



**PASMINCO EXPLORATION**  
**TULLAH EL 22/90**  
**& STERLING RIVER EL 24/91**  
**WESTERN TASMANIA**

**ANNUAL REPORT**  
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Plate 1. OLD FARRELL MINES, TULLAH. LOOKING EAST ACROSS HENTY FAULT

056002



MURCHISON MINE  
BASE METAL DEPOSIT

LAKESIDE GOLD  
DEPOSIT

Plate 2. TULAM FLATS AREA. LOOKING SE ACROSS HENTY FAULT

056003

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## 1. SUMMARY

The coordinated 1991–92 work programme on the contiguous Tullah EL 22/90 and Sterling River EL 24/91, saw the continuing evaluation and collation of the voluminous data from previous exploration. A total of 98 old surface drillholes and 78 underground holes were catalogued, and details of 57 surface holes entered in the Pasmenco computer database.

Examination of records from the old Murchison Mine showed that the recorded production of only 300t of Pb–Ag ore to be highly misleading. Available data indicates the deposit is significantly larger than previously realized, originally containing at least 30,000t of high grade Zn–Pb–Ag–Au ore. An unknown amount of this has been mined as only the Pb–rich sections of the mainly Zn–rich orebody were extracted. Potential exists for extensions to the deposit and drilling is recommended.

A geological study of the Sterling River EL by Canadian consultant Jerry Blackwell identified a sulphidic mudstone horizon on the eastern margin of the Farrell Slates as a possible massive sulphide host. The Murchison Mine deposit lies on this zone. Further exploration of this important horizon is planned, concentrating initially in the Murchison Mine area. Early drilling is recommended for any targets identified within the zone.

Blackwell also highlighted a previously unmapped major mylonite zone on the eastern side of the volcanic belt. Theoretically, this structure may have mineral potential similar to the Henty Fault, although no mineral showings are as yet known along it. Further investigation of the structure is recommended.

A large barite occurrence in the HEC's Anthony Tunnel was examined and surveyed with EM. The barite lies on the contact of the Murchison Granite and Tyndall Group Volcanics, and contains disseminated galena (maximum 2.8% Pb). It is considered to be of Cambrian age (Pb–isotope data supports this), of vein style, and associated with the intrusion of the granite. The barite does not appear to have significant economic potential but studies are continuing.

Apart from the work already mentioned, the recommended 1992–93 exploration programme includes gravity surveys, completion of the aeromagnetic coverage and use of enhanced satellite imagery. The two principal aims of this work being:

1. To detail the structural framework of the EL areas, particularly along the Henty Fault which is the feature regarded as having most influence on the mineral potential.
2. To define the sub-surface topography of the large Cambrian and Devonian granite intrusions, which have also clearly influenced mineral deposition on the EL's.

It is proposed to continue the geological investigation of prospective areas on both EL's, with emphasis on zones around the known mineral deposits, particularly Farrell (the largest). This work includes mapping, core relogging, lithogeochemical sampling and reviews of old data, especially that from previous mining, geophysics and drilling. It is hoped the latter will assist in the production of computer-generated geological sections across and along the Henty Fault Zone.

The 1992-93 programme is intended to enable a major drilling campaign to be mounted on the EL's in 1993-94.

056008



*Plate 3. LOOKING NNE ALONG HENTY FAULT FROM  
VICINITY OF LAKESIDE GOLD DEPOSIT*

056009



*Plate 4. VIEW NE DOWN STERLING VALLEY FROM  
VICINITY OF STERLING VALLEY MINE*

## 2. INTRODUCTION

This report details exploration carried out in the second year of tenure of the 27 sq km Tullah EL 22/90 and the first 9 months of tenure of the contiguous 48 sq km Sterling River EL 24/91.

The licences cover units of the Cambrian Mt Read Volcanics lying along the Henty Fault in Western Tasmania (see Figure 3).

The work programmes on both EL's have been coordinated as they have the same principal objective of finding buried auriferous basemetal deposits associated with the Henty Fault. On the Sterling River EL there may be additional potential similarly associated with a major structure marking the margin of the Tyennan Nucleus east of Mt Murchison.

Much of the Tullah EL has good access and large areas of open space or low scrub. The rugged and inaccessible Farrell Range occupies the eastern 40% of this EL. The Sterling River EL is largely forested, rugged and inaccessible. Access is best in the Sterling Valley along the Henty Fault in the north-central part of the EL, and along the HEC's Anthony Road and their other associated works areas in the eastern part of the EL.

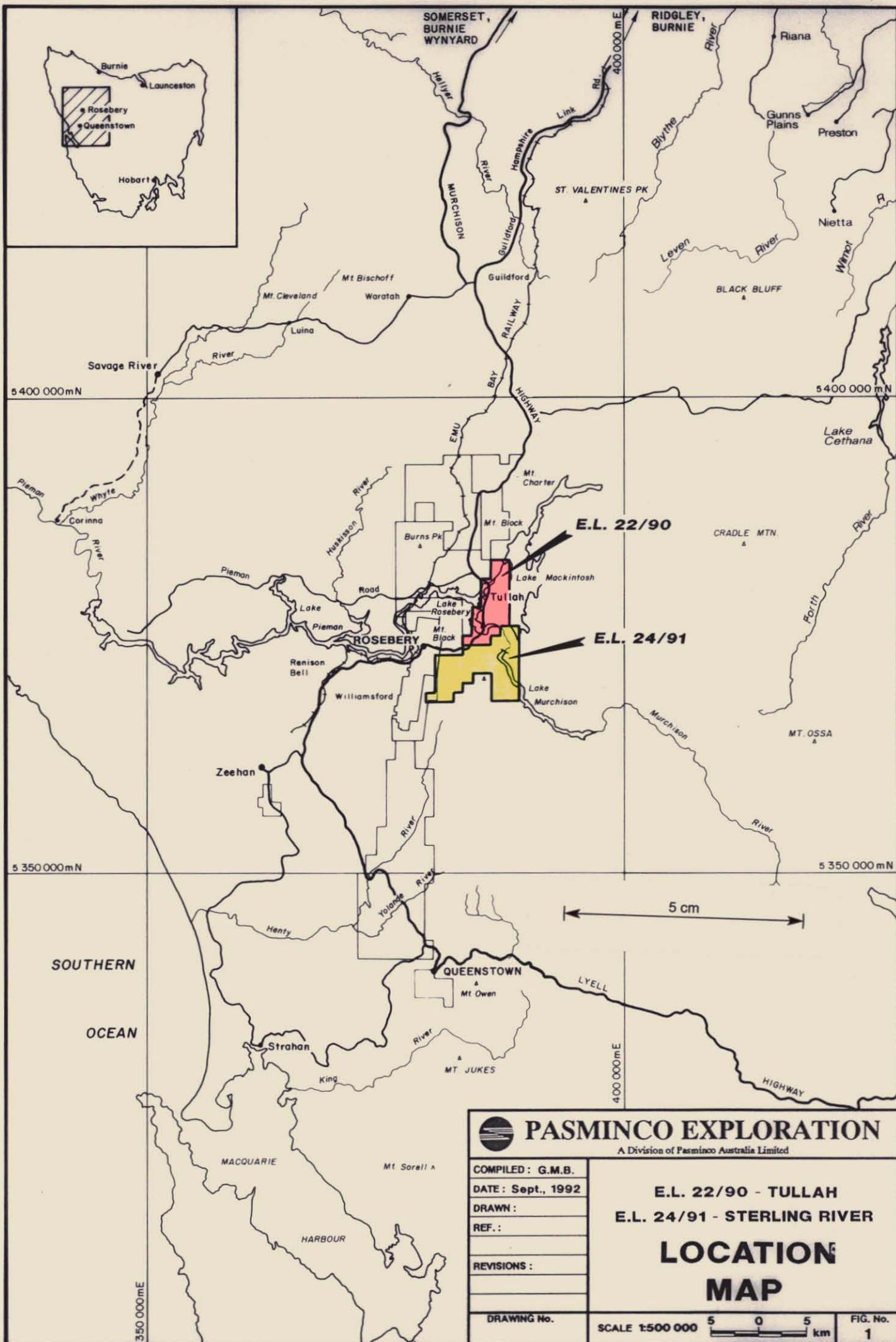
The 1991-92 work programme centred on the continuing evaluation and processing of previous exploration data. The Tullah-Sterling River area is one of the most heavily explored (and prospective) areas of the Mt Read Volcanics, and there is an enormous amount of old data. Attention was particularly directed at collating old drillhole records and information on the old Murchison Mine which is much larger than previously realized.

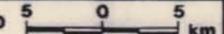
At least 98 identified surface exploration diamond drillholes have been drilled within the EL areas in past years. A further 78 holes were drilled underground in the now defunct New North Mt Farrell Mine. Of these 176 holes, AMG survey details have been calculated for 57 of the surface holes and entered into the Pasmenco Exploration computer database.

A field-based geological study was carried out on the Sterling River EL in January-February 1992 by Canadian consultant geologist Jerry Blackwell. Blackwell, formerly with Cominco, is an expert on volcanogenic massive sulphide deposits. His work included examination of the barite occurrence in the HEC's Anthony Tunnel, mapping traverses across the Mt Read Volcanics near Mt Murchison, and relogging of drillcore from the Sterling Valley. Blackwell's

report appears in Appendix 1.

Other work carried out on the licences in 1991–92 included examination of the Henty Fault in the Tullah area by Eoin Rothery, Pasmenco's structural geologist; geochemical sampling and a trial EM survey across the barite zone in the Anthony Tunnel; and geological study of this occurrence by Honours student Paul Abbott of Tasmania University.



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COMPILED : G.M.B. DATE : Sept., 1992 DRAWN : REF. : REVISIONS :	<b>E.L. 22/90 - TULLAH</b> <b>E.L. 24/91 - STERLING RIVER</b> <b>LOCATION</b> <b>MAP</b>
DRAWING No.	SCALE 1:500 000 
	FIG. No. 1

056012

### 3. TENURE

Tenure details for the Tullah and Sterling River licences are shown in Figure 2.

The Tullah EL 22/90 covers 27 sq km, extending along 10km of the Henty Fault to the NNE and SSW of Tullah Township in Western Tasmania. A total area of 5.15 sq km has been excluded from the EL, including 3.4 sq km of land vested in the HEC and 1.45 sq km of Mine Leases held by Pasminco Mining.

The original Tullah licence application was made in August 1990 by Peko Exploration Limited – a subsidiary of North Broken Hill Limited. In September 1990 Pasminco Australia Limited (of which NBH then owned 45%), came to an agreement with Peko whereby the EL application was transferred to Pasminco. The licence was granted to Pasminco on 20th October 1990.

The Tullah EL comprises:

- 43% Crown Land
- 40% Land vested in the HEC
- 15% South West Conservation Area and Murchison Highway State Reserve
- 2% Private Property

About 5% of the EL area is covered by the Mt Murchison RAP (Recommended Area For Protection).

The Sterling River EL 24/91 covers 48 sq km to the west, north and east of Mt Murchison, extending 7km along the Henty Fault from the southern boundary of the Tullah EL. A total of 6.9 sq km has been excluded from the Sterling River EL, comprising 2.6 sq km of land vested in the HEC, 3.5 sq km of Mine Leases held by Pasminco Mining and 0.8 sq km of State Reserve along the Murchison Highway. These areas are shown on Figure 2.

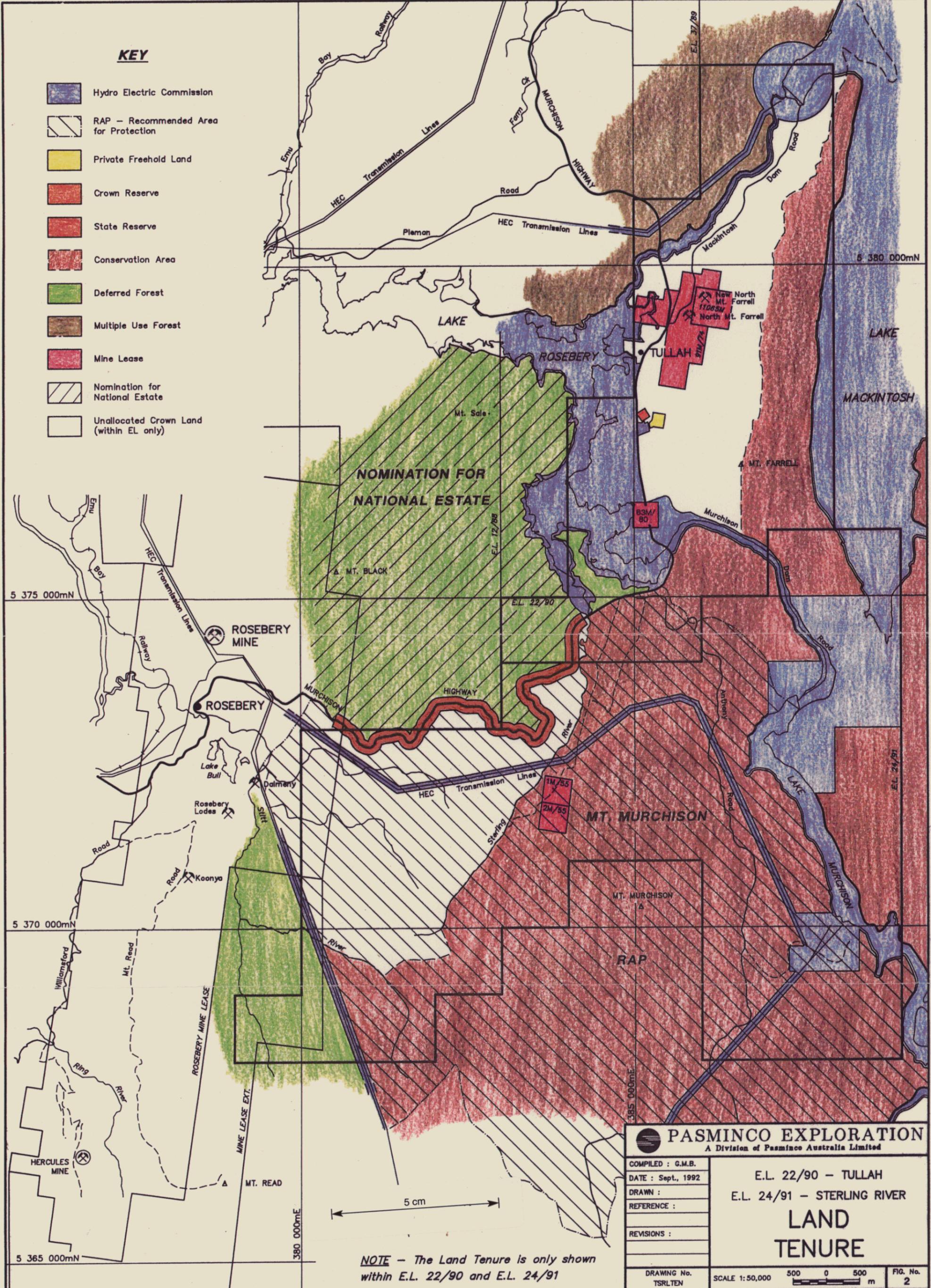
EL 24/91 is 100% owned by Pasminco Exploration. It was originally applied for as 42 sq km in August 1991, but a further 6 sq km to the southeast of Mt Murchison was added to the original application in October 1991. The entire 48 sq km was granted on 10th January 1992.

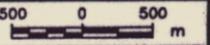
Sterling River largely comprises Crown Land. About 70% of the EL falls within the Southwest Conservation Area and just over 75% is covered by the Mt Murchison RAP.

In May 1992, the Division of Mines approved the rationalisation of the reporting and renewal dates for both the Tullah and Sterling River licences. The annual renewal date for both EL's is now 19th October.

**KEY**

-  Hydro Electric Commission
-  RAP - Recommended Area for Protection
-  Private Freehold Land
-  Crown Reserve
-  State Reserve
-  Conservation Area
-  Deferred Forest
-  Multiple Use Forest
-  Mine Lease
-  Nomination for National Estate
-  Unallocated Crown Land (within EL only)



<b>PASMINCO EXPLORATION</b> A Division of Pasminco Australia Limited	
COMPILED : G.M.B. DATE : Sept., 1992 DRAWN : REFERENCE : REVISIONS :	E.L. 22/90 - TULLAH E.L. 24/91 - STERLING RIVER <b>LAND TENURE</b>
DRAWING No. TSRLTEN	SCALE 1:50,000  FIG. No. 2

**NOTE - The Land Tenure is only shown within E.L. 22/90 and E.L. 24/91**

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#### 4. EXPENDITURE

Expenditure on **Tullah EL 22/90** in the 12 months from 1st September 1991 to 31st August 1992, was **\$47,951**. Total expenditure on the EL since its granting in October 1990 is **\$99,225**.

Expenditure on the **Sterling River EL 24/91** in the eight months from initial granting in January 1992 to 31st August 1992, was **\$38,337**.

Details of the 1991-92 expenditure on both EL's is as follows:

	Tullah EL	Sterling River EL
Personnel	13,637	6,971
Travel & Accommodation	754	1,051
Geological Consultants	8,314	12,131
Geochemical Consultants & Assays	-	1,310
Geophysical Consultants	460	-
Geophysical Surveys	2,471	-
Other Consultants & Contractors	6,002	1,614
Drilling	3,953	998
Stores & Supplies	827	1,263
Vehicles, Plant & Equipment	1,383	1,843
Tenement Rentals	633	1,316
Computing	2,053	1,344
Office Expenses	3,105	5,011
Administration Fee	4,359	3,485
<b>TOTAL</b>	<b>\$47,951</b>	<b>\$38,337</b>

## 5. GENERAL GEOLOGY

The Tullah and Sterling River licences cover units of the highly prospective Cambrian Mt Read Volcanics and associated sediments, extending along a 16km length of the Henty Fault – a major NNE–SSW trending structure located towards the eastern margin of the volcanic belt. See Figures 3 & 4.

Within the EL's the volcanics range from rhyolitic to basaltic in composition but are generally dacitic. They include lavas, intrusives, pyroclastics and volcanomict epiclastics, the latter incorporating a large unit of black shales and bedded sandstones – the Farrell Slates.

In general terms, most of the lavas and subvolcanic intrusives are concentrated in the dacitic to mafic Mt Black Volcanics west of the Henty Fault, while the volcanoclastics and sediments are concentrated in a belt running up the eastern side of the Fault – the Farrell Slates and Tyndall Group. The latter include units of rhyodacitic lava. East of the fault the volcanics are overlain by the Ordovician Owen Conglomerate.

The volcanics are extensively intruded and underlain by granites which cause widespread alteration of the surrounding rocks. The large synvolcanic Murchison Granite outcrops on the eastern part of the Sterling Valley EL and underlies large areas of the adjacent volcanics.

Devonian granite outcrops at Granite Tor immediately NE of the Tullah EL, and a buried NE–SW trending ridge of Devonian granite is known from regional magnetic and gravity data (as well as ample surface geological evidence), to cut across beneath the northern end of the Sterling Valley at an inferred depth of less than 1km (Leaman & Richardson, 1989).

Basemetal, silver, gold, arsenic, tin and barite mineralization is widespread in the Farrell Slates, and to a lesser extent in the Tyndall Group volcanoclastics, along the eastern side of the Henty Fault. The mineralization is of structurally-controlled lode and vein style, commonly almost conformable with the primary layering in the enclosing rocks. Lodes closest to the Henty Fault tend to parallel the steep west dip of this structure (as does sedimentary bedding).

The presence of gold–tin mineralization, as well as evidence from lead and sulphur isotopes,

indicates that the mineralization in the Tullah–Sterling River area is a Cambrian–Devonian hybrid. It appears that the bulk of the mineralization, particularly the basemetals, silver and gold, are of Cambrian volcanogenic origin and were remobilized in the Devonian with inputs at that time of tin, arsenic, further basemetals and silver.

However, gold is a notable absentee from the Pb–Zn–Ag ore in the Farrell orebodies at Tullah – the largest on the field.

[For more than a decade the author has many times pointed out that the Devonian granite–related tin mineralization in Western Tasmania is almost always only auriferous where these systems stope into the Mt Read Volcanics and associated sediments. With a few minor exceptions (such as the Mt Ramsay and Stanley River skarns against the Meredith granite, which contain up to 0.2g/t Au), tin mineralization outside the Mt Read Volcanics is spectacularly barren of gold. Anywhere in Western Tasmania that significant gold and tin mineralization occurs together, as in the Sterling Valley, a Cambrian–Devonian mineralization hybrid can be suspected.]

Previous prospecting/exploration activities discovered several significant mineral deposits along the Henty Fault within the Tullah–Sterling River EL areas. Some of these deposits supported large mining operations in the past – most notably the Farrell lodes at Tullah.

Details of the significant known deposits are shown in Table 1 and on Figure 4. All are held by Pasminco Exploration or Pasminco Mining.

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**E.L. 22/90 - TULLAH**  
**E.L. 24/91 - STERLING RIVER**  
**REGIONAL GEOLOGY**  
FROM MAP 6 OF THE  
**MT. READ VOLCANICS PROJECT**

SCALE 0 2 4 km  
FIG. No. 3

**ACKNOWLEDGEMENT:**  
Mt. Read Volcanics Project Map adopted from Map 6 - Geological Compilation Map of the Mt. Read Volcanics and Associated Rocks, from Hellyer to South Darwin Peak. K. D. Corbett B Sc (HON) PhD and A. W. McNeill B Sc (Hon), 1988

<b>QUATERNARY</b>	Q	Glacial deposits, alluvium, etc.
<b>TERTIARY</b>	Tb	Basalt
	Ts	Sediments - gravel, sand, clays
<b>JURASSIC</b>	Jd	Dolerite
<b>PERMIAN - CARBONIFEROUS</b>	P	Undifferentiated
<b>DEVONIAN</b>	Dd	Dolerite
	Dg	Granite
<b>DEVONIAN - SILURIAN</b>	Db	Bell Shale
	Df	Florence Sandstone
	S	Silurian
<b>ORDOVICIAN</b>	Og	GORDON GROUP limestone
<b>EARLY ORDOVICIAN - LATE CAMBRIAN</b>	COu	Upper sandstone sequence including Pioneer Beds (COu)
	COo	Undifferentiated conglomerate and sandstone (COo)
	COa	Newton Creek Sandstone (COa) - interbedded sandstone siltstone and conglomerate with marine fossils

**MT. READ VOLCANICS**  
**NORTH AND WEST OF HENTY FAULT**  
**DUNDAS GROUP AND CORRELATES**

Cp	Quartz-feldspar porphyry, mostly intrusive
Cds	Mostly sedimentary rocks - greywacke, siltstone, conglomerate
Eds	Interbedded tufts and sedimentary rocks
Edq	Quartzwacke-slate-siltstone units, e.g. Slitt Quartzite
Edv	Mostly felsic volcanics - mainly tufts
Edm	Mixed felsic and mafic volcanics and epiclastic breccias, Que-Hellyer area
Eda	Basaltic to andesitic volcanics

**CENTRAL VOLCANIC COMPLEX**

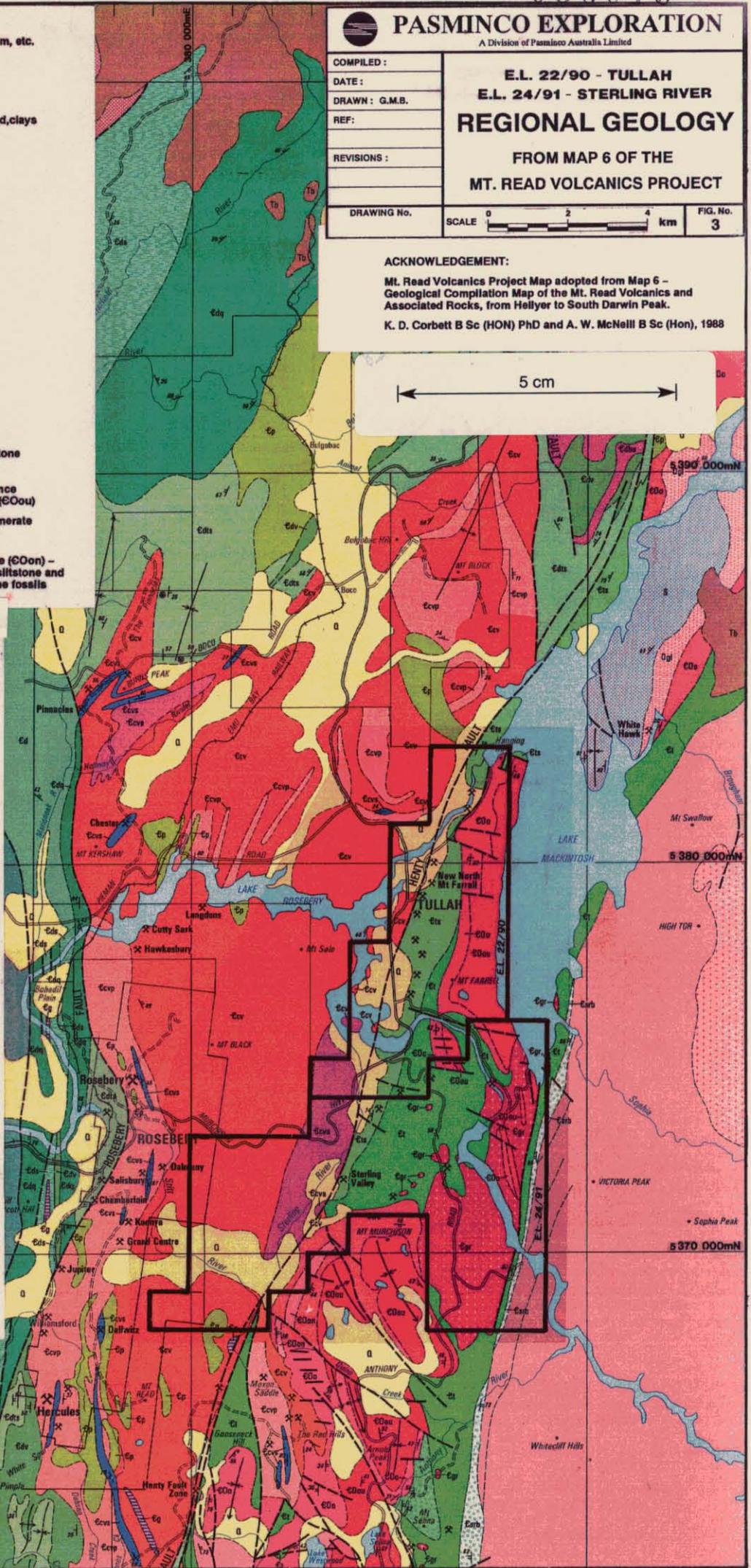
Ccv	Mainly feldspar-phyric volcanics - dacite, rhyolite, minor andesite (Ccv)
Cp	Felsic porphyry, mainly intrusive
Ccp	Mainly pyroclastic rocks
Ccs	Sedimentary rocks, mainly shale and sandstone
Cva	Andesitic volcanics

**SOUTH AND EAST OF HENTY FAULT**  
**TYNDALL GROUP AND CORRELATES**

Et	Mainly sed. rocks, incl Farrell Slates
Et	Mainly quartz-feldspar-phyric volcanic and volcanoclastic rocks (Et)
Et	Mainly volcanoclastic congl. and sandstone
Est	Sticht Range Beds - sandstone, siltstone, siliciclastic conglomerate

**CAMBRIAN INTRUSIVE ROCKS**

Egr	Granite
Ep	Felsic porphyry
Eg	Gabbro
Eum	Ultramafic rocks & serpentinite



## 6. PREVIOUS EXPLORATION & MINING

Because of its high prospectivity and numerous known mineral showings, the ground covered by the Tullah–Sterling River EL's is some of the most heavily explored in Western Tasmania. A comprehensive chronology of these exploration efforts and the reports produced, was provided in last years Annual Report for the Tullah EL (Lorrigan, 1991).

Recorded exploration began in the area in 1896 and has been more or less continuous since that time. Mining commenced with the opening of the North Mt Farrell Mine at Tullah in 1899. This mine shut in 1933 (reputedly with the orebody continuing underfoot – Jensen, 1959), the same year that the adjacent New North Mt Farrell deposit was discovered and developed. The latter was taken over by the EZ Company (the forerunner to Pasminco), who shut it down as uneconomic in 1973. The two Farrell mines produced 731,000t of high-grade Pb–Ag ore.

Although the ore also contained Zn (apparently averaging around 2% Zn according to the old mine records), very little was recovered by the Farrell mill. In 1972 most of the Farrell tailings were trucked to Rosebery and retreated, where substantial volumes were found to grade in excess of 5% Zn. The 71,000t remaining reserves in the bottom of the now-flooded New North Mt Farrell Mine average 4.8% Zn.

Prospecting along the 'Farrell Line of Lode' discovered numerous other Pb–Zn–Ag +-Au shows extending as far as the Sterling Valley Mine, 7km south of Tullah. Many of these were worked on a small scale, mainly in the period before the First World War. The largest seems to have been the Murchison Mine, 2km SSE of Tullah, where recorded production of Pb–Ag ore is only 300t but the scale of workings indicates the deposit is (or was) in the order of 30,000t at least.

Although the Farrell Mining Company conducted some poorly documented shallow exploration drilling around Tullah in the early 1940's, modern systematic exploration in the Tullah–Sterling River area commenced with the advent of EZ in 1947. Over the subsequent 45 years, major exploration programmes have been undertaken by EZ, Rio Tinto Australia, Abminco (now Aberfoyle), Asarco, Getty Oil and Billiton Australia.

The exploration programmes included large scale grid-based soil and rock geochemical surveys, as well as ground magnetics, IP and EM (including UTEM, SIROTEM and Max–Min

EM). Aerial surveys included magnetics and DIGHEM. A total of at least 98 surface exploration diamond drillholes were put down. A further 78 underground exploration holes were drilled in the New North Mt Farrell Mine prior to its closure.

The major successes of this systematic exploration were two shallowly buried mineralized bodies: the Lakeside gold deposit (750,000t @ 2.1g/t Au), found by Billiton in late 1986, and the 'Arsenic Resource' (480,000t @ 5% As, 1g/t Au), found in the Sterling Valley by EZ in 1980.

TABLE 1

**MINERAL DEPOSITS ALONG HENTY FAULT  
ON TULLAH & STERLING RIVER EL's**

<b>Deposit</b>	<b>Commodities</b>	<b>Resource</b>	<b>Status</b>
North Mt Farrell	Pb-Ag-Zn	Mined: 432,000t @ 11.4% Pb, 370 g/t Ag, 2% Zn.	Mined 1899-1933
New North Mt Farrell	Pb-Ag-Zn	Mined: 299,000t @ 14.9% Pb, 506g/t Ag, 2.5% Zn. Proved reserves: 71,000t @ 12.3% Pb, 378 g/t Ag, 4.8% Zn. *	Mined 1933-73. Shaft flooded
Lakeside	Au-As-Sn	Indicated resource: 750,000t @ 2.1g/t.	Undeveloped & inactive. Resource calc by Billiton, based on 9 drillholes.
'Arsenic Resource'	As-Au-Sn	Inferred resource: 480,000t @ 5% As, 1 g/t Au.	Inactive. Estimate by EZ, based on 4 drillholes.
Murchison Mine	Zn-Pb-Ag-Au	Inferred resource (partly mined): 30,000t @ 15% Zn, 10% Pb, 350g/t Ag, 2 g/t Au.	Inactive. V approx Pasminco estimate based on old reports.
Sterling Valley Mine	Pb-Zn-Ag-Au	?	Inactive. Ore-grade intercepts in old DDH's, best STP 96: 5.5m @ 9% Pb, 6% Zn, 160 g/t Ag, 1 g/t Au.

\* Pasminco Mining estimate (1989) of remaining combined resource at both North Mt Farrell and New North Mt Farrell, including the proved reserve, is: 177, 000t @ 11.3%Pb, 345g/t Ag, 4.1% Zn.

## **7. 1991-92 EXPLORATION**

### **7.1. Geological Study by J.Blackwell**

Canadian geological consultant Jerry Blackwell carried out a one month geological study of the Sterling River EL in January-February 1992. The aim was to synthesise the main structural and stratigraphic elements of the area as a guide to massive sulphide mineralization.

Blackwell focussed his attention on the Murchison Granite and the Henty Fault Zone. He did not have sufficient time to work on the Tullah EL as had originally been intended. His report appears in Appendix 1.

Results of Blackwell's work included:

1. Clear demonstration that the Murchison Granite has been tectonically emplaced with the eastern boundary defined by a previously unrecognised major mylonite zone against inferred Precambrian rocks of the Tyennan Nucleus.
2. Identification in the Sterling valley of an altered and basemetal-mineralized sulphidic mudstone unit on the eastern side of the Farrell Slates where they contact the sericitized rhyodacitic Murchison Volcanics. On the basis that the sulphidic sediment overlies the altered volcanics, it may represent the initial deposition in the transition from active volcanism to a period of quiescence - a classic massive sulphide position.

These and other findings by Blackwell, as well as his recommended programme for follow-up work, are detailed in his report in Appendix 1.

### **7.2. Evaluation of Old Data**

The evaluation and compilation of previous exploration/mining data (commenced by Angela Lorrigan in 1991), was continued and is still far from complete. Attention focussed on trying to get all the old exploration drillhole information into the Pasmenco computer database, as well as obtaining all old reports pertaining to the Tullah-Sterling River area.

Billiton (a previous major explorer in both the Tullah and Sterling River areas), transferred their stored drillcore to Pasminco Exploration's facility at Tullah, and granted access to their comprehensive files on the area. Some time was spent going through this data and copying much of it.

A total of 98 old surface exploration drillholes and 78 underground exploration holes, have so far been positively identified within the area covered by the Tullah and Sterling River licences.

These holes are listed in Appendix 2. The list does not include several poorly documented holes put down in the Tullah area in the early 1940's by the Farrell Mining Company, for which there are apparently no survey or geological records.

The list also does not yet include several deep HEC drillholes put down as part of their continuing hydro-electric construction activities. These holes, some of which are known to have encountered basemetal sulphides, will provide important data on areas not previously targeted by the mineral explorers.

However, what should be a relatively straight forward task is being frustrated by multitudinous inconsistencies and errors in the old drill records. The situation is worst with the survey data, and while trouble was expected in conversion of the older information from poorly-surveyed holes on local grids, the problem even exists in some holes drilled in recent years, which reflects badly on the geologists concerned.

In many cases it has been necessary to go back to the downhole camera discs (where they still exist) because no sense could be made of what was written in the log.

As a result of these problems full AMG survey details for only 57 surface exploration drillholes have to date been entered in the Pasminco database. The holes and their survey details are listed in Appendix 3 and shown on Figures 6-8.

### **7.3. Examination of Murchison Mine**

The old Murchison Mine lies 2km SSE of Tullah (see Figure 4). The occurrence has attracted Pasminco's interest because it has the highest zinc content of any of the known mineral showings in the Tullah-Sterling River area. It also contains some gold.

Previous data was examined, including EZ's 1947 evaluation and drilling (4 holes), and Billiton's systematic exploration there in the late 1980's (soil geochemistry, IP, Max-Min EM, but no drilling). The old mine workings were visited and sampled.

The Murchison Mine lode comprises partly-banded semi-massive to massive sphalerite, pyrite, arsenopyrite, galena, chalcopyrite, pyrrhotite and tetrahedrite, in a gangue of quartz and siderite, with minor barite, fluorite and chlorite (Brooks, 1962).

The lode occurs within the Farrell Slates adjacent to their eastern (lower?) contact with the sericitized rhyodacitic Murchison Volcanics unit of the Tyndall Group, ie: the contact zone highlighted as an exploration target by Blackwell (see 7.1). The lode is hosted by a 20m thick band of epiclastic crystal-lithic sandstone of rhyodacitic provenance, flanked to east and west by black shale. The sediments strike north and dip 70° west, but the lode occurs on a crosscutting shear trending NNE and dipping very steeply west (Whitten, 1947a).

The known lode is developed where the shear is within the crystal-lithic sandstone. The shear continues within the flanking shale north and south of the lode, but is apparently unmineralized (although also largely untested). The relative geometries of bedding dip and shear orientation give the lode a southerly plunge averaging around 50° (see Figure 5).

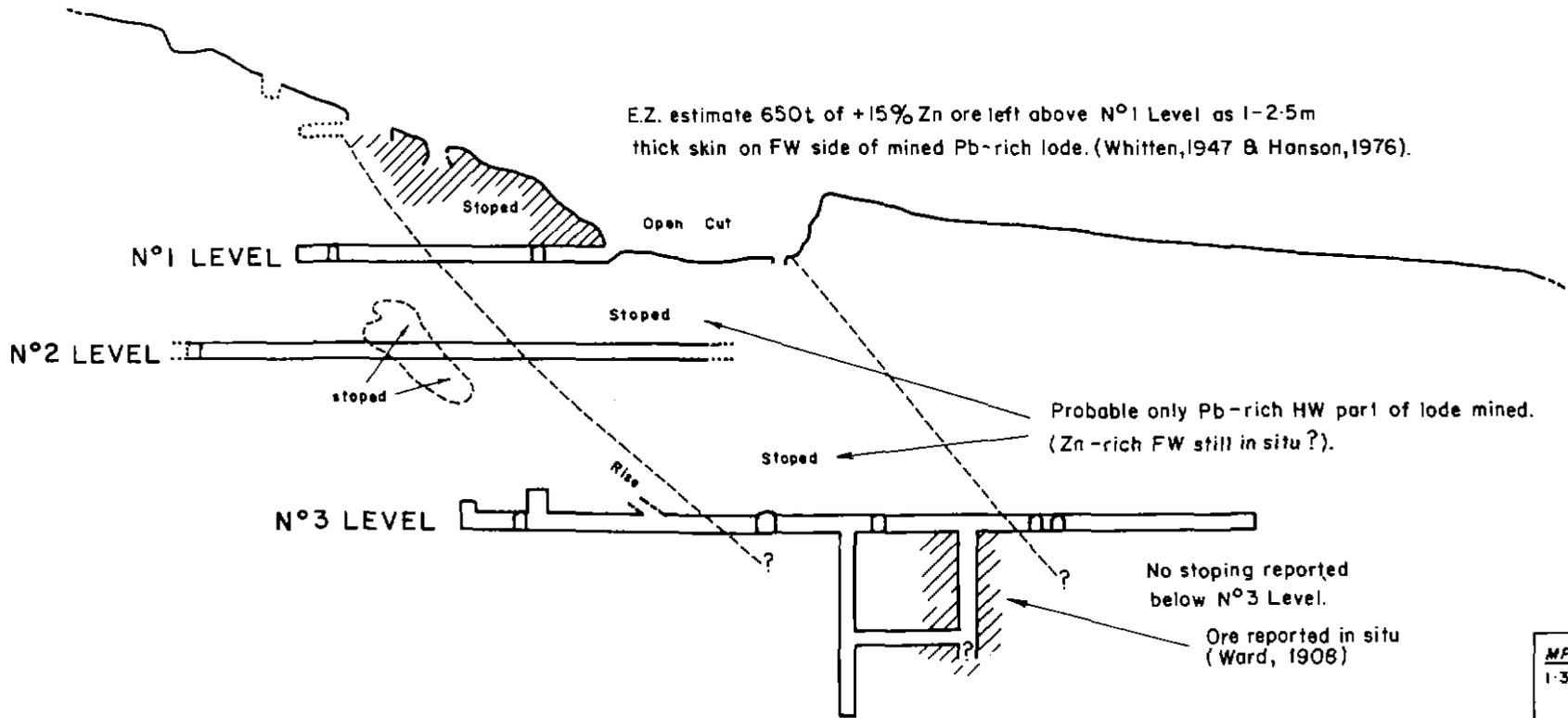
Reports on the old mine repeatedly list recorded production as only 300t @ 40% Pb, 1650 g/t Ag & 2.1 g/t Au. This figure emanates from Ward (1908), and when read in its original context is a quote from the mine assay book for 4 months in 1907 which, as stated by Ward, "will give a reasonable representation of the value of the mine products". While it may be true that the 300t figure is now the only record of production, clearly it bears no relationship to total production from the old mine, and its repeated quotation gives a very misleading impression of the property.

It is immediately apparent from the recorded dimensions of the old workings that the 300t production figure is only a tiny fraction of the actual size of the lode, and that the property is alot larger and more significant than previously thought.

The old data (Ward 1908, Whitten 1947a&b, Hanson 1976), shows that the vertical depth between the original lode outcrop and the lowest worked level (3 Level), is 50-55m. The horizontal dimension averages 40-45m and the thickness varies from 1.2 - 6.5m, averaging

NORTH

SOUTH



**MP28**  
 1.3m @ 7.5% Pb, 16.9% Zn,  
 401 g/t Ag, 0.85 g/t Au

**MP30**  
 1.3m @ 0.1% Pb, 0.7% Zn  
 22 g/t Ag, 0.07 g/t Au

MP28 ●  
 Drillholes by EZ (1947-48)  
 MP30 ●

MP29 ● Barren

COMPILED FROM OLD E.Z.  
 AND OTHER RECORDS.

056036

<b>PASMINCO EXPLORATION</b> A Division of Pasminco Australia Limited	
COMPILED: J.G.P.	E.L.22/90-TULLAH <b>MURCHISON MINE</b> LONGITUDINAL PROJECTION LOOKING EAST
DATE: Sept. '92	
DRAWN: N.W.D.S.	
REF.:	
REVISIONS:	
DRAWING No.	SCALE 1:1000  FIG. No. 5

around 2–3m. The ore was proved by underground development to extend at least a further 17m vertically below 3 Level. See Figure 5.

Using an SG of 4, this suggests that the original size of the lode above 3 Level was in the order of 20–25,000t, with possibly another 7,000t below 3 Level. While an unknown amount of the ore above 3 Level was mined there was apparently no mining carried out on the material below 3 Level.

The drilling beneath 3 Level by EZ in 1947–48 (1 hole with 1.3m of ore, 2 holes barren), did not close off the possible extensions of the mineralized zone – see Figure 5.

The old miners were only interested in the high grade Pb–Ag parts of the lode, whereas Brooks (1962) states quite clearly "sphalerite is the most abundant sulphide mineral in the ore". It has been well documented that the lode contains a sphalerite–rich footwall section, a remnant of which (estimated at 650t @ 15–20% Zn – Hanson 1976), is visible in the old open cut.

All the Zn–rich material, along with much ore 'seconds' (ie: lower grade Pb–Ag), was rejected by the old miners and this very probably was the majority of the lode. This material was either broken and used as dry stope fill or left in situ on the walls of the stopes.

The grade of the remaining lode material can only be guessed at. Based on existing assays it is considered it may have a grade around 15% Zn, 10% Pb, 350 g/t Ag and 2 g/t Au.

At this stage it is impossible to accurately gauge just how much of the lode remains and what grade it has. However, because Zn is the dominant constituent of the ore and the old miners were only after the Pb–rich sections, it is probable that the majority of the orebody was not extracted.

While this is of some immediate interest to Pasminco Mining at Rosebery, the important point from Pasminco Exploration's perspective is that the Murchison Mine lode is much larger and stronger than previously recognised, is Zn–dominated, and lies within the prospective zone defined by Blackwell. The Murchison Mine occurrence and its vicinity are an obvious exploration target and the evaluation is continuing with a view to undertaking a drill

programme there as soon as possible.

#### 7.4. Anthony Tunnel Barite

In early October 1991 HEC geologists informed the author that a large zone of barite mineralization had been intersected between the 2595m and 2615m marks in the northern heading of the HEC's Anthony Tunnel, southeast of Mt Murchison. This occurrence was examined and sampled later in October and the Sterling River ELA was enlarged by 6 sq km to cover it. Jerry Blackwell mapped the barite and its setting in the tunnel during his work on the Sterling River EL. The barite zone is also being studied by Tasmania University geology student Paul Abbott as part of his Honours thesis.

The barite lies on the contact between intensely K-feldspar altered Murchison Granite and altered Tyndall Group volcanics comprising rhyodacitic lava and volcanoclastic sandstone. It occurs as massive tectonically disrupted and dismembered lenses from 1–5m thick exposed over a 20m length of the tunnel. The barite is finely laminated in places, with extensive finely disseminated galena also commonly arranged in thin laminae. Other minerals present in the barite include fluorite, pyrite, magnetite and chalcopyrite. See Plates 5 & 6.

The barite zone is described in detail by Blackwell in his report – see pages 10–13 of Appendix 1. (Note particularly his sketch on page 11). Assay samples returned values up to 2.79% Pb, 0.11% Cu and 14 g/t Ag. Values for Zn, As, Sb, and Au were all negligible, and the barite did not contain Sn, W, Bi or Mo. Full results are listed in Appendix 4A.

Blackwell's conclusion that the barite is basically of vein style, of Cambrian age and genetically related to fluids associated with the intrusion of the Murchison Granite, is supported by the Pb-isotope data for two samples of galena from within the barite. Both samples give identical results and plot within the Rosebery field, suggesting a cambrian age – see Appendix 4C.

In February 1992 a moving loop Crone Pulse EM survey was carried out over the barite zone in the Anthony Tunnel. Cultural noise was not as bad as anticipated (the tunnel contains steel pipes and electrical cables), and the survey effectively showed that no significant conductor exists in the vicinity of the barite mineralization. The EM survey results appear in



Plate 5. 3m thick massive barite lens in Anthony Tunnel.



Plate 6.  
Detail of barite showing  
sulphidic laminae

#### Appendix 4D.

The barite occurrence does not appear to have significant economic potential.

### 7.5. Structural Analysis of Henty Fault

In September 1991 Eoin Rothery, Pasminco Exploration's structural expert, examined exposures of the Henty Fault Zone in the Tullah–Sterling River area. Rothery's observations were:

1. The compressive strain angle on the west-dipping Henty Fault implies a reverse movement during east-dipping crenulation cleavage development.
2. The fact that the north–south sections of the fault are more mineralized than the NNE–SSW sections, implies that the mineralizing event occurred during sinistral movement on the fault (ie: east–west extension). This may have been the same deformation event that led to the east–west extension seen generally in the Rosebery–Hercules sequence.
3. The possibility exists that this extension was important in the main mineralizing event (dilation zones at maximum normal movement), and represents a continuation of an extensional phase that encouraged the production of silicic volcanism.
4. The quartz–tourmaline veining along the Rosebery and Mt Black thrusts suggests that the compressional deformation occurred later, during the Devonian.

## 8. DISCUSSION

### 8.1. General Prospectivity of the EL's

The Henty Fault is the feature having most influence on the potential for ore deposits on the Tullah and Sterling River EL's. The major structure identified by Blackwell on the eastern margin of the volcanics may also have similar influence and potential, but the lack of known mineral shows on this latter structure means at present it cannot be regarded as being in the same class as the Henty Fault.

The Henty Fault is one of those major north-south structures in the Mt Read Volcanics that seem to exert a fundamental control on the location of the known ore deposits, as well as many of the major volcanic features such as extrusive edifices and basins of epiclastic deposition.

This control apparently involves the formation of deep-seated conduits for magma and hydrothermal fluids, formation of physical features such as fault angle depressions and escarpments, and the manufacture of structurally-prepared sites for mineral accumulation.

The Henty Fault (and perhaps the proto-Henty Fault), is implicated in the formation of the Hellyer and Que River basemetal orebodies (Purvis 1992), the Henty gold deposit, and the basemetal and gold deposits already known in the Tullah-Sterling River area: the Farrell bodies, Murchison Mine, Lakeside and the Sterling Valley 'Arsenic Resource'.

The vital secondary control that helps determine the actual siting of the hydrothermal fluid conduits is believed to be deep-seated E-W structures. These have little or no surface expression but are apparent on gravity and magnetic data, and satellite imagery. Intersection of a fundamental N-S lineament by a major E-W cross-structure is clearly implicated in the formation of the Rosebery deposit and similar intersects are believed to control the siting of the Que and Hellyer deposits (Leaman, 1991).

Thus the strategy for exploring the Tullah and Sterling River EL's must sensibly initially involve defining the basic structural framework, especially along the Henty Fault. The main aim being to define zones where deep-seated cross-structures intersect the fault. This can be done

by principally using gravity, magnetics and satellite imagery.

One small proviso with using cross-structure intersections as exploration targets, is that the history of movements on the Henty Fault obviously has to be taken into account. Orebodies occur at relatively shallow levels and could easily be moved away from over or near the original deep-seated structural intersect sites by later movements of the fault.

In the Tullah-Sterling River area there is another important control on the location and characteristics of the mineral deposits. These are the granite intrusions.

Cambrian and Devonian granite masses exist on or under parts of both EL's. These have had some influence on the location, form and mineralogy of much of the known mineralization. Isotopic and other studies (eg: Taheri & Green 1990), provide evidence for mixing of both Cambrian and Devonian mineral species in the known larger mineral deposits on the EL's, all of which are remobilized lode or vein type.

While tectonic forces on the Henty Fault appear partly responsible for the remobilization, the form and mineralogy of some mineralization (eg: the pyrrhotitic As-Sn-Au hybrid veins/lodes at the Sterling Valley 'Arsenic Resource'), indicate that the granites (especially the Devonian granites), have also remobilized pre-existing mineralization and added mineral constituents of their own.

Clearly, accurate definition of the sub-surface granite topography is an important part of mineral exploration in this area, and both gravity and magnetics have a role in doing this.

Once the structural framework and granite topography is adequately known the information can be used to help target the extensive drilling that will be needed to find buried mineral deposits associated with the Henty Fault. Given the numerous small to medium-sized base and precious metal deposits that are already known along this section of the Henty Fault, there can be no doubt that the Tullah-Sterling River area is amongst the most prospective in the whole Mt Read Volcanic Belt.

## 8.2. Specific Target Areas

### 8.2.1 THE TYNDALL GROUP/FARRELL SLATES CONTACT ZONE

Blackwell highlighted this eastern contact of the Farrell Slates, specifically a sulphidic mudstone unit along it, as a potential massive sulphide position. He targeted the horizon on the basis that it represented the initial sedimentary deposition and onset of quiescence, following the rhyodacitic volcanism that formed the lavas and volcanoclastics of the underlying highly altered Murchison Volcanics.

It must be noted that Ian Freytag of Cominco drew attention to this same zone for much the same reasons, over 15 years ago (Freytag, 1976).

There is no doubt the targeted zone is worthy of serious attention, given the amount of mineralization along it. The Murchison Mine deposit (30,000t of high grade Pb-Zn-Ag-Au), lies on the zone and is the obvious place to commence exploration.

However, the geological basis Blackwell uses for calling attention to the zone is only valid if the Farrell Slates face west (ie: stratigraphically overlie the Murchison Volcanics), and evidence on this point is inconclusive. It is ironic that the only facing in the Farrell Slates that Blackwell actually observed was to the east (at 980' in hole STP 105).

Good facings are generally hard to find in the Farrell Slates. Billiton spent 2 years exploring 2km of Blackwell's target zone in the vicinity of the Murchison Mine without finding any facing evidence for the sequence.

Although the weight of evidence from previous workers does support a west facing for the Farrell Slates (eg: Corbett & McNeill 1986, Freytag 1976, Rivers 1975), there is also good evidence for an east facing (Brooks 1962, McKibbin 1968). East-facing volcanic sediments occur in a similar position to the Farrell sequence at Henty Prospect, 7km south of the area examined by Blackwell. EZ catalogued all facing measurements in their Sterling Valley drillholes at 34 westerly and 5 easterly (McDonald 1985).

Mapping to try and confirm the postulated overall westerly facing for the Farrell Slates should

obviously form part of the follow-up work on Blackwell's potential massive sulphide horizon.

## 8.2.2 THE AREA WEST OF THE HENTY FAULT

Although almost all the known mineralization along the Henty Fault in the Tullah–Sterling River area is in the Farrell Slates and Tyndall Group volcanics to the east of the fault, the area up to 2km west of the fault is prospective also. All known volcanogenic massive sulphide deposits in the Mt Reads are on the hangingwall side of the major north–south structures – in this case, the western side of the Henty Fault.

Remobilized mineralization, similar to that at the 'Arsenic Resource' in the Sterling Valley, obviously has the potential to occur in the volcanics west of the Henty Fault, but conceptually, the best targets in these rocks are massive sulphides in discrete volcanic edifices built alongside the fault – analogous to the Que–Hellyer situation.

In the Tullah–Sterling River area such rocks (if they exist) are apparently covered by the barren Mt Black and Mt Block lavas/intrusives. Searching for such targets would obviously be more difficult than exploring the exposed mineralized rocks east of the fault.

## 9. CONCLUSIONS

1. The mineralized horizon on the eastern margin of the Farrell Slates may represent a classic massive sulphide position. As such it merits immediate attention. The overall facing of the Farrell Slates needs to be determined to check on the validity of the concept.
2. The Zn-dominated Murchison Mine deposit is much larger and more significant than previously recognised. Its location on the mineralized horizon mentioned above further enhances its status. Priority should be given to drill testing for possible extensions around the known deposit.
3. The Henty Fault is the feature having most influence on the mineral potential of the EL's. It is implicated in the formation of all the known base and precious metal deposits in the area. Definition of the structural framework along the Henty Fault and environs, particularly cross-structural intersects, is vital for future exploration.
4. Likewise, accurate definition of the sub-surface granite topography is important because of the control these bodies have also exerted on the known mineral deposits in the area.
5. The major structure on the eastern margin of the volcanic belt could theoretically have influence and potential similar to the Henty Fault. However, until mineralization is shown to be associated with the structure it cannot be regarded as prospective as the Henty.
6. The Anthony Tunnel barite occurrence does not appear to have significant economic potential.

## 10. RECOMMENDATIONS

1. Drilling be undertaken in the vicinity of the old Murchison Mine with the aim of locating extensions and additions to the known Zn-rich deposit.
2. The geological work proposed by Blackwell be undertaken to initiate testing of the mineralized horizon on the eastern side of the Farrell Slate sequence, initially in the Murchison Mine vicinity. This programme to be augmented by geochemical sampling and examination of existing geophysical data over the zone for untested anomalies. Target areas defined by this work to be drilled as soon as possible.
3. The 1992-93 exploration programme on the EL's to include completion of the aeromagnetic coverage, gravity surveys and use of enhanced satellite imagery. The aim being to define the structural framework, particularly along the Henty Fault, and to map the sub-surface topography of the granite intrusions.
4. Geological evaluation of prospective zones on the EL's to be continued with emphasis on areas around the known mineral deposits, especially Farrell. Work to include mapping, litho-geochemical sampling, and reviews of previous drilling and geophysical surveys.
5. The compilation of old drilling data to be continued with a view to compiling computer-generated geological sections across and along the Henty Fault Zone.
6. The major structure on the eastern margin of the volcanic belt should be mapped and a search made along it for signs of mineralization.
7. All the data gained from the above to be used, in combination with other geological information, to target a major drilling campaign on the EL's in 1993-94.

## 11. REFERENCES

- Brooks, C. 1962. The Geology of the Tullah Area.  
BSc. Honours Thesis, Univ. of Tasmania.
- Corbett, K.D., 1986. Map 2, Geology of Rosebery – Mt Block Area.  
McNeill, A. W. MRV Project, Geol. Surv. of Tas.
- Freytag, I.B. 1976. Dundas Trough Project. Notes on the Field Stratigraphy of the Farrell  
Slates, South of Tullah, Tasmania.  
Cominco Exploration Report. *Unpub.*
- Hanson, N. 1976. Report on Ore Potential of the Murchison Mine.  
EZ Report No.127. *Unpub.*
- Jensen, H.E. 1959. Examination of Farrell Mining Company's Properties at Tullah,  
Tasmania.  
Rio Tinto Aust. Exploration Report No. 20/1959. *Unpub.*
- Leaman, D.E., 1989. The Granites of West and North–West Tasmania – a  
Richardson, R.G. Geophysical Interpretation.  
Bull. Geol. Surv. Tasm.66.
- Leaman, D.E., 1991. Interpretation Update Number 1, Bulgobac Hill EL 37/89.  
Report to Pasminco Exploration. *Unpub.*
- Lorrigan, A.N. 1991. Tullah EL 22/90 Annual Report October 1990 – September 1991.  
Pasminco Exploration Report No.T91–11. *Unpub.*
- McDonald, I.R. 1985. A Geological Review of EL 4/73 – Sterling Valley, With Special  
Emphasis on the Potential for Gold–Arsenic Mineralisation.  
EZ Report No.T210. *Unpub.*
- McKibben, J.P. 1968. Geology of the Mt Farrell Orebodies.

- BSc. Honours Thesis, Univ. of Tasmania.
- Purvis, J.G. 1992. EL 37/89 - Bulgobac Hill, Annual Report for the Period 3 February 1991 to 2 February 1992.  
Pasminco Exploration Report No.T92-2. *Unpub.*
- Rivers, W.M. 1975. The Geology & Geochemistry of the Tullah Area.  
BSc. Honours Thesis, Univ. of Tasmania.
- Taheri, J., 1990. The Origin of Gold-Tin-Copper Mineralization at the Lakeside  
Green, G.R. Deposit, Western Tasmania.  
MRV Project Geological Report 5, Div. of Mines, Tas.
- Ward, L.K. 1908. The Mt Farrell Mining Field.  
Tas. Mines Department Annual Report 1908.
- Whitten, G.F. 1947a. First Report on the Murchison Mine, Silver-Lead-Zinc, Mt Farrell.  
EZ Report No.4. *Unpub.*
- Whitten, G.F. 1947b. Second Report on the Murchison Mine, Silver-Lead-Zinc, Mt Farrell.  
EZ Report No.6. *Unpub.*

**KEYWORDS & LOCALITY****KEYWORDS**

ZINC, SILVER, LEAD, GOLD, CAMBRIAN, DEVONIAN, DATA REVIEW, DRILLING,  
MINERAL RESOURCES, STRUCTURE, EXPLORATION POTENTIAL.

**LOCATION**

1:100 000 SHEET SOPHIA

TENEMENTS: TULLAH EL 22/90 & STERLING RIVER EL 24/91

DISTRICT: WEST COAST TASMANIA

MT READ VOLCANICS

HENTY FAULT ZONE

# APPENDICES

**APPENDIX 1**

**SUMMARY REPORT  
STERLING VALLEY & TULLAH AREA  
TASMANIA**

**J. Blackwell**

**March, 1992**

SUMMARY REPORT

STERLING VALLEY AND TULLAH AREA

TASMANIA

J.D.Blackwell

March 1992

## SUMMARY REPORT

## STERLING VALLEY AND TULLAH AREA, TASMANIA

## INTRODUCTION

During the month of February, 1992, the writer conducted a programme examining the geology and base metal potential of the Sterling Valley and Tullah areas, six kilometres east of Rosebery.

Five broad objectives to this work include:

- i. Establishment of a stratigraphic sequence;
- ii. Resolution of Devonian deformation from inferred earlier structural events;
- iii. Examination of the Cambrian Murchison Granite and its contact relationships and alteration/mineralization effects;
- iv. Evaluation of the Farrell Ag-Pb-Zn lodes and their exploration potential; and
- v. Development of a "revised" geological model relating differing styles of mineralization to new understandings gained in i. to iv.

The area of interest is large, and has been explored during numerous in-house and competitor campaigns in the past four decades. Owing to the limited duration of the writer's on-site field period and the potential large scale of the project, an attempt was made to "kick start" a major programme by focusing on a narrow corridor through the area of interest. It is expected that the observations and interpretations made here will subsequently be applied and tested elsewhere in the project area.

## SOURCES

Literature

There are numerous geological, geophysical and engineering sources for the subject area, and the writer has reviewed only a small fraction of that written or available. These include:

- Various company reports, often summary or "project termination" in nature, dating to the early 1950's. These are stored at the Pasminco Exploration office in Burnie. Associated maps, drill logs and sections are fairly complete.

- Geological maps and reports published by the Geological Survey of Tasmania, Department of Mines.

- Geological reports and papers produced by researchers at the Centre for Ore Deposit and Exploration Studies, University of Tasmania, Hobart.
- Survey plans from the Hydro-Electric Commission (H.E.C.).
- Pasminco Exploration internal reports, most notable of which is a Summary Exploration Review of the Tullah E.L. by Lorrigan (1991) and a Base Metal Regional Study of Western Tasmania by Wright, Lees and Lorrigan (1991).

It is important to note that the writer has not undertaken a comprehensive review of all the written information for the Sterling Valley - Tullah area, nor has all the available data been assembled in one location. The writer has provided written comments (under separate cover) for several reports of particular interest.

#### Field

A rough cross section from the western edge of the Precambrian supracrustal rocks through the Cambrian and older Sticht Range Beds, Tyndall Group, Farrell Slates and Murchison Granite and the Ordovician Denison Group (Owen Conglomerate) was examined, from the mouth of the Anthony Tunnel at Lake Murchison, west along the Anthony Road to the Murchison Highway south of Lake Rosebery.

The Anthony Power Tunnel was examined to 3200 metres from the portal collar, as were the landings and access roads.

The Tyndall - Denison Group contact was examined at a well known Anthony road cut 3.5 kilometres south of the tunnel turn-off.

Miscellaneous road exposures were examined along the Murchison Highway and the Murchison Dam Access Road.

Diamond drill core was examined from holes STP 101, 105, 217, 220, 221 and SVD 87-1A.

The writer's notes and comments on both the drill core and the Anthony Power Tunnel are available under separate cover.

## DISCUSSION

The writer examined a section through the Mount Read Volcanics from the portal of the Anthony Power Tunnel in the southeast to diamond drill core from holes drilled in the vicinity of the Murchison Highway - Anthony Road to the northwest. This section provided an opportunity to examine:

1. The nature of the older Precambrian supracrustal - Mount Read contact;
2. The nature of the Mount Read - Denison Group contact;
3. The contact of the Murchison Granite with the Mount Read (Tyndall Group) and Denison Group;
4. The Tyndall Group - Farrell Slates contact;
5. Internal rock unit variations in the Murchison Granite, the Tyndall Group volcanic rocks and the Farrell Slates epiclastic rocks of the Mount Read Volcanics;
6. Mineralization known to be present in the Anthony Power Tunnel (Barite with minor galena, sphalerite and fluorite), in drill core and road cuts in the Sterling Valley area (Farrell-type argentiferous galena and sphalerite, as well as "Lakeside - type" auriferous pyrrhotite), and previously unrecognized (more accurately - unappreciated) sulphidic black mudstone at Tyndall - Farrell contact; and
7. The Henty Fault Zone.

## Review

Important results include:

1. The contact between the older Precambrian supracrustal rocks (siliciclastic units of quartz arenite, quartz pebble to cobble conglomerate, grit and wackestone) and the Mount Read Volcanics (mapped as being the Sticht Range Beds, a unit of interbedded micaceous siltstone, sandstone and siliciclastic conglomerate) is a major north-trending fault zone, marked by a vertical mylonite in excess of 300 metres wide. Units mapped as being Sticht Range, in the Anthony Power Tunnel area, are highly tectonized, with severely transposed bedding. No primary contact relationships are preserved. Kinematic indicators suggest reverse movement.

The equivalence of tectonized siliciclastic rocks in the Anthony Power Tunnel landing area and access roads, to type area(s) of Sticht Range Sections is uncertain. The writer could see no meaningful break between what has been mapped as Sticht Range in the west and Precambrian in the east (McNeil, 1987). An obvious implication is that the Sticht Range is a tectono-stratigraphic unit.

Chlorite-altered Tyndall Group volcanoclastic and pyroclastic rocks mapped by McNeil west of the Sticht Range Beds, are instead tectonized Murchison Granite. Within the mylonite, the Murchison Granite displays progressive extension, grain-size diminution, dark green chlorite alteration, feldspar augen development, and C-S fabric towards the "Sticht Range" contact. The combination of a clastic appearance (of tectonic origin) and coarse feldspathic material in a fine-grained chloritic matrix, has led to an incorrect rock identification, and a misleading stratigraphic picture (by McNeil and others). Where seen in outcrop, the Sticht Range - Murchison Granite contact is marked by up to 50 cm of interleaved ultramylonite, which in outcrop maybe mapped as "tuff" or "siliceous siltstone".

The age of the mylonite event is uncertain. It postdates the Murchison Granite, but is cut by Devonian-aged 160°N, east dipping reverse faults, generally attributed to the earliest phase of the Devonian Tabberabberan Orogeny. Therefore it is implied that: (a) there exists a pre-Tabberabberan phase of deformation, no older than the Late to Middle Cambrian Murchison Granite (524 Ma), and (b) the Mount Read Volcanic sequences and the Murchison Granite may be allochthonous, and where structurally emplaced over the Precambrian "basement".

2. The Mount Read - Denison Group contact is an angular unconformity. Early Tabberabberan 160°N reverse faulting and folding has produced a folded and faulted contact, creating a local decollement.

The writer examined road cut exposures south to west and north of the Tyndall - Denison Group contact exposed 3.5 kilometres south of the Anthony Tunnel turn-off on the Anthony Road. The Late Precambrian to Early Cambrian Tyndall Group map unit of the Mount

Read Volcanics can be subdivided into two and possibly three subunits. From southwest to northeast this includes (a) a dark purple and dark green, clast supported lapilli breccia, with both rhyolitic (quartz phyrlic) and andesitic (plag phyrlic, no quartz) fragments. The matrix is chlorite, quartz and plagioclase. The more mafic fragments are highly altered and deformed. The middle unit (b) is a light grey to greenish, matrix supported rhyolite breccia, with minor lapilli. It has abundant quartz phenocrysts and minor plagioclase. Many fragments have a purplish hue. All are strongly prolate extended. The third unit (c), nearest the Denison contact in the east, is a dark grey to purple rhyolite breccia. It is notably quartz phyrlic, with quartz grains both increasing in size and abundance towards the Denison. Clasts are highly stretched, approaching a two-dimensional aspect. This unit (c) may be a more deformed and altered equivalent to the middle unit (b). No reliable bedding contacts were seen, and facing is unknown.

Tyndall Group units are deformed, schistose and greenschist metamorphic rank. Cleavage is at approximately  $140^{\circ}/80^{\circ}$  West. Numerous fault and shear zones cut the cleaved volcanic units at  $160^{\circ}$  to  $170^{\circ}/40^{\circ}$  to  $65^{\circ}$  East. Cleavage is rotated and gash veins are common. A reverse sense on movement is indicated. A major structure of this orientation is mapped by McNeil 600 metres southwest of the Denison - Tyndall contact. The degree of displacement is uncertain, however it appears to have a greater throw at higher elevations in the Denison than at lower elevations in the Tyndall. Based on only a limited number of observations, it appears that these structures (which are attributed to the earliest deformation of the Tabberabberan Orogeny) are listric in aspect, probably flattening at depth.

The Tyndall - Denison contact (see enclosed photocollage) is well exposed. Foliations in the underlying Tyndall Group remain near vertical to within 20 cm of the contact, rotating to near parallelism where the contact dips east. As the contact steepens, numerous quartz-filled gash veins and siliceous veinlets overprint both units, as well as very minor disseminated pyrite. Overlying Denison Group (Owen Conglomerate) is in sharp contact. There is no evidence of clast stretching parallel to the contact. Several distinct beds are present. In ascending stratigraphic order this includes (i) a lens of grey, locally pyritic cobble to pebble conglomerate, (ii) a thick and thin bedded, white siliceous siltstone with discontinuous, one pebble thick horizons, (iii) a thick bedded, pink to grey pebbly quartz arenite, (iv) a thin bed of maroon-coloured, laminated quartz arenite, and (v) a distinct grey thick-bedded quartz arenite with two middle intervals marked by pebble layers. The rocks probably represent shallow marine to fluviodeltaic deposits. No fanglomerate facies were noted. The lower two and possibly three subunits may be traced through the roadcut exposure, appearing to be overturned to the east about a gently ( $10$  to  $20^{\circ}$ ) north-plunging fold. The fold culmination is not clearly evident, lying close to the road surface. Numerous east-trending vertical faults with dextral throws cut both Tyndall and Denison Group units.

Further north, within the main mass of the Denison, similar north plunging asymmetrical fold structures, at 160 to 175°N, are common. The east limbs are often near vertical to slightly overturned. Axial planes are often marked by moderately east dipping reverse faults and shears, also oriented at 160 to 175°. These faults, near to bedding parallel, appear to persist along the upper or lower contacts of conglomeratic beds, ramp steeply through finer-grained arenite and produce recumbent folds, then flatten again at the contact with the next conglomerate.

Based on the observations described herein, the writer feels no compulsion to place a major "thrust" [sic] at the Tyndall - Denison contact as suggested by Wright et al (1991). This is based largely on a lack of supporting evidence from the location examined. It does appear, however, that the Tyndall was deformed and metamorphosed prior to Denison Group deposition. Folding and fault structures observed in both the Tyndall and Denison Groups appear to be of later Devonian Tabberabberan origins.

An important aspect to the observed 160° North trending reverse faults and associated shallow plunging folds bears consideration. It appears that this Devonian deformation has resulted in an unknown amount of shortening of the Denison Group, accomplished by means of thrusting and folding. It should be expected that the underlying Mount Read Volcanics would similarly be shortened. Convention would suggest that the more massive, isotropic volcanic mass of the Mount Read Volcanics will not readily fold, instead being thrust into a series of imbricate sheets. With few marker units to map, thrust sheets in the Mount Read would be difficult to identify. The Denison - Mount Read contact will locally be a decollement.

Two additional sources of information need to be examined in the course of future programmes. The H.E.C. drilled a single diamond drill hole through the Denison Group into Tyndall Group (?) volcanics at a location beside the Anthony Road at Murchison Creek. The H.E.C. drill logs suggest a zone of minimal recovery and low R.Q.D. at the contact. The core was not available to the writer, being stored not at the H.E.C. Tullah compound, but to the south at a similar facility. The complete drill hole should be re-logged by an exploration geologist. Also, the Anthony Power Tunnel is being driven from both ends. The southwestern entry has not been seen by the writer. It is reported to be entirely in Denison Group rocks, however it will cross the contact into the underlying Tyndall Group this year. It is important that an exploration geologist map out this contact before all the timbers and rock bolts are placed.

Based on the writer's experience, there is nothing special about the Denison Group. Hematitic siliciclastic sequences of similar age are well known throughout the world. Hematitic alteration (read regolith) beneath these sequences are ubiquitous. In the writer's opinion the Denison Group preserved in western Tasmania is comparable to similar aged sequences in the North America, Europe and Africa. Perhaps Sino-Australasian Cambro-Ordovician sequences are special, but not based on the Tasmanian example. Suggestions made by Wright et al concerning the exotic

origin of the Denison as part of the Megasequence concept are interesting but without unequivocal support. Their discussion proposing an entirely late, epigenetic origin for hematitic alteration observed both within the Denison members and the underlying "basement" is so contentious that it detracts from what might otherwise be an plausible scenario.

3) The eastern contact of the Murchison Granite is a major fault and mylonite zone (see 1 above); elsewhere it is in intrusive or fault contact with Tyndall Group volcanic rocks, or in fault contact with Denison Group sedimentary rocks.

Contacts of the Murchison Granite with the Tyndall Group are not well exposed. Two such contacts are present in discontinuous road cuttings along the Anthony Road, one along the Murchison Dam Access Road, and a complete exposure is present underground in the Anthony Power Tunnel. In the Anthony Power Tunnel the granite is separated from volcanic rocks by several metres of massive barite mineralization. The barite is in fault contact with the volcanics. Displacement along the fault is unknown, but is thought to be minor. The adjacent granite is brick red-coloured and rich in fine-grained K-feldspar. Volcanic rocks are marked by contact-parallel foliation and weak to moderately strong, joint controlled K-feldspar alteration over a horizontal distance of up to 100 metres. There is no macroscopic evidence of a contact metamorphic aureole. The surface projection of this contact is present on the Anthony Road, 1.6 kilometres south of the Tunnel turn-off. The actual contact is obscured by thin overburden, however there is sufficient exposure to indicate that the granite and the volcanic rocks are both heavily K-feldspar altered. No fault was noted. It appears in both cases that the contact is near vertical. No barite was noted on surface. A second contact, approximately 2.0 kilometres north of the same turn-off is again obscured by overburden. It appears that the volcanic rocks may be highly sheared and chloritic near the granite. The granite itself is highly saussuritized. On the Murchison Dam Access Road the granite is in fault contact with the Tyndall Group volcanic rocks.

It appears that the Murchison Granite was emplaced passively into the Tyndall Group, accompanied by considerable late potassic alteration. The lack of a thermal aureole may suggest that the Tyndall Group was at relatively high P - T conditions during granite intrusion, with a bulk composition that did not favour contact metamorphic mineral stability, or that the granite and the volcanic rocks are consanguineous and the granite is incestuously intruding its own daughter volcanic pile. All faults appear to post date intrusion, and there is no evidence of structural (thrust ?) emplacement, or major shear along its margins.

A contact between Murchison Granite and Denison Group quartz pebble conglomerate is exposed at several locations along the southwest shoreline of Lake Mackintosh. All contacts trend near 160°N, dip east and are marked by thin shears, zones of fracturing and base metal veining. The writer would interpret these contacts as post-granite, post-Denison faults, probably related to early

reverse faults attributed to the Devonian Tabberabberan Orogeny.

4) The contact between the Tyndall Group volcanic rocks and the Farrell Slates, an epiclastic-dominated sequence, appear to be conformable and gradational over several tens of metres. This contact is best viewed in drill core, as Anthony Road and Murchison Dam Access Road exposures in the vicinity of the contact are covered.

The writer is not aware of any formal definition to the Farrell Slates. Its lower stratigraphic boundary is thus undefined. It is suggested here that the base of the Farrell Slate unit be defined by the first grey, laminated mudstone, siltstone or volcanic wacke present above quartz and feldspar-phyric volcanic (being either epiclastic, pyroclastic or of flow origin) rock typical of the Tyndall Group. As grey epiclastic rocks with abundant and self-evident sedimentary bedforms are rare in the Tyndall Group, this definition should be viable. Quartz-phyric volcanic debris units, however, are characteristic of both the Tyndall Group and the Farrell Slate.

Two diamond drill holes, STP 101 and 105, appear to penetrate the lower Farrell Slates and upper Tyndall Group. The upper Tyndall is a thick-bedded, quartz-phyric pumiceous rhyolite. A debris flow origin is likely. Some flow tops are more chlorite and tuff (?) - rich. Bedded-appearing, chloritic lithic tuff, up to 4 metres core length, overlie the Tyndall-type rhyolite, which is in turn overlain by laminated, siliceous, tuffaceous and sulphidic mudstone of uncertain thickness. Several tens of metres of intercalated quartzose and tuffaceous wacke, mudstone and debris breccia occur above this.

Both holes may have been drilled down-dip, though structure is uncertain. Core recovery was poor, perhaps indicating the presence of faults and/or un-recovered mudstone. The Tyndall Group - Farrell Slate contact may be placed at the base of the siliceous, sulphidic laminate. The writer believes that these holes are located in an area of volcanogenic massive sulphide potential, which, if true, would suggest that these holes may be poor candidates with which to define the contact. Additional work, including re-logging of holes well north and south of STP 101 and 105, is required. Also, a check of prior geophysical survey plans should be made in order to assess whether other parallel zones of conductivity exist, deeper in the Tyndall Group, to the east, which might be attributed to additional mudstone units and lend support to moving the actual contact deeper in the section.

5) The Murchison Granite is composed of two primary rock types. A third phase is thought to be hydrothermal in origin. The Tyndall Group displays considerable variation in lithology, however these may be difficult to map at scales coarser than 1:1000. The Farrell Slates are very heterogenous, however a "facies" approach to mapping maybe more applicable than a conventional, layercake succession approach. The writer noted considerable evidence of transposition of bedding and clasts by deformation in both the

Farrell Slates and the Tyndall Group. In general, many measured bedding attitudes are suspect, and only attitudes derived from the gross distribution of major units is reliable.

Only exposures of the Murchison Granite in the Anthony Tunnel were examined. The principal phase is a grey to pink, medium-grained to sub-porphyrific granodiorite. Dark to mid-grey xenoliths of unknown lithology are only locally common. A second phase, a coarse grained white to greenish-white leucogranite is common from 1500 to 2000 metre from the portal at the eastern margin. It is characterized by white to greenish plagioclase and quartz. There is a marked paucity of ferromagnesium minerals such as hornblende or biotite. Local patches of greenish colouration may be owing to weak saussuritization. Contact relations between the two intrusive phases is uncertain. Exposures were located which clearly displayed leucogranite xenoliths as large blocks in the granodiorite. Elsewhere, dykes of leucogranite were seen to cut granodiorite. Brick red colour alteration, along horizontal and vertical joints in the granodiorite is common. It is most abundant and pervasive nearest the contact with the Tyndall Group volcanic rocks. This alteration appears to be a hydrothermal, potassium feldspar overprint. Again ferromagnesium minerals appear to be minor to rare. The age of this alteration is unknown. It maybe Cambrian and therefore related to the granite, or later, possibly Devonian. The writer prefers an older age.

The Tyndall Group is characterized by rhyodacite to rhyolite block breccia, tuff breccia and tuff. Ninety percent of the time it appears as a dark-coloured rock with pink to grey clasts in a dark green to grey matrix. Clast and matrix contacts are indistinct, rarely sharp. Quartz phenocrysts, and to a lesser abundance plagioclase, is ubiquitous. Three variations in Tyndall lithology are noted in (2) above. In addition, between the Murchison Granite and the Farrell Slates, other lithologic units are present including white-weathering, grey coloured on fresh surfaces quartzose lithic tuff, water-laid tuff and tuffaceous wacke. A distinct "swarm" of massive greenish grey to red coloured, weakly foliated dykes or sills of quartz-feldspar porphyry are common both underground in the Anthony Power Tunnel and along the Anthony Road north of the granite. These may constitute a north-trending swarm of regional extent. Although not established by mapping, the writer suspects that the Tyndall Group is (i) more massive and truly pyroclastic or flow-rich towards the base, and more thick and thin-bedded, epiclastic in nature towards the top, and (ii) the transition between i and ii is rapid and occurs in the vicinity of the dyke swarm. Additional mapping, both underground and surface, is required to test this notion.

The Farrell Slates appear to be a fining-upward sequence of felsic debris flow breccia, tuffaceous wacke, siltstone and mudstone. Bedding transposition and bedding parallel shears appear to be common and severe, making succession type geology unreliable. No markers have been noted to date. Crude facies mapping, employing the relative proportions of breccia, tuff, wacke, siltstone and mudstone suggest:

-the base of the Farrell is marked by a siliceous, sulphidic black mudstone, of unknown (though probably less than 10 metres) thickness. Of note is that this mudstone is the only truly black carbonaceous mudstone seen by the writer, the rest being dark grey, chloritic and carbon-poor.

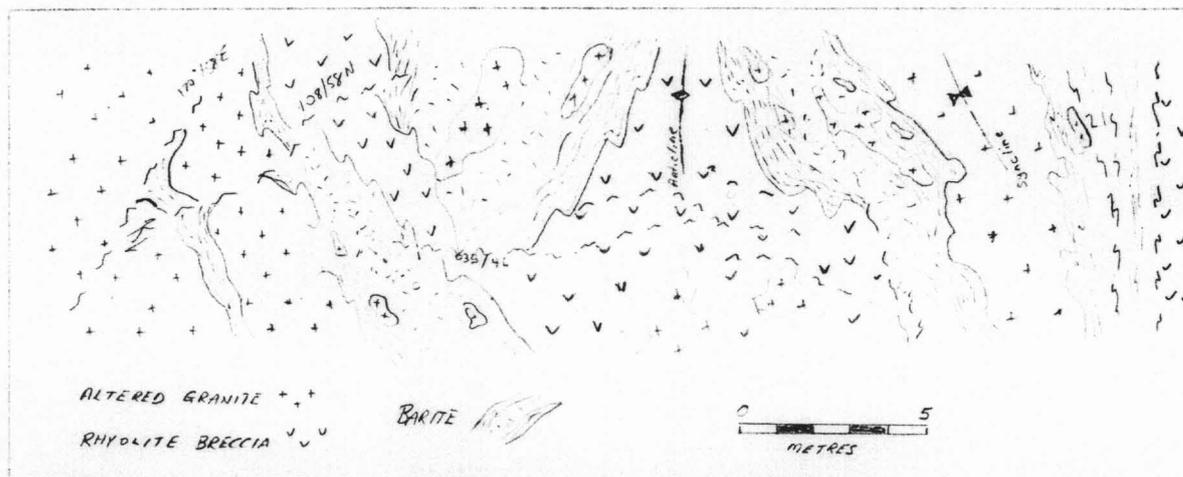
-overlying is a thick (several hundred metres ?) sequence of felsic debris. The overall impression is that the sequence both fines up-section and to the north. The writer has not logged enough core from different sections to establish this north to south trend. The upward fining is based on the increase in the proportion of wacke (sandstone) to siltstone to mudstone up section with a corresponding decrease in felsic debris and tuff, and a general change from massive, thick-bedded units to thick and thin-bedded laminates. It is envisioned that felsic debris breccia was derived from the Tyndall Group volcanic pile to the southeast, transported north and west into a flanking depression. The decrease in volcanic detritus indicates either a reduction in debris flow incidents, or a progressive shift to more distal regimes. Of note is that the Tyndall Group to Farrell Slates transition may be diachronous, and time is not necessarily parallel to the contact. A second major influx of volcanic debris maybe indicated by the occurrence of rhyolite debris breccia and tuff high in the Farrell sequence, outcropping along the Murchison Highway south of Lake Rosebery, near the Thomas Blocks prospect.

-it appears that the Farrell sequence may have an important intermediate to mafic volcanic detritus component near the top. This is based on hole SVD 87-1A, to which the reader is referred (see diamond drill log notes). This has important correlation implications across the Henty Fault Zone (see 7, following).

6) The discovery of a new, economic base metal deposit, preferably of a "volcanogenic massive sulphide" style as typified by the Rosebery and Heliyer Mines, is the *number one* objective of the exploration programmes in the Mount Read Volcanic Belt. The writer examined four styles of mineralization: (i) a barite occurrence exposed underground by the Anthony Power Tunnel, (ii) argentiferous galena vein mineralization in the Farrell Slates, (iii) auriferous pyrrhotite stockwork vein mineralization (Lakeside type) in close proximity to the Henty Fault Zone, and (iv) sulphidic black mudstone found in drill cores at the contact between the Tyndall Group volcanic rocks and the Farrell Slates.

*Mineralization in the sulphidic mudstone at the contact between the Tyndall Group and the Farrell Slates (style iv) is regarded as the most economically promising and is considered to be a priority target for follow-up exploration.* A low priority target is the barite mineralization exposed in the Anthony Power Tunnel, while Farrell-type and Lakeside-type veins are of minimal interest.

(i) Barite mineralization in the Anthony Power Tunnel is of potential interest, as it is similar in appearance to barite



Anthony Tunnel Barite Sketch Southeast Wall

mineralization found in the hanging wall of polymetallic volcanogenic massive sulphide deposits elsewhere in the belt. It is a laminated-appearing lens, from 2.0 to 4.0 metres true thickness, exposed in the tunnel walls over a horizontal distance of 20 metres. The lens is repeated by folding and faulting. Minerals include abundant barite with minor galena and calcite, trace sphalerite and fluorite, and rare chalcopyrite and pyrite. Total sulphide mineral content ranges from 0.5 to 2.0%. Mineralization occurs at the contact between a strongly potassium feldspar-altered phase of the Murchison Granite and deformed rhyolite breccia of the Tyndall Group.

A number of features are of note which may or may not be of importance in determining the age and origin of the barite lens:

- The lens is situated within a structural transition from brittle to ductile. To the northeast, in granite, no evidence of foliation is present, and veinlets are confined to straight vertical and horizontal joints. Within 10 metres of the lens the granite is cut by at least five "moderate to strong"  $155$  to  $168^{\circ}N/60^{\circ}$  East reverse faults, each marked by several centimetres of gouge and a well developed chlorite cleavage in the adjacent granite. Southwest of the lens, in the volcanic rocks, a strong foliation is present (however this is cut by reverse faults of the same orientation), and gash veins in reidel shears indicate reverse movement. Within the zone, the barite is complexly faulted, it is folded, and granite inclusions appear to be "milled", segmented and rotated.

The writer's opinion is that the barite mineralization does not owe its origin to a structural control of this type. It is thought that the brittle to ductile transition noted is a reflection of the transition from the relative isotropy of the granite to the anisotropy of the volcanic rocks, and would thus be a ~~look~~ of shear.

- The lens is folded into an anticline and syncline, with the footwall and hanging wall contacts marked by numerous barite peircement and cusplate structures. The folds trend approximately

160°N, plunging north at an estimated 30°. The western limb of the syncline is marked by numerous vertical faults with dextral throws. The core of the anticline is foliated rhyolite breccia; foliations are parallel to the barite contact, and clasts have not been stretched or transposed parallel to the axial plane of the folding. Numerous flat to slightly curving faults and shears are present in the volcanic core, perhaps developed as a result of compensation between the two differing mediums (the volcanic as compared to the barite). Flat faults in the volcanic disappear into box folds in the barite.

It is thought that this folding is synchronous with the previously mentioned reverse faulting. It is evidence that the barite lens was present prior to this phase of deformation, which is considered to represent the earliest phase of Devonian Tabberabberan Orogeny. Thus being the case, the barite mineralization is older than the Devonian.

- The lens has a vein-like symmetry, with laminar edges and a coarse, possibly inward-pointing bladed interior. Grain orientations are a guess by the writer, and supporting thin section studies are required. In addition the interior, coarse-grained portion of the lens is marked by numerous inclusion trains of altered granite. Though supporting evidence is incomplete, the writer suspects that the barite lens has a vein symmetry suggesting open-space growth. There is as yet no evidence of layer-by-layer bedding parallel growth as would be expected if mineralization was 'exhalative', nor is there evidence of strain-controlled growth. Thus the barite lens *does not* represent a "xenolith" of barite-rich mineralization from an as yet undiscovered polymetallic massive sulphide deposit.

- The Murchison Granite appears to be highly potassium feldspar altered in the vicinity of the barite lens. Potassium feldspar metasomatism has been noted elsewhere at the margin of the granite, and it appears that this is a late alteration phase of the intrusion, suggesting that the spatial relationship observed underground is coincidental, not genetic. However, the isolated occurrence of barite, galena, fluorite etc associated with and confined to a feldspar altered joint at 2432 meterage in the tunnel, some 162 metres distant, strongly suggests a genetic link. It is suggested that the barite mineralization is genetically related to late potassium metasomatic fluids derived from the Murchison Granite. This interpretation is supported by the "age" obtained from lead isotope studies of galena from the barite lens.

- Fluorite, and to a lesser extent coarse crystalline calcite appear to be paragenetically later than barite and base metal sulphide, occurring near crosscutting fault structures and in gash veins. It is postulated that these are syndeformation, related to Devonian-aged folding and faulting.

In summary, it is thought that barite and base metal mineralization in the Anthony Power Tunnel is vein-type, hydrothermal in origin and epigenetic in nature, and not indicative of conditions

favouring the existence of polymetallic, volcanogenic massive sulphide deposits. It is thought to be Cambrian-aged and related to late fluids derived from the Murchison Granite. This is a significant departure from convention which would relate most barite - fluorite +/- sulphide mineralization to Devonian granite-affiliated fluid systems. The mineralization is of uncertain, though probably low priority exploration potential. It has been exposed fortuitously by the H.E.C., and has not been tested down or up plunge by diamond drilling or surface prospecting. It is possible that this style of mineralization may change along strike and base metal tenor may increase, however it does not possess the characteristics which would suggest a major base metal ore zone is concealed nearby.

(ii) Argentiferous galena veins, usually accompanied by minor sphalerite, pyrite, chalcopyrite, arsenopyrite in a gangue of quartz, epidote, calcite and minor to rare tourmaline occur in the Farrell Slates in the Tullah and Sterling Valley area. This style of mineralization is referred to as Farrell-type mineralization. The writer did not devote much time to assessing the economic potential of this style of mineralization. It has had sufficient mining development and exploration drilling to demonstrate a low "tons per vertical foot" potential. It has been suggested that Farrell-type veins are related to pre-existing mineralization (Cambrian volcanogenic massive sulphide?), and that a metal-rich "source bed" might be present which can be traced by exploration drilling into a viable deposit. This possibility merits additional work.

The following are comments and observations concerning "Farrell" mineralization, and suggestions for follow-up exploration.

- the writer is impressed by the along strike predictability and continuity of the vein systems for "fissure vein" style mineralization. The veins appear to be hosted in late vertical extension faults, and mineralization occurs as spectacular, crystalline, crudely crustiform veins. Mine longitudinal sections suggest strike extent equals minimum vertical extent. "What one sees on surface is what one will get underground."

- not all vein systems have the same metal and mineral assemblage. Veins to the south have more copper, arsenic and gold (i.e. Sterling Valley), while mid-trend veins are more zinc and possibly barite-rich (i.e. Murchison Mines), and to the north the veins are lead and silver-rich (i.e. Farrell Mines, etc.), as the entire belt is usually described to be. The writer would suggest that much of the old mine development on the belt would have been controlled by local economic issues, such that those deposits with poor lead and silver tenor or poor metallurgy would be under-explored even though they might be equally strong and impressive sulphide mineralized systems. Several of the occurrences might be very misrepresented in the literature.

It is suggested that an effort be made to produce longitudinal

sections in the belt, and that drill assay and production data be collated so as to test for, and illustrate metal zonation patterns, both vertically and along strike.

- Though not studied in detail, all prospects and producers appear to have developed ore or explored in Farrell Slate epiclastic units. There has been little or no testing down to the contact between the Farrell Slates and the Tyndall Group. This may be due in part to the near parallel nature of veins and bedding in the northern part of the belt, however to the south the veins are closer to this contact. Interesting enough, the metal signature to the south is different, with more Cu, As, Au and possibly Zn. The intersection of Farrell-type vein structures and the Tyndall - Farrell contact might see two things: one is the source bed, or two, a significant change in vein morphology owing to the contrast in rock fracturing characteristics.

- It is a widely held belief that Devonian Granite underlies this area at relatively shallow depths. The mudstone members of the Farrell Slates should develop contact metamorphic mineral assemblages which will reflect the presence of the alleged intrusion. If this were known to be the case, it would be interesting to further compare the vein metal zonation data relative to proximity to the intrusion.

(iii) Veins of massive pyrrhotite and quartz stockwork breccia, accompanied by very low tenor gold, occur near the junction of the Murchison Highway and the Anthony Road. The "Lakeside Deposit" (Taheri and Green, 1990) and the "Arsenic Resource" are the best examples of this mineralization. Minerals include abundant pyrrhotite and arsenopyrite, and minor to trace magnetite, stannite, electrum, pyrite, galena and sphalerite in a gangue of quartz with minor tourmaline, epidote, calcite and muscovite. Mineralization appears to be erratic to spotty. Vein structures are present on both sides of the Henty Fault Zone, and are clearly crosscutting and not strata-controlled. Mineralization is thought to be related to Devonian granite intrusives which are thought to underlie the valley at relatively shallow depths.

Mineralization of this type has been explored in previous programmes. Results to date have not been encouraging.

(iv) Two holes drilled through the projected Tyndall Group - Farrell Slates contact intersected an attractive sequence of weakly mineralized and altered volcanic and sedimentary rocks. STP 101 and 105 were drilled in the early 1960's by EZ, apparently to test I.P. and Gravity anomalies (see JDB logging notes, under separate cover). Much of the core was un-split. It is in a poor state.

The geology is not well understood, however it appears that a steep (west ?) dipping sequence of unmineralized rhyolite breccia, tuff breccia and tuff, thought to be Tyndall Group, is in conformable contact with an unknown thickness (<10 metres) of black finely laminated mudstone. The mudstone consists of alternating laminae of chert, tuffaceous mudstone and what appears to be grey, granular barite, pyrite and trace sphalerite. Assay results for

this and other newly split and assayed intervals is not available to the writer. It is thought that this "pregnant" mudstone could be the base of the Farrell Slates. Notwithstanding its ultimate stratigraphic position, its appearance and mineralogy suggest that style of mineralization which found at the distal edges of a volcanogenic massive sulphide deposit. Unfortunately core below this mudstone penetration has scrambled footage markers and very poor recovery. However an oblique-to-bedding fault zone is probably present. Small fragments of core recovered suggest the occurrence of quartz-epidote-tourmaline veins with minor arsenopyrite, pyrrhotite, magnetite, galena and sphalerite. This is a style of mineralization usually blamed on the Devonian, and not considered to be of economic interest. The relation between the chips of vein mineralization and the sulphidic tuff is uncertain, but it is worth assuming that it is coincidental, until proven otherwise.

East of the zone of poor recovery, hole 105 intersected up to 81 metres core length of silicified, locally sericitic rhyolite tuff and breccia which hosts numerous folded veinlets of sphalerite, pyrite and chalcopyrite. The alteration and mineralization is reminiscent of the footwall alteration at Rosebery. Farrell type tuffaceous wacke and mudstone was intersected beneath the altered rhyolite. Graded bedding in this unit suggest a east, or up-hole facing! Unfortunately these are the only facings obtained, and would suggest that the altered rhyolite is indeed stratigraphic footwall, and the upper barren rhyolite is stratigraphic hanging wall. An alternative hypothesis is that the sequence is thrust faulted and possibly folded, such that the same rhyolite to mudstone sequence has been intersected twice.

The mineralization found in holes STP 101 and 105 is the most interesting seen by the writer in the Sterling Valley area. It is an attractive exploration target, warranting priority follow-up. The writer has not examined core from holes drilled north and south, however it appears that few, if any, test the Tyndall - Farrell contact. It appears that little by way of exploration has been done to examine this contact, either by means of geophysics, geological mapping or diamond drilling since the EZ Company campaigns of the late 1950's to early 1960's. It is an underexplored, previously unappreciated strip of geology which warrants renewed exploration.

7) The Henty Fault Zone is an important structural element in the Mount Read Volcanic Belt and the Sterling Valley and Tullah areas. It has been subject to many studies and reports, such that the writer has little new to contribute to the discussion. Several comments follow:

- the Farrell and Lakeside-type mineral occurrences appear to be spatially associated with the strike of the Henty. The nature of the mineralized structures and their relation to the Henty Fault Zone has not been well established. Establishing this relation is an important aspect of the source bed origin of metals for these veins.

- the writer had difficulty in distinguishing the difference

between intermediate volcanoclastic units present in drill hole SVD 87-1A west and east of the fault. A metamorphic difference is apparent, however lithology is very similar. This problem would be important if it were a widespread phenomena, however the writer suspects it is not.

- the Henty Fault Zone has a relatively undeformed and unmetamorphosed hanging wall, and a highly foliated, folded and metamorphosed footwall. Bedding transposition is evident in the Farrell Slates near the fault, however it was also noted at several locations in the Tyndall Group, and is again evident in the "Sticht Range" exposures at the Anthony Power Tunnel landing. It is possible that both the Henty and the Anthony structures are coeval, as they are of similar attitude, magnitude and aspect. This would imply a mid to late-Cambrian age for the Henty. The writer is tempted to think that the entire 5 kilometre wide panel of rock between the two faults is a single zone of ductile deformation, and that this deformation is mid to late Cambrian in age. It would be interesting if this interpretation could be developed further, and tied to the Rosebery and Great Lyell faults.

- the writer finds a basic appeal to the Cambrian "thrust" repetition scenario proposed by Allen and others at Rosebery - Hercules, and the implications of Wright, Lees and Lorrigan. It is of interest partly because the Henty and Anthony relationship suggested above may 'tie-in', however more importantly it opens up a greater area to exploration. It can be asked whether or not the original thickness of the felsic pile was much thinner than currently thought, and that the apparent great thickness is owing to thrust repetitions. A simplified implication of this is that those areas in the Mount Read where rhyolite passes upward into mudstone (thence upward into a thrust ?) may be equivalent stratigraphy to the Rosebery and Hercules ore position, regardless of which side of the Henty, or Rosebery Fault it occurs on.

## Geological Models

An objective of this work was to develop a "revised" geological model which relates mineralization seen in the Sterling Valley and Tullah area to new understandings of the regional geology. Most of the writer's observations and conclusions are preliminary; the following are comments only:

### 1) Regional Geology

The panel of Mount Read Volcanic rocks east of the Henty Fault Zone is a generally west-dipping homoclinal sequence. In ascending stratigraphic order this sequence is composed of Early Cambrian (?) Tyndall Group, including a lower member of massive volcanic breccia and flows, and an upper sequence of thinner-bedded volcanoclastic debris breccia and tuff, separated by an intrusive porphyry sill and dyke swarm. The base of the Tyndall Group is not exposed. The Farrell Slates conformably overlie Tyndall Group felsic debris flows, and are a generally upward fining sequence of felsic debris flows, felsic tuff, wacke, siltstone and mudstone. The Farrell Slate sequence is cut by the Henty Fault Zone. The Middle Cambrian Murchison Granite intrudes the lower Tyndall Group. The Late Cambrian to Ordovician Denison Group, a quartz arenite and conglomerate sequence deposited in a mixed fluvial to shallow marine environment, unconformably overlies the Tyndall Group, Farrell Slates and the Murchison Granite. No Devonian granitoid intrusive rocks are mapped in the area, however they are postulated to be present at relatively shallow depth (1000 m) in the Tullah area.

Cambrian units older than the Denison Group have been deformed by as yet poorly constrained late Cambrian tectonic event. The eastern contact of the Mount Read Volcanic Belt with older Precambrian rocks is seen to be a major mylonite zone (herein called the Anthony Fault Zone), which is post-Murchison Granite in age, but pre-Devonian Tabberabberan. The Henty Fault Zone is postulated to be a contemporaneous structure of comparable magnitude. Both the Henty and Anthony Fault Zones are regionally important structures. It is postulated that they represent Late Cambrian east-directed thrusts. Other, less evident thrust faults are postulated to be present. The entire panel of rocks, including the Denison Group, has been folded and faulted during Devonian Tabberabberan deformation.

### 2) Mineralization

No known deposits of Cambrian volcanogenic massive sulphide mineralization are known to occur in the Sterling Valley and Tullah area. It is postulated that the most favourable stratigraphic position to explore for mineralization of this type is along the contact between the Tyndall Group and the Farrell Slates. Though largely untested and under-explored, weakly mineralized black mudstone is present in core, and additional work is warranted.

Laminated-appearing barite mineralization, with minor base metal sulphide, fluorite and calcite, occurs at the contact between the Murchison Granite and the Tyndall Group volcanic breccia in the Anthony Power Tunnel. The occurrence is thought to be a vein, and genetically related to late hydrothermal potassic fluid derived from the Murchison Granite. It is of dubious importance as an exploration target, however it is evidence of the "mineralizing" capability of Murchison Granite-related fluid systems. Showings with this mineralogical and chemical signature is often attributed to Devonian fluid systems. The Anthony Tunnel occurrence is therefore important as it exposes the risk inherent in these sweeping assumptions and generalizations.

The Farrell Lodes, argentiferous galena fissure veins, with varying amounts of sphalerite, arsenopyrite, chalcopyrite and pyrite, occur in the Farrell Slates. The occurrences are again often attributed to Devonian fluid systems, focused into dilatant zones along the Henty Fault Zone. Lead isotope and sulphur signatures suggest an important contribution of metal from Cambrian-aged sources. The writer concurs with a post-Cambrian, probably Devonian age to the mineralized structures. If lead isotopic evidence is to be weighed into a genetic model, then a Cambrian metal source conclusion is inescapable. This is derived either from a "source bed" in the Cambrian, or from mineralization assimilated by Devonian granitoid, subsequently remobilized into the Farrell Lodes structures. The Tyndall Group - Farrell Slates contact is a possible "source bed".

### 3) Models

Emphasis need not be placed on developing new exploration models solely because geological models are constantly being revised.

The search for polymetallic massive sulphide mineralization such as Rosebery or Hellyer may still proceed using long established guidelines, providing that they are applied consistently. Regardless of whether the sulphide mineralization is truly stratiform or locally cross-cutting, several fundamental characteristics of most VMS deposits remain:

- i) Mineralization is strata-bound;
- ii) Underlying units are altered and frequently mineralized by cross-cutting, fracture-controlled mineralization;
- iii) Overlying units are rarely mineralized and only weakly altered. Alteration minerals differ from those underlying the sulphide lens;
- iv) The stratigraphic position at which either stratiform sulphide mineralization occurs, or at which cross-cutting mineralization terminates, is often characterized by a "halo" of altered and mineralized rock, and often by detritus of both sulphide-mineralized and altered rock fragments. The halo or detrital apron exceeds the immediate strike extent of economic sulphide mineralization;

- v) Mineralization occurs at the intersection of bedding surfaces and fractures. These fractures are frequently seen to effect the distribution of rock facies and thicknesses both above and below the mineralization, and are the loci of alteration (and sometimes later intrusion). Facies and thickness changes about these fracture corridors are easiest to document and are more evident in overlying units. Underlying units are often too altered to satisfactorily demonstrate original rock variations. Fracture systems displaying these types of geological control are interpreted to be synvolcanic in age; and
- vi) While mineralization is essentially strata-bound in character, and may occur or even cluster along a specific stratigraphic horizon, mineralization is not so evenly or so randomly distributed as to suggest only stratigraphic control on deposition. Syndepositional elements, such as growth faults, doming above intrusive sills etc, and corridors of contemporaneous fluid discharge are equally important controls, and the recognition of such are critical to discovery.

The writer suggests that these exploration guidelines may effectively be applied to subsequent exploration programmes in the Sterling Valley and Tullah area, particularly to the stratigraphic interval represented by the transition from the Tyndall Group volcanic rocks to the Farrell Slates.

Several aspects of the regional geological model are important to exploration. Most of all is recognition of the nature and extent of the enigmatic Late Cambrian deformation event. The best evidence and most plausible interpretations proposed suggest a period of large scale thrust faulting, possibly across the entire Mount Read Volcanic Belt. Recognition of thrust-related structural elements is therefore of utmost importance. The scope for structural repetition of both favourable stratigraphy and mineralization is great in such a tectonic environment, and merits careful consideration during exploration mapping. Also, massive barite such as in the Anthony Power Tunnel is important, as it testifies to the ability of the Murchison Granite to produce mineralization (which, if encountered in drill core would have precipitated a lot of drilling). It also calls into question the frequently expressed assumption that "if its not a polymetallic massive sulphide, then blame it on the Devonian." (and walk away).

Other regional geological and exploration models have been proposed for the Mount Read Volcanic Belt, all with some merit, and worth consideration. A contemporary model proposed by Wright, Lees and Lorrigan take standing lithostratigraphic subdivisions and suggest that they are instead tectonostratigraphic subdivisions. Six megasequences result, such that the Denison Group becomes Megasequence 4, the Precambrian is Megasequence 1 etc. Each megasequence is bounded by a thrust, and each has been successively

and allocthonously stacked onto western Tasmania. Accompanying deformation therefore occurred in the Cambrian and Ordovician, as well as the more easily recognized Precambrian and Devonian deformations. There is some appeal to the thrust-stacking model, though the writer suspects evidence is slim for separating megasequences 4 through 6. Notwithstanding this personal hesitation, regional tectonostratigraphic analyses of this nature are probably beneficial, even at the property scale.

Wright, Lees and Lorrigan further suggest that important polymetallic massive sulphide deposits such as Rosebery, Hercules, Mt. Lyell, Que and Hellyer are epigenetic and syntectonic, formed post-deposition during the Late Cambrian to Early Ordovician. They propose that older megasequences formed "kitchens" wherein metals were leached from thermally mature source rocks and migrated along Middle Cambrian to Early Ordovician thrust faults, called freeways (or is it fairways: if we are expected to use contrived words, lets expect the authors to set the standard of consistent usage). Fluids were then trapped in structures or replaced units in dilational zones, or at impermeable shale beds, or reduction fronts. Other aspects are considered, and the reader is referred to their 1991 report.

The writer tried to examine the ore deposit model of W.L. & L. during the time while in Tasmania, especially with respect to Rosebery, Que, Hellyer and the Farrell Lodes. This model has all the aspects of being the "flavour of the month" and has management if not worker appeal. Therefore it was thought that it should be carefully considered during the course of work on Tullah and Sterling Valley. The writer is of the opinion that many of the observations made in the report are highly interpretive and questionable. Many arguments are made and hypotheses advanced which are based on incorrect or incomplete (dare say misleading) data and suspect interpretation. The writer saw no geology which supported their epigenetic and syntectonic ore model, as outlined. No grassroots exploration or mine properties were encountered where this model could provide a useful exploration shortcut or alternative.

## RECOMMENDATIONS

1) Additional exploration is warranted on the Tullah and Sterling Valley E.L.'s. Future programmes should include:

- drill hole database should be computerized, complete with survey data,
- drill core to be re-logged on a sequential fence-to-fence basis, emphasizing the Tyndall Group - Farrell contact and facies relationships above and below this contact,
- a geological map should be produced, based upon core and outcrop information, demonstrating unit continuity or facies distribution of the Farrell Slates, the effect of folding and shear, and the nature of the contact of Farrell members with the Henty Fault Zone, the Tyndall Group and possibly the Denison Group,
- drill holes, geological interpretation, mineralization, geophysical anomalies and trends, and soil geochemistry should be compiled onto a single map,
- a second plan should illustrate surface exploration coverage, type and vintage,
- longitudinal sections should be developed illustrating metal zonation on the Farrell Lode system,
- a new grid should be established in the STP 101 & 105 area, geologically mapped and ground geophysically surveyed with I.P., HLEM, and UTEM and possibly gravity.
- careful consideration should be given to drill testing the Tyndall - Farrell contact at the STP 101 site, perhaps by drilling in the opposite direction from west to east.

2) The Anthony Power Tunnel should be re-mapped, from end to end, with the Tyndall Group - Denison Group contact being examined in detail.

3) Government and university geologists should be encouraged to continue examining fundamental issues thought by Pasminco geologists to be important. This report identifies several possibilities, including the Anthony Fault Zone and the stratigraphic definition of the Farrell Slates.

*J. Blackwell*

U. Blackwell

03/92

jdb/JDB

APPENDIX 1

ANTHONY TUNNEL BARITE OCCURRENCE

Field Notes

## ANTHONY TUNNEL BARITE OCCURRENCE

## Field Notes

Following are abbreviated notes made from an examination of the tunnel exposures.

**The Murchison Granite:**

Three phases are present, possible oldest to youngest:

Coarse-grained (1-2 cm.) quartz and plagioclase, less than 10% feldspar: **Leucogranite**. Relationship to other phases uncertain. Seen as dykes cutting granodiorite. Also seen to be cut by, and be xenoliths in the granodiorite. Note also published descriptions mention late "aplite" dykes. Similarity between aplites and leucogranite uncertain.

Tunnel notes, metres from portal entrance;

At 1950 m leucogranite in reverse fault contact with granodiorite. To 1935 m. Note cpy, gal veinlets

At 1970 m: 3 m wide leucogranite dyke

at 1880 m: 12 m wide dyke. Grey xenoliths. U contact sharp. L contact indistinct.

1790 - 1800 m: xenoliths of leucogranite in granodiorite Dykes of granodiorite cutting leuco.

1770 m: leuco dykes.

Grey/green to reddish, medium-grained **Granodiorite**. Equigranular to sub-porphyrific. Plag, K-spar, quartz, hornblende, sparse biotite. Locally intense green chlorite as cross-cutting veinlets, and after hbl and bio. Blocky breaking habit. Seen as vertical dykes cutting leucogranite and in (subtle) chilled contact. Also seen in fault contact. Age relationship uncertain.

**Brick-red Granite**. Fine to very fine-grained, sub-porphyrific K-spar (?) -rich, probably minor plag. abundant quartz, 10 to 20% hbl and biotite in more crystalline phases. Tends to break with a conchoidal habit in fine-grained areas, blocky elsewhere. Seen to cut granodiorite as sub-horizontal sills and near-vertical dykes. In vicinity of barite occurrence, joints in granodiorite are stained red, and can be seen to be loci of granite intrusion. Granite also cuts country rock volcanics. Contacts diffuse to sharp, often fracture controlled. This phase appears to be superimposed upon both granodiorite, leucogranite, and the volcanic units. It is probably not a discrete granite phase, instead being a product of intense, late hydrothermal, potassic

alteration. Alteration appears to be focused along late joints and fractures. It is offset and deformed by faults assigned to Devonian movement. It is very intense in the vicinity of the barite occurrence, and "xenoliths" of this protolith are present in the barite mass.

#### Volcanic Rocks:

Rhyodacite to rhyolite volcanic breccia is seen in contact with the barite. It is composed of large white to grey lapilli to breccia sized fragments, up to 1 m length, in a dark siliceous and chlorite matrix. Frags and matrix are notably quartz, and to a lesser extent plagiophyric. Pronounced flattening of clast and matrix schistosity is noted. Volcanic units (and fabric) is folded at the barite occurrence, suggesting a pre-Devonian phase of Deformation.

#### Late-Volcanic Dykes:

Beyond meterage 3000 m, large dyke or sill-like masses of grey to green quartz and feldspar porphyry are common. Contacts with adjacent volcanic breccias are sharp to foliated. The dykes display little internal schistosity. Possibly late, syn-tectonic dykes?

#### Structure:

Reverse faults, at  $165^{\circ}/45-60^{\circ}E$  are present. Several observed in first 2 km of tunnel, often associated with quartz pyrite vein breccias (i.e. at 850 m). Noted as being more frequent at the barite locality, and in the volcanic rocks. Reverse sense of motion. Subtle C-S fabric development in granite, marked by chlorite around feldspar "augens." Gash veins (plag, qtz, ct) horizontal and vertical north of faults. Reidel shears south in the volcanics, same sense. These structures are seen elsewhere, and are known to cut the Precambrian, Sticht Range Beds, CVC and Tindale Volcanics and the Denison Group. They are manifest as thrusts in all units, and are parallel in trend to the major and minor north and south plunging folds in the Denison. They are probably Devonian, possibly Berry's D1. Folding in the barite and adjacent volcanic and granitic rocks is seen to be a product of this deformation. This strengthens a pre-Devonian age for the barite mineralization.

Anticline-syncline in barite based on secondary folds and vein symmetry. Cuspate +/- or piercement structures also present. Numerous rafts of granite in barite, possibly as boudins. Folds plunge south, probably between  $20$  and  $30^{\circ}$ . Volcanic units in core of antiform also deformed, with cleavage and clast orientation paralleling barite contact. Numerous curving faults, within core, possibly developed to accommodate fold.

Late dextral faults at south end of barite. Badly segmented. Possibly Berry D2, Devonian fault. As seen elsewhere in the belt.

**Barite Vein**

Vein composed of barite, fluorite, calcite, minor galena, sphalerite, trace pyrite, chalcopyrite. At thickest, where not cut by displacing faults, vein has a pronounced laminated appearance on one side (F/W) and coarse, random and massive appearance on other (H/W). Xenoliths (? check not cross-cutting) of red Granite found in banded barite, very common at transition from laminated to massive.

Banding: appears to be crustiform, however check for alignment in thin section, to see if crystals point perpendicular to vein walls, or parallel laminations. Granite frags appear rotated; check for pressure shadows or concentric growth. Also reddish stain pervasive about frags and vein walls, as seen on joints elsewhere.

Second fabric seen in vein, subhorizontal. Possible calcite alteration along gash veins, as seen in adjacent volcanics.

Adjacent to late faults, coarse granular calcite is abundant. Possible location of most fluorite.

**Origin:**

Uncertain. Barite deformed in a manner consistent with regional deformation. Granite not chilled against vein. Possibly barite is a xenolith. Writer's preference is a Cambrian vein, related to Murchison granite, subsequently assimilated by late red granite. Occurrence within two bounding structures, at change from brittle to ductile deformation no co-incidence. If Cambrian, this departs from conventional placement of most barite-fluorite-base metal veins in region as Devonian-aged mineralization associated with Dev. granites.

**Geophysics:**

An EM37 survey was completed 07-02-92 down tunnel with the electricity on. No response. Bullshit survey, but worth the shot. If any highly conductive body was present, survey should have detected something.

**Supporting documents:**

Analabs Report #111310.60.08365 assays & analyses, whole rock  
 Purvis to supply sample descriptions  
 Tas Uni: Lead Isotopes  
 Stolz: Thin section report

**Miscellaneous:**

Presence of epidote +/- hornblende, quartz, plag. veins along some of the fault and joint surfaces north of the barite zone. Possible Devonian signature. Veins of coarse grained Galena, fluorite, pyrite in association with a large vein of qtz,

calcite and coarse pyrite, adjacent to a D1 structure in granodiorite north of barite zone (2260 m). Associated with gently NE dipping quartz veins (strongly brecciated, but not deformed or rotated), cutting granodiorite. Galena in splay. Berry reports other gal occurrences in Murch gran. Also, at 2432 m, 1.5 by 0.4 m "patch of vuggy fluorite, galena and barite in "granite" altered vertical joint. Does not extend into granodiorite. Suggest relation to Kspar alteration event.

APPENDIX 2

REVIEWS OF TECHNICAL REPORTS

STERLING VALLEY (E.L. 4/73) FINAL REPORT  
by  
HALL, HUNGERFORD & PURVIS  
for  
BILLITON AUSTRALIA  
Rept #08.3912

Comprehensive report, following upon drill testing the Henty Fault Zone for gold Mineralization. Useful review of targets. Of value to current VMS - directed programme, as it reviews many of the geophysical targets in the lease area.

Page 19: abbreviated log for hole SVD 87-1A. Re-examined by writer. Note also Appendix 1 has full logs and assays. note Purvis calls rocks Basalt, Blackwell andesite. All but one of Purvis' thin section reports suggest andesite.

Page 23: last paragraph discusses broad conductive zone, 200 - 300 m east of Henty. not well tested. This may be the feature in the vicinity of holes STP 101 & 105. Need to investigate and establish grid location.

Page 27: point 2 on aeromagnetic anomalies in SE corner. May be due to moderately magnetic quartz - feldspar porphyry dykes, seen in Anthony tunnel and on road.

Also, and IMPORTANT: note discussion on gravity survey on 3260N. it appears from this discussion that an anomaly exist(ed) [you know geophysicists] where STP 101 was drilled. Also, a coincident IP/resistivity anomaly is reported. A state-of-the-art re-survey might be considered, covering more than just one line.

Page 31: has intersection of "arsenic resource" and chloritic Lakeside trends been explored. Probably don't meet. Check. Suggested by others they are fault offsets of the same vein. This might also be tough to swallow.

Page 34: Anomaly D. I believe that there is a misprint, and that the anomaly is west. It reads to much like the latter pg 27 description, and says it was tested by SV 3 & STP 105. It must join or be very close to the STP 101 feature, as both 101 and 105 cut the same panel of rocks.

Page 35: Note discussion on Henty appearing to cut out units. this is an important phenomena to document. Is the Henty a thrust in this area or not. JDB notes on ddh 87-1 suggest that volcanics west of the fault are overturned, and that the Farrell units immediately east are difficult to distinguish from the western volcanoclastics, save that they maybe more deformed.

Page 36: point 3. this possible alteration corridor needs further examination. If the rocks of STP 101 and 105 extend this far south, let's check this cross-feature where it hits the favourable horizon.

## Sterling Valley E.L. 4/73

Report by I.R. MacDonald (1985) - T210

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Interesting report, addressing Au - As Mineral potential.

Value may lay in stratigraphic nomenclature and alteration zones.

Specific items to consider:

Page 5: East contact of Farrell Slates with Mace Mine Volcs (Eastern Volcs, CVC; Proposed re-name) Use DDH STP 101 & 105

Re-log 101 & 105

Check for shear contact, transposed bedding in Farrell.

Page 6: Strat notes Units 1 & 2. Note suggested thickening and thinning relationships. If primary depositional attributes, consider presence of syn volcanic fault. Constrain. Alteration? Note Unit 2 hosts Sterling Mine mineralization.

Page 7: Note discussion of section preservation. Does not suggest units cut by Henty fault. This is a substantial thickness variation in just 1500 metres. If real, is it due to faulting or depositional processes or prolate extension or ?? Is there any correspondence to the Units 1 & 2 changes, noted pg. 6.

Page 11: 65<sup>0</sup> west dip to Henty fault. Comments on relatively inconspicuous nature of the HFZ.

Page 26: Bousquet comparisons. Many of the rock samples seen on the Henty Gold development muck dumps could have come from Bousquet or Hemlo. The similarities may be tempting, but I know few details of Henty, and other, perhaps more applicable models have been proposed for Bousquet & Hemlo. Regardless, banded-appearing pyrite - muscovite - quartz Au deposits in high strain zones remain a likely exploration bet in the Tindale Group felsics.

## NOTES ON:

## "GEOLOGY OF THE TULLAH - MT. BLOCK AREA"

by

MCNEIL &amp; CORBETT (1989)

Mt. Read Volcanics Project; Geological Report 2

Map published separately

Page 7: Section on the Dundas Group, Correlation and Stratigraphy

-note comments on the 'fiamme'-bearing rocks in an ash matrix. Talks about rafts of micaceous greywacke and shale, up to 100 mm long. North of Tullabardine Creek [CP887878].

Is this similar in nature to Allen's mica --> feldspar replacement phenomena seen at Whitespur, Hercules and Rosebery?

Page 11: Section on Farrell Slates.

- note comments on 'fiamme' rocks. "It is possible that the ignimbritic lithology is part of the CVC and the Henty Fault passes through the position marked by dykes. At CP870827, the Henty Fault may also be intruded by a mafic dyke, which separates vitric tuff, to the north-east, from pink dacite lava, typical of the CVC near Tullabardine dam."

This has strong implications on both the position of the fault and local stratigraphy. Should be checked in drill core if possible, to see distribution of this unit. Also dykes could provide age constraints.

Page 16: Barite

- field check barite mineralization at two locations around the Mackintosh copper - silver mine.

APPENDIX 3

ABBREVIATED DRILL LOGS

## ABBREVIATED DRILL LOGS

J. Blackwell

## README:

These notes are not designed to be a detailed re-examination of old core. The objective is to note major rock units, identify potential markers, test ideas on structure and correlation, and develop ideas on facies distributions. These do not replace a good, careful, detailed examination of all these holes and others by one geologist, with a purpose of developing a comprehensive understanding of the Tullah and Sterling Valley areas.

File Note  
STP 101 & 105: Points to Ponder

Holes STP 101 & 105 were logged simultaneously, as they appear to cut correlative units. The exercise is frustrated by the deteriorated and scrambled footage blocks in 101, and poor recoveries in both holes. Regardless, an attempt is made. One good question, is why should two holes, supposedly drilled downdip, have such a variation in lithology; i.e. they appear to cut a great many units, suggesting either much steeper dips (75 to 90°) or folding, or the dips are to the east here. STP 105 could have cut a major fold, however the axial region is a zone of very poor recovery, and only a crude unit symmetry and numerous interfolio folds suggest a fold. The writer favours thick and thin bedded units, with a steep west dip.

Another question/observation. The rocks have a hornfels appearance. Both holes have numerous quartz veins and siliceous zones. Pyrrhotite, pyrite, and minor galena is present. Quartz, epidote and minor tourmaline are also observed. Possibly the favoured Devonian granites are relatively nearby. This may be further supported by the presence of widespread biotite in sandstones and siltstones.

Hole 101 has a thin interval of very heavy mudstone with minor lamination parallel pyrite and sphalerite. It may contain barite as well. In isolation it is an attractive rock, however the core recovery is very poor, and fragments of core are present beneath this zone which contain quartz, pyrite, arsenopyrite and tourmaline. Recovery is so bad that this latter mineralization may be 1m to 20 m further downhole. Hole 101 may have got hung up in a west-dipping, fault, that may be mineralized by the Devonian vein-type assemblage. An enigma. Regardless, the pyritic mudstone is seen also in hole STP 105, such that there might be a favourable horizon to test with additional diamond drilling. Underlying felsic units in 105 are siliceous, locally micaceous, and cut by numerous stringer veins of sphalerite, pyrite and minor galena and chalcopyrite. None of these weakly mineralized intervals have been split and assayed, nor have they been "flagged" as being of potential exploration interest by previous workers.

The STP 101 "hit" should be scissored with a hole from west to east, penetrating the area of interest at the same elevation. This will solve geological correlation concerns, has well as testing the prospective horizon.

Both STP 101 and 105 contain the most "proximal" volcanic units seen in holes logged to date from east of the Henty Fault. It may be suggested, with obvious danger, that the upper "Tindale Group" to "Farrel Slates" transition is characterised by relatively thin-bedded sequences of pumiceous epiclastic debris flows which appear to source from depth to the south. The section becomes increasingly distal northwards and up section. This pattern is a

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generalisation only, and is not yet fully evaluated by logging of additional holes. No true primary pyroclastic or flow volcanic units have been identified in the core logged to date.

## STP 101 and STP 105

Note: Original drill logs not available. Re-log by MacDonald available. Down hole survey data in MacDonald. Many missing intervals, either assayed in the round or poor recovery or both. Wooden footage chips. Plastic trays. Chips scrambled and not reliable in poor recovery segments. Many mineralized intervals remain unsplit and not assayed. Most of these are narrow. Intervals are at best approximations after first major felsic interval.

Marker chips in feet.

General Observations: Core cuts "proximal" lithic breccia and tuff. Probably epiclastic debris flows. Grading not clearly evident, however this could be from oblique coring angle.

Mineralized interval of interest, baritic (?), pyritic mudstone at approximately 172 metres in 101. Unsplit, not assayed. Unsplit sphalerite stringers evident in volcanic units deeper in 105. Deeper intervals below toe of 101.

Good correlation of units to top half of STP 105. Recovery problems in both hole make correlations throughout uncertain. STP101 at 290Az (-47°)/STP105 at 290Az (-53°)

STP 101	STP 105
0 to 330.0 ft	0 to 308.5 ft
0 to 100.6 m	0 to 94.1 m
Rhyolite lapilli tuff, lapilli breccia. Pinkish when weathered, otherwise cream to buff coloured. Variably schistose, most so in zones of extremely quartz phyrlic tuff. Very quartz phyrlic. Both prismatic, glassy crystalline, and rounded, milky (metamorphic ?) shapes. Locally to 25 - 30%. Plag phenos also abundant, to 10%. Large "pumice" blocks, variably flattened, quartz and feldspar phyrlic. Grey, black and mid-green coloured. Vague sense of sorting of clasts, but not clear. Variably schistose, siliceous, not notably micaceous. Base of sequence streaky and laminar appearance, perhaps mylonitic; very siliceous.	
330.0 to 344.0 ft	308.5 to 321.0 ft
100.6 to 104.9 m	94.1 to 97.9 m
Fairly distinct mid to dark green coloured lithic lapilli tuff, possibly andesitic. Good to chlorite alteration zone. Well-packed angular shards of andesite, rounded clasts of felsic pumice (?). Gradational upper and lower contacts.	
344.0 to 559.0 ft	321.0 to 417.0 ft
104.9 to 170.4 m	97.9 to 127.1 m
Very distinct unit of laminated, fissile, tuffaceous mudstone. Lams are high contrast, with alternating black mud,	

873.0 to 985.0 ft

266.2 to 300.3 m

Tuffaceous sandstone and mudstone. Proportions are 50:50. Typical Farrell type epiclastic unit, locally severely foliated. Small lapilli to ash-size clasts common, dacitic. Feldspar phenos locally common, rare quartz. Few laminated, medium bedded mudstone intervals, to 20cm. Local grading, up hole (978 to 980 ft.).

985.0 to 1040.0 ft

300.3 to 317.1 m

Dacite tuff, minor grey mudstone. Highly foliated. Sharp lower contact Quartz vein in brecciated areas, with pyrite, up to 4 cm core length. associated with muscovite, epidote, bluish green phyllosilicate.

1040.0 to 1059.0 ft

317.1 to 322.9 m

Black Mudstone. Massive to laminar, trace pyrite. Cleavage 90° c.a.

1059.0 to 1062.0 ft (EOH)

322.9 to 323.8 m

Interbedded Dacite ash tuff and tuffaceous mudstone.

JDB/jdb

25/02/92

*Note this page & the next  
are in reverse order*

grey chert and silt, and sulphidic, rusty mud. Tuff debris common. Pyritic, slightly graphitic.

Last metre appears to be mineralized with barite, minor pyrite, trace sphalerite. Poor recovery after this, chips and core frags scrambled. Small frags of grey dacite tuff, Quartz vein material with aspy, po, py, tour, trace epidote. Hole probably hung up going down a fault.

572.0 to 702.0 ft  
170.4 to 214.0 m

Very little recovery. Badly scrambled and confusing footage chips. Little core. Mudstone?

702.0 to 860.0 ft  
214.0 to 262.2 m

Andesite tuff (?). Grey to dark green. Possibly a dyke? Cleaved, chloritic. Interval in 105 has several narrow mudstone intervals in centre of unit.

860.0 to 870.0 ft (EOH)  
262.2 to 265.2 m

Grey dacite lapilli and interbedded black mudstone. Dacite much more abundant in 101. Mudstone black, carbonaceous, massive to thin bedded, locally laminated and tuffaceous. Trace pyrite. End of interval in 105 marked by narrow quartz vein with pyrite, minor arsenopyrite.

Correlation of units between holes is breaking down, possibly owing to last interval being a dyke, as well as faulting, or both.

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Hole STP 105 Continued

607.0 to 873.0 ft  
185.1 to 266.2 m

Dacite to rhyodacite tuff and tuff breccia. Pumiceous. Moderately cleaved. At least two indistinct coarsening. Local black cherty frags and mudstone to 4 cm. Gradational upper contact over 60cm. Lower contact ground. Appears to be brecciated, silicified with pyrite.

Unit silicified, locally muscovitic. Numerous pygmatic veinlets of black sphalerite, trace chalcopyrite and pyrite. Separate distinct veined zones with arsenopyrite and pyrite (i.e. at 763 ft or 200.8m). Ptygmaform sulphide veinlets appear deformed. Perhaps early (?) stockwork - style veining. Not split or assayed!

Trace minor pyrite as discontinuous lams throughout. Possible sphalerite. Barite not evident. Poor recovery at end of interval, core ground.

455.0 to 519.0 ft  
138.7 to 158.2 m

519.0 to 607.0 ft  
158.2 to 185.1 m

## STP 217

Note: Core complete, though much has been quarter round sampled. Core badly shaken, many interval measurements may be inaccurate.

General observations: Hole cuts Western Volcanics, Henty Fault and Farrell Slates. Top correlates to STP 221. Good mineralized intervals of massive pyrrhotite.

0 to 14.6 m:

Overburden. Note oxidation extends to 45.5 m.

14.6 to 73.0 m:

Dolerite Dyke. Dark green, salt and pepper texture, medium to fine-grained, magnetic, not deformed.

73.0 to 103.6 m:

Andesite Flow, flow breccia. Mid to dark green, fine-grained, plag-phyric. Upper and lower contacts obscure due to poor recovery and alteration. Variably weak magnetics.

74 - 77 m and 91.5 - 95.4 m: quartz veins with disseminated pyrite and pyrrhotite.

98.4 - 99.4 and 100.8 - 103.6 m: Quartz vein stockwork with disseminated pyrrhotite.

99.4 - 100.8 m: massive pyrrhotite.

103.6 to 119.9 m:

Andesite Flow Breccia. Distinctive unit of variably-hued green andesite clasts in a dark to mid-green andesite matrix. Clasts are tuff to lapilli-sized, locally breccia, angular and cusped to sub-spherical. Fragments slightly stretched. Matrix plag-phyric. Fragments are usually fine-grained, some appear to have chilled rims, others reaction rims. More spherical clasts are lighter green to white, very plag-phyric. Matrix surrounding clasts is highly textured, appearing to be spherulitic.

Unit coarsens to base.

119.9 to 121.3 m:

Dolerite dyke. Fine-grained, mid-green, weakly magnetic, not deformed. Chilled upper and lower contacts.

121.3 to 122.0 m:

Andesite Flow Breccia. Very distinct, mid to light green hues. Mottled dark and light, numerous cusped cracks, "roundish" to angular clasts in a darker fine-grained matrix. Rare plag phenocrysts. Probably was a plagonite ash layer. Local drill marker potential.

122.0 to 146.6 m:

Andesite Flow Breccia. As in 103.6 to 119.9 m. Fragments are dominant very angular, cusped. Note buff-coloured clasts - possibly Kspar altered hyaloclastite. Large lapilli and block-sized clasts are notably plag-phyric with remarkable twinned phenos to 3mm. Cream-coloured clasts often flow-laminated or

## STP 220

Note: Core available complete, much quarter sampled, some boxes labelled at wrong end.

## General Observations:

Different units than STP 284, perhaps a deeper stratigraphic cut in epiclastic pile. Hole furthest east in area. Possible comparison to SV1 and STP 105 & 101 (drilled opposite azimuth). Check for more recent holes offering a further eastward collar location, resulting in a deeper stratigraphic cut.

Core characterised by both small and large scale upward fining cycles of volcanoclastic debris. Reliable and consistent west facing indicated.

Unit has potential as a correlatable sequence. "Conglomeratic" or sulphidic breccias present. Attractive markers and exploration target horizon present.

0 to 8.9 m  
Overburden

8.9 to 20.1 m  
Medium to finely laminated siltstone, mid-grey. Highly cleaved, locally convoluted and brecciated.

20.1 to 24.5 m  
Dacite tuff or flow, light grey to white. Quartz and plagioclase bearing granular aspect, highly cleaved and fragmented. May have been a dacite breccia, but textures obscure.

24.5 to 30.8 m  
Laminated fine sandstone and siltstone, dark grey to dark green. No reliable bedding. Upper and lower contacts infolded and sheared. Kink banding.

30.8 to 32.4 m  
Dacite tuff or flow, light grey to white. Plagioclase and quartzitic. Foliated upper and lower contacts. (as in 20.1 - 24.5).

32.4 to 35.9 m  
Laminated siltstone and sandstone. Dark grey to greenish black. Highly cleaved. Note presence of rusty "alteration spots". These may have a lithic nuclei. Watch for elsewhere. Sheared upper contact, gradational lower contact.

35.9 to 88.0 m  
Andesitic or Dacitic Tuff. Mid to dark grey. Well cleaved. "Muddy" aspect, possibly graphitic in upper 5 m. No good lithic clasts, "ghosts" of tuff to ash sized particles. Possibly a fine-grained flow, but biased to tuff.

88.0 to 95.0 m  
"TUFF". Fine grained white to grey tuff. Very siliceous, altered appearance, brecciated. Cleavage not pronounced. Could be

a separate unit as indicated, however also could be a alteration feature superimposed onto top of underlying unit. Has been quartered.

95.0 to 268.8 m

Graded Volcanoclastic Debris Units. Multiple units, possible most "proximal" at top, as coarsest.

95.0 to 125.6 m: Tuff, lapilli tuff. Dacite. Clasts of grey mudstone common, matrix supported. Well cleaved, stretched. Note small clasts of highly sericite altered tuff, straw yellow, with pyrite.

125.6 to 129.4 m: Conglomerate. Mudstone and tuff clasts, matrix and clast supported. Coarse at base. Sericite clasts. Pyritic. Possible exploration horizon. Need to find in two more holes.

Possibility is that this is an "old" fault, and 136.7 to 139.5 interval as well. Not the writer's favoured interpretation, however two more identifications in core would help to discount one or the other.

129.4 to 136.7 m: Lapilli tuff, as in 95.0 - 125.6.

136.7 to 139.5 m: Conglomerate. Upper portion distinct, lower half has abundant fin-grained pyrite, trace pyrrhotite, galena. Siliceous aspect. Either superimposed alteration or a sulphidic debris flow.

139.5 to 161.9 m: Tuffaceous mudstone, minor tuff. Mid-grey, mottled, faintly laminated. Tuffaceous intervals well cleaved. Upper 3 m looks altered, has disseminated and veinlet pyrite, and "patchy" ankerite-pyrite alteration. Gradational lower contact over 4.5 m, becoming increasingly clastic and tuffaceous. Base of interval: 30 cm bull quartz vein.

161.9 to 174.6 m: Dacite tuff and lapilli tuff. Grey. Plag-phyric, rare quartz.

174.6 to 181.2 m: Tuffaceous Siltstone. abundant quartz veining.

181.2 to 212.2 m: Dacite tuff, Lapilli Tuff. Coarsens to base with breccia fragments of mudstone, dacite and sericite-altered tuff.

212.2 to 220.0 m: Siltstone. Dark grey. More tuffaceous to base. Cleaved and contorted.

220.0 to 250.6 m: Dacite tuff. Grey. Ash and rare lapilli to base. Thin intervals, to 0.40 m, of highly cleaved, possibly mudstone-rich tuff. Indistinct.

250.6 to 260.5 m: Dacitic to andesitic tuff. Medium to finely bedded. Flattened ash and lapilli. Coarsens up hole!. Biotite-bearing. Sharp upper and lower contacts. Bedding 80° c.a.

260.5 to 268.8 m (EOH): Dacite ash. Grey to white. Rare lapilli. Cleaved at 90° c.a.

DDH:220  
JDB/jdb  
19/02/92

## STP 221

Note: Core is complete, some quarter round sampling. Bedrock setup (?), as coring starts at 1 m.

## 1.0 to 24.2 m:

Andesite Flow, flow breccia. Olive to dark green. Plag phytic. As seen in first interval in STP 217.

## 24.2 to 28.7 m:

Debris Breccia. Very coarse block breccia, polyolithic with amygdaloidal andesite blocks, small clasts of grey mudstone, and fine-grained ankeritized andesite (pillow rims?). Barely matrix supported. Not seen in STP 217.

## 28.7 to 33.4 m:

Fault

## 33.4 to 38.8 m:

Mineralization. Massive to semi-massive pyrrhotite; pyrrhotite and white quartz over lower 1.5 m. Interval poorly recorded, as it has been quartered and is loose and scrambled. Maybe superimposed mineralization on next rock unit, however original lithology obscure.

## 38.8 to 46.0 m:

Andesite Flow. Fine-grained andesite flow, with flow breccia at top and base. Vague phenocrysts of plagioclase. Sharp irregular lower contact.

## 46.0 to 104.0 m:

Andesite Flow, flow breccia. Mixed regime of flow debris. Clasts range from ash to lapilli to block size. Angular to cusped.

## Subintervals:

46.0 to 53.7 m: flow top breccia, coarsens to base.

53.7 to 57.5 m: amygdaloidal flow with thin hyaloclastic top of small lapilli-sized debris.

57.5 to 60.0 m: Mineralization. Siliceous zone, with minor pyrrhotite.

60.0 to 73.7 m: Andesite flow. Epidote altered. Ash-sized hyaloclastic top, amygdaloidal base. Rare plagioclase phenocrysts.

73.7 to 79.8 m: Andesite flow breccia. Lapilli-sized clasts; angular to cusped. Light green to white frags in in mid-green matrix. matrix is very fine-grained, could have been glass. Nice small twinned plagioclase phenocrysts in clasts.

79.8 to 104.0 m: interbedded andesite flow and ash to (rare) block breccia. Amygdaloidal nature of both flow and debris evident, slightly stretched. From 102.5 to 103.0 small layers of banded light coloured tuff, weakly silicified. Could equate to STP 217 at 79.0 m.

104.0 to 123.0 m:

Fault. Poor recovery, mostly Farrell debris.

123.0 to 268.8 m (EOH):

Tuffaceous Sandstone and Siltstone. 80:20 proportion. Grey to greenish grey. Distinctly more tuffaceous, less laminates, more sandstone, no mudstone than seen previously. More proximal, but a long way to go. Short intervals with plagioclase debris, rare quartz. Unit not highly cleaved, but all internal bedform contacts are sheared, and there is few reliable bedding features. Tuffaceous sandstones marked by gash veins.

STP 221  
JDB/jdb  
19/02/92

## STP 284

Note: Core available incomplete. Missing intervals (significant) include: 0 to 30.4 m;

38.0 to 45.8 m; and  
61.6 to 77.4 m.

## General observations:

Deformation is very intense, with few useable bedforms to denote bedding attitudes. Cleavage has transposed bedding throughout, with only locally preserved laminates which might be useful. Major bed contacts are sheared and disrupted, with coarser-grained sediments juxtaposed against finer. Pseudo-volcaniclastic textures common from transposition.

Fine-grained biotite common throughout sandstone members. Not necessarily fabric-controlled.

Entire hole appears to be in the same unit. Distal facies relative to epiclastic rocks cored east and south.

## 30.4 to 38.0 m

Tuffaceous, fine-grained sandstone. Mid to dark grey coloured, strong cleavage. White quartz veins throughout.

## 45.8 to 61.6 m

Tuffaceous, fine-grained sandstone with wispy laminated mud and siltstone. May have originally been laminated throughout, but now obscure.

at 57.3 m tightly folded laminate

at 58.4 m transposed bedding

at 59.2 m mudstone "clasts" along slip surfaces in sandstone

at 61.1 m transposed bedding

## 77.4 to 116.7 m (EOH)

Interbedded fine-grained grey sandstone and dark grey siltstone. Bedforms appear to be thicker.

at 81.9 m distinctly granule-rich mudstone

after 91.0 m unit has a 60% sandstone to 40% siltstone mix, as discrete "beds"

at 94.0 m infolded sand and siltstone bedforms

from 109.5 to 111.1 m best examples of interbedded silt and sandstone being folded, and bedding transposed by cleavage. Adjacent thicker sandstones are sheared along contacts with laminated, folded members.

DDH:284

JDB/jdb

18/02/92

## STERLING VALLEY E.L. Hole SVD 87-1A

Note: Hole stored at Tullah Compound. Logs in Billiton Report 08.3912. Core in good shape, one box marked dropped, possibly scrambled (does not appear to be serious). Obvious mineralization has been sampled.

General Observations: Interesting hole, as collared west of Henty Fault. Upper andesite flow and breccia units are very similar to those logged north. Of interest is the lower part of the sequence, containing moderately deformed interbedded andesite breccia, tuff, waterlain tuff and grey to black mudstone. This sequence is overturned. Further, after penetrating a sizeable gouge zone, or fault, the hole continues in much more deformed, more highly metamorphosed (biotite isograd ?) units which at first glance look very much like typical Farrell Slates tuffaceous sandstone, yet is devoid of quartz, and again is interbedded andesitic tuff, waterlain tuff and black mudstone. Is the real Henty Fault still to the east, or is the sequence basically continuous without major disruption by the Henty, or am I mistaken with my rocks (Purvis logged this portion of the hole as being quartzose, so a re-examination, even a thin section, maybe warranted. I'd prefer to compare geochem signatures, but quartz may suffice). No quartz was seen during thin section examination of rocks west of the gouge zone (see Billiton Report, Appendix 1). No thin sections were done on core samples from east of the gouge.

Oxidised and broken to 66.3 m. "Core" poorly preserved to 29 metres.

0 to 36.6 m:

Probably Andesite tuff with minor mudstone. Badly weathered, oxidised.

36.6 to 55.3 m:

Dolerite Dyke. Coarser-grained than seen previously. Subporphyritic, with hornblende phenos.

55.3 to 211.0 m:

Mega-unit of Andesite Flow, breccia and waterlain tuff. As seen in other holes drilled to north, collared west of the Henty Fault. Subintervals of note:

55.3 to 91.7 m: andesite flows, rare thin intervals of waterlain tuff, flow bottom breccia. Hornblende (?) phenocrysts, lesser plag. Vague suggestion of alternation of plag phenocrystic flows (up to 2 m) and hbl phyric flows. Poor cleavage core angle at 10 to 25°. Bedding obscure due to cleavage transposition, probably at 30 to 35° c.a.

91.7 to 104.4 m: Andesite breccia. Very angular, rotated blocks. Coarsest in middle of unit. Several large blocks have crowded, large plag phenocrysts. Melanocratic clasts, appear to be dacite, however probably altered

andesite clasts, perhaps Kspar.

104.4 to 105.6 m: Andesite flow. Narrow interval of massive-appearing, dark green andesite. foliated. Possibly a dyke.

105.6 to 106.9 m: Broken, brecciated interval, melanocratic. Possible zone of Kspar flooding. Note "ghost" areas of dark andesite as in above interval. Very indistinct boundaries. Possible alteration of above unit.

106.9 to 113.3 m: Andesite waterlain tuff. Schistose. Ash to lapilli sized fragments interbedded with tuff, rare breccia. Altered fragments, buff coloured (Kspar?). Grades upwards into laminated tuff, beds 2 to 8 cm.

113.3 to 211.0 m: Andesite flows, breccia and waterlain tuff. Flows and breccia plag phyrlic, amygdular. waterlain tuff has intercalated breccia horizons, buff coloured altered fragments. Bedding at 70 - 75° c.a. Numerous stepped offsets. lower contact, with fault, marked by more intense fabric development, carbonate and quartz alteration.

211.0 to 217.0 m:

Henty Fault. Poor recovery zone. Probably tuffaceous andesite. Mineralized with quartz, pyrrhotite, pyrite. Trace tourmaline, possibly fluorite.

217.0 to 223.0 m:

Andesite (?) tuff and tuffaceous wacke. Highly cleaved, bedding still evident, locally highly transposed. Grey to green. Little quartz, feldspar, andesite tuff and ash. Similar to 113.3 - 211.0, but deformed. Poor core angle, cleavage at 15° c.a. and bedding at 25° c.a.

223.0 to 242.8 m:

Intercalated Andesite tuff and wacke. Grey/green tuff; grey to black tuffaceous mudstone and wacke. Increasing mud down interval. Facings down hole. Mudstone intervals are mostly 4 to 10 cm thick.

242.8 to 298.5 m (EOH):

Interbedded Tuffaceous wacke (sandstone), mudstone, minor tuff. Mid-grey/green to light grey. Bedding at 75° c.a. at bottom of hole. Unit schistose, locally transposed contacts, but generally internal contacts are well preserved. Unit appears to be fairly mafic. Plag detritus common, quartz rare except after 266.2m, when the entire interval becomes more light coloured, and minor quartz is evident. Approx 20% tuff, 60% sandstone, 20% mudstone.

247.0 to 248.0 & 270.5 to 275.4 m: Graded wacke units to 8cm, relatively undisturbed, facings downhole.

266.8 to 270.8 m: Light grey ash tuff with small, flattened "pumice" shapes. Plag, minor quartz phyrlic.

JDB\jdb  
26/02/92

APPENDIX 4

RESULTS OF SAMPLING IN HOLES STP 101 & 105





**APPENDIX 2**

**LIST OF OLD DRILLHOLES ON TULLAH  
- STERLING RIVER AREA**

## LIST OF DRILLHOLES ON TULLAH &amp; STERLING RIVER EL's

No.	Hole	S/UG	Area	Date	Coy	Logs in File	Comments
1	SS1	S	Sth Stitt	1985	Getty	Y	
2	SS2	S	Sth Stitt	1985	Getty	Y	
3	STP74	S	SV Mine	1949	EZ	Y	
4	STP75	S	SV Mine	1949	EZ	Y	
5	STP76	S	SV Mine	1949	EZ	Y	
6	STP77	S	SV Mine	1949	EZ	Y	
7	STP78	S	SV Mine	1949	EZ	Y	
8	STP79	S	SV Mine	1949	EZ	Y	
9	STP80	S	SV Mine	1949	EZ		
10	STP96	S	SV Mine	1959	EZ	Y	
11	STP98	S	SV Mine	1960	EZ	Y + EZ 80	
12	STP100	S	SV Mine	1961	EZ	Y	
13	STP299	S	SV Mine	1988	EZ	Y	
14	STP300	S	SV Mine	1988	EZ	Y	
15	STP301	S	SV Mine	1988	EZ	Y	
16	STP302	S	SV Mine	1988	EZ	Y (part)	
17	STP101	S	Sterling V	1961	EZ	Y + EZ 80	
18	STP105	S	Sterling V	1962	EZ	Y + EZ 80	
19	SV1	S	Sterling V	1977	Abminco	Shell 87	
20	SV2	S	Sterling V	1977	Abminco	Y + Shell 87	
21	SV3	S	Sterling V	1977	Abminco	Y + Shell 87	
22	STP217	S	Sterling V	1980	EZ	Y + Shell 87	
23	STP218	S	Sterling V	1980	EZ	Y	
24	STP220	S	Sterling V	1980	EZ	Y	
25	STP221	S	Sterling V	1980	EZ	Y + Shell 87	
26	STP231	S	Sterling V	1981	EZ	Y	
27	STP232	S	Sterling V	1981	EZ		
28	STP232A	S	Sterling V	1981	EZ	Y	
29	STP232A1	S	Sterling V	1981	EZ	Y + Shell 87	
30	STP234	S	Sterling V	1981	EZ	Y + Shell 87	
31	STP283	S	Sterling V	1985	EZ	Y	
32	STP284	S	Sterling V	1985	EZ	Y	
33	SVD87-1	S	Sterling V	1987	Shell	Y	
34	SVD87-1A	S	Sterling V	1987	Shell	Y	
35	SVD87-2	S	Sterling V	1987	Shell	Y	
36	SVD89-1	S	Sterling V	1989	Shell	Y	
37	SVD89-2	S	Sterling V	1989	Shell	Y	
38	SVD89-3	S	Sterling V	1989	Shell	Y	
39	MRP212	S	Lakeside	1979	EZ	Y	
40	MRP219	S	Lakeside	1980	EZ	Y	
41	MRP233	S	Lakeside	1981	EZ	Y + Shell 87	
42	RED87-2	S	Lakeside	1987	Shell	Y	
43	RED87-3	S	Lakeside	1987	Shell	Y	
44	RED87-5	S	Lakeside	1987	Shell	Y	
45	RED87-6	S	Lakeside	1987	Shell	Y	
46	RED87-7	S	Lakeside	1987	Shell	Y	
47	RED87-8	S	Lakeside	1987	Shell	Y	
48	RED87-10	S	Lakeside	1987	Shell	Y	
49	RED88-1	S	Lakeside	1988	Shell	Y	
50	RED88-2	S	Lakeside	1988	Shell	Y	
51	RED88-3	S	Lakeside	1988	Shell	Y	
52	RED88-4	S	Lakeside	1988	Shell	Y	
53	MR1	S	Murchson R	1984	Getty	Y	
54	MR2	S	Murchson R	1984	Getty	Y	
55	RED36-1	S	Murchson R	1986	Shell	Y	
56	MP28	S	Murch Mine	1947	EZ	Y + Shell 87	
57	MP29	S	Murch Mine	1948	EZ	Y + Shell 87	

<u>No.</u>	<u>Hole</u>	<u>S/UG</u>	<u>Area</u>	<u>Date</u>	<u>Coy</u>	<u>Logs in File</u>	<u>Comments</u>
58	MP30	S	Murch Mine	1948	EZ	Y + Shell 87	
59	MP32	S	Murch Mine	1948	EZ	Y + Shell 87	
60	6627	S	Murch Dam		HEC		
61	6630	S	Murch Dam		HEC		
62	MP33	S	Duttons	1948	EZ	Y	
63	MP35	S	Duttons	1948	EZ	Y	
64	MP37	S	Duttons	1948	EZ	Y	
65	MP38	S	Duttons	1948	EZ	Y	
66	MP43	S	Duttons	1948	EZ	Y	
67	MP44	S	Duttons	1948	EZ	Y	
68	MP70	S	Duttons	1949	EZ	Y + Shell 87	
69	MP71	S	Duttons	1949	EZ	Y + Shell 87	
70	MP88	S	Duttons	1951	EZ	Y + Shell 87	
71	MP89	S	Duttons	?	EZ	Y	
72	MRP226	S	Duttons	1981	EZ	Y + Shell 87	
73	MRP227	S	Duttons	1981	EZ	Y + Shell 87	
74	RED87-4	S	Duttons	1987	Shell	Y	
75	DOM1N	S	Farrell	1946	DOM	Y	
76	DOM2N	S	Farrell	1947	DOM	Y	
77	DOM3N	S	Farrell	1947	DOM	Y	
78	DOM4N	S	Farrell	1948	DOM	Y	
79	DDH1S	S	Farrell	?	Farrell		
80	DDH2S	S	Farrell	?	Farrell		
81	DDH3S	S	Farrell	?	Farrell		
82	DDH4S	S	Farrell	?	Farrell		
83	DDH5S	S	Farrell	?	Farrell		
84	DDH6S	S	Farrell	?	Farrell		
85	DDH7S	S	Farrell	?	Farrell		
86	DDH8S	S	Farrell	?	Farrell		
87	DDH9S	S	Farrell	?	Farrell		
88	DDH10S	S	Farrell	?	Farrell		
89	DDH11S	S	Farrell	?	Farrell		
90	DDH12S	S	Farrell	?	Farrell		
91	DDH13S	S	Farrell	?	Farrell		
92	MP86	S	Farrell	1951	EZ	Y + Shell 87	
93	MP87	S	Farrell	1951	EZ	Y + Shell 87	
94	1F	S	Farrell	1965	EZ	Y	
95	2F	S	Farrell	1965	EZ	Y	
96	3F	S	Farrell	1965	EZ	Y	
97	TP133	S	Farrell	1968	EZ	Y + Shell 87	
98	TP134	S	Farrell	1968	EZ	Y	
99	TP135	S	Farrell	1968	EZ	Y + Shell 87	
100	RED87-11	S	Farrell	1987	Shell	Y	

**APPENDIX 3**

**AMG SURVEY DETAILS FOR OLD DRILLHOLES  
TULLAH - STERLING RIVER AREA**

Page 1  
Tullah Sterling valley DDH collars

HOLE_ID	A_N	A_E	RL	EOH
1F	5379599.20	385573.00	172.90	483.1
2F	5378821.60	385286.40	177.80	258.8
3F	5378821.60	385286.40	177.80	626.1
MR1	5375175.00	384964.00	165.00	111.0
MR2	5375226.00	384972.00	160.50	122.0
MRP212	5375330.60	384424.40	170.00	293.5
MRP219	5375106.30	384449.20	173.40	140.8
MRP226	5376288.40	384692.80	165.10	211.5
MRP227	5376394.00	384778.00	158.50	155.6
MRP233	5375400.00	384465.00	160.00	197.7
RED86-1	5375604.00	384943.00	167.00	235.2
RED87-10	5375746.20	384592.90	163.50	169.2
RED87-11	5380330.00	386038.00	177.00	250.1
RED87-2	5375420.50	384436.20	160.10	260.3
RED87-3	5375401.40	384516.20	159.90	153.4
RED87-4	5376995.00	384890.00	172.00	328.0
RED87-5	5375350.00	384530.00	165.30	145.5
RED87-6	5375300.30	384499.70	174.20	157.0
RED87-7	5375550.90	384411.80	162.90	277.0
RED87-8	5375551.00	384412.20	162.90	280.0
RED88-1	5375551.10	384411.10	162.90	322.0
RED88-2	5375249.50	384375.80	173.70	289.3
RED88-3	5377450.20	385093.10	170.40	178.5
RED88-4	5375352.10	384386.00	167.90	325.0
SS1	5370000.00	382609.00	610.00	145.6
SS2	5370000.00	382609.00	610.00	211.4
STP100	5372164.40	383839.20	250.50	218.2
STP217	5374393.00	384190.00	176.00	249.1
STP218	5374717.00	383904.00	256.00	165.0
STP220	5374200.00	384625.00	178.00	268.8
STP221	5374399.00	384271.00	173.70	203.3
STP231	5374266.80	384216.30	175.40	150.6
STP232	5374729.40	384393.00	174.00	14.0
STP232A	5374728.50	384395.80	174.00	92.8
STP232A1	5374728.50	384395.80	174.00	198.2
STP234	5374400.00	384413.00	176.00	342.5
STP283	5373443.00	383894.00	235.00	179.6
STP284	5374386.00	384418.00	176.00	116.7
STP299	5371903.70	383858.60	282.70	70.1
STP300	5371948.30	383885.10	279.00	79.5
STP301	5371918.00	383919.00	287.40	142.7
STP302	5371883.00	383887.80	289.60	119.0
STP74	5371920.40	383867.50	276.60	45.4
STP75	5371959.70	383889.30	273.20	45.7
STP76	5371881.20	383845.10	283.30	45.7
STP77	5371843.90	383815.70	284.20	45.7
STP78	5371812.10	383799.00	291.50	45.7
STP79	5371781.20	383782.80	296.10	45.7
STP80	5372006.20	383900.00	269.30	45.7
STP96	5371913.50	383950.00	294.30	239.3

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Tullah Sterling valley DDH collars

HOLE_ID	A_N	A_E	RL	EOH
STP98	5371940.60	383719.90	259.60	267.6
SVD87-1	5373385.00	384073.00	215.00	30.0
SVD87-1A	5373385.00	384072.00	215.00	298.5
SVD87-2	5374243.00	384295.00	177.50	142.5
SVD89-1	5372600.00	383975.00	225.00	154.1
SVD89-2	5371245.00	383290.00	330.00	129.5
SVD89-3	5374400.00	385091.00	208.00	364.2

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Tullah Sterling Valley DDH surveys

HOLE_ID	DEPTH	AZ	DIP
1F	0.0	100.80	-88.00
1F	30.5	97.80	-88.00
1F	61.0	94.80	-85.50
1F	91.4	91.80	-79.00
1F	121.9	88.80	-75.50
1F	152.4	85.80	-66.00
1F	182.9	85.00	-58.50
1F	213.4	85.00	-48.00
1F	243.8	85.00	-37.50
1F	274.3	85.00	-30.00
1F	304.8	85.00	-25.00
1F	335.3	85.00	-21.00
1F	365.8	85.00	-18.50
1F	396.2	85.00	-17.00
1F	426.7	85.00	-16.50
1F	483.1	85.00	-16.00
2F	0.0	15.30	-90.00
2F	30.5	15.30	-90.00
2F	61.0	15.30	-88.50
2F	91.4	15.30	-87.00
2F	121.9	15.30	-87.50
2F	152.4	15.30	-84.75
2F	182.9	15.30	-82.50
2F	213.4	15.30	-80.00
2F	243.8	15.30	-78.50
2F	258.8	15.30	-77.50
3F	0.0	100.80	-85.00
3F	30.5	94.80	-84.75
3F	61.0	88.80	-83.50
3F	91.4	82.80	-82.75
3F	121.9	76.80	-82.25
3F	152.4	70.80	-81.25
3F	182.9	64.80	-81.00
3F	213.4	66.50	-77.50
3F	243.8	68.20	-73.00
3F	274.3	69.80	-70.00
3F	304.8	72.60	-61.00
3F	335.3	74.00	-45.50
3F	365.8	75.50	-36.50
3F	396.2	77.00	-24.50
3F	426.7	78.50	-22.00
3F	457.2	80.00	-18.00
3F	626.1	88.00	-15.00
MR1	0.0	90.00	-60.00
MR1	57.0	88.50	-55.00
MR1	110.0	82.50	-47.00
MR1	111.0	82.50	-47.00
MR2	0.0	90.00	-60.00
MR2	51.0	88.50	-57.00
MR2	120.0	88.50	-48.50

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Tullah Sterling Valley DDH surveys

HOLE_ID	DEPTH	AZ	DIP
MR2	122.0	88.50	-48.25
MRP212	0.0	90.00	-60.00
MRP212	49.0	90.00	-54.50
MRP212	143.0	89.00	-43.00
MRP212	200.5	90.00	-37.00
MRP212	293.5	96.00	-25.00
MRP219	0.0	101.90	-58.50
MRP219	56.0	101.90	-56.50
MRP219	98.0	101.90	-55.50
MRP219	140.8	101.90	-54.00
MRP226	0.0	90.00	-60.00
MRP226	39.0	94.00	-58.50
MRP226	75.0	86.00	-48.00
MRP226	120.0	88.00	-44.00
MRP226	165.0	92.00	-41.50
MRP226	210.0	88.00	-39.00
MRP226	211.5	88.00	-39.00
MRP227	0.0	90.00	-65.00
MRP227	20.0	92.00	-63.50
MRP227	65.0	92.00	-61.50
MRP227	110.0	91.00	-60.00
MRP227	155.0	96.00	-58.00
MRP227	155.6	96.00	-58.00
MRP233	0.0	90.00	-60.00
MRP233	34.0	86.00	-57.00
MRP233	70.0	84.00	-51.00
MRP233	112.0	84.00	-47.00
MRP233	154.0	87.00	-44.00
MRP233	196.0	89.00	-30.00
MRP233	197.7	89.00	-29.50
RED86-1	0.0	90.00	-55.00
RED86-1	30.0	91.00	-52.00
RED86-1	60.0	90.50	-48.00
RED86-1	110.0	91.50	-41.00
RED86-1	160.0	93.00	-38.50
RED86-1	210.0	95.00	-36.00
RED86-1	235.2	96.00	-35.00
RED87-10	0.0	90.00	-50.00
RED87-10	58.1	92.00	-49.00
RED87-10	105.0	89.50	-47.50
RED87-10	169.2	89.50	-44.00
RED87-11	0.0	144.00	-50.00
RED87-11	49.0	142.50	-45.50
RED87-11	100.0	134.00	-35.25
RED87-11	160.0	133.00	-32.75
RED87-11	199.0	132.50	-28.50
RED87-11	250.1	130.50	-22.00
RED87-2	0.0	90.50	-60.00
RED87-2	45.0	91.50	-58.50
RED87-2	72.5	91.70	-56.50

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HOLE_ID	DEPTH	AZ	DIP
RED87-2	102.0	92.50	-56.00
RED87-2	129.0	93.00	-56.25
RED87-2	162.0	92.50	-55.50
RED87-2	192.0	94.00	-55.00
RED87-2	231.0	93.50	-54.70
RED87-2	260.3	94.50	-53.25
RED87-3	0.0	90.00	-45.00
RED87-3	35.0	91.00	-43.70
RED87-3	69.0	91.00	-43.00
RED87-3	98.0	91.00	-42.70
RED87-3	141.0	92.30	-42.20
RED87-3	153.4	92.50	-42.00
RED87-4	0.0	90.00	-50.00
RED87-4	30.0	89.50	-49.50
RED87-4	60.0	89.00	-50.00
RED87-4	98.0	88.50	-49.50
RED87-4	142.0	89.00	-49.25
RED87-4	186.0	88.50	-48.70
RED87-4	237.0	89.50	-48.00
RED87-4	280.0	91.50	-47.50
RED87-4	328.0	94.00	-44.30
RED87-5	0.0	90.00	-56.50
RED87-5	37.0	90.50	-55.70
RED87-5	67.0	90.50	-55.70
RED87-5	97.0	89.50	-53.30
RED87-5	128.0	89.50	-51.30
RED87-5	145.5	89.50	-50.20
RED87-6	0.0	90.00	-51.00
RED87-6	30.0	92.00	-51.00
RED87-6	60.0	91.50	-50.30
RED87-6	90.0	91.70	-49.75
RED87-6	125.0	92.00	-49.25
RED87-6	157.0	92.00	-48.75
RED87-7	0.0	106.00	-45.00
RED87-7	30.0	106.00	-45.00
RED87-7	60.0	106.00	-44.00
RED87-7	90.0	107.00	-43.75
RED87-7	120.0	107.00	-43.00
RED87-7	150.0	107.00	-42.50
RED87-7	180.0	107.00	-42.00
RED87-7	210.0	107.00	-42.00
RED87-7	240.0	108.00	-41.50
RED87-7	270.0	107.00	-41.00
RED87-7	277.0	107.00	-41.00
RED87-8	0.0	90.00	-45.00
RED87-8	30.0	90.00	-45.00
RED87-8	60.0	92.00	-42.70
RED87-8	90.0	91.50	-42.00
RED87-8	120.0	93.00	-41.50
RED87-8	150.0	93.50	-40.80

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Tullah Sterling Valley DDH surveys

HOLE_ID	DEPTH	AZ	DIP
RED87-8	180.0	94.50	-40.50
RED87-8	210.0	95.50	-40.00
RED87-8	240.0	96.00	-40.00
RED87-8	270.0	96.00	-39.20
RED87-8	280.0	96.00	-39.00
RED88-1	0.0	106.00	-60.00
RED88-1	51.0	106.00	-60.00
RED88-1	102.0	105.00	-59.00
RED88-1	201.0	106.00	-57.50
RED88-1	250.0	106.00	-57.00
RED88-1	300.0	107.00	-56.00
RED88-1	322.0	107.50	-55.50
RED88-2	0.0	90.00	-50.00
RED88-2	51.0	93.00	-50.00
RED88-2	101.0	93.00	-49.00
RED88-2	150.0	94.50	-49.00
RED88-2	200.0	97.00	-47.50
RED88-2	250.0	97.00	-42.00
RED88-2	289.3	98.00	-39.00
RED88-3	0.0	110.00	-60.00
RED88-3	51.0	106.00	-57.00
RED88-3	110.0	104.50	-57.00
RED88-3	160.0	108.00	-51.50
RED88-3	178.5	109.30	-49.50
RED88-4	0.0	90.00	-65.00
RED88-4	25.0	86.70	-64.00
RED88-4	75.0	80.00	-61.50
RED88-4	125.0	80.00	-60.00
RED88-4	177.0	81.00	-59.00
RED88-4	225.0	83.00	-58.50
RED88-4	275.0	83.00	-58.00
RED88-4	322.0	82.50	-55.00
RED88-4	325.0	82.50	-54.80
SS1	0.0	94.00	-63.00
SS1	30.0	100.50	-63.00
SS1	34.0	101.50	-64.00
SS1	75.0	97.50	-66.00
SS1	100.0	94.00	-66.00
SS1	130.0	93.00	-64.00
SS1	145.6	92.50	-63.00
SS2	0.0	272.00	-53.00
SS2	30.0	270.75	-51.00
SS2	70.0	269.00	-51.00
SS2	100.0	268.00	-50.50
SS2	131.0	266.50	-48.50
SS2	180.0	264.50	-47.00
SS2	202.0	265.00	-47.00
SS2	211.4	265.00	-47.00
STP100	0.0	129.00	-57.00
STP100	30.5	129.00	-55.50

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Tullah Sterling Valley DDH surveys

HOLE_ID	DEPTH	AZ	DIP
STP100	61.0	129.00	-52.50
STP100	91.4	129.00	-48.50
STP100	121.9	129.00	-40.50
STP100	152.4	129.00	-34.50
STP100	182.9	129.00	-29.50
STP100	213.4	129.00	-28.00
STP100	218.2	129.00	-27.75
STP217	0.0	108.00	-60.00
STP217	30.0	108.50	-63.00
STP217	66.0	109.00	-60.00
STP217	84.0	112.00	-58.50
STP217	120.0	112.00	-56.00
STP217	150.0	108.00	-50.00
STP217	200.0	109.00	-40.00
STP217	249.0	108.00	-26.50
STP217	249.1	108.00	-26.50
STP218	0.0	87.00	-60.00
STP218	44.0	92.00	-56.50
STP218	74.0	97.75	-53.75
STP218	104.0	100.00	-52.50
STP218	134.0	105.00	-50.50
STP218	164.0	105.00	-49.00
STP218	165.0	105.00	-49.00
STP220	0.0	108.00	-60.00
STP220	91.8	101.40	-46.00
STP220	121.8	99.25	-44.00
STP220	157.8	96.70	-41.00
STP220	208.8	93.00	-26.00
STP220	239.0	96.50	-22.00
STP220	261.8	95.00	-21.00
STP220	268.8	94.50	-20.70
STP221	0.0	75.50	-60.00
STP221	79.8	75.50	-56.50
STP221	109.8	75.50	-55.00
STP221	178.8	75.50	-38.00
STP221	203.0	75.50	-33.00
STP221	203.3	75.50	-33.00
STP231	0.0	108.00	-60.00
STP231	60.0	110.00	-56.00
STP231	90.0	111.50	-55.00
STP231	120.0	110.00	-52.00
STP231	150.0	109.00	-50.50
STP231	150.6	109.00	-50.50
STP232	0.0	108.00	-60.00
STP232	14.0	108.00	-60.00
STP232A	0.0	108.00	-60.00
STP232A	92.8	108.00	-60.00
STP232A1	0.0	108.00	-60.00
STP232A1	67.0	106.50	-52.00
STP232A1	109.0	105.00	-49.50

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Tullah Sterling Valley DDH surveys

HOLE_ID	DEPTH	AZ	DIP
STP232A1	151.0	98.00	-45.00
STP232A1	192.0	98.00	-39.00
STP232A1	198.2	98.00	-38.00
STP234	0.0	108.00	-70.00
STP234	72.0	101.00	-67.00
STP234	102.0	101.50	-65.00
STP234	132.0	98.00	-61.00
STP234	162.0	97.00	-58.00
STP234	192.0	100.00	-54.50
STP234	222.0	98.00	-49.50
STP234	252.0	97.00	-45.00
STP234	282.0	98.00	-43.00
STP234	312.0	93.50	-38.50
STP234	342.0	96.00	-32.00
STP234	342.5	96.00	-32.00
STP283	0.0	108.00	-45.00
STP283	83.0	102.00	-46.00
STP283	131.0	102.00	-46.00
STP283	179.0	98.00	-46.00
STP283	179.6	98.00	-46.00
STP284	0.0	108.00	-60.00
STP284	26.0	99.00	-60.00
STP284	71.0	102.00	-56.00
STP284	116.0	100.00	-51.00
STP284	116.7	100.00	-51.00
STP299	0.0	307.00	-60.00
STP299	34.0	302.00	-59.00
STP299	70.0	300.00	-56.30
STP299	70.1	300.00	-56.30
STP300	0.0	302.00	-60.00
STP300	24.0	294.00	-55.60
STP300	56.0	296.60	-53.30
STP300	79.0	298.50	-50.00
STP300	79.5	298.50	-50.00
STP301	0.0	302.00	-63.00
STP301	41.0	299.00	-60.60
STP301	83.0	297.50	-56.20
STP301	116.0	299.50	-47.20
STP301	134.0	299.00	-43.00
STP301	142.7	298.00	-41.80
STP302	0.0	302.00	-63.00
STP302	50.0	290.00	-58.00
STP302	75.0	302.50	-53.30
STP302	110.0	301.50	-49.50
STP302	119.0	300.00	-47.00
STP74	0.0	309.00	-55.00
STP74	45.4	309.00	-55.00
STP75	0.0	309.00	-55.00
STP75	45.7	309.00	-55.00
STP76	0.0	309.00	-55.00

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Tullah Sterling Valley DDH surveys

HOLE_ID	DEPTH	AZ	DIP
STP76	45.7	309.00	-55.00
STP77	0.0	309.00	-55.00
STP77	45.7	309.00	-55.00
STP78	0.0	309.00	-55.00
STP78	45.7	309.00	-55.00
STP79	0.0	309.00	-55.00
STP79	45.7	309.00	-55.00
STP80	0.0	309.00	-55.00
STP80	45.7	309.00	-55.00
STP96	0.0	308.00	-81.00
STP96	30.5	308.00	-78.00
STP96	61.0	308.00	-76.00
STP96	91.4	308.00	-73.00
STP96	121.9	308.00	-67.50
STP96	152.4	308.00	-62.50
STP96	182.9	308.00	-59.50
STP96	213.4	308.00	-56.25
STP96	239.3	308.00	-53.50
STP98	0.0	128.00	-57.00
STP98	30.5	128.00	-56.50
STP98	61.0	128.00	-56.25
STP98	91.4	128.00	-51.25
STP98	121.9	128.00	-45.50
STP98	152.4	128.00	-42.00
STP98	182.9	128.00	-39.00
STP98	213.4	128.00	-36.00
STP98	243.8	128.00	-33.00
STP98	267.6	128.00	-30.70
SVD87-1	0.0	108.00	-56.00
SVD87-1	30.0	108.00	-56.00
SVD87-1A	0.0	108.00	-76.00
SVD87-1A	30.0	108.50	-76.50
SVD87-1A	59.0	108.00	-75.75
SVD87-1A	100.0	107.00	-76.30
SVD87-1A	158.0	105.50	-72.75
SVD87-1A	212.0	105.00	-70.30
SVD87-1A	266.0	102.00	-61.30
SVD87-1A	298.0	103.50	-53.70
SVD87-1A	298.5	103.50	-53.70
SVD87-2	0.0	108.00	-61.00
SVD87-2	100.0	106.50	-59.00
SVD87-2	140.0	107.30	-54.00
SVD87-2	142.5	107.30	-53.70
SVD89-1	0.0	112.00	-50.00
SVD89-1	50.0	111.70	-50.00
SVD89-1	100.0	111.70	-47.00
SVD89-1	150.0	109.70	-44.00
SVD89-1	154.1	109.50	-43.75
SVD89-2	0.0	112.00	-50.00
SVD89-2	50.0	116.50	-48.30

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Tullah Sterling Valley DDH surveys

HOLE_ID	DEPTH	AZ	DIP
SVD89-2	126.0	115.50	-44.00
SVD89-2	129.5	115.50	-43.80
SVD89-3	0.0	90.00	-50.00
SVD89-3	49.0	87.00	-48.50
SVD89-3	100.0	88.00	-48.00
SVD89-3	155.0	89.00	-48.00
SVD89-3	201.0	89.50	-46.00
SVD89-3	250.0	90.50	-45.00
SVD89-3	300.0	92.00	-44.50
SVD89-3	350.0	94.00	-44.00
SVD89-3	364.2	94.60	-43.90

**APPENDIX 4**

**DATA ON ANTHONY TUNNEL BARITE OCCURRENCE**

- A. - ASSAY RESULTS**
- B. - PETROLOGICAL RESULTS**
- C. - LEAD ISOTOPE DATA**
- D. - CRONE PULSE EM SURVEY**

**A. - ASSAY RESULTS**

## ANTHONY TUNNEL BARITE – ASSAY SAMPLE LOCATIONS

Sample No.	Location	Rock Type
031390B ✓	– 0.5m chip @ 2575m, E Wall	'Normal' granite
031391B ✓	– Grab @ 2585m, E Wall	Altered granite
031392B ✓	– Grab @ 2595m, E Wall	Altered granite
031393B	– Grab @ 2595m, E Wall	Barite with sulphides
031394B ✓	– Grab @ 2600m, E Wall	Sheared granite
031395	– Grab @ 2603m, E Wall	Altered granite
031396	– Grab @ 2610m, E Wall	Barite with sulphides
031397B	– Grab @ 2615m, E Wall	Barite/granite contact zone
031398B ✓	– Grab @ 2615m, E Wall	Altered & sheared volcanic
031399B ✓	– 3m chip @ 2615 – 2618m, E Wall	Altered & sheared granite?
031400B ✓	– 5m chip @ 2618 – 2623m, E Wall	Altered volcanoclastic sst
032701	– 1m chip 2597.5 – 2598.5m, E Wall	'Average' barite
032702	– 2m chip @ 2609 – 2611m, E Wall	'Average' sulphidic barite
032703	– 1.7m chip 2611 – 2612.7m, W Wall	'Average' sulphidic barite
032704	– 0.3m chip 2612.7 – 2613m, W Wall	Granite, barite & fluorite
032705	– 2m chip @ 2613 – 2615m, W Wall	Sulphidic barite
032707	– Grab @ 2612m, W Wall	Highly sulphidic barite
032708B	– Grab @ 2613.5m, W Wall	Highly sulphidic barite
032709	– Grab @ 2613m, W Wall	Repeat of 032704
032710	– Grab @ ?(taken by HEC)	Massive sulphidic barite
032711	– Grab @ ?(taken by HEC)	Massive 'barren' barite
032712	– Grab approx. 2610m, E Wall	Highly sulphidic barite



# ANALABS

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## ANALYTICAL REPORT No.

111310.60.08365

THIS REPORT MUST BE READ IN CONJUNCTION WITH THE ACCOMPANYING ANALYTICAL DATA

INVOICE TO:

Pasminco Exploration  
P.O. Box 886  
BURNIE TAS 7320

ORDER No. 0168 PROJECT 3000

DATE RECEIVED 24/10/91 RESULTS REQUIRED ASAP

No. OF PAGES OF RESULTS	DATE REPORTED	No. OF COPIES
1	25/11/91	1

TOTAL No. OF SAMPLES 22

SAMPLE NUMBERS	SAMPLE DESCRIPTION	ELEMENT/METHOD
031390B & others	RD Prep : 6P029,P1	Cu,Pb,Zn,Ag,Bi,Mo/GA104
031390B & others	RD Prep :	Ba,W,Sn,Sb/GX404
031390B & others	RD Prep :	As/GA114
031390B & others	RD Prep :	Au,Au(R),Au(S)/GE309
031390B & others	RD Prep :	Al2O3,SiO2,TiO2,Fe2O3,MnO,CaO,K2

REMARKS

RESULTS

TO

Mr F Fitzgerald  
Pasminco Exploration  
P.O. Box 886  
BURNIE TAS 7320

RESULTS

TO

Mr JG Purvis  
JG Purvis & Associates Pty Ltd  
P.O. Box 1026  
BURNIE TAS 7320

RESULTS

TO

[Empty box for results recipient]

AUTHORISED OFFICER

056108

# ANALABS

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## ANALYTICAL DATA

SAMPLE PREFIX

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PAGE

TUBE No.	SAMPLE No.	Cu	Pb	Pb:1	Zn	Ag	Bi	Mo		
		111310.60.08365			26/11/91		016B		1 OF 1	
1	031390B	<25	89	-	245	<2.5	<100	<50		
2	031391B	33	49	-	104	<2.5	<100	<50		
3	031392B	<25	1615	-	25	<2.5	<100	<50		
4	031393B	220	5800	-	<25	<2.5	<100	<50		
5	031394B	<25	103	-	248	<2.5	<100	<50		
6	031395	<25	46	-	111	<2.5	<100	<50		
7	031396	212	5357	-	<25	<2.5	<100	<50		
8	031397B	49	-	1.33	94	5.0	<100	<50		
9	031398B	105	699	-	387	<2.5	<100	<50		
10	031399B	<25	110	-	266	<2.5	<100	<50		
11	031400B	117	123	-	355	<2.5	<100	<50		
	032701	603	1508	-	<25	<2.5	<100	<50		
13	032702	109	3607	-	<25	<2.5	<100	<50		
14	032703	89	-	1.94	72	<2.5	<100	<50		
15	032704	183	-	2.14	<25	<2.5	<100	<50		
16	032705	123	4449	-	<25	<2.5	<100	<50		
17	032707	126	-	2.79	134	<2.5	<100	<50		
18	032708B	58	-	1.88	36	5.0	<100	<50		
19	032709	493	6500	-	45	7.0	<100	<50		
20	032710	74	-	1.67	32	<2.5	<100	<50		
21	032711	119	132	-	38	<2.5	<100	<50		
22	032712	1068	6600	-	35	14.0	<100	<50		
23	DETECTION	25	25	0.01	25	2.5	100	50		
24	UNITS	ppm	ppm	%	ppm	ppm	ppm	ppm		
25	METHOD	GA104	GA104	GA104	GA104	GA104	GA104	GA104		

Results in ppm unless otherwise specified  
 T = element present, but concentration too low to measure  
 X = element concentration is below detection limit  
 - = element not determined

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## ANALYTICAL DATA

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REPORT NUMBER

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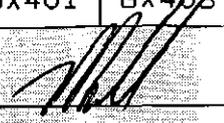
0168

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TUBE No.	SAMPLE No.	Au	Au (R)	Au (S)	W	Sn	Sb	As	Ba	Ba
1	031390B	<0.008	-	-	<20	6	<3	5	1700	-
2	031391B	<0.008	-	-	<20	6	<3	4	1850	-
3	031392B	<0.008	-	-	<20	<3	<3	8	-	4.2
4	031393B	<0.008	-	-	<20	<3	6	20	-	44.1
5	031394B	<0.008	-	-	<20	3	<3	<2	2750	-
6	031395	<0.008	-	-	20	<3	3	3	1450	-
7	031396	0.028	-	-	<20	<3	<3	10	-	47.5
8	031397B	0.009	-	-	<20	<3	10	<2	-	36.0
9	031398B	<0.008	-	-	<20	<3	<3	15	4250	-
10	031399B	<0.008	-	-	<20	<3	<3	<2	2000	-
11	031400B	<0.008	-	-	<20	5	<3	5	1750	-
12	032701	0.024	0.034	-	<20	<3	20	15	-	46.6
13	032702	0.015	-	-	<20	<3	15	20	-	47.6
14	032703	0.009	-	<0.008	<20	<3	<3	<2	-	34.9
15	032704	<0.008	-	-	<20	<3	5	<2	-	31.9
16	032705	<0.008	-	-	<20	<3	25	30	-	41.5
17	032707	0.009	-	-	<20	<3	10	15	-	42.9
18	032708B	<0.008	-	-	<20	<3	6	<2	-	41.7
19	032709	0.010	-	-	<20	<3	5	<2	-	29.6
20	032710	<0.008	-	-	<20	<3	10	<2	-	40.4
21	032711	<0.008	-	-	<20	<3	15	25	-	55.4
22	032712	0.024	0.035	0.028	<20	<3	8	6	-	46.7
23	DETECTION	0.008	0.008	0.008	20	3	3	2	10	0.1
24	UNITS	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	%
25	METHOD	GG309	GG309	GG309	GX401	GX401	GX401	GX401	GX401	GX401

Results in ppm unless otherwise specified  
 T = element present, but concentration too low to measure  
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## ANALYTICAL DATA

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PAGE

			111310.60.08365			25/11/91		0168		1 OF 1	
TUBE No.	SAMPLE No.	Y	Sr	Zr	Rb	V	Nb				
1	031390B	30	320	190	230	130	15				
2	031391B	25	180	200	310	85	15				
3	031392B	15	750	150	200	<5	9				
4	031394B	30	180	240	320	75	15				
5	031398B	30	150	290	300	85	15				
6	031399B	35	140	240	310	45	15				
7	031400B	30	180	240	240	70	20				
8											
9											
10											
11											
12											
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16											
17											
18											
19											
20											
21											
22											
23	DETECTION	5	5	5	5	5	3				
24	UNITS	ppm	ppm	ppm	ppm	ppm	ppm				
25	METHOD	GX401	GX401	GX401	GX401	GX401	GX401				

Results in ppm unless otherwise specified  
 T = element present; but concentration too low to measure  
 X = element concentration is below detection limit  
 - = element not determined

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056111

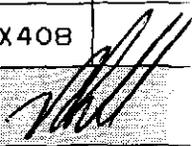
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## ANALYTICAL DATA

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE					
	111310.60.08365	26/11/91	0168	1 OF 1					
TUBE No.	SAMPLE No.	Al2O3	SiO2	TiO2	Fe2O3	MnO	CaO	K2O	MgO
1	031390B	14.79	60.2	0.74	6.05	0.20	4.65	4.29	2.35
2	031391B	12.25	67.0	0.51	4.22	0.22	3.01	5.78	0.99
3	031392B	11.28	66.6	0.35	2.49	0.06	1.33	6.08	0.41
4	031394B	13.33	64.6	0.60	5.58	0.25	2.41	5.22	2.13
5	031398B	13.66	63.0	0.62	8.20	0.41	1.20	4.60	2.51
6	031399B	12.55	69.6	0.40	4.23	0.27	1.44	5.49	1.61
7	031400B	12.68	66.4	0.48	8.04	0.51	1.06	5.35	1.80
8									
9									
10									
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									
21									
22									
23	DETECTION	0.05	0.1	0.01	0.01	0.01	0.01	0.01	0.01
24	UNITS	%	%	%	%	%	%	%	%
25	METHOD	OX408	OX408	OX408	OX408	OX408	OX408	OX408	OX408

Results in ppm unless otherwise specified  
 T = element present but concentration too low to measure  
 X = element concentration is below detection limit  
 - = element not determined

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## ANALYTICAL DATA

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TUBE No.	SAMPLE No.	P205	Na2O	SO3	LOI	TOTAL			
1	031390B	0.180	2.03	0.13	3.94	99.72			
2	031391B	0.129	1.02	0.41	3.88	99.62			
3	031392B	0.080	1.56	2.27	2.34	99.52			
4	031394B	0.120	0.63	0.37	4.13	99.64			
5	031398B	0.130	<0.05	0.95	3.83	99.53			
6	031399B	0.070	0.15	0.20	3.31	99.52			
7	031400B	0.090	0.54	0.40	2.89	100.41			
8									
9									
10									
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									
21									
22									
23	DETECTION	0.005	0.05	0.01	0.01	1.00			
24	UNITS	%	%	%	%	%			
25	METHOD	OX40B	OX40B	OX40B	OX40B	OX40B			

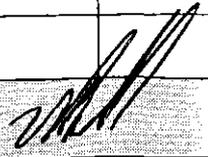
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056113

**B. - PETROLOGICAL RESULTS**

Report To Pasminco Exploration  
on Samples From

- Anthony Power Tunnel

for Gerald Purvis

by Joe Stolz  
20 Bath St.,  
Battery Point,  
Tas. 7004.

18th January 1992

ANTHONY POWER TUNNEL  
(Sterling Valley ELA)

031390A Granodiorite

At 2575m mark,  
East Wall, Anthony Tunnel.  
'Normal' granite.

Mineralogy	%
quartz	25
K feldspar	15
plagioclase	50
biotite/chlorite	5
carbonate	3
Fe-Ti oxides	1
apatite	trace
sphene	<1
zircon	trace

This is a granitic rock with a hypidomorphic granular fabric. Euhedral plagioclase crystals (1 - 4 mm) display albite twinning, concentric zoning and pervasive moderate sericite alteration. Some plagioclase crystals display extensive carbonate and chlorite alteration with minor associated pyrite. Euhedral to subhedral books of biotite are extensively altered to chlorite, and frequently occur in aggregates with accessory euhedral apatite, zircon, epidote, sphene and Fe-Ti oxides.

Alkali feldspar and quartz appear to have crystallised subsequent to the plagioclase and biotite, and occur as interstitial anhedral grains. The alkali feldspar displays fine albite exsolution lamellae and only minor alteration to clay minerals.

On the basis of the classification scheme for granitoids devised by the IUGS subcommission on the systematics of igneous rocks, this sample would be classified as a granodiorite (ie. >25% modal quartz, and the ratio of plagioclase:alkali feldspar is in excess of 3:2).

The presence of biotite and absence of hornblende suggests that this is probably a Ca-poor granitoid or S-type rather than an I-type in the scheme of White and Chappell. However, more detailed

classification using their scheme requires a chemical analysis. In addition, the rock may be a little altered to successfully apply some of their chemical discriminants.

031391A

Sheared Adamellite

At 2585m mark,

East Wall.

*Altered granite close to banite.*

Mineralogy	%
quartz	25
K feldspar	35
plagioclase	30
chlorite	2
carbonate	2
pyrite	<1
rutile	<1
zircon	trace

This sample consists of subidiomorphic plagioclase grains which display extensive sericite alteration and bent twin lamellae.

Anhedral alkali feldspar grains (1 - 4 mm) are frequently cracked and display carbonate alteration along fractures. They also have a pervasive weak clay alteration. Quartz occurs as anhedral recrystallised grains in narrow (0.5 mm) bands indicating recrystallisation under moderately high strain levels. All of the quartz exhibits strained extinction and most of the larger grains display extensive subgrain development.

Fine interlocking veinlets of sericite occur throughout the rock. These are sometimes associated with chlorite, fine granular aggregates of rutile and pyrite.

There is also some patchy alteration by carbonate and cross-cutting veins of carbonate-chlorite, and quartz-albite with minor sericite which appear to be largely unstrained.

Despite the moderately high levels of strain and recrystallisation which have modified this rock, its granitic character is still evident. This sample has a higher ratio of alkali feldspar to plagioclase than 031390A and would be more appropriately termed an adamellite.

031392A

Altered Adamellite/Baryte vein

*At 2595m mark,  
East Wall,  
Contact between  
granite and barite.*

Mineralogy	%
quartz	25
K feldspar	35
sericite	40
sulphides (pyrite)	<1
rutile	trace

This sample consists of angular quartz and alkali feldspar grains in a sericitic matrix. The original granitic textures are not obvious, but there are a few aggregates of quartz and alkali feldspar which may represent relict patches of relatively unaltered granitoid.

The alkali feldspar occurs as relatively large angular grains with only minor clay alteration, whereas the quartz typically occurs as small (0.1 - 0.5 mm but up to 2 mm) angular broken grains with strained extinction. The very fine sericitic matrix lacks a foliation and has a small amount of associated pyrite and fine granular rutile.

The rock is traversed by quartz and baryte veins up to 1 cm wide. The baryte-rich vein is composed of fine grained baryte (0.01 - 0.1 mm) with subordinate quartz characterised by granoblastic polygonal textures. The vein also includes narrower carbonate veinlets, some patchy aggregates of carbonate and minor disseminated anhedral sulphide grains. The contact between the baryte vein and the host rock is fairly sharp and is marked by a narrow selvage of sericite in places, and a fine grained quartz-rich margin.

031394A

Altered Adamellite

At 2600m mark,  
East Wall.  
(Between barite lenses).

Mineralogy	%
quartz	35
plagioclase	12
K feldspar	15
sericite	25
chlorite	3
carbonate	8
opaques/pyrite	1
rutile	<1

This rock has been substantially deformed and altered leaving few of the primary textures. Angular, highly fractured quartz (0.5 - 2 mm) grains are characterised by extensive subgrain development and strained extinction. These occur with angular alkali feldspar and plagioclase grains (1 - 3 mm) and smaller quartz grains in a strongly sericite and chlorite altered matrix. The plagioclase and alkali feldspar display variable alteration to sericite and carbonate (often along fractures), as well as pervasive weak clay alteration.

Sericite is abundant in the matrix probably resulting from more extensive hydrothermal alteration of feldspars. There appear to be two oblique, weak foliation directions depicted by the sericite veinlets in the matrix.

Cleavage development also appears to be closely associated with narrow veinlets of chlorite, carbonate and opaques (pyrite). However, carbonate also occurs in irregular patches and apparently randomly oriented fracture fill veins.

Minor patches of chlorite with granular rutile may be after original biotite and Fe-Ti oxides.

The mineralogical features of this rock strongly suggest a granitic precursor similar to 031390A, 031391A and 031392A. This rock has experienced moderate hydrothermal alteration and deformation resulting in the present textural characteristics. Textural relationships suggest that sericite-chlorite-pyrite-carbonate

alteration occurred prior to the last major deformation, although some carbonate has been subsequently remobilised.

031398A

## Chlorite-Sericite Schist (Dacitic Lava)

Mineralogy	%
quartz	3
chlorite	20
sericite	40
silicic matrix	30
carbonate	7
apatite	<1
opaques(?pyrite)	<1
secondary Fe oxides	<1

At 2615 m mark,  
West Wall.  
Altered Tyndall Group  
Volcanic adjacent to  
bante lenses.

This rock consists of angular to elongate aggregates of quartz (0.1 - 1 mm), sericite pseudomorphs after subidiomorphic plagioclase phenocrysts, and sparse euhedral microphenocrysts of apatite in a foliated chlorite-sericite-altered silicic matrix. The quartz grains display strong subgrain development and strained extinction, and may represent original sparse quartz phenocrysts.

Subidiomorphic plagioclase phenocrysts have been almost completely replaced by sericite, but vague evidence of albite twinning indicates the identity of the precursor phase. Intergrown fine sericite and chlorite have extensively replaced an extremely fine grained silicic matrix/groundmass. There are fine opaques (possibly pyrite) and minor secondary Fe oxides with granular rutile disseminated throughout the matrix. the latter may originally have been fine grained quartz and feldspar resulting from the devitrification of silicic glass, but most of the feldspar has probably been altered to sericite leaving only fine xenoblastic quartz.

The rock has evidence of several cleavages; the principal cleavage has been folded resulting in development of a weak axial plane cleavage.

Carbonate occurs in patches and veins. Some of the veins appear to have been folded with the major cleavage, whereas others cross-cut both cleavages and probably represent later remobilisation of carbonate.

The extreme level of alteration makes it difficult to be certain of the original rock type. However the presence of pseudomorphed plagioclase phenocrysts and relict apatite microphenocrysts, together with the fine silicic groundmass suggests an original dacitic volcanic or volcanoclastic rock. The interpretation favoured is that this was originally a lava, but there are vague relict structures within the matrix which resemble recrystallised pumice fragments. Therefore the possibility that it represents some sort of pumiceous mass-flow deposit cannot be entirely discounted.

031400A

## Volcaniclastic Sandstone

Mineralogy	%
quartz	2
alkali feldspar	3
plagioclase	8
chlorite	10
sericite	8
lithic fragments	2
silicic matrix	65
carbonate	2
opaques(?pyrite + secondary Fe oxides)	2
zircon	trace
apatite	trace

At 2622m mark,  
East Wall.  
Altered hornfels (tuffaceous  
sediment?) adjacent to  
barite lenses.

Subidiomorphic plagioclase and alkali feldspar grains (0.3 - 1 mm) and angular quartz grains (0.2 - 1 mm) occur in a very fine grained siliceous matrix which has been variably altered to chlorite, sericite, pyrite and carbonate.

The plagioclase grains are often zoned, display albite twinning and extensive sericite and chlorite alteration. The alkali feldspar grains are typically unzoned, untwinned and appear less altered than the plagioclase grains. The quartz mostly occurs as small angular grains, but there are some larger grains with relict embayments indicating a volcanic origin. In addition, there is a relatively small proportion of very fine grained silicic lithic fragments. These are very similar in grains size and texture to the matrix, and hence not easy to distinguish

The very fine grained quartz and feldspar-rich matrix also contains abundant fine chlorite and disseminated pyrite (0.02 - 0.05 mm) with some larger grains of secondary Fe oxides. There are also dispersed euhedral crystals of apatite (0.1 mm long), and rare grains of zircon. Sericite tends to occur as subparallel fine veinlets which define a weak cleavage. The matrix also displays some variation in texture and grain size which appears to be a primary (sedimentary) feature.

Patchy carbonate alteration occurs mostly associated with pyrite concentrations, and there are also cross-cutting veins of carbonate (up to 0.1 mm) and coarse quartz veins (up to 4 mm wide).

The textural features of this rock and the presence of lithic fragments suggest a sedimentary origin, as a poorly sorted mass-flow deposit derived from unconsolidated volcanic detritus. The mineralogy seems most consistent with a broadly dacitic volcanoclastic precursor.

Sample 032706

Barite Vein (GJD)

Mineralogy:

	%
Barite	55
Fluorite	30
Carbonate	5-10
Quartz	5-10
Galena	5
Chalcopyrite	<1

At 2612m mark,  
West Wall.  
Barite lens with  
above-average sulphide  
content.

This sample is a vein or replacement-related barite-fluorite-galena assemblage.

The dominant fabric consists of coarse, interlocking, optically-continuous lenses of clear fluorite (up to 2 cm X 1 cm), intergrown with smaller plates of anhedral barite, and oriented roughly parallel to one another across the slide. Barite crystal size varies greatly, from single crystals 1.5 cm long, down to equigranular mosaics with an average size of 100 $\mu$ . The latter are intimately and interpenetratively intergrown with anhedral quartz of similar dimensions. A preferred elongation in this grain-size population, and undulose extinction in larger crystals, is evidence of deformation following barite growth.

Anhedral carbonate has an invasive texture concentrating along fractures, cleavage, and grain boundaries of the large crystal phases; in places it coalesces into distinct 1-5 mm clots. Although both barite and fluorite are replaced, fluorite has been replaced far more pervasively. Carbonate replacement proceeded in two events, an early fracture and cleavage-controlled phase, and a second generation of well-defined carbonate veins 1-2 mm across.

Galena and included chalcopyrite are wholly associated with carbonate replacement, particularly, the second carbonate vein-stage. Typically galena fingers out along fractures and grain boundaries on the selvage of carbonate zones, as optically continuous anhedral plates.

The mineral assemblage represents a sequence of hydrothermal growth and replacement, with no vestige of the original rock remaining.

032722

## Altered and Recrystallised Granitoid?

Mineralogy	%	
quartz	3	At 2700m mark, East Wall. Altered Tyndall Group lava or subvolcanic intrusive.
plagioclase	5	
chlorite	4	
sericite	10	
silicic matrix	75	
carbonate	2	
apatite	trace	
opaques(?pyrite + secondary Fe oxides)	1	
rutile	<1	
zircon	trace	

This sample consists of large subidiomorphic plagioclase grains (0.5 - 5 mm) and angular quartz grains (1 - 2 mm) in a sericite-chlorite-pyrite-carbonate altered silicic matrix.

The plagioclase grains display pervasive weak sericitic alteration, which is sometimes more extensively developed along fractures. The quartz grains are invariably angular with crenulated margins and strained extinction. Some of the finer matrix quartz (0.05 - 0.3 mm) and feldspar displays incipient granoblastic polygonal textures due to recrystallisation.

Chlorite occurs in patches or 'clots' with variably oriented cleavage together with anhedral opaque aggregates of fine granular rutile and minor prismatic apatite (up to 0.4 mm long).

The rock is traversed by two oblique spaced cleavages depicted by veinlets of sericite or sericite-intergrown with chlorite, and chlorite with carbonate.

It is very difficult to be certain about the identity of the original character of this rock. The presence of large quartz and plagioclase grains in a finer silicic matrix is consistent with a porphyritic rhyolitic to rhyodacitic volcanic. However, none of the larger quartz grains display any of the characteristics (eg. partial resorption textures) which are so frequently preserved even in volcanoclastic rocks. This

together with the lack of lithic fragments, the large grain size of the plagioclase and apatites, and the 'clot-like' distribution of the chlorite possibly after biotite suggest this may be a recrystallised porphyritic granitoid. Unfortunately the rock is too strongly recrystallised to be more definite and a volcanoclastic origin cannot be discounted.

032723

## Rhyodacitic Lava

At 4,400m mark,  
Anthony Tunnel

Mineralogy	%
quartz	3
sericitised plagioclase	5
chlorite	15
sericite	10
silicic groundmass	64
carbonate	<1
opaques(?magnetite)	3

Subidiomorphic to angular crystals of quartz (0.2 - 1 mm) and subidiomorphic plagioclase (0.3 - 2 mm) occur in a fine silicic groundmass that has been extensively altered to sericite and chlorite with subordinate magnetite.

The plagioclase crystals have been largely pseudomorphed by fine sericite, and the quartz displays strained extinction with some magmatic resorption features, but no subgrain development.

In addition to pseudomorphing the plagioclase, sericite occurs in elongate wispy blebs which have the appearance of flattened pumice fragments. In areas of more extensive alteration these sericite patches are intergrown with similar patches of chlorite. The latter also have fine octahedra of magnetite disseminated throughout them. Magnetite also occurs as larger (0.1 - 0.3 mm) anhedral disseminated throughout the rock.

The matrix intergrown with the chlorite and sericite is very fine grained quartz with xenoblastic textures. The rock is also traversed by several quartz-chlorite veins with minor carbonate.

The pumice fragments may in fact be pseudo-pumice resulting from the combined effects of selective alteration and recrystallisation (*cf.* Allen, 1988). The lack of strongly fractured and fragmented quartz grains tends to support this interpretation. The preferred alternative is that the original rock was a quartz-plagioclase-phyric rhyodacitic

lava. It has experienced substantial sericite-chlorite alteration and recrystallisation.

**C. - LEAD ISOTOPE DATA**



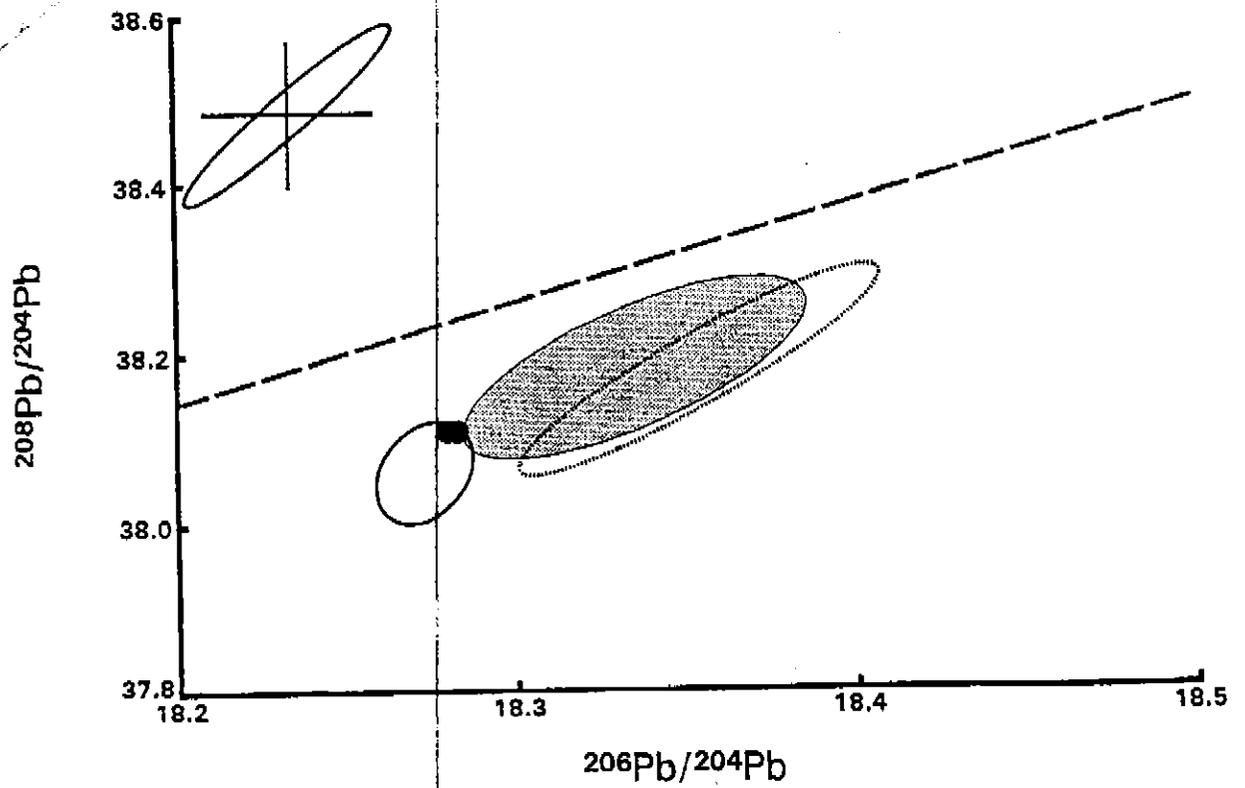
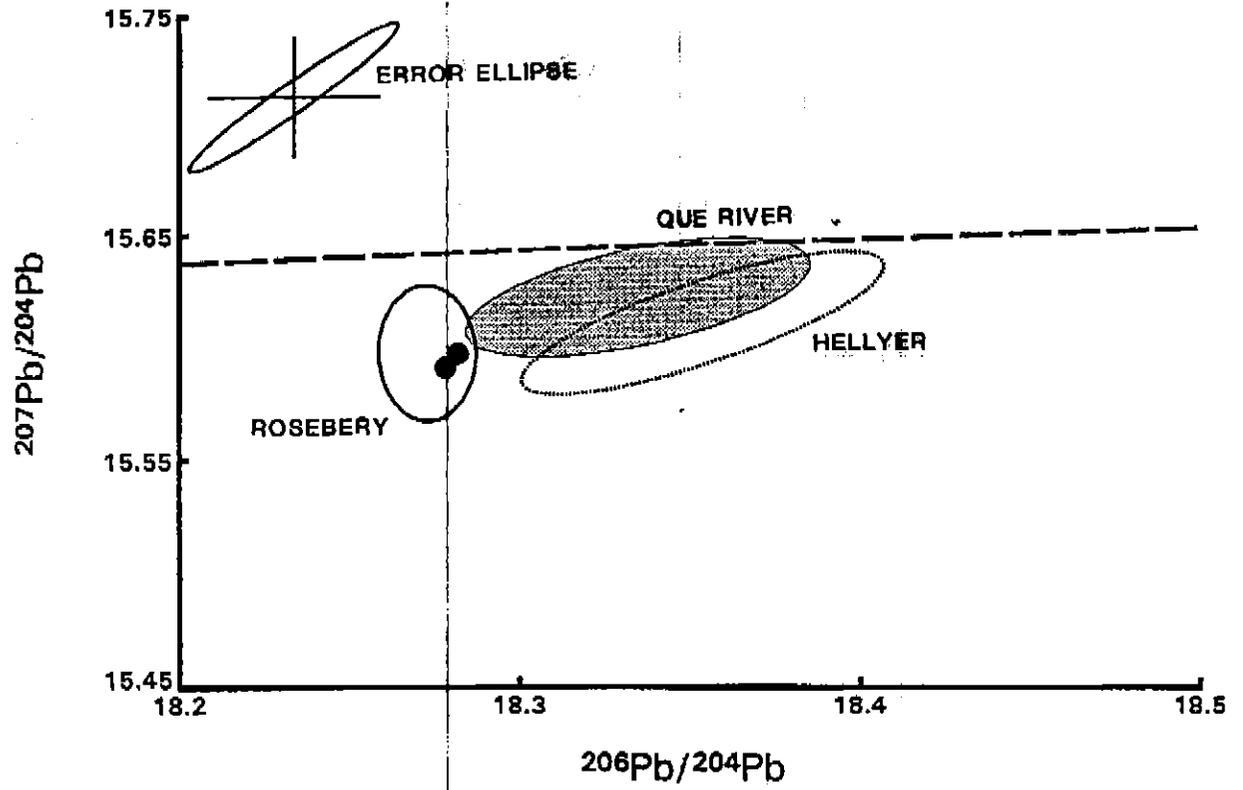
CENTRE FOR ORE DEPOSIT  
AND EXPLORATION STUDIES

A Key Centre at the University of Tasmania

FAX COVER SHEET

To:		From:																			
FERGUS FITZGERALD PASMINGO EXPLORATION BURNIE, TASMANIA		J. BRUCE GEMMELL CODES UNIV. OF TASMANIA																			
Fax No: (004) 318949		Fax No: (002) 232547	INTERNATIONAL (02) 232547																		
No. of pages including this one: 2		Date: 10/12/91																			
Subject: ANTHONY POWER TUNNEL BARITE - GALENA																					
Message:																					
<p>FERGUS,</p> <p>HERE ARE THE Pb ISOTOPE ANALYSES FOR THE ANTHONY POWER TUNNEL GALENAS. THEY ARE BOTH IDENTICAL AND PLOT WITHIN THE ROSEBERY FIELD. IT LOOKS LIKE IT IS CLEARLY CAMBRIAN MINERALISATION.</p> <table border="1"> <thead> <tr> <th>Print Number</th> <th>8/6</th> <th>7/6</th> <th>6/4</th> <th>7/4</th> <th>8/4</th> </tr> </thead> <tbody> <tr> <td>AR 032706</td> <td>2.0845</td> <td>0.85319</td> <td>18.282</td> <td>15.598</td> <td>38.109</td> </tr> <tr> <td>AR 032709</td> <td>2.0849</td> <td>0.85303</td> <td>18.279</td> <td>15.593</td> <td>38.110</td> </tr> </tbody> </table> <p>GOOD LUCK WITH THE EXPLORATION!</p> <p>cheers, Bruce</p>				Print Number	8/6	7/6	6/4	7/4	8/4	AR 032706	2.0845	0.85319	18.282	15.598	38.109	AR 032709	2.0849	0.85303	18.279	15.593	38.110
Print Number	8/6	7/6	6/4	7/4	8/4																
AR 032706	2.0845	0.85319	18.282	15.598	38.109																
AR 032709	2.0849	0.85303	18.279	15.593	38.110																





**D. - CRONE PULSE EM SURVEY**



**PASMINCO  
EXPLORATION**

A Division of Pasmaenco Australia Limited,  
A.C.N. 004 074 962

Level 2, The Atrium,  
290 Burwood Road,  
Hawthorn, Australia, 3122

**MEMORANDUM**

**TO:** FG FitzGerald  
**FROM:** RS Smith  
**DATE:** 30 March 1992  
**SUBJECT:** Barite Zone in the Anthony Tunnel

On 7 February 1992, Crone Pulse EM measurements were taken in the Anthony Tunnel, in the vicinity of a barite zone. The interpretation is potentially difficult because the effect of conductive air-ducts and steel pipes in the tunnel could overpower the response of a geological conductor. The measured response is actually quite small, decaying to the noise level by channel 5 (0.259 msec), so the cultural effect is not as bad as it could have been. On some stations there does appear to be long decays at signal levels less than 2 nV/Am<sup>2</sup>, but the rapid spatial variation implies a cultural source. There is however a slight increase in response for stations less than 2 500m, which if not geological may be as a consequence of the effect of the culture increasing.

The signal levels have been normalised to give a primary pulse of 1 000 at each station. The readings are all quite small, about 1% or less of the primary. There is therefore no cohesive evidence for a conductive zone of any significance near the part of the tunnel where measurements were taken.

Richard Smith

RSS141SR

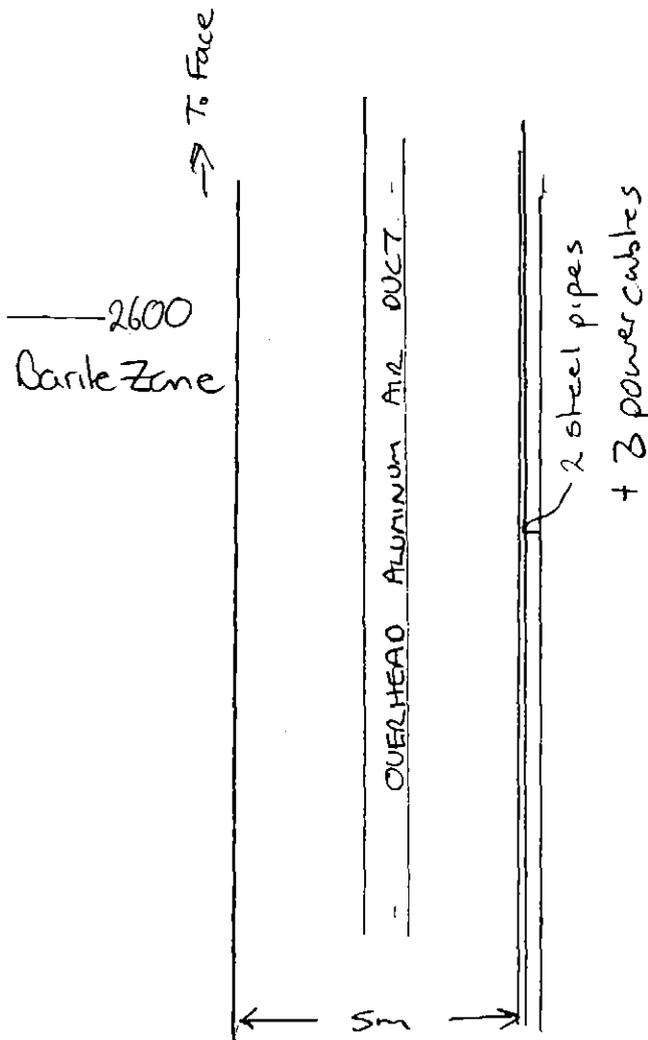
CRONE GEOPHYSICS & EXPLORATION LTD  
 Moving Loop Survey 056137

Client : Pasminco Exploration  
 Grid : Anthony Tunnel  
 Date : Feb 7, 1992  
 Time Base : 10.00 ms  
 Ramp Time : 0.50 ms  
 # Channels: 17  
 Sync Type : Cable  
 Loop Size : 5m X 8m  
 Current : 13 Amps

Hole : Tunnel  
 Tx Loop : 8x5x4  
 File name : tunnel.new  
 # Readings: 13  
 Stn Units : Metric  
 Coil Area : 4000 sq m  
 Polarity : +  
 Receiver : Digital #120  
 Operator : N.H.

Channel Times (usec)

Ch	Start	End	Center	Ch	Start	End	Center	Ch	Start	End	Center
PP	-198	-99	-149	1	76	104	90	2	104	131	117
3	131	171	151	4	171	225	198	5	225	292	259
6	292	378	335	7	378	490	434	8	490	639	565
9	639	828	733	10	828	1075	952	11	1075	1395	1235
12	1395	1809	1602	13	1809	2348	2078	14	2348	3046	2697
15	3046	3951	3498	16	3951	5121	4536	17	5121	6646	5884



# CRONE GEOPHYSICS & EXPLORATION LTD

## Moving Loop Survey

056138

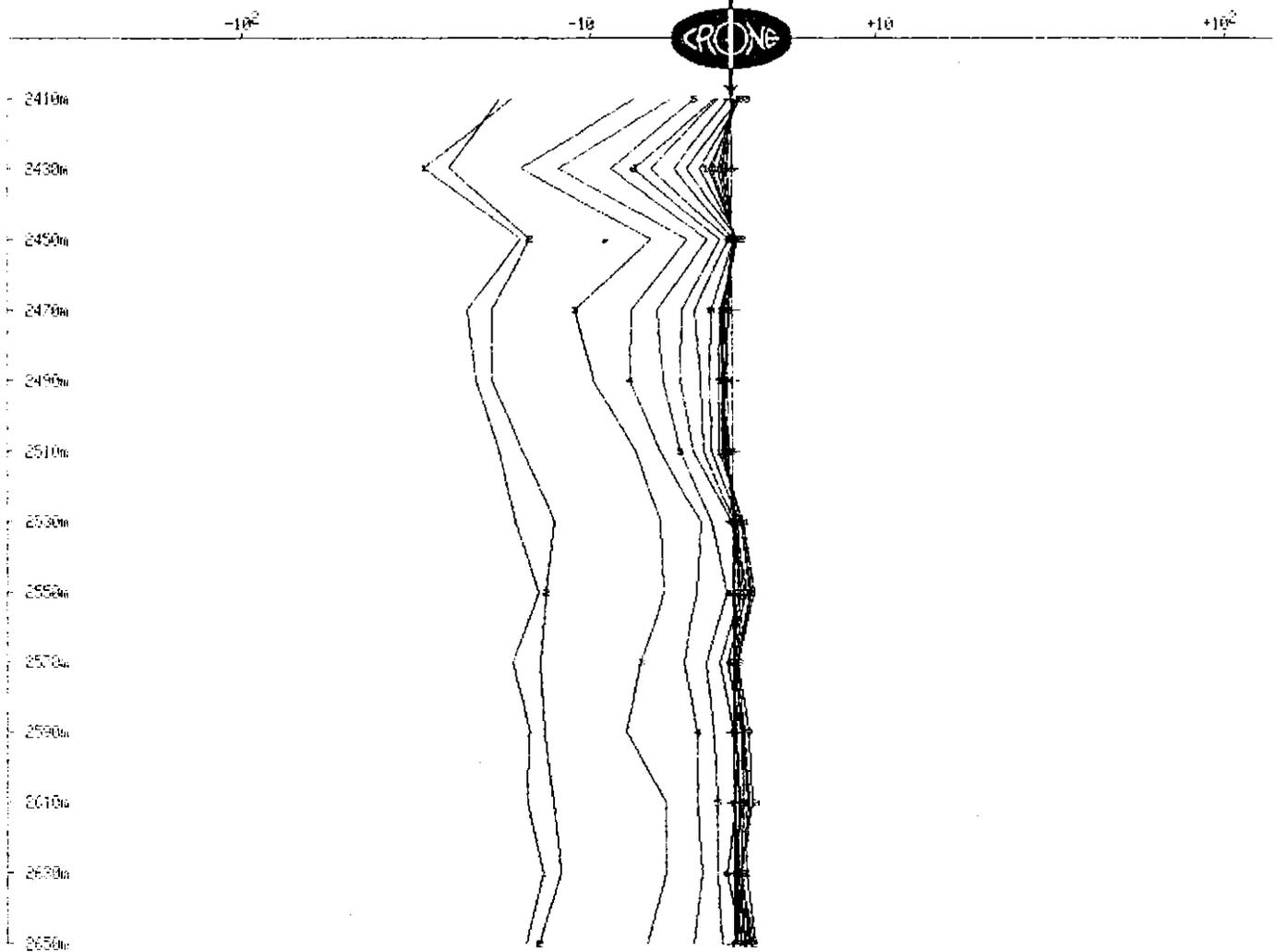
Client : Pasminco Exploration  
Grid : Anthony Tunnel  
Date : Feb 7, 1992

Hole : Tunnel  
Tx Loop : 8x5x4  
File name : tunnel.new

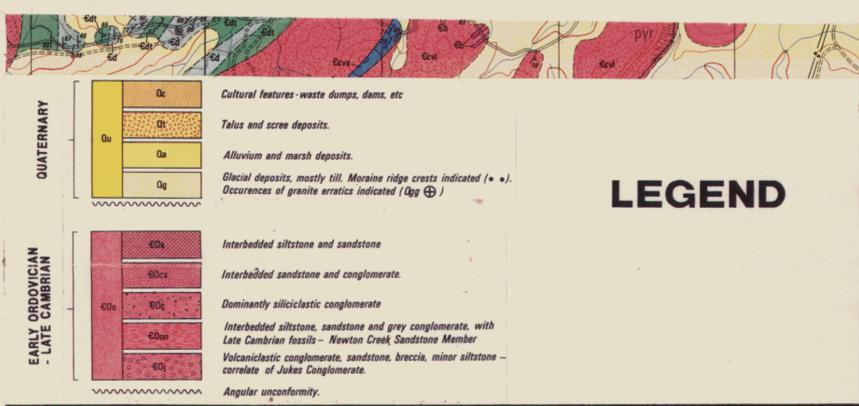
NORMALIZED TO PPz = 1000

Z COMPONENT dBz/dt nanoVolts/Amp-m<sup>2</sup> - 17 channels and PP

Scale: 1:2000



**FIGURES**

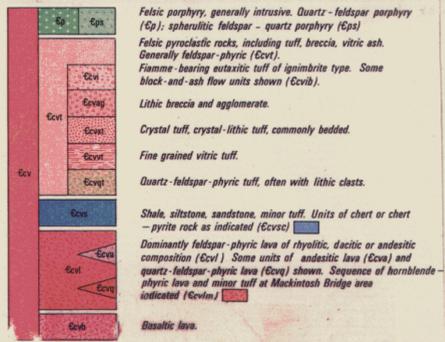


# LEGEND

## CAMBRIAN

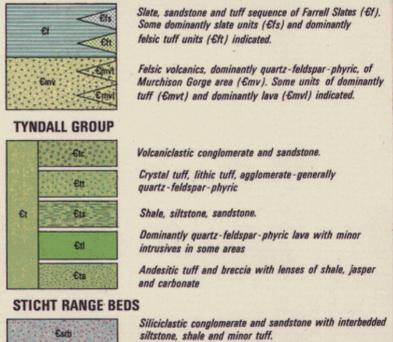
### WEST AND NORTH OF HENTY FAULT ZONE

#### CENTRAL VOLCANIC SEQUENCE - HERCULES - MT. BLOCK

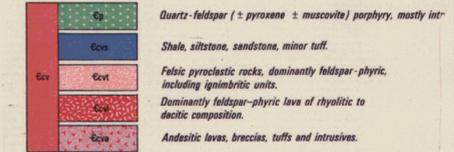


### EAST AND SOUTH OF HENTY FAULT ZONE

#### FARRELL - MURCHISON SEQUENCE



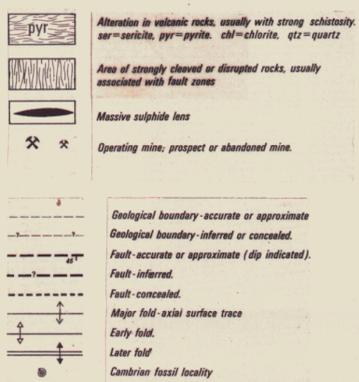
#### CENTRAL VOLCANIC SEQUENCE - RED HILLS - BASIN LAKE



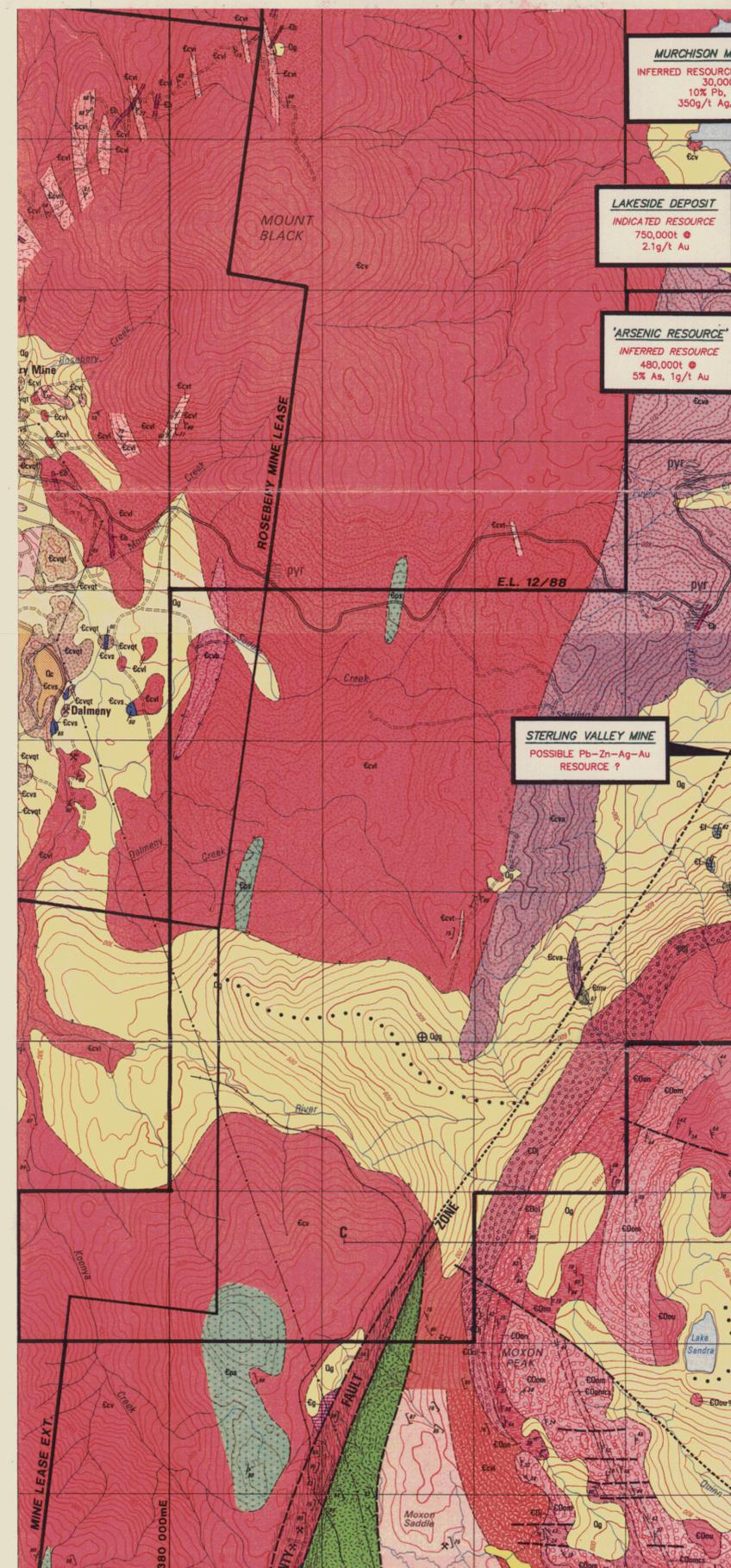
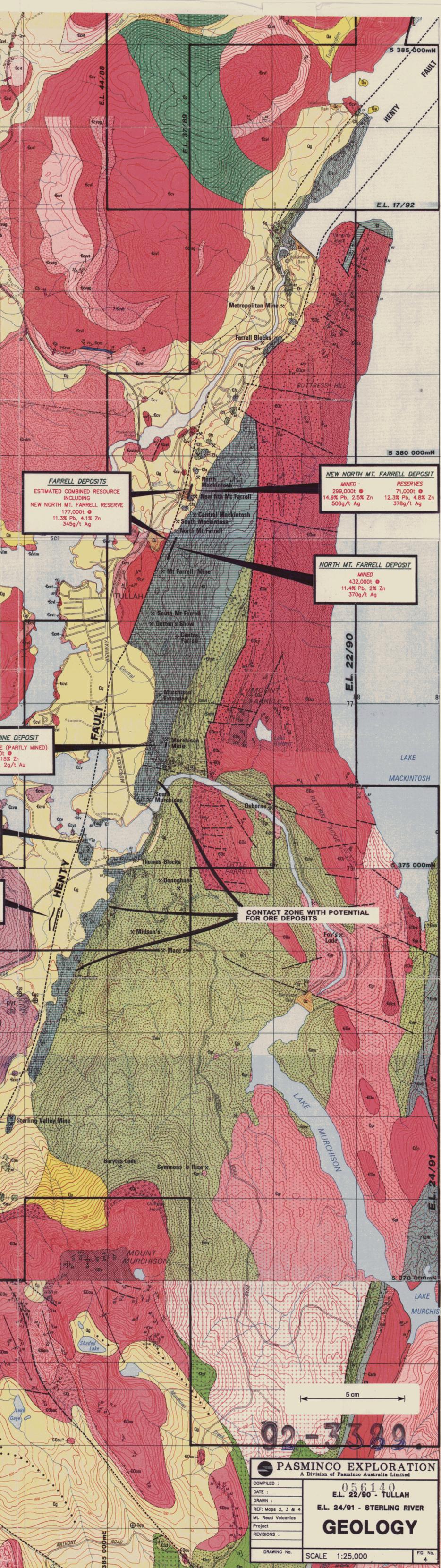
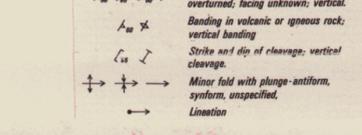
#### WESTERN VOLCANO - SEDIMENTARY SEQUENCE - LANGDON RIVER



### OVERPRINTS AND MINERALISATION



#### Strike and dip of bedding - facing known; overturned, facing unknown; vertical.



5 cm

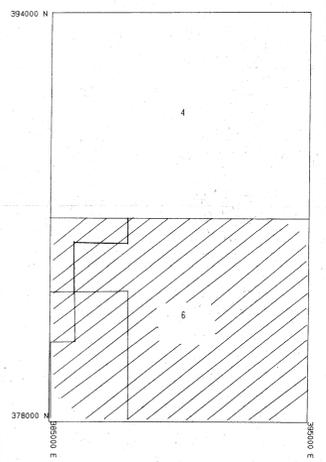
02-3389

**PASMINCO EXPLORATION**  
A Division of Pasminco Australia Limited

COMPILED :  
DATE :  
DRAWN :  
REF: Maps 2, 3 & 4  
MT. Reed Volcanics  
Project  
REVISIONS :

056140  
E.L. 22/90 - TULLAH  
E.L. 24/91 - STERLING RIVER  
**GEOLOGY**

DRAWING No. SCALE 1:25,000 FIG. No. 4



Prepared by: HEC ENTERPRISES CORPORATION

Date of Photography: 30 November '90  
 Contours derived from photogrammetric scanning (ZEISS C120 PLANICOMP), ground survey (PASMINGO), digital surface modelling (MICRO STATION) and graphics enhancement (PLANMAP).

056141  
 5 cm

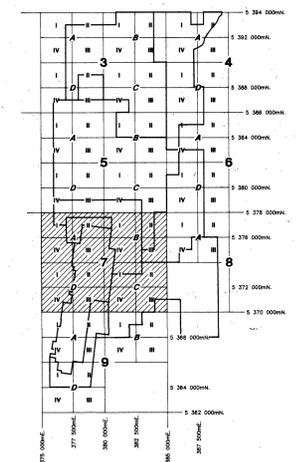
PASMINGO EXPLORATION  
 A Division of PASMINGO AUSTRALIA LIMITED

COMPILED: J.G.P.  
 DATE: 10-9-92  
 DRAWN: N.W.D.S.  
 REF:  
 REVISIONS:

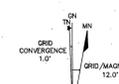
**92-3389**  
 E.L. 22/90-TULLAH

**DRILLHOLE LOCATIONS**  
 SHEET 6

DRAWING No: 6 SCALE: 1:10000 FIG No: 6



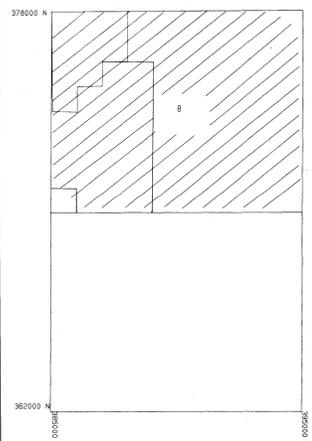
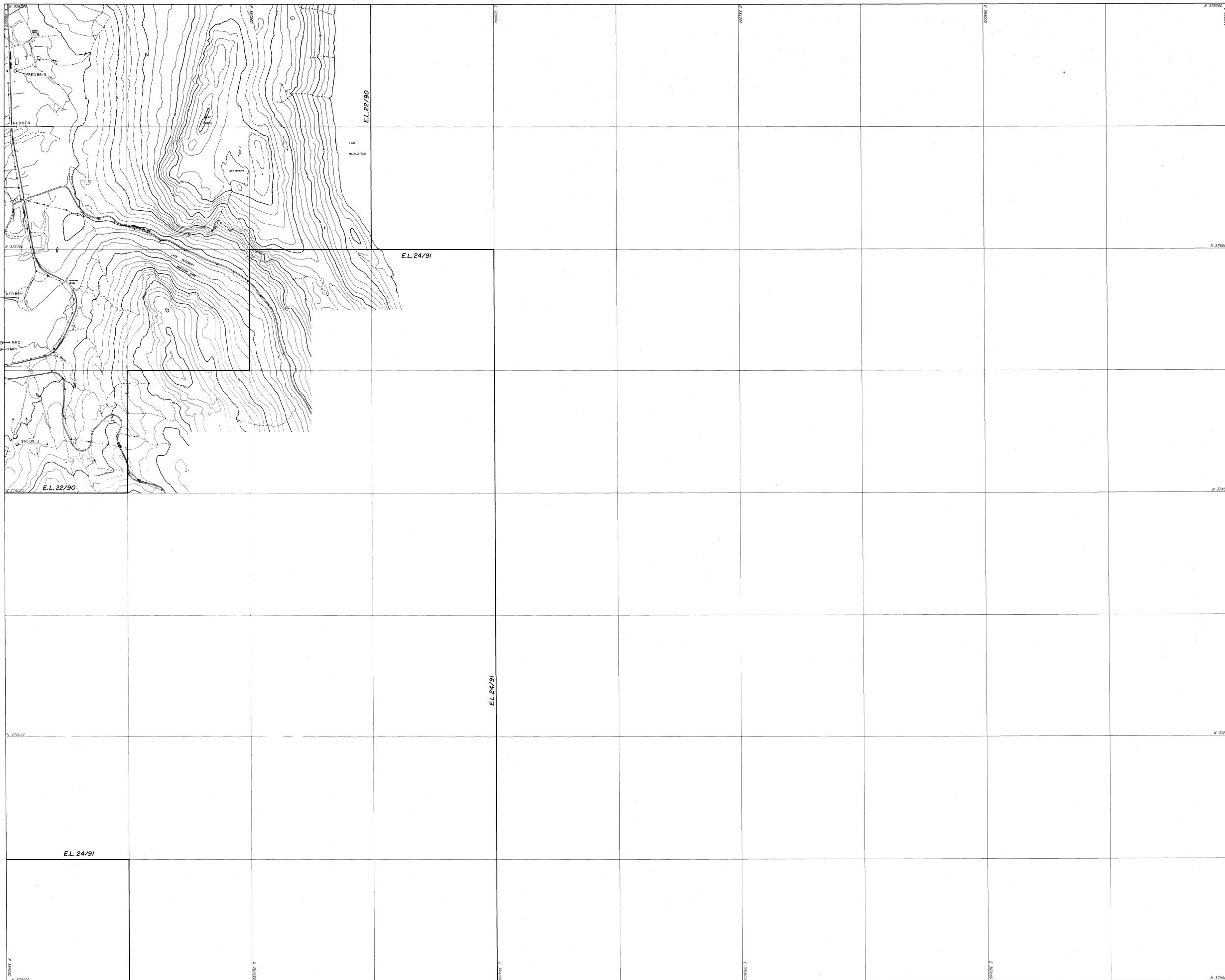
5 cm



056142 **92-3389.**

**PASMINCO EXPLORATION**  
A Division of Pasminco Australia Limited

COMPILED : J.G.P.	E.L. 22/90 - TULLAH
DATE : 10-9-92	E.L. 24/91 - STERLING RIVER
DRAWN : N.W.D.S.	<b>DRILLHOLE LOCATIONS</b>
REFERENCE :	<b>SHEET 7</b>
REVISIONS :	
DRAWING No.	SCALE 1:10000
	FIG. No.



Prepared by: HEC ENTERPRISES CORPORATION  
 Date of Photography: 30 November '90  
 Contours derived from photogrammetric scanning  
 (ZEISS CLEO PLANICOMP), ground survey (PASMINGO),  
 digital surface modelling (MICRO STATION) and  
 graphics enhancement (PLANIMAP)

056143 

**92-3389.1**

**PASMINCO EXPLORATION**  
 A DIVISION OF PASMINCO AUSTRALIA LIMITED

E.L. 22/90 - TULLAH  
 E.L. 24/91 - STERLING RIVER  
**DRILLHOLE LOCATIONS**  
 SHEET 8

COMPILED: J.G.P.  
 DATE: 10-9-'92  
 DRAWN: N.W.D.S.  
 REF:  
 REVISIONS:  
 DRAWING NO: B SCALE: 1:10000 FIG NO: 8