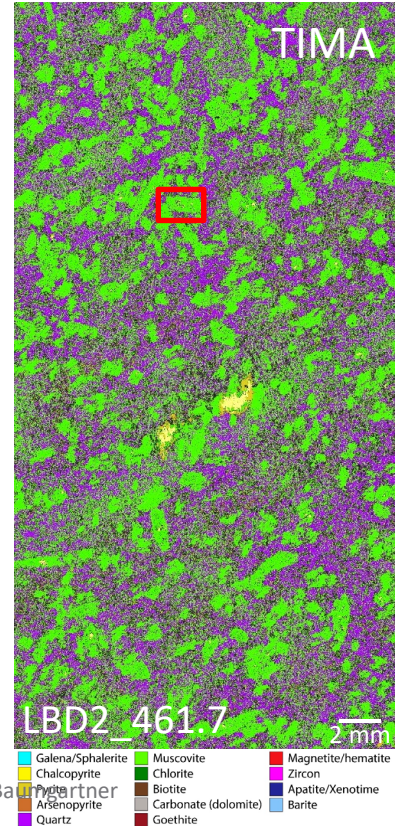
identifying parts of the mineral system

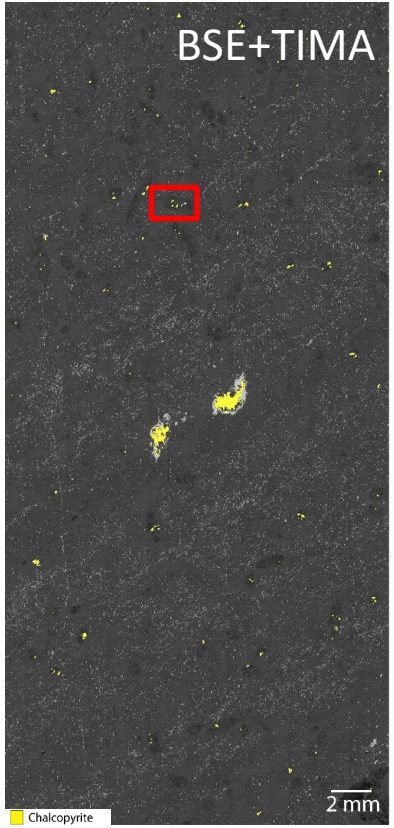


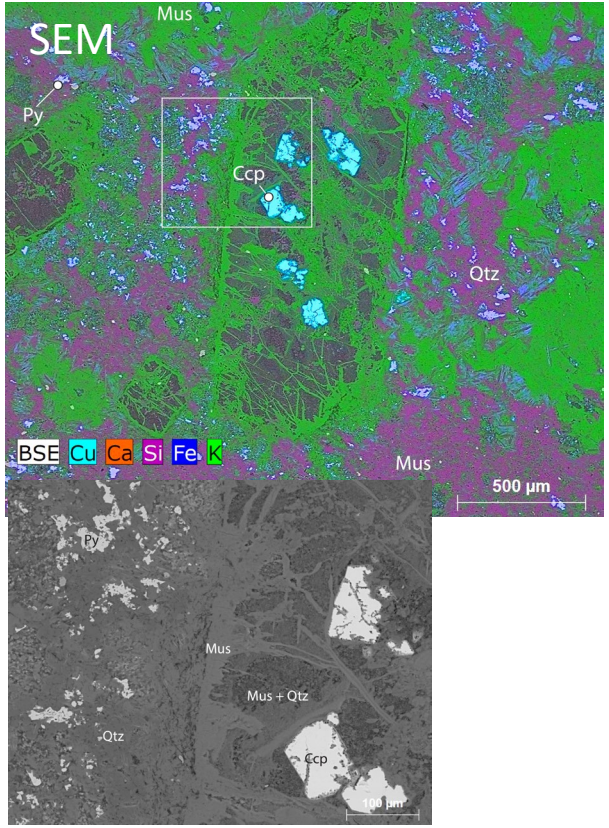
Drill Cores – Petrography and Mineralogy



Phyllic alteration: muscovite + quartz + chlorite + pyrite ± chalcopyrite







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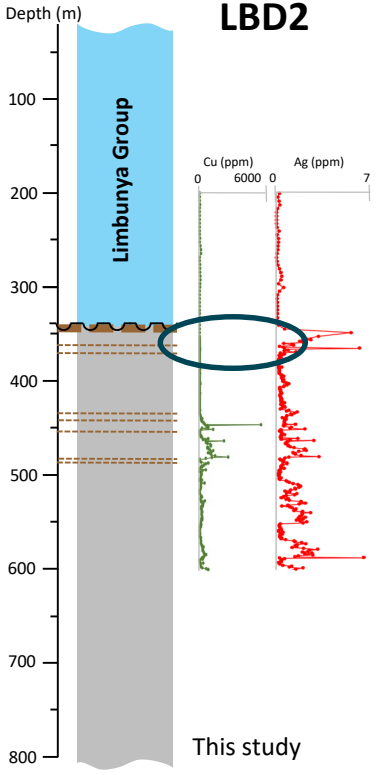
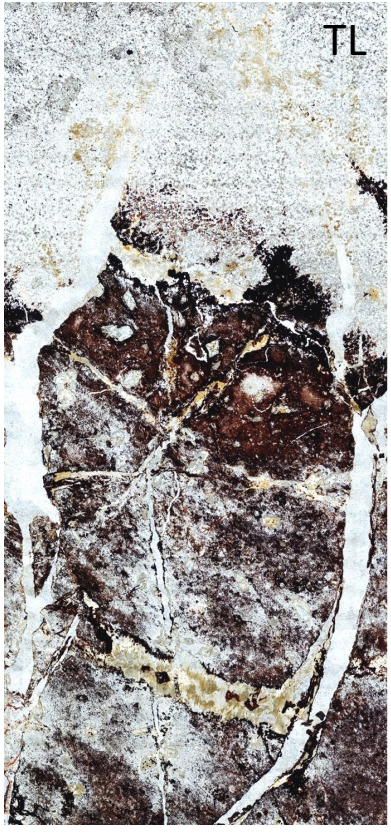


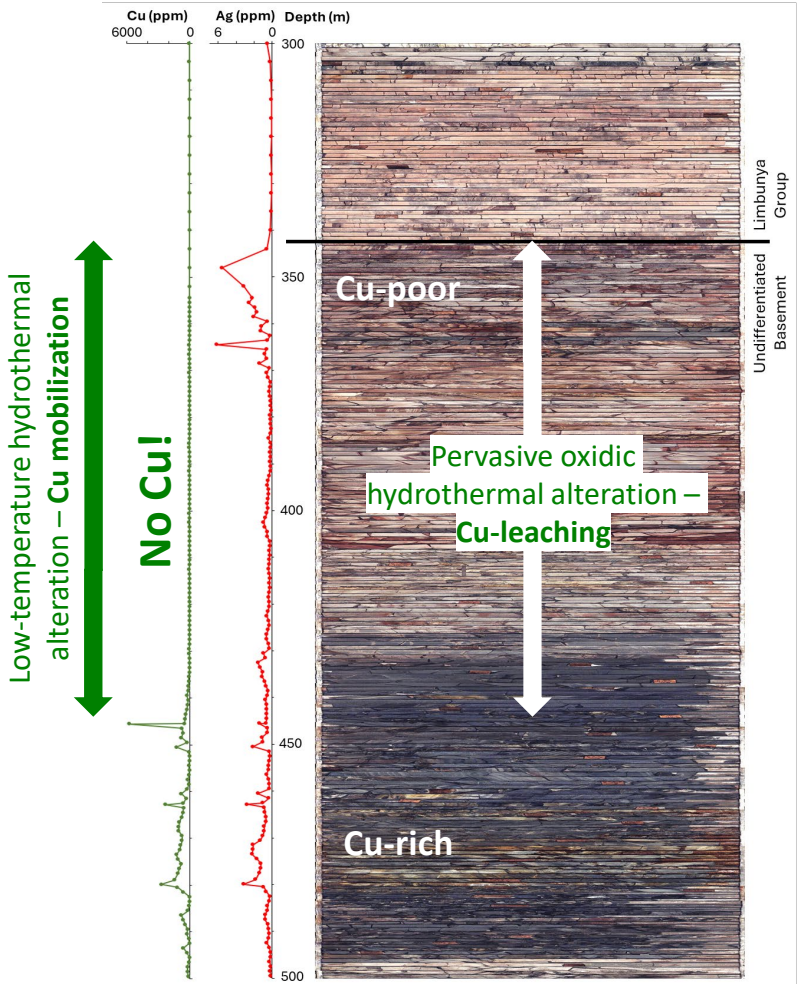
Hydrothermal veining: goethite/hematite



Sed-Cu Mineral Systems

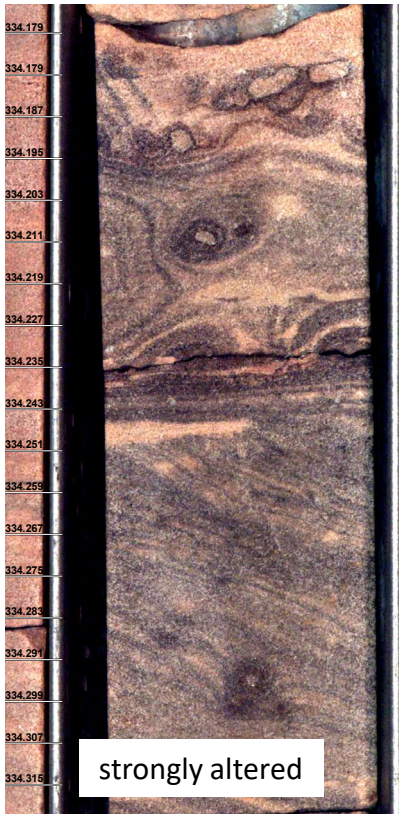
Metavolcanics underlying the Birrindudu Basin experienced contact metamorphism, pervasive phyllic alteration, and iron-oxide/hydroxide hydrothermal alteration/veining:

- Contact metamorphism: pervasive recrystallisation; andalusite and cordierite porphyroblasts.
- Phyllic alteration (~200-300 °C) – enrichment of Cu.
- **Iron-oxide/hydroxide hydrothermal alteration/veining (<100-200 °C) – mobilization of Cu.**

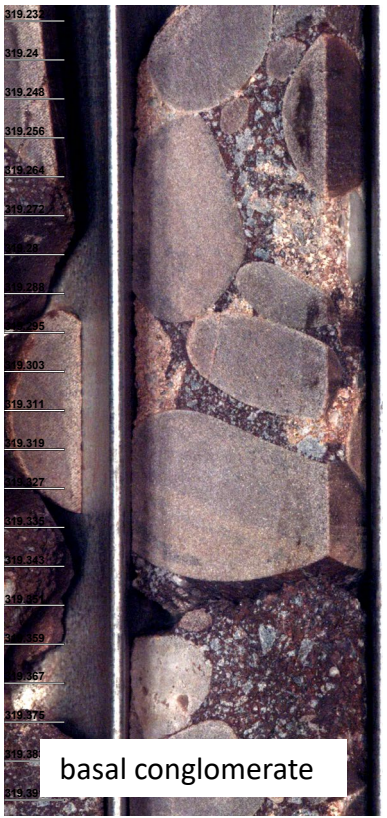


Fluid Pathways - Aquifers

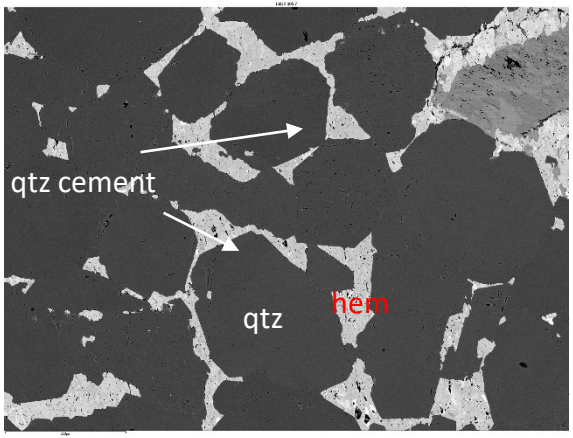
LBD2



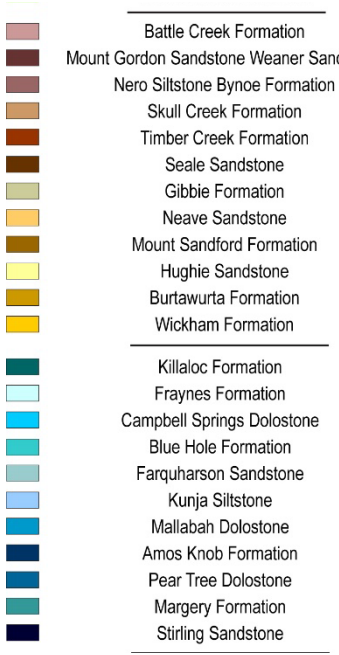
LBD4



channel facies



- intense hematite alteration after burial of basin – epigenetic
- typical alteration associated with oxidised, saline brines (confirmed by fluid inclusion data)

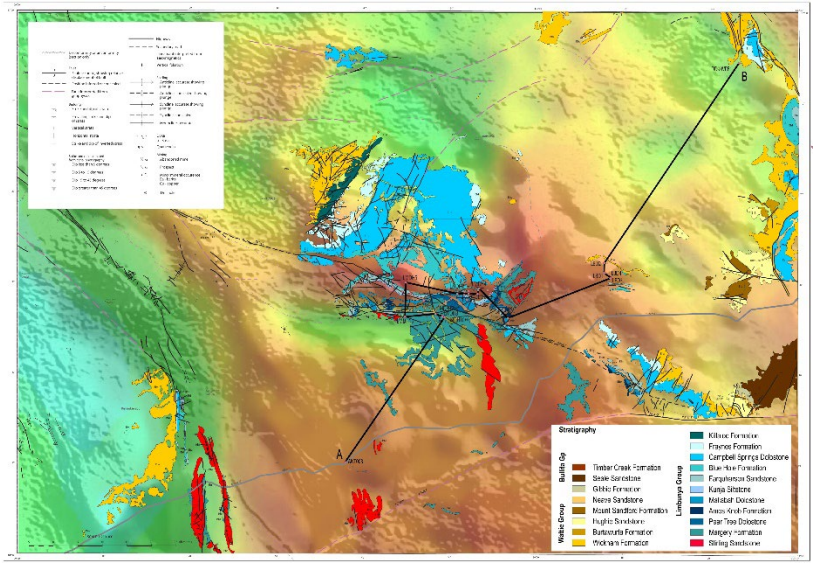


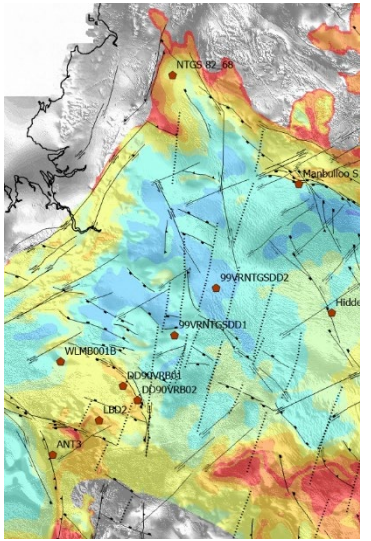
Stirling Sandstone

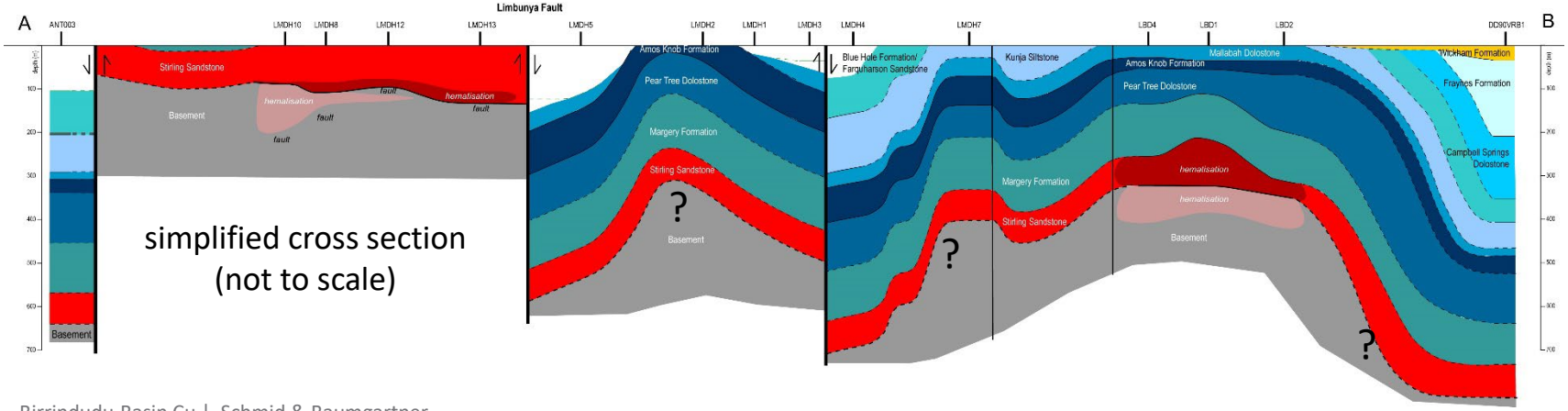
- sandstone - fluvial
- unconformity below
- up to ~240 m thick

Alteration

- mapping alteration regionally
- finding fluid pathways and host rocks nearby
- basin reconstruction needed
- finding suitable host rocks

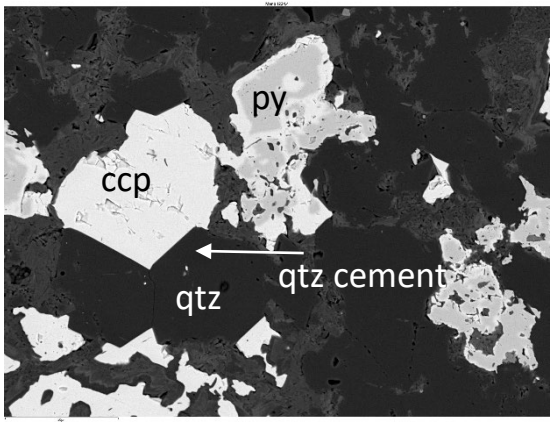




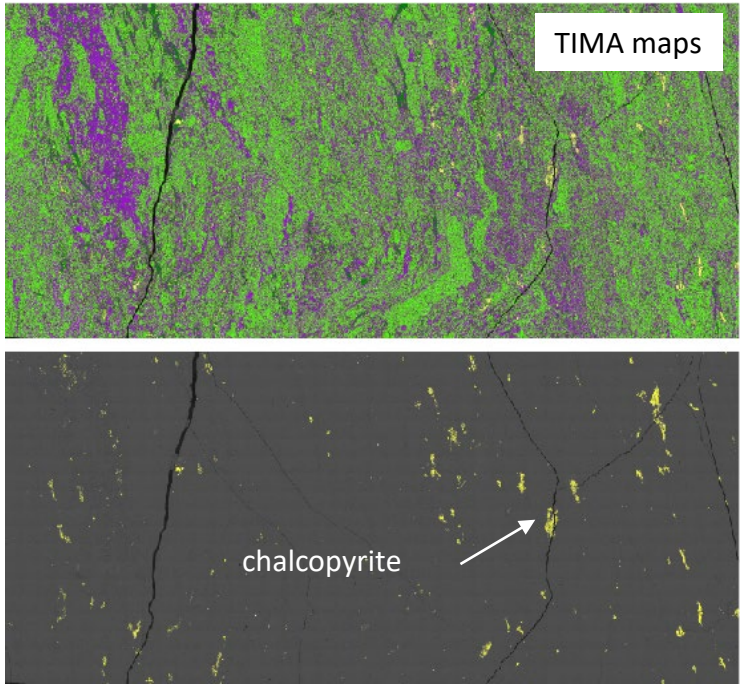


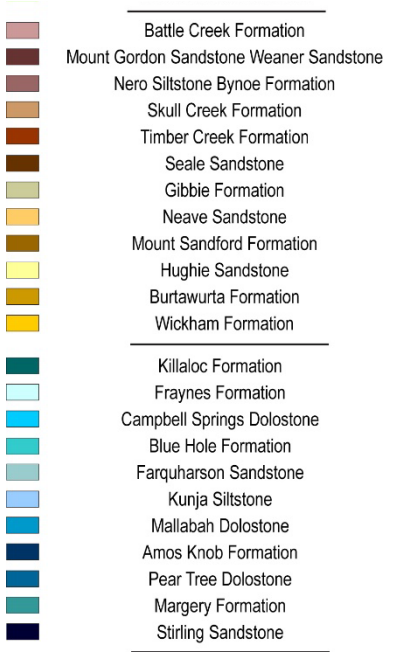
Host Rocks

Manbulloo S1 - 1224.4 m



pro-delta facies



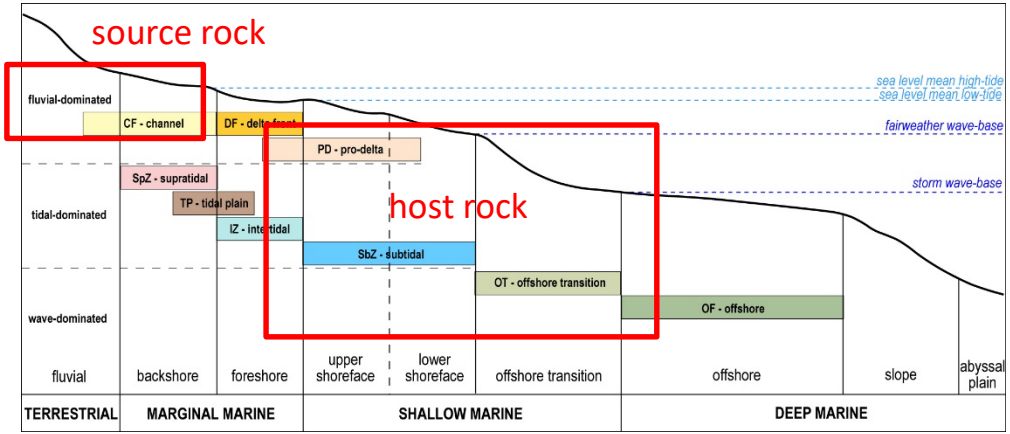


- chalcopyrite replacement of pyrite occurred after burial – epigenetic
- relative timing same as hematisation suggesting link between source and host

Amos Knob Formation

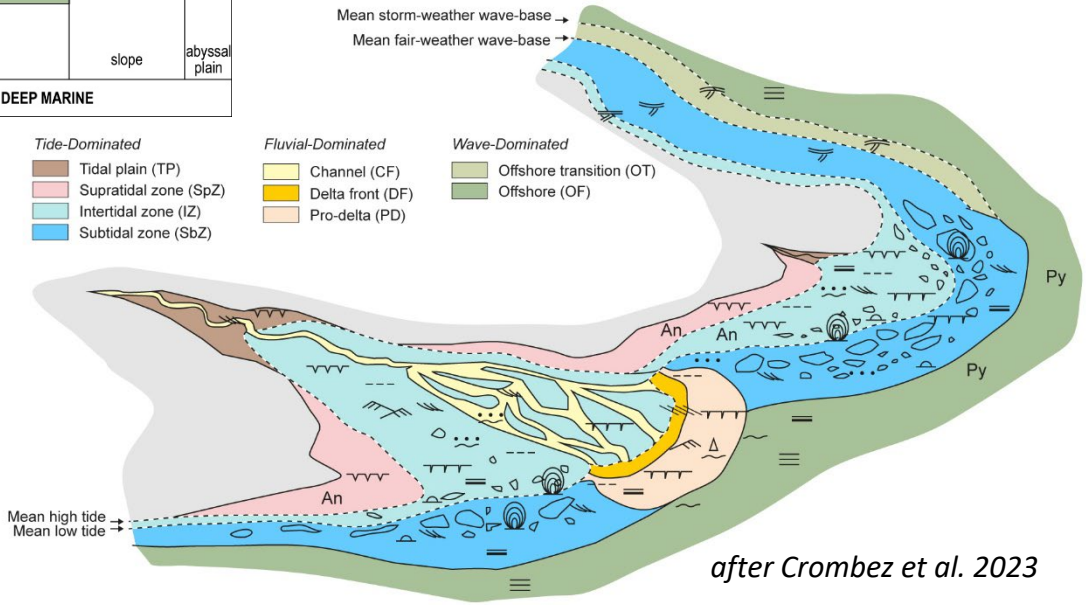
- black shale – offshore
- widely distributed
- up to ~140 m thick

Facies Analysis



Facies Assocations	Co		Br			CoSd		Sd				St				Sh						Do					Ca	Ev
	1	2	1	2	3	1	2	1	2	3	4	1	2	3	4	1	2	3	4	5	10	11	1	2	3	4	5	1	2	1
Tidal plain (TP)																														
Supratidal zone (SpZ)																														
Intertidal zone (IZ)																														
Subtidal zone (SbZ)																														
Delta front (DF)																														
Pro-delta (PD)																														
Channel (CF)																														
Offshore transition (OT)																														
Offshore (OF)																														

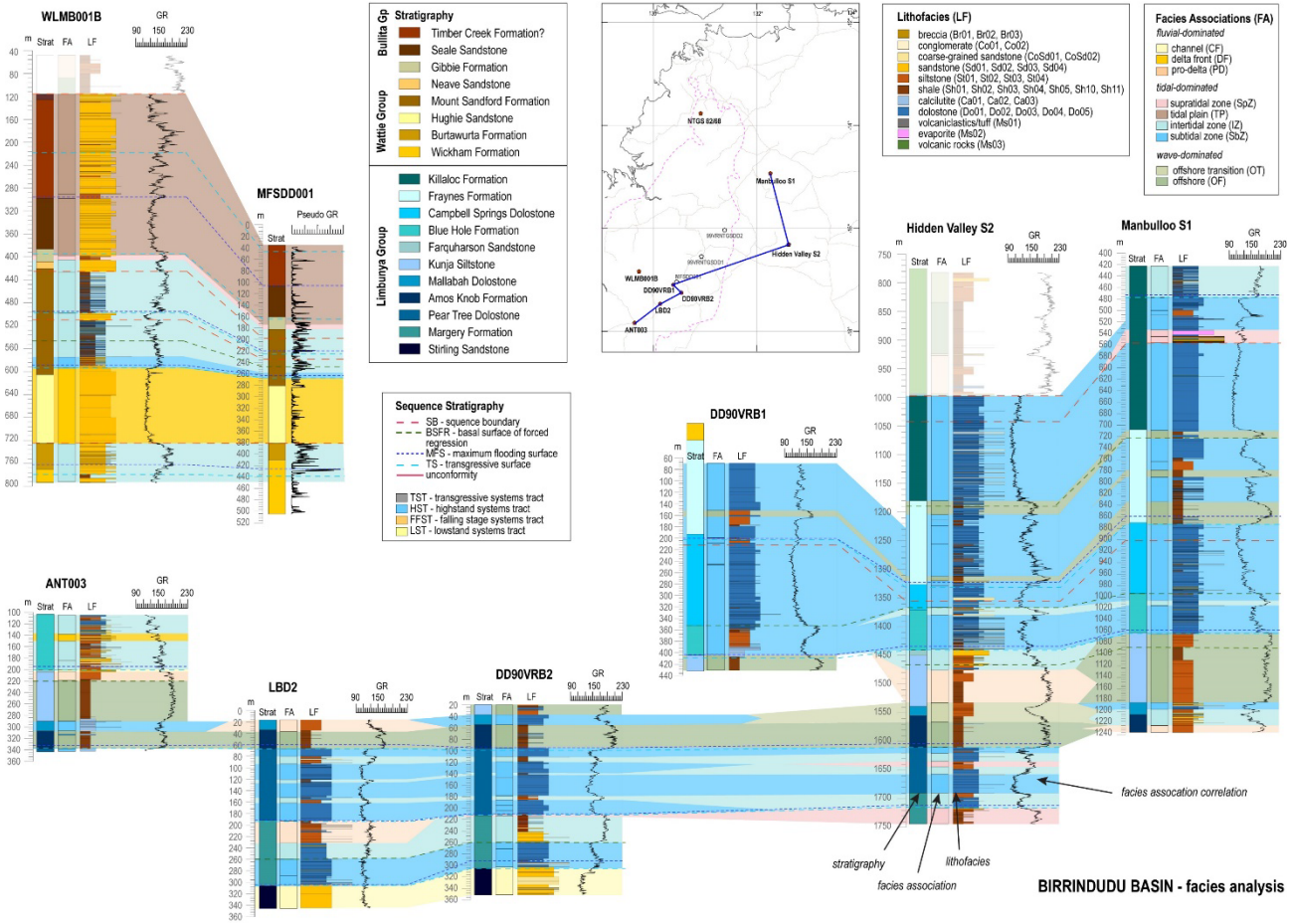
definition of lithofacies and facies associations - depositional environments

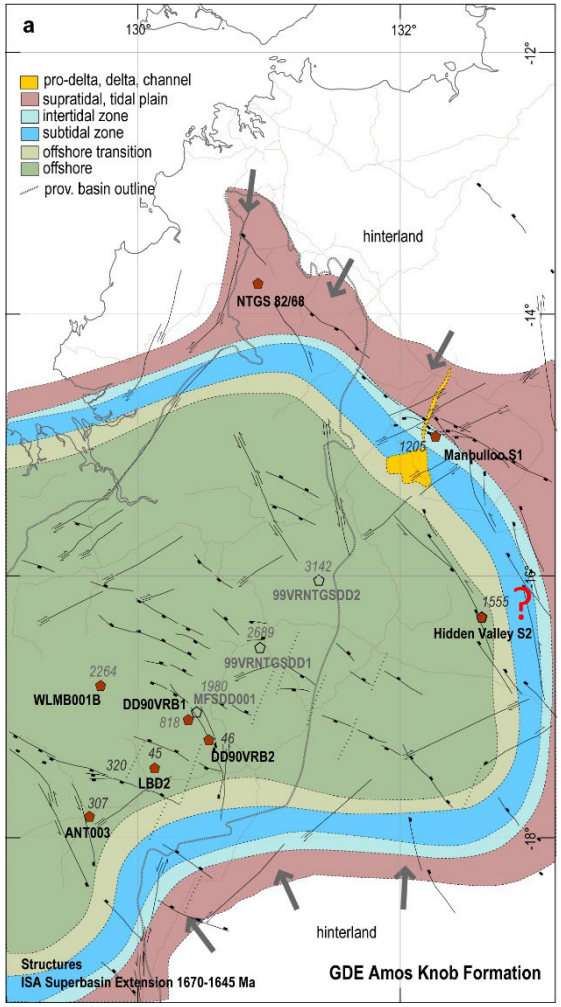


after Crombez et al. 2023

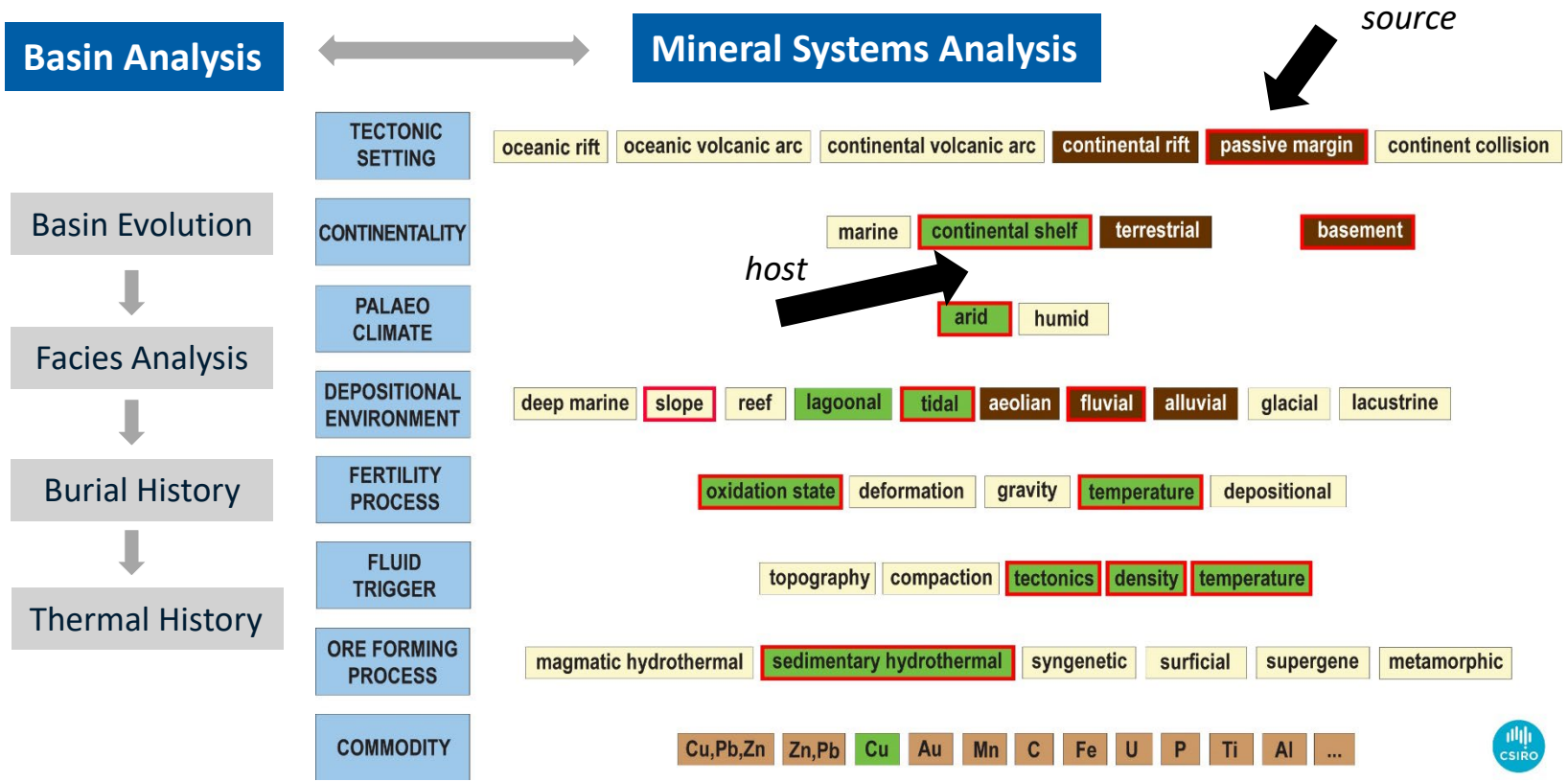
Important for **identification** of potential
source/host rocks
migration pathways
fluid carriers
in a mineral system!

Sequence Stratigraphy





Sed-Cu Mineral Systems



Thank you

CSIRO Mineral Resources – Discovery
Susanne Schmid
susanne.schmid@csiro.au

https://research.csiro.au/basins/