SMEDG May Meeting 2022

Bowdens Epithermal Silver Deposit: Recent knowledge advancements & Machine Learning cogitations

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&
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Contributions:

- Paper Authors: David Biggs, Tom Klein, Dr Darren Holden (GeoSpy) and Dr Ian Graham (University of NSW).
- Anthony McClure and the Silver Mines Limited Board.
- Angela Lay 2019 – “A comparative study of the mineralogy and geochemistry of ore minerals from silver-rich polymetallic deposits of the Lachlan and Southern New England Orogens, New South Wales, Australia”.
- Souvanane Keothammavong (2018) – “Origin and evolution of sediment hosted mineralisation and alteration within the Coomber Formation underlying the volcanic hosted Bowdens epithermal Ag deposit, Lue NSW”.
- Bowdens Project geologists and Field crew past and present.
- Previous Project Owners: CRA Exploration, Golden Shamrock, Silver Standard and Kingsgate Consolidated.
- Contractors and support staff.

Overview:

- Project Development.
- History and work completed.
- Deposit Setting.
- System Analogues.
- Geochronology and Stratigraphy.
- Seismic Data and preliminary results.
- Mineralisation characteristics.
- Underground Mining Targets.
- Research and Development.
- Machine Learning Applications.

Project Overview: Development

- Final submission process near completion for Independent Planning Commission determination in second half 2022.
- Development of an open cut mine.
- Processing on site of up to 2.0 million tonnes of ore per year.
- Approximately 53 million ounces of silver will be produced over the life of the mine with zinc and lead as a by-product.
- Conventional flotation circuit with two concentrate products:
  - Silver-lead concentrates by road/rail to Port Pirie, S.A.;
  - Zinc concentrates by road or road/rail to Botany or Newcastle for shipping.
- Project life of 23 years (mine life of 16 years).

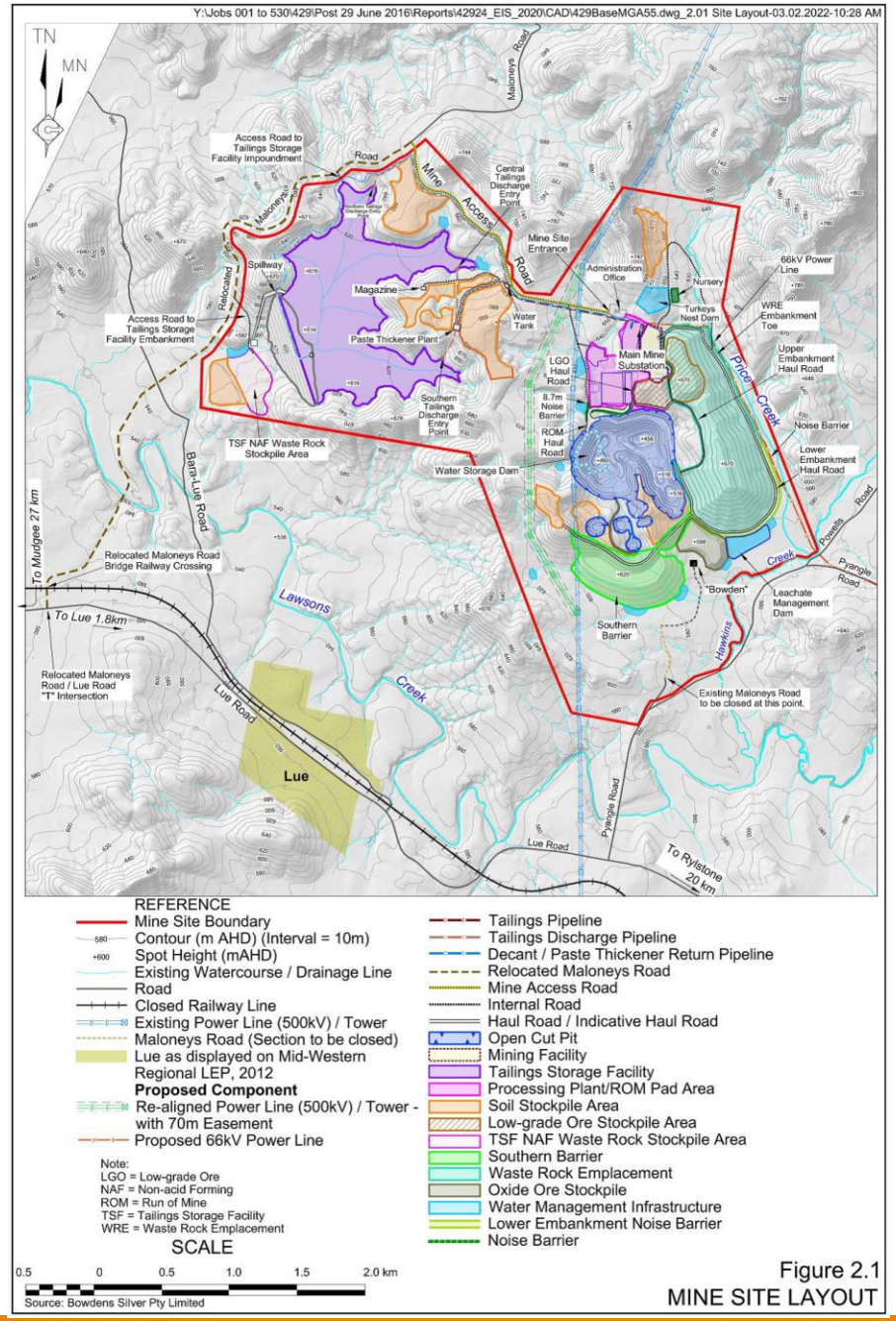


Figure 2.1
MINE SITE LAYOUT

Project Overview: History and Work completed.

- 1988: Discovered via stream sediment sampling by CRAE.
  - 1992: First resource of 6.2Mt @ 85g/t silver, 0.52% zinc and 0.28% Lead.
- 1997: Transferred to Silver Standard Resources Inc of Vancouver (SSA) via Golden Shamrock Exploration purchase.
  - Several scoping studies completed by SSA.
- 2011: Project sold to Kingsgate Consolidated.
  - 2012: Resource Estimate of 52Mt @ 52g/t silver, 0.40% zinc and 0.30% lead (Measured and Indicated) and 36Mt @ 41g/t silver, 0.40% zinc and 0.30% lead (Inferred).
- 2016: Project bought by Silver Mines Limited.
  - 2017/18: Resource Estimate totalling 275Moz silver equivalent and Reserve totalling 97Moz silver equivlanet.
  - 2020/21: Environmental Impact Assessment, Development Application and Mining Lease Application Submitted.

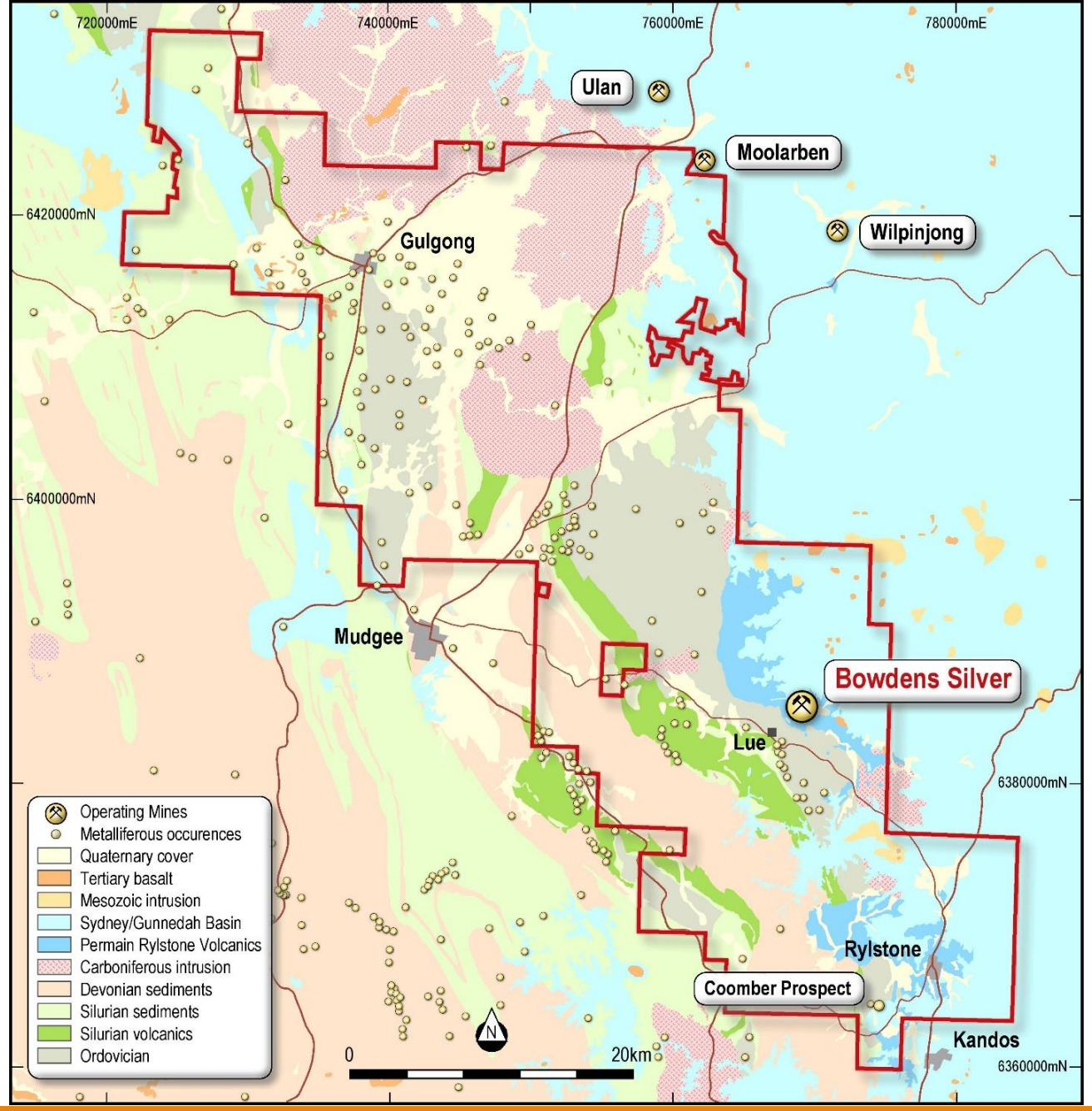
Project Overview: History and Work completed.

Total Drilling metres by Company.

Company	DD	RC	Total
CRA, Silver Std, Golden Shamrock	8,764	40,965	49,729
Kingsgate Consolidated	6,146	12,785	18,931
Silver Mines Limited	53,662	15,277	68,939
Total	**68,572**	**69,027**	**137,599**

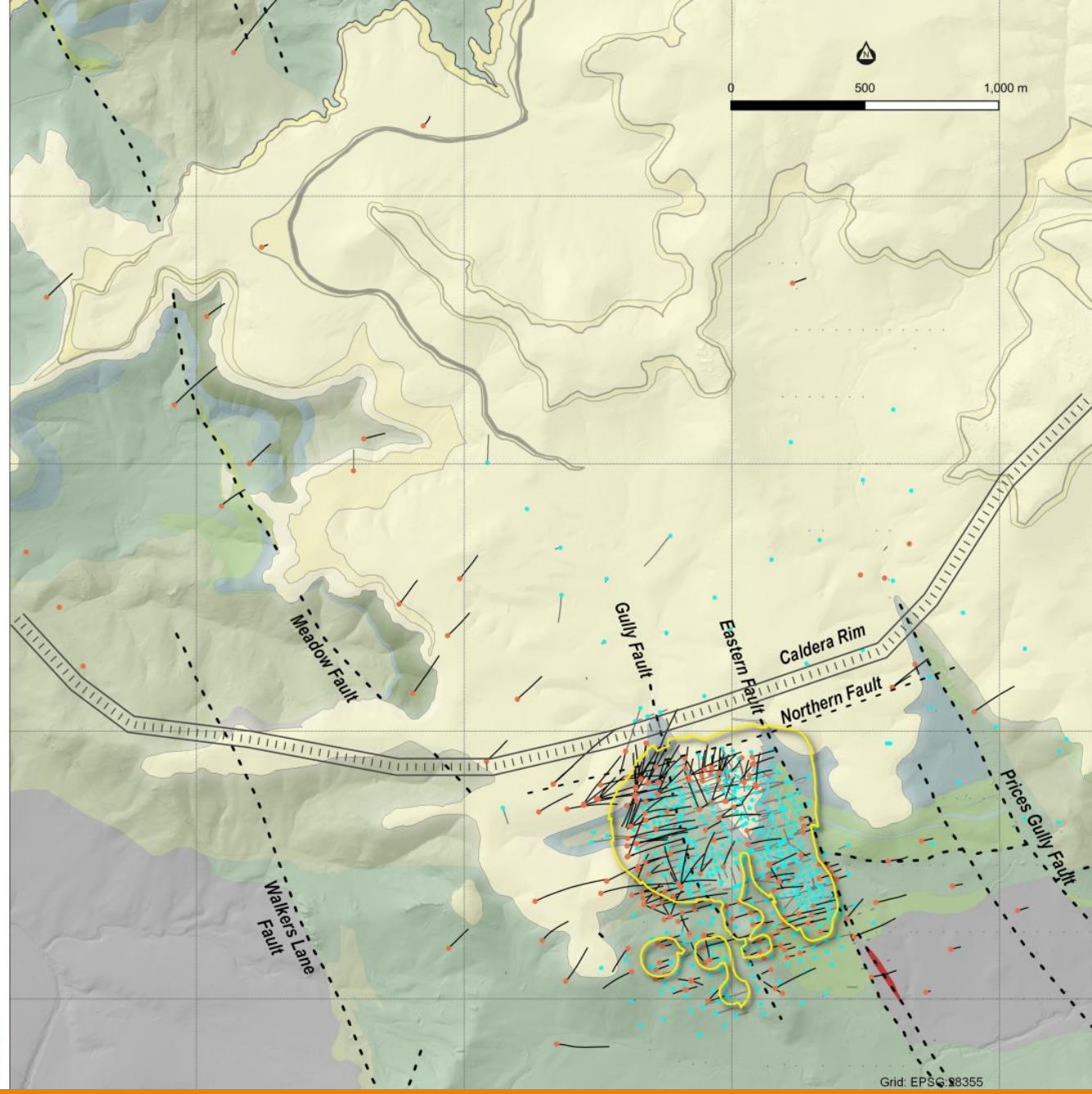
Deposit Setting: Regional Geology

- Northeastern limb of the Lachlan Orocline.
- Ordovician through to Carboniferous age basement.
- Work demonstrates the eastern limb of the Macquarie Arc has the potential for discovery on significant mineralisation.
- Extensional type intermediate sulphidation Ag-Pb-Zn(+Au).



Deposit Setting: Local Geology

- Rylstone Volcanics consist of rhyolitic to dacitic pyroclastics, epiclastics and lava's with recently defined porphyritic intrusion.
- Volcanics are characteristic of caldera and intra-caldera facies, thickness of > 500 metres.
- Hardrock cover of Sydney Basin sediments and coal measures.



Legend

- Proposed Open Cut Mine
- Drilling < 2016
- Drilling > 2016

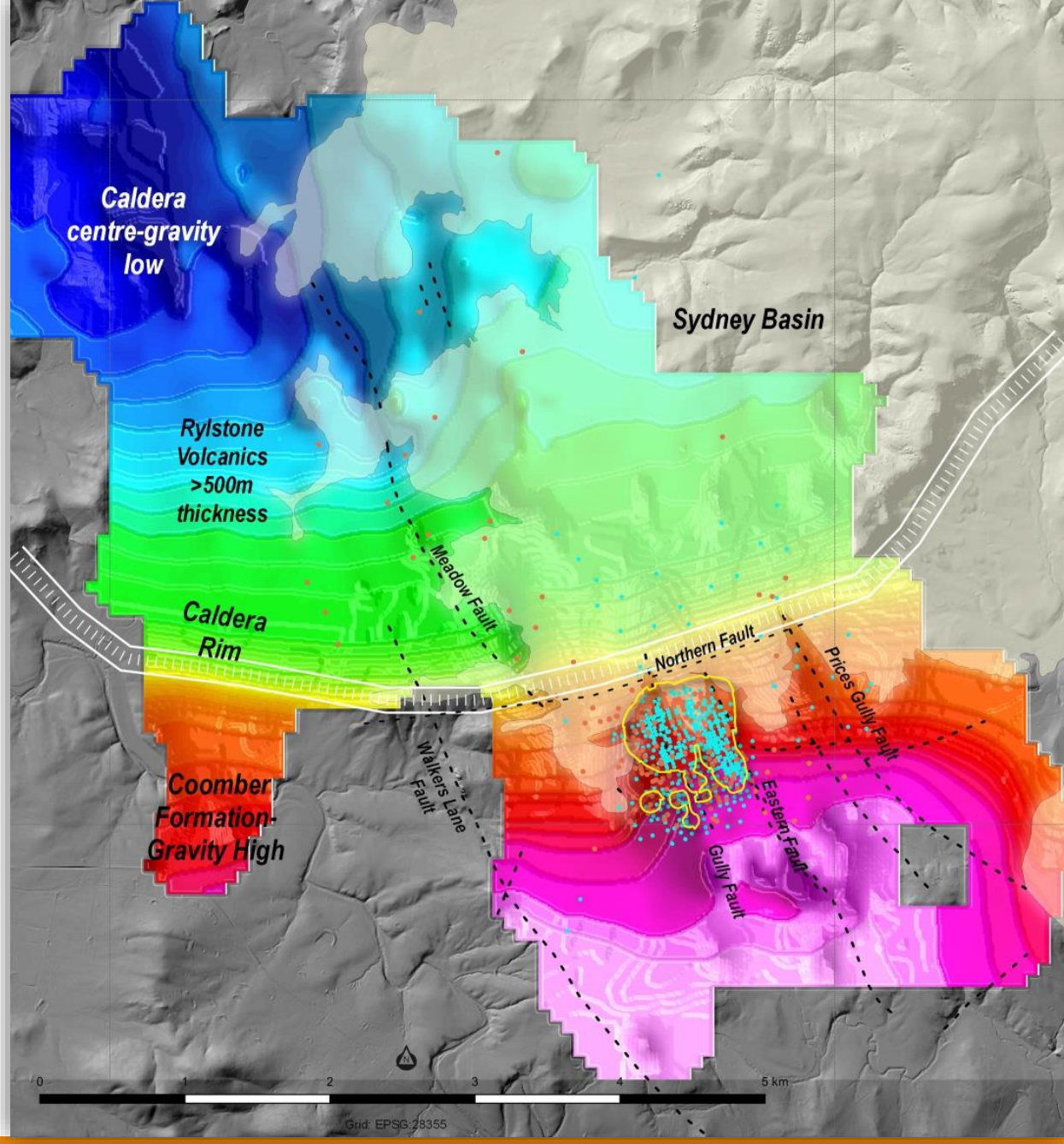
Geology

- coal seam
- conglomerate
- interbedded sandstone siltstone & shale
- Sydney Basin Sediments
- Quartz Vein
- Subvolcanic Intrusive Rhyolite
- Upper Crystal Lithic Tuff
- Volcaniclastics
- Volcanic Breccia
- Welded Tuff (ignimbrite)
- Crystal Tuff
- Ordovician Coomber Forma

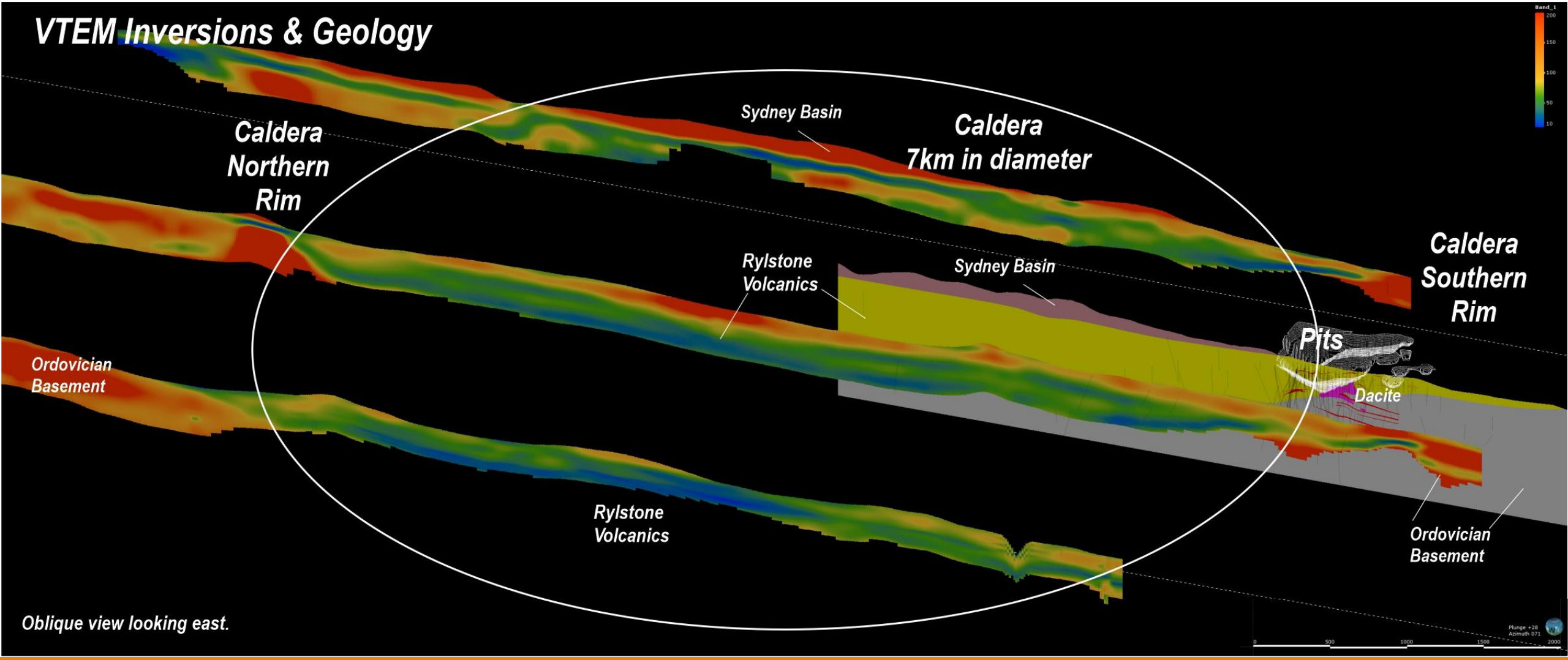
BOWDENS SILVER

Deposit Setting: Density

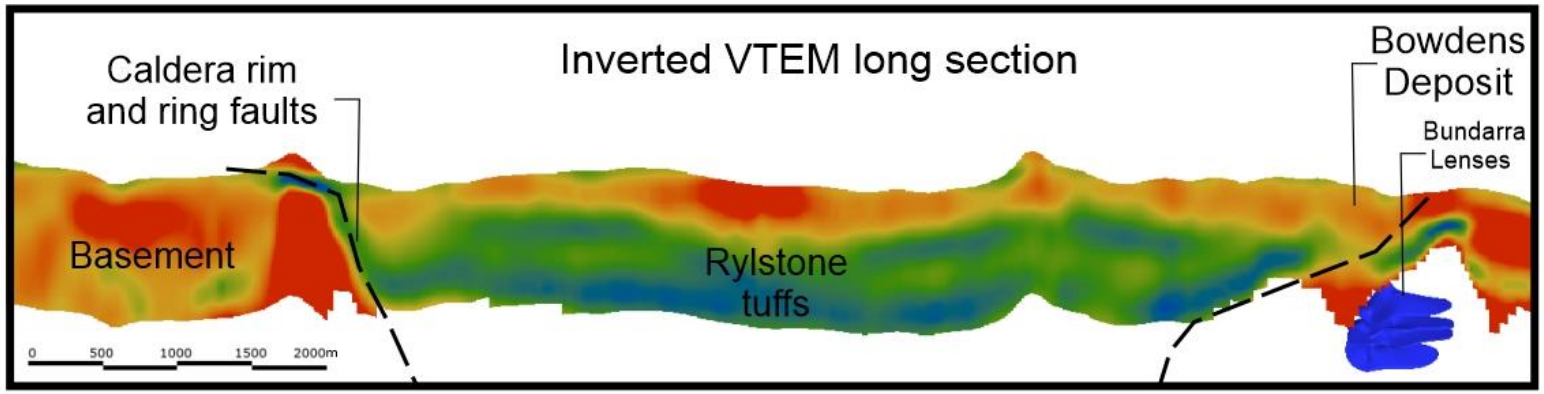
- Rylstone Volcanics consist of rhyolitic to dacitic pyroclastics, epiclastics and lava's with recently defined porphyritic intrusion.
- Volcanics are characteristic of caldera and intra-caldera facies, thickness of > 500 metres.
- Data supports the interpretation of a > 7 kilometre in diameter caldera structure.
- Gravity is a useful tool in mapping geology and deposit recognition.

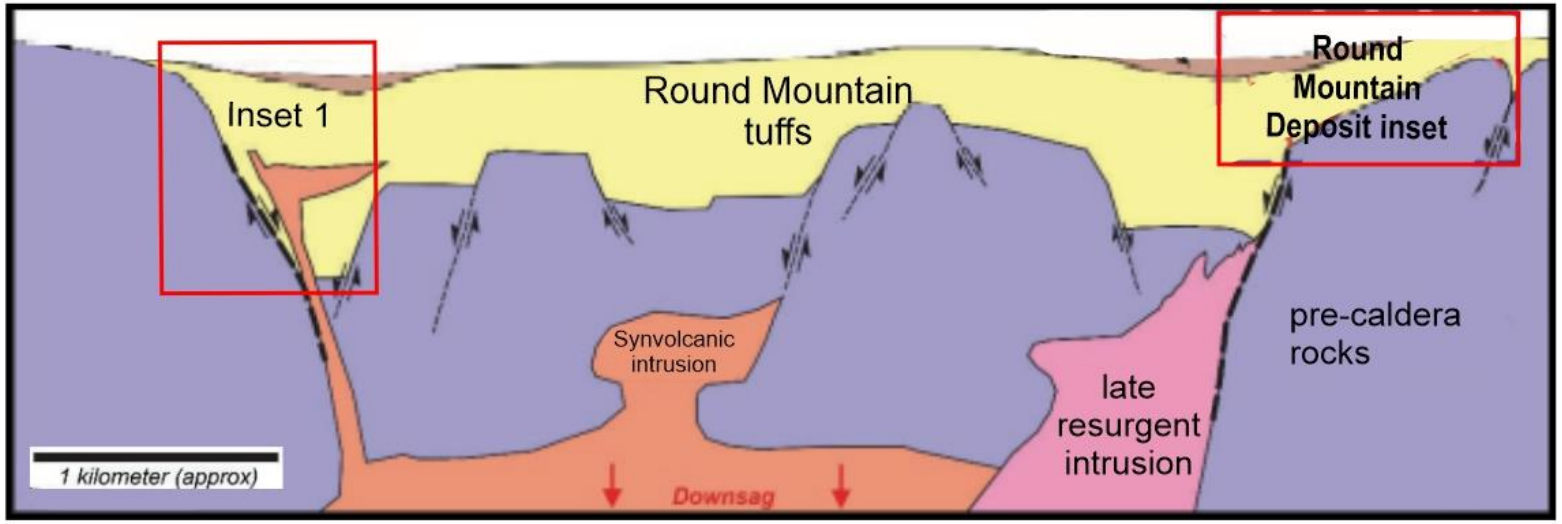


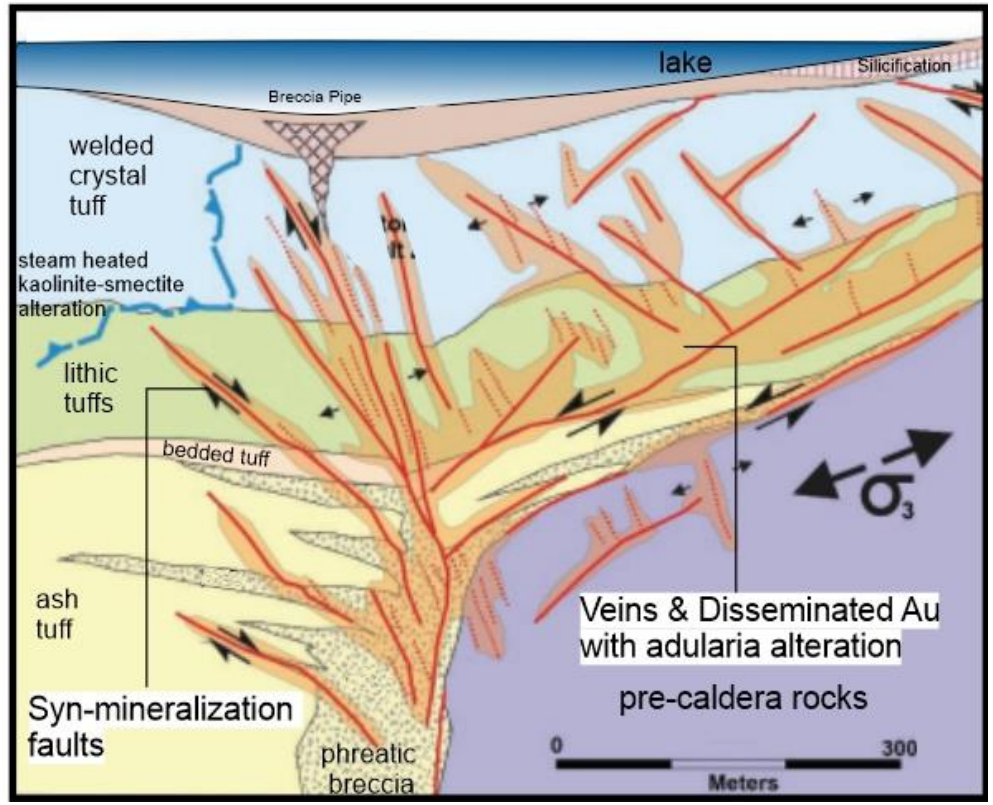
Deposit Setting: Conductivity



System Analogues

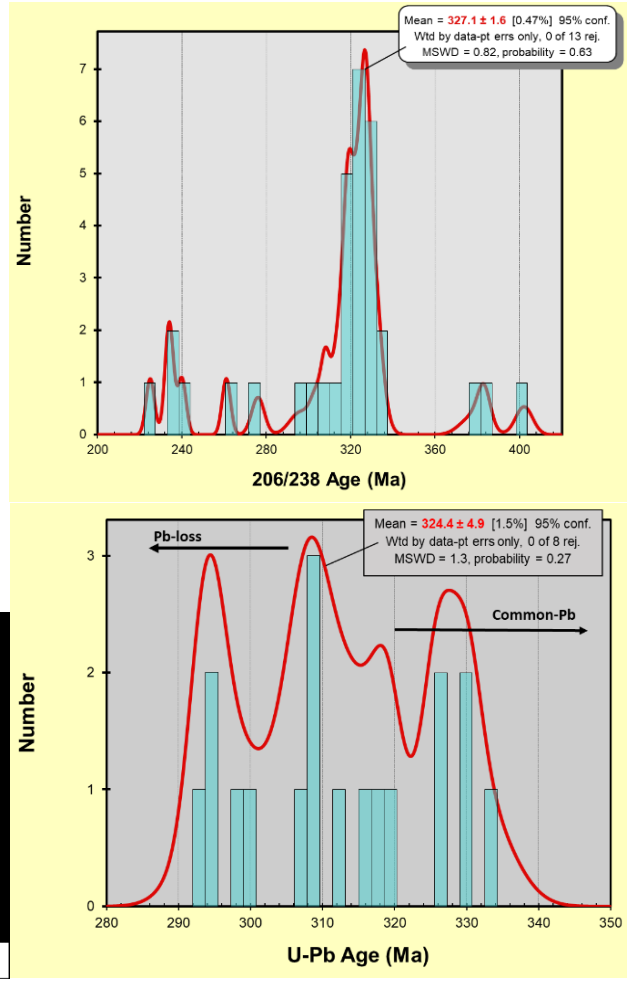


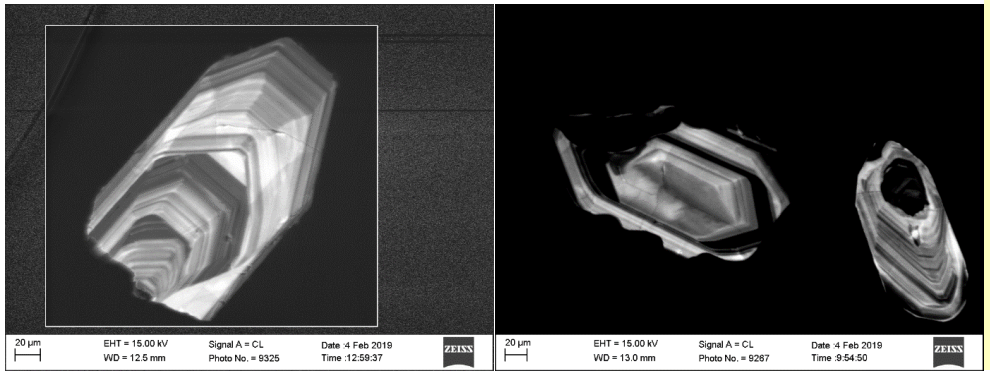


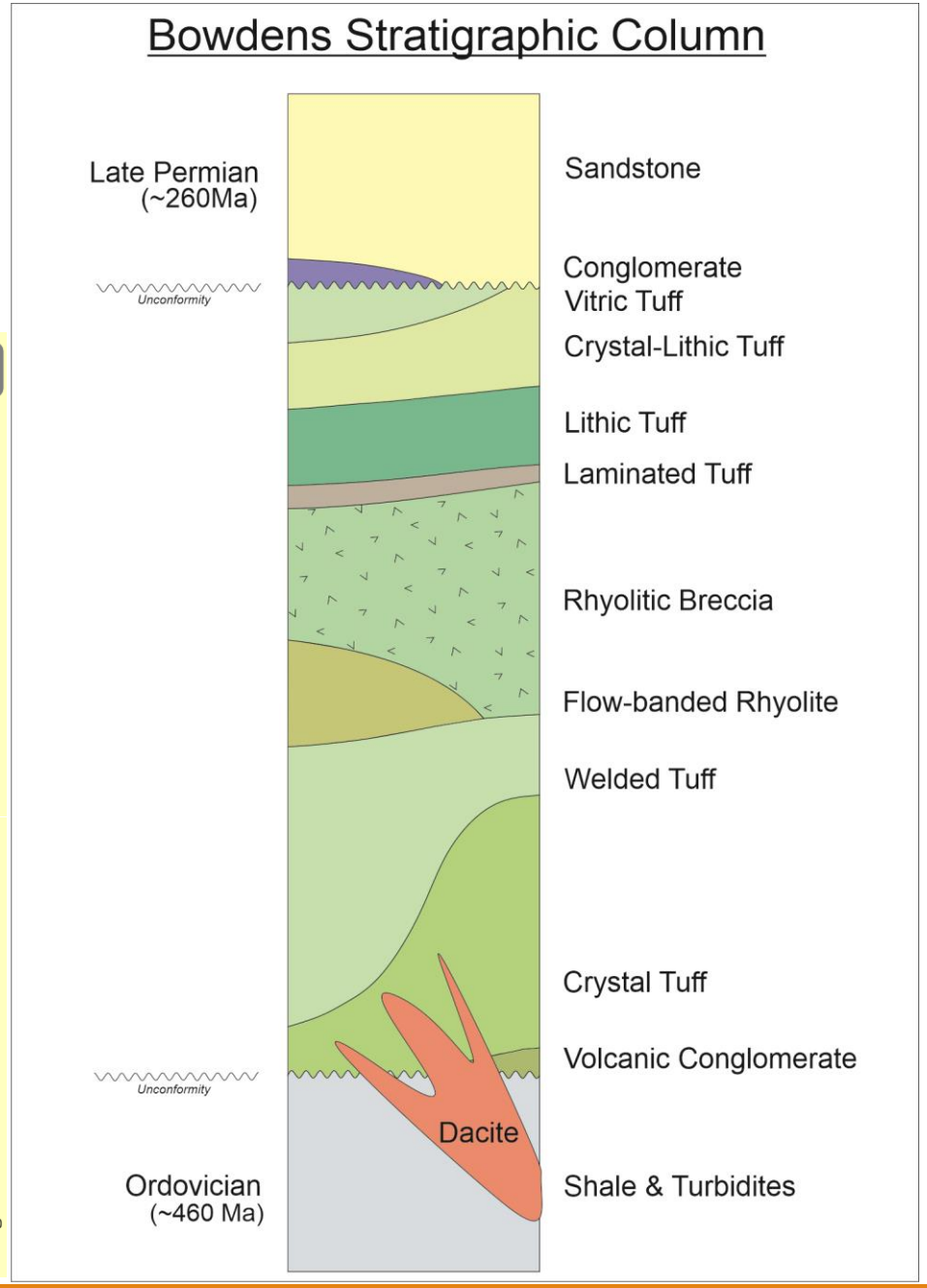


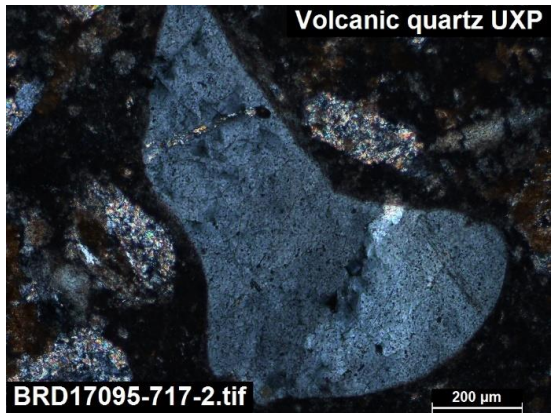
Geochronology and Stratigraphy:

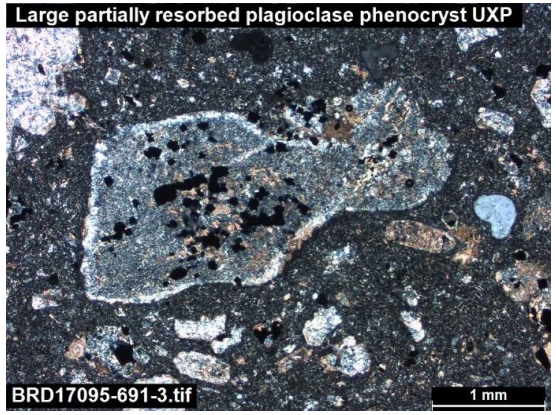
- Current U-Pb date for the Rylstone Volcanics is 292 ± 10 Ma.
- Our studies show concordant ages of zircons in dacite are 327.1 ± 1.6 Ma and 324.4 ± 4.9 Ma.
- Hydrothermal muscovite & adularia + biotite from outcropping Rhyolite submitted for Ar-Ar dating.

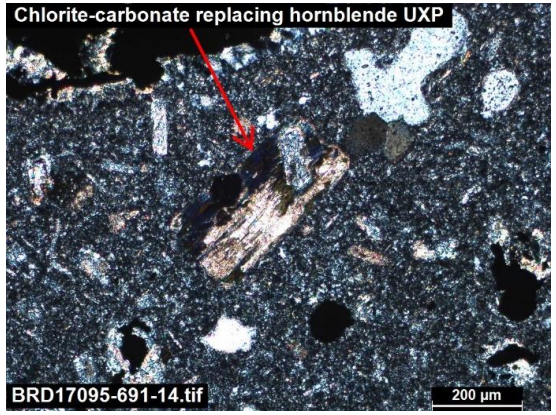


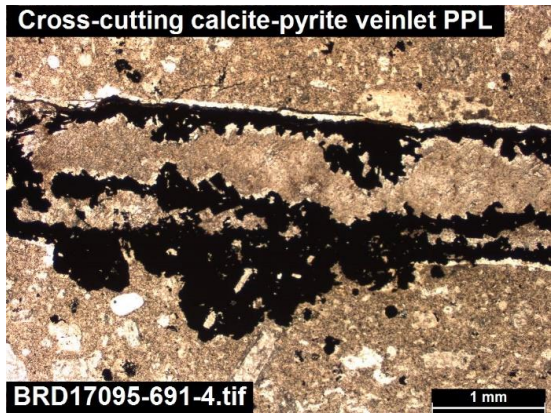


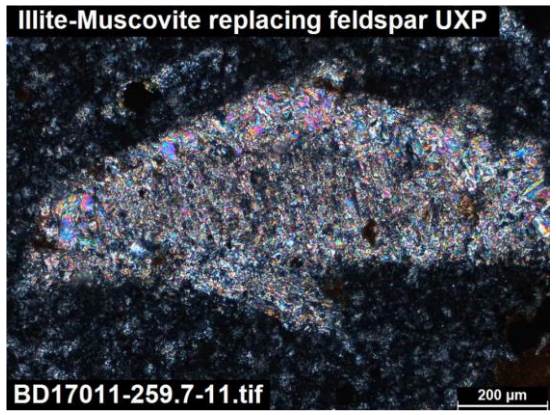






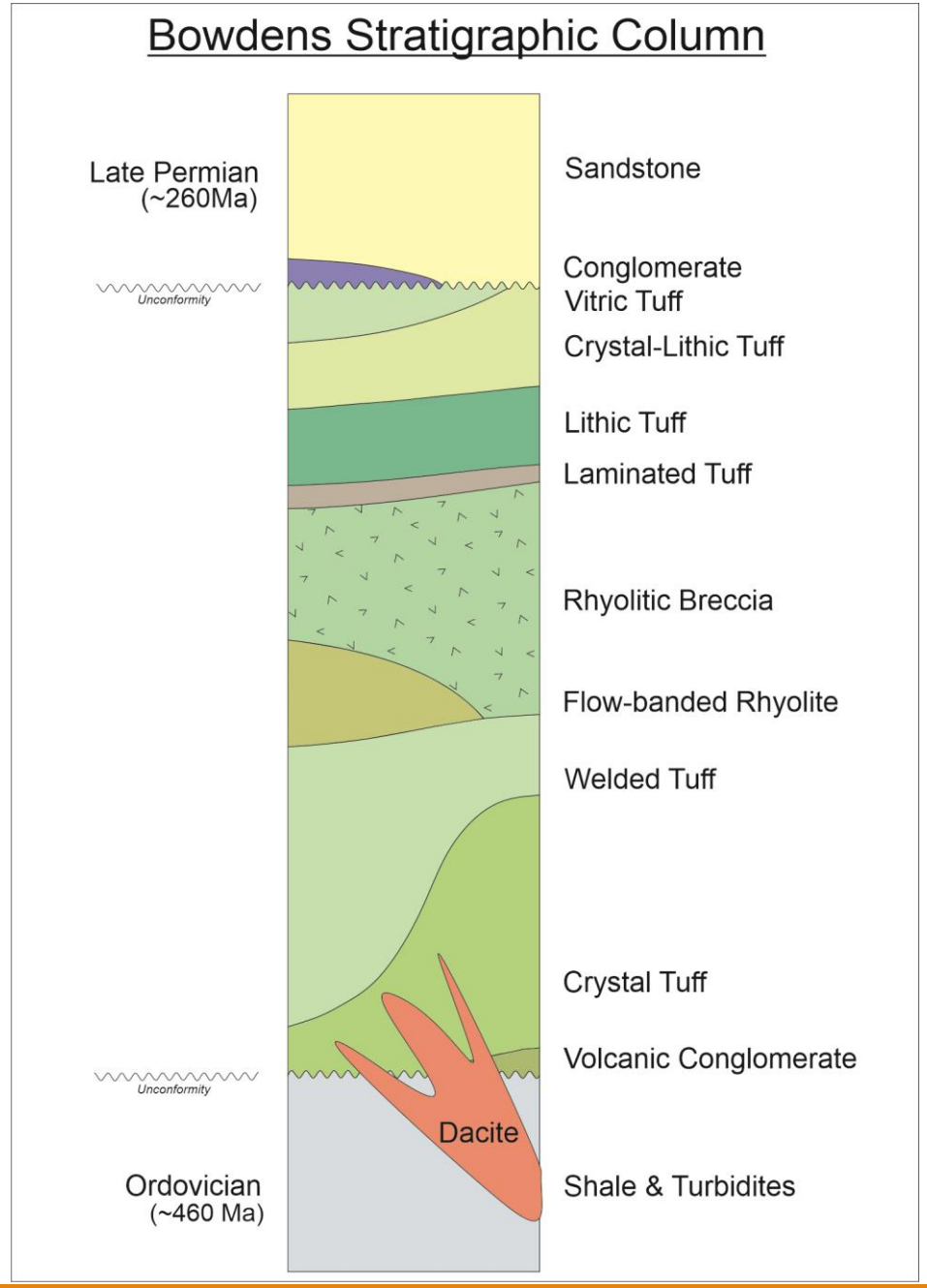






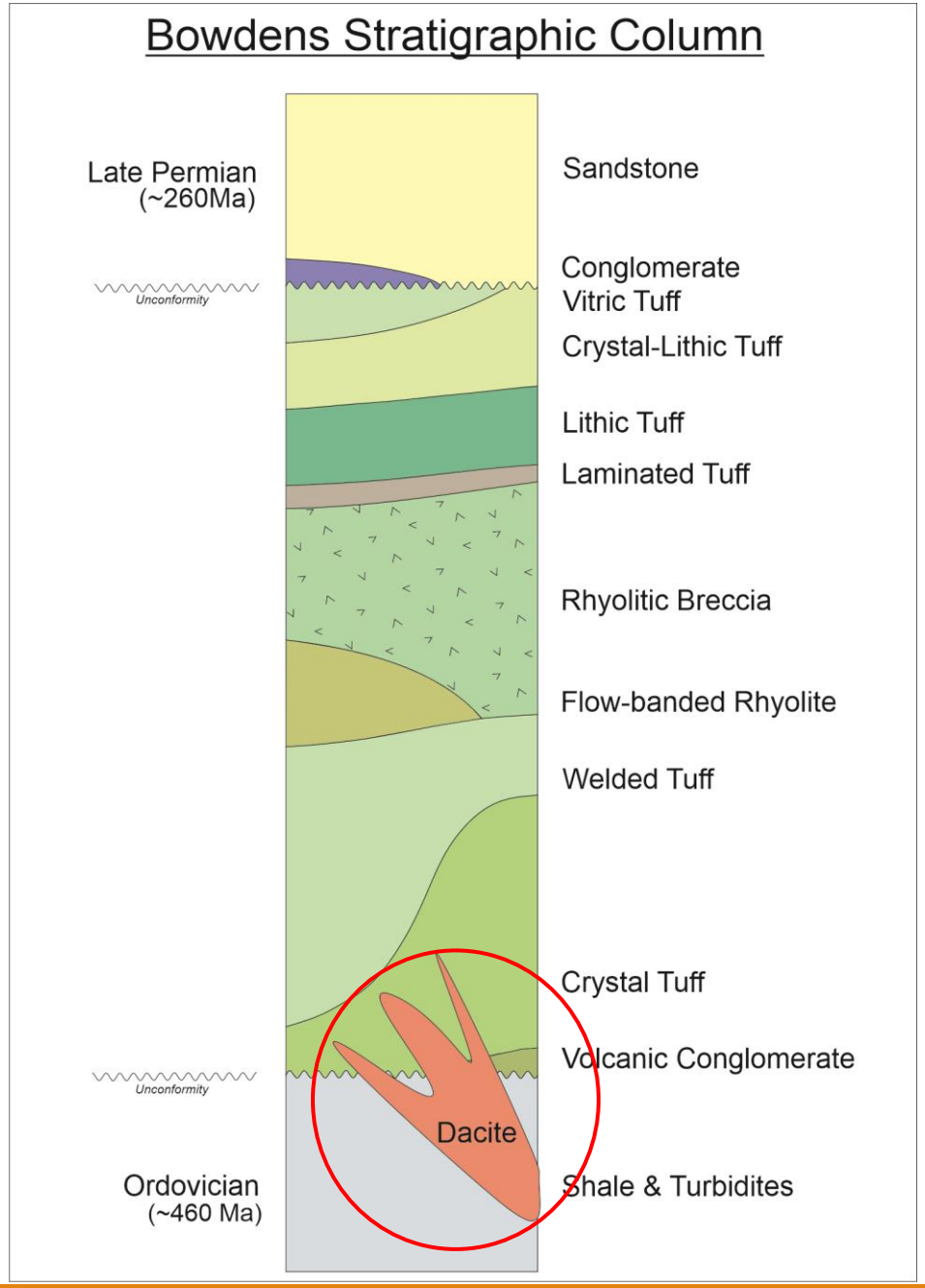
Geochronology and Stratigraphy

- Thin section work confirms intrusive origin.
- Porphyritic quartz and plagioclase dacite.
- Strong to complete alteration.
- Common calcite-pyrite veinlets.



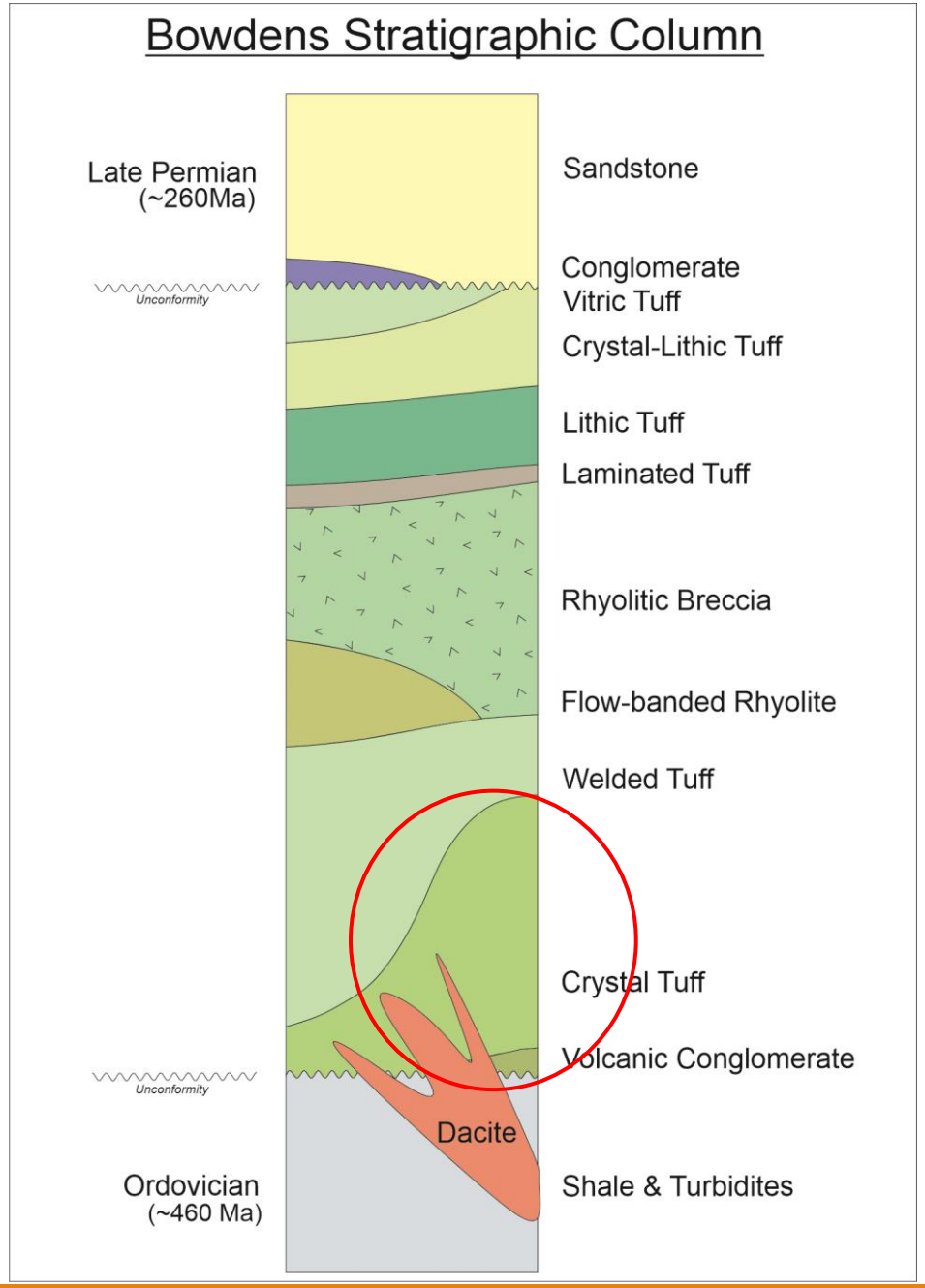
Geochronology and Stratigraphy:

- Dacite Intrusions.



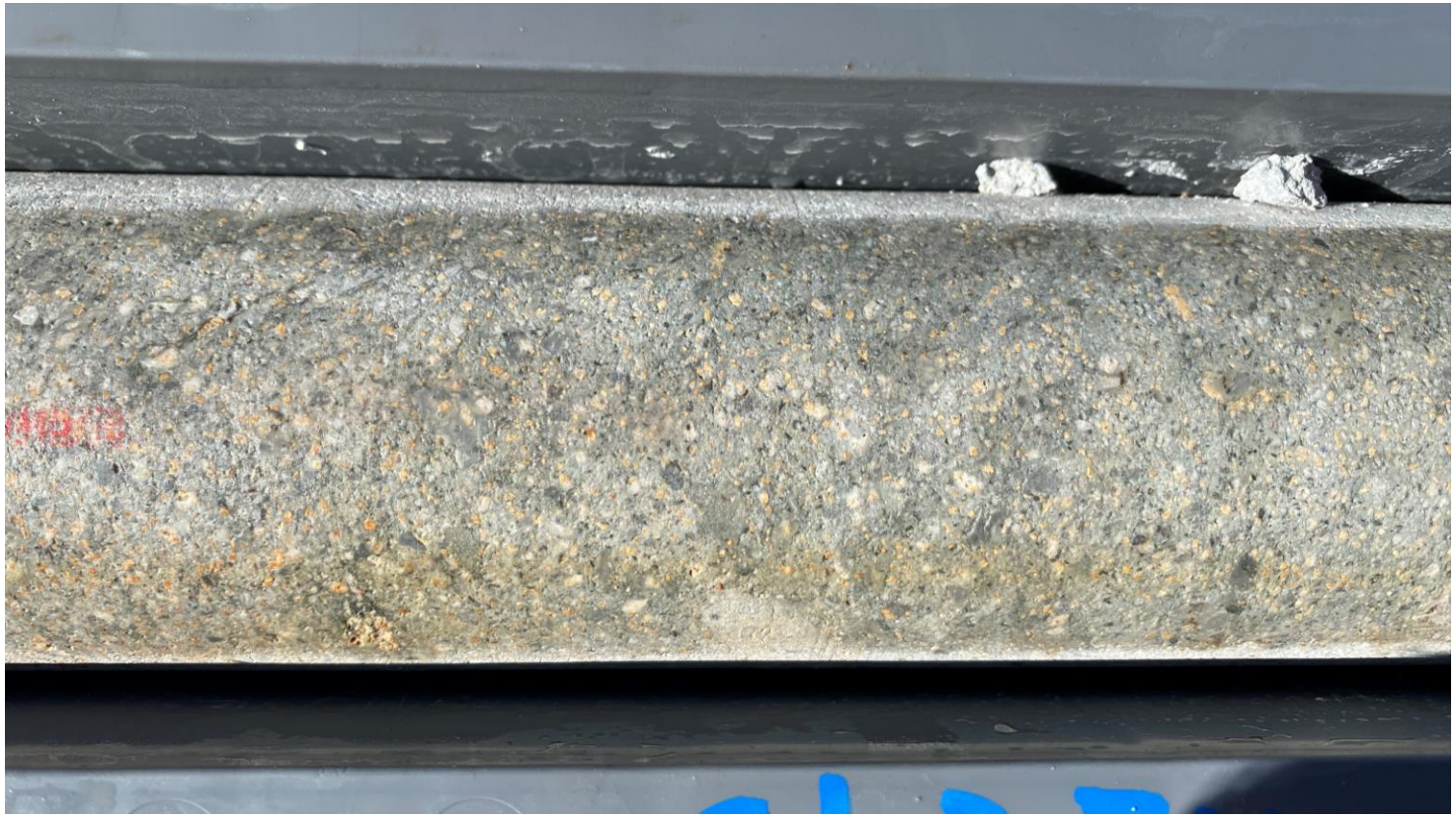
Geochronology and Stratigraphy:

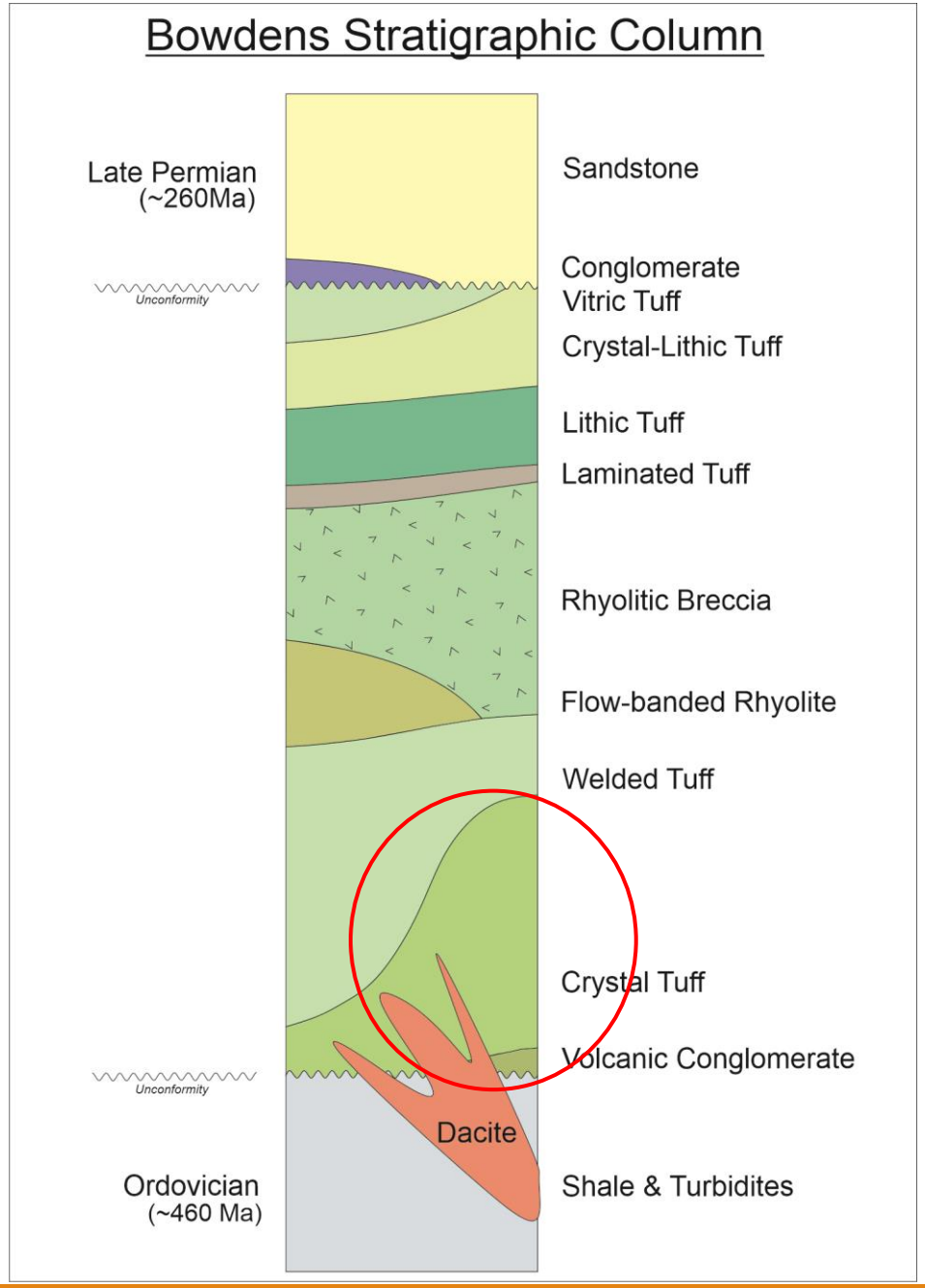
- Basal Conglomerate.



Geochronology and Stratigraphy:

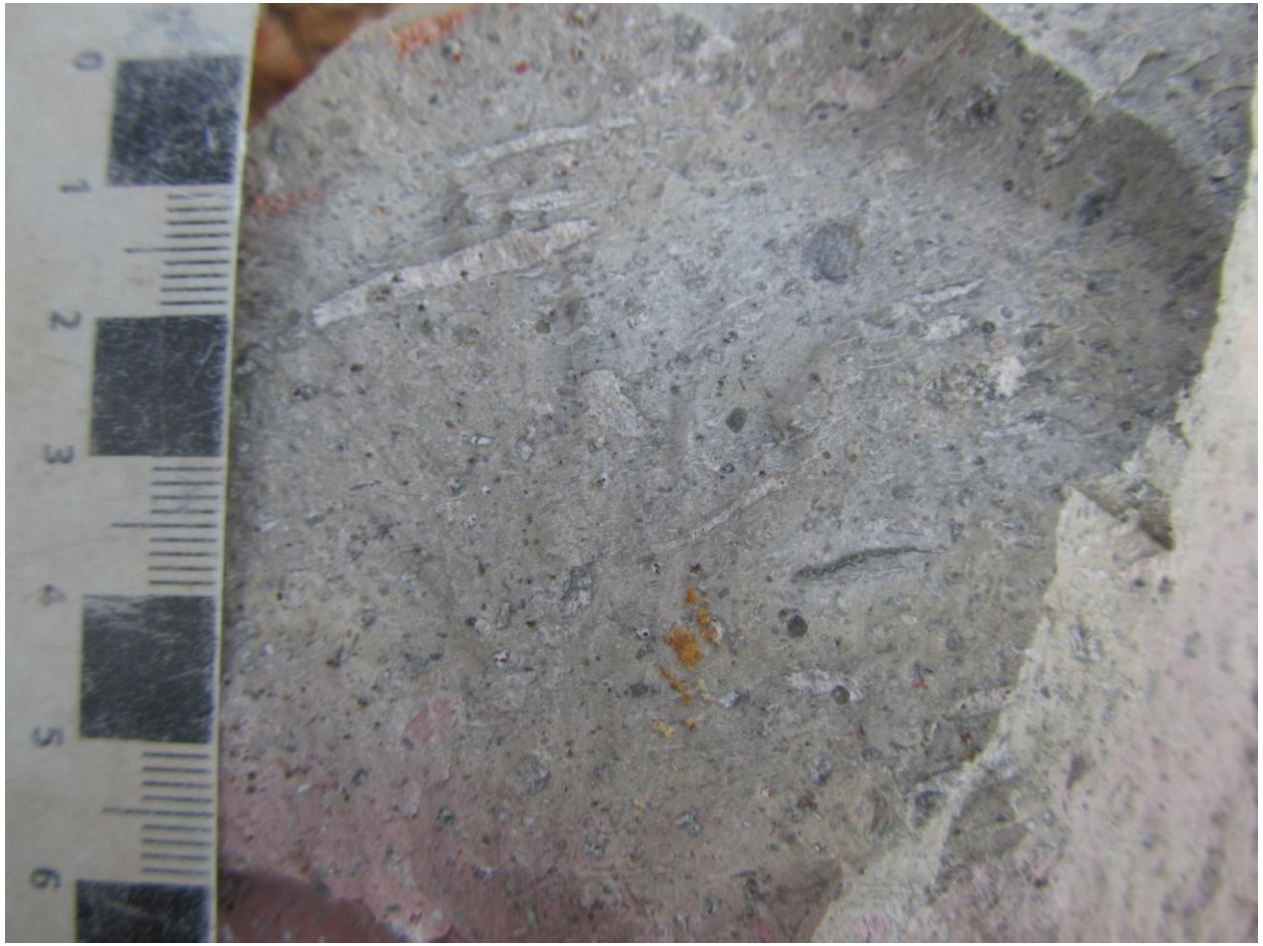
- Crystal Tuff.

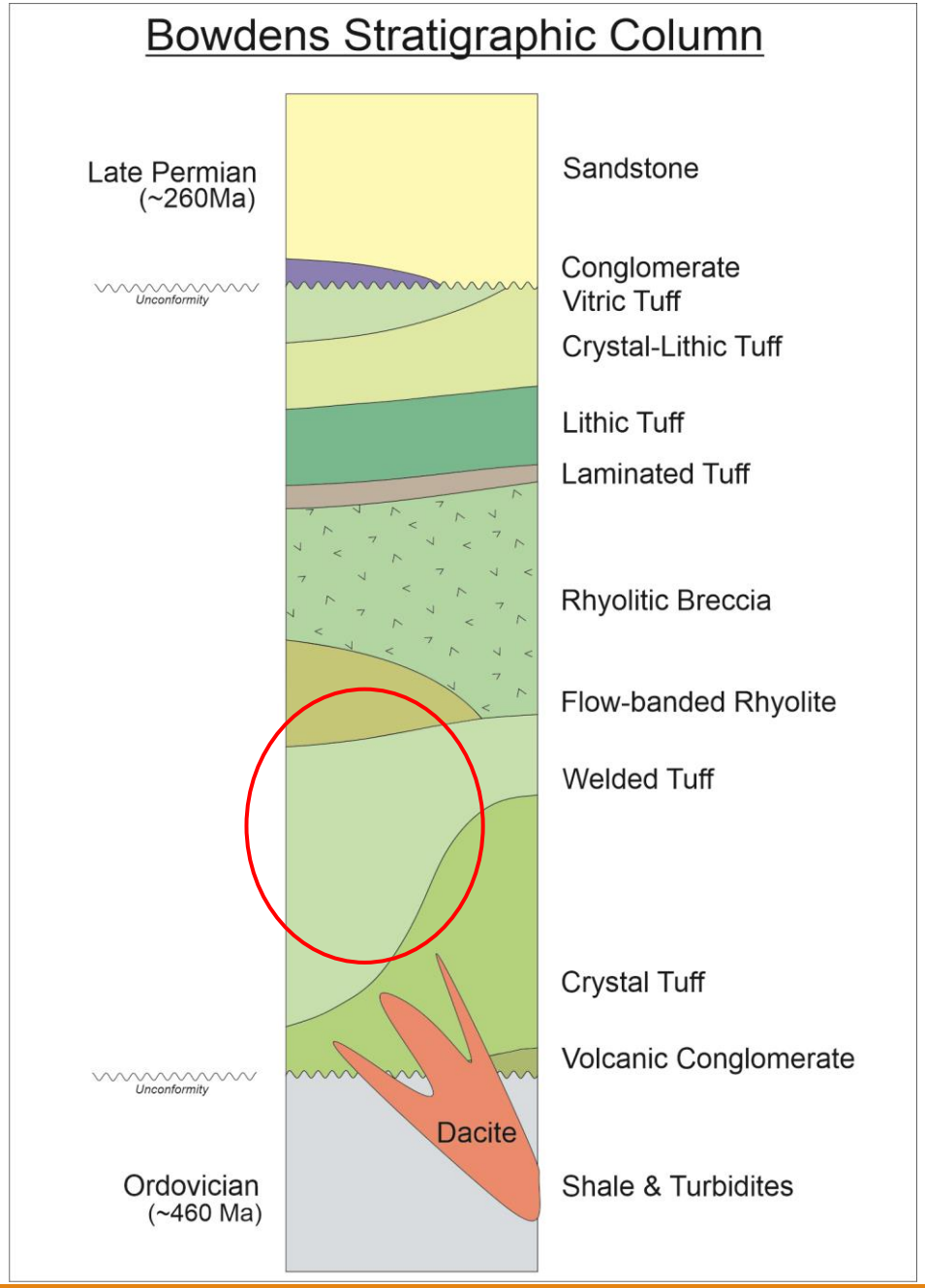




Geochronology and Stratigraphy:

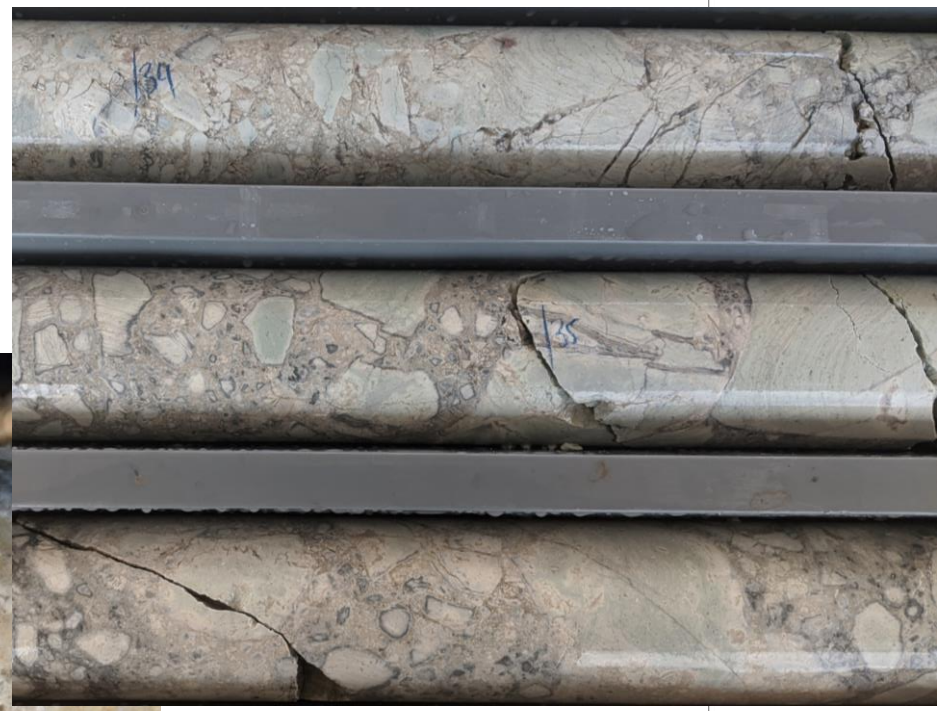
- Welded Tuff/ignimbrite.

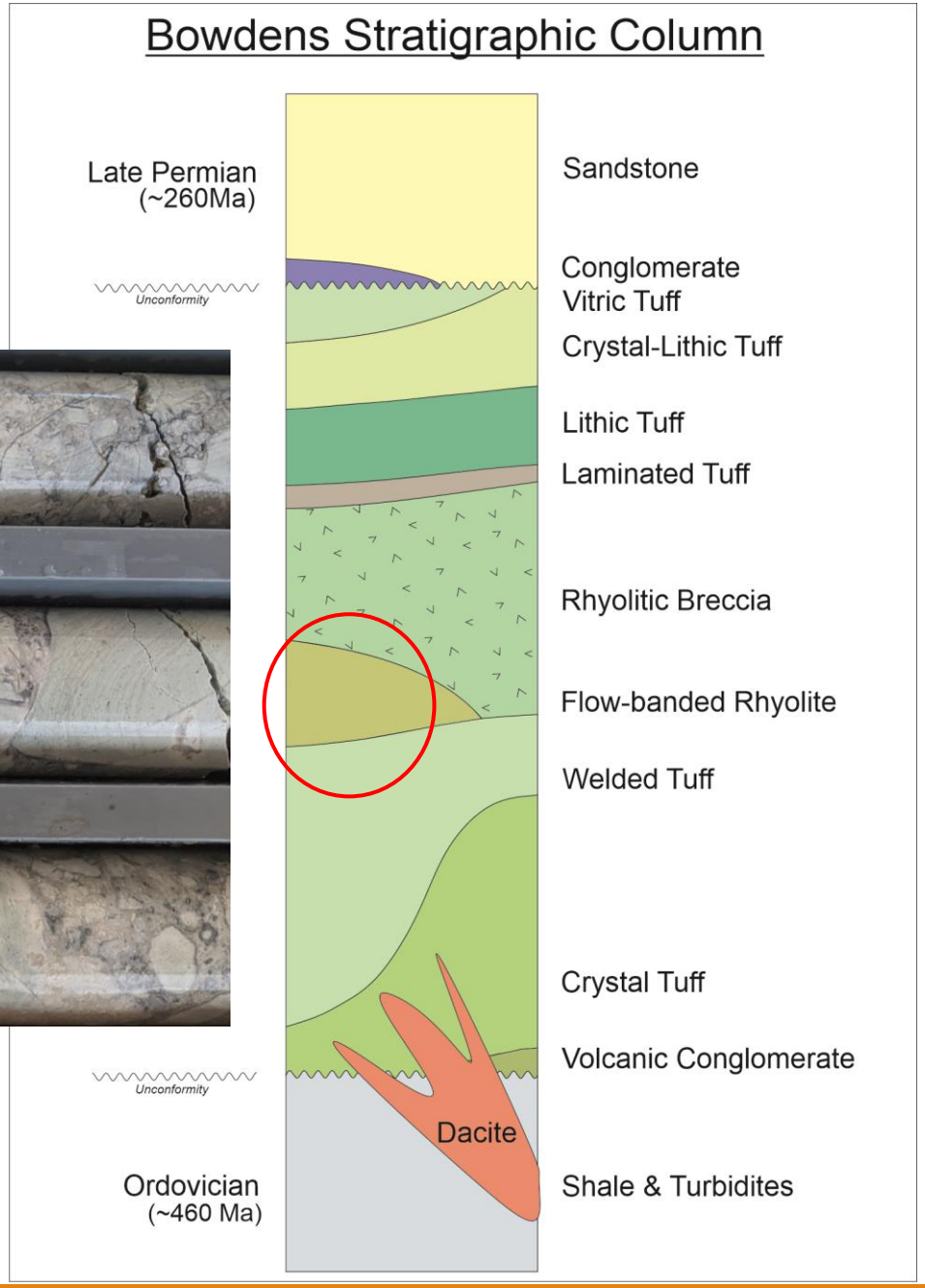




Geochronology and Stratigraphy:

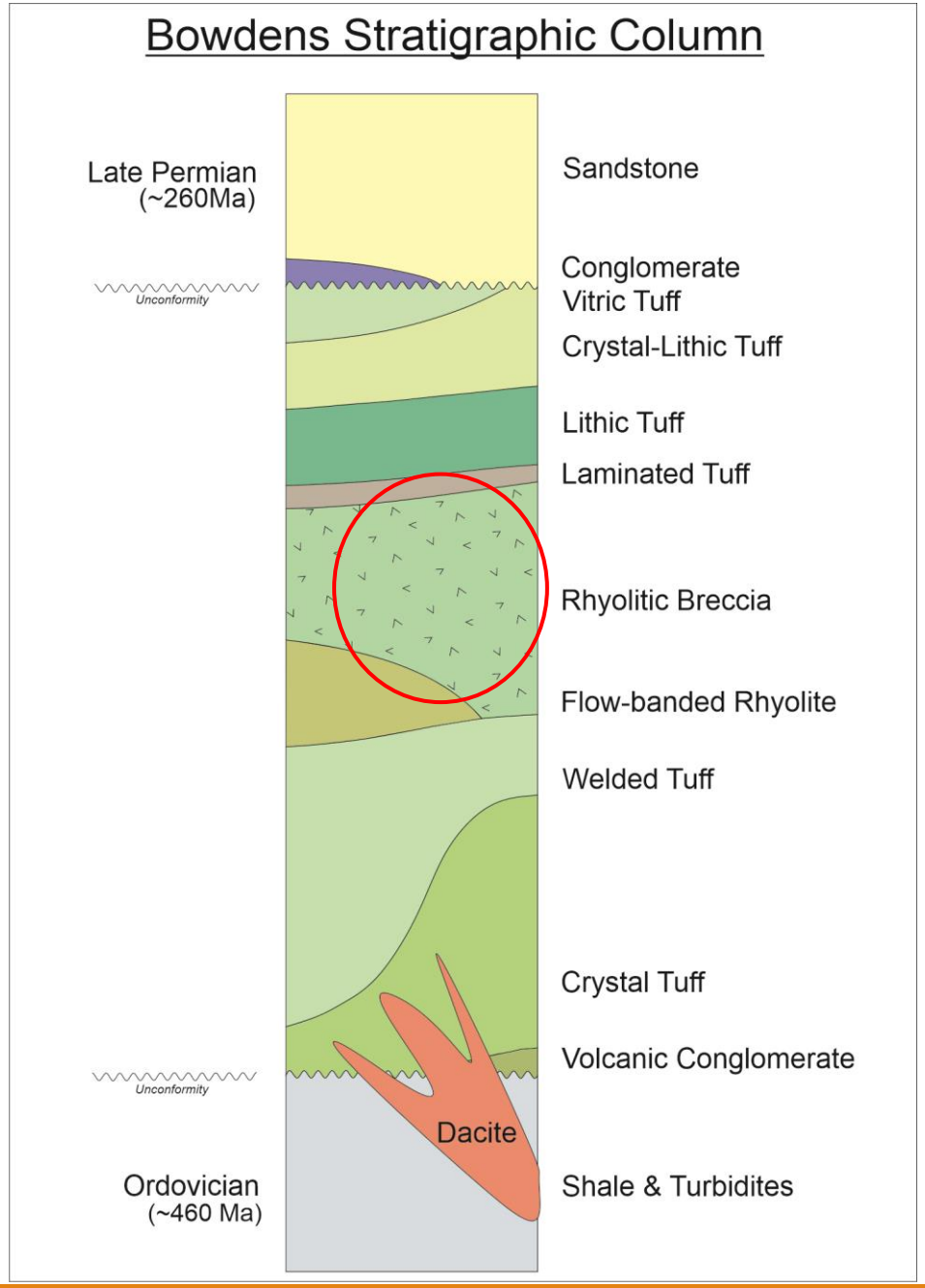
- Flow banded and spherulitic Rhyolite.





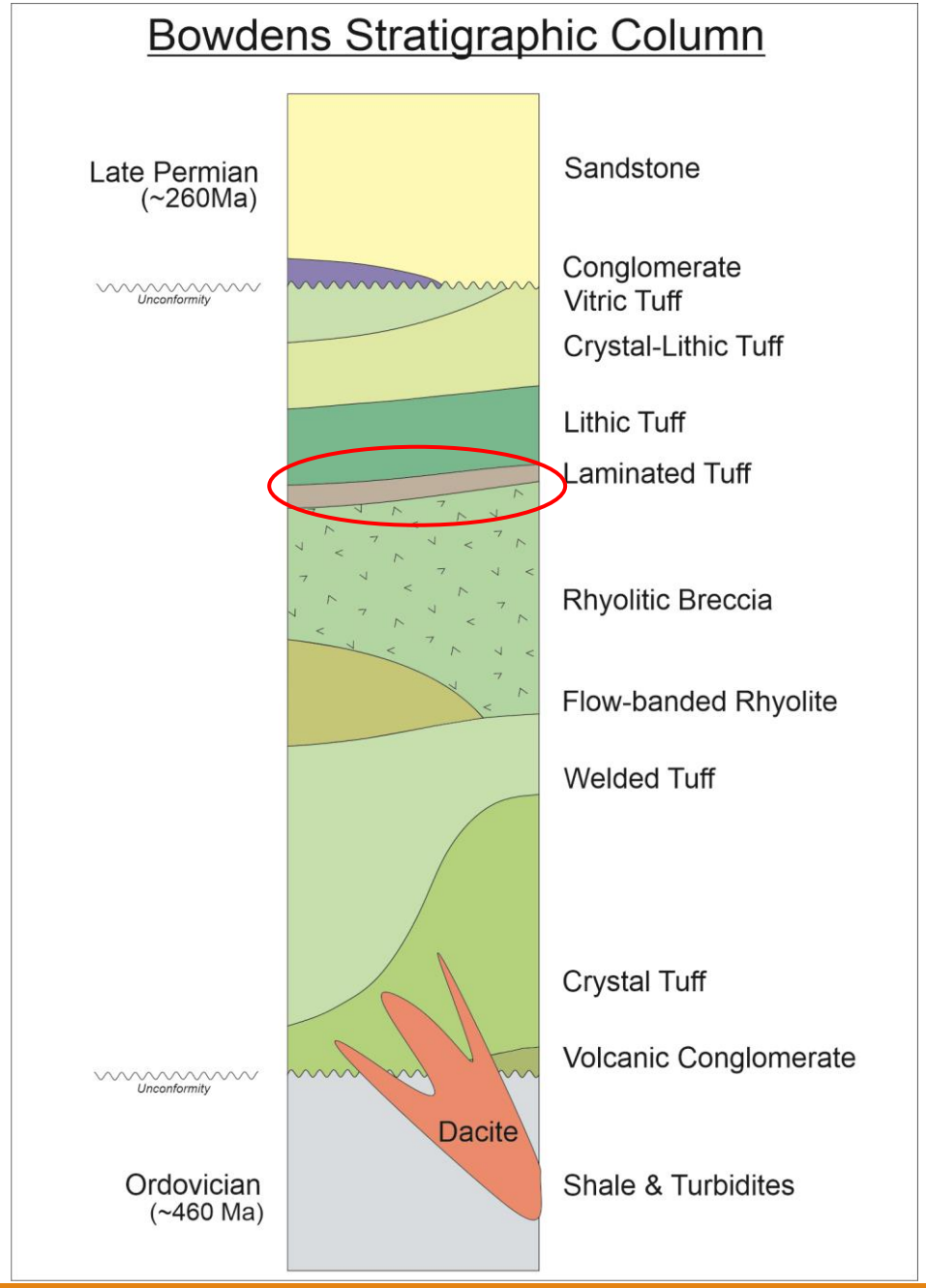
Geochronology and Stratigraphy:

- Volcanic Breccia.



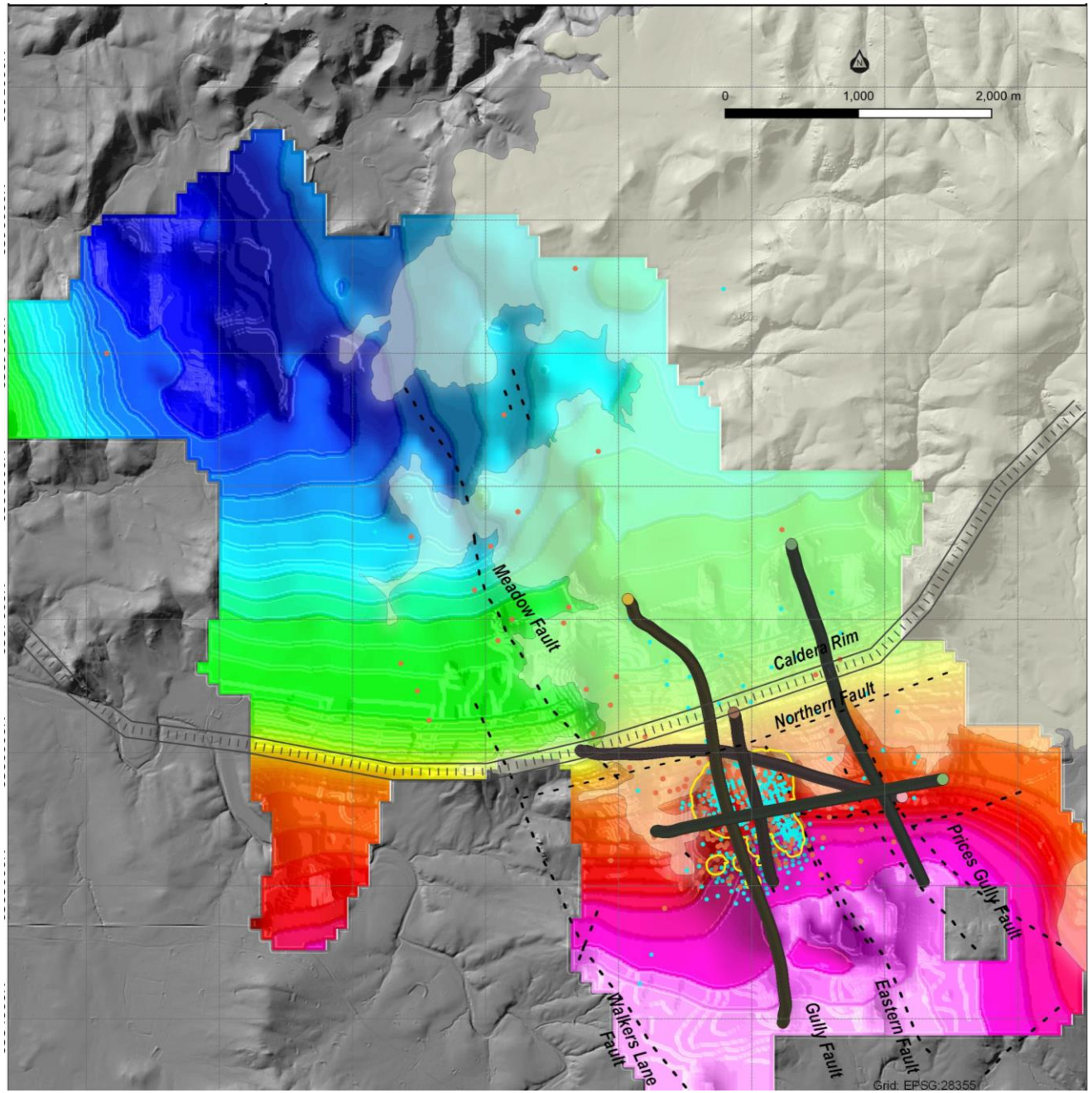
Geochronology and Stratigraphy:

- Laminated Ash Tuff.



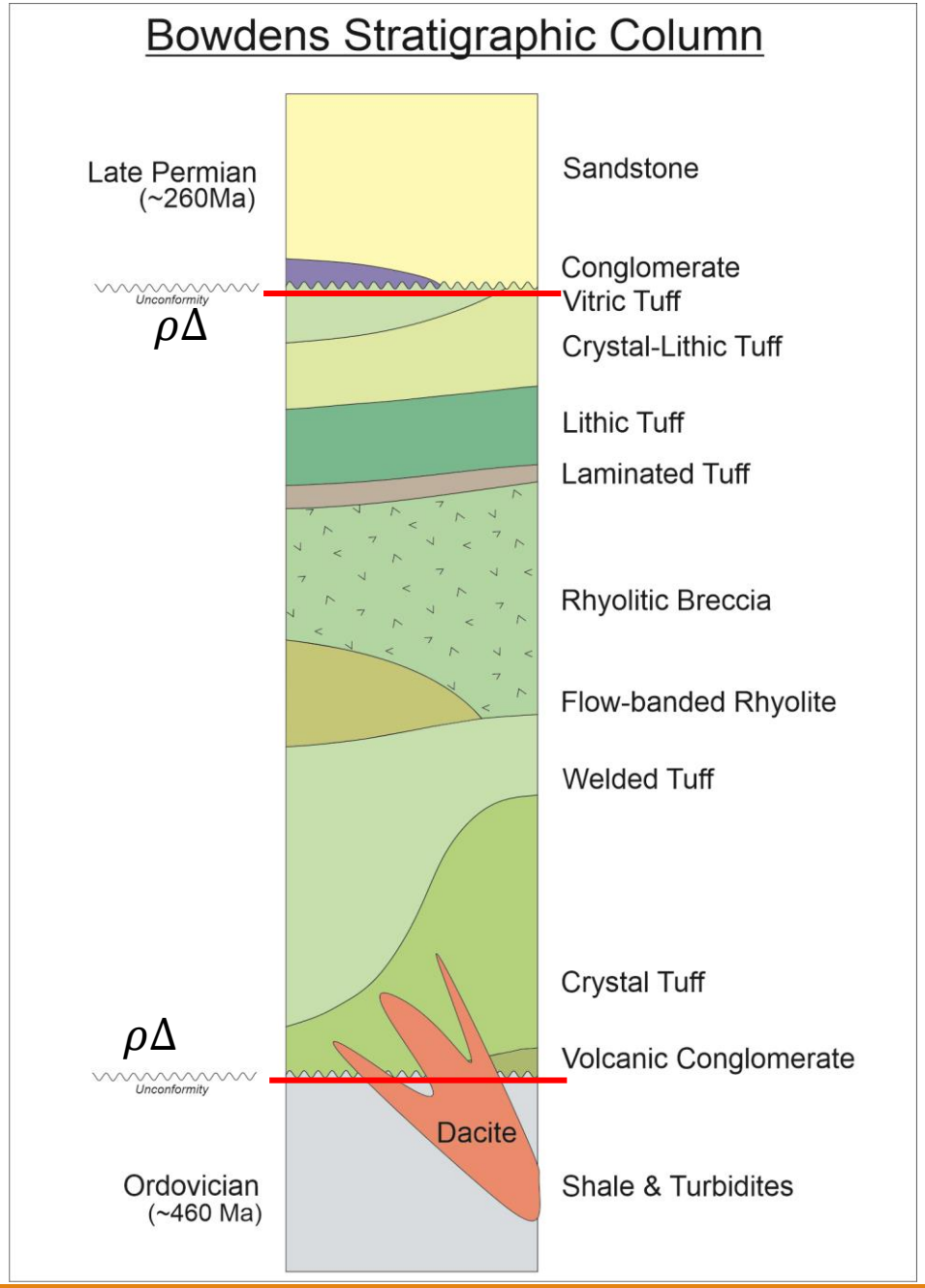
Seismic Data: How can it be used:

- Preliminary survey of ~13 line kms.
- In Hard Rock environments, contrast can be given by:
  - Stratigraphic boundaries.
  - Faults with enough movement and scale.
  - Intrusive bodies.
  - Significant fluid migration pathway (dense fracture zones and highly altered pathways).

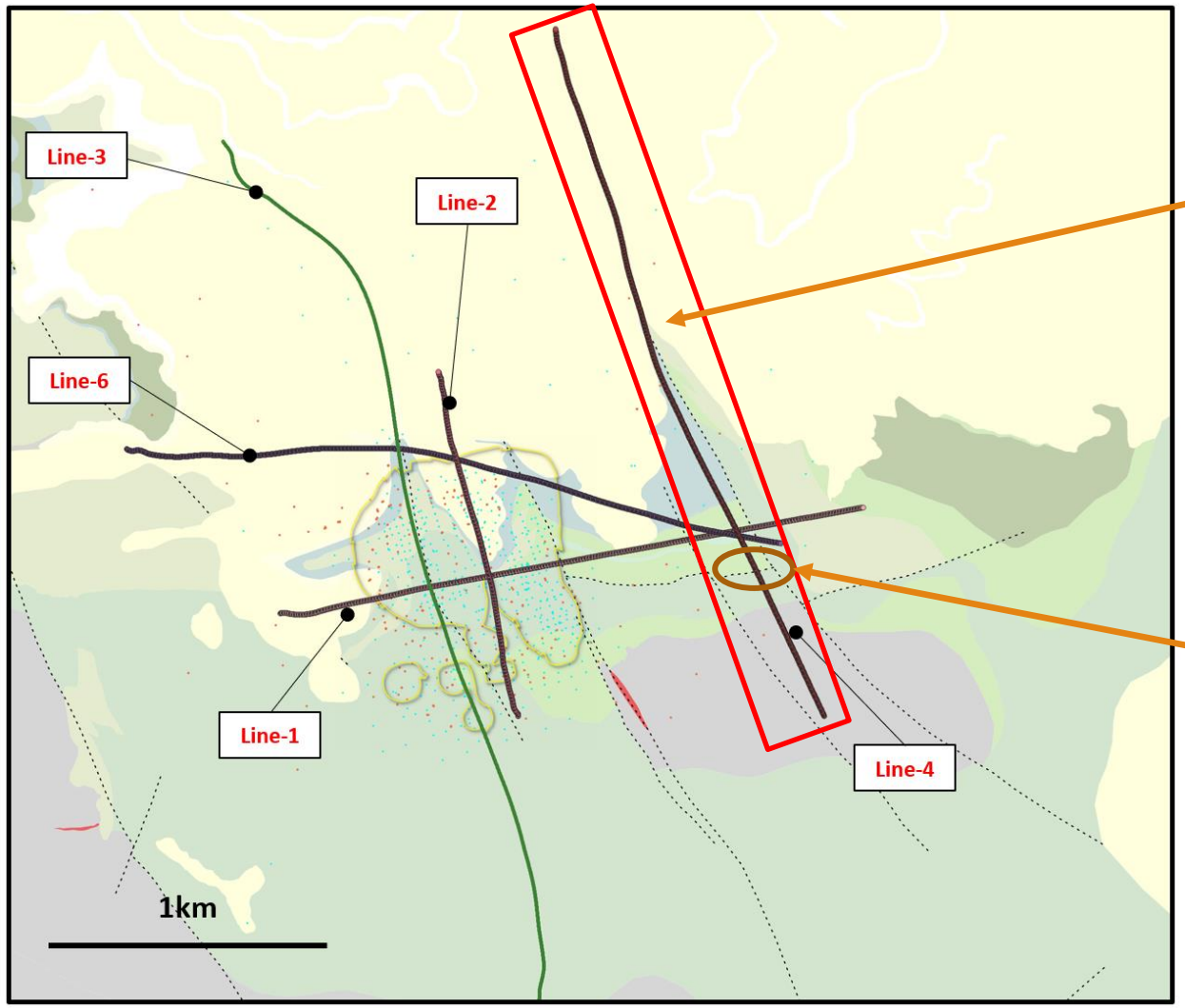


Seismic Data: What do we expect to see?

- Stratigraphy (seismic facies)
  - Cover and Volcanics unconformity
  - Volcanics and Basement unconformity
  - Dykes and sills
- Faults & Structure (fluid pathways)
  - Listric Faults (Eastern, Gully & Prices Gully)
  - Caldera Rim (Normal Faults)
- Intrusive (heat source) –
  - Dacite intrusive body & precursor to mineralisation
  - Hydrothermal fluid pathways (alteration and fracture zones)

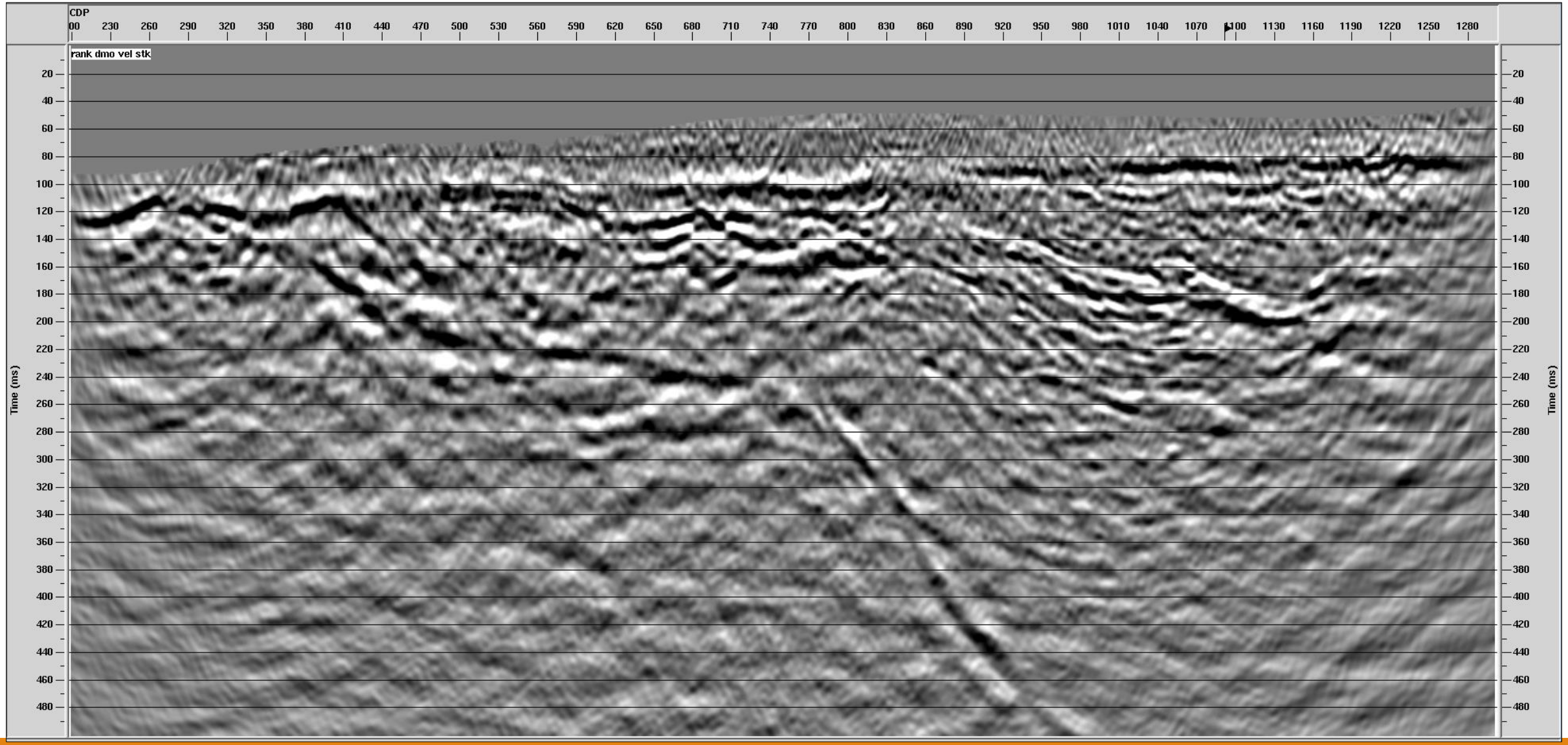


Seismic Data: Preliminary Section



- Edge of sediments.
- Line 4 is optimally oriented to image East-West trending faults

Seismic Data: Preliminary Section



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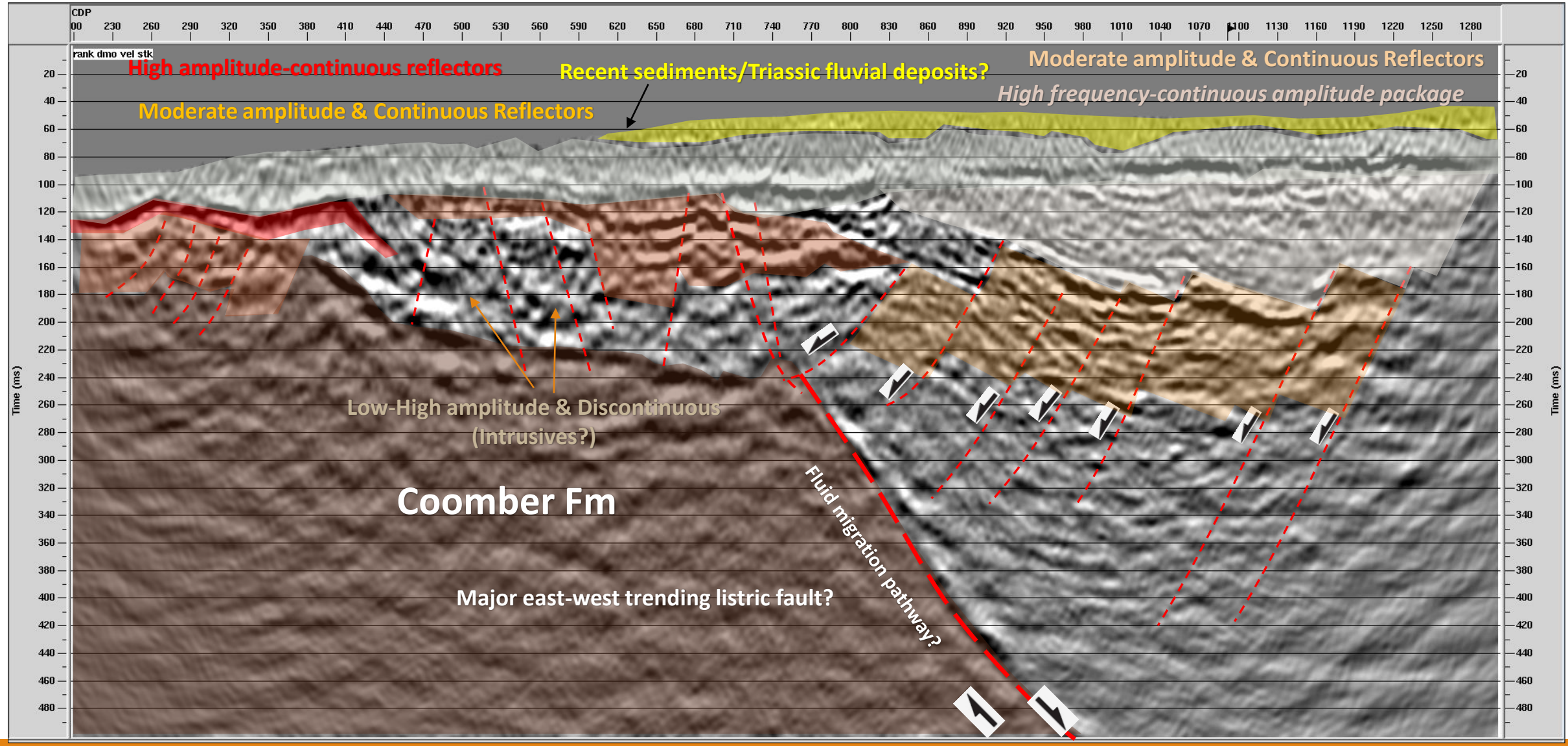
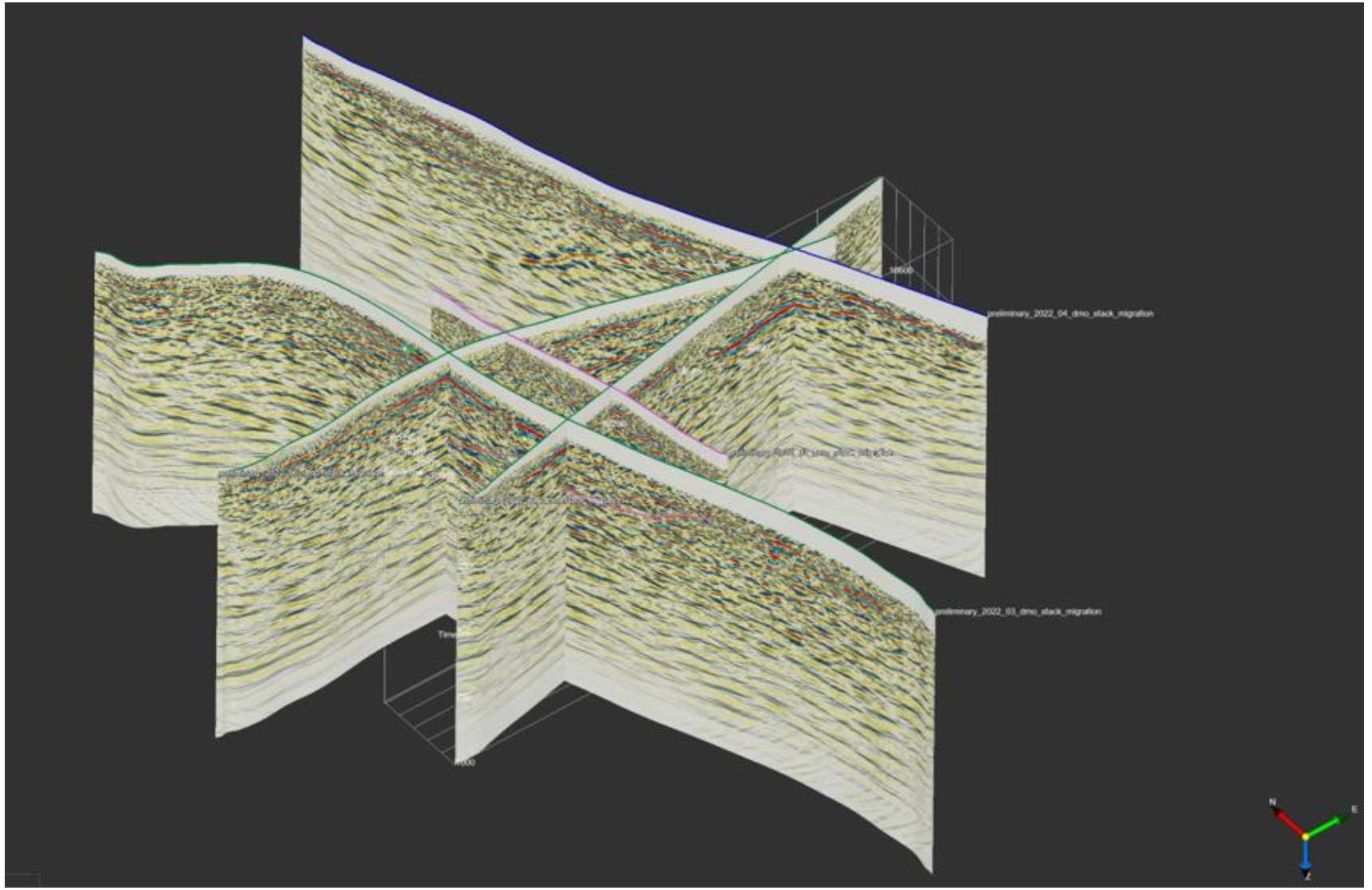


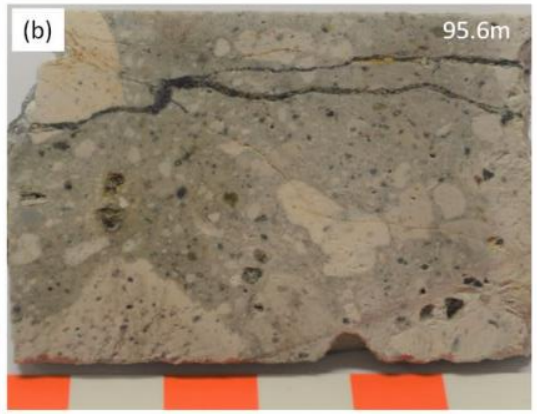
Seismic Data: Preliminary Data



Mineralisation in the Rylstone Volcanics

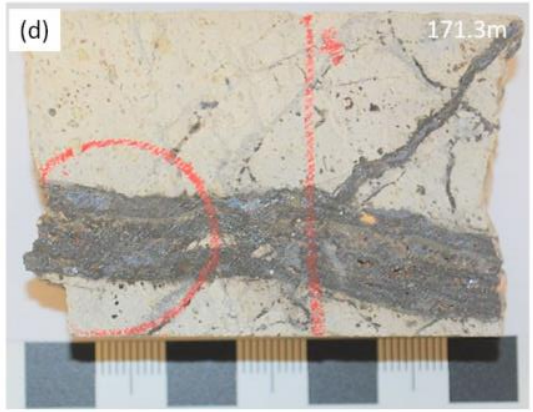
a. Breccia-filled mineralization within polymictic breccia.

b. Polymictic breccia with later sulphide veinlets.



c. Sulphide and rhodochrosite vein within welded tuff.

d. Polyphase sulphide vein, minor rhodochrosite and disseminated sulphide within bleached welded.

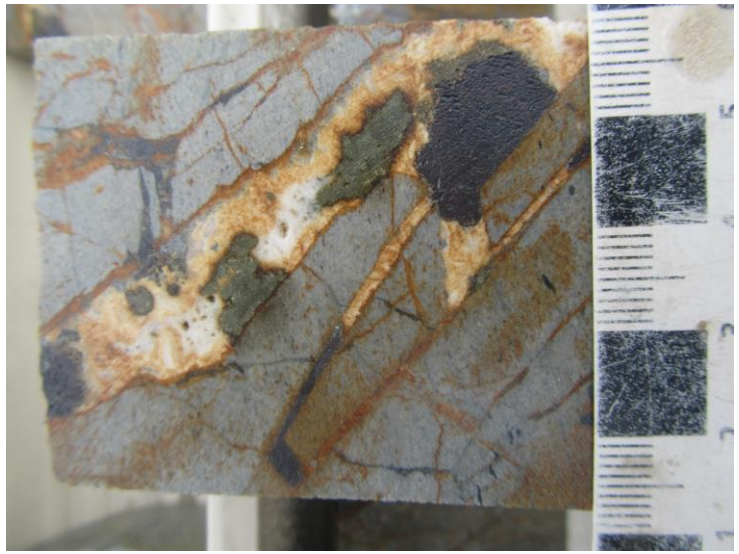


e. Sulphide vein with minor rhodochrosite and ankerite hosted within crystal lithic tuff.

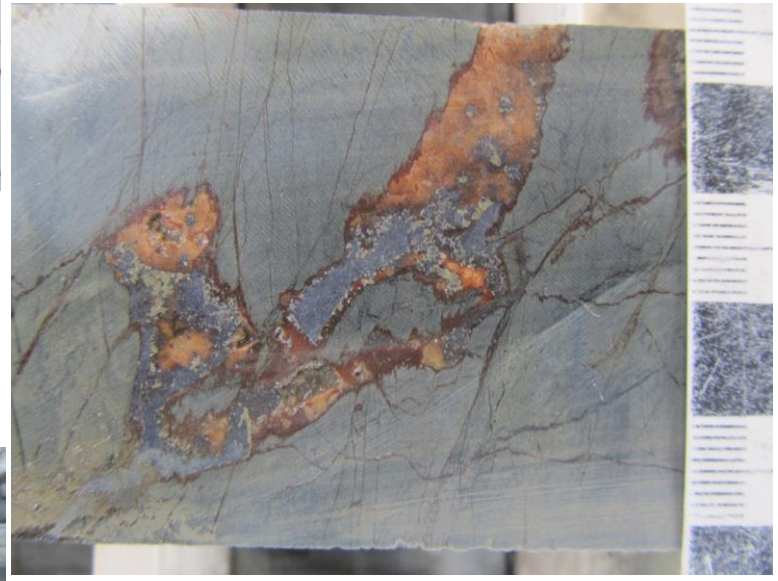
f. Sulphide infilling space within the crystal lithic tuff containing primarily sphalerite.

Mineralisation in the Coomber Formation

Sulphide, carbonate and quartz vein in sandstone.



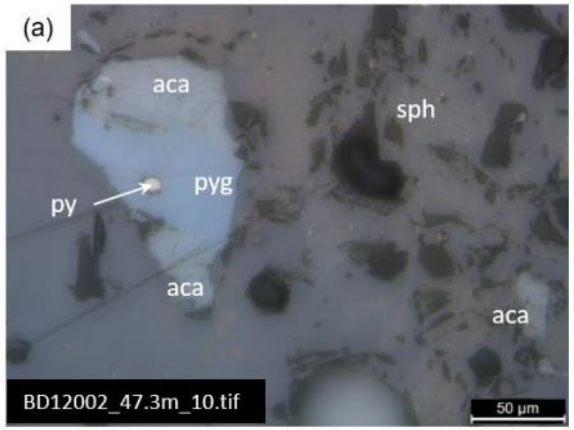
Sulphide and carbonate vein in siltstone.

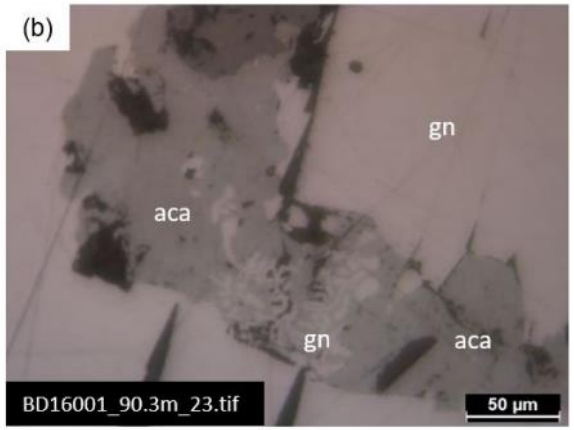


Sulphide, quartz and carbonate vein in sandstone.

Primary Ore Mineralogy

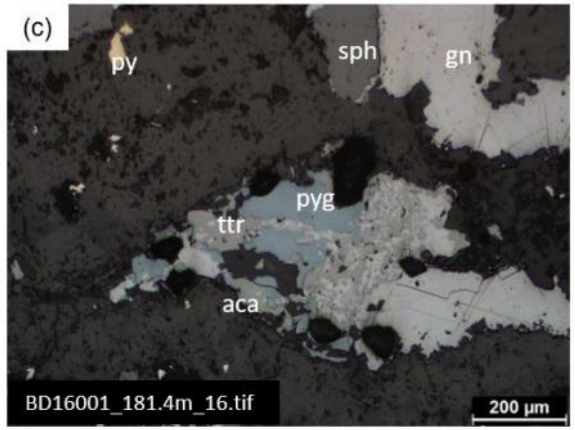
a. Pyrargyrite-acanthite rimming pyrite as inclusion in sphalerite.

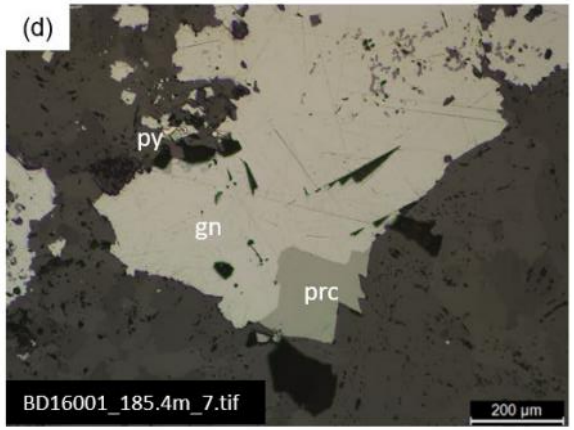




b. Acanthite with atypical symplectite texture with galena.

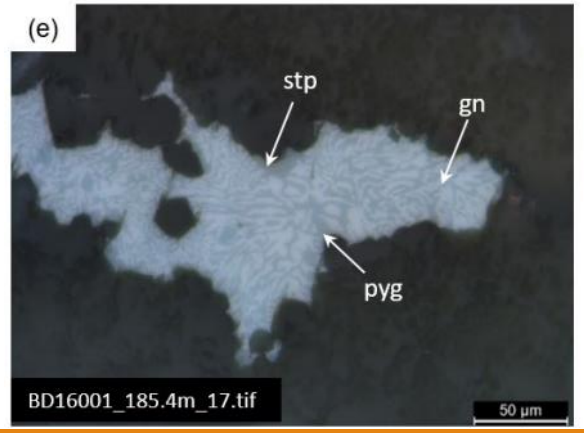
c. Pyrargyrite-acanthite rimming galena with later tetrahedrite cutting pyrargyrite and replacing galena.

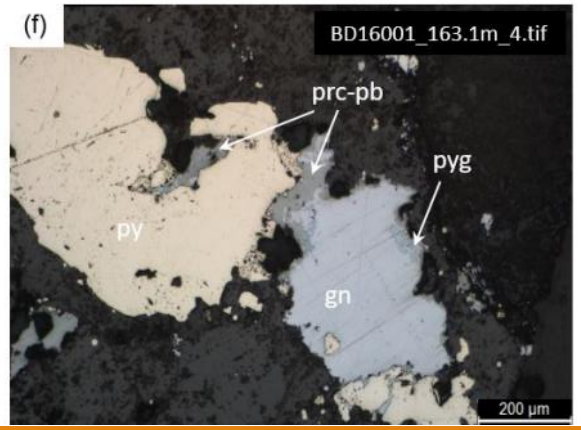




d. Coarse-grained pearceite rimming galena.

e. Typical symplectite texture of galena-pyrargyrite with stephanite.





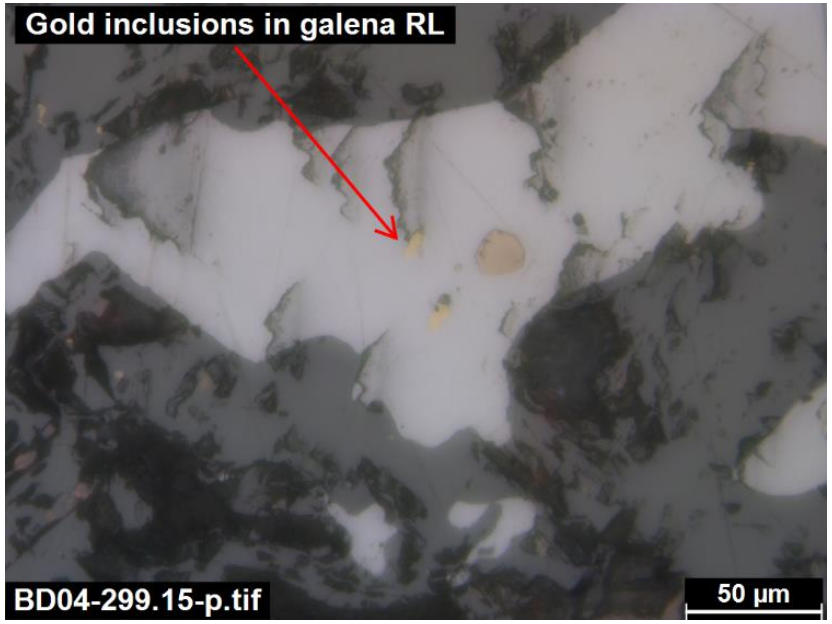
f. Co-existing pearceite-polybasite rimming pyrargyrite-galena and pyrite.

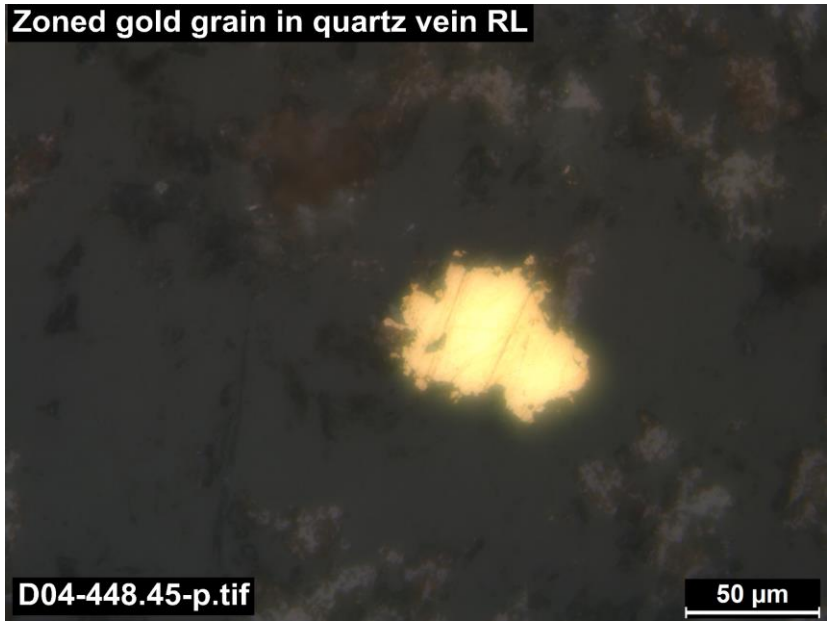
Gold Mineralogy

Two compositional and textural groupings:

1) Au in quartz veins – 48 wt% Au and 52 wt% Ag
Au-rich electrum of earlier orogenic origin formed > 250C.

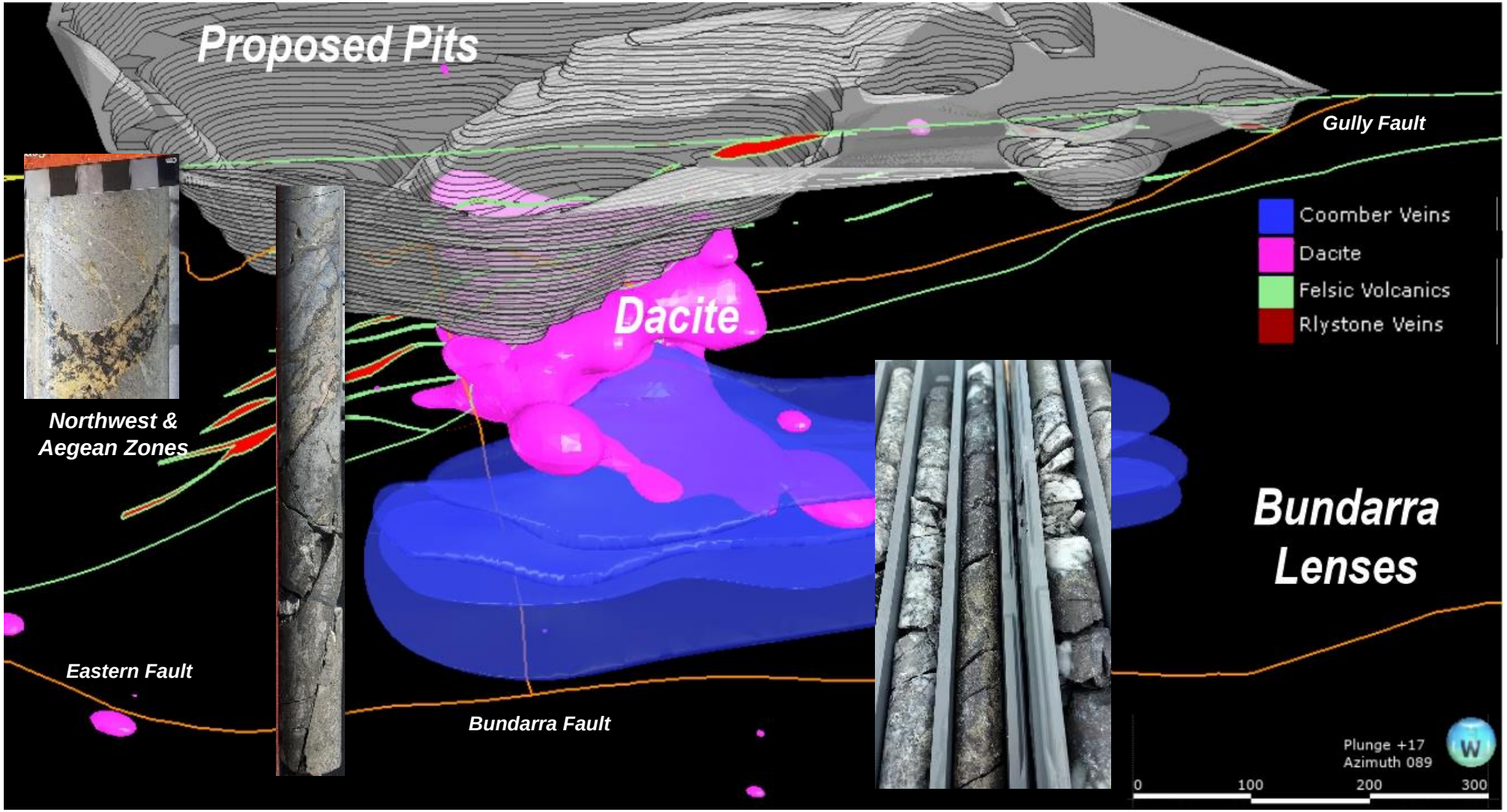
2) Au associated with pyrite/sphalerite/galena veins – 26 wt% Au and 74 wt% Ag
Ag-rich electrum of epithermal origin and part of the overall mineralising system.





Mineral Zonation

- 3 zones targeted for underground high-grade mineralisation.
- Each zone mineralogically distinct.
- 39,028 metres drilled since 2020
- 34,723 metres included in Resource Estimate due end of Q2 2022.

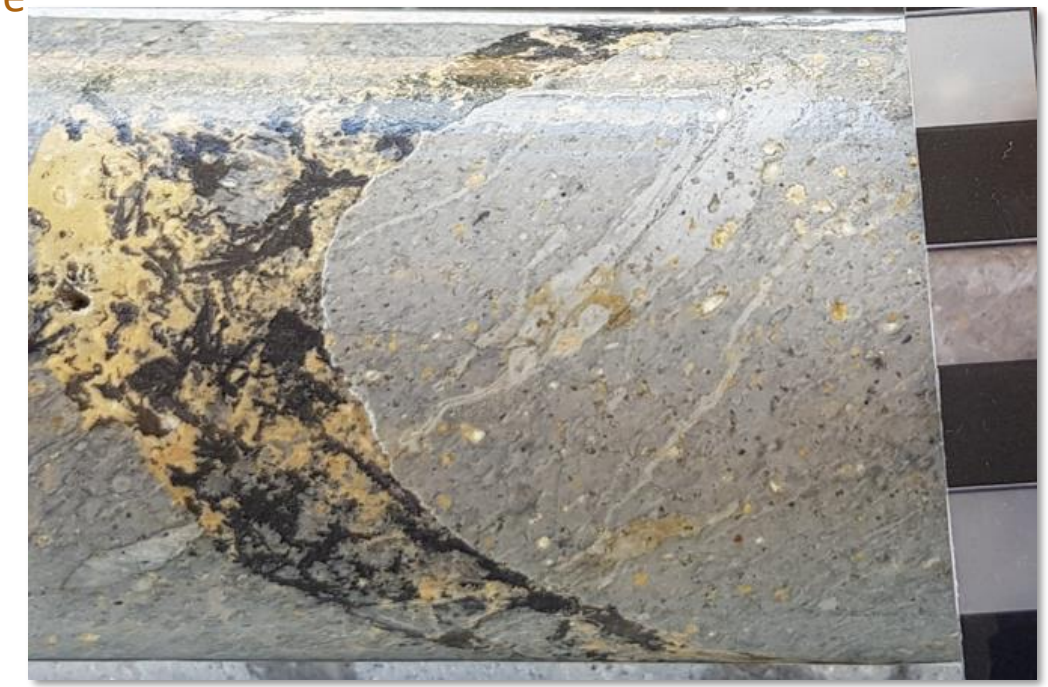


Main and Aegean Zones

- Main Zone is silver-lead-zinc ore to be mined initially.

- Highest grade zone of silver at Bowdens:
  - 34.6m @ 471g/t AgEq incl 7.0m @ 1090g/t AgEq.
  - 6.1m @ 874g/t AgEq

- Aegean Zone is high-grade silver only mineralisation below Main Zone characterised by discrete fracture fill and veinlet style veins.



- Silica-siderite-pyrite alteration. Mineralisation pearcite-polybasite.

- Intercepts include:
  - 8.0m @ 543g/t Ag
  - 4.0m @ 979g/t Ag
  - 2.0m @ 1421g/t AgEq
  - 6.0m @ 382g/t AgEq

- Both Main and Aegean Zones are devoid of gold.

Northwest Zone

- Characterised by veins and breccias of galena – sphalerite – acanthite ± chalcopyrite.
- Polyphasal, colloform banded carbonate – silica – sulphide veins and veinlets are common.
- Intercepts include:
  - 10.1m @ 460g/t AgEq
  - 8.0m @ 555g/t AgEq
  - 4.0m @ 1007g/t AgEq
- Gold present in the centre of the Zone coincident with copper and up to 5.41g/t.

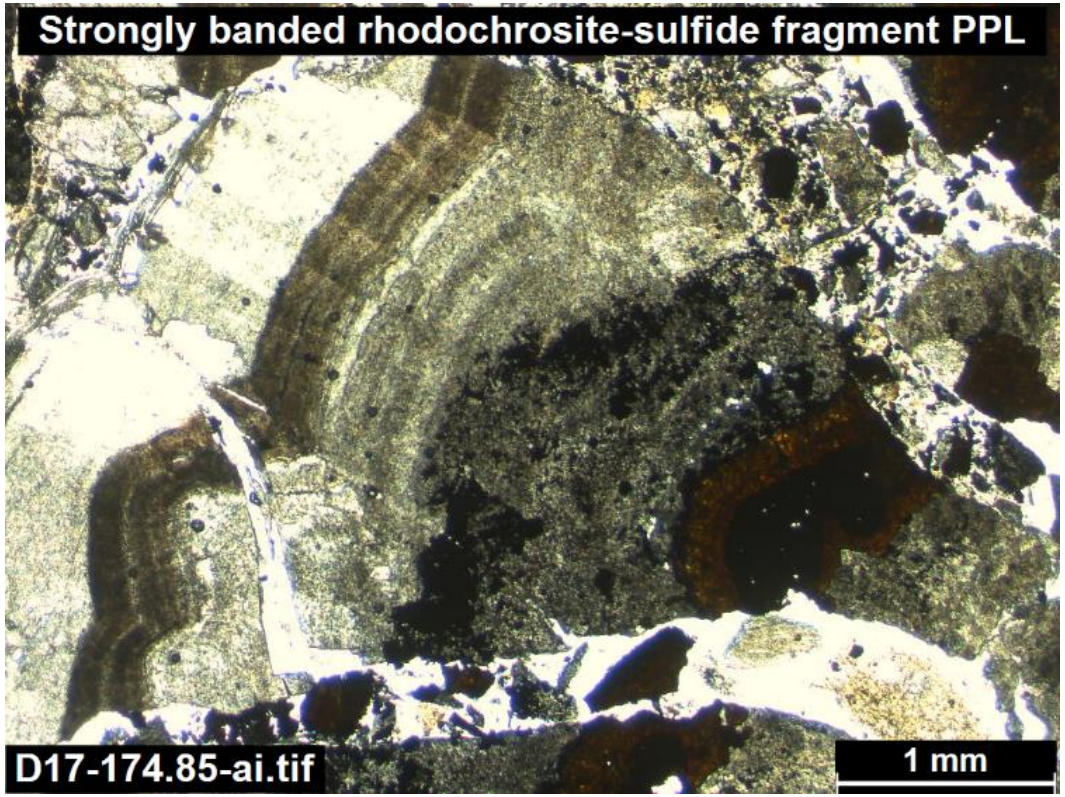
Bundarra Zone

- Highest temperature component of the Bowdens System characterised by stacked lenses to at least 600 metres depth.
- Characterised by semi – massive, stinger, quartz – carbonate sulphide and fracture filling vein styles.
- Sphalerite – pyrite – galena ± chalcopyrite and gold.
- Dacite acting as a fluid trap as semi massive sulphide veins forming at the contact.
- Intercepts include:
  - 14.2m @ 374g/t AgEq (36g/t Ag, 4.86% Zn, 2.35% Pb & 0.23g/t Au) *incl*
    - 4.6m @ 694g/t AgEq (72g/t Ag, 8.76% Zn, 4.40% Pb & 0.49g/t Au)
  - 2.4m @ 1520g/t AgEq (269g/t Ag, 15.80% Zn, 10.33% Pb, 0.78% Cu & 0.42g/t Au)
  - 18.25m @ 313g/t AgEq (31g/t Ag, 4.60% Zn, 3.0% Pb & 0.52g/t Au)
- Chalcopyrite and gold increasing with depth.

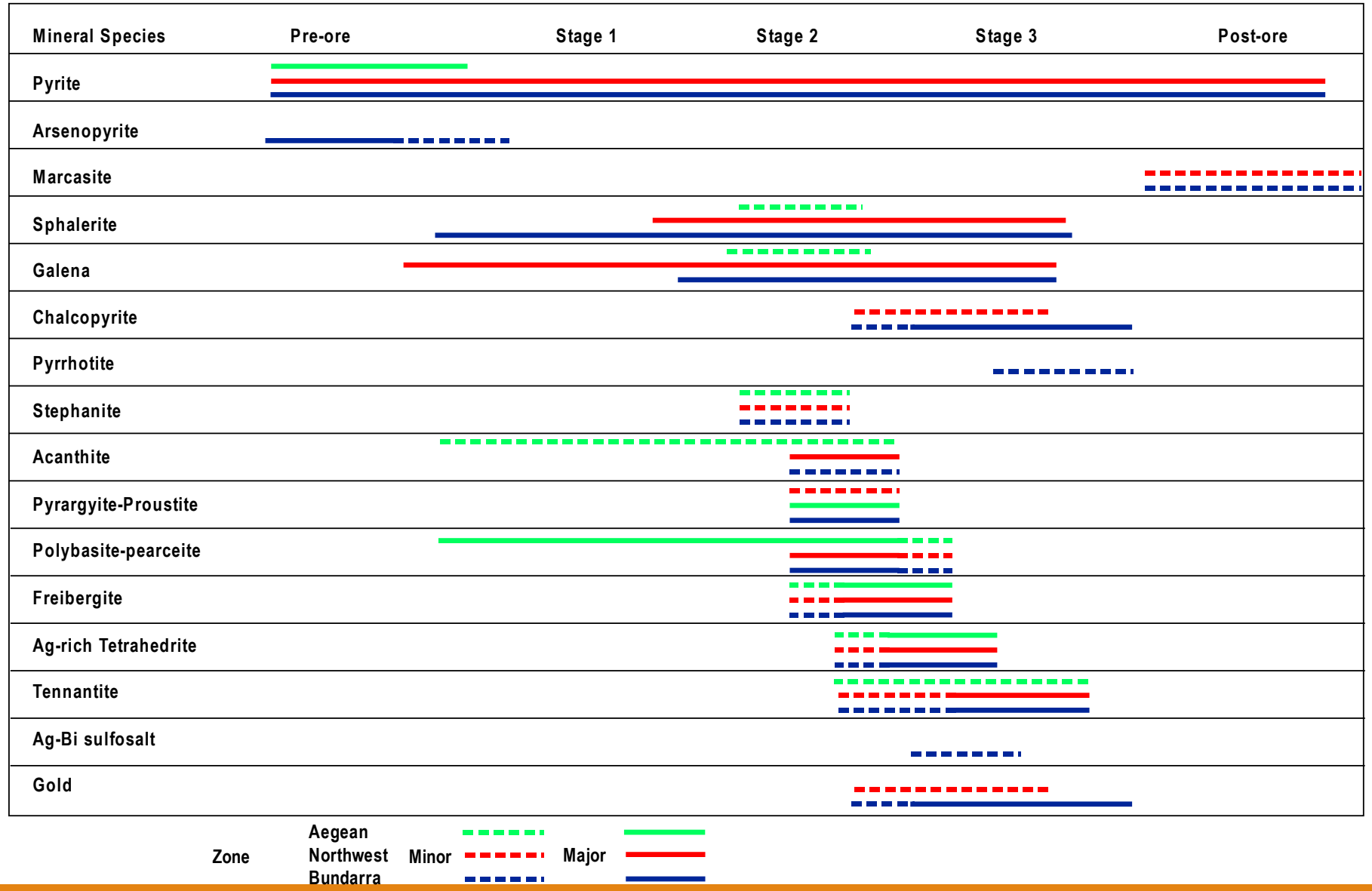
Alteration

- Illite transitions to muscovite with depth in the Rylstone Volcanics through the ore zone.
- Adularia increases with depth also.
- Quartz occurs throughout the deposit often early with pyrite.
- Actinolite-tremolite in the Coomber Formation.
- A wide range of Carbonate species throughout the deposit, currently interpreting their carbon and oxygen isotopes to determine their various origins (i.e. meteoric water, mixing, hydrothermal waters).

- Ankerite $Ca(Fe, Mg, Mn)(CO_3)_2$
- Calcite $CaCO_3$
- Dolomite $CaMg(CO_3)_2$
- Kutnohorite $Ca(Mn, Mg, Fe)(CO_3)_2$
- Magnesite $MgCO_3$
- Rhodochrosite $MnCO_3$
- Siderite $FeCO_3$



Ore Paragenesis



Research & Development: Machine Learning

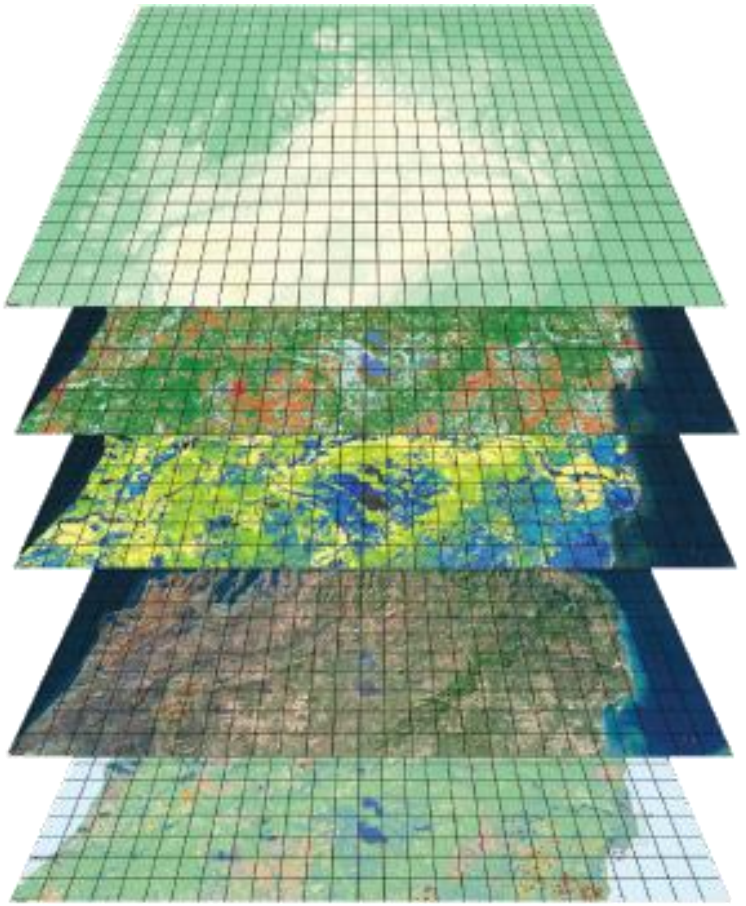
- 2016/17 – Project Titled:

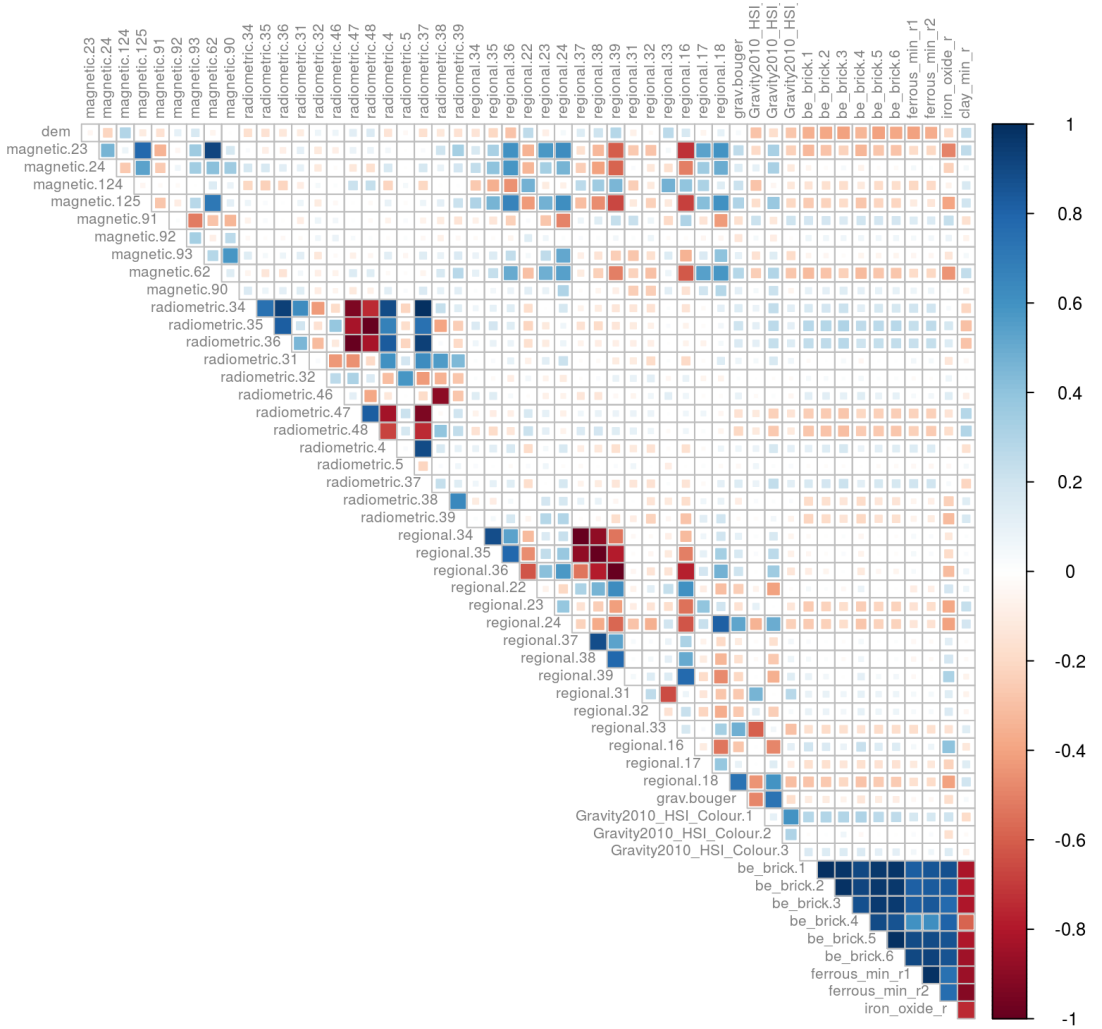
  Advanced Research into “Integrated Technique”: *characterizing and mapping the Permian Volcanics, controlling basement structures and metallogenesis using an integration of geophysical and chemical characterisation and placing into the context of the Permian of Eastern Australia.*

- Project finalised in 2021.
- Significant contribution to the project by Blake Bentley from University of Technology Sydney.

- Work involved the use of classical geochemical techniques applied to predicted outputs.
- Objective characterisation.

How much data, and which to predict what?



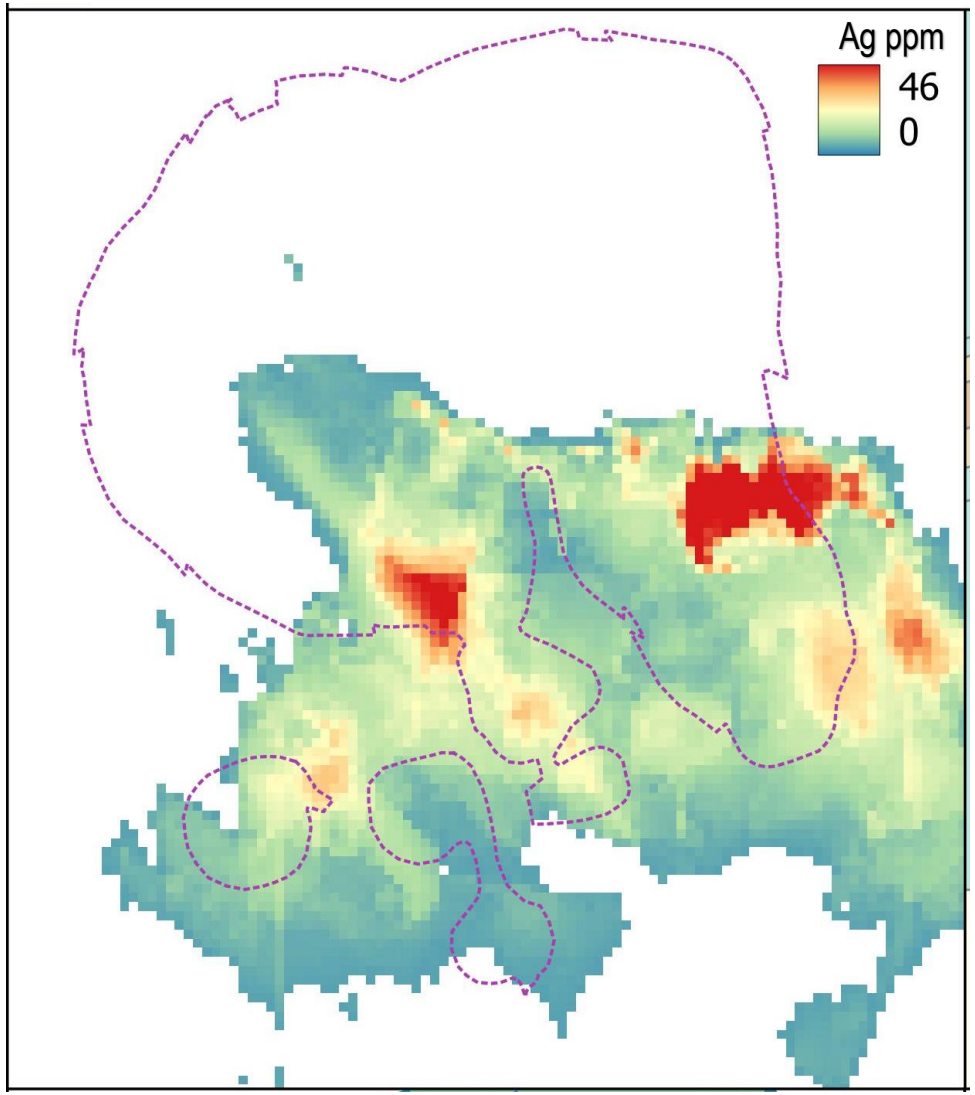


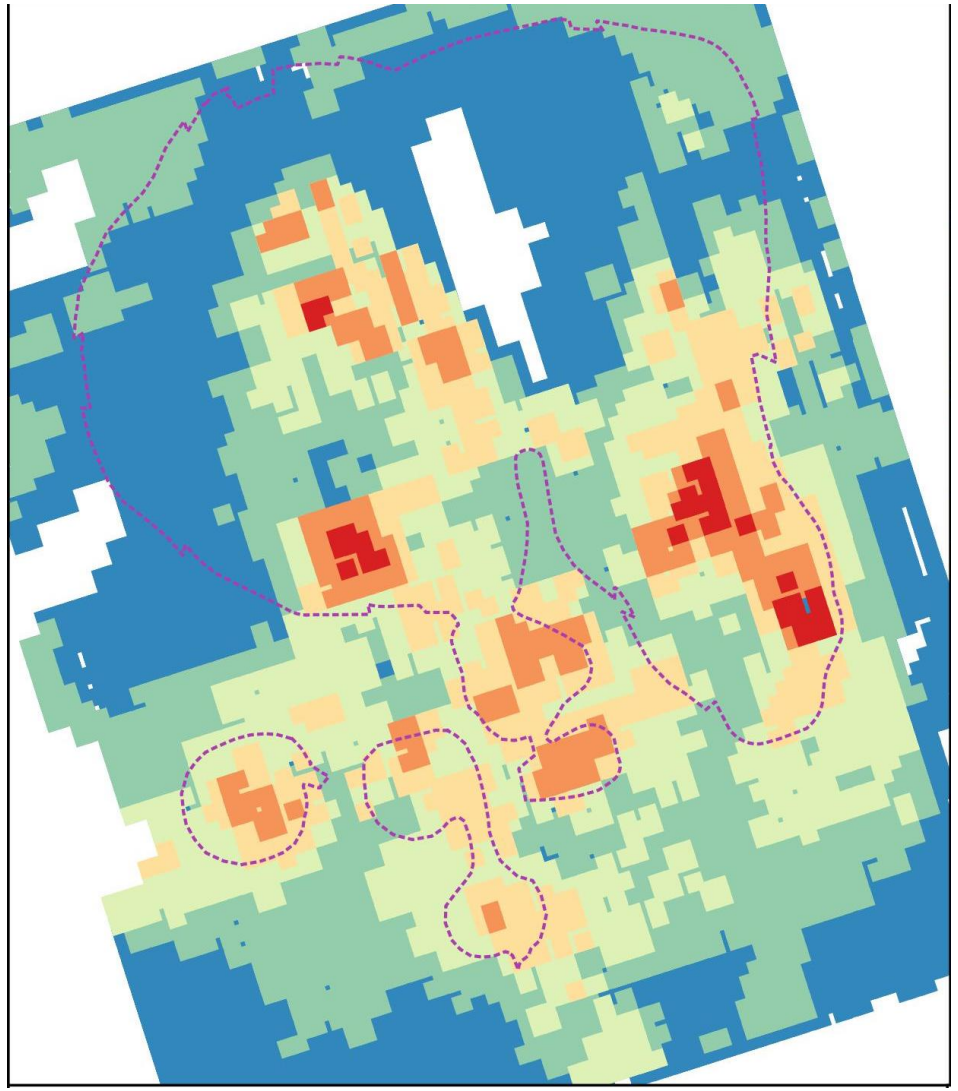
Soils and weathering well suited to ML prediction

Regionally shallow soil profile development

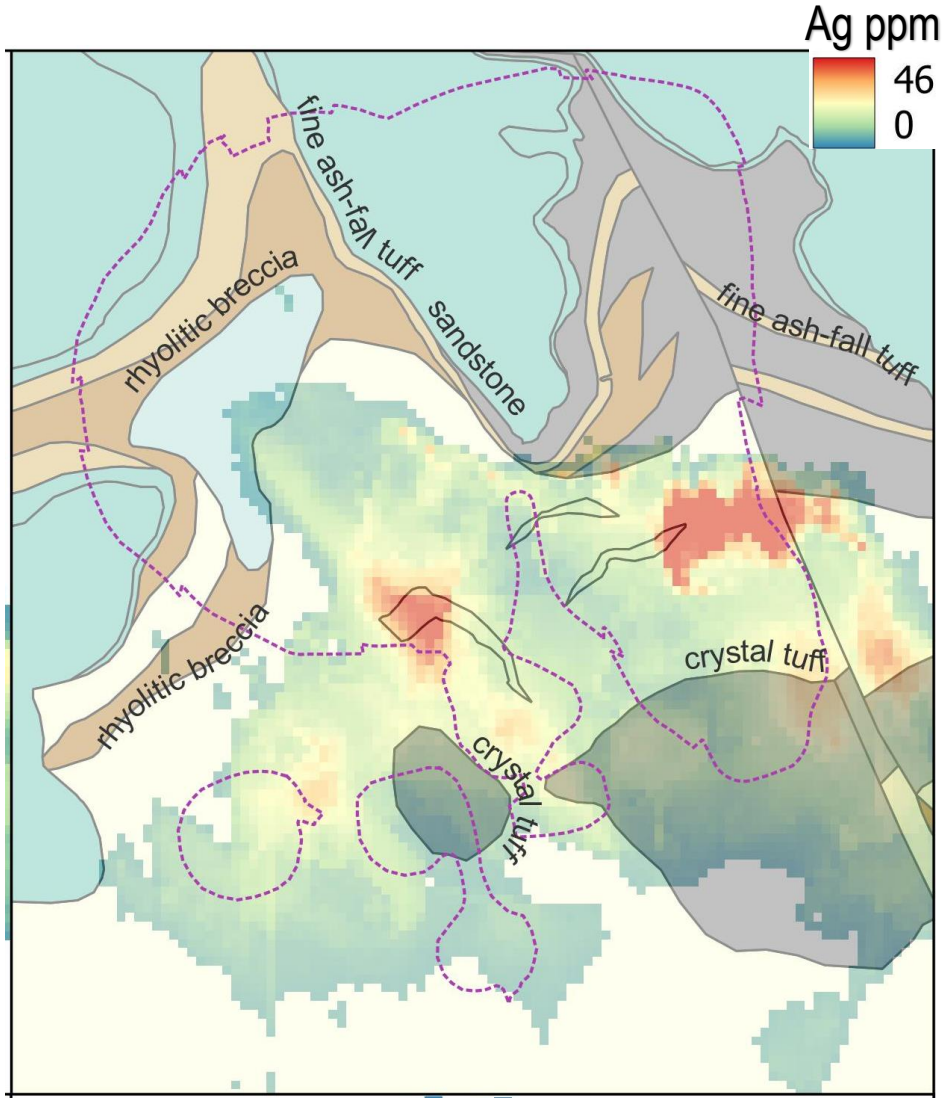
Deposit oxidation from 0 to 8m

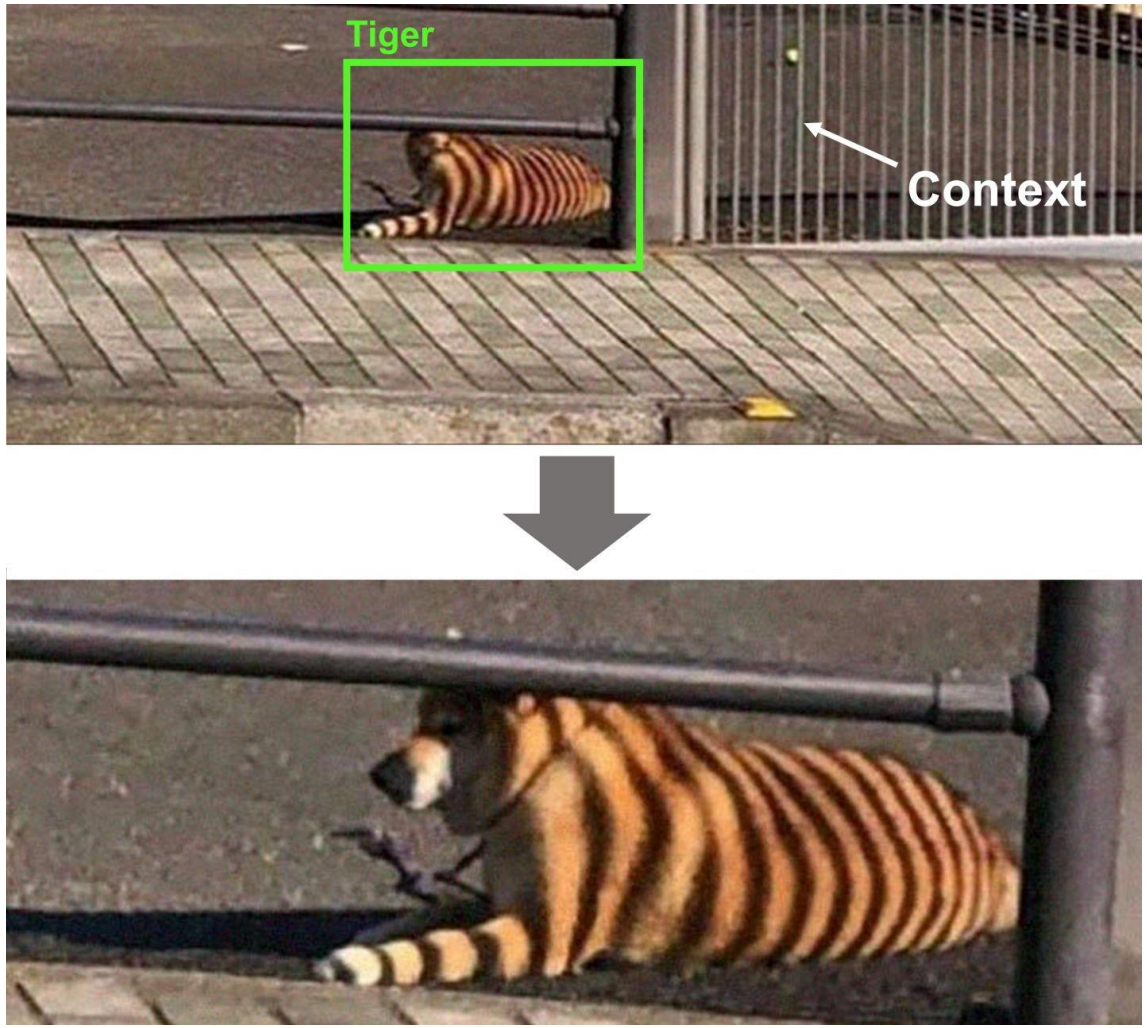
Predicted Silver from ML Vs Surface blocks of MIK estimate



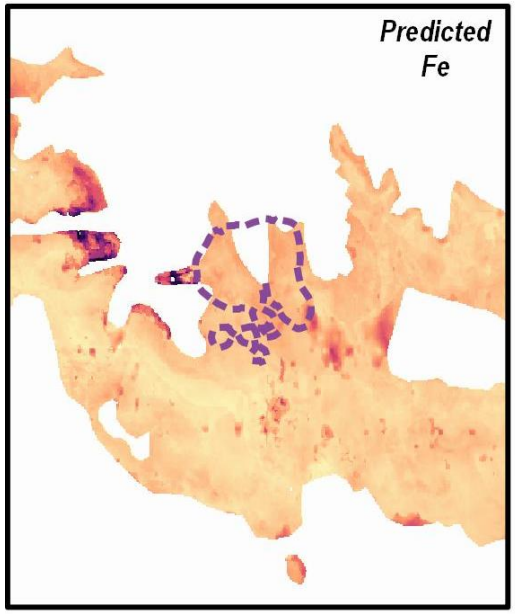


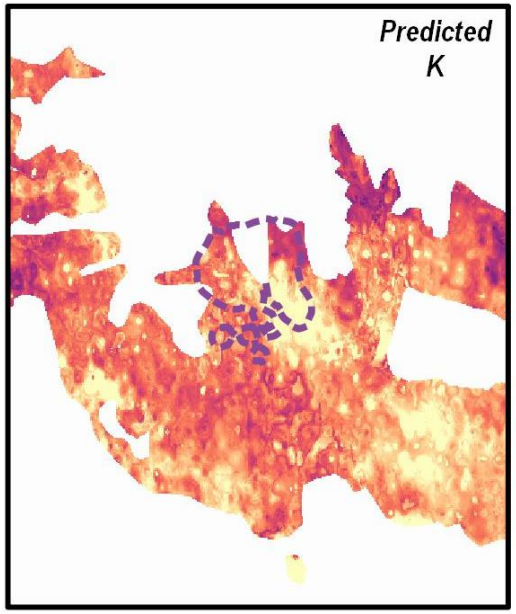
ML at small scales but context matters

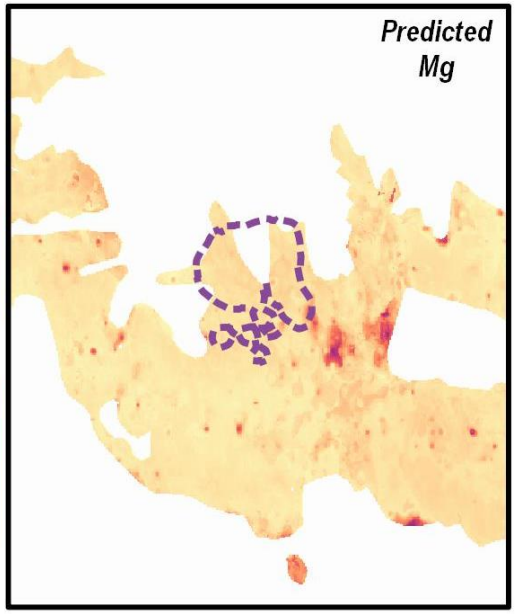


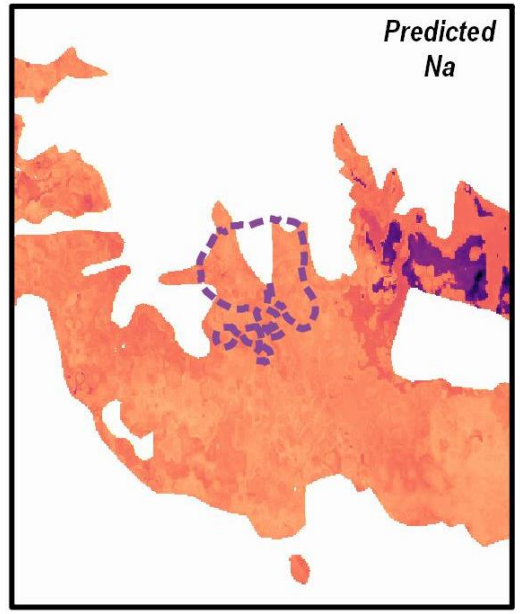


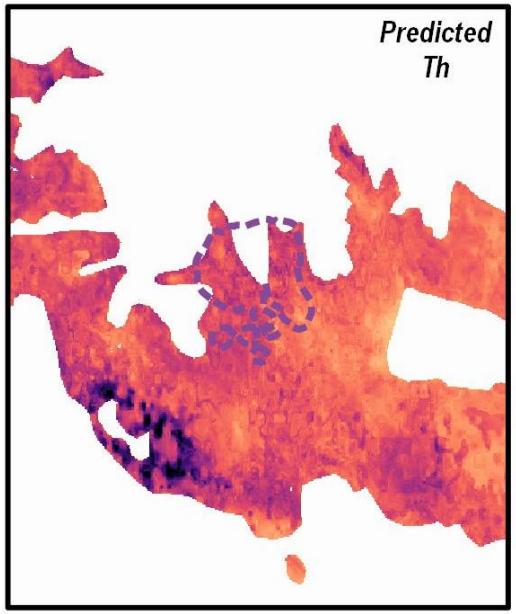
Predictions masked to mapped Rylstone (majors)

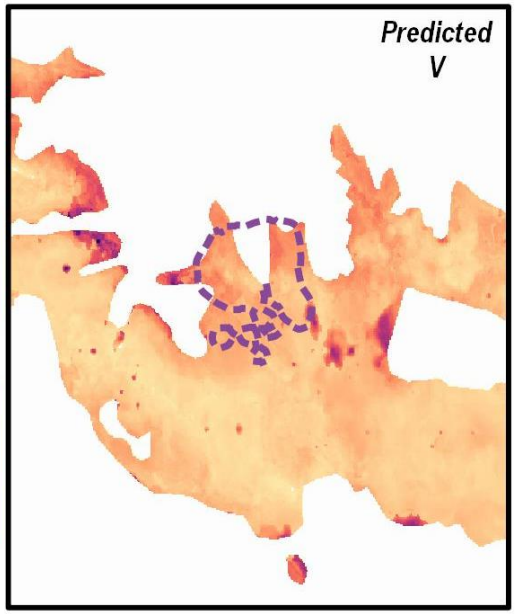


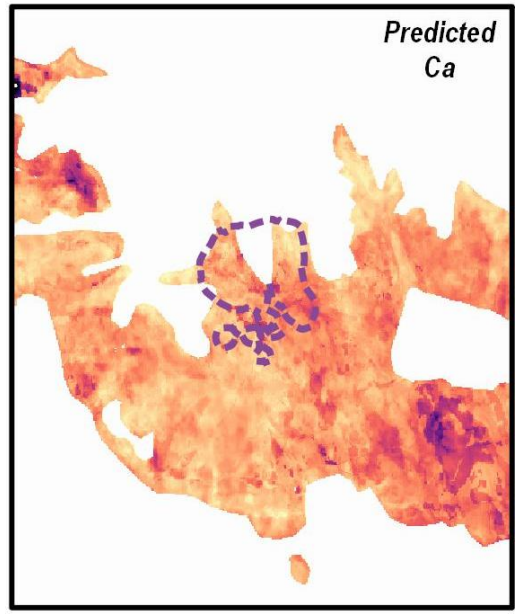






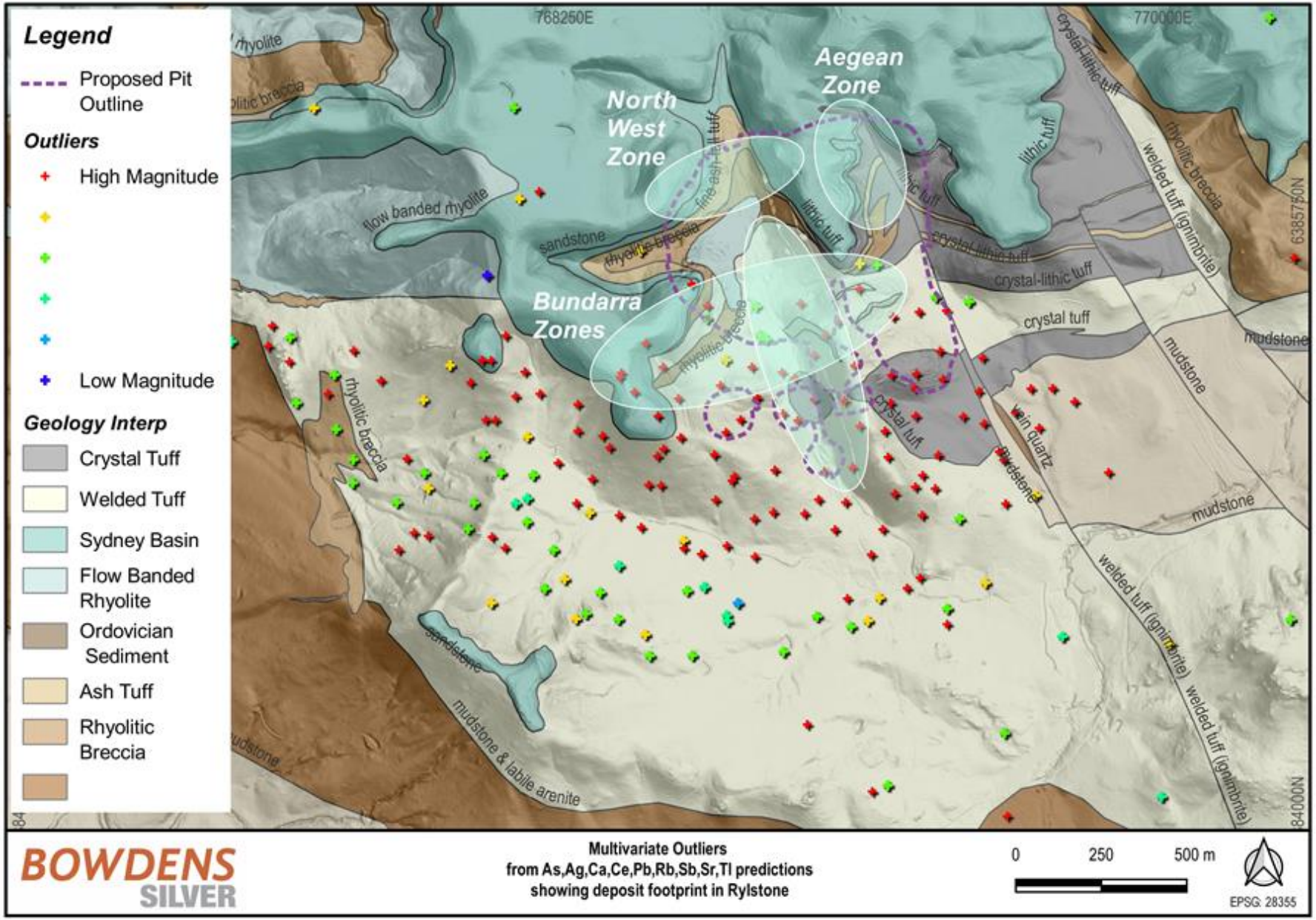




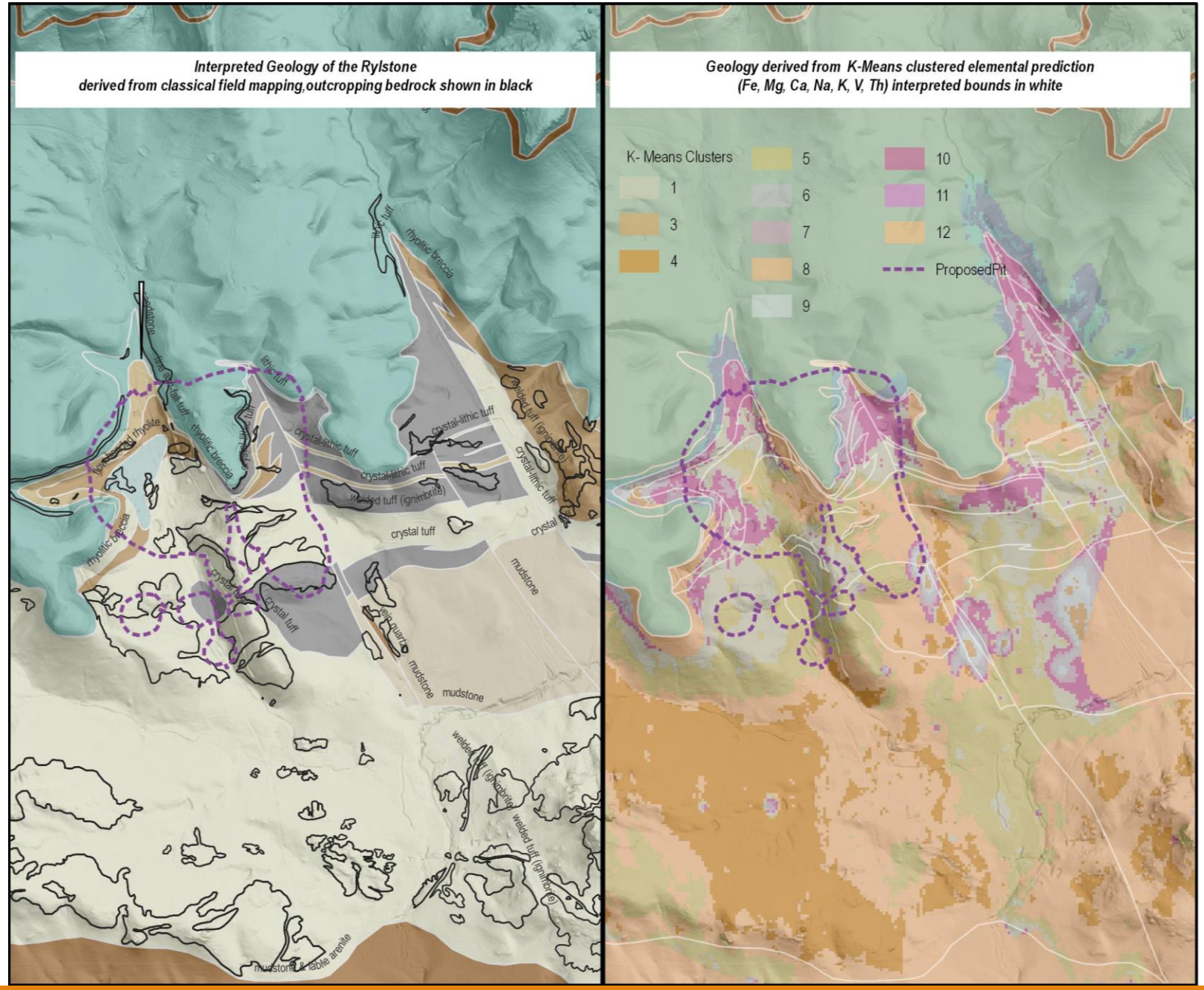


Predicted multivariate

Anomaly generation



Predict Geology in an unsupervised manner



Thank You.