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MACKINTOSH DISTRICT

EXPLORATION LICENCE 106/87

TASMANIA

Progress Report for the Period

May 1990 to April 1991

Volume 1

Text and Appendices 1 - 6

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REGIONAL MANAGER

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1. SUMMARY

Areas of exploration activity in the Mackintosh district for the period May 1990 to April 1991 are shown on Plate MAC 318. Significant results are:

i) In the Southwell-Leven River area Pb, Zn and As stream sediment anomalies have been followed up by mapping which located a zone of sericite-pyrite ±silica alteration. This zone was surveyed with UTEM which did not locate any significant conductors.

ii) A re-interpretation of the diamond drilling and geophysical data south of the Que fault has indicated an alternate interpretation of the extent of the Que River alteration zone, previously thought to daylight at around 6200N. Lineament studies suggested the zone may plunge to the south beneath barren cover rocks. A diamond drill test of this concept (MAC 28) intersected a significant (+100m) zone of sericite pyrite±silica±fuchsite alteration similar to Que River footwall style alteration. This result significantly enhances the prospectivity of this area south of Que River.

iii) A diamond drill test (MAC 26) of the interpreted Que-Hellyer host horizon beneath the Charter dacite and of the base and precious metal mineralisation within the dacite produced mixed results. The interpreted Que Hellyer host horizon was intersected approximately 600m below surface and although unmineralised, was marked by potential host rocks.
Low grade base and precious metal mineralisation was intersected within the stringer system

viz.

0 - 58.4m	58.4m at 0.7% Pb, 1.15% Zn, 31 g/t Ag and 1.75 g/t Au
76.2 - 106.2m	30.0m at 1.6% Pb, 2.87% Zn, 10 g/t Ag and 1 g/t Au

Results from geochemical and isotopic studies in progress are required before further drilling can be recommended.

iv) DDH MAC 27 was drilled to test disseminated sphalerite rich mineralisation hosted by fuchsite altered volcanics in the vicinity of the Mount Charter dolerite area (best 94.7m of 0.52% Zn). This hole failed to intersect the interpreted Que-Hellyer host horizon at the base of the dacite due to a thick (570m) hangingwall sequence and fault complications.

v) Complete coverage of the Que Hellyer Volcanics by soil geochemistry, UTEM, ground magnetics and geological mapping has virtually sterilised the top 200m of this sequence.
To aid the development of deep conceptual targets, structural and lineament studies, further geological mapping in poorly understood areas and investigations into geochemical vector indicators were undertaken during the reporting period. These investigations indicate that a combination of geological and geochemical techniques show promise as vector indicators.

2. INTRODUCTION

The Lake Mackintosh Exploration Licence (EL 106/87) was granted to Aberfoyle Resources Limited on 5 February, 1988 subject to the Hellyer Mine Agreement Ratification Act 1987. The licence comprised 135 sq. km. previously covered by EL's 2/70 (Mackintosh) and 15/73 (Hatfield) and encloses the 20.2 km^2 of CML's 68M/84 and 103M/87 (encompassing the Que River and Hellyer mines and facilities).

Under the terms of this Act, EL 106/87 was reduced to 95 sq. km. on 5 February, 1990. Current tenure is shown on Figure 1.

This report summarises exploration completed in the Mackintosh district on EL 106/87 for the period April 1990 to March 1991.

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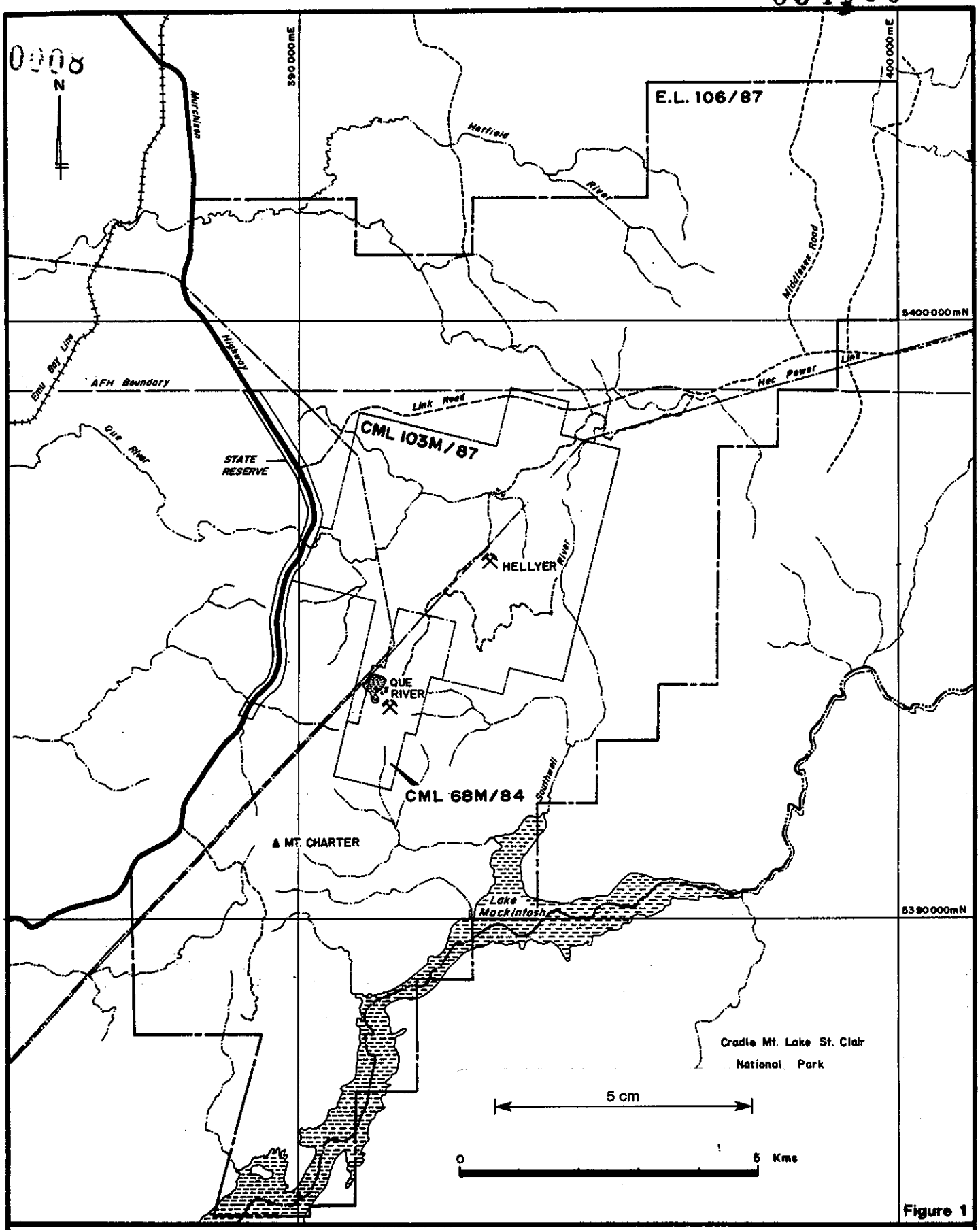

Figure 1

Aberfoyle Resources Limited

EXPLORATION DIVISION

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Init.	Date	Init.	Date
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NORTH WEST TASMANIA

MACKINTOSH DISTRICT

TENURE SUMMARY

Compiled : AMcN

Drawn :

Traced :

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Location Code : K55/6/44

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Date : May, 1990

Plate No. : MAC 181

3. REGIONAL PROJECT

3.1 Introduction

Exploration of the licence to date has resulted in virtual complete coverage of the QHV by soil geochemistry, UTEM, ground magnetics and geological mapping with the conclusion now evident that the probability of near surface deposits being discovered is extremely low and that future targets will be deep (>200m) blind systems.

To aid in defining deep conceptual targets, structural and lineament studies, further geological mapping in poorly understood areas and investigations into geochemical vectors for blind mineralised systems were undertaken during the reporting period.

Progress is also being made in an attempt to systematically organise the vast amount of geochemical, isotopic and geological data generated by over 10 years of intensive exploration of the Que River and Hellyer deposts and environs.

3.2 Geology

3.2.1 Research

Three research projects into aspects of the geology and geochemistry of the Mackintosh district are currently being supported they are:-

i) A PhD project on the volcanology and sedimentology of the Que-Hellyer volcanics. This project, initiated in 1988, is being undertaken by J. Waters under the supervision of Dr. R. Cas, Monash University. Two progress reports were issued during the reporting period (appendix 2). Work was concentrated on an E-W cross section of the Que-Hellyer vocanics, lithologies in the immediate vicinity of the Que River deposit and textural and geochemical variations of the 'mixed sequence' dacites.

ii) The style and palaeoenvironment of the upper rhyolitic sequence (Southwell Sub-group) is being studied as an M.Sc. project by G.A. Lees, also under the supervision of Dr. R. Cas. One progress report was issued during the reporting period (appendix 3) and details work both proximal (DDH HL40,62) and distal (MAC-22) to the Hellyer area.

iii) The "Hellyer Stringer Zone project" is being completed by Dr. J. B. Gemmell, CODES, University of Tasmania. Progress report 3 was issued during the reporting period and a final report is currently due. Recent work has focussed on a regional cross section (approximately 10500N), the Pb isotope characteristics of the Stringer Zone, regional oxygen isotope variations and detailed isotopic and minerological studies of phases in stage 2A, B and C Stringer veins.
This project has lead to a proposal for investigation of the significance of Pb isotopes in potential source rocks.

In addition Dr. R. Henley of Epithermex International, was contracted to review the geology and geochemistry of the Mt. Charter alteration system to determine if it exhibited any hangingwall style alteration features indicative of a VMS deposit at depth that may now be partially remobilised.

The initial problem has since been broadened to include studies of a more regional nature. An initial report (appendix 4) has been followed up by two pilot studies:

i) Rb-Sr isotope characteristics and alteration geochemistry (Appendix 5).
Samples from lithologies footwall to the Hellyer ore position on Bruce Gemmell's research section (approx. 10500N) indicated that the Rubidium concentration and Rb/Sr ratio may be used, with an "alteration index filter", as a vector for VMS alteration from 200-2000m from the alteration zone. Follow up work, on down hole variation distal to the Hellyer alteration system using samples from DDH'S MAC-11 and MAC-19, is in progress. Assay results have been received (Appendix 5) but interpretation is not complete. Studies at Mt. Charter and Hangingwall to the Hellyer ore position are recommended.

ii) A review of structural and stratigraphic relationships in the QHV and possible structural architecture models for the district that may influence the understanding of the setting of VMS mineralisation (Appendix 6).

A further recommendation of the initial report was the compilation of a comprehensive database of reports, papers and data from the Mackintosh district.

3.2 Mackintosh lineament study

The initial lineament study, (McNeill, 1990) has been expanded to include interpretation of recent image processed Ba, As, Cr, Ti and Zr 'C' horizon soil geochemistry. Results are shown on plates MAC-306, 311 and 313.

Major linears have also been plotted on 1:10,000 cross sections (Mac 269 series) to aid interpretation, but these have not been re-drafted (copies held in Burnie).

In addition to the three areas of interest defined by the previous study a further three target cones have been defined (plate Mac306):

a) Related to L1 (a major linear parallel to the Hellyer feeder zones and stringer veins) west of the Que River alteration zone. The possibility that the Que-Hellyer host horizon has been down-thrown on the east side of the linear should be considered. Also interesting as basalt in this area has an M2 signature.

d) The intersection of the L5 and cross linear coupled with geochemical highs, and inadequate drill testing combine to make this area attractive.

e) A major cross structure intersects the L4 linear (sub-parallel to the NNE trend of Hellyer feed zones) and is associated with Ba and As soil anomalies (? hangingwall style alteration). The area is poorly drill tested.

A review of Cu, Cr and Ti soil images suggest that it may be possible to differentiate between upper (M2 signature) and lower (M3 signature) basalts and dolerite (M1 signature) as shown on plate Mac311. If this sub-division is correct then it will require major reinterpretation of the area South of the Que River portal. Follow-up is being undertaken by statistical analysis of the soil data.

Further work on this project should include interpretation of ground magnetics, I.P. and E.M. data to confirm these interpretations.

3.3 Geochemistry

3.3.1 Soil Geochemistry

The image processed geochemical maps of "C" horizon soil data at Mackintosh are attached as Plates MAC 290 a-d, f, j-l.

Data was retrieved from field data base in ascii form and imported into a binary format for the gridding/contouring package.

Gridding was carried out using a random gridding technique with a 16 sector radial search pattern and a maximum search radius of 300 metres. Element values were converted to logs prior to the gradient based interpolation procedure and converted back afterwards so that interpolated values did not pass below zero concentration.

The gridded data was converted to image processing format (real) and displayed in 256 colours using in-house image processing software. The data was stretched interactively using both linear and log look up tables.

A stretch was selected for each element which clearly highlighted features of interest and this was then printed at 1:10,000 scale on a colour inkjet printer.

Multivariate statistics were computed for the full element suite and principle components images generated.

A number of three element RGB combinations, ratios and the PC's were examined by image processing techniques with the objective of enhancing rock type and alteration signatures. More work is planned in this area.

3.4 Diamond Drilling

3.4.1 Core Grind Geochemistry

To follow-up discrepencies between logged rock types and classifications based on core-grind geochemistry, using Cr vs Ti/Zr, in McNeill (1990), a selection of thin sections have been described from DDH's HAT-1, 2 and MAC-10 (see Appendix 7 for description and locations).

HAT-1

Footwall lithologies in this hole were logged as andesites but have low Cr, <20 ppm, and Ti/Zr 15, i.e. on the border between andesite and dacite. Sample 563788 was described as a glassy silic andesitic lava while 563787 is a polymict andesitic-dacitic lava breccia, confirming the andesitic nature of the footwall.

HAT-2

Lithologies below 140m in this hole have equivocal geochemistry, on the andesite/dacite border, however descriptions of samples 563790 and 791 suggests lithologies are altered plagioclase-augite phyric andesite lavas.

MAC-10

Description of sample 383705 confirms that the interval 260.7-310m is dacitic however, further work is required on the interval 310-352.8m to determine its compositional affinities.

3.4.2 Core Geochemical Data Base

Studies of the Que-Hellyer district have indicated several potential geochemical vectors for both hangingwall and footwall alteration and/or mineralisation (Jack, 1989; Gemmell, 1990; McNeill, 1990 and Henley, section 3.2.4 this volume). A programme of systematic data collection from

i) Whole rock data in published and un-published sources:- Jack (1989), CSIRO, AMIRA and Department of Mines.

ii) Data from adjacent EL's released through joint venture or on open file.

iii) Further sampling of drill core. A total of 89 samples collected and analysed for Cu, Pb, Zn, Ba, As, Ag, Cr, Ni, Ti, Zr, Mn, CaO, K_2O, MgO, Na_2O, Sr and Rb (results and locations are in Appendix 8).

is in progress. Samples have been taken from un-weathered drill core as initial studies (McNeill, 1990) indicated that weathering of surface samples and leached zones in drill core had a marked effect on some element abundances, most notably the alkalii.

In an attempt to minimise primary compositional effects, samples were selected from five stratigraphic horizons within the QHV, e.g. within 10m of the base of the hangingwall basalt/andesite. The database now is up to date for the Top and base of the hangingwall basalt/andesite sequence. Data from these two horizons are presented in Appendix 8. Initial interpretation of the data is in progress and it is planned to apply statistical techniques such as trend surface analysis (Gannicott et al, 1979) to define alteration patterns.

3.5 Summary and Recommendations

Investigation of the various geochemical and geological aspects of the Que Hellyer Volcanics have shown promise as vector indicators for massive sulphide mineralisation. Some of the research and pilot studies are at an early stage and benefits are as yet not readily apparent. It is recommended that this approach to assist in the definition of more conceptual targets continue. More specifically;

- Continue support of higher degree research into palaeoenvironments at Mackintosh (J. Waters, G. Lees).
- Evaluate B. Gemmell's proposal for further research of Pb isotopes.
- Continue Rb-Sr studies of Hellyer hangingwall rocks and at Mount Charter.
- Evaluate Alisdair Cookes pilot structural study.
- Initiate a structured compilation of the comprehensive Mackintosh data base.
- Follow up lineament study by statistical analysis of soil data in conjunction with regional interpretation of geophysical data.

- Continue interpretation of the core geochemical data base using statistical techniques such as trend surface analysis.

4. SOUTHWELL - LEVEN RIVER

4.1 Introduction

Exploration of the Southwell Sub-Group, a volcano-sedimentary sequence conformably overlying the QHV, was concentrated in the Southwell valley this reporting period. Mapping was completed over the grid established in 1989, with the aim of locating the source of Pb, Zn and As -72# stream sediment anomalies (McNeill 1989). During the course of the mapping a zone of footwall style alteration was located. A small (2.5 line km) extension to the existing grid was cut and the alteration zone surveyed with UTEM.

4.2 Geology

4.2.1 DDM MAC-20

During the course of relogging this hole, as part of a study of the Southwell Sub-Group (Section 3.2.4) Dr. K.D. Corbett, noted the presence of trilobite fossils in unusual carbonate rich clasts from a course lapili volcaniclastic at 350-365m down-hole. Two samples were provided to Dr. J. Jago, University of South Australia, who identified the fossils, see appendix 9 for report. He concluded that the fauna was older than the Crade Mt. Link road locality (Tyndall Group) but the same age or slightly younger than the fauna in the Que River Shale, confirming the correlation of this unit with the Southwell Sub-group.

4.2.2 Southwell Valley

Mapping at 1:2500 scale was completed on lines 10200N-12200N and in the small creeks around 11700N, 7800E. Results are shown on plates MAC89WW, A1 and 7 (see plate MAC114 for legend). An interpretation is shown on plate MAC161B. Major lithological types in this area have been described previously (McNeill 1989c) and no further petrological work has been completed. It is now considered that, using the criteria of Allen (1988), some lithologies previously identified as volcaniclastic (flv on interpretive geology plans) are rhyolitic-dacitic lavas or intrusives, with false clastic texture produced by a combination of alteration and devitrification. These felsic lavas/intrusives are much more widespread than previously interpreted and form two major N-S trending bodies, disrupted by interpreted N.W. trending faults. Between these two bodies is a sequence of felsic medium lapilli to ash volcaniclastics and interbedded micaceous greywacke-shale, which are intruded by small rhyolitic bodies that appear to be sub-parallel to bedding in some outcrops (e.g. 10400N, 8170E).

It is difficult to sub-divide these lithologies due to poor exposure north of 11400N but in the southern part of the grid a nose of greywacke and shale is flanked to the east and west by volcaniclastics. Bedding in this nose of sediment is steeply NW to NE dipping suggesting a north plunging anticlinal closure however, the larger scale structure of this area is poorly understood.
Southwell sub-group lithologies are overlain by Tyndall Group correlates, purple-green polymict volcaniclastic sandstone and conglomerate. The apparent kink in the contact around 11800N, 8350E may be the result of fault complication.

No obvious source for the stream sediment anomalies was located but intense quartz ± k-feldspar-carbonate veins in parts of the rhyolitic lava/intrusives are a potential source. The source of anomaly iv (McNeill 1989b) would appear to be a zone of pyrite veined, pyrite-sericite ± silica altered rhyolitic lava around 11600N, 7800E. Alteration within this zone is patchy with apparently unaltered lithologies intercalated with strongly altered types.

4.3 Geochemistry

A total of 12 rock chip samples were submitted for assay from the Southwell Valley grid. Results and sample locations are included in appendix 10. Results from these samples were disappointing with base metal, As and precious metal values in apparently quite intensely altered lithologies all much lower than would be expected from stringer envelope zone type alteration. A maximum of 485 ppm Pb and 17 ppm As was recorded from a pyritic ash volcaniclastic. Cu and Zn values were all low.
Ti/Zr ratios indicate all lava samples are rhyolitic (Ti/Zr <6) although Cr values are variable but, generally low, with a maximum of 140 ppm in sample 563726.

4.4 Geophysics

4.4.1 UTEM

A one loop UTEM survey, completed over lines 11200N - 12200N from 8000E - 7400E, resulted in the collection of 3.6 line km of 50m spaced Hz component data. Results and interpretations are included in appendix 11. No responses attributable to massive sulphide accumulations were located.

4.4.2 Ground Magnetics

A total of 13.1 line km of 10m spaced data was collected on the Southwell valley grid using an EDA Omni 4 magnetometer, levelling was completed using tie-lines. Stacked profiles and contoured data are shown on plates MAC296b and 298 respectively. No anomalies were detected and the major feature appears to be a high associated with Tyndall Group lithologies. This data has been merged with the Mackintosh data base, which will be re-processed and a 1:10,000 image of the Mackintosh district produced.

4.5 Summary and Recommendations

Mapping of the Southwell Valley grid failed to locate the source of 1st order Pb and Zn stream sediment anomalies, now considered to be the result of vein style mineralitation on the margins of rhyolitic intrusives, but defined a zone of sericite-pyrite±silica alteration, the probable source of an Au and As stream sediment anomaly. This zone was surveyed by UTEM with negative results. No further exploration is warranted at present, although the results of research into the palaeo-environment and style of volcanism of the Southwell Sub-group may provide encouragement in the future

5. I_1 ZONE

5.1 Introduction

Diamond drilling on the Que River mining lease failed to close off the Que River alteration zone south of the Que fault. A fence of 5 holes, on section 6700N, intersected sericite-pyrite-silica± chlorite alteration which hosts stringer veins (e.g. DDH QR-29 213.75 - 214.25m, 0.55m @ 0.86% Cu, 6.06% Pb, 10.7% Zn, 17.0 g/t Ag) while strong Na depletion, in samples analysed from QR-29, indicates intense typical footwall alteration (Whitford et al, 1989).

Previous interpretation, based on IP data and mapping, suggested the alteration zone plunged to the north and daylighted around 6200N. However, lineament studies (I. B. Freytag, section 3.2.2) suggested that the alteration zone may plunge to the south, while a brief review of geophysical data by J. Silic (pers. comm., 1990) indicated that:

i) there is a probably plunging channel 7 UTEM conductor (anomaly H2) in the alteration zone.

ii) 25m dipole-dipole IP data suggests alteration becomes less intense to the south, but no predictions as to the plunge of the system could be made.

Diamond drilling was therefore proposed to test for a southern extension of this alteration while surface sampling was completed to aid geological interpretation of this poorly understood area.

5.2 Geology/Geochemistry

The access track from the 5800N costean to the MAC-28 drill site was mapped (see plate MAC89/BB) and rock chip samples collected at 10m intervals and analysed for Cu, Pb, Zn, Ba, As, Ag, Cr, Ti and Zr. Results are included in Appendix 12. Lithological indicator elements confirm the mapped sequence of, from south to north, Andesite and minor dacite passing through high Cr (> 1000 pm) and Ti/Zr (to 48) basalt with minor interbedded polymict andesitic lapilli volcaniclastic to andesitic/dacitic lava at the drill site. The presence of andesitic-dacitic lavas on 6000N, was not expected as Cr values from 'c' horizon soils on this line suggested basaltic lithologies. Base metal values from these rock chip samples were generally low with a maximum of 2400 ppm Pb from the polymict andesitic unit and 941 ppm Zn, 60 ppm As from the enclosing basalt.

5.3 Diamond Drilling

5.3.1 DDH MAC-28

Geology

DDH MAC-28, see plate MAC 161C for collar location, was designed to test the interpreted southern extension of the Que River alteration zone on 6000N, at an estimated easting of 4600E and at a depth of approximately 400m, i.e. below effective UTEM. The hole was also designed to provide stratigraphic information, particularly the depth of the interpreted Que-Hellyer host horizon, in a poorly drilled area.

A detailed log and petrographic descriptions are included as Appendix 13 while a section of the hole is included as plate MAC319 (see plate MAC 115 for legend). A summary log is as follows:

0 - 25	Dacite lava.
25 - 149	Basaltic lava breccia with intercalated andesite.
149 - 155	Polymict andesitic volcaniclastic.
155 - 716	Feldspar phyric andesitic volcaniclastics with polymict andesitic volcaniclastics from 481-490 and 546-563.
716 - 827	Alternating sericite, silica, pyrite alteration ±fuchsite with andesitic lava.
827 - 891	Strongly sericite, silica±fuchsite, pyrite altered volcanics (Que River footwall style).
891 - 899	Andesite lava.
899 - 907.5	Strongly altered volcanics as above.

Geochemistry

Core grind samples from MAC28 are attached as Appendix 14. Initial interpretation of this data confirms the rock types as logged. Base metal values in the alteration zone are generally low. This is not unusual in this style of alteration at Que River.

Geophysics

The planned down hole EM survey of MAC28 has been delayed by equipment availability.

5.4 Summary and Recommendations

The intersection of Que style footwall alteration south of the previously interpreted termination is significant. The occurrence of footwall style alteration covered by barren volcanics indicates the presence of a prospective host horizon at the contact between alteration and cover rocks. This opportunity will be tested by down hole EM at the earliest opportunity. Further, the prospectivity of Que Hellyer Volcanics at depth south of 6000N in the Baryte Creek area is enhanced and further work in the form of stratigraphic drilling is necessary.

6. MOUNT CHARTER

6.1 Introduction

Exploration at Mount Charter has been directed at both base metals (Hespe, 1984, Hespe, 1985) and more recently gold (McNeill, 1990) in sericite-pyrite alteration beneath a zone of massive and vein barite, replacing discontinuous volcaniclastic units, at the contact of hangingwall andesite and dacite. A re-interpretation of geochemical data from drilling in this area indicates that all previous holes were terminated in dacite and did not intersect the interpreted Que-Hellyer host horizon. Further drilling was therefore proposed to test the intersection of this alteration zone and the Que-Hellyer host horizon

6.2 Diamond Drilling

6.2.1 DDH MAC-26

Geology

DDH MAC-26 (see Plate MAC 161C for collar location) was designed to drill down the core of the interpreted steeply north plunging alteration system, to provide information on variation in style of alteration and grade of mineralisation with depth; to intersect the interpreted Que-Hellyer host horizon and continue to basement to provide information on the thickness of the QHV in this area.

A detailed log and petrographic descriptions are included as Appendix 15 while a section of the hole is included as Plate Mac 302 (see Plate MAC 115 for legend). A summary log is as follows:

0-167.8m	Strongly silica-pyrite altered dacite lava and volcaniclastic with strong barite and BMS veining. Includes 20.6m (29.7-49.3m) of massive barite with pyrite rich veins.
167.8-360m	Strongly to moderately sericite-silica-pyrite ± fuchsite altered dacite lava, lava breccia and polymict volcaniclastic. Includes intervals of up to 5m with >10% disseminated sphalerite + galena associated with barite veining.
360 -447.6m	Moderately fuchsite-sericite and weakly pyrite altered polymict volcaniclastic with minor dacite lava and lava breccia.
447.6-528.0m	Variably calcite-silica-pyrite, with minor fuchsite spotting, altered dacite lava and lava breccia.
528.0-539.7m	Vesicular basalt lava.
539.7-654.7m	Pyrite-chlorite-fuchsite altered dacitic lava with minor interbeded of vesicular basalt lava, to 601.7m, and polymict volcaniclastic.
654.7-661m	Chloritic andesitic lava breccia and volcaniclastic.
661 -681.7m	Siliceous dacitic lava.

681.7-691.7m	Andesitic lava breccia.
691.7-731.4m	Mixed sequence of andesitic lava and lava breccia, polymict breccia to lapilli volcaniclastic and minor dacite lava.
731.4-739.7m	Grey siliceous dactic lava.
739.7-850.7m	Andesitic lava and lava breccia with minor polymict volcaniclastic.

The hole appears to have passed through pervasive silica-sericite-pyrite alteration with associated base metal and barite rich veining, from 0-447.6m before a zone of silica-pyrite±carbonate±chlorite alteration with minor base metals. This change corresponds to the passage from the core of the alteration zone to the envelope zone of Rand (1988). When correlated with other drilling and surface exposure the section seen in this hole indicates the Mount Charter alteration is essentially vertical, as would appear to be the case with other alteration systems on the licence, and not steeply N plunging as previously interpreted.

Mineralisation in the top 360m of the hole occurs dominantly as disseminated sphalerite and galena in the matrix of clastic lithologies or associated with barite-quartz veins. The barite is either massive, with bands of sulphides, or brecciated possibly after a primary lava breccia or volcaniclastic.

The apparent true thickness of >500m of dacite is the largest seen in the Mackintosh district but is complicated by a gradual dacite-andesite contact, from 650 - 750m, with mixed andesite, dacite and minor basaltic lavas and polymic volcaniclastic, which represent potential host horizons. As with DDH MAC-25 (section 7.2) several basalt flows were logged in the dacite unit.

Geochemistry

The entire length of DDH MAC-26 was core-ground or split and a total of 144 samples analysed for Cu, Pb, Zn, Ba, As, Ag, Au, Cr, Ti and Zr. Results are presented in appendix 16. Major mineralised intersections were:-

0-58.4m: 58.4m @ 0.7% Pb, 1.15 % Zn, 31.6 g/t Ag, 1.75 g/t Au

76.2-106.2m: 30m @ 1.6% Pb, 2.87% Zn, 10.46 g/t Ag, 1 g/t Au
including: 2.9m @ 4.85% Pb, 7.18% Zn, 25 g/t Ag, 1.09 g/t Au
2.5m @ 1.99% Pb, 5.78% Zn, 13.8 g/t Ag, 2.3 g/t Au

215.8-225.3m: 9.5m @ 1.35% Pb, 2.69% Zn, 18.1 g/t Ag, 0.93 g/t Au

245.7-249.0m: 3.3m @ 2.52% Pb, 5.13% Zn, 24.5 g/t Ag, 0.6 g/t Au
including: 1.3M @ 3.8% Pb, 7.4% Zn, 29.5 g/t Ag, 0.68 g/t Au

304.4-308.7m: 4.3m @ 1.31% Pb, 1.63% Zn, 12 g/t Ag, 0.24 g/t Au

353.4-361.8: 8.4m @ 0.67% Pb, 2.31% Zn, 7.7 g/t Ag, 0.36 g/t Au

Within these intervals high Ba, to 44%, is associated with the base metals while a maximum of 1350 ppm As (0-14.2m) and 3400 ppm Cu (73.3-76.2m) were recorded. Below 361.8m base and precious metal values are generally low with the exception of 595.7-597.1m, 1.4m @ 409 ppm Cu, 0.9% Zn, 0.57 g/t Au and 23% Ba, an interval which is intensely barite veined. Litho geochemical elements, particularly Ti and Zr, were affected by high Ba concentrations when analysed by XRF.
This reduces their usefulness in the top 360m of the hole however, low Cr value and petrological description (appendix 15) confirm this interval is cominantly dacite.
Below 360m lithologic may be sub-divided on the basis of the following geochemical characteristics:

i) Dacites have a Ti/Zr from 9-14 and low Cr, generally from <5 to 20 ppm but up to 148 ppm,

ii) Andesites have a Ti/Zr of >17 and Cr values from <5 to 140 ppm.

iii) Basalts have a Ti/Zr from 11 to 35.7, but generally clustered around 20-22, and Cr values of 258 to 1257 ppm.

These sub-divisions have been confirmed by thin section description (appendix 15). Volcaniclastic units appear to vary from dacite in the upper part of the hole to andesitic lower in the sequence.

Geophysics

DDH MAC-26 was read with DHEM (Zonge GDP-16). Loop locations and results are included in appendix 23. No off-hole conductors attributable to VMS accumulations were detected.

6.3 Summary and Recommendations

DDH MAC-26 (850.7m) passed through the core of the, now interpreted to be vertically dipping, Mt. Charter alteration system intersecting baritic base and precious metal rich zones of mineralisation (e.g. 245.7-247m, 1.3m @ 3.8% Pb, 7.4% Zn, 29.5 g/t Ag, 0.65 g/t Au).
The interpreted Que-Hellyer host horizon was intersected approximately 600m below surface and although un-mineralised was marked by potential host rocks. Despite the lack of a DHEM reponse there remains room for economic mineralisation, at the Que-Hellyer host horizon, below, i.e. to the south of, DDM MAC-26. Before any further drilling can be recommended the results of a geochemical/isotopic study, (Section 3.2.4),into the potential for the Mt. Charter system to host economic mineralisation, should be assessed.

7. MOUNT CHARTER DOLERITE

7.1 Introduction

Previous drilling at the Mount Charter Dolerite prospect (DDH MC-14 [McNeill, 1989a]), designed to test soil geochemical anomalies, intersected a sequence of intercalated andesite and basalt that were interpreted to represent both hangingwall and footwall with no intervening potential ore horizon. However, sphalerite rich disseminated and vein style mineralisation, immediately below the Que River shale, averaged 0.52% Zn over 94.7m.

A similar style of mineralisation has also been recorded from drilling by BHP on EL 5/63, immediately west of the Mount Charter Dolerite prospect, where DDH HP-1 (anon, 1988) intersected 235m @ 0.21% Zn and DDH HP-4 (Wilde and Kerr, 1989) intersected 125m of sphalerite rich mineralisation (no assay values reported). In both HP-1 and HP-4 zones of calcite-fuchsite ± pyrite hangingwall style alteration have been described. This coupled with exposure of fuchsite altered basalt at 4500N, 2600E suggested that a substancial hydrothermal system was active in this area and, although generally unfocussed, the potential for localised economic accumulations of BMS existed.

7.2 Diamond Drilling

7.2.1 DDH MAC-27

Geology

This hole (see Plate MAC 161C for collar locations) was designed to test the Que-Hellyer host horizon, below effective UTEM, in an area of hangingwall style alteration and unusual sphalerite rich mineralisation.

A detailed log and petrographic descriptions are included in Appendix 17 while a section of this hole is presented on Plate MAC 312 (See Plate MAC 115 for legend). A summary log is as follows:

0 - 223.6m	Que River shale with minor sandstone interbeds
223.6 - 225.8m	Vesicular basalt lava. Abrupt conformable contact to:
225.8 - 249.8m	Que River shale. Irregular conformable contact to:
249.8 - 400m	Massive brecciated basalt lava. Patchy sphalerite ± pyrite ± pyrrhotite mineralisation.
400 - 526.7m	Massive to brecciated feldspar-phyric, weakly vesicular andesitic lava.
526.7 - 652.35m	Massive to brecciated vesicular and weakly feldspar-phyric basalt lava.
652.35- 653.1m	Massive black shale. Conformable contact to:
653.1 - 664m	Massive vesicular basalt lava.
664 - 668.4m	Shale coarsening to fine sandstone down-hole.
668.4 - 759.3m	Massive to brecciated basalt lava.
759.3 - 767m	Mottled yellow-green feldspar-phyric massive andesitic-dacitic lava, disseminated sphalerite -pyrite-chalcopyrite mineralisation.
767 - 837.4m	Massive to brecciated basalt lava. Conformable contact, through 1.1m chert matrix volcaniclastic to:
837.4 - 877.3	Mottled pink-green pyritic dacitic lava and lava breccia. Fault contact to:
877.3 - 883.8m	Basalt lava and lava breccia.

The Que River Shale section was much thicker than anticipated and differs from many intersections in the number of intercalated units of ash volcaniclastic, fine lapilli volcaniclastic, mica sandstone and pyritic volcaniclastic sandstone. Grading in some of these units (e.g. 35.5m) implies an up-hole facing.

The interpreted hangingwall andesite-basalt lava sequence (249.8-837.4m) was also much thicker than expected and is the thickest, interpreted 570m true thickness, Hellyer basalt correlate yet intersected on EL 106/87. In view of this it is now suggested that DDH MC-14 did not reach footwall lithologies, no dacite was intersected, but terminated hangingwall to the Que-Hellyer host horizon. Other features of the andesite-basalt sequence include the presence of reacted quartz xenocrysts, with pyroxene mantles, similar to those reported from the Sock Creek volcanics to the south, and minor interbeds of sandstone and shale of predominantly metamorphic provenance, similar to the Animal Creek Greywacke (sample 563715, Appendix 17).

The hangingwall lithologies pass through a 1.1m (836.3-837.4m) breccia unit, in which the proportion of basalt lava fragments decreases until they disappear and dacite clasts appear at 837.3m, into variably pyritic plagioclase-phyric dacite lava and lava breccia. This is in faulted contact with basalt lavas that are petrographically very similar (563717, Appendix) to the hangingwall lithologies and are interpreted to be ablock down thrown on a structure related to the Mount Charter fault system.

Alteration of hangingwall lithologies is dominated by albite± carbonate ± silica assemblages that are most intense in lava breccia where it pervasively smaller clasts and forms pink rims, often with finely disseminated sphalerite, on the margin of larger clasts. Light green silica-sericite (?fuchsite) occurs in more massive units or is associated with zones of hydraulic brecciation. The dacitic lavas are silica-sericite± chlorite altered with pervasive disseminated pyrite.

Mineralisation is concentrated in the interval 249.8m-400m and is rich in sphalerite which occurs as:

i) fine patches in vesicles and the groundmass of lavas.
ii) fine quartz-sphalerite veins.
iii) coarse red-brown grains in devonian carbonate ± quartz veins.

The sphalerite is generally accompanied by pyrite, although in two intervals (334.1-388m and 656-710.3m) the iron sulphide phase is pyrrhotite. Galena and chalcopyrite are minor phases that are often intergrown with pyrrhotite. Elsewhere in the basalt-andesite sequence mineralisation is restricted to traces of sphalerite and pyrite.

The andesitic-dacitic lava from 759.5-767 is moderately silica-sericite altered with disseminated and vein sphalerite-pyrite and chalcopyrite while the dacite from 837.4-870m hosts pyrite-sphalerite and chalcopyrite that are concentrated in brecciated zones as veinlets and disseminations but also occur disseminated in the groundmass of more massive lava.

Geochemistry

The interval from 217m, close to the base of the Que River shale, to the end of the hole was core ground on nominal 10m intervals and samples analysed for Cu, Pb, Zn, As, Ag, Au, Cr, Ti and Zr. Results and sample intervals are included in Appendix 18.

Base metal values in the basal part of the Que River shale with a maximum of 0.13% Pb, 0.38% Zn from 245.3-249.8m are anomalous and are associated with weakly elevated Ag and Au (to 40 ppb). The basalt hosted by the QRS is anomalous in Au to 0.1 g/t (in sample 563711) but has very low Ba (45 ppm).

The upper part of the hangingwall lava sequence is anomalous in Zn, i.e. from 249.8-335m, 85m @ 0.3% Zn, 0.1% Pb, howevermost Zn rich interval is 759.3-761m i.e. 1.7m @ 1.23% Zn which is associated with weakly elevated Cu, 120 ppm, but very low Pb (25 ppm).

Lithochemical data confines the andesitic and basaltic units logged in the hangingwall and suggest that the interval 759.3-767m logged is altered andesitic-dacite is andesitic with Ti/Zr ~ 20 and Cr of 70 ppm.

Ti/Zr ratios in the basalt below the sandstone and shale, from 652-668.3m, are high, from 40-57, and in the range of the core lava of Jack (1989). The separation of this lava type from more typical Hellyer basalt by a sedimentary unit is a feature that has recently been recognised from many holes in the Hellyer area (S. Richardson, pers. comm. 1991). The lack of these high Ti/Zr basalts in DDH MC-14 to the east suggests that their occurence is localised, although this hole did not the basal part of the haningwall basalt/andesite sequence, and may be related to the Mount Charter fault.

The High Ti/Zr values are not reflected in petrological samples (563716, 717 Appendix 16) from this interval. As standards were included in the core-grinds and are satisfactory it is possible there were analytical problems with the petrological samples. Some correlations have been attempted using this petrological data (see Appendix 16) and comments by the petrologist suggest there may be problems with these assays.

Geophysics

DDH MAC-27 was cased with PVC and read with DHEM. (Zonge GDP-16). No off-hole conductors attributable to massive sulphides were detected. Results of the survey are included in Appendix 23.

7.3 Summary and Recommendations

DDH MAC-27 failed to intersect the interpreted Que-Hellyer host horizon at the base of the dacite due to a very thick (570m) hangingwall basalt and andesite sequence and fault complications. The hole did intersect a large thickness of weakly sphalerite mineralised hangingwall lavas that coupled with the intersections in DDH MC-14, HP-1 and 4 indicate a large low temperature unfocussed hydrothermal system was active in this area. The basal basalt unit in the hangingwall sequence has Ti/Zr ratios similar to that of the core lava of Jack (1989).

The results from this hole indicate the Que-Hellyer host horizon is much deeper than previously interpreted, and below effective UTEM penetration, in the area from DDH MAC-27 in the west to DDH MC-15 in the east. This coupled with the proximity of the Mount Charter fault, thought to have beenactive in the Cambrian acting as a source for the more primitive core type lavas and a potential conduit for hydrothermal fluids, makes further drilling in this area attractive.

8. SOUTHWEST MOUNT CHARTER

8.1 Introduction

A re-interpretation of petrological and geochemical data from drill holes in the Mount Charter area (McNeill, 1990) suggested a potential host horizon equivalent to Que River and Hellyer may occur at the lower contact of the dacite with footwall andesite. This new interpretation, coupled with strong Pb/Zn geochemistry in soils, and the intersection of syngenetic sulphides within a thin volcaniclastic unit DDH MC-9 (0.4m @ 1.14% Zn) led to the design of DDH MAC-25 to test the interpreted Que/Hellyer ore position.

DDH MAC-25 commenced in late January, 1990 and was completed in early March of the same year. A report on drill hole design, geology and results from the DHEM survey on DDH MAC-25 were included in McNeill (1990). At the time of reporting however, a number of geochemical results and petrological reports were unavailable. Some revision of the original geological drill logs has resulted from this new information.

8.2 Diamond Drilling

Geology

Petrological examination of representative lithologies coupled with Ti/Zr and Cr geochemistry from both petrology and core grind samples have led to minor re-interpretation of the geology of DDH MAC-25.

Minor units of andesitic lava and polymict andesitic volcaniclastic have been recognised in the upper basalt, specifically over the interval 29.8 - 61.7m. Ti/Zr ratios of 17.2 and 20.6 and Cr values of 181 and 175 ppm respectively characterise the two samples petrologically described as andesites from this interval. The basalts have considerably higher Ti/Zr ratios in the order of 20 to 35 and Cr values commonly greater than 1000 ppm.

A thin unit of vesicular basalt lava breccia has been identified from 249.9 - 253.2m. A Ti/Zr ratio of 22.5 and Cr value of 800 ppm in core grinds, along with visual examination of drill core confirms this interval was incorrectly logged as a dacite lava breccia.

Elsewhere, in the interbedded greywacke and black shale sequence beneath the Mount Charter fault, petrological examination of samples taken from units thought to be basalt lavas at 482.5 - 489.9m and 502.9 - 503.9m has confirmed these lithologies are in fact volcanic derived greywackes.

A sample from the interval 520.9 - 530.3m, previously logged as interbedded basalt lava and greywacke has been petrologically identified as a dacitic to andesitic dyke. This is somewhat confirmed by a Ti/Zr ratio of approximately 18.9 and a Cr value of 75 ppm for the petrology sample and a Ti/Zr ratio of 18.3 and Cr value of 100 ppm for the core grind sample over this interval.

Polished section examination of mineralisation intersected between 121.5 - 125.38m suggests original pyrite formed during silica vein development and recrystallised during brittle deformation, has been partially replaced by sphalerite and lesser chalcopyrite and galena. This base metal sulphide replacement most likely occurred during post-deformation calcite veining which contains abundant inclusions of sphalerite throughout the entire basalt sequence.

In general lithogeochemical results for the dacite were consistent with Ti/Zr ratios generally between 8-12 and Cr generally less than 35 ppm for both petrology and core grind samples.

Polished section examination of pyrite mineralisation contained within a polymict volcaniclastic unit at the interpreted Mount Charter host horizon between 156.2 - 156.33m appears almost identical to the mineralisation described previously. Although silica-pyrite veining and brittle fracturing has occurred the post-deformation sphalerite-calcite alteration is not present.

A revised section of the hole is presented as Plate MAC-291. Petrological descriptions and results of geochemical analysis on these samples are included in Appendix 19.

Geochemistry

Results for split core geochemistry in the strongly mineralised zone from 121.5 - 125.38m have been reported previously in the progress report for the period February, 1989 to April, 1990. These results along with those from split core over the interval 156.2 - 156.33m and core grinds for the remainder of the hole are given in Appendix 20.

Results from core grind analysis appear to reflect the concentrations of base metal sulphide in drill core. The upper basalt, which contains abundant sphalerite as both inclusions in calcite veins and as disseminations on pillow margins, was significantly enriched in Zn with several intervals of greater than 10m containing above 1000 ppm. Results for both Cu and Pb were disappointing with maximum values of 215 ppm and 190 ppm respectively. No other values were considered anomalous for the elements analysed.

Results from split core over the interval 156.2 - 156.33m were equally disappointing with no anomalous values for the elements tested.

8.3 Summary and Recommendations

Drilling at Mount Charter (DDH MAC-26, Section 6.4) suggests the dacite in the Mount Charter Region is upwards of 550m in true thickness. It is possible the Que/Hellyer host horizon at southwest Mount Charter in the vicinity of DDH MAC-25 has not been adequately tested with DHEM, given that only 300m of dacite were intersected before encountering the Mount Charter fault.

Although potential may exist at depth beneath DDH's MC-9 and MC-10 to the north, further drilling should await interpretation of stratigraphic information gained from proposed future drilling at Mount Charter.

9. SOUTH MACKINTOSH

9.1 Introduction

Mapping, summarized in McNeill (1990) in this area, South of the Que River Mine and between 4500E and 6000E, has defined the basic structure and stratigraphy but, failed to close the QHV off South of 2000N and east of 6000E. Further mapping and a brief review of existing UTEM data were completed during the reporting period.

9.2 Geology/Geochemistry

Mapping at 1:2500 Scale, Shown on plates MAC89KK, LL and TT, was completed in creeks draining east between 1800 - 2200N, tape and compass traverses south of 1800N and part of one line (7400N) of the Pan-Continental (EL42/85) grid. Mapping by Hermmann (1986) on this grid was also compiled onto plate MAC89TT. A total of 12 rock-chip samples were submitted for analysis, see appendix 22 for results and sample locations, while three of these samples were also described in thin section, appendix 21.

The Southern part of the area mapped is dominated by micaceous greywacke, of the Animal Creek greywacke, which has been intruded by many feldspar and ferromagnesian - now dominantly chlorite altered - phyric bodies that were mapped as rhyodacite or dacite but, which have an andesitic geochemistry (e.g. 562660, 664). This is confirmed by thin section description of 562550, classified as an plagioclase-augite-phyric andesite dyke rock. Interbedded with the greywacke are minor units of ash volcaniclastic and volcaniclastic sandstone (562662).

Mapping by McNeill (1990) indicated that the lower basalt was underlain by pink-brown dacitic lava and probable andesitic lava on lines 2200N to 1800N. More detailed mapping indicates this area is largely underlain by a complex sequence of dacitic (e.g. 562653) and andesitic (e.g. 562659) intrusives and basaltic lava (e.g. 562654) intercalated with micaceous greywacke and shale. In the creek south of line 2200N the upper part of this sequence is dominated by interbedded lava, basaltic volcaniclastic and micaceous greywacke which pass into basaltic lava at approximatley 5600E.

Structural northeast to easterly data from around 1800N, 5500N where measurements indicate a dip, support the interpreted synclinal structure in this area while the contact between diacitic intrusive and mica sandstone at 2230N, 5960E suggest that at least some intrusives are sill like and sub-parallel to bedding.

Mineralisation and alteration are rare, with only one sample of sericite altered and pyrite veined andesite (562663) located. This sample (562663) was not anomalous in base or precious metals.

9.3 Summary and Recommendations

Geological mapping of the South Mackintosh area is now complete. Dacitic and andesitic lithologies considered, by McNeill (1990), to be part of the QHV below the lower basalt are now, after more detailed mapping, considered to be intrusives in the Animal Creek greywacke and as such the QHV have been closed off the the south.

The possibility that the Que-Hellyer host horizon in the core of the South Mackintosh syncline had not adequately been tested by EM promoted a brief review of the 1983 UTEM survey data. It was concluded that (J. Silic pers. comm.) although the target horizon was approximately 1 km from the loop front (loop 3), the potentially flat lying target would have been detected at the depth of approximately 200m suggested by the regional geological interpretation (plate MAC269d). Consequently, no further work can be recommended at this stage.

10. REHABILITATION

Rehabilitation completed during the reporting period included:

i) Black Harry Road. Costeans 1615E and 1645E were infilled and the area fertillised. Top soil and sub soil was re-spread on the access track from the DDH MAC-24 (Mines Dept.BWLHY-1) drill site to the water supply dam on a small creek, at 12600N, 1770E and this dam removed. This area was also fertillised using EZ 6:5:5 + Mg fertiliser.

ii) Mount Charter. The 4750N, 4050E costean was infilled and the area spread with fertiliser while stockpiled top soil was re-spread on a large open area immediately south of the DDH MX-8 drill collar (4530N, 4020E). This area was also fertilised.

A programme of on-going fertilisation and monitoring of re-habilitated drill site and costeans, both on EL 106/87 and CML 103M/87 is in progress, and a photographic record to compare rates of re-vegetation is being compiled.

An initial rehabilitation plan for the Mount Charter and South Mackintosh areas has been prepared and is included as Appendix 25.

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APPENDIX 1

Aberfoyle Exploration — GEOCHEMICAL SAMPLE LEDGER

Collected: A McN

PROJECT: Mackinlay Tailings Dam

BSS SIEVE SIZE CODE - MESH NUMBER: A 200 | B 150 | C 100 | D 80 | E 60 | F 40 | G 30 | H 20 | T = TOTAL

SAMPLE TYPE CODE: [ ] OXIDIZED PRODUCTS O | [x] FRESH ROCK R | [ ] STREAM SEDIMENTS S | [x] WEATHERED BEDROCK W | [ ] SURFACE TRANSPORTED T | [ ] RESIDUAL SOIL E | [ ] MINE DUMP M

CARD PUNCH PRINT: YES [ ] NO [ ] — VERIFY: YES [ ] NO [ ]

DATE: 22/5/90

SHEET: 1 of 2

EASTINGS	NORTHINGS	SAMPLE NUMBER	DEPTH in CMS	SIZE FRACTION	Sample Type	METAL VALUES PPM	GEOLOGICAL LOG
4521	9894	56362			Channel	Cu, Pb, Zn, Ag, As, Ag, Au	0-2m Qtz Feld Sericite Shale
4521	9894	6238			"	"	2-4m "
4520.9	9891.6	6239			"	"	4-6m "
4520.8	9889.2	6330			"	"	6-7m " Qtz veins Cutting to Bgt.
4520.7	9886.8	6331			"	"	8-10m Basalt pillow lava, weakly sericitic
4520.6	9884.4	6332			"	Cu, Pb, Zn, Ag, As, Ag, Cr, Ti and Zn	10-12m "
4520.5	9882	6333			"	"	12-14m "
4520.4	9879.6	6334			"	"	14-16m "
4520.3	9877.2	6335			"	"	16-18m "
4520.2	9874.8	6336			"	"	18-20m "
4520.1	9872.4	6337			"	"	20-22m "
4520	9870	6338			"	"	22-24m "
4526	9890	6339			R/c	o/c Cu, Pb, Zn, Ag, As, Ag, Au	Quartz-pyrite vein from fault zone in shale
4526	9885	6340			R/c	o/c "	Pyritic inter-pillow chert
3260	11095	6341			R/c	o/c Cu, Pb, Zn, As, Ag, As, Cr, Ti, Zr	? leached basaltic lava. (Field No. DC-5)

6540035

0035

654036

(3)

ANALABS

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ANALYTICAL REPORT No. 23.3.08.07117

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

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Exploration Division
P.O. Box 952
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ORDER No.	PROJECT
9870	

DATE RECEIVED	RESULTS REQUIRED
25/05/90	ASAP

No. OF PAGES OF RESULTS	DATE REPORTED	No. OF COPIES	TOTAL No. OF SAMPLES
1	02/07/90	1	15

	SAMPLE NUMBERS	PRE-TREATMENT: DRY	CRUSH	SPLIT	PULVERISE	SIEVE	OTHER SEE REMARKS	NONE	ANALYSIS: REFER TO ANALYSIS SECTION	PREPARATION	METHOD
	<5636,27/41	RC	Prep: 006,010,011,012,013,016						Cu,Pb,Zn,Ag/101		
	<5636,27/41	RC							Ba,As/401		
	<5636,27/31,39/40	RC							Au,AuChk/309		
	<5636,32/38	RC							Cr,Zr,Ti/401		
	<5636,32/38	RC							Zr:Ti/401		

RESULTS TO

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

RESULTS TO

REMARKS

MACK ML
TAIL DAM

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

AUTHORISED OFFICER Jenkins

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ANALYTICAL DATA

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
	23.3.08.6717	02/07/90	9870	1 OF 1

SAMPLE No.	Cu	Pb	Zn	Ag	Au	AuChk	Ba	As	Cr
563627	30	65	60	0.5	0.018	0.025	551	19	–
563628	50	65	90	1.0	0.020	–	557	21	–
563629	45	25	115	0.5	0.022	–	520	11	–
563630	100	60	70	<0.5	0.021	–	518	21	–
563631	145	50	115	1.5	0.013	–	802	62	–
563632	95	20	80	<0.5	–	–	48	616	740
563633	85	25	70	0.5	–	–	110	136	690
563634	70	20	75	<0.5	–	–	130	19	640
563635	175	25	75	0.5	–	–	784	25	770
563636	90	20	145	0.5	–	–	664	23	740
563637	115	25	95	0.5	–	–	608	14	710
563638	235	25	95	1.0	–	–	647	43	750
563639	2425	85	95	3.5	0.040	–	671	20	–
563640	150	35	10	2.5	0.018	–	719	27	–
563641	10	30	80	<0.5	–	–	724	38	–
DETECTION	5	5	5	0.5	0.008	0.008	10	2	5
UNITS	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
METHOD	101	101	101	101	309	309	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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ANALYTICAL DATA

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
	23.3.08.07117	02/07/90	9870	1 OF 1

SAMPLE No	Zr	Ti	Zr:Ti
563627	—	—	—
563628	—	—	—
563629	—	—	—
563630	—	—	—
563631	—	—	—
563632	160	2975	18.6
563633	140	2776	19.8
563634	130	2572	19.8
563635	160	2867	17.9
563636	150	2657	17.7
563637	160	2916	18.2
563638	160	2799	17.5
563639	—	—	—
563640	—	—	—
563641	—	—	—
DETECTION	5	50	0.1
UNITS	ppm	ppm	%
METHOD	401	401	199

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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Aberfoyle Exploration

GEOCHEMICAL SAMPLE LEDGER

Collected: AMcN

PROJECT: Mackintosh NL. North Arunta

BSS SIEVE SIZE CODE - MESH NUMBER: A 200, B 150, C 100, D 80, E 60, F 40, G 30, H 20, T = TOTAL

SAMPLE TYPE CODE: ☐ OXIDIZED PRODUCTS O; ☑ FRESH ROCK R; ☐ STREAM SEDIMENTS S; ☑ WEATHERED BEDROCK W; ☐ SURFACE TRANSPORTED T; ☐ RESIDUAL SOIL E; ☐ MINE DUMP M

CARD PUNCH PRINT: YES ☐ NO ☐ VERIFY: YES ☐ NO ☐

DATE: 1/6/90

SHEET: 1 of 1

EASTINGS	NORTHINGS	SAMPLE NUMBER	DEPTH in CMS	SIZE FRACTION	Sample Type	METAL VALUES PPM	GEOLOGICAL LOG
4805	8440	563651				Cr, Ti, Zr	Sericite-silica altered dacitic lava.
4795	8455	6552				"	brecciated pink dacite lava & green chloritic matrix
4780	8480	6553				"	green brecciated feldspar-pyric. Andesite sericite-silica alt.
4725	8575	6554				"	white-brown massive devitrified dacite lava.
4680	8640	6555				"	light brown vesicular silicified dacitic lava
4640	8730	6556				"	feldspar-pyric siliceous andesite-dacitic lava.
4575	8805	6557				"	Siliceous fp. chlorite spotted dacite lava
4550	8825	6558				"	Andesitic lava fp in dacitic matrix
4935	9000	6559				Cu, Pb, Zn, Ba, As, Ag, Cr, Ti, Zr	Weakly sericite altered andesite lava.
4915	9990	6560				"	grey sericite-silica - ?pyrite altered dacite.
4590	9000	6561				"	? Andesitic lava.
4725	9385	6562				"	? brecciated siliceous andesitic-dacitic lava.

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A division of MacDonald Hamilton & Co. Pty. Ltd.
Phone (09) 458 7999 — 52 Murray Road, Welshpool, W.A. 6106 — Telex AA92560
FAX: 004 31 8890

ANALYTICAL REPORT No. 23.3.08.07158

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

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

ORDER No.	PROJECT
9897	

DATE RECEIVED	RESULTS REQUIRED
07/06/90	ASAP

No. OF PAGES OF RESULTS	DATE REPORTED	No. OF COPIES	TOTAL No. OF SAMPLES
2	03/07/90	1	12

	PRE-TREATMENT							ANALYSIS		
SAMPLE NUMBERS	DRY	CRUSH	SPLIT	PUL-VERISE	SIEVE	OTHER SEE REMARKS	NONE	REFER TO ANALYSIS SECTION	PREPARATION	METHOD
<563,651/662	RC	Prep: 016						Cr,Zr,Ti/401		
<563,659/662	RC							Cu,Pb,Zn,Ag/101		
<563,659/662	RC							Ba,As/401		
<563,651/662	RC	Prep: 016						Ti:Zr/9825		

RESULTS TO

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

RESULTS TO

REMARKS

MACK MC
AMOEBA
ZONE

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

AUTHORISED OFFICER C Jenkins

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0940

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ANALYTICAL DATA

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
	23.3.08.07158	03/07/90	9897	1 OF 2

SAMPLE Nc	Cu	Pb	Zn	Ag	Ba	As	Cr	Zr	Ti
563651	—	—	—	—	—	—	128	194	2028
563652	—	—	—	—	—	—	27	266	2143
563653	—	—	—	—	—	—	85	187	3396
563654	—	—	—	—	—	—	50	210	2596
563655	—	—	—	—	—	—	11	151	3051
563656	—	—	—	—	—	—	74	121	2998
563657	—	—	—	—	—	—	8	225	2473
563658	—	—	—	—	—	—	26	212	1869
563659	23	20	56	1.0	780	2	66	153	3841
563660	19	45	40	0.5	464	36	62	152	1326
563661	6	21	55	0.5	510	<2	16	125	2154
563662	6	7	59	0.5	309	<2	32	146	2665
DETECTION	5	5	5	0.5	10	2	5	5	50
UNITS	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
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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0941

ANALYTICAL DATA

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
	23.3.08.07158	03/07/90	9897	2 OF 2

	SAMPLE No	Ti:Zr									
	563651	10.4									
	563652	8.0									
	563653	17.8									
	563654	12.4									
	563655	20.2									
	563656	24.7									
	563657	11.0									
	563658	8.8									
	563659	25.1									
	563660	8.7									
	563661	17.2									
	563662	18.2									
	DETECTION	0.1									
	UNITS	%									
	METHOD	9825									

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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APPENDIX 2

91-3268-A

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ERUPTIVE ACTIVITY, PRODUCTS AND DEPOSITIONAL SETTING OF THE CAMBRIAN VOLCANIC-SEDIMENTARY SUCCESSION HOSTING MASSIVE SULPHIDE MINERALISATION (VMS) AT HELLYER AND QUE RIVER MINES, MT. READ VOLCANIC BELT, WESTERN TASMANIA.

PROGRESS REPORT NO.7

by
John Waters, Ph.D. Student,
Department of Earth Sciences, Monash University.

OCTOBER 1989 - DECEMBER 1989

Introduction

This report is the seventh in a series of progress reports to Aberfoyle Resources on the Ph.D study of the Hellyer - Que River Volcano - Sedimentary succession. This report deals mainly with the footwall units found in exploration holes to the north and south of the Que River deposit. These holes, Hat-5 (9313.8 N), and Hat-7 (5777.98 N, I-zone), contain a mix of both massive and brecciated units, covering the bulk of the different facies types within the footwall sequence of the Que - Hellyer Volcanics.

Field Work

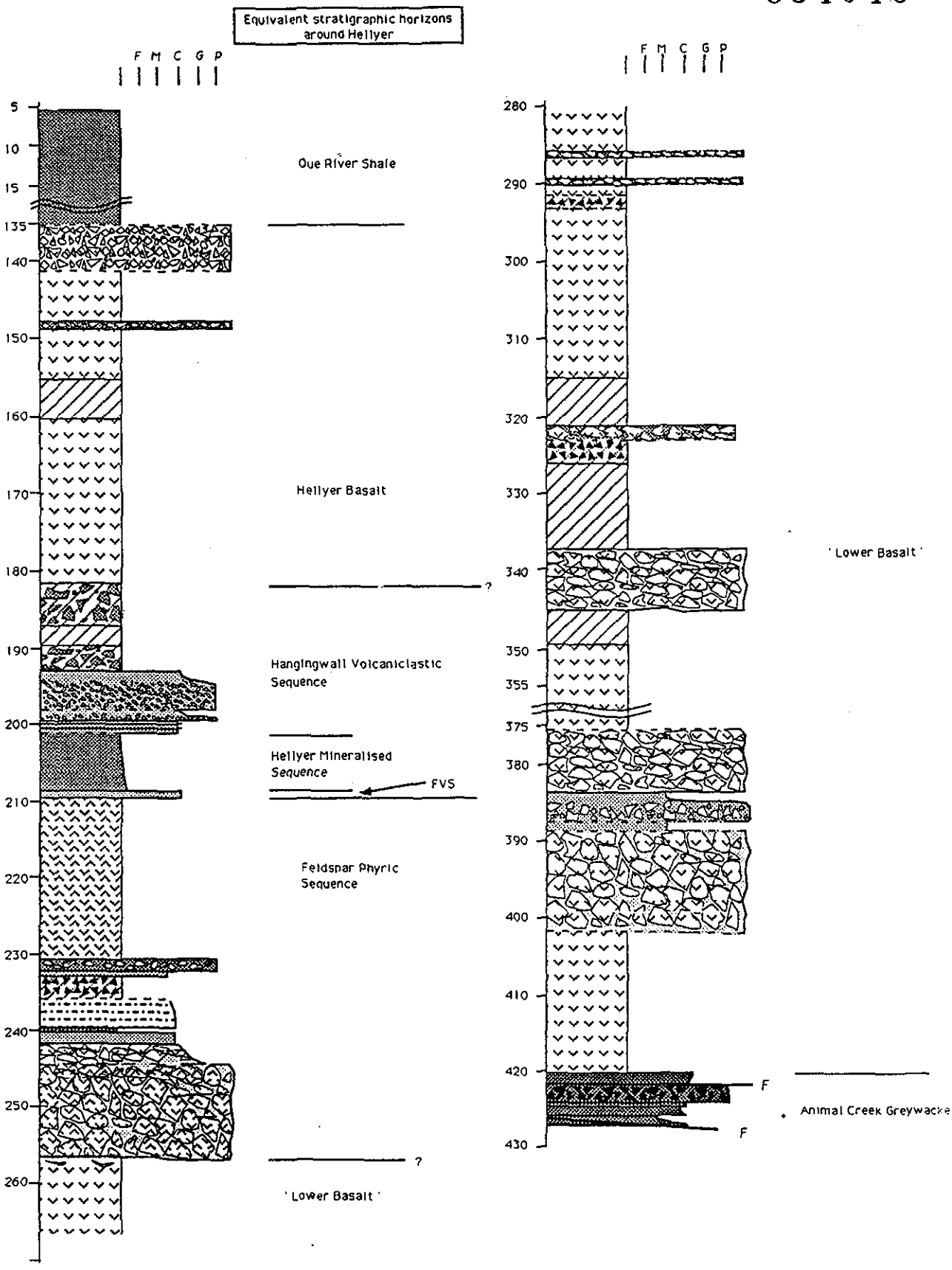
This work was a result of a field trip carried out during October in which several holes, including Hat-5 and Hat-7 were logged. A few days were also spent during this trip to photograph exposures of the Pillow Lava Sequence (adit) and Hangingwall Volcaniclastic Sequence (450 L).

Lower Basalt

Introduction: A moderately thick sequence of what appeared to be basaltic lava occurs within Hat-5 (256.7 - 420.1 metres)(Fig. 1). This unit of massive to pillowed lavas and peperitic breccias is texturally very similar to the Pillow Lava Sequence or Hellyer Basalt. These basaltic volcanics lie below units identified as footwall andesites and above the Animal Creek Greywacke and as such are part of the 'Lower Basalt'.

The contact of the Lower Basalt unit with the underlying Animal Creek Greywacke is fairly sharp. The contact is marked by extensive development of carbonate, both within veins and as an alteration product, along with chlorite, of the basalt. The basalt is intensely fractured and vesiculation increases from a few percent to 7-10% within the last 50 centimetres before the contact. The top contact of the unit with the andesitic lavas and breccias is also sharp with the upper most lava of the Lower Basalt showing signs of chilling and abundant sedimentary inclusions. The unit immediately overlying the Lower Basalt is a primary fragmental/ volcaniclastic unit which is strongly altered to sericite bearing assemblages.

This Lower Basalt unit has a limited, patchy distribution and appears to be thickest around the Que River mine area. This patchy distribution may reflect the units style of emplacement or the original sea floor topography.


Equivalent stratigraphic horizons around Hellyer
F M C G P
5
10
15
135
140
150
160
170
180
190
200
210
220
230
240
250
260
Oue River Shale
Hellyer Basalt
?
Hangingwall Volcaniclastic Sequence
Hellyer Mineralised Sequence
FVS
Feldspar Phyric Sequence
?
'Lower Basalt'
F M C G P
280
290
300
310
320
330
340
350
355
375
380
390
400
410
420
430
'Lower Basalt'
F
F
Animal Creek Greywacke

The Lower Basalt in drill hole Hat-5 is probably equivalent to the 'Lower Tuff and Lava' sequence of Corbett and Komyshan (1989), which they describe as consisting of both felsic and mafic lavas and tuffs in the order of 200-300 metres maximum thickness.

Facies: All of the three main facies within the Pillow Lava Sequence are contained within the Lower Basalt, which, like the PLS, contains several flow units.

The lower most facies in the Lower Basalt is a *massive lava facies*. This is comprised of massive, mid to dark green-grey, porphyritic basaltic lava. The lava is weakly vesicular with less than 2-3% vesicles which are circular to sub-circular and vary in size from 1 to 35 millimetres in diameter. The in core thickness of this unit is around 18 metres.

In gradational contact, and overlying this massive lava facies is a peperitic breccia or quench fragmented lava facies. This facies consists of angular to sub-angular porphyritic basaltic fragments ranging in size from millimetres to 40-50 centimetres. Some of these larger fragments have small (1-2 mm) chilled margins and look as if they may be small isolated whole pillows. These 'small pillows' often show fracturing parallel to their margins, probably arising from contraction due to rapid quenching. The majority of the fragments range in vesicularity up to 5% with vesicles averaging 1-2 millimetres in size, filed with either carbonate or chlorite. Margins of fragments are straight to weakly cuspate and lack 'jig-saw' fit, possibly indicating some transport of individual fragments post quench fragmentation.

The matrix to the peperitic breccias varies from approximately 40% on average, up to 80% locally over small intervals. It consists of muddy, medium to coarse grained, crystal rich volcaniclastic sediments, which varies in mud to sand ratios. In places the matrix is comprised exclusively of dark grey muds.

One peperitic horizon from Hat-5 (~383-387 metres) grades into a greywacke at its top and bottom contacts via a rapid decrease in quench fragmented volcanic fragments.

The upper most facies within the 'Lower Basalt' in Hat-5 is a *pillow lava facies*. The facies contains close packed pillows with associated interpillow sediments. Diameters of pillows, in core, range from 0.5 to 1 metre and often have chilled margins. Internally pillows are porphyritic and weakly vesicular (< 2-3%). This facies generally has gradational contacts with the *quench fragmented lava facies* over varying distances up to 1 metre.

Interpretation: The 'Lower Basalt' is mainly comprised of alternating intervals of massive and quench fragmented lava facies. This probably reflects the extrusion, shallow intrusion of multiple, small volume, basaltic flows, where the tops and bottoms of the flows are quench fragmented. In core thickness of these flows, including peperitic tops, is in the order of 25-35 metres. Often the internal massive portions of the flows are hydraulically fractured post emplacement.

The amount of sediment mixed in with the 'Lower Basalt', both in the form of matrix to the fragmental facies (peperites), and as small discrete greywacke/ volcaniclastic horizons suggest that the basalts were emplaced as shallow intrusions or extrusions onto wet unconsolidated sediments, most likely of the Animal Creek Greywacke. Peperitic textures, like those within this sequence also suggest that volcanism and sedimentation was contemporaneous (Busby-Spera and White, 1987).

The matrix to the peperitic intervals, in places, is coarser than that of a similar facies within the Hellyer Basalt (Pillow Lava Sequence). This difference may reflect the differences in grain size of the unconsolidated sediments being extruded over/intruded into, or may be due to a higher degree of well granulated hyaloclastite in the matrix of the peperitic facies of the Lower Basalt.

Feldspar Phyric Sequence

Introduction: The Feldspar Phyric Sequence (FPS), which occurs as the footwall to the mineralisation through out the Que - Hellyer area, is comprised of predominantly andesitic volcanics with a minor basaltic component in places. These volcanics are currently thought to be mainly fragmental in character, mainly as a result of primary fragmentation process (ie. auto brecciation, quench fragmentation), with massive or coherent lavas making up a minor proportion. In the two exploration holes

currently under investigation (DDH HAT-5 and DDH HAT-7), which are to the north and south of known mineralisation at Que River, the Feldspar Phyric Sequence contains moderate sized intervals of coherent andesitic lava.

In HAT-5, where the bottom of the unit is reached, it can be seen to conformably overlie the 'Lower Basalt'. At this location the lower most unit of the FPS is an extremely altered (sericite-silica) fragmental volcanic/ volcaniclastic. This unit grades into a buff coloured volcanic breccia. Coarse grained volcaniclastics are also present within the lower parts of the FPS in this drill hole (fig. 1).

Facies: Two main volcanic facies exist within the FPS in the two drill holes currently under investigation. These facies are described below.

Massive andesitic lava facies (MAL_f): Within the Feldspar Phyric Sequence in the two 'Hat' holes under investigation is a massive andesitic lava facies comprised of intervals of up to 20 metres, in core, of massive, porphyritic andesitic lava. This lava ranges from buff coloured to dark green depending on the style and degree of alteration. This facies is poorly to non vesicular. Texturally the lava consists of phenocrysts and glomerocrysts of plagioclase feldspar (up to 25%), which are now totally altered to albite ± sericite ± carbonate, giving the lava a white 'spotted' appearance typical of the units within the FPS. The groundmass of the massive lava is dominated by feldspar and varies from pilotaxitic to hyalopilitic, with the later often perlitically fractured. Most of the groundmass is extensively altered to chlorite, sericite, silica and carbonate bearing assemblages, especially in areas of hydrothermal alteration close to the stringer systems of the massive sulphide deposits. Away from areas affected by hydrothermal alteration regional metamorphic effects result in the pervasive development of chlorite ±carbonate ±pumpellyite assemblages.

In places patchy chlorite - sericite alteration gives these lavas an apparent brecciated appearance (figure 2). In these more altered areas a 'banding' may be seen which could be alteration of an original primary feature, possibly flow banding.

Interpretation: This facies appears to consist of multiple sheet flows of andesitic lava separated by areas of andesitic hyaloclastite breccia facies (see below). Massive parts of flows tend to be, with the exception of some flows within DDH HAT-5, less than 10 metres thick. Complete individual flow units however are believed much thicker, commonly in excess of 10-15 metres, due to the bulk of the flows being made up of fragmental facies. Contacts between individual flows are often very hard to identify.

Perlitic fracturing within this facies, and within andesitic rocks of the Que River area has been noted previously by Whitford et. al. (1982), and more recently Corbett and Komyshan (1989). This style of fracturing results from the hydration of glass during cooling (Ross and Smith, 1955), and hence its presence within this facies testifies to the original glassy nature of the groundmass.

Andesitic hyaloclastite Breccia facies (AHBf): The most dominant facies in the Feldspar Phyric Sequence within the whole of the Que - Hellyer sequence is the andesitic hyaloclastite breccia facies. This facies is comprised of mid-dark green to buff coloured hyaloclastites and hyaloclastite breccias. Texturally the facies is very poorly sorted with fragments ranging in size from millimetres up to 10's centimetres. These fragments are typically angular with straight to weakly cuspate margins. Internally the fragments are identical to the massive andesitic lava facies, being weakly vesicular and plagioclase phyric.

The framework of these hyaloclastites and hyaloclastite breccias vary from closed to open, with open framework varieties supported by very fine grained sand to mud sized sediment giving the rock a peperitic texture. The coarser, closed framework breccias vary from 'jigsaw' to non 'jigsaw' fit. Grainsize generally increases towards the contact of this facies with the massive andesitic lava facies. Commonly this facies lapilli sized (2-4 millimetres), grading over a metre or so to blocks in excess of 6 centimetres.

This facies is commonly found by itself or overlying the massive andesitic lava facies in gradational contact. In the vicinity of mineralisation at Hellyer this is the most common primary volcanic facies. Intense hydraulic



Figure 2: Andesitic (FPS equivalent) lava / lava breccia in HAT-5 (below 209 metres). Patchy chlorite-sericite alteration gives the plagioclase phyric lava a brecciated appearance in places.

fracturing and subsequent hydrothermal alteration often masks the primary textual features and the identification of either this facies or the massive andesitic lava facies is extremely difficult in areas immediately footwall to mineralisation (ie. stringer zones).

Interpretation: This facies most likely represents the quench fragmentation of an andesitic lava due to its contact with cold sea water, or in the case of the peperitic varieties, wet unconsolidated sediments. The degree of fragmentation increases away from areas adjacent to the massive andesitic lava facies, or toward individual flow margins. The degree of quench fragmentation decreases away from individual flow margins due to the insulating effect of the envelope of quench fragmented glass surrounding the lava. This insulating layer has the effect of reducing convective heat transfer, thus slowing the rate of cooling and reducing cooling contraction granulation (Pichler, 1965; Kokelaar, 1986)

Possible Ore Horizons (HAT-5 & HAT-7)

Within DDH HAT-5 a sequence of volcaniclastics ranging from pebble to medium sand sized and an underlying interval of muds/silts is interpretated as being stratigraphic equivalents to the Hangingwall Volcaniclastic Sequence (HVS) and Hellyer Mineralised Sequence (HMS) of the Hellyer deposit (Figures 1 and 3). This interval of clastic is also a possible equivalent to the Mixed Sequence horizon at Que River. The fine to very fine grained sediments in the equivalent stratigraphic position to the HMS at Hellyer represents the hiatus in volcanism during which the massive sulphide mineralisation accumulated.

The HVS equivalent in Hat-5, in core, consists of 9 to 10 metres of bedded mid to dark grey-green, poorly sorted, coarse to pebble sized volcaniclastics. The coarser units vary in core, from 1.3 to in excess of 5 metres in thickness and are weakly graded. These units consist dominantly (~80%), of angular to sub angular, porphyritic mafic to intermediate fragments along with minor fine grained sedimentary lithics. The matrix to these units appears to be a light grey mud.

The coarse sand sized volcaniclastics appear to be compositionally the same as the pebble sized units, but show slightly better sorting characteristics. These beds are thinner, not exceeding 50 centimetres in thickness, and lack

grading. Beds often show extensive development of carbonate-quartz alteration in the matrix.

In this hole the Hellyer ore position is indicated by approximately 7 metres of thinly bedded to laminated muds/silts and minor medium to fine sands. These medium sandy horizons have sharp top and bottom contacts with associated soft sediment deformation only occurring in the top 20 centimetres of the interval. The remainder of the unit consists of light to dark grey to black laminated very fine sands, silts and muds. These silts and muds are often moderately pyritic.

Similar equivalents to the ore position and HVS within Hat-7 are more difficult to find and as yet haven't been identified with any certainty.

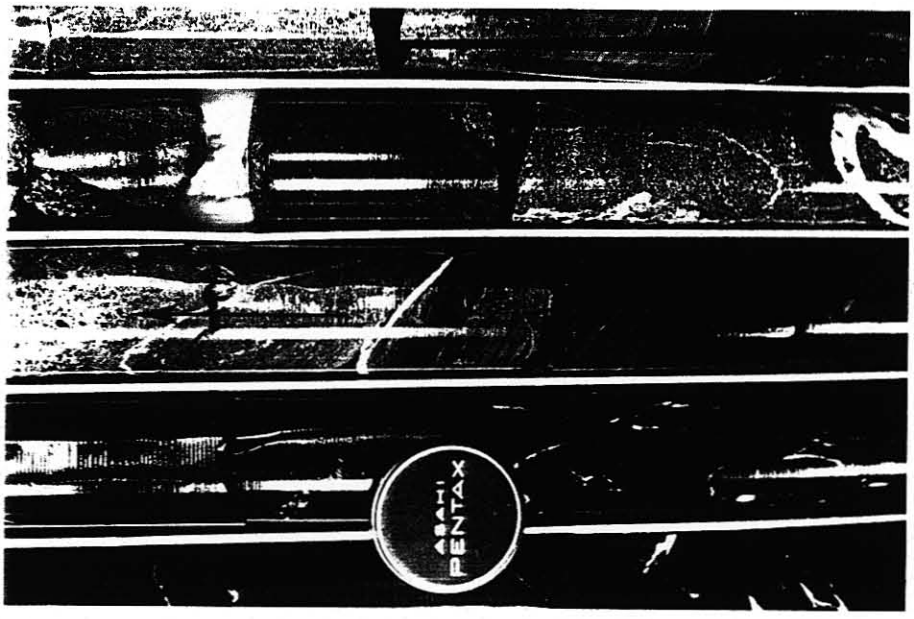


Figure 3: Contact between shales/muds (possible Hellyer ore position equivalent) and lithic rich volcaniclastics (HVS equivalent) in HAT-5 (~201 metres) to the south of Hellyer. The ore position in this hole is marked by ~7 metres of dark grey to black shales/muds, pyritic at the base. The volcaniclastics overlying these shales are generally finer grained than the volcaniclastics overlying the ore at Hellyer.

Future Work:

Future work to be undertaken in the next six months includes:-

(i) Log and sample Que River DDH's on selected sections (ie. 7200 N., 7400N., 7800 N., 7925N.). OF holes on these sections only the most recently drilled holes will be in good enough condition to look at the textures. Drill holes from these sections encompass the volcanics and sediments from adjacent to both PQ and S lenses.

(ii) Select traverses for surface mapping and compile surface logs around the Que and Hellyer mines and surrounding exploration leases

(iii) Continue logging and sampling of selected Exploration DDH's. Some of the holes targeted for logging in the near future are Mac-19, Mac-4, Hat-8, Hat-3. These holes will help complete regional scale north-south and east-west sections.

(iv) Continue logging and sampling of selected Hellyer DDH's.

References:

Busby-Spera, C. J. and White, J. D. L. 1987: Variation in peperite textures associated with differing host-sediment properties. Bull. Volcanol.,49. p.765-775.

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ERUPTIVE ACTIVITY, PRODUCTS AND DEPOSITIONAL SETTING OF THE CAMBRIAN VOLCANIC-SEDIMENTARY SUCCESSION HOSTING MASSIVE SULPHIDE MINERALISATION (VMS) AT HELLYER AND QUE RIVER MINES, MT. READ VOLCANIC BELT, WESTERN TASMANIA.

PROGRESS REPORT NO.8

by
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Department of Earth Sciences, Monash University.

JANUARY 1990 - JUNE 1990

Introduction

This report is the eighth in a series of progress reports to Aberfoyle Resources on the Ph.D study of the Hellyer - Que River Volcano - Sedimentary succession. It covers data collected over the six month period starting from January 1990, and is the first of the reports covering material from the Que River deposit.

Work on the Que River deposit has concentrated so far, on the volcanics and volcaniclastics about the ore horizon. Several sections have been targeted for detailed investigation, this includes the re-logging of several holes on each section. To date two sections have been completed (7212.5 N and 7437.5 N), and these will be discussed in this report. Further sections to be investigated include 7375 N, 7712.5 N, 7800 N and 7900 N.

During the period covered by this report a deep hole (QR-1060), collared on 7300 N and to the west of the mine was logged in detail to investigate the nature of the footwall (FPS) unit in the Que River area. The results and initial interpretation of units logged in this hole are also included in this report along with a comparison with footwall units previously recorded from exploration and Hellyer drill holes.

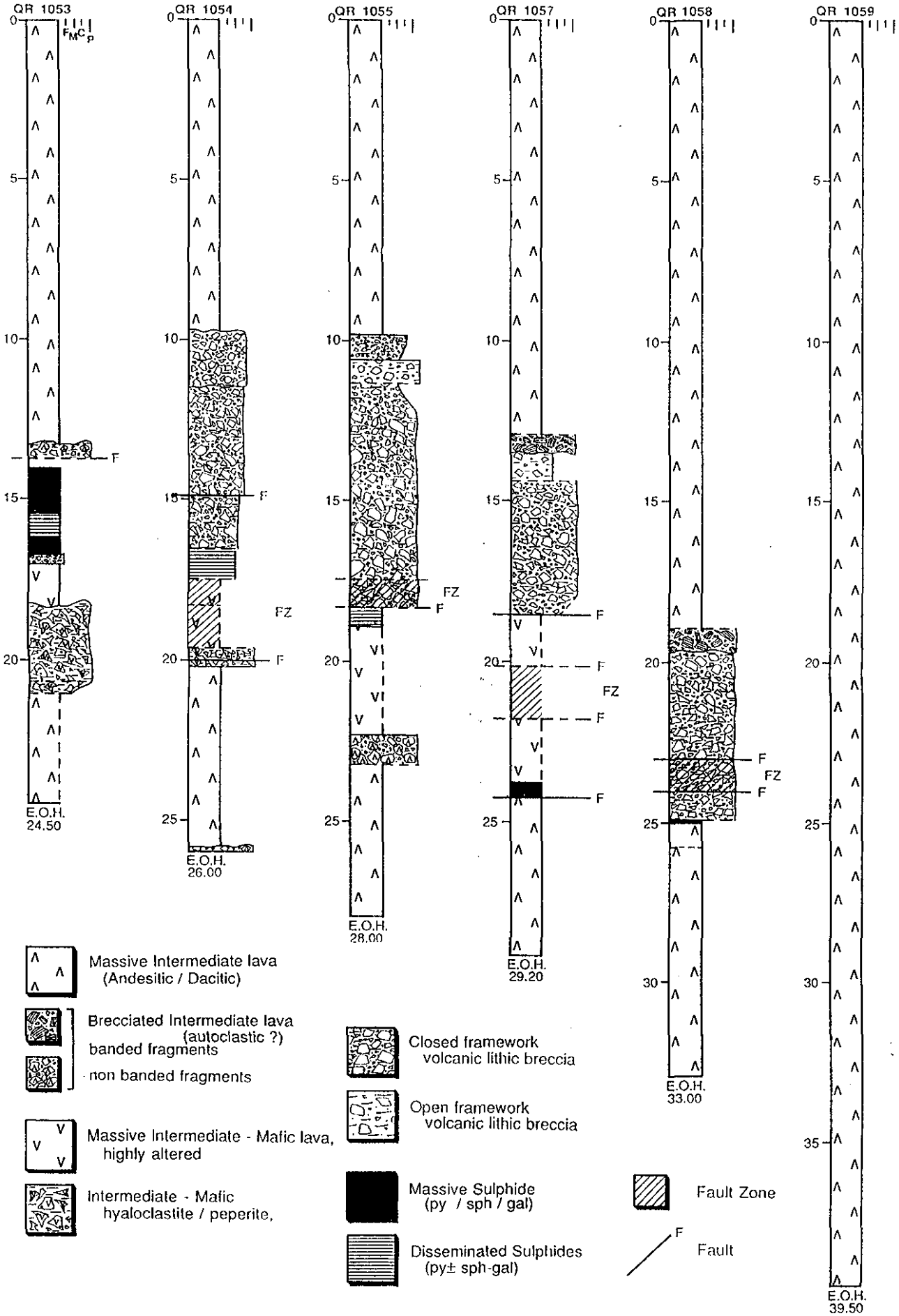
Field Work

This report covers work carried out on a field trip during late March early April. This field work involved the logging and sampling of 11 drill holes from the Que River area. Of these 10 were based on sections 7212.5 N and 7437.5 N.

7437.5 N and 7212.5 N Sections

Six drill holes on section 7437.5 N (QR-1053, QR-1054, QR-1055, QR-1057, QR-1058 and QR-1059), and four drill holes on the 7212.5 N section (QR-919, QR-920, QR-921 and QR-923), were re-logged to investigate the relationship between the volcaniclastics, lavas / porphyritic dacites (PD), and mineralisation (Figs. 1, 2 and 3). These sections and drill holes were selected because of their content and variation in volcaniclastics (LTP, RwP, HAT) and volcanic (PD, D, DTL) units. These sections are two of several that were also selected to investigate the "IHCo" (fuchsite-carbonate) rock/alteration type which occurs mainly at the northern end of the deposit.

These sections both lie in the southern half of the ore body with the 7212.5 N section the southern most selected at Que River, lying at the southern tip of



7437.5 N SECTION SCHEMATIC DRILL HOLE LOGS

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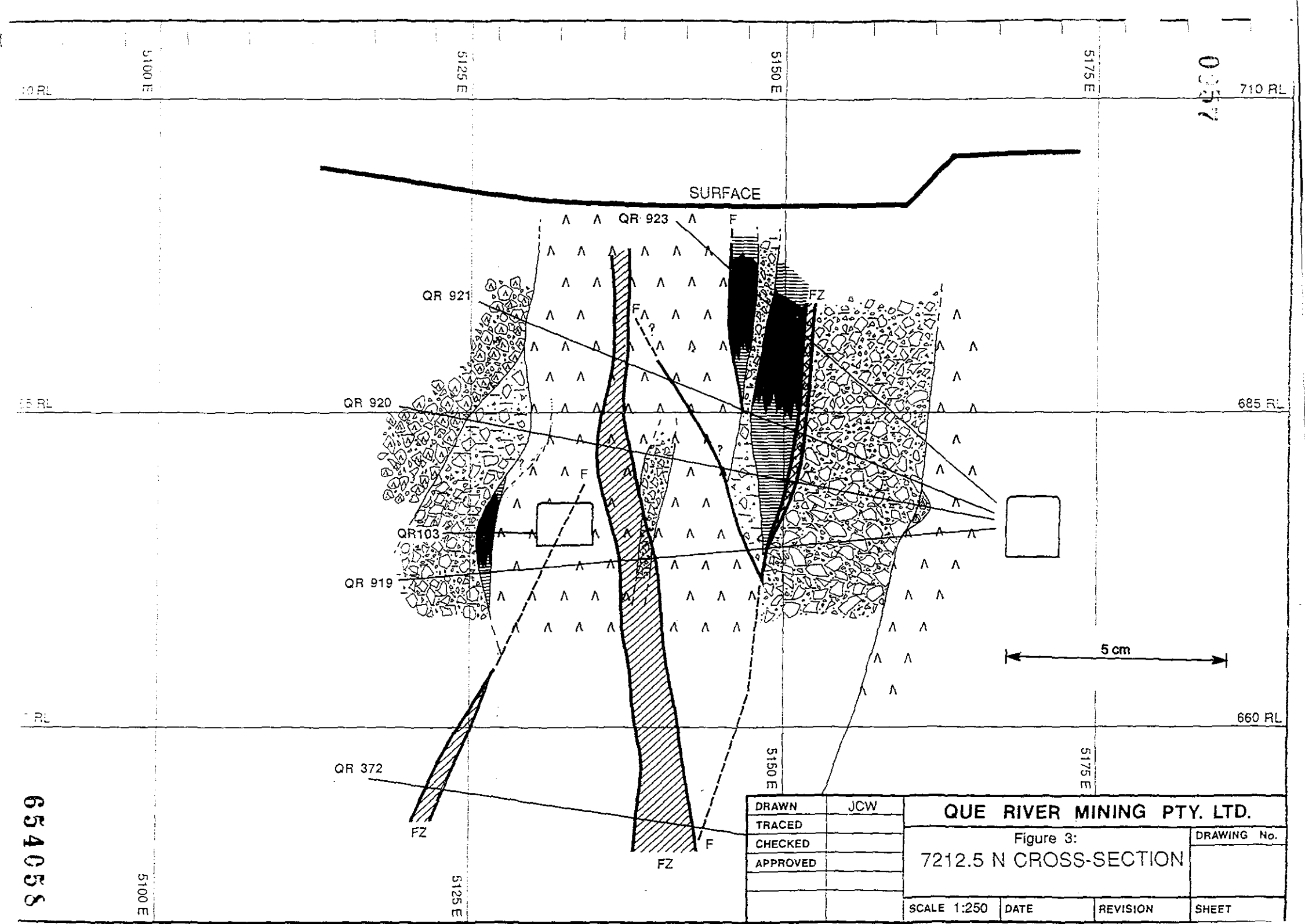

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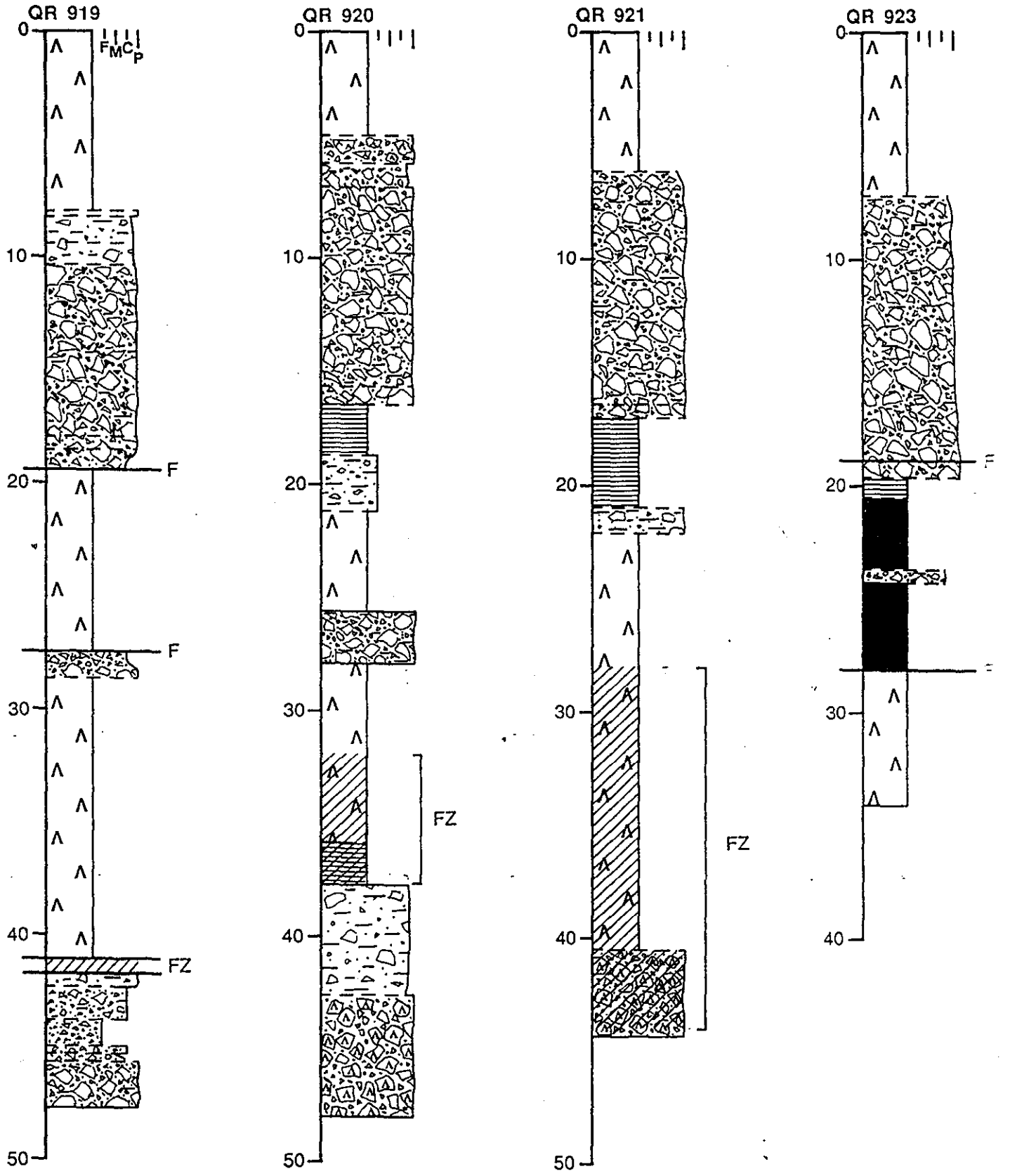


7212.5 N SECTION SCHEMATIC DRILL HOLE LOGS

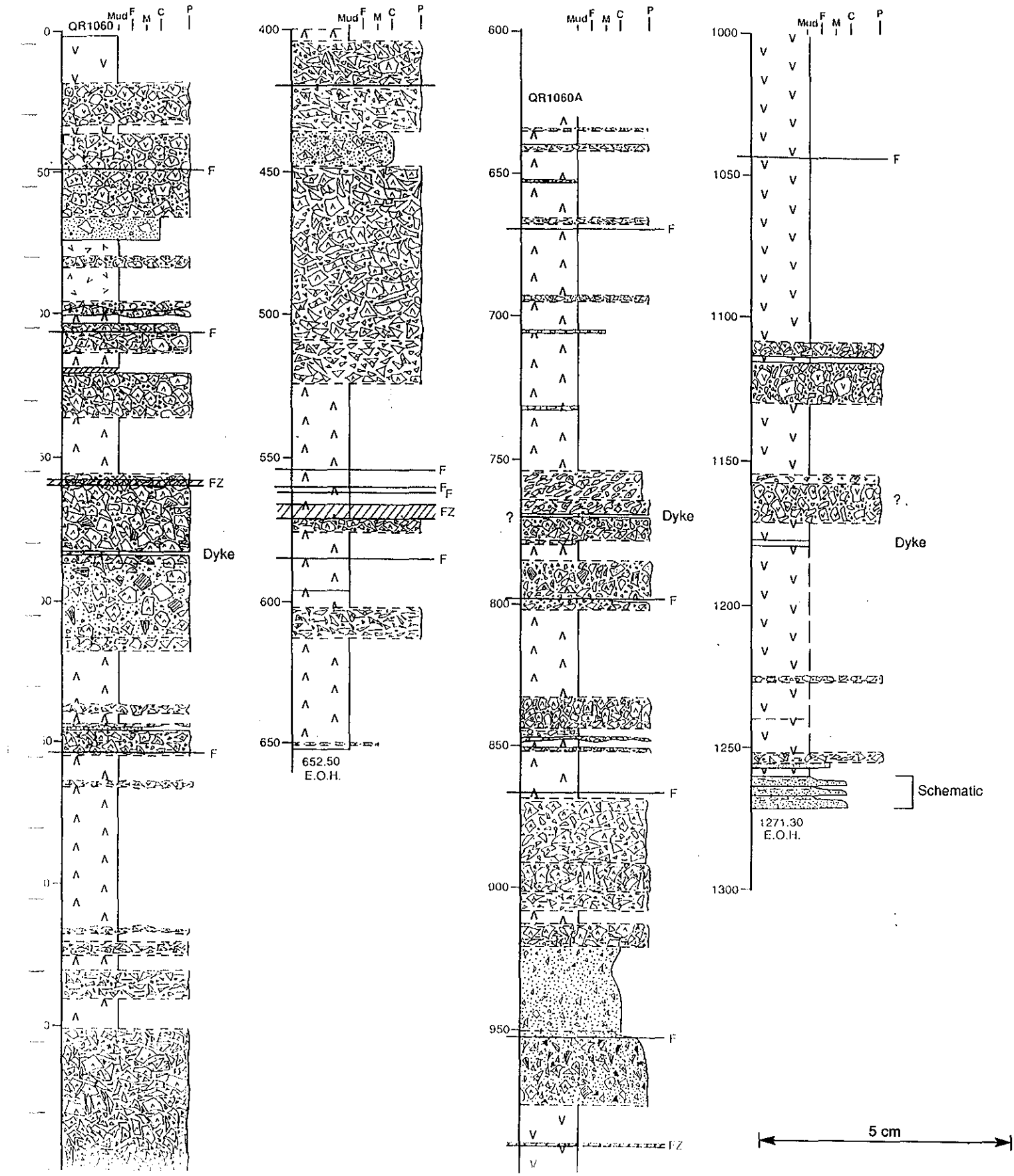
PQ mineralisation. Like most of the sections at Que River these were complicated by complex faulting relationships.

Volcanics: The volcanics present within the two sections are dominated by massive, intermediate (andesitic - dacitic) compositions (Figs. 1 and 2). These massive volcanics often have associated autoclastic margins, which in some cases have been resedimented. This resedimented autoclastic debris suggests that these volcanics are most likely extrusive to very shallow intrusive lavas. The lavas show varying degrees of alteration, mainly hydrothermal, and range from dark grey through khaki to pale cream. Deformation of these volcanics appears to vary as a function of the degree of alteration but on the whole they are much less deformed than the associated volcaniclastics.

In hand specimen the lavas vary from weakly plagioclase-phyric (ie. QR-1053), to plagioclase-phyric with rare quartz phenocrysts (ie. QR-919 and QR-921?). The total phenocryst content of these lavas rarely exceeds 15 percent, which seems to be common in lavas within, and closely associated to the Mixed Sequence units. The groundmass appears in most cases to have been originally glass and has been subsequently devitrified as seen by the presence of spherulites within lavas present in QR-919. Some of these lavas also appear to have been vesicular (ie, QR-921). Alteration of the lavas is dominated by silica - sericite - clays ± fuchsite, with up to 5 percent disseminated pyrite also being present.

The presence of rare quartz phenocryst in the lavas present below about 20 metres in drill holes from the 7212.5 N section suggest that these may be dacitic in composition, while those apparently lacking quartz (ie. those on 7437.5 N), may be either dacitic or more andesitic in composition. It is therefore suggested that the units initially described as 'porphyritic dacite' (PD), may in some cases be dacites as originally believed and not andesitic as presently thought. This distinction between andesites and dacites in the Que - Hellyer Volcanics has been an on going problem, especially in the footwall units, and it's now being recognised that some of the lithologies previously logged as andesite within the footwall are most likely dacitic in composition (ie. feldspar - quartz phyric lavas from Hat 5).

The brecciated margins of the flows can be sub divided into two types. The first type consists of a closed framework, irregular arrangement of flow banded


QR1060
Mud F M C P
0
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Dyke
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E.O.H.
400
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650
QR1060A
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1250
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E.O.H.
Schematic
5 cm

0061 intermediate blocky fragments which range in size up to 25 centimetres long in core (eg. QR-1057, QR-1058)(Fig. 1). These are generally very poorly sorted and vary from angular to sub-angular. The breccia has a matrix of less than 15 percent, which is generally rich in sericite. The second type consists of non banded fragments which vary from a closed to a moderately open framework (eg. QR-920, QR-1053)(Figs. 1 and 2). This second type of breccia is also poorly sorted and generally extensively altered to sericite rich assemblages. The moderately open framework breccia consists up to 60 percent matrix in places making it more of a sandy to blocky mudstone (ie. QR-920). Both types of breccia have gradational contacts with the massive lavas, suggesting that they are autoclastic in origin. The first breccia type is interpreted to be an autobrecciated margin to the flow while the second type may be of hyaloclastic origin.

Also present within the drill holes on section 7437.5 N is an apparently more intermediate to mafic lava (andesitic - basaltic)(Fig. 4). This unit is 4 to 5 metres thick in core and can lie either stratigraphically above or below the mineralisation, although the variation in its position on this section may be a function of faulting, or may indicate that the lava cross cuts the mineralisation. This unit does however lie below the dacitic / andesitic units on this section and a similar basaltic unit has been recorded from QR-49 below one of the Mixed Sequence dacites at the northern end of the Que River deposit. The lava is typically porphyritic and moderately vesicular (up to 15%) and extensively altered to chlorite - fuchsite. Fuchsite 'spotting' throughout this unit leds to it commonly being logged as 'IHCO" or fuchsite-carbonate rock. Contacts with adjacent units are generally sharp. In some instances (ie. QR-1053 and QR-1054), the lava grades down hole into a hyaloclastite / peperitic unit. This hyaloclastite contains angular to sub-angular, very poorly sorted fragments with up to 20 % vesicularity. Fracturing of these fragments across the vesicle walls produces cuspate margins. Fragment size decreases away from the massive lava from pebble down to coarse to granule sized fragments. The unit has a moderately open framework in places supported by a matrix of pale grey mud and finely granulated fine to medium sand sized hyaloclastite material. This hyaloclastite represents the quenched margin of an extrusive to shallow intrusive flow.

In places this unit looks very similar to the Hellyer Basalt and may represent the initial eruption of this basaltic material in the upper parts of the Que -

Hellyer Volcanics. Due to the increasing frequency of this intermediate to mafic lava and associated volcaniclastics toward the northern end of the deposit it is most likely that the source of this lava is to the north of Que River.

Volcaniclastics: The volcaniclastics in both sections appear to be lithology and depositional very similar to the volcaniclastics present at the Hellyer deposit (Waters, 1988, 1989). The volcaniclastics associated with the Que River deposit do however, appear to lack the finer grained facies found at Hellyer.

The breccias present at Que River are dominated by mass flows of volcanic lithic rich material up to 5 - 10 metres thick in core (Figs. 1, 2 and 3). These breccias are typical poorly to very poorly sorted chaotic units which vary from open to closed framework. Often the one unit can grade laterally from closed to open framework (Fig. 3). The breccias vary from polymictic to monomictic, dominated by angular to sub-rounded, locally derived volcanic fragments which vary from a few millimetres to about 2 to 5 centimetres in size (Fig. 5). Compositionally these range from quartz-phyric dacites (~20 - 25%), through to more intermediate to mafic porphyritic volcanic fragments (~65-70%). Dark to mid grey, massive, silicified fragments have also been noted in the framework to these breccias (~5-10%)(eg. QR-923). Framework fragments show varying degrees of alteration ranging from silicic through to sericitic and chloritic. The matrix to these breccias ranges up to 35-40% in the open framework types and in comprised of mid to dark grey muds and muddy fine to medium sands.

These breccias are generally massive, but both normal and reverse grading have been observed. Reverse grading occurs at the base of some units (ie. QR-1055; NB: some holes are drill up therefore the logs shown are upside down), and is accompanied by a change from a relatively open framework with a mud matrix to a more closed framework with a decrease in matrix content. It is possible that this muddy, more open framework base results from the incorporation of mud into the debris flows base as it moves over the sea floor. This removal and incorporation of the mud from the sea floor into the bottom of the debris flow units may account for the relative lack of preserved fine grained pelagic deposits associated with the massive sulphide mineralisation.

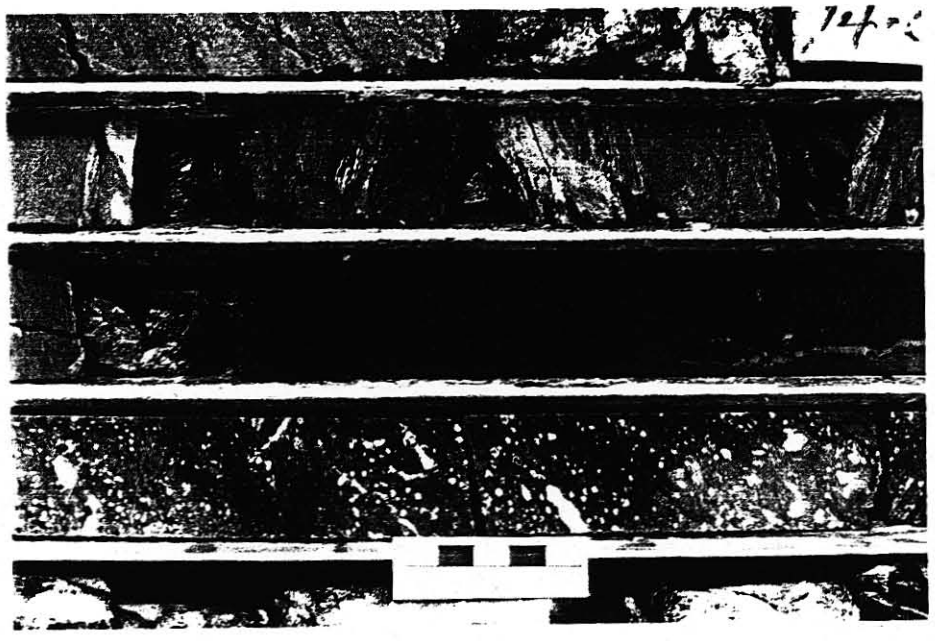

Figure 4: Intermediate to mafic lava from QR 1053 (~17-18 metres). Lava is massive and vesicular (~15%). Unit lies within half a metre of mineralisation and is extensively altered to fuchsite and chlorite rich assemblages.

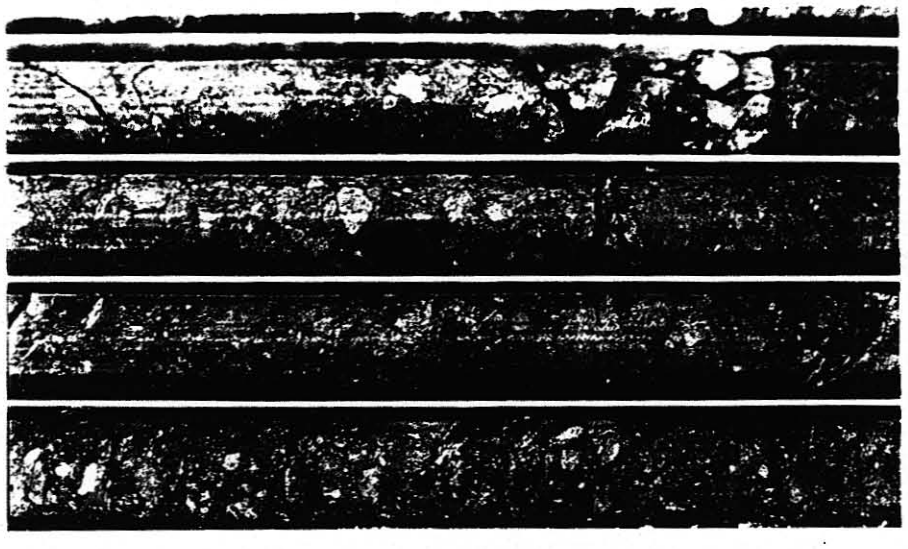

Figure 5: Polymictic closed framework volcanic lithic breccia from QR 921 (area between 6 and 17 metres). Volcanic lithic fragments vary in composition from andesite / basalt through to dacitic. Some sedimentary / meta-sedimentary lithics have also been identified. Lithics are typically sub-angular to sub-rounded and poorly sorted.

0264 Alteration of the volcaniclastics is fairly pervasive and dominated by 'quellite' type assemblages (ie. sericite-pyrite). This pervasive alteration is also accompanied by a moderate to strong tectonic cleavage.

These breccias have been interpreted as possibly cross cutting mineralisation on the 7212.5 N section (Fig. 3). At this location a single debris flow unit separates two small lenses of mineralisation. This feature may also be explained by faulting.

QR 1060 & QR 1060A

A drill hole and wedge on 7300 N (QR 1060 & QR 1060A) to the west of the Que River mine site were logged to investigate the footwall sequence (FPS) in the vicinity of the Que River deposit (Fig. 6). This hole cuts through what is interpreted as the FPS and Lower Basalt units and was stopped in what appeared to be graded interbedded volcaniclastics, possibly of the Animal Creek Greywacke.

The hole is dominated by intermediate, andesitic to possibly dacitic volcanics and autoclastic breccias (Fig. 7). These become the dominant lithology below the ~100 metre mark in QR1060. Quartz phyric lavas and autoclastics (ie. true dacitic to rhyodacitic compositions) appear to be relatively restricted to the top of QR 1060 (~50 - 100 metres). These dacites are interpreted as belonging to the Mixed Sequence. Volcanics of intermediate to mafic compositions occur at the very top of QR 1060 and also toward the base of QR1060A (last 300 metres approximately).

The composition of the volcanics in these two holes was determined by a combination of petrology, alteration and trace element geochemistry. Dacitic units were distinguished from other compositions by their pale buff colour combined with the presence of quartz phenocrysts and elevated Zr, Y and lower Ti/Zr and Cr contents relative to the other units (Fig. 8). Andesitic/ basaltic units at the bottom of the hole were distinguish from the more intermediate andesitic/dacitic compositions by the elevated Cr and apparently higher concentrations of mafic phenocrysts (ie pyroxenes).

Andesitic/Basaltic Volcanics: Volcanics of intermediate to mafic compositions are restricted to the very top? and base of the drill hole QR-1060 (Fig. 7). These

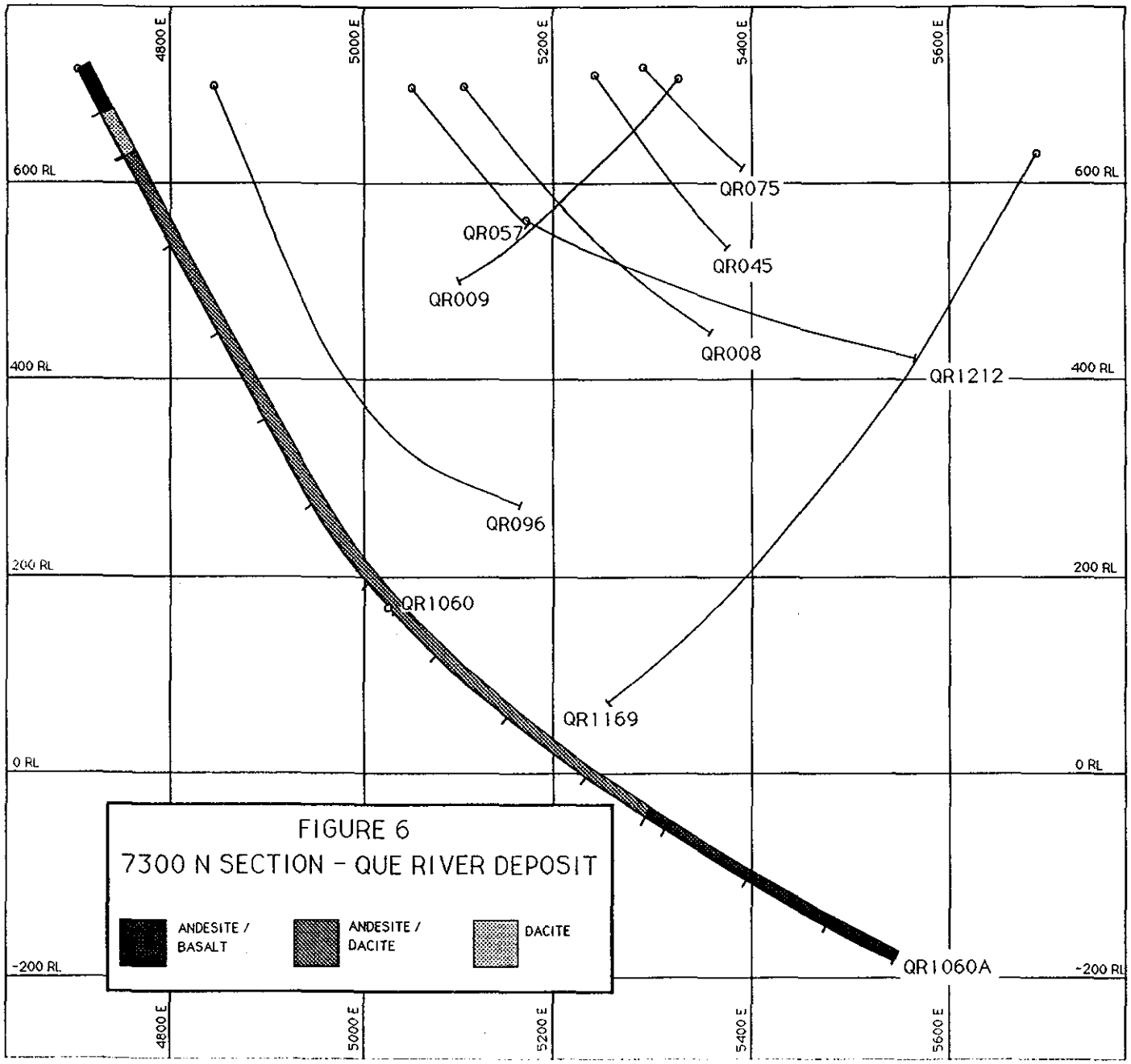

FIGURE 6
7300 N SECTION - QUE RIVER DEPOSIT

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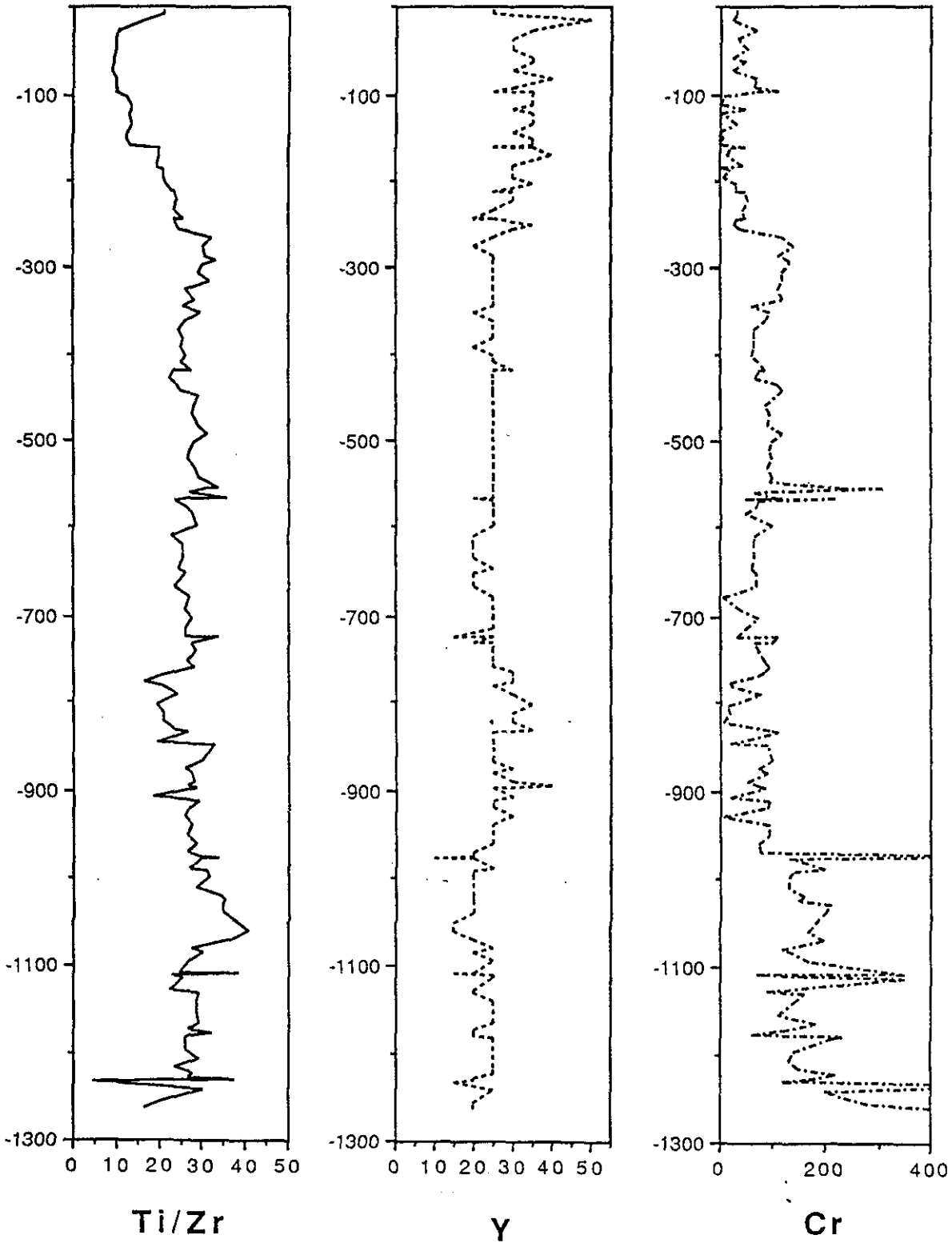

Figure 8: Selected down hole trace element geochemistry for QR 1060 and QR 1060A. The depressed Ti/Zr ratio and elevated Y toward the top of the hole (~50-100 metres) represents the dacitic compositions. Elevated Cr values from around the 1000 metre mark down reflects the slightly more mafic compositions (ie. andesite/basalt of the Lower Basalt). Y and Cr are expressed as ppm. Data from core grinds.

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volcanics most likely belong to the Hellyer Basalt and Lower Basalt units respectively. The upper most andesitic/basaltic unit is highly oxidised and completely altered to clays making its identification doubtful. The lower andesitic/basaltic unit (ie. below 977 metres), is comprised of grey through to dark green porphyritic, vesicular lavas, up to 130 metres thick in core, and hyaloclastite breccias. These show gradational contacts between each other, with the breccias generally representing the top and bottom margins of individual flow units. These hyaloclastite breccias are typically very poorly sorted, closed to open framework units consisting of angular to sub-angular fragments which periodically exhibit jig-saw fit. The matrix content of the breccias varies up to 40% in the open framework types. This matrix consists of muds and up to gravel sized hyaloclastite material.

Andesitic/Dacitic Volcanics: The bulk of QR-1060 and QR-1060A is comprised of massive andesitic lavas and autoclastic breccias. The lavas are feldspar-phyric and mid green grey to buff coloured depending on the style of alteration. Feldspar phenocrysts make up to 20% of the lavas and are commonly cream to pink in colour, while another phenocryst phase present, in some flows making up to 15%, is probably clinopyroxene. Up to 10% vesicularity has been recorded from the intermediate lavas in the footwall sequence (ie. 802-832m; 910 m), however the lavas are typically non vesicular to very weakly vesicular. Flow banding has been recorded from the tops of some flows which, in core, vary in thickness up to about 50 metres (Fig. 9). The contact of these massive lavas with the autoclastic breccias is gradational.

The autoclastic breccias consist of very poorly sorted, closed to open framework breccias up to 10's of metres thick. Fragments within the breccias vary from aphyric to strongly porphyritic, averaging in size between 5 and 15 centimetres with fragments up to 30 centimetres having been recorded (Figs. 10a and 10b). These fragments are typically angular to sub-angular and splintery in appearance and have straight to very weakly concave margins. These margins in some cases appear to have been chilled. Some of the larger fragments exhibit jig-saw fit (ie.330-340m), with the margins of these larger fragments commonly enveloped by finer granulated material. The frequency of fragments with jig-saw fit as well as fragment size generally increases toward the contacts with massive lavas.



Figure 9: Massive intermediate porphyritic lava (QR 1060; ~847 metres). Top contact of lava with volcanic lithic breccia appears to be flow banded.

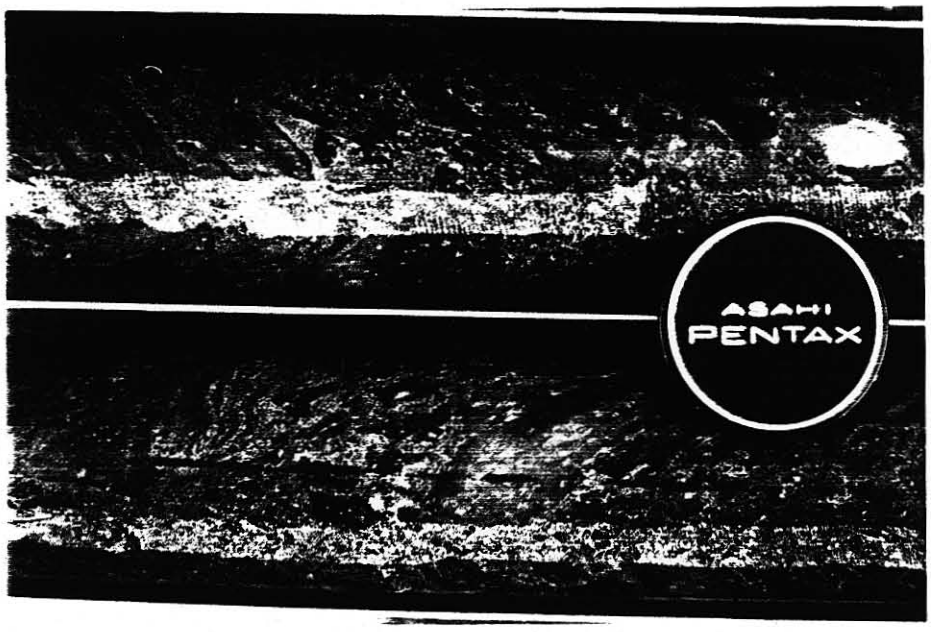

Figure 10a: Intermediate hyaloclastite(?) breccia from QR 1060 (~106 metres). Fragments are porphyritic and show varying degrees of alteration which in some fragments defines a banding which may have originally been flow banding. The matrix to unit makes up to 20 - 25% and consists of a sandy volcanic lithic rich mud. (Lens cap is 5 centimetres in diameter).

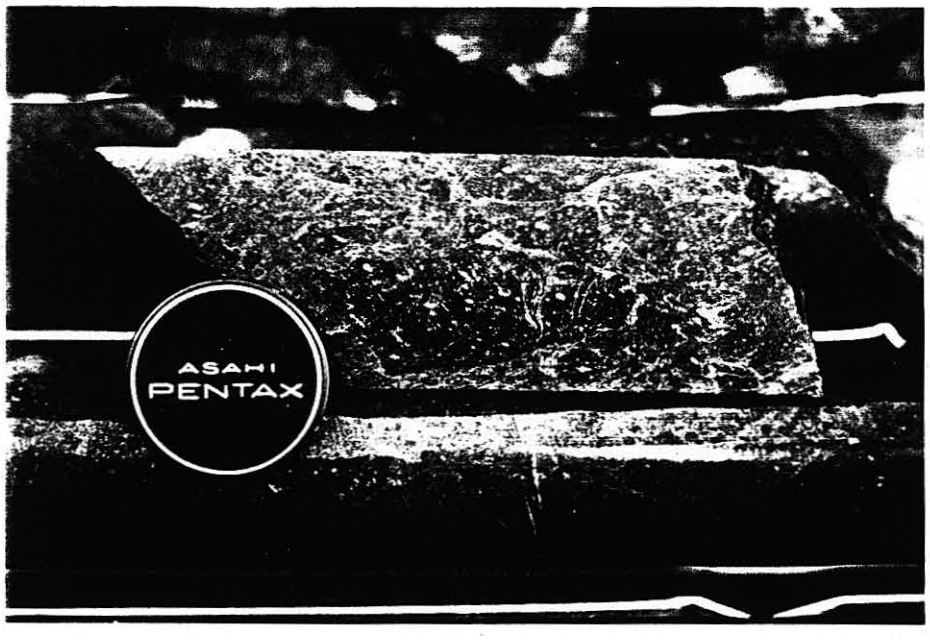

Figure 10b: Intermediate hyaloclastite (resedimented?) breccia from QR 1060 (~161 metres). Fragments porphyritic to non porphyritic and range in size up to 10 centimetres. Unit very poorly sorted with the matrix content varying from 5 to 35 %. Fragments most likely of autoclastic origin, although this unit may be resedimented (ie. debris flow). Unit most likely from the footwall and very similar to the 'FPS' type breccias found in the footwall to the north around Hellyer. (Lens cap is 5 centimetres in diameter).

The matrix to these breccias consists primarily of mud with subordinate amounts of finely granulated material dominated by coarse angular volcanic fragments of probable quench origin. This matrix comprises up to 20% of the closed framework breccias and 40% of the open framework types. This gives the breccias a 'peperitic' type texture in places. The mud matrix immediately adjacent to some of the larger fragments is darker and appears 'baked'. Locally the matrix has fine to coarse bands of sediment which shows signs of disruption, possibly due to fluidisation or soft sediment deformation.

These breccias are generally massive with the occasional unit exhibiting grading of fragments away from the contact with the massive lava. Some of these breccias, especially the open framework 'peperitic' types may represent resedimented rather than insitu autoclastic debris.

Dacitic Volcanics: Lavas and autoclastic of true dacitic to rhyodacitic compositions within QR 1060 are restricted to between the 50 and 100 metre marks. Dacitic lavas at this locality are red brown to pale cream and quartz - feldspar phyric, with up to 15% phenocrysts generally dominated by quartz. These originally massive lavas are now altered to fuchsite bearing assemblages and are extensively fractured in places. The in core, thickness of these lavas ranges up to 11 metres.

The margins of these lavas show a gradual transition to dacitic breccias of probable autoclastic origin. These breccias vary from closed to open framework and consist of angular to sub-angular splintery fragments of dacite which vary from 1 to 15 centimetres in size, generally with the larger fragments and closed framework closer to the coherent lava. These fragments in places appear to have fragmented insitu and some minor jig-saw fit. The matrix makes up to 30% of the breccia and consists of muds to coarse/very coarse sand sized material, most likely of hyaloclastite origin. Alteration of the fragments within the breccia varies from siliceous to sericitic with fuchsite 'spotting'. These breccias have a sharp, slightly irregular contact with surrounding lithologies.

The gradational nature of the contact between the coherent lava and the breccia combined with its angular fragments which show occasional jig-saw fit suggests that the breccia is autoclastic in origin. The abundance of material

which is fragmented to less than a few centimetres in size further suggests that the breccia is a hyaloclastite breccia rather than a autobreccia.

Volcaniclastics: Horizons of volcaniclastic material occur at various levels throughout both QR 1060 and QR 1060A. These, like the majority of volcaniclastic units found in the Que - Hellyer succession, appear to be debris flows dominated by locally derived material. These vary from open to closed framework (Fig. 11). The majority of the framework within the debris flow is angular to sub-rounded porphyritic intermediate (andesitic?) fragments up to 40 centimetres in size. Other framework types found include chloritically altered whispy to cuspate volcanic fragments and buff coloured dacitic? fragments which occasionally show a relict banding. These debris flows have a matrix of mud and coarse sand sized material which comprises up to 30 - 40% of the open framework types.

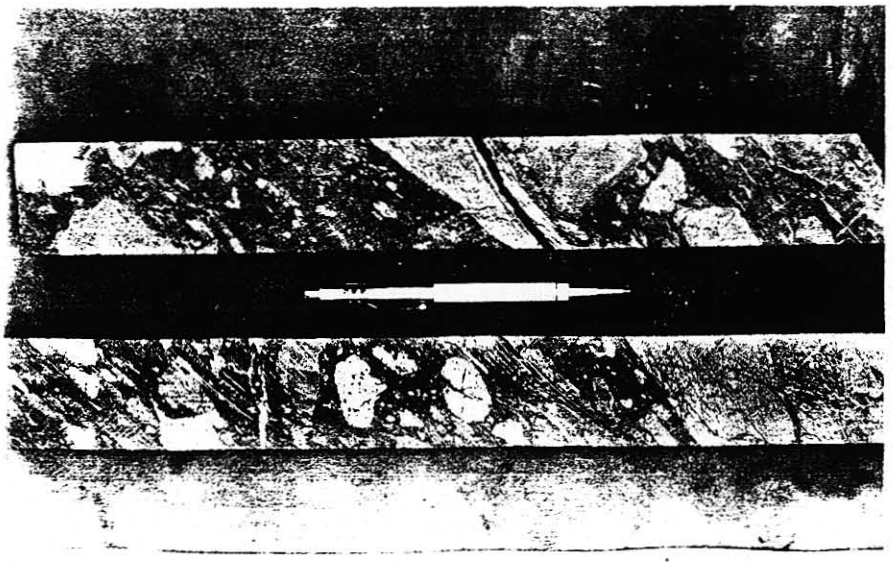

Figure 11: Open framework debris flow unit (QR 1060; ~731 metres). Comprised of porphyritic volcanic lithics which are extensively altered to "quellite" like assemblages (sericite - pyrite - clays). Matrix to debris flow is dark grey muds which makes up to 30 - 40% of the unit.

These units are generally massive and occasionally have normally graded tops which grade rapidly, over 10's centimetres or less,to the main body of the debris flows. The thickness of these debris flows, in core, varies from around

10 metres to in excess of 25 metres. The contacts of these units with autoclastic breccias appears in may cases to be gradational, in that there is a rapid change from polychromatic, polymictic rocks to monomictic breccias which have gradational contacts to massive lavas (Fig. 7).

Comparison of Footwall Units at Que River and Elsewhere

The footwall sequence in the Que River area (ie. QR-1060) is nearly identical to that recorded from other holes around Hellyer and from between the two deposits. The footwall sequence (FPS) is dominated by lavas and autoclastics of intermediate composition which suggest that the emplacement of the sequence was via multiple small volume flows from apparently non-explosive eruptions. Due to the relative lack of thick deposits of volcaniclastics and pelagic deposits between flow units it is interpreted that there were only short time breaks between flows. Those volcaniclastic deposits which are present between flows represent resedimented autoclastic debris (ie. debris flows), indicating that the lavas and associated autoclastic breccias were extrusive to very shallow intrusive.

Future Work:

Future work to be undertaken in the next six months includes:-

(i) Continue logging and sampling Que River DDH's on selected sections (ie. 7200 N., 7400N., 7800 N., 7925N.).

(ii) Log QR 1001 (7700 N.) to further investigate the footwall sequence around Que River.

(iii) Continue logging and sampling of selected Exploration DDH's. Some of the holes targeted for logging in the near future are Mac-19, Mac-4, Hat-8, Hat-3. These holes will help complete regional scale north-south and east-west sections.

(iv) Log selected holes on a east - west traverse over Hellyer (Hat-9, HL-246, Mac-17, Mac-4, HL-80, Mac-11, Mac-19)

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Waters, J. 1988: Eruptive activity, products and depositional setting of the Cambrian volcanic-sedimentary succession hosting massive sulphide mineralisation (VMS) at Hellyer and Que River Mines, Mt. Read Volcanic Belt, Western Tasmania. Ph.D Progress report 2 to Aberfoyle Resources, unpublished.

Waters, J. 1989: Eruptive activity, products and depositional setting of the Cambrian volcanic-sedimentary succession hosting massive sulphide mineralisation (VMS) at Hellyer and Que River Mines, Mt. Read Volcanic Belt, Western Tasmania. Ph.D Progress report 4 to Aberfoyle Resources, unpublished.

APPENDIX 3

91-3268 B

The Eruptive and Depositional History of the Cambrian Upper Rhyolitic Sequence, Hellyer Region, Mt. Read Volcanic Belt, Western Tasmania

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654076

Progress report No.1

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1. Introduction

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This is the first progress report to Aberfoyle Resources Ltd. on the M.Sc. study being carried out on the Upper Rhyolitic Sequence of the Hellyer Mine region. It contains a progress report on work already commenced, and a proposed program for future work.

The Hellyer massive sulphide deposit and the associated volcano-sedimentary sequence is hosted within the northern most exposures of the Cambrian Mt. Read Volcanic Belt of north west Tasmania. The Mt. Read belt has a sequence of felsic to intermediate and minor mafic volcanics and sediments, and are exposed from Elliot Bay in the south to the Hellyer area to the north. The belt also extends further to the north under the Tertiary basalt cover. The meridional extent of the belt is some 180km, with an east-west width varying between 10-15km. To the east, the Mt. Read Volcanic overly the Precambrian Tyennan nucleus, and are thought to occupy the eastern margin of the Dundas Trough. To the west, the belt is faulted against, and partially interfingers with Cambro-Ordovician Owen conglomerate. Within the stratigraphy of the Mt. Read Volcanics, the Hellyer deposit and associated volcano-sedimentary sequence has been assigned to the Dundas group (Corbett and Solomon 1986).

After McArthur (1986), the stratigraphy of the Hellyer area may be defined:

Unit	Thickness	Description
Upper Rhyolitic Sequence	500m	rhyolitic lithic/crystal volcaniclastics
Que River shale	100m	pyritic shales
Pillow lava sequence	220m	pillow basalts and associated hyaloclastites, sheet basalt, chert
Hanging wall volcaniclastic	10m	polymict breccias, ash shale
Hellyer mineralised sequence	40m	base metal sulphide, barite
Feldspar phyric sequence	100 + m	andesite lavas, volcaniclastics

The proposed main focus of this study is the Upper Rhyolitic Sequence, which represents a distinctive package of volcanics, volcaniclastics and associated sediments in the Hellyer Mine area geology. It represents a distinct change in both composition and eruptive mechanism to that found in the footwall and immediate hanging wall, which is basaltic, andesitic and dacitic in composition. The upper hanging wall is marked by more acidic volcanism, including horizons of pumice debris, and some apparent eutaxitic texture.

Previous work (MacArthur, 1986), and work in progress, (Waters, Ph.D study, Monash) suggests that the footwall to immediate hanging wall has variably altered coherent to brecciated and quenched lavas, intrusives and associated resedimented volcaniclastics of similar composition. Apart from vesicular debris in the Hanging Wall Volcaniclastic Sequence, there is little or no evidence of pyroclastic activity (J. Waters, *pers. comm.)* and this material may represent quenched vesiculated lava, not pyroclastic debris. The associated sedimentary succession is consistent with a relatively deep, quiet water environment, as is indicated by the black, anoxic shales of the overlying Que River Shale.

The pumiceous debris units in the Upper Rhyolitic Sequence represent pyroclastic activity, but the depositional setting and source of this material is unclear. Previous work by Scott (1987) has suggested a change in the environment and in the *in situ* style of volcanism to an explosive plinian style from the "Hellyer Volcanic Centre", but, this has not been shown from the sedimentology of the associated sediments, nor from the volcanics and volcaniclastics themselves.
The main objectives of this study are to investigate the eruptive and post eruptive depositional history the volcanic and volcaniclastic units within the Upper Rhyolitic Sequence, and to examine the sedimentology of the sequence as whole, taking particular note of the effect of volcanism on sedimentation patterns. An examination of the Que River Shale is also proposed, to document the differences (if any) between these shales and the shales found within the Upper Rhyolitic Sequence.

2. Work Completed

2.1. Field Work

A preliminary excursion to the mine area was made over two weeks in October 1989. This time was spent evaluating resources and identifying areas of specific interest. Drill core of the Upper Rhyolitic Sequence from three holes was examined and sampled. Selection of these holes, based on advice from mine and exploration staff, was such that the lateral continuity of units between two closely spaced holes (HL40 and HL62) might be examined, and that the large scale lateral and vertical variation between these holes and a more distant example of the sequence might be examined (e.g. HL62 compared against Mac 22).

2.2. Drill Hole Logging and Sampling

Drill Holes HL40, HL62 and Mac-22 were logged and sampled at a scale of 1:50. Detailed drill logs are presented in figure 1. Representative samples were taken of most different lithologies present. Sometimes, several samples were taken to document vertical variation within units. All 62 samples taken have been described, and most have also been thin sectioned for textural analysis. All samples taken have been noted in the core trays with wood blocks. Where full core is available, half-core samples have been taken, where less core was available, smaller samples (e.g., thin slabs) were taken. All core samples taken have been catalogued and stored at Monash.

3. Results

A summary of the work completed on the logged drill holes is presented with a further comparison of the differing depositional and eruptive styles observed. The data gathered suggest an immediate subdivision of the Upper Rhyolitic Sequence into two distinct zones. The basal zone, immediately overlying the Que River Shale is represented in HL40 and HL62, while the upper zone is represented in the younger sediments observed in MAC22.

3.1. Summary of features of HL40, HL62 and MAC22.

At least two different types of explosive volcanism may be distinguished in the rocks examined, with at least two penecontemperaneous effusive magmatic phases. An attempt to relate these more effusive magmas to the obviously explosive magmas may be warranted.

HL62

The first examples of both explosive and effusive volcanism are identified in drill hole HL62. They are identified by the deposition immediately above the Que River Shale of a basal closed framework polymict breccia (fig 2). This contains a variety of lava clasts, ranging in composition from vesicular andesite to feldspar-phyric rhyolite. The unit grades uphole into a fine grained grey unit with scattered crystal and lithic fragments, set in a matrix of what appear be fine grained cuspate glass shards (figs. 3,4) . This unit represents the almost concurrent onset of both effusive magmatic activity, represented by the lava clasts, and explosive eruptive activity, represented by the abundant glass shards in the upper part of the unit. This unit is absent in HL40, where the highly sheared and silicified basal contact with Que River Shales indicates a fault contact.

The first phase of explosive activity is followed by continued deposition of ~40m of sand sized sedimentary material, which appears to contain a fairly large percentage of volcanic material, consisting of pumiceous fragments, crystals and lithics. These are interbedded with and grade into fine sands and siltstones. These sand units appear to be tubiditic in origin, with graded bedding being common. Bed thicknesses usually average ~1.0m, with some considerably thicker units. The massive nature of these thicker units may be a function of silicification obscuring the original depositional texture.

The next indicator of a change of volcanic style is found at and ~42.5 m. It is represented by the deposition of several thick mud supported volcaniclastic breccias. The first of these occurs at 42.5 m and consists of mud supported clasts of feldspar and quartz phyric sericite altered pumice. The matrix is also rich in fragmented crystals and lithics. This unit is ~2.0m thick, and is followed by 1.0m of black shale with a thin lens of crystal sandstone. This is followed by a 14.0m thick interval of crystal pumice breccia. Examples of these units are shown in figure 5. An interval of 4.0m consisting of black shales and crystal lithic sandstones is overlain by 14.0m thick unit of similar appearance.

The major volcanic components of these breccias are large, poorly vesicular pumice clasts (up to 20cm thick in core) with large feldspar and fractured quartz crystals. These units are distinctive in that they contain intensely fractured embayed quartz grains (fig. 6), both as individual disaggregated fragments, and as whole original grains with internal fracture patterns. These grains may be useful in that they appear to be confined to these thick mass flow units and so represent good stratigraphic marker horizons. The embayments and rounded edges of the grains truncate fractures, implying that fracturing has occurred before or during the resorption of the grain boundaries within the magma chamber. The regular shape of the fragments and the lack of crystallographic lattice misorientation across grain boundaries suggests that fracturing has occurred in an isotropic stress field. The fractures are probably the result of thermal shocking of xenocryts incorporated into the magma chamber or conduit. This is further supported by the presence of glassy magmatic material within some of the larger fractures.

These units are frequently matrix supported, indicating a mass flow mode of deposition, although in places they are clast supported. The units may vary considerably in their appearance, corresponding to the amount of mud matrix . This feature may be in part due to alteration of the matrix to give a more massive appearance. Examples of these differing textures are shown in figure 7.

Another feature of the depositional style of this lower part of the sequence is the presence of large mudstone intraclast breccias with shale clasts of up to 20cm in diameter (e.g. at ~43m in HL62). These units may be up to 1m thick in core. They usually contain some fraction of sandy material as matrix, and represent disruption of the basin floor. This is possibly caused by volcanic related seismic activity, or

they may have formed as the result of disturbance of the substrate by mass flow deposition within adjacent parts of the basin.

The coarser sandy deposits within this part of the sequence probably are also largely volcanic in origin, as in thin section, there is little evidence of older basement metamorphic clasts.

HL40

The units found in HL40 are similar to those found in HL62, and some cross hole correlation may be possible. However, several significant differances are also present.

The base of the URS is not represented in HL40. The basal contact appears to be a fault, indicated by the sheared and silicified nature of the contact. Almost immediately above the contact is a 14.0m thick mudstone intraclast breccia similar to those described in HL62, and probably representing a lateral correlative of one of these units. This unit is overlain by a 7.0m thick package of crystal lithic sandstone that passes upwards into a 30.0m thick black shale interval. The shale interval is broken at two places (55m and 50m) by mudstone intraclast breccias. These breccias contain small volcanic lithics and crystals, but are composed dominantly of fine grained mud and silt as matrix, and larger clasts of the same composition as framework. Rare sericitic pumice(?) patches may also be found. These units appear similar to the breccia found at 43m in HL62.

Overlying thick interval of shale is a 30m thick pumice clast breccia. A fault passes through the middle of this unit, and so it may have been structurally thickened. This unit is followed by 5m of mudstone, which is in turn overlain by another thick pumiceous breccia, which carries through to the top of the hole.

The upper part of the stratigraphy in both of these holes is quite similar in that there are two thick breccias separated by an interval of mudstone, and so they may be correlated laterally. However, the downsequence stratigraphy of the two holes is quite different. It may be that the two holes represent different parts of the overall stratigraphy, that are similar in style of deposition, but this seems unlikely as the holes are separated by only about 200m spatially. As the basal contact of the URS is not preserved in HL40, it is difficult to determine this. An alternative explanation may be that seafloor topography due to syn-depositional deformation is controlling deposition, leading to marked differences in observed facies over short lateral distances.

Overall, it is also interesting to note that there is a super-position of Que River Shale type sedimentation, with coarser sandy deposits of a most probable volcanic origin. It suggests that the main controls on sedimentation within the basin remained largely unaltered, and that the volcanic deposition is simply imposed over an already stable system, without externally altering the dynamics of the pre-

existing system. This further suggests that deposition is occurring in an environment that is fairly distal to the volcanic source(s).

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MAC 22

The rock types observed at HL40 and HL62 are different in character from those observed at Mac 22, which is located much further to the north, and represents rocks from higher in the stratigraphy. The basal contact of the Upper Rhyolitic Sequence is not exposed in this hole.

The rocks in this part of sequence represent a distinct change in the composition of the major magmatic phase associated with volcanism, and possibly a change in eruption rates. The volcanic component of the rocks present in HL40/62 are distinctive by the presence of large pumice clots with abundant quartz and feldspar phenocrysts, whereas the pumice found in MAC22 is almost totally without any phenocrysts. The pumice found lower in the sequence also appears fairly massive, and usually poorly vesicular whilst the pumice found in MAC22 preserves delicate tube pumice textures (fig 8,9)

The first unit in this hole is a massive to slightly feldspar phyric rhyolitic lava. The rock is vesicular in places, indicating a lava flow or shallow intrusive origin. It also contains what appear to be lithophysae and devitrification spheriods. This is overlain by a 40m sequence of pumice and lava rich coarse sandstones and fine breccias. The beds are marked by an apparent lack of internal structure, although some grainsize variation mat be detected. The is a definite density grading of clasts, with most units being enriched in pumice at their tops, and enriched in lava and other dense clasts at their bases. Several of the pumice rich tops display psuedo-eutaxitic textures (figure 10).

Up to approximately 300m, there are repeated several thick units of coarse sandstone to breccia. These units have varying amounts of mud matrix, but overall, the sequence becomes more mud rich moving upsequence. The volcanic clasts present are usually tube pumice fragments and lava fragments. All volcanic clasts have been strongly sericite altered. Examples of some the thin section and hand specimen textures of these units are shown in figures 10-11.

The middle part of the sequence is composed of volcanic greywackes with a large portion of volcanic material. At 213m is a large 27m thick lava clast breccia. It contains dominantly rhyolitic and intermediate lava clasts, as well as more vesicular pumiceous clasts. This unit is followed by volcanic sandstones, with the last appearance of URS material being at ~167m

In general, the rocks in MAC22 display less variation than those previously describe

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3.3. Magma types and eruption mechanisms.

Several different magma types may be empirically observed in the samples examined so far, but at present it is difficult to predict if they are related by some differentiation process to one or a few magma chambers, or if they represent discrete magmatic events from unrelated magmatic sources. At least two different domains of magmatism have so far been identified on a broad scale. These are the quartz/feldspar phyric volcaniclastics from the basal part of the sequence as observed in HL40 and HL62, and the almost aphyric units representing the upper part of the sequence as represented in MAC22. Within both domains are abundant lava clasts that appear to be similar in each case, ranging in composition from andesites to dacite/rhyolite. These clasts are variably vesicular, and some display flow banding.

The volcanic clasts found in HL40 and HL62 are dominantly quartz and feldspar phyric pumice, with crystal grainsizes of several millimetres being common (fig 12). The quartz mostly is probably of xenocrystic origin, with the primary magma being a poorly crystalized rhyodacite/rhyolite. The dominant magma type found in MAC22 is almost aphyric, with some rare, very small feldspar crystals observed. Being higher in the sequence, these probably represent eruption from a separate, less crystalised magma chamber.

From observation of the products, several different eruptive mechanisms may be inferred to have been operating during the deposition of the Upper Rhyolitic Sequence. A complete spectrum, ranging from effusive magmatic lava forming eruptions to explosive, fragmental lava producing eruptions, to explosive pumice (ignimbrite?) forming eruptions, may be inferred. The pumice found in the upper sequence preserves fine tube pumice textures indicative of shallow subaqueous or subaerial eruption. There is no indication in thin section of any flattening of these pumice clasts. In hand specimen, some of these units appear to show a eutaxitic texture, but there is no microtextural evidence for welding of these units. The flattening observed is probably due to diagenetic and tectonic flattening and strain. Of the primary depositional mechanisms of the volcanic units, little can be said at present with much confidence, however, several tentative interpretations may be made.

a) The material found in HL40 and HL62 seems to be redeposited. The intimate mixing of much of the volcanic material with the shales suggests that deposition occurred elsewhere, and that the remobilization of the volcanic material caused mixing the with the shale, and that the material has a fairly distal source.

b) The material found in MAC22 may represent much more juvenile material than that found in HL40/62. The density grading of the clasts observed in some units seems to suggest that deposition has occurred from a source in which

little previous sorting had taken place. This may include deposition directly from a pyroclastic flow erupted either subaerially or in a shallow subaqueous environment.

c) Deposition of the volcaniclastic did not initially interrupt the established sedimentation patterns in the basin, as indicated by the continuance of Que River Shale style deposition. This seems to indicate a fairly distal source for the volcanics, at least initially.

d) The change in magmatic style going upsequence indicates the emergence of several different eruptive centres, perhaps located close to the source of deposition.

3.4. Sedimentary petrology and depositional mechanisms

The characteristics of most of the clastic units examined indicate a mass flow mode of deposition. Usually, units display typical mass flow deposit structures, such as normally graded bases of beds, massive zones, and cross bedded tops. In the thick dominantly volcanic units, a mass flow origin seems to be the only realistic option, as the deposits themselves are thick (up to 30m), and structureless. Some internal variation is commonly visible, such as vertical grainsize variation, and variations in the percentage of matrix.

A common texture noted in drill core has been a type of reverse grading at the base of units that overly or were presumed to overly shale units. The base of the coarse overriding unit is commonly enriched in mud sized material, with the percentage of mud material decreasing to zero over a few tens of centimetres. These units may grade directly from shale horizons, or may directly overlie similar volcaniclastic units, and in some cases be erosive into the tops of these units. These features suggest that the flow carrying the volcanic material was in some way eroding and incorporating the underlying material. This is evident in the examples where the bases of these units grade directly into distinct shale horizons. In the cases where there is no immediately underlying shale, but the unit still has a mud enriched base, it suggests that the small layer of mud that was existing previously has been totally eroded. For this type of erosion and incorporation of the material at the base of the flow to occur, the flow would be required to be more expanded than is accepted for typical mass flow deposits, where flow occurs as plug flow along a basal high shear zone (Allen,1982).

One possible explanation may be that deposition is occurring from flows that are more expanded than is commonly believed. The incorporation and intimate mixing of the shaly material, rather than incorporation of mud as intraclasts suggests that the underlying sediment usually has been somewhat unconsolidated, and that the overriding flow has not been separated from the substrate by a typical basal shear zone.

3.5. "Pyroclastic" textures

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Within the units represented in MAC22 are several that display textures that mimic welded ignimbrite textures (fig. 13). Whilst these units are composed of pyroclastic material, there is no evidence to suggest that they were deposited in a hot state. Usually, individual shards are not visible, which may be a function of alteration, but the dominant clast type is tube pumice. This pumice does not appear to have collapsed vesicles.

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3.6. Alteration

Typical alteration of the rocks in the Upper Rhyolitic Sequence is carbonate (calcite and minor dolomite), and widespread sericite alteration of the juvenile glassy material. Some silica alteration is also present in the fine grained units in the lower section. Alteration may strongly modify the original depositional textures, producing psuedoclastic (fig 14,15) and pseudoeutaxitic textures.

3.7. Proposed Future Work

A course of further detailed drill hole examinations is proposed, with three major aims:

1. to step out from the two HL holes already logged to both attempt further correlation to the north and south, and to document lateral changes within both the prominent volcaniclastic units ands the more conventional sedimentary units and;
2. To document the lateral variation and extent of the distinctive pumiceous units found in Mac-22, and to try to constrain the spatial and temporal relations between the two distinct types of magmatism observed between the two areas.
3. a detailed examination of the haulage road and Link Road sections examine the lateral variation within units on the outcrop scale, and to attempt to correlate with units found in drill holes.
4. attempt to reconstruct the depositional surface of the URS, to determine the nature of the topographic controls on sedimentation

Further, it has been suggested by Ray Cas to devote some time to the sedimentology of the Que River Shale, with the intention of explaining the anomalously thick accumulation of shale.



Figure 8: Tube pumice preserved in MAC22. XPL. Mag. x40.

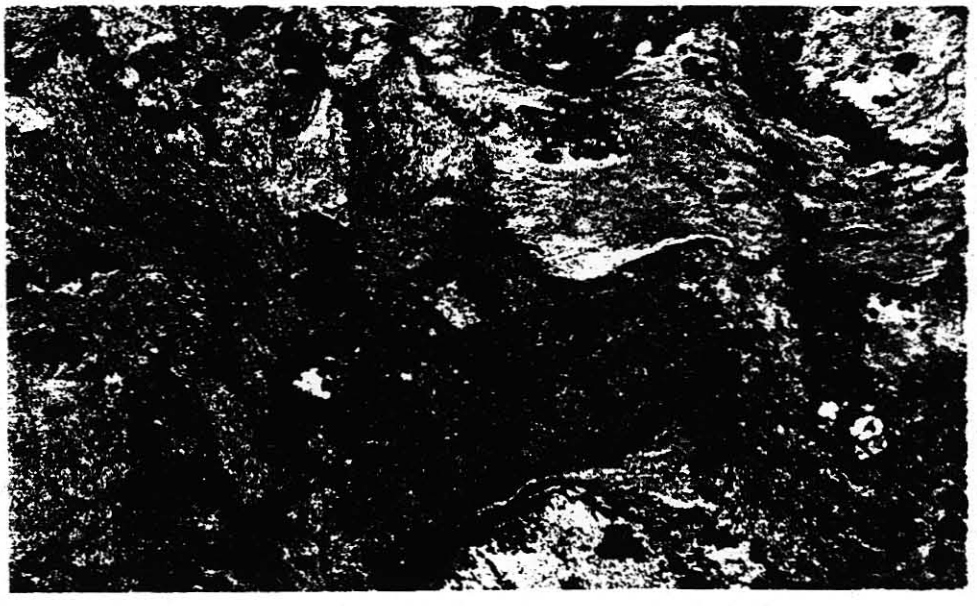

Figure 9: Tube pumice preserved in MAC22. XPL, Mag. x10.

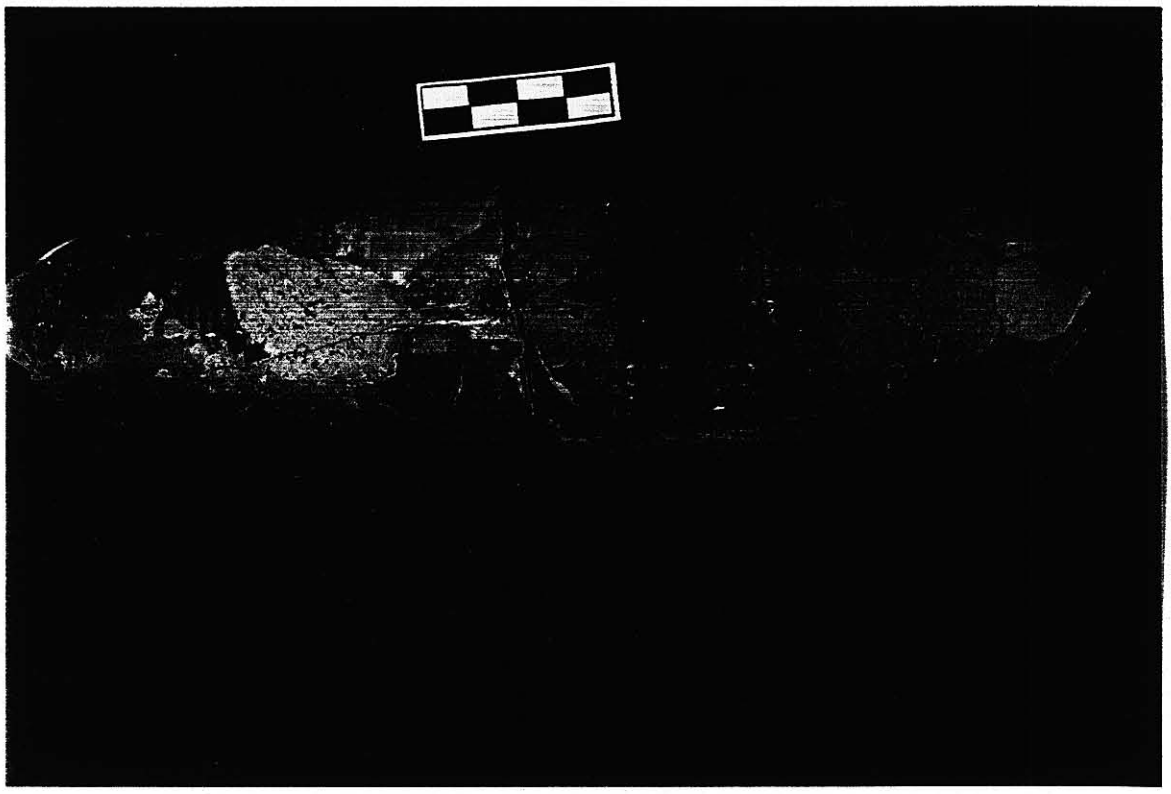

Figure 2: Basal breccia of Upper Rhyolitic Sequence. Sample taken from HL62



Figure 3.4: Possible shard textures from HL62-02. PPL and XPL. Mag. x10

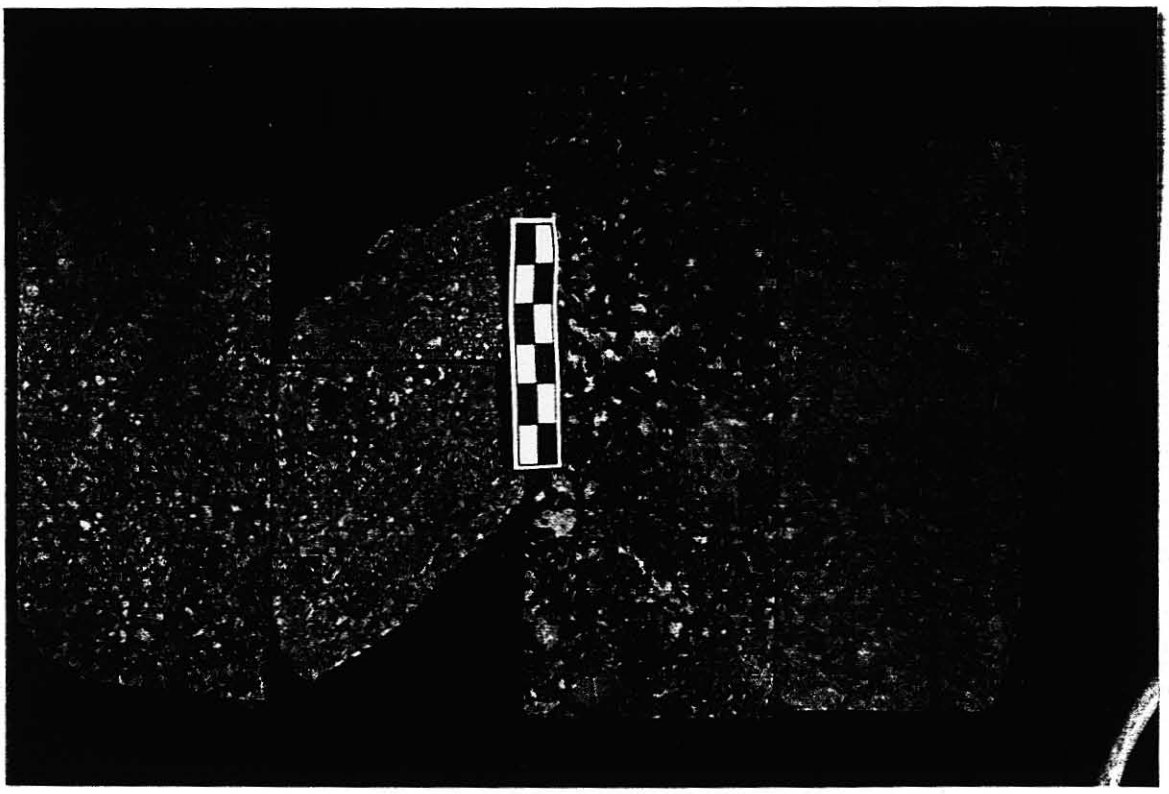

Figure 5: Pumiceous mud supported breccia samples. Textures due to differing amounts of matrix and matrix alteration are illustrated. Samples from HL62

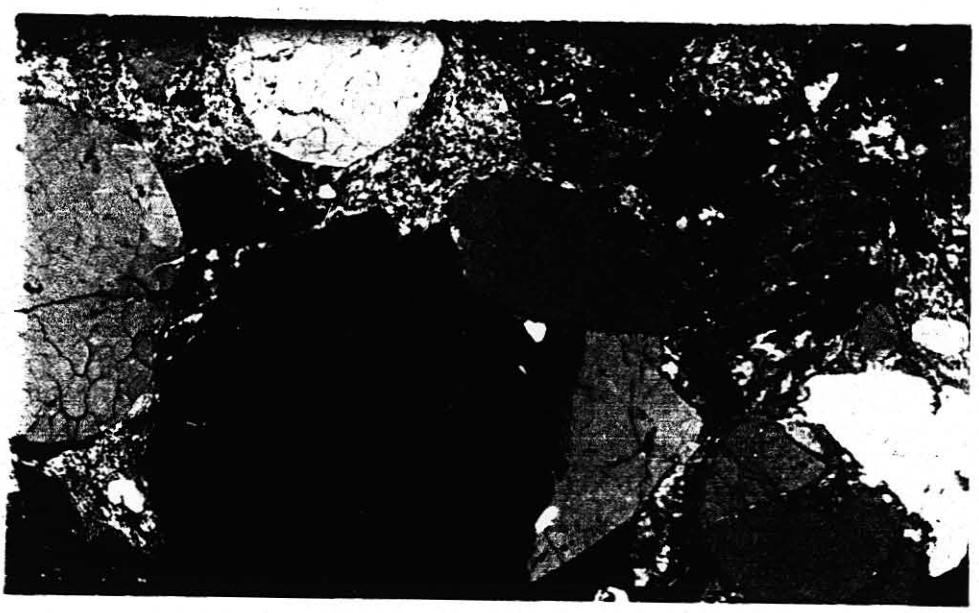

Figure 6: Fractured quartz xenocrysts from HL40. XPL, Mag. x10.



Figure 10: Psuedo-eutaxitic textures from MAC22.

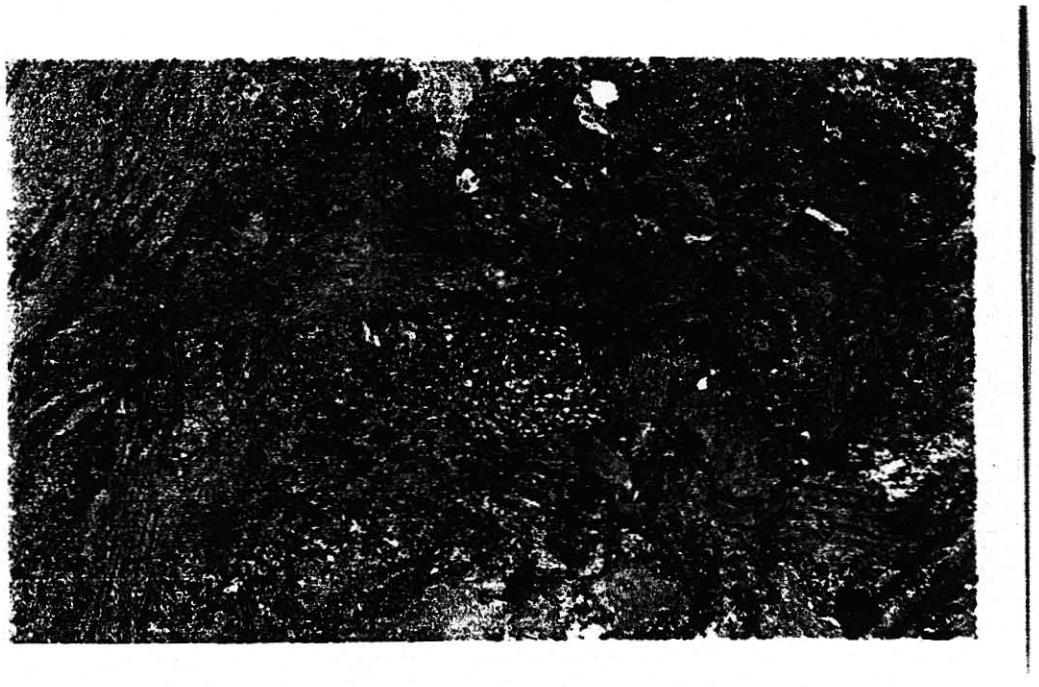

Figure 11: Tube pumice preserved in MAC22. XPL, Mag. x10.

APPENDIX 4

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12/22/90

Exploration Research in the Mt Read Volcanics, Tasmania

R.W. Henley

Summary

Re-evaluation of data related to the Mt Charter exploration problem has prompted the following recommendations and action.

Recommendation to develop a comprehensive compilation of reports, papers and data for the the Mackintosh district

Recommendation that a more complex structural architecture may occur in the Mackintosh district than previously recognized. A pilot study is proceeding in January to examine this and its exploration implications.

Recommendation that lithogeochemistry may be useful in enhancing the search radii of deep exploration drillholes in the Mackintosh district. This has led to a pilot programme of whole rock strontium isotope analysis designed to detect any halo and or vector property of strontium isotopes with respect to VMS-style mineralisation. Emphasis is also recommended on completion of a whole rock geochemical database from available reports and publications - this is proceeding with Andrew MacNeil.

Results of the Strontium Isotope study will be provided separately. Further evaluation of the Mt Charter problem and the development of the geochemical database are continuing.

Introduction

The initial problem posed by Aberfoyle is as follows:

- *Given that barite mineralisation* at Mt Charter has similarities to VMS deposits elsewhere in the district, that it occurs above the stratigraphic level of the Hellyer and Que River deposits and that no significant mineralisation has been encountered by drilling to date, is it possible and demonstrable that it is representative of a either a remobilisation event from some more deeply buried VMS style deposit or is related to a stacked massive sulphide sequence?

Consideration of this problem has required review of existing isotope data, geochemistry and geology of the district and allowed redefinition of the problem in terms of wider ranging exploration-related research in the district. In this report, a number of avenues of exploration related research are discussed including aspects of structural interpretation, lithogeochemistry and isotope geology. *A specific programme* of strontium isotope and trace element geochemistry has also been implemented in regard to the use of these techniques in future deep exploration drilling in the Mt Read *Volcanic Belt.*

The above prompted a very useful seminar and discussion at Hellyer on November 7th. Following an underground visit to Hellyer, I provided a talk on the structure of volcanic belts based on case histories at Buchans, Aberfoyle's exploration at Bimurra(N.E. Queensland) and some recent evaluation of the structural architecture of the Taupo Volcanic Zone (New Zealand) which I am currently undertaking. The latter, previously ascribed a simple graben structure, now appears to be a divergent fault array comprising a number of basins between two major transcurrent faults (Abstract attached). *Discussion after the talk provided an* overview of the excellent isopach mapping which is on-going at Hellyer itself and the interesting "unfolding" of the complex Que River structure currently being undertaken by Ed Dronseika . Both studies suggest that the essential localisation and ponding of sea floor VMS bodies may have occurred in transtensional strike slip basins rather than in simple extensional basins. I am grateful to the staff at Hellyer and Que River who interacted in this way.

As the review progressed the assistance of Andrew MacNeil and Dave Wallace has been invaluable in resurrecting a number of older reports on the district. *This has highlighted one possible* information problem, common to a number of exploration activities, as to whether Aberfoyle has a comprehensive data base of in-house reports, papers, maps and documents for this or other

districts? The question prompts the recommendation that completion of this information base should be a priority in respect of future review of data and integration with deep drilling exploration programmes in the district.

Overview

Discussion with Aberfoyle geologists has suggested that geophysics and drilling have essentially sterilised the district to about 200 meters depth apart from areas close to major power lines. Any research program relating to future exploration should therefore focus on techniques which may enhance the information recovery and search radius of deep drillholes.

The inter-related information bases required for evaluating exploration non-geophysical exploration tools below 200 metres are as follows and presume that deep drilling on geophysical targets will provide samples suitable for isotopic and geochemical analysis.

- Detailed geological structure of the district
- Recognition of chemical or isotopic vectors
- Systematics of post -VMS isotope and geochemical remobilisation

This report provides discussion of some of the key geological and geochemical information which will be required to aid deep exploration in the Mount Read volcanic belt.

Geological Structure

The structural geology of the Mackintosh region has recently been reviewed on the broad regional scale (Rattenbury, 1990). This review provided a broad scale NNW-SSE balanced cross section and an interpretation of the Henty and Mount Charter Faults as primary listric normal faults governing sedimentation in the Dundas Group. Devonian compression along this axis is believed to have reactivated these structures as reverse faults. In this regional scale work the possibility of local thrusting is not admitted although not explicitly excluded. The synoptic view which is gaining acceptance is that VMS mineralisation is localised by syn-depositional faulting within a series of basins and implicit in this view are acceptance of a simple extensional basin morphology and assumptions regarding the style and role of the

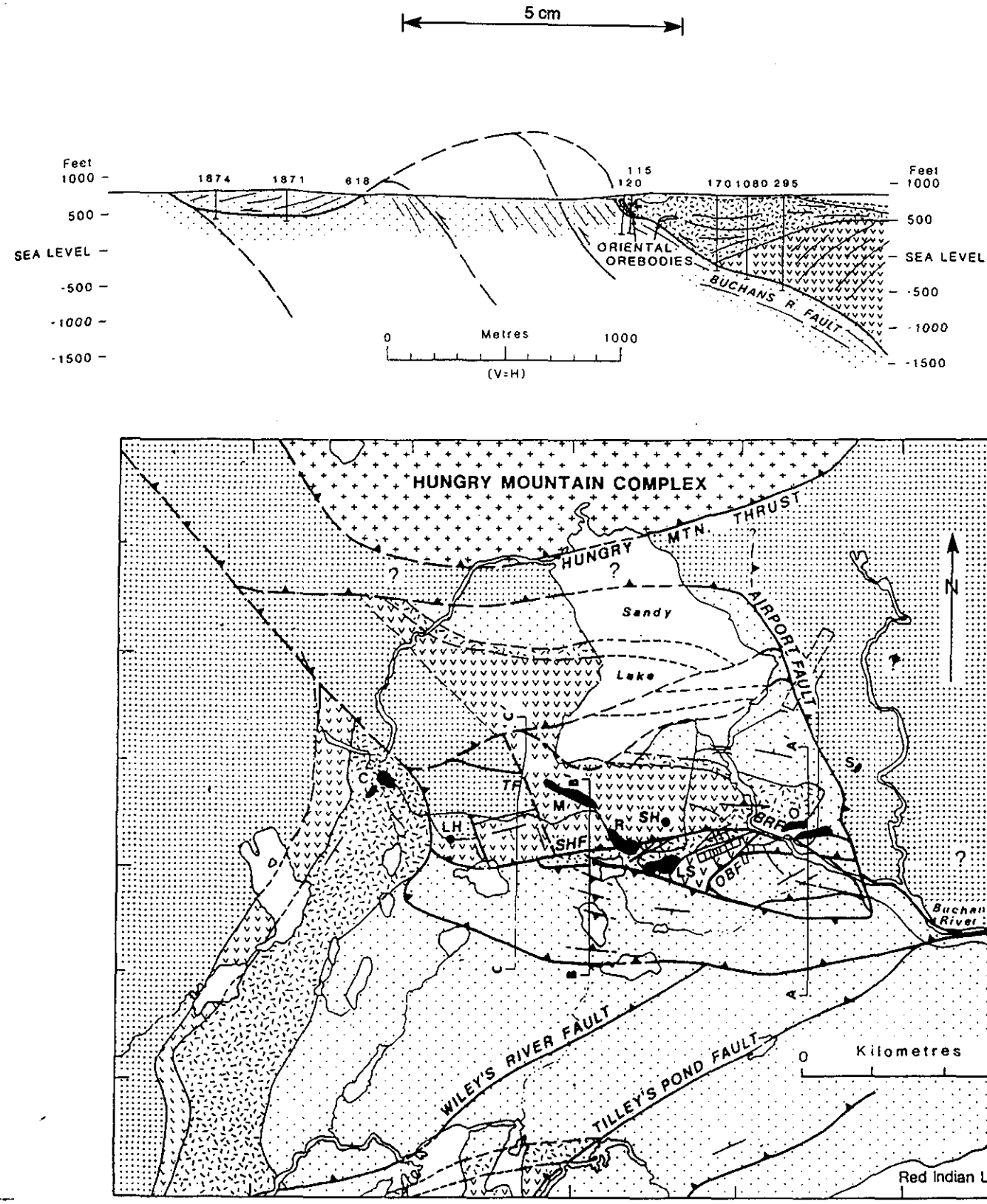

Figure 1. Structural relations in the Buchans district, Newfoundland (from Kirkham, 1987). In 1975 a simple layer cake stratigraphy without significant faulting was assumed for the area, subsequent work has also shown that parts of the stratigraphy were incorrect.

Charter and other prominent faults at the time of deposition. One problem (which has also been highlighted in Rattenbury's report) is that rapidly varying facies and thickness of different units make reliable development of balanced cross sections unlikely. An additional problem applies when significant wrench faulting occurs; provided sufficient geological control is available this can be handled by modern software for balancing sections. However this possibility has not been addressed by Rattenbury despite the *recognition of several kilometers of post-Devonian strike slip* displacement.

The significant changes which occurred with respect to structural interpretation and development of exploration opportunities in the Buchans district suggests that re-evaluation of the detailed structure of the Que River-Hellyer district is warranted as a prelude to any programme of deeper exploration. While a simplistic structural picture was assumed for the Buchans VMS deposit in Newfoundland in the mid-1970's, recent studies have now resolved a number of the structural paradoxes and are believed to have resulted in definition of new target areas, particularly through the major revision of the stratigraphy which resulted(Kirkham, 1987, Thurlow, 1988). Figure 1 compares the interpretations of the structural framework and stratigraphy at Buchans in1975 and 1988. If there are any intraformational thrusts at Hellyer - Que River there may likewise be implications for exploration.

On the 200 km^2 scale, maps of the region are structurally dominated by the Rosebery and Henty Faults. Devonian compression has developed fold and thrust structures which have strongly influenced the evaluation of the Cambrian structural setting, however it is possible that these major fault systems are reactivated from an earlier strike slip system whose architecture controlled the development of strike slip or pull apart basins and localised VMS deposition.

This suggestion may be evaluated through a review of existing magnetic, gravity and satellite imagery on this scale. Exploration implications would include recognition of a possible (*fractal ?*) spacing relationship between centers of mineralisation controlled by the architecture of the fault arrays .

Aberfoyle maps of the district show an apparent structural repetition of parts of the stratigraphy: this is most prominent in the Upper Rhyolite Sequence, north-east of Hellyer. Examination of Mount Charter core showed that structural breaks may occur on the contacts in 4 out of 5 holes and this permits that thrusting may be more common than previously considered in

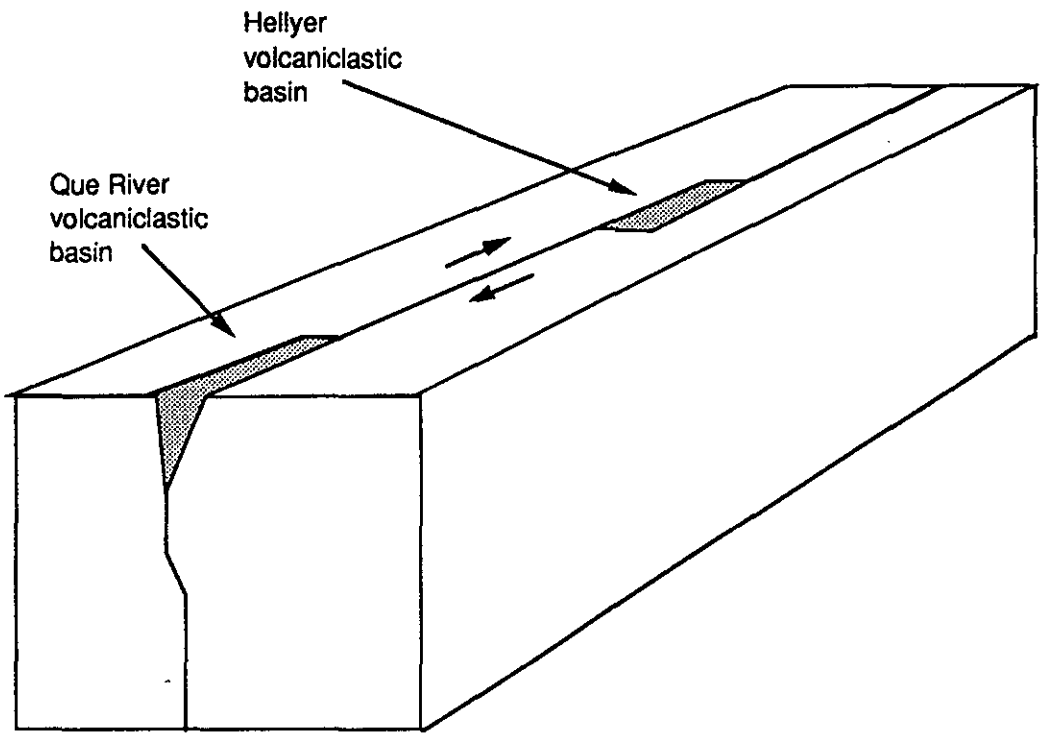

Figure 2. Simplistic and speculative schema for the possible controls on depositional basins in the Mackintosh district along a strike slip fault system. Volcaniclastics and sediments provide the basin fill and overlap the surrounding terrane. Extrsive domes and/or VMS deposits follow similar controls. Fault reactivation may be responsible for the post mineral Jack Fault at Hellyer and deformation at Que River. Note that no attempt has been made to consider the sense of movement or geometry of the control structure. Not to scale.

Interpreting sub-surface structure. An additional factor which has influenced interpretation of the original structure of the district has been the **hidden assumption of a relatively flat-lying layer cake stratigraphy.** In any proximal volcanic sequence this is always a dangerous assumption. At Mount Charter extreme paleo-topography occurred adjacent to the Mount Charter dacite dome, itself possibly localised by deep faulting and localising the accumulation of epiclastics with both rapid thickness and facies variations.

Figure 2 provides a speculative picture of the deposit settings in the Que-Hellyer district based on a presumed dominance of strike slip faulting. Isopach mapping at Hellyer and reconstruction of the pre-folding setting of Que River both suggest that strike slip basins may have controlled accumulation of volcaniclastics, 'ponding ' of VMS deposits and perhaps overall localisation of the deposits. **Reactivation** of strike slip faults in the basement may be responsible for the faulting superimposed on Hellyer(Jack Fault) and the deformation at Que River.

There are a number of major differences between the GST 1:25000 regional mapping and the detailed Aberfoyle 1:10000 mapping of the Que River - Hellyer district. Aberfoyle 1:10000 cross sections show little structural information and assume no structural discontinuity or intraformational thrusting and a simplistic formation geometry.

This of course allows imagination to run riot as follows (and I claim no special structural expertise in making these suggestions!):

I question whether the sedimentary-volcanic sequence is more internally deformed than generally accredited, whether this sequence, including the known deposits, is part of an imbricate thrust stack above a more extensive detachment and whether on a larger scale the district has evolved during Devonian compression by reactivation of a pre-existing strike-slip fault array closely related to the Henty Fault Zone. At this stage further work would require close interaction with geologists familiar with the detailed mapping of the district and careful relogging of core for discontinuities. Implications of this structural setting for exploration are the possible thrusting of Que River shale over ore horizon volcanics to the west of the Que River-Hellyer axis and displacement of ore sequences due to thrusting. **Figure 3 is a <u>totally speculative</u> cross section based on the above.**

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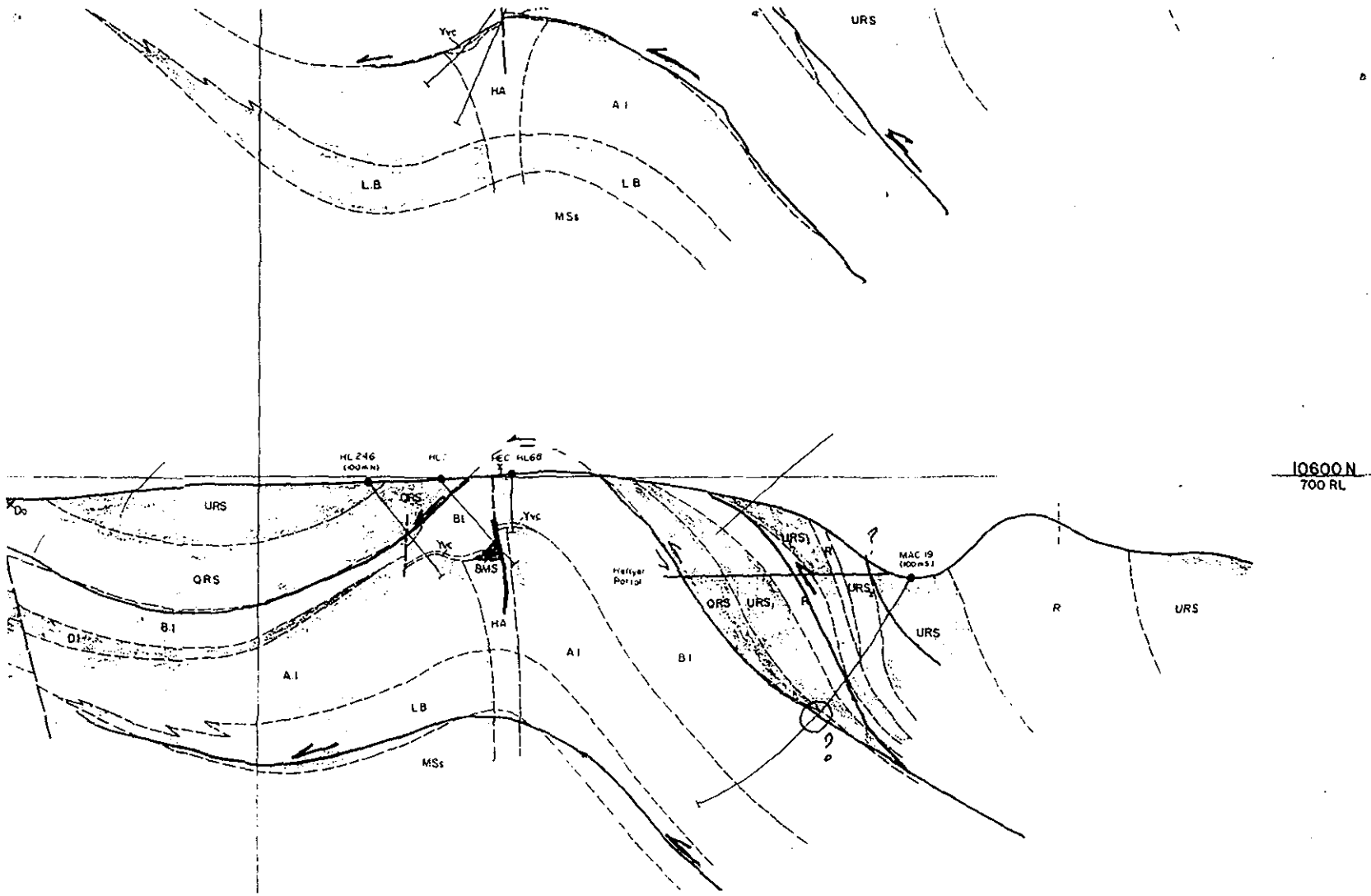


Figure 3. Cross section 10600N from Aberfoyle mapping showing the possible presence of intraformational thrusting and stratigraphic repetitions. Note that volcaniclastic facies and thickness variations also need to be added to the structural cross sections

Lithogeochemistry in deep exploration

Critical to maximising the information return from deep drilling on geophysical anomalies is the ability to recognize lithologies and to correlate with established stratigraphy to develop a structural and geochemical picture of the anomaly. Since deep diamond drilling is costly it is sometimes advantageous to use lower cost RC drilling for initial exploration but this reduces the return on geological data particularly where textural information is required for correlation. In such programmes some of this otherwise lost lithological and alteration information can be retrieved by whole rock geochemical analysis. The practicality of this is now high and cost effective through the development of reliable low cost ICP whole rock analysis and, through PC based storage and data analysis, the ability to develop more rapid data interpretation methods.

In the Que River- Hellyer district this approach will require compilation of a lithogeochemical database for the whole range of lithologies present and recognition of the effects of alteration due to mineralization and any later events - through studies of VMS mineralization in the district the latter is well advanced through Pb-isotope data (Gemmell, 1990).

Andrew MacNeil and I have been working on the format for a geochemical data base and he has been accummulating available data. There are two routes through which to use these data; use of established petrochemical routines to produce comparative triangular or variation diagrams or use of free format 'exploratory data analysis incorporating statistical routines. The latter is likely to be most useful in analyzing trace element and alteration data and is a relatively new technique available through desktop computers. The discussion below on the strontium geochemistry uses the latter to partition and to analyze data from Jack(1979) for an alteration profile across Hellyer.

Alteration studies have been completed on Que River, Hellyer and Mount Charter(e.g. Bruce Gemmell: Reports to Aberfoyle on the Hellyer Stringer Zone Project, Theses by D. Jack, 1989, S. Rand, 1988). These focus on major element and mineralogical variations.

Less well advanced in the district is the recognition of chemical or isotopic vectors which may expand the drilling target. Most isotope approaches to date have been focussed on attempts to

recognize unique isotopic signatures which may confirm the presence of mineralisation in the district but which have no vector properties (Miscellaneous CSIRO Reports). I have not examined recently acquired ^{18}O data but I understand that neither this nor some of the trace element methods attempted to date have proved very useful; the haloes apparently are at mine scale only. Bruce Gemmell kindly provided ^{18}O data received to date and this shows some depletion by about 2 permil in the alteration stringer zone but otherwise no strong vector pattern at the larger scale. This is perhaps paradoxical in view of the extent of mappable alteration in the district although the greater abundance of oxygen relative to other elements used in isotope analysis leads to a smoothing out of alteration effects. In part this may relate to the common choice of East-West cross-sections to represent the ore environment when the trend of the district, including the Hellyer ore body, is structurally controlled(see above) and more south-south west oriented.

One technique that has not been tested is the use of **whole rock strontium isotope ratios and strontium concentrations** both of which were shown in a single Kuroko study(Farrell and Holland, 1983) to have vector properties at the scale of 1 km. Figure 4 shows their isotope data which suggested that Sr itself was depleted in a similar pattern by a factor of about 10 to 20 - their data set contains one outlier Sr concentration value which suggests that Sr on its own may be difficult to use.

The systematics behind this behaviour relate to the loss of Sr largely from primary sites in silicates as alteration proceeds during through-flow of high temperature seawater, itself modified by rock alteration deeper in the system. Strontium may be partially retained in the alteration system by coprecipitation with calcium and barium minerals and, to a lesser extent adsorbed onto alteration clays. These reactions lead to a resetting of the whole rock Sr-isotope ratio to values between that of the modified convecting sea-water and the primary whole rock ratio. In this way Sr and its isotopes provide a monitor of the cumulative water-rock ratio which is less sensitive to temperature than parallel oxygen isotope ratio variations.

Jack(1989) has tabulated a wide range of geochemical data for hanging wall and footwall rocks at Hellyer over an east west sample interval of about 1500 metres. His data analysis focussed on variation of the major elements and alteration indices but provided little discussion of trace element patterns. Strontium data are shown in Figure 5. Strontium depletion in the stringer zone by a factor of at least five with respect to less altered

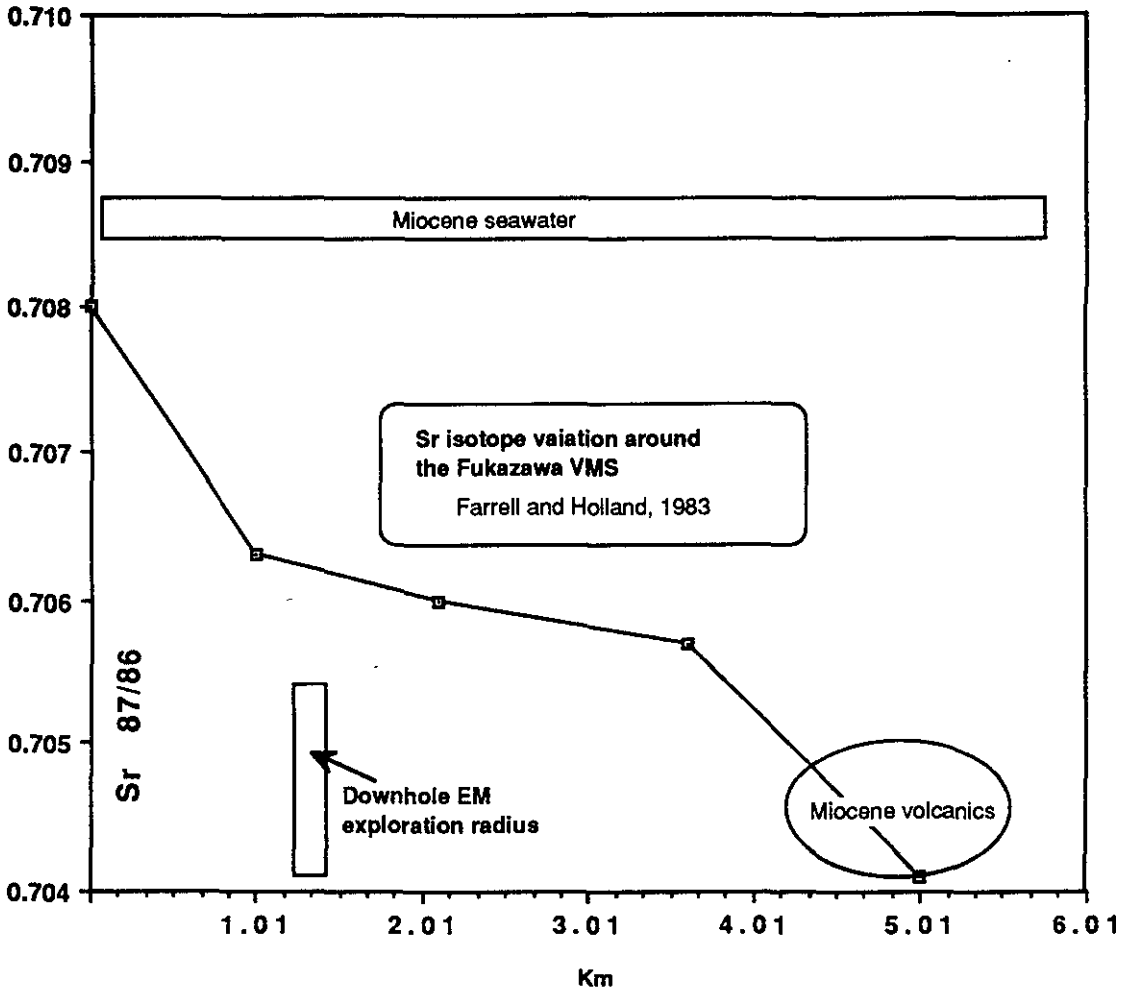
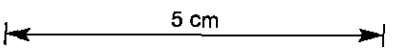


Figure 4. *Spatial variation of Sr isotope ratio around the Fukazawa VMS deposit in Japan. The exploration radius for downhole EM is shown in comparison with the Fukazawa Sr isotope halo. In the Mount Read Belt a similar strontium isotope variation is expected around the VMS deposits due to exchange with modified seawater in the convection cell; the Sr isotope ratio for Cambrian seawater is similar to that in the Miocene. The precision of the Sr ratio data is ± 0.00007.*



andesites is quite clear from the sample plots. A similar difference in barium contents is also observed but this is weakly inverse with respect to strontium and shows a much wider range due to barite precipitation as discrete veins within the alteration profile. On an east-west section these data show a strontium depletion over at least 600 metres.

Based on the available chemical and isotope data a pilot Sr isotope study of the ore sequence in the Mackintosh district has been initiated to evaluate its potential to provide a vector useful in deep exploration. A selection of 13 core samples from profiles through Hellyer - Que River has been collected for this study. The background petrography has been detailed by Gemmell(1990) for this sample suite. Results of this study will be reported separately.

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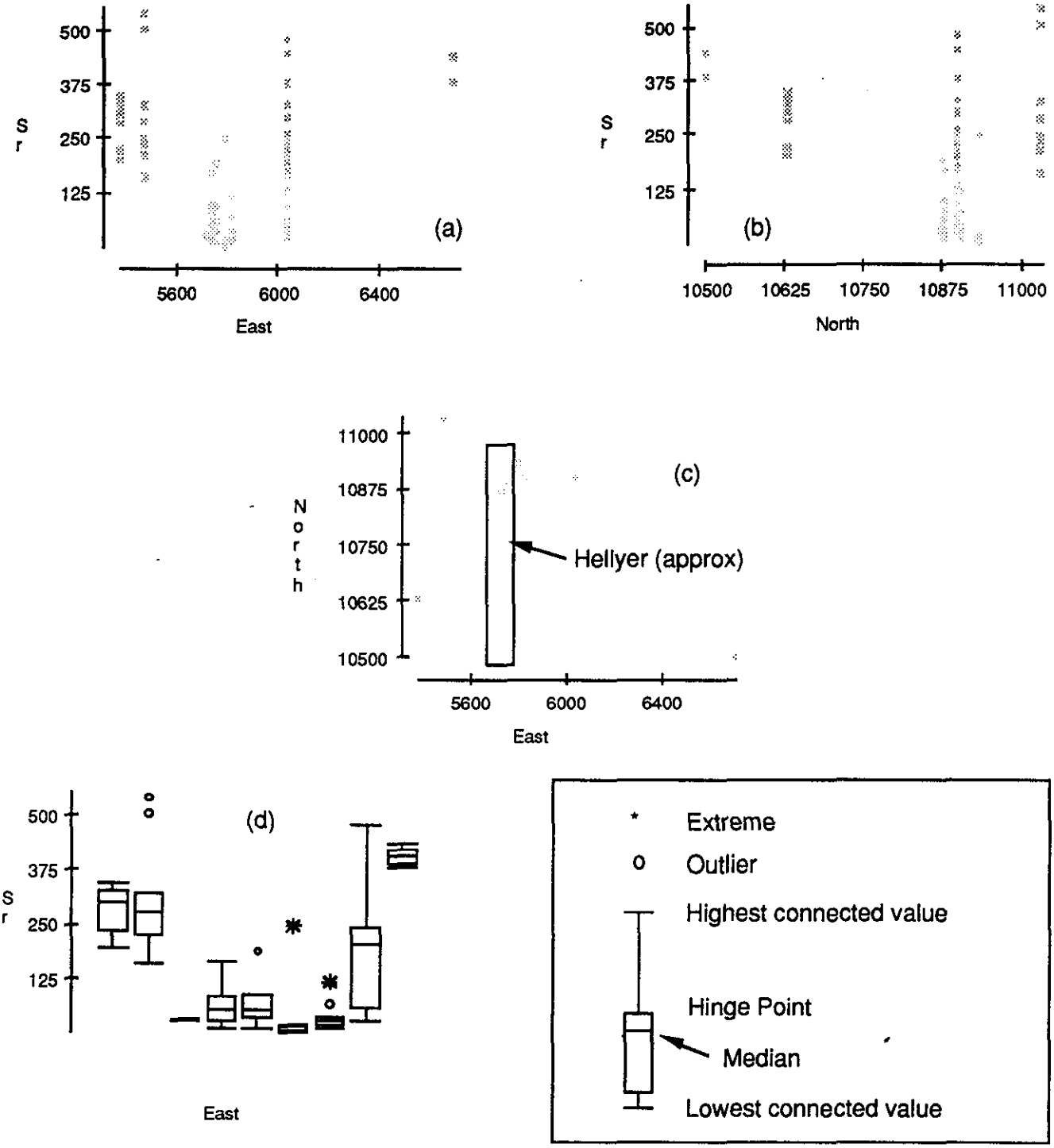

Figure 5. Variation of total strontium(ppm) in drillcore samples in the Hellyer district. (Data from Jack, 1989). The central figure (c) shows the location of drillholes and figures (a) and (b) show the full range of strontium data for drillholes projected onto east-west and north-south planes respectively. Figures (d) and (e) show the median and range of these data using box and whisker plots see below.

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TECTONIC CONTROLS ON VOLCANISM AND ACTIVE EPITHERMAL GOLD MINERALISATION IN THE TAUPO VOLCANIC ZONE, NEW ZEALAND.

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Despite extensive exploration for geothermal energy, the structural architecture of the Taupo Volcanic Zone is poorly understood. It has been generally believed that the Taupo Volcanic Zone comprises a relatively simple series of north-easterly trending normal faults and associated graben developed in response to back-arc extension during the last 2.1 Ma. A number of calderas and rhyolite dome fields have also been recognized and the extensive Holocene ashflow volcanism of the Taupo Volcanic Zone has been described in detail.

High resolution SPOT satellite imagery shows that in addition to the young north-easterly fault array a series of north striking lineaments of regional extent transect the Taupo Volcanic Zone . Assuming these northerly lineaments to be faults, the structural pattern they define suggests that the Taupo Volcanic Zone developed initially as a subsidence basin between the diverging right slip Hauraki Rift in the west and the Kaingaroa Fault - North Island Shear Belt in the east. A number of internal fault geometries are possible; one of these suggests that the location of the major rhyolite dome fields is controlled by divergent splays such as the Paeroa Fault which were reactivated or were developed *subsequently* along the fault array.

Hydrothermal activity occurs throughout the Taupo Volcanic Zone in response to the regional high heat flow, however the geochemistry of individual systems reflect a spatial control. The high gas, precious metal depositing systems are colinear and sub-parallel to the south-eastern margin of the Taupo Volcanic Zone. These systems are believed to be located on structures which penetrate deep below the volcanic basement and which may also localise andesite magmatism. Rotation of fault bound blocks developed within the original basin leads to dilation of earlier structures, linkage of fluid reservoirs and focussing of hydrothermal upflow and may, in equivalent older terranes, be responsible for the development of spectacular 'bonanza' gold vein deposits.

Recognition of the tectonic controls on magmatism and hydrothermal activity in an active volcanic belt provides a basis for evaluating controls on precious and base metal mineralisation in older volcanic terranes such as the Drummond Basin, N.E.Queensland, the 'Walker Lane' , Nevada and the well known VMS districts, and in turn provides a basis for defining deep exploration plays for high grade deposits.

APPENDIX 5

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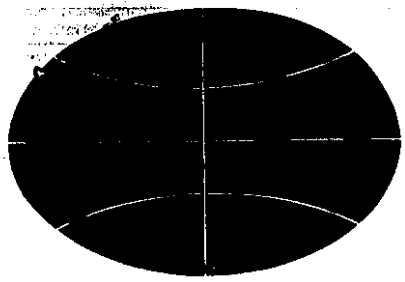

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Richard W. Henley
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Exploration Research in the Mt Read Volcanics, Tasmania

Lithochemistry in the Exploration of the Que River-Hellyer district

II. Rb-Sr Isotope Data and Alteration Geochemistry

R.W. Henley

February 1, 1991

Summary

The results of this pilot study suggest that rubidium/strontium isotope ratios preserved in altered footwall volcanics at Hellyer relate directly to the throughflow of primary ore transport fluid.

Since the Rb/Sr isotope ratio is directly related to the concentration ratio of these elements, rubidium and the Rb/Sr concentration ratio may be used directly as first order whole rock lithochemical parameters to map alteration and vector the centre of a VMS hydrothermal alteration system in the 200 to 2000m distance range. Use of the vector to increase the search radius of an exploration drillhole array requires application of an alteration index 'filter' to counter heterogenous alteration in rocks at this distance.

The above is based on a limited data set and some additional whole rock geochemistry from within the stringer zone, proximal to the Hellyer deposit. The study is to be extended to assess variability of Rb and Sr downhole in distal parts of the alteration zone at Hellyer and will also be trialed at Mount Charter within the altered dacite sequence for which geochemical data are currently limited; intersections are currently too few to permit use of the Rb vector in the 'ore sequence'. Further studies may be warranted in the hanging wall sequence above the Helyer deposit.

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Introduction

Apart from zonation **patterns**, the use of alteration geochemistry as a **vector** in exploration depends on the identification of an element(or set of elements) or isotope which distinguishes between concentration changes due to the environment of formation of the deposit and primary concentrations in the host rocks. It also depends on the assumption that alteration geochemistry varies systematically around an ore body.

Farrell and Holland(1983) suggested that both the Sr isotope ratio and Sr concentrations varied systematically with distance around the Japanese Fukazawa volcanogenic massive sulphide deposit. The pattern found in their limited data set could be readily related to alteration due to seawater -rock reaction during the formation of the deposit. This pattern suggested that;

- strontium isotope ratios decreased progressively over 5 kilometres away from the deposit
- strontium isotopes, which were directly related to the fluid present during ore formation, might be useful as a vector for exploration.

As part of an analysis of the Hellyer district in relation to the applications of geochemistry during a deep exploration programme (Henley, 1990), it was suggested that this isotope vectoring method was worth a limited investigation. This report describes the results of a pilot study and their interpretation.

Sampling and Analysis

Recent detailed alteration studies of the altered footwall andesites and dacites at Hellyer (Jack, 1989, Gemmell, 1989, 1990) provided the essential springboard to this study as well as the opportunity to cross check strontium isotope systematics for the deposit with the results of other techniques. Samples were taken from a drill hole cross section previously described by Jack(1989) and Gemmell (1990) together with a small number of additional samples suggested by Gemmell.

Sample locations are shown in plan and cros section in Figures 1 and 2.

Whole rock Sr isotope data were obtained under contract from DSIR Physical Sciences in New Zealand together with Sr and Rb concentration data obtained by XRF analysis at the Victoria University of Wellington. These data are provided in Table 1 together with whole rock geochemical data.

Interpretation

Geochronology

Figure 3 is a standard Rb-Sr isotope isochron plot. Most of the data for the Hellyer district closely fit to a 387 Ma isochron whereas, as demonstrated below, these data also reflect alteration during the Cambrian (~500 Ma) volcanic event which led to the formation of VMS deposits in the district. Three of the thirteen data are not on the Devonian isochron and reflect a larger radiogenic Sr component. These show no unique relations with respect to rock type or proximity to ore. They are assumed here to represent incomplete isotopic reequilibration within this heterogenous altered rock suite.

Alteration

Gemmell(1990) applied an alteration index to whole rock geochemical data as a means of quantifying the alteration intensity of each sample relative to exchange of alkali and alkali earth metals. The index applied,

$$\frac{K_2O + MgO}{K_2O + Na_2O + CaO + MgO}$$

increases with alteration from values of 36 in unaltered andesite to 91 in the core of the Hellyer deposit. This index operates effectively because of the general pattern of leaching of Na_2O and CaO during VMS alteration and addition of K_2O. Interelement correlation coefficients (Table 2) reflect these exchange processes.

The alteration index data for the strontium isotope sample suite are, with the exception of MAC15-106, low and indicative of weak alteration. MAC15-106 has the highest value but is distal relative to the Hellyer deposit.

Sr Isotopes and Geochemistry. As noted above the majority of the data fit to a single 387 Ma isochron indicating Devonian resetting. In order to retrieve the original Sr isotope profile from these data standard recalculation procedures have been applied based on an assumed formation date for the Hellyer deposit of 500 Ma. These recalculated data are shown as a function of distance from the Hellyer massive sulphide deposit in Figure 4a.

It is apparent from Figure 4a that an Sr isotope halo occurs around the Hellyer deposit similar in scale to that observed around the Fukazawa Kuroko-style VMS deposit in Japan(Farrell and Holland, 1983). However variability of the calculated initial Sr isotope ratio within samples from

individual drillholes obscures the trend; a simple regression least squares correlation is shown but R^2 is too low to attach any real significance to it.

Rb/Sr isotope zoning. Rb/Sr isotope ratios readily distinguish altered and relatively unaltered rocks as defined by the Alteration Index . As noted by Gemmell primary values of this index for unaltered or weakly altered rocks are about 35.

With the exception of one altered footwall sample(L), these data show a weak correlation between Rb/Sr and Alteration index for both andesitic and felsic footwall rocks(Figure 5a). These data also define a **linear relation between Rb/Sr and distance from the Hellyer deposit** for altered rocks where the alteration index is greater than 40(Figure 5b) but less than values related to the intense stringer zone alteration(>55).

The same subset of data defined by AI>40 also show a stronger correlation with alteration index and distance for $Sr_{initial,\ 500}$ data(Figure 5 c and d) and indicate a depletion halo up to 2km in extent from the deposit.

Rb and Sr concentrations. The subset of more altered samples (AI>40) also directly permit recognition of Rb and Sr depletion haloes of 2km extent around the Hellyer deposit. As shown in Figure 6a, Sr concentrations are variable across the profile. Rubidium by contrast shows a systematic pattern consistent with alkali leaching and alteration(Figure 6c and d) and is far less variable than potassium(Figure 6 e and f) with respect to distance and alteration index(In the stringer zone itself rubidium correlates directly with potassium at the 96% level).

Rb/Sr concentration ratios are directly related to their isotopic ratio* and therefore plot in a similar fashion(Figure 7a) again reflecting the dominance of potassium mass transfer during alteration and progressive increase in the number of available Rb exchange sites in sericite. This observation suggests that alteration mapping may proceed through the use of Rb/Sr concentration ratios using an alteration index filter to counter heterogenous alteration of host rocks in the distal parts of the alteration zone.

Figure 7b shows the variation of Rb/Sr downhole in drillhole HL306 which is *proximal* to the feeder zone of the ore body(data of Gemmell,1989). In this hole Rb/Sr ranges from 0.1 to 5.6 compared to a maximum of 2.27 in the proximal data set reported in Table 1. Similarly

* $^{87}Rb/^{86}Sr = (Rb/Sr)_{conc}\ [Ab^{87}Rb/Ab^{86}Sr\ ][WSr/WRb]$, where $^{87}Rb/^{86}Sr$ is the present day ratio as measured, $Ab^{87}Rb$ and $Ab^{86}Sr$ are the isotopic abundances of ^{87}Rb and ^{86}Sr respectively and WRb and WSr are the respective atomic weights. $Ab^{86}Sr$ and WSr are calculated for each sample.

alteration indices and potassium contents are higher in HL306 reflecting the intensity of sericitic alteration.

These data, coupled with the alteration profile data, suggest that Rb and Rb/Sr may be non-linear steepening toward the core of the deposit and flattening on the outer margin of any given profile toward values for primary rocks. The relatively linear part of this curve is the region of interest in this study in defining a geochemical exploration vector in the distance range of 0.2 to 2 kilometres.

Discussion

The subset of Hellyer data, filtered through the alteration index, define linear trends with respect to distance from the Hellyer deposit; the gradients of Rb and Sr are better defined than the alteration index alone. The diluting influence of primary whole rock ^{18}O in weakly altered host rocks, with respect to $\delta^{18}O$ in fluid, is likely to preclude the use of $\delta^{18}O$ as an alteration mapping tool in the district. Rb and Sr however appear to show much stronger contrast between primary and altered rocks.

The alteration trends described above may be explained as follows:

Sr. Primary Sr is selectively removed during alteration due to the leaching of calcium. Some exchange occurs on residual Ca sites and in alteration barite to provide a weak Sr halo around the deposit.

Rb. Fixation of potassium as clay-sericite during alteration leads to a systematic change of Rb concentrations (Note that the absolute Rb concentration however increases with distance from the deposit reflecting flushing out of components during wholesale alteration). Alteration sites available in the new assemblage exchange strongly with the bulk fluid.

Since Rb and Sr have been shown to selectively replace K and Ca** , it would be possible to argue that their isotope and concentration profiles were entirely generated during a Devonian resetting event with an ambient fluid selectively replacing K and Ca throughout the district. The uniformity of the above trends for the significantly altered rocks(AI>40) especially with respect to distance from the deposit is hard to accept if

** Table 2 explores the correlation between alkali and alkaline earth metals, the alteration index and initial strontium isotope data. Strontium isotope ratios have a strong negative correlation with K_2O. The correlations which are highlighted in Table 2 confirm that Rb-Sr isotope systematics are related directly to the primary alteration process in the district.

such a Devonian event were proposed. Rather these data, and the analogous data from the Fukazawa deposit(op.cit.) argue in favour of a Cambrian alteration signature being preserved through the Devonian metamorphic event.

It is therefore reasonable to infer from the above that Rb and the Rb/Sr concentration ratio, may be used as **exploration vectors** in conjunction with whole rock geochemical data. **The search radius provided by these geochemical and isotopic vectors is in the range 0.2 to 2km.**

The magnitude of the depletions observed is related to the cumulative fluid flow through the footwall. Since the mass of metal present in a deposit is itself related to the cumulative fluid flow rate(albeit in a complex fashion) the slope of the Rb/Sr, Rb and Sr concentration data against distance may itself provide an indication of proximity to a potentially viable deposit. **Alteration geochemical Rb/Sr data, for example, may potentially be used to locate possible trends at Mount Charter and to seek new drilling targets.**

Further interpretation of these data is not strictly warranted as directly related to exploration but will impact on the growing data base for ore formation controls in the district.

Water-rock ratios and basement interactions. Only a limited number of data are available for the primary Rb and Sr isotope composition of host rocks to the Hellyer deposit. Sr isotope ratios for primary volcanics fall in the range .7066 - .7086 in published data. The present data confirm suggest this range for least altered samples (AI<40) in the Hellyer footwall sequence are in the range .706 - .709. Data for basement rocks are of course few: Brooks(1966) gives values for granites from .7354 - .700 and the McIvors Hill Gabbro(518 Ma) has a ratio of .7132.

The primary Sr isotope composition of Upper Cambrian seawater is broadly known from global data but local variations may have been present in the marine environment of the Mount Read belt. The flow schema for a VMS style deposit involves fluid both from seawater directly and seawater modified by alteration reactions deeper in the volcanic pile and its basement. The isotope ratio of the latter relates to primary host rock values or of specific minerals preferentially undergoing alteration.

One way of deriving a local 'mean' for this mixture of fluids is from Sr isotope data for barite. Data for stratiform and vein barites (from miscellaneous CSIRO reports to Aberfoyle) are in the ranges .7130 - .7180 and .7100 - 7112 respectively. Both ranges are higher than the estimated Upper Cambrian seawater value of .7091 - .7096(e.g. Whitford et al., 1985).

An additional sample of a limestone clast from the Upper Rhyolite sequence has been sent for analysis to attempt to constrain the primary seawater Sr isotope ratio and to allow comparison with Sr isotope data for barites. This additional data may allow some estimate of the minimum fluid rock ratios involved in ore formation and comparison with genetic scenarios based on other techniques such as Pb isotopes(Gemmell, 1990)

Hydrology. Field mapping of alteration and the isotopic data reported above define a sub-sea floor hydrothermal alteration system of at least 4 km in extent transverse to the Que-Hellyer alteration corridor. There have been a number of models proposed to describe the hydrodynamics of such alteration systems and, through these, interpretations of, for example, leach source geometry for the ore metals and specific isotope data. Gemmell(1990), for example,utilises a popular focused convection schema and invokes progressive deepening of the convection system with time to account for singularities in the lead isotope

systematics. Models such as this implicitly assume a homogenous porous medium as host to the convection system. Field experience of active terrestrial hydrothermal systems however demonstrates that the permeability characteristics of the host are bimodal reflecting the intrinsic porosity of the host lithologies and the higher permeability fractures which dominate flow in the system particularly during any transient behaviour such as might be induced by fault movement.

Henley(1990) has suggested that the distribution of VMS deposits in the Hellyer district may be controlled by a transcurrent fault array and associated basement-linked faults which may be manifest in the volcanic cover sequence as pseudo-growth faults. This has two important implications; firstly the occurrence of transient tectonic events impacting on flow and secondly the provision of a connection to deeper fluid reservoirs. In turn this provides an alternative explanation for the isotopic data and for the transient formation of individual VMS deposits. The strontium isotope(and lead isotope data, Gemmell, 1990), for example, shows that the Hellyer deposit is characterised by relatively heavy Sr signature compared to host rock and ambient Cambrian seawater, whereas the bulk of the alteration is characterised by signatures reflecting progessive exchange between a seawater dominated fluid and volcanic lithologies. This is illustrated by Figure 8 which also highlights the various fluid reservoirs which may contribute to VMS formation. Note that the bulk of the alteration may be ascribed to relatively shallow seawater circulation whereas VMS formation relates to transient fault controlled fluid flow from a deeper more exchanged reservoir.

Further investigations

The data set for the pilot project described in this report is small. Follow up studies have been instituted as follows,

- Downhole variation of Rb and Sr concentrations in MAC 11 and MAC 19
- Rb, Sr analysis and whole rock analysis of sample suites from the Mount Charter prospect - note that only one hole intersects the possible interpreted ore horizon footwall to date
- Recompilation of Hellyer whole rock geochemical data(from Jack, 1989) and analysis of Rb, Sr alteration patterns.

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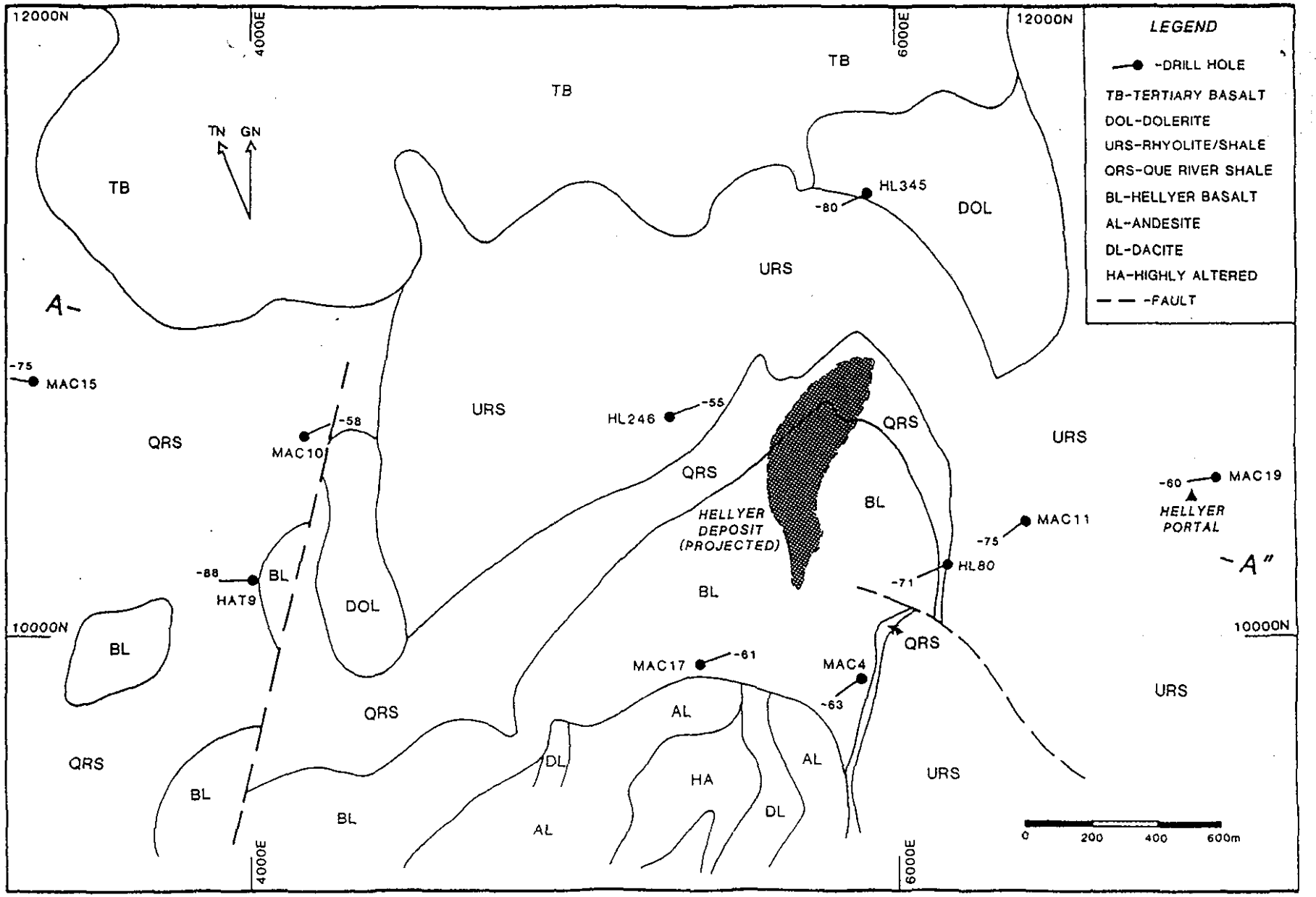

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Figure 1. Drillhole location and mapping data for the Hellyer district(from Gemmell, 1990)

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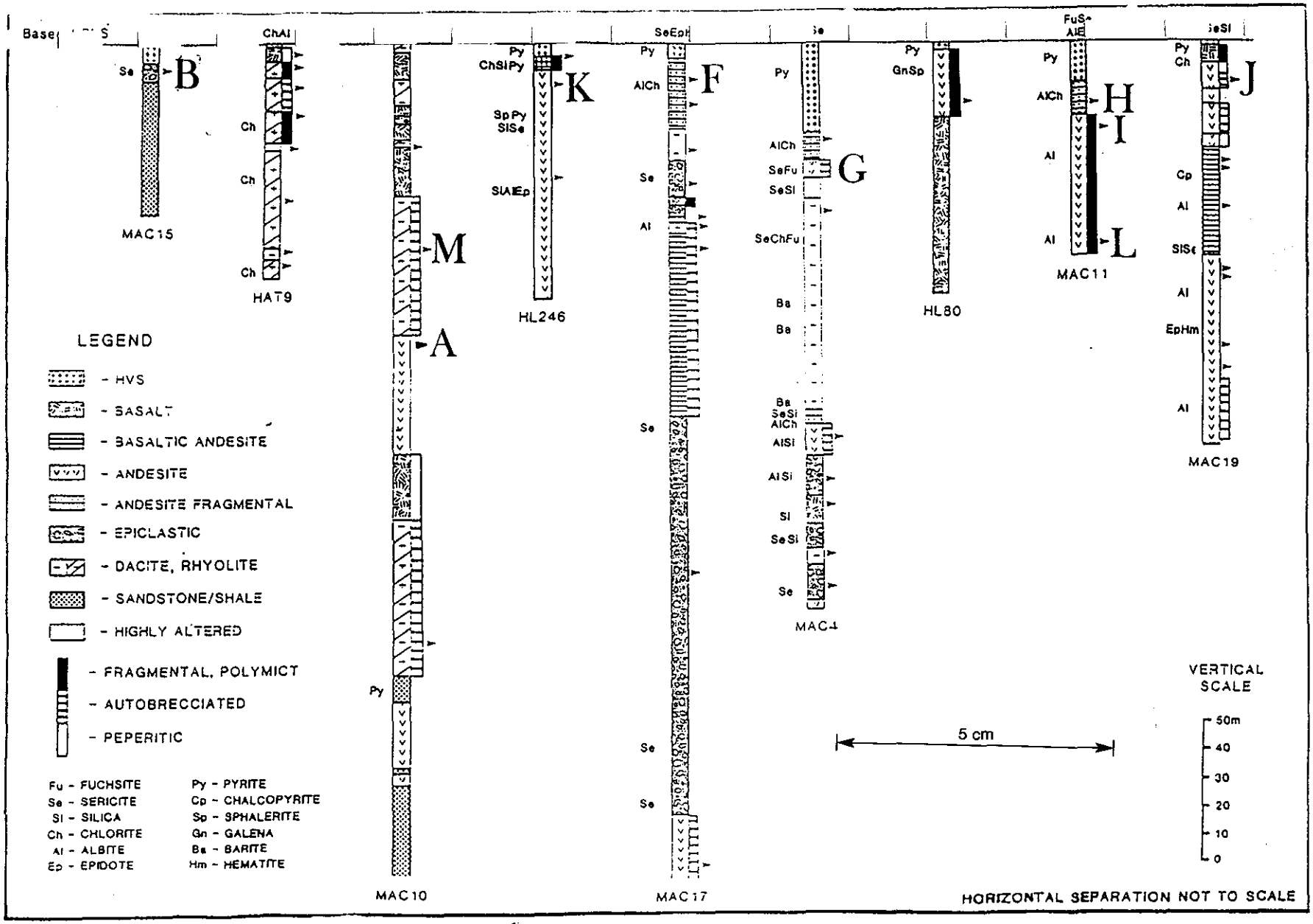

Figure 2. Location and petrographic data for samples analysed in this study(from Gemmell, 1990)

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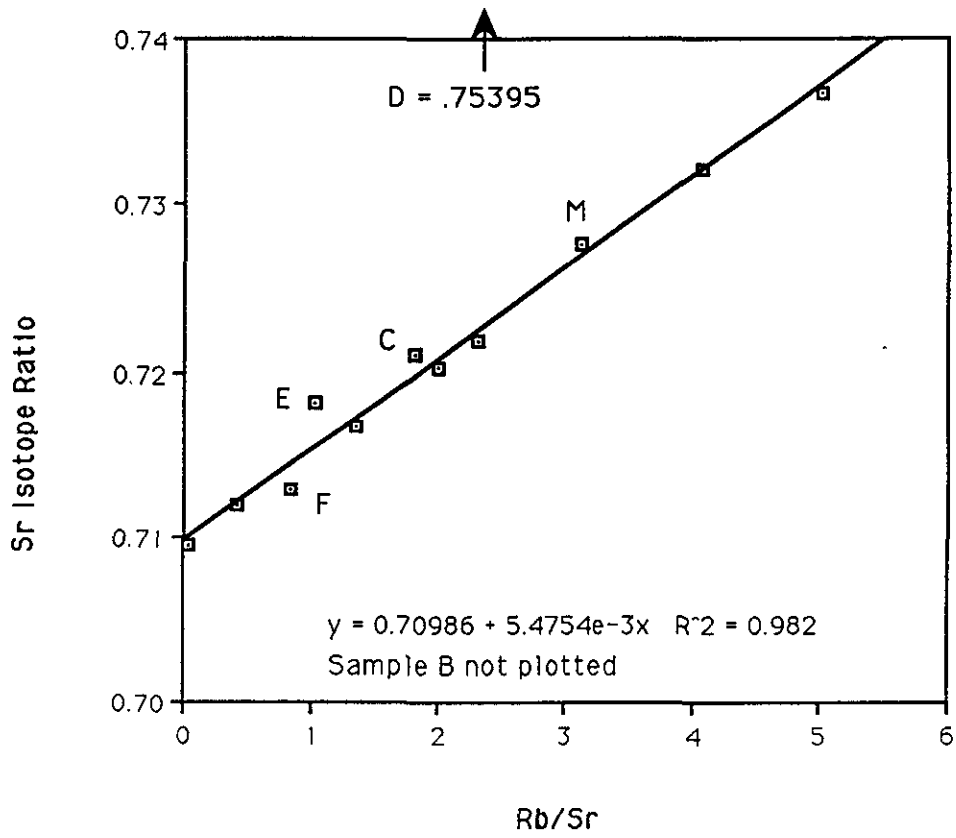
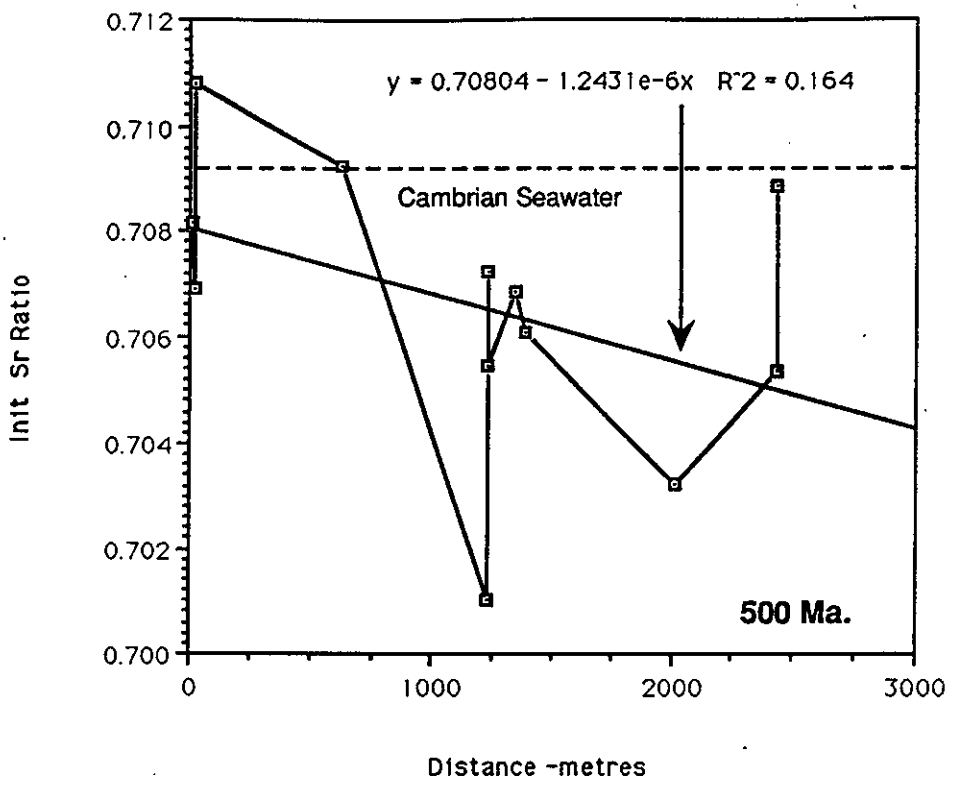


Figure 3. Standard Sr - Rb-Sr isochron plot for Hellyer samples; sample B not plotted.



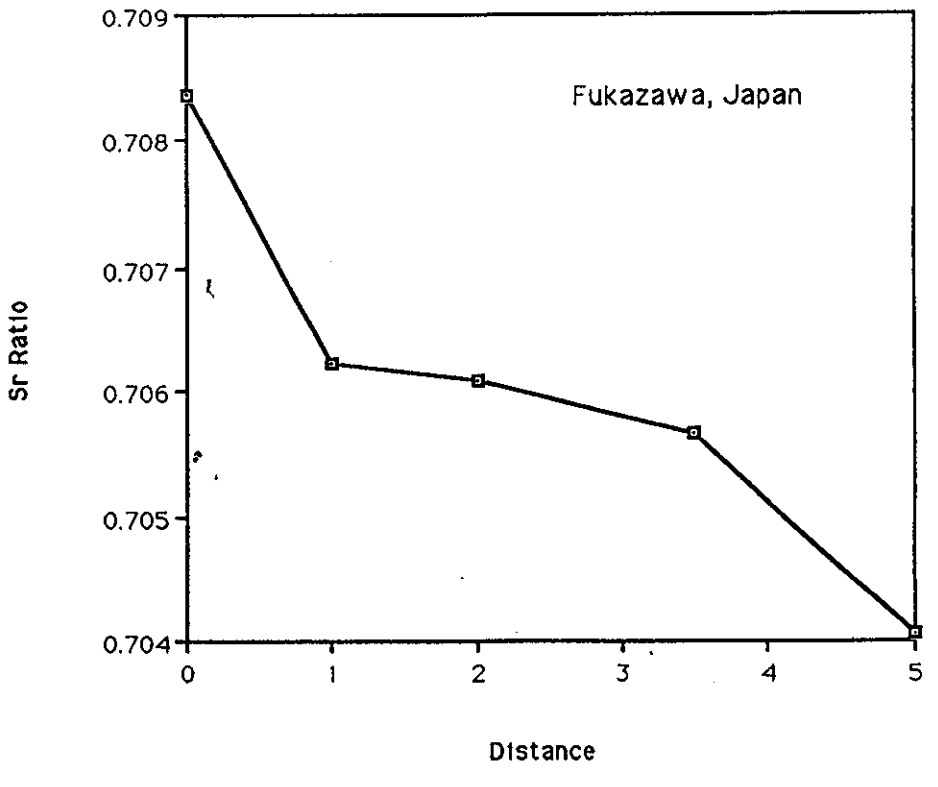
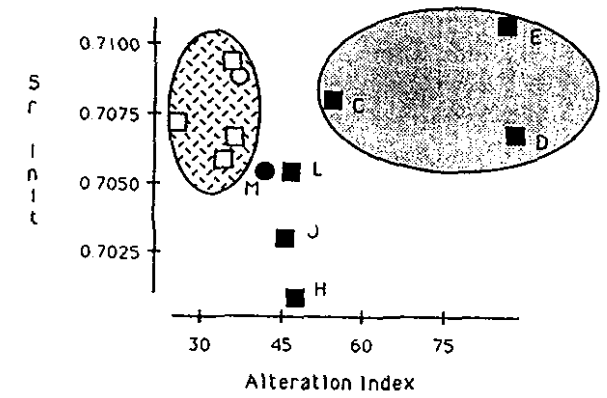
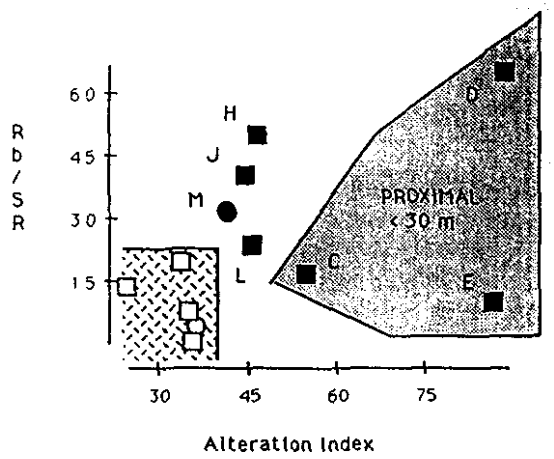
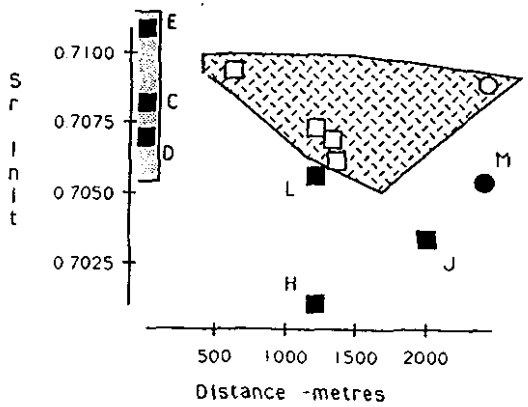
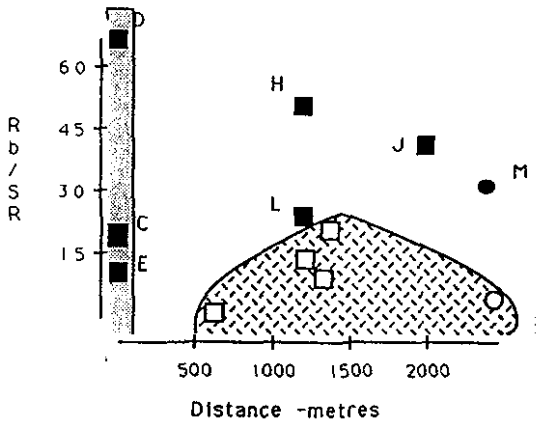


Figure 4. a) Variation of footwall Sr_{init} ratio at Hellyer with respect to distance from the deposit. (N.B. Sample B is excluded from all data plots.) Figure 4b shows the equivalent variation at Kukazawa, Japan.









5 cm

	ANDESITIC	FELSIC
HIGH ALTERATION INDEX	■	●
LOW ALTERATION INDEX	□	○

Figure 5. (a and d) Scatterplots for Rb/Sr isotope ratio and $Sr_{init.}$ data with respect to distance and alteration index.

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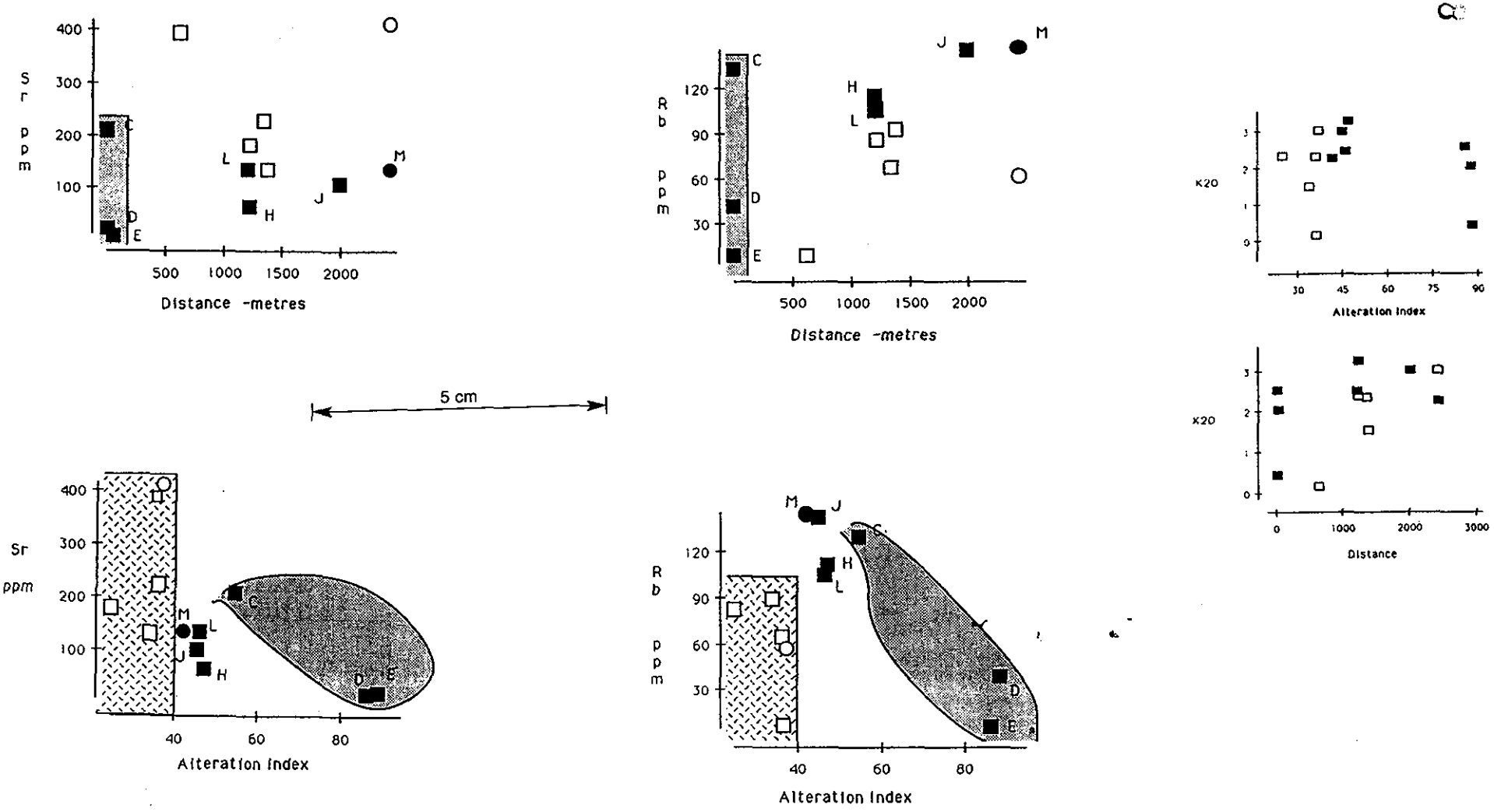

Figure 6. (a and f) Scatterplots for Sr, Rb and K_2O concentration data with respect to distance and alteration index.

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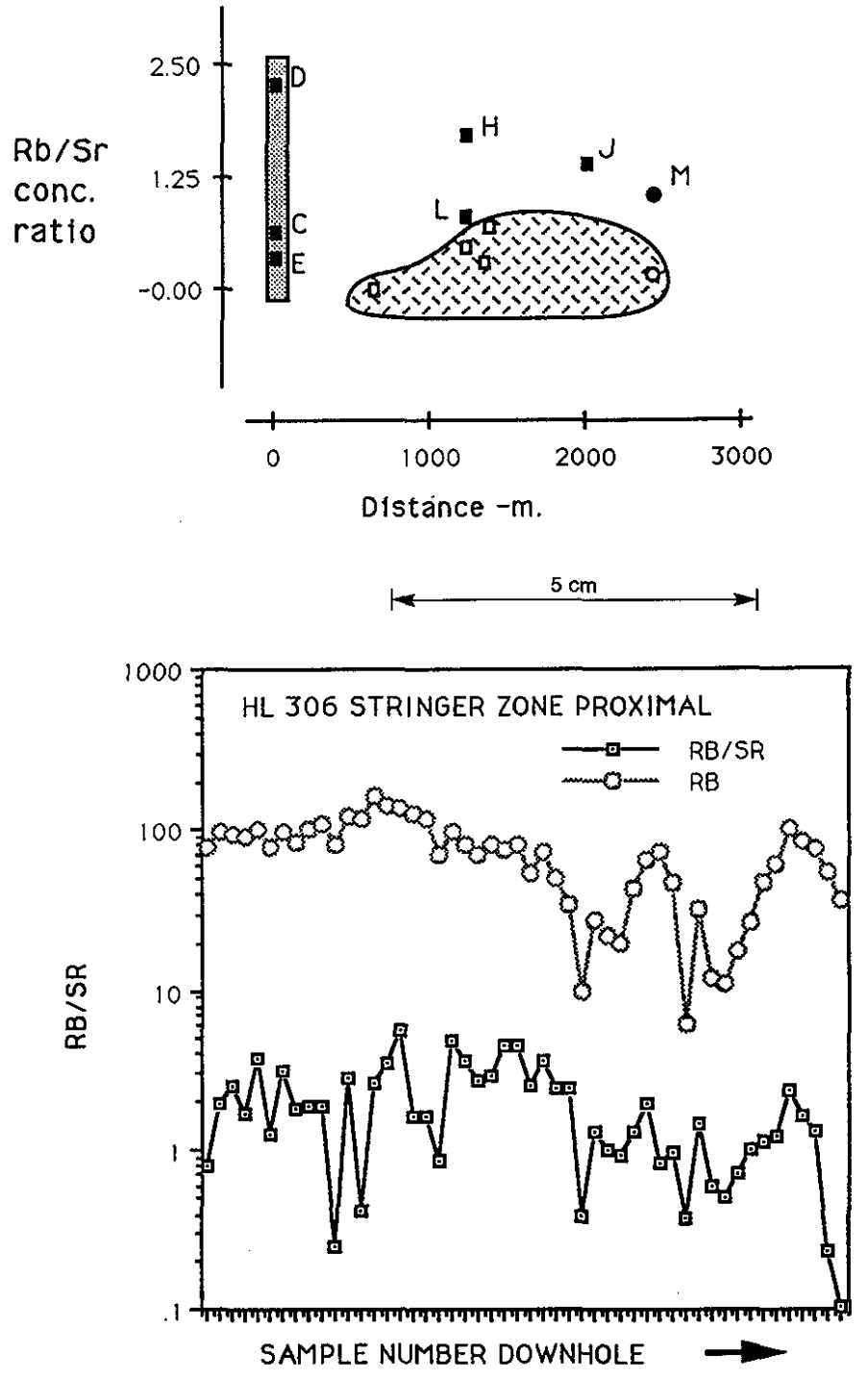

Figure 7. a) Scatterplot for Rb/Sr concentration ratio in the Hellyer footwall.
b) Systematic downhole Rb/Sr concentration ratio changes in HL 306(Data from Gemmell, 1990).

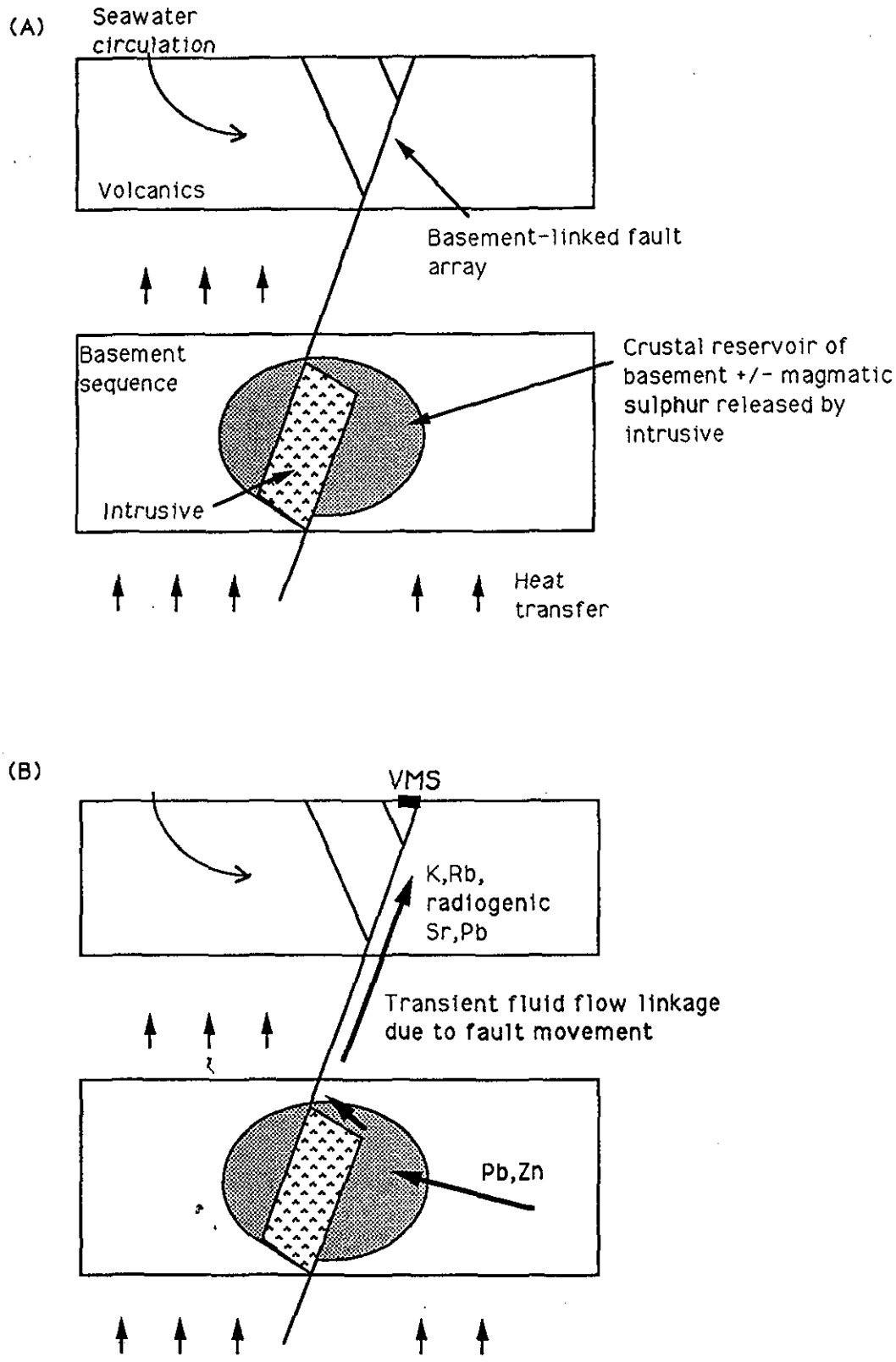

Figure 8. Flow schematics for the generation of a VMS style deposit emphasizing the importance of transient connectivity of fluid reservoirs due to movement on basement linked fault arrays.

Table 1: Rb-Sr isotope and geochemical data: Hellyer

DDH	Graph Ref	Depth -m.	Distance -m.	Sr Ratio Isotopic Measured	Sr Init 500 Ma	Rb/Sr Isotopic	Sr ppm	Rb ppm
HL15	**C	270.7	8.75	.72107 +/- 6	0.70814	1.8146	206.6	129.3
HL306	D*	205	17.5	.75395 +/- 7	0.70687	6.6068	17.1	38.9
HL306	E*	404.8	17.5	.71810 +/-8	0.71079	1.0259	13.1	4.6
HL246	K	277.5	630	.70952 +/- 5	0.70923	0.0411	391.2	5.6
MAC11	H	784	1225	.73676 +/-3	0.70102	5.0153	64.5	111.4
MAC11	I	793.9	1225	.71674 =/-3	0.70725	1.3323	178.3	82
MAC11	L	836.8	1225	.72184 +/-4	0.70545	2.3003	133.2	105.7
MAC17	**F	117.2	1347.5	.71810 +/-8	0.70682	0.8379	225	65.1
MAC4	G	188	1382.5	.72027 +/-5	0.70605	1.9956	129.6	89.2
MAC19	**J	804	2012.5	.73217 +/- 9	0.70324	4.0609	101.6	142.2
MAC10	**M	277.5	2432.5	.72768 +/- 4	0.70535	3.1341	133	143.7
MAC10	A	315	2432.5	.71187 +/-5	0.70888	0.4194	410.1	59.4
MAC 15	B	106	3762	.9214 +/-18	0.67769	34.2037	9.28	107.4

* Whole rock analyses refer to composite core samples over 10 metre intervals;

STD = NBS987

Rb,Sr data refer to isotope samples

** Samples due for isotope analysis confirmation

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Table 1: Rb-Sr isotope and geochemical data: Hellyer

DDH	Rb/Sr Concentration	Alteration Index	Lithology	Alteration	SiO2	TiO2	Al2O3	Fe2O3
HL15	0.63	86	AND			0.66		
HL306	2.27	88	AND	SeClSiPy	57.16	0.44	12.26	21.71
HL306	0.35	88	AND	Cl	60.26	0.39	12.31	16.59
HL246	0.01	36	AND	Se	60.27	0.72	16.53	9.01
MAC11	1.73	47	ANDFRAG	SiAlCl	63.53	0.63	18.75	5.9
MAC11	0.46	25	AND	SiAlCl	69	0.44	15.22	2.91
MAC11	0.79	46	AND	AlSi	69.04	0.56	15.56	5.49
MAC17	0.29	36	ANDFRAG	SiClAlCo	65.52	0.52	16.33	5.17
MAC4	0.69	34	ANDFRAG	SiCl	74.33	0.29	11.66	3.49
MAC19	1.4	45	AND	Se	69.02	0.56	14.77	5.42
MAC10	1.08	42	RHY	Cl	73.46	0.19	13.35	4.74
MAC10	0.14	37	RHY	Se	68.86	0.41	14.24	4.78
MAC 15	11.57	94	V-CLAST	Se	76.19	0.24	14.84	2.91

Petrography and geochemical data from Gemmell(1990)

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Table 1: Rb-Sr isotope and geochemical data: Hellyer

DDH	MnO	MgO	CaO	Na2O	K2O	P2O5	LOI	Ni
HL15	0.16	2.8	1.16	3.44	2.55	0.14		12
HL306	0.49	4.69	0.54	0.54	2.05	0.11	9.81	43
HL306	0.62	8.16	0.59	0.54	0.45	0.09	6.86	63
HL246	0.12	4.61	1.74	6.71	0.17	0.13	4.16	53
MAC11	0.04	1.84	2.62	3.23	3.25	0.2	6.97	21
MAC11	0.06	0.74	5.61	3.52	2.36	0.14	4.99	16
MAC11	0.06	1.72	2.77	2.15	2.45	0.17	3.92	16
MAC17	0.07	2.01	4.7	3.12	2.34	0.22	4.94	<25
MAC4	0.08	1.86	4.08	2.59	1.54	0.08	5.04	239
MAC19	0.09	1.42	4.65	0.85	3.02	0.18	4.87	26
MAC10	0.07	1.14	2.3	2.44	2.29	0.04	3.33	36
MAC10	0.12	1.22	3.88	3.33	3.02	0.14	5.48	26
MAC 15	0.01	1.93	0.27	0.05	3.51	0.05	4.12	63

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Table 1: Rb-Sr isotope and geochemical data: Hellyer

DDH	Cr	Zr	Ba	Cu	Pb	Zn	Ag	Au
HL15	55	170	1991	12	<100	156	<.05	
HL306	267	67	2142	273	1764	876	12	0.15
HL306	314	46	320	10	49	244	0	0.08
HL246	201	138	307					
MAC11	<5	247	838	360	38	118	<.5	<.008
MAC11	<5	179	1053	32	11	89	<.5	<.018
MAC11	<5	167	1769	47	10	135	<.5	<.008
MAC17	21	168	1157	32	42	131	<.5	<.008
MAC4	48	170	642	1432	21	1326	<.5	<.008
MAC19	8	168	715	37	16	110	0.5	
MAC10	<5	228	455	98	52	62	<.5	<.008
MAC10	32	190	719	26	5	42	<.5	<.008
MAC 15	7	261	521	31	26	584	1.6	<.008

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Table 1: Rb-Sr isotope and geochemical data: Hellyer

DDH	As	Ti/Zr
HL15		11.9
HL306	167	39
HL306	39	50
HL246	16	31
MAC11	24	15
MAC11	3	15
MAC11	3	20
MAC17	8	19
MAC4	<2	10
MAC19	2	20
MAC10	8	5
MAC10	2	13
MAC 15	14	6

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Pearson Product-Moment Correlation

	Tl/Zr	Ba	K2O	Na2O	CaO	MgO	Alteration Index...	Rb/Sr Conc....	Rb ppm	Sr ppm	Rb/Sr Isotopic...	Sr Init. 500Ma
Tl/Zr	1.000											
Ba	-0.004	1.000										
K2O	-0.625	0.378	1.000									
Na2O	-0.308	-0.247	-0.230	1.000								
CaO	-0.560	-0.214	0.438	0.141	1.000							
MgO	0.909	-0.104	-0.753	-0.207	-0.741	1.000						
Alteration Index	0.591	0.450	-0.187	-0.507	-0.823	0.701	1.000					
Rb/Sr Conc	0.061	0.419	0.417	-0.558	-0.251	-0.060	0.358	1.000				
Rb ppm	-0.771	0.199	0.739	-0.176	0.332	-0.732	-0.195	0.350	1.000			
Sr ppm	-0.314	-0.224	-0.065	0.790	0.272	-0.279	-0.495	-0.697	-0.199	1.000		
Rb/Sr Isotopic	0.065	0.419	0.415	-0.559	-0.253	-0.057	0.359	1.000	0.347	-0.696	1.000	
Sr Init	0.471	-0.083	-0.665	0.170	-0.316	0.580	0.293	-0.656	-0.702	0.383	-0.654	1.000

Table 2. Correlation coefficient matrix for Hellyer sample suite not including Sample B.
High positive and negative correlations are highlighted (note no emphasis placed on correlations involving derived variables such as the alteration index). Note that geochemical data other than Rb and Sr concentrations are from samples adjacent to the isotope samples.

APPENDIX 6

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STRUCTURAL STUDY

OF THE

HELLYER - QUE RIVER AREA

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Prepared for

ABERFOYLE EXPLORATION
BURNIE, TASMANIA

HELLYER - QUE RIVER STRUCTURAL STUDY

EXECUTIVE SUMMARY

Analysis of geological structure in the area of the Hellyer Mine indicates the geometrical arrangement of lithologies is largely controlled by two major folding events and late faults of predominantly dip slip displacement. The axes of the first fold event were formed on an approximately 290° trend. These are folded by the second event with axes along an approximately NNE trend. Deformation in the immediate area of the deposits at Hellyer and Cue River may be related to the late fold event but is of much higher and inconsistent strain. This is attributed to local reactivation of basement faults in these areas producing extreme shortening in narrow zones. Shortening is manifest as tight, assymetrical folding and attenuation of fold limbs. The relationship between the position of the deposits and the high strain zone is interpreted to be a generic control. Structures reactivated in the basement during shortening are assumed to be fundamental basement features related to the formation of the basin and the localisation of mineralisation. There is no data available from this study to indicate the exact nature of these structures.

Revision of the geometry of the sediment package indicates steeper dips and more extensive faulting than previously mapped. Future drilling programmes may be better planned with regard to localisation of targets and the orientation of holes if local structure is analysed in more detail prior to drill planning. Enhanced understanding of detailed structure will also improve interpretation of existing outcrop mapping as well as guiding future mapping with more efficiency.

Without this proper recognition of structural geometry, which this study indicates is quite achievable, all other geochemical and petrological work, not to mention drill targetting, is without proper lithological context. Through understanding of this structural geometry there is also the potential to recognise areas of complexity relating to the fundamental controls on mineralisation. Present interpretation of these controls within the mine is handicapped by the lack of proper framework to distinguish between early and late structure. At surface this form of interpretation is not attempted but should be possible.

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APPENDIX 1: Stereonet plot illustrating geometry of Hellyer Anticline.
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1. INTRODUCTION

The observations of structure and geology presented in this report were made during field visits by the author to the Hellyer-Que River area in January 1991. These observations are supplemented by geological and structural data acquired by Aberfoyle up to the time of the visit. Particular use is made of structural information gathered from the Hellyer and Que River mines during various studies of joint and bedding plane orientations and the 1:2,500 scale geological mapping, with the 1:10,000 interpretive geology.

The original aim of this study was to examine the structure of the area with special reference to the Mt Charter prospect. After visiting Mt Charter it was clear that the present exposure was too poor to gather meaningful data on the structural style. Instead, the scope of the study was broadened to look at the general Hellyer area but concentrate on areas where exposure allowed some observation of the structural styles. From the study of these areas a model of the fold geometries has been established for use in the interpretation of sparse data in the poorly exposed localities.

Around the Hellyer Mine the best exposure was in the recently constructed stream diversion drains around the tailings dam and along the main haul road cutting. Additional data has been obtained from previous studies and routine mapping of the Hellyer and Que River underground development. The data from the two mines does not have any form of specific location details, hence it is only used as an overview of structural orientations in the mines.

Due to the discontinuity of exposure in the Hellyer area, and the small areal extent of most exposures, the interpretation of small groups of structural orientations is very prone to misleading results. This is due to the lack of representative sampling. The problem is compounded by the difficulty in visualising the structure of an area with extreme terrain variation and observation of structure in many different planes of view, such as within the drains. Under such conditions it is necessary to obtain as many records of structure orientations as is feasible, and in order to interpret this data the most useful method is plotting onto a stereonet. This allows the recognition of patterns and trends in the orientation of bedding and structure that could not otherwise be visualised. Study of structure by this method also allows areas with a poor statistical sample to be compared against all other data, thus providing a model within which to interpret the small number of data. Details of the stereonet analysis procedure are outlined in Appendix 3. References to published

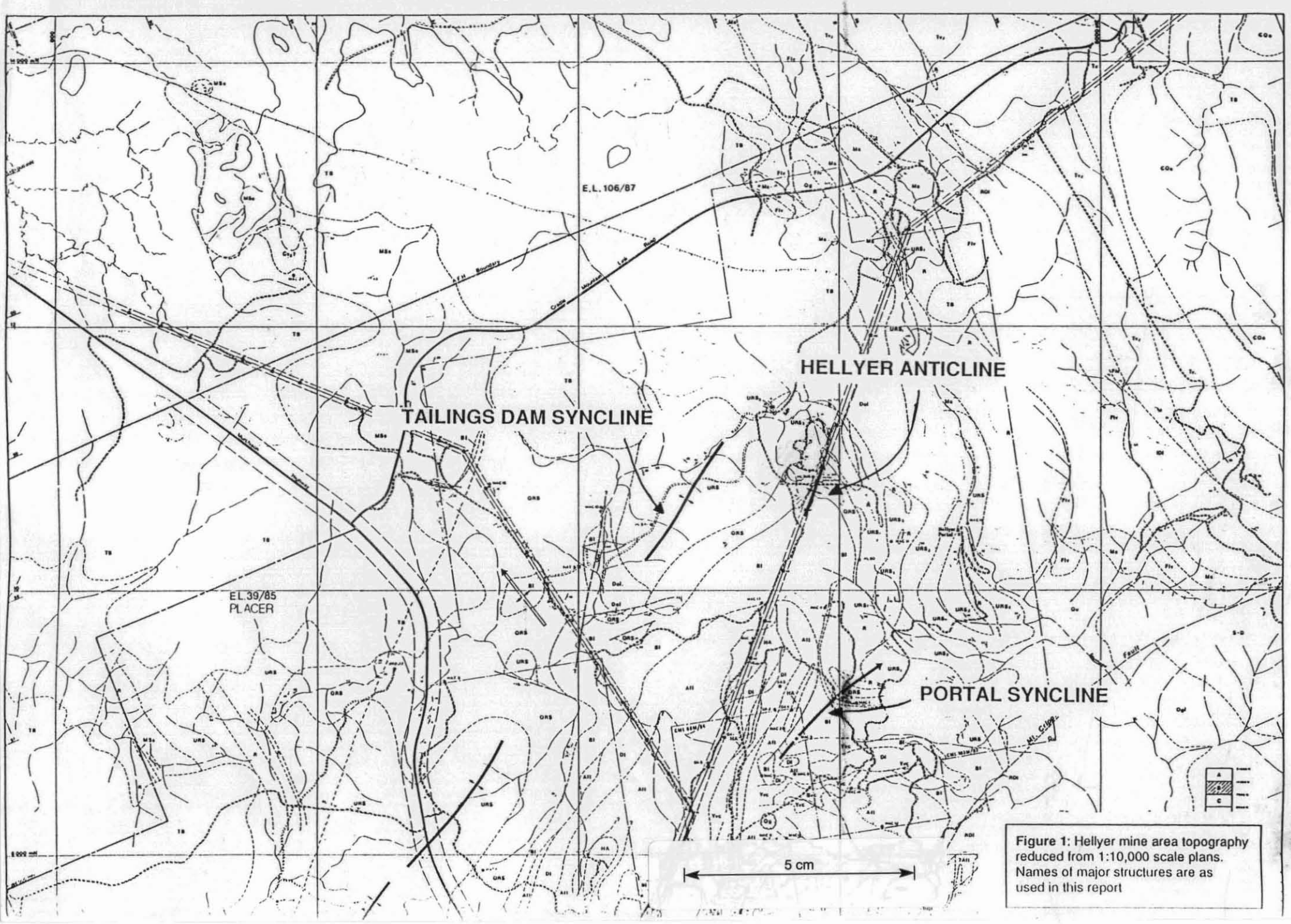

Figure 1: Hellyer mine area topography reduced from 1:10,000 scale plans. Names of major structures are as used in this report

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descriptions of stereonet use are also given in this section along with reproductions of key extracts.

2. STRUCTURAL OBSERVATIONS

Structural measurements and observations from the detailed study of the Haul Road and Tailings Dam areas help define the overall geometry of folding structures in the Hellyer area. This data allows some refinement of the outcrop interpretation map and is important in the construction of the 3 dimensional model.

Bedding data from all areas at Hellyer is well correlated into several groups. These define the orientations of deformed bedding planes relating to the various folding events. Interpretation of this data is discussed in the following section. The distribution of the joint orientations also shows patterns relating to the major folding and faulting events, as discussed in section 2.2.

2.1 FOLD STRUCTURES

The following interpretation of fold structures is based mainly on data collected to the west of the Hellyer Anticline. The strain in this area is relatively low and it is therefore assumed to represent a good record of structure formed prior to the events producing the higher strain and more complex deformation along the Hellyer to Que River structural zone. A comparison of this interpretation of the structural events and previous interpretations is discussed in Section 5.

Within the immediate area of the structural study there is interpreted from the outcrop distribution to be three main fold closures, as shown in Figure 1, which shall be referred to as the Tailings Dam Syncline (TDS), the Hellyer Anticline (HA) and the Portal Syncline (PS). The structural data used in this project provides a reasonably similar picture of these fold closures as does the interpretation from outcrop distribution. However, the geometry of these folds, as defined from the plots of bedding plane orientations, shows a highly irregular style of folding. Each of the three closures has entirely different fold styles and orientation of limbs. These are described in detail later in this section.

Away from the Hellyer anticline, and the other complex structures around the mine area, it is possible to identify a second folding event which pre-dates the main N trending axis of folding already mentioned. Evidence for this

other event is drawn mainly from the distribution of bedding plane orientations as shown in Figure 2, although its effect on outcrop is most evident in some locations.

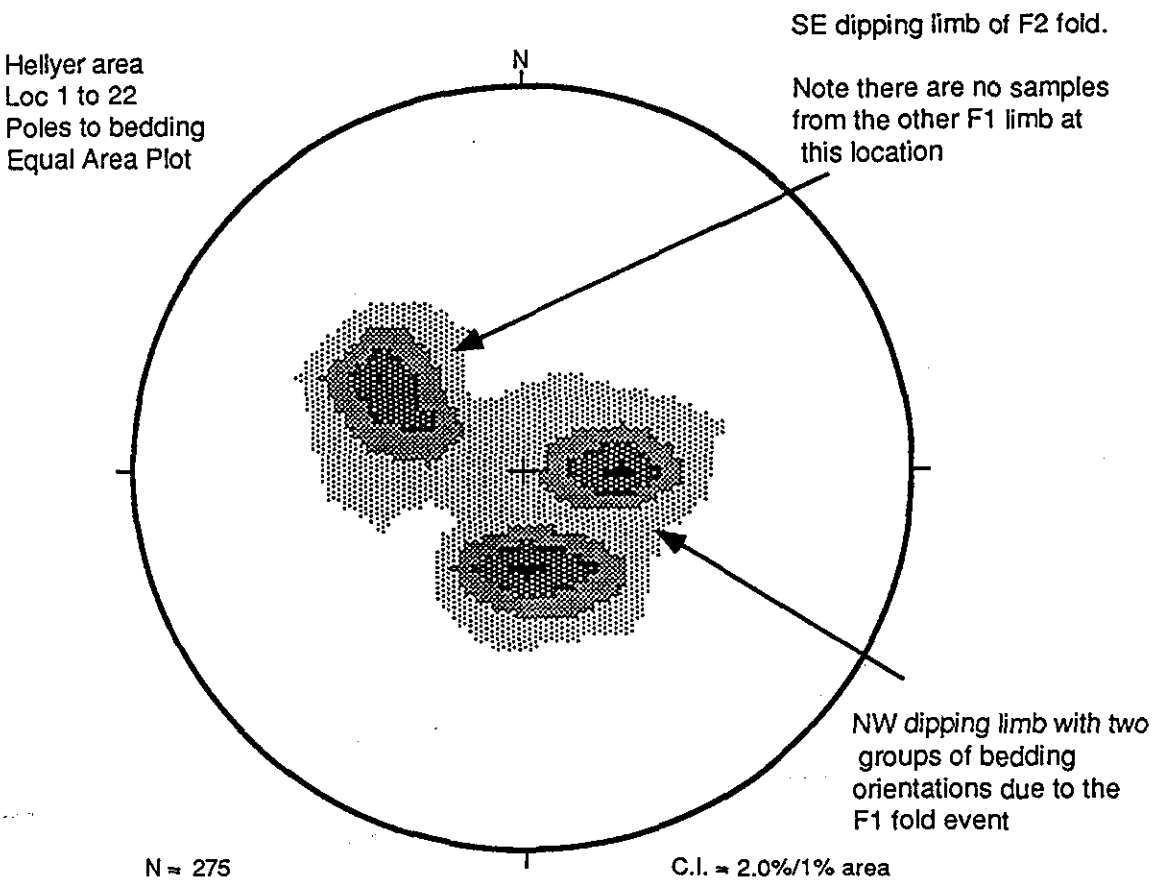

Figure 2: Stereonet contour plot of poles to bedding for locations 1 to 22. The distinct grouping of the poles is related to the two major fold events.

This first fold event, which shall be referred to in this report as F1, is a very open folding along an approx. 280° GN axis, though this is observed to vary by up to 30° at other locations. The dip of limbs is around 15° from horizontal, as calculated from stereographic procedures to remove the later folding event and restore the original fold axis to a horizontal plane, as illustrated in Figure 3. Evidence of this earlier fold event is present in both the Mica Sandstone and Que River Shale. It appears to be a regional or at least basin scale event, with record of its occurrence from outcrop south far as Mt Charter to north of the Cradle Mt. Link Road. It is, however, of only small magnitude in terms of strain. The implied stress field is an approx. E-W σ^3 and N-S σ^1, or simply E-W extension and N-S shortening.

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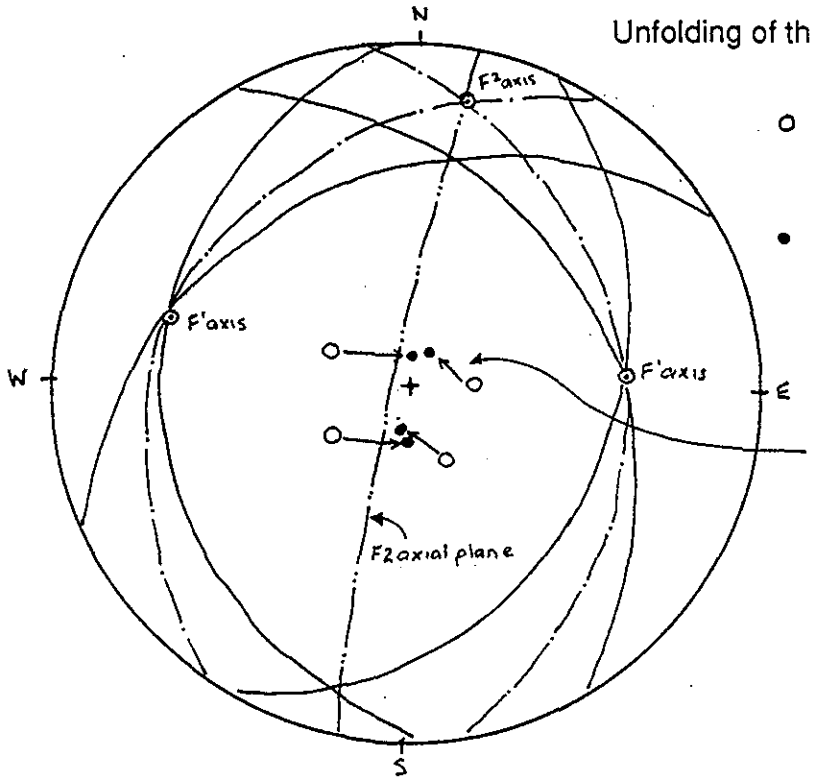
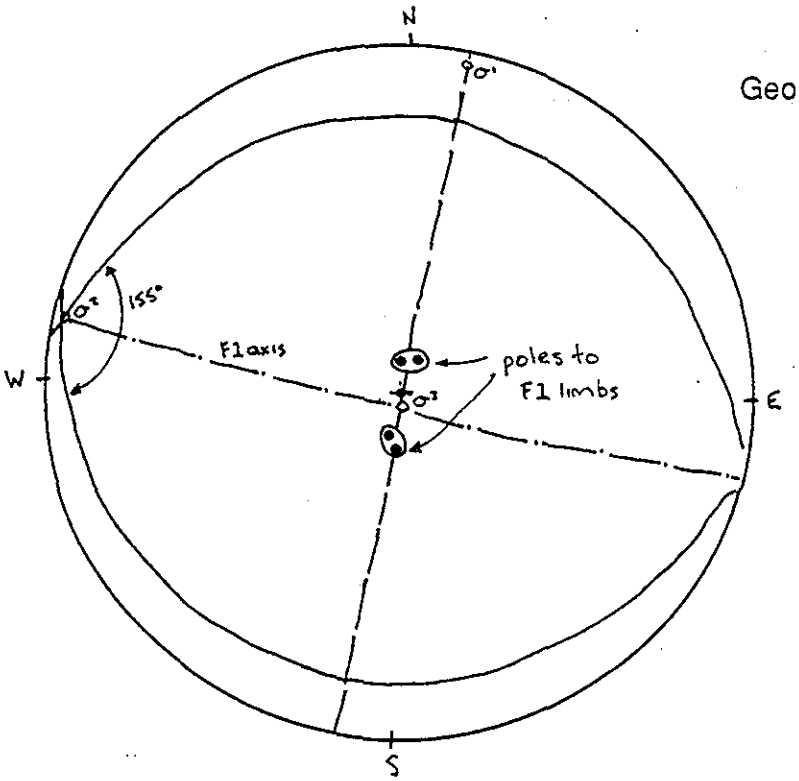


Unfolding of the F2 event

- o clusters of poles to bedding plane after F2
- • clusters of poles prior to F2

rotating the F1 axes back to horizontal removes the F2 fold event.



Geometry of F1 folds

Original F1 folds were very open, upright folds. Strike varies and data from this examples shows an approx. 100° strike of fold axis.

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Figure 3A: Unfolding the F2 deformation event to reveal the original geometry of the F1 folds.

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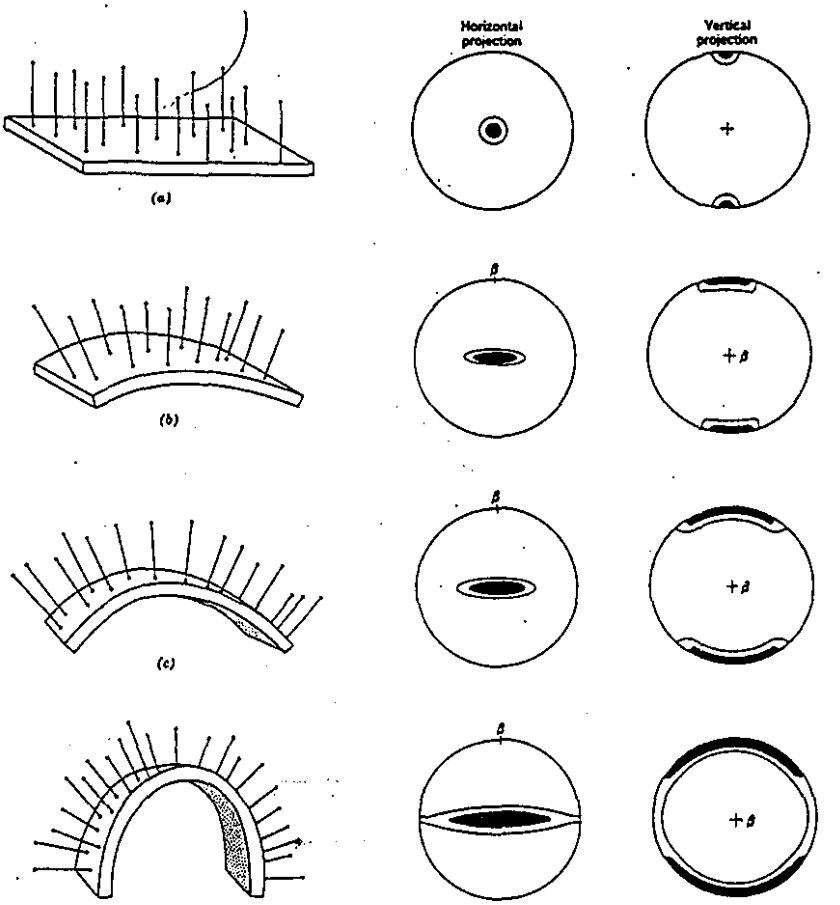

FIGURE 13.7 Development of the *S*-pole diagram during folding. Note that the same stereographic diagrams would result for both antiforms and synforms: (*a*) statistically planar horizontal layer, (*b*) layer bent through 45°, (*c*) layer bent through 90°, (*d*) layer bent through 180°.

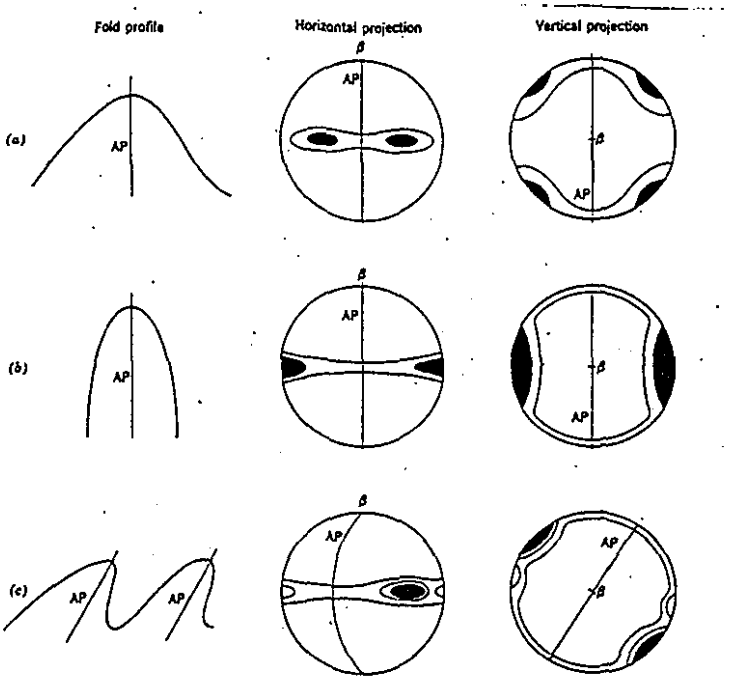

FIGURE 13.8 Patterns of folds: (*a*) symmetrical open fold, (*b*) symmetrical isoclinal fold, (*c*) asymmetrical fold with inclined axial plane.

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Figure 3B: Models of stereonet plots from data collected over folded stratigraphy.

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The later deformation event (F2) refolds the F1 structures about an axis trending NNE to N. This results in the distribution of bedding planes at widely varying dips and dip direction, though averaging a NNE trending strike. The variable nature of the folds is related to locality, and the degree of folding can be observed to change gradually across different localities. The variation in folding style and intensity is also well illustrated by the complexity in the 1:10,000 geological interpretation by A McNeil et al. This fold pattern is illustrated in an interpretive structural map, based on the 1:2,500 geology, presented in Appendix 3 and described in the following section.

In order to examine the major structural features around Hellyer, each area of distinct structural style shall be described separately as follows:

2.1.1 TAILINGS DAM SYNCLINE AREA (TDS)

The main feature of the tailings dam area, the TDS, is expressed in the mapping as a trough of Upper Rhyolite Sequence (URS) volcanics, gradually thickening to the NE with the gentle plunge of the syncline. The structure is covered by Tertiary basalt past 11,000N but appears to terminate at approx. 12,000N against a NW fault, with mica sandstone mapped on the northern side. To the south the syncline is complicated by other structures but is mapped to continue to the Mt Charter Fault. Analysis of the bedding plane data from the vicinity of the TDS indicates the syncline plunges at an average of approx. 7°>030°. The axis has a significant variation in plunge due to interference with F1 fold closures trending along approximately 310°. The interaction between the TDS and related F2 fold structures with the F1 folds forms a classic interference pattern of basins and domes. An interpretation of the interference pattern and position of fold axes is illustrated by plotting the inferred position of these structures on the 1:2,500 outcrop geology plans contained in Appendix 3. The indicated strike of the TDS is more northerly than interpreted in the 1:10,000 solid geology. This requires the fold axis to be placed further north in order for the closure to run through the nose of the URS and Dolerite.

The other closures parallel to the TDS are interpreted from bedding reversals and outcrop patterns. Although significant, it appears these structures are secondary to the TDS. The anticline to the adjacent north controls the domal outcrop of Basalt Lava south-west

of the tailings dam. The F1 fold associated with this dome is better developed than others and has a marked effect on outcrop patterns in this area. In general, the F1 folds have a lesser effect on outcrop patterns than the F2 folds.

The F1 fold axes are often associated with areas of strong shearing and quartz veins, along both synclinal and anticlinal axes. This is best illustrated at locations 4 and 5 as well as in the canal behind the tailings dam. Location 5 is complicated by the dip of bedding back toward the north, contrary to the southern dips expected if the F1 structure is an anticline. The complexity in this area, and possibly other zones of similar geometry, may be due to the problems associated with synclinally folding an existing anticline in a competent, massive unit. This is illustrated in Figure 4 (normal faults parallel to fold axis) where the F2 fold event results in normal faulting parallel to the F1 fold axis. This can be produced under the same stress conditions if F2 folding is initiated with sigma 2 approx. equal to sigma 3, where sigma 3 begins in the vertical axis and switches to the horizontal initiating normal faulting. This would also explain why the normal faults are such late, planar structures. Relationships between fold structures and faulting are further discussed in section 2.2.

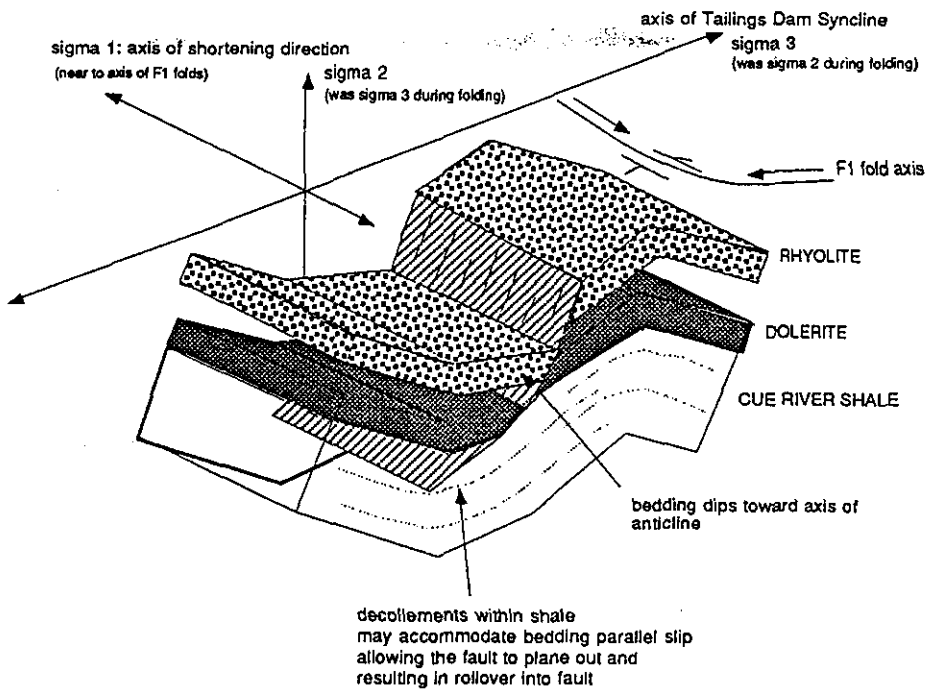

Figure 4: Diagrammatic illustration of rollover into normal faulting along the F1 fold axis during F2 fold event.

2.1.2 PORTAL SYNCLINE

Data relating to the portal syncline is mainly derived from measuring structure along the Hellyer haul road cutting. This tends to follow close to the apparent closure of the syncline and therefore the data is somewhat biased toward measurements near the orientation of the axis. Results from the plotting of this data do generally support the current interpretation of the fold orientation in plan. It does appear, however, that the syncline axis trends toward the east and shallows in plunge away from the Hellyer anticline. The approximate plunge of the axis through the area of the haul road is 63°>078°. This steepens to approx. 72°>050° adjacent to the Hellyer Anticline. This shift in plunge and trend of the fold axis can be attributed almost entirely to the effect of the NW limb of the syncline, which is common to the Hellyer Anticline. Bedding in the NW limb usually strikes NNE and has a moderate dip. This orientation appears to be transposed into a N striking, steeply E dipping high strain zone, thus affecting the geometry of the Portal syncline accordingly. It is difficult to illustrate this process of transposition but the plot of contoured poles to bedding in Figure ?? shows the unusual nature of bedding orientations along the haul road with respect to all other areas.

2.1.3 HELLYER ANTICLINE

Geometry of the Hellyer Anticline is a composite of the west limb of the Portal syncline and the east limb of the TDS. As expected from this the anticline has characteristics common to both the other structures but all are sufficiently different that they cannot be considered as products of the same deformation event.

Assuming the TDS and the Portal Syncline are normal fold structures, and may have originated from the same event, it is probable the Hellyer Anticline was originally a consistent anticlinal fold. To attain its present geometry it appears there has been considerable attenuation of the eastern limb, to the extent of some overturning. The high strain related to this attenuation is well indicated by the 1:10,000 scale interpretive geology, showing the faulting of the east limb in the Hellyer area and the continuation of

this high strain into the anticlinal closure at Que River Mine. This zone is then truncated by the Que River Fault.

Structure of the Hellyer Anticline is not consistent with any kind of folding. The most likely process to produce the localised, asymmetric deformation is basement controlled deformation. Such a situation may occur where the bounding faults related to basin formation have been reactivated in reverse movement and produced irregular folding in the sediments immediately overlying the area of shortening (illustrated in Figure 7). This process is assumed to have followed a period of broad, regular folding during the initial shortening. Once the basement faults are reactivated it is assumed they accommodate virtually all the remaining strain through reverse movement in the basement and irregular folding in the overlying cover. With high strain the cover folds may become detached through shearing and faulting along the fold axis or limbs. Geometry of the cover folds may vary along strike due to variations in the basement fault pattern and the degree of reverse movement varying along the fault, which may be related to variation in strike.

It is possible for both reverse and normal faults to occur in the cover deformation during shortening. Reverse faults will probably be steep and close to the orientation of the fold axis. In many cases these faults will run close to the axis of anticlinal closure and may shear out one limb of the fold, usually the steep or overturned limb. Normal displacement may occur due to the localised nature of the shortening producing over-thickening which will spread by extensional failure. These are expected to form perpendicular to the fold axes and post-date the main shortening structures. Normal displacement might also occur parallel to related fold axes and reverse faults due to the special conditions of basement controlled faulting, as illustrated in Figure 5. This form of faulting is peculiar to inversion of basement faults and may be indicative of their position and style. Faulting along the east margin of the Hellyer Anticline could be related to a form of inversion normal fault, based upon the observed nature of displacement across the structure.

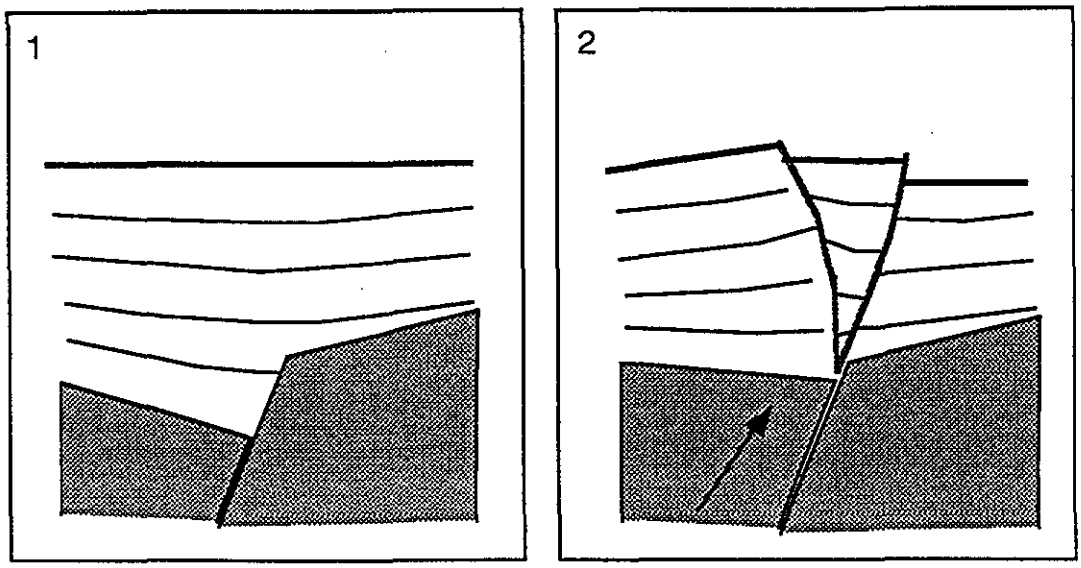

Figure 5. Diagrammatic illustration of 'normal' faults forming in the plane of shortening during inversion on basment faults. Note the dip direction on the normal fault and the dip on the basement structure are always opposite. Also, the normal fault will always be over the hanging-wall of the basement fault.

The model for basement controlled folding at Hellyer has important implications for understanding the relationship between Hellyer and Que River with zones of strong deformation. An association between high strain and the zone of mineralisation in both mines has been attributed to the susceptible nature of the phyllosilicate alteration zone to accommodating shortening. Brief observation of the alteration zone in the Hellyer underground indicates the phyllosilicates have indeed accommodated shortening and developed a strong foliation fabric consistent with the fold event. However, the magnitude of shortening within these phyllosilicates is far too small to be consistent with the considerable difference in shortening between the volcanic package hosting the deposit and the degree of shortening in surrounding areas. The same applies to the Que River deposit which has even higher strain and a smaller alteration zone. An alternative explanation for the observed relationship could be the deposits are localised along major basement structures that have been reactivated during compression and localise folding in the overlying sediments. If this is so, the occurrence of high strain fold closures in the volcanics may be indicative of prospective basement structures below.

2.2 FAULTS AND JOINTING

2.2.1 INTERPRETATION OF FAULTS IN STUDY AREA

Field mapping of faults around Hellyer relies largely upon the recognition of discontinuity in lithologies, and only rarely can a major fault be observed directly and then usually in an excavated trench or cutting. The majority of recognised large faults have some associated quartz veining, which is often the best indication of its presence. Complexities in the folding make the recognition of bedding drag into the fault very difficult, though it is often present. The majority of fault structures observed at Hellyer are zones of fracturing up to several meters wide. Wider zones are difficult to recognise as faults unless they juxtapose different lithologies. If there is no juxtaposition they may simply appear to be complex folding, such as at location 2. These types of structures are best described as fault zones or brittle shears. The occurrence of both foliation and bedding drag, as well as transposition of earlier features is best described by shear related processes.

There is no evidence for plastic or ductile deformation in the study area. All fault or shear zones are brecciated to some extent and therefore are poorly preserved in any kind of exposure including drill core. This also relates to their relationship with topography and it is a reasonable expectation that most major shears have a strong influence on topography and drainage. This can be observed in both the aerial photography and topographic base plans, from which some degree of lineament interpretation can be made. Through drafting the linear alignments of the drainage pattern around Hellyer a number of consistent trend directions can be resolved. These are illustrated in the 1:10,000 scale interpretive geology plan in Appendix 4.

Most prominent of the linears on the 1:10,000 plans is the due NW trends, one of which passes next to the portal entrance and two others 800m to either side. Although not recognised in the field mapping as structures these features do in several localities lie along significant discontinuities in the mapped lithologies and there is good justification for assuming them to be faults. If the trends are continued to the NW of the mine these structures are coincident in

strike and spatial distribution with the F1 anticlinal axes. This correlation between the F1 axes and the NW fault trends was not realised during the field stage of the study and therefore there is insufficient data to properly explain the nature of the field relationships. In theory the observed relationship between faulting and fold axes is to be expected. The late folding event is approximately orthogonal to the F1 folds and the plane of maximum extension is therefore close to the F1 axial plane. Structural weakness in the existing fold axes make them prone to failure as normal fault planes. It is unclear how such faulting relates to the formation of F2 folds, but it would be expected to postdate the folding as a response to changing stress due to fold thickening of the sequence. The relatively linear trace of the interpreted late faults is consistent with them being post fold events.

2.2.2 INTERPRETATION OF REGIONAL FAULTS

The faults described below have not been visited during this study. The interpretation of these structures is based solely upon their mapped character and displacement of lithology in conjunction with their correlation in style with faults in the study area.

2.2.2.1 QUE RIVER FAULT

Clearly post-dating most other deformation it appears the Que River Fault has a component of dextral displacement and may also have accommodated some reverse movement. This oblique dextral/reverse displacement probably ranges from dominantly dextral/sub-horizontal movement where the fault trends NE to a larger component of reverse movement where the fault swings more northerly.

Magnitude of displacement across the fault is difficult to calculate from the mapped geology. This may in part be due to differential displacement across the fault. This is possible if the fault is a boundary between areas of different amounts of shortening. To the north of the fault is the high strain zone through Cue River and Hellyer, due mainly to increased shortening in this zone. No such high strain has been recognised south of the fault hence it may be a differential strain boundary.

2.2.2.2 MT CHARTER FAULT

The Mt Charter fault is along the same trend as the recognised normal faults around Hellyer. The non-linear nature of the fault and the geometry of displacement are consistent with its interpretation as a predominantly normal fault. This interpretation would have the NE block downthrown against the lower stratigraphy of the Animal Creek Greywacke to the south. The complexity around Mt Charter is most probably related to splay faults juxtaposing lithologies in this area. As with the observations of normal faults being related to F1 fold axes in other areas, this should again be considered with the Mt Charter fault. Potential certainly exists for re-interpreting the area in this context, although the available data does not permit further comment in this report. Previous interpretations of this fault are discussed in section 5.

2.2.2.3 HENTY FAULT

Little is known of the Henty Fault regarding its orientation or movement vector. Displacement across this structure is consistent with either an east dipping normal fault or west dipping reverse movement. Since the major strain in the Hellyer area is shortening along a NW axis the most likely model is for reverse movement. This is supported by very sparse data suggesting a steep west dip. The major offset across this structure and its regional extent indicate the Henty may be a fundamental feature in the structural evolution of the area.

2.2.3 RELATIONSHIP BETWEEN JOINTS AND BEDDING

Measurement of joint plane orientations were collected in order to assess their relationships with bedding orientations as an aid to structural interpretation in the massive volcaniclastic units, which display little bedding information. The main localities in which this relationship was examined were between 3 and 7 along the trench through the Upper Rhyolite sequence, immediately east of the tailings dam. Bedding information in these localities was mainly from shale units interbedded with the volcaniclastics. Due to the high contrast in competency between the shale and the volcaniclastics there is a strong influence on the jointing due to differential strain

between these units. The main effect of this is an abundance of joints in the shale perpendicular to the bedding orientation. In addition to the scatter of joint orientations associated with differential strain there is some clustering of joint trends around certain trends. Distribution of bedding planes and joint surfaces is illustrated by the stereonet plots in Appendix 3. The main groups of joint planes are interpreted as follows;

a) Axial planar joints, varying over 45° in trend but broadly distributed around the local axial plane of the F2 fold structures.
b) Tensional joints, also varying over 45° in trend and usually steeply dipping in both directions with the mean trend perpendicular to the F2 fold axis. These may form one group of planes of variable dip direction and similar strike, or two approximately conjugate groups. It is difficult to determine to what extent the joint trends are influenced by folding subsequent to formation, but it is reasonable to assume this has contributed to the scattering of the joint families. It is also difficult to determine the extent of jointing related to the F1 fold event. Small clusters that fall in the groups of tensional joints could be related to the F1 axial plane.

The degree of joint fracturing is strongly influenced by the distance from the nearest fold closure, with the number of joints parallel to the opposite limb increasing with proximity. In the vicinity of a fold closure this interaction of joints may lead to pervasive fracturing and a virtual crush zone comprised only of small fragments. Such zones will produce very poor recovery in drill intersections hence disguising reversals in dip and preventing recognition of fold closure.

Orientations of joint planes within the Hellyer Mine are illustrated by stereonet plot in Figure 6. Groupings of joint planes are again closely related to the planes of minimum and maximum orthogonal stress, with the axis of sigma 1 interpreted to be through approx. NW.

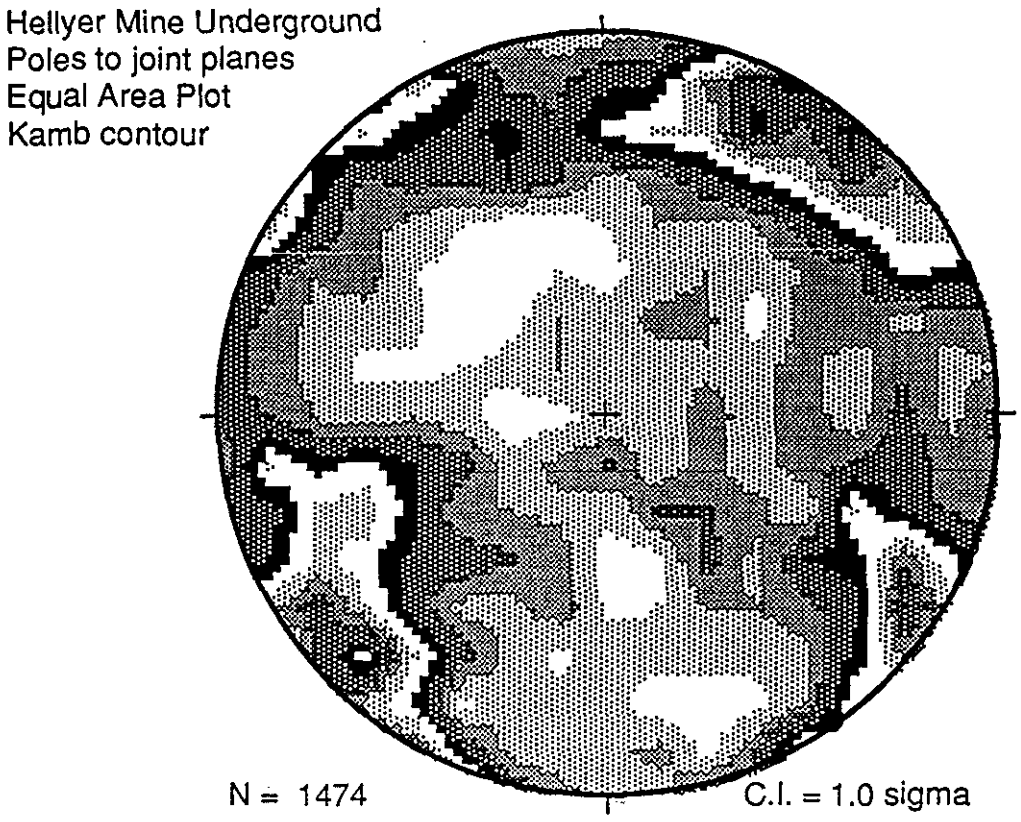

Figure 6: **Stereoplot showing contours of poles to joint planes in Hellyer mine.**

2.2.4 STRUCTURE IN HELLYER VMS OREBODY

Deformation of the VMS orebody is mainly through extensive jointing and varying amounts of strike-slip movement on these joints and other faults. The most significant of the faults being the Jack Fault which accommodates mainly strike-slip displacement and slices the VMS at Hellyer into two blocks, though the displacement is small enough to still leave the halves of the VMS juxtaposed along about half of each side's length. Formation of the Jack Fault is most probably due to the re-activation of a deeper controlling fault during the late strike faulting event.

Aside from the brittle faulting of the VMS it is unclear what component of ductile or plastic strain the body may have experienced. Work by the underground mine geologists suggests there has been little non-brittle deformation of the sulphide body.

With regard to a Kuroko-style model for the VMS, there are two main points that are difficult to understand. The first is the very high aspect ratio of the orebody, i.e. its relatively short width with respect

to thickness. This is either suggestive of a highly localised depocentre for the precipitating mineralisation or some process of mineralisation other than a typical sub-aqueous exhalative system. The second is the lack of any significant sediment input within the ore. This may indicate an extremely rapid mineralising process, which is not repeated at any other stage in the sedimentary sequence, again an unusual process not typical of a sub-aqueous exhalative. These two characteristics seem incompatible since a deep, narrow depocentre is likely to be associated with influx of sediment from the margins. These problems are far beyond the scope of this study, but do remain as curiosities.

3. MODEL OF STRUCTURAL EVENTS

The following outline describes how the major structural features and related deformation events may be related to the overall formation of the volcanic sequence and the mineralisation. Much of the inferred tectonic setting etc. is speculation based on the predicted axes of stress indicated by the geometry of structures. A diagrammatic illustration of this model is presented in Figure 7.

A. Basin Formation

The only structural features that may be directly related to the early history of the basin is the F1 folding event and possibly the Henty Fault and associated structures in the basement. If the F1 folding is indicative of tectonics active during basin formation then the axis of shortening appears to have been approximately N-S. Since there is very little evidence of strain due to shortening in this direction it is likely that strain was accommodated by either E-W extension or wrenching. A combination of both is likely, the degree of each type of strain possibly relating to the orientation of major controlling structures. For example, wrenching on a major structure such as the Henty Fault, or its precursor, may result in local areas of extension due to changes in fault orientation. These types of "pull-apart basins" are common features of major wrench zones, and the deep structure of such zones is a common control on volcanic activity. Basins formed under such conditions are often asymmetrical, or half-grabens with major bounding faults.

It may have been in this kind of setting that the Que-Hellyer Volcanic sequence was deposited into a relatively small basin within a larger area of active sedimentary and volcanic deposition. Exhalative and extrusive

products of the volcanism are deposited into the sub-basin and intersperse the continuing deposition of Que River shale over the Mica Sandstone basal sequence.

B. VMS Ore Formation

If VMS formation is a product of sub-aqueous hydrothermal activity on the basin floor, this may be controlled by intra-basin faults acting as conduits for alteration systems. The hydrothermal systems are presumably driven by heat sources related to the volcanism and high thermal gradients along the faults.

The spatial relationship between the VMS and the intra-basin faults is a fundamental aspect of the model. Given the structural setting these faults assumed to be transtensional.

C. Basin Closure

Volcanism and sedimentation continued subsequent to formation of VMS until a change in tectonics halted the extension of the basin. At this stage the early folds have formed along a 100° MN trend, possibly indicating the trend of the σ^1 plane at this time.

Major changes in the tectonics produced a new stress field which resolved a NW-SE shortening effect on the basin. This was accommodated by re-activation of the basement extension faults and folding and faulting of the overlying sediments. Most shortening was taken up by reverse movement on the basement faults, there was relatively low strain in the volcano-sedimentary cover sequence, other than immediately over the reactivated faults.

VMS bodies overlying the controlling faults are folded and faulted during fault reactivation. With higher strain the orebodies may be attenuated and broken into distinct bodies, as at Que River.

D. Late Faulting

Normal faults and some strike faults developed after folding. These offset the original trends of basement faults and cover fold axes. The Jack Fault may have been formed at around the same time as this episode of faulting, possibly due to re-activation of the basement structure to accommodate horizontal movement. Many of the early formed joint planes also appear to have been re-activated as faults during this period. Offsets of the VMS

orebodies are likely to have occurred at this stage. Such as occurs with the Jack Fault, though possibly along NW normal faults or N-NE reverse faults.

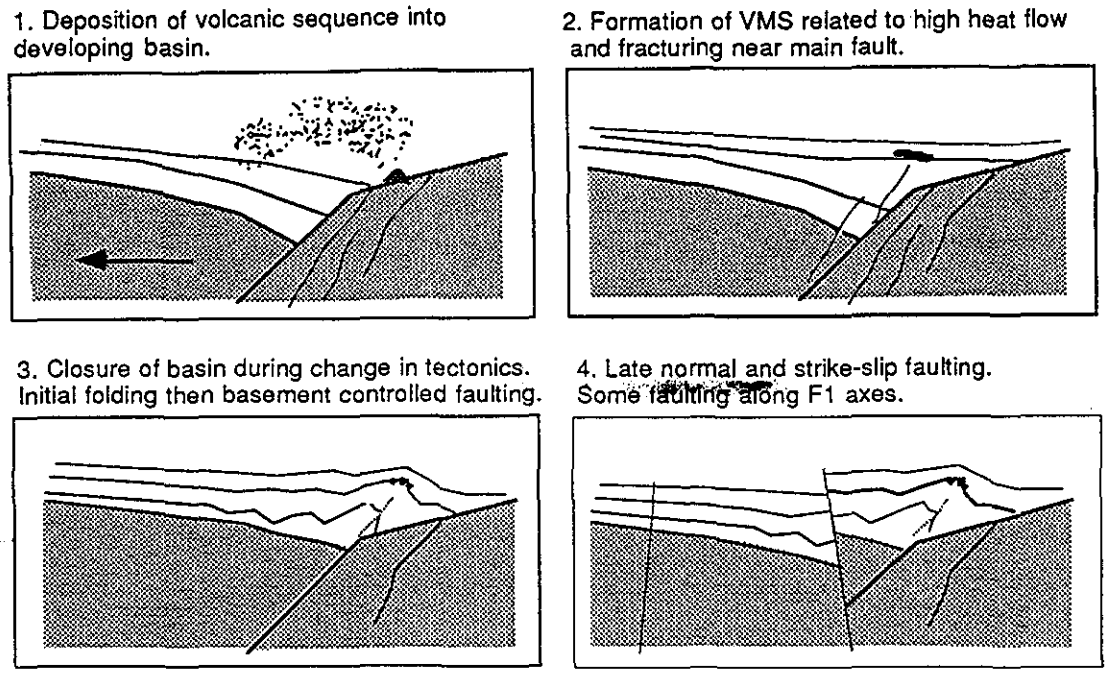

Figure 7: Schematic model of basin formation showing timing of main structural events.

4. SPECIAL CONSIDERATIONS FOR THE MODEL

A number of points should be made regarding features that are ambiguous or poorly explained by the proposed model.

Assuming the Henty Fault is the major bounding fault, then the structure controlling Hellyer and Que River, and possibly Mt Charter, should be either a synthetic or antithetic normal fault. Synthetic and antithetic refer to its dip direction with respect to the master fault, as illustrated in Figure 7. Dip direction can be inferred from the style of folds produced by reverse movement on the fault. It should be expected that the folds over these basement faults will be asymmetric, particularly at higher strains, and the steepest limb of the fold will be on the footwall side. This may serve as a guide to where the fault contact is at depth. Based on the fold asymmetry at Hellyer the controlling fault is probably west dipping. The indication of fault dip from the fold asymmetry can be tested against the interpreted thickness of sediment changes across the fault, though at high strain these dimensions will be difficult to calculate. If Hellyer does lie on a west dipping syn-sedimentary fault the sediment thickness should be greatest in the area of the Hellyer Anticline. This has not been examined in this report but if this

aspect of the model can be tested at Hellyer it may provide important guides to the deep drilling at Mt Charter.

It should also be considered that not all basement faults have been re-activated sufficiently to produce folding in the cover sediments. If VMS have developed on such faults then strain in the cover sequence will provide no guide to finding such deposits. Assuming the faults will have significant normal displacements preserved they should be detectable by other means, such as gravity or possibly magnetics. Interpretation of such data sets should consider the style of response produced by the change in depth to basement or possibly the difference in thickness of units with growth onto the fault. In particular, the magnetics should map a relatively low frequency response associated with sediment thickness against the fault. It is important to note that if Hellyer and Que River do sit on a reactivated basement fault the original displacement on this structure has been reduced and would have less detectable expression.

5. PREVIOUS INTERPRETATIONS

The report by Peter Komyshan (internal memo September 1987) places the F1 and F2 fold events described in this report in the opposite order. The diagram illustrating the unfolding of the two events (Figure 3) shows that there is only one way of grouping the data onto two planes, i.e. the limbs of the latest fold event. ??

Suggestions presented in the paper by Rattenbury regarding the Mt Charter fault are contrary to the observations in this study that the fault is a late feature with predominantly normal movement. If the evidence for significant changes in thickness in stratigraphy suggests these are directly related to the fault then it may be that the fault has an early syn-depositional origin. However, the trace of this structure in the 1:10,000 scale interpretive geology, which is presumably more detailed than the mapping available in Rattenbury's work, indicate the fault is significantly less deformed than the adjacent stratigraphy. If related to an early structure then the present fault can only be the result of new faulting on a reactivated early structure, though there seems little need to invoke such processes in order to explain the observed geometries. Other observations in the Rattenbury paper are generally consistent with the structures described in this study, although his conclusions on their significance may differ.

6. IMPLICATIONS FOR WORK ON MT CHARTER PROSPECT

In applying some of the concepts developed during this study to the Mt Charter area there arises a few ideas which may be useful in interpreting data from work in this area.

Most significantly the findings give encouragement that Mt Charter is of similar structural setting to Hellyer and Que River. This is based on the situation of the prospect on the same N-S trend as the other deposits, though this trend is now displaced by the fault south of Que River. The mapped indications of fold closure support the presence of an underlying basement structure, though the structural geometry at Mt Charter is somewhat complicated by adjacent faults to the SW. The presence of the barite cap at Mt Charter could provide an interesting addition to the proposed model with the possibility that the barite is remobilised during deformation and has precipitated as a saddle-reef higher in the stratigraphy above the source mineralisation. A similar model has been proposed for the precious metal deposits on the Henty Fault, which are thought to have originated from VMS mineralisation.

It is difficult to pursue any model for Mt Charter without first reinterpreting the structure. Much of the information must come from drilling, due to lack of exposure, but more surface structural information is vital. The present mapping shows complexities that cannot be explained. Basalt Lava to the south of Mt Charter suggest a south plunging syncline strikes through the barite zone, though an adjacent F1 fold is interpreted as synclinal in contradiction of the F1 plunges (see Figure 8).

7. RECOMMENDATIONS

The most immediate implications of the results from this study are for the interpretation, or re-interpretation, of ore position targets in planned drilling. The results of this study show that important features of the structure in the Hellyer area are not evident from the outcrop mapping. Complexity due to fold interference and faulting can cause significant problems in the geological interpretation, resulting in an incorrect model of the attitude of bedding and therefore incorrect interpretation of drill targets. By more representative sampling of bedding orientations, and routine analysis of this data during interpretation of outcrop, a far more accurate model can be achieved for three dimensional geometry of lithologies. Use of the stereonet in analysing bedding planes can also provide accurate projections of apparent dip in constructing geological sections.

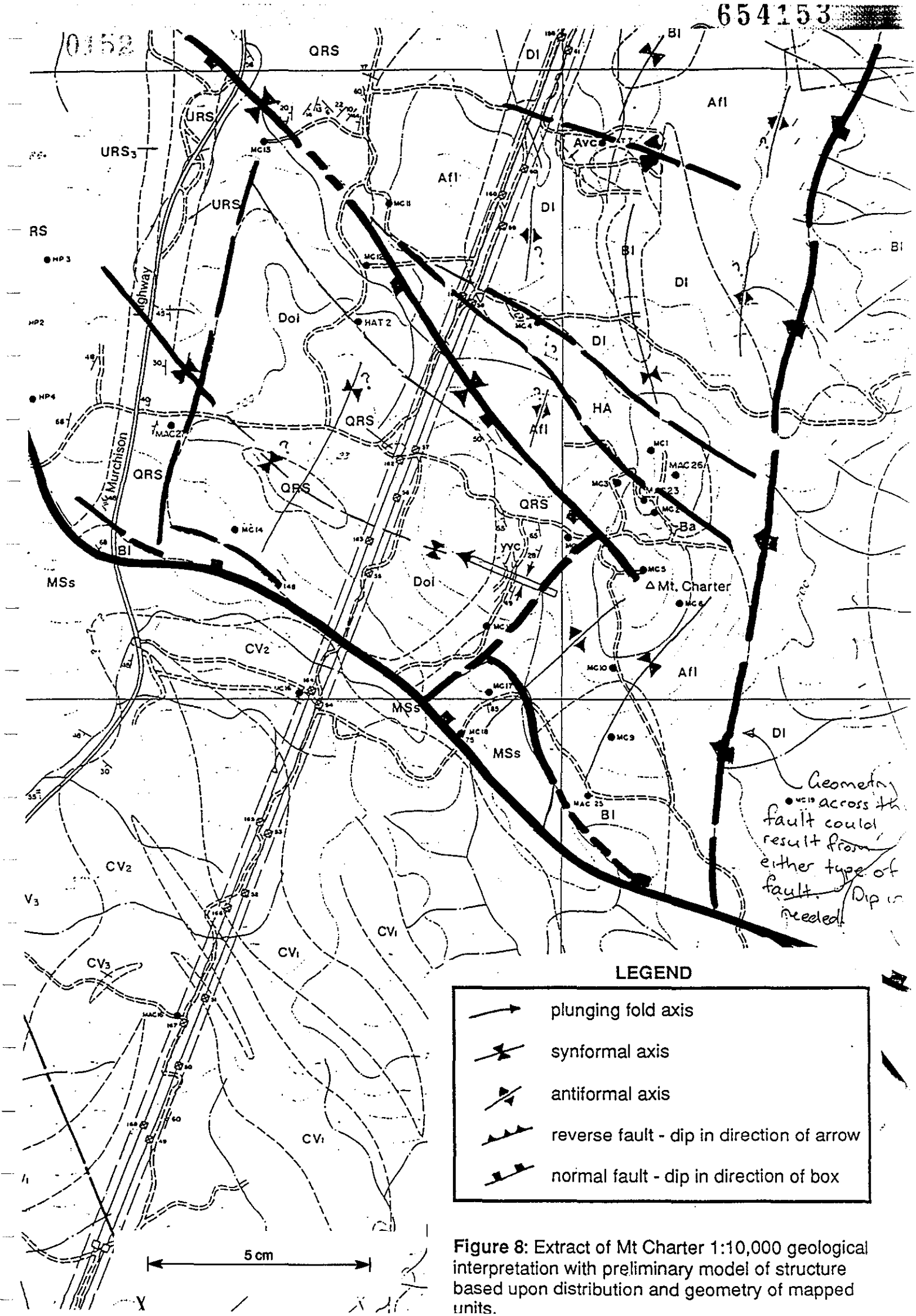

Figure 8: Extract of Mt Charter 1:10,000 geological interpretation with preliminary model of structure based upon distribution and geometry of mapped units.

Considering the scale of the proposed drilling program the construction of an accurate three dimensional model of the geology is going to be fundamental in planning and interpreting the drilling. The effort involved in such an exercise must be justified many times over by the more effective planning of the drilling. Logistically the problem in constructing such a model demands it should probably be constructed using a specialised computer package. Increased flexibility and time saving of a computer model would be most important. The expertise in this area already exists with the mine geologists.

Special attention should also be given to the proposed orientations of future diamond holes. If the main considerations are maximising the structural and lithological information in reaching a target then drilling at a high angle to the bedding orientation is essential. This can most only be planned if good structural data is available, and then most easily calculated on the stereonet (see Figure 9). In doing this it should be possible to minimising problems in core recovery due to drilling down orientations near the intersection of major joint populations. The relationship between bedding, jointing and joint intersections and drill orientations is illustrated using a stereonet projection in Figure 9.

Some effort was made in this study to develop a means of orientating core from the geometric relationships between bedding, jointing, fabric development, etc. There were no conclusive results in this area, though I do believe a great deal more information could be gained from the structural data in the core. Even if only limited accuracy can be achieved it may be possible to identify from drill core which limb of a fold the core is within and the approximate dip. This would add an extra dimension of confidence to cross-sectional interpretations. Some methods for solving these types of problems have been published in recent press and may be of use.

From the model of structure presented in this report there is many important implications for understanding and targeting VMS deposits in the Hellyer-Que River area. Whilst the specific details of structural geometry around Hellyer should be relatively accurate, given the data they are based upon, the overall model is purely an attempt to synthesise these observations. With regard to developing the model the next steps are clearly to test other observations of lithology, chemistry etc. within this framework. This is independent of the problems in understanding structural geometry of the area and should be clearly separated. Understanding the geometry is essential in the immediate exploration problems and is virtually unrelated to the genetic model of the VMS. The

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Area A shows the main grouping of poles to bedding for a typical site (similar to location 11). At high angle to the bedding planes are the range of poles to joint families shown at B. The mean of this distribution of joint planes is shown as X with the great circle representing the mean plane. For a drill hole to most efficiently represent the stratigraphy it should be orientated perpendicular to the bedding, but in many cases this will also place the hole orientation close to the orientation of maximum joint planes intersections. This may lead to poor recovery and difficulties in drilling. The ideal orientation can only be planned with representative sampling of the structure. Plotting of the structural planes onto the stereonet allows planning of a hole orientation at a high angle to bedding whilst avoiding the orientations of major joint intersections, such as at D.

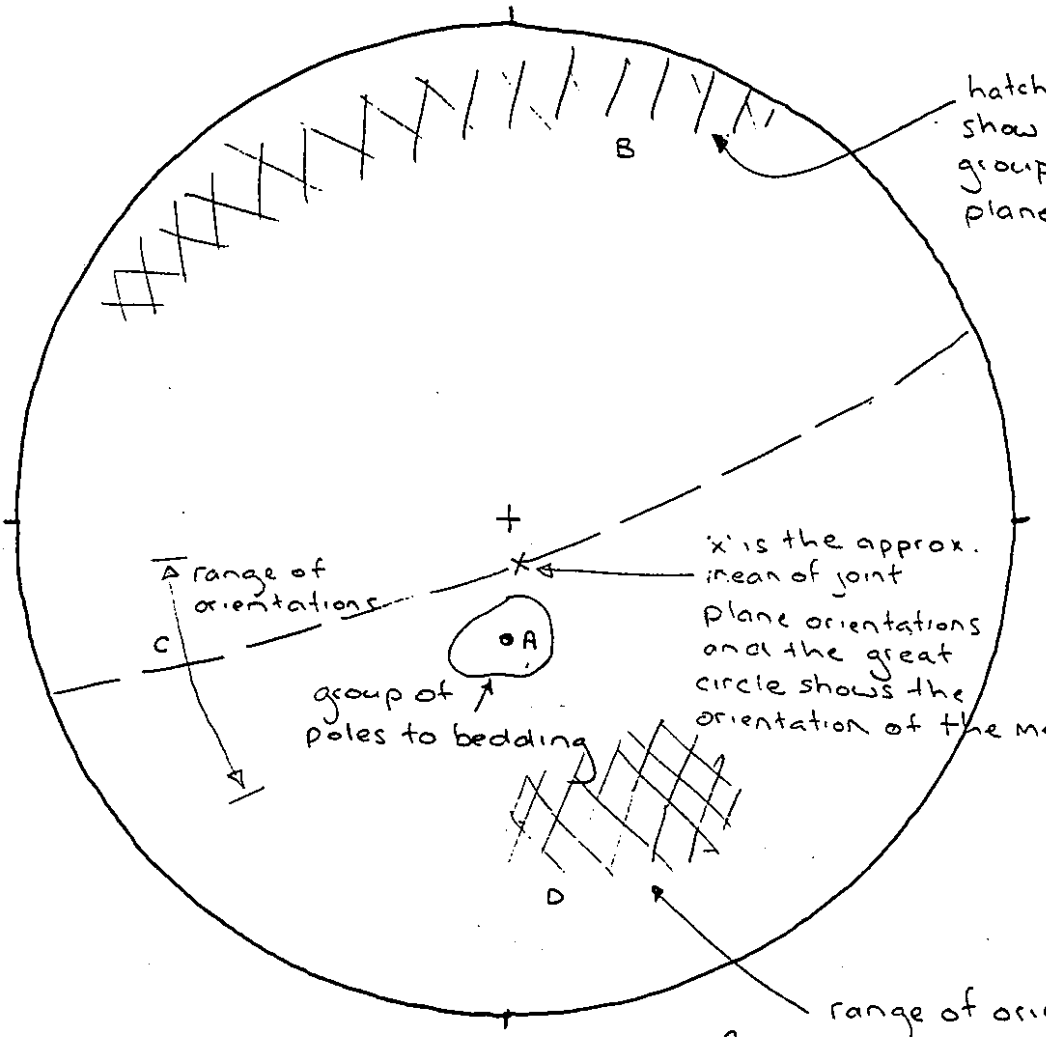

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Figure 9: Relationships between major structural elements and drill hole orientations.

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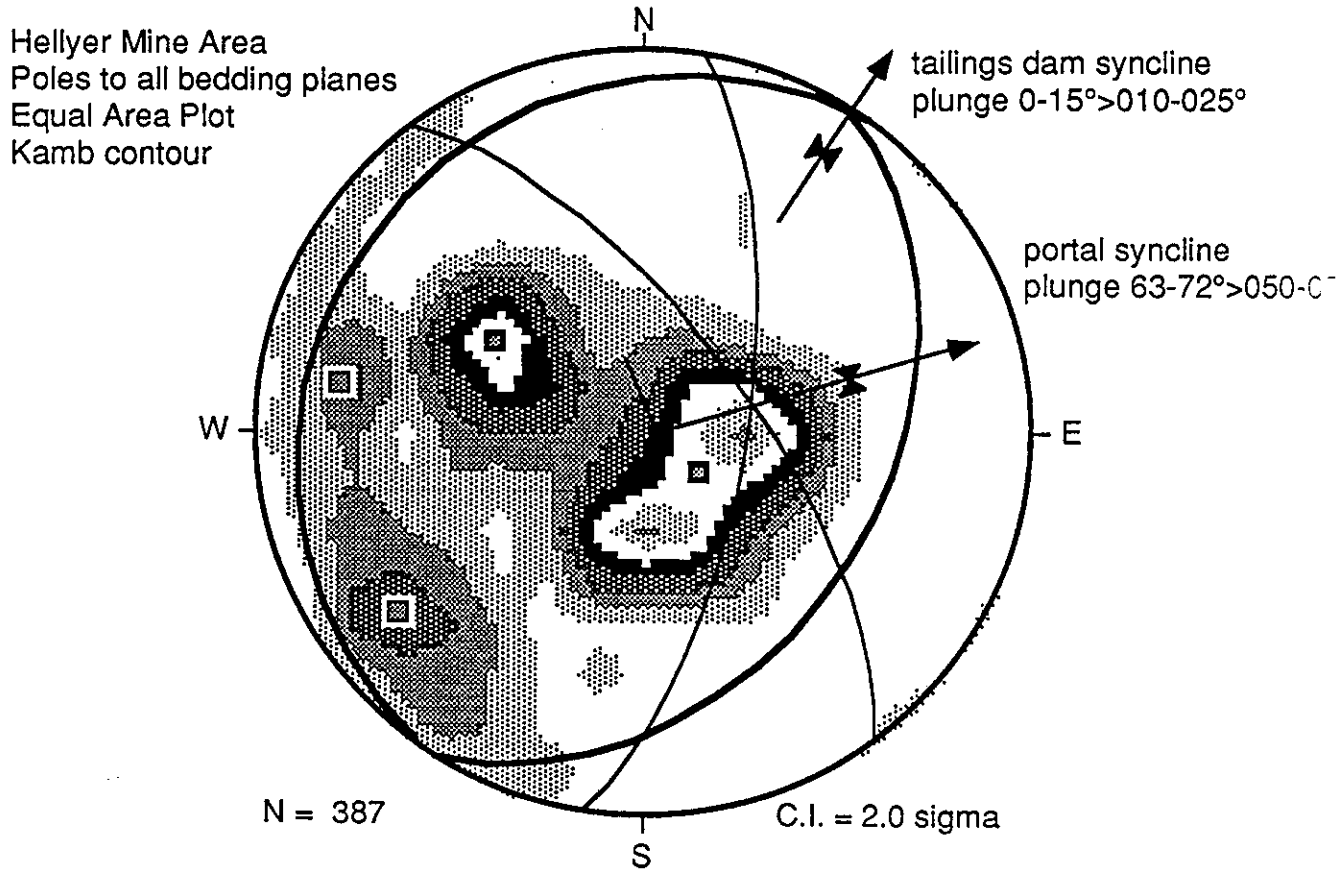
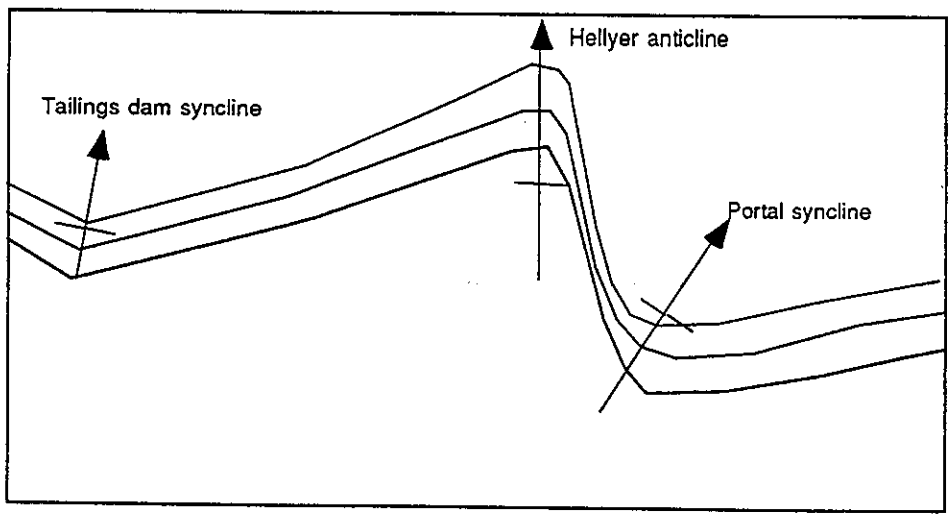
geometry at Hellyer is a model that can formulated and refined continually with little extra effort and significant improvement in results.

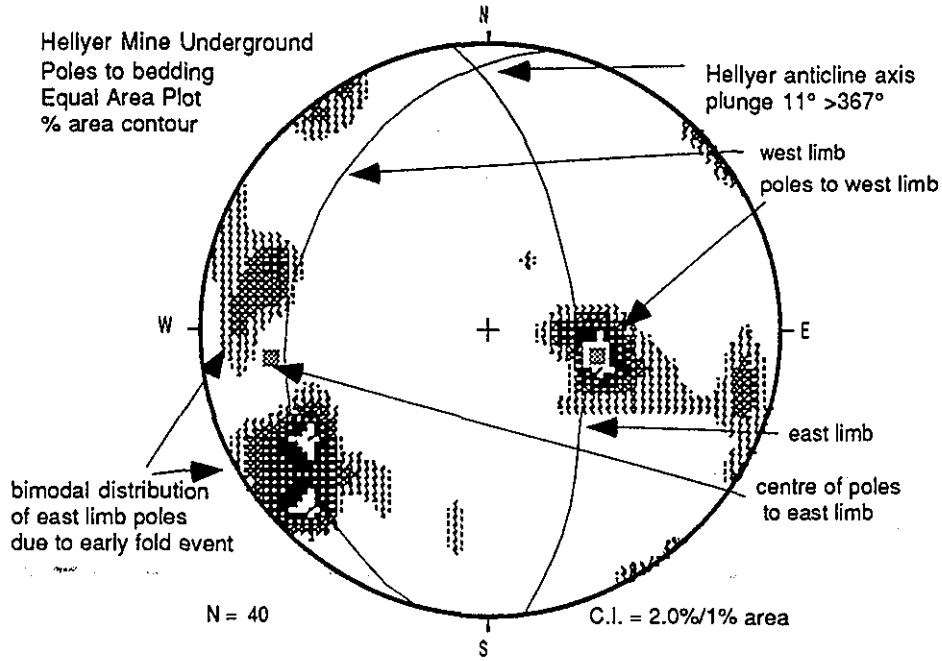
APPENDIX 1: Stereonet plot illustrating the geometry and orientation of the Portal Syncline and the Tailings Dam Syncline. The diagrammatic section at bottom illustrates the asymmetry of the Hellyer anticline and its irregular nature with respect to the adjacent synclines.

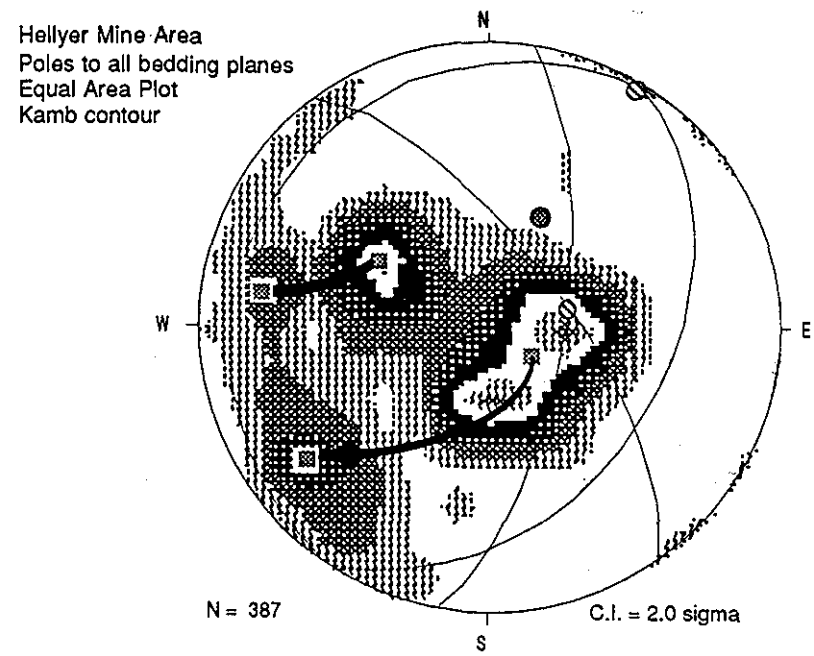




Diagrammatic illustration of major fold closures in Hellyer area

APPENDIX 2: Stereonet illustration of the Hellyer anticline. The illustration at bottom shows the change in orientation of bedding during transposition into the high strain zone.

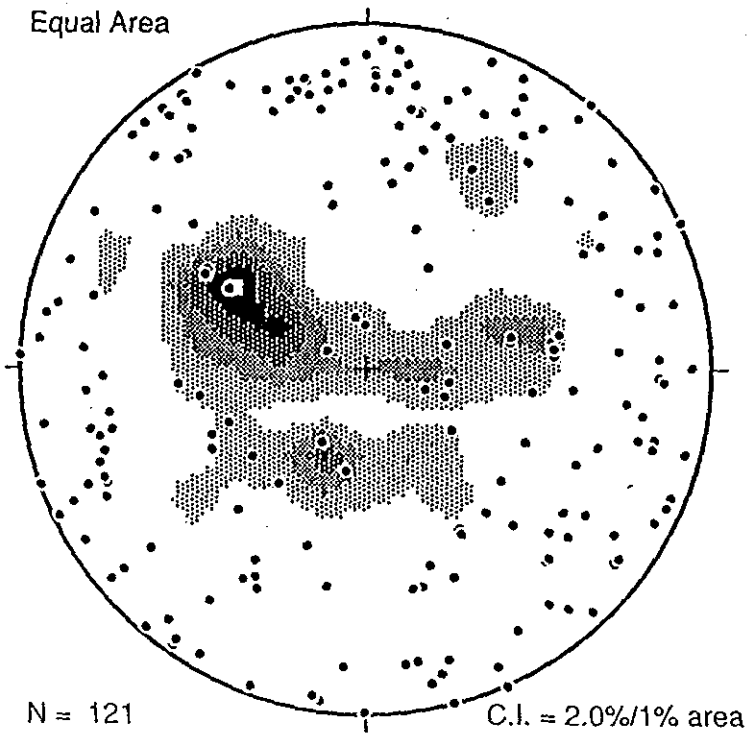




0156

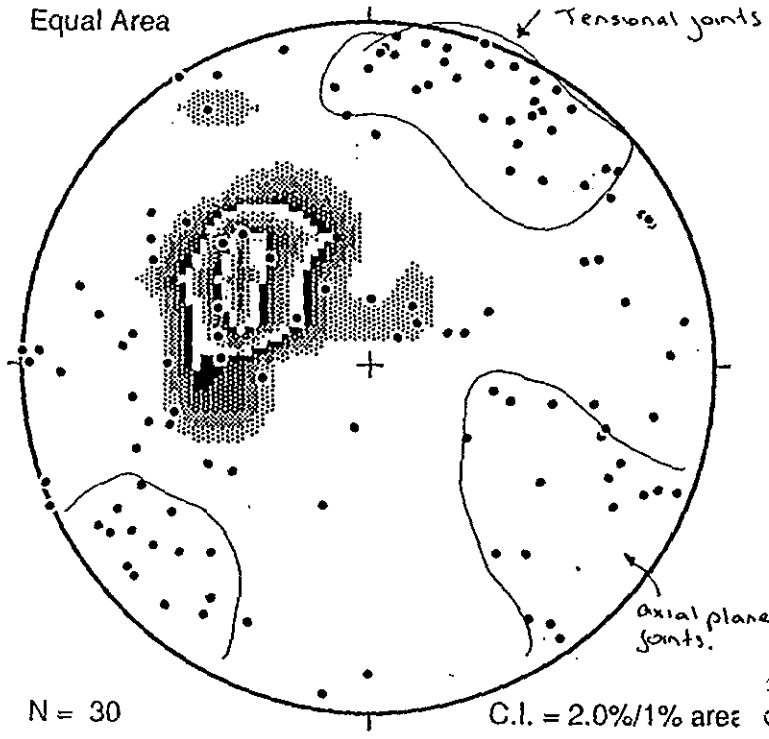
Appendix 3A: Individual plots of contoured poles to bedding and point plots of poles to joint surfaces for locations 1 to 37.

LOCATION 1 BEDDING AND JOINTS



Mica Sandstone

LOCATION 2 BEDDING AND JOINTS

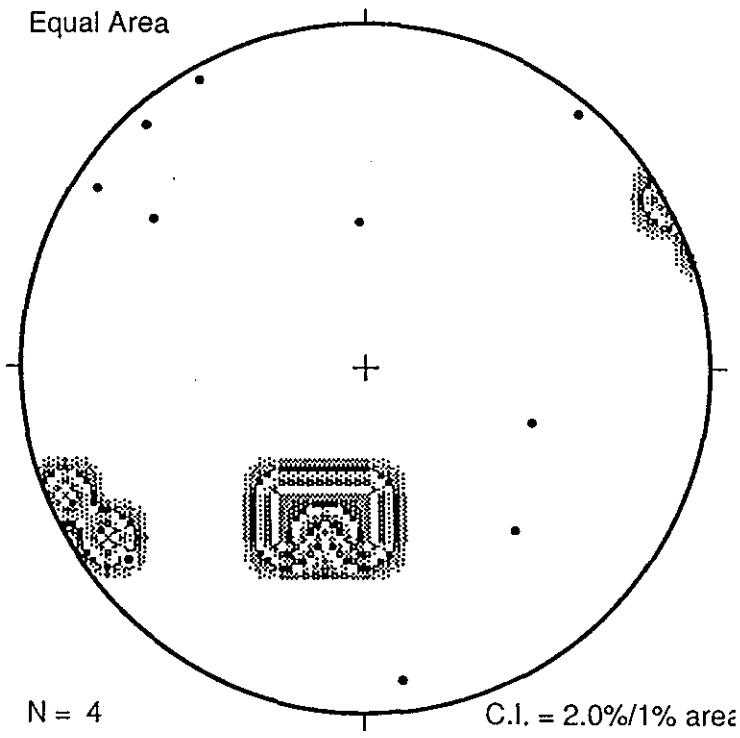


Cue River Shale

6541599

LOCATION 4 BEDDING AND JOINTS

Equal Area

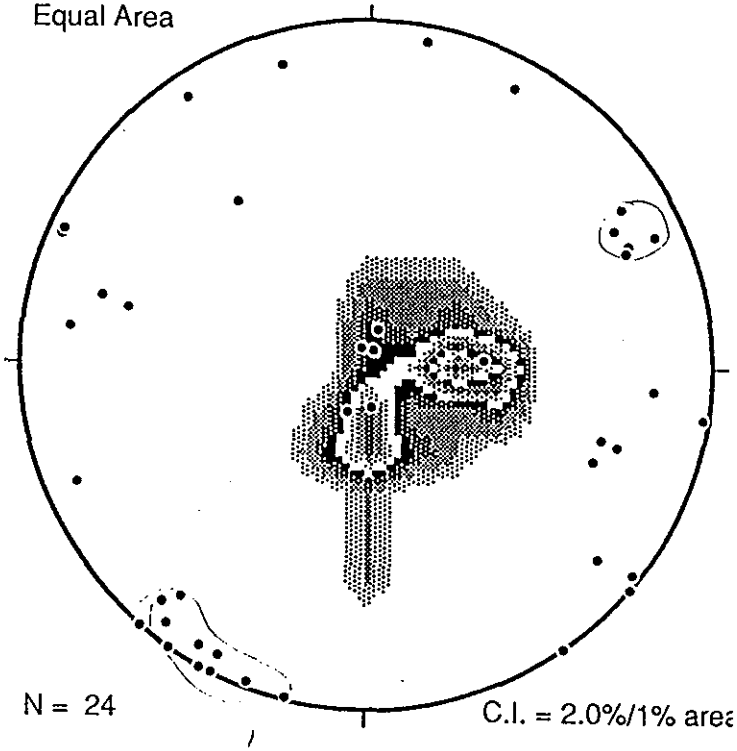


N = 4

C.I. = 2.0%/1% area

LOCATION 5 BEDDING AND JOINTS

Equal Area



N = 24

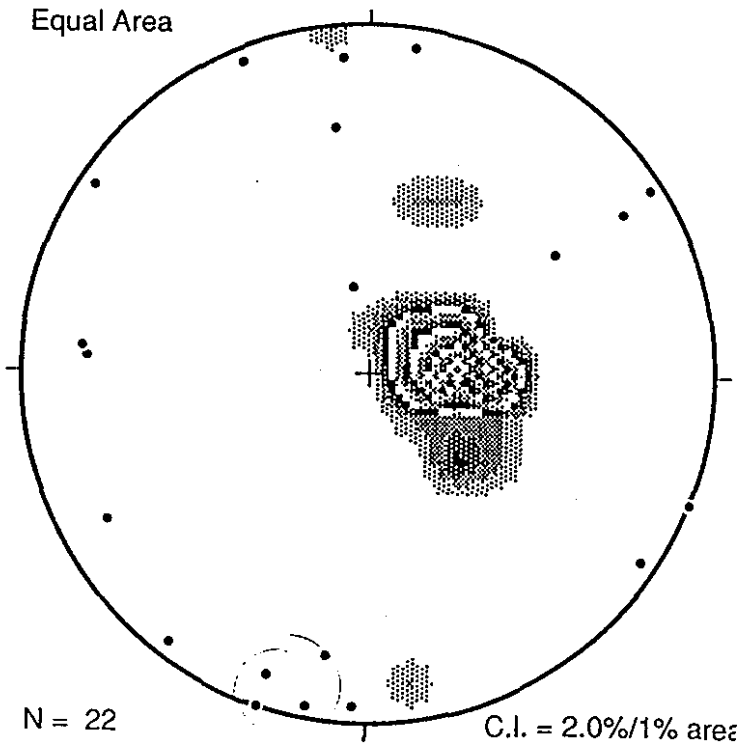
C.I. = 2.0%/1% area

654160

0160

LOCATION 6 BEDDING AND JOINTS

Equal Area

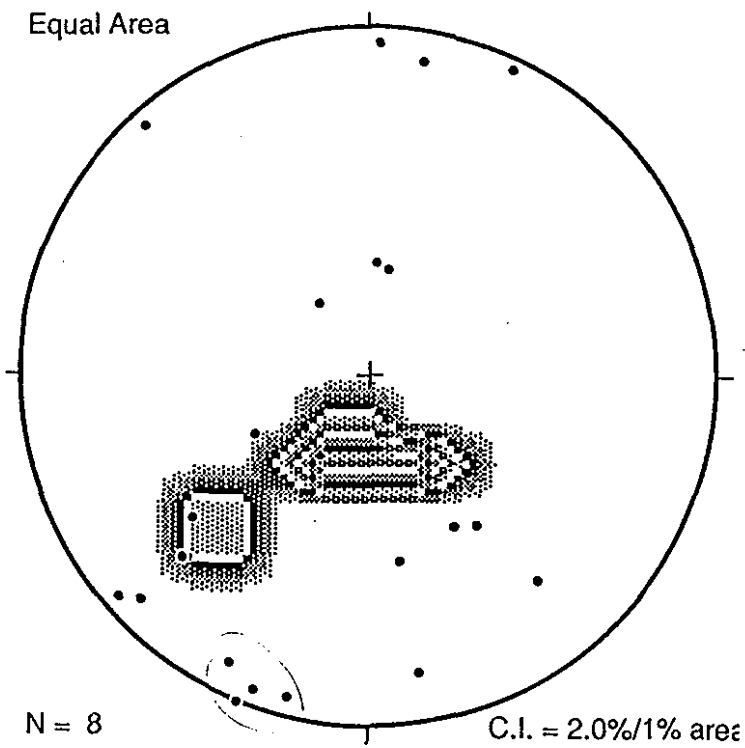


N = 22

C.I. = 2.0%/1% area

CATION 7 BEDDING AND JOINTS

Equal Area



N = 8

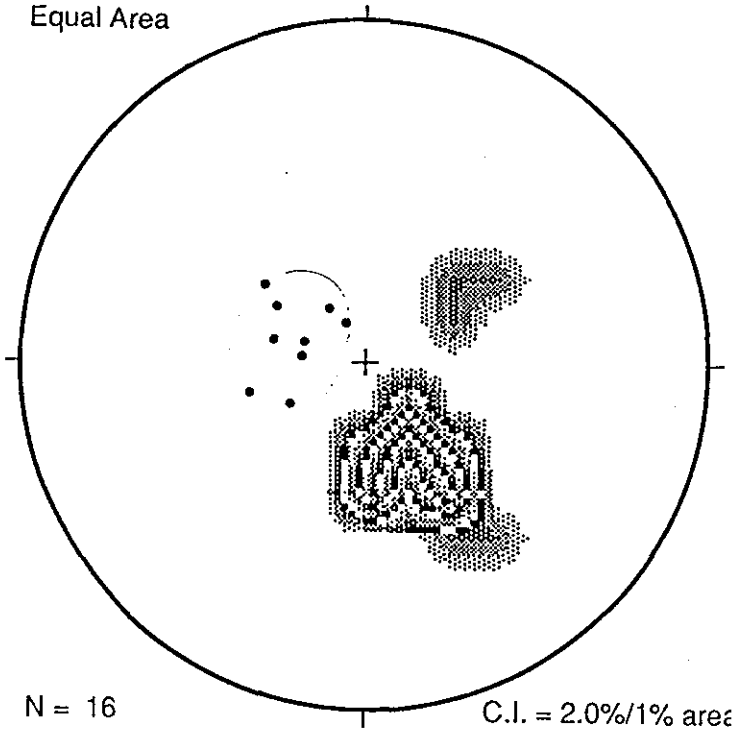
C.I. = 2.0%/1% area

6541161

0194

LOCATION 8 BEDDING AND JOINTS

Equal Area

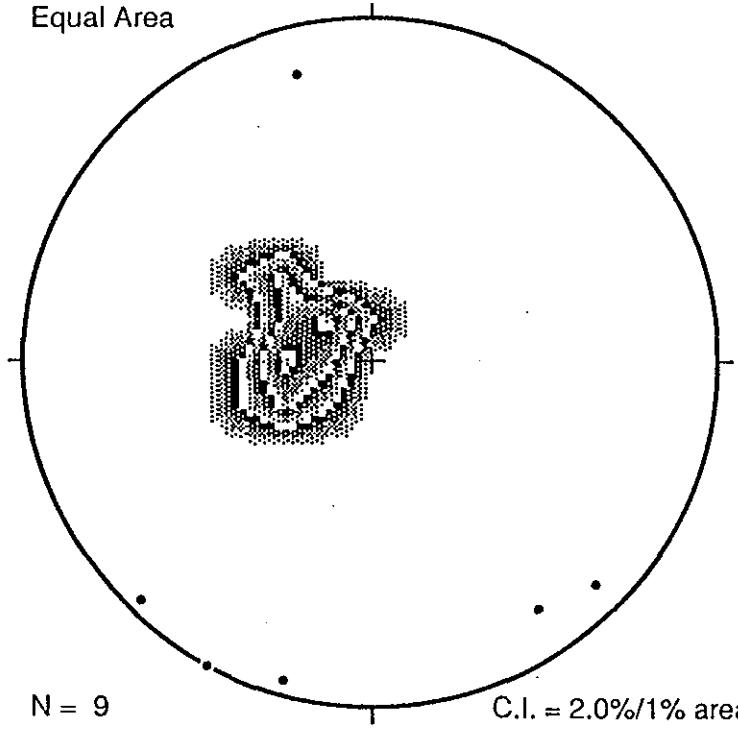


N = 16

C.I. = 2.0%/1% area

)CATION 9 BEDDING AND JOINTS

Equal Area

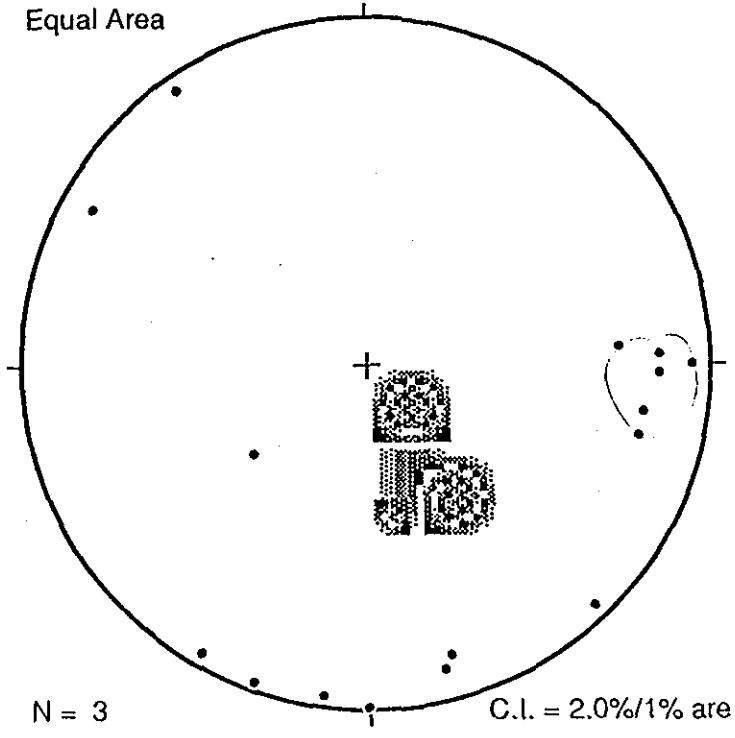


N = 9

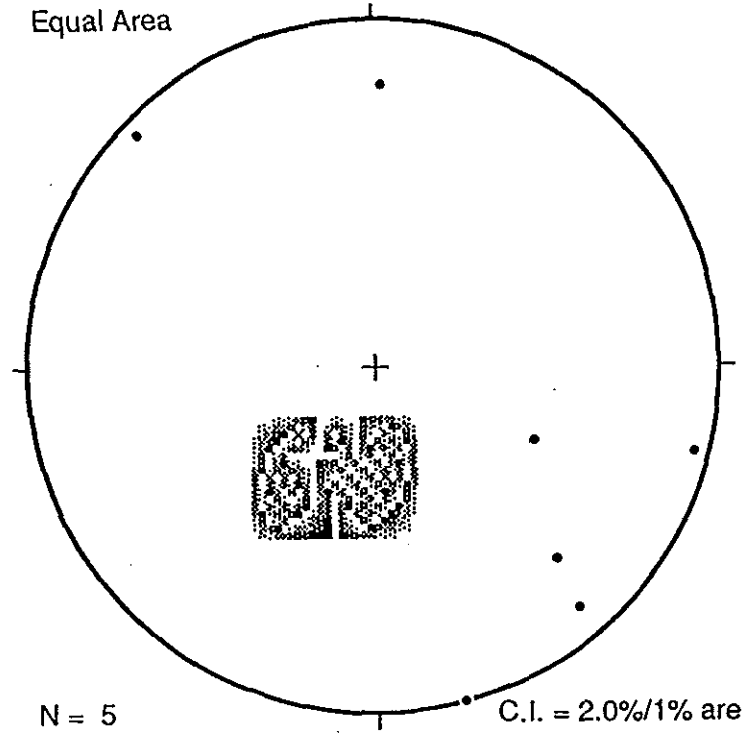
C.I. = 2.0%/1% area

6541162

LOCATION 10 BEDDING AND JOINTS



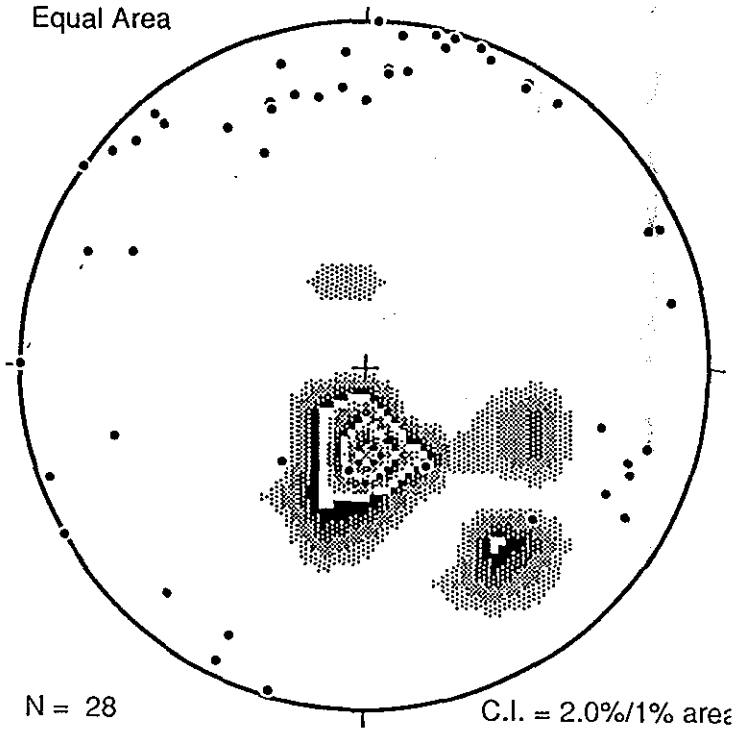
LOCATION 11 BEDDING AND JOINTS



654163

LOCATION 11 BEDDING AND JOINTS

Equal Area



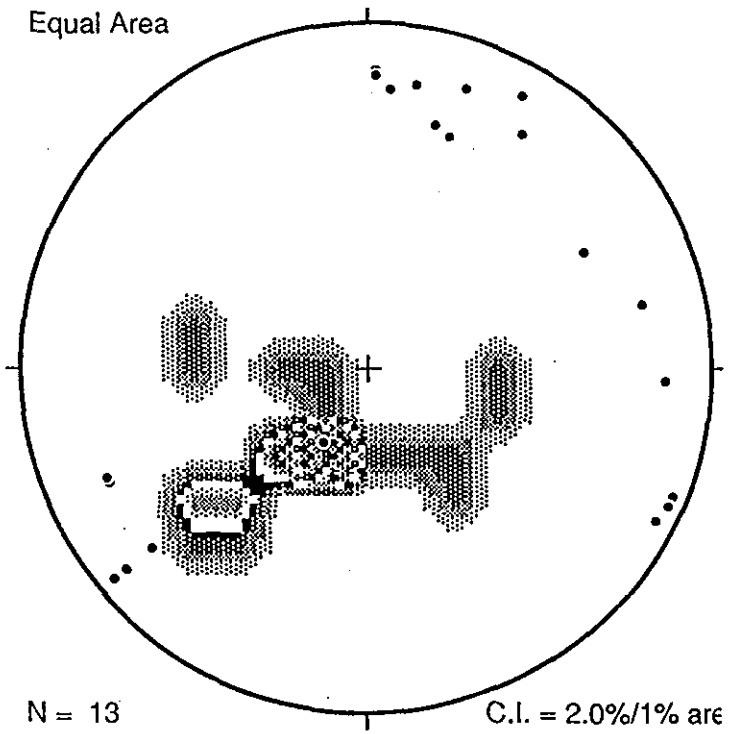
N = 28

C.I. = 2.0%/1% area

joints generally 90° to S_o

LOCATION 12 BEDDING AND JOINTS

Equal Area



N = 13

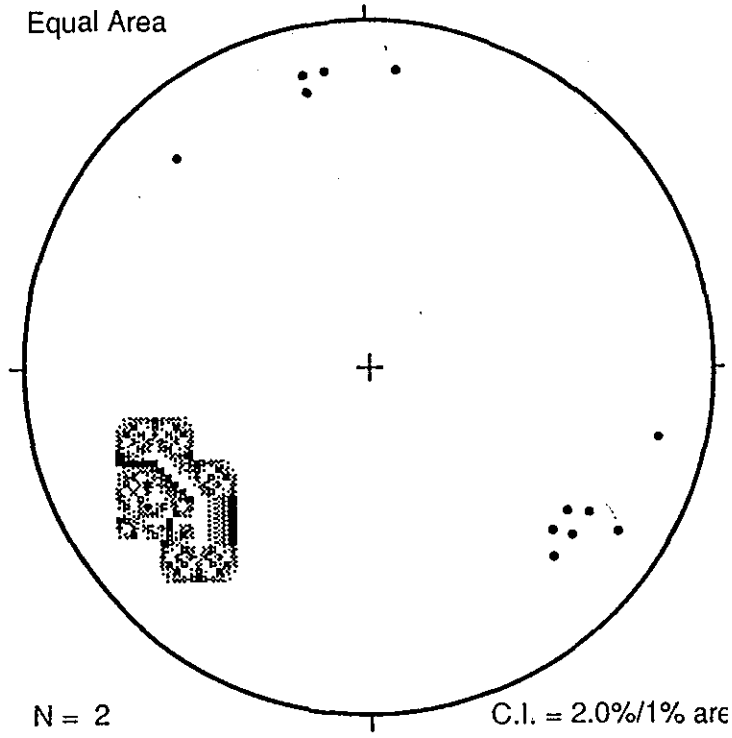
C.I. = 2.0%/1% are

Joints @ 90 to S_o

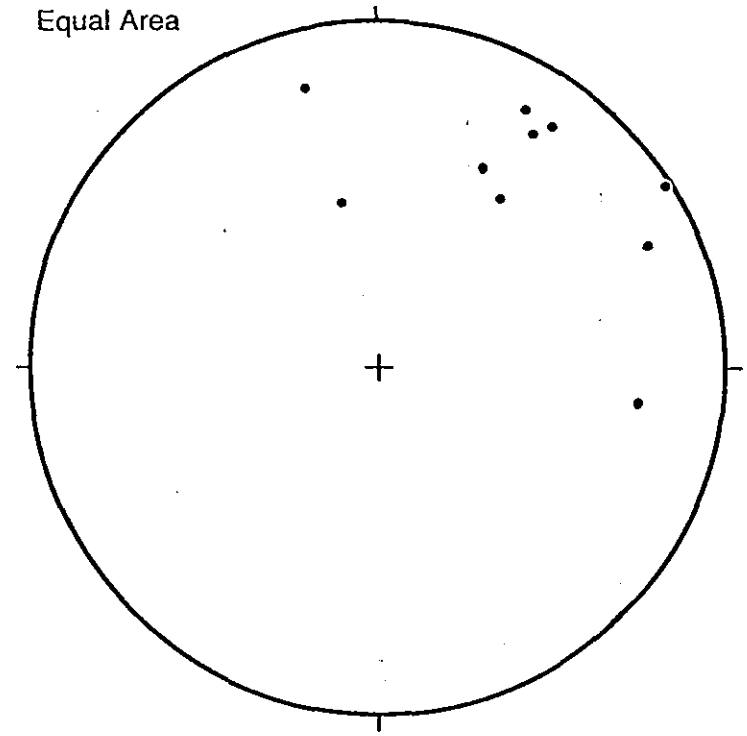
654164

0164

LOCATION 13 BEDDING AND JOINTS



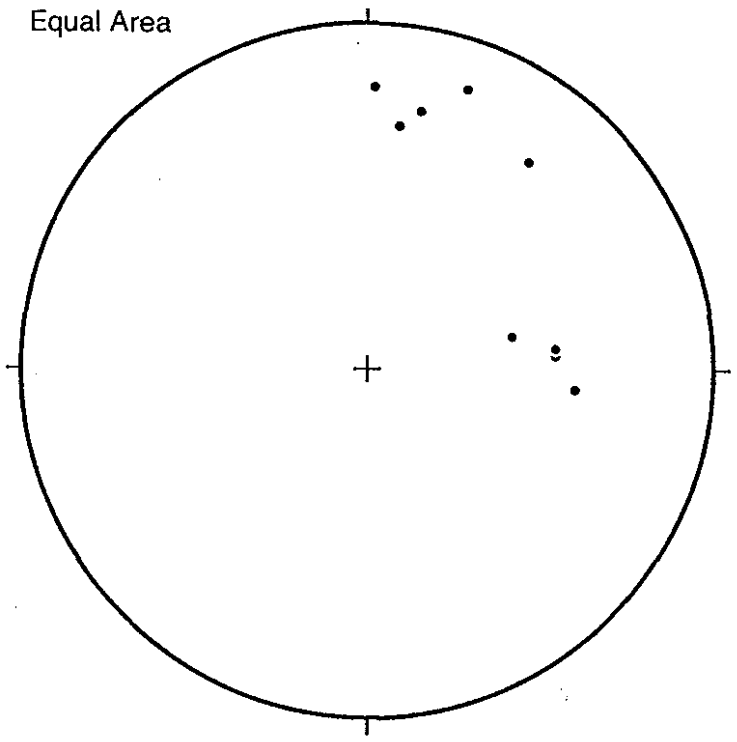
LOCATION 14 BEDDING AND JOINTS



6541165

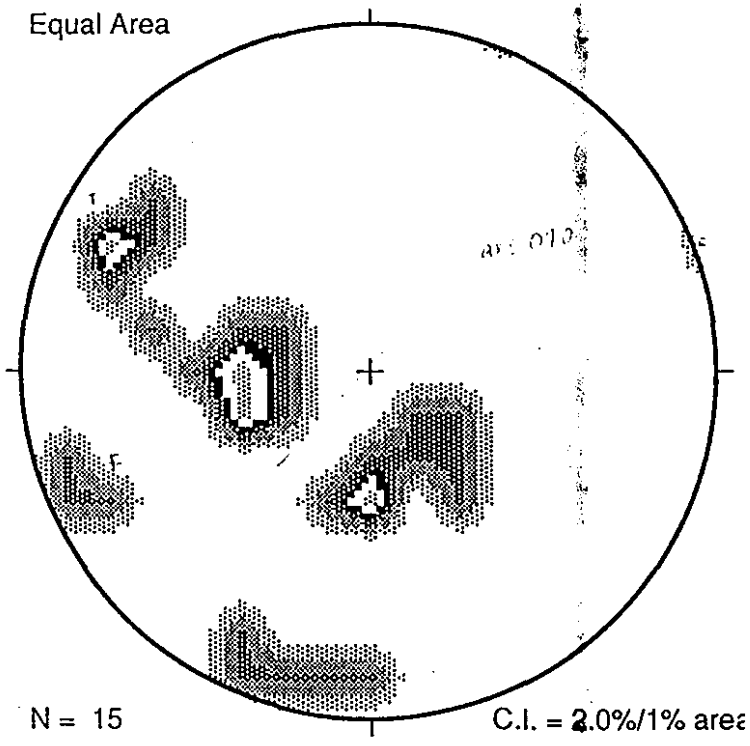
LOCATION 15 BEDDING AND JOINTS

Equal Area



LOCATION 16 BEDDING AND JOINTS

Equal Area



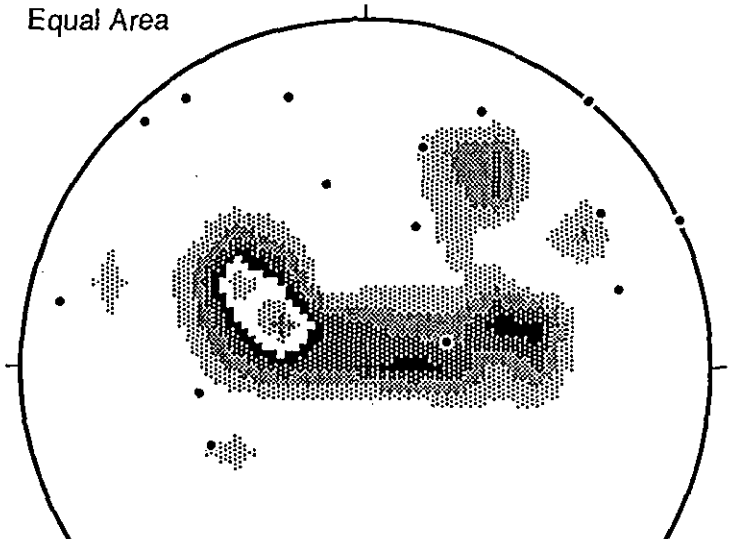
N = 15

C.I. = 2.0%/1% area

6541166

LOCATION 17 BEDDING AND JOINTS

Equal Area

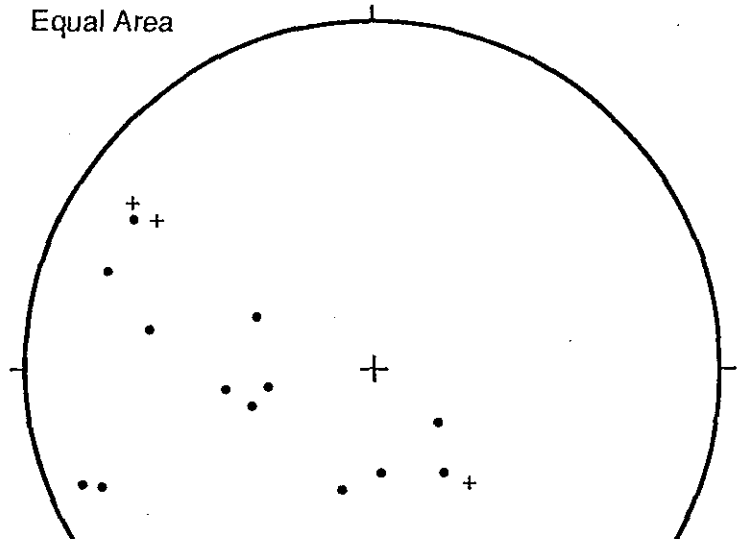


N = 65

C.I. = 2.0%/1% area

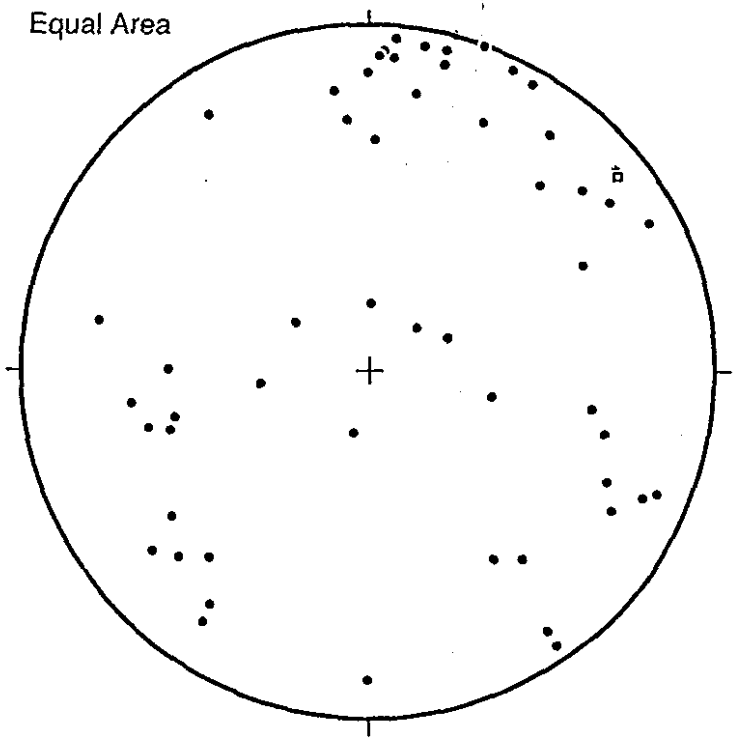
LOCATION 18 VEINS AND JOINTS

Equal Area



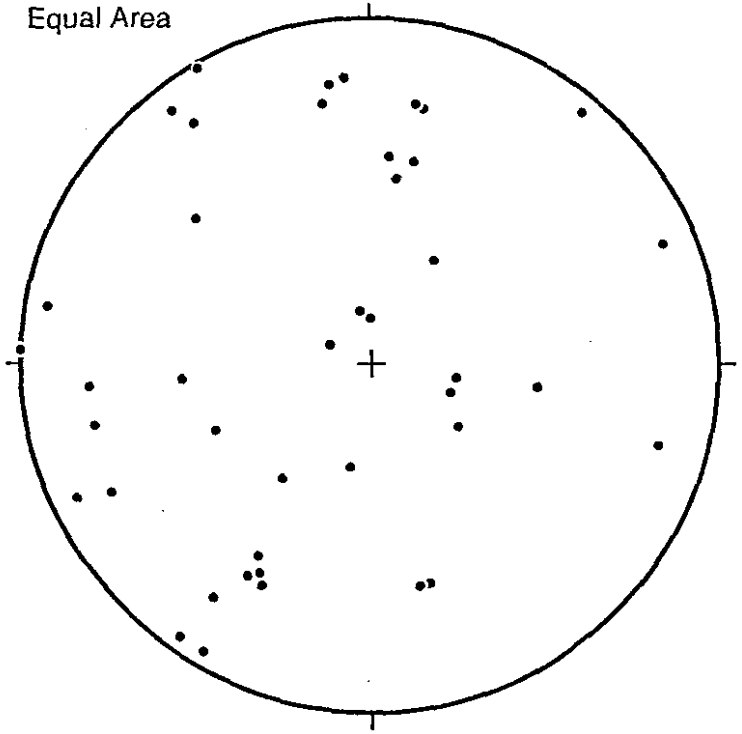
LOCATION 18/19 JOINTS

Equal Area



LOCATION 19 JOINTS

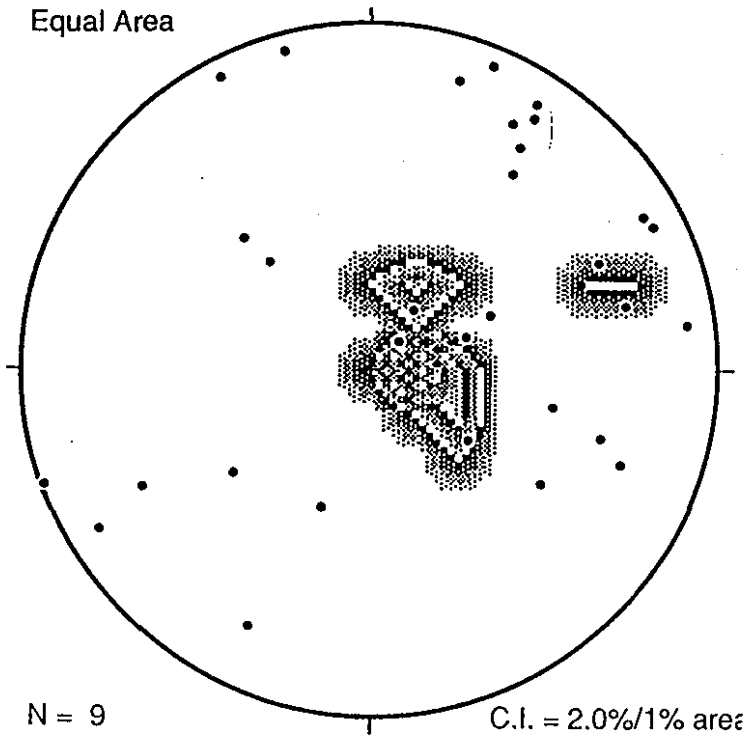
Equal Area



6541168

LOCATION 20 BEDDING AND JOINTS

Equal Area

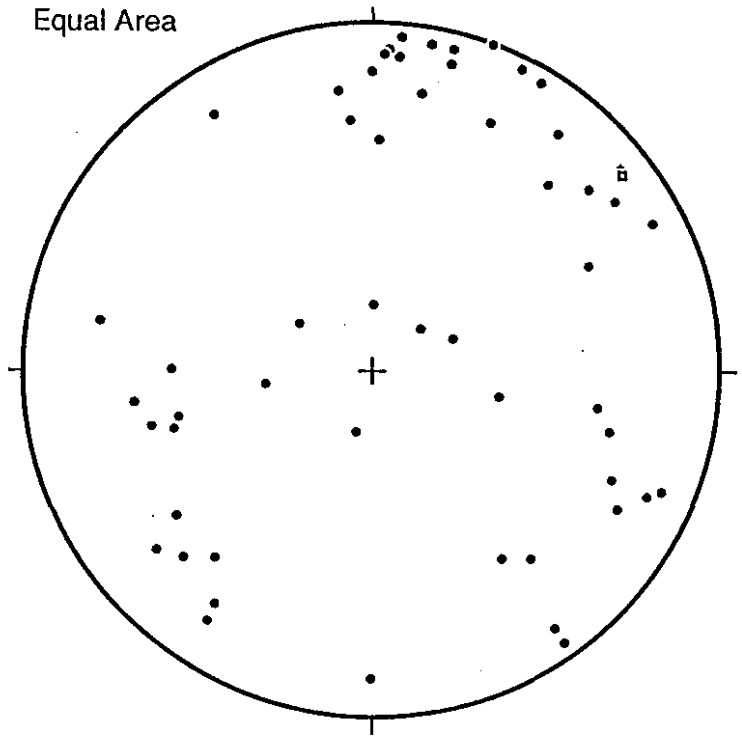


N = 9

C.I. = 2.0%/1% area

LOCATION 21/22 JOINTS

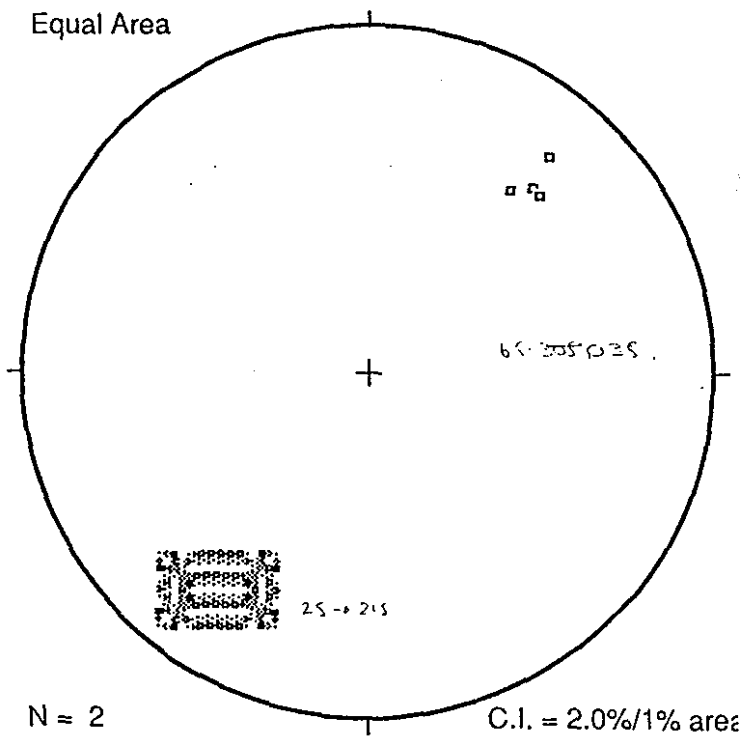
Equal Area



654169

LOCATION 30 BEDDING AND JOINTS

Equal Area

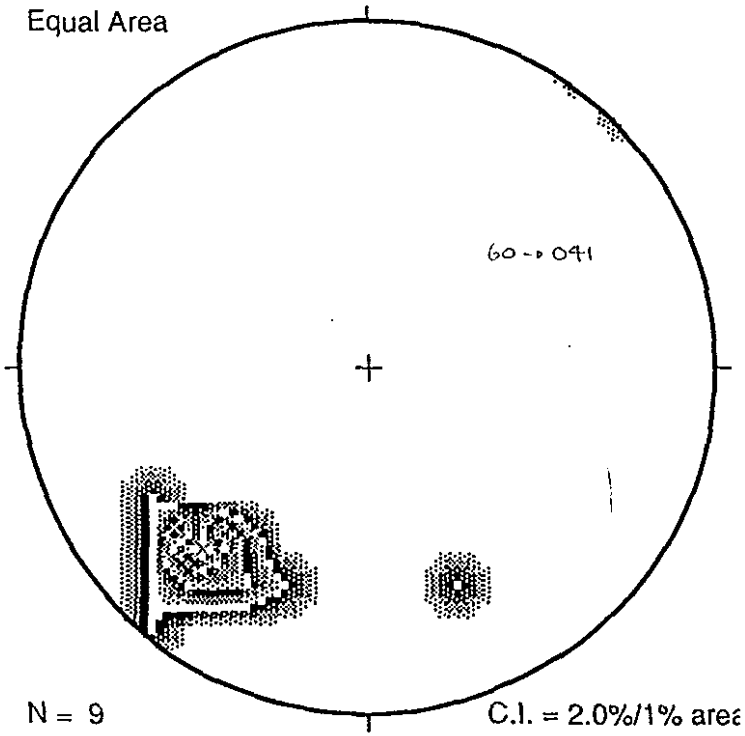


N = 2

C.I. = 2.0%/1% area

LOCATION 31 BEDDING

Equal Area



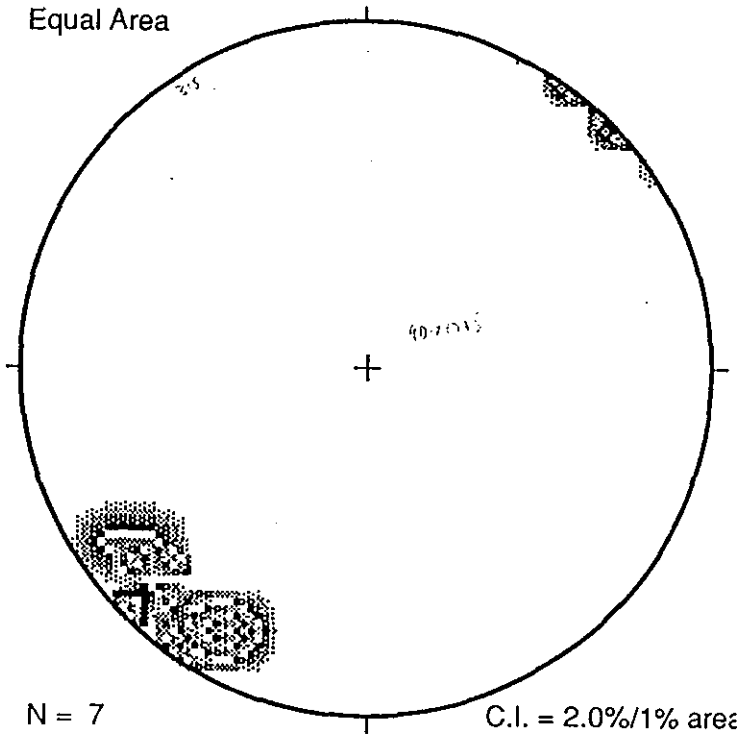
N = 9

C.I. = 2.0%/1% area

63470

LOCATION 32 BEDDING

Equal Area

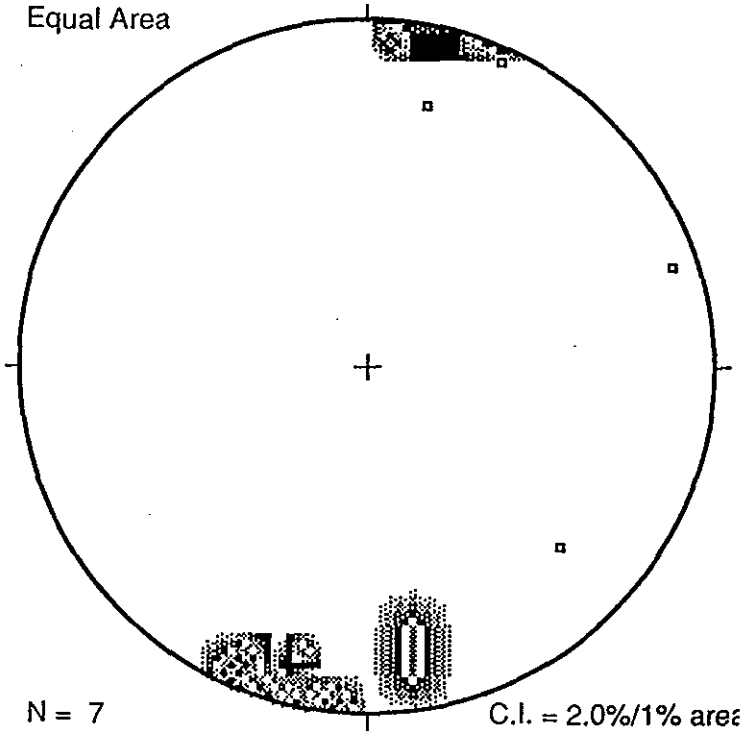


N = 7

C.I. = 2.0%/1% area

LOCATION 33 BEDDING AND JOINTS

Equal Area



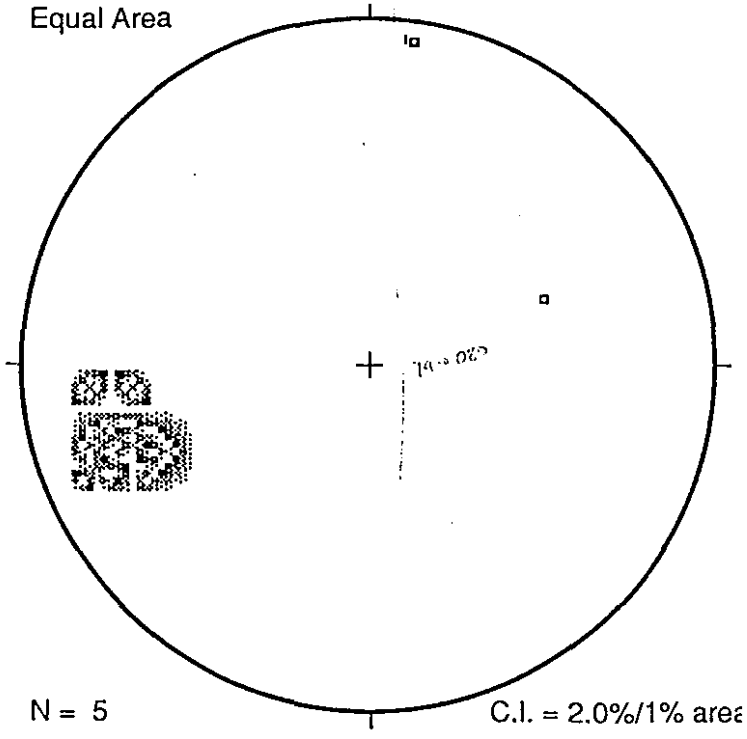
N = 7

C.I. = 2.0%/1% area

6541171

LOCATION 34 BEDDING AND JOINTS

Equal Area

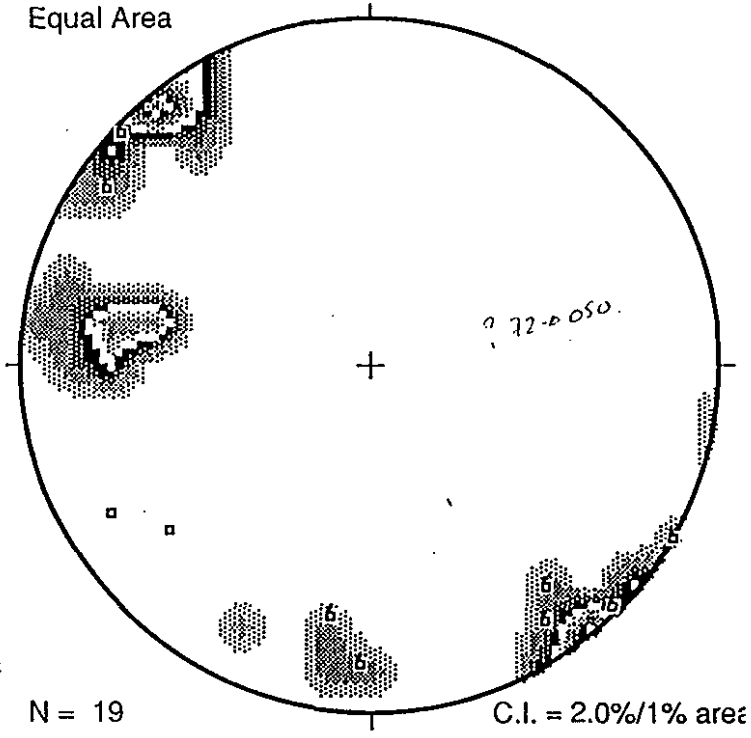


N = 5

C.I. = 2.0%/1% area

LOCATION 35 BEDDING AND JOINTS

Equal Area

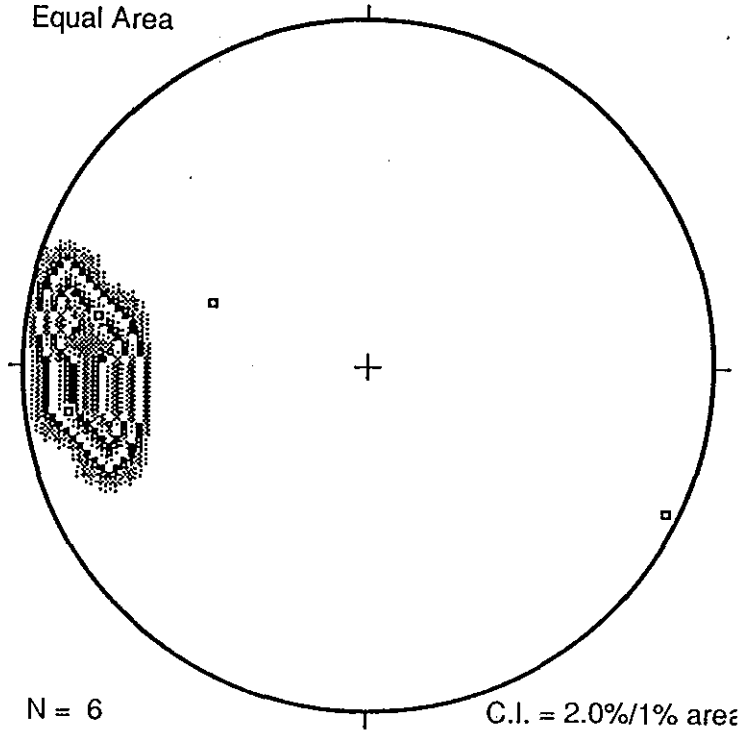


N = 19

C.I. = 2.0%/1% area

LOCATION 36 BEDDING AND VEINS

Equal Area

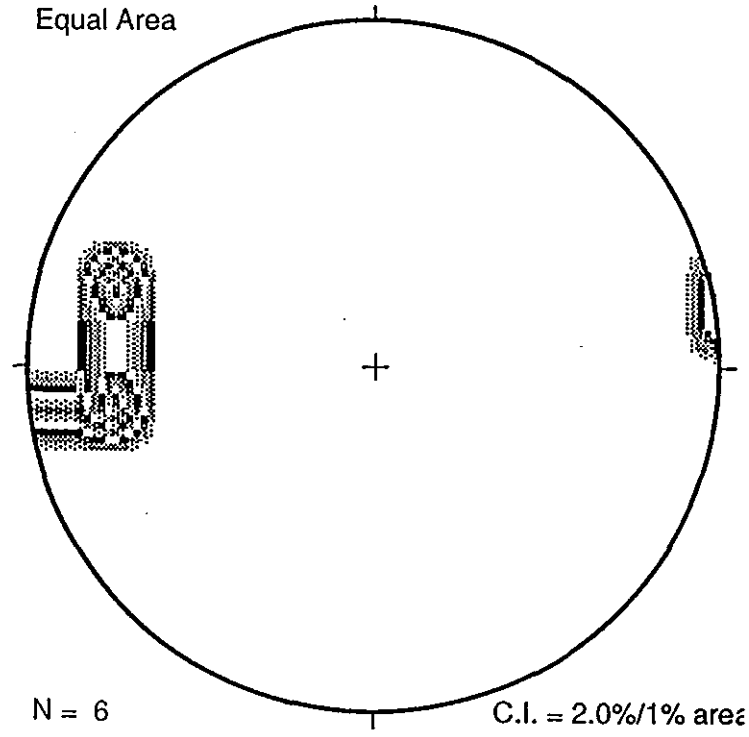


N = 6

C.I. = 2.0%/1% area

LOCATION 37 BEDDING

Equal Area



N = 6

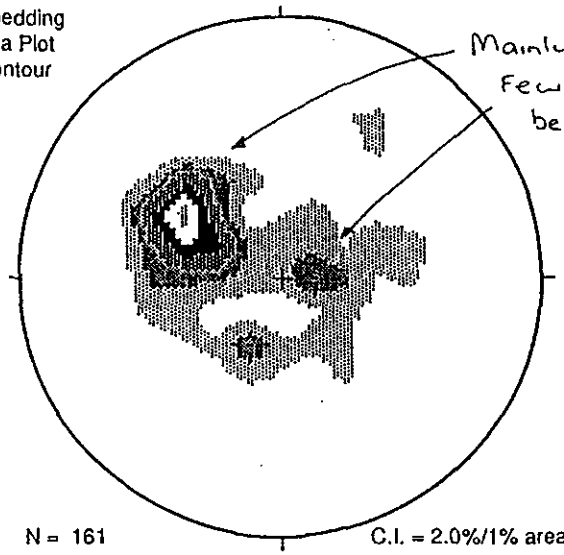
C.I. = 2.0%/1% area

01172

65417273

Appendix 3B: Summary of stereoplots showing contours of poles to bedding for groups of data exhibiting the major structural styles.

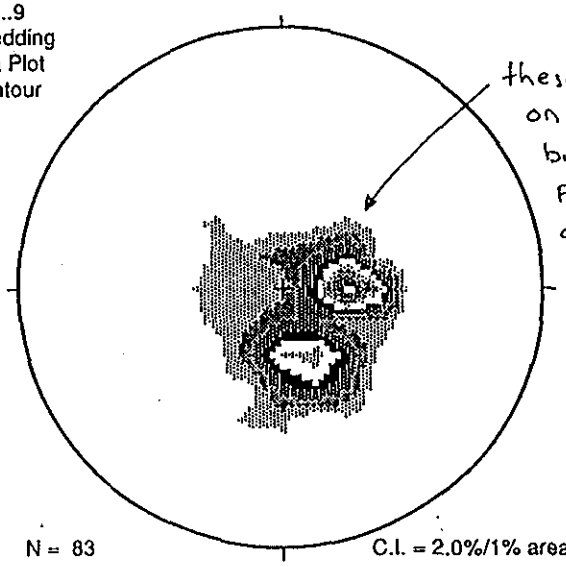
Hellyer Mine Area
Location 1...2
Poles to bedding
Equal Area Plot
% area contour



Mainly E limb. Few NW dips may be parasitic folds.

N = 161 C.I. = 2.0%/1% area

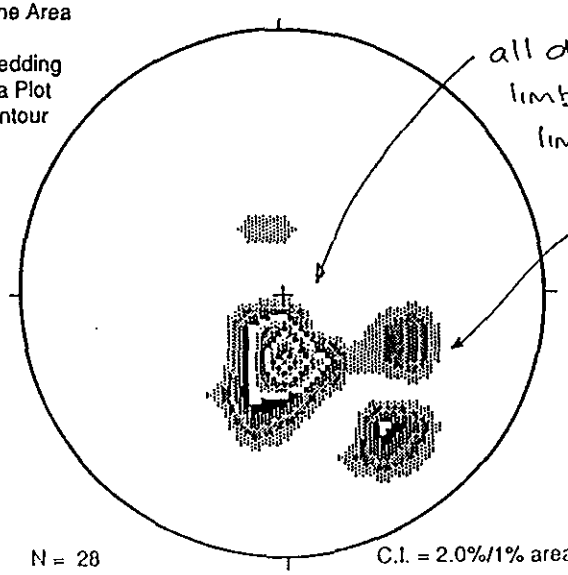
Hellyer Mine Area
Location 4...9
Poles to bedding
Equal Area Plot
% area contour



these locations are all on the same F2 limb but straddle a F1 fold. Note almost 90° change in strike trend.

N = 83 C.I. = 2.0%/1% area

Hellyer Mine Area
Location 3
Poles to bedding
Equal Area Plot
% area contour

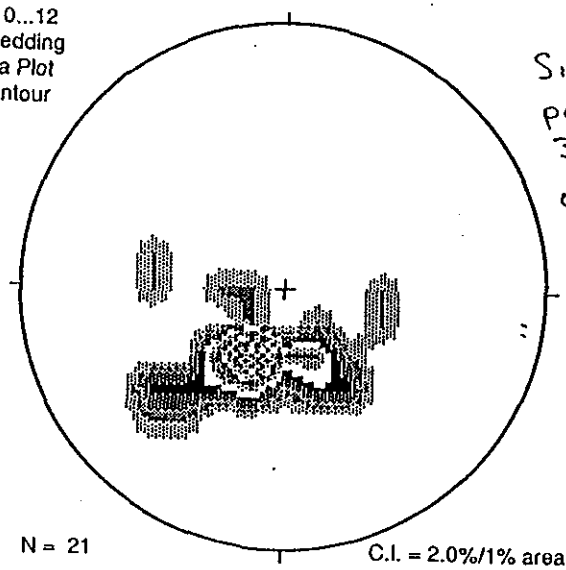


all data on W limb of F2 and N limb of F1.

outliers of data may be drag into NE trending structure.

N = 28 C.I. = 2.0%/1% area

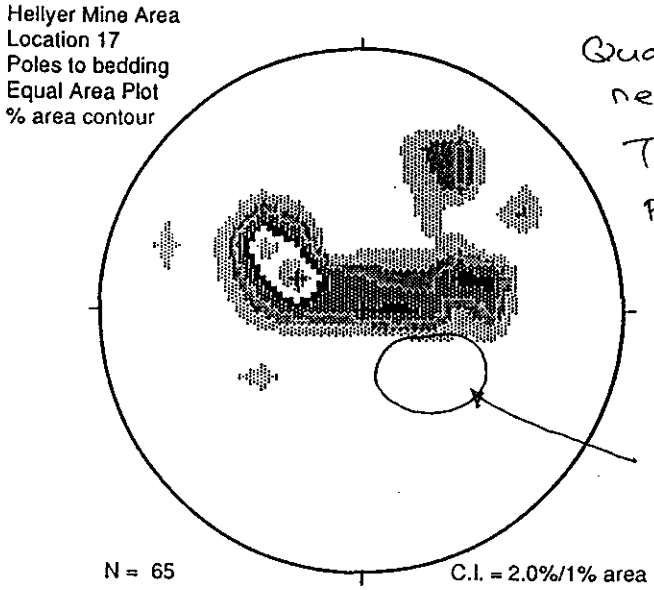
Hellyer Mine Area
Location 10...12
Poles to bedding
Equal Area Plot
% area contour



Similar structural position to location 3. Wider spread of orientation may indicate proximity to F1 axis.

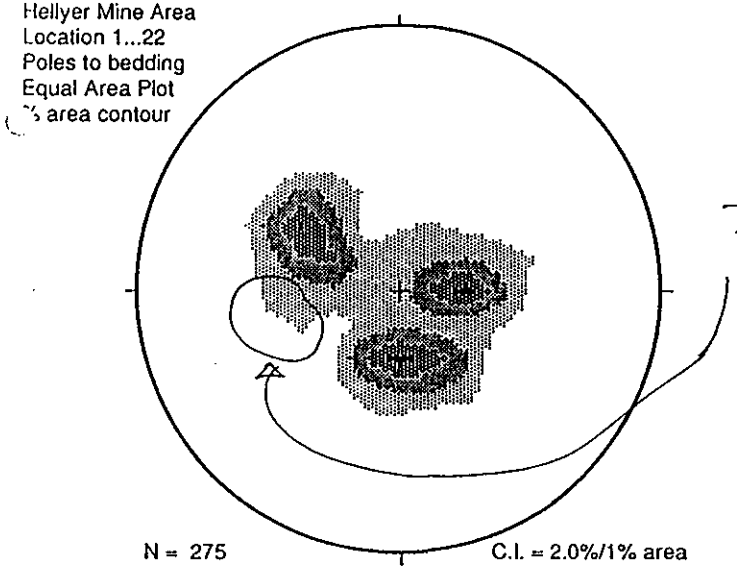
N = 21 C.I. = 2.0%/1% area

654174



Quarry in Cue River Shale, near Tailings Dam Wall. This site crosses an F2 fold axis and falls largely on the S limb of an F1 ~~axis~~ structure.

Note that orientations of beds on other side of dam all fall in this area.



It is not clear why the N limbs of F1 are not preserved on the F2 East limbs.

ORIGINAL.
0175

Appendix 4: Extract from Regan on use of stereonet plots to analyse structural data.

654176

11

Graphic Solutions with the Stereonet

STEREOGRAPHIC PROJECTION

The solution of problems by the usual methods of descriptive geometry requires the construction of at least two orthographic views, and this consumes much time and effort. Fortunately, there is an alternative approach by which the *angular* relationships of lines and planes can be determined more readily.

If a sphere is constructed centered at some point O on the outcrop trace of an inclined structural plane (Fig. 11.1*a*), the plane and its extension will intersect this sphere as a great circle (Fig. 11.1*b*); that is, one whose plane includes the center point O. In order to be of

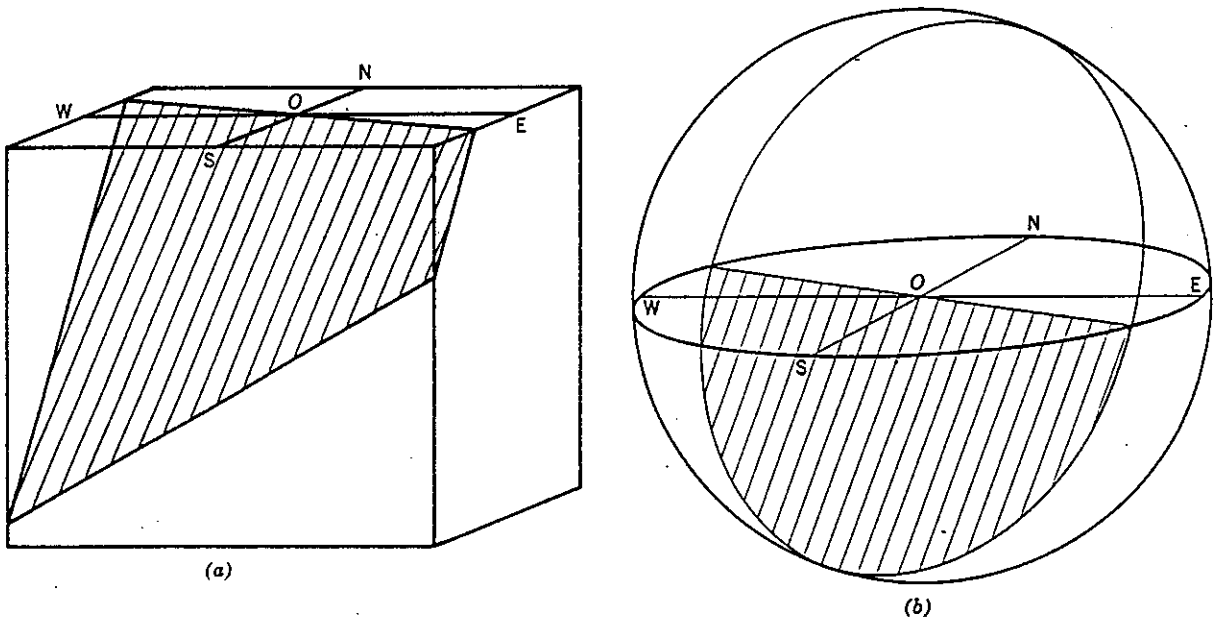


FIGURE 11.1 Representation of an inclined plane. (*a*) Block diagram with point *O* on the outcrop trace. (*b*) A sphere constructed with center at point *O*. (After Phillips, 1971.)

654177

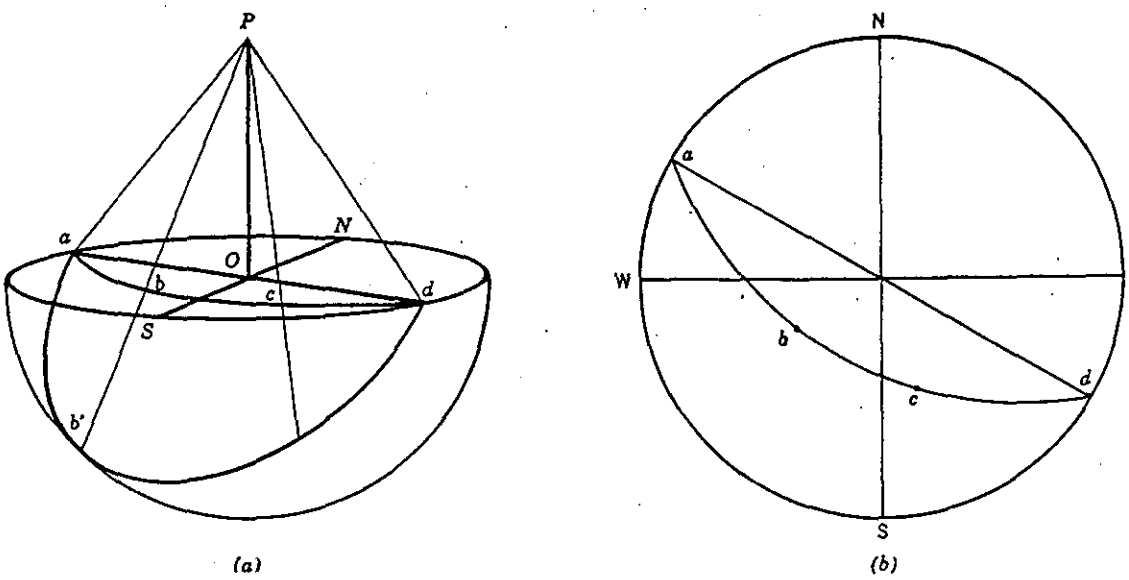


FIGURE 11.2 Stereographic projection of an inclined plane. (*a*) Projection to the horizontal equatorial plane. (*b*) Corresponding stereogram. (After Phillips, 1971.)

practical use this *spherical projection* must be represented in two dimensions. World maps are familiar examples. For present purposes, the most useful way is to project all points on the lower part of the great circle to the horizontal plane by joining them to the zenithal point P (Fig. 11.2*a*), yielding arc *abcd*. Similarly, a structural line through point O will intersect the sphere as a point, and this point is projected to the horizontal plane also using P; for example, point b is the projection of line Ob' (Fig. 11.2*a*). The resulting representation consists of lines and points plotted inside the horizontal great circle. This limiting circle is termed the *primitive*. This is the method of *stereographic projection*, and the figure drawn on this horizontal diametral plane, together with the cardinal compass directions is a *stereogram* (Fig. 11.2*b*).

One of the more important properties of the stereographic projection is that a great

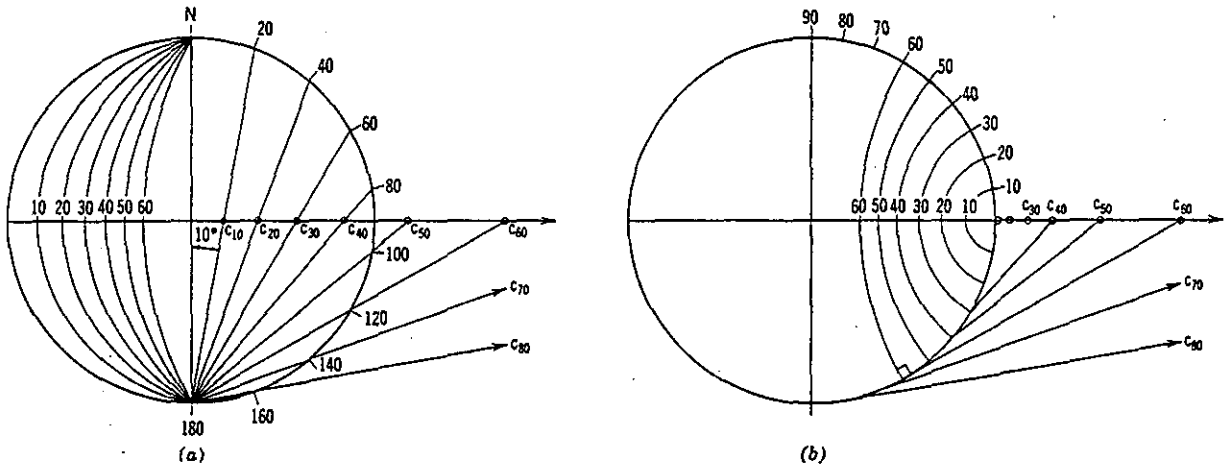


FIGURE 11.3 Construction of the stereonet. (*a*) Centers of the great circle arcs at the intersection of the east-west line and the various chords. (*b*) Centers of the small circle arcs at the intersection of the north-south line and the tangents to the primitive.

654178

circle on the sphere is also a circle on the stereogram. This permits the representation of any plane to be constructed easily. The geometric centers of the great circle arcs may be found graphically (Fig. 11.3*a*), or from the relationship:

$$d = r \tan \delta \qquad (11.1)$$

where d is the distance from O to the center, r is the radius of the primitive, and δ is the dip angle. Fig. 11.3*a* shows a family of meridional great circles representing a series of planes striking due north and inclined to the west at intervals of 10°. Once constructed, a full net of these curves permits the direct plotting of any structural plane.

Planes not passing through the center of the sphere cut the surface as small circles. A second and closely related property of the stereographic projection is that these small circles also plot as circular arcs. These too can be found graphically (Fig. 11.3*b*), or from

$$d = r/\cos a \qquad (11.2)$$

where, as before, d is the distance from O to the center, r is the radius of the primitive, and a is the angle the small circle makes with a point on the primitive. Thus a family of curves representing a series of such planes can be added to the net (Fig. 11.3*b*).

The result, in its full form, is the Meridional Stereographic or Wulff Net, or more simply the *stereonet*, in which the two families of curves are drawn every 2° (Fig. 11.4; see p. X-11 for a full-scaled version). The use of this net is a great aid in graphic constructions. Problems are solved by simple manipulation of data which are plotted directly. In short, the net is a portable computer on which many practical problems can be solved quickly, including a number which would be far more taxing by any other manual means. Once the technique is learned, greatest benefit is gained if a net is permanently available. This is easily accomplished if the printed form is mounted on a rigid backing and its surface protected with a clear plastic sheet (see suggested materials, p. viii). In use, data are plotted and problems solved on an overlay sheet of tracing paper. This overlay is affixed to the net by a map pin placed exactly at the center which allows the sheet to revolve freely. A small piece of clear plastic tape on the back side of the tracing sheet to reinforce the pin hole will prevent tearing or enlarging of the point of rotation.

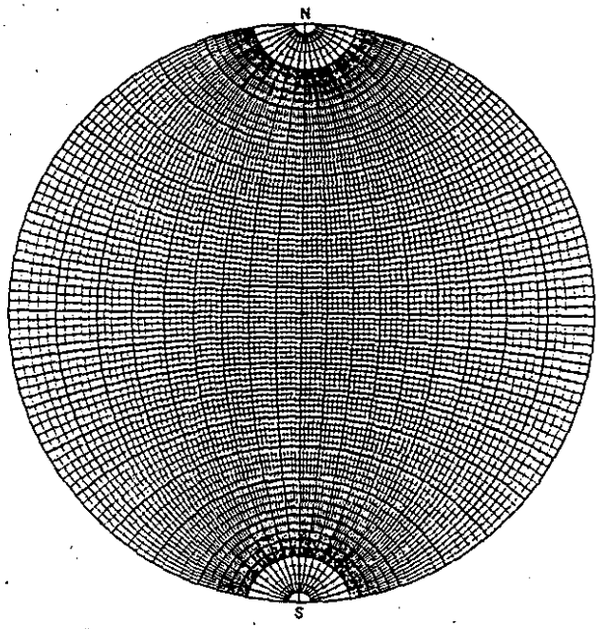


FIGURE 11.4 The Meridional Stereographic or Wulff Net.

TECHNIQUES OF PLOTTING

When using the stereonet, it is important to visualize the net as if you are looking into a hemispheric bowl, and to imagine that the circular arcs are inscribed on its inner surface. Illustrations such as Fig. 11.1*b* and 11.2*a* may help in achieving this mental picture. Then the various structural elements to be plotted can be visualized as passing through the center of the sphere and intersecting its surface. *The importance of this visualization can not be overemphasized.* Not only does it make the plotting easier, but it serves as an important check on the proper location, and on the general correctness of the various manipulations. For example, there are four different positions which satisfy the numerical components of dip and strike, but three of these are incorrect. Visualization will quickly show which of these is the correct one. The following examples should be worked through

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in every detail by the student on his own stereonet. Once the three dimensional picture is clearly and firmly in mind, a variety of short cuts will suggest themselves by which the plotting process can be speeded considerably.

PROBLEM

Given the attitude of a plane (N 30 E, 40 E), plot its great circle representation in stereographic projection.

VISUALIZATION

With the net in front of you (oriented as in Fig. 11.4) hold the flattened left hand, palm upward, over the center of the net with the fingers pointing toward N 30 E, and the plane of the hand inclined 40° to the southeast. The plane of the hand can readily be imagined to extend into the lower hemisphere and intersect its surface (Fig. 11.5*a*). The trace will cut through the southeast quadrant, and this is where the final plot must also be.

PLOTTING A PLANE (Fig. 11.5)

1. With an overlay sheet in place, make a small mark over the north point of the net and label it *N*.
2. To locate the line of strike, count off 30° clockwise from north, and make a small mark over the primitive at this point.
3. As no great circle on the net passes through this marked point, it is necessary to revolve the overlay until one does. Therefore turn the sheet until the strike mark exactly overlies the north point of the net, that is revolve anticlockwise 30°.
4. To locate the great circle representing a plane dipping 40° east, count off from the primitive on the right side of the net inward along the east-west diameter of the net. Trace in this arc of a great circle.
5. Revolve the overlay back to the original position and check the result by visualization (Fig. 11.5*c*). Note that it would have been easy to revolve the overlay in the opposite direction, or plot from the left, or both, with erroneous results.

In common with most other projections, the dimensions of the plot are reduced by one. The hemisphere is reduced to a plane, a plane to a line and a line to a point. A further advantage of this particular projection is that a plane can be represented as a point, reducing the dimensions of the plot by one more. For every plane there is a unique line normal to the plane, called the *pole* of the plane. To visualize, hold the hand oriented as before, but with a pencil held between the fingers perpendicular to the plane of the hand. The pencil will pierce the lower hemisphere at a point in the northwest quadrant. This point is everywhere 90°

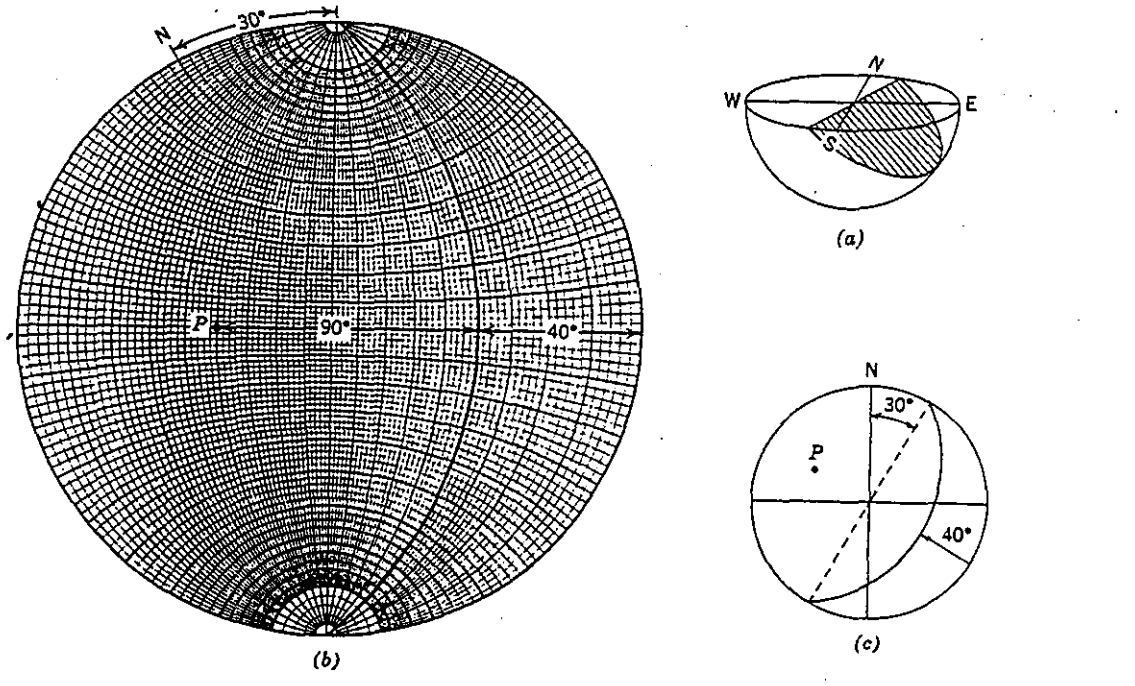

FIGURE 11.5 Stereographic plot of a plane and its pole. (*a*) Perspective view of the inclined plane to be plotted. (*b*) The position of the overlay and net for the actual plot. (*c*) The overlay as it appears after the plot.

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from the plane; *therefore*, from the great circle trace count off 90° from the right to left along the east-west diameter and mark *P*, the projection of the pole of the plane (Fig. 11.5).

The line which is the pole is *projected* as a point; this point *therefore* represents the plane. Any linear structure can be similarly represented by a direct plot, but when a pole is used to represent a plane it is a *reciprocal* plot.

PROBLEM

Given a line (30, S 42 E), plot on the stereonet.

VISUALIZATION

Hold a pencil with the given orientation over the net and visualize its intersection in the southeast quadrant of the hemisphere.

PLOTTING A LINE (Fig. 11.6)

1. With the overlay in place and the south index marked *S*, locate a point on the primitive representing the trend of the line by counting 42° anticlockwise from *S*.
2. Revolve this trend mark to the south point of the net.
3. Count off 30° from the primitive toward the center along the north-south diameter, and plot the point.
4. Restore the overlay to the starting position and recheck by visualization.

In this particular exercise, the graduations marked by the small circles were used for the first time. However, the trend mark (Step 2 above) could just as easily have been moved to the east point of the net, and the point plotted by counting off along the east-west diameter. In order to assure yourself that this is so, revolve your plotted point to the east-west line and check that the vertical angle measured here is also 30°. Thus in some routines there is a choice of plotting positions. This confuses some beginners, and it is advisable to stick closely with the listed steps until confidence develops. Once the process becomes familiar, however, it will be found that the use of these alternative techniques increases the speed of plotting.

Just as structural lines and planes often occur in combination, so too can they be combined in a single, simple plotting routine.

PROBLEM

Given a plane (N 0, 45 W), and a line in that plane (31, N 36 W), plot both features on the stereonet.

VISUALIZATION

The flattened hand with a pencil held against it in

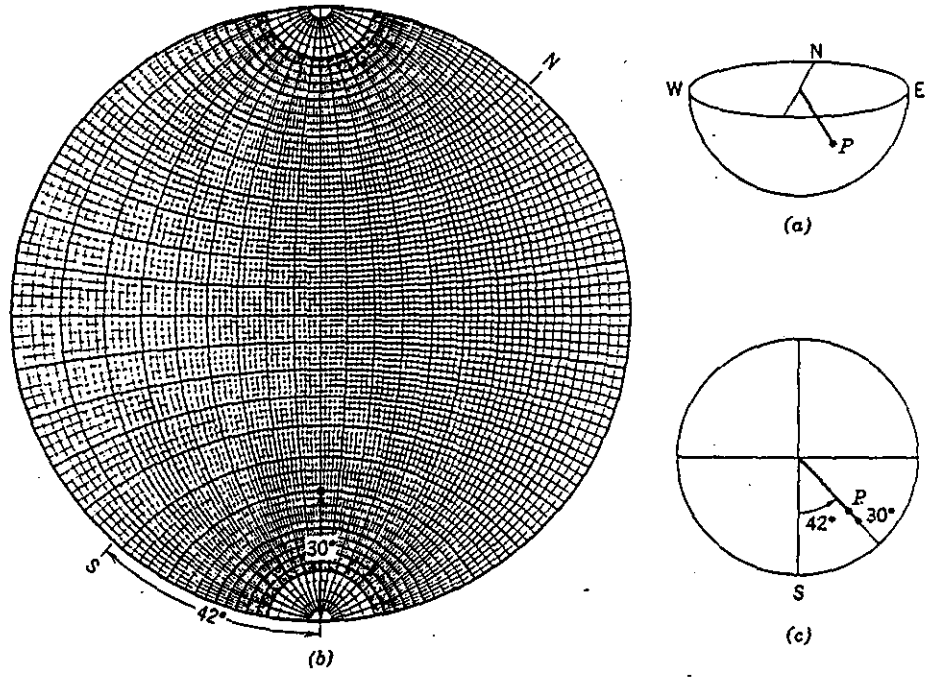

FIGURE 11.6 Stereographic plot of a line. (*a*) Perspective view of the inclined line. (*b*) The position of the overlay and net for the actual plot. (*c*) The overlay as it appears after the plot.

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the proper orientation helps one see the three-dimensional aspects of the problem more clearly.

PLOTTING A PLANE CONTAINING A LINE (Fig. 11.7)

1. To plot the plane:
   (a) Mark the direction of strike on the primitive (in this special case, the north mark serves this function).
   (b) Count off 45° from the left on the east-west diameter of the net.
   (c) Trace in the great circle on the overlay (dashed arc on Fig. 11.7).
2. To plot the line:
   (a) With the overlay oriented to north, mark the trend of the line.
   (b) Revolve this mark to the north point of the net. Count off 31° from this point along the north-south diameter.
   (c) Plot the point.
3. Just as the line lies in the plane, so too must the point representing the line lie on the great circle (solid arc of Fig. 11.7). If it does not, then an error has been made, either in plotting or in the original measurement.

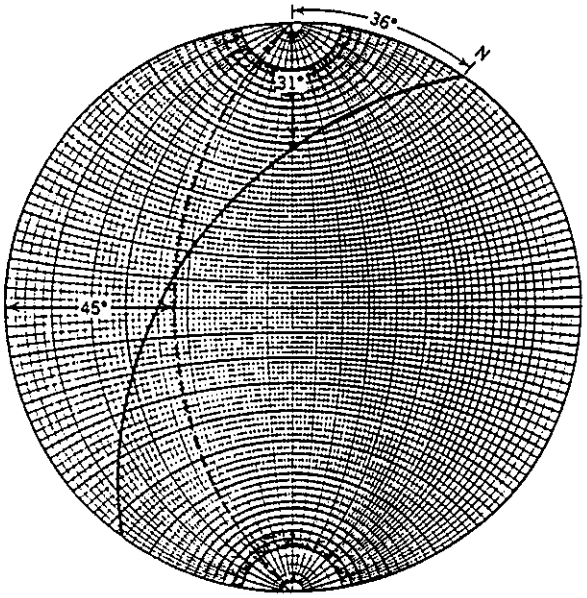

FIGURE 11.7 Stereographic plot of a plane containing a line: the overlay in position for locating the line on the plane.

ATTITUDE PROBLEMS

Problems dealing with angular relationships of planes and lines which were solved by orthographic methods in Chapters 1 and 4 can be solved directly on the stereonet.

PROBLEM

Given an inclined plane (N 50 E, 50 SE), find its apparent dip in the N 80 E direction.

CONSTRUCTION OF APPARENT DIP (Fig. 11.8)

1. To plot the plane:
   (a) Revolve the north mark on the overlay 50° anticlockwise.
   (b) From the east point of the net, count off 50° along the east-west diameter.
   (c) Trace in the great circle.
2. Revolve the overlay back to the starting position, and mark N 80 E on the primitive.
3. Revolve this mark to the east point, and read off the angular position where the great circle crosses the east-west diameter.

ANSWER

The apparent dip in the N 80 E direction is 31°.

From such a diagram, the pitch of a line on an inclined plane can be obtained by determining the angle between the primitive and the point measured *along* the great circle trace. In the example, the pitch of the line is 42° NE (that is, measured from the northeast end of the great circle).

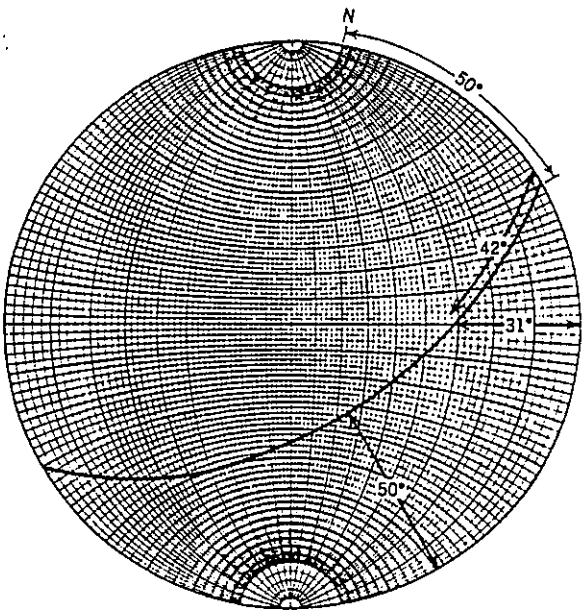

FIGURE 11.8 Apparent dip from true dip and strike: the overlay in position for measuring the apparent dip angle.

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PROBLEM

Given two apparent dips, (1) 28, N 56 W, and (2) 22, N 14 E, find the true dip.

CONSTRUCTION OF TRUE DIP (Fig. 11.9)

1. Plot the two apparent dip lines:
   (a) Line 1: revolve the north mark 45° clockwise and count off 30° from north along the north-south diameter.
   (b) Line 2: revolve the north mark 14° anticlockwise and count off 22° from north.
2. Revolve the overlay until the points representing the apparent dips lie on the same great circle. Trace in this arc. The true dip of the plane is read when traced; the strike is easily determined by restoring the overlay to the north position.

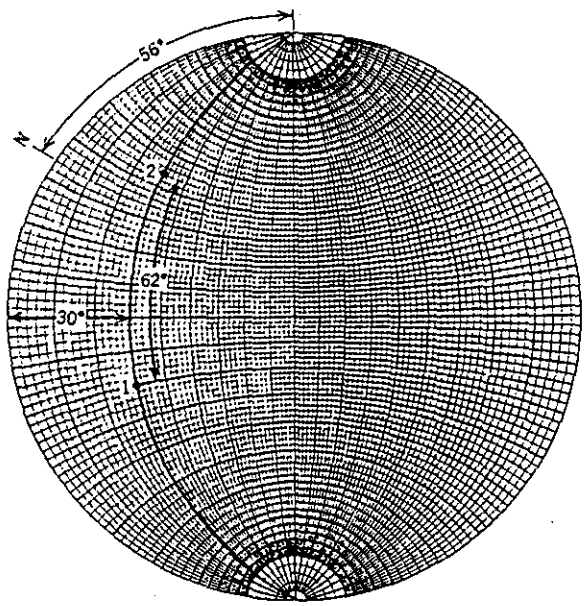

FIGURE 11.9 True dip from two apparent dips: the overlay in position for locating the great circle.

ANSWER

The true attitude is N 56 E, 30 N. The angle between the two lines is the angular distance between the two points (= 62°).

PROBLEM

Given two planes, (1) N 50 E, 60 SE, and (2) N 70 W, 20 S, find the plunge of the line of intersection.

CONSTRUCTION OF THE INTERSECTION OF TWO PLANES (Fig. 11.10a)

1. Plot the two planes:
   (a) Plane 1: revolve the overlay 50° anticlockwise from north and count off 60° from the east point along the east-west diameter. Trace in this great circle.
   (b) Plane 2: revolve the overlay 70° clockwise from north and count off 20° from the west point on the east-west diameter, and complete the great circle.
2. The point of intersection of the two great circles represents the line of intersection of the two planes. To read the plunge angle and bearing, revolve this point until it lies on the north-south diameter of the net.

ANSWER

The plunge of the line of intersection is 20, S 38 W.

Another useful relationship between two intersecting planes is the dihedral angle. This can be easily determined by measuring the angle between the poles of the two planes. Alternatively, by constructing the great circle of which the line of intersection is the pole, the angle between the two planes can be read directly (See Fig. 11.10b). Note that the poles of the planes lie on the great circle perpendicular to the line of intersection.

ROTATIONS

In a number of situations it is necessary to geometrically *rotate* structural elements in space. Every rigid body rotation can be defined by an angle and sense of rotation about a specified axis. The simplest rotation to perform on the stereonet is when the axis R is vertical. Fig. 11.11 illustrates a plane (N 0, 45 E) rotated 45° clockwise about a vertical R to a new orientation (N 45 E, 45 SE). Either the great circle trace or the pole of the plane may be rotated with equivalent results. As is evident from this figure, to find the new position one simply revolves the overlay sheet by the required angle—a familiar manipulation. Yet there is an important difference. Before, the process of turning the overlay about the center of the net was one of convenience in plotting and measuring, but the overlay always carried with it the North mark, so that the original orientations were never really changed. The term *revolve* has been used specifically to describe this maneuver. In contrast, after rotation a plane or line has an entirely new orientation relative to some fixed coordinate direction.

A rotation about a horizontal axis can also be performed readily on the stereonet. First,

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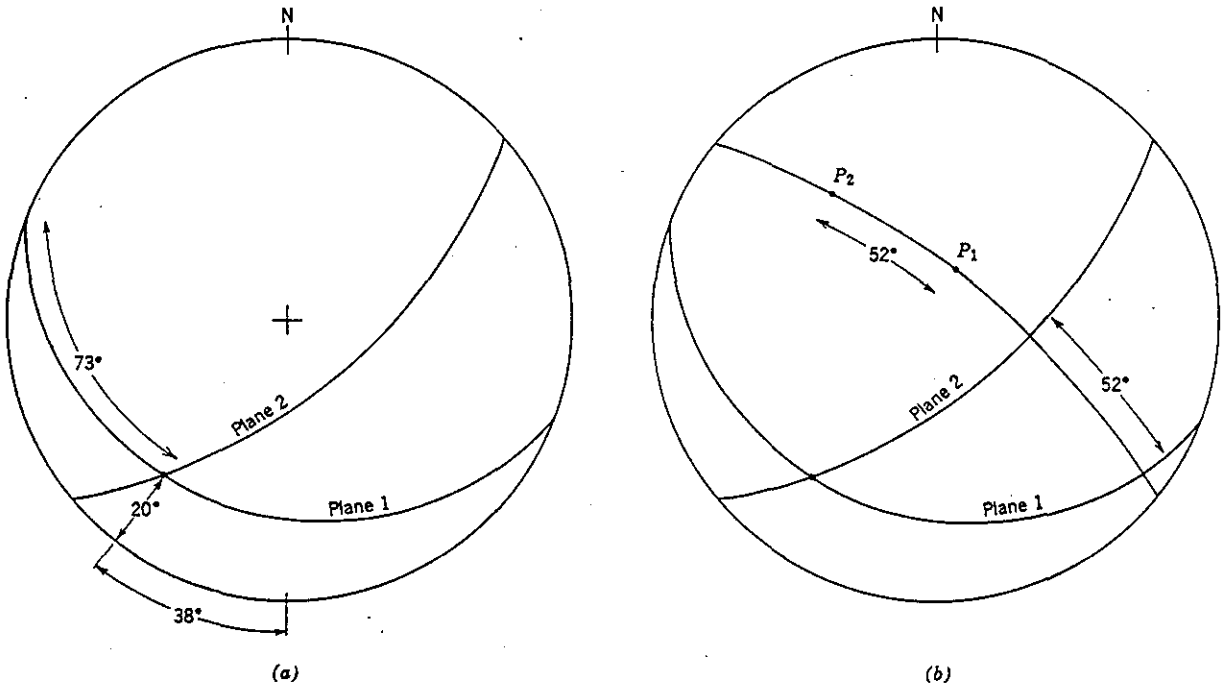

FIGURE 11.10 The line of intersection of two planes. (*a*) The overlap after the plot showing the plunge and pitch of the line. (*b*) The dihedral angle between the two planes.

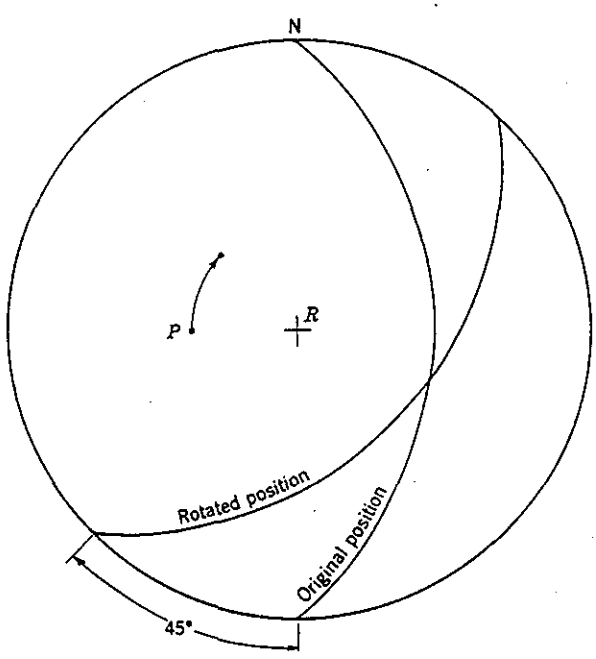

FIGURE 11.11 The rotation of a plane about a vertical axis.

the overlay is revolved so that R coincides with the north-south diameter of the net. In this position, a rotation moves points along the small circle paths. In Fig. 11.12 a plane dipping 60° is rotated anticlockwise as viewed from the south end of R. Although either points or great circles may be rotated, it will be found that working with points is much easier.

It is sometimes necessary to rotate a structural element to horizontal and beyond. Fig. 11.13 illustrates how this is handled. A line (30, N 29 E) is rotated anticlockwise 100°. After just half of this rotation the point lies on the primitive—the line is horizontal. With a further increment of rotation the other end of the line moves into the lower hemisphere at a point diametrically opposite and proceed along the same small circle.

Two methods for rotating about an inclined axis are available. The first depends on previous methods, and consists of rotating R to a horizontal orientation, performing the

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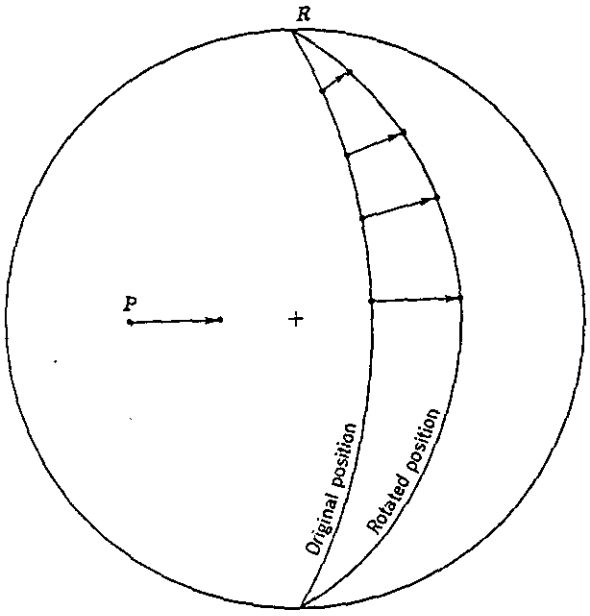

FIGURE 11.12 The rotation of a plane about a horizontal axis.

required rotation, and then returning R to its original position. The second is more direct, though perhaps somewhat more time consuming.

PROBLEM

Rotate the plane (N 83 E, 52 S) 80° clockwise, as viewed looking toward the northeast, about an axis plunging 30° to the N 42 E.

APPROACH

As a pole P rotates about the axis R with constant angle, it will generally describe a small circle on the surface of the sphere. This circle projects as a small circle on the stereonet. While it is useful to draw this circle as an aid to visualization (Fig. 11.14; see Chapter 14 for the method), it is not necessary to do so. A sketch will do. The construction technique consists of rotating the plane containing both the rotational axis and the line in question, rather than rotating the line directly.

CONSTRUCTION (Fig. 11.14; after Turner and Weiss, 1963, p. 69)

1. Plot the rotational axis R and the pole P of the plane to be rotated.
2. Construct the great circle trace representing the plane perpendicular to R.
3. Construct the trace of the plane containing P and R to intersect the plane of step 2 at L. The angle between P and R can be easily read (= 41°).
4. As P rotates about R, so too will the line of intersection L rotate in the plane perpendicular to R. To find the final position of L (= L') count off the required 80° from L going clockwise. In this

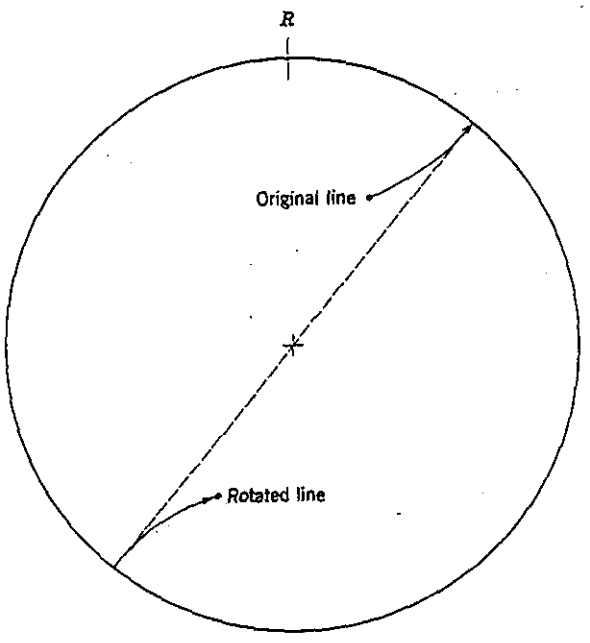

FIGURE 11.13 The rotation of a line to the horizontal and beyond.

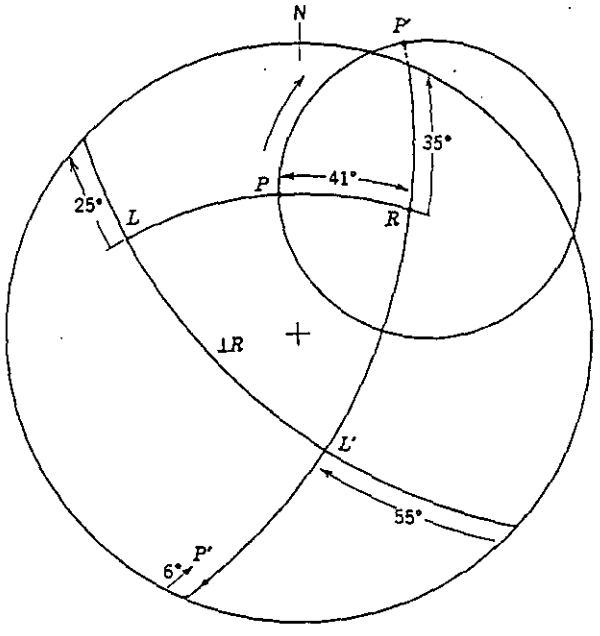

FIGURE 11.14 Rotation of a plane about an inclined axis.

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example, the line passes through the primitive so that the 80° is measured in two segments (25° + 55°).

5. Measure 41° from R to P′ in the great circle L′R.

ROTATIONAL PROBLEMS

It is often of interest to determine the orientation of a given feature as it existed before tilting (Fisher, 1938). Simple examples include the restoration for paleogeographic studies of primary sedimentary features such as current lineations (see Potter and Pettijohn, 1963, p. 259), and the pretilt attitude of structures below an angular uncomformity. The most common type of tilting movement occurs during folding, but may also be associated with faulting. With flexural folds, it is a simple matter to unfold the structure and thus restore the beds to a horizontal position. Provided there are no distortions due to strain the various features contained within the folded rocks are thereby also returned to their original positions.

To restore to horizontal the beds of a nonplunging fold, the bedding planes are rotated about an axis parallel to the strike of the beds, which is also parallel to the fold axis, through an angle equal to the dip angle.

PROBLEM

An inclined bed of sandstone (N 20 E, 20 W) contains cross-bedding (N 72 W, 21 S). Determine the original current direction.

CONSTRUCTION (Fig. 11.15)

1. First plot the pole of the cross-beds (=*P*), and then the sandstone bed as a great circle (=Plane 1).
2. With Plane 1 still in the plotting position, the rotational axis, which is also the line of strike of the sandstone bed, is north-south.
3. To restore the sandstone bed to horizontality Plane 1 rotates 20° to the primitive. At the same time *P* moves along a small circle in the same direction and by the same amount to *P′*.
4. From this new pole position *P′* the great circle representing the restored cross-bedding can be drawn (=Plane 2). The original current direction is parallel to the dip.

ANSWER

The original attitude of the cross-beds was N 67 E, 30 S, and the associated current moved toward S 24 E. Note that if the orientation of the tilted cross-beds is assumed to reflect the original current direction, an error of 41° is introduced.

The movement leading to the development of a plunging fold can be considered to have two rotational axes: one of them the fold axis, and the other a horizontal axis perpendicular to the fold axis. Reversing the rotation about these two axes unrolls the fold.

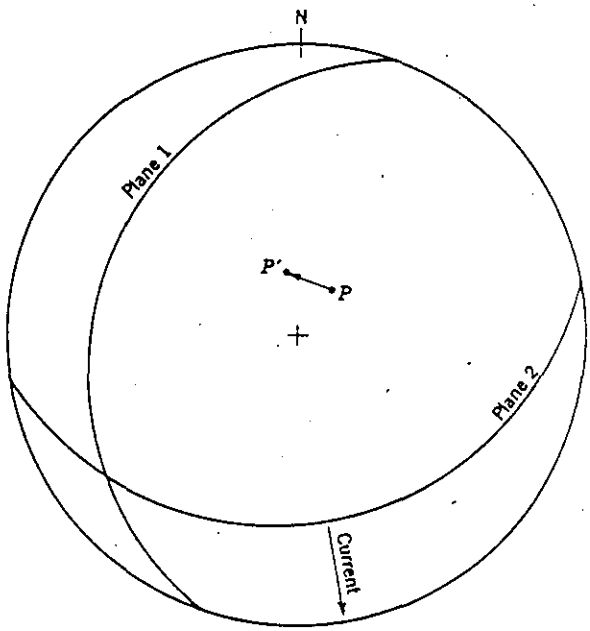

FIGURE 11.15 The two tilt problem.

PROBLEM

Given an anticline plunging 30° due north. Beds on the east limb (N 19 W, 60 E) contain sole markings which trend due east. Determine the original orientation of this sedimentary lineation.

CONSTRUCTION (Fig. 11.16; after Ramsay, 1961)

1. Plot the geometrical elements of the problem: Plane 1 = plane bedding, *l* = lineation within bedding, and *F* = fold axis.
2. The rotation of Plane 1 and *l* about the inclined axis *F* could be constructed (as in Fig. 11.14), but there is a simpler approach. If the beds are unrolled about the fold axis, the result will be a plane dipping 30° due north. During this rotation, the angle between *l* and *F* remains constant. Thus the plane after the first rotation (= Plane 2) and the associated lineation (= *l′*) can be plotted directly.
3. In rotating Plane 2 about its line of strike to horizontality, the lineation moves along a small circle to the primitive (= *l″*).

ANSWER

The original trend of the sedimentary lineation was N 65 E. Again, if the correction is ignored, a considerable error results.

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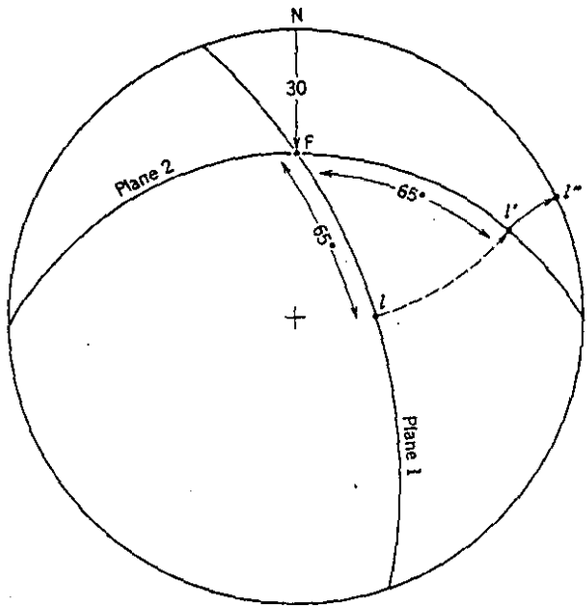

FIGURE 11.16 Unfolding about an inclined axis.

EXERCISES

1. Construct a stereogram 15 cm in diameter of the 45° great and small circles graphically or with the aid of equations (11.1) and (11.2). Compare your results with the printed Wulff net.
2. Repeat exercises 2 and 3 of Chapter 1. Compare the stereographic and orthographic projection methods for accuracy and speed.
3. Determine the plunge of the line of intersection and the pitch of this line in one of the planes for each of the following pairs of planes:

   a. N 60 W, 46 S; N 15 E, 20 E. (*Ans.:* Plunge = 17, S 43 E)
   b. N 25 E, 33 W; N 36 W, 70 SW. (*Ans.:* Pitch in Plane 2 = 35°N)
   c. N 65 W, 50 N; N 25 E, 90 (vertical).

4. A plane contains two linear structures: Line 1 (30, N 40 W) and Line 2 (20, N 10 E). What is the attitude of the plane, and what is the angle between the two lines measured in the plane? (*Ans.:* Plane = N 48 E, 30 NW)
5. The beds below an angular unconformity have an attitude of N 30 W, 40 W. The sequence above the unconformity is tilted (N 20 E, 30 E). What was the attitude of the lower beds before the tilting of the younger beds occurred?
6. An anticlinal fold axis plunges 24, N 40 E. On the east limb, where beds have an attitude of N 5 W, 32 E, the crest line of current ripple marks pitches 70° N in the plane of the bedding. What was the pretilt orientation? Compare the result with that based on the assumption that the tilted lineation adequately represents the original direction. Comment.
7. A fold plunges 50, N 25 E. At a point on the overturned limb, a lineation is found to trend due east, and the strike of the plane containing the lineation is due

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north. What was the orientation of the lineation before folding? (This is sufficient information to solve the problem. *Ans.:* N 10 W).

8. Rotate a line (40, N 45 W) 50° anticlockwise (as viewed northward along the rotational axis) about an inclined axis (30, N 20 W). Perform this maneuver in two ways: (1) as a single rotation about the inclined axis, and (2) as a series of steps involving rotation of the axis to horizontal, rotating the line about the axis, and returning the axis to its original orientation.

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11,000 N

10,500 N

10,000 N

3000 E

3500 E

4000 E

4500 E

5000 E

5500 E

6000 E

TAILINGS DAM SYNCLINE

JACK FAULT

bms

sh

rhyj

?

see note on larger plan for details of this area.

dol

F1 axes

F2 axes.

LEGEND

- plunge of fold axis
- synformal axis
- antiformal axis
- inferred position of axis
- shear or fault along axis
- bedding dip from 1:2,500 mapping.

5 cm

REV	DATE	REVISION	DRAWN	CKD	APP	APP

NORTH

SCALE 1:10,000

DRAWN	ACC	APRIL 91
CHECKED		
DESIGNED		
DESIGN CKD		
DESIGN APP		
PROJECT APP		

Aberfoyle Resources Limited

HELLYER DIVISION

INTERPRETATION OF MAJOR FOLD STRUCTURES IN TAILINGS DAM AREA.

EXTRACT FROM APPENDIX 5

DRAWING No.

REVISION

654189

Appendix 7: Locality map for field locations 30 to 37 along the Hellyer haul road.

Location Code : K55/6/44

11,500 N

11,000 N

10,500 N

10,000 N

9500 N

3000 E

3500 E

4000 E

4500 E

5000 E

5500 E

6000 E

West dipping beds at Loc 1 may only be due to parasitic folding.

10→190

15→215

05-10→031

15→187

There is no field evidence for this structure. This position is based entirely upon the spatial distribution of other axes.

inferred axis

antiformal axis

synformal axis

Stratigraphy may indicate plunge at closure to SW.

Abandoned logging road

axis of closure?

Mapping on canal shows reversal of dips appox on this axis.

Fault zone

TAILINGS DAM EMBANKMENT

apparent closure in dtion

Position of fault from 1:10,000 aerial photo interpretation

MAL 10

Fault zone

Bedding at these locations has a general dip toward N despite being on south side of inferred anticlinal axis. Faulting on the east is interpreted to be normal and N dips may be due to 'rollover' of bedding; see photo.

This may be a feature of synclinal F2 closures through anticlinal F1 folds.

Gossanous veining and shearing in pos' relative to axis position

Gossanous veining with shearing of qtz veins

creek may follow axis of antiform

basalt lava

shale

Fault is prob. S/d block of unit based on outcrop distribution of basalt lava

~15° plunge

dome of exposure mapped as basalt lava

~15° plunge

Bedding in this area does not conform to the trend of structure.

inferred axis

shale

Cut River may follow axis

TRAIL FAULT

LEGEND

- plunging fold axis
- synformal axis
- antiformal axis
- inferred axis, no field evidence
- shear or fault, inferred unless described
- bedding plane orientation
- locality boundary and number

HELLYER MINE
TAILINGS DAM AREA

STRUCTURAL INTERPRETATION
Based on outcrop mapping and bedding orientation

Author: A. Cooke Feb 1991

APPENDIX 5

BTM

ON

0 50 100 150 200

metres

SCALE 1:2,500

5 cm

CC1490



LEGEND

- reverse fault
- normal fault
- synformal axis
- anticlinal axis
- shear / fault
- bedding orientation
- inferred boundary
- lithological boundary

NOTE: Only some of the lithological boundaries have been transferred to this plan.

This interpretation is based upon the 1:10,000 scale solid geology maps and is intended to illustrate how the interpretation of structure may assist in mapping.

REV	DATE	REVISION	DRAWN	CKD	APP	APP

NORTH

SCALE	1:10,000
SHEET No.	
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PROJECT APP	

Aberfoyle Resources Limited
HELLYER DIVISION

654191

STRUCTURAL INTERPRETATION OVERLAY FOR 1:10,000 SOLID GEOLOGY MAP

APPENDIX 6

DRAWING No.

REVISION

5 cm

654192

0191

OPEN FILE

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- 6 JUN1991
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TASMANIA

Progress Report for the Period

May 1990 to April 1991

Volume 2

Appendices 7 - 14

91-3268
2/5
VOL

Distribution

Aberfoyle - Burnie (1/3)
Aberfoyle - Hawthorn (2/3)
Department of Resources & Energy (3/3)

APPENDIX 7

Attachment: DDH-MAC-10

Sample No:	Depth	Logg Description
396705	300.5m	Altered andesitic lava
396708	364.1m	Basalt
396709	379.2m	Vesicular basalt
396710	399.1m	Altered andesite
396711	407.4m	Feldspar-phyric andesite
396712	431.2m	Flow banded andesite
396714	457.4m	Feldspar-phyric andesite

0194

654195

PETROGRAPHIC REPORT

(Rocks from DDH MAC-10)

for

ABERFOYLE RESOURCES Ltd
(attn. Andrew McNeill)

by

Anthony J. Crawford
Geology Department
University of Tasmania

26/5/90

0195

SAMPLE NUMBER: MAC-10: 300.5m: 396705

SUMMARY:

This is a difficult sample: I suggest that it was a very glassy dacitic lava breccia, with at least one quite different almost holocrystalline andesite fragment. It has suffered variable but quite strong silica alteration and later calcite overprinting; the latter is of moderate intensity.

THIN SECTION DESCRIPTION:

This is a altered, heterogeneous-textured and probably polymict dacitic lava breccia. It is composed of a number (possibly five or six at least) of lava fragments, all of sparsely plagioclase-phyric formerly highly glassy dacitic lava and one or two slightly more crystal rich vitric crystal tuff fragments. Due to extensive devitrification and recrystallization of glass, plus superimposed quite strong calcite-sericite alteration, the margins of individual fragments are difficult to recognize in many instances, but rapid changes in groundmass texture and grainsize are taken to reflect fragment boundaries. Most fragments are composed of originally glassy dacite lava with about 2-5 modal% albitized plagioclase phenocrysts, most of them occurring as pale pink stubby laths, often intergrown with several other albite crystals in crystal clots to 2mm across. The recrystallized and strongly heterogeneous groundmass of these fragments consists dominantly of a mosaic intergrowth of secondary quartz and albite, trending to sugary silica-ricg areas of local silica metasomatism. Wispy pale green chlorite forms along fragment boundaries and dispersed sparsely through the rock. Calcite overprints the groundmass as tiny brown spots and patches, meandering veinlets, and common well-formed small rhombs. Concentrations of tiny altered FeTi oxide or pyrite grains occur along some fractures and in a few narrow veinlets, but are modally insignificant.

Several areas with significantly more phenocrystal material, including many broken and partially rounded crystals of albite, may be former crystal tuffs with a glassy matrix. One distinctive small fragment is almost holocrystalline, and composed of sparsely plagioclase-phyric andesite, in which abundant mafic plates now replaced by calcite occur intergrown in the groundmass with albite laths.

If it wasn't for the one very clear volcanic lithic (andesite) fragment in this sample, I would have had great trouble convincing myself that the texture of this rock could not have been an alteration-induced false pyroclastic texture. Probably the hand specimen would be useful to further support or refute this stance. Combined recrystallization following devitrification, and superimposed silica-alteration, followed by later calcite overprinting, have combined to produce a rock with a very 'fragmental' appearance. I have no doubt that the magma responsible for the bulk of this sample was dacitic in composition.

SAMPLE NUMBER: MAC-10: 364.1m: 396708

SUMMARY:

This is an excellent quenched sparsely augite+plagioclase+ olivine-phyric basaltic lava with a distinctive texture, reminiscent of boninites. It may be from a geochemically and petrographically mappable unit.

THIN SECTION DESCRIPTION:

This is a beautifully preserved, quenched augite+plagioclase+olivine -phyric basaltic lava, one of the best I have seen from the MRV. It is composed of about 2-4 modal% of small rather stubby lath-like prisms of perfectly fresh augite, rarely longer than 0.5mm, much less abundant elongate microphenocrystal laths of albitized plagioclase, and a few rare former small olivine phenocrysts completely replaced by microcrystalline silica, but retaining typical olivine shape and occasional reddish chromite euhedral inclusions. These are set in a groundmass of former glass charged with acicular to prismatic tiny augite microlites and very elongate tiny albite needles and thin laths. The glass has altered to albite, which is the background 'matrix' in which all the groundmass microlites and phenocrysts are set.

Small bright yellow epidote granules are the main alteration phase besides albite, and are clearly produced from Ca released in albitization of calcic plagioclase and glass. Chlorite is remarkably rare, making up probably less than 1 modal% of this basalt, in strong contrast to the usually much more chlorite-rich and altered Hellyer basalts. Sparse calcite overprints the rock and occurs in a few thin veinlets, and secondary polycrystalline quartz also occurs in small fracture fillings.

The texture of this rock is distinctive and unusual within the Hellyer basalts. It is transitional to boninitic, and reminds me of only a single sample I have seen before, from Doug Jack's thesis (I think no. 334207, but I can't remember exactly if this is the one-compositionally it is trending to boninite). I would like a piece of this for careful analysis and REE study if I may. It may be a distinctive and recognizable unit, although more work would have to confirm this.

SAMPLE NUMBER: MAC-10: 379.2m: 396709

SUMMARY:

This is a primitive olivine+augite-phyric basaltic lava, typical of the Hellyer hangingwall basaltic lavas regionally.

THIN SECTION DESCRIPTION:

This is a more typical Hellyer basalt. It is very slightly vesicular olivine+augite-phyric basaltic lava, with vesicles filled by polycrystalline quartz and chlorite. Characteristically-shaped pseudomorphs after quite large (to almost 2mm long) olivine phenocrysts, many with abundant small euhedral chromite inclusions, make up about 5 modal% of this sample, and are replaced by very fine-grained chalcedonic or microcrystalline silica. Augite occurs as stumpy small (<0.5mm long generally) microphenocrysts, and constitutes around 5 modal% of the sample. Plagioclase phenocrysts were never present in this fairly primitive basalt.

The groundmass of this lava was composed of randomly orientated albitized plagioclase microlites and tiny prismatic augite crystals set in glass. The glass has altered to albite, which has a slightly dusty appearance, and water-clear secondary quartz and chlorite. The latter occurs in small patches and spots, and in places clearly replaces groundmass augite; it is notably more abundant than in the previous basalt (39678). Small granular epidote crystals are present in the groundmass, and tiny leucoxene granules after FeTi oxide dust are abundant through the altered groundmass. Several veinlets composed of cores of chalcedonic quartz and rims of calcite transect the rock.

This is a typical, primitive Hellyer basalt, rather more altered (although still very well preserved) than the previous sample.

SAMPLE NUMBER: MAC-10: 399.1m: 396710

SUMMARY:

This is a strongly altered formerly glassy and perliticically-cracked plagioclase+sparsely augite-phyric silicic andesite. It suffered strong silica (+minor pyrite) alteration and later calcite overprinting.

THIN SECTION DESCRIPTION:

This is a strongly carbonate-altered formerly glassy andesitic to dacitic lava characterized by common albite phenocrysts and less abundant altered augite phenocrysts set in an even-textured perlitic cracked groundmass. The plagioclase phenocrysts are equidimensional blocky, to rather elongate prismatic crystals, often intergrown in two and three-crystal clots. They make up about 10-15 modal% of the sample, and are invariably partially replaced by very pale green chlorite and sericite mixtures. Long apatite needles and prisms are quite common inclusions in the plagioclase phenocrysts. Former augite phenocrysts make up much less of this rock than albite phenocrysts, but the original modal abundance of augite is much more difficult to judge due to the alteration. They appear to be replaced by pale green chlorite and secondary quartz, and also contain common small apatite needles. Augite and plagioclase phenocrysts were intergrown in a number of tiny gabbroic inclusions together with equigranular FeTi oxide grains that are marginally altered to leucoxene.

The groundmass of this sample, where best preserved, retains excellent curved perlitic cracks picked out by very fine-grained secondary silica, that also forms much thicker and more angular fracture fillings. The groundmass of this rock was clearly originally glassy, but was probably strongly silica-altered prior to being strongly overprinted by dirty brown fine-grained calcite. Some of the thicker zones of very fine-grained silica alteration and veining contain disseminated and quite common well-formed small pyrite grains.

The relative abundance of both plagioclase and augite phenocrysts in this rock, plus the abundance of apatite, suggest to me that it was more andesitic than dacitic, although the extensive silicification and calcite overprinting would preclude a judgement one way or the other from major element compositions. I haven't seen very many perlitically-cracked andesites fromthe MRV, but he Ti/Zr ratio of this unit is clearly greater than the unambiguously dacitic unit (eg 396705) somewhat higher in the hole, and supports the contention that it was probably a silicic andesite.

SAMPLE NUMBER: MAC-10: 407.4m: 396711

SUMMARY:

This is a plagioclase+sparsely augite-phyric high-Si andesite lava with flattened vesicles and perlitic cracks preserved in the formerly glassy groundmass.

THIN SECTION DESCRIPTION:

This is a vesicular formerly glassy plagioclase+sparsely augite-phyric andesitic to dacitic lava. The once-glassy groundmass shows well-preserved perlitic cracks in several parts of the slide. The albitized plagioclase phenocrysts are quite large, to almost 2mm long, and occur as blocky to elongate prisms often grouped in multi-crystal clots, sometimes with altered augite; they are partially sericitized, and sometimes overprinted by calcite, and often contain long apatite needles. Plagioclase phenocrysts make up close to 15-20 modal% of this sample. Former augite phenocrysts are probably less abundant than in the previous sample, and are replaced by chlorite and calcite. Equigranular FeTi oxide microphenocrysts partially altered to leucoxene are quite common.

The groundmass of this sample is quite vesicular, with characteristically aligned and (primary, not deformation-produced) flattened elongate vesicles filled by chlorite and polycrystalline secondary quartz. The perlitic cracks in the devitrified glass ase picked out by chlorite concentrations, with 'cells' within the curved chlorite cracks being composed of very fine-grained quartz and albite, with minor sericite and chlorite.

This sample is essentially a better preserved and vesicular version of the previous sample, with the same implications for the original composition. I suggest that it is an andesite at the high-Si end of the andesite spectrum, transitional to dacite.

SAMPLE NUMBER: MAC-10: 431.2m: 396712

SUMMARY:

This is a formerly glassy plagioclase-phyric low-Si dacite to silicic andesite lava with a banding of calcite-chlorite-rich darker bands and chlorite-calcite-poor light bands that may be inheritied and enhanced from devitrification banding.

THIN SECTION DESCRIPTION:

This rock is a banded formerly glassy dacite to andesite with quite common albitized plagioclase phenocrysts set in former glass that has reacted variably to devitrification-recrystallization and subsequent alteration. The albitized plagioclase phenocrysts are mainly 0.5-2mm across blocky prisms, often occurring as anhedral intergrown crystals in multi-crystal clots. They make up about 10 modal% of this sample, and are partially altered by calcite and sericite flecking. Only a few small euhedral chlorite pseudomorphs after augiet were noted, but altered FeTi oxide microphenocrysts are not uncommon.

The distinctive banding of this sample is clearly seen to be due to variable concentrations of chlorite and calcite. Darker bands are composed almost entirely of dirty, patchy green brown chlorite and intergrown calcite in which albite phenocrysts are distributed in no manner different from the lighter coloured bands. The latter are more informative with regards the former nature of the groundmass, They are now composed of a relatively coarse mosaic intergrwoth of albite and quartz after glass, in which tiny acicular quench crytals of albite are set. These lighter coloured bands are much more lightly sprinkled with calcite and chlorite than the dark bands.

This sample was probably a glassy plagioclase-phyric low-Si dacite or high-Si andesite lava. The banding is clearly secondary, but whether it is replacing a former devitrification banding (common on this scale in glassy arc rocks) or entirely secondary is impossible to tell.

SAMPLE NUMBER: MAC-10: 457.4m: 396714

SUMMARY:

This is a distinctive plagioclase+augite+hornblende-phyric andesite lava, reminiscent in many respects to the Crown Hill andesites which mainly intrude the CVC N of Queenstown.

THIN SECTION DESCRIPTION:

This is a distinctive andesite lava with abundant phenocrysts of albitized plagioclase, and less abundant large augite phenocrysts, with important but modally subordinate small olive green hornblende phenocrysts. Albitized plagioclase phenocrysts make up about 20 modal% of this sample; they are generally small (<0.5mm long) rather ragged subhedral crystals, clear of any alteration, and frequently occur in multi-crystal clots. In contrast, augite phenocrysts are much less abundant (2-4 modal%) but are relatively large, up to 3mm long. They are almost entirely altered to dirty brown calcite, but cells of fresh augite are occasionally preserved in the bigger crystals. A notable feature of this sample is the presence of four or five small phenocrysts of brownish-olive hornblende, less than 0.5mm long. Microphenocrysts of FeTi oxide are dispersed sparsely through the sample.

The groundmass of this rock was glssy, and again, suggestions of fine-scale perlitic cracks are preserved in places. The groundmass has recrystallized to quartz and albite mosaics blotched with chlorite and calcite. Fracture fillings of green chlorite are common.

This sample is important. It is the only one I have seen in the Hellyer sections that contain primary hornblende, and in this regard invites comparison with the very similar hornblende-plagioclase-augite andesites from Crown Hill, where they intrude the CVC. Significantly, the Ti/Zr of the latter andesites is around 22-24, as is this sample from MAC-10. Further geochemical study of this unit in MAC-10 is required to confirm or otherwise this correlation. If valid, it records a period of transitional andesitic magmatism from the dacite-rhyolite dominated CVC to the basalt dominated Hellyer basalts. I should talk to you more about this.

SAMPLE NUMBER: MAC-10: 364.1m: 396708

SUMMARY:

This is a

THIN SECTION DESCRIPTION:

654203

0202

ATTACHMENT

DDH HAT 1

563785	65.2m	Hellyer basalt equivalent
563786	91.75m	Hellyer basalt equivalent
563787	97.5m	andesite lava
563788	134.85m	?Dacite lava

DDH HAT-2

563789	133.45m	?basalt lava
563790	142.75m	andesite lava
563791	156.5m	andesite lava

TC 45

0203

654204

PETROGRAPHIC REPORT

(Rocks from DDH HAT-1 and 2)

for

ABERFOYLE RESOURCES Ltd
(attn. Andrew McNeill)

by

Anthony J. Crawford
Geology Department
University of Tasmania

22/11/90

SAMPLE NUMBER: 563785 HAT-1, 62.5m

SUMMARY:

This is a strongly carbonate-altered, Hellyer-type, formerly cpx+olivine-phyric basaltic lava with distinctive quartz xenocrysts and not uncommon hematite-altered, disseminated and fine-grained pyrite.

THIN SECTION DESCRIPTION:

This sample is a massive, thoroughly carbonate-altered porphyritic basaltic lava. Major phenocryst phases were clinopyroxene and olivine, but both phases have been totally replaced by calcite. Due to the strong calcite overprint, it is difficult to estimate accurately the relative abundances of clinopyroxene and olivine, although I am certain olivine was subordinate. Mainly euhedral clinopyroxene phenocrysts probably made up around 10 modal% of this rock, whereas olivine phenocrysts made up less than 5 modal%. Both phases are rarely larger than 1mm long, although some definite former cpx phenocrysts reach 2mm long; phenocrysts grade in size through microphenocrysts to groundmass crystals. Some former cpx and olivine phenocrysts have clusters of hematite(?) euhedral and subhedral crystals growing in the replacing calcite. In this section, there are at least five quite large (to 2mm across) xenocrysts of quartz that have been strongly reacted around the margins and fractured internally. Calcite is even overprinting these quartz xenocrysts, which appear to be monocrystalline volcanic quartz rather than polycrystalline pelitic metamorphic grains. Well-preserved small chromite euhedra occur in some altered olivine crystals.

The groundmass of this sample was quite crystalline relative to many of the quenched Hellyer basalts, implying derivation from within a resonably thick flow unit or dyke. The groundmass is extensively altered and recrystallized, but was clearly made up of abundant stubby prisms of augite, and almost certainly quite abundant longer prisms of plagioclase. Both are totally replaced by calcite, and interstitial material (altered glass?) has recrystallized to a messy aggregate of quartz, chlorite and patchy fine-grained hematite. Small disseminated cubes of hematite-altered pyrite are relatively common.

I have no doubt that this sample is a Hellyer basalt. It has suffered considerably stronger hydrothermal alteration, dominated by carbonate-pyrite (hematite) alteration, than many Hellyer basalts I have seen. The presence of quartz xenocrysts draws comparison with basalts from Sock Ck Sth and MAC-27 (eg 563714).

3

SAMPLE NUMBER: 563786 HAT-1, 91.75m

SUMMARY:

This is a less-altered and more primitive basalt than the previous sample, with subequal amount of altered olivine and fresh augite phenocrysts, and quartz xenocrysts, in a quenched groundmass.

THIN SECTION DESCRIPTION:

This is a better preserved olivine+augite-phyric basaltic lava with clear affinities to typical Hellyer basalts. It contains a few large (to 4mm long) oval vesicles filled by calcite, but consists of almost equal amounts (10-12 modal% each) of perfectly fresh euhedral clinopyroxene phenocrysts usually less than 1mm long, and larger, altered olivine phenocrysts that reach 3mm long set in a quenched groundmass. Olivine phenocrysts have been replaced in almost every case by a zoned assemblage composed of olive chlorite in the core and extremely fine-grained quartz mosaics around the outer third to two-thirds of each crystal; these are not uncommonly partially overprinted by calcite. Small chromite euhedra are not uncommon in the altered olivines. As in the previous sample, cpx grades in size from phenocrysts through microphenocrysts to stubby groundmass prisms. Also as in the previous rock, this basalt contains five or six quartz xenocrysts to a few mm across, that show pronounced reaction rims composed of very fine-grained clinopyroxene.

The groundmass of this basalt was finer-grained than that of the previous sample, and probably consisted mainly of glass charged with feathery aggregates and sheaves of quenched plagioclase and augite. Glass has altered to very fine-grained secondary quartz and intimately-intergrown dull green chlorite, with minor spotting by calcite.

As for the previous sample, this is unambiguously a Hellyer-type quite primitive basalt, that shows the same unusual quartz xenocrysts discussed under 563785. It may be a valuable exercise to test whether these rocks with quartz xenocrysts are from a single eruptive unit, or whether they are more widespread within the thick pile of Hellyer basalts. I interpret the xenocrysts to mean that basalt pumped into a magma chamber in which quartz-phyric rhyolite was sitting. The only evidence of such magma mixing, if the volume of basalt exceeded the rhyolite, would be reacted quartz phenocrysts.

SAMPLE NUMBER: 56378 HAT-1, 97.5m

SUMMARY:

This is a polymict lava breccia dominated by formerly glassy evolved andesite and dacite fragments. Given that diagnosis, it contains a surprising amount of sphene as an alteration product, which may reflect a largely andesitic precursor.

THIN SECTION DESCRIPTION:

This is an polymict lava breccia composed dominantly of andesitic to dacitic lava fragments, mainly less than 1cm across. They are invariably plagioclase-phyric, whereas some also contain euhedral phenocrysts of altered cpx, and others a few reacted phenocrysts of quartz. Groundmass textures are considerably more variable than would be able to be produced during explosive eruption of a single flow unit. Many of the larger, dark-coloured fragments are probably from a single unit, being sparsely plagioclase+augite-phyric evolved andesite or dacite, with formerly glassy groundmass that has devitrified to a variable fine- to medium-grained mosaic texture dominated by quartz and albite. In all fragments, plagioclase, which is almost always rather elongate prisms, is totally sericitized, as are the subordinate former augite phenocrysts. A few distinct sugary-textured rhyolite fragments are present, with reacted small quartz phenocrysts. Some more chloritic fragments had microlitic cpx throughout the altered groundmass, and were almost certainly andesitic.

The alteration of this sample is patchy and variable, reflecting the original inhomogeneity in texture and fragment composition. Although sericite is by far the most abundant alteration phase, chlorite is also present (but not common), and brownish, highly birefringent and rather amorphous sphene is quite abundant, often occurring with hematite, but clearly not occupying sites of former FeTi oxides. Sphene and hematite often form trails and concentrations along fragment margins. Since TiO_2 abundances in Mount Read Volcanics are fairly strongly inversely correlated with SiO_2 contents of lavas, the abundant secondary sphene may indicate a more andesitic precursor than the andesite-to-dacite suggested on purely petrographic grounds.

This sample is probably a lava breccia produced by explosive submarine eruption of a rather evolved andesitic magma, that mixed into the breccia odd fragments of other rocks occurring in the vicinity. I don't believe that it has been reworked. I wonder whether the chemistry will be very informative; presumably it will give some hybrid numbers between dacite and andesite.

SAMPLE NUMBER: 563788 HAT-1, 134.85m

SUMMARY:

This is a plagioclase+sparsely augite-phyric glassy andesite lava that has been finely fractured and brecciated during eruption.

THIN SECTION DESCRIPTION:

This is a mottled grey-green massive dacitic lava with diffuse segregations of quartz. It shows in thin section a beautiful microjig-saw fit texture produced by in situ fracturing of what was a dacitic to andesitic lava. The rock was largely glassy, consisting of about 5 modal % of quite euhedral and often elongate plagioclase phenocrysts mainly less than 0.6mm long, and much less abundant, but not uncommon small augite phenocrysts partially altered to epidote. Plagioclase phenocrysts have been albitized, and contain variable amounts of yellow epidote and some dirty sericite. Former FeTi oxide microphenocrysts are also not uncommon, and are altered to rims of hematite enclosing cores composed of leucoxenic aggregates.

The distinctive texture of this lava is primary, not the result of hydroblasting or 'false brecciation'. Jig-saw fit small fragments are composed of almost opaque, brownish devitrified glass, and are separated one from the other by an anastomosing network of "fractures" that have been filled by the same magma, which in the fractures cooled rather more slowly, forming a more crystalline (albeit extremely fine-grained) material containing abundant aligned plagioclase microlites. Patches of secondary quartz more than 1cm long are present, and sometimes contain epidote inclusions, and narrow cross-cutting quart-calcite veinlets sometimes contain tiny pyrite euhedra.

The not uncommon augite, common epidote in the alteration assemblage, and rather elongate plagioclases, all suggest to me that this is an andesitic lava rather than a dacite, although in hand specimen, the rock is rather pale compared with other Hellyer region andesites I have seen. It is quite reminiscent of the glassy silicic andesites recorded and described from MAC-10 (eg. 396710, 11 and 12).

SAMPLE NUMBER: 563789 HAT-3, 133.45m

SUMMARY:

This is an intensely sericite-pyrite (+hematite?)-altered strongly plagioclase+augite-phyric basaltic to andesitic lava.

THIN SECTION DESCRIPTION:

This is a rather paler grey, speckled and strongly altered basaltic lava in which much of the original texture, and all of the primary mineralogy has been obliterated. It is clear that the rock was phenocryst-rich, although the identity of the former phenocrysts is rather difficult to ascertain. Phenocrysts range up to 2mm long, and are totally replaced by fine-grained sericite, although far from the majority (a large minority?) of them have shapes suggestive of plagioclase precursors. Many were probably augite. No clear former olivine phenocrysts could be identified.

The groundmass of this rock was probably vitrophyric, but it has been thoroughly replaced by fine-grained sericite and very fine-grained quartz riddled with tiny to 0.4mm-sized altered(?) pyrite clusters and trails of grains and possibly abundant very fine-grained hematite.

This rock was probably a strongly plagioclase+augite-phyric andesite to basalt lava. It has suffered severe sericite-pyrite (hematite) alteration.

SAMPLE NUMBER: 563790 and 563791 HAT-2, 142.75 and 156.5m

SUMMARY:

These are both very similar plagioclase+sparsely augite-phyric andesitic lavas that suffered an intense early sericite-pyrite (hematite or magnetite?) alteration event, then a silica alteration episode that produced a false brecciation texture, followed by diffuse carbonate alteration.

THIN SECTION DESCRIPTION:

These are texturally fairly well-preserved plagioclase-phyric andesitic lavas that show in both the core slices and thin section, abundant evidence for false brecciation associated with silicification of the rock. Where best preserved, both are seen to be composed of around 5-8 modal% of totally sericitized plagioclase phenocrysts, mostly less than 1mm long. Very few altered phenocrysts have shapes suggestive of mafic precursors, although a few small chlorite euhedra may have been augite. Small FeTi oxide microphenocrysts are replaced fine-grained aggregates of hematite or magnetite and leucoxene.

The groundmass of both rocks was vitrophyric, in 790 with abundant plagioclase microlites set in subordinate glass that has been thoroughly replaced by sericite, fine, granular magnetite or hematite (after pyrite in places?), and some spotty secondary quartz, and in 791 an originally more glassy groundmass that is now composed of almost opaque devitrified glass. Sample 790 is crosscut by angular fracture fillings and coarse vein networks of very fine-grained, almost chalcedonic secondary silica, that have produced the false brecciation texture so evident in the hand specimen. In places, and more typically in 791, the silica alteration has soaked from the veins into the groundmass of the rock, creating a coarse-grained polygonal silica-rich groundmass. The silicification has been overprinted by diffuse calcite alteration, but the common, disseminated opaques are clearly related to the early sericite alteration event and not the silica- or carbonate alteration.

st	north	sample	PROSPE	S	T	REPORT No.
5980	8500	87507	MACK	N	N	?
5980	8500	87508	MACK	N	N	?
5980	8400	87509	MACK	N	N	?
4400	7400	87510	MACK	N	N	?
5075	6900	94516	HAT	Y	Y	PONT1827
4700	7260	94518	HAT	Y	Y	PONT1827
4150	7200	94519	HAT	Y	Y	PONT1827
5700	8400	94522	MACK	Y	Y	PONT1845
5760	8400	94524	MACK	Y	Y	PONT1845
5850	8400	94526	MACK	Y	Y	PONT1845
5950	8400	94528	MACK	Y	Y	PONT1845
6300	8400	94530	MACK	Y	Y	PONT1845
4830	8000	94532	MACK	Y	Y	PONT1845
3730	7400	94540	MACK	Y	Y	PONT1845
3850	7400	94541	MACK	Y	Y	PONT1845
3900	7430	94542	HAT	Y	Y	?
5300	1000	95877	MACK	Y	Y	?
5320	7450	95886	MACK	Y	Y	?
5150	7550	95887	MACK	Y	Y	?
5780	7480	95898	HAT	Y	Y	PONT1827
4550	6400	99387	HAT	Y	Y	PONT1827
2800	5000	99401	HAT	Y	Y	PONT1856
2750	5020	99402	HAT	Y	Y	PONT1856
3090	5400	99403	HAT	Y	Y	PONT1856
2462	8411	141023	?	Y	Y	?
<999	<999	141049	?	Y	Y	?
2218	2319	141079	?	Y	Y	?
2335	2269	141080	?	Y	Y	?
1452	3433	141111	?	Y	Y	?
<999	<999	141116	?	Y	Y	?
1173	8740	141157	?	Y	Y	?
5650	6950	141159	MACK	Y	Y	?
5930	6700	141160	MACK	Y	Y	?
3850	3230	141172	HAT	Y	N	CM75/9/32
<999	<999	141255	?	Y	Y	?
<999	<999	141264	?	Y	Y	?
<999	<999	141581	?	Y	Y	?
2852	2458	141582	HAT	Y	N	CM75/9/32
3174	1692	141583	HAT	Y	N	CM75/9/32
3285	1446	141584	HAT	Y	N	CM75/9/32
3365	1316	141585	HAT	Y	N	CM75/9/32
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5180	8420	147140	MACK	Y	Y	?
5390	7760	147144	MACK	Y	Y	?
5420	7780	147146	MACK	Y	Y	?
5520	7840	147147	MACK	Y	Y	?
5580	7840	147148	MACK	Y	Y	?
5580	7840	147149	MACK	Y	Y	?
4700	6450	148941	HAT	Y	Y	PONT1827
3860	6400	148949	HAT	Y	Y	PONT1827
4300	9050	155052	HAT	Y	Y	PONT1856
4500	9850	155055	HAT	Y	Y	PONT1856
4680	9070	155064	HAT	Y	Y	PONT1856

3630	9370	155073	HAT	Y	Y	PONT1856
6420	8000	155131	MACK	Y	N	CM75/5/1
3200	6560	155139	HAT	Y	Y	CM75/6/7
3300	6550	155140	HAT	Y	Y	CM75/6/7
5600	7870	155176	MACK	Y	N	CM75/5/1
5650	7970	155177	MACK	Y	N	CM75/5/1
5730	7860	155178	MACK	Y	N	CM75/5/1
5850	7970	155179	MACK	Y	N	CM75/5/1
6170	7960	155180	MACK	Y	N	CM75/5/1
6300	7960	155181	MACK	Y	N	CM75/5/1
6550	7860	155182	MACK	Y	N	CM75/5/1
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5380	8060	155413	MACK	N	Y	?
5105	8105	155423	MACK	Y	Y	?
5495	8205	155429	MACK	Y	Y	?
5300	8035	155430	MACK	Y	Y	?
5020	8300	155433	MACK	Y	Y	?
2400	3400	156088	HAT	Y	Y	PONT1913
2550	3400	156089	HAT	Y	Y	PONT1913
3575	3400	156095	HAT	Y	Y	PONT1913
5780	7870	157538	MACK	Y	Y	?
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<999	<999	159891	?	Y	Y	?
<999	<999	159895	?	Y	Y	?
<999	<999	159898	?	Y	Y	?
<999	<999	159899	?	Y	Y	?
3650	3400	166566	HAT	Y	Y	PONT1913
3965	3400	166567	HAT	Y	Y	PONT1913
4130	3400	166568	HAT	Y	Y	PONT1913
3660	6000	166580	MACK	Y	Y	PONT1918
3700	5720	166584	MACK	Y	Y	PONT1918
6350	8930	166593	?	N	Y	?
7300	9900	166599	HAT	Y	Y	PONT1913
6960	9330	179602	MACK	Y	Y	PONT1918
6750	7550	183170	MACK	Y	Y	PONT1965
2720	4150	183175	MACK	Y	Y	PONT1965
2720	4150	183175	MACK	Y	Y	PONT1965
5300	1950	183187	MACK	Y	Y	PONT1965
5300	2010	183190	MACK	Y	N	CM76/9/22
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<999	<999	183302	?	N	Y	?
<999	<999	183303	?	N	Y	?
<999	<999	183304	?	N	Y	?
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4680	5570	183566	MACK	Y	Y	CM76/8/15
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3800	<999	206006	MACK	Y	N	CM77/5/21
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6001	11426	206136	MACK	Y	Y	CM77/3/18
<999	<999	206150	MACK	Y	Y	CM77/3/18
6920	7700	206337	MACK	Y	Y	CM77/3/18
6925	7730	206338	MACK	Y	Y	CM77/3/18
7430	6400	206348	MACK	Y	N	CM77/4/18

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4520	3600	206349	MACK	Y	N	CM77/4/18
6400	7400	206350	MACK	Y	Y	CM77/3/18
6600	7400	206351	MACK	Y	Y	CM77/3/18
6045	5270	206373	MACK	Y	N	CM77/5/21
5977	5110	206375	MACK	Y	N	CM77/5/21
5970	4980	206376	MACK	Y	N	CM77/5/21
5930	4950	206392	MACK	Y	N	CM77/5/21
6497	12820	265305	SV*	Y	Y	CM86/3/9
6590	12500	265306	SV	Y	Y	CM86/3/9
6490	12200	265307	SV	Y	Y	CM86/3/9
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6480	12120	265310	SV	Y	Y	CM86/3/9
6565	11870	265311	SV	Y	Y	CM86/3/9
6570	11870	265312	SV	Y	Y	CM86/3/9
6595	11640	265313	SV	Y	Y	CM86/3/9
4035	5215	265908	IZ	Y	Y	CM86/2/2
4095	5205	265910	IZ	Y	Y	CM86/2/2
4225	5167	265914	IZ	Y	Y	CM86/2/2
4260	5145	265917	IZ	Y	Y	CM86/2/2
4296	5100	265918	IZ	Y	Y	CM86/2/2
4395	5040	265922	IZ	Y	Y	CM86/2/2
4955	4923	265925	IZ	Y	Y	CM86/2/2
4510	4563	270684	MC	Y	Y	CM84/1/6
4516	4558	270685	MC	Y	Y	CM84/1/6
4447	4561	270686	MC	Y	Y	CM84/1/6
4383	4563	270687	MC	Y	Y	CM84/1/6
4384	4564	270688	MC	Y	Y	CM84/1/6
4352	4560	270689	MC	Y	Y	CM84/1/6
4323	4560	270690	MC	Y	Y	CM84/1/6
4306	4505	270691	MC	Y	Y	CM84/1/6
4431	4505	270692	MC	Y	Y	CM84/1/6
4451	4508	270693	MC	Y	Y	CM84/1/6
4504	4506	270694	MC	Y	Y	CM84/1/6
4526	4499	270695	MC	Y	Y	CM84/1/6
4111	4496	270696	MC	Y	Y	CM84/1/6
4059	4009	270697	MC	Y	Y	CM84/1/6
4005	3901	270698	MC	Y	Y	CM84/1/6
4250	4436	270699	MC	Y	Y	CM84/1/6
4122	7743	270885	AZ	Y	Y	CM84/3/3
4097	7738	270886	AZ	Y	Y	CM84/3/3
4028	7740	270887	AZ	Y	Y	CM84/3/3
4007	7742	270888	AZ	Y	Y	CM84/3/3
4002	7741	270889	AZ	Y	Y	CM84/3/3
4001	7740	270890	AZ	Y	Y	CM84/3/3
3999	7742	270891	AZ	Y	Y	CM84/3/3
3994	7740	270892	AZ	Y	Y	CM84/3/3
3979	7742	270893	AZ	Y	Y	CM84/3/3
3963	5804	270894	IZ	Y	Y	CM84/3/3
4034	5791	270895	IZ	Y	Y	CM84/3/3
4139	5792	270896	IZ	Y	Y	CM84/3/3
4159	5800	270897	IZ	Y	Y	CM84/3/3
4320	5810	270898	IZ	Y	Y	CM84/3/3
4300	5804	270899	IZ	Y	Y	CM84/3/3
4004	5744	270900	IZ	Y	Y	CM84/3/3
5686	4105	270901	IZ	Y	Y	CM84/3/3
5685	4110	270902	IZ	Y	Y	CM84/3/3
4219	5703	270903	IZ	Y	Y	CM84/3/3
3713	5391	270904	IZ	Y	Y	CM84/3/32
3665	5397	270905	IZ	Y	Y	CM84/3/32

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3580	5390	270906	IZ	Y	Y	CM84/3/32
4097	7535	270939	AZ	Y	Y	CM84/3/32
4046	7506	270941	AZ	Y	Y	CM84/3/32
4041	7505	270942	AZ	Y	Y	CM84/3/32
4026	7502	270943	AZ	Y	Y	CM84/3/32
4016	7497	270944	AZ	Y	Y	CM84/3/32
4015	7492	270945	AZ	Y	Y	CM84/3/32
4016	7483	270946	AZ	Y	Y	CM84/3/32
4015	7499	270947	AZ	Y	Y	CM84/3/32
4000	7466	270948	AZ	Y	Y	CM84/3/32
3991	7467	270949	AZ	Y	Y	CM84/3/32
3992	7466	270950	AZ	Y	Y	CM84/3/32
3922	7530	270951	AZ	Y	Y	CM84/3/32
4114	7867	270963	AZ	N	Y	CM84/3/41
4093	7871	270964	AZ	N	Y	CM84/3/41
3997	7883	270965	AZ	N	Y	CM84/3/41
3960	3490	271205	HAT *	Y	Y	CM86/5/4
2710	3000	271206	HAT *	Y	Y	CM86/5/4
2884	2992	271232	SH	Y	Y	CM86/6/6
2885	2993	271235	SH	Y	Y	CM86/6/6
2886	2994	271236	SH	Y	Y	CM86/6/6
2790	2919	271237	SH	Y	Y	CM86/6/6
2775	2915	271238	SH	Y	Y	CM86/6/6
2712	2897	271239	SH	Y	Y	CM86/6/6
2725	2900	271240	SH	Y	Y	CM86/6/6
2615	2634	271243	SH	Y	Y	CM86/6/6
2552	2615	271244	SH	Y	Y	CM86/6/6
4450	3500	271247	SH	Y	Y	CM86/11/12
2730	2740	271250	SH	Y	Y	CM86/6/6
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5530	13675	271257	SV*	Y	Y	CM86/6/6
4790	8420	271258	ML*	Y	Y	CM86/6/6
4860	8300	271259	ML*	Y	Y	CM86/6/6
2190	3000	271401	SH	Y	Y	CM86/11/12
2270	3000	271402	SH	Y	Y	CM86/11/12
2280	3235	271403	SH	Y	Y	CM86/11/12
2115	2730	271404	SH	Y	Y	CM86/11/12
2100	2775	271405	SH	Y	Y	CM86/11/12
2040	2500	271407	SH	Y	Y	CM86/11/12
2050	3205	271408	SH	Y	Y	CM86/11/12
2040	3135	271409	SH	Y	Y	CM86/11/12
1925	2880	271410	SH	Y	Y	CM86/11/12
2670	3940	271411	SH	Y	Y	CM86/11/12
2583	3830	271412	SH	Y	Y	CM86/11/12
2450	3690	271413	SH	Y	Y	CM86/11/12
2400	3650	271414	SH	Y	Y	CM86/11/12
2300	3530	271415	SH	Y	Y	CM86/11/12
2235	3460	271416	SH	Y	Y	CM86/11/12
3100	3000	271417	SH	Y	Y	CM86/11/12
3425	3000	271418	SH	Y	Y	CM86/11/12
3900	3000	271419	SH	Y	Y	CM86/11/12
4620	3000	271421	SH	Y	Y	CM86/11/12
6029	5000	271423	BC	Y	Y	CM86/11/14
6878	5000	271424	BC	Y	Y	CM86/11/14
6780	4803	271425	BC	Y	Y	CM86/11/14
6780	4814	271426	BC	Y	Y	CM86/11/14
6770	4800	271427	BC	Y	Y	CM86/11/14
6108	4800	271429	BC	Y	Y	CM86/11/14
5095	5035	271430	SM	Y	Y	CM86/11/14
4430	4995	271431	SM	Y	Y	CM86/11/14

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6000	5350	271432	BC		Y	Y CM86/11/14
6000	4350	271433	BC		Y	Y CM86/11/14
6000	5475	271434	BC		Y	Y CM86/11/14
5975	5475	271435	BC		Y	Y CM86/11/14
6075	5600	271436	BC		Y	Y CM86/11/14
6375	5600	271438	BC		Y	Y CM86/11/14
6035	5400	271439	BC		Y	Y CM86/11/14
6000	4620	271440	BC		Y	Y CM86/11/14
6000	3840	271441	BC		Y	Y CM86/11/14
6000	3755	271442	BC		Y	Y CM86/11/14
6000	3625	271443	BC		Y	Y CM86/11/14
6150	3600	271444	BC		Y	Y CM86/11/14
6075	3800	271445	BC		Y	Y CM86/11/14
6475	4000	271447	BC		Y	Y CM86/11/14
6035	4400	271449	BC		Y	Y CM86/11/14
6100	4400	271450	BC		Y	Y CM86/11/14
6235	4400	271451	BC		Y	Y CM86/11/14
6255	4400	271452	BC		Y	Y CM86/11/14
6275	4400	271453	BC		Y	Y CM86/11/14
6350	4400	271454	BC		Y	Y CM86/11/14
6360	4600	271455	BC		Y	Y CM86/11/14
4970	4990	271459	SM		Y	Y CM86/11/14
5325	5095	271461	SM		Y	Y CM86/11/14
6100	5300	271469	BC*		Y	Y CM86/11/14
2570	2165	271902	HAT		Y	Y CM86/5/4
2815	2976	271903	HAT		Y	Y CM86/5/4
3000	3355	271904	HAT		Y	Y CM86/5/4
3080	3545	271905	HAT		Y	Y CM86/5/4
2630	4490	271906	HAT	*	N	Y CM86/5/4
6040	10970	315601	ML*		N	Y CM84/5/20
6040	10970	315602	ML*		N	Y CM84/5/20
6040	10970	315603	ML*		N	Y CM84/5/20
6040	10970	315604	ML*		N	Y CM84/5/20
5390	11330	315605	ML*		N	Y CM84/5/20
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6050	10870	315611	ML*		N	Y CM84/5/20
6050	10870	315612	ML*		N	Y CM84/5/20
<999	<999	315663	ML		Y	Y CM86/1/13
5770	8595	315670	ML		Y	Y CM86/1/13
5680	8475	315672	ML		Y	Y CM86/1/13
5660	8460	315673	ML		Y	Y CM86/1/13
4780	2008	315695	SH*		Y	Y CM85/4/25
5320	1800	315740	SM		Y	Y CM84/11/3
5680	1800	315741	SM		Y	Y CM84/11/3
5740	1800	315742	SM		Y	Y CM84/11/3
6147	1800	315743	SM		Y	Y CM84/11/3
6175	2000	315744	SM		Y	Y CM84/11/3
6000	2000	315745	SM		Y	Y CM84/11/3
5750	2000	315746	SM		Y	Y CM84/11/3
5695	2000	315747	SM		Y	Y CM84/11/3
5890	2400	315748	SM		Y	Y CM84/11/3
6290	2200	315749	SM		Y	Y CM84/11/3
6000	2200	315750	SM		Y	Y CM84/11/3
5925	2200	315751	SM		Y	Y CM84/11/3
5590	2200	315752	SM		Y	Y CM84/11/3
5560	2200	315753	SM		Y	Y CM84/11/3

5460	2200	315754	SM	Y	Y	CM84/11/3
4068	3776	315755	SM	Y	Y	CM84/11/3
6360	12850	333301	SV	Y	Y	CM85/4/26
6200	13082	333302	SV	Y	Y	CM85/4/26
6661	13165	333303	SV	Y	Y	CM85/4/26
5400	13750	333304	SV*	Y	Y	CM85/4/26
6426	12850	333305	SV	Y	Y	CM85/4/26
6721	12917	333306	SV	Y	Y	CM85/4/26
6275	8750	355063	MACK	Y	Y	CM86/4/4
6275	8720	355064	MACK	Y	Y	CM86/4/4
6235	8690	355065	MACK	Y	Y	CM86/4/4
6200	8625	355066	MACK	Y	Y	CM86/4/4
6530	8665	355067	MACK	Y	Y	CM86/4/4
6475	8640	355068	MACK	Y	Y	CM86/4/4
6455	8640	355069	MACK	Y	Y	CM86/4/4
6430	8630	355070	MACK	Y	Y	CM86/4/4
6375	8615	355071	MACK	Y	Y	CM86/4/4
6315	8595	355072	MACK	Y	Y	CM86/4/4
6215	8520	355073	MACK	Y	Y	CM86/4/4
6205	8545	355074	MACK	Y	Y	CM86/4/4
6215	8520	355075	MACK	Y	Y	CM86/4/4
6575	8845	355147	MACK	Y	Y	CM86/4/4
6660	8645	355149	MACK	Y	Y	CM86/4/4
5540	6900	355153	MACK	Y	Y	CM86/2/19
6200	7060	355154	MACK	Y	Y	CM86/2/19
6230	7130	355155	MACK	Y	Y	CM86/2/19
6240	7160	355156	MACK	Y	Y	CM86/2/19
6320	7325	355157	MACK	Y	Y	CM86/2/19
6370	7395	355158	MACK	Y	Y	CM86/2/19
6500	7500	355159	MACK	Y	Y	CM86/2/19
6570	7530	355160	MACK	Y	Y	CM86/2/19
6630	7605	355161	MACK	Y	Y	CM86/2/19
6640	7630	355162	MACK	Y	Y	CM86/2/19
6650	7645	355163	MACK	Y	Y	CM86/2/19
6740	7690	355164	MACK	Y	Y	CM86/2/19
6740	7780	355165	MACK	Y	Y	CM86/2/19
6710	7910	355167	MACK	Y	Y	CM86/2/19
6550	8625	355168	MACK	Y	Y	CM86/2/19
6580	8570	355169	MACK	Y	Y	CM86/2/19
6255	8410	355807	MACK	Y	Y	CM86/4/4
6380	8395	355808	MACK	Y	Y	CM86/4/4
6950	8400	355809	MACK	Y	Y	CM86/4/4
7055	8400	355810	MACK	Y	Y	CM86/4/4
6340	8000	355811	MACK	Y	Y	CM86/4/4
6515	8210	355813	MACK	Y	Y	CM86/4/4
6130	8520	355819	MACK	Y	Y	CM86/4/4
6100	8515	355820	MACK	Y	Y	CM86/4/4
6090	8650	355821	MACK	Y	Y	CM86/4/4
6105	8625	355822	MACK	Y	Y	CM86/4/4
5980	8375	355823	MACK	Y	Y	CM86/4/4
5955	8405	355824	MACK	Y	Y	CM86/4/4
5945	8430	355825	MACK	Y	Y	CM86/4/4
4184	5607	355831	IZ	Y	Y	CM86/7/16
4097	5596	355832	IZ	Y	Y	CM86/7/16
6718	7950	355834	GT	Y	Y	CM86/8/11
6768	8050	355835	GT	Y	Y	CM86/8/11
6810	8150	355836	GT	Y	Y	CM86/8/11
6965	8240	355837	GT	Y	Y	CM86/8/11
6892	8562	355838	GT	Y	Y	CM86/8/11
6905	8566	355839	GT	Y	Y	CM86/8/11

4840	4430	355842	MC	Y	Y	CM86/8/10
3740	4150	355844	MC	Y	Y	CM86/8/10
3580	4028	355845	MC	Y	Y	CM86/8/10
3800	4100	355846	MC	Y	Y	CM86/8/10
2610	4510	355847	CD	Y	Y	CM86/8/10
2615	4470	355848	CD	Y	Y	CM86/8/10
3130	4327	355849	CD	Y	Y	CM86/8/10
3140	4325	355850	CD	Y	Y	CM86/8/10
4195	8749	355882	HAT	Y	Y	CM86/4/15
4100	8783	355883	HAT	Y	Y	CM86/4/15
4157	8640	355884	HAT	Y	Y	CM86/4/15
4156	8641	355885	HAT	Y	Y	CM86/4/15
4147	8642	355886	HAT	Y	Y	CM86/4/15
6755	9760	378377	SV	Y	Y	CM87/11/16
6625	9800	378378	SV	Y	Y	CM87/11/16
7100	9850	378381	SV	Y	Y	CM87/11/16
6800	10080	378382	SV	Y	Y	CM87/11/16
6795	10105	378383	SV	Y	Y	CM87/11/16
6745	10215	378384	SV	Y	Y	CM87/11/16
6960	9815	378385	SV	Y	Y	CM87/11/16
6305	9260	378394	SV	Y	Y	CM87/11/16
6315	9275	378395	SV	Y	Y	CM87/11/16
6305	9300	378397	SV	Y	Y	CM87/11/16
6350	9350	378398	SV	Y	Y	CM87/11/16
6355	9350	378399	SV	Y	Y	CM87/11/16
6395	9350	378400	SV	Y	Y	CM87/11/16
6200	11650	379425	ML	Y	Y	CM87/5/35
4300	10250	379426	TD	Y	Y	CM87/5/35
2950	10270	379427	TD	Y	Y	CM87/5/35
3560	4750	379428	CD	Y	Y	CM87/5/35
6540	9490	379456	SV	Y	Y	CM87/11/16
5480	<2000	379701	HF	Y	Y	CM87/6/22
5800	<1180	379702	HF	Y	Y	CM87/6/22
5998	<1100	379703	HF	Y	Y	CM87/6/22
5800	<1020	379704	HF	Y	Y	CM87/6/22
4600	2200	379705	SH	Y	Y	CM87/2/14
4300	1910	379707	SH	Y	Y	CM87/2/14
4300	1580	379708	SH	Y	Y	CM87/2/14
4845	1400	379710	SH	Y	Y	CM87/2/14
4900	1420	379711	SH	Y	Y	CM87/2/14
4900	1420	379712	SH	Y	Y	CM87/2/14
4935	1400	379713	SH	Y	Y	CM87/2/14
4965	1400	379715	SH	Y	Y	CM87/2/14
4975	1400	379716	SH	Y	Y	CM87/2/14
5400	1400	379717	SH	Y	Y	CM87/2/14
6700	310	379727	HF	Y	Y	CM87/6/22
6700	310	379732	HF	Y	Y	CM87/6/22
7525	4100	379734	HF	Y	Y	CM87/6/22
7525	4100	379735	HF	Y	Y	CM87/6/22
6850	2830	379737	HF	Y	Y	CM87/6/22
6850	2830	379739	HF	Y	Y	CM87/6/22
6850	2830	379740	HF	Y	Y	CM87/6/22
6660	2400	379743	HF	Y	Y	CM87/6/22
6660	2400	379745	HF	Y	Y	CM87/6/22
7200	<10	379746	HF	Y	Y	CM87/6/22
7200	<10	379747	HF	Y	Y	CM87/6/22
6580	2570	379749	HF	Y	Y	CM87/6/22
6570	<1780	379750	HF	Y	Y	CM87/6/22
<999	<999	379752	BH	Y	Y	CM87/6/22
<999	<999	379753	BH	Y	Y	CM87/6/22

654218

<999	<999	379754	BH	Y	Y	CM87/6/22
<999	<999	379755	BH	Y	Y	CM87/6/22
<999	<999	379756	BH	Y	Y	CM87/6/22
6580	11900	379761	SV	Y	Y	CM87/2/15
6520	12430	379770	SV	Y	Y	CM87/1/25
6520	12370	379771	SV	Y	Y	CM87/1/25
6558	12357	379772	SV	Y	Y	CM87/1/25
6500	12190	379773	SV	Y	Y	CM87/1/25
6495	12176	379775	SV	Y	Y	CM87/1/25
6476	12148	379777	SV	Y	Y	CM87/1/25
6490	12130	379779	SV	Y	Y	CM87/1/25
6506	12118	379780	SV	Y	Y	CM87/1/25
6506	12096	379781	SV	Y	Y	CM87/1/25
6480	12066	379783	SV	Y	Y	CM87/1/25
6520	12005	379785	SV	Y	Y	CM87/1/25
6555	11430	379787	SV	Y	Y	CM87/1/25
6570	11430	379789	SV	Y	Y	CM87/1/25
6547	11682	379790	SV	Y	Y	CM87/2/15
6585	11700	379791	SV	Y	Y	CM87/2/15
6590	11745	379792	SV	Y	Y	CM87/2/15
6595	11762	379793	SV	Y	Y	CM87/2/15
6598	11770	379794	SV	Y	Y	CM87/2/15
6614	11795	379796	SV	Y	Y	CM87/2/15
6210	11000	383614	ML	Y	Y	CM87/5/16
6490	11500	383615	ML	Y	Y	CM87/5/16
5900	11010	383616	ML	Y	Y	CM87/5/16
5905	11010	383617	ML	Y	Y	CM87/5/16
5860	10960	383618	ML	Y	Y	CM87/5/16
5865	10960	383619	ML	Y	Y	CM87/5/16
5830	10840	383620	ML	Y	Y	CM87/5/16
3430	10530	383621	TD	Y	Y	CM87/5/17
3280	10760	383622	TD	Y	Y	CM87/5/17
2790	10850	383623	TD	Y	Y	CM87/5/17
2680	11340	383624	TD	Y	Y	CM87/5/17
3115	11040	383625	TD	Y	Y	CM87/5/17
6605	4570	424462	HF	Y	Y	CM88/6/31
3445	1000	427317	SH	Y	Y	CM88/1/18
3375	1800	427324	SH	Y	Y	CM88/1/18
3510	2000	427326	SH	Y	Y	CM88/1/18
3430	2200	427327	SH	Y	Y	CM88/1/18
3325	2400	427328	SH	Y	Y	CM88/1/18
3480	2400	427330	SH	Y	Y	CM88/1/18
3680	2600	427334	SH	Y	Y	CM88/1/18
3760	2600	427335	SH	Y	Y	CM88/1/18
3465	2800	427338	SH	Y	Y	CM88/1/18
2580	3200	427343	SH	Y	Y	CM88/1/18
3495	3200	427344	SH	Y	Y	CM88/1/18
3515	3200	427345	SH	Y	Y	CM88/1/18
6890	8750	427352	CF	Y	Y	CM88/1/18
7140	9000	427354	CF	N	Y	CM88/1/18
7015	9090	427355	CF	Y	Y	CM88/1/18
6980	8990	427356	CF	Y	Y	CM88/1/18
6100	10480	427366	MC	Y	Y	CM88/2/21
6120	10470	427367	MC	Y	Y	CM88/2/21
6600	13570	427368	SV	Y	Y	CM88/2/21
6970	11970	427369	SV	Y	Y	CM88/2/21
6990	11000	427370	SV	Y	Y	CM88/2/21
6910	11300	427371	SV	Y	Y	CM88/2/21
7140	13510	427372	SV	Y	Y	CM88/2/21
6680	11945	427376	SV	Y	Y	CM88/3/34

654219

6275	14420	427386	SV	Y	Y	CM88/3/34
7050	12100	427391	SV	Y	Y	CM88/3/34
7150	12100	427392	SV	Y	Y	CM88/3/34
7590	12410	427393	SV	Y	Y	CM88/3/34
7050	10995	427399	SV	Y	Y	CM88/3/34
8565	10720	427404	SV	Y	Y	CM88/3/34
8330	10820	427405	SV	Y	Y	CM88/3/34
8205	11335	427407	SV	Y	Y	CM88/3/34
8195	11380	427409	SV	Y	Y	CM88/3/34
7640	10440	427415	SV	Y	Y	CM88/3/34
7780	10570	427416	SV	Y	Y	CM88/3/34
7150	13880	427421	SV	Y	Y	CM88/3/34
6755	13540	427422	SV	Y	Y	CM88/3/34
6670	13470	427424	SV	Y	Y	CM88/3/34
9400	10080	427440	SV	Y	Y	IN HOUSE
9330	9960	427442	SV	Y	Y	IN HOUSE
7620	13270	427443	SV	Y	Y	IN HOUSE
4755	10330	427447	MC	Y	?	IN HOUSE
4735	10320	427448	MC	Y	?	IN HOUSE
4830	10800	427449	MC	Y	?	IN HOUSE
6155	4380	427451	HF	Y	Y	CM88/6/31
6300	4075	427455	HF	Y	Y	CM88/6/31
6550	4310	427457	HF	Y	Y	CM88/6/31
6490	4535	427459	HF	Y	Y	CM88/6/31
5990	6610	427463	HF	Y	Y	CM88/6/31
6400	6190	427464	HF	Y	Y	CM88/6/31
6400	6055	427465	HF	Y	Y	CM88/6/31
6010	5960	427467	HF	Y	Y	CM88/6/31
6395	5800	427472	HF	Y	Y	CM88/6/31
6110	5210	427474	HF	Y	Y	CM88/6/31
6880	2830	427478	HF	Y	Y	CM88/6/31
8000	16130	427479	MW	Y	Y	CM88/6/28
7550	16440	427482	MW	Y	Y	CM88/6/28
6750	14900	427486	MW	Y	Y	CM88/6/28
7200	15120	427488	MW	Y	Y	CM88/6/28
7950	16700	427489	MW	Y	Y	CM88/6/28
7630	16440	427490	MW	Y	Y	CM88/6/28
7460	16390	427491	MW	Y	Y	CM88/6/28
7200	16330	427492	MW	Y	Y	CM88/6/28
7140	16320	427493	MW	Y	Y	CM88/6/28
7020	16160	427494	MW	Y	Y	CM88/6/28
7520	15650	427495	MW	Y	Y	CM88/6/28
7630	16440	427808	MW	Y	?	IN HOUSE
2250	12710	427809	BH	Y	Y	CM88/7/36
1570	13080	427811	BH	Y	Y	CM88/7/36
1880	12680	427814	BH	Y	Y	CM88/7/36
1880	12490	427815	BH	Y	Y	CM88/7/36
2350	19430	427818	BH	Y	Y	CM88/7/36
2510	12230	427819	BH	Y	Y	CM88/7/36
2800	11760	427821	BH	Y	Y	CM88/7/36
4760	6200	427827	IZ	Y	Y	CM88/8/2
4750	6000	427829	IZ	Y	Y	CM88/8/2
4325	5800	427830	IZ	Y	Y	CM88/8/2
4500	5745	427833	IZ	Y	Y	CM88/8/2
4535	5600	427834	IZ	Y	Y	CM88/8/2
4780	5390	427836	IZ	Y	Y	CM88/8/2
4470	5100	427840	IZ	Y	Y	CM88/9/5
4725	5000	427841	IZ	Y	Y	CM88/9/5
4790	5100	427842	IZ	Y	Y	CM88/9/5
4075	4500	427847	MC	Y	Y	CM88/9/5

654220

5285	4500	427848	MC	Y	Y	CM88/9/5
5400	8310	500358	ML	Y	Y	CM85/4/6
5510	8300	500359	ML	Y	Y	CM85/4/6
5350	8400	500360	ML	Y	Y	CM85/4/6
5990	8950	500361	ML	Y	Y	CM85/4/6
5400	8400	500362	ML	Y	Y	CM85/4/6
5300	8200	500363	ML	Y	Y	CM85/4/6
5110	8700	500821	ML	Y	Y	CM85/9/21
5140	8700	500822	ML	Y	Y	CM85/9/21
5750	8820	500823	ML	Y	Y	CM85/9/21
5270	7900	500824	ML	Y	Y	CM85/9/21
5550	8250	500830	ML	Y	Y	CM85/9/21
5520	8300	500831	ML	Y	Y	CM85/9/21
5500	8340	500982	ML	N	N	CM86/3/14
5590	8410	500983	ML	N	N	CM86/3/14
5650	8450	500984	ML	N	N	CM86/3/14
5690	8480	500985	ML*	N	N	CM86/3/14
5880	8620	500986	ML	N	N	CM86/3/14
5835	8630	500987	ML	N	N	CM86/3/14
5600	8525	500988	ML	N	N	CM86/3/14
5080	6800	515043	SM	Y	Y	CM89/3/22
5090	6585	515048	SM	Y	Y	CM89/3/22
5980	5600	515052	SM	Y	Y	CM89/3/22
5915	4200	515115	SM	Y	Y	TC21
4975	4000	515122	SM	Y	Y	TC21
5452	4000	515123	SM	Y	Y	TC21
5585	4000	515125	SM	Y	Y	TC21
5655	4000	515126	SM	Y	Y	TC21
5200	5400	515130	SM	Y	Y	TC21
6120	8450	515206	GT	Y	Y	TC9
6240	8275	515207	GT	Y	Y	TC9
6450	8150	515209	GT	Y	Y	TC9
6270	8050	515210	GT	Y	Y	TC9
6270	8000	515211	GT	Y	Y	TC9
4030	4780	515311	MC*	N	Y	TC
6400	11450	562344	ML	Y	Y	NOT DESCRI
4325	10350	562345	ML	Y	Y	NOT DESCRI
4100	10350	562348	ML	Y	Y	NOT DESCRI
3000	10300	562346	ML	Y	Y	NOT DESCRI
3200	9900	562347	ML	Y	Y	NOT DESCRI
5670	1260	562660	SM	Y	Y	TC46
5485	1210	562662	SM	Y	Y	TC46
4310	5825	562665	IZ	Y	Y	TC46
3930	9710	562666	TD	Y	Y	TC46
4300	5964	562685	IZ	Y	Y	TC46
5680	2160	562656	SM	Y	Y	TC46

APPENDIX 8

Aberfoyle Exploration — SAMPLE REGISTER — Collected AMcN + RWM

PROJECT: Mackintosh
Core geochem database

DATE:

SHEET: 1 of 1.

0221

LOG

HAT-1	65.2m		567	785	Top H.W. Basalt
HAT-1	91.75m			786	Base H.W. Basalt.
HAT-1	97.5m			787	? Top footwall andesite
HAT-1	134.85m			788	? footwall andesite
HAT-2	133.45m			789	Top of H.W. Basalt.
HAT-2	148.75m			790	
HAT-2	156.5m			791	
HL-15	109.6m			792	Top H.W. Basalt
HL-15	257.7m			793	Base HW Basalt.
HL 2A6	263.1m			794	Base H.W. Basalt.
Mac-4	157.7m	(Footwall)		795	
HL-15	270.7m.	(Footwall)		796	
Standard - Core grind				797	
Standard - Soil				798	
Standard - Core grind			563	799	

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A Division of Inchcape Inspection and Testing Services Australia Pty. Ltd.

Analabs - A Division of Inchcape Inspection & Testing Services

Phone (004) 31 6837 | 14 Thirkell St. Cooee Tas 7320 | Fax No. (004) 31 8890

ANALYTICAL REPORT No. 100560.60.07510

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

INVOICE TO: Richard de Bomford
Aberfoyle Resources Limited
Exploration Division
P.O. Box 952
Burnie Tasmania 7320

ORDER No.	PROJECT
11019	

DATE RECEIVED	RESULTS REQUIRED
14/11/90	ASAP

No. OF PAGES OF RESULTS	DATE REPORTED	No. OF COPIES
3	13/12/90	1

TOTAL No. OF SAMPLES: 15

SAMPLE NUMBERS	SAMPLE DESCRIPTION	ELEMENT/METHOD
563785/99	sc Prep: GP005,GP009,GP016	Ag/GA101
563785/99	sc Prep: GP005,GP009,GP016	Ag/GA101
563785/99	sc	As,Cr,Zr,Ti/GX401
563785/99	sc	As,Cr,Zr,Ti/GX401
563785/99	sc	Cu,Pb,Zn,Ba,K2O,MgO,CaO,Na2O,P2O5,Mn,Ni,Sr,Rb/

RESULTS TO: b

RESULTS TO:

RESULTS TO:

REMARKS

AUTHORISED OFFICER

654224

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A Division of Inchcape Inspection and Testing Services Australia Pty. Ltd.

0293

ANALYTICAL DATA

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
	100560.60.07510	13/12/90	11019	1 OF 3

TUBE No.	SAMPLE No.	Cu	Pb	Zn	Ag	Ba	As	Cr	Zr	Ti
1	563785	83	<100	51	<0.5	716	3	850	140	260
2	563786	91	<100	65	<0.5	1036	40	900	170	2800
3	563787	42	<100	149	<0.5	1643	40	10	180	250
4	563788	26	<100	56	<0.5	1271	15	30	170	270
5	563789	72	<100	142	<0.5	1978	130	6	270	440
6	563790	35	140	69	<0.5	1590	15	9	180	350
7	563791	54	1129	1552	<0.5	1296	<2	<5	160	225
-	563792	110	<100	106	<0.5	743	10	730	150	425
9	563793	88	<100	94	<0.5	2711	5	470	140	355
10	563794	119	<100	57	<0.5	436	15	340	140	285
11	563795	20	<100	50	<0.5	583	4	45	210	185
12	563796	12	<100	156	<0.5	1991	15	55	170	400
13 X	563797 CSRI	115	200	2225	<0.5	1058	20	1100	85	240
14 X	563798 Soil	20	190	159	<0.5	534	70	50	240	375
15 X	563799 CSRI	115	198	2232	<0.5	1060	15	1100	75	240
16										
17										
18										
19										
20										
21										
22										
23	DETECTION	5	100	5	0.5	5	2	5	5	50
24	UNITS	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
25	METHOD	GI201	GI201	GI201	GA101	GI201	GX401	GX401	GX401	GX401

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

AUTHORISED OFFICER

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0224

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A Division of Inchcape Inspection and Testing Services Australia Pty. Ltd.

ANALYTICAL DATA

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
	100560.60.07510	13/12/90	11019	2 OF 3

TUBE No.	SAMPLE No.	Ti:Zr	CaO	K2O	MgO	Mn	Na2O	Ni	P2O5	Sr
1	563785	18.6	18.30	1.19	6.10	1430	1.29	172	0.44	324
2	563786	16.5	8.78	0.89	9.67	1414	1.60	198	0.48	444
3	563787	13.9	2.99	3.43	2.57	729	3.21	<10	0.25	464
4	563788	15.9	6.48	1.35	1.64	877	3.55	14	0.25	987
5	563789	16.3	2.15	6.30	1.14	172	1.19	13	0.42	162
6	563790	19.4	3.80	4.02	2.39	458	1.37	<10	0.27	125
7	563791	14.1	4.72	2.00	2.77	1646	3.75	<10	0.24	385
8	563792	28.3	11.70	1.79	6.43	979	1.64	109	0.36	344
9	563793	25.4	7.82	1.44	8.84	1172	2.14	97	0.25	462
10	563794	20.4	11.40	0.08	7.33	1469	4.35	68	0.29	362
11	563795	8.8	3.16	2.99	2.17	431	1.28	<10	0.06	79
12	563796	23.5	1.16	2.55	2.80	1216	3.44	12	0.14	238
13	563797	28.2	3.93	1.19	7.08	6468	3.41	281	0.15	274
14	563798	15.6	0.13	1.91	0.78	283	0.03	<10	0.08	35
15	563799	32.0	3.95	1.20	7.10	6570	3.42	284	0.15	274
16										
17										
18										
19										
20										
21										
22										
23	DETECTION	0.1	0.01	0.01	0.01	15	0.01	10	0.02	1
24	UNITS	—	%	%	%	ppm	%	ppm	%	ppm
25	METHOD	S9825	GI201	GI201	GI201	GI201	GI201	GI201	GI201	GI201

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

654226

0225

ANALABS

A Division of Inchcape Inspection and Testing Services Australia Pty. Ltd.

ANALYTICAL DATA

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
	100560.60.07510	13/12/90	11019	3 OF 3

TUBE No.	SAMPLE No.	Rb
1	563785	82.00
2	563786	41.90
3	563787	197.00
4	563788	60.40
5	563789	411.00
6	563790	213.00
7	563791	124.00
8	563792	85.30
9	563793	46.20
10	563794	1.96
11	563795	112.00
12	563796	155.00
13	563797	40.20
14	563798	149.00
15	563799	36.30
16		
18		
19		
20		
21		
22		
23	DETECTION	0.05
24	UNITS	ppm
25	METHOD	GI222

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

Aberfoyle Exploration

M. MN + R.K.B.

Mack
Core Database

23/11/90

SHEET 1 of 2

LOG

HL-9	258.3m	S 62 600	split core.	Cu, Pb, Zn, Ba, As, Ag, Cr, Ti, Zr, Sr, Rb, Mn, Na_2O, MgO, K_2O	Base of Hw. Basalt
HL-9	261.95m	601		CaO, P_2O_5, Ni	Top Fps.
HL-17	110.7m	602			Base H.W. Basalt.
HL-17	130.5m	603			Top Fps.
HL-23	271.65	604			Top H.W. Bas.
HL-23	417.5	605			Base " "
HL-23	445.95	606			Top FPS
HL-79	194.6m	607			Top H.W.B.
HL-79	461.25	608			Base "
HL-79	484.7	609			Top fps
HL-246	226.5m	610			Top HWB
HL-345	236.9m	611			Top HWB
HL-345	615.5m	612			Base "
HL-345	634.3m	613			Top fps
HAT-4	161.3	614			Top HWB
HAT-4	388.55	615			Base "
HAT-5	147.6 m	616			Top "
HAT-9	96.0	617			Base "
Mac-1	52.9	618			Top "
Mac-1	118.0	619			Base "
Mac-4	15.1	620			Base HWB
Mac-5	81.9	621			Top HWB.
Mac-10	255.9	622			Base of B-1
Mac-15	95.4	623			HWB.
Mac-17	98.5	624			Base HWB.

654227

Aberfoyle Exploration

GEOCHEMICAL SAMPLE REPORT

AMN + RRB

PROJECT: Mack Core Database

DATE: 23/11/90

SHEET: 2 of 2

Mac-21	102.2m		562625		Split Core	Base Hard.
Mac-21	134.6m		626			Top Pl.
Mac-21	234.7		627			Base "

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A Division of Inchcape Inspection and Testing Services Australia Pty. Ltd.

Analabs - A Division of Inchcape Inspection & Testing Services

Phone (004) 31 6837 | 14 Thirkell St. Cooee Tas 7320 | Fax No. (004) 31 8890

ANALYTICAL REPORT No. 100560.60.07549

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

INVOICE TO:

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

ORDER No.	PROJECT
11027	Mack

DATE RECEIVED	RESULTS REQUIRED
26/11/90	ASAP

No. OF PAGES OF RESULTS	DATE REPORTED	No. OF COPIES	TOTAL No. OF SAMPLES
6	08/01/91	1	28

SAMPLE NUMBERS	SAMPLE DESCRIPTION	ELEMENT/METHOD
562600/627	DC Prep: GP005,GP009,GP016	Ag/GA101
562600/627	DC	As,Cr,Zr,Ti/GX401
562600/627	DC	Cu,Pb,Zn,Ba,Mn,Ni,Sr,Rb,K2O,MgO,CaO,Na2O,P2O5/G
562600/627	DC	Ti:Zr/S9825
562600/627	DC Prep: GP005,GP009,GP016	Ag:1/GA101

RESULTS TO

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

RESULTS TO

RESULTS TO

REMARKS

AMENDED Ni RESULTS

APOLOGIES

AUTHORISED OFFICER

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A Division of Inchcape Inspection and Testing Services Australia Pty. Ltd.

ANALYTICAL DATA

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
	100560.60.07549	08/01/91	11027	1 OF 6

TUBE No.	SAMPLE No.	Cu	Pb	Zn	Ag	Ag:1	Ba	As	Cr	Zr
1	562600	13	<100	152	<0.5	–	484	14	21	14
2	562601	36	<100	96	<0.5	–	1030	6	39	14
3	562602	77	<100	119	<0.5	–	722	35	657	5
4	562603	89	<100	50	13.0	12.0	837	149	163	11
5	562604	66	<100	65	<0.5	–	408	5	862	5
6	562605	220	2230	3580	4.0	3.0	65	68	78	11
7	562606	51	105	136	<0.5	–	1410	52	339	4
8	562607	104	<100	75	<0.5	–	738	13	578	14
9	562608	111	<100	90	<0.5	–	255	<2	810	5
10	562609	47	117	242	<0.5	–	630	8	63	14
11	562610	85	<100	55	<0.5	–	305	<2	572	9
12	562611	138	<100	74	<0.5	–	234	<2	830	10
13	562612	199	<100	103	<0.5	–	83	18	896	5
14	562613	66	<100	31	<0.5	–	1140	109	13	1
15	562614	57	<100	57	<0.5	–	915	<2	758	10
16	562615	32	285	591	<0.5	–	82	<2	144	5
17	562616	83	<100	53	<0.5	–	275	<2	871	9
18	562617	96	<100	190	<0.5	–	251	4	788	31
19	562618	41	<100	75	<0.5	–	126	<2	647	7
20	562619	14	<100	165	<0.5	–	388	<2	903	3
21	562620	62	<100	208	<0.5	–	169	<2	600	12
22	562621	56	<100	58	<0.5	–	963	13	54	32
23	562622	32	388	221	<0.5	–	1200	<2	580	10
24	562623	133	<100	659	<0.5	–	627	<2	1051	8
25	562624	68	<100	98	<0.5	–	1210	11	5	15

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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A Division of Inchcape Inspection and Testing Services Australia Pty. Ltd.

ANALYTICAL DATA

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
	100560.60.07549	08/01/91	11027	2 OF 6

TUBE No.	SAMPLE No.	Cu	Pb	Zn	Ag	Ag:1	Ba	As	Cr	Zr
1	562625	95	<100	52	1.0	–	477	<2	176	5
2	562626	9	<100	40	<0.5	–	820	<2	<5	366
3	562627	5	<100	20	<0.5	–	214	<2	25	16
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22										
23	DETECTION	5	100	5	0.5	0.5	5	2	5	5
24	UNITS	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
25	METHOD	GI201	GI222	GI201	GA101	GA101	GI201	GX401	GX401	GX401

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

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ANALYTICAL DATA

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
	100560.60.07549	08/01/91	11027	3 OF 6

TUBE No.	SAMPLE No.	Ti	Ti:Zr	CaO	K2O	MgO	Mn	Na2O	Ni	P2O5
1	562600	2656	18.2	1.570	0.970	2.840	1350	5.770	<10	0.19
2	562601	2556	17.5	2.180	2.450	2.160	514	3.780	16	0.24
3	562602	2285	38.7	10.000	0.260	10.200	1970	3.130	213	0.18
4	562603	3366	29.0	0.740	5.820	1.490	139	0.510	57	0.24
5	562604	2397	47.0	19.800	1.430	6.460	1480	1.030	218	0.14
6	562605	2161	19.0	2.650	<0.060	20.100	1800	0.020	20	0.10
7	562606	2173	44.3	3.330	3.360	5.050	6900	0.990	79	0.08
8	562607	3718	26.0	13.300	2.780	4.560	3090	0.540	63	0.29
9	562608	2488	46.1	8.910	0.150	8.360	1480	2.920	210	0.16
10	562609	3150	21.4	1.940	0.760	2.310	848	6.170	34	0.14
11	562610	1931	19.7	12.400	1.070	5.760	1040	0.970	178	0.15
12	562611	3056	28.8	10.000	0.700	8.350	980	3.040	180	0.27
13	562612	2440	48.8	16.000	0.080	5.660	1340	3.780	181	0.13
14	562613	3672	18.5	0.680	3.500	0.850	191	3.340	13	0.11
15	562614	1915	19.0	7.340	0.660	7.930	870	2.630	194	0.13
16	562615	2350	42.0	5.750	0.120	6.530	1920	5.020	37	0.14
17	562616	2564	27.9	6.580	1.690	4.490	1490	1.710	145	0.35
18	562617	4623	14.7	12.200	0.380	5.930	2500	2.910	242	0.76
19	562618	2042	27.2	6.220	0.110	6.880	642	3.310	122	0.07
20	562619	1631	48.0	10.900	1.730	7.630	1590	0.140	276	0.12
21	562620	2856	22.7	8.750	0.450	6.110	1740	3.290	133	0.17
22	562621	4825	14.9	7.490	3.960	3.590	1240	0.800	24	0.65
23	562622	2288	21.0	12.300	0.920	8.160	2130	2.820	140	0.45
24	562623	3259	38.8	0.270	1.660	8.540	438	0.040	277	0.14
25	562624	3581	23.7	3.460	2.320	2.880	506	1.810	18	0.66

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

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ANALYTICAL DATA

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
	100560.60.07549	08/01/91	11027	4 OF 6

TUBE No.	SAMPLE No.	Ti	Ti:Zr	CaO	K2O	MgO	Mn	Na2O	Ni	P2O5
1	562625	2150	40.6	17.000	2.160	3.950	1390	0.140	39	0.19
2	562626	2372	6.5	1.740	6.080	1.220	197	0.910	<10	0.11
3	562627	1498	9.4	0.840	0.970	0.310	490	5.290	14	0.08
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23	DETECTION	50	0.1	0.007	0.060	0.003	15	0.007	10	0.020
24	UNITS	ppm	%	%	%	%	ppm	%	ppm	%
25	METHOD	GX401	S9825	GI201	GI201	GI201	GI201	GI201	GI201	GI201

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

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ANALYTICAL DATA

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
	100560.60.07549	08/01/91	11027	5 OF 6

TUBE No.	SAMPLE No.	Sr	Rb
1	562600	526	59.80
2	562601	164	107.00
3	562602	799	9.19
4	562603	59	234.00
5	562604	285	61.00
6	562605	56	0.95
7	562606	163	129.00
8	562607	168	90.70
9	562608	385	5.71
10	562609	398	32.10
11	562610	218	48.70
12	562611	215	27.90
13	562612	183	3.71
14	562613	171	159.00
15	562614	335	28.60
16	562615	406	5.50
17	562616	116	65.80
18	562617	242	14.10
19	562618	174	6.52
20	562619	82	72.50
21	562620	146	21.70
22	562621	189	160.00
23	562622	686	31.60
24	562623	71	92.60
25	562624	128	91.70

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

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ANALYTICAL DATA

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
	100560.60.07549	08/01/91	11027	6 OF 6

TUBE No.	SAMPLE No.	Sr	Rb
1	562625	150	93.70
2	562626	81	236.00
3	562627	99	46.20
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23	DETECTION	1	0.05
24	UNITS	ppm	ppm
25	METHOD	GI201	GI222

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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Aberfoyle Exploration

Mack.
Core database

DATE 7-1-91 SHEET 1 of 1

Mac-5	146.1m.	271984	Base H.W. Basalt
MC-5	95.3m	315703	Base H.W. andesite
MC-8	54 m.	315714	Base H.W. "
MC-9	157.3 m.	315731	Base " Basalt.
MC-13	242.9m	355136	Top H.W. Basalt.
HAT-9	45.1m	378359	Top H.W. Basalt.
HAT-8	189.4m.	379370	Base " "
HAT-7	67.5m.	379379	" " "
MAC-10	128.7m.	396701	Top H.W. Basalt.
HL-80	20.45	427101	Top H.W. Basalt.
Mac-19	469.5m.	430630	Top H.W. Basalt
Mac-19	784.3m.	430756	Base H.W. Basalt
Mac-23	9.9m.	515481	Base H.W. andesite
Core Grind Standard		562644	
Mac-27	833.8m.	563717	Base H.W. Basalt.
Hat-9	110.9 m	9/4	Top Rhyolite/Dacite.
Mac-10	277.5 m	10/2	" " "
Mac-11	784.0m	11/1	Top footwall andesite.
Mac-19	804.0m	19/1	" " "
HL-246	277.5m	246/4	" " "

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A Division of Inchcape Inspection and Testing Services Australia Pty. Ltd.

Analabs - A division of Inchcape Inspection & Testing Services

Phone (004) 31 6837 | 14 Thirkell St. Cooee Tas 7320 | Fax No. (004) 31 8890

ANALYTICAL REPORT No. 100560.60.07649

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

INVOICE TO:

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

ORDER No.	PROJECT
11053	

DATE RECEIVED	RESULTS REQUIRED
07/01/91	ASAP

No. OF PAGES OF RESULTS	DATE REPORTED	No. OF COPIES
1	21/01/91	1

TOTAL No. OF SAMPLES: 22

SAMPLE NUMBERS	SAMPLE DESCRIPTION	ELEMENT/METHOD
9.4,10.2.11.1,19.1,246.4	DC Prep: GP009.GP016	Sr,Rb,Mn/BI201
271984,427101	PU	P2O5,Sr,Rb,Mn/BI201
563717	PU	Mn,Sr,Rb,Ni/BI201
Various	PU	P2O5,Sr,Rb,Mn,K2O,Na2O,MgO,CaO/BI201
430630,430756,515481,562644	PU	P2O5,Sr,Rb,Mn,K2O,Na2O,MgO,CaO,Ni/BI201

REMARKS

RESULTS TO:

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

RESULTS TO:

RESULTS TO:

AUTHORISED OFFICER

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A Division of Inchcape Inspection and Testing Services Australia Pty. Ltd.

ANALYTICAL DATA

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
	100560.60.07649	21/01/91	11053	1 OF 1

TUBE No.	SAMPLE No.	Mn	Ni	Rb	Sr	CaO	K2O	MgO	Na2O	P2O5
1	9.4	821	—	84.50	192	—	—	—	—	
2	10.2	667	—	129.00	126	—	—	—	—	
3	11.1	333	—	102.00	110	—	—	—	—	
4	19.1	542	—	166.00	102	—	—	—	—	
5	246.4	901	—	3.64	363	—	—	—	—	
6	271984	920	—	67.50	224	—	—	—	—	0.0
7	427101	3560	—	20.80	395	—	—	—	—	0.1
8	563717	1790	170	90.50	293	—	—	—	—	
9	315703	4730	—	43.00	557	5.980	1.44	6.580	3.110	0.2
10	315714	1340	—	32.00	529	1.780	0.64	2.090	4.590	0.2
11	315731	1410	—	21.20	278	13.400	0.83	7.470	3.490	0.1
12	355136	849	—	103.00	91	6.510	1.95	5.960	0.935	0.0
13	378359	8550	—	181.00	47	2.040	3.01	5.320	0.039	0.7
14	379370	975	—	33.60	504	8.020	0.89	4.740	1.760	0.1
15	379379	2870	—	4.93	105	8.380	0.17	14.100	0.165	0.2
16	383630	702	—	8.66	449	12.500	0.36	1.730	3.380	0.1
17	383639	1677	—	30.30	936	8.970	1.15	7.900	2.090	0.3
18	396701	5461	—	32.40	299	16.800	1.58	5.680	2.690	0.3
19	430630	968	90	117.00	172	8.140	3.32	4.370	0.455	0.4
20	430756	812	119	57.30	116	10.000	1.33	5.820	0.156	0.1
21	515481	142	10	276.00	24	0.370	9.94	1.820	0.105	0.3
22	562644 SD	6330	280	34.40	262	3.940	1.24	7.730	3.400	0.1
23	DETECTION	15	10	0.05	1	0.007	0.06	0.003	0.007	0.0
24	UNITS	ppm	ppm	ppm	ppm	%	%	%	%	%
25	METHOD	GI201	GI201	GI222	GI201	GI201	GI201	GI201	GI201	GI20

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

Aberfoyle Exploration

GEOCHEMICAL SAMPLE DETAILS

PROJECT: Mackintosh Core Database

DATE: 27-1-91

SHEET: 1 of 1

MC-14	150.0m.	562628		Mn, Cu, Pb, Zn, Ba, As, Ag, Cr, Ti, Zr, Ni, P_2O_5, Na_2O, K_2O, MgO, CaO, Sr, Rb	Base of H.W. Basalt.
MOC-27	250.5m.	562629		" " " " " "	" "
HL-541	332.2m.	562630		" " " " " "	" "
MOC-11	262.3m	427127		P_2O_5, Sr, Rb, Mn	" "
Core-grind	Standard	562632 *		All elements	standard.
HL-008	233.3m	631 * NB.		"	Base H.W. Basalt.
HL-008	259.6m	633		"	Top F.W. Andesite
MOC-11	724.2m.	634		"	Base H.W. Basalt/Andesite
MOC-25	155.3m.	562635		"	" "
MC-3	53m	206249		K_2O, MgO, CaO, Na_2O, P_2O_5, As, Ag, Ti, Mn.	" "
MC-10	244.0m	562636		All elements.	" "
MC-12	345.9m	355134		All elements	" "
HL-541	584.8m	562637		"	Base H.W. Basalt/Andesite
HL-541	588.5m.	638		"	Top Dacite
HL-541	660.45	639		"	Rise Dacite
HL-541	663.55	640		"	Top Andesite
HL-469	1461.25m	562641		"	Top footwall.

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A Division of Inchcape Inspection and Testing Services Australia Pty. Ltd.

Analabs - A Division of Inchcape Inspection & Testing Services

Phone (004) 31 6837 | 14 Thirkell St. Cooee Tas 7320 | Fax No. (004) 31 8890

ANALYTICAL REPORT No. 100560.60.07718

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

INVOICE TO:

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

ORDER No.	PROJECT
11081	

DATE RECEIVED	RESULTS REQUIRED
29/01/91	ASAP

No. OF PAGES OF RESULTS	DATE REPORTED	No. OF COPIES
3	26/02/91	1

TOTAL No. OF SAMPLES: 17

SAMPLE NUMBERS	SAMPLE DESCRIPTION	ELEMENT/METHOD
562628/641,355134	SC Prep: GP009,GP018	Ag/GA101
562628/641,355134	SC	Cu,Pb,Zn,Ba,Mn,Ni,Sr,K2O,MgO,CaO,Na2O,P2O5/GI
562628/641,355134	SC	As,Cr,Zr,Ti,Rb/GX401
562628/641,355134	SC	Ti:Zr/9825
427123	SC	Sc,Mn,P2O5/GI201

RESULTS TO

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

RESULTS TO

RESULTS TO

REMARKS

MACK CORE D.B.

AUTHORISED OFFICER

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ANALYTICAL DATA

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
	100560.60.07718	26/02/91	11081	1 OF 3

TUBE No.	SAMPLE No.	Cu	Pb	Zn	Ag	Ba	As	Cr	Zr	Ti
1	206249	—	—	—	4.0	—	110	—	—	3238
2	355134	142	<50	78	2.0	4010	9	827	85	2639
3	427123	—	—	—	—	—	—	—	—	
4	562628	73	<50	58	3.0	487	<2	487	107	329
5	562629	40	1140	3660	3.0	815	<2	77	221	351
6	562630	28	167	769	3.0	258	<2	799	86	311
	562631	88	<50	76	2.0	467	10	941	65	177
*	562632 STD.	151	173	2200	2.0	1160	14	928	75	228
9	562633	23	50	411	2.0	1090	9	44	160	362
10	562634	57	159	252	2.0	2210	50	60	77	195
11	562635	31	<50	300	2.0	137	4	421	143	315
12	562636	114	<50	158	2.0	517	12	320	45	184
13	562637	84	<50	103	2.0	189	18	328	106	259
14	562638	12	<50	68	2.0	667	2	35	141	299
15	562639	21	<50	31	1.0	1000	68	11	314	249
16	562640	6	<50	58	1.0	1630	<2	14	186	186
	562641	6	<50	41	<0.5	830	<2	21	215	169
18										
19										
20										
21										
22										
23	DETECTION	5	50	5	0.5	5	2	5	5	5
24	UNITS	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
25	METHOD	GI201	GI201	GI201	GA101	GI201	GX401	GX401	GX401	GX40

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

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ANALYTICAL DATA

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
	100560.60.07718	26/02/91	11081	2 OF 3

TUBE No.	SAMPLE No.	Ti:Zr	CaO	K2O	MgO	Mn	Na2O	Ni	P2O5	Sc
1	206249	—	0.073	3.97	6.220	455	0.381	—	0.23	
2	355134	31.05	5.630	4.17	9.460	1300	0.933	224	0.32	
3	427123	—	—	—	—	256	—	—	0.04	
4	562628	30.79	14.100	3.23	4.230	1410	0.254	100	0.20	
5	562629	15.92	7.260	2.62	4.220	1530	1.330	32	0.74	
6	562630	36.23	0.804	0.96	10.600	1810	0.062	214	0.14	
7	562631	27.32	9.740	1.00	7.230	867	1.400	236	0.13	
8	562632	30.41	3.940	1.20	7.810	6910	3.560	299	0.20	
9	562633	22.68	5.080	2.52	6.120	1700	3.250	33	0.57	
10	562634	25.36	1.620	5.13	4.420	1070	0.240	29	0.10	
11	562635	22.05	6.910	0.18	5.400	2280	3.850	85	0.30	
12	562636	40.89	12.900	0.63	5.930	2810	3.110	84	0.22	
13	562637	24.47	2.520	0.29	6.520	1440	3.770	46	0.12	
14	562638	21.24	0.690	1.46	3.150	693	4.600	17	0.16	
15	562639	7.96	0.606	5.56	1.670	243	1.780	15	0.14	
16	562640	10.13	0.808	3.44	1.330	378	4.230	18	0.11	
	562641	7.87	0.794	2.02	0.940	334	5.300	24	0.08	
18										
19										
20										
21										
22										
23	DETECTION	0.01	0.007	0.06	0.003	15	0.007	10	0.02	
24	UNITS	%	%	%	%	ppm	%	ppm	%	pp
25	METHOD	9825	GI201	GI201	GI201	GI201	GI201	GI201	GI201	GI

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

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ANALYTICAL DATA

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
	100560.60.07718	26/02/91	11081	3 OF 3

TUBE No.	SAMPLE No.	Sr	Rb
1	206249	—	—
2	355134	470	124
3	427123	—	141
4	562628	211	148
5	562629	122	179
6	562630	17	52
7	562631	129	65
o	562632	307	38
9	562633	348	129
10	562634	82	176
11	562635	240	9
12	562636	207	31
13	562637	235	17
14	562638	281	77
15	562639	66	344
16	562640	198	120
	562641	167	74
18			
19			
20			
21			
22			
23	DETECTION	1	5
24	UNITS	ppm	ppm
25	METHOD	GI201	GX401

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

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Aberfoyle Exploration

Collected: AMCN + RRB.

Project	Date	Sheet
Mack Core Database.	18-2-91	1 of 1

Location	Depth	Sample Number		Analysis	Geological Log
QR95	56.2m	562667	Scor	C, Pb, Zn, Ba, As, Ag, Cr, Ni, Ti, Zr, Rb, Sr, MnO, K2O, Na2O, CaO, MgO	Base H.W. Basalt
QR-95	86.0m	668	"	" " "	Top Dacite
QR-95	180.2	669	"	" " "	Base Dacite
QR-95	199.6	562643	"	" " "	Top Andesite
QR-1060	153.0	562644	"	" " "	Base Dacite
QR-1060	161.2	562699	"	" " "	Top andesite
MC-15	109.9m	383639	"	K2O, MnO, MgO, CaO, Na2O, Rb, Sr,	Base H.W. Basalt.
MC-15	69.5m	MC-15.	Sc	Ba, Ni, Cr, As, Ag	Top H.W. Basalt.
QR1001	158.5m	562809	Scor		Base Basalt.
QR1001	158.2m	810	"	All elements.	Top dacite
QR1001	361.0m	811	"		Base Dacite
QR1001	381.9m	562812	"		Top Andesite

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Phone (004) 31 6837 | 14 Thirkell St. Cooee Tas 7320 | Fax No. (004) 31 8890

ANALYTICAL REPORT No. 100560.60.07791

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INVOICE TO:

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

ORDER No.	PROJECT
11503	

DATE RECEIVED	RESULTS REQUIRED
25/02/91	ASAP

No. OF PAGES OF RESULTS	DATE REPORTED	No. OF COPIES
3	11/03/91	1

TOTAL No. OF SAMPLES: 12

SAMPLE NUMBERS	SAMPLE DESCRIPTION	ELEMENT/METHOD
Various	SC Prep: GP009,GP018	Ag/GA101
Various	SC	As,Cr,Zr,Ti/GX401
Various	SC	Ti:Zr/S9825
Various	SC	K2O,MgO,CaO,Na2O,MnO,P2O5,Ni,Sr,Cu,Pb,Zn,Ba/GI...
383639	SC Prep: GP009,GP018	K2O,MgO,CaO,Na2O,MnO,P2O5,Sr/GI201,Rb/GI222

RESULTS TO:

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

RESULTS TO:

RESULTS TO:

REMARKS

Mackintosh Core database

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ANALYTICAL DATA

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
	100560.60.07791	12/03/91	11503	1 OF 3

TUBE No.	SAMPLE No.	Cu	Pb	Zn	Ag	Ba	As	Cr	Zr	Ti
1	562643	17	<50	73	1.0	536	2	15	144	3108
2	562644	12	<50	59	1.0	882	<2	<5	179	2058
3	562667	27	<50	59	<1.0	718	5	23	145	2798
4	562668	17	<50	48	<1.0	814	15	95	246	2351
5	562669	23	<50	53	<1.0	596	<2	64	179	1742
6	562699	6	<50	161	<1.0	1460	2	11	181	3109
7	562809	6	<50	97	<1.0	122	<2	244	60	2695
8	562810	<5	<50	72	1.0	930	<2	55	334	1953
9	562811	20	<50	62	1.0	597	<2	44	177	2125
10	562812	38	<50	74	<1.0	105	3	111	139	3740
11	383639	—	—	—	—	—	—	—	—	
12	MC 1-B	—	—	—	<1.0	1470	4	—	—	
13										
14										
15										
16										
18										
19										
20										
21										
22										
23	DETECTION	5	50	5	1.0	5	2	5	5	50
24	UNITS	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
25	METHOD	GI201	GI201	GI201	GA101	GI201	GX401	GX401	GX401	GX401

Results in ppm unless otherwise specified

T = element present; but concentration too low to measure

X = element concentration is below detection limit

— = element not determined

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ANALYTICAL DATA

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
	100560.60.07791	12/03/91	11503	2 OF 3

TUBE No.	SAMPLE No.	Ti:Zr	CaO	K2O	MgO	MnO	Na2O	Ni	P2O5	Sr
1	562643	21.58	6.240	2.360	2.120	0.101	1.910	12	0.13	144
2	562644	11.50	3.570	2.680	0.430	0.072	3.280	<10	0.11	170
3	562667	19.28	1.160	2.980	2.070	0.030	1.130	23	0.17	7[illegible]
4	562668	9.56	1.150	3.840	1.320	0.036	1.550	14	0.12	7[illegible]
5	562669	9.73	4.840	2.640	1.030	0.084	2.350	21	0.08	158
6	562699	17.18	1.710	3.510	1.920	0.075	3.610	<10	0.18	336
7	562809	44.92	6.550	0.310	7.560	0.123	2.620	49	0.09	12[illegible]
8	562810	5.85	3.630	3.570	2.020	0.068	0.670	<10	0.08	11[illegible]
9	562811	12.00	6.350	3.400	0.730	0.078	0.480	16	0.10	16[illegible]
10	562812	26.91	2.500	0.120	3.840	0.094	6.400	24	0.18	182
11	383639	–	8.160	1.400	8.190	0.269	1.900	–	0.41	85[illegible]
12	MC 1-B	–	–	–	–	–	–	126	–	–
13										
14										
15										
16										
18										
19										
20										
21										
22										
23	DETECTION	0.01	0.007	0.060	0.003	0.002	0.007	10	0.02	[illegible]
24	UNITS	%	%	%	%	%	%	ppm	%	ppm
25	METHOD	S9825	GI201	GI201	GI201	GI201	GI201	GI201	GI201	GI201

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

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ANALYTICAL DATA

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
	100560.60.07791	12/03/91	11503	3 OF 3

TUBE No.	SAMPLE No.	Rb
1	562643	97.50
2	562644	96.40
3	562667	115.00
4	562668	134.00
5	562669	91.00
6	562699	128.00
7	562809	13.10
8	562810	164.00
9	562811	120.00
10	562812	3.63
11	383639	40.10
12	MC 1-8	—
13		
14		
15		
16		
18		
19		
20		
21		
22		
23	DETECTION	0.05
24	UNITS	ppm
25	METHOD	GI222

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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APPENDIX 9

REPORT ON CAMBRIAN FOSSILS FROM LIMESTONE BOULDERS IN DIAMOND DRILL HOLE MAC 20

The fossils occur in limestone boulders from within a conglomerate intersected in Diamond Drill Hole MAC 20 of Aberfoyle Resources exploration programme in the Hellyer area. The boulders were obtained from Mr. Andrew McNeill of Aberfoyle Resources Exploration Division on December 18, 1990.

Trilobite cross-sections could be seen clearly in two limestone boulders within MAC 20 - one boulder was intersected at a depth of about 364m and the other at a depth of about 353m. The boulder intersected at 364m was quite richly fossiliferous, and most of the fossils listed below come from that boulder. However, no real difference could be seen in the faunas from the two blocks so they are discussed below as a single fauna.

In order to extract the fossils the limestone was placed in an electric furnace at about 800°C for an hour prior to quenching in water. This split most of the limestone with some further mechanical preparation required.

Fossils Present

All fossils seen were trilobites (listed below) with the great majority being polymeroid trilobites. It is quite a rich fauna of shallow water aspect and includes some genera not previously recorded in Tasmania. Many of the specimens show a slight tectonic distortion.

Agnostoid trilobites:	Peronopsis(?)
Polymeroid trilobites:	Amphoton
	Liopeishania
	Monocephalites(?)
	a member of the Anomocarellidae
	a possible member of the Damesellidae
	a possible member of the Solenopleuridae

Age of Fauna

The above assemblage of fossils indicates a late Middle Cambrian age in the range from the Ptychagnostus nathorsti Zone to about the Lejopyge laevigata II Zone, or in terms of the Australian stage names from Undillan to mid-Boomerangian. This age range of the MAC 20 fauna is shown on the accompanying correlation chart which is from page 75 of the recent "Geology and Mineral Resources of Tasmania". For comparitive purposes I have also put on the age of the fauna from the Cradle Mountain Link Road. As shown the MAC 20 fauna is older than the Link Road fauna, but is about the same age as or possibly slightly younger than the fauna in the Que River Beds from near the Que River Bridge on the Murchison Highway. There is a little uncertainty in comparing the ages of the faunas in the limestone boulders with the fauna of the Que River Beds. The reason for this is that the fauna from the Que River Beds represents an open ocean cosmopolitan fauna whereas the fauna in the limestone boulders represents a shallow water and more endemic fauna. There are no genera in common between the faunas

J.B. Jago

January 25, 1991.

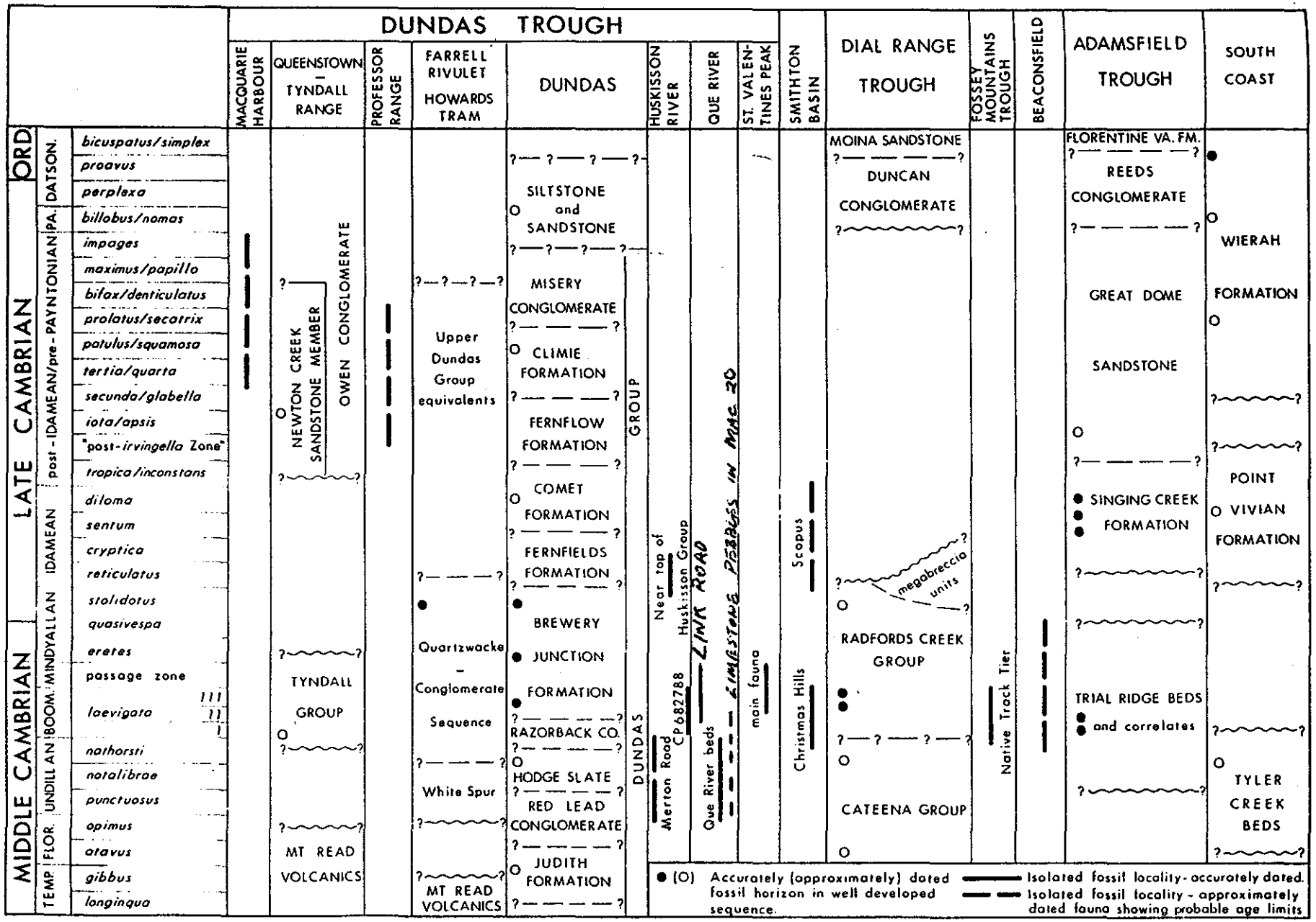

Fig. 3.10 Palaeontological correlation chart.

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APPENDIX 10

Aberfoyle Exploration

GEOCHEMICAL SAMPLE LEDGER

Collected AMCN/RJH

PROJECT	BSS SIEVE SIZE CODE - MESH NUMBER	SAMPLE TYPE CODE		CARD PUNCH PRINT	VERIFY	DATE	SHEET
Southwell Valley Mack E.L.	A 200 D 80 G 30 B 150 E 60 H 20 C 100 F 40 T = TOTAL	☐ OXIDIZED PRODUCTS O ☐ FRESH ROCK R ☐ STREAM SEDIMENTS S	☐ WEATHERED BEDROCK W ☐ SURFACE TRANSPORTED T ☐ RESIDUAL SOIL E ☐ MINE DUMP M	YES ☐ NO ☐	YES ☐ NO ☐	16/10/90	1 of 1

EASTINGS	NORTHINGS	SAMPLE NUMBER	DEPTH in CMS	SIZE FRACTION	Sample Type		METAL VALUES PPM	GEOLOGICAL LOG
7802	11800	563726			RC	o/c	Cu, Pb, Zn, Ba, As, Ag, Au, Cr, Ti, Zr.	gy-pk Q+fp R.I. / Si py (1-3)
8010	11600	727			"	"		lgt-dk gn RDI / SeSi(2) Py(1-2)
7930	11600	728			"	"		br-gn fp RDI / SeSi(2) Py(2)
7875	11600	729			"	"		br-gn fp. Fbn RDI / Si(3-4) Py(2) vn+disr.
7840	11635	730			"	"		gy-gn fp RDI / SeSi(3) Py(2)
7030	11400	731			"	float		bk-gy lm sil av / py(2)
8150	10200	732			"	o/c		or-gn wth Flv & mnr py pat.
8415	11215	733			"	"		or-pk R.I. & Qvn.
7820	11650	562650			"	"		gy-gn fp (se. alt.) R.I. / SeSi(2-3) py(2)
7805	11658	562651			"	"		lgt gn-br fp. R.I. / Se(3) py(2-3)
7795	11710	652			"	"		gy-bl RDI / SeSi py(3)

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ANALYTICAL REPORT No. 100560.60.07550

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INVOICE TO:

Aberfoyle Resources Limited
Exploration Division
P.O. Box 952
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ORDER No.	PROJECT
11028	Mack E.L.

DATE RECEIVED	RESULTS REQUIRED
26/11/90	ASAP

No. OF PAGES OF RESULTS	DATE REPORTED	No. OF COPIES
2	13/12/90	1

TOTAL No. OF SAMPLES: 11

SAMPLE NUMBERS	SAMPLE DESCRIPTION	ELEMENT/METHOD
562650/52.563726/33	RC Prep: GP005,GP009,GP016	Cu,Pb,Zn,Ag/GA101
562650/52,563726/33	RC	Au,Au:1/GG309,Au/RAW,AU/Wt
562650/52,563726/33	RC	Ba,As,Cr,Zr,Ti/GX401
562650/52,563726/33	RC	Ti:Zr/S9825

RESULTS TO:

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

RESULTS TO:

RESULTS TO:

REMARKS

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ANALYTICAL DATA

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
	100560.60.07550	13/12/90	11028	1 OF 2

JBE No	SAMPLE No.	Cu	Pb	Zn	Ag	Au	Au:1	Ba	As	Cr
	562650	15	50	90	<0.5	<0.008	–	848	11	<5
	562651	10	5	40	<0.5	<0.008	–	925	<2	<5
	562652	20	45	90	<0.5	<0.008	–	926	21	<5
	563726	15	40	85	<0.5	<0.008	–	415	8	140
	563727	15	45	35	<0.5	<0.008	–	1902	8	<5
	563728	15	5	5	<0.5	<0.008	<0.008	2705	2	<5
	563729	15	25	125	<0.5	<0.008	–	776	15	9
	563730	15	10	120	<0.5	<0.008	–	1119	6	<5
	563731	20	485	115	<0.5	<0.008	–	302	17	29
	563732	10	<5	60	<0.5	<0.008	–	729	<2	<5
	563733	10	<5	30	<0.5	<0.008	–	277	<2	24
	DETECTION	5	5	5	0.5	0.008	0.008	10	2	5
	UNITS	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
	METHOD	GA101	GA101	GA101	GA101	GG309	GG309	GX401	GX401	GX401

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

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ANALYTICAL DATA

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
	100560.60.07550	13/12/90	11028	2 OF 2

JBE No.	SAMPLE No.	Zr	Ti	Ti:Zr
1	562650	317	1032	3.2
2	562651	280	1026	3.7
3	562652	258	1055	4.1
4	563726	185	936	5.1
5	563727	312	1017	3.3
6	563728	226	886	3.9
7	563729	288	927	3.2
8	563730	288	1025	3.6
9	563731	122	1742	14.3
10	563732	288	1770	6.1
11	563733	122	434	3.6
12				
13				
14				
15				
16				
17				
18				
19				
20				
21				
22				
23	DETECTION	5	50	0.1
24	UNITS	ppm	ppm	%
25	METHOD	GX401	GX401	S9825

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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APPENDIX 11

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ABERFOYLE RESOURCES

Exploration Division

INTERPRETATION REPORT

UTEM SURVEY

SOUTHWELL LEVEN RIVER GRID

MACKINTOSH E.L. 106/87

Prepared by:

J SILIC

Distribution

Hawthorn (1)
Burnie (1)

Issued by:



J SILIC
Chief Geophysicist

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Survey Specifications

Interpretation of the data

Conclusions and Recommendations

Appendix I

Interpretation of TDEM data using first and second spatial derivative and time decay anomalies.

Appendix II

UTEM profiles Figs 1-6

Introduction

Electromagnetic surveys have played an important part in the discovery of the Que and Hellyer deposits (Webster and Skey, 1978, Silic et al 1985).

As part of an ongoing EM program, UTEM (West et al, 1984) data was collected over the Southwell Leven grid, in searching for buried conductive deposit.

The purpose of this report is to present the analysis of this data set and to make recommendations for future exploration.

Survey Specification

A 1km x 1km loop with a front edge at 8000E was used to energise the ground. Vertical comparent (Hz) data was collected on six lines (11200N, 11400N, 11600N, 11800N, 12000N and 12200N) at 50 metre station spacings covering an area extending from 8000E - 7400E in the E-W direction. Both the continuous and point norm data sets are presented (West et al 1984).

Interpretation of the data

Using simple spatial derivative techniques from Silic, 1989 (Appendix I), it is concluded that all cross-overs in the vertical component, are due to variations in the near surface conductivity, in particular a number sharp second derivative peaks are evident in the data and represent near surface contacts in the resistivity profile of the ground (< 25 metres from the surface).

No responses which could be attributed to confined BMS type conductors are evident in the data (Appendix II)

Conclusions and Recommendations

No responses which can be attributed to confined BMS type conductors are evident in the data sets. The data set however is good enough, so that if a 2 mt target at a depth 150-200 metres exists on the grid, it would have been detected.

References

Silic J., Eadie E.T., Jack D.J., (1985), `Application of Time Domain electromagnetic methods in the discovery of the Hellyer ore deposit, Tasmania, Australia', Expanded Abstracts, Society of Exploration Geophysicists, 55th Annual Meeting and Exposition, Washington D.C., 241-243.

Silic J, (1989) `Interpretation for TDEM Data using first and second spatial derivatives and time decay analysis, Exploration Geophysics, V20.

Webster and Skey, (1979), `Geophysical and Geochemical case history of the Que River deposit Tasmania', in Geophysics and Geochemistry in the Search for Metallic ores' Peter J. Hood editor, Geological Survey of Canada, Economic Geology Report 31, 697-720.

West G. F. MacNae J. C., Lamontagne Y, (1984), `A time domain EM system measuring the step response of the ground, Geophysics 49, 1010-1026.

APPENDIX I

Interpretation of TDEM Data Using First and Second Spatial Derivatives and Time Decay Analysis

J. Silic
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123 Camberwell Road
Hawthorn East Vic 3123

Abstract

Current gathering in fixed loop electromagnetic data often dominates responses from large high-grade ore bodies as well as responses from less desirable features such as fault zones, weathering troughs and regional conductors. Through decay curve analysis, current gathering can now be unambiguously recognised.

Many widely used EM interpretation techniques are not applicable to current gathering (channelling) responses. An effective method of deriving the location and shape of the causative source is to study the second spatial derivative, as is shown in several examples.

Key words: Time Domain electromagnetics, spatial derivatives, decay analysis, current gathering, deposits, formational conductors

Introduction

The discovery of the Hellyer orebody in Tasmania by Aberfoyle Resources (Silic *et al*, 1985), has shown that important economic discoveries need not be characterised by long time constant, time domain electromagnetic (TDEM) responses. At the time of the discovery it was recognized that the Hellyer response was largely dominated by current gathering effects, and that other non-economic features such as lithologies or weathering troughs which have a resistivity contrast with their surroundings, may produce responses lasting to similar times. Some authors have reported on some of these problems from case histories as difficulties or limitations of TDEM (Spies and Parker, 1984; Irvine and Staltari 1984).

The purpose of this paper is to show that these problems can be overcome; to discuss decay analysis techniques for recognising responses which are largely dominated by the 'static' interaction between the half spaces electric field and the target, commonly known as current gathering (West and Edwards, 1985), and to illustrate the use of the spatial *derivative of fixed loop TDEM data in recognizing the* geometry of the conductive targets. Only the 2-D solution for the geometry of the targets will be presented; however, the concept can be extended to 3-D bodies.

Application of the Integral Equation Method

Numerous authors have discussed the generalized frequency domain integral equation for the total vector electric field that is composed of a primary field $\underline{E}^p$ within a half space perturbed by a secondary field $\underline{E}^s$ from a local conductivity variation within the earth (Hohmann, 1975; Raiche, 1974; Weidelt, 1975). Similar formulations apply to the solutions for the magnetic field (eg. West and Edwards, 1985). San Filipo and Hohmann (1985), and Oristaglio and Hohmann (1984) have successfully obtained solutions for the time domain.

The purpose of this section however is not to discuss the solutions for the 'scattering' or 'anomalous' current $\underline{J}^s(\underline{r}',t)$ within the inhomogeneity, but rather to determine the effect of a conductive half space on the problem of determining the secondary magnetic field from the scattering current. The equation relevant to the problem expresses the secondary magnetic field as

$$\underline{H}^s(\underline{r},t) = \iint_{vo}^{t} \underline{Gh}(\underline{r},\underline{r}',t-\bar{t})\ \underline{J}^s(\underline{r}',\bar{t})\ d\bar{t}d\underline{r}' \quad -(1)$$

and only the convolution integral

$$\int_o^t \underline{Gh}(\underline{r},\underline{r}',t-\bar{t})\ \underline{J}^s(\underline{r}',\bar{t})d\bar{t} \quad -(1a)$$

needs to be considered. To study this effect the Green's tensor *solutions for a line source in a half space were evaluated (Silic,* 1989). By assuming that current density with an arbitrary time dependence can be synthesised as a discreet or continuous sum of exponential decay functions $I_n e^{-t/\tau_n}$ it was concluded by evaluating equation 1a for a number of time constants τ_n, that for $\frac{t}{\sigma\mu r^2} \geq 1.0$ (r being the distance to the source, σ the halfspace conductivity) and measuring times up to about $4\tau_n$, free-space approximations may be used to relate the magnetic-field components to the current source, although in some instances a time delay which is largely a function of $\sigma\mu r^2$ may have to be incorporated into the calculation (Silic, 1989).

Identical results are obtained for a current dipole which is relevant to the 3-D problem. As an example, for a 200Ωm half *space, and a distance r of 200 m,* $\frac{t}{\sigma\mu r^2} = 1.0$ *gives a time* of 252 microseconds, a very early time for most TDEM responses.

However the preceding conclusions are not suggesting that the half space is not affecting the current distribution within the inhomogeneity at these 'late' times since the two effects can scale differently in time. It is only suggested that free space approximations may be used to relate the magnetic field to a current source. This concept is vital to the following sections.

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Recognition of Current Gathering Responses:

West and Edwards (1985) have shown by studying the response of a disk inhomogeneity in a conductive half space that to calculate the scattering current, direct interaction between the scattering current and the eddy currents they induce in the host medium may be neglected to a first order approximation. These static or DC solutions suggest that in the case where the body is reasonably compact, and the primary electric field has the same general direction throughout, then as long as the target's 'skin effect' does not dominate, current gathering 'anomalous' current density $\underline{J}g^S(r',t)$ may be written from magneto metric response solutions (eg. Edwards, 1974) as,

$$\underline{J}g^s(\underline{r}',t) = C\ \underline{E}^p(\underline{r}',t) \quad -(2)$$

where C is a conductivity contrast/geometrical (body shape) function.

The current gathering 'anomalous' current density will then essentially have the time dependence of the primary electric field in the vicinity of the body. Therefore, as long as the 'late' time free space approximation from the previous section is valid, the magnetic field will have the same time dependence. To study this time dependence, electric field in a half space solutions from Lewis and Lee (1978) and Silic (1987) are used.

It is shown that for step TDEM systems (eg. UTEM, West *et al*, 1984) at 'late' times when $(a^2 + z^2 + r^2)\ \frac{\sigma\mu}{4t} << 1.0$ where a is the loop radius, r is the distance from the loop centre and z is the depth,

$$\underline{E}^p(r,z,t) = \frac{a^2 r}{40\sigma\sqrt{\pi}}\left(\frac{\sigma\mu}{t}\right)^{5/2} + \frac{5a^2rz\Gamma(5/2)}{48\sigma\sqrt{\pi}}\sqrt{\frac{\sigma\mu}{4t}}\left(\frac{\sigma\mu}{t}\right)^{5/2} \quad -(3)$$

while for the impulse systems (Buselli and O'Neill, 1977; McNeill, 1982)

$$\underline{E}^p(r,z,t) = \frac{a^2 r}{16\sigma^2\sqrt{\pi}}\left(\frac{\sigma\mu}{t}\right)^{7/2} + \frac{a^2rz\Gamma(5/2)}{32\sigma^2\sqrt{\pi}}\left(\frac{\sigma\mu}{t}\right)^{4} \quad -(4)$$

Essentially at 'late' times the step system electrical field is characterized by a $t^{-5/2}$ power-law decay, while the impulse system's electric fields will have a $t^{-7/2}$ time dependence. To determine whether current gathering effects are dominating the response, a power law decay is fitted with care to the latest anomalous times. If this power law then dominates the response for most of the anomalous time, and its exponent depending on the system is close to -5/2 or -7/2, then current gathering effects may be inferred.

It is also recognized from Kaufman and Keller (1985), that the 'very late' time inductive effect, when the vortex currents in the conductive target are following the decay of the half space magnetic field, will also have a $t^{-5/2}$ or $t^{-7/2}$power law decay. However, this effect may only be important for thick or relatively flat-lying targets since the direction of the half space primary magnetic field is relatively vertical at the 'late' times. However, unlike the current gathering effect, it begins as a 'very late' time phenomena. As such it is not expected to dominate the response for most of the anomalous time.

Interpreting Spatial Derivatives of Fixed Loop TDEM Data

Different interpretation methods must be used for current gathering anomalies than for vortex current induction responses. The strength of a current gathering effect is a function of conductivity contrast between the anomalous body and the host medium, the body's geometry and the conductivity of the half space, whereas the time dependence of the response is largely a function of the host medium's primary electric field. The latest time at which the anomalous response will be detected, will therefore be largely a function of the maximum amplitude of the magnetic field at early time, this also being a function of depth or distance to the conductor. Therefore, discriminating techniques which rely on conductivity-thickness estimates from decay analysis, or the latest time affected by a conductor, are not valid for current gathering responses.

This section looks at the problem of attempting to obtain the shape of the conductive source from spatial derivative data, and its implementation as a discriminating technique. It is reasoned that if the shape of the target can be estimated from the profile data, then we may discriminate between the conductive bodies on the basis of their interpreted geometry.

1: Theoretical Considerations

By using the approximation discussed in the previous section that at 'late' times free space Green's tensors may be used in equation 1, considerable simplication results in evaluating the potential field problem which links the magnetic field components to a current distribution. In this section, only results for 2-D bodies will be discussed. Formal solutions have been obtained for arbitrary current distributions within dipping sheets and blocks; however only some of the formal solutions for a dipping current sheet will be presented, as they have a similar, but simpler form to block conductor formulations (Silic, 1989). More complex shapes can be modelled by a superposition of a number of blocks and sheets. By assuming that a current density distribution can be expressed as a polynomial, then analytical solutions for the vertical (Hz) and horizontal (Hx) field components are obtained using Gradshteyn and Ryzhik (1980). Furthermore by manipulating the integral equation which links the magnetic field components to a current density it is shown (Silic, 1989) that the first and second horizontal spatial derivatives of the magnetic field components are related through a set of geometric functions to the current density and its first spatial derivative at the edges of the conductor. As a result a number of simple relationships between the first and second derivatives of the magnetic field components and the edges of the conductive units are obtained. For example, for relatively uniform current flow in a current sheet

$$\left(\frac{\partial Hz}{\partial x}\right)^2 + \left(\frac{\partial Hx}{\partial x}\right)^2 = \frac{J(o)^2}{x^2+h^2} + \frac{J(L)^2}{(x_L^2+h_L^2)} \quad -(5)$$

where J(O) and J(L) are the current densities at the respective edges of the sheet, while x, h and x_L, h_L, are the horizontal and vertical distances to the edges. This function is completely

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independent of dip, and is a sum of two bell shaped functions which peak over the edges of the sheet with halfwidths 2h and $2h_L$.

Similarly it is shown that over a current sheet that is flat lying and has uniform current (eg. current gathering weathering trough), the second horizontal derivative of the vertical magnetic field peaks over the edges of a sheet with halfwidths equal to the depth to top of the sheet. The peak to peak distance in the vertical magnetic field however, is always greater than or equal to the width of the sheet. In cases where the width of the sheet is large in comparison to its depth to top, the peaks in the second derivative and the vertical magnetic field are in close proximity to each other. Similar conclusions apply for non-uniform current flow (Silic, 1989).

Figure 1 illustrates these important points. Some responses are superficially similar. For example the magnetic field over a vertical sheet at depth may approximate the vertical magnetic field over a wide sheet. However, the second derivative method will highlight the short halfwidths in the derivative over the 'shallow' edges of a flat lying sheet and allow the discrimination between the two responses as will the 'proximity' of the second derivative maxima with respect to the peaks in the vertical magnetic field. Over vertical conductors the peaks in the second derivative for Hz are at least a half depth unit closer to the cross-over point than the peaks in the magnetic field (Silic, 1989). By considering block conductors, similar conclusions apply; second derivatives peak over the edges of relatively steeply dipping blocks, with halfwidths equal to twice the depth to top. Also, in comparison with sheets, the inflection points of the vertical magnetic field are further out from the edges. Discrimination between block conductors, simulating broad lithological units, and relatively steeply dipping sheets then depends on the identification of block edges through the second derivative technique.

2: Analysis of Field Data

All three techniques, the forward modelling of the magnetic field components and first and second derivatives have the capacity to recognise the shape and location of conductive bodies. The spatial derivatives however, are preferred as they have a set of simple relationships with the edges of an arbitrary shaped conductor as discussed previously.

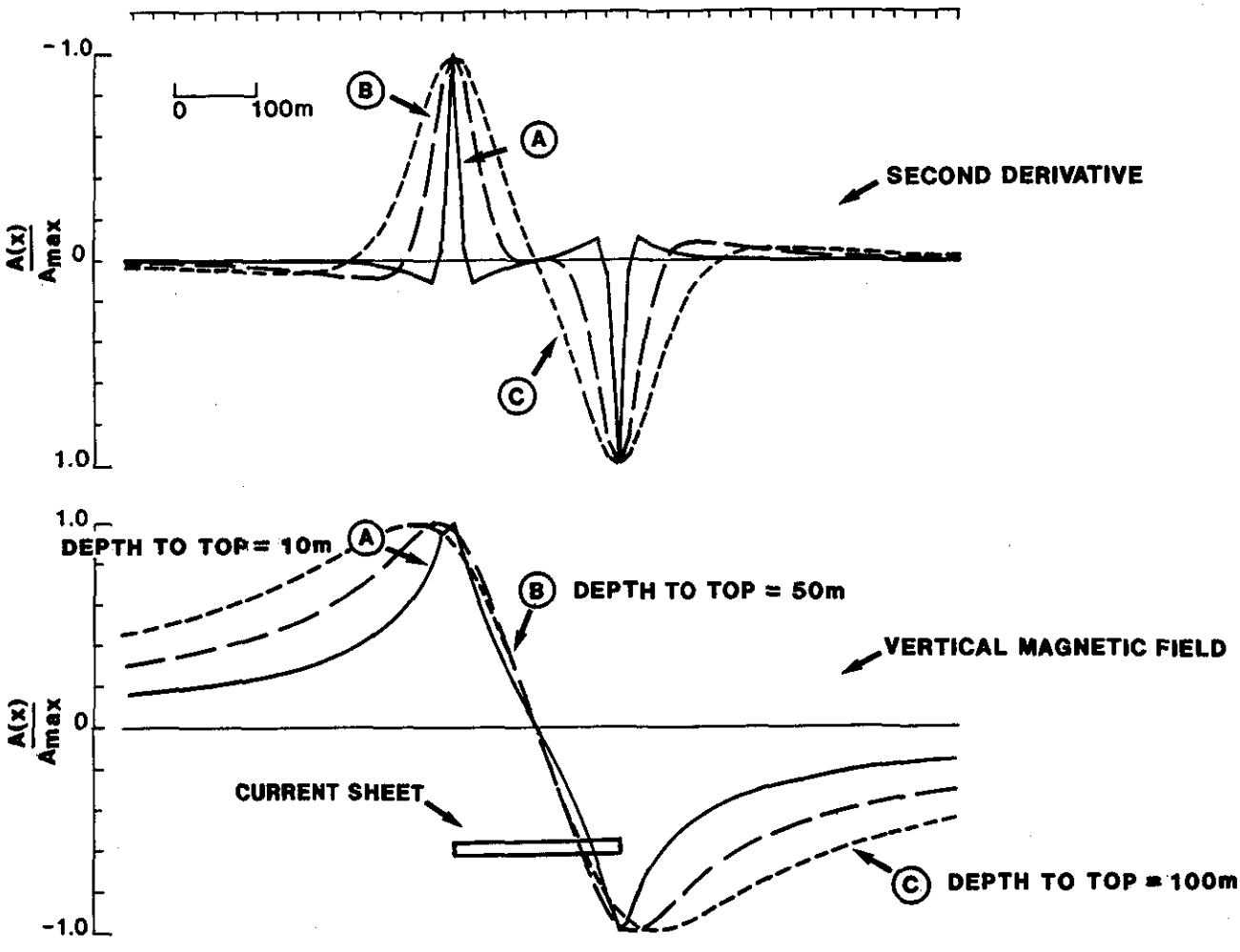

FIGURE 1
Normalized vertical (Hz) magnetic fields (bottom) and second horizontal derivatives (top) over a current sheet with a constant current. The profiles are normalized by their peak values, with the magnetic field showing cross-over type responses over the sheet, and the second derivative peaking over the edges of the sheet. The halfwidth of the second derivative over the edges is equal to depth to top. Peak to peak distances in the vertical magnetic field are greater than or equal to the width of the sheet. Second derivative peaks are close to the minima and the maxima in the vertical magnetic field.

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Four field examples, all of which have a dominant current gathering $t^{-5/2}$ 'late' time decay and a scale model data set will be used to illustrate interpretation techniques which are based on the insights from previous sections. Of the four field examples, two are over world class orebodies, one is over a lithological conductor which shows superficial similarities with responses over the two orebodies and a fourth is a complex response which may contain a worthwhile exploration target. No second derivatives are actually calculated for reasons discussed in the following section. However to follow the logic of the arguments it is sufficient to know that the locations of the peaks in the second derivative can be estimated as points corresponding to the maximum change in the slope of the raw data, and that zeroes occur where the slope of the raw data does not change over some profile length. The examples are used not so much to give a recipe for the interpretation technique but rather to demonstrate the general principles on which an interpretation can be based so that a plausible explanation for the EM processes and for the shape of conductive bodies can be obtained. Both the qualitative technique and the present limitations to the quantitative approach will be discussed.

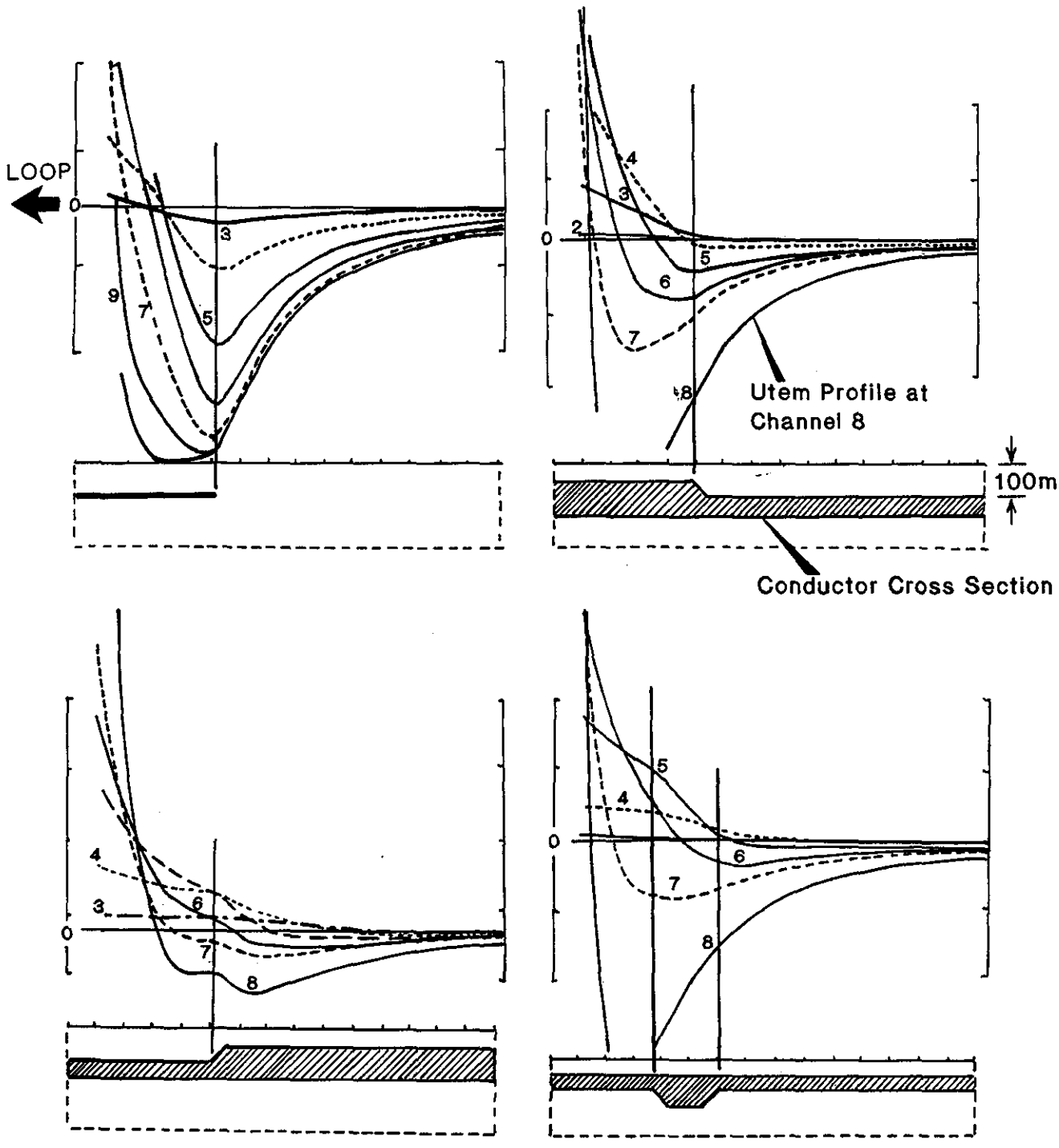

FIGURE 2
UTEM (Hz) scale models over disruptions in a thin layer adapted from MacNae *et al.* (1983). Every disruption within the layer corresponds to one of the maximum changes in the slope of the profile. Additional maximum changes in the slope are due to normal thin layer moveout.

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(a) Qualitative Approach

By visually estimating the variation in the slope of the Hz profiles, we can determine the location of the second derivative maxima and its wavelength. We can use this information in conjunction with Hz data, to estimate the shape of the source and its depth to top. In particular any sudden changes in the slope are to be understood as indicating a shallow edge to a conductive unit, or an abrupt variation within a wider conductor.

UTEM scale model data in Figure 2 adapted from Macnae *et al* (1983), shows that every edge within a conductor, (in this case representing variations within the overburden), corresponds to one of the maximum changes in the slope of the profile. Away from these second derivative peaks the slopes are relatively constant, indicating a 'narrow' second derivative and therefore that the source is shallow. This is supported by the fact that the peaks in the second derivative are also close to the minima and/or maxima of the anomaly due to the variations in the overburden as

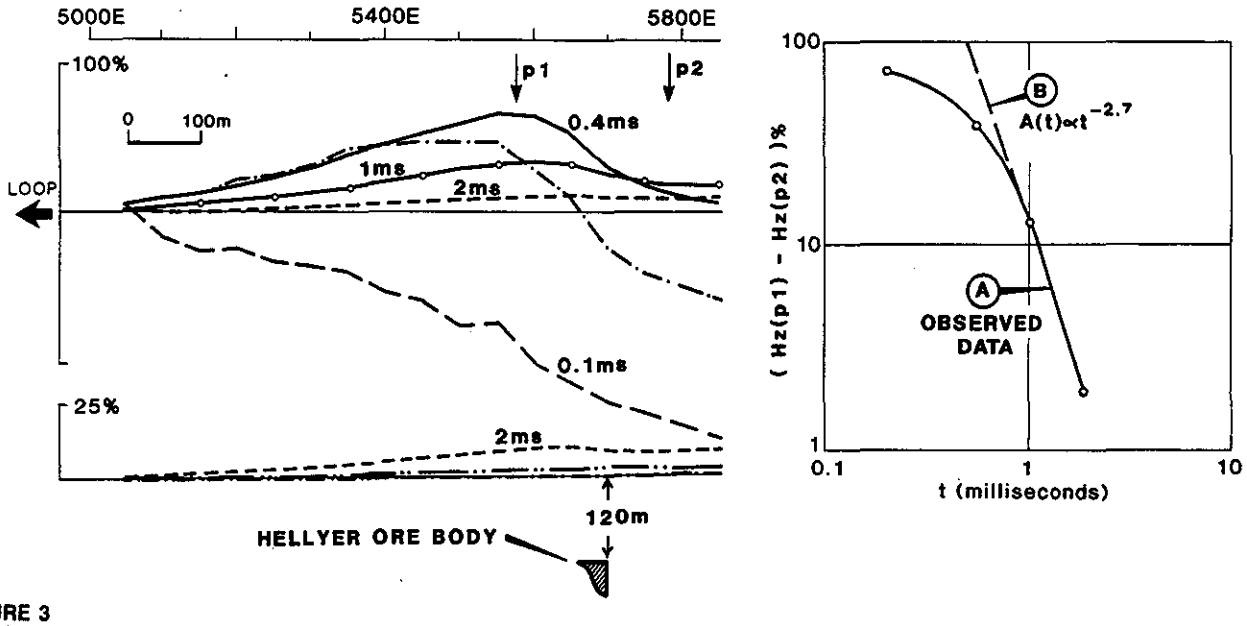

FIGURE 3
UTEM (Hz) data from Hellyer ore body. The variation in the slope of the profile is continuous and smooth indicating a broad second derivative. No obvious edge effects are evident. The decay between the two arrows is dominated by a $t^{-2.7}$ power law decay, and so a current-gathering effect is inferred.

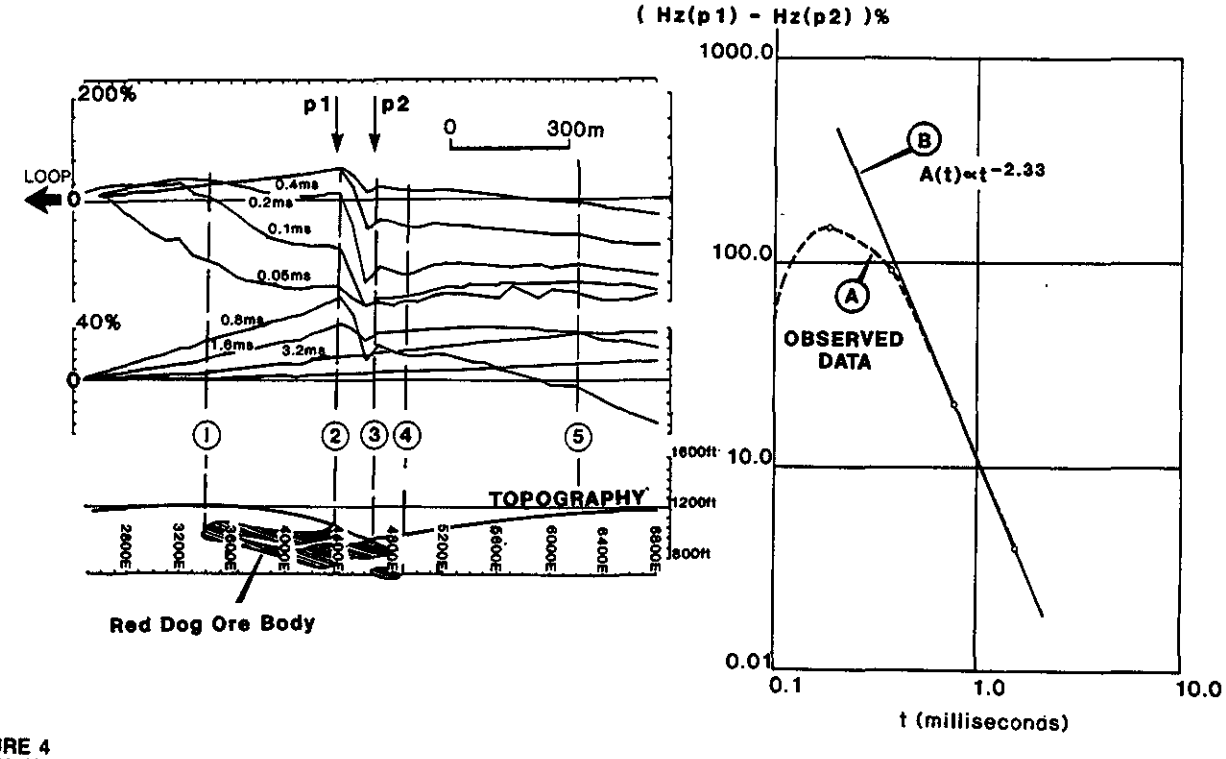

FIGURE 4
UTEM (Hz) data from Red Dog deposit, Alaska. Maximum changes in the slope of the profile correspond to the edges of the orebody. Smoother changes correspond to the deeper terminations. Edge 5 outlines a nonprospective outcropping conductor. The decay analysis for the data between the two arrows, shows that a $t^{-2.33}$ 'late' time asymptote dominates.

discussed in the previous section. Other maximum changes in the slope are due to normal thin layer, early to late time moveouts.

This simple analysis could have led Spies and Parker (1984) and Irvine and Staltari (1984) to recognise their responses as being due to variations in overburden and not from a conductor at depth.

The response over the Hellyer deposit in Tasmania shown in Figure 3 is dominated by a 'late' time $t^{-2.7}$ power law decay and hence current gathering effects may be inferred. The reason that current gathering dominates is that in this cross section the dimension of the deposit is small in comparison to its depth. Therefore, at the surface, vortex flow effect is small compared to the magnetic field from unidirectional current gathering flow. This is not to say that the body is a poor conductor. The time constant obtained from down hole EM measurements is about 3-4 milliseconds (Eadie, 1987). In spite of the fact that current gathering was known to dominate this response, the conductor became a primary target because the visual estimate of the second derivative of the profile shows a smooth continuous variation not indicative of any obvious edge effects which may be related to a broad shallow formational conductor.

The response over the very large Red Dog deposit (Van Blaricom and O'Connor, 1986), is dominated by a current gathering effect, due to its bulk resistivity of 125 Ωm (Figure 4). Any attempt to explain these results in terms of a free space model fails. However the maximum changes in the profile slope uniquely correspond with the edges of the mineralization, with the smoother slope variation corresponding to deeper terminations. The response between edges 2 and 3 is not diagnostic of any particular source and interpreting it by conventional techniques would result in identification of a shallow conductor. However connecting edges 2 and 3, with the deeper edges at 1 and 4, results in a unique interpretation of a substantial, mostly buried flat-lying target. As a comparison, the response marked by edge 5 is interpreted to be a very broad and outcropping source, and surface inspection downgraded it as a prospect.

Superficially, the current gathering response in Figure 5 is similar to the Hellyer anomaly. However, analysis of the very sudden changes in the slope of the profile identifies very shallow edges (less than 10 m from surface) from a broad conductive unit. In this area, this was not considered to be an orebody target.

A more complex profile (Figure 6) can be evaluated as a superposition of a number of responses, some of which show obvious near surface edge effects as sharp changes in the slope of the curve. Their locations have been confirmed by a conventional resistivity survey. These anomalous responses all have an approximate $t^{-5/2}$ 'late' time power law decay lasting until about 4 ms, and have no separation in time. However, since the objective on this property is to find a deeply buried deposit, the smooth continuous variation in the profile's slope, indicating a 'broad' second derivative gave evidence of a primary target. In this case the smooth part of the profile is outlining only a part of a normal cross-over type anomaly making quantitative interpretation difficult.

(b) Quantitative Approach

The problem posed in the quantitative approach is to remove or identify responses from sources which are not considered to be of economic importance, and to quantitatively interpret the second derivative.

As an example the profile data from Figure 6 is splined and the subsequently splined second derivatives is produced (Figure 7). This highlights the 'broad' non-zero second derivative and the near surface edge effects. Since, as discussed earlier, the halfwidth of the second

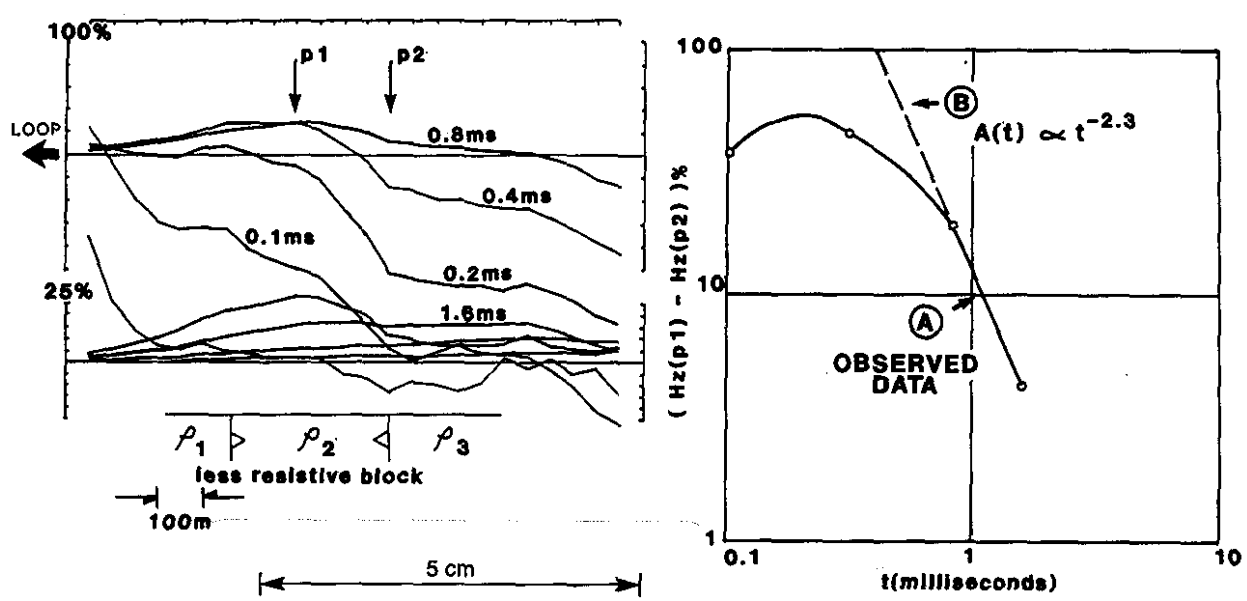

FIGURE 5
Current gathering response from a prospect near Marysville, B C, Canada shows superficial similarities to the Hellyer response in Figure 3. Sudden changes in slope identify this response to be from a broad near-surface source.

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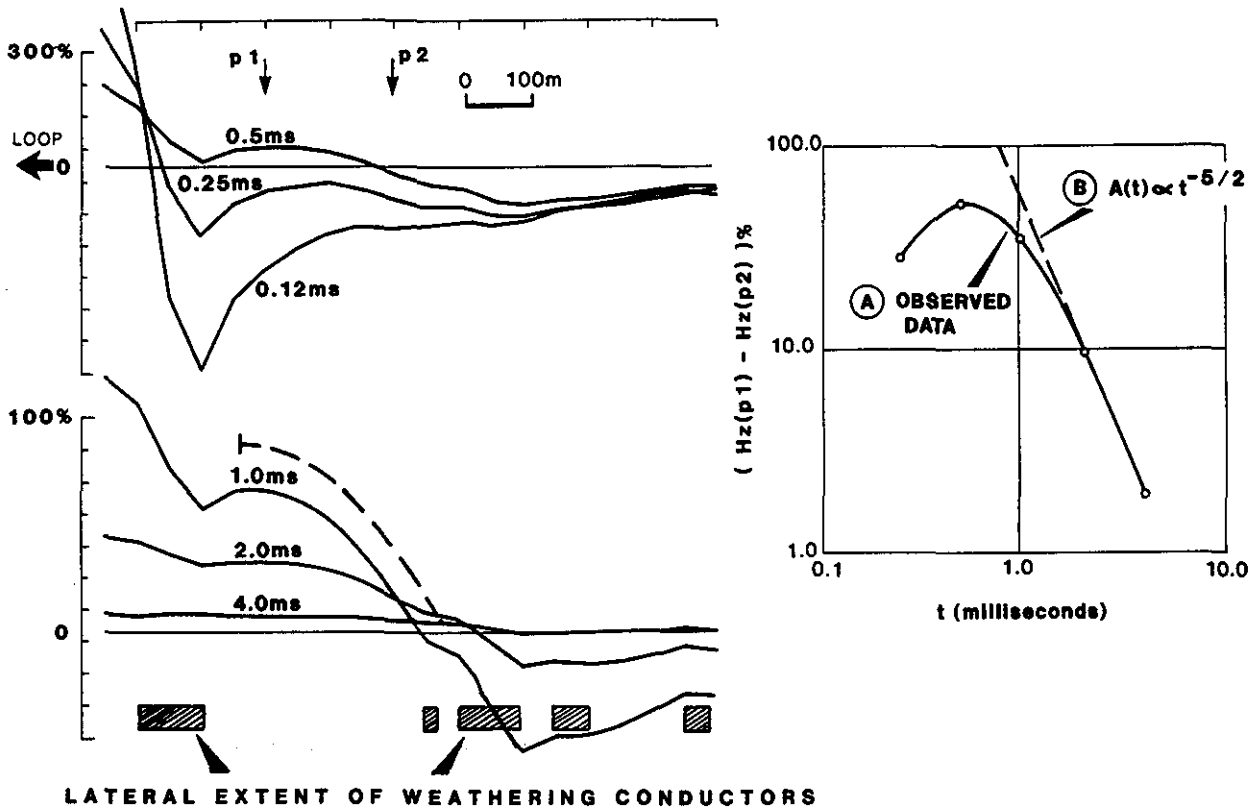

FIGURE 6
UTEM (Hz) data showing superposition of a number of responses, some of which show obvious edge effects from near surface broad conductors. All responses asymptote to a $t^{-5/2}$ power law. No separation between responses in time is evident. The response marked with the shaded line has a broad second derivative as indicated by a continuous variation in the profile slope, and could represent a buried target at a depth of 200-250 m. The shaded line represents only a part of a normal Hz cross-over anomaly.

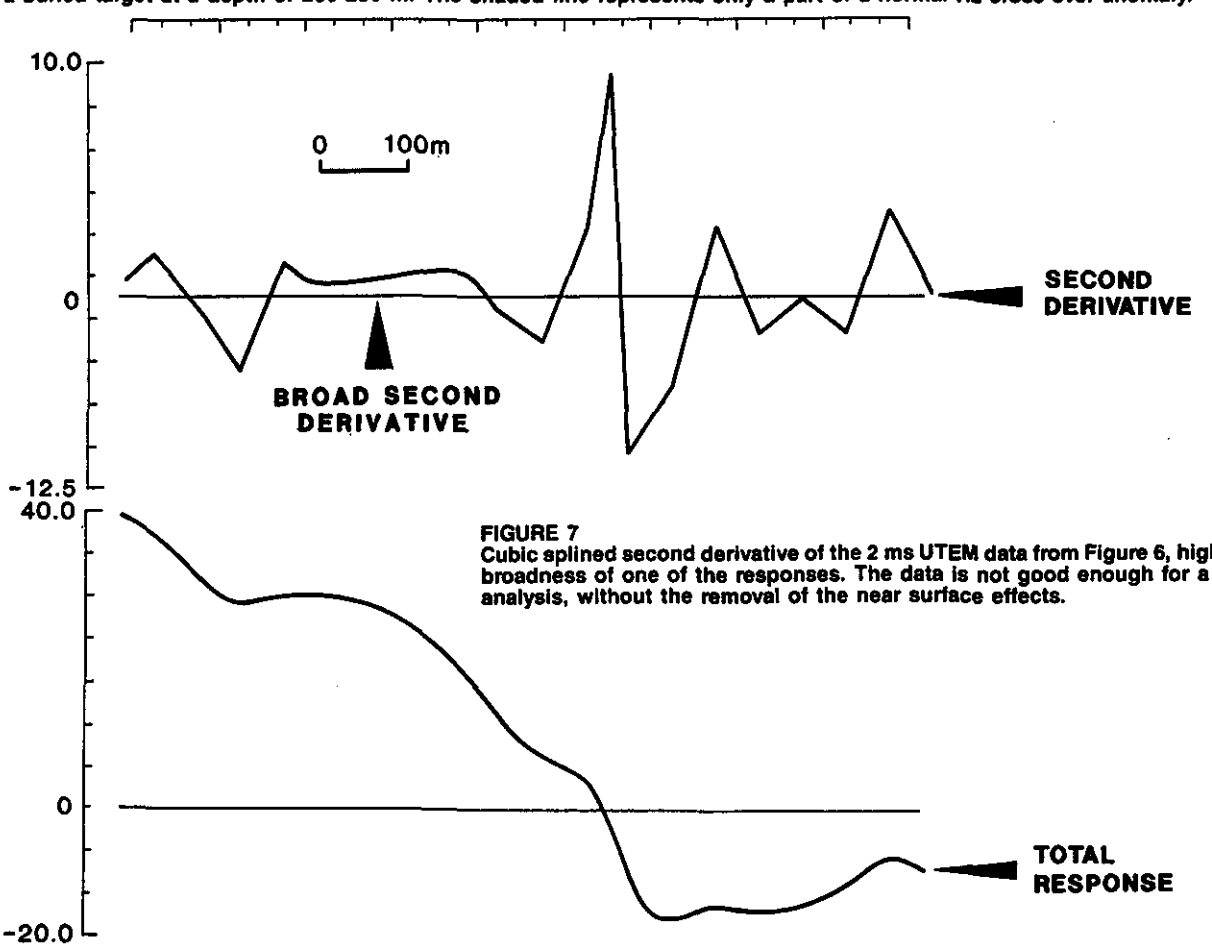

FIGURE 7
Cubic splined second derivative of the 2 ms UTEM data from Figure 6, highlighting the broadness of one of the responses. The data is not good enough for a quantitative analysis, without the removal of the near surface effects.

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derivative data due to broad conductors is approximately equal to its depth to top, a problem is encountered. Fifty metre sampling of the data, as was done in this case, seriously undersamples the field data for very shallow sources. The splined second derivative data in this case has minimum halfwidths of about 50 metres. As a result, any attempt to quantitatively remove the shallow 'edge' effects is inaccurate. More closely spaced profile data is needed to accomplish this.

The quantitative approach to this type of interpretation is still being developed. A simple filter has been formulated to remove shallow edge effects from data, and a full inversion technique is the next step.

Conclusion

We in the exploration industry who have worked on interpretation problems have been frustrated over the difficulty of 3D-EM generalized modelling techniques to provide answers and inversion algorithms that are usable over a complex set of conductivity structures. As a result the historical tendency has been to discriminate between responses on the basis of their time constants or latest anomalous times. Our experience has however shown that this can be a very dangerous practice, if current gathering effects dominate, as the examples over the Hellyer and Red Dog deposits illustrate. As a result a new discrimination technique had to be found. Current gathering effects can now be recognised through decay analysis, and information about the shape and location of the source can be derived through analysis of the spatial derivatives. Although only some aspects of the spatial derivative and these new modelling techniques have been discussed in this paper and examples have been restricted to understanding current gathering responses, the technique can be applied to a completely general current flow.

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APPENDIX II

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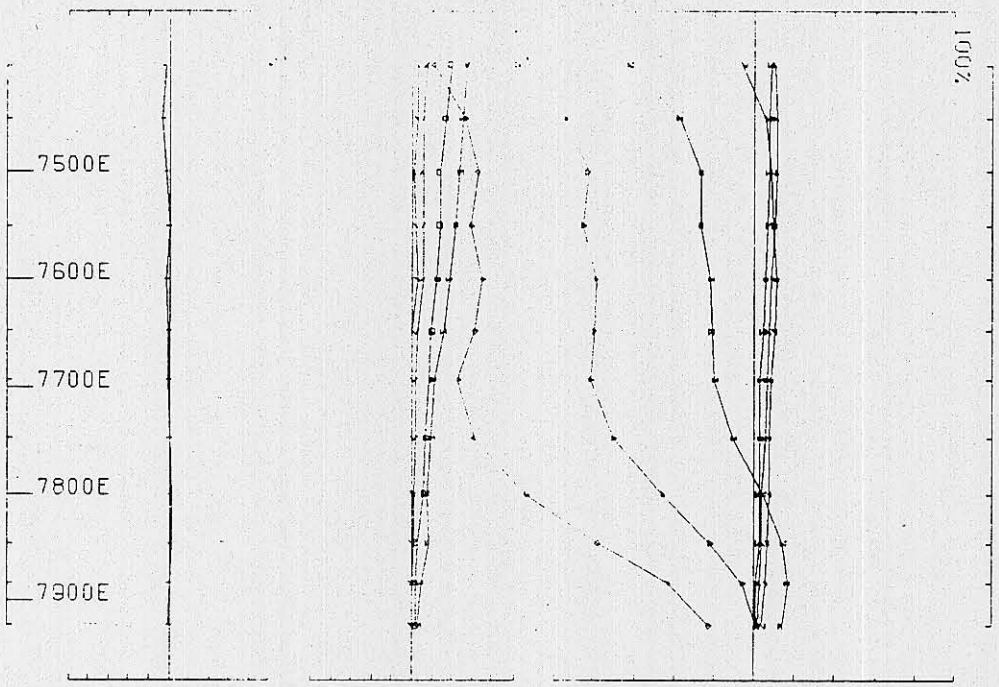
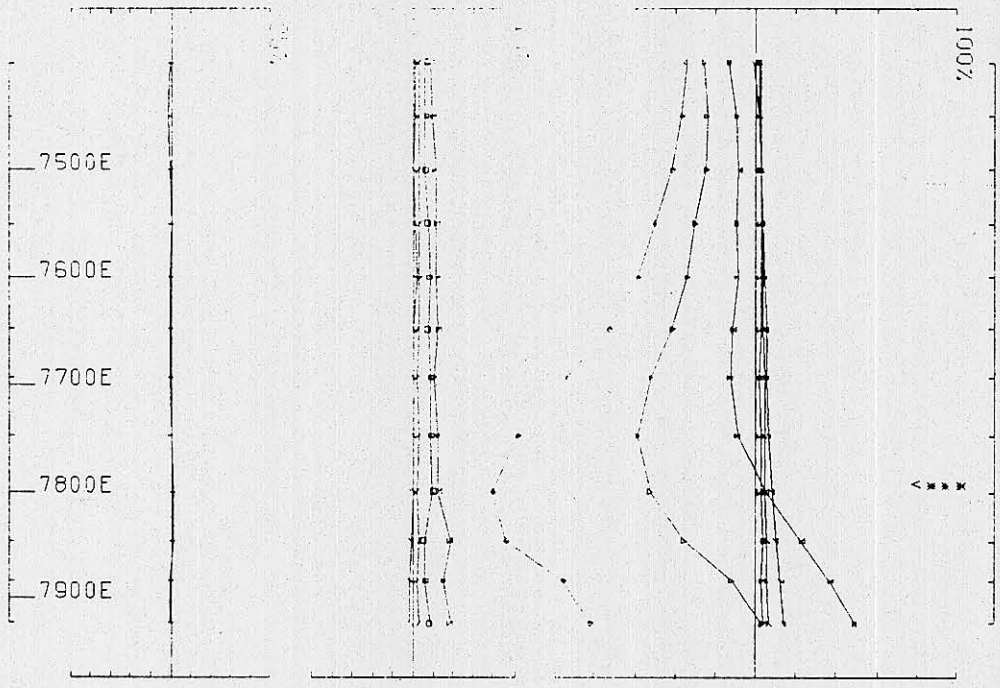


UTEM SURVEY AT MACINTOSH FOR ABERFOYLE RESOURCES FEBRUARY 1991
CONDUCTED BY LAMONTAGNE GEOPHYSICS LTD JOB 9102 BASE FREQ (HZ) 26.23
LOOP NO 1M LINE 11200 N COMPONENT HZ SECONDARY FIELD CHI CONTIN. NORM.

Fig 1



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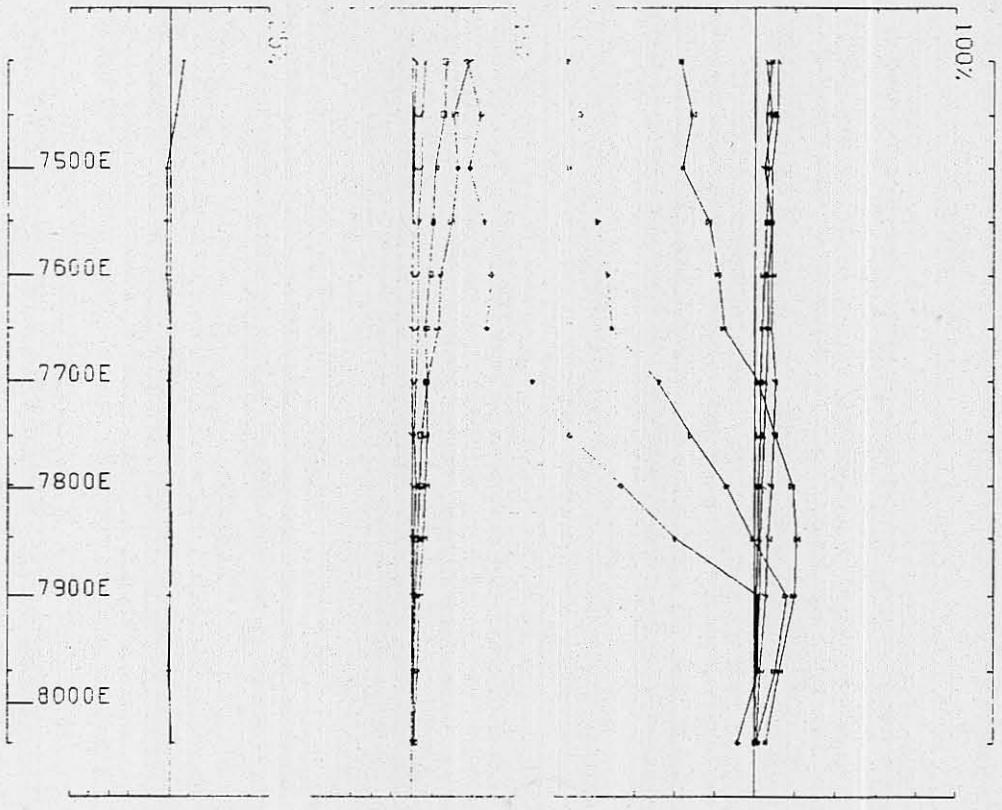
CONDUCTED BY LAMONTAGNE GEOPHYSICS LTD JOB 8100 BASE FREQ (HZ) 26.23
LOOP NO 1M LINE 11200 N COMPONENT HZ SECONDARY FIELD CH1 POINT NORM

Fig 1a



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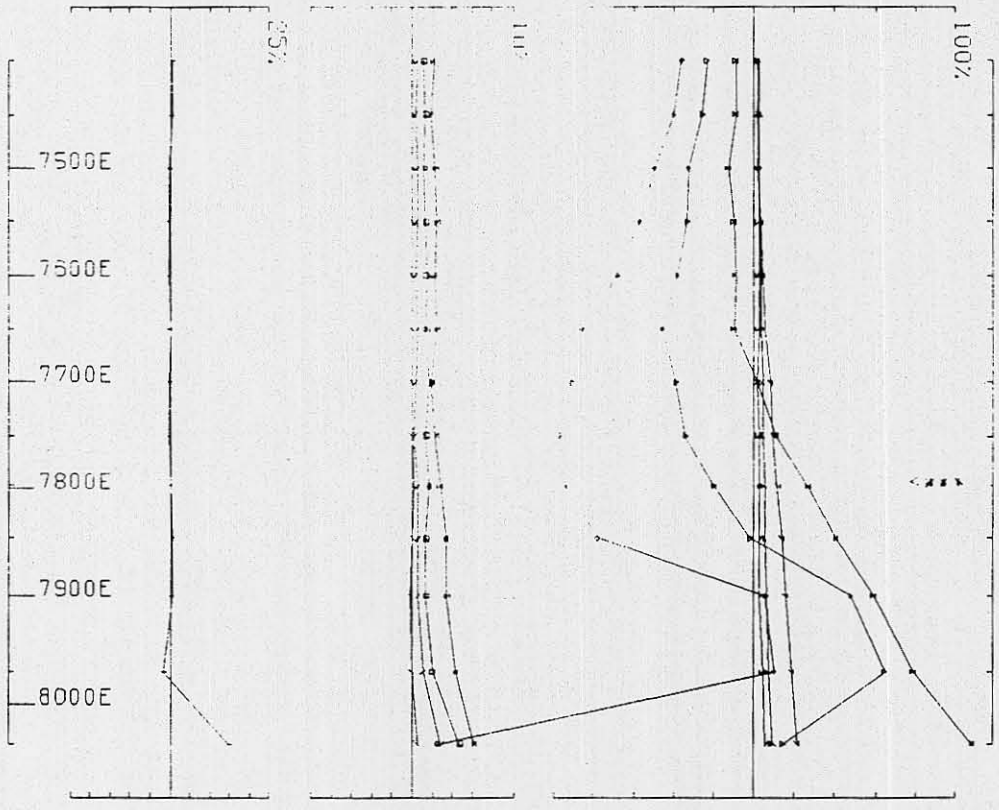
LOOP NO 1M LINE 1 [illegible] COMPONENT [illegible] FIELD CH1 CONTIN. NORM.

Fig 2



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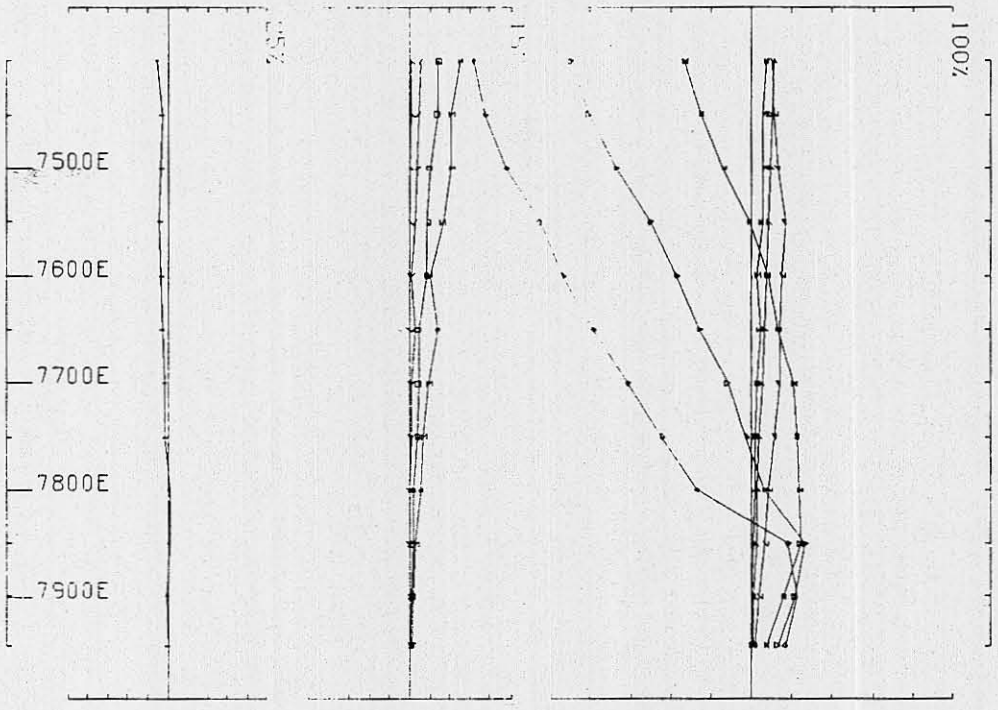
LOOP NO 1M LINE 11400 N COMPONENT HZ SECONDARY FIELD CH1 POINT NORM.

Fig 2a



UTEM SURVEY AT MACINTOSH FOR ABERFOYLE RESOURCES FEBRUARY 1991
CONDUCTED BY LAMONTAGNE GEOPHYSICS LTD JOB 9102 BASE FREQ (HZ) 26.25
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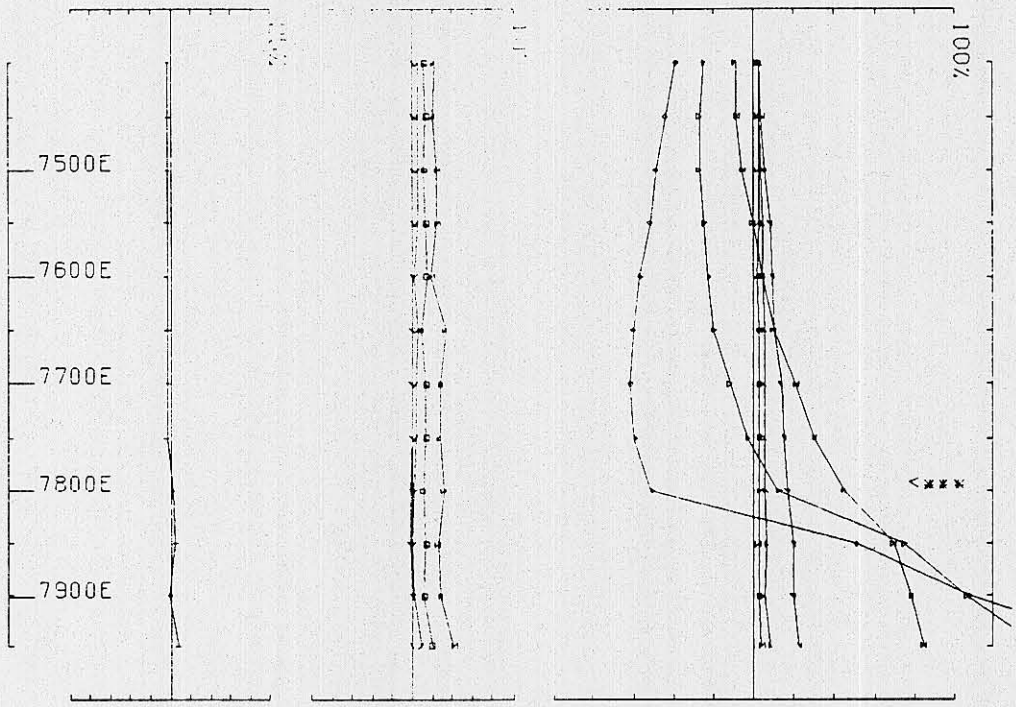
Fig 3



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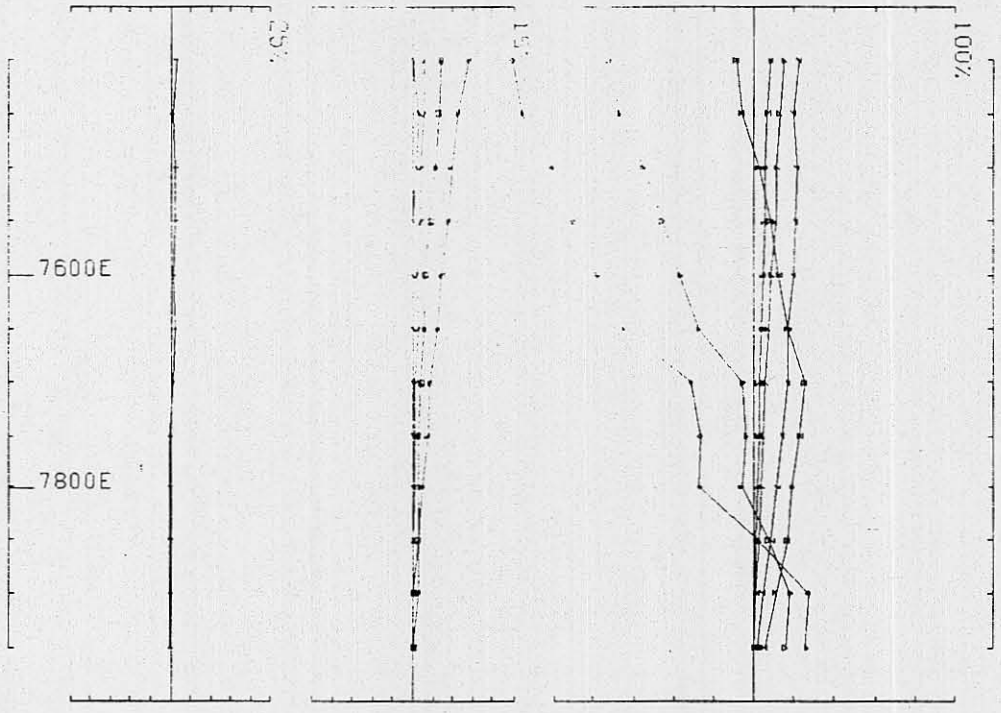
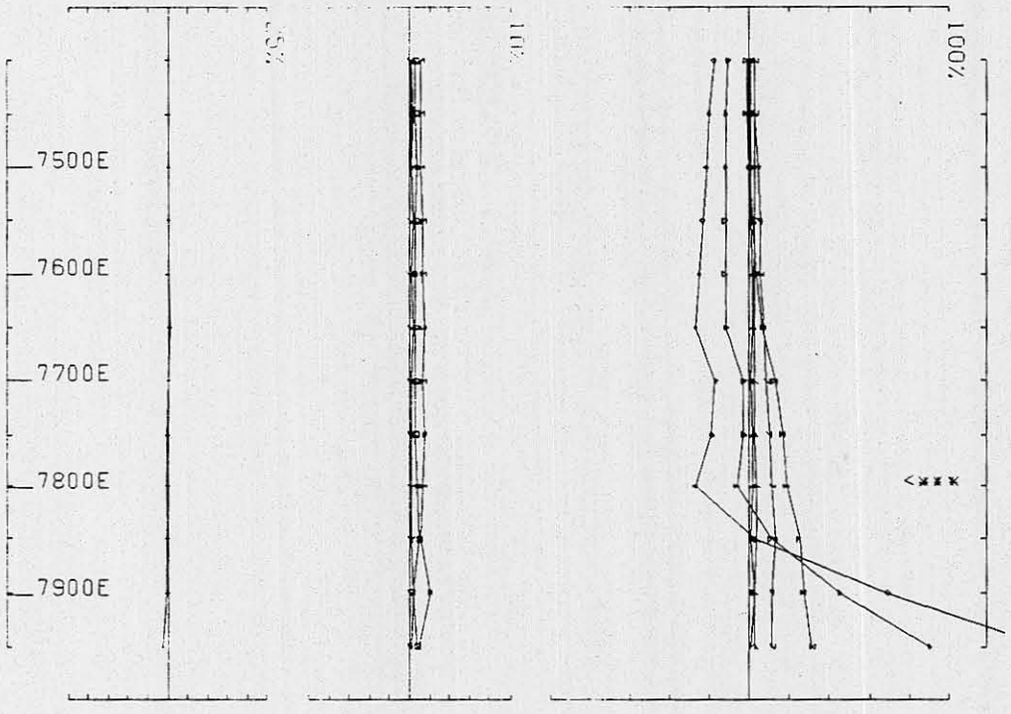
LOOP NO 1M LINE 11600 N COMPONENT HZ SECONDARY FIELD CHI POINT NORM.

Fig 3a



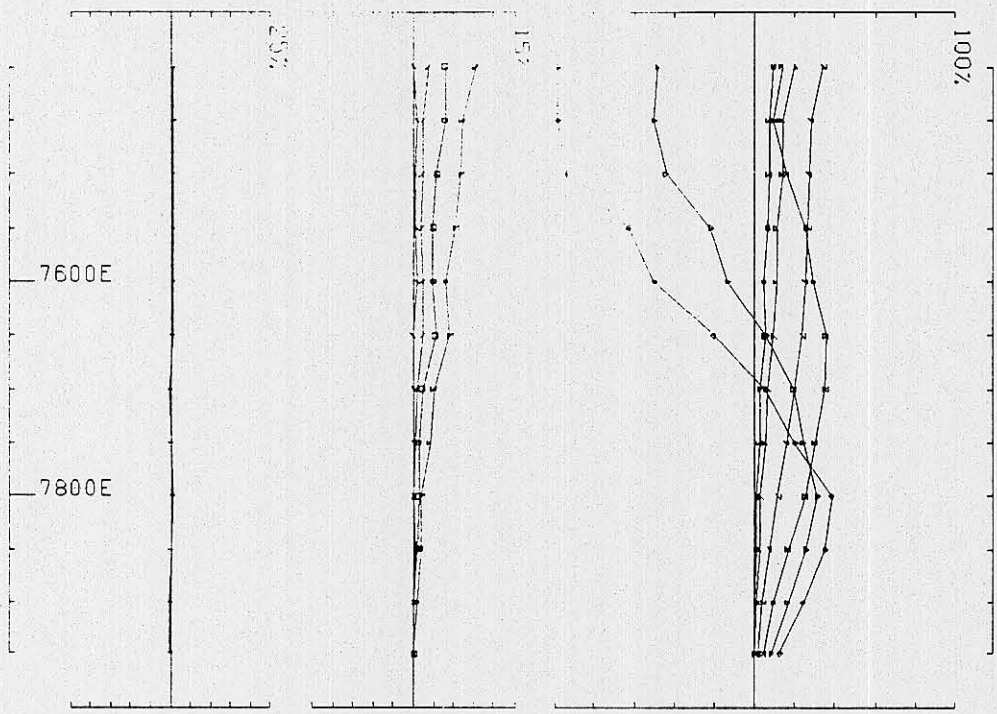
UTEM SURVEY AT MACINTOSH FOR ABERFOYLE RESOURCES FEBRUARY 1991
CONDUCTED BY LAMONTAGNE GEOPHYSICS LTD JOB 9102 BASE FREQ (HZ) 26.23
LOOP NO 1M LINE 11800 N COMPONENT HZ SECONDARY FIELD CH1 CONTIN. NORM.

Fig 4



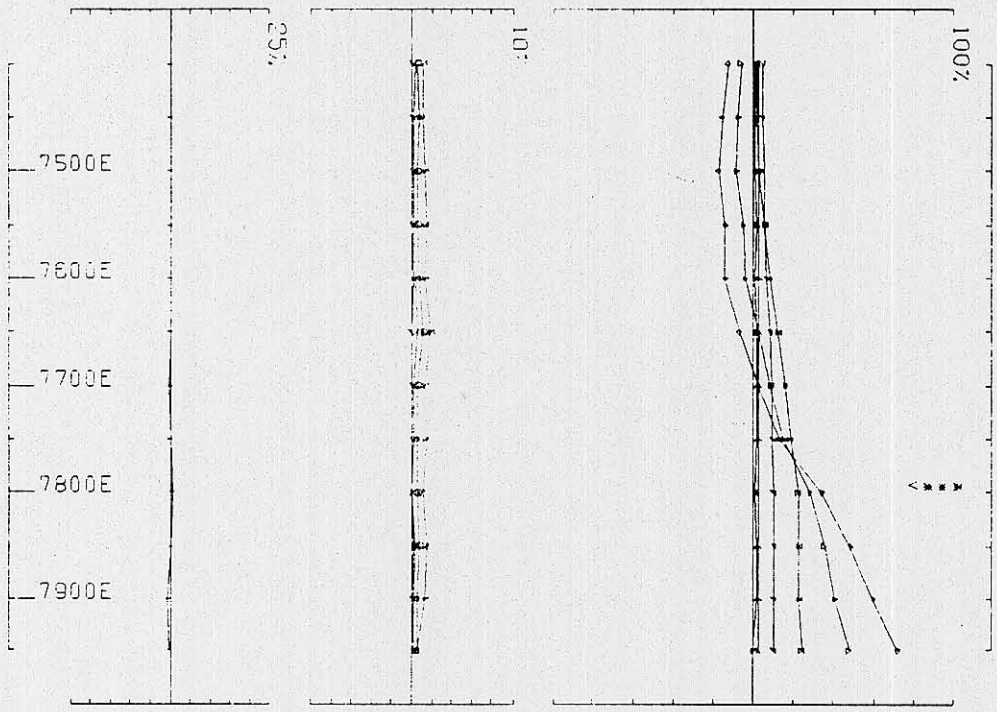
UTEM SURVEY AT MACINTOSH FOR ABERFOYLE RESOURCES FEBRUARY 1991
CONDUCTED BY LAMONTAGNE GEOPHYSICS LTD JOB 9102 BASE FREQ (HZ) 26.25
LOOP NO 1M LINE 11800 N. COMPONENT HZ SECONDARY FIELD CH1 POINT NORM.

Fig 4a



UTEM SURVEY AT MACINTOSH FOR ABERFOYLE RESOURCES FEBRUARY 1991
CONDUCTED BY LAMONTAGNE GEOPHYSICS LTD JOB 9102 BASE FREQ (HZ) 26.23
LOOP NO 1M LINE 12000 N COMPONENT HZ SECONDARY FIELD CH1 CONTIN. NORM.

Fig 5

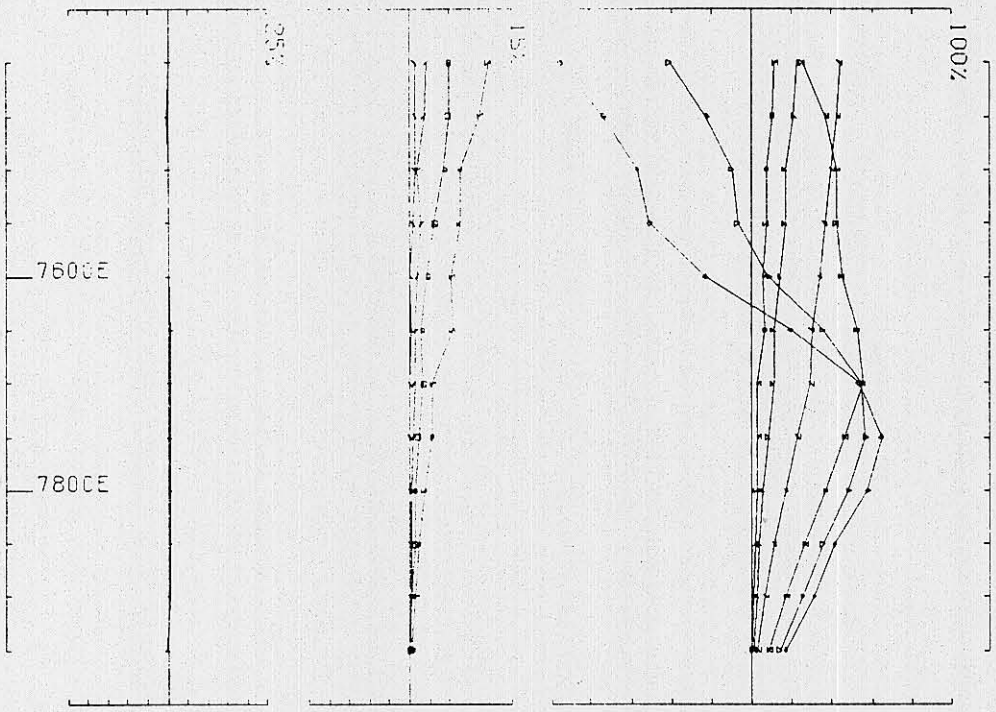


UTEM SURVEY AT MACINTOSH FOR ABERFOYLE RESOURCES FEBRUARY 1991
CONDUCTED BY LAMONTAGNE GEOPHYSICS LTD JOB 9102 BASE FREQ (HZ) 26.23
LOOP NO 1M LINE 12000 N COMPONENT HZ SECONDARY FIELD CH1 POINT NORM.

Fig 5a

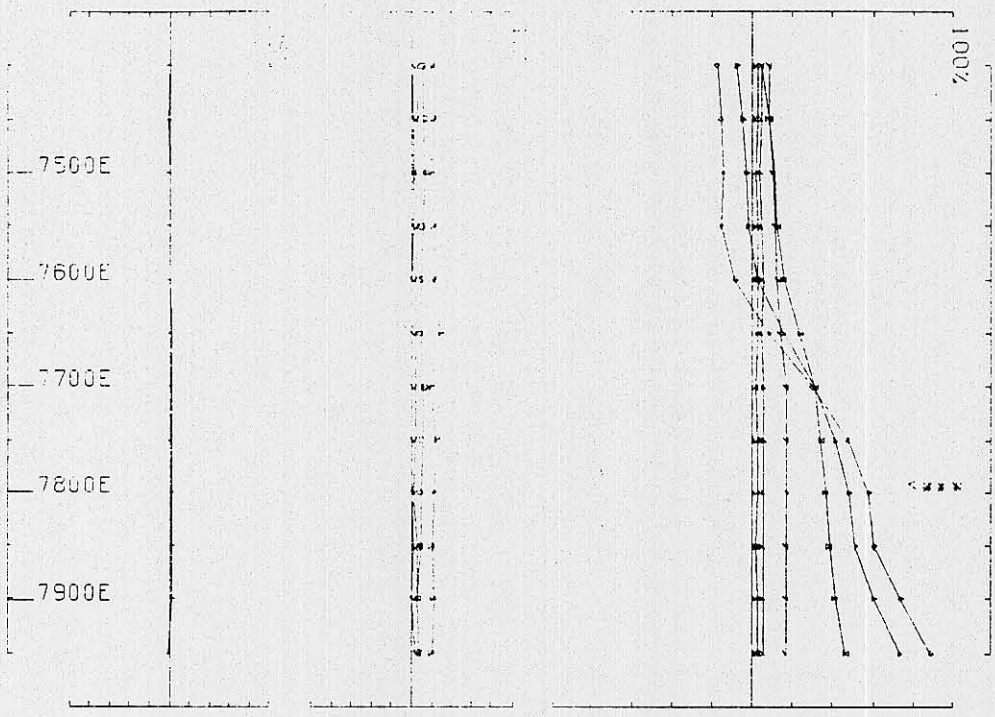
0282

654283



UTEM SURVEY AT MACINTOSH FOR ABERFOYLE RESOURCES FEBRUARY 1991
CONDUCTED BY LAMONTAGNE GEOPHYSICS LTD JOB 9102 BASE FREQ (HZ) 26.25
LOOP NO 1M LINE 12200 N COMPONENT HZ SECONDARY FIELD CHI CONTIN. NORM.

Fig 6



UTEM SURVEY AT MACINTOSH FOR ABERFOYLE RESOURCES FEBRUARY 1991
CONDUCTED BY LAMONTAGNE GEOPHYSICS LTD JOB 9102 BASE FREQ (HZ) 26.29
LOOP NO 1M LINE 12200 N COMPONENT HZ SECONDARY FIELD CHI POINT NORM.

Fig 6a

APPENDIX 12

Aberfoyle Exploration — GEOCHEMICAL SAMPLE LEDGER

A.N.N + R.A.B.

PROJECT: Mac-28 access track (I zone) Mackintosh

BSS SIEVE SIZE CODE - MESH NUMBER: A 200 D 80 G 30 / B 150 E 60 H 20 / C 100 F 40 T = TOTAL

SAMPLE TYPE CODE: ☐ OXIDIZED PRODUCTS O / ☒ FRESH ROCK R / ☐ STREAM SEDIMENTS S / ☒ WEATHERED BEDROCK W / ☐ SURFACE TRANSPORTED T / ☐ RESIDUAL SOIL E / ☐ MINE DUMP M

CARD PUNCH PRINT: YES ☐ NO ☐ — VERIFY: YES ☐ NO ☐

DATE: 23/11/80

SHEET: 1 of 1

EASTINGS	NORTHINGS	SAMPLE NUMBER	DEPTH in CMS	SIZE FRACTION	Sample Type	METAL VALUES PPM	GEOLOGICAL LOG
42850	58150	56267010			R.C.	O/C	10m wht-br mas ff ?ves. A-D.I.
42900	58200	56267011			"	"	20m " " " " "
43000	58260	56267012			"	"	30m br-gn ff mas A-D.I./ox ?.
43100	58250	56267013	Petrology 562665 (from augen)		"	"	40m dk gn ff cl spt A-D.I./Lch(?)
43184	58334	56267014			"	"	50m dk gn. ff. cl spt: A-DI/Lch(?)
43200	58440	56267015			"	"	60m lyt-dk gn mas ?Q+ff A-D.I./Si(?)
43222	58550	56267016			"	"	70m gn ff mas A-D.I.
43222	58650	56267017			"	"	80m " "
43223	58880	56267018			"	"	100m Mtl. gn ff A-D.I./ wk Si.
43240	59100	56267019			"	"	120m br-or mas. A-D.I./Ox(4)/Mn Stained
43220	59200	56267020			"	"	130m " " "
43217	59300	56267021			"	"	140m " " "
43214	59400	56267022			"	"	150m " " "
43308	59500	56267023			"	"	160m br-or mas. A-D.I./Ox(4)/Mn Stained.
43305	59580	56267024			"	"	170m br-or ff mas. lava (A-D?) /Ox(4)/Mn Stained
43300	59640	56267025	Petrology.		"	"	180m gn YA f-mlv : Ch+Di ff /Sc(1-2)
42944	59740	56267026			"	"	190m br-rd mas lava/Ox(4)/mar cl vn + Mn stained
42850	59800	56267027			"	"	200m br-rd mas lava/Ox(4)/mar cl vn + Mn stained
42888	59900	56267028			"	"	210m kh+br ff mas ?A-D.I./cl va./Lch(5)
42866	60020	56267029			"	"	220m gn-pk sil. cl va. A-D.I.
42844	60080	56267030			"	"	230m wht-gn-pk ff lava/Lch(4) (+10m E)

56267030

0286

654287

40

ANALABS

A Division of Inchcape Inspection and Testing Services Australia Pty. Ltd.

Analabs - A Division of Inchcape Inspection & Testing Services

Phone (004) 31 6837 | 14 Thirkell St. Cooee Tas 7320 | Fax No. (004) 31 8890

ANALYTICAL REPORT No. 100560.60.07552

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

INVOICE TO:

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

ORDER No.	PROJECT
11030	Mack E.L.

DATE RECEIVED	RESULTS REQUIRED
26/11/90	ASAP

No. OF PAGES OF RESULTS	DATE REPORTED	No. OF COPIES
2	14/12/90	1

TOTAL No. OF SAMPLES: 21

SAMPLE NUMBERS	SAMPLE DESCRIPTION	ELEMENT/METHOD
562670/690	RC Prep: GP005,GP009,GP016	Cu,Pb,Zn,Ag/GA101
562670/690	RC	Ba,As,Cr,Zr,Ti/GX401
562670/690	RC	Ti:Zr/S9825

RESULTS TO

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

RESULTS TO

RESULTS TO

REMARKS

MAC-28
ACCESS TRACK

AUTHORISED OFFICER

0287

654288

ANALABS

A Division of Inchcape Inspection and Testing Services Australia Pty. Ltd.

ANALYTICAL DATA

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
	100560.60.07552	14/12/90	11030	1 OF 2

JBE No.	SAMPLE No.	Cu	Pb	Zn	Ag	Ba	As	Cr	Zr	Ti
	562670	10	<5	65	1.0	320	6	73	230	4200
	562671	15	<5	55	<0.5	1100	3	13	220	3150
	562672	10	<5	110	<0.5	1200	<2	13	250	3050
	562673	10	<5	140	<0.5	1350	15	20	200	2750
	562674	10	30	145	<0.5	370	10	103	310	5000
	562675	10	<5	70	<0.5	980	<2	10	220	2000
	562676	10	<5	90	<0.5	1150	4	18	170	1450
	562677	10	<5	205	<0.5	300	4	25	210	3200
	562678	10	<5	115	1.0	1650	15	53	160	3750
	562679	80	25	940	<0.5	310	<2	1800	70	2350
	562680	60	40	360	<0.5	410	3	1810	75	3600
	562681	70	30	210	<0.5	240	2	1463	95	3300
	562682	120	40	300	<0.5	280	<2	1558	85	3200
	562683	65	25	275	<0.5	65	<2	1413	70	3000
	562684	110	60	390	<0.5	65	7	1736	100	3550
	562685	30	2400	260	1.0	190	15	65	160	4050
	562686	115	195	850	<0.5	130	35	1044	160	5850
	562687	115	120	945	<0.5	150	60	1464	120	4450
	562688	15	<5	185	1.0	1100	2	146	210	2350
	562689	5	<5	85	1.0	1150	<2	10	170	1900
	562690	25	10	145	<0.5	610	<2	38	180	1900
	DETECTION	5	5	5	0.5	10	2	5	5	50
	UNITS	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
	METHOD	GA101	GA101	GA101	GA101	GX401	GX401	GX401	GX401	GX401

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

AUTHORISED OFFICER

654389

0288

ANALABS

A Division of Inchcape Inspection and Testing Services Australia Pty. Ltd.

ANALYTICAL DATA

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
	100560.60.07552	14/12/90	11030	2 OF 2

UBE No.	SAMPLE No.	Ti:Zr									
	562670	18.3									
	562671	14.3									
	562672	12.2									
	562673	13.8									
	562674	16.1									
	562675	9.1									
	562676	8.5									
	562677	15.2									
	562678	23.4									
	562679	33.6									
	562680	48.0									
	562681	34.7									
	562682	37.6									
	562683	42.9									
	562684	35.5									
	562685	25.3									
	562686	36.6									
	562687	37.1									
	562688	11.2									
	562689	11.2									
	562690	10.6									
	DETECTION	0.1									
	UNITS	%									
	METHOD	S9825									

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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APPENDIX 13

654291

0290

MACKINTOSH / HATFIELD DATA BASE ENTRY FORM 1 of 2

DRILL HOLE NAME MAC 28

LOCATION QUE RIVER SOUTH

TOTAL DEPTH 907.5m

NUMBER SURVEYS
(Incl. collar P.U.)

NUMBER ASSAY INTERVALS

COLLAR NORTHING 5999.9 G 5392623.7 AMG

COLLAR EASTING 4302.7 G 390215.8 AMG

COLLAR R.L. 701.8m.

COLLAR DEPTH 0m.

SECTION 6000N
(To nearest 50m)

STATUS OF DATA New

DATE STARTED 28/11/90

DATE FINISHED 21/2/91

LOGGED BY AMcN

FROM	TO	HOLE SIZE	CASING TYPE	CASING I.D.
0	3	Tricone (HW)		
3	93	HQ		
93	907.5	NQ		
0	428		PVC Class 12	40 mm
428	907.5		PVC Class 18	40 mm.

COMMENTS 3m HW casing left in top of hole.

Aberfoyle Resources Limited
EXPLORATION DIVISION

DIAMOND DRILL LOG

654692

PROJECT : Mackintosh EL

PROSPECT: I1 Zone

HOLE NO: Mac-28
PAGE: 1 of 22
LOGGED: AMcN
DATE: 19-12-90

DEPTH	DRILL RUNS	CORE LOSS	LITHOLOGY: ROCK NAME	LITHOLOGY: DESCRIPTION	ALTERATION	VEINING	MINERALISATION	STRUCTURE	WEATHERING	VISUAL LOG	REMARKS	DEPTH
2			3.0m.	No Core - tricone								
4			Dacitic lava	lgt brown-pink massive feldspar-phyric, chlorite spotted lava. Strong Mn staining on joints.		Qz (1) Mn filled fractures (2)			Ox3			
6												
8												
10												
12		88 / 60%										
14		133										
16												
18		177										
19.3		60%										
20		20%										
22		229										
24				24.6m.								
26			?Basalt lava breccia	Mottled pink-green massive to brecciated lava as above. ie zones of fresh unweathered lava. unweathered lava looks basaltic					Pot Ox			
28												
30												
32								32.4 fault = 85° to c.a.				
34								32.0 fault = 60° to c.a.				
36								34.2 fault = 50° to c.a.				
38								all faults puggy.				
40									Ox2			
42												

PROJECT : Mackintosh GL

PROSPECT : I, Zone

Aberfoyle Resources Limited
EXPLORATION DIVISION
DIAMOND DRILL LOG

654293

2820

HOLE NO : Mac-28
PAGE : 2 of 22
LOGGED : AMcN
DATE : 19-12-90

DEPTH	DRILL RUNS	CORE LOSS	LITHOLOGY: ROCK NAME	LITHOLOGY: DESCRIPTION	ALTERATION	VEINING	MINERALISATION	STRUCTURE	WEATHERING	VISUAL LOG	REMARKS	DEPTH
44			Basalt lava breccia	light brown - pink, with some green - pink, feldspar-phyric + chlorite spotted lava. breccia texture in places in less weathered intervals	Dendritic MnO_2 on Core surface.	Q+Mn (1) Mn (2)			Ox 2			
46												
48												
50									Ox 1-2			
52												
54									Ox 1			
56						Q + Mn + Se (2) Mn (1)		55.1 - 55.3m broken Core.				
58				58.8 green-pink highly vesicular Basalt lava fragments and silicious pink-brown feldspar-phyric Andesite-dacitic fragments in a massive green feldspar-phyric matrix. Some andesitic-dacitic fragments look weakly vesicular								
60												
62												
64					Cosecl (1)	Co + Q ± Cpy ± Hmt (1)	63.7 Py (1)					
66				65.4m 15cm diameter andesitic-dacitic lava clast.		Q+Co (2)						
68												
70												
72												
74												
76					Cokecl (1) fu (1) in vesicular clasts).	76.2 - 76.7 hydraulic bx ± Q+Co ± Py vn mtx (4)						
78						Q+Co (3)						
80											80.45m Petrology - 562691 Basalt lava breccia.	
82												
84			Andesite lava.	84.3 ↑ Gradational Contact. ↓		84.3 Q (1) Co (1)						

Aberfoyle Resources Limited
EXPLORATION DIVISION

DIAMOND DRILL LOG

654294

C820

PROJECT : _____

PROSPECT : I Zone

HOLE NO : Mac-28
PAGE : 3 of 22
LOGGED : AMcN
DATE : 19-12-90

DEPTH	DRILL RUNS	CORE LOSS	LITHOLOGY: ROCK NAME	LITHOLOGY: DESCRIPTION	ALTERATION	VEINING	MINERALISATION	STRUCTURE	WEATHERING	VISUAL LOG	REMARKS	DEPTH
86			Andesite feldspar-phyric lava.	Massive to brecciated green to pink feldspar-phyric sub-aerial andesitic - dacitic lava. Minor hydraulic breccia.	Se Si (1-2)	Q (1) Co (1) Q + Co + Cl (1)					35.3m petrology 562692.	
88								88.5 - 89.7 Sheared with disrupted veins => fault.				
90					90 Si (1-2)	Co (2) Q (1)						
92											92.8m HQ / NQ	
93.3								93.7 fault = 80° to CA.				
94			Basalt lava breccia	dark-green weakly feldspar-phyric matrix with clasts of vesicular pink-green basalt lava and minor dacitic clasts.	Se Si Cl (1) fu spt (1)	Co (2-4) Co + Se (1) Q (1)	Py (1) on joints + minor in Vesicles					
96												
98												
100								99.3 broken Core 100.3 ? fault zone				
100.3			Andesitic feldspar-phyric lava.	Massive to brecciated pink-brown-green feldspar-phyric lava with irregular carbonate patches (? vesicles) and chloritic spots (? after ferromagnesian phenocrysts.)		Co (3)						
102												
104								104.6 fault = 65° to CA. Rubbly.				
106												
108												
110												
111.2				irregular carbonate filled vesicles obvious.								
112						Q + Hmt (1) Co (2)	Py (1-2)					
114												
116				116 A Gradational contact lava becomes brecciated.		Q (2) Co (2)						
118											172.4 petrology 562693	
119.5			Basalt lava breccia	119.5 B mottled green matrix with light green feldspar-phyric clasts and scattered pink-brown lava clasts. Incl 12cm pink-green vesicular basalt lava and green massive aphyric andesitic-basaltic lava clasts.	Co (1-3) Cl (3)	Q (1) Co (1)	Py (1)					
120												
122												
124												
126				by 12.7m clast to 10 cm diameter								

Aberfoyle Resources Limited
EXPLORATION DIVISION

DIAMOND DRILL LOG

654295 6620

PROJECT : _____

PROSPECT : I1 Zone

HOLE NO : MAC-28
PAGE : 4 of 22
LOGGED : AMcN
DATE : 16-1-91

DEPTH	DRILL RUNS	CORE LOSS	LITHOLOGY: ROCK NAME	LITHOLOGY: DESCRIPTION	ALTERATION	VEINING	MINERALISATION	STRUCTURE	WEATHERING	VISUAL LOG	REMARKS	DEPTH
128			Basalt lava breccia.	Pink-green vesicular basalt lava and massive feldspar-phyric Andesitic-basaltic lava fragments in a mottled light-dark green feldspar-phyric matrix. Clasts from 0.5-30cm diameter.	Cl(1)	Q(1) Q+Co(2) Qv(Co+Ep)(1)	Py(1) Cpy(1)					
130												
132											132.4m Petrology 562694 Polymict basalte lava breccia.	
134												
136												
138												
140						Q+Co(2) Q(1)						
142												
144												
146			146.5 Andesite lava breccia	irregularly shaped green-pink feldspar-phyric lava fragments in a light green-grey chert matrix. Matrix contains to fine lapilli grade clasts-bole	Si fd(1-2) ? alteration of clasts. Cl(2)		No obvious mineralisation					
148								148.3 fr. elongate ∥ To Si = 40° to LCA.				
150			149.5 Polymict Andesitic volcaniclastic	fine lapilli volcaniclastic containing to medium lapilli volcaniclastic clasts-bole. Polymict with andesitic, dacitic and basaltic lava clasts in a massive to weakly laminated matrix.	151 pyroclastic dendrites on broken surfaces.		Py(1-2)	149.4 Si = 30° to LCA. 149.7 bedding = 35° to LCA. 151 149.8 bedding = 60° to LCA. 151.6 broken core.			149.85m Petrology 562695 Polymict felsic lapilli volcaniclastic.	
152												
154			155 feldspar-phyric Hornblendic lava.	green feldspar-phyric weakly brecciated andesitic lava with scattered pink dacitic lava fragments to 9cm diameter, but generally <2cm diameter.		Q+Co(1)						
156												
158												
160											159.45m Petrology 562696 Andesitic to dacitic lapilli volcaniclastic	
162												
164					164.8 - 165.5 Co(3) 4H matrix.							
166					165.9 - 166.5 Si5e(2) Cl(1)			166.1 fault: 1cm gouge : 55° to LCA.				
168						Q+Co(2) Q(1)						

Aberfoyle Resources Limited
EXPLORATION DIVISION

DIAMOND DRILL LOG

654296

PROJECT :

PROSPECT: I1 Zone

HOLE NO: Mac-28
PAGE: 5 of 22
LOGGED: AMcN
DATE: 6-1-91

DEPTH	DRILL RUNS	CORE LOSS	LITHOLOGY: ROCK NAME	LITHOLOGY: DESCRIPTION	ALTERATION	VEINING	MINERALISATION	STRUCTURE	WEATHERING	VISUAL LOG	REMARKS	DEPTH
170			feldspar-phyric Andesitic lava.	Massive to weakly brecciated green-pink feldspar-phyric Andesitic lava. by 169.9m Dacitic lava fragments appear. fragments are angular Minor Aflv interbeds.	Sifd. (1)	Q(1) Q+Co(1-2)	None obvious.	170.7 broken core 2-3cm = fault.				
172												
174												
176					Se(3) Si(1)							
178					Si(1) pat pk-cm. Sefd (1)			177.8 fault = 15-20° to cos Puggy				
180												
182												
184												
186												
188												
190								189.5 So = 35° to LCA. = bedding.				
192												
194												
196												
198								199.1 broken core = fault				
200												
202												
204												
206						Q+Co ± Se (2-3) Q(1) Q+Co+Hmt(1)						
208						Q(1) Co(1) Q+Co+Hmt(2)						
210												

Aberfoyle Resources Limited
EXPLORATION DIVISION

DIAMOND DRILL LOG

654297 9620

PROJECT : _____

PROSPECT: I, Zone

HOLE NO: Mac-28
PAGE: 6 of 22
LOGGED: AMcN
DATE: 16-1-91

DEPTH	DRILL RUNS	CORE LOSS	LITHOLOGY: ROCK NAME	LITHOLOGY: DESCRIPTION	ALTERATION	VEINING	MINERALISATION	STRUCTURE	WEATHERING	VISUAL LOG	REMARKS	DEPTH
232			Feldspar-phyric Andesitic lava	Mottled light-dark green massive to brecciated feldspar-phyric andesitic lava. minor pink rounded dacite lava fragments and green massive andesitic lava clasts.	Si (1) Pot. fdSe (1) Mar pyrobusite on joints.	Q (1) Co (1) Q+Co+Hmt (2)	None obvious					
234						Q (2) Q+Co (3)	Py (1)					
236												
238						Q (1-2) Co (1)	None obvious					
240												
242												
244						Q (1) Co + Ab (1-2) pink mineral = Ab?						
246								231 fault = 20° to LCA. puggy + broken.				
248						Q (1) Co + Ab (2-3)						
250						Q (1) Co (1-2)						
252				209.3 Gradational contact to: mottled light-dark green massive feldspar-phyric andesitic lava. 254.6 Andesitic lava breccia as above	247.4 pot fdSe (1) alteration " SeSi (1) " minor lt gn-grey Ep (1) replaces ferromagnesian phenocrysts ?							

Aberfoyle Resources Limited
EXPLORATION DIVISION

DIAMOND DRILL LOG

PROJECT :

PROSPECT: I zone

654298

1620

HOLE NO: MAC-28
PAGE: 7 of 22
LOGGED: AMcN
DATE: 16-1-91

DEPTH	DRILL RUNS	CORE LOSS	LITHOLOGY: ROCK NAME	LITHOLOGY: DESCRIPTION	ALTERATION	VEINING	MINERALISATION	STRUCTURE	WEATHERING	VISUAL LOG	REMARKS	DEPTH
254			feldspar-phyric Andesitic lava.	Mottled light-dark green feldspar-phyric with chlorite altered ?ferromagnesian phenocrysts. Some possible irregular silica? carbonate filled vesicles. Feldspars are sericite-epidote altered. Where brecciated has a light green-grey lava matrix.	SeSi (1-2) fdse (1)	Co (1) Q+Co (1-2)	None obvious	253.6 fault = 40° to LCA. 1cm pug. 254.3 fault = 40° to LCA. 254.5 fault = 20° to LCA.				
256												
258												
260												
262								262.6 fault = 15° to LCA.				
264								264 fault = 10° to LCA. 264.2 fault = 20° to LCA. 264.5 fault - broken + puggy.				
266				appearance of massive Andesitic and dacitic lava fragments.								
268			268.5	lithology appears more volcaniclastic like. fine downhole to ash volcaniclastic.				267.1 bedding = 30° to LCA. 268.1 (av unit) 268.9 fault zone pug + breccia at 15° to L.C.A.				
270			Andesitic lapilli volcaniclastic	green feldspar-phyric Andesitic volcaniclastic with Dacitic lava fragments.	SeSi (2) Cl (1) patchy.	Q (2) Q+Co (1-2)						
272				272.6 ? feldspar-phyric andesitic lava with a band of dacitic lava fragments (274.6-274.8m)								
274											274.1 petrology 562697 feldspar phyric volcaniclastic.	
276			275.9		275.6-275.8 SeSi (3-4)			275.9 fault = 20° to LCA annealed by Co vn.				
278			feldspar-phyric Andesitic lava.	Mottled light-dark green massive to weakly brecciated feldspar + chlorite altered ferromag.-phyric lava with minor. Pink Sil. fragments and interbedded grey-green weakly laminated ash volcaniclastic or chert	SeEp (1) Minor patches of grey mineral (?sulfide ?oxide)	Co ± Ab (2) Q (1)		278.5 bedding = 20° to LCA.				
280												
282												
284												
286				ash volcaniclastic interbeds + Dacite fragments disappear		Q (1) Co+Q+Ep (1-2)						
288												
290												
292												
294												

Aberfoyle Resources Limited
EXPLORATION DIVISION

DIAMOND DRILL LOG

PROJECT :

PROSPECT: I. Zone

654299

0298

HOLE NO: Mac-28
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DEPTH	DRILL RUNS	CORE LOSS	LITHOLOGY: ROCK NAME	LITHOLOGY: DESCRIPTION	ALTERATION	VEINING	MINERALISATION	STRUCTURE	WEATHERING	VISUAL LOG	REMARKS	DEPTH
296			feldspar-phyric Andesitic lava	Massive to brecciated light-dark green feldspar- and altered ferromag. phyric Andesitic lava. Minor light green-pink Dacite and vesicular light pink Basalt fragments.	pat SeSi (1-2) SeEp (1)	Q (1) Q+trem (1-2) Q+trem+cl (1)	none obvious.					
298												
300						300-300.2 Q+trem+cl vn.						
302												
304												
306												
308				307 - 307.5 volcaniclastic with grey laminae (ash volcaniclastic?) minor lava fragments and light green, rounded devitrification structures.	SeSi (1) Ep (1)			307.3 bedding = 45° to c.c.a.				
310				below 307.5m Andesitic lava has irregular silica filled vesicles, spherulitic patches and some fragments of holocrystalline andesitic lava. (? cognate xenoliths from Magma Chamber)							309.5 Petrology 562698	
312												
314						Q (1) Q+Ep (2) Co+Ab (1)		314.3 fault = 40° to c.c.a. 2cm broken + pug.				
316												
318												
320				319.7-319.9 fine grained ashy, weakly laminated inter-flow volcaniclastic with minor lava fragments and feldspar crystals.				320.5 fault = 55° to c.c.a. annealed by veins.				
322						323.1 9cm Q+Co vn.		322.2 fault = 55° to c.c.a. Annealed by veins.				
324					SeSi (1-2) pat.	Q (1-2) Q+Co (1)						
326												
328					Se (1) Si (2)	Q (2) Q+Co (2) Co (1)		327.5 - 327.8 fault zone. at 327.8 fault = 40° to c.c.a. Puggy			327.8m Minor Cave-in	
330												
332			333.1	333.1	332.8-333.1 SeSi (3)	332.8-333.1 Q+Co+Ep ± sp ± Cpy (3)						
334			Andesitic fine lapilli Volcaniclastic 334.75	Matrix supported; andesitic and Minor Dacitic lava clasts in a fine lapilli-ash volcaniclastic matrix	SeSi (1)			334.75 fault = 55° to c.c.a. annealed by veins.			333.8 Petrology 562801	
336			Andesite lava.	brecciated feldspar-pyroxene-phyric lava.		Q (1) Q+Co (1)	None obvious.					

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DIAMOND DRILL LOG

654300 6620

PROJECT : _____

PROSPECT : Nth I, Zone

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DATE : 23-1-91

DEPTH	DRILL RUNS	CORE LOSS	LITHOLOGY: ROCK NAME	LITHOLOGY: DESCRIPTION	ALTERATION	VEINING	MINERALISATION	STRUCTURE	WEATHERING	VISUAL LOG	REMARKS	DEPTH
338			Andesite lava.	Massive to weakly brecciated, green, feldspar + pyroxene-phyric lava.	Se Si (1)	Q (1) Q+Co (1)	V. trace py on joint surfaces. + V. trace Cpy disseminated					
340												
			341.4					341.4 bedding = 30° to c.a.				
342			342.4 Volcaniclastic	laminated ash volcaniclastic with andesite fragments				341.5-341.7 fault zone Pug + Rubble.				
344			Andesite lava	lava as above but with scattered yellow-green ductile lava frags.	Se Si (1) pat.			342.4 bedding = 15° to c.a.				
346				Andesite lava partially devitrified with cream colored siliceous ovoids.				345 fault - broken core.				
348						Co + Ab (1-3) Q (1) Q + Co + trem (1)						
350												
352												
354					- 355.4 v. fine grained py (1)		None obvious					
356												
358								359.5 broken core ? fault.				
360					Se Si (2)							
362												
364												
366												
368												
370					Se (1) Mar pat Se Si (2)	Q (1) Co (1)						
372												
374				- 375 large fragments of light grey-green vesicular ? Basalt lava appear.								
376												
378												

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DIAMOND DRILL LOG

654301

0300

PROJECT :

PROSPECT: Nth I, zone

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DEPTH	DRILL RUNS	CORE LOSS	LITHOLOGY: ROCK NAME	LITHOLOGY: DESCRIPTION	ALTERATION	VEINING	MINERALISATION	STRUCTURE	WEATHERING	VISUAL LOG	REMARKS	DEPTH
380			Andesite lava	light-dark green weakly brecciated feldspar-pyroxene-phyric lava. Pyroxenes ?Ep-Se altered. feldspars as single crystals or glomerocrysts.	Se (1) Mnr pat SeSi (2)	Q (1) Co (1)	None obvious					
382				- basalt clasts disappear								
384					383 8cm of Se (4) Ep (1) Sp (2) @ 55° to LCA.							
386							diss Sp + Cpy (0-1)					
388					387 SeSiCo (4) c̄ Sp (2) pat. @ 55° to LCA.	388.1-388.3 Q+Co+tren ± Sp (2-4) 388.3-388.5 Se (2) Q+Cl (1)						
390					389.5 1cm SeSi (3)							
392						392.6-392.8 Q+Co+tren+Sp (3)						
394					394.3-394.35 Co+Ep+Se+Sp (4) zone at 45° to LCA.	Q+Co (2) Q+Ep (2)						
396							None obvious					
398												
400						Q (1) Q+Co (1)						
402												
404												
406												
408				407.9 Minor dacitic lava fragments	Se Si (1) Ep (1) c̄ pat Ep (2)	409-409.3 Q+Co+Cl (4)						
410												
412												
414												
416				417 lava begins to look polymict (polychromatic) with altered (SeEp) Andesite, fresh Andesite and dacitic lava fragments.		Q+Ep (2-3) some veins c̄ tr py. Q (1)		416.2 fault = 65° to LCA. 416.8 fault = 35° to LCA.				
418												
420				421 lava looks less polymict.				419.7 fault = 45° to LCA. Partially annealed.				

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DIAMOND DRILL LOG

654302

1030

PROJECT : _____

PROSPECT: Nth I, Zone

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DEPTH	DRILL RUNS	CORE LOSS	LITHOLOGY: ROCK NAME	LITHOLOGY: DESCRIPTION	ALTERATION	VEINING	MINERALISATION	STRUCTURE	WEATHERING	VISUAL LOG	REMARKS	DEPTH
422			Andesite lava.	massive - brecciated, mottled light-dark green feldspar-pyroxene (secl altered) - phyric lava with scattered pink-brown feldspar-phyric? dacite lava clasts, generally <1.5cm diameter. and minor holocrystalline andesite fragments. (Cognate xenoliths?)	kSi(1) Ep(1)	Q(1) Q+Co+Ep(1)	tr (py (0-1) diss.					
424												
426												
428												
430						430.8-431 20cm qtz-calc vn						
432												
434												
436				435.9-436.1 light green ash volcaniclastic with coarse, to 10cm, Andesite lava fragments.		Co(2-3) Q+Ep(2)	436.1-436.3 Py(1)					
438				438 Appearance of light pink-green massive, vesicular Basalt lava fragments in andesitic lava. V. minor component.			diss Py(1)					
440						440.2 Q+py vn. 440.4-440.5 Co(3-4)	V. trace py.	440.4-440.5 brecciated + veined zone = fault.				
442												
444												
446			445.7 Andesitic lapilli volcaniclastic	Lithology becomes matrix rich, distinctly matrix supported, with a fine lapilli to ash grade Matrix (weakly laminated in parts). Andesite and light green chloritic altered basaltic lava fragments.		Q+Co(1-2)	445.7-445.9 py pod (2)	446.5 bedding = 25° to LCA.				
448												
450												
452												
454												
456												
458												
460			460.1 Andesite lava.	brecciated green feldspar-pyroxene-phyric lava with vesicular basaltic lava clasts. ↓ Contact Strongly Co vnd.	Si(1-2)	Q+Ab(1) Co(1)						
462												
464			464.1 ?Andesitic breccia	dark green aphyric lava, brecciated with light green ash				466.0 fault = 65° to LCA. annealed by vn				

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DIAMOND DRILL LOG

654303

0302

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DEPTH	DRILL RUNS	CORE LOSS	LITHOLOGY: ROCK NAME	LITHOLOGY: DESCRIPTION	ALTERATION	VEINING	MINERALISATION	STRUCTURE	WEATHERING	VISUAL LOG	REMARKS	DEPTH
			?Andesitic breccia	as above	Sicl (1-2)	Q+Ab(1) Co(1)	V. trace Py.	464.9 Sheard zone 465.5 fault = 50° to CCA. pug+vein.				
466			465.5 Andesitic-Dacitic lava	Massive pink-green siliceous lava.	Sicl (2)	Co+Ep (2-3) Py (3) Q+Cl (2)	Py (3) diss.	468.1 fault = 60° to CCA.				
468			468.1 Andesite lava	Siliceous lava to 469m then 'normal' feldspar-phyric lava with scattered rounded pink Dacite fragments.	Si (1-2)	Se-Ep (1) Q (1) Cl (1)	Py (1-2) diss.					
470												
472												
474							No obvious mineralization					
476												
478							478.4-478.5 Pat. Py (2)					
480			480.7 Polymict Andesitic lapilli volcaniclastic	finely brecciated polymict, with Andesite, dacite and green chert fragments. Also some chloritic "fragments". Andesite frags to 5cm diameter, other clast types generally <0.7cm diameter		480.7 Q+Cpy vn.	Py (1-2) diss.				481.2 Petrology SG2802 Dacitic lapilli volcaniclastic	
482												
484												
486												
488				Gradational contact.								
490			490 Andesite lava.	v feldspar-phyric, brecciated lava with obvious devitrification textures and dacitic lava frags.								
492												
494				494.6 green vesicular Andesitic-Basaltic frags. Appear		Q (1) Co+Ep (2)						
496												
498			498.4 Andesitic-dacitic lava.	Massive green weakly feldspar-phyric lava. Minor vesicles. Matrix hosts green-grey devitrification ovoids. Vesicles, Co+Ent filled, more common below 502.5m		Q (1) Co (1) Q+py (1-2)	None obvious					
500												
502								502.5 vesicles elongate at 30° to CCA. ? bedding.			502.4 Petrology SG2803 glassy feldspar-phyric andesitic-Dacitic lava.	
504					503.7 Cl py (3) 504.3		Py pat. (1-3)					
506					Sicl (1)	Co (1-2) Cl (1)	Py (0-1) diss.					

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DIAMOND DRILL LOG

654304

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PROSPECT : I Zone

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DEPTH	DRILL RUNS	CORE LOSS	LITHOLOGY: ROCK NAME	LITHOLOGY: DESCRIPTION	ALTERATION	VEINING	MINERALISATION	STRUCTURE	WEATHERING	VISUAL LOG	REMARKS	DEPTH
508			Andesitic - Dacitic lavas.	green, vesicular, massive poorly feldspar-phyric lava with mottled (? devitrified) groundmass. Vesicles Cal Hmat. filled. Minor zones of weak brecciation.	Si Cl (1)	Co (1-2) Cl (1)	Py (0-1) diss	510.9 fault: 20° to LCA. breccia & chloritic Mtx.				
510												
512												
514												
516												
518												
520												
522												
524												
526						Co (2)						
528					528.5 - 529.6 Si Py (2)	Co (3)		528.1 fault: 70° to LCA annealed by Co + Cl vn.				
530						529.5 Py vn.						
532				532.1 appearance of light brown dacite fragments								
534							534.3 - 534.4 Py (2) pat + diss.					
536								535.3 - 536.1 fault Sub parallel to LCA. Py + broken core.				
538												
540							540.2					
542					Se (3) Cl (2)	Co (1)	Py (1-3) pat.	542.2 fault: 70° to LCA Puggy.				
544					Si Cl (1)		542.6 Py (0-1)					
546			Polymict Andesitic lava breccia	Dacitic and vesicular andesitic - basaltic lava fragments in mottled light - dark green Andesitic, weakly feldspar-phyric and devitrified, groundmass. Some fragments have weakly Pyritic rims.		Co (1-2)					545.7 Petrology SG2904 Polymict Andesitic lava breccia.	
548												

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DIAMOND DRILL LOG

654305 0304

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DEPTH	DRILL RUNS	CORE LOSS	LITHOLOGY: ROCK NAME	LITHOLOGY: DESCRIPTION	ALTERATION	VEINING	MINERALISATION	STRUCTURE	WEATHERING	VISUAL LOG	REMARKS	DEPTH
550			Polygaret Andesitic lava breccia	fragments of vesicular Andesitic-basaltic lava and occasional dacitic lava in a weakly feldspar-phyric, partially devitrified matrix.	1; Cl (1)	Co(1-2) Se(1)	Py (0-1)					
552												
554												
556												
558												
560												
562												
			563.2									
564			Andesitic lava	Massive green vesicular lava with light green devitrification spots in groundmass.		Co(3)		564 fault: 15° to LCA. Puggy.				
566						Co(2) Si(1-2)						
			566.7									
568			Andesitic lava breccia	green massive to brecciated vesicular, weakly feldspar-phyric lava.				566 - 566.7 fault: 10-15° to LCA. brecciated + cemented by Co va.				
570												
572												
574												
576												
578												
580								580.1 - 580.5 fault: sub parallel to LCA. Puggy + veined.				
582												
584												
586					Si Cl (1-2)							
588												
			589.5									
590			Andesitic - basaltic lava.	massive to weakly brecciated, green, weakly vesicular feldspar + pyroxene - phyric lava.								

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DIAMOND DRILL LOG

654306

0305

PROJECT :

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DEPTH	DRILL RUNS	CORE LOSS	LITHOLOGY: ROCK NAME	LITHOLOGY: DESCRIPTION	ALTERATION	VEINING	MINERALISATION	STRUCTURE	WEATHERING	VISUAL LOG	REMARKS	DEPTH
592			Andesitic-basaltic lava.	light-dark green massive weakly feldspar-pyroxene-phyric lava with patches of rounded vesicles. Mar white ?leucoxene flecks.	SiCl(1) Ep(1)	Co(2)	Py (0-1)					
594												
596												
598												
600												
602						-602.4-602.6 Co+Py(3)						
604						Py(1) (0-3)						
606						Co(3)						
						Co(2)						
608						Co(2) Py(1)	Py spt + dis(1-2)					
610												
612					SeSi(1) Cl(2)	Co(2-3)		-611.4 fault zone.				
			613					-613.1 Sheared + veined at 613.0 minor fault = 15° to L.C.A.				
614			Basalt lava breccia	light green, brecciated, chlorite spotted, weakly vesicular (irregularly shaped, elongate at 25° to LCA.) Minor zones of hydraulic brecciation.		Co(1-2)	None obvious					
616												
618												
620												
622											-621.75 Petrology SG2805 hyaloclastite derived from an Augite-phyric basalt.	
			623.2	Abrupt Conformable Contact:								
624			Basalt lava	Massive light green Basalt lava. Vesicular.	SeSi(1)	Q(1) Co(1) Co+Se(2)	Py veinlets (1-2)					
626												
628												
630												
632			632.4	lava breccia as for 613-623.2m	SeCl(1-2) Si(1)	Co(1-2)	Py(1)					

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DIAMOND DRILL LOG

654307

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PROSPECT: I, Zone

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DEPTH	DRILL RUNS	CORE LOSS	LITHOLOGY: ROCK NAME	LITHOLOGY: DESCRIPTION	ALTERATION	VEINING	MINERALISATION	STRUCTURE	WEATHERING	VISUAL LOG	REMARKS	DEPTH
634			Basalt lava Breccia 634.2	as for 623-623.2	SeCl (1-2) Si(1)	Co(1-2)	Py(1)					
636			Andesitic - Basaltic lava.	massive, green, weakly vesicular lava with ?leucocene flecks and minor feldspar-phenocrysts. Some holocrystalline andesitic fragments. (Cognate Xenoliths?). Vesicles sparse, irregularly shaped and Co ± Hat ± Cl. filled. minor intercalated volcaniclastic sediment	SeCl(1)	Si(1) Co(1-2) Co+Se(1-2)	Py (0-1) diss.					
638												
640												
642												
644												
646												
648												
650												
652												
654												
656												
658												
660												
662			661.5 Brecciated Andesitic-basaltic lava.	as for 623-623.2 m.			Py (2) dis+vn.					
664												
666			666.5 massive andesitic-basaltic lava	massive green feldspar-phyric, patchily vesicular lava. Common white leucocene flecks. lava looks weakly siliceous	FeCl (1) Si(1) Pot. Se(2-3)	Co(1-2) Si(1)	Py (1-2)					
668												
670												
672												
674												

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DIAMOND DRILL LOG

654308

0307

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DEPTH	DRILL RUNS	CORE LOSS	LITHOLOGY: ROCK NAME	LITHOLOGY: DESCRIPTION	ALTERATION	VEINING	MINERALISATION	STRUCTURE	WEATHERING	VISUAL LOG	REMARKS	DEPTH
676			Andesite - basalt lava.	Massive lava as above	SeCl(1) Si(1) part Se(2-3)	Co(1-2) Si(1)	Py(0-1)					
678												
680			680.3									
682			Andesitic - basaltic lava breccia	Monomict breccia of lava as described above. Some variably altered clasts.	SeSi(1) Cl(2)							
684						Si(2-3) Co(1)	No obv min					
686						Si(1) Co(1)						
688												
690			689 Andesitic - basaltic lava.	Massive green chlorite spotted lava with white - cream leucoxene flecks. Minor feldspar - phenocrysts.	SeCl(1)	Si(1) Co(1-2)	Py(1)					
692					SeSi(1-2) Cl(2)	Si(1) Co±Cl(1-2)		691.9 - 692.1 fault zone annealed by veining.				
694												
696												
698												
700							None obvious					
702												
704												
706												
708												
710					SeCl(2-3) incr down-hole	Co(2) Si(2)	Py(1-2)					
712												
714					Se(3) Si(2) Cl(1)		Py(2)	715 fault = 70° to Lcs. Puggy.				
716			715 Highly altered lava	brecciated grey-green lava with patches of vesicles.	Se(3) Si(2) Cl(1) Fu(1) ↑ Dies out.	Co(2)	Py dis tvn (4) ↓ Dies out					

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DIAMOND DRILL LOG

654309

0308

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DEPTH	DRILL RUNS	CORE LOSS	LITHOLOGY: ROCK NAME	LITHOLOGY: DESCRIPTION	ALTERATION	VEINING	MINERALISATION	STRUCTURE	WEATHERING	VISUAL LOG	REMARKS	DEPTH
715			Highly altered lava	brecciated grey-green lava with patches of vesicles moderate "Quellite" texture	Se(3) Si(2) Cl(1) Fu(1)	Co(2)	Py(4) ↓ Decreases.					
720			715 Andesite lava	grey-green massive lava. minor cl spots + altered feldspar phenocrysts. leucoxene flecks noted. Minor vesicles	Si(1) SeCl(1-2)		Py(1)					
722			722.3	Abrupt Contact				722.3 Contact = 25° to CCA				
724			Strongly altered Andesitic lava.	Massive to brecciated green-grey lava. Some vesicles obvious.	SeSi(2-3) Cl(2) Co(1)	Py(3) Co(2) Q(1)	diss py (3-4) V. minor Cpy in Co veins.					
725				Relatively unaltered interval	SeCl(2)							
730												
732					SeSi(3) Cl(2) Co(1)							
734												
736												
738			738.4 Volcaniclastic	polymict, medium lapilli, c̄ wispy Se(5) altered clasts			Py(4)					
			738.9 Altered lava				Py(3-4)					
740			740.15	Abrupt Contact				740.15 contact = 25° to CCA				
742			Andesite lava.	green vesicular, chlorite spotted lava with minor sericitized feldspar-phenocrysts. Vesicles quite irregularly shaped	SeCl(2)	Co(2) Si(1)	Py(1)					
746												
748												
750			751.6									
752			Highly altered lava	brecciated light-green altered lava. no obvious phenocrysts or vesicles	SeSi(3) Cl(2) Co(1)	Co(2) Py(3)	Py(3) diss.					
754			753.9									
756			Andesite lava.	Massive green chlorite spotted lava. minor altered feldspar-phenocrysts and white-cream leucoxene flecks. Appear weakly siliceous	SeCl(1)	Py(1) Co(1)	Py(1)					
758											757.1 Petrology SL2DOG glassy Andesite lava.	

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DIAMOND DRILL LOG

654310 0309

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DEPTH	DRILL RUNS	CORE LOSS	LITHOLOGY: ROCK NAME	LITHOLOGY: DESCRIPTION	ALTERATION	VEINING	MINERALISATION	STRUCTURE	WEATHERING	VISUAL LOG	REMARKS	DEPTH
760			Andesite lava	Massive green, chlorite spotted & leucoxene spotted lava. Minor sec'l altered feldspar-phenocrysts. Minor zones of breccia with sericitic-pyritic matrix eg 766-766.2m.	Se Cl (1) Si (1)	Co (1-2)	Py (1) dis					
762												
764												
766												
768												
770			769 Strongly altered lava	green-grey 'Quellite' like lava breccia	Se (2-3) Si Cl (1-2)		Py (1-2)					
772			772.1 Andesite lava.	Massive green weakly siliceous, leucoxene spotted lava. No obvious feldspar-phenocrysts.	Se (3) Si Cl (2)	Co (1-2) Py (3)	Py (3-4)	772.1 fault = 65° to CCA. annealed by veins.				
774					Se Cl (2) Si (1-2)	Co (1-2) Se (1)	Py (1)					
776			776.8 Strongly altered lava	Abrupt irregular contact green-grey brecciated 'Quellite' type lithology Crackle vein type texture.	776.6-777.8 Se Cl (3) Se (4) Si Cl (2-3) Fu Co (1)	Co (1) Py (2-4)	Py (4)	776.3 Contact = 45° to CCA. 780.8 Contact = 55° to CCA.				
778							Py (2-3)					
780												
782							Py (4)					
784							Py (2-3)	784.8 bedding = 50° to CCA				
786												
788			787.3 Altered polymict Andesitic volcaniclastic	Medium lapilli grade volcaniclastic with lava frags in highly altered and pyritic matrix							789.35 Petrology 562807 Polymict andesitic lava breccia	
790			790.6 Strongly altered lava	as for 786.8 - 787.3.			Py (3-4)					
792												
794												
796												
798					Se (4) Si Cl (2-3) Fu (2-3) Co (1)							
800												

Aberfoyle Resources Limited
EXPLORATION DIVISION

DIAMOND DRILL LOG

654311

0310

PROJECT : _____

PROSPECT: I Zone

HOLE NO: Mac-28
PAGE: 60 of 22
LOGGED: AMcN
DATE: 20-2-91

DEPTH	DRILL RUNS	CORE LOSS	LITHOLOGY: ROCK NAME	LITHOLOGY: DESCRIPTION	ALTERATION	VEINING	MINERALISATION	STRUCTURE	WEATHERING	VISUAL LOG	REMARKS	DEPTH
			Altered 801.1 lava	grey-green Quellite type lithology.	Se(4) Sicl(2-3) Fu(2) Co(1)		Py(3-4)	801.1 Contact: 80° to LCA. prob a fault.				
802			Andesitic lava	dark green, massive amphyric, weakly Siliceous lava with leucoxene flecks interbedded with minor polymict andesitic lapilli volcaniclastic.	Sicl(1) Ie(2)	Co(2) fine Se(2-3) anastomosing veins.	Py(1) diss	802.2 bedding = 10-15° to LCA.				
809											809.5 Petrology 562808 Glassy andesitic lava.	
812			812.65	Abrupt Contact	812.55-812.65 Se Sicl(2)							
814			Altered lava	green-grey brecciated 'Quellite'. Primary lithology was probably a lava as above.	Se(4) Sicl(2) Co(1)	Co(1) Py(2-4)	Py(3-4)	812.65 Contact = 45° to LCA.				
818					818.5 Fu(2) Sicl appear							
821			821.4	Abrupt Contact				821.4 Contact = 45° to LCA.				
824			Andesite lava	Massive green lava. Chlorite spots, Leucoxene flecks and minor fecl altered feldspar Phenocrysts.	Se(1) Sicl(1)	Co(2) 825.4-826.1 Co+Cl vn.	Py(1-2)					
827			827.7	Abrupt Contact	Se incr down-hole			827.7 Contact = 30° to LCA				
830			Strongly altered lava.	light grey-green vesicular 'quellite' alternate with zones of slightly less altered lava.	Se (3-4) Sicl(2) pyz fo Spt (1-2) Co(1)	Co(1-2) Py(3)	Py(3-4)					
833												
836												
839												
842												

Aberfoyle Resources Limited
EXPLORATION DIVISION

DIAMOND DRILL LOG

PROJECT : _____

PROSPECT : I, Zone

654312

031

HOLE NO : Mac-91
PAGE : 21 of 22
LOGGED : HMcN
DATE : 20-2-91

DEPTH	DRILL RUNS	CORE LOSS	LITHOLOGY: ROCK NAME	LITHOLOGY: DESCRIPTION	ALTERATION	VEINING	MINERALISATION	STRUCTURE	WEATHERING	VISUAL LOG	REMARKS	DEPTH
844			Altered lava.	grey-green massive-brecciated 'quellite' type lithology. vesicular in part.	Se (3-4) Si Cl (2) Co (1) Fu Sit (1-2)	Co (1-2) Py (3)	Py (3-4)	868.9 fault = 60° to Lca. 870.6 fault = 65° to Lca. Piggy 881 fault = 55° to Lca. fault zone. Sheared + small brittle faults.				
846												
848												
850												
852												
854												
856												
858												
860												
862												
864												
866												
868												
870					870.3 Fu Si Sit.							
872												
874												
876												
878												
880												
882												
884												

Aberfoyle Resources Limited
EXPLORATION DIVISION

DIAMOND DRILL LOG

654313

0312

PROJECT :

PROSPECT : I. Zone

HOLE NO : MAC-28
PAGE : 22 of 22
LOGGED : AMCN
DATE : 20-2-91

DEPTH	DRILL RUNS	CORE LOSS	LITHOLOGY: ROCK NAME	LITHOLOGY: DESCRIPTION	ALTERATION	VEINING	MINERALISATION	STRUCTURE	WEATHERING	VISUAL LOG	REMARKS	DEPTH
			Altered lava	grey-green brecciated lava with ?polymit intervals. 'Quellite' like.	SeSi (3) Cl (1) Co (1)	Py (3) Co (1-2)	Py (3-4)	885.8 f = 55° to LCA. 886.7 f = 45° to LCA. 887.4 Fault zone - broken core 889.8 fault = 80° to LCA.				
			888.3 Andesite lava 889.8	dark green vesicular (irregularly shaped) SeCl spotted. leucoxene spotted lava.	SeSi (1-2)							
			891.1 Altered lava	light green 'Quellite' with Se spots after Fp.	SeSi (3) Fu (1)							
			Andesite lava	dark green lava as for 888.3 - 889.8 m.	SeSi (2)	Co+Cl (1-2) Si (1)	Py (1-2)	898.5 fault = 55° to LCA. Annealed by Co vn.				
			894.6 Altered lava	grey - light green massive to brecciated 'Quellite' like lava.	Se (3) Si (2) Cl (1)	Py (3) Co (1-2)	Py (3)	905.6 fault = 55° to LCA. annealed by Co vn.				
			907.5 E.O.H.									

0313

Attachment - MAC-28

Sample No:	Depth	Description
562691	80.45m	Andesitic-basaltic lava breccia.
562692	85.3m	Brecciated ?dactic lava.
562693	112.4m	Massive vesicular dacitic lava.
562694	132.4m	Andesitic-basaltic lava breccia.
562695	149.85m	Andesitic lapilli volcaniclastic interbedded with ash volcaniclastic.
562696	159.45m	Polymict andesitic lapilli volcaniclastic.
562697	274.1m	Massive andesitic feldspar-phyric lava.
562698	309.5m	Massive andesitic feldspar-phyric lava.

0314

654315

SAMPLE: 562691

SUMMARY: This sample is a strongly carbonate-chlorite-altered augite+ plagioclase-phyric basaltic pumice breccia.

HAND SPECIMEN:

This is a dark green basaltic lava breccia with fragments varying from highly vesicular to massive, up to several cm long.

THIN SECTION DESCRIPTION:

This sample is composed of numerous rather large fragments of augite+plagioclase-phyric basaltic lava that vary from almost massive to almost totally vesiculated. The rock is intensely calcite-chlorite-altered, and the original texture of many fragments is obliterated. Former augite phenocrysts are replaced by calcite and minor chlorite, and reach almost 3mm long, although their original modal abundance is difficult to estimate. Plagioclase phenocrysts were about equally as abundant, but are much smaller (mainly <1mm long) and albitized; most are totally sericitized. Most of the highly vesicular fragments were clearly pumiceous, but are now composed of calcite, chlorite in the vesicles, and rims of Fe oxide or hydroxide often rim the chlorite-filled vesicles. Thin meandering quartz veinlets are overprinted by calcite, but several generations of carbonate alteration are probably present.

This sample was a highly vesicular and glassy augite+plagioclase-phyric basaltic lava breccia or pumice breccia. An identical unit was noted in Placer hole BRD-05 near the top of the Hellyer basalt. The extensive alteration is likely due to the originally highly glassy and porous nature of the pumice breccia.

SAMPLE: 562692

SUMMARY: This rock is a weakly autobrecciated formerly glassy and sparsely plagioclase-phyric dacite lava that has suffered quite strong silica alteration, and subsequent weak sericitization.

THIN SECTION DESCRIPTION:

This sample was probably a weakly autobrecciated dacitic lava composed of around 3-5 modal% of altered feldspar phenocrysts in a formerly glassy groundmass that has been strongly recrystallized and probably silicified. The former plagioclase phenocrysts are 0.5-2mm long and strongly sericite-altered blocky prisms with probably near-euhedral shapes originally; however, recrystallization of glassy groundmass has involved reactions with margins of phenocrysts, which are rather ragged in many cases. Former FeTi oxide microphenocrysts were present but not very common, and have altered to leucoxenitic material. One or two very small chlorite-filled crystal sites may have been small augite phenocrysts.

The groundmass of this sample was originally glassy to extremely finely vitrophyric. However, in most areas of the slide, devitrification quartz-albite mosaic textures have been obliterated by recrystallization to granular quartz-dominated regions with minor interstitial pale green chlorite, and even less-abundant calcite spotting. In some areas the fine-grained sugary silica increases in grainsize in irregular patches cored by larger concentrations of chlorite . Quartz also forms small veinlets that transect the rock. Intense sericite alteration occurs in zones that cut across the rock, and appear to post-date the silicification, although fine-grained sericite is abundant throughout the rock, except in those areas of strongest and most-coarse-grained silica alteration.

SAMPLE: 562693

SUMMARY: This sample is a microvesicular formerly plagioclase+augite - phyric basalt or basaltic andesite lava.

HAND SPECIMEN:

This is a massive dark grey-brown mafic or intermediate lava with calcite spots to several mm across and small phenocrysts of feldspar and a mafic phase.

THIN SECTION DESCRIPTION:

This sample was a microvesicular plagioclase+augite-phyric basalt or basaltic andesite that has suffered quite strong calcite alteration. Former augite phenocrysts to about 1.5mm across make up about 3-5 modal% of the rock and are totally replaced by dirty brown calcite with intergrown green chlorite. Plagioclase phenocrysts are notably more abundant than augite and range from 0.1-2mm long; they are albitized, and many are slightly rounded and resorbed-looking. They commonly occur in multi-crystal clots, or intergrown with augite in small cognate gabbroic inclusions. Small epidote granules commonly occur in albite crystals, although sericite is uncommon. Small leucoxenitized FeTi oxide microphenocrysts are reasonably abundant. A reasonable man may well ask just what is reasonable when it comes to FeTi oxide abundances.

The groundmass of this sample was vitrophyric and riddled with tiny gas bubbles and trails. The former glass, now devitrified to a dark irresolvable material, is charged with tiny microlites of albite, and full of blebs of quartz and chlorite, with occasional intergrown epidote. Calcite occurs as brownish patches overprinting groundmass, and as angular patches and veinlets.

This is a plagioclase+augite-phyric evolved basaltic lava, probably approaching an andesite composition.

SAMPLE: 562694

SUMMARY: This sample is a strongly carbonate-chlorite-altered polymict basaltic lava breccia.

HAND SPECIMEN:

This is a heterogeneous, rather coarse, strongly carbonate altered lava breccia including massive, finely porphyritic, to highly vesicular and chloritized lava fragments in a very heterogeneous, altered matrix.

THIN SECTION DESCRIPTION:

This sample is seen in thin section to be a basaltic lava breccia composed of two distinct domains corresponding to different lava fragments. The better preserved lava is strongly vesicular, but with very small (<<0.5mm across) vesicles that are filled with secondary quartz and calcite. It contains around 10 modal% of very large (to 4mm long) and complexly intergrown fresh augite phenocrysts, and considerably less but noticeable amounts of totally altered small olivine phenocrysts, now replaced by finely granular quartz and chlorite, with minor calcite. The groundmass of this fragment was glassy and very finely vesicular, and has devitrified and altered to an isotropic irresolvable material shot through with tiny blebs of quartz and quartz-lined, chlorite-filled cavities. The other lava fragment(s) was far more coarsely vesicular, and evolved than the fragment described above. It consists of around 10 modal% of large fresh augite phenocrysts, but unlike the other fragment, also contains quite common smaller (<1mm long) albitized plagioclase phenocrysts. The highly vesicular (almost pumiceous) glassy groundmass has been extensively replaced by matted green chlorite and abundant calcite, with common stringers of epidote and secondary quartz.

This sample was clearly a polymict basaltic lava breccia in which the more glassy and vesicular fragments were more intensely carbonate-chlorite-altered.

SAMPLE: 562695

SUMMARY: This sample is either a lithic tuff, or a felsic lapilli volcaniclastic derived from mass flow that involved minimum reworking.

HAND SPECIMEN:

This is a dark green polymict andesitic volcaniclastic or lithic tuff, with fragments up to around 1cm long; it is interbedded with a finer-grained tuff or shale in which lava fragments also occur.

THIN SECTION DESCRIPTION:

This rock is clearly polymict, with fragments varying widely in their texture and abundance of phenocrysts. Most fragments were probably fairly glassy quite strongly plagioclase-phyric andesite to dacite, dominated by blocky to tabular albite phenocrysts rarely longer than 1.5mm. Few, if any, former mafic phenocrysts were originally present in the lava fragments that make up this sample. The main petrographic difference between fragments is the original degree of crystallinity of the groundmass, and the degree to which the devitrified groundmasses have been altered. A few fragments are devitrified rhyolitic glass, variably vesicular (vesicles are quartz-filled), but not attaining enough vesicularity to be termed pumice.

The matrix of this rock is very difficult to discern from the fragments, and was probably very largely composed of glassy ash, tiny angular fragments of largely glassy felsic lava and angular albite crystal fragments. The degree of devitrification and superimposed alteration precludes preservation of glass shards. Devitrification produced variably-textured quartz-albite± minor chlorite mosaics from glassy groundmasses, and quite strong sericite-carbonate alteration has overprinted devitrification textures. The sericite alteration defines a very weak fabric that crosscuts the entire rock, but is better developed in some fragments than others, probably reflecting original 'glassiness'. Some degree of silicification has also affected this sample, and is best evidenced by irregular seams and patches of groundmass that are much 'clearer' and 'cleaner' than the remainder of the rock. Broadly, these parallel the weak foliation and may have developed at the same time.

This sample was probably a lithic tuff deposited from some hot mass flow without significant .reworking. It cannot be precluded, however, that it is a slump-type mass flow derived from the side of a felsic volcanic edifice, and in this case would best be classified as a felsic lapilli volcaniclastic.

SAMPLE: 562696

SUMMARY: This sample is an andesitic to dacitic lithic tuff dominated by fragments of strongly plagioclase-phyric lava. It has suffered variable but generally quite strong calcite-sericite alteration.

HAND SPECIMEN:

This is a dark green volcaniclastic sandstone with diverse clasts ranging up to around 1cm long.

THIN SECTION DESCRIPTION:

This sample in thin section is seen to be probably more akin to a lithic tuff than a sandstone. It is composed dominantly of abundantly (15-18 modal%) plagioclase- phyric andesitic to dacitic lava clasts with fine-grained but not highly glassy groundmasses charged with tiny albite microlites. These fragments/clasts are probably derived from a single flow/eruption, with textural differences in the groundmass simply reflecting cooling or quenching history differences. Rather more fine-grained or formerly glassy lava fragments are also present, and are not as common, or as phenocryst-rich as the main lava fragments. One quite large sparsely plagioclase -phyric dacitic lava fragment with a sericitized glassy groundmass is distinctive. Many albitized plagioclase phenocrysts are broken and are probably sitting in formerly glassy ash that has variably devitrified and been overprinted by the extensive calcite-sericite alteration that typifies this sample.

This rock was probably a lithic tuff of andesitic to dacitic affinities. I think it has not suffered any reworking, and is therefore unlikely to be a volcaniclastic sediment. However, when a lapilli sandstone dominated by glassy lava fragments and a juvenile, glassy matrix devitrifies, it becomes exceedingly difficult to judge whether the primary texture implies reworking or not. The geological implications of choosing one or the other alteranative are not terribly significant, I suppose.

SAMPLE: 562697

SUMMARY: This sample was a glassy felsic crystal lithic tuff that has suffered some brecciation and silicification.

HAND SPECIMEN:

This is a grey-green plagioclase-phyric massive dacitic lava with a rather heterogeneous groundmass, possibly partially silicified.

THIN SECTION DESCRIPTION:

This is a difficult sample to diagnose with confidence. It is clearly a felsic, plagioclase-phyric volcanic rock, although whether it is a crystal tuff, a massive 'false-brecciated' lava, or a genuine lava breccia, is difficult to ascertain. The only important mineral phase in the rock is albitized plagioclase. This occurs as well-formed phenocrysts to at least 2mm long, but also is present in abundance as angular crystal fragments and rounded and reacted crystals, suggesting some heterogeneity in the origin of these feldspars. Many albitized feldspars are riddled with yellow epidote crystals. No definite former mafic phenocrysts were noted.

The groundmass of this sample is quite heterogeneous texturally. A few areas that were probably definite fragments of altered glassy felsic lava are present. However, In its least-altered areas, the matrix of this rock is clearly formerly glassy, and well-developed former perlitic cracks are evident in several 'fragments'. In some places, this groundmass seems to have devitrified to isotropic irresolvable material, but in other areas, blebby fine-grained quartz has crystallized from the devitrified glass. Dark 'fragments' of least-altered rock are surrounded by angular and anastomosing regions of paler-coloured, quartz-rich material, slightly more coarse-grained than the devitrified glass; these areas are though to be due to soaking by silica-rich solutions during alteration. The rock is cut by veinlets of quartz, quartz-albite, quartz-chlorite, and rare calcite. This sample was probably a glass-rich crystal lithic tuff in which the uncommon lithic fragments were also glassy felsic lava.

SAMPLE: 562698

SUMMARY: This rock was a basaltic to basaltic andesite hyaloclastite composed of mainly vesicular fragments spalled of a gas-rich flow. Subsequent strong silica-alteration filled vesicles and inter-fragment spaces.

HAND SPECIMEN:

This rock is appears to be a feldspar-phyric andesite, although close examination suggests that there are some small (<2mm across) formerly glassy lithic fragments.

THIN SECTION DESCRIPTION:

This is an exceptionally difficult sample to diagnose, due to the very unusual texture of the rock. It was originally probably a basaltic andesite compositionally, and consists essentially of abundant augite and altered plagioclase phenocrysts in a rather bizarre groundmass that probably was originally quite glassy. I suggest that the sample was a hyaloclastite composed of quite small (mainly << a few mm long) fragments of vesicular porphyritic lava with a quenched groundmass. These consist of about subequal amounts of blocky and tabular phenocrysts of sericite+prehnite-altered albite after calcic plagioclase, and mainly euhedral augite phenocrysts less than 1mm long; the augite is fresh and often occurs in multi-crystal clots. Three or four small crystal shapes now composed of pale green chlorite may have been former olivine phenocrysts, although in all cases, the shapes are not diagnostic.

The groundmass of this sample is strikingly unusual, and the interpretation offered is a best guess, rather than a positive identification. The texture of the groundmass shows several major domains that are quite different and probably correspond to different events in the formation of the sample.. The first of these, notably the clear fragmental texture, may confidently be assigned to a primary origin, since some fragments are non-vesicular, whereas others are highly vesicular (although of the same 'parent' lava). These fragments are rather angular, dark coloured and charged with flow-orientated tiny plagioclase microlites in devitrified glass. Within and between the darker coloured fragments are areas of lighter-coloured material, probably cryptocrystalline silica. This fills elongate and flattened vesicles in the dark lava

0322 fragment domains, and fills most interstitial areas between fragments. Jigsaw-fit fragments are often separated by narrow projections and channels of the light very fine-grained silica. A most deceptive and important feature of this rock is the strange mix of euhedral augite crystals (within dark fragments) and remarkably angular, 'broken-looking' augite crystals (in lighter-coloured matrix). This initially led me to think that there was a major pyroclastic component in this sample. However, it is clear (upon the 345th look) that the angular fragments are relics of former euhedral crystals that have reacted and been eaten away by the silica-rich solutions from which formed the interstitial matrix cryptocrystalline silica. A third unusual feature of this sample is small areas (mainly 0.5-2mm across) of intense sericite alteration of the normally dark groundmass of many lava frgments. These are 'invisible' in plane polarized light, but show up remarkably strongly in crossed polars mode; they are well-defined, clearly not former feldspar phenocrysts or vesicle-fillings, and occasionally spherical (circular in section). These are very unevenly distributed throughout the rock, and are appear to post-date the silica alteration.

I suggest that this rock was a fine-grained basaltic or basaltic andesite hyaloclastite composed of fragments spalled from the gas-charged top of a single flow. Hot very silica-rich solutions permeated the rock, filling vesicles, pore spaces, and inter-fragments cavities with cryptocrystalline silica, and digesting augite crystals in the 'matrix' of the hyaloclastite. Subsequent sericite-alteration developed in irregular areas, probably controlled by whether or not secondary silica effectively sealed some areas from K diffusion.

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654324

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ANALYTICAL REPORT No. 100560.60.07717

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

INVOICE TO:

Aberfoyle Resources Limited
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P.O. Box 952
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ORDER No.	PROJECT
11080	

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3	25/02/91	1	8

SAMPLE NUMBERS	SAMPLE DESCRIPTION	ELEMENT/METHOD
562691/698	SC Prep: GP009,GP018	Ag/GA101
562691/698	SC	As,Cr,Zr,Ti,Rb/GX401
562691/698	SC	Ti:Zr/9825
562691/698	SC	Cu,Pb,Zn,Ba,Ni,Sr,Mn,K2O,MgO,CaO,Na2O,P2O5/612

RESULTS TO

Mr R. de Bomford
Aberfoyle Resources Limited
Exploration Division
P.O. Box 952
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RESULTS TO

RESULTS TO

REMARKS

MAC-28 DET.

AUTHORISED OFFICER

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654225

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ANALYTICAL DATA

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
	100560.60.07717	25/02/91	11080	1 OF 3

TUBE No.	SAMPLE No.	Cu ✓	Pb ✓	Zn ✓	Ag ✓	Ba ✓	As ✓	Cr ✓	Zr ✓	Ti
1	562691	55	<50	155	2.0	339	<2	649	82	2348
2	562692	12	<50	40	1.0	365	7	15	180	2480
3	562693	35	<50	308	1.0	1220	<2	246	113	2450
4	562694	38	212	391	1.0	1120	<2	421	81	1870
5	562695	13	<50	81	1.0	577	2	60	133	3250
6	562696	12	<50	82	1.0	576	<2	77	137	3510
7	562697	7	<50	245	1.0	463	17	39	165	4400
	562698	30	<50	117	2.0	269	<2	91	102	3040
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22										
23	DETECTION	5	50	5	0.5	5	2	5	5	50
24	UNITS	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
25	METHOD	GI201	GI201	GI201	GA101	GI201	GX401	GX401	GX401	GX401

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

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ANALYTICAL DATA

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
	100560.60.07717	25/02/91	11080	2 OF 3

TUBE No.	SAMPLE No.	Ti:Zr	Rb	CaO	K2O	MgO	Mn	Na2O	Ni	P2O5
1	562691	28.63	39	7.780	0.88	6.530	2340	1.540	118	0.2
2	562692	13.77	72	1.290	1.76	1.420	706	4.330	24	0.1
3	562693	21.68	29	6.790	1.22	2.590	1670	4.760	75	0.2
4	562694	23.18	35	14.830	1.00	5.950	2080	1.870	130	0.2
5	562695	24.44	137	2.940	2.83	3.450	843	2.430	18	0.1
6	562696	25.63	102	1.820	1.88	3.710	758	3.460	24	0.1
7	562697	26.69	40	4.670	0.96	4.580	1800	3.380	29	0.2
8	562698	29.80	39	9.000	0.80	4.940	1110	1.460	28	0.1
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11										
12										
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18										
19										
20										
21										
22										
23	DETECTION	0.01	5	0.007	0.06	0.007	15	0.007	10	0.02
24	UNITS	%	ppm	%	%	%	ppm	%	ppm	%
25	METHOD	9825	GX401	GI201	GI201	GI201	GI201	GI201	GI201	GI201

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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0326 654327

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ANALYTICAL DATA

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
	100560.60.07717	25/02/91	11080	3 OF 3

TUBE No.	SAMPLE No.	Sr ✓
1	562691	151
2	562692	95
3	562693	486
4	562694	294
5	562695	110
6	562696	110
7	562697	435
8	562698	364
9		
10		
11		
12		
13		
14		
15		
16		
17		
18		
19		
20		
21		
22		
23	DETECTION	1
24	UNITS	ppm
25	METHOD	GI201

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

Attachment:

Sample No:	Depth	Description
562801	333.8m	Andesitic lapilli volcaniclastic
562802	481.2m	Andesitic lapilli volcaniclastic
562803	502.4m	Andesitic lava.
562804	545.7m	Andesitic-basaltic lava.
562805	621.75m	Andesitic lava breccia.
562806	757.1m	Andesitic-basaltic lava.
562807	789.35m	Highly altered lava or volcaniclastic.
562808	809.5m	Andesitic-basaltic lava.

SAMPLE: 562801

SUMMARY: This rock is a lapilli volcaniclastic derived almost entirely from detritus from submarine, glassy andesite lavas.

HAND SPECIMEN:

This rock is a grey-green volcaniclastic sandstone composed dominantly feldspar-phyric andesitic clasts or fragments; rock is traversed by elongate streaky zones of silicification (?). Max. size of clasts is ~1cm, but most are much smaller.

THIN SECTION DESCRIPTION:

This sample is clearly a volcaniclastic sediment, although it must have had a high original detrital glassy ash content. It is composed of three major clasts types; most abundant and notable are angular to subhedral phenocryst fragments of augite, and clasts of almost euhedral to slightly rounded strongly altered albite phenocrysts, and somewhat larger lithic clasts mainly derived from glassy andesites. The augite crystal debris forms about 5 modal% of this rock and is quite fresh; the crystals are clear, rarely longer than 1mm, and also occur as phenocrysts in some of the larger lithic clasts. They are typical andesitic clinopyroxenes. Former plagioclase phenocrysts and crystal fragments were probably about as modally abundant as the augite, but are more difficult to 'see', due to strong sericite-clay alteration. Lithic clasts constitute about 3-5 modal% of this rock, but are also difficult to differentiate from the devitrified formerly glassy ash matrix. Most lithic clasts were glassy plagioclase- or plagioclase+augite -phyric andesites and dacites. The groundmasses of these lava fragments is invariably devitrified and rather dark, often with calcite overprinting the original groundmass. Another common clast type has similar phenocryst assemblages to that described, but a vitrophyric groundmass charged with tiny albite microlites.

The matrix of this rock is a dark murky mixture probably of comminuted glassy lava fragments similar to those just described, and glassy ash. The glass has totally devitrified and recrystallized to messy extremely fine-grained quartz-albite-sericite intergrowths with no regular fabric. Lacy calcite overprints areas of groundmass. Several bands of constantly finer-grained detritus, some only a few mm wide, are almost certainly discrete beds. Some other zones, in places almost perpendicular to the bedding, are characterized by cleaner matrix areas, and probably represent zones that were soaked in silica solutions and which recrystallized largely as very fine-grained quartz without the (sericitized) feldspar.

This is clearly a lapilli volcaniclastic derived largely, if not entirely from submarine, glassy andesitic lavas.

SAMPLE: 562802

SUMMARY: This rock is a lapilli volcaniclastic composed of lithic clasts and feldspar crystals and crystal fragments derived entirely from dacitic glassy volcanics. It has suffered strong pressure solution

HAND SPECIMEN:

This rock is a dark grey-green lapilli volcaniclastic composed of clasts of fine-grained, sometimes feldspar-phyric formerly glassy lavas, mainly less than 5mm across.

THIN SECTION DESCRIPTION:

This sample is a volcaniclastic sandstone (lapilli volcaniclastic) that despite its striking hand-specimen similarity to the previous rock, is quite different in thin section and provenance. The sample lacks the fine-grained devitrified messy matrix of 562801, and consists almost entirely of framework grains composed of either clasts of formerly glassy felsic lava, or phenocryst fragments derived therefrom. These clasts are mainly 1-3mm across, and are remarkably interlocked with adjacent fragments, due to intense pressure solution at clast boundaries; this is evident by the dark rims on every grain composed of 'insoluble' components concentrated on grain boundaries during pressure solution. The clasts are invariably formerly glassy, plagioclase-phyric or aphyric probably dacitic lavas. The glassy groundmasses have devitrified and recrystallized to a variety of different textures, with rather coarse snowflake textures perhaps being dominant. Plagioclase phenocrysts were albitized, and are mainly 1-2mm across and slightly resorbed blocky prisms speckled with sericite. Multi-crystal clots are abundant, and discrete detrital albite phenocrysts make up a significant amount of the finer grainsize fraction in this rock. Interestingly, no quartz phenocrysts, and only a few small chloritized augite phenocrysts were noted. Alteration phases include uncommon chlorite, leucoxene and overprinting calcite.

This sample is clearly a volcaniclastic sandstone that suffered strong winnowing of finer matrix, and subsequent pressure solution. It is derived entirely from plagioclase-phyric and aphyric dacitic glassy lavas.

SAMPLE: 562803

SUMMARY: This rock was a glassy plagioclase-phyric evolved andesitic or dacitic lava.

HAND SPECIMEN:

This rock is a massive grey-green finely porphyritic andesite lava transected by cm-sized calcite streaks that may be very elongate vesicles.

THIN SECTION DESCRIPTION:

This is a vesicular, formerly glassy plagioclase-phyric andesitic to dacitic lava with an unusual groundmass texture due to devitrification of glass. It was composed of about 3-5 modal% of tabular albitized plagioclase phenocrysts up to 2mm long set in glass. The plagioclase has been strongly sericitized. A few elongate chloritized mafic phenocrysts were probably augite, and FeTi oxide microphenocrysts are present but rather uncommon and altered to leucoxene. Long narrow apatite microphenocrysts are present but not common.

The groundmass of this lava was glassy, but has devitrified and recrystallized to a most unusual mottled intergrowth composed of curving and impersistent domains of three types. Most abundant is a relatively coarse-grained but 'dirty' snowflake textured mosaic, rendered murky by the presence of tiny clay- or sericite-altered plagioclase microlites. These zones pass outward into even murkier areas in which tiny chlorite flakes are riddled through glass and leucoxenitic blebs are common. These zones grade into areas composed entirely of secondary polycrystalline quartz; the latter reach more than 1mm long. This unusual devitrification texture may have developed in response to a more fluid-assisted alteration than the normal devitrification textures seen in felsic Mount Read lavas, with the domains in the groundmass defining 'diffusion fronts'. Vesicles are relatively abundant, and vary from strongly elongate (but not deformed) to almost rounded, with the larger vesicles being most elongate. All vesicles are filled by calcite, often with a quartz border. Several stylolitic zones only a fraction of a mm wide are defined by concentrations of tiny hematite(?) grains.

It is difficult to judge whether this sample was a dacite or an evolved andesite. The paucity of (former) augite phenocrysts compared to Que andesites with only a few % MgO suggest that the rock may well have been dacitic. However, the amount of fine-grained chlorite in the groundmass, and the un-dacite-like (new term) devitrification texture make me lean more to an evolved andesite.

SAMPLE: 562804.

SUMMARY: This rock was probably a polymict fine-grained lava breccia derived from evolved plagioclase-phyric andesitic glassy lavas,

HAND SPECIMEN:

This rock is a dark green andesitic lapilli volcaniclastic composed of feldspar-phyric and chloritic lithic clasts, mainly less than a few mm long.

THIN SECTION DESCRIPTION:

It is obvious in thin section that this rock is either a lapilli volcaniclastic or fine-grained polymict lava breccia. Dominant clasts or fragments are highly vesicular to non-vesicular quite strongly plagioclase-phyric andesites that had glassy to vitrophyric groundmasses. Many fragments are highly angular. One such fragment is almost 1cm long. Although a variety of clast types are evident, most notably varying in the extent of vesiculation, it is not so evident that these fragments need be from separate lava flows. All have partially sericitized elongate tabular plagioclase phenocrysts to 2mm long maximum, that commonly occur in glomeroclots, and very fine-grained formerly glass-dominated groundmasses. Chloritized mafic phenocrysts are not common, but present in many fragments. In some fragments, groundmass has been replaced by chlorite, and shows a weak foliation.

Between fragments, the matrix is a relatively coarse-grained polycrystalline quartz plus minor albite intergrowth. It is most unlike similar intergrowths replacing glass, and seems to be more a replacement, or void filling. Vesicles are filled by coarse-grained polycrystalline clear quartz sometimes intergrown with minor chlorite.

This rock was probably a polymict fine-grained lava breccia derived almost entirely from evolved andesitic glassy lava flows. If it suffered any reworking, it had the effect of eliminating any matrix, so that matrix voids between packed angular lava fragments (and vesicles) were subsequently filled by silica.

SAMPLE: 562805

SUMMARY: This rock was a hyaloclastite derived from an augite-phyric basalt. It contains a low greenschist facies alteration assemblage.

HAND SPECIMEN:

This rock is a grey-green lava breccia with diffuse-edged (highly altered?) clasts of dacite or andesite in a darker more chlorite-rich matrix.

THIN SECTION DESCRIPTION:

This sample is likely to have been a monomict glassy lava breccia or hyaloclastite composed dominantly of augite-phyric basaltic glass fragments to almost 1cm long. Many fragments were exceptionally vesicular, crystal-free glass that altered to pale brown to honey coloured sideromelane in which quite large (to 3mm) clear augite phenocrysts are set. The augite phenocrysts are euhedral and are commonly partially altered to calcite and chlorite. No plagioclase phenocrysts were present in this sample. Less vesicular glassy lava fragments do not show sideromelane alteration, but rather show heterogeneous and rather messy quartz-albite-chlorite- sericite mosaic intergrowths. In many places, these lighter coloured areas texturally resemble alteration-brecciation rather than primary volcanic brecciation, and appear to have resulted from the passage of hot fluids through the mass of glassy fragments, leaving some sideromelane areas 'unstewed'; in such areas, augite phenocrysts have been quite strongly altered to chlorite. Vesicles are filled with quartz and calcite that is riddled with sheaves of pale green actinolite needles. Veinlets of lower-temperature actinolite-free calcite cut the rock.

This was probably a basaltic hyaloclastite derived from a single flow of vesicular, augite-phyric basalt. It has suffered fairly strong hydrothermal alteration, reaching greenschist facies as indicated by the unusual presence of actinolite; temperatures of the calcite-quartz-actinolite alteration assemblage would have been around 300-350°C.

SAMPLE: 562806

SUMMARY: This rock was a glassy plagioclase+augite-phyric evolved andesitic lava.

HAND SPECIMEN:

This rock is a dark green massive aphyric basaltic or andesitic lava.

THIN SECTION DESCRIPTION:

This rock was a sparsely plagioclase+augite-phyric andesitic lava with a glassy groundmass. It has been quite strongly recrystallized and altered. Albitized plagioclase phenocrysts are totally replaced by very fine-grained sericite, as is albite in the recrystallized groundmass, resulting in the phenocrysts being very hard to differentiate from surrounding matrix, and precluding sensible modal abundance determination. However, a best guess would be that this sample had 5-10 modal% of plagioclase phenocrysts; these were less than 1mm long, and occasionally occur in multi-crystal clots. More obvious but much less abundant are chloritized augite phenocrysts that are less than 1mm long euhedra. FeTi oxide phenocrysts and microphenocrysts are altered to leucoxene, and were not uncommon. Apatite microphenocrysts are also notable but not common.

The groundmass of this sample was undoubtedly glassy. It has recrystallized after devitrification to a messy quartz-albite uneven snowflake mosaic in which the feldspar is largely replaced by fine-grained sericite. Angular patches of polycrystalline quartz to several mm, and green chlorite, are common, and tiny leucoxenic blebs riddle the quartz-albite(sericite) mosaic.

This rock was probably a glassy evolved andesite lava, as suggested by the relatively large apatite microphenocrysts and abundance of Ti-alteration phases in the groundmass among other things. Texturally, and in the size of the plagioclase phenocrysts, the rock is unlike typical dacites from the Que-Hellyer area.

SAMPLE: 562807

SUMMARY: This rock was a polymict glassy dacitic to andesitic lava breccia that has suffered strong quartz-pyrite-sericite alteration, especially in the matrix areas.

HAND SPECIMEN:

This rock is a very strongly altered polymict lava breccia with dacitic(?) to chloritic basalt lava fragments to at least 4cm long in a carbonated matrix that contains abundant disseminated and local concentrations of pyrite.

THIN SECTION DESCRIPTION:

This sample was probably originally a polymict lava breccia composed of plagioclase-phyric dacite and evolved andesite lava fragments that were quite glassy. Lava fragments are angular and show a diversity of devitrification-recrystallization textures that have, in turn, been overprinted by intense quartz-pyrite alteration and calcite alteration. Most fragments appear to have been evolved andesites with small tabular albitized plagioclase phenocrysts that are thoroughly sericitized. In fact many fragments are little different from the lava described above (562807). Mafic phenocrysts are rare in these fragments. A small percentage of the fragments are chloritized vesicular glass probably derived from basaltic glass. Curved fragments of vesicular glass entirely replaced by sericite may have been more felsic.

The matrix of this rock is exceptionally altered. It is now a relatively even-textured and very fine-grained quartz-feldspar mosaic, with dominant quartz, and is riddled by abundant and quite large pyrite crystals and sericite. Calcite probably post-dates the quartz-sericite-pyrite alteration and overprints quite large areas of the section. It is not associated with pyrite alteration.

This sample was probably a polymict lava breccia dominated by glass andesitic to dacitic lava fragments. Strong alteration, particularly of the matrix was associated with the passage of fluids through the rock that produced first strong quartz-sericite-pyrite alteration, and subsequently calcite alteration.

SAMPLE: 562808

SUMMARY: This rock was a sparsely plagioclase+augite-phyric glassy andesitic lava.

HAND SPECIMEN:

This rock is a dark green mottled massive andesitic lava.

THIN SECTION DESCRIPTION:

This is a petrographically simple and texturally well-preserved sparsely plagioclase+augite-phyric andesitic lava not very different from 562806, except that this sample has a more uniform groundmass. Plagioclase phenocrysts are small (<0.5mm) and make up only about 2-3 modal% of this rock. They are tabular to elongate prisms quite different from the large blocky plagioclase phenocrysts that dominate the felsic lavas in the Mount Read Volcanics. Small elongate former augite phenocrysts are chloritized, and FeTi oxide microphenocrysts are altered to leucoxenitic material.

The groundmass of this sample was entirely glassy. It has devitrified, then crystallized to a very even-textured sugary intergrowth of quartz and albite that is permeated by quite abundant fine-grained chlorite and sericite. Remarkably sinuous stylolitic banding transects the rock in many places, and is marked by an abundance of leucoxenitic material that is presumably insoluble residues from pressure solution. This banding is responsible for the feint mottling seen in the hand specimen.

The shapes of the feldspar phenocrysts, and the abundance of chlorite in the groundmass suggest to me that this was a glassy andesitic lava.

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ANALYTICAL REPORT No. 100560.60.07790

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

INVOICE TO:

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

ORDER No.	PROJECT
11502	

DATE RECEIVED	RESULTS REQUIRED
25/02/91	ASAP

No. OF PAGES OF RESULTS	DATE REPORTED	No. OF COPIES
3	06/03/91	1

TOTAL No. OF SAMPLES: 8

SAMPLE NUMBERS	SAMPLE DESCRIPTION	ELEMENT/METHOD
562801/08	SC Prep: GP009.GP018	Ag/GA101
562801/08	SC	As,Cr,Zr,Ti/GX401
562801/08	SC	Ti:Zr/S9825
562801/08	SC	Cu,Pb,Zn,Ba,Mn,Ni,Sr,K2O,MgO,CaO,Na2O,P2O5/GI2

RESULTS TO:

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

RESULTS TO:

RESULTS TO:

REMARKS

Mar-28

Petrology.

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ANALYTICAL DATA

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
	100560.60.07790	06/03/91	11502	1 OF 3

TUBE No.	SAMPLE No.	Cu	Pb	Zn	Ag	Ba	As	Cr	Zr	Ti
1	562801	54	<5	198	<0.5	1510	5	106	110	3032
2	562802	68	<5	416	<0.5	887	4	109	125	3656
3	562803	36	<5	138	<0.5	1190	7	18	153	4535
4	562804	89	<5	179	<0.5	1040	12	70	128	3923
5	562805	68	<5	141	<0.5	783	4	544	109	3542
6	562806	14	<5	185	<0.5	801	5	11	142	2374
7	562807	55	<5	188	<0.5	789	42	361	106	3272
8	562808	27	<5	675	<0.5	1040	4	21	168	1906
9										
10										
11										
12										
13										
14										
15										
16										
17										
18										
19										
20										
21										
22										
23	DETECTION	5	5	5	0.5	5	2	5	5	50
24	UNITS	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
25	METHOD	GI201	GI201	GI201	GA101	GI201	GX401	GX401	GX401	GX401

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

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ANALYTICAL DATA

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
	100560.60.07790	06/03/91	11502	2 OF 3

TUBE No.	SAMPLE No.	Ti:Zr	CaO	K2O	MgO	Mn	Na2O	Ni	P2O5	Sr
1	562801	27.56	6.760	2.010	4.670	1230	2.080	45	0.13	365
2	562802	29.25	3.660	1.740	3.590	1060	3.810	47	0.16	361
3	562803	29.66	3.790	2.930	1.120	1130	2.740	19	0.20	247
4	562804	30.63	5.440	1.800	3.150	1380	3.700	39	0.20	43[illegible]
5	562805	32.49	6.150	1.100	7.690	1350	3.140	115	0.20	27[illegible]
6	562806	16.72	5.270	2.600	1.560	862	2.270	<10	0.16	23[illegible]
7	562807	30.87	4.820	2.370	4.440	1760	1.410	94	0.20	15[illegible]
8	562808	11.35	1.350	1.720	1.360	629	4.360	<10	0.11	46[illegible]
9										
10										
11										
12										
13										
14										
15										
16										
[illegible]										
18										
19										
20										
21										
22										
23	DETECTION	0.01	0.007	0.060	0.003	15	0.007	10	0.02	1
24	UNITS	%	%	%	%	ppm	%	ppm	%	ppm
25	METHOD	S9825	GI201	GI201	GI201	GI201	GI201	GI201	GI201	GI201

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

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ANALYTICAL DATA

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
	100560.60.07790	06/03/91	11502	3 OF 3

TUBE No.	SAMPLE No.	Rb
1	562801	67.60
2	562802	47.60
3	562803	100.00
4	562804	51.60
5	562805	28.40
6	562806	91.60
7	562807	70.30
8	562808	60.00
9		
10		
11		
12		
13		
14		
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17		
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19		
20		
21		
22		
23	DETECTION	0.05
24	UNITS	ppm
25	METHOD	GI222

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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APPENDIX 14

0341 654242 PAGE 1 OF 2

CORE GRIND SAMPLING - MACKINTOSH / HATFIELD HOLE No. Mac-13

DATE

No.	SAMPLE NUMBER	INTERVAL	ELEMENTS REQUIRED	ST	SAMPLE NUMBER	INTERVAL	ELEMENTS REQUIRED	ST
1	562701	3-13.3 m			562733	286.0-296.0		
2	702	13.3 → 23.3			734	296.0-306.0		
3	703	23.3 → 33.3			735	306.0-316.0		
4	704	33.3 - 43.3			736	316.0-326.0		
5	705	43.3-53.3			737	326.0-336.0		
6	706	53.3- 63.3m			738	336.0-345.4		
7	707	63.3- 73.3m			739	Standard.		
8	709	73.3 - 84.3			562740	345.4-355.5		
9	709	84.3- 93.3.			741	355.5-365.5		
10	710	93.3-103.1			742	365.5-375.5		
11	711	103.1-110.2			743	375.5-385.5		
12	712	Standard.			744	385.5-395.5.		
13	713	110.2-119.5			745	395.5-406.5		
14	714	119.5-129.5			746	405.5-410.5		
15	715	129.5-139.5			747	410.5-420.5		
16	716	139.5-145.2			748	422.5-430.5		
17	717	145.2-149.45			749	430.5-440.5		
18	718	149.45-155			562750	440.5-451.5		
19	719	155-165.7			751	451.5-463.9		
20	720	165.7-175.0			752	463.9-468.4		
21	721	175-186.0			753	468.4-480.7		
22	722	186-189.2			754	480.7-493.5 498.5		
23	723	189.2-199.2			755	493.5-503.3		
24	724	199.2-209.2			756	503.3-513.3		
25	725	209.2-219.2			757	513.3-523.0		
26	726	219.2-229.2			758	523.0-532.1		
27	727	229.2-239.2			759	532.1-544		
28	728	239.2-249.2			562760	544-554		
29	562729	249.2-259.2			761	554-563.2		
30	562730	259.2-267.7			762	563.2-573.5		
31	731	267.7-276.0			763	573.5-584.9		
32	732	276.0-286.0			764	584.9-597.2		

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PAGE 2 OF 2

CORE GRIND SAMPLING - MACKINTOSH / HATFIELD

HOLE No.

DATE

No.	SAMPLE NUMBER	INTERVAL	ELEMENTS REQUIRED	ST	SAMPLE NUMBER	INTERVAL	ELEMENTS REQUIRED	ST
1	562765	597.2 - 607.2			562797	849.5 - 859.5		
2	766	607.2 - 613.2			798	859.5 - 869.5		
3	767	613.2 - 623.2			562799	869.5 - 879.5		
4	768	623.2 - 632.4			562800	879.5 - 889.5		
5	769	632.4 - 644.0			562826	889.5 - 899.5		
6	770	644.0 - 653.5			562827	899.5 - 907.5		
7	771	653.5 - 663.5				EOH.		
8	772	Standard						
9	773	663.5 - 673.5						
10	774	673.5 - 680.3						
11	775	680.3 - 691.9						
12	776	691.9 - 701.9						
13	777	701.9 - 710.0						
14	778	710.0 - 718.0						
15	779	718.0 - 722.3						
16	780	722.3 - 731						
17	781	731.0 - 740.15						
18	782	740.15 - 751.6						
19	783	751.6 - 753.9						
20	784	753.9 - 763.0						
21	785	763.0 - 770.6						
22	786	770.6 - 772.1						
23	787	772.1 - 776.8						
24	788	776.8 - 787.3						
25	789	787.3 - 790.4						
26	790	790.4 - 801.1						
27	791	801.1 - 812.65						
28	792	812.65 - 821.4						
29	793	821.4 - 827.2						
30	794	827.2 - 839.0						
31	795	839.0 - 849.5						
32	796	849.5 Standard						

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ANALYTICAL REPORT No. 100560.60.07811

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ORDER No.	PROJECT
11507	

DATE RECEIVED	RESULTS REQUIRED
06/03/91	ASAP

No. OF PAGES OF RESULTS	DATE REPORTED	No. OF COPIES	TOTAL No. OF SAMPLES
4	26/03/91	1	40

SAMPLE NUMBERS	SAMPLE DESCRIPTION	ELEMENT/METHOD
62701/740	CG Prep: SP016	Cu,Pb,Zn,Ag/6A101
562701/740	CG	Au,Au(R),Au(S)/GG309,Au/RAW,Au/Wt
62701/740	CG	Ba,As,Cr,Zr,Ti/GX401
562701/740	CG	Ti:Zr/S9925

RESULTS TO

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

RESULTS TO

RESULTS TO

REMARKS

MAC-28
GRIDS

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ANALYTICAL DATA

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
	100560.60.07811	26/03/91	11507	1 OF 4

TUBE No.	SAMPLE No.	Cu	Pb	Zn	Ag	Au	Au(R)	Ba	As	Cr
1	562701	20	15	210	<0.5	<0.008	–	1176	<2	42
2	562702	15	10	180	<0.5	<0.008	–	1147	<2	13
3	562703	105	25	210	<0.5	<0.008	–	755	<2	312
4	562704	240	40	285	<0.5	<0.008	–	660	<2	315
5	562705	115	85	430	<0.5	0.010	–	1099	3	432
6	562706	140	115	470	<0.5	<0.008	–	1463	3	518
7	562707	65	170	525	<0.5	<0.008	–	1031	<2	506
8	562708	130	65	300	<0.5	0.020	–	431	<2	614
9	562709	35	20	70	<0.5	<0.008	–	427	7	12
10	562710	40	10	175	<0.5	<0.008	–	220	<2	510
11	562711	165	20	185	<0.5	<0.008	–	592	<2	169
12	562712	130	185	2200	0.5	0.015	–	1112	15	906
13	562713	90	20	255	<0.5	<0.008	–	727	<2	244
14	562714	90	200	690	<0.5	<0.008	–	1480	<2	488
15	562715	75	155	400	<0.5	0.015	–	582	5	547
16	562716	100	135	360	<0.5	0.010	–	414	4	514
17	562717	75	25	140	<0.5	<0.008	–	585	6	227
18	562718	55	30	110	<0.5	<0.008	–	568	4	89
19	562719	40	15	100	<0.5	<0.008	–	647	<2	56
20	562720	50	30	160	<0.5	<0.008	–	810	<2	118
21	562721	75	35	170	<0.5	<0.008	–	926	<2	114
22	562722	55	15	180	<0.5	0.010	0.010	764	3	34
23	562723	70	215	495	<0.5	<0.008	–	1133	3	64
24	562724	70	145	265	<0.5	0.010	–	680	<2	69
25	562725	115	210	270	<0.5	0.010	–	434	<2	62

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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A Division of Inchcape Inspection and Testing Services Australia Pty. Ltd.

ANALYTICAL DATA

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
	100560.60.07811	26/03/91	11507	2 OF 4

TUBE No.	SAMPLE No.	Cu	Pb	Zn	Ag	Au	Au(R)	Ba	As	Cr
1	562726	60	90	350	<0.5	<0.008	–	539	2	71
2	562727	60	30	190	<0.5	<0.008	–	549	2	68
3	562728	90	45	275	<0.5	<0.008	–	798	<2	60
4	562729	35	45	375	<0.5	0.010	–	1036	5	76
5	562730	40	40	420	<0.5	0.010	–	1028	<2	94
6	562731	45	50	385	<0.5	0.010	–	189	3	38
7	562732	45	75	180	<0.5	<0.008	–	1266	3	91
8	562733	65	30	150	<0.5	<0.008	–	898	3	93
9	562734	45	125	345	<0.5	0.010	–	528	5	101
10	562735	50	35	150	<0.5	<0.008	–	478	2	82
11	562736	40	45	180	<0.5	<0.008	–	1082	<2	79
12	562737	45	45	205	<0.5	<0.008	–	1144	<2	60
13	562738	50	60	185	<0.5	<0.008	–	491	6	90
14	562739 A	130	170	2250	<0.5	0.010	–	1050	15	862
15	562740	65	35	125	<0.5	0.010	–	540	7	63
16										
17										
18										
19										
20										
21										
22										
23	DETECTION	5	5	5	0.5	0.008	0.008	10	2	5
24	UNITS	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
25	METHOD	GA101	GA101	GA101	GA101	GG309	GG309	GX401	GX401	GX401

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

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A Division of Inchcape Inspection and Testing Services Australia Pty. Ltd.

ANALYTICAL DATA

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
	100560.60.07811	26/03/91	11507	3 OF 4

TUBE No.	SAMPLE No.	Zr	Ti	Ti:Zr
1	562701	195	2139	10.97
2	562702	194	2182	11.25
3	562703	114	3071	26.94
4	562704	123	3241	26.35
5	562705	113	3128	27.68
6	562706	98	2826	28.84
7	562707	98	2708	27.63
8	562708	88	2431	27.62
9	562709	196	2671	13.63
10	562710	99	2807	28.35
11	562711	105	2740	26.09
12	562712	77	2398	31.14
13	562713	98	2414	24.63
14	562714	91	2484	27.30
15	562715	87	2380	27.36
16	562716	89	2397	26.93
17	562717	164	2395	14.60
18	562718	138	3448	24.98
19	562719	110	2972	27.02
20	562720	124	3125	25.20
21	562721	130	3176	24.43
22	562722	128	2688	21.00
23	562723	117	2999	25.63
24	562724	115	2889	25.12
25	562725	107	2809	26.25

Results in ppm unless otherwise specified
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A Division of Inchcape Inspection and Testing Services Australia Pty. Ltd.

ANALYTICAL DATA

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
	100560.60.07811	26/03/91	11507	4 OF 4

TUBE No.	SAMPLE No.	Zr	Ti	Ti:Zr						
1	562726	113	2976	26.34						
2	562727	125	3061	24.49						
3	562728	114	2923	25.64						
4	562729	121	3117	25.76						
5	562730	113	2949	26.10						
6	562731	124	3142	25.34						
7	562732	95	2963	31.19						
8	562733	96	2987	31.11						
9	562734	96	3018	31.44						
10	562735	103	3087	29.97						
11	562736	100	2869	28.69						
12	562737	112	3074	27.45						
13	562738	96	2984	31.08						
14	562739	73	2317	31.74						
15	562740	94	2712	28.85						
16										
17										
18										
19										
20										
21										
22										
23	DETECTION	5	50	0.01						
24	UNITS	ppm	ppm	%						
25	METHOD	GX401	GX401	S9825						

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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654349

RECEIVED
2 MAY 1991

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A Division of Inchcape Inspection and Testing Services Australia Pty. Ltd.

Analabs - A Division of Inchcape Inspection & Testing Services

Phone (004) 31 6857 | 14 Thirkell St. Cooee Tas 7320 | Fax (004) 31 8890

ANALYTICAL REPORT No. 100560.60.07916

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

INVOICE TO:

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

ORDER No.	PROJECT
11551	

DATE RECEIVED	RESULTS REQUIRED
16/04/91	ASAP

No. OF PAGES OF RESULTS	DATE REPORTED	No. OF COPIES	TOTAL No. OF SAMPLES
6	29/04/91	1	62

SAMPLE NUMBERS	SAMPLE DESCRIPTION	ELEMENT/METHOD
562741/800,562826/27	CG Prep: GP011	Cu,Pb,Zn,Ag/GA101
562741/800,562826/27	CG	Au,Au(R),Au(S)/GG309,Au/RAW,Au/Wt
562741/800,562826/27	CG	Ba,As,Cr,Zr,Ti/GX401
562741/800,562826/27	CG	Ti:Zr/GX401

REMARKS

RESULTS TO

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

RESULTS TO

RESULTS TO

AUTHORISED OFFICER

0349

654250

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A Division of Inchcape Inspection and Testing Services Australia Pty. Ltd.

ANALYTICAL DATA

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
	100560.60.07916	29/04/91	11551	1 OF 6

TUBE No.	SAMPLE No.	Cu	Pb	Zn	Ag	Au	Au(R)	Ba	As	Cr
1	562741	80	100	155	<0.5	0.010	–	654	11	74
2	562742	75	35	160	<0.5	<0.008	–	747	6	86
3	562743	55	15	135	<0.5	<0.008	–	731	6	96
4	562744	55	35	300	<0.5	<0.008	–	761	6	80
5	562745	75	20	120	<0.5	0.010	–	834	8	67
6	562746	50	30	175	<0.5	0.010	–	591	5	74
7	562747	70	10	145	<0.5	0.010	–	784	4	84
8	562748	55	5	150	<0.5	<0.008	–	893	6	97
9	562749	45	20	130	<0.5	<0.008	–	677	10	96
10	562750	50	45	120	<0.5	<0.008	–	580	7	117
11	562751	55	5	130	<0.5	0.010	0.010	1073	8	130
12	562752	70	20	160	<0.5	0.010	–	1087	83	85
13	562753	45	10	210	<0.5	0.010	–	556	9	155
14	562754	60	<5	160	<0.5	<0.008	–	685	8	70
15	562755	75	<5	110	<0.5	0.010	–	917	21	32
16	562756	55	<5	120	<0.5	<0.008	–	539	73	210
	562757	60	<5	125	<0.5	0.030	–	724	8	18
18	562758	65	10	130	<0.5	<0.008	–	808	17	29
19	562759	55	5	120	<0.5	0.010	–	436	73	22
20	562760	70	30	160	<0.5	<0.008	–	979	6	79
21	562761	85	15	115	<0.5	0.010	<0.008	497	9	124
22	562762	40	<5	170	<0.5	0.040	–	52	4	201
23	562763	60	<5	170	<0.5	0.010	–	136	2	197
24	562764	85	15	150	<0.5	0.015	–	497	4	479
25	562765	50	<5	105	<0.5	<0.008	–	204	5	309

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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654251

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A Division of Inchcape Inspection and Testing Services Australia Pty. Ltd.

ANALYTICAL DATA

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
	100560.60.07916	29/04/91	11551	2 OF 6

TUBE No.	SAMPLE No.	Cu	Pb	Zn	Ag	Au	Au(R)	Ba	As	Cr
1	562766	25	<5	120	<0.5	<0.008	–	103	5	481
2	562767	65	5	110	<0.5	<0.008	–	804	7	527
3	562768	80	25	175	<0.5	<0.008	–	429	9	272
4	562769	55	5	105	<0.5	<0.008	–	801	2	153
5	562770	30	10	90	<0.5	0.010	–	775	<2	72
6	562771	35	40	550	<0.5	<0.008	–	884	5	66
7	562772	115	180	2200	<0.5	<0.008	–	1115	17	929
8	562773	110	15	300	<0.5	<0.008	–	735	7	153
9	562774	80	5	220	<0.5	<0.008	–	810	7	118
10	562775	80	5	155	<0.5	<0.008	–	1306	6	419
11	562776	25	<5	95	<0.5	0.010	0.010	240	7	286
12	562777	15	<5	60	<0.5	0.010	–	436	2	74
13	562778	90	5	125	<0.5	0.010	–	198	13	523
14	562779	45	<5	108	<0.5	<0.008	–	516	4	23
15	562780	75	65	290	0.5	0.010	–	395	16	482
16	562781	70	25	110	0.5	0.010	–	417	22	264
17	562782	85	<5	125	<0.5	0.015	–	587	8	128
18	562783	65	5	110	<0.5	0.015	–	638	9	151
19	562784	25	<5	80	<0.5	0.010	–	802	7	11
20	562785	25	<5	75	<0.5	0.010	–	725	5	15
21	562786	75	15	85	0.5	0.010	0.020	708	33	144
22	562787	30	<5	65	<0.5	0.015	–	588	4	<5
23	562788	65	20	110	<0.5	0.010	–	841	31	171
24	562789	90	30	165	<0.5	0.020	–	868	56	303
25	562790	65	30	115	<0.5	0.015	–	929	47	261

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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A Division of Inchcape Inspection and Testing Services Australia Pty. Ltd.

ANALYTICAL DATA

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
	100560.60.07916	29/04/91	11551	3 OF 6

TUBE No.	SAMPLE No.	Cu	Pb	Zn	Ag	Au	Au(R)	Ba	As	Cr
1	562791	35	<5	80	<0.5	<0.008	–	934	6	24
2	562792	80	20	100	<0.5	0.010	–	844	42	249
3	562793	20	<5	70	<0.5	<0.008	–	868	7	9
4	562794	65	10	130	<0.5	<0.008	–	599	30	354
5	562795	45	<5	80	<0.5	<0.008	–	674	13	140
6	562796	110	175	2200	0.5	0.010	–	1091	20	924
7	562797	90	25	135	<0.5	0.015	–	427	39	496
8	562798	80	25	80	<0.5	0.015	–	433	36	655
9	562799	70	20	95	<0.5	0.010	–	524	32	514
10	562800	60	20	100	<0.5	0.020	–	660	42	329
11	562826	75	10	130	<0.5	<0.008	0.010	764	10	88
12	562827	70	30	160	<0.5	0.010	–	665	20	93
13										
14	?									
15										
16										
18										
19										
20										
21										
22										
23	DETECTION	5	5	5	0.5	0.008	0.008	10	2	5
24	UNITS	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
25	METHOD	GA101	GA101	GA101	GA101	GG309	GG309	GX401	GX401	GX401

Results in ppm unless otherwise specified
T = element present; but concentration too low to measure
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– = element not determined

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ANALYTICAL DATA

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
	100560.60.07916	29/04/91	11551	4 OF 6

TUBE No.	SAMPLE No.	Zr	Ti	Ti:Zr						
1	562741	100	2850	28.5						
2	562742	98	2907	29.7						
3	562743	113	3182	28.2						
4	562744	109	3114	28.6						
5	562745	123	3240	26.3						
6	562746	112	3087	27.6						
7	562747	109	3378	31.0						
8	562748	113	3745	33.1						
9	562749	116	3580	30.9						
10	562750	110	3623	32.9						
11	562751	103	3651	35.4						
12	562752	102	3249	31.9						
13	562753	102	3901	38.2						
14	562754	118	4002	33.9						
15	562755	130	4551	35.0						
16	562756	134	4665	34.8						
17	562757	136	4395	32.3						
18	562758	126	3975	31.5						
19	562759	124	4254	34.3						
20	562760	116	3810	32.8						
21	562761	102	3393	33.3						
22	562762	84	2702	32.2						
23	562763	81	2726	33.6						
24	562764	74	2639	35.7						
25	562765	104	3838	36.9						

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

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
	100560.60.07916	29/04/91	11551	5 OF 6

TUBE No.	SAMPLE No.	Zr	Ti	Ti:Zr						
1	562766	85	3318	39.0						
2	562767	81	3017	37.2						
3	562768	102	3416	33.5						
4	562769	104	3103	29.8						
5	562770	126	2867	22.7						
6	562771	117	2703	23.1						
7	562772	68	2373	34.9						
8	562773	96	2983	31.1						
9	562774	99	2511	25.4						
10	562775	111	3565	32.1						
11	562776	111	3096	27.9						
12	562777	126	2936	23.3						
13	562778	87	3252	37.4						
14	562779	141	2752	19.5						
15	562780	117	4036	34.5						
16	562781	102	3599	35.3						
	562782	102	3288	32.2						
18	562783	122	3473	28.5						
19	562784	142	2614	18.4						
20	562785	140	2624	18.7						
21	562786	110	3625	33.0						
22	562787	152	1668	11.0						
23	562788	99	3111	31.4						
24	562789	109	3507	32.2						
25	562790	119	3718	31.2						

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

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ANALYTICAL DATA

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
	100560.60.07916	29/04/91	11551	6 OF 6

JBE No.	SAMPLE No.	Zr	Ti	Ti:Zr						
1	562791	154	1811	11.8						
2	562792	103	3472	33.7						
3	562793	135	2746	20.3						
4	562794	111	3403	30.7						
5	562795	124	3221	26.0						
6	562796	74	2420	32.7						
7	562797	60	2548	42.5						
8	562798	68	2790	41.0						
9	562799	77	2822	36.6						
10	562800	100	2849	28.5						
11	562826	103	3404	33.0						
12	562827	108	3482	32.2						
13										
14										
15										
16										
18										
19										
20										
21										
22										
23	DETECTION	5	50	0.1						
24	UNITS	ppm	ppm	%						
25	METHOD	GX401	GX401	GX401						

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

AUTHORISED OFFICER

0355

654356

OPEN FILE

MICROFILMED

91-3268

MINES
File Ref. E.L. 106/87
- 6 JUN1991
Doc. Ref.
Action Officer | Initials
REFER TO
CORRES 4.6.91
Resubmit to | Date

MACKINTOSH DISTRICT

EXPLORATION LICENCE 106/87

TASMANIA

Progress Report for the Period

May 1990 to April 1991

Volume 3

Appendices 15 - 17

91-3268
3/5
VOL

Distribution

Aberfoyle - Burnie (1/3)
Aberfoyle - Hawthorn (2/3)
Department of Resources & Energy (3/3)

APPENDIX 15

0357

654358

MACKINTOSH / HATFIELD DATA BASE ENTRY FORM 1 of 2

DRILL HOLE NAME MAC-26

LOCATION MT. CHARTER

TOTAL DEPTH 850.7

NUMBER SURVEYS
(Incl. collar P.U.)

NUMBER ASSAY INTERVALS

COLLAR NORTHING 4717.11 MG 5391417.0 AMG

COLLAR EASTING 4353.01 MG 389779.6 AMG

COLLAR R.L. 837.51

COLLAR DEPTH 0

SECTION
(To nearest 50m)

STATUS OF DATA NEW

DATE STARTED 900417

DATE FINISHED 900620

LOGGED BY RJH

FROM	TO	HOLE SIZE	CASING TYPE	CASING I.D.
0	3	HW		
0	156.0	HQ		
156.0	850.7	NQ		
PVC	TO BOTTOM			

1m HW casing kept / hole.

COMMENTS
(Casing lost etc.)

Aberfoyle Resources Limited
EXPLORATION DIVISION

DIAMOND DRILL LOG

PROJECT : MACKINTOSH EL 106/87

PROSPECT: MT CHARTER

HOLE NO: MAC-26
PAGE: 1 of 41
LOGGED: RJH
DATE: 24/5/90

0358

DEPTH	DRILL RUNS	CORE LOSS	LITHOLOGY: ROCK NAME	LITHOLOGY: DESCRIPTION	ALTERATION	VEINING	MINERALISATION	STRUCTURE	WEATHERING	VISUAL LOG	REMARKS
1		1.5m Core Loss	D.l.v. - D.b.v.	gw-gy D.l.vld. (lapilli to breccia) /Si.Se.Py (variably altered) clasts & Py/Ba mtx c̄ mod Ba/wk Py veins (0.0 - 4.2m)	variable clast related str - mod Se 2-4, Py 1-3 & Si 1-2 alteration. also mnr gn, Fe? alt of some clasts.	generally mnr wk Ba/Py/Sr veining with larger massive Ba veins with minor BM as Sph Cp & Gn.	str Py mineralised interstitial mtx (up to 20% TOTAL ROCK) other Sph/Gn/Cp dissemination with Ba veining.	breccia fragments generally sub-angular to sub-rounded. with Ba/Py mtx.			
3	3.0										
4	4.2										
5											
6											
7	7.2			PETROLOGY @ 12.8m (#43479P)		str mass Ba v @ 7.1 - 7.8m.					
8					Se 3-4. Ox 2 alterat'n associated c̄ with Ba veins.	with mass Ba shtd veins from 8.8 - 10.6m.					
9											
10	10.2										
11							mtx almost totally Py (to 40% TOTAL ROCK) from 13.1 - 13.8 m.				
12											
13	13.2										
14			14.2		14.2	14.2	14.2	14.2			
15			D.l.b.	gy-gn D.l.b./Se 2-3. Py 1-2. Si 1-2 c̄ Py/Ba/mnr Sph veins (14.2 - 19.5)	variable Se 2-3. Si 1-2 Py 1-2 alteration of clasts	dominantly irregular Ba/Py veins with mnr gy-gn Sph inclusions & rare Gn.	str Py stns forming interstitial mtx c̄ Ba. elsewhere Py with mnr Gn & Sph c̄ Ba veins. Note: 2 phases of veins 1 -> Ba/Py 2 -> Ba/Py/Sph/Gn	lava breccia "hualoclastite?" c̄ thnr vld interbeds b. frags to 10 cm. ø			
16	16.2										
17					mod - str Si 2 from 15.1 - 16.8m.	mass Py vein @ 15.0m.					
18				mnr ibd D.l.vld. @ 18.1m.	argillic -> sericite? alteration of f.pheno.						
19	19.2		19.5		19.5	19.5	19.5	19.5			
20			ibd. D.l.v. & D.l.b.	gy ibd D.l.vld. & D.l.b./Se 2. Si 2 Py 1-2 c̄ str - wk Py/Ba v. (19.5 - 23.6m)	clast related Se 2 Si 2 Py 1-2 alteration	dominantly Ba/Py v	dominantly Py as interstitial material to l.b. & vld. Py/mnr Sph/rare Gn c̄ some Ba veining.				
21											

654359

Aberfoyle Resources Limited
EXPLORATION DIVISION

DIAMOND DRILL LOG

PROJECT : MACKINTOSH EL 106/807

PROSPECT: MT CHARTER

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0359

DEPTH	DRILL RUNS	CORE LOSS	LITHOLOGY: ROCK NAME	LITHOLOGY: DESCRIPTION	ALTERATION	VEINING	MINERALISATION	STRUCTURE	WEATHERING	VISUAL LOG	REMARKS	DEPTH
22	22.2				as for sheet #1	as for sheet #1	as for sheet #1					
23					patchy Se alteration of some fp. phenos	mass Ba/mnr Py/Sph/Gn veins @ 20.8 & 21.8-21.4 m.						
24			23.5		23.5	23.5	23.5	23.5				
25	25.2		Ba.	mass Ba c̄ mnr chert & quartz & rare D.l. clasts (23.5-25.2 m)	Se 2/Py 2 alteration of D.l. clasts	mnr Py & Sph (mnr) veins c̄ rare Gn.	minor blebs or fragments? of Py & Sph & rare Gn.					
26			25.2		25.2	25.2	25.2					
			Dl. b.	str Ba veined gy-gn Dl b. (25.2-25.6 m)	Se 2 Si 1-2							
			25.6		25.6							
27			D.l.b.	gy-gn D.l. vld c̄ str Ba/Py veins. (25.6-27.4 m)		dominantly Py/Ba/mnr Sph & Gn veins						
28	28.2		27.4		variable clast related Se 1-2. Si 1-3. Py 1 alter^n of D.l. clasts		mod Py veins & str's str Py/mnr Sph & Gn associated c̄ mass Ba veining					
29			Dl.b.	gy-gn Dl.b. c̄ Py/Ba mtx & veins carrying mnr Sph & Gn (27.4-29.4 m)		str to mass Ba/Py/rare Sph & Gn veining from 26.6-27.5 m. & 28.9-29.2 m.						
30			29.4		29.4	29.4	29.4	29.4				
31	31.2		Ba.	gy essentially massive Ba c̄ mnr clasts of Chert & variably Se Si Py altered D.l. X-cut by later with Ba veins (29.4-41.0 m)	Strongly Se. Py. Si altered D.l. clasts. => Se 2-3. Si 2. Py 2-3	Abn Py veins to 5 mm // to cleavage. Others as stockworks X-cutting dominant cleavage direc^n	Py/mnr BMs occurs as veins // & X-cutting cleavage to 5% for Rock dies blebs & disseml of Sph & Gn/mnr Cp associated c̄ Ba veins	massive Ba generally mod sheared. Weakly vld c̄ Dl & chert clast to 10 cm ϕ				
32												
33				PETROLOGY @ 32.4 m. (#431480P)		X-cutting shd with & ox^d Ba veins from 43.0-41.0 m						
34	34.2			mnr sulphide, dominantly pyrite clasts throughout entire Ba sequences								
35												
36				PETROLOGY @ 35.0 m (#431481P)								
37	37.2											
38												
39												
40	40.2											
41												
42												

654360

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EXPLORATION DIVISION

DIAMOND DRILL LOG

PROJECT : MACKINTOSH (LL Wolfe)
PROSPECT: Mk CHARGER

0360

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DEPTH	DRILL RUNS	CORE LOSS	LITHOLOGY: ROCK NAME	LITHOLOGY: DESCRIPTION	ALTERATION	VEINING	MINERALISATION	STRUCTURE	WEATHERING	VISUAL LOG	REMARKS	DEPTH
43	52.2				as for Sheet 2	as for Sheet 2	as for Sheet 2	as for Sheet 2				
44												
45												
46	dic 2											
47			—47.0—		47.0	47.0	47.0	47.0				
48			shd Dlv.	gy-gn shd ch Ba veined D.l.vfcl. ± dom v/fg ll to cleavage direction & str X-cutting vein Ba. (47.0 - 51.3m)	str Sc3-4 Py2-3. Si1-2 alteration of D.l. clasts	str Py veins. shd Ba veins throughout segm. mas Ba vein from 46.9 - 50.3m.	str Py veins ± cleavage direction up to 5% total Rock. veins & disem. of Sph & Gn ± Ba veins & as incl. in Dlv. Qv.	str schistose @ ~ 40-50° to LCA.				
49	50.2					mnr Dlv. Qv.						
50			—51.3—		51.3	51.3	51.3	51.3				
51				gy-gn cil Dl.b./Sa2-3. Si2-3 Py2 ± dom Ba/mnr BMS veins & str to mod Py veins. (51.3 - 56.4m)	str Sa2-3 Py1-2 Si2-3 & min. pockety Fu1-2 alteration of D.l. clasts	dom inwng. Ba/Py/mnr BMS veins	dom Py as veins & interstitial mtx. dom diss of BMS (Sph & Gn) in both altered D.l clasts & with Ba veining.	wk schistose b. fragments to 15cm ø				
52	52.2											
53												
54												
55	55.2		D.l.b.		str Sa3-4 Py1-2 alt. from shd ~ 52.2m & 55.2 - 56.7m.		mas interstitial Py @ 56.0m					
56												
57												
58	58.2		—56.4—		56.4	56.4	56.4.	56.4				
59				gy-gn str altered D.vfcl. ± mnr Ba vns & diss blebs Py in interstitial material. (56.4 - 60.2m)	str clast related Fu2 Sa1-2 Si2-3 & Py1-2 alt ⁿ							
60			Dlv. - Dlv.		59.9 str clast related Sa3-4. Fu1. Py2 alt ⁿ		dom. Py (up to 20%) of interstitial mtx material. Mnr Sph & Gn associated ± Ba veins.	mt to mod schistose ± rotat ⁿ of clasts b. fragments from mm to 5cm ø				
61	60.2				60.3 str Si3-4. Sa1. Py1-2 sto 60.0 ev. sto clast related Sa2-4. Si1-2 Py1-2. Fu1-2 alt ⁿ.	vkly Ba vnlt ± veins containing Sph/mnr Gn inclusions.						
62												
63												

6543661

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EXPLORATION DIVISION

DIAMOND DRILL LOG

PROJECT : Mackintosh GL 1006/89
PROSPECT: Mt Charlotte

Form 030

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DEPTH	DRILL RUNS	CORE LOSS	LITHOLOGY: ROCK NAME	LITHOLOGY: DESCRIPTION	ALTERATION	VEINING	MINERALISATION	STRUCTURE	WEATHERING	VISUAL LOG	REMARKS	DEPTH
64	64.2			Recovered 2.0m 64.1 m (# 421560E)								
65					as for Sheet 3	as for Sheet 3		as for Sheet 3				
66			Dl.v. - Db.v.			str Ba vnd from 66.5-67.3 m ± abn Sph/minr Gn inclusions	minr Sph/Gn as inclusions in Ba vns. Up to 5% vein material. 66.5 - 67.3 m					
67	67.2											
68			68.2		68.2	68.2	68.2	68.2 wk sch. 68.2 - 68.4 m				
69				gy-yw Db.v.lcl. ± minr lbds of fine Dl.lcl. & abn Ba/minr BMS vns as strk btn Dl clasts. (68.2 - 71.8 m)	dom. vn Se 2.2. Si 1. Py 1-2 aff" of clast material.	Str Ba strk btn lava clasts. Also Py veins & strks minr BMS (Sph+Gn) incl. in vein material (to 3%)	Py to 5% total Rock as veins & strk ± Ba vns. Minr Sph/Gn inclusions in vein material (to 2% total vein)	b. fragments to 10cm ø commonly 2-3 cm ø			
70	70.2		Db.v.									
71					71.8	71.8	71.8	71.8				
72			71.8	gy Dl.v.lcl ± minr lbds of Db.v. ± str Ba strn & vn Se. Si Py aff" (71.8 - 73.0 m)	var Se 1-2. Si 2 Py 1-2 aff" of clast material.			fine lapilli fragments to 1-2 mm ø & frags to 5-10 cm ø				
73	72.2		Dl.v. - Db.v.		73.0	73.0	73.0					
74			73.0									
75			Dl.v.	gy cil Dl.v.lcl. ± str Ba/BMS vains Recovered 2 75.2 m (# 423560E)	dom. Si 2 wk Se 1-2 Py 1 aff of clast material.	2 dominant vein sets (1) Py/minr Cpy veins & strks (2) Ba/BMS (Sph Gn & Cpy) assoc. ± Ba dominantly (1) to 5% total (2) to 80% total	Py/minr Cp as veins & strks & as disc in siliceous Dl clasts. str BMS up to 80% of Ba veins					
76	76.2		76.2		76.2	76.2	76.2	76.2				
77												
78												
79	80.2		Dl. ± minr lbds of Dlb.	yw-gy massive fp. Dl. Ise 2. Si 1-2 Py 1 ± minr Dl.L. & abn Ba/BMS veins and strks & Py veins & strks (76.2 - 80.0 m)	var. Se 1-2, Si 1-2 Py 1 alteration of Dl. rare fuchsite spotting							
80												
81												
82	82.2											
83												
84												

Sph, Gn & Py ± Ba vains & strks. BMS to 60-80% of vein material

Py also as disc veins & strks and as Ba/Py veins only

weakly locally schistose

6543662

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EXPLORATION DIVISION

DIAMOND DRILL LOG

PROJECT : MACKINTOSH EL 106/87

PROSPECT: MT CHARTER

HOLE NO: MAC-26

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0362

DEPTH	DRILL RUNS	CORE LOSS	LITHOLOGY: ROCK NAME	LITHOLOGY: DESCRIPTION	ALTERATION	VEINING	MINERALISATION	STRUCTURE	WEATHERING	VISUAL LOG	REMARKS	DEPTH
85	85.2					massive Ba vein from 84.9 - 85.2 m.						
86								as for Sheet 4				
87												
88	88.2							generally massive 'hydrofractured' or 'hyaloclastic' lavas				
89			D.l. & mnr ibd's D.lb.				as for Sheet 4					
90					as for Sheet 4	as for Sheet 4						
91	91.2			mnr ibd D.lb. from 91.1 - 94.4m.								
92												
93												
94	94.2											
95												
96			96.0			96.0	96.0	96.0				
97	97.2		D.l.b.	gw-gy D.lb. c̄ str Ba/BMS & Py veins & var Se.Si.Py altered. (96.0-98.5m)		abn mass Ba/Sph.Gn.Cpy Py veins & stwk's c̄ BMS up to 90% of vein material & 8-10% total rock.	Sph.Gn Cpy & Py assoc. c̄ Ba veins and stwks as both massive sulphides and as disseminated inclusions. Other Py veins & stwks	mod schistose sch @ 10-20° to LCA				
98			98.5			98.5	98.5	98.5				
99												
100	100.2			gw-gy wk sch Dl. c̄ mnr brecciation and mod to str Ba/BMS veins & var Se.Si.Py alteration. (98.5 - 103.6m)				wk locally schistose massive lavas c̄ 'hydrofractures' & or 'hyaloclastic' features				
101			Dl			as for 76.2 - 96.0m	as for 76.2 - 96.0m					
102												
103	103.2											
104			103.6		103.6	103.6	103.6	103.6				
105				gy sil D.l.b. c̄ mnr Ba/BMS veins & patch sto Se alt^n (103.6 - 106.2 m)	Dev. Si 2-3 & clast controlled Se 1-2 Py 1-2 alt^n	mnr Ba/BMS veins and stwks to 5% total rock	BMS as veins & inclusions c̄ Ba veins. Py as blebs & dis in breccia mix	b. fragments up to 2cm in ∅ dominantly 5-10 mm ∅				

654263

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DIAMOND DRILL LOG

PROJECT : MACKINTOSH EL 106/87

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0363

DEPTH	DRILL RUNS	CORE LOSS	LITHOLOGY: ROCK NAME	LITHOLOGY: DESCRIPTION	ALTERATION	VEINING	MINERALISATION	STRUCTURE	WEATHERING	VISUAL LOG	REMARKS	DEPTH
106	106.2		Dl6. — 106.2		as for Sheet 5 106.2	massive Ba/Ox sulphide vein from 105.6-106.2m 106.2	as for Sheet 5 106.2	as for Sheet 5 106.2				
107				gy-gn massive 'hfd' Dl c̄ pen Se.Si.Mnr Py.Fel alteration 106.2 - 114.2 m								
108												
109	109.2				pen Si2.Se1-2.Py1 alteration. Mnr fer spotting within lavas and in some veins as inclusions	mod to wk Ba/Py/mnr BMS veins & stwks c̄ X-cutting mnr Q/Cl & Q/mnr Sph (DEVONIAN) also Q/Py veins (CAMBRIAN) X-cutting	BMS as veins and incl. in Ba veins. all associated with Ba. Sph inclusions in DEVONIAN Q veins Mnr Py in other CAMBRIAN Q veins and as dis in D.l.	wkly 'hydrofractured'				
110			Dl.									
111												
112	112.2											
113				Petrology @ 113.8m (#431565P)								
114			— 114.2 —		114.2	114.2 massive - veggy Q vein (DEVONIAN) containing Se at D.l clasts from 114.2-114.7 m & 115.2-115.4 m	114.2	114.2				
115	115.2			gy-gn massive Dl & ibd Dl.b c̄ mod Se Si Py alteration & Ba/BMS & DEVONIAN Q veins (114.2-124.4 m)								
116			Dl - Dl.b.									
117					Si2-3.Se1-2.Py1 Mnr rare fer spotting	Ba/Sph.Gn.rare Cpy veins and stwks throughout. Mnr X-cutting DEVONIAN Q veins and also mod Q/Py/mnr Cpy veins	Sph.Gn. Mnr Cp & Py mnr with Ba veins. BMS up to 60-80% of total vein material in places Py/mnr Cpy c̄ mnr Q veins & stwks	generally massive weakly locally schistose massive lavas with patchy 'hydrofracturing' and brecciation				
118	118.2											
119												
120												
121	121.2				121.2	massive Ba/Sph.Gn & mnr Cpy & Py vein from 124.4 - 124.6m						
122					Si2.Se2.Py1							
123												
124	124.2		— 124.6 —	gy-gn variably Si Se altered Y-Dvc (124.6 - 125.2 m)	124.6 mnr fer spotts clasts variably Si Se alt.	124.6 Py/Si BMS/Ba & Se/Si vein & stwks	124.6 Py/Si, Ba/Sph.Gn.Py vns & stwks	124.6 clast ø mnr - 10 cm			for Yvc @ 124.6 - 125.2 clast dom. var. alt. D.l. c̄ mnr Gn? Ba? & Q clasts.	
125			Yvc — 125.2 —	Petrology @ 125.0m (#431566P)	125.2	125.2 massive Q.Py sph.Gn. vein (DEVONIAN) from 125.5 - 125.8m	Massive DEVONIAN Q.Py Sph.Gn. vein from 125.5 - 125.8m	125.2				
126			Dl.	gy-gn var Se Si Py. alt. D.l (125.2 - 141.4 m)	as for Sheet 7	as for Sheet 7	as for Sheet 7	as for Sheet 7				

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DIAMOND DRILL LOG

PROJECT : MACKINTOSH EL 106/87

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DEPTH	DRILL RUNS	CORE LOSS	LITHOLOGY: ROCK NAME	LITHOLOGY: DESCRIPTION	ALTERATION	VEINING	MINERALISATION	STRUCTURE	WEATHERING	VISUAL LOG	REMARKS	DEPTH
127	127	2										
128					Se 1-2 Si 2-3 Py 1 alt^n Py & siliceous alteration halos to Ba/BMS veins & stwks.	Devonian Q/Sph Gn Py vein Ests @ 129.0m, 130.0-130.2, 130.8, 131.8, 137.3, 138.0, 139.2, 129.6 & 139.9m.						
129												
130	130	2										
131					130.8	mod-wk Ba/Sph. Gn. Py. mnr Cpy veins throughout. BMS up to 30-40% of vein material with some veins up to 90% BMS. vein orientation irreg.	dominantly Ba/BMS veins and stwks. BMS => Sph. Gn, Py & mnr Cpy comp up to 90% of vein material					
132				gy-gn var Se Si Py altered D.I. c Ba/BMS Dev Q/Sph Gn & Py veining. (125.2 - 141.4m)				generally massive wkly flowband? or schistose? lavas. wkly 'hydrofractured' with Ba/BMS stwks.				
133	133	2	D1.									
134					dom less siliceous & more sericitic => Se 2-3 Si 2 Py 1. c Si/Py alteration halos to Ba/BMS veins & stwks.	Devonian Q veins contain coarse Sph. Gn & mnr Py and D1 b. fragment. General orientation @ btn 40-70° to LCA. Other mnr Q/Py veins and stockworks. Ba/BMS veins up to 5% Total Rock in places	Massive Devonian Q veins also contain coarse Sph. Gn, Py & rare Cpy as both as inclusion and major vein components					
135												
136	136	2										
137												
138												
139	139	2										
140												
141			141.4	Mnr. Fault @ 141.4m.	141.2	141.4	141.4	141.4			Fault @ 141.4m. 40° to LCA. [Qv c Sph & Gn => Devonian rubble & Se Si Py Argillic alt. D.I pug]	
142	142	2		gy-gn sil Se alt D.I. c mnr Dev Q vein & Ba/Py mnr BMS veins & stwks. (141.4 - 156.7m)	more Argillic alt^d close to fault from 141.4 - 141.9m.	Mass Dev Q @ 142.8m		fault related brecciation from 141.4 - 141.9 Ba stwk to fault breccia				
143					Si 2-3 Se 1-2 Py 1. Mnr Fu spotting throughout siliceous/sericitic halos to some Ba veins. Wavy green Se alteration of fd phenocrysts	mod to wk Ba/Py mnr BMS veins. Distinct lack of Sph Gn & Cpy with Ba veins & stwks in this interval.	noticeably less BMS in Ba veins & stwks. Dom. Ba/Py mnr Cpy Gn & Sph	wkly 'lifd' and schistose				
144												
145	145	2										
146												
147					str Fu/Py spotting @ 148.2m		Ba/BMS veining @ 147.4m.					

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EXPLORATION DIVISION

DIAMOND DRILL LOG

PROJECT : MACKINTOSH EL 106/87

PROSPECT: MT CHARTER

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0365

DEPTH	DRILL RUNS	CORE LOSS	LITHOLOGY: ROCK NAME	LITHOLOGY: DESCRIPTION	ALTERATION	VEINING	MINERALISATION	STRUCTURE	WEATHERING	VISUAL LOG	REMARKS	DEPTH
148	148.2											
149												
150												
151	151.2				as for Sheet 1	as for Sheet 1	as for Sheet 1					
152			D1.					as for Sheet 1				
153												
154	154.2											
155												
156	156.0											
157			156.1 — sh Ba vnd D1. — 157.7	sh Ba/BMS vnd D1. (156.1 - 157.7 m)	156.1	156.1 — str Ba/BMS (Gn. Sph. Py) as vns & stwks 50% total Rock — 157.7	156.1	156.1				
158												
159												
160					Se1-2 Si2 Py1 c̄ mnr fe spotting and Se/Si alteration haloes around some Ba/BMS veins. Fe haloes c̄ diss Py							
161	160.7		D.1	Massive gy-gn Si/D1 c̄ mod to wk Ba BMS veining		mod to wk Ba/BMS veining BMS dom. Gn. Sph & Py in some Ba vein sets. Other Ba veins & stwks almost barren of sulphide	mnr Sph Gn Py associated c̄ some Ba veins and as diss. in D.1.	generally massive to wk schistose				
162												
163												
164												
165												
166	166.7		166.0		166.0	166.0	166.0	166.0	BROKEN GROUND	166		
167			D.16.	gy-gn wk Ba/BMS vnd D.16. (166.0 - 169.1 m)	Se2-3 Si2 Py1. Mnr fe spotting and as alt haloes to some diss Py. Waxy an Se alt of fd phenocrysts	wk-mod Ba/BMS veins and stwks. Some veins c̄ Se/Si alteration haloes	Ba veins c̄ 'zoned' Sph Gn & Py outer rims. Dom sulphide = Py to 30% total vein	wk-mod brecc'd c̄ Ba/BMS stwk.				
168												

654366

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DIAMOND DRILL LOG

PROJECT : MACKINTOSH Ga 106/87

PROSPECT: Mt CHARLES

0390

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DEPTH	DRILL RUNS	CORE LOSS	LITHOLOGY: ROCK NAME	LITHOLOGY: DESCRIPTION	ALTERATION	VEINING	MINERALISATION	STRUCTURE	WEATHERING	VISUAL LOG	REMARKS	DEPTH
160			D.Mb. 160.1	gy-gn var Sc Si Cl alt massive Dl ? tuffs/ lapilli of Dlb and wk Ba/BMS veins + X-cutting Devonian Q/Cl/EMS veins. (160.1 - 191.2 m)	as for Sheet 5 160.1	as for Sheet 5 160.1	as for Sheet 5 160.1	as for Sheet 5 160.1 B.G.	B.G.	160.1		
170	170.1											
180												
190	190.7											
200												
210	210.7											
220												
230												
240	240.7											
250												
260												
270												
280												
290												

Dlb. Ilst from 175.2 - 175.5 m.

Dl

Sa1-2 Cl2-3 Si1-2 Py1-2 Cl/Py/Si alteration halos to some Ba/BMS veins. Also X-cutting & Stk alteration halos to Dl/Dlb contacts

Sa2 Cl2-3 Py1. Py/Si alt halos to Sa veins & stks. Cl alt of fel phenocrysts

Sa1 Si2 Cl2 Py1 + Sh Cl/Py alteration halos to Sa veins & Cl alt of fel phenocrysts

Sa2 Si2 Py1 alt + Py/Si alteration halos to Sa veins & stks

Devonian Q/Cl/Mn Sph. Ga stks from 175.5 - 176.2 m

generally wk irregular spaced + cross-cutting Ba/BMS veins & stks. Generally < 1cm width, with varying amounts of Si/Mn. Other X-cutting Devonian Q/Cl/EMS are mm => cm in 5-10 cm and generally @ 40-50° to CA.

Devonian massive Q/Cl vein from 184.2 - 184.4 m

Massive Ba/Ga/Sph/Py vein @ 184.7 - 185.6 m

Devonian Q/Cl/Sph. Ga vein @ 191.0 m

Mineralisation predom concentrated in Sa veins. Minor Sulphide Py + Sph. Ga in lesser varying amounts. Mn Py/Sh veins & stks. also present.

Coarse Sph & Ga occur with Devonian Q/Cl veins @ 187.0 m.

Mn remarks of Py as disseminations, wall halos to some Ba veins.

A few veins containing up to 30-50% total vein + mm Ba @ 190.0 m

massive Sph Ga Py in Ba vein. BMS to 5% of vein from 194.7 - 195.0 m.

wk brecciated + Cl alt/ fault 174.2 - 176.4 m

generally massive with 'hydrothackered' D. fabric

6543937

Aberfoyle Resources Limited
EXPLORATION DIVISION

DIAMOND DRILL LOG

PROJECT : MACLINTOSH EL 106/87

PROSPECT: MT CHARTER

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0367

DEPTH	DRILL RUNS	CORE LOSS	LITHOLOGY: ROCK NAME	LITHOLOGY: DESCRIPTION	ALTERATION	VEINING	MINERALISATION	STRUCTURE	WEATHERING	VISUAL LOG	REMARKS	DEPTH
190			DI.		as for SHEET 9	Devonian Q/Cl vein @ 190.6 m. as for SHEET 9	as for SHEET 9	as for SHEET 9				
191	190.7		191.2		191.2	191.2	191.2	191.2		191.2		
192			FAULT ZONE	fault zone com. str. Cl3-4 Se1-2 pyritic puggy cleavage DI c mm Ba/BMS veins. (191.2 - 192.4 m)	Cl3-4 Se1-2 Py1 c str Cl development of cleaved surfaces	mm Ba/BMS veining	Ba veins containing some Cpy. Sph Gn & Py	str cleaved c cleavage @ 20-45° to LCA	BROKEN GROUND			
	192.4		192.4			192.4	192.4	192.4		192.4		
193												
194					Se1. Si2. Cl2. Cl alt^n of fd phenocrysts							
195					195.0	massive Dev Q/Cl vein @ 194.7 m.						
196												
197	196.7			gy-gn mass D.I. c mod-to str Ba/BMS & mm Dev Q/Cl/BMS veining & var Se. Si. Cl alteration (192.4 - 215.8 m)								
198						mod-to str Ba/BMS veins & stwks throughout. Also other dominantly Py/Cl/Q veinlets & stwks (Dev?) Ba veins from mm's to >10 cm in thickness.	dom BMS in 2 forms. 1. Irregular Devonian Q/Cl/BMS veins as coarse Sph. Gn mm Py. Not present in all veins.					
199								generally massive wkly hydrofractured DI.				
200			DI.		var Se1-2 Si1-3 Cl1-2 alt^n. Si. Py c Cl alt^n halos to some Ba/BMS veins & stwks.	massive Devonian Q/Cl/BMS (dom Sph. Gn) @ 199.6 m, 200.0 m, 200.6 - 201.0 m & 201.4 m.	2. Ba/BMS stockworks. & veins. Sph. Gn. Py & mm Cpy present in varying amounts up to 30-40% of TOTAL VEIN. These Ba/BMS veins comprise approx 2-3% of TOTAL ROCK					
201												
202												
203	202.7					mass Ba/mm BMS vein @ 204.2 - 204.4 m, 206.1 m, 210.2 m & 211.8 - 212 m.						
204												
205												
206							massive coarse Sph & Gn c Devonian Q/Cl veins @ 199.6 & 200.6 - 201 m up to 80% of TOTAL VEIN					
207												
208							coarse Sph c Gn rims in mass. Ba vein @ 204.2 - 204.4 m.					
209	208.7											
210					210.3							

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EXPLORATION DIVISION

DIAMOND DRILL LOG

PROJECT : MACKINTOSH CL 106/87

PROSPECT: MT CHARTER

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DEPTH	DRILL RUNS	CORE LOSS	LITHOLOGY: ROCK NAME	LITHOLOGY: DESCRIPTION	ALTERATION	VEINING	MINERALISATION	STRUCTURE	WEATHERING	VISUAL LOG	REMARKS	DEPTH
211												
212												
213			Dl.		Se1-2 Si2-3 alt^{n} & Si Py alt^{n} haloes to Ba/BMS veins and patchy Py1 alt^{n}	as for Sheet 10	as for Sheet 10	as for Sheet 10				
214												
215	214.7											
216			215.8		215.8	215.8	215.8	215.8		215.8		
217			str Ba/BMS vnd Dl.	gy-gn Si Se Py alt^{d} hydrofractured Dl. (or D.lb.) & str Ba/BMS veins & stwks. (215.8 - 218.4 m)	Se1-2 Si3 Py1-2 & Se alt of fd phenocrysts Some Si/Py alt haloes to vns.	str banded Ba/BMS vns & stwks. Up to 90% TOTAL ROCK Other Py veins abaear as alt^{n} haloes to Ba/BMS vein sets	banded Ba/BMS veins with coarse Sph. Gn. Mnr Cpy as central core with Ba outer rim. Py veins & alteration as outer haloe. BMS to 15-20% TOTAL VEIN.					
218			218.4	PETROLOGY @ 217.6 m (# 431567P)		218.4	218.4					
219												
220								wk to mod. hfd depending on intensity of veining	SPLIT CORE			
221	220.7		Ba/BMS vnd Dl.	gy-gn massive Dl. & mod to str Ba/BMS veins. (218.4 - 223.3 m)		Ba/BMS irreg. veins & stwks up to 10% TOTAL ROCK	mod to str Ba/Sph. Gn. Cpy veins & stwks. Strong development of temp. zonation of sulphides BMS to 50-60% TOTAL VEIN					
222												
223			223.3	PETROLOGY @ 224.5 m (# 431568P)	223.3	223.3	223.3					
224			str Ba/BMS vnd Dl.	gy-gn str hfd Dl & str Ba/BMS vns & Se Si Ba BMS? alt^{n} (223.3 - 225.3 m)	str Se3 Si3 BMS? 2-3 alt^{n} of remaining lava fragments Si Py Se alt^{n} haloes to vns.	str Ba/BMS massive vns & stwks. Ba/BMS to 30% TR av. ~15% TR	str Ba/BMS massive veins and stwks & Ba/Gn? alt^{n} of Dl. BMS => Cpy. Sph. Gn Py to 60-70% TOTAL VEIN					
225			225.3		225.3	225.3	225.3	225.3		225.3		
226						mass Dev Q/Cl/BMS & CAMBRIAN Ba/BMS vein @ 231.7 - 231.9 m.						
227	226.7		Dl.	gy-gn mass Dl & Se/Si/Cl alt^{n} and mnr BMS/Ba & Dev Q/Cl/BMS veins & stwks. (225.3 - 245.7 m)								
228					var. Se1.Cl1-2.Si2-3 alt^{n} of Dl. Some Si/Py & Cl/Si/Py alt^{n} haloes to Ba/BMS vns.	Mnr Ba/BMS veins & stws with BMS generally < 5% TOTAL VEIN Other Dev Q/Cl/Mnr BMS throughout. up to 10 cm thick. commonly < 1 cm.	Almost totally confined to Ba veins & stwks. BMS as Sph. Gn. Py & mnr Cpy. in most cases < 5% TOTAL VEIN. Coarse Sph & Gn in Dev Q/Cl veins.	generally massive tavas. locally hfd with Ba & Q/Cl veins.				
229												
230								str brecciated @ 230.2 by Dev Q/Cl veins.				
231												

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DIAMOND DRILL LOG

PROJECT : MACKINTOSH CL 06/87

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DEPTH	DRILL RUNS	CORE LOSS	LITHOLOGY: ROCK NAME	LITHOLOGY: DESCRIPTION	ALTERATION	VEINING	MINERALISATION	STRUCTURE	WEATHERING	VISUAL LOG	REMARKS	DEPTH
232					as for Sheet 11							
232.7				Peridotite @ 232.5 m (& 233.50 m)	232.2							
233					Pervasive Sa1. "spotty" Cl. Si alt^n							
234					234.0							
235						as for Sheet 11						
236												
237			Di.				as for Sheet 11	as for Sheet 11				
238												
238.7												
239												
240					patchy variable Sa1-2 Si2-3 Cl 1-2 ful alt^n some Py-Si alt^n haloes to Ba|BMS veins Many green Sa alt^n of Fd phenocrysts	mass Dev'n Hbl Cl/Cl mm BMS vn @ 237.7 - 239.9 m.	mm Cpy in Dev'n Q vn @ 237.7 m					
241												
242												
242.7												
243												
244												
244.7												
245												
245.7					245.7	245.7	245.7	245.7				
246			Str Ba|BMS vnd Di.	gy-gn str Ba|BMS vnd Di.	Sa1-2 Si2 Py1 alt^n Py Si Sa Ba? alt^n haloes to some veins	str Ba|BMS veins & stwks up to 50% TOTAL ROCK average 20-25% TOTAL ROCK	tourmalinisation assoc'd str Gn. Sph Py mm ± Ba veins. Total sulphide approx 35-40% TOTAL VEIN	var hbl depend on intensity of veining				
247												
248												
249					249.0	249.0	249.0	249.0				
249.0												
250				gn mass vfg - mod Ba|BMS vnd Di (249.5 - 252.9 m)	Sa1-2. Si2. mm Cl alt^n, Si Py alt^n haloes to Ba|BMS veins	dom mod. Ba|BMS vns. 5-10% TOTAL Rock	dom Py ± mm Sph Gn & Cpy in Ba veins total sulphide approx 15% TOTAL VEIN	generally wkly hbl Dacite texture				
250.7			Di.			251.6		251.6				
251												
252												

STRUCTURE: CORE LOST

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DIAMOND DRILL LOG

PROJECT : MACKINTOSH EL 106/87

PROSPECT: MT CHAFFER

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DEPTH	DRILL RUNS	CORE LOSS	LITHOLOGY: ROCK NAME	LITHOLOGY: DESCRIPTION	ALTERATION	VEINING	MINERALISATION	STRUCTURE	WEATHERING	VISUAL LOG	REMARKS	DEPTH
253												
254												
255					perv. wkly gn chlorite alt^n of fd phenos							
256												
257	256.7		D.I.		as for SHEET 12	wk Ba/BMS vnc & stwks to 2-3% TOTAL ROCK Mnr Py veinlets & stwks	as for SHEET 12	generally massive lavas c̄ wk hydrofracturing in areas of stronger Ba/BMS veining			F@ 257.2-257.4m @ 40-45° to LCA [broken Cl/Py alt^d D.I. rubble c̄ str. Cl devel^t on cleavage surfaces]	
258												
259												
260					260.1							
261					Si 1-2. Se 1 Cl 1-2 c̄ Si/Py alt^n haloes to some Ba/BMS veins							
262	262.0											
263			262.9		262.9	262.9	262.9	262.9				
264			var Se/Si alt^d Yvc	gn-gn variably Se. Si altered Yvc c̄ mnr mass. ibd Dlb. & mnr Ba/BMS veining. (262.9 - 265.8 m)	variable clast related Si 1-3 Se 1-3 alt^n		Py as clots/intergrowths in vlcl mtx.	clast size gen to 5-10 mm ø. Up to 3-4 cm				
265				PETROLOGY @ 265.6 m. (# 431570P)								
266			265.8		265.8		mnr Py. Sph & Gn in Ba veins to 5% TOTAL Vein. Mnr Py c̄ Q veins & stwks	265.8				
267			D.I.	gy mas wk hfd D.I (265.8 - 266.9 m)	Si 2-3 Se 1-2 alt^n	wk Ba/mnr BMS veining < 1% TOTAL ROCK Mnr rare Q/Py veins & stwks						
268			266.9		266.9			266.9				
269	268.5			gy-gn ibd Dlb. & D.I.v./D.b.v. (266.9 - 288.5 m)								
270			ibd Dlb & Dlv.		var Si 1-3. Se 1-2 alt^n of clastic material. More Si 2-3 alt^n of Dlb. c̄ stronger Si 3-4 alteration haloes around breccia fragments			clasts size in vlcl range from 2-3 m ø to 5 cm ø			Dlb. appears as post deposition hydrofracturing rather than hyaloclastite textures.	
271												
272						271.9	271.9					
273						as for SHEET 14	as for SHEET 14					

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DIAMOND DRILL LOG

PROJECT : MACKINTOSH EL 106/81

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0371

DEPTH	DRILL RUNS	CORE LOSS	LITHOLOGY: ROCK NAME	LITHOLOGY: DESCRIPTION	ALTERATION	VEINING	MINERALISATION	STRUCTURE	WEATHERING	VISUAL LOG	REMARKS	DEPTH
274					273.7							
275	274.7				str per. Se 2-3. Si 2 alt^n of Dl & vlcl clasts Mnr patchy Py 1 alt^n	wk to mod Ba/mnr BMS veining & strks. Upto 3% Tonal Rock. Mnr Py veinlets. Ba invades vlcl. mtx in some places						
276												
277					277.7							
278												
279												
280			ilcl Dlb. & Dlv & Dlv.				Sph Cpy & Py associated with Ba veining. BMS & Py content of veins varies from < 1% to > 90% in some cases General tendency for Ba veins to be barren at top end of this interval Mnr Py veinlets & diss^ns	as for SHEET 13				
281	280.7					281.7						
282					patchy Si 2-4. Se 2-4 Py 1 alt^n in both Dlb & Dvlcl. => clast related in vlcl material							
283												
284												
285						mod to str. Ba/BMS veins & strks to 5% Tonal Rock						
286												
287	286.7											
288			288.5		288.5	288.5	288.5	288.5				
289												
290												
291	291.2		FAULT ZONE	FAULT ZONE containing both Dlb. and Dvlcl rubble which is generally strongly argillic. altered. (288.5 - 295.0 m)	strong argillic (Se?) 3-4 Si 1-2 Py 2-3 alteration of rubble material	Ba/BMS & Qtz Py veining in rubble material	mnr Sph. Cpy. Py c̄ Ba vns abn Py as disseminations & with Q veins	badly broken wkly and rubble vlcl fragments to 2-3 cm ø	BROKEN GROUND		FAULT ZONE @ 288.5 - 295.0 m (Dlb. & Dvlcl (str altered) c̄ mnr Ba/BMS and Q rubble)	
292												
293												
294	293.0											

654372

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DIAMOND DRILL LOG

PROJECT : MACINTOSH EL 1006/97
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DEPTH	DRILL RUNS	CORE LOSS	LITHOLOGY: ROCK NAME	LITHOLOGY: DESCRIPTION	ALTERATION	VEINING	MINERALISATION	STRUCTURE	WEATHERING	VISUAL LOG	REMARKS	DEPTH
295.0			FAULT ZONE		ctc fr. Sheet 14	295.0	295.0	295.0				
296.1			Dl.	gy-gn massive hfld Dl. ± mod Sa.Si alteration & musc. Ba/BMS veins & stwks (295.0 - 303.8m)	var Sa 2-3 Sil-2 Pyl ctd in ± Si.Py alteration halos ± at veinlts and boundaries of Dlb. fragments	wk to mod Ba/BMS vns & stwks. Major vein set up to 2 cm in thickness & @ ± 20% to CA	Py, mnr Sph & Gn ± Ba veinlts & stwks up to 40% of 10cm vein Mnr blebs & diss of coarse Py	wk hfld.				
303.8					303.8	303.8	303.8	303.8				
306.1			Mod Dlv/Dbv.	gy-gn var SaSi alt Dlv & Dbv ± sch - mod Ba/BMS veins & stwks (303.8 - 306.1 m)	var dist related Si 2-3. Sa 2-3 alt in mm to cloudy & dir halos to Ba/BMS veins	str Ba/BMS & Py veins & stwks to 10% 10cm Rock	coarse Sph & Gn ± mnr Py as inclusions & bands in Ba veins & stwks up to 50% BMS in places	clasts from 1-5 mm ø to up to 10 cm ø				
306.1					306.1	306.1	306.1	306.1				
				Recovery @ 308.0 (Ht 431511P)	Si 1-2 Sa 1-2 mnr Pyl							
310.1			Dl.	gy-gn var SaSi altered hfld Dl ± wk Ba/BMS & Dev. @ BMS vns (306.1 - 312.4 m)	306.1	wkm Ba/BMS & DEVONIAN @ BMS veins & stwks	Py/mnr BMS (Sph & Gn) in Ba vns. Coarse Sph & Gn ± DEVONIAN @ veins	wk hfd				
312.4					Sil Sa 2-3 Pyl ± Sa alt in of fit/chip stems							
			Dlv.	gy-gn Dlv & mnr Dbv ilet's (312.4 - 314.1 m)	312.4	312.4	312.4	312.4				
314.1					Sa1 Sil-2 alt in Si.Py alt halos to clasts & bled frags & Ba/BMS vns	wk Ba/BMS Py & rare Dev @ BMS veins to 1% Tonne Rock	as for Sheet 16	clasts from 2-3 mm ø to 2-3 cm ø				
			Dl./Dl.b.	gy-gn var Sa.Si alt of Dl/Dl.b. ± mod to wk Ba/BMS veining (314.1 - 328.5 m)		mass Ba/mnr BMS to 5 cm thick @ 313.7 & 315.0 m		314.1				
								as for Sheet 16				

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DIAMOND DRILL LOG

PROJECT : MACKINTOSH KL 106/87

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0373

DEPTH	DRILL RUNS	CORE LOSS	LITHOLOGY: ROCK NAME	LITHOLOGY: DESCRIPTION	ALTERATION	VEINING	MINERALISATION	STRUCTURE	WEATHERING	VISUAL LOG	REMARKS	DEPTH
316												
317	316.7											
318												
319					as for Sheet 15							
320												
321							Sph. Gn. Py & Cpy c̄ Ba veins. up to 15% TOTAL VEIN. Coarse Py. mnr Sph & Gn c̄ DEV Q veins	wk to mod hfd				
322			D.l./D.lb.			as for SHEET 15						
323	322.7											
324												
325					325.2							
326												
327					Si 1-2 Se 2-3 mnr Py dtn c̄ Si Py dtn halos to Ba/BMS veins & rims to br. frags							
328												
329	328.7		D.l.v. 328.9 / 329.4	gy-gn D.l.v c̄ mnr BMS/Ba vns & stwks (328.9 - 329.4)	328.9 var dark related Si 1-2 Se 1-2 / 329.4	329.4		328.9 darts to 2cm ø / 329.4				
330												
331												
332												
333			D.l/D.lb.	gy-gn D.l/D.l.b. c̄ mnr Ba/BMS & DEV Q/mnr BMS veins & stwks (329.4 - 341.8 m)	patchy Se 1-2 Si 2-3 dtn Si Py dtn rims & halos	mod to str Ba/BMS Py veins & stwks. Mnr DEV Q/BMS veins		mod to wk hfd				
334												
335	334.7					str Ba/BMS Py vn & stwks 335.0 - 336.3 m						
336												

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DIAMOND DRILL LOG

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DEPTH	DRILL RUNS	CORE LOSS	LITHOLOGY: ROCK NAME	LITHOLOGY: DESCRIPTION	ALTERATION	VEINING	MINERALISATION	STRUCTURE	WEATHERING	VISUAL LOG	REMARKS	DEPTH
337						as for sheet 16	as for sheet 16					
338						337.0	337.0					
339												
340								as for sheet 16				
341	341.7											
342			Dl./Dlb.		as for sheet 16	wk Ba/mm BMS & Py veins & stwks. Also wk Dev? Q/mm BMS veins & stwks. mod (<5mm thick) stwks of dom. Py c̄ Si/Se alt^n halos throughout.	only mm to rare amounts of Sph & Gn c̄ both Ba & Q veins. Dominant mineralisation is Py as veinlets & stwks <1-2% total sulphide in core.					
343												
344												
345												
346												
347	346.7		346.8		346.8			346.8				
348												
349			mxd seq Dlv, Dlb & Dl	gy-gn mxd seq Dlv., hfd Dlb & mm Dl c̄ str var Si Se alt^n & wk to strong Ba/BMS & Q (Dev) stwks (346.8 - 353.4 m)	str serv. Si 2-4 Se 1-2 alt^n of entire sequence Clasts in both vld & lb. May be var Se Si alt^d. Some Se Si alt^n halos to veins & as rim in Dlb clasts. Waxy gn se alt^n of fd phenocrysts	350.1						
350								lapilli vld clasts to 10mm ø generally < 5mm ø. wk to mod hydrofracturing in Dlb.				
351						dom str Q (Dev?) veins and stwks. Only mm Ba/rare BMS veinlets.						
352				PETROLOGY @ 352.7m (# 431572 P)								
353	352.7		353.4			353.1	353.1	353.1				
354							abn Cpy/mm BMS c̄ Q veining from 354.4 - 354.6m					
355			Dl./Dlb.	gy wk hfd var Se Si alt^d Dl & Dlb c̄ mm ibd Dlv. & str Ba/BMS veins (353.4 - 356.9m)		mod to str Ba/BMS & Py veins & stwks. Mm Q & Q Py veins	abn Sph Gn Cpy & Py c̄ Ba veins & stwks. Also where Py c̄ Q vein systems BMS to 80-90% total vein in places	Cpy, Sph & Gn c̄			massive Gn. Sph. Py mm Cpy. Ba vein from 355.0 - 355.6m upto 90% BMS in VEIN MATERIAL	
356												
357								wkly hfd			massive Ba mm Sph Gn vein from 355.7 - 356.1 m	

654375

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DIAMOND DRILL LOG

PROJECT : MACKINTOSH 6 106/87

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0375

DEPTH	DRILL RUNS	CORE LOSS	LITHOLOGY: ROCK NAME	LITHOLOGY: DESCRIPTION	ALTERATION	VEINING	MINERALISATION	STRUCTURE	WEATHERING	VISUAL LOG	REMARKS	DEPTH
358			Dl/Dlb.					as for Sheet 17				
359	358.7		358.9			as for Sheet 17	as for Sheet 17	358.9				
360					as for Sheet 17							
361			mixd seq Dl.v. & Dlb	gy-gn mixd seq. Dl.v. & Dlb. c̄ wk Ba/mnr BMS veins & Py stwks to some vlcl units. (358.9 - 364.3 m)				wk to mod. shd vlcl clasts gen to 5 mm ø up to 2 cm ø lava breccias wk hfd.				
362					wk fn spotting from 361.8 - 364.3 m.	361.8	361.8					
363						mnr Ba & Q veins. Str Py stwks to some vlcl units	only mnr BMS in Ba vns. str Py c̄ Q veins & as stwks to some vlcl units				F @ 364.3 - 364.7 m @ 50° to LCA [Cl.Se.Py alt D.l]	
364			364.3	FAULT ZONE c̄ Se.Cl.Py alt Dl. pug (364.3 - 364.7 m)	364.3	364.3	364.3	364.3			NOTE: 364.3 appears to be end to Ba/BMS veins & stwks	
365	364.7		364.7		364.7	364.7	364.7	str shd & 364.7 broken			⇒ Fault truncated	
366												
367			Dl.	gy-gn hfd Dl c̄ var. Cl Si Se alt^n & str Cl stwks	var Si 1-2 Se 1. Py 1-2 & Cl 1-2 alt^n. Py appears to be related to intensity of Si alt^n	mnr rare Q/Cl Str. fine Cl stwks throughout. Cl stwks appear to have pyritic rims or alt^n halos.	diss Py as alt^n associated c̄ Si. Py as alt^n rims to Cl stwks. Some Py stwks in hfd lavas.	wk to mod shd & hfd c̄ Cl stwks		BROKEN GROUND @ 364.3 - 364.7 m.		
368												
369	368.8		369.0		369.0	369.0		369.0				
370												
371				PETROLOGY @ 372.7 m (#431573P)								
372				gn-gy Tvc c̄ var Si Se Cl alt^n of clasts and var perv Si Cl alt^n c̄ mnr Cc veining (369.0 - 371.0 m)	perv patchy Cl 1-2 Si 1-2 alt^n. var Si Se Cl alt^n of clastic material. Se alt^n of fd phenocrysts in some clasts	mnr Cc veins & stwks. Rare Py veinlets mod Cl veining	mnr Py as rare veinlets and as intergrowths in vlcl material	wk to mod shd c̄ clearage gen. ~20-30° to LCA. clast sizes range from 2-3 m to 5 cm ø				
373	373.7		shd Tvc									
374								375.9				
375												
376												
377			377.0		377.0	377.0	377.0	377.0 376.9				
378			Dlb. 378.1	gy-gn hfd Dlb. (377.0 - 378.1 m)	Se 1-2 Si 2 alt^n. Mnr Se alt^n of fd phenos 378.1	mnr Cc/Cl veins & stwks 378.1	mnr Py diss at breccia margins 378.1	mod hfd 378.1	Stem cake			
					as for Sheet 19	as for Sheet 19	as for Sheet 19	as for Sheet 19				

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PROJECT : MACKINTOSH EL 1006/87

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EXPLORATION DIVISION
DIAMOND DRILL LOG

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DEPTH	DRILL RUNS	CORE LOSS	LITHOLOGY ROCK NAME	LITHOLOGY DESCRIPTION	ALTERATION	VEINING	MINERALISATION	STRUCTURE	WEATHERING	VISUAL LOG	REMARKS	DEPTH
380												
381												
382	382.1											
383				gn dom. dacitic tuc ± minr A-B rich units (382.1 – 384.2 m)	var. Sa1-2 Si1-2 Cl1 ful alt^{n} of clastic material. ± Sa-Si alt^{n} dominant in more felsic rich zones & Cl ful dom in mafic zones	minr Ca/Cl veining and most fine Cl stkrs.	minr disc blebs Py interstitial clastic interfaces	wk to mod sch ± cleavage @ 20 to 40° to LCA				
384	384.2			Petrology @ 382.1 m (#431514P)	384.2	384.2	384.2	384.2			POSSIBLE ƒ @ 384.2 @ 20° to LCA	
385				gn var Ca Si ful altered vas B1b or B/dcl? ± minr ilds of tuc (384.2 – 387.8 m)								
386												
387			ilds vas B1b & tuc.									
388						most – wk Ca veins. Minr Qveinlets & Ca infill of vesicles. Some Cl ± Q & Ca veins. as both laths/frags & inclusions	gn minr Py as blebs interstitial/recrystallised in bt & dcl interfaces cons Py veinlets	wk – mod dvd ± cleavage @ ~40–45° to LCA.				
389	388.8			Petrology @ 389.5 m (#431515P)	388.8		str Py mineralisation (60%) from 387.4 – 387.6m. Possibly recrystallised by dynamothermal metam. ⇒ interstitial intergrowth					
390					patchy Ca 2-3 ful-Cl1-2 alt^{n} as both pervasive & clast related alt^{n}							
391	391.8		tuc	gn var Ca Sa Si ful alt^{n} tuc ± minr Q & Ca veining (391.8 – 398.0 m)	391.8	391.8	391.8	391.8				
392	392.0		FAULT ZONE	str shd & broken FAULT ZONE ± argillic alt^{n} tuc. (398.7 – 399.1 m)	gn clast related Ca Sa 1-3 ful-2 Si1-2 Cl1 alt^{n} 398.0 str clear cont. argillic 2-3 alt^{n}	as for Sheet 20	as for Sheet 20	392.0 wk shd. 398.0 rubbly broken str stained ±				
393												
394												
395												
396												
397												
398												
399												

BROKEN GROUND FROM 382.2 – 384.2 m

BROKEN GROUND @ 398.0 – 398.7 m

[ƒ @ 398.0 – 398.7 m @ 40° to LCA ± str argillic alt^{n} tuc frag]

6543771

Aberfoyle Resources Limited
EXPLORATION DIVISION

DIAMOND DRILL LOG

PROJECT : MACKINTOSH EL 106/87

PROSPECT : MT CHARTER

HOLE NO: MAC-26

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DATE: 5/7/90

0377

DEPTH	DRILL RUNS	CORE LOSS	LITHOLOGY: ROCK NAME	LITHOLOGY: DESCRIPTION	ALTERATION	VEINING	MINERALISATION	STRUCTURE	WEATHERING	VISUAL LOG	REMARKS	DEPTH
400			FAULT ZONE 399.7		as for sheet 19 399.7			cl @ 35-50° to LCA 399.7				
401	401.4											
402						mnr Cc/Cl & Q/Cl veining & stuks						
403	403.1		Yvc	gn var SaSiFuCc alt'd Yvc c mnr Q/Cl & Cc veining (399.7 - 408.8 m)	gen Clast related Sa1-3 Si1-2 Fu1-2 alt'n Mnr patchy pen. Cc alt'n		Mnr recrystallised Py intergrowths as blebs and disseminations	wk shd c clast sizes from 2-3 mm ø up to 4-5 cm ø				
404												
405												
406												
407	407.4											
408			408.8		408.6	408.8	408.8	408.8				
409	409.7		D.L. 410.0	gy-gn var SaSiClCc alt'd DL (408.8 - 410.0 m)	Sa1-2 Si1-2 & patchy Cc alt'n 410.0	str Q/Cl veining @ 409.8 m.						
410												
411												
412												
413				gn-gy hfd DI c SaSi mnr FuPy alt'n & mnr Q/Cl & Cl/Py stuks & veins (410.0 - 426.3 m)	dom Sa1-2 Si1-2 Py1 alt'n c SiPy alt'n halos to Cl/Py stuks & Sa alt'n of fd phenocrysts. Mnr Fu spotting	gen wk Q/mnr Cc & Cl veins up to 10-15 mm in thickness. Mod thin Cl/Py veinlets & stuks throughout entire sequence	Mnr Py as alt'n disseminat'n and in Cl/Py stuks and (<2% total rock) as alt'n halos to these veins.					
414			DI c mnr Yvc ild's									
415	415.7			Note mnr. Yvc unit 413.8 - 414.0 m				wkly hfd c Cl/Py stuks				
416												
417												
418												
419												
420												

654278

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EXPLORATION DIVISION

DIAMOND DRILL LOG

PROJECT : MACKINTOSH EL 106/87

PROSPECT: MT CHARTER

HOLE NO: MAC-26

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DATE: 9/7/90

0378

DEPTH	DRILL RUNS	CORE LOSS	LITHOLOGY: ROCK NAME	LITHOLOGY: DESCRIPTION	ALTERATION	VEINING	MINERALISATION	STRUCTURE	WEATHERING	VISUAL LOG	REMARKS	DEPTH
421												
422	421.7											
423												
424												
425												
426			Dl.									
427					as for SHEET 20	as for SHEET 20	as for SHEET 20	as for SHEET 20				
428	427.7											
429												
430												
431												
432				PETROLOGY @ 432.1 m (# 431482 P)								
433												
434	433.7											
435												
436			436.3		436.3	436.3	436.3	436.3				
437				gy-gn var SiSe alt^d Dlb. c mnr Cc, Q & Py veins & stwks. (436.3 - 439.5 m)	str Si 2.3 Se 1.2 Py 1 alt^n other clast related Se Si Py alt^n Si Py alt^n halos to veins	dom mnr Q, Q/Cl, Cc & mnr Py veins & stwks throughout.	mnr Py as disseminations in Dl clast and as fine Py veins & stwks.	gen. angular fragments c diam ranging from 5 m to 4-5 cm				
438			Dlb.									
439												
440	439.7		439.5		439.5	439.5	439.5	439.5				
441			Dl. c mnr lbd of Dlv.	gn-gy var SiCl alt^d Dl c mnr lbd Dlv. & Q, Cc, Cl & Py veins & stwks (439.5 - 454.9 m)	as for SHEET 22	as for SHEET 22	as for SHEET 22	as for SHEET 22				

654379

PROJECT : MACKINTOSH (& HOLDEN)

PROSPECT: MT CHARLES

Aberfoyle Resources Limited
EXPLORATION DIVISION
DIAMOND DRILL LOG

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DEPTH	DRILL RUNS	CORE LOSS	LITHOLOGY: ROCK NAME	LITHOLOGY: DESCRIPTION	ALTERATION	VEINING	MINERALISATION	STRUCTURE	WEATHERING	VISUAL LOG	REMARKS	DEPTH
442												
443												
444												
445												
446	446.7				pervasive Si 1-2, Cl 1-2 Py 2 some Si Sa alt^{n} haloes to Py & Q/Cl veins. Some Cl/k Si alt^{n} of fd. phenocrysts							
447												
448	448.7				448.6							
449												
450	449.9					mm Q, Q/Cl/Cc, Cc/Cl & Py/Cl veins & shaks throughout.	Py as alt^{n} blebs & dissemination after Py veins and shaks throughout.	generally massive tidy bed DI.				
451			DI = mm bed of DIV.									
452				PETROLOGY @ 451.5 m (# 431402P)	pervasive Si 1-2 Cl 2 Py 1-2. some Si Sa alt^{n} haloes to Py veins. Elsewhere halos may be Cl Sa & Cl alt^{n} of fd phenocrysts							
453												
454	454.7				454.9		454.9	454.9				
455												
456			YVC	gn dtc Sa Si Cl alt^{n} YVC = mm Cc, Q/Cl & Py/Cl veins & shaks (454.9 - 457.5 m)	clast related Cl & Sa Si alt^{n} Mm fg scalloping in some clasts. Pervasive Si 1-2 Cl 1-2 alt^{n}			Recrystallised aggregates of coarse fg. < 1% of total Rock. Mm Py with Py/Cl veins & shaks	clast size from 1-2mm ϕ to 1-4cm ϕ			
457					457.5			457.5				
458												
459				gy-gn massive wk-fp DI = mod Si Cl alt^{n} and Cc, Q, Cl/Py veins & shaks (457.5 - 462.0 m)	dom pervasive Cl 1-2 Si 1-2 alt^{n} / Sa & Cl alt^{n} of fd phenocrysts. Si Cl alt^{n} haloes to veins and fr's			Py as alt^{n} blebs & discs. Found in Py/Cl veins < 1% in TOTAL ROCK	gen wkly bfd. Some wkly schistose & cleavage 30-50° to LCA in places			
460	460.7		DI									
461												
462												

Drill core, NQ, 447.1 - 462.0 m

447.1 - 447.3 m @ 30-35° to LCA. [Cl Sa Si alt^{n} shd DI rubble]

447.8 - 448.0 m @ 25° to LCA [Sa Si Cl alt^{n} shd DI rubble]

65423 80

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DIAMOND DRILL LOG

PROJECT : MACKINTOSH CA 106/87
PROSPECT: MT CHARGER

0380

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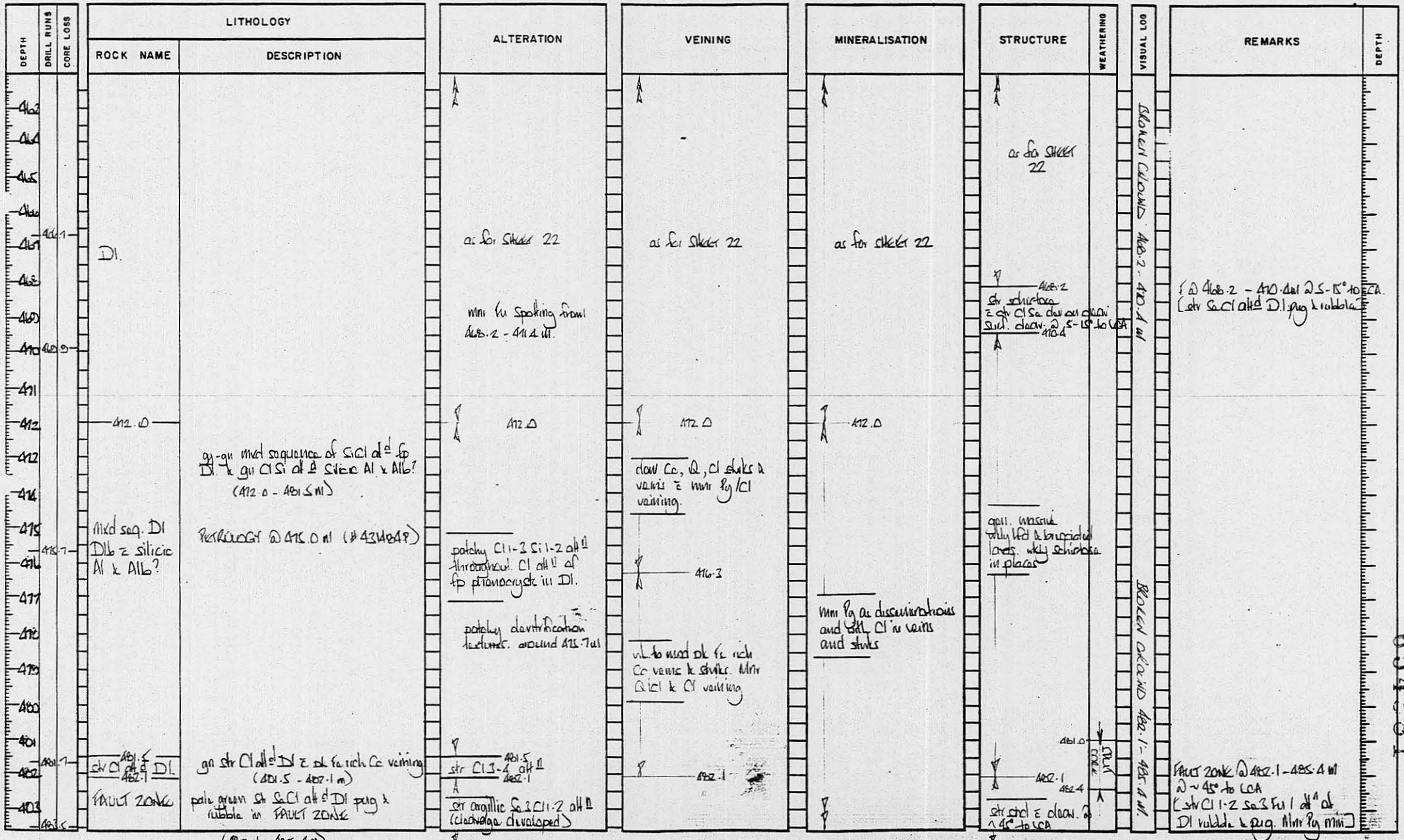

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EXPLORATION DIVISION

DIAMOND DRILL LOG

PROJECT : MACKINTOSH EL 106/87

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0381

DEPTH	DRILL RUNS	CORE LOSS	LITHOLOGY: ROCK NAME	LITHOLOGY: DESCRIPTION	ALTERATION	VEINING	MINERALISATION	STRUCTURE	WEATHERING	VISUAL LOG	REMARKS	DEPTH
484			FAULT ZONE		as for sheet 23			as for sheet 23				
485	484.7		485.4		485.4	485.4	as for sheet 23.	485.4				
486	485.9					wk Py/Cl veins & mnr Cc Q veins & stwks. Fine Cl stwks throughout.		wk brecciated around 486.5 - 488.9 m				
487	487.7			gy-gn var Cl. Si. Se att^d massive Dl. c̄ Cl/Py & Q/Cc veins & stwks (485.4 - 505.3 m)		488.5	488.5					
488						str Cl/Py/mnr Q veins & stwks to 20% TOTAL ROCK	str coarse Py in Cl/Q stwks 50-60% TOTAL VEIN					
489						490.1	490.1					
490			Dl									
491	490.7				dom Sel Si 2-3 Py 1-2 perv. att^n. Mnr Fu spotting Cl? att^n of Fp phenocrysts and Si att^n halos to Py/Cl veins & stwks	mod fine Cl/Py veins & stwks. Also less regular Q/Cc/Hm veinlets. Mnr amounts of Fu in some veins.	Mnr Py as disseminations c̄ att^n & c̄ Cl & Q veins & stwks	gen massive Dl. wk schistose in places. local brecc^n				
492												
493												
494												
495												
496												
497	496.7											
498						498.5	498.5					
499						str Cl/Py/mnr Q stwks to 10% TOTAL ROCK	str coarse Py c̄ Cl/Q stwks. 50-70% TOTAL VEIN					
500	500.2					499.8	499.8					
501												
502	502.1				502.1	mod to str fine Cl stwks & mnr Cc/Cl & Cl Py veins & stwks. Rare Q/Cl veins	Mnr Py as att^n disseminations elsewhere c̄ Cl veins & stwks					
503					per Cl 1-2 Si 1-2 Py att^n c̄ Si att^n halos to some veins							
504					str Fu att^n 504.3 m.							

654282

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DIAMOND DRILL LOG

PROJECT : MACKINTOSH Ea 106/87

PROSPECT: MT CHARLES

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DEPTH	DRILL RUNS	CORE LOSS	LITHOLOGY: ROCK NAME	LITHOLOGY: DESCRIPTION	ALTERATION	VEINING	MINERALISATION	STRUCTURE	WEATHERING	VISUAL LOG	REMARKS	DEPTH
S05	S05	1	D.1	gn.cl. ves Bl ± wk bwnd Qtz vnlts ± stvlts ± wm limits of Blb. (S05.0 - S10.6 m)	as for sheet 2A	as for sheet 2A	as for sheet 2A	as for sheet 2A				
S06			S05.3		S05.2	S05.3	S05.3	S05.1				
S07												
S08	S08	3										
S09												
S10												
S11												
S12	S11.6		ves. Bl. ± wm Blb.	PETROLOGY @ S12.5 m (#431405?)	dom pard Cl1-2, Py1 ah!! ± Cc & Q infill of vesicles.	dom.wnd Qtz Cc veins and stvlks	wm Py dissem in some Qtz Cc veins & stvlks. Occasional aggregates of recrystallised coarse Pyrite in Bl.	sth brecciated in Qtz Cc. Sil. ± Cl ± Cc/Q/wm Py stvlks !				
S13												
S14												
S15	S15	2										
S16												
S17												
S18												
S19												
S20												
S21	S20	1										
S22												
S23	S23	0										
S24												
S25												

sth brecciated in Qtz Cc. Sil. ± Cl ± Cc/Q/wm Py stvlks !

agn massive Bl ± vesicular. Wkly schistose and brecciated in places

654883

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DIAMOND DRILL LOG

PROJECT : MACHUNTOSH Co 10/87
PROSPECT: MT CHRISTIE

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0330

DEPTH	DRILL RUNS	CORE LOSS	LITHOLOGY: ROCK NAME	LITHOLOGY: DESCRIPTION	ALTERATION	VEINING	MINERALISATION	STRUCTURE	WEATHERING	VISUAL LOG	REMARKS	DEPTH
S25												
S26												
S27												
S28												
S29	S29.1											
S30												
S31												
S32												
S33												
S34			Bl ± minor bod's of Blb.	Petrology @ S33.1m (# 431487P)	as for Sheet 25	as for Sheet 25	as for Sheet 25	as for Sheet 25				
S35	S35.7											
S36												
S37												
S38												
S39												
S40												
S41												
S42	S41.7											
S43												
S44												
S45												
S46												

S30.6

Bl ± minor bod's of Blb.

Petrology @ S32.1m (# 431488P)
gn-gy sil Dl ± minor Q/cc/Cl veining & Cl alt" halos to veins & fg dissemination (S30.6 - S33.5 m)

S33.5

Dl.

S34.2

mixed Dl/Bl vlcl.

gn-gy mixed Dl/Bl vlcl ± minor cc/Q veins (S33.5 - S34.2m)

S35.7

Petrology @ S36.0m (# 431489P)
gn vcs. Bl ± minor amounts of local brecciation & Q/Cc veins & stwks. (S34.2 - S39.6 m)

Bl.

S39.6

gy sil Dl ± minor Q/cc/Cl veins & fg disc (S39.6 - S41.7 m)
Petrology @ S41.6m (# 431500P)

S41.7

Dl.

S42.1

Dl/Bl vlcl.

gy-gn sil Dl/Bl. vlcl ± minor Q/Cc & fg veins & minor fg alt"
(S41.7 - S43.0 m)

S43.0

Bl

gn massive locally brecciated vcs Bl ± minor Dl xenos on it's.
(S43.0 - S47.5m)

S30.6

S32-3 Pg 1 alt" ± Cl alt" halos to veins & fg disseminations

S33.5

Cl alt" of Bl clasts.

Cl. Pg 1-2 alt" Cc infill of vesicles

S39.6

S42-3 Pg 1-2 alt" minor fg spotting. Cl & Cc alt" of ft phenocrysts. Sc alt" halos to Pg/Cc veins

S41.7

str S42.3 Pg 2-3 alt"

S43.0

pav. Cl 1-2 alt" Patchy. Si. Sal & minor fg spotting

S30.6

as for Sheet 25

dom minor Q, Cc, Q/Cc/Cl veins ± min amounts of disseminated Pg as inclusions

S41.1

as for Sheet 27

S30.6

Pg as alt" disseminations elsewhere as minor veinlets and coarse recrystallised aggregates

S39.6

Pg as alt" and coarse recrystallised aggregates. Also as min veinlets up to 1% Total Rock

S43.0

Pg as disseminations and as part of vesicle infill. Elsewhere as recrystallised aggregates ± Dl fld's

S33.5

vlcl clasts to 3-4cm ϕ

gn massive lavas ± minor local brecciation

S41.7

angular breccia fragments up to 3-4cm ϕ

S43.0

massive vesicular lavas ± minor local brecciation

6543984

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EXPLORATION DIVISION

DIAMOND DRILL LOG

PROJECT : MACINTOSH EL 106/87

PROSPECT: MT CHARTER

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0384

DEPTH	DRILL RUNS	CORE LOSS	LITHOLOGY: ROCK NAME	LITHOLOGY: DESCRIPTION	ALTERATION	VEINING	MINERALISATION	STRUCTURE	WEATHERING	VISUAL LOG	REMARKS	DEPTH
547			Bl		as for Sheet 26		as for Sheet 26	as for Sheet 26				
548	547.7		547.8		547.6		547.8	547.8				
549					perv. Si1-2. Cl alt^n of fd & Sc alt^n halos to Py vns	mod Q/Cl/Cc vein & stwks also mnr Cl stwk and rare Py veins						
550					549.9	str Q/Cl/Cc veining from 549.9 - 551.5 M.						
551												
552						552.0						
553	553.0			gy-gn var SiCl alt^d Dl c̄ Q/Cc/Cl, Cl & Py veins & stwks (547.8 - 574.3 M)	Si.Cl1-2 alt^n. Cl alt^n halos to Q/Cc veins. Cl alt^n of fd phenocrysts in places			generally massive locally brecciated lavas				
554												
555				PETROLOGY @ 556.2m (# 43/548 P)								
556							Mnr Py as inclusions in Q/Cl/Cc veins. Elsewhere in Cl veins and as rare alt^n disseminations. Mnr recrystallised agg of Pyrite (<1% TOTAL ROCK					
557	556.7		Dl			mod to wk Q/Cl/Cc veins str Cl stwks associated c̄ brecciation throughout Occassion Py c̄ Cl veins as disseminations or inclusions						
558												
559					559.3							
560												
561												
562					Si.Cl2-3 alt^n Cl alt^n of fd & as halos to some Cc/Cl veins							
563	562.7											
564						10cm Q/Cl/Cc vein @ 563.8m.						
565											LOST WATER @ 564.6 M F@ 564.6 M @ 60° to LCA [str sch Cl alt^d Dl rubble]	
566	565.7											
567												

654285

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EXPLORATION DIVISION

DIAMOND DRILL LOG

PROJECT : MACKINTOSH EL 106/87

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0385

DEPTH	DRILL RUNS	CORE LOSS	LITHOLOGY: ROCK NAME	LITHOLOGY: DESCRIPTION	ALTERATION	VEINING	MINERALISATION	STRUCTURE	WEATHERING	VISUAL LOG	REMARKS	DEPTH
568					as for SHEET 27							
569	568.7											
570			Dl.		569.8	as for SHEET 27	as for SHEET 27					
571					pers Si1-2 Cl1 alt^{n} ≈ Cl alt^{n} of fd phenocrysts							
572												
573			572.3		573.3	573.3	572.2					
574								as for SHEET 27				
575	574.7			gn massive wk vesicular Bl ≈ mnr Q/Cc/Cl x Cl veins & stwks & local brecciation. (573.3 - 581.3 m)								
576												
577			Bl. ≈ mnr Dl ibd's		pers Si1 Cl1-2 alt^{n} ≈ Cl alt^{n} of both fp phenos & as halos to Cc veins	dom. mnr Q/Cc/Cl vns & mnr stwks. Cl stwks assoc. ≈ local brecciat^{n}				BROKEN GROUND 581.2 - 583.7 m		
578				mnr gy sil Dl. ibds @ 580.0 - 580.2 m.							LOST WATER @ 577.7 m	
579				PETROLOGY @ 577.5 m (#431549P)								
580	580.3					580.3						
581			581.3				only mnr Py as disseminations & with Cl/Q/Cc veins Elsewhere as rare recrystallised aggregates	581.3				
582	582.0		FAULT ZONE	gn str Cl alt^{d} Bl rubble in FAULT ZONE (581.3 - 582.6 m)				sh shd & brecciated Bl rubble			FAULT ZONE from 581.3 - 583.7 m shd str brec^{d} Bl & mnr Q rubble	
583	583.5		582.6					583.6				
584			Bl	PETROLOGY @ 584.5 m (#431597P) gn mass. wk ves Bl ≈ local brecciat^{n} & mnr Q/Cc/Cl veins & Cl stwks (583.6 - 586.7 m)	Cc infill of vesicles	dom str but fine Cl stwks ≈ brecciation. Mnr Q/Cl/Cc veining up to 5-10 m width but irregular ⇒ every 2-3 metres btw each vein		mass. ves locally brecciated B.t.				
585	585.6											
586												
587			586.7		586.7			586.7				
588			Dlb.	pale gn - gy Dlb. ≈ var Si.Se alt^{n} & mnr Q/Cc/Cl x Cl/Py veins & stwks (586.7 - 592.6 m)	patchy Si1-2 Se2-3 Fu1-2 alt^{n}. Se Si alt^{n} halos to veining			hyaloclastic text.?				

654286

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EXPLORATION DIVISION

DIAMOND DRILL LOG

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0386

DEPTH	DRILL RUNS	CORE LOSS	LITHOLOGY: ROCK NAME	LITHOLOGY: DESCRIPTION	ALTERATION	VEINING	MINERALISATION	STRUCTURE	WEATHERING	VISUAL LOG	REMARKS	DEPTH
589				PETROLOGY @ 588.5m (#431550P)								
590	590.4				as for Sheet 28			as for Sheet 28				
591			Dlb.									
592			592.6		592.6			592.6		592.6		
593					Si 2-3 Cl 1 alt'n							
594	594.3		Dl.	gy-gn var SiCl alt'd Dl c̄ mnr local brecciation. (592.6 - 595.7 m)	595.4	as for Sheet 28	as for Sheet 28	gen mass Dl c̄ local brecc'n	SPLIT CORE	593.4		
595				PETROLOGY @ 594.0m (#431551P)	Sil Cl 1-2 alt'n							
596			595.7	FAULT ZONE c̄ str Si.Se.Fu alt'd Dl rubble (595.7 - 597.0 m)	595.7			595.7		595.7	FAULT ZONE from 595.7 - 597.0m [str SiSeCl alt'd Dl rubble & pug & mnr Q rubble]	
597	596.7		FAULT ZONE 597.0		Si 2-3 Se 2-3 Fu 1 alt'n of Dl rubble 597.0	pk fe rich cc. veins & stulks	mnr diss & veinlets of Py mnr BMS? < 1%	rubbly broken unkly sand core 597.0	SPLIT CORE	597.1		
598			Dl.	gn Cl Si alt'd Dl c̄ mnr local brecciation. (597.0 - 599.5 m)	Derv. Sil Cl 1-2 alt'n Cl alt'n of fd phenos & as halos to Q/Cl veins Mnr patch Fu alt'n	as for Sheet 28	as for Sheet 28	gen mass Dl c̄ local brecc'n				
599			599.5		599.5		599.5	599.5				
600	600		D.lb.	var SiSeCl alt D.lb. c̄ str Cl stulks & mnr Py veining (599.5 - 601.7 m)	patchy Cl 1-2 Si 1-2 Sel alt'n	str Cl stulks Mnr irregular deformed Py veins.	Mnr Py disseminations also mnr irregular deformed Py veins from 600.6 - 601.1 m	strongly brecciat'd throughout				
601			601.7		601.7		601.7	601.7				
602				PETROLOGY @ 602.5m (#431552P)								
603			Dl.	gy mass sil Dl c̄ mnr Q & Q/Py veins. (601.7 - 606.7 m)								
604	605.7					Mnr Q & Q/Py & Py veinlets & stulks	Mnr Py as alt'n diss & c̄ Q veins. Wk Py veining	massive Dl				
605					str perv. Si 1-2, 3 alt'n mnr perv Py 1-2 alt'n							
606												
607												
608												
609												

654387

Aberfoyle Resources Limited
EXPLORATION DIVISION

DIAMOND DRILL LOG

PROJECT : MACKINTOSH EL 106/87

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0387

DEPTH	DRILL RUNS	CORE LOSS	LITHOLOGY: ROCK NAME	LITHOLOGY: DESCRIPTION	ALTERATION	VEINING	MINERALISATION	STRUCTURE	WEATHERING	VISUAL LOG	REMARKS	DEPTH
610			Dl.					as for SHEET 29				
611	610.7		610.7 Dlb.	pk-gy siliceous Dlb ≥ minor Q & Q/Py veining (610.7 - 613.5)	as for SHEET 29			610.7 wk to mod hfd				
612												
613			613.5		613.5			612.5				
614			silicic Al.	pale gn fp SiCl altered siliceous Al. ≥ Mnr Q/Py, Q & Py Cl vns. (613.5 - 616.2 m)	Sil Cl 1-2 alt^n Cl alt^n of fd phenos & SiSe alt^n halos to some veinl sets		as for SHEET 29	massive lavas				
615												
616			616.2		616.2			616.2				
617	616.7		Dlb.	pk-gy siliceous Dlb. ≥ mnr Q & Py/Q vns (616.2 - 618.9 m) PETROLOGY @ 618.4 m (#431553P)	str Si 2-3 Se 1 Py 1 alt^n Se alt^n halos to some veinl sets			wk to mod hfd	SPLIT CORE			
618												
619			618.9 YVC 619.5	gy var Se Si alt^d YVC ≥ mnr blebs Py (618.9 - 619.5 m)	618.9 var clast related Si 1-2 Se 1-3 alt^n 619.5	as for SHEET 29	618.9 mnr Py as recrystallised aggregates 619.5	618.9 clasts to 2-3 cm ϕ 619.5		618.9 619.5		
620												
621												
622			Dl.	gy sil wk hfd Dl ≥ mnr Q & Py vns (619.5 - 624.8 m)	Si 2-3 Se 1 Py alt^n Se alt^n halos to Q & Py vns Mnr Se alt^n of fd phenos		Mnr Py as fine veins. wk Py dissemination as alt^n Mnr recrystallised Py aggregates especially in vld units but present elsewhere Py < 1% TOTAL ROCK	massive wk hfd lavas				
623	622.7											
624												
625			624.8 YVC 625.6	gy sil YVC. ≥ var Se Si alt^n of clasts (624.8 - 625.6)	624.8 var clast related Se 1-2 Si 1-2 Py 1 alt^n 625.6		625.6	624.8 clasts to 10 cm ϕ 625.6	SPLIT CORE	624.8 625.6		
626												
627			ibd Dl/Dlb & mnr YVC.	gy sil ibd Dl/Dlb & mnr YVC. (625.6 - 627.1 m)	dom Si 1-2 Se 1 Py 1-2 alt^n mnr Fu alt^n of clasts in vld units. Some Se Si & Cl alt^n halos to Q & Py veins respectively		Mod Py as both fine veins and as alt^n diss Mnr amount of recrystallised Py aggregates throughout. Py < 3% TOTAL ROCK	dom wk to mod hfd Dl. Clast size in YVC to 10 cm ϕ				
628	628.7											
629												
630												

654288

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EXPLORATION DIVISION

DIAMOND DRILL LOG

PROJECT : MACKINTOSH EL 106/87

PROSPECT: MT CHARTER

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0388

DEPTH	DRILL RUNS	CORE LOSS	LITHOLOGY: ROCK NAME	LITHOLOGY: DESCRIPTION	ALTERATION	VEINING	MINERALISATION	STRUCTURE	WEATHERING	VISUAL LOG	REMARKS	DEPTH
631												
632												
633												
634			lbd DI/DIb k mnr Yvc		as for SHEET 30							
635	631.7					as for SHEET 30	as for SHEET 30	as for SHEET 30		BROKEN GROUND 637.1 - 639.2 M.		
636												
637			637.1		637.1			637.1			F@ 637.1m @ 45° to LCA. [Si Se alt^d DI rubble]	
638	637.7							broken Schistose rubbly core				
639	639.2					639.2	639.2	639.2			F@ 639.2m @ 45° to LCA [Si Se Py alt^d DI rubble]	
640				gn-gy sil DI c̄ mnr Q/CI k CI veins k stwks. (637.1 - 646.2 m)								
641			DI.		Si 2-3 CI 1-2 Py 1 alt^n CI alt^n of fd phenocrysts. Some CI alt^n halos to Q k Py vns							
642												
643												
644	643.7					med to wk Q/CI/Co veining abn fine CI stwks. Mnr CI/Py veins k stwks		massive wkly hfd lavas				
645												
646			646.2		646.2	large Sm thick Q/CI/Co vein 646.4 m.	Py as alt^n disseminations Atm Py in CI/Py and Py veins k stwks < 1% TOTAL ROCK					
647				PETROLOGY @ 647.7m (#43354 P) gn silicic Al. c̄ mnr Q/CI/Co k Py/CI veins k stwks								
648			silicic Al.									
649					Si 1 CI 1-2 Py 1 alt^n CI alt^n of fd phenos Some Se k CI halos to Pyrite vns							
650	649.7											
651												

654289

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EXPLORATION DIVISION

DIAMOND DRILL LOG

PROJECT : MACKINTOSH 4L 1066/651

PROSPECT: MT CHARLES

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DEPTH	DRILL RUNS	CORE LOSS	LITHOLOGY: ROCK NAME	LITHOLOGY: DESCRIPTION	ALTERATION	VEINING	MINERALISATION	STRUCTURE	WEATHERING	VISUAL LOG	REMARKS	DEPTH
652			silicic Al									
653				655.4		as for Sheet 31		as for Sheet 31				
654						655.4		655.4				
655												
656	655.7		bod Al & Alb ± minr fvc.	gn bod Al & Alb ± minr bod of fvc (655.4 - 657.4 m)	as for Sheet 31	dom Q ± minr Qlclcc & Cl stwks & veins. Minr Py veinlets	as for Sheet 31	bx fragments to 2-3 cm; 4. fvc clasts cms to 1cm diam. sharp contacts bet bod's				
657				657.4				657.4				
658												
659			Alb.	gn Alb ± minr Qlcc / Cl vnls (657.4 - 661.0 m)				bx fragments up to 4 cms cm 4				
660												
661				661.0	661.0	661.0	661.0	661.0				
662	661.7											
663												
664												
665				gn var Cl Si alt^{d} Dl. ± minr Q & Qlcl veins & stwks. (661.0 - 665.2 m)								
666			Dl		var Si 1-3 Cl 1-2 Py 1 alt^{d} Mnr patchy Ca 1-2 alt^{n} in places Cl alt^{n} of feldspars & as haloes to Py. aggregates.	Predominantly Qlcclcl/Py and Cl stwks & veins Mnr Py veins	Py as alt^{n} disc & as inclusions in some Qlclcc veins. Also minr veins Py ± Mo-Tour Qz	open massive brkly hfd bxes				
667												
668												
669												
670												
671	670.7											
672												

654390

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DIAMOND DRILL LOG

PROJECT : MACLINTOSH EL 106/87

PROSPECT: MT CHARTER

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0390

DEPTH	DRILL RUNS	CORE LOSS	LITHOLOGY: ROCK NAME	LITHOLOGY: DESCRIPTION	ALTERATION	VEINING	MINERALISATION	STRUCTURE	WEATHERING	VISUAL LOG	REMARKS	DEPTH
673				PETROLOGY @ 673.3m (#431556P)								
674	673.7											
675												
676												
677			D.I		as for sheet 32	as for sheet 32	as for sheet 32	As for sheet 32				
678												
679												
680	679.7			some Al clasts in DI from 679.7 - 681.9m								
681												
682			681.9		681.9	681.9	681.9	681.9				
683												
684												
685				PETROLOGY @ 685.7m (#431557P)			mnr-var disc Py blebs					
686	685.7			gn Alb. c mnr Q/Cc/Cl veining (681.9 - 691.7m)	Abn. Se alt^n of fophenes Mnr patchy Se/Py/Cl alt^n			breccia fragments up to 5-10cm ϕ				
687			Alb.			wk Q/Cl/Cc veining mnr Py Cl veins & stringers throughout						
688												
689												
690												
691												
692	691.7		691.7		691.7		691.7	691.7				
693			Tvc	gn-yw str var Si/Cl/Se alt^d Tvc c mnr Q/Cl/Cc veins (691.7 - 693.7m)	str clast related Se 2-3. Py/Si 2-3 Cl alt^n		Mnr recrystallised aggregate of Py < 3% TOTAL ROCK	wkly schistose. Clasts up to 10cm ϕ. Dom 1-2 cm ϕ				

654291

PROJECT : MACKINTOSH & NOLAN

PROSPECT: MT CHARLIE

Aberfoyle Resources Limited
EXPLORATION DIVISION
DIAMOND DRILL LOG

0391

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DEPTH	DRILL RUNS	CORE LOSS	LITHOLOGY: ROCK NAME	LITHOLOGY: DESCRIPTION	ALTERATION	VEINING	MINERALISATION	STRUCTURE	WEATHERING	VISUAL LOG	REMARKS	DEPTH
699			VNC		as for Sheet 33		as for Sheet 33	as for Sheet 33		BROKEN GROUND @ 700.2 - 701.0m		
			699.7		699.7		699.7	699.7				
700			ALB	gn ALB ± minr Qtz/Ca vnlt (699.7 - 700.7m)	dom Se alt^{n} of fd phenos	as for Sheet 33	Minr/rare disc Py and Py inclusions in Qtz/Ca veins	breccia frags to 5 cm ø				
			700.7		700.7		700.7	700.7				
701	701.7		DI.		Si1-2 Cl1-2 alt^{n}. Minr Se alt^{n} of fd phenos.			moderate str lnfld ± Cl ultr				
			700.2		700.2		700.2	700.2				
	701.1			Petrology @ 702.5m (#A31550P)	Se alt^{n} of DI clasts. Argillic alt^{n} of fd phenos in DI clasts	dom. Qtz/Ca ± minr Cl stwks. Minr Py veinlets.	Minr blebs of Py as recrystallised aggregates. Some Py alt^{n} of clasts in VNC unit. Minr strongly 'wispy' Py vnlt.	wk to mod structure ± cleavage @ 20 to 30° to LCA → DI clasts up to 10 cm ø				
702			DI/AI incl.	gn mixed DI/AI incl ± minr bands of VNC & wk Qtz/Ca veining (700.2 - 701.6m)								
	703.1											
704												
705												
706												
707												
708												
	708.1											
709												
710												
			701.6		701.6	701.6	701.6	701.6				
711			DI	gn str clalt^{d} DI ± minr Qtz/Ca vnlt (701.6 - 710.1m)	str Cl2-3 Si1-2 alt^{n}. Both Cl & Se alt^{n} of fd phenos	Minr Qtz/Ca veins. Dom Cl vnlt & stwks. Minr Py/Cl vnlt	Minr Py as recryst. blebs & with some Cl veins	massive wkly fg bands				
				Petrology @ 708.8m (#A31550P)								
712			710.1		710.1	710.1	710.1	710.1				
	712.1		VNC	gn-gy VNC ± minr Qtz/Cl veins (710.1 - 715.6m)	patchy clast related Si1-3 & Py1. Cl1-2 alt^{n}	minr Q, Qtz/Cl & Qtz vnlts most Cl stwks	Py as minr vnlets ± Q & Cl. Elsewhere as recrystallised aggregates.	clasts to 10 cm ø commonly ± lam ø mod schistose				
713												
714												

(a) 700.2m @ 10° to LCA. [Cl. Se. alt DI rubble]
(a) 700.7m @ 15 to 20° to LCA [Cl Se Arg. alt^{d} DI rubble]

654992

PROJECT : MACWATTOOK EL 10616m

PROSPECT: MK CHERRY EL

Aberfoyle Resources Limited
EXPLORATION DIVISION
DIAMOND DRILL LOG

0392

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DEPTH	DRILL RUNS	CORE LOSS	LITHOLOGY: ROCK NAME	LITHOLOGY: DESCRIPTION	ALTERATION	VEINING	MINERALISATION	STRUCTURE	WEATHERING	VISUAL LOG	REMARKS	DEPTH
715			TVC		as for sheet 34	as for sheet 34	as for sheet 34	as for sheet 34				
716			714.6		714.6	714.6	714.6	714.6				
717												
718												
719	718.7			gn var SaSiFyCc alt^{d} mixed sequence of Alv & Alb Alv. (714.0 - 720.5 m)	patchy Si1-2 Sa1-2 Fy1 Cc1-2 alt^{n} Argillic alt^{n} of fd plagioclase. Variations in intensity of alteration in clasts in Alv.	dom cl/wmn Fy vns & stks. Rare Qtz Cl Cc veining		wkly schistose in places. Breccia and volcaniclastic clasts up to 10 cm d. dom 1-2 cm d				
720							Fy as wmn constituent of Qtz Qtz Cl veins. Disseminations as alt^{n} dissem minerals and recrystallised aggregates					
721			mixed seq Alv. Alv & Alb									
722				Petrology @ 720.1 m (# 421560 P)								
723												
724												
725	724.7											
726												
727												
728			728.5		728.5			728.5				
729			Dib	gy siliceous PyCc alt^{d} Dib & wmn cc & Cl veining (728.5 - 729.6 m)	dk Si 3-4 Py1-2 Sa1-2			broken & schistose ground.				
730	729.6		729.6		729.6			729.6				
731			Alv & Alb	gn patchy SaSiCl alt^{d} Alv & Alb (729.6 - 731.7 m)	patchy SaSiCl alt^{n} Alv/Alb gg alt^{n} of fd phenocrysts			breccia & vlcl clasts to 5 cm ϕ				
732			731.7		731.7	731.7	731.7	731.7				
733				Petrology @ 733.0 m (# 421561 P)								
734	733.7		Di.	gg-gn SaSiCl alt^{d} massive Di & abn QtzCc vns & stks (731.7 - 739.0 m)	dk Si 2-3 Sa1-2 Cl1-2 alt^{n}	abn Qtz, QtzCc, Cl/Fy & minor QtzFy vns. Abn fine Cl stks	diss Fy as alt^{n} and with Qtz vns & stks	massive brecc				
735												

BROKEN GROUND 728.5 - 729.5 m.

654393

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DIAMOND DRILL LOG

PROJECT : MACKINTOSH Ca 106/87
PROSPECT: Mt CHARLES

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0393

DEPTH	DRILL RUNS	CORE LOSS	LITHOLOGY: ROCK NAME	LITHOLOGY: DESCRIPTION	ALTERATION	VEINING	MINERALISATION	STRUCTURE	WEATHERING	VISUAL LOG	REMARKS	DEPTH
136												
137												
138												
139												
140	139.7		DI		as for sheet 25	as for sheet 25	as for sheet 25	as for sheet 25				
141					140.9	140.9	140.9	140.9				
142				gn Alb ± wisp Qlclc veining (140.0 - 146.0)								
143			Alb		var Cc 1-3 all" of intersticial wisp material. Argillic alt" of fd phenos in Alt fragments	Minr rare Qlcc veins	Minr recrystallised aggregates & discontinuous Py	Breccia fragments up to 15 cm ϕ				
144												
145												
146	146.0				146.0	146.0	146.0	146				
147												
148												
149												
150			fn & mnr Tav	gn-gn variable clast altered frc ± minr ashy vlcl units (146.0 - 153.7 m)	variable Si Sa Cl Py alt" of clastic material. Cc 1-2 pervasive overprint	Minr Q, Qlclcl x Qlpy & Cl Py veins & stwks	Abn recrystallised Py aggregates. Elsewhere Py occurs with Q & Cl veins. Approx 1-2% Py in tonal rock	Clasts up to 10 cm ϕ diam 1-2 cm ϕ				
151												
152	151.7											
153												
154	153.7			gn Si Sa altered Dlb (153.7 - 154.2 m)	153.7 Si 1-2 Sa 1-2 Py 1 154.2 Cl 1-2 154.2 - 155.6m Si 1-2	153.7 154.1 - 156.6m.	153.7	153.7	153.7			
155	154.2		Dlb			Minr Q, Qlclcc & rare Cl Py veining	Minr Py as recrystallised aggregates	Breccia fragments to ≤ cm ϕ	154.2			
156			Alb ± minr ibdl's Al.	gn Alb ± minr Qlclcc veining (154.2 - 161.4 m)	Mk Cc 1-2 all" of intersticial mtx. Arg alt" of fd phenos							

0543.94

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DIAMOND DRILL LOG

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0394

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DEPTH	DRILL RUNS	CORE LOSS	LITHOLOGY: ROCK NAME	LITHOLOGY: DESCRIPTION	ALTERATION	VEINING	MINERALISATION	STRUCTURE	WEATHERING	VISUAL LOG	REMARKS	DEPTH
757												
758	757.7											
759												
760			Alb ≡ mnr ibd's Al.		as for sheet 36			as for sheet 26				
761												
762												
763				PETROLOGY @ 763.9 m (A 431562P)								
764	763.7		764.4		764.4			764.4				
765						as for sheet 36	as for sheet 36					
766												
767					Mnr Cl & Py spotting							
768			Bl. ≡ mnr ibd's Alb.	gn var SiSeCo alt^d Bl ≡ mnr ibd's Alb & Co infilled vesicles & str local Q/Cl/Co/Py veining (764.4 - 770.8 m)								
769												
770	769.7							generally massive basalt lavas Alb interbed with fragments commonly < 3 and				
771					771.0	771.0	771.0					
772												
773					Str Si 1-3 Se 1-2 alt^n Also Patchy Py 1-2 alt^n	Str Si/Cl/Co, Si/Cl & Py/Si veining. Also fine Py veins & stwks	Py ~ 5-7% Tonk Rock as recrystallised aggregates & as Py/Si veins & Py veins & stwks					
774					774.5	774.5	774.5					
775												
776	775.7				Mnr Cl & Py spotting. Argillic alt^n of fit shears	Mnr Q/Cl/Co veining	Mnr Py as recrystallised disseminations					
777						2 cm Q/Cl/Co vein @ ~ 777.0 m						

654395

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DIAMOND DRILL LOG

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DEPTH	DRILL RUNS	CORE LOSS	LITHOLOGY: ROCK NAME	LITHOLOGY: DESCRIPTION	ALTERATION	VEINING	MINERALISATION	STRUCTURE	WEATHERING	VISUAL LOG	REMARKS	DEPTH
778			Bl c̄ mnr ibd's of Alb.		as for sheet 37			as for sheet 37				
779			778.8		778.8			778.8				
780												
781												
782	781.7											
783					Mnr Cc 1-2 alt^n of interstitial mtx material. Argillic alt^n of fp phenos							
784												
785												
786				gn Alb c̄ minor Q/Cl/Cc veining (778.8 - 801.8m)								
787						as for sheet 37	as for sheet 37					
788	787.7		Alb c̄ mnr tvc					breccia fragments generally <5cm ø				
789												
790												
791												
792					792.5							
793												
794												
795	794.7											
796					str Cc 2-3 alt^n of interstitial mtx							
797												
798												

654396

PROJECT : MACKINTOSH EL 1016/87

PROSPECT: NT CHARTER

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EXPLORATION DIVISION
DIAMOND DRILL LOG

0399

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DEPTH	DRILL RUNS	CORE LOSS	LITHOLOGY ROCK NAME	LITHOLOGY DESCRIPTION	ALTERATION	VEINING	MINERALISATION	STRUCTURE	WEATHERING	VISUAL LOG	REMARKS	DEPTH
799												
800	800.7		Alb ± minr ibd Tvc.		as for Sheet 38	as for Sheet 38	As for Sheet 38	as for Sheet 25		Broken ground 800.0-800.9m		
801												
802		802.0	801.8 FAULT ZONE 802.9 Tvc 804.4	str Cal Cl/Arg all Al rubble & clay in FAULT ZONE (801.8 - 802.9 m) Pde qu str Cl Fu Co all ᵈᵉ Tvc ± mod Ke/Ca & Cl veins & stks (802.9 - 804.4 m)	801.8 str Ca Cl/Argillic all ᵈᵉ of Al rubble 802.9 str Co 2-3 sul Cl 1-2 Se 1 all ᵈᵉ clast/matrix Sil Py Fel & Co all ᵈᵉ 804.4 mod Co 2-3 sul all ᵈᵉ. Argillic all ᵈᵉ of Fel phenos 806.6	801.8 802.9 mnr Cal ± Qtz Cal Cl veins @ 803.6 m. mnr Bns & Cpy ± Py in Cal Cl vn @ 806.1 m. abn Qtz Cal Cl veins containing str amounts of Py as vein & inclusions & mnr Bns gan Sph & Cp as inclusions. Elsewhere barren Qtz Cal Cl veins	801.8 mnr Py blebs in Gsull rubble 802.9 sonic crack strongly Pyritic up to 70-80%. Otherwise minor Py & rare Bns in Qtz Cal Cl vnlts 804.4	802.9 sch dsrd and broken clean. @ ~10-20° to CA. well rounded clasts up to 5cm @ upto 804.4	802.9 Clay Cake		F @ 801.8 - 802.9m @ ~10-20° to CA Sch Cl. Arg. Co all Al rubble & clay	
803												
804												
805												
806												
807												
808												
809	809.7		Alb ± minr ibd Alv.	gn var Co Si all ᵈᵉ Alb ± minr bod's Alv ± X-cutting Qtz Cal Cl Py trace Bns veins (804.4 - 813.4 m)				Well to poorly developed brecciation. Most likely autobrecciation or hydroclastite. Volcaniclastic units dominantly Volcaniclastic Al ± Co all ᵈᵉ matrix Widely sheared in places				
810												
811												
812												
813			813.4	gn mass Co Cl all ᵈᵉ Al (814.4 - 817.9 m)	813.4	813.4	813.4	813.4				
814												
815	815.7											
816			Al.			815.7 - 816.1 m	mnr vnlz dist Py	Massive lava				
817												
818			817.9	gn var Cl/Co/Co/Si all ᵈᵉ Alb ± mnr clasts of Alv & Alb & Tvc & Kl (817.9 - 821.8 m)	817.9 as for Sheet 40	817.9 as for Sheet 40	817.9 as for Sheet 40	817.9 as for Sheet 40				
819	819.0		Alb ± mnr bods of Al, Alb & Tvc									

654397

PROJECT : MACKINTOSH EL 1061/97

PROSPECT: MT CHARLES

Aberfoyle Resources Limited
EXPLORATION DIVISION
DIAMOND DRILL LOG

0397

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DEPTH	DRILL RUNS	CORE LOSS	LITHOLOGY: ROCK NAME	LITHOLOGY: DESCRIPTION	ALTERATION	VEINING	MINERALISATION	STRUCTURE	WEATHERING	REMARKS	DEPTH
820				mnr unit of fvc @ 820.1 - 820.5 m.	↑	↑ dr Cal Qtz Py/minn BMS veining 820.2 - 820.2 m	↑	↑			
821											
822											
823											
824	823.7					Qtz Cal Py vein @ 823.0 m					
825											
826								locally weakly sheared Breccia fragments up to 5.6 cm ϕ in Mlc. fvc clasts from fine ash < 1-2 mm ϕ to 2-2 cm ϕ.			
827						Qtz Cal Py/minn BMS vn @ 826.1 m.					
828											
829					patchy Cal-Ser-Chl Py ± alt'n ± abn brg. alt'n assoc in Mlc fragments. Clast isolated Ser±Cal alt'n in fvc units	dom Qtz Cal/minn Py ± BMS veins throughout Mlc fine Cl stockworks throughout	Py ± minn BMS ± some Qtz Cal Co veins ± stwks up to 20-60% Py in some veins; normally <5% TOTAL VEIN.				
830	829.7		Mlc minn clasts of fvc. Mlc ≥ Al								
831											
832											
833											
834	834.1										
835											
836											
837											
838											
839	838.7			mnr unit of fvc/Mlc @ 838.1 - 838.5 m							
840					↓	↓	↓	↓			

654398

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EXPLORATION DIVISION

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0398

DEPTH	DRILL RUNS	CORE LOSS	LITHOLOGY: ROCK NAME	LITHOLOGY: DESCRIPTION	ALTERATION	VEINING	MINERALISATION	STRUCTURE	WEATHERING	VISUAL LOG	REMARKS	DEPTH
841												
842												
843			Alb c̄ mnr ibd's of Al, Avl & Tvc		as for Sheet 40	as for Sheet 40						
844	844.7					str Qlcc/Py veining @ 845.0 & 845.25 m.	as for Sheet 40	as for Sheet 40				
845												
846												
847												
848			847.8		847.8	847.8	847.8 m	847.8				
849			Al	an massive wldy Co alt'd Al c̄ mnr Qlcc/Cc/Py & rare BMS vns (847.8 - 850.7 m)	mnr perv. Col-2 sil alt'n Argillic alt'n of fd dike rocks	mnr Qlcc veins & stwks Other mnr Cc/Cl & Cl stwks	mnr Py & BMS c̄ some Qlcc veins	massive lava.				
850	850.7		850.7 (KOH)		850.7	850.7	850.7 m	850.7				

654399

654400

0399

Aberfoyle Resources Limited

Incorporated in Victoria

EXPLORATION DIVISION

July 13, 1990

ABERFOYLE RESOURCES LIMITED
EXPLORATION DIVISION
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Dr. Tony Crawford
University of Tasmania
GPO Box 252C
HOBART TASMANIA 7001

Dear Tony,

Please find enclosed 41 drillcore samples for petrological description from DDH MAC-26 drilled at Mount Charter, essentially down the alteration system.

Four of the samples require polished thin section preparation. The rest require the usual preparation and description.

I have included available Ti/Zr and Cr results as well as Alteration Index elements, which may prove to be of some assistance in lithology identification.

The following samples require polished thin section preparation and description:

#431481	35.0m	Grey massive Barite rich volcaniclastic with some pyrite clasts? and minor base metal sulphide (BMS) disseminations.
#431564	75.2m	Grey siliceous Dacite volcaniclastic with strong barite/BMS veining.
#431567	217.6m	Grey massive banded barite/BMS vein.
#431568	224.5m	Grey-green Dacite lava with strong sericite/silica alteration and barite/BMS veins and stockworks.

NB: Please examine the bluish purple alteration of the dacite clasts in sample #431568 which I mentioned to you when we last spoke. It has a grey/black streak and has the appearance of some form of metallic sulphide.

The remaining 37 samples require thin section preparation and description only:

#431479	12.8m	Grey-green Dacite volcaniclastic with moderate sericite/pyrite alteration.
#431480	32.4m	Grey massive Barite with minor Dacite clasts and abundant recrystallised? pyrite intergrowths.

NB: Please comment on the apparent clastic texture of the barite in sample #431480. This appears to be the commonest form of massive barite at Mount Charter and is distinct from the massive vein-style barite, which is also present at Mount Charter, in that it lacks banded/colloform textures.

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#431563	64.1m	Grey-green sericite altered Dacite volcaniclastic.
#431565	113.8m	Green sericite/silica/pyrite altered Dacite lava.
#431566	125.0m	Grey-green variably sericite/silica/pyrite altered Dacite volcaniclastic with minor barite/BMS and quartz/BMS veining.
#431569	233.5m	Grey-green mottled sericite/silica/chlorite? altered Dacite lava with minor pyrite veins and disseminations.
#431570	265.6m	Grey siliceous dominantly dacitic polymict volcaniclastic with variable silica/sericite/pyrite alteration and recrystallised pyrite intergrowths.
#431571	309.0m	Green sericite/silica pyrite altered Dacite lava with crosscutting barite/BMS/pyrite veins.
#431572	352.7m	Green-grey siliceous Dacite lava with minor amounts of disseminated pyrite and fracture related silica alteration haloes.
#431573	372.7m	Green sheared polymict Dacite/Basalt volcaniclastic with variable clast-related sericite/silica alteration.
#431574	382.1m	As for #431573 but less sheared.
#431575	394.5m	Grey-green siliceous Dacite volcaniclastic with variable clast related sericite/fuchsite/silica/minor pyrite alteration and some blebs of recrystallised pyrite.
#431482	432.1m	Green-grey silica/sericite/pyrite altered Dacite lava breccia with siliceous alteration haloes to pyrite/minor calcite stockworks and minor fuchsite spotting. Ti:2150ppm, Zr:180ppm & Cr:30ppm
#431483	451.5m	Green sheared silica/chlorite altered Dacite or Andesite? lava with minor recrystallised blebs of pyrite and aggregates of chlorite. Ti:2850ppm, Zr:170ppm & Cr:16ppm
#431484	475.0m	Green silica/chlorite/pyrite altered Dacite or Andesite? lava with minor chlorite/calcite stockworks. Ti:2750ppm, Zr:170ppm & Cr:17ppm
#431485	494.7m	Pale green silica/sericite altered massive Dacite lava with fracture related silica alteration haloes and minor fuchsite spotting. Ti:2450ppm, Zr:180ppm & Cr:26ppm
#431486	512.5m	Green weakly pyrite altered massive Basalt lava with minor calcite veining. Ti:2500ppm, Zr:100ppm & Cr:602ppm

#431487 529.1m Green pyrite altered weakly vesicular Basalt lava breccia with calcite infill of vesicles.
Ti:3550ppm, Zr:140ppm & Cr:877ppm

#431488 532.3m Green-grey siliceous massive Dacite lava with minor quartz/calcite veining and recrystallised aggregates of chlorite and pyrite.
Ti:1850ppm, Zr:150ppm & Cr:37ppm

#431489 536.0m Green sheared silica/pyrite altered weakly sheared Basalt lava with calcite infill of remnant vesicles.
Ti:2700ppm, Zr:120ppm & Cr:561ppm

#431500 541.6m Grey siliceous dacite lava breccia with abundant aggregates of pyrite/minor chlorite, minor calcite veining and waxy green sericite on fracture surfaces.
Ti:2200ppm, Zr:200ppm & Cr:89ppm

#431548 556.2m Green-grey silica/chlorite altered massive Dacite lava.
Ti:2200ppm,Zr:180ppm & Cr:28ppm

#431549 577.7m Green-grey silica/chlorite/pyrite altered massive silicic Andesite lava with fine chlorite stockworks.
Ti:2900ppm,Zr:160ppm & Cr:30ppm

NB: Nowhere is the problem of determining whether samples are Dacites or silicic Andesites more well illustrated than between samples #431548 and #431549. There appears to be little textural difference between the two samples and on the strength of what I have seen elsewhere in the Que/Hellyer Volcanics, especially in DDH MAC-25 where we had similar problems, I would have said both were chlorite altered siliceous dacite lavas. But then considering the Ti/Zr ratios of 12.2 and 18.1 for samples #431548 and #431549 respectively the assumption would be that they are in fact different lithologies. Thin sections may enlighten me to something I haven't seen in the hand specimen. It is also worth noting that there appears to be no lithological contact or fault between the two samples, only a slight gradational change in the intensity of chlorite alteration. It is possible we are seeing some sort of fractionation?

#431597 584.5m Green silica/chlorite/pyrite altered weakly vesicular? Basalt lava with moderate calcite/chlorite stockworks.

NB: Sample #431579 is one of these samples which I have some difficulty in identifying. It is texturally similar to some of the rocks which I am sure are Dacites and have a low Ti/Zr ratio in the range of 12-14 with low Cr of around 20-35. It does however, appear slightly vesicular? and contains abundant chloritised feldspars.

#431550 588.5m Green weakly sheared silica/sericite altered Dacite lava with minor chlorite veining.
Ti:3250ppm, Zr:230ppm & Cr:129ppm

#431551 594.0m Green silicic Andesite? lava with minor aggregates of recrystallised pyrite and

chlorite and chlorite veining.
Ti:2600ppm, Zr:160ppm & Cr:12ppm

#431552	602.5m	Grey silica/pyrite altered massive Dacite lava with minor quartz veining. Ti:1300ppm, Zr:140ppm & Cr:35ppm
#431553	618.4m	As for sample #431552. Ti:1300ppm, Zr:150ppm & Cr:11ppm
#431554	647.7m	Green chlorite/pyrite altered silicic Andesite lava with some argillic alteration of feldspar. Ti:2844ppm, Zr:165ppm & Cr:22ppm
#431555	658.7m	Green pyrite altered Andesite lava breccia with cherty quartz/calcite stockworks and some argillic alteration of feldspar. Ti:2935ppm, Zr:135ppm & Cr:26ppm
#431556	673.3m	Green-grey silica/pyrite altered Dacite lava with minor quartz chlorite veining and recrystallised aggregates of pyrite and chlorite. Ti:1829ppm, Zr:137ppm & Cr:21ppm
#431557	685.7m	Green Andesite lava breccia or lapilli volcaniclastic with minor argillic alteration of feldspar. Ti:2846ppm, Zr:133ppm & Cr:27ppm
#431558	703.5m	Green sheared mixed Andesite/Dacite volcaniclastic with argillic alteration of feldspar phenocrysts and chlorite stockworks. Ti:3042ppm, Zr:135ppm & Cr:40ppm
#431559	709.8m	Green silica/chlorite/minor pyrite altered massive Dacite lava. Ti:2021ppm, Zr:158ppm & Cr:11ppm
#431560	720.7m	Green massive Andesite lava with minor argillic alteration of feldspar and quartz filled devitrification textures. Ti:3313ppm, Zr:147ppm & Cr:45ppm
#431561	733.9m	Pale green silica/sericite/pyrite altered massive Dacite lava with minor quartz/calcite/pyrite veining. Ti:1593ppm, Zr:199ppm & Cr:14ppm
#431562	763.9m	Green Andesitic lapilli volcaniclastic with patchy chlorite/sericite alteration, argillic alteration of feldspar phenocrysts and minor calcite veining. Ti:2848ppm, Zr:188ppm & Cr:131ppm

I look forward to hearing from you.

Regards,

R.J. Henham
GEOLOGIST

0403

SAMPLE NUMBER: 431482

SUMMARY:

This is a rhyolitic lava breccia that has suffered quite strong sericite-silica alteration, with the introduction of minor disseminated pyrite.

HAND SPECIMEN:

This is a pale grey sericite-altered monomict felsic lava breccia with darker chloritic matrix between fragments and disseminated pyrite.

THIN SECTION:

This sample is actually quite well-preserved texturally, despite rather pervasive very fine-grained sericite. alteration. It was clearly a glassy, sparsely plagioclase + quartz-phyric rhyolitic lava breccia. Former plagioclase phenocrysts are small (<1mm long) and make up only a few modal% of the sample, and are totally replaced by sericite. Quartz phenocrysts are much less common still than plagioclase phenocrysts and are mainly less than 0.5mm long and quite strongly resorbed and rounded. FeTi oxide microphenocrysts are replaced by dirty brown leucoxenic material.

The groundmass of this sample was undoubtedly glassy and devitrified before it recrystallized to a uniform-textured fine-grained quartz-sericite intergrowth in which the sericite mainly forms a fine oriented mesh through the rock. Disseminated clusters of small (<0.5mm across) pyrite euhedra make up about 1-2 modal% of the sample and often have quartz-coarse-grained sericite pressure fringes. A few narrow quartz-sericite-calcite veinlets subparallel to the weak foliation defined by the sericite mesh contain relatively abundant small pyrite euhedra.

SAMPLE NUMBER: 431483

SUMMARY:

This is a strongly silica-sericite-altered aphyric felsic lava with disseminated pyrite.

HAND SPECIMEN:

This is a dark grey-green weakly foliated felsic(?) lava or lava breccia with disseminated pyrite and streaks of black chlorite.

THIN SECTION:

This rock is very strongly sericite-quartz altered, to the extent that the original texture is almost obliterated. It was almost certainly an almost aphyric, slightly vesicular glassy lava. A few sericitized sites with slightly stretched euhedral crystal shapes were probably former sericitized plagioclase phenocrysts. No mafic phenocrysts were present, although small former FeTi oxide now altered to leucoxenic material and sericite are not uncommon.

The originally glassy slightly vesicular groundmass of this sample has altered to a weakly foliated sericite-quartz matrix in which small rounded to ovoid vesicles are filled by polycrystalline quartz, and abundant small anhedral polycrystalline quartz blebs are distributed in irregular fashion. The matrix material is unusual in that it is intensely riddled with tiny Fe oxide (?) grains related to alteration of the original glass. Patches of former quartz-albite mosaic textured groundmass derived from devitrified glass are still evident, but are intensely pervaded by sericite; the latter forms an orientated mesh throughout the sample. Several angular fractures subparallel to the foliation are filled by pale green chlorite and overprinting calcite, with which occasional euhedral pyrite grains to around 1mm across are associated. Disseminated pyrite grains with quartz-sericite pressure fringes are fairly uncommon throughout the sample.

The question of whether this sample was andesitic or dacitic cannot be answered from thin section alone. It is far too recrystallized and altered. I would have guessed that it was a dacitic lava, but aphyric slightly vesicular, originally glassy andesites are not uncommon beneath the Hellyer basalts in this area (Mines Dept hole and Placer holes). These are far fresher than the MC26 material, thus more easily recognizable as dacites or andesites.

SAMPLE NUMBER: 431484

SUMMARY:

This is a sericite-silica ± pyrite-altered formerly glassy aphyric andesitic lava.

HAND SPECIMEN:

This is a medium grey massive silicified felsic(?) lava with chloritic fractures.

THIN SECTION:

This sample is a weakly vesicular even-textured sparsely plagioclase-phyric felsic lava that was originally largely glassy. The glassy matrix has altered to a quartz-sericite intergrowth in which scattered small pyrite grains and finer-grained Fe oxide dust are set. The rare small feldspar phenocrysts are replaced by sericite. Chlorite occurs as three associations: firstly in microshears with calcite, secondly in vesicles with secondary quartz and pyrite, and thirdly with disseminated pyrite as small marginal coatings and pressure fringes.

There is nothing petrographically in this sample to judge with any certainty whether the rock was originally dacitic to andesitic. It looks more like the glassy aphyric andesites I have seen (and analyzed) from the Placer holes W of the highway. I think it can also correlate with the diverse andesite-dacite ± basalt sequence in the lower half (360m - 495m depth) of the Mines Dept Mt Charter hole MCH-1.

SAMPLE NUMBER: 431485

SUMMARY:

This is a formerly glassy aphyric dacitic lava in which the groundmass has suffered sericite-silica alteration.

HAND SPECIMEN:

This is a massive, uniform buff-coloured felsic lava with a few tiny green fuchsite-like spots.

THIN SECTION:

This is a texturally well-preserved felsic lava in which sparse euhedral sericitized plagioclase phenocrysts and quite rounded and resorbed quartz phenocrysts less than 0.4mm across in a recrystallized formerly glassy matrix. Phenocrysts probably make up less than one modal% of this rock, which could be described as aphyric.

The groundmass of this sample was originally glassy. It devitrified and then crystallized to an even-textured, fine-grained quartz-sericite intergrowth with rare small pyrite grains. As well as forming a weakly foliated dispersed web through the groundmass, sericite also forms elongate, sheared clots that form along microshears.

This sample is petrographically rhyolitic to dacitic, and is relatively well-preserved, although the groundmass probably underwent the same silica-sericite alteration that has affected all the samples described in the previous pages.

SAMPLE NUMBER: 431486

SUMMARY:

This is a thoroughly recrystallized former basaltic lapilli tuff that suffered strong chlorite-quartz-pyrite alteration, followed by strong calcite overprinting.

HAND SPECIMEN:

This is a uniform-textured mafic lava with fairly extensive alteration, probably calcite-chlorite dominated.

THIN SECTION:

This sample bears minor relict textural evidence that it was originally an exceptionally vesicular basaltic lava, or else a basaltic lapilli tuff. Rounded to ovoid bodies often aggregated too close to have been vesicles, are defined by chlorite and secondary quartz. The few outlines of former phenocrysts are suggestive of olivine precursors, and a few deep red chromite inclusions are present, supporting this interpretation. Most of the rock consists of extremely variable textured intergrowths of very fine-grained saccharoidal secondary quartz and chlorite, and this has been overstamped by strong to intense calcite alteration. Calcite probably constitutes 50 modal% of the sample. In a few areas, secondary quartz and chlorite are coarser-grained and may represent disrupted veinlets. Idiomorphic pyrite grains to about 0.5mm maximum diameter are not uncommon disseminated throughout the sample, and often have quartz pressure fringes.

This sample was almost certainly composed essentially of glassy basaltic lapilli. It has been very strongly silica-chlorite ± pyrite altered, leading almost complete recrystallization and obliteration of the original texture. Subsequent calcite alteration, with no associated pyrite mineralization, has strongly overprinted the rock.

SAMPLE NUMBER: 431487

SUMMARY:

This is a basaltic lava breccia composed of formerly glassy to less rapidly cooled lava fragments of olivine-phyric, vesicular lava that has suffered strong chlorite-quartz alteration with associated weak disseminated pyrite mineralization. Later calcite and sericite alteration has overprinted the original alteration assemblage.

HAND SPECIMEN:

This is a strongly altered mafic tuff or lava that has suffered strong chlorite-calcite alteration. It has almost a fragmental appearance, but this may be due to the alteration.

THIN SECTION:

This sample is texturally better-preserved than the previous sample. It was clearly a strongly vesicular basaltic lava or lava breccia with common large totally chloritized former olivine phenocrysts. The olivine phenocrysts probably constituted around 10-15 modal% of the rock, and are replaced by pale green chlorite and also by secondary quartz intergrown with the chlorite in some former crystal sites. Some were at least 2-3mm long and quite well-formed, and small chromite inclusions are present in many crystals.

The groundmass of this sample shows enough primary textural variation to suggest that the rock was originally a basaltic lava breccia. Some domains of the thin section are clearly originally glassy, with glass replaced by quartz and chlorite in a mottled texture typical of recrystallization of devitrified glass. In other areas, the groundmass was more slowly cooled, with small albite microlites randomly orientated in chlorite after interstitial glass. The abundant vesicles in this rock are filled by rather coarse-grained polygonal secondary quartz with less abundant chlorite and calcite, and common idiomorphic crystals of pyrite, usually two or three per vesicle. The sample is cut by a weak web of sericite, and calcite occurs in clots overprinting large areas of the section.

SAMPLE NUMBER: 4317488

SUMMARY:

This is a formerly glassy sparsely plagioclase-phyric dacitic lava that has suffered strong silica-sericite alteration.

HAND SPECIMEN:

This is a pale grey even-textured felsic aphyric lava with a few thin calcite veinlets and spots of darker chlorite concentration.

THIN SECTION:

Despite intense alteration and recrystallization, this sample preserved its original texture well enough that the rock can be confidently identified as having been a sparsely plagioclase-phyric glassy dacite lava. The former plagioclase phenocrysts are entirely sericitized, and some are slightly stretched out and deformed; they originally made up less than about 2 modal% of this rock and were smaller than 1mm long.

The originally glassy groundmass of this sample probably devitrified then recrystallized as quartz and albite. However, relatively strong alteration has led to extensive recrystallization of the groundmass to fine-grained and rather uniform-textured quartz riddled by sericite and small Fe oxide grains. The sericite shows a weak orientation across the section. Disseminated pyrite grains to about 0.3mm across are sparse. A few thin calcite veinlets transect the sample, but calcite overprinting is insignificant.

SAMPLE NUMBER: 431489

SUMMARY:

This is a formerly glassy olivine-phyric basaltic lava or lava breccia, less vesicular than 431487 but otherwise very similar. It underwent a strong silica-chlorite ± minor pyrite alteration of glass, then was overprinted by intense calcite alteration.

HAND SPECIMEN:

This is a medium to dark grey strongly altered and recrystallized mafic lava or lava breccia with abundant calcite alteration.

THIN SECTION:

This sample is remarkably similar to sample 431487 in most respects, except that it was much less vesicular. It is composed of about 5-10 modal% of totally chloritized former olivine phenocrysts, some up to 2mm long, with occasional chromite inclusions, in a recrystallized formerly glassy groundmass. Vesicles are much smaller and less abundant than in similar sample 431487. The once glassy groundmass has been twice altered, first to fine-grained quartz and chlorite, and later it was totally overprinted by calcite, so that very little of the first stage of alteration is preserved. Disseminated pyrite grains to about 0.5mm across are not uncommon, and almost certainly are associated with the earlier stage of alteration. This sample could have been either a basaltic lava or a lava breccia; whichever was the case, it was certainly highly glassy.

SAMPLE NUMBER: 431500

SUMMARY:

This is a sparsely plagioclase+quartz-phyric formerly glassy rhyolitic lava breccia, probably monomict, with variably silica-sericite -altered fragments and disseminated pyrite.

HAND SPECIMEN:

This is probably a formerly glassy dacitic lava breccia with abundant clots and irregular veinlets of pyrite, a few calcite veinlets, and some dark clots of chlorite-rich material.

THIN SECTION:

This sample in thin section is clearly a felsic lava breccia, probably monomict, with the original texture still fairly well-preserved despite strong recrystallization after devitrification of the glassy groundmass. The sample contained around 3-5 modal% of albitized plagioclase phenocrysts, mainly single crystals less than 1mm long, that have been totally sericitized. Quartz phenocrysts are slightly less abundant, and show fairly strong reaction and rounding, and are also rarely larger than 1mm diameter. Small former FeTi oxide phenocrysts are leucoxenitized.

The groundmass of this sample is composed of recrystallized devitirified glass. However the texture of the groundmass varies from fragment to fragment depending on the degree of alteration. Some fragments have a weakly altered very fine-grained mosaic-textured quartz-feldspar intergrowth with minor sericite, whereas others are

clearly much more intensely sericitized, with coarser grained saccharoidal quartz between the dense sericitic mesh. Sericite also occurs as dense streaks some 2-5mm wide that may define margins of some lava fragments. Pyrite occurs as quite common disseminated grains and grain aggregates with grainsize up to about 0.6mm across. A few veinlets of fibre calcite cut the sample.

SAMPLE NUMBER: 431548

SUMMARY:

This is a strongly recrystallized silica-sericite-altered formerly glassy sparsely feldspar+quartz-phyric rhyolitic lava.

HAND SPECIMEN:

This is a massive, uniform-textured almost aphyric pale grey dacitic lava.

THIN SECTION:

This sample is clearly a strongly recrystallized formerly glassy dacite lava with a few plagioclase and quartz phenocrysts. The former feldspar phenocrysts are less than 1mm long and totally sericitized. The few small quartz phenocrysts are strongly rounded and blend marginally into quartz in the altered groundmass. FeTi oxide microphenocrysts are altered to leucoxenitic material, with opaque granular margins and sericite-quartz cores.

The groundmass of this sample is quite strongly recrystallized from what was almost certainly devitrified glass. It is composed of granular quartz averaging around 0.1-0.2mm across with interstitial sericite pervading this matrix as an orientated meshwork. Chlorite is rare in this sample, calcite also, and pyrite is present only as a few small grains.

This is a strongly recrystallized silica-sericite-altered rhyolitic lava.

SAMPLE NUMBER: 431549

SUMMARY:

This is a formerly glassy sparsely plagioclase+augite-phyric andesitic lava with strong silica-sericite alteration of the groundmass

HAND SPECIMEN:

This is a massive dark apparently aphyric grey felsic to intermediate lava with a few chloritic veinlets and fracture fillings.

THIN SECTION:

This sample is a sparsely plagioclase+augite-phyric andesitic lava that originally had a glassy groundmass. The former plagioclase phenocrysts are totally sericitized small euhedra less than 1mm long, that make up less than 2 modal% of the sample. Only two or three former augite phenocrysts were noted, all less than 1mm long and all completely chloritized. Former FeTi oxide microphenocrysts are relatively common and all replaced by translucent brown leucoxenic material and limonite(?).

The groundmass of this sample was originally glassy, but has devitrified than recrystallized to a medium-grained mosaic texture composed of quartz and sericite, quite strongly pervaded by wispy pale green chlorite and riddled with tiny equigranular Fe oxide grains. Dispersed commonly throughout the groundmass are small anhedral patches of angular secondary quartz, often polycrystalline, that are growing from the matrix. The rock is transected by a few diffuse and meandering chlorite veins, and disseminated small pyrite grains make up about 0.2 - 0.5 modal% of the sample.

With regard to your comment about dacitic versus andesitic affinities of this sample and 431548, I offer the following thoughts. Although nobody could have ever picked it from hand specimen alone, particularly if, as you say, the interval from 548 to 549 is gradational in hand specimen (chlorite content etc), these two samples are undoubtedly petrographically different. 548 is unambiguously a rhyolitic lava, while the present sample (549) is notably more mafic, as indicated by the few augite phenocrysts, the abundant chlorite, and the abundant Fe oxides in the recrystallized groundmass. As I noted earlier in this report, I have seen quite a few aphyric to sparsely plagioclase and augite-phyric formerly largely glassy andesitic lavas in the sections between the Hellyer basalts and the Animal Ck Greywacke. I draw your attention to the

Mines Dept hole MCH-1 (that I'm sure you know more about than me) in the interval 407-494m, where evolved andesites to dacites with Ti/Zr from 11-14 overlie more andesitic lavas with Ti/Zr from 16-18. Is correlation with this level of MCH-1 reasonable?

SAMPLE NUMBER: 431597

SUMMARY:

This is a vesicular aphyric formerly glassy andesite lava almost identical to the previous sample.

HAND SPECIMEN:

This is a pale grey weakly vesicular dacitic lava with a stockwork of fractures highlighted by dark chlorite and quartz.

THIN SECTION:

This sample is seen in thin section to be a vesicular aphyric andesite lava very similar texturally to the previous lava except that this rock contains even fewer sericitized plagioclase phenocrysts, and no augite phenocrysts.

The groundmass of this sample contains around 10 modal% of rounded to ovoid vesicles filled by polycrystalline quartz and minor pale green chlorite. It was probably glassy to vitrophyric, with small totally sericitized plagioclase laths set in modally dominant glass. The glass has recrystallized to a medium-grained intergrowth of quartz and minor sericitized albite, with common sericite pervading the matrix as a weak mesh, and relatively abundant interstitial chlorite and tiny granular Fe oxide grains. Quartz-chlorite veinlets cut the sample, and some of the thicker of these have marginal zones in which small idiomorphic pyrite grains have crystallized.

This is definitely an andesitic lava essentially identical to the previously described sample, with the same implications. I would say that the Ti/Zr value would have to be around 16-17.

0414

SAMPLE NUMBER: 431550

SUMMARY:

This is an intensely sericite-silica-altered sparsely plagioclase-phyric formerly glassy dacitic lava breccia with quartz-chlorite veinlets post-dating the sericite-quartz alteration.

HAND SPECIMEN:

This is a mid-grey strongly sericite-altered felsic lava or lava breccia.

THIN SECTION:

This is an intensely altered and recrystallized felsic lava breccia with few traces remaining of the original texture. Only rather abrupt textural variations in the style and extent of alteration and recrystallization of the groundmass allow identification of this sample as a lava breccia. The few areas of the sample where sericite-quartz alteration has not obliterated the texture indicate that this was a very sparsely plagioclase-phyric dacite lava breccia.

The groundmass of this rock has recrystallized entirely from glass to a heterogeneous but fine-grained mixture of saccharoidal quartz and dirty brown sericite. Some fragments have less sericite and coarser-grained quartz, and more Fe oxide granules through the quartz. The sample is cut by intersecting and meandering quartz-chlorite veinlets without associated pyrite.

SAMPLE NUMBER: 431551

SUMMARY:

This is a formerly glassy sparsely plagioclase-phyric acid andesite lava with strongly recrystallized silica-sericite groundmass; it is almost identical to 431597.

HAND SPECIMEN:

This is a grey aphyric recrystallized and altered dacitic to andesitic lava cut by chlorite-quartz veinlets.

THIN SECTION:

Although the glassy groundmass of this sample has recrystallized thoroughly to a silica-sericite intergrowth, the texture is relatively well-preserved. The sample is composed of about 3-5 modal% of small plagioclase phenocrysts that are completely sericitized, and one or two small chloritized augite phenocrysts, and small leucoxenized FeTi oxide grains in a uniform recrystallized groundmass. The groundmass is composed of granular secondary quartz and abundant interstitial sericite, with minor chlorite, and relatively abundant equidimensional Fe oxide grains. A few narrow chlorite-quartz grains cut the sample.

This sample is very similar to 431597 in every way, and has the same implications. It is an evolved andesitic lava with silica-sericite alteration of the originally glassy groundmass.

SAMPLE NUMBER: 431552

SUMMARY:

This is a sparsely quartz+feldspar-phyric glassy rhyolitic lava that has had the groundmass recrystallized as silica-sericite-pyrite.

HAND SPECIMEN:

This is an almost aphyric pale grey formerly glassy felsic lava with strong silica-sericite alteration and a few quartz veinlets.

THIN SECTION:

This sample is clearly a sparsely quartz+feldspar-phyric rhyolitic lava that originally had a glassy groundmass. It consists of several modal% of small (<1mm across) subhedral to rounded and resorbed quartz

phenocrysts and subordinate small totally sericitized plagioclase phenocrysts, set in a recrystallized groundmass composed of equigranular almost saccharoidal quartz with interstitial webs of sericite. Well-formed pyrite grains to 1.5mm across occur scattered throughout the sample, but make up much less than 1 modal% of this rock. Most pyrite grains are <0.2mm across, and many are associated with quartz veinlets and have pronounced quartz pressure fringes.

This sample is clearly a sparsely quartz+feldspar-phyric formerly highly glassy rhyolitic lava in which the groundmass recrystallized via strong silica-sericite alteration, as in most of the felsic samples described in this set of rocks.

SAMPLE NUMBER: 431553

SUMMARY:

This is a strongly silica-altered sparsely plagioclase and quartz-phyric formerly glassy rhyolitic lava.

HAND SPECIMEN:

This is a creamy pink coloured probably silicified aphyric felsic lava.

THIN SECTION:

This sample is a formerly glassy felsic lava with around 3-5 modal% of small (<<1mm long) completely sericitized feldspar phenocrysts, and one or two small almost totally resorbed quartz phenocrysts set in a strongly silicified very fine-grained groundmass composed of almost chalcedonic silica with much less interstitial sericite than is present in many of the other recrystallized groundmasses in the felsic lavas described in this report. A few microshears are emphasized by coarser-grained recrystallized quartz and concentrations of extremely fine-grained Fe oxides in a manner resembling stylolites, indicating these shears are sites of pressure solution. A very small amount of well-formed pyrite grains to about 0.5mm across are disseminated throughout the sample. This sample has suffered stronger silicification than many of the other samples of felsic lavas in this hole.

SAMPLE NUMBER: 431554

SUMMARY:

This is a sparsely plagioclase+augite-phyric formerly glassy andesite lava with notably more apatite in the groundmass than in the foregoing andesites; it is much less altered than most of the samples described herein.

HAND SPECIMEN:

This is a mid-grey altered intermediate lava with a few narrow pyritic veinlets and spots of dark chlorite.

THIN SECTION:

In thin section, it is clear that this is an andesitic lava. It consists of approximately equal modal abundances (around 1-2 modal%) of very small plagioclase phenocrysts (<1mm long) that are totally replaced by aggregates of polycrystalline quartz, and small well-formed augite prisms that are completely chloritized.

The formerly glassy groundmass of this sample is texturally well-preserved and consists of a mosaic-textured intergrowth of quartz and minor albite riddled by fine-grained sericite and tiny Fe oxide granules, with quite common interstitial chlorite and a notable amount of small apatite microphenocrysts and needles throughout the groundmass. Whereas most other features of this sample are similar to the andesites from higher in this hole, such as 431549 and 431597, the absence of apatite in both the latter and its relative abundance in this sample clearly indicate differing magmatic groups, albeit andesitic, for these rocks. A small amount of disseminated pyrite occurs throughout this rock.

SAMPLE NUMBER: 431555

SUMMARY:

This is a formerly glassy aphyric andesitic lava that was silica-sericite altered during recrystallization of the glassy groundmass, then hydrofractured during a second episode of intense silica-alteration. Disseminated pyrite seems associated with the silica-sericite alteration.

HAND SPECIMEN:

This is a stongly altered polymict(?) lava breccia with intense fluid fracturing autobrecciation and silica-carbonate in interfragment areas. Some fragments are dark and chlorite-rich whereas others are probably silica-sericite altered.

THIN SECTION:

In thin section, this sample is seen to be a lava breccia or coarse lithic tuff that at first appears quite polymict; however careful examination of the section shows that much of the brecciation is probably hydrothermal, and the rock may originally have been a felsic or intermediate lava. Most fragments are composed of fairly coarse mosaic-textured intergrowth of anhedral quartz and feldspar, the latter intensely riddled by tiny sericite flakes. A few ghost outlines of sericitized and recrystallized former small feldspar phenocrysts are evident, but most of the primary texture of this sample has been thoroughly destroyed. Opaque grains include quite common altered FeTi oxide microphenocrysts, larger and sharper-edged disseminated pyrite (<< 1 modal%) and abundant tiny Fe oxide granules throughout the recrystallized groundmass. Chlorite occurs commonly throughout the rock intergrown with quartz and sericite.

The rock has been quite strongly silicified, with the silica alteration being responsible for the false brecciation of the rock so evident in the hand specimen. In thin section, this interstitial silica alteration between 'fragments' appears as extremely fine-grained microcrystalline material that is almost chalcedonic. It contains small patches that are recrystallizing as coarser-grained quartz, and is overprinted by small common calcite rhombs. It appears that this silica alteration post-dates the sericite-silica alteration that produced recrystallization of the once devitrified glassy groundmass.

I would say that this sample was originally a glassy, almost aphyric andesitic lava (abundant chlorite and tiny Fe oxide grains suggest a more

mafic precursor than dacite) that suffered strong sericite-silica alteration during recrystallization of the glassy groundmass, then a later strong fluid fracturing alteration event that brecciated the sample along fluid passageways and caused intense silica alteration.

SAMPLE NUMBER: 431556

SUMMARY:

This is a formerly glassy sparsely plagioclase and quartz-phyric rhyolitic lava in which the groundmass recrystallized during strong silica-sericite ± pyrite alteration. It is essentially identical to 431552 and 553.

HAND SPECIMEN:

This is a massive pale grey silicified felsic lava with irregular dark spotting of more chlorite-rich matrix.

THIN SECTION:

This sample is a silica-sericite altered formerly glassy sparsely plagioclase-phyric dacite lava almost perfectly identical to 431552 and 553. It consists of a few modal % of small totally sericitized plagioclase phenocrysts smaller than 1mm long, and a few almost completely resorbed and rounded quartz phenocrysts in a silica-sericite-altered once-glassy matrix. The latter has recrystallized as an even-textured intergrowth of equidimensional granular quartz with grains less than 0.05mm across, and interstitial pale sericite that does not (at least in the orientation of this section) form an orientated mesh as often seen in such rocks. The sample is cut by a few strained quartz-chlorite veinlets that contain common idiomorphic pyrite grains to about 0.7mm across. Disseminated grains of pyrite are quite common throughout the recrystallized matrix.

SAMPLE NUMBER: 431557

SUMMARY:

This is a formerly glassy sparsely plagioclase+augite-phyric dacite or acid andesite lava that has undergone extensive silica-chlorite (+minor sericite) alteration.

HAND SPECIMEN:

This is a dark green-grey andesitic lava or lava breccia with paler coloured silica-altered (?) areas between apparent fragments.

THIN SECTION:

This is an exceptionally strongly altered, slightly vesicular formerly glassy andesitic lava with totally altered sparse plagioclase phenocrysts and even less augite phenocrysts. The plagioclase phenocrysts are completely sericitized, and the few recognizable former augite phenocrysts are chloritized. The remainder of this rock is so heterogeneous as to almost defy description. It is composed of weakly foliated, curving, highly irregular domains of darker colour that have a very fine-grained chloritic base overprinted by secondary quartz and angular patchy areas of sericite. Paler coloured domains are more sericite and quartz-rich, and include areas with finely granular saccharoidal silica intergrown in an almost banded fashion with streaky pale green chlorite. Larger patches of deformed coarse secondary quartz appear to be slightly flattened vesicles.

The abundance of chlorite and the few augite phenocrysts suggest that this was a dacite to acid andesite. It has suffered intense silica-chlorite alteration, but has minimal associated pyrite.

SAMPLE NUMBER: 431558

SUMMARY:

This is a strongly recrystallized and weakly foliated originally glassy dacitic to andesitic lava with strong silica-sericite alteration.

HAND SPECIMEN:

This is a grey-green intensely sericitized felsic or intermediate lava or lava breccia with a weak foliation and cut by chloritic veinlets.

THIN SECTION:

This sample is a formerly glassy dacitic to andesitic lava composed of about 3-5 modal% of small altered plagioclase phenocrysts in a groundmass that is strongly and variably recrystallized, and weakly foliated. The former plagioclase phenocrysts are mainly less than 1mm long and are entirely replaced by polycrystalline aggregates of very fine-grained quartz and sericite. A few phenocrysts replaced entirely by fine-grained quartz may have been originally augite.

In the least-altered ares of groundmass, the texture is seen to be a fairly coarse snowflake texture after devitrified glass. However, this has been strongly modified by variably intense alteration and foliation development. The most common style of alteration is granular fine-grained ailica and intergrown sericite and subordinate chlorite.

Foliation planes and microshears, and crosscutting fractures are marked by strong chlorite development and recrystallization of groundmass secondary quartz. Patchy calcite alteration overprints the altered groundmass and the assemblages developed along the veinlets and foliation planes.

I think it is not possible to judge petrographically whether this sample is andesitic (as the Ti/Zr data suggest) or dacitic. I would say it is closer to dacite in thin section, as chlorite is a minor phase and augite phenocrysts were scarce.

SAMPLE NUMBER: 431559

SUMMARY:

This is a formerly glassy, sparsely plagioclase+quartz -phyric dacitic lava with a groundmass that is probably less silicified than many of the other samples in this set.

HAND SPECIMEN:

This is a mid-green to grey mottled felsic to intermediate lava with a few diffuse patches of more chloritic matrix.

THIN SECTION:

This sample is texturally quite well-preserved, and one of the least-altered rocks in this set. It is a sparsely plagioclase+quartz-phyric dacitic lava with a very fine-grained groundmass after devitrified glass. The plagioclase phenocrysts are less than 1mm long and totally sericitized. A few phenocrysts that have shapes more typical of plagioclase than augite are replaced by pale green chlorite. Quartz phenocrysts are less than 1mm across and are strongly rounded and resorbed, with no crystal faces preserved. Former FeTi oxide phenocrysts were also not uncommon and are replaced by very fine-grained aggregates of leucoxenitic material.

The groundmass of this sample was originally devitrified glass that has recrystallized to a very uniform-textured intergrowth of fine-grained quartz and sericite. The extent of silicification of the recrystallized groundmass is less than most of the other samples described herein. A few fractures and microshear zones are defined by more intense sericite development and subordinate intergrown chlorite. This sample was originally very similar to most of the other dacites described above.

SAMPLE NUMBER: 431560

SUMMARY:

This is a strongly recrystallized formerly glassy, sparsely plagioclase+augite-phyric andesitic lava with intense silica-chlorite ± pyrite alteration of the glassy groundmass. The original rock was very similar to 431557.

HAND SPECIMEN:

This is a very strongly chlorite-silica altered andesitic lava or lava breccia.

THIN SECTION:

This sample was originally a sparsely plagioclase+augite-phyric andesitic lava with a slightly vesicular glassy groundmass. Former plagioclase phenocrysts are small and occur as single crystals less than 1mm long; some are albitized and others are sericitized; they originally made up less than 5 modal% of this rock. Former small augite phenocrysts were much less abundant than feldspar phenocrysts and are all altered to chlorite. Former FeTi oxide microphenocrysts have broken down to very fine-grained aggregates of leucoxenitic material.

The formerly glassy, weakly vesicular groundmass of this lava has altered to a variably coarse-grained, heterogeneous intergrowth dominated by chlorite and secondary quartz. Sericite is developed in abundance locally, but does not form a meshwork through the rock as in many of the other samples described herein. Vesicles make up only 1-2 modal% of the rock and are filled by coarse-grained secondary quartz. Similar strained coarse-grained quartz forms disrupted veins through the sample. Small grains of disseminated pyrite are present through the rock, but not common.

SAMPLE NUMBER: 431561

SUMMARY:

This is a formerly glassy sparsely plagioclase-phyric dacitic lava in which the glassy groundmass has altered to silica-sericite ± pyrite.

HAND SPECIMEN:

This is a massive cream coloured dacitic lava with some zones of more intense silicification of the originally glassy groundmass. It contains quite common disseminated pyrite.

THIN SECTION:

Despite thorough recrystallization of this originally highly glassy lava, its original identity is still obvious. It was a very sparsely plagioclase-phyric dacitic lava with less than 1 modal% of small (<0.7mm long) totally sericitized plagioclase microphenocrysts in a groundmass that has recrystallized to an even-textured fine-grained granular intergrowth of secondary quartz and sericite, pervaded by wispy meshworks of sericite. Clusters of disseminated pyrite grains mainly less than 0.5mm across are quite common, while a narrow veinlet composed entirely of fibrous quartz and idiomorphic pyrite also cuts the sample. A vein almost 1cm wide composed of coarse-grained quartz with calcite in the vein core is also present. This dacitic lava is very similar in most respects to the other felsic lavas decribed earlier on, except that this sample lacks quartz phenocrysts; the alteration is identical to 431552, 556 and 548.

SAMPLE NUMBER: 431562

SUMMARY:

This is a formerly augite+hornblende(?)+plagioclase-phyric andesitic lava breccia with intense quartz-chlorite-dominated alteration of the formerly glassy groundmass.

HAND SPECIMEN:

This is a dark green strongly altered basaltic or andesitic lava breccia.

THIN SECTION:

This sample is clearly a andesitic lava breccia that has extensively recrystallized and altered. The least altered lava fragments were composed of quite abundant large well-formed former augite(?) or hornblende phenocrysts in a formerly glassy chloritic matrix in which perlitic cracks are preserved. The former mafic phenocrysts are euhedral, up to 2mm long and entirely replaced by polycrystalline granular quartz. Many crystal shapes are more like hornblende than augite. Some phenocrysts may also have been plagioclase, but are similarly altered. Most other fragments and their boundaries are rather indistinct and were probably like that just described, but with notably fewer phenocrysts and much stronger alteration. This alteration is broadly defined by two major types, chlorite-sericite-quartz and chalcedonic quartz. The latter is dominated by extremely fine-grained secondary quartz that is clearly interstitial between angular lava fragments in which primary glass has altered to chlorite-quartz-sericite mixtures.

0424 This sample was almost certainly a monomict lava breccia probably derived from a single glassy andesitic lava flow that was strongly recrystallized and brecciated by fluid fracturing during intense hydrothermal alteration.

SAMPLE NUMBER: 431563

SUMMARY:

This is a strongly recrystallized and altered formerly sparsely plagioclase-phyric glassy dacitic lava, with strong quartz-sericite-Fe oxide alteration of the original groundmass; it contains segregations with minor barite and sphalerite in addition to pyrite.

HAND SPECIMEN:

This is a foliated grey dacitic lava breccia with cream coloured lava fragments to several cm long in a darker matrix.

THIN SECTION:

As is common in strongly altered originally glassy felsic lava breccias, the fragmental nature of this sample is not at all obvious in thin section. The rock was clearly a glassy sparsely plagioclase-phyric dacitic lava (breccia). Sericitized albite phenocrysts make up less than 2 modal% of the sample and were less than 1mm long. No former mafic phenocrysts were apparently present, but small leucoxenitized FeTi oxide microphenocrysts were not uncommon.

The groundmass of this sample was entirely glassy, but has recrystallized to a very fine-grained felted intergrowth of quartz and sericite (and possibly also albite) with abundant very fine-grained granular Fe oxide dust throughout. Streaky discontinuous veinlets of quartz and sericite parallel the weak foliation defined by sericite and trains of oxides in the altered groundmass. An area more than 1cm wide is composed of much coarser-grained polygonal secondary quartz and intergrown sericite and subordinate pyrite cubes; it also contains a few small patches of barite, and sphalerite overgrowing one large pyrite grain. Quartz veins branch off from this segregation, indicating that it is not a discrete fragment.

SAMPLE NUMBER: 431564

SUMMARY:

This is a thoroughly recrystallized felsic glassy lava that has suffered strong hydrothermal alteration and recrystallization to an assemblage dominated by polygonal quartz and barite, with abundant sphalerite and chalcopyrite replacing galena; pyrite is rare in this sample, possibly much of it has been replaced by the sphalerite.

HAND SPECIMEN:

This is a grey-green strongly recrystallized and silicified glassy felsic lava with thin quartz veinlets, disseminated pyrite and a few patchy barite development.

THIN SECTION:

The only trace of the original texture or mineralogy left in this sample is a few ghost remnants of former plagioclase phenocrysts now replaced by polycrystalline quartz. The remainder of the rock is composed of a medium- to coarse-grained intergrowth of polygonal quartz and abundant anhedral barite that often occurs as rather large grains to several mm long in a finer-grained recrystallized matrix of polygonal quartz and barite. By far the most abundant other phase is colourless to very pale yellow sphalerite, that occurs as abundant interstitial amorphous patches, that in about half of the thin section form a connected intergrowth.

OPAQUE MINERALOGY

Disseminated pyrite grains are much less common than in many of the other samples in this set, and occur as rather ragged, moth-eaten grains (eaten by the rare migratory moth, the spotted Sudanese sulphide-sucker, that stinks when you squash it). The abundant sphalerite contains relic patches of galena being replaced by the sphalerite. Many contacts between sphalerite and galena are sites of chalcopyrite growth, but chalcopyrite never seems to occur within galena unless there is sphalerite also in contact. This sample contains more chalcopyrite than the previous two polished thin sections, probably totalling around 5 modal% of the sulphide assemblage.

SAMPLE NUMBER: 431565

SUMMARY:

This is a formerly sparsely plagioclase-phyric glassy dacite that has undergone a silica-sericite ± pyrite alteration.

HAND SPECIMEN:

This is a pale grey-green recrystallized and possibly silicified glassy dacitic lava with thin quartz veinlets, disseminated pyrite and a few tiny fuchsite spots.

THIN SECTION:

This sample was clearly a sparsely plagioclase-phyric glassy dacitic lava that has been devitrified and extensively recrystallized. Former plagioclase phenocrysts are either totally altered to sericite or recrystallized as aggregates of small polygonal quartz grains. They were rarely larger than 1mm long and make up only about 2-3 modal% of this rock. There were no quartz phenocrysts in this rock, but the occasional small FeTi oxide phenocrysts are altered to sericite and limonitic material.

The groundmass of this sample was originally entirely glassy. The glass probably devitrified but then was strongly altered, recrystallizing to a fine-grained patchy mosaic quartz intergrowth streaked with fine meshes of sericite. Subparallel with the sericite streaking are many elongate patches of coarser-grained secondary quartz. These are cut by narrow veinlets of fibre quartz. Disseminated small pyrite grains make up about 1 modal% of the rock, and are scattered throughout the recrystallized groundmass. Fine-grained granules of either Fe oxide of pyrite are very common in the quartz-sericite groundmass.

This sample was a glassy dacite that has suffered some silica-sericite-pyrite alteration.

SAMPLE NUMBER: 431566

SUMMARY:

This is a polymict felsic lava breccia or coarse-grained lithic tuff that has suffered weak silica-sericite-pyrite alteration, more strongly in the formerly ashy matrix than the lava fragments.

HAND SPECIMEN:

This is a pale grey strongly altered and recrystallized felsic polymict lava breccia with fragments to at least 1cm long; it contains a very small amount of disseminated pyrite.

THIN SECTION:

This sample retains clearly in thin section the fragmental nature of the rock. Various fragments are all formerly glassy felsic lava, some aphyric, and some sparsely feldspar+quartz-phyric. The groundmass of all samples has recrystallized to varying degrees with variable textures from devitrified glass. Some fragments have quite clear mosaic-textured intergrowths of quartz and minor albite, overprinted by abundant sericite alteration, whereas others are exceptionally fine-grained quartz-sericite intergrowths hosting abundant small ragged patches of recrystallized secondary quartz. Former plagioclase phenocrysts are small and totally sericitized, and quartz phenocrysts are rather well-formed (not rounded and reacted as in many of the felsic rocks described herein), but also less than 0.8mm long.

The matrix between the lava fragments is a devitrified and probably silicified formerly highly glassy ash that contains occasional quartz and feldspar (sericitized) crystal fragments. It is less sericitized than the lava fragments and contains quite common well-formed small pyrite euhedra that are absent in the lava fragments. In a few places, this matrix is strongly sheared and fibre quartz with well-crystallized sericite and abundant tiny pyrite cubes have crystallized from the matrix.

This was clearly a felsic polymict lava breccia or coarse-grained lithic tuff. It has suffered weak silica-sericite-pyrite alteration that most strongly affected the ashy matrix.

SAMPLE NUMBER: 431567

SUMMARY:

This is a barite-sulphide vein composed of polygonal barite with diffuse bands of pyrite with interstitial galena; sphalerite is replacing both pyrite and galena; chalcopyrite is a minor opaque phase, probably being released during sphalerite replacement of galena and pyrite.

HAND SPECIMEN:

This is a grey rock composed of finely crystalline barite with diffuse bands of pyrite, and occasional patches of much coarser-grained barite.

THIN SECTION:

This sample consists almost entirely of medium-grained intergrown polygonal barite in which a few larger anhedral porphyroblasts of barite are preserved. Sulphides form several diffuse bands through the barite, and include a sphalerite band and several bands of abundant small pyrite grains with sparse intergrown barite. In reflected light, the pyrite grains are seen to be idiomorphic and up to several mm across. Some have narrow rims and veinlets in cracks of chalcopyrite, although this is modally insignificant. As pyrite in bands become less abundant or more diffuse, more galena and sphalerite occur interstitially to the pyrite. Chalcopyrite occurs in these minerals as small blobs and spots. As in the three other polished sections described herein, the sphalerite clearly post-dates and is overgrowing the galena, and to a much lesser extent, the pyrite.

SAMPLE NUMBER: 431568

SUMMARY:

This is a formerly glassy felsic lava breccia that suffered strong silica-sericite-pyrite alteration, and further silicification and recrystallization in a hydrothermal alteration event that produced silica-barite-pyrite-galena-tetrahedrite-sphalerite assemblages, in which sphalerite was clearly the last phase to precipitate.

HAND SPECIMEN:

This is an extensively hydrothermally altered and recrystallized felsic lava breccia, with a few fragments to 1.5cm across still evident.It contains abundant disseminated pyrite and minor barite, in a matrix that is probably highly siliceous.

THIN SECTION:

A few lava fragments are still obvious, with variable textures following devitrification of glassy groundmass. Most have fine-grained quartzose mosaic textures in which sparse former plagioclase phenocrysts are replaced by polycrystalline quartz. The recrystallized quartzose groundmasses of the various lava fragments are also variably peppered by tiny opaques, some of which may be exceptionally fine-grained sphalerite. Meandering narrow quartz veinlets cut the fragments, and pass into inter-fragment matrix areas composed of medium- to coarse-grained polygonal quartz riddled with tiny sericite-muscovite needles and submicroscopic Fe oxide(?) dust and very fine-grained disseminated sphalerite. These areas contain abundant pyrite grains (to almost 1mm across) and anhedral patches of colourless to pale yellow sphalerite. Barite occurs as a subordinate phase intergrown with polycrystalline quartz in veinlets and strongly recrystallized inter-fragment matrix areas.

OPAQUE MINERALOGY

The sulphides in this sample form extensive stockworks through the inter-fragment matrix areas. Pyrite grains, mainly less than 0.5mm across, are well-formed and inclusion-free, and occur as disseminated grains and disrupted small trains and veinlets. Amorphous colourless to pale yellow anhedral sphalerite occurs as patches to several mm across, and is clearly replacing and overgrowing pyrite. It is probably the most abundant sulphide phase in this rock. Galena occurs as anhedral patches interstitial to pyrite, and as quite large (to several mm) pools unrelated to pyrite, and is also being overgrown by sphalerite. Tetrahedrite

occurs overgrowing galena in a few patches, and the borders between tetrahedrite and the galena are decorated with small blebs and trains of chalcopyrite. The tetrahedrite is being invaded and replaced by sphalerite that has abundant tiny inclusions of chalcopyrite.

0431

SAMPLE NUMBER: 431569

SUMMARY:

This is a strongly altered sparsely plagioclase- and apatite-phyric silicic andesite lava that suffered an earlier sericite alteration and was later overprinted by intense chlorite-quartz ± pyrite (the latter mainly in veinlets) alteration that produced a false brecciated texture in this rock.

HAND SPECIMEN:

This is a grey mottled chloritized felsic lava with an unusual devitrification texture.

THIN SECTION:

This is a very difficult sample to diagnose with certainty. It certainly was a felsic sample, either a lava or a lava breccia, but it has suffered strong and variable alteration that has overprinted and largely obliterated the primary texture. Former feldspar phenocrysts make up about 5 modal% of the rock but are totally replaced by polycrystalline quartz. Small apatite needles are common in the secondary quartz replacing feldspar, and were almost certainly inclusions in the original feldspar. One or two small phenocrysts were possibly augite, but are also now replaced by polycrystalline quartz. The only other phenocryst phases were small FeTi oxide microphenocrysts that are totally altered to leucoxenic material, and not uncommon prismatic elongate apatite microphenocrysts.

The remainder of this rock is a rather heterogeneous textured matrix with what is probably a false pyroclastic or false breccia texture. A few least altered remnants have clear mosaic textures after devitrified glass. Domains from 0.5-4mm across (that give the rock its mottled appearance) have fairly sharp boundaries against other domains with variable alteration mineralogies. The dominant alteration assemblage is chlorite-sericite-pyrite-quartz, with the relative abundances of these minerals varying from domain to domain in the groundmass, with the paler-coloured domains being more silica- and sericite-rich. Sericite occurs as a fine web-like mesh lacking any obvious alignment or foliation. Chlorite is all-pervasive and relatively fine-grained except in veins. Diffuse veinlets composed of diaggregated polycrystalline quartz grains intimately sutured grain boundaries occur with in a matrix of pale green chlorite; idiomorphic pyrite grains rarely larger than 0.5mm across make up about 10-15 modal% of these veinlets

Much finer grained pyrite occurs in similar association as winding trains that wander in the interstitial areas bounding 'fragments' or domains.

I think that this was probably a dacitic to silicic andesite lava with a glassy groundmass. The relative abundance of apatite is generally unlike the dacites in the Que-Hellyer area that I am familiar with, and makes me lean towards silicic andesite. Intense alteration, probably in several stages, has almost destroyed the original identity of the rock. The first alteration event probably involved sericitization of devitrified glass and some feldspar phenocrysts. Subsequent silica-chlorite-pyrite alteration overprinted the sericite alteration.

SAMPLE NUMBER: 431570

SUMMARY:

This is a strongly silica-sericite ± pyrite-altered polymict felsic lava breccia composed originally of largely glassy lava fragments.

HAND SPECIMEN:

This is a grey strongly sericitized polymict lava breccia composed of abundant fine-grained felsic lava fragments to about 1cm maximum length

THIN SECTION:

As is frequently the case with strongly altered formerly glassy felsic lava breccias, the fragmental texture is much less evident in thin section than in the hand specimen. A few undoubted totally recrystallized devitrified dacitic to rhyolitic lava fragments are obvious, but most of the others tend to merge imperceptibly into the matrix of the very altered rock. In the few clear lava fragments, sparse small feldspar phenocrysts have been totally replaced by polycrystalline quartz. The sample has been quite strongly silica-altered (silicified) with saccharoidal fine-grained silica replacing many former fragments and coarser-grained polycrystalline quartz being abundant through the matrix, usually intergrown with a pale sericite and very fine-grained Fe oxide dust, and minor crystalline pyrite. The pyrite occurs disseminated through matrix quartz as idiomorphic grains to about 0.4mm across. Several clots of multi-crystalline pyrite have pronounced quartz fringes in which coarse-grained sericite is growing. At first, these clots appear to be detrital, but I think

it is more likely that they are disaggregated veinlets, since some of the marginal pyrite grains in these aggregates are too 'loose and sticking out' to have survived transport.

This is clearly a polymict felsic lava breccia composed dominantly of formerly glassy lava fragments of sparsely plagioclase-phyric dacite to rhyolite, that has suffered strong silica-sericite-pyrite alteration. Your hand specimen description is spot on.

SAMPLE NUMBER: 431571

SUMMARY:

This is a totally recrystallized felsic lava or lava breccia that has suffered intense sericite-quartz alteration followed by veining by quartz-barite-calcite-pyrite-sphalerite. Sphalerite seems to have been the last-crystallized phase, and may have replaced pyrite in the cores of some veins.

HAND SPECIMEN:

This is a pale grey strongly silica-sericite altered felsic lava(?) with veinlets of creamy quartz-barite-sphalerite-pyrite veins and quartz-pyrite veins with marginal barite envelopes, in which pyrite concentrations up to 4mm thick are present.

THIN SECTION:

The original identity of this sample has been obliterated by intense silica-sericite alteration. It was probably a very glassy felsic lava or lava breccia that has been totally replaced by a fine-grained rather heterogeneous mixture of quartz threaded throughout by intense sericite meshes, and disseminated pyrite. As for sample 431469, small prismatic apatite crystals are quite abundant.

The widest vein in this sample is zoned from outer marginal polygonal and well-formed quartz and subordinate intergrown anhedral barite to a core of non-pleochroic almost colourless, not very Fe-rich sphalerite rarely thicker than 1mm, that has rims of pyrite and calcite. It is possible that the sphalerite is replacing pyrite. Another cross-cutting vein has sheared quartz and sericite with idiomorphic pyrite grains to almost 1mm across, but only a very minor amount of colourless

sphalerite, and no barite. A couple of anastomosing quartz veinlets lacking sulphides have core of anhedral barite.

This rock was probably a glassy felsic lava that devitrified then suffered strong sericite - quartz alteration followed by fracturing and hydrothermal alteration that produced zoned quartz-barite-calcite-sphalerite-pyrite veins. The sphalerite-rich veins appear to post-date the more pyritic veinlets, but they may all be related to a single mineralizing event.

SAMPLE NUMBER: 431572

SUMMARY:

This is a totally quartz-sericite-Kspar(?) altered formerly glassy aphyric felsic lava cut by abundant quartz veinlets containing sparse barite and pyrite.

HAND SPECIMEN:

This is a strongly quartz-sericite altered felsic glassy lava cut by a few diffuse veinlets of vuggy quartz-calcite-barite(?) -pyrite.

THIN SECTION:

This sample was probably a glassy felsic aphyric lava. A few small feldspar microphenocrysts have been replaced by polygonal quartz, and the entire sample has been silica-sericite altered, producing a fairly fine-grained and even-textured matrix peppered by fine-grained Fe oxides. About 30 modal% of the matrix is dirty brown, dusty material intergrown with quartz, that may be incipiently altered Kspar. Sericite forms mainly fine-grained patchy interstitial spots rather than a pervasive mesh.

The sample is cut by abundant narrow quartz veinlets with diffuse margins grading into the silicified matrix; the only other phases in the quartz veinlets are rare pyrite and interstitial anhedral barite.

SAMPLE NUMBER: 431573

SUMMARY:

This is a coarse volcaniclastic sandstone composed of detritus from altered felsic volcanics, and Animal Ck-type greywacke, cut by common quartz-chlorite veinlets.

HAND SPECIMEN:

This is a polymict, probably silicified lava breccia including rather elongate (sheared?) clasts of both fine-grained felsic lava and darker chloritized lava to at least 2cm long.

THIN SECTION:

Thin section examination shows that this sample is a weakly sheared coarse-grained epiclastic sediment. The largest clast in the section is an aphyric silica-sericite-altered formerly glassy felsic lava very similar to many of the altered fragments in 431570. Several other highly altered clasts have elongate sericite blotches that strongly resemble altered, flattened pumice fragments in a recrystallized and silicified felsic vitric tuff matrix.

A single large distinctive clast is petrographically clearly identical to the Animal Ck Greywacke, being a poorly-sorted quartz-rich arenite with abundant detrital muscovite and three or four large chromite grains derived from the ophiolite (I've checked this on similar samples), in a chloritic matrix.

The sample is cut by several quartz-chlorite veins, and contains disseminated idiomorphic pyrite to about 0.3mm across.

This is clearly a volcanogenic coarse, sandstone derived from a mixed felsic volcanic - Animal Ck greywacke source. I think it is important to note that the Animal Ck Greywacke was being eroded and redeposited at this stage, reflecting the local instability of the basin in which all this was going on.

SAMPLE NUMBER: 431574

SUMMARY:

This is a either a lithic-vitric tuff derived from a submarine ash-cloud type eruption, or else from a mass flow that resulted from basin margin tectonism that loosened and transported basinward a cloud of silty volcanic ash (now devitrified and altered).

HAND SPECIMEN:

This is a dark grey, possibly silica-altered lava breccia, probably polymict, with lava fragments to at least 2cm across.

THIN SECTION:

This sample is probably a lithic vitric tuff. Most of the sample is composed of an unusual heterogeneous lithotype that was originally sparsely plagioclase-phyric and largely glassy, and has a texture strongly suggesting a vitric tuff, although the degree of recrystallization is too severe to have preserved glass shard shapes. This section of the sample is composed of irregular fine-grained spots of angular secondary quartz and streaky sericite in an exceptionally fine-grained irresolvable matrix probably after devitrified glass.

A few small clasts of altered felsic lava composed of polycrystalline quartz-sericite, and a larger clast of glassy felsic lava-derived mosaic-textured quartz-albite with sericite-calcite alteration, are also present. A few narrow calcite veinlets transect this sample.

This rock is rather difficult to diagnose, but I would say that is is either a hot cloud-type ash flow erupted into this submarine basin, or else it is a mass flow unit involving abundant silty felsic volcanic ash that was shaken loose and flowed basinward from basin-margin instability.

SAMPLE NUMBER: 431575

SUMMARY:

This is a volcaniclastic sediment derived from a mixed basaltic lapilli - felsic lava source; it has suffered intense carbonate alteration with minor pyrite crystallization or recrystallization during the carbonate alteration.

HAND SPECIMEN:

This is a pale grey polymict strongly calcite-sericite-altered volcaniclastic sediment or lava breccia with fragments to several cm long. Most fragments appear to be fine-grained felsic lava. Bright green chlorite or fuchsite is a notable and not uncommon alteration phase.

THIN SECTION:

This sample is intensely calcite-altered, with most of the original texture completely obliterated by the alteration. However several small areas have original textures preserved. In these, it seems that the sample was a volcaniclastic sediment or vitric tuff, lacking detrital quartz (primary or secondary), but composed mainly of strongly altered basaltic lapilli and slightly flattened fragments of highly vesicular altered basaltic lava. Several perfectly euhedral red chromite microphenocrysts are present, supporting the textural indication that this material was originally basaltic. A few small clasts composed almost solely of very fine-grained saccharoidal quartz could be silicified felsic lava fragments. Disseminated small pyrite grains are common in the sample, and are associated with the calcite alteration, which is pervasive, and appears to post-date an alteration event in which much of the matrix of this sample was altered to very fine-grained silica. A single half centimeter-sized concentration of very fine-grained pyrite grains is seen to be a core cluster of intergrown pyrite euhedra with strong quartz-chlorite pressure fringes passing out into fine-grained quartz-chlorite-calcite riddled with tiny pyrite grains.

This sample is a polymict volcaniclastic sediment containing a mixed basaltic and felsic component, that has been intensely carbonate ± minor pyrite altered .

SAMPLE NUMBER: 431479

SUMMARY:

This is a felsic polymict lava breccia or coarse-grained lithic tuff that has an intensely altered and recrystallized formerly ash (?) matrix now composed of polygonal quartz-barite-muscovite-sphalerite-opaque sulphides.

HAND SPECIMEN:

This is a pale grey felsic polymict lava breccia with fragments of sparsely plagioclase-phyric dacite to several cm long, in a recrystallized matrix that contains abundant fine-grained pyrite and some white barite spots.

THIN SECTION:

Four of five distinct lava fragments are preserved in this section, and are obviously derived from at least three different original lithologies. Several fragments are of a distinctive flow-textured dacite with sparse albitized small plagioclase phenocrysts, that, unlike most of the dacitic rocks seen in this set, was originally more crystalline than glassy. The groundmass of these fragments is composed of orientated narrow laths of albite speckled with sericite and fine Fe-oxide dust. Others fragments were more typical of devitrified glassy felsic lava, with fine-grained quartz-albite-sericite mosaics recrystallized from the devitrified glass. These contain small angular and ragged patches of secondary quartz crystallizing from the matrix mosaic. The third fragment variety is also after glassy felsic lava that has recrystallized to fine-grained quartz and albite, but this type is cut by anastomosing sericite bands that produce a snake-skin pattern in the fragment.

The matrix between the various lava fragments in this sample is intensely altered and strongly recrystallized, suggesting that it was probably a porous vitric ash (although the extensive alteration and recrystallization has destroyed any original texture). It consists dominantly of relatively coarsely crystalline polygonal quartz with abundant opaque sulphides and intergrown pale yellow to colourless sphalerite. Less abundant components of the recrystallized strongly altered matrix are well-formed muscovite of phengite crystals commonly intergrown with sulphides, and polygonal anhedral crystals of barite.

SAMPLE NUMBER: 431480

SUMMARY:

This is an intensely hydrothermally altered formerly felsic lava or lava breccia that has been strongly silica-barite altered with abundant interstitial sphalerite and pyrite.

HAND SPECIMEN:

This is an intensely altered former dacitic lava breccia(?) with vague evidence of a fragmental nature, overprinted by strong silicification of the groundmass and patches and streaks of pyrite, white barite and quartz.

THIN SECTION:

No trace of the original texture of this rock is preserved. It has suffered intense silica-barite-sericite-sulphide alteration. The sample is texturally very heterogeneous with most of the sample being composed of a well-formed polygonal intergrowth of quartz and barite that host large anhedral barite crystals with abundant fluid inclusions, strong internal strain features and subgrain recrystallization in high strain zones. High-strain zones with fibre quartz, elongate and stretched barite crystals and wispy trains of well-crystallized sericite wind through the more polygonal and coarse-grained matrix. Disseminated interstitial sulphides are quite abundant, perhaps making up 5-10 % of the sample overall. These consist of fine-grained pyrite always less than 0.5mm across, often with overgrowths of clear sphalerite; the latter also occurs as discrete grains interstitially.

This sample could originally have been a glassy dacitic lava or lava breccia. It has suffered intense silica-barite-sericite-sulphide hydrothermal alteration and has an almost annealed texture dominated by finer-grained quartz and coarser barite.

SAMPLE NUMBER: 431481

SUMMARY:

This is a totally hydrothermally altered and recrystallized formerly glassy felsic lava or lava breccia that suffered intense replacement by silica-barite-pyrite-galena-tetrahedrite-sphalerite. Further granulation and recrystallization in microshears cutting the sample rotated and digested some pyrite grains and may have been associated with remobilization of sphalerite and its replacing galena.

HAND SPECIMEN:

This is an intensely altered and mineralized felsic lava breccia (?) with abundant disseminated pyrite, coarser clots of pyrite and barite, and minor galena and sphalerite in a strongly silica-altered matrix.

THIN SECTION:

This sample is composed of a few relic areas of recrystallized but not intensely altered formerly glassy felsic lava or lava breccia fragments in a strongly hydrothermally altered and recrystallized matrix. In these least altered areas, a few ghosts of former small feldspar phenocrysts are present, and are totally replaced by very fine-grained sericite. The groundmass of these areas is fine-grained mosaic-textured quartz riddled with small pyrite grains and anhedral small patches of colourless-pale yellow sphalerite that host bundles of well-formed muscovite or phengite crystals. Veins of barite and quartz with both pyrite and sphalerite along the vein margins transect the groundmass of some fragments (?). Most of the rest of this sample is composed of a polygonal fine- to medium grained intergrowth of barite and quartz in which much larger anhedral rather moth-eaten barite grains are set. These are cut by microshears in which barite has recrystallized to polygonal small interlocking grains. Sericite trains and streaks are quite common in the recrystallized quartz-barite-sulphide matrix. The sulphides in these recrystallized matrix areas are pyrite (fairly well-formed crystals and aggregates of a few crystals) and anhedral patches of clear sphalerite.

OPAQUE MINERALOGY:

The sulphides in this sample occur in diffuse bands. Pyrite is generally fine-grained (<0.5mm across) and many grains have clearly been rotated and partially reacted. Intergrown galena and sphalerite occur more abundantly in areas where pyrite

grains are less abundant. The galena occurs interstitially to the quartz-barite, and is clearly being replaced and overgrown by the sphalerite. Tetrahedrite is quite common, occurring mainly intergrown with galena, but not apparently being replaced by sphalerite. There is no chalcopyrite in this sample.

MACKINTOSH
EL 106187

3/7/90 #1

0442

MAC-26 PETROLOGY

Cu, Pb, Zn, Au, Ag, As, Ba, Zr, Ti, Cr, S, CaO, MgO, Na_2O, K_2O

432.1 M	431482	SPLIT CORE	gy-gn D.1 c̄ mnr fu spotting & mod. Py/Bav.
451.5 M	483	—"—	gy-gn wk shd D.1/Sa1Si1 c̄ mnr diss Py
475.0 M	484	—"—	gy-gn D.1/Sa1Cl1 c̄ Cl/Co Stuk.
494.7 M	485	—"—	pale gn D1/Si1-2 c̄ mnr fu spotting
512.5 M	486	—"—	gn mass. wk Co alt. B.1
529.1 M	487	—"—	gn Ave/Py 1-2 ??
532.3 M	488	—"—	gy mass D.1/Si2-3
536.0 M	489	—"—	gy-gn mass B.1.
541.6 M	431500	—"—	gy mass D.1/Si2-3Sa2 c̄ dbn Py/Co vns
556.2 M	431548	—"—	gy mass D.1/Si2Cl1
577.7 M	549	—"—	gy mass D.1/Si2
588.5 M	550	—"—	gy-gn mass D.1/Si2-3Sa2 c̄ mnr Py
594.0 M	551	—"—	gn mass D.1/Si1-2.Cl2 c̄ mnr Cl vns
602.5 M	552	—"—	gy mass D.1/Si3
618.4 M	553	—"—	gy-pk mass D.1/Si3-4Sa1-2 c̄ mnr Py

654443

MACKINTOSH
EL 106187

4/7/90 #2

0444

EASTINGS	NORTHINGS	SAMPLE NUMBER			
MAC-26 PETROLOGY					Cu, Pb, Zn, Au, Ag, As, Ba, Zr, Ti, Cr, S, CaO, MgO, Na2O, K2O
647.7 m		431554		Split core	gn mass D.1/Si1-2Cl2 Py1?
658.7 m		555		—"—	gn Al.b. ē abn disc Py
673.3 m		556		—"—	gy mass D.1/Si3 Py1.
685.7 m		557		—"—	gn A.l.v ē alt fp.
703.5 m		558		—"—	gy-gn chd A.k.D vld./Co2 ē Co/Cl stwks
709.8 m		559		—"—	gn mass D.1/Cl1-2Si2 Py1
720.7 m		560		—"—	gn mass Al6.
723.9 m		561		—"—	pale gn D.1/Si2Sa1 Py1-2 ē abn Co m
763.9 m		562		—"—	gn A.l.v. ē patch Cl.Sa.Py.Fu altn

654444

OPERATOR COMPUTER CHECK PLOTTER DATE

Aberfoyle Exploration — Geological Sample Tracer

MACKINTOSH
EL 106/87

DATE 13/7/90 | SHEET #3

0443

MAC-26 PETROLOGY

Cu, Pb, Zn, Au, Ag, As, Ba, Zr, Ti, Cr, S, CaO, MgO, Na_2O, K_2O

12.8 m	431479	gn-gy Dacite volcaniclastic/Se 2 c̄ abn Py
32.4 m	431480	gy massive Ba c̄ mnr Dl clasts & abn Py
35.0 m	431481 *	gy mass. Ba rich vlcl c̄ Py clasts & mnr Sph
64.1 m	431563	gy-gn Se alt^d Dlv c̄ mnr Py.
75.2 m	431564 *	gy sil Dlv c̄ abn Ba/Sph Gn Cpy Py veins
113.8 m	431565	gn Si/Se alt^d massive Dl c̄ mnr Py
125.0 m	431566	gy-gn Dlv c̄ clast related Se Si alt^n
217.6 m	431567 *	gy massive Ba/BMS vein c̄ band Py
224.5 m	431568 *	gy-gn Dl c̄ str Se Si BMS? alt^n & Ba/BM veins & stwks.
233.5 m	431569	gn variably Se Si Py alt^d massive Dl
265.6 m	431570	gy polymict essentially D. vlcl.
309.0 m	431571	gy-gn Se Si Py altered Dl c̄ Ba/BMS vns
352.7 m	431572	gy-gn sil Dl c̄ minor Se Py alt^n
372.7 m	431573	gn-gy shd Dlv. or Yvc?
382.1 m	431574	gn dom D Yvc c̄ str Cl alt^n overprint
394.5 m	431575	gy-gn str Cc Si Fu alt Yvc
584.5 m	431597	gn sil wk ves Bl.

* Polished Thin Section Available

654445

0445 654446

ANALABS

A division of MacDonald Hamilton & Co. Pty. Ltd.
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FAX: 09 458 7890

ANALYTICAL REPORT No. 23.3.08.07240

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

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

ORDER No.	PROJECT
10030	MAC 26
DATE RECEIVED	**RESULTS REQUIRED**
17/07/90	ASAP

No. OF PAGES OF RESULTS	DATE REPORTED	No. OF COPIES	TOTAL No. OF SAMPLES
1	08/08/90	1	17

STATE OF SAMPLES		PRE-TREATMENT								ANALYSIS		
REFER BELOW	SAMPLE NUMBERS	DRY	CRUSH	SPLIT	PUL-VERISE	SIEVE	OTHER SEE REMARKS	NONE		REFER TO ANALYSIS SECTION	PREPARATION	METH
	<431,479/481,563/575,597	SC								Cu,Pb,Zn,Ag/101		
	<431,479/481,563/575,597	SC								Au,AuChk/309		
	<431,479/481,563/575,597	SC								Ba,As,Cr,Zr,Ti/401,S/613		
	<431,479/481,563/575,597	SC								K2O,MgO,CaO,Na2O/104		
	<431,479/481,563/575,597	SC								Ti:Zr/9825		

RESULTS TO

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

RESULTS TO

REMARKS

MAC-26
PETROLOGY

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

AUTHORISED OFFICER

0446 654447

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ANALYTICAL DATA

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
	23.3.08.07240	08/08/90	10030	1 OF 2

TUBE No.	SAMPLE No.	Cu	Pb	Pb	Zn	Ag	Ag	Au	AuChk	Ba
1	431479	75	–	0.39	4750	–	14	1.023	1.030	>250(
2	431480	705	–	1.04	18600	–	36	2.060	2.010	>250(
3	431481	1200	–	1.70	23700	–	32	1.551	1.661	>250(
4	431563	40	30	–	405	6.0	–	0.629	0.625	>250(
5	431564	6100	–	5.99	13700	–	27	2.870	3.860	>250(
6	431565	85	255	–	520	1.0	–	0.567	0.502	247(
7	431566	1150	200	–	655	4.0	–	1.023	–	>250(
8	431567	1400	–	1.19	34200	–	5	0.498	–	>250(
9	431568	805	–	7.18	11900	–	23	1.051	–	>250(
10	431569	40	295	–	1150	0.5	–	0.078	–	>250(
11	431570	25	370	–	1150	1.0	–	0.147	–	>250(
12	431571	295	570	–	3300	4.0	–	0.170	0.212	>250(
13	431572	210	20	–	310	<0.5	–	0.080	0.073	>250(
14	431573	45	50	–	210	<0.5	–	<0.008	–	117(
15	431574	25	50	–	130	<0.5	–	<0.008	–	92(
16	431575	120	85	–	170	<0.5	–	<0.008	<0.008	724
	431597	35	25	–	115	<0.5	–	0.084	0.092	109(
18										
19										
20										
21										
22										
23	DETECTION	5	5	0.01	5	0.5	2	0.008	0.008	1(
24	UNITS	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm
25	METHOD	101	101	104	101	101	104	309	309	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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ANALYTICAL DATA

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
..	23.3.08.07240	08/08/90	10030	2 OF 2

TUBE No.	SAMPLE No.	Ba ✓	Ba ✓	As ✓	As ✓	Cr ✓	Zr ✓	Ti	Ti	Ti:Zr
1	431479	2.71	–	800	–	<5	172	2071	–	12.
2	431480	>7.00	40.8	1200	–	<5	39	–	0.06	–
3	431481	>7.00	32.5	900	–	<5	46	–	0.07	–
4	431563	1.01	–	–	305	<5	233	3616	–	15.
5	431564	5.35	–	110	–	<5	71	628	–	8.
6	431565	–	–	–	59	25	187	3116	–	16.
7	431566	0.50	–	–	60	5	147	2113	–	14.
8	431567	>7.00	47.3	<100	–	<5	24	–	0.05	–
9	431568	2.16	–	500	–	<5	103	1103	–	10.
10	431569	0.39	–	–	68	10	152	2501	–	16.
11	431570	0.28	–	–	86	<5	166	1366	–	8.
12	431571	0.27	–	450	–	15	136	2025	–	14.
13	431572	2.74	–	–	36	<5	162	1419	–	8.
14	431573	–	–	–	18	150	150	2466	–	16.
15	431574	–	–	–	18	110	141	2514	–	17.
16	431575	–	–	–	78	1350	48	1689	–	35.
17	431597	–	–	–	48	310	135	2522	–	18.
18										
19										
20										
21										
22										
23	DETECTION	0.01	0.1	100	2	5	5	50	0.01	0.
24	UNITS	%	%	ppm	ppm	ppm	ppm	ppm	%	%
25	METHOD	403	406	101	401	401	401	401	403	982

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

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ANALYTICAL DATA

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
	23.3.08.07240	08/08/90	10030	1 OF 1

TUBE No.	SAMPLE No.	S	K2O	MgO	CaO	Na2O				
1	431479	6.500	6.94	0.46	0.03	0.40				
2	431480	12.500	0.35	0.13	<0.01	<0.01				
3	431481	12.100	0.85	0.26	<0.01	<0.01				
4	431563	3.800	9.62	1.88	0.41	0.34				
5	431564	10.300	0.62	0.20	<0.01	<0.01				
6	431565	2.300	8.38	1.89	0.15	0.11				
7	431566	2.400	5.50	1.07	<0.01	0.09				
8	431567	13.100	0.07	0.07	<0.01	0.09				
9	431568	15.300	3.00	0.45	0.20	0.12				
10	431569	1.650	5.12	3.42	0.28	0.28				
11	431570	2.750	4.31	0.88	0.07	0.13				
12	431571	4.800	4.54	0.82	0.49	0.50				
13	431572	1.900	3.93	0.69	0.04	0.62				
14	431573	0.830	4.28	3.68	0.19	0.22				
15	431574	0.760	4.75	2.98	1.10	0.09				
16	431575	2.050	3.05	5.05	14.20	0.07				
	431597	1.200	3.22	2.62	1.75	1.03				
18										
19										
20										
21										
22										
23	DETECTION	0.005	0.01	0.01	0.01	0.01				
24	UNITS	%	%	%	%	%				
25	METHOD	613	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

0449 654450

ANALABS

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FAX: 004 31 8890

ANALYTICAL REPORT No. 23.3.08.07170

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

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

ORDER No.	PROJECT
10007	Mack E L

DATE RECEIVED	RESULTS REQUIRED
18/06/90	ASAP

No. OF PAGES OF RESULTS	DATE REPORTED	No. OF COPIES	TOTAL No. OF SAMPLES
1	09/07/90	1	9

STATE OF SAMPLES	PRE-TREATMENT								ANALYSIS		
REFER BELOW	SAMPLE NUMBERS	DRY	CRUSH	SPLIT	PUL-VERISE	SIEVE	OTHER SEE REMARKS	NONE	REFER TO ANALYSIS SECTION	PREPARATION	METH
	<4315,54/62	DC	Prep: 018						Cu,Pb,Zn,Ag/101		
	<4315,54/62	DC							Au,AuChk/309		
	<4315,54/62	DC							Ba,As,Cr,Zr,Ti/401,S/613		
	<4315,54/62	DC							K2O,MgO,CaO,Na2O/104		
	<4315,54/62	DC							Ti:Zr/9825		

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	
whole core	WC	perchloric acid	A1	cold acid	CA	atomic absorbtion	AAS
split core	SC	hydrochloric acid	A2	specific sulphide	SS	x-ray fluorescence	XRF
cutting	CU	nitric acid	A3	other mixed acids	Ma	spectrophotometry	SPEC
rock	Ro	aqua regia	A4	alkaline attack	AA	colorimetry	COL
soil	SO	nitric-perchloric	A5	volatilization	VO	chromatography	CHR
pulp	PU	HF mixture	A6	ignition	IG	titration	TTN
water	WA	HF under pressure	A7	pressed powder (XRF)	PP	other chemicals means	CHEM
tissue	TI	fusion	A8	glass fusion (XRF)	GF	miscellaneous	MISC
stream sediment	SS					fluorescence	FLUOR
heavy mineral	HM					inductively coupled plasma	ICP

AUTHORISED OFFICER [signature]

0450

654451

ANALABS

A Division of Inchcape Inspection and Testing Services Australia Pty. Ltd.

ANALYTICAL DATA

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
	23.3.08.07170	09/07/90	10007	1 OF 1

TUBE No.	SAMPLE No.	Cu	Pb	Zn	Ag	Au	AuChk	Ba	As	Cr
1	431554	16	<5	73	1.0	<0.008	<0.008	678	<2	2
2	431555	<5	<5	137	1.5	<0.008	–	900	3	2
3	431556	7	6	33	1.0	0.111	–	1013	12	2
4	431557	11	<5	129	1.5	<0.008	–	843	13	2
5	431558	81	<5	70	1.5	0.010	–	708	6	4
6	431559	52	<5	69	1.5	<0.008	–	810	2	1
7	431560	12	<5	75	1.5	<0.008	–	848	2	4
8	431561	<5	<5	21	1.5	<0.008	–	981	2	1
9	431562	48	5	146	2.0	0.014	–	1085	5	13
10										
11										
12										
13										
14										
15										
16										
17										
18										
19										
20										
21										
22										
23	DETECTION	5	5	5	0.5	0.008	0.008	10	2	
24	UNITS	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
25	METHOD	101	101	101	101	309	309	401	401	40

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

0451

654152

ANALABS

A Division of Inchcape Inspection and Testing Services Australia Pty. Ltd.

ANALYTICAL DATA

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
	23.3.08.07170	09/07/90	10007	1 OF 1

TUBE No.	SAMPLE No.	Zr	Ti	Ti:Zr	S	K2O	MgO	CaO	Na2O
1	431554	165	2844	17.2	0.950	3.89	1.79	0.49	2.02
2	431555	135	2935	21.7	1.350	3.83	2.40	2.76	1.00
3	431556	137	1829	13.3	2.500	4.53	0.73	0.28	1.16
4	431557	133	2846	21.4	0.580	3.12	1.89	1.09	0.86
5	431558	135	3042	22.5	0.210	3.90	1.79	1.05	0.36
6	431559	158	2021	12.8	0.120	4.37	1.18	0.62	0.75
7	431560	147	3313	22.5	0.150	3.98	1.87	0.39	1.40
8	431561	199	1593	8.0	1.750	5.04	0.61	0.18	0.36
9	431562	188	2848	15.1	0.490	3.80	3.02	0.49	0.13
10									
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									
21									
22									
23	DETECTION	5	50	0.1	0.005	0.01	0.01	0.01	0.01
24	UNITS	ppm	ppm	%	%	%	%	%	%
25	METHOD	401	401	9825	613	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

654453

0452

ANALABS

A division of MacDonald Hamilton & Co. Pty. Ltd.

Phone (09) 458 7999 — 52 Murray Road, Welshpool, W.A. 6106 — Telex AA92560

ANALYTICAL REPORT No: 23.3.08.07159

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

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

ORDER No.	PROJECT
9896	Mac-26

DATE RECEIVED	RESULTS REQUIRED
07/06/90	ASAP

No. OF PAGES OF RESULTS	DATE REPORTED	No. OF COPIES	TOTAL No. OF SAMPLES
1	02/07/90	1	15

REFER BELOW	SAMPLE NUMBERS	STATE OF SAMPLES	PRE-TREATMENT: DRY	CRUSH	SPLIT	PULVERISE	SIEVE	OTHER SEE REMARKS	NONE	ANALYSIS: REFER TO ANALYSIS SECTION	PREPARATION	METH
	<431,482/489,500,548/553	RC	Prep: 016							Cu,Pb,Zn,Ag/101		
	<431,482/489,500,548/553	RC								Au,AuChk/309		
	<431,482/489,500,548/553	RC								Ba,As,Cr,Zr,Ti/401,S/613		
	<431,482/489,500,548/553	RC								K2O,MgO,CaO,Na2O/104		
	<431,482/489,500,548/553	RC								Ti:Zr/199		

RESULTS TO

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

RESULTS TO

REMARKS

MAC-26
PET

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

AUTHORISED OFFICER

654454

0453

ANALABS

A Division of Inchcape Inspection and Testing Services Australia Pty. Ltd.

ANALYTICAL DATA

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
	23.3.08.07159	02/07/90	9896	1 OF 1

TUBE No.	SAMPLE No.	Cu	Pb	Zn	Ag	Au	AuChk	Ba	As	Cr
1	431482	35	15	40	<0.5	0.019	–	840	50	3
2	431483	20	25	55	<0.5	0.019	–	760	170	1
3	431484	20	20	125	<0.5	0.028	–	1150	35	1
4	431485	10	5	15	<0.5	0.011	–	1150	45	2
5	431486	70	10	140	<0.5	0.011	–	100	7	60
6	431487	20	10	125	<0.5	0.010	–	320	3	87
7	431488	20	<5	25	<0.5	0.020	–	1000	8	3
8	431489	75	5	130	<0.5	0.013	–	600	4	56
9	431500	15	5	20	<0.5	0.011	–	2100	5	8
10	431548	10	<5	30	<0.5	0.026	–	9600	8	2
11	431549	20	<5	65	<0.5	0.019	–	740	15	3
12	431550	15	5	80	<0.5	0.057	–	1850	15	12
13	431551	10	5	145	<0.5	0.011	0.028	2150	7	1
14	431552	10	10	20	<0.5	0.036	–	1400	6	3
15	431553	5	<5	40	<0.5	0.020	–	1200	<2	1
16										
17										
18										
19										
20										
21										
22										
23	DETECTION	5	5	5	0.5	0.008	0.008	10	2	
24	UNITS	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
25	METHOD	101	101	101	101	309	309	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 Jenkin

0454

654455

ANALABS

A Division of Inchcape Inspection and Testing Services Australia Pty. Ltd.

ANALYTICAL DATA

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
	23.3.08.07159	02/07/90	9896	1 OF 1

TUBE No.	SAMPLE No.	Zr	Ti	Ti:Zr	S	K20	MgO	CaO	Na20
1	431482	180	2150	11.9	2.400	3.79	0.76	0.45	0.09
2	431483	170	2850	16.8	1.700	4.23	1.77	0.70	0.12
3	431484	170	2750	16.2	1.600	3.99	2.22	1.41	0.27
4	431485	180	2450	13.6	0.500	4.24	0.66	0.32	0.90
5	431486	100	2500	25.0	0.890	0.14	6.63	9.85	1.01
6	431487	140	3550	25.3	2.950	0.78	8.55	3.97	1.02
7	431488	150	1850	12.3	2.500	3.72	1.69	0.63	0.12
8	431489	120	2700	22.5	2.650	1.22	6.58	11.50	0.66
9	431500	200	2200	11.0	3.350	4.45	1.62	1.17	0.13
10	431548	180	2200	12.2	0.650	4.25	1.47	0.40	0.16
11	431549	160	2900	18.1	0.730	3.17	2.49	0.56	0.73
12	431550	230	3250	14.1	0.360	5.13	2.37	0.38	0.43
13	431551	160	2600	16.2	0.390	3.60	2.14	0.42	0.71
14	431552	140	1300	9.3	1.950	3.43	0.83	0.15	0.13
15	431553	150	1300	8.7	0.320	3.55	0.53	0.09	0.13
16									
17									
18									
19									
20									
21									
22									
23	DETECTION	5	50	0.1	0.005	0.01	0.01	0.01	0.01
24	UNITS	ppm	ppm	%	%	%	%	%	%
25	METHOD	401	401	199	613	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

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APPENDIX 16

0456

654457 PAGE 1 OF 6

CORE GRIND SAMPLING

HOLE No. MAC-26

DATE 15/5/00

No.	SAMPLE NUMBER	INTERVAL	ELEMENTS REQUIRED	ST	SAMPLE NUMBER	INTERVAL	ELEMENTS REQUIRED
1	562416	0 - 14.2			562448	209.8-212.2	
2	417	14.2-23.5			449	212.2-215.8	
3	418	23.5-25.6			450	215.8-217.0	SPLIT CORE
4	419	25.6-29.4			431363	217.0-218.4	"
5	420	29.4-43.0			381	218.4-220.0	"
6	421	43.0-50.9			388	220.0-221.0	"
7	422	50.9-58.4			398	221.0-222.0	"
8	423	58.4-68.2			399	222.0-223.0	"
9	424	68.2-77.3			400	223.0-224.0	"
10	425	73.3-76.2			562460	224.0-225.3	"
11	426	76.2-85.2			461	225.3-233.2	
12	427	85.2-96.0			462	233.2-235.0	
13	428	96.0-98.5			463	235.0-238.1	
14	429	98.5-103.6			464	238.1-245.7	
15	430	103.6-106.2			465	245.7-247.0	SPLIT CORE
16	431	106.2-114.2			516212	247.0-248.0	"
17	432	114.2-124.4			214	248.0-249.0	"
18	433	124.4-130.6			562466	249.0-251.6	
19	434	130.6-139.8			467	251.6-262.9	
20	435	139.8-142.4			468	262.9-268.1	
21	436	142.4-150.0			469	268.1-274.8	
22	437	150.0-156.0			470	274.8-277.7	
23	438	156.0-160.7			471	277.7-288.5	
24	439	160.7-175.9			472	288.5-295.0	
25	440	STANDARD X			473	295.0-301.4	
26	441	175.9-179.7			474	301.4-308.7	
27	442	179.7-184.8			475	308.7-312.4	
28	443	184.8-191.2			476	312.4-325.8	
29	444	191.2-197.4			477	325.8-337.1	
30	445	197.4-202.3			478	337.1-350.1	
31	446	202.3-206.5			479	350.1-357.4	
32	447	206.5-209.8			480	353.4-358.7	

0457

CORE GRIND SAMPLING

654458

PAGE 1 OF 3

HOLE No. MAC-21

DATE 18/5/90

No.	SAMPLE NUMBER	INTERVAL	ELEMENTS REQUIRED	ST	SAMPLE NUMBER	INTERVAL	ELEMENTS REQUIRED
1	562481	358.7 - 361.8			562513	544.0 - 547.8	
2	482	361.8 - 364.7			514	547.8 - 550.3	
3	483	364.7 - 368.2			515	550.3 - 569.8	
4	484	368.2 - 373.3			516	569.8 - 573.3	
5	485	373.3 - 375.9			517	573.3 - 581.3	
6	486	375.9 - 376.9	SPLIT CORE		518	581.3 - 586.7	
7	487	376.9 - 384.6			519	586.7 - 592.6	
8	488	384.6 - 396.7			520	592.6 - 593.4	SPLIT CORE
9	489	398.7 - 401.4			521	593.4 - 595.7	
10	490	401.4 - 403.7			522	595.7 - 597.1	SPLIT CORE
11	491	STANDARD			523	597.1 - 601.7	
12	492	403.7 - 405.7			524	601.7 - 610.3	
13	493	405.7 - 409.3			525	610.3 - 613.7	
14	494	409.3 - 421.9			526	613.7 - 616.2	
15	495	421.9 - 437.3			527	616.2 - 618.9	
16	496	437.3 - 439.3			529	618.9 - 619.5	SPLIT CORE
17	497	439.3 - 445.7		*	529	STANDARD	
18	498	445.7 - 454.3			530	619.5 - 624.8	
19	499	454.3 - 457.5			531	624.8 - 625.6	SPLIT CORE
20	562500	457.5 - 471.4			532	625.6 - 632.1	
21	501	471.4 - 476.3			533	632.1 - 637.1	
22	502	476.3 - 481.0			534	637.1 - 646.2	
23	503	481.0 - 482.4	SPLIT CORE		535	646.2 - 653.4	
24	504	482.4 - 485.4			536	653.4 - 657.4	
25	505	485.4 - 502.1			537	657.4 - 661.0	
26	506	502.1 - 505.3			538	661.0 - 671.0	
27	507	505.3 - 516.2			539	671.0 - 681.9	
28	508	516.2 - 520.7			540	681.9 - 692.1	
29	509	520.7 - 530.6			541	692.1 - 696.7	
30	510	530.6 - 533.5			542	696.7 - 710.7	
31	511	533.5 - 539.6			543	710.7 - 714.6	
32	512	539.6 - 544.0			544	714.6 - 725.2	

0458

CORE GRIND SAMPLING

654459

PAGE 3 OF 7

HOLE No. MAC-21

DATE 20/6/90

No.	SAMPLE NUMBER	INTERVAL	ELEMENTS REQUIRED	ST	SAMPLE NUMBER	INTERVAL	ELEMENTS REQUIRED
1	S62545	725.2-731.0					
2	S46	731.0-730.9					
3	S47	730.9-746.0					
4	S48	746.0-753.7					
5	S49	753.7-754.2	SPLIT CORE				
6	S50	754.2-759.6					
7	S51	759.6-764.4					
8	S52	764.4-770.9					
9	S53	770.9-774.8					
10	S54	STANDARD					
11	S55	774.8-780.1					
12	S56	780.1-791.8					
13	S57	791.8-802.6					
14	S58	802.6-804.4	SPLIT CORE				
15	S59	804.4-813.4					
16	S60	813.4-820.0					
17	S61	820.0-826.9					
18	S62	826.9-838.4					
19	S63	838.4-847.9					
20	S64	STANDARD					
21	S65	847.9-850.7	EOH.				
22							
23							
24							
25							
26							
27							
28							
29							
30							
31							
32							

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ANALABS

A division of MacDonald Hamilton & Co. Pty. Ltd.
Phone (09) 458 7999 — 52 Murray Road, Welshpool, W.A. 6106 — Telex AA92560
FAX: 004 31 8890

ANALYTICAL REPORT No. 23.3.08.07241

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

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

ORDER No.	PROJECT
10031	MAC 26
DATE RECEIVED	**RESULTS REQUIRED**
17/07/90	ASAP

No. OF PAGES OF RESULTS	DATE REPORTED	No. OF COPIES	TOTAL No. OF SAMPLES
6	26/07/90	1	52

STATE OF SAMPLES		PRE-TREATMENT							ANALYSIS		
REFER BELOW	SAMPLE NUMBERS	DRY	CRUSH	SPLIT	PUL-VERISE	SIEVE	OTHER SEE REMARKS	NONE	REFER TO ANALYSIS SECTION	PREPARATION	METH
	<562,514/565	CG	Prep: 016,018						Cu,Pb,Zn,Ag/101		
	<562,514/565	CG	Prep: 016,018						Cu,Pb,Zn,Ag/101		
	<562,514/565	CG							Au,AuChk/309		
	<562,514/565	CG							Au,AuChk/309		
	<562,514/565	CG							Ba,As,Cr,Zr,Ti/401		

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	
whole core	WC	perchloric acid	A1	cold acid	CA	atomic absorption	AAS
split core	SC	*hydrochloric acid*	A2	*specific sulphide*	SS	*x-ray fluorescence*	XRF
cutting	CU	nitric acid	A3	other mixed acids	Ma	spectrophotometry	SPEC
rock	Ro	aqua regia	A4	alkaline attack	AA	colorimetry	COL
soil	SO	nitric-perchloric	A5	volatilization	VO	chromatography	CHR
pulp	PU	HF mixture	A6	ignition	IG	titration	TTN
water	WA	*HF under pressure*	A7	pressed powder (XRF)	PP	other chemicals means	CHEM
tissue	TI	fusion	A8	glass fusion (XRF)	GF	miscellaneous	MISC
stream sediment	SS					fluorescence	FLUOR
heavy mineral	HM					inductively coupled plasma	ICP

AUTHORISED OFFICER

.0469

654461

ANALABS

A Division of Inchcape Inspection and Testing Services Australia Pty. Ltd.

ANALYTICAL DATA

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
	23.3.08.07241	26/07/90	10031	1 OF 6

TUBE No.	SAMPLE No.	Cu	Pb	Zn	Ag	Au	AuChk	Ba	Ba	Ba
1	562514	15	15	55	1.0	0.014	0.017	949	–	
2	562515	18	65	110	1.0	0.013	–	873	–	
3	562516	26	15	90	1.5	0.141	–	835	–	
4	562517	21	34	93	1.5	0.089	–	770	–	
5	562518	26	23	97	1.0	0.065	–	1042	–	
6	562519	27	8	117	0.5	0.126	–	>2500	0.30	
7	562520	21	8	27	0.5	0.590	–	1960	–	
8	562521	19	9	163	1.0	0.045	–	>2500	0.34	
9	562522	409	24	9000	1.5	0.370	–	>2500	>7.00	23.
10	562523	69	6	239	1.0	0.085	–	>2500	2.00	
11	562524	11	9	28	0.5	0.012	–	1666	–	
12	562525	13	<5	23	0.5	0.039	–	1326	–	
13	562526	12	5	43	0.5	0.028	0.033	1377	–	
14	562527	10	<5	19	0.5	0.029	–	1583	–	
15	562528	14	9	32	1.0	0.060	–	1504	–	
16	562529	23	173	146	1.0		–	640	–	
* SYD	562530	17	19	24	1.0	0.078	0.084	1070	–	
18	562531	12	14	21	1.5	0.190	–	1394	–	
19	562532	13	19	20	1.0	0.150	–	891	–	
20	562533	16	35	25	1.0	0.059	–	908	–	
21	562534	8	7	22	0.5	0.020	–	860	–	
22	562535	28	8	63	1.0	0.022	–	838	–	
23	562536	20	9	68	0.5	0.011	–	1117	–	
24	562537	12	13	133	0.5	0.010	–	1114	–	
25	562538	19	16	59	0.5	0.010	–	1115	–	

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

654462

ANALABS

A Division of Inchcape Inspection and Testing Services Australia Pty. Ltd.

ANALYTICAL DATA

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
	23.3.08.07241	26/07/90	10031	2 OF 6

TUBE No.	SAMPLE No.	Cu	Pb	Zn	Ag	Au	AuChk	Ba	Ba	Ba
1	562539	33	15	59	0.5	0.034	–	1122	–	
2	562540	39	38	126	0.5	0.011	–	1185	–	
3	562541	45	26	89	1.5	0.058	–	1089	–	
4	562542	24	27	65	1.0	0.014	–	863	–	
5	562543	64	18	81	1.5	0.059	–	828	–	
6	562544	43	20	92	0.5	<0.008	<0.008	907	–	
7	562545	15	17	55	0.5	0.012	0.015	1074	–	
8	562546	9	8	23	0.5	0.015	–	981	–	
9	562547	38	8	108	1.0	0.010	–	1308	–	
10	562548	24	7	104	1.0	0.062	–	>2500	0.51	
11	562549	180	12	47	<0.5	0.054	–	2156	–	
12	562550	67	15	101	<0.5	0.025	–	1750	–	
13	562551	41	28	157	<0.5	0.031	–	1328	–	
14	562552	36	14	112	0.5	0.019	–	1451	–	
15	562553	77	163	162	1.0	0.215	–	1340	–	
16	562554	23	190	158	0.5	<0.008	–	634	–	
* SD	562555	45	65	162	<0.5	0.019	–	1295	–	
18	562556	29	33	147	<0.5	0.012	–	944	–	
19	562557	28	88	361	0.5	0.017	–	1409	–	
20	562558	123	835	2050	1.0	0.074	–	1537	–	
21	562559	38	219	396	0.5	0.022	–	2079	–	
22	562560	30	29	264	1.0	0.028	–	>2500	2.07	
23	562561	55	177	389	1.5	0.080	–	>2500	1.53	
24	562562	21	38	133	1.0	0.010	–	1648	–	
25	562563	27	14	104	1.5	0.021	0.024	1372	–	

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

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ANALYTICAL DATA

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
	23.3.08.07241	26/07/90	10031	3 OF 6

TUBE No.	SAMPLE No.	Cu	Pb	Zn	Ag	Au	AuChk	Ba	Ba	Ba
1	562564 * SD	24	186	170	1.0	<0.008	–	639	–	
2	562565	15	16	67	1.0	0.010	–	1257	–	
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20										
21										
22										
23	DETECTION	5	5	5	0.5	0.008	0.008	10	0.01	0.
24	UNITS	ppm	ppm	ppm	ppm	ppm	ppm	ppm	%	
25	METHOD	101	101	101	101	309	309	401	403	40

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

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
	23.3.08.07241	26/07/90	10031	4 OF 6

TUBE No.	SAMPLE No.	As	Cr	Zr	Ti	Ti:Zr
1	562514	12	95	156	2122	13.60
2	562515	12	38	195	2566	13.16
3	562516	15	<5	185	2587	13.98
4	562517	17	<5	146	2788	19.09
5	562518	17	<5	163	2927	17.96
6	562519	20	184	216	3143	14.55
7	562520	7	5	149	1379	9.25
8	562521	15	<5	163	2693	16.52
9	562522	31	<5	76	1563	20.56
10	562523	25	<5	147	7532	51.24
11	562524	7	<5	157	1374	8.75
12	562525	10	13	154	1566	10.17
13	562526	8	<5	159	2698	16.97
14	562527	9	<5	159	1540	9.68
15	562528	19	37	137	2568	18.74
16	562529 ✱	64	25	230	3810	16.56
	562530	18	<5	140	1346	9.61
18	562531	28	46	142	2367	16.67
19	562532	23	9	128	1338	10.45
20	562533	8	13	157	1859	11.84
21	562534	9	<5	161	1997	12.40
22	562535	12	<5	155	2705	17.45
23	562536	3	13	156	2706	17.35
24	562537	5	14	143	2834	19.82
25	562538	7	<5	151	2016	13.35

Results in ppm unless otherwise specified
T = element present; but concentration too low to measure
X = element concentration is below detection limit
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ANALYTICAL DATA

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
	23.3.08.07241	26/07/90	10031	5 OF 6

TUBE No.	SAMPLE No.	As	Cr	Zr	Ti	Ti:Zr				
1	562539	11	<5	158	1935	12.25				
2	562540	14	18	153	3041	19.87				
3	562541	42	32	146	3055	20.92				
4	562542	15	13	152	2626	17.28				
5	562543	53	31	155	3106	20.04				
6	562544	12	24	149	3204	21.50				
7	562545	13	18	143	2798	19.57				
8	562546	9	8	185	1719	9.29				
9	562547	14	17	145	3040	20.96				
10	562548	20	40	131	2545	19.43				
11	562549	45	20	141	2820	20.00				
12	562550	14	96	135	3098	22.95				
13	562551	31	140	136	3086	22.69				
14	562552	17	33	154	2864	18.60				
15	562553	91	5	141	2580	18.30				
16	562554	70	23	227	3842	16.92				
	562555	26	57	153	3085	20.16				
18	562556	17	131	129	2739	21.23				
19	562557	33	<5	130	3367	25.90				
20	562558	46	69	119	2355	19.79				
21	562559	25	133	125	2819	22.55				
22	562560	52	<5	136	2725	20.04				
23	562561	55	31	127	2776	21.86				
24	562562	19	16	131	3094	23.62				
25	562563	54	31	128	2834	22.14				

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

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ANALYTICAL DATA

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
	23.3.08.07241	26/07/90	10031	6 OF 6

TUBE No.	SAMPLE No.	As	Cr	Zr	Ti	Ti:Zr				
1	562564 *	72	21	231	3855	16.47				
2	562565	44	<5	146	1491	10.21				
3										
4										
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21										
22										
23	DETECTION	2	5	5	50	0.01				
24	UNITS	ppm	ppm	ppm	ppm	%				
25	METHOD	401	401	401	401	9825				

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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A division of MacDonald Hamilton & Co. Pty. Ltd.
Phone (09) 458 7999 52 Murray Road, Welshpool, W.A. 6106 Telex AA92560
FAX: 09458 8890

ANALYTICAL REPORT No. 23.3.08 07171

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

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

ORDER No.	PROJECT
10006	

DATE RECEIVED	RESULTS REQUIRED
18/06/90	ASAP

No. OF PAGES OF RESULTS	DATE REPORTED	No. OF COPIES	TOTAL No. OF SAMPLES
6	10/07/90	1	54

REFER BELOW	SAMPLE NUMBERS	STATE OF SAMPLES	PRE-TREATMENT: DRY	CRUSH	SPLIT	PULVERISE	SIEVE	OTHER SEE REMARKS	NONE	ANALYSIS: REFER TO ANALYSIS SECTION	PREPARATION	METH
	<562,448/449,461/464,466/513	C6	Prep: 018							Cu,Pb,Zn,Ag/101		
	<562,448/449,461/464,466/513	C6								Au,AuChk/309		
	<562,448/449,461/464,466/513	C6								Ba,As,Cr,Zr,Ti/401		
	<562,448/449,461/464,466/513	C6	Prep: 018							Pb,Zn,Ag/104		
	<562,448/449,461/464,466/513	C6								Ba/405,Ba/406		

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	
whole core	WC	perchloric acid	A1	cold acid	CA	atomic absorbtion	AAS
split core	SC	hydrochloric acid	A2	specific sulphide	SS	x-ray fluorescence	XRF
cutting	CU	nitric acid	A3	other mixed acids	Ma	spectrophotometry	SPEC
rock	Ro	aqua regia	A4	alkaline attack	AA	colorimetry	COL
soil	SO	nitric-perchloric	A5	volatilization	VO	chromatography	CHR
pulp	PU	HF mixture	A6	ignition	IG	titration	TTN
water	WA	HF under pressure	A7	pressed powder (XRF)	PP	other chemical means	CHEM
tissue	TI	fusion	A8	glass fusion (XRF)	GF	miscellaneous	MISC
stream sediment	SS					fluorescence	FLUOR
heavy mineral	HM					inductively coupled plasma	ICP

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A Division of Inchcape Inspection and Testing Services Australia Pty. Ltd.

ANALYTICAL DATA

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
	23.3.08.07171	10/07/90	10006	1 OF 6

TUBE No.	SAMPLE No.	Cu	Pb	Pb	Zn	Zn	Ag	Ag	Au	AuCh
1	562448	1005	–	4547	–	16200	–	22	0.681	0.61
2	562449	247	–	4538	5508	–	8.0	–	0.399	
3	562461	626	–	4626	6836	–	5.0	–	0.237	
4	562462	45	356	–	810	–	2.0	–	0.159	
5	562463	583	436	–	1740	–	2.5	–	0.205	
6	562464	422	–	3856	9625	–	7.0	–	0.342	
7	562466	1152	–	2221	–	9840	7.0	–	0.802	
8	562467	217	–	2900	8745	–	3.5	–	0.166	
9	562468	363	550	–	5294	–	4.0	–	0.370	
10	562469	42	39	–	148	–	1.5	–	0.135	
11	562470	45	49	–	292	–	1.0	–	0.135	
12	562471	159	1039	–	4198	–	2.5	–	0.192	
13	562472	267	291	–	1267	–	5.0	–	0.252	
14	562473	161	846	–	6944	–	3.0	–	0.189	
15	562474	804	–	13100	–	16300	12.0	–	0.237	
16	562475	261	567	–	1563	–	4.0	–	0.177	0.1
17	562476	278	738	–	3550	–	3.5	–	0.120	
18	562477	202	–	4202	6975	–	5.5	–	0.197	
19	562478	54	82	–	294	–	3.0	–	0.160	
20	562479	875	91	–	1913	–	5.0	–	0.187	
21	562480	1479	–	4508	–	23500	9.5	–	0.344	
22	562481	1712	–	10700	–	22500	11.0	–	0.398	
23	562482	207	92	–	186	–	3.5	–	0.298	
24	562483	22	19	–	160	–	3.0	–	0.069	
25	562484	51	42	–	232	–	2.0	–	0.020	

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

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ANALYTICAL DATA

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
	23.3.08.07171	10/07/90	10006	2 OF 6

TUBE No.	SAMPLE No.	Cu	Pb	Pb	Zn	Zn	Ag	Ag	Au	AuChk
1	562485	38	100	—	199	—	1.0	—	0.011	
2	562486	132	55	—	238	—	1.0	—	0.018	
3	562487	61	54	—	146	—	1.0	—	0.010	
4	562488	120	32	—	139	—	1.5	—	<0.008	
5	562489	48	49	—	88	—	1.5	—	0.014	
6	562490	33	27	—	37	—	1.0	—	<0.008	
7	562491 * SD	119	164	—	2261	—	1.5	—	<0.008	<0.008
8	562492	44	26	—	104	—	2.0	—	<0.008	
9	562493	46	26	—	74	—	2.0	—	0.011	
10	562494	149	24	—	85	—	1.5	—	0.010	
11	562495	42	28	—	47	—	1.0	—	0.009	
12	562496	36	20	—	61	—	<0.5	—	0.016	
13	562497	32	42	—	80	—	0.5	—	0.014	
14	562498	25	22	—	72	—	<0.5	—	0.010	
15	562499	24	101	—	47	—	1.5	—	0.039	
16	562500	31	12	—	47	—	0.5	—	0.046	
17	562501	21	38	—	98	—	0.5	—	0.070	
18	562502	39	37	—	154	—	1.0	—	0.089	
19	562503	39	29	—	184	—	0.5	—	0.064	
20	562504	26	133	—	99	—	1.0	—	0.026	
21	562505	55	62	—	64	—	1.0	—	0.040	
22	562506	121	27	—	42	—	1.0	—	0.097	
23	562507	78	20	—	147	—	1.5	—	0.011	0.012
24	562508	94	10	—	128	—	1.0	—	<0.008	
25	562509	45	7	—	130	—	1.0	—	<0.008	

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

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
	23.3.08.07171	10/07/90	10006	3 OF 6

TUBE No.	SAMPLE No.	Cu	Pb	Pb	Zn	Zn	Ag	Ag	Au	AuChl
1	562510	24	15	—	52	—	1.5	—	0.009	
2	562511	61	7	—	149	—	2.0	—	<0.008	
3	562512	29	7	—	55	—	1.0	—	0.015	
4	562513	63	<5	—	94	—	1.0	—	<0.008	
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22										
23	DETECTION	5	5	25	5	25	0.5	2	0.008	0.00
24	UNITS	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
25	METHOD	101	101	104	101	104	101	104	309	30

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

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
	23.3.08.07171	10/07/90	10006	4 OF 6

TUBE No.	SAMPLE No.	Ba	Ba	Ba	As	Cr	Zr	Ti		
1	562448	>2500	24.9	>7.00	310	<5	123	630		
2	562449	>2500	–	5.19	230	<5	149	1885		
3	562461	>2500	–	0.10	75	<5	146	1944		
4	562462	>2500	–	1.00	71	<5	164	2531		
5	562463	>2500	–	1.08	69	5	157	2380		
6	562464	>2500	–	5.06	116	<5	143	1835		
7	562466	>2500	–	2.17	212	<5	125	1657		
8	562467	>2500	–	3.50	32	<5	148	2039		
9	562468	>2500	–	2.26	109	<5	160	1288		
10	562469	>2500	–	3.05	64	36	181	1171		
11	562470	>2500	–	1.61	39	<5	183	1381		
12	562471	>2500	–	1.33	81	<5	166	1094		
13	562472	>2500	–	0.40	101	<5	188	1317		
14	562473	>2500	–	2.65	97	6	169	1147		
15	562474	>2500	–	4.56	342	<5	169	964		
16	562475	>2500	–	1.21	151	<5	138	1942		
17	562476	>2500	–	6.68	159	<5	180	1148		
18	562477	>2500	10.0	>7.00	127	<5	295	748		
19	562478	>2500	–	1.34	121	<5	192	1199		
20	562479	>2500	9.3	>7.00	127	<5	130	816		
21	562480	>2500	17.3	>7.00	92	<5	165	390		
22	562481	>2500	17.2	>7.00	76	<5	131	397		
23	562482	>2500	–	1.64	318	8	166	1214		
24	562483	>2500	–	1.06	19	23	190	2437		
25	562484	1051	–	–	40	103	180	2753		

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

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
	23.3.08.07171	10/07/90	10006	5 OF 6

TUBE No.	SAMPLE No.	Ba	Ba	Ba	As	Cr	Zr	Ti		
1	562485	878	–	–	27	91	158	2198		
2	562486	833	–	–	43	73	165	2235		
3	562487	773	–	–	55	165	144	2553		
4	562488	657	–	–	90	1215	58	2076		
5	562489	1222	–	–	86	259	184	2049		
6	562490	1110	–	–	34	25	190	1712		
7	562491	1018	–	–	10	944	85	2403		
8	562492	678	–	–	101	100	176	2227		
9	562493	1112	–	–	40	28	208	2082		
10	562494	902	–	–	56	13	178	2124		
11	562495	862	–	–	57	12	179	2089		
12	562496	848	–	–	47	15	166	1973		
13	562497	831	–	–	29	13	166	2205		
14	562498	748	–	–	50	6	166	2651		
15	562499	992	–	–	45	36	188	1987		
16	562500	989	–	–	41	8	68	2543		
17	562501	1091	–	–	24	16	159	2596		
18	562502	1034	–	–	36	11	160	2470		
19	562503	886	–	–	25	16	146	2513		
20	562504	1096	–	–	40	81	164	2236		
21	562505	1057	–	–	86	14	179	2264		
22	562506	873	–	–	87	76	148	1858		
23	562507	423	–	–	26	807	133	2865		
24	562508	89	–	–	12	618	112	2523		
25	562509	340	–	–	10	856	127	2807		

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

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
	23.3.08.07171	10/07/90	10006	6 OF 6

TUBE No.	SAMPLE No.	Ba	Ba	Ba	As	Cr	Zr	Ti		
1	562510	1060	–	–	7	55	157	1850		
2	562511	794	–	–	5	771	115	2430		
3	562512	1158	–	–	4	258	160	2192		
4	562513	1011	–	–	3	796	120	2171		
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21										
22										
23	DETECTION	10	0.1	0.01	2	5	5	50		
24	UNITS	ppm	%	%	ppm	ppm	ppm	ppm		
25	METHOD	401	406	~~406~~ 403	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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A division of MacDonald Hamilton & Co. Pty. Ltd.
Phone (09) 458 7999 — 52 Murray Road, Welshpool, W.A. 6106 — Telex AA92560
FAX (09) 458 8990

ANALYTICAL REPORT No. 23.3.08.07102

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

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

ORDER No.: 09866
PROJECT:
DATE RECEIVED: 21/05/90
RESULTS REQUIRED: ASAP

No. OF PAGES OF RESULTS	DATE REPORTED	No. OF COPIES	TOTAL No. OF SAMPLES
4	09/07/90	1	43

REFER BELOW	SAMPLE NUMBERS	STATE OF SAMPLES	PRE-TREATMENT: DRY	CRUSH	SPLIT	PULVERISE	SIEVE	OTHER SEE REMARKS	NONE	ANALYSIS: REFER TO ANALYSIS SECTION	PREPARATION	METH
	Various	CG	Prep: 005,010,011,016							Cu,Pb,Zn,Ag/101		
	Various	CG								Au,AuChk/309		
	Various	CG								Ba,As,Cr,Zr,Ti/401		
	Various	CG	Prep: 005,010,011,016							Pb,Zn/104		
	Various	CG								Ba/403,Ba/406		

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	
whole core	WC	perchloric acid	A1	cold acid	CA	atomic absorbtion	AAS
split core	SC	hydrochloric acid	A2	specific sulphide	SS	x-ray fluorescence	XRF
cutting	CU	nitric acid	A3	other mixed acids	Ma	spectrophotometry	SPEC
rock	Ro	aqua regia	A4	alkaline attack	AA	colorimetry	COL
soil	SO	nitric-perchloric	A5	volatilization	VO	chromatography	CHR
pulp	PU	HF mixture	A6	ignition	IG	titration	TTN
water	WA	HF under pressure	A7	pressed powder (XRF)	PP	other chemicals means	CHEM
tissue	TI	fusion	A8	glass fusion (XRF)	GF	miscellaneous	MISC
stream sediment	SS					fluorescence	FLUOR
heavy mineral	HM					inductively coupled plasma	ICP

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ANALYTICAL DATA

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
	23.3.08.07102	09/07/90	09866	1 OF 4

TUBE No.	SAMPLE No.	Cu	Pb	Pb	Zn	Zn	Ag	Au	AuChk	Ba
1	431363	1950	–	1.23	–	3.45	9.5	0.980	1.267	>250
2	431387	1150	–	0.80	–	1.76	11.0	0.706	–	>250
3	431388	1300	–	0.90	–	2.24	5.5	0.944	–	>250
4	431398	2200	–	1.71	–	2.64	19.5	0.625	0.525	>250
5	431399	1150	–	1.76	–	1.60	25.0	1.065	–	>250
6	431400	1250	–	1.96	–	3.44	22.5	1.463	–	>250
7	516212	830	–	1.44	–	3.23	14.0	0.341	–	>250
8	516214	1450	–	1.94	–	4.08	28.5	0.756	–	>250
9	562416	295	–	0.43	7050	–	38.0	1.408	–	>250
10	562417	215	–	0.38	–	0.88	28.5	1.380	–	>250
11	562418	610	–	0.74	–	1.64	29.0	1.460	–	>250
12	562419	435	–	0.60	–	1.52	51.5	1.850	–	>250
13	562420	805	–	0.95	–	1.84	32.5	1.508	–	>250
14	562421	525	–	1.03	–	1.01	26.0	3.560	–	>250
15	562422	795	–	0.84	–	0.90	18.5	1.450	–	>250
16	562423	45	75	–	815	–	2.5	0.438	0.494	>250
17	562424	415	–	0.44	–	0.87	9.0	0.690	–	>250
18	562425	3400	–	4.85	–	7.18	25.0	1.098	–	>250
19	562426	690	–	1.27	–	1.90	8.5	0.595	–	>250
20	562427	510	–	0.88	–	1.56	7.0	0.899	–	>250
21	562428	1800	–	1.99	–	5.78	13.5	2.300	–	>250
22	562429	515	–	0.89	–	2.77	6.5	0.780	–	>250
23	562430	385	–	1.31	–	1.08	7.5	0.634	–	>250
24	562431	230	895	–	2250	–	1.5	0.432	–	>250
25	562432	840	1550	–	6400	–	6.5	0.704	–	>250

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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0475

654476

ANALABS

A Division of Inchcape Inspection and Testing Services Australia Pty. Ltd.

ANALYTICAL DATA

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
	23.3.08.07102	09/07/90	09866	2 OF 4

TUBE No.	SAMPLE No.	Cu	Pb	Pb	Zn	Zn	Ag	Au	AuChk	Ba
1	562433	290	–	1.22	–	1.95	4.0	0.449	–	>250
2	562434	95	145	–	2500	–	1.5	0.319	–	>250
3	562435	230	25	–	1650	–	3.0	0.449	–	>250
4	562436	565	400	–	2700	–	1.5	0.330	–	>250
5	562437	180	655	–	1350	–	<0.5	0.210	–	>250
6	562438	280	35	–	2300	–	1.5	0.438	–	>250
7	562439	85	70	–	1950	–	<0.5	0.236	0.230	>250
8	562440	125	180	–	2350	–	<0.5	<0.008	–	139
9	562441	60	365	–	1400	–	1.0	0.170	–	>250
10	562442	80	–	0.16	–	0.26	1.5	0.160	–	>250
11	562443	400	910	–	7650	–	4.5	0.313	–	>250
12	562444	160	55	–	285	–	2.0	0.458	–	>250
13	562445	440	–	0.68	–	1.51	7.0	0.949	–	>250
14	562446	570	–	0.32	–	0.85	6.5	0.654	–	>250
15	562447	125	540	–	1800	–	1.0	0.255	0.245	>250
16	562450	1150	–	0.97	–	3.06	26.0	0.996	–	>250
17	562460	1150	–	1.78	–	3.31	21.0	0.651	0.683	>250
18	562465	2200	–	3.80	–	7.40	29.5	0.677	–	>250
19										
20										
21	Errors on Cr & Ti may be greater than expected due to massive Ba									
22	interference									
23	DETECTION	5	5	0.01	5	0.01	0.5	0.008	0.008	1
24	UNITS	ppm	ppm	%	ppm	%	ppm	ppm	ppm	ppm
25	METHOD	101	101	104	101	104	101	309	309	40

* STD

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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- 04?6

ANALABS

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ANALYTICAL DATA

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
	23.3.08.07102	09/07/90	09866	3 OF 4

TUBE No.	SAMPLE No.	Ba	Ba	As	Cr	Zr	Ti			
1	431363	–	28.1	470	50	51	840			
2	431387	3.30	–	240	28	128	1550			
3	431388	4.28	–	75	17	133	1500			
4	431398	2.24	–	460	25	164	1540			
5	431399	–	10.8	530	<10	137	1900			
6	431400	–	13.2	310	<10	127	1500			
7	516212	4.57	–	60	25	129	1046			
8	516214	–	10.8	240	<10	125	677			
9	562416	–	21.9	1350	<10	88	694			
10	562417	–	17.0	770	<10	80	827			
11	562418	–	40.7	460	30	30	<100			
12	562419	–	20.8	780	<10	110	120			
13	562420	–	42.5	500	25	28	<100			
14	562421	–	44.0	300	28	44	<100			
15	562422	6.20	–	800	<10	118	1300			
16	562423	2.12	–	270	20	198	2989			
17	562424	6.93	–	510	<10	130	1050			
18	562425	–	17.3	140	<10	155	120			
19	562426	6.48	–	230	<10	146	923			
20	562427	3.18	–	280	15	152	1889			
21	562428	2.80	–	490	12	146	1473			
22	562429	5.96	–	160	<10	170	1300			
23	562430	6.49	–	190	<10	160	980			
24	562431	0.35	–	150	34	156	2550			
25	562432	3.68	–	410	<10	151	1996			

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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04 : 7

654478

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ANALYTICAL DATA

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
	23.3.08.07102	09/07/90	09866	4 OF 4

TUBE No.	SAMPLE No.	Ba	Ba	As	Cr	Zr	Ti			
1	562433	4.55	–	200	11	166	2419			
2	562434	2.58	–	230	13	158	1931			
3	562435	4.41	–	350	13	129	1987			
4	562436	1.34	–	190	24	143	2350			
5	562437	0.68	–	120	37	152	2507			
6	562438	5.04	–	250	13	139	2155			
7	562439	0.90	–	140	28	164	2707			
8	562440 * STD	–	–	30	793	89	2371			
9	562441	0.43	–	220	23	158	2552			
10	562442	2.19	–	100	15	157	2506			
11	562443	2.27	–	150	14	168	2337			
12	562444	0.64	–	160	23	152	2388			
13	562445	4.85	–	250	12	136	1790			
14	562446	–	17.9	190	<10	926	1066			
15	562447	1.43	–	95	22	144	2292			
16	562450	–	7.7	480	<10	109	1007			
17	562460	–	10.1	330	<10	142	1137			
18	562465	3.92	–	130	20	184	736			
19										
20										
21										
22										
23	DETECTION	0.01	0.1	2	10	5	100			
24	UNITS	%	%	ppm	ppm	ppm	ppm			
25	METHOD	403	406	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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APPENDIX 17

654480

04?9

MACKINTOSH / HATFIELD DATA BASE ENTRY FORM 1 of 2

DRILL HOLE NAME MAC-27

LOCATION MT. CHARTER DOLERITE

TOTAL DEPTH 883.8m

NUMBER SURVEYS
(Incl. collar P.U.)

NUMBER ASSAY INTERVALS

COLLAR NORTHING 4864.35 G. 5392143.84 AMG.

COLLAR EASTING 2784.07G 388381.94 AMG

COLLAR R.L. 693.6

COLLAR DEPTH 0

SECTION
(To nearest 5Cm)

STATUS OF DATA

DATE STARTED 2/7/90 (ACTUAL COMMENCED DRILLING)

DATE FINISHED 6/9/90 (ACTUAL DATE RODS PULLED AFTER SUCCESSFULLY CASING P.V.C.)

LOGGED BY AM, N

FROM	TO	HOLE SIZE	CASING TYPE	CASING I.D.
0	3	TRIC		
3	177	HQWL		
177	883.8	NQWL		
0	883.8		P.V.C.	41 mm CLASS 18 + 12

COMMENTS
(Casing lost etc.)

3m HW TO COLLAR.

Aberfoyle Resources Limited
EXPLORATION DIVISION

DIAMOND DRILL LOG

PROJECT : Mackintosh
PROSPECT : Mt. Charter Dolerite

0480

HOLE NO : MAC-27
PAGE : 1 of 22
LOGGED : A.McN
DATE : 9-7-90

DEPTH	DRILL RUNS	CORE LOSS	LITHOLOGY: ROCK NAME	LITHOLOGY: DESCRIPTION	ALTERATION	VEINING	MINERALISATION	STRUCTURE	WEATHERING	VISUAL LOG	REMARKS	DEPTH
2				No Core - Tricone								
3m												
4			Que River Shale	Black shale, massive to weakly laminated. Minor Pyritic laminae and patches.		No veins		Core broken.	Lch(1-2)			
6								6.5m bedding = 40° to LCA.			4.9m Core highly broken. 6.6m	
8												
10								9.4m 10cm fault - Graphitic sheen. 11m bedding = 55° to LCA.				
12											12.9m	
13.6				interbedded light grey siliceous siltstone and black shale.	13.6 Si(1-3)	13.6 Co(1)		14cm <10cm peg - fault.			highly broken Core (? fault)	
15.0					15.0	14					16.8m	
16						No veins						
18								17.7m bedding = 30° to LCA.				
19.7				Pyrite framboid ≥ 0.5cm diameter. Pyrite becomes more common!								
22				22.6m 0.4cm thick fine pyritic grey sandstone interbed.		22.6 Co(1-2) - fine, subparallel to LCA.		22.6m bedding = 75° to LCA.				
23.7m				pyrite clot with Carbonate overgrowth.		24						
24						No veins						
26												
28												
30												
32												
34												
35.5m				7.5cm light green-grey pyritic volcaniclastic sandstone. grading indicates facing up-hole.		35 Co(1-2) - fine (<3mm thick) Variable orientation		35.5m bedding = 65° to LCA.				
36				thin (1-2mm) light grey siltstone laminae common to 39.5m								
38												
39.5m				1cm grey siltstone to fine sandstone interbed. lamination contorted by small faults and veins facing up-hole				39.5m bedding = 70° to LCA				
40												
42												

65481

Aberfoyle Resources Limited
EXPLORATION DIVISION

DIAMOND DRILL LOG

0481

PROJECT : Mackintosh

PROSPECT : Mt. Charter Dolerite

HOLE NO : MK-27
PAGE : 2 of 22
LOGGED : AMcN
DATE : 9-7-90

DEPTH	DRILL RUNS	CORE LOSS	LITHOLOGY: ROCK NAME	LITHOLOGY: DESCRIPTION	ALTERATION	VEINING	MINERALISATION	STRUCTURE	WEATHERING	VISUAL LOG	REMARKS	DEPTH
44			Gue River Shale	Massive to weakly laminated black shale. bedding defined by fine pyritic laminae		Qtz+Cb (1) / Py (1) } fine veinlets (<2mm thick) dominantly sub-parallel to L.C.A.		43.9 fault Pug at 40° to LCA.				
46												
48								47.8 bedding at 60° to LCA				
50												
52												
54								55.4 bedding = 50° to LCA				
56								Fault (puggy) sub-parallel to LCA.				
58												
60				61.5 – 61.8m fine irregularly laminated interbeds of olive green Volcanic siltstone. lamination disturbed by soft Sediment deformation. load casts and flame Structures indicate up-hole facing.				60.2 bedding = 45° to LCA.				
62						Qtz+Cb (1)		Core splits conspicuously on a surface sub-parallel to LCA.				
64				65.3m 2.7cm fine to medium grained grey-green micaceous sandstone interbed.								
66												
68				67.6 Interbedded shale, ash volcaniclastic, micaceous sandstone								
70				69.3 and polymict fine lapilli volcaniclastic 69.5 → to black shale with minor sandstone interbeds.				69.5 bedding = 40° to LCA.				
72				Black Shale								
74				74.8m 2cm band of strong disseminated py (5)								
76								76.0m bedding = 45° to LCA				
78				78.4 78.9 → Volcaniclastic interbed. Grades from fine to medium lapilli at top to fine lapilli at base. 80.3 → at 80.3m 10cm grey-green fine lapilli volcaniclastic interbed.				79.5 fault = 3cm of pug. 80.3 bedding = 55° to LCA Core splits on a Prominent surface sub-Parallel to L.C.A. Core quite strongly broken			82.4m lost water	
80												
82												
84												

9541.83

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EXPLORATION DIVISION

DIAMOND DRILL LOG

PROJECT : Mackintosh

PROSPECT : Mt. Charter Dolerite

HOLE NO : MAC-27

PAGE : 3 of 22

LOGGED : H. McN

DATE : 17-7-90

0482

DEPTH	DRILL RUNS	CORE LOSS	LITHOLOGY: ROCK NAME	LITHOLOGY: DESCRIPTION	ALTERATION	VEINING	MINERALISATION	STRUCTURE	WEATHERING	VISUAL LOG	REMARKS	DEPTH
86			Que River Shale	Massive to weakly laminated black shale lam. defined by rare pyrite bands. Minor pyritic framboids (often with fibrous Quartz + Carbonate overgrowths.		Q+Co (1) both sub-parallel to and at a high angle to L.C.A.						
88												
90												
92								92.2 Pug (3cm) = fault.				
94				94.5 Prominent (to 1cm dia.) Pyrite framboids with tectonic Q+Co overgrowths.				94.6 95.1 strongly broken zone				
96				96.3 96.6 → green-grey fine lapilli volcaniclastic with minor shale fragments, pyrite bands and shale beds.				96.5 bedding = 40° to L.C.A				
98												
100												
102						103.2 Q+Co (2)						
104						104.5 Q+Co (1)						
106												
108												
110												
112												
114		50%						114.6 Highly broken core. Weakly Co veined, weakly sheared and graphitic.				
116												
118												
120								Fault Zone				
122												
124								124.1 Very puggy zone				
126								125.6				

654483

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EXPLORATION DIVISION

DIAMOND DRILL LOG

PROJECT : Mackintosh

PROSPECT : Mt. Charter Dolerite

HOLE NO : Mac-27

PAGE : 4 of 22

LOGGED : A. McN

DATE : 17-7-90

0483

DEPTH	DRILL RUNS	CORE LOSS	LITHOLOGY: ROCK NAME	LITHOLOGY: DESCRIPTION	ALTERATION	VEINING	MINERALISATION	STRUCTURE	WEATHERING	VISUAL LOG	REMARKS	DEPTH
128			Que River Shale	Massive to very weakly laminated black shale		Co(1) Q+Co(1)						
130								129.6 fault at 35° to LCA.				
132												
134												
136												
138												
140												
142												
144												
146												
148												
150												
152												
154												
156				156.8 – 157.2m Prominent Pyritic banding.				156.9m bedding = 40° to LCA				
158				158.8m 10cm banded bed of disseminated pyrite (4) has sharp base and graded top implying ? up-hole facing.				158.6 bedding = 40° to LCA.				
160						160.4		160.4 broken core, weak graphitic sheen. Fault Zone				
162						Q+Co+Py (2)						
164						163.4 Co(1) Q+Co(1)		163.4				
166												
168												

654484

Aberfoyle Resources Limited
EXPLORATION DIVISION

DIAMOND DRILL LOG

0403

PROJECT : Mackintosh

PROSPECT : Mt Charter Dolerite

HOLE NO : Mac-27
PAGE : 5 of 22
LOGGED : A. McN.
DATE : 24-7-90

DEPTH	DRILL RUNS	CORE LOSS	LITHOLOGY: ROCK NAME	LITHOLOGY: DESCRIPTION	ALTERATION	VEINING	MINERALISATION	STRUCTURE	WEATHERING	VISUAL LOG	REMARKS	DEPTH
170			Que River Shale	Massive to weakly laminated black shale		Qt+Co(1) Qt+Co+Py(1)						
172												
174												
176											177.0 HQ NQ	
178						178.7 Qt+Co(1) Qt+Co+Py+Sp(1) 180 Qt+Co(1) Qt+Co+Sp(2)		177.6 bedding = 55° to L.c.a.				
182						182.1 Qt+Co+Sp +/- Gn +/- Py (3)		183.2 Fault Zone 184.3				
184						184.3 Qt+Co(1-2)		186 Fault Zone 186.5				
186												
188												
190						191 Qt+Co(1-2) Qt+Co+Sp(1-2)		191 Fault Zone 194.9				
192												
194												
196												
198								198.7 fault = 90° to L.c.a.				
200						200m 20cm thick Qt+Co+Sp vn. sub parallel to L.c.a.		200.2 bedding = 75° to L.c.a. (?disrupted by veining)				
202						Qt+Co(1-2) Qt+Co+Sp(2)						
204												
206						206.1 appearance of grey angular carbonate (or ? barite) crystals in veins, in addition to white carbonate.						
208												
210												

65A85

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EXPLORATION DIVISION

DIAMOND DRILL LOG

PROJECT : Mackintosh
PROSPECT : Mt. Charter Dolerite

0480

HOLE NO : Mac-27
PAGE : 6 of 22
LOGGED : AitkN
DATE : 24-7-90

DEPTH	DRILL RUNS	CORE LOSS	LITHOLOGY: ROCK NAME	LITHOLOGY: DESCRIPTION	ALTERATION	VEINING	MINERALISATION	STRUCTURE	WEATHERING	VISUAL LOG	REMARKS	DEPTH
212			Gale River Shale	Weakly laminated black shale		Qt+Co+Sp ± Py(2)		211.5 Broken Core = fault?				
214											217.0 lost water.	
216												
218						220						
220						220.5 Qt+Co+Sp (3) Sp(1)						
222						Qt+Co+Sp (2)						
224			Basalt lava	222.2 2cm thick Py rich band. → Abrupt Contact. 223.5 green-grey vesicular (Co or Cl filled) basalt lava.				223.2 bedding = 80° to L.C.A.				
226				225.8		225.8		225.8 Contact = 75° to L.C.A.			228.1 Petrology * SG3711	
228			Gale River Shale	black shale ↓ Abrupt Conformable Contact		Qt+Co ± Sp (1) Qt+Co+Py (2)						
230												
232								233.3 bedding = 60° to LCA				
234												
236												
238				238 Py banding becomes more obvious								
240								239.7 bedding = 75° to LCA				
242												
244								243.3 fault zone. 244.8 ↓ Buggy zones at 244.5 (@ 40° to LCA) 244.4 (@ 70° to LCA)				
246												
248				247.8 2cm band rich in Py framboids				249.1 bedding = 60° to LCA				
250			Basalt lava	249.8 Abrupt irregular, conformable Contact Olive green basalt lava. Vesicular. brecciated with grey clayey matrix.	249.8 Si (1-2) Concentrated on Rims of lava fragments.	249.7 Co+Sp+Py (2) Qt+Co (2) Q(1) Some veins have bleached pyritic margins. Angular coarsely xtalline grey Co (or ? Ba) also common	Py pat. + Spt. (3-4) 252.5 Appearance of Sp pat.	251.3 fault = broken core → 251.5 fault = broken core			251.3m lost water	
252												

6314

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EXPLORATION DIVISION

DIAMOND DRILL LOG

PROJECT : Mackintosh

PROSPECT : Mt. Chester Dolerite

HOLE NO : Mac-27

PAGE : 7 of 22

LOGGED : AM+N

DATE : 24-7-90

DEPTH	DRILL RUNS	CORE LOSS	LITHOLOGY: ROCK NAME	LITHOLOGY: DESCRIPTION	ALTERATION	VEINING	MINERALISATION	STRUCTURE	WEATHERING	VISUAL LOG	REMARKS	DEPTH
254			Basalt lavas.	light to dark olive green weakly vesicular basalt lava. brecciated with a grey-black cherty matrix. Margins of lava frags, and smaller frags., may be quite thoroughly silica altered. Some B.I. frags. are rimmed ± pyrite. Minor zones of hydraulic breccia with calc matrix	Si(1-3)	Q(1) Q+Ca (2) Q+Ca+Sp+Py (2)	Sp(1) Py(1)					
256						254.4 Q+Ca+Py (4)	254.2 Sp(2-5) as: i) patches in B.I. groundmass and vesicles ii) Q+Sp veins iii) Q+Ca+Sp veins.					
258						255.2 Q(2) Q+Ca+Sp+Py(1-2)	Py(1-3)					
260						259.5m Core ± Honey Coloured Sphalerite						
262							261.1 - 261.3 Sp(3-4)					
264												
266												
268				-267 appearance of more massive zones. Lava less brecciated.		268 Q+Ca+Sp (2-3) Q+Sp (1-2) Q(1)	Variable Sp(1-3) Py(1-2) Mineralisation.				267.6 lost water	
270				-269.6 Pronounced pink Si+Sp alteration rims on lava fragments. -270.8								
272												
274				-274 No obvious pyrite rimming lava fragments.		274.5 Q(2) Q+Ca+Sp(1-2)						
276												
278												
280												
282				-283.1 Appearance of feldspar phenocrysts in more massive lava units. Massive lava units now dominate.	283.1 Si(1-2)	283.1 Q+Ca ± Py ± Sp (2) Q (1-2)	283.1 Sp(1-2) Py(1)					
284												
286												
288												
290												
292												
294												

65487

Aberfoyle Resources Limited
EXPLORATION DIVISION

DIAMOND DRILL LOG

PROJECT : Mackintosh

PROSPECT : Mt. Charter Dolerite

0487

HOLE NO : Mac-27

PAGE : 8 of 22

LOGGED : AMCN

DATE : 24/7-90

DEPTH	DRILL RUNS	CORE LOSS	LITHOLOGY: ROCK NAME	LITHOLOGY: DESCRIPTION	ALTERATION	VEINING	MINERALISATION	STRUCTURE	WEATHERING	VISUAL LOG	REMARKS	DEPTH
296			Basalt lava.	light green to brown feldspar-phyric lava. Minor zones of lava/clastic breccia with grey chert matrix. lava frags. in these zones may have Si altered rims.	Si (1-2)	Q (1-2) Q+Co (1-2) ± Sp.	Py (1) Sp (1-3) 296.4 Py (1) Sp (2-3)					
298								298.6 299.1 broken Core				
300												
302												
304							304.9 Py (1-2) Sp (1-3)					
306				306.9 basaltic lava breccia. black cherty matrix. Intense Si ± Se of small frags. and on margins of larger frags.	306.9 Si (5) Se (1) 311.5 ? Fu spt (1) on margins of altered frags.							
310												
312												
314												
316				317.7 Dominantly massive basalt lava. Minor breccia zones 319.4 basalt lava breccia with grey-black chert matrix. lava is vesicular in part (Co + Cl filled) Basalt clasts are weakly altered on margins.	317.7 Si (1-3)	317.7 Sp (2) Q+Co ± Py ± Sp (1) Minor grey angular Co (Ba)						
318												
320												
322												
324												
326						Co + Sp (1-2) Q (1-2) Q+Py (1) - sub parallel to 2 c.a.		325.5 325.9 broken rubbly Core - fault?				
328												
330												
332												
334						334.1 Co + Sp (1-2) Q+Co + Po (1) * Appearance of Pyrrhotite	Pyrite disappears - replaced by Po Sp (1-2) dis + vn. Po (1)					
336												

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DIAMOND DRILL LOG

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338			Basalt lava.	basalt lava breccia with grey-black chert matrix. Smaller frags and margins of larger fragments altered to light green-yellow colour. lava weakly vesicular and feldspar-phyric. Minor zones of hydraulic brecciation with intense Co veined matrix.	Si (1-3) Se (1)	Q+Co+tremolite (1-2) Veins at high < (≈90°) to L.C.A. Q+Co+Sp (1-3) Q (1-2)	Sp (1-2) po (1)					
340							340.5 Gn appears.					
344												
346					345.9 Se?Fu (1-2) spts.		345.9 Po (2-3) Sp (2-3) Gn (1)					
348												
350					349.65 minor ?fu spt. (1)		350 Po (2) Sp (1-2) Gn (1) Po+Sp may be intergrown.					
352												
354												
356				355 Massive to weakly brecciated basalt lava. weakly Vesicular.	355 Fu Se (1) pat Si (1-2)	355 Q+Co ± Po ± Sp ± Gn ± Cpy (2)	355 Po (1-3) diss+pat. Sp (1-2) Gn (1)					
358												
360												
362				361.5 basalt lava breccia as above	361.5 Se (1) Si (1-3) pat. lgt gn. FuSe (1)	361.5 Q+Co ± Po (1-2) Q (1)	361.5 Po (2) often mantling Sp (1) or Gn (1).					
364				364 light to dark green vesicular massive basalt lava.	Se pat. (1-3) Si (1-2)	364 Q+Co+Cl+Po+Gn (1) Q (2-3) Co ± Po (2)	364 Po (2-3) often intergrown with trace Sp, Gn, Cpy.					
366				367.1 basalt lava breccia	Se (1) Si (1-3) SeFu (1)		Po (1-2) Sp (2)					
368				369.3 Massive, vesicular basalt lava.	Si (1-2) Se (1-2)	Q+Co+tremolite (2-3) Veins at high < to L.C.A. Veins to 3cm thick.	Po (2) Sp (1-2) Gn+Cpy (1)					
372				373.1 Vesicular, dark green basalt lava breccia	Si (1-3)	Q+Co (1) Q (2)	Po (1-3) Sp (1-2) Gn (1-2) } diss+pat.					
374												
376												
378												

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DIAMOND DRILL LOG

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DEPTH	DRILL RUNS	CORE LOSS	LITHOLOGY: ROCK NAME	LITHOLOGY: DESCRIPTION	ALTERATION	VEINING	MINERALISATION	STRUCTURE	WEATHERING	VISUAL LOG	REMARKS	DEPTH
380			Basalt lava	brecciated andesitic - basaltic lava.	Si(1-3)	Q(1-2) Q+Co ± Sp ± trem (1-2)	Po(1) Sp(1-3) po appears to gradually disappear down-hole					
382												
384												
386												
388						388.7 Q(1)	388.7 Sp(1-3) vn ± dissipat atten ± alteration halo				* Po disappears.	
390					yellow-brown Si(3) Se(1) on fragment margins. matrix = pervasive Si(1-2)	Q+Co ± Sp ± Cpy/Py (1-3) Q+Co ± Se(1)	Ga(1) Cpy/Py(1) dissp + in vesicles					
392												
394												
396												
398												
400				400 Veined Contact light to dark green felsenar-phyric, vesicular (Qtz+Co filled) andesitic - basaltic lava breccia. Some zones of more massive lava that are hydraulically brecciated ie. with Qtz+Co vein matrix. Clasts in lava breccia are sub-rounded with no obvious jigsaw fit	va Si(1-2) Minor bands of Si(2) Se(1) alteration confined to areas of strong hydraulic brecciation.	Q(1-2) Q+Co ± Sp (1-3)	Sp(1-2) Py(1) 404.1 Py(1-2) 409.9 Py(1) Sp(1) 410.8 Si(1-3) Py(1) 411.1 Py(1-2) Sp(1)				415.45m Petrology * 563712	
402												
404												
406												
408												
410												
412												
414												
416												
418												
420												

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422			Basalt lava and lava breccia	brecciated andesitic-basaltic lava as described above	Si (1-2) of breccia matrix	Q+Co ± sp ± py (1-2) Q (1)	Py (1) Sp (1) } diss + in Va.					
424												
426												
428					427 Si (1-3)							
430												
432												
434								433.6 fault = 25° to L.C.A.				
436								436.4 - 436.6 fault = 20° to L.C.A.				
438												
440					439.9 Si (3)							
442												
444												
446				445 lava gradually becomes more massive	445 Si (3) Co (1)							
448				447.1 abrupt irregular Contact light green-grey vesicular (irregularly shaped, Q+Co filled) feldspar-phyric (se altered) basalt lava ?andesite	447.1 Si (1-2) associated c patchy dv	447.1 Q+Co+Cl (1-2) Q (1)	447.1 Py (1) Sp (1)					
450					450 Si (1-2) Cl (1) pat.							
452												
454												
456												
458				459 Abrupt Contact dark green feldspar-phyric ?vesicular. lava fragments in a light green weakly silica altered lava matrix		459 Q+Co (2)	459 Py (1) Sp (1)	457.5 broken Core = fault? 458.8				
460												
462												

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464			Basalt lava and lava breccia	Andesitic-basaltic lava breccia as above	Si (1-2) Cl (1) pat.	Q+Co (2)	Py (1) Sp (1)					
466												
468				467 Massive to brecciated feldspar-phyric, vesicular lava light green-brown colour	467 Si (2-3) Se (1)	467 Q+Co + trem (1-2) Q+Co+Cl (1) Q (1) 470-6 Q+Co + rd. Sp vn. 0.5cm thick	467 Sp (1)	467 fault = 50° to L.CR. Veined brecciated and sheared.				
470												
472							472 Sp (1-2) Py (1)					
474												
476												
478												
480				480.5 Massive green vesicular feldspar-phyric (se altered) basalt lava. Patches of round siliceous dv structures	480.5 Si (1) Se (1)	480.5 Q+Co+Cl (2) Co (1) Q (1)	480.5 Py (1)					
482												
484												
486												
488												
490												
492												
494							493 Py (1) Sp (1)					
496												
498												
500												
502												
504												

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506			Basaltic lava and lava breccia	massive basalt lava as described above	Si(1) Se(1)	Q+Co+Cl (2) Co (1) Q(1)	Py(1) Sp(1)					
508												
510												
512												
514												
516											515.45 Petrology # 563713	
518												
520					520.5 Si(2-3)	520.5	519.7 Sp(2)					
522				521.9 Abrupt irregular contact Strongly feldspar-phyric andesitic - basaltic lava breccia.	521.9 Si(1-2)	521.9 ↳ 522m Q+Co+po vn.	521.9 Sp(1-3) Cpy, Gn, po (1)				* trace pyrrhotite	
524						Q+Co+Se (2)	523.9 Sp (1-2)					
526				526.7 Abrupt contact to: massive olive green vesicular (Q+Co filled) basalt lava. 526.7-527m brecciated lava with grey-black chert matrix. Minor breccia zones with chert matrix in dominantly massive lava.		526.7 Q(1-2) Q+Co ± Sp(1) Q+Co ± Cl ± Se (2)	526.7 Sp(2) disstpnt.					
528												
530												
532												
534							534.8 Sp(1)	534.5-534.8m Fault Zone. Fault = 25° to L.C.A.				
536												
538												
540				541 Cl filled vesicles obvious but majority Q+Co filled.								
542												
544											544.9 Cave in.	
546												

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			Basalt lava and lava breccia	Massive basalt lava as described above	Si(1-2)	Q(1-2)	Sp(1)					
548					S48	Q+Co ± Sp(1)						
					Si(1)	Q+Co ± Cl ± Se(2)						
550					Cl(1)			S49.7 broken Core = fault?				
								S50.7				
552												
554												
556												
558												
560												
562												
564												
				S64.7 Contact in rubbly zone	S64.7	S64.7						
566				brecciated (both hydraulic and auto-?) vesicular	Si(2)	Q+Co ± trfu (1-3)						
				Basalt lava.		Q(2)						
568												
570				S70.3	S70.3	S70.3	S70.3					
				Massive green vesicular + weakly feldspar-phyric	Si(1)	Q+Co ± Se ± Sp(2)	Sp(1-2)					
572				Basalt lava	Se(1)	Q(1)						
				Minor zones of brecciation								
574												
576												
						S77.2	S77.2					
578						Q+Co + trem ± Sp(1-2)	Sp(1)					
580												
				S81.05 abrupt irregular 'Conformable' Contact	S81.05	S81.05						
582				dark green andesitic-basaltic lava breccia. feldspar-phyric and vesicular.	Si(2)	Q+Co(1-2)						
					Se(1)							
584												
586												
				S86.6	S86.6	S86.6						
588				Massive Green vesicular basalt lava.	Si(1)	Q(1)						
					Pot SeFu? (1)	Q+Co + trem ± Sp(1-3) – thick veins at high < to L.c.a.						

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590			Basalt lava and lava breccia	Massive basalt lava. as above	Si(1) Se(1)	Q(1) Q+Co+trem ± Sp (1-2)	Sp (1-2)					
592												
594												
596				595.1 Abrupt irregular Contact dk green vesicular lava fragments in light green-yellow silicified lava matrix	595.1 Si(2-3) Se(1)	595.1 Q(1) Q+Co(2)	595.1 Sp(2)					
598												
600				600.6 Abrupt 'conformable' Contact. Massive vesicular basalt lava Zones of ovoid devitrification(?) structures	600.6 Si(1)	600.6 Q+Co+trem(2) Q(1) Q+Co ± Se ± Sp (1)	600.6 Sp(1)					
602												
604				604.2 lava breccia as for 595.1 - 600.6 m	604.2 Si(2-3) Se(1-2) Sp	604.2	604.2 Sp(1)					
606												
608											607.45 Petrology # SG3714	
610				609.3 Abrupt irregular 'conformable' Contact 610.3 Massive vesicular basalt lava. lava breccia as above.	609.3 Si(1)	609.3 610.3 Q(1) Q+Co(2) Q(2) Q+Co(2)	609.3 Sp(2)					
612				611.8 Massive basalt lava	611.8 Si(1) Cl(1)	611.8 Q(1) Q+Co+trem(1) Q+Co(1)	611.8 Sp(1)					
614				615 lava breccia, andesitic-basaltic as above	615 Si(2-3)	615 Q(1) Q+Co(1)						
616				617.4 Massive vesicular basalt lava	617.4 Si(1) Cl(1) Se(?fs) (1) pat.	617.4 Q(1) Q+Co(1) Q+Co+trem(1)						
618												
620				624.4 lava breccia as above 625.9 Massive feldspar-phyric + vesicular basalt lava.	624.4 Si(2-3) 625.9	624.4 Q(1) Q+Co+trem(1) 625.9 Q+Co (1-2) Q(1) Q+Co+trem(1)	625.9 Sp(1) Ga(1)					
622												
624												
626												
628												
630												

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632			Basalt lava and lava breccia.	Massive basalt lava as described above 632.4 633.3 lava breccia as above Dominantly massive basalt lava. Minor zones of hydraulic ± Q+Co vn mtx, and black chert matrix breccia	632.4 633.3 Si(2-3) Se(1) pat. Se ?Fu ?py (2-3) Si(2)	632.4 633.3 Q(1) Q+Co(1) Q(1-2) Q+Co ± sp(1) Q+Co + tren ± sp (1)	Sp(1) Gn(1) 632.4 633.3 Sp(2-3) Sp(1-2) diss + vn.					
652			black shale Basalt lava and lava breccia	652.35 653.1 Massive black shale irregular conformable contact Massive vesicular Basalt lava as above	652.35 653.1 Si(1-2) Cl(1) pat Se ?fu (2-3)	652.35 Q+Co ± sp ± py (4) 652.4 Q+Co ± py ± sp (2-3) 653.1 Q(1) Q+Co ± sp(1)	652.35 653.1 Sp(1) 656 Sp(1) Po(1)					
664			black shale	664 Veined but apparently conformable irregular contact. black shale, weakly laminated coarsens to fine siltstone down-hole.	664	664 Q+Co + po ± sp (2-3) Q(2) Po(1)	664 po (2-3) Sp (1) dom. in veins	661.8-661.9 Cave-in ?fault 664.1 fault: 45° to Lem. 664.4 fault: broken core				
668			Basalt lava breccia.	668 - 668.4 m laminated fine-grained sandstone/siltstone intercalated with basalt lava green vesicular (Co+Cl or Cl filled) basalt lava brecciated with grey-black chert/shale matrix Smaller basalt fragments are silica altered. Minor feldspar phenocrysts are sericite altered	668.4 Cl(1) Si(1-2)	668.4 Q+Co(2) Q ± sp(2)	668.4 Sp (1-2) diss. Po (1)	667.7 - 668.2 fault zone broken core & shearing			667.7m Petrology. # 563715	

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674			Basalt lava and lava breccia	673.6 brecciated basalt lava.	671.6 Si(1-2) Cl(1)	673.6 Q+Co(2) Q±Sp(2)	673.6 Sp(1-2) Po(1)					
676				Dominantly massive basalt lava with minor zones of chert/shale matrix breccia.	Si(1) Cl(1)	Q(1-2) Q+Co(1)	Sp(1) Po(1)					
678												
680												
682												
684												
686												
688				687.25 - 687.45 Po rich light green siliceous ash volcaniclastic intercalated with basalt								
690				689.1 lava breccia with laminated light green-grey chert/ash matrix. 690.5	689.1 Pat. se Si ?fu (3) 690.5	689.1 Q(2) Q+Co(1) 690.5	689.1 Po(2) 690.5					
692				Dominantly massive basalt lava with minor green-grey ash volcaniclastic/chert matrix breccia.	Si(1) Cl(1) pat. se ?fu Si (3) dominantly in breccia zones	Q(1) Q+Co±Po±Sp (2-3) Q+Co+trem (1-2)	Po(1) Cpy(1)					
694												
696												
698												
700												
702												
704												
706												
708				709.05 lava breccia with light green-grey ash volcaniclastic			709.05 Po(1)					
710				710.25 Massive green vesicular basalt lava	710.25 Si(1-2) Cl(1)	710.25 Q(1) Q+Co(1) Q+trem(1)	710.25 No obvious Mineralisation					
712												
714											713.5m Petrology * 563716P	

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716			Basalt lava and lava breccia	Massive to weakly brecciated (with grey-light green chert/ash volcaniclastic matrix), vesicular	Si(1) Cl(1) pat. Se 7fu Si(2) pat. ox on lava fragment margins	Q+Co (1-2) Q(1) Q+Co + Sp(1) Q+Co + trem (1)	None obvious.					
718												
720												
722												
724												
726												
728												
730												
732												
734												
736												
738												
740												
742												
744				As above			742.9 Sp(1-2) diss + vn.					
746												
748												
750												
752												
754												
756					755.1 755.65 Si(2) Cl(1)	755.1 755.65 Q+Co(3) Q(2) Q+Co(2) Q(1)	755.1 Sp(2) diss.	755.65 fault = 40° to c.c.a. Veined and sheared				

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755			Basalt lava and lava breccia	as above	Si(1) Cl(1)	Si(1) Q+Cot trem (2)	Sp(1) 757.2 Sp(2-3) Py(1)					
760			Andesitic - Dacitic lava.	759.5 Mottled yellow-green feldspar-phyric massive Siliceous lava.	Si(2) Si Se(3) in pat.	Q+Co + Sp(1) Q(1)	759.8 Sp(3) Py(2) Cpy(1) 761 Py(2) Cpy(2)					
765			Basaltic lava and lava breccia	767 767.8 lava breccia with grey chert matrix. Dominantly massive light-dark green vesicular basaltic lava. Minor breccia zones.	767 Si(1) Cl(1)	767.8 Q(1) Q+Co ± Sp (1)	766 Py(1) Sp(3) 767.8 Sp(1) Py(1)					
780							779.5 No obvious mineralisation.					
782					781.5 Cl(1) SeSi(2) pat - lgt gn.							
784					784 Si(1) Cl(1)							

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800			Basalt lava and lava breccia	Massive basalt lava as above		Q+Co(2) Q(1)	No obvious mineralisation.					
802												
804												
806												
808												
810												
812												
814				812.8 irregular grey-light green ash volcaniclastic interbed				813.9 fault = 35° to LCA.				
816												
818				818.4 brecciated vesicular lava with light green siliceous lava matrix	818.4 Si.Cl(1)	818.4 Q(2) Q+Co(1)						
820												
822												
824				824.4 Massive vesicular basalt lava	824.4 Cl(1)	824.4 Q+Co(2)						
826												
828				827.9 lava breccia as above	827.9 Si.Cl(1)	827.9 Q+Co(1)						
830				829.6 Weakly feldspar-phyric massive vesicular basalt lava.	829.6 Cl(1)	829.6 Q+Co ± Sp(2-3)	Sp(1) diss.					
832												
834								834.7 10cm fault Zone Puggy-broken Core			833.8m Petrology # 563717P	
836				836.3 brecciated basalt lava with light green-grey chert matrix 837.4 proportion R.I. fr decrease downhole. By 837.3 D.I. fr appear.	836.3 837.4 Cl(1) Li(2) Cl(1)	836.3 837.4 Q+Co(1) Q(2)	836.3 837.4 No obvious mineralisation Sp(2) at contact cpy+py (2) } disseminated Sp (1)					
838			Dacite lava and lava breccia	Mottled yellow-green feldspar phyric lava. Weakly brecciated in part with weakly chlorite altered lava matrix.								
840												

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DATE : 5-10-90

DEPTH	DRILL RUNS	CORE LOSS	LITHOLOGY: ROCK NAME	LITHOLOGY: DESCRIPTION	ALTERATION	VEINING	MINERALISATION	STRUCTURE	WEATHERING	VISUAL LOG	REMARKS	DEPTH
			Dacite lava and lava breccia	Mottled Pink - dark green Siliceous feldspar-phyric lava. flow banded in part. weakly brecc-ated in part with pink siliceous fragments in a green lava matrix.	Si (2) Cl (1)	Q (2-3) Q+Co ± Py (1-2)	Si (1-3) diss + vn. Py (1-3) " " Cpy (1) 849 Cpy (1) Py (1-3) py concentrated in brecciated Zones as Veinlets and disseminations but also dissem. in matrix of massive lava.	851.1 flow-banding = 35° to LCA. 853.2 veined + broken Core ? fault. 857.3 fault: 35° to LCA Puggy. 870 Py (1)			841.35 Petrology * 563718 P 865.3 Petrology * 563719 P	
			Basalt lava and lava breccia	875.2 876 Intensely brecciated and veined dacite 877.3 Fault Zone - Dominated by basaltic material dark green vesicular (Si+Co+Cl filled) , Cl Set, feldspar - phyric basalt lava. Minor Zones of brecciation with grey-Chert matrix	877.3 Cl (1)	875.2 Q+Co (3) Q (2) 877.3 Q+Co ± Trem (3)	877.3 No mineralisation obvious	875.2 fault. 876 fault Zone - Veined 877.3 bx + puggy 881.1 fault (Pug) = 60° to LCA.	877.3 Lch/2		875.6 hot water 882.2 Petrology * 563720P	

Aberfoyle Resources Limited
EXPLORATION DIVISION

DIAMOND DRILL LOG

PROJECT : Mackintosh

PROSPECT : Mt. Charter Dolerite

HOLE NO : MAC-27
PAGE : 22 of 22
LOGGED : AMCN
DATE : 5-10-90

0501

DEPTH	DRILL RUNS	CORE LOSS	LITHOLOGY: ROCK NAME	LITHOLOGY: DESCRIPTION	ALTERATION	VEINING	MINERALISATION	STRUCTURE	WEATHERING	VISUAL LOG	REMARKS	DEPTH
			Basalt lava and lava breccia	as above	Cl(1)	Qtz Co ± trem (3)	No Mineralisation		Lch 2.			
884			883.8	E.C.H.								
886												
888												

654502

0502

Attachment - MAC-27

Sample No:	Depth	Description
563711	225.1m	Basalt lava.
563712	415.45m	Brecciated andesitic-basaltic lava.
563713	515.45m	Massive basalt lava.
563714	607.45m	Brecciated andesitic-basaltic lava.
563715	667.7m	Fine grained sandstone.
563716	713.5m	Massive basalt lava.
563717	833.8m	Massive basalt lava.
563718	841.35m	Siliceous dacitic lava.
563719	865.3m	Siliceous dacitic lava.
563720	882.2m	Massive basalt lava

654504
TC 44

1 0595

PETROGRAPHIC REPORT

(Rocks from MAC-27)

for

ABERFOYLE RESOURCES Ltd
(attn. Andrew McNeill)

by

Anthony J. Crawford
Geology Department
University of Tasmania

22/10/90

SAMPLE NUMBER: 563711

SUMMARY:

This sample is a strongly carbonate-altered primitive olivine+augite basaltic lava or lapilli tuff.

HAND SPECIMEN:

This is a pale- to mid-grey mafic(?) lava cut by calcite veinlets and segregations.

THIN SECTION:

This sample was probably a basaltic lava or tuff with phenocrysts of augite and olivine. Its original texture and mineralogy has, however, been totally overprinted and largely destroyed by pervasive carbonate alteration. Relic mafic phenocrysts outlines are not well enough preserved to be diagnostic, but occasional replacement by chlorite-serpentine minerals and the common presence of large euhedral chromite inclusions suggests that most were likely to have been olivine. A few shapes reminiscent more of augite were also noted.

The groundmass of this sample was probably highly glassy. The obliteration of the primary texture by carbonate alteration renders accurate identification difficult, but in many places relic textures seem to me more like a former basaltic lapilli tuff than a lava. Abundant curved fractures define a discontinuous fairly weakly developed foliation that transects one generation of calcite veins but is itself cut by later calcite veins. The latter have relatively coarse-grained calcite crystals with finely-sutured grain boundaries, and make up most of the carbonate veins in the rock.

The abundant chromite and serpentine (?) or colourless chlorite that makes up most of this rock besides calcite suggest that it was a Cr-rich fairly primitive basalt compositionally. The texture, although not definitive due to strong carbonate alteration, is more suggestive of a basaltic lapilli tuff than a basaltic lava.

SAMPLE NUMBER: 563712 MAC-27, 415.45m

SUMMARY:

This sample is an autobrecciated andesitic lava with sparse albitized plagioclase and quartz phenocrysts in a matrix that has been strongly overprinted by albite alteration.

HAND SPECIMEN:

This is a strongly altered felsic or intermediate lava or lava breccia in which dark grey fragments of dacite(?) to at least 3cm long are set in a paler groundmass that has an almost cherty texture in places.

THIN SECTION:

This sample is a polymict andesitic lava breccia with a strongly recrystallized groundmass. The best preserved fragments are all identical texturally and mineralogically, and rather unusual in having albitized plagioclase (<5 modal%) and quartz phenocrysts in a groundmass charged with albite microlites set in abundant chlorite. The three or four quartz phenocrysts are strongly reacted and resorbed, but are definitely phenocrysts and not silica alteration. Albitized plagioclase phenocrysts are also rather rounded, rarely larger than 1mm, and show dirty brown clayey alteration in places. There is no clear evidence for the former presence of mafic phenocrysts.

The margins of most fragments merge imperceptibly into the matrix of this rock. The matrix is exceptionally heterogeneous texturally, although where best preserved it is little different texturally from the fragments. Most of the sample, however, is mainly fairly well-crystallized intergrowths of quartz and albite flecked with chlorite and dirty brownish calcite. Quite coarse-grained segregations of intergrown dusty brownish albite and calcite are abundant.

This sample is probably an autobrecciated andesitic lava that has been soaked with albite-forming hydrothermal solutions during regional alteration. It is unusual for Hellyer region lavas in having quartz phenocrysts (however uncommon).

SAMPLE NUMBER: 563713 MAC-27, 515.45m

SUMMARY:

This sample is a massive sparsely plagioclase+quartz (+rare augite) - phyric andesitic lava identical to the precursor lava of 563712.

HAND SPECIMEN:

This is a massive, uniform textured pale- to mid-grey finely porphyritic basaltic to andesitic lava.

THIN SECTION:

Despite the fact that it apparently comes from exactly 100m deeper in the drillhole than the previous sample (563712), this rock bears an astonishing similarity to 563712 petrographically; the only significant difference prior to alteration is that this rock is unbrecciated. It consists of around 2-3 modal % of dirty brownish somewhat rounded albite phenocrysts less than 1mm across, some of which are flecked with chlorite and granular pale yellow epidote. A few microphenocrysts of fresh augite are preserved. Two definite quartz phenocrysts (xenocrysts?) were noted, both rounded and reacted, with narrow high-temperature reaction rims of very fine-grained clinopyroxene.

The bulk of this sample is a relatively even textured groundmass composed of abundant albite laths set in a matrix of anhedral quartz, and abundant dirty brown extremely fine-grained epidote and chlorite. A few elongate fractures are filled by secondary quartz and pale green chlorite.

This sample is undoubtedly identical to the precursor lava of the preceding sample. It is unusual and distinctive in having both rounded dusty albite phenocrysts and rounded quartz phenocrysts or xenocrysts. I have not seen similar samples in other drillholes in the region, although I have not looked at MCH-1. The chemistry of this sample would be interesting. I suggest that it is andesitic.

0507

SAMPLE NUMBER: 563714, MAC-27, 607.45m

SUMMARY:

This sample is a well-preserved, sparsely augite+plagioclase -phyric basaltic lava breccia; it contains similar reacted quartz xenocrysts to those noted in the previous samples.

HAND SPECIMEN:

This is an intensely brecciated and quartz(?)-veined dark grey basaltic (?) lava.

THIN SECTION:

Despite the brecciation, this rock is texturally and mineralogically very well-preserved within fragments. It is clearly a plagioclase+augite-phyric basalt, and, as for the two preceding samples, is unusual in containing (in this case) quite common rounded and resorbed quartz phenocrysts or xenocrysts. Augite and albitized plagioclase phenocrysts each make up about 3-5 modal% of the sample, although the albite phenocrysts are invariably much larger (mainly 0.5-1.5mm long), and more rounded. The small squat augite microphenocrysts are mainly fresh and grade into equidimensional groundmass prisms. Quartz phenocrysts or xenocrysts are almost as abundant as albite in this sample. They are invariably rounded and reacted, with occasional high-temperature reaction rims of augite; a few have brown melt inclusions, and several show prominent internal strain features such as tiny parallel microshears. They are, as in the previous sample, quite clearly out of equilibrium with the host magma (in this case, basaltic), and therefore best identified as xenocrysts.

The groundmass of this lava breccia, within fragments, was very fine-grained to glassy and charged with randomly orientated tiny albite microlites. Patchy development of secondary quartz is common, and several large segregations composed of intergrown radiating sheaves of secondary albite and minor intergrown prehnite and calcite are also present.

This sample is a relatively evolved basaltic lava; it is more primitive, however, than the preceding two samples, in which augite never was a significant primary phase.

SAMPLE NUMBER: 563715, MAC-27, 667.7m

SUMMARY:

This sample is a fine-grained poorly sorted quartz sandstone that has been strongly carbonate-altered. It is derived largely from pelitic metamorphic detritus, and resembles strongly the Animal Ck greywacke.

HAND SPECIMEN:

This is a uniform (unbedded in the small hand spec) dark grey fine-grained silty sandstone.

THIN SECTION:

This is a poorly sorted and strongly altered fine-grained sandstone in which about 3 modal% of small (<<1mm across) angular detrital quartz grains, and flakes of detrital muscovite to 1.4mm long, are set in a heavily carbonate-altered matrix. The quartz grains include both monocrystalline (volcanic?) and polycrystalline (metamorphic) quartz; the latter are sometimes schistose intergrowths with muscovite.

The matrix of this rock is uncleaved and was probably clayey, but it has been pervasively overprinted by murky very fine-grained calcite. Veinlets of calcite with scattered euhedral opaque minerals (pyrite or pyrrhotite) are not uncommon cutting this rock.

The sample shows obvious strong similarities to the Animal Ck Greywacke petrographically, and clearly is derived in large part from a nearby pelitic metamorphic source.

SAMPLE NUMBER: 563716 MAC-27, 713.5m

SUMMARY:

This sample is a strongly augite-phyric basaltic lava that also contains about 3 modal% of altered olivine phenocrysts.

HAND SPECIMEN:

This is a massive pale- to medium grey finely porphyritic and weakly vesicular basaltic lava in which the vesicles (to 1cm long) are filled by either calcite or chlorite or both.

THIN SECTION:

This is a distinctive basaltic lava that contains around 20 modal% of well-formed augite phenocrysts and about 3-5 modal% of totally carbonate-altered former olivine phenocrysts, set in a very fine-grained matrix that was originally largely glassy. The augite phenocrysts vary from 4mm long to groundmass microlites; most are euhedral to subhedral and are perfectly fresh, and show minimal optical zoning. A few small euhedral chromite inclusions were noted, but these are more abundant in the altered olivines. The augite crystals commonly occur in multi-crystal clots of 10-20 crystals, especially the smaller grainsize (micro)phenocrysts. Former olivine phenocrysts are mainly <1mm long and are replaced by calcite.

The groundmass of this sample is very murky and fine-grained and charged with tiny acicular albite and augite microlites. It was probably quite glassy. Calcite occurs as polygonal crystal aggregates filling vesicles, and as occasional veins and patches through the rock.

This is a distinctive augite-rich (ankaramitic) basaltic lava.

SAMPLE NUMBER: 563717, MAC-27, 833.8m

SUMMARY:

This sample is a well-preserved olivine+augite-phyric fairly primitive basaltic lava typical of many of the Hellyer basalts.

HAND SPECIMEN:

This is a massive pale- to medium grey finely porphyritic basaltic lava cut by narrow calcite veinlets, and with common tiny blebs of black chlorite in the groundmass.

THIN SECTION:

This is a texturally well-preserved olivine+augite-phyric basaltic lava. Former olivine phenocrysts are entirely replaced by very fine-grained polygonal silica and minor calcite, and make up about 7-10 modal% of this sample. They are up to 3mm long, euhedral, and commonly contain tiny red euhedral chromite inclusions. Augite phenocrysts are equally as abundant as olivine, mainly finer-grained (0.5-1.5mm long), perfectly fresh and unzoned. Unlike olivine, they usually occur as clusters of crystals, often intergrown.

The groundmass of this sample is very similar to that in the previous sample. It is murky, very fine-grained and charged with tiny albite and augite microlites. In places, small sheaves of intergrown albite and augite represent quenched spherulitic crystallization, typical of the margins of pillowed units. Fractures through the groundmass are filled by pale green chlorite and lined by tiny blebs of quartz. Narrow meandering calcite veinlets transect this sample.

SAMPLE NUMBER: 563718, MAC-27, 841.35m

SUMMARY:

This sample is a weakly plagioclase-phyric dacitic lava breccia.

HAND SPECIMEN:

This is a mid-grey-green weakly autobrecciated felsic lava in which altered plagioclase phenocrysts are quite common.

THIN SECTION:

This is a plagioclase-porphyritic dacitic lava in which albitized plagioclase phenocrysts make up about 5 modal% of the rock, and are partially altered to sericite. Most albite phenocrysts are 0.5-1mm long, and vary from euhedral to subhedral. No mafic phenocrysts were present in this sample.

The groundmass of this sample was not entirely glassy, like most Hellyer dacites that I have seen. It is composed of a matrix of interlocking tiny laths and microlites of albite and subordinate anhedral chlorite in which are set abundant almost perfectly round albite blebs to about 0.2mm across. These presumably crystallized from interstitial glass, and are not spherulites. In inter-fragment areas, the matrix is much cleaner-looking, more silica-rich and chlorite-free. Dispersed wave-fronts of small opaque grains (magnetite?) form trails through the rock, but are not abundant. This is clearly a lava breccia of probable dacitic composition; the texture (relatively 'glass-poor') suggests that it comes from within, rather than from the margins of, a dacitic cooling unit.

SAMPLE NUMBER: 563719, MAC-27, 865.3,

SUMMARY:

This sample is a massive sparsely plagioclase-phyric dacitic lava with a few chloritized augite phenocrysts.

HAND SPECIMEN:

This is a massive, pinkish-green almost aphyric felsic lava.

THIN SECTION:

This is a sparsely plagioclase-phyric dacitic lava that is similar to that above in most respects except for the following points:

1: this sample contains two or three small chloritized augite phenocrysts.
2: this sample is unbrecciated, and has a generally finer-grained groundmass than 563718, lacking the microlitic plagioclase and rounded blebs of albite that characterize that rock.
3: this sample contains a 1.5mm diameter inclusion composed of shallow magma chamber or counduit during ascent.

This is a texturally well-preserved dacitic lava, and is perhaps unusual in that former FeTi oxide phenocrysts are apparently absent; this is not a common feature of Hellyer sequence dacites.

SAMPLE NUMBER: 563720 MAC-27, 882.2m

SUMMARY:

This sample is an olivine+augite-phyric quite primitive basaltic lava quite similar petrographically to sample 563717.

HAND SPECIMEN:

This is a vesicular porphyritic mafic lava cut by calcite veinlets; the vesicles are also calcite veined.

THIN SECTION:

This is a texturally well-preserved augite+olivine-phyric vesicular basaltic lava. The augite and olivine phenocrysts are approximately equally modally abundant, around 10-15 modal%, and mainly less than 1.5mm long. Whereas augite is entirely fresh, all olivine is altered to fine-grained polygonal intergrowths of quartz. Small euhedral red chromite inclusions are present in many altered olivines. Augite phenocrysts are euhedral to subhedral and frequently occur in multi-crystal clots; they are unzoned.

The groundmass of this sample is murky brown and charged with tiny acicular albite microlites. It was probably quite glassy, and contains small angular patches of green chlorite. Vesicles reach almost 1cm in diameter, and make up around 10 modal% of the sample. They are filled by radiating to polygonal intergrowths of secondary quartz; calcite veinlets are not uncommon.

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654515

ANALABS

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316837

ANALYTICAL REPORT No. 23·3·08·07430

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

INVOICE TO: ABERFOYLE RESOURCES LTD
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P.O BOX 952
BURNIE TAS 7320

ORDER No.	PROJECT
10095	MAC-27

DATE RECEIVED	RESULTS REQUIRED
10/10/90	24/10/90

No. OF PAGES OF RESULTS	DATE REPORTED	No. OF COPIES	TOTAL No. OF SAMPLES
1	17/10/90	1	10

SAMPLE NUMBERS	SAMPLE DESCRIPTION	ELEMENT/METHOD
63711/563720	DRILL CORE	Cu, Pb, Zn, Ag/101 Au, AuCHK/309 Ba, As, Cr, Zr, Ti/401 K_2O, MgO, CaO, Na_2O/104 Ti Zr/0825

RESULTS TO: MR R DE BOMFORD
ABERFOYLE EXPLORATION
PO BOX 952
BURNIE TAS 7320

RESULTS TO:

RESULTS TO:

REMARKS

Jenkins
AUTHORISED OFFICER

0515

654516

ANALABS

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ANALYTICAL DATA

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
	23.3.08.07430	17/10/90	10095	1 OF 1

SAMPLE No.	Cu ✓	Pb ✓	Zn ✓	Ag ✓	Au ✓	AuChk ✓	Ba ✓	As ✓	Cr ✓
563711	90	830	1000	1.0	0.140	0.220	45	15	952
563712	20	10	180	1.0	<0.008	–	1554	6	68
563713	15	10	175	1.0	0.030	0.040	1748	5	84
563714	5	<5	380	1.0	0.030	–	2166	3	240
563715	20	10	240	1.0	0.010	–	614	21	53
563716	45	<5	75	1.0	0.040	–	541	<2	572
563717	130	30	200	1.0	0.030	–	308	5	390
563718	20	<5	430	1.0	0.010	0.020	818	13	<5
563719	20	<5	40	1.0	0.040	–	364	4	36
563720	50	<5	135	1.0	0.025	–	403	<2	618
DETECTION	5	5	5	0.5	0.008	0.008	10	2	5
UNITS	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
METHOD	101	101	101	101	309	309	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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ANALYTICAL DATA

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
	23.3.08.07430	17/10/90	10095	1 OF 1

SAMPLE No.	Zr √	Ti	Ti:Zr	K2O	MgO	CaO	Na2O		
563711	60	1521	25.3	0.10	10.14	13.15	0.14		
563712	141	2764	19.6	1.50	4.40	4.48	4.16		
563713	158	2677	16.9	3.20	4.44	4.54	3.44		
563714	124	2748	22.2	3.00	5.10	6.24	2.92		
563715	137	1613	11.8	3.86	2.10	5.35	0.37		
563716	79	2650	20.9	0.80	8.87	14.91	2.18		
563717	60	2376	39.6	0.30	7.45	8.02	2.01		
563718	206	1997	9.7	1.96	1.61	1.01	4.53		
563719	120	1077	9.0	8.50	0.91	1.28	3.29		
563720	80	3059	38.2	0.32	8.34	7.49	2.33		
DETECTION	5	50	0.1	0.01	0.01	0.01	0.01		
UNITS	ppm	ppm	%	%	%	%	%		
METHOD	401	401	9825	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

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0517

654518

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A Division of Inchcape Inspection & Testing Services Aust PL

Phn: (004) 316 837 | 14 Thirkell St Cooee Tas 7320 | Fax: (004) 318 890

ANALYTICAL REPORT No. 100560.60.07526

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No. OF PAGES OF RESULTS	DATE REPORTED	No. OF COPIES
1	21/11/90	1

TOTAL No. OF SAMPLES: 10

SAMPLE NUMBERS	SAMPLE DESCRIPTION	ELEMENT/METHOD
63711/20	DC	P205/6X401

RESULTS TO

Mr R de Bomford
Aberfoyle Resources Limited
Exploration Division
P O Box 952
Burnie Tas 7320

RESULTS TO

RESULTS TO

REMARKS

THESE SAMPLES WERE ORIGINALLY PART OF OUR JOB. NO. 07430

EXTRA WORK WAS REQUESTED

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0516

654519

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ANALYTICAL DATA

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
	100560.60.07526	21/11/90	10095	1 OF 1

TUBE No.	SAMPLE No.	P205									
	563711	0.080									
2	563712	0.284									
3	563713	0.314									
4	563714	0.149									
5	563715	0.057									
6	563716	0.151									
7	563717	0.131									
	563718	0.103									
	563719	0.062									
1	563720	0.149									
5											
6											
8											
9											
20											
1											
22											
3	DETECTION	0.007									
24	UNITS	%									
25	METHOD	GX401									

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

AUTHORISED OFFICER

AmcN

0519

654520

SELECTION OF ELEMENTS FOR DIAGNOSTIC GEOCHEMISTRY AND REGIONAL/LOCAL CORRELATION OF ALTERED VOLCANICS, WITH PARTICULAR EMPHASIS ON THE MOUNT READ VOLCANICS

Tony Crawford, 21/11/90

In sequences of altered lavas, it is obvious that different styles of alteration, and variable vein assemblages, produce differing extents and directions of modifications of the primary rock composition. The common vein and alteration minerals and assemblages in Mount Read Volcanic lava sequences, such as calcite, quartz, sericite, chlorite and to a lesser extent pyrite and barite, indicate that SiO2, CaO and the alkalis (Na, K, Sr, Rb, Ba..) are all mobile to some extent during both regional burial metamorphism, and more localized hydrothermal alteration. Therefore, in assessing the geochemical data from such lava suites with regard to determining primary affinities or making regional or local correlations, due weight should be put on those elements and element ratios which are known to be essentially immobile during such post-eruptive alteration. These so-called immobile elements are those with a high charge to radius ratio, ie. Ti, Nb, Ta, Hf, Zr, Y, P, the rare earth elements (REE), and some other transition elements such as Sc, V, and normally Ni and Cr.

During several years of studying the geochemistry of the Mount Read Volcanics, most recently the thick basalt-andesite sequences in the subsurface west of Hellyer (Rept. for Placer Expln., 1990), I have found that the following elements and ratios are most useful.

1: TiO2, Zr and Ti/Zr (Ti ppm = %TiO2 multiplied by 5995). For the Mount Read Volcanics (MRV), and most other suites of arc-related lavas I am familiar with, Nb data is useless, due mainly to its low abundance levels in arc lavas. I suggest that it is not worth the expense of analyzing for Nb. I rarely use Y abundances for diagnostic geochemistry. XRF data seems fairly sloppy, and for the MRV I am not convinced that the primary range of Y warrants using this element as a petrogenetic indicator. Ti/Zr is accurate and apparently very effective in defining magmatic units within a pile of lavas.

2: REE patterns. These cost around $40-60 per sample, but are of exceptional value in the petrogenetic interpretation of the suites involved, and in correlation of lava units. Due to the expense and time involved in obtaining REE analyses, I have found P2O5 abundances to be a useful substitute.

3: P2O5 abundances are very useful for local and regional correlations within the Mount Read Volcanics . This is because much of the MRV is composed of high-K andesites and shoshonitic basalts which have generally high P2O5 contents (0.2-1.5%) that are directly proportional to REE abundances. Also, there is a strong indication from my work that in a given pile of basalts (eg W of Hellyer) that P2O5 abundances generally increase upwards in the pile.

4: Cr abundances are also useful, both for judging how 'primitive' a lava is in the absence of MgO data, and for differentiating between lava units/suites that have similar Ti/Zr and P2O5 contents. For instance in the Mines Department Mount Charter hole MCH-1, there is a 150m-thick unit of Hellyer-type basalts with Ti/Zr = 34-44, P2O5 ~ 0.35%, but very low Cr abundances (<70ppm). In the Placer holes that penetrated the same stratigraphic section W of the Murchison Hwy, there are quite a few units of basaltic lavas with similar Ti/Zr and P2O5 contents as this MCH-1 unit, but the Placer basalts have Cr abundances usually in excess of 500ppm; and cannot be the same unit.

5. Of the major elements, MgO is probably the most useful, as it gives an indication of the degree of differentiation of the sample, and can be used in a general way to infer SiO2 abundances. CaO, Na2O and K2O are generally highly mobile, and are only useful in assessing extents and styles of alteration; they are of little or no use in regional or local correlation.

Some examples of the utility of the selected elements and element ratios mentioned above are shown below, using data from the MRV. Figure 1a-d shows how simple element ratios such as Ti/Zr and TiO2/P2O5 can effectively discriminate the main lava suites within the Mount Read Volcanics. Figure 2 shows how similar 'diagnostic' element ratios and abundances can clearly separate different lava units within a single drillhole (Placer BRD-05) through the thick lava sequence beneath the Que River Shale west of Hellyer.

CORRELATION OF THE MAC-27 LAVA SEQUENCE

The data provided for the basalts and associated lavas from MAC-27 to the west of Mount Charter can be compared with data for lavas in the sequences beneath the Que River Shale from W of the Murchison Hwy, and with data for the lavas in the Mines Dept hole MCH-1 at Mt Charter.

COMPOSITIONAL GROUPING OF LAVAS IN MAC-27.

GROUP 1: SAMPLE 563711; (225.1m): Olivine+augite-phyric primitive basalt: TiO2=0.25%, MgO=10.1%, Cr=952ppm, Zr=60ppm, Ti/Zr = 25, P2O5 =0.08%. This sample occurs within the basal Que River Shale and has a distinctively low TiO2 content.

GROUP 2A: SAMPLES 563712 (415.5m) and 563713 (515.5m): These are petrographically identical sparsely plagioclase-phyric andesitic rocks (one being brecciated, the other a massive lava) that extend over at least 100m of section in MAC-27 from 415m - 515m. TiO2 contents are 0.45%, Cr = 68-84ppm, MgO = 4.4%, Ti/Zr = 17-20 and Zr ppm = 140-160, P2O5 = 0.28-0.31%.

GROUP 2B: SAMPLE 563714 (607.5m) and 563716 (713.5m): 563714 is a plagioclase+ augite-phyric evolved basaltic lava breccia with 0.46% TiO2, Ti/Zr = 22, 5.1% MgO and 240ppm Cr and 0.15% P2O5. 563716 is a strongly augite-phyric basalt with a few modal % of olivine phenocrysts. It has 0.44% TiO2, Ti/Zr=21 and 9% MgO, and 572ppm Cr. These basalts are probably part of the same geochemical unit, and could be broadly incorporated into a geochemical unit that included 563712 and 563713. This would be defined as a unit that contains basalts and andesites with MgO from 4-9%, with TiO2 contents around 0.5% and Ti/Zr = 17-22, and low P2O5 contents, with the higher Ti/Zr values occurring in the more primitive members of the suite..

GROUP 3: SAMPLE 563717 (833.8m) and 563720 (882.2m): These are both olivine+ augite-phyric basalts with Ti/Zr = 38-40, 0.40-0.51% TiO2, >390ppm Cr and 7.5-8.3% MgO, and P2O5 contents from 0.13 - 0.15%. They are clearly compositionally different from the overlying basalts, most notably in their much higher Ti/Zr values.

GROUP 4: SAMPLES 563718 (841.3m) and 563719 (865.3m): These are autobrecciated to massive dacitic lavas with sparse plagioclase phenocrysts and rare augite microphenocrysts. Their TiO2 contents are

between 0.18% and 0.33%, and Ti/Zr = 9-10, and P2O5 contents from 0.06 - 0.10%. Sample 563719 has over 8% K2O, which suggests that the mineral identified as albite in the groundmass is orthoclase and not albite. It is not evident to me why the K2O content of 563718 is not also very high, as the mineral making up groundmass and coarser patches in this rock is to me identical to that in the groundmass of 719. I wonder if the analysis for K2O is correct, as in more than 60 analyses of Hellyer region dacites, I have no record of K2O being >6%, and in those most K-rich samples, Na2O and CaO approached zero, unlike in 563719. The 8+% K2O rocks are more typical of granitoid-related metasomatism such as is well shown south of Queenstown.

CORRELATION

An attempt is offered below to compare and correlate MAC 27 lava groups identified above with similar compositional groups known from drilled sections of the Hellyer stratigraphy elsewhere inn the region, mainly from the Placer holes west of the highway, and MCH-1 at Mt Charter.

GROUP 1:

Compositionally similar low-Ti basalts (single analysis has 0.31% TiO2 and Ti/Zr = 22, 0.11% P2O5) occur immediately below the Que Rv Shale around 400m depth in Placer Hole BRD-02 (located 500m due SE of BRD-01) and are around 20-30m thick. Significantly, no similar low-Ti basalts are known from the Mines Dept hole MCH-1.

Another group of low-Ti basalts compositionally very similar to the MAC-27 Group 1 low-Ti basalts occur as Unit 3 (~755-800m depth) in the Placer Hole BRD-01 some ~4km further north (TiO2=0.27-0.35%, Cr=500-700ppm, P2O5 < 0.06%). This unit in BRD-01 is separated from the base of the Que River Shale by some 250m of fairly primitive basalts with significantly higher TiO2 contents and Ti/Zr. This implies that a direct correlation of 563711 and associated basalts in MAC-27 with the compositionally similar Unit 3 in BRD-01 can only be possible if there is a pronounced wedging southward out of the upper lava units in BRD-01 (see below).

The basalts interbedded in the basal Que Rv Shale in MAC-27 are unlike those at an identical position within the Que Rv Shale in Placer hole BRD-05 (600m due S of BRD-01), which have around 0.5% TiO2, P2O5>0.33% and Ti/Zr fairly constant at 22.

GROUP 2

These andesites and basalts show some compositional similarities to those interbedded in basal Que River Shale in BRD-05. However, the P2O5 contents of the MAC-27 Group 2 samples, especially the more basaltic samples 14 and 16 (0.15%), are uniformly lower than those for the basalt

within Que Rv Shale in BRD-05 (0.33-0.39%). No similar lavas to this Group are recorded from BRD-01. Basalts in MCH-1 immediately below the dacite (uppermost lava unit in MCH-1) show strong similarities to those of Group 2, but again the single P2O5 analysis for one of these basalts (0.53%) is well above the low P2O5 abundances in MAC-27 Group 2 rocks.

Thus, no basaltic to andesitic lava unit chemically distinguished in the other holes I have studied can be confidently correlated with the Group 2 lavas in MAC-27, based mainly on the very low P2O5 abundances of the latter.

GROUP 3

The characteristic geochemical features of these lavas are low P2O5 (0.13-0.15%) and high Ti/Zr (38-40). The only lava units in the holes I am familiar with that compositionally approach these, especially in having Ti/Zr >35, are the uppermost basalts (immediately below the Que Rv Shale) in BRD-01. However, again the P2O5 contents of the MAC-27 Group 3 lavas are significantly lower (0.21-0.30% P2O5 for BRD-01 uppermost basalts). Basalts with Ti/Zr values >35 are not known from BRD-05 and BRD-02, and those with Ti/Zr >35 in MCH-1 (which occur immediately below the Mixed Sequence) are invariably quite evolved, with Cr<70ppm and P2O5 around 0.35%. In BRD-01, basalts with Ti/Zr values >30 occur both above and below the low-Ti basalts perhaps correlated with Group 1 herein. Thus there are no lava units in any of the regional drillholes for which data are available to me that are obviously correlated with the basalts with high Ti/Zr Group 3 unit in MAC-27.

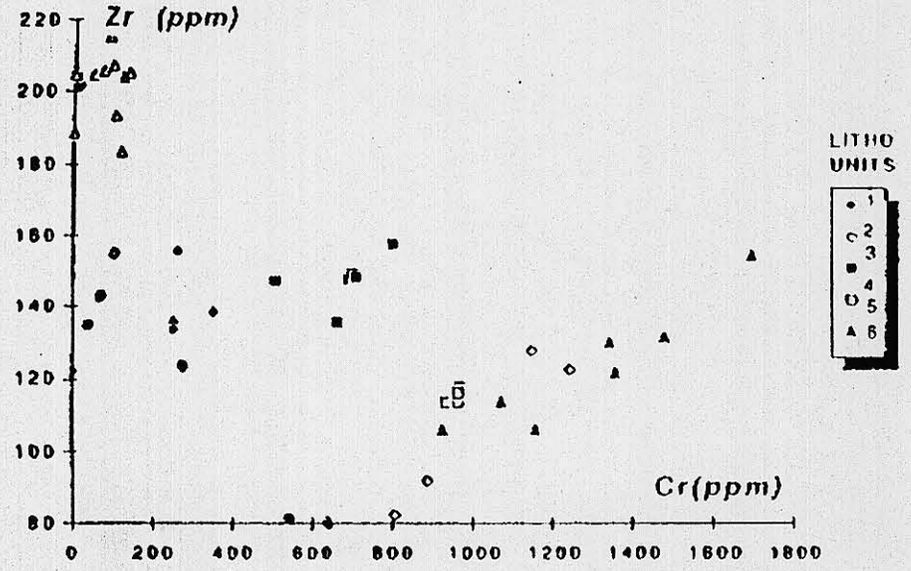
GROUP 4:

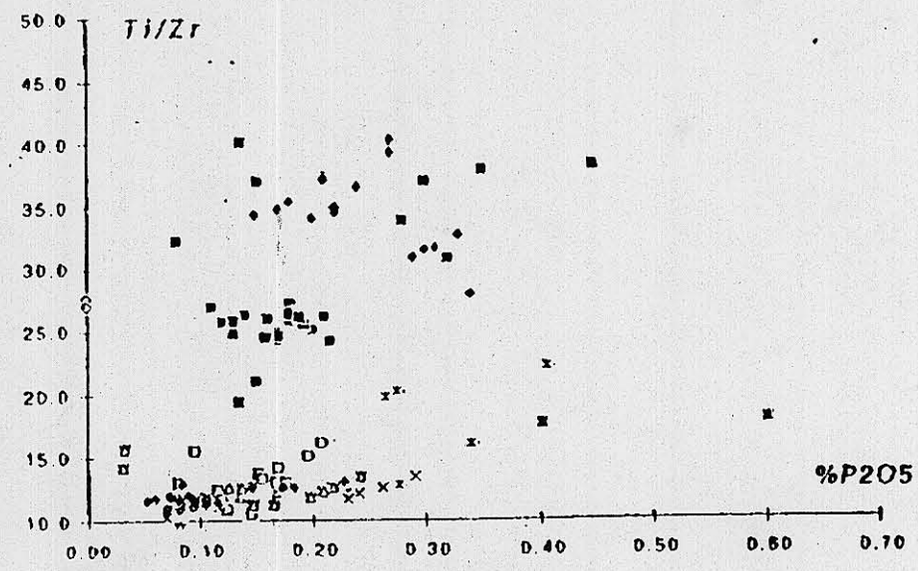
Without more detailed geochemical study, it is difficult to distinguish between various dacitic lava units in the Que-Hellyer stratigraphy. Dacites form the uppermost lava unit in MCH-1 (imm. below the Que Rv Shale), but the basal lava unit (beneath 400m of basalts) in BRD-05. In BRD-01, two dacite units occur; an upper unit some 50m thick, separated by ~50m of basalts /andesites from a thicker, lower dacite unit. The upper dacite is separated from the base of the Que Rv Shale by ~350m of basalts and andesites.

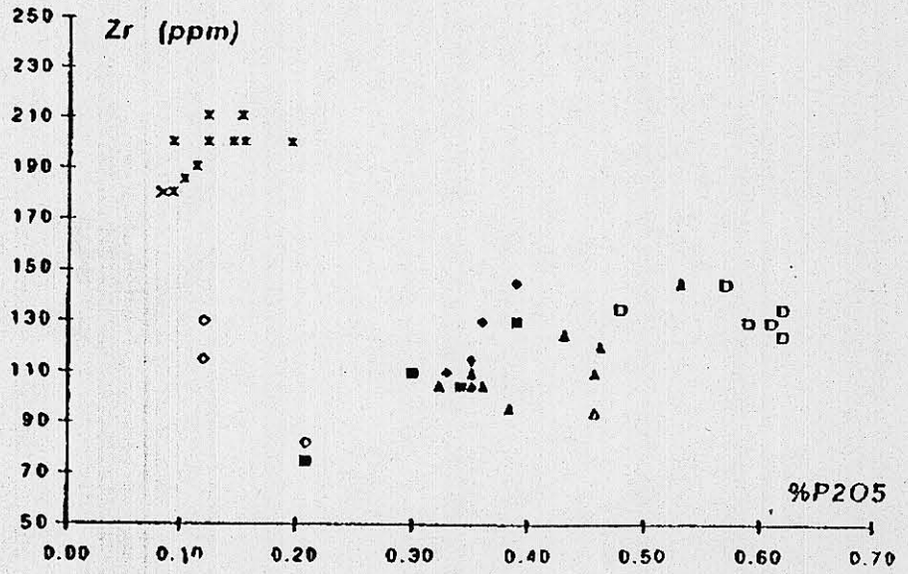
SUMMARY:

I am left wondering if this approach is at all useful, and whether the P2O5 analyses you had done were reliable. Did you get a TASBAS or TASGRAN run by this method. A few more correlations would be obvious if your P2O5 values were higher, although I would not be surprized if your data were good and the correlations were absent! I am confident that we can say that an episode of unusually low-Ti basaltic magmatism, with Ti/Zr ~22-25 and low P2O5 occurred late in the history of the Hellyer basalts. It is not everywhere present. Eg: the continuous coregrinds in MCH-1 did not pick it up, nor was it picked up in the uppermost basalt section of BRD-01, although in BRD-01, a

single coregrind analysis represents the top 20m of the basalts in that hole, and could represent a mixture of a low-Ti unit and an underlying higher-Ti unit. I think that if you get the Placer Report I did, and home in with all your data for all your other holes, and spend a month toting it all up, you will probably find something worthwhile. Correlating 'arc-type' submarine volcanic units across many kms of ground is a hazardous task. Good luck.







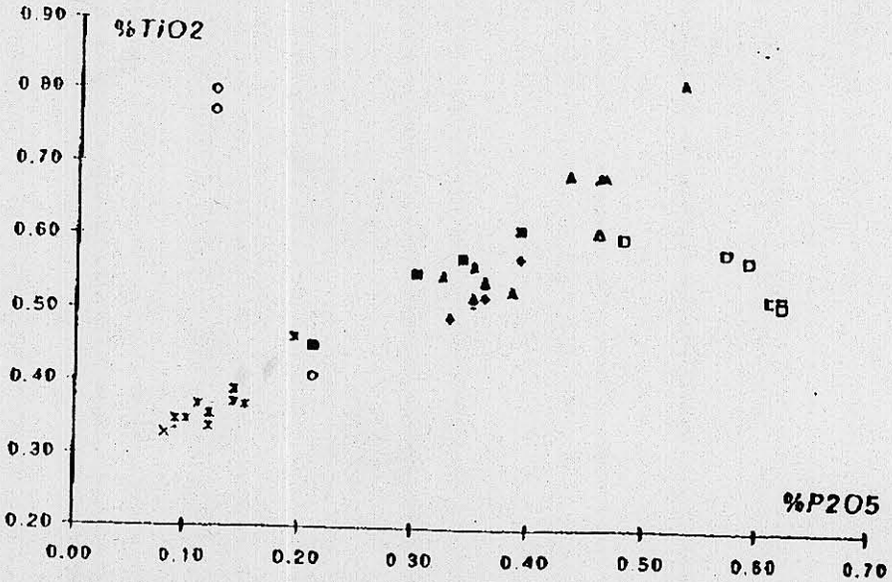
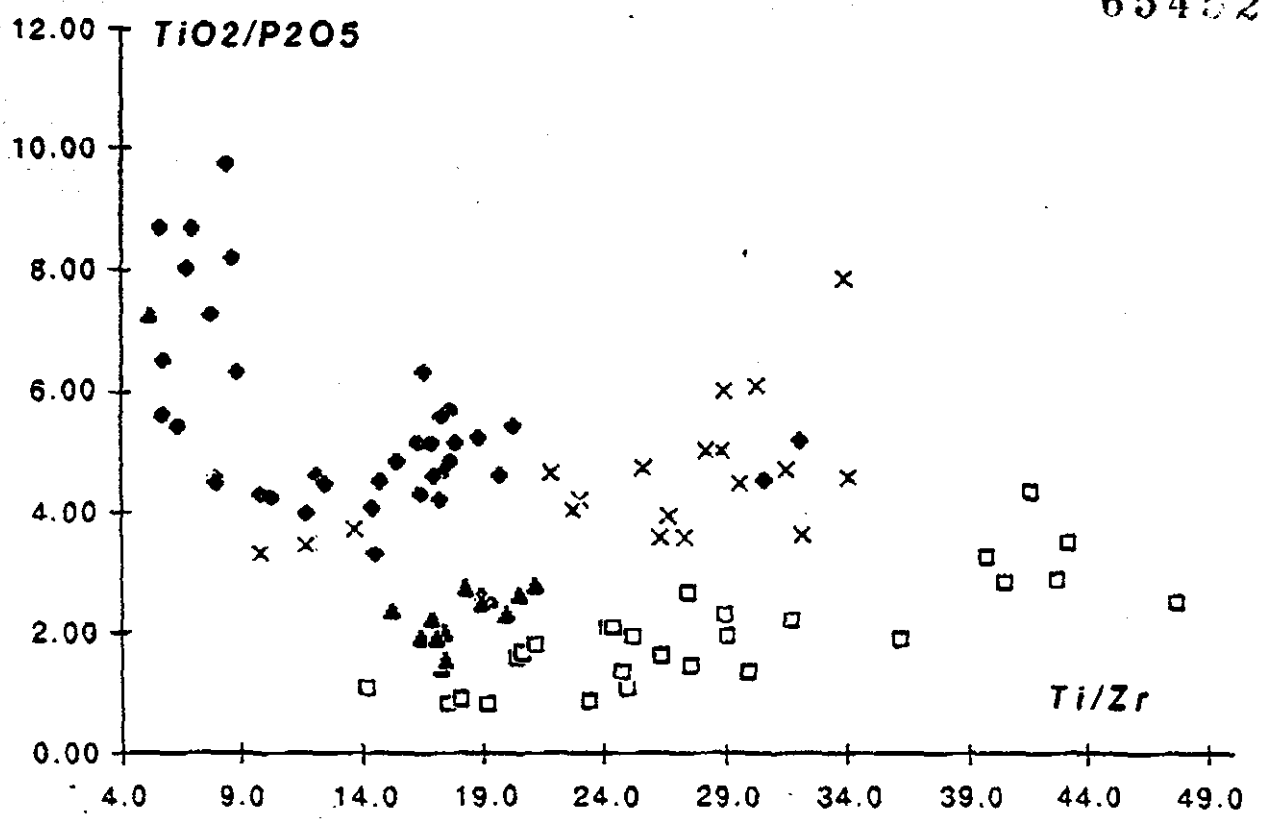


Figure 2. Immobile element variation diagrams for BRD-05 showing the clear definition of distinct magmatic units. The same applies equally as well to BRD-01


TiO2/P2O5
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10.00
8.00
6.00
4.00
2.00
0.00
Ti/Zr
4.0
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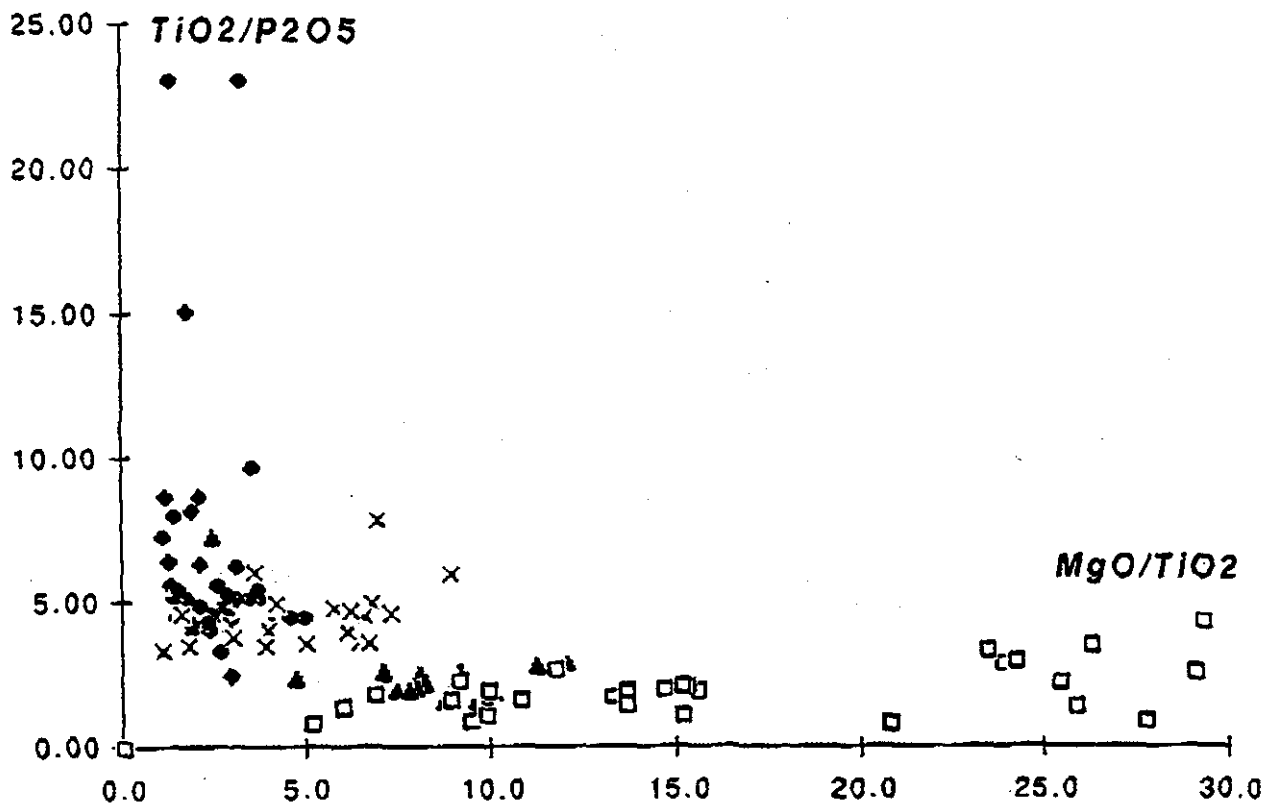
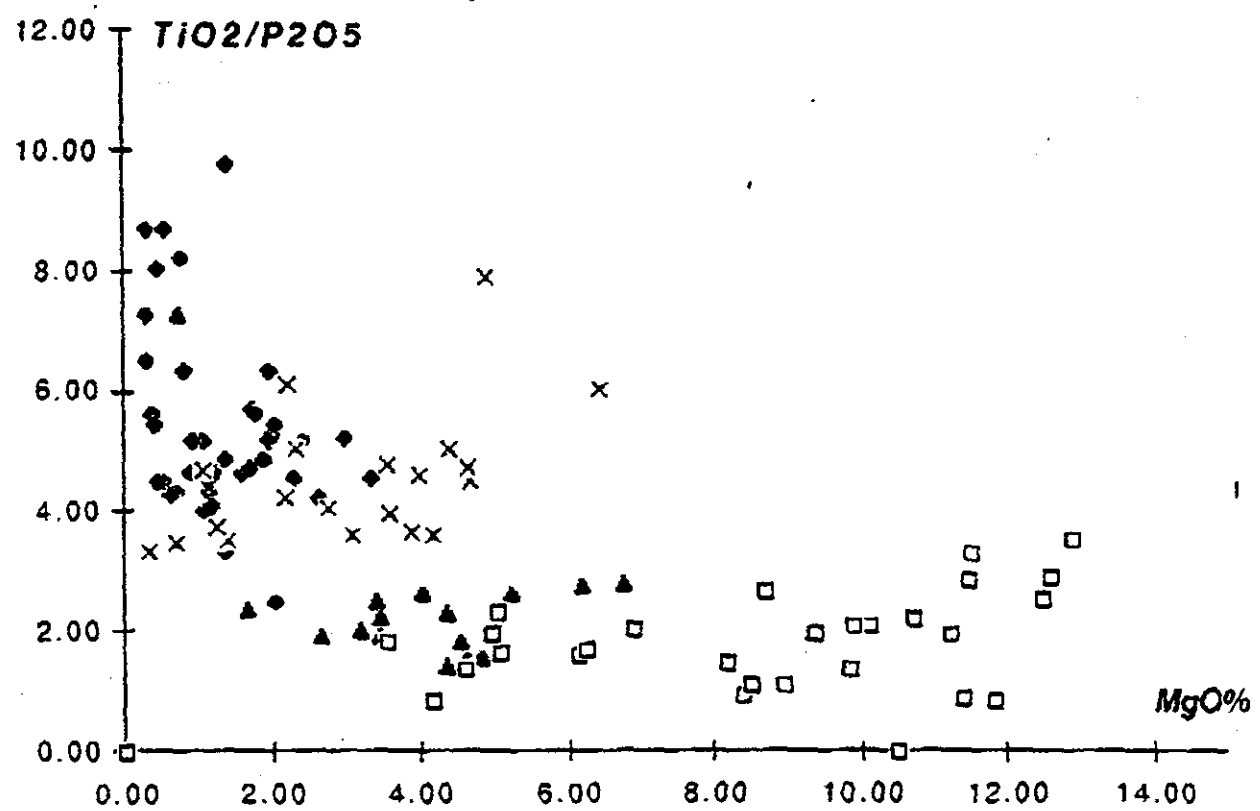
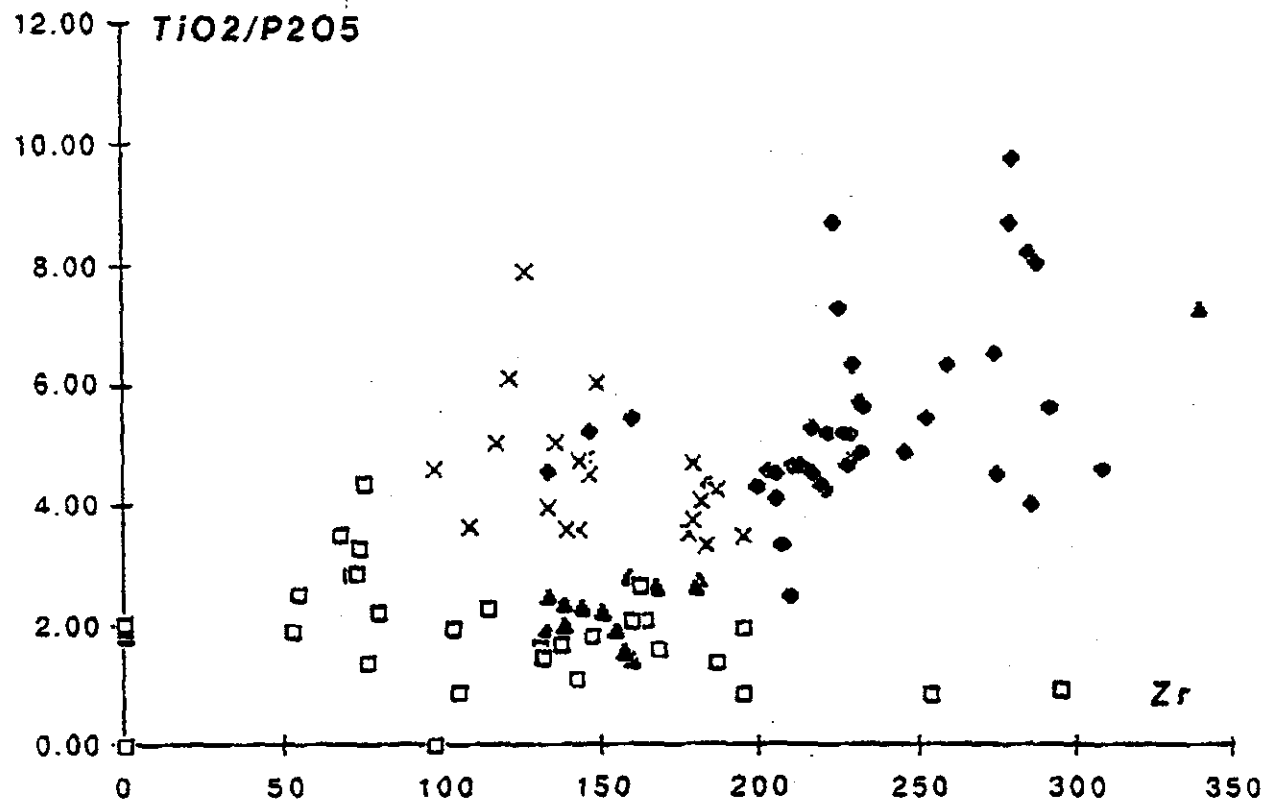
24.0
29.0
34.0
39.0
44.0
49.0


TiO2/P2O5
25.00
20.00
15.00
10.00
5.00
0.00
MgO/TiO2
0.0
5.0
10.0
15.0
20.0
25.0
30.0





◆ CVC Gp1 × Q-H Footwall Andesites

▲ CVC Gp2 □ WVS Basalts (Lynchford/Hellyer)

0520

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OPEN FILE
MICROFILMED

91-3268

MINES
File Ref. E.L. 106/87
- 6 JUN 1991
Doc. Ref.
Action Officer | Initials
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Corres. | 4.6.91
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EXPLORATION LICENCE 106/87

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Progress Report for the Period

May 1990 to April 1991

Volume 4

Appendices 18 - 25

91-3268. 4/5
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Department of Resources & Energy (3/3)

APPENDIX 18

CORE GRIND SAMPLING

654531

HOLE No. MAC-27

0530

DATE

No.	SAMPLE NUMBER	INTERVAL	ELEMENTS REQUIRED	ST	SAMPLE NUMBER	INTERVAL	ELEMENTS REQUIRED	S
1	563630	217-223.55	QRS		563662	469-479	A1	
2	631	223.55-225.8	Scor B1		663	479-493.9		
3	632	225.8-235.8	Scor QRS		664	493.9-503.9		
4	633	235.8-245.3	QRS		665	503.9-513.9		
5	634	245.3-249.8	QRS		666	513.9-521.9		
6	635	249.8-256.9	B1		667	521.9-531.9	↓	
7	636	256.9-266.9	↓		668	531.9-540.9	B1	
8	637	266.9-276.9			669	540.9-549.7		
9	638	276.9-286.9			670	549.7-560.5		
10	639	286.9-296.9			671	560.5-570		
11	640	STD. ✱			672	570-580		
12	641	296.9-306.9			673	580-589.9		
13	642	306.9-317.7	↓		674	589.9-600.6		
14	643	317.7-327.7	A1		675	600.6-610.3		
15	644	327.7-335			676	610.3-619.5		
16	645	335-345.9			677	619.5-632.4		
17	646	345.9-354.9			678	632.4-640.45		
18	647	354.9-361.5			679	640.45-652.35	↓	
19	648	361.5-364	Scor		680	652.35-653.1	Scor Sh Bk	
20	649	364-367.1	Scor		681	653.1-663	B1	
21	650	367.1-373.1			682	663-668.3	S+	
22	651	373.1-383.1			683	668.3-679.9	B1	
23	652	383.1-393.1			684	679.9-689.6	↓	
24	653	393.1-403.9			685	689.6-699.6		
25	654	403.9-413.9			686	699.6-709.6		
26	655	413.9-423.9			687	709.6-719.6		
27	656	423.9-433.9			688	719.6-729.6		
28	657	433.9-447.1			689	729.6-739.6		
29	658	STD ✱			690	739.6-754.9		
30	659	447.1-454.4			691	754.9-759.3	↓	
31	660	454.4-459			692	STD ✱		
32	661	459-469	↓		693	759.3-761.0	Scor D1	

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PAGE 2 OF 2

CORE GRIND SAMPLING

HOLE No. MAC-2

DATE

No.	SAMPLE NUMBER	INTERVAL	ELEMENTS REQUIRED	ST	SAMPLE NUMBER	INTERVAL	ELEMENTS REQUIRED	S
1	563694	761.0-766.0	D1					
2	695	766.0-767.8	scan B1					
3	696	767.8-773.6						
4	697	773.6-777.5						
5	698	777.5-784.1						
6	699	784.1-794.1						
7	700	794.1-804.1						
8	701	804.1-814.1						
9	702	814.1-824.1						
10	703	824.1-837.3						
11	704	837.3-847.3	D1					
12	705	847.3-857.3						
13	706	857.3-867.3						
14	707	867.3-877.3						
15	708	877.3-883.8	B1					
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Phn: (004) 316 837 | 14 Thirkell St Cooee Tas 7320 | Fax: (004) 318 890

ANALYTICAL REPORT No. 23.3.08.07400

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

INVOICE TO:

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

ORDER No.	PROJECT
10085	MAC - 27

DATE RECEIVED	RESULTS REQUIRED
26/09/90	ASAP

No. OF PAGES OF RESULTS	DATE REPORTED	No. OF COPIES
8	23/10/90	1

TOTAL No. OF SAMPLES: 79

SAMPLE NUMBERS	SAMPLE DESCRIPTION	ELEMENT/METHOD
363,630/708	SC Prep: 016,018	Cu,Pb,Zn,Ag/101
363,630/708	SC	Au,AuChk/309
363,630/708	SC	Ba,As,Cr,Zr,Ti/401
363,630/708	SC	Ti:Zr/9825
363,630/708	SC Prep: 016,018	Zn/105

RESULTS TO

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

RESULTS TO

RESULTS TO

REMARKS

Jenkins
AUTHORISED OFFICER

0535 654534

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ANALYTICAL DATA

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
	23.3.08.07400	23/10/90	10085	1 OF 8

BE	SAMPLE No.	Cu	Pb	Zn	Zn	Ag	Au	AuChk	Ba	Ba
	563630	50	730	3050	–	1.0	0.020	0.025	507	–
	563631	50	295	1150	–	1.0	0.015	–	65	–
	563632	85	500	860	–	<0.5	0.030	–	549	–
	563633	35	400	2100	–	1.0	0.025	–	603	–
	563634	65	1300	3750	–	1.0	0.040	–	665	–
	563635	50	450	1850	–	1.0	0.025	–	363	–
	563636	50	1350	4150	–	<0.5	0.020	–	821	–
	563637	45	1050	7100	–	<0.5	0.025	–	1193	–
	563638	85	1500	3400	–	<0.5	0.025	–	1191	–
	563639	75	1450	2550	–	<0.5	0.020	–	1421	–
D	563640 X	125	185	2300	–	<0.5	0.015	–	1058	–
	563641	70	930	2100	–	<0.5	0.010	–	1092	–
	563642	65	990	1700	–	<0.5	0.020	–	1836	–
	563643	60	250	1800	–	<0.5	0.015	–	1741	–
	563644	65	1025	2500	–	<0.5	0.020	–	1610	–
	563645	65	500	925	–	<0.5	0.015	0.035	1924	–
	563646	75	490	1250	–	<0.5	0.015	–	1896	–
	563647	75	280	900	–	1.0	0.010	–	2358	–
	563648	90	100	190	–	1.0	0.020	–	1474	–
	563649	75	50	160	–	<0.5	0.020	–	1609	–
1	563650	80	180	345	–	<0.5	0.015	–	2411	–
2	563651	95	675	1800	–	<0.5	0.010	–	1288	–
3	563652	85	650	1400	–	<0.5	0.015	–	>2500	0.34
4	563653	75	195	1650	–	<0.5	0.015	–	1280	–
5	563654	40	25	800	–	<0.5	0.025	–	997	–

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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SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
	23.3.08.07400	23/10/90	10085	2 OF 8

SAMPLE No.	Cu	Pb	Zn	Zn	Ag	Au	AuChk	Ba	Ba
563655	40	5	200	–	<0.5	0.015	0.015	1420	–
563656	35	5	180	–	<0.5	0.015	–	786	–
563657	30	55	315	–	<0.5	0.015	–	2253	–
563658	125	175	2350	–	<0.5	0.015	–	1053	–
563659	30	5	175	–	<0.5	0.020	–	1284	–
563660	65	<5	150	–	<0.5	0.015	–	1171	–
563661	85	15	200	–	<0.5	0.025	0.025	>2500	0.30
563662	35	20	900	–	<0.5	0.030	–	2250	–
563663	125	30	350	–	<0.5	0.030	–	1257	–
563664	75	35	500	–	<0.5	0.020	–	1260	–
563665	75	15	275	–	<0.5	0.025	–	1134	–
563666	60	160	1800	–	<0.5	0.035	–	1606	–
563667	25	5	1250	–	<0.5	0.030	–	1685	–
563668	25	<5	475	–	<0.5	0.020	–	259	–
563669	30	<5	450	–	<0.5	0.035	–	1048	–
563670	80	5	250	–	<0.5	0.040	–	901	–
563671	25	35	610	–	<0.5	0.040	–	1061	–
563672	65	10	880	–	<0.5	0.055	–	904	–
563673	30	10	1350	–	<0.5	0.025	–	1043	–
563674	25	5	630	–	<0.5	0.015	–	>2500	0.30
563675	20	15	695	–	<0.5	0.030	–	1768	–
563676	20	40	610	–	1.0	0.030	–	1537	–
563677	20	80	575	–	1.0	0.030	0.025	964	–
563678	35	340	625	–	1.0	0.030	–	1067	–
563679	30	180	445	–	<0.5	0.030	–	967	–

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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0535

654536

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SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
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563681	30	180	650	–	<0.5	0.035	–	1134	–
563682	30	105	890	–	1.0	0.035	–	1185	–
563683	70	95	875	–	<0.5	0.015	–	736	–
563684	70	20	120	–	<0.5	0.015	–	417	–
563685	55	5	90	–	1.0	0.040	–	565	–
563686	65	<5	100	–	<0.5	0.025	–	386	–
563687	55	<5	80	–	<0.5	0.040	–	478	–
563688	75	<5	85	–	<0.5	0.020	–	298	–
563689	85	<5	85	–	<0.5	0.020	–	345	–
563690	80	30	320	–	<0.5	0.040	–	673	–
563691	70	10	3000	–	<0.5	0.025	–	84	–
563692	95	180	2400	–	<0.5	<0.008	–	1018	–
563693	120	25	>10000	1.23	<0.5	0.030	–	2413	–
563694	80	10	130	–	<0.5	0.030	–	1348	–
563695	85	575	4350	–	<0.5	0.015	–	1527	–
563696	90	385	605	–	<0.5	0.030	–	1156	–
563697	90	145	395	–	<0.5	0.025	0.020	1121	–
563698	55	20	205	–	<0.5	0.010	–	95	–
563699	85	165	270	–	<0.5	0.020	–	473	–
563700	95	125	270	–	<0.5	0.015	–	495	–
563701	70	135	295	–	<0.5	0.025	–	594	–
563702	90	80	200	–	<0.5	0.025	–	673	–
563703	100	80	295	–	<0.5	0.025	–	726	–
563704	40	20	2700	–	<0.5	0.025	–	850	–

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

0536

654537

ANALABS

A Division of Inchcape Inspection and Testing Services Australia Pty. Ltd.

ANALYTICAL DATA

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
	23.3.08.07400	23/10/90	10085	4 OF 8

BE	SAMPLE No.	Cu	Pb	Zn	Zn	Ag	Au	AuChk	Ba	Ba
	563705	25	<5	375	–	<0.5	0.015	–	759	–
	563706	40	10	60	–	<0.5	0.025	–	630	–
	563707	340	10	95	–	<0.5	0.030	–	1255	–
	563708	60	5	130	–	<0.5	0.015	–	465	–

0537

654538

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A Division of Inchcape Inspection and Testing Services Australia Pty. Ltd.

ANALYTICAL DATA

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
	23.3.08.07400	23/10/90	10085	5 OF 8

SAMPLE No	As	Cr	Zr	Ti	Ti:Zr				
563630	30	100	120	3091	25.7				
563631	77	1106	56	2358	42.1				
563632	14	105	118	3299	27.9				
563633	15	105	112	3309	29.5				
563634	15	98	116	3143	27.1				
563635	30	477	52	2245	43.2				
563636	18	517	60	2476	41.3				
563637	<2	487	64	2437	38.1				
563638	9	438	56	2149	38.4				
563639	22	420	59	2218	37.6				
563640	12	850	74	2300	31.1				
563641	<2	400	55	2194	39.9				
563642	6	455	66	2279	34.5				
563643	4	174	119	2528	21.2				
563644	15	126	137	2593	18.9				
563645	11	107	137	2535	18.5				
563646	<2	101	135	2560	19.0				
563647	5	91	133	2432	18.3				
563648	4	83	128	2403	18.8				
563649	6	88	126	2349	18.6				
563650	2	65	129	2432	18.8				
563651	<2	68	136	2524	18.5				
563652	10	56	137	2477	18.1				
563653	<2	59	135	2507	18.6				
563654	<2	60	130	2702	20.8				

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

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A Division of Inchcape Inspection and Testing Services Australia Pty. Ltd.

ANALYTICAL DATA

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
	23.3.08.07400	23/10/90	10085	6 OF 8

BE	SAMPLE No.	As	Cr	Zr	Ti	Ti:Zr				
	563655	<2	51	137	2678	19.5				
	563656	<2	54	139	2755	19.8				
	563657	<2	55	129	2587	20.0				
	563658	16	811	74	2311	31.2				
	563659	<2	62	131	2485	19.0				
	563660	<2	52	125	2411	19.3				
	563661	<2	69	137	2680	19.6				
	563662	3	56	135	2516	18.6				
	563663	2	58	135	2515	18.6				
	563664	3	53	133	2354	17.7				
	563665	<2	62	140	2454	17.5				
	563666	13	58	132	2495	18.9				
	563667	7	177	122	2931	24.0				
	563668	<2	293	119	3253	27.3				
	563669	2	266	115	2949	25.6				
	563670	2	286	121	3168	26.2				
	563671	<2	270	117	3048	26.0				
	563672	5	254	113	3075	27.2				
	563673	2	246	122	3074	25.2				
	563674	<2	230	117	2888	24.7				
	563675	8	235	121	3004	24.8				
	563676	<2	217	116	2872	24.7				
	563677	<2	224	120	2995	24.9				
	563678	<2	231	114	2896	25.4				
	563679	3	210	107	2760	25.8				

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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0539 654540

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A Division of Inchcape Inspection and Testing Services Australia Pty. Ltd.

ANALYTICAL DATA

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
	23.3.08.07400	23/10/90	10085	7 OF 8

BF	SAMPLE No	As	Cr	Zr	Ti	Ti:Zr				
	563680	<2	65	195	2118	22.3				
	563681	15	94	129	3530	27.4				
	563682	20	94	141	2557	18.1				
	563683	8	600	69	3110	45.1				
	563684	6	581	72	3074	42.7				
	563685	2	532	63	2898	46.0				
	563686	3	546	59	2882	48.8				
	563687	2	525	60	2788	46.5				
	563688	<2	584	61	2919	47.8				
	563689	2	571	67	2992	44.6				
	563690	5	588	60	3029	50.5				
	563691	4	642	52	2976	57.2				
	563692	17	824	72	2287	31.8				
	563693	29	70	130	2632	20.2				
	563694	13	27	140	1649	11.8				
	563695	35	244	93	1974	21.2				
	563696	10	327	50	2233	44.7				
	563697	2	323	56	2276	40.6				
	563698	4	364	58	2421	41.7				
	563699	<2	274	43	2009	46.7				
	563700	<2	286	44	2025	46.0				
	563701	4	324	40	2198	54.9				
	563702	5	338	50	2306	46.1				
	563703	6	326	43	2179	50.7				
	563704	19	<5	173	1715	9.9				

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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0540

654541

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ANALYTICAL DATA

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
	23.3.08.07400	23/10/90	10085	8 OF 8

SE	SAMPLE No.	As	Cr	Zr	Ti	Ti:Zr				
	563705	12	<5	179	1688	9.4				
	563706	7	<5	177	1725	9.7				
	563707	9	67	161	1878	11.7				
	563708	2	601	63	2913	46.2				
3	DETECTION	2	5	5	50	0.1				
24	UNITS	ppm	ppm	ppm	ppm	%				
5	METHOD	401	401	401	401	9825				

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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APPENDIX 19

SPLIT CORE
~~CORE GRIND~~ SAMPLING - MACKINTOSH / HATFIELD

654543

HOLE No. MAC-25

0542

Cu, Pb, Zn, Au, Ag, As, Ba.

DATE 12/2/90

No.	SAMPLE NUMBER	INTERVAL	ELEMENTS REQUIRED	ST	SAMPLE NUMBER	INTERVAL	ELEMENTS REQUIRED
1	431307	121.5-122.32					
2	431308	122.32-123.61					
3	431309	123.61-125.38					
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
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24							
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26							
27							
28							
29							
30							
31							
32							

MACKINTOSH
EU 106/87

DATE 12/2/90

SHEET #1

0543

LOG

MAC 25.- PETROLOGY

188.9m	431310	SPLITCORE	Cu, Pb, Zn, Au, Ag, As, Ba, Cr, Ti, Zr,	gn D.1 c̄ mnr vCc
241.2m	431311	— " —	MgO, K_2O, CaO, Na_2O.	gn D.1/Cl 2-3 c̄ mnr vCc

654544

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A division of MacDonald Hamilton & Co. Pty Ltd

Phone (09) 458 7999 | 52 Murray Road, Welshpool, W.A. 6106 | Telex AA92560

ANALYTICAL REPORT No. 23.3.08.08.06846

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

R DeBomford
Aberfoyle Resources Exploration Division
P O Box 952
Burnie
Tas 7320

ORDER No.	PROJECT
8622	Mackintosh

DATE RECEIVED	RESULTS REQUIRED
12/02/90	ASAP

No. OF PAGES OF RESULTS	DATE REPORTED	No. OF COPIES	TOTAL No. OF SAMPLES
0544	20/02/90	1	5

STATE OF SAMPLES	PRE-TREATMENT								ANALYSIS		
REFER BELOW	SAMPLE NUMBERS	DRY	CRUSH	SPLIT	PULVERISE	SIEVE	OTHER SEE REMARKS	NONE	REFER TO ANALYSIS SECTION	PREPARATION	METH
	431307/431311	SC	Prep: 018						Cu,Pb,Zn,Ag/101		
	431307/431311	SC							Au,AuChk/309		
	431307/431311	SC							Ba,As/401		
	431310/431311	SC							Cr,Zr,Ti/401		
	431310/431311	SC							K2O,MgO,CaO,Na2O/104		

RESULTS TO

R DeBomford
Aberfoyle Resources Exploration Division
P O Box 952
Burnie
Tas 7320

RESULTS TO

REMARKS

MAC-25

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

AUTHORISED OFFICER

654545

ANALABS

A Division of Inchcape Inspection and Testing Services Australia Pty Ltd

ANALYTICAL DATA

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
0545	23.3.08.08.06846	20/02/90	8622	1 OF 2

TUBE No.	SAMPLE No.	Cu	Pb	Pb	Zn	Zn	Ag	Ag	Au	AuCh
1	431307	130	800	-	4550	-	3.5	-	0.011	<0.00
2	431308	100	150	-	2075	-	2.0	-	<0.008	<0.00
3	431309	125	-	1000	-	2.60	-	5	0.022	
4	431310	10	15	-	310	-	0.5	-	<0.008	
5	431311	10	15	-	200	-	<0.5	-	<0.008	
6										
7										
8										
9										
10										
11										
12										
13										
14										
15										
16										
17										
18										
19										
20										
21										
22										
23	DETECTION	5	5	25	5	0.01	0.5	2	0.008	0.0
24	UNITS	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	pp
25	METHOD	101	101	104	101	104	101	104	309	3

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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654546

ANALABS

A Division of Inchcape Inspection and Testing Services Australia

ANALYTICAL DATA

SAMPLE PREFIX: 0520 | REPORT NUMBER: 23.3.08.08.06846 | REPORT DATE: 20/02/90 | CLIENT: B62

TUBE No.	SAMPLE No.	Ba	As	Cr	Zr	Rock Type	K2O	[illegible]	[illegible]	[illegible]
1	431307	940	95	-	-	B1	-	[illegible]	[illegible]	[illegible]
2	431308	1100	35	-	-	B1	-	-	[illegible]	[illegible]
3	431309	1100	75	-	-	B1	-	-	[illegible]	[illegible]
4	431310	960	<2	30	200	2400	2.07	1.99	0.81	3.5
5	431311	1700	<2	35	210	2550	3.06	1.66	0.88	5.2
6										
7										
8										
9										
10										
11										
12										
13										
14										
15										
16										
17										
18										
19										
20										
21										
22										
23	DETECTION	10	2	5	5	50	0.01	0.01	0.01	0.0
24	UNITS	ppm	ppm	ppm	ppm	ppm	%	%	%	
25	METHOD	401	401	401	401	401	104	104	104	10

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

654547

Slit core
~~CORE GRIND~~ SAMPLING

654548

HOLE No. MAC-2

0547

Cu, Pb, Zn, Au, Ag, As, Ba

DATE 24/4/90

No.	SAMPLE NUMBER	INTERVAL	ELEMENTS REQUIRED	ST	SAMPLE NUMBER	INTERVAL	ELEMENTS REQUIRED
1	431312	156.2-156.33					
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							
21							
22							
23							
24							
25							
26							
27							
28							
29							
30							
31							
32							

MACKINTOSH
EL 106/87

24/4/90 | SHEET #2

0548

MAC 25 - PETROLOGY

Cu, Pb, Zn, Au, Ag, As, Ba, Cr, Ti, Zr, S, K2O, MgO, CaO, Na2O

29.8 m	562243	SPLIT CORE		gn B.lb. c̄ Cc stwks
59.5 m	562244	— " —		gn B.lb/Cc/Sil & Cc stwks
96.1 m	562245	— " —		gy-gn Bpl c̄ intapillow chert & mnr Cc vn.
233.0 m	562249	— " —		pk-gn var Cl alt. Dlb. c̄ Cl stwk & Q/Cl/Cc vn
297.6 m	562451	— " —		gn wk. ves Bl c̄ Cc stwks
301.3 m	562452	— " —		gn ves. Bl
361.5 m	562453	— " —		gn Mass Dl/Cl3
368.2 m	562454	— " —		gn Dlv/Cl2.Sil-2
402.8 m	562455*	— " —		gn Dlv/Cl2 c̄ Cherty/Py nltx
446.6 m	562456	— " —		pale gn Dl/Si2Cl2
485.9 m	562457	— " —		gn B.l/Si2 ?
503.6 m	562458	— " —		gn Bl/Cc1-2 Sil c̄ mnr diss. Py & Cc vn.
526.2 m	562459	— " —		gn sch Bl ?
123.3 m	562246*	— " —		gn Bl/Fu/Cc1 & abn Py
125.2 m	562247*	— " —		gn sch Bl. c̄ abn Sph/mnr Py mnr
156.3 m	562248*	— " —		gn Bl./Dl vlc c̄ abn Py mnr & mnr Fu spot.

PETROLOGY ONLY

NOTE: 1. Sample no: 562248 submitted for Petrology Only. Analysis of same interval submitted as Sample no: 431312
2. Sample nos: 562246 & 247 submitted for Petrology Only. Sample no: 562246 submitted for analysis as part of Sample no: 431307. Sample no: 562247 submitted for analysis as part of sample no: 431309

* Denotes Polished Section Available

654549

ANALABS

A division of MacDonald Hamilton & Co. Pty. Ltd.

Phone (09) 458 7999 — 52 Murray Road, Welshpool W.A. 6106 — Telex AA92560

ANALYTICAL REPORT No. 23 3 08 07045

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

ORDER No.	PROJECT
9819	Mackintosh

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

DATE RECEIVED	RESULTS REQUIRED
26/04/90	ASAP

No. OF PAGES OF RESULTS	DATE REPORTED	No. OF COPIES	TOTAL No. OF SAMPLES
0549	04/07/90	1	14

REFER BELOW	SAMPLE NUMBERS	STATE OF SAMPLES	PRE-TREATMENT: DRY	CRUSH	SPLIT	PULVERISE	SIEVE	OTHER SEE REMARKS	NONE	ANALYSIS: REFER TO ANALYSIS SECTION	PREPARATION	METH
	Various	SC	Prep: 00b,010,011,012,013,016							Cu,Pb,Zn,Ag/101		
	Various	SC								Au,AuChk/309		
	<562,243/245,249,451/459	SC								K2O,MgO,CaO,Na2O/104		
	Various	SC								Ba,As/401		
	<562,243/245,249,451/459	SC								S/613,Cr,Zr,Ti/401		

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	
whole core	WC	perchloric acid	A1	cold acid	CA	atomic absorption	AAS
split core	SC	hydrochloric acid	A2	specific sulphide	SS	x-ray fluorescence	XRF
cutting	CU	nitric acid	A3	other mixed acids	Ma	spectrophotometry	SPEC
rock	Ro	aqua regia	A4	alkaline attack	AA	colorimetry	COL
soil	SO	nitric-perchloric	A5	volatilization	VO	chromatography	CHR
pulp	PU	HF mixture	A6	ignition	IG	titration	TTN
water	WA	HF under pressure	A7	pressed powder (XRF)	PP	other chemicals means	CHEM
tissue	TI	fusion	A8	glass fusion (XRF)	GF	miscellaneous	MISC
stream sediment	SS					fluorescence	FLUOR
heavy mineral	HM					inductively coupled plasma	ICP

AUTHORISED OFFICER Jenkins

654550

ANALABS

A Division of Inchcape Inspection and Testing Services Australia Pty. Ltd.

ANALYTICAL DATA

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
0550	23.3.08.07055	04/07/90	9819	1 OF 2

TUBE No.	SAMPLE No.	Cu	Pb	Zn	Ag	Au	AuChk	Ba	Ba	As
1	431312	90	45	250	<0.5	0.009	<0.008	>2500	0.38	30
2	562243	90	30	365	<0.5	<0.008	–	824	–	<2
3	562244	20	5	80	<0.5	<0.008	–	139	–	<2
4	562245	50	190	1000	<0.5	<0.008	–	1305	–	25
5	562249	20	<5	50	<0.5	<0.008	–	1540	–	<2
6	562451	40	10	190	<0.5	<0.008	–	807	–	3
7	562452	45	5	310	<0.5	<0.008	–	1122	–	<2
8	562453	15	5	100	<0.5	<0.008	–	334	–	10
9	562454	25	<5	50	<0.5	<0.008	–	1970	–	8
10	562455	25	40	275	<0.5	<0.008	–	1253	–	40
11	562456	20	<5	20	<0.5	<0.008	–	1239	–	<2
12	562457	35	<5	60	<0.5	<0.008	–	145	–	<2
13	562458	15	<5	40	<0.5	<0.008	–	126	–	<2
14	562459	10	<5	55	<0.5	<0.008	–	211	–	<2
15										
16										
17										
18										
19										
20										
21										
22										
23	DETECTION	5	5	5	0.5	0.008	0.008	10	0.01	
24	UNITS	ppm	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm
25	METHOD	101	101	101	101	309	309	401	403	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

654551

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A Division of Inchcape Inspection and Testing Services Australia Pty. Ltd.

0551

ANALYTICAL DATA

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
	23.3.08.07055	21/05/90	9819	1 OF 1

TUBE No	SAMPLE No.	K2O	MgO	CaO	Na2O					
	431312	—	—	—	—					
	562243	1.69	4.79	16.92	2.28					
	562244	2.05	2.20	13.82	1.44					
	562245	2.07	8.24	4.60	1.02					
	562249	4.92	1.19	2.08	1.40					
	562451	1.17	4.67	13.20	3.46					
	562452	1.77	6.48	9.60	3.60					
	562453	1.11	2.88	0.84	3.76					
	562454	3.90	1.31	1.68	2.90					
	562455	2.59	1.81	2.03	3.80					
	562456	5.18	0.36	2.20	5.08					
	562457	1.00	6.76	7.01	1.59					
	562458	1.73	1.79	12.42	0.88					
	562459	1.59	4.44	6.87	2.75					
	DETECTION	0.01	0.01	0.01	0.01					
	UNITS	%	%	%	%					
	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

654552

ANALABS

A Division of Inchcape Inspection and Testing Services Australia Pty Ltd

ANALYTICAL DATA

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
0552	23.3.08.07055	04/07/90	9819	2 OF 2

TUBE No.	SAMPLE No.	Cr	Zr	Ti	S	Rock Type				
1	431312	-	-	-	-	Yilc				
2	562243	181	100	1715	0.025					
3	562244	175	85	1748	0.190					
4	562245	1050	70	2264	0.230					
5	562249	31	200	884	0.055					
6	562451	360	110	2550	0.010					
7	562452	348	120	2817	0.025					
8	562453	89	220	2549	0.240					
9	562454	22	190	2004	0.200					
10	562455	24	180	2045	1.100					
11	562456	19	190	1953	0.040					
12	562457	385	100	2476	0.055					
13	562458	59	140	925	0.080					
14	562459	79	140	2640	0.035					
15										
16										
17										
18										
19										
20										
21										
22										
23	DETECTION	5	5	50	0.005					
24	UNITS	ppm	ppm	ppm	%					
25	METHOD	401	401	401	613					

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

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PETROGRAPHIC REPORT

Rocks from Mackintosh EL DDH MAC 25

for Aberfoyle Resources Ltd
Attn. Rod Henham

by

Anthony J. Crawford
Geology Department
University of Tasmania

25/5/90

SAMPLE NUMBER: 431310

SUMMARY:

This is a monomict sparsely plagioclase-phyric dacitic lava breccia dominated by formerly perlitic-cracked glassy lava fragments. It has suffered relatively strong chloritic alteration

HAND SPECIMEN:

This sample is a dark green massive ~~andesitic~~ dacitic lava breccia with diffuse-margined fragments to at least 1cm across and disseminated very fine-grained pyrite.

THIN SECTION:

This is a chloritized monomict dacitic lava breccia made up of fragments, mostly less than 5mm across, of sparsely plagioclase-phyric dacitic lava with originally perlitically cracked glassy groundmass. Albitized plagioclase phenocrysts are elongate to blocky prisms from 0.5-2mm long that mainly occur in small multi-crystal clots, and make up less than 5 modal% of the lava fragments. They are fairly thoroughly sericitized, and commonly contain small chloritized melt inclusions. No mafic silicate phenocrysts were present, but occasional small leucoxene-altered FeTi oxide microphenocrysts are preserved.

The groundmass of this sample is composed mainly of texturally distinctive lava fragments composed of devitrified glass that shows clear perlitic cracks still evident, due to their being picked out by chlorite. The remainder of the glass has altered to fine-grained variably textured mosaics composed of quartz-albite ± minor sericite. This altered formerly glassy groundmass assemblage has been overprinted significantly by relatively abundant fine-grained and patchy chlorite alteration. The chlorite is pale to deep green and forms felted masses of quite fine-grained plates that are concentrated along former perlitic cracks, but that also permeate the remainder of the groundmass of many fragments.

Small opaque grains scattered sparsely through the groundmass, but lacking obvious secondary breakdown features, are probably pyrite. A few lava fragments were slightly less glassy, with groundmasses composed of masses of tiny aligned albite microlites. These probably represent slightly more slowly cooled fragments from the same flow.

The rock was probably a lava breccia, although it cannot be ruled out that it was the brecciated marginal phase of an emerging dacitic lava dome from which quenched, largely glassy fragments were crackling and spalling off into water. The extent of chlorite alteration

is much greater than normally seen in dacites from this area, and suggests localized chloritization. A few small fractures and veinlets are filled by quartz-calcite, or quartz-chlorite-fuchsite(?) (the latter in a single fracture as a highly birefringent and well-crystallized very pale green mica rather unlike standard sericite).

SAMPLE NUMBER: 431311

SUMMARY:

This is a weakly chloritized, formerly perlitic, sparsely plagioclase-phyric dacitic lava or lava breccia with zones of silica-Kspar(sericite) alteration. The protolith was essentially identical to 431310.

HAND SPECIMEN:

This sample is a dacitic chloritized lava breccia with very poorly defined fragments, suggesting the possibility that the fragmental texture may be false, and due to alteration. Parts of the sample appear to be somewhat silica-altered.

THIN SECTION:

This sample is essentially identical to the previous sample in most respects. The main difference, hardly significant, is that, as noted in the hand specimen, discrete lava fragments are not nearly as obvious as in 431310. The rock was clearly a sparsely plagioclase-phyric perlitic dacitic lava. Between 'fragments' the rock is made up of extremely fine-grained granular quartz and sericite (after Kspar?), lacking chloritized perlitic cracks, that might represent zones of fluid passage through the cracked lava flow, along which alteration was more intense than within the lava fragments themselves.

Narrow veinlets, almost stylolitic in places, are filled by chlorite-quartz, with minor calcite, sericite and quite crystalline sphene grains in a few places. In a few spots, the sericite intergrown with quartz is quite coarse-grained, and again looks quite like fuchsite, although no fuchsite is obvious in either this, or the previous sample in hand specimen. This sample is notably less chloritized than the previous sample, yet still shows more chlorite alteration than most formerly glassy Mount Read Volcanics dacites. The relative timing of the silica- versus the chlorite alteration is impossible to determine.

SAMPLE NUMBER: 562243

SUMMARY:

This is a strongly carbonate veined probably polymict andesitic lava breccia composed of augite+plagioclase-phyric andesitic lava fragments.

HAND SPECIMEN:

This sample is a brecciated and strongly carbonate-veined and altered andesitic lava or lava breccia. Fragments of lava between veins of calcite are generally bleached and more pinkish than the more chlorite-rich dark green fragments further from veins.

THIN SECTION:

This thin section is composed of two large lava fragments separated by a calcite vein. The two fragments are both andesitic but are texturally quite different, and almost certainly are not from the same flow unit, suggesting that this lava breccia is polymict. The lighter coloured fragment is vesicular and contains relatively common augite and plagioclase phenocrysts in a microcrystalline to vitrophyric groundmass. The vesicles reach almost 3mm long and are calcite-filled; they make up around 5-10 modal% of the fragment. Augite phenocrysts and microphenocrysts are mainly less than 1mm long, and are blocky subhedral and often fractured prisms with minimal chlorite alteration; they make up about 10 modal% of this fragment. Plagioclase phenocrysts are less abundant than the augite, and are rather elongate prisms of albitized calcic plagioclase with occasional messy patches of epidote inclusions. The groundmass of this fragment is composed of abundant tiny albite microlites and laths and small granular augite crystals immersed in an albite-chlorite matrix spotted by distinctive small, rather angular holes filled by quartz growing into green chlorite; this matrix may have been formerly glassy. Patchy brownish calcite overprints about 30 modal% of the groundmass

The other fragment is less porphyritic, and not apparently vesicular. It is finer-grained and has one margin that appears to be quenched glass. The augite phenocrysts are smaller than in the other lava fragment, and are partially chloritized. Plagioclase phenocrysts are less abundant than augite, and albitized, and also contain small granular epidote-clinozoisite inclusions. The matrix of this fragment is much finer grained, with tiny microlites of albite charged through chloritized glass that is heavily overprinted by calcite.

Both lava fragments are from what are probably compositionally very similar andesitic lavas, although textural differences and phenocryst sizes suggest that they are unlikely to be from the same flow. The calcite vein in the thin section, reaching almost 1cm width, is virtually monomineralic, and shows strained and aligned calcite crystals along its margins, but massive undeformed crystals in the vein centre. Epidote is abundant in the glassy part of the second fragment adjacent to the calcite vein.

SAMPLE NUMBER: 562244

SUMMARY:

This is a formerly fairly glassy, sparsely augite+plagioclase -phyric andesitic lava which has developed an unusual alteration texture characterized by abundant quartz blebs; it contains notably less chlorite than the previous samples, and is strongly calcite-veined.

HAND SPECIMEN:

This sample is an andesitic lava or lava breccia, very similar to the paler fragments in the previous sample, with hairlike chlorite veinlets and wider carbonate veins.

THIN SECTION:

The texture of this sample in thin section is deceptively like an epiclastic sediment. However, careful examination shows that the rock has a weakly vesicular volcanic-textured groundmass, and strongly altered phenocrysts are also present, although uncommon. Sparse former augite phenocrysts are replaced by coarse-grained sericite, an alteration mode that I have not seen before in the Mount Reads, but I am sure that this sericite is replacing augite and not plagioclase. A few former albitized plagioclase phenocrysts are replaced by calcite and sericite.

The unusual and distinctive feature of this sample is the abundant small (average around 0.2-0.4mm across) blebs of quartz growing in the groundmass, and giving the appearance of detrital grains of quartz. These make up around 30 modal% of the groundmass of this sample; they show patchy extinction and abundant tiny fluid and solid inclusions, and are so common as to suggest that they may be filling tiny holes in a particularly porous and 'aerated' andesitic lava, with the pores being much smaller than typical vesicles. Alternatively, although less likely in my opinion, the quartz blebs have grown from devitified glassy

groundmass. In the groundmass areas between the quartz blebs, tiny albite microlites are set in devitrified glass replaced y very fine-grained albite, quartz and chlorite, with minor sericite and tiny FeTi oxide granules. Patchy and abundant calcite overprints the groundmass. Calcite veins are mainly coarsely crystalline and composed of pure calcite, but almost foliated schistose sericite-rich margins are present on many veins. Tiny crystals of disseminated pyrite are scattered through the sample.

SAMPLE NUMBER: 562245

SUMMARY:

This is a strongly chlorite+calcite-altered formerly glassy pillow margin of an augite+olivine-phyric basalt typical of the upper basalts at Hellyer.

HAND SPECIMEN:

This sample is a dark green chloritized glassy basaltic or andesitic lava breccia with fragments and patches of interpillow(?) grey cherty or chalcedonic material; the brecciation may be alteration-induced rather than primary.

THIN SECTION:

This is clearly the highly altered formerly glassy margin of a pillow basalt. The glass was charged with phenocrysts of augite (possibly up to 20 modal%) and possibly olivine, and much smaller microphenocrysts of albitized plagioclase, and contains angular fragments and streaks of interpillow cherty sediment. Dirty brown calcite thoroughly replaces all former mafic phenocrysts, but shapes characteristic of augite predominate in those grains where former outlines are still visible. However, grains with olivine-like terminations are also present, although much less common, and several of these contain euhedral reddish to opaque chromite inclusions. The albite plagioclase microphenocrysts are unaltered.

The glassy bulk of this pillow lava margin has altered to straky pale green chlorite intergrown with patches of polycrystalline secondary quartz, with the boundaries between these domains often defined by narrow rims of dirty brownish opaque leucoxene.

The common interpillow sediment in this sample is probably composed mainly of extremely finely comminuted glass that has altered to quartz-albite-chlorite and been strongly overprinted by fine-grained calcite in places.

This sample is characteristic of the upper basalt at Hellyer and west of the highway in the Placer holes (don't dob on me for saying so), being pillowed, strongly porphyritic primitive basalts with abundant mafic phenocrysts. The alteration, although apparently intense, is also typical of the pillow rims of such glassy and magnesian lavas.

SAMPLE NUMBER: 562246

SUMMARY:

This is a highly altered formerly augite+olivine+plagioclase -phyric basaltic lava breccia containing pyritic veining that has been partially overprinted by sphalerite mineralization associated with later calcite-dominated alteration and veining.

HAND SPECIMEN:

This sample is a brecciated basaltic lava with abundant calcite veinlets and small spots of bright green fuchsite, and abundant fine-grained disseminated and aggregated pyrite, particularly in one corner (fragment?) of the thin section.

THIN SECTION:

This is a texturally well-preserved formerly augite+olivine-phyric basaltic lava. It consists of around 15 modal% of totally altered augite, and probably 5-10 modal% of altered olivine phenocrysts, and about 5 modal% of elongate albitized plagioclase microphenocrysts in a microcrystalline to vitrophyric groundmass. The augite phenocrysts are replaced by dirty brown calcite, and are mainly well-formed euhedra to about 2mm long. Olivine phenocrysts are similar-sized and replaced by either very fine-grained polycrystalline quartz or the same brownish calcite that replaces augite, and much less commonly by pale green chlorite. They frequently contain small chromite inclusions.

The groundmass of this sample is charged with albitized plagioclase laths that vary from about 1mm long microphenocrysts to tiny microlites. The remainder of the groundmass was probably composed of tiny augite plates and FeTi oxide grains with interstitial glassy mesostasis. Common angular holes are filled by pale green chlorite identical to that replacing olivine.

Although calcite veins are not uncommon in the sample, the pyrite mineralization appears to be related to streaky zones of silicification and recrystallization in a single basalt fragment in the rock in which chlorite is much reduced in abundance relative to the remainder of the sample. Reddish sphalerite, however, is clearly related to the calcite

veining, as it occurs intergrown with crystalline calcite in several places.

OPAQUE MINERALOGY

In reflected light, the most obvious sulphides are disrupted trains and augen of fractured and granulated pyrite, that appear to have been originally rather larger entire grains in quartz-rich veinlets that have been broken up and rotated. Interstitial grains of pyrite are occasionally quite rounded, and strongly reminiscent of framboids. Two possibilities of the origin of these are: 1: that they are genuine framboids deposited from hot sulphide solutions in angular interstices with the basalt breccia framework, or 2: that they are small spheroidal framboid-like pyrite grains grown from very localized solutions rich in pyrite dissolved during fracturing and fragmentation of the original euhedral pyrite trains. Both types of pyrite are clearly being overgrown and replaced by bright orange-red Fe-rich sphalerite, that occurs as disseminated anhedral spots throughout the sulphide-rich part of the section, and as the internal parts of the relatively thick calcite veins. Small areas of both chalcopyrite and galena are associated with the sphalerite.

The paragenesis of this sample is pyrite crystallizing with silica as veinlets and fracture fillings, then fractured, partially dissolved and recrystallized during brittle deformation, and finally being overgrown and partially replaced by sphalerite and very minor chalcopyrite and galena during a later alteration event which is best documented by the cross-cutting calcite veins with sphalerite inclusions in the core areas.

SAMPLE NUMBER: 562247

SUMMARY:

This is a weakly foliated distinctive almost aphyric basaltic lava, recognized elsewhere in the Hellyer section, which has suffered intense alteration, with silica-pyrite veining being post-dated by spahalerite-calcite alteration

HAND SPECIMEN:

This sample is a streaky, schistose and highly altered basalt with abundant disseminated pyrite and sphalerite.

THIN SECTION:

This sample is a texturally variable and variably veined and altered almost schistose basalt that lacks former mafic phenocrysts although it contains abundant small plagioclase (albitized) microphenocrysts. In the least altered portions of the sample, it is clearly an essentially aphyric basaltic lava which had very little glassy mesostasis compared with the overlying basalts. It varies texturally due more to alteration and shearing rather than primary textural control, with the best preserved areas being composed of intergrown albite and chlorite in which randomly orientated albite microlites are set.

The sample is traversed by common shear zones in which extensive granulation and recrystallization has occurred, with strong sericite-pyrite development along the shears. Very patchy development of silica alteration pervades much of the rock, and is associated with disaggregated pyrite bands in places. Sphalerite is distributed throughout the sample intergrown with calcite in calcite veinlets, or else with quartz and albite in small patches of recrystallized groundmass.

This aphyric basalt unit has been recorded from within the upper basalts at other locations in the Hellyer area, and may be a useful and distinctive marker horizon.

OPAQUE MINERALOGY

This section has an opaque mineral assemblage and paragenesis almost identical to the previous rock. It contains disrupted and granulated bands of fine-grained pyrite being replaced by orange, Fe-rich sphalerite. Many former euhedral pyrite crystals, some up to 1-2mm across, have been broken up and dragged out in augen-shaped bodies with ribbon quartz shadows and sericite defining a weak foliation. Discrete pyrite crystals and anhedral spots of sphalerite also occur disseminated throughout the rock in very minor amounts.

0552

SAMPLE NUMBER: 562248

SUMMARY:

This is a polymict lava breccia dominated by small basaltic fragments, but containing at least one distinct formerly glassy dacite lava fragment. It contains weak disseminated pyrite mineralization, but lacks sphalerite.

HAND SPECIMEN:

This sample is a polymict basalt breccia with grey green basaltic, and lighter coloured almost cherty fragments to at least 1cm across set in a basaltic dark green matrix

THIN SECTION:

This is clearly a polymict lava breccia, dominated by a variety of basaltic lava fragments, but also containing a single distinct, well-preserved dacite lava fragment. Three dominant basalt fragments are present. The first is mildly vesicular and very well-preserved texturally, and consists of perfectly euhedral but totally altered olivine and rare augite phenocrysts set in a vitrophyric groundmass charged with tiny albite and augite microlites set in glassy mesostasis that has altered to chlorite and albite. Olivine phenocrysts are chloritized. Other basalts contain dominant augite and albitized plagioclase phenocrysts; augite is ofetn preserved, and albite is partially altered to sericite. The groundmass of these more evolved basaltic fragments was considerably more glassy than the fragment described above, and the glass has altered to microcrystalline quartz, chlorite and sericite. These fragments are traversed by shear zones that have produced mild to strong local foliations and sericite development associated with pyrite mineralization. Chlorite veinlets clearly crosscut and postdate the foliation, as do calcite veinlets.

The dacite fragment is sparsely plagioclase phyric with small (mainly around 0.5mm-long) albite phenocrysts set in a typically felsic formerly glassy matrix that has devitrified to very fine-grained quartz and albite in which spotty chlorite is not uncommon; albite is largely replaced by sericite. Irregular small angular patches of secondary quartz are common in the recrystallized groundmass of the dacite.

The diverse lava fragments, including the dacite fragment mixed in with obvious Hellyer basalts, dictates that this is a polymict lava breccia unit.

OPAQUE MINERALOGY

The opaque minerals in this sample are dominantly sparsely disseminated small discrete pyrite euhedra, but occasional disrupted trains and veinlets of pyrite in quartz are present. As in the previous two samples, the pyrite has often been brittle-fractured; however, unlike the previous two samples, sphalerite-calcite alteration is not present.

SAMPLE NUMBER: 562249

SUMMARY:

This is a strongly and variably altered formerly glassy sparsely plagioclase-phyric dacite lava or lava breccia. The most notable alteration is patchy silicification.

HAND SPECIMEN:

This sample is a strongly altered dacite with an alteration-induced 'autobrecciated' texture, with dark grey chlorite-rich domains and pink-brown strongly silicified domains or 'fragments'.

THIN SECTION:

The least altered areas of this sample show that it was a sparsely plagioclase-phyric, glassy dacitic lava before being strongly altered. The strong heterogeneity of groundmass textures makes it very difficult to determine whether this rock was originally a lava breccia, or whether the sample has a false pyroclastic texture due to intense and variable alteration. Former plagioclase phenocrysts are albitized blocky prisms, mainly less than 1mm across, that have been extensively replaced by calcite and sericite. Although plenty of fresh albite can still be found, it is rather pinkish, due to abundant submicroscopic Fe oxide grains. No former mafic silicate phenocrysts were apparently present in this sample, although small leucoxenized FeTi oxide grains are not uncommon.

The groundmass of this sample was essentially glassy. The glass has devitrified to intergrown albite and secondary quartz of variable grainsize, and the various devitrification assembalges and textures have themselves been overprinted by several styles of alteration. Most distinctive is simple silicification, where sugary fine-grained secondary silica and reddish albite replaces irregular patchy areas of the groundmass. In other areas of groundmass, texturally better preserved, relic perlitic cracks are still obvious, being picked out by chlorite and an unusual brownish sericite or similar layer silicate. A fine meshwork of pale sericite traverses much of the sample, but this rock is considerably less chloritized than texturally (initially) similar dacites higher in the hole. Sparsely disseminated euhedral pyrite grains are not obviously associated with any particular style of alteration. A notable vein composed of calcite and coarse-grained quartz, charged with tiny vermiform pale green chlorite crystals, cuts the rock.

0554

SAMPLE NUMBER: 562451

SUMMARY:

This is an augite+plagioclase-phyric basaltic lava cut by abundant calcite veins, and is typical of the basalts at Hellyer.

HAND SPECIMEN:

This sample is a dark grey-green finely porphyritic basaltic lava cut by abundant angular networks of calcite veins, some almost 1cm thick.

THIN SECTION:

This is a texturally well-preserved formerly augite+plagioclase - phyric basaltic lava, typical of the Hellyer basalts. Former augite phenocrysts are mainly stubby prisms less than 1mm long that have been completely pseudomorphed by brownish calcite, and make up about 12-15 modal% of the sample. The albitized plagioclase phenocrysts are rather elongate, lath - shaped crystals also less than 1mm long, that are relatively free of alteration, except for a slight pinkish hue from submicroscopic Fe oxide dust. Thay make up about 7-10 modal% of this sample.

The groundmass of this rock is fairly crystalline, and composed of well-formed laths of albite and small altered granular augite grains in subordinate chloritized glassy mesostasis charged with small leucoxene blebs after tiny FeTi oxide grains. Slightly larger abgular patches of green chlorite fill angular fractures, and often contain granular gold epidote crystals. Calcite is abundant as irregular patches overprinting the groundmass of this sample, and as quite thick veins lacking any associated pyrite or other sulphides. Except for the calcite veining, this is a quite well-preserved basaltic lava.

SAMPLE NUMBER: 562452

SUMMARY:

This is an excellent weakly vesicular augite+plagioclase +olivine-phyric basaltic lava typical of the Hellyer basalt.

HAND SPECIMEN:

This sample is a massive vesicular finely porphyritic basaltic lava, with calcite-filled vesicles.

THIN SECTION:

This is a beautifully preserved augite+plagioclase+olivine-phyric basaltic lava. It consists of approximately 20-25 modal% of augite phenocrysts, about 5-8 modal% of albitized plagioclase phenocrysts, and about 1-2 modal% of former olivine phenocrysts. The augite phenocrysts often occur in multi-crystal clots of subhedral stubby, almost equigranular crystals which are perfectly fresh, and usually less than 1mm long. Albitized plagioclase phenocrysts are mainly elongate single crystals less than 1mm long with a mild sericite flecking. Occasional former olivine crystals are euhedra around 1mm long now totally replaced by calcite, but often containing small chromite inclusions.

The groundmass of this sample is essentially identical to the previous sample, with abundant laths of albite, grading continuously from microphenocryst to microlite sized, and small granular augite and leucoxenized FeTi oxides set in a modally subordinate amount of chloritized glassy mesostasis. The rounded to oval vesicles make up about 2-5 modal% of this sample and are filled by chlorite and calcite. A few diffuse veinlets of calcite transect this basalt. This is a typical Hellyer basalt, and well preserved enough for a useful wholerock analysis (I'll see you in Burnie to try to get a 10 cm bit of core from this section if that is OK).

SAMPLE NUMBER: 562453

SUMMARY:

This is a strongly chlorite-altered weakly plagioclase-phyric dacite lava (spot-on, Rod).

HAND SPECIMEN:

This sample is a dark green chlorite-altered weakly plagioclase-phyric dacite lava.

THIN SECTION:

This rock was originally a sparsely plagioclase-phyric glassy dacitic lava. The groundmass has altered to a heterogeneous quartz-chlorite-albite mixture subsequent to devitrification. The rock contains around 1-2 modal% of small albite phenocrysts which occur in multi-crystal clots less than 2mm across, or as occasional poorly-formed single crystals often notably reacted and rounded. They are partially replaced by calcite and sericite, but are mainly fairly fresh. No definite former mafic silicate phenocrysts have been observed, but leucoxenized FeTi oxide microphenocrysts are not uncommon.

The groundmass of this sample was undoubtedly glassy, and even though the texture of the groundmass now is exceptionally heterogeneous, I think that the sample was a massive or weakly hydraulically fractured lava rather than a lava breccia. The groundmass varies in both grainsize of the intergrown secondary quartz and albite crytallized from devitrified glass, and in the amount and concentration of chlorite in various domains of the altered groundmass. Chloritic regions appear to define diffuse channels and large angular 'intersections' of channels that probably represent primary cracks in the fractured surface of the cooling dacite lava flow or lava dome. In places the chloritic alteration is so intense that the virtually pure chlorite domains are evident. Weak calcite and sericite alteration is spread diffuselt throughout the rock.

This dacite is certainly more chlorite altered than standard regionally metamorphosed Mount Read Volcanics dacites, and except for the lack of perlitic cracking, this sample is essentially identical to chloritized dacites such as 431310 from 170m higher in the hole.

SAMPLE NUMBER: 562454 and 562455

SUMMARY:

These are very similar formerly glassy sparsely plagioclase-phyric dacitic lavas showing intense silica alteration and patchy chloritization, and weak pyrite mineralization associated with the silica alteration in 455.

HAND SPECIMEN:

These samples are heterogeneous-textured, strongly altered sparsely plagioclase-phyric dacitic lavas with alteration-induced false pyroclastic textures and trains of small pyrite crystals in 455.

THIN SECTION:

The least altered parts of these samples are beautifully preserved perlitically cracked glass that has crystallized following devitrification to an even-textured mosaic intergrowth of quartz and feldspar. About 5 modal% of each sample is made up of quite large blocky albitized plagioclase phenocrysts to at least 3mm long, that are almost entirely replaced by sericite and vary from euhedral to rounded. No mafic phenocrysts were apparently present in either sample, although quite large leucoxenitized FeTi oxide phenocrysts are not uncommon.

Significant areas of groundmass have been replaced by fine-grained to relatively coarse-grained (to 0.5mm long) silica in domains up to almost a cm long of exceptionally fine-grained even-textured material that resembles shale or tuff. Several angular discontinuous fractures filled by quite clear, relatively large intergrown quartz crystals in 454 are occasionally lined by small pyrite crystals, and the fine-grained intensely silicified areas of 455 are rimmed by trains of small pyrite and contain meandering thin seams of very fine-grained pyrite parallel to the length of the silicification zones. Calcite veinlets containing orange sphalerite clearly crosscut and postdate the silicification-pyrite development. 455 contains a stronger meshwork of sericite than 454, and also more intense silicifcation and chloritization zones.

OPAQUE MINERALOGY

Trains of tiny pyrite varying from euhedral to anhedral are present in the sample, although not abundant. Many pyrite grains are actually aggregates of five or six discrete crystals. A few tiny spots of sphalerite are present, but the pyrite crystals are inclusion- and alteration-free. The pyrite appears to be associated with silicification domains, and pre-dates calcite veinlets that contain coarser-grained orange-red Fe-rich sphalerite.

SAMPLE NUMBER: 562456

SUMMARY:

This is a well-preserved sparsely plagioclase-phyric formely glassy dacitic lava probably reasonably considered as a much less altered representative of those chlorite-silica-altered dacites higher in the hole.

HAND SPECIMEN:

This sample is a massive, unbrecciated pale grey dacite lava with tiny spots and veinlets of chlorite.

THIN SECTION:

This is a texturally very well-preserved dacitic lava that contained small phenocrysts of albitized plagioclase and rare augite and FeTi oxide in a formerly glassy groundmass. The plagioclase phenocrysts make up around 12-15 modal% of this rock, and more frequently occur in multi-crystal clots up to 2mm across than as single phenocrysts. The albite phenocrysts are fairly free of sericite or calcite alteration. Occasional small chloritized augite phenocrysts occur intergrown in the albite crystal clots. FeTi oxide microphenocrysts have altered to small euhedral clots of tiny sphene crystals cored by sericite.

The groundmass of this sample was undoubtedly glassy, although perlitic cracking as seen in the dacitic lavas described above is not evident. The glass has devitrified to a uniform intergrowth of mosaic-textured fine-grained quartz and albite with rare chlorite and spotty sericite in which angular voids filled with polycrystalline quartz and relatively coarse-grained sericite are common, and are sometimes cored by calcite. The intense chlorite alteration shown by most of the dacites higher in the hole is missing from this sample, which may therefore be a reasonable example of what those higher lavas were before they were subjected to the intense silica-chlorite alteration. It would thus be a sensible sample to analyze carefully and compare with the more altered dacitic lavas to give some idea of the extents and directions of element mobility accompanying this type of alteration.

0563

SAMPLE NUMBER: 562457

SUMMARY:

This is a tuffaceous epiclastic fine sandstone with an intensely carbonate altered matrix; detrital volcanic quartz grains are a notable but not abundant component of this sample.

HAND SPECIMEN:

This sample is an altered massive pale grey-green weakly foliated or laminated lithic tuff or quartz-poor sandstone.

THIN SECTION:

This sample in thin section is clearly an epiclastic tuffaceous sediment that has suffered intense carbonate alteration. Framework grains, mainly in the fine sand range, are dominantly volcanic quartz and sericitized albite phenocrysts, often still with original crystal shapes. These make up only about 15 modal% of the rock, which was dominantly fine-grained matrix material. Quite abundant angular small voids are filled by secondary quartz, and less frequently, chlorite. Calcite rhombs in the carbonate-rich matrix, and also chlorite-filled voids, are quite drawn out into a weak foliation. Much of the matrix may have been dacitic glassy ash that was readily altered to calcite. Small euhedral pyrite grains are disseminated sparsely through the rock, mainly in association with the secondary quartz filling small voids.

The extensive carbonate alteration and weak foliation of the matrix of this sample render a positive identification difficult, but I am sure the sample was a tuffaceous epiclastic sediment derived from felsic volcanics. The presence of indisputable quartz phenocrysts as detrital grains in this sample is notable, and implies some imput from beyond the local dacite source, in which quartz phenocrysts have not been seen (either here or west of the hwy). The intense all-pervading calcite alteration also clearly implies a porous and reactive sediment rather than a massive glassy lava or vitric tuff.

SAMPLE NUMBER: 562458

SUMMARY:

This is a greywacke derived mainly from pelitic metamorphics, but with some volcanic quartz; it is definitely correlatable with the Animal Creek Greywacke.

HAND SPECIMEN:

This sample is a massive pale grey fine sandstone with strong calcite alteration, both through the sandstone and as thick veins and segregations.

THIN SECTION:

Welcome to the 'I called the greywacke a basalt' club, founded by me, with about 150 members, and most enthusiastically supported and contributed to by Dougie Jack.

This sample is a fine sandstone with a generally finer-grained but more abundant detrital fraction than the previous sample. The framework grains constitute about 30 modal% of this rock, but are occasionally concentrated into thin coarser, sandy layers with much reduced matrix. Most of the detrital grains are angular and irregular strained quartz, of probable metamorphic or vein origin, although even-extinguishing probable volcanic quartz fragments are also present. A notable detrital component is quite coarse-grained flakes of muscovite, sometimes kinked and clearly of pelitic metamorphic origin. The sericitized albite phenocrysts noted as detrital grains in the previous sample are absent from this rock. Occasional small zoned pleochroic tourmaline grains also suggest derivation from a granitic or pelitic metamorphic source.

The matrix of this rock is shaley to silty, and quite strongly overprinted by calcite, and shows a well-developed meshwork of sericite that defines a weak foliation. This is classic Animal Creek Greywacke.

SAMPLE NUMBER: 562459

SUMMARY:

This is a sparsely plagioclase-phyric holocrystalline dacitic dyke rock, probably a feeder to dacites higher in the section.

HAND SPECIMEN:

This sample is a dark grey relatively coarse-grained andesitic lava or volcaniclastic sediment with some calcite veining.

THIN SECTION:

In thin section, this sample is seen to be an unusual virtually holocrystalline sparsely plagioclase-phyric dacitic or andesitic dyke rock. It consists of about 5 modal% of blocky subhedral to anhedral albite phenocrysts to about 1.5mm long with slight sericite speckling, often intergrown at their rims with relatively coarse groundmass albite. No mafic phenocrysts were observed, although small leucoxenized FeTi oxide grains are quite common.

The groundmass of this sample is almost holocrystalline, and composed of stubby laths of albite with interstitial anhedral quartz, Kspar (or sericitized albite) and chlorite. Streaky discontinuous chlorite and sericite veinlets are quite common. Fine-grained calcite is quite abundantly diffused through the rock, and strained calcite veinlets are not uncommon.

The most satisfactory explanation of this sample is that it is a feeder dyke in the Animal Creek Greywacke to the overlying dacites (which dacites should be easily testable with wholerock chemistry). The holocrystalline texture, and sparse blocky plagioclase phenocrysts and lack of mafic phenocrysts all support this interpretation.

APPENDIX 20

CORE GRIND SAMPLING

654574 HOLE No. MAC-2

DATE 21/3/00

0573 Cu, Pb, Zn, Au, Ag, As, Ba, Zr, Ti, Cr.

No.	SAMPLE NUMBER	INTERVAL (M)	ELEMENTS REQUIRED	ST	SAMPLE NUMBER	INTERVAL (m)	ELEMENTS REQUIRED
1	S62250	0 - 10.2			S62282	261 - 275	
2	251	10.2 - 19.5			283	275 - 281.4	
3	252	19.5 - 23.2			284	281.4 - 296.7	
4	253	23.2 - 30			285	296.7 - 299.5	
5	254	30 - 40			286	299.5 - 302.5	
6	255	40 - 51			287	302.5 - 310	
7	256	51 - 59.3			288	STANDARD	
8	257	59.3 - 68.7			289	310 - 320	
9	258	68.7 - 81.4			290	320 - 330	
10	259	81.4 - 89.8			291	330 - 337.8	
11	260	89.8 - 100			292	337.8 - 340.2	
12	261	100 - 110			293	340.2 - 343.7	
13	262	110 - 116			294	343.7 - 353.4	
14	263	116 - 121.5			295	353.4 - 361.1	
15	264	STANDARD			296	361.1 - 370	
16	265	125.38 - 130			297	370 - 380.7	
17	266	130 - 140			298	380.7 - 390	
18	267	140 - 150			299	390 - 400	
19	268	150 - 156.2			300	400 - 410.3	
20	269	STANDARD			S62401	410.3 - 412.1	
21	270	156.23 - 164.3			402	412.1 - 424.4	
22	271	164.3 - 173.2			403	424.4 - 427.7	
23	272	173.2 - 180			404	427.7 - 438.7	
24	273	180 - 190			405	438.7 - 445	
25	274	190 - 200			406	445 - 456.4	
26	275	200 - 210			407	456.4 - 467.3	
27	276	210 - 220			408	467.3 - 478.8	
28	277	220 - 228.2			409	478.8 - 482.5	
29	278	228.2 - 233.9			410	STANDARD	
30	279	233.9 - 240.9			411	482.5 - 489.9	
31	280	240.9 - 251.2			412	489.9 - 502.9	
32	281	251.2 - 261			413	502.9 - 503.9	

CORE GRIND SAMPLING

0574

654575

HOLE No. MAC-2

DATE 12/4/00

No.	SAMPLE NUMBER	INTERVAL (M)	ELEMENTS REQUIRED	ST	SAMPLE NUMBER	INTERVAL	ELEMENTS REQUIRED
1	562414	503.0 - 520.0					
2	562415	520.0 - 530.3 (60ft)					
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
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32							

ANALABS

A division of MacDonald Hamilton & Co. Pty. Ltd.

Phone (09) 458 7999 — 52 Murray Road, Welshpool, W.A. 6106 — Telex AA92560
FAX (09) 451 0890

ANALYTICAL REPORT No. 23.3.08.07054

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

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

ORDER No.	PROJECT
9818	Mackintosh

DATE RECEIVED	RESULTS REQUIRED
26/04/90	ASAP

No. OF PAGES OF RESULTS	DATE REPORTED	No. OF COPIES	TOTAL No. OF SAMPLES
2	10/07/90	1	66

STATE OF SAMPLES		PRE-TREATMENT							ANALYSIS		
REFER BELOW	SAMPLE NUMBERS	DRY	CRUSH	SPLIT	PULVERISE	SIEVE	OTHER SEE REMARKS	NONE	REFER TO ANALYSIS SECTION	PREPARATION	METH
	<562,250/300,401/415	CG	Prep: 018						Cu,Pb,Zn,Ag/101		
	<562,250/300,401/415	CG							Au,AuChk/309		
	<562,250/300,401/415	CG							Ba,As,Cr,Zr,Ti/401		
	<562,250/300,401/415	CG							Ba/403		

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	
whole core	WC	perchloric acid	A1	cold acid	CA	atomic absorption	AAS
split core	SC	hydrochloric acid	A2	specific sulphide	SS	x-ray fluorescence	XRF
cutting	CU	nitric acid	A3	other mixed acids	Ma	spectrophotometry	SPEC
rock	Ro	aqua regia	A4	alkaline attack	AA	colorimetry	COL
soil	SO	nitric-perchloric	A5	volatilization	VO	chromatography	CHR
pulp	PU	HF mixture	A6	ignition	IG	titration	TTN
water	WA	HF under pressure	A7	pressed powder (XRF)	PP	other chemicals means	CHEM
tissue	TI	fusion	A8	glass fusion (XRF)	GF	miscellaneous	MISC
stream sediment	SS					fluorescence	FLUOR
heavy mineral	HM					inductively coupled plasma	ICP

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ANALYTICAL DATA

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
0576	23.3.08.07054	10/07/90	9818	1 OF 6

TUBE No.	SAMPLE No.	Cu	Pb	Zn	Ag	Au	AuChk	Ba	Ba	As
1	562250	165	25	1450	<0.5	<0.008	<0.008	690	–	4
2	562251	75	10	1225	<0.5	<0.008	–	1050	–	1
3	562252	45	<5	300	<0.5	0.013	<0.008	230	–	
4	562253	40	<5	255	<0.5	<0.008	–	840	–	<
5	562254	75	<5	240	<0.5	<0.008	–	1050	–	
6	562255	25	<5	160	<0.5	<0.008	–	700	–	
7	562256	20	<5	170	<0.5	<0.008	–	660	–	
8	562257	100	15	340	<0.5	<0.008	–	730	–	
9	562258	85	160	1025	<0.5	<0.008	–	530	–	1
10	562259	60	175	550	<0.5	<0.008	–	1150	–	1
11	562260	95	190	1100	<0.5	<0.008	–	800	–	
12	562261	80	105	900	<0.5	<0.008	–	940	–	
13	562262	120	<5	165	<0.5	<0.008	–	340	–	<
14	562263	45	55	440	<0.5	<0.008	–	1200	–	
15	562264 STANDARD	129	191	2336	<0.5	<0.008	–	1150	–	
16	562265	215	25	1650	<0.5	<0.008	<0.008	1450	–	
17	562266	105	95	860	<0.5	<0.008	–	>2500	0.30	1
18	562267	115	125	1300	<0.5	<0.008	–	1100	–	
19	562268	95	35	1100	<0.5	<0.008	–	1000	–	1
20	562269 STANDARD	124	186	2314	<0.5	<0.008	–	1150	–	1
21	562270	25	<5	75	<0.5	<0.008	–	1400	–	<
22	562271	25	<5	60	<0.5	<0.008	–	1550	–	<
23	562272	20	<5	85	<0.5	<0.008	–	1400	–	<
24	562273	15	<5	85	<0.5	<0.008	–	1100	–	<
25	562274	15	35	75	<0.5	<0.008	–	1300	–	<

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

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ANALYTICAL DATA

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
05	23.3.08.07054	10/07/90	9818	2 OF 6

TUBE No.	SAMPLE No.	Cu	Pb	Zn	Ag	Au	AuChk	Ba	Ba	As
1	562275	20	<5	65	<0.5	<0.008	–	1050	–	
2	562276	15	<5	105	<0.5	<0.008	–	810	–	
3	562277	15	<5	150	<0.5	<0.008	–	410	–	
4	562278	15	<5	70	<0.5	<0.008	–	1800	–	
5	562279	15	<5	110	<0.5	<0.008	–	1150	–	
6	562280	25	5	160	<0.5	<0.008	–	1100	–	
7	562281	30	<5	100	<0.5	<0.008	<0.008	1150	–	
8	562282	20	<5	80	<0.5	<0.008	–	1100	–	
9	562283	20	<5	80	<0.5	<0.008	–	970	–	
10	562284	15	<5	80	<0.5	<0.008	–	1200	–	
11	562285	35	10	210	<0.5	<0.008	–	1350	–	
12	562286	65	10	280	<0.5	<0.008	–	1800	–	
13	562287	30	5	90	<0.5	<0.008	–	1750	–	
14	562288 STANDARD	124	181	2327	<0.5	<0.008	–	1200	–	
15	562289	30	5	90	<0.5	<0.008	–	1400	–	
16	562290	15	<5	85	<0.5	<0.008	–	1200	–	
17	562291	15	<5	75	<0.5	<0.008	–	1050	–	
18	562292	15	<5	115	<0.5	<0.008	–	480	–	
19	562293	20	<5	130	<0.5	<0.008	–	760	–	
20	562294	60	5	240	<0.5	<0.008	–	1400	–	
21	562295	20	<5	95	<0.5	<0.008	–	950	–	
22	562296	20	5	95	<0.5	<0.008	–	1600	–	
23	562297	10	<5	70	<0.5	<0.008	<0.008	1300	–	
24	562298	15	5	65	<0.5	<0.008	–	1100	–	
25	562299	15	<5	75	<0.5	<0.008	–	1100	–	

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

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ANALYTICAL DATA

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
0570	23.3.08.07054	10/07/90	9818	3 OF 6

TUBE No.	SAMPLE No.	Cu	Pb	Zn	Ag	Au	AuChk	Ba	Ba	As
1	562400	20	10	105	<0.5	<0.008	-	1200	-	
2	562401	60	5	85	<0.5	<0.008	-	670	-	
3	562402	15	10	85	<0.5	<0.008	-	800	-	1
4	562403	25	15	95	<0.5	<0.008	-	770	-	
5	562404	15	5	70	<0.5	<0.008	-	810	-	
6	562405	15	5	70	<0.5	<0.008	-	710	-	
7	562406	15	5	40	<0.5	<0.008	<0.008	940	-	
8	562407	46	8	73	<0.5	<0.008	-	325	-	2
9	562408	35	16	63	<0.5	<0.008	-	189	-	
10	562409	25	<5	59	<0.5	<0.008	-	342	-	1
11	562410 STANDARD	129	190	2425	<0.5	<0.008	-	991	-	1
12	562411	32	<5	71	<0.5	<0.008	-	150	-	<1
13	562412	14	<5	64	<0.5	0.010	<0.008	346	-	1
14	562413	16	<5	55	<0.5	<0.008	-	279	-	
15	562414	10	<5	60	<0.5	<0.008	-	95	-	<1
16	562415	10	<5	65	<0.5	<0.008	-	410	-	
17										
18										
19										
20										
21										
22										
23	DETECTION	5	5	5	0.5	0.008	0.008	10	0.01	
24	UNITS	ppm	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm
25	METHOD	101	101	101	101	309	309	401	403	40

Results in ppm unless otherwise specified
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ANALYTICAL DATA

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
0579	23.3.08.07054	10/07/90	9818	4 OF 6

TUBE No.	SAMPLE No.	Cr	Zr	Ti	Ti/Zr	Rock Type				
1	562250	1150	150	4050	27.0	BI.				
2	562251	860	100	3400	34.0	BI				
3	562252	300	90	2500	27.80	BI.				
4	562253	347	100	2900	29.0	BI.				
5	562254	335	100	2750	27.5	BANC.				
6	562255	376	95	3950	41.6	BANC.				
7	562256	332	90	2750	30.6	BI.				
8	562257	359	95	3000	31.6	AL.				
9	562258	975	80	2150	35.80	BI.				
10	562259	588	80	2450	30.6	BI				
11	562260	1151	70	2450	35.0	BI				
12	562261	1149	70	2450	35.0	BI				
13	562262	921	55	2000	36.4	BI				
14	562263	1114	70	2650	37.9	BI				
15	562264 STANDARD	959	90	2500	27.80	STANDARD				
16	562265	1062	80	2400	40.0	BI				
17	562266	1212	70	2600	37.1	BI				
18	562267	1047	60	2350	39.2	BI				
19	562268	697	60	2100	35.0	BI				
20	562269 STANDARD	967	90	2500	27.8	STANDARD				
21	562270	13	230	1900	8.3	DI				
22	562271	17	220	1950	8.9	DI				
23	562272	11	240	2550	10.6	DI				
24	562273	11	210	2450	11.7	DI				
25	562274	7	330	2350	7.1	DI				

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

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ANALYTICAL DATA

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
0580	23.3.08.07054	10/07/90	9818	5 OF 6

TUBE No.	SAMPLE No.	Cr	Zr	Ti	Ti/Zr	Rock Type				
1	562275	17	240	2250	9.4	DI				
2	562276	68	230	2450	10.7	DI				
3	562277	560	160	2200	13.8	DVC *				
4	562278	12	420	1400	3.3	DI				
5	562279	89	230	2100	9.1	DVC				
6	562280	800	100	2250	22.5	BI				
7	562281	50	220	2400	10.9	DVC				
8	562282	21	230	2100	9.13	DVC				
9	562283	26	220	2050	9.3	DVC				
10	562284	9	240	2000	8.3	DVC				
11	562285	386	100	2000	20.0	BI				
12	562286	416	110	2300	20.9	BI				
13	562287	15	240	2100	8.7	DI				
14	562288 STANDARD	925	85	2500	29.4	STANDARD				
15	562289	7	230	2100	9.1	DI				
16	562290	9	230	2200	9.6	DI				
17	562291	7	230	2050	8.9	DI				
18	562292	59	140	3050	21.7	BI				
19	562293	86	120	5000	41.7	BI				
20	562294	95	140	5150	36.8	BI				
21	562295	72	230	2250	9.8	DI				
22	562296	51	230	2450	10.65	DI				
23	562297	8	210	2250	10.71	DI				
24	562298	15	200	2100	10.5	DVC				
25	562299	12	200	2250	11.3	DI				

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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654581

ANALABS

A Division of Inchcape Inspection and Testing Services (Australia) Pty Ltd

ANALYTICAL DATA

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
0581	23.3.08.07054	10/07/90	9818	6 OF 6

TUBE No.	SAMPLE No.	Cr	Zr	Ti						
1	562300	9	220	2250	10.3	DI				
2	562401	16	220	2450	11.1	DI				
3	562402	8	200	2150	10.8	DI				
4	562403	32	190	1950	10.3	Dvc				
5	562404	12	210	2200	10.5	Dvc				
6	562405	14	190	2150	11.3	DI				
7	562406	16	200	2200	11.0	DI				
8	562407	386	190	2917	15.3	Scm				
9	562408	351	150	2132	14.2	Scm				
10	562409	309	188	2846	15.1	Scm				
11	562410 STANDARD	904	79	2360	20.9	STANDARD				
12	562411	429	100	2739	21.4	Scm				
13	562412	256	197	2572	13.1	Scm				
14	562413	62	212	1344	6.4	Scm				
15	562414	362	140	2200	15.7	Scm				
16	562415	100	150	2750	18.3	DI/AI				
17										
18										
19										
20										
21										
22										
23	DETECTION	5	5	50						
24	UNITS	ppm	ppm	ppm						
25	METHOD	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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APPENDIX 21

Attachment

Sample Locations

Sample Number	Location	Field Description
562656	2160N, 5680E	Basaltic volcaniclastic.
562660	1260N, 5670E	Rhyodacitic lava/intrusive.
562662	1210N, 5485E	Andesitic volcaniclastic.
562665	5825N, 4310E	Andesitic-dacitic lava.
562666	9710N, 3930E	?Basalt lava.
562685	5964N, 4300E	Polymict volcaniclastic.

0584

654585

SAMPLE NUMBER: 562656

SUMMARY: This is a texturally well-preserved bedded basaltic vitric tuff or fine-grained hyaloclastite.

HAND SPECIMEN:

This is a dark green-grey thinly bedded tuffaceous siltstone .

THIN SECTION:

This is a beautiful vitric tuff, composed almost entirely of silt-sized fragments of glass that have devitrified to chlorite and minor quartz. The glassy ash was composed largely of cuspate shards up to about 0.2mm across, but are now replaced by pale green chlorite in which blebs of secondary quartz and leucoxene are set. The matrix between the former shards varies from bed to bed from about 20-50 modal% of the rock, and consists probably of devitrified finely comminuted glass that has altered to an irresolvable mixture of quartz, chlorite, feldspar(?) and tiny leucoxene grains that is riddled by sericite. A few narrow darker-coloured bands parallel to the bedding in the ash are thought to be stylolite-like concentrations of less soluble components in zones of stronger pressure solution. The relative abundance of chlorite in this sample suggests that the precursor was basaltic. It could be termed a vitric tuff, or a very fine-grained hyaloclastite.

05[illegible]

SAMPLE: 562660

SUMMARY: This sample is a holocrystalline plagioclase+augite-phyric andesitic dyke rock with a low greenschist facies alteration assemblage.

HAND SPECIMEN:

This is a weathered pinkish speckled felsic lava or shallow intrusive with abundant clay-altered feldspar phenocrysts and black chloritic spots, some several mm long.

THIN SECTION DESCRIPTION:

In thin section, it is clear that this sample is a holocrystalline andesitic rock, probably a dyke rock, with abundant phenocrysts of augite and albitized plagioclase, and common groundmass quartz. The plagioclase phenocrysts make up around 10 modal% of this rock, and are totally albitized; many are longer than 2mm, although multi-crystal clots of intimately intergrown plagioclase crystals are present. These are speckled with sericite and little crystals of epidote, but are not clay-altered, as suggested in the hand specimen description. Rather, it is the augite phenocrysts that are partly altered to dirty brownish-red clayey material. Augite crystals make up around 5-8 modal% of this rock and are often altered to chlorite and the clay material noted above; significantly, they show actinolite fringes on many crystals, indicating lowermost greenschist facies conditions of recrystallization. They range from several mm long to tiny crystals in the matrix, and are rather ragged and often intergrown with plagioclase at their margins. Several small gabbroic inclusions are composed of intergrown augite and plagioclase crystals identical to the phenocrysts, and are clearly cognate.

The groundmass of this rock is holocrystalline, being composed of intergrown albite laths, stubby chloritized augite, and common interstitial quartz, with subordinate tiny leucoxenitized FeTi oxide grains. Angular patches of green chlorite up to several mm across frequently have quartz crystals projecting into the chlorite. Secondary minerals other than albite and chlorite include not uncommon granular epidote, that also forms veinlets, and interstitial palest green acicular actinolite.

This sample was definitely an intrusive andesite or basaltic andesite. The greenschist metamorphic assemblage is unusual for the Hellyer area, and may be of some significance.

0586

SAMPLE: 562662

SUMMARY: This sample is a volcaniclastic sandstone containing detritus from both felsic volcanics (mainly tuffs) and also from pelitic metamorphics.

HAND SPECIMEN:

This is a dark green volcaniclastic with detrital altered plagioclase crystals to several mm long, lithic fragments of dacite or andesite, and black areas of intensely chloritized groundmass.

THIN SECTION DESCRIPTION:

By far the most abundant component of this volcaniclastic sandstone are large partially to totally sericitized detrital phenocrysts of albitized plagioclase, most of which are 1-2mm long. These have blocky shapes typical of the more evolved Mount Read Volcanics (ie. felsic lavas and tuffs), and their well-preserved crystal shapes suggest that they have been liberated from ashes or non-welded tuffs rather than lavas. Detrital quartz grains are less common than feldspar, and smaller, rarely being larger than 1mm long. They show features indicative of both volcanic (even extinction, relic crystal faces) and pelitic metamorphic (multi-crystalline, uneven extinction) quartz, indicating unambiguously that the quartz was supplied from two different sources. Detrital muscovite crystals are not uncommon, and lithic clasts composed of quartz-muscovite schist, and quartzite, are also present (~5 modal%). A few lithic clasts were clearly once-glassy sparsely plagioclase-phyric lavas; one large clast was a plagioclase-phyric andesite with perlitic cracks in the glassy groundmass. Common former FeTi oxide crystals have totally altered to dirty brown leucoxenitic material.

This sandstone was crystal-rich, but not quite framework supported. The matrix of this rock was largely a mixed volcanogenic silt with a large vitric component, although tiny detrital muscovite and metamorphic quartz are also common. Areas of the groundmass have been replaced by pale green streaky chlorite, and dirty brownish carbonate is not uncommon overprinting both groundmass and phenocrysts. This sandstone was clearly derived from two sources, one composed of felsic volcanic tuffs and lavas, and the other Precambrian pelitic metamorphics.

0587

SAMPLE: 562665

SUMMARY: This sample was a sparsely plagioclase-phyric dacitic lava that now shows a false brecciated texture due to fracturing and partial silicification.

HAND SPECIMEN:

This is a hard, green feldspar-phyric felsic lava breccia with lava fragments to at least 2cm long. It may be silicified to some degree.

THIN SECTION DESCRIPTION:

This is appears to be a monomict lava breccia composed of fragments mainly around 0.5-1cm long of sparsely plagioclase-phyric dacite. Careful examination suggests that the lava breccia texture may well be 'false', being produced during fracturing-related silicification of this once-massive lava. Plagioclase phenocrysts form around 2-4 modal% of this rock, and are albitized prisms, mainly around 1mm long or less, with common chloritized melt inclusions and pale brownish patches due to sericite and micro-inclusions of Fe oxides(?). These phenocrysts often occur in multi-crystal clots. Few if any former mafic phenocrysts were present in this rock; only two adjacent elongate crystals now composed of multicrystalline quartz and chlorite may have been former augite crystals. A few leucoxenitized former FeTi oxide microphenocrysts are present.

Where least altered and recrystallized, the groundmass of this sample was glass y to vitrophyric, with tiny plagioclase microlites charged through altered glass. The glass has recrystallized to a very fine-grained irresolvable quartz-albite-chlorite(?) intergrowth. Those areas between apparent fragments are cleaner, somewhat coarser-grained and certainly more quartz-rich than within fragments. They grade imperceptibly into typical fragment lithology in most places, although sharp boundaries between fragment and interstitial domains are sometimes apparent. These areas are almost certainly parts of the rock that have been soaked in quartz-rich solutions during fracturing of this dacitic lava. These areas sometimes pinch out into quartz veinlets. This rock is interpreted as a former dacitic lava that shows a false brecciation texture due to silicification during fracturing.

SAMPLE: 562666 (in Que Rv Shale at 3830E 9710N)

SUMMARY: This sample was a microvesicular clinopyroxene+ plagioclase+sparsely olivine-phyric basaltic lava. It is not a typical Hellyer basalt.

HAND SPECIMEN:

This is a grey-green well-preserved finely porphyritic (plagioclase+cpx) metabasalt.

THIN SECTION DESCRIPTION:

In thin section, this sample is seen to be a microvesicular basalt with common phenocrysts of augite, less abundant albitized plagioclase phenocrysts, and possible former olivine phenocrysts now altered to quartz and chlorite. Augite phenocrysts make up around 10 modal% of this sample, and are mainly stumpy, clear and fractured prisms that often occur in multi-crystal clots; they are fresh, and mainly less than 0.5mm long, although some reach almost 1mm long. Plagioclase phenocrysts constitute about 5 modal% of this basalt and are clear to pale brown dusty albite crystals, also less than 1mm long. Many of the plagioclase phenocrysts appear rather rounded and reacted, suggesting that they may be derived from another batch of more felsic magma that mixed with the mafic crystal-rich basalt before eruption. Two or three crystal sites around 1-1.2mm long, with typical olivine crystal shapes, are now composed of intergrown secondary quartz and pale green chlorite. Quite abundant (10-15 modal%) subrounded cavities, mainly less than 0.5mm across, but sometimes up to several mm diameter, are filled by green chlorite and may represent small gas bubbles (vesicles).

The groundmass of this sample was vitrophyric, with abundant and randomly-orientated tiny acicular and feathery albite microlites set in chloritized glass, together with abundant tiny subspherical blebs of sphene probably after groundmass FeTi oxides, and dirty brownish epidote granules. The texture of this sample is in my opinion, typical of an extrusive basaltic lava, rather than a dolerite (although vesicular shallow dolerites are not rare, so I didn't laugh!). The sample strikes me as slightly different from typical Hellyer cpx-phyric basalts, mainly in that the cpx phenocrysts are small and fractured; also the abundant tiny sphene granules in the groundmass (assuming that they are sphene and not all epidote) imply a relatively high-Ti (ie. > typically in Hellyer basalts, perhaps >0.8% TiO2) content.

SAMPLE NUMBER: 562685

SUMMARY: This rock is a very immature massive volcaniclastic sandstone derived very largely from plagioclase-phyric dacitic volcanics.

HAND SPECIMEN:

This is a buff-coloured volcaniclastic sediment with fragments of felsic volcanics up to several cm across, although most are sand-sized grains.

THIN SECTION:

The largest clast in this juvenile volcaniclastic is a plagioclase- phyric dacite lava with a formerly largely glassy groundmass that has devitrified to a very fine-grained quartz-albite-chlorite intergrowth. The remainder of the rock is a very poorly-sorted volcaniclastic sandstone dominated by fragments of dacite and large blocky albitized plagioclase phenocrysts and phenocryst fragments. The great majority of lithic fragments in this sample are of a single rock type, namely a holocrystalline dacite or acid andesite with common albitized plagioclase phenocrysts mainly less than 0.5mm long set in a flow-textured groundmass composed almost entirely of small albite laths. Most of these lava fragments have slightly rounded margins suggestive of water transport and abrasion.

The matrix of this sandstone is a mixture of comminuted fragments of albite, devitrified felsic volcanic clasts and probably quite a large component of glassy ash that has devitrified to quartz, albite and chlorite. Relatively fine-grained yellow epidote and minor hematite are not uncommon alteration minerals in the matrix, but chlorite is quite sparse.

This is an immature volcanogenic sandstone derived largely from dacitic volcanics.

APPENDIX 22

Aberfoyle Exploration

GEOCHEMICAL SAMPLE LEDGER

Collected AMcN + RRB.

PROJECT	BSS SIEVE SIZE CODE - MESH NUMBER	SAMPLE TYPE CODE		CARD PUNCH PRINT	VERIFY	DATE	SHEET
South Mackintosh Mack EL.	A 200 D 80 G 30 B 150 E 60 H 20 C 100 F 40 T = TOTAL	☐ OXIDIZED PRODUCTS O ☒ FRESH ROCK R ☐ STREAM SEDIMENTS S	☒ WEATHERED BEDROCK W ☐ SURFACE TRANSPORTED T ☐ RESIDUAL SOIL E ☐ MINE DUMP M	YES ☐ NO ☐	YES ☐ NO ☐	22-11-90	1 of 1

EASTINGS	NORTHINGS	SAMPLE NUMBER	DEPTH IN CMS	SIZE FRACTION	Sample Type		METAL VALUES PPM	GEOLOGICAL LOG
6125	2295	562653			R C	O/C		wht-Cm fp. D.I./Sc(2)/wk shd.
6110	2295	654			"	"		gy mno fp + ?pxp/Ep spt. A.I.
5805	2165	655			"	"		lgt gn-gy Mas B.I.
5680	2160	656		?petrology	"	"		Lm sh + Bar.
5575	2190	657			"	"		pyritic B.I.
6025	2125	658			"	"		gn fp A.I./wk shd.
5890	2085	659			"	"		Lgt gn fp sil cl pnt A.I.?

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INVOICE TO:

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

ORDER No.	PROJECT
11029	Mack E.L.

DATE RECEIVED	RESULTS REQUIRED
26/11/90	ASAP

No. OF PAGES OF RESULTS	DATE REPORTED	No. OF COPIES
2	13/12/90	1

TOTAL No. OF SAMPLES: 7

SAMPLE NUMBERS	SAMPLE DESCRIPTION	ELEMENT/METHOD
562653/59	RC Prep: GP005,GP009,GP016	Cu,Pb,Zn,Ag/GA101
562653/59	RC	Ba,As,Cr,Zr,Ti/GX401
562653/59	RC	Ti:Zr/S9825

REMARKS

RESULTS TO

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

RESULTS TO

RESULTS TO

AUTHORISED OFFICER

654593

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ANALYTICAL DATA

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
	100560.60.07551	13/12/90	11029	1 OF 2

TUBE No.	SAMPLE No.	Cu	Pb	Zn	Ag	Ba	As	Cr	Zr	Ti
1	562653	30	<5	50	<0.5	476	5	12	158	3049
2	562654	65	60	220	<0.5	754	<2	333	124	2950
3	562655	75	<5	125	<0.5	337	<2	24	80	3017
4	562656	90	10	130	<0.5	434	5	550	81	2683
5	562657	55	<5	85	<0.5	820	23	107	193	2225
6	562658	35	<5	125	<0.5	300	3	947	46	2706
7	562659	5	<5	60	<0.5	419	<2	24	165	3191
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	50
24	UNITS	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
25	METHOD	GA101	GA101	GA101	GA101	GX401	GX401	GX401	GX401	GX401

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

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ANALYTICAL DATA

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
	100560.60.07551	13/12/90	11029	2 OF 2

JBE NO.	SAMPLE No.	Ti:Zr
	562653	19.3
	562654	23.8
	562655	37.7
	562656	33.1
	562657	11.5
	562658	58.8
	562659	19.3

Aberfoyle Exploration

GEOCHEMICAL SAMPLE LEDGER

Collected AMCN + AD

PROJECT	BSS SIEVE SIZE CODE - MESH NUMBER	SAMPLE TYPE CODE		CARD PUNCH PRINT	VERIFY	DATE	SHEET
Mackintosh South Mackintosh	A 200 D 80 G 30 B 150 E 60 H 20 C 100 F 40 T = TOTAL	☐ OXIDIZED PRODUCTS O ☒ FRESH ROCK R ☐ STREAM SEDIMENTS S	☒ WEATHERED BEDROCK W ☐ SURFACE TRANSPORTED T ☐ RESIDUAL SOIL E ☐ MINE DUMP M	YES ☐ NO ☐	YES ☐ NO ☐	28-12-90	1 of 1

EASTINGS	NORTHINGS	SAMPLE NUMBER	DEPTH in CMS		SIZE FRACTION	Sample Type		METAL VALUES PPM	GEOLOGICAL LOG
5670	1260	562660		Petrology		R C	flt.	Cu, Pb, Zn, Ba, As, Ag, Cr, Ti, Zr	gn-pk cl spt. fp sil RDI
5515	1225	661				R C	O/L	" "	gn-gy sil av. ?fp.
5485	1210	662		Petrology		R C	O/L	" "	gn. fp. ≈ cl pot. + D.I. fp sil A-Blv/py(1)
6075	2080	663				R C	O/L	" "	br wk. shd. fp. cl. spt. A-D.I. / Se(2) / py Pn(1)
5450	0830	562664				R C	O/L	" "	ver Pk-br fp+cl spt RD-DI
3930	9710	562666		Petrology		R/C	O/L	Cu, Pb, Zn, Ba, As, Ag, Cr, Ni, Ti, Zr MgO, P_2O_5	dk gy-bl fp+ves ?Bl. or Dol.

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ORDER No.	PROJECT
11083	

DATE RECEIVED	RESULTS REQUIRED
29/01/91	ASAP

No. OF PAGES OF RESULTS	DATE REPORTED	No. OF COPIES
2	21/02/91	1

TOTAL No. OF SAMPLES: 6

SAMPLE NUMBERS	SAMPLE DESCRIPTION	ELEMENT/METHOD
3626.60/64,66	RC Prep: GP006,GP009,GP018	Cu,Pb,Zn,Ag/GA101
3626.60/64,66	RC	Ba,As,Cr,Zr,Ti/GX401
3626,60/64,66	RC	Ti:Zr/9825
362666	RC	Ni/GA101
62666	RC	MgO/GA104

RESULTS TO

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

RESULTS TO

RESULTS TO

REMARKS

SOUTHMACK
ROCK CHIPS

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ANALYTICAL DATA

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
	100560.60.07720	21/02/91	11083	1 OF 2

JBE No.	SAMPLE No.	Cu	Pb	Zn	Ag	Ba	As	Cr	Zr	Ti
	562660	20	40	100	2.0	764	<2	165	94	3343
	562661	5	30	20	3.0	115	<2	18	219	1201
	562662	10	30	100	1.0	834	<2	90	186	3263
	562663	45	35	40	<0.5	528	68	26	141	3089
	562664	5	30	50	<0.5	1069	<2	63	170	3638
	562666	145	35	90	2.0	533	<2	436	132	3519
	DETECTION	5	5	5	0.5	10	2	5	5	50
	UNITS	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
	METHOD	GA101	GA101	GA101	GA101	GX401	GX401	GX401	GX401	GX401

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

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ANALYTICAL DATA

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
	100560.60.07720	21/02/91	11083	2 OF 2

SAMPLE No.	Ti:Zr	Ni	MgO	P2O5
562660	35.56	—	—	—
562661	5.48	—	—	—
562662	17.54	—	—	—
562663	21.91	—	—	—
562664	21.40	—	—	—
562666	26.66	80	9.43	0.408
DETECTION	0.01	5	0.01	0.007
UNITS	%	ppm	%	%
METHOD	9825	GA101	GA104	GX401

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

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APPENDIX 23

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ABERFOYLE RESOURCES

Exploration Division

INTERPRETATION REPORT

DHEM SURVEY

DDH MAC26 AND MAC27

MACKINTOSH E/L 106/87

Prepared by:

J SILIC

Distribution

Hawthorn (1)
Burnie (1)

Issued by:

J SILIC
Chief Geophysicist

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Fig 3 : DHEM MAC27 Loop 2
Fig 4 : DHEM MAC27 Loop 2

Introduction

Electromagnetic techniques have played an important role in the discoveries of the Que River and Hellyer deposits (Webster and Skey, 1979; Silic et al, 1985: Eadie et al, 1985). Since the Hellyer discovery, downhole Em techniques (DHEM, Silic and Eadie, 1989, Appendix I) have been an important part of the exploration strategy in the volcanic sequence hosting the above deposits because of the failure of blanket Em surveys to locate further targets worthy of follow up and because no other method can accurately target drill holes at depths beyond the surface Em detection limits.

The purpose of this report is to discuss and present the results from DHEM surveys in DDH MAC26 and MAC27, on the Mackintosh EIL 106/87.

Survey Specifications

All loops were designed so that their primary magnetic field would couple with targets at specified target horizons. Possible variations in dips of the targets from the predicted dips (based on the geological knowledge) was also taken into account, as was the detection limitations of the DHEM surveys, the parameters of which are known from in-house research studies (Silic and Eadie 1989).

Two 300m x 300m Loops with Loop 1 centered on the MAC26 drill hole collar, with Loop 2 sharing Loop 1's wsternmost edge, were used to collect the data in MAC26, while two 300m x 300m Loops sharing a common edge 100 metres to the east of the MAC27 collar with Loop 2 being the westermost Loop were used to collect data in MAC27.

Discussion of Results

Only responses from host volcanics are evident in the MAC26 data (Appendix II). The data quality however is good enough for a target of approximately 2 mt to have detected if it was within 150 metres from the holes. The MAC27 data set of similar quality, only shows the effect of the overlaying Que River Shales.

Conclusion

Not BMS target worthy of follow up have been detected by the DHEM surveys in MAC26 and MAC27.

References

Eadie, E T., Silic, J. and Jack, D J (1985), 'The application of geophysics to the discovery of the Hellyer ore deposit, Tasmania', Explor. Geophys. 16, 207-209.

Silic, J., Eadie, E T and Jack, D J (1985), 'Application of time domain electromagnetic methods in the discovery of the Hellyer ore deposit, Tasmania, Australia', in volume of Extended Abstracts of the 55th SEG meeting, Washington, DC.

Silic J., Eadie E T., (1989), DHEM: The Que Hellyer Volcanics Experience, Explor. Geophys. 720.

Webster, S.S. and Skey, E H (1979), 'Geophysical and Geochemical case history of the Que River deposit, Tasmania', in Geophysics and Geochemistry in the Search for Metallic Ores; Peter J Hood, editor, Geological Survey of Canada, economic Geology Report 31, 697-720.

APPENDIX I

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DHEM: The Que-Hellyer Volcanics Experience

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123 Camberwell Road
Hawthorn East Vic. 3123

Abstract

The intermediate volcanic sequence hosting the Que River and Hellyer mines provides an excellent environment for electromagnetics in that the only two strong conductors ever found in them have been developed into mines. Now that the ground has been thoroughly explored by surface EM and the search is by necessity becoming deeper, downhole EM has become an extremely important aspect of the exploration programme. However, even in this ideal environment for EM, there are factors that cause interpretation headaches, although all can be overcome with care and experience. These problems include the overlying moderately conductive black shales, instrumentation responses from the Sirotem unit, responses from culture, and the effect of strong conductors such as the known ore bodies close to the target.

Key words: downhole electromagnetics, Que River, Hellyer, volcanics

Introduction

Electromagnetic techniques have played an important role in the discoveries of the Que River and Hellyer deposits (Webster and Skey, 1979; Silic *et al*, 1985; Eadie *et al*, 1985). Since the Hellyer discovery, downhole EM techniques (DHEM) have become an important part of the exploration strategy in the volcanic sequence hosting the above ore bodies (referred to in this paper as the Que-Hellyer volcanics) because of the failure of blanket surface EM surveys to locate further targets worthy of follow up and because no other method can accurately target drillholes at depths beyond the surface EM detection limits. Some forty exploration drillholes have been logged with EM since the Hellyer discovery. Recently drillhole patterns have been designed and are being drilled to be used as geophysical platforms for potential targets at depths beyond the detection capabilities of the surface systems.

This paper discusses our experience with DHEM techniques in the Que-Hellyer volcanics by illustrating the power of the method and also some of the problems encountered.

The EM environment of the Que Hellyer volcanics

The Que-Hellyer volcanics are known to be relatively resistive with a bulk value of about 500 ohm-m (Webster and Skey, 1979). The overlying Que River Shales are slightly more conductive, although variable, with resistivities as low as 100 ohm-m. Conductive weathering is not a problem in this environment, and there are not many other spurious conductors. In fact the only two first-priority surface EM conductors followed up in the Que-Hellyer volcanics are the two ore bodies, Que River and Hellyer. However, given the relatively short time constants associated with parts of these deposits (Silic *et al*, 1985; Eadie *et al*, 1985; Staltari, 1986) there have been two candidates identified as having the potential to overshadow an EM response from an ore body: the shales that overlie the Que-Hellyer volcanics and the Sirotem instrumentation response.

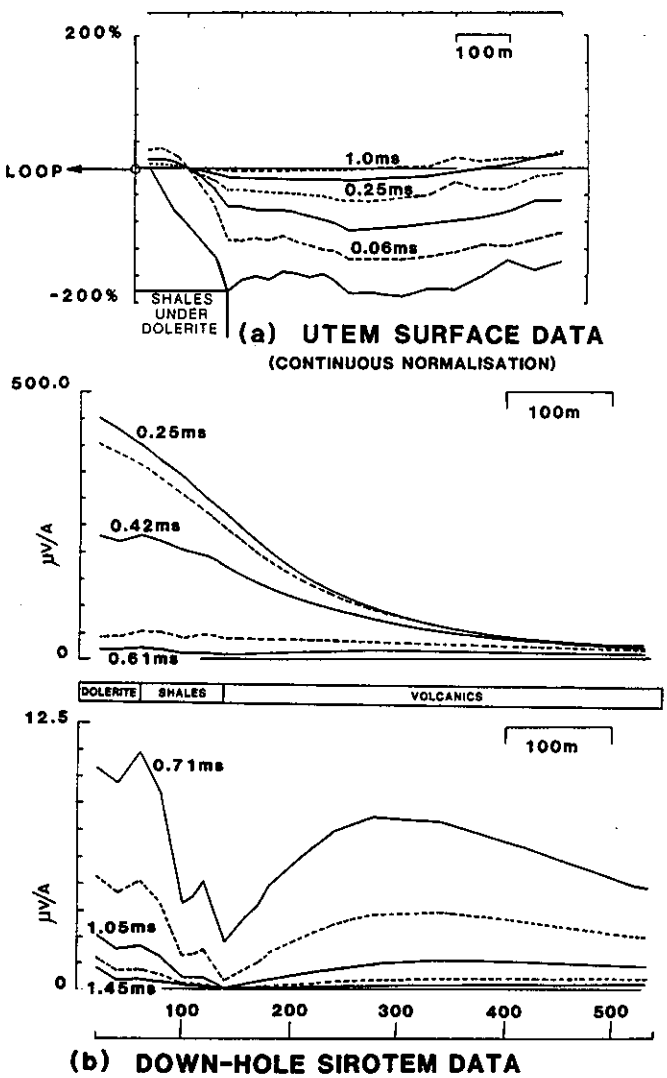

FIGURE 1
Surface and downhole response to the overlying shale unit. (a) The surface UTEM anomaly lasts to comparable times to that of the Que River and Hellyer ore bodies. (b) The DHEM response is interpreted to be from a large body with a moderately low resistivity.

DHEM through the overlying shale horizon

The UTEM anomaly shown in Figure 1 is one of the few surface responses in the area that is comparable in strength to the Hellyer UTEM discovery anomaly and the Que River response, with the anomaly lasting beyond 1 ms. An experienced interpreter, using for example the second derivative technique of Silic (1989), would recognise that the sudden changes in slope of the profile mark the edge of a conductive unit, in this case the Que River shale horizon beneath a dolerite sill. This was understood prior to drilling, and a hole was designed not to test the conductor, but rather a prospective horizon some hundreds of metres below the surface. Unlike the surface data which superficially resembles the Hellyer results, the DHEM data (Figure 1) do not at all *replicate the DHEM results at Hellyer where a time constant* of 3-4 ms is evident (Eadie, 1987).

Instead the response can be interpreted to be from a large body with a moderately low resistivity (the shales), and would not be confused with a good inductive ore body response.

Sirotem instrumentation response

A number of responses occur with elevated signal levels which are impossible to reconcile with the resistivites of the Que-Hellyer volcanics. The shape of the response and the signal levels vary significantly with the transmitter loop position. Similar effects have been observed by other companies working in relatively resistive terrains (Irvine, 1986). An example of this effect is shown in Figure 2, where the Sirotem response at 2.05 ms is shown for three loops. Although only the data at 2.05 ms is shown here, the responses at other times have identical shapes with amplitudes decreasing monotonically with time. In this case the signal levels are much higher than the expected signal from the volcanics, which should produce 0.1-0.2 uV/A at this delay time for this set up. The shape of the profile and signal levels vary considerably from loop to loop, with the secondary field being practically zero for Loop 1. The response correlates very closely with the axial component of the primary magnetic field produced by each transmitter loop (Figure 2), as was confirmed by inverting the data using simple current filament

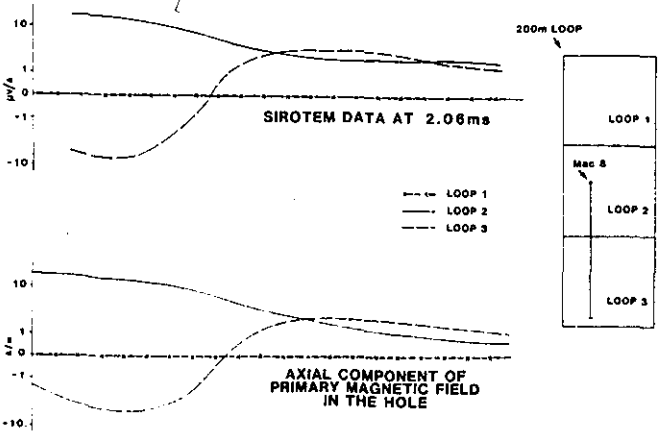

FIGURE 2
The Sirotem data in MAC 8 from loops 1, 2 and 3 (top) correlates with the axial component of the primary magnetic field of the transmitter loops (bottom). This instrumental response is referred to as 'probe self-response'.

models (eg Fullagar, 1987). This response is presently referred to as the 'probe self response', although without further investigations we cannot be absolutely certain whether this is the case. Nevertheless, we have made the observation that in resistive terrains when the loop is close to the drillhole and the primary field is therefore expected to be large, these 'probe self responses' have invariably been noted. To ensure that no target responses are overshadowed, it is good practice to keep the loop as far away from the drill hole as is possible.

Locating targets in electromagnetically active areas

One of the important exploration problems in the Que-Hellyer volcanics is to locate targets in the immediate vicinity of the existing deposits. In these cases the responses from the existing deposits and the associated culture invariably contribute to the DHEM data. Thus, the problem posed in these situations is to understand the effects from the known ore bodies and culture so that these responses may be separated from those of the other targets. Two examples, one a discovery near the Hellyer deposit and the other a target near the Que River mine will be used to show some of the problems and solutions.

Figure 3 shows the Sirotem response at 3.4 ms in two drill holes on a section about 100 m north of the northern limits of the Hellyer ore body. The problem is to determine if the total response can be explained by the nearby orebody or if there is an unknown conductor influencing the results. Data from both drillholes show similar amplitude variations from loop to loop which are for the most part explainable by the Hellyer orebody, but in drillhole HL045, there is a consistent migration of crossovers from Loop 1 to 4, with a corresponding reduction in the width of the anomalies. It was this observation that suggested that a target conductor may lie close to this hole and therefore northeast of the known orebody. In particular, loops 3 and 4, which couple relatively well with a hypothesised flat-lying conductor north east of Hellyer and poorly with Hellyer itself, generate current flow within about 50-70 m of HL045. The intersection of 1.9 m of conductive base *metal sulphides in HL069A gives geological support to the* hypothetical conductor.

Another example of this type occurred during a drilling programme at Que River. Two deep holes were drilled 400 m apart beneath the mine. This pattern was based on the size and conductivity parameters of the target and the detectability limitations of DHEM. Both holes were surveyed using Sirotem with a late time broad negative trough detected in one of the holes, QR1060A (Figure 4), centred at 975 m down the hole. This trough is at least 700 m wide at 4.8 ms with a half-width greater than 500 m (half-width is defined as the width of the anomaly at half of its peak amplitude). Two questions arose regarding this response. The first question was whether or not the response was due to the Que River massive sulphides or culture associated with the mine, 500 metres above the hole. This possibility was ruled out because no late time anomaly was observed in the other hole, QR1001, which was the same distance from the deposit. The second question *involved the change in anomaly sign at approximately 2 ms.*

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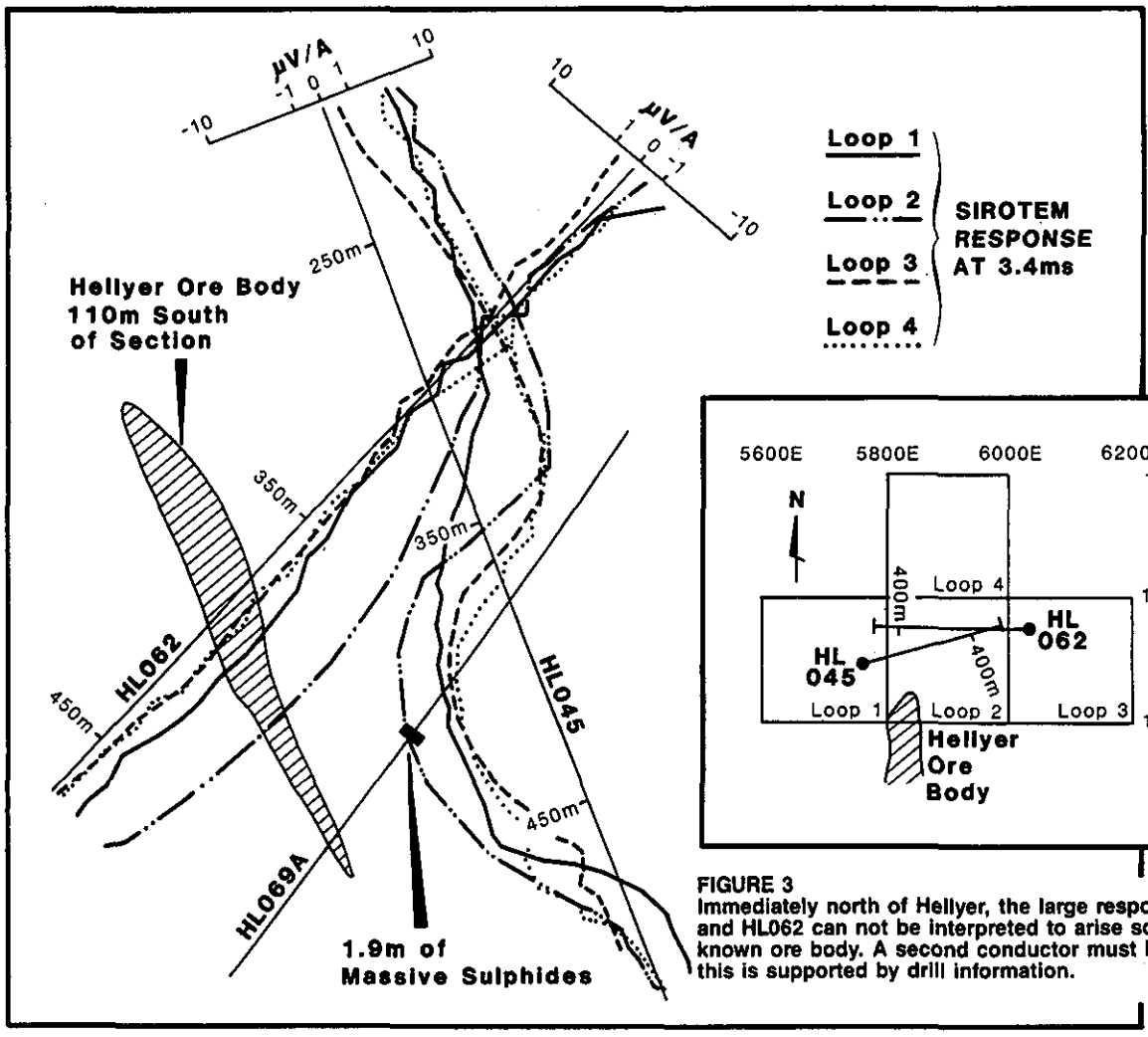

FIGURE 3
Immediately north of Hellyer, the large responses in HL045 and HL062 can not be interpreted to arise solely from the known ore body. A second conductor must be invoked and this is supported by drill information.

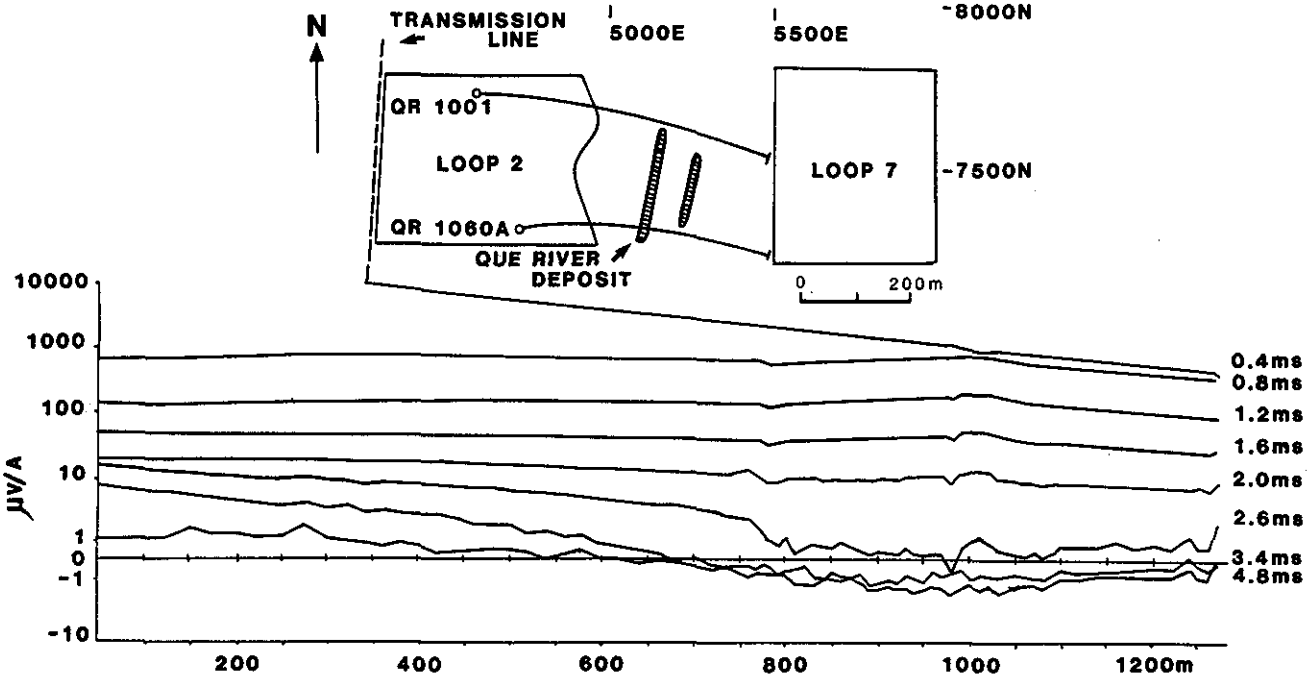

FIGURE 4
Downhole Sirotem response for QR1060A, loop 2. A very broad anomaly centred at 975 m changes from a positive to a negative with increasing delay time.

654609

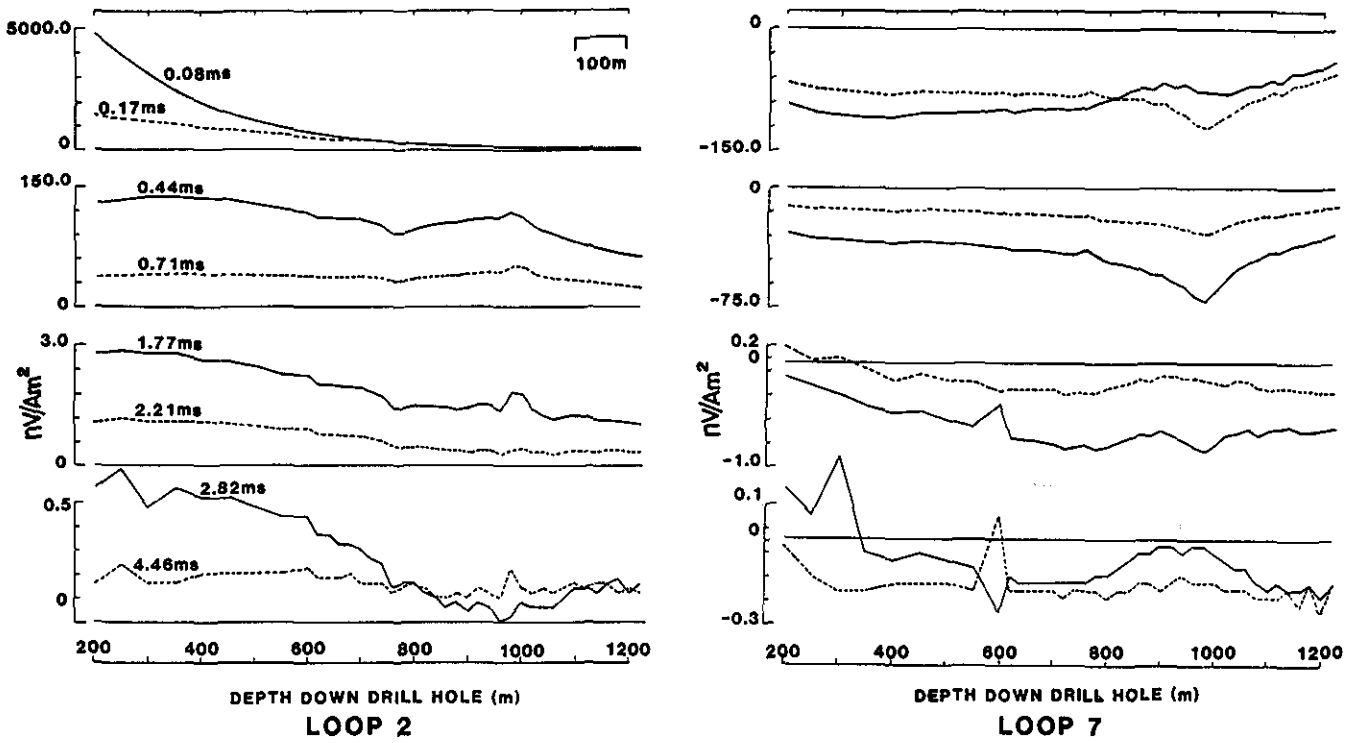

FIGURE 5
Downhole EM-37 responses for QR1060A, loops 2 and 7.
The loop 2 response can be seen to have a very large long wavelength response strongest at shallow depths from culture near the Que River Mine, which superimposes a large background on the response to depth. The loop 7 response is initially dominated by a negative response (current channelling) at about 1000 m. It undergoes a sign change, and is finally dominated by a broad positive peak (vortex flow).

To better understand the response, both holes were resurveyed with EM-37, and data was obtained from additional surface loops. Selected time channels from two of the loops are shown in Figure 5.

The early time capability and close channel sampling of the EM-37 system enable a thorough interpretation. In the loop 2 data, a strong broad cultural response can be seen clearly at early times shallow in the hole. In fact this cultural effect which decreases slowly down the hole imprints a large long wavelength background response on the data to late delay times even at depth. It is this background response that gives the apparently large half-width in both the EM-37 and Sirotem loop 2 data. Therefore loop 7 data, which has no cultural contamination is used for the interpretation. The signs of the responses are inverted for the loop 7 data because the loop position is on the opposite side of the conductor.

The major effect to be explained is the transition from a broad negative, centred at 975 m depth to a broad positive late in time. A similar effect has been noted by Asten *et al*, (1987) and ascribed to drive delay. However in rocks as resistive as these, this effect can be calculated (Silic, 1987) to die out by 0.1 ms. Another possibility is a change in the magnetic field from being current channelling dominated to vortex flow dominated as documented and reported as a possible effect at Thalanga (Irvine, 1987). This appears to explain the response very well in that from our experience in these volcanics, strong current channelling effects generally last to about 2 ms. In addition, at the changeover time, which in this case is between 1.77 ms and 2.21 ms, the response shows some characteristics of both channelling and vortex flow, instead of just passing straight through zero. Since the channelling and vortex flow responses are of opposite polarity, the conductor is interpreted to lie above the drill hole as shown in Figure 6.

Discussion

Even in the most ideal terrains for electromagnetics, care and experience are necessary to not only ensure that drastic errors are not made in DHEM interpretation, but also to derive the maximum possible information from the data. In fact in these

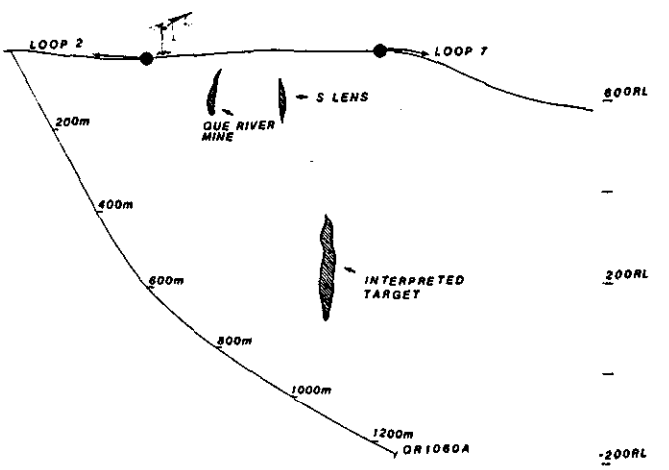

FIGURE 6
Location of drillhole QR1060A , transmitter loops, Que River Mine and interpreted conductor.

5 cm

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areas, DHEM should be more than just another step in the exploration programme. Rather it should actually lead the effort with every drill hole planned to make full use of its potential. One could also extrapolate the power of DHEM to areas of conductive cover. Having the receiver down the hole overcomes many of the problems of weathering and makes DHEM a powerful exploration tool even in areas where surface EM has been only a limited success.

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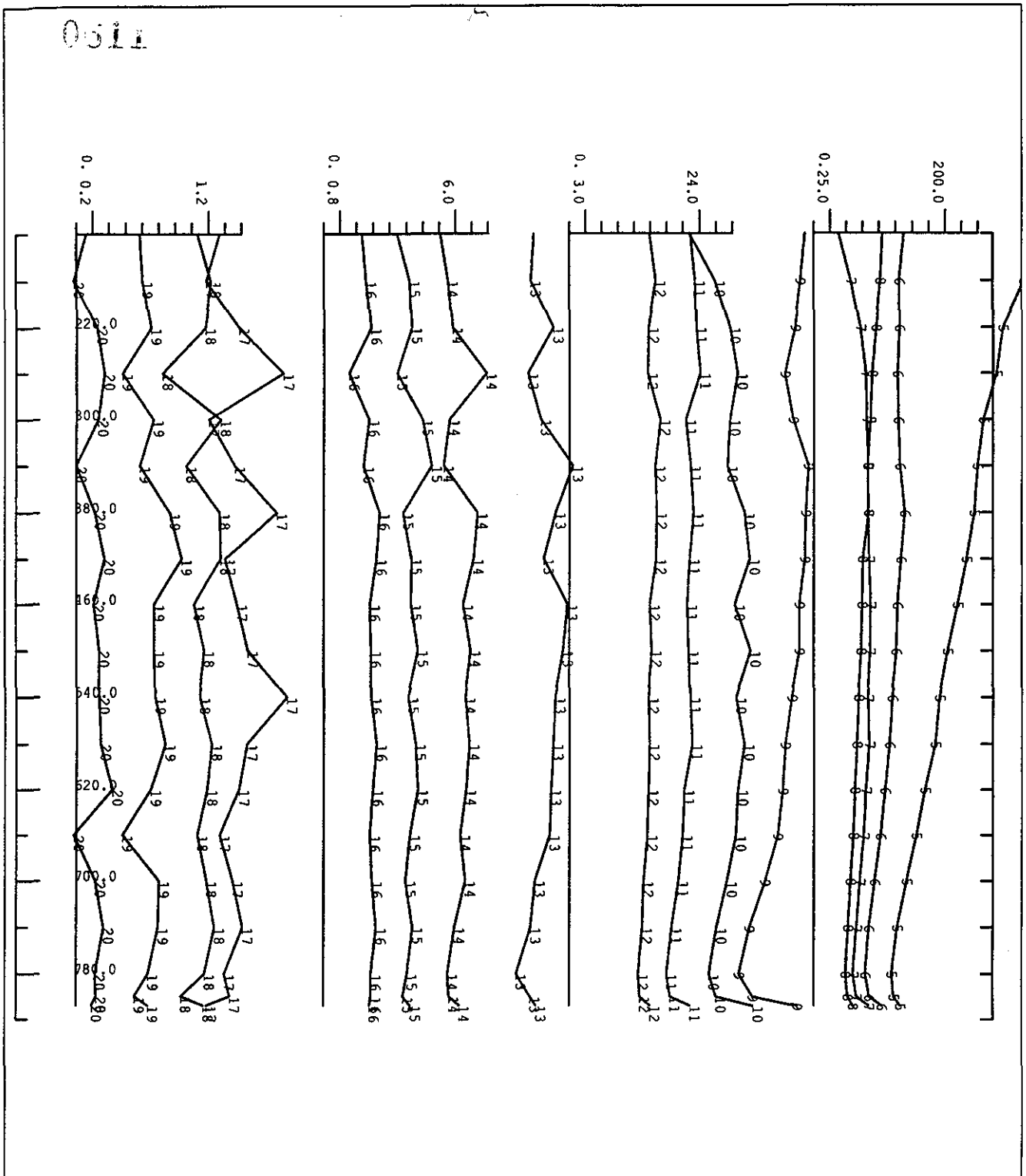
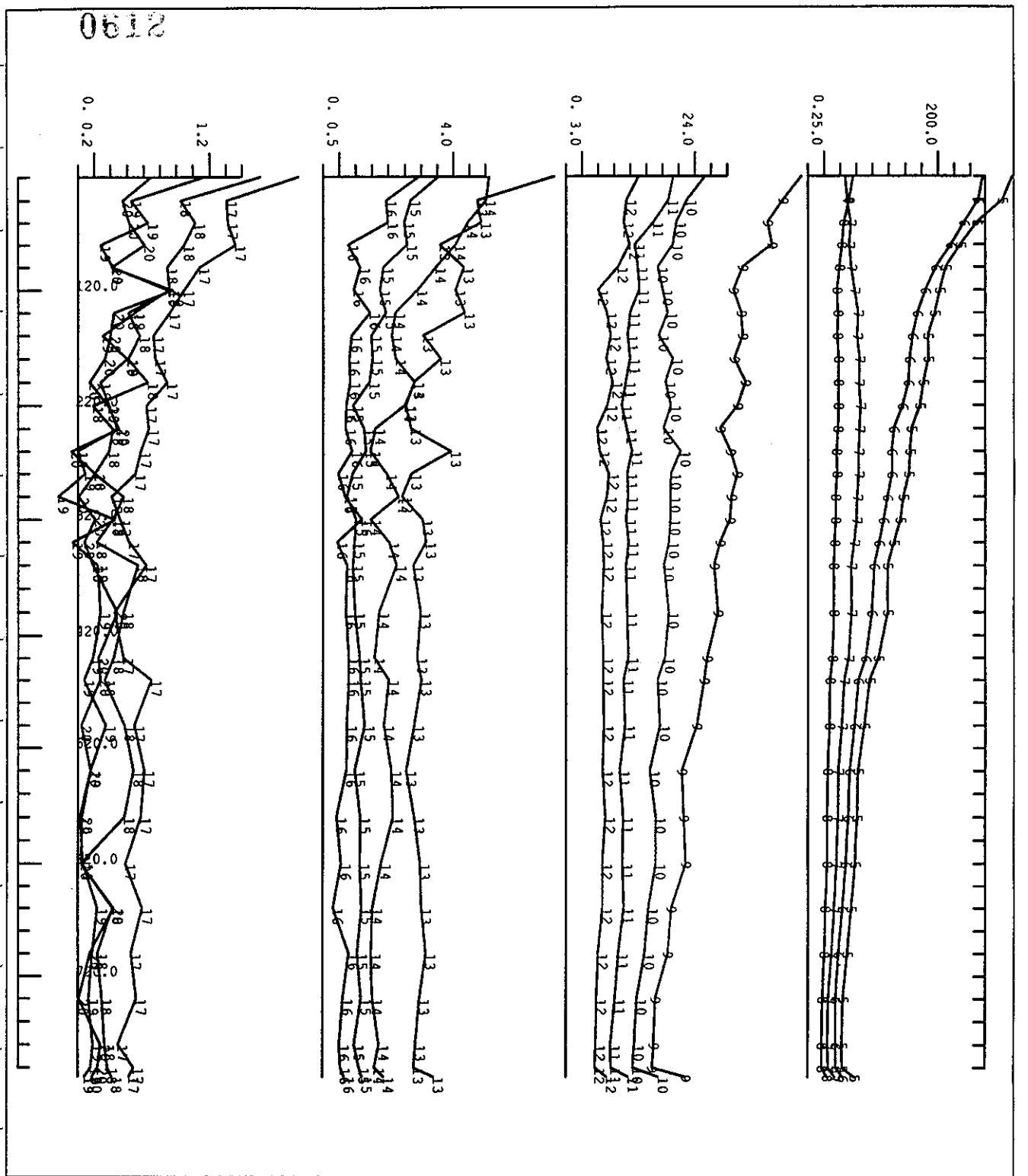
APPENDIX II



MAC26
ZONGE GDP_16 32 Hz
DOWN HOLE EM
LOOP 1

Aberfoyle Resources Limited

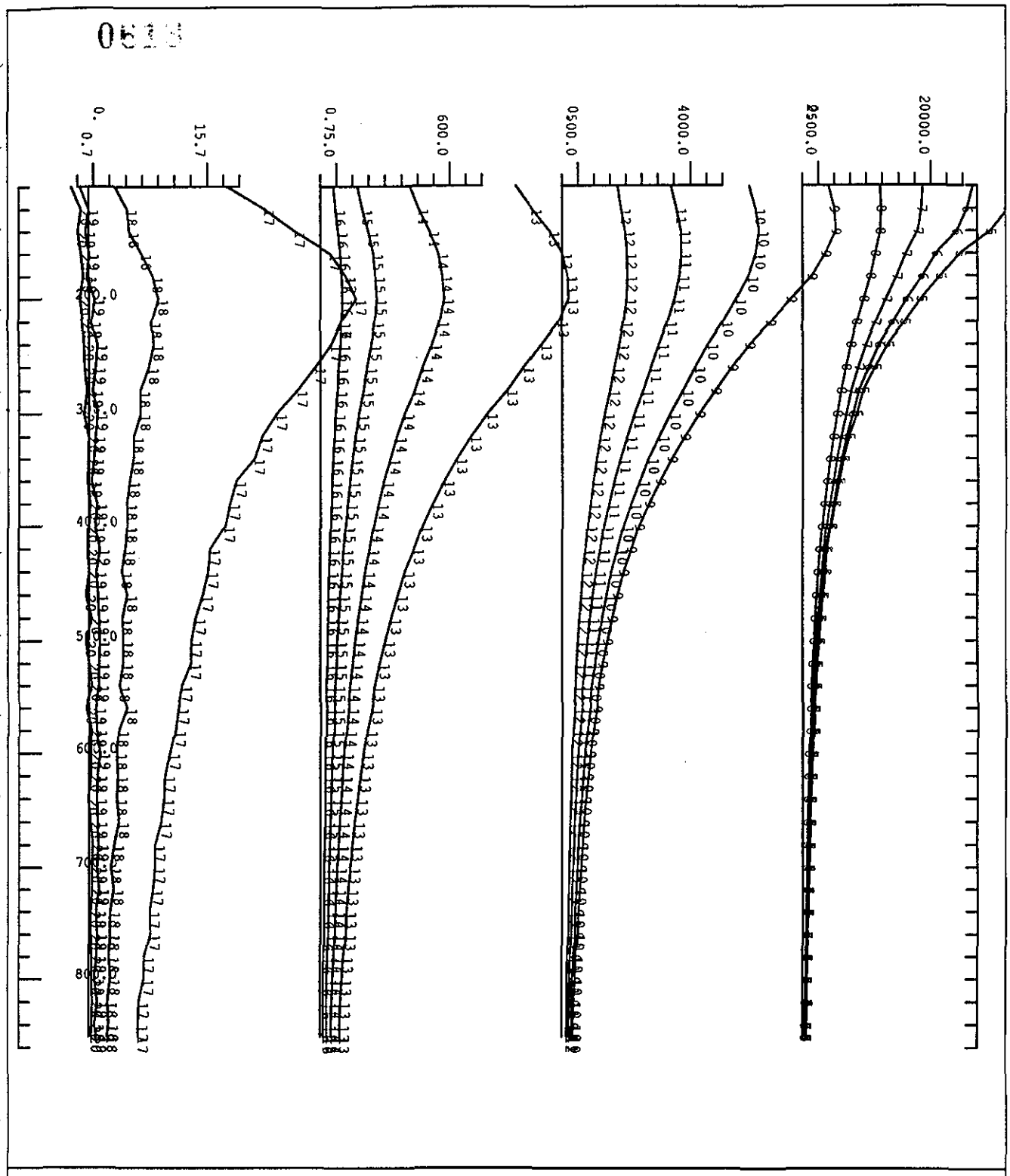
Fig 1



MAC26
ZONGE GDP_16 32 Hz
DOWN HOLE EM
LOOP 2

Aberfoyle Resources Limited

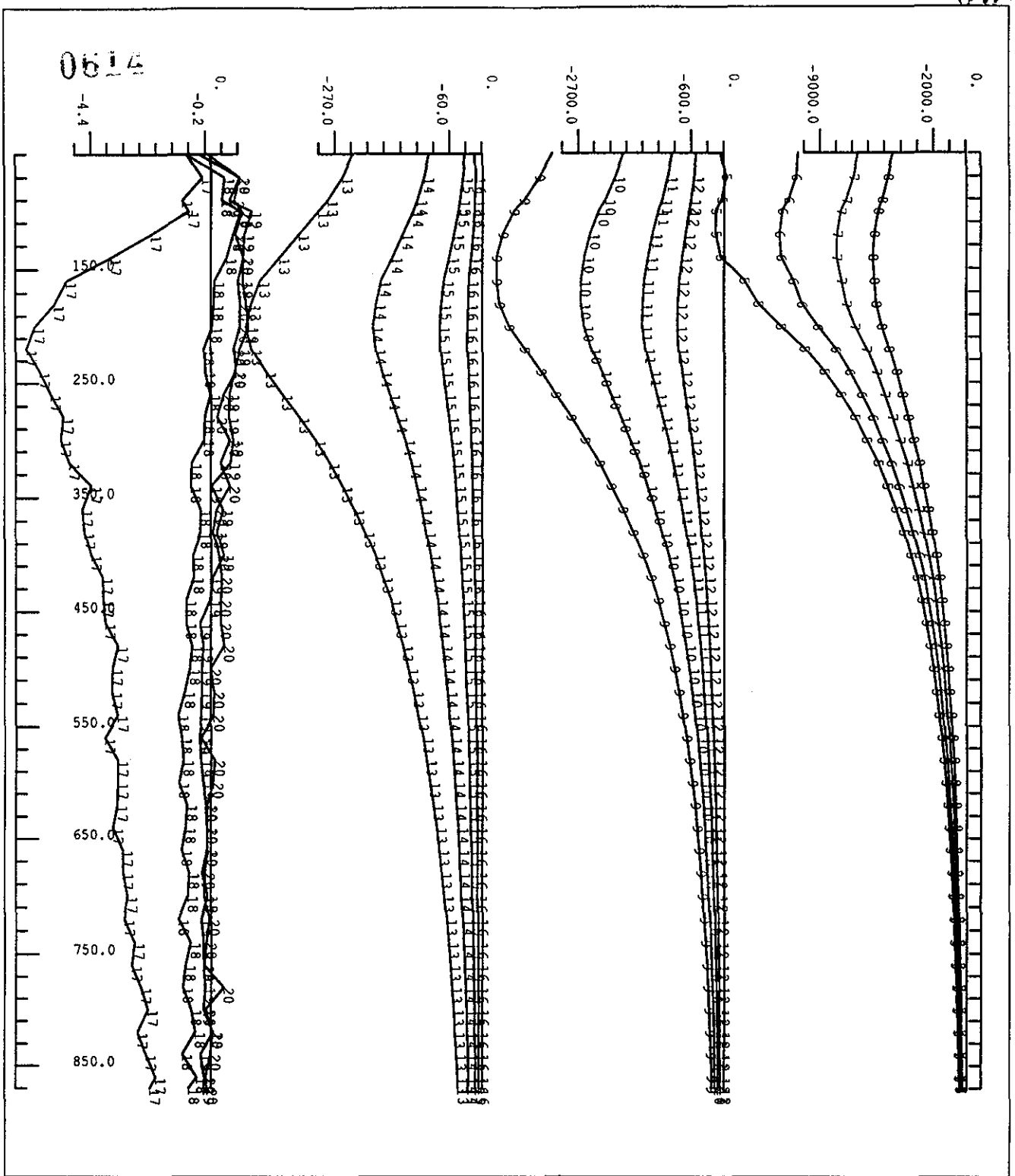
Fig 2



MAC 27
ZONGE GDP_16 32 Hz
DOWN HOLE EM
LOOP 1

Aberfoyle Resources Limited

Fig 3



MACKINTOSH E/L

MAC27

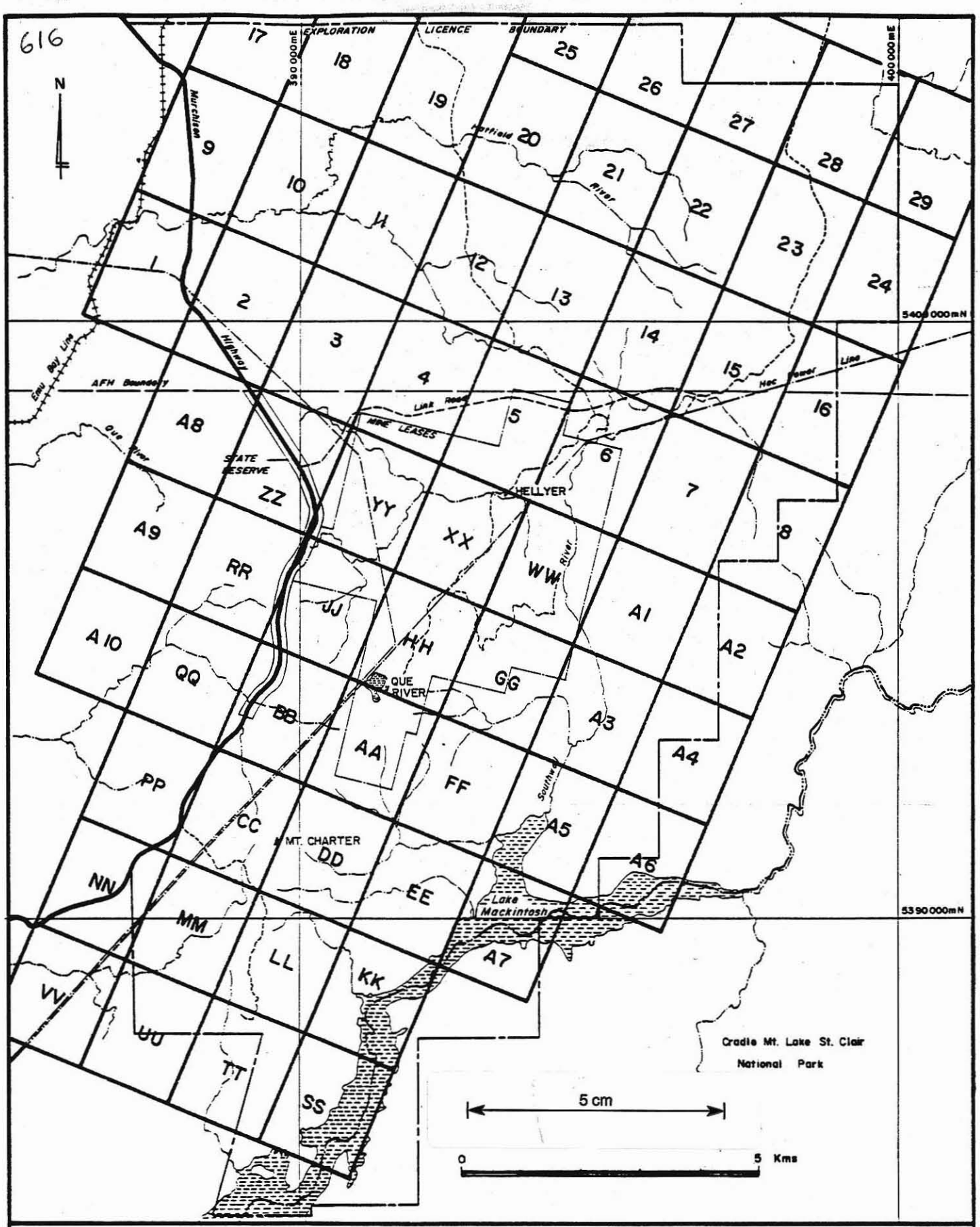
DOWN HOLE EM

ZONGE GDP_16

32 Hz

Fig 4

APPENDIX 24



Aberfoyle Resources Limited

EXPLORATION DIVISION

654617

REVISIONS			
Init.	Date	Init.	Date

NORTH WEST TASMANIA

MACKINTOSH DISTRICT

1: 2500 MAP SHEETS — INDEX

Compiled :

Drawn : RJE

Traced :

Checked :

Location Code : K55/6/44

Scale : As shown

Date : February, 1988

Plate No. : MAC 181

1511

654618

* geolabbrv Mon 03-Sep-90 15:39:05

GEOLOGICAL ABBREVIATIONS

Abundant	abn
Adularia	Adl
Agglomerate	agg
Albite	Ab
Alkali feldspar	Afd
Altered	alt
Amphibolitic	amb
Amphibole	Amb
Amygdaloidal	amg
Andalusite	An
Andesite	A
Angular	ang
Ankerite	An
Aplite	Ap
Approximate	apx
Arcuate	ar
Arenaceous	arn
Argillaceous	arg
Argillite	Arg
Arkose	Ak
Arkosic	ak
Arsenopyrite	Ap
Ash volcaniclastic	av
Autobrecciated	aub
Average	ave
Banded	bnd
Barite	Ba
Basalt	B
Bedded	bd
Biotite	Bio
Black	bk
Black shale	Bsh
Blue	bl
Boulder	bld
Breccia	b
Breccia volcaniclastic	bv
Bright	brt
Brown	br
Calcareous	cc
Calcite	Cc
Carbonaceous	carb
Carbonate	Co
Cassiterite	Cass
Cavernous	cav
Cemented	cem
Chalcopyrite	Cp
Chert	Ch
Chlorite	Cl
Chromite	Cr
Chromitiferous	cr
Clay	cy
Coarse	c
Coarse grained	cg
Colloform	coll
Colour	col
Common	com
Conglomerate	Cg
Conglomeratic	cg
Crimson	cm
Crystal	x
Crystal volcaniclastic	xv
Dacite	D
Dark	dk
Dense	dns
Devitrification	dv
Diorite	Di
Disseminated	dis
Dolerite	Dol
Dolomite	Dm
Dyke	dy
Elongated	el
Emphasised	emp
Epiclastic (noun)	E
Epidote	Ep
Euhedral	euh
Eutaxitic	eux
Fabric	fab
Fault	F
Fault zone	FZ
Feldspar	Fd
Feldspathoid	Fdd
Feldspar phyric	fp
Felspathic	fel
Ferruginous	fer
Fibrous	fb
Fine	f
Fine grained	fg
Fissile	fis
Flowbanded	fbn

****** geolabbrv Mon 03-Sep-90 15:39:05

Fluorite	Fl
Foliated	fo
Fragments	fr
Fuchsite	Fu
Gabbro	Gb
Galena	Gn
Glass	Gl
Glassy	gl
Gossan	Gos
Granite	Gr
Granodiorite	Gd
Granular	glr
Graphite	Gt
Graphitic	gt
Green	gn
Grey	gy
Greywacke	Gw
Groundmass	gm
Haematite	Hmt
Hornblende	Hb
Ignimbrite	Ig
Illite	Ill
Interbedded	ibd
Intercalated	icl
Intrusive	int
Jurassic	Ju
K-Feldspar	Kfd
Khaki	kh
Laminated	lm
Lapilli volcaniclastic	lv
Lava	l
Lava breccia	lb
Leached	lch
Leucite	Lct
Leucitite	Ltt
Limonitic	Lim
Light	lgt
Limestone	Lst
Lithic	lh
Magnetite	Mt
Manganese	Mn
Marl	Ml
Massive	mas
Matrix	mtx
Matrix dominated	md
Medium	med
Medium grained	mg
Metamorphosed	meta
Mica	Mic
Micaceous	mic
Mineralised	min
Minor	mnr
Mixed	mxd
Mottled	mtl
Mudstone	Mst
Nodule	nd
Off white	ow
Olivine	Ol
Oolitic	oo
Orange	or
Ordovician	O
Oxidised	ox
Pale	pl
Patchy	pat
Peperitic	pep
Perlitic	prl
Pervasive	per
Phenocrysts	phn
Phyllite	phyl
Phyric	p
Picrite	Pic
Pillow lava	pl
Pink	pk
Polymict	Y
Porphyritic	por
Predominantly	pred
Pumice	Pu
Pumiceous	pu
Purple	pp
Pyrite	Py
Pyritic	py
Pyroxene	Px
Pyrrhotite	Po
Quartz	Q
Quartzite	Qtz
Quellite	Qll
Questionable	?
Recrystallised	rx
Red	rd
Rehealed	rhd
Reworked	rw
Rhyodacite	RD

****** geolabbrv Mon 03-Sep

Rhyolite	R
Ripple marks	rmk
Round	rnd
Rubble	rbb
Sandstone	Ss
Schist	Sch
Schistose	sch
Sediment	sed
Selected fragments	sfr
Sericite	Se
Serpentine	Srp
Shale	Sh
Sheared	shd
Sheeted	sht
Siderite	Sid
Silica	Si
Siliceous	sil
Siltstone	Slt
Slickenside	slk
Sphalerite	Sp
Spotted	spt
Spotty	spt
Stockwork	stw
Stratabound	stb
Strong	str
Structure controlled	stc
Syngenetic	syn
Talc	Tc
Tertiary	T
Tourmaline	Tm
Trace	tr
Trachyte	Tr
Tuff	Tf
Tuffaceous	tf
Variable	var
Variolitic	vr
Vein	vn
Vein concordant to bedd	cV
Vein discordant to bedd	dV
Very	v
Vesicular	ves
Vitric	vtr
Volcanic	vlc
Volcaniclastic	vlcl
Weak	wk
Weathered	wth
White	wh
Yellow	yw

APPENDIX 25

0019

654620

ABERFOYLE

MEMORANDUM

Date 27 May, 1991 Ref

To D B Wallace From A McNeill

At Burnie At Burnie

Copies JWH Keep

Subject **MOUNT CHARTER REHABILITATION PLAN**

This memo is an initial attempt to highlight areas around Mount Charter that require rehabilitation. It is by no means exhaustive but could serve as a starting point for a rehabilitation plan. For detailed track/costean locations refer to plate MAC 89/CC.

Mount Charter Dolerite

Access to the MC-14 drill site should be maintained as new interpretations suggest the Que-Hellyer host horizon has not been tested in this area. However, the 3000E/4425N costeans are no longer required and could be rehabilitated. A dozer push from this costean to the 4200N/3200E trench was not inspected but could be rehabilitated if warranted. The 4300N/3200E and 3300E/4200N costeans should be left open as they provide probably the best exposure of the Mount Charter fault in this area. To the NE the 4800N/3800E costean was not visited but could be rehabilitated.

South Charter

Gordon's Hill Road, and the small trenches around 4000N/3600E, should be closed off and rehabilitated south of the MC-15 drill site. A north trending track from the MC-17 drill collar could be rehabilitated as should the drill site. This hole has been making water which is causing some erosion of the South Charter track. Further work on this drainage is required.

Southwest Mount Charter

Work required on the 3900N/4100E costean and the link track from the south Charter track to the MC-10 site has not been assessed, however regrowth on the track north of the 4000N/4100E costean is good with negligible erosion and no further work would appear to be necessary. The track from the MC-10 collar to the 4400N costean also shows good regrowth but some hand dug drainage may be required. The access track to the MC-19 drill site was not visited.

South Mackintosh

The south Charter track currently extends to 1650N/5050E, however for some time vehicular access has virtually been impossible past 2300N/4680E. It is suggested that this section of track should be rehabilitated.

Mount Charter

The main access track to Mount Charter area has two major problem areas, crossing the dolerite.

A steep section east of the MC-8 site. If further work is planned in this area serious consideration should be given to re-routing this track. Two major E-W costeans on 4500N and 4550N are steep and show some regrowth but are mildly eroded. Advice should be sought on the best method of rehabilitation as these costeans are no longer required. The junction of the 4500N costean and the MC-6 access track should be re-contoured and fertilised while the MC-6 access track itself appears to have no major drainage problems but regrowth is only marginal. Advice on rehabilitation of this section of track and the drill site itself should be sought. The system of tracks north of MC-3 and leading east to the MAC-25 site are generally revegetating satisfactorily, however in some steep areas, particularly the track just north of 4800N, erosion is occurring. Hand dug drainage channels may rectify this problem.

A. McNeill.

10263

FACT GEOLOGICAL MAPPING LEGEND MAC 79,110 PLAN SERIES

(NOTE: COMPLETE LIST OF ABBREVIATIONS IS STORED ON HP-1000 FILE ABBRV:HL:14)

LITHOLOGY COMPOSITION

R	Rhyolite
D	Dacite
A	Andesite
B	Basalt
Y	Polymict
Ss	Sandstone
Sh	Shale
Slt	Siltstone
Ba	Barite
Py	Pyrite
BMS	Base Metal Sulphide
Ch	Chert
TB	Tertiary Basalt
JDo	Jurrasic Dolerite
OCg	Ordovician Conglomerate

LITHOLOGY TEXTURE / FORM

l	lava
lb	lava breccia
pl	pillow lava
av	ash volcaniclastic
flv	fine lapilli volcaniclastic
mlv	medium " "
clv	coarse " "
bv	breccia "
xv	crystal "
ves	vesicular
por	porphyritic
eux	eutaxitic
fbn	flowbanded
gnlr	granular
ibd	interbedded
md	matrix dominant
gl	glassy
mas	massive
lm	laminated
fp	feldspar phyric
rnd	rounded
pep	peperitic

VOLCANICLASTIC SIZE RANGE

> 2mm	ash
2-8	fine lapilli
8-32	medium lapilli
32-64	coarse lapilli
> 64	breccia

ALTERATION COMPOSITION

Co	Carbonate
Cl	Chlorite
Kf	K-feldspar
Fu	Fuchsite
Py	Pyrite
Se	Sericite
Si	Silica

ALTERATION TEXTURE / FORM

per	pervasive
dis	disseminated
pat	patchy
spt	spotty
sfr	selected fragments
stw	stockwork
stc	structure controlled
vn	vein
mtx	matrix

ALTERATION INTENSITY WEATHERING INTENSITY

1	trace
2	weak
3	moderate
4	strong
5	extreme

COLOUR

br	brown
bk	black
gy	grey
gn	green
or	orange
pk	pink
wh	white
yw	yellow
bl	blue

FAULT TERMS

cav	cavernous
lch	leached
slk	slickenside
rhd	rehealed
rbb	rubble
shd	sheared

GENERAL TERMS

tr	trace
lgt	light
dk	dark
brt	bright
ox	oxidised
fg	fine grained
mg	medium grained
cg	coarse grained

ABBREVIATED DESCRIPTION FORMAT

LITHOLOGY:

LITHOLOGY	WEATHERING	ALTERATION
colour. composition. form. texture	/ intensity	/ composition. intensity. form. texture

example gy - gn. YA. flv / Ox 3 / Fu.3. dis

Interpretive comment can be added in brackets ( )

FAULT:

WIDTH (cms) / MINERALOGY. TEXTURE

example F 20 / Cl. cav.

VEIN:

WIDTH (cms) / MINERALOGY. TEXTURE

example V 5 / Q. Py.cav

INTERPRETIVE GEOLOGICAL MAPPING LEGEND MAC89,111 PLAN SERIES

VOLCANICS

R.l R.lb	26	Rhyolite lava, lava breccia
R.av R.lv R.bv R.xv	25	Rhyolite volcaniclastic
YR.av YR.lv YR.bv	65	Rhyolitic Polymict volcaniclastic
D.l D.l.b	63	Dacite lava, lava breccia
D.av D.lv D.bv D.xv	54	Dacite volcaniclastic
YD.av YD.lv YD.bv	66	Dacitic Polymict volcaniclastic
A.fp.l A.fp.lb	46	Andesite feldsparphyric lava, lava breccia
A.l A.lb	41	Andesite lava, lava breccia
A.av A.lv A.bv A.xv	44	Andesite volcaniclastic
YA.av YA.lv YA.bv	40	Andesitic Polymict volcaniclastic
B.l B.lv	45	Basalt lava, lava breccia
B.pl	50	Basalt pillow lava
B.av B.lv B.bv B.xv	49	Basalt volcaniclastic
YB.av YB.lv YB.bv	42	Basaltic Polymict volcaniclastic
Y.av Y.lv Y.bv	58	Polymict rock
av	52	Ash volcaniclastics (composition not determined)

SEDIMENTS

Ss Gw	71	Sandstone, micaceous Greywacke
Sh	68	Shale, black (carbonaceous, pyritic)
Slt	69	Siltstone, tuffaceous Siltstone

SULPHIDES, SULPHATES

BMS	21	Base Metal Sulphide rock
MPy	29	Massive pyrite rock
GS P	23	Glassy silica, colloform pyrite rock
Ba	22	Barite

POST CAMBRIAN ROCKS

TB	8	Tertiary Basalt
JD	32	Jurassic Dolerite
OCg	20	Ordovician Siliciclastics

ALTERATION ROCK TYPES

HA	6	Highly altered rock
Qll	18	Quellite
Q-lv Q-bv	17	Quellite fragmental

PARTIAL STRATIGRAPHIC COLUMN

TB	8	TERTIARY BASALT
JD	32	JURASSIC DOLERITE
OCG	20	ORDOVICIAN SILICICLASTICS
URS	65	UPPER RHYOLITIC SEQUENCE
QRS	68	QUE RIVER SHALE
MGW	71	MT. CHARTER MICACEOUS GREYWACKE
HBS	45	HELLYER BASALT SEQUENCE
HVS / SWB	56	HANGINGWALL VOLCANICLASTIC SEQUENCE / SWITCHBACK VOLCANICLASTIC SEQUENCE
HMS	21	HELLYER MINERALISED SEQUENCE
FPS	48	ANDESITE FELDSPAR PHYRIC SEQUENCE

ALTERATION SYMBOLS

Overprint on "HA" symbol (Combinations can be used)

Carbonate	Illite
Chlorite	Feldspar
Fuchsite	Pyrite
Sericite	Silica

SYMBOLS MAC79,110 AND MAC89,111 SERIES

(SYMBOLS AS SHOWN IN ABEX "STANDARDS FOR GEOLOGICAL DRAWINGS", JAN. 1983)

LINE TH'NESS / LEROY LETTER SIZE (LENGTH AS SHOWN)

.35		Outcrop boundary
.35		Float
.35		Contact known
.35		Contact interpreted
.35		Contact inferred
.35		Facies change
.35		Unconformity
.25		Anticline, syncline with plunge and trend
.25		Minor fold with plunge and trend
.25/50	20 350	Bedding, strike, dip
.25/50	20 350	Foliation, strike, dip
.25/50	20 350	Joint, strike, dip
.5/50,100	F 200 70	Fault, definite, strike, dip, mineralogy
.5/100	F	Fault, inferred
.35		Shear zone
.35/60	A.lv	DDH collar and trace, top 20m geology shown
.25		Grid line, stadia surveyed
.25		Grid line, tape and compass survey
.25		Grid line, nominal position
/60	P 355012	Petrology sample location
.35		Track, unsurveyed
.35		Road (unsealed) or track, surveyed
.7		*Major road*
.35		Costean
.25		Creek
.35		Mining Lease boundary
.5		Exploration Licence boundary
/60	• 13	Peg with number, tape and compass surveyed
/60	⊕ HT17	Peg with number, stadia surveyed
.25		Alteration boundary

5 cm

91-3268.

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Aberfoyle Exploration Pty Ltd

REVISIONS			
Init.	Date	Init.	Date
GLC	12-85		
GLC	1-86		

Location Code: K55/6/44

NORTH WEST TASMANIA

MACKINTOSH E.L.2/70, HATFIELD E.L.15/73

SURFACE GEOLOGICAL MAPPING LEGEND

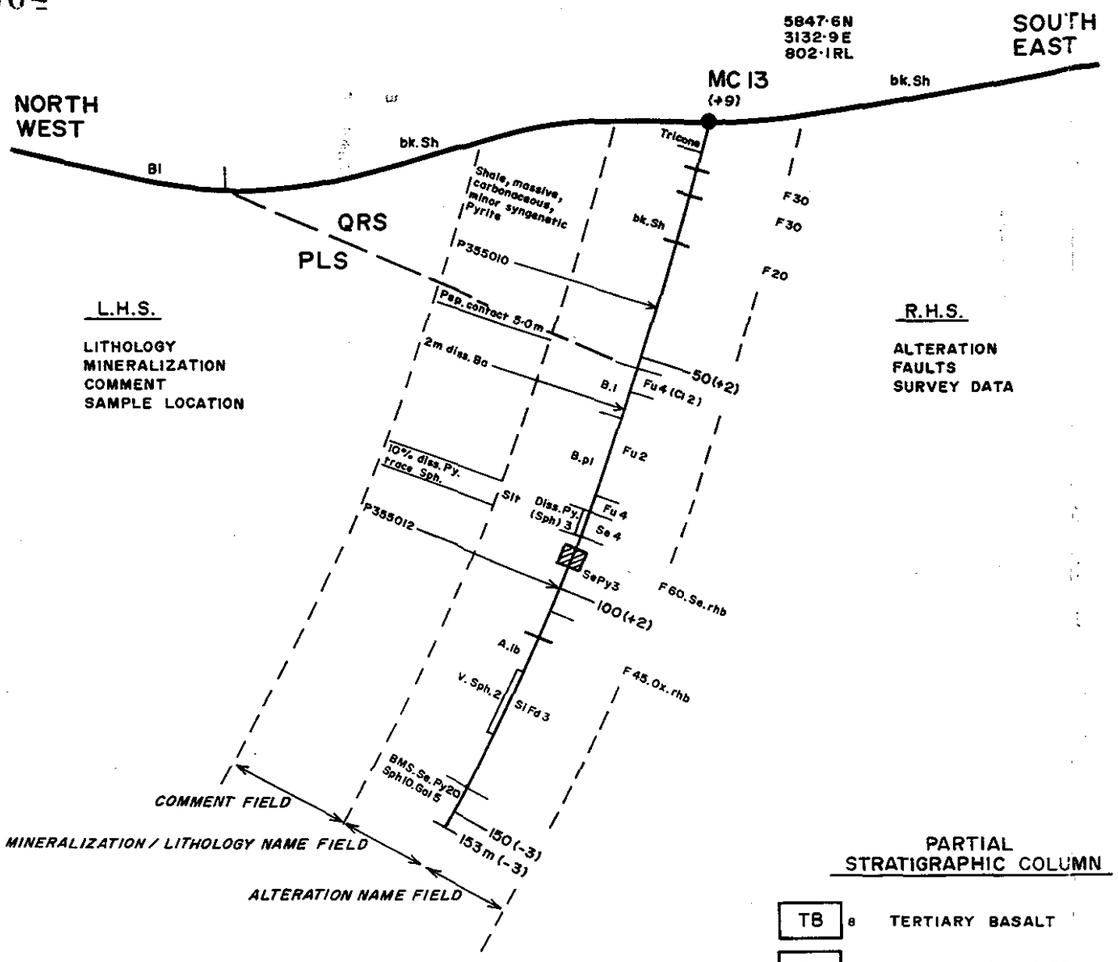
Scale: ———

Date: November, 1985

Compiled:	AMH
Drawn:	AMH
Traced:	GLC
Checked:	AMH
Plate No:	MAC 114

RMO 554

10264



L.H.S.

LITHOLOGY
MINERALIZATION
COMMENT
SAMPLE LOCATION

R.H.S.

ALTERATION
FAULTS
SURVEY DATA

PARTIAL STRATIGRAPHIC COLUMN

TB	8	TERTIARY BASALT
JD	32	JURASSIC DOLERITE
OCG	20	ORDOVICIAN SILICICLASTICS
URS	65	UPPER RHYOLITIC SEQUENCE
QRS	68	QUE RIVER SHALE
MGW	71	MT. CHARTER MICACEOUS GREYWACKE
HBS	45	HELLYER BASALT SEQUENCE
HVS / SWB	56	HANGINGWALL VOLCANICLASTIC SEQUENCE / SWITCHBACK VOLCANICLASTIC SEQUENCE
HMS	21	HELLYER MINERALISED SEQUENCE
FPS	48	ANDESITE FELDSPAR PHYRIC SEQUENCE

MC 13 (+9) — DDH number, DDH collar distance behind (+), in front (-) of section *(-35/100,60)*

5847·6 N, 3132·9 E, 802·1 RL — Survey pick-up of collar *(/60)*

50(+2) — Downhole fiducial, 50m interval for 1:1000 section *(-25/60)*

Lithology, alteration boundary - DDH and surface *(-18/)*

DDH to surface correlation *(-35/)*

B. pl — Lithology abbreviation classification, colour on adjoining table *(/50)*

QRS — Stratigraphic classification *(/100)*

Fu4 (Cl 2) — Alteration composition, intensity. Subordinate alteration type in brackets *(/50)*

F60.Se.rhb — Fault zone, angle to core axis, gouge composition *(-35/50)*

F45.0x.rhb — Fault, angle to core axis, gouge composition *(-35/50)*

Diss. Py. (Sph) 3 — Low grade mineralization disseminated, composition, intensity. Minor sulphides in brackets *(-18/50)*

V. Sph. (Py) 2 — Low grade mineralization vein, composition, intensity. Minor sulphides in brackets *(-18/50)*

P 355010 — Petrology sample location, specify other sample type eg. Pb isotope *(/50)*

BMS. Se. Py20. Sph. 10. Gal. 5 — High grade mineralization, composition, visual estimate *(/50)*

ALL LINEWORK AND LETTERING SHOWN AT ACTUAL SIZE
(LINE THICKNESS / LEROY LETTER SIZE)

NOTE : GEOPHYSICAL AND GEOCHEMICAL DATA ARE SHOWN ON OVERLAYS

VOLCANICS

R.I, R.Ib	26	Rhyolite lava, lava breccia
R.av, R.iv, R.bv, R.xv	25	Rhyolite volcaniclastic
YR.av, YR.iv, YR.bv	65	Rhyolitic Polymict volcaniclastic
D.I, D.I.b	63	Dacite lava, lava breccia
D.av, D.iv, D.bv, D.xv	54	Dacite volcaniclastic
YD.av, YD.iv, YD.bv	56	Dacitic Polymict volcaniclastic
A.fp.I, A.fp.Ib	48	Andesite feldsparphyric lava, lava breccia
A.I, A.Ib	41	Andesite lava, lava breccia
A.av, A.iv, A.bv, A.xv	44	Andesite volcaniclastic
YA.av, YA.iv, YA.bv	40	Andesitic Polymict volcaniclastic
B.I, B.Iv	45	Basalt lava, lava breccia
B.pl	50	Basalt pillow lava
B.av, B.Iv, B.bv, B.xv	49	Basaltic volcaniclastic
YB.av, YB.Iv, YB.bv	42	Basaltic Polymict volcaniclastic
Y.av, Y.iv, Y.bv	58	Polymict rock
av	52	Ash volcaniclastics (composition not determined)

SEDIMENTS

Ss Gw	71	Sandstone, micaceous Greywacke
Sh	66	Shale, black (carbonaceous, pyritic)
Slt	69	Siltstone, ruffaceous Siltstone

SULPHIDES, SULPHATES

BMS	21	Base Metal Sulphide rock
MPy	29	Massive pyrite rock
GS P	23	Glassy silica, colloform pyrite rock
Ba	22	Barite

POST CAMBRIAN ROCKS

TB	8	Tertiary Basalt
JD	32	Jurassic Dolerite
OCg	20	Ordovician Siliciclastics

ALTERATION ROCK TYPES

HA	6	Highly altered rock
Qll	18	Quellite
Q-lv, Q-bv	17	Quellite fragmental

ALTERATION

Si	2	Silica	SeCl	30	Sericite Chlorite
SiFd	13	Silica Feldspar	SePy	39	Sericite Pyrite
SiFdCl	14	Silica Feldspar Chlorite	Se	38	Sericite
Cl	47	Chlorite	Fu	46	Fuchsite
ClCo	41	Chlorite Carbonate	Il	19	Illite

5 cm

INTENSITY SCALE

1 Trace
2 Weak
3 Moderate
4 Strong
5 Extreme

91-3268.

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REVISIONS			
Init	Date	Init	Date
GLC	12·85		

NORTH WEST TASMANIA

MACKINTOSH E.L.2/70, HATFIELD E.L.15/73

GEOLOGICAL LEGEND
1:1000 SCALE DDH SECTIONS

Location Code: K55/6/44 | Scale: ——— | Date: November, 1985.

Compiled:	AMH
Drawn:	AMH
Traced:	GLC
Checked:	AMH
Plate No:	MAC 115

654023

RMO 554

10265

— LITHOLOGICAL LEGEND —

QUATERNARY

- Qa,g,u_2 — ALLUVIUM/SWAMP(a), GLACIAL(g) UNDIFFERENTIATED(u)

TERTIARY

- TB_8 — BASALT LAVA
- TS_7 — SILCRETE

DEVONIAN SILURIAN

- $S\text{-}D_{30}$ — ELDON GROUP SEDIMENTS (UNDIFFERENTIATED)

ORDOVICIAN

- Ogl_{34} — GORDON GROUP (UNDIFFERENTIATED)
- Oms_{33} — MOINA SANDSTONE

EARLY ORDOVICIAN LATE CAMBRIAN

- ϵOuu_{15} — UPPER UPPER OWEN - CHERT BEARING CONGLOMERATE & SANDSTONE (PIONEER BEDS EQUIVALENT)
- ϵOul_{17} — LOWER UPPER OWEN - WELL BEDDED PINK SANDSTONE
- ϵOom_{14} — MIDDLE OWEN - DOMINANTLY PEBBLE CONGLOMERATE
- ϵOon_{16} — NEWTON CREEK SANDSTONE MEMBER EQUIVALENT

Tyndall Group

- $TV_{1\ 39}$ — RED VOLCANICLASTIC CONGLOMERATE (? DORA CONGLOMERATE EQUIVALENT)
- $TV_{2\ 38}$ — RED ASH-LAPILLI VOLCANICLASTIC, MINOR CONGLOMERATE

Southwell Sub-Group

- RDI_{26} — RHYOLITIC-DACITIC LAVA & SHALLOW INTRUSIVE
- Ms_{29} — MICACEOUS SANDSTONE, SHALE & MINOR CONGLOMERATE
- Flv_{25} — FELSIC LAPILLI VOLCANICLASTICS, OFTEN EUTAXITIC
- URS 1_{65} — QTZ.XTAL RICH VOLCANICLASTICS ± BLACK SHALE MATRIX, BLACK VITRIC VOLCANICLASTIC ± EUTAXITIC FRAGS
- URS 2_{69} — GREY LAMINATED SILTSTONE & LITHIC WACKE CONTAINING BLACK SHALE & CHERT FRAGMENTS
- URS 3_{68} — BLACK SHALE LENSES
- 65 4_{52} — QTZ.XTAL RICH VOLCANICLASTICS WITHOUT BLACK SHALE OR BLACK VITRIC MATRIX

Que River Beds

- QRS_{68} — BLACK CARBONACEOUS QTZ./MICA SHALE

Dundas Group

Que-Hellyer Volcanics

- Bpl_{50} / Bl_{45} — AMYGDALOIDAL BASALT SHEET LAVA (Bl) & PILLOW LAVA (Bpl) WHICH INCLUDES HYALOCLASTITE BRECCIA & INTERPILLOW CHERT
- Bvc_{49} — BASALT VOLCANICLASTIC (± BMS SULPHIDE FRAGMENTS IN GOLDEN TRIANGLE)
- $Afpl_{48}$ — ANDESITE FELDSPARPHYRIC LAVA, COMMONLY AUTOBRE-CCIATED
- Avc_{44} — ANDESITIC VOLCANICLASTIC
- Dl_{63} — DACITE LAVA MASSIVE, COMMONLY FLOW BANDED, WEAKLY FELDSPAR PORPHYRITIC
- Dvc_{54} — DACITIC VOLCANICLASTIC
- Yvc_{58} — CLAST DOMINANT, LAPILLI TO BRECCIA VOLCANICLASTICS. CONTAINS CLASTS OF ANDESITE, BASALT, DACITE & BASE METAL SULPHIDES COMMONLY IN A CHERT MATRIX.
- HA_6 — STRONGLY SERICITE-PYRITE-QUARTZ ALTERED ROCKS ALTERATION OBLITERATES PRIMARY FEATURES
- BMS_{21} — BASE METAL SULPHIDE LENSES
- Ba_{22} — MASSIVE COARSELY CRYSTALLINE TO WEAKLY BEDDED BARITE
- MSs_{71} — MASSIVE QTZ./MICA SANDSTONE. COMMON INTERBEDS OF BLACK CARBONACEOUS QTZ./MICA SHALE

S.W. of Mt. Charter Fault

- R_{26} — QTZ. FELDSPAR PORPHYRY INTRUSIVES
- Sh_{68} — BLACK SHALE, SILTSTONE
- Fl_{46} — FELSIC LAVA, MOSTLY FELDSPARPHYRIC, MASSIVE TO VESICULAR

Central Volcanic Complex

- CVl_{18} — FELSIC VOLCANICLASTIC ± EUTAXITIC FRAGMENTS (IGNIMBRITE?)
- $CV_{2\ 13}$ — RHYODACITIC - RHYOLITIC LAVA & POSSIBLE INTRUSIVES
- $CV_{3\ 11}$ — ASH TO FINE LAPILLI VOLCANICLASTIC

CAMBRIAN

INTRUSIVE LITHOLOGIES

- Kl_{19} — ?CRETACEOUS LAMPROPHYRE DYKES
- Dol_{32} — ?DEVONIAN DOLERITE SILLS
- R_{26} — QTZ.(FELDSPAR) PORPHYRITIC RHYOLITE SILLS
- ADi_{64} — ANDESITIC - DACITIC INTRUSIVES. COMMON IN MSs GROUND 1600 N 6000E

UNASSIGNED SEQUENCE – East of Henty Fault

- RDl_{26} — RHYOLITIC TO RHYODACITIC LAVA &/OR INTRUSIVE
- MSs_{71} — MICACEOUS SANDSTONE & INTERBEDDED SHALE
- Dvc_{54} — DACITIC VOLCANICLASTIC
- Rvc_{27} — RHYOLITIC VOLCANICLASTIC
- Bl_{45} — BASALTIC LAVA

- GEOLOGICAL BOUNDARY, ACCURATE/APPROXIMATE
- GEOLOGICAL BOUNDARY, INFERRED/CONCEALED
- ? ? ? LIMIT OF INFORMATION
- FAULT, ACCURATE / APPROXIMATE
- FAULT INFERRED
- EARLY ANTICLINE, SYNCLINE
- LATE ANTICLINE, SYNCLINE
- STRIKE & DIP OF BEDDING – FACING KNOWN, OVERTURNED, FACING UNKNOWN, VERTICAL
- STRIKE & DIP OF CLEAVAGE, VERTICAL CLEAVAGE
- FLOW BANDING IN INTRUSIVE OR EXTRUSIVE ROCKS, VERTICAL FLOW BANDING
- DIAMOND DRILLHOLE COLLAR
- TB 0 / SD 200 / 210 — DDH ± THICKNESS OF TERTIARY BASALT & BASEMENT ROCK TYPE
- MACROFOSSIL LOCALITY

5 cm

91-3268.

Aberfoyle Resources Limited
EXPLORATION DIVISION
654624

REVISIONS			
Init.	Date	Init.	Date

Location Code :

NORTH WEST TASMANIA
MACKINTOSH E.L. 106/87
GEOLOGICAL LEGEND
1:10 000 INTERPRETIVE GEOLOGY

Scale : N/S
Date : June, 1989

Compiled : AMcN
Drawn : JLR
Traced :
Checked :
Plate No. : MAC 247

1511

10266

SOUTH WEST CONSERVATION AREA

LAKE MACKINTOSH

CONSERVATION BOUNDARY

3500 N 3000 N 2500 N 2000 N 1500 N

7500 E 7000 E 6500 E 6000 E

392000 mE 391000 mE

280 260 240 220 200 180 160 140 120 100 080 060 040 020 000 980 960 940 920 900 880 860 840 820 800 780 760 740 720 700 680 660 640 620 600 580 560 540 520 500 480 460 440 420 400 380 360 340 320 300

6700E 3400N pegs

6400E, 1750N peg

6000E peg

gr-gy,vcs,vn A-B lb. (515119P)

min l gt - dk gn fp A-B l

gy-gn dv vcs A-B l

pk - br D.I / cl. spr

bx - gn A fp l

gy D.I / S:5/Q vn

gy-gn mas A fpl

dk gy-gn fp A l

gn A-B l. (517851 P)

038m

Qtz (gloci-ol)

D. I (517850)

Cliff

B.l mas m to

Py & fg B l-b

B l

gn bx B l & Ch mtx crsel of hill (5151137 P)

A.l + B.l

A fp to f B l & f

gn fp A-B l

pk gn br D.l / S:(1-2) gy Py p. + fp. A-B l.

A. l

gr-gy B l

A fp to f B l & f

A. l + B l.

A. l

gn-gy B l / Ep. spr / Py (2)

lgt gr-gy hx B.l (515152 P)

gn-br fp A-B l

gn-gy B l / Ep. spr B l.

dk. gn-gy Ep. spr B l.

lgt gy-gn ves B.l.

vr. l bd. A-B. f fv. (5151137 P)

D.l + A.l.

A - D.l.

D. l

A-D.l.

gn-br. Cl. spr sil. D.l.

D.l. + B.l.

dk. gn. fp. A.l.

rd - Pk sil Cg m.g / Qvn 3-4

shd. vlcl. / hmt 4

Pk Qtz + Qg

D.l / hmt 2-3

shd. D.l. / Qvn 3-4 (429477P)

Qtz / Sil 3-4 / Qvn 3-4

gy Sil Cg m.g

br-gn shd. D.l. / Sil 3-4

gn. vlc. / Sil 3-4

Pk - gy Qtz / Sil 2-3 / Qvn 3-4 (Ord)

Pk - gy Qtz / Sil 1-2

br. D.l. ? shd. / Sil 2 (427478P)

gy-gn. vlc. shd. phyllitic / Ser 2-3

gy-wht. vlc. shd. / ser 3-4 Ch mix bands + mm. ibd. sh. / Qvn l-2 (429476P)

shd. Mic Ss / Qvn l-2

shd. vlc. sh. & sil. Qz.

vlc. sh. / ser 5, chl. l. / Qvn l-2

gy Mic Ss wk. fold

shd. vlc. + phyllitic qtzsh.

rd - Pk sil Cg m.g / Qvn 3-4

shd. vlcl. / hmt 4

gy sh. (phyllitic) mvr. ibd. Mic Ss. mvr. folding

gy phyllitic sh. mvr. kink bands. ibd. xv / Q + Co vn.

gy Mic Ss

xv. fp. sh / Ser 3

gr-gy. gn. wk. shd.

(427440 P)

gy phyllitic sh / Qvn. Mullions

gy sh. shd / Qvn. Σ kink bands

gy Mic Ss. mas.

gy Mic Q + fp Ss. ibd gy sh.

sh. shd. / Q + Co vn.

gy xv. fp. Sil. / Qvn (427436 P.)

gy-br Mic Ss. mas / Qvn

(427437 P.)

Mic Ss. ibd. sh.

Mic Ss. mas.

gy Mic Ss / Qvn

gy sh. ibd Mic Ss. fg.

Mic Ss. ibd sh.

Mic Ss / Qvn

Mic Ss. ibd. sh. / Sil 3 / Qvn

gr. A. l ? fp. mas. (427438P)

lgt-dk gn. A fp. l. ves (427439P)

gy Mic Ss

Mic Ss. ibd. sh.

Mic Ss

gy sh. ibd Mic Ss. fg.

gy-sh. phyllitic

gy phyllitic sh. ibd. Mic. Ss / Qvn (427435P)

gn-gy. xv. Q + fp. ibd. gy sh.

wht. vlcl. fp ? / Lch 5

gy sh / Lch 4

gy-br Mic Ss. mas. / Qvn.

gy-gn Mic Ss

R. l. fp. / Se (1-2) (315749 P)

Mic Ss

gy-br. gn. fp. D.l. / wk. Shd.

Mic Ss

xx. cm. Cl. Spt + Sil. D.l. / wk. Shd

D.l. / Si Se (2)

gloci-ols

xv. gy. mas. f. mg. Mic. Ss

lgt. gn fp. D.l. / wk. Shd. (562653)

mas. gy fg + ?pep. A.l. / Ep. Spr (562654)

gloci-ols (Mica Schist + Qtz)

gn. br f.g. Mic Ss / Qvn (2)

gr. br. A. D.l.

Mic Ss

gy-gn Cl. Spt D.l. / wk Shd

gn. br. sil. fp. D.l. / wk Shd

br. m.g. mas. Mic Ss

gy-br. wk. Shd. D.l.

gn. fp. A.l. / wk. Shd (562658)

A.l. ?

Mic Ss.

dk. gn. A.l. (515750 P)

D.l. + A.l.

mas. fg. Mic Ss.

fp. D.l.

Mic Ss. ibd. Sh.

D.l. + Mic. Ss.

px. br. mas. fp. D.l. (315751 P)

br. gy mas. Mic Ss.

fp. D.l.

fp. lb. ?

gr. br. fg. Mic Ss.

gy-br. Mic Ss. mas. / mnr Q vn

gy-br. Mic Ss. mas. / Qvn.

gy-br. gn. fp. D.l. / wk. Shd.

gn. br. fg. Mic Ss / Qvn (2)

gr. br. A. D.l.

Mic Ss

gy-gn Cl. Spt D.l. / wk Shd

gn. br. sil. fp. D.l. / wk Shd

br. m. g. mas. Mic Ss

gy-br. wk. Shd. D.l.

gn. fp. A.l. / wk. Shd (562658)

dk. gn. A.l. (515750 P)

mas. fg. Mic Ss.

gloci-ols (gy Qtz)

gn. fp. Cl. por. A.l (562659)

Mic Ss.

Mic Ss

gy fr. D.l.

Mic Ss. ibd. sh.

Mic Ss.

Mic Ss. ibd. sh.

Mic Ss.

Mic Ss.

Mic Ss. ibd. sh. / Sil 3 / Qvn

gr. A.l. ? fp. mas. (427438P)

lgt-dk gn. A fp. l. ves (427439P)

gy-br Mic Ss. mas. / Qvn.

gy-br Mic Ss.

R. l. fp. / Se (1-2) (315749 P)

Mic Ss.

gn. br. fg. Mic Ss / Qvn (2)

gr. br. A. D.l.

Mic Ss.

gy-gn Cl. Spt D.l. / wk Shd

gn. br. sil. fp. D.l. / wk Shd

br. m. g. mas. Mic Ss.

gy-br. wk. Shd. D.l.

gn. fp. A.l. / wk. Shd (562658)

A.l. ?

Mic Ss.

dk. gn. A.l. (515750 P)

D.l. + A.l.

mas. fg. Mic Ss.

fp. D.l.

Mic Ss. ibd. Sh.

D.l. + Mic. Ss.

px. br. mas. fp. D.l. (315751 P)

br. gy mas. Mic Ss.

fp. D.l.

fp. lb. ?

gr. br. fg. Mic Ss.

gy-br. Mic Ss. mas. / mnr Q vn

gy-br. Mic Ss. mas. / Qvn.

gy-br. gn. fp. D.l. / wk. Shd.

gn. br. fg. Mic Ss / Qvn (2)

gr. br. A. D.l.

Mic Ss

1026

3500 N
3000 N
2500 N
2000 N
1500 N
6000 E
5500 E
5000 E
4500 E

OPEN RAINFOREST
HORIZONTAL

25m step south

MC-19

5 cm

91-3268.

Aberfoyle Resources Limited
EXPLORATION DIVISION
654C26

NORTH WEST TASMANIA

MACKINTOSH E.L. 2/70 / HATFIELD E.L. 15/73

OUTCROP GEOLOGY

REVISIONS			
Init.	Date	Init.	Date
AMcN/rje	20-1-89	AMcN tn	4-4-91
AMcN/rje	5-10-89		
AMcN/jms	16-2-90		
AMcN/rje	13-6-90		
AMcN/rje	20-12-90		
AMcN/rje	2-1-91		

Location Code : K55/6/44

Scale: 1 : 2500

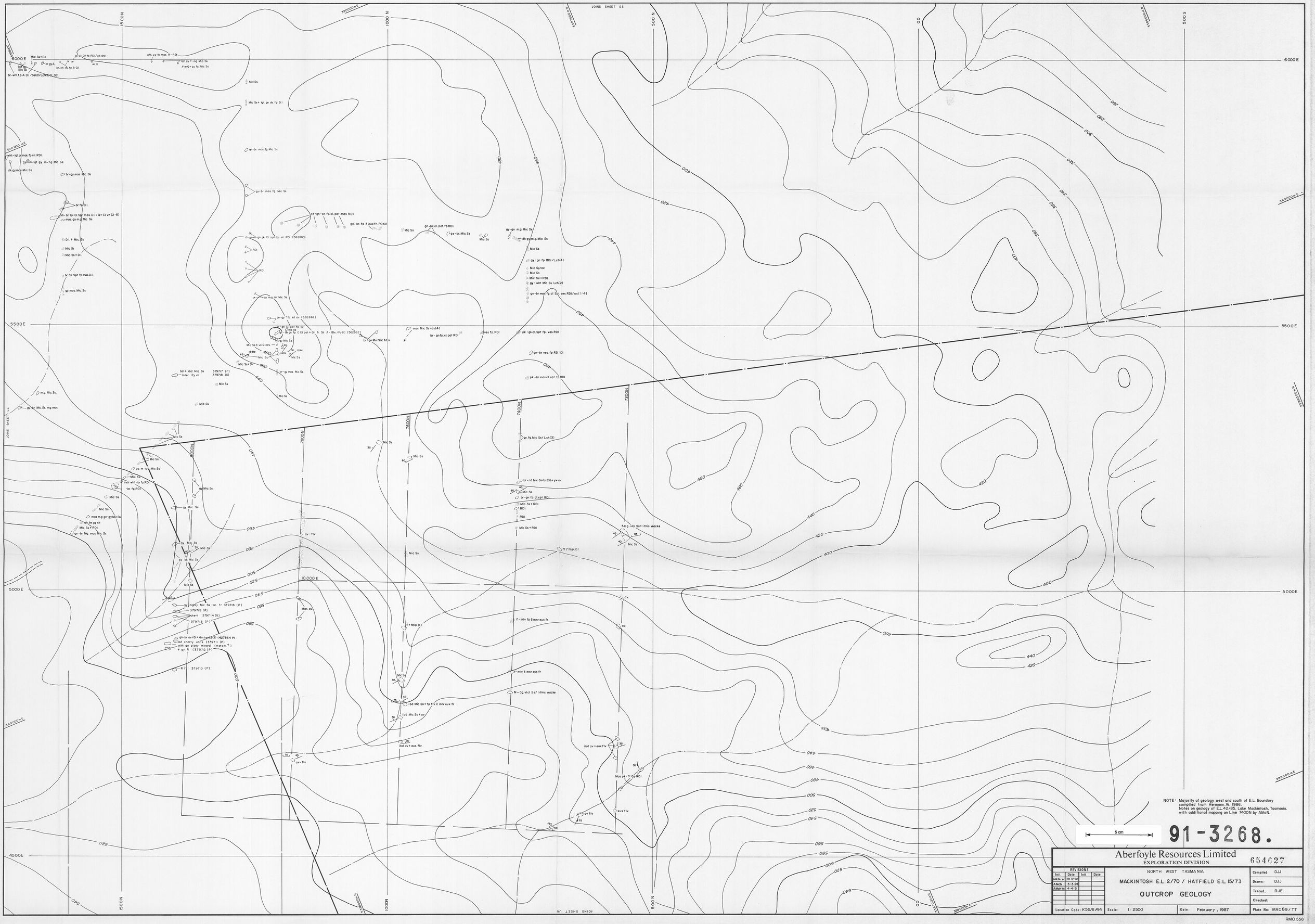
Date: January 1989

Compiled: AMcN
Drawn: RJE
Traced: RJE
Checked: AMcN

Plate No: MAC 89/LL

RMO 556

10268



NOTE: Majority of geology west and south of E.L. Boundary compiled from Hermann, W. 1986.
Notes on geology of E.L. 42/85, Lake Mackintosh, Tasmania, with additional mapping on Line 7400N by AMcN.

5 cm

91-3268.

Aberfoyle Resources Limited
EXPLORATION DIVISION

654627

REVISIONS			
Init.	Date	Init.	Date
AMcN/JR	28-12-90		
AMcN	5-3-91		
AMcN/H	4-4-91		

NORTH WEST TASMANIA

MACKINTOSH E.L. 2/70 / HATFIELD E.L. 15/73

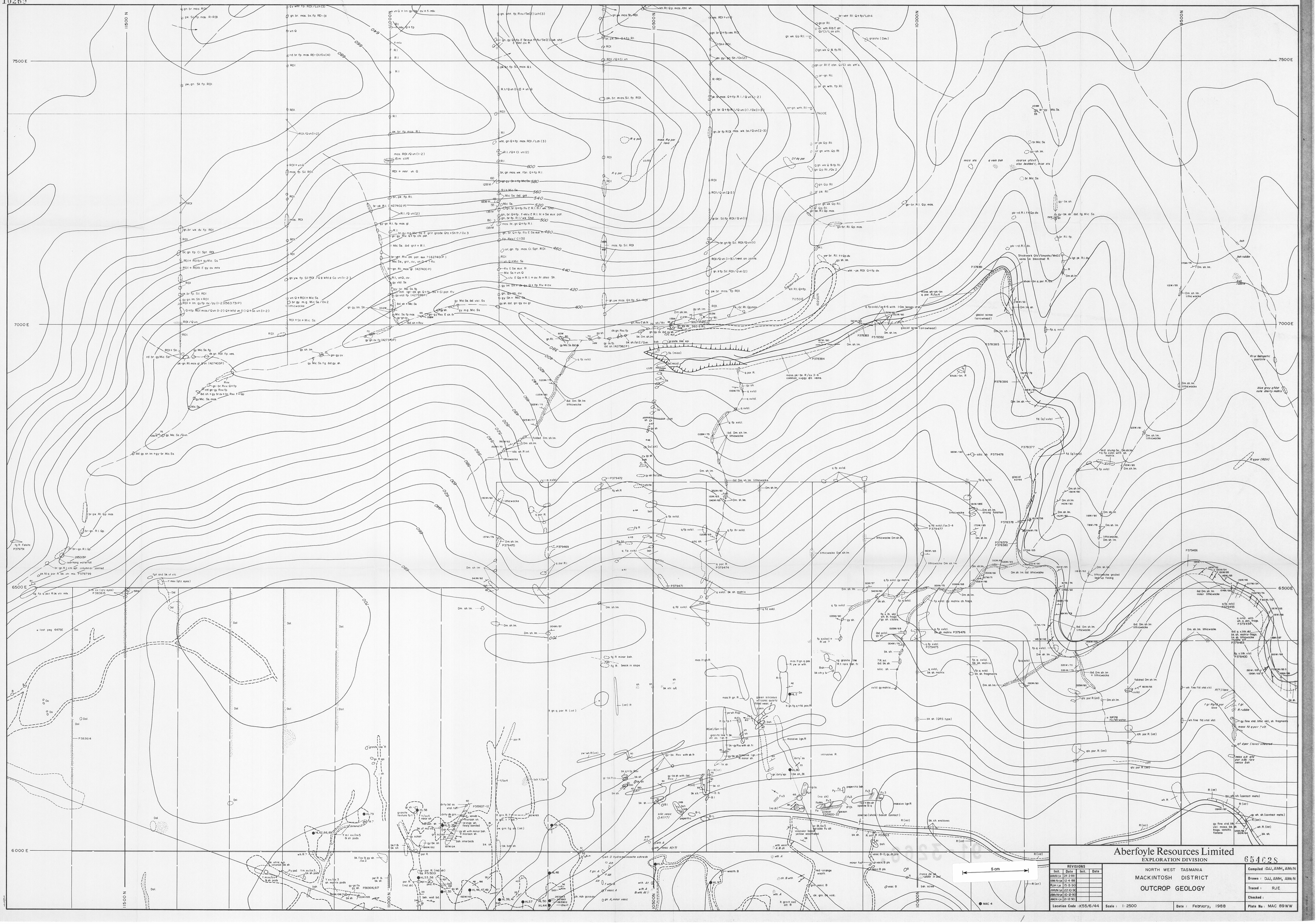
OUTCROP GEOLOGY

Compiled: DJJ
Drawn: DJJ
Traced: RJE
Checked:

Location Code: K55/6/44 | Scale: 1:2500 | Date: February, 1987 | Plate No: MAC89/TT

RMO 556

10269



Aberfoyle Resources Limited

EXPLORATION DIVISION

654628

NORTH WEST TASMANIA

MACKINTOSH DISTRICT

OUTCROP GEOLOGY

REVISIONS			
Init.	Date	Init.	Date
AMcN/rje	24-2-88		
AMcN/rje	12-4-88		
RJH/rje	15-8-90		
AMcN/rje	22-10-90		
AMcN/rje	10-12-90		
AMcN/rje	21-12-90		

Location Code : K55/6/44

Scale : 1:2500

Date : February, 1988

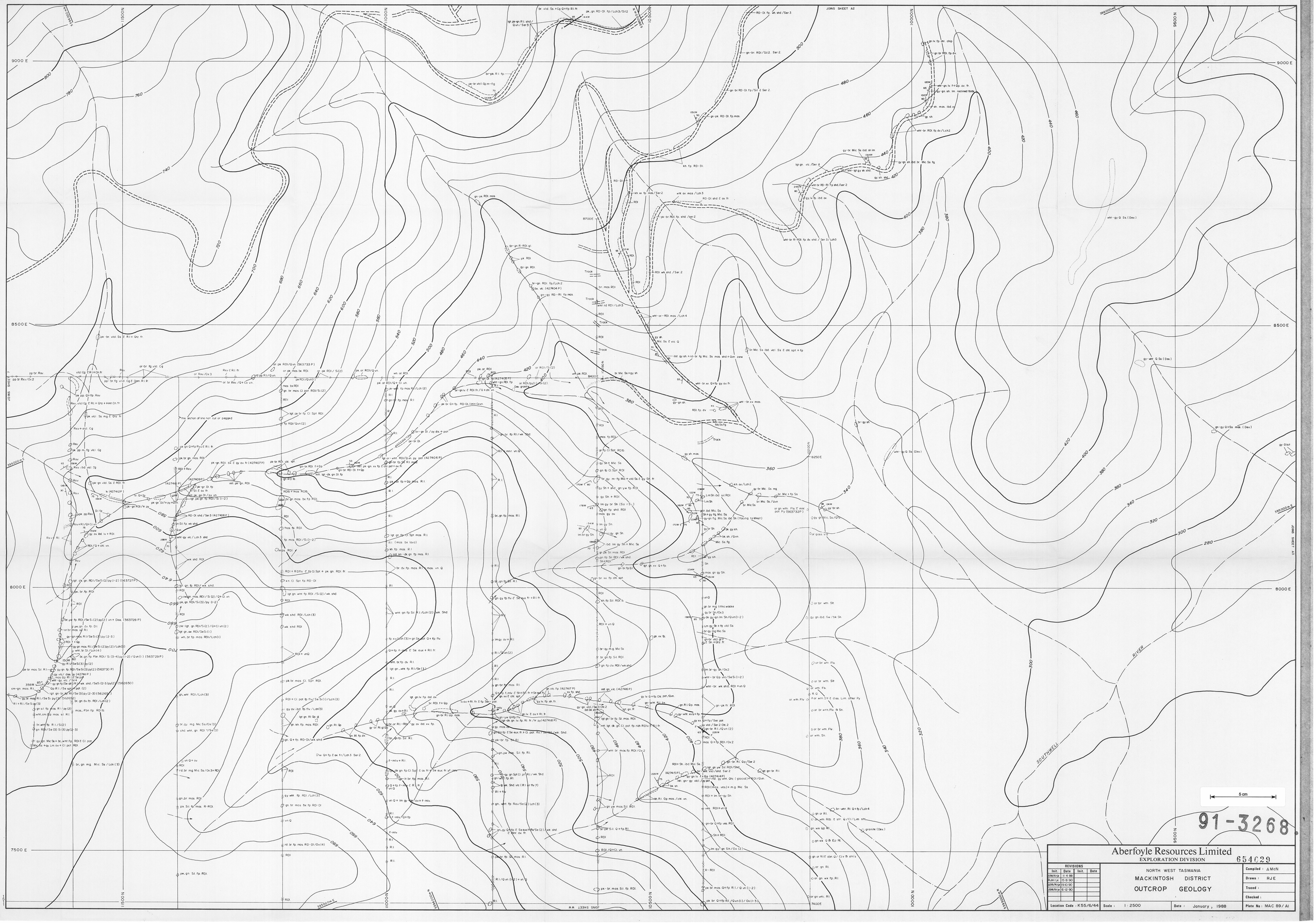
Compiled : DJJ, AMH, AMcN

Drawn : DJJ, AMH, AMcN

Traced : RJE

Checked :

Plate No : MAC 89WW


JOINS SHEET A2
JOINS SHEET A3
JOINS SHEET 7
9000 E
8500 E
8000 E
7500 E
11500 N
11000 N
10500 N
10000 N
9500 N
SOUTHWELL
RIVER
5 cm
91-3268.
Aberfoyle Resources Limited
EXPLORATION DIVISION
654629
REVISIONS
Init. Date Init. Date
AMcNrje 11-4-88
RJHrje 15-8-90
AMcNrje 19-10-90
AMcNrje 6-12-90
NORTH WEST TASMANIA
MACKINTOSH DISTRICT
OUTCROP GEOLOGY
Compiled : AMcN
Drawn : RJE
Traced :
Checked :
Location Code : K55/6/44
Scale : 1 : 2500
Date : January , 1988
Plate No : MAC 89/ A1

10271

JOINS SHEET 8

JOINS SHEET 15

JOINS SHEET 9

JOINS SHEET A1

14000 N

13500 N

13000N

12500N

12000 N

9000 E

8500 E

8000E

7500 E

Rivr.

Southwell

TASMANIAN HIKE TRACK

CRIPPS

TB foot + red soil

pk-br vicl Cg

pk-br xv f + Qp

vicl Cg c.g / Lch 4

pk-br vicl Cg c.g

pk-br vicl Cg c.g. E fp. l fr.

pk-br vicl Ss fp mos.

pk-br vicl Ss fp (427394P)

pk-br xv. / mnr. Qvn.

pk-br xv. E mnr. Hem. fr (427943P)

pk-r d. xv. f + Qp mnr. fp. l. fr.

pk-br vicl Cg. fp. E Q+fp. l. fr.

pk-br xv. f + Qp

pk-br Sh. ibd. xv. f.g. f + Qp. mnr. fp. l. fr.

pk-br xv. Q + fp.

pk-br Sh.

xv. E ibd. Sh.

pk-br Sh. ibd. xv.

Pk. br xv. m-f fp. fr. / Qvn.

vicl Cg. fg

gn-br vicl Ss. Q + fp. Mic. E R-RDI fr

br xv. Q + fp. mos. / Lch. 3

br. Mic. Ss. f.g.

pk-gn. Rxv. Q + fp.

br. ov. mos. / MnO_2 stained

vicl Cg. mnr. ibd. xv.

pk-br vicl Cg. m-cg

or. br. fg. v.ibd. xv / Ox (2)

vicl Cg. ibd. mnr. xv.

g. pp. br. Q + fr. Rxv. E mnr. R.I. fr.

vicl. cg. f.g.

pk-br vicl. Cg. c.g. over-lies xv.

pk-br vicl. Ss. f + Qp. ibd. mos. vicl. Cg.

pk-br vicl. Ss.

vicl. Ss.

pk. br. R x.v.

pp-gn Q + fp. Rxv.

pp Lm cv - f.g. Rxv

pk-gn-pp Q + f p Rxv

pk-gn Q + fp. Rxv E mos. R.I. fr.

pp-gn Rlv Q + fp. E R.I. + Qtz. fr.

Rlv E R.I. + Qtz. fr.

Q + fp Rlv

pk-gn Q + fp Rlv E R.I. fr.

wht. br. Q + fp. Rx.v / Lch (4)

gn. pp Q + fp. Rxv E R.I. fr.

Rxv. E R.I. + Δ l. fr.

pp. pk. f. mg. vicl. Cg. mos. Rxv. + fg. vicl. Cg.

pk. gn f.g. vicl. Cg.

pk. rd. mos. Q + fp. Rxv.

wht. lgn. gn. R.I / Mnr. on joints / Qvn (2)

gy. pk. Q + fp. R.I / Si-pp (1-3) (563726 P)

gn-br. Q + fp R.I.

vicl. Cg. mnr. ibd. xv

Rxv.

Rev

5 cm

91-3268.

Aberfoyle Resources Limited

EXPLORATION DIVISION

654630

REVISIONS			
Init.	Date	Init.	Date
AMcN	28-4-88		
AMcN	19-10-90		
AMcN	8-4-91		

NORTH WEST TASMANIA

MACKINTOSH DISTRICT

OUTCROP GEOLOGY

Compiled :

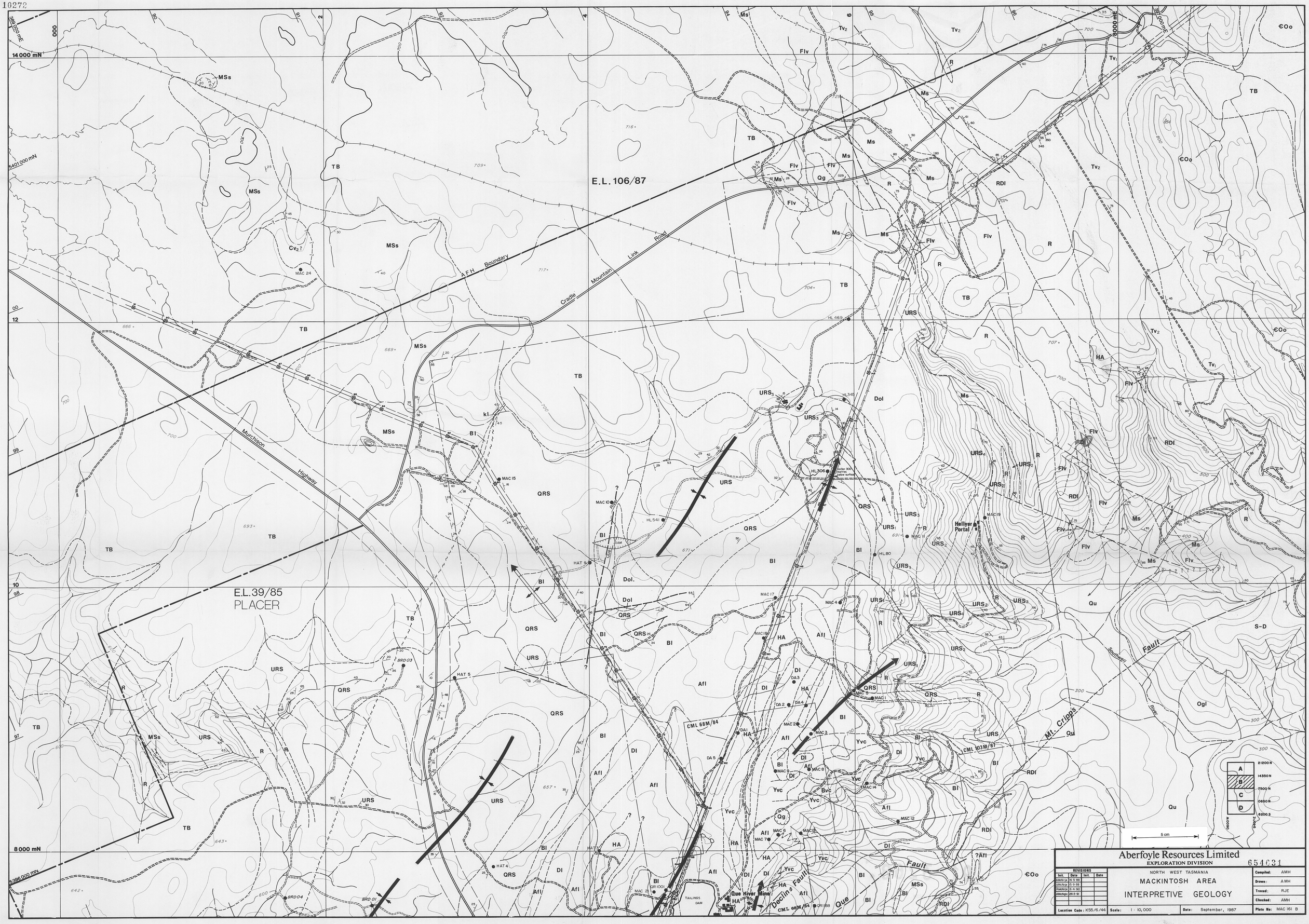
Drawn : RJE

Traced :

Checked :

Location Code : K55/6/44 | Scale : 1: 2500 | Date : December, 1987 | Plate No : MAC 89/7

10272



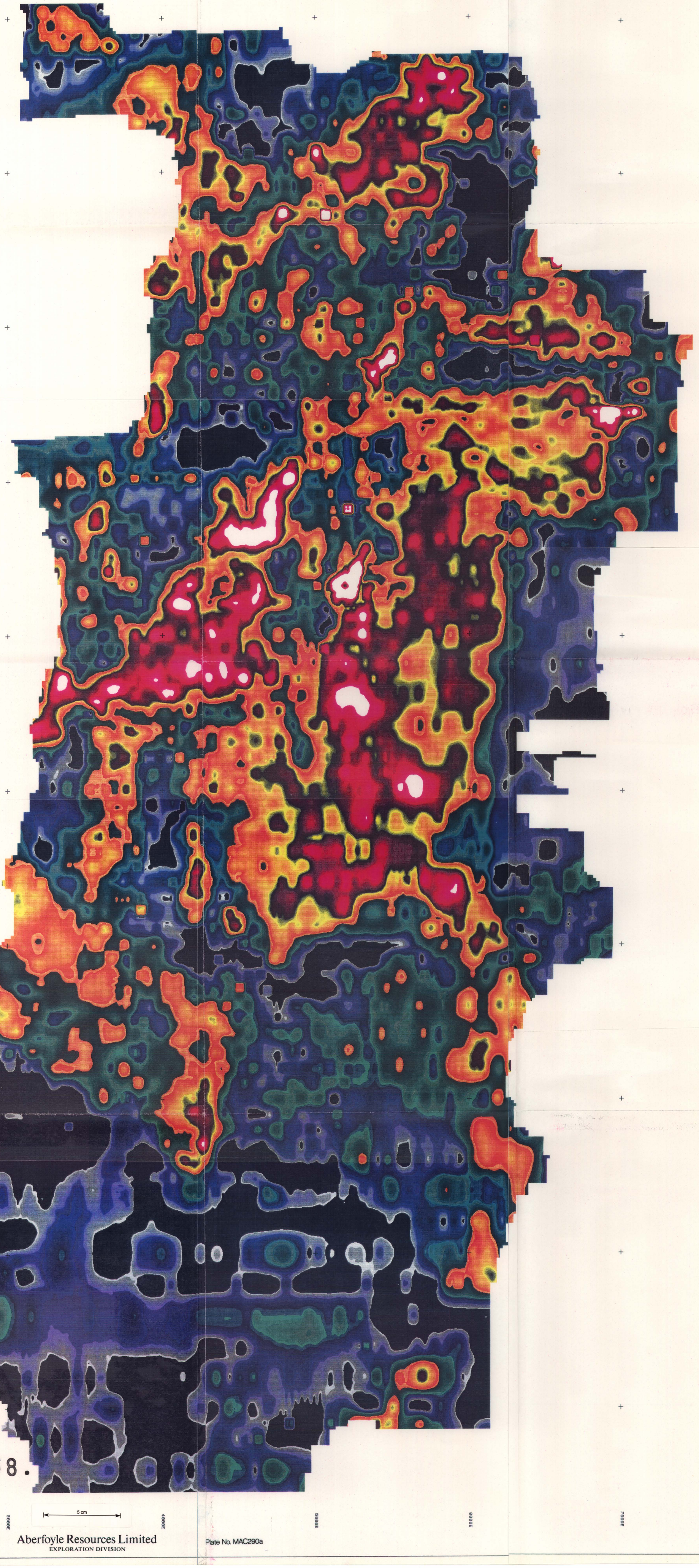
E.L. 106/87
E.L. 39/85
PLACER
AFH Boundary
Cradle Mountain Link Road
Murchison Highway
Hellyer Portal
Que River Mine
Decline Fault
Que Fault
Mt. Cripps Fault
Southwell River
CML 68M/84
CML 103M/87
TAILINGS DAM
14 000 mN
8 000 mN
5 cm
Aberfoyle Resources Limited
EXPLORATION DIVISION
654C31
NORTH WEST TASMANIA
MACKINTOSH AREA
INTERPRETIVE GEOLOGY
REVISIONS
Compiled: AMH
Drawn: AMH
Traced: RJE
Checked: AMH
Location Code: K55/6/44
Scale: 1:10,000
Date: September, 1987
Plate No: MAC 161 B

10273



E.L.39/85
PLACER
E.L. 37/89
PASMINCO
E.L.106/87
E.L.2/90
BILLITON
E.L.42/85
PAN CON
E.L. 106/87
Mt. Charter Fault
Que Fault
Henty Fault
Mackintosh Lake
Mine Access Road
Murchison Highway
Que River Portal
Mt. Charter
The Shark's Fin
Sock Creek
CONCEALED WESTERN LIMIT OF QUE-HELLYER VOLCANICS
5395000 mN
6000 mN
2000 mN
5390000 mN
387000 mE
8000 mE
395000 mE
A
B
C
D
21200 N
14350 N
7500 N
0650 N
6200 S
5 cm
Aberfoyle Resources Limited
EXPLORATION DIVISION
654632
NORTH WEST TASMANIA
MACKINTOSH AREA
INTERPRETIVE GEOLOGY
REVISIONS
Init. Date Init. Date
AMcN/jr 16·5·88
AMcN/jr 21·5·89
AMcN/jrs 24·10·89
RJE 21·2·90
AMcN/jrs 2·4·90
AMcN/jrs 27·3·91
Location Code: K55/6/44
Scale: 1:10,000
Date: September, 1987
Compiled: AMH, AMcN
Drawn: AMH, AMcN
Traced: RJE
Checked: AMH
Plate No: MAC 161C

10274



91-3268.

654633

5 cm

Mackintosh Soil Geochemistry
C Horizon Cu
Scale: 1-10000 18-4-90

Aberfoyle Resources Limited
EXPLORATION DIVISION

Plate No. MAC290a

10275

11000N

10000N

9000N

8000N

7000N

6000N

5000N

4000N

3000N

2000N

457.33

173.57

65.87

25.00
MIN. 0.00
units = PPM

91-3268.

654634

3000E

4000E

5000E

6000E

7000E

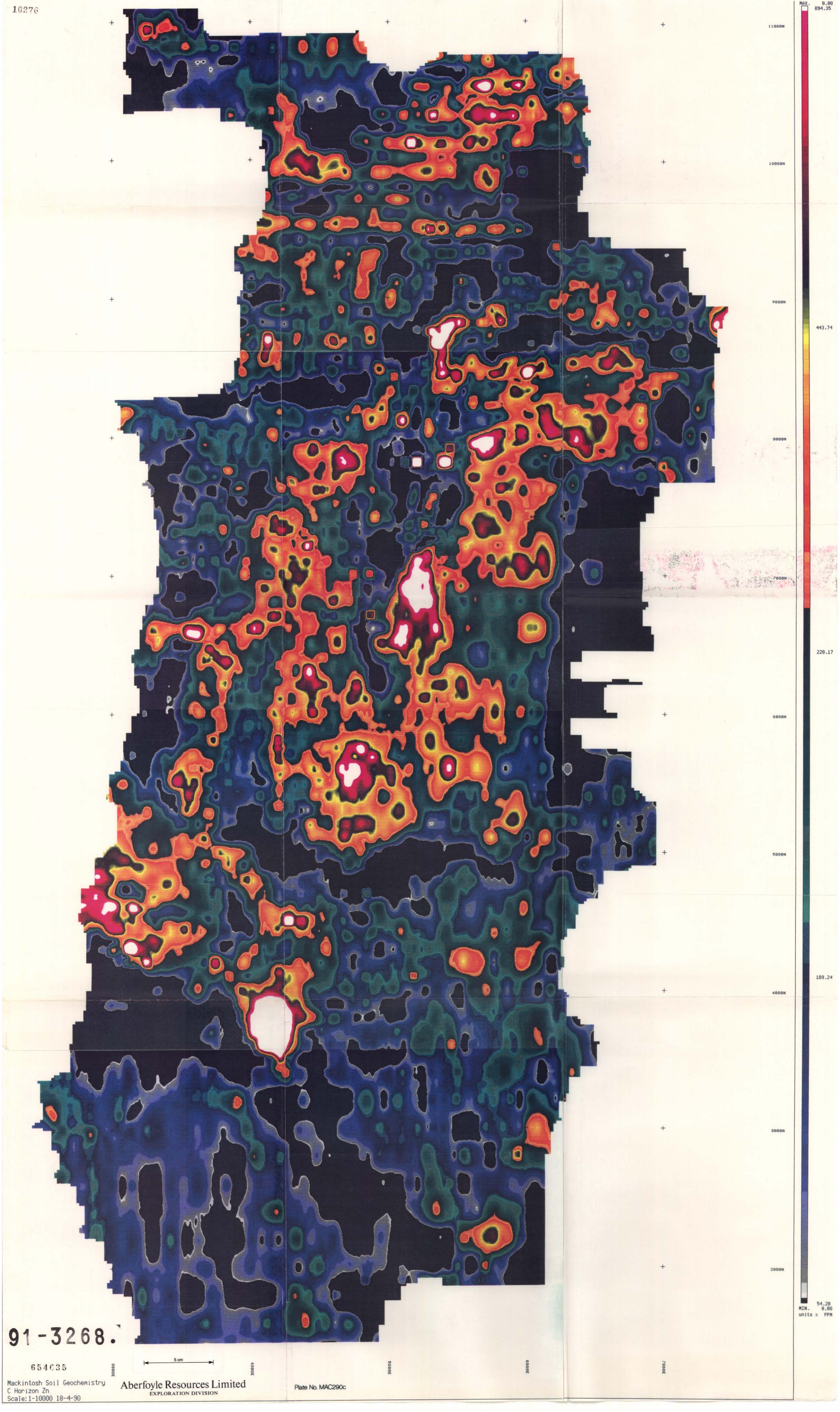
5 cm

Mackintosh Soil Geochemistry
C Horizon Pb
Scale: 1-10000 18-4-90

Aberfoyle Resources Limited
EXPLORATION DIVISION

Plate No. MAC290b

10276



91-3268.

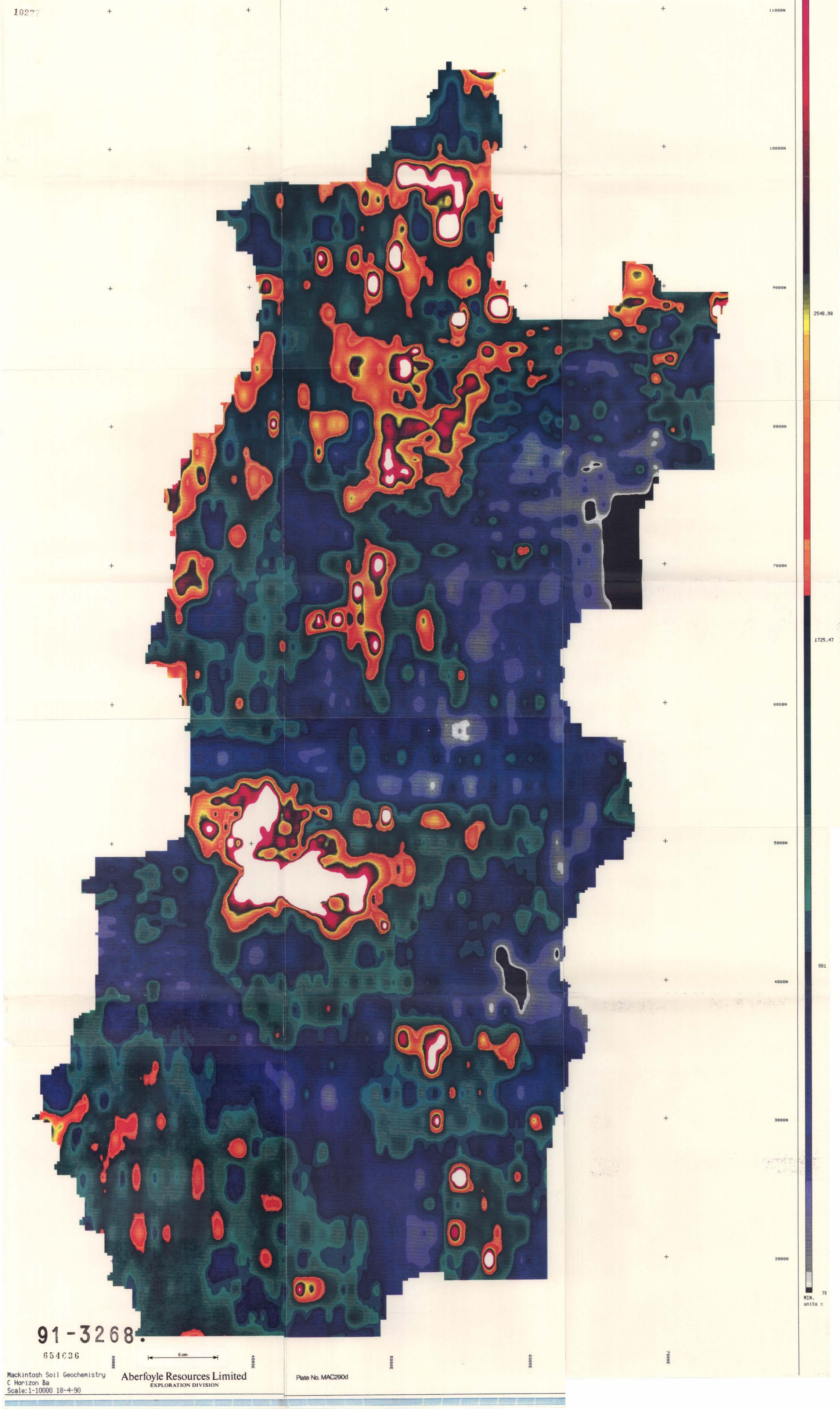
654035

Mackintosh Soil Geochemistry
C Horizon Zn
Scale: 1-10000 18-4-90

Aberfoyle Resources Limited
EXPLORATION DIVISION

Plate No. MAC290c

10277



91-3268.

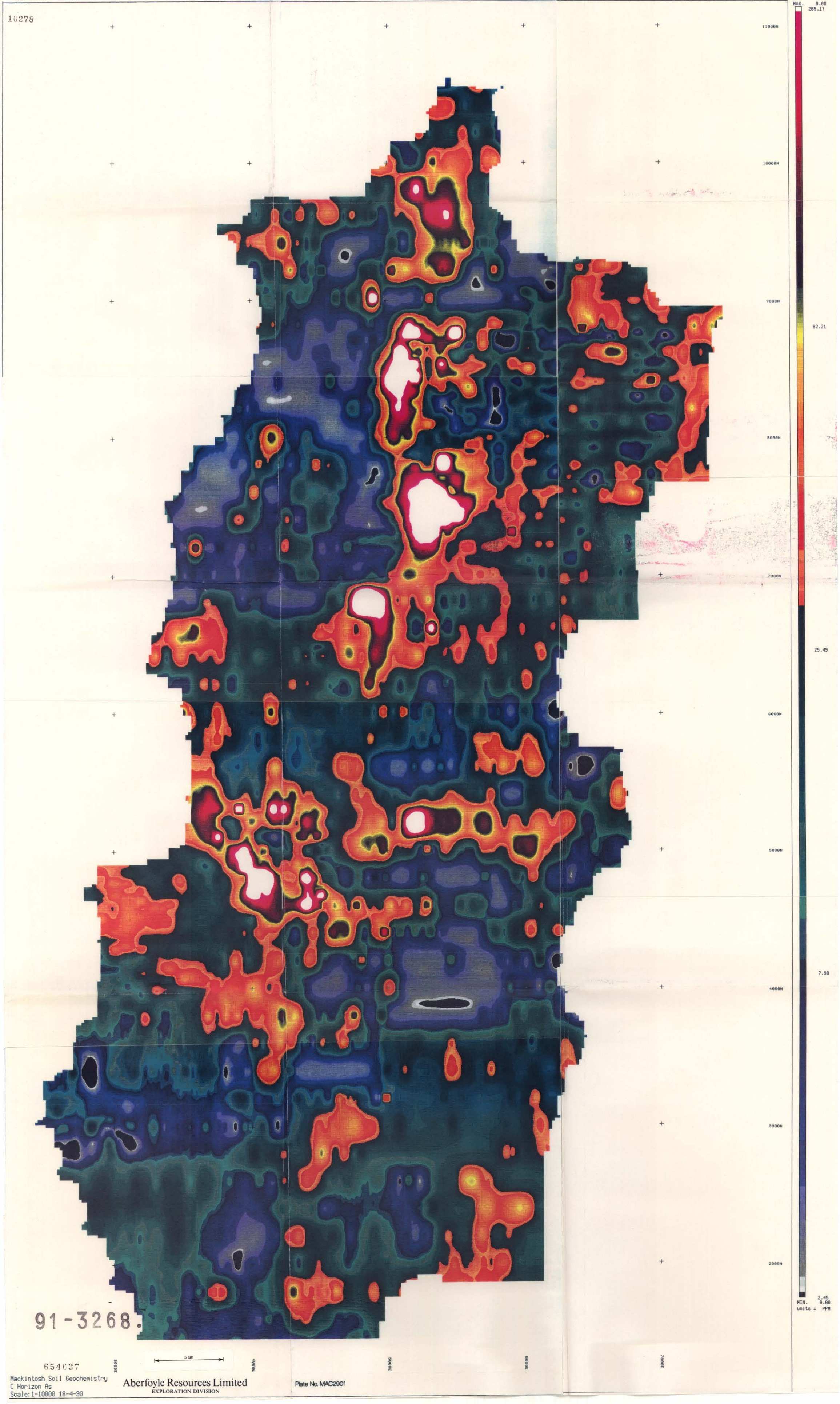
654636

Mackintosh Soil Geochemistry
C Horizon Ba
Scale: 1-10000 18-4-90

Aberfoyle Resources Limited
EXPLORATION DIVISION

Plate No. MAC290d

10278



91-3268.

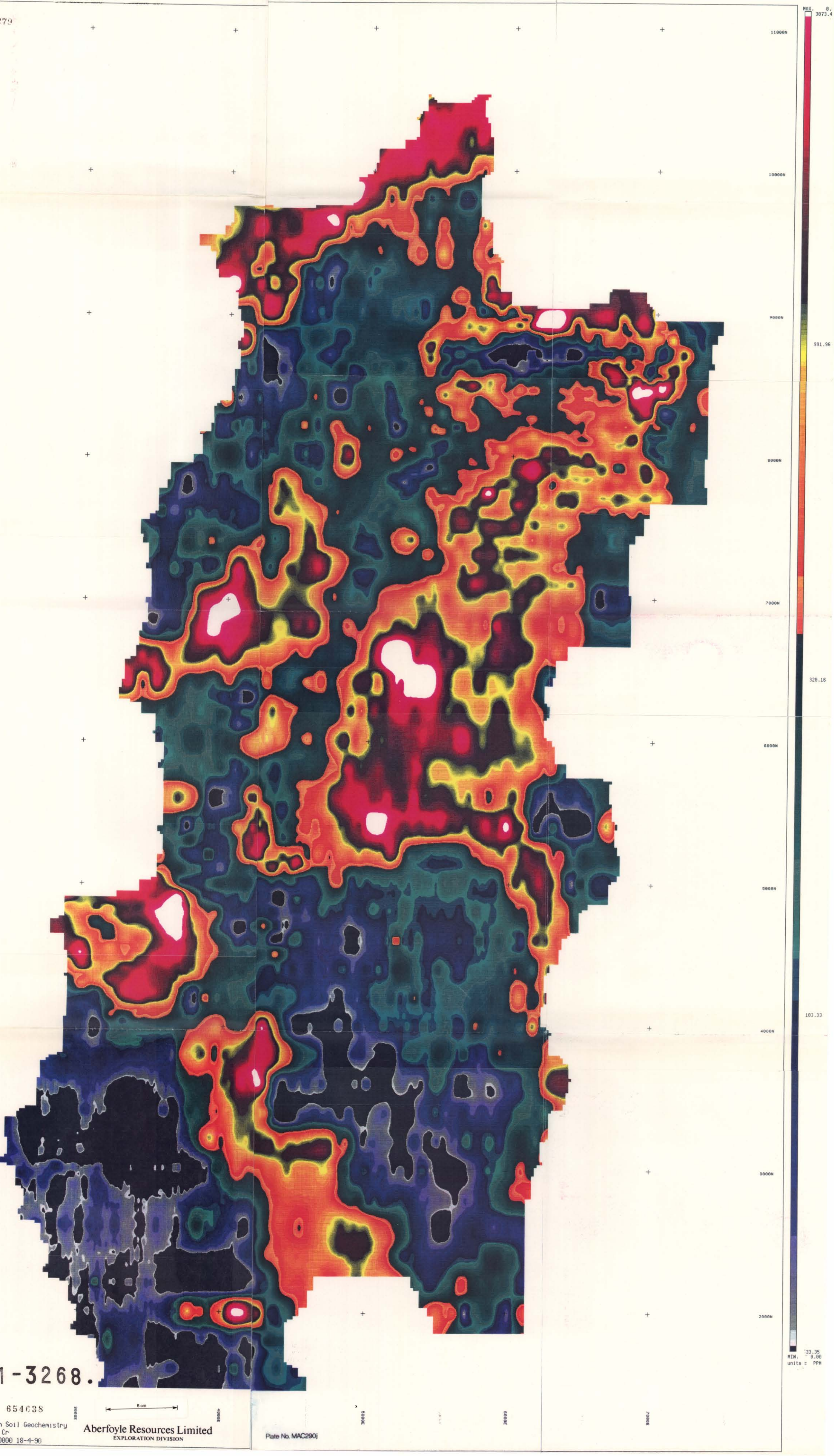
654637

Mackintosh Soil Geochemistry
C Horizon As
Scale: 1-10000 18-4-90

Aberfoyle Resources Limited
EXPLORATION DIVISION

Plate No. MAC290f

10279



91-3268.

654638

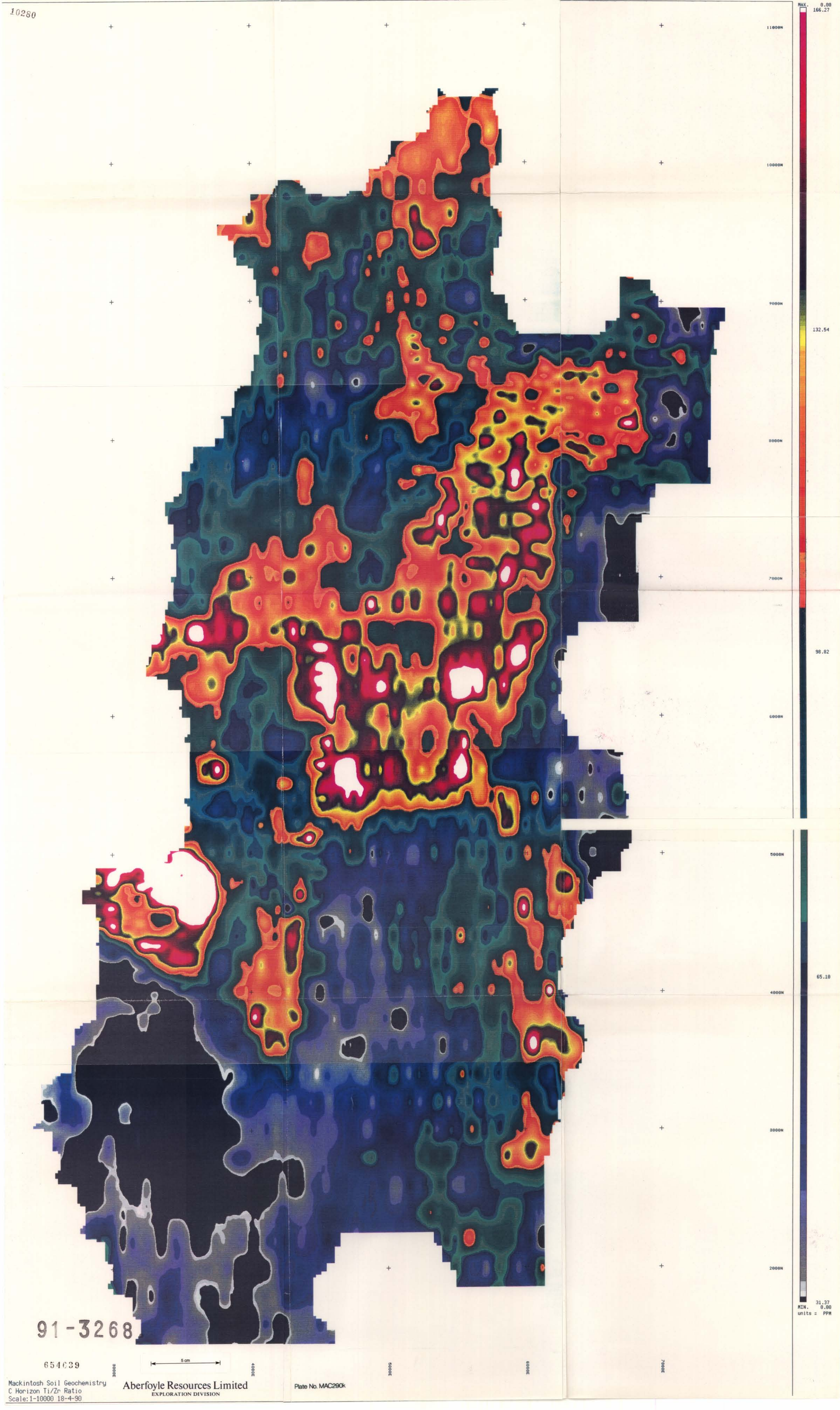
5 cm

Mackintosh Soil Geochemistry
C Horizon Cr
Scale: 1-10000 18-4-90

Aberfoyle Resources Limited
EXPLORATION DIVISION

Plate No. MAC290j

10280



91-3268

654639

Mackintosh Soil Geochemistry
C Horizon Ti/Zr Ratio
Scale: 1-10000 18-4-90

Aberfoyle Resources Limited
EXPLORATION DIVISION

Plate No. MAC290k

10281

4000 N | 3800 N | 3600 N

800 RL | 800 RL

NORTH

SOUTH

MAC 25
3700·12 N
4098·76 E
711·89 RL

0·0 (-1)

B.I.

562 243 P

wth. / O x 3

F45 B.I. x Ccv.
stc. Cc. I-2
F10 B.I. x Ccv.

CREEK

ibd BI / BIb & Alb

pat. Cc. I-2. Si. I-2

562 244 P

50·0 (2)

A.I

stc. Cl. I.

Minor Sp. inclusions in Cc. veins.

pat. stc. Cc. 2.

Dis. & veinlets of Sp. / mnr. Py. in B.I. as 'rims' to interpillow cherts.

B. pl.

B.I. c mnr. B.I.b.

pat. Cc. 2. Si. I-2.

mnr. dis. Py. in interpillow chert

B. pl.

562 245 P

B. I. b.

pat. Cc. 2. Si.2.

100.0 (4)

600 R L | 600 R L

B. pl.

Py. / Sp. 'stringer' min. possibly inter-pillow (5% Sp. to 30 % Py.)

B.I. / B. pl. 'stringer' Py. / Sp. (Sp.) 3 = 4

562 246 P

562 247 P

Fu 2

Fu 2 ~ 3

Cc. 3. Ful.

Cc. I-2.

B. I. c mnr. B.I.b.

562 248 P

MT. CHARTER HOST HORIZONS. (to 30% Py.)

mnr. Y. B. Iv. 'g. mass' Py. (Sp.) 2.

Fu. 3

150·0 (5)

Cc. 2. pat. Se. I.

Si. I ~ 2

Si. 3

D. I.

Si. I ~ 2

431 310 P

pat. Si. I.

ibd. D.I. & D.I.b.

200·0 (5)

Si. I.

F 20 Cc.v. & D.I. / Cl. 2

D. I.

Si. 2

562 249 P

ibd. D.I. & D.I.b.

D. I.

pat. Si. I ~ 2

431 311 P

stc. Cl. 2

ibd. D.I. & D.I.v.

ves. B.I. 250·0 (5)

ibd DI & D.Iv

stc. (clast related) Cl. I ~ 2

D. bv.

562 451 P

D. Iv.

B. I. b.
B. I.
D. I.

562 452 P

300·0 (6)

stc. Cl. 2

Cl. 2

Si. 2

400 RL | 400 RL

ibd. D.I. & D.Iv.

Cl. I ~ 2 Si. I ~ 2

ibd. B.I. & B.I.b

pat. Cc. I ~ 2

350·0 (6)

562 453 P

562 454 P

D. bv.
D. Iv.
DI.

pat. Cl. I ~ 2 Si. 2

Cl. 3

D. Iv. c mnr. D. I.

D. Iv. b.

Cl. 2 ~ 3 pat. Si. 2

D. I.

Si. 2

562 455 P

D. Iv.

Cl. 2 ~ 3

400·0 (7)

pat. Cl. I ~ 2 Si. I

Si. 2

F 30 sch. D.I. / Si. 2 Cl. 2

D. I.

Cl. I ~ 2

D. Iv.

Cl. I Si. 2

Cl. 2

F 45 D.I. / Cl. I Se.I & Q.v.
F 20 D.I. / Cl. 2 Se.I & Q.v.
F 10 D.I. / Cl. 2 Se.2 & Q.v.

562 456 P

med. DI. & D.Iv.

D.I. c mnr. D.Iv.

Si. I Cl. 2

MT. CHARTER FAULT ZONE

450·0 (7)

Cl. I ~ 2 Si. 2

ibd. Sh. & Gw. c mnr. shd. D. I.

Gw.

Sh. & mnr. Gw. ibd.

stc. Gt.

F 40 bk. Sh. & Gw.
F 40 Gw. & Q.v.
F 30 Gw. & bk. Sh.

Gw. & mnr. Sh.

562 457 P

ibd. Sh. & Gw.

Gw

562 458 P

ibd. Gw. & Sh.

F 50 ibd. Sh. & Q.v.

Gw

500·0 (7)

Si. I ~ 2 Se. I

Gw. & mnr. ibd. Sh

562 459 P

D ~ Al2 mnr. ibd. Gw

530·3 (7)

pat. Cl. I Si. I ~ 2

200 RL | 200 RL

4000 N | 3800 N | 3600 N

91-3268.

5 cm

Aberfoyle Resources Limited
EXPLORATION DIVISION
654640

REVISIONS			
Init.	Date	Init.	Date
RJH rje	26.7.90		

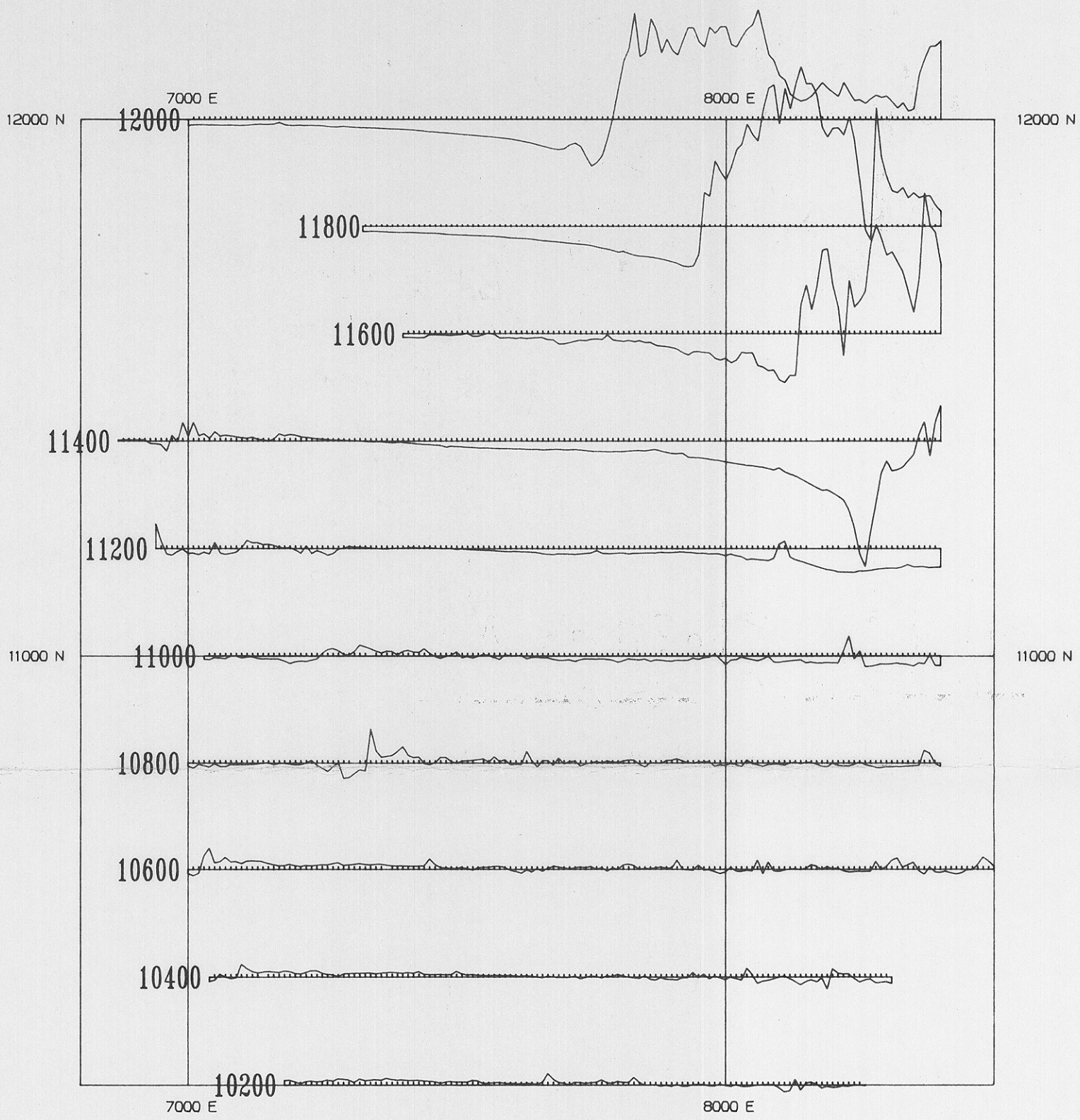
NORTH WEST TASMANIA
MACKINTOSH E.L. 106/87
DDH MAC-25
SECTION THROUGH MINE GRID

Location Code :

Scale : 1 : 1000 | Date : March 1990

Compiled : R J H
Drawn :
Traced : J M S
Checked :
Plate No : MAC 291

10282



TOTAL MAGNETIC INTENSITY STACKED PROFILES
Units: nanoTeslas
Vertical Scale: 250 nT/cm
Base Level: 62100 nT

5 cm

200 0 200 400 600 metres

AUSTRALIAN MAP GRID

91-3268.

654641

Data Acquisition:
G. Walker
G. Cooper
Data Processing:
G. Walker

ABERFOYLE RESOURCES LIMITED

EXPLORATION DIVISION

REVISIONS			
Init.	Date	Init.	Date

NORTHWEST TASMANIA

GroundMagnetics

MACKINTOSH EL106/87

SOUTHWELL GRID

Compiled: GBW

Drawn: APOLLO SYSTEM

Traced:

Checked: GBW

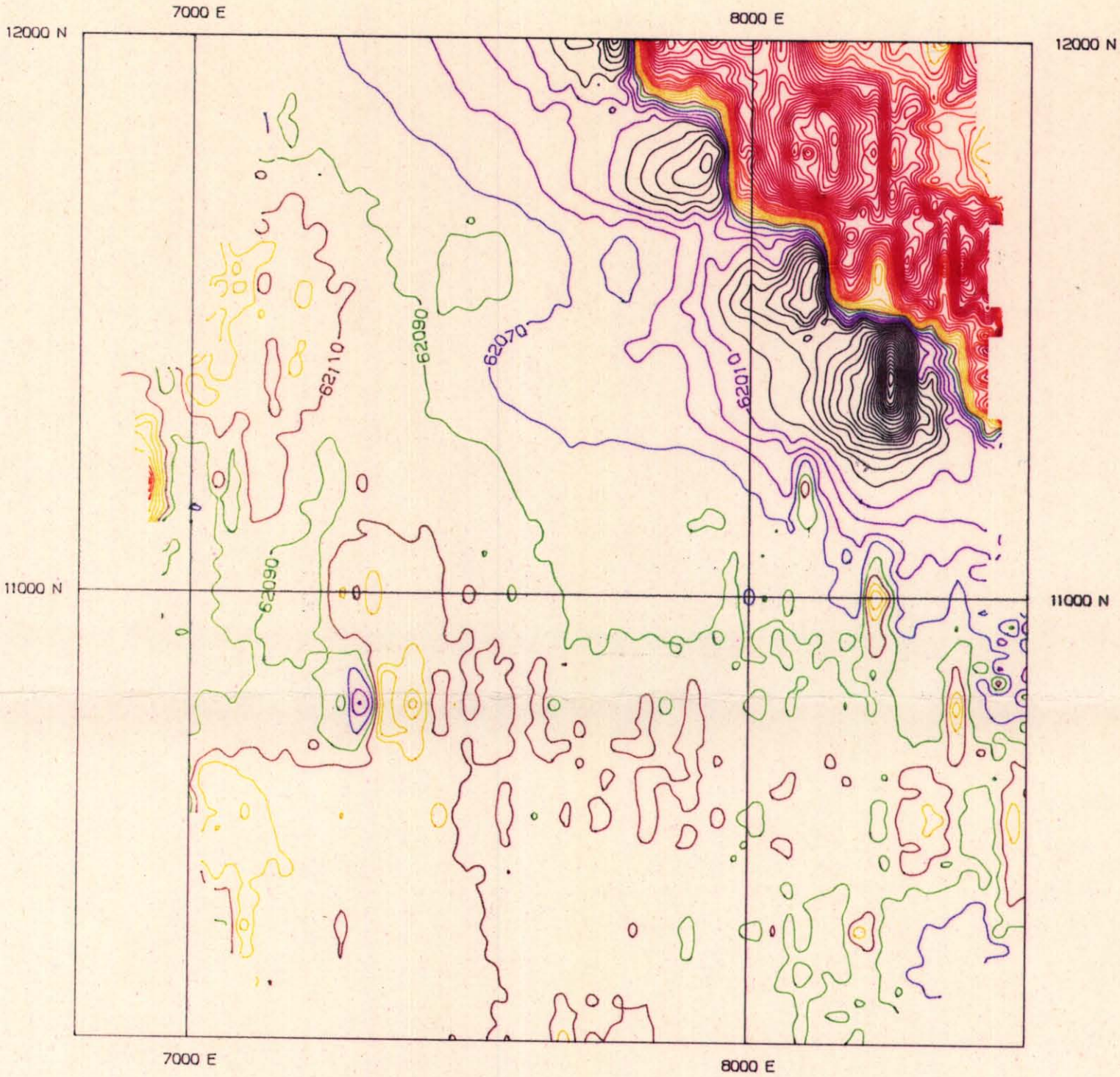
Location Code:

Scale:10000

Date: 8 JUNE 1990

Plate No: 296 B

10283



TOTAL MAGNETIC INTENSITY CONTOURS

Range	Contour Interval (nT)
61550-62300	10
62300-62800	20

PEN COLOUR RANGES

Range	Colour
61550-62000	Black
62000-62050	Purple
62050-62075	Blue
62075-62100	Green
62100-62125	Brown
62125-62200	Yellow
62200-62300	Orange
62300-62800	Red

200 0 200 400 600 metres

AUSTRALIAN MAP GRID

654642

5 cm

Data Acquisition:
G. Walker
G. Cooper
Data Processing
G. Walker

91-3268.

ABERFOYLE RESOURCES LIMITED

EXPLORATION DIVISION

REVISIONS			
Init.	Date	Init.	Date
eS			

NORTHWEST TASMANIA

GroundMagnetics

MACKINTOSH EL106/87

SOUTHWELL GRID

Location Code:

Scale:10000

Date: 8 JUNE 1990

Compiled: GBW

Drawn: APOLLO SYSTEM

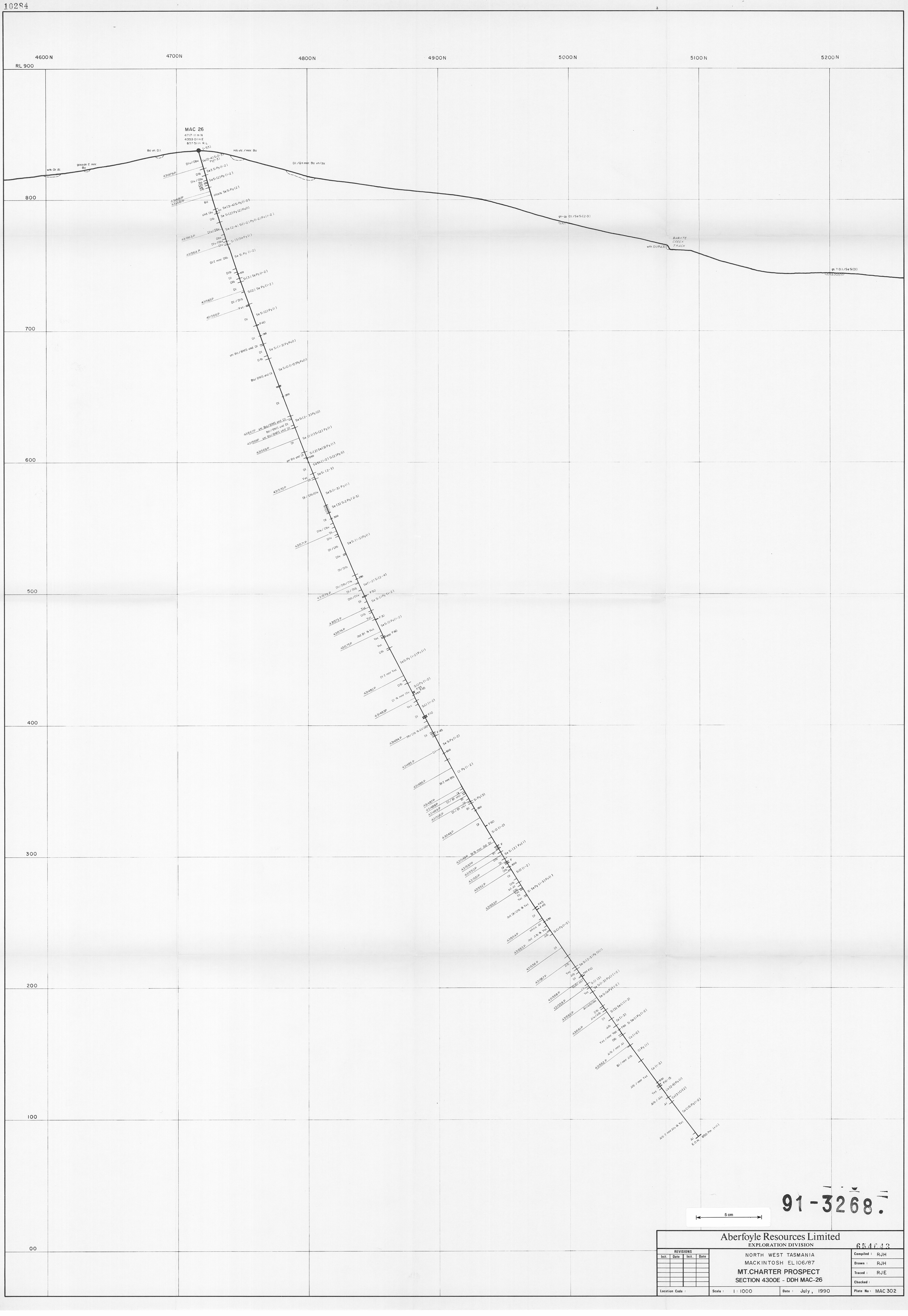
Traced:

Checked: GBW

Plate No:

MAC 298

10284


4600 N
4700N
4800N
4900N
5000N
5100N
5200N
RL 900
800
700
600
500
400
300
200
100
00
MAC 26
4717.11 m N
4353.01 m E
857.51 m R.L.
(-53)
Ba vn. Dl.
HA vlc / mnr. Ba
Dl./Q+ mnr. Ba vn/py.
wth Or Al.
gossan & mnr. Ba
gn-qv Dl./SeSi.(2-3)
BARYTE CREEK TRACK
wth Dl/Fu(3)
gn. ? Dl./SeSi(3)
431479P
431480P
431481P
431563P
431564P
431565P
431566P
431569P
431570P
431571P
431572P
431573P
431574P
431575P
431482P
431483P
431484P
431485P
431486P
431487P
431488P
431489P
431490P
431548P
431597P
431650P
431651P
431652P
431653P
431654P
431655P
431656P
431657P
431658P
431659P
431660P
431661P
431562P
Dl/Dbv
Dlb
Dlv/Dbv
Dbv
Dlv
Dl
Dl/Dlb
Dlb/Dlv
Dl/Dlb/Dlv
Dl/Dbv
Dl/Dlv
Dl/Dlb
Dlv/Dbv
Dl/Dlb/Dlv
Dl/Dlb/Dlv
Dl/Dlb
Dlb/Dlv
Dl/Dlv
Dl/Dlb
Dl/Dlb
Dl/Dlb

10285

N

Tertiary Basalt

015° TREND-ORE FEEDERS AND STAGE 2A PYRITIC VEINS

Areas D and E are interesting geochemical anomalies in structurally favourable locations, without much drilling.
A critical factor may be in stratigraphic position, particularly the relationship of "dacitic lavas" to ore horizon.

045° TREND-STAGE 2B BASE METAL VEINS

JACK FAULT

L5

L4

L2

L1

?L1

L3

shales

Lineaments L1-L5 are considered major fault lines. Their influence on volcanism and VMS mineralization has not been followed up at this stage.

E

D

A

B

C

MOUNT CRIPPS FAULT

QUE FAULT

HENTY FAULT ZONE

Apparent H-Q-C exhalative zone defined by metal highs and structure

10000N

8000N

6000N

4000N

2000E

5000E

8000E

0 500 1000 metres

Areas A.B.C may have become more prospective with clearer recognition of fundamental structure L1, and interpretation of HW Basalt in this area (i.e. a chance that the ore horizon at top of the andesitic sequence, is preserved).
Consider a south plunge -
area A is especially interesting in this respect.
B has a strong cross structure.
C may be tied up with the Mt.Charter system (N.B. almost complete mirror image of Hellyer area), but this is structurally very complex and could stand a more detailed geologic evaluation.

LEGEND

- INFERRED MAJOR FAULT
- PROBABLE EXTENSION, INFERRED FAULT ZONE
- POSSIBLE MAJOR FAULT ZONE
- MAPPED FAULT
- AIRPHOTO LINEAR

GEOCHEMICAL "HIGHS"
(arbitrary levels from imagery)

Cu Ba
Pb As
Zn Ag

5 cm

91-3268.

Aberfoyle Resources Limited
EXPLORATION DIVISION 654644

REVISIONS			
Init.	Date	Init.	Date

Location Code :

MACKINTOSH EL 106/87
SUMMARY MAP
STRUCTURAL LINES, QUE RIVER SHALE MARKER AND EXHALATIVE GEOCHEMISTRY

Scale : 1 : 10,000 Date : October, 1990

Compiled : IBF
Drawn : IBF
Traced : RJE
Checked :
Plate No : Mac 306

10286

N

Tertiary Basalt

JACK FAULT

10000N

Cu-Cr-Ti signature of Hanging Wall Basalt
-M_2-"Mafics 2" on cross section.
Interesting association of isolated Cr and/or Ti high spots?
?? extrusive centres.

MOUNT CRIPPS FAULT

8000N

An interesting "clean" Cu anomaly included in the HWB area but without associated Cr or Ti
-compare to Cu anomaly over Que River deposit
Could it be part of metal-zoned system with Pb anomaly adjacent to the north-east?

QUE FAULT

Eastern copper signature (M -"Mafics 3" on cross sections)
spotty Cu with relatively moderate contrast,
lacking Cr(-Ti) association.
≡ Lower Basalt ?
?

M_2 Hanging Wall Basalt?

6000N

The Cu-Cr-Ti association on this map probably outlines the main areas of near-surface mafic rocks, and may help to differentiate, on geochemical evidence, the lower basalts from those higher in the section.
Some statistical correlations and further detailed interpretation of the imagery may improve this picture.

HENTY ZONE FAULT

Slightly distinctive Cu(-Cr-Ti) signature of Mt.Charter Dolerite.
M_1- "Mafics 1" on cross section (not that different to M_2 HWB)

M_2 Hanging Wall Basalt

4000N

8000E

2000E

5000E

0 500 1000 metres

LEGEND

- INFERRED MAJOR FAULT
- PROBABLE EXTENSION, INFERRED FAULT ZONE
- POSSIBLE MAJOR FAULT ZONE
- MAPPED FAULT
- AIRPHOTO LINEAR

GEOCHEMICAL HIGHS IN "C" HORIZON
(arbitrary levels chosen from imagery)

Cu
Cr
Ti

5 cm

654645

91-3268

Aberfoyle Resources Limited
EXPLORATION DIVISION

REVISIONS			
Init.	Date	Init.	Date

Location Code :

MACKINTOSH EL 106/87
SUMMARY MAP
SELECTED LARGER LINEAMENTS AND LINEARS,
GEOCHEMICAL HIGHS IN "C" HORIZON

Scale : 1:10,000 | Date : November, 1990

Compiled : IBF
Drawn : IBF
Traced : RJE
Checked :
Plate No : Mac 311

10287

4500N 4600N 4700N 4800N 4900N 5000N 5100N

700 RL
600
500
400
300
200
100
00
−100
−200

MAC 27
4864.35N
2784.07E
693.6 RL
0 (+16)
Tricone
bk. Sh.
gy. Slt.
F
bk. Sh. F
50 (+16)
lbd ov + Mic Ss + flv
F
F
FZ
100 (+15)
FZ
F35
bk. Sh.
150 (+13)
FZ
FZ
F
FZ
F90
200 (+13)
F
225.1 563711P
B.I
225.8 Contact = 80° to LCA
bk. Sh.
FZ
250 (+12)
F
diss + pot py 3-4 (Sp)
B. pl.
Si 1-3
diss Sp 3 (py)
Si 1-2
B.I.
FZ
300 (+11)
B. Ib
Si2 Se1
diss Sp3 (py) B.I.
F
334.1
B.Ib
diss. Sp1 Po, Gn, Cpy
350 (+11)
A-B.I.
minor Po
A-B.Ib
B.I
A-B.Ib
A-B.I
Si 1-3
388.7
diss. Sp1-3 (Gn, Cpy, Py)
400 (+10)
A-B.Ib
Si 1-2 Se1
415.45 563712P
Si 1-3
F25
F20
450 (+10)
A-B.I.
Si Cl2
FZ
A-B.Ib
F50
Se Si 1-2
A-B.I
500 (+9)
515.45 563713P
diss. Sp1-3 (Cpy, Gn)
A-B.Ib
Se Si 1-2
F25
B.I.
FZ 550 (+9)
B.Ib
B.I
B.Ib
B.I
B.Ib
600 (+8)
B.I.
607.45 563714P
B.Ib
B.I
B.Ib
Se Si Cl1
B.I.
B.Ib.
B.I
Si2 Se1
650 (+7)
bk. Sh.
656
B.I.
Si2Cl1
667.7 563715 P
bk. Sh+Slt
B.Ib
minor Po
710
B.I
700 (+7)
Si Cl1 Se1-2
713.5 563716 P
F40
750 (+6)
diss Sp2
diss Sp3 Cpy2 Py2
A-D.I
Se Si (3)
B.I
Si Cl1
800 (+6)
F35
B.Ib
833.8 563717 P
B.I
F
841.35 563718 P
Si Cl2
951.1 flow banding = 35° to LCA
850 (+6)
F
D.I
F35
965.3 563719 P
F
FZ
982.2 563720P
B.I
F40
EOH 883.6 m (+6)

QRS
Dol
QRS
Mt. Charter access track
QRS
B.I.
MSs
MT. CHARTER FAULT
F
?
B.I.
D.I.
B.I.

5 cm

91-3268.

654646

Aberfoyle Resources Limited
EXPLORATION DIVISION

REVISIONS			
Init.	Date	Init.	Date
AMcN/rje	21290		

NORTH WEST TASMANIA
MACKINTOSH EL106/87
MT. CHARTER DOLERITE PROSPECT
Section 2800E - DDH Mac27

Location Code :
Scale : 1 1000
Date : November, 1990

Compiled : AMcN
Drawn : AMcN
Traced : RJE
Checked :
Plate No : MAC 312

10288

N

Tertiary Basalt

JACK FAULT

MOUNT CRIPPS FAULT

QUE FAULT

HENTY FAULT ZONE

10000N

8000N

6000N

4000N

2000E

5000E

8000E

The map conveys evidence for inter-relationships between direct exhalative activity (Pb, Zn, Ba) and structures which may have influenced those processes.

N.B. Generally, there is no geological inference in the linear discontinuities interpreted from the geochemical data.
Most of these lines define lithological changes, such as normal formational contacts, faults, and maybe mineralized zones.

0 500 1000 metres

LEGEND

5 cm

INFERRED MAJOR FAULT

PROBABLE EXTENSION, INFERRED FAULT ZONE

POSSIBLE MAJOR FAULT ZONE

MAPPED FAULT

AIRPHOTO LINEAR

GEOCHEMICAL HIGHS IN "C" HORIZON
(arbitrary levels chosen from imagery)

Pb

Zn

Ba

654647 91-3268.

Aberfoyle Resources Limited
EXPLORATION DIVISION

REVISIONS			
Init.	Date	Init.	Date

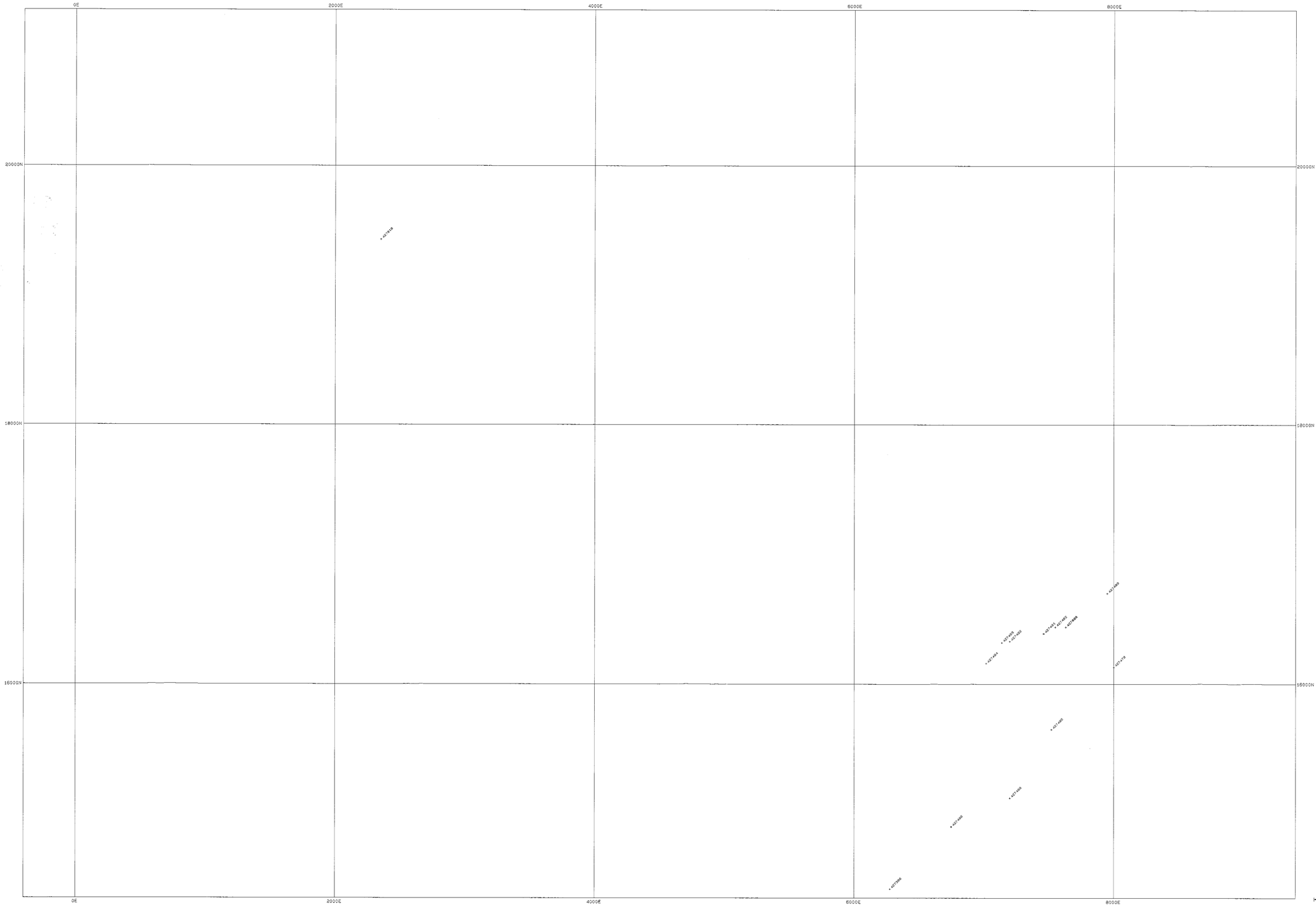
Location Code :

MACKINTOSH EL106/87
SUMMARY MAP
SELECTED LARGER LINEAMENTS AND LINEARS,
GEOCHEMICAL HIGHS IN "C" HORIZON

Scale : 1:10,000 | Date : November, 1990

Compiled : IBF
Drawn : IBF
Traced : RJE
Checked :
Plate No : Mac 313

10282

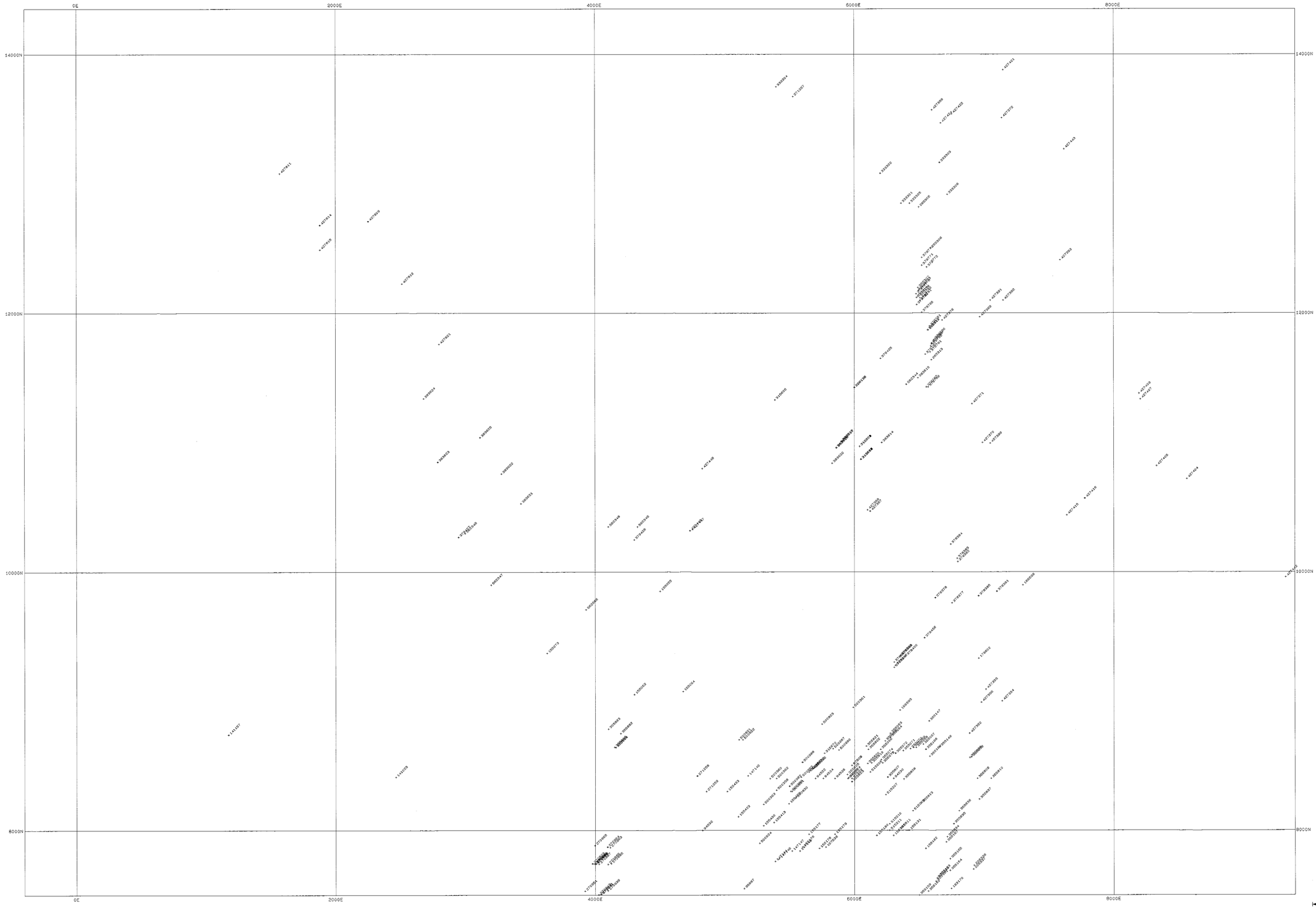


91-3268.1

Legend:
results

Aberfoyle Resources Limited
EXPLORATION DIVISION
654C48

REVISIONS				TASMANIA MACKINTOSH DISTRICT PETROLOGY SAMPLES LOCATIONS	Geologist:
Init.	Date	Init.	Date		Drawn:
					Traced:
					Checked:
Location Geol. MAO				Scale: 1 : 10000 Date: 27/02/91	Plate no.: MAC3678



91-3268.

Aberfoyle Resources Limited
EXPLORATION DIVISION

654C49

REVISIONS				TASMANIA MACKINTOSH DISTRICT PETROLOGY SAMPLE LOCATIONS	Compiled:
Init.	Date	Init.	Date		Drawn:
					Traced:
					Checked:
Location Code: MAC				Scale: 1 : 10000 Date: 27/02/91	Plate no.: MAC317b

Legend:
Sample

10291

0E
2000E
4000E
6000E
8000E
6000N
4000N
2000N

5cm

91-3268.

654650

Legend:
• sample

Aberfoyle Resources Limited
EXPLORATION DIVISION

REVISIONS			
Init.	Date	Init.	Date

Location data: MAC

TASMANIA
MACKINTOSH DISTRICT
PETROLOGY SAMPLE
LOCATIONS

Compiled:
Drawn:
Traced:
Checked:

Scale: 1 : 10000 Date: 27/02/91 Plate no.: MAC3170

10292

REGIONAL PROJECT
- MAPPING
- DRILL CORE, GEOCHEMISTRY
- LINEAMENT STUDY
- STRUCTURAL STUDY

SOUTHWELL VALLEY
- MAPPING
- GROUND MAGNETICS
- UTEM

I ZONE
- MAPPING
- DIAMOND DRILLING

MT.CHARTER DOLERITE
- DIAMOND DRILLING

MAC-28
MAC-27

MT.CHARTER
- DIAMOND DRILLING

MAC-26

S.W.MT.CHARTER
- DIAMOND DRILLING

MAC-25

SOUTH MACKINTOSH
- MAPPING

QUE RIVER MINE

Mt Cripps
Mt Charter
Mt Block
Mt Romulus

Cradle Mt. Lake St.Clair National Park

South West Conservation Area

HELLYER
MEDWAY
LEVEN
VALE
SOUTHWELL
QUE
BULGOBAC
ANIMAL
FURY
Lake Mackintosh
Murchison Highway
Cradle Mt. Link Rd.
Button Road
Racecourse Road
Murray's Plain Road
Middlesex Road
Yellow Marsh Road
Moory Road
Emu Bay Line
Cattley Road
Beezcott Road
HEC POWER LINE
AFH BOUNDARY
MINE LEASES
STATE RESERVE
Mine Access Road
TULLABARDINE DAM

5 cm

91-3268.

654651

Aberfoyle Resources Limited
EXPLORATION DIVISION

REVISIONS			
Init.	Date	Init.	Date

NORTH WEST TASMANIA
MACKINTOSH DISTRICT
EXPLORATION ACTIVITY
APRIL 1990 - MARCH 1991

Location Code : K55/6/44 | Scale : 1:25 000 | Date : APRIL 1991

Compiled : AMcN
Drawn : GLC
Traced :
Checked :
Plate No : MAC 318

10293

MAC 28
5999 · 9 N
4302 · 7 E
701 · 8 RL

4 200m E | 4 400m E | 4 600m E | 4 800m E | 5 000m E

700m R.L. | 500m R.L. | 300m R.L. | 100m R.L.

0 (0) Triassic
0.1
50 (0)
100 (1)
150 (3)
200 (4)
250 (6)
300 (7)
350 (9)
400 (10)
450 (11)
500 (11)
550 (11)
600 (11)
650 (9)
700 (5)
750 (-10)
800 (-10)
850 (-10)
EOH 905.5 (-19)

Bib.
Alp
Alp-Ib.
Alt1
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5 cm

91-3268

654652

Aberfoyle Resources Limited
EXPLORATION DIVISION

REVISIONS			
Init.	Date	Init.	Date

NORTH WEST TASMANIA
MACKINTOSH E.L. 106/87
DDH MAC 28
SECTION 6000N

Location Code : K55/6/44 | Scale : 1:1000 | Date : March 1991

Compiled : A. McN.
Drawn : A. McN.
Traced : MAR
Checked :
Plate No : MAC 319