

WAGGA TANK/SOUTHERN NIGHTS AND MALLEE BULL, EVOLVING STORIES

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ACKNOWLEDGEMENTS

Past exploration geos too numerous to name

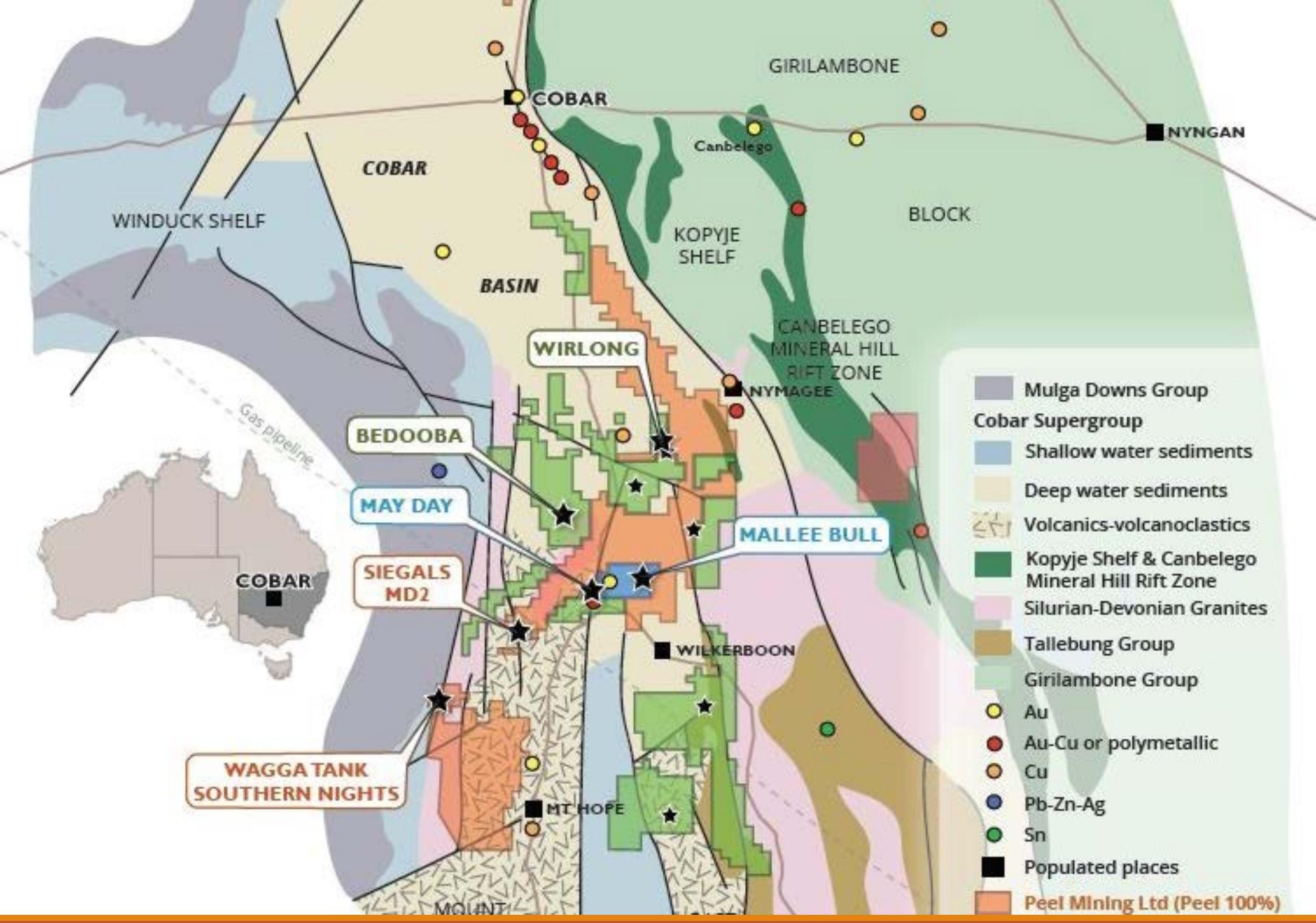
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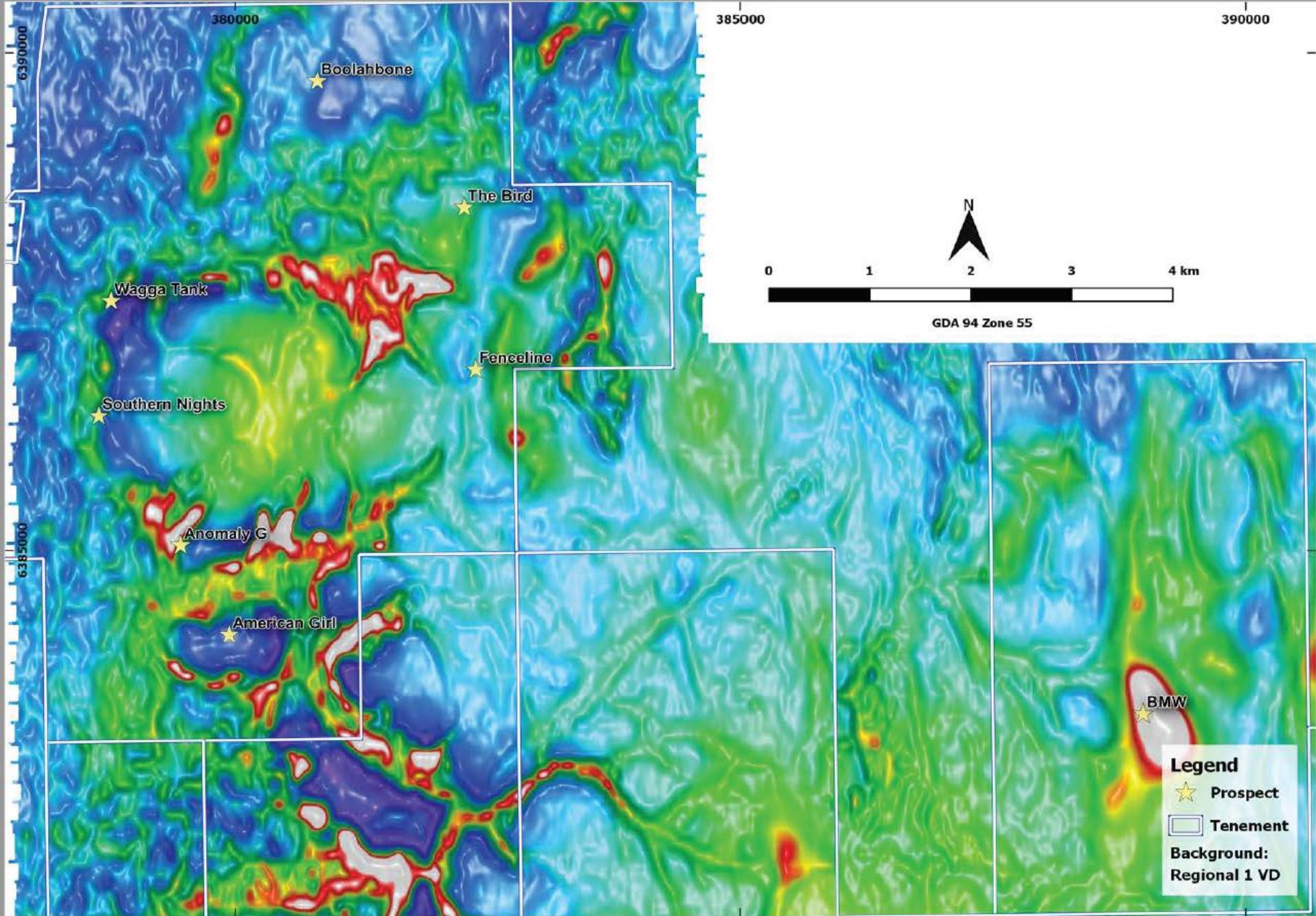




Wagga Tank discovery site (1968)



Volcaniclastic breccia, Wagga Tank Prospect



WTRCDD150 October 2018

18.2 m 40.3% Zn, 15.7% Pb, 0.97% Cu, 356 g/t Ag, 2.77 g/t Au
from 182m



MINERAL RESOURCE ESTIMATE

30/6/2019

Indicated + Inferred: 3.8Mt 5.5% Zn, 2.1% Pb, 0.27% Cu, 75 g/t Ag, 0.31 g/t Au

Including: 0.29 Mt 21.4% Zn, 9.1% Pb, 0.28% Cu, 215 g/t Ag, 0.57 g/t Au

STRATIGRAPHY

Formal units	Informal units	Lithology
Upper Amphitheatre Group / Mt Kennan Volcanics	Wagga Tank Fmn	Turbidite facies shale and siltstone.
	Vivigani Fmn	Coarse polymict volcaniclastic sandstone and breccia, mass debris flow breccia, minor shale/siltstone, possible peperites. Top contact often transitional.
Lower Amphitheatre Group	Eastern Fmn	Turbidite facies shale and siltstone. Top contact sharp.

STRUCTURE

Steep (70-80°) west dipping sequence

Generally upright but locally overturned

Flanks domal antiform to east, cored by Mt Kennan Volcanics and Boolahbone Granite

Very low metamorphic grade

Shearing at contacts

Cross-cutting faults



Eastern Formation turbidites

→ ↓ 297

WTRC00150
HD: 297.0
D: 3-1
Q: 3-1
ori: ✓
→

297

↑ 297.0 ↑

↓ 298

298

WTRC00150

T 43

299 ↓

299

↓ 300.1 ↓ ↓ 300

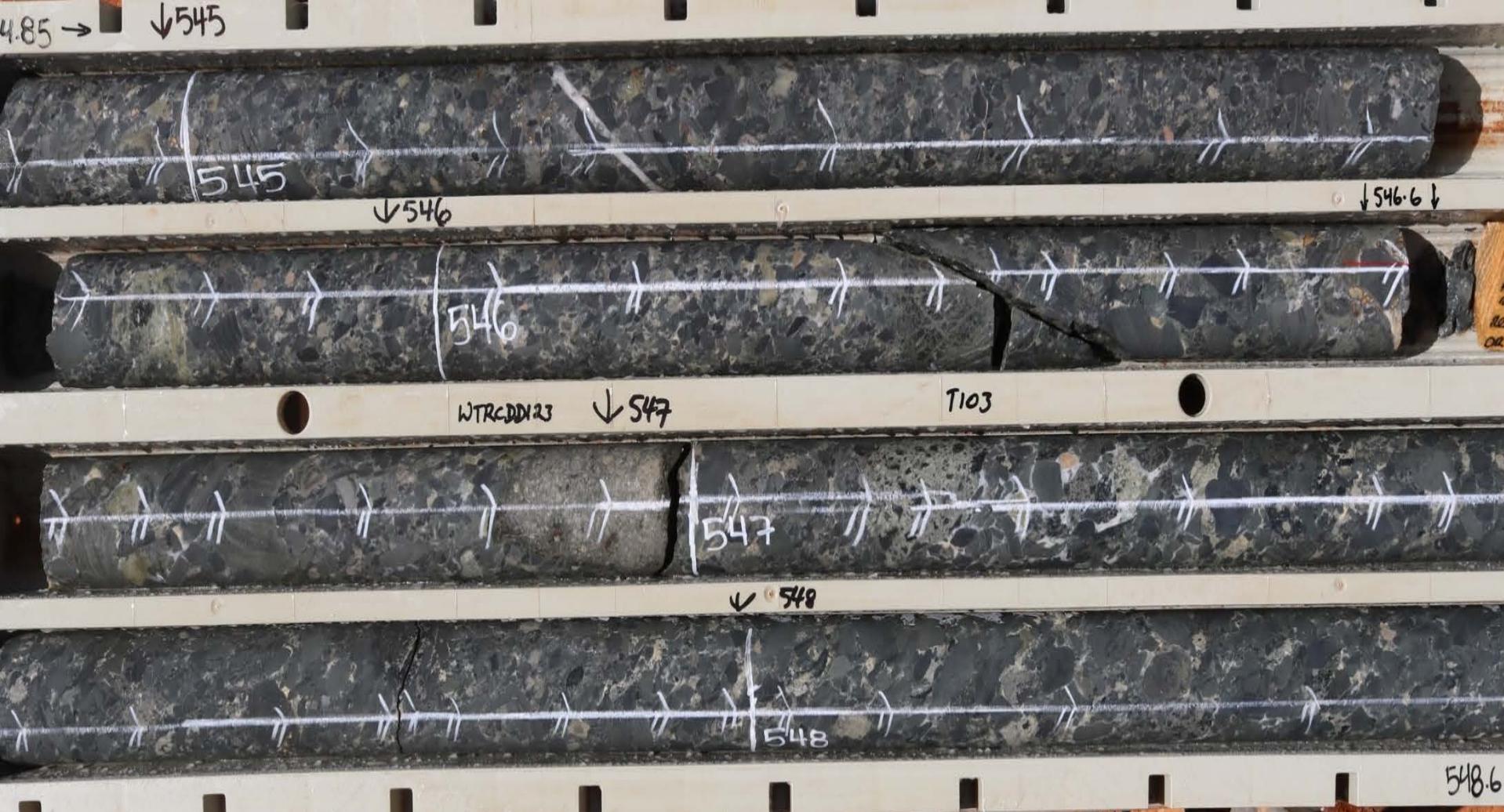
MD: 300.1
B: 3-1
R: 3-1
ori: X
→

300

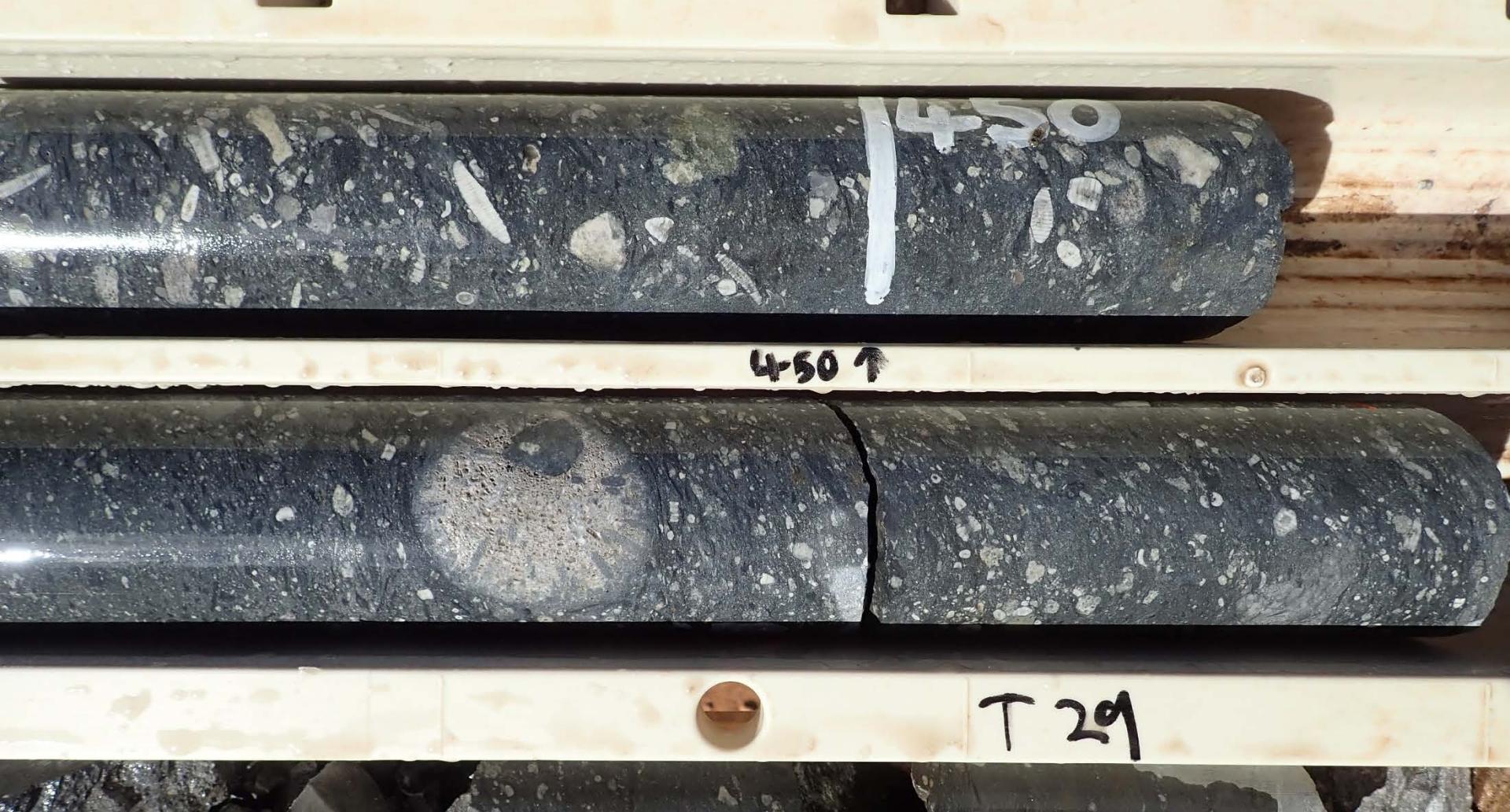
300.15

Vivigani Formation volcaniclastic sandstone

4.85 → ↓545



Vivigani Formation polymict volcaniclastic breccia



Vivigani Formation polymict breccia with abundant fossil clasts,
hole WTRCDD141W1

Porphyritic rhyolite/dacite – in situ or allochthonous?

NTRC00122
HD - 531.5 m
RON - 3.0 m
REC - 3.0 m
021 - ✓

↑ 531.5 ↑

Vivigani Formation possible peperite breccia

8-7

↓279

279

↓280

280

WTRCOD153

T42



281

↓281-3L

WTROD 153
HD: 281-5
D: 3-0
R: 3-0
D: 7

↑281

282

↑282

282.1

Wagga Tank Formation turbidites

ALTERATION



WT RCDD-048: 329-337 m

Eastern Formation: Silica, calcite and ?scapolite alteration

WTRCD0150
HD - 318.4
RUN - 3.0m
REC - 3.0m
ORI - ✓

↑ 318.4 ↑

WTRCD0 150

T49

321 ↑

WTRCD0150
HD - 321.4
RUN - 3.0m
REC - 3.0m
ORI - ✓

↑ 321.4 ↑

Vivigani Formation: Dark chlorite altered volcaniclastic sandstone

↓542

542

WTRCDD123

T102

WTRCDD123
HD - 543.6
RUN - 3.0 m
REC - 3.0 m
021 - ✓

↑ 543.6 ↑

Vivigani Formation: Patchy sericite/silica/pyrite alteration
overprinting chlorite altered volcaniclastic breccia



Texture destructive sericite/silica alteration
overprinting chlorite altered volcaniclastic breccia



Detail of texture destructive sericite/silica
alteration front from previous slide



Wagga Tank Formation: Pyrite +/- sericite +/- silica +/- calcite aggregates

OTHER ALTERATION MINERALS IN VIVIGANI FORMATION

Siderite

Calcite

Rhodochrosite

Adularia

Rutile

Fluorite

?Scapolite

MINERALISATION

MAJOR STYLES:

STRINGER VEIN SULPHIDES - ZONATION

MASSIVE/LAMINATED SULPHIDES

“COBAR STYLE” OR VHMS/VAMS?



Stringer chalcopyrite/pyrite/silica veining, lower Vivigani Formation, hole WTRCDD188: 442m.

266 ↓



↓ 267

↑ 267.4 ↓



↓ 267

WTRC00105

T25

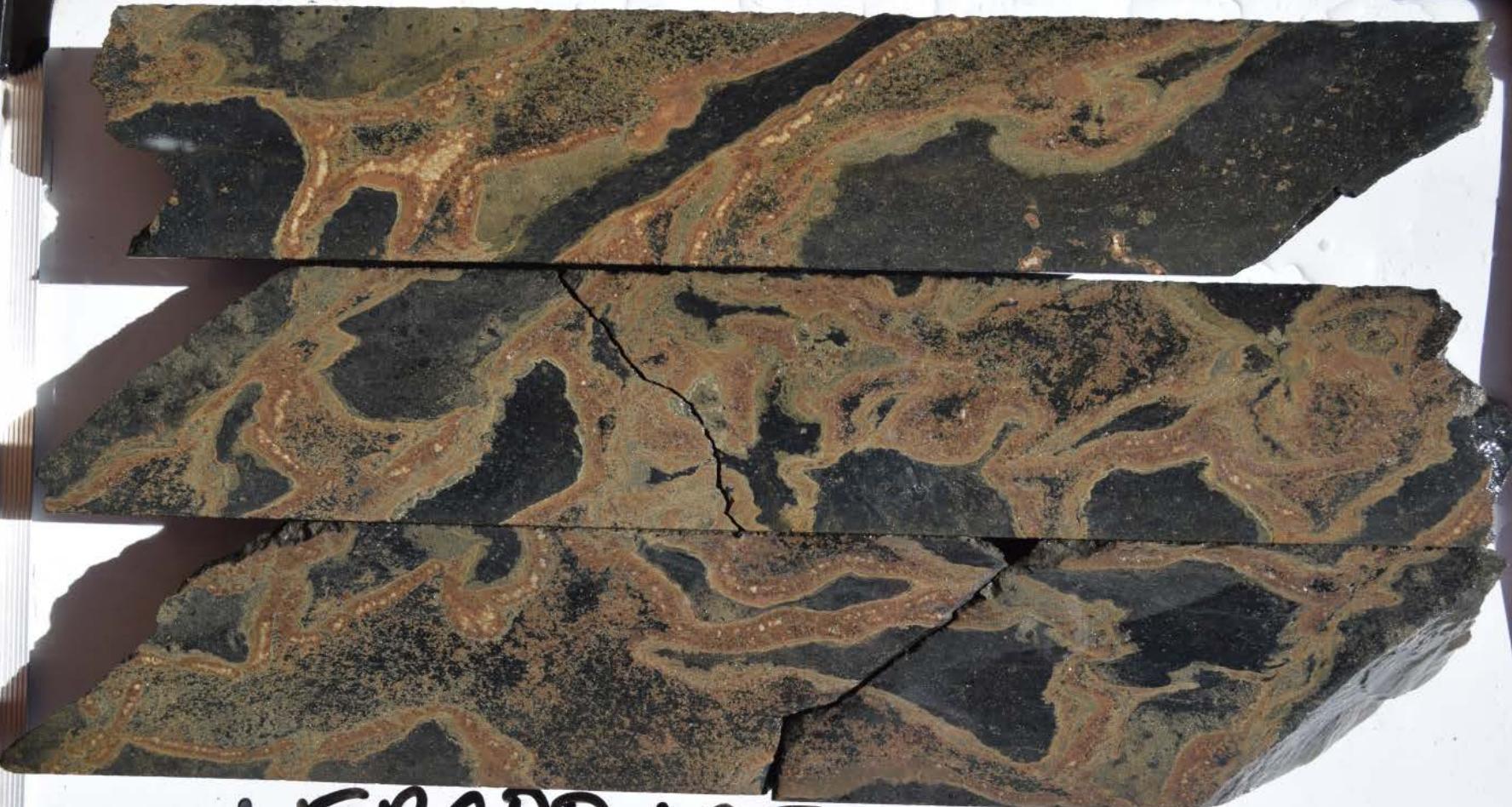


↑ 268

↓ 269



Sphalerite/pyrite stringer veining



WTRCDD105: 265-266

Sphalerite/pyrite stringer veining, hole WTRCDD105: 265m

T61

WTRCDD148

WTZDD148

HD: 353
D: 3.0
R: 3.0
O: ✓

Colloform silica/pyrite/sphalerite/galena veining in chlorite altered volcaniclastics

T185



T186

WTRCDD179

T12

186.8↑



↑187

↓188



WTRCDD168

T17

187

↑187



SG-17-10

T188

198.3

Stringer sphalerite/galena/pyrite veining, top Vivigani/base Wagga Tank Formation, holes WTRCDD179 & WTRCDD168



Laminated pyrite dominated sulphides in Vivigani Formation
shale, hole WTRCDD188W1: 515m

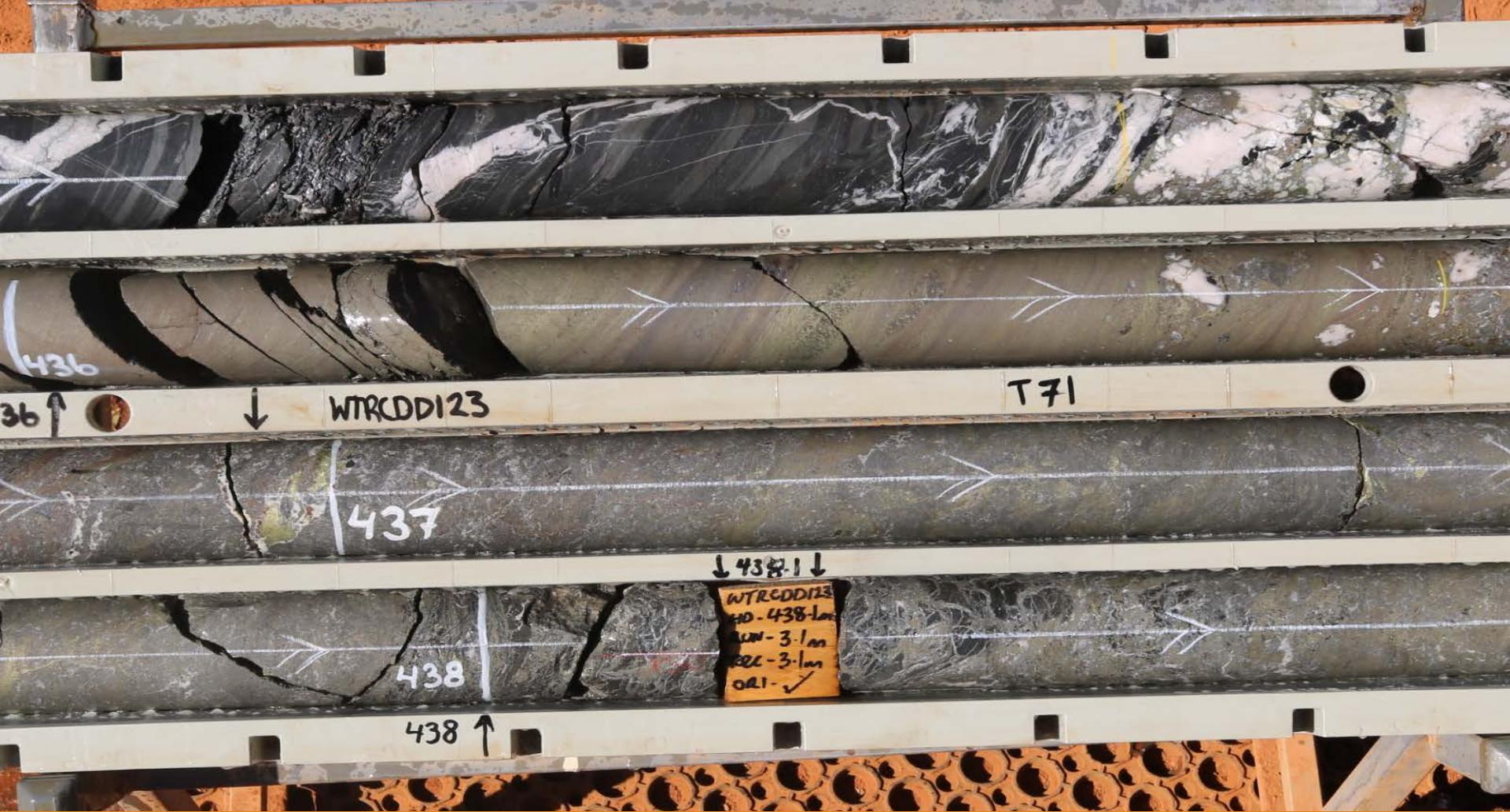


Laminated sphalerite/galena/pyrite, Vivigani/Wagga Tank contact, hole WTRCDD192:~358m

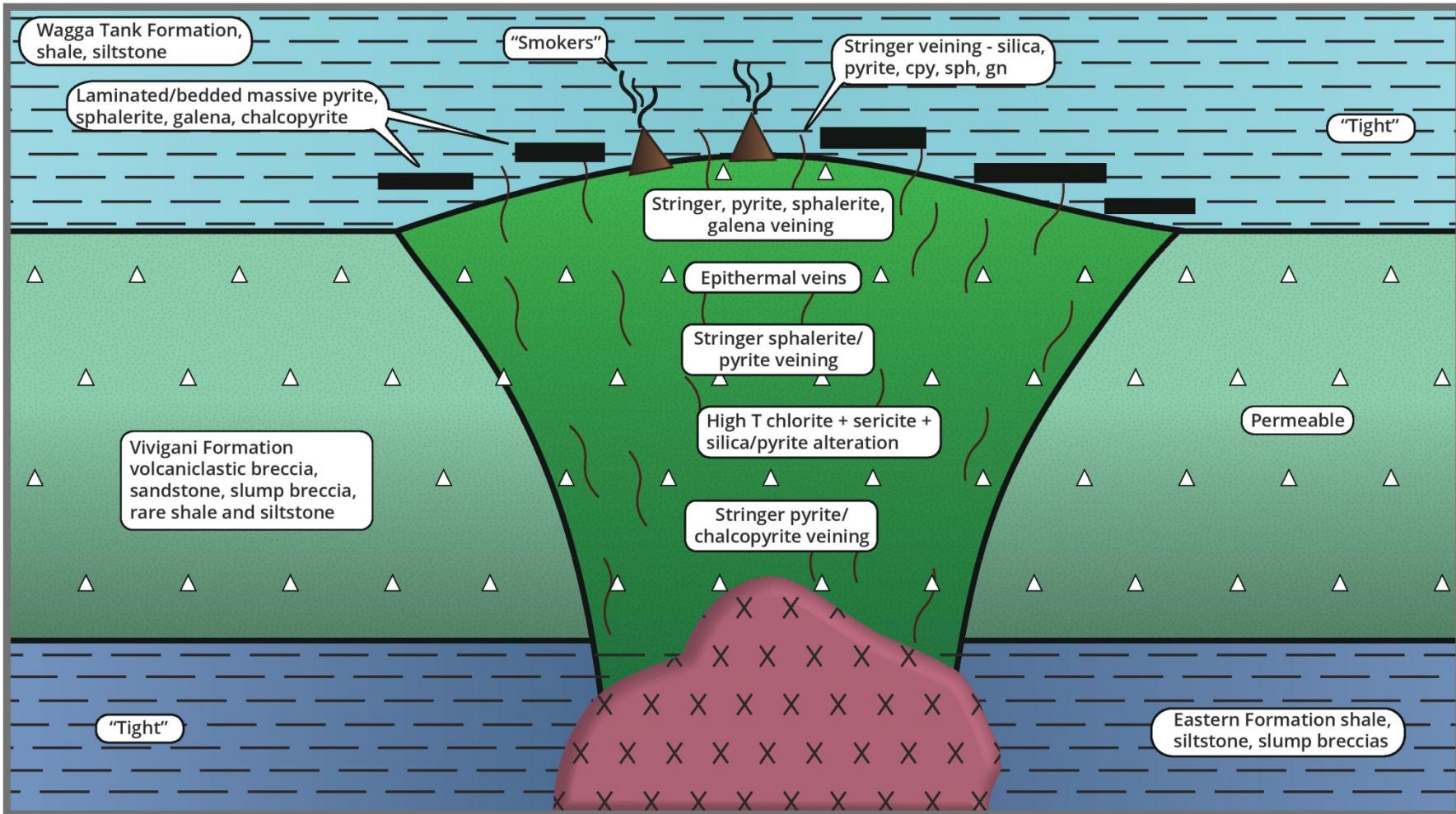
352-360m: 8m 19.23% Zn, 11.11% Pb, 1.36% Cu, 307 g/t Ag, 0.64 g/t Au



Very high grade laminated and brecciated massive sphalerite/galena/pyrite, basal Wagga Tank Formation



Laminated sphalerite/pyrite/galena overlying brecciated stringer veined zone hosted in dark shale, Wagga Tank Formation shale/siltstone at top



Wagga Tank Formation

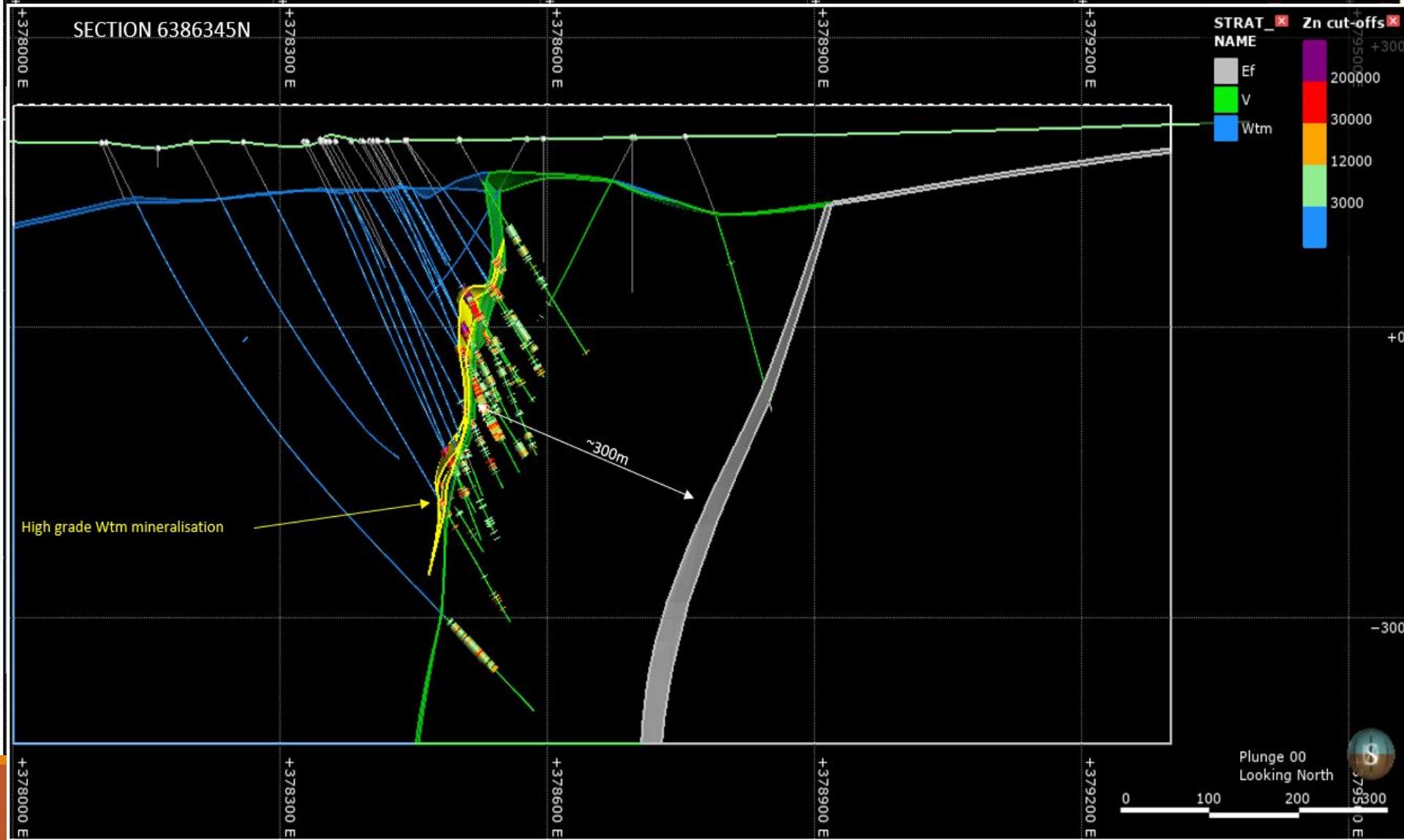
Eastern Formation

Laminated/bedded massive sulphides

Vivigani Formation

Vivigani Formation, alteration + mineralisation

Rhyolitic-Dacitic intrusive



Section 6386345N, view North

Rosebery/Mt Read Volcanics VHMS/VAMS comparison

What next?

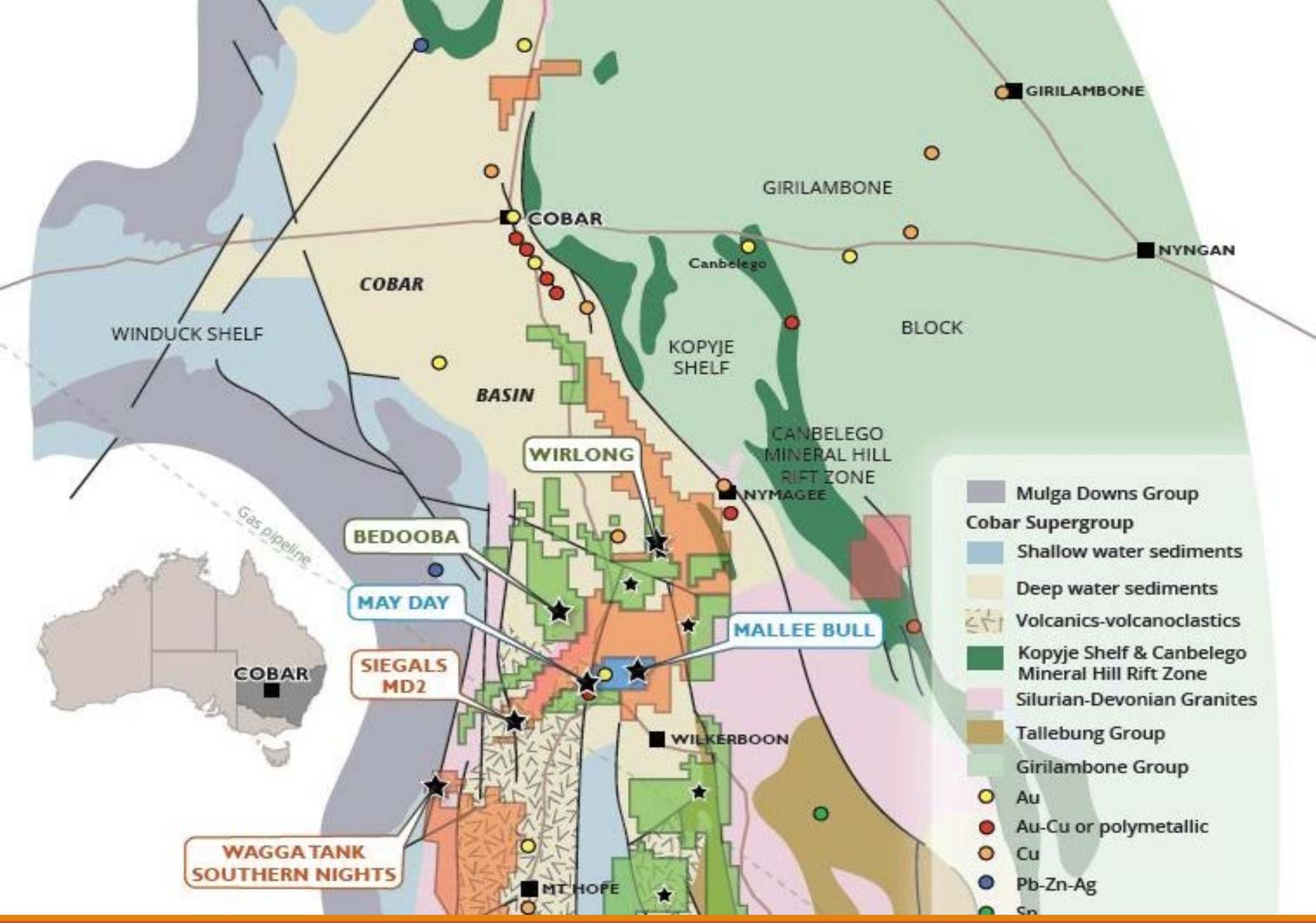
MALLEE BULL

Discovered by Peel in 2011 drilling co-incident magnetic and EM anomalies

Mineral resource estimate 30/6/2018:

Indicated + inferred: 6.76 Mt 1.8% Cu, 31 g/t Ag, 0.4 g/t Au, 0.6% Zn, 0.6% Pb

Pyrrhotite/chalcopyrite and pyrite/sphalerite/galena lodes



STRATIGRAPHY

Formal units	Local informal units	Lithology
Upper Amphitheatre Group	Mallee Bull Formation	Shale, siltstone, fine sandstone, turbidite facies
	Upper Volcaniclastics	Volcaniclastic breccia and sandstone, mass flow slump breccias, slump blocks
	Keep It Dark Sandstone ("KID")	Fine to medium grained quartzose sandstone, very minor volcaniclastic sandstone and shale
	Lower Volcaniclastics	Volcaniclastic breccia and sandstone, mass flow slump breccias, slump blocks
Lower Amphitheatre Group	Shume Formation	Shale, siltstone, fine sandstone, turbidite facies

Tentative correlation Mallee Bull to Wagga Tank/Southern Nights

Formal units	Mallee Bull Informal	WT/SN Informal
Upper Amphitheatre Group / Mt Kennan Volcanics	Mallee Bull Fmn	Wagga Tank Fmn
	Upper Volcaniclastics	Vivigani Fmn
	Keep It Dark Sandstone	
	Lower Volcaniclastics	
Lower Amphitheatre Group / Shume Fmn	Shume Fmn	Eastern Fmn

STRUCTURE

Northwest limb of SSW plunging anticline

Steep (~70°) NW dipping sequence

Upright

Cross-cutting faults

Very low metamorphic grade



Shume Formation turbidites



MBDD 009W1 452.4m ↑

Lower Volcaniclastics polymict breccia



Keep It Dark Sandstone ("KID")

400

MISOCOOGWI T22

↓

Upper Volcaniclastics, silica-sericite altered polymict breccia

369-2

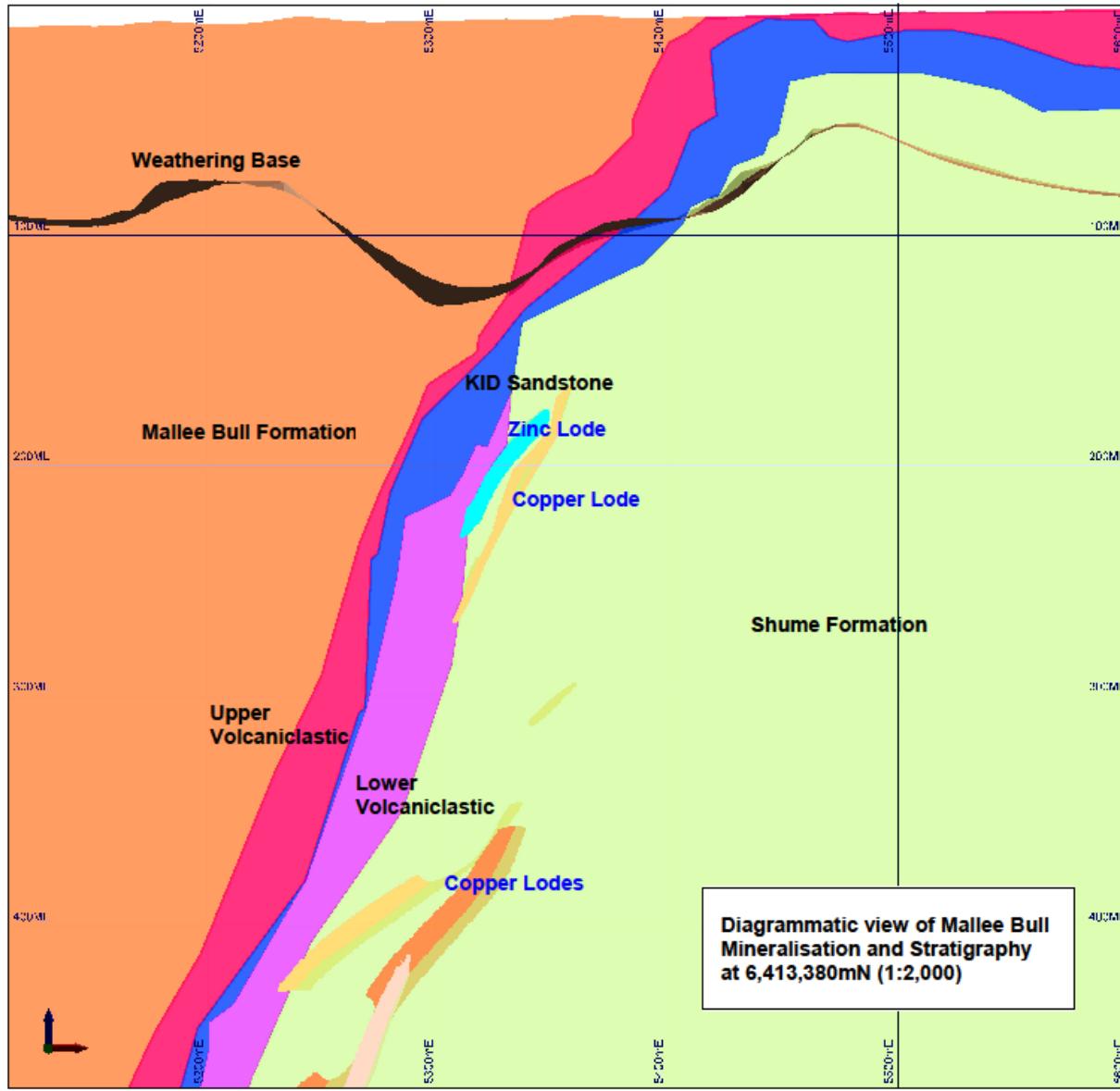


Mallee Bull Formation turbidites

ALTERATION

Local informal units	Lithology	Alteration (Chapman, 2012)
Mallee Bull Fmn	Shale, siltstone, fine sandstone, turbidite facies	Unaltered
Upper Volcaniclastics	Volcaniclastic breccia and sandstone, mass flow slump breccias, slump blocks	Common silica-sericite alteration
Keep It Dark Sandstone (“KID”)	Fine to medium grained quartzose sandstone, very minor volcaniclastic sandstone and shale	Weak silica and chlorite alteration
Lower Volcaniclastics	Volcaniclastic breccia and sandstone, mass flow slump breccias, slump blocks	Fe-chlorite/silica/albite at depth grading upwards to Mg-chlorite/silica-sericite
Shume Fmn	Shale, siltstone, fine sandstone, turbidite facies	

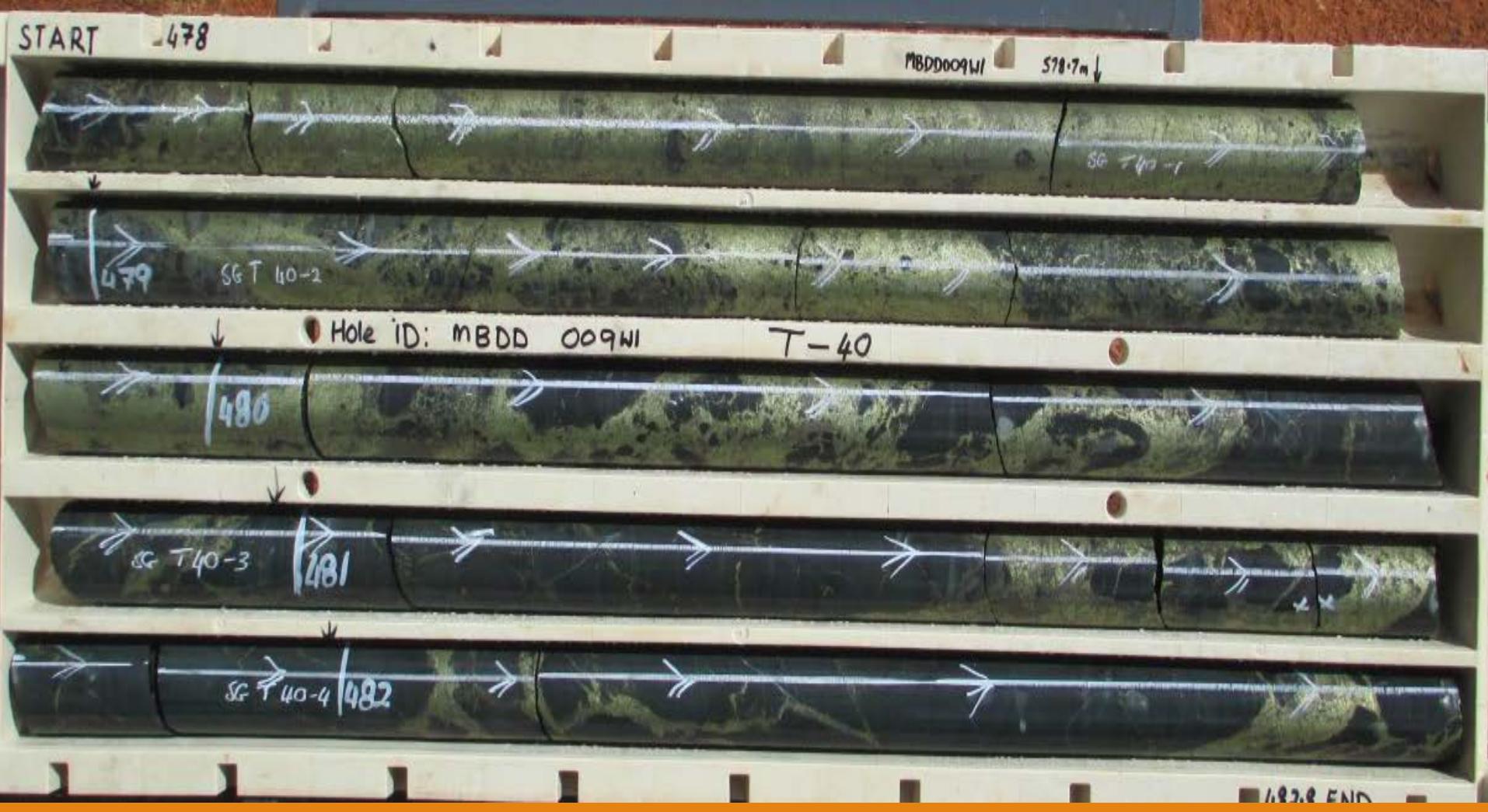
SULPHIDE MINERALISATION



Average intersections for Silver Ray Main Zn/Pb Lode and all copper lodes

Lode	Zn %	Pb %	Cu %	Ag ppm	Au ppm	As ppm	Bi ppm	Co ppm	Sb ppm
Silver Ray	19.4	11.9	0.3	281	1.44	8,711	0	44	819
All Cu/Po	0.2	0.4	4.3	55	0.54	2,380	188	198	696

CHALCOPYRITE/PYRRHOTITE LODES

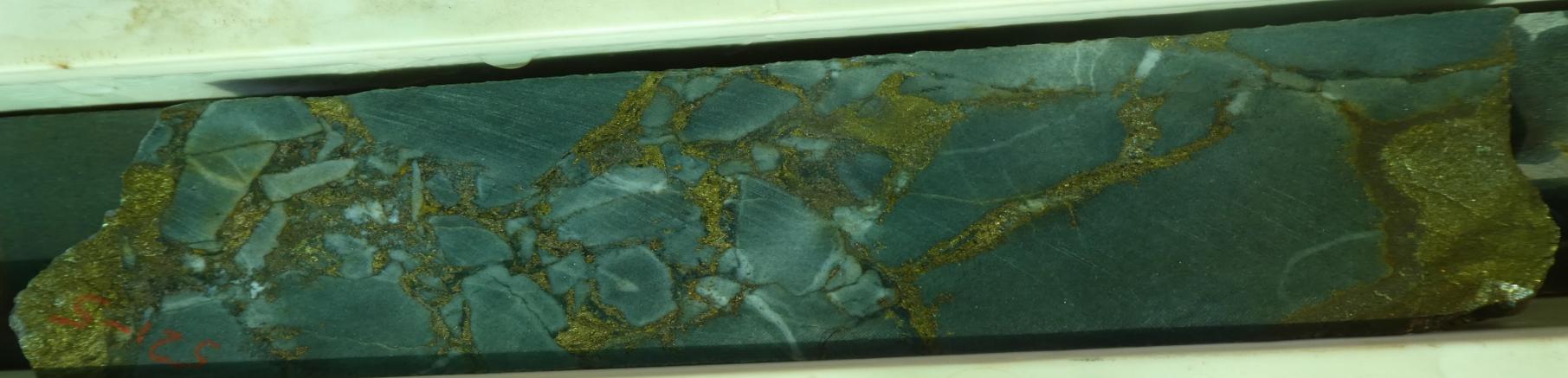


Chalcopyrite/pyrrhotite mineralisation in silica altered Shume Formation



Crackle brecciated silica altered Shume Formation shales,
pyrrhotite/chalcopyrite fracture fill, hole MBRCCDD110: ~272m

HD:519.8
DR:6.0
R: 6.0



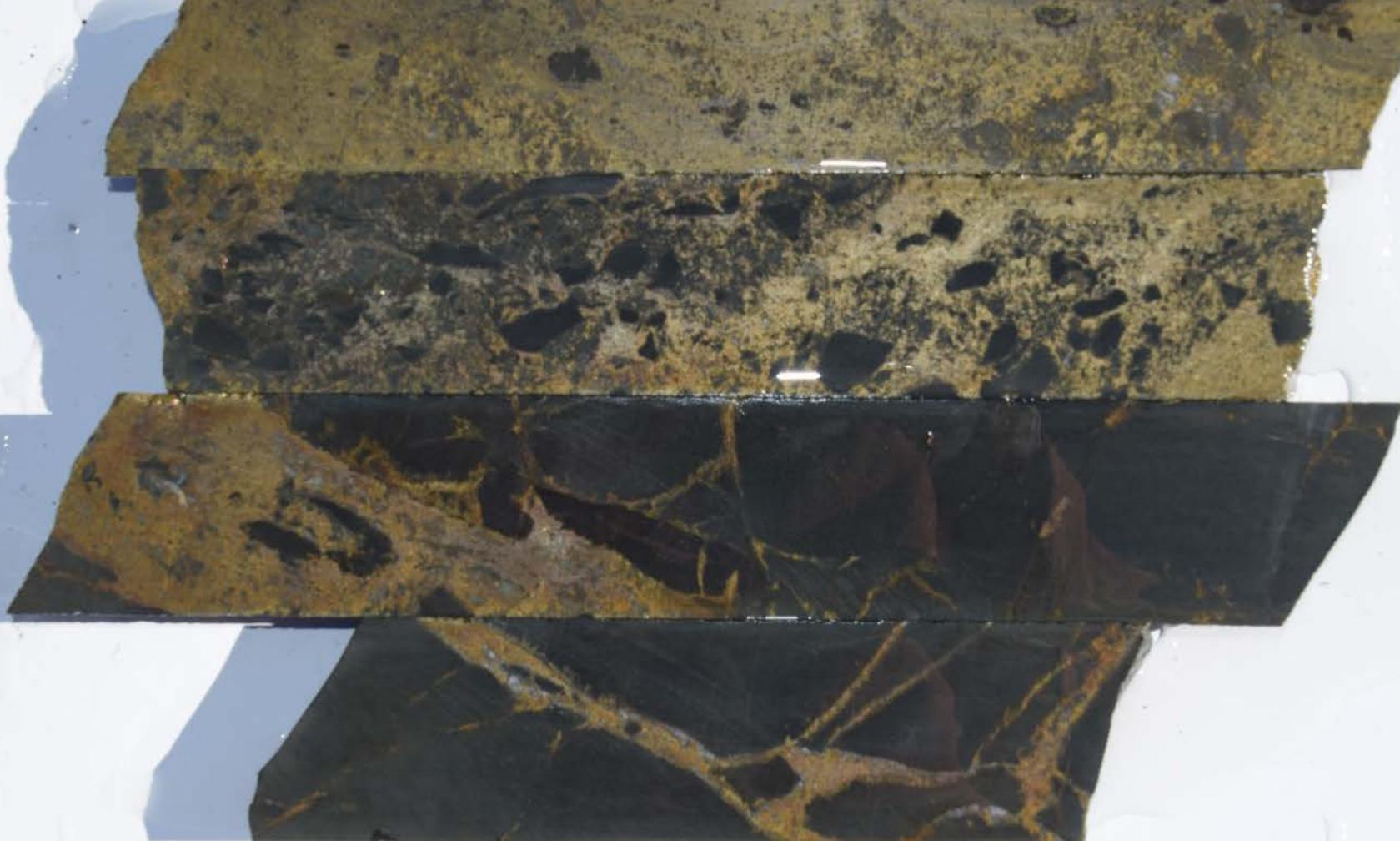
MBDD009 HI S21-bm

Mosaic breccia, chalcopyrite/pyrrhotite void fill



MBDD-002: 422 m

Chaotic breccia, silica altered shale fragments in
chalcopyrite/pyrrhotite matrix



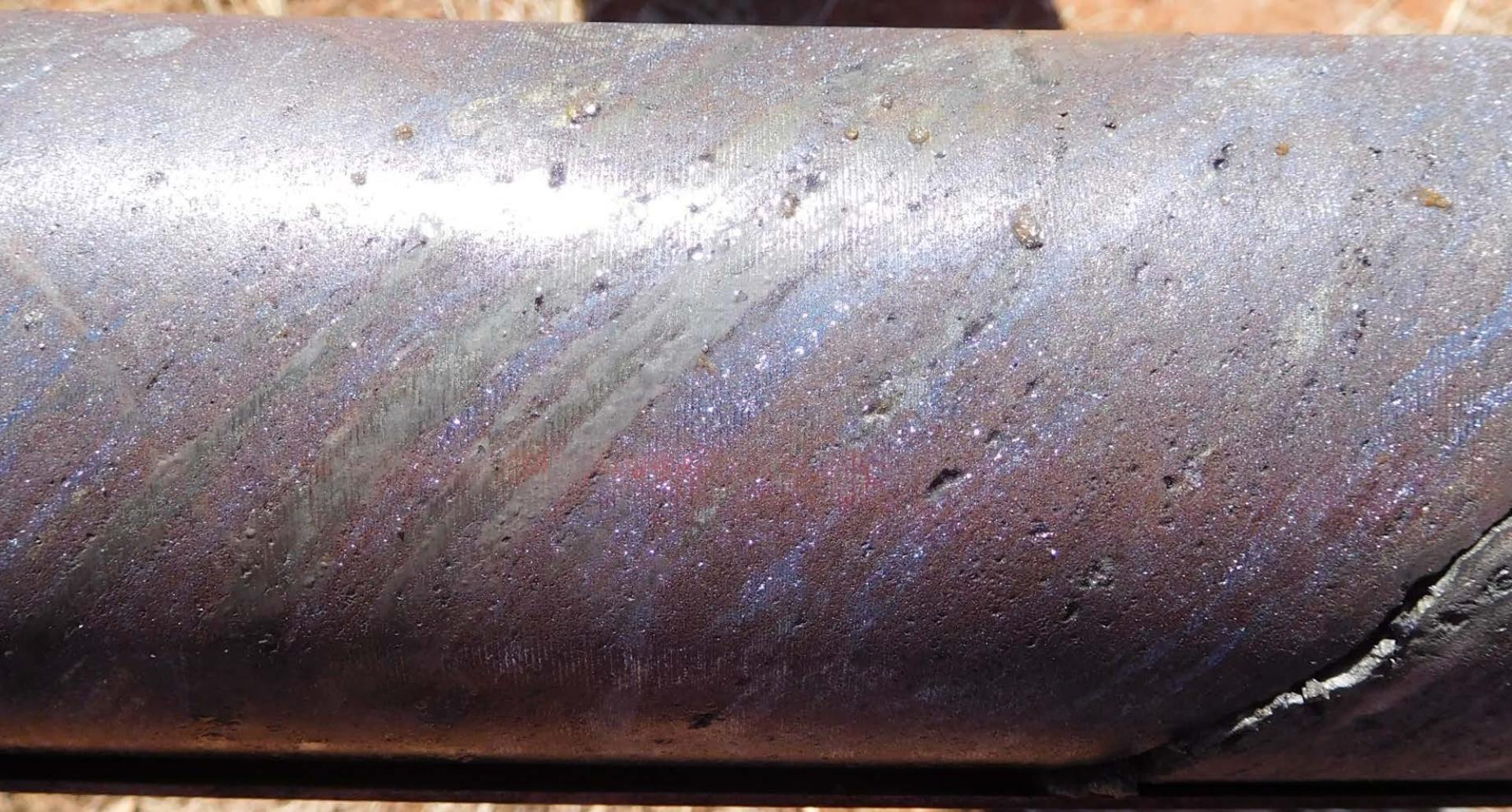
MBDD-009W1-478-481

Progression from crackle breccia to massive sulphide
MBDD009W1: 478-481m

PYRITE/SPHALERITE/GALENA LODES



MBDD028: Laminated massive sphalerite/galena/pyrite
82.0-95.5m: 13.5 m 21.1% Zn, 14.1% Pb, 268 g/t Ag



MBDD028: 85.45m, laminated sphalerite/galena/pyrite
85.0-85.5m: 0.5m 32.97%Zn, 20.59% Pb, 0.59% Cu, 559 g/t Ag



34

Laminated pyrite/sphalerite/galena, hole MBDD003: 376m



Stringer sphalerite/pyrite/galena veining in upper Shume Formation. Hole 4MRCDD010: ~291m



Rafted Zn/Pb sulphide clast in volcaniclastic breccia, MBDD024:
313.25m

	Pyritic sphalerite/galena “lodes”	Pyrrhotite/chalcopyrite “lodes”
Cu	Very low	High
Zn/Pb	High	Low
Bi	Very low	High
Co	Low	High
Cassiterite*	None recorded	Acicular void fill
Albite**	None recorded	Common accessory
Fracture/breccia void filling	No	Yes
Laminated	Commonly	Rarely
Occur also as rafted clasts in volcaniclastic breccias	Yes	No
Sulphur activity**	High (pyrite)	Lower (pyrrhotite)
Fluid temperature**	<320°C	340-400°C

*Brown (2018), **Chapman (2012)



M8DD-003

Chalcopyrite/pyrrhotite fracture/void fill overprinting stratiform laminated pyritic Zn/Pb sulphides and brecciated silica altered shale

MALLEE BULL Zn/Pb/Py vs Cpy/Po

Zn/Pb/Py interpreted as VHMS/VAMS, comparable to Wagga Tank/Southern Nights laminated massive sulphides.

Cpy/Po is later void fill, preceded by silica/albite alteration and brecciation allowing fluid ingress. Comparison with Cloncurry Proterozoic ISCGs.

More work on sulphur isotopes planned. Currently do not support magmatic source for S.

Mallee Bull Cpy/Po

Is the chalcopyrite/pyrrhotite mineralisation at Mallee Bull classical “Cobar style” or is it more akin to a magmatic related Iron Sulphide Copper Gold?