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Aberfoyle Resources Limited

EXPLORATION DIVISION

EXPLORATION LICENCE 9/88

WINTERBROOK

TASMANIA

FINAL REPORT

ON EXPLORATION FOR THE PERIOD JULY, 1989 TO FEBRUARY, 1990.

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DISTRIBUTION:

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1.0 SUMMARY AND RECOMMENDATIONS

The Cambrian geology of the Winterbrook licence (E.L. 9/88) is dominated by a sequence of volcaniclastic sediments comprising mainly felsic sandstones to cobble-conglomerates. Only minor quartz-andesite lavas and dacitic to rhyolitic lavas have been located.

Precise interpretation of the volcanic setting is difficult. Facies analysis of a number of units suggests a definite submarine depositional environment (ie pyritic grey shales and siltstones), though minor evidence visible in other units suggests possible sub-aerial deposition.

Alteration observed in a number of samples collected from around the licence is attributed to metamorphism and deformation events. Anomalous alteration indices for some samples, produced by slight to strong calcium and/or sodium depletion are attributed to similar causes. The samples do not contain significantly elevated base or precious metal values.

No positive indications of potential massive sulphide mineralisation have been detected in any of the previous exploration programmes conducted on the licence. UTEM programmes undertaken within the licence by CRA and Aberfoyle have effectively covered approximately 23 square kilometres, nearly half of the total licence area. No conductors attributable to massive sulphide accumulations have been detected by these programmes.

The recently completed mapping and sampling programme has produced very little further encouragement and provided no significant indications of potential massive sulphide mineralisation either within the areas already covered by UTEM or areas outside this coverage. The value of further UTEM programmes to explore Cambrian lithologies under Tertiary and Recent cover must therefore be considered limited. In light of these conclusions it is recommended that the licence be relinquished.

2.0 INTRODUCTION

Exploration licence 9/88 Winterbrook (refer to plate WINT6) was granted to Aberfoyle Resources on 9th August, 1988. Previously, the ground formed part of EL 7/74 Moina, held up to July 1987 by Comalco, The Shell Co. of Australasia and CRA Exploration Pty. Ltd. Exploration for volcanogenic massive sulphide mineralisation within the licence was conducted initially by Comalco in 1976, and then Shell and CRA before the licence was granted to Aberfoyle in 1988.

The Winterbrook licence covers an area of approximately 7 x 8 km (54 square kilometres total) east from Black Bluff and south of the Leven River (refer to plate WINT 6).

The licence area is rugged in the south and west where it is covered by highland vegetation. In the east and north the ground is relatively flat and is covered by a mixture of rain forest, eucalypts and forestry pine plantations.

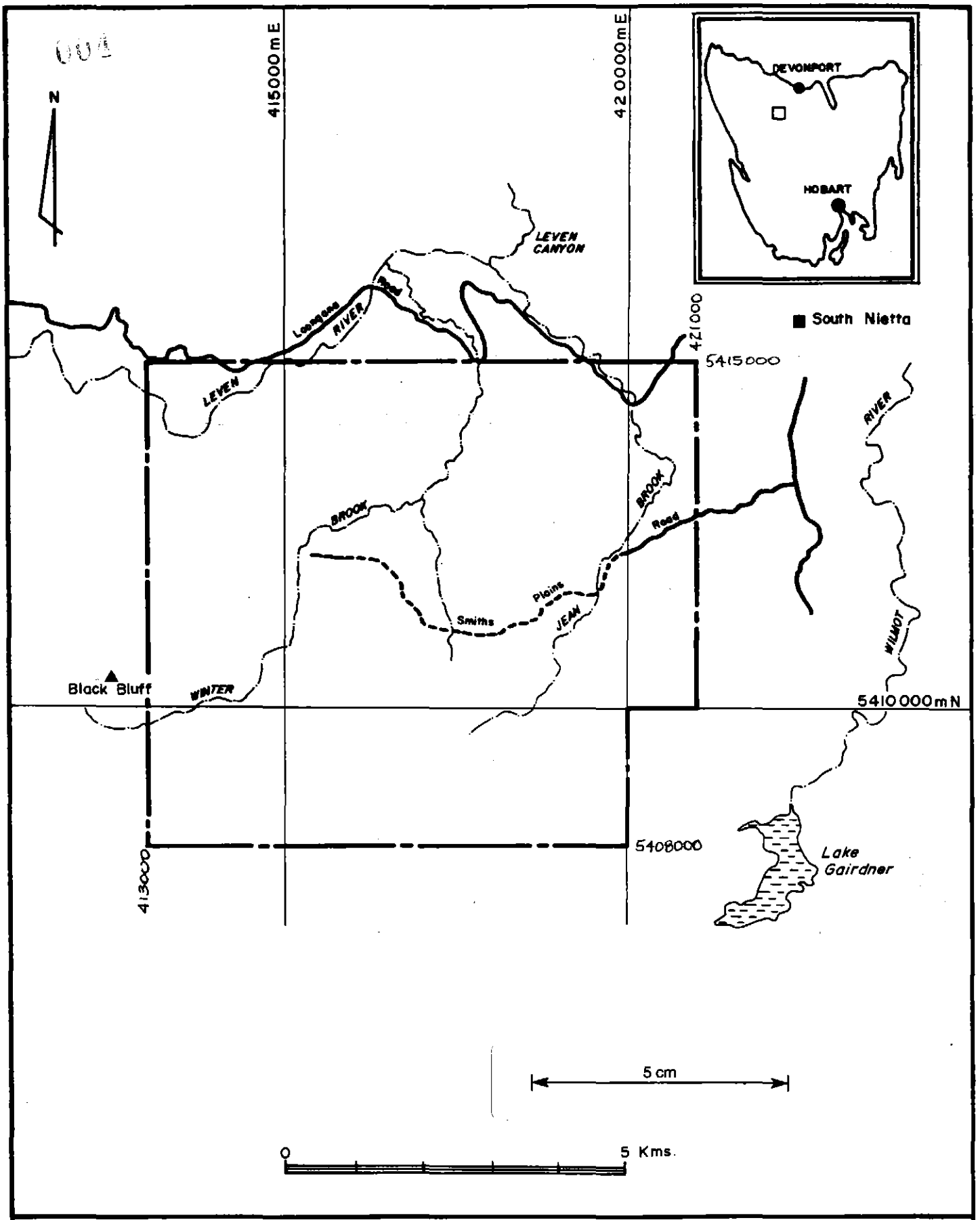
Access is via a number of minor roads (Smiths Plains Rd. and Loongana Rd.) plus a network of logging roads. Walking tracks to Black Bluff and Winterbrook Falls start from within the southwestern corner of the licence area.

The geology of the area comprises outcropping Cambrian volcaniclastics and minor lavas of bimodal composition. Younger rocks comprise Cambro-Ordovician sediments (Owen correlates) and minor Ordovician limestone (Gordon Group) around the northern, western and southern perimeters of the licence, while Tertiary Basalt and Quaternary cover are common throughout the licence area. The regional geology of the area has recently been described as part of the Department of Mines Mount Read Volcanics Project (refer to map 9, Pemberton and Vicary, 1989).

No significant mineralisation has yet been discovered on the licence. Granite related mineralisation, however, is common southeast of the licence in the Moina area.

Active exploration for volcanogenic massive sulphide mineralisation within the licence has occurred over the last three decades. Stream sediment sampling and airborne magnetic survey programmes have led to a number of follow-up IP, UTEM and soil geochemical programmes. A total of eight drillholes (965m) have been drilled within the licence. No significant mineralisation has yet been detected within the licence.

As a follow-up to the most recent phase of exploration by Aberfoyle, involving an extensive but unsuccessful UTEM programme (Rand,1989), a mapping and geochemical sampling programme has been undertaken. The programme has been aimed at assessing the remaining exploration potential of the licence and forms the basis of this report.



Aberfoyle Resources Limited

EXPLORATION DIVISION

REVISIONS			
Init.	Date	Init.	Date

NORTHERN TASMANIA

E.L. 9/88 WINTER BROOK
LOCATION PLAN

Compiled :	SWR
Drawn :	SWR, RJE
Traced :	RJE
Checked :	SWR
Plate No. :	WINT. 6

Location Code :

Scale : As shown

Date : July , 1989

3.0 SUMMARY OF PREVIOUS EXPLORATION

Previous exploration within the area has concentrated initially on granite related mineralisation similar to that located at Moina. This exploration was aimed primarily at the Ordovician sediments. A number of areas of Cambrian volcanics, however, were included within the licence between areas of skarn prospective Ordovician rocks.

Exploration for volcanogenic massive sulphide mineralisation in the Cambrian volcanics was initially undertaken by Comalco in 1976. This involved establishing two grids (Lower and Upper Winterbrook grids) to follow-up initial soil, stream and IP anomalies. Following a joint venture with Shell in 1980, the grids were joined and soil sampling was repeated over the entire grid combined with VLF surveying. An aeromagnetic survey produced a number of anomalies, follow-up of these indicated a source due to magnetite within the Cambrian volcanics. No areas of further encouragement were generated by these programmes.

Following the entry of CRA into the joint venture a UTEM survey was conducted over the entire gridded area, with follow-up soil sampling and EM-37 surveying in limited areas. Eight drillholes (3 percussion and 5 diamond) totalling 964.8m were completed to test unexplained UTEM anomalies. These intersected a mixture of sheared volcanics and limestones, with no significant mineralisation. The UTEM responses were therefore considered to have been due to the intersected shear zones (von Strokirch,1987).

CRA considered that all prospects in the area had been adequately tested and subsequently relinquished the licence in July,1987.

Following the granting of the licence to Aberfoyle in August,1988, a reassessment of the CRA UTEM data was undertaken. It was considered that the data was of adequate quality but it was recognised that several areas of Cambrian volcanics, including many areas beneath younger cover had not been surveyed.

Aberfoyle programmes undertaken within the licence involved initially a 41.3 line kilometre gridding programme over the most prospective areas. UTEM surveying, totalling 43 line kilometres, was conducted over the grid in a number of phases (Rand,1989).

In total, the Winterbrook licence has now been surveyed by UTEM over an approximately 23 sq. km area, representing nearly half of the total licence area (refer to plate WINT 5). These have failed to produce any indications of potential massive sulphide accumulations. Areas not yet covered by UTEM include areas of Cambro-Ordovician and Ordovician sediments in the northwest of the licence, a small block of Cambrian volcanics beneath Tertiary cover in the centre of the licence and areas of Cambro-Ordovician sediments overlying Cambrian volcanics around Winterbrook Falls and the Tiger Plains areas in the southwest of the licence.

4.0 1989/1990 EXPLORATION

4.1 Exploration aims

Exploration during the reporting period involved a limited mapping and sampling programme. The programme was aimed at providing a range of samples to allow an assessment of areas not yet covered by UTEM. A total of 19 samples were collected (refer to appendix 1 for locations and field descriptions, and map WINT 7A and 7B). Mafic samples rather than felsic ones were preferentially chosen as these contain a larger primary range of elements and hence addition or subtraction of elements during alteration is more readily observable.

4.2 Geology and Petrology

The Cambrian geology of the Winterbrook licence comprises predominantly volcaniclastics of felsic to andesitic composition (mapped as tcs,tc,tca,tt, and tta by Pemberton and Vicary,1989a, refer to WINT 7A and 7B and appendix 4) with minor felsic and andesitic lavas (tt, tlf and ta) and quartz-feldspar porphyry intrusives (tlq).

The volcaniclastics are dominated by pebble-cobble conglomerates to finer sandstones. These volcano-sedimentary units typically contain quartz-feldspar phyric lava fragments and lesser andesitic fragments with rare exotic clasts of other sediments and occasionally vein quartz and granite. Lesser finer grained sediments vary from siltstones to fine sandstones.

Sample 562185 (refer to appendices 1 and 2) is a sand sized sediment classified as a rhyolitic, welded?, quartz crystal lithic volcaniclastic which contains common chloritic pumice fragments. This sample also contained occasional fine pyrite. Sample 562196 is a similar quartz rich volcaniclastic sandstone (quartz-feldspar pummiceous lithic tuff, Pemberton and Vicary,1989b). This sample is unusual in that it contains common elongate reddish 'patches' of flattened pumice. The sample could represent a possible sub-aerial welded? ignimbrite (Based on petrology description and R. Allen pers. comm.,1989).

Immediately overlying the above unit is a fine grained sediment with reasonably well defined bedding with occasional eroded tops indicating a dip and facing to the southeast. Sample 562184 is a fine grained weakly pyritic grey siltstone (almost certainly of submarine origin) thought to have been derived from quartz rich volcanics and pelitic metamorphics based on the presence of detrital muscovite.

The detrital muscovite could, however, have been derived from Cambrian granitic sources as some of volcaniclastics contain granite fragments and/or common to abundant detrital magnetite (eg. around 416100mE,5411200mN). These magnetite rich units have certainly produced the "magnetic anomalies within volcaniclastic sediments" described by von Strokirch (1987).

No Cambrian granites were noted in the Winterbrook area (Pemberton and Vicary,1989b) though possible outcrops occur to the north in the Leven Canyon area (A. Crawford pers. comm.,1990).

Lavas in the area are represented by both felsic, comprising minor quartz-feldspar phyric lavas (tt) and a rhyolitic to rhyodacitic feldspar-phyric lava (tlf), and intermediate units comprising quartz andesites (ta).

Sample 562195 (mapped as tlf) is from outcrop close to the base of the Cambro-Ordovician sediments in the southeast of the licence. The sample is a devitrified, sparsely feldspar phyric rhyolitic to rhyodacitic, fine grained lava.

Samples 562004 to 562007 and 562185 to 562194 are all examples of the more mafic lavas visible in outcrop from around the licence. They are typically green, fine to medium grained massive units which contain visible feldspar and rare mafic phenocrysts. An interesting feature observed for many of the samples is the presence of minor quartz phenocrysts (samples 562005, 562007, 562186 and 562188 to 562192). This indicates that these units are probably best classified as quartz (or acid) andesites or low Si dacites. Other interesting features^@(the relativly common occurrence of trace amounts of pyrite (and/or pyrrhotite) within the lavas. This sulphide phase is interpreted to be a primary feature given its fairly widespread distribution and occurrence in texturally very well preserved samples (eg. 562192). Another accessory mineral which is found in many of the samples is apatite (to quite large sized crystals, eg. 562006), which combined with fresh pyroxene from a sample might provide a useful Sm-Nd dating tool.

The major Cambrian intrusive unit within the Winterbrook licence comprises a quartz-feldspar porphyry in the northeast of the licence. Very minor strongly weathered thin basaltic ?dykes have been considered to be of possible Cambro-Ordovician age as they appear to be fault related and intrude the major Cambrian pile. These are possibly related to other rare Cambro-Ordovician intrusions and minor flows? found in the southwest of the licence around Black Bluff (Pemberton and Vicary,1989a and 1989b).

4.3 Structure

Bedding dips and facings within Cambrian volcano-sedimentary units are to the southeast in the northern portion of licence but to the northwest in the southern portion of the licence (Pemberton and Vicary,1989). This has been interpreted by Pemberton and Vicary (1989a) to indicate a possible syncline trending roughly east-west through the centre of the licence. This poses problems, however, when one considers the dips and facings of the overlying (unconformably) Cambro-Ordovician sediments, which indicate instead a broad anticline. Other evidence of Devonian deformation is visible in a number of northwest-southeast trending faults through the area. The major of these is the Kauri Fault which runs close to the peak of Black Bluff.

4.4 Alteration

The alteration in most of the collected samples was predominantly due to the effects of devitrification, metamorphism and weathering (refer to appendix 2). Devitrification has produced fine grained quartz and sericite, occasionally with minor albite, chlorite and rarely k-spar (examples are 562195 and 562004). Metamorphic assemblages visible in most of the samples include quartz, chlorite, calcite, albite and occasionally epidote and sphene. These assemblages reflect metamorphism to sub-greenschist grades (prehnite-pumpellyite), though the presence of actinolite in some samples suggests lower grade greenschist facies (eg.562006 and 562192).

Hydrothermal alteration was considered by the petrologist to have affected four of the samples collected (562003,562005, 562188 and 562190)(refer to appendix 2). This style of alteration has produced predominantly chlorite, sericite and possibly minor secondary quartz and calcite.

562003 is a cobblestone of fine grained andesite lava collected from a volcaniclastic conglomerate unit. The strong chlorite alteration interpreted to be hydrothermally derived might possibly be a result of devitrification and metamorphism of this glassy fragment rather than being a true hydrothermal feature. Nearby outcropping andesite lavas (562004 and 562006)(possibly a source flow for the volcaniclastic sediment) do not show petrographic evidence for hydrothermal alteration.

Sample 562005 is from an outcrop of massive quartz andesite lava. This sample is strongly chlorite altered with minor quartz veinlets and sericite. This is also possibly due to metamorphism and/or local deformation rather than hydrothermal alteration as additional samples from the area (562191 and 562192, taken as follow-up checks) provided no additional evidence of hydrothermal alteration. Sample 562192 is in fact, apart from metamorphic effects, quite unaltered (refer to appendix 2).

Samples 562188 and 562190 are both similarly sericite-calcite altered quartz andesite lavas. The alteration in both of these cases is almost certainly related to Devonian deformation. Sample 562190 is taken from an outcrop very close to the major Kauri Fault system and contains abundant micro-fractures visible in thin section (refer to appendix 2). 562188 is similarly from an outcrop close to a mapped fault. Other samples collected during mapping traverses approaching the fault systems appear to show slight increases in alteration intensity (eg. samples 562186, 562187 and 562189).

The strong alteration (predominantly chlorite) observed in four of the samples is probably due to deformation and metamorphism (including hydrothermal alteration associated with Devonian faulting) rather than alteration associated with a volcanogenic hydrothermal system.

4.6 Geochemistry

As part of routine exploration practice, all samples collected were submitted for geochemical analysis for a range of elements (refer to appendix 3). This is to obtain lithogeochemical information and to provide indications of any geochemical alteration.

Lithogeochemical indicator elements such as chromium, titanium, zirconium, and yttrium all show remarkably consistent results (refer to appendix 3). All of the andesite lava samples contain similar values for chromium (between 25 and 50ppm) and yttrium (between 20 and 40ppm). Titanium to zirconium ratios (Ti/Zr) for these samples is also well constrained between 13 and 20. These values are consistent with a compositional classification of quartz andesite (or low silica dacite) to andesite. Samples which contain significantly different Ti/Zr ratios are the basaltic dyke rock (562008, Ti/Zr = 49), the felsic lava sample (562195, Ti/Zr = 5) and one sample of an andesite boulder from a volcaniclastic unit (562003, Ti/Zr = 32). The basaltic unit also contains a significantly elevated chromium content relative to the other samples (Cr = 400 ppm) while the felsic unit displays an expected deficiency in chromium (Cr = 6 ppm). The andesite boulder, however, has a similar chromium level to the other andesite lava units (Cr = 50ppm).

Base metal, barium, silver and arsenic levels in the samples are all very low with the exception of three andesite lava samples. These three samples (562007, 562191 and 562193) contain slightly elevated lead values (485, 910 and 310 ppm respectively) but are not significantly enriched in any other elements (maximum Zn is 670ppm for sample 562193). These samples show no strong evidence for hydrothermal alteration (refer to section 4.5) and the anomalous values therefore possibly reflect a natural rock variation or a slight enrichment as a result of Devonian deformation.

Studies of the alteration index often prove useful in detecting primary dispersion haloes associated with volcanogenic systems (McNeill,1990). The alteration index, [AI = 100 * (K2O + MgO)/(K2O + MgO + Na2O + CaO)] was calculated for all of the collected samples (refer to appendix 3).

The most important point to note from the calculated values is that most samples have alteration indices between 35 and 50, with only 5 samples with alteration indices greater than 60, this suggests no significant deviation from typical primary values (refer to McNeill,1990). Of the anomalous samples, most of the high AI's (due to calcium and/or sodium depletion) can be attributed to weathering.

The sample of weathered basaltic dyke rock (562008, AI = 99) as expected shows an extreme depletion of sodium and calcium. The sample also, however, contains a significant concentration of potassium (K2O = 9.84%).

562005 and 562007 have both been interpreted as hydrothermally chlorite altered and show elevated AI's (87 and 89, due to calcium depletion but no significant sodium depletion). These values are consistent with those obtained for chlorite-carbonate altered andesites from the footwall of the Hellyer deposit (Gemmell,1989). However, only one follow-up sample from the same area (562191) contained an elevated AI (99, due to extreme calcium and sodium depletion), while other samples of the same unit (562192 and 562193) are considered to be fresh and virtually unaltered. The anomalous AI values are therefore probably related to a depletion of calcium and/or sodium during weathering. Interestingly, however, is that sample 562191 (AI = 99) also contains the peak lead value (910ppm).

The sample of sparsely feldspar phyric lava (tlf, 562195) also contains a high AI (97). This is considered to be result of weathering combined with strong sodium depletion due to sericitisation of albite during devitrification of the glassy rock (refer to appendix 2).

4.7 Discussion

The mapping and sampling programmes within the Winterbrook area have recognised that the Cambrian rocks are dominated by volcaniclastic sediments with a limited lava component. A tentative correlation proposed by the DOM geologists based on rock types and field relations is that the rock package is an equivalent of the upper part of the Dundas Group and Tyndall Group (Pemberton and Vicary,1989b).

Precise determination of the depositional setting is difficult. The large volume of volcaniclastic sediments could be a result of either sub-aerial or submarine volcanism. A submarine depositional environment is indicated by the presence of fine pyrite in grey siltstones and shales (definitely of submarine origin, R.Allen, pers. comm.,1989) interbedded with volcaniclastic units. The possibility of sub-aerial volcanism is also suggested, however, by the presence of a possible welded ignimbrite (refer to section 4.2). Also, some of the andesitic conglomerates located close to andesite lava units could possibly be subaerial agglomerates (R,Allen, pers. comm., 1989). If the presence of mixed sub-aerial and submarine facies is correct, this implies an environment of only shallow water depths. If the interpretation of subaerially deposited volcanic sediments is correct, then the potential of the licence for hosting volcanogenic massive sulphide deposits is downgraded.

Alteration observed for a number of samples (predominantly intermediate lavas) is probably related only to devitrification, metamorphism and deformation. While individually some of the samples could be considered to provide favourable indications of potential mineralisation, collectively, the samples

provide no positive evidence of large scale systematic variations in alteration as would be expected around a typical Kuroko style massive sulphide deposit. Mapping and sampling of outcrops outside the areas so far covered by UTEM (such as the Tiger Plains area in the southwest of the licence) similarly provides no significant encouragement.

The mapping and sampling programme failed to produce any areas of further interest or generate any anomalies that require additional follow-up. It is therefore recommended that the licence be relinquished.

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APPENDIX 1

Sample Locations and Field Descriptions

WINTERBROOK PETROLOGY AND GEOCHEMISTRY SAMPLE LOCATIONS

SAMPLE#	COORDINATES	DESCRIPTION
562003P,G	416475E,5410650N 5350E,5550N (grid)	tca - Andesitic volcaniclastic pebble conglomerate.

This sample is of a large cobble stone within the unit. The conglomerate unit itself contacts an andesitic lava unit (sample 562006) so the volcaniclastics must be very proximal to their source.

562004P,G	415730E,5409870N 4300E,5250N (grid)	ta - Andesite lava.

This sample is from an outcrop of quite fresh massive lava. This unit is seperated from the andesite conglomerate (562003) and its associated lava (562006) by a thin unit of tt (quartz-feldspar+/-biotite crystal and crystal lithic tuff, with minor quartz-feldspar phyric lava).

562005P,G	419400E,5409770N 7425E,3250N (grid)	ta - Andesite lava.

This rock is a green typically feldspar phyric andesite lava. This sample definitely contains sparse quartz phenocrysts throughout the rock.

562006P,G.	416350E,5410700N 5250E,5650N (grid)	ta - Andesite lava.

In outcrop, this unit contacts an andesitic conglomerate unit (sample 562003). This sample is of a feldspar + mafic phyric massive lava, which does not contain visible quartz.

562007P,G	419300E,5409330N 7100E,2900N (grid)	This is from another outcrop of ta- Andesite lava.

562008P,G	416050E,5412100N	b - Basaltic dyke unit.

This a sample of a strongly weathered and cleaved outcrop of a small dyke (<1m) quite close to, and aligned with, a ?minor fault. The rock is strongly cleaved and weathered. The outcrop is almost certainly a dyke, but interestingly is also quite vesicular. It could be a possible feeder to the thin basalt flows which have been located within (near the base of) the Owen Conglomerate near Paddys Lake and Winterbrook Falls.

562184P	5413070N,419970E	Grey siltstone.

This sample is of a finely laminated weakly pyritic grey siltstone. The rock outcrops in Winter Brook within a unit mapped as tcs - volcaniclastic conglomerates and sandstones.

562185P 5413040N,419950E Bedded quartz volcaniclastic sandstone.

This sample occurs close to 562184 and also contains minor traces of pyrite.

562186P,G 5409280N,418000E Float sample of andesite lava.

This sample is a green feldspar plus mafic phyric andesite which contains minor quartz phenocrysts, traces of pyrite and occassional calcite vugs.

562187G 5409160N,418000E Massive andesite lava.

This samples is from an outcrop of typical green andesite lava which is weakly calcite altered.

562188P,G 5408950N,418150E Andesite lava.

This sample is similar to above, but also contains trace quartz phenocrysts and minor pyrite.

562189P,G 540790N,415200E Andesite lava (as above)

562190P,G 5408050N,414775E Andesite lava (as above).

562191G 5409480N,419300E Andesite lava float sample.

562192P,G 5409800N,419250E Andesite lava (as for 562188).

562193P,G 5409350N,418800E Andesite lava (as above), weak flowbanding?

562194P,G 5412080N,415800E Andesite lava (as above) with trace pyrite or pyrrhotite?

562195P,G 5409000N,419450E tlf - Green fine grained feldspar phyric lava.

562196P 5411950N,415580E tcs - quartz volcaniclastic sandstone with elongate red patches (fiamme'?). Float sample.

Appendix 2

Petrology Descriptions

(Provided by Dr. Tony Crawford)

PETROGRAPHIC REPORT

ROCKS FROM WINTERBROOK AREA

For Aberfoyle Resources Ltd (attn Sven Rand)

by Anthony J. Crawford
Geology Dept
University of Tasmania
18/1/89

SAMPLE No: 562003

SUMMARY:

This is a formerly glassy plagioclase+augite ± hbd-phyric acid andesite with an extensively altered and recrystallized groundmass containing abundant very fine-grained Fe(Ti) oxide grains.

THIN SECTION DESCRIPTION:

This is a strongly plagioclase-phyric evolved andesitic lava with subordinate thoroughly altered augite and hornblende phenocrysts and occasional altered FeTi oxide phenocrysts in a very altered groundmass. The plagioclase phenocrysts have been albitized, and make up around 20 modal% of the sample. They vary from about 3mm long to 0.3mm long, are ususally simply twinned blocky to elongate prsimatic euhedra, and often occur in multi-crystal clots. Many albite phenocrysts contain ghost compositional zoning, and rows of tiny chloritized melt inclusions parallel to crystal faces. Former augite phenocrysts make up about 1 modal% of the sample, and are generally much smaller (<0.5mm) than the plagioclase phenocrysts. Most are small euhedral prisms totally replaced by pale green chlorite, with very narrow opacite rims. Similarly altered crystals with possible primary amphibole crystal shapes are almost as abundant as former augite crystals; the state of alteration precludes definitive identification of these crystals as former hornblende microphenocrysts, but the evidence strongly points this way in my opinion. Former FeTi oxide microphenocrysts are altered to epidote, magnetite, sphene and chlorite (leucoxene). At least two small microgabbroic nodules are present in this sample, composed of holocrystalline intergrowths of albitized plagioclase and a much smaller modal abundance of chloritized interstitial augite and altered FeTi oxide grains. These were probably plucked from a magma chamber or conduit wall during eruption of this lava.

The groundmass of this lava was almost certainly mainly glassy. However, it has altered extensively to a quite heterogeneous mixture of exceptionally fine-grained secondary quartz and albite, riddled with tiny chlorite flakes, and characterized by irregular patches to several mm long in which tiny granules of secondary magnetite are abundant. Also abundant in the groundmass are angular fracture fillings of chlorite in which small quartz and epidote crystals are growing from fracture margins. Small murky yellow-brown patches of poorly crystalline very fine-grained epidote are common in the altered groundmass.

This rock was probably transitional compositionally between an andesite and a dacite lava; it has suffered fairly strong hydrothermal alteration producing abundant chlorite and Fe(Ti?) oxides from altered glass.

SAMPLE No: 562004 AMG 415730E 5409870N

SUMMARY:

This is a plagioclase+augite-phyric low-Si dacite lava with common apatite microphenocrysts and a formerly glassy groundmass much less altered than the previous sample.

THIN SECTION DESCRIPTION:

This is a porphyritic dacite lava dominated by albitized plagioclase phenocrysts set in a very fine-grained formerly largely glassy groundmass. The albite phenocrysts make up around 15-20 modal% of the sample, and are generally somewhat rounded and reacted blocky to elongate euhedra, mainly as clots of one or more crystals totalling 0.5-2mm long, partially altered to very fine-grained sericite. Augite phenocrysts, mainly less than 0.5mm long, make up around 2 modal% of the rock, and are mainly altered to green chlorite and poorly crystalline yeloowish epidote, although many contain relic patches of fresh augite. Small FeTi oxide microphenocrysts are not uncommon, most showing alteration to leucoxene. Quite common apatite microphenocrysts are a feature of this sample, although most are less than 0.3mm long.

The groundmass of this sample was almost certainly largely glassy. It has devitrified and partially crystallized to a very fine-grained intergrowth of quartz, chlorite and probably albite. Randomly distributed small patches of more coarsely crystalline groundmass are also quartz-albite dominated, and sometimes contain fan-shaped yellowish epidote patches.

This rock is probably a low-Si dacite (64-66% SiO_2); it differs from the preceding sample only in the presence of common apatite microphenocrysts and its notably less altered groundmass. The metamorphic grade is sub-greenschist facies, probably prehnite-pumpellyite facies.

SAMPLE No: 562005

SUMMARY:

This is a strongly chlorite-altered plagioclase-phyric formerly glassy rhyodacitic lava.

THIN SECTION DESCRIPTION:

This sample is a very strongly altered formerly glassy plagioclase-phyric rhyodacitic lava with a chloritized groundmass. Plagioclase phenocrysts to around 2mm maximum dimension made up around 20 modal% of this lava, although this is difficult to judge due to the strong alteration of both phenocrysts and groundmass. The plagioclase phenocrysts are slightly rounded blocky euhedra partially to completely replaced either by dense sericite, or by a clear granular mosaic of secondary quartz and albite. There is no unambiguous evidence for the former presence of mafic phenocrysts in this sample. A few strongly resorbed and fractured quartz phenocrysts are present, and show marginal reaction with recrystallized groundmass. Quite large FeTi oxide microphenocrysts are not uncommon, and are altered to sphene, magnetite and epidote, with minor chlorite. Several quite large (~0.2mm long) apatite microphenocrysts were noted.

The groundmass of this sample is very heterogeneous and strongly altered. It is criss-crossed by meandering very narrow veinlets of quartz and overprinted by a fairly dense mesh of pale green chlorite and subordinate sericite. Abundant small irregular patches of the groundmass have been replaced by mosaic intergrowths of clear quartz and albite.

The texture, blocky plagioclase phenocrysts and sparse quartz phenocrysts suggest to me that this is a formerly glassy rhyodacite lava. It has suffered strong chlorite alteration, probably of local hydrothermal, rather than regional burial metamorphic origin.

SAMPLE No: 562006 AMG 416350E 5410700N

SUMMARY:

This is a a peculiar plagioclase+augite+apatite-phyric andesitic lava with a lowest greenschist facies metamorphic assemblage marked by the presence of fibrous and acicular actinolite growing in chlorite.

THIN SECTION DESCRIPTION:

This is a texturally well-preserved porphyritic andesite with strikingly unusual huge phenocrysts of apatite, as well as abundant phenocrysts of albitized plagioclase and altered augite. Albitized plagioclase phenocrysts to 3mm across make up around 20 modal% of this sample and are mainly altered to an intergrowth of sericite, chlorite and dirty spots of granular brown-yellow epidote. Former augite phenocrysts, mainly less than 1mm long, make up around 2 modal% of this sample, and are altered to green chlorite intergrown with yellow epidote, and less abundant acicular palest green actinolite. A most intriguing and notable feature of this sample is the presence of large (to 2mm long), and relatively common apatite phenocrysts and microphenocrysts. These are clear perfectly formed euhedra with a slightly streaky smoky appearance and prominent partings perpendicular to [001]. A single large phenocryst of quartz is highly angular, fractured and anhedral, with internal strain features, and is apparently made up of several discrete grains. I suggest that this is likely to be xenocrystic rather than cognate. Common FeTi oxide microphenocrysts have exsolved ilmenite along octahedral planes and then altered to leucoxene.

The groundmass of this sample was glassy to microcrystalline, and glass has devitrified and crystallized to extremely fine-grained quartz and albite, flecked with chlorite and sericite, and tiny altered FeTi oxide granules.

This sample is a very distinctive and peculiar andesitic lava with abnormally large and common apatite phenocrysts and microphenocrysts. This is a potentially very useful sample, in that it may be possible to use the apatite (separated) and wholerock compositions to get a Sm-Nd isochron, possibly the best opportunity I know for this from the Mount Read Volcanics. The sample is also notable in that actinolite is present, indicating that the sample probably reached 300^{o}C during regional alteration, being lowest greenschist facies (in contrast to the previous samples that showed prehnite-pumpellyite facies assemblages). Sven, could you resample this outcrop and collect a few kg of rock please, if possible?

SAMPLE No: 562007

SUMMARY:

This is a plagioclase-phyric low-Si dacite with strong chlorite alteration. It is very similar to sample 562004.

THIN SECTION DESCRIPTION:

This sample is a strongly plagioclase-phyric very similar to 562004 in many respects. It consists of around 30 modal% of former plagioclase phenocrysts set and probably less than 1 modal% of chloritized augite and leucoxene-altered FeTi oxide phenocrysts and microphenocrysts, and sparse quartz phenocrysts. The plagioclase phenocrysts are mainly around 1mm long, but commonly occur in clots or four or more crystals. They are entirely replaced by a dense, high-birefringent (ie well-crystallized) sericite. Former augite phenocrysts are not common, and are replaced by chlorite and tiny opaque oxide dusty grains. All FeTi oxide microphenocrysts have been fine-grained leucoxene and chlorite. A few euhedral but slightly reacted quartz phenocrysts, less than 1mm across are also present. A few apatite microphenocrysts were noted.

The groundmass of this lava was largely glassy. It devitrified and crystallized as very fine-grained quartz-albite-chlorite-sericite mosaics that have been overprinted, in turn, by fairly intense chlorite-epidote alteration. Streaky and patchy green chlorite and less abundant dirty brown fine-grained patches of epidote are the most abundant phases in the altered groundmass.

This sample is probably a low-Si dacite or acid andesite. It has clearly suffered a fairly strong chlorite alteration, and the alteration assemblage is probably just below the basal greenschist facies.

SAMPLE NUMBER: 562008

SUMMARY:

This is a very strongly weathered and altered former basaltic to andesitic dyke rock, showing intense clay-very fine carbonate alteration.

HAND SPECIMEN:

This is a clayey, slightly cleaved, very strongly altered fairly fine-grained volcanic or dyke rock

THIN SECTION:

This sample is an exceptionally strongly weathered mafic or intermediate dyke rock, almost wholly replaced by very fine-grained clayey material. Relic igneous textures are preserved in several places in the slide, mainly defined by intergrown former plagioclase laths that reach almost 1mm long; dirty brown former FeTi oxide grains are relatively common in interstices, but altered to goethite-clay aggregates. A few former phenocrysts are entirely replaced by clay-very fine-grained carbonate-sericite mixtures; some of these have shapes suggestive of plagioclase precursors, but at least one large former phenocryst could have been clinopyroxene.

The rock almost certainly had a holocrystalline texture, and was probably a dyke rock. The elongate nature of the dominant former plagioclase, and the intersertal to subophitic texture suggest a basaltic to andesitic parent rock. The total replacement of this sample by clay and subordinate fine-grained carbonate, and the very minor amount of chlorite, albite etc suggest to me that it was unlikely to have been a Mount Read Volcanics rock. Even when strongly weathered, MRV rocks generally retain some of the original low grade burial metamorphic mineralogy. This sample either never had such an assemblage, or else suffered an intense and unusual style of alteration. The alteration style is very reminiscent of the strongly altered Curtin Davis Volcanics that occur in the Dundas Group east of Melba Flats. These are probably much higher in the stratigraphy of the MRV than most of the Que-Hellyer and other MRV lava piles. The fact that they occur as thin flows and dykes in a sediment dominated sequence sounds very similar to the scenario you describe for this horrible sample. Perhaps alteration fluids this high in the stratigraphy are more likely to produce argillic-type alteration than fluids buffered by large volumes of mafic, intemediate and felsic lavas.

PETROGRAPHIC REPORT

ROCKS FROM WINTERBROOK-CETHANA

FOR ABERFOYLE RESOURCES LTD

attn Sven Rand

by

Anthony J. CRAWFORD
Geology Department
Uni of Tasmania
17/2/90

SAMPLE NUMBER: 562184

SUMMARY:

This is a siltstone derived from nearby pelitic metamorphic and felsic volcanic sources.

HAND SPECIMEN:

This is a dark grey-blue banded tuffaceous siltstone, with layers mainly from 0.5 -1cm thick.

THIN SECTION:

This sample is clearly a siltstone somposed of detritus from two distinct terrains. The most readily identifiable detrital grains are quartz and muscovite, with subordinate albite and FeTi oxide grains. Much of the quartz appears to be of volcanic origin, as judged by the even extinction and occasional crystal faces preserved, although small grains of either vein or metamorphic quartz are common also. Muscovite flakes rarely larger than 0.3mm long are clearly detrital, as the larger flakes occur in the more coarse-grained layers. These almost certainly demand a nearby pelitic metamorphic source. A very weak incipient cleavage defined by dicontinuous streaks of sericite is evident almost perpendicular to bedding. The colour banding (light versus dark grey) seems to be due to variable ratios of detrital quartz versus micaceous/sericitic material.

SAMPLE NUMBER: 562185

SUMMARY:

This is a welded crystal lithic tuff of rhyolitic composition.

HAND SPECIMEN:

This is a texturally well-preserved, massive crystal vitric tuff with common black chloritic former pumice fragments.

THIN SECTION:

This is a crystal tuff dominated by broken crystals of quartz and minor albite, with not uncommon flattened former pumice fragments replaced by chlorite and minor sericite. Most quartz crystals are subhedral to rounded, and many are crystal fragments; most are around 0.5-1mm across; they make up about 30-40 modal% of the sample. . Former plagioclase crystals are albitized and generally strongly sericitized, and probably only make up 3-5 modal% of the rock.

Lithic clasts are relatively uncommon, and two types may be distinguished. The first is small, almost rounded snowflake textured aphyric formerly glassy lava fragments, rarely larger than 1mm across. The second, and more obvious, is constituted by the chloritized pumice fragments, that reach several cm length.

The groundmass of this sample is fairly uniform in texture, and was probably originally a welded glass. It has devitrified and been stongly streaked and laced by sericite, dominantly in the plane of the flattening of the pumice clasts.

SAMPLE NUMBER: 562186

SUMMARY:

This is an autobrecciated plagioclase+augite+quartz-phyric andesitic lava.

HAND SPECIMEN:

This is a texturally well-preserved dark green porphyritic andesite lava breccia with small calcite veinlets.

THIN SECTION:

This is a fairly coarse lava breccia, probably monomict, in that only a few adjacent, very similar fragments seem to have been cut by the section. All are strongly plagioclase-porphyritic andesitic fragmants varying only in their original vesicularity. Plagioclase phenocrysts make up around 20-25 modal% of these lava fragments, and occur as generally quite large (<3mm long) euhedral crystals that have been albitized, but show very little sericite alteration. The albite is generally quite pinkish, due probably to tiny Fe oxide inclusions. Much less abundant (probably < 3 modal%) are small (<1mm long) former augite phenocrysts that have been totally replaced by chlorite-calcite-minor quartz intergrowths. Former FeTi oxide microphenocrysts are well-formed prisms pseudomorphed by pale green chlorite in which elongate sphene crystals are growing. An unusual feature of this andesite is the presence of about six or seven small, rounded subhedra of quartz that have clearly been reacting with the groundmass. Also notable are several quite large apatite microphenocrysts.

The groundmass textures of the lava fragments that make up this sample are heterogeneous and rather unusual. The most obvious textural feature of the groundmass is the presence of a pseudo-variolitic texture, resembling filled vesicles, in several fragments. These probably represent sites of incipient crystallization in a glass, and have responded differently to metamorphic degradation than the glass in which the grew; the glass has generally devitrified and crystallized to a very fine-grained quartz-albite-chlorite aggregate. In some areas, glassy groundmass has been totally replaced by green chlorite. Highly irregular and discontinuous veinlets and fracture fillings of rather coarse-grained secondary silica and calcite are not uncommon in this sample.

The metamorphic assemblage in this sample, quartz, chlorite, albite, calcite and sphene, is typical of the prehnite-pumpellyite facies of buria; metamorphism of Fe-poor lavas.

The rock is a lava breccia, probably derived from a single autobrecciated flow of andesite that was transitional to dacite in primary composition (le a high-Si andesite). The presence of small quartz phenocrysts is unusual in a rock that is clearly not rhyolitic. The only other MRV andesites that I am aware of that commonly contain quartz phenocrysts are those hornblende andesites from around Crown Hill intrusive into the Central Volcanic Complex..

SAMPLE NUMBER: 562188

SUMMARY:

This is a plagioclase+augite+FeTi oxide-phyric andesite lava with relatively strong sericite-calcite alteration compared with the andesites described above from the same area.

HAND SPECIMEN:

This is a fairly altered grey-green porphyritic massive andesite lava.

THIN SECTION:

This sample is a porphyritic andesite lava very similar in extent of alteration to sample 562190. It consists of around 15-20 modal% of albitized plagioclase phenocrysts that have been thoroughly sericitized, although ghost compositional zoning is still occasionally preserved; considerably less abundant are chlorite-calcite-altered augite phenocrysts and leucoxenized FeTi oxide phenocrysts. Quite large apatite microphenocrysts (to almost 1mm long) are also not uncommon in this sample.

The groundmass is exceptionally fine-grained and was originally microcrystalline to glassy. It shows slight sericite alteration, and patches and veinlets of calcite are not uncommon. A few fracture fillings composed dominantly of chlorite, epidote and calcite are present. In general terms, this sample is almost certainly comagmatic with the andesites described above, although the extent of alteration (and abundance of calcite) in this sample is greater than all those except 562190 (which has only a very small amount of calcite).

SAMPLE NUMBER: 562189

SUMMARY:

This is a plagioclase+hornblende+augite+FeTi oxide-phyric andesitic lava.

HAND SPECIMEN:

This is a texturally very well-preserved dark green porphyritic andesite lava.

THIN SECTION:

This sample consisted originally of around 20 modal% of plagioclase phenocrysts and 3-5 modal% of mafic phenocrysts, with a few % of FeTi oxide microphenocrysts in a glassy groundmass. The plagioclase phenocrysts are mainly euhedral prisms 1-2mm long, and are almost entirely replaced by sericite; however, pronounced ghost compositional zoning is still obvious in many crystals, despite the sericite alteration. Unsericitized areas of the formerly calcic plagioclase phenocrysts are now albite. Former mafic phenocrysts, rarely longer than 1mm, include probably both hornblende and augite. Many have outlines strongly suggestive of hornblende precursors, although like those altered mafic phenocrysts that were clearly originally augite, all are replaced by green chlorite and subordinate calcite. Former euhedral small FeTi oxide phenocrysts are leucoxenized, and small apatite microphenocrysts are not uncommon.

The groundmass of this sample is very uniform, and almost certainly derived from devitrification and recrystallization of glass. It is now composed of an extremely fine-grained micro-snowflake-textured intergrowth of albite and quartz, speckled by chlorite and sericite.

It was noted for sample 562186 that the small quartz phenocrysts in a clearly andesitic rock were unusual, and resembled those in the hornblende andesites from around Crown Hill and on the Anthony Road. Although 562186 had few former mafic phenocrysts (and of those, nonethat were convincingly former hornblende phenocrysts), this sample (562189) undoubtedly had hornblende phenocrysts, and forces the consideration that these Winterbrook lavas might be broad compositional and time correlates of the andesite (albeit mainly intrusive) intruding CVC in the areas N of Queenstown. I will keep a piece of this well-preserved sample, and do REE, to test this suggestion.

SAMPLE NUMBER: 562190

SUMMARY:

This is a formerly plagioclase+hornblende+augite+FeTi oxide + quartz-phyric andesitic lava, very similar to the previous sample except more intensely sericite altered.

HAND SPECIMEN:

This is a massive, strongly sericite-altered porphyritic andesitic to dacitic lava.

THIN SECTION:

This sample was a plagioclase+mafics+FeTi oxide-phyric andesite lava originally very similar to 562189, except that it also had a small number of partially reacted and resorbed quartz phenocrysts, and probably somewhat less plagioclase phenocrysts. The sample differs from 562189 in being considerably more altered. The alteration takes two forms: one is that all plagioclase phenocrysts and most of the groundmass has been strongly sericitized, to the extent that it often difficult to discern the former plagioclase phenocrysts. The other form of alteration of this sample is abundant microfracture networks and veinlets that have brecciated the sample on a microscale, probably by fluid-driven fracturing. These fracture networks are now filled by clear secondary quartz and calcite.

The groundmass of this sample, besides being more sericitized than 562189, has a different recrystallization texture, being composed of tiny almost spherical blebs of secondary quartz in a sericitized feldspar matrix.

This sample was almost certainly a plagioclase+hornblende+augite+FeTi oxide-phyric andesite lava with sparse quartz phenocrysts, and is closely comparable but more altered than 562189.

SAMPLE NUMBER: 562192

SUMMARY:

This is a very well-preserved plagioclase+augite+quartz +FeTi-oxide-phyric andesite lava with a lowermost greenschist facies metamorphic assemblage.

HAND SPECIMEN:

This is a texturally well-preserved, massive plagioclase+mafic-phyric andesitic to dacitic lava.

THIN SECTION:

This sample is a very well-preserved porphyritic andesite lava composed of approximately 15-20 modal% of albitized plagioclase phenocrysts, around 5 modal% of partially chloritized augite phenocrysts and about 1 modal% of each of quartz and FeTi oxide phenocrysts. The plagioclase phenocrysts are slightly sericitized blocky to euhedral prisms with slight sericite speckling. They are rarely longer than 2mm and often occur in multi-crystal clots, or in small gabbroic clots with augite. Former augite phenocrysts are partially to completely replaced by green chlorite and sparse acicular very pale green actinolite, and small granular prisms of yellow epidote, although plenty of fresh augite is preserved. An interesting feature of this andesite lava is the presence of a number of large (1-2mm across) quartz phenocrysts, most of which are either euhedral or slightly reacted and rounded subhedra. FeTi oxide phenocrysts or microphenocrysts are replaced by leucoxenic aggregates. A few fresh apatite microphenocrysts were noted.

The groundmass of this sample is uniform-textured and was probably originally microcrystalline to glassy. It consists principally of a fine-grained mosaic intergrowth of quartz, albite and possibly Kspar, speckled with minor chlorite and sericite.

The metamorphic grade represented by the assemblage albite-chlorite-actinolite-epidote-leucoxene-quartz is lowest grenschist facies, slightly higher than many of the other andesites and associated rocks from the northern section of the MRV. The rock was clearly an andesitic lava, and again the presence of quartz phenocrysts in an andesitic lava is unusual and recalls the Crown Hill andesites, although there is no sign of hornblende in this rock. This is such a well-preserved sample I would like to put it into my analysis pile.

SAMPLE NUMBER: 562193

SUMMARY:

This is a plagioclase+augite+quartz+hornblende+FeTi oxide -phyric andesite very similar to 562192.

HAND SPECIMEN:

This is a porphyritic andesite lava with variable groundmass alteration from pinkish sericite-altered to greenish chlorite/epidote-rich domains.

THIN SECTION:

In thin section, this sample is seen to be almost identical to 562192, being dominated by albitized plagioclase and partially chlorite-epidote-altered augite phenocrysts, with less abundant but notable large euhedral but reacted quartz phenocrysts. One important difference though, is that this lava has quite common small (<0.5mm) fresh hornblende phenocrysts that show strong olive to colourless pleochroism. Small gabbroic clots are abundant, composed of aggregated plagioclase, augite and FeTi oxide phenocrysts.

The only other notable difference between this sample and 562192 is the abundance of fine-grained epidote in the groundmass of this sample. The epidote is restricted to irregular patches of groundmass. The sample shows the same lower greenschist facies metamorphic assemblage as 562192, and is very reminiscent of the Crown Hill andesites indeed.

SAMPLE NUMBER: 562194

SUMMARY:

This is a plagioclase+augite+FeTi-oxide-phyric andesitic lava , very similar to 562192.

HAND SPECIMEN:

This is a texturally well-preserved, massive porphyritic andesite lava that shows a colour zonation from a pinkish groundmass over most of the sample to a dark grey-green colour, with a rather sharp, irregular boundary between the two domains.

THIN SECTION:

In thin section, this well-preserved sample is seen to be essentially identical to 562192, in being a plagioclase+augite+FeTi oxide-phyric andesite with a formerly largely glassy groundmass. Unlike 562192, this lava has no quartz phenocrysts, and it has more abundant apatite phenocrysts. The groundmass is a uniform rather 'coarse-grained' patchy mosaic of quartz and pinkish albite, speckled by a small amount of sericite and chlorite, and is certainly crystallized from a glassy original matrix.

The transition noted in hand specimen from pinkish matrix (as described immediately above) to dark grey matrix is seen to be sharp, and due to the groundmass of the grey domain being composed almost entirely of chlorite, with subordinate quartz blebs. The phenocryst assmblage in both domains is identical, so the difference is probably due to intense fluid passage though that area now with the chloritic matrix.

The metamorphic assemblage is also identical to 562192, being albite-chlorite-actinolite-epidote-quartz-leucoxene, and indicates low greenschist facies of regional metamorphism.

SAMPLE NUMBER: 562195

SUMMARY:

This is a sparsely plagioclase-phyric rhyolitic to rhyodacitic formerly glassy lava, in which recrystallization and alteration of glass has led to obliteration of albite and a strong depletion of Na in the rock.

HAND SPECIMEN:

This is a pale grey-fawn sparsely plagioclase-phyric dacitic or rhyodacitic lava.

THIN SECTION:

This is a petrographically very simple rock composed of around 2-4 modal% of altered plagioclase phenocrysts in a devitrified formerly glassy matrix. The plagioclase phenocrysts are entirely altered to a mixed sericite-clay aggregate, and were mainly euhedral prisms less than 1mm long. The only other phenocryst phase was <<1 modal% of totally leucoxenized FeTi oxide microphenocrysts, often with small zircon crystals attached.

The groundmass of this sample is very uniform textured and is dominated by an even, patchy mosaic of secondary quartz riddled with sericite, possibly replacing former albite. The texture is a text-book example of a recrystallization of devitrified felsic glass, although the alteration of recrystallized albite to sericite has produced the massive Na depletion evident from the analytical data.

This sample is probably a rhyodacitic lava. I usually prefer to see quartz phenocrysts in an appropriate-looking felsic lava before I use the term rhyolite, although I note from your chemistry that this sample has an essentially rhyolitic Ti/Zr.

SAMPLE NUMBER: 562196

SUMMARY:

This is a very quartz crystal-rich welded ash flow crystal tuff.

HAND SPECIMEN:

This is a massive grey quartz-phyric felsic lava with a few elongate reddish features that resemble large flattened pumice clasts or fragments.

THIN SECTION:

This section clearly shows an excellent texture typical of a welded felsic crystal-rich ash flow tuff. It contains around 50 modal% of quartz phenocrysts to at least 5mm across set in a devitrified glassy matrix that shows a pronounced fluidal texture. The quartz crystals vary from angular and euheral, to almost perfectly rounded. All are volcanic in origin. Probably around 1 modal% of the sample is composed of totally sericitized plagioclase euhedra, mainly less than 1mm long. A few strongly altered FeTi oxide grains are also present.

Unfortunately, none of the flattened pumice(?) fragments were sampled in this section, however the texture of the formerly glassy matrix is strongly fluidal and tends to wrap around crystals. No traces of glass shards are present, and the sample is considerably too crystal-rich (and virtually monomineralic) to represent a normal rhyolite flow. I suggest that this sample represents a welded flow of quartz-phyric crystal tuff that probably originated as a hot, crystal-charged ash flow.

Appendix 3

Geochemical Results

(Analysis by ANALABS)

492039

SWR

ANALABS

(09) 458 7999 — 12 Murray Road, Welshpool, W.A. 6106 — Telex AA92560

ANALYTICAL REPORT No. 23.1.08.0A723

Aberfoyle Resources Limited
Exploration Division
P.O. Box 952
Burnie Tasmania 7320

7487

11/12/89 ASAP

1	21/12/89	1	6

C562,003/008	RC	Prep: 006,010,011,012,013,016						Cu,Pb,Zn,Ag/104
C562,003/008	RC							Ba,As,Cr,Zr,Ti,Y/401
C562,003/008	RC							K2O,MgO,CaO,Na2O/104

RESULTS TO

R. de Bomford
Aberfoyle Resources Limited
Exploration Division
P.O. Box 952
Burnie Tasmania 7320

RESULTS TO

REMARKS

W' Rock
rock CHIPS

STATE OF SAMPLES		ANALYSIS — PREPARATION				ANALYSIS — METHOD	
whole core	WC	perchloric acid	A1	cold acid		atomic absorption	AAS
split core	SC	hydrochloric acid	A2	specific sulphide		x-ray fluorescence	XRF
cutting	CU	nitric acid	A3	other mixed acids		emission spectrometry	SPEC
rock	RO	aqua regia	A4	alkaline attack		colorimetric	COL
soil	SO			volatilisation			CHR
pulp	PU	mixture		ignition			TITR
water	WA	under pressure	A7	pressed powder (XRF)		other chemicals means	CHEM
tissue	TI	fusion	A8	glass fusion (XRF)		miscellaneous	MISC
stream sediment	SS					fluorescence	FLUOR
heavy mineral	HM					inductively coupled plasma	ICP

AUTHORISED OFFICER

492010

ANALABS

Division of Inchcape Inspection and Testing Services Australia Pty Ltd

ANALYTICAL DATA

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
	23.3.08.06723	21/12/89	7487	1 OF 2

TUBE No.	SAMPLE No.	Cu	Pb	Zn	Ag	Ba	As	Cr	Zr	Ti
1	S62003	40	5	145	<0.5	460	<2	50	230	7450
2	S62004	20	5	70	<0.5	1250	<2	30	210	3650
3	S62005	10	<5	115	<0.5	760	<2	30	230	4000
4	S62006	25	15	85	0.5	1050	<2	40	220	4450
5	S62007	15	485	225	0.5	770	<2	30	240	4450
6	S62008	15	90	155	0.5	1200	<2	400	170	8300
7										
8										
9										
10										
11										
12										
13										
14										
15										
16										
17										
18										
19										
20										
21										
22										
23	DETECTION	5	5	5	0.5	10	2	5	5	30
24	UNITS	PPM	PPM	PPM	PPM	ppm	ppm	ppm	ppm	ppm
25	METHOD	101	101	101	101	401	401	401	401	401

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

AUTHORISED OFFICER

040 492041

ANALABS

Division of Inchcape Inspection and Testing Services Australia Pty Ltd

ANALYTICAL DATA

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER NO.	PAGE
	23.3.08.06723	21/12/89	7487	2 OF 2

TUBE No.	SAMPLE No.	Y								
1	562003	30								
2	562004	25								
3	562005	35								
4	562006	30								
5	562007	30								
6	562008	35								
7		—								
8										
9										
10										
11										
12										
13										
14										
15										
16										
17										
18										
19										
20										
21										
22										
23	DETECTION	5								
24	UNITS	ppm								
25	METHOD	401								

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

AUTHORISED OFFICER

492042

ANALABS

Division of Inchcape Inspection and Testing Services Australia Pty Ltd

ANALYTICAL DATA

SAMPLE PREFIX		REPORT DATE	CLIENT ORDER No.	PAGE
	23.3.08.06723	21/12/89	7487	1 OF 1

TUBE No.	SAMPLE No.	K2O	MgO	Fe2O3	Na2O					
1	562003	1.27	5.22	0.68	5.63					
2	562004	4.87	3.66	2.18	4.08					
3	562005	4.62	3.61	0.09	1.16					
4	562006	3.16	3.30	3.96	3.18					
5	562007	3.92	3.45	0.84	0.04					
6	562008	9.84	1.74	0.03	0.05					
7		—								
8										
9										
10										
11										
12										
13										
14										
15										
16										
17										
18										
19										
20										
21										
22										
23	DETECTION	0.01	0.01	0.01	0.01					
24	UNITS	%	%	%	%					
25	METHOD	104	104	104	104					

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

AUTHORISED OFFICER

492043

ANALYSIS

Telex AA

23-08-0480

Aberfoyle Resources Limited Exploration Division P.O. Box 952 Burnie Tasmania 7320	9379 — WINTERBROOK 22/01/90 — ASAP

1	24/01/90	1	10

562186/562195	RC	Prep: 004,010,011,012,013,016	Cu,Pb,Zn,Ag/101
562186/562195	RC		Ba,As,Cr,Zr,Ti,Y/401
562186/562195	RC	Prep: 004,010,011,012,013,016	K2O,MgO,CaO,Na2O/104

RESULTS TO

R. de Bomford
Aberfoyle Resources Limited
Exploration Division
P.O. Box 952
Burnie Tasmania 7320

RESULTS TO

REMARKS

STATE OF SAMPLES		ANALYSIS — PREPARATION				ANALYSIS — METHOD	
core	WC	perchloric acid	A1	cold acid		atomic absorbtion	AAS
	SC	hydrochloric acid	A2	specific sulphide		x-ray fluorescence	XRF
	CU	nitric acid	A3	other mixed acids		spectrophotometry	SPEC
	Ro	aqua regia	A4	alkaline attack		colorimetry	COL
	SO	nitric-perchloric	A5	volatilization		chromatography	CHR
	PU	HF mixture	A6	ignition		titration	TTN
	WA	HF under pressure	A7	pressed powder (XRF)		other chemicals means	CHEM
	TI	fusion	A8	glass fusion (XRF)		miscellaneous	MISC
stream sediment	SS					fluorescence	FLUOR
heavy mineral	HM					inductively coupled plasma	ICP

AUTHORISED OFFICER

ANALABS

A Division of Inchcape Inspection and Testing Services Australia Pty Ltd

ANALYTICAL DATA

SAMPLES RECEIVED	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
[illegible]	23.3.08.06803	24/01/90	9379	1 OF 1

	SAMPLE No.	Cu	Pb	Zn	Ag	Ba	As	Cr	Zr	Y
1	562186	20	10	115	<0.5	250	<2	30	200	3250
2	562187	30	15	95	<0.5	940	<2	50	220	3350
3	562188	30	70	250	0.5	1100	<2	30	210	3100
4	562189	30	5	100	<0.5	800	<2	30	210	3150
5	562190	15	<5	300	<0.5	960	<2	30	230	3450
6	562191	15	900	390	<0.5	870	<2	35	210	3850
7	562192	20	20	110	<0.5	1150	<2	30	210	2850
8	562193	45	310	670	<0.5	800	<2	45	200	2700
9	562194	35	15	95	<0.5	750	<2	25	220	2900
10	562195	10	<5	40	<0.5	770	<2	6	290	1400
11										
12										
13										
14										
15										
16										
17										
18										
19										
20										
21										
22										
23	DETECTION	5	5	5	0.5	10	2	5	5	50
24	UNITS	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
25	METHOD	101	101	101	101	401	401	401	401	401

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

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ANALABS

ANALYTICAL DATA

SAMPLE PREFIX

	23.3.08.06803	24/01/90	9379	1 OF 1

TUBE No.	SAMPLE No.	W	K	Rb	Sr	Y	Zr	Nb	Mo
1	562186	35	0.66	3.48	3.17	4.67			
2	562187	40	2.60	3.33	2.46	2.68			
3	562188	40	3.23	2.38	3.06	2.87			
4	562189	35	2.96	2.86	2.33	3.59			
5	562190	35	3.20	1.87	2.74	2.95			
6	562191	20	2.79	1.54	<0.01	0.06			
7	562192	30	3.61	2.41	2.61	3.78			
8	562193	35	2.15	2.25	3.11	4.48			
9	562194	35	2.24	2.37	2.65	5.48			
10	562195	35	4.28	0.53	<0.01	0.13			
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									
21									
22									
23	DETECTION	3	0.01	0.01	0.01	0.01			
24	UNITS	ppm	%	%	%	%			
25	METHOD	401	104	104	104	104			

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

AUTHORISED OFFICER

Appendix 4

Legend for 1:10,000 maps WINT 7A and WINT 7B

(After Pemberton and Vicary,1989)

046

492047

QUATERNARY

Qu

- Qc — *Cultural features — waste dumps, dams, etc.*
- Qt — *Talus, scree, slope deposits — derived from siliciclastic rocks (Qts), Cambrian volcanics (Qtv) and Tertiary basalt (Qtb).*
- Qa — *Alluvium, swamp deposits — may include older alluvium.*
- Qpg — *Coarse gravelly deposits of mainly fluvioglacial and/or glacial origin.*
- Qpm — *Bouldery morainal deposits. Moraine ridge crest indicated. (•••).*

TERTIARY

- Ts — *Unconsolidated sediments — gravel, sand, clay and minor lignite with some horizons of plant fossils.*
- Tb — *Vesicular to massive basalt flows. Columnar jointing common. Overprint indicates areas of hyaloclastic breccias.*
- Tg — *Silicified gravel and/or breccia of locally derived rock type ("Greybilly").*

ORDOVICIAN

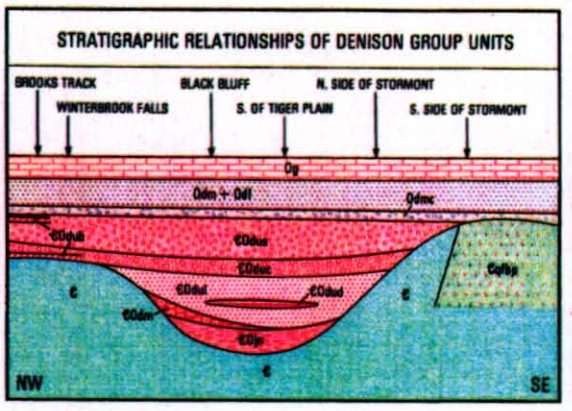
- Og — *Limestone and minor shale. Commonly stylolitic and fossiliferous — Gordon Group.*

LATE CAMBRIAN — EARLY ORDOVICIAN

DENISON GROUP — OWEN CONGLOMERATE

- Odl — *Fawn weathering siltstone and calcareous sandstone — Correlate of Florentine Valley Mudstone.*
- Odm — *Grey siliciclastic sandstone, thick bedded to massive, commonly bioturbated and with tubicolar burrows — Maina Sandstone.*
- Odmc — *Grey medium to coarse-grained sandstone and pebble-cobble conglomerate, rarely bioturbated (Odmc).*
- €Odub — *Pink medium to coarse-grained sandstone and granule-pebble conglomerate. Clasts of chert common but not ubiquitous. (€Odus). Localised thin flows of purple weathering hematite altered fine grained basalt (€Odub): Massive to brecciated generally well cleaved, vesicular, rare pillow structures and feldspar rich. Overpint indicates related unit of basaltic volcaniclastic sediment.*
- €Oduc — *Pink pebble to pebble-cobble conglomerate with minor lenses of coarse sandstone (€Oduc). Commonly chert-bearing. Base transgressive and erosional in some areas. Minor basic lava at base (€Odub).*
- €Odul — *Dominantly thin bedded pink to grey sandstone with minor siltstone, calcareous sandstone and granule-pebble to pebble-cobble conglomerate. Bioturbated on some horizons. Sill-like bodies of subophitic dolerite (€Odud).*
- €Odm — *Thickly bedded pebble-cobble to cobble-boulder conglomerate with minor sandstone lenses — correlate of Middle Owen Conglomerate.*
- €Odp — *Grey to purple volcaniclastic pebble-cobble conglomerate and minor coarse sandstone. Mostly correlates of Jukes Conglomerate but may include equivalents of Newton Creek Sandstone.*

STRATIGRAPHIC RELATIONSHIPS OF DENISON GROUP UNITS



CAMBRIAN — MOUNT READ VOLCANICS

WINTERBROOK-BELL MOUNTAIN AREA

CORRELATES OF TYNDALL GROUP AND DUNDAS GROUP

- Ctc — *Dominantly volcaniclastic pebble-cobble conglomerate and sandstone, usually quartz-feldspar-phyric with lesser felsic to intermediate volcanic rocks. (Ctcs). Mappable unit of volcaniclastic pebble-cobble conglomerate; clasts predominantly quartz-feldspar-phyric.*
- Ctcs — *Andesitic volcaniclastic pebble-cobble conglomerate.*
- Ctt — *Quartz-feldspar ± biotite crystal and crystal lithic tuff with minor quartz-feldspar phyric lava.*
- Ctql — *Quartz-feldspar-phyric lavas; commonly spherulitic auto-brecciated and flow banded. Includes rare vitriclastic tuff in some units.*
- Ctaa — *Andesitic pyroclastics, predominantly feldspar-phyric crystal lithic tuff.*
- Ctv — *Andesite, brown weathering mostly massive rarely flow-banded and autobrecciated lava, feldspar ± hornblende-phyric.*
- Ctfp — *Felsic, feldspar-phyric lava, cream-grey in colour, commonly spherulitic.*
- Ctst — *Interbedded tuffaceous sandstone, siltstone, vitric tuff, crystal tuff and minor volcaniclastic conglomerate, generally quartz-feldspar-phyric, with minor lava.*
- Ctfp — *Felsic, feldspar-phyric lava, cream-grey in colour, commonly spherulitic.*
- Ctqh — *Quartz-feldspar-hornblende porphyry-possible lava.*

BOND RANGE-STORMONT-BULL CREEK AREA

Ctcu

- Cgbp — *Quartz-feldspar-biotite ± hornblende porphyry ("Bond Range Porphyry").*
- Ctcs — *Interbedded tuffaceous sandstone, vitric tuff and minor crystal lithic tuffs, generally quartz-phyric.*
- Ctcl — *Medium to coarse grained quartz-feldspar-biotite-phyric crystal lithic tuff.*
- Ctct — *Medium grained quartz-feldspar ± biotite-phyric crystal tuff.*

Aberfoyle Resources Limited

EXPLORATION DIVISION

REVISIONS			
Init.	Date	Init.	Date

NORTH WEST TASMANIA

WINTERBROOK E.L.9/88

GEOLOGICAL LEGEND

Compiled : Dept. Mines

Drawn :

Traced :

Checked :

Location Code :

Scale :

Date : March, 1990

Plate No. : WINT 8

415000mE

420000mE

5410000mN

N

LEVEN RIVER

Taylors Bridge

PATRICKS CREEK

△ Black Bluff

WINTERBROOK AREA

WINTER BROOK

JEAN BROOK

RIVER LEA

WILMOT RIVER

LN1

WI1

WI2

AL1

AL2

AL3

MA1

MA2

427276 Y. A av.

427282 A.l. av. tr Py

427280 maroon R. (min. karat.)

427281, 27179] A. pl. ch.

bd. A av. pk. K. Py

gy. R. (int.)

10000E

9000E

8000E

7000E

6000E

5000E

6000N

6500N

5200N

MT. JACOB AREA

LAKE GAIRDNER

Cradle Mt. Road

Cethana Road

5 cm

0 1 2 Kilometres

492048

90-3124

— LEGEND —

	Q	Quaternary glacials and sediments
6	Tb	Tertiary Basalts
32	Os	Ordovician sediments
45	€av	Cambrian acid volcanics & volcaniclastics
70	slt	Siltstone, tuff shale
47	v	Volcaniclastic conglomerate reworked tuff, minor tuff-shale sandstone minor lithic & crystal tuffs.
58	€iv	Cambrian intermediate volcanics & volcaniclastics

Unconformity

CRA and Aberfoyle grids

● CRA drillholes (1986-87)

Aberfoyle UTEM loops

Aberfoyle reading lines

CRA UTEM loops

CRA reading lines

Aberfoyle Resources Limited
EXPLORATION DIVISION

NORTHERN TASMANIA

WINTERBROOK E.L. 9/88

UTEM COVERAGE

REVISIONS			
Init.	Date	Init.	Date
SWR jms	23-10-89		

Location Code :

Scale : 1:25,000

Date : July, 1989

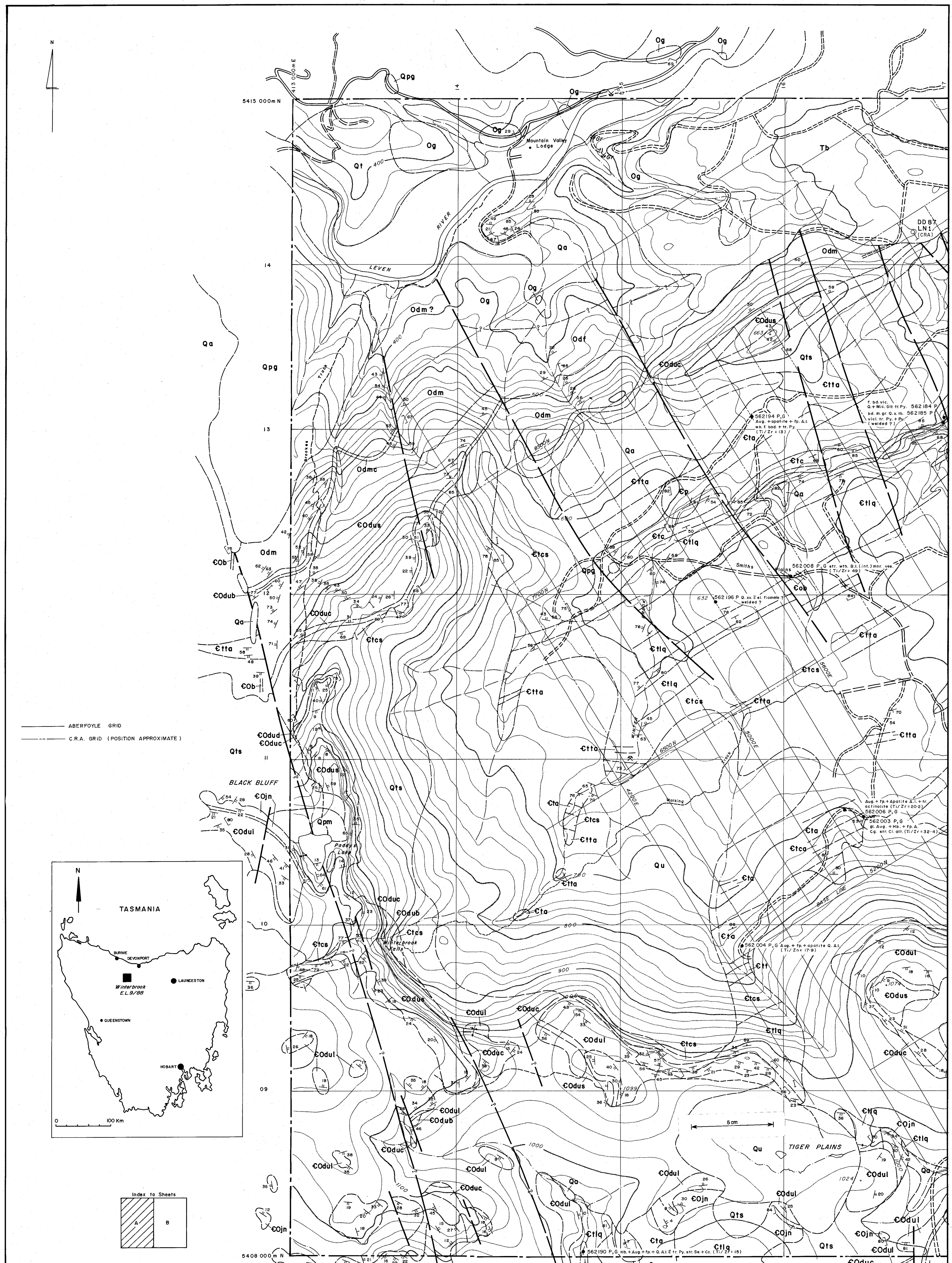
Compiled : DJJ SWR

Drawn : RJE

Traced : RJE

Checked : DJJ SWR

Plate No : WINT. 5



90-3124

FOR GEOLOGICAL LEGEND REFER PLATE WINT.8

492049

Aberfoyle Resources Limited
EXPLORATION DIVISION

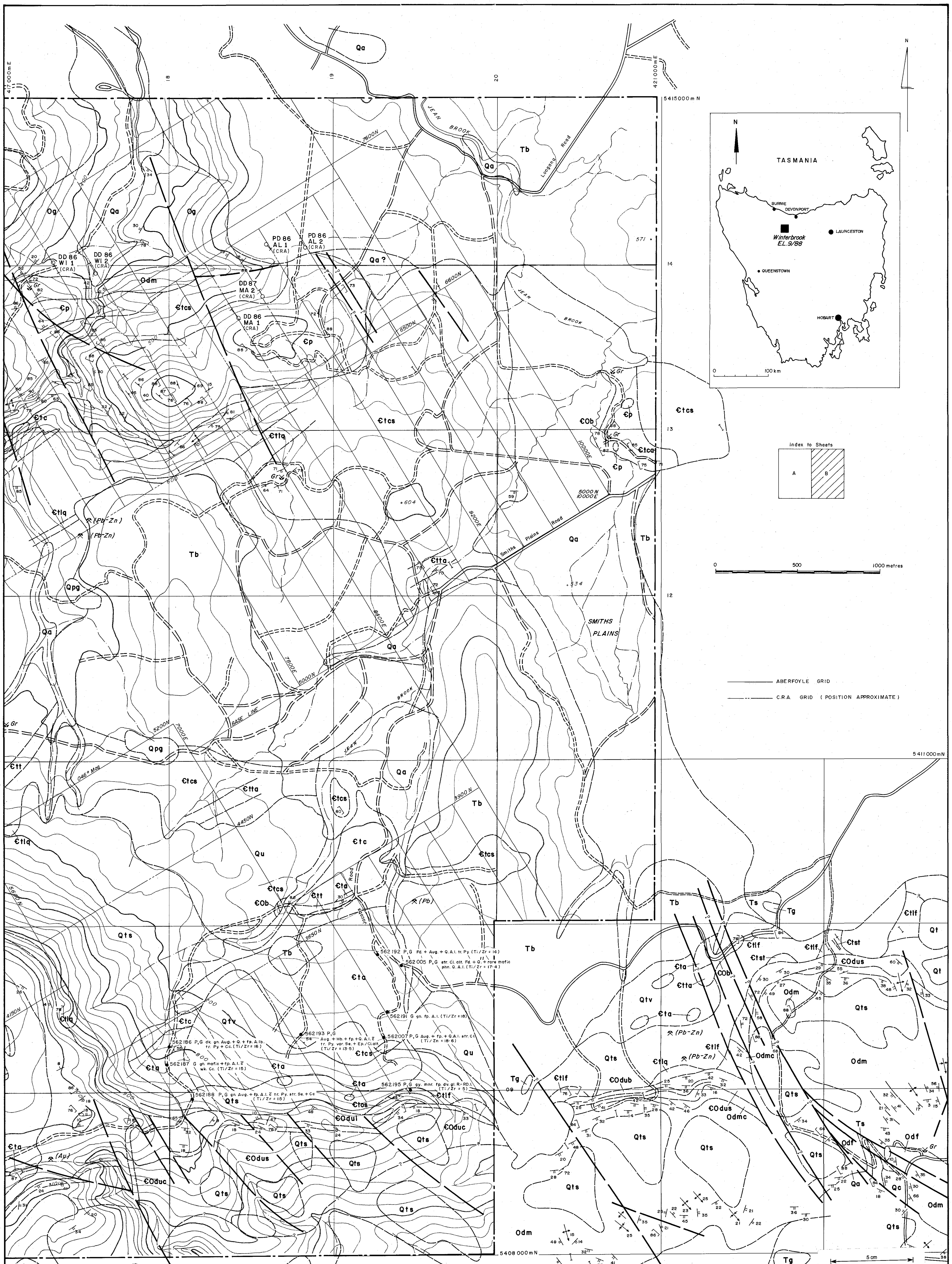
REVISIONS			
Init.	Date	Init.	Date
RJE	11·1·90		
SWRjs	19·1·90		
SWRjms	23·2·90		

NORTHERN TASMANIA

WINTERBROOK E.L. 9/88
INTERPRETIVE GEOLOGY
(AFTER PEMBERTON & VICARY 1989)

Compiled : Dept. of Mines
Drawn :
Traced : J. M. S.
Checked :

Location Code : K55/3
Scale : 1:10 000
Date : November 1989
Plate No : WINT. 7 A



FOR GEOLOGICAL LEGEND REFER PLATE WINT.8

90-3124

492050 **Aberfoyle Resources Limited**
EXPLORATION DIVISION

REVISIONS			
Init.	Date	Init.	Date
RJE	11·1·90		
SWRjms	23·2·90		

NORTHERN TASMANIA

WINTERBROOK E.L.9/88
INTERPRETIVE GEOLOGY
(AFTER PEMBERTON & VICARY 1989)

Compiled : Dept. of Mines
Drawn :
Traced : J.M.S.
Checked :

Location Code : K55/3 | Scale : 1:10000 | Date : November 1989 | Plate No : WINT. 7B