96-3935.

PLUTONIC OPERATIONS LIMITED

EXPLORATION LICENCE 10/88

GOWRIE PARK

Annual Report on Exploration Activity

August 1995 to August 1996

See folio 49

Prepared by: R J Close

12 November 1996

96-3935

ANNUAL REPORT-EL10/88
GOWRIE PARK - PLUTONIC OPS
R.J.CLOSE

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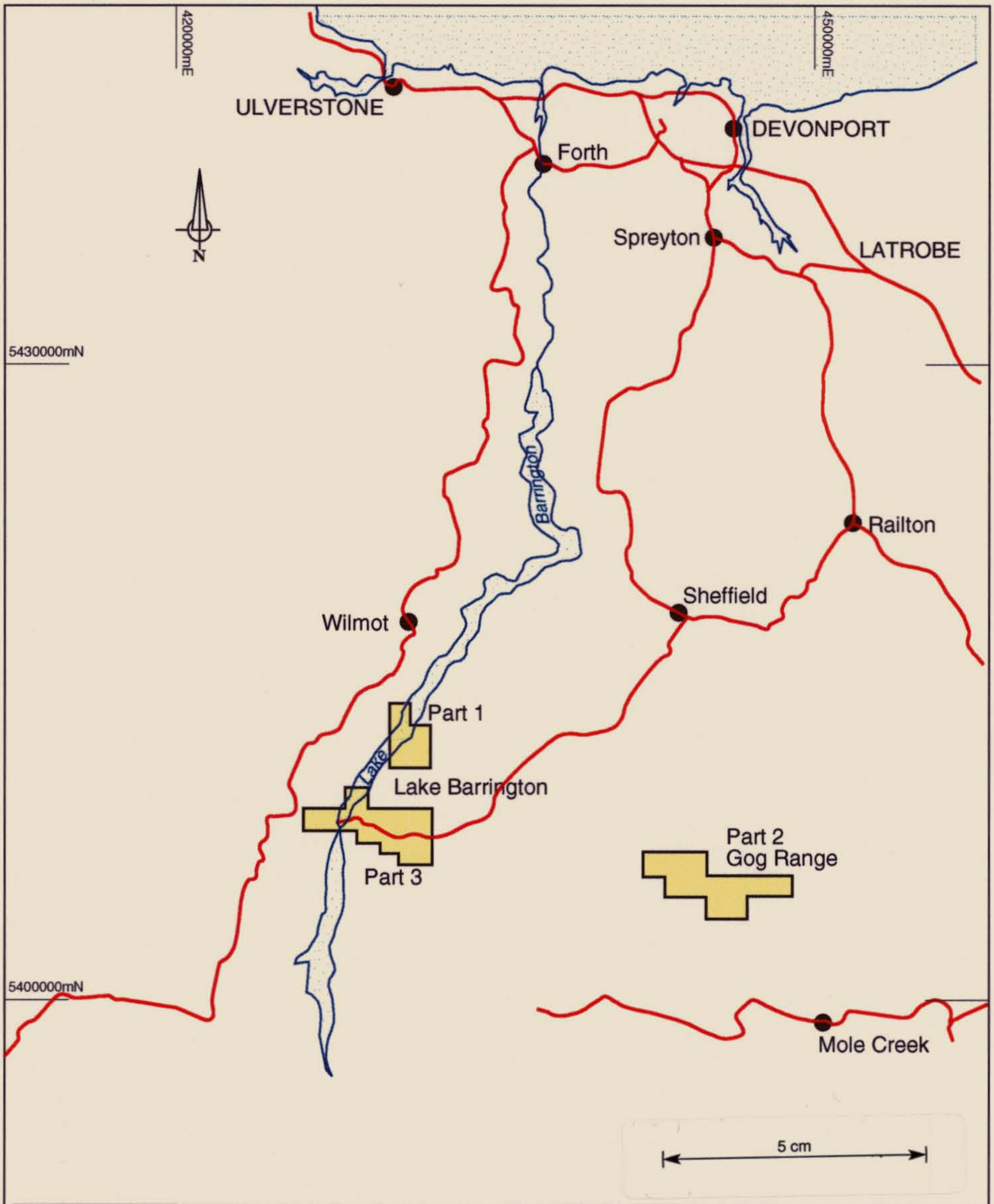

REVISION	PLUTONIC OPERATIONS LIMITED	
Technical Report No.	PROJECT: 706 - GOWRIE PARK	
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FIGURE 1

1.0 SUMMARY AND RECOMMENDATIONS

1.1 Summary

A detailed review of previous exploration at Cethana and Staverton was undertaken. The objective was to define new target areas for VHMS mineralisation, discuss the merits and effectiveness of earlier work and propose an ongoing exploration strategy. The Staverton prospect was regarded as having little prospectivity but the campground alteration zone to the southwest requires further investigation.

At Cethana, the relationships between volcanic facies, sericite alteration, base metal mineralisation and potential favourable exhalative horizons is somewhat obscure. Remaining VHMS potential is focussed on the Cethana East prospect in the upper part of the altered felsic volcanic sequence above the dominantly pyritic base metal mineralised zone tested by all previous drilling.

In 1995 - 1996 Plutonic attempted to gain a geological and geochemical perspective of the upper target sequence by conducting pattern power auger bedrock sampling. However this was only partly successful due to thick scree and glacial cover preventing penetration to bedrock over half of the grid. Nevertheless a major Pb-Zn anomalous zone related to gossanous volcaniclastics was demonstrated in the norther part of the grid.

It was decided to test the peak geochemically anomalous zone north and west of Olivers Road with a series of shallow reverse circulation drill holes but this programme has been delayed due to inappropriate field conditions and rig non-availability.

1.2 Recommendations

A successful drill programme at Cethana will lead to further testing of the prospective horizon along strike as well as diamond drilling at depth.

2.0 INTRODUCTION

2.1 Tenure

EL 10/88 (Figure 1) was previously a joint venture between Plutonic Operations Ltd and Noranda Pty Ltd, however on 2 June 1992 Plutonic Operations Ltd became the sole licensee and operator.

Previously the ground was part of EL 7/73 which was granted to Asarco in March 1973. In 1974 Asarco relinquished 297km^2 of the original 743km^2 CRA Exploration Pty Ltd (CRAE) joint ventured into the EL in July 1976 and also pegged EL 10/76 which covered the southern part of the Lake Barrington portion of the present Gowrie Park licence.

CRAE became the license holders in December 1979, reducing the total area of 7/73 to 199km^2 and Asarco sold its share to Carpentaria Exploration Co Ltd in June 1980. In 1983 CRAE became the sole lease holder until relinquishment of the licence in 1988.

Noranda Pty Ltd successfully tendered for the ground in August 1989, and added another 8km^2 as EL 35/88. The Mines Department subsequently added another 0.9 km^2 in order to rationalise the boundaries with AMG grid lines. The licence was in two parts, but joint reporting has been conducted as if one license. Following relinquishment of half of the original area in 1993 the licence was divided into three parts (see Figure 2).

2.2 Access and Land Usage

Good access to all parts of the licence is provided by bitumen roads as well as HEC and old forestry tracks. However, access to individual prospects and/or desirable drill sites can be problematic because of steep topography. Lake Barrington itself provides excellent access by boat for the purposes of mapping.

Effectively all of the prospective rocks in the licence are within State Forest, the exception being part of the Cethana West Prospect which lies within land vested to the HEC.

3.0 REGIONAL GEOLOGY

The prospective rocks within the licence are part of the Cambrian Mt. Read Volcanics which host five gold rich polymetallic VMS deposits in Western Tasmania. These include Mt Lyell, Hercules, Rosebery, Que River and Hellyer as well as the Henty gold deposit. In addition, there are numerous occurrences of sub-economic deposits and VMS style alteration throughout the belt.

All of the above deposits occur in the Dundas Trough along the major north-south trending part of the volcanic belt which runs from Elliott Bay to north of Hellyer. The Mt Read volcanics that outcrop in EL 10/88 occupy a subsidiary region, the Fossey Mountain Trough, which trends roughly east-south-easterly from north of Hellyer to beyond Deloraine.

In the vicinity of the Gowrie Park tenement, (refer Figure 2), Tasmanian Mines Department MRBP 1:50,000 mapping stops just within the western most boundary of the EL and is included in the "Geology of the Winterbrook-Moina" area. Other than this, the most recent Mines Department regional mapping is the very outdated "Sheffield" (1959) and Middlesex (1958) one mile to one inch mapping. Proposed revision of the "Sheffield" sheet has been shelved indefinitely.

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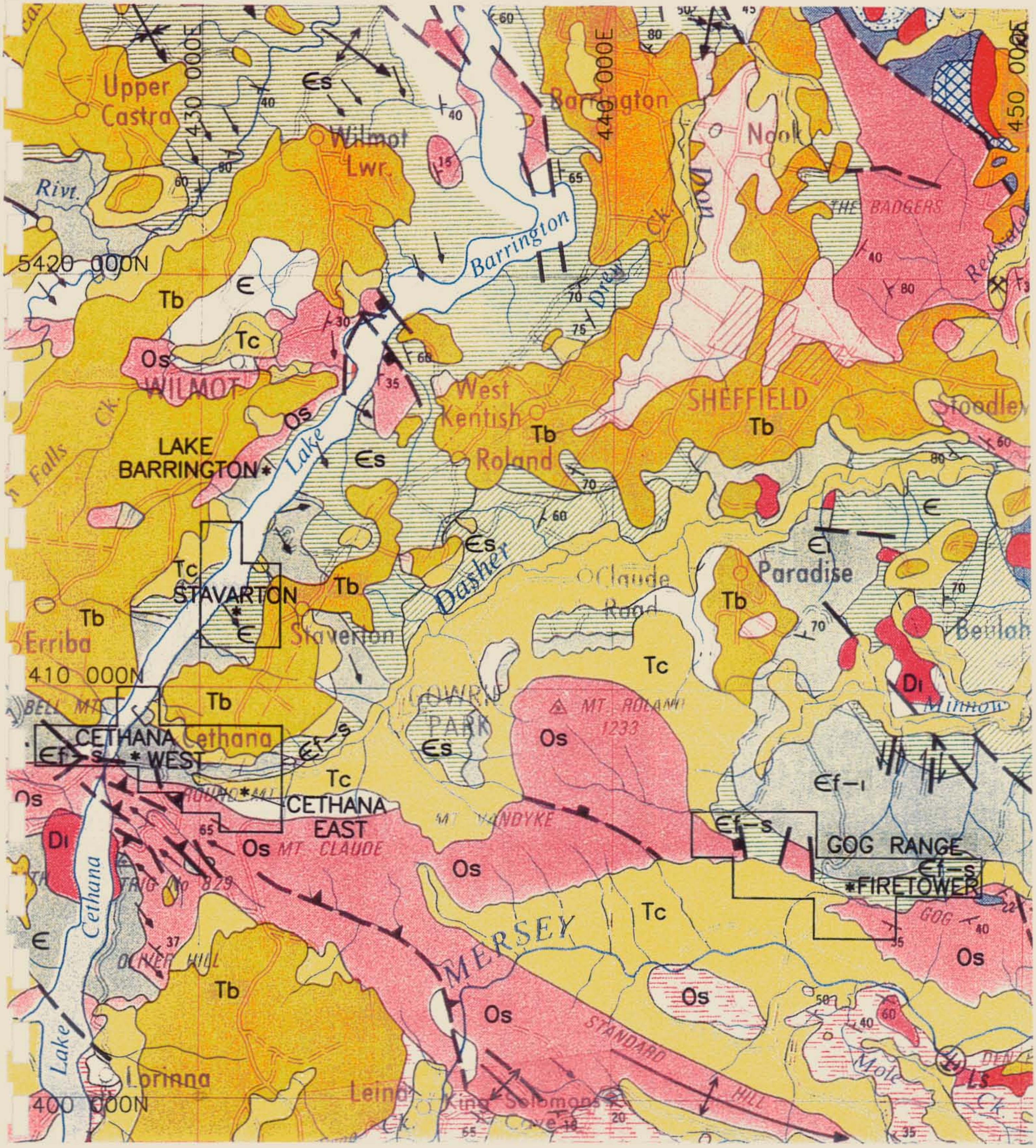

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LEGEND

Tc	TERTIARY-RECENT COVER
Tb	TERTIARY BASALT
Di	DEVONIAN INTRUSIVE
Os	ORDOVICIAN SEDIMENTS
∈s	CAMBRIAN SEDIMENTS
∈f-ı	CAMBRIAN FELSIC-INTERMEDIATE VOLCANICS
*	PROSPECTS

REVISION:

Plutonic

Plutonic Operations Limited

A.C.N. 004 880 997

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PROJECT: 706 - GOWRIE PARK

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REGIONAL GEOLOGY AND PROSPECTS

SCALE: 1 : 125 000

SOURCE:

DWG. NO.: 2

Early Cambrian volcanism in the main Mount Read Belt was rhyolitic to dacitic in composition followed by a period of andesitic-basaltic volcanism before a return to felsic volcanism in the late Cambrian. The VMS orebodies of Rosebery and Hercules are believed to have formed later in the initial felsic volcanic phase, whereas the Que and Hellyer orebodies formed during the subsequent mafic-intermediate phase. The disseminated copper orebodies at Mt Lyell are hosted in the lower felsic phase but may be time correlates of the mafic intermediate phase having mainly been deposited sub-surface, possibly due to fluid boiling.

This relative ageing of mineralising events is subject to considerable debate due to the overprinting of alteration and deformation over initially complex inter-fingering relationships of volcanic packages related to separate volcanic centres.

The volcanics and associated sediments of the Fossey Mountain Trough have an uncertain position within this stratigraphy because regional mapping has revealed significant differences between the volcanic sequences in the Dundas Trough and the Fossey Mountain Trough. In particular the mafic-intermediate phase as represented by the Beulah Formation south of Sheffield, may be more significant in the north of the state than in the central western part of the belt.

In the Fossey Mount Trough the siliciclastic largely Precambrian derived Roland Conglomerate and Moina Sandstone, of Late Cambrian-Ordovician age, unconformably overlie the Cambrian volcanics with small outliers of these younger rocks capping the volcanics in many places. The observation that the unconformity is clearly angular in many places indicates that there was a major phase of deformation, (compressional) in the Late Cambrian, prior to the deposition of the siliciclastics.

The siliciclastics are overlain by the Gordon Limestone. These younger post volcanic rocks were themselves folded, during the mid-Devonian Tabberabberan Orogeny at which time some thrust faulting is believed to have taken place. (Jennings, 1979).

Williams (1979) refers to two phases of mid-Devonian folding; earlier east-west "Loongana/Wilmot trend" folds with a half wavelength of 5 km and later north-westerly to northerly "Deloraine/Railton trend" folds with a half wavelength of 2.5 km. These two folds trends interfere in the Fossey Mountain Trough.

In general, Cambrian deformation is not considered to have produced the S1 cleavage which is considered to be consistent with the earlier of the two mid-Devonian fold trends. However, Woodward et al (193) has highlighted the significance of thrusting during both late-Cambrian and mid-Devonian deformation. Recognition of thrust faulted contacts along portions of the southern margin of the Fossey Mountain Trough, indicate similar thrusts may be present in the Cambrian volcanic sequence, though none have been recognised.

Following the mid-Devonian deformation the north and west of Tasmania was intruded by granitic batholiths. Intrusive bodies in the region of EL10/88 include the Dalcoath Granite to the south of Cethana, and the Beulah Granite to the north of the Gog Range. The former granitoid was responsible for a number of relatively minor and possibly zoned base metal mineral deposits in the Moina area south-west of Cethana.

Tertiary tholeiitic basalt lavas which originally infilled most topographic lows, now occupy topographic highs and cover prospective Cambrian volcanics and associated sediments in many parts of the belt.

Glaciation in the Quaternary has produced both glacial deposits and scree which is locally widespread and covers much of the northern area of the Cethana East prospect.

4.0 EXPLORATION PHILOSOPHY

Exploration has targeted two mineralisation styles in EL 10/88. The initial target of ASARCO/CRAE was a polymetallic volcanic hosted massive sulphide (VHMS) orebody such as those found at Rosebery, Hercules, Que River and Hellyer. The pervasive alteration at Cethana and Staverton is very similar to that seen around these orebodies.

The presence of a number of small occurrences of VHMS style mineralisation within felsic volcaniclastics at Cethana East and West emphasise the relatively high prospectivity of these prospects in relation to the rest of the Fossey Mountain Trough.

In addition, whole rock/REE geochemistry and petrology on samples from Staverton suggest that these rocks are strongly altered correlates of the mafic Que-Hellyer footwall sequence and therefore are also highly prospective.

The second target is a Cambrian volcanic-hosted gold deposit. Models initially explored for by Noranda (Jones 1989) were South Hercules and Henty which are considered to be VHMS related, although the higher grade quartz vein-silicic mineralisation at the Henty Mine is probably syndeformational and Devonian in age.

Another discretely different style of volcanic hosted gold orebody is exemplified by Voyager 12 and 24 at Elliott Bay at the extreme south of the main Mt Read Belt, and other occurrences such as Anio Creek/Ten Mile Creek which lie south-east of Que and Hellyer. These occurrences are not spatially related to VHMS orebodies but appear to be spatially/genetically related to Cambrian quartz-feldspar-biotite porphyries which occur along the eastern and southern margin of the Dundas Trough and Fossey Mountain trough respectively. The Gog Range part of the EL, including the Fire Tower gold prospect is clearly prospective for this style of deposit.

5.0 LOCAL GEOLOGY

5.1 Introduction

This district would benefit from a good regional compilation map of the type produced for the Mount Read Volcanic Project. Within the tenement area Plutonic has mapped at 1:1000 to 1:2500 prospect scales augmented by previous mapping by Aberfoyle and CRAE and reconnaissance traverses compiled by Macdonald 1993.

The oldest recognised Cambrian strata at Cethana occur in the southern part of Cethana West. These sediments are moderately to steeply dipping, face north-north-east and comprise fine chloritic, pyritic siltstones and lesser sandstones with interbedded conglomeratic mass flows which are haematite and magnetite bearing towards the top of the sequence.

The sediments are overlain by a package of felsic lavas, volcaniclastics (reworked tuffs) grading to fine tuffaceous sediments, which are all at least moderately sericite $\pm$ chlorite $\pm$ pyrite $\pm$ haematite altered with increasing intensity up sequence to the north. This pervasively altered package is overlain by steeply dipping, unaltered greywackes and conglomerates of probable intermediate derivation, together with interbedded intermediate lavas.

Along strike at Cethana East the altered felsic sequence is similar though the felsic volcaniclastics are more dominant and associated hydrothermal alteration more widespread than at Cethana West.

An enigmatic body of quartzite low in the package, just north of Olivers Road lookout may either be a thrust slice of Precambrian or Moina Sandstone as mapped by Herrmann (1989).

North of Cethana West the intermediate sediments/lava sequence is followed by relatively unaltered felsic lavas, felsic volcaniclastics and minor sediments until another zone of strong alteration and north-north-west striking schistosity is encountered at "Campground". North of these altered felsic volcaniclastics, alteration intensity decreases and the rocks become more clearly sedimentary up to just before the Staverton prospect where outcrop includes intermediate derived mass flows and lava breccias amongst siltstones and sandstones. These sediments in turn are overlain by strongly altered andesitic to dacitic lavas at Staverton.

Further north between Staverton and the Lake Barrington prospect the stratigraphy becomes quite complex with interbedded unaltered mafic lavas, intermediate lavas and lava breccias, felsic volcaniclastics, siltstones and sandstones. However, it would appear that this predominantly mafic-intermediate package at Staverton occupies a major synclinal position. Evidence for this interpretation is found in dip/facing orientations at both the Staverton and Lake Barrington prospects.

At the Lake Barrington prospect intermediate lavas and associated sediments overlie sediments which are in turn underlain by felsic lavas and mass flows. North of the Lake Barrington prospect these felsic lavas are underlain by siltstones and felsic volcaniclastics.

The stratigraphy in the Staverton to Lake Barrington area has strong similarities to the Cethana sequence, the main difference being the major development of mafic to intermediate volcanics around Lake Barrington compared to the relatively restricted intermediate unit at Cethana West.

5.2 Cethana East Prospect

Geological interpretation at Cethana East, (refer Figure 3) is based largely upon G J Purvis' (1979) mapping with some check mapping and re-logging of drill holes DD77CC4 - CC8 and mapping of road cuttings. The two new diamond drill holes CED1 and CED2, support the previous lithological interpretation but suggest the hydrothermal system is weakening to the east.

The Cethana East prospect lies along strike from Cethana West with the intervening ground covered by Quaternary glacials and periglacial Roland Conglomerate scree which extends eastwards over the northern part of Cethana East. This cover obscures potentially prospective rocks for VHMS mineralisation which remain untested.

As recognised at Cethana West, the southern contact between the Cambrian volcanics/sediments and the younger Late Cambrian - Ordovician siliciclastics is an angular unconformity. Towards the southern end of lines 21600E, 21700E and 21750E an unaltered siliceous sandstone outcrops. This may be fault bounded sliver of the Moina Sandstone (Herrmann 1979) but as Purvis (1979) indicates, it looks quite like a Precambrian quartzite. The contact between this sandstone/quartzite and the Cambrian volcanics to the north does not outcrop but appears as a very weak anomaly on the CRONE EM survey (MacDonald 1993) and it is probably a fault.

No facing indications were found at Cethana but it is very likely that the sub-vertical sequence youngs to the north, based on the younging orientation of similar rocks to the west and along strike at Cethana West.

The Cambrian rocks at Cethana East essentially consist of a package of felsic volcaniclastics and cherty tuffaceous siltstones, the former characterised by fine grained to coarse grained quartz eyes with variable pumice, feldspars and lithics including rounded cherty (quenched felsic lava?) clasts and tuffaceous siltstones. Felsic lavas/porphyries are less common at Cethana East than along strike both east and west.

Overall the package appears to fine up sequence to the north in the area of Olivers Road where drilling has taken place, though the rocks further north are obscured by Quaternary cover.

A felsic lava with a hyaloclastic margin outcrops in the western part of the prospect on lines 21400E and 21450E and extends at depth in DD77CC6, (refer Figure 4). Similar lava was intersected in CED1 and CED2 to the east but lava has not been mapped in this area.

Alteration is restricted and less intense in the lavas compared to the surrounding felsic volcaniclastics, which exhibit ubiquitous but variable quartz ± sericite ± and chlorite development together with common post-cleavage carbonate veining.

Low-grade sulphidic mineralised zones were intersected in all CRAE drillholes. Of most significance are the semi-massive pyrite-sphalerite-galena-chalcopyrite lens from 37.8m - 38.8m in DD77CC3 and the thin massive pyrite lenses at 62.7m - 62.8m in DD77CC7 and from 61.5m - 61.75m in DD77CC4. Most sulphidic zones consist of pyrite stringer veins and blebs partially aligned in the S_2 cleavage, which suggests an early, possibly syngenetic origin.

The most important galena-sphalerite bearing stringer zone was intersected over twelve metres from 31.0m to 43.0m in DD77CC6. This is correlated with the semi-massive zone in DD77CC5 along strike to the east. Petrology suggests this zone could be syngenetic in origin and may represent a weak early phase of exhalative mineralisation above a dominantly pyritic footwall alteration zone to the south. The lack of a significant sulphide intersection in DD77CC8 directly below the promising intercept in DD77CC5, is considered indicative of a poorly developed lenticular mineralised zone which is unlikely to have significant lateral or vertical extent. This may be a result of rapid ongoing sedimentation swamping and diluting the sulphide mineralisation, or erratic sub-seafloor syndiagenetic mineralisation which was controlled by relative permeability in the volcaniclastic package.

Potential remains for this mineralisation to be better developed in a more quiescent sedimentary environment, which may have existed along strike to the west of DD77CC6 but more likely was up sequence where finer lithologies are reported north of the hairpin bend on Olivers Road.

6.0 EXPLORATION COMPLETED

6.1 Introduction

A review (presented as Appendix 1) was conducted of the Cethana and Staverton prospects in order to promote more effective exploration of the project. In essence, the review concluded that the Staverton area held little VHMS prospectivity but potential remains at Cethana East. However, the geological setting on both regional and prospect scales remains poorly understood, and the known mineralisation is low grade, possibly remobilised in deformation zones.

In order to properly assess the VHMS prospectivity of the Cethana East area it was recommended that a program of outcrop mapping, drill core reinterpretation of volcanic facies, alteration and structure supplemented by whole rock geochemistry be undertaken. This work has not yet been conducted.

Prior to the review a programme of bedrock auger sampling to provide geochemical and geological data in covered areas at Cethana East was carried out in late 1995.

6.2 Auger Sampling

A total of 75 bedrock soil samples were collected from 0.3 to 2.0 metres depth using a modified power auger.

Sample locations and assay results are presented in Plate 1 and details are provided in Appendix II. The sampling pattern was originally designed at 25m intervals and 100m spaced north-south grid lines. However, because the auger could not penetrate to bedrock over much of the western and northern portions of the grid, samples were taken wherever feasible on the gridlines.

Samples were dried and sent to the Analabs laboratory facility in Burnie where they were sieved to -80#, pulverised and assayed by AAS method GA101 for Cu, Pb, Zn, Ag, Fe and Mn. Resultant Cu, Pb and Zn analysis have been plotted together with previous bedrock results on Plate 1, with lead values contoured at 100, 250, 500 and 1000 ppm levels.

Peak values were generally achieved downslope or directly along strike from previous highly anomalous results. In the vicinity of known mineralisation intersected in drillholes DDHCC3 and 6, the geochemistry suggests there is little possibility of significant near surface strike extensions west of 21500E and south of 3400S.

To the north however, the data is insufficiently detailed west of 21750E to preclude the possibility of a minor overlying mineralised position around 34000S-3450S. In this area maximum values of 97 ppm Cu, 4590 ppm Pb and 1735 ppm Zn with strong Fe and Mn in limonitic ferricrete are located along strike from subcropping ironstone gossanous felsic volcanics at 21790E - 3410S.

Two hundred and fifty metres north and down slope an extensive but only partly defined Pb-Zn anomalous zone trends across the grid from 21200 near the Claude Road to the tenement boundary around 22400E. This zone is best developed along the 21800E line centred at 3150S where earlier sampling achieved 2860 ppm Pb, 630 ppm Zn and 3970 ppm Mn. Along the powerline track crossing the 21900E line the anomalous target zone subcrops as a variably Fe-Mn rich gossanous felsic volcaniclastic, this lithology appears to extend east to Olivers Road around 22150E 3200S. To the west of 21800E the zone is mostly obscured under thick cover but it reappears south of the Claude Road along the 21200E and 21400E lines.

In general, the auger sampling did not provide a very meaningful assessment of the geology in the covered areas to provide adequate definition of potential exhalative positions. Nevertheless the programme did highlight several target zones which warrant further evaluation by drilling.

6.3 Conclusions

A technical review of the Cethana and Stavarton prospects focussed remaining base metal prospectivity on the Cethana East area where previous exploration has not clearly demonstrated the existence of synvolcanic exhalative mineralisation.

An auger bedrock sampling programme over the northern scree covered slopes at Cethana East has partially outlined an extensive geochemically anomalous target zone related to gossanous felsic volcaniclastics. This zone may represent an upper exhalative mineralized horizon and is the target for a proposed reverse circulation drilling programme to be conducted whenever a suitable rig is available.

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APPENDIX 1

REVIEW OF CETHANA AND STAVERTON EXPLORATION AND POTENTIAL

331018

PLUTONIC OPERATIONS LIMITED

MEMORANDUM

TO: Bob Close, District Geologist - Base Metals

FROM: Wally Herrmann, exploration geologist, Tasmania

DATE: May 24, 1996

SUBJECT: **Review of Cethana and Staverton Exploration & Potential**

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1. SUMMARY and CONCLUSIONS

This report presents an overview and discussion of extensive and detailed exploration programmes, including soil geochemical, IP and TEM surveys and drilling of 16 holes, which have been carried out in the Cethana and Staverton areas of EL 10/88 over the past two decades.

The exploration to date at Cethana and Staverton has been narrowly focussed on areas of variably altered felsic and intermediate volcanics, originally identified by surface or drainage geochemical anomalies. However, all the discovered mineralisation is low grade, possibly re-mobilised in deformation zones. There is some evidence that extensive sericite alteration zones are also structurally controlled, and the relationship between volcanic facies, alteration, mineralisation and potential favourable horizons remains obscure.

The drilling of soil geochemical and geophysical anomalies has established that weak mineralisation gives rise to quite strong Pb-Zn geochem and IP anomalies and I think there is little value in systematically continuing this style of testing of remaining second rate anomalies on the gridded areas. Exploration opportunities for the easy to find, near surface, deposits have been largely exhausted on the gridded areas and the remaining potential appears to lie laterally or deeper.

Dreadful as it is to admit, after the extensive grid based exploration and drilling, the geological setting on both regional and prospect scales remains too poorly known to make a good estimate of conceptual exploration potential, or to dismiss the area as unprospective.

The prominence of quartz phyric felsic volcanics suggests a correlation with the Tyndall Group of the Mount Read Volcanics, as inferred by Pemberton and Vicary (1989) for the Mt Jacob - Bell Mt area nearby to the west. The andesites in the sequence at Staverton and Lake Barrington Road and the apparent north dipping, reverse faulted, contact between volcanics and Denison Group siliciclastics are faintly analogous to the Anthony Road setting (between Henty and Mt Lyell), which is currently regarded as highly prospective. The apparent geochemical similarity of Staverton andesites with Que-Hellyer footwall andesites obliquely infers potential for Hellyer type VHMS deposits.

I am inclined to recommend a two to three month (<$35,000) programme of good surface mapping and drill core re-interpretation of volcanic facies, alteration and structure, supplemented by additional wholerock geochemistry, to address the uncertainties of litho-stratigraphic correlations with the western part of the Mt Read Volcanics, favourable horizon(s), alteration vectors and deformation, and allow greater confidence in the siting of (probably inevitably) "stratigraphic-exploratory" drill holes. However, I am under no illusions about the limitations of outcrop and will readily concede that such work may not be conclusive.

2. CETHANA AREA

2.1 Summary of Cethana Exploration History

1974 T. Porter (CRAE) recognised altered volcanics in road cuttings, probably while investigating the source of Asarco stream geochem anomalies.

1976 Gridded 4.5km of strike;

Mapping: outlined a regionally extensive WNW trending zone qtz-ser-chl-CO3 alteration associated with strong schistosity in north facing? felsic volcaniclastics.

EAST CETHANA

B-C soil & rock chip geochem: patchy weak Pb-Zn anomalies at eastern end, possibly transported.

Gradient IP: chargeable zone 1300 x 250m corresponding to soil geochem.

Magnetics:

2 DDHs: to test coincident IP & Pb-Zn soil anomalies:

CC4 significant Pyrite (~3%) throughout, low base metals,

CC5 widespread minor minz: 1m @ 0.8%Pb, 3.9%Zn, 1.2%Cu, 185Ag, 0.7Au; 5m @ 0.1%Pb, 0.4%Zn etc.

WEST CETHANA

B-C soil & rock chip geochem indicated several small, strike parallel Pb-Zn anomalies peaking at 1550ppm Pb and 3000ppm Zn in the south eastern area.

Gradient IP: no significant anomalies

3 DDHs targeted on geochemical anomalies over 600m of strike:

CC1 intersected qtz-sericite altered felsic volcanics with widespread minor sulphides (~1% Sp+Gn+Py) in quartz veinlets and disseminated trains with 5m unit of black shale near end of hole grading 1%Pb, 0.9%Zn.

CC2 intersected an alternating sequence of green chloritised and hematitic felsic volcaniclastics with some short intervals of <0.5% Pb+Zn in the upper part of the hole.

CC3 intersected a sequence of variably chloritic-sericitic, weakly pyritic (1-2% Py) and locally hematitic altered felsic volcaniclastics with several short intervals of ≤0.5% Pb+Zn mainly associated with carbonate veining and alteration.

1977 3 more DDHs at CETHANA EAST:

CC6 & CC7 to test IP anomaly peaks; minor mineralisation in graphitic? vitric tuffs, few metres ~1-1.5% Pb+Zn.

CC8 60m down dip of CC5: several short intervals of <0.6% Pb+Zn, not comparable to CC5, possibly faulted off?

Zn Ratio: (CCs 4,5,6,7,8, n=112 where Pb & Zn >500ppm) Mean=59, σ=19; with 34% of samples < 55. This is just outside typical VHMS range (means: 60-77, σ: <15); equivocal, possibly indicating Devonian vein style overprint or remobilised? Cambrian mineralisation.

1978-79 20m dipole-dipole IP on lines 21500E to 21800E at CETHANA EAST showed that the (already drilled) gradient IP anomalies were spurious but did, however, detect a new anomaly northeast of the previous drill holes, at >60m depth on lines 21750E and 21800E and beneath a road cutting chip sample of 7m @ 1.2%Pb, 0.2%Zn, in a favourable environment near the top of zone of "altered, dirty, cherty tuffs". Drilling was recommended but not carried out. It was concluded that the remaining gradient IP and spot geochem anomalies were either spurious or related to minor vein style mineralisation and did not warrant testing.

1981 DIGHEM II survey detected anomaly near western end of Cethana East grid; follow up with VLF showed linear conductor associated with moderate gradient IP chargeability anomaly in a talus covered area along strike from a black shale unit; Cronc PEM showed no response but data was affected by power line noise.

1984 UTEM survey continuous across Cethana East and West with some gaps due to power line noise, (data was not well reported by CRAE but 1991 Noranda plan showed a gap between 21600E and 22200E).
No anomalies worth drilling at CETHANA EAST.

Two UTEM anomalies at CETHANA WEST and CENTRAL were drilled by percussion holes CC9 & CC10, respectively.
CC9, drilled NE on line 600E, intersected variably (quartz-sericite-chlorite-epidote) altered felsic volcaniclastics and schists with generally 2-3% disseminated pyrite and upto 7-15% pyrite in the interval 72-96m which coincides with the geophysical target at 65-75m down hole. Pb & Zn values are generally <500ppm but are slightly higher in the pyritic zone with max: 320ppm Pb and 820ppm Zn. DHEM failed to indicate in or off hole responses and suggested that the UTEM target anomaly was due to surficial conductive effects!

The UTEM target on 20400E was drilled to the SW by CC10 which intersected mixed chloritic volcaniclastics and minor quartzites and grey shales with widespread 1-3% disseminated pyrite and passed into siliciclastic Roland Conglomerate at 83m. Base metal values are generally <100ppm with isolated peaks of 1800ppm Pb and 760ppm Zn. DHEM failed to indicate conductive responses and the UTEM target anomaly was again attributed to surface effects.

Previous holes CC1-CC8 were selectively re-assayed for gold (where Pb+Zn > 0.15%, Ag >5g/t or Pyrite >5%) but no significant Au was detected.

1986 CRAE cored two diamond drill holes at CETHANA WEST, CC12 & CC13 both inclined to the southwest, on lines 900E and 700E respectively, to test a concept that Cu-Pb-Zn zonation in soil geochemistry eastwards along strike from CC9 indicated a southerly facing. (CC12 was a redrill of CC11 which was abandoned due to drilling difficulties). Both holes intersected chloritic and sericitic lithic felsic volcaniclastics with clastic material increasing downhole in CC13 to end in cherty mudstone. Pb and Zn values are mostly <500ppm but erratically range upto 0.6% apparently in association with quartz-carbonate veins and shear zones.
DHEM was unsuccessful due to power line noise problems.

1989 NORANDA
A review of CRAE geophysics by Zarzavation (in: Jones, 1989) showed that not all of the alteration zone had been covered by IP and UTEM; numerous IP anomalies at ends of lines and some others with coincident geochem had not been followed up; IP-Res anomalies between 20200E and 21800E were recommended for detailing.

Reconnaissance mapping and sampling was carried out; 30 whole rock and petrographic samples, isotope studies foreshadowed.

Petrographic report by A.J.Crawford noted stronger than normal MRV regional sericite alteration and suggested "that this significant hydrothermal alteration appears to have accompanied deformation"; (sample No: C106).

Pb-isotope studies indicated that mineralisation in previous Cethana DDHs has a Cambrian signature similar to Rosebery.

P.A.Jones (NORANDA) considered that Cethana had been adequately explored at shallow depths but potential remained for deeper mineralisation within the alteration zone.

1990 D.E.LEAMAN supervised acquisition of additional gravity data and a helicopter borne high resolution aeromagnetic survey. He interpreted the gravity data to indicate major NE trending basement structures? intersecting a WNW trending gravity gradient (Erriba Zone) in the Lake Barrington-Cethana area suggesting that these were deep crustal structures related to mineralisation; it pointed to the area SW and W of Staverton grid (later called "Campground" by MacDonald) as being the most prospective area. Complex thickness variations in the Cambrian volcanic rocks (=growth faulting?) and possible thrust sheet stacking was inferred. The northern margin of the Dolcoath granite was interpreted to dip steeply north and most of the Cethana pyrite-sericite alteration zone is outside of its metamorphic aureole. The gravity-magnetic data also outlined three minor lobe like intrusions of probable Cambrian (or possible Devonian) granite in the Cethana area. Assessment of magnetic characteristics of alteration was not attempted (pending acquisition of located data tapes from the survey contractor).

D.Hicks' Hons. project concluded that:

* Cethana ser-chl-CO3-qtz-py alteration is associated with Na,Ca,Sr depletion and Mg,K,Rb enrichment, therefore was VHMS type?
*- O-isotopes showed sea water dominated system with high water/rock ratios, O_{18} depletion ~11.6 around altered zone; temperatures estimated ~200°C, possibly re-equilibrated during Devonian deformation.
* S-isotopes, by contrast, indicated magmatic source; leached from volcanics? mean ~6.5 comparable to other Tasmanian VHMS; eastern end has lowest ∂S_{34} suggesting it may be more proximal to hydrothermal centre?
* Zn Ratios for Cethana East drilled mineralisation (>200ppm Pb+Zn!) showed Mean=68, SD=19.4 which is a higher variance than for Tasmanian VHMS deposits and indicates some re-mobilisation and overprinting.

50m dipole IP on 6 wide spaced lines (200-100m apart) produced strong well defined responses indicative of significant sulphide (or black shales?) on lines 21700E and 21800E (100m either side of CC4). Also some chargeability anomalies further east on lines 22200E, 22400E & 22600E; these are not particularly associated with low resistivity or UTEM anomalies.
Diamond drilling and DHEM was proposed but not carried out.

1992 PLUTONIC
P.Zarzavation reviewed all geophysics again and found many weak anomalies at the western end of Cethana East but was especially keen on CHAR-CE1, at the eastern

end, which he considered to be a single continuous chargeability anomaly running E-W between 21600E and 22600E, probably extending beyond in both directions and speculatively connecting with (CHAR-CW2) chargeability anomaly at Cethana West giving an interpreted strike length of ~3km.

The existing DDHs had not adequately tested this anomaly, partly due to inadequate consideration of topography, but CC4 must have gone close; perhaps through the fringe of the anomaly. It intersected a broad zone of 1-5% pyrite, locally upto 10-15%. Zarzavation suggested that the anomaly was probably related to pyrite, hoped for some base metal sulphides in (unspecified) adjoining zones and proposed 10 diamond drill holes totalling 1950m on 5 sections to test this anomaly between 21600E and 22600E!

1993 Crone PEM survey covered 2 lines on CETHANA WEST and 13 lines (=1500m strike) on CETHANA EAST but recorded no significant anomalies apart from possible power line effects (which could obscure bedrock responses?).

DHEM (Crone PEM) surveys of CETHANA WEST holes CC1, CC9 & CC13 recorded no anomalies, some power line and surface conductive responses.

Reconn geochem sampling produced upto 0.3% Zn in soil north of Claude Rd.

Mapping and geological interpretation by G.MacDonald suggested that the northern contact of the extensive Cethana quartz-sericite-(pyrite) alteration zone, against relatively unaltered overlying? volcano-sedimentary rocks, represented a favourable horizon for VHMS deposits. It was argued that the extensive IP anomalies reflected a pyritic footwall alteration zone stratigraphically below this contact, which is marked by a string of weak UTEM anomalies at CETHANA WEST, but had not anywhere been adequately covered by IP nor tested by drilling.

An EL area reduction resulted in fragmentation leaving 10sqkm at Cethana, 5sqkm at Staverton and 9sqkm at Gog Range.

1994-95 2 DDHs at CETHANA EAST

CED1 (200m) to test 1991 IP anomaly on 22400E about 150m below surface; it intersected cleaved moderately chloritic-diffusely hematitic felsic volcaniclastics with two narrow zones of 2-20% pyrite in blebs and stringers at about the target depth with low base metals and gold. This was not considered likely to be a favourable horizon.

CED2 (295m) on 21825E, was designed to test at depth and along strike of mineralised chloritic sediments intersected in CC5 (on 21750E) and the same IP trend as CED1. It intersected a sequence of sericitic felsic volcaniclastics and tuffaceous siltstones with minor disseminated and veiny hematite and pyrite (of separate orientation/generation?) with local mineralisation in post-cleavage Py-quartz-carbonate-sulphide veinlets in a chloritic siltstone-sandstone (6m @ 0.2%Pb, 0.6%Zn) probably equivalent to the CC5 intersection. Below this was a 70m interval of 1-5% (locally 10%) Py in deformed stringer veinlets in medium grained sericitic-hematitic felsic volcaniclastics and sparse Pb-Zn anomalous qtz-carbonate veins.

DHEM (Crone) in CEDs 1 &2 and CCs 4, 6,7 & 8 showed no off hole responses; a weak in- hole response in CC7 at 60m corresponds to 25cm massive pyrite lens but it is a single point response (readings at 10m intervals) indicating it has no significant extent.

It was concluded that the zone of high chargeability between 21600E & 22600E tested by CC4, CC7, CED1, CED2 is a broad zone of pyrite-qtz-carbonate (?) stringers considered to be a typical VHMS footwall stringer zone (although carbonate is not typical of good stringer zones, *WH*). Vein style Pb-Zn in CC5 & CED2 was considered to be remobilised? Cambrian VHMS related mineralisation apparently petering out eastwards but remaining open west of CC6 (suggested by soil geochem). A recommendation was made to test this zone by drilling a fence of percussion holes along the track at ~21400E.

The exploration concept was re-modelled to suggest that a favourable horizon exists up sequence to the north between a pyritic "footwall" zone and Claude Road.
It was recommended that soil geochem sampling, augmented by shallow percussion drilling over covered areas, should be undertaken to locate targets related to the new concept.

Soil geochemical sampling was attempted over talus covered areas at CETHANA EAST in late 1995 but the portable motorised "post hole" auger employed did not enable consistent penetration to bedrock and large gaps in the geochemical data remain, especially in the hypothetical favourable zone north of the IP responses. This phase of sampling turned up a few anomalous values upto a few hundred ppm Pb and Zn, mainly in the vicinity of previously known and drilled geochemical anomalies, but it has not significantly upgraded the geochemical picture or provided support for the favourable horizon concept.

2.2 Interpretation of Hicks' (1989) Wholerock Geochem Data

Hicks (1989) analysed 35 rock outcrop samples, from three roughly north-south traverses across the CPZ, for major and immobile trace elements. The sample locations are shown on "Enclosure 2" of Jones, 1989.

Hicks' geological map and sample descriptions are, unfortunately, barely adequate to allow correlations between samples on different traverses (to check "geochemical stratigraphy") nor comparison between altered and unaltered samples of individual volcanic units (to estimate chemical changes due to alteration).

Figure 2 shows an immobile, compatible-incompatible (TiO_2-Zr) scatter plot of the samples from the Cethana area divided (as near as I can guess) into Hick's "lower altered volcanics" (LAV) and "upper unaltered volcanics" (UUV) respectively south and north of the main "Cethana pyrite zone" (CPZ).
There is obviously considerable overlap between LAV and UUV. Even if the two UUVs with Ti/Zr ≥30 are excluded (C174 & C184 in Table 1), about half the samples from both groups fall in the overlap field between 7.4 and 13.4 Ti/Zr; this could be partly due to volcaniclastic mixing of materials from different eruptive sources. The generally lower average Ti/Zr ratios of the UUV samples in comparison to LAV, and the suggestion that Ti/Zr ratios decrease northward away from the CPZ at Staverton Rd and Day's Rd (not evident at Oliver's Rd), are consistent with the expected magmatic differentiation trend and faintly support Hick's assertion that it is a north facing sequence. It is, however, not very clear evidence of volcanic stratigraphy; nowhere near as distinct as, for example, the Thalanga favourable horizon where altered footwall rhyolites with Ti/Zr <7 are overlain by unaltered hangingwall dacites with Ti/Zr >11.

The most striking thing about Hicks' data is the extent of apparent sodium depletion! In the entire batch of Cethana samples only two (C78 & C200) have Na_2O contents remotely approaching normal felsic volcanic levels (>1.5%) and both are within the LAV; the majority (including those from the so called UUV) contain <0.5% or zero Na_2O. The CaO contents are similarly low and consequently these analyses generate very high Alteration Indices (AI = 100[MgO+K_2O] / [MgO+K_2O+CaO+Na_2O]. These samples are from an area apparently representing ~1500m of stratigraphic thickness and ~4km of strike which, if judged by AI or sodium depletion, would represent a monster hydrothermal alteration zone.

However, the lack of internal AI and Na_2O zonation within this area, and the observation that the samples logged as relatively unaltered (C164, C169 etc.) are equally "depleted", strongly suggests an analytical problem, probably related to sampling of weathered surface outcrops. This implies serious limitations in the use of this data for estimating hydrothermal alteration effects - it is greatly preferable to use fresh drill core samples to eliminate surface weathering effects.

Nevertheless, I have separated the analyses into a number of groups, corresponding to the cross strike traverses, and attempted to identify good linear correlations on immobile compatible-incompatible component plots which could indicate variable alteration within a single volcanic precursor unit. Most of the groups (Fig. 1) show a fair scatter and range and, given the lack of geological detail, it's doubtful if anything can be done with them.

There is one exception: the five samples spaced over ~500m of section north of Cethana Bridge (Group 1 in Table 1; labelled C88..C106 in Fig. 1) have a high correlation (r= 0.978) with a linear regression line which passes close to the origin on the TiO_2-Zr scatter plot (Fig. 1) consistent with the type of distribution attributable to alteration mass changes (eg: MacLean & Barrett, 1993; Herrmann, 1994). These five samples could (but are not proven to) represent differing degrees of hydrothermal alteration of an originally chemically uniform volcanic unit or series of co-magmatic units and, on this assumption, may be used to estimate the mass changes due to alteration.

The sample locations from this group, C88 to C106, are consecutively spaced along Cethana Road 200m, 270m, 430m, 600m and 700m NNE of the bridge over the Forth River. Hicks' descriptions (Table 1) are ambiguous referring to altered quartz phyric lavas and/or tuffs; C103 supposedly preserves an ignimbritic texture and C106 is quartz+feldspar phyric and glassy; the first four are within Hicks' LAV and the last, C106, is just within his CPZ.

I have mapped this section myself, in 1988, and found that outcrops near the bridge are of fairly fresh quartz+(feldspar+biotite) phyric rhyolite with minor patches of strong silicification. The degree of sericite alteration and foliation gradually increases (but some relict feldspars are preserved) northwards over about 400m (the zone including C88 & C93) before passing abruptly into quartz+sericite schists in which former volcanic textures, apart from relict quartz phenocrysts, are completely destroyed (the zone including C98, C103 & C106).
This zone of strong foliation and sericitisation? is what I would term the CPZ although it contains very little pyrite: at most <1% finely disseminated pyrite with no observed stringer development. Hicks (1989) places the southern margin of the CPZ about 300m further north.

Comparison of the analyses from, what I consider to be, the less altered zone (C88 & C93) with those from the strongly altered CPZ (C98, C103 & C106) shows that the latter have higher concentrations of the immobile components TiO_2, Al_2O_3 and Zr, suggesting that the alteration has been associated with nett mass loss. It is slightly problematic to quantify the mass changes because one of the less altered samples, C93, has anomalously high Fe_2O_3 and because of the above mentioned doubts about Na and Ca analyses.

However, two versions of calculated mass changes are shown on Page 2 of Table 1, using the method of MacLean & Barrett (1993) with Zr as the immobile monitor and, alternately, C88 and the mean of C88 & C93 as the least altered precursor composition. In both precursor cases the dominant apparent mass changes are losses of SiO_2 in the range 12 to 28 g/100g. It is notable that the greatest mass loss appears to be in C98, from the southern edge of what I interpret to be the strongly altered CPZ.

Silica loss is not characteristic of Australian VHMS footwall alteration zones. For examples: the Hellyer footwall has SiO_2 gains ranging from 10g/100g in the stringer envelope (outer) zone to 95g/100g in the siliceous core (Gemmel and Large, 1992) and the Thalanga footwall appears to have gained from ~10g/100g SiO_2 in the moderately altered peripheral zones to ~35g/100g in the proximal pyritic stringer zones (Herrmann, 1994). (There is a slight anomaly in the Hellyer mass change pattern in that the chloritic zone, between the siliceous core and outer sericitic zones, appears to have lost about 12g/100g SiO_2 but still had a net mass gain due to addition of Fe_2O_3, MgO and S.)

In the VHMS sea floor hydrothermal model, silica loss is likely to occur in the peripheral "recharge" zones of convective systems where cool descending seawater leaches silica from hot glassy rocks. In a brittle deformation environment, fracture permeability could increase water/rock ratios and hydrothermal flow leading to silica depletion in glassy rocks intersected by fault zones.

These limited and dubious Cethana analytical data, with inadequate geological control, cannot provide an unequivocal interpretation, but tend to indicate that the western end of the CPZ is not proximal VHMS type footwall alteration.

It is regrettable that wholerock analyses are not available from drill core of holes CC1 which appears to be entirely within the CPZ, and CC2 and CC3 which appear to have intersected the margin of the CPZ and passed southward into less altered rocks, (Herrmann, 1989 - Appendix 1 in: Jones, 1989) to allow better estimates of mass changes and from the Cethana drill holes in general, to assess alteration intensity zonation.

2.3 Notes on CED1 Alteration Style

(Based on a cursory core log by W.Herrmann)

Disseminated granular hematite is virtually ubiquitous in all lithologies intersected by the hole except where overprinted by quartz-sericite-pyrite alteration. Hematite could be a primary accessory or at least a very early alteration phase following devitrification.

Moderate to strong semi pervasive to fracture controlled dark chlorite alteration is also common and seems to be co-stable with hematite (eg: specimen from 61m which contains granules of disseminated hematite and hematite stained fringes of chlorite-carbonate veins. Chlorite is most abundant in apparent volcaniclastic lithofacies and is restricted to veinlets and fractures in the more coherent units (as in specimen from 61m) suggesting permeability control on this type of alteration.

Patchy quartz-sericite-pyrite alteration undoubtedly post dates hematite formation and pyrite and hematite never closely co-exist; (eg: in coherent QFphyric rhyolite at 163m there are diffuse relict kernels of purplish grey with disseminated hematite separated by bands and vein selvedges of quartz-sericite-pyrite alteration around narrow trains of pyrite.

In general, pyrite is fairly restricted in the hole to narrow zones and fracture related alteration especially near brittle-puggy fault zones (eg: 38m, 72m). Near the end of the hole (eg: in coherent rhyolite at 199m) pyrite is concentrated in spaced anastomosing fractures and finely milled zones separating kernels of relatively unaltered pinkish rhyolite.
Although locally significant, pyrite does not generally exceed ~5% over more than a metre or two; 1-2% is more typical over several metre intercepts. Silicate alteration in association with pyrite does not seem particularly strong and I would not be surprised to find some relict feldspar in these zones; ie: this does not look like very proximal - high fluid/rock ratio - VHMS footwall type alteration.

The association of quartz-sericite-pyrite alteration with brittle fault zones is consistent with earlier interpretations (Herrmann, Appendix 1; Crawford, Appendix 2; in: Jones, 1989) that alteration accompanied deformation - possibly Devonian thrusting. Clearly, the dominant chlorite-hematite alteration was produced by (oxidised) fluids, unlike those expected in VHMS footwall systems. A possible source of oxidised fluids could be Cambrian granitoids (like the hematite bearing Dove Granite) which are inferred to exist as small intrusive stocks in the Cethana area (Leaman, in: Jones 1990).

The latest phase of alteration and veining is straw-white carbonate-quartz-minor chlorite in tensional veinlets which cross cut or exist within pyritic zones. There is locally an increased frequency of carbonate-quartz veinlets adjacent to or in quartz-pyrite alteration zones suggesting late stage brittle failure around earlier silicified fault zones. This late carbonate-quartz-minor chlorite assemblage does not include hematite.

2.4 Discussion (Cethana)

After two decades of intermittent exploration there is still no good geological map or convincing interpretation of stratigraphy, volcanic facies and hydrothermal alteration. Although the poor outcrop and low readability of rocks (apart from in the road cuttings) has been a major factor, I suspect that this could be a case where there have been too many geoscientists having sporadic hit or miss exploration potshots without expending the time to really put the whole story together.

After Gerald Purvis' earliest work for CRAE, Phil Jones, for Noranda, came closest to seeing the "big picture" recognising that VHMS potential could lie down dip or along strike of the large "Cethana Pyrite Zone" (CPZ) and that exploration should seek alteration vectors and mega-structural and facies controls. Regrettably, he farmed out a lot of the important observation and interpretation work to other geologists, students and geophysicists. No less than three consultant geophysicists were involved in reviews and additional surveys during 1989 & 1990, and one wonders how much of a grasp they had of the previous data and particularly of geological concepts. The work (as reported) seems to have lacked integration and unifying interpretation.

The greatest deficiencies are in volcanic facies and alteration mapping; various workers have been impressed by the extent of the CPZ but none have produced an alteration intensity or mineral zonation map. The nearest documented attempts at outlining the sericitic (foliated) zone are Jones' (1989) 1:10,000 presentation (which is based on my own cursory mapping of road cuttings only, over a contract period of a few days) and Hicks' nearly illegible and unsophisticated 1:10,000 map (in: Jones, 1990) which is not convincing in terms of volcanic facies and CPZ boundaries which do not coincide with my interpretation.

Surface mapping and drill core logging has not been integrated to produce a 3D alteration model of the whole area.

Referring again to my cursory mapping in 1989: it is apparent that the CPZ is a series of elongate zones of strong sericitisation and cleavage development (but quite low pyrite content ≤1%), possibly strata bound in pumiceous quartz phyric felsic volcaniclastic units, and aligned sub parallel to the WNW trending, probably thrust faulted, contact between volcanics and Denison Group siliciclastics. It is possible that sericitisation was due to broad unfocussed hydrothermal circulation in an extensive, aquifer like, permeable volcaniclastic or pumice breccia unit sandwiched amongst less permeable units, not necessarily in proximity to a favourable (sea floor-exhalative) horizon.
Alternatively, the almost regional extent (>4km strike) of the sericitic-foliated zones at Cethana and the apparent sub parallel repetitions 2.5km and 4km to the north (at Campground and

Staverton prospects), could indicate that the foliation is related to brittle-ductile shearing in weak pumiceous units in a contractional-reverse fault structural setting, analogous to that adjacent to the Great Lyell Fault etc.

This is supported by numerous petrographic observations (AJ Crawford in: Jones, 1989) inferring a relationship between alteration and deformation such as: shearing accompanying sericitisation; sericitisation along lacework fractures in non pervasively altered more competent rhyolite, and tourmaline in quartz veinlets in altered rhyolite suggesting an association with Devonian? granite emplacement and deformation.

In CED1, near the eastern end of the sericite zone, quartz-sericite-pyrite alteration is spatially associated with brittle faults and fractures and overprints an earlier chlorite-hematite alteration assemblage.
Near Cethana Dam, the Moina Sandstone (=Denison Group) locally contains 2-5% disseminated pyrite although elsewhere it is generally hematitic. This clearly post volcanic, probably post depositional, hydrothermal alteration might be similar to that in the CPZ and would have been a useful comparison for Hicks' (1989) isotope study. Obviously, if all the alteration can be attributed to post volcanic events, then the VHMS prospectivity is not enhanced by the existence of the CPZ.

On the other hand, the CPZ contains a few sniffs of base metal mineralisation which (although it is mostly in syn or post cleavage veinlets) has Pb isotopic and Zn/Pb ratios which are equivocal but consistent with a Cambrian VHMS origin modified by Devonian granitoid related overprint. This supports the possibility that the CPZ represents a synvolcanic (Cambrian) sericitic alteration zone which, due to relative incompetence, has localised strain during Devonian deformation.

If so, the important exploration questions are:

Which is the favourable horizon?
Was the favourable horizon detached from its sericitic footwall by deformation?
Are there any alteration vectors pointing to ore?

At this point, none of the important questions can be convincingly answered. All are worthy of attention but I think the last is likely to be most fruitful.

Hicks' 1989 wholerock analytical and alteration study proved inconclusive due to a dubious sampling method and would need to be expanded in drill core sampling and better geological and alteration mapping. The objective is to recognise zonations, such as pyrite concentration, absolute mass changes and δO_{18} depletion, to infer hydrothermal fluid flow paths and explore the areas down stream and up stratigraphy for VHMS deposits. The potential alteration picture which could be developed might be fairly skeletal due to the clustering of drill holes at Cethana West and East giving an uneven spread of fresh samples.

I have looked at Hicks' (1989) O & S isotopic data and remain quite unconvinced of his conclusions in regard to lighter $\delta S34$ at East Cethana indicating a more proximal hydrothermal setting, the validity of comparing weathered surface samples with unoxidised drill core for $\delta O18$ zonation and the rough and ready calculation of fluid temperatures suggesting that Cethana was not hot enough to transport and deposit base metals. I am not an isotope expert but it seems that Hicks has used a fairly "black box" approach for comparison with known deposits, largely in the absence of a good geological and alteration framework.

The IP chargeability compilation (enclosure 8 in: Jones, 1991) indicates a broad area of high chargeability over at least 1km of strike (open ended to east) at Cethana East which is broadly coincident with soil geochem anomalies and much stronger than the chargeability responses over Cethana West (where the soil geochem is equally anomalous). In terms of the sericite-pyrite footwall alteration concept, this suggests that the eastern end experienced higher hydrothermal fluid/rock ratios and possibly temperatures, and was therefore perhaps more proximal to a VHMS deposit.

JR Bishop (in: Jones, 1991) noted that these eastern chargeability anomalies correspond with resistivity highs; he speculated on increased resistivity due to silicification and possible connections with epithermal gold mineralisation and suggested that the higher resistivities may be enhancing the IP effect due to a relatively low concentration of sulphides.

Certainly, the rather low concentration and irregular distribution of pyrite intersected by CED1 barely accounts for the ~4 times background chargeability response on line 22400E. It is not clear how this hole was targeted (Close and MacDonald, 1995) but it seems to have been collared 170m too far north and too steeply to test the "main" anomaly (A) zone identified by Zarzavation (in: MacDonald & Tomlinson, 1992) and without taking account of Zarzavation's comments about topographic effects.

Whatever the case, I remain doubtful, in view of the association between faults and alteration, and the presence of carbonate, about the conclusion of Close and MacDonald (1995) that the broad zone of "pyrite+/-silica-carbonate stringers" reflected in the eastern chargeability anomaly (21600E to 22600E) is "typical of a deformed footwall stringer zone beneath a potential exhalative target horizon". I regard it as a good concept, and not a new one, but not yet well established.

Accordingly, an attempt to test the favourable horizon by drilling (either fences of short RC holes or longer diamond core holes) would be of an essentially stratigraphic nature, and unlikely to be conclusive, if not carried out in conjunction with studies enabling a better interpretation of alteration vectors, volcanic facies and structural controls.

The previous coverage by "black box" geophysical surveys is more or less adequate although many of the surveys have been rather restricted in cross strike extent due to the assumption that the initial grid and soil geochem anomalies had already defined the favourable horizon. Various IP and EM surveys have fairly well covered the ~4km of gridded strike length and the best anomalies have been tested by 14 drill holes. None of them are very deep holes but DHEM surveys in 7 holes at Cethana East, 3 holes at Cethana West and CC10 in the Central area have not indicated any off hole conductors to encourage further work in those areas.

The 4km long grid more or less covers the width of the EL; the ground to the east (where the pyritic zone appears to be open ended) is held by RGC but the CPZ possibly extends westward for ~1km before running under Tertiary basalt cover west of the Forth River. There is, therefore, not a great deal of scope for further work along strike.

Induced Polarisation, with 50m dipoles, is a most useful method to map out shallow pyritic VHMS footwall alteration and IP could be extended across strike in both north and south directions on selected lines, particularly at Cethana East, with this objective. Some kind of mathematical filtering to integrate the existing diverse IP surveys and dipole spacings to produce contourable chargeability and resistivity plans, would be a useful adjunct to alteration mapping.

I am inclined to agree, with G.MacDonald, that the results of UTEM and PEM surveys do not necessarily downgrade the prospectivity of the Cethana area; not particularly because the target deposits may not be very conductive but rather because these surveys have not been convincingly demonstrated to have covered the favourable horizon(s). However, I do not advocate extension of the EM blanket coverage. It would be preferable to use IP to map pyrite distribution and infer alteration patterns to point to favourable horizons or zones, with more selective TEM to assist targeting, and DHEM to increase the "search radius", of future exploratory holes.

Soil geochemistry has proven almost too effective in producing red herrings - moderately strong anomalies over very weak primary mineralisation - but it has been useful in drawing attention to the CPZ and suggesting that the hydrothermal system had some primary or secondary? connection with Cambrian mineralisation. However, I don't think it can be relied on for targeting buried massive deposits, especially under areas of transported soil, and at this stage of exploration should only be selectively used where the favourable horizon(s) are otherwise identified.

3. STAVERTON AREA

3.1 Summary of Staverton Prospect Exploration History

Early 1970's The prospect was identified by ASARCO's regional drainage geochem survey; a brief soil and rock sampling follow up produced a spot soil anomaly of 590ppm Pb but low Cu & Zn and was dismissed as unprospective.

1977 CRAE established a 400m spaced grid over 1200 x 800m, carried out mapping, rock & soil geochem and gradient IP surveys and found that some felsic? volcanics were strongly altered to quartz-sericite schists locally containing several percent disseminated pyrite. Soil geochem gave encouragement with peaks of 1800ppm Pb and 1100ppm Zn but IP detected only weak responses.

1982 The grid was "infilled" to 100m line spacings and further mapping, rock chip sampling, dipole-dipole IP (mostly 25m dipoles, additional 50m dipole survey on 500E, 1000E & 1100E) and limited Pulse EM surveys, were undertaken. Rock chip samples of sericitic altered volcanics from the soil anomaly zone were found to contain upto 0.9% Pb and 0.26% Zn but PEM results were flat. IP responses correlated with soil geochem but were interpreted as superficial and depth limited. The coincident IP-geochem anomaly trends south over ~600m, apparently parallel to the strike of the country rocks but also near parallel to a "major fault .. possible discontinuity" shown, 100-200m west of the anomalous trend, on CRAE's geological plan.

1983 UTEM survey was undertaken on three short (275m) traverses on lines 400E, 500E & 600E across the main soil geochem anomaly but it detected only very weak responses.

A short percussion hole (SP1, 102m) was drilled southwestwards to test the geochem-IP anomaly on 600E; it intersected quartz-sericite-(chlorite) schists with minor pyrite, galena and chalcopyrite mineralisation. The interval 20-44m averaged 0.85% Pb, 0.54% Zn and 9g/t Ag with the best assay at 32-34m of 1.9% Pb, 1.2% Zn and 22g/t Ag; background values elsewhere in the hole ranged ~100-500ppm Pb & Zn and <1g/t Ag. Copper peaked at 610ppm in the anomalous zone but elsewhere was generally <100ppm whilst Ba had background levels of ~200-600ppm and appeared to be slightly depleted to <250ppm in the Pb-Zn-Ag anomalous zone. (Gold was not reported, probably not analysed.) Zn Ratios for the zone with >0.1% Pb & Zn (interval 20-50m) showed mean = 38 and $\sigma = 15$ for n = 16 samples; unlike Tasmanian VHMS deposits.

Further UTEM was recommended along strike to cover geochem anomalies on lines 700E-1000E.

1986 A re-appraisal of geophysics in light of results of SP1 implied that the body is likely to be shallow but of too low conductivity to be a large sulphide body and no further work was recommended.

1989 Zarzavation reviewed the geophysical data for NORANDA and expressed concern about the effects of topography on IP interpretation and whether SP1 had been an adequate test. He recommended further exploratory drilling along strike of the IP zone.

1992 Zarzavation again reviewed the geophysical data for PLUTONIC and recommended two to four additional holes, 100-120m deep, to test the coincident IP-geochem anomaly on lines 900E and 1000E. He suggested that IP coverage should be extended along strike to the south east if the results of drilling proved encouraging.

1993 PLUTONIC re-established the CRAE grid, did a bit of mapping over the anomalous zone, covered the grid by Crone PEM and ground magnetic surveys, and core drilled a hole (STD1, 267.2m, drilled -45° to SW) to test the IP-geochem anomaly on 900E.

The PEM grid survey and a 2 loop DHEM survey of STD1 did not detect any conductive responses.

STD1 intersected a thick sequence of plagioclase phyric dacitic to andesitic lavas, related holocrystalline intrusives and minor volcaniclastics interrupted by several sericitic shear zones before passing through a major? brittle fault zone at 255m into bedded, coarse to fine grained, quartz phyric-pumiceous felsic volcaniclastics. Patchy disseminated to veiny galena-sphalerite-pyrite mineralisation, upto 0.6% Pb+Zn but with low Cu, Ag and Au, exists in the dacitic-andesitic units above the lower fault, more or less associated with sericite-carbonate altered shear zones and quartz-tourmaline-chlorite alteration.

Zinc Ratios were reported as equivocal but tending towards a Cambrian VHMS pattern. Petrographic study and limited wholerock geochemistry suggested the "highly altered" andesites are geochemical correlates of Suite I of the MRV (= Que-Hellyer footwall andesites.

It was concluded that the hole had "explained" the IP and geochemical anomalies, that the altered rocks were favourable and that much VHMS potential remained. Tentative evidence (grading in volcaniclastics on opposite shore of Lake Barrington) that the sequence faces northeast was interpreted to indicate that highest prospectivity was northeast of the grid, ie: up stratigraphy from the "footwall" Que-Hellyer andesite equivalents.

3.1 *Discussion (Staverton)*

MacDonald's (1993a) calculation of Zn Ratios for 113 samples from STD1 indicated a mean of 64 and $\sigma = 21.7$ which he interpreted as equivocal (on account of the high σ) but tending to indicate Cambrian VHMS (because of the appropriate mean). The cut off grade was not stated but his population evidently included fairly low values to come up with 113 samples.

I have calculated Zn Ratios for STD1 samples in two groups as below:

Samples with both Pb & Zn >500ppm:	n = 24, mean = 48, $\sigma = 12$
Samples with either of Pb or Zn >500ppm:	n = 49, mean = 43, $\sigma = 22$

This provides a pretty clear indication that the "mineralisation" (ie: above background levels) has a Zinc Ratio population unlike Tasmanian VHMS deposits and is in accord with the results from CRAE's SP1.

I have also made a cursory inspection of the STD1 core (stored at MRT in Hobart) and was not much impressed by the degree of alteration. It seems that patchy pale sericite-carbonate "bleaching" of the dacitic-andesitic rocks is closely associated with semi-ductile shear zones. Some of these zones appear to be intruded? by pink quartzo-feldspathic assemblages resembling granite, locally associated with veiny quartz-chlorite-tourmaline alteration. There is no strong pervasive alteration away from these fracture zones.

Samples which AJ Crawford (in: MacDonald, 1993 a) described as moderately to intensely altered (eg: petrographic and analytical samples 23, 27, 28 & 33) generally have well preserved textures and the feldspars are albitised but intact. This is borne out by the four wholerock analyses ranging from 2.5 to 4.2% Na_2O and alteration indices (AI) from 40 to 48.

These analyses are almost comparable with the average unaltered andesite from the Hellyer footwall (quoted by Gemmell and Large, 1992) and certainly indicate lesser alteration than that of the Hellyer outer footwall "stringer envelope zone". In isolation, these relatively unaltered samples do not provide us with an alteration vector to ore.

However, as is well known, the Hellyer footwall alteration system is tightly focussed, on a synvolcanic fault in relatively coherent and impermeable andesites, and the stringer envelope zone generally extends only a few tens of metres to a maximum of ~100m laterally from the central siliceous core directly under the ore deposit.
To pursue the analogy: it is not valid to suggest that this lack of pervasive alteration in a pile of mainly coherent andesites and related intrusives in STD1, precludes the nearby presence of a VHMS deposit and hydrothermal alteration system.

On the other hand, the grid PEM and DHEM results and the style of possibly deformation-granite emplacement related? mineralisation intersected to date, do not suggest a deposit in close proximity.

Unlike Cethana, however, the Staverton prospect work has been restricted to a fairly small grid (1200m x 800m) and relatively unexplored country, not covered by Tertiary basalt, extends for about 3km to the NE and 3km to the SW along the Forth River valley, partly within the current EL boundary and on adjacent "open ground".
There is insufficient knowledge of litho-stratigraphic and structural relationships to form any convictions on where further potential may lie.

The Campground sericite alteration zone 1.5km SW of the Staverton Prospect was identified by Leaman (in: Jones, 1990) as being most prospective from a regional structural interpretation but appears to have had very little follow up investigation. Even Leaman's interpretation, particularly of magnetics, seems to have been fairly preliminary and could probably be rendered more user friendly by preparation of enhanced gravity and magnetic images.

4. REFERENCES

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5. ATTACHMENTS

Table 1 Cethana Volcanics - Hicks' (1989) Wholerock analyses and mass change calculations, (2 pp.)

Fig. 1 TiO2-Zr scatter plot of Cethana Volcanics.

Fig. 2 TiO2-Zr scatter plot differentiating? Hicks' (1989) LAV and UUV.

Table 1 CETHANA VOLCANICS - Analyses of surface samples from Hicks, 1989 May 21, 1996 Page 1

Sample	Description	Gp	SiO2	TiO2	Al2O3	Fe2O3	MnO	MgO	CaO	Na2O	K2O	P2O5	CO2	S	LOI	Total	Nb	Y	Zr	Ti/Zr	A.I.
			%	%	%	%	%	%	%	%	%	%	%	%	%	%	ppm	ppm	ppm		
C88	alt QpR	1	77.59	0.50	14.19	2.29	0.01	0.58	0.02	0.00	4.60	0.05			2.86	102.69	11	19	234	12.8	100
C93	alt QpR or tuff	1	70.81	0.48	13.50	7.88	0.64	2.36	0.03	0.00	4.08	0.08			4.02	103.88	12	80	235	12.2	100
C98	alt QpR or tuff	1	69.12	0.73	18.46	4.21	0.37	0.95	0.02	0.00	5.88	0.13			3.62	103.49	15	27	329	13.3	100
C103	xtR/Ign	1	73.58	0.64	17.55	3.39	0.13	0.43	0.01	0.26	3.86	0.15			4.53	104.53	15	28	279	13.8	94
C106	alt QFp felsic	1	72.13	0.57	14.90	7.48	0.03	0.34	0.01	0.00	4.35	0.04			3.88	103.73	13	41	273	12.5	100
C5	Qwacke	2	88.43	0.47	7.14	1.28	0.00	0.42	0.01	0.00	2.23	0.03			1.47	101.48	12	35	321	8.8	100
C2	alt QpR or xt	2	86.62	0.21	11.01	1.87	0.01	0.46	0.03	0.00	3.72	0.03			2.55	106.51	12	30	143	8.8	99
C78	alt QpR	2	77.56	0.25	13.43	1.53	0.06	0.60	0.05	1.68	4.81	0.03			2.01	102.01	13	38	169	8.9	76
C9	~alt QpR	2	75.39	0.41	14.71	3.09	0.01	1.02	0.01	0.00	5.30	0.03			2.95	102.92	14	35	244	10.1	100
C4	QFp felsic?	2	71.31	0.51	17.01	5.00	0.09	1.22	0.03	0.00	4.73	0.07			4.70	104.67	13	28	242	12.6	99
C14	Qwacke	2	80.15	0.70	9.91	3.32	0.01	0.90	0.74	0.00	3.59	0.51			3.57	103.40	12	41	285	14.7	86
C7	alt Dac ltuff	2	69.7	0.77	14.76	7.86	0.04	3.17	0.43	0.00	3.97	0.16			5.63	106.49	17	27	287	16.1	94
C164	fresh Qpr	3	82.49	0.23	12.93	1.35	0.00	0.24	0.01	0.00	2.68	0.00			3.32	103.25	15	41	244	5.7	100
C161	alt QpR	3	80.16	0.33	13.66	1.10	0.01	0.26	0.02	0.28	4.19	0.00			2.25	102.26	13	28	282	7.0	94
C200	cherty Vc	3	78.82	0.16	13.66	1.41	0.03	0.44	0.03	1.71	3.71	0.03			2.09	102.09	19	41	129	7.4	70
C190	alt QFp xlt	3	70.2	0.93	20.60	1.41	0.01	0.46	0.07	0.00	6.09	0.09			3.64	103.50	22	51	485	11.5	99
C210	mudst/Sst	3	76.01	0.81	14.79	2.82	0.00	0.59	0.10	0.20	4.72	0.15			2.99	102.98	14	35	288	12.7	95
C215	Slst	3	74.98	0.58	17.08	1.45	0.00	0.51	0.01	0.00	5.17	0.04			3.05	102.87	16	29	233	14.9	100
C204	bd slst/shale	3	75.03	0.40	15.82	2.17	0.01	1.14	0.01	0.00	5.37	0.02			3.25	103.22	14	24	147	16.3	100
C194	chl alt cg Vc	3	56.71	0.85	18.05	18.45	0.18	4.01	0.02	0.00	1.70	0.07			7.22	107.06	7	15	124	31.4	100
C179	fg Vc	4	80.27	0.19	13.48	1.71	0.01	0.14	0.00	0.53	3.65	0.00			2.22	102.20	18	38	251	4.5	88
C175	fg Vc	4	76.7	0.25	16.53	2.84	0.02	0.59	0.02	0.23	2.78	0.03			5.33	105.32	14	44	330	4.5	93
C169	fresh QFpR	4	75.6	0.65	14.78	3.77	0.02	0.50	0.00	0.00	4.60	0.04			3.13	103.09	15	34	374	10.4	100
C174	fg Vc	4	70.33	1.18	19.90	1.80	0.00	0.53	0.30	0.30	5.27	0.39			4.08	104.08	17	26	236	30.0	91
C225	alt QFpRxt	5	78.89	0.57	14.86	1.02	0.01	0.16	0.02	0.24	4.21	0.02			2.36	102.36	11	24	387	8.8	94
C218	alt QpR	5	77.67	0.56	15.32	1.58	0.01	0.26	0.01	0.30	4.20	0.09			2.73	102.73	14	48	252	13.3	94
C232	alt pum? Vc	5	70.9	0.81	17.67	4.27	0.00	0.44	0.06	0.00	5.52	0.21			3.69	103.57	15	28	275	17.7	99
C184	alt Rhy?	5	68.56	1.00	22.82	1.19	0.00	0.19	0.01	0.66	5.47	0.10			4.02	104.02	13	51	135	44.4	89
225106		6	81.22	0.21	13.81	1.04	0.00	0.21	0.01	0.30	3.18	0.02			2.75	102.75	15	29	209	6.0	92
226101		6	79.85	0.37	13.84	2.27	0.01	1.21	0.16	0.64	1.59	0.05			2.39	102.38	16	30	328	6.8	78
225222		6	72.11	0.41	14.79	3.21	0.06	1.39	1.97	2.42	3.56	0.07			4.71	104.70	15	31	260	9.5	53
225221		6	59.03	0.73	16.08	7.49	0.15	4.35	6.58	2.38	3.02	0.17			8.09	108.07	9	27	142	30.8	45
225223		6	59.96	1.06	17.65	7.02	0.12	2.73	6.46	3.62	1.17	0.20			3.89	103.88	9	28	150	42.4	28
C52	alt+wd GDiorite		64.73	0.91	16.75	7.52	0.19	3.45	0.44	0.00	3.52	0.22			3.87	101.40	13	23	204	26.7	94
C28	Moina Sst		94.77	0.27	2.92	0.89	0.01	0.21	0.06	0.00	0.72	0.12			0.90	100.89	4	17	97	16.7	92

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Table 1 CETHANA VOLCANICS - Analyses of surface samples from Hicks, 1989 May 21, 1996 Page 2

Sample	Description	Gp	SiO2	TiO2	Al2O3	Fe2O3	MnO	MgO	CaO	Na2O	K2O	P2O5	CO2	S	LOI	Total	Nb	Y	Zr	Ti/Zr	A.I.
Least altered precursor? (Average of C88 & C93)																					
			74.20	0.49	13.84	5.09	0.32	1.47	0.02	0.00	4.34	0.06			3.44	103.29	12	50	234	12.5	99.58

MASS CHANGES in CPZ Group 1 relative to least altered precursor? = C88; Zr as immobile monitor

	(g/100g)		SiO2	TiO2	Al2O3	Fe2O3	MnO	MgO	CaO	Na2O	K2O	P2O5	CO2	S	Nettchange g/100g
C88	alt QpR	1	0	0	0	0	0	0	0	0	0	0			0
C93	alt QpR or tuff	1	-7	-0	-1	6	1	2	0	0	-1	0			-0
C98	alt QpR or tuff	1	-28	0	-1	1	0	0	-0	0	-0	0			-29
C103	xtR/ign	1	-16	0	1	1	0	-0	-0	0	-1	0			-18
C106	alt QFp felsic	1	-16	-0	-1	4	0	-0	-0	0	-1	-0			-14

MASS CHANGES in CPZ Group 1 relative to least altered precursor? = Average of C88 & C93; Zr as immobile monitor

	(g/100g)		SiO2	TiO2	Al2O3	Fe2O3	MnO	MgO	CaO	Na2O	K2O	P2O5	CO2	S	Nettchange g/100g
C88	alt QpR	1	4	0	0	-3	-0	-1	-0	0	0	-0			0
C93	alt QpR or tuff	1	-4	-0	-0	3	0	1	0	0	-0	0			-0
C98	alt QpR or tuff	1	-25	0	-1	-2	-0	-1	-0	0	-0	0			-29
C103	xtR/ign	1	-12	0	1	-2	-0	-1	-0	0	-1	0			-16
C106	alt QFp felsic	1	-12	-0	-1	1	-0	-1	-0	0	-1	-0			-14

Group Locations:

Gp 1	North of Cethana Bridge
Gp 2	South of Cethana Bridge
Gp 3	Day's Rd to Machinery Creek
Gp 4	Staverton Rd north of Cethana Rd
Gp 5	Oliver's Road
Gp 6	Staverton Prospect & Lake Barrington Road

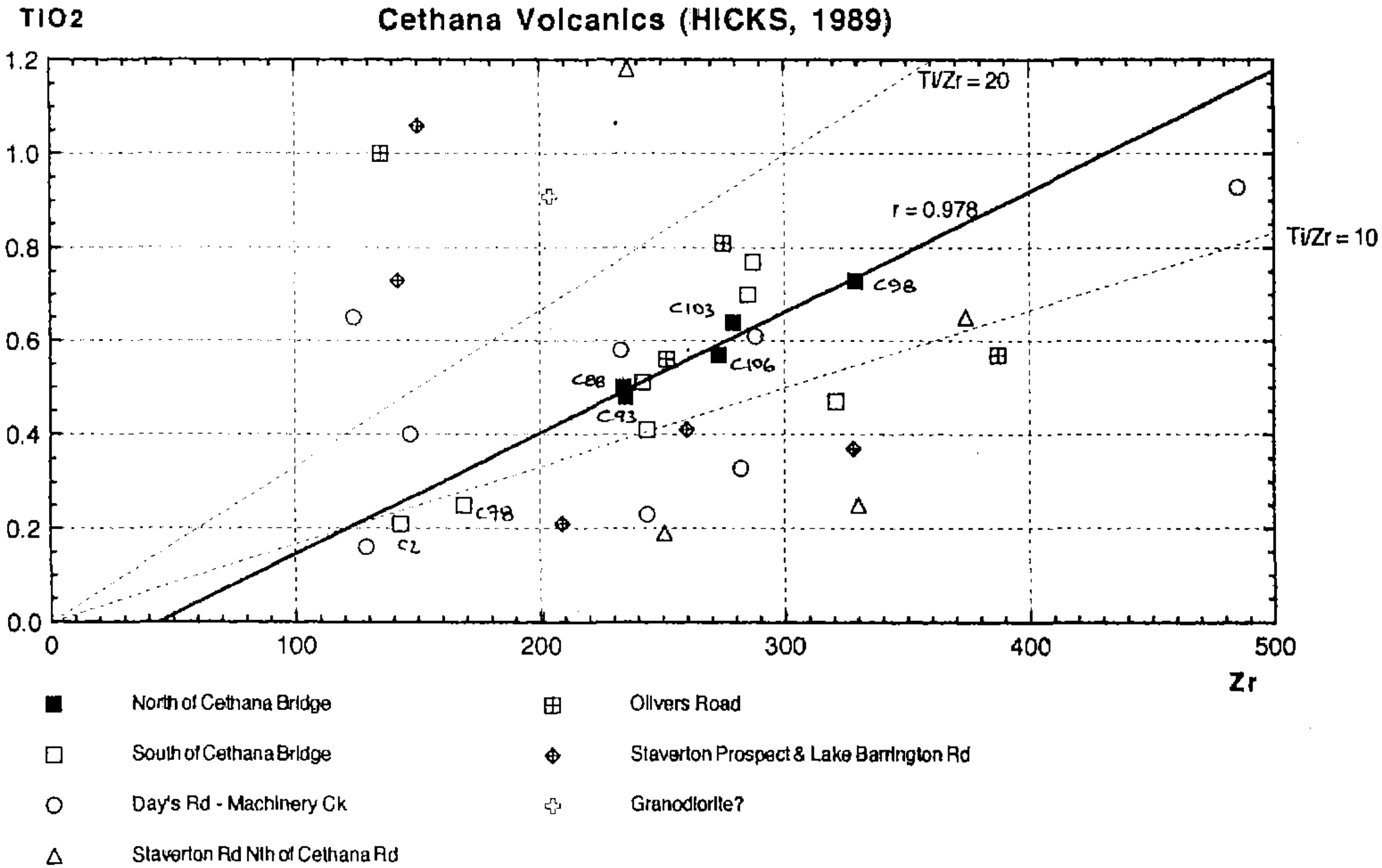

Fig 1. TiO2-Zr scatterplot of Cethana Volcanics

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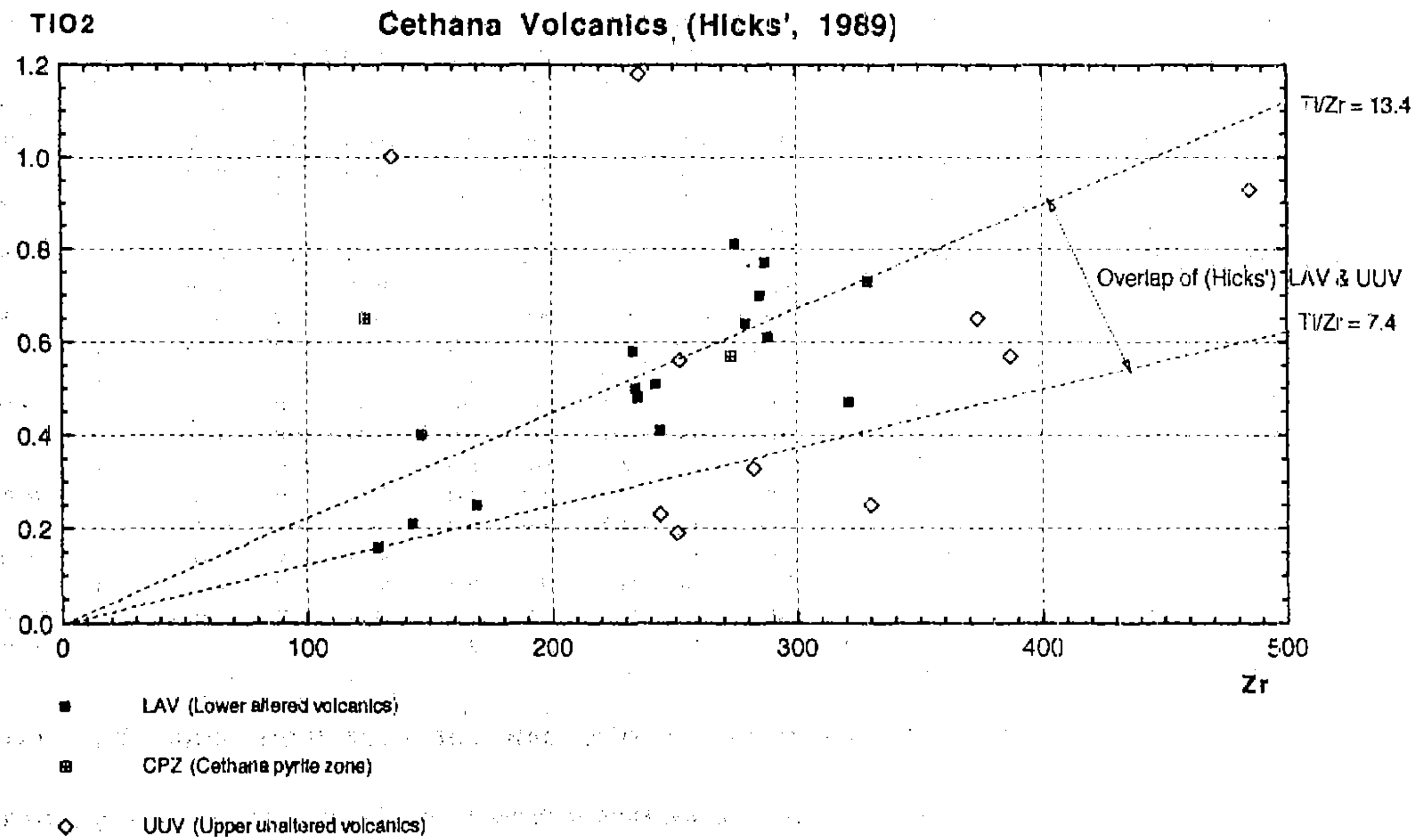

Fig 2 TiO2/Zr scatterplot differentiating? Hicks' (1989) LAV and UUV

331036

APPENDIX 2

ASSAY RESULTS AND SAMPLE LOCATION DATA

Analabs

Analabs Pty. Ltd.
A.C.N. 004 591 664

Phone (004) 316837 | 14 Thirkell St. CODEE TAS 7320 | Fax (004) 318890

ANALYTICAL REPORT No. 111715.60.11542

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

INVOICE TO:
Plutonic Operations Limited
Level 37
100 Miller Street
NORTH SYDNEY NSW 2060

ORDER No.	PROJECT
2017003	

DATE RECEIVED	RESULTS REQUIRED
10/01/96	ASAP

No. OF PAGES OF RESULTS	DATE REPORTED	No. OF COPIES	TOTAL No. OF SAMPLES
4	24/01/96	1	75

SAMPLE NUMBERS	SAMPLE DESCRIPTION	ELEMENT/METHOD
S15181/255	SG Prep : GP031	Cu,Pb,Zn,Ag,Fe,Mn/GA101 Fe,Mn/GA104 E, CETHANA Soils Purchase Order : 2017003

RESULTS TO:
Rob Reid
Plutonic Operations Limited
P O Box 282
ZEEHAN TAS 7469

RESULTS TO:
W Herrman
Plutonic Operations Limited
P O Box 282
ZEEHAN TAS 7469

RESULTS TO:

REMARKS

AUTHORISED OFFICER

331038

ANALYTICAL DATA

SAMPLE PREFIX	REPORT No.	REPORT DATE	CLIENT ORDER No.	PAGE
	111715.60.11542	24/01/96	2017003	1 OF 4

	SAMPLE No.	Cu	Pb	Zn	Ag	Fe	Fe	Mn	Mn	
METHOD		GA101	GA101	GA101	GA101	GA101	GA104	GA101	GA104	
1	S15181	8	68	122	<2	5.98	-	139	-	
2	S15182	29	47	66	2	4.20	-	58	-	
3	S15183	14	40	62	<2	3.95	-	65	-	
4	S15184	12	28	18	<2	0.32	-	15	-	
5	S15185	<4	66	26	<2	0.90	-	12	-	
6	S15186	<4	44	195	<2	>10.00	15.20	719	-	
7	S15187	<4	7	12	<2	0.64	-	27	-	
8	S15188	41	188	144	<2	2.26	-	54	-	
9	S15189	46	294	178	<2	5.35	-	271	-	
10	S15190	39	312	121	<2	3.32	-	421	-	
11	S15191	22	245	66	<2	1.55	-	45	-	
12	S15192	4	8	<4	<2	0.27	-	13	-	
13	S15193	8	21	25	<2	0.43	-	21	-	
14	S15194	<4	32	14	<2	1.44	-	34	-	
15	S15195	15	34	53	<2	5.60	-	34	-	
16	S15196	14	45	24	<2	3.05	-	21	-	
17	S15197	19	44	55	<2	0.42	-	38	-	
18	S15198	13	49	37	<2	0.35	-	30	-	
19	S15199	8	34	12	<2	0.55	-	20	-	
20	S15200	14	48	62	<2	2.03	-	35	-	
21	S15201	20	105	58	<2	3.16	-	21	-	
22	S15202	66	110	102	<2	4.25	-	72	-	
23	S15203	4	14	8	<2	0.40	-	10	-	
24	S15204	<4	9	<4	<2	0.11	-	10	-	
25	S15205	5	23	13	<2	0.37	-	19	-	

...sults in ppm unless otherwise specified
- = element not determined

IS = insufficient sample
SNR = sample not received

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331039

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Analabs Pty. Ltd.
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ANALYTICAL DATA

SAMPLE PREFIX	REPORT No.	REPORT DATE	CLIENT ORDER No.	PAGE
	111715.60.11542	24/01/96	2017003	2 OF 4

	SAMPLE No.	Cu	Pb	Zn	Ag	Fe	Fe	Mn	Mn	
METHOD		GA101	GA101	GA101	GA101	GA101	GA104	GA101	GA104	
1	S15206	<4	20	16	<2	0.62	-	16	-	
2	S15207	22	31	40	<2	3.22	-	21	-	
3	S15208	31	74	137	<2	6.86	-	54	-	
4	S15209	13	35	30	<2	2.60	-	19	-	
5	S15210	18	199	20	<2	1.96	-	31	-	
6	S15211	40	343	22	<2	2.79	-	255	-	
7	S15212	51	211	128	<2	3.73	-	>5000	0.64	
8	S15213	25	201	119	<2	4.32	-	73	-	
9	S15214	46	222	160	<2	4.96	-	447	-	
10	S15215	36	121	161	<2	3.74	-	264	-	
11	S15216	53	1236	309	<2	6.98	-	216	-	
12	S15217	31	387	129	<2	3.92	-	1317	-	
13	S15218	55	621	219	<2	1.48	-	56	-	
14	S15219	28	214	82	<2	1.10	-	25	-	
15	S15220	48	190	107	<2	6.77	-	74	-	
16	S15221	52	223	205	<2	7.52	-	97	-	
17	S15222	13	151	75	<2	5.33	-	55	-	
18	S15223	45	194	143	<2	7.25	-	110	-	
19	S15224	31	102	131	<2	6.50	-	51	-	
20	S15225	23	96	73	<2	5.11	-	69	-	
21	S15226	17	131	58	<2	4.73	-	131	-	
22	S15227	62	485	158	<2	5.77	-	705	-	
23	S15228	97	4590	1735	<2	>10.00	25.50	>5000	2.50	
24	S15229	92	595	411	<2	6.96	-	1186	-	
25	S15230	46	376	109	<2	4.13	-	137	-	

Results in ppm unless otherwise specified
– = element not determined

IS = insufficient sample
SNR = sample not received

AUTHORISED OFFICER

331040

Analabs

Analabs Pty. Ltd.
A.C.N. 004 591 664

ANALYTICAL DATA

SAMPLE PREFIX	REPORT No.	REPORT DATE	CLIENT ORDER No.	PAGE
	111715.60.11542	24/01/96	2017003	3 OF 4

	SAMPLE No.	Cu	Pb	Zn	Ag	Fe	Fe	Mn	Mn	
METHOD		GA101	GA101	GA101	GA101	GA101	GA104	GA101	GA104	
1	S15231	8	60	25	<2	0.64	-	14	-	
2	S15232	19	87	159	<2	3.86	-	105	-	
3	S15233	22	146	110	<2	4.87	-	363	-	
4	S15234	14	130	52	<2	3.91	-	25	-	
5	S15235	5	146	8	<2	0.87	-	12	-	
6	S15236	12	6	259	<2	0.84	-	43	-	
7	S15237	37	60	129	<2	6.77	-	40	-	
8	S15238	19	81	13	<2	1.08	-	15	-	
9	S15239	9	70	27	<2	3.21	-	17	-	
10	S15240	10	87	30	<2	3.18	-	36	-	
11	S15241	8	120	28	<2	4.42	-	37	-	
12	S15242	81	308	146	<2	>10.00	24.00	36	-	
13	S15243	19	187	110	<2	>10.00	15.20	62	-	
14	S15244	11	52	48	<2	>10.00	11.90	41	-	
15	S15245	48	258	717	<2	9.96	-	534	-	
16	S15246	22	56	70	<2	3.77	-	57	-	
17	S15247	27	88	129	<2	3.23	-	57	-	
18	S15248	35	141	156	<2	3.45	-	408	-	
19	S15249	28	160	211	<2	3.40	-	488	-	
20	S15250	40	224	303	<2	3.92	-	3096	-	
21	S15251	52	472	163	<2	3.32	-	>5000	0.72	
22	S15252	52	152	274	<2	7.29	-	197	-	
23	S15253	30	208	333	<2	6.18	-	1693	-	
24	S15254	17	65	68	<2	5.55	-	633	-	
25	S15255	14	25	24	<2	0.49	-	28	-	

Results in ppm unless otherwise specified
– = element not determined

IS = insufficient sample
SNR = sample not received

331041

AUTHORISED OFFICER

Analabs

Analabs Pty. Ltd.
A.C.N. 004 591 664

ANALYTICAL DATA

SAMPLE PREFIX	REPORT No.	REPORT DATE	CLIENT ORDER No.	PAGE
	111715.60.11542	24/01/96	2017003	4 OF 4

	SAMPLE No.	Cu	Pb	Zn	Ag	Fe	Fe	Mn	Mn	
METHOD		GA101	GA101	GA101	GA101	GA101	GA104	GA101	GA104	
1										
2										
3										
4										
5										
6										
7										
8										
9										
10										
11										
12										
13										
14										
15										
16										
17										
18										
19										
20										
21										
22										
23										
24	DETECTION	4	5	4	2	0.01	0.01	5	0.01	
25	UNITS	ppm	ppm	ppm	ppm	%	%	ppm	%	

Results in ppm unless otherwise specified
– = element not determined

IS = insufficient sample
SNR = sample not received

331042

AUTHORISED OFFICER

PLUTONIC
Plutonic Operations Limited
A.C.N. 004 680 997
Level 37, 100 Miller Street, North Sydney, NSW 2060
Telephone (02) 959 3433, Facsimile (02) 955 9620

181
75 samples

SAMPLE RECORD SHEET

PROJECT NAME: GOWRIE PARK EAST CETHANA - TAS CODE: 706 TENEMENT: (or SHEET No.)

PROSPECT NAME: ↓

SAMPLER: P. VANINI / J. WILSON SAMPLE TYPE: SOIL SAMPLED BY POWER AUGER DATE: 3/1/96

HOLE I.D.: Chips/Soils logged by W. HERRMANN P.O. No.: 2017003

SAMPLE No.	TYPE	INTERVAL/ LOCATION/CO-ORDS	DESCRIPTION
S 15181	B-C Soil	20800E 3150S	Greyish orange clay c̄ chips fe st. felsic Volc.
2	"	" 3175S	" "
3	"	" 3200S	Light brown stony clay c̄ chips fe st. felsic Volc.
4	A-B transported	" 3250S	Yellowish grey clay c̄ qtzite pebbles.
5	C-? Soil	" 3600S	Yellowish grey stony clay c̄ chips sev. @ p Phyllite
6	"	" 3625S	Greyish orange stony clay c̄ felsic Volc + limonite
7	A-B transported	21000E 3190S	Yellowish brown stony clay c̄ chips Qtzite + chips felsic Vol.
8	B-C Soil ?	21300E 5010N	Greyish orange plastic clay.
9	B Soil	" 4975N	Dark yellowish orange plastic Clay.
S 15190	"	" 4875N	Moderate yellow brown plastic Clay.
1	B-C Soil	" 4850N	Greyish orange stony clay c̄ Qtzite + felsic V chips
2	B transported	" 4825N	Pinkish grey gritty stony clay c̄ Qtzite chips
3	C - Soil	" 4800N	Very Pale orange gritty clay.
4	" "	" 4775N	Pale yellowish orange gritty clay
5	B-C Soil	" 4750N	Dark yellowish orange gritty clay
6	"	" 4725N	Pale yellowish orange gritty clay
7	B transported	" 4700N	Pale pinkish grey gritty-plastic clay.
8	"	" 4675N	V pale orange to white gritty clay
9	B-C /transported	" 4650N	Light brown gritty clay c̄ some qtzite chips
S 15200	C Soil	" 4625N	Pale yellowish orange gritty clay.
1	"	" 4540N	" " c̄ wd. [illegible] felsic volcanic
2	B-C transported	" 4510N	Dark yellowish orange c̄ some qtzite chips.
3	A-B transported	21500E 5125N	Brownish grey to white gritty clay.
4	"	" 4825N	Light brownish grey c̄ wd. qtzite chips
5	"	" 4800N	" Sandy loam c̄ qtzite pebbles
6	B? transported	" 4750N	Pinkish grey-white gritty clay.
7	B-C [illegible]	" 4725N	Dk yellowish orange gritty clay
8	"	" 4700N	" " c̄ wd. felsic volc chips
9	C Soil	" 4675N	Pale yellowish orange gritty clay " "
S 15210	B-C Soil	" 4650N	Greyish orange gritty clay.

REMARKS:
* Colours are from Geol Soc. America Rock Colour Chart 1980 edition.

WHITE: Assay File
PINK: Project File
YELLOW: Field Copy

331043

PLUTONIC
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SAMPLE RECORD SHEET

PROJECT NAME: EAST CETHANA CODE: 706 TENEMENT: (or SHEET No.)

PROSPECT NAME: GOWRIE PARK TAS

SAMPLER: Vanini + Wilson SAMPLE TYPE: Soil/Power Auger DATE: 3/1/96

HOLE I.D.: Chips logged by W. Herrmann P.O. No.: 2017003

SAMPLE No.	TYPE	INTERVAL/ LOCATION/CO-ORDS	DESCRIPTION
S 15211	A-B-C	21500E 4625N	Organic pale yellowish brown stony clay c̄ chips of felsic volc.
2	C residual	21600E 3125S	Greyish orange stony clay loam c̄ felsic volc
3	"	" 3175S	" " " c̄ QpPhyllite ch[illegible]
4	C "	21700E 3375S	Dark yellow orange stony clay c̄ coarser felsic volc
5	"	" 3400S	Pale yellow orange " " "
6	C	" 3450S	Dark yellow orange gritty clay
7	B-C	" 3500S	Greyish orange stony clay few Qtz to pebbles
8	B-C ?	21750E 365N	Pale yellowish brown clay.
9	B-C	" 340N	Pale yellowish orange stony clay c̄ Qtz to [illegible]
S 15220	B-C	" 315N	Dark yellowish orange gritty clay.
1	"	" 290N	" " "
2	B	" 265N	Light brown clay, gritty.
3	B	" 240N	Dark yellowish orange gritty clay
4	B	" 215N	" " "
5	B-C	" 190N	Greyish orange gritty stony clay c̄ felsic v[illegible]
6	"	" 165N	" " " QpPhyllite chips
7	B	" 142N	Light brown stony clay c̄ few felsic volc chips
8	B	" 130N	Dusky brown - black limonitic earth + [illegible]
9	B	" 105N	Light brown gritty clay
S 15230	B-C	" 80N	Dark yellowish orange stony clay c̄ felsic volcs
1	A-B	21800E 2525[illegible]	Light grey gritty clay and organics.
2	B transported	21900E 450N	Pale yellow orange grey clay c̄ qtz to pebbles
3	"	21925E 450N	Light brown - Dk yellow orange gritty clay.
4	C soil	21900E 125N	Pale yellow orange - grey stony clay, few QpPh chips
5	B soil	" 150N	Greyish orange pink gritty clay.
6	B transported	" 155N	Light grey silty loam.
7	B-C residual	" 175N	Dark yellowish orange gritty clay.
8	C residual	" 200N	Greyish orange gritty clay.
9	C "	" 225N	Pale yellowish orange gritty clay
S 15240	B-C soil	" 250N	Pale yellow orange - grey gritty clay

REMARKS:

WHITE: Assay File
PINK: Project File
YELLOW: Field Copy

331044

PLUTONIC
Plutonic Operations Limited
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Level 37, 100 Miller Street, North Sydney, NSW 2060
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SAMPLE RECORD SHEET

PROJECT NAME: EAST CETHANA CODE: 706 TENEMENT: (or SHEET No.)

PROSPECT NAME: GEORGIE PARK

SAMPLER: Vanini + Wilson SAMPLE TYPE: Soil/Power Auger DATE: 3/1/96

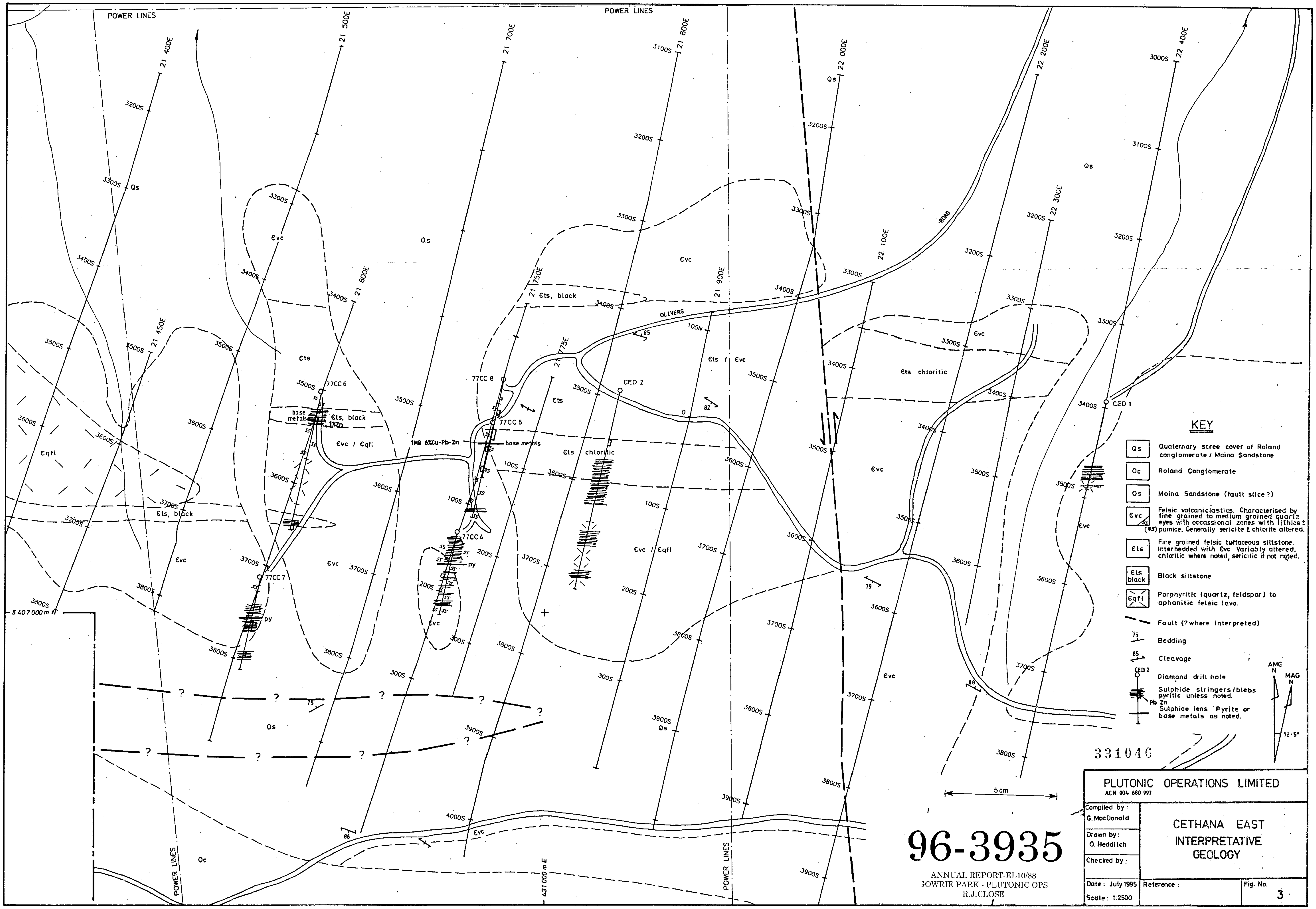
HOLE I.D.: Soils logged by W. Heumann P.O. No.: 2017003

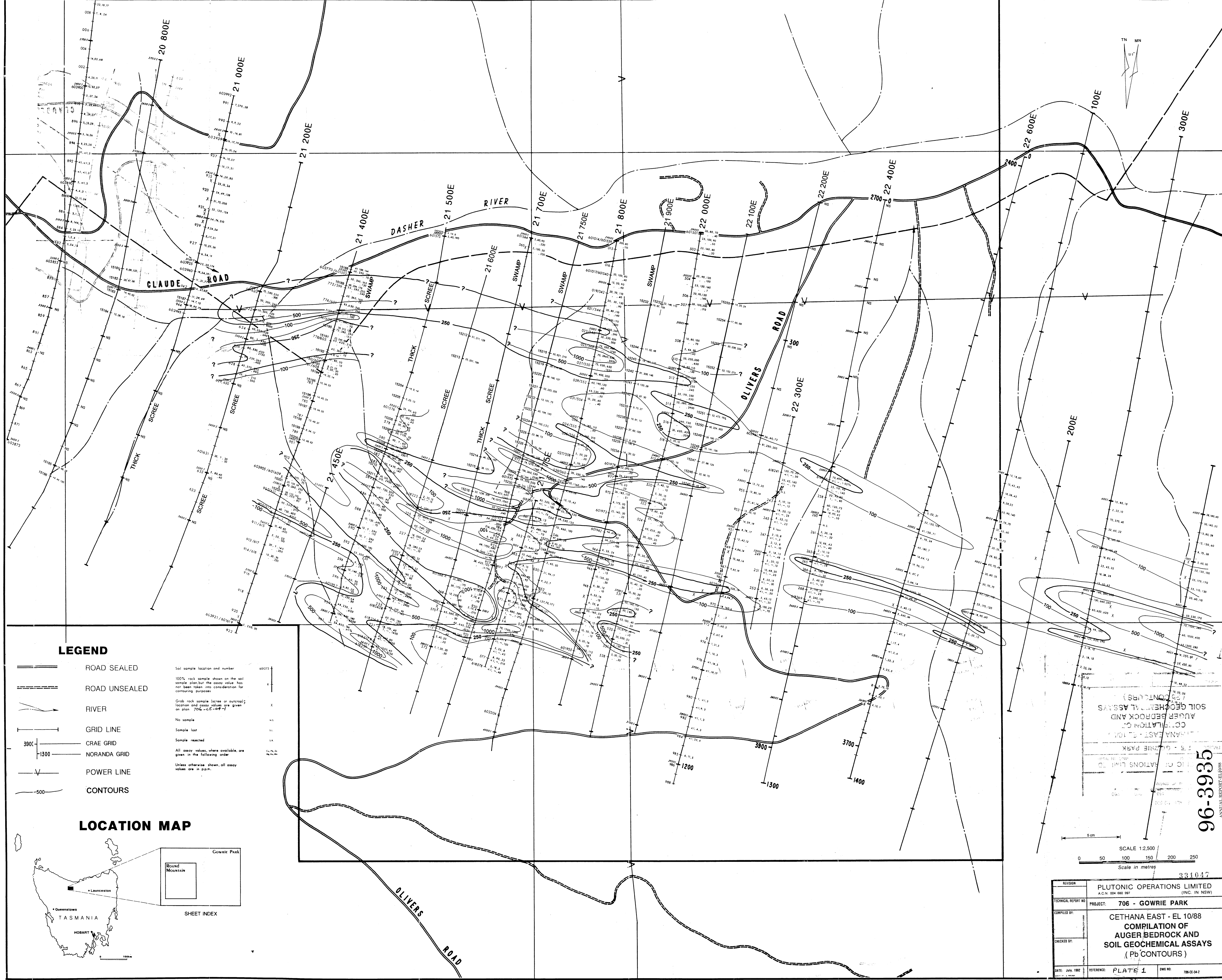
SAMPLE No.	TYPE	INTERVAL/ LOCATION/CO-ORDS	DESCRIPTION
S 15241	B (transported)	21900E 275N	Light brown - grey stony clay c qtzite chips
2	B	" 300N	Dark yellow orange clay
3	B	" 325N	Dk. yellow orange to yellow brown clay.
4	B	" 350N	" " "
5	B	22100E 4725N	Light Brown gritty clay.
6	B	" 4750N	Light Brown - grey gritty clay.
7	A-B	" 4775N	" " "
8	B	" 4800N	Light Brown stony clay c qtzite chips
9	B	" 4825N	Moderate Brown stony clay c CypR chips.
S 15250	A-C	" 4850N	Brown stony clay, qtzite + Fdine volc chips
1	B-C	" 4875N	Brown - grey stony clay c Fdine volc chips
2	B-C	" 4975N	Dark yellow orange gritty clay c lost CypR chips
3	B	" 5025N	Moderate brown gritty clay.
4	B-C	" 5075N	Greyish orange stony clay c [illegible] chips
5	C transported	" 5114N	Light grey silt similar: 15236
6			
7			
8			
9			
S 15260			
1			
2			
3			
4			
5			
6			
7			
8			
9			
S 15270			

REMARKS:

331045

WHITE: Assay File
PINK: Project File
YELLOW: Field Copy


POWER LINES
POWER LINES
OLIVERS ROAD
KEY
Qs Quaternary scree cover of Roland conglomerate / Moina Sandstone
Oc Roland Conglomerate
Os Moina Sandstone (fault slice?)
Єvc Felsic volcaniclastics. Characterised by fine grained to medium grained quartz eyes with occassional zones with lithics ± (ss) pumice. Generally sericite ± chlorite altered.
Єts Fine grained felsic tuffaceous siltstone. Interbedded with Єvc Variably altered, chloritic where noted, sericitic if not noted.
Єts black Black siltstone
Єqfl Porphyritic (quartz, feldspar) to aphanitic felsic lava.
Fault (? where interpreted)
Bedding
Cleavage
Diamond drill hole
Sulphide stringers/blebs pyritic unless noted.
Sulphide lens Pyrite or base metals as noted.
AMG N
MAG N
12·5°
5 cm
331046
PLUTONIC OPERATIONS LIMITED
ACN 004 680 997
Compiled by: G. MacDonald
Drawn by: O. Hedditch
Checked by:
CETHANA EAST
INTERPRETATIVE GEOLOGY
Date: July 1995
Scale: 1:2500
Reference:
Fig. No. 3
96-3935
ANNUAL REPORT-EL10/88
GOWRIE PARK - PLUTONIC OPS
R.J.CLOSE
5 407 000 m N
431 000 m E
77CC 4
77CC 5
77CC 6
77CC 7
77CC 8
CED 1
CED 2
1M@ 6%Cu-Pb-Zn
base metals
1%Zn
Єts, black
Єts chloritic
Єvc / Єqfl
Єts / Єvc



DASHER RIVER
CLAUDE ROAD
OLIVERS ROAD
SWAMP
SCREE
THICK SCREE
20 800E
21 000E
21 200E
21 400E
21 450E
21 500E
21 600E
21 700E
21 750E
21 800E
21 900E
22 000E
22 100E
22 200E
22 300E
22 400E
22 600E
100E
200E
300E
LEGEND
ROAD SEALED
ROAD UNSEALED
RIVER
GRID LINE
CRAE GRID
NORANDA GRID
POWER LINE
CONTOURS
Soil sample location and number
100% rock sample shown on the soil sample plan, but the assay value has not been taken into consideration for contouring purposes
Grab rock sample (scree or outcrop); location and assay values are given on plan 706-CE-04-1
No sample
Sample lost
Sample rejected
All assay values, where available, are given in the following order
Unless otherwise shown, all assay values are in p.p.m.
LOCATION MAP
Gowrie Park
ROUND MOUNTAIN
SHEET INDEX
Launceston
Queenstown
TASMANIA
HOBART
100km
TN
MN
SCALE 1:2,500
Scale in metres
96-3935
331047
PLUTONIC OPERATIONS LIMITED
A.C.N. 004 680 997 (INC. IN NSW)
PROJECT: 706 - GOWRIE PARK
CETHANA EAST - EL 10/88
COMPILATION OF AUGER BEDROCK AND SOIL GEOCHEMICAL ASSAYS
(Pb CONTOURS)
DATE: July, 1992
REFERENCE: PLATE 1
DWG NO. 706-CE-04-2