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EXPLORATION LICENCE 12/2017 RINGVILLE, TAS

REPORT TO: 5 DECEMEBER 2021

Report by:

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1:250,000 Map Sheets Geology of Southwest Tasmania, 2011

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EXECUTIVE SUMMARY

The Ringville Project Exploration Licence (EL) 12/2017 (1995) is located 6km west of Rosebery, Tasmania.
The exploration strategy applied by Argent Minerals Limited at EL 12/2017 is primarily focused on the targeting of Renison intrusion related skarn tin and vein lode, and Avebury nickel sulphide within Cambrian sediments of western Tasmania.

During the reporting period 6 December 2020 to 5 December 2021, Argent Minerals Limited conducted only desktop activities totaling $17,258.41due to the COVID19 Tasmanian boarder closures between NSW and W.A.

A synthesis of the geophysical measurements over existing MRV mineral deposits suggests that sulphide deposits tend to be dense, non-magnetic, chargeable but lacking high conductivity. Significant deposits may lie within a large area of pyritic alteration and may occur in close association with graphitic shales and share similar electrical properties. A key insight has been that massive sulphides can be discriminated from pyritic mineralisation and black shales based on in situ measurements.

A conventional greenfield exploration strategy uses a combination of gravity, aeromagnetics, radiometrics etc. to broadly define areas of interest, with electromagnetics providing structural information on a more local scale. However, explorers have concluded after many decades of intensive exploration in the area, that it's **unlikely that shallow economic sulphide deposits exist close to the surface,** so the mineralised favourable horizons are anticipated around and below 500m.

New magnetotelluric data now offers support to existing deep inversion interpretations. With the goal of locating deeper mineralisation, further combinations of detection technologies are required, particulaly on a local scale, such as the following:

- Ground electrical surveying should be completed to assist drill targeting over areas with good access. Targeted **Induced Polarisation** has previously been effective in detecting nearby VMS deposits. For non-conductive sphalerite deposits, IP has been the most successful exploration technique.
- **Drone-based AEM** has good potential because of the complex terrain, cost and versatility. Within one day of fieldwork, dense coverage of an area can be achieved with output datasets including surficial morphology, mineral distributions and the shape of the local magnetic anomaly at multiple scales (recent example from Finland is shown in Figure 6).
- For areas with limited ground access, either a helicopter-based electromagnetic survey using a time-domain system is recommended over any geophysical and geochemical anomalies. The key parameter is line density. Sufficient resoution at depth is a requirement.
- **Timedomain HEM** is suited for the detection of deep massive sulphide conductors and can detect mineralisation at depths up to 500m under favourable conditions.
- Commercial **CSAMT** is useful to map resistivity shallower than 1km (typically 300-600m).
- **DHEM** should be used on any holes drilled to search for conductive offhole mineralisation.
- Petrophysics is essential for advanced 3D model building and understanding the geological characteristics of the area of investigation.

Results have proven promising permitting the Company to continue its exploration of the Ringville Project. Activities planned for the 2020-2021 reporting period are:

- Detailed 1:10,000 geological and structural field mapping to confirm previous authors observations and improve our understanding of the region.
- Stream sediment and grid-based sampling campaign and analysis.
- Resource calculation for Salmons Lode

1 BACKGROUND

1.1 Location and access

The Ringville tenement EL 12/2017 is located approximately 6km west from the town of Rosebery, Western Tasmania. The tenement is situated between the Rosebery VHMS Polymetallic Mine in the east and intrusion related Renison Bell Tin Mine in the west (Figure 1) and spans 11 kilometres further south. The tenement area covers 33 square kilometres under a category 1 Exploration Licence granted for a five-year term.

Main access on to the E12/2017 tenement is from the Murchison Highway which runs east-west across the northern end of the licence or via main dirt 4WD tracks of Ring River Road (Salmons/Pieman Deposit access) Williamsford Road (Colebrook Hill deposit access) or Dundas Road and North East Dundas Tramway track (southern Access). The environment is comprised of dense temperate rainforest, numerous creeks and streams with an undulating topography. Much of the Renville tenement is inaccessible due to thick vegetation and variable terrain. West Coast Tasmania's annual high rainfall can result in difficult ground condition which can impede activities for much of the year. Datum used in this report is GDA 94.

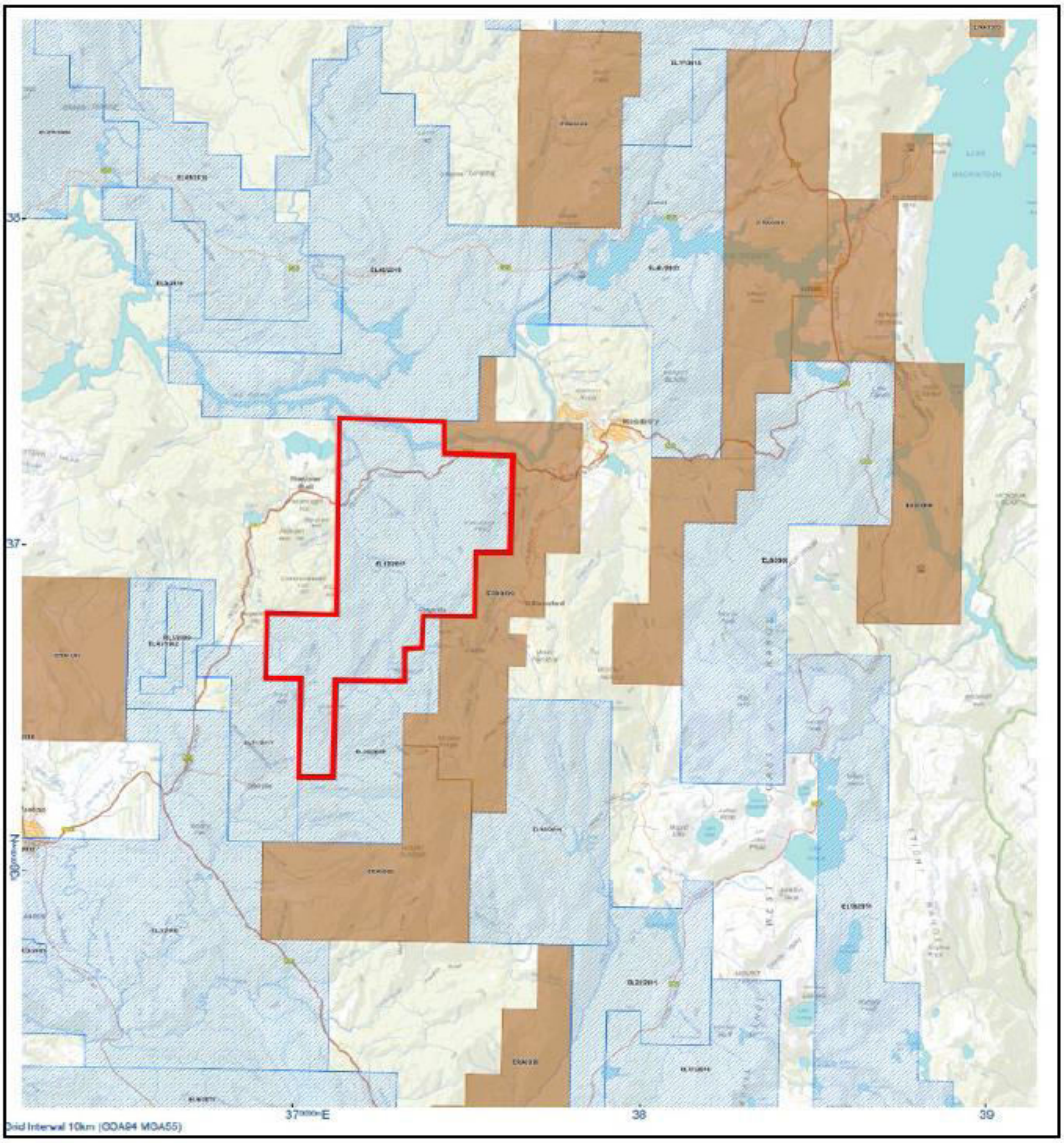

Figure 1. Location of EL12/2017

1.2 Regional Geology and Mineralisation

The geological history of Tasmania has had four major economic mineralisation episodes; magnesium during the Proterozoic ("Wichham" Orogeny); basemetals/gold/PGE during (Tyennan Orogeny); gold/base metal during the Devonian (Tabberabberan Orogeny) (McNeil, Triassic/Tertiary coal (Seymour, Green and Calver, 2006). In brief, Western Tasmania's basement is made up of Precambrian low-grade (up to greenschist facies) meta-sediments grade (up to eclogite facies) of mafic meta-igneous metamorphic assemblages. These overlain by volcanic and sedimentary rocks of the early Cambrian Crimson Creek Formation Cambrian Mt Read Volcanics.

Structurally, the Cambrian period's Tyennan Orogeny is comprised of three dominate phases; Cambrian syn-collision convergence; a Mid Cambrian MRV N–S compression, E-W extension formation; and Late Cambrian E–W compression and basin inversion (McNeil 2012).

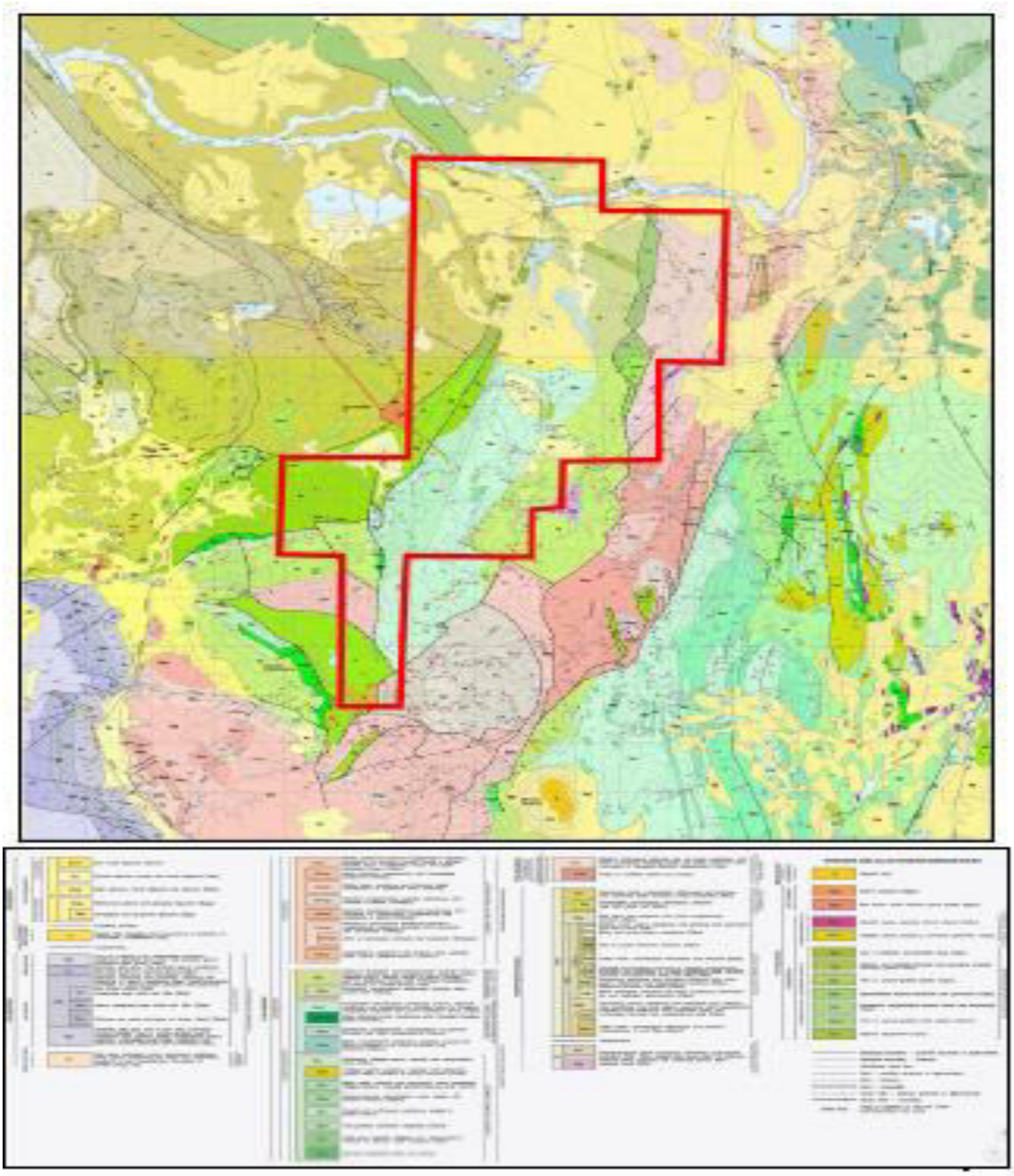

Figure 2. Regional Geological Interpretation over EL12/2017

The granite forms an ENE trending ridge at approximately one kilometre depth and connects to granite outcrops at Pine Hill in the west and Granite Tor in the east. Intrusion of the granite has resulted in extensive alteration of the adjacent sediments and mafic-ultramafic belts, ranging from contact metasomatism adjacent to the granite to more distal alteration, caused by migrating hydrothermal fluids. The ultramafics, which were probably pyroxenites, were altered to dark-green serpentinite carrying abundant magnetite. Gabbros, particularly associated with the western ultramafic, were extensively altered to talc-carbonate. This alteration appears most intense around structural zones (faults) cutting the gabbro. Calcareous sediments were extensively altered to marbles and garnet rich skarns.

Prior to exploration conducted by Allegiance Mining/Eastern, a variety of mineralisation styles were known from extensive previous exploration by others, such as:

- iron metasomation in the serpentinites, in the form of abundant late-stage veins
- Cu-Pb-Zn-Ag veins in altered gabbros in the western mafic/ultramafic sequence (Salmon)
- Quartz-cassiterite veining at Pieman and Exe River prospects
- Large Cu-As (-W) skarns on Colebrook Hill
- Pervasive (sometimes massive) pyrrhotite mineralisation in altered gabbros and altered sediments around the western mafic/ultramafic complex
- Scheelite mineralisation in metasomatised sediments on Colebrook Hill and in altered gabbros near Salmon

1.3 Local Geology

The current interpretation of the geology within the EL 12/2017 Ringville tenement is as follows (figure 2). The geology in the area is comprised of Early Cambrian to Devonian rocks capable of containing mineral deposits comparable to the Renison intrusion related skarn tin and vein lode, and Avebury style nickel sulphide. The tenement contains 52 known mineral occurrences, including three deposits to which pre-JORC historical mineralisation estimates have been attributed, featuring tin, copper, zinc, lead and silver (Table 1).

The western half of EL 12/2017 contains the Cambrian Crimson Creek Formation of volcaniclastic greywackes, feldspathic tuffs, mudstones, siltstones and shales which overlies the Cambrian Success Creek Group. The Success Creek Group is made up of siliceous clastics and carbonate sequence of siltstones, mudstones, dolomite clast-bearing, oolitic and chert breccia units. Both the Crimson Creek Formation and Success Creek group are intruded by Cambrian Ultramafics and gabbro complexes (north-south belts) identified from historic mapping and airborne magnetics. The area has also subsequently undergone alteration from a buried ridge of Devonian-Carboniferous ENE trending quartz porphyry granite at an assumed depth of approximately one kilometre. The Devonian granite has no known outcrop within the licence (found at Pine Hill in the west) although has been intercepted by several historic drillholes. The Crimson Creek Formation is known to host Renison intrusion related skarn tin (Pieman) and vein lode (Salmons) mineralisation in the Northwest. Quaternary alluvials and fluvioglacials covered the northern section of the tenement partially.

In the eastern half the Colebrook Hill area consists of the Crimson Creek Formation and Early Cambrian basaltic lithiwackes, siltstones, mudstones intruded by theolitic basalts and mafic intusives. The area is host to many mines and uneconomic deposits of axinite-actinolite skarns within the Crimson Creek Formation (Drake 1979).

In the middle of the tenement lies the Godkin Mine area and is also considered to be part of the Crimson Creek Formation. The area is home to numerous small sulphides mineralisation deposits, while further south within the tenement is the Kapi Creek Copper Mines and Dundas Mineral Field Crocoite Mine (in operation).

1.4 Mineralisation

Notable deposits within the EL 12/2017 tenement have been briefly summarised below:

1.4.1 Salmon Deposit

The Salmon Deposit (Table 1) located in the north of the tenement is a series of sub-parallel Ag-Pb-Zn and Cu rich veins hosted within Cambrian upper Crimson Creek Formation sediments. These veins have been developed in an intensely altered ultramafic unit, striking roughly north south and lying immediately east of the Renison Tin Mine.

1.4.2 Pieman Deposit

The Pieman deposit (Table 1) occurs along strike from, and partially overlaps, the Salmon deposit and is a structurally hosted Sn carbonate replacement.

1.4.3 Colebrook Hill Deposit(s)

The Colebrook Hill Cu-As deposit group is a skarn alteration system. Noteworthy mines within area include the Colebrook Copper Mine, Clifton Copper Mine, Lynton Lead Mine, Olympic Tine Mine, and Athenic Tin Mine.

1.4.4 Godkin Deposit(s)

The Godkin Sn deposit (Table 1) and the surrounding area is home to numerous small sulphides mineralisation deposits. Mineralisation coincides with a north trending shear zone which is thought to broadly aligned along the trend of the Federal Bassett Fault associated with the Renison Sn Mine. (Purvis, 1989). The following mineralisation assemblages in the area having been reported:

- Narrow arsenopyrite and quartz-arsenopyrite dominated veins.
- Fracture-filled and replacement pyrrhotite, arsenopyrite and cassiderite.
- Quartz-pyrrhotite pyrite veins, metasomatic veins

Table 1. Pre-JORC Code Historical Mineralisation Estimates within E12/2017

Pre-JORC Code Historical Mineralisation Estimates										
Deposit	**Category**	**Tonnes (t)**	**Sn (%)**	**Cu (%)**	**Au (g/t)**	**Pb (%)**	**Zn (%)**	**Ag (%)**	**Estimation Method**	**Estimation Date**
Pieman	Probable	433,300	1	0.2	-	0.1	0.3	8	Polygonal	1985
	Possible	744,900	0.3	0.2	-	0.1	0.3	8		
	Total	1,178,200	0.6	0.2	-	0.1	0.3	8		
Salmons	Probable	830,200	0.2	0.6	-	3.2	2.2	104	Polygonal	1985
	Possible	1,016,000	0.1	0.1	-	1.3	1.4	58		
	Total	1,846,200	0.1	0.3	-	2.1	1.8	79		
Godkin	Probable	299,400	0.9	-	-	-	-	-	Polygonal	1983

1.4 Authority History

The tenement area of EL 12/2017, located in West Tasmania has been explored since the late 1800's. Historical exploration has been focused primarily on Sn mineralisation (Pieman / Godkin Deposit), Pb-Zn-Ag mineralisation (Salmon Deposit) and the Cu-As mineralisation (Colebrook Hill). The past ~40 years of exploration in the area of EL 12/2017 has been conducted dominantly by Comstaff Proprietary Limited and Electrolytic Zinc Company of Austrasia Ltd. These two companies have occupied most of the tenements during 1970 and 1980's with both entities focused on base metal exploration.

In more recent times Allegiance Metals Pty Ltd, Eastren Pty Ltd & OZ Minerals Australia Ltd/MMG Australia have explored for VHMS, intrusion related skarn tin and Avebury nickel type sulphides. A drilling history of EL 12/2017 has been summarised in Table 2.

Table 2. Summary of authority history and previous exploration drilling

Authority history and previous exploration of EL12/2017		
Company	**Period**	**Previous Exploration Drilling Completed**
Tasmania Department of Mines	1958	2 x DDH @ Kapi Mine, 1 x DDH @ Melba Flats
Mines Exploration Pty Ltd	1967	1 x DDH @ Renison Bell Exe River
Texins Development Pty Ltd	1972	2 x DDH @ Dundas Carbine West
Minops Pty Ltd	1974	2 x DDH @ North Dundas
Comstaff Pty Ltd	1974-1983	53 x DDH @ East Renison
Renison Ltd	1977-1978	2 x DDH @ Kapi Mine
Electrolytic Zinc Company of Australasia Ltd	1981-1984	5 x DDH @ Colebrook Hill, 8 DDH @ Mt Black
Goldfields Exploration Pty Ltd	1985	2 x DDH @ Grand Prize
RGC Exploration Pty Ltd	1990	5 x DDH @ Montezuma
Rubicon Mintech Ventures Pty Ltd & Stellar Resources Ltd	2007	2 x DDH @ Black Hill
Allegiance Metals Pty Ltd, East Ren Pty Ltd & OZ Minerals Australia Ltd	2007-2010	7 x DDH @ East Renison, 2 x DDH @ Karlson Riley, 1 x DDH @ Godkin, 1 x DDH @ Ringville
MMG Australia Limited	2013	4 x DDH @ East Renison

EL 12/2017 was granted to Argent Minerals Limited on 6 December 2017 for a period of five years with a minimum expenditure of $60,000 required over the first two years.

1.5 Exploration rationale

Argent Minerals Limited is an ASX listed Company focused on creating shareholder wealth through the discovery, extraction and marketing of precious and base metal products within the highly productive Eastern Australian Palaeozoic geologic terrane.

Argent's strategy to achieve this goal comprises of three key elements; exploration, capital efficiency and production, with exploration featuring as the key immediate driver of growth. The exploration strategy of Argent Minerals at EL 12/2017 is primarily focused on the targeting of Sn carbonate replacement and vein styles and Cu-As skarn mineraliation similar to what has been previously discovered at Renison and the historical Godkin and Colebrook Hill areas.

2 EXPLORATION COMPLETED IN REPORTING PERIOD

During the reporting period 6 December 2020 to 5 December 2021, Argent Minerals engaged in Internode Seismic on a detail geophysical review.

Exploration for the 2020-2021 reporting period was a selection of non-invasive geological activities due to the COVID19 Tasmanian boarder closures between NSW and W.A:

The titles previous exploration and mining efforts date back to the late 1800's / early 1900's where mining of historic locations such as Colebrook Hill and Godkin had commenced. More recent and better documented exploration activity has occurred from the 1960's and has now been all reviewed.

2.1 Geophysical review – seismic study

A consultant from Internode Seismic has been contracted to complete a tenement wide review of historic geophysics completed. Available seismic, IP, magnetic, radiometric, LIDAR and gravity data will be compiled and incorporated into the geological model with the intent to further define stratigraphic and resource targets. The report is due early 2021.

In accordance with s.26 of the Mineral Resources Development Act 1995, the minimum expenditure for the first two years of the licence has been determined to be $60,000. Argent is endeavoring to continue this minimum expenditure over the life of the grant. For current expenditures and expenditure breakdown, please see the Annual Rental Return (Appendix 1).

3 RESULTS AND DISCUSSION

3.1 Continuing review of existing data collected, and work conducted

The Company has reviewed all known existing data to maximise the Company's budget and the potential for discovery. Much of the past exploration activities were non-invasive geological activities such as mapping, soil sampling and geophysical surveys. From the late 1950's, 99 diamond drillholes have been drilled within the tenement. Much of the data was in paper log form with some data sets such as structure or assays either not completed or missing. The data has helped bring insight to the project, however there are concerns with the lack of QAQC data which includes assay method and confidence of results as well as overall hole positioning.

3.2 Geophysical review – seismic study

As the geophysical report and integrated 3D package was given to Argent in December 2020 by Internode Seismic with the following outlined below. The full report is attached under Appendix 1.

A synthesis of the geophysical measurements over existing MRV mineral deposits suggests that sulphide deposits tend to be dense, non-magnetic, chargeable but lacking high conductivity. Significant deposits may lie within a large area of pyritic alteration and may occur in close association with graphitic shales and share similar electrical properties. A key insight has been that massive sulphides can be discriminated from pyritic mineralisation and black shales based on in situ measurements.

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New magnetotelluric data now offers support to existing deep inversion interpretations. With the goal of locating deeper mineralisation, further combinations of detection technologies are required, particulaly on a local scale, such as the following:

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- Petrophysics is essential for advanced 3D model building and understanding the geological characteristics of the area of investigation.

Expenditure during the Reporting Period

During the current reporting period of 06 December 2019 to 5 November 2020 (date of report generated) Argent Minerals had a total exploration expenditure of $21,890.33 and $42,793.16 over the past 2 years. This tenements spending meets the 2-year minimum expenditure requirements of $60,000.00. During this reporting period the company has expended $17,258.41

4 FUTURE EXPLORATION

Despite the lack of ground activities during the current reporting period EL 12/2017 holds known mineral deposits and the work completed by the Company to date justifies further exploration in 2020. Planned exploration work will encompass:

- Detailed 1:10,000 geological and structural field mapping to confirm previous authors observations and improve our understanding of the region.
- Stream sediment and grid-based sampling campaign and analysis.
- Resource calculation for Salmons Lode
- Integration of LIDAR and geophysical data with 3D geological model
- Collection of data (digitising) on numerous prospects within the tenement.
- Drilling assessment Salmons Lode and other prospects

5 ENVIRONMENTAL MANAGEMENT

All exploration activities completed during the reporting period were of low disturbance with no notable environmental impact and therefore subsequently did not require rehabilitation. None-the-less, Argent Minerals endeavours to maintain/leave any tenement in its possession in the same condition or better.

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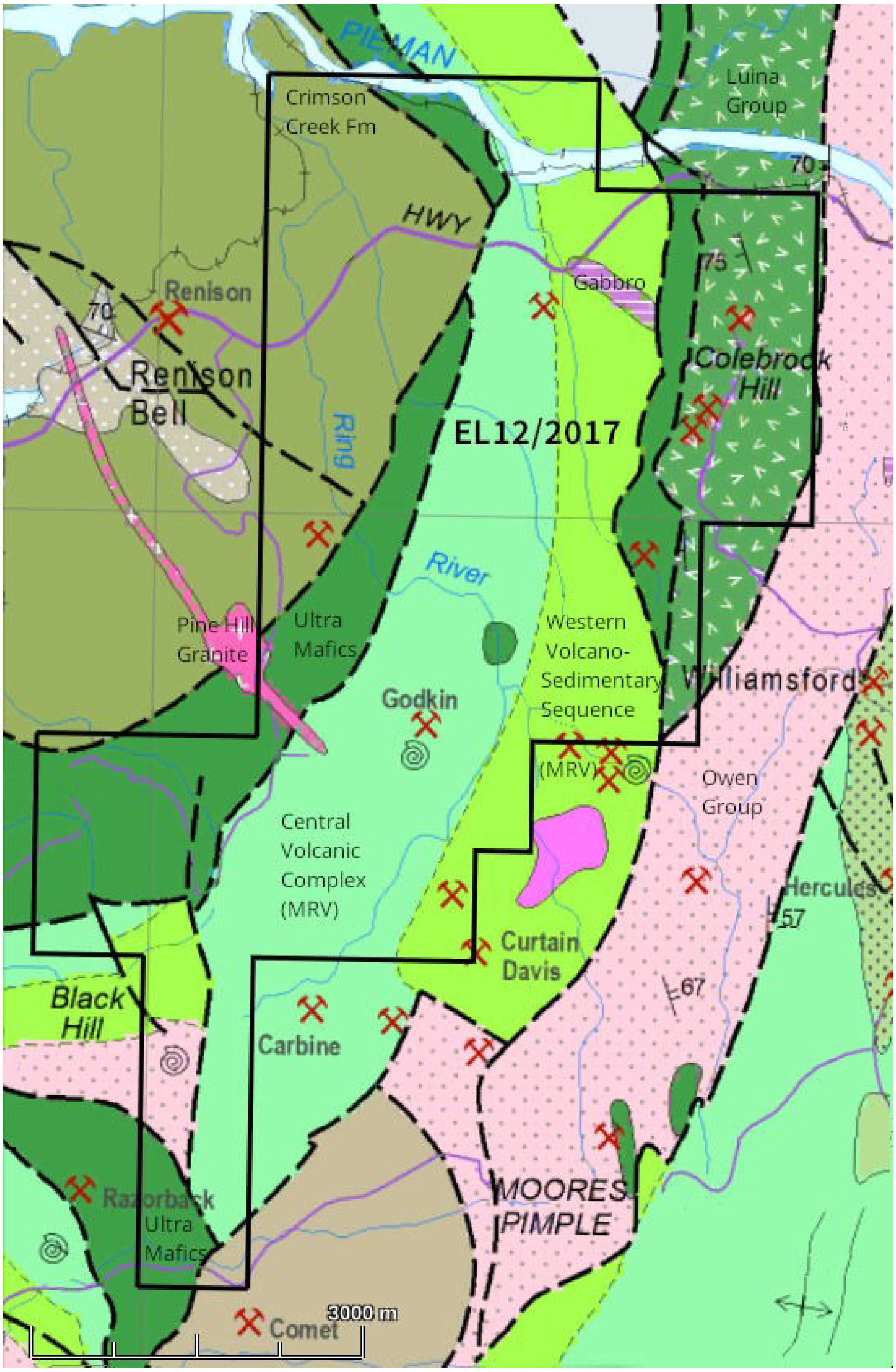
APPENDIX 1

Geophysical Review of EL12/2017

Geophysical Review of EL12/2017



Internode Seismic

December 2020

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Geophysical technology abbreviations

1VD	First Vertical Derivitive
AEM	Airborne EM
ASTER	AdvSpaceThermalEmissionReflection Radiometer
AusLAMP	Aust. Lithospheric Architecture MT Project
AWAGS	Australia-wide Airborne Geophysical Survey
B	Magnetic Field
BBMT	Broadband MT
BH	BoreHole
BIPTEM	B field, Induced Polarization, Electromagnetic
CODES	Centre Ore Deposit & Earth Sciences
CSAMT	Controlled Source Audio MT
DC	Direct Current
DEM	Digital Elevation Model
DHEM	Down Hole EM
DMO	Dip Move-Out
DOI	Depth of Investigation
DTM	Digital Terrain Model
EDI	Electronic Data Interchange
EL	Exploration Licence
EM	Electromagnetic
ERT	Electrical resistivity tomography
FFT	Fast-Fourier Transform
FTG	Full Tensor Gravimetry
FTMG	Full Tensor Magnetic Gradient
GA	Geoscience Australia
GIS	Geographic Information System
GPR	Ground Penetrating Radar
GPS	Global Positioning System
GUI	Graphical User Interface
Hydro	Hydro Tasmania
HTEM	Helicopter TEM
IGRF	International Geomagnetic Reference Field
IMU	Inertial Measurement Unit
IOCG	Iron Oxide Copper Gold
IP	Induced Polarization
LiDAR	Light Detection and Ranging
MAD	Magnetic Anomaly Detection
MASW	Multichannel Analysis Surface Waves
MIMDAS	MIM Distributed Acquisition System
MMR	Magnetometric Resistivity
MRT	Mineral Resources Tasmania
MRV	Mt Read Volcanics
MT	MagnetoTelluric
MVP	Magneto-variational Profiling
NASA	National Aeronautics and Space Admin
NIA	Dipole Moment of EM loop
NIR	Near Infra-red
QA	Quality Assurance
QC	Quality Control
RMIT	Royal Melbourne Institute of Technology
RTK	Real-Time Kinematic
RTP	Reduction to the Pole
SAR	Synthetic Aperture Radar
SimPEG	Simulation and Parameter
SP	Self Potential
SQUID	Superconducting Quantum Interference Device
SRTM	Shuttle Radar Topography Mission
SWIR	Short-wave Infra-red
TDEM	Time Domain EM
TEM	Transient EM
TEMPEST	TEM Pulse Emanation Standard Telecom
TMI	Total Magnetic Intensity
TOPSAR	Terrain Observation with Progressive Scans
SAR	Synthetic Aperture Radar
Tx/Rx	Transmitter/Receiver
UAV	Unmanned Airborne Vehicle
UTEM	Step Response TEM Lamontagne Geophysics
UTM	Universal Transverse Mercator
VMS	Volcanogenic Massive Sulphide
VRMI	Vector Residual Magnetic Intensity
VTEM	Versatile Time Domain Electromagnetic

1. INTRODUCTION

Argent Minerals sought a review of the existing geophysical data within the **EL12/2017** tenement area, including a quality assessment of and their utility for exploration. This report also presents an analysis of the effectiveness of different geophysical methods for exploring for mineral deposits on the tenement. The advantages and disadvantages of possible survey techniques are discussed. As a result, some recommendations for possible future geophysical surveys have been made.

EL12/2017 was granted to Argent Minerals Ltd on 6th December 2017. The EL covers an area of 33km^2 and is located in western Tasmania. It is sandwiched between large mining leases, Renison Bell (Sn) on the west and Rosebery and Hercules (both Pb-Zn-Ag) on the east.

Land tenure is mainly Permanent Timber Production and Informal Reserve - Forestry Tasmania Land or Future Potential Production Forest in the south. A fossicking area covers the western slopes of Colebrook Hill and nearby is a small Commonwealth Land designated area, see Figure 1.

Previous tenement holders over E12/2017 over recent decades include:

Renison Ltd (Exploration)	EL101/1987
Pan Australian Resources NL	EL12/1994
Pasminco Australia Ltd	EL21/1996
MMG Exploration Pty Ltd	EL05/2002
Australian Hualong	EL21/2004
Eastren Pty Ltd	EL50/2007
Australian Hualong	EL13/2014

The renowned Mount Read Volcanics lies within the tenement. The percieved VMS prospectivity is less because 1) the existing VMS large deposits lie east of the tenement and 2) there are no major crustal faults intersecting the tenement. Conversely the MRV offers 1) multiple mineralisation styles in a complex stratigraphy and 2) the area is underlain by a geochemically anomalous granite.

Renison Ltd considered the area highly prospective for 1) structural/sediment replacement tin mineralisation, and to a lesser degree, structure-related gold and polymetallic sulphide deposits. Extensive exploration by the above explorers identified the following mineralisation types;
2) Iron metasomation in the serpentinites, in the form of abundant late stage veins
3a) Cu-Pb-Zn-Ag veins in altered gabbros in the western mafic/ultramafic sequence
3b) Pervasive and massive pyrrhotite mineralisation in the same altered gabbros.
4a) Significant Cu-As in skarns on Colebrook Hill
4b) Scheelite mineralisation in in contact metamorphic skarns on Colebrook Hill
5) Avebury-style remobilised nickel sulphide deposits.

Hence recent investigations have focussed on the ultramafic and skarn located mineralisation. The serpentinised ultramafic units are the thrust-emplaced remnants of highly magnetic, oceanic island arc crust that collided with proto-Tasmania ~520Ma. Sn±Cu,W, Ni and Au skarn and vein deposits are the product of magmatic fluids exsolved from Devonian granite magmas. Altered gabbro-sourced mineralisation is less well understood.

There are over 28 abandoned mines on the tenement, eleven for Pb-Zn, eight Sn and nine others with a diverse range of mineables (Cu-Sb-Bi-Ag-As-FeS2-Ni), eg. South West Curtin Davis mine (Cu-Sb-Bi-Ag) and Hecla mine (Cu-As-Bi-Ag-Ni) which are 700m apart, both goldless.

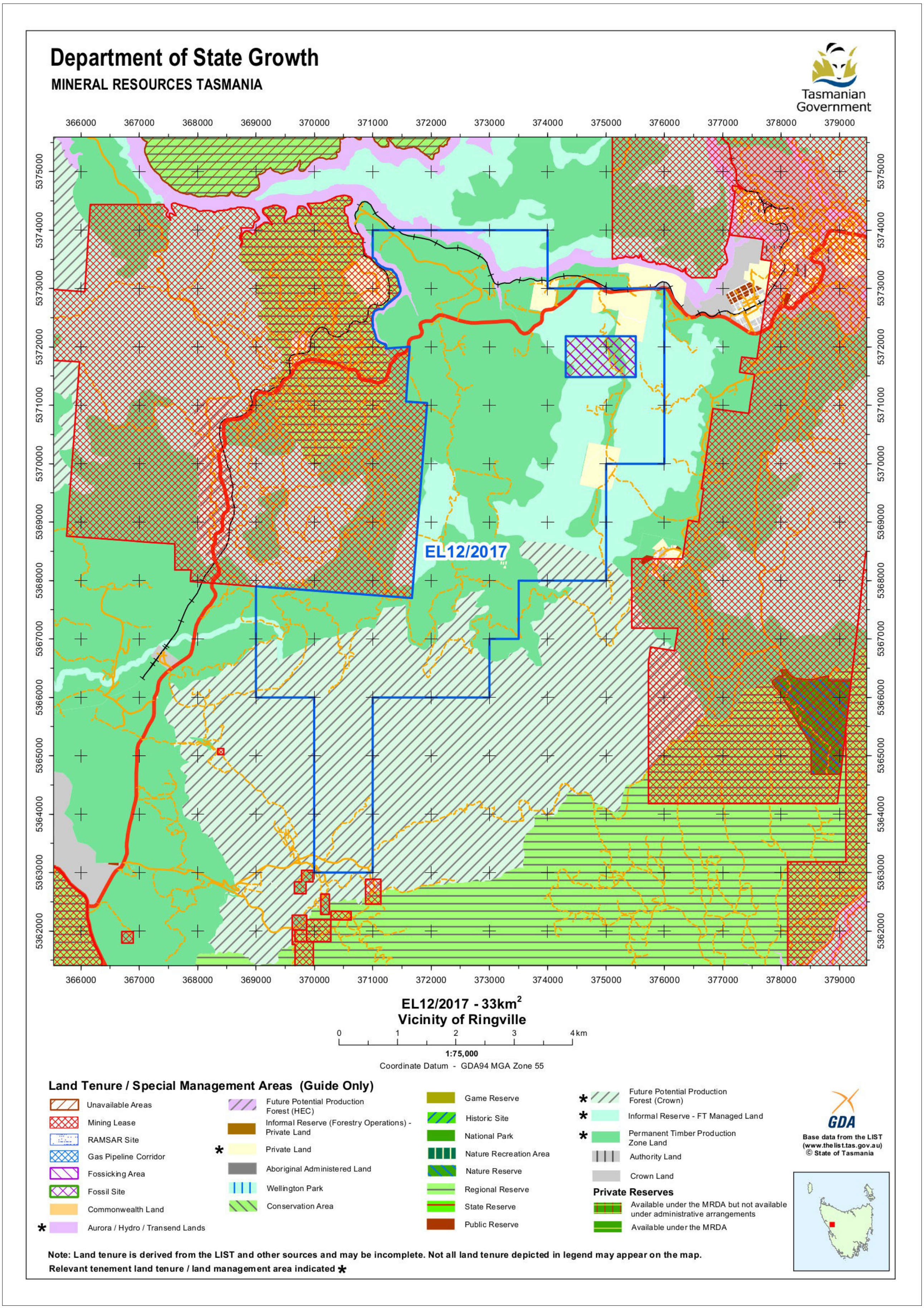


Figure 1 Land tenure map showing the location of EL12/2017

2. GEOLOGICAL SETTING

Geological Setting

The following major units outcrop within the EL12/2017 tenement area;
1) a complex sequence of Cambrian volcanic sediments principally the MRV,
2) cut by two, highly magnetic Cambrian mafic/ultramafic belts and mélange unuts
3) and later intruded and altered by Late Devonian Granites.

The stratigraphic relationships between the units are indicated in Figure 2 (left image).

Earliest Units

Crimson Creek Formation is a ~5km thick, volcaniclastic formation consisting of mafic volcaniclastic greywacke and siltstone with minor carbonate, tholeiitic basalt and tuff. The contact between the Ediacaran Crimson Creek Formation and underlying Success Creek Group is in places conformable, else faulted. Cambrian flysch and ultramafics have overtrhust the Crimson Creek Formation while gabbros and Devonian Granite later intruded it. The Dundas Group conformably overlies it.

Allochthonous Units

Preceding the prolific MRV volcaniclastic deposition, allochthonous units were intercalated due to a microcontinent collision with an intra-oceanic island arc, initiating the Tyennan Orogeny which was synchronous with the Delamerian Orogent (SE Australia) and the Ross Orogeny (Antarctica).

Luina Group is an Early Cambrian mélange unit featuring allochthonous blocks hosted in a large volume of rift related basaltic lava flows, maroon siltstone and other clastics. It was formerly referred to as the Cleveland-Waratah association or Luina Beds. It was emplaced via obduction.

The Tyennan Orogeny strongly deformed the Late Neoproterozoic and Early Cambrian rocks and resulted in the south and mainly westward emplacement (via low-angle thrust faults and thrust sheets) of an allochthonous, serpentinised, ultramafic complex ~520 Ma. **Ultramafic complex units** are stratigraphically located between the Cambrian Dundas Group sediments and the underlying Luina Group or Crimson Creek and Success Creek units, perhaps marking the limbs of a major synclinal fold. They exhibit a high degree of internal deformation. They were originally pyroxenites now altered to dark-green serpentinite.

Characterization of petrophysical data indicates that the ultramafic complex is divided into two distinct units 1) low density and high magnetic susceptibility and 2) high density and low magnetic susceptibility. These differences are due to the degree of serpentinisation (where a higher degree of serpentinisation leads to lower densities and higher magnetic susceptibilities and vice versa).

The ultramafics also feature layered cumulates (as a dense, layered dunite-harzburgite) which are favourable for PGE's and disseminated sulphides. Their strong magnetic signature is due to abundant magnetite released during the serpentinisation process and subsequent Fe metasomatism.

Gabbros appear to be associated with the ultramafics, which have been extensively altered to talc-carbonate. This alteration appears most intense around structural zones (faults). The gabbros also show a well developed border of amphibolite on the contact with the ultrabasic rocks. Their geometries in relation to the host rocks and their source is poorly understood, yet they have the potential to be significant exploration targets.

Cambrian Units

Dundas Group sediments occupy a trough in the central part of the tenement consisting of mixed epiclastic and minor volcaniclastic sediments comprised of turbiditic to shallow water sediments containing immature conglomerates, sandstone, siltstones and shales. Towards the top of the sequence felsic to intermediate tuffs, related volcaniclastic sediments and minor lava flows occur. The Dundas Group contains abundant felsic volcanics derived from the MRV as a 3km thick, extensive conglomeritic flysch sequence as the Dundas Group was positioned to the west of the MRV. Submarine fan sediments interfinger and link the two, which are considered syngenetic.

The **Mt Read Volcanics** comprises five major lithostratigraphic associations (Sticht Range Beds, Eastern Quartz-Phyric Sequence, Central Volcanic Complex (CVC), Western Volcano-Sedimentary Sequences and Tyndall Group). These are a result of a prolific phase of magmatism and clastic deposition lasting from 507-494 ±1 Ma with mineralisation confined to 500 ±1Ma along major faults. Only the CVC and Tyndall outcrop on the tenement.

The Central Volcanic Complex is a Middle-Late Cambrian (504-495 Ma), ~3km thick, highly complex suite of mainly feldspar-phyric rhyolite and dacite lavas, with ignimbrite tuffs, intrusives, pyroclastics and local andesite lenses. It stratigraphically dominates the central part of the tenement.

Western Volcano-Sedimentary Sequence is a Drumian (505-500 Ma) section of the MRV. It comprises lithiwacke, mudstone, siltstone, shale and subordinate intrusive rocks and lavas, commonly andesitic. Contact with the underlying CVC ranges from interfingering to disconformable or faulted.

The Tyndall Group formed between Middle Cambrian and Furongian (504-494 Ma) and overlies all other MRV units (including the Western Volcano-Sedimentary Sequence and Central Volcanic Complex) because it was the the final phase of magmatism. As such it forms an extensive marker sequence. Lavas and syn-volcanic intrusions are predominantly rhyolites and dacites, with locally abundant calc-alkaline andesites and basalts.

Unconformably overlying the Tyndall Group is the Late Cambrian-Early Ordovician **Owen Group** (490-470 Ma), an areally extensive, thick sequence of marine, syn-orogenic rocks consisting of siliciclastic conglomerate and sandstone. Perhaps confusingly, biostratigraphy indicates that the Owen Group correlates with the Upper Dundas Group in the Dundas area but elsewhere the lower contact is either unconformable or thrust faulted. The Owen Group effectively marks a change from intense orogenic activity and deposition to a prolonged persiod of marine quiessence.

Devonian Granites

A major Late-Devonian granite intrusion extensively altered and metasomatised both the Cambrian volcaniclastics and ultramafic intrusions. ranging from contact metasomatism adjacent to the granite to more distal alteration, caused by migrating magmatic-hydrothermal fluids exsolved from crystallised felsic magmas. It has extensively altered carbonate bearing units along its contact and is responsible for the metasomatic replacement of dolomitic elements of the Success Creek Group.

The Pine Hill I-type granite (366 ±3 Ma) granite outcrops on the tenement. It connects via an ENE trending saddle at a depth of 1-2 km to the I-type and S-type Heemskirk Granite (that outcrops 20km west) and the S-type Granite Tor (that outcrops 20km east)(Figure 2 right).

The underlying, pervasive, Devonian granites played a role in modifying mineralisation structurally and hydrothermally within the Cambrian units. The granites are associated with a world class Sn-W deposit at Renison. They exhibit Sn enrichment factors such as prolonged fractional crystallisation, low oxygen fugacity and volatile enrichment. The abundant tin mineralisation was triggered by the emplacement of a Devonian granite into Cambrian host rocks.

The granites have a source with isotopic characteristics similar to the Lachlan Orogen in south-east Australia and were emplaced after the Tabberabberan Orogeny. In specimen, they are pale grey, well fractionated and has a porphyritic texture with subhedral quartz phenocrysts. The Pine Hill intrusion is described as a porphyritic adamellite. Locally it exhibits early silica and sericite alteration of the both the granite and country rocks, followed by later boron metasomatism.

The gravity and radiometric data define the location the Devonian granites extremely well in a regional sense. Their sub-surface geometries have been mapped via gravity modeling as they are generally non-magnetic so are not delineated by the aeromagnetic data. Additionally, gravity is useful in determining the structural control on mineralisation.

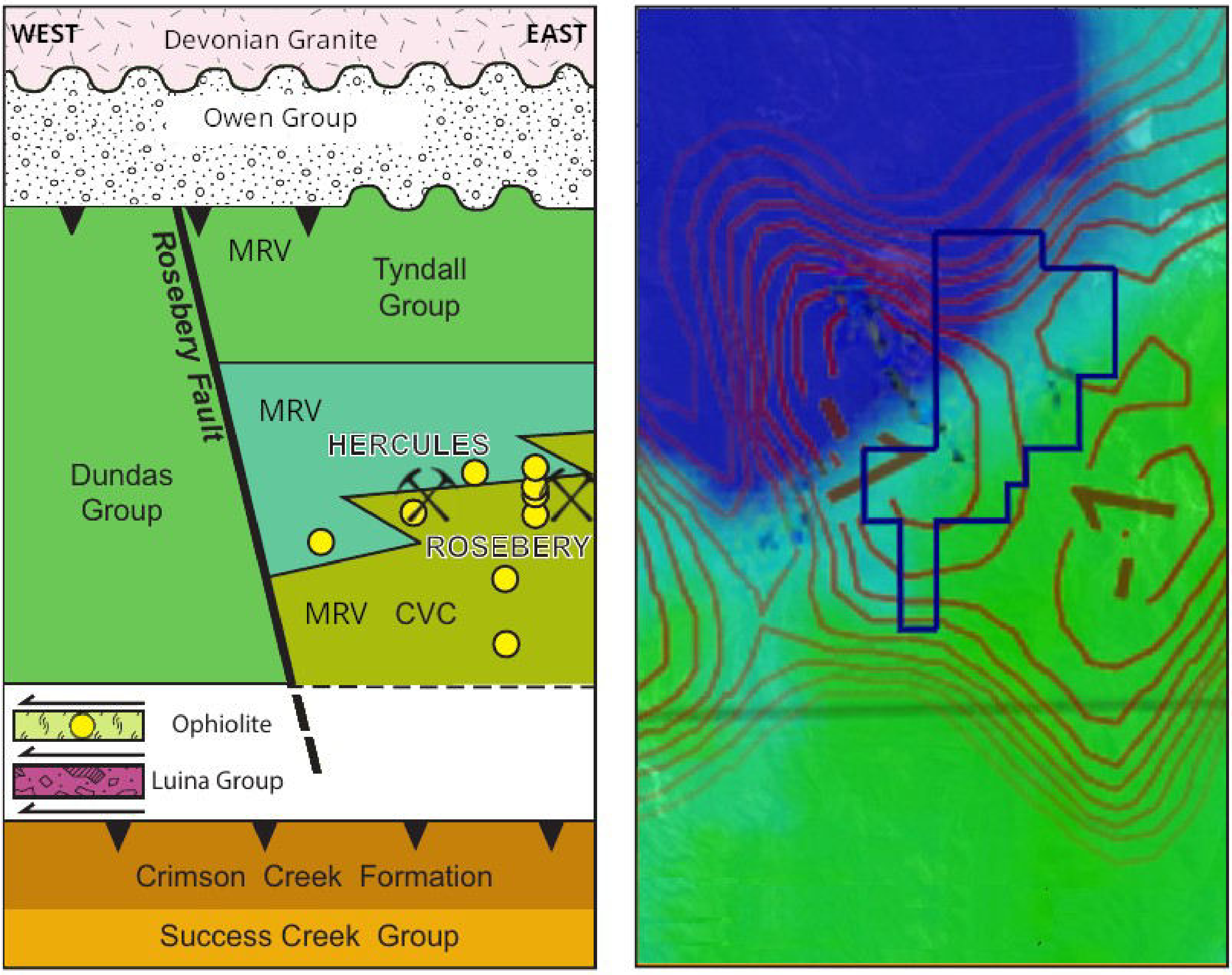


Figure 2 Stratigraphic diagram (left) and granite depth (red), tenement (blue) and gravity (right).

Cover

Quaternary alluvials and fluvioglacials cover about 30% of the tenement, principally in the triangle formed by the Pieman, Ring and Exe Rivers. Quaternary fluvioglacial sediments and Quaternary-Recent alluvial gravels cover the topographic lows of the tenement with patches of laterite and saprolite present in isolated places. On the one hand, concentrated, alluvial mineral deposits exist, whereas on the other, detrital magnetite is common in glacials and can obscure deeper anomalies.

Drilling

Serious, systematic exploration commenced over the area in 1980 and was sustained until 1986. The principal target for the EZ-Getty JV was either Renison-style metasomatic replacement tin-sulphide deposits or Queen Hill-style tin-sulphide vein mineralisation. Some encouragement was obtained form the discovery of zones up to 5m wide averaging 1% Sn being delineated in the Olympic Mine workings. Exploration involved regional airborne geophysical surveys covering part or all of the area including aeromagnetics, TURAM EM and DIGHEM. Five drill holes in the Colebrook Hill area were surveyed by down-hole SIROTEM by the EZ-Getty JV. Several zones of semi-massive sulphide were intersected while drilling targets in the Colebrook Hill area. CHP240 had significant mineralisation with the best interval being 11m at 1.3% Cu.

Mrt.tas.gov.au drilled a deep hole atColebrook Hill (CB1) to test the granite contact aureole beneath Colebrook Hill. It intersected several broad zones of encouraging Cu±As±W mineralisation (10.8 m 1.22% WO_3). The potential for economic deposits of that type was not as thoroughly investigated as was the tin mineralisation potential.

Between 2006-2008, Oz Minerals and MMG drilled 11 diamond drillholes (on what is now EL 12/2017) seeking Avebury-style Ni-sulphide deposits in the serpentinised ultramafics and skarns, however no significant deposits were encountered.

Only 5km north of EL12/2017, in 2017, Yunnan Tin targeted mineralisation overlying the granite estimated to be ~1km deep. Diamond drilling (TCGA-01) intercepted serpentinite, faults and abundant shear zones, however, drilling was abandoned at 582 m due to the very high hydraulic load on the drilling rods. Increasing magnesite/dolomite in shear/fault zones representative of a distal hydrothermal system arising from granite were encountered with insignificant mineralisation.

Existing Deposits

Renison Tin

Metals X - Yunnan Tin JV recommissioned Australia's largest tin mine and produced tin in 2008. In 2020 the JV reported a Measured and Indicated mineral resource of 15.88Mt grading 1.6% Sn. Renison Bell underground tin mine currently has a production of 7kt of tin metal from 800kt of ore at an average head grade of 1.32% Sn, with recoveries of 72.36% Sn. This represents about 2% of global annual demand for tin (half of which used in solder and batteries). It has a projected 7 year underground mine life with plans for a smelter to reprocess tailings.

Pieman and Salmon deposits

In the far north of tenement EL12/2017, Devonian granite-related fissue vein deposits occur including the Pieman Sn vein (0.43 Mt @ 1.0% Sn) and Salmons Pb-Zn vein (0.83 Mt @ 3.2% Pb, 2.2% Zn, 104 g/t Ag, 0.19% Sn, 0.61% Cu). Pieman and Salmon had a combined strike length of 1 km and are developed within a series of veins within the Crimson Creek sediments in the north (Pieman) and altered gabbro in the south (Salmon). Further investigation of the Salmons vein ceased in 2014 when metallurgical issues and moderate grades weer encountered by MMG.

Colebrook Hill (Cu-W-Sn-As)

In the north-eastern corrner of the tenement are Cu-W skarns in altered sediments. The skarn appears to have formed where boron and sulphur-rich magmatic fluids from the underlying Devonian granite reacted with reactive calcareous unit. This area contains a sizeable metasomatic alteration system dominated by significant Cu-W mineralisation with lesser Sn. The rocks have been extensively altered by the underlying Devonian granite. The metasomatic system has yet to be fully tested. Cu was originally mined although Ag, Au, Sn, Pb, Zn, W and other minerals are also present. Pasminco in 2001 identified several anomalous EM responses but concluded that the Cu-As-Sn-W skarn zone contained a steeply dipping lode hosted sub-economic copper mineralisation (1.3m @ 3.02%Cu). Colebrook Hill also hosts the Lynton Mine (Ag, Pb, Barite) in altered ultramafic margins. Oz Minerals investigated the site in 2005 and obtained samples containing significant Pb-Zn-S and anomalous nickel 0.6% Ni (sulphide or silicate?).

Godkin Prospect (Sn)

The Godkin prospect is of exploration interest because it lies near the Sn-mineralised centre of the North Dundas mineral field, a collection of partly Sn-bearing base metal vein deposits comparable to the Zeehan field. The stratigraphy includes possible carbonate-bearing lithologies within the Dundas Group, including a calcareous conglomerate and dolomitic sediments of the kind seen in the Great Northern Mine area to the south-west. The prospect has potential for Renison or Queen Hill-style fracture-controlled and carbonate-replacement Sn mineralisation. Best results from early trenching were up to 3.3m @ 0.88% Sn, and 3m @ 0.33% Sn.

Hecla and Hecla North Mine (Cu, As, Bi, Ag, Ni)

The Hecla Deposit is a complex two stage type (arsenopyritic breccia and massive siderite) deposit akin to the Godkin deposit. Like most of the Curtin Davis lodes it is anomalous in base metals, As, Bi, Sb and Ag but devoid of Au.

Lynton Mine

MMG concentrated on the Lynton Mine area between 2004-05 on the western margin of the eastern ultramafic. They sought Ag-Pb mineralisation associated with barite veins in the ultramafic margin. Some Ni sulphides were reported from these workings. Samples contained significant Pb-Zn-S and anomalous Ni including an assay of 0.6% Ni. So ER002 was drilled to test the ultramafics beneath the Lynton Mine. It intersected serpentinised ultramafics from 125m but did not reach the eastern margin of the ultramafics which exceed 300 m in width. Ni values were very low suggesting Ni present was present in Ni silicates not sulphides. Geochemical analysis produced no evidence to suggest that the granite-related metasomatic event has remobilised Ni from Ni silicates to Ni sulphides. However, ER002 did not test the interpreted prime Avebury mineralisation site, the footwall of the altered ultramafic, so ER002 cannot be considered a definitive test of prospectivity.

LEAD-ZINC	TIN	OTHER
No. 1 Curtin Davis Ag-Cu-Pb	Exe Proprietary Sn	South Curtin Davis West Ag
South Curtin Davis Ag-Pb-Zn	Exe Falls Sn	South West Curtin Davis Cu-Sb-Bi-Ag
Hasset Prospect Pb	Exe Gorge Sn	Crown Curtin Davis Cu-As-Ag
Lynton Mine Pb-Barite	Greens Prospect Sn	Colebrook Hill Cu
Dundas Pb-Ag-Zn-PbCrO4	Fraser Cu-As-Sn	North Colebrook Cu-As
Madam Melba Pb-Ag	Olympic Mine Sn	Section 331-93M Ag
Unnamed Zn-Pb	Section 5274M Sn	Unnamed Pyrite FeS2
Unnamed Zn-Pb-Ag	Dunn and Archers Sn	Hecla Mine Cu-As-Bi-Ag-Ni
3 x Unnamed Pb		Hecla North Cu-As-Ag

Table 1 Lists of mines within EL12/2017 sorted by mineralisation.

3. GEOPHYSICAL DATA

From-To	Organisation	Geophysical work	Results
1962-1972	Aberfoyle	Aeromag, ground mag, SP surveys	500m spacing, few targets defined
1976-1987	CSR	EM, Magnetics, IP, DIGHEM	7 unsuccessful holes.
1978-1986	Electrolytic ZincJV	DIGHEM, Turam, IP	Encouraging Sn-Cu Colebrook Hill
1979-1984	Minops Pty Ltd	Geophysics	Godkin 300,000t @ 0.9% Sn
1981-1983	Renison JV	IP in key areas	Nothing significant
1998-1999	Pasminco	Airborne EM survey	Anom conductivity, most glacial
1999-2001	Pasminco	HEM survey	13 anomalies identified
2004	Allegiance& Fugro	DIGHEM, Turam, IP	Ultramafic focus
2009	Creat Resources	Airborne EM survey and SkyTEM	Ag-Pb-Zn prospects towards SE
2013-2015	MRT	Gravity, mag inversion 3D model	
2015-2019	tas.gov.au, MMG	LiDAR	Hi-res 1x1m with veg removed
2017	MRT	Radiometric compilation	Input 100-200m, output 100m grid
2018	MRT	Gravity detailed terrain corrections	Good results
2018-2020	CODES, MRT	Magnetotelluric survey	Unpublished (Tom Ostersen PhD)
2020	Argent Minerals	Reprocessed aeromag and LiDAR	Good results
2020	utas.edu.au	Gravity, mag inversion for 3D mod	Published (Esi Eshagi PhD)

Table 2 List of geophysical surveys and results in or adjacent to the EL12/2017 tenement

Gravity

Gravity is an efficient method to target VMS deposits because of the potentially strong density contrast between the host (volcanics, volcaniclastics and other sediments on the one hand) and the sulphide ore. Gravimetric methods are based on the sensitivity of the gravity field, with respect to the lateral density change of the rocks. This lateral change can in principal can be linked to geological anomalies, such as a magmatic intrusion or an ore deposit.

Tasmanian, onshore, Bouguer gravity and residual gravity grids, gridded to a 125 m cell size, from over 84,000 observation points (<1-7km spacing) has been compiled from numerous government, academic and commercial surveys and is available in the public-domain. Terrain calculation improvements were applied to the dataset in 2018. To study Tasmania at a local scale, the residual Bouguer gravity anomaly dataset is used to assess the contribution of the geological features within the upper 10 km of the crust.

For regional VMS exploration, the effectiveness of gravity is related to the density contrast between the sulphide deposits (densities > 4 g/cm^3 in massive sulphides and ~3-4 g/cm^3 in stockwork veins) and the surrounding MRV host rock e.g. felsic volcanic rocks, black shales and volcaniclastics which exhibit densities below 3 g/cm^3. In general, felsic minerals, containing lighter cations such as Na and K, are noticeably less dense than mafic minerals whose cations are mainly heavier elements such as Fe, Mg and Ca. Felsics exhibit smaller ranges in density than mafics.

At a local scale, massive sulphide deposits can be small and difficult to find targets.

Sulphide stockwork and vein type structures have the potential to be identifiable although gravity has a number of intrinsic modifying factors. One modifier is mineral distribution. Within the same geological formation, the presence of metallic minerals (e.g. sulphide or magnetite veins or disseminations) will increase its average density, while low-density minerals (eg. clays, silica, sericite, carbonates) will have the opposite effect.

Other modifiers include porosity, fracturing and weathering alteration.

Gravity also has limitations which need to be considered in the context of the program such as;
1) Thickness and depth: The method typically requires a thickness (~50 m) and depth (<300 m)
2) Resolution: The tenement gravity coverage has a station spacing of ~2km so a useful wavelength ~4 km whereas for mineral exploration the required wavelength is much less than that. Airborne gravity gradiometry has a higher spatial resolution than conventional gravity.
3) Ground gravity: While expertly reprocessed, high-resolution, ground gravity data is an asset to an exploration program it does require greater field effort and more time. Exploration companies are not permitted to acquire ground-based gravity data outside of their tenements so are reliant on regional, airborne gravity data.
4) Terrain correction: The observed gravity is either reduced to the terrain-corrected Bouguer or free-air anomaly because gravitational attraction of topography depends on the size of the features and decreases with increasing distance from the gravity station. Tasmania has significant topographic variation so the terrain correction is a major component of the complete Bouguer anomaly calculation. Terrain correction values > 1 mGal are not uncommon and can swamp anomalies of exploration interest.
5) The station distribution over the tenement is highly uneven. A statistically irregular distribution of stations can produce distortions and anomaly artifacts. Decreasing the gravity station spacing would significantly improve the resolution of the regional gravity and the interpreted positions of major structures.
6) Where weathering is deep and irregular or where shallow thick glacials or basaltic cover exist, gravity interpretation can be more uncertain.
7) Non-uniqueness: It is less useful for determining the structural control on mineralisation and must rely on seismic and magnetics for inverse solutions because (on its own) gravity can't sufficiently constrain subsurface structure because it’s inverse solutions are inherently non-unique.

The gravity field at Rosebery was detectable despite being affected by the underlying uneven basement topography. Mineralised zone at the Renison Bell mine coincides with an indent on northern flank of a marked negative gravity anomaly. Gravity data delineates the 80,000 t ore body at South Comet accurately. All three are within 2km of the tenement.

The Devonian granites exert the strongest influence on the gravity, so are very evident. The regional Bouguer gravity field derived from the MANTLE-09 program was used in conjunction with regional aeromagnetic data to build a 3D geological model of the MRV in 2013 by MRT.

Radiometrics

Radiometric responses originate from only the top of Earth's surface because the gamma-rays only pass through a few centimetres of rock before being absorbed but it does map mineral species containing anomalous radioactive isotopes. The response originates in the near-surface but is affected by high noise levels and masked by the vegetation cover and weathering.

There are several, public-domain, regional, radiometric datasets available although they both substantially draw from the same Tasmanian radiometric surveys which were typically acquired with a line spacing between 100-200m. Over the EL12/2017 tenement they are remarkably similar.

The Radiometric Map of Australia dataset comprises grids of potassium (K), uranium (U) and thorium (Th) element concentrations, and derivatives of these grids. The 2015 edition was derived by seamlessly merging 595 surveys into a grid using Gridmerge levelled to AWAGS to control the base levels. The cell sizes of the original survey grids range from 50-800 m, but most have a cell size of about 100 m (0.001 degrees). The filtered and unfiltered grids are available. Over the EL12/2017 tenement, the 2015 ternary radiometric dataset appears more heavily filtererd than the MRT generated ternary radiometric map of Tasmania in 2017. The MRT image was compiled from airborne radiometric surveys flown between 1996 and 2013 with typical line spacings ~200 m.

Generally, felsic or intermediate rocks may have high radioactivity, whereas mafic and ultramafic rocks and Fe and base-metal sulphides have little or no natural radioactivity. The white areas on ternary radiometric image correlate with a high concentration of felsic rocks such as in the Curtain Davis mapped area. The concentration is due to the abundance of feldspars and micas and is in complete contrast to the adjacent (black) mafic and ultramafics with extremely low U and Th concentrations. Flanking water bodies such as the Pieman River are also black.

As well as rock identification, radiometrics can be used for the detection and mapping of hydrothermal alteration. Although no direct detection of ore is indicated in the natural gamma-ray radiation elements potassium (K), thorium (Th) and uranium (U), some evidence of hydrothermal alteration related to mineralisation process may be present in the case of shallow deposits. Potassic alteration has been documented as a region. Radiometrics have been widely used to map potassium alteration associated with different styles of mineralisation because alteration halos associated with mineralisation produces potassium anomalies which can be distinguished from normal lithologic potassium variation by characteristic high K/ Th ratios. Often K*K/Th ratio is used instead of K/Th as it further enhances the role of K in the ratio and reduces the high number of anomaly occurrances.

At Renison Bell Mine there is a strong response from siltstone in the Success Creek Group, with the greatest response from these rocks adjacent to the Mine Sequence and where the siltstone intersects an outcropping granite dyke. Th and U is particularly marked. Carbonate-bearing Success Creek Group rocks in the Mine Sequence show moderate response, but considerably higher than the same rocks outside the mine.

Tasmania is often highly saturated and as water attenuates gamma radiation (in fact gamma radiation attenuation is used to evaluate porosity and soil saturation), saturation suppresses gamma.

Other radiometric applications also include the detection and mapping of subtle regolith features, heavy-mineral sands plus it can be used as a machine learning input.

Aeromagnetics

Most of the open-file AEM surveys have been flown in the vicinity of EL 12/2017 in the past 40 years have been completed by either Pasminco or MRT. A summary of the airborne magnetic data is listed in Table 2. Detailed surveys have usually been small (typically ~100 line kms) and restricted to their exploration licenses or part of their exploration licenses. Most of the modern AEM surveys have been flown along E-W flight lines, a line spacing between 100-200m and ~80 m clearance.

Argent Minerals contracted Montana GIS to review and reprocess all relevant aeromagnetic datasets using current algorithms to allow optimal interpretation of exploration targets within EL12/2017.

The input aeromagnetic data for the interpretation was the open-file, 2019 release, AWAGS levelled, total magnetic intensity (TMI) datsets from MRT. Montana GIS assembled, QC'd, projected, rescaled, stitched together and output multiple surveys which were flown with either a 100 or 200 m line-spacing. Each survey was gridded to a 50 m cell size using the minimum curvature method prior to stitching. The grid resolution was ideal for the task.

The reduction to the pole (RTP) FFT filter was first applied to ensure that asymmetry in data was representative of source geometry or magnetic properties. Other image processing techniques and filters were then applied to the stitched grid including VRMI a filter used to remove the effects of remanence for anomalies where it appears to dominate the observed signal. Parameters were 11 cells, variable direction RTP, band pass filter: 100m to 10km, geomagnetic data magnetic inclination -71.779°, magnetic declination +13.385° IGRF intensity 61705.8 nT and geographic data map projection MGA94 datum UTM zone 55S (EPSG 28355).

The principal aims of the interpretation was to provide a better regional geological and structural framework of EL 12/2017 and to highlight any specific target areas encountered during the interpretation. The interpretation of magnetic data employed was largely semi-quantitative.

The newly reprocessed magnetics were evaluated in conjunction with the geological and other geophysical datasets. The customised data processing enhancements were sufficient to enable the analysis of regional and local scales while low frequencies were filtered to enhance deep magnetic sources and high frequencies were retained to enhance shallow sources. The datasets were analysed at a fine scale to capture local detail and at a coarser scale to identify regional picture in order to maximise geological understanding. Interpretation of the newly reprocessed magnetics identified a number of key observations on E12/2017.

Quite a few of the localised, non-linear, positive anomalies in the tenement area containing the Central Volcanic Complex are interpreted as clays within glacial remnant cover (high amplitude, shallow features). VRMI filtering was used to separate the shallow effects but in the reprocessed magnetics, the overburden anomalies had such high amplitudes that frequency separation was insuffient to remove their imprint. This was in part due to hydrolectric power lines that cut across the area having a strong magnetic (and EM) signature that masks underlying anomalies.

Sulphides with high values of magnetic susceptibility (monoclinic pyrrhotite) are often associated with VMS ore bodies. Magnetism readily distinguishes deposits bearing magnetite or ferromagnetic pyrrhotite (particularly VMS deposits). It can have high induced magnetisation, but pyrrhotite also has a significant remnant magnetisation which can cause difficulties in modelling. Massive sulphide replacement ore bodies can have high susceptibilities and high remnant magnetisation and that is true of Renison Bell mine. Disseminated pyrrhotite with low susceptibilities can produce local anomalies but in general, aeromagnetics is less effective for finding disseminated as opposed to massive targets.

Electromagnetics

In principal, electromagnetic techniques allow the detection of conductive deposits, based on the EM induction principle. Electromagnetic data has been recognised as a contributor to VMS discoveries over many decades because it directly detects highly conductive VMS mineralisation. Sulphides with high values of magnetic susceptibility (pyrrhotite) are associated with VMS ore bodies. Magnetite in VMS deposits typically occurs in the core of the stockwork in the unit of the overlying sulphide lens. Magnetite and hematite contribute to strong positive magnetic anomalies. Electromagnetics can highlight lithological boundaries, shallow weathering, alteration, metamorphism and particularly help with structural interpretation.

The Western Tasmanian Regional Minerals Program (WTRMP) acquired aeromagnetics, radiometrics, radar and frequency-domain EM (FDEM) in 2001 with datasets and results published between 2002-2003. It was acquired via AeroSpatiale helicopter with a nominal flight height of 80m, lines oriented E-W, every 200m plus N-S tie lines every 1km. EL12/2017 coverage is 88% with a coverage gap in the south-east corner. The WTRMP equipment towed birds at ~30m for the following surveys 1) aeromagnetics using total field magnetics, 2) radiometrics used a 256-channel spectrometer, 3) radar altimeter data and 4) Hummingbird 5 channel, frequency-domain EM (FDEM) survey with 5 channels; Ch1 7000Hz (Orientation CX) Coil Separation 6.26m, Ch2 6600Hz (Orientation CP) Coil Separation 6.26m, Ch3 980Hz (Orientation CX) Coil, Separation 6.01m, Ch4 880Hz (Orientation CP) Coil Separation 6.01m and Ch5 34000Hz (OrientationCP) Coil Separation 4.93m. Excellent lateral spatial resolution was acquired.

The FDEM system measured resistivity at five frequencies whereby higher frequencies measured resistivity in the shallow subsurface and lower frequencies measure deep resistivity. Differences in resistivity were attributed to a range of factors including geological variance, groundwater and salinity, and regolith type and depth. Multiplots showing raw HEM responses, TMI, radar altimeter, and CDI and Sengpiel sections have been found to be the most valuable interpretation products. The maximum depth of investigation for the the FDEM system has been estimated at ~150m but may be <50 m in very conductive areas. In general, compared to modern EM survey systems the survey had low penetration therefore it just images Hellyer at a depth of 100m. A good EM anomaly response was obtained over the Renison Bell mine (except the consistently resistive far NW extent). The conductive zone extends to include mineral prospects and deposits south of Renison and the tailings dam to the north. However, there was no consistent or differentiable response between mineralised zones and variable response observed in adjacent rocks. Fourteen new, anomalous EM responses were delineated by Pasminco in 2000 following analysis of the apparent resistivity data. Analysis of stacked profiles provided the best means of anomaly prioritisation. A majority of the low resistivity responses were determined to be dominantly high frequency quadrature responses (poor conductors). All identified EM responses were within 50-150m from the ground surface and often from Permian sediments and glacial cover.

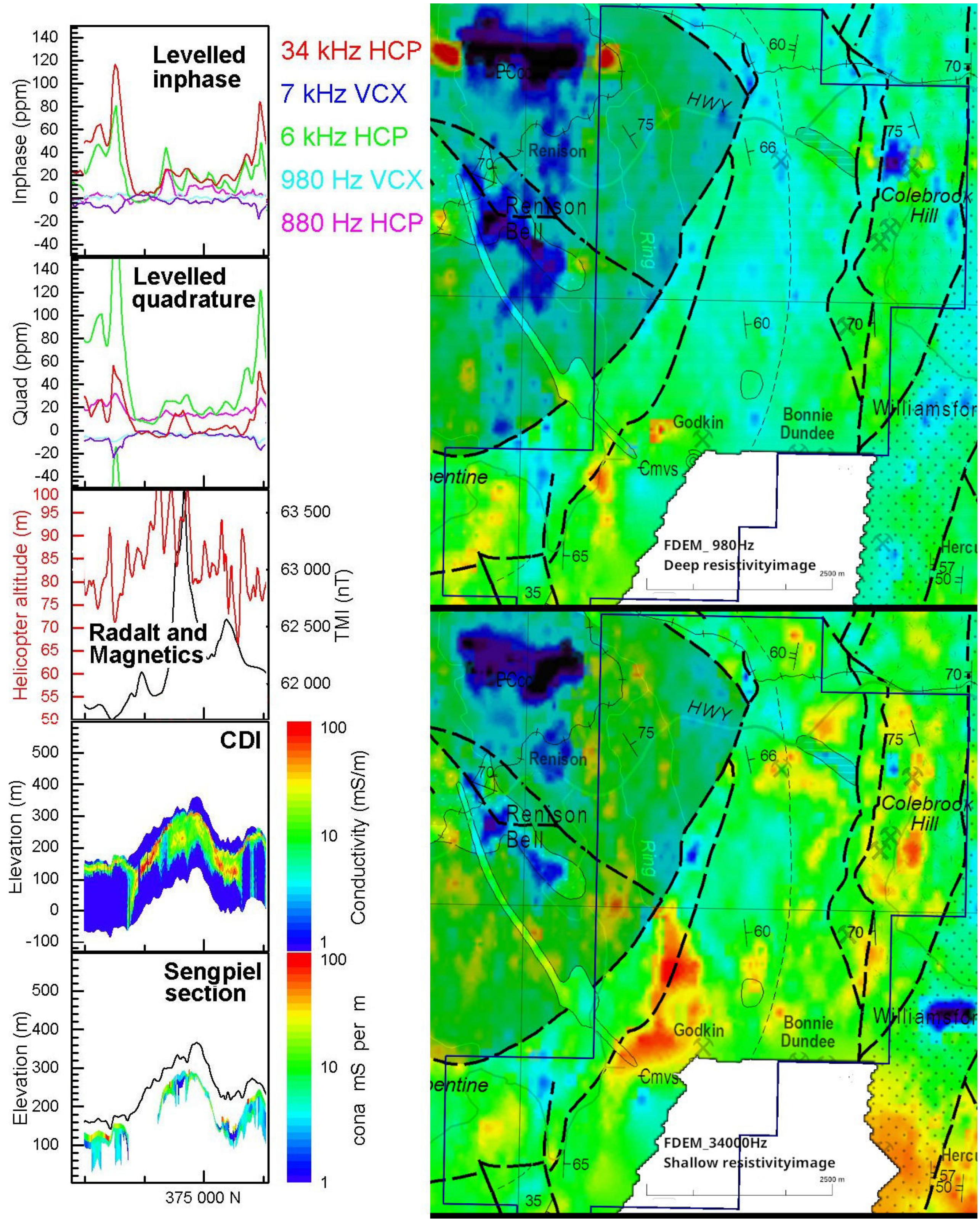


Figure 3 Western Tasmania Regional Minerals Program (WTRMP) Hummingbird 5 frequency EM datasets developed by Geotech. Left panels shows levelled inphase and quadrature, radar and magnetics, CDI and Sengpiel section for a segment of panel D12171, an E-W section through EL12/2017 along 5374000mS, easting is indicated. Plan view of deep apparent resistivity image (of vertical coaxial coil 980Hz)(top right) and shallow apparent resistivity (coplaner coil 34133Hz) (bottom right) showing key structures and tenement EL12/2017 boundary. Note that (apart from Renison Bell) the most anomalous, deep response is the Colebrook Hill mineralised skarn system which is interpreted to be due to magnetic pyrrhotite.

Colebrook Hill EM Anomalies

Anomalous EM responses in the 1999 FDEM data coincided with the known Colebrook Hill skarn mineralisation (D4 and D5 below). Twelve other FDEM responses were defined as worthy of ground follow-up with most having had some previous work conducted on them. D4 and D5 remain undrilled and lie within the tenement. Details about site access, ground check, lithology, geophysics, drilling, target and source are included below.

Anomaly D4 targets a possible northern extension of the Colebrook Hill skarn system with the same geophysical characteristics. D4 = 374350mE 5372200mS AMG AGD84

Anomaly D5 targets the Colebrook Hill area, extensively explored in the early 1980s by the EZ-Getty Oil JV who concluded that the area is a Cu-As-Sn-W skarn zone containing a steeply dipping lode hosting sub-economic copper mineralisation (max. 1.3m @ 3.02%Cu). Key factor: The area is underlain by a geochemically anomalous granite. Intense hydrothermal activity, alteration, tectonic activity and mineralising events are associated with the granite. A massive 1km wide aureole of boron-fluorine-iron metasomatism surrounds the granite ridge, resulting in the extensive alteration of ultramafic rocks to serpentinite and talc-carbonate bodies. High levels of S, As, Sn, W, Cu, Pb and Zn appear to have accompanied the metasomatic event. D5 = 375000mE 5371500mS AMG AGD84

ID	**ACCESS**	**LITHOLOGY**	**GROUND CHECK**	**COMMODITY**
D4	Inaccessible	Contained within Undifferentiated Dundas Group. On the western side of a fault which is against a N-S rending Cambrian Ultramafic rocks, serpentinite and talc carbonate rocks of the Henty River Sequence.	Not checked	Late Devonian replacement Cu-As (<100t)
D5	Accessible NS-trending vehicle track = FOOT (Natone Ck impassable?)	Centrally located within the Crimson Creek Formation. Contains undifferentiated basaltic lithic wacke, siltstone and red to green mudstone, with minor basalt to ultramafic intrusives.	Black pyritic shale and interbedded greywacke and grey silt. So 140/85SW. Old workings on topographic high with py-chpy-arpy disseminated veins with Fe-Mn oxide zones	Late Devonian vein Cu, Sn, As (10kt-1Mt)/ replacement Cu, W, Sn,Ag

ID	**GEOPHYSICS FDEM**	**GEOPHYSICS MAG**	**DRILLING RESULTS**	**SOURCE**
D4	A small N-S striking anomaly lying to the NW of Colebrook hill. The anomaly has the same characteristics as the Colebrook Hull mineralisation.	The D4 anomaly lies within a NW-SE striing lineament (structural break) delineated from the magnetic data.	Not drilled	Colebrook Hill Skarn
D5	Colebrook Hill mineralisation. The anomaly has several separate sources, shows great depth potential and appears to be plunge to the south. The type of mineralisation and extent of existing drilling needs assessmt.	The Colebrook Hill EM anomaly is situated directly on the high amplitude (several 100's nT) magnetic anomaly and lies within a NW-SE lineament (same as D4)	Not drilled	Colebrook Hill Skarn

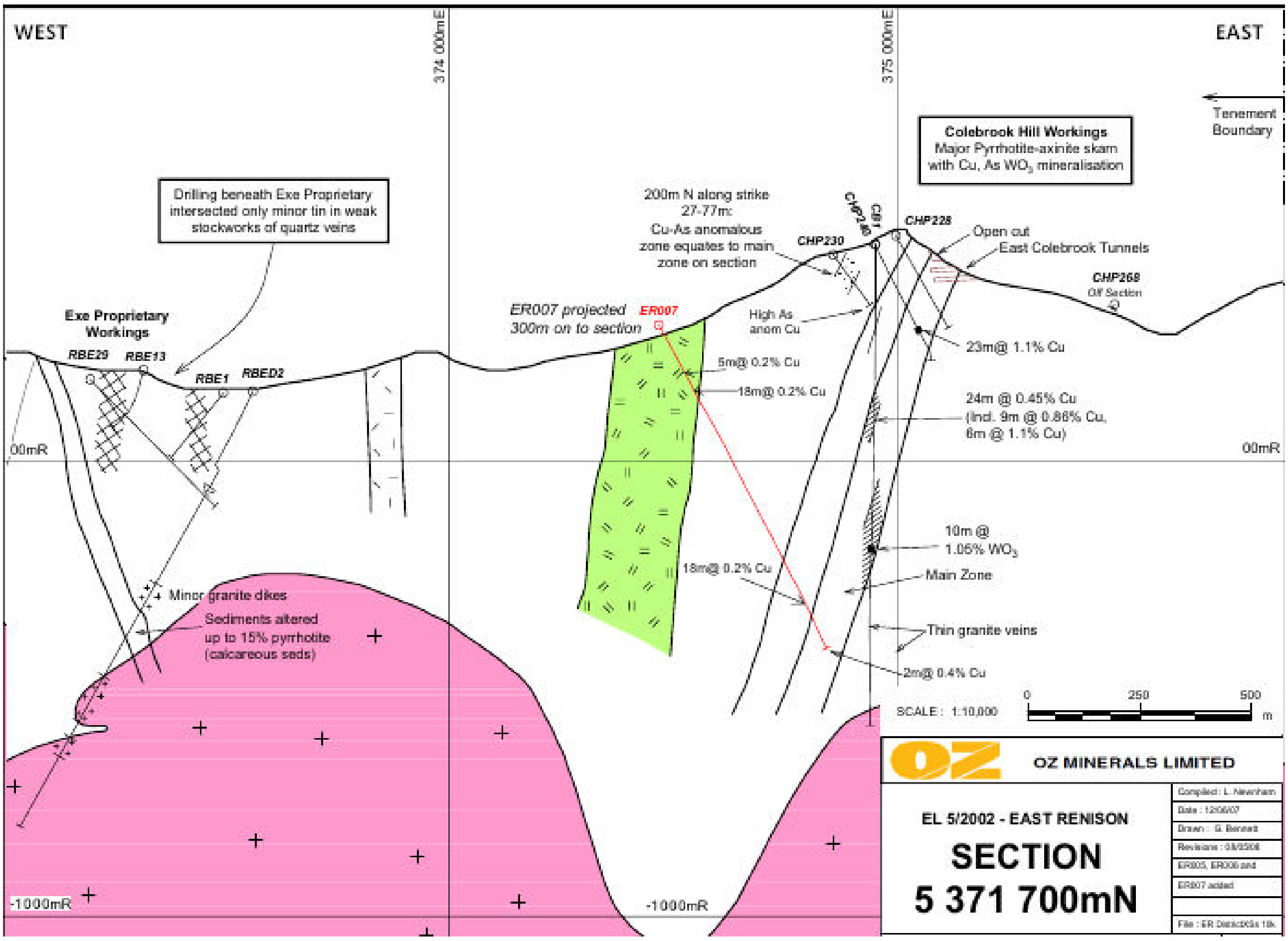


Figure 4 Colebrook Hill cross-section (2007) showing granite and ultramafics in relation to drilling.

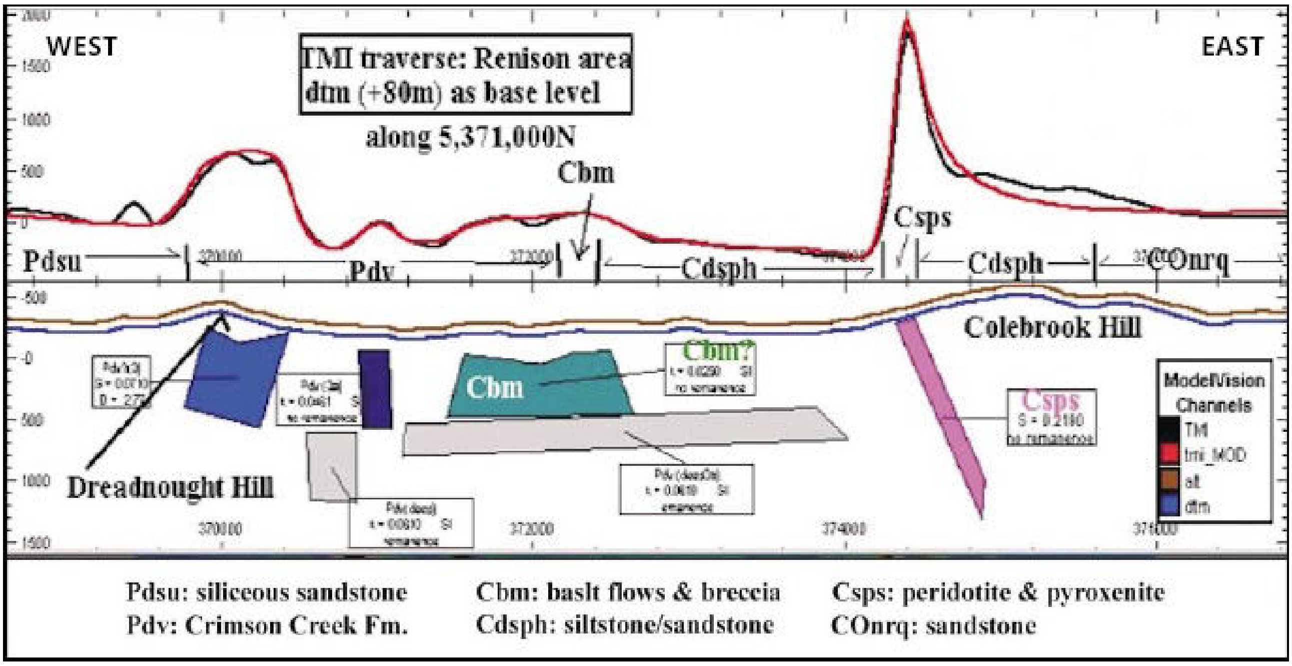


Figure 5 Colebrook Hill cross-section (2002) showing ultramafics based on inversion modeling.

Resistivity, IP and Magnetotellurics

Resistivity and IP

Unlike the electrical resistivity signature, very few materials produced a strong IP response and so often IP acquisition is combined with resistivity measurement. Induced Polarisation (=Induced Potential) is an electrical method that responds to the ability of the ground to become electrically polarised. It works by inducing an electric field in the ground and measuring the chargeability (mV/V) and resistivity of the subsurface. IP measures the storage of the electrical charge in the ground.

Fe sulphides are good conductors and can help to detect the associated Pb-Zn deposits, even if the strongest IP signal does not always correspond to the highest Pb-Zn content. **For non-conductive sphalerite deposits, IP has been the most successful exploration technique**, although EM might perform better, as other sulphides may actually still produce an anomaly.

The water content greatly influences the conductivity of a unit. Saturated overburden may produce conductivity values that effectively mask the EM of the VMS mineralisation

Regional aeromagnetic, airborne electromagnetic and gravity surveys did not identify the Hercules VMS Zn-Pb-Cu-Ag-Au mineralisation even though it is hosted within highly resistive volcanics. The deposit is made up of a number of small, steeply dipping, ore lenses. Limited petrophysical data indicated the ore to be poorly conductive, non-magnetic, of moderate density and moderately chargeable. However mineralisation was indirectly detected from IP surveys because the overlying black shale sequence was found to be chargeable.

In 2016, researchers evaluated airborne IP responses from airborne inductive and galvanic ground systems in the vicinity of the tenement. They found that a range of airborne IP responses were found to considerably improve the fit to the observed AEM data and the overall fitted IP parameters were spatially consistent, although the locations of anomalous IP parameters were quite distinct from anomalies in other geophysical data. The airborne chargeability highs were adjacent to the ground chargeability highs. Modeling for sulphides predicted that an inductive airborne system was insensitive to conventional IP targets, unless the mineral grain size is substantially <1 mm. Where airborne IP responses were adjacent to ground IP targets they concluded that the airborne IP response may be due to finer grained minerals in an alteration halo surrounding the sulfide sources of the large ground IP anomalies.

In western Tasmania, mild silicification reduces the conductivity of massive-sulphide mineralised units. Further complications are the poor conductivity of sphalerite, having a saturated (non-saline) overburden, complex geometry and topography. The following are resistivity and IP conclusions;
1) Good discrimination of pyrite zones and massive pyrites on the basis of electrical properties,
2) Can distinguish massive sulphides from black shales via DC resistivity and chargeability,
3) There are some abnormally low deposit resistivities (eg Hellyer) and
4) Conical-shaped deposits produce weaker electrical anomalies than the tabular shapes (Rosebery)

Northwest of Lake Rosebery was covered by BHP's extensive blanket TEM survey and by Pasminco's 50-m dipole-dipole IP-Resistivity survey. Three expert groups, BHP, Mitre Geophysics and Lamontagne interpreted the TEM data and all concluded that there were no 'good' anomalies instead only numerous weak responses presumably related to lithological contacts and resistivity differences, water or clay-filled shear zones, and variations in overburden thickness and conductivity.

Magnetotellurics

Magnetotellurics is a passive electromagnetic technique that records the Earth's electrical response to natural, time-varying magnetic fields. The fields (for a bandwidth between 0.001 s and 10,000 s) are generated by interactions between solar winds and Earth's ionosphere and magnetosphere. Recording time-varying fields with a bandwidth range of 0.001–1000 s are required for lithospheric investigations. Magnetotellurics measures the strength and direction of the electric and magnetic fields associated with the telluric currents, from which the subsurface resistivity is obtained. Data processing uses a Fourier transformation of the electric and magnetic field time series data into the frequency domain to derive the complex impedance tensor of the subsurface.

The impedance tensor links the horizontal components of electric and magnetic fields in the frequency domain and reflects the Earth's resistivity structure beneath the measurement point.

The apparent resistivity and phase as a function of frequency are then derived from the impedance tensor.

CSAMT can also be done explicitly for exploration purposes but none have been acquired either in or near the tenement. MT discriminates resistive as well as conductive zones (whereas EM responds only to conductive features).

Also it allows a broader range of depths than other geophysical techniques except seismic, it has a greater level of sensitivity to lateral and vertical electrical conductivity variations and it tends to be used for low-cost exploration for larger electrical targets and for mapping the deep crustal roots as a vector to undercover deposits.

The Australian Lithospheric Architecture Magnetotelluric Project (AusLAMP) acquired broadband (0.001–1000 s)(i.e. wide frequency) MT data in Tasmania in 2016. The data collected is of a high quality with smooth impedance and tipper responses.The data has been processed (inverted using a smooth 3D inverse algorithm) and is being finalised in 2020.

Advanced 3D visualisation is being used to investigate relationships between the newly determined conductivity structures at depth, and crustal architecture such as granite bodies. This has clear mineral exploration ramifications by revealing conductive regions below the base of the crust that may represent fossil fluid pathways though to the crust.

Other Geophysical Methods

SAR Dataset and Interpretation

SAR datasets were also used in 2018 for a lithological classification study in the nearby Heazlewood region. It validated the method for geological mapping in remote and inaccessible Tasmania but stressed that there was an inconsistent relationships between geology and vegetation or geology and topography and so it should be used in conjunction with other datasets such as hyperspectral datasets (with a similar resolution).

PALSAR2 swaths acquired by JAXA were processed by Internode Seismic. Shadows in the SAR images occur as dark regions tarnished by thermal noise. Preprocessing involved 1) ortho-rectification of SAR subsets using the 12.5-m DEM 2) adaptive Lee filtering to remove the radar speckles while preserving key features 3) mosaicking and subset and 4) layer stacking and 5) output. By utilizing the dielectric properties of the polarimetric radar data, the surface texture or roughness was mapped, providing lithological and structural trend information. In particular, the 21 m resolution PALSAR2 data (L-HH) revealed information about outcrops and structural trends whereas the L-HV polarisation showed improvement for mapping lineaments and moisture content. An important point about SAR data is that it is relatively unaffected by vegetation because radar waves penetrate leaf canopies and ground cover. In areas of shallow sand cover, the radar data provides some indication of bedrock morphology.

Detailed digital elevation models (eg SRTM) are created from these SAR datasets but these are increasingly being surplanted by LiDAR coverage.

Hyperspectral Datasets and Interpretation

Bass Metals deployed an ASTER remote sensing program to map regional wall rock alteration using low-res (30m and 90m) ASTER imagery. The program failed to reliably indicate any anomalous areas due to the dense vegetation over the North Rosebery tenement (EL54/2004).

Hyperspectral Shortwave Infrared (SWIR) and Thermal Infrared (TIR) data has been well documented in the exploration of many mineralisation types including the vectoring VHS targets.

Spectroscopy signatures are detectable in minerals on hi-res satellite, aerial and ground-based spectral data. These can be used in the MRV as mineralisation vectors.

The effect is quite subtle, it uses *spectral absorption* and *wavelength position* around 2250 nm and 2340 nm to differentiate Mg-rich chlorite from Fe-rich chlorite. Chlorite wavelength position is minimised nearer an orebody and chlorite absorption feature depth is shallowest nearest an orebody. Specifically the *wavelength positions* shift from 2254 to 2249 nm and from 2343 to 2332 nm and the *absorption depths* decrease from around 35% to 5% respectively, moving from ~1.6 km to 500 m away from an orebody. A shift in white mica wavelength can be used as a hydrothermal pH indicator too.

As above, the K-mica (sericite) mineral signature can be detected and mapped by measuring precise wavelength shifts around 2200nm and biotite spectra can map the transition from Mg-rich biotite (proximal ore system) to Fe-rich (distal area). Finally, Epidote exhibits a major feature near 2340 nm with a sharp, but lesser, absorption near 2258 nm. Subject to the spectral bands being present, a vast range of mineral spectra can be characterised in this way.

Conventionally the best VMS vectors and halos in order of increasing size are 1) Ishikawa Alteration Index (smallest size), 2) Mn 3) S/Na2O, 4) Ba/SR and 5) Tl and Sb (largest size). Rosebery for example has a clear thallium and antimony halo (100ppm near and 1-10ppm far). The formulas have evolved. Now semi-volatile metal distribution (As, Se, Cd, In, Sn, Sb, Te, Hg, Tl, Bi) is being used for VMS deposit pathfinding. The alteration halo can comprise a narrow proximal chlorite and wider distal sericite zones. The proximal signature of the chlorite zone is enriched in Sb and Li while the distal signature of the sericite zone is enriched in Sn, W, and Tl.

LiDAR Dataset and Interpretation

The tenement terrain is characterised by steep terrain, high rainfall and forest. The trees are Blackwood, Sassafras, Beach Myrtle, Waratah, Horizontal, King Billy and Huon Pine and eucalypts. Cambrian target unit exposure is generally very poor, especially in valleys where Pleistocene glacial moraines, alluvial fans and colluvial slopes form blankets of highly variable thickness.

Previous, on-ground access over the steep, slippery gullies was via cut lines at 100m intervals through dense horizontal scrub and forest. Finding a gossan, mineralisation, structure or horizon continuity in such conditions was extremely difficult given the abundant summer tiger snakes.

LiDAR surveys by mineral exploration companies in rainforested areas in western Tasmania in 2008-2012, produced relatively poor DEMs, characterised by poor ground point density (average point spacing of 5–30 m), high noise and other errors.

Australian LiDAR service providers and consultants used to recommended small diameter pulses and staying close to nadir whereas Fugro recommend increased canopy penetration for large spot sizes and a significant decline in ground returns when more than 15° off nadir. Together with advances in LiDAR instrumentation, including increased power and pulse frequency, decreased echo separation and faster detection electronics indicate that the technology may now be capable of better imaging the ground surface below Tasmania's densely forested areas.

Full waveform LiDAR datasets have since been acquired by exploration companies and state government bodies. A low altitude offered an average point density of 4 points per square metre and a high level of accuracy). The vertical positional accuracy was at least ±30cm and the horizontal positional accuracy was at least ±50cm (both have $2\sigma = 95\%$ over flat, open ground). Closely spaced, generally N-S flight lines yielded survey coverage with swath overlap due to the low density of ground returns underneath vegetated terrain featuring dense, multi-storeyed forest canopies and steep terrain. The LiDAR dataset outputs were seamless, AHD, bare earth terrain tiles on a 1x1m grid.

When the high-resolution airborne LiDAR data was applied to study areas near Rosebery and Luina, it revealed unprecedented views of the surface geomorphology of bedding traces, faults, shear zones and ground works associated with historical mining operations hidden beneath the thick vegetation. For the first time, evidence of multiple, new, multi-km-long faults across EL12/2017 is presented. Tilt derivative filtered LiDAR data and with multiple azimuths and illumination angles reveal bedding traces can be seen on high-resolution 1x1m DEMs enabling the extraction of structural bedding data for 3D geological mapping purposes.

4. RECOMMENDATIONS

In the search for deeper mineral targets, this project has reprocessed and interpretated existing AEM, LiDAR and SAR datasets. Next, the following section evaluates further selected techniques that are best suited at regional and local scales to exploring the EL12/2017 tenement. The cost of each has not been defined except for the IP survey proposal.

The geophysical signatures of base metal mines and key deposits have been presented and evaluated. Induced polarisation (IP) is the best method for directly detecting unmetamorphosed sediment-hosted deposits and carbonate-hosted deposits. Electromagnetics (EM) is probably the best for volcanogenic and metamorphosed sediment-hosted orebodies. Magnetics is best for skarns. For all targets, it is emphasised that usually more than one method is required.

Regional Scale

For the past several decades there has been no economically significant mineralisation discovered on EL12/2017.

The key features of the shallow exploration model were proximity to deep-seated, long-life structures within the MRV and the existence of major alteration and mineralised zones associated with those structures. **Now the current goal is to find deeper mineralisation** which represents a major opportunity. Conventional exploration techniques are being surplanted as **new detection technologies**, data, information and business models are required to meet the challenge. Deep detection techniques include magnetotellurics (MT) and gravity. Data inversion techniques (particulalry anisotropic inversion of resistivity data) in conjunction with other geophysical methods offer improvement in deep imaging.

In support of this, a regional understanding of the structural and stratigraphic framework has emerged via advances in geochronology, lithospheric architecture, geodynamics, mineral system footprints and vectoring, often via consolidated research centres (eg. CODES). The optimal contribution of regional analysis of mineral deposits is in it's predictive capability as the targeting process transitions from prediction to detection in the deep-covered tenement areas. **Development of a regional predictive capability** represents a signicant challenge but it’s the first step to being able to refine which areas have the best target potential.

Prediction and new detection technologies must be supported by associated data compilation and potentially new acquisition need to be considered. **Data compilation** of geology, geochemistry, geophysics, geodetic and other datasets allows the better value to be from previous work. Data compilation is about getting full value from an earlier investment. Compilation reveals coverage gaps while reprocessing old datasets with advanced techniques and algorithms should result in cost-effective, better quality imaging.

As a generalisation, the following broad-scale methods are used to identify prospect areas: *Stratigraphy*: Economic mineralisation appears restricted to quiescent intervals (fine to medium grained volcaniclastics, often overlain by shales) at the top of the Central Volcanic Complex or in the Lower Tyndall Group. *Structure*: Syn-volcanic Cambrian structures that may be related to mineralisation are defined by volcanic facies changes and gravity/magnetic data (for deep structures) and(or) using fault orientations derived from detailed 3D studies of orebodies. *Geochemistry*: regional stream sediment coverage may highlight areas of interest, Pb isotopes are used to differentiate Devonian and Cambrian mineralisation in outcrop and(or) soils. *Geology*: Locate areas of footwall (sericite-pyrite-silica) or hangingwall (sericite-carbonate) alteration.

Inversion and 3D Model

MRT developed a high resolution, regional, 3D inversion model of the Rosebery-Lyell province in 2016. The Rosebery-Lyell 3D model was constructed using public-domain datasets; aeromagnetic, gravity, drilling and a petrophysical database. The model was discretised to 200 × 200 × 100 m cells for forward and inverse gravity and magnetic modelling using the GOCAD potential field module and unit property estimates derived from MRT’s petrophysical database and previous work. Deterministic geophysical validation was used to ensure the final output model was realistic.

Petrophysical Database

In parallel with the various geophysical techniques, the development of a comprehensive multiple parameter petrophysical database of properties from the mineralized environment would allow better workflows and advanced analytic tools to build geophysical interpretations of exploration targets at greater depth and under cover. Understanding the relationship between the geological characteristics of rocks and their detectable physical properties remains an essential goal in the drive for successful discoveries. Without that understanding linkages between geology and geophysics, petrophysical knowledge cannot build a proper 3D model of the subsurface.

A specific exploration purpose would be to decipher the relationship between mineralogy and the petrophysical, mechanical, and hydraulic behaviors of the target volcanics in order to correlate and predict where the mineral abundances are located. An exploration program in the area would benefit by petrophysical characterisation because it enables hard rock physical properties to be related to geological characteristics. This involves building a multi-parameter database of petrophysical properties (such as density, magnetic susceptibility, velocity and perhaps electrical properties, then analysing the data within a rigorous geological framework to (for example) enable controls on properties other than lithology to be recognised at greater depth and under cover eg. Table 3.

The GOCAD Mining Suite now includes gravity and magnetic modelling and inversion that allows modelling and testing of plausible 3D geological models, consistent with geological and geophysical data.

Stratigraphic Unit	**Density (g cm-3)**	**SD**	**Magnetic Susceptibility ($\times 10^{-3}$)**	**SD**	**P-wave velocity (m/s)**	**SD**	**S-wave velocity (m/s)**	**SD**
Success Creek	2.80	0.10	0.65	3.79	5895	383	3943	480
Crimson Creek	2.88	0.10	7.25	19.92	6057	420	3617	371
Ultramafics	2.73	0.23	10.29	14.82	6087	551	3916	306
Ultramafics1	2.65	0.19	14.45	16.08	-	-	-	-
Ultramafics2	2.86	0.14	0.75	0.66	-	-	-	-
Owen Group	2.63	0.07	0.08	3.52	5578	165	3648	366
Devonian Granite	2.62	0.05	0.39	1.19	5223	497	3543	552

Table 3 Estimated petrophysical properties for rock units within tenement EL12/2017.

Gravity and Radiometrics

Gravity data infers subsurface geometry in the upper crust when there are strong density contrasts.

Using the existing gravity grid only provides basic regional information such as depth of cover (or depth to basement), the dips of major fault networks plus it contributes to 3D inversion solutions.

Currently aerogravity costs are similar to ground surveys for reconnaissance-scale surveys. The spatial resolution is equivalent, lower aerogravity precision is less critical and airborne and ground data can be merged seamlessly for interpretation. Airborne gradiometry has advantage of not requiring ground access.

Exploration companies tend to rely on government-commissioned regional gravity surveys with a recent preference for full-tensor gravity gradiometer data (eg. all of Western Australian covered via AIRGrav). The full tensor gradiometry system measures the rate of change of gravity in all directions of the field, caused by subsurface geology. High-resolution airborne gravimetry would be an ideal regional technique for illuminating the near surface geology. The principal drawback is that to achieve high resolution a dense line spacing is required which increases the cost, making it an expensive survey technique even for government.

Microgravimetric surveying techniques are developing but are used for geotechnical investigations because they lack resolution at mineral deposit depths. The GOCE-based satellite gravity can only provide a regional gravity field model. The best potential for obtaining detailed gravity in highly-variable topographic terrain, might be drone-based methods but these currently require significant development so are not feasible at this time.

Using existing, gridded radiometric datasets, the following regional mapping work should include;

1) Draping radiometric data on a radar or LiDAR-based elevation model to separate anomalous topographic, landform weathering and moisture effects from mineralised, host rocks - especially in rugged terrain.

2) Combining radiometrics with hyperspectral remote sensing for spectral characterisation of alteration minerals for vectoring purposes because they also are only sensitive to surface material. SWIR reflectance spectral analysis of wavelength positions or absorption depths may highlight key alteration indicator minerals while thermal-infrared spectral analysis can map quartz and feldspars subject to sufficient spectral resolution.

3) Combining radiometrics with the aeromagnetic data as it supplements the radiometric data. While it does not define stratigraphy as well, in some places it clearly defines major geological units and structural events.

4) All of the above tasks can be united in knowledge-driven prospectivity analysis (via combined radiometric, elevation, magnetic and spectral products) to perform unsupervised classification to cluster then characterise lithological units.

There has been less success in the radiometric detection of potassic alteration haloes associated with VMS deposits than porphyry deposits but there have been recent development in data processing, reduction methods and progress in understanding the radioelement behaviour. Hydrothermal alteration zones are a potential source of radiometric response detection at EL12/2017. These areas will tend to be linear, have a width of about 1 km and be located adjacent to Cambrian and Devonian structures. The depth of erosion is an important control on the radiometric response too.

Local Scale

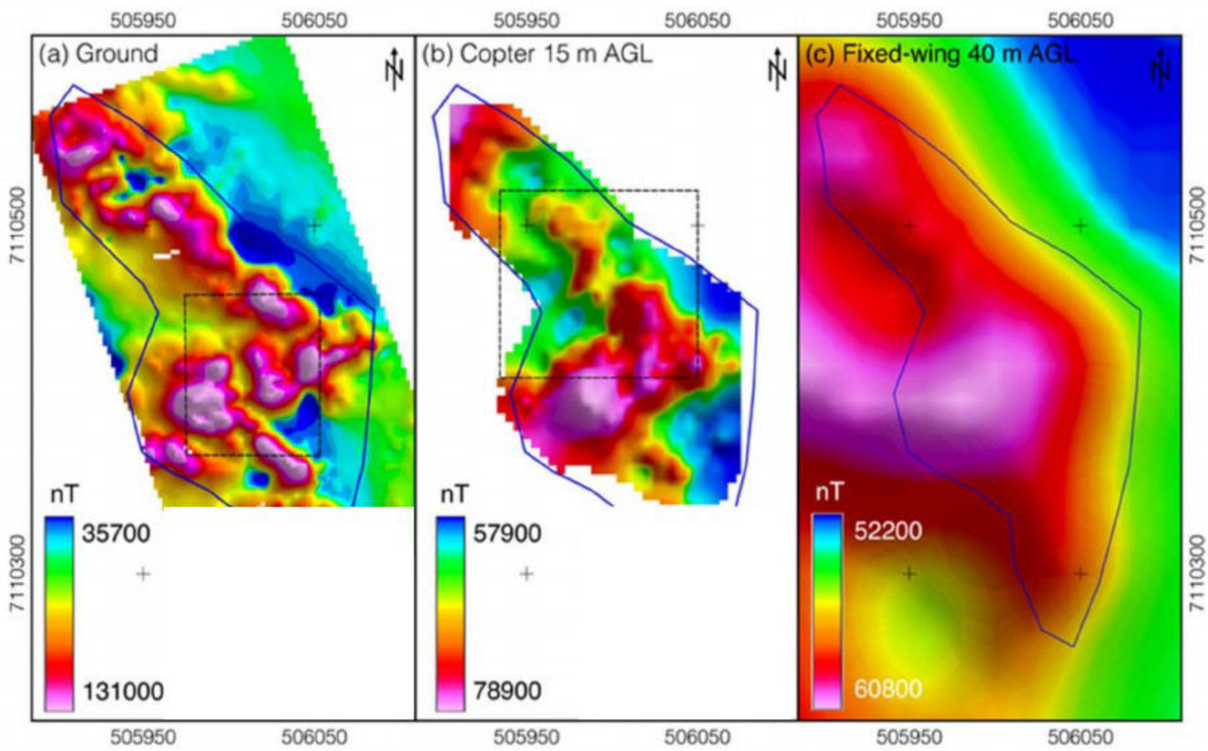
The following section evaluates and recommends selected techniques that are best suited to exploring the EL12/2017 tenement on a local scale. The cost of then has not been defined.

Pasminco expressed the idea that the key to the next generation of MRV discoveries in the area would come from local scale exploration using partial leach soil sampling (a mobile metal ion geochemical technique), geological mapping and selected ground geophysics. Traditionally the following local-scale geophysical methods have been used to identify and directly target shallow MRV VMS targets: Ground EM, DHEM, IP and CSAMT. These have been deployed in the search for potential host stratigraphy adjacent to interpreted Cambrian or Devonian structures.

The following geophysical technologies should be prioritised to further refine the regional findings:
1. Drone AEM **2. Targeted IP** **3. Time domain HEM** **4. Magnetotellurics**

Most of the MRV area is covered by AEM surveys which completely cover the tenement at a line spacing of 200 m or better. This line spacing is similar to publicly available data in most other mineral provinces in Australia. VMS exploration has always been strongly oriented towards geophysical methods, so the recent developments in electromagnetic techniques that result in deeper and higher resolution are expected to have some impact on VMS exploration success. However, it seems unlikely that acquiring any AEM with a regional line spacing will map formational bedrock conductors and hence wouldn't provide the assistance necessary for geological targeting. Ground magnetic surveys may, but the terrain is in general, problematic. Ground EM would however provide broad indications on where the conductivity of the cover is too great for AEM to effectively test for bedrock conductors. Ground EM is often deployed to verify AEM and to test proximal areas exhibiting geochemical anomalism. Subject to suitable acquisition specifications, it offers additional resolution and depth penetration in order to accurately resolve target conductance and geometry.

FTMG magnetics are being used intensively for mineral exploration. This new generation system is capable of detecting minerals and precious metals that were deemed "undetectable" before. Currently the most commonly used and accepted practical FTMG system was developed by IPHT. SQUID-based full tensor magnetic gradiometer technology has been successfully applied in areas of conductive cover. Spectrem Air and DIAS Airborne offer HeliFTMG however FTMG is expensive.Fixed-wing and rotary-wing UAV's or drones are being deployed for mineral exploration purposes to acquire magnetic data at altitudes between ground level to >100 m. Fluxgate vector magneto-meters are suited to UAVs because they are small, have a low power consumption and have precision navigation. Scalar calibration corrects both the sensor-related measurement errors and the magnetic effects of the UAV. Despite not being absolute magnetometers and having a lower sensitivity than scalar magnetometers, a UAV-mounted three component (3C) magnetometer with scalar calibration would be able to perform surveying with an equivalent quality to conventional ground or airborne surveys. 3C fluxgates tend to be used in areas of little to no conductive cover.



Remote Sens. 2019, 11, 2084; doi:10.3390/rs11182084 Figure 11

Figure 6. TMI plots from all magnetic surveys with flight type and heights indicated, note drone.

A locally available time-domain EM contractor for BIPTEM is Thompson Aviation. BIPTEM uses a combination of rotation rate sensing, waveform optimization and suspension to collect useful inductive magnetometer B and dB/dt field data at extremely low base frequencies, and been successfully tested over known IP targets. Most time-domain systems use a base frequency >25 Hz.

MIMDAS is an advanced electrical geophysical technique which collects multiple geophysical datasets (chargeability (IP), resistivity/conductivity (IP and MT)). ConsultGRS.com.au offer MIMDAS surveys with better versatility and potential depth penetration than standard geophysics. Many of the 3D IP services and equipment contractors are based in Canada.

Several of the best suited for detecting moderately conductive VMS deposits under a thick overburden are CGG TEMPEST 12.5 Hz system and the SpectremAir SPECTrem. Other powerful systems are VTEM, Helitem (25 Hz), SkyTEM, Xcite. The principal goal of using these systems is to penetrating through thick, conductive or moist cover sequences and in conjunction with other geophysical techniques, map the strong conductive trends in the most prospective, deep MRV units.

If zinc-prospective host sequences in the MRV are conductive themselves or associated with conductive pyritic formations while also associated with a low magnetic response, then they should be detectable with combined electromagnetic and magnetic techniques. An MT program would be warrented to map and prioritise any significant base-metal conductive area.

AMT provides information about crustal resistivity at a variety of depths. Three types with specific investigation depth ranges; Audiomagnetotelluric (AMT) record time of 2 hours and investigation depth range of 50 m to 5 km (100-1000m station spacing), Broadband (BBMT)record time of 16 hours and investigation depth range of 300 m to 150 km and Long Period MT record time of 3 weeks and investigation depth range of 15 km to 500 km. Controlled-source AMT would ideal unless deep crustal conductivity pathways are of importance.

Key considerations are that MT surveys are designed to help regional target exploration rather than drilling. Inversion is used to generate resistivity depth models which involves interpretation with the potential for non-unique solutions which can impact target resolvability and interpretation outcome.

IP Survey Proposal

As part of the ongoing exploration program, Argent Minerals Ltd should commission a **combined induced polarisation (IP) and resistivity survey** on a prospective area on Colebrook Hill, located between Rosebery and Renison. The fieldwork can take place between February - March 2021 and consist of ~10 line-km over an area of 1.5 km^2.

The IP survey would be designed to test the primary structure located in western face of Colebrook Hill over a structural anomaly first identified in the ultramafic unit by LiDAR reprocessing and interpretation in late 2020. Subsequent drilling would be dependent upon successful IP imaging.

It is recommended to deploy an IP/RS (induced polarisation and resistivity) survey using a double offset dipole-dipole or double offset pole-dipole array with an electrode spacing of 50 m and line spacing of 100m (given the anticipated size of the mineralisation/vein and depth of investigation) followed by a 3D inversion and modelling. Alternatively a gradient array survey with the same geometry can be acquired foregoing the need for 3D inversion and modelling, cost saving ~25%.

Following permitting, line cutting can commence in December and be ready for IP acquition in February 2021. Late summer is the optimal time for this. Access would be via existing tracks.

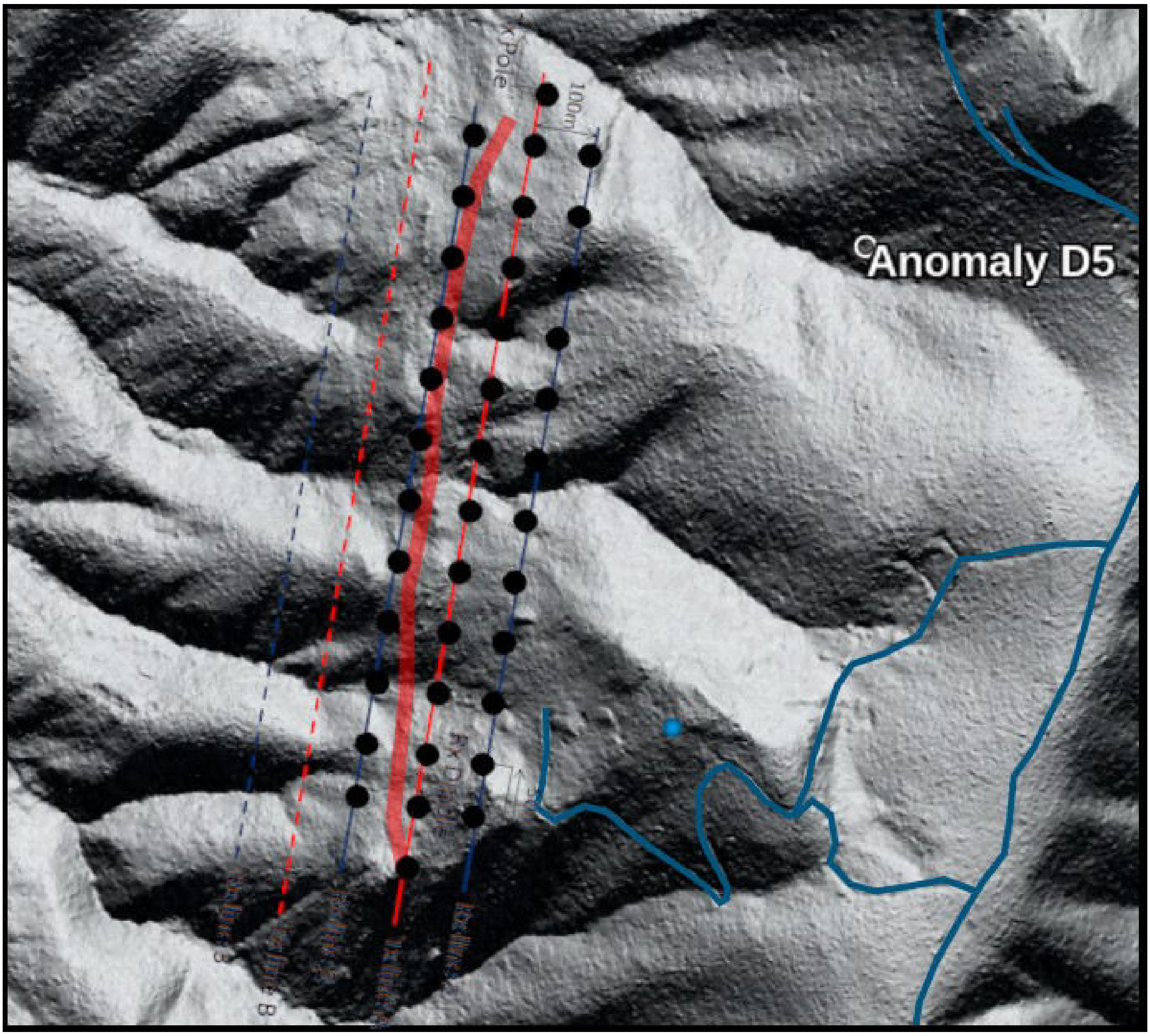


Figure 7 Proposed IP survey geometry over LiDAR surface and access tracks (blue)

BUDGETARY ESTIMATE: Line cutting by two people taking up to 4 weeks = **$6000.**

Several transmitter lines are needed (Figure 7) both oriented in an N/S direction and 1.1 km long and located over an area with a mild slope of ~5 degrees. Recievers require clearing a limited area every 50 m instead of cutting a full line. The induced polarization equipment would consist of Scintrex transmitting and GDD receiving apparatus using a commuted signal. A motor generator would drive the transmitter capable of supplying 10 kW of continuous power. Stainless steel electrodes would inject a stable current.

BUDGETARY ESTIMATE: Gradient Array IP survey including mod-demob using these specifications: time domain cycle: 2 seconds or 0.125 Hz and block size 3km x 500m = **$34,800.**

Total acquisition costs would be $40K. Processing and interpretation to be evaluated in 2021.

From the resitivity results, the sub-cover morphology variations and structural features of the target area should emerge and from the IP phase, the conductivity of disseminated, vein or massive mineralisation should be evident.

5. SUMMARY

A synthesis of the geophysical measurements over existing MRV mineral deposits suggests that sulphide deposits tend to be dense, non-magnetic, chargeable but lacking high conductivity. Significant deposits may lie within a large areas of pyritic alteration and may occur in close association with graphitic shales and share similar electrical properties. A key insight has been that massive sulphides can be discriminated from pyritic mineralisation and black shales on the basis of in situ measurements.

A conventional greenfield exploration strategy uses a combination of gravity, aeromagnetics, radiometrics etc. to broadly define areas of interest, with electromagnetics providing structural information on a more local scale. However, explorers have concluded after many decades of intensive exploration in the area, that it's **unlikely that shallow economic sulphide deposits exist close to the surface** so the mineralised favourable horizons are anticipated around and below 500m.

The development of an initial, regional, predictive capability has been achieved via data compilation and the selected reprocessing and interpretation of existing electromagnetic datasets. New magnetotelluric data now offers support to exitsting deep inversion interpretations. With the goal of locating deeper mineralisation, further combinations of detection technologies are required, particulaly on a local-scale, such as the following:

- Ground electrical surveying should be completed to assist drill targeting over areas with good access. Targeted **Induced Polarisation** has previously been effective in detecting nearby VMS deposits. For non-conductive sphalerite deposits, IP has been the most successful exploration technique.
- **Drone-based AEM** has good potential because of the complex terrain, cost and versatility. Within one day of fieldwork, dense coverage of an area can be achieved with output datasets including surficial morphology, mineral distributions and the shape of the local magnetic anomaly at multiple scales (recent example from Finland is shown in Figure 6).
- For areas with limited ground access, either a helicopter-based electromagnetic survey using a time-domain system is recommended over any geophysical and geochemical anomalies. The key parameter is line density. Sufficient resoution at depth is a requirement. **Time-domain HEM** is suited for the detection of deep massive sulphide conductors and can detect mineralisation at depths up to 500m under favourable conditions.
- Commercial **CSAMT** is useful to map resistivity shallower than 1km (typically 300-600m).
- **DHEM** should be used on any holes drilled to search for conductive offhole mineralisation. **FTG** is highly recommended if government-commissioned.
- **Petrophysical database** development is highly desirable subject to budgetary constraints. Petrophysics is essential for advanced 3D model building and understanding the geological characteristics of the area of investigation.

  Techniques offering negligible exploration benefit are GPR, SAR, ERT, MASW & ASTER.

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