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PASMINCO EXPLORATION
WARATAH EL 48/94
ANNUAL REPORT
PERIOD ENDING OCTOBER 1996

MICROFILMED
FICHE No. 014158-59

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Date: December 1996
Report No.: TA-33
Submitted to: Regional Exploration Manager - Tasmania
Distribution: Mineral Resources Tasmania - Hobart
Pasminco Exploration - Rosebery
- Melbourne

EL48/94 PT1
see EL48/94 PT1
folio 34

Submitted by: *NK McGunnigle*

Accepted by: *[Signature]*

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SUMMARY

Work completed in Waratah EL 48/94 during the period December 1995 - November 1996 has included the acquisition and interpretation of a detailed aeromagnetic survey, two ground magnetics surveys and geological mapping. Twelve magnetic regions have been identified from the aeromagnetic data. The area appears to become more structurally complex in the SW of the tenement.

Further exploration in the Waratah tenement is recommended for the forthcoming year to follow up features identified on the aeromagnetic survey, particularly geological mapping to assist with a better understanding between magnetic signatures and outcropping rock units. Regional geochemistry is recommended through rock chip and stream sediment sampling. Follow up of DDH BR1 along Butlers Road is also recommended.

The Waratah area contains historical discoveries of lead-silver, tin, copper and iron. Several anomalies defined through previous exploration remain untested or are inadequately drilled, therefore the potential remains good for the discovery of basemetal mineralisation cannot be disregarded.

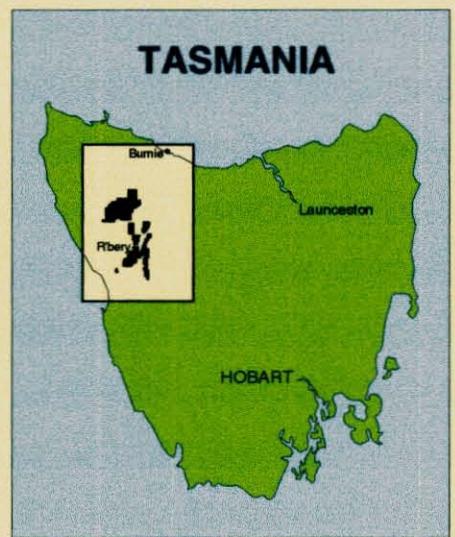
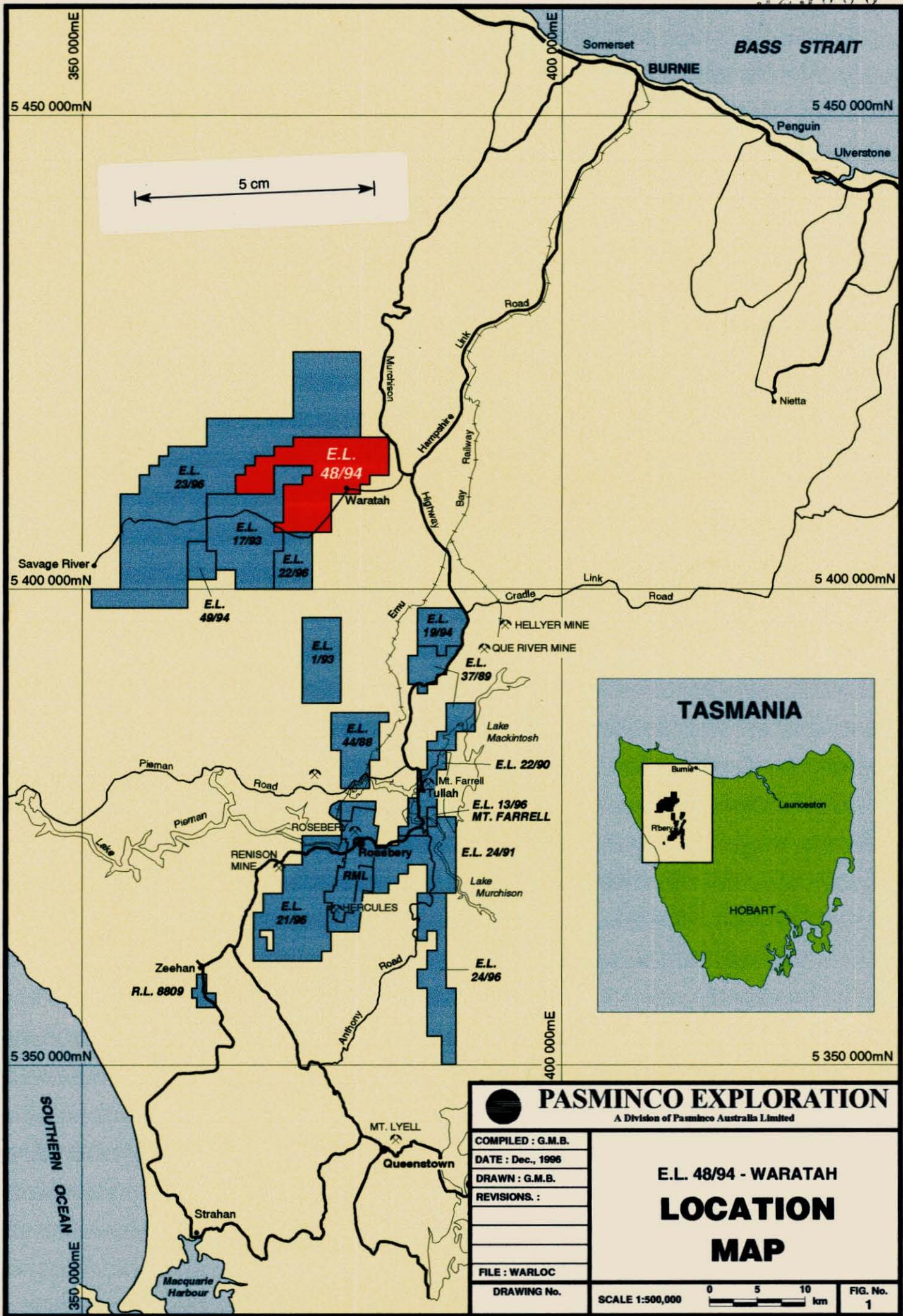
1 INTRODUCTION

The Waratah EL 48/94 is located 60km southeast of Burnie just off the Hampshire Link Road (Figure 1). It covers 87km² from the Deep Gully Creek area northeast of Waratah township to Arthur Dam in the southwest. Work completed in the period from December 1995 to November 1996 has included a regional aeromagnetic survey and regional ground mapping and geophysics. Much of this work has been carried out concurrently with EL 17/93, immediately west of EL 48/94, which is joint ventured with MPI Gold Pty Ltd.

The Mt Bischoff (Sn) and Magnet (Pb-Ag-Zn) Mines lie within and just outside the Licence, along with numerous other small tin and base metal shows. Base metal mineralisation appears to be hosted by Precambrian and Cambrian volcano-sedimentary sequences, with all reported occurrences being vein-style.

Much of the EL area is Crown Land, covered by patches of rainforest and forestry, ti-tree scrub and button grass plains. Access is provided by Waratah Road, numerous logging and old exploration tracks, and walking tracks. Much of the area is accessible only by foot.

Corinna Road officially



 PASMINCO EXPLORATION A Division of Pasmenco Australia Limited	
COMPILED : G.M.B. DATE : Dec., 1996 DRAWN : G.M.B. REVISIONS : FILE : WARLOC	E.L. 48/94 - WARATAH LOCATION MAP
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	FIG. No. 1

2 TENURE

Waratah EL 48/94 was issued to Pasminco Australia Limited on December 23 1994 for a period of 12 months and was renewed from December 1995 for a further 12 months. The licence area covers 87km², which excludes a land area of 4 km² (RL8807), 4ha Crown Reserves (82M/77) and a 9 ha Mining Lease (58M/87, Figure 2).

The land tenure of the area comprises predominantly Crown Land, as non-allocated, Deferred Forest Land, and Recommended Area for Protection - the Savage River RAP, Mt Ramsay RAP and Deep Gully RAP. As well as State Forest land and private property, the area also contains part of the Savage River Australian Heritage Commission Act, Registered Entry.

3 PREVIOUS EXPLORATION AND MINING

A comprehensive review of previous exploration in the Waratah area is included in McGunnigle (1995). Previous exploration conducted in the area is summarised in Table 1.

Modern exploration in the area commenced in the early 1970's and has been undertaken within several exploration licences since then. The work has included stream sediment sampling and geological mapping, a range of geophysical surveys and several drill holes. Numerous tin and base metal anomalies have been discovered in the area, although much of the anomalism is thought to be related to contamination from Magnet and Mt Bischoff mines.

TABLE 1. PREVIOUS EXPLORATION IN THE WARATAH AREA

- 1870's- 1940 *Early prospecting.*
Discovery of tin ore in Tinstone Creek and Mt Bischoff tin deposit. 1877: Magnet Mine discovered, producing approx. 630,000t @ 6% Pb, 7% Zn and 394 g/t Ag (1895 - 1940). 1890's: small discoveries of Ag-Pb, Au, Sn, Cu and Fe lodes opened up.
- 1963-1989 *EL 5/63, 7AP/AM, Comstaff Pty Ltd (plus BHP Co Ltd).*
1969+: Stream sediment sampling, reconnaissance mapping, gridding and soil sampling around the eastern margin of Meredith Granite.
Early 1970's: Extensive stream sediment sampling and geological mapping (Shaw and Everett, 1985a, b; BHP, 1988), regional TURAM EM survey, CRONE EM and magnetic surveys over 3 grids. Drilled BAB1, MAG1 and MAG2.
1981: Investigation of Deep Gully Creek anomaly; gridding, soil geochemistry, geological mapping, ground magnetics and aeromagnetics identified anomalous tin.
1983: Regional DIGHEM survey identified anomalies in the Deep Gully Creek area (not further investigated). BHP joint-ventured into EL 5/63 in 1985 and drilled BR1.
1984: 5 holes drilled through Tertiary cover.
- 1963-1989 *EL 1/63, Cominco Exploration Pty Ltd.*
1974 helimag survey, 52m line spacing; 1980 - 1981 DIGHEM EM and stream sediment geochemistry.
- 1983-1985 *Department of Mines, Luina and Wombat Flat Exempt areas.*
Regional mapping (Brown, 1986), magnetic and DIGHEM surveys and soil geochemistry. Two holes drilled at Arthur Dam, AD1 and AD2.
- 1988-1990 *EL 46/88, Billiton Australia.*
Gridding of 1983 Comstaff DIGHEM anomaly; geological mapping, ground magnetics and UTEM. Drilling intersected background levels of tin and basemetals.
- 1989-1990 *EL 47/88 Placer Exploration Ltd.*
Regional stream sediment sampling, rock chip geochemistry (Magnet Mine) and resampling of MAG1, MAG2 and BAB1.
- 1990-1993 *EL 12/90, EL 15/90, RGC Exploration Ltd.*
Regional data review, magnetic and gravity interpretation of existing data, mapping and rock chip sampling and regional gravity survey led to initiation of Deep Gully Creek Grid and multi-element soil geochemistry. Geochemical anomaly identified close to the Waratah River (remains untested).
- 1991-1992 *EL 21/90, Geopeko.*
1: 25 000 compilation maps of Comstaff stream sediment data. Limited water and rock float sampling.
- 1994- *EL 17/93, EL 49/94, MPI Gold Pty Ltd.*
Regional stream sediment sampling, rock chip sampling (Magnet Mine) and resampling of AD1 and AD2.

5 GEOLOGY

5.1 Regional Geology

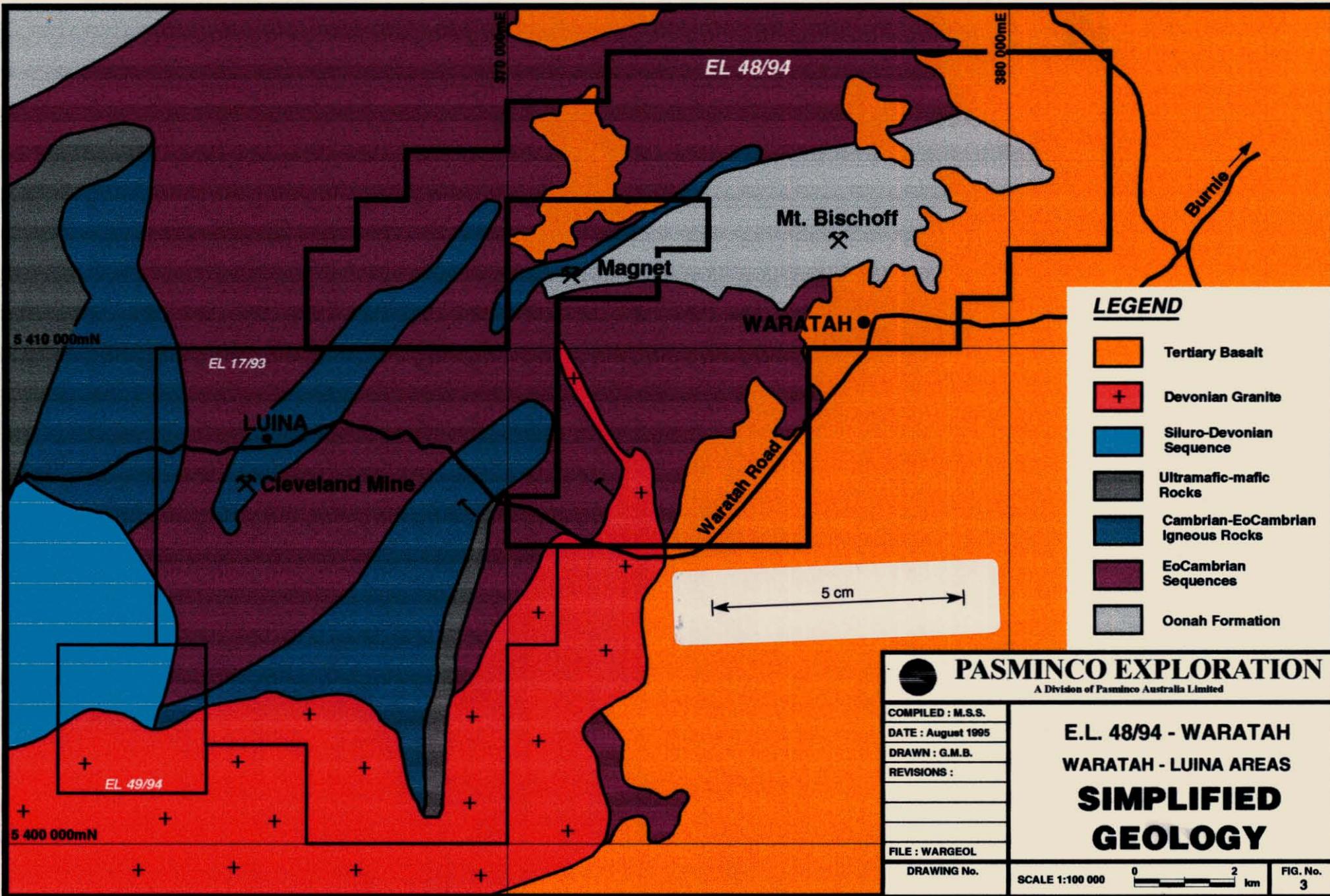
The regional geology of the Waratah area consists of Precambrian to Ordovician rocks of the Dundas Trough. Lithologies which are well described in Brown (1986) include carbonates, intermediate to mafic volcanics and ultramafics. The Devonian Meredith Granite forms a shallow ridge extending from outcrop on the Waratah Road to the northeast underneath Mt Bischoff mine (Brown, 1986, Figure 3). Observations from field mapping detailed in Appendix 1 are included in the summaries of outcropping lithologies below, and sample numbers quoted are consistent with descriptions included in Appendix 2.

5.1.1 Oonah Formation

A block of Oonah Formation of approximately 17km² in size surrounds the Mt Bischoff mine and extends below basalt to the east. The Proterozoic Oonah Formation is composed of pale grey quartz sandstones, pale grey siltstones, dark grey shales, dolomites and minor mafic lavas and volcanoclastics. A high degree of deformation often distinguished it from younger rocks.

The Oonah Formation has been divided into upper and lower successions on the basis of lithology. The lower sequence is dominated by micaceous quartz sandstones and siltstone with minor interbedded phyllitic mudstone. The upper Oonah has a greater abundance of mudstone and shale with dolomite and occasional intercalated mafic volcanics.

In the Mt Bischoff area, the Oonah Formation is comprised of a shale and siltstone succession with thick units of dolomite that correlates to the upper sequence. It is inferred that the Oonah/Crimson Creek Formation contacts in the Mt Bischoff area are faulted, possibly involving significant thrusting of Precambrian over the Eocambrian sequences.



LEGEND

- Tertiary Basalt
- + Devonian Granite
- Siluro-Devonian Sequence
- Ultramafic-mafic Rocks
- Cambrian-EoCambrian Igneous Rocks
- EoCambrian Sequences
- Oonah Formation

PASMINCO EXPLORATION <small>A Division of Pasma Australia Limited</small>	
COMPILED : M.S.S. DATE : August 1995 DRAWN : G.M.B. REVISIONS : FILE : WARGEOL	E.L. 48/94 - WARATAH WARATAH - LUINA AREAS SIMPLIFIED GEOLOGY
DRAWING No.	SCALE 1:100 000 km
FIG. No. 3	

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5.1.2 *Crimson Creek Formation*

The Crimson Creek Formation occurs to the north and east of the Meredith Granite, and is, in part, overlain by Tertiary basalt. The formation is comprised largely of basalt lavas (78013), basaltic volcanoclastics, and finely bedded siltstone and mudstone (78017). Brown (1986) notes that the Crimson Creek Formation becomes more basaltic to the north of the Meredith Granite. Thin carbonate horizons occur in the Crimson Creek Formation but rarely outcrop.

Contact metamorphism of the Crimson Creek by the Meredith Granite has resulted in hornfelsing of the sediments about the granite. It is probable that this magnetic signature will add to the complexity of responses when using magnetics as an exploration tool.

Ultramafic and mafic rocks have been locally thrust onto the Crimson Creek Formation.

5.1.3 *Eocambrian pyroxenite and basalt lava sequences*

Mixed intermediate to mafic volcanics dominate an area to the west of Arthur Dam and are mapped also in an area between Magnet and Mt Bischoff mines. The volcanics are referred to as high-magnesian andesites and low-titanium tholeiite basalts by Brown (1986) and are, so far, the only known sequences of their type in Tasmania, derived within the Dundas Trough. They most commonly range in textures from interstratified volcanoclastics to lava and lava breccia and are believed to be mostly subaqueously emplaced.

Lava and lava breccia ranges from vesicular, fine to coarse grained porphyritic to basaltic pyroxenite intercalated with volcanoclastic sandstone and siltstone. Outcrop is green to grey-brown in colour, slightly to highly chloritic with goethite weathered surfaces. Andesite is feldspar-pyroxene phyric, with pyroxene phenocrysts up to 8mm in size (and up to 20% abundance), and commonly contain amygdales infilled with carbonate and/or silica (78007). Spilitic basalt is characterised by classic spherulitic-spray spilitic textures, and fine grained feldspar \pm pyroxene (78011).

5.1.4 *Ordovician - Devonian sediments*

A sequence of Ordovician to Devonian sediments overlies the Crimson Creek Formation and associated ultramafic rocks within a small syncline to the north of the Meredith Granite in the Mt Stewart-Heazlewood area. These sediments belong to the conformable Gordon Limestone-Eldon Group sequence, and the Gordon Limestone at the base of the sequence may have a stratigraphic thickness of up to 500m. It is overlain by the Crotty Sandstone, a white, friable, quartz rich unit up to 400m in thickness, which forms a prominent ridge around the edge of the syncline. Much of the sequence is poorly exposed and covered by alluvium.

5.1.5 *Meredith Granite*

The Meredith Granite has been radiometrically dated at 356 Ma. Around the north-eastern tip and eastern margin the granite is porphyritic close to the contact and contains feldspar (up to 25mm) and biotite phenocrysts (up to 15mm) (78006). The granite becomes increasingly equigranular towards the core, and contains biotite throughout. Zones of greisenisation and concentrations of tourmaline veining are common and conspicuous close to the granite margins. Quartz feldspar porphyry dykes related to the Meredith granite occur at Mt Bischoff and at Deep Gully Creek.

Modeling of the shape of the Meredith Granite (Leaman and Richardson, 1989) demonstrates a shallow ridge extending from outcrop on the Corinna Road to the northeast underneath Mt Bischoff mine. An infill of gravity stations by RGC during 1990/91 in this area confirmed this ridge and highlighted the granite topography.

5.1.6 *Tertiary Basalt*

An extensive plateau of Tertiary basalt covers the area east and south of Waratah with erosional outliers elsewhere. Basalt cover may be up to 300m in thickness, comprised of flows ranging from less than 1m to greater than 10m thick. Fluvial and lacustrine sediments occur between basalt flows, ranging from mud to gravel grain size.

Magnetic character and variation in thickness of the basalt severely hinders interpretation of sub-basalt basement magnetic features.

5.1.7 *Known Mineralisation*

The Waratah-Luina area is well known for large skarn-style Sn deposits (Mt Bischoff and Cleveland), but lesser known for Pb-Zn mineralisation.

The largest base metal orebody discovered and mined to date is Magnet, from which approximately 630,000t grading 6% Pb, 7% Zn and 394 g/t Ag were extracted. Magnet lies to the immediate west of EL 48/94. The orebody has a strike length of 90m, a true width averaging 5.5m, and was worked to 365m vertical depth. The orebody is described as occupying a steep west-northwest dipping fracture system within an early Cambrian mafic/ultramafic body known as the Magnet dyke, close to its discordant footwall contact with early Cambrian sedimentary rocks.

The ore at Magnet consists of sphalerite and argentiferous galena with lesser amounts of arsenopyrite, pyrite, boulangerite, pyrargyrite, tetrahedrite and chalcopyrite in a gangue of manganosiderite.

Other base metal mineralisation sites are discussed in Nye (1923), however each are small vein style galena dominated accumulations which were worked to a shallow depth only.

The Cleveland Sn-Cu deposit located 6km west of EL 48/94 comprises several stratabound lenses of pyrrhotite-cassiterite-stannate-chalcopyrite mineralisation formed by metasomatic replacement of limestone beds. The limestone is a small part of the Crimson Creek Formation in the area, forming the transitional sequence between mafic volcanics and the overlying turbidite sequence. The tabular lenses are up to 30m in thickness, and are disrupted by a series of sub-parallel reverse faults that were mineralisation conduits.

At Mt Bischoff, massive pyrrhotite has partially replaced a 40-60m thick dolomite bed within a sequence of turbiditic sandstone, siltstone and shale of the Oonah Formation. Quartz-feldspar porphyry dykes intrude this sequence. Other mineralisation styles include topazised porphyry dykes and late stage quartz-carbonate-fluorite veins.

6 WORK COMPLETED

During the 1995 - 1996 period, work undertaken on Waratah EL 48/94 has continued to contribute to the regional database established in Pasminco's GIS. A regional aeromagnetic survey was completed in conjunction with neighbouring EL's 17/93 and 49/94, and regional geological mapping and ground geophysics undertaken.

6.1 Regional Data Compilation

A regional database for the Waratah area includes adjacent EL's 17/93 (Luina) and 49/94 (Whyte River) which are Joint Ventured with MPI Gold Pty Ltd. The database which was initiated last year in Pasminco's GIS, has been continually updated with relevant data.

Information available includes previous stream sediment and soil geochemistry (MPI Gold, 1994; Placer, 1988; Comstaff, 1977; and Collins 1983), water and drainage maps, roads, tracks and access in the area, known mineralisation and possible sources of contamination.

6.2 Field Activity

actually Corinna Rd

Geological mapping was undertaken during the year as part of a regional mapping programme over the Waratah area (Figure 4). Most of the mapping in EL 48/94 was restricted to Butlers Road, Waratah Road and Betts Track. Observations of regional lithologies are reported in Appendix 1, and descriptions of selected rock samples collected during mapping are included with corresponding thin section descriptions in Appendix 2. The samples reported are representative specimens for various outcropping lithologies and alteration types observed in the area, and include many from adjacent EL 17/93.

Tertiary basalt and Oonah Formation which outcrop in EL 48/94 were not mapped during the field season.

Observations of geology and contacts from ground mapping have been discussed with respect to the magnetic responses along Butlers Road and Betts track.

6.3 Aeromagnetic Survey

A detailed aeromagnetic survey was flown over Waratah EL 48/94 in conjunction with a survey over the Luina and Whyte River Joint Venture tenements. UTS Geophysics were contracted to conduct the survey, with specifications of 100m line spacing, flight lines East-West and flight height to average 50m. Navigation was through the use of Real-time GPS, and height above ground level was monitored using radar altimeter.

Data over the Waratah tenement can be separated into twelve domains based on magnetic character. Correlation with the regional geology as compiled by Brown (1986) varies from good in the region of the Tertiary Basalt cover and Oonah Formation to poor in more complex areas.

Cultural responses that may be within the data set include the Waratah township, the Mt Bischoff mineralised workings and powerlines that run close to the southern edge of the EL. There is possibly an abundance of other cultural responses indicated by high frequency magnetic bulls-eye highs. These need to be checked against the aerial photographs and ground truthed.

6.4 Magnetic Domains

The twelve magnetic domains have been characterised by the observed magnetic signature and the regional geological interpretation (Figures 5-7).

Zone 1 - A magnetically quiet response related to the sub-cropping Meredith granite. The granite is interpreted to intrude to the north of Betts Track and appears to continue north, however the location of the contact is difficult to determine. A small isolated magnetic high is located within the 'granite zone'. This is likely to be hornfelsed sediments, on the surface above the granite intrusion (see Butlers Road mapping and ground magnetics). An airborne EM anomaly within this local magnetic high was drilled by BHP in 1985 (BR1), intersecting Sn mineralisation.

Zone 2 - This zone is part of the major NE-SW trending package of highly magnetic rocks. The magnetic signature is high amplitude and high frequency, but also contains a number of continuous magnetic units. A number of NW-SE structural breaks can be observed through the zone.

Surface geology consists of the Crimson Creek Formation (sediments and basalt lavas), an ultramafic serpentinite (see Arthur Dam region) and hornfelsed sediments. Mapping and drilling in the area confirms the existence of these lithologies, however, they can not be distinguished from each other using the magnetics.

Zone 3 - This zone is similar in character to zone 2 and contains high frequency responses as well as several discrete and continuous magnetic units. The zone trends nearly N-S at the south end of the EL, and heads west as the unit is traced north, representing a dislocated folded unit.

There are actually two 'components' within this magnetic package, the first containing the more intense magnetic response along the granite contact, the second component consisting of less intense, more dispersed high frequency responses. This second component gives the appearance that the feature is dipping gently to the north and north-west, representing an antiform.

Geological interpretation of this zone indicates the unit to be Crimson Creek Formation. Regionally this signature continues south to the Huskisson River area where ultramafics have been interpreted to intrude the Crimson Creek Formation. Therefore it is interpreted that the first component in this magnetic zone contains within it ultramafic rocks, which may account for the different magnetic intensity observed between the two components.

Mapping along Butlers Road indicated that some of the sediments had undergone hornfelsing. It is unknown to what extent this has occurred, however, it will add to the complex nature of the magnetic signature.

Zone 4 - This is characterised by the bland magnetic response in the centre of the tenement. The signature is moderately similar to that observed over the granite. Gravity data (Leaman and Richardson, 1980) indicates that the granite does plunge to the north-west, however, it is not interpreted to sub-crop in this region except close to the Bischoff mineralisation (seen as a large magnetic high related to pyrrhotite and culture at 376500mE , 5412220mN). The outline of this response correlates well with the interpreted Oonah Formation that covers this zone. The western contact, trending NE-SW, appears to be a large fault plane (thrust?). To the NE of this fault structure is a 'raft' of weakly magnetic material, which may be related to the material in zone 8.

Zone 5 - The response of zone 4 is bounded to the south-east, east and north-east by a high frequency magnetic package (zone 5). The magnetic signature is interpreted to correlate to Tertiary basalt cover. Correlation of the magnetic boundaries with the interpreted geological boundaries is very good. There are some apparent structures within the data which may be related to post-tertiary faults. At the contact of this zone and zone 6a is a large magnetic low (possible alteration affect?) located at 378870mE, 5415250mN, which requires ground truthing.

Zone 6 - The area with moderate magnetic intensity defines this zone at the north end of the tenement. This zone can be sub-sectioned into, zone 6a (directly west of zone 5) and zone 6b, located to the west of zone 6a. The two are separated due to the slight difference in magnetic response, with zone 6a containing more high frequency discontinuous data.

The geology of zone 6a has been interpreted to be Tertiary basalt overlying Crimson Creek Formation. There is a component of the Tertiary basalt magnetic signature in the zone, however, it is interpreted that the cover is thin and is underlain by Crimson Creek Formation, indicated by a more continuous magnetic response.

Zone 6b is interpreted to be a dominantly basalt rich component of the Crimson Creek Formation and correlates well with the interpreted geology.

Zone 7 - This area consists of a weakly magnetic signature which extends from the NW, of the tenement boundary in a NE-SW direction, and is interpreted to be derived from a thin sheet of Tertiary basalts overlying Crimson Creek Formation. The zone continues to the end of the tenement where it is bounded by a NW-SE fault. Brown's (1986) geological interpretation infers limited Tertiary Basalt cover and more Crimson Creek Formation, and does not indicate the presence of the NW-SE structure. The magnetic interpretation has distinguished this zone as different from zone 9 due to the Tertiary basalt cover. Both units were mapped as one large zone by Brown (1986).

Zone 8 - This magnetically quiet zone is at the contact of the Oonah Formation. It is similar to a number of areas within the magnetic data but is distinguished as it correlates with a region of low-titanium tholeiitic basalts as indicated in the geological interpretation.

Zone 9 - This covers the western portion of the tenement and consists of a dominantly bland magnetic response. Detail within the unit is evident when viewing sun-angle data. A number of NW-SE units are interpreted at the western edge of the tenement, all of which terminate at the southern point by a NE-SW trending feature. It is possible that these features are either basalt flows within the Crimson Creek Formation, or that they are dykes.

There is also a small portion of this zone located between zones 7 and 6b. Geological mapping interprets the two regions to be Crimson Creek Formation.

Note

Zone 10 - A small fault bounded area of the magnetic data at the southern end of the tenement characterises this zone. Located within it is a complex magnetic high, which correlates with mapped gabbro units. There are also two linear anomalies located to the south of the licence. The remainder of the area may be related to Crimson Creek Formation.

Zone 11 - A complexly folded magnetic unit is also evident at the south end of the tenement, which correlates moderately with the position of a high magnesium andesite. The geological interpretation indicates a long continuous zone of the andesite, however, this boundary is not evident in the magnetic data. The complex magnetic response may be defining a more magnetic unit within the larger geologically mapped body. Alternatively, the andesite unit may not be continuous as inferred by Brown (1986). It should also be recognised that the signature is similar to data to the south, which is defined as basaltic flows within the Crimson Creek Formation. A thin skin of the andestic unit is therefore possible, with the magnetic signature relating to the presence of underlying Crimson Creek basalt.

Zone 12 - This consists of moderate to poorly magnetic units in the remainder of the licence and correlates to interpreted positions of the Crimson Creek Formation.

6.5 Structural Framework

The structure of the area consists of a number of NE-SW and NW-SE faults and lithological contacts. In some areas there is apparent displacements with both dextral and sinistral movement indicated. There is also evidence of N-S and E-W faults within the Tertiary basalts. The area contains regions of intense folding, however, most of these features lie to the south-west of the EL.

The highly magnetic units of zones 2 and 3 may indicate a fold, with the west limb sheared off and displaced. The data does not indicate any major structure that would produce such an affect.

6.6 Ground Magnetic Survey

Two ground magnetic traverses were carried out in March 1996, one along Butlers Road, the other along Betts Track. Both surveys used the GSM-19F fast sampling magnetometer for data collection, with samples taken every second. Base station data was collected using the Scintrex OMNI-IV magnetometer, sampling every ten seconds, to correct for diurnal variation. A topo-counter was used to create control stations, spaced fifty metres apart. The control stations were used to convert time into distance.

A single profile has been created for each traverse and compared with geological mapping.

6.6.1 *Butlers Road*

The traverse along Butlers Road was 3.5 km long. Data dominantly consists of numerous high frequency responses, as well as two lower frequency responses (Figure 8). The low frequency data is interpreted to be a response of the Meredith Granite. High frequency responses are associated with the Crimson Creek Formation, however, it is unclear which high frequency responses are primary and which are secondary due to hornfelsing from the granite. As there is no pattern to the high frequency data, it may be difficult to correlate with lithology.

The most prominent low frequency response is observed in the middle of Butlers Road between 1400 and 2700m. This is interpreted to be the response from the Meredith Granite. It contains within it some minor high frequency responses that are possibly related to variations in the surface of the granite (depth of burial), or due to alteration effects on top of the granite. A magnetic low at 2050m may be structurally related, possibly a fault cutting through the top of the granite.

The second low frequency response is at the end of the line (3100 to 3500m). This response is also interpreted to be related to the Meredith Granite.

Two contacts between the granite and hornfels were observed along the road, the first at around 2325m. This contact contrasts to the geophysical contact at 1400m. A thin veneer of cover overlying the granite that has undergone hornfelsing easily explains the mis-match in contact location.

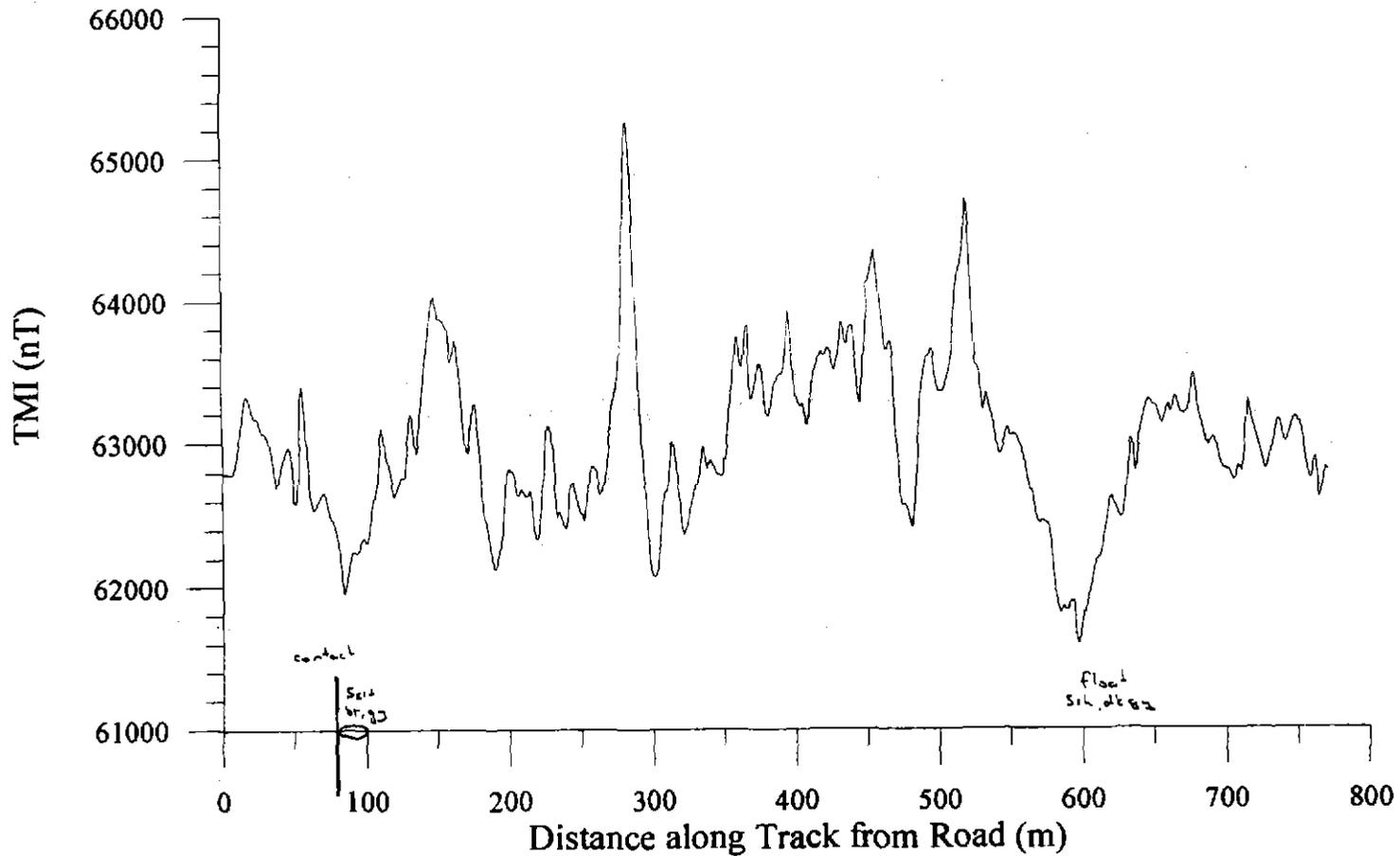
The second contact is located at 2850m and lies between the two interpreted contacts in the magnetics. This area is dominated by high frequency responses associated with hornfels. It is interpreted that a thin veneer of hornfelsed sediments overlies the granite

at this point.

Granite float observed around 3300m supports the interpretation that the last magnetic province is granite-related.

6.6.2 *Betts Track*

Betts Track covers both the Waratah tenement and Luina EL 17/93. A total of 0.77 km of the survey is located within the Waratah EL. Data along this section of Betts Track (Figure 9) is characterised by a magnetic response similar to that observed in the first 1150m of Butlers Road. This is believed to be related to the Crimson Creek sediments and mafic lavas, however, it is unknown if it is also related to the hornfelsing event observed along Butlers Road. Because outcrop is limited along this traverse geology has also been mapped by float. Lithologies observed include sedimentary units of siltstone and shales which are probably part of the Crimson Creek Formation. The high frequency magnetic responses observed indicates that sources of the anomalies are shallow.



 PASMICO EXPLORATION <small>A Division of Pasmico Australia Limited</small>		
COMPILED : P.W.B.	E.L 48/94 - WARATAH BETTS TRACK GROUND MAGNETIC PROFILE	
DATE : April 1996		
DRAWN :		
REVISIONS :		
FILE :		
DRAWING No.	SCALE	FIG. No. 9

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7 ENVIRONMENTAL DISTURBANCE AND REHABILITATION

Reconstruction of Betts Track, south of Waratah Road, was undertaken during the 1994-1995 period to provide vehicle access into more remote parts of EL 17/93 to the south. The first 770m of the track lies within EL 48/94 which then continues into Luina EL 17/93.

Other field visits within EL 48/94 have been restricted to traverses on foot and the use of existing road tracks. No environmental disturbance was associated with this activity and no rehabilitation was required.

8 EXPENDITURE

Expenditure for the 1995-96 year outlined below is \$91 760.

Personnel & Oncosts	23 551
Travel & Accommodation	2 001
Geochemical Consultants/Assays	501
Drilling (including access & core processing/storage)	15 262
Geophysical Surveys/Consultants	31 254
Other contractors	1 761
Stores & Supplies	1 411
Vehicles & Equipment	799
Computing	1 712
Tenement/Land Costs	1 619
Office Running Costs	3 547
Management Fee	8 342
TOTAL EXPENDITURE	91 760

9 CONCLUSIONS AND RECOMMENDATIONS

Exploration over the 1995-1996 year in Waratah EL 48/94 has helped to define regional structures and lithological signatures in the area. The aeromagnetic data indicates twelve separate magnetic regions, some of which correlate with geology as interpreted by Brown (1986). The area appears to become more structurally complex in the SW of the tenement, with abundant NW-SE and NE-SW structures. Several isolated magnetic anomalies have been identified, plus one major magnetic low.

Continued exploration of Waratah EL 48/94 is recommended. Activity in the following year should include:

- Follow up of the aeromagnetic survey, initially with ground investigation of spot highs and the large magnetic low at 378870mE, 5415250mN.
- Regional geological mapping and rock chip sampling. Mapping of lithologies along regional lines is required to generate a better understanding between magnetic signatures and outcropping rock units.
- Regional scale stream sediment geochemistry survey.
- Follow up of DDH BR1 along Butlers Road and proximal magnetic high.

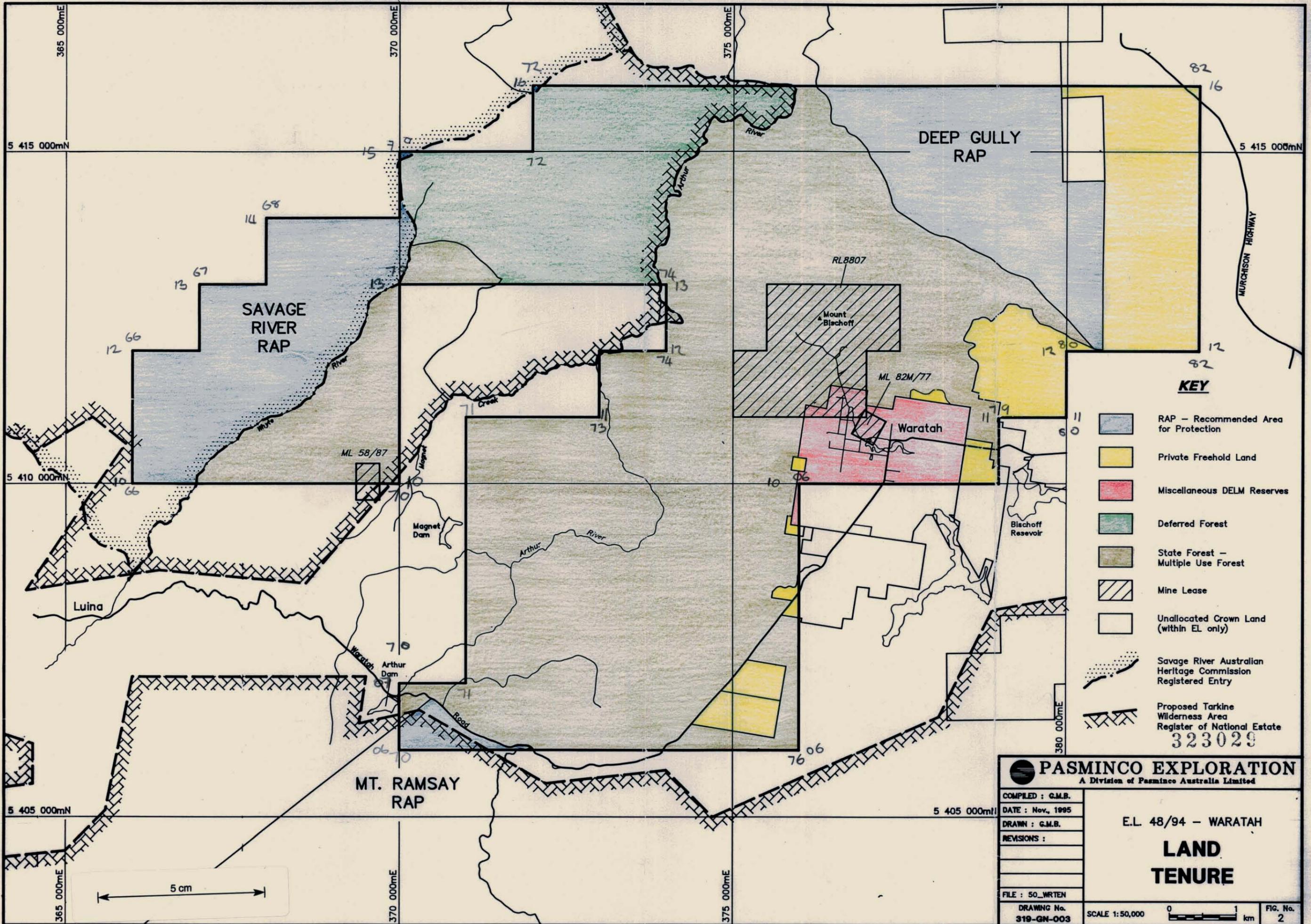
10 REFERENCES

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KEYWORDS AND LOCALITY

BASIC VOLCANICS, BRECCIA, GRANITE, CARBONATE, BASE METALS, TIN, GOLD, REPLACEMENT, STOCKWORKS, VEINS, PRECAMBRIAN, CAMBRIAN, DEVONIAN, ORDOVICIAN, TERTIARY, DATA REVIEW, GEOLOGY, GEOCHEMISTRY, GEOPHYSICS, AEROMAGNETICS, GROUND MAGNETICS

BURNIE SK5503, WARATAH, RUSSELL, DUNDAS



KEY

- RAP - Recommended Area for Protection
- Private Freehold Land
- Miscellaneous DELM Reserves
- Deferred Forest
- State Forest - Multiple Use Forest
- Mine Lease
- Unallocated Crown Land (within EL only)
- Savage River Australian Heritage Commission Registered Entry
- Proposed Tarkine Wilderness Area Register of National Estate

323029

PASMINCO EXPLORATION
A Division of Pasminco Australia Limited

COMPILED : G.M.B.	E.L. 48/94 - WARATAH
DATE : Nov., 1995	LAND TENURE
DRAWN : G.M.B.	SCALE 1:50,000
REVISIONS :	0 1 km
FILE : 50_WRTEN	FIG. No. 2
DRAWING No. 319-GN-003	

NORTH WEST TASMANIA - MAGNETICS
 Waratah EL 48/94 Area
 1:25000

Waratah EL 48/94 (Oct 96)

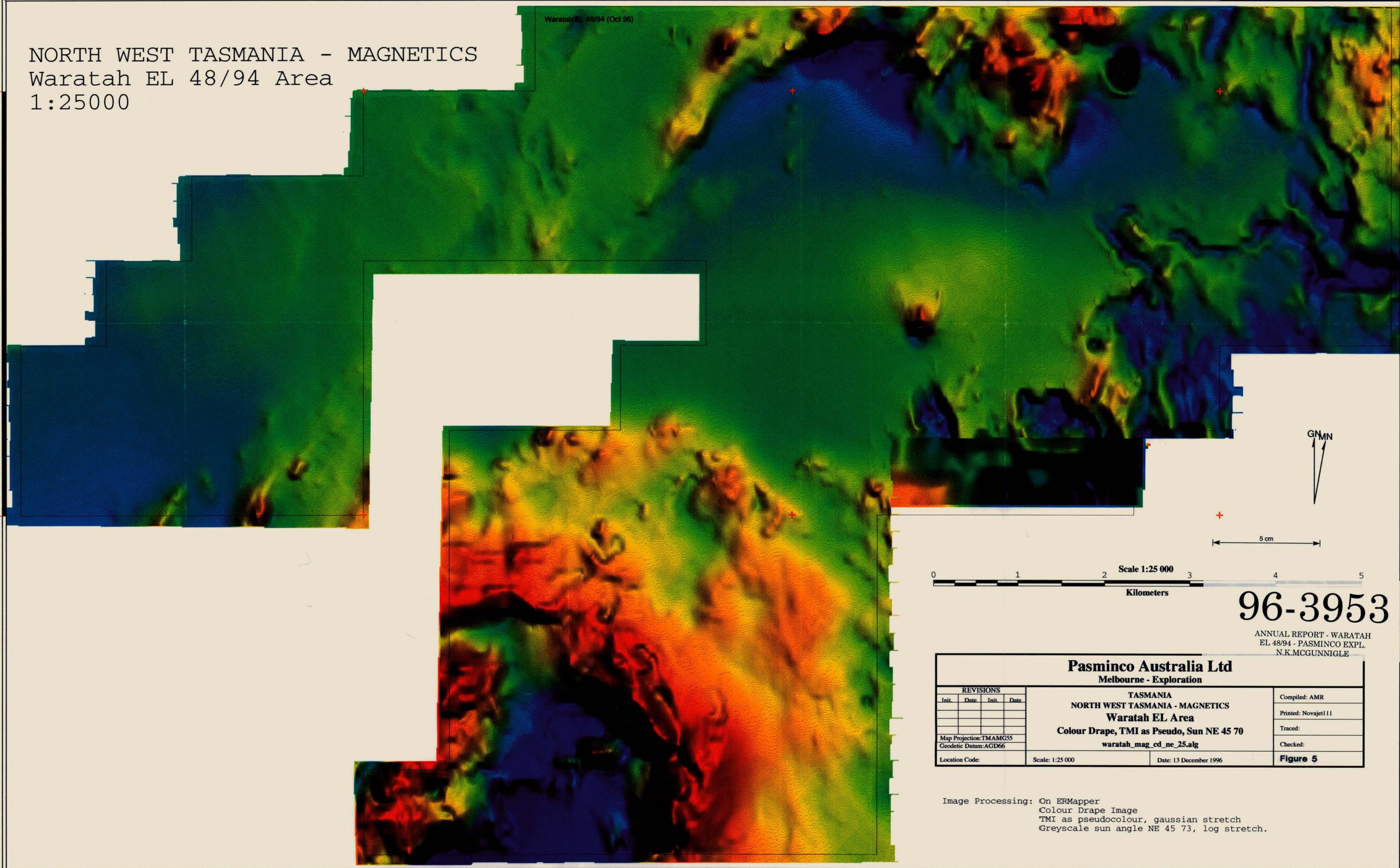
5415000N

5410000N

370000E

375000E

380000E

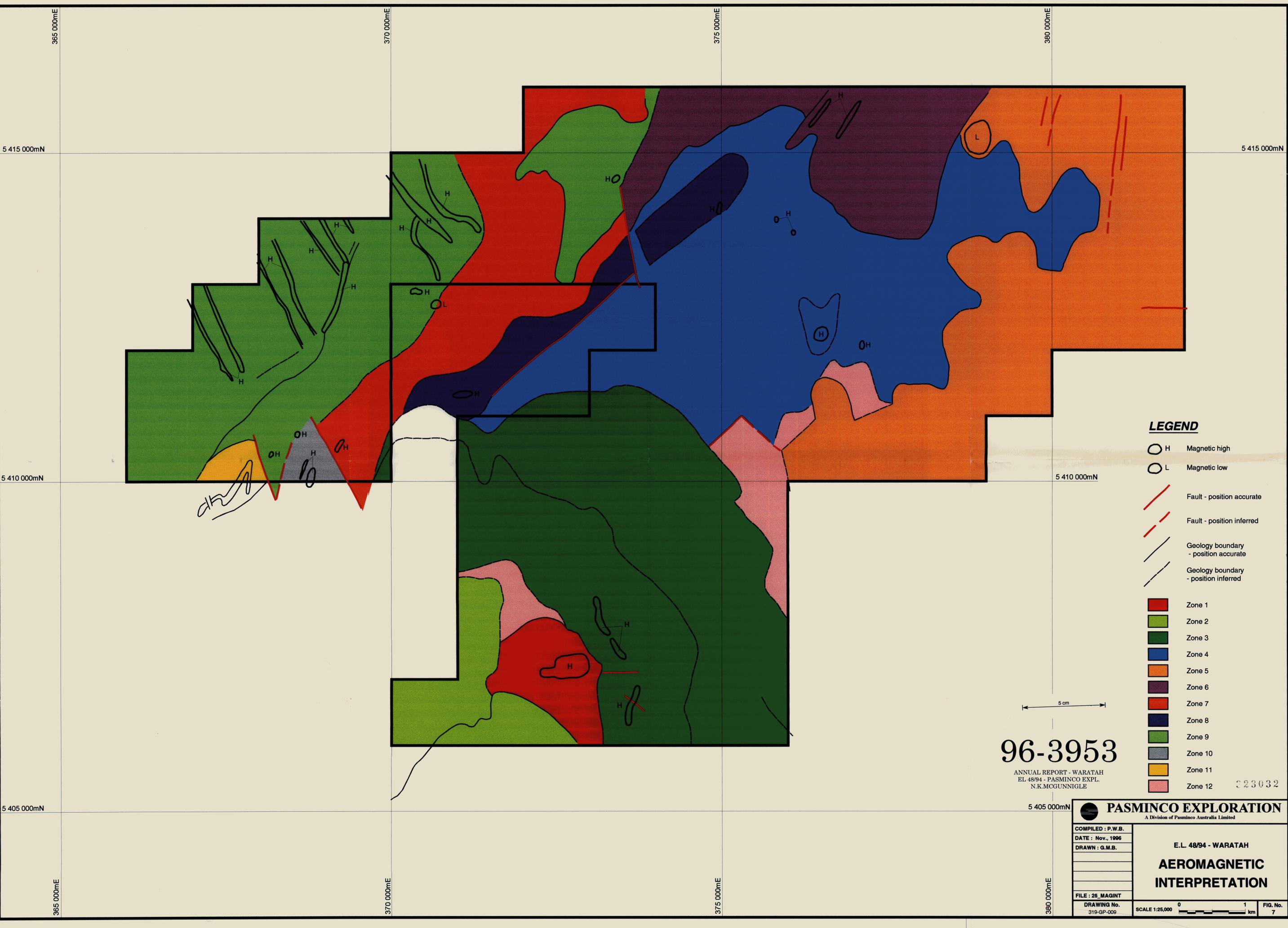


96-3953

ANNUAL REPORT - WARATAH
 EL 48/94 - PASMINGO EXPL.
 N.K.MCGUNNIGLE

Pasminco Australia Ltd Melbourne - Exploration			
TASMANIA NORTH WEST TASMANIA - MAGNETICS Waratah EL Area Colour Drape, TMI as Pseudo, Sun NE 45 70 waratah_mag_cd_ne_25.alg		Compiled: AMR Printed: Novajet111 Traced: Checked: Figure 5	
Map Projection: TMAMG55 Geodetic Datum: AGD66		Location Code:	Date: 13 December 1996
REVISIONS		Scale: 1:25 000	
Init.	Date	Init.	Date

Image Processing: On ERMapper
 Colour Drape Image
 TMI as pseudocolour, gaussian stretch
 Greyscale sun angle NE 45 73, log stretch.



LEGEND

- H Magnetic high
- L Magnetic low
- Fault - position accurate
- - - Fault - position inferred
- Geology boundary - position accurate
- - - Geology boundary - position inferred
- Zone 1
- Zone 2
- Zone 3
- Zone 4
- Zone 5
- Zone 6
- Zone 7
- Zone 8
- Zone 9
- Zone 10
- Zone 11
- Zone 12

96-3953

ANNUAL REPORT - WARATAH
 EL 48/94 - PASMINGO EXPL.
 N.K.MCGUNNIGLE

5 cm

323032

PASMINGO EXPLORATION
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COMPILED : P.W.B.
 DATE : Nov., 1996
 DRAWN : G.M.B.
 FILE : 25_MAGINT
 DRAWING No. 319-GP-009

E.L. 48/94 - WARATAH
AEROMAGNETIC INTERPRETATION

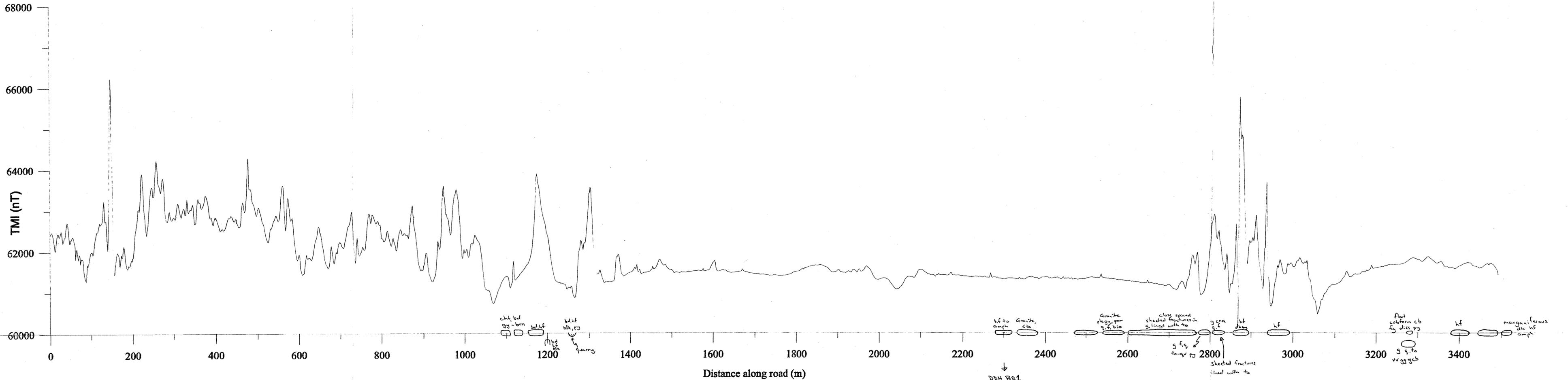
SCALE 1:25,000 FIG. No. 7

365 000mE
 5 415 000mN
 5 410 000mN
 5 405 000mN
 365 000mE

370 000mE
 370 000mE
 370 000mE

375 000mE
 375 000mE
 375 000mE

380 000mE
 380 000mE
 380 000mE



323033

PASMINCO EXPLORATION <small>A Division of Pasminco Australia Limited</small>		
COMPILED: P.W.B.	E.L. 48/94 - WARATAH BUTLERS ROAD GROUND MAGNETIC PROFILE	
DATE: April 1996		
DRAWN:		
REVISIONS:		
FILE:		
DRAWING No.	SCALE	FIG. No. 8

APPENDIX 1

**Waratah Project Area
Regional Geology**

Regional Geology - Waratah Project Area
EL's 17/93, 48/94, 49/94

Introduction

Regional mapping in the Waratah-Luina area has been carried out on a regular basis since management of the EL's commenced in the last quarter of 1995. Mapping has extended outwards from the Arthur Dam area, with the best outcrop exposed in road cuttings, creeks and quarry workings. Geology has been recorded on the Waratah 1: 5000 Sheets (W1 and W2, A-D), with the intention of producing a Pasminco 1: 25 000 Geology map for the area.

Current published maps for the area include Brown (1986), which I believe should be treated as a guideline for the broad geological features only as it appears to be mapped from minimal outcrop and groundwork. A 1: 25 000 colour interpretation of the Government Geology Map has been compiled as a temporary map for the office (note the polygonal contacts!) and is available on MapInfo in d:\mapdata\projects\waratah as wgeol.tab (wgeolcol.tab is in the early days of being colour coded in MapInfo).

Described below are the main geological formations and structures which I have observed from field mapping. During the mapping period, a range of representative samples of lithologies and alteration has been collected for whole rock, thin section and XRD analyses. A description of sample specimens, location, number, and analysis is included as Appendix 1.

Lithologies

Not all lithological units over the project area have been mapped to date. Those covered have been mapped by description, and include the following groups:

- Basalt lava and volcanics (Crimson Creek Formation)
- Pyroxenite and mafic volcanic (and Betts basin volcanoclastic) sequences
- Serpentinite
- Ultramafic intrusions
- Granite

Basalt volcanics

The basalts in the area, mapped as Crimson Creek Formation by Brown (1986) are defined as a succession of rocks dominated by compacted mudstone with volcanoclastic and lava horizons. Turbiditic sequences of volcanoclastic lithicwackes and laminated siltstone and mudstone are interbedded with [tholeiitic (Brown, 1986)] basalt. Bedded siltstone-shale appears to be fairly uniform in composition, and ranges from black, dark red to crimson, to grey-fawn in colour. In places, eg. Magnet Road, siltstone is

interbedded with a pale brown to yellow, medium to coarse grained micaceous sandstone (78012), which also contains feldspar, quartz and ilmenite. Soil above the sandstone is characterised by a yellow brown colour and slightly granular texture, contrasting to reddish brown soils above the finer grained units.

Variations of the fine grained siltstone-shale beds is most likely to be related to the relative proportion of mafic detritus in its composition in a particular area. For example, the grey-fawn siltstone-chert exposed in the quarry along Magnet Road (5409650mN, 369150mE) contains relatively little mafic component compared to the black and dark-red mudstones observed further to the east, and south eg. Arthur Dam. Hornfels is observed in sediments located close to the granite contact, eg Butlers Road, as a black, dense, sometimes pyritic outcrop with varying magnetic response. Interpretation of ground magnetic data along Butlers Road suggests that the occurrence of high frequency shallow sources may be granite related alteration effects (Basford, 1996). Hornfelsing rapidly decreases away from the granite contact to black shale.

Crimson Creek volcanoclastic beds exposed in the Magnet area and to the east of Arthur Dam have a dominant NE-SW strike, dipping to the west. In the gully west of Arthur Dam, approx. 5407200mN, 367800mE (accessed by HEC tracks and Cleveland tramway), steep west dipping beds (roughly N-S striking) are observed proximal to steep east dipping beds, inferring a tight fold axis in the area. Beds further to the west are again dipping to the west, which suggests anticline-synclinal development in local area.

Basalt lava

Lava horizons, interspersed with the Crimson Creek sediments are common in the area. The lavas are dark grey to black, aphyric and feldspar phyric, and include pillow lavas and sills. In outcrop, fine feldspar laths are observed (up to 0.5mm) in the groundmass, which is commonly manganese altered on weathering. Aphyric basalt exposed on the Cleveland Tram Road may be basalt sills associated with the sequence. Textures associated with pillow lavas were observed in an area dominated by basalt west of Arthur Dam (5407200mN, 366600mE), which is easily accessed via the Cleveland Tram Road. Infilling of amygdales or vesicles is also apparent. On the Magnet Road (5409075mN, 369090mE) emplacement of basalt in siltstone-sandstone sediments is observed. Hyaloclastite ± peperitic margins are observed on the margins of the pillow sequence on Magnet Road.

What is interpreted to be altered basalt is exposed in a creek bed accessed by the HEC line west of Arthur Dam (5407020mN, 368320mE). It is altered to green and red in colour, with increased green alteration on the weathered surfaces, and contains large irregularly shaped vugs (up to 15mm) which have been filled with carbonate (Hand specimen 78016).

Intermediate to mafic volcanics - pyroxenite and basalt lava sequences

Mixed intermediate to mafic volcanics dominate an area to the west of Arthur Dam. These are referred to as high-magnesian andesites and low-titanium tholeiite basalts by Brown (1986). They are so far the only known sequences of their type in Tasmania,

↑
not so: eg. high Mg andesite at Stirling / Zeehan
low Ti tholeiite at Black Hill / Denlos

derived within the Dundas Trough. The volcanics range in texture, most commonly as interstratified volcanoclastics, lava and lava breccia believed to be mostly subaqueously emplaced. A wide variety of interesting textures are exposed in the basin accessible by Betts track, including interbedded pumiceous breccia, agglomerate and tuffaceous sediments.

Lava and lava breccia outcrops range from vesicular, fine to coarse grained porphyritic to basaltic pyroxenite. Examples of these are exposed along the track and drill pad site of DDH AD2, intercalated with volcanoclastic sandstone and siltstone. Outcrop is green to grey-brown in colour, slightly to highly chloritic with goethite weathered surfaces. Andesite is feldspar-pyroxene phyric, with pyroxene phenocrysts up to 8mm in size (and up to 20% abundance), and commonly contain amygdalites infilled with carbonate and/or silica. Spillitic basalt is characterised by classic spherulitic-spray spillite textures, and fine grained feldspar \pm pyroxene. Aphyric mafic volcanics, eg. hangingwall to alteration zone along Magnet Road (5417300mN, 372000mE; Sample 78013) are dark green, chloritic and slightly silicic. A sample from this location has been taken for petrographic examination.

This distinguishable volcanic package has been collared at each of the 3 diamond holes drilled in the Arthur Dam area. The core shows the complexity of the intercalated sequences, incorporating a range of rapidly changing textures over 10's of metres of depth (to 220m in AD2). The abundance of lava breccia, hyaloclastite and interpreted peperite intercalated with bedded sediments suggests emplacement in a subaqueous environment. Alteration of the sequence varies from slightly to highly chloritic, with minor to moderate sericite in places, and minor to moderate carbonate alteration. Carbonate most commonly occurs in veinlets and matrix replacement in volcanoclastic and hyaloclastite beds.

Local NNE striking cleavage increases within this sequence, particularly around the Arthur Dam grid and Magnet alteration zones. A strong fabric is observed in the most highly altered areas, with carbonate veinlets and replacement having developed parallel to the fabric. At Arthur Dam, cleavage development exposed in two costeans coincides with anomalous Pb, Zn, As, Au and Ag rock chip geochemistry. This will be discussed in more detail in a subsequent report

Betts basin volcanics and volcanoclastics

Approximately 5km along Betts track, a variety of volcanoclastic and conglomeritic textures are observed in boulder outcrops. Textures which are well exposed on weathered surfaces are obliterated internally by alteration overprint when broken. The preliminary selection of samples for thin section examination will assist in the determination of these internal textures, and with the detailed mapping which is required in the area.

A matrix supported conglomerate boulder is located slightly to the north of Betts Track (5403765mN, 367090mE). The conglomerate is poorly sorted, containing clasts from 2-4mm to 150mm, composed of pyroxene-feldspar phyric, chloritic lava and volcanoclastics, and red-brown sandstone. Clasts vary from coarse grained gravel to rounded pebbles. Fabric is dipping steeply to the north, striking 090° (AMG).

A variety of textures located in the basin include bedded agglomerate, ranging from fine grained tuffaceous through to coarse sandstone matrix, with small gravel sized clasts (2-5mm, up to 10mm)(5403350mN, 367180mE). Weathering of the clasts is vesicular with an inferred fibrous nature in places, within an apparent glass shard like matrix. Tubular clasts show a different fabric orientation to the local foliation which strikes 107° (AMG). The outcrop is interpreted to be comprised of pumiceous and tuffaceous beds, either airfall and/or re-sedimented pyroclastic sandstone-lapillistone.

At 5403360mN, 367040mE (78009), large pumice clasts are exposed in agglomeritic (mass flow?) boulder outcrops, proximal to bedded volcanoclastics similar to the beds described above. Weathering exposes the relict shapes of eroded feldspar and pyroxene crystals within the pumice clasts, which also appear to be vesicular, and slightly tubular. Pumice clasts are up to 80mm in size, averaging 5-8mm and comprise 5-10% abundance within a green-grey chloritically altered matrix.

The pyroclastic genesis of the basin agglomerates and bedded volcanoclastics is so far unique to the Waratah project area. The mineralogy of pumice clasts in the units is an essential link to petrogenesis, and until detailed geochemistry is carried out, the relict shape of eroded pyroxene and feldspar crystals in the weathered surface of outcrops infers an intermediate mineralogical composition (ie. andesite to dacite). The sequences, comprised of possible mass flow breccias and tuffs, or re-sedimented pyroclastic mass flow and tuff deposits, may be unrelated to the formations previously identified and analysed in the region. It is possible that they may be related to the high magnesian andesites in the area.

Serpentinite

A serpentinised NNE striking wedge of ultramafic rock outcrops to the east of the mafic volcanic units, clearly exposed approximately 1.5km down Betts' track (eg. 5406540mN, 369135mE). The serpentinite is highly weathered to blue-green coloured (expanding) clays where broken. Where fresher, it is observed as a complex of dark to light grey and green-black swirly, fragmented, fractured and sheared mafic unit. In places an apparent clastic texture is created by the presence of fragments within a grey, fine-grained, vein-like netted matrix. It is clearly seen in DDH AD1 which intersected serpentinite from 95.0 - 155.0m.

The northern contact of the serpentinite with mafic volcanoclastics is exposed on Betts track (5405620mN, 369250mE). It is highly altered and deformed, with quartz-carbonate veins parallel to the shear fabric, bleaching and hematite alteration overprinting the original lithology (Sample 36803). The southern contact clearly exposed at the surface of Betts track (540500mN, 369070mE) has a sharp (?faulted) contact with adjacent mafic volcanics, striking 037° (AMG). The serpentinite is interpreted to have been tectonically emplaced.

The serpentinite is highly magnetic, and is distinctive in both the ground and aeromagnetic data sets. Six 'C' horizon soil samples were taken over the serpentinite body, located by the ground magnetic response, in an attempt to define the background geochemistry for future surveys (Sample No's: 36832 - 36838).

Granite

The Meredith Granite is a creamy buff coloured, medium to coarse grained equigranular to porphyritic biotite granite (78006). Biotite phenocrysts are up to 5mm in size, but are predominantly fine grained (<1mm) in the groundmass. Feldspar phenocrysts are present up to 25mm long. The granite is increasingly porphyritic and finer grained towards the margins where late stage quartz tourmaline veins are observed, often lining sheeted fractures, with tourmaline up to 40mm eg. Butlers Road (5407350mN, 372090mE), and South Bishoff track (5405385mN, 372070mE). Zones of greisenisation are also common along the margins of the granite.

The Meredith granite has a low frequency gravity response, observed in aeromagnetic data and a ground magnetic survey conducted along Butlers Road (Basford, 1996). Interpretation of the ground magnetic data suggests that low frequency responses over areas marginal to the granite which are mapped as hornfels, are most likely to be related to the granite which is now covered on the surface by a thin veneer of hornfels.

Ultramafic rocks

Ultramafics have been mapped in the area by Brown (1986), and an intrusive sequence is located 700m west of Waratah Road, exposed along the AD2/HEC access track (5407200mN, 368800mE). The unit is dark green to black in colour, and is moderately to highly chloritised, particularly along grooved (?slicenslide) textures on fractured surfaces (78014). It is possible that the ultramafic in this location has been tectonically (or at least partially) emplaced.

Ambiguous lithologies

Proximal to the Meredith Granite contact in the creek draining from Betts basin, some unusual lithologies were observed. Located between the granite (78006; 5402860mN, 367345mE) and volcanoclastic sandstone (78008: 5402980mN, 367400mE), some complex flowbanded ± bedded units were observed. The flowbanded unit is pale grey, bleached and apparently massive in outcrop, and may be a lava associated with the pyroclastic-volcanoclastics observed in the basin or perhaps is extrusively related to the granite. Additional observations of flowbanding/bedding were also observed in this area, proximal to the granite contact. As these lithologies are in the area of anomalous stream sediment geochemistry, it is recommended that they are followed up with more detailed mapping and sampling.

Alteration

Alteration types in the Waratah area are related to lithology (ie. chemistry). The andesite and pyroxenite volcanics are characteristically moderately to highly chloritic. With increasing foliation, carbonate veinlets parallel the fabric, which are replaced with goethite where exposed at surface. Manganese alteration is also common in the area, with black manganese present on weathered surface planes and fractures.

Alteration associated with mineralisation is complex, but is characterised as vein-style

quartz-carbonate, with chlorite, sericite and occasional trace of hematite. Carbonate is again replaced by goethite on weathering, producing gossanous outcrop eg, Magnet Road (Sample 36802) and the Magnet Gossan (75514).

A representative range of samples have been collected for XRD analysis to assist with correlative thin section mineralogy and a more thorough understanding of alteration types in the area. Sample type and location are listed in Appendix 1.

Known Mineralisation

Historically, the Waratah area is well known for its large replacement-style Sn deposits (Cleveland, Mt Biscoff). The largest basemetal orebody discovered and mined to date is Magnet, from which approximately 630 00t @ 6% Pb, 7% Zn and 394g/t Ag were extracted. The orebody is described as occupying a steep WNW dipping fracture system within an early Cambrian mafic/ultramafic body known as the "magnet dyke", close to its discordant footwall contact with early Cambrian sedimentary rocks (Cottle, 1953). One possible interpretation of this geology is tectonic movement of the andesite-pyroxenite units, which have consequently been sheared, and thrust against earlier sediments.

There are numerous small base metal prospect sites in the the area, which according to Nye (1923) are small vein style galena dominated accumulations that were worked to a shallow depth only. A few of these have been investigated eg. Campbells Galena Prospect (75513; 5406830mN, 371555mE), a small costean at 5410190mN, 369870mE, (36801, 36802), old tin shows and workings along South Bischoff Road and Wombat Creek track, and several adits located on the hillside west of Magnet Creek (south of Magnet Mine) which proved inaccessible.

Anomalous soil geochemistry over the Arthur Dam Grid identified by the Mines Department (Collins, 1983) has been followed up with further soil geochemistry to confirm a NNE striking anomalous Pb-Zn zone (McGunnigle, *in prep*). Two costeans excavated over the grid were rock chip sampled, revealing anomalous Pb, Zn, As, Au and Ag values in goethitic horizons in cleaved mafic volcanics. Goethite commonly replaces carbonate along cleavage planes and in veins. Quartz appears to fill vugs in carbonate veins, and surface outcrops to coincide with the best Au assays (0.6g/t over 4m). It is believed that the anomalous metal values are associated with mineralisation in quartz-carbonate veins, similar to stockwork veins and massive sulphide mineralisation observed at 100-123m in DDH AD2 (McGunnigle, 1996). It is possible that mineralisation intersected in AD1 (minor) and AD2 is part of a stockwork of veins in the region.

Conclusions and recommendations

Six main lithological groups (and associated facies) have been identified in the area. Representative samples selected for thin sectioning require petrological descriptions, which should assist with determining the characteristics of these groups. Continued field mapping and follow up of the more ambiguous lithologies eg. Betts basin volcanics is required. A small study of the litho geochemistry of representative samples will be beneficial to determine geochemical characteristics of identified lithologies and

determine any association or distinctions between groups. The use of XRD analyses, thin and polished sections are recommended to determine alteration and mineralisation characteristics in the area, particularly in the Magnet and Arthur Dam areas. Also recommended with regional mapping is the follow up of known small prospects in the area and rock chip sampling.

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Appendix 1

Samples collected in the Waratah Project area

Sample No.	AMG N	AMG E	Lithology	Alteration	Reason collected
38501	5407710	369000	Vsst	Q, Mn, py	ass
38801	5410190	369870	Lb, f	Gos, sil, gn	ass
38802	5410190	369870	Lb, f	Gos, sil, gn	ass
38803	5405620	369250	Ms, v	Chl, sil, q-cb-hmass	
38804	5410350	370015	Lb,	Chl, cb v	ass
38805	5407420	372700	G, f, bio	Q-to v	ass
36806	5406680	373000	Vb, sst/sh	Chl, Mn,	ass
36807	5407275	369660	Lb	Chl, q, hm	ass
75513	5406830	371555		q-cb-py-gn v	ass
75514	5411800	370610	Magnet Gossan		ass
75515	5411800	370610	Magnet Gossan		ass
75516	5411800	370610	Magnet Gossan		ass
75517	5411800	370610	Magnet Gossan		ass
75518	5411800	370610	Magnet Gossan		ass
78001	5410750	370270	Magnet dump	col cb-gn-sp	TS (min par)
78002	5410750	370270	Magnet dump	col cb-gn-sp	TS (min par)
78004	5510690	370080	Lb	Chl, cb, (sh)	XRD
78005	5410200	369760	Lb,	Chl, cb, q-cb v	TS
78006	5402860	367345	G, f-bio		TS, WR
78007	5404004	367730	L, por	Chl	TS
78008	5402980	367400	Vsst, pum, bd	Chl	TS, WR
78009	5403360	367040	V, msf, pum	Chl	TS, WR
78010	5407150	372970	M, hf	Amph	TS
78011	5410340	369850	Lb, spil,	Chl, Mn, amph	TS, XRD
78012	5410860	370340	Vsst, b, mic		TS, WR
78013	5417300	372000	Lb, aph	Chl, cb	TS
78014	5407200	368800	lu	Chl	TS
78015	5405260	369250	Msp	Sil, hm	hand
78016	5407020	368320	Lb, amy,	Chl, hm, cb	hand
78017	5406770	369998	CC, sst, slt		TS, WR
78018	5406854	369470	V, shd	Mn, chl	XRD

Costmann

Campbell's Bakery

note: = thin section *
 PS = polished section *
 WR = whole rock geochemistry
 XRD = XRD analysis
 ass = assay geochemistry

APPENDIX 2

**Waratah Regional Geology
Rock and Thin Section Descriptions**

78001 Massive galena in carbonate

5410750mN
370270mE
Magnet Mine dump
EL 17/923
polished thin section

Reason Collected To investigate mineralisation and alteration styles at Magnet Mine and to add to regional database.

Hand Specimen Description

Coloform banded carbonate with massive galena in vugs and inter-banding. Goethite on weathered surface.

Thin section description

Intergrown coloform carbonate exhibits composite and cockade growth textures, commonly in bands. Remnant galena and pyrite is interspersed along carbonate banding, where 'sieve textures' parallel to bands are common. Late brown ankerite and/or siderite has consumed sulphides; galena and pyrite are observed on margins and in the cores of this late phase carbonate which has infilled vugs in earlier banded carbonate and sulphides.

78002 Coloform carbonate-quartz and galena

5410750mN
370270mE
Magnet Mine dump
EL 17/93
polished thin section

Reason collected To investigate mineralisation and alteration styles at Magnet Mine and to add to regional database.

Hand Specimen Description

Coloform banded carbonate-quartz with finely inter-banded galena in vugs. Yellow-cream (high Fe carbonate?) alteration also replaces vugs in banding.

Thin Section Description

Coloform banded and cockade intergrown carbonate with minor sulphides including galena, pyrite and sphalerite, with a late phase carbonate. Mineralisation paragenesis appears to be:

galena
pyrite
sphalerite

Late siderite/ankerite fills vugs and veins between banding, replacing and consuming along the margins and fractures of sulphides which are commonly only remnant along margins.

78005 Pyroxene basalt lava

5410200mN
369760mE
Magnet Road
EL 17/93
thin section

Reason Collected Volcanics HW to Magnet Gossan
Add to regional geological database

Hand Specimen Description

Dark green, highly altered, pyroxene-phyric mafic lava. Relict and zoned pyroxene phenocrysts have been replaced by chlorite \pm carbonate, which is also pervasive throughout the groundmass. Quartz and carbonate veinlets cross-cut a minor foliation.

Thin Section Description

This sample is highly altered and is most likely of basaltic lava origin. Anhedral and highly resorbed pyroxene (?augite) is remnant within an intensely quartz-chlorite-epidote \pm carbonate altered matrix. Very fine grained epidote (?) replaces carbonate on the margins and as a whole. The matrix exhibits a mild foliation, with quartz veins developed (\pm carbonate-siderite?) parallel to the foliation. Minor opaques (possibly sulphide?) occur with some quartz veins.

78006 Meredith Granite

5402860mN
367345mE
Betts Basin
EL 17/93
thin section

Reason collected Sample of Meredith Granite for geological database.

Hand Specimen Description

Medium to coarse grained porphyritic granite. Pink feldspars up to 15mm comprise 30% of the rock, and biotite, sized up to 4mm constitutes about 5%. Coarse grained quartz up to 15mm are observed.

Thin Section Description

This sample is a granular textured granite composed primarily of medium to coarse grained quartz and feldspar, with 3-4% biotite. Feldspar includes plagioclase, with twinning observed in some crystals, and potassic feldspar which is commonly grainy in appearance (as a result of alteration). Brown and green biotite are present as variably sized crystals and glomerocrysts.

78707 **Pyroxene Andesite Lava**

5404004mN
367730mE
Betts Track
EL 17/93

Reason Collected To add to regional geological database

Hand Specimen Description

Pale green-grey porphyritic andesite. The grey groundmass has mottled chlorite + carbonate alteration. Relict phenocrysts are dark green, replaced by chlorite, and constitute approximately 3%. Pseudomorph shapes suggest that the phenocrysts were originally pyroxene.

Thin Section Description

This sample shows a relict hyalocrystalline and vesicular groundmass with pseudomorphs of tabular (now sub-euhedral) feldspar laths and pyroxene phenocrysts (now altered to chlorite-actinolite). Pyroxene is replaced by chlorite in whole, or partly with corona textures developing on the margins. Granular chlorite commonly forms the outer margins which are often rimmed by quartz. Prismatic actinolite has grown inwards from the margins and also within the chlorite where it has wholly replaced pyroxene. Vesicles are infilled with chlorite and/or quartz, and a fine quartz-chlorite vein is observed in the section. Minor Fe-Ti oxides are also observed.

possibly clinocristine?
JK

78008 **Silicified Volcanic**

5402980mN
367400mE
Betts basin ridge
EL 17/93

Reason Collected To investigate unidentified geology and alteration types in the Betts basin area.

Hand Specimen Description

Grey to green, highly silicified ?volcaniclastic sandstone. Weathered surface resembles fine to medium grained sandstone, while internal textures are obliterated by pervasive silica alteration. Euhedral ilmenite crystals are observed.

Thin Section Description

The overall mottled texture is dominated by a complex mosaic lattice of very fine intergrown amphibole (?tremolite) needles, with patches of fine grained granular secondary quartz. Some larger (fine to medium grained) subhedral-anhedral and ragged crystals of amphibole are possibly paramorphs or pseudomorphs of original amphibole or pyroxene crystals. This suggests amphibolisation (uralisation) of the sample. Pseudomorphs of what appear to be feldspar crystals are altered and overgrown on the margins by extensive amphibolisation and silica. These may represent original composition of the sample. Long, fine and medium grained needles of amphibole crystals are also observed to be earlier than the widespread very fine grained matrix. Quartz infills fractures in the sample indicating later silicification. 2-3% fine to medium grained sub-euhedral Fe-Ti oxide (?ilmenite) is present.

78009

Pumice Breccia

5403365mN

367180mE

Betts Basin

EL 17/93

thin section

Reason Collected Representative sample of pumiceous outcrop in Betts basin area.

Hand Specimen Description

Grey pumiceous mass flow or resedimented pyroclastic deposit. Pumice clasts highlighted in the weathered surface are vesicular and tubular, with larger clasts containing relict crystal shapes characteristic of feldspar and proxene. The matrix is mostly altered to sericite-chlorite, with clasts commonly altered to chlorite also.

Thin Section Description

Chlorite-sericite altered pumice breccia. Pumice clasts are fibrous and swirly, commonly altered to sericite or chlorite in the matrix, and contain altered and pseudomorphed feldspar and pyroxene crystals. Feldspar has been replaced by silica and fine chlorite \pm actinolite and pyroxene with chlorite-actinolite. Pumice vesicles are infilled with sericite, carbonate \pm silica. The matrix of the breccia is highly sercitic-

chloritic with chlorite-silica replacement of clasts and vesicles. Fine chlorite \pm actinolite is common with granular quartz.

78010 **Boninitic lava**

5407150mN
372970mE
Butlers Road
EL 48/94
thin section

Reason Collected To investigate alteration assemblage
Add to regional geological database

Hand Specimen Description

Dark grey to black boninitic lava. Fine pyroxene laths and phenocrysts (up to 2mm) constitute approximately 10%, with additional amphibole phenocrysts also. The dark grey groundmass appears to be altered to chlorite.

Thin Section Description

Pyroxene phyric subophitic boninite lava. Abundant (20-30%) relict subhedral to euhedral pyroxene (\pm hornblende?) laths altered to chlorite-actinolite are embedded in a groundmass of amphibole. It is not clear whether the amphibole is original or is a product of urialisation. Minor rutile is present also with amphibole. Chlorite has replaced some of the groundmass which was probably originally of high glass composition. Chlorite is also common on the margins of phenocrysts and around pyroxene cumulates.

78011 **Spillitic basalt**

5410340mN
369850mE
Magnet Road
EL 17/93
thin section

Reason Collected To investigate alteration assemblage.
To add to regional geological database.

Hand Specimen Description

This sample of spillitic basalt is weathered brown-black with goethite-manganese on weathering and joint surfaces. Chlorite-manganese has replaced relict phenocrysts (?feldspar) which highlights spillitic sprays. Goethite has also replaced carbonate, after phenocrysts. Medium grained ?amphibole alteration is observed in the groundmass.

Thin Section Description

Highly chloritic and weathered spillite. Relict pyroxene and feldspar phenocrysts up to 1-2mm are set in a mosaic-textured goethitic and chloritic groundmass. The groundmass texture is reminiscent of snowflake texture derived from devitrification of felsic glass. Feldspar laths in the sprays are intermittent with chlorite and goethite. Vesicles are infilled with chlorite and quartz. The overall composition also appears to be vesicular. It is thought to be spillitic (quenched) lava of mafic composition which has undergone extensive chlorite alteration and weathering.

78012**Micaceous Sandstone**

5410860mN

370340mE

Magnet Road

EL 17/93

thin section

Reason Collected To add to regional geological database*Hand Specimen Description*

Pale brown-green micaceous sandstone. Medium grained, slightly chloritic sandstone contains clasts of feldspar, mica and Fe-Ti oxides.

Thin Section Description

This sandstone is comprised of medium to coarse grained crystals in a very fine matrix weathered to brown (Fe-rich clays). Dominant medium grained crystals are subrounded to rounded mica, plagioclase and rounded quartz. Quartz also appears to replace pyroxene, for which pseudomorphs are observed. Amphibolisation of finer pyroxene crystals to tremolite-actinolite is also apparent. Very fine grained chlorite and rutile are observed in the matrix and on the margins of crystals, and rutile in needle-like sprays. Apatite is also observed on plagioclase and relict pyroxene crystals.

78013**Basalt lava**

5407200mN

366375mE

Magnet Road

EL 17/93

thin section

Reason Collected Add to regional geological database*Hand Specimen Description*

Gadhin Ridge's

Dark grey, massive aphyric basalt. Occasional fine grained feldspar are visible in outcrop.

Thin Section Description

Weathered and altered aphyric basalt lava composed of intergrown pyroxene (?augite) and feldspar (?plagioclase) with 2-3% Fe-Ti oxides. Feldspar phenocrysts are sub-euhedral, sericitised around margins and finely sericitised within. Augite occurs ophitic-like between feldspar phenocrysts and is variably altered to actinolite. Fe-Ti oxides are quite large and comprise 2-3%. The groundmass is moderate to highly sericitised with chlorite interstices and very minor rutile.

78017 **Volcanogenic Siltstone**

5406770mN

369998mE

Cleveland Tramway

EL 17/93

thin section

Reason Collected To add to regional geological database

Hand Specimen Description

Fawn-brown coloured siltstone. Fine grained with mafic volcanic provenance including mica and leucoxene.

Thin Section Description

This sample is a volcanogenic siltstone unit which is relatively weathered and altered. Very fine grained siltstone is intercalated with fine grained siltstone of matching composition. Clasts are comprised of predominantly subround to rounded crystals within a matrix highly weathered to Fe-rich clays (including goethite). Subrounded feldspar (?plagioclase) is orientated sub-parallel to bedding. Ragged and subrounded tremolite-actinolite has formed from amphibolisation of pyroxene. Rounded quartz clasts are also present.