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EXPLORATION LICENCE
12/2019
Mt FARRELL, TAS

REPORT TO:
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Report by:

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EXECUTIVE SUMMARY

The Mt Farrell Project Exploration Licence (EL) 12/2019 The EL covers an area of ~71km^2 and is located in western Tasmania, centred on the town of Tullah, 7km northeast of the Rosebery polymetallic base metal mine.

The exploration strategy applied by Argent Minerals Limited at EL 12/2019 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.

The tenement area of EL 12/2019 has a long history of previous mining (mainly small-scale Pb-Ag) and is oneof the more heavily explored parts of the Mt Read Volcanics. Between 1889 and 1973 several small Pb-Ag mines operated in the Tullah area. The largest and most successful of these were the New North Mt Farrell and North Mt Farrell mines, which were operated continuously between 1899 & 1973. Both mines were established on a series of narrow (1.6m average mining width) lead-silver-zinc lodes and veins within zones of structural disruption in the Farrell Slates. Ore grades in these deposits were modest (typically **8-12% Pb, 2% Zn and 300-500g/t Ag**) and the mined tonnages low

During the reporting period 3 February 2021 to 3 February, Argent Minerals Limited conducted only desktop activities due 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 (eg. Rosebery) 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 (via DHEM, see below).

The MRV massive-sulphide and gold mineralisations are flanked in the west by the Rosebery and Mt lack (shallow thrusts) faults and in the east by the Henty (steep vertical) Fault which are difficult to map (buried and fragmented). MRV massive-sulphide mineralisation emplacement occurred during continental elding over a remarkably brief mineralising event and was subsequently deformed and metamorphosed in part by the underlying, pervasive granites. Internode Seismic reprocessed the eastern half of 2D seismic line 95AGS-T1 because it intersected Argent Minerals Ltd's EL12/2019 tenement in August 2020. The original processing was poor because it did not image dipping reflectors well due to the lack of DMO and was insufficiently reverberated. This mandated a conceptual interpretation from which explorers were ubsequently mislead by the potential of the mapped structures.

The 2021 reprocessing of the same seismic line shows clearly defined, near-surface and deep structures and stratigraphy enabling an interpretation made with confidence because it agrees with up-to-date geological maps, deep magneto-telluric and granite mapping and geodynamic models.

- 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
- Drilling assessment Salmons Lode and other prospects

1 BACKGROUND

1.1 Location and access

The Mt Farrell tenement EL 12/2019 is located approximately west of Lake Mackintosh, Western Tasmania. The tenement area covers 33 square kilometres under a category 1 Exploration Licence granted for a five-year term. Located in north-western Tasmania on the flanks of Mount Farrell at Tullah, access to The Farrell field is via the Murchison Highway, approximately 25 minutes trucking distance from Hellyer, and 15 minutes from Rosebery. Exploration access for drilling requires care, as potential sites, particularly for drilling mid to deep workings level, are likely to be located in and around the town of Tullah on private land titles. Access for geochemistry and geophysics to the east of Tullah township is dominantly Crown Land, on moderate to steep

terrain of the flanks of Mount Farrell. To the west of Tullah Access is truncated by Lake Rosebery.

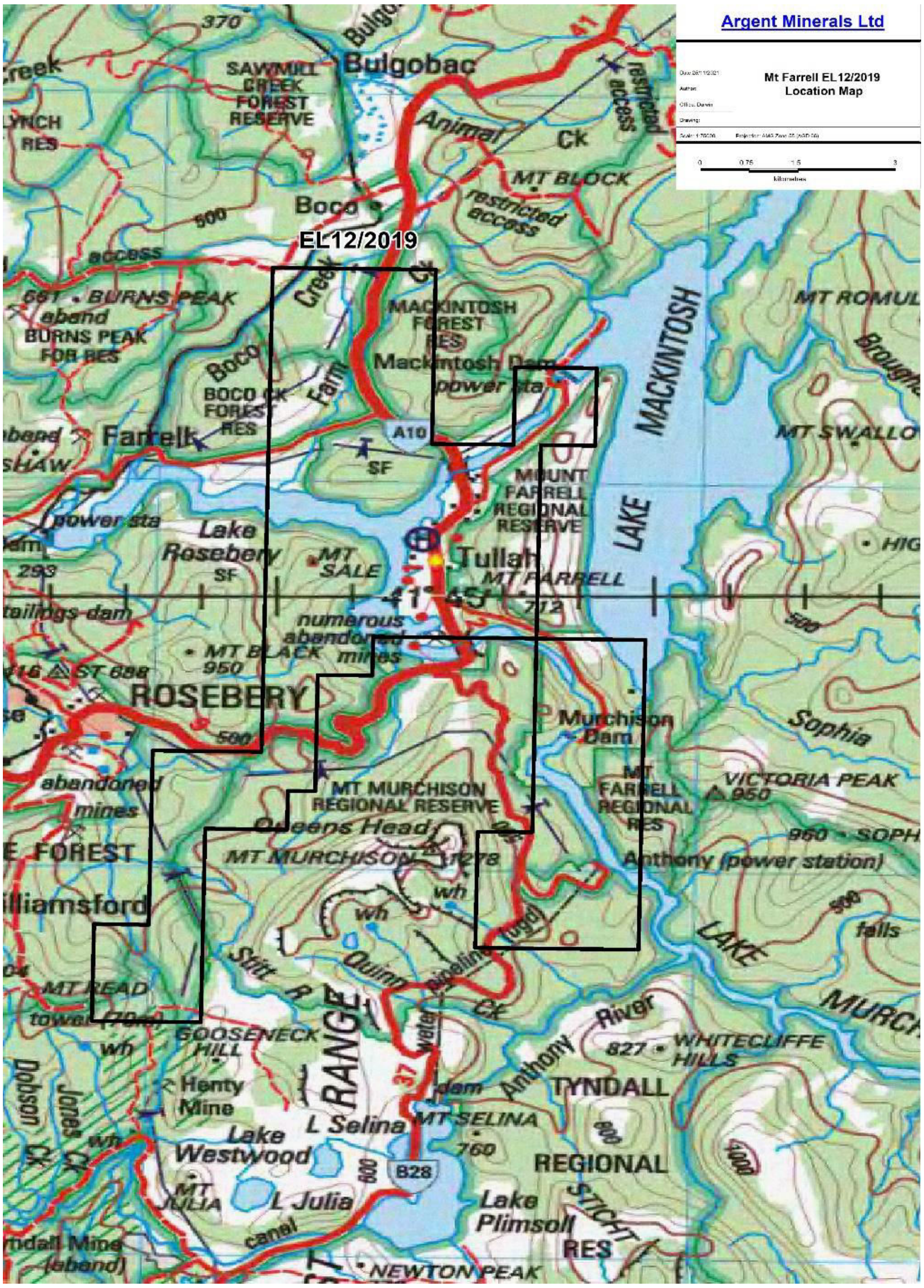


Figure 1. Location of EL12/2019

1.2 Regional Geology and Mineralisation

EL 3/01, Tullah overlies rocks of the Cambrian Mt. Read Volcanics and the Cambro-Ordovician siliciclastic Owen Conglomerate. The Mt Read volcanics are an arcuate belt of acid to intermediate volcanics occupying the eastern margin of the Dundas Trough. They are bounded to the east by Precambrian basement rocks of the TyennanRegion and younger Cambro-Ordovician siliciclastics. The Mt Read Volcanics interfinger with fossiliferous volcanosedimentary rocks of the Dundas Group andWestern Sedimentary Sequence to the west.
A major north south striking structure, the Henty Fault divides the Mt Read Volcanics into two parts, north and west of the Henty Fault and south and east of the Henty Fault. Within the Henty Fault are rocks of the Henty Fault Sequence to the south of Mt Murchison. The Mt. Read Volcanics north and west of the Henty Fault (Figure 2) host the Pb-Zn rich polymetallic volcanogenic massive sulphide (VHMS) deposits of Rosebery, Hercules, Que River and Hellyer while the volcanics south and east host the Henty Gold Mine, Mt Julia Prospect and copper gold deposits of the Mt. Lyell Field.

The Mt. Read Volcanics south and east of the Henty fault are divided into four lithological groups (Corbett, 1992),

1. Central Volcanic Complex (CVC) consisting of mainly rhyolitic to andesitic volcanics with minor sediments and mafic units.
2. Eastern Quartz Phyric Sequence of quartz porphyritic lavas and volcaniclastics.
3. Tyndall Group comprising mainly quartz-phyric felsic and intermediate extrusives and volcaniclastics with interbedded epiclastics.
4. Western Sequence of volcanosedimentary siltstones, shales, quartzose and volcaniclastic turbidites and felsic porphyry intrusives.

The oldest rocks belong to the CVC and Western sequence. The Tyndall Group overlies the CVC both conformably and unconformably. Northwest of the Henty Fault the Mt Read Volcanics are divided into three lithological groups (Corbett, 1992).

1. Central Volcanic Complex (CVC) consisting of mainly rhyolitic to basaltic lavas and volcaniclastics.
2. Dundas Group consisting of tuffaceous volcaniclastics, polymictic conglomerates, graywacke, siltstone and shale.
3. Mt Charter Group consisting of basaltic to felsic lavas and volcaniclastics, siliciclastic wackes and black shales.

The oldest rocks belong to the CVC. The Mt Charter Group and Dundas Group both overlie the CVC and are probably stratigraphically equivalent (Corbett, 1992).

1.3 Local Geology

The Mt Read Volcanics within the Tullah ETA contain four main NNE trending stratigraphic units, the Mt Black Volcanics, Sterling Valley Volcanics, Farrell Slate and the Murchison Volcanics (Allen, 1995). The Cambrian Murchison granite is located in the SE of the ETA (McNeill and Corbett, 1992). Overlying the volcanics in
the east of the ETA are the siliciclastics of the Owen Conglomerate. The geology of the local region is strongly controlled by two prominent steeply west dipping, NNE trending Faults, the Henty Fault and the Farrell Fault (McNeill and Corbett, 1989).

The Henty Fault appears to be the major fault, dividing the geology into northwest and southeast domains (Purvis, 1995, Allen, 1995). Where available stratigraphic and structural vergence data suggest rock units dip steeply west and stratigraphically young west (Allen, 1995). Relogging historic drill core by AurionGold Staff supports this observation. A westerly trending spine of Devonian granite is interpreted from gravity and magnetic survey to underlie the centre of the ETA (Leaman and Richardson, 1989, Archer, 1989).

1.4 Mineralisation and Structure

Mineralisation is located principally along the Henty Fault Zone and is represented by a number of different deposit styles including Devonian, fissure related Pb-Zn-Ag sulphides such as the Mt Farrell Mines and Devonian Polymetallic-Au-Sn vein mineralisation.

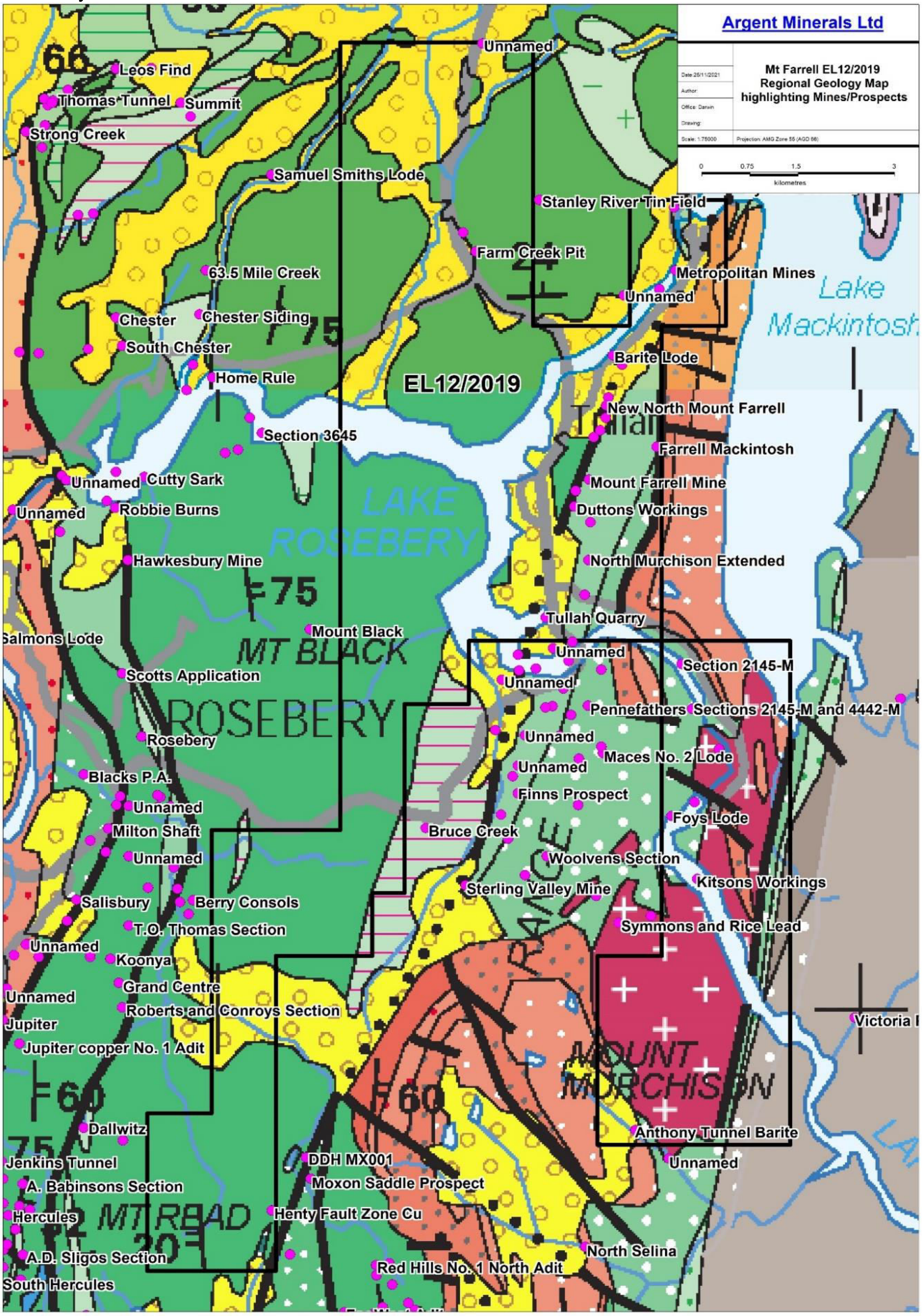


Figure 2. Regional Geological Interpretation over EL12/2017

Rivers, 1975, describes the ore of the New North Farrell Mine as an association of galena, chalcopyrite with minor pyrite, tetrahedrite and jamesonite, with quartz and siderite. Further observations by Rivers, 1975 include:

- Ore is brecciated in some cases, containing fragments of slate, tuff and quartz.
- Galena is deformed and shows slickensides in several ore bodies.
- Some ore is banded, with finely crystalline and nearly pure galena adjacent to coarsely galena-sphalerite-chalcopyrite ore (NNMF 10 level).
- Several ore bodies are undeformed (adits south of Nth Mt Farrell open cut).

McNeill and Corbett describe bedding in the Farrell slates as sub parallel to cleavage, and folded into 'angular, tight to isoclinal, reclined folds and kink bands with low angle fold axes', with a steeply W dipping cleavage, and west facings where folding is not apparent. The Farrell Slates are known to strike NNW to NNE, dipping 70 degrees west.

The orebodies are hosted in NNW to NNE shears within the Farrell slates and appear to be mainly fracture fill occurrences (McKibben 1968). Purvis, 1995, suggests that some of the orebodies may be hosted in faulted isoclinal fold axes.

The Lodes are up to 300 feet high, 250 feet long, average three to five feet in width. The mined orebodies consisted mainly of two to three sub parallel ore channels spaced over a width of 100 feet, though some sections in the North Mt Farrell Mine are reported to consist of up to 11 productive lodes (Purvis, 1995). Some mining has been carried out along mineralised structures known as branch lodes, which intersect the main fractures at acute angles. Ward, 1957 reports (for the NNMF mine) that the 'main lode and quartz footwall lode strike north to 10 degrees magnetic and dip 60 to 65 degrees west. Branch lodes strike at 17, 35 and 170 degrees magnetic and dip about 60 degrees west.

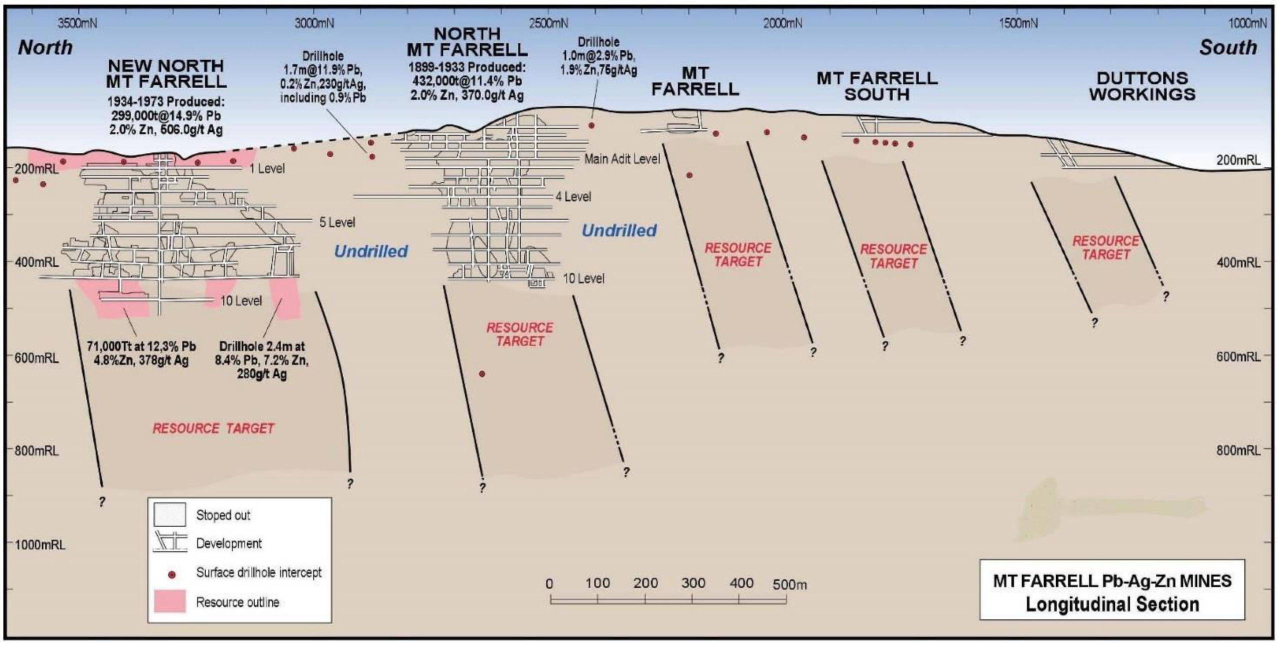
The main hanging wall lode at the New North Mt Farrell Mine plunges at 75 degrees south. Two smaller shoots south of the main shaft, stoped between the surface and 7 level had an average width of two feet and plunged 30 degrees south. At the North Mt Farrell Mine, the main lode strikes approximately magnetic north and dips 60 degrees west, plunging south at 70 degrees (McKibben 1968).

The Richest ore in the Farrell Mines is known to occur at the intersections between shears, and at the intersection of shears with tuff beds in the Murchison Mine to the south (McKibben 1968, J. Smythe pers. comm.) In some places the pitch of intersecting shears forms the boundaries of ore shoots (Jensen, 1959) Evidence of this can be seen from level mapping in the New Nth Farrell Mine which indicates intersecting NE and NW trending structures in drives that have been stoped, and a NE fault set recorded by Rivers, 1975. It is likely that the lines of intersection between cross faults and the main N-S Lode structures explains the southerly plunge of the ore shoots.

Table 1. Significant Resources within EL12/2019

Deposit	Resource
New North Mt Farrell	Mined: 299,000t @ 14.9% Pb, 2% Zn, 506 g/t Ag U/G Resource: 71,000t @ 12.3% Pb, 2% Zn, 378 g/t Ag Surface Resource: 100,000t @ 6.3% Pb, 1.6% Zn, 201 g/t Ag
North Mt Farrell	Mined: 432,000t @ 11.4% Pb, 2% Zn, 307 g/t Ag
Murchison Mine	30,000t @ 10% Pb, 15% Zn, 307 g/t Ag, 2 g/t Au

Figure 3. Longitudinal Section running North to South along Mineralised Trend



1.4 Authority History

The tenement area of EL 12/2019 has a long history of previous mining (mainly small-scale Pb-Ag) and is one
of the more heavily explored parts of the Mt Read Volcanics. There have been more than one hundred and thirty (130) diamond and reverse circulation drill holes collared on the tenement at a range of geophysical, geochemical and geological targets. As well as several generations of stream, soil and rock geochemistry, electrical geophysics (primarily IP & EM) and geological mapping. Most of the work has been concentrated along the Henty Fault while less accessible zones, such as the southern and eastern parts of the Sterling River and east of the Farrell Mines, have received minimal attention.

Between 1889 and 1973 several small Pb-Ag mines operated in the Tullah area. The largest and most successful of these were the New North Mt Farrell and North Mt Farrell mines, which were operated continuously between 1899 & 1973. Both mines were established on a series of narrow (1.6m average mining width) lead-silver-zinc lodes and veins within zones of structural disruption in the Farrell Slates. Ore grades
in these deposits were modest (typically **8-12% Pb, 2% Zn and 300-500g/t Ag**) and the mined tonnages low. The only other discoveries of any significance, which have been made on the tenement by previous exploration effort, are two small (<400,000t) arsenic/gold resources (Lakeside Prospect & Lorrigans Luck Prospect – formally Arsenic Resource). Both deposits straddle the Henty Fault and are concealed below glacial overburden. No significant base metal discoveries have been made.

Year	Company	EL	Work Conducted
1950's	-	-	Dominantly geophysics-IP, ground mag & fixed loop EM
1973/74	Asarco Pty Ltd	4/73	Stream sediment survey – identified Sn & basemetal anomalies
1973-78	Asarco-Cominco JV	4/73	Bedrock Auger sampling, mag, EM, IP & 3 DDH
1979	EZ	1/62	Review of past work
1979/80	EZ	1/62	Murchison River area, ground mag, IP and drilling
1979/80	EZ	4/73	Henty fault Zone – mapping, soil geochem., ground mag, stream seds.
1980/81	EZ	1/62	Stream sed., soil geochem., grid mapping, ground mag, drilling.
1981	EZ	4/73	DDH to test ground mag & IP anomalies. Minor sulphides and Sn intersected.
1981	EZ	1/62	Drilling, data review and lineament analysis.
1982	EZ	4/73	Soil geochem over Mt Black volcanics along Henty Fault. Anomalous Sn resulted in costeaning and rock chip sampling with high Au. Mineralisation style considered unattractive and work discontinued. 1 DDH drilled under costean in 1985 with minor sulphides.
1983	EZ	4/73	Data review, costean sample analysis.
1983/84	EZ	1/62	DIGHEM survey, gridding, ground mag, mapping, rock chip geochem, EM, costeaning.
1984	EZ	1/62	Gold study, core sampling
1984	EZ	4/73	High As intersections resulted in shift from Sn to As. Informal resource calculated, 4 lenses in 4 holes est. 480 000t @ 5% As ("Arsenic Resource"). Open Nth, Sth and down dip. Au analysed by aqua regia/AAS with Au masked by sulphides.
1984/85	EZ	4/73	DIGHEM, grid mapping, core from Arsenic Resource re assayed for Au (fire assay):- 12 samples > 1g/t Au. Au resource calculated for As zones with resource est. of 480 000t @ 5.02% As, 0.84 g/t Au.
1985/86	EZ	4/73	DDH to test geophysical targets, Henty fault Zone and cross structures.
1986	EZ	4/73	Review
1986/87	EZ	1/62	Henty Fault Zone core sampling, UTEM, compilation of Farrell Mines data.
1986/87	EZ	4/73	Metallurgical testing of As zones, re-assay of core (fire assay), rock chip sampling.
1987/88	EZ	1/62	Drilling, down-hole IP & resistivity (Lakeside), BCL survey, drillcore re-assays, gravity, EM, ground mag, mapping, rock chip sampling, drillcore re-assay (Farrell-Mackintosh, drillcore re-assay, IP, rock chip and BCL sampling (Murchison Mine)
1989	EZ	1/62	Indicated resources for Lakeside. 750 000t @ 20 g/t Ag, 2.1 g/t Au, 4% As, 0.2% Sn, 0.2% Cu.
1990-93	Pasminco	22/90	Helimag and radiometric survey, gravity, DDH (MM1a) and evaluation of Murchison Mine. Relogging of 12 UG/DDH Farrell Mines. Mapping and rockchip sampling of Sterling valley, Murchison Gorge, Farrell range Henty Fault. EM survey, DHEM.
1993/94	Pasminco	22/90	DDH & DHEM (Mackintosh dam and Tullah Flat), MALM & IP (Mackintosh Dam), interp of 91-93 gravity and aeromag, mapping and rock chip sampling (Mackintosh Dam & Sth Stitt), resurvey of DDH collars for all surface DDH.
1994/95	Pasminco	22/90	4 DDH & DHEM, relogging and sampling of old core, mapping of alteration zone along Farrell Slates-Murchison Volcanics contact. Ground mag, mapping of Sterling Valley volcs. Evaluation of Farrell Mines. Rod Allen's mapping and core relog for Sterling Valley Transect.
1995/96	Pasminco	22/90	12 DDH (Mt Farrell and Sterling Valley), rock chip sampling (Murchison Gorge alteration), mapping and rockchip sampling (Sterling Valley), geophysics review and exploration review (Lakeside and Lorrigan's Luck).
1996/97	Pasminco	22/90	Au exploration associated with Henty Fault, exploration review, soil orientation, mapping and rockchip sampling in Sterling Valley area including Lakeside, Lorrigan's Luck and Sth Stitt. Geophysics review. 7RC holes and 3 DDH intersecting significant low grade Au at Lakeside.
1997/98	Pasminco	22/90	Review and reinterp of existing IP data. Gridding, mapping soil and rock chip sampling and IP surveys.
1998/99	Pasminco	22/90	Partial leach soil sampling, mapping and drilling of Bruce Creek Prospect. Mapping and airborne EM over Nth Murchison, mapping and soil geochem over East Stitt.

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.

2 EXPLORATION COMPLETED IN REPORTING PERIOD

During the reporting period 3 February 2021 to 3 February 2022, 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:

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.

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 2).

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.

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

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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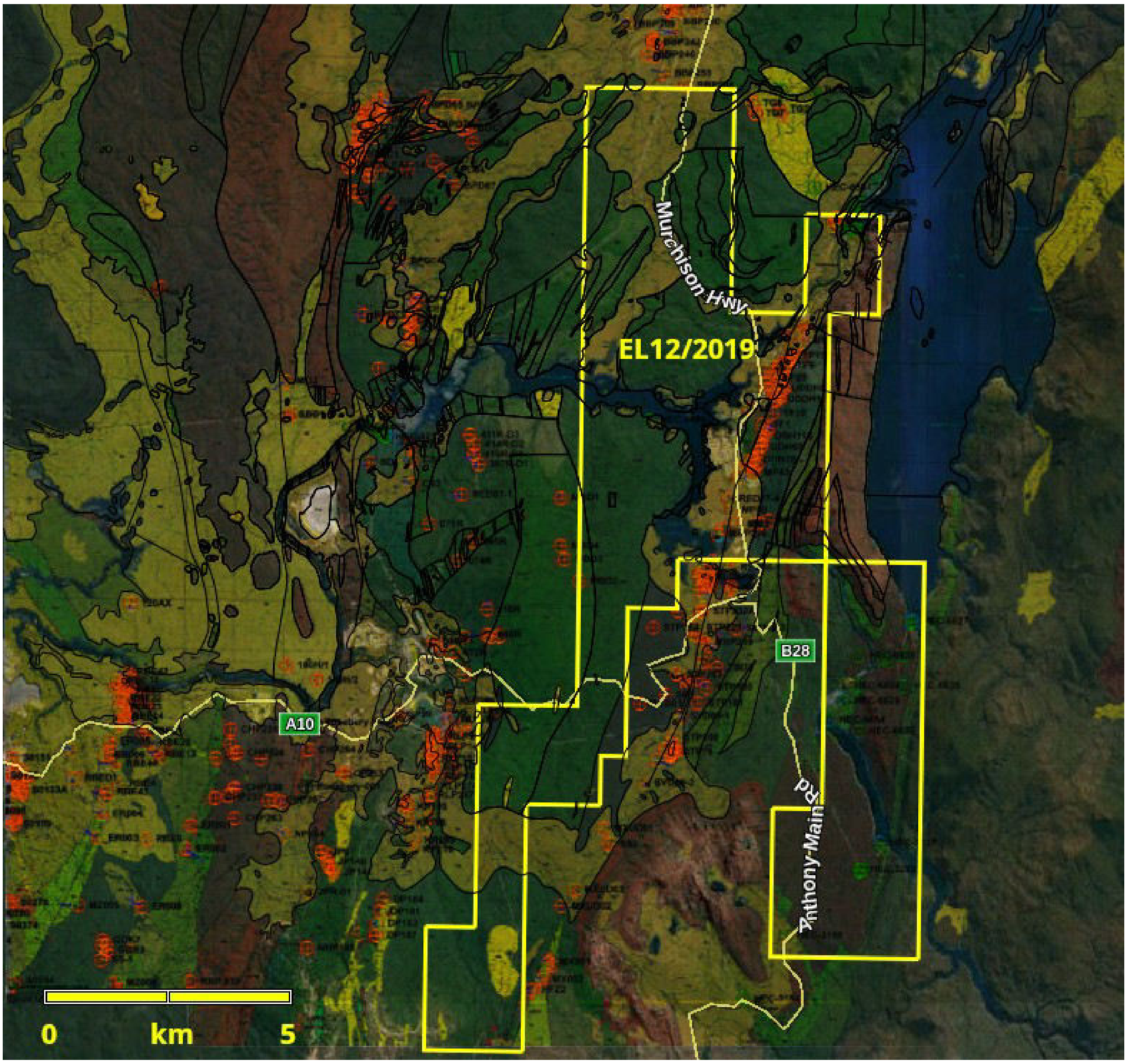
APPENDIX 1

Geophysical Review of EL12/2019

Geophysical Review of EL12/2019



Internode Seismic

September 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 for Ore Deposit and 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
HEC 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 by Lamontagne Geophysics
UTM Universal Transverse Mercator
VMS Volcanogenic Massive Sulphide
VRMI Vector Residual Magnetic Intensity
VTEM Versatile Time Domain Electromagnetic

1. INTRODUCTION

Argent Minerals requested a review of the existing geophysical data within the **EL12/2019** tenement area and the near vicinity, 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 VMS mineral deposits. The advantages and disadvantages of possible survey techniques are discussed. As a result, some recommendations for possible future geophysical surveys have been made.

Previous tenement holders over E12/2019 over the past 30 years have included: Pasminco Australia (EL02/1990 EL22/1990 EL24/1991 EL13/1996, Lachlan Resources EL12/1996), Auriongold Exploration (EL3/2001), Bass Metals (EL47/2003), Bass Metals and Geoinformatics Exploration (EL54/2004) and Unity Mining (EL34/2010). Land tenure includes Authority Land, Crown Land, FPPF, HEC Land, Informal Reserve, Nature Recreation Area, Private Parcel, Public Reserve, Regional Reserve and State Forest. Most of the tenement is Regional Reserve or HEC Land.

EL12/2019 was applied for by Argent Minerals' subsidiary Mt Read Pty Ltd on 25 September 2019. The EL covers an area of ~79km^2 and is located in western Tasmania, centred on the town of Tullah, 7km northeast of the Rosebery polymetallic base metal mine (Figure 1, next page).

2. GEOPHYSICAL DATA REVIEW

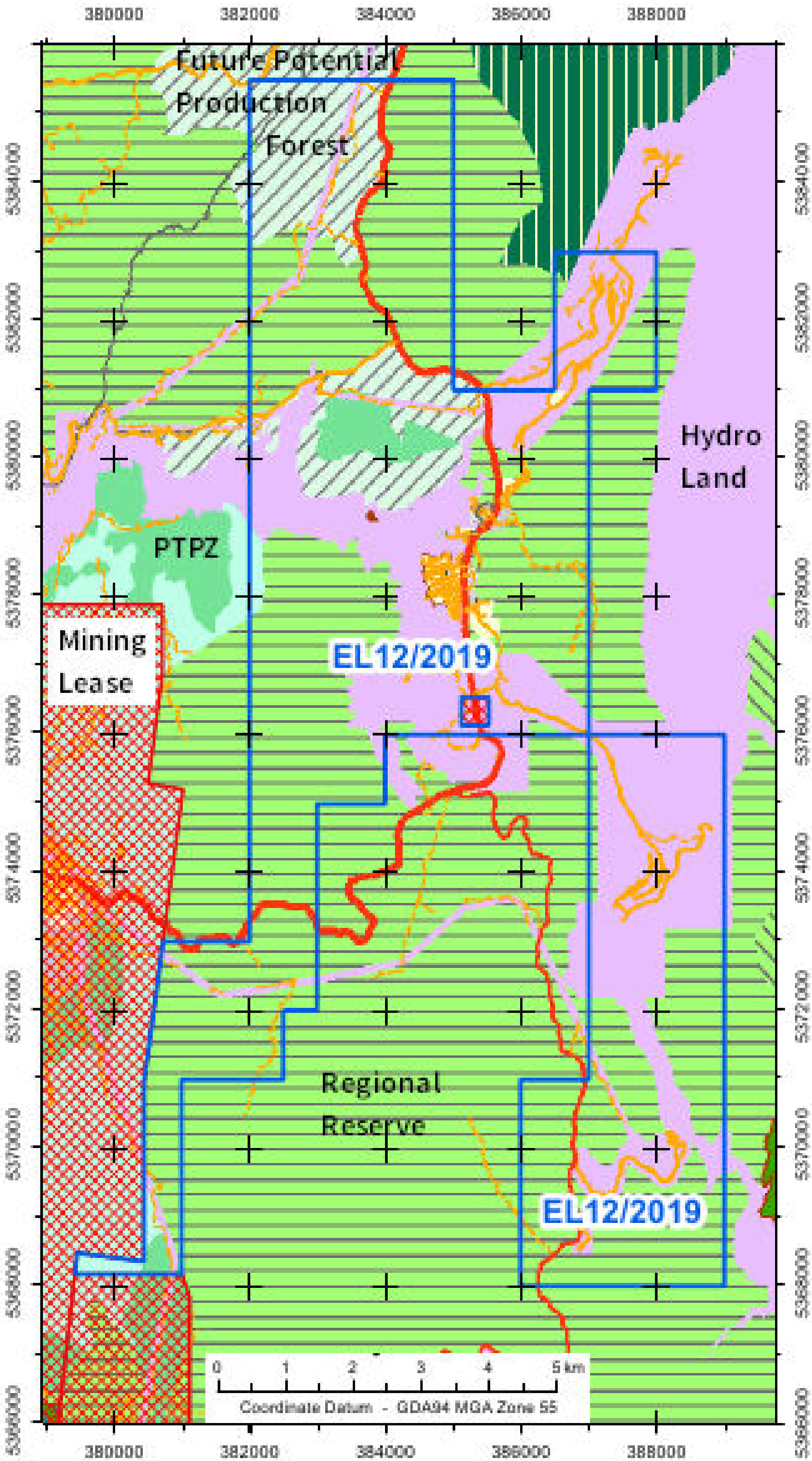
Methodology

Despite many decades of studies and investigations over the Mt. Read Volcanics (MRV), Zn-Pb ore deposits remain amongst the most difficult to find and map using geophysical exploration methods.

Some of the key limitations are that the mineralogy, texture and shape of Zn- Pb deposits can be so variable, even within a specific area. A good example of this are the profound differences between the Rosebery and Chester VMS deposits. Both lie just outside the tenement boundary, are separated by only a few kilometres and are structurally aligned, yet the mineralogy, texture and shape differ for reasons that are poorly understood. Geophysical properties are also quite diverse, such as Hellyer VMS, which is considerably more conductive than the other VMS deposits. Hellyer is conical while Rosebery is relatively flat and tabular.

On the other hand, we know that Zn-Pb VMS deposits tend to be felsic volcanic-hosted and that the deposits tend to occur in clusters within districts. A good example of remarkable similarity are the Que River and Rosebery deposits that share electrical properties, yet are quite different from the Mount Lyell style of mineralization. The similarity extends to having extremely conductive pyritic components.

VMS deposits are syngenetic (formed at the same time as volcanic host deposition). Typically their architectures are massive lenses or tabular-shaped bodies, underlain by discordant vein mineralisation and altered volcanic rocks. The Tasmanian VMS deposits in the MRV do consist of massive accumulations of sulphide minerals occurring in small lenses or tabular bodies, are oriented parallel to the volcanic stratigraphy, and underlain by a footwall stockwork of vertical vein and stringer sulphide mineralisation and hydrothermal alteration.



Future Potential
Production
Forest
Hydro
Land
PTPZ
Mining
Lease
EL12/2019
Regional
Reserve
EL12/2019
0 1 2 3 4 5 km
Coordinate Datum - GDA94 MGA Zone 55
380000
382000
384000
386000
388000
5384000
5382000
5380000
5378000
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5366000

Research informs that key factors for the formation of large VMS deposits are: (1) a large volume of mantle-derived mafic-ultramafic magmas that contribute to the formation of the deposits; (2) fractional crystallization and crustal contamination, particularly the input of sulphur from crustal rocks, resulting in sulphide immiscibility and segregation; (3) the timing of sulphide concentration in the intrusion. This review hasn't evaluated the deep lithospheric geodynamic history of the area nor does it go into detail about the potential size and timing of sulphide formation although this may be something to consider at some stage. **The focus instead has been on which geophysical properties can lead to the detection of sulphides, at depth, within the tenement.**

In VMS exploration the geophysical properties can be described in general terms of the rock type (cover, host and target sulphides). The cover rocks are magnetic in places and resistive. Economic sulphides have an association with magnetite and pyrrhotite which makes them relatively magnetic and non-sphalerite sulphides tend to be conductive. Felsic volcanic rocks that host the deposits are resistive and only slightly magnetic although they can be adjacent to conductive layers making an interpretation more problematic.

From-To	Organisation	Geophysical work	Results
1972		Macintosh EM regional helicopter survey	
1973-1978	Asarco-Cominco JV	Magnetic, EM and IP	
1974-1975	Electrolytic Zinc	IP	Pb-Zn anomalism found
1979	Electrolytic Zinc	Gradient array IP, magnetics Mt Black, Langdons, Mt Sale	Numerous IP responses recorded.
1979	Electrolytic Zinc	Dipole-dipole IP - Mt Black, Mt Sale areas	IP responses downgraded.
1979-1980	Electrolytic Zinc	Gradient array IP - Langdons, Mt Sale, Mt Black areas	Several anomalies outlined in Mt Sale area
1979-1980	Electrolytic Zinc	Murchison River area, ground mag and IP	
1979-1980	Electrolytic Zinc	Henty fault Zone – ground mag	
1980-1981	Electrolytic Zinc	IP - Mt Sale area	No significant anomalies recorded
1980-1981	Electrolytic Zinc	Ground mag	
1981	Geoex	West Tasmania regional aeromag survey	14710km at 197 mean AGL, 500m spacing
1981	Electrolytic Zinc	Ground mag & IP anomalies	
1983-1984	Electrolytic Zinc	DIGHEM III survey, VLF-EM at Mt Black	Highlighted area of interest at Mt Black.
1984-1985	Electrolytic Zinc	VLF-EM, magnetics at Mt Black	Some potential for Au
1986	Electrolytic Zinc	UTEM at Mt Black, Mt Sale	No anomalous UTEM anomalies.
1987-1988	Electrolytic Zinc	Down-hole IP & resistivity (Lakeside), gravity, EM, ground mag	
1987-2000	Pasminco	Downhole geophysics, surface geophysics	Numerous anomalies defined.
1988	Aberfoyle	Test a deep CSAMT and UTEM conductor.	No significant results.
1988-1989	Climax Mining Ltd	Ground magnetics to test Billiton UTEM anomalies.	No significant mineralisation
1990	Geo Instruments	Burns Peak aeromagnetic and radiometric survey	642km helicopter survey 200m spacing
1990	Geo Instruments	Bulgobac aeromagnetic and radiometric survey	624km helicopter survey 100m spacing
1991-1993	Pasminco	Gravity, EM survey, DHEM.	
1993		Tullah Gap aeromagnetic and radiometric survey	126 km helicopter survey 100m spacing
1993		Lake Macintosh aeromagnetic and radiometric survey	193 km helicopter survey 100m spacing
1993-1994	Pasminco	DHEM Tullah Flat, MALM & IP (Mackintosh Dam)	
1994-1995	Pasminco	DHEM, Ground mag,	
1995-1996	GA	2D seismic line 95AGS-T1	Good acquisition, poor processing result
1996-1997	Pasminco	Geophysics review	
1997-1998	Pasminco	Review and reinterp of existing IP surveys.	
1998-1999	Pasminco	Airborne EM and magnetics over Nth Murchison	223km helicopter survey 100m spacing
2001	Geo Instruments	West Tasmania aeromagnetic and radiometric survey	43535km helicopter survey 200m spacing
2002	Geo Instruments	Mr Read Volcanics aeromagnetic and electromagnetic survey	7788km helicopter survey 200m spacing
2005-2010	Bass Metals	ASTER spectral remote sensing	
2011-2012	MMG Ltd	3D seismic survey	Good acquisition, poor initial processing
2013	MRT	3D geophysical modelling (airborne mag and gravity)	
2015	GA	Radiometric compilation	Input 100-200m surveys, output 100m grid
2015	Pacrim Polsar	TOPSAR review	
2017	MRT	Radiometric compilation	Input 100-200m surveys, output 100m grid
2018	MRT	Reprocessing gravity data using detailed terrain corrections	
2018	CODES/MRT	Magnetotelluric survey	Work still in progress
2020	Argent Minerals	Reprocessing 2D seismic data	Good processing result – Internode Seismic
2020	Argent Minerals	Reprocessing aeromagnetic compilation	Good processing result – Montana GIS

Table 1 List of geophysical surveys and results in or adjacent to the EL12/2019 tenement

Year	Deposit	Method	Comments
1956	Crown Lyell	IP/EM	
1957	Lyell Cape Horn	IP/EM	
1973	South Hercules	Turair/IP	Hg soil geochemistry
1973	Henty	IP/soils	Originally a Pb-Zn showing
1974	Que River	AEM	Stream sediments
1983	Hellyer	UTEM	Considerable geological input
1991	Rosebery North	Drilling	Geologically based
1995	Henty Mt Julia	Geology	Structural model from Henty

Table 2 Selected historic Mt Read Volcanics deposit discovery methods and year of discovery

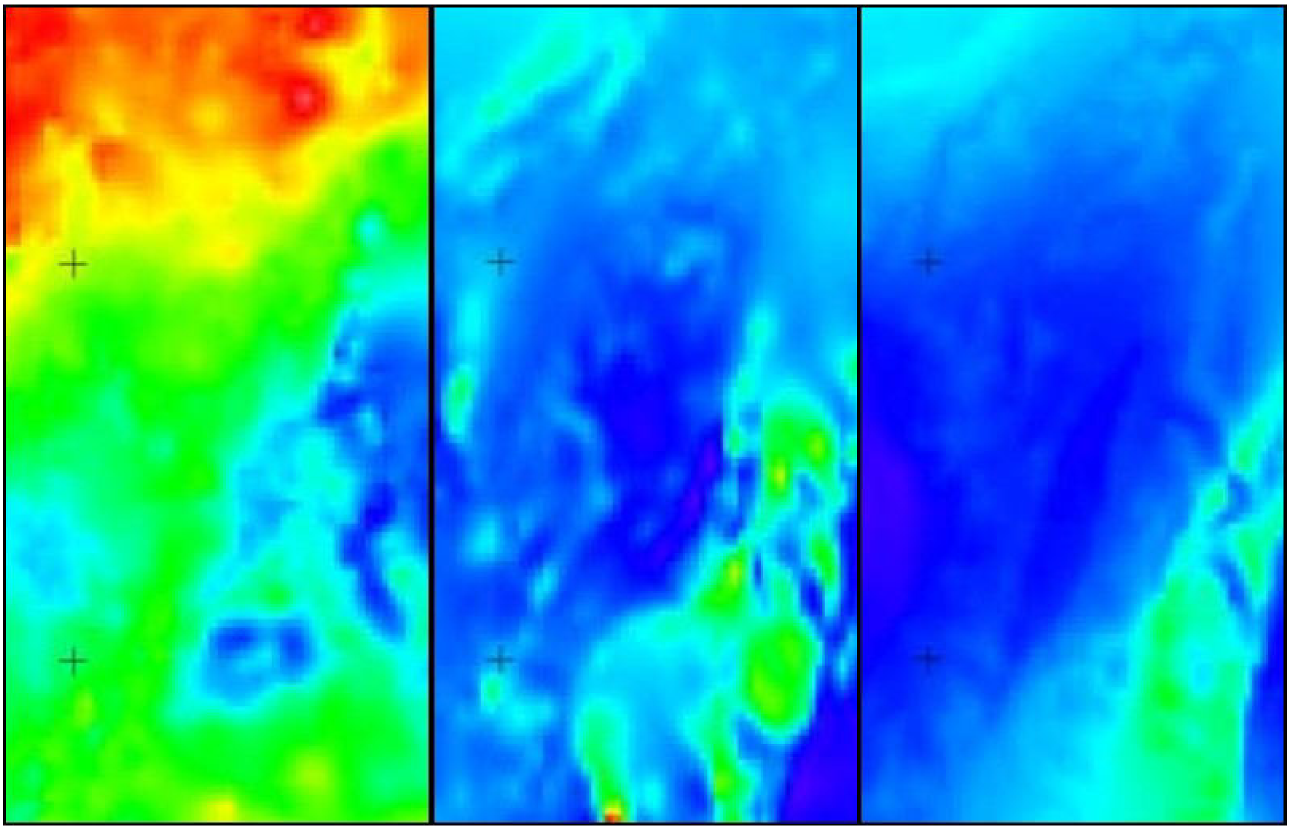


Figure 2. Triptych showing observed Bouguer gravity field derived from the MANTLE-09 2009 program with minimum curvature interpolation (left), observed total magnetic intensity with IGRF removed (middle) and calculated TMI response from the MRT 's 2013 inversion model (right). Note the magnetic low in the right image has an en-echelon shape.

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.

Gravity Datasets

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 (Figure 3).

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.

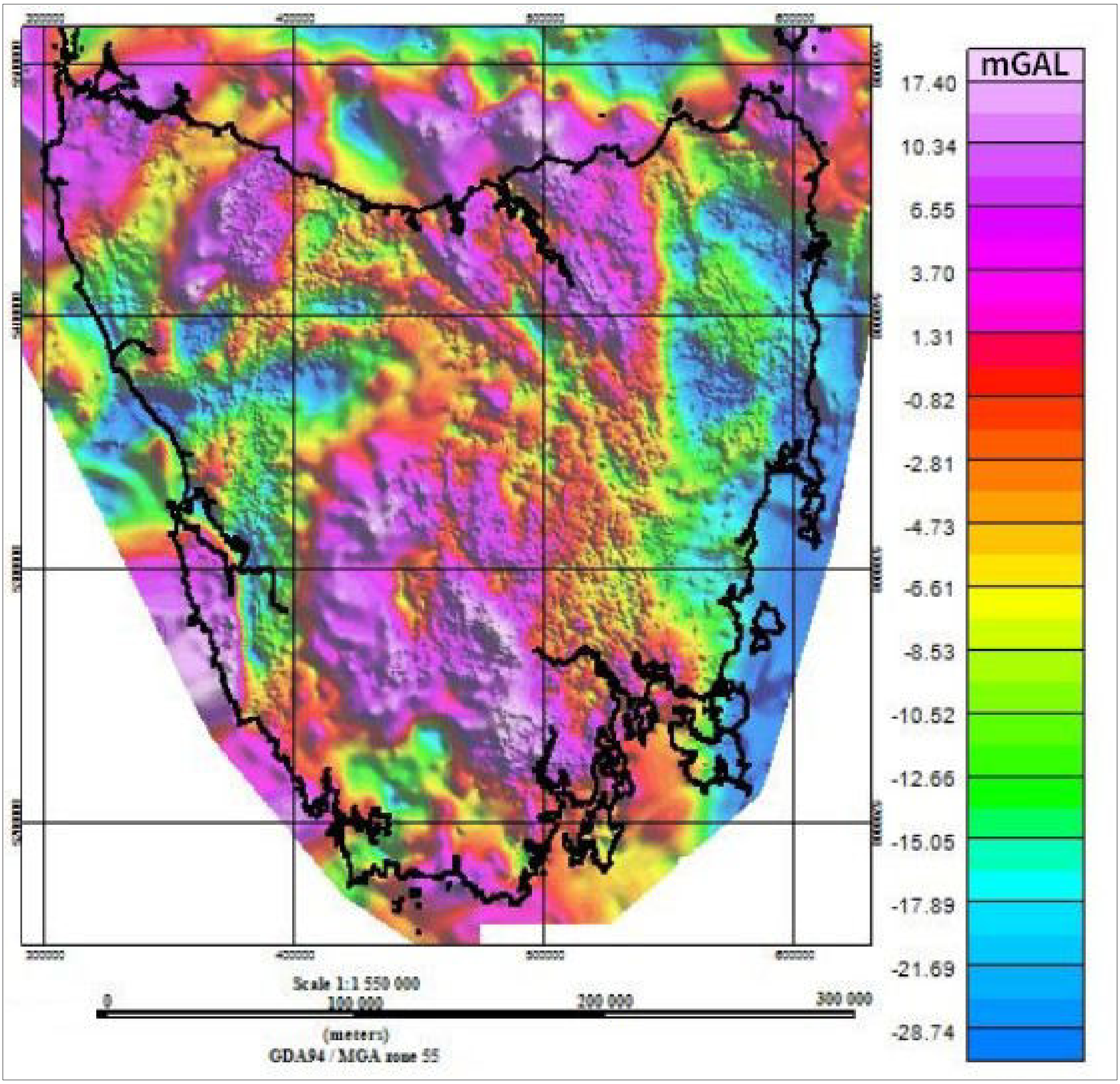


Figure 3 Residual gravity map of Tasmania upon Bouguer anomaly data

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.

Limitations

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 Hellyer VMS deposit did produce a marked density contrast from the host sediments (MRV) indicating a residual gravity anomaly of approximately 0.5m Gal. The gravity field at Rosebery was detectable despite being affected by the underlying uneven basement topography. Gravity data delineated the 80,000 t ore body at South Comet remarkably accurately.

Gravity surveys in the vicinity of the Rosebery VMS deposit (hosted within the MRV) show a shallowly dipping base metal ore system generating significant perturbations in the gravity field. Rosebery is an outcropping tabular deposit dipping at 45 degrees East, with a strike length of 1700m and an average thickness of 6m. The ore horizons occur in an altered, pyritised sequence of siltstones and shales which are overlain by pyritic black shales. These sedimentary horizons are underlain by altered footwall schists and overlain by massive pyroclastics. While the lode has now been mined, a gravity survey would have located the subcropping Rosebery lode but be affected by the underlying uneven basement topography.

The regional Bouguer gravity image shows that a reasonable correlation exists between the geological boundaries and gravity gradients in the MRV. The Devonian granites exert the strongest influence on the gravity so are very evident. The 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 and the results are shown in Figures 2 and 3.

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.

Radiometric Datasets

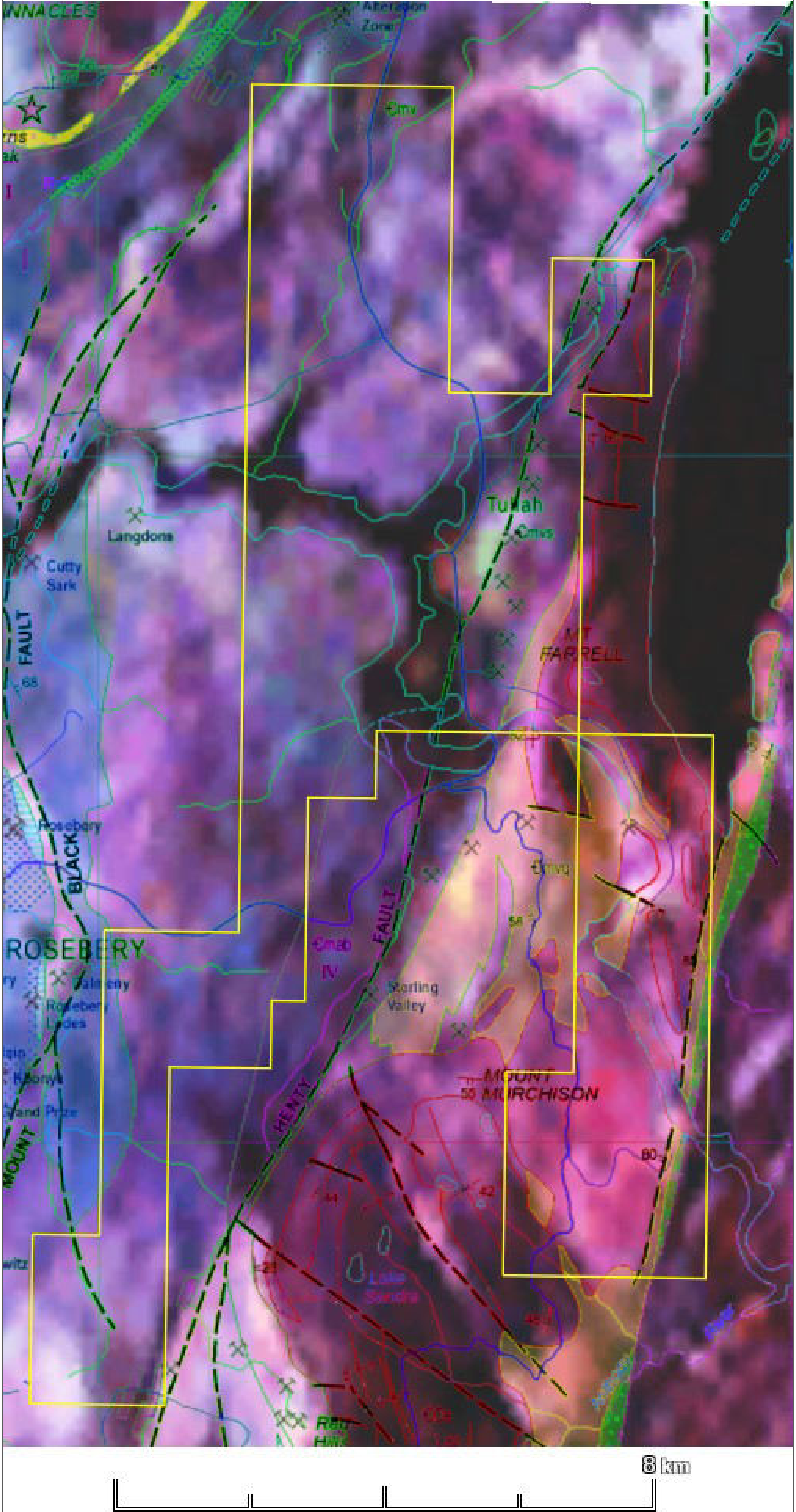
There are several, public-domain, regional, radiometric datasets available although they both substantially draw from the same Tasmanian radiometric surveys which were typically acquired with a line spacing between 100-200m. Over the EL12/2019 tenement they are remarkably similar.

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 EL12/2019 tenement, the 2015 ternary radiometric dataset appears more heavily filtererd than the MRT produced 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.

Radiometric Interpretation

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 (Figure 4, next page) correlate with a high concentration of felsic rocks within the Central Volcanic Complex mapped area. The concentration is due to the abundance of feldspars and micas and is in complete contrast to the adjacent (black) Oonah Formation mafic and ultramafics with extremely low U and Th concentrations. An irregular zone of high radiometrics within the Central Volcanic Complex rocks around the Tullabardine Valley, north of the Mackintosh Dam may relate to large cliffs of felsic volcanics. Flanking water bodies are also black.

As well as rock identification, radiometrics can be used for the detection and mapping of hydrothermal alteration. Although no direct indication of VMS ore can be predicted in the natural gamma-ray radiation elements potassium (K), thorium (Th) and uranium (U), some evidence of hydrothermal alteration related to mineralization process (VMS or any other) may be present in the case of shallow deposits. Potassic alteration has been documented as a regional alteration product in the MRV and at the specific deposits (Que River). 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.



Langdons
Cutty Sark
FAULT
Tullah
MT FARRELL
Rosebery
BLACK
ROSEBERY
Sterling Valley
FAULT
HENTY
MOUNT MURCHISON
MOUNT
8 km

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

Several local radiometric element concentration peaks occur within the Mt Black Volcanics mapped (Gifkins 2001) as pumice-lithic clast-rich breccia and sandstone (sites 2 and 3 below). Site 3 is on Tullah's northern boundary and lies several hundred metres from the Henty Fault. It may therefore be caused by a man-made disturbance of the ground surface.

1 383700 m E 5383500 m S Th & U
2 385300 m E 5381625 m S Th & K
3 385600 m E 5379325 m S Th, K, U and ternary high
4 387825 m E 5373925 m S Th, K, U and ternary high
5 382825 m E 5380275 m S U only
6 379300 m E 5366550 m S Th, K, U and ternary high

Location 1 is a Th & U mapped as a Sterling Valley Volcanics monomictic mafic breccia.
Location 5 is a Uranium only mapped as a Sterling Valley Volcanics monomictic mafic breccia.
Location 4 is clearly associated with the mapped granite and related porphyry.
Location 6 is next to Mt Read, Hercules and several hundred metres from the Henty Fault.

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

Electrical and Electromagnetic

Aeromagnetics and VMS

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.

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

Other common sulphide minerals in VMS deposits, such as chalcopyrite, sphalerite and galena, have lower values of magnetic susceptibility that are similar to those found for sedimentary and volcanic host rocks and so do not contribute to any magnetic anomaly associated with a VMS ore body. Sphalerite is not magnetic, quite resistive, and has a low specific gravity.

In Tasmania, silicification, even though not intensive, reduces the conductivity of massive-sulphide mineralised units. Observed conductivity response can be generated from separate, sulphide-rich lenses rather than a base metal orebody. Further downsides are the poor conductivity of sphalerite, having a saturated (non-saline) overburden, complex geometry and topography. Each of these factors can contribute to disguising the electromagnetic signature. VMS mineralisation at Rosebury and similar deposits are not very conductive - but the iron sulphides are, so the method may be considered effective for VMS targets where Fe sulphides dominate over massive sphalerite mineralisation. It is more effective when supported by other geophysical techniques.

Electromagnetics can also highlight lithological boundaries, shallow weathering, alteration, metamorphism and particularly help with structural interpretation.

Aeromagnetic Datasets

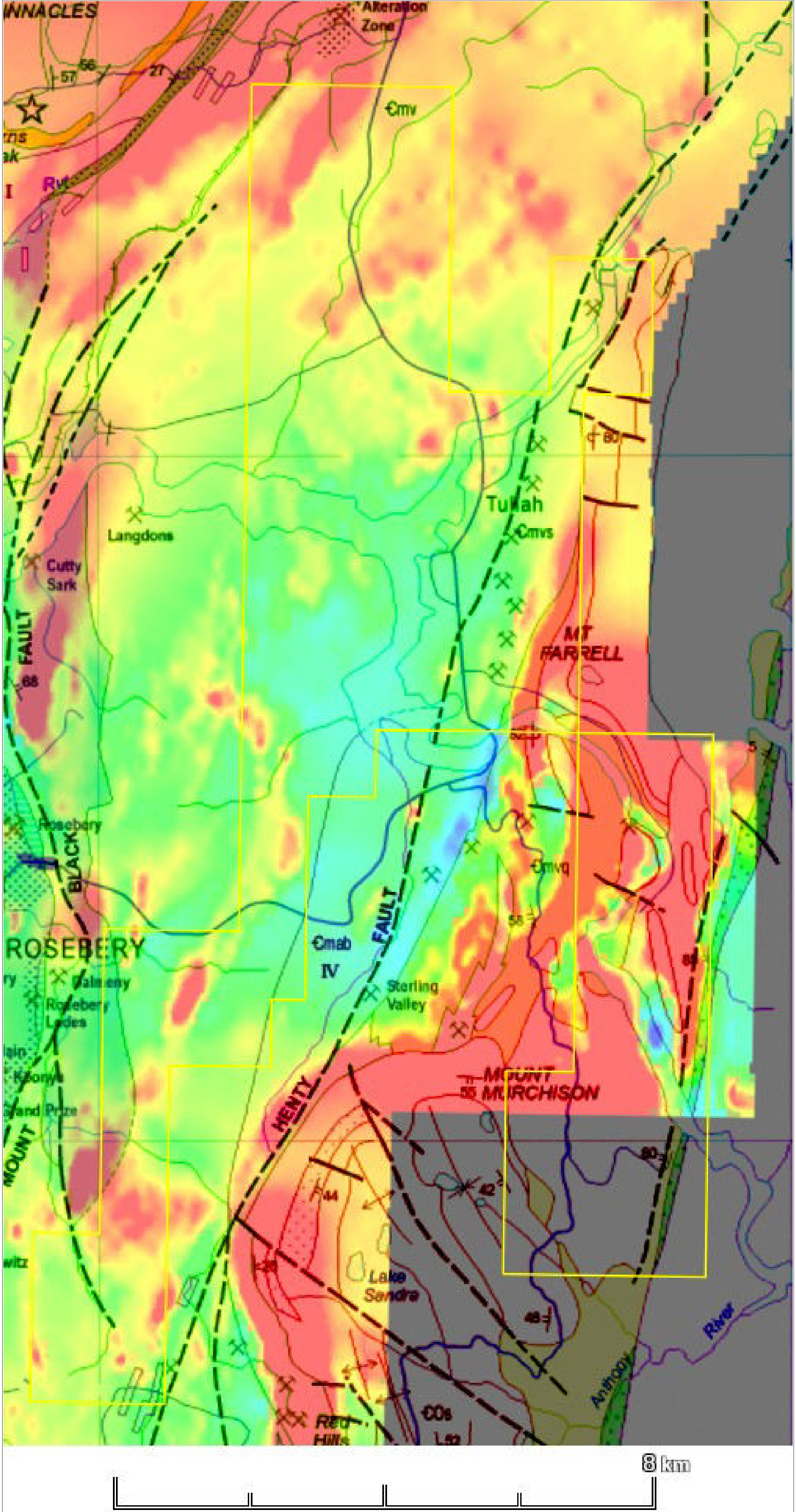
Most of the open-file AEM surveys have been flown in the vicinity of EL 12/2019 in the past 40 years have been completed by either Pasminco or MRT. A summary of the airborne magnetic and radiometric data is listed in Table 1. Detailed surveys have usually been small (typically ~100 line kms) and restricted to their exploration licenses or part of their exploration licenses. Most of the modern AEM surveys have been flown using helicopter systems with E-W flight lines, a line spacing between 100-200m and ~80 m clearance.

The 2002, airborne, DIGHEM MRV survey covered 90% of the EL12/2019 tenement with a small coverage gap in the south-east corner. The acquisition featured a helicopter-towed electromagnetic transmitter and sensor coil, where the transmitter generated a primary electromagnetic field and the sensor picked up the field response. Differences in resistivity were attributed to a range of factors including geological variance, groundwater and salinity, and regolith type and depth. It's a frequency domain electromagnetic system that measured resistivity at five frequencies; 880, 980, 6000, 7000 and 34000 Hz whereby higher frequencies measured resistivity in the shallow subsurface and lower frequencies measure deep resistivity.

The DIGHEM regional dataset (shown in Figure 5, next page) highlights selected lithological boundaries and broad structural features for geological mapping. It is less effective for finding exploration targets. For example, the DIGHEM survey helps to identify areas of no or thin basalt cover in the north-east (as more pronounced zones in the low frequency data) but does not provide the necessary detail to recognise faults breaks and truncations nor identify formations, marker units and host lithologies. As a result, Argent Minerals decided to contract Montana GIS to completely review and reprocess all relevant aeromagnetic datasets using current algorithms to allow for the optimal interpretation of exploration targets within EL12/2019.

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 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 (EPGS 28355).



Alteration Zone
Ꞓmv
Langdons
Cutty Sark
FAULT
Tullah
Ꞓmvs
MT FARRELL
Rosebery
BLACK
ROSEBERY
Dalmeny
Rosebery Lodes
Koonya
Grand Prize
MOUNT
Ꞓmvq
Ꞓmab
IV
FAULT
Sterling Valley
HENTY
MOUNT MURCHISON
Lake Sandra
Ꞓ0s
Red Hills
Anthony
River
8 km

Aeromagnetic Interpretation

The principal aims of the interpretation was to provide a better regional geological and structural framework of EL 12/2019 and to highlight any specific target areas encountered during the interpretation. The interpretation of magnetic data employed was largely semi-quantitative.

Interpretation of the DIGHEM MRV survey has identified the following observations on E12/2019.

1) At the north boundary of tenement is a north-trending conductive zone (centred on 384000 mE and 5385300 mN to 5392900 mN) corresponding to mapped Quaternary alluvium. TEM and DC resistivity soundings over Pleistocene glacial deposits around 100 m thick are located near Boco. The glacial deposits had resistivities of 100-500 ohm-m, consistent with the apparent resistivities determined from the HEM data. However, TEM and resistivity data also indicated a 18 m thick, highly conductive (<0.5 ohm-m) layer within the glacial cover, which was interpreted as clays. It is not clear whether the conductive clay layers within the glacial cover are widespread or rare features.

2) Areas of predominantly very high apparent resistivity (around 385600 mE 5383300 mN; 381400 mE 5375600 mN; and 378430 mE 5366400 mN) correspond to outcrops of the Central Volcanic Complex of the MRV (Dundas Group) at Mt Block, Mt Black and Mt Read.

The 20m conductivity-depth slice showed considerable geological detail in highlighting stratigraphic conductors although most of the conductive sections in the area corresponded to mapped Quaternary alluvium (often glacial sediments). Some cultural anomalies were evident (due to power and railway lines). The highly resistive sections corresponded to the Tyndall Group (volcaniclastic and volcanics) and the Owen Conglomerate.

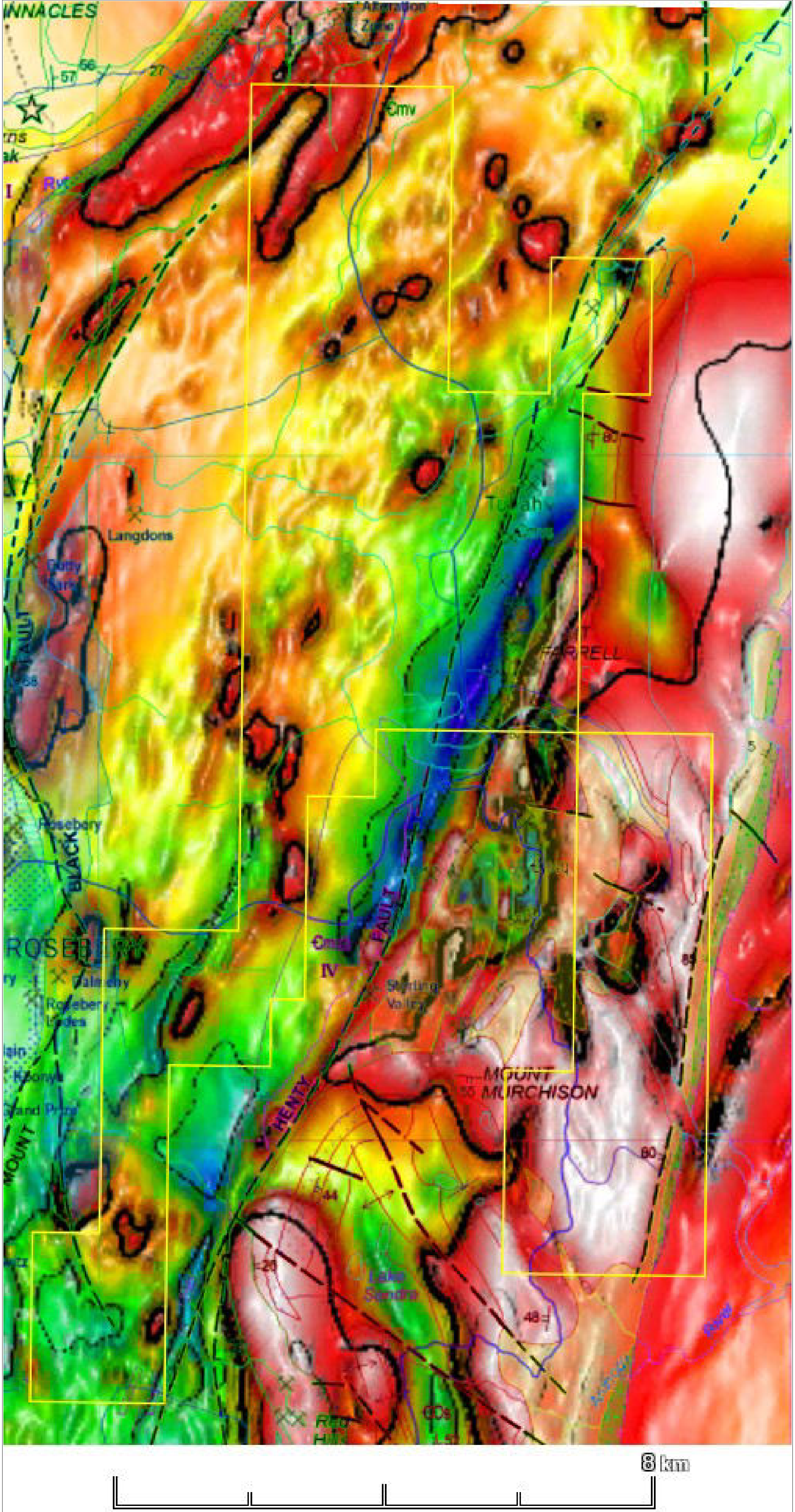
The 70m conductivity-depth slices show considerable geological detail, particularly in the Rosebery area (beyond the tenement) in contrast to the relatively little geological information on the 120 m depth slice.

The newly reprocessed magnetics were compiled and exported as Geotiff images. The customised data processing enhancements provided sufficient datasets to capture 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 has identified the following observations on E12/2019. 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). A string of these highs form lines that parallel the north-easterly, dominant, fold axes direction and parallel to the bounding Henty Fault. These folds are spaced evenly and well expressed in Gifkins'cross-section through the tenement (centred on 5380000 mN) (see appendix). VRMI filtering is typically 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.

Linear Hydro powerlines and some roads show as conductors although these have been effectively filtered. It was difficult to interpret lineations and faults via breaks and truncations.

Figure 6 (next page) Reprocessed VRMI aeromagnetic dataset with edge detection over EL12/2019


Cmv
Langdons
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BLACK
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IV
Stirling Valley
MOUNT MURCHISON
HENTY
MOUNT
Lake Sandra
8 km

Time-domain EM Datasets and Interpretation

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.

It is important to note that surface and airborne EM methods have a reduced depth of exploration for steeply dipping conductors when compared with shallow dipping or flat lying conductors. The short strike length typical of VMS deposits reduces the effectiveness of surface and airborne EM.

It is recognised that some zinc-rich sulfide deposits have poor conductance that could generate only weak anomalous responses or be undetected by TEM surveys.

The following electrical observations regarding western Tasmania were made. Alteration zones in the volcanics can't easily be distinguished on electrical properties and the Hellyer-Que River high conductivity TEM responses are exceptional relative to other Tasmania TEM responses.

Resistivity and IP

Electrical resistivity tomography (ERT) enables the mapping of the distribution of bulk electrical resistivity in the subsurface. The method was based on the measurement of the electric potential distribution (ΔV), which results from the injection of an electric current (I) in the ground.

A theoretical limitation exists for ERT, that because the primary control on the depth of investigation is the distance between the electrodes, or in other words, the geometry of the cables (array type, number of electrodes, spacing between electrodes, number of segments). In practice a 1km line might typically image to a depth of 100 m but if the line is shorter then good images are available from the shallow section. There is a second limitation, the measurability of the signal by the equipment, whereby the signal amplitudes must be sufficient to stack out electrical noise. Therefore this method lacks the depth needed to be of practical use in a deep exploration program.

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.

An IP survey was acquired over the EL12/2019 tenement by HEC (now Hydro Tasmania) on Pieman Rd. The survey location is 3km NW of Tullah, at the easternmost 3km of Pieman Rd (383000E 5381700S). The chargability values were the lowest of 67 samples from MRV VMS sites and while all MRV sites had partially altered volcanics, in this area, the volcanics were unaltered.

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 mineralization

The original discovery of the Que River deposit proved that despite the mineralisation being non-conductive and not outcroppoing, it still had a strong response to IP in close proximity (albeit geo-sampling provided crucial support for the discovery).

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.

Pasminco acquired a 50 m dipole-dipole South Kershaw IP-Resistivity survey in 1993 that defined two significant anomalies 1) a strong, continuous linear chargeability-resistivity anomaly along the Rosebery Fault between 5378700N and 5380100N, and 2) a distinct shallow IP chargeability anomaly with weak coincident low resistivity, in a northeast trending zone on lines 5379500N and 5379700N correlated with the southern extension of the Chester Pyrite Zone. A follow-up hole did not intersect significant base metal mineralized zones.

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.

Finally, in the volcanics, gold deposits may be structurally controlled; associated with intrusives or perhaps replacement type. Gold is likely to occur with disseminated sulphides (perhaps only in low concentrations in quartz veins) however IP should be an effective direct search technique.

In general, in western Tasmania, the following resistivity and spectral IP conclusions can be drawn.
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 spectral chargeability (eg Rosebery and Hercules)
3) There are some abnormally low deposit resistivities (eg Hellyer)
4) Conical-shaped deposits produce weaker electrical anomalies than the tabular shapes (Rosebery)

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).

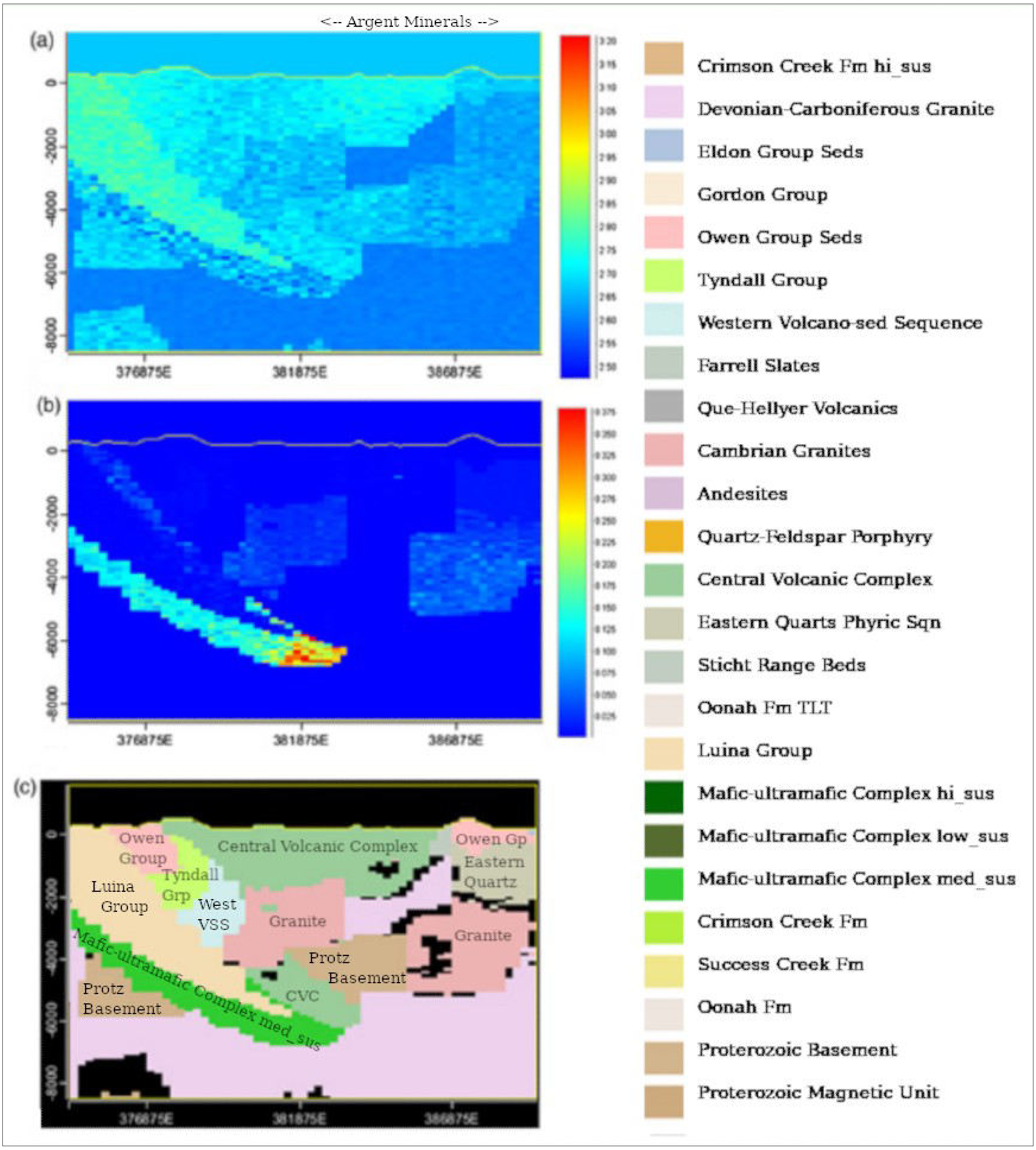

Figure 7 AusLAMP magnetotelluric results showing a) Density (t/m3), b) Magnetic susceptibility (SI) and c) Geology across Rosebery with longitude indicated.

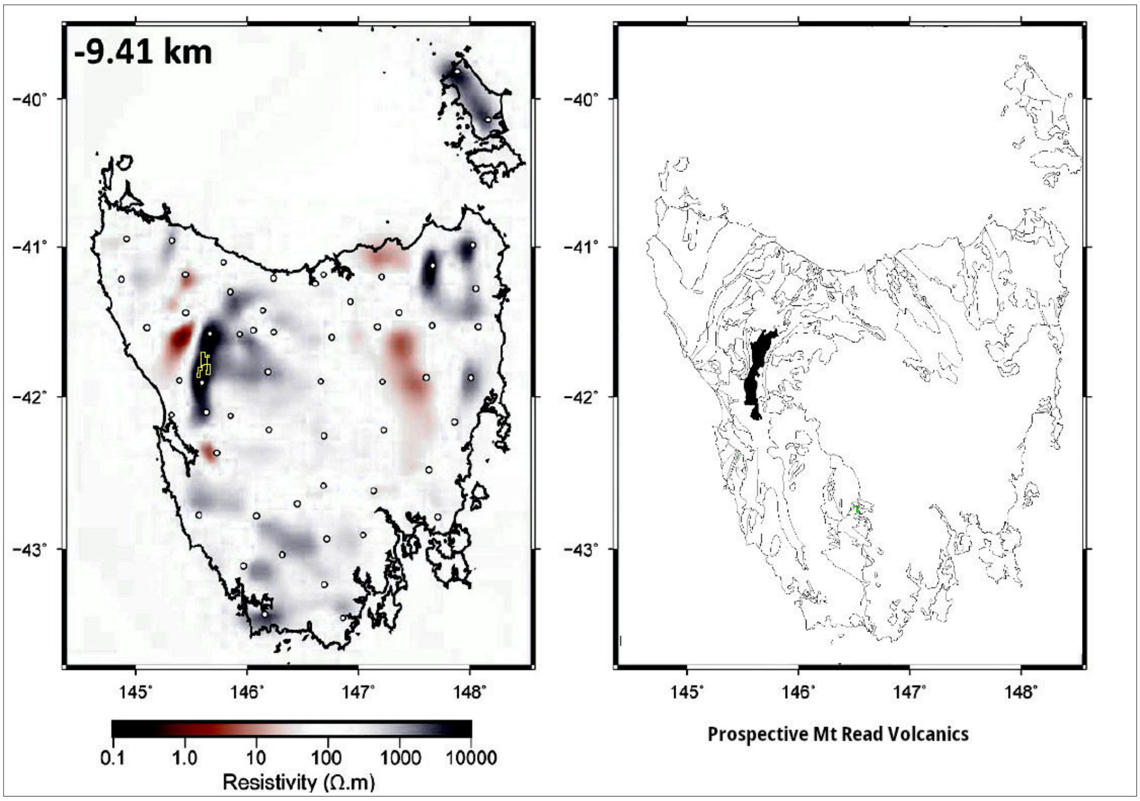

Figure 8 AusLAMP megnetotelluric results showing a) resistivity depth slice at -9.41km with yellow tenement location (left) and geological map with MRV in black (right).

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.

The preliminary results show that the crust in the vicinity of the MRV to be electrically complex with areas of anomalously low resistivity being spatially correlated with outcropping Cambrian metamorphic complexes bounding the Dundas-Fossey Trough. 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.

Magnetics

Conventional magnetic surveys are sometimes not efficient enough to detect Pb-Zn mineralization. The failure can be attributed to the absence of ferro-and paramagnetic minerals such as hematite, magnetite and pyrrhotite associated with the Pb-Zn mineralisation.

Seismic

Seismic Datasets and Interpretation

Seismic has been used in exploration for about a century. Hydrocarbon exploration refined the method to the point where regional seismic is considered for deep, lithological and structural mapping projects. While it is technically possible to obtain excellent local target imaging with the possibility of direct detection, the likelihood of a line intersecting such a small target is minute (while the cost of acquiring seismic is huge).

In practice, massive sulphides have a low velocity but high density and therefore can produce a strong acoustic impedance contrast generating a seismic reflector. Significant reflectors indicate lithological boundaries while discontinuities indicate faults and fractures.

Passive seismics for mineral exploration results are low resolution. For example, it can indicate basement but has insufficient spatial resolution to image intervening layers or faults. It doens have a small environmental footprint and is inexpensive.

2D Seismic line 95AGS-T1 Acquisition and Processing

95AGS-T1 was acquired by GA in January 1995 to provide a regional tectonic framework as a basis for mineral exploration. The survey obtained 133.8 km of seismic data along 5 lines over an 8 week period and gravity data was acquired at 120 m intervals. Line T1 measured 49.2km.

The eastern half was reprocessed for Argent Minerals in 2020. Commencing with the original field data, an advanced 2D land imaging sequence was applied including pre-stack DMO followed by post-stack migration. The full reprocessing flow is summarised in a separate report.

Reprocessing this legacy data was worth the effort even though the data was low-fold and missing documentation. Comparison of the new results with the previously processed seismic section illustrates the improvements obtained by utilising a modern, hard rock specific, processing workflow.

Rosebery 3D

800 metres west of EL12/2019, while exploring on the south bank of Lake Rosebery, MMG projected that terrain difficulties would lead to significant drilling costs. As a solution, the Rosebery 3D seismic survey was acquired and processed by Hiseis to image the Rosebery and Mt Black Faults and to constrain the prospective Z-lens mineralisation.

Due to the complex geology, extreme topographical variation (400 m), survey design limitations (survey grid of ~1.5 km^2) and other factors, the identification of these primary structures initially failed and subsequent drilling based on the new data did not find a mineral deposit. After padding the migration space and remigrating the contractor announced that it had “unambiguously imaged the controlling structures (Rosebery and Mt Black Faults) and (had therefore) achieved the major objectives”. The later work showed that the subsurface position of the Mt Black Fault was inferred from a change in dip of reflectors. The Rosebery Fault was a high amplitude, coherent reflector, particularly up dip.

Exploration using seismic data has becoming more routine over the past decade partly due to lowering of costs. Over the past three years, 2D seismic (in conjunction with magnetotelluric surveys) have been used to image deep structures and conductivity pathways as a means of understanding the significant role that the mantle plays in constraining conductive fluids.

Several unique benefits are that seismic reflection does not fundamentally lose resolution with depth (unlike magnetic, gravity and electrical methods) plus structures and stratigraphy can be directly and highly resolved.

Other Geophysical Methods

Synthetic Aperture Radar Dataset and Interpretation

1993 POLSAR and 2000 PACRIM TOPSAR swaths were acquired byNASA /JPL and processed by RMIT (Hewson, 2018). Virtually all of the heavily forested tenement EL12/2019 was covered except the remote north-east corner, near Lake Mackintosh.

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 5 m resolution TOPSAR data (C-VV) revealed information about dykes, lineaments and high-potential structural trends. The P-band radar with P-HV polarisation showed improvement over other bands for mapping lineaments, moisture content, ground cover related to geological units and geobotanical associations. 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.

The SAR dataset is a high quality one and was used in a 2018 study for lithological classification 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).

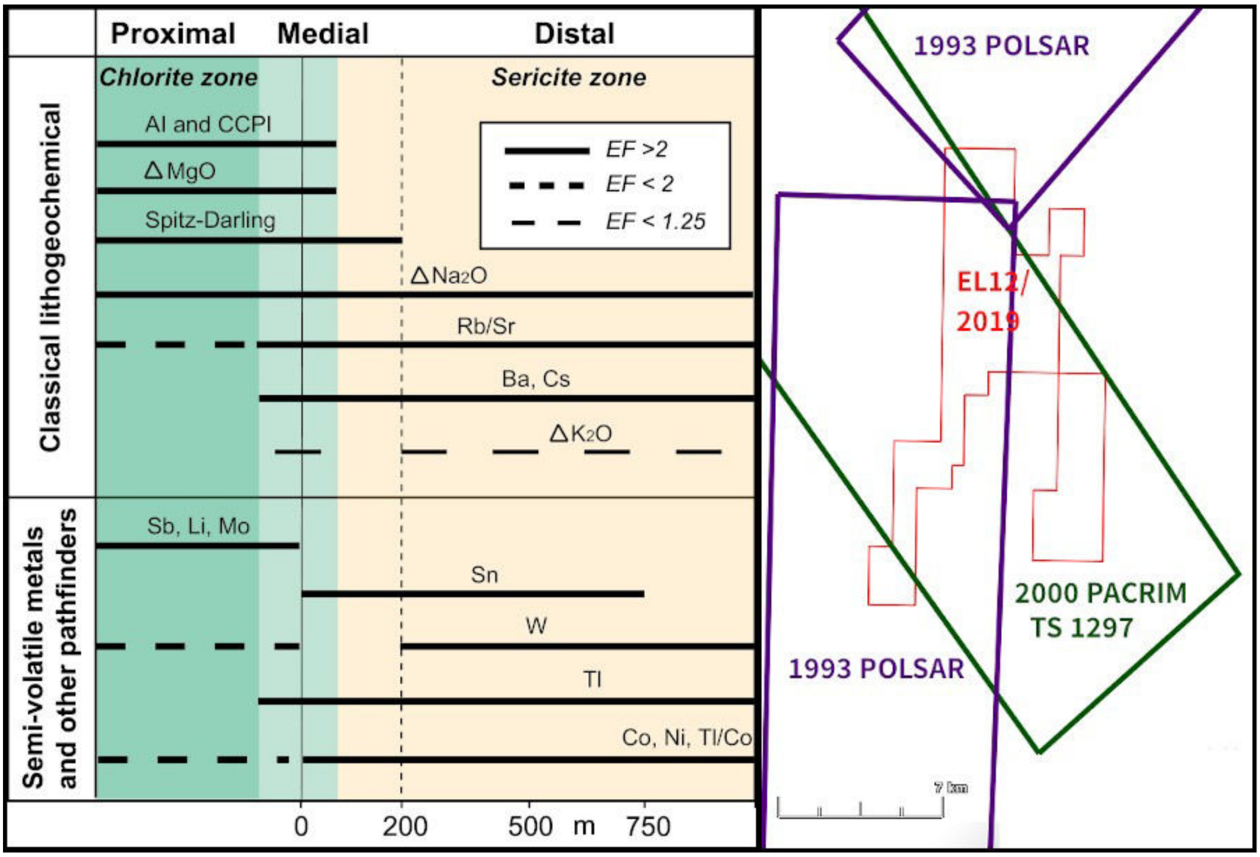

Figure 9 VMS pathfinder minerals (left) and synthetic aperture radar coverage (right)

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

Finally, GPR can not be considered to be of practical use in a deep exploration program because radio waves cannot penetrate deep enough.

Hypserspectral 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 (Figure 9).

Holy Host Marker Horizon

The timing of VMS mineralisation within the MRV is recognised to have formed ~500 ±1 Ma. This marker horizon is represented by the “Holy Host” horizon which is a particularly favorable chronostratigraphic interval that is being targeted by explorers across the region. The presence or absence of the “Holy Host” horizon in an area has had a profound influence on the perceived exploration potential.

The horizon’s identification is independently acredited to Rosebery geologists and to the seminal paper about alteration in the MRV in 1987 which states "most syngenetic deposits and sedimentary lenses in the Rosebery-Hercules area may lie on a single host horizon". The horizon’s presence was subsequently validated (Mortenson 2015) using hi-resolution geochronology.

The "Holy Host" is a continuous, Cambrian, sea-floor, sedimentary sequence that features previously active "black smokers", the type found today at sea-floor spreading centres. In the southern MRV, the horizon is not a single horizon but rather a number of mineralised horizons within a single package of rocks tens of metres thick. The mapped “Holy Host” shows the horizon clipping the southernmost and northernmost boundary of E12/2019.

LiDAR Datasets

LiDAR was acquired over much of tenement E12/2019 by MMG between 2011-2014 to be used as a base DEM to be draped with aerial photography using visualisation capabilities. The 2m gridded, bare-earth filtered, DEM was also used to construct multiple shaded-relief images with the goal of identifying poor outcrop, indistinct stratigraphy, subtle topographic features suggestive of folds, fault and lineations that had been covered in dense vegetation. It allowed MMG geologists to find subtle geologic features that might be otherwise be missed, build a georeferenced, orthographic mapping base and as a "firm foundation for topographic control".

2011 MMG Rosebery Avebury LiDAR acquired 287 km along 1000 m traverses and also the 2014 MMG Rosebery LiDAR and orthophotography acquired 584 km on 1400 m traverses.

3. RECOMMENDATIONS

Regional Scale

For the past several decades there has been considerable consensus that no economically significant mineralisation remains undiscovered in the shallow MRV. Therefore shallow cover represents a major technical barrier to the discovery of new mineral deposits. Approximately 53% of the belt is under shallow cover (>10m of post-Cambrian sediments/volcanics). Cover typically comprises Quaternary glacial deposits (to 100m thick), Tertiary flood basalts and associated sediments (highly variable thickness, to 350m) and the siliciclastic Cambro-Ordovician Owen Conglomerate (up to >800m of cover).

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), reflection seismic, gravity, hydrochemistry and to a lesser extent potential field and passive seismic. 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.

In the search for deeper mineral targets, this project has reprocessed and interpretated existing seismic and AEM datasets and confirmed the results via MT. Next, the following section evaluates further selected techniques that are best suited to exploring the EL12/2019 tenement on a regional scale. The cost of each has not been defined.

Stratigraphic drilling is worthy of consideration. Many exploration methods are limited to inference, whereas stratigraphic drilling allows actual stratigraphic correlation of drillholes, seismic reflectors and subsurface structures in areas either previously unexplored (because they are far from faults) or where previous exploration methods have failed to image anticipated targets (ie. alteration along faults). Obtaining continuous core through though a target stratigraphy or basement and the potential for the acquisition of downhole geophysical surveys would be expensive but possilby the only way forward. An area where stratigraphic drilling has been suggested is between Tullah and the Lake Macintosh Dam because there is an opportunity to better extend the Henty Fault mineralisation trend. Also into the “Holy Host” in the far northwestern corner of the tenement.

Mineral prospectivity analysis

In 2000 Pasminco considered the key to the next generation of MRV discoveries would come from a combination of regionally understanding of the stratigraphic setting of mineralisation in the MRV and regional examination of high-quality geochemical and geophysical datasets to highlight zones of interest.

Project T3 consisted of Melbourne Uni and GA geoscientists compiling all significant geoscientific data sets onto a single platform, then applying geostatistics via mapped (worms) of faults, gravity, magnetic and other datasets to highlight areas of higher MRV VMS potential. T3 found a clear trend of increasing metal endowment with proximity to length–weighted faults. They also found the MRV to be segmentated by northwest-trending structures (Figure 10) and associated with major mineral systems, eg. Henty Gold and Hercules on one feature, Hellyer on another, while Rosebery and Mt Lyell lay at major northwest deflections or jogs suggesting that the role of northwest-trending structures and their fault intersections controlled the location of Cambrian VMS deposits. They concluded that the best potential for repetition of similar structural positions was in the

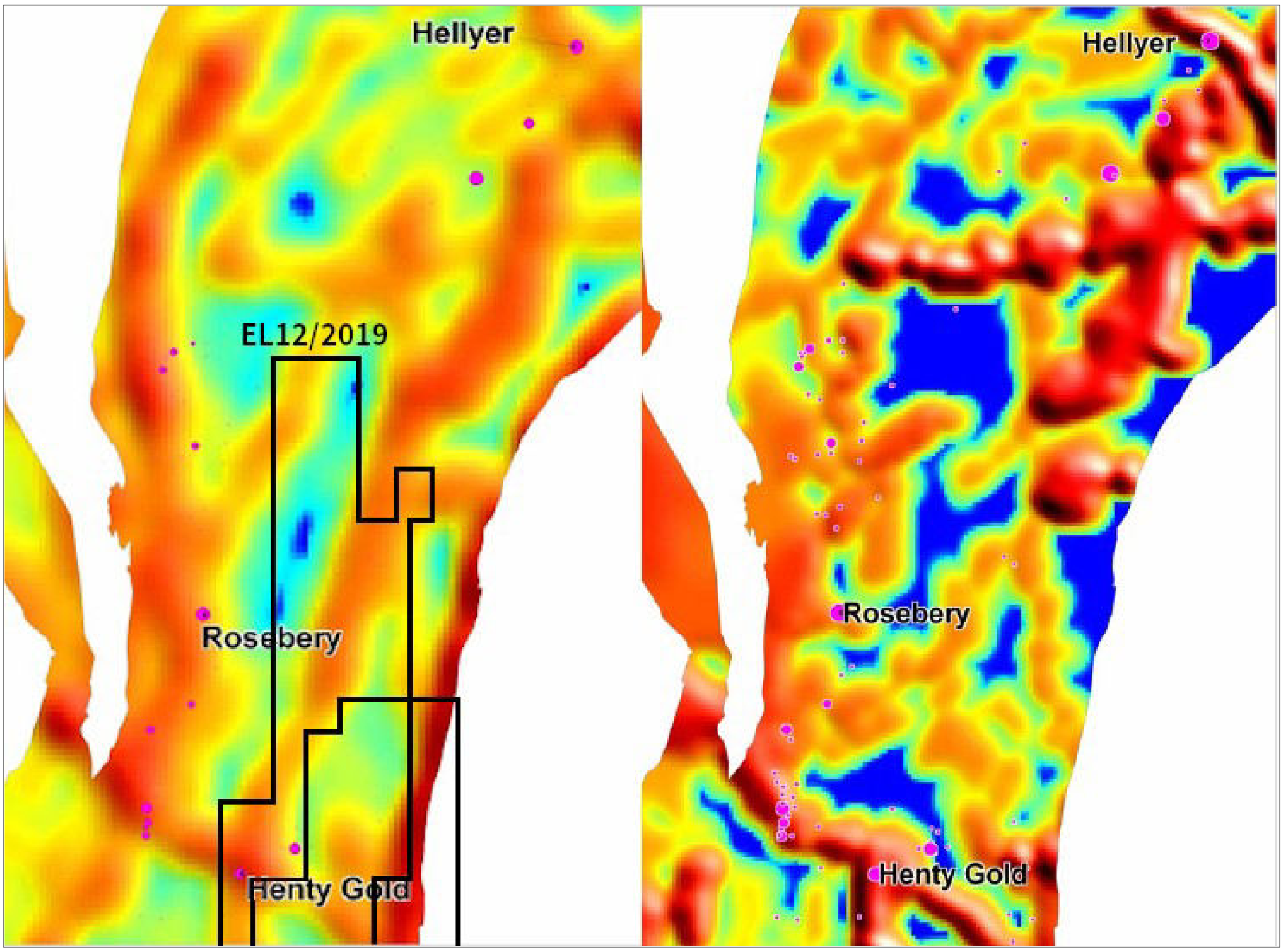

Figure 10 VMS, total edge length and EL12/2019 (left) and total worm relative depth (right)

northern MRV. A priori it's clear that long strike length faults penetrate deeper into the crust so have a higher metal carrying capacity, but has recent MRV exploration been more successful near long faults because existing finds were already there?

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, electrical properties, seismic velocity 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. Table 3 tabulates some basic petrophysical characteristics of the mineral deposits in the vicinity.

Location	Deposit type	Susceptibility	Density	Conductivity	IP effect	Resistivity
		X10^-6 cgs	t/m^2	S/m	PFE	ohm m
Hellyer	VMS	30	4.1-4.9	4-100	100	20
Que River	PQ Lens		4.4-4.5	20	100	6
Rosebery	VMS	20	4.2	20	50	1
Elliot Bay	VMS			negligible	0-20	1-800
Basin Lake	VMS		4.1-4.2	2-3	30	100
Kara	Magnetic skarn	400K-1M	3.5		0-48	3-416
Mt Lyell	Low-grade Cu ore	0-100	2.76-3.15			
Renison	Tin in pyrrhotite	2790-21400	3.2-4.0	270-410		

Table 3 Basic multi-parameter, petrophysical property database of existing VMS deposits

Eshagi 2017 p44-78 compiled petrophysical data from the tenement to better constrain modelling.

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.

Gravity

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.

Radiometrics

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 EL12/2019. 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.

Seismic

Altered zones can be differentiated from host rock via their acoustic impedance depending on the direction of seismic propagation and depth. This is principally due to a subtle difference in porosity. Further reprocessing of the existing seismic line 95AGS-T1 could be considered for alteration mapping and if a target, by chance, coincides with the seismic line location, then potential imaging.

Passive seismic is the only affordable seismic method. It cannot offer the necessary spatial resolution for targeted hard-rock mineral exploration although it can reveal fundamental boundaries where sufficient velocity or density contrast exists.

Further seismic acquisition and processing would be too expensive given the isolation of Tasmania, the extent of vegetation coverage and the high terrain. In principal, the following 2D seismic acquisition configuration has merit for imaging multiple prospects on the tenement. Using a thumper source and zero-footprint landstreamer would be a versatile and economical way of providing a clear, structural and stratigraphic image of the deep subsurface (0-1km). In contrast a MASW (a refraction seismic method) offers only shallow details.

Local Scale

The following section evaluates and recommends selected techniques that are best suited to exploring the EL12/2019 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 (particulalry for Henty-style and Rosebery-style mineralisation).

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.

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.

Moombarriga Geoscience are a local MT and IP contractor.

4. 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 (eg. Rosebery) 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 (via DHEM, see below).

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 seismic and electromagnetic datasets. New magnetotelluric data supports the seismic interpretation at depth. With the goal of locating deeper mineralisation, further combinations of detection technologies are required, particulaly on a local-scale, such as the following:

- **Drone-based AEM** has good potential because of the complex terrain, cost and versatility.
- Ground electrical surveying should be completed to assist drill targeting over areas with good access. Electromagnetic techniques should work well for mapping stratigraphic indicators eg. the "Holy Host" marker horizon and provide a vector towards potential mineralisation. 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. Spectral IP would assist in the discrimination of auriferous targets via disseminated sulphides.
- 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 and further consideration should be given to high-resolution **2D seismic.**
- **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, LiDAR and conventional gravity. Finally, every exploration drillhole on the EL12/2019 tenement was either located 1) adjacent to the Henty Fault or 2) drilled by Hydro Tasmania (for geotechnical purposes) located above Lake Rosebery, on the western side above Lake Macintosh. Over 90% of the tenement remains undrilled so stratigraphic drilling is warrented where geophysics indicates.

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APPENDIX

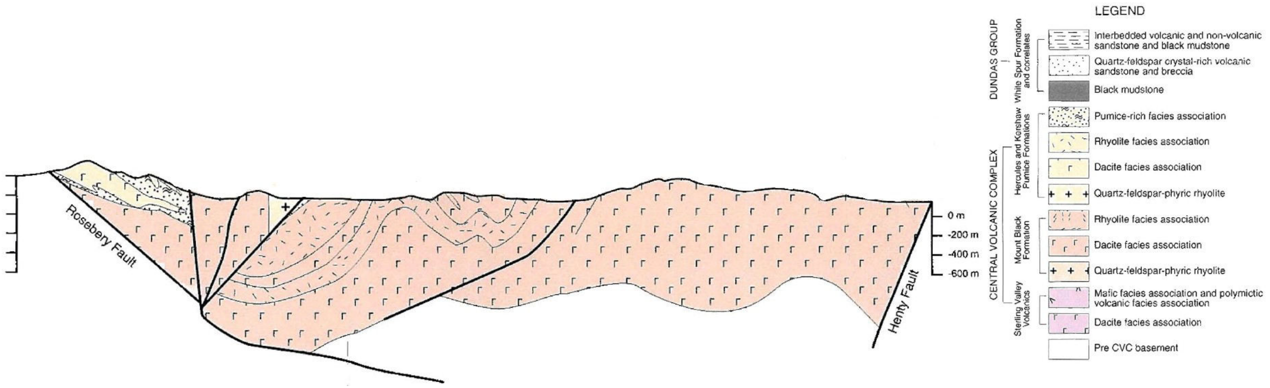


Figure 11 from Gifkin's PhD of cross-section through 5380000m S, parallel to the seismic section.

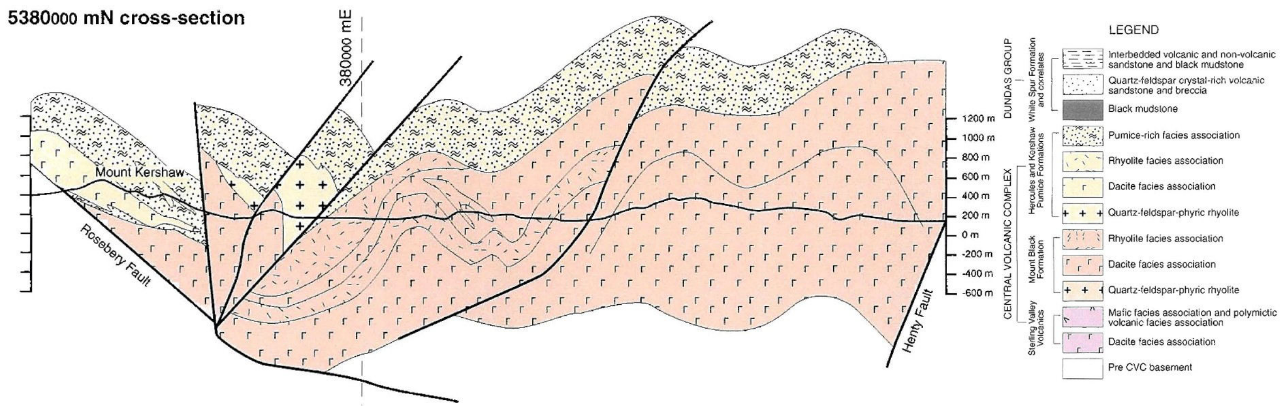
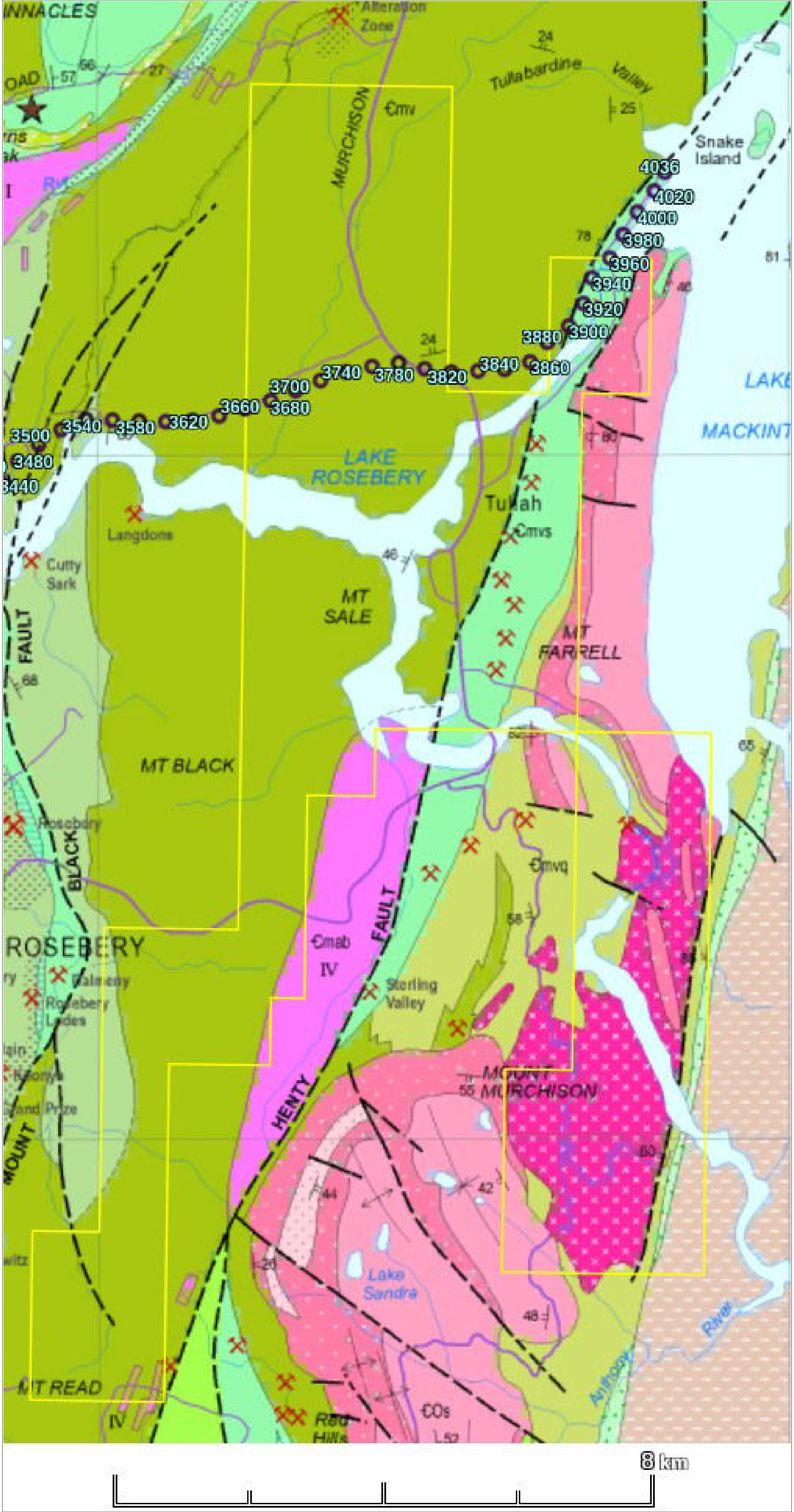


Figure 12 2002 MRT geological map showing 2D seismic line location and CDP locations

Figure 13 Pre-2002 MRT geological map, note western faults not marked.

Figure 14 Tenement drillhole distrubution (orange) over satellite image show how concentrated drilling is in the vicinity of the Henty and Rosebery Faults and spares elsewhere.



PINNACLES
Alteration Zone
Tullabardine Valley
MURCHISON
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Snake Island
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LAKE
MACKINT
LAKE ROSEBERY
Tullah
Ꞓmvs
Langdons
Cutty Sark
FAULT
MT SALE
MT FARRELL
MT BLACK
Rosebery
BLACK
Ꞓmvq
ROSEBERY
Ꞓmab
FAULT
Sterling Valley
Rosebery Lodes
Grand Prize
HENTY
MOUNT MURCHISON
MOUNT
Lake Sandra
Anthony
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MT READ
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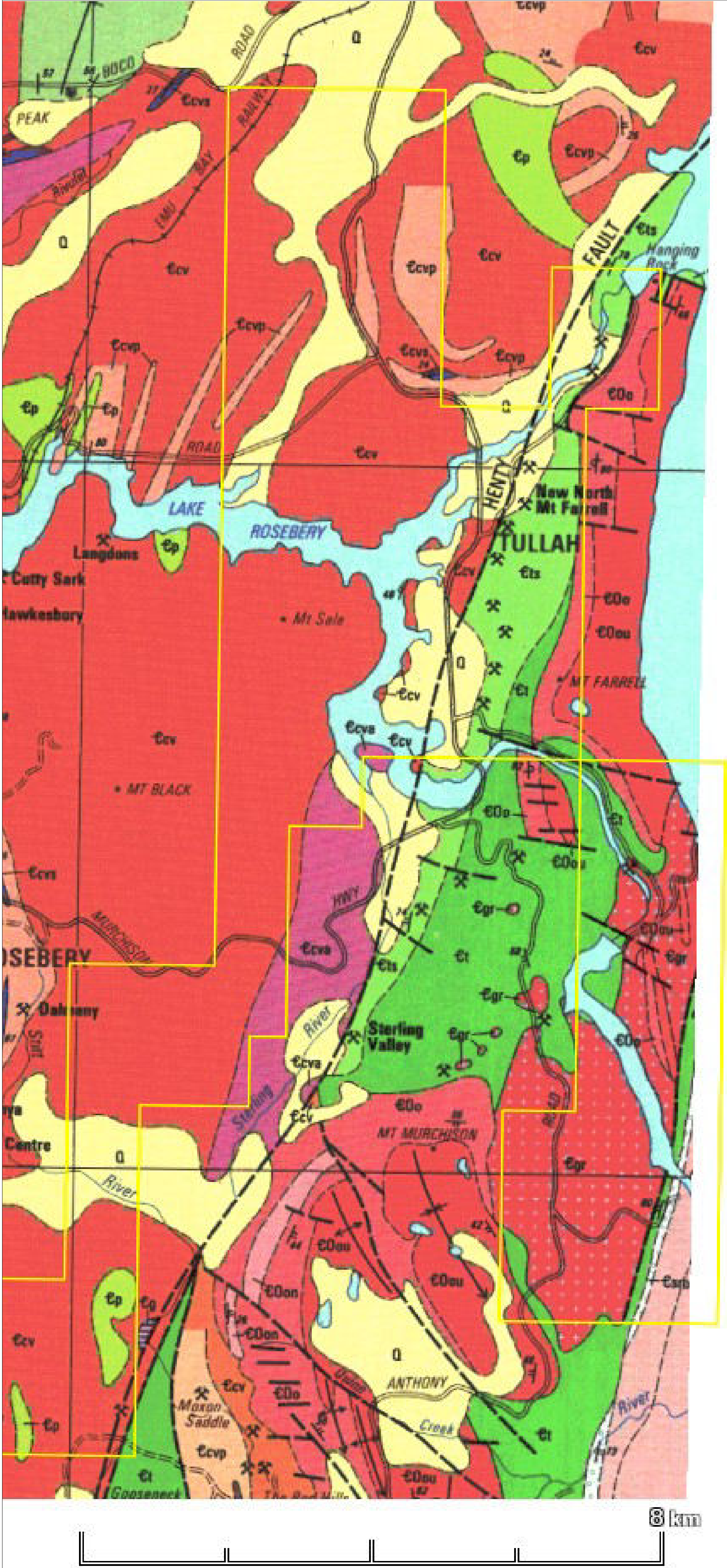
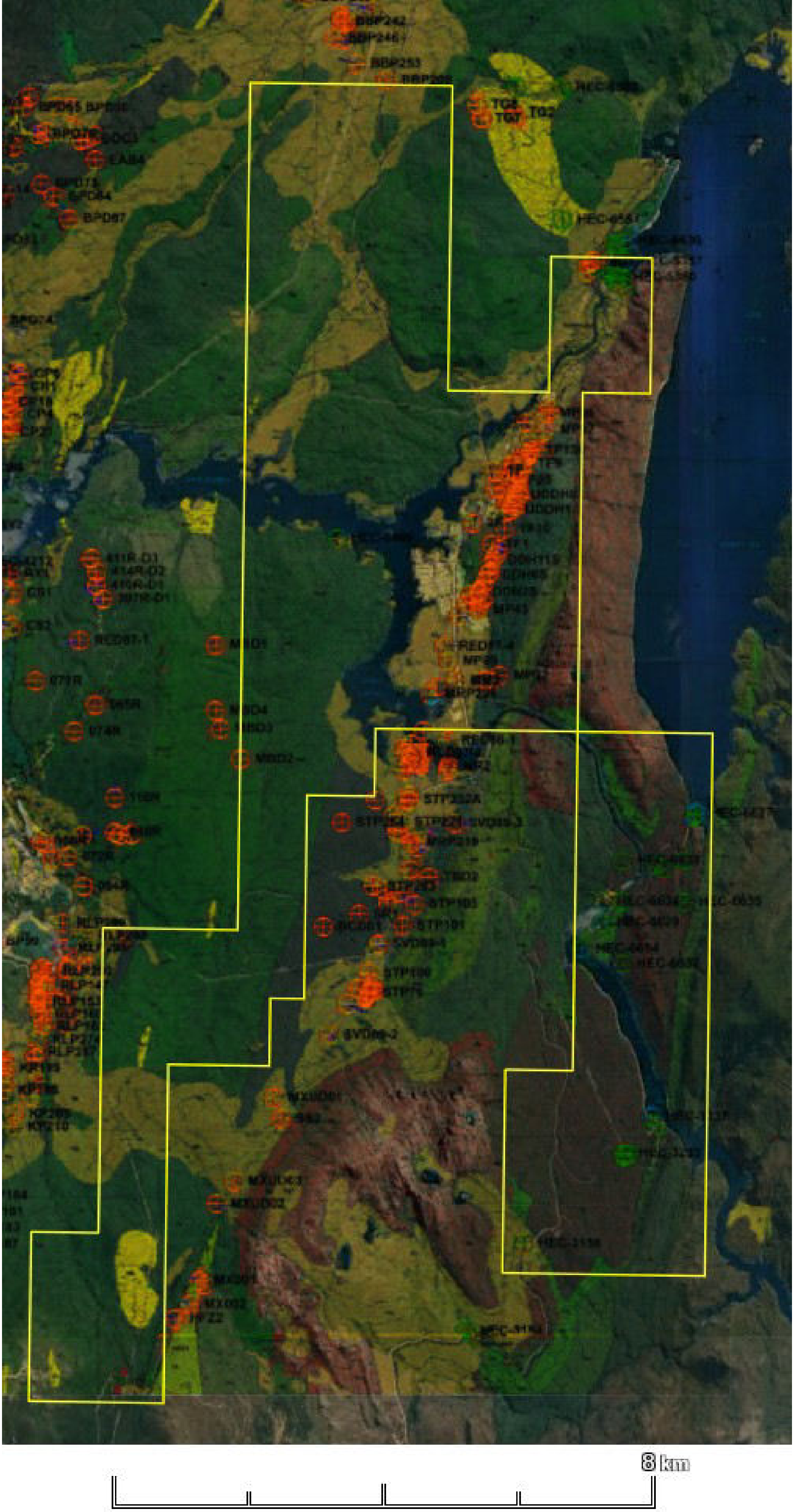
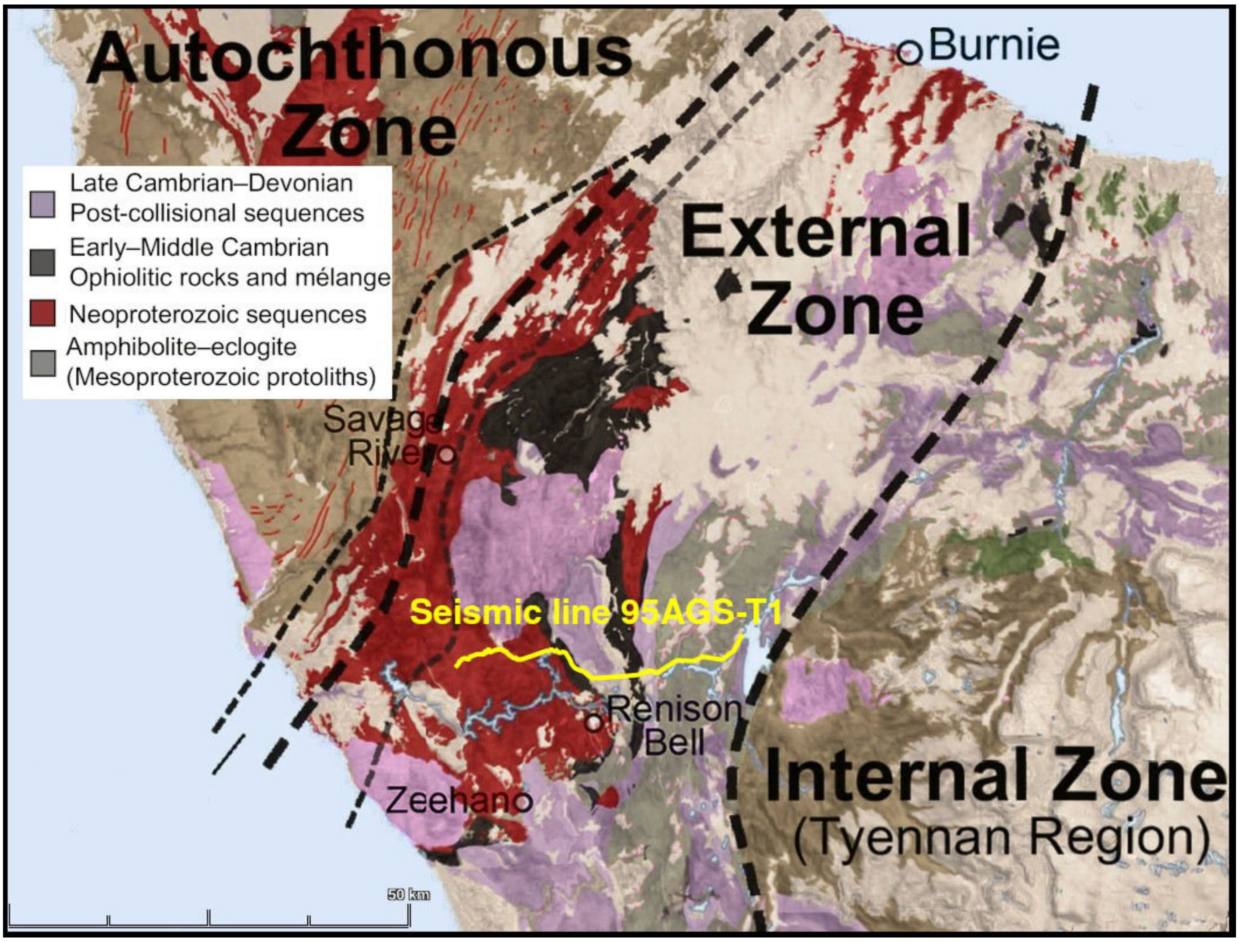
Red Hills
8 km


LAKE ROSEBERY
TULLAH
New North Mt Farrell
HENTY
FAULT
Hanging Rock
Langdons
Cutty Sark
Hawkesbury
Mt Sale
MT BLACK
MT FARRELL
ROSEBERY
Oakleny
Sterling Valley
MT MURCHISON
ANTHONY
Creek
Moxon Saddle
PEAK
ROAD
RAILWAY
HWY
River
8 km


BBP242
BBP246
BBP253
BPD55
BPD78
EAB4
BPD84
BPD87
BPD74
TG2
HEC-6551
411R-D1
414R-D2
RC087-1
071R
065R
074R
STP232A
STP224
SVD89-3
STP209
STP203
STP185
STP191
SVD89-1
STP199
STP75
SVD89-2
MXUD01
MXUD03
MXUD02
MX001
MX002
HEC-5135
HEC-9151
KP195
KP210
8 km

Interpretation of seismic line 95AGS-T1 in NW Tasmania



Internode Seismic

September 2020

Table of Contents

1. INTRODUCTION

Internode Seismic reprocessed the eastern half of 2D seismic line 95AGS-T1 because it intersected Argent Minerals Ltd's EL12/2019 tenement in August 2020. For comparison, the original 1995 processed stack section was depth converted. The location map is shown in Figure 1.

The reprocessing and interpretation objectives were to:
1. Generate a shallow sub-surface image that could be link to the mapped surface geology
2. Generate a deep structural image of the area between the Henty and Rosebery Faults
3. Obtain stratigraphic information for understanding the geological evolution of the area
4. Delineate any potential areas for more detailed mineral exploration targeting

Acquiring new seismic lines would have been costly, whereas interpreting the reprocessed seismic data offered better value to Argent Mineral's mineral exploration program because depth reprocessing produces a more detailed and reliable depth image of the subsurface geology compared to the original seismic time section. New structural and stratigraphic details may become clear, leading to new exploration insight.

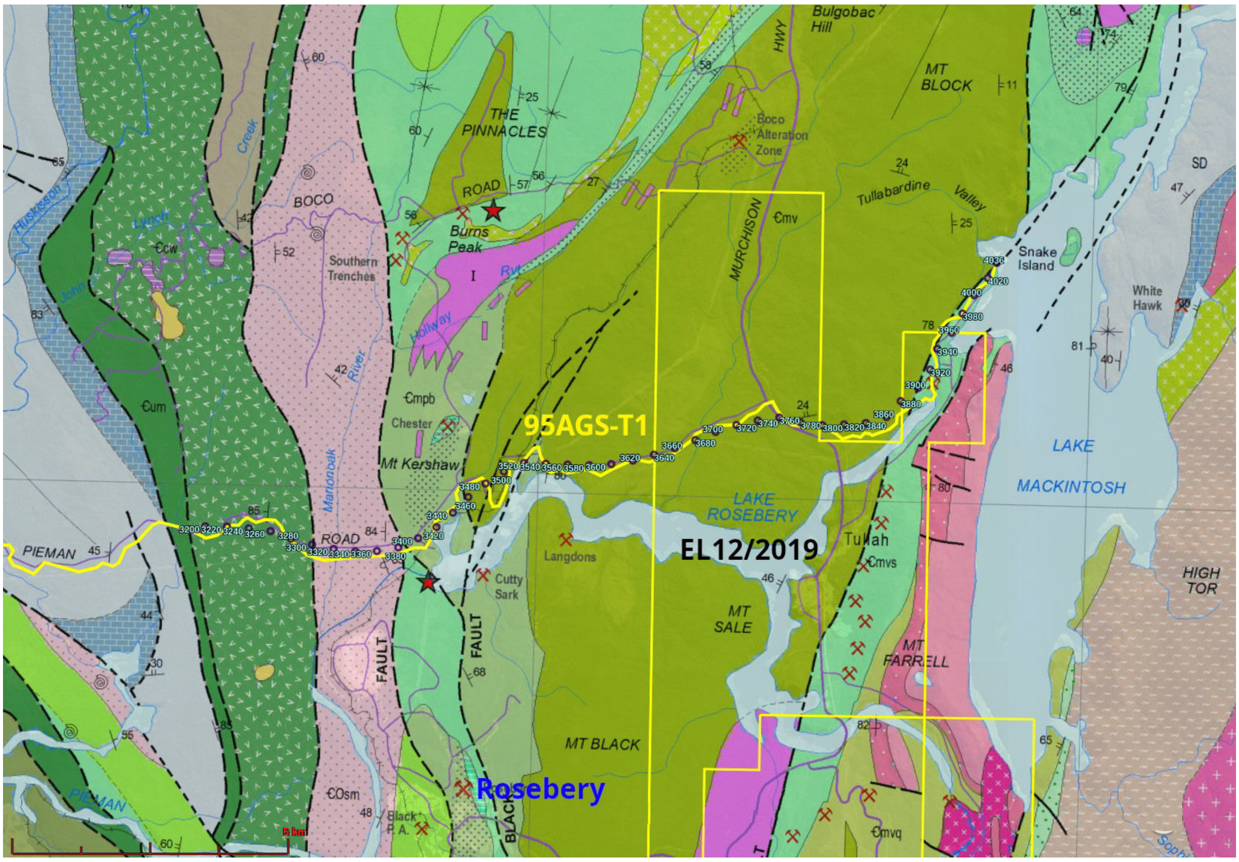


Figure 1. Location maps of seismic line 95AGS-T1, tenement EL12/2019, mines and geology.

2. GEOLOGY

Proterozoic to Paleozoic Tectonostratigraphy

Mesoproterozoic strata unconformably underlies Neoproterozoic rift deposits in north-western Tasmania. The Neoproterozoic rifting was contemporaneous with punctuated Tonian to Ediacaran rifting along the paleo-margins of the Pacific Ocean in southeast Australia, East Antarctica, and western Laurentia.

Following Neoproterozoic continental shelf and slope strata deposition in rift basins, Cambrian volcanics and volcaniclastics deposition and active extensional faulting occurred. Then the Cambrian Tyennan orogeny (via low-angle thrust faults and thrust sheets as shown in Figure 4) strongly deformed the Neoproterozoic and early Cambrian rocks, resulting in the westward emplacement of allochthonous units including;
1) high-strain, blueschist facies metasedimentary and meta-igneous rocks,
2) early to middle Cambrian mafic-ultramafic complexes and
3) mélange units containing deep marine chert, mudstone and basalt.

The potential base-metal exploration target units lie within these Mt Read Volcanics. A prolific phase of magmatism lasted from **507-494 ±1 Ma** with mineralisation confined to **500 ± 1Ma**. This is the primary exploration target. (This specific time horizon, as represented by the "Holy Host" marker horizon that cuts the tenement in two places, is described in more detail in a separate, detailed geophysical review report).

The Tyennan Orogeny was followed by post-collisional magmatism and rapid uplift of the neighbouring Tyennan Region which shed voluminous coarse-grained detritus over the major fault boundary, filling the rift basins.

Finally, Ordovician to early Devonian marine sedimentation was strongly deformed and intruded by voluminous granitoids and hydrothermal fluids during the Tabberabberan Orogeny. The granites are a secondary potential exploration target. Their zircon U-Pb ages indicate that the granites were mostly intruded between **374-360 Ma.** The Tabberabberan Orogeny was also responsible for N-S trending folds in the Mt Read Volcanics, regional metamorphism and the reactivation of faults (eg. Rosebery, Mt Black and Henty Faults).

Recent provenance and paleomagnetic research suggests that this segment of Tasmania's Proterozoic crust represents an exotic microcontinent (named VanDieland) that was transferred from the Pacific plate onto the eastern margin of Australia-Antarctica during the Delamerian Orogeny **514–490 Ma**.

In summary, Mt Read Volcanics massive-sulphide mineralisation emplacement occurred during continental welding, synchronous with a very brief mineralising event. The rocks were subsequently deformed and metamorphosed.

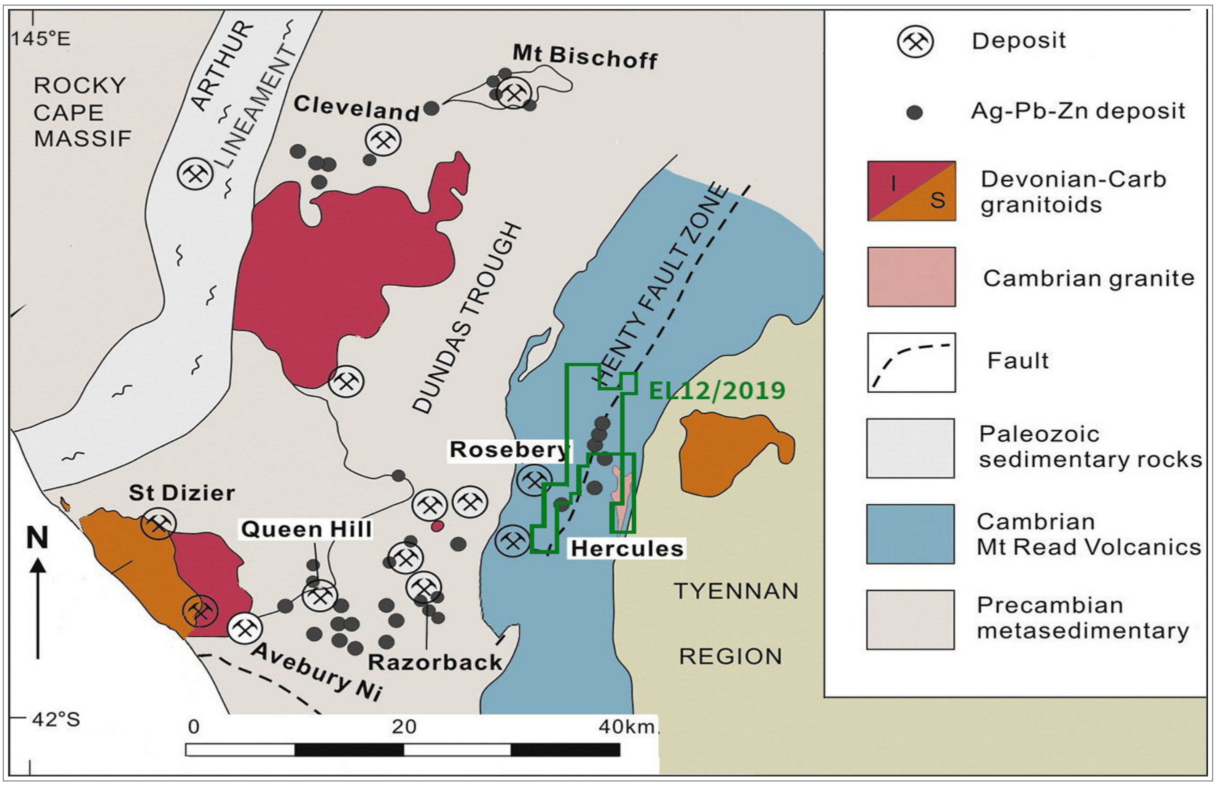


Figure 2 Major tectonic elemements, deposits and tenement EL12/2019 location map.

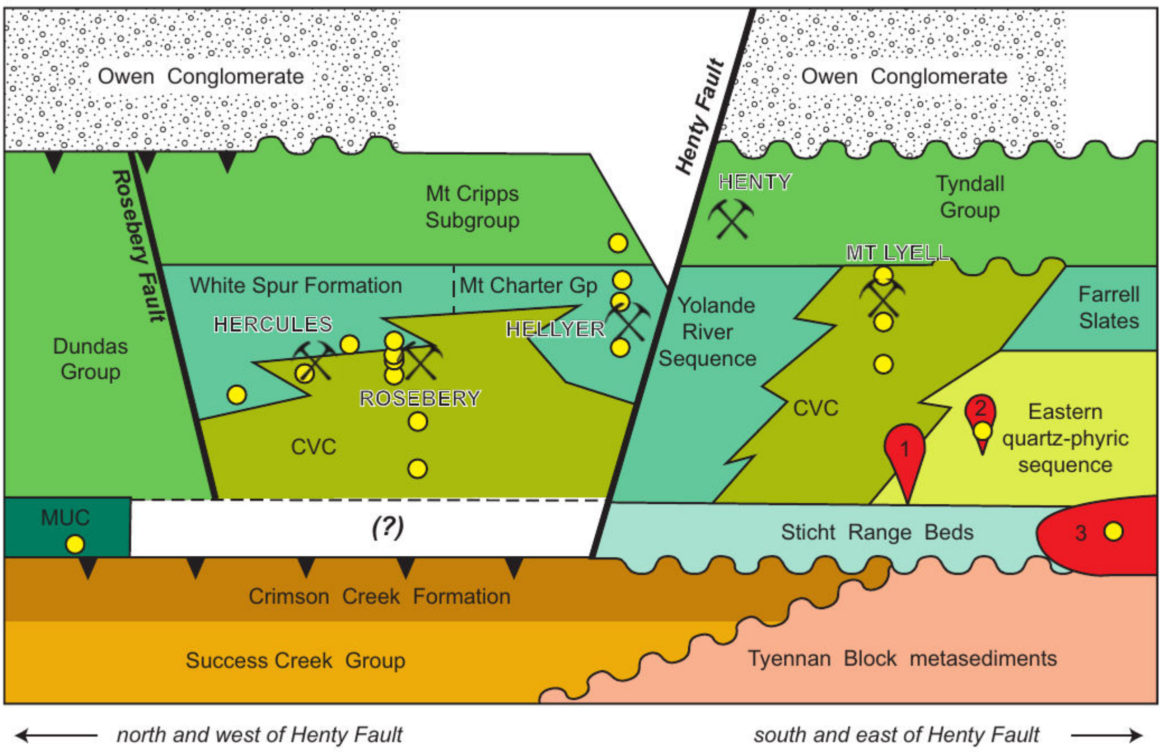


FIG. 2. Simplified stratigraphic relationships within the Mount Read Volcanic belt, showing the approximate stratigraphic position of the main VHMS deposits in the belt, as well as each of the samples dated in this study (modified after Martin, 2004). The numbered units are the Darwin (1) and Murchison (2) granites and the Bonds Range Porphyry (3).

Figure 3 Simplified stratigraphic relationships within the Mt Read Volcanic belt

Cambrian Mt Read Volcanics

The Mt Read Volcanics (MRV) host world-class volcanogenic deposits such as Hellyer-Que River, Hercules and Rosebery polymetallic VHMS deposits and the high grade Henty Gold Mine. These major deposits are located north of the Henty Fault (technically the Henty Gold Mine is on the fault) where magmatism occurred in three short pulses, separated by sedimentation. The Mt Lyell Cu-Au deposit is also only 8km from the fault.

The wide spectrum of mineral deposits in the MRV represents a continuum from classic sea-floor VHMS ores toward those with porphyry Cu-Au and epithermal Au-Ag deposit features where the interplay between submarine volcanic geology and hydrothermal fluid character has lead to a wide spectrum of alteration scenarios and exploration vectors. The spectrum of VHMS deposit types includes: Cu-type at Mt Lyell, Au-only at Henty, Zn-Pb-Cu-type at Rosebery, Hellyer-Que River and Hercules, and Pyrite-only at Chester. Rosebery and Chester are adjacent to E12/2019.

The MRV comprises five major lithostratigraphic associations (Sticht Range Beds, Eastern Quartz-Phyric Sequence, Central Volcanic Complex (CVC), Western Volcano-Sedimentary Sequences and Tyndall Group). The Tyndall Group was the the final phase of magmatism forming an extensive marker sequence. Lavas and syn-volcanic intrusions of the MRV are predominantly rhyolites and dacites, with locally abundant calc-alkaline andesites and basalts.

The principal volcanic facies in the MRV are:
1) Silicic, intermediate, and mafic lavas - lavas common in the Central Volcanic Complex
2) Syn-eruptive volcaniclastic deposits - subaqueous, juvenile clast-rich, volcaniclastic mass-flow deposits including non-vesicular, blocky lava clasts and abundant silicic pumice clasts
3) Syn-volcanic intrusions - conformable, emplaced into and locally mixed with wet, unconsolidated host sediments, forming peperite and sill complexes.
These volcanic facies are interbedded with sedimentary facies comprising laminated or massive, black mudstone and sandstone turbidites.

Stratigraphically underlying the MRV are Cambrian sedimentary sequences. Cambrian macro-fossils have been found in sedimentary units in the MRV. Overlying (i.e. above the Tyndall Group) is the Owen Conglomerate **490-470Ma**. The Cambrian Dundas Group borders the western side of the MRV. These submarine fan sediments interfinger with, and are thought to have been deposited at the same time as, the MRV.

MRV Alteration

Rocks of the MRV have been affected by regional deformation and metamorphism, and locally hydrothermal alteration is intense. The area has been affected by the following events;
1) Cambrian, syn-volcanic and syn-mineralisation alteration overprinted by the main regional cleavage and shear zones
2) lower greenschist grade regional metamorphism
3) localized syn-tectonic alteration with strong cleavage development and shear zones and
4) localized to widespread post-cleavage alteration zones around Devonian granites.

Syn-volcanic alteration in the MRV display: 1) regional diagenetic alteration with various assemblages of white mica, chlorite, plagioclase, quartz, epidote and K-feldspar; 2) localized, zoned hydrothermal alteration, directly associated with massive sulfide mineralisation and composed mainly of assemblages of quartz, chlorite, white mica and carbonate; and 3) K-feldspar and chlorite-rich hydrothermal alteration spatially associated with Cambrian granites that intrude the volcanics.

How alteration and mineralisation are connected in the MRV is not straightforward. Later deformation and recrystallisation is quite evident at Rosebery, Mount Lyell and Henty VHMS deposits, which is dated between **400-374 Ma**. The Hellyer deposit is less strongly altered and deformed and is dated between **477-447 Ma** perhaps a result of the analysis of mixtures of Cambrian hydrothermal and Devonian metamorphic minerals.

Post-Cambrian Geodynamics

The MRV was deposited in the Dundas Trough which joins with the Fossey Trough in the north. Curvature of the Dundas-Fossey Trough is interpreted as an orocline. Curvature initiation may have commenced during the (post-Delamerian Orogeny) Ordovician Haulage Unconformity **~472Ma** as indicated by a major zircon provenance change. Pre-Haulage, the rocks have Tyennan provenance whereas post-Haulage the zircon history reflects Gondwana provenance.

A recent geodynamic model (2020) uses a deforming tectonic plate model from **450-412 Ma** to rotate and reconstruct tectonic, geochemical and a suite of relevant geological data back in time to see how fertility indicators are distributed. The model suggests that Cambrian accretion of the microcontinent VanDieland commenced from a position between two opposing subduction zones in the Palaeo-Pacific. Suturing of VanDieland with mainland Australia-Antarctica afforded the conditions for oroclinal bending of the originally north-striking terranes of the modern southern Lachlan Orogen such that it assumed its modern configuration following compression during the Tabberabberan Orogeny **~385Ma**.

Henty Fault

The Henty Fault is an 80km, major, NNE trending, high-angled (dipping 70° W) fault that appears in places to be zone of anastamosing faults giving rise to the term Henty Fault Zone (Figure 2).

The Henty Fault has existed throughout the Phanerozoic and perhaps even earlier (Figure 3 and 4). The movement history on the Henty Fault is complex, with oblique to dip-slip reverse motion, five phase history including the early reverse movement stages followed by sinistral wrenching, wrench faulting and normal faulting. While it does not form the boundary between the Dundas-Fossey Trough and the Tyennan Region, it tracks that boundary (offset to the west by 5-10km for 80km). That active fault boundary was where the Tyennan Block was uplifted during the Ordovician.

There appears to be sub-surface connectivity between the Henty Fault and the Mt Cripps Fault in the north. In the south, it splits into a series of faults (North Henty, South Henty and Great Lyell Fault) and terminates around EL9/2016 (Argent Minerals' Queensbury tenement). The Henty Fault is often interpreted as the northern extension of the Great Lyell Fault. The North and South Henty Faults originated as back-thrusts to the east-dipping Rosebery and Marionoak thrusts, resulting in a Devonian "pop-up" structure.

The MRV north and west of the Henty Fault host the Pb-Zn rich VHMS deposits while the volcanics south and east host the Mt Julia Prospect and Cu-Au deposits (Mt. Lyell).

The Henty Fault divides the MRV into two parts, north and west of the Henty Fault and south and east of the Henty Fault.

Northwest of the Henty Fault, the MRV is divided three distinct lithological groups.
1. Central Volcanic Complex (CVC) consisting of mainly rhyolitic to basaltic lavas and volcaniclastics.
2. Dundas Group consisting of tuffaceous volcaniclastics, polymictic conglomerates, greywacke, siltstone and shale (these are sometimes considered separate from the MRV).
3. Mt Charter Group consisting of basaltic to felsic lavas and volcaniclastics, siliciclastic wackes and black shales. The oldest rocks belong to the CVC. The Mt Charter Group and Dundas Group both overlie the CVC and are stratigraphically equivalent. This section corresponds to reprocessed seismic line 95AGS-T1 CDP's 3455-3900 (378551E 5379790S to 386787E 5381990S).

South-east of the Henty Fault the MRV are divided into four lithological groups.
1. Central Volcanic Complex consisting of mainly rhyolitic to andesitic volcanics with minor sediments and mafic units.
2. Eastern Quartz Phyric Sequence of quartz porphyritic lavas and volcaniclastics.
3. Tyndall Group comprising mainly quartz-phyric felsic and intermediate extrusives and volcaniclastics with interbedded epiclastics.
4. Western Sequence of volcano-sedimentary siltstones, shales, quartzose and volcaniclastic turbidites and felsic porphyry intrusives. The oldest rocks belong to the CVC and Western sequence.
This section corresponds to reprocessed seismic line 95AGS-T1 CDP's 3900-4036 (386787E 5381990S to 388184E 5384280S).

The Henty Fault has been explored for base-metals and minor gold for over a century where it is found disseminated in quartz and pyrite lenses in alteration zones.

On the Henty Fault and within the EL12/2019 tenement are a 4km line of lead (with minor silver and zinc) mines that closely follow the fault. From north to south are the New North Mt Farrell, Central Mackintosh, South Mackintosh, North Mt Farrell, South Mt Farrell, Duttons Workings, Central Farrell, North Murchison, South Murchison and more, located just outside the town of Tullah. The last operating was the New North Farrell that trucked high grade lead ore to the Rosebery concentrator about 40 years ago. Recently a range of companies (eg Saracen) have re-evaluated the proven reserves finding highs grades but small lodes. The chain of mines ends due to steep topography.

The Henty gold deposit is located ~2km south of the tenement right on the Henty Fault. It formed in a shallower submarine environment (than the base-metal VHMS) and shows evidence of remobilisation and re-deposition during upper Palaeozoic deformation along the fault. The deposit is slightly younger than the nearby massive-sulphide deposits. It occurs in the Tyndall Group, the last phase of the Central Volcanic Complex. Sulphide-associated gold mineralisation is located in a persistent envelopes of chlorite-tourmaline alteration within the volcanogenic sediments.

Successful, deeper exploration for Henty Fault gold has sought 1) the presence of large alteration and mineralised zones 2) in Cambrian sedimentary-volcanic environments and 3) adjacent to major, long lived segments of the Henty Fault. These targets were not necessarily magnetic or strongly conductive but the alteration systems are chargeable and therefore IP is probably the most effective pre-drilling technique. In summary, almost 10km of the Henty Fault lies within the EL12/2019 tenement. Deeper exploration has good potential for base-metal and gold discoveries.

Mt Black and Rosebery Faults

The Mt Black Fault is a large, east dipping (~45°) structure that appears to parallel the Rosebery Fault. Overlying the Mt Black (thrust) Fault are the Mt Black Volcanics which predominantly consist of massive to brecciated lavas of dacitic to andesitic composition with volcaniclastics. At Rosebery it delineates the Rosebery sequence, being recognised between the Rosebery hangingwall sequence and the overlying rocks on Mt Black, and has been mapped north to Lake Rosebery and south to the Hercules area. It had a role in dividing the northern CVC into three units, younging to the west: Sterling Valley Volcanics (andesitic-basaltic) at the base, Mt Black Volcanics (dacitic-rhyolitic), and Kershaw Pumice Formation at the top, reversing the earlier stratigraphy. Rosebery and Hercules may correlate with the lower part of the White Spur Formation and even the Southwell Subgroup from the Hellyer-Pinnacles area. So the Mt Black Fault is of stratigraphic significance as well as being a regional structure (see Figure 4).

Despite this, it's mapped location is almost always dashed (not solid). One of the aims of the MMG's 3D seismic survey was to locate the Rosebery and Mt Black Faults in the sub-surface while using LiDAR to detect their surface exposure. 3D seismic showed that the Mt Black Fault is less easily observed as a strong reflector, so its location was inferred from a change in dip of reflectors.

Mt Black (thrust) Fault corresponds to an area of intense fan faulting on the reprocessed 2D seismic line 95AGS-T1 in the broad range between CDP 3460-3520 (378614E 5379870S to 379620E 5380510S). This matches the 2002 Tasmanian Geological Survey geological revision map showing the Mt Black Fault splitting into multiple, dashed fault elements as it emerges northwards from the Rosebery deposit and fans out towards the north-east. (see Figure 1). The cause of the dense faulting is probably due to 1) the underlying Rosebery Fault which gathers and resolves the split components at the base the Mt Black Fault cluster ~1800m underground and 2) the sub-surface granite emplaced under Lake Rosebery (see Figure 8).

The 3D seismic survey showed the Rosebery Fault to be a high amplitude, coherent reflector, consistent with drilling, particularly up dip. This is the same on the 2D reprocessed seismic section located 1500m north. The Rosebery Fault is a regionally extensive east dipping (~45°) of Cambrian age, corresponding to CDP 3390 (377528E 5379028S) on the 2D reprocessed seismic line where is soles (~25°).

Rosebery Deposit

The Rosebery deposit is a volcaniclastic-hosted Zn-Pb-Cu-Ag-Au VHMS deposit in the MRV belt. It is the nearest and largest VHMS in the region lying 2km from E12/2019's western edge. It's location is indicated in Figures 1,2, 3 and 4.

Remaining measured + indicated + inferred mineral resources in 2014 were 17.2 Mt @ 0.4% Cu, 3.6% Pb, 11.3% Zn, 123 g/t Ag, 1.7 g/t Au and this year Rosebery is expected to produce 60Kt of zinc, down from 84Kt in 2019 with remaining mine life projected to 2023.

Stacked, stratabound massive-sulphide lenses lie between the Rosebery (thrust) Fault and the Mt Black (thrust) Fault. The sulfide lenses are entrained within a high-strain, ductile shear zone that is bounded the two faults. Rosebery is an outcropping tabular deposit dipping at 45°East, with a strike length of several kilometres (down plunge to a depth of over 1.5 km) and an average thickness of 6m. It is one of Australia's deepest (1.85km) and hottest mines.

The ore horizons occur in an altered, pyritised sequence of siltstones and shales which are overlain by pyritic black shales. These sedimentary horizons are underlain by altered footwall schists and overlain by massive pyroclastics.

The Rosebery VHMS ore-bodies occur in stratiform lenses interpreted to have formed below the seafloor in an arc setting. Underlying the massive sulfide lenses are several long, thin, stringer mineralisations. In the immediate footwall, zones of diffuse pipe-like alteration occur along synvolcanic faults, consisting of extreme leaching, silica mobility and Fe metasomatism. Typical alteration assemblages are sericite and chlorite as matrix cement and pervasive replacement of glass-rich clasts. The diffuse pipe-like zones merge outward into more widespread semi-conformable alteration zones.

While the lode is now substantially mined, the base metal ore system still generates perturbations in the gravity field despite being affected by the underlying uneven basement topography. While the Cambrian geometry and structural controls on mineralisation are poorly understood, the Rosebery mineralisation had early Devonian deformation then subsequent metasomatism related to intrusion of mid-Devonian granites at depth.

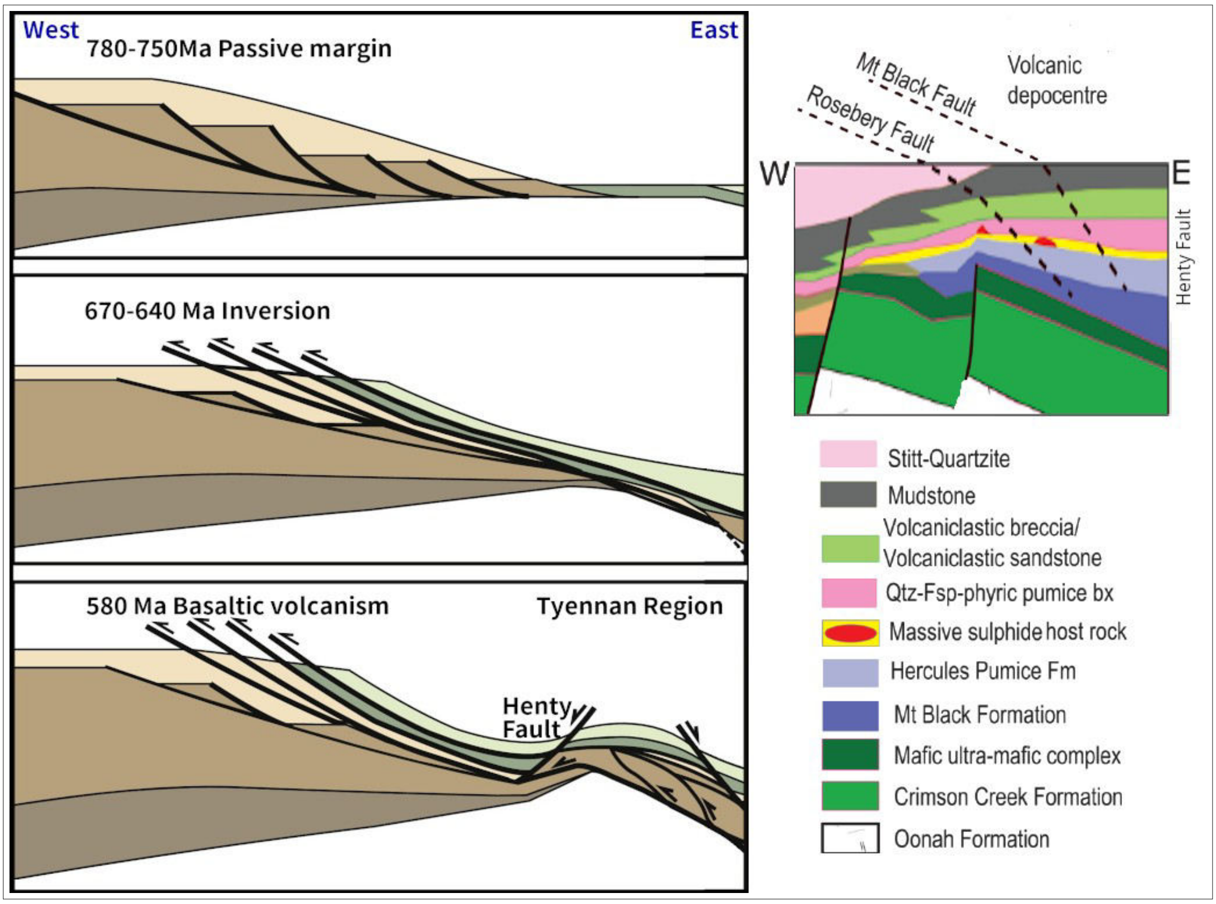


Figure 4 Simplified three-stage tectonic model of the Tyennan Orogeny onset involving collision of the Western Tasmania Terrane (WTT) with an island arc off to the east (left). The pale green unit is ophiolite that has been back-thrust onto the WTT. The coloured cross-section (right) is of the same area but shows the area post-MRV deposition, west-east stratigraphic relationships and principal faults (the low-angle fault Rosebery and Mt Black thrust faults and the high-angle Henty Fault).

Granite emplacement

The following section describes the two phases of granite emplacement and tries to clarify whether either had a significant role in the development of mineralisation.

Cambrian Granite

A minor Cambrian, I-type, biotite granite outcrops in the south-eastern corner of E12/2019 (see Figures 2 and 3) named the Murchison Granite. It is a strongly altered, high K, magnetite series granite varying in composition from diorite to granite. It is joined in the subsurface to the Darwin granite via an intrusive “spine” of granite beneath the volcanic belt. Geophysical evidence indicates that it forms a narrow discontinuous body about 60km long and 2-4km wide toward the base and eastern margin of the volcanic pile that hosts the deposits.

The outcropping Murchison Granite is sandwiched between the the Henty Fault in the west and the Tyennan Region bounding structure in the east (now submerged under Lake Macintosh). A series of granite sills (intrusions) occur at depth along the eastern margin of the MRV.

Importantly, a date of 497.3 ± 1 Ma for the Murchison Granite indicates that it post-dates the MRV VHMS deposits by a few million years so hydrothermal fluid drivers that led to VHMS mineral formation remains a question. It's possible that earlier phases may have been involved in the magmatic-hydrothermal systems that generated the VHMS deposits. Exactly how the granite is connected to the development of the MRV deposits is still poorly known despite many decades of exploration and research. Another unanswered question is, are the sub-surface granites (in Figures 2, 3 and 8) Cambrian or Devonian? The overall volume of Cambrian granite emplacement is a small fraction of the volume emplaced during the Devonian phase.

Devonian Granite

The gravity and radiometric data define the location the Devonian granites extremely well. 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 has been useful in determining the structural control on mineralisation.

I and S-type granites (Figure 2) were emplaced during the Tabberabberan Orogeny after the two (east and west) crustal components had coalesced. These plutons have distinct crustal sources with substantially different isotopic characteristics to the abundant Devonian granites in East Tasmania. (The assumed) Devonian Granites lie close to the surface in and near the tenement including in several places along 2D seismic line 95AGS-T1 (see Figure 8).

West of the tenement, at the Renison mine, abundant tin mineralisation is due to hydrothermal Sn transport triggered by the emplacement of a Devonian granite into Cambrian (Dundas) host rocks.

In summary, the MRV massive-sulphide and gold mineralisations are flanked in the west by the Rosebery and Mt Black (shallow thrusts) faults and in the east by the Henty (steep vertical) Fault which are difficult to map (buried and fragmented). The underlying, pervasive, Devonian granites appear to have played a role in modifying mineralisation structurally and hydrothermally.

3. ORIGINAL 1995 INTERPRETATION

The original processing was poor in comparison to equivalent, contemporary, seismic results, which mandated a conceptual interpretation. The interpretaion was published in the 1995 GA's Research Newsletter and is reproduced here. "Line 95AGS-T1 was oriented roughly east-west along public roads. It crossed the highly mineralised Dundas Trough and MRV outcrop before terminating at the Henty Fault Zone. The Moho in northwest Tasmania appears as a transition zone, over 5 km thick, in which strong lower crustal reflectors give way to a non-reflective mantle.

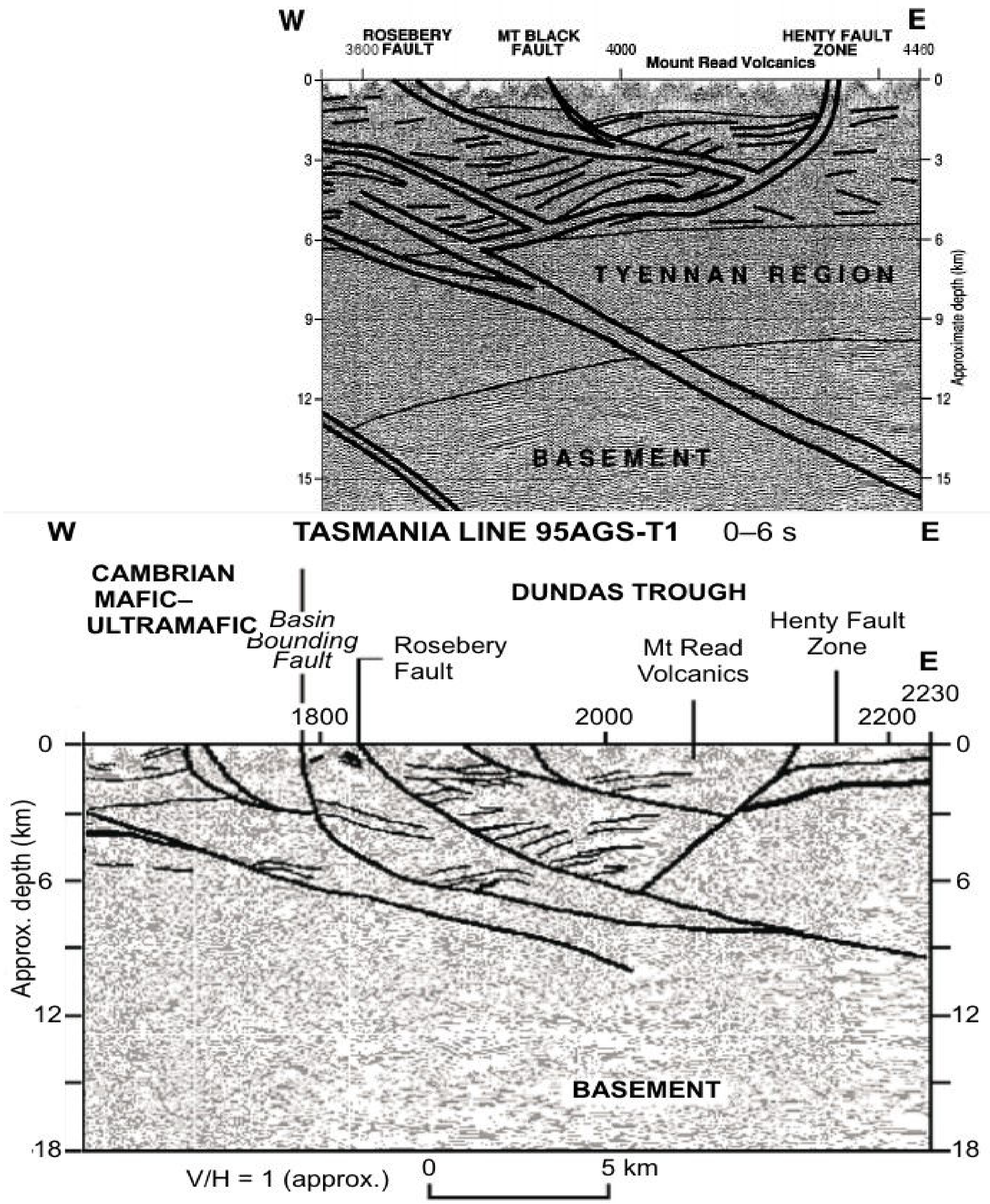


Figure 5 Aligned original interpretations of the eastern half of seismic line 95AGS-T1.

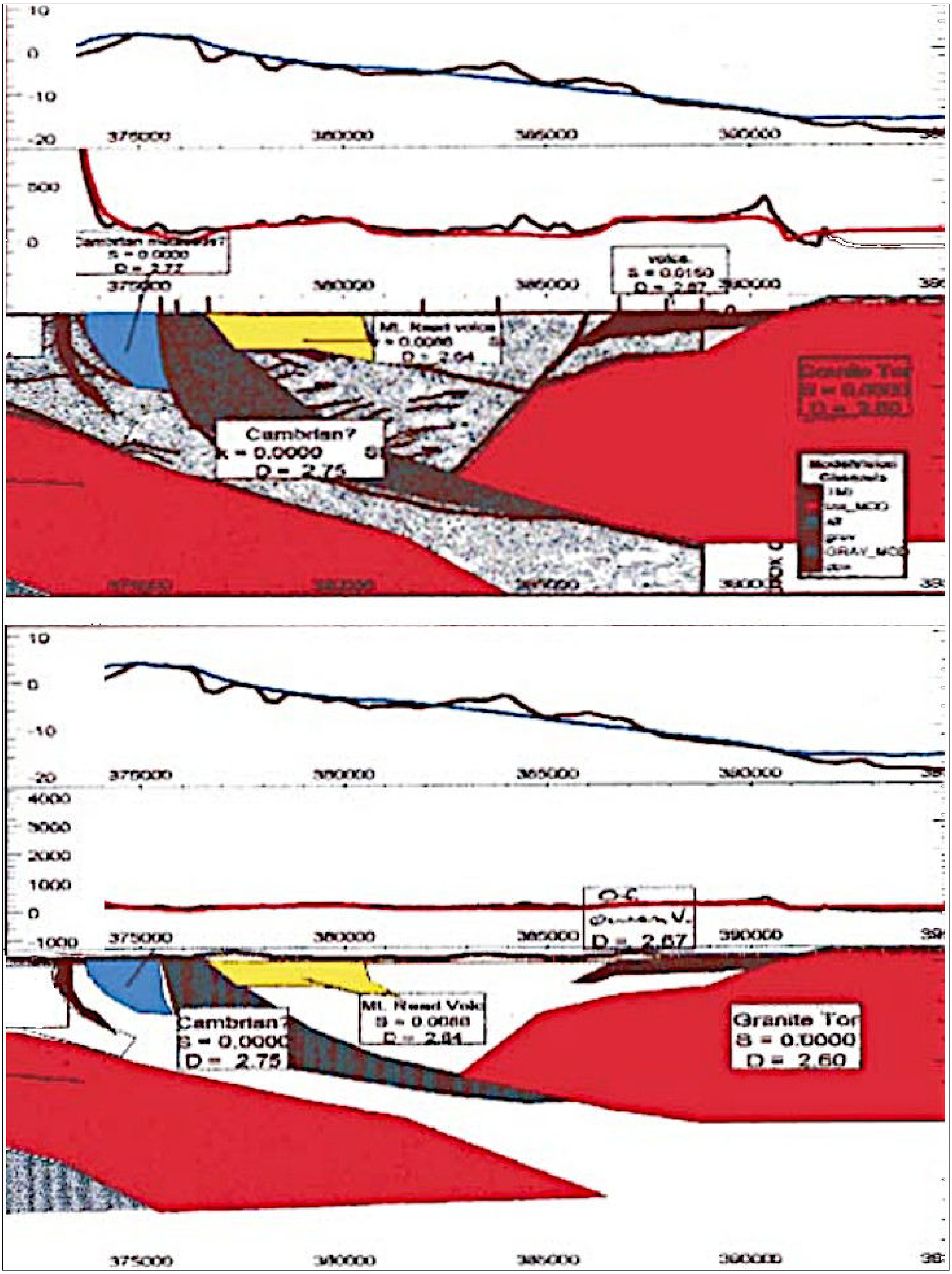


Figure 6 Modelling of gravity (above) and TMI data (below) eastern part of line 95AGS-T1.

The top of the transition zone is ~30 km deep. The crust is partitioned into several distinct blocks. The eastern end of line T1 displays a consistent seismic reflection pattern of a very reflective lower crust, labelled as basement to the Tyennan region, which extends upwards to within about 10 km of the surface. This basement is overlain by several kilometres of rocks which are poorly reflective, interpreted to be the monotonous, mainly quartz-rich lithologies found in the Tyennan region. They, in turn, are overlain by more reflective rocks of the lower Palaeozoic. The boundary between the Tyennan region and basement appears to dip gently to the west in the west. On the eastern side of line T1, a major fault system extends upwards to the west from within the Tyennan basement. Some splays off this fault system are associated with serpentinite outcrops.

Other major fault systems are also linked to this deep structure. The Henty Fault “zone”, for example, dips west from the surface and meets it at a depth of about 7-8 km. The Rosebery Fault and several other unnamed faults link to a detachment intersecting the Henty Fault at a 3km depth.

These fault systems are close to volcanic-hosted massive sulphide deposits; the interpretation of the seismic data therefore suggests that crustal-scale tectonics have controlled the location of mineral deposits in northwest Tasmania.

The Cambrian section in the Dundas Trough, and the MRV in particular, have a cumulative thickness of several kilomentres. The seismic data suggest that the thickening to the west is stratigraphic rather than tectonic. Even so, the rocks are clearly highly folded and faulted, and the reflectivity of the data varies; the MRV, for example, are poorly reflective and their thickness is interpretative.”

Eight years later it was reported that “A high resolution seismic section was attempted across parts of the region but the lack straight roads, complex geology (with steep dips and complex variations in layering) has hampered interpretation of this data. At present the only public interpretations are too simple to be any help in structural interpretation. The deep seismic sections have no resolution in the top few kilometres and have not been integrated with the surface geology.”

The following section has been extracted from Tasmanian Geological Survey Record 2002/15 p75.

Although data recording problems resulted in a final product that was not of the highest quality, an interpreted section (Figure 5) has been produced by AGSO that shows shallowly east-dipping extensional thrusts to be the main structural regime.

The interpreted section has been used as a base for modelling of the available gravity and magnetic data (Figure 6) to ascertain if these data complement the AGSO result. As the modelling software would not support the actual meanders of the AGSO line, an east–west profile along 5380000 mN was used to simulate the position of the seismic line. Figure 8 shows the model results at two magnetic amplitude (vertical) scales to allow for both the large amplitude anomalies caused by ultramafic units and the subtle features of the metasedimentary rocks.

The models do not fit exactly with the AGSO section in dip and depth extent; this may be due to the effects of remanence that have not been incorporated into the physical properties.

The Cambrian metasediment units located in the centre of the line can explain the observed gravity variations, although these are minor and there is little magnetic grain to be used to support the interpretation. The main feature in the east is the continued gravity gradient that requires the Granite Tor granite to extend, at depth, under the Mt Read Volcanics, to the Henty Fault. The mafic rocks of the MRV can be used to explain the shallow magnetic anomalies in this vicinity and are in accord with the limited depth extent for these units.

In summary, the interpretation of features in the magnetic and gravity data on the 5380000S line is not in contradiction with the AGSO interpretation of the seismic data which would require major modification of the result.

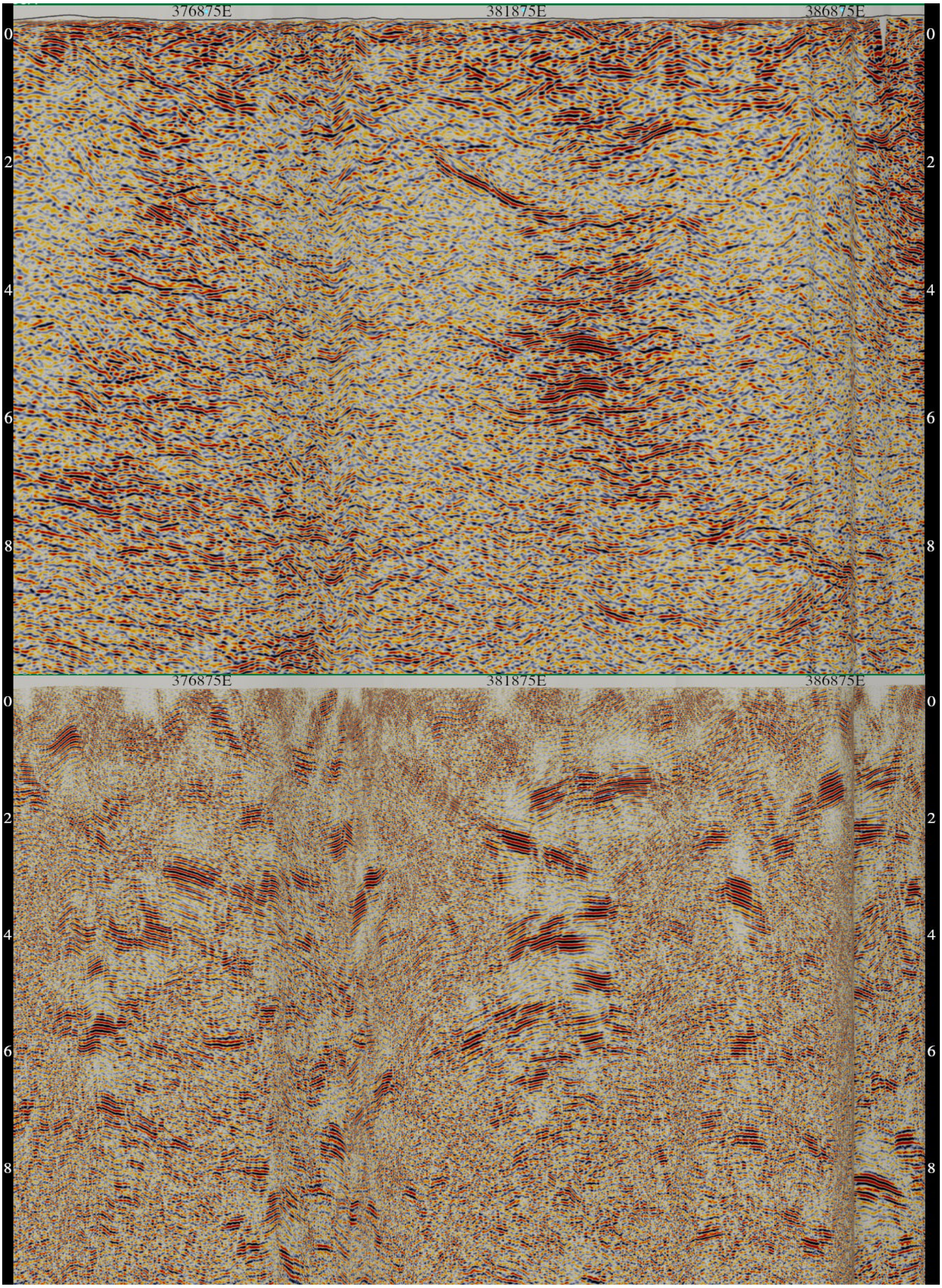


Figure 7 Seismic reprocessing 2020 (above) and original 1995 processing of 95AGS-T1 (below)

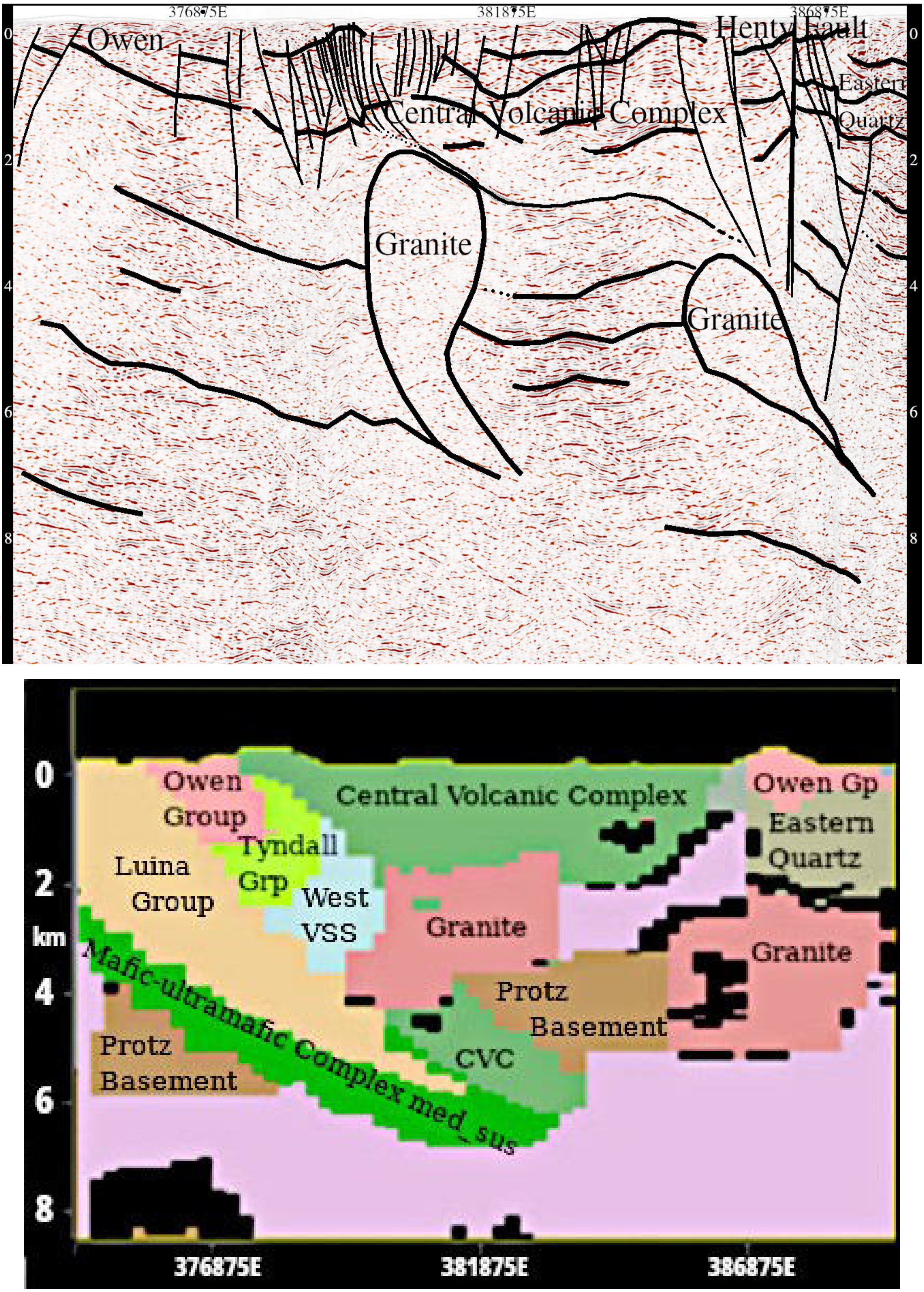


Figure 8 Seismic interpretation of 95AGS-T1 (above) and magnetotelluric interpretation (below)

Exploration repercussion

Lachlan Resources NL held the area from 1996-97 as EL 12/96 – Lake Rosebery. Their primary interest stemmed from the seismic line T1 carried out by AGSO, which detected a major east-dipping reflector – possibly a thrust fault zone (Mt Black Fault) that suggested potential for structural repetition of the Rosebery host sequence east of Rosebery. The company did not perform fieldwork nor submit exploration reports to Mineral Resources Tasmania (MRT).

For further details refer to "Exploration History and Prospectivity of North Rosebery EL 54/2004" by Walter Herrmann Geoscience Pty. Ltd. In 2009.

4. NEW INTERPRETATION

Interpretation Datasets

The primary seismic dataset used for this interpretation is the 2020 final depth domain migration This stack section of line 95AGS-T1 is shown in Figure 7 without interpretation and Figure 8 with interpretation between CDP 3200-4036 (west 373821E 5379260S to 388184E 5384280S east end). The final interval velocities (in depth), 2020 reprocessed magnetics, 2019 radiometrics, 2018 Bouguer gravity anomaly data, SRTM radar altimetry and over a dozen geological maps were used. The datasets were integrated in a 3D geological visualisation system that featured horizon, fault and geobody interpretation capabilities. Other geophysical techniques and datasets are explored in a separate report (E12/2019 Geophysical Review) however only the above were used for this interpretation.

Although a final depth seismic section resembles a geological cross-section, on such low-fold data it is difficult to relate observed reflectors to the known geology and available drillhole intersections. Three deep drillholes are clustered at the western end of the seismic line targeting the Rosebery Fault M01 (371.0m) and Mt.Black Faults (set of splay faults) FDD03 (depth of 362.8m) and KP210 (360.5m). Two deep drillholes are located at the eastern end of the line along the Henty Fault; 413R (601.7m) and DM3 (362.8m) whereas there are no deep holes located in the middle of the line (due to a perceived lack of prospective structures).

Shallow Section

Shallow Section west of EL12/2019

The 2020 reprocessing shows clearly defined, near-surface, closely-spaced, fan-faulting above a clearly-imaged, high-amplitude, low frequency, arcuate-shaped reflector between CDP 3470-3530 (378766E 5380000S to 387654E 5383530S). This is interepreted as the subsurface extension of the Rosebery Fault. The Rosebery Fault is mapped at the surface at CDP 3390 (377528E 5379028S). There and for 3km eastward, the fan-faults have a moderate easterly dip. Some are mapped at the ground surface as splays of the Mt Black Fault (eg by MMG), but around 2km they coalesce and sole out. This area lies outside and to the west of the EL12/2019 tenement.

The Rosebery, low angle, thrust fault (~2km depth) appears to underpin the overlying units which are interepreted as belonging to the Central Volcanic Complex, one of the key lithostratigraphic associations found in the MRV. This interpretation conforms to both the original seismic interpretation, the 2020 magnetotelluric interpretation and Gifkins 2001 PhD cross-section at 5380000S.

Even further outside and west of the tenement the geology of the area is poorly understood. This correlates with CDP 3460-3390 (378614E 5379870S to 377528E 5379028S) on the 2020 seismic. TGS have mapped the area asCenozoic cover sequences . Basement geology maps show a range of different units eg 1) TGS digital maps interpret it as Luina Group and correlates 2) MMG map is as Western Volcano-Sedimentary Sequences (incorporating Dundas Group, Mt Charter Group and Yolande River Sequence) 3) TGS 1:100K geology maps (2002) shows it as ?Early Ordovician-Cambrian Owen Group (as the 2011.1 revision does) and the magnetotelluric interpretation identifies it as Owen Group too. The seismic reflectors are gently dipping to the east but the faults dip in multiple directions. In thickness it ranges from several hundred metres (in the west) to 1500m (in the east). A close inspection of 1985 deep drillhole M01 may help to resolve the basement unit.

Shallow Section within EL12/2019

At the western edge of the tenement the Rosebery Fault is clearly 3km below the ground surface. It is a relatively flat fault (no dip) but further east it deviates up then down as a result of displacement by a granite body near CDP 3800 (385051E 5381280S)). The Rosebery, low angle, thrust fault (~2km depth) appears to underpin the overlying units which are interepreted as as 2-3km thick section of MRV. Near vertical faults are spaced at intervals across the the tenement in the subsurface although none appear to be significant or longer than ~1.5km.

The Henty Fault “zone” is interpreted to commence on the seismic section near CDP 3880 (386473E 5381740S) and continues east. As the remaining section (leading towards Lake Macintosh) veers north, it tracks parallel to the Henty Fault “zone” for 3km and is overlain by Cenozoic sequences. The seismic data shows the Henty Fault as a near-vertical, splaying fault system in the shallow sub-surface. Three closely spaced thrust folds are evident between the ground surface and 1km below ground which are interpreted as shallow expressions of the Henty Fault “zone” splays, imaged along strike of the faults.

North of CDP 3960 (387384E 5383000S) the seismic line exits tenement EL12/2019. There the stratigraphy dips east, again in response to displacement by the later, sub-surface emplacement of granite having an apex ~3km below ground. This area is problematic to interpret because several metres east is Lake Macintosh, where land it is Cenozoic-covered so it is tenatively ascribed to the Eastern Quartz and part Owen Group (Figure 8) on the basis of drilling and geological mapping.

Deep Section

The deep section requires further investigation due to the complex interaction of a number of geological elements including several granites, Proterozoic basement, a 1km thrust slice of a mafic-ultramafic complex, and a 3-5km thick sequence of Cambian volcanics and volcaniclastics. The crust should be qualitatively analysed via co-located magnetotelluric conductivity data with seismic reflectivity and acoustic property data in order to elucidate possible signatures of past geodynamic (magmatic and fluid-related) processes. This bottom-up approach would suggest implications for melt/fluid ascent processes and structural controls thereby showing which deeper areas (500-1500m) of the tenement contain higher potential for locating prospective exploration targets.

Electromagnetic Signatures of VHMS deposits

In theory VHMS deposits have distinct geophysical properties: higher density and higher conductivity than silicate rocks. Electromagnetic data has been recognised as a contributor to VHMS discoveries over many decades because it directly detects high conductive VHMS mineralisation. Sulphides with high values of magnetic susceptibility (pyrrhotite) are associated with VHMS ore bodies and magnetite and hematite contribute to strong positive magnetic anomalies often near the base of the VHMS mineralisation. Electromagnetics can also highlight lithological boundaries, shallow weathering, alteration, metamorphism and particularly help with structural interpretation.

In Tasmania, silicification, even though not intensive, reduces the conductivity of massive-sulphide mineralised units. The observed conductivity response can be generated from separate, sulphide-rich lenses rather than a base metal orebody. Further downsides are the poor conductivity of sphalerite, having a saturated (non-saline) overburden, complex geometry and topography. Each of these factors can contribute to masking of the electromagnetic signature. VHMS mineralisation at Rosebury, Hellyer and similar deposits are not very conductive - but the iron sulphides are so the method may considered effective for VHMS targets where Fe sulphides dominate over massive sphalerite mineralisation. It’s also effective when supported by other geophysical techniques. However it is less effective for disseminated targets and deep targets.

Seismic Signatures of VHMS deposits

A key factor in seismic reflectivity is the difference in acoustic impedance between lithologies where impedance is defined as the product of density and velocity.

While on a local scale the direct detection of sulphide ore via seismics is unrealistic (due to low spatial resolution and an undiagnostic range of acoustic impedance contrasts), seismics does have the potential to image regional-scale hydrothermal alteration systems associated with VHMS deposits (Schetselaar 2019).

Instead of directly targeting the sulphide mineralization or volcanic protolith composition, seismics are used to image the silicate-dominant mineral assemblages of VHMS-proximal hydrothermal conduits where hydrothermal alteration of host rock and metamorphic recrystallization has occurred post-emplacement within a regional orogenic belt. For example, hydrothermally-altered rocks transformed into schist and gneiss with aluminum-silicate porphyroblasts of garnet, staurolite, cordierite, kyanite and anthophyllite that show an acoustic impedance contrast. Cordierite in particular is diagnostic for amphibolite facies metamorphism and has a unique low density, high velocity signature in comparison to other silicate minerals.

Laboratory velocities and densities of common sulphide minerals are highly variable, for example, pyrite’s velocity is 8.04 km/s and density is 5.02 g/cm^3 (and similar to magnetitie), whereas pyrrhotite’s velocity is 4.68 km/s and density is 4.63 g/cm^3, sphalerite’s velocity is ~5.5 km/s and density is 4.2 g/cm^3 while graphite’s velocity is ~3 km/s and density is ~2 g/cm^3.

In general, ore minerals associated with pyrite-dominated ores increase in velocity with increasing density, whereas sphalerite-, chalcopyrite-, and pyrrhotite-dominated ores typically have velocity values that decrease with increasing density. Host rocks tend to have a narrower and lower range of density values and have a wide range of velocities. Velocity vs densities are displayed in Figure 9.

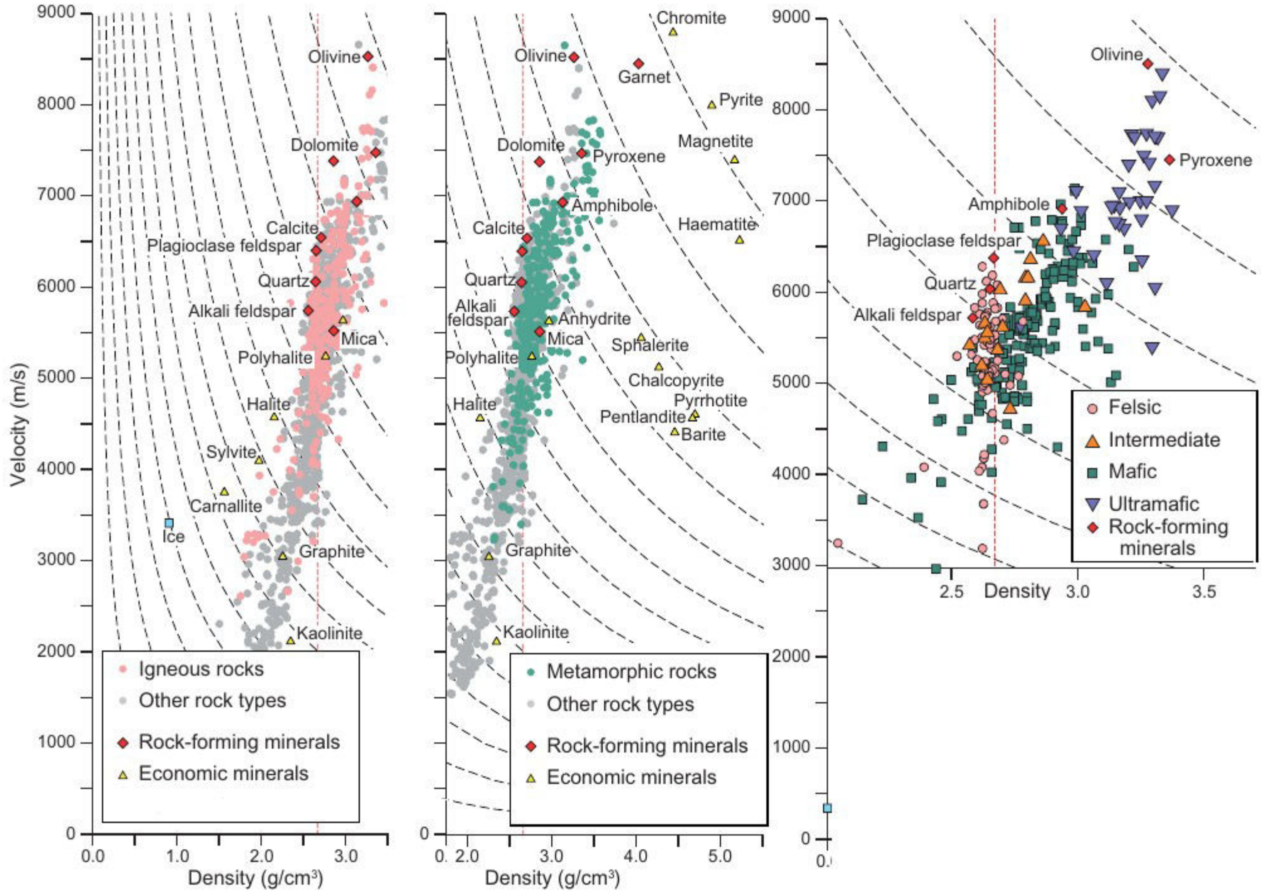


Figure 9 Compilation of published seismic velocity and density measurements of igneous (left) and metamorphic (centre) rocks for pressure-temperature conditions occurring in the upper 1km of the Earth's crust with selected rock-forming minerals and economic minerals identified. The (right) graph shows v/p for igneous rocks and selected minerals showing a rough correlation between how silicic the rocks are and their seismic properties. Also note that the mafic and ultramafic rocks show greater scatter than the other types (due to serpentinisation?).

Magnetotelluric model

A new resistivity model is being devloped as part of the AusLAMP project. The preliminary deeper results (eg. 9.41km seeFigure 10) are considered to be reliable. There is a clear spatial association between the MRV and low-conductivity on that slice. The same slice is aligned with the curved geometry that supports the Dundas-Fossey oroclinal. The results indicate how well the magnetotelluric method helps us to understand subsurface structures and tectonic processes on a continental scale.

It is important to interpret the slices in 3D because in metalogenic provices, the conductivity paths tend to be angled towards the surface. Therefore the conductivity maxima to the north-west of the tenement in Figure 10 may be angled towards EL12/2019 (marked in yellow). The full results are anticipated over the coming months when the lithospheric conductivity pathways in 3D.

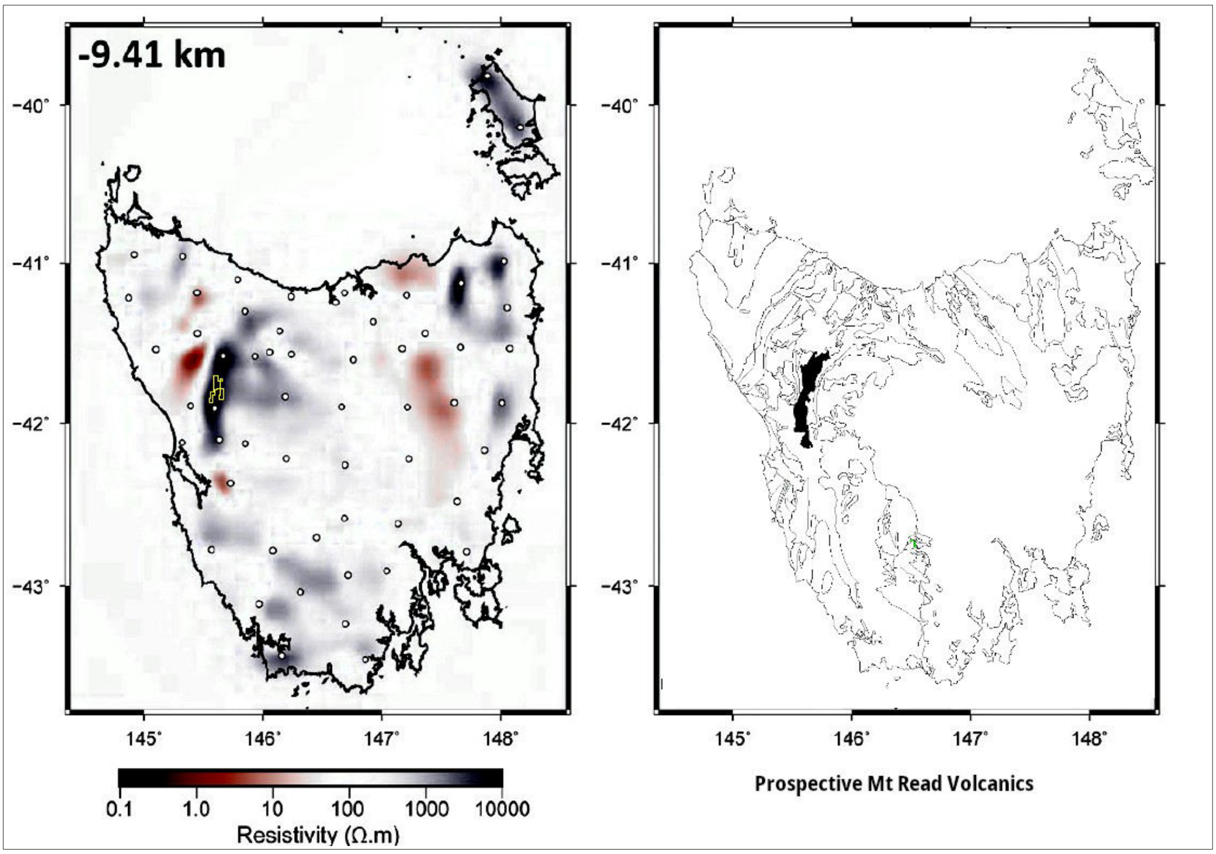


Figure 10. Deep 9.41km resistivity depth slice of Tasmania from the AusLAMP MT project.

5. SUMMARY

The MRV massive-sulphide and gold mineralisations are flanked in the west by the Rosebery and Mt Black (shallow thrusts) faults and in the east by the Henty (steep vertical) Fault which are difficult to map (buried and fragmented). MRV massive-sulphide mineralisation emplacement occurred during continental welding over a remarkably brief mineralising event and was subsequently deformed and metamorphosed in part by the underlying, pervasive granites.

Internode Seismic reprocessed the eastern half of 2D seismic line 95AGS-T1 because it intersected Argent Minerals Ltd's EL12/2019 tenement in August 2020. The original processing was poor because it did not image dipping reflectors well due to the lack of DMO and was insufficiently dereverberated. This mandated a conceptual interpretation from which explorers were subsequently mislead by the potential of the mapped structures.

The 2020 reprocessing of the same seismic line shows clearly defined, near-surface and deep structures and stratigraphy enabling an interpretation made with confidence because it agrees with up-to-date geological maps, deep magnetotelluric and granite mapping and geodynamic models.

Separate, detailed, geophysical review and seismic reprocessing reportswere also produced.

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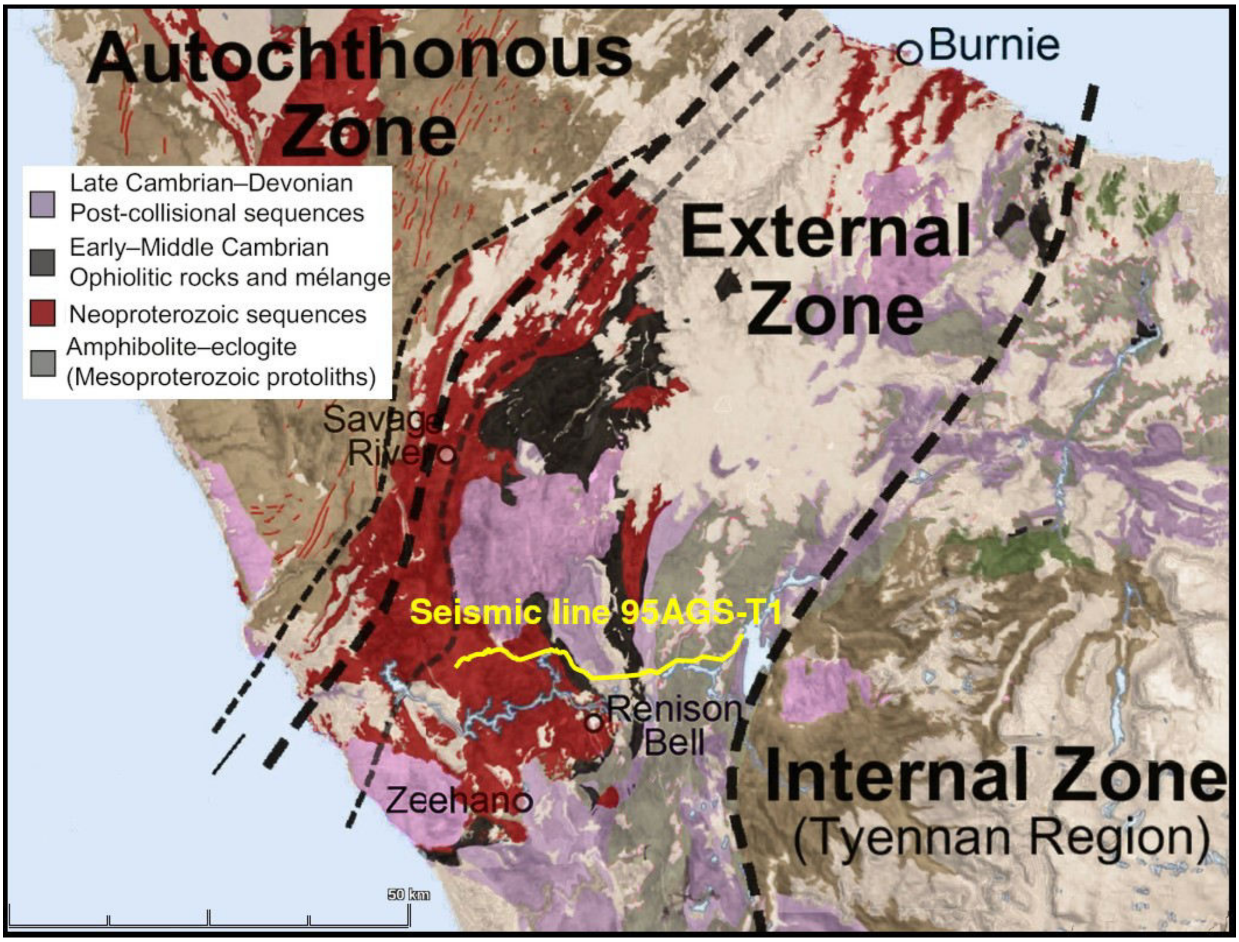
Reprocessing of seismic line 95AGS-T1, NW Tasmania



Internode Seismic

August 2020

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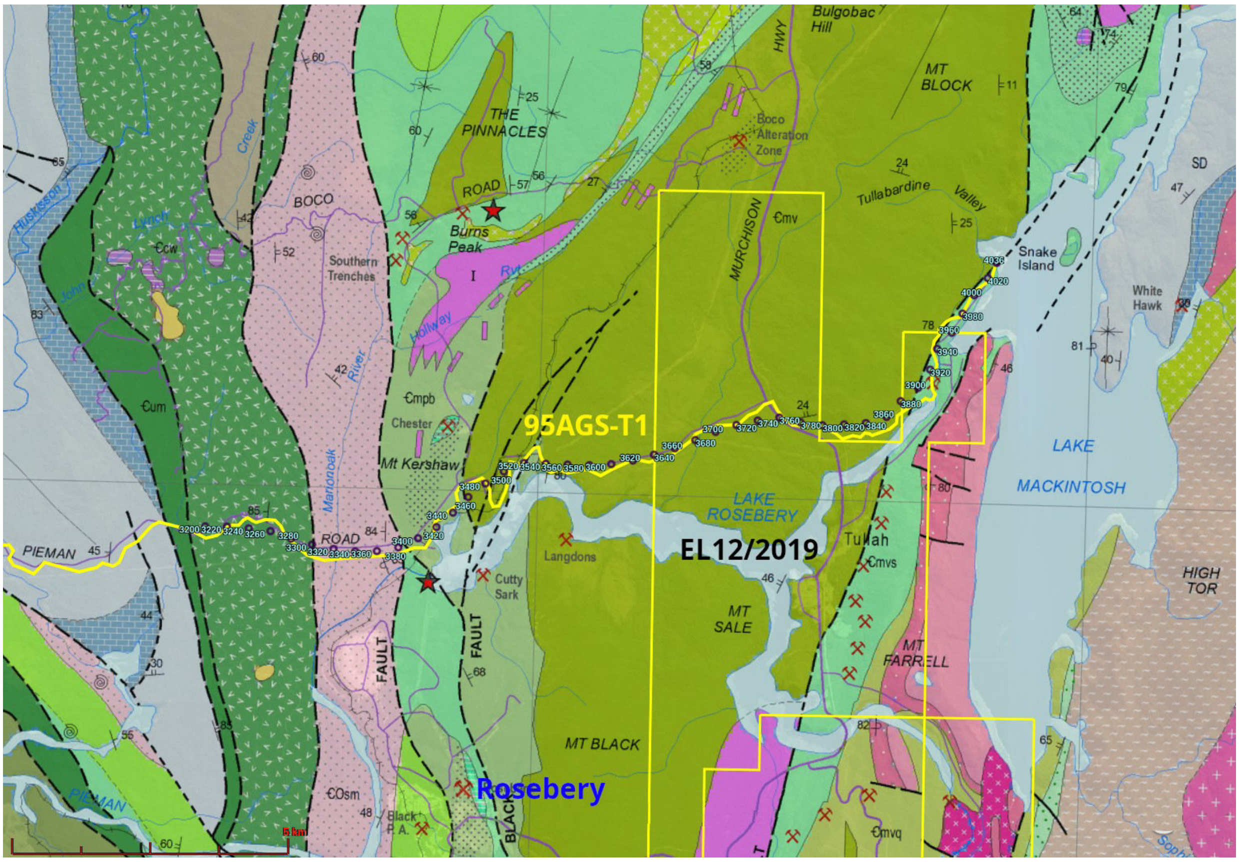


Figure 1. Seismic line 95AGS-T1, geology, tenement EL12/2019and CDP number location map.

1. INTRODUCTION

Internode Seismic reprocessed the eastern half of 2D seismic line 95AGS-T1 because it intersected Argent Minerals Ltd's EL12/2019 tenement in August 2020. For comparison, the original 1995 processed stack section was depth converted. The location map is shown in Figure 1.

The reprocessing and interpretation objectives were to:
1. Generate a shallow sub-surface image that could be linked to the mapped surface geology
2. Generate a deep structural image of the area between the Henty and Rosebery Faults
3. Obtain stratigraphic information for understanding the geological evolution of the area
4. Delineate any potential areas for more detailed mineral exploration targeting

Acquiring new seismic lines would have been costly, whereas reprocessing the vintage seismic offered better value to Argent Mineral's mineral exploration program because new techniques can improve old data so that structural and stratigraphic details become much more evident.

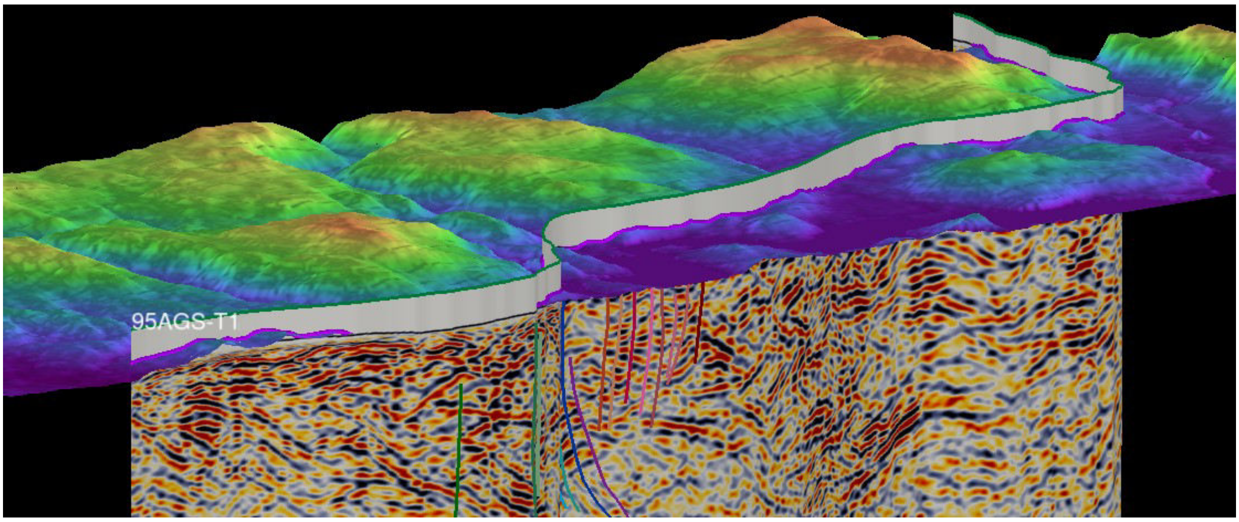


Figure 2. Seismic line 95AGS-T1 with 3D, coloured, elevation profile, looking north.

2. ACQUISITION

Geoscience Australia (ga.gov.au) acquired seismic **reflection** line 95AGS-T1 between January-March 1995 as part of the 'TASGO' project, a National Geoscience Mapping Accord (NGMA) project performed in conjunction with the Tasmanian Geological Survey (mrt.tas.gov.au).

The project should not be confused with the 1995 TASGO wide-angle seismic **refraction** project where AGSO's research vessel Rig Seismic circumnavigated Tasmania while it fired ~36,000 airgun shots every 50 m and a network of 44 refraction recording stations throughout Tasmania recorded the seismic energy for deep crustal imaging.

One objective of the seismic **reflection** project was to provide a regional tectonic framework as a basis for mineral exploration. At the time, onshore crustal seismic reflection technology was immature, time consuming and highly expensive. It was the first time that the mineralised Dundas

Trough and it's underlying crustal architecture had been imaged, therefore TASGO was a pioneering geoscience achievment.

The entire seismic reflection survey acquired a total of 133.8 km, along 5 lines, over an 8 week period. Gravity data was also acquired at 120 m intervals. Line T1 measured 49.2km.

Topographically the full line 95AGS-T1 commenced in the west about 1 km west of Whaleback Ridge on the Pieman Road and continued east until it met the Murchison Highway. It followed the highway south for 1.5 km, then along an access road to the Macintosh Dam overflow and across the spillway before ending several kilometres along the dam access road. No line clearing was required along any part of this traverse. As a safety measure, shot gaps coincided with key infrastructure, without significantly impeding shallow imaging.

Prior to commencing acquisition on line 95AGS-T1, tests were carried out to determine which acquisition parameters were best suited to meet the imaging objectives. Parameters tested were a 50 Hz notch filter test and low cut filter tests. The notch filter removed power line noise effectively although since the 50 Hz was not saturating the signal, it was decided to perform filtering during the processing phase in Canberra. An 8 Hz low-cut filter best attenuated ground roll and shot-generated noise. First breaks were picked in-field and utilsed during the computation of refraction statics.

Field QC also included the checking of shot geometry from the monitor records and observer’s reports. Loading, drilling and shot firing logs were also cross-checked for correctness in the field. Survey positioning from Dynamic Satellite Surveys was verified in-field the on the elevation profiles (see Figure 2), x, y plots and subsequently by radar altimetry.

Map sheets covered were 1:250K Tasmania NW and 1:100K Pieman and Sophia.

ACQUISITION PARAMETERS	
Name	L139 TASGO seismic survey
Years	1995
Source Type	Dynamite 10kg
Charge Depth	12 metres (nominal)
Shot Point Interval	120 metres (every 3rd station)
Recording Instruments	Sercel SN368 S/No 17
Number of Channels	120 + 4 aux
Station Interval	40 metres
Split Spread Configuration	2360m----20m--0--20m-----2360m
CDP Spacing	20 metres
CDP fold	20 fold
Recording system	Sercel SN368
Record length	20000 msec
Sample interval	2 msec
Low and high cut filters	8 Hz 18db/Oct and 178Hz 72db/oct
Datum of Projection	GDA-94 (originally AGD 66)
Projection	UTM Zone 55 South

3. ORIGINAL DATA PROCESSING

1995 Processing

Geoscience Australia processed the seismic line using 'Disco' and interactive 'Focus' software running on an IBM RS6000 UNIX computer in October 1995. T. Barton, D. Johnstone and A. Owen were the processing team in Canberra.

Crooked line processing generated CMP binning locations, binned with an 80m maximum offset. The shallow section processing also included pre-stack spectral equalisation to enhance high frequency, near surface events.

Constant velocity analysis was undertaken on coherency stacked data which was a crude technique, although Leaman Geophysics noted in 1996 that the stacking velocities employed during processing were consistent with the mapped changes in rock type. (David) Leaman elaborated that much of the patchy character was “generated off line” (meaning that the seismic image was contaminated with reflections sourced from areas away from the line). He claimed that the results were “deficient, inadequate tests performed.. and that the lines do not advance requirements or specification needs for future surveys; they are not good enough, and perhaps pessimistically indicate that either seismic methods will yield very patchy results in Tasmanian conditions or require extensive research - especially in terms of processing issues”.

The original processing was poor for several other reasons. Primarily it did not image dipping reflectors well due to the lack of DMO although it was “not applied due to limited fold and offset variability”. Second, the data was insufficiently dereverberated.

Figure 6 compares the original 1995 processing with the 2020 reprocessing section.

1995 Processing Sequence

1. Crooked line geometry definition
2. Field SEG-Y to internal format
3. Resample to 4 ms
4. Quality control display and edits
5. Crooked line binning
6. Spherical divergence and gain correction
7. Statics computation (first breaks or uphole method, differing datums)
8. CMP sort
9. 50 Hz notch filter
10. Constant velocity analysis
11. Normal moveout correction
12. Pre-stack NMO mute (55% stretch mute)
13. Common mid-point stack
14. Post stack balance
15. Bandpass filter
16. Time varying equalisation
17. Signal enhancement (FX-decon and Digistack)
18. Display and output in SEG-Y format

The 2020 depth conversion of the original 1995 migrated stack is summarised here:

1. Reformat SEG-Y
2. Time to depth conversion using final 2020 velocity model
3. Shift to fixed datum 400m AHD
4. Output SEG-Y

4. 2020 REPROCESSING

Commencing with field data, an advanced 2D land imaging sequence comprising 23 stages (listed below) was applied in 2020. Seismic reprocessing involved pre-stack data enhancement and post-stack migration with optomised parameterisation designed to ensure that reflections observed on shot records were preserved in the final section. Pre-stack dip move-out (DMO) followed by post-stack migration is well known to be more useful in hard-rock reprocessing than pre-stack migration. Pre-stack algorithms were tested however pre-stack DMO and post-stack migration were applied during production.

The 2020 full reprocessing flow is summarised here:

1. Reformat field data
2. Geometry crooked line profile/binning
3. Spherical divergence compensation
4. Refraction statics
5. Shot domain noise attenuation, dip filter
6. Surface consistent amplitude compensation
7. Velocity analysis (1st pass)
8. Surface consistent static correction (1st pass)
9. Velocity analysis (2nd pass)
10. Surface consistent static correction (2nd pass)
11. Offset domain noise attenuation
12. Surface consistent deconvolution
13. Spectral balancing
14. Dip Move Out (DMO)
15. Offset noise attenuation
16. NMO/Mute/Stack
17. Coherency filter
18. Post-stack Finite-Difference migration
19. TVF 0-300ms 16-70Hz and 600-5000ms 7-50Hz

20) Velocity model building
    - DMO and PSTM velocity analysis
    - First arrivals used to generate refraction inversion velocity model
    - Interval velocity model build using refraction velocities for the shallow and PSTM velocities deeper. Interval velocities used for depth(VintZ).

21. Time to depth conversion using VintZ
22. Datum from floating to fixed 400m AHD
23. SEG-Y format output

Pre-processing phase 1

Reformating the field data

The original seismic shot records were retrieved from the NOPIMS database. Some the auxilliary or support information was incomplete, including missing observers' logs and partial and missing elevations. Observers' log information was reconstructed as necessary. The input seismic records were dynamite records, the processing sample rate was 2ms and record length was 20 seconds. Quality control involved the identification of bad or missing shot records and assessing the total number of channels, record length and polarity

Geodetics and crooked-line binning

Gaps in navigation information were interpolated then QC'd via modern satellite images. The acquisition datum/projection was transformed from AGD66 UTM zone 55 into GDA94 with an transform error margin of <5m. All deliverables are in GDA94/MGA94 zone 55. Shot points trace headers were recovered from acquisition reports.

Crooked line geometries are common and practical in a hard rock environments despite violating the implicit assumption that seismic line direction coincides with the dip direction of the subsurface structures. Crooked-line acquisition minimises time and costs by shooting along existing roads. Seismic data acquired along straight lines is more easily ascribed to geologic reflectors whereas on crooked-lines, out-of-plane or cross-dip events may appear anomalous.Common depth point (CDP) bins are defined at regular intervals along a crooked line that is a smoothed version of the actual acquisition profile and the bins are expanded away from the CDP line in a roughly perpendicular direction to the acquisition direction. Midpoints outside the specified maximum lateral distances from the bin centres were dropped if they fell outside the maximum lateral offset. From an input of 509 stations spaced at 40m intervals, a CDP geometry for the survey line created 837 CDP locations along a crooked line with bins spaced at 20 m intervals giving 20-fold coverage.

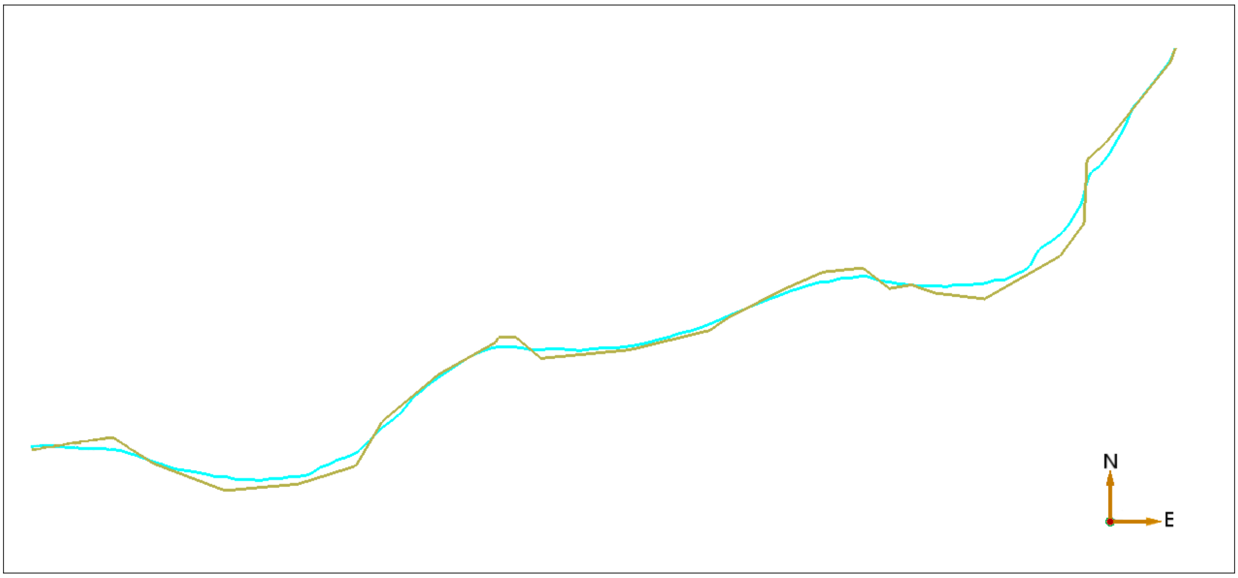


Figure 3. Map showing the difference between the 1995 and 2020 binning locations
The olive coloured line is the 1995 binning and aqua line is the 2020 binning.

Spherical divergence compensation

An amplitude scaling correction was applied to compensate for the decrease in wave strength with depth as a result of wave-front spreading and attenuation.

Shot domain noise attenuation, dip filter

Low-frequency, surface wave noise is prominent because dynamite was the source. While the generated surface waves masked reflectivity, they were effectively suppressed by denoise, trace editing and dip filtering which attenuated the majority of random and coherent noise sources. Reflections were imaged most clearly in the 20 to 70 Hz frequency band, but higher frequencies also contained energy related to reflections. High-amplitude linear and erratic noise was attenuated by transforming the traces into the F-K domain, muting the noise, then transforming back to the original domain. A before and after pre-processed shot record is shown in Figure 4.

Surface consistent amplitude compensation

Surface consistent trace equalisation was applied using a single-window, trace-by-trace amplitude balancing algorithm.

Statics and velocity analysis

Near-surface travel-time irregularities distorted refraction and reflection continuity. These distortions are evident in shot records on the right side of Figure 4. They are caused by elevation and weathered low-velocity material being present, which is often referred to as the weathering layer. To overcome this, arrival times were computed that would have been observed had all measurements been made on a flat plane. First breaks were re-picked on every shot gather to obtain an initial near-surface model. Using the entire record, a refraction solution was sought via an inverse iterative solution to solve for the near-surface velocity field. The weathering layer varied in thickness between 0-50m along the line segment.

Refraction statics were computed and applied to all shot gathers to remove most of the longer wavelength travel-time distortions caused by the near-surface weathering layer. A replacement velocity of 4000 m/s and flat datum were used in the final static calculations.

The low frequency (regional) component of the statics was obtained by smoothing the statics over a cable length. The high frequency (residual) component (the difference between the total refraction static and the low frequency component) was applied after the first pass velocity analysis. It corrected the data to the floating datum which was near to the ground surface.

The purpose of velocity analysis is to calculate a velocity that accurately compensates for the effects of move-out and involves flattening reflection events on the CDP gathers' far offsets. Velocity functions were initially picked every 2 km to derive a starting velocity field for the calculation of residual statics. Later, velocity functions were refined and output every 500m.

The velocity model in the first 100-150 metres (of the vertical section) was derived from the inversion of the refracted first break arrivals (as mentioned above). The deeper velocities were derived from the subsequent phases of PSTM velocity analysis.

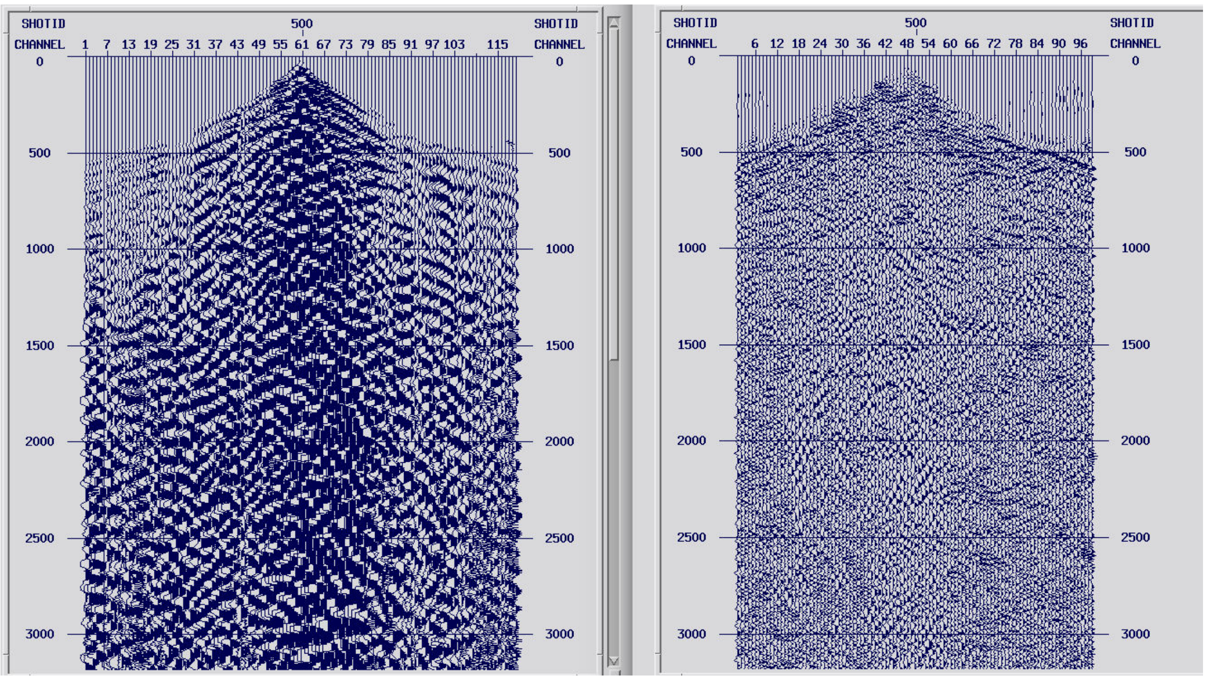


Figure 4 Shot records before (left), after (right) shot domain noise attenuation and dip filter.

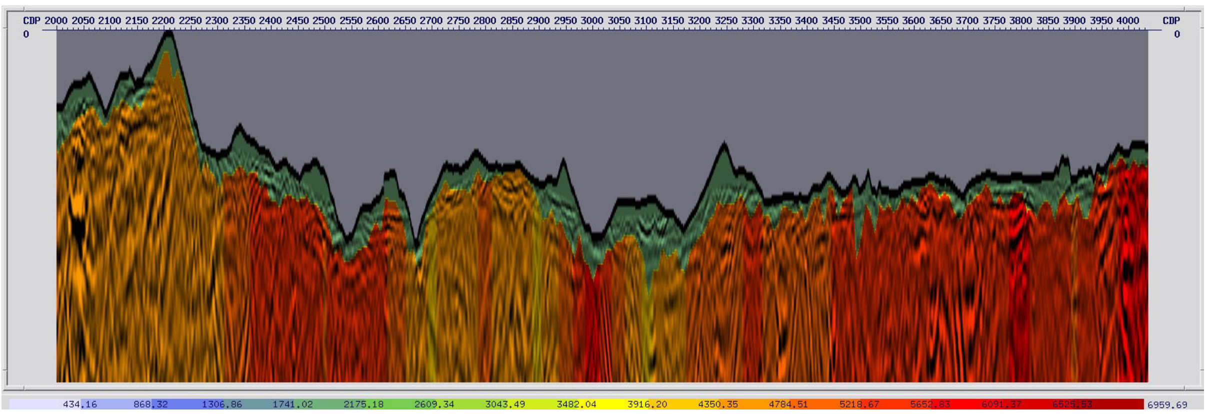


Figure 5 Line 95AGS-T1 with interval velocity overlain. Note velocity scale on the bottom.

Pre-processing phase 2 and stack

Offset domain noise attenuation was applied to remove residual random noise.

Surface consistent deconvolution

Deconvolution tries to increase the temporal resolution by sharpening the effective source wavelet containing the seismic trace. Deconvolution with a prediction lag (or gap that's equal to the first or second zero crossing of the autocorrelation function) is used to remove reverberations. Various deconvolutions were tested including trace by trace deconvolution with different gaps and filter lengths and surface consistent deconvolution which was preferred. The optimal gap length was tested and chosen then different filter lengths. The final deconvolution parameters were gap=24ms and operator length =160ms.

Spectral Balancing was applied between 8-80Hz.

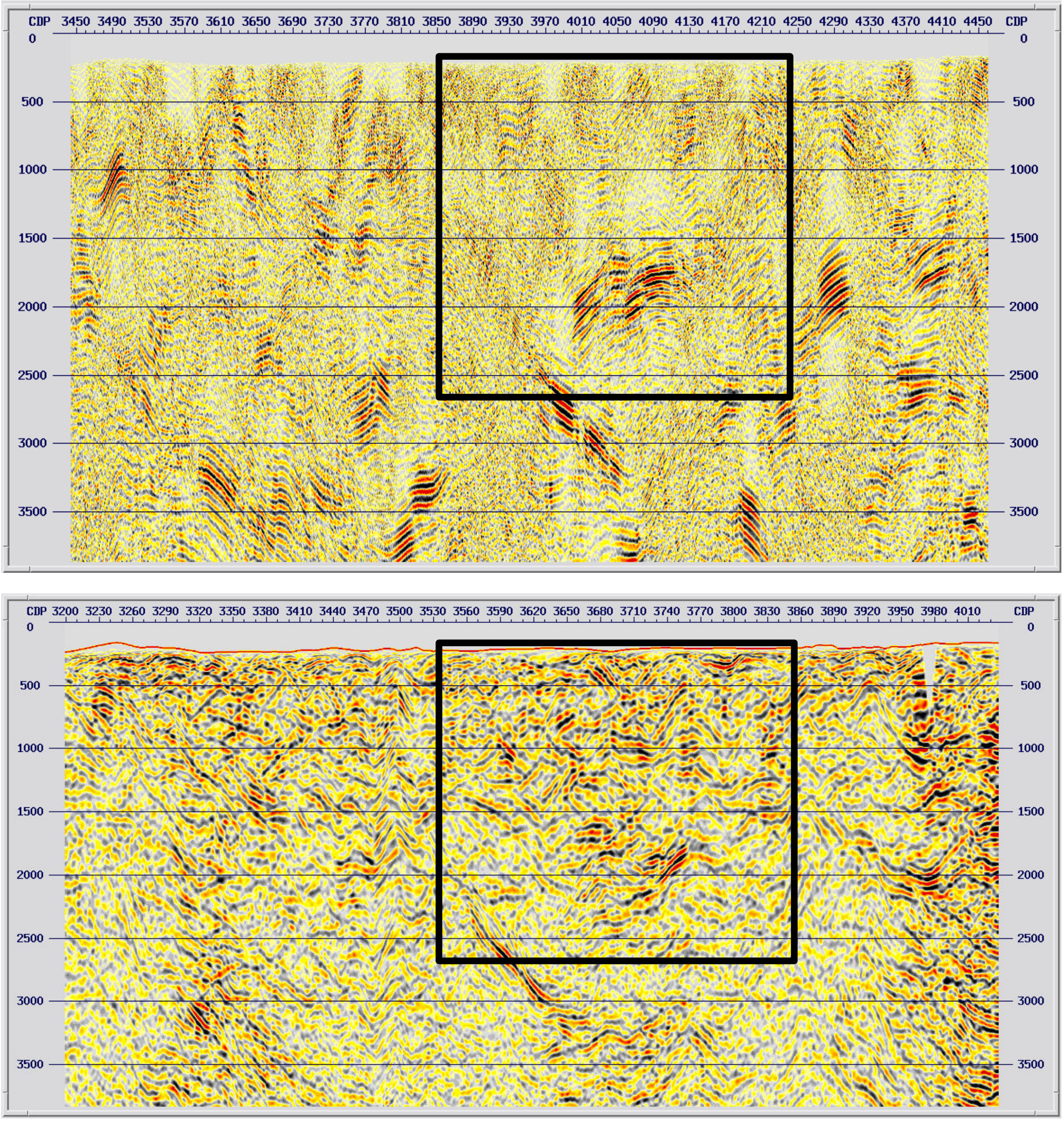


Figure 6. Migration in depth of the 1995 reprocessing (above) and 2020 reprocessing (below). The black box indicates the area zoomed in Figure 7.

Dip Move Out (DMO) was applied to migrate each trace to a zero offset (coincident with the source). Coherent noise with impossibly steep dip is removed.

Following DMO, a mute was applied to eliminate over-stretched parts of the far offsets, then all seismic traces within a CDP bin (gather) were summed (stacked).

Offset noise attenuation

F-X Deconvolution was applied post-stack to attenuate random noise. The filter applied was a complex Wiener-Levinson prediction filter with a filter generally the length of 5 samples, and a 7 trace wide prediction window and over a length of 500ms.

Migration and post-processing

Finite-Difference Migration

Migration collapses diffractions which focusing the final image thereby improving the final image quality. The accuracy of the final migrated section is highly dependent on the quality of the velocity model. Several migration methods were tested, a ray-based migration and a differential equation-based migration method, with the latter preferred. The Finite-Difference algorithm (is a downward continuation process) better handles a wider range of subsurface velocities, albeit requiring careful dip approximation parameterisation. The Finite-Difference algorithm is often used for imaging in hardrock environments, whereas the ray-based method struggles to handle the residual noise frequently found in onshore seismic datasets.

A time-variant band-pass filter was applied between 0-300ms 16-70Hz and 600-5000ms 7-50Hz.

Velocity depth model building every 500m involved DMO and PSTM velocity analysis. As mentioned in the Static and Velocity Analysis section, the first arrivals were used to generate a refraction inversion velocity model. PSTM velocities were used in the deeper section with a tapered from the refraction velocities. The output interval velocities were used for time-depth conversion.

The penultimate processing step was to shift the datum from floating to fixed at 400m AHD (which means that the first sample of the seismic trace corresponds to a 400m height datum).

Final products were converted from the internal processing format and output in SEG-Y format, the international standard, then checked and archived. See the Deliverables section below.

5. CONCLUSION

A seismic line segment acquired in the Rosebery region in 1995 was reprocessed in mid-2020.

The depth reprocessing resulted in a more detailed and reliable image of the subsurface geology compared to the original seismic section (for comparison refer to Figures 6 and 7). The new dataset provided and good basis for a new detailed interpretation and the development of a structural and stratigraphic model of the tenement area which could assist in understanding the potential distribution of mineralisation and consequently reduce exploration risk.

Even with a reasonably conventional processing flow, the reprocessed line segment provides a high-resolution image of the shallow and deep section across the tenemented area and further westward.

The results are encouraging and should motivate further use of the seismic reprocessing for deep, undercover exploration and targeting.

A separate, detailed interpretation report was produced.

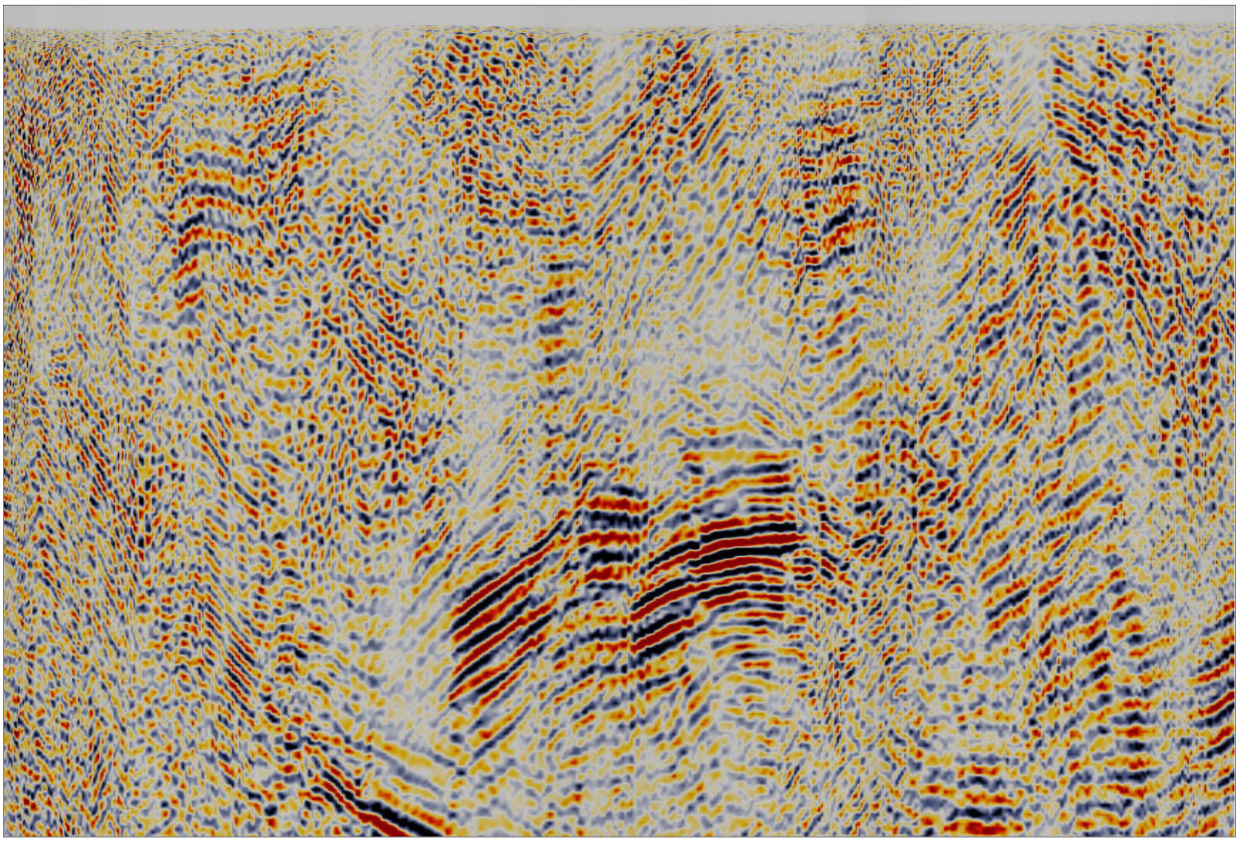
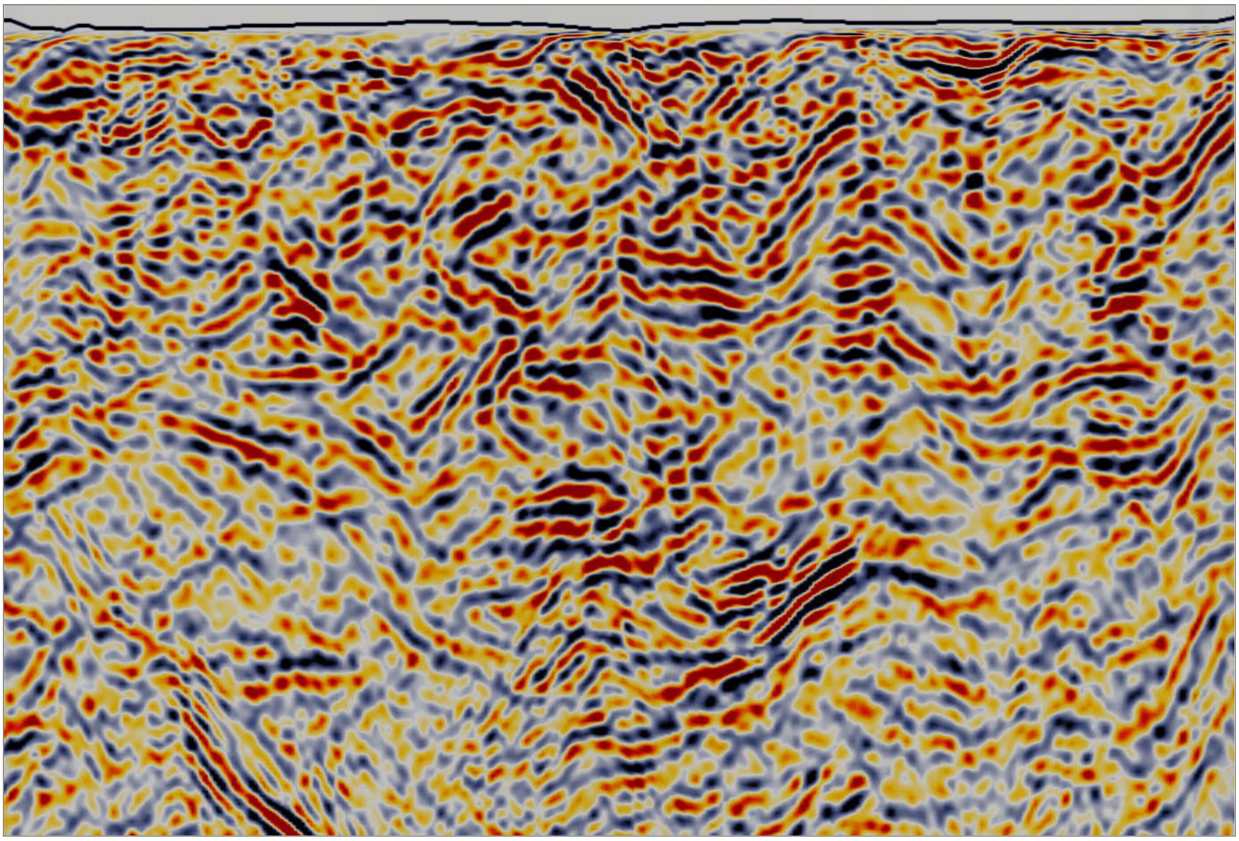


Figure 7. Zoomed segment of 95AGS-T1 1995 (above) and 2020 (below). Horizontal distance is 6.3km. Vertical scale: top of image is 250m AHD and bottom of image -2250m AHD. Ground surface is indicated by the continuous black line near the top of the 2020 reprocessed image.



6. DELIVERABLES

Line 95AGS-T1 (20km eastern segment)

PROCESS/ITEM	FORMAT	MEDIA
Original 1995 migration in depth domain (10km depth)	SEG-Y	USB
Original 1995 migration in depth domain (20km depth)	SEG-Y	USB
2020 Final migration in depth domain (10km depth)	SEG-Y	USB
2020 Final interval velocities in depth domain (10km)	SEG-Y	USB
2020 Refraction inversion velocities in depth domain	SEG-Y	USB
Final processing report	PDF	USB

SEG-Y Byte locations:

SHOTPOINT NUMBER	: BYTES 9-12 INT4
CMP NUMBER	: BYTES 21-24 INT4
CMP-X	: BYTES 73-76 INT4 (Stored as decimetres)
CMP-Y	: BYTES 77-80 INT4 (Stored as deicmetres)

7. REFERENCES

Relevant AGSO reports relating to TASGO operations were:

94/1085 Land Seismic Tasmania – Surveying,
94/1086 Land Seismic Tasmania
94/1087 Land Seismic Tasmania – Drilling
95/72 TASGO Seismic Survey Operation Report

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Lorregan, A.N 1996 Tullah El22/90, and Sterling River EL24/91, Annual report for the period ending September 1996, MRT report 96-3923, October 1996

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Goleby, B, Drummond, B, Owen, A, Yeates, A. Jackson, J. Swager, C and Upton, P., 1997, Structurally Controlled Mineralization in Australia - How Seismic Profiling Helps Find Minerals: Recent Case Histories in “Proceedings of Exploration 97: 4th Decennial Int Conf on Mineral Exploration” edited by A.G. Gubins, 1997, p. 409–420

Drummond, B, Barton, T, Korsch, R, Rawlinsonb N, Collins C, Brown A and Yeates, A 2000 Evidence for crustal extension and inversion in eastern Tasmania, Australia, during the Neoproterozoic and Early Palaeozoic. Tectonophysics v 329, p 1-21 https://doi.org/10.1016/S0040-1951(00)00185-2