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Resourcing Australia's Prosperity

Well correlations and age constraints reveal emerging resource potential in the Birrindudu Basin region

Liuqi Wang, Diane Jorgensen, Jade Anderson, Paul A. Henson, Emmanuelle Grosjean, Natalie Kositcin, Lidena K. Carr, Chris Southby, Carmine Wainman and Maggie Li

Geoscience Australia

Acknowledgement of Country

Geoscience Australia values the lands, water and sky as we work to deepen a shared understanding of Country and Earth.

We respect First Nations peoples and their enduring connection, contribution and obligations to Country. Reflecting on our shared history, we are committed to listen and learn.

Geoscience Australia: A Journey of Connection
Artwork by Lani Balzan

Outline

- Introduction
- Methodology
- Stratigraphic correlation
- Resource potential
- Summary

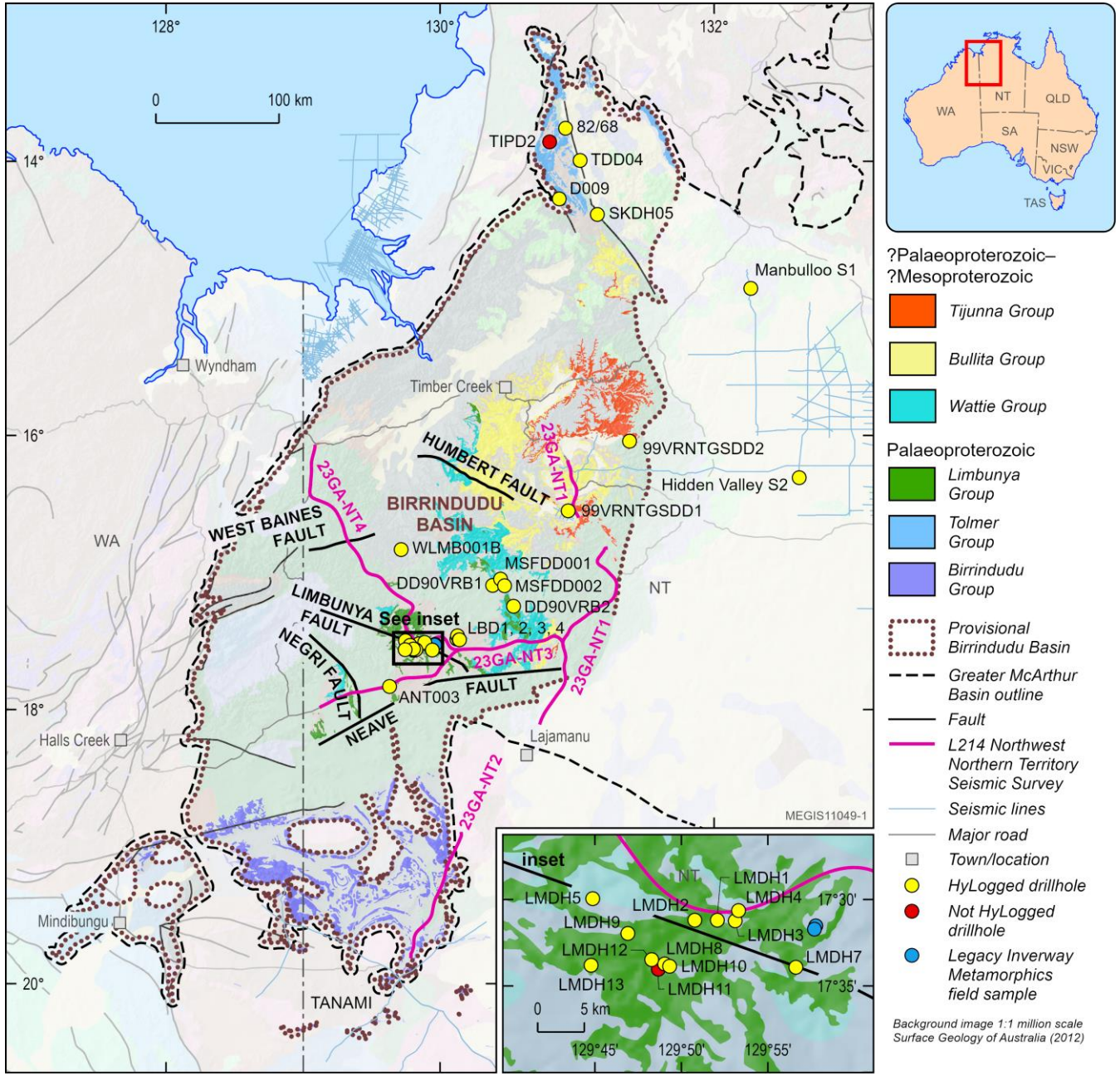
Introduction

- Birrindudu Basin region:
  - Birrindudu Basin
  - Basement successions

- Previous work:
  - Munson (2023), Crombez et al (2023), Schmid and Baumgartner (2024), Foley (2024), etc.

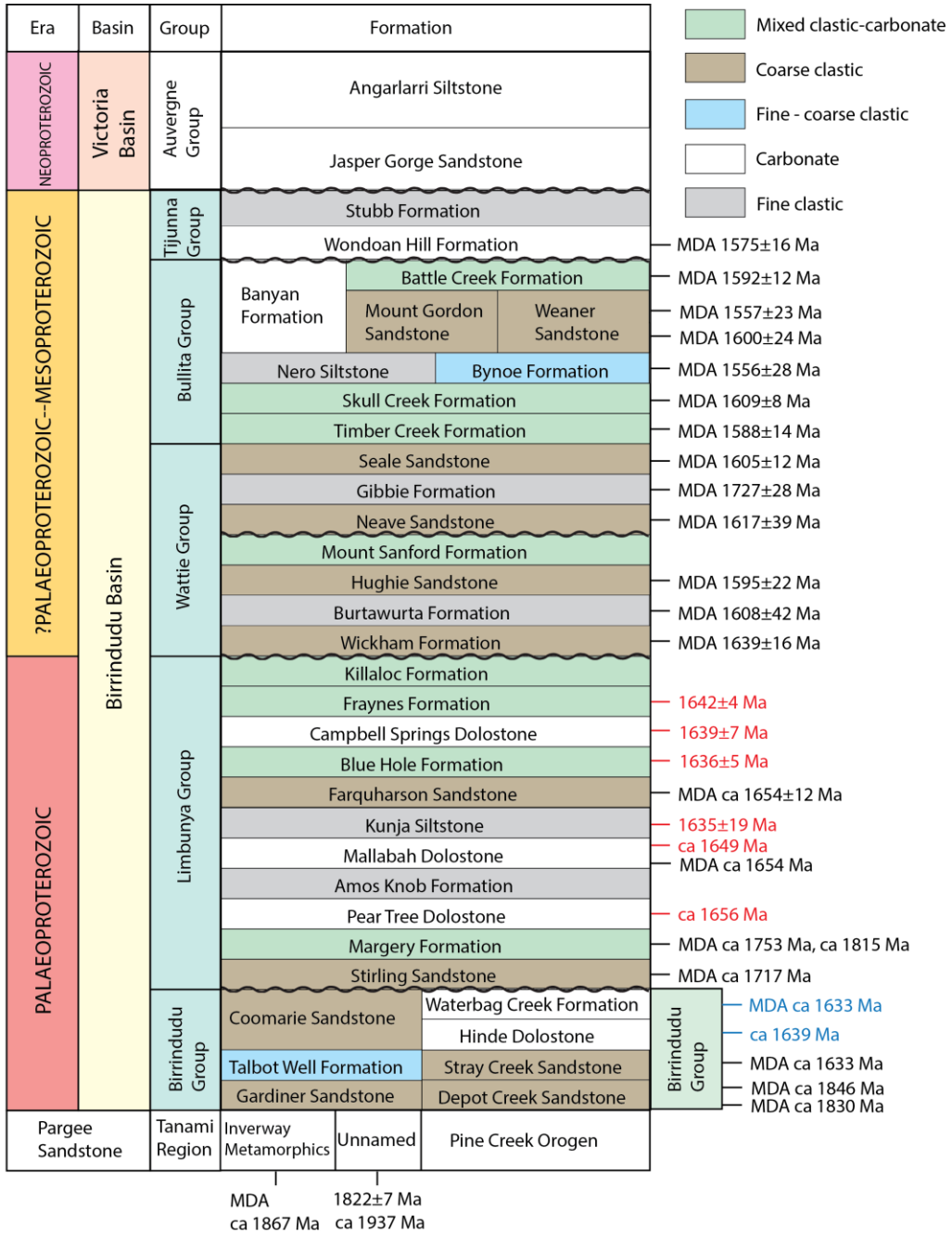
Objective:

- Stratigraphic correlation with the age constraints on the Palaeoproterozoic and Mesoproterozoic successions to reveal the emerging resource potential in the Birrindudu Basin region in NT
  - 26 hylogged drillholes



Methodology – Geochronology

- Shallow marine clastic and carbonate deposits in the Limbunya, Wattie, Bullita and Tijunna groups
- Legacy and new SHRIMP U-Pb ages (Kositcin *et al* in press).
- Geochronological ages derived from tuffaceous and sedimentary horizons.
- Highlighting the potential to host mineralising systems of similar to McArthur Basin and Mt Isa Province.



Methodology – Multi-sourced data inputs

Data inputs:

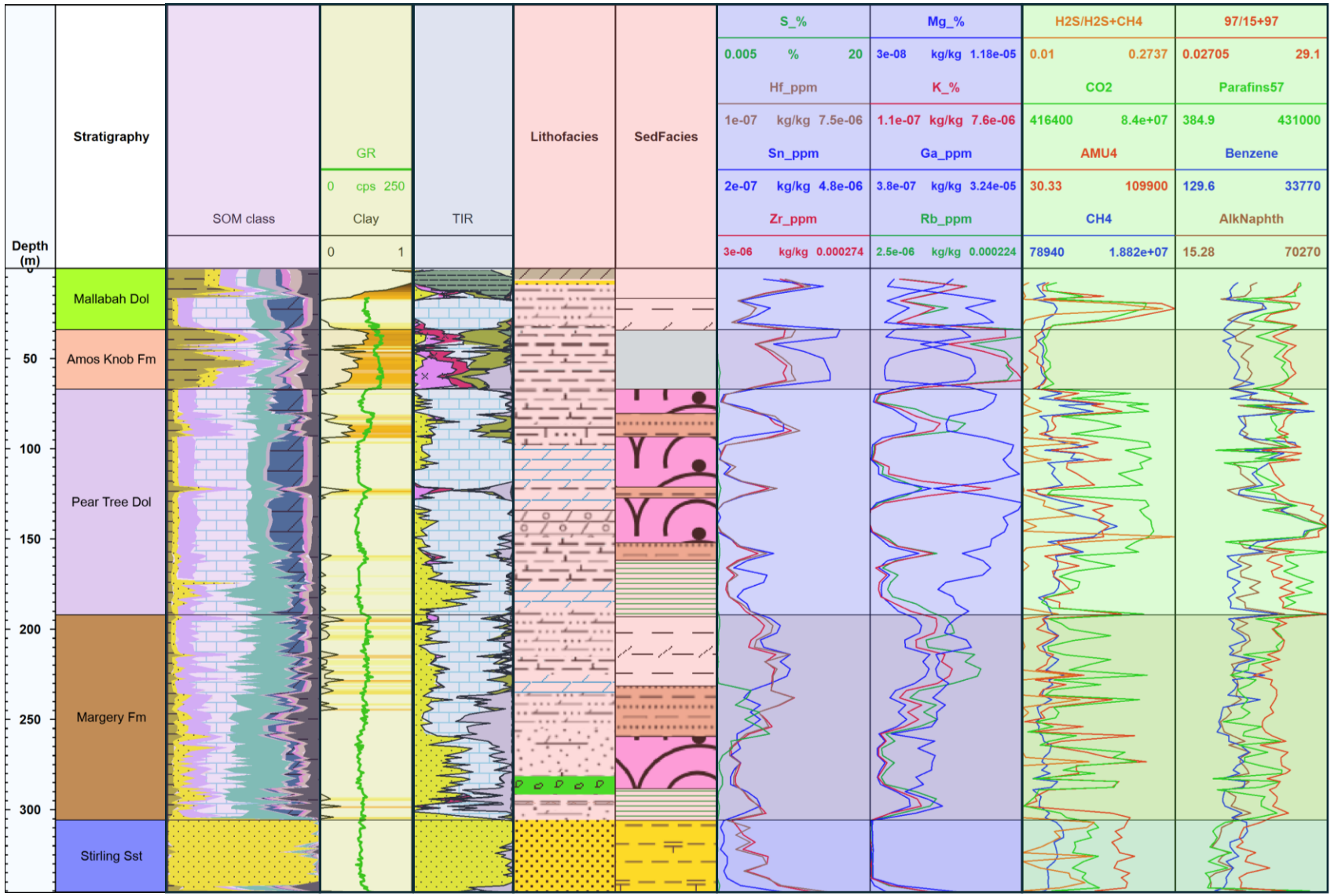
- Mineral profiles from HyLogger data interpretation
- Lithofacies and sedimentary facies
- pXRF/ICP
- Fluid inclusions
- Petrophysical logs (GR)

Data analysis:

- clay-ratio – Pseudo-gamma ray logs

$$clay\ ratio = \frac{clay}{quartz + feldspar + carbonate + cLay}$$

- Self-organising map (SOM) clustering:
  - Probability that rock type belongs to petrophysical class



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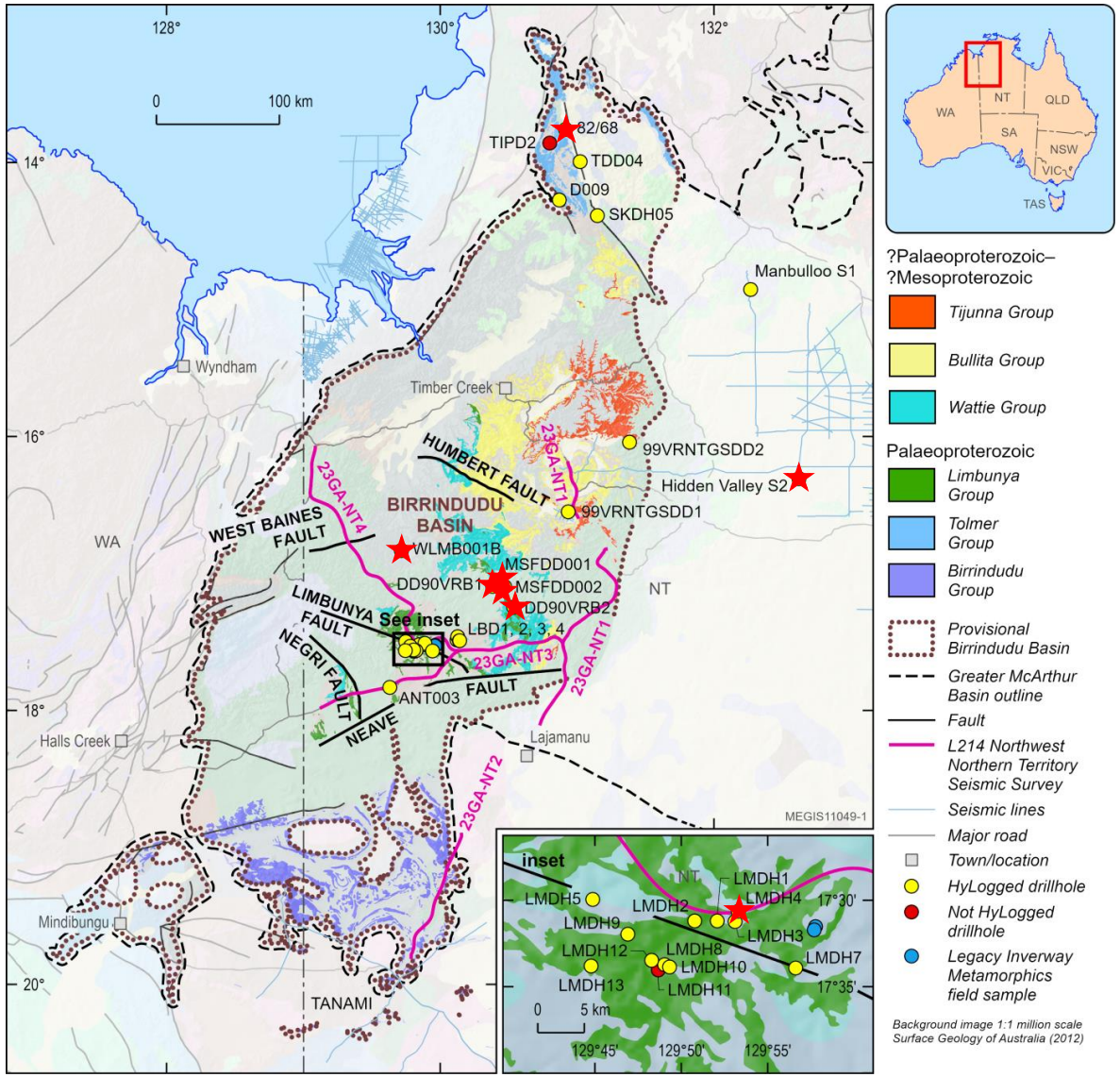

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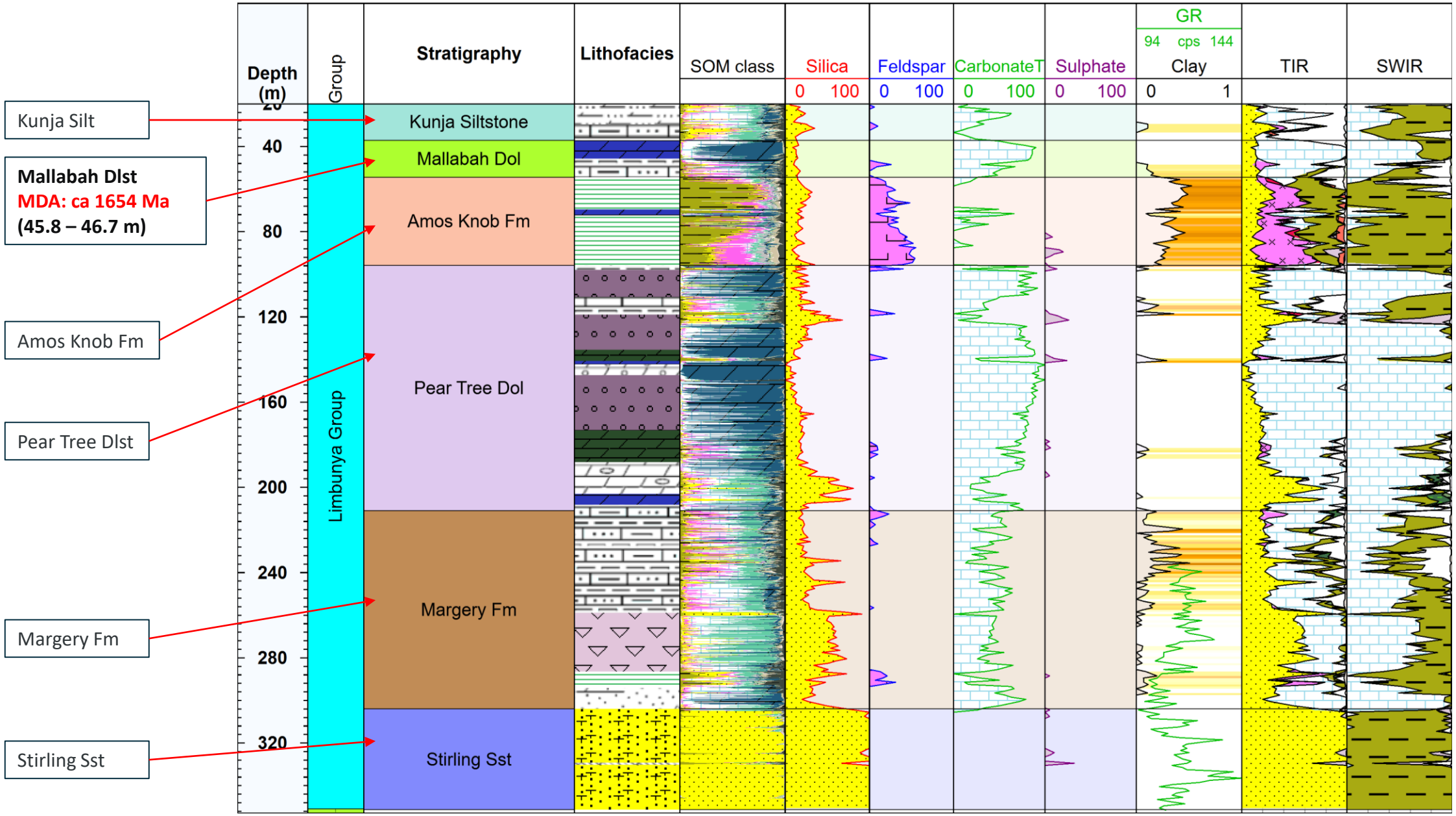
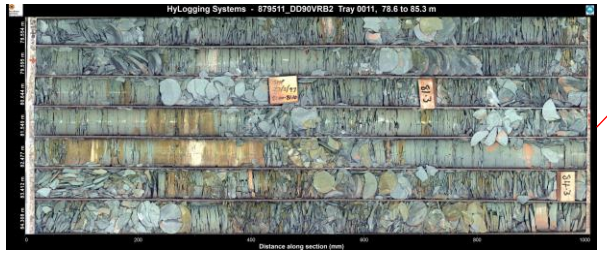
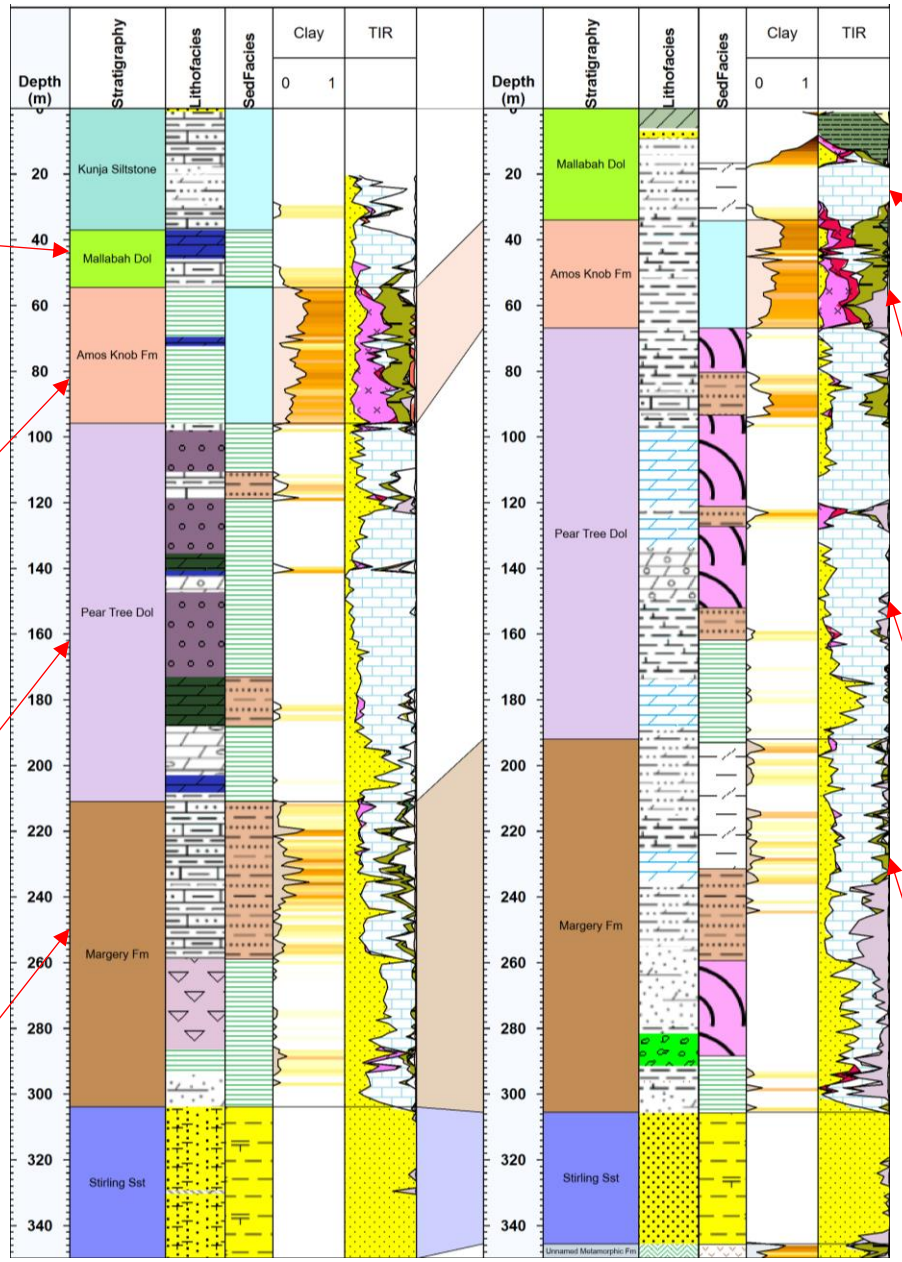
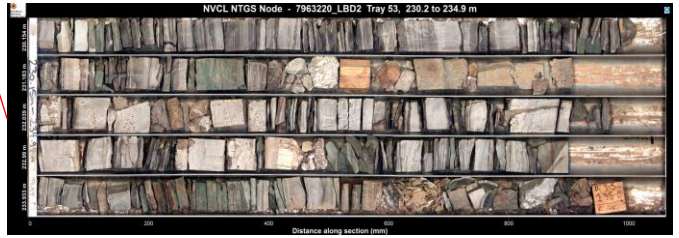
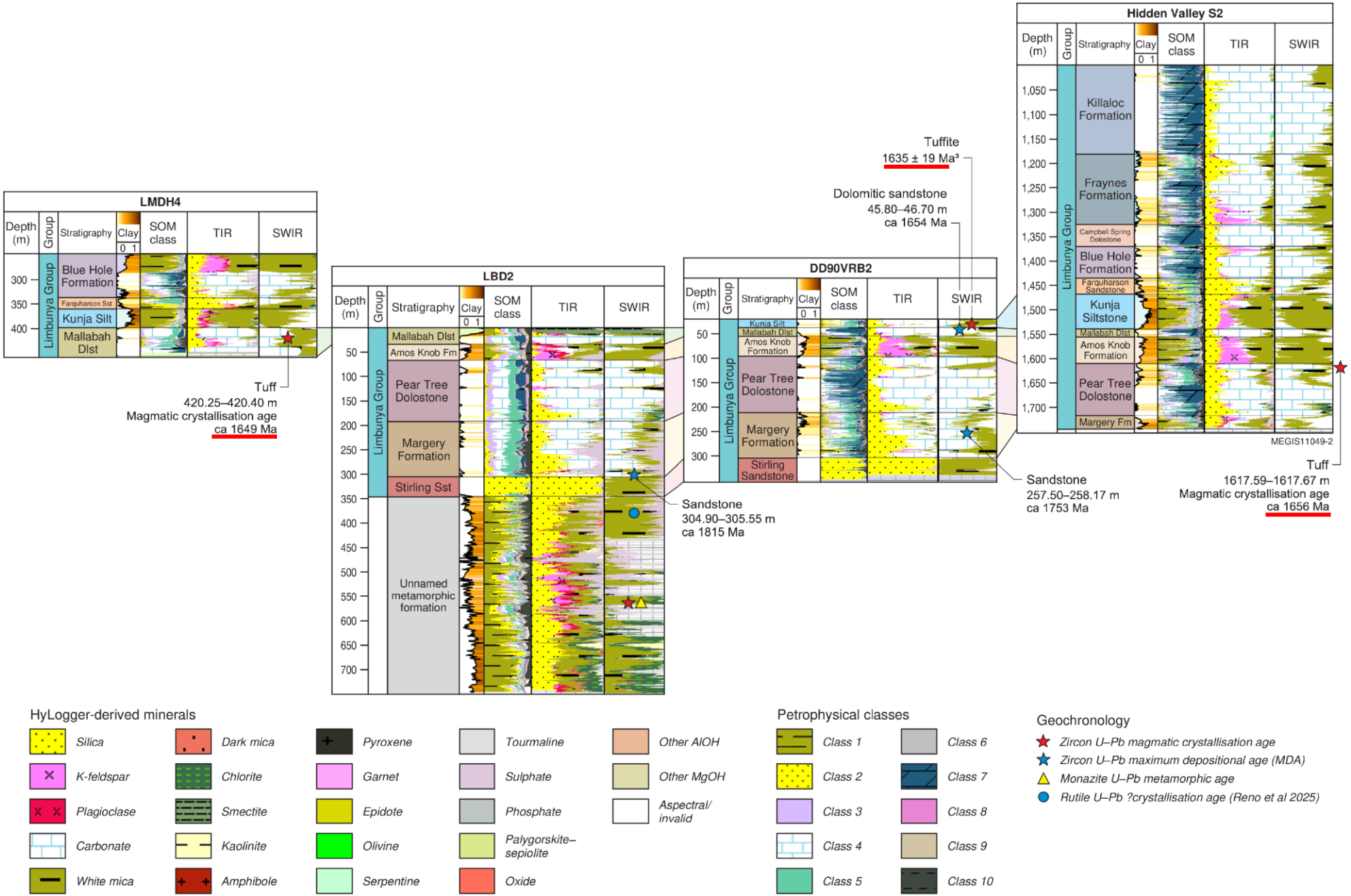

Kunja Silt
Mallabah Dlst
MDA: ca 1654 Ma
(45.8 – 46.7 m)
Amos Knob Fm
Pear Tree Dlst
Margery Fm
Stirling Sst
Depth (m)
Group
Stratigraphy
Lithofacies
SOM class
Silica
Feldspar
CarbonateT
Sulphate
GR
94 cps 144
Clay
TIR
SWIR
0 100
0 100
0 100
0 100
0 1
40
80
120
160
200
240
280
320
Limbunya Group
Kunja Siltstone
Mallabah Dol
Amos Knob Fm
Pear Tree Dol
Margery Fm
Stirling Sst

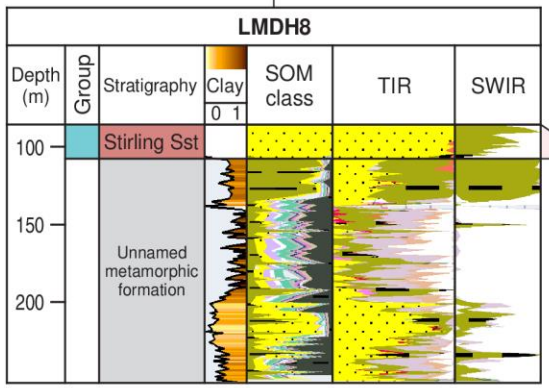


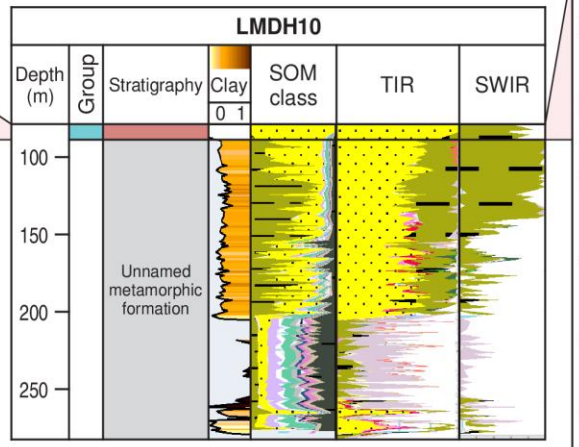


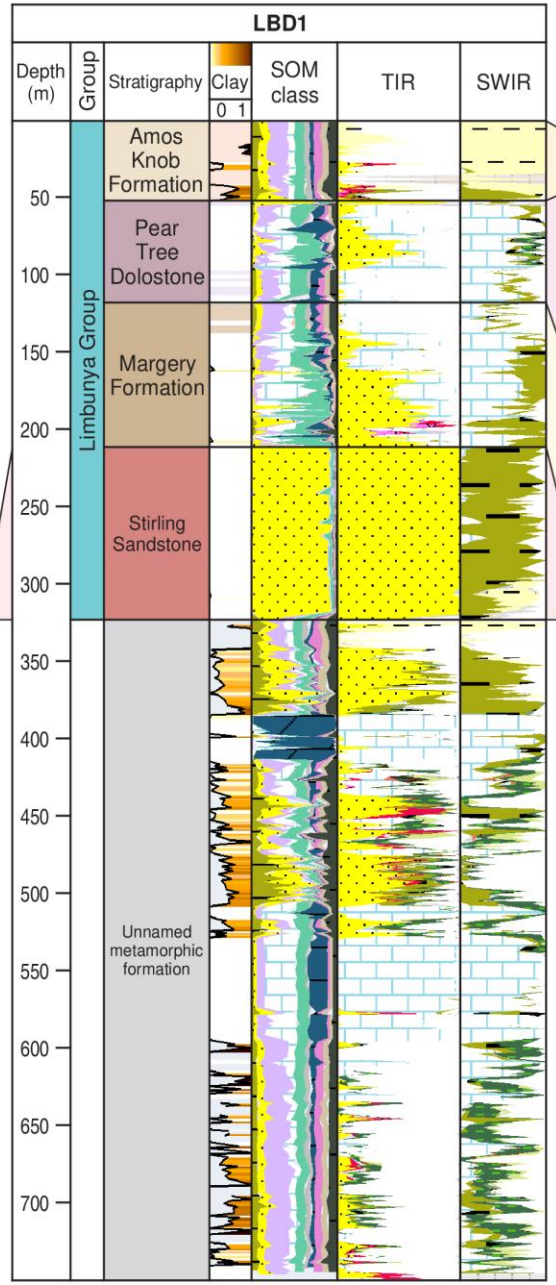


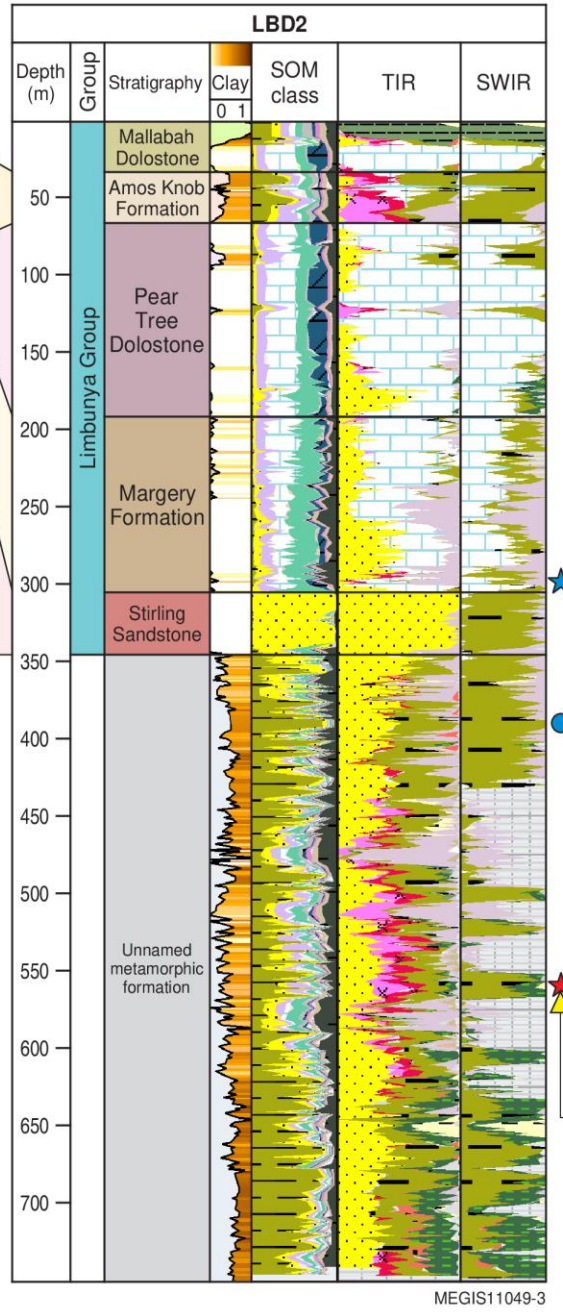
Core images from HyLogger dataset.


LMDH4
Depth (m)
Group
Stratigraphy
Clay
0 1
SOM class
TIR
SWIR
Limbunya Group
Blue Hole Formation
Farquharson Sst
Kunja Silt
Mallabah Dlst
300
350
400
Tuff
420.25–420.40 m
Magmatic crystallisation age
ca 1649 Ma
LBD2
Mallabah Dlst
Amos Knob Fm
Pear Tree Dolostone
Margery Formation
Stirling Sst
Unnamed metamorphic formation
50
100
150
200
250
300
350
400
450
500
550
600
650
700
DD90VRB2
Kunja Silt
Mallabah Dlst
Amos Knob Formation
Pear Tree Dolostone
Margery Formation
Stirling Sandstone
Tuffite
1635 ± 19 Ma³
Dolomitic sandstone
45.80–46.70 m
ca 1654 Ma
Sandstone
304.90–305.55 m
ca 1815 Ma
Hidden Valley S2
Killaloc Formation
Fraynes Formation
Campbell Spring Dolostone
Blue Hole Formation
Farquharson Sandstone
Kunja Siltstone
Mallabah Dlst
Amos Knob Formation
Pear Tree Dolostone
Margery Fm
1,050
1,100
1,150
1,200
1,250
1,300
1,350
1,400
1,450
1,500
1,550
1,600
1,650
1,700
MEGIS11049-2
Sandstone
257.50–258.17 m
ca 1753 Ma
Tuff
1617.59–1617.67 m
Magmatic crystallisation age
ca 1656 Ma
HyLogger-derived minerals
Silica
K-feldspar
Plagioclase
Carbonate
White mica
Dark mica
Chlorite
Smectite
Kaolinite
Amphibole
Pyroxene
Garnet
Epidote
Olivine
Serpentine
Tourmaline
Sulphate
Phosphate
Palygorskite–sepiolite
Oxide
Other AlOH
Other MgOH
Aspectral/ invalid
Petrophysical classes
Class 1
Class 2
Class 3
Class 4
Class 5
Class 6
Class 7
Class 8
Class 9
Class 10
Geochronology
Zircon U–Pb magmatic crystallisation age
Zircon U–Pb maximum depositional age (MDA)
Monazite U–Pb metamorphic age
Rutile U–Pb ?crystallisation age (Reno et al 2025)









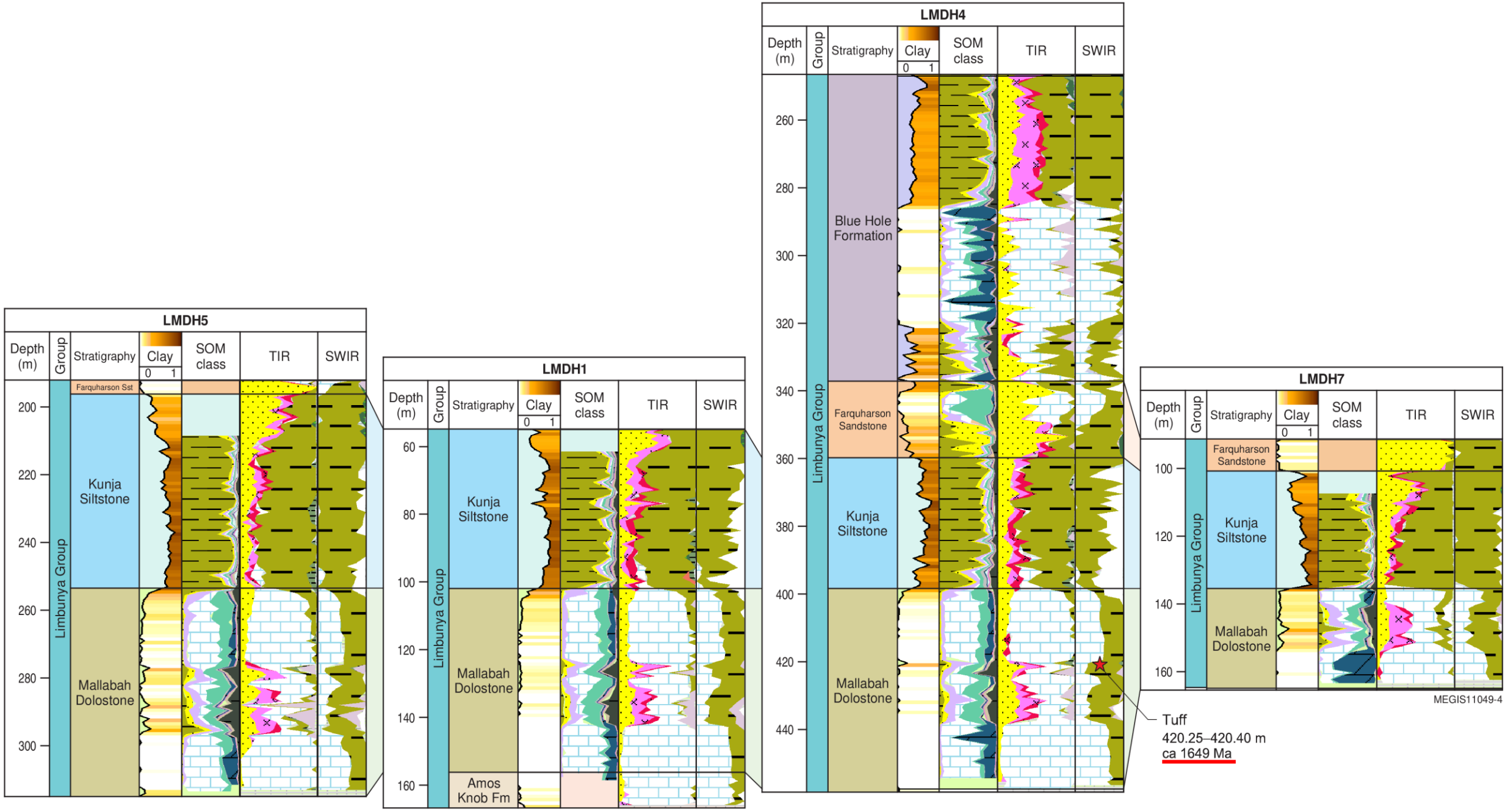
Sandstone
304.90–305.55 m
ca 1815 Ma

Metatuff/ metamudstone
386.20–391.90 m
?crystallisation age ca 2060 Ma[1]

Feldspar porphyry
562.50–563.00 m
Magmatic crystallisation age 1822 ± 7 Ma[2]

Metapelite
572.50–572.57 m
Metamorphic age (minimum) ca 1937 Ma

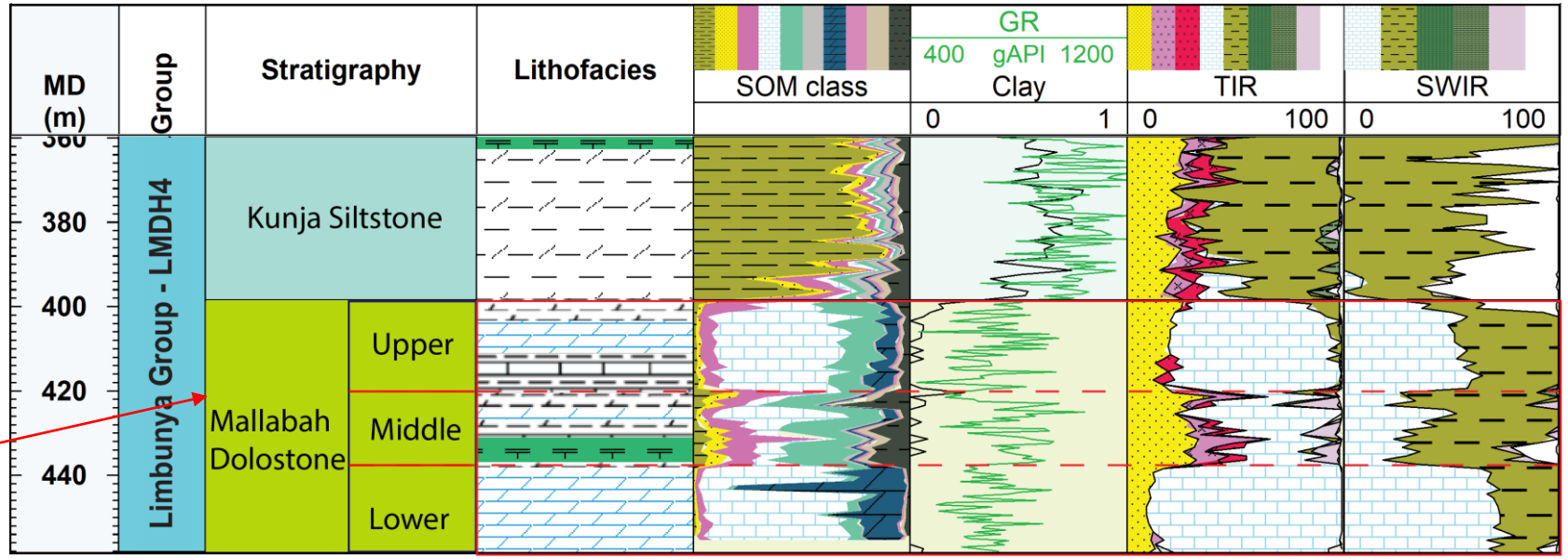
- ✓ In LMDH11, a zircon U–Pb maximum depositional age of **ca 1867 Ma** on a quartz phyllonite sample.


LMDH5
Depth (m)
Group
Stratigraphy
Clay
0 1
SOM class
TIR
SWIR
Farquharson Sst
Kunja Siltstone
Mallabah Dolostone
Limbunya Group
200
220
240
260
280
300
LMDH1
60
80
100
120
140
160
Amos Knob Fm
LMDH4
260
280
300
320
340
360
380
400
420
440
Blue Hole Formation
Farquharson Sandstone
LMDH7
100
120
140
160
Tuff
420.25–420.40 m
ca 1649 Ma
MEGIS11049-4

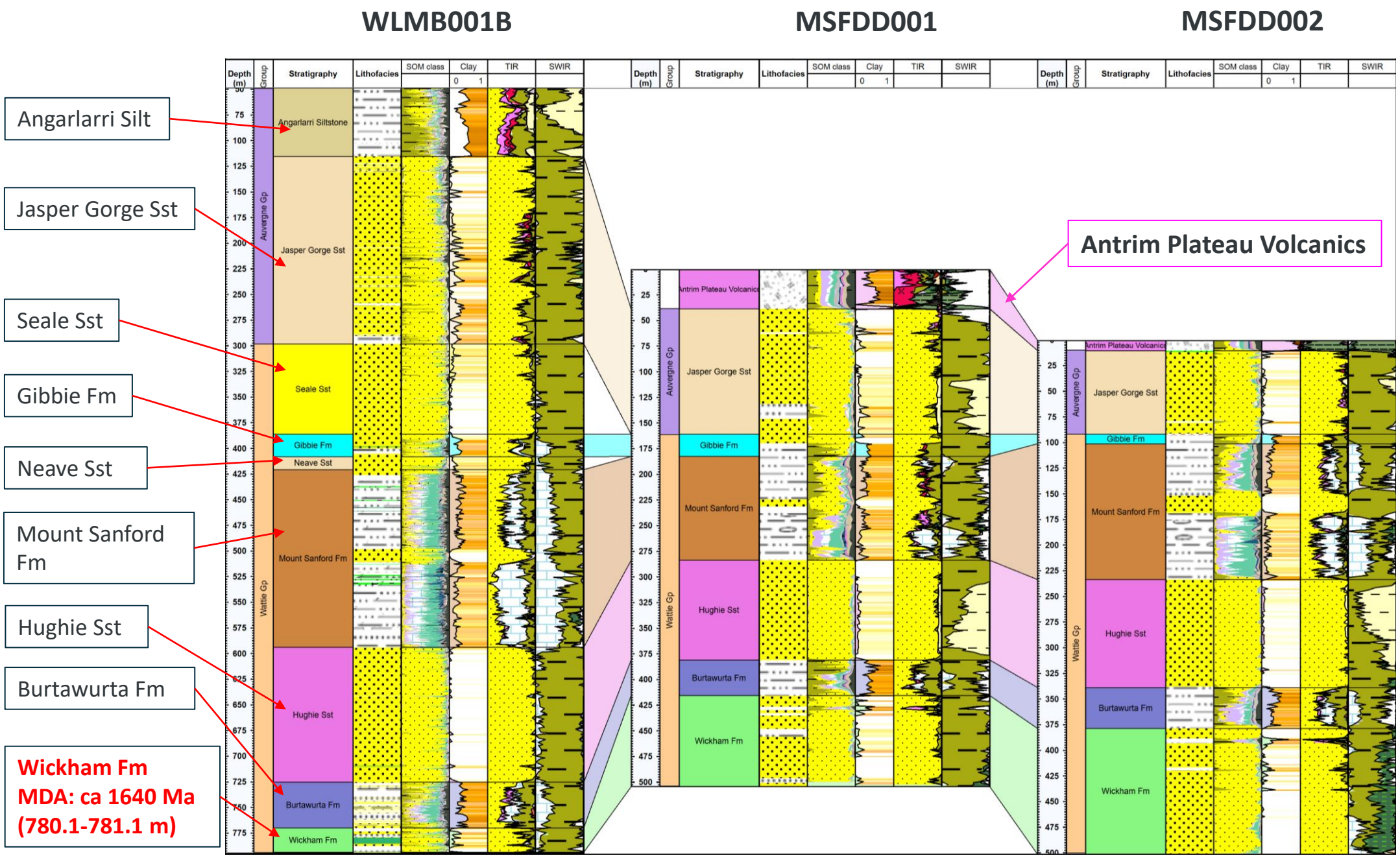
Sulphides – Base metals

(LMDH4)

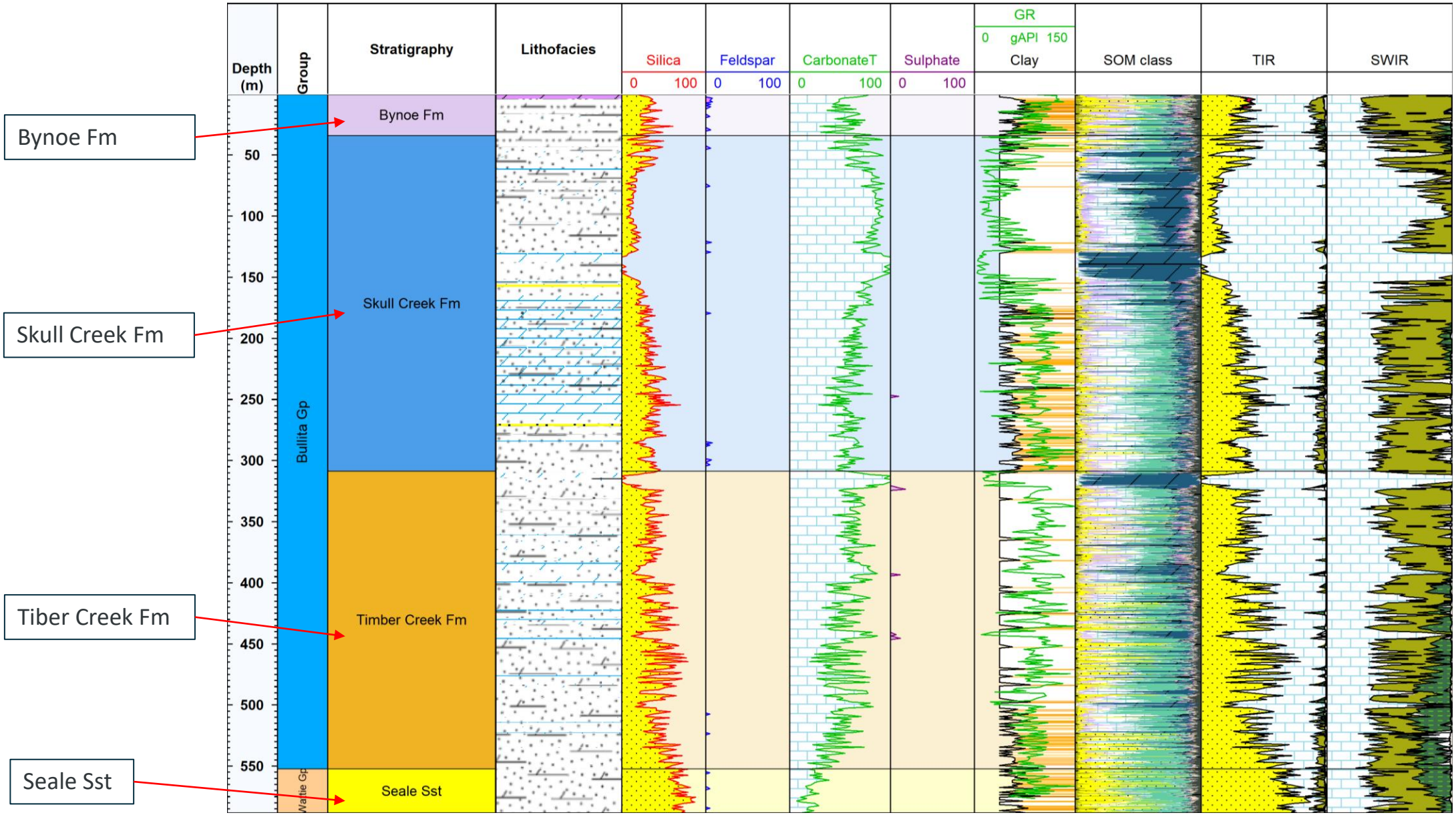
Mallabah Dlst
Tuff: **ca 1649 Ma**
(420.25 – 420.4 m)



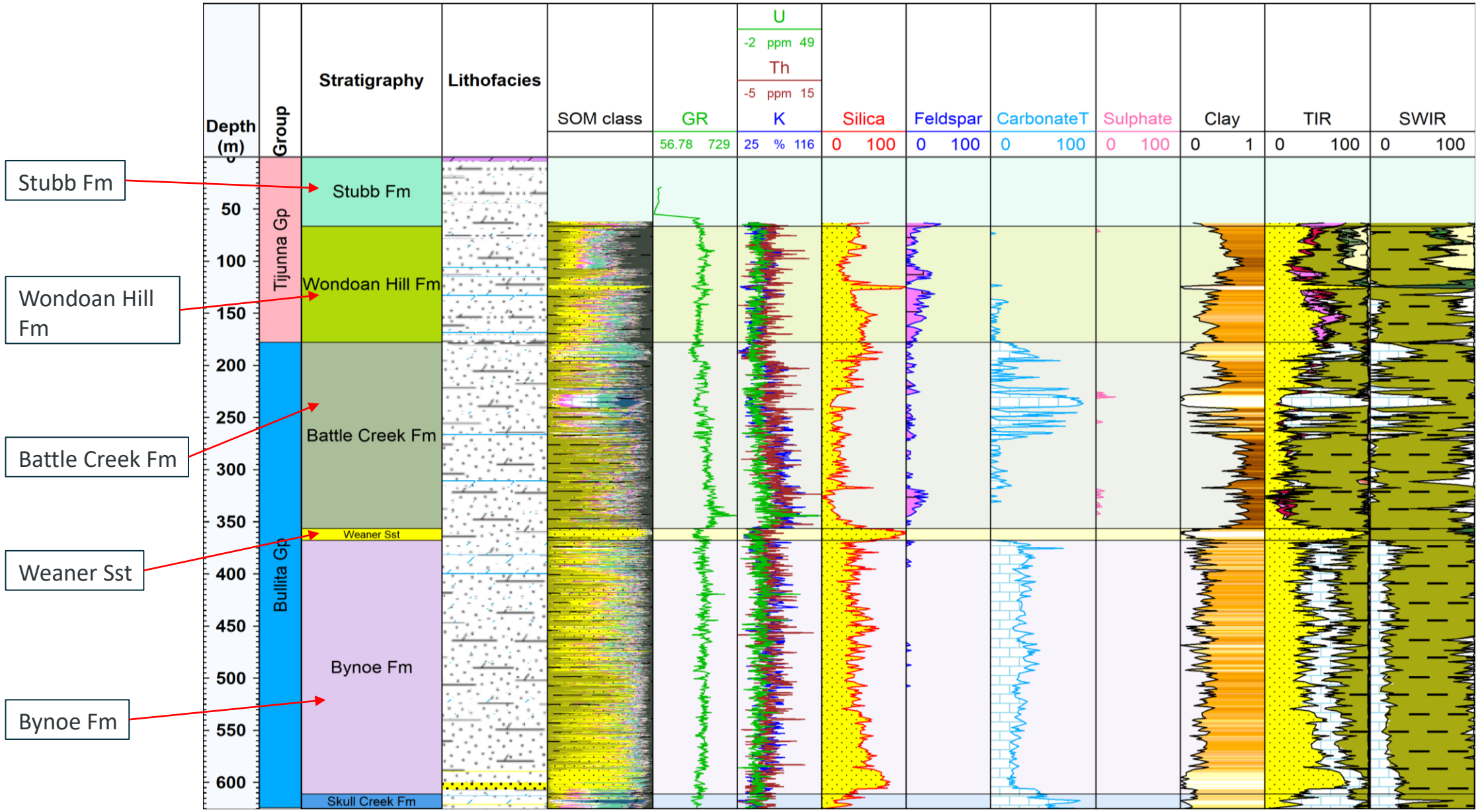
Hole	Depth	Carbonate	Total clay	Feldspar	K-Feldspar	Plagioclase	Silica	Smectite	Sulphate	White-mica
LMDH5	upper	69.2	9.2	0.5	0	0.5	19.6	0.5	0	8.7
	middle	33.5	9.3	17.9	15	2.9	27	1.1	10	8.2
	lower	81.1	1.9	0.7	0.3	0.4	14.4	0.6	0.6	1.4
LMDH1	upper	74.9	4.6	0.5	0.5	0	18.5	0	0	4.6
	middle	42.2	4	18.4	13.2	5.2	24.7	0	8.4	4
	lower	86.7	0	0	0	0	11.6	0	0.6	0
LMDH4	upper	71.8	5.2	2.2	0	2.2	19.3	0	0	5.2
	middle	43.1	3	16.5	10.9	5.6	28.8	0.6	6.5	2.4
	lower	86.2	0.5	0.9	0.6	0.3	11.3	0.0	0.0	0.5
LMDH7	upper	62.5	15	1.3	1.3	0	18.5	0	1	15
	middle	32.9	12.9	24.75	19.5	5.3	21.4	0.5	5.3	12.4
	lower	83.8	1	2.5	0.5	2	11.3	0	0	1


WLMB001B
MSFDD001
MSFDD002
Angarlarri Silt
Jasper Gorge Sst
Seale Sst
Gibbie Fm
Neave Sst
Mount Sanford Fm
Hughie Sst
Burtawurta Fm
Wickham Fm
MDA: ca 1640 Ma
(780.1-781.1 m)
Antrim Plateau Volcanics
Depth (m)
Group
Stratigraphy
Lithofacies
SOM class
Clay
TIR
SWIR
Auvergne Gp
Wattle Gp

99VRNTGSDD1 – Wattie and Bullita Groups



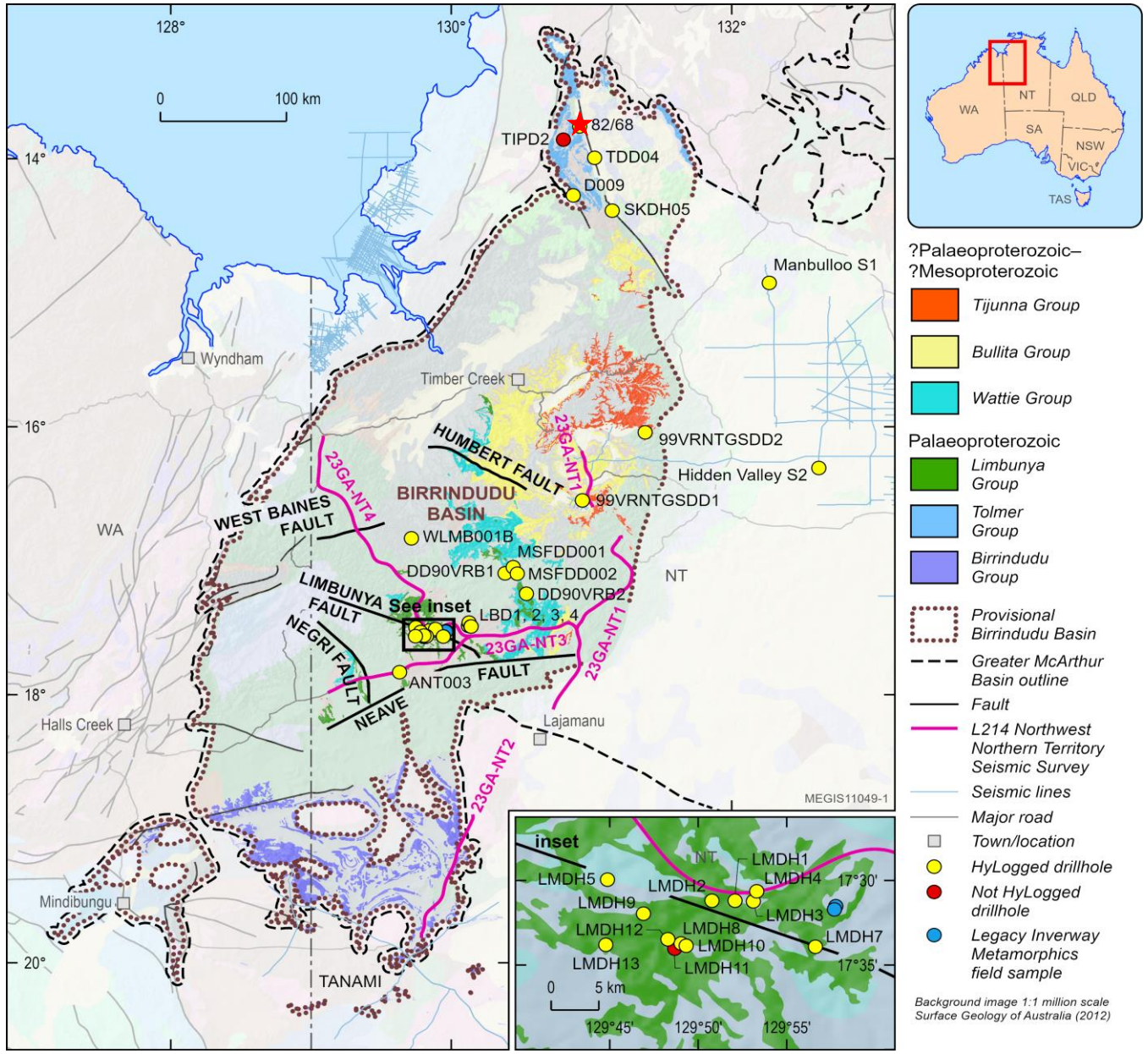
99VRNTGSDD2 – Bullita and Tijunna Groups



TIPD2:

- A tuff bed, which was previously defined as the Hinde Dlst, has been dated as **ca 1639 Ma** recently.

- This provides a critical marker demonstrating that middle to upper Limbunya age volcanic activity extends into the areas previously mapped as older Tolmer Group.



82/68 – Reinterpretation

Antrim Plateau Volcanics

Killaloc Fm

Fraynes Fm
MDA: ca 1633 Ma
(142.65 – 143.7 m)

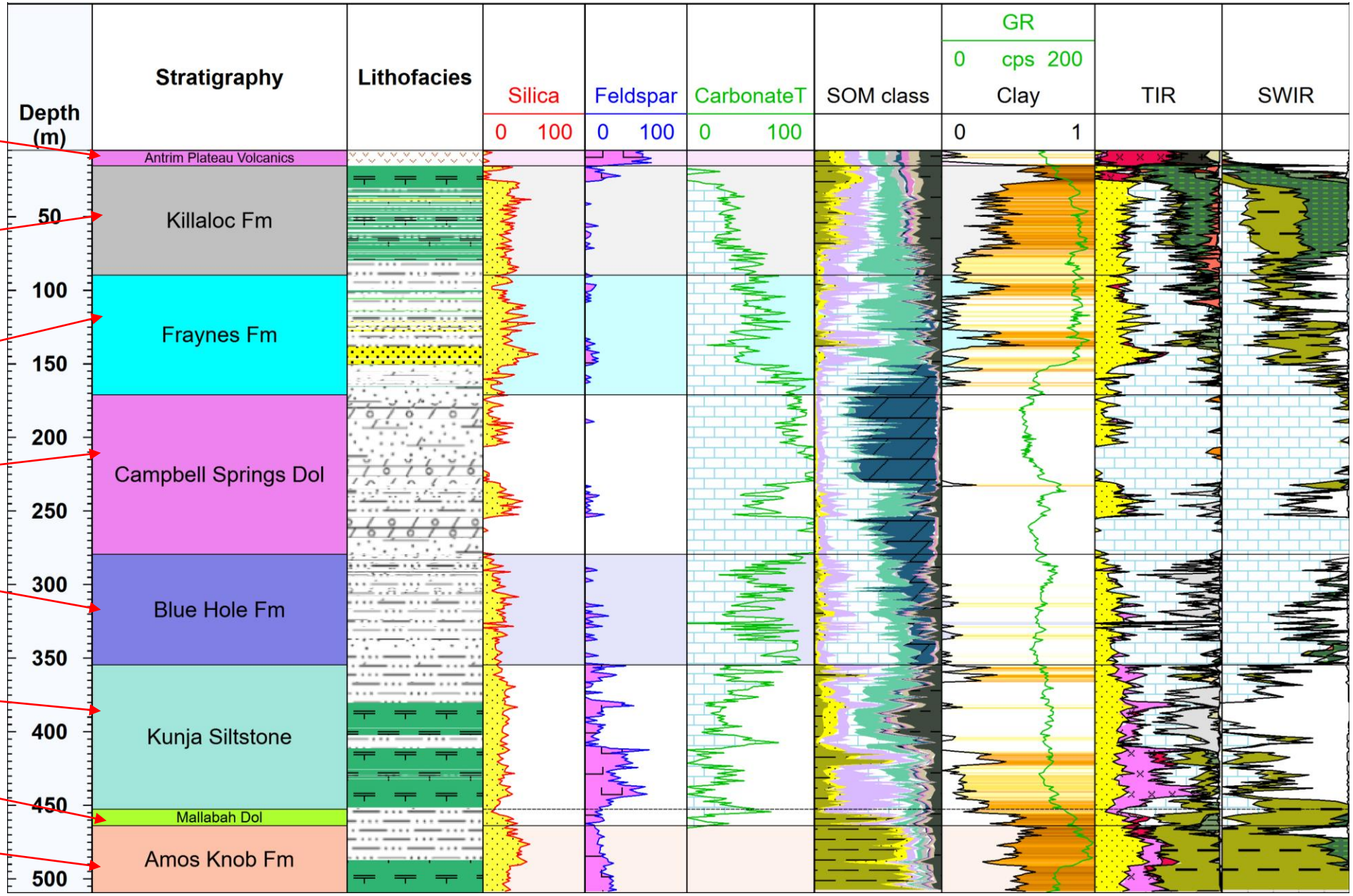
Campbell Springs Dlst

Blue Hole Fm

Kunja Silt

Mallabah Dlst

Amos Knob Fm



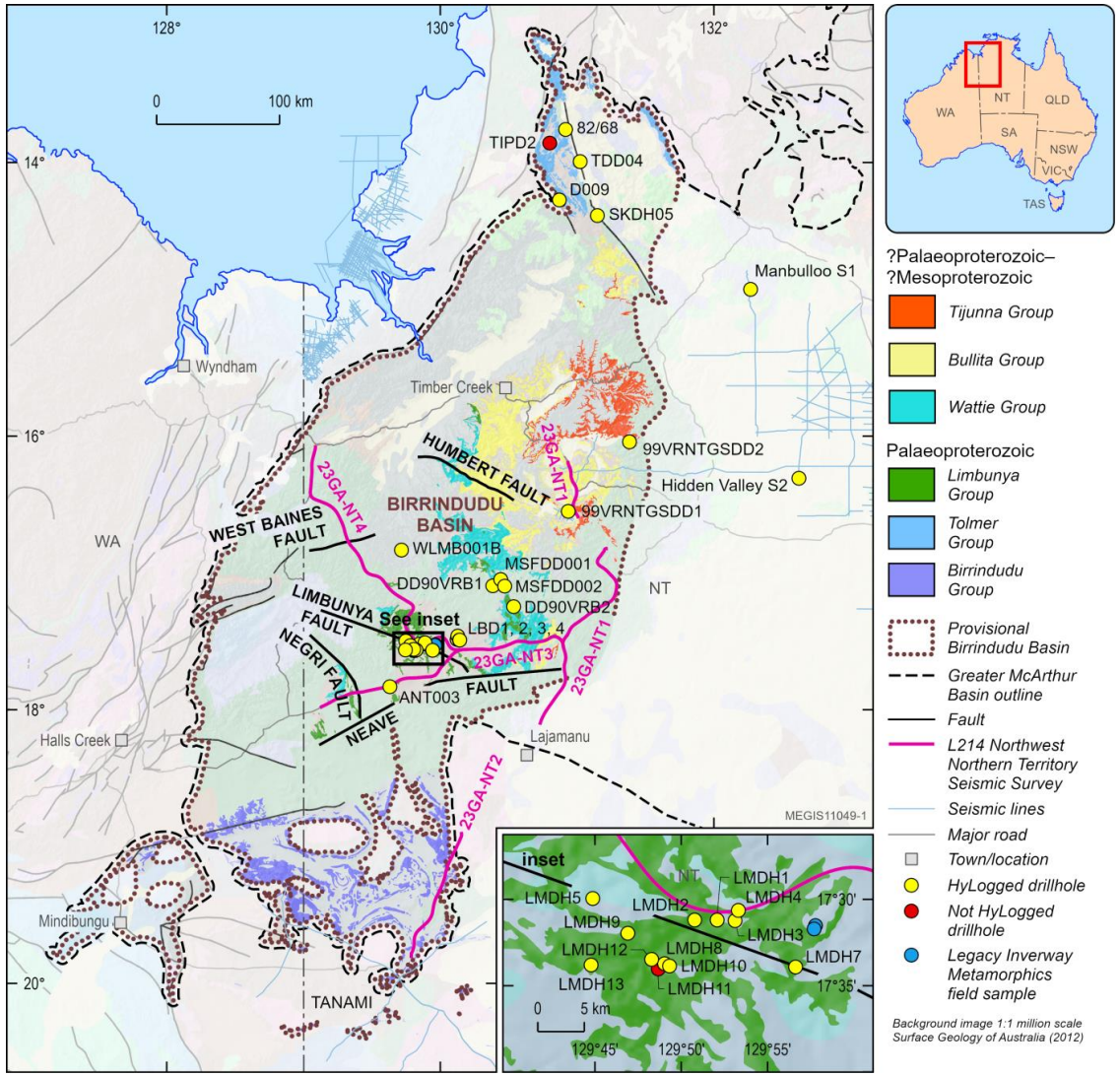
Summary and Future Work

- Stratigraphic correlations for 26 drill holes:
  - Integrating the geochronological aging, mineral profiles derived from HyLogger data, lithofacies/sedimentary facies, geochemical elements , fluid inclusions data
  - Clay-ratio and SOM class

- Update the stratigraphy of the Limbunya, Wattie, Bullita, Tijunna and Auvergne groups in the Birrindudu Basin

- Limbunya deposits extending to 82/68 and TIPD2.

- Resources:
  - Base metals suggested by the anomalies of elements and observations of sulphides
  - Graphite



Thank you

Further information

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