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PROJECT NAME: COMSTAFF PROPRIETARY LIMITED

TITLE:

CHESTER/PINNACLES INTERIM REPORT
EL 5/63 PART 4

BROWN'S WORKINGS

Closed

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COMSTAFF PROPRIETARY LIMITED

CHESTER/PINNACLES INTERIM REPORT

EL 5/63 PART 4

BROWN'S WORKINGS

CHAPTER ONE
INTRODUCTION

1.1 LOCATION

Pinnacles prospect is part of Comstaff's EL 5/63 Pt 4 which is situated on the western edge of the Central Belt of Mount Read Volcanics between Que River and Rosebery (TAS/2/1801). The Pinnacles prospect in this report refers to the area covered by the newly constructed EAF grid (1984). The centre of the grid occurs on the western flank of Burns Peak (EAF 5000/5000 AMG Co-ords 5384317.99N, 377708.09E, 497.07 RL). Brown's Workings are a group of old diggings, including a 45m long tunnel, west of Pinnacles Tramway Road between L5200N and L5400N on the EAF grid.

1.2 REGIONAL GEOLOGICAL SETTING

The Pinnacles prospect is within Cambrian rocks and lies across the contact between the Central Belt of Mount Read Volcanics and the undifferentiated sedimentary sequences (as defined by Corbett, 1981) to their west. Corbett (1981) shows the contact to be a fault. However, evidence at Pinnacles suggests the contact may be gradational from an eastern volcanic terrain westward into a depositional sedimentary basin.

Pinnacles is in the same stratigraphic position as the mines of Rosebery (Cu, Pb, Zn), Hercules (~2 million tonnes Cu, Pb, Zn) and Chester (pyrite mine), all which lie virtually in a N-S trending line with Pinnacles approximately 12 km north of Rosebery. Que River mine (2-3 million tonnes of Pb, Zn, Ag, Au) and the new Hellyer prospect (>10 million tonnes Pb, Zn, Ag, Au), approximately 17 km NE of Pinnacles, are also in a similar stratigraphic position. The geology of the Pinnacles is correlatable with that at Rosebery. The thick sequence of pyroclastics at the Pinnacles is the northern extension of the Primrose pyroclastics, while the Rosebery slate-bearing host units are equivalent to the host horizons at Pinnacles.

The 1:2 500 scale geology of the Pinnacles is shown in TAS/2/3990. The contact between the western sedimentary sequences and the volcanics lies on the western edge of the EAF grid.

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The volcanics consist of a thick sequence of pyroclastics and lavas (younging to the east) interrupted by a series of N-S trending horizons of sedimentary and volcaniclastic units (broadly classified as horizons of cherts, volcaniclastics and shales). These horizons are interpreted to result from quiescent periods within the volcanism, and are hosts to the deposition of siliceous exhalitic material and massive sulphides within the prospect. One such horizon, containing all known major occurrences of mineralisation to date in the Pinnacles prospect, occurs on the western edge of the volcanics and is referred to here as the "chert line". This line links mineralisation at Southern Trenches, McGuiness's Workings, Thomas's Tunnel and Brown's Workings. This report describes recent exploration carried out at Brown's Workings.

1.3 PREVIOUS WORK

1) Cu-Pb-Zn mineralisation was discovered at Pinnacles in 1896 by the McGuiness Bros.. The deposits were worked by means of small open cuts, trenches, and shafts, including the surface workings at Brown's. Brown's Tunnel was dug in 1899 (by R T Brown) on behalf of Tasmanian Pinnacles Proprietary Ltd. Production at Brown's Workings was 395.5 tons at an average grade of about 5.8% Fe, 0.4% Cu, 0.8% Pb, 2.0% Zn, 44.3 g/t Ag, 4 g/t Au.

2) Electrolytic Zinc Company (EZ) drill tested the mineralisation at Pinnacles in 1949-50 with 13 small-bore holes. This included one drill hole (PP 31) at Brown's Workings, testing for mineralisation beneath the shaft. PP 31 was collared 50m east of the shaft and passed 60m vertically below it. A cherty mineralised zone was recognised from 153.3m (503 ft) to 167m (548 ft) with 4.5m averaging over 3% Zn. The hole ended at 186.3m.

3) Work has been carried out in the Pinnacles area by Comstaff P/L over several periods since 1965-66. Despite three separate phases of drilling at Pinnacles between 1971 and 1983 no work had specifically been focussed on the Brown's Workings area.

1.4 AIMS OF THE PRESENT REPORT

This report aims to document work carried out and results achieved since May 1983, leading to and encompassing the drilling programme at Brown's Workings from March 1984 to December 1984.

It discusses the geological history and environment of mineralisation recognised at Brown's Workings, and relates this to the potential of the remainder of the chert line and Pinnacles prospect. Consequently, recommendations for further follow-up are proposed.

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CHAPTER TWO
WORK DONE

This section presents a broad chronological outline of the work carried out at the Brown's Workings. It is considered in two parts:

1) work associated with regional exploration of the Pinnacles,

2) work carried out as part of a fifteen-hole drilling project at Brown's Workings.

Procedural details of the geochemical and geophysical surveys are outlined in the relevant sections and appendices.

2.1 REGIONAL EXPLORATION

Data review and compilation of summary maps of the geology and soil geochemistry from 1966-1983 in EL 5/63 Pt 4 was carried out by Dr R W L Shaw (May-July 1983). Results of an airborne EM survey (DIGHEM), flown over EL 5/63 Pt 4 in April 1983, were received in August 1983.

Initial exploration by Dr R H Roberts concentrated in the Pinnacles prospect between Burns Peak and the Marionoak River. This work involved surveying and remapping of roads, costeans and old workings, relocation of old drill collars, channel sampling of all mineralisation, and relogging of old drill cores.

High gold values in the channel samples at Brown's Workings, McGuiness's Workings and the Southern Trenches areas invoked renewed interest in the Pinnacles prospect, especially as many of the highest gold values were contained in cherty outcrops containing only minor sulphides. A second channel-sampling phase was instigated of all siliceous (cherty) outcrops (TAS/2/4058).

Twenty four rock samples were sent for petrographic examination to ascertain information on the geological setting, style of mineralisation, and nature of the gold (Appendix 2A).

2.1.1 EAF Grid

To follow up the gold a new grid (EAF) was constructed. A two kilometre base line was professionally surveyed, and lines, varying in length from 1.4 km to 1.2km, were cut every 200m. EAF grid has been tape and compass surveyed and subjected to C-Horizon soil sampling, plus ground magnetic and UTEM (University of Toronto Electromagnetic) geophysical surveys based on 20m station intervals.

2.2 DRILLING

An initial hole was drilled north of Brown's Workings to examine a northerly trending geochemical anomaly recognised in the previous soil geochemistry. This hole was drilled by the Overland Drilling Company using a bombardier-mounted Warman 250.

The EAF series of drill holes (EAF 1-14) was instigated in the Brown's Workings area to follow up the high-grade gold mineralisation channel sampled at surface. All holes were drilled by Longyear Aust P/L. EAF-1 was drilled using an old BBS-1 rig. The remainder were drilled by a Longyear 38. These drill holes were geologically logged (Appendix 3), photographed, and sampled for analysis. Nineteen samples were collected for petrological study. Forty-six SG determinations were commissioned on a range of mineralised material. EZ drill hole PP 31 was collected from Rosebery and logged.

2.2.1 Surface Exploration in Conjunction With Drilling

An infill grid (40m spread lines) over Brown's Workings (and Thomas's Tunnel) was constructed and surveyed. This was C-horizon auger sampled (20m stations) and geologically mapped. All old and newly exposed roads and costeans were mapped (1:1000 TAS/2/3893) and channel sampled. Surface mapping began north of Huskisson Road (1:2500).

CHAPTER THREE
GEOLOGY

3.1 TERMINOLOGY

The terminology used for pyroclastic rocks in this work is based broadly on the work of Cas and Wright (from the course entitled "Modern and Ancient Volcanic Succession, 1984"). The term "pyroclastic" is used where the rock is considered to have been derived strictly from a vent source. Epiclastic is used where the units have clearly been redeposited by sedimentary processes. Volcaniclastic is used where the origin is uncertain.

When naming epiclastic and volcaniclastic units, size-related sedimentary terms (eg sandstone, siltstone, etc) are used, whereas with pyroclastics the grainsize terms ash (<4mm) and lapilli (4mm - 6 cm) commonly are applied. Tuff is not a grainsize-related term and refers simply to all rocks of pyroclastic origin. Ignimbrite is rock derived from a pumiceous pyroclastic flow.

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3.2 STRUCTURE

There is a general NNE strike trend at Pinnacles. Major structures are difficult to determine because of the lack of marker horizons within the volcanic terrain. In costean 18, folding within shales has a 30° plunge towards 006° TN. This broadly is consistent with the attitude of the Que Syncline north of the prospect. A foliation is present commonly in the volcanics and shales which roughly parallels strike and has a steep to vertical orientation.

Structural data in the core from Brown's Workings outline an overall vertical stratigraphy. Detailed structural analysis was limited by the absence of bedding in most of the volcanics and intense folding (commonly slump folding) within the shales. Where obtainable facing directions in the core showed a younger direction to the east.

3.3 GENERAL STRATIGRAPHY

The geology in the vicinity of Brown's Workings has been split into a western footwall unit of "green porphyry", a host horizon of cherts, volcaniclastics and shales containing mineralised lenses, and an eastern sequence of epiclastic breccias, lapilli tuffs, and quartz-feldspar porphyry (glomeroporphyric). Thick units of pyroclastic ash occur both footwall and hangingwall to mineralisation.

3.4 LITHOLOGIES

The distribution of rock types in Brown's Workings is shown on the interpretative geological sections TAS/2/4181, 2, 3, 5, 6, 7. These sections are collated diagramatically as stacked sections on TAS/2/4189. A geological legend used in conjunction with the interpretative geological sections is included on TAS/2/4182. More detailed descriptions of the major units are outlined below. A comprehensive legend of all units recognised in the drill core is included with the summary logs in Appendix 3.

3.4.1 Footwall

Green Porphyry (G-Pf)

This is a composite term for a sequence of porphyritic volcanics. The sequence is dominated by andesitic to dacitic lavas (or lava-like units).

The dacitic lavas typically have euhedral to subhedral feldspar and spheroidal quartz phenocrysts within a fine-grained ground mass, whereas the more andesitic lavas lack the quartz phenocrysts. The degree of porphyritic character and size of the phenocrysts can vary markedly.

The green colouration of the porphyries is related to the ubiquitous presence of chlorite-sericite alteration. Varying styles and degrees of alteration affect the appearance of the green porphyry (see alteration section). Sections of green porphyry seem quite fragmented, and although pyroclastic phases probably occur, much of the fragmented appearance is related to alteration.

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3.4.2 Host Horizon

This horizon is dominated by a mixture of cherts, volcaniclastics and shales (Ch/Vc/S). Proportions of the three lithologies can vary markedly. The descriptive term "chert" encompasses a diversity of origins from sedimentary marine cherts (recrystallised radiolaria recognised in thin section: eg RP 324A, Appendix 2A), to chemical "exhalite" cherts with sintery character (eg EAF-3/1, Appendix 2B), to silicified (cherty) volcaniclastics and sediments. Few (if any) of the cherts are pure, containing varying amounts of ash and clay component.

The volcaniclastics are typically green to grey (clay impurities) and vary from mudstones to coarse breccias. The shales occur as thin units within the volcaniclastics (grading into volcaniclastic mudstones), as thick (>10 metre) units of thinly bedded grey/black shales, or as massive black shales commonly with thin sphalerite veins.

1) Exhalite Units

Units within the host horizon consisting predominantly of cherts or cherty sediments with sulphides have been termed "exhalite units". This implies that there has been input of silica, sulphur, iron and base metals of varying quantities into the depositional environment. Contacts between exhalite and chert-rich Ch/Vc/S can be gradational. Pyrite commonly is disseminated throughout the chert, whereas the base metal sulphides occur more as veins and lenses within and around chert blocks.

2) Massive Sulphides

Massive to semi-massive sulphide mineralisation is associated with and generally enveloped by exhalite. It is a lead-zinc style of mineralisation consisting mainly of sphalerite (pale brown) and galena with varying amounts of pyrite and chalcopyrite. Accessory tetrahedrite (-tennantite) is common.

Varying proportions of quartz, sericite (white mica), and Fe-Mn-Ca carbonate make up the gangue, which typically constitutes between 5-10% of the rock.

The massive sulphides are generally well banded with alternations between monomineralic sulphide layers (galena or sphalerite) and sulphide-gangue mixtures. The base metals exhibit a polygonal-mosaic texture which commonly is weakly directed parallel to the banding. Pyrite typically forms as weakly poikilitic subhedral grains. These textures are metamorphic in origin. Minor relic textures of pyrite framboids and patches of colloform galena-sphalerite (+ - pyrite) intergrowths have been identified in thin section (EAF-10/1, Appendix 2B).

Overall the mineralisation has a medium grainsize (~ 75 u), and with its recrystalised texture would be metalurgically simple.

3.4.3 Hanging Wall

A sequence of geochemically barren units overlie the host horizon.

Epiclastics (Ec)

The epiclastics are characterised by mixed lithotypes, poor sorting, and some evidence of mechanical working. They consist of an assortment of volcanic and sedimentary fragments. A distinctive unit of epiclastic breccia (Ec-B) contains large (1-10 cm) rip-up fragments of shale. An environment of rapid deposition within a volcanic terrain is appropriate for formation of the epiclastics.

Lapilli Tuff (Pc-L)

This refers to a volcaniclastic breccia comprising angular lapilli-sized fragments of porphyritic volcanic within a fine-grained matrix of lithic and crystal fragmental components. The fragments vary from dark green to pink in colour, the pink colouration probably represents iron oxide-silica alteration. The unit is typically hard and silicified. Features are consistent with a pyroclastic flow (hence lapilli tuff), and the rock is interpreted to be an ignimbrite.

Contacts of the Pc-L can be quite sharp. However, often a volcanic breccia of Pc-L and other rock types (eg shale and epiclastic) is developed. A grey siliceous porphyry (Gy-P), showing possible flow banding, can occur within the lapilli tuff and may represent acid lava flows within the ignimbrite.

Quartz Feldspar Porphyry (QFP)

A most distinct unit with glomeroporphyritic texture. This is a classical quartz-eye porphyry (Hopwood, 1976) of the type commonly associated with volcanogenic massive sulphide deposits.

3.4.4 Footwall Units Within The Host Horizon

Drilling at Brown's Workings has intersected footwall green porphyry within the host horizon. A contact facies of mixed lithologies appears to have developed between the porphyry and host units. These lithologies have been grouped into three types.

Buff Volcanic (B-P) - characteristically a fine-grained non-porphyritic volcanic of buff-green colour. This unit may represent a chilled and fractured phase of porphyry. Chlorite veining is a common characteristic of this unit.

Composite Breccias - predominantly composite breccias of green porphyry and chert (G-PfC), (though a mixture of porphyry and black shale (G-PfS) was intersected in EAF-10). The porphyry-chert composite breccias consist of jagged-edged porphyritic fragments within a grey chert matrix. Textures are consistent with the breccia having been derived by lava flowing into, or emanating from beneath unconsolidated chert.

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Green Porphyritic Pyroclastic (G-Pc) - this unit has distinct fragmental character and consists predominantly of altered (silicified-sericitised) porphyritic fragments. Although of questionable origin this unit is envisaged as forming by quench fragmentation of a lava (a hyaloclastite) where it has flowed into water-rich unconsolidated sediments. Foreign fragments of chert (or cherty sediment) occur within the G-Pc, and where the chert component increases this unit can grade into a composite breccia (G-PfC).

It appears that these mixed lithologies occur predominantly where the porphyry lavas contact exhalite. This may relate to the unconsolidated gel-like nature of much of the chert which would readily facilitate mixing with inflowing lavas.

3.4.5 Footwall - Hanging Wall Pyroclastic Ash (Pc-A)

Pyroclastic ashes occur both footwall and hangingwall to the host horizon. In EAF-14 a thick sequence of pyroclastic ash occurs west (footwall) of the host horizon and appears to be the deeper facies equivalent of the green porphyry. However, in most of the drilling a persistent unit of pyroclastic ashes has been delineated directly east of (overlying) the host cherts, volcaniclastics and shales.

Pyroclastic ash (Pc-A) is a broad term referring to a collection of fine-grained pale-green siliceous volcaniclastics. The rocks commonly display a streaky wavy texture which is interpreted to be a relict eutaxitic texture. Silicified shards and shard fragments have been recognised in thin section (eg RP-194, Appendix 2B). Elongate clots of massive sericite in these rocks have been described as altered fiamme (collapsed pumice fragments) in thin section (eg RP 194, 313, 314, 327; Appendix 2). These textures are consistent with derivation from pumiceous ash flows and consequently the pyroclastic ashes (ash tuffs) are considered to be ignimbrites.

Several textural features in the pyroclastic ashes are worthy of note. A shear fabric is typically developed in the ashes; this is related to sericite-chlorite alteration prior to deformation. A quartz porphyry texture can be developed in the pyroclastic ashes (Pc-Aq). Units consisting of siliceous nodules (boudins) within an ash matrix are commonly recognised (cherty pyroclastic ash: C-Pc-A). The siliceous nodules may result from original composition, silica alteration, or inclusion of siliceous fragments.

3.5 ALONG STRIKE DISTRIBUTION AND FACIES VARIATIONS IN THE LITHOLOGIES

Rapid facies variations within units, relict topographic features, and high angle unconformities (related to deep rapid erosion), all of which are expected in a proximal volcanic environment, destroy any layer-cake stratigraphy, and make correlations between drill holes extremely difficult even over short distances.

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3.5.1 Host Horizon

Facies variations within the host horizon are extremely marked both within the broad grouping of cherts, volcaniclastics, and shales, and the degree of mineralisation. Similarly, the amount of interruption by the green porphyry, plus its marginal phases, within the host horizon varies from section to section.

Mineralisation

The best intersection of mineralisation is on L5320N. Going north and south from this section the green porphyry becomes extensive in the host horizon and the mineralisation becomes split. Southwards the massive sulphide mineralisation appears to peter out into two small lenses near surface, and although the host horizon is still quite distinguishable on L5200N well developed exhalite and massive sulphide is not present. The petering out of sulphides may also be emphasised by the lower RL of the topography southwards.

Northwards the host horizon is virtually squeezed out by the dominance of green porphyry as shown on section L5400N. However, 1m of rich mineralisation was still intersected at a deep RL in EAF-11.

3.5.2 Hanging Wall

Along strike and vertical changes within the hanging wall sequence appear to be related to deeply cut erosive surfaces rather than lithological facies changes. The best example of this is the PcL unit which is shown in the southern sections (L5320N to L5200N) to unconformably cut into the host horizon. This explains how holes (EAF-1 and PP 31), drilled directly beneath mineralisation in Brown's Shaft and Tunnel on section L5240N, gave barren results.

3.5.3 Footwall

The footwall is typically dominated by green porphyry. However, the deep drilling in EAF-14 on section L5280N appears to show the green porphyry interfingering into pyroclastic ash (Pc-A) at depth. The pyroclastic ash thus occurs as footwall to the host horizon.

3.6 ALTERATION

Both low-grade alteration effects and high-grade alteration zones are recognisable in the geology at Brown's Workings. Only the high-grade zones are indicated on the interpretative geological sections. However, all forms of alteration are included on the detailed summary logs (Appendix 3).

3.6.1 Low-Grade Alteration Effects

Common alteration features present in the Brown's Workings area are

1) Silicification (Si)
2) Iron oxide alteration (Fe)
3) Sericitisation (Se)
4) Chloritisation (Cl)
5) Carbonisation (Co3)
6) Pyritisation (Py)

Phyllosilicate alteration (sericitisation and chloritisation) and varying degrees of silicification are virtually ubiquitous throughout the volcanics; the phyllosilicate alteration results in their typical green to pale-yellow-green colouration. Minor carbonate alteration is also ubiquitous in the altered green porphyry with the carbonate derived from the breakdown of feldspar and mafic phenocrysts.

Leucoxene is similarly associated with alteration of mafic components in the volcanics and can result in a strong yellow colouration. The extent to which this low-grade style of alteration represents diagenetic processes within the acid to intermediate volcanics rather than source-related hydrothermal processes is debatable.

"Cherty"-Pyrite Alteration

"Cherty" silicification and pyritisation of volcaniclastics and sediments is closely associated with mineralisation. This alteration is gradational to exhalite.

3.6.2 High-Grade Alteration Zones

Zinc-Rich Stringer Zone

Distinct veins of grey chert and sphalerite (minor galena and chalcopyrite) anastomose through the green porphyry. These veins typically vary from 5mm to 3cm in width. Intense zones of quartz-sericite alteration (pale yellow-green colour) surround the veins (eg EAF-9/4 Appendix 2B), and often occur as circular zones 10-20cm in diameter. Fine-grained pyrite and leucoxene (adding to the yellow colouration) is distributed throughout the alteration.

Peripheral Effects: Pyrite-Silica Alteration

Pyrite-silica alteration of the green porphyry occurs adjacent to the zinc-rich stringer zone. This can give the porphyry a "fragmented" appearance with patches and veins of steel-grey alteration, consisting of silica and ultrafine pyrite, occurring between relatively unaltered porphyry. Where well developed this has the look of a composite breccia (G-PfC (A:Py, Si)).

Pyrite-Chlorite Alteration

This type of alteration has been delineated in both the green porphyry and pyroclastic ash units. However, the alteration is so intense that recognition of the original rock type is difficult. Characteristically, it is a very black alteration containing pyrite euhedra. The pyrite cubes can range from <1mm to >5mm in size. The black alteration is a fine-grained sericite-chlorite mixture. The chlorite is a dark-green near-isotropic Mg-Fe chlorite (EAF-9/3 Appendix 2B) which gives the alteration its distinctive colour. Although this alteration need not accompany any apparent veining, in parts it is closely associated with chalcopyrite-pyrite stringer veins, often occurring as distinct thin rims.

Pb-Zn-Co_3 Alteration

Intense carbonate alteration occurs within sericite-altered pyroclastic ashes and green volcaniclastics. The degree of carbonate alteration varies with some sections being almost pure carbonate. The carbonate has nodular to spotted appearance and is identical to the "oolitic" carbonate described by Braithwaite (1974) as occurring around the margins of the Rosebery zinc-lead ore body. Fine-grained lead-zinc mineralisation (Pb-Zn ratios ~1) is diffusely distributed within the carbonate-rich sections (eg EAF-14 248.2 - 272.5m). Rare sulphide-rich veins (1-2 cm wide) are associated with the alteration.

Testing of the carbonate within the core has shown a substantial manganese content. The carbonate is probably compositionally variable from mangancalcite to kutnohorite to mangansiderite. The high manganese content is again analagous to the carbonate at Rosebery.

It is noteworthy that parts of the nodular carbonate alteration are also identical in appearance to the Co_3-sericite unit described at Que River mine as laterally equivalent to their mineralisation. Similarly, carbonate alteration identical to that in our drill core again occurs along strike to the mineralisation at Hercules (pers.com.G. Green - Mines Dept. Tas.).

Peripheral Effects

Less intense carbonate alteration of sericitic ashes and volcaniclastics is present in several of the drill holes (eg EAF-13: 192-216m). The carbonate again has spotty to nodular appearance, and although mineralisation is not consistent patches of lead-zinc mineralisation (Pb-Zn ratios ~ 1) are associated with the alteration (eg EAF-13: 212.2 - 212.9m)

3.6.3 Presence of Fuchsite

The presence of fuchsite is significant in that it occurs diagnostically within "dacite porphyry" adjacent to massive sulphide mineralisation at Que River mine. Fuchsite has been recognised in the drilling at Brown's Workings within an intensely carbonate-sericite-altered volcanic (D-P), similar to the "dacite porphyry" of Que River, in EAF-9 (220.5 - 243.7m) and EAF-13 (243.7-245.3m). The fuchsite is a chromium-rich alteration product resulting from the breakdown of mafic components in the volcanics, and its importance in the Brown's drilling is uncertain.

CHAPTER FOUR

LITHOGEOCHEMISTRY

4.1 DOWNHOLE GEOCHEMISTRY

The analytical data for fifteen drillholes at the Brown's Tunnel target have been studied and classified into distinct suites. They conform, in the main, to recognisable rock types or association of rock types and permit a geochemical profile of the volcanogenic system to be defined.

Sixty blocks have been delineated from the fifteen drillholes in which anomalous through to "ore" grade assays have been returned. These blocks are illustrated for drillhole cross sections L5280 and L5320 on TAS/2/4205 and 4206 respectively.

Length-weighted values for each block have been calculated and are tabulated in Appendix 4. Seven geochemically distinctive styles are recognised for which an arithemetic mean and range have been determined for each element (Cu, Pb, Zn, Ag, Au) (TABLE 1). These styles are discussed briefly below.

4.1.1 Geochemical Groups

"Ore" Grade

High-grade zones which when calculated in dollar terms (see CHAPTER SIX Resource) are theoretically mineable on a $53 cut-off. These are intersections of massive sulphide, or massive sulphide with highly anomalous Au-bearing chert (Au: 6 ppm). The major intersection of "ore" is in EAF-9. This correlates upwards and to the north and south with intersections in EAF-6, 3/4, and 10.

"Sub-Ore" Grade

This material has lower grades of mineralisation with the same metal proportions as the "ore". Spacially it is intimately associated with the ore and correlates with sulphide-rich cherts and volcanics.

TABLE 1

GEOCHEMICAL CLASSIFICATION (DRILL HOLES)

CLASS	No of Blocks	Cu Mean	Cu Range	Pb Mean	Pb Range	Zn Mean	Zn Range	Ag Mean	Ag Range	Au Mean	Au Range
W.ANOM	18	126	25-532	693	160-1584	0.28	1320-0.56	1.79	x-4.9	0.047	x - .244
EXHALITE	9	543	127-1142	1393	753-0.32	0.53	0.3-1.12	6.79	1.7-15.8	0.234	.054 0.52
"SUB-ORE GRADE	6	0.37	1600-0.68	0.78	0.25 1.22	3.26	1.94 6.02	17.4	4 - 27.7	0.27	0.12 0.44
"ORE" GRADE	Based 8 INT See Res Sec	1.26		6.58		18.83		122		4.09	
F.W. PIPE	4	678	384-1300	984	864 1090	0.85	0.39 1.30	4.75	3.4-6.1	0.04	.006 .067
"S.ORE" F.W. PIPE	1	0.52		1240		5.13		25		0.11	
COPPER ZONE	6	0.52	0.31 0.79	1600	374 0.31	0.30	604 0.82	38	14-75	0.08	0.03-0.13
a) Exhlic	(3)	0.52	0.31 0.79	0.26	.22 .31	0.41	1900 -0.82	45	18.6-75	0.103	.084-0.13
b) Ft.W.	(3)	0.52	0.44 0.59	699	374-1080	1931	604-0.41	31	13.8-60	0.039	.033-.05
Pb-Zn - Co3	7	263	37-500	0.60	1500-1.63	0.80	0.09-1.72	4.8	2.3-7	0.039	0.01-.099
ORE GRD Pb-Zn-Co3	1	0.61		6.55		5.94				.03	

NB Cu, Pb, Zn values>1999 ppm expressed as % (2 decimal places)

Exhalite

The "ore' and "sub-ore" mineralisation is enclosed typically in an envelope of exhalite which again has proportionally the same metal ratios as "ore" but at substantially reduced levels of concentration. The rock typically consists of blue-grey chert with veins and veinlets of base-metal sulphides. An 0.1 ppm Au cut-off can usually distinguish this zone from the weakly anomalous geochemistry in the host horizon.

Weakly Anomalous

This classification is characterised by low Cu, Pb, Ag values, but slightly enhanced Zn (mean - 0.28%) and Au (mean = 0.047). It relates closely to the host horizon grouping of cherts, volcaniclastics and shales.

Broadly there is a geochemically gradational sequence from "ore-grade" material through "sub-ore" to exhalite and weakly anomalous units. However, the separate subdivisions are geochemically, and petrographically, real.

Zn-Rich Footwall Pipe (Stringer Alteration)

The footwall pipe has been intersected in EAF-9, 12 and 13. It occurs within geochemically barren green porphyry. Relative to the porphyry all elements are elevated in value, but only Zn is present in significant quantities (Zn mean = 0.85%). The footwall pipe is characterised by stringers of chert and sphalerite with minor galena and chalcopyrite (described above).

Stringer mineralisation is intensified at the stratigraphic top of the pipe resulting in a "sub-ore" stringer zone (only intersected in EAF-9) beneath mineralisation.

Cu Zones

These are typified by ~0.5% Cu, high Ag (30-50ppm), but only mildly anomalous quantities of the other elements. A Cu zone occurs in EAF-9 and 13 directly below the best intersection of massive sulphide mineralisation. One also occurs over a wide drill width (3 blocks between 197.2 and 248.2m) in EAF-14 (40m south of 9, 13), but at a much deeper RL than the intersections in 9 and 13. It is debatable whether these zones can be directly linked.

The Cu-rich zones are related directly to chalcopyrite-pyrite stringer veining in the rocks. These zones can be subdivided into two groups which are separated by their Au content. The higher gold group (mean 0.103 ppm Au) is related to chalcopyrite-pyrite stringers in chert (exhalite), whereas the lower gold group (mean 0.039 ppm Au) correspond to chalcopyrite-pyrite veining, with associated intense pyrite-chlorite alteration, in the porphyries and pyroclastic ashes.

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Pb-Zn-CO_3 Zones

These are the Pb-Zn-CO_3 alteration zones described in the lithology section, and geochemically they are distinguished by Pb:Zn ratios which typically are close to 1:1 (Pb mean = 0.6%; Zn mean = 0.8%).

This type is best developed in EAF-14, but is also identified near the bottom of EAF-9, 11, 12, and 13. The base metals are usually fine grained and distributed diffusely within these zones. The intersection in EAF-11 is somewhat atypical being coarse grained, associated with chert, and having "ore-grade" base-metal values (Pb: 6.55%, Zn: 5.94%). However, it is associated with carbonate-altered rocks and has the characteristic Pb:Zn ratio of 1:1.

Barren Zones

Within the drilling, the unaltered footwall porphyries and pyroclastics, plus the hanging wall pyroclastics, epiclastics lapilli tuffs, and quartz feldspar porphyries are all geochemically barren.

4.2 SURFACE LITHOGEOCHEMISTRY

"Ore" blocks and anomalous zones are recognised from surface channel sampling within a delineated host horizon (TAS/2/4209). Results are tabulated in a similar manner to that discussed for the drilling geochemistry (TABLE 2). Study of the surface geochemical data at Brown's Workings reveals an eighth class - the Au/Ag facies. It is characterised by variable but low quantities of Cu, Pb and Zn, but high Ag and Au values (Ag mean: 42 ppm, Au mean : 1.49 ppm).

It is this style of mineralisation, exemplified by channel sampling of Brown's Tunnel and open cut, which attracted our attention to the area and led to the drilling stage. Only drilling in parts of EAF-3 (eg 35.7 - 37m - Cu: 0.55%, Pb: 0.32%, Zn : 0.15%, Ag : 28.5 ppm, Au : 28.7 ppm) and to a lesser extent EAF-4 approached this style of mineralisation.

It is apparent that near-surface the southern outer fringe of the Brown's massive sulphide carries an Au/Ag (? epithermal) kind of mineralisation. Large (1984) has suggested that low-sulphide stratiform/stratabound gold (+ Ag) mineralisation (at Elliot Bay) may represent a shallow marine or subaerial version of the more normal massive sulphide depositing processes in the Mount Read Volcanics.

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TABLE 2

SURFACE GEOCHEMICAL CLASS CLASSIFICATION

CLASS	No of Blocks	Cu Mean	Cu Range	Pb Mean	Pb Range	Zn Mean	Zn Range	Ag Mean	Ag Range	Au Mean	Au Range
Au/Ag	6	465	260-923	0.24%	100-.55%	0.15%	83-0.35%	42	10.3-121.5	1.49	0.11-4.59
EXHALITE	1	% 0.12		% 0.13		% 0.26		7.1		0.09	
ORE	2	% 1.40		% 7.42		% 26.17		160		8.63	

CHAPTER FIVE
GEOLOGICAL HISTORY AND ORE GENESIS

5.1 GEOLOGICAL INTERPRETATION

Geological relationships, alteration features and facing recognised in the drill core suggest that the geology in the Brown's Workings area youngs to the east. The geological history of the Brown's area is best visualised by studying the cross section of L5320N (TAS/2/4182) including drill holes EAF 6, 9, 13), and recognising that the geology has now been turned through 90° to a near vertical position. Consequently, examining this cross section from a western view presents the geology as it is envisaged to have been laid down. Extrapolations north and south of this section are best followed using the stacked section (TAS/2/4189).

Initially a pile of porphyritic acid to immediate volcanic lavas and minor pyroclastics (green porphyry) were deposited with minor intercalations of volcaniclastics and shales. A break in the volcanism allowed the host horizon sequence to be deposited in an inferred low-energy subaqeous environment.

Siliceous exhalitic material and mineralisation was deposited from a vent in the basement porphyry. The exhalitic facies, comprising massive sulphide lenses and sintery cherts in an exhalitic envelope dominates the host formation both proximal to and down dip from the vent. The exhalite units grade into anomalous host horizon sediments.

The mineralising fluids appear to have percolated up through the green porphyry producing a stringer alteration pipe 70m in diamater and at least 100m deep. Intensity of veining and sulphide mineralisation increases towards the top of the pipe developing a "sub-ore" - grade zone below the massive sulphide mineralisation.

The pipe is characterised by sphalerite-rich stringers and accompanying sericite-quartz alteration of the porphyry. However, at the top of the pipe there is a copper-rich zone containing chalcopyrite-pyrite stringer veining and pyrite-chlorite alteration. Pyrite-silica alteration occurs peripheral to the main alteration pipe and appears to represent a milder form of green porphyry alteration.

Exhalitic material has spread laterally downslope from the pipe such that in its present orientation it extends towards surface. In so doing it also fanned out in a north-south direction. The exhalitic horizon can be envisaged as a 10-15 thick sheet spreading outwards in a fashion analogous to delta (TAS/2/4147).

However, the amount of massive sulphide relative to exhalitic chert appears to diminish sharply away from the source vent. Deposition of the host horizon sequence, including mineralisation, was interrupted by contemporaneous outpourings of porphyritic lavas which produced a complex contact facies of mixed lithologies.

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The end of the host horizon event is marked by a major ash flow (Pc-A), or series of flows, of ignimbritic origin. A change to a possible subaerial depositional environment is indicated followed by incisive erosion and rapid deposition of the poorly sorted epiclastics. Further extensive erosion took place followed by a major proximal ignimbrite flow (lapilli tuff : Pc-L). The lapilli tuff cuts deeply into the older units, often apparently cutting well into the host horizon, and probably much of the erosive force was related directly to the flow itself. The lapilli tuff is coarser grained to the north suggesting flow from this direction. Concordant units of quartz-feldspar porphyry cap the epiclastic and lapilli tuff. Although not intersected in the drilling, from the surface geology it is apparent that another unit of cherts, volcaniclastics and shales (possibly a host horizon) succeeds this Brown's Tunnel sequence.

5.1.1 Pb-Zn-Co_3 Alteration

No reference has been made of the Pb-Zn-Co_3 type of alteration in the above geological history. The strongest development of this alteration occurs in the Pc-A at the bottom of hole 14, and it has not been intersected in any of the drilling above the 320m RL. It is unlikely that the Pb-Zn-Co_3 alteration is related to the zinc-rich stringer pipe because

1) there is no obvious physical link between the two styles of alteration - in fact units occurring at RL's between the two styles of alteration appear virtually unaltered,

2) the Pb-Zn metal ratios of the mineralisation associated with the Co3 alteration are significantly different from the mineralisation associated with the zinc-rich stringer pipe.

Consequently, it appears that the Pb-Zn-Co_3 alteration is associated with an as yet untested deeper occurrence of lead-rich mineralisation.

The carbonate alteration is similar to that at Rosebery, Que River, and Hercules mines where it occurs stratigraphically lateral to mineralisation.

5.2 GEOCHEMICAL PROFILE

The geochemical profile corroberates that a classical proximal volcanogenic system has been drilled. The geochemistry delineats a footwall stringer pipe within the porphyry basement beneath massive sulphide development in a host horizon. Mineralisation is enveloped by an exhalitic chert horizon which in turn occurs within anomalous sediments and volcaniclastics. The system is capped by barren epiclastics and tuffs. A schematic cross section based on the geochemistry of section L5320N is shown on TAS/2/4184. At surface a Au/Ag facies of mineralisation has been recognised peripheral to the massive sulphide lode.

5.2.1 Copper Zone

The formation and significance of the copper zone is uncertain. Three features of the copper zone are worthy of note:

1) this is the only zone which cuts across a lithological boundary, with the copper enrichment associated with chalcopyrite-pyrite stringer mineralisation in either the basement porphyry (low Au values) or host horizon exhalite (higher Au values),

2) the chalcopyrite in the copper-rich exhalite of EAF-13 (135.6-143.9m) and EAF-14 (216.228.6m) typically occurs as aligned blebs cutting across the general layering of the other base metals, strongly suggesting that the copper was later,

3) the graph showing metal distribution from footwall through to the top of the host horizon of section L5320N (TAS/2/4215) clearly shows its anomalous depletion in zinc compared to both the overlying sulphide and the underlying pipe.

These features suggest that the copper zone may have resulted from mineralisation which post dated the main stage of zinc deposition. The copper could be a later phase of the same system producing the classical copper-keel zoning in Kuroko deposits (Eldridge, Barton, and Ohmoto, 1983). Alternatively, the copper may simply have impinged on the zinc-rich system from a distal source. With the copper zone considered to be a later superimposed event the initial phase of zinc mineralisation is greatly simplified; for zinc content then increases progressively towards the ore zone (TAS/2/4215).

As noted previously the Pb-Zn-Co_3 alteration appears to relate to a separate deeper mineralising system than the identified zinc-rich pipe. The widest intersection of copper mineralisation (associated with pyrite-chlorite alteration) is spatially related to the Pb-Zn-Co_3 alteration in EAF-14.

It is suggested that both forms of alteration and mineralisation are related to a second, as yet undefined source, deeper and southwards of the EAF drilling.

CHAPTER SIX
RESOURCE

6.1 INTRODUCTION

Fifteen drillholes (ESB-1, EAF 1-14) have adequately closed off a resource of 110,000 tonnes of massive mineralisation at a grade of 1.26% copper, 6.58% lead, 18.83% zinc, 122 ppm silver and 4.09 ppm gold. The geological setting and occurrence of mineralisation has been fully outlined above. The data for this section are taken virtually from Brown's Tunnel Resource, Pinnacles, EL 5/63 (Shaw, Roberts, 1985).

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6.2 ECONOMIC VALUATION

The parameters for defining "ore" grade were calculated by GAB (14.9.84)(Appendix 5) providing a cutoff value of $53 in a polymetalic system.

The geometry of the mineralisation has been derived by interpretation from drilling and surface mapping. The zones of mineralisation with values greater than cut-off have been interpreted to conform to this geometry.

Widths used in calculating the resource tonnage have been measured from cross sections. The area of influence of each hole has been measured on long section and the SG has been derived graphically from an initial batch of 46 determinations (TAS/2/4214).

The drill intercepts which exceed $53 recovered value over 2 or more metres are tabulated below.

Hole	Drill Depth	Drill Width	$Value	Cu %	Pb %	Zn %	Ag ppm	Au ppm
EAF 3	35.7-38.5	2.8m	$204.27	1.49	8.55	13.56	89.6	14.14
EAF 4	36.4-39.7	3.3m	50.0	0.25	0.41	0.48	20.5	6.55
EAF 3 & 4	intercepts are less than 2m apart	mean value	121.0	0.82	4.15	6.49	52.3	10.04
EAF 6	56.6-59.6	3.0	148.0	1.1	5.72	17.64	171	0.6
EAF 9	162-173.1	11.1	171.0	0.96	8.01	18.92	93	4.74
EAF 10	1) 98-101 2) 112-116	3.0 4.0	211.5 75.5	2.16 1.54	5.96 0.39	26.36 10.56	185 50	2.39 0.37

The above potentially economic intersepts identify a lens of mineralisation beneath Brown's Workings. The geological environment of the lens has been clearly defined and major economic extensions to the lens are unlikely. The tonnage potential, as a geological resource is calculated on the table below.

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Section	Intercept Used	Value							Tonnes
		SG est	Cu	Pb	Zn	Ag	Au	$	
5360N	EAF 10 98-101m	3.9	2.16	5.96	26.36	175	2.39	212	26185
5320N	EAF 6 56.6-59.6	3.6	1.1	5.72	17.64	171	0.6	148	20700
	EAF 9 162-173.1	3.7	0.96	8.01	18.92	93	4.74	171	47820
5280N	EAF 3&4 35.7-38.5 and 36.4-39.7	3.23	0.82	4.15	6.49	52.3	10.04	121	14350
TOTAL		3.67	1.26	6.58	18.83	122	4.09	170	109055

The sensitivity of the deposit to cut-off was tested by application of a $35 value. The additional mineralisation gained by this devise is quite small and is illustrated on the accompanying sections. The apparent limited increment in tonnage is insufficient to warrant calculation of a resource at the $35 cut off.

6.3 CORRELATIONS

The table below compares Browns Working's resource with the Rosebery, Que and Hellyer deposits.

Factor	Browns Tunnel deposit	Rosebery (Reserves'81)	Que (Dil.Res)	Hellyer (Est. Res
Zn	18.83	10.6	12.51	14
Pb	6.58	3.6	6.97	7
Cu	1.26	0.7	0.35	0.3
Ag	122	119	171	180
Au	4.09	2.4	3.36	2.5
Zn/Pb	2.86	2.94	1.79	2.0
Zn + Pb/Cu	20.2	20.3	55.7	70
Ag/Au	30	50	51	72

It is misleading to compare grade figures in absolute terms because of the variable way in which they are determined - (cut-off, diluted etc). However, in absolute terms Brown's Workings "ore" is rich in zinc and gold, relatively good in copper and lead, but somewhat poorer in silver. Looking at the metal ratio's the "ore" has more in common with Rosebery than it does with Hellyer/Que particularly in the base metals. Precious metals in ratio form emphasise the gold signature of the Brown's deposit.

CHAPTER SEVEN
SURFACE EXPLORATION TECHNIQUES AND RESULTS

7.1 SOIL GEOCHEMISTRY

7.1.1 Orientation Studies

C-horizon soil sampling studies were carried out over known mineralisation at Brown's Workings and the Southern Trenches. A sample spacing of 20 metres was used. Details of the oreintation studies are included in Appendix 1. Results of the studies confirmed that C-horizon auger samples successfully delineated the mineralisation. Best overall results were obtained from assaying the split sample without any selective sieving of a size fraction. Cu, Pb, Zn and Au were chosen for assay with further elements (eg As, Ag) proving to be superfluous.

7.1.2 EAF Grid Survey

Procedure

The entire EAF grid and the infill grid lines have been hand auger sampled at 20 metre intervals. Samples were collected typically between half and one metre depth aiming to gather C-Horizon material.

Results

1) Chert Line

A line of anomalous Cu, Pb, Zn, and Au runs from Brown's Workings to Thomas's Tunnel delineating the chert line (TAS/2/4210, 11, 12, 13). Major dispersion has occurred westward downslope and down creek, with the eastern limit of the chert line being defined by the eastern cut-off of the geochemistry.

Brown's Workings are delineated well by high geochemical values, but how much is contamination from the surface workings is difficult to assess. It is very significant that the anomalous geochemistry at Brown's, cuts out north of L5280N. The surface topography RL increases to the north resulting in more deeply buried mineralisation in this direction. From the stacked geological interpretation section (TAS/2/4189) it appears that mineralisation more than 20m below surface does not cause a soil geochemical anomaly in this environment. To emphasise this point further the projected surface position of the mineralisation at Brown's Workings is shown on the contoured geochemical maps, and it is clear that the major part of the body lies under barren soil geochemistry.

There is further geochemical anomalism more or less along strike of the chert line around and north of Huskisson Road. The significance of this to the possibility of mineralisation north of Brown's Workings needs further study.

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2) Other Anomalies

A second line of gold and base-metal soil anomalism can be identified east (upslope) of the chert line (eg 0.25 ppm Au at L5200N/4960E, 220 ppm Zn, at L5160N/4900E). This correlates with a further horizon of cherts, volcaniclastics, and shales which are separated from the chert line by barren epiclastics.

A Cu, Pb, Zn anomaly without gold has been detected on the eastern edge of the infill grid, west of East Chester Road. The highest value in this anomaly lies at L5200N/5020E. The significance of this anomaly is as yet unknown.

7.2 GEOPHYSICS

7.2.1 Ground Magnetic Survey

Procedure

A ground magnetic survey was completed over the main EAF grid with readings recorded at 20 metre intervals. The survey was carried out using both manual and memory proton precession magnetometers. Readings were recorded every five minutes at a base station and results were adjusted for diurnal variation by computer.

Results

No anomalous magnetic response was recorded over Brown's Workings. The lack of magnetic anomalism was typical of the whole grid.

7.2.2 EM Surveys

Airborne EM Survey

DIGHEM was flown over EL 5/63 Part 4. Results were disappointing with no well defined bedrock conductor being located. Three low-amplitude responses, which could be related to "bird" turbulence, were outlined. No response was obtained over Brown's Workings.

Ground EM Survey

System

A UTEM (University of Toronto Electromagnetic) geophysical survey was conducted over the EAF grid. The UTEM system is a fixed transmitter broad band EM system (Lamontagne et al.,1978). The system was tested by Aberfoyle over the Que River orebody and close analysis showed that is was capable of detecting their PQ (sphalerite-rich) lens. UTEM provided the initial response which led to the discovery of the Hellyer deposit (>10 million tonnes at >18% Zn plus Pb, > 150 g/t Ag, >2 g/t Au) three kilometres north of Que River mine. UTEM is a deep probing EM system believed to be capable of detecting high-quality conductors to depths of 200 metres.

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Procedure

Two 1 km square transmitter loops were used, with the EAF grid lines extending at right angles off the eastern sides of the loops. Consequently, on the longest lines readings were taken as far as 1.4 km away from the source loop. Readings were initially taken at a spacing of 20 metres on lines 5400N, 5600N, and 5800N. However, to increase production rate a 40 metre interval was used on the remainder of the lines.

Results

Only poor conductors were registered in the survey. These were interpreted to occur within three zones running virtually parallel to strike which were suggested as being probable geological horizons (TAS/2/3990). Zone B has an average width of 50 metres and runs approximately along the chert line.

In detail only one poor conductive effect is noted in the vicinity of Brown's Workings at L5200N/4840E, and this appears to correlate with the geological contact between footwall green porphyry and the host horizon mixture of chert, volcaniclastics and shales.

CHAPTER EIGHT

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Drilling and surface mapping at Brown's Workings has delineated a 110,000 tonnes resource of massive sulphide mineralisation with a grade of 1.26% Cu, 6.58% Pb, 18.83% Zn, 122 ppm Ag, and 4.09 ppm Au within a classical, proximal volcanogenic system. This represents a success for the first target tested along the prospective chert line. The find has approximately doubled the measured resource at the Pinnacles.

8.1 GEOLOGY

A classical proximal volcanogenic system has been defined at Brown's Workings. Massive sulphide and its associated mineralised cherty envelope occurs stratabound within a host horizon of cherts, volcaniclastics and shales. The host horizon lies stratigraphically above an acid to intermediate volcanic pile of porphyries and is capped by a sequence of epiclastics and tuffs (ash and lapilli sized pyroclastics). The host horizon is envisaged as a quiescent break in the predominantly volcanic sequence, and the cherty envelope is consistent with mineralisation occurring within a siliceous exhalitic environment.

A Zn-rich feeder pipe has been delineated both lithologically and geochemically within the green porphyry substrate directly beneath mineralisation. A simple system is visualised whereby siliceous zinc-rich mineralised fluids have percolated up through the footwall porphyries (the feeder pipe) and deposited metal proximal to the vent in a subaqueous environment.

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It appears that a later copper-pyrite phase has overprinted the zinc-rich mineralisation. Deep drilling to the south of the Brown's Workings area has intersected a thick sequence of lead-rich carbonate mineralisation (Pb-Zn-Co_3 alteration) which does not seem to be related to the zinc-rich pipe. It is possible that these two styles of mineralisation/alteration are related to an apparently larger system southwards.

8.2 EXPLORATION TECHNIQUES

Geological mapping, surface lithogeochemical sampling, and follow-up diamond drilling primarily led to the discovery of massive sulphide mineralisation at Brown's Workings.

C-horizon geochemical soil sampling clearly delineates the near-surface mineralisation at Brown's Workings. However, mineralisation deeper than 20m below surface, or beneath glacial cover, has not been detected.

Neither the airbourne DIGHEM nor ground UTEM EM surveys successfully identified the massive sulphide mineralisation occurring 30-140 m below surface at Brown's Workings. In both cases this is probably related to the poor conductivity of the zinc-rich massive sulphide. Also in the case of the UTEM system the mineralisation lies between two lines (200m apart), and it is possible that the source loop was too far (400-500m) from Browns Workings to pick up the relatively small body of poorly conductive sulphide. The UTEM system did broadly outline the chert line (host horizon) at the Pinnacles, probably registering lithological contacts between shale members and the massive pyroclastics.

8.3 RECOMMENDED FOLLOW-UP

8.3.1 Further Drilling at Brown's Workings

Drilling at Brown's Workings appears adequately to close off a lens of 100 000 tonnes. However, mineralisation appears to be continuous from L5320N to the pod of mineralisation uncovered on drill site 5 on L5240N (see stacked sections). If so, further tonnes would probably be defined by infill drilling of the western side of the host horizon at shallow depth .

Shallow drilling across the host horizon on L5200N above EAF-2 is likely to intersect massive sulphide or gold-bearing chert, because the soil geochemistry shows a continuation of gold and base-metal anomalism from Brown's Workings southward to Thomas's Tunnel. These two targets are considered to be of low priority as only minor additional tonnes would be achieved.

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Further drilling is required to test the possible continuation of the extensive intersection of copper-pyrite-chlorite and Pb-Zn-Co_3 mineralisation/alteration in the bottom of EAF-14 southwards to a larger system. A deep hole drilled at 60 degrees from the east on section L5240N aimed at an RL 40 metres below that of EAF-14 would test this possibility. There is also possibly a direct link between the Pb-Zn-Co_3 style of alteration in EAF-14 and the Pb/Ag-rich mineralisation in Thomas's Tunnel (280 metres south of Browns Workings). A hole should be designed north of Thomas's Tunnel to test this possibility. Drilling of the deep hole on L5240N should be carried out following encouragement from drilling north of Thomas's Tunnel. Follow-up of the mineralisation south of EAF-14 is of high priority because

1) the extent of alteration in EAF-14 suggests that mineralisation could be substantial,

2) the Co_3 style of alteration is very similar to carbonate units occurring lateral to the mineralisation at Rosebery, Hercules, and Que River.

Mineralisation has not been fully closed off to the north at Brown's Workings. A 2m intersection of "ore" grade mineralisation occurs from 217 to 219m in EAF-11. This could be related to a deeper mineralising system, and further drilling may be warranted to test its extension.

8.3.2 Regional

Drilling at Brown's Workings has sucessfully delineated a time horizon within the volcanics at which stratabound massive sulhide mineralisation has taken place. It is emphasised that Brown's Workings was only the first drilling target of several sites of known mineralisation along this horizon - the chert line. All sites should be tested by shallow drilling. Drilling at Thomas's Tunnel and Southern Trenches has already commenced (EAF-15 to 18).

Geological mapping, lithogeochemical sampling, and soil geochemistry have all been useful in delineating the surface or near-surface manifestation of the massive sulphide mineralisation at Brown's Workings. These techniques should be employed in further follow-up along the chert line north and south of the presently known targets. It is stressed, however, that mineralisation of the style at Brown's Workings hidden 20m below surface could easily go undetected. Consequently, weak surface responses, or in fact no surface response at all, should not deter further exploration if it is recognised geologically that the host-to-ore horizon exists.

Further exhalite-bearing intravolcanic horizons have been delineated within the Pinnacles prospect (e.g. the eastern gold line including Leo's Find). These should be followed up using the same philosophy as employed on the chert line. Similarly, this approach can be extrapolated to the remainder of EL 5/63 Pt 4.

R H ROBERTS
MARCH 1985.

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TABLE 3

ORIENTATION STUDY COMPARISON OF SECOND SPLITS

SAMPLE INTERVAL	Au	Au (S/S)	Difference
Brown's Creek			
156.6-157.6	0.10	0.06	.04
157.6-159	13.33	10.16	3.17
159-160	0.16	0.15	.01
160-163	0.36	0.27	.09
163-166	0.16	0.15	.01
Sth Brown's Creek			
157.3-158.3	0.07	0.06	.01
158.3-159.2	0.77	0.58	.19
159.2-160.2	0.60	0.57	.03
Thomas's Tunnel			
70.6-71.6	0.05	0.04	.01
71.6-71.9	0.16	0.14	.02
71.9-72.9	0.30	0.32	.02
72.9-74.3	0.17	0.08	.09
74.3-75.3	0.06	0.04	.02
75.3-76.3	0.13	0.11	.02
76.3-77.6	0.07	0.07	-
77.6-78.6	0.05	0.05	-
Southern Trench			
36-39	0.15	0.19	.04
39-42	0.28	0.20	.08
42-43	4.30	3.30	1.00
43-45	45.20	57.20	12.00
45-47	0.58	0.61	.03
47-49	1.08	1.02	.06
49-50	0.39	0.38	.01
50-51	0.74	0.68	.06
51-54.5	0.23	0.22	.01
54.5-58	0.07	0.06	.01
Brown's Workings			
0-1	0.42	0.22	.20
1-1.5	2.52	2.48	.04
1.5-2.5	13.02	14.73	1.71
2.5-3.5	0.70	0.56	.14
BT 2 Sth			
15.5-17.0	0.01	0.02	0.01

TABLE 4

ORIENTATION STUDY

PULP CROSS CHECKS BETWEEN ANALABS AND AMDEL LABORATORIES

BASE METALS

INTERVALS	Cu		Pb		Zn	
	An	Am	An	Am	An	Am
ST 36-39	249	290	1.15%	1.10%	1450	1600
ST 39-42	255	270	5.41%	5.20%	2950	2800
ST 42-43	2950	3300	3.92%	4.00%	2.80%	3.00%
ST 43-45	7500	7800	11.56%	10.70%	9.86%	9.90%
ST 45-47	8900	9100	15.78%	15.00%	8.41%	7.90%
ST 47-49	6700	6700	15.34%	14.60%	5.20%	5.60%
ST 49-50	1400	1300	6.04%	5.70%	0.95%	9200
ST 50-51	2350	2000	14.28%	12.90%	2.20%	2.10%
ST 51-54.5	615	590	4.58%	4.70%	2550	2600
ST 54.5-58	565	650	4950	6200	2950	3400

PRECIOUS METALS

	Ag		Au	
	An	Am	An	Am
ST 36-39	26	21	0.84	0.89
ST 39-42	40	38	0.94	1.60
ST 42-43	113	102	40.2	43.0
ST 43-45	185	175	64.2	64.0
ST 45-47	121	118	2.11	2.8
ST 47-49	95	90	2.56	3.56
ST 49-50	50	48	1.80	3.4
ST 50-51	78	74	3.02	4.2
ST 51-54.5	26	25	0.61	0.8
ST 54.5-58	9.5	11	0.19	0.35

An = ANALABS
Am = AMDEL

APPENDIX 1

SAMPLING TECHNIQUES PINNACLES

APPENDIX 1

COMSTAFF PROPRIETARY LIMITED

SAMPLING TECHNIQUES PINNACLES

1. SOIL SAMPLING

Orientation Studies

Two orientation studies were carried out over known localities of gold mineralisation. Three test lines were cut over both localities. The lines were spaced forty metres apart and were each two hundred metres long. C-horizon auger samples were collected every 20 metres at depth typically between 1/2 and 1 metre. The samples were dried, disaggregated by mortar and pestle, and split evenly into two halves. One half was sieve separated into -80#, +80 to -20#, and +20# fractions. The three sieve fractions plus the unsieved half of the original sample were sent for analysis to Analabs in Tasmania. The samples were assayed (see assaying below) for Cu, Pb, Zn, As, Ag and Au.

Techniques and Procedures

Sampling

Results of the orientation studies have shown that C-horizon auger sampling successfully delineates the mineralisation. C-horizon sampling has been carried out over the entire EAF grid.

Preparation

From the orientation studies it was concluded that the best overall results, especially considering gold, were obtained from the split but unsieved sample. Consequently, all samples from the EAF grid have been dried, disaggregated and split at the Comstaff Offices. One half was sent for analysis, the remainder was stored for description and checks.

Laboratory Techniques

Orientation results indicate that As and Ag assays were superfluous; the soil samples are analysed for Cu, Pb, Zn and Au.

Laboratory Preparation

At the laboratory the samples are

1) Fine pulverised to -200# in a ring pulveriser (pulp)

2) Split and assayed.

Assaying

Cu, Pb and Zn are assayed by Analabs 102 method; perchloric acid digestion followed by Atomic Absorption Spectrophotometry (AAS). Au is assayed by Analabs 329 method; 20 gram sample, aqua regia digestion followed by AAS - lower limit of detection is 0.0125 ppm. On every tenth sample a repeat assay is taken from the pulp as an internal check.

2. CHANNEL SAMPLING

Techniques and Procedures

Sampling

One to two metre wide samples are typically collected across the zone of interest. Samples either side of the zone are also collected. A single gouge of uniform depth (usually a couple of centimetres) is taken across each sample interval, with samples generally varying from 1 to 2 kilograms in weight.

Preparation

Channel samples are dried and sent for analysis.

Laboratory Techniques

Preparation

The following procedure is carried out

1) Crush whole sample through jaw crusher.

2) Disk pulversise whole sample to approximately 60#.

3) Roll and Riffle split to 100 - 200 grams

4) Fine pulverise split to -200# in ring pulveriser (pulp)

5) Split and assayed.

All residues from this preparation are stored at Analabs.

Assaying

All channel samples have been assayed for Cu, Pb, Zn, and Au evaluation samples collected within a known horizon of mineralisation are assayed for Cu, Pb, Zn by Analabs 104 method (dissolution by Nitric Perchloric Hydrochloric and Hydrofluoric acid followed by AAS), and Au is assayed by Analabs 309 method (30 gram sample, digestion by fire assay; analysis by AAS). Reconnaissance samples are analysed by cheaper methods: Cu, Pb, Zn by Analabs 101 method (Perchloric acid digestion followed by AAS) and Au by Analabs 329 method (20 gram aqua regia digestion followed by AAS). For internal checking, on every tenth sample a repeat assay is carried out on the pulp and on every twentieth a second split is taken (from the residue of stage 3 above) pulverised, split and assayed.

Orientation Study: Table 1 represents the results of an orientation study carried out on a batch of samples to compare assays from two splits taken at stage 3 in the preparation procedure. Differences can be up to 25% of the initial value which can cause large (e.g. 12 grams) differences at higher values. Analabs Laboratories have suggested that such variation could result from the presence of coarse (>100 micron) gold in the samples which can agglutinate during disk pulverisation. Screened fire assay (Analabs method 315) could be used to achieve greater consistency between the splits. With screened fire assay large particles are screened out and assayed in one fire assay, while duplicate splits of the material passing the screen are taken and also fire assayed. A weighted-average gold content is reported. Cost of a screened fire assay is approximately twenty dollars compared with approximately eight dollars for a normal fire assay.

Continues monitoring of the second splits during follow-up drilling has shown that gold-value variation between the splits is not sufficiently great to warrant a blanket increase in the cost of assaying by 250%.

3. CORE

Sampling

Only HQ and NQ core is drilled. Sludge samples were collected at three metre intervals udring the early stages of drilling.

Preparation

The core is logged into appropriate sampling intervals by the geologist (typically 1 metre intervals in the main zones of interest, 2 to 3 metre intervals outside these zones). The core is split with half the core bagged and sent for analysis. If desired, further zones can be reconnaisance checked by chip sampling.

Laboratory Techniques

Preparation

The five stage procedure carried out on channel samples is identical for split core.

Assaying

The split core is assayed for Cu, Pb, Zn, Ag by Analabs 104 technique. Au is assayed by Analabs 309 technique. Reconnaissance checking is carried out by the cheaper methods 101 and 329 (see channel sampling for discussion of various techniques). As drilling has proceeded greater definition of the zones of interest has allowed more core to be checked by the cheaper methods.

Resulting from the orientation study carried out on second splits from channel samples (Table 1) all results of repeats and second splits (taken as internal checks) are now requested by Comstaff (discussed above). Where core recovery is poor, sludge samples are assayed for Cu, Pb, Zn, Ag and Au by the 101 and 329 methods. However, only Au is assayed in the sludges where recovery is good.

4 CLIENT CONTROL ON THE LABORATORY

The regular use of international standards in exploration is not cost effective. The possibility of professionally prepared control samples being made from bulk samples collected from the Pinnacles has been assessed. It is considered that the cost and difficulty of regularly producing large bulk samples of uniform gold concentration is not warranted at the present stage of the Pinnacles prospect.

The present means of laboratory control is by submission of cross-checks to another laboratory. At the initial stages of the Pinnacles gold search ten pulp samples analysed by Analabs were sent to an umpire laboratory (Amdel) for assay. Results from the two laboratories are extremely close (Table 2). These results further confirmed our confidence in the accuracy and reliablity of results provided by Analabs. During drilling one in every 15 samples (approx) has been selected for umpire analysis. This has monitored variation between the laboratories and proven to be a useful check on the possibility of a poor batch of results.

To date little variation has occurred between the results from the two laboratories. However, it is noted that the Au fire-assay technique of Amdel (K4/2) generally gives slightly higher values that the similar technique carried out by Analabs (309). The checking procedure has discovered one bad batch of analyses from Analabs which resulted from a labelling mix up in their laboratory. Cross checking in the manner described does not check on precision. A record of Analabs internal precision checks is now sent to Comstaff.

APPENDIX 2

PETROLOGICAL REPORTS

042

180043

Central Mineralogical Services

CMS
39 Beulah Road
Norwood, S.A. 5067
Telephone 42 5659

Mr. R. H. Roberts
Geologist
Comstaff Pty. Ltd.
Mt. Bischoff Road
WARATAH / TAS. 7321

APPENDIX 2A

18th June, 1984

ROCK SAMPLES FROM THE PINNACLES PROSPECT

REPORT CMS 84/5/40

YOUR REFERENCE:	Letter dated 22.5.1984
DATE RECEIVED:	25th May, 1984
SAMPLE NOS.:	24 Samples
SUBMITTED BY:	R.H. Roberts
WORK REQUESTED:	Petrology

for

H.W. Fander, M. Sc.

043

180044

REPORT CMS 84/5/40

Twenty-four slabbed rock samples were received for petrological examination. Representative thin-sections were prepared and examined together with their respective offcuts in transmitted and oblique incident light. Twelve polished sections were prepared from relatively base metal sulphide-mineralised and/or apparently Au-anomalous samples to verify the opaque assemblage and nature of Au-Ag mineralisation.

This suite exhibits strictly limited variations in silicate mineralogy and thus brief tabulated descriptions were prepared. These include interpretative comments and are supplemented by mineragraphic notes.

Summary

Lithologies may be categorised into three broad groups, following Roberts' brief description of field relationships, as follows:

1. A "Western" sequence, represented by samples 304, 305 and 306, comprises rhyolitic lithic-crystal tuffs and tuffaceous pelite.(305) of subaqueous character. These rocks are weakly microfossiliferous (recrystallized simple, and spined radiolaria, spicules), reflect variable silicification and sericitisation, and are generally stained with very fine pyrite.

   In detail, the tuffs may be classified as biotite-rhyolitic. Sample 327, an altered and pyritised biotite rhyolitic tuff would be correlated with this western sequence on petrological grounds but, in contrast, exhibits ignimbritic features.

2. An "Eastern" sequence of similarly altered, but relatively quite weakly pyritic felsitic pitchstone, vitric and lithic-vitric tuffs represented by samples 310-314 inclusive. These rocks are deficient in crystal components, notably quartz, in comparison with the western sequence, and may be considered as dacitic. More or less ubiquitous relict ignimbritic features are consistent with subaerial depositional modes, in contrast to the western series. Sample 328 could be correlated with this sequence on petrological grounds, as could similarly sample 154B.

3. An "Ore" series comprising the channel-sampled zones. This sequence is dominated by fine-grained sediments, variously classifiable as impure cherts, cherty argillites, "massive" sulphide rocks, and pelitic ashes. Sediments are pyritic, variably tuffaceous types, with ashes apparently grading into cherts, and may be microfossiliferous (radiolarian). There are thus certain transitional aspects with respect to the western sequence, which could then be interpreted as the stratigraphic footwall.

   The "ore" sequence reflects a composite of siliceous, chemical and distal tuffaceous sedimentation with an inferred low-energy subaqueous environment. Variably recrystallized "primitive" pyrite (framboidal, microcrystalline, nodular to semi-colloform) is more or less ubiquitous in the sediments, which reflect cherty silicification of labile constituents (e.g. shards) broadly contemporaneous with deposition. Cherts include ?baritic types of sintery character, and massive sulphide rocks are (recrystallized) pyritic poly-metallic types with affinities to, for example, the Rosebery Pb-Zn(-Cu) ores. Overall, a siliceous exhalative environment, associated with a break in an acid pyroclastic sequence, is reasonably inferred.

Alteration is characterised by simple quartz-mica assemblages. Silicification is relatively marked in the "ore series" rocks, but is rarely developed to the complete exclusion of sericite. Similarly, the country rocks are relatively sericitised, but exhibit widely variable quartz/sericite ratios; within, and between, individual samples. This suite as a whole reflects a multi-stage alteration/mineralisation sequence, which may be summarised:

Stage 1. Development of "primary" (syngenetic/diagenetic) pyrite, dominantly framboidal, with marked concentrations in the "ore" series.

Stage 2. Development of quartz-sericite alteration assemblages with varying proportions of fine-grained pyrite. Associated veins (strictly veinlets) consist of fine to microcrystalline quartz and generally subordinate sericite. This phase appears partly contemporaneous with sedimentation of the ore series. Significantly, the ?barite laths in sintery cherts, and sparse feldspar crystals in country rock tuffs, appear to have survived this phase of "cherty" silicification.

Stage 3. Comprises quartz veinlet-hosted and disseminated to semi-massive polymetallic sulphide assemblages. Associated phyllosilicates are fine-grained (but non-sericitic) white mica, pale phlogopite and accessory pale chlorite. The sulphide assemblage is sphalerite-rich with subordinate to minor pyrite, galena and chalcopyrite. Veins are fine- to locally medium-grained, but relatively coarse in comparison with, and clearly postdate, Stage 2 veins.

Quartz pseudomorphs of ?barite laths and feldspar crystals with associated fine-grained sulphide disseminations developed contemporaneously with this stage. Veins grade into the semi-massive ores with strictly comparable gangue, and sulphide assemblages. This assemblage is distinctly concentrated in the ore series rocks, but minor veinlets are evident in the western and to a lesser degree the eastern country rock sequences.

These sphalerite-rich ores represent the main apparent and possibly the only locus of Au and Ag mineralisation.

Gold was detected in four of the twelve polished sections examined. Grainsize is variable in a range from submicron to approaching 100 μ. As observed, gold exhibits in invariable association with sphalerite and occurs either in sphalerite or in quartz marginal to sphalerite-quartz contacts. In terms of optical colouration, gold appears weakly but variably argentiferous. Gold was not observed in association with pyrite.

In comparison with gold, the distribution of silver, at this stage, is relatively obscure. Traces of tennantite appear in association with sphalerite-rich sulphide assemblages, but this phase is likely to represent no more than a minor locus of Ag.

Tennantite is locally accompanied by a near-isotropic, greenish sulphosalt identified, on the basis of optical characteristics, as antimonpearceite (as distinct from polybasite). A (Cu-)Ag-As-sulphosalt assemblage thus appears to relate to the Ag mineralisation. By analogy with similar situations, proustite may be expected to occur in this context, although this phase was not detected in the available sections.

Analogies may be drawn with several composite volcano-epithermal situations. There are affinities with, for example, the Drake (N.S.W.) Ag-Au situation which is, problematically, poorly described in the literature.

D. Cowan, B. Sc.

Sample No.	Classification - Composition	Fabric	Accessories	Comments
53 T.S. 0066)	CHERT ? SULPHIDES Silicified ?Ash. Fine to microcrystalline quartz with subordinate/variable proportions of sericite, minor fine to ultrafine pyrite. Frequent discontinuous, variably sulphide-mineralised quartz veinlets.	Variously massive, featureless to weakly laminated and fractured/quartz-healed; very incipiently stressed.	Sporadic sericitic fractures transecting early cherty quartz veinlets. Traces secondary jarosite.	Interpreted as a thoroughly cherty-sericitised pelitic ash on vague relict textural grounds. Early veinlets are pyritic, marginally sericitic. Late veinlets are sphalerite-rich, non-sericitic, weakly pyritic.
54A	Silicified Ash. Cherty quartz with subordinate to minor sericite, semi-pervasive ultrafine pyrite. Sporadic sericite-selvedged pyritic cherty quartz veinlets and crosscutting sulphide-mineralised, weakly sericitic, fine-grained quartz veinlets.	Analogous to 153; relatively banded in comparison and weakly silty to fine sandy clastic.	Traces relict detrital silt-sized muscovite, silt- to fine sand-sized quartz, silicified feldspar; leucoxenic opaques.	Close affinities with 153, similarly reflecting early pyritic, relatively sericitic cherty quartz veinlets; subsequently weakly sericitic, relatively base metal sulphide-mineralised quartz veinlets.
54B	Silicified Pitchstone. Cherty quartz, subordinate to minor sericite with thinly disseminated quartz-pseudomorphed feldspar crystals/fragments. Frequent quartz veinlets with sporadic films, irregular vugs of sulphide.	Weakly banded, finely "porphyritic" lava-like with rare fine-scale fiamme-like lithic clasts, ill-defined microshards.	Traces fine to ultrafine pyrite in host rock, minor fine-grained muscovite in veinlets.	Interpreted as a fine-grained welded ignimbritic tuff; distal characteristics. Alteration analogous to 153, 154A. In contrast this rock is only weakly pyritic.
04	Sericitised Tuff. Semi- to sericitic white mica with subordinate to minor sericite-stained microcrystalline quartz. Frequent relict quartz crystals/fragments, sporadic silicified/sericitised lithic clasts, semi-pervasive fine-	Poorly sorted (psammitic to lapilli grade) fragmental with a sheared sericitic matrix.	Minor sericitised biotite flakes, silicified feldspar crystal fragments, leucoxenised opaques.	Biotite-rhyolitic lithic crystal tuff in absence of detectable shards. Strongly sericitic in comparison with 153 etc., with pyrite the only detectable sulphide.
05	Tuffaceous Pelite. Microcrystalline quartz and semi-sericitic white mica in near-equant proportions with sparse silt-sized clastic quartz. Sporadic to frequent variably continuous quartz veinlets.	Faintly laminated, vaguely relict silty vitroclastic; very incipiently sheared.	Rare recrystallized radiolaria, minor clastic leucoxene. Traces pyrite. Rare late quartz veinlets (weakly mineralised).	Vitroclastic silty pelite (impure pelitic ash). Bulk of white mica is clastic. Reflects mild silicification, early pyritic and rare crosscutting weakly sphalerite-mineralised quartz veinlets.
06	Sericitised Tuff. Sericite with minor intergrown sericitic microcrystalline quartz as matrix to frequent quartz crystals/fragments, subordinate silicified lithic clasts. Pervasively disseminated, variably sericite pressure-shadowed pyrite.	Closely analogous to 304, relatively mildly sheared.	Minor recrystallized radiolaria, ?sponge spicules, leucoxenised opaques; rare sericitised biotite flakes.	Close affinities with 304, similarly biotite-rhyolitic, similarly altered, with selectively silicified lithic clasts; thoroughly sericitised matrix. (Clearly subaqueous.)
07	Tuffaceous Pelite. Microcrystalline quartz with minor but pervasive relict detrital silt-sized white mica flakes. Frequent irregular/intersecting quartz veinlets grading into irregular millimetric-scale aggregates with spongy to semi-massive sulphides.	Host rock analogous to 305. Veins are fine- to medium-grained, mildly stressed.	Relatively conspicuous ill-defined recrystallized radiolaria. Frequent recrystallized weakly sericitic-pyritic quartz veinlets.	Finer textural detail obscured by cherty silicification, but interpreted as vitroclastic by analogy with 305. ? Alteration, veining sequence closely analogous to 153, 154A, 154B.
08A1	"Massive Sulphides". Semi- to near-massive sulphides with a gangue of granular, weakly directed quartz and fine-grained white mica, minor colourless chlorite.	Essentially fine- to medium-grained, schistose. Crudely lenticularly banded and weakly mica-foliated.	None detected.	Moderately sheared, weakly pyritic, polymetallic Pb-Zn(-Cu) ore with a simple quartz-mica(-chlorite) gangue assemblage.

045

Sample No.	Classification - Composition	Fabric	Accessories	Comments
308A2	Semi-Massive Sulphides. Spongy to semi-massive sulphide aggregates with interspersed bands of quartz/intergranular sulphide, subordinate/ variable proportions of fine-grained white mica.	Fine- to medium-grained, with a semi-custiform millimetric-scale banding. Mildly stressed.	Traces of near-colourless Mg-chlorite.	Close affinities with 308A1; relatively siliceous, banded, pyritic and incipiently sheared in comparison.
309A1	Impure Chert. Crypto- to microcrystalline quartz with a semi-pervasive network of silicified ?barite laths, minor silt-sized mica flakes, disseminated fine pyrite. Semi-pervasive spongy impregnations, quartz veinlet-hosted films of sulphide.	Vaguely (silicified-) microfossiliferous and vitroclastic. Massive to brecciated/quartz-sulphide-healed. Incipiently stressed.	Minor sericitised ill-defined lithic clasts, shard fragments. Minor semi-sericitic white mica in quartz-sulphide veinlets.	Primarily a highly impure/micro-fossiliferous, ?baritic, tuffaceous silty chert; sinter-type characteristics. Veining/mineralisation analogous to 153 etc.
309A2	Silicified "Tuff". Framework of variously selectively silicified and sericitised, angular to rounded lithic clasts; interspersed zones, clasts of massive to pelletal chert. Cherty quartz matrix. Semi-pervasive disseminations, films of pyrite.	Variable, from moderately sorted medium sandy clastic to soft-pebble conglomeratic. Weakly stressed.	Silicified ?barite laths in chert. Patchy sericite in pyrite films. Traces sphalerite in late discontinuous quartz veinlets, vugs.	Intraformational breccia; composite of psammitic tuff, impure chert; silicified-sericitised with contemporaneous pyritic veinlets, subsequent minor mineralised quartz veinlets.
310	Altered Felsite. Sericite and quartz in variable but overall near-equant proportions, with thinly disseminated to locally conspicuous fine-grained pyrite; disseminated leucoxenic semi-opaques.	Massive to weakly perlitic, felsitic. Vaguely lithic fragmental; very incipiently sheared.	Rare microscopic blebs of chalcopyrite and ?tetrahedrite.	Detail obscured by felsitic devitrification and thorough alteration (silicification, sericitisation but this rock is clastic lava-like ("tuff lava"). No definite pyroclastic features.
311	Altered Vitric Tuff. Sericite and fine to microcrystalline quartz in near-equant proportions with thinly disseminated fine pyrite. Minor clots, films of quartz and sulphide (sphalerite, chalcopyrite, minor pyrite).	Relict flow-brecciated, eutaxitic. Incipiently sheared with pressure-shadowed sulphide clots (to 2.5 mm).	Rare weakly sheared films of fine-grained muscovite with disseminated sulphides.	Welded/flow-brecciated vitric tuff. Devitrified, sericitised/silicified, weakly pyritised. Accessory base metal sulphides associated with small vugs, films of quartz and white mica.
312	Sericitised Vitric Tuff. Sericite and subordinate closely intergrown, microcrystalline quartz; minor disseminations of fine-grained pyrite.	Vaguely relict flow-brecciated, eutaxitic (sim. 311, finer-grained). Very incipiently sheared.	Thinly disseminated leucoxenic semi-opaques.	Close affinities with 311. In comparison this rock is relatively fine-grained, relatively sericitic and is unmineralised apart from minor fine-grained pyrite disseminations.
313	Silicified Ignimbrite. Fine to microcrystalline quartz with relatively minor sericite, minor single grains, small clusters of pyrite. Sporadic clots of quartz with spongy sulphide aggregates.	Felsitic, weakly perlitic. Relict eutaxitic, vitric tuffaceous, with sporadic flattened pumice clasts.	Thinly disseminated leucoxenic semi-opaques, rare zircons, minor silicified feldspar crystals.	Devitrified, thoroughly silicified ignimbritic lithic-vitric tuff. Base metal sulphides partly concentrated in feldspar-pseudomorphous quartz aggregates.
314	Silicified Ignimbrite. Fine to microcrystalline quartz with subordinate to minor sericite; thinly disseminated fine-grained pyrite.	Flow-brecciated, eutaxitic; relatively conspicuous flattened pumice clasts.	Rare leucoxenic semi-opaques. Sparse barren quartz veinlets. Minor traces of ultrafine ?covellite.	Close affinities with 313, relatively flattened-pumiceous and flow-brecciated. Similarly altered, but with unmineralised late quartz veinlets replacement.

Sample No.	Classification - Composition	Fabric	Accessories	Comments
324A	Cherty Argillite. Semi-sericitic white mica and crypto- to microcrystalline quartz with disseminated silt-sized detrital quartz grains, more or less pervasive fine to ultrafine oxidised pyrite, sporadic quartz veinlets.	Weakly laminated, massive to silty clastic, locally pelletal. Very incipiently sheared.	Thinly disseminated recrystallized radiolaria. Sporadic films oxidised microcrystalline pyrite.	Composite chemical-clastic sediment devoid of tangible tuffaceous features. This rock is (oxidised) "syngenetic" pyritic, rather incipiently silicified/pyritised.
324B	Silicified Breccia. Clasts of sericitic shale, cherty argillite (sim. 324A) and oxidised pyritic impure (argillaceous) chert. Matrix, veinlets of fine-grained quartz with pervasive sulphide-derived limonite.	Angular sub- to millimetric clasts, uneven-grained incipiently stressed matrix.	Minor clasts of weakly oxidised pyritic vein-quartz. Rare corroded relics of sphalerite in matrix.	Veined to brecciated/sulphide-mineralised, quartz-healed chert/pelite paragenesis. Matrix is (oxidised) pyritic, with conspicuous ill-defined sphalerite-galena-chalcopyrite box-works.
325	"Massive Sulphides". Semi- to near-massive sulphide with subordinate to minor fine to semi-sericitic "white mica", minor quartz, phlogopite, pale chlorite.	Fine- to medium-grained, banded on sub- to fine millimetric scale, weakly pyrite-porphyroblastic, schistose.	None detected.	Close affinities with 308A2 and particularly 308A1; relatively pyritic in comparison. The "white mica" component is possibly talc, but is too fine-grained for positive optical determination.
326A	Impure Chert. Crypto- to microcrystalline quartz with thinly but pervasively disseminated silt-sized relict detrital muscovite flakes, minor quartz grains. Frequent variably continuous irregular to straight-walled quartz veinlets.	Weakly laminated on a sub- to millimetric scale, weakly (recrystallized) nodular.	Sparse clastic leucoxenic semi-opaques. Rare fine-grained quartz pseudomorphs after carbonte rhombs.	Mildly recrystallized, extensively diagenetically quartz-veined, slightly nodular chert. Weakly (quartz-mica) silty, but devoid of tangible tuffaceous features. Unmineralised, essentially unstressed.
326C	Impure Chert. Crypto- to microcrystalline quartz, minor sericite, minor silt-sized detrital mica flakes; pervasive cherty-silicified microshards/fragments. Semi-pervasive quartz (+ sulphide-muscovite) pseudomorphed ?barite laths.	Analogous to 309A1, but relatively homogeneous in comparison.	Semi-pervasive ultrafine pyrite in host rock. Sporadic weakly micaceous quartz veinlets, pyritic films of sericite.	Close affinities with 309A1. Strongly vitroclastic chert, verging on pelitic ash. Silicified/pyritised, with chalcopyrite-rich sulphide disseminations concentrated in quartz veinlet pseudomorphs.
326D	Impure Chert. Crypto- to microcrystalline quartz, minor silt-sized white mica flakes, pervasive ultrafine pyrite. Disseminated to conspicuous quartz (± muscovite, sulphide) veinlets, pseudomorphs after ?barite laths.	Similar to 309A1, 326C, but only vaguely vitroclastic in comparison. Weakly stressed.	Coarse millimetric-scale lens, minor films of quartz-mica-veined massive, microcrystalline pyrite.	Affinities with 309A1 and 326C and similarly altered and veined. The "massive" pyrite is of syngenetic character, predates weakly (chalco-pyrite-sphalerite) mineralised veinlets, pseudomorphs.
327	Altered Tuff. Fine-grained to microcrystalline quartz and sericitic white mica in varying proportions with disseminated quartz crystals/fragments, silicified/sericitised lithic clasts, sparse to conspicuous ultrafine pyrite.	Flow-structured/flow-brecciated lithic-crystal tuff with frequent "fiamme". Incipiently sheared.	Thinly disseminated sericitised biotite flakes, minor leucoxenic semi-opaques.	Compositional affinities (biotite-rhyolitic) with 304 and 306; similarly altered. In contrast, this rock exhibits ignimbritic characteristics. (? more like 310-314)
328 (T.S. 0089)	Altered Tuff. Fine to microcrystalline quartz, subordinate to minor sericite, thinly disseminated fine to ultrafine pyrite. Minor relict quartz crystals, sporadic sericitic "fiamme" (flattened pumice clasts), sericitised feldspar grains.	Partly obscured by devitrification, alteration, but essentially eutaxitic, weakly banded, incipiently sheared.	Sporadic discontinuous stressed quartz veinlets with traces of barite, sphalerite, ?chalcocite.	Devitrified, silicified/sericitised, weakly pyritised ignimbritic vitric (-lithic-crystal) tuff. Reasonably correlated with the 310-314 suite on petrological grounds.

REPORT CMS 84/5/40

Mineragraphic Notes

153 (P.S. 50066)
Exhibits semi-pervasive disseminations of variably recrystallized framboidal pyrite, supplemented by quartz veinlet-hosted and vein-marginal sulphide disseminations. This latter assemblage comprises mainly sphalerite with subordinate to minor associated disseminations and discontinuous films of sub- to euhedral pyrite, minor films and microscopic blebs of chalcopyrite and isolated blebs of galena. Vein-marginal impregnations are spongy and fine-grained (typically less than 50 μ). Vein-hosted sphalerite films range to 2 mm in width and are relatively coarse-grained.

Sphalerite exhibits more or less ubiquitous ultrafine (<< 1 μ) exsolution blebs of chalcopyrite. These features are strongly concentrated in the finer grains and in marginal zones of the vein-hosted discontinuous films which then appear grey-black in hand specimen, contrasting with the yellowish (low Fe) core zones.

Vein-marginal pyrite subhedra are sized to 400 μ and exhibit minor semi-zonally arranged micro-inclusions of galena, or rarely chalcopyrite. Recrystallized framboidal pyrite is similarly subhedral, but is relatively fine-grained and devoid of inclusions.

Chalcopyrite is locally altered to supergene covellite. This is the low-temperature "permanent blue" variety and is microcrystalline ("sooty").

Five particles of gold were detected. Three are < 5 μ diameter, crudely flaky particles hosted by vein-marginal sphalerite blebs. A 3x5 μ particle was observed in vein-quartz adjacent to a coarse sphalerite bleb. A 15x36 μ crudely rectangular particle was noted enclosed in (vein) sphalerite marginal to the contact with adjacent quartz.

154A (P.S. 50067)
General features here are closely analogous to those noted in 153. In contrast, the vein-hosted and vein-marginal sulphide assemblage includes relatively conspicuous galena and chalcopyrite, although these phases are typically subordinate to variably exsolution chalcopyrite-stained sphalerite. Veinlets also carry relatively abundant pyrite disseminations as marginally corroded subhedra (to 600 μ), with semi-zonally arranged galena inclusions, in a matrix of medium-grained granular sphalerite.

Seven particles of gold were detected. All occur within vein-hosted sphalerite or at sphalerite/vein-quartz contacts. Sizing ranges from a 15 μ equant bleb to 40x80 μ, as sectioned, with a mode in the 20-50 μ range. Colouration is slightly paler (trend electrum) in comparison with the particles in 153, but uniform.

X Two irregular blebs of ?antimonpearceite (sized 20 μ, 80 μ) with marginal selvedge films of galena and chalcopyrite were observed intergranular to vein-quartz.

154B (P.S. 50068)
Exhibits discontinuous millimetric-scale vein-hosted films of sphalerite with interspersed crude lenses and discontinuous marginal films of chalcopyrite, disseminated pyrite subhedra and traces of galena. These aggregates grade into relatively pyritic vein-marginal spongy impregnations and submillimetric aggregates associated with small vug-like quartz aggregates.

Sphalerite exhibits semi-ubiquitous ultrafine exsolution chalcopyrite blebs concentrated in marginal zones of single grains and aggregates. Minor traces of sooty covellite occur as an incipient replacement of chalcopyrite. The host rock exhibits thinly disseminated < 50 μ pyrite, partly of variably recrystallized framboidal habit. Close inspection revealed no detectable gold.

307 (P.S. 50072)
Exhibits a relatively coarse and continuous millimetric-scale vein-hosted sphalerite film and irregular to spongy, sub- to fine millimetric scale sulphide aggregates variously associated with quartz veinlets, vugs and marginal areas of the host rock.

The coarse sphalerite film is near-monomineralic, but includes thinly disseminated intergranular microscopic blebs of chalcopyrite, or rarely galena in addition to ultrafine exsolution chalcopyrite particles.

The "disseminated" assemblage is similarly sphalerite-rich, but exhibits relatively abundant associated chalcopyrite, subordinate and thinly disseminated pyrite. Rare to locally conspicuous blebs (20-200 μ, mean 50-70 μ) of pearceite occur marginal to, or loosely intergrown with, chalcopyrite and sphalerite. These rarely include corroded relics of chalcopyrite at the cores and may be accompanied by similarly sized and distributed blebs of incipiently red internal-reflecting tennantite.

Chalcopyrite is locally incipiently supergene-altered and sphalerite locally marginally oxidised. Close inspection revealed no detectable gold.

308A1 (P.S. 50073)
Polished section examination confirms a simple sulphide assemblage of sphalerite with subordinate, variable but generally minor proportions of galena and chalcopyrite, supplemented by more or less ubiquitous subhedral variably poikilitic ("poikiloblastic") pyrite. Sphalerite is uneven-grained and polygonal-mosaic textured, with chalcopyrite and galena intergranular where disseminated and mosaic-textured where relatively massive. Overall, grain-sizings are widely variable, although this rock may be classified as medium-grained. Pyrite is relatively even-grained with a mean about 65 μ, inclusions are largely galena with accessory chalcopyrite and rare sphalerite and tend to be zonally arranged.

At high magnification several sub- to micron-sized gold particles were detected. All occur at, or marginal to, quartz-sphalerite grain contacts. Habit is flaky, suggesting those particles in quartz are actually intergranular rather than included. Maximum observed dimensions were approximately 1x3 μ.

This ore exhibits mild late stress effects with sporadic microfractures and incipient associated granulation.

308A2 (P.S. 50074)
General features here are closely analogous to 308A1. In comparison, the sulphide assemblage is relatively pyritic and banded, but exhibits only an incipient preferred orientation consistent with the relatively competent (siliceous) gangue assemblage.

The sphalerite-pyrite-chalcopyrite-galena assemblage is supplemented by isolated clustered blebs (to 150 μ) of tennantite loosely intergrown with granular (polygonal mosaic) sphalerite-chalcopyrite-galena composite aggregates. Close examination revealed no detectable gold, or optically specific silver minerals (e.g. pearceite).

309A1 (P.S. 50075)
General features here are similar to 307, with a composite assemblage of vein-hosted sphalerite and semi-pervasive spongy, fine-grained disseminations impregnating the host rock and grading into microscale discontinuous films associated with quartz veinlets. The overall assemblage is sphalerite-rich, with relatively minor galena, chalcopyrite, pyrite (recrystallized framboidal in part), and isolated discrete to sphalerite-marginal blebs of tennantite (max. 125 μ). A single 8 μ diameter, crudely rectangular gold particle was observed in a spongy veinlet-distal mass of sphalerite.

309A2 (P.S. 50076)
Exhibits more or less pervasive disseminations of weakly recrystallized framboidal pyrite grading into fractured and segmented semi-massive lenses and films of microcrystalline (clustered framboidal to nodular, semi-colloform) pyrite. These features predate ill-defined, weakly pyritic veinlets with minor traces of galena as micro-inclusions in pyrite. Minor irregularly distributed spongy fine-grained disseminations of sphalerite with a little associated chalcopyrite and galena occur in, and marginal to, the late quartz veinlets and vugs of quartz. There is no detectable sulphosalt component, and close inspection revealed no detectable gold.

324B (P.S. 50083)
Exhibits conspicuous impregnations of sulphide-derived limonite,variously pseudomorphous to crudely boxworked and derived from a fine-grained pyrite-sphalerite(-chalcopyrite) assemblage. Minor traces of chalcopyrite and sphalerite persist as corroded relics,and ultrafine relics of pyrite are thinly disseminated throughout. Close examination revealed no detectable gold.

325 (P.S. 50084)
Exhibits semi-banded "massive" sphalerite aggregates studded throughout with an- to subhedral poikilitic pyrite. Accessory to minor traces of chalcopyrite and galena occur intergranular to sphalerite,with chalcopyrite locally forming spongy semi-massive composite lenses with sphalerite. Textural features overall are analogous to 308A1 but, in comparison, this rock is relatively coarse-grained, banded and mica-foliated.

Pyrite is rarely enclosed by films of microcrystalline marcasite which appear secondary after pyrrhotite in the absence of relics. Sphalerite is pervasively strongly stained with ultrafine (<< 1 μ) chalcopyrite exsolution blebs. Close examination revealed no detectable gold or optically specific silver minerals.

326C (P.S. 50086)
Exhibits more or less pervasive disseminations of weakly recrystallized framboidal pyrite. This "primary" Fe-sulphide component is supplemented by accessory veinlet-hosted fine-grained disseminations of pyrite, chalcopyrite, subordinate tennantite and minor sphalerite. This assemblage, and notably chalcopyrite, locally impregnates vein-marginal areas of the host rock.

Veinlet-hosted sulphides are silicate-intergranular with irregular grain shapes and are typically sized < 50 μ, although ranging up to a few hundred microns diameter. Chalcopyrite is partly replaced by covellite. There is no detectable gold.

326D (P.S. 50087)
Exhibits semi-pervasive disseminations, grading into massive lenses, of extensively recrystallized primary microcrystalline pyrite. These are supplemented by traces of veinlet-hosted and vein-marginal spongy fine-grained impregnations of sphalerite, second generation pyrite, and chalcopyrite. Traces of covellite appear as an incipient marginal replacement of chalcopyrite. In contrast to 326C there is no detectable tennantite. No gold, galena, or optically specific silver minerals were detected.

D. Cowan, B. Sc.

052

180053

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APPENDIX 2B

7th December, 1984

ROCK SAMPLES FROM THE DRILLING AT BROWN'S WORKINGS

REPORT CMS 84/11/33

YOUR REFERENCE:	Letter dated 11.11.1984
DATE RECEIVED:	23rd November, 1984
SAMPLE NOS.:	23 Samples
SUBMITTED BY:	Dr. R.H. Roberts
WORK REQUESTED:	Petrology

for

H.W. Fander, M. Sc.

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180054

REPORT CMS 84/11/33

At the request of Dr. R.H. Roberts, nineteen drill core and four rock chip samples were received for petrological examination. Representative thin-sections were prepared, with supplementary polished sections of the six delineated "ore" samples, and were examined together with their respective offcuts, with K-feldspar and carbonate stain tests carried out as warranted.

Attached petrological descriptions and mineragraphic notes summarise the microscopic data, with some rocks described in relative detail and others partly by analogy.

Summary

The drill core samples represent a volcanic/inferred volcanogenic polymetallic (Zn-Pb(-Cu) "massive" sulphide situation, [redacted] Whilst sampling at this stage is rather limited, certain characteristics may be summarised, although these may require modification on the basis of subsequent data.

1. Lithologies comprise altered felsic intermediate to acid (strictly rhyolitic in part) volcanics, including lavas, fragmentals and high-level intrusive-type facies. Fragmental rocks include ignimbritic types and lava-sediment composite breccias with [redacted] (compare with, for example, the Rosebery situation).

   [redacted] and mild but essentially penetrative low-grade regional metamorphic effects.

   The so-called [redacted] and is compositionally variable. Alteration features represent the common link with mesoscopic greenish colourations reflecting either chlorite and/or pale green varieties of sericite (hydromuscovite in part and including, rarely, bright green chromian (or vanadian) mica). Paler colourations and faint yellowish pigmentations partly reflect leucoxenic TiO_2 pigmentation. Mid- to dark green colourations usually reflect ultrafine pyrite disseminations.

   [redacted] and include vitroclastic (ashy) types which represent the matrix in composite breccias. [redacted] with minor late, fracture-controlled films of ?remobilised sulphide.

   [redacted] in general, are reasonably [redacted] These rocks could be classified broadly as peperites. Analogous types are prominent at certain N.W. Tasmanian volcanogenic massive ore zones.

2. [redacted] variously semi- to near-massive, with accessory copper (as chalcopyrite) and slightly colour-variable tetrahedrite-tennantite representing a potential locus of silver.

Gangue components comprise white mica, quartz and compositionally variable carbonate in varying proportions. [redacted]

[redacted], in general, reflect low-grade regional metamorphic fabrics, may be classified as medium-grained, and as such [redacted] in comparison with e.g. Rosebery.

Relcis of framboidal and "colloform" primitive textures persist locally, however, and could be metallurgically deleterious in relatively poorly recrystallized zones.

3. [redacted] rather consistent with [redacted] correlating with the ore zone gangue assemblage. [redacted] (Fe-calcite, ankerite, siderite) [redacted]. Whilst temporal relationships are partly obscured by metamorphic effects, carbonation appears to overprint the bulk of quartz-sericite alteration in the volcanics, but appears contemporaneous with the quartz-mica gangue in orezones.

[redacted]. With the constraints of limited sampling in mind, this pattern [redacted]

The four hand specimens submitted are lithologically diverse. Two samples (Rp-194, BP-3) represent altered fragmental volcanics.

Sample BP-1 is a cassiterite-mineralised pyrrhotite-quartz rock with close affinities to the Cleveland- and Renison-type contact-metasomatic tin situations. The association with the above-noted volcanogenic ores may be entirely co-incidental in that contact-related alteration/mineralisation effects are developed sporadically throughout the Mount Read Volcanics (refer e.g. Green et al 1981, Econ. Geol. Vol. 76, No. 2, p 305).

Sample BP-2 is an altered microgabbro and similarly exhibits contact-metamorphic effects. Similar rocks represent hosts to Au-mineralisation in, for example, the Kalgoorlie goldfield, where their relatively competent nature represents a fracture-control in contrast to relatively incompetent low-grade metasedimentary "country rock" sequences.

D. Cowan, B. Sc.

REPORT CMS 84/11/33

Petrological Descriptions

EAF-1/1 (T.S. 52101)

62.9 M

This rock may be classified broadly as a [redacted] Major features comprise a moulded framework of psammite to lapilli grade lithic clasts and pervasive weakly perlitic, felsitic, devitrification-induced microtextures.

[redacted] are variously homogeneous to weakly porphyritic in sericitic albite, with the [redacted]. Overall, the fabric is analogous to that of a [redacted] In detail, this rock may be [redacted] as a [redacted] vitric-crystal tuff.

Mineralogically, the rock consists largely of albite with relatively minor quartz and K-feldspar, consistent with dacitic/trend rhyodacitic primary composition. Alteration is reflected in weak but semi-pervasive sericite- and minor chlorite stainings, and sporadic clots and discontinuous veinlets of ankeritic carbonate.

EAF-2/1 (T.S. 52102)

70.7 M

This rock may be categorised as a breccia and consists essentially of randomly sorted angular to irregular, millimetric to centimetric clasts of (altered) porphyritic lava in a matrix of impure chert "grading" into cherty argillite.

Lava clasts exhibit disseminated variably sericitic sanidine phenocrysts in a chlorite-sericite-altered indeterminate microcrystalline groundmass, apparently consisting primarily of felsic glass. Many clasts, notably the coarser angular types exhibit some evidence of marginal chilling. A few exhibit intraclasts of the matrix sediment.

The matrix consists of sericite-stained cherty crypto- to microcrystalline quartz with more or less ubiquitously thinly disseminated fine silt-sized clastic quartz grains and white mica flakes. Vauge fine silt-sized relict vitroclastic microtextures are evident locally, and this sediment thus reflects a composite of pelitic ashy, detrital, and cherty "chemical" components.

Thin discontinuous fibrous quartz pressure-shadowed films of pyrite are disseminated around the margins of, and locally appear as intraclasts within, the lava clasts. These features also include thinly disseminated microscopic blebs of galena.

The relatively incompetent (sericitic-chloritic) clasts reflect mild shearing. Late but pretectonic clots of sideritic carbonate occur sporadically. [redacted].

056

180057

EAF-3/1
36.9 M

(T.S. 52103)
This rock may be classified as an impure chert. It consists largely of crypto- to microcrystalline quartz with thinly disseminated fine silt-sized clastic white mica flakes and minor traces of ultrafine carbonaceous matter representing impurities. [redacted]

[redacted] are lined to infilled with very fine-grained quartz crystals. Some of these features are derived from carbonate rhombs, but shapes are typically non-diagnostic and possibly other "soluble" phases (e.g. alunite, gypsum) were present.

Minor fine-grained pyrite disseminations are accompanied by discontinuous fracture-controlled films of chalcopyrite, galena and pale brown sphalerite. Sulphide-bearing fractures are partly quartz-infilled and include sporadic films and clots of (secondary, exotic) kaolin and fine silt-sized quartz. Fractures postdate minor stressed irregular quartz veinlets.

EAF-3/2
38.4 M

(T.S. 52104)
This is a banded massive sulphide rock, consisting largely of galena, pyrite and pale brown sphalerite in varying but overall near-equant proportions. Banding is developed on a fine millimetric scale and comprises an alternation of sphalerite lenses with bands of near-massive galena and composite (pyrite-sphalerite-galena) bands.

Fine-grained white mica is the major gangue component, comprising from 1-20 % of the rock, with a mode of 5;10 %. Accessory traces of quartz and ankeritic carbonate are present. This rock exhibits a weak tectonic overprint, with sphalerite and galena exhibiting a weakly orientated polygonal mosaic fabric enhanced by semi- to orientated mica.

EAF-4/2
46.9 M

(T.S. 52105)
This rock may be classified as an altered and mildly sheared felsitic (devitrified) obsidian.

Major constituents are fine-grained felsitic-textured quartz and vaguely feldspar-pseudomorphous sericite. Sporadic discontinuous quartz veinlets carry traces of ankeritic carbonate and grade into kaolinitic carbonate and late, relatively carbonate (sideritic)-rich veinlets. Accessory leucoxenic opaques and minor traces of apatite (primary) are present.

This rock exhibits a vague relict fragmental fabric, with sporadic ill-defined clasts ranging to 2 mm diameter exhibiting fiamme-like (collapsed pumiceous) microtextures. Ill-defined shardy microtextures persist locally. There is no crystal or phenocrystal component, and relict features are consistent with a [redacted]

EAF-5/1 4.8 M

(T.S. 52106)
This is a weakly pyritic quartz-sericite phyllite and [redacted]

The relict fabric is poorly sorted, sericite-matrixed, psammitic, with quartz crystals/crystal fragments and silicified/sericite-stained felsitic obsidian and pitchstone clasts (to 2 mm+) comprising the loose framework. Interspersed patches of relatively massive sericite carry disseminated quartz crystal fragments. There are no detectable shards and although these features may have been obliterated by devitrification, alteration and shearing effects, the rock is best classified as a [redacted]

Fine to ultrafine pyrite is thinly disseminated throughout, with marked concentrations in the matrix, ill-defined (sheared) sericitic veinlets and similarly ill-defined sericitic pelite clasts. [redacted]

EAF-7/2 170.3 M

(T.S. 52107)
This rock may be categorised as a [redacted], and general features are consistent with a [redacted]

The rock consists essentially of moulded to lava-matrixed, millimetric- to centimetric-scale, angular to irregular, weakly [redacted]s. The majority are [redacted] in carbonated-albitised plagioclase and leucoxene-stained carbonate-pseudomorphed pyroxene, with a variably sericite-stained, chloritic, perlitic (devitrified) to feldspar-microlitic groundmass. These grade into microgranular types analogous to the sparse matrix lava phase. Whilst primary compositional detail is obscured, [redacted]. Staining reveals the groundmass components, where relatively unaltered, [redacted] K-feldspathic [redacted].

This rock is weakly pyritic. Semi-pervasive impregnations of calcite appear overprinted on the chlorite-sericite assemblage, with [redacted]

EAF-7/3 173.7 M

(T.S. 52108)
[redacted] General features (phenocrystal, textural components) are similar to EAF-7/2, to the degree that little special comment is warranted. Dependent on macroscopic relationships, notably the presence or absence of coarse clasts, the rock could represent a simple contact between two lavas or, alternately, an agglomerate lava.

[redacted] This phase exhibits a K-feldspathic groundmass which gives the rock a certain hybrid character and, in part at least, explains the differential alteration.

058

In detail, the contact consists of a millimetric zone of cherty microcrystalline quartz with thinly disseminated feldspar (albitised plagioclase grains). This may represent an intraclast or sediment intercalation, dependent on meso- to macroscale relationship.

Both lavas reflect late calcite impregnations and calcite-quartz veinlets analogous to the carbonation overprint in EAF-7/2.

EAF-9/1 (T.S. 52109)
166.4 M

This is a semi-massive sulphide ore, broadly analogous [redacted].

Main constituents are pale sphalerite, fine-grained subpolygonal quartz and galena with accessory to minor trace proportions of pyrite. Sideritic carbonate and semi-sericitic muscovite are minor accessory components.

In common with EAF-3/2, this rock is banded on a sub- to fine millimetric scale. The area sectioned is largely uniform. One margin, however, represents a disseminated sulphide-mineralised impure (argillaceous) chert with interspersed small-scale vugs and films of relatively sphalerite-mineralised fine-grained quartz.

EAF-9/2 (T.S. 52110)
171 M

This rock is very similar to EAF-9/1, but is distinctly sulphide-rich ("massive") in comparison. Planar to lenticular banding is paralleled by a preferred orientation (directed polygonal mosaic texture) which is relatively marked. Relatively conspicuous chalcopyrite occurs interspersed with the major (pale sphalerite, galena) sulphide components. Gangue comprises < 1 to 5 % of the area sectioned, with fine subpolygonal quartz accompanied by traces of sideritic carbonate.

EAF-9/3 (T.S. 52111)
176.6 M

This is a [redacted] and is rather featureless in terms of the mode of origin.

The rock is crudely banded in terms of the distribution of [redacted]rictly pale green hydromuscovite) [redacted]. An incipient slaty cleavage parallels the banding.

Pyrite is disseminated throughout as fine, weakly mica-siderite pressure-shadowed euhedra, and exhibits a weakly banded distribution.

Some chloritic zones exhibit a faint relict eutaxite-like fabric. On this basis, the rock is [redacted]

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180060

EAF-9/4 (T.S. 52112)
193 M

This is a [redacted] on relict textural grounds.

Frequent fine-grained quartz pseudomorphs after feldspar phenocrysts are accompanied by leucoxene-stained clots of sericite and quartz, representing altered phenocrystal ferromags (pyroxene, amphibole). These features are accompanied by evenly disseminated leucoxenised opaques within a featureless sericitised groundmass. Fine-grained, incipiently quartz-sericite pressure-shadowed pyrite is thinly disseminated throughout. Minor traces of pale sphalerite are present as microscopic clots in rare discontinuous quartz veinlets.

EAF-9/6 (T.S. 52113)
229·2 M

This is a weakly sheared [redacted] consisting essentially of stressed, sub- to millimetric-scale aggregates of sideritic carbonate in a matrix of sericitic hydromuscovite.

Carbonate is variously microcrystalline to fine-grained,granular to sparry and subradiating. Interspersed sericite aggregates are weakly sheared and generally featureless. Fine-grained pyrite is thinly disseminated throughout. Accessories include thinly disseminated leucoxenised opaques, fine-grained zircons and traces of apatite. These features indicate an [redacted] and micro- and mesoscopic characteristics are consistent with a sericitised and carbonated perlitic obsidian.

There is some vague microtextural evidence that this rock was primarily a welded ignimbrite, notably sporadic relict fiamme-like textures in the sericite aggregates.

EAF-9/7 (T.S. 52114)
244·8 M

This rock is compositionally similar to EAF-9/6 ([redacted], but is relatively sericitic in comparison, with a relatively marked slaty cleavage. The bulk of siderite is fine-grained and evenly disseminated. Minor irregular recrystallized veinlets are present, and there is minor development of "nodular" carbonate analogous to that in EAF-9/6. Accessories comprise conspicuous very fine leucoxenised opaques, traces of quartz, minor traces of pyrite and rare microscopic [redacted]

This rock exhibits a vague [redacted] with ill-defined sericite-quartz-pseudomorphed feldspar microphenocrysts in a matrix carrying vague but ubiquitous sericitic "ghosts" of feldspar microlaths. [redacted] Primary compositional detail is obscure, although the absence of relict phenocrystal quartz is consistent with a felsic-intermediate (leuco-andesitic or trachytic) facies.

060

180061

EAF-9/8 260.5 M

(T.S. 52115)
This rock may be classified broadly as an [redacted]

The conspicuous evenly disseminated [redacted] calcite-stained albite and calcite-sericite(± albite)-pseudomorphed ?sanidine in near-equant proportions. These are embedded in a fine-grained felsitic (devitrified) groundmass of sericitised feldspar and subordinate quartz with minor calcite and thinly disseminated leucoxenic semi-opaques.

Sparse calcite-quartz veinlets are present. This rock is incipiently sheared. Relict features are consistent with a semi-chilled [redacted]

EAF-10/1 99.2 M

(T.S. 52116)
This is a semi-massive micaceous [redacted] with affinities to EAF-3/2, 9/1 and 9/2. Major constituents are pale sphalerite, galena and fine-grained white mica. Accessories comprise chalcopyrite, pyrite, locally conspicuous fine subpolygonal quartz and minor ankeritic carbonate.

The rock is lenticularly to planar banded, with lenses of pale brown sphalerite interspersed with relatively continuous fine-grained galena-mica bands, and is weakly concordantly sheared (phyllitic), with consequent partial remobilisation of chalcopyrite into discontinuous films.

EAF-10/2 138 M

(T.S. 52117)
This disseminated to [redacted] a relatively pyritic galena-sphalerite assemblage with a composite gangue of sericite, calcite and varying proportions of quartz. This rock is relatively sheared (phyllitic) in comparison with EAF-10/1 and is rather crudely banded.

Relict features a[redacted]. Clasts are poorly defined, but tend to be outlined by leucoxenic stainings. Sulphides are largely interstitial to these features, but also impregnate the clasts. Alteration is differential in part, with clasts tending to exhibit sericite- and sericite-quartz assemblages, contrasting with a relatively calcitic matrix. General features are consistent with a (altered/mineralised, sheared) lithic tuff, although primary compositional detail is obscured.

Sphalerite is colour-variable, from pale through mid-brown to red-brown, with a certain tendency to banding in the variations (and inferred Fe-content). Pyrite is of metablastic habit, occurring as relatively coarse, weakly pressure-shadowed subhedra.

(081)

180062

EAF-11/1 (T.S. 52118)
164.2 M

This rock is a [redacted] of thoroughly sericitised felsitic (devitrified glass) volcanic and cherty argillite and [redacted]

The volcanic is represented by dimensionally orientated sub- to millimetric clasts and coarser "rafts" of pervasively leucoxene-stained sericite rock (pale yellowish in hand specimen), variously featureless to weakly felsitic-textured, or carrying thinly disseminated quartz and altered(carbonate-quartz-pseudomorphed) feldspar phenocrysts.

The matrix consists of sericitic kaolin-illite (grey in hand specimen) with subordinate to minor closely intergrown microcrystalline quartz, thinly but pervasively disseminated fine silt-sized clastic white mica flakes, and rare silt- to fine sand-sized quartz grains. In common with EAF-2/1, the matrix is locally vaguely vitroclastic on a microscale, and appears as isolated intraclasts within the clasts.

This rock is weakly pyritic, with fine to ultrafine particles concentrated in the matrix and locally conspicuous in thin shaly partings with accessory traces of galena. Minor sideritic carbonate impregnations are related to thin discontinuous carbonate-quartz veinlets.

EAF-11/2 (T.S. 52119)
227.2 M

This is an [redacted].

Flow-orientated lensoid amygdales of quartz and sericite exhibit sideritic carbonate-stained sericitic selvedges. These features are accompanied by variably sericite-carbonate-altered phenocrysts of sanidine, supplemented by minor leucoxenic sericite-pseudomorphed ferromag (?pyroxene) phenocrysts in a thoroughly sericitised indeterminate microcrystalline feldspathic groundmass with a vague relict trachytic (flow-orientated feldspar-microlitic) fabric. Sporadic recrystallized carbonate veinlets complete the alteration assemblage. Conspicuous fine to ultrafine leucoxenised opaques are incipiently impregnated with (minor traces of) pyrite.

RP-194 (T.S. 52120)

This is a pyritic sericite-quartz phyllite and [redacted] Relict features are consistent with a [redacted] [redacted] supplemented by [redacted].

Minor angular to subangular xenoliths of impure (sericitic) chert, and sparsely disseminated ill-defined sericitic pseudomorphs of feldspar crystal fragments are present. Fine to very fine, weakly sericite pressure-shadowed pyrite is disseminated throughout.

BP-1

DUG OUT OF SAMPLE OUT ON SIDE OF BURNS PEAK

(T.S. 52121)
This rock may be classified as a [redacted]

The rock is crudely banded in the distribution of granular to euhedral, medium-grained quartz grains and aggregates which occur interspersed with semi- to near-massive weakly pyritised pyrrhotite. Banding is emphasised by the distribution of fine-grained (10-200 μ, mean 60-70 μ) cassiterite which occurs in thin spongy lenses variously intergranular to pyrrhotite and included in quartz.

Accessories include films of sideritic carbonate, traces of chlorite, minor spongy patches of chalcopyrite, thinly disseminated arsenopyrite euhedra, and minor traces of stannite.

[redacted] Dependent on field relationships, it could be interpreted as representing a vein-type or metasomatised carbonate paragenesis.

BP-2

AS ABOVE

(T.S. 52122)
This sample represents an altered microgabbro. It consists largely of vaguely pyroxene-pseudomorphous fine-grained actinolite and plagioclase-replacive untwinned albite with subordinate fine epidote. Evenly disseminated magnetite and leucoxenised ilmenite represent the primary accessory opaques, accompanied by traces of apatite.

Chlorite, minor fine pyrrhotite, and rare grains of green schorl complete the alteration assemblage. Texturally, this rock is weakly sheared-hornfelsic, with a faint but diagnostic relict "doleritic" (medium-graine subophitic) fabric. Chlorite is retrograde after biotite, in part at least.

[redacted] The inferred albite-epidote hornfels facies contact alteration is not inconsistent with potential tin mineralisation in suitably reactive host rocks. This rock also represents a relatively competent facies and thus a potential host to "epigenetic" Au-mineralisation (assuming relatively incompetent country rocks) analogous to that developed in dolerites and iron formations in, for example, the Kalgoorlie, Pine Creek and related situations.

BP-3

BURNS PEAK

(T.S. 52123)
This is a weakly stressed [redacted]

Major constituents are microgranular quartz, conspicuously disseminated fine relict phenocrystal quartz grains, and subordinate to minor sericite concentrated in clots of irregular to angular shape and ranging up to a few millimetres diameter.

A faint-relict perlitic devitrification texture is evident. The rock is clearly a fragmental type, but obliteration of the finer textural detail negates detailed classification. The alternatives would be a tuff lava (i.e. a clastic- or flow-brecciated lava) or a lithic-crystal tuff. Alternately, the fragmental aspects may simply reflect devitrification-induced "autobrecciation".

D. Cowan, B. Sc.

064

180063

REPORT CMS 84/11/33

Mineragraphic Notes

EAF-3/1 (P.S. 52103)

Exhibits a disseminated vug- and fracture-controlled assemblage of chalcopyrite and sphalerite with thinly disseminated an- to euhedral pyrite (mean 50 μ) and a little fine-grained galena.

Sphalerite, chalcopyrite and galena are typically fine-grained, with occasional irregular simple and composite patches to a few millimetres diameter. Sphalerite exhibits incipient development of chalcopyrite exsolution blebs. Pyrite exhibits micro-inclusions of galena and chalcopyrite and is variously discrete or enclosed within the base metal sulphide aggregates.

[redacted]

The host rock carries thinly disseminated ultrafine pyrite of "syngenetic" character, supplemented by isolated discrete to loosely clustered framboids.

EAF-3/2 (P.S. 52104)

Exhibits semi-banded, weakly directed, medium-grained, polygonal mosaic-textured aggregates of ultrafinely chalcopyrite exsolution-stained sphalerite, galena, and pyrite.

Pyrite is an- to subhedral, typically enclosed within, and marginally corroded by, galena. These effects appear to reflect weak granulation of formerly sub- to euhedral metablastic pyrite. A minor proportion of the pyrite exhibits a highly corroded poikilitic-skeletal habit. Elsewhere, pyrite exhibits sparse micro-inclusions, crudely zonally arranged, of galena and rarely chalcopyrite.

Minor blebs of chalcopyrite are interspersed with the mosaic-textured sphalerite-galena intergrowths. Isolated blebs of tetrahedrite-tennantite are similarly distributed. Extremely rare blebs of luzonite appear to be of supergene chalcopyrite- or tetrahedrite-replacive origin.

EAF-9/1 (P.S. 52109)

This ore is texturally similar to EAF-3/2, although relatively banded, siliceous, and weakly pyritic in comparison. ~~Minor~~ components are sphalerite, galena and quartz. Accessory chalcopyrite and relatively conspicuous tennantite(-tetrahedrite) are largely restricted to thin, relatively siliceous interbands as is the bulk of the thinly disseminated euhedral/weakly poikilitic pyrite.

Banding is developed on a sub- to fine millimetric scale, is mildly contorted and, mesoscopically, is defined largely by the distribution of galena. In common with EAF-3/2, [redacted] exhibit a wide sizing range, but are medium-grained overall, with a mode [redacted].

EAF-9/2 (P.S. 52110)
A relatively massive, banded, polygonal mosaic-textured/weakly directed Pb-Zn(-Cu) ore, this section exhibits a galena-sphalerite/accessory chalcopyrite-pyrite assemblage analogous to that in EAF-3/2 and 9/1.

Banding comprises an alternation of relatively massive galena with composite (galena-sphalerite) units and is enhanced by the distribution of fine-grained (mean 75 μ) euhedral, weakly poikilitic pyrite and chalcopyrite.

Tetrahedrite(-tennantite) appears in minor traces only as ovoid blebs (mean 50 μ in galena. Pyrite is incipiently microfractured. There is minor development of remobilised galena in the form of discontinuous high-angle discordant veinlets with interspersed films of carbonate and quartz.

EAF-9/3 (P.S. 52111)
Cu-rich
Exhibits conspicuously disseminated [redacted]

Pyrite exhibits minor chalcopyrite micro-inclusions and tends to be incipiently chalcopyrite pressure-shadowed where relatively coarse-grained. Accessory traces of galena and sphalerite appear as isolated micro-inclusions in pyrite and as isolated fine-grained intergrowths with pyrite-intergranular chalcopyrite.

In comparison with EAF-9/1 and 9/2, this assemblage is distinctly [redacted] *

EAF-10/1 (P.S. 52116)
The sectioned area represents a coarse band of near-massive sphalerite with interspersed films of galena and pyrite-chalcopyrite lenses.

Sphalerite forms fine millimetric-scale lensoid masses with interstitial galena or, elsewhere, in a centimetric zone, pyrite-chalcopyrite composite aggregates. These features grade marginally into galena-chalcopyrite composites and locally into discordant/discontinuous chalcopyrite (± galena) films.

Microtextural relationships are similar to those noted in the EAF-3 and EAF-9 "orezones", with the base metal sulphides essentially polygonal mosaic-textured and pyrite weakly poikilitic-subhedral ("metablastic"). These textures are metamorphic in origin.

This sample exhibits minor relics of "primitive" or primary sulphides in the form of isolated partly recrystallized pyrite framboids and microscopic patches of colloform-microtextured galena-sphalerite (± pyrite) intergrowths.

EAF-10/2 (P.S. 52117)

Exhibits crudely lensoid to spongy irregular masses of sphalerite studded with poikilitic sub- to euhedral, medium-grained pyrite and with accessory proportions of galena and sphalerite.

A low-angle discordant vein-like mass of chalcopyrite and pyrite is similar to that noted in EAF-9/3.

This rock exhibits sporadic late microfractures with associated fine-scale granulation of the sulphides, notably pyrite. In common with EAF-9/3, the assemblage is relatively pyrite-chalcopyrite-rich, although sphalerite is rather ubiquitous.

D. Cowan, B. Sc.

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Central Mineralogical Services

CMS

39 Beulah Road
Norwood, S.A. 5067
Telephone 42 5659

Dr. R.H. Roberts
Comstaff Pty. Ltd.
Mt. Bischoff Road
WARATAH / TAS. 7321

17th December, 1984

REPORT CMS 84/11/33
Supplement

YOUR REFERENCE:	Letter dated 11.11.1984
DATE RECEIVED:	23rd November, 1984
SAMPLE NOS.:	23 Samples
SUBMITTED BY:	Dr. R.H. Roberts
WORK REQUESTED:	Mineralogy

H.W. Fander

H.W. Fander, M. Sc.

068

180069

REPORT CMS 84/11/33
Supplement

Following a telephoned request from R.H. Roberts, selected offcuts of carbonate-bearing drill core were tested qualitatively for manganiferous carbonate.

Samples EAF-7/2 and EAF-10/2 were selected as representing calcite-impregnated altered volcanic and calcite-gangued "massive" sulphide respectively. Samples EAF-9/6 and EAF-9/7 were selected as representative of sideritic alteration zones.

Small chips or dental drill-extracted powder samples were tested using the permanganate test described in the attached notes. All four carbonates gave strongly positive test results and were thus confirmed as manganiferous.

Subsequently, the two mangancalcite-bearing offcuts were examined in UV light. These proved non-fluorescent in indirect confirmation of the apparently substantial Mn-content.

These results tend to confirm the analogy with Rosebery, where the compositionally variable carbonate mineraloy includes manganiferous types (mangancalcite-kutnohorite, mangansiderite).

It should be noted that this interpretation is supportable and largely dependent on field- and petrological data. Manganiferous carbonates are widespread in N.W. Tasmania in a wide variety of geological environments (including,for example, Ordovician dolomitised limestones and Devonian granitic veins/replacements).

D. Cowan, B. Sc.

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"PERMANGANATE" TEST FOR MANGANESE

Equipment

1. Pyrex Test Tubes
2. Spirit or Bunsen Burner
3. Test-tube Tongs
4. 50 % HNO_3
5. Sodium Bismuthate ($NaBiO_3$) powder.
6. Small spatula (pref. nickel or nickel-plated)

Principle

Dissolution of manganese or manganiferous material, oxidation to permanganate ion, giving a rapid diagnostic colouration to aqueous solution.

Method

1. Dissolve a small quantity of the mineral in HNO_3, heated to boiling. Remove test tube from flame and allow to cool slightly (and/or until effervescence ceases).

2. Add a small amount of sodium bismuthate to the solution (with the spatula). Strongly manganiferous solutions will be indicated by an immediate dense purple colouration. Weaker solutions may require addition of excess bismuthate to cessation of effervescence.

Notes

a) Use of acids other than HNO_3 may produce an indifferent result.

b) As a guide to quantities, a match-head sized particle of a weakly manganiferous carbonate dissolved in a 2 cm column of acid in a 15 m.m.I.D. test tube will give reliable results.

c) It is preferable to place the bismuthate powder on the inside-top of the test tube and to get it into the solution by tipping the tube to a near-horizontal position. Instant addition of excess bismuthate will produce a deep brown colouration which will mask the permanganate and may require settling of precipitate.

d) With a little practice, this test can be used as a semi-quantitative guide to Mn-contents of relatively soluble phases, notably carbonates.

e) Weakly manganiferous carbonates (notably calcite) may fluoresce in UV light. The range of fluorescent carbonates is strictly limited (high Mn-contents "quench" the fluorescence).

CARBONATE FIELD DETECTION KIT

CHEMICALS

Alizarin Red S:- 1 gm of indicator in 16 fluid ounces (425 cc) distilled water, containing 3 cc of conc. HCl.
(30% NaOH solution, for stage 2 only)

PROCEDURE: Stage 1

Treat Rock chip with A.R.S. for 30 seconds, then wash with distilled (if possible) water for 5 to 10 seconds.

RESULT

DEEP RED (A)	PURPLE (B)	NO COLOUR (C)
CALCITE	ANKERITE	DOLOMITE
ARAGONITE	STRONTIANITE	ANHYDRITE
WITHERITE	CERUSSITE	SIDERITE
		RHODOCHROSITE
		MAGNESITE
		SMITHSONITE

Stage 2

Boil sample B or C with equal volumes of A.R.S. and 30% NaOH; B for 2 minutes, C for 5 minutes, and wash as before.

RESULT

(B)

DARK PURPLE	RED BROWN	NO COLOUR
ANKERITE	CERUSSITE	STRONTIANITE

(C)

BROWN TO BLACK	PURPLE	NO COLOUR
SIDERITE	DOLOMITE	ANHYDRITE
	RHODOCHROSITE	
	MAGNESITE	
	SMITHSONITE	

NOTE: To distinguish Dolomite and Magnesite, boil original sample in A.R.S. + 5% NaOH solution for 5 minutes. Magnesite and also Smithsonite, stain purple, Dolomite does not.

FIELD TESTS FOR CARBONATE

Notes on carbonate stain tests are attached.The method outlined may be simplified to a major degree with a division of carbonates into three major groups, notably calcites, dolomite-ankerite, and "siderite".

Chemicals

1. Dilute HCl (10% - 15%)
2. Alizarin Red indicator in weak HCl solution (refer accompanying sheet).

Method

a) Apply Dilute HCl:

Strong effervescence indicates calcite.

Weak effervescence indicates dolomite-ankerite.

Nil effervescence indicates "siderite".

b) Apply ARS solution to a separate (fresh area) of calcitic-dolomitic aggregate:

Rapid deep red stain confirms calcite.

Slow generation of deep purple stain indicates ankerite.

Very slow generation of purple stain indicates dolomite.

Siderite will stain extremely slowly, particularly on scratches, if impure.

Notes

1. This test may be supplemented by the test for manganese, permitting further subdivision into calcite/mangan-calcite, dolomite/mangandolomite, etc.

2. For most intents and purposes aragonite, witherite, strontianite and cerussite may be ignored.

3. Certain impure (calcareous) siderites are weakly soluble in cold dilute HCl and may give a purplish stain with ARS solution. There is little practical benefit in distinguishing these phases from broadly compositionally similar ankeritic carbonates.

4. Sideritic carbonates, if relatively massive, are generally distinguished by relatively high S.G. (3.7+). The only exception is magnesite, which is strictly insoluble in cold dilute HCl.

5. Stains are best observed under a stereobinocular microscope to delineate two-phase aggregates (e.g. composite veins, overprinting veins, partly dolomitised limestones, etc.).

Notes cont.

6. Dilution of the HCl solution may be required to successfully delineate dolomite-ankerite from calcite on the basis of effervescence alone. Alternately (and preferably), the ARS solution should be used as a standard procedure.

7. These tests are applicable to sawn slabs, drill cores and massive aggregates only. Use of fine particles and powdered materials will yield suspect results.

8. Field determinations should be confirmed by petrological data, at least as a control measure.

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APPENDIX 3

a) Drilling Statistics Log

b) Summary Drill Logs
ESB-1
EAF-1 to 14

BROWN'S DRILLING STATISTICS

DDH	Collar AMG	Collar Local	Commenced	Finished	DIR DECL	Depth
ESB 1	377811.88E/ 5384705.05N	40m Husk Rd	14/2/84	23/2/84	287 MN/ -45o	188.00
EAF 1	5384562.94N 377719.88E	L5250N 4956E	15/6/84	28/6/84	270o -45o	84.4
EAF 2	5384531.73N 377679.81E	L5400N 4924.5E	29/6/84	8/7/84	270o -45o	132.4
EAF 3	5384606.63N 377717.79E	L5290N 4946.5E	10/7/84	23/7/84	270o -45o	95.6
EAF 4	5384606.50N 377718.18E	L5280N 4947E	23/7/84	28/7/84	269o -47o	65.6
EAF 5	5384578.03N 377648.39E	L5240N 4882E	29/7/84	1/8/84	270o -45o	52.1
EAF 6	5384638.69N 377744.63E	L5320N 4967E	1/8/84	9/8/84	270o -45o	102.4
EAF 7	5384595.85N 377760.82E	L 5280N 4992E	12/8/84	23/8/84	270o -45o	186.9
EAF 8	5384673.71N 377769.10E	L5360N 4984E	24/8/84	30/8/84	270o -45o	106.00
EAF 9	5384633.22N 377793.78E	L5325N 5017E	31/8/84	18/9/84	270o -45o	262.00
EAF 10	5384664.52N 377811.73E	L5360N 5030E	21/9/84	9/10/84	270o -45o	256.00
EAF 11	5384746.91N 377630.08E	L5400N 4831.5E	11/10/84	29/10/84	90.5 -60o	313.6
EAF 12	5384704.92N 377629.29E	L5360N 4836.5E	30/10/84	13/11/84	90o -60o	285.4
EAF 13	5384666.75N 377600.94E	L5320N 4816E	14/11/84	24/11/84	90o -59o	240.00
EAF 14	5384595.34N 377761.90E	L5280N 4993.8E	27/11/84	17/12/84	270o -54o	334.5

DETAILED GEOLOGY LEGEND

HANGINGWALL

QFP	Glomeroporphyritic Quartz-Feldspar Porphyry
P	Siliceous Porphyry
Pc-L	Lapilli Tuff (A Volcaniclastic Breccia (Vc-B) commonly occurs adjacent to Pc-L)
Gy-P	Grey Siliceous Porphyry (commonly within Lapilli-Tuff)
Ec	Undifferentiated Epiclastics
Ec-B	Epiclastic Breccia
Ec-S	Epiclastic Sandstone
Ec-M	Epiclastic Mudstone

HOST HORIZON

Ch/Vc/S	Undifferentiated Cherts, Volcaniclastics and Shales
Ch	Cherts (or cherty units)
B-S	Predominantly Shales (both well bedded grey/black shales and massive black shales)
Vc	Predominantly Volcaniclastics
Vc-B	Volcaniclastic Breccia
Vc-S	Volcaniclastic Sandstone
Vc-M	Volcaniclastic Mudstone
Si-Vc	Siliceous Volcaniclastic
Vc/S	Mixture of green and grey (? shaly) volcaniclastics with possible minor shale units
Ex	Predominantly Grey Chert associated with Sulphides (incl. lenses of massive sulphide) - "Exhalite Unit".
MS	Massive Sulphide

FOOTWALL

(NB Footwall lithologies commonly occur within the host horizon sequence)

G-Pf	Green Porphyry - predominantly quartz-feldspar porphyritic lavas (and associated pyroclastic phases) - andesitic to dacitic in composition
D-P	: Cream coloured Sericite - Co_3 (Mn) rich unit commonly associated with minor fuchsite - probable alteration product of volcanic
D-Vc-B	: Volcaniclastic Breccia containing D-P fragments

MIXED FOOTWALL-HOST HORIZON UNITS

B-P	Fine-grained Non-Porphyritic Volcanic - typically buff-green colour (? chilled lava phase)
G-PfC	Composite Breccia of Green Porphyritic Lava fragments and Grey Chert
G-PfS	Composite Breccia of Green Porphyritic Lava and Shale fragments
G-Pc	Pyroclastic unit consisting predominantly of green porphyritic (? lava) fragments:(? hyaloclastite) - typically foliated - with increasing chert component G-Pc grades into G-PfC

Pc-A	Pyroclastic Ash (Ash Tuff)
Pc-Aq	Pyroclastic ash with a quartz porphyry texture
Pc-Ap	Intense foliated texture (? eutaxitic) in Pc-A
C-Pc-A	Cherty Pyroclastic Ash : Siliceous (cherty) nodules in an ash-sized matrix

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ALTERATION

LOW GRADE ALTERATION FEATURES

SYMBOLS:

Si	:	Silicification
Se	:	Strong Sericite Alteration
Cl	:	Strong Chlorite Alteration
Co3	:	Carbonate Alteration
Fe	:	Iron Oxide Alteration
Py	:	Iron Sulphide Alteration
Buff	:	Buff Colouration
Fu	:	Presence of Fuchsite

HIGH-GRADE ALTERATION ZONES

SYMBOL

S-Z : Zinc-rich stringer zone alteration. Veins of grey chert and sphalerite (minor galena and chalcopyrite). Associated intense chlorite-sericite-leucoxene alteration (pale yellow-green colour). Typically within G-Pf.

Py-Si : A peripheral style of alteration adjacent to stringer zone alteration (S-Z). Varies from diffuse grey siliceous veins (with ultrafine pyrite) within green porphyry to a composite breccia (G-PfC) appearance. With decreasing intensity it grades into mild Fe, Si alteration.

Py-Cl : Black chlorite-sericit-pyrite alteration. Often associated with chalcopyrite-pyrite veining (A:Py-Cl-Cpy). Has been recognised within green porphyry and pyroclastic ash.

Pb-Zn-Co_3 : Nodular carbonate alteration typically associated with diffuse Pb-Zn mineralisation. Peripheral effect of this type of alteration (A:Co_3) occur in several holes. Generally occurs within pyroclastic ash (Pc-A).

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AUSTRALIAN ANGLO AMERICAN LIMITED
DRILLHOLE LOG
Summary Sheet

180079

Page of

PROJECT PINNACLES	AREA EL 5/63	DRILLHOLE TYPE
CO-ORDS 5384705.05N 377811.88E	DEC^LN -45°. AZIMUTH 287° MN RL 499.71	DH No. ESB-1

DATE COMMENCED	DATE COMPLETED	DRILLED BY	DRILL RIG
14/2/84	23/2/84	OVERLAND	W-250

Non Coring to: 0-7 m HQ Core to: 7-23m NQ Core to: 23-188m BQ Core to: EOH 188m

SURVEY DATA Instrument:

DEPTH	DECLINATION Uncorr	DECLINATION Corr	AZIMUTH	DEPTH	DECLINATION Uncorr	DECLINATION Corr	AZIMUTH
0	-45		287° MN				
188	-43.5		281° MN				

LOG SUMMARY

m	ROCK TYPE	MINERALIZATION Style		Grade	Intersection width (Corr)
0-7	No Core				
7-59.5	Volcanic Breccia (Pc-L)				
	7-19m: fine-grained breccia (<1cm frags.)				
	19-59.5m: fragment 1-6cm - pink rhyolite and dark-green feldspar porphyry fragments				
59.5-71	Pale-green pyroclastic ash - probable eutaxitic texture (Pc-Ap). Foliated shear texture.		59.5-71	V. Minor Py/Sph/Gal	
	* Contains patches of blue & grey ash/shale.				
71-82.8	Fine-grained buff-coloured volcanic (B-P) Commonly cut by green chloritic veins		71-82.8	Minor sulphides in chlorite veins	
82.8-99.8	Feldspathic porphyry with buff colouration (G-Pf; A: Buff)				
99.8-107	Green-coloured porphyry (G-Pf)		99-188	Minor veins of Py/Sph/Gal with quartz	
107-122.6	Green porphyry with pink-coloured iron-stained silicification (G-Pf; A: Fe, Si)				
122.6-123	Mixture of chert + volcaniclastics (Ch/Vc/S)			164-180: rich in sulphide veins	
123-131.1	Green porphyry with mild pyrite-silica alteration (G-Pf; A: Py, Si)				
131.1-135	Composite breccia of green porphyry and pyrite-silica alteration (G-PfC; A: Py, Si)				
135-164	Green porphyry with mild pyrite-silica alteration (G-Pf; A: Py, Si)				
164-188	Green porphyry with silicification and iron staining (G-Pf; A: Fe, Si)				

Signature [signature] Date 6/9/84

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AUSTRALIAN ANGLO AMERICAN LIMITED
DRILLHOLE LOG 180080
Summary Sheet

PROJECT	5/63 Pt 4	AREA	PINNACLES	DRILLHOLE TYPE	DDH
CO-ORDS	5384562.94N 377719.88E	DEC^LN -45°	AZIMUTH 270° MN	RL 469.21	DH No. EAF-1
DATE COMMENCED	15.6.84	DATE COMPLETED 28/6/84	DRILLED BY LONGYEAR	DRILL RIG	BBS -1
Non Coring to: 9m	HQ Core to: 45	NQ Core to: 83.4	BQ Core to:	EOH	83.4

SURVEY DATA

Instrument:

DEPTH	DECLINATION Uncorr	DECLINATION Corr	AZIMUTH	DEPTH	DECLINATION Uncorr	DECLINATION Corr	AZIMUTH
Collar		-45	270				
83.4		-45.5	269				

LOG SUMMARY

	ROCK TYPE	MINERALIZATION		
0 - 9m	No Core			
9 -23.1	Epiclastic breccias and volcaniclastics (Ec).			
23.1-39.65	Epiclastic breccia with large shale fragments (Ec-B)			
	34.1-39.65: quartz/sericite alteration			
39.65-83.?	Pyroclastic lapilli-sized breccia (lapilli tuff) -(Pc-L). Dark green porphyritic fragments and pink siliceous fragments. Varying degrees of siliceous alteration.			
	39.65-43.0: quartz/sericite alteration			
83.6-84.4	Cherty Volcaniclastic (Ch/Vc/S)	84.3-84.4	Pyrite layer	

Signature RHRoberts Date 20/7/84

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AUSTRALIAN ANGLO AMERICAN LIMITED

DRILLHOLE LOG 180081

Summary Sheet

PROJECT	EL 5/63 Pt 4	AREA	PINNACLES			DRILLHOLE TYPE	DDH
CO-ORDS	377679.81 5384531.73	DECLN	-45°	AZIMUTH	270°	RL 465.53	DH No. EAF-2
DATE COMMENCED	29/6/84	DATE COMPLETED	8/7/84	DRILLED BY	LONGYEAR	DRILL RIG	L/Y 38
Non Coring to:	6m	HQ Core to:	57m	NQ Core to:	132.4m	BQ Core to:	EOH 132.4m

SURVEY DATA Instrument:

DEPTH	DECLINATION Uncorr	DECLINATION Corr	AZIMUTH	DEPTH	DECLINATION Uncorr	DECLINATION Corr	AZIMUTH
0		270	-45				
132.4		268.5	-46				

LOG SUMMARY

ROCK TYPE		MINERALIZATION		
0 - 6	No Core			
6-20.6	Epiclastic Breccia (Ec-B)			
20.6-32	Fragments of green porphyry in a sludge			
32-39	Volcaniclastic Breccia (Vc-B)			
39-45.5	Siliceous Lapilli tuff (Pc-L)			
45.5-64.4	Cherts, volcaniclastics and shales (Ch/Vc/S)	47.7-47.8	Massive Pyrite	
		47.8-47.9	Semi-massive Py-Sph	
		48.5-64.4	Dissem Py and minor Sph/Gal<1%	
64.4-82	Composite breccia of chert and porphyry (G-PfC)	65. -70	Syngenetic Py-rich patches (↑30%)	
82.-85.7	Green porphyry (G-Pf) - chert veins			
85.7-92.5	Cherts and volcaniclastics (Ch/Vc)			
92.5-95.5	Composite breccia of chert and porphyry (G-PfC)			
95.5-107.2	Green porphyry (G-Pf)- finegrained and dark green			
107.2-113	Mixture of fine-grained volcaniclastics and shales (Vc/S)			
113-127.8	Green porphyry-fractured appearance with Co3, sericite, pyrite and silica alteration (G-Pf;A:Co3, Se; Py, Si)			
127.8-128.6	Volcaniclastics and shales (Vc/S)			
128.6-132.4	Green porphyry (G-Pf)			

Signature [signature] Date 23/7/84

AUSTRALIAN ANGLO AMERICAN LIMITED
DRILLHOLE LOG
Summary Sheet 180082

PROJECT	EL 5/63 Pt 4	AREA	PINNACLES	DRILLHOLE TYPE	DDH
CO-ORDS	377717.79 5384606.63	DEC^LN -45°	AZIMUTH 270°	RL 471.25	DH No. EAF-3
DATE COMMENCED	10/7/84	DATE COMPLETED 23/7/84	DRILLED BY LONGYEAR	DRILL RIG	L/Y 38
Non Coring to: 1m	HQ Core to: 23	NQ Core to: 95.6	BQ Core to:	EOH	95.6

SURVEY DATA Instrument:

DEPTH	DECLINATION Uncorr	DECLINATION Corr	AZIMUTH	DEPTH	DECLINATION Uncorr	DECLINATION Corr	AZIMUTH
0		-45	270° MN				

LOG SUMMARY

ROCK TYPE		MINERALIZATION		
0 - 1	No Core			
1-3.25	Pyroclastic ash (Pc-Ap)			
3.25-15.2	Blue-grey chert and chert with			
	volcaniclastics (Ex)	3.25-8.3	Minor Py-Sph	
	11.67-15.2: Volcaniclastic breccia	9.69-11.6	" "	"
	with pyrite fragments	11.6-13.1	Py lenses and	
			fragments ≃ 1%	
15.2-29.5	Grey volcaniclastic mudstone (Vc-M)			
	26.2-29.5: increased silicification			
29.5-37	Grey chert with sulphides (Ex)	29.5-37	Veins and patches	
			of Py-Sph ≤ 1%	
37-38.5	Massive sulphide (Ex-MS)	37-38.5	Massive sulphide:	
	- coarse grained (>1mm) and layered		Py/Sph/Gal/Cpy (>60%)	
38.5-40.6	Fine-grained buff-coloured volcanic			
	(B-P)-silicification and Fe oxide			
	staining.			
40.6-45.8	Green volcaniclastic sandstone (G-Pc)	40.6-45.8	Pervasive Py<1%	
	Contains chert and green porphyry	41.8-41.9	Massive Py with	
	fragments		Co_3	
45.8-48.1	Buff-coloured fine-grained volcanic			
	(B-P)			
48.1-75	Green volcaniclastic (to porphyry-			
	chert mix) (G-Pc)			
75-84.9	Mixture of cherts and volcaniclastics	75-84.9	Minor Py-Sph	
	(Ch/Vc/S)			
84.9-88.7	Green volcaniclastic (G-Pc)			
	87-88.7: grades into a composite breccia			
88.7-95.6	Chert and volcaniclastics (Ch/Vc/S)			

HOLE ABANDONED Signature RHRoberts Date 17/10/84

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AUSTRALIAN ANGLO AMERICAN LIMITED
DRILLHOLE LOG 180083
Summary Sheet

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PROJECT	5/63 Pt 4	AREA	PINNACLES		DRILLHOLE TYPE DDH
CO-ORDS	377718.18 5384606.50	DECLN -47	AZIMUTH 269°	RL 471.25	DH No. EAF-4
DATE COMMENCED	23/7/84	DATE COMPLETED 27/7/84	DRILLED BY LONGYEAR	DRILL RIG	L/Y 38
Non Coring to: 1.3m	HQ Core to: 65.6	NQ Core to:	BQ Core to:	EOH	65.6

SURVEY DATA — Instruments:

DEPTH	DECLINATION Uncorr	DECLINATION Corr	AZIMUTH	DEPTH	DECLINATION Uncorr	DECLINATION Corr	AZIMUTH
0		-47	269° MN				

LOG SUMMARY

ROCK TYPE		MINERALIZATION		
0 - 1	No Core			
1 - 3.6	Pyroclastic Ash (Pc-Ap)			
3.6-16.2	Blue-grey chert abd chert with			
	volcaniclastics (Ex)	3.6-9.0	Py-Sph	patches
	13.2-16.2: volcaniclastic breccia	10.1-12.3	Minor Py-Sph	
16.2-32.4	Grey volcaniclastic mudstone(Vc-M)	13.2-14.1	Py fragments	
	26.9-32.4: increasing silicification			
32.4-39.7	Grey chert with sulphides (Ex)	32.4-39.6	Veins and patches	
	39.6-39.7: massive sulphide - coarse		of Py-Sph-Cpy1-2%	
	grained and banded	39.6-39.7	Massive	Py-Sph-Gal
39.7-41.3	Buff-coloured volcanic (B-P) Silica			
	and iron oxide alteration.			
41.3-41.4	Massive sulphide (Ex-MS)	41.3-41.4	Massive	Py-Sph
41.4-44.25	Grey chert with sulphide (Ex)	41.4-44.25	Veins of	
			Py-Sph-Gal-Cpy2%	
44.25-44.9	Massive sulphide with chert (Ex-MS)	44.25-44.9	Massive	
			Py-Cpy-Gal-Sph	
44.9-50.9	Buff-coloured fine-grained volcanic (B-P)			
50.9-52.3	Massive Sulphide (Ex-MS)	50.9-52.3	Massive	
52.3-65.6	Green volcaniclastic (G-Pc) grades		Py-Sph-Gal	
	into a chert-porphyry mix.			

Signature RHRoles Date 17/10/84

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AUSTRALIAN ANGLO AMERICAN LIMITED
DRILLHOLE LOG
Summary Sheet

180084

PROJECT 5/63 Pt 4	AREA PINNACLES		DRILLHOLE TYPE DDH
CO-ORDS 377648.39 5384578.03	DEC^LN -45°	AZIMUTH 90° RL 460.08	DH No. EAF-5
DATE COMMENCED 29/7/84	DATE COMPLETED 1/8/84	DRILLED BY LONGYEAR	DRILL RIG LY 38
Non Coring to: 1.3m	HQ Core to: 52.1m	NQ Core to: BQ Core to:	EOH 52.1m

SURVEY DATA Instrument:

DEPTH	DECLINATION Uncorr	DECLINATION Corr	AZIMUTH	DEPTH	DECLINATION Uncorr	DECLINATION Corr	AZIMUTH
Collar		-45	90°				
50.6		-45	88.5°				

LOG SUMMARY

	ROCK TYPE	MINERALIZATION		
0 1.3	No Core			
1.3-9.8	Dark green volcaniclastic (G-Pc) Predominantly green porphyry fragments. Fine-grained grey silica and ultrafine pyrite in some parts lime-green chlorite/ sericite lenses	1.3-9.8	Dissem.Py	
9.8-15.9	Shales, volcaniclastics and cherts (Ch/Vc/S)	13.2-15.9	Dissem, veined and layered Py/Sph	
15.9-19.5	Cream-green siliceous volcanic (B-P) chlorite veining			
19.5-28.1	Blue-grey chert with pyrite and a mixture of volcaniclastics and shales (Ex)	19.5-22.2	Minor Py/Sph	
		22.2-28.1	Py layers 1-2% Minor Sph/Gal	
28.1-32.1	Volcaniclastic Breccia (Vc-B)			
32.1-52.1	Lapilli Tuff (Pc-L)			

Signature [signature] Date 2/8/84

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AUSTRALIAN ANGLO AMERICAN LIMITED
DRILLHOLE LOG
Summary Sheet

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Page 1 of 1

PROJECT	5/63 Pt 4	AREA	PINNACLES		DRILLHOLE TYPE: DDH
CO-ORDS	377744.63 5384638.69	DEC^LN -45°	AZIMUTH 270°	RL 478.7	DH No. EAF-6
DATE COMMENCED	1/8/84	DATE COMPLETED 9/8/84	DRILLED BY LONGYEAR		DRILL RIG LY 38
Non Coring to: 1.3m	HQ Core to: 62.6	NQ Core to: 102.4	BQ Core to:		EOH 102.4

SURVEY DATA — Instrument:

DEPTH	DECLINATION Uncorr	DECLINATION Corr	AZIMUTH	DEPTH	DECLINATION Uncorr	DECLINATION Corr	AZIMUTH
Collar		-45	270° MN				
100.9		-45.5	265° MN				

LOG SUMMARY

	ROCK TYPE	MINERALIZATION		
0-1.3	No Core			
1-3-8.0	Rubble and poor core of quartz-bearing pyroclastic ash (Pc-Aq)			
8.0-14.5	Epiclastic Breccia (Ec-B)			
14.5-28.8	Volcaniclastic sandstone to breccia (Ec) - chert fragments	14.5-28.8	Sub-rounded frags of Py	
28.8-42.2	Fine-grained pale green pyroclastic ash (Pc-A) - eutaxitic texture			
42.2-50.3	Cherts, volcaniclastics and shales varying into grey chert with sulphide (Ex)	45-50.2	Minor Py.Sph in veins	
		50.2-50.3	Massive sulphide pod -Sph/Gal	
50.3-52	Dark green porphyritic pyroclastic (G-Pc) with chert component			
52-59	Blue-grey chert with sulphides (Ex) - sections of broken massive sulphide	52-59	Veins and patches of Py-Sph - lesser Cpy Gal: up to 10%	
		56.6-57.5 / 58.4-59	Sections of massive sulphide	
59-59.6	Green porphyritic pyroclastic (G-Pc)			
59.6-74.5	Blue-grey chert with sulphides (Ex)	59.6-74.5	Thick veins of coarse grained Sph-Py 1-5%	
74.5-102.4	Green porphyry-patches of cream coloured alteration (G-Pf, A:Si, Fe)			

Signature [signature] Date 12/8/84

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AUSTRALIAN ANGLO AMERICAN LIMITED

DRILLHOLE LOG

Summary Sheet 180086

PROJECT	PINNACLES	AREA	5/63 Pt 4	DRILLHOLE TYPE	DDH
CO-ORDS	377760.82E 5384595.85N	DEC^LN -45 °	AZIMUTH 270° MN	RL 477.74	DH No. EAF-7
DATE COMMENCED	12/8/84	DATE COMPLETED 23/8/84	DRILLED BY LONGYEAR	DRILL RIG	L/Y 38
Non Coring to: 1.5	HQ Core to: 53	NQ Core to: 186.9	BQ Core to:	EOH	186.9

SURVEY DATA

Instrument:

DEPTH	DECLINATION Uncorr	DECLINATION Corr	AZIMUTH	DEPTH	DECLINATION Uncorr	DECLINATION Corr	AZIMUTH
185.4		-43	271° MN				

LOG SUMMARY

ROCK TYPE		MINERALIZATION	
0 - 1.5	No Core		
1.5-9.9	Quartz Feldspar porphyry (QFP)		
9.9-11.6	Steel grey pug		
11.6-31.9	Epiclastic breccia(Ec-B)with patches of well bedded shales		
31.9-44.3	Pyroclastic ash to lapilli tuff(Pc-L)		
44.3-62.2	Grey siliceous porphyry (Gy-P)		
62.2-105.3	Lapilli tuff (Pc-L)		
105.3-117.8	Black shale (B-S)	105.3-117.8	Minor dissem. blebs and veins of sulphide
117.8-130.8	Volcaniclastics and shales(Vc/S) 124.5-130.8: Composite breccia of green porphyry fragments and black shale(G-PfS)		
130.8-134.5	Composite breccia of porphyry and chert(G-PfC)		
134.5-142.6	Green feldspathic porphyry(G-Pf)		
142.6-144.1	Volcaniclastic sandstone to breccia (Vc) with pyrite grains		
144.1-148.6	Cream-coloured volcanic, highly fractured (B-P)		
148.6-154.3	Green volcaniclastic mudstones to breccias (Vc)	148.6-154.3	Minor Py,Sph, Cpy: dissem, veins & lenses
154.3-165.8	Grey chert with pyrite (Ex)	154.3-165.8	Py 5-50%
165.8-168.3	Green volcaniclastic mudstone to breccia (Vc)	165.8-168.3	Minor Py

Signature [signature] Date

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AUSTRALIAN ANGLO AMERICAN LIMITED

DRILLHOLE LOG 180087

Summary Sheet

PROJECT	AREA	DRILLHOLE TYPE
CO-ORDS	DEC^LN AZIMUTH RL	DH No. EAF-7

DATE COMMENCED	DATE COMPLETED	DRILLED BY	DRILL RIG

Non Coring to:	HQ Core to:	NQ Core to:	BQ Core to:	EOH

SURVEY DATA Instrument:

DEPTH	DECLINATION Uncorr	DECLINATION Corr	AZIMUTH	DEPTH	DECLINATION Uncorr	DECLINATION Corr	AZIMUTH

LOG SUMMARY

ROCK TYPE		MINERALIZATION		
168.3-186.9	Green porphyry (G-Pf) Minor chlorite - Py alteration.			

Signature Date

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AUSTRALIAN ANGLO AMERICAN LIMITED
DRILLHOLE LOG
Summary Sheet

180088

PROJECT	PINNACLES	AREA	5/63 Pt 4			DRILLHOLE TYPE	DDH
CO-ORDS	377769.10E 5384673.71N	DEC^LN	-45°	AZIMUTH	271	RL	488.74
DH No.	EAF-8						
DATE COMMENCED	24/8/84	DATE COMPLETED	30/8/84	DRILLED BY	LONGYEAR	DRILL RIG	L/Y 38
Non Coring to:	1.5	HQ Core to:	63.8	NQ Core to:	106	BQ Core to:	
EOH	106						

SURVEY DATA

Instrument:

DEPTH	DECLINATION Uncorr	DECLINATION Corr	AZIMUTH	DEPTH	DECLINATION Uncorr	DECLINATION Corr	AZIMUTH
104.5		-46	264.5				

LOG SUMMARY

ROCK TYPE		MINERALIZATION		
0 - 1.5	No Core			
1.5-9.1	Siliceous Porphyry (P)			
9.1-26.6	Volcanic breccia (Pc-L) containing fragments of rhyolite and green porphyry			
26.6-42.4	Pyroclastic ash with pumiceous texture (Pc-Ap)			
42.4-46,5	Black shale (B-S)	42.4-46.5	Thin Sph veins	
46.5-53.5	Volcaniclastic sandstone to breccia (Vc)			
53.5-57.3	Cream-coloured volcanic (B-P)			
57.3-59.1	Volcaniclastic (Vc/S)			
59.1-74.2	Cream-coloured volcanic (B-P)			
74.2-92.8	Grey chert with sulphide (Ex)	74.2-92.8	Sph and minor Cpy <1%	
92.8-106	Green porphyry (G-Pf)			

Signature [signature] Date 23/9/84

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AUSTRALIAN ANGLO AMERICAN LIMITED
DRILLHOLE LOG
Summary Sheet

180089

PROJECT EL 5/63	AREA PINNACLES			DRILLHOLE TYPE DDH
CO-ORDS 377793.78 5384633.22	DEC^LN -45°	AZIMUTH 270° MN	RL 490.07	DH No. EAF-9
DATE COMMENCED 31/8/84	DATE COMPLETED 18/9/84	DRILLED BY LONGYEAR	DRILL RIG L/Y 38	
Non Coring to: 3	HQ Core to: 65.2	NQ Core to: 262	BQ Core to:	EOH 262

SURVEY DATA — Instrument:

DEPTH	DECLINATION Uncorr	DECLINATION Corr	AZIMUTH	DEPTH	DECLINATION Uncorr	DECLINATION Corr	AZIMUTH
100		-46	268				
150		-45.5	269.5				
200		-44.25	270				
262		-41.25	272				

LOG SUMMARY

ROCK TYPE		MINERALIZATION
0 - 3	No Core	
3 - 29	Pyroclastic ash with quartz phenocrysts (Pc-Aq): poor core and rubble	
29-45.9	Epiclastic breccia (Ec-B)	29-45.9 slugs of Py
45.9-48.6	Volcaniclastic breccia (Vc-B)	
48.6-54	Grey siliceous porphyry (Gy-P)	
54 - 60	Volcaniclastic breccia (Vc-B)	
60-101.2	Lapilli tuff (Pc-L)	
101.2-131.7	Lapilli tuff with large (1-10cm) black shale fragments	
131.7-149	Volcaniclastics and shales (Vc/S)	131.7-149 Minor Py, Sph
149-161.3	Silicified volcaniclastic (Vc, A:Si)	149-161.3 Minor Py, Sph, Cpy-Gal
161.3-163.5	Chert and massive sulphide (Ex)	162.5-163 Py-Sph 3-5% 163-163.5 Massive sulphide (Sph/Gal)
163.5-165.6	Green Volcaniclastic (Vc)	
165.6-171.8	Minor sulphide (Ex-MS)	165.6-171.8 Sph-Gal-Cpy-Py
171.8-175.6	Chert abd sulphide (Ex)	171.8-173.6 Sph-Cpy-Py >40% 173.6-175.6 Py>30%
175.6-183.3	Intense pyrite -chlorite (black) alteration of green porphyry (G-Pf, A:Py-Cl)	175.6-183.3 Py>25%
183.3-201.9	Chert-sphalerite veins within green porphyry. Intense chlorite-sericite alteration associated with veining (G-Pf, A: S-Z)	183.3-210.9 Thick veins and patches of sulphide (Sph, Py, Cpy)

Signature *RJ Holet* Date

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AUSTRALIAN ANGLO AMERICAN LIMITED
DRILLHOLE LOG
Summary Sheet 180090

PROJECT	AREA	DRILLHOLE TYPE
CO-ORDS	DEC^LN: AZIMUTH RL	DH No. EAF - 9

DATE COMMENCED	DATE COMPLETED	DRILLED BY	DRILL RIG

Non Coring to: HQ Core to: NQ Core to: BQ Core to: EOH

SURVEY DATA Instrument:

DEPTH	DECLINATION Uncorr	DECLINATION Corr	AZIMUTH	DEPTH	DECLINATION Uncorr	DECLINATION Corr	AZIMUTH

LOG SUMMARY

ROCK TYPE		MINERALIZATION		
			sulphide	ranges
			from 5-10% up to	
	185.4-187.1: Chalcopyrite-pyrite veining within the green porphyry. Intense chlorite (black)-pyrite alteration associated with veining (G-Pf, A; Py-Cl-Cpy)		50%	
201.9-220.5	Green porphyry with minor chert-sphalerite veining(G-Pf,A:minor S-Z)	201.9-220.5	Minor	Sph/Py ~1%
220.5-228.5	Volcaniclastic with patches of sericite- nodular carbonate alteration (Vc, A: Se-Co_3)			
228.5-243.7	Volcaniclastic breccia with patches of sericite-carbonate alteration. Some coarse fragments altered to sericite,carbonate and fuchite (D-Vc-B,A:Se-Co_3-Fu)			
243.7-254.3	Pale-cream volcanic with sericite, carbonate and fuchsite alteration (D-P-, A:Co_3-Fu)			
154.3-262	Green porphyry			

Signature [signature] Date

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AUSTRALIAN ANGLO AMERICAN LIMITED
DRILLHOLE LOG
Summary Sheet

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PROJECT	5/63 Pt 4	AREA	PINNACLES	DRILLHOLE TYPE: DDH
CO-ORDS	DEC^LN -45°	AZIMUTH 270°	RL	DH No. EAF-10

DATE COMMENCED 21/9/84	DATE COMPLETED 9/10/84	DRILLED BY LONGYEAR	DRILL RIG L/Y 38
Non Coring to: 3m	HQ Core to: 53.3m	NQ Core to: 256m	BQ Core to:	EOH 256m

SURVEY DATA Instrument:

DEPTH	DECLINATION Uncorr	DECLINATION Corr	AZIMUTH	DEPTH	DECLINATION Uncorr	DECLINATION Corr	AZIMUTH
Collar		-45°	270° MN				
100							
150							
200							
250							

LOG SUMMARY

ROCK TYPE		MINERALIZATION		
0-12.9	No Core			
12.9-79	Coarse-grained lapilli tuff (Pc-L)			
79-98.1	Mixture of volcaniclastic shales sandstones and breccias (Ch/Vc/S)	97.9-98.1	Py :	1-2%
98.1-100.4	Coarse-grained massive sulphide (Ex-MS)	98.1-100.4	Massive sulphide Gal/Sph (coarse patches of Sph (orange brown) and Cpy)	
100.4-116	Dark grey chert with sulphides (Ex), minor volcaniclastics	100.4-100.9	Minor Py:	<1%
		100.9-102.8	Py	:1-5%
		102.8-103.1	Massive Py	
		103.1-112	Veining of Py-Sph-Gal-Cpy	:1-5%
		112-116	Veins and patches of Py-Sph-Gal-minor Cpy	:10-60%
116-136	Composite breccia of chert and green porphyry varying to green Porphyritic volcaniclastic with major chert (G-PfC/G-Pc)	116-136	Py stringers	
136-147.4	Chert and cherty volcaniclastics (Ex) 137-6-139.5: Co_3 alteration	136-137.6	Py and minor Sph, Gal	:1-2%
		137.6-139.5	Sph (red)-Py-Gal	

Signature RHRoberts Date 12/10/84

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AUSTRALIAN ANGLO AMERICAN LIMITED
DRILLHOLE LOG
Summary Sheet

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PROJECT	AREA	DRILLHOLE TYPE
CO-ORDS	DEC[LN] AZIMUTH RL	DH No. EAF-10

DATE COMMENCED	DATE COMPLETED	DRILLED BY	DRILL RIG
Non Coring to:	HQ Core to:	NQ Core to:	BQ Core to: EOH

SURVEY DATA Instrument:

DEPTH	DECLINATION Uncorr	DECLINATION Corr	AZIMUTH	DEPTH	DECLINATION Uncorr	DECLINATION Corr	AZIMUTH

LOG SUMMARY

ROCK TYPE		MINERALIZATION		
			Coarse grained:	
				5-10%
		139.5-	Py-minor	Sph, Cpy
		147.4		:1-2%
147.4-194.1	Green porphyry with silicification and iron staining (G-Pf, A: Fe, Si)			
194.1-240.2	Green Porphyry with chert-sphalerite veins and stringers (G-Pf, A: S-Z)	194.1-240.2	Massive sulphides with chert veins: Py-Sph-Gal :<1%	
240.2-256	Green porphyry			

Signature [signature] Date

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AUSTRALIAN ANGLO AMERICAN LIMITED
DRILLHOLE LOG 180093
Summary Sheet

PROJECT 5/63 Pt 4	AREA PINNACLES		DRILLHOLE TYPE DDH
CO-ORDS	DEC^{LN} -60°	AZIMUTH 90.5° MN RL	DH No. EAF-11
DATE COMMENCED 11/10/84	DATE COMPLETED 29/10/84	DRILLED BY LONGYEAR	DRILL RIG L/Y 38
Non Coring to: 1.5m	HQ Core to: 44.6m	NQ Core to: 313.6m	BQ Core to: — EOH 313.6m

SURVEY DATA

Instrument:

DEPTH	DECLINATION Uncorr	DECLINATION Corr	AZIMUTH	DEPTH	DECLINATION Uncorr	DECLINATION Corr	AZIMUTH
0		-60°	90.5° mag	300		59.25°	98° mag
100		-61.5°	92.5° mag				
150		-60.75°	93° mag				
200		-60.5°	95° mag				
250		-59.75°	96.5° mag				

LOG SUMMARY

ROCK TYPE		MINERALIZATION		
0 - 1.5:	NO CORE			
1.5- 58:	Green Porphyry (G-Pf)			
	- weathered out pitted texture			
58 - 88:	Mixed Green Porphyry and Chert			
	(G-PfC)	58-77.6	Disseminated << 1%	
	- angular green porphyritic		Py	
	fragments in grey chert			
88-149.3:	Green Porphyry (G-Pf)			
149.3-154.8:	Porphyry (G-Pf) - altered to a			
	pink-red colour by Si Fe			
	alteration (A: Si, Fe)			
154.8-168.2:	Altered and fragmented green		Py	Minor
	Porphyry (G-Pf, A: Py, Si). Grey silica			
	matrix around porphyry - 163-166:			
	pale cream-green spots (? fragments)			
	in porphyry which can contain			
	fuchsite (A: Si, Fe, Fu)			
168.2-176.5:	Green Porphyry (G-Pf) - pink			
	colouration (A: Si, Fe)			
176.5-199.4:	Green Porphyry (G-Pf)			
199.4-222.6:	Volcaniclastic sandstones,	203.2-217.2	Minor	Sph-Gal
	siltstones and mudstones. Vary		in veins	
	to cherts and shales.		Diss. Py	
	(Ch/Vc/S)	217.2-222.6	Minor	blebs of
			Py-Cpy-Sph	
	208.7-209.9: Volcaniclastic	217.6-218.5:	Vein	1-2cm wide
	mudstone with rounded Co_3 spots	with coarse grained		
	(A: Co_3)	sulphides		

Signature [signature] Date 1/11/84

AUSTRALIAN ANGLO AMERICAN LIMITED

DRILLHOLE LOG

Summary Sheet

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PROJECT		AREA		DRILLHOLE TYPE: DDH
CO-ORDS	DEC^{LN}	AZIMUTH	RL	DH No. EAF-11
DATE COMMENCED	DATE COMPLETED	DRILLED BY	DRILL RIG	
Non Coring to:	HQ Core to:	NQ Core to:	BQ Core to:	EOH

SURVEY DATA　　Instrument:

DEPTH	DECLINATION Uncorr	DECLINATION Corr	AZIMUTH	DEPTH	DECLINATION Uncorr	DECLINATION Corr	AZIMUTH

LOG SUMMARY

ROCK TYPE	MINERALIZATION		
222.6-280.6: Dark green porphyry (G-Pf)	-Sph-Gal-Cpy-Py-cuts		
247-256.6: Buff colouration(A:Buff)	core at a small angle		
280.6-285.7: Green Volcaniclastic mudstone	222.6-227: Minor		Sph-Gal-Py
(? pyroclastic ash) (Pc-A) with	234.3-257.8: Minor Py		
a shear fabric		veins	
285.7-297.2: Volcaniclastic breccias and	289.6-297.2: Sph		Minor
epiclastic sandstones (Vc) Qtz,		in veins	
CO_3, Chl Veins			
288.7-293.5: Pyroclastic breccia			
with lapilli fragments (Pc-L)			
297.2-298.45: Black Shale (B-S)	297.2-298.45:Sph		↑ 1%
		in veins	
298.45-298.55: White Quartz			
298.55-313.6: Glomeroporphyritic Quartz-	310-313.6: Thin veins with		
Feldspar porphyry (QFP)		Py-CPY	Minor
298.55-299.7 Buff colour(A:Buff)			

Signature RHRoberts　　Date 1/11/84

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AUSTRALIAN ANGLO AMERICAN LIMITED

DRILLHOLE LOG

Summary Sheet 180095

PROJECT	EL 5/63 Pt 4	**AREA**	PINNACLES	**DRILLHOLE TYPE**	DDH
CO-ORDS		**DEC^{LN}** -60°	**AZIMUTH** 90: MN	**RL**	**DH No.** EAF-12
DATE COMMENCED 30/10/84	**DATE COMPLETED** 13/11/84	**DRILLED BY** LONGYEAR		**DRILL RIG** L/Y 38	
Non Coring to: 3m	**NQ Core to:** 53.8	**NQ Core to:** 285.4	**BQ Core to:**	**EOH** 285.4	

SURVEY DATA

Instrument:

DEPTH	DECLINATION Uncorr	DECLINATION Corr	AZIMUTH	DEPTH	DECLINATION Uncorr	DECLINATION Corr	AZIMUTH
0		-60	90°	285.4		-57.75	95
100		-60.75	93				
150		-59.25	96.5				
200		-59.0	95				
250		-58.0	94.5				

LOG SUMMARY

ROCK TYPE		MINERALIZATION		
0 - 3	No Core			
3 -37.1	Weathered green porphyry (G-Pf)			
37.1-41	Sericite altered green porphyry			
	(G-Pf, A: Se)			
41-49.7	Green porphyry with pink colouration			
	(G-Pf, A: Fe, Si)			
49.7-54.3	Altered green porphyry. Fragmented	49.7-54.3	Py	5 10%
	appearance resulting from pyrite-			
	silica alteration (G-Pf,A:Py,Si)			
54.3-77.3	Green porphyry (G-Pf, A: Fe, Si)			
77.3-86.3	Composite breccia of chert and	77.3-86.3	Minor Py	
	porphyry resulting from pyrite-			
	silica alteration (G-PfC,A:Py,Si)			
86.3-97	Altered green porphyry(G-Pf,A:Py,Si)			
97-106.8	Composite breccia (G-PfC,A:Py,Si)			
106.8-121.5	Green porphyry with buff			
	alteration(G-Pf, A:Fe, Si)			
121.5-141.5	Green porphyry with buff-chlorite			
	alteration(G-Pf,A:Fe,Si,Cl)			
141.5-152.5	Composite breccia of chert and	141-152.7	Minor Py	
	porphyry(G-PfC,A:Py,Si)			
152.5-157.4	Green pyroclastic (G-Pc)			
157.4-166.2	Volcaniclastics with a cherty	157.4-160	Minor Py-Cpy	
	component (Ch/Vc/S)	160-166.2	Pyrite	fragments
				1%
			Sph blebs	1%
166.2-211.85	Green Porphyry (G-Pf)	199.2-211.85	Minor Py in	
				veins

Signature RHRoberts Date 19/11/84

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AUSTRALIAN ANGLO AMERICAN LIMITED

DRILLHOLE LOG

Summary Sheet

180096

PROJECT	AREA	DRILLHOLE TYPE DDH
CO-ORDS DEC^LN	AZIMUTH RL	DH No. EAF-12
DATE COMMENCED	DATE COMPLETED	DRILLED BY / DRILL RIG

211.85-232: :Volcaniclastics and shale-cherty component (Ch/Vc/S)	211.85-219.9	Minor	Py in veins & layers
	219.9-222.7	Pyrite-rich layers Py up to 30%	
	222.7-229	Minor Py and blebs of Sph (± Gal)	
232-247.8 : Volcanic Breccia (Pc-L)			
247.8-256.9: Grey-green siliceous porphyry(P)			
256.9-264.6: Volcanic Breccia (Pc-L)			
264.6-269.6:Volcaniclastics and Shale (Vc/S)			
269.6-285.4:Quartz-Feldspar-Porphyry. Coarse Glomeroporphyritic quartz (QFP)			

Signature RHRobert Date 19/11/84

096

AUSTRALIAN ANGLO AMERICAN LIMITED
DRILLHOLE LOG
Summary Sheet

180097

PROJECT 5/63 PT 4	**AREA** PINNACLES		**DRILLHOLE TYPE** DDH
CO-ORDS	**DEC^LN^** -59° ;	**AZIMUTH** 090° MN **RL**	**DH No.** EAF-13
DATE COMMENCED 14/11/84	**DATE COMPLETED** 24/11/84	**DRILLED BY** LONGYEAR	**DRILL RIG** L/Y - 38
Non Coring to: 3m	**HQ Core to:** 41m	**NQ Core to:** 240.0m	**BQ Core to:**
EOH 240.0m			

SURVEY DATA

Instrument:

DEPTH	DECLINATION Uncorr	DECLINATION Corr	AZIMUTH	DEPTH	DECLINATION Uncorr	DECLINATION Corr	AZIMUTH
0		090	-59				
100		89	-60.75				
150		090	-60.5				
200		091	-60.5				
238		092	-60.0				

LOG SUMMARY

ROCK TYPE	MINERALIZATION		
0 - 3 : NO CORE			
3 - 34.5: Weathered green porphyry (G-Pf)			
34.5- 35.2: Silica flooded green porphyry (G-PfC)	Sph blebs		= 1%
35.2- 43.6: Green porphyry (G-Pf)			
43.6- 50.3: Green porphyry with silica alteration (G-Pf, A: Py, Si)			
50.3- 59.6: Green porphyry (G-Pf)			
59.6- 64.3: Buff-coloured porphyry (G-Pf, A: Buff)			
64.3- 67.8: Green porphyry (G-Pf)			
67.8-69.4: Volcaniclastic mudstone (Vc/S)	Sph/Py		Minor
69.4-129: Varies from fragments of green porphyry in grey chert to predom, green porphyry with thin veins of grey chert (G-Pf, A: S-Z)	Pockets of Sph/Py and lesser Gal with chert		= 1%
129-135.6: Intense chlorite-carbonate-minor pyrite alteration of green porphyry (almost black colour) (G-Pf/A:Cl, Co_3Py)	Sph/Py with Co_3		<1%
135.6-142.9: Grey chert with sulphides and minor fragments of green porphyry (Ex)	135.6-138.3	Py:	3-5%
		Cpy:	=1%
	138.3-143.9	Py:	=30%
		Cpy:	=1%
142.9-143.1: ? Fracture Zone: nodular silicified volcanic - Top contact 33°/CA, Button contact 45°/CA			
143.1-145.3: Silicified Volcanicl. (Vc/A:Si)			
145.3-162.2: Well bedded siliceous shales and pale green volcaniclastics (Vc/S)			

Signature [signature] **Date** 30/11/84

092

AUSTRALIAN ANGLO AMERICAN LIMITED
DRILLHOLE LOG
Summary Sheet

180098

PROJECT	AREA	DRILLHOLE TYPE DDH
CO-ORDS	DEC^LN : AZIMUTH RL	DH No. EAF-13

DATE COMMENCED	DATE COMPLETED	DRILLED BY	DRILL RIG

Non Coring to: HQ Core to: NQ Core to: BQ Core to: EOH 240.0m

SURVEY DATA Instrument:

DEPTH	DECLINATION Uncorr	DECLINATION Corr	AZIMUTH	DEPTH	DECLINATION Uncorr	DECLINATION Corr	AZIMUTH

LOG SUMMARY

ROCK TYPE	MINERALIZATION
162.2-178.7: Green porphyry (G-Pf)	
178.7-183.4: Grey, volcaniclastic mudstone to sandstone (Vc)	
183.4-184: Cream coloured volcanic with fuchsite specks D-P (A:Fu)	
184-192: Silicified volcaniclastics (Vc/A:Si)	
192-216: Pale yellow-green fine-grained volcaniclastic with foliation fabric(Pc-A/A:Co_3) contains spots and ragged patches of carbonate	192-201.5: Sulphide-rich blebs(Sph-Gal) with Co_3 = 1% 202.5-211.2: small(<1cm) clots of pyrite<1% 211.2-212.9: Blebs & lenses of sulphide(Gal-Sph-Py) with Co_3 = 20%
216-216.6: Grey shale (S)	216-216.6:Pyrite slugs-minor
216.6-222: Epiclastic breccia with large(>5cm) shale fragments (Ec-B)	
222-240: Lapilli tuff mixed with grey siliceous porphyry (Pc-L)	

Signature [signature] Date 30/11/84

098

AUSTRALIAN ANGLO AMERICAN LIMITED

DRILLHOLE LOG

Summary Sheet

180099

PROJECT	PINNACLES	AREA	5/63 Pt 4	DRILLHOLE TYPE	DDH
CO-ORDS	5384595.34N 377761.90E	DEC LN -54°	AZIMUTH 270°	RL 477.84	DH No. EAF-14
DATE COMMENCED	27/11/84	DATE COMPLETED 17/12/84	DRILLED BY LONGYEAR	DRILL RIG	L/Y 38
Non Coring to: 3m	HQ Core to: 48	NQ Core to: 334.5	BQ Core to:	EOH	334.5

SURVEY DATA

Instrument:

DEPTH	DECLINATION Uncorr	DECLINATION Corr	AZIMUTH	DEPTH	DECLINATION Uncorr	DECLINATION Corr	AZIMUTH
100		-54	271				
150		-53,25	?				
200		-50,25	273.5				
250		-50,25	274				

LOG SUMMARY

ROCK TYPE		MINERALIZATION
0 - 3	NO CORE	
3 - 22.7:	Glomeroporphyritic quartz feldspar porphyry (QFP)	
22.7-38.9:	Volcaniclastic Breccia (Vc-B)	
38.9-48:	Siliceous Lapilli tuff (Pc-L)	
48-52:	?Fault zone	
52- 67.8:	Grey-green siliceous porphyry (P)	
67.8-113.7:	Lapilli tuff (Pc-L)	
113.7-139.4:	Sequence of cherts, volcaniclastics and laminated black to grey-black shales (Ch/Vc/S) 128.6-133.8: Calcareous shales	113.7-139.4: Minor blebs and layers of Py + Sph
139.4-181.7:	Green Porphyry (G-Pf)	
181.7-198.2:	Mixture of volcaniclastics siltstones and breccias with cherts (Ch/Vc)	
198.2-207.9:	Intense pyrite-chlorite alteration (A: Py-Cl)(? G-Pf)	198.2-207.9: Coarse-grained Py cubes: disseminated, veined (1-2%) and in massive patches. 198.5-198.7: semi-massive Py (.50%) Cpy veins
207.9-216:	Angular fragments of green porphyry in chert (G-PfC, A:Py,Si,Cl)	
216-223.85:	Cherts and Volcaniclastics (Ch/Vc) (222.9-223.85: Intense pyrite-chlorite) alteration	216-222.9 Disseminated Pyrite (minor-5%) Minor Sph-Gal

Signature RHRobes Date 20/12/84

099

AUSTRALIAN ANGLO AMERICAN LIMITED
DRILLHOLE LOG
Summary Sheet

180100

DRILLHOLE TYPE: EAF-14

PROJECT	AREA			DH No.
CO-ORDS	DEC[LN]	AZIMUTH	RL	

DATE COMMENCED	DATE COMPLETED	DRILLED BY	DRILL RIG
Non Coring to:	HQ Core to:	NQ Core to:	BQ Core to: EOH

SURVEY DATA
Instrument:

DEPTH	DECLINATION Uncorr	DECLINATION Corr	AZIMUTH	DEPTH	DECLINATION Uncorr	DECLINATION Corr	AZIMUTH

LOG SUMMARY

ROCK TYPE	MINERALIZATION		
	222.9-223.85:Py		10-20%
223.85-227: Grey chert with sulphides	223.85-227: Py		5-40%
		CPY	1-5%
227-248.2: Pyroclastic ash(Pc-A)	227.248.2: Py-Minor-10%		
Pyrite-chlorite alteration(A:Py-Cl)		Cpy-Minor-1%	
248.2-268.1: Near-pure Co_3 units with	248.2-268.1:Py-Sph-Gal		
Co_3 altered pyroclastic ashes			1-4%
(Co_3/Pc-A/A: Pb-Zn-Co_3)			
268.1-272.5: Siliceous ash (Pc-A) (A:Si,Co_3)	268.1-272.5:Sph-Gal 1-2%		
272.5-282.6: Cherty pyroclastic ash (C-Pc_A)	272.5-282.6: Minor sulphides		
282.6-287.6: Green Porphyry (G-Pf)			
287.6-306.9: Cherty pyroclastic ash (C-Pc-A)			
306.9-330.7: Altered pyroclastic ash			
(Pc-A) (A:Se, Cl, Co_3)			
330.7-334.5: Green Porphyry (G-Pf)			

Signature RHRoberts Date 20/12/84

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AUSTRALIAN ANGLO AMERICAN LIMITED
DRILLHOLE LOG 180101
Summary Sheet

Page 1 of 1

PROJECT	PINNACLES	AREA	5/63 PT. 4	DRILLHOLE TYPE	
CO-ORDS	5384569.0 N 377774.8 E	DEC^LN	-50°	AZIMUTH 289° M.N. RL 478-5	DH No. PP-31
DATE COMMENCED	7/4/48	DATE COMPLETED 2/6/48	DRILLED BY E.Z. Co.	DRILL RIG	

Non Coring to: 18.9 M ~~HQ Core to:~~ ~~NQ Core to:~~ AX ~~BQ~~ Core to: 186.24 M EOH 186.24

SURVEY DATA
Instruments:

DEPTH	DECLINATION Uncorr	DECLINATION Corr	AZIMUTH	DEPTH	DECLINATION Uncorr	DECLINATION Corr	AZIMUTH

LOG SUMMARY

ROCK TYPE		MINERALIZATION Style		Grade	Intersection width (Corr)
0 - 18.9	No Core				
18.9 - 48.8	Volcaniclastics and shales (Vc/S)				
48.8 - 57.9	Siliceous pyroclastic (? Pc-L)				
57.9 - 112.2	Distinctive unit of siliceous pyroclastic breccia with lapilli-sized fragments: lapilli tuff (Pc-L)				
112.2 - 129	Mixture of well-bedded shales, siltstones, epiclastics, volcaniclastics and minor cherts. (Ch/Vc/S).				
129 - 142.3	Green feldspathic porphyry (G-Pf) - parts contain amygdales				
142.3 - 153.1	Fine-grained cream coloured sil. volcanic with chlorite veins (B-P)				
153.1 - 167	Black shales, grey sulphide-bearing chert, grey-white chert, and cherty volcaniclastics (Ex)		153.1 - 167	Veins and patches of Py/Sph/	Cpy 1-3%
167 - 186.24	Green porphyry - pink silicification and apparent fragmented texture (G-Pf; A: Fe, Si)				

Signature [signature] Date /6/84

APPENDIX 4

Downhole and Surface Geochemistry Summary

Geochemical Data Refer To
Blocks Shown On TAS/2/4203 to 4208

DATA MATRIX

FILENAME B:BRWGEO.DAT

	FROM	TO	M	Cu	Pb	Zn	Ag	Au	CLASS
ESB 1-1	68.5	71	2.5	25	195	1320	0	.244	W.ANOM
EAF 1-1	82	84.4	2.4	50	160	.33	1	.02	W.ANOM
EAF 2-1	45.45								
		95	49.55						
				75	919	.39	1.92	.023	W.ANOM
EAF 2-2	107.26								
		113	5.74	30	702	.21	1.39	.021	W.ANOM
EAF 3-1	73	95.6	22.6	227	1051	.35	2.6	.043	W.ANOM
EAF-3 2	3.25	7.	3.75	447	753	.66	5.2	.52	EX
EAF-3 3	29	32	3	1142	1475	.33	8	.157	EX
EAF 3-4	32	35.7	3.7	.48	.61	2	19.3	.4	SUB ORE
EAF 3-5	35.7	38.5	2.8	1.49	8.55	13.56			
							89.6	14.4	ORE
EAF 4-1	3.65	14.4	10.75						
				193	794	.38	2.8	.37	EX
EAF 4-2	33.4	36.4	3	.68	1.18	3.02	27.7	.247	SUB ORE
EAF 4-3	36.4	39.7	3.3	.25	.41	.48	20.5	6.55	ORE
EAF 4-4	39.7	43.3	3.6	463	.32	.715	5.2	.17	EX
EAF 4-5	43.3	44.25							
			1.6	1.46	4.66	8.16	61.7	.61	ORE
EAF 4-6	50.9	52.3	1.4	.69	4.94	25.76			
							266.7		
								1.24	ORE
EAF 5-1	8	15.9	7.9	532	1584	.21	1.9	.055	ANOM
EAF 5-2	19.5	28.1	8.600001						
				188	1490	.33	4.47	.112	EX
EAF 6-1	42.2	48.6	6.4	190	775	3395	2.2	.27	EX
EAF 6-2	48.6	56.6	8	1593	.916	3.48	21	.44	SUB ORE
EAF 6-3	56.6	59.6	3	1.1	5.72	17.64			
							171	.6	ORE
EAF 6-4	59.6	74.5	14.9	.195	1.22	1.94	9.600001		
								.12	SUB ORE
EAF 7-1	105.3								
		117.8							
			12.5	127	1148	.41	1.7	.025	W.ANOM
EAF 7-2	149	154	5	330	440	.56	4.6	0	W.ANOM
EAF 7-3	154	168.8							
			14.8	814	1180	2977	15.8	.054	EX
EAF 8-1	42.4	53.45							
			11.05						
				25	714	3157	.18	9.000001E-02	
									W.ANOM
EAF 8-2	74.8	92.8	18	692	2100	11200			
							5.11	.195	EX
EAF 9-1	131.7								
		146	117.1						
				34	522	3012	.003	.003	W.ANOM
EAF 9-2	146	162	16	762	772	.584	12.3	.26	EX
EAF 9-3	162	173.1							
			11.1	.96	8.01	18.92			
							93	4.74	ORE
EAF 9-4	173333.1								
		173.1							
			2	.79	.215	1900	75	.095	Cu-Ex
EAF 9-5	175.1								
		182.82							
			7.72	.54	.108	.109	60	.05	Cu-FW
EAF 9-6	182.82								
		201.9							

			19.08						
				.52	.124	5.13	25	.11	Sub-Ore FW
EAF 9-7	201.9								
		211.9							
			10	.13	943	1.3	6.1	.03	FOOT-PIPE
EAF 9-8	211.9								
		220.5							
			8.600001						
				542	864	.39	4.9	.006	FOOT-PIPE
EAF 9-9	236.5								
		238.5							
			2	38	.225	9.000001E-02			
							4.25	.045	PB-Zn-Co3
EAF 10-1	80	97	17	35	307	1493	0	.005	W.Anom
EAF 10-2	98	101	4	2.16	5.96	26.36			
							175	2.39	ORE
EAF 10-3	112	116	4	1.54	.39	10.56			
							50	.37	ORE
EAF 10-4	101	112	11	.356	.49	3.11	23	.029	SUB ORE
EAF 10-5	136	141	5	.354	.25	6.02	4	.12	SUB ORE
EAF 10-6	141	147	6	217	1142	2392	0	.07	W.Anom
EAF 10-7	194.1								
		236.7							
			42.6	485	1090	.64	3.4	.06	FOOT PIPE
EAF 11-1	203	217	14	87	.2	.72	4.4	.03	Pb-Zn-Co3
EAF 11-2	217	219	2	.61	6.55	5.94	24	0	Co3 ORE
EAF 11-3	219	223	4	313	.44	.68	7	.04	Pb-Zn-Co3
EAF 12-1	157.4								
		167.2							
			9.8	215	862	2181	4.9	.11	W.ANOM
EAF 12-2	212.85								
		234.85							
			22	67	340	2477	2.3	.05	W.ANOM
EAF 13-1	69.8	135	65.2	384	1039	1.08	4.6	.067	FOOT PIPE
EAF 13-2	135	143	7	.47	.31	.82	42	.13	EX
EAF 13-3	146	166	20	66	800	1879	2.1	.029	W.Anom
EAF 13-4	178	211.2							
			33.2	71	261	1583	1.3	.017	W.Anom
EAF 13-5	211.2								
		212.9							
			1.7	500	1.63	1.72	5	.01	Pb-Zn-Co3
EAF 14-1	122	142	20	81	866	.33	2.1	.003	W.Anom
EAF 14-2	190	197.2							
			7.2	54	465	1850	2.9	.024	W.Anom
EAF 14-3	197.2								
		200	2.8	.59	643	.41	13.8	.033	Cu-Fw
EAF 14-4	216	228.6							
			12.6	.31	.24	.23	18.6	.084	Cu-Ex
EAF 14-5	241	248.2							
			7.2	.44	374	604	19.6	.033	Cu-Fw
EAF 14-6	248.2								
		272.5							
			24.3	410	.98	.96	2.9	.099	Pb-Zn Co3
EAF 14-7	272.5								
		282.7							
			10.2	274	.15	.19	3.16	.017	Pb-Zn-Co3
EAF 14-8	287.6								
		306	18.4	108	.29	.44	2.7	.034	Pb-Zn-Co3

APPENDIX 4A

Brown's Workings Surface Geochemistry

: Geochemical Data Refer to Blocks Shown on TAS/2/4209

NB Cu, Pb, Zn values 1000 ppm are
expressed as % (2 dec.places)

ABBREVIATIONS

TN - Trench north side
TS - Trench south side
TL - Tunnel
OC - Open Cut

DATA MATRIX

FILENAME B:BRNGEO.DAT

	FROM	TO	M	Cu	Pb	Zn	Ag	Au	CLASS
Rig Tk 1	141	147	6	342	.24	83	59.3	.48	Au-Ag
Rig Tk 2	171	202	31	.12	.13	.26	7.1	9.000001E-02	Ex
Rig Tk 3	207	210	3	260	100	152	18.3	.11	Au-Ag
Rig Tk 4	0	1	1	.68	12.44	25.97	173	3.92	ORE
Brn Tn	159	166	7	471	.26	.35	10.3	.34	Au-Ag
Brn TS 5	158.3	160.2	1.9	471	.26	.35	10.3	.34	Au-Ag
Brn Tn 6	157.6	159	1.4	2.12	2.39	26.37	146	13.33	ORE
Brn Tn 7	128 "1M" SAMPLES		48.5	463	.38	.24	14.6	.65	Au-Ag
Brn Oc 8	0	3.5	3.5	923	.55	.26	30.3	4.59	Au-Ag
Cst 14 9	0	2.3	2.3	328	233	353	121.5	2.76	Au-Ag

APPENDIX 5

Derivation of a $53 "Ore" Cut Off

MEMORANDUM

To : RWLS CC : IGPW

From : GAB

Re : PINNACLES CUT OFF GRADE

Date : 14.9.84

You have asked me to advise what cut off you might use in calculating reserves at Pinnacles using two alternative scenarios:

a) As a gold mine.

b) As a base metal mine with precious metal credits.

It is too early (for lack of knowledge on the deposit) to give you any enduring advice. Too much depends on the mineralisation, recoveries, production rate, mine parameters and methods, marketing arrangements and, of course, metal prices. However, as a guide for present studies I suggest the following.

As a Gold Mine

Total treatment charge to bullion	=	$70/t
Variable cost component 50%	=	$35/t
Recovery to bullion	=	85%
Mining dilution	=	15%
Medium term gold price	=	$16/g
Therefore:		
Adjusted marginal cost	:	$48/t
Cut off grade calculated	:	3.0 g/t

If you also have appreciable silver, you might substitute for the above a combined cut off for Au/Ag by substituting at a rate of 100 g Ag = 1 g Au.

I must point out that running a gold treatment operation on ores containing significant base metal values can be very expensive in cyanide consumption, but for grades of around 4g/t would not be prohibitive.

As a Base Metal Mine with Precious Metal Credits

Assume all ore is sold to EZ Rosebery primary crushed.

Total cost delivered to Rosebery	:	$55/t	
Rosebery treatment charge	:	$15/t	
Variable cost component 65%	:	$45/t	
Mining dilution	:	15%	
Recovery to concentrate	:	Zn	90%
		Pb	70%
		Cu	50%
		Au	50%
		Ag	70%
Realisable value of metal in concentrates as part of respective metal values	:	Zn	50%
		Pb	60%
		Cu	50%
		Au	80%
		Ag	90%
Medium term metal prices	:	Zn	$1 200/t
		Pb	$500/t
		Cu	$1 500/t
		Au	$16/g
		Ag	$0.30/g

.../2

Therefore if we assume an overall average geological orebody grade of

:	Zn	7%
	Pb	9%
	Cu	0.4%
	Au	4g
	Ag	225g

then we end up with a realisable net value of each tonne of ore in the ground of

:	Zn	$ 38
	Pb	$ 19
	Cu	$ 2
	Au	$ 26
	Ag	$ 42
	Total	$127

Therefore:

Adjusted marginal cost = $53/t

Cut off grade calculated = 42% of average geological grade

Assuming then that the ratios of metal values of ore remain constant (which is a very heroic thing to do of course) you come down to a gold value in cut off grade of 1.7g/t. By giving you all the recoveries, realisable parts and prices above you can do your own calculations according to the likely ingredients of cut off ore in the various parts of the orebody. The critical factor is to keep the net realisable insitu value above $53/t.

Generally speaking, I expect our ability to contract the tonnage through EZ will depend on our zinc level and their other contract arrangements. Now that NBH has taken over EZ, the Risdon refinery is fed 100% from internal sources; roughly one third of concentrates coming from each of:

EZ Rosebery (incl Que River)
EZ Elura
NBH Broken Hill

They may not want further tonnages, but then with Hellyer, Aberfoyle might go its own way and make some space at Rosebery.

Good luck.

G A Buckett

GAB:rpb

To. Norm McM.
From. RWLS.
Subject. Pinnacles EAF drilling.
Date. 18/9/84.

I have the following formulae to pemit $ e,uivalent values to be calculated for the analytical results from the EAF drilling.

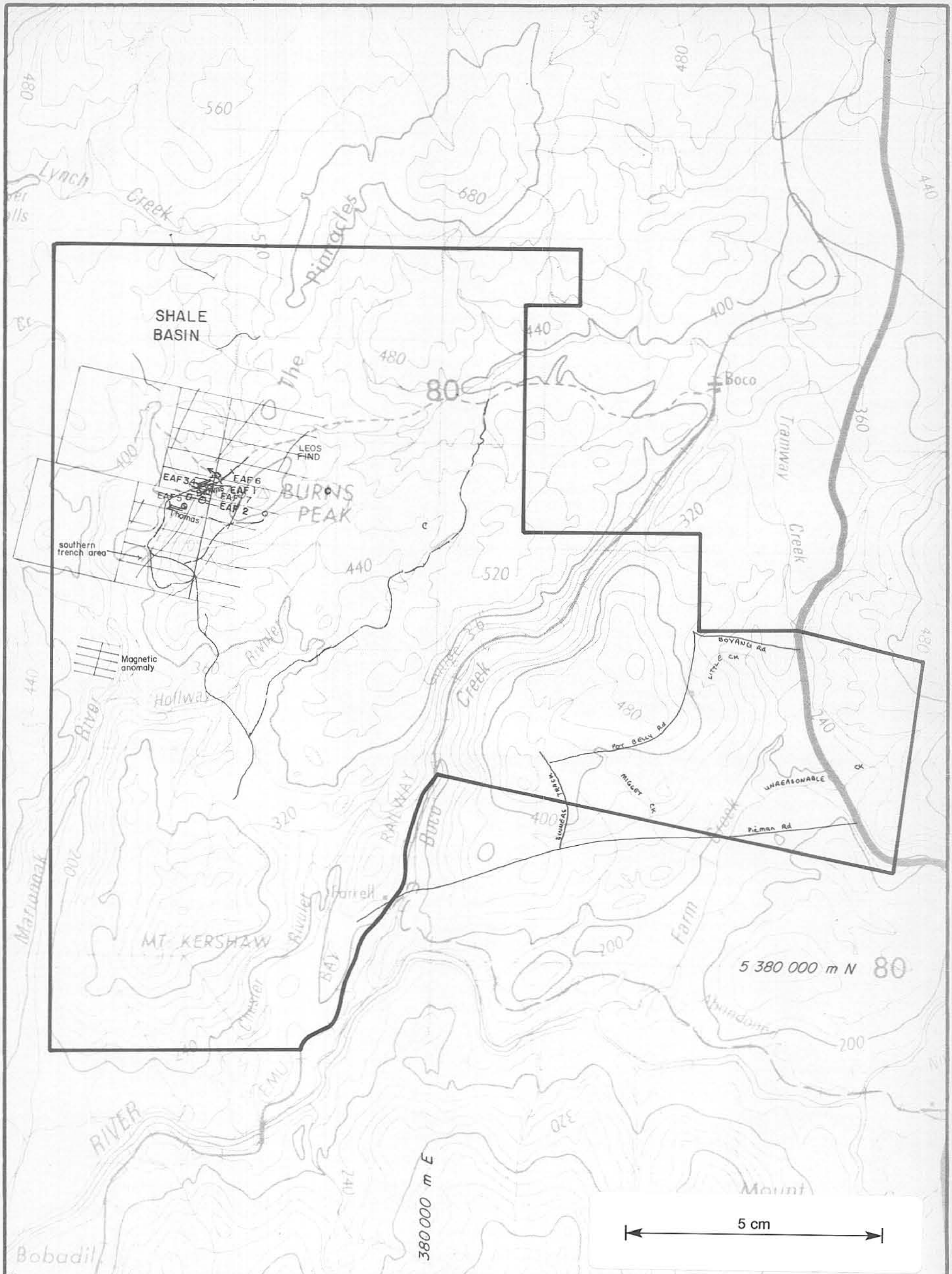
Au	ppm	x	6.4	=	$
Ag	ppm	x	0.19	=	$
Cu	%	x	3.75	=	$
Pb	%	x	2.1	=	$
Zn	%	x	5.4	=	$

Please apply these formulae to the results, sum the products for each i interval and using the proceedure established in the E. Renison study length weight the products for intervals exceeding the designated cut off $ value which is $53.

Rgds.

110

180111



LEGEND

- Access rd/walking track construction
- Grid lines cut
- Grid line/drainage surveying
- Grid line/drainage sampling
- Geophysical survey
- Geological mapping
- Drilling

COMSTAFF PROPRIETARY LIMITED

EL 5/63 AREA 4
CHESTER/PINNACLES
PLAN TO ACCOMPANY MONTHLY REPORT FOR JANUARY 1985

COMPILED	DRAWN	SCALE	
R.H.R.	GEODRAFT	1 : 50 000	TAS/2/1801

85-2386

180112

HOLE NUMBER	R.L.(m)
◎ DDH ESB 1	479·71
○ DDH EAF 1	469·21
○ 2	465·53
○ 3	471·25
○ 4	471·25
○ 5	460·08
○ 6	478·60
○ 7	477·74
○ 8	488·74
○ 9	490·07

5 cm

Note : For geological legend see sheet 3991.

3990

3991

N

85-2386

COMSTAFF PROPRIETARY LIMITED

LEASE No EL 5 /63	001	COMPILED R. H. ROBERTS
AREA 4	PINNACLES GRID - EAF	DRAWN J. HARDISTY
AMENDMENTS 1 25/10/84 2 19/12/84 3 25/3/85	GEOLOGICAL INTERPRETATION PLAN	DATE 12/9/84
		SCALE 1 : 2500
		REF No TAS/2/3990

GEOPHYSICAL LEGEND

✱ ♦ } For description see 1984 UTEM report

GEOLOGICAL LEGEND

INTRUSIVES

Q.f.P.	glomeroporphyritic quartz-feldspar-porphyry

LAVAS ?

Pf	felsic porphyry – typically contains quartz and feldspar phenocrysts
G-Pf	green porphyry – predominantly quartz-feldspar porphyritic lavas (andesitic to dacitic composition)
B-P	buff coloured non-porphyritic volcanic
an	andesite

PYROCLASTICS

Pc	undifferentiated pyroclastics
Pc-L	lapilli tuff – typically contains angular fragments of pink and green porphyry
Pc-A	ash tuff : pale green fine grained siliceous ash
Pc-Ap	wavy (?eutaxitic) texture developed in ash
C-Pc-A	silica rich pyroclastic ash – typically contains "cherty" nodules
Pc-A(ch)	pyroclastic ash containing blocks of "cherty" material
Si-Pc-A	intensely silicified pyroclastic ash

VOLCANICLASTICS AND SEDIMENTS

Ch/Vc/S	undifferentiated mixture of cherts, volcaniclastics and shales, "host" within the volcanics to pyritic and massive sulphide mineralisation
Ch	chert (or cherty) units
Vc	undifferentiated volcaniclastics
Vc-B	volcaniclastic breccia – typically consists of coarse (<10cm) porphyritic fragments – varies in colour from pink to green, and is commonly silicified (A: Si)
Vc/S	mixture of volcaniclastic and shales
S	shales or shaley (volcaniclastic mudstone) units
B-S	black shale and well bedded shale
Ec	undifferentiated epiclastics
Ec-B	epiclastic breccia
C-B	composite breccia – mixture of two rock types generally formed as a contact facies

WESTERN SERIES SEDIMENTS

S-B	thinly bedded grey-black shales (commonly calcareous) – part of shale basin
xl.tu.ss	crystal rich tuffaceous sandstone, consists predominantly of quartz and feldspar crystal fragments

MINERALISATION

- (stippled) presence of sulphides – predominantly pyrite
- (solid black) massive sulphide : Cu – Pb – Zn – Py mineralisation

3990	
3991	

N

85-2386

COMSTAFF PROPRIETARY LIMITED

LEASE No EL 5 /63	PINNACLES GRID – EAF 002	COMPILED R. H. ROBERTS
AREA 4		DRAWN J. HARDISTY
AMENDMENTS 1 25/3/85 8; 2 9; 3 10; 4 11; 5 12; 6 13; 7 14	GEOLOGICAL INTERPRETATION PLAN	DATE 12/9/84
		SCALE 1 : 2500
		REF No TAS/2/3991

No	LOCATION	DISTANCE			AVERAGE	Au	Ag	Cu	Pb	Zn
1	THOMAS' TUNNEL	53·0	—	70·6	9	0·02	2	299	0·49%	992
2	"	70·6	—	71·6		0·05	2	61	0·38%	600
3	"	71·6	—	71·9		0·17	38	1314	6·32%	0·96%
4	"	71·9	—	72·9		0·30	67	1833	16·13%	2·04%
5	"	72·9	—	74·3		0·17	75	181	6·15%	2·91%
6	"	74·3	—	75·3		0·06	64	144	2·42%	1·25%
7	"	75·3	—	76·3		0·13	993	403	6·66%	5·09%
8	"	76·3	—	77·6		0·08	134	203	6·35%	3·14%
9	"	77·6	—	78·6		0·05	28	28	2·10%	1·71%
10	"	78·6	—	104·4	13	0·02	4	163	1995	0·66%
11	"	142·5	—	179·3	12	0·02	1	104	1006	1036
12	" main zone	71·6	—	78·6	7	0·13	200	474	6·58%	2·65%
13	BROWNS TRENCH 1 (N)	156·6	—	157·6		0·10	2	85	125	508
14	" main zone	157·6	—	159·0		13·33	146	2·12%	2·39%	26·37%
15	"	159·0	—	160·0		0·16	8·2	308	2736	881
16	"	160·0	—	163·0		0·36	9·1	203	0·24%	0·19%
17	"	163·0	—	166·0		0·16	5·5	54	0·14%	527
18	" (S)	157·3	—	158·3		0·07	X	X	258	212
19	"	158·3	—	159·2		0·77	33	2851	0·72%	1·67%
20	"	159·2	—	160·2		0·60	10	548	0·26%	0·79%
21	BROWNS TRENCH 2 (N)	10·7	—	14·7	2	0·02	1·4	21	131	198
22	"	14·7	—	17·5	2	0·05	2·3	33	220	203
23	"	17·5	—	18·5		0·11	5	50	2000	350
24	"	18·5	—	20·5	2	0·04	2	28	248	188
25	" (S)	13·7	—	15·5		0·03	2	25	95	210
26	"	15·5	—	17·0		0·01	1·5	20	330	125
27	"	17·0	—	19·9		0·09	3·0	25	525	245
28	BROWNS TRENCH 3	3·0	—	5·0		0·02	1	10	55	35
29	"	5·0	—	10·0	2	0·02	1	10	43	30
30	"	10·0	—	17·0	4	0·01	1	10	75	33
31	"	17·0	—	19·0		0·03	1	20	85	50
32	BROWNS TUNNEL (N)	-7·0	—	-1·0	2	0·06	4	75	1288	275
33	"	-1·0	—	0·0		0·20	5	25	950	175
34	"	0·0	—	3·0	3	0·18	44	0·37%	1·35%	2·14%
35	"	3·0	—	4·0		2·16	11	175	1825	850
36	"	4·0	—	5·0		1·44	9	125	1525	1225
37	"	5·0	—	6·0		2·52	13	200	2050	1000
38	"	6·0	—	14·0	8	0·10	9	275	2663	1138
39	"	14·0	—	15·0		1·26	9	350	2475	1450
40	"	15·0	—	19·0	4	0·28	16	88	0·35%	913
41	"	19·0	—	29·0	10	0·48	14·5	700	4110	2358
42	"	29·0	—	30·0		1·62	15	1050	1600	3325
43	"	30·0	—	31·0		3·70	16	825	4950	2825
44	"	31·0	—	32·0		5·15	25	725	0·78%	4075
45	"	32·0	—	33·0		4·33	19	450	3800	2575
46	"	33·0	—	34·0		2·92	22	475	0·86%	3575
47	"	34·0	—	35·0		1·16	13	175	2325	1875
48	"	35·0	—	36·0		1·02	18	100	4325	700
49	"	36·0	—	37·0		1·73	17	225	1775	750
50	" main zone	29·0	—	37·0	8	2·70	18	503	4409	2425
51	"	37·0	—	45·0	8	0·39	8	488	2672	2566
52	" (S)	-7·0	—	-1·0	2	0·10	10	88	2000	425
53	"	-1·0	—	0·0		0·11	11	100	1375	275
54	"	0·0	—	1·0		0·23	17	125	3575	250
55	"	1·0	—	2·0		2·02	18	150	1925	525
56	"	2·0	—	3·0		1·29	57	600	3275	1225
57	"	3·0	—	6·0	3	0·48	16	1100	5833	6900
58	"	6·0	—	19·0	11	0·11	6	125	3677	1309
59	"	19·0	—	29·0	10	0·73	21	448	0·65%	3520
60	"	29·0	—	30·0		1·67	6	875	2100	1825
61	"	30·0	—	31·0		0·72	8	375	2225	950
62	"	31·0	—	32·0		7·45	6	125	800	1125
63	"	32·0	—	33·0		0·64	8	375	2650	850
64	"	33·0	—	34·0		0·68	9	550	3425	1775
65	"	34·0	—	35·0		1·76	12	425	0·89%	2475
66	"	35·0	—	36·0		3·29	14	200	3600	2100
67	"	36·0	—	37·0		1·19	37	1650	1·00%	4800
68	" main zone	29·0	—	37·0	8	2·19	13	572	4213	1988
69	"	37·0	—	45·0	8	0·59	19	366	3434	2119
70	" cross cut 1				10	0·29	6	243	2703	1093
71	" cross cut 2				21	0·60	11	460	6588	4117
72	BROWNS OPEN CUT	0·0	—	1·0		0·42	3	27	1494	109
73	"	1·0	—	1·5		2·67	68	516	2·71%	0·73%
74	"	1·5	—	2·5		13·66	50	0·27%	1652	1043
75	"	2·5	—	3·5		0·66	19	244	0·26%	0·43%
76	" main zone	1·0	—	2·5	1·5	10·00	56	1972	1·01%	0·31%
77	McGUINESS WORKINGS	5·0	—	8·0		0·00	6·5	110	355	1100
78	"	8·0	—	8·9		0·13	7·5	110	1300	550
79	"	8·9	—	11·0		0·15	17·5	1350	4300	1·70%
80	COSTEAN 17 A	48·0	—	49·0		0·14	8·5	580	2300	5300
81	COSTEAN 17 W	58·5	—	59·5		0·94	28·5	0·5%	1·55%	12·0%
82	McGUINESS SHAFT	Z 3447 (grab)				5·71	18·0	1925	2025	0·60%
83	"	Z 3448 (grab)				46·20	84·0	0·37%	8·28%	14·33%
84	PP 46				2·4	0·93				
85	PINNACLES TRAMWAY RD	Z 3415 (grab)				1·24	233	2·12%)	19·53%	39·63%
86	DUNIAMS DIGGINGS	0·0	—	1·3		0·14	3·5	50	180	60
87	COSTEAN 14	0·0	—	1·0		5·07	260·0	625	275	650
88	"	1·0	—	2·3		0·98	15·0	100	200	125
89	"	2·3	—	3·3		0·09	1	75	100	50
90	COSTEAN 14 B	20·0	—	34·0	7	0·01	1	23	346	79
91	"	34·0	—	38·0	2	X	X	25	50	63
92	RIG TRACK	116	—	141	11	0·03	2	45	186	802
93	"	141	—	147	3	0·48	59·3	342	0·24%	83
94	"	147	—	171	9	0·02	2	40	632	74
95	"	171	—	175	2	0·13	14	0·22%	988	0·39%
96	"	175	—	191·5	11	0·06	4	0·12%	0·14%	0·22%
97	"	191·5	—	192·5	1	0·32	4	625	725	550
98	"	192·5	—	195·5	4	0·03	5	613	769	0·11%
99	"	195·5	—	202	8	0·13	12	938	0·18%	0·36%
100	"	202	—	207	4	0·05	3	35	65	115
101	"	207	—	210	2	0·11	18·3	260	100	152
102	"	210	—	235	5	X	X	25	45	125
103	DRILL PAD "A"	0·0	—	3·0	3	X	X	200	650	433
104A	DRILL PAD "B"		1m			2·99	154	0·78%	5·17%	19·44%
104B	"		1m			4·85	192	0·58%	19·71%	32·49%
105	ABOVE DDH EAF 5	0·00	—	10·00	10	0·02	2	55	409	319
106	"	10·00	-	11·00	1	X	X	X	X	50
107	DRILLSITE EAF 7	0·0	—	4·0	4	X	X	10	215	25
108	"	4·0	—	19·0	5	X	0·4	X	26	30
109	DRILLSITE EAF 8	0·0	—	12·0	12	X	0·5	X	18	25
110	"	12·0	—	29·0	9	X	0·5	5	30	36
111	DRILLSITE EAF 9	0·0	—	6·0	3	X	1·6	X	92	X
112	"	6·0	—	14·0	4	X	0·5	19	141	111
113	"	14·0	—	26·0	6	X	0·5	7	23	8
114	DRILLSITE EAF 10	0·0	—	23·0	8	X	X	6	10	4
115	BROWNS TRENCH 2A	0·0	—	4·0	4	X	0·4	5	22	24
116	"	4·0	—	10·0	6	0·017	0·3	14	182	24
117	"	10·0	—	13·0	3	X	X	7	8	12
118	BROWNS TRENCH 3A	0·0	—	1·0	1	X	X	5	5	15
119	"	1·0	—	6·0	5	0·762	0·64	4	14	8
120	TRACK TO B1	25·0		26·1	1	0·04	5·5	90	0·48%	950
121	COSTEAN 17 A	57·0		59·8	2	0·02	2·5	178	0·37%	0·78%

FOR DETAILS SEE TAS/2/4057

85-2386

COMSTAFF PROPRIETARY LIMITED

LEASE No	EL 5/63
AREA	4
AMENDMENTS	1 3/9/84

PINNACLES GRID - EAF
BROWNS WORKINGS AREA
CHANNEL SAMPLING RESULTS
FOR Au

003

COMPILED	R. H. ROBERTS
DRAWN	J. HARDISTY
DATE	22/8/84
SCALE	1 : 1000
REF No	TAS/2/4058


NOTE :- FOR LEGEND SEE TAS/2/4182
massive sulphide
pyrite and minor base metals
ch chert
outcrop
glacial cover
glacial cover
G-Pf
G-Pf
Pc-L
Pc-A
Pc-A
Pc-A
Pc-L
Pug
Vc-M
Ex
Q.F.P.
Ch/Vc/S
Ch/Vc/S
Ec-B
DDH EAF 11
DDH ESB 1
DDH EAF 12
DDH EAF 8
DDH EAF 10
DDH EAF 13
DDH EAF 6
DDH EAF 9
DDH EAF 7
DDH EAF 14
DDH EAF 1
DDH PP 31
DDH EAF 2
5 384 500 m N
377 500 m E
180115
5 cm
85-2386
COMSTAFF PROPRIETARY LIMITED
EL 5/63
4
BROWNS WORKINGS AREA
004
GEOLOGICAL INTERPRETATION PLAN
R. H. ROBERTS
J. HARDISTY
24/1/85
1 : 1000
TAS/2/3893

180116

85-2386

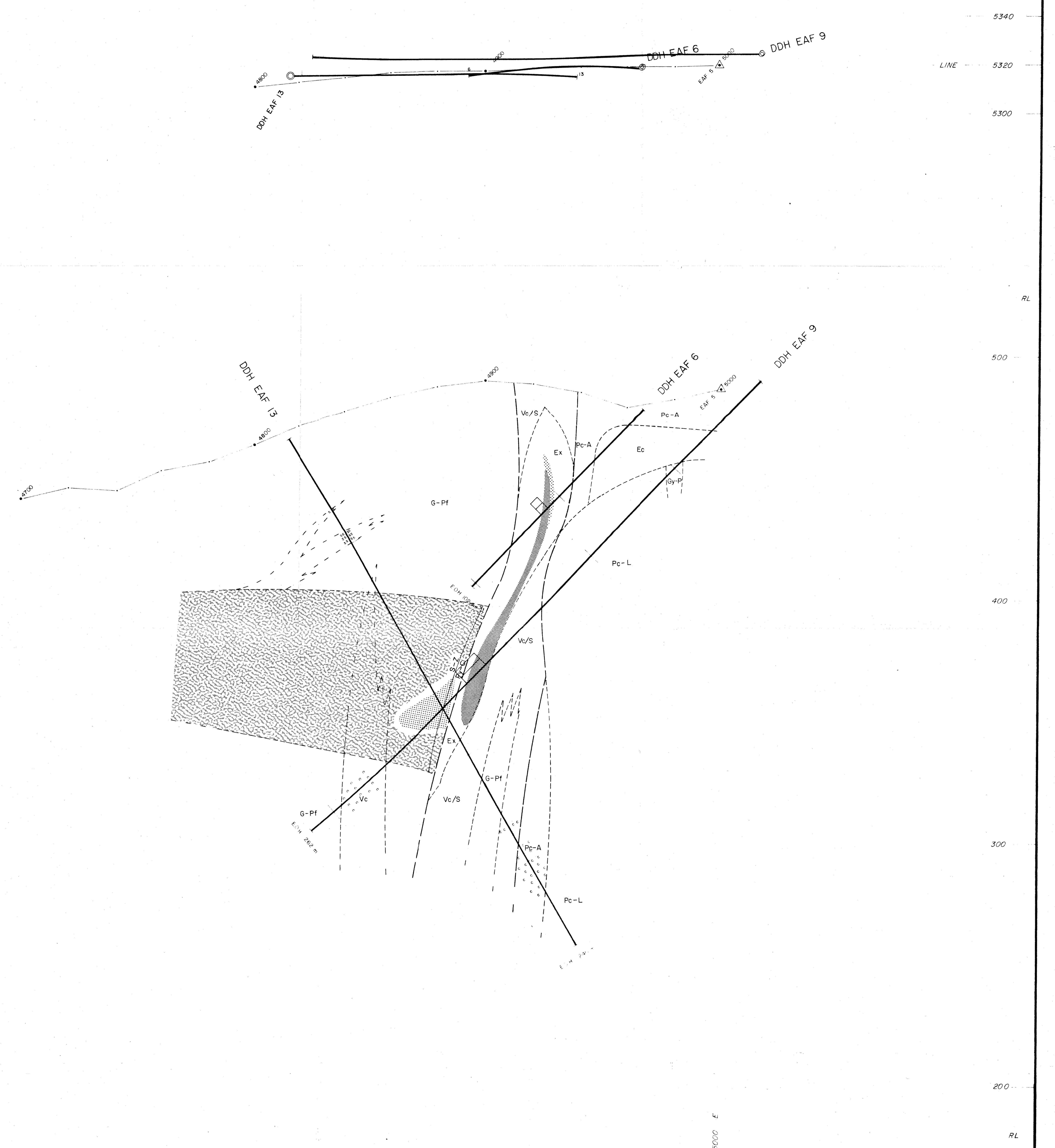
NOTE:- FOR GEOLOGICAL LEGEND SEE TAS/2/4182

5 cm

COMSTAFF PROPRIETARY LIMITED

LEASE No. EL 5/63	PINNACLES GRID – EAF	COMPILED R. H. ROBERTS
AREA 4	SECTION OF LINE 5280 N	DRAWN J. HARDISTY
AMENDMENTS	005	DATE 24/1/85
	GEOLOGICAL INTERPRETATION	SCALE 1 : 1000
		REF. No. TAS/2/4181

SECTION ORIENTATION 270° MN



GEOLOGICAL LEGEND

HANGING WALL

40	Q.F.P.	glomeroporphyritic Quartz-Feldspar-Porphyry
19	Pc-L	lapilli tuff
19	Gy-P	grey siliceous porphyry (within lapilli tuff)
2	Ec	epiclastic (Ec-B: epiclastic breccia)

HOST HORIZON

8	Ch/Vc/S	undifferentiated cherts (Ch), volcaniclastics (Vc) and shales (S) – individual groups (e.g. Vc) or various combinations (e.g. Vc/S) can dominate
8	Vc-M	grey volcaniclastic mudstone
19	Ex	predominantly grey chert associated with sulphides (including lenses of massive sulphides) "exhalite" unit

MIXED FOOTWALL - HOST HORIZON UNITS

45	B-P	fine grained non-porphyritic volcanic – typical buff-green colour (? chilled lava phase)
45	G-PfC	composite breccia of green porphyritic lava fragments and grey chert
45	G-Pc	pyroclastic unit consisting predominantly of green porphyritic (? lava) fragments (? hyaloclastite)-typically foliated – with increasing chert component G-Pc grades into G-PfC

FOOTWALL

47	G-Pf	green porphyry-predominantly quartz-feldspar porphyritic lavas (associated pyroclastic phases) - andesitic to dacitic in composition

FOOTWALL - HANGING WALL

31	Pc-A	pyroclastic ash (ash tuff) (A·Si – silicified Pc-A, typically with minor sulphides)
31	C-Pc-A	cherty pyroclastic ash – siliceous cherty nodules in an ash matrix

ALTERATION ZONES

	siliceous alteration of green porphyry (Si-flooding) - varies from diffuse grey siliceous veins to composite breccias of chert and porphyry
S-Z	Zn rich "stringer zone": with veins (5-30mm) of grey chert and sphalerite (minor galena and chalcopyrite)-associated sericite-chlorite alteration of porphyry (pale yellow-green colouration)
Py-Cl	black chlorite-pyrite(-sericite) alteration of green porphyry and pyroclastic ash - parts distinctly associated with stringer veins of chalcopyrite-chlorite (black colouration related to the presence of Mg rich chlorite)
Pb-Zn-CO_3	carbonate alteration of pyroclastic ash - associated diffuse Pb-Zn mineralization (minor veining)
	nodular carbonate alteration – peripheral style of the Pb-Zn-CO_3 alteration

MINERALIZATION

- > $53 cut off mineralization
- > $35 cut off mineralization

5 cm

180117

85-2386

COMSTAFF PROPRIETARY LIMITED

LEASE No. EL 5/63	PINNACLES GRID - EAF SECTION OF LINE 5320 N 006 GEOLOGICAL INTERPRETATION	COMPILED R. H. ROBERTS
AREA 4		DRAWN J. HARDISTY
AMENDMENTS 1 2 3 4 5 6 7 / 8 9 10 11 12 13 14		DATE 24/1/84
		SCALE 1 : 1000
		REF. No. TAS/2/4182

NOTE :- FOR GEOLOGICAL LEGEND SEE TAS/2/4182

5 cm

180118

85-2386

COMSTAFF PROPRIETARY LIMITED

LEASE No EL 5/63	PINNACLES GRID - EAF SECTION OF LINE 5360 N 007. GEOLOGICAL INTERPRETATION	COMPILED R.H. ROBERTS
AREA 4		DRAWN J. HARDISTY
AMENDMENTS 1 2 3 4 5 6 7 8 9 10 11 12 13 14		DATE 24/1/85
		SCALE 1 : 1000
		REF. No. TAS/2/4183

NOTE :- FOR GEOLOGICAL LEGEND SEE TAS/2/4182

5 cm

180119 85-2386

COMSTAFF PROPRIETARY LIMITED

EL 5/63	PINNACLES GRID - EAF	COMPILED R. H. ROBERTS
AREA 4	SECTION OF LINE 5200 N 008	DRAWN J. HARDISTY
AMENDMENTS		DATE 4/2/85
	GEOLOGICAL INTERPRETATION	SCALE 1 : 1000
		TAS/2/4185

NOTE :- FOR GEOLOGICAL LEGEND SEE TAS/2/4182

5 cm

180120

SS -2386

COMSTAFF PROPRIETARY LIMITED

LEASE No. EL 5/63	PINNACLES GRID – EAF	COMPILED R. H. ROBERTS
AREA 4	SECTION OF LINE 5240 N	DRAWN J. HARDISTY
AMENDMENTS	GEOLOGICAL INTERPRETATION	DATE 4/2/85
		SCALE 1 : 1000
		REF. No. TAS/2/4186

009

180121

85-2386

COMSTAFF PROPRIETARY LIMITED

LEASE No EL 5/63	PINNACLES GRID - EAF	COMPILED R. H. ROBERTS
AREA 4	SECTION OF LINE 5400 N 010	DRAWN J. HARDISTY
AMENDMENTS 1 8 / 2 9 / 3 10 / 4 11 / 5 12 / 6 13 / 7 14	GEOLOGICAL INTERPRETATION	DATE 4/2/85
		SCALE 1 : 1000
		REF No TAS/2/4187

FOR GEOLOGICAL LEGEND SEE TAS/2/4182

180122

85-2386

COMSTAFF PROPRIETARY LIMITED

LEASE No EL 5/63	PINNACLES GRID - EAF 011	COMPILED R. H. ROBERTS
AREA 4	BROWNS TUNNEL AREA	DRAWN J. HARDISTY
AMENDMENTS 1 8 / 2 9 / 3 10 / 4 11 / 5 12 / 6 13 / 7 14	STACKED GEOLOGICAL INTERPRETATION SECTIONS	DATE 15/2/85
		SCALE 1:1000
		REF No TAS/2/4189

180123

85-2386

COMSTAFF PROPRIETARY LIMITED

LEASE No EL 5/63	PINNACLES GRID – EAF 012	COMPILED R. H. ROBERTS
AREA 4	SECTION OF LINE 5280 N	DRAWN J. HARDISTY
AMENDMENTS 1 8 2 9 3 10 4 11 5 12 6 13 7 14	DOWNHOLE GEOCHEMICAL BLOCKS	DATE 13/3/1985
		SCALE 1 : 1000
		REF No TAS/2/4205

180124

85-2386

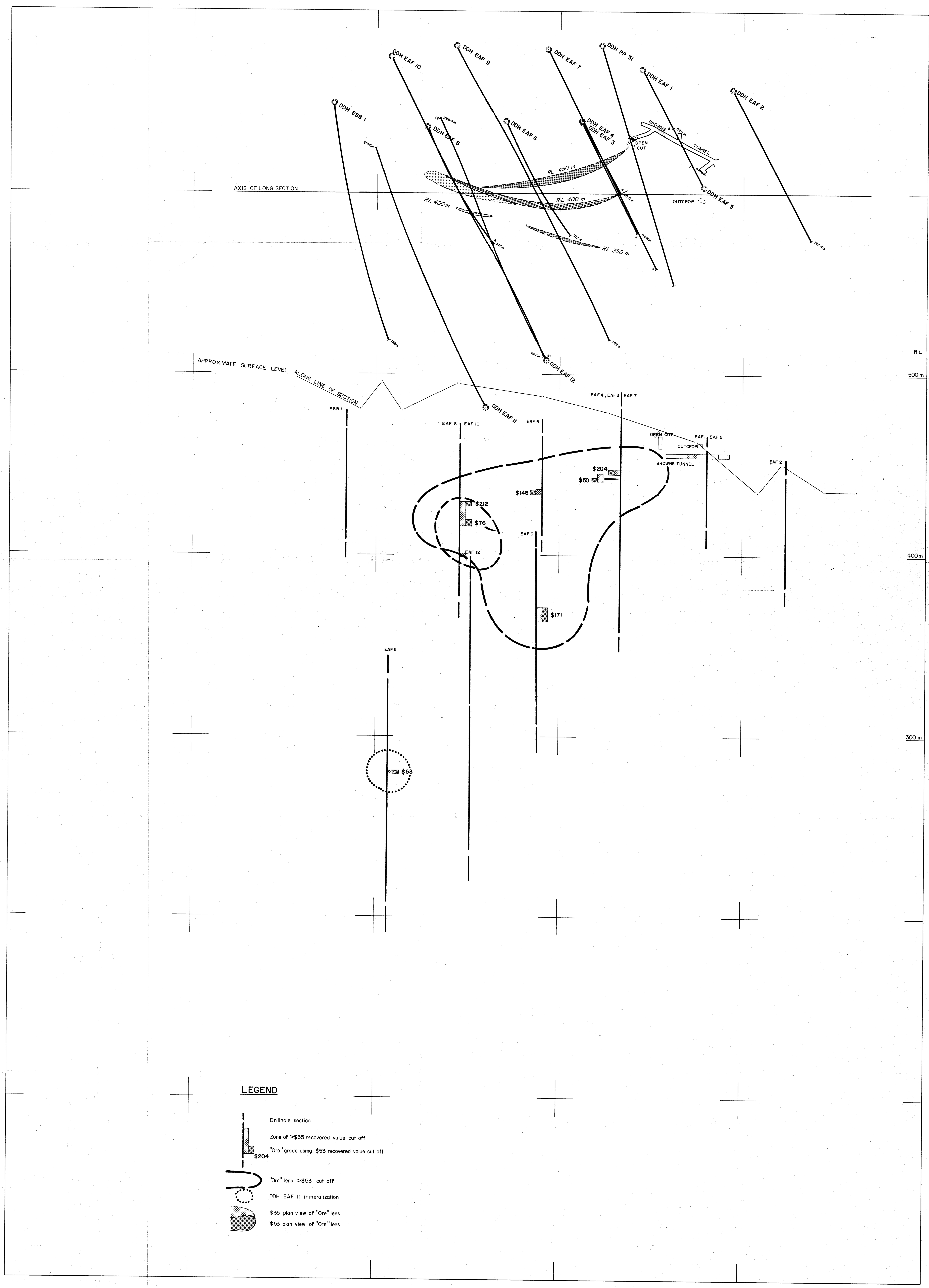
COMSTAFF PROPRIETARY LIMITED

LEASE No: EL 5/63	PINNACLES GRID - EAF	COMPILED: R.H. ROBERTS
AREA: 4	SECTION OF LINE 5320 N 013	DRAWN: J. HARDISTY
AMENDMENTS: 1 8, 2 9, 3 10, 4 11, 5 12, 6 13, 7 14	DOWNHOLE GEOCHEMICAL BLOCKS	DATE: 13/3/85
		SCALE: 1 : 1000
		REF No: TAS/2/4206

180125

COMSTAFF PROPRIETARY LIMITED

LEASE No. EL 5/63	BROWNS WORKINGS AREA 014	COMPILED R. H. ROBERTS
AREA 4		DRAWN J HARDISTY
AMENDMENTS	PLAN SHOWING GEOCHEMICAL BLOCKS	DATE 13/3/84
		SCALE 1 1000
		REF No TAS/2/4209



5 cm

COMSTAFF PROPRIETARY LIMITED

PINNACLES GRID - EAF 015

BROWNS TUNNEL AREA

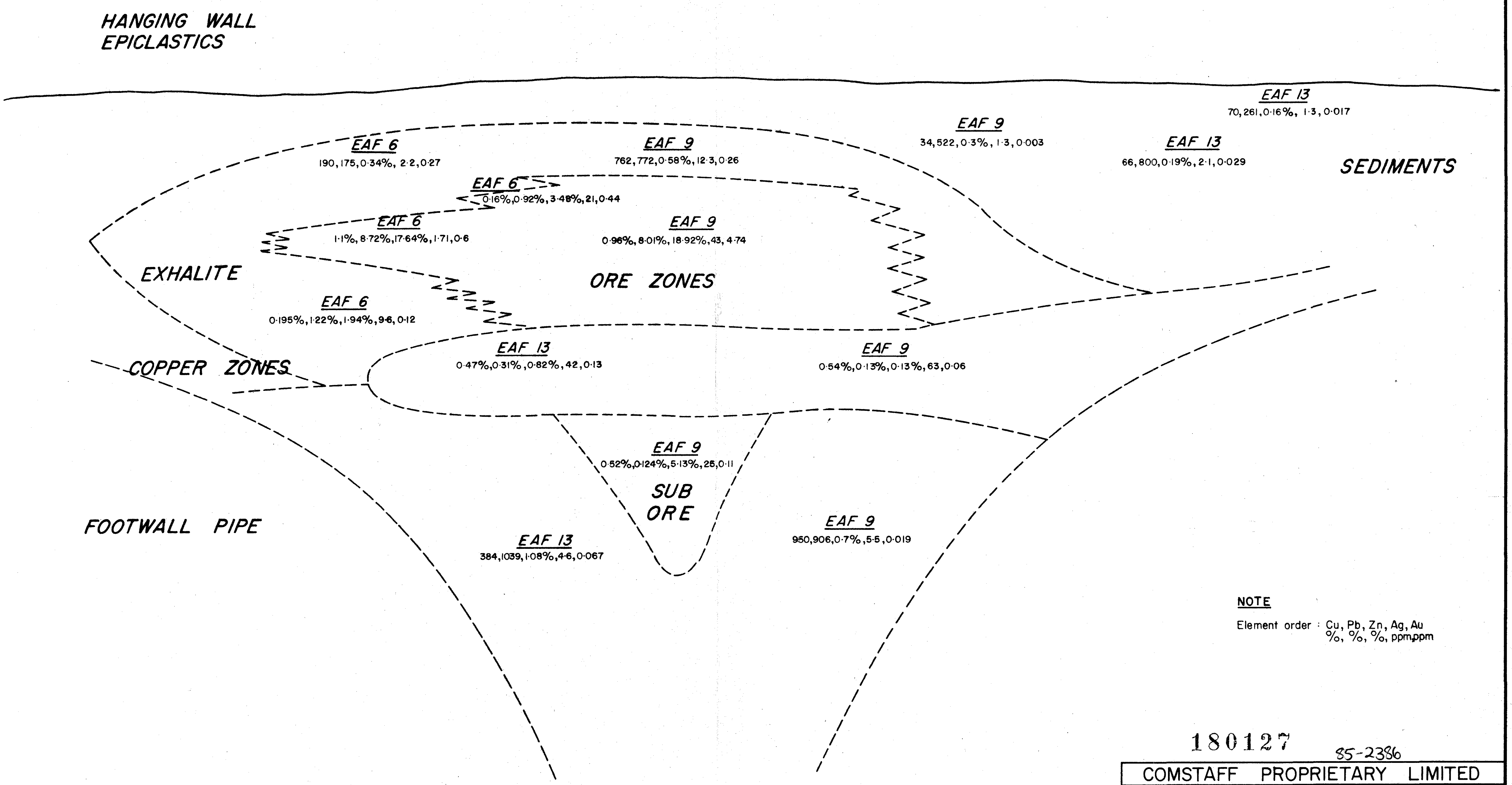
LONG SECTION THROUGH TARGET AREA

180126

85-2386

EL 5/63	AREA 4
COMPILED	R.W.L. SHAW
DRAWN	J. HARDISTY
DATE	23/10/84
SCALE	1 : 1000
REF. No.	TAS/2/4147

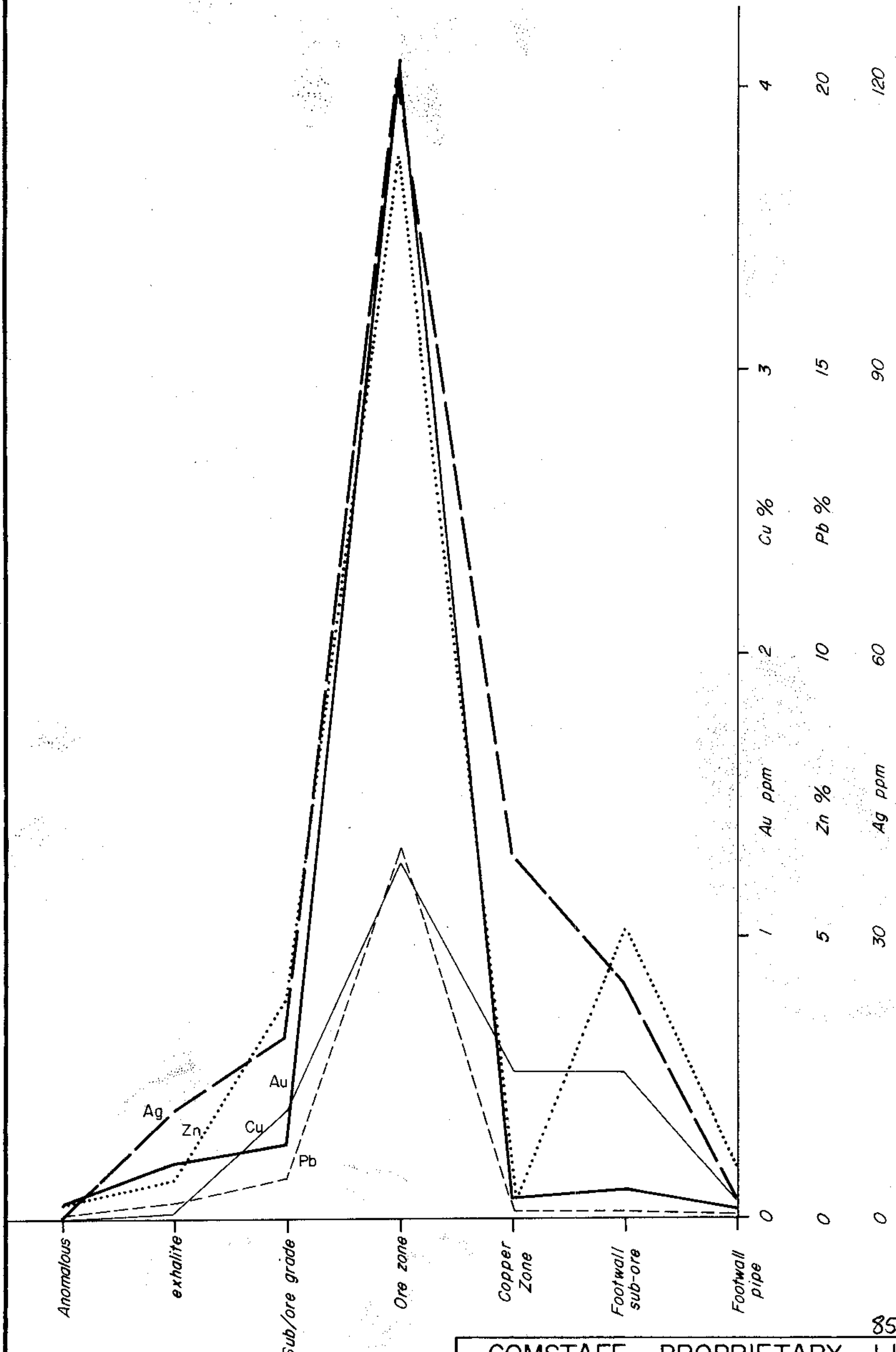
AMENDMENTS
1 29/10/84
2 30/11/84
3 23/1/85



180127
85-2386

COMSTAFF PROPRIETARY LIMITED			
PINNACLES GRID - EAF L 5320 N 016 TYPE SECTION GEOCHEMISTRY			
COMPILED R.W.L. SHAW	DRAWN J. HARDISTY	DATE 18/1/84	AMENDED
LEASE No EL 5/63	AREA 4	SCALE NTS	PLAN No TAS/2/4184

111



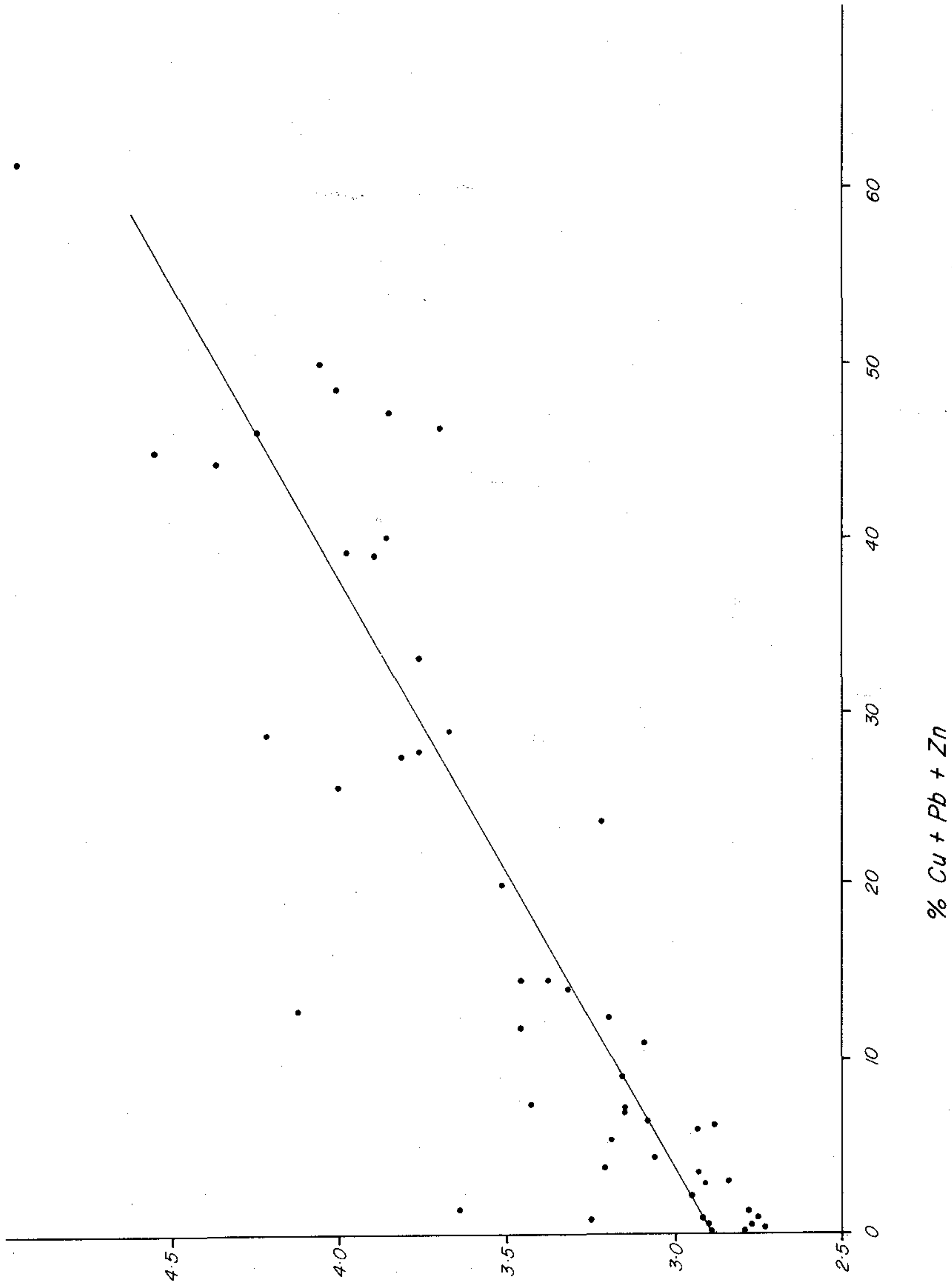
85-2386

COMSTAFF PROPRIETARY LIMITED			
BROWNS TUNNEL AREA **METAL DISTRIBUTION GRAPH**			
COMPILED R.W.L. SHAW	DRAWN J. HARDISTY	DATE 12/3/85	AMENDED
LEASE No EL 5/63	AREA 4	SCALE AS SHOWN	PLAN No TAS/2/4215

180128

5 cm

112



85-2386

COMSTAFF PROPRIETARY LIMITED

BROWNS TUNNEL AREA
GRAPH SHOWING SPECIFIC GRAVITY FACTORS

COMPILED	DRAWN	DATE	AMENDED
R.W.L. SHAW	J. HARDISTY	12 /3 /85	
LEASE No EL 5/63	AREA 4	SCALE AS SHOWN	PLAN No TAS/2/4214

180129

5 cm


450 m RL 'ORE ZONE' AS PROJECTED TO SURFACE
5 384 500 m N
377 500 m E
COSTEAN
THOMAS' TUNNEL
Cu Pb Zn Au
X = BLD
180130
5 cm
COMSTAFF PROPRIETARY LIMITED
EL 5/63
AREA 4
BROWNS WORKINGS AREA
GEOCHEMICAL GRID AUGER SAMPLING
COPPER CONTOURS in ppm
017
R. H. ROBERTS
J. HARDISTY
11/3/85
1 : 1000
TAS/2/4210

180131

85-2386

COMSTAFF PROPRIETARY LIMITED

EL 5/63
AREA 4

BROWNS WORKINGS AREA 018
GEOCHEMICAL GRID AUGER SAMPLING
LEAD CONTOURS in ppm

COMPILED: R H ROBERTS
DRAWN: J HARDISTY
DATE: 11/3/85
SCALE: 1 : 1000
REF. No.: TAS/2/4211

450m RL 'ORE ZONE' AS PROJECTED TO SURFACE
5 384 500 m N
377 500 m E
COSTEAN
ROAD
TRACK
BROWNS WORKINGS
PEOPLES
THOMAS TUNNEL
McGUINESS
CREEK
Cu Pb Zn Au
X = BLD
5 cm
180132
COMSTAFF PROPRIETARY LIMITED
EL 5/63
4
BROWNS WORKINGS AREA 019
GEOCHEMICAL GRID AUGER SAMPLING
ZINC CONTOURS in ppm
R. H. ROBERTS
J. HARDISTY
11/3/85
1 : 1000
TAS/2/4212

180133

COMSTAFF PROPRIETARY LIMITED

EL 5/63	BROWNS WORKINGS AREA 020	COMPILED: R. H. ROBERTS
AREA: 4	GEOCHEMICAL GRID AUGER SAMPLING	DRAWN: J. HARDISTY
AMENDMENTS	GOLD CONTOURS in ppm	DATE: 11/3/85
		SCALE: 1 : 1000
		REF. No. TAS/2/4213