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PASMINCO EXPLORATION

EL 37/89 BULGOBAC HILL

ANNUAL REPORT
AUGUST 1994 – AUGUST 1995

Vol 1 of 1

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15 AUG 1995
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AUTHOR: JG Purvis

DATE: August 1995

REPORT No.: T95-8

SUBMITTED TO: Regional Exploration Manager - Tasmania

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Pasminco Exploration - Burnie
- Melbourne

SUBMITTED BY: J. G. Purvis

ACCEPTED BY:

PASMINCO EXPLORATION EL 37/89 BULGOBAC HILL ANNUAL REPORT 1995 PURVIS J G

BURNIE
August
1995

95-3757

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SUMMARY

770004

During 1994–95, deep drill hole BHD6 (1061m) successfully intersected the target Que–Hellyer Mixed Sequence at **High Point**.

The 200m thick intersection was dominated by epiclastics of andesitic to dacitic provenance. Dispersed zinc mineralization, up to 9m @ 0.4% Zn (including 2m @ 1.2% Zn), and patchy strong hydrothermal alteration, was present in both the Mixed Sequence and the mafic volcanics footwall to it.

BHD6 is the first hole in the western part of the Que–Hellyer Basin to encounter an epiclastic–dominated Mixed Sequence. The result is considered very significant, given the association of the known orebodies at Hellyer and Que River with epiclastic–dominated sections of the Mixed Sequence.

A DHEM survey of BHD6 got a response from the Que River Shale in the upper part of the hole and a very weak response due to carbonaceous sandstone at the top of the Mixed Sequence.

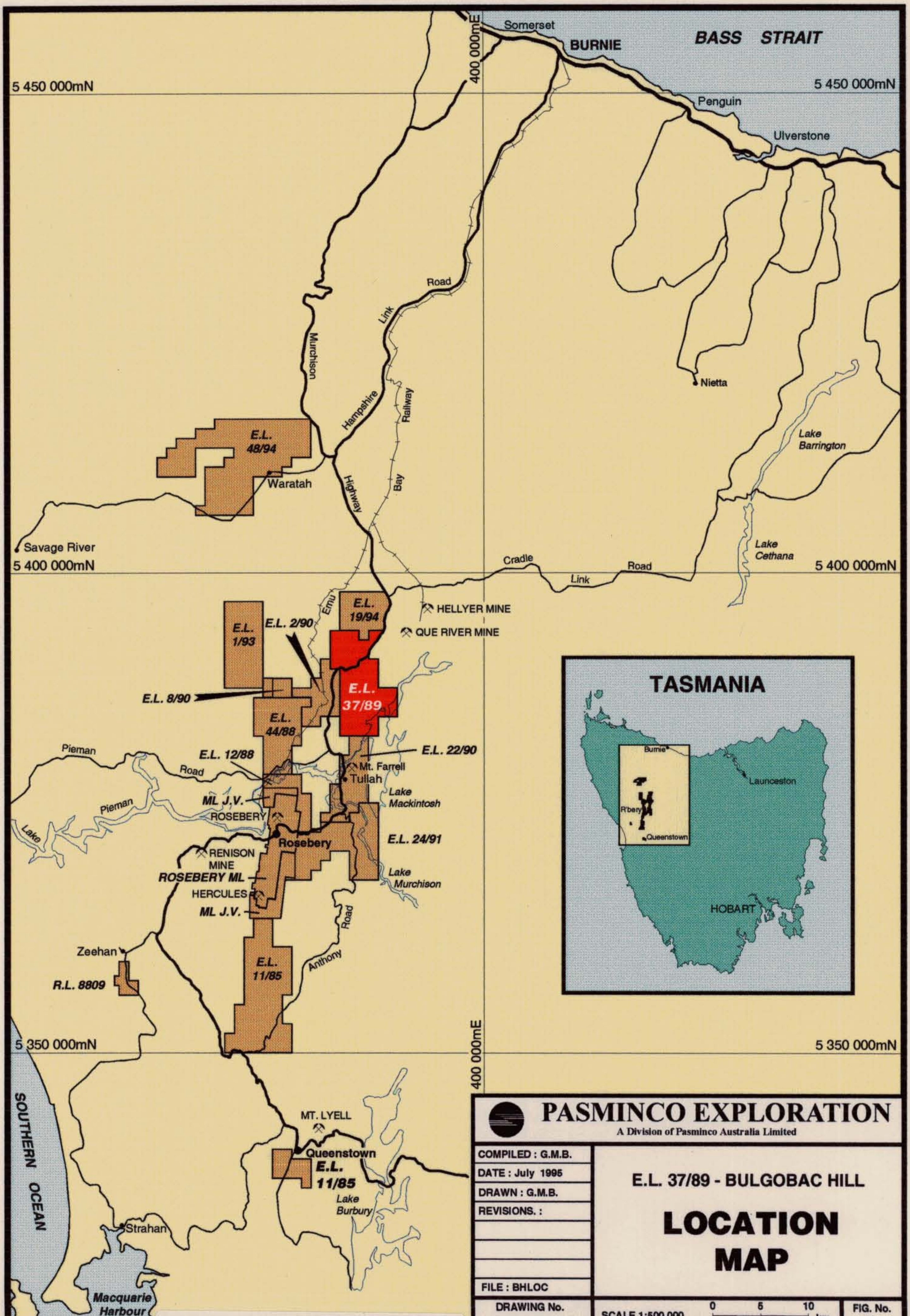
A comprehensive lithochemical–stratigraphic study was completed over the western part of the Que–Hellyer Basin by Dr A. Crawford. The study incorporated results from 19 drill holes and highlighted the complex rapid facies and geochemical variations in the Que–Hellyer Volcanics in this area. These variations are attributed to magma mixing and contamination, as well as extensive faulting.

Drilling to follow–up the BHD6 Mixed Sequence intersection is recommended in the large untested area north of **High Point**. Most favoured is a 1150m vertical hole at a site 500m north of BHD6 and 250m east of the Mt Charter Fault.

This site is only 200m from existing hole HP3 (577m). Removing the PVC casing from HP3 and deepening it to 1150m is a viable option, but less favoured than the new hole.

The EL will be reduced in September 1995 from 49sq km to 28sq km. The relinquished area largely comprises CVC volcanics centred on Mt Block.

770005



PASMINCO EXPLORATION
A Division of Pasminco Australia Limited

COMPILED : G.M.B.	E.L. 37/89 - BULGOBAC HILL
DATE : July 1995	
DRAWN : G.M.B.	**LOCATION MAP**
REVISIONS. :	
FILE : BHLOC	
DRAWING No.	SCALE 1:500,000 — 0 5 10 km — FIG. No. 1

5 cm

1 INTRODUCTION

This report details work done on Bulgobac Hill EL 37/89 in the period 2nd August 1994 to 2nd August 1995. The planned programme for 1995-96 is outlined.

As per statutory requirements the EL is to be reduced from 49sq km to 28sq km on 2nd September 1995 (see Figure 2). A separate relinquishment report catalogues all work done on the dropped ground during the past five years.

EL 37/89 covers Cambrian Mt Read Volcanics SW of Hellyer Mine in Western Tasmania (Figure 3). A Hellyer-type volcanogenic Pb-Zn-Cu-Ag-Au massive sulphide deposit is the main target of the exploration programme. The terrain is rugged and vehicular access limited.

Although the old prospectors found no mineralized showings on the EL area, near-continuous exploration over the past 30 years has discovered three zinc occurrences in the volcanics:

High Point (found by BHP in 1988 during drilling of an EM anomaly. BHP drilled 4 holes 1988-89).

Sock Creek (detected 1973 by drainage survey by Comstaff, who drilled 14 holes prior to 1978).

Sock Creek South (found by BHP in 1988 during drilling of an EM anomaly. They put in 4 holes 1988-89).

In addition, BHP drilled 9 shallow diamond drill holes (each less than 50m) at Tullabardine Gorge, without encountering mineralization. They also covered almost the entire EL with UTEM.

Pasminco's involvement in the area commenced in 1990 and has concentrated on testing the mineralized Que–Hellyer Volcanics at High Point. A further 4 diamond drill holes (BHD1, 2/3, 5 & 6), totalling 3313m, have been put down there. A deep hole (BHD4, 617m) was also completed at Sock Creek in 1993.

The EL has also been covered with detailed aeromagnetics and photogrammetry, and regional-scale gravity surveys extended over the majority of the EL area.

In the 1994–95 year Pasminco has:

* Drilled hole BHD6 (1060.9m) to basement at High Point.
* Carried out a DHEM survey of BHD6.
* Completed a comprehensive analysis of the stratigraphy and volcanic facies in the western part of the Que–Hellyer Basin, using lithogeochemical and petrological data from 19 drill holes.
* Supported an Honours Thesis by Sam Watkins of Monash University, on the palaeovolcanic history and stratigraphic correlations of the Que–Hellyer Volcanics at High Point (in progress).

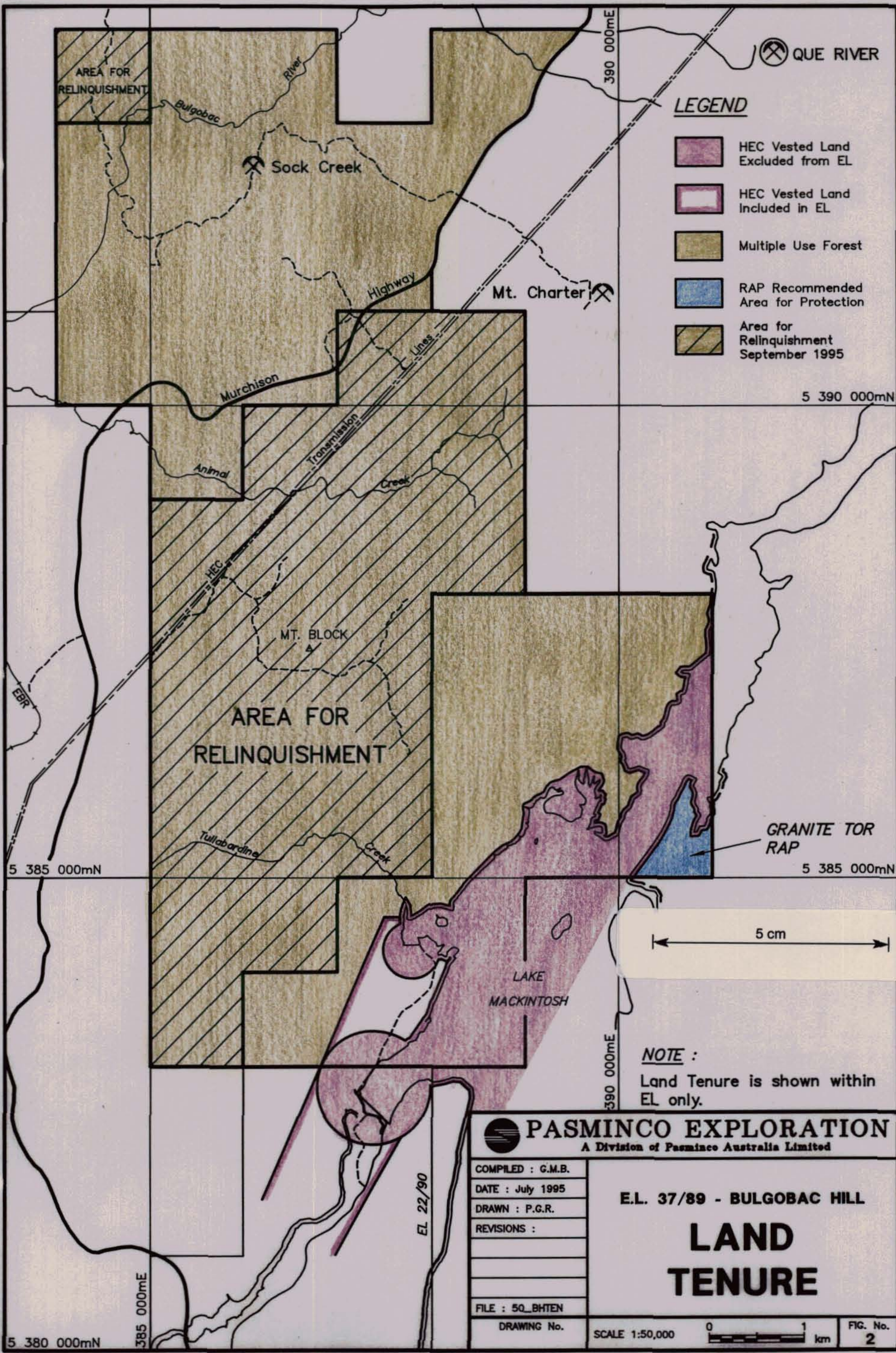
2 TENURE

The Bulgobac Hill Exploration Licence 37/89, covering 32sq km, was granted to Pasminco Mining Rosebery in March 1990. In August 1990 the licence was transferred to Pasminco Exploration.

In May 1992 and October 1993, EL 37/89 was increased to 49sq km by the addition of 7sq km in the Lake Mackintosh area (EL 17/92) and 10sq km in the South Mt Charter area (EL 7/93).

On 2nd September 1995, EL 37/89 will be reduced to 28sq km and a 12 month renewal of tenure sought.

The reduced EL is almost entirely Unallocated Crown Land. See Figure 2.



QUE RIVER
LEGEND
HEC Vested Land Excluded from EL
HEC Vested Land Included in EL
Multiple Use Forest
RAP Recommended Area for Protection
Area for Relinquishment September 1995
AREA FOR RELINQUISHMENT
River
Bulgobac
Sock Creek
390 000mE
Highway
Mt. Charter
Murchison
Lines
Transmission
5 390 000mN
Animal
Creek
HEC
MT. BLOCK
EBR
AREA FOR RELINQUISHMENT
GRANITE TOR RAP
Tullabardine
Creek
5 385 000mN
5 385 000mN
5 cm
LAKE MACKINTOSH
NOTE :
Land Tenure is shown within EL only.
390 000mE
EL 22/90
385 000mE
5 380 000mN
PASMINCO EXPLORATION
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COMPILED : G.M.B.
DATE : July 1995
DRAWN : P.G.R.
REVISIONS :
FILE : 50_BHTEN
DRAWING No.
E.L. 37/89 - BULGOBAC HILL
LAND TENURE
SCALE 1:50,000
0
1
km
FIG. No.
2

770069

3 EXPENDITURE

Expenditure statement for the 12 month period ending June 1995.

	$
Personnel & Oncosts	38 950
Travel & Accommodation	3 710
Geological Consultants	29 778
Geochemical Consultants & Analytical Costs	14 334
Geophysical Surveys & Consultants	10 223
Drilling (including access & core processing/storage)	114 274
Other Consultants	2 197
Stores & Supplies	2 587
Vehicles & Equipment	5 884
Computing	1 738
Tenement Costs	1 036
Office Running Costs	15 666
Total Direct Costs	**$240 377**
Administration Fee	24 338
TOTAL EXPENDITURE	**$264 715**

This brings total expenditure on EL 37/89 since its inception to **$1 131 591.**

4 GEOLOGY

4.1 Stratigraphy & Structure

The geology of EL 37/89 is shown in Figures 3, 4 & 5.

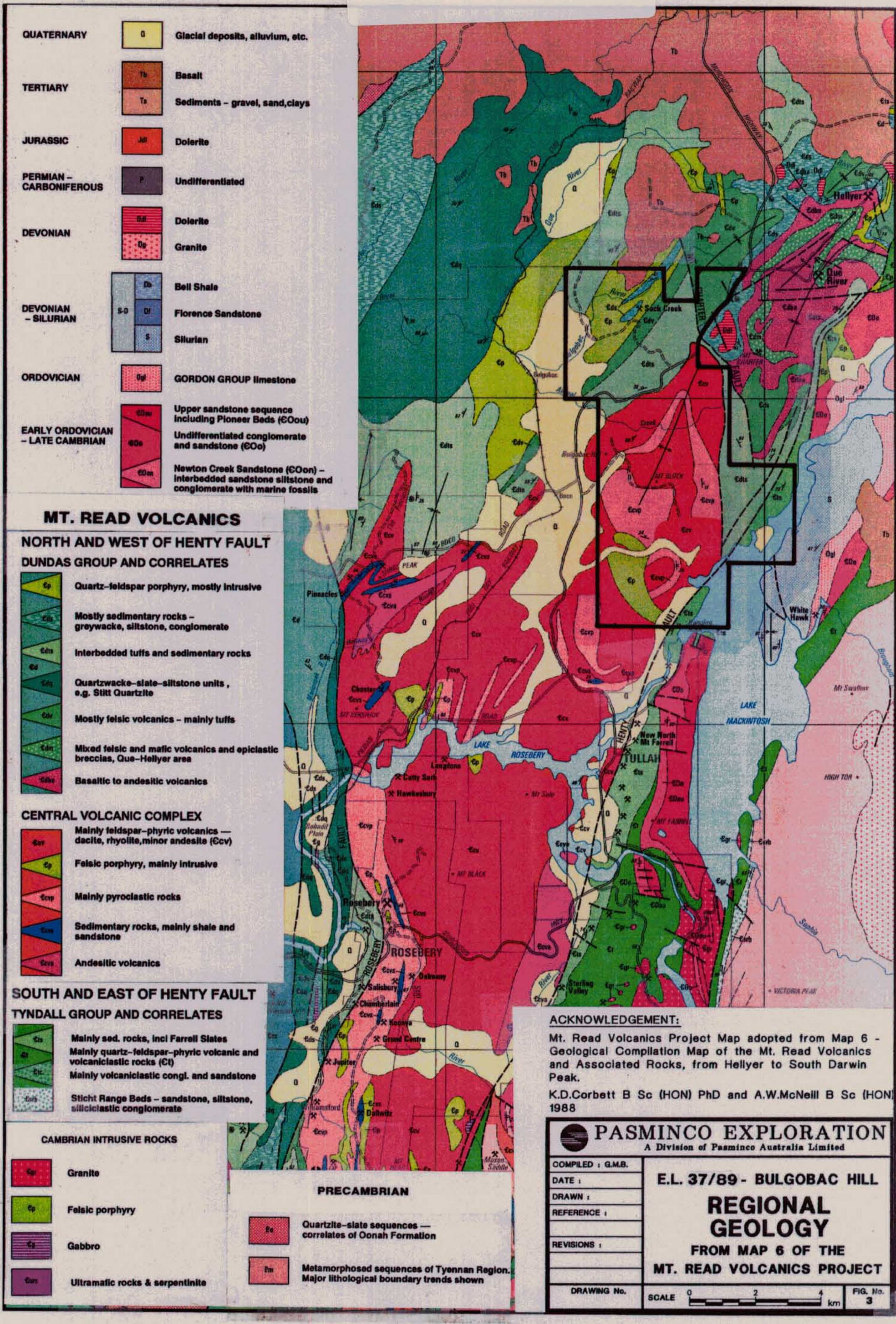
The EL covers two main groups of the Cambrian Mt Read Volcanics – the Central Volcanic Complex (CVC), and correlates of the Dundas Group. A small sliver of the Farrell Slates east of the Henty Fault occurs in the SE part of the EL.

The Central Volcanic Complex covers the southern part of the EL and comprises rhyodacitic lavas, porphyries and volcaniclastics (mostly pyroclastics with minor epiclastics). These rocks are known as the Mt Block Volcanics.

Dundas Group and correlates cover the northern half of the EL. They comprise the Que–Hellyer Volcanics (a mafic volcanic complex), sediments (including the Animal Creek Greywacke, Que River Shale and Southwell SubGroup), quartz–feldspar porphyry bodies, and rhyodacitic volcanics (mainly lavas). The relationship between the various units is shown in Figure 5.

The boundary between the Central Volcanic Complex and the Dundas Group within the EL area is gradational, facing and dipping to the west, with the Dundas Group apparently conformably overlying the CVC.

Major structures on the EL include the NE–trending Henty Fault and the N–S trending Mt Charter Fault. However, the magnetics and gravity highlight the presence of several major, apparently deep–seated, unmapped or poorly–mapped structures trending broadly E–W.


QUATERNARY
Q Glacial deposits, alluvium, etc.
TERTIARY
Tb Basalt
Ts Sediments - gravel, sand,clays
JURASSIC
Jdl Dolerite
PERMIAN - CARBONIFEROUS
P Undifferentiated
DEVONIAN
Ddl Dolerite
Dg Granite
DEVONIAN - SILURIAN
Db Bell Shale
Df Florence Sandstone
S Silurian
ORDOVICIAN
Ogl GORDON GROUP limestone
EARLY ORDOVICIAN - LATE CAMBRIAN
Upper sandstone sequence including Pioneer Beds (€Oou)
Undifferentiated conglomerate and sandstone (€Oo)
Newton Creek Sandstone (€Oon) - interbedded sandstone siltstone and conglomerate with marine fossils
MT. READ VOLCANICS
NORTH AND WEST OF HENTY FAULT
DUNDAS GROUP AND CORRELATES
Quartz-feldspar porphyry, mostly intrusive
Mostly sedimentary rocks - greywacke, siltstone, conglomerate
Interbedded tuffs and sedimentary rocks
Quartzwacke-slate-siltstone units, e.g. Stitt Quartzite
Mostly felsic volcanics - mainly tuffs
Mixed felsic and mafic volcanics and epiclastic breccias, Que-Hellyer area
Basaltic to andesitic volcanics
CENTRAL VOLCANIC COMPLEX
Mainly feldspar-phyric volcanics — dacite, rhyolite,minor andesite (€cv)
Felsic porphyry, mainly intrusive
Mainly pyroclastic rocks
Sedimentary rocks, mainly shale and sandstone
Andesitic volcanics
SOUTH AND EAST OF HENTY FAULT
TYNDALL GROUP AND CORRELATES
Mainly sed. rocks, incl Farrell Slates
Mainly quartz-feldspar-phyric volcanic and volcaniclastic rocks (€t)
Mainly volcaniclastic congl. and sandstone
Sticht Range Beds - sandstone, siltstone, siliciclastic conglomerate
CAMBRIAN INTRUSIVE ROCKS
Granite
Felsic porphyry
Gabbro
Ultramafic rocks & serpentinite
PRECAMBRIAN
Quartzite-slate sequences — correlates of Oonah Formation
Metamorphosed sequences of Tyennan Region. Major lithological boundary trends shown
Hellyer
Que River
Sock Creek
Pinnacles
White Hawk
LAKE MACKINTOSH
LAKE ROSEBERY
TULLAH
New North Mt Farrell
Rosebery
ROSEBERY
Sterling Valley
HIGH TOR
VICTORIA PEAK
ACKNOWLEDGEMENT:
Mt. Read Volcanics Project Map adopted from Map 6 - Geological Compilation Map of the Mt. Read Volcanics and Associated Rocks, from Hellyer to South Darwin Peak.
K.D.Corbett B Sc (HON) PhD and A.W.McNeill B Sc (HON) 1988
PASMINCO EXPLORATION
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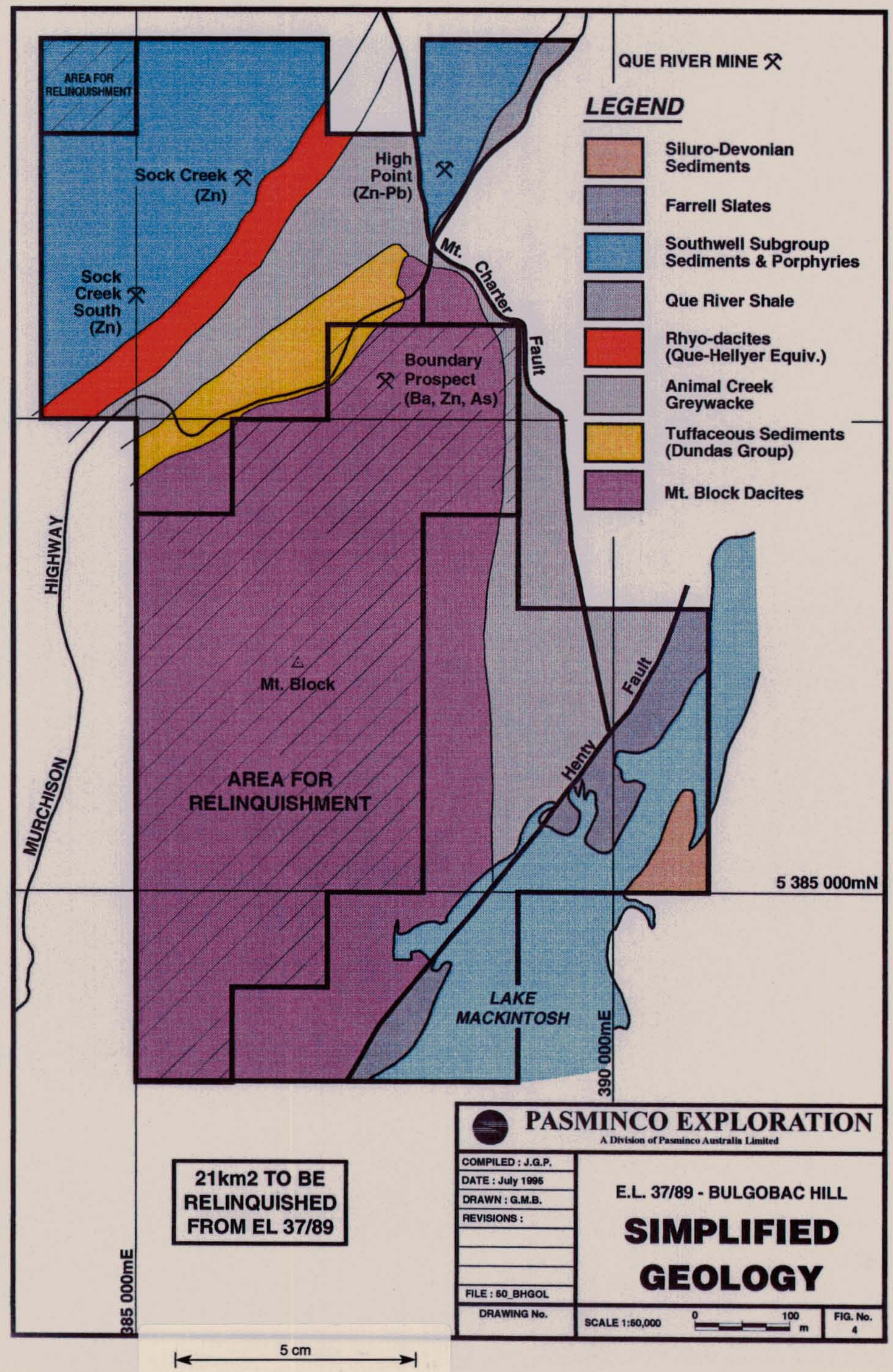
COMPILED : G.M.B.
DATE :
DRAWN :
REFERENCE :
REVISIONS :
DRAWING No.
E.L. 37/89 - BULGOBAC HILL
REGIONAL GEOLOGY
FROM MAP 6 OF THE MT. READ VOLCANICS PROJECT
SCALE 0 2 4 km
FIG. No. 3

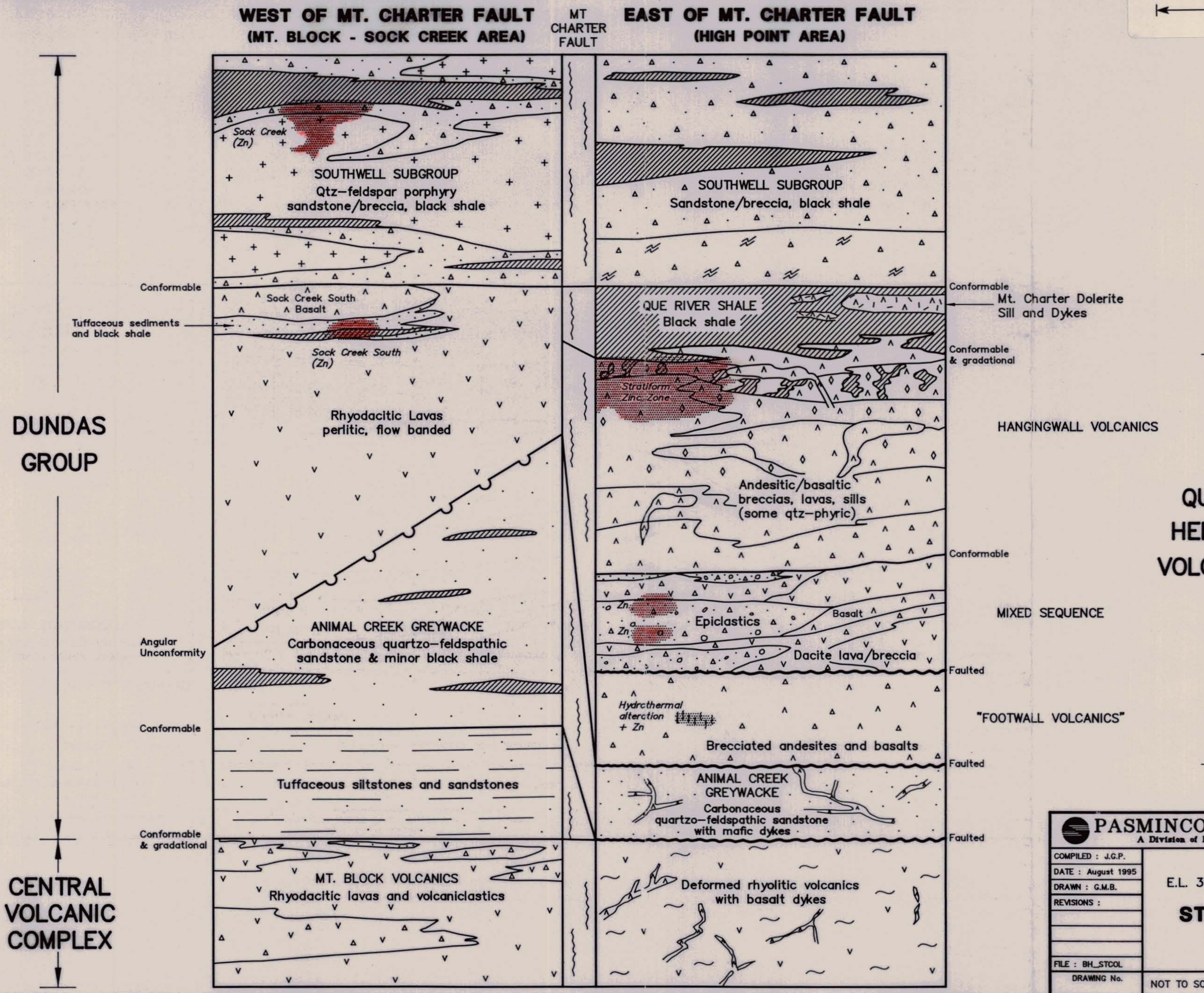


QUE RIVER MINE
LEGEND
Siluro-Devonian Sediments
Farrell Slates
Southwell Subgroup Sediments & Porphyries
Que River Shale
Rhyo-dacites (Que-Hellyer Equiv.)
Animal Creek Greywacke
Tuffaceous Sediments (Dundas Group)
Mt. Block Dacites
AREA FOR RELINQUISHMENT
Sock Creek (Zn)
Sock Creek South (Zn)
High Point (Zn-Pb)
Mt. Charter Fault
Boundary Prospect (Ba, Zn, As)
Mt. Block
AREA FOR RELINQUISHMENT
Henty Fault
MURCHISON HIGHWAY
LAKE MACKINTOSH
5 385 000mN
390 000mE
385 000mE
21km2 TO BE RELINQUISHED FROM EL 37/89
PASMINCO EXPLORATION
A Division of Pasminco Australia Limited
COMPILED : J.G.P.
DATE : July 1995
DRAWN : G.M.B.
REVISIONS :
FILE : 50_BHGOL
DRAWING No.
E.L. 37/89 - BULGOBAC HILL
SIMPLIFIED GEOLOGY
SCALE 1:50,000
0
100
m
FIG. No. 4
5 cm

770013

5 cm

770014



PASMINCO EXPLORATION
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COMPILED : J.G.P.	E.L. 37/89 – BULGOBAC HILL
DATE : August 1995	
DRAWN : G.M.B.	**STRATIGRAPHIC COLUMN**
REVISIONS :	
FILE : BH_STCOL	
DRAWING No.	NOT TO SCALE
FIG. No.	5

4.2 Mineralization

Three zinc–dominated and gold/silver–poor sulphide occurrences are known on the EL. These comprise disseminated sp–py in altered Que–Hellyer Volcanics adjacent to the Mt Charter Fault at **High Point**, sp with lesser py–gn–cp in net–veins on the contact between quartz–feldspar porphyry and black shale at **Sock Creek**, and weak disseminated sp in black shale at **Sock Creek South** (best intersection of 1m @ 2.5% Zn).

High Point is by far the most significant occurrence, although the tenor of Zn values intersected to date is not as high as at Sock Creek.

Mineralization occurs at High Point at several stratigraphic levels within the Que–Hellyer Volcanics. At the top of the Hangingwall Volcanics (Hellyer Basalt equivalents), there is an areally–extensive stratiform zone of disseminated sp–py up to 200m thick and averaging 0.2–0.5% Zn. The zone extends onto Aberfoyle ground east of High Point (see Figure 6).

Recent hole BHD6 at High Point has shown there is also disseminated Zn mineralization in both the Mixed Sequence and underlying altered "footwall volcanics". (The Mixed Sequence is the principal target of the exploration programme as this unit hosts both the Hellyer and Que River massive sulphide orebodies). The BHD6 result is taken to indicate potential for massive sulphide development in the Mixed Sequence in this area.

At Sock Creek the mineralization attains grades up to 10% Zn over 1.7m, with a general tenor around 2–5% Zn over 5–10m. There is untested potential at this prospect for an open–cuttable body of mineralization in the order of 100–200,000t @ 5–10% Zn (Purvis, 1993). Pasminco has tried unsuccessfully to interest small mining groups in the property.

No other sulphide occurrences of note are known anywhere on the EL.

5 RESULTS

5.1 Drill hole BHD6, High Point

After the failure of BHD5 to reach the Mixed Sequence beneath the stratiform zinc zone at High Point (Purvis, 1994), a second attempt was made to test this important target.

Initially, it was decided to try and deepen existing hole BHD1 which had terminated in the Hangingwall Volcanics at 563.2m (see Figure 11). However, only the top 130m of the PVC casing in BHD1 was able to be removed before it broke off, rendering it impossible to re-enter the hole. A new hole was thus designed to complete the test initiated by BHD5.

BHD6 was commenced on 26th August 1994, sited 60m east of the Mt Charter Fault at 5 392523mN, 387999mE, angled at -80° towards 132° AMG. The hole was successfully completed at 1060.9m on 21st November 1994.

The drill log appears in Appendix 1 and the detailed drill section in Figure 12. The hole location is shown on Figures 6 & 11, and a summary section in Figure 7.

BHD6 collared in the volcaniclastic sandstones and breccias of the Southwell Sub-Group before intersecting the Que River Shale from 211 – 336.5m. A major fault at the base of the shale appears to have removed the upper part of the Que-Hellyer Hangingwall Volcanics (Hellyer Basalt equivalents), including the stratiform zinc zone which is missing from the hole.

The Hangingwall Volcanics, characterised by quartz xenocryst-bearing andesitic and basaltic breccias, extend down to the top of a 6m thick quartzo-feldspathic sandstone at 614.8m. From this depth to a major fault at 815.1m, BHD6 intersected the Que-Hellyer Mixed Sequence, the principal target of the hole.

Note, during logging the perlitic dacite breccia unit in the upper part of the top of the Mixed Sequence was mis-identified as basalt and placed in the Hangingwall Volcanics. The mistake has been corrected on the sections (Figures 7 & 12).

The Mixed Sequence in BHD6 has a true thickness of approximately 130m and is largely made up of epiclastics, principally andesitic to dacitic breccio-conglomerates, with lesser intervals of dacitic lava breccia and quartzo-feldspathic volcaniclastic sandstone. Alteration, notably silicification, is patchy, but significant sericite-fuchsite-pink calcite alteration is associated with faults in the basal part of the Mixed Sequence.

Mineralization in the Mixed Sequence comprises widespread weak disseminated and veinlet sphalerite-pyrite, concentrated in the more-reworked sections and producing best intersections of 7.7m @ 0.33% Zn and 11m @ 0.25% Zn. Barium is also elevated, averaging 0.2-0.3% Ba. Minor small clasts of massive pyrite (to 15x8mm) occur in the top of the uppermost epiclastic unit.

At the base of the Mixed Sequence is a unit of distinctive brecciated variolitic basalt (815.1-881m), overlying 19m of non-variolitic basalt hyaloclastite breccia. The variolitic unit contains zones of very strong sericite-bleaching alteration with minor fuchsite and pink calcite. The largest of these altered zones (856-869m) is associated with the best zinc mineralization in the hole: 9m @ 0.41% Zn, including 2m @ 1.2% Zn.

This lower basalt package is bounded by major faults at 815m and 900m. During logging the package was assigned to the Que-Hellyer Footwall Volcanics because the variolitic unit appeared totally different to any intersected higher in the hole.

However, Crawford (1995, - see Section **5.3** and Appendix 3), on the basis of their lithogeochemistry interprets the variolitic basalt as part of the Mixed Sequence, and the underlying basalt as being of Mt Charter Dolerite type and similar to a unit overlying the Mixed Sequence in Aberfoyle hole MAC27 (400m SE of BHD6). In his opinion true Footwall Volcanics were not intersected by BHD6.

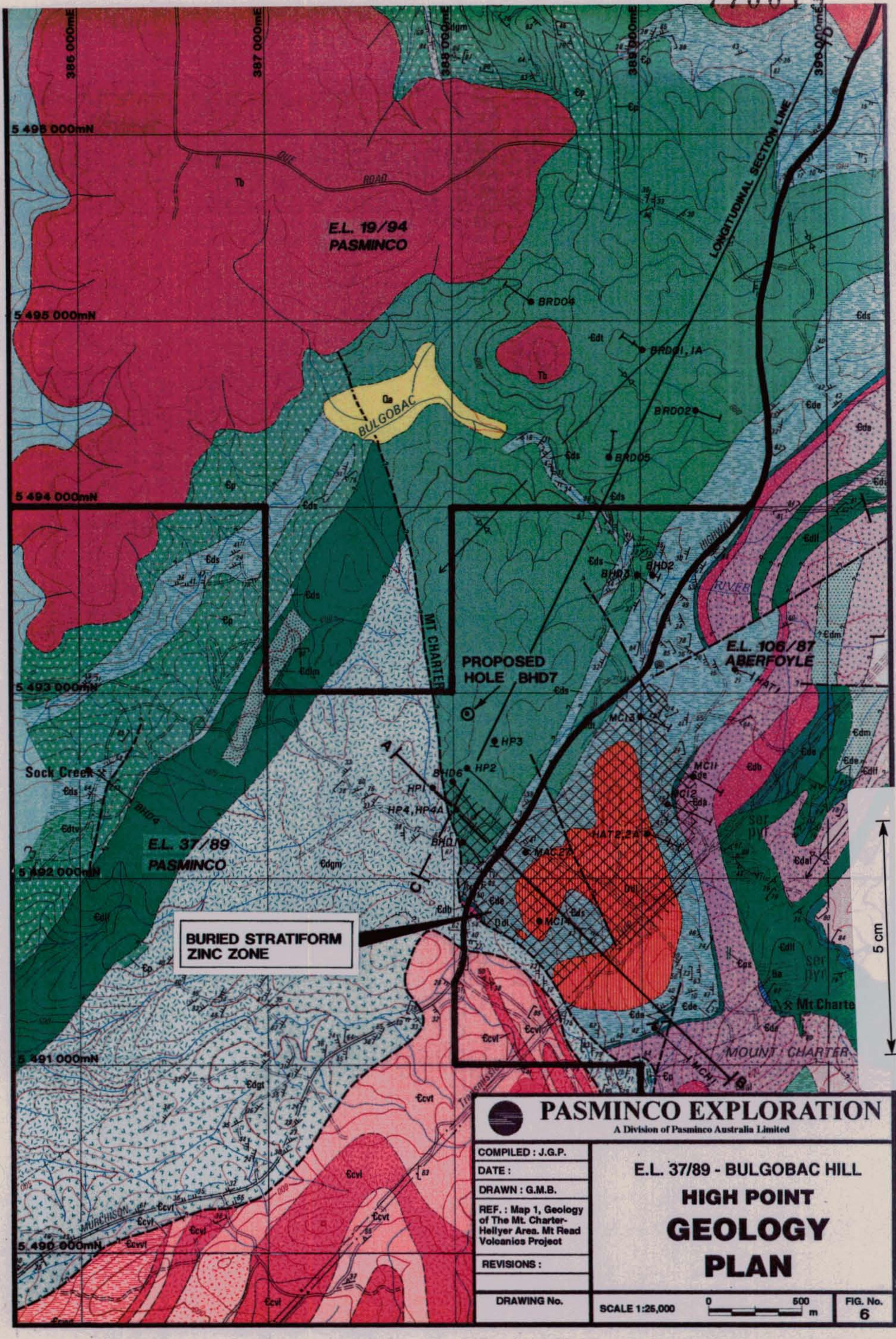
If this interpretation is correct, the faults bounding and within this lower basalt package have clearly extensively disrupted the stratigraphy.

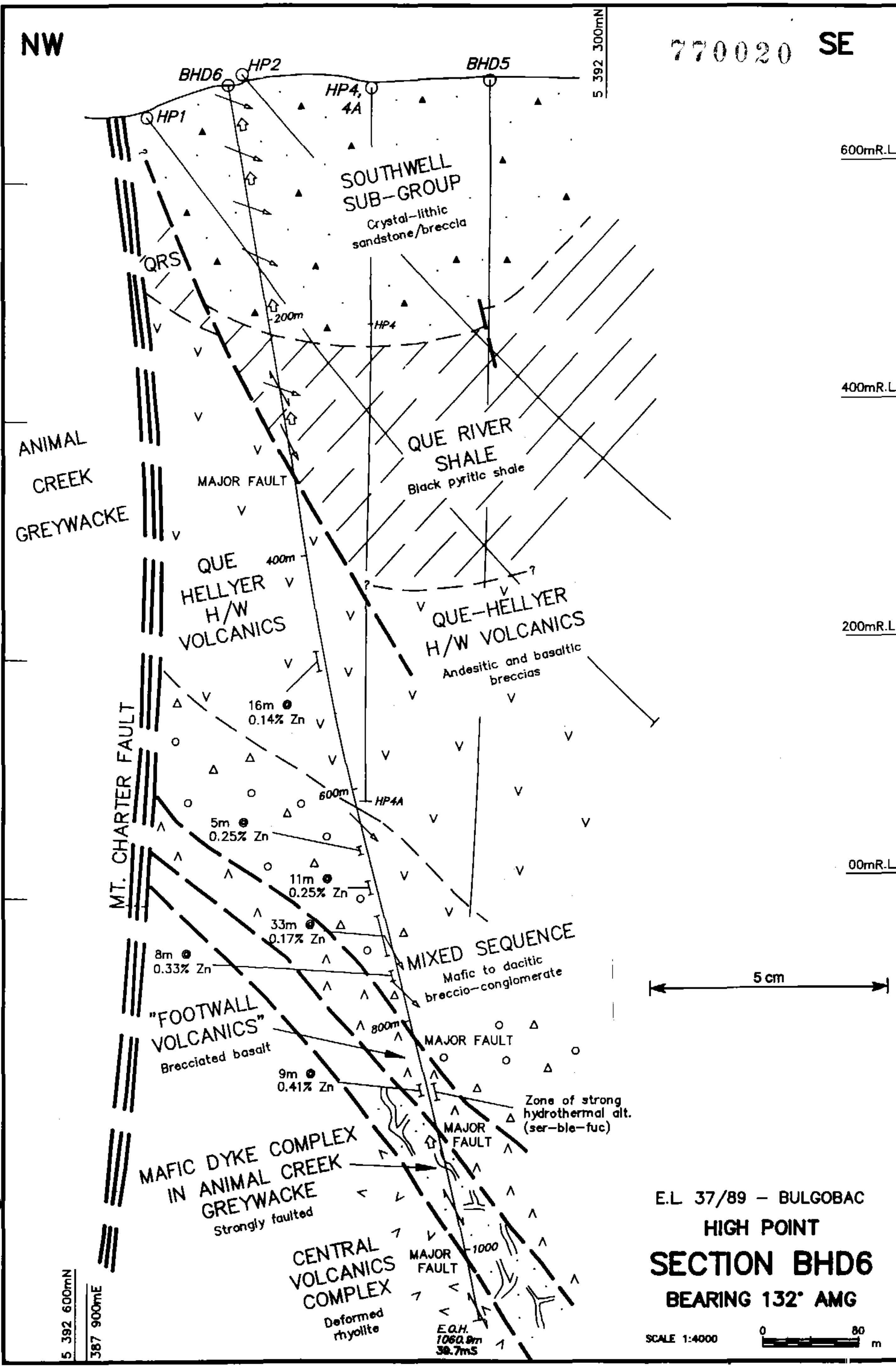
From 900m to 1013m, BHD6 intersected the Animal Creek Greywacke, comprising carbonaceous quartzose sandstone with common dykes of amygdaloidal basaltic andesite (the latter co-magmatic with the Hangingwall Volcanics below 450m in the hole according to Crawford). The entire sequence is highly sheared and faulted, part of the pattern of increasing deformation in the basal section of the hole.

Below a major fault zone at 1013m, to EOH at 1060.9m, strongly deformed and brecciated, sericitised, poorly quartz-phyric rhyolites with dismembered basalt dykes of Mt Charter Dolerite affinity, were encountered. These felsic volcanics are confidently considered to be local CVC basement.

[Note, Crawford (1995) disagrees, citing both the apparent intrusive nature of the BHD6 rhyolites and his opinion that quartz-phyric lavas are rare in the CVC north of the Henty Fault. However, the author has spent over 15 years mapping and drilling the Mt Read Volcanics and while the CVC is dominantly feldspar-phyric, quartz-phyric volcanics including pyroclastics, lavas and intrusives, are quite common. Good examples are catalogued in mapping and sampling undertaken in the Mt Block area in 1992 (see section **6.4** and Appendix 7, in Purvis, 1992).]

770019


386 000mE
387 000mE
388 000mE
389 000mE
390 000mE
5 496 000mN
5 495 000mN
5 494 000mN
5 493 000mN
5 492 000mN
5 491 000mN
5 490 000mN
E.L. 19/94
PASMINCO
LONGITUDINAL SECTION LINE
BRDO4
BRDO1, IA
BRDO2
BRDO5
BULGOBAC
PROPOSED
HOLE BHD7
MT CHARTER
BHD2
BHD3
E.L. 106/87
ABERFOYLE
HP3
HP2
BHD6
HP1
HP4, HP4A
BHD1
Sock Creek
E.L. 37/89
PASMINCO
BUZIED STRATIFORM
ZINC ZONE
MAC2
MC1
MC13
MC11
MC12
HAT2,2A
HAT1
MOUNT CHARTER
Mt Charter
MCH1
5 cm
PASMINCO EXPLORATION
A Division of Pasminco Australia Limited
COMPILED : J.G.P.
DATE :
DRAWN : G.M.B.
REF. : Map 1, Geology of The Mt. Charter-Hellyer Area. Mt Read Volcanics Project
REVISIONS :
DRAWING No.
E.L. 37/89 - BULGOBAC HILL
HIGH POINT
GEOLOGY
PLAN
SCALE 1:25,000
0
500
m
FIG. No.
6



E.L. 37/89 – BULGOBAC

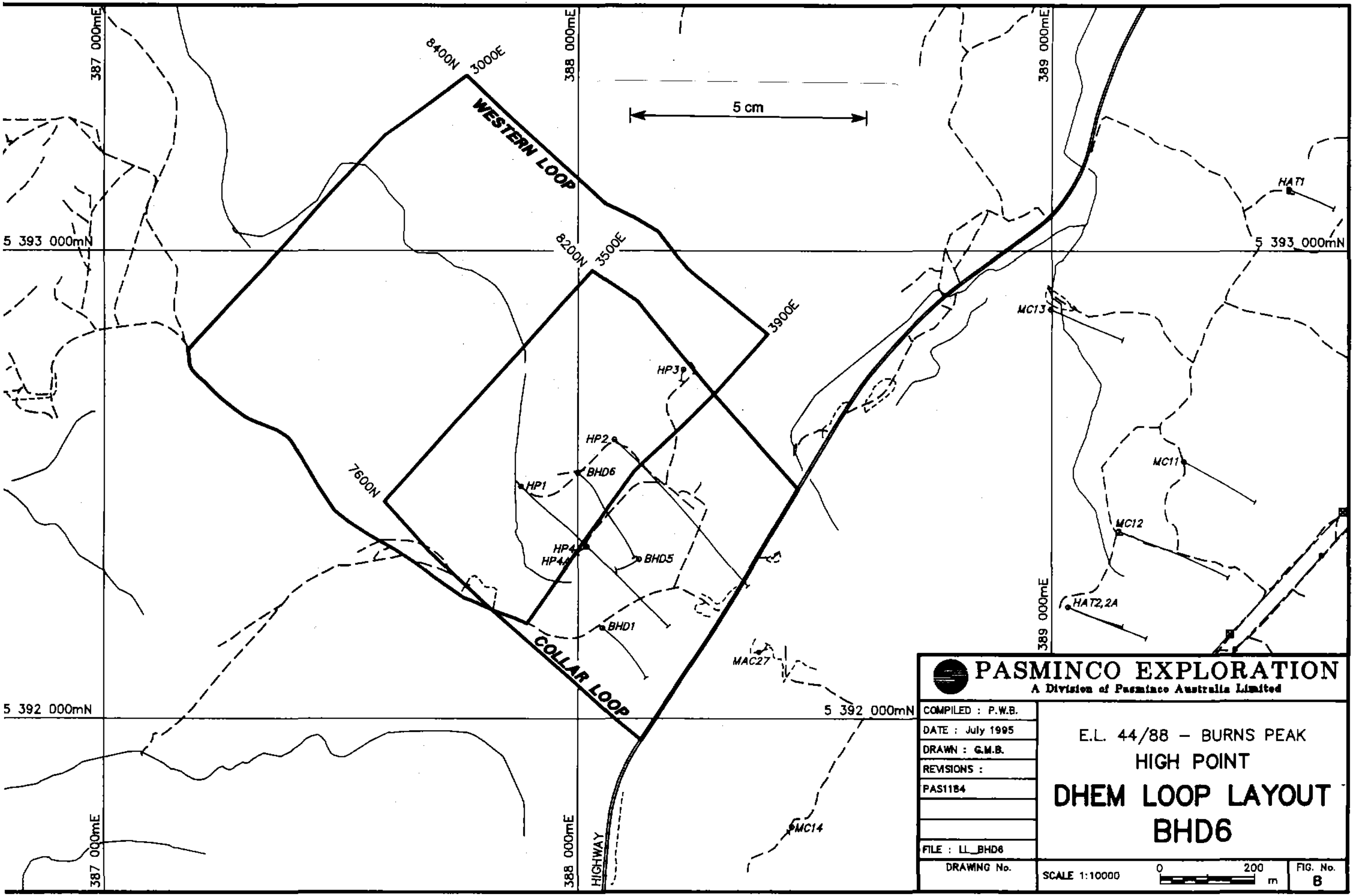
HIGH POINT

SECTION BHD6

BEARING 132° AMG

SCALE 1:4000 0 80 m

770021


387 000mE
388 000mE
389 000mE
5 393 000mN
5 392 000mN
8400N 3000E
8200N 3500E
3900E
7600N
5 cm
WESTERN LOOP
COLLAR LOOP
HP1
HP2
HP3
HP4
HP4A
BHD1
BHD5
BHD6
MC11
MC12
MC13
MC14
MAC27
HAT1
HAT2,2A
HIGHWAY
PASMINCO EXPLORATION
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COMPILED : P.W.B.
DATE : July 1995
DRAWN : G.M.B.
REVISIONS :
PAS1184
FILE : LL_BHD6
DRAWING No.
E.L. 44/88 – BURNS PEAK
HIGH POINT
DHEM LOOP LAYOUT
BHD6
SCALE 1:10000
0
200
m
FIG. No.
8

5.2 DHEM Survey of BHD6

PVC casing was placed to the base of BHD6 upon completion of the drilling. In April 1995 the hole was surveyed using the CRONE PEM system. The results were interpreted by P. Basford (1995, – see Appendix 2). The loop layout is shown in Figure 8.

Basford attributes an anomalous response in the upper part of the hole to a more conductive layer within the Que River Shale. Modelling suggests the anomaly is centred to the north of the hole. This interpretation is supported by BHP drill hole HP2, 100m north of BHD6, where the Que River Shale is thicker and deeper than in BHD6.

A small in–hole response at 600–620m is probably due to the pyritic carbonaceous sandstone band marking the top of the Mixed Sequence at 615–622m.

5.3 Lithochemical Stratigraphic Study - High Point

In April 1995, Dr Tony Crawford completed a major lithochemical study of the Que–Hellyer Volcanics in the western part of the Que–Hellyer Basin. Data from 19 drill holes, including six Pasminco and BHP holes at High Point, four Placer holes on Bulgobac River and seven Aberfoyle holes east of High Point, formed the basis for the study.

The Summary and Recommendations from Crawford's report are reproduced below. Other important sections of the report appear in Appendix 3.

<u>EXECUTIVE SUMMARY (Crawford, 1995):</u>

"All available petrographic and lithochemical data for 19 drill holes in the High Point – Bulgobac area, including holes in the Aberfoyle data swap area, have been collated. Using key immobile elements and element ratios (namely TiO_2, Zr, Ti/Zr, P_2O_5 and Cr), a series of colour lithochemical logs has been produced. These are used as a basis for making correlations in the +500m-thick stratigraphic sections of the extensive Hellyer Basalt. In much of the area under consideration, correlations between adjacent drill holes can be made with some confidence, and a broad lithochemical stratigraphy can be deciphered. However, in the High Point region, extensive faulting has led to lateral impersistence of units and greatly complicated correlations of lava units, even between adjacent drill holes.

A model is proposed for the dispersed Zn mineralisation in the High Point region. This model takes into account the strikingly similar spatial distribution of this sub-economic mineralisation with both the Mount Charter Dolerite and the distinctive quartz xenocryst-bearing basaltic and andesitic units of this area. A reasonable assumption might have been that the dispersed Zn mineralisation is derived by hydrothermal fluids, driven by Mount Charter Dolerite sheet intrusion, accessing and remobilising Zn and S from some underlying VHMS body. However, I suggest that a precipitous drop in S solubility of basalt magmas upon contamination by quartz-phyric rhyolite, to produce the quartz xenocryst-bearing basalts and andesites, resulted in disseminated sulphides crystallising or precipitating within these basalts. Later passage of hydrothermal fluids, related to the cooling Mount Charter Dolerite, through these basalts scavenged sulphides and reprecipitated them in favourable sites higher in the pile, mainly in porous units and fractures.

Recommendations

1. All future drilling in the Que-Hellyer region should be followed up by continuous core grind assaying of all lava sections for Ti, Zr, Cr and P_2O_5. These elements successfully discriminate various lava units within the Hellyer Basalt, Que Footwall Andesites and Mixed Sequence, and facilitate interpretation of stratigraphic position and 'depth to Mixed Sequence'.

2. Shallowing of the Mixed Sequence around BHD3, plus the common occurrence of epiclastics in the only hole at High Point that reached the Mixed Sequence (BHD6), suggest that the poorly known region between BHD3 and HP3, and the area immediately west of BHD3, might be prospective drilling sites for Mixed Sequence-hosted Hellyer-Que type VHMS deposits. A significant gravity structure recorded 500m SW of BHD3 by Placer deserves further investigation.

3. Lateral impersistence of lava units in the immediate area of High Point (between BHD1 and HP3), due largely to intense faulting probably mainly related to the Mount Charter Fault zone, suggests that any VHMS deposit in this area might be heavily faulted and discontinuous along strike."

5.4 Geochemical & Petrological Sampling, Hole HP4/4A

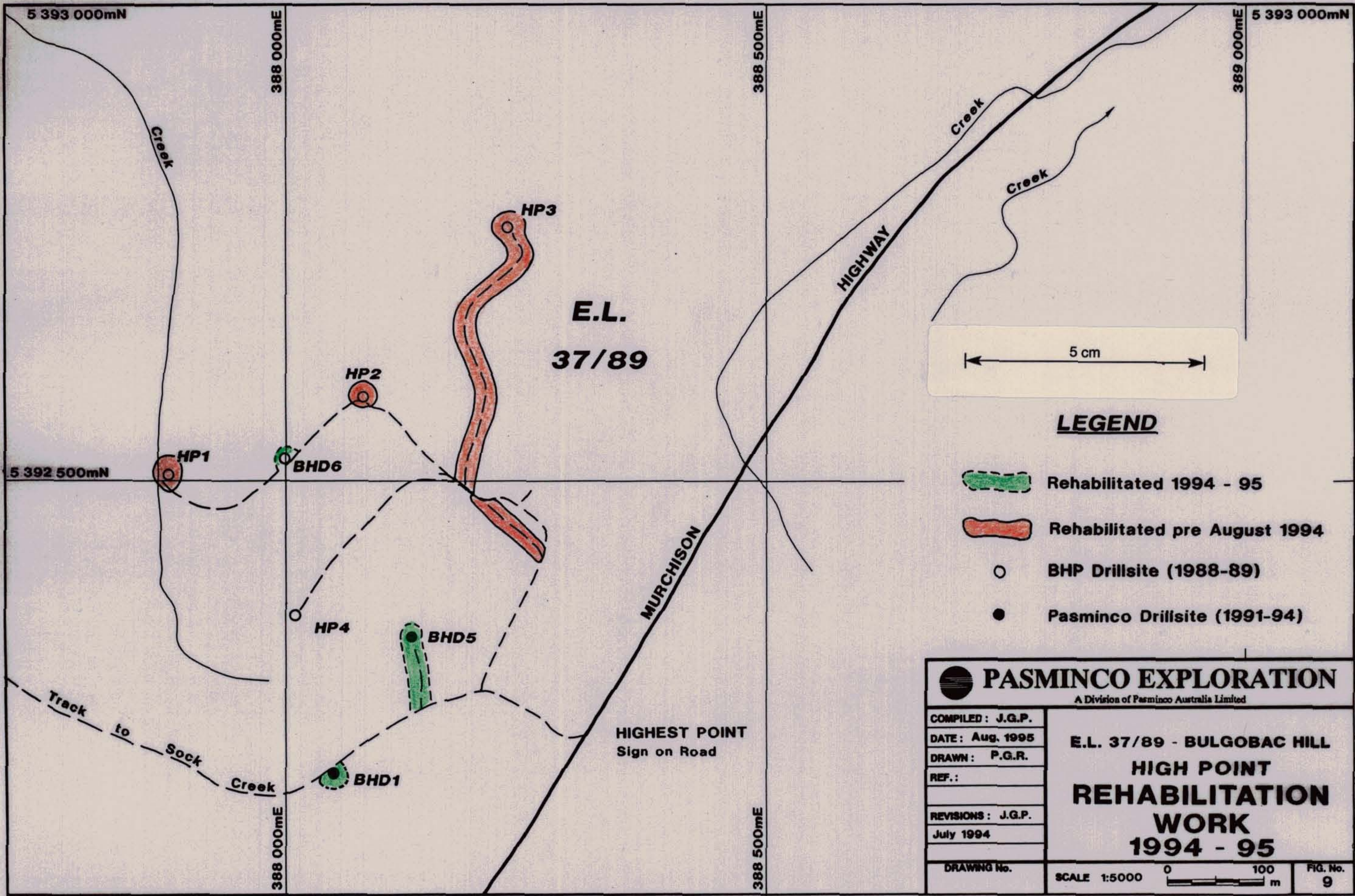
In August 1994, additional geochemical and petrological samples were taken from the core of 1989 BHP hole HP4/4A at High Point. The results are listed in Appendix 4 and were used by Crawford in his study.

5.5 Environmental Rehabilitation

See Figure 9.

In August 1994 the 70m drill access track and site of hole BHD5 at High Point was rehabilitated using an excavator to replace stockpiled topsoil and slashed vegetation. After the aborted attempt to re-open hole BHD1, the damaged rehabilitation work on this site was repaired using the excavator to replace disturbed topsoil and slashed vegetation.

The site for hole BHD6 at High Point was constructed on disturbed ground beside the existing BHP track to 1988 hole HP1. Water flowing from the collar of HP1 is the local water supply for drilling, so the access track is kept open. The BHD6 site was largely rehabilitated when drilling finished in November 1994. However, vehicle access to the collar was maintained so the hole could be surveyed with downhole EM in April 1995. Rehabilitation of the BHD6 site will be completed when the new planned deep hole is put in at High Point later this year.



5 393 000mN
388 000mE
388 500mE
389 000mE
5 393 000mN
Creek
Creek
Creek
HIGHWAY
HP3
E.L.
37/89
HP2
HP1
BHD6
5 392 500mN
MURCHISON
HP4
BHD5
Track to Sock Creek
BHD1
HIGHEST POINT
Sign on Road
388 000mE
388 500mE
5 cm
LEGEND
Rehabilitated 1994 - 95
Rehabilitated pre August 1994
BHP Drillsite (1988-89)
Pasminco Drillsite (1991-94)
PASMINCO EXPLORATION
A Division of Pasminco Australia Limited
COMPILED: J.G.P.
DATE: Aug. 1995
DRAWN: P.G.R.
REF.:
REVISIONS: J.G.P.
July 1994
DRAWING No.
E.L. 37/89 - BULGOBAC HILL
HIGH POINT
REHABILITATION
WORK
1994 - 95
SCALE 1:5000
0
100
m
FIG. No.
9

920027

6 DISCUSSION

6.1 Significance of BHD6 Epiclastics

The dominance of epiclastics in the Mixed Sequence in BHD6 is a positive step forward for the ore search at High Point.

The Que and Hellyer orebodies occur in areas where the Mixed Sequence is predominantly epiclastic (of andesitic to dacitic provenance, like BHD6), as opposed to areas where the unit is largely or totally made up of dacitic lavas and lava breccias.

At High Point the Mixed Sequence has been intersected by BHD6 (epiclastics). To the east and south-east it has been intersected in MAC27 (dacite lava/breccia), MCH1 (mafic lava/breccia), and MC12 (dacite lava/breccia). See Figure 6.

To the north the Mixed Sequence has been intersected in BHD3 (dacite lava/breccia with minor epiclastics), BRD05 (dacite lava/ breccia), and BRD01A (dacite and andesite lava/breccia, with minor epiclastics).

Thus the dominantly-epiclastic Mixed Sequence section in BHD6 has no counterpart in any other hole drilled to date in the western part of the Que-Hellyer Basin. The BHD6 intersection is 120m east of the surface trace of the Mt Charter Fault. One reason for siting BHD6 so close to the fault was the thought that a narrow trench or sub-basin of epiclastics may have collected beside the structure during the Cambrian. The Mt Charter Fault, the western marginal structure of the Que-Hellyer rift, must have been a scarp in the Cambrian with a marked topographic low to its east. Thick units east of the fault, such as the Que-Hellyer Volcanics and Que River Shale, are thin or absent west of it.

On the basis of the known association of massive sulphide ore with epiclastic sections of the Mixed Sequence, the results of BHD6 require follow-up drilling.

6.2 Drilling to Follow-Up BHD6

The EL boundary lies only 250m east of the BHD6 Mixed Sequence intersection, and it would seem that in this direction the unit is dominated by dacitic lavas and breccias anyway.

To the south of BHD6 room is limited to a narrowing 450m long wedge between the converging EL boundary and Mt Charter Fault. While the epiclastic lens probably extends in this direction it is not worth testing because of the limited space and the known problems with faulting in this block.

North of BHD6 lies a large area of untested ground – the obvious target for follow-up drilling. In fact, this space strongly enhances the BHD6 result. The nearest holes into the Mixed Sequence are BHD3 1.5km to the NE, and BRD05 1.9km to the NNE (see Figure 6).

The rapid facies variations in the Que-Hellyer Volcanics make it risky to initially step out very far north of BHD6. Drilling by Pasminco and other Companies demonstrates drill spacings wider than 400-500m in these rocks run the risk of encountering substantially different geology hole to hole. For example, the distance from the epiclastic Mixed Sequence intersection in BHD6 to the all-dacite lava/breccia Mixed Sequence in MAC27 is only 420m (see Figure 11).

The strong but patchy hydrothermal alteration in the Mixed Sequence and "Footwall Volcanics" in BHD6 also suggests that significant mineralization may not be far from the hole – perhaps as close as a few hundred metres.

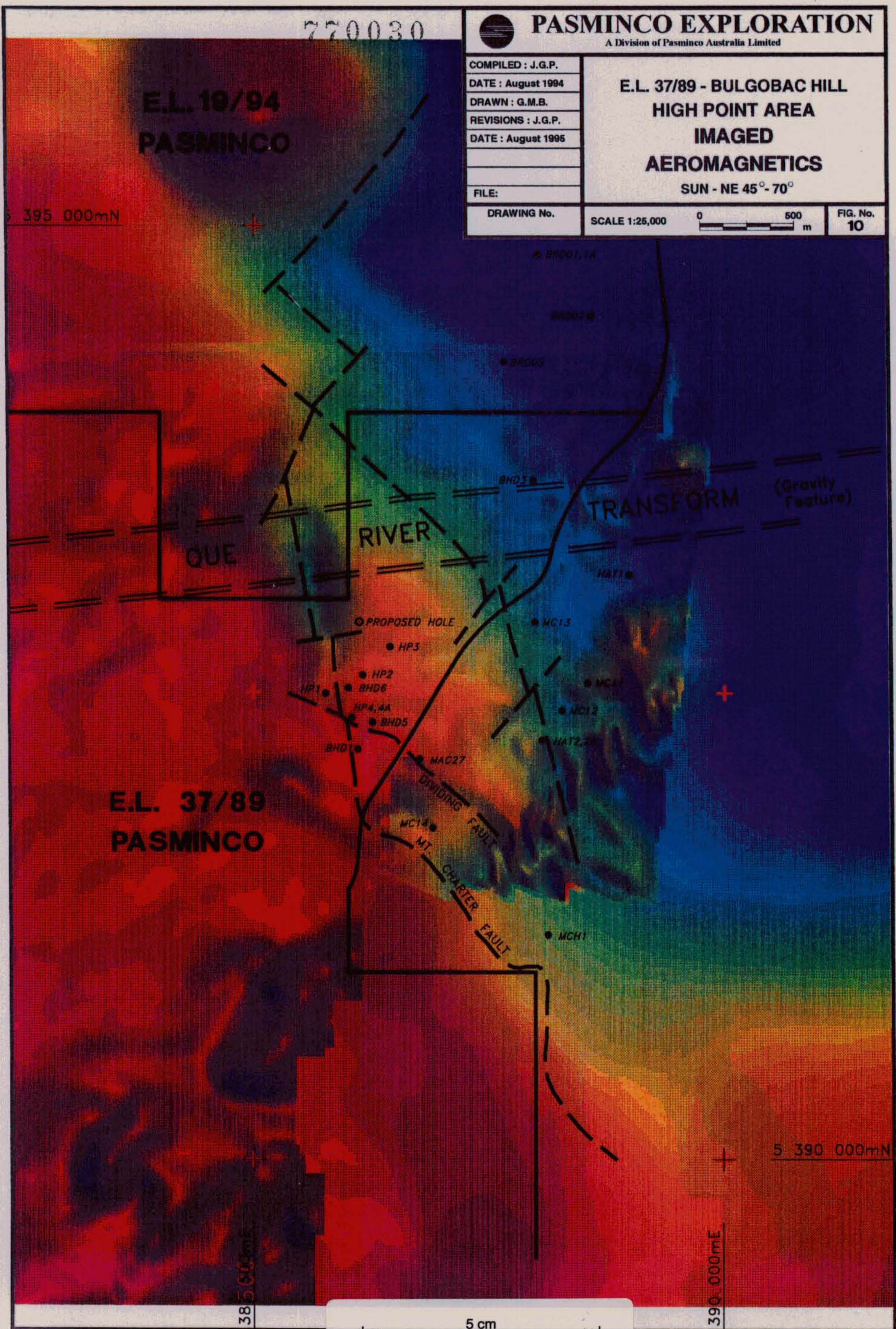
With the BHD6 result seemingly confirming the fault-associated epiclastic-filled sub-basin idea, logically any follow-up drill hole should also be sited adjacent to the Mt Charter Fault. A magnetic low extending north along the Mt Charter Fault from the vicinity of hole HP1 becomes very pronounced beyond 400m north of BHD6, where it coincides with an east-west gravity feature that passes beneath the Que River Mine 4km to the east (Leaman, 1991, in Purvis, 1992). See Figure 10.

The magnetics also show the Mt Charter Fault is disrupted by cross-faults to the north of High Point. Because of this it is considered prudent to step any follow-up drill hole a little further from the fault than BHD6's 120m.

Taking into account all the features mentioned above, the site selected for a vertical follow-up drill hole is 500m north of the BHD6 intersection and about 250m east of the Mt Charter Fault, at AMG co-ordinates 5392900mN/ 388100mE. The site is marked on Figures 6 & 11. Based on the known gentle northerly plunge of the Que River Shale at High Point and the effects of cross-faults, the estimated depth to the Mixed Sequence at this site is 900m, with total hole depth 1150m.

This location is only 200m NW of 1989 BHP hole HP3, a vertical hole which ended in the Que River Shale at 577m. The hole is lined to bottom with PVC casing, but this may be able to be removed as the hole encountered few faults and was in good condition at the completion of drilling (P. Sharp, Diamond Drilling Tasmania, pers comm 1993). Realistically, the chances are probably no better than 50%.

HP3 is 360m NNE of the BHD6 intersection and about 300m east of the Mt Charter Fault. It is a little closer to BHD6 and further from the fault than considered optimum. The estimated depth to the Mixed Sequence here is the same as for the preferred site mentioned above: 900m to target and 1150m total depth. If HP3 could be deepened it would provide a satisfactory follow-up to BHD6 at about half the cost of drilling a new hole.


770030
PASMINCO EXPLORATION
A Division of Pasminco Australia Limited
COMPILED : J.G.P.
DATE : August 1994
DRAWN : G.M.B.
REVISIONS : J.G.P.
DATE : August 1995
FILE:
DRAWING No.
E.L. 37/89 - BULGOBAC HILL
HIGH POINT AREA
IMAGED
AEROMAGNETICS
SUN - NE 45°- 70°
SCALE 1:25,000
0
500
m
FIG. No.
10
E.L. 19/94
PASMINCO
5 395 000mN
BHD3
QUE
RIVER
TRANSFORM
(Gravity Feature)
HAT1
PROPOSED HOLE
MC13
HP3
HP2
HP1
BHD6
HP4,4A
BHD5
MC12
BHD1
MAC27
DIVIDING FAULT
MC14
MT. CHARTER FAULT
MCH1
E.L. 37/89
PASMINCO
5 390 000mN
390 000mE
5 cm

6.3 Comments on Lithochemical Stratigraphic Study

Crawford's lithochemical facies mapping of the volcanics in the western Que-Hellyer Basin is excellent and will assist in guiding future exploration.

Unfortunately, parts of his sections and stratigraphic interpretations suffer from artifacts due to insufficient acknowledgement of rock and drill hole relationships on the ground.

For example, he recommends testing the area W and SW of hole BHD3 because of the "shallowing of the Mixed Sequence" in the vicinity of this hole. The shallowing is put at +200m, but is due almost entirely to the fact that BHD3 is the furtherest up the westerly regional dip of any hole on EL 37/89. East of BHD3, on Aberfoyle ground, the Mixed Sequence actually outcrops. In raw RL terms the top of the Mixed Sequence in BHD3 is 70m lower than in BHD6.

Artifacts due to the prevailing westerly dip also affect Crawford's sectional interpretations. An example among several: the apparent +200m throw on his Bulgobac Crossing Fault between holes MC11 and MC12 (see p14 and section E–F), is exaggerated by the fact that from hole MC14 to MC11 the section runs obliquely up the dip, turning north of MC11 to run obliquely down the dip. Collared furtherest up-dip the geology in MC11 will of course be shallowest. While evidence points to a fault between MC12 and MC11, the degree of arching Crawford associates with it is not nearly as marked as he describes. His interpretation is also complicated by the fact that if the fault trends as he shows it on his Figure 4, it has to pass through MC12 at depth, not between MC12 and MC11 as drawn on section E–F.

Sections E–F and G–H are also drawn with hole collars on a horizontal plane, which in this sort of terrain will affect structural correlations between holes.

The points raised above are quite important given the significance Crawford rightly attaches to highs dominated by felsic lavas (p15 & 29). His interpreted bathymetric felsic ridge extending broadly N-S from MC14 to BRD01, has implications for the location of future drilling and needs to be verified (if possible) by looking at the thinning or otherwise of facies onlapping it.

The upshot is that Crawford's excellent lithochemical logs and correlations should be married to redrawn sections through the western Que-Hellyer Basin.

Some comments on other matters raised by Crawford's study:

Stratiform Zinc Zone

If the stratiform zinc mineralization in the upper part of the Hellyer Basalts at High Point was associated with emplacement of the Mt Charter Dolerite body (Crawford, p30), why didn't the mineralization pond beneath the Que River Shale, which would have formed an ideal cap-rock? Also, why isn't there evidence of depleting alteration within the mafic pile below, from where the sulphides were supposedly scavenged?

Que River Transform

All the holes containing quartz-contaminated mafics lie on the southern side of Leaman's (1991) Que River Transform. This E-W gravity feature is shown in Figure 10. Apart from one quartz-phyric sample in hole BRD05, all the holes north of the transform are quartz-free. Given the "major differences in lithochemical stratigraphy" (Crawford, p24), between BHD6 and the deep holes further north (BRD01, BRD02, BRD05 and BHD3), it may be that the transform marks a real and fundamental syn-volcanic feature.

Magnetic Linear

A major and previously unmapped structure is evident on the magnetics, trending NW in a broad arc from near Mt Charter to its intersection with the Mt Charter Fault 1.5km north of hole HP1. The southern 1.8km of this structure broadly coincides with Crawford's Bulgobac Crossing Fault. See Figure 10 and compare with Figure 4 in Appendix 3.

CVC or not CVC?

The quartz-phyric rhyolites at the base of BHD6 are seamed by Hellyer Basalt dykes and were obviously emplaced before the mafic unit was erupted. This suggests they are part of the underlying CVC. As the source of contaminating quartz xenocrysts in the upper part of the Hellyer Basalt has to have been a contemporaneous liquid magma according to Crawford, it seems the source of the quartz is more likely to have been the other candidate: the quartz-feldspar porphyries in the Southwell SubGroup, which were erupted shortly after the Hellyer Basalt. The rhyolites in BHD6 and the quartz-feldspar porphyries are totally dissimilar in appearance.

Flows v Sills

Re: the flow v sill argument for the origin of many units within the Hellyer Basalt (Crawford, p12). Detailed logging of BHD6 (see graphic log in Appendix 1), shows some peperites have finer and apparently slightly re-worked, tops. This suggests these mafics were flows on shale rather than sills burrowing in it. Like Crawford, the author concludes that most of these units are flows. Dykes and other intrusives within the mafic pile are usually identifiable by weak sub-ophitic texture.

6.4 EL Reduction and Remaining Targets

On 2nd September this year EL 37/89 has to be reduced by at least 16sq km. The actual reduction will be 21sq km, as shown on Figures 2 & 4.

The reduction has been largely guided by the review of the mineral potential of the EL outlined in the 1993-94 Annual Report (Purvis, 1994). The reduction comprises 20sq km of CVC volcanics in the Mt Block area and 1sq km of Dundas Group sediments in the NW corner of the EL.

However, some modifications have been forced on the 1994 mineral potential assessment by exploration results this year on Pasminco's Burns Peak EL 44/88, 5km west of Bulgobac Hill. Here, patchy basemetal mineralization and intense silica alteration has been found in the top of the CVC volcanics adjacent to the contact with the Dundas Group. This mineralization was located while following up magnetic lows along the contact.

A similar, although weaker, magnetic low on the CVC/Dundas Group contact occurs on the Bulgobac Hill and was investigated with ground magnetic traverses, mapping and rock sampling, in 1992 (Purvis, 1992). No alteration or mineralization was found. The magnetic anomaly is actually the most north–easterly in a chain of more pronounced lows that extend through the Boco area. Here, in 1992 Pasminco drilled hole AK1 into a magnetic low adjacent to the Bulgobac Hill anomaly without locating any mineralization.

Thus it has been considered wise to retain as much of the CVC / Dundas Group contact on EL 37/89 as possible, most particularly the magnetic low and the poorly–known area where the contact junctions with the Henty Fault south of Mt Charter.

The Sock Creek area has also been retained, although it is not rated highly. The zone of interest here is not the well–known Sock Creek mineralization itself, but the potential for zinc deposits indicated by the weak mineralization associated with the Sock Creek South basalts. This stratigraphic position is considered to mark the last stages of Que–Hellyer volcanism (Crawford, 1995). See Figure 5. On this basis it must be considered to have some prospectivity.

It is interesting to note that the dacitic lava breccia at the top of the Mixed Sequence in BHD6 at High Point has the same high Zr signature as the rhyodacites underlying the Sock Creek South basalt and occupying the Que–Hellyer stratigraphic position.

As mentioned in the 1994 Annual Report, the best-ranked target on the EL outside of High Point is the poorly explored Henty Fault / Mt Charter Fault junction area south of Mt Charter, considered to have been a site of concentrated extension in the Cambrian. Commitments at High Point have to date delayed the start of reconnaissance work in this area.

7 CONCLUSIONS

1 The epiclastic–dominated Mixed Sequence intersected in hole BHD6 at High Point significantly upgrades the prospectivity of the area and warrants follow–up drilling.

2 As no other holes to date in the western part of the Que–Hellyer Basin have encountered such an epiclastic section, initial follow–up drilling needs to be reasonably close to BHD6. Rapid facies variations in the Que–Hellyer Volcanics suggest the new hole should be a maximum of 500m from BHD6.

3 The best target zone for follow–up drilling is adjacent to alteration on the Mt Charter Fault in the large untested area immediately north of BHD6. Depth to the Mixed Sequence in this area is estimated at 900m.

4 The deepening of existing hole HP3 from 577m to 1150m, could potentially provide a satisfactory test of the Mixed Sequence at half the cost of a new hole. The location of HP3, 370m north of BHD6 and 300m east of the Mt Charter Fault, is closer to BHD6 and further from the fault, than considered optimum.

5 The lithochemical stratigraphic study by Crawford should be completed by the production of accurate new sections through the western part of the Que–Hellyer Basin.

6 The remaining identified targets on the EL outside of the High Point area are considered to be (in order of priority):

- The Henty Fault/Mt Charter Fault junction area
- The CVC/Dundas Group Contact
- The Que–Hellyer stratigraphic–equivalent volcanics in the Sock Creek area.

8 RECOMMENDATIONS

1. A deep drill test be made of the Mixed Sequence adjacent to the Mt Charter Fault north of BHD6 to follow up the epiclastic intersection in this hole. The new 1150m vertical hole should be sited at 5392900mN / 388100mE, approximately 500m north of BHD6 and 250m east of the Mt Charter Fault.

2. A second option, to try and deepen existing hole HP3, is less favoured because the location is not as ideal as that for the new hole.

   (Note, the new hole site is only 200m NW of HP3 and the access track to it would go past the collar of HP3. Chances of removing the PVC casing from HP3 are rated at 50:50).

3. Reconnaissance mapping and rock sampling be commenced south of Mt Charter in the areas where the Henty Fault junctions with the Mt Charter Fault and the CVC/Dundas Group contact.

9 REFERENCES

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10 KEYWORDS & LOCALITY

Keywords

ZINC, MAFIC VOLCANICS, STRATIGRAPHY, STRUCTURE, VOLCANOGENIC, RIFT, GEOCHEMISTRY, DRILL DIAMOND, GEOPHYS BOREHOLE

Locality

BURNIE SK55-3: BULGOBAC HILL, QUE RIVER, HELLYER

APPENDICES

APPENDIX 1

Log of Hole BHD6, High Point

PASMINCO EXPLORATION
DIAMOND DRILL CORE RECORD

HOLE No. BHD 6

LOCATION	TASMANIA
PROJECT	BULGOBAC HILL
PROSPECT	HIGH POINT
DESIGNED BY	J.G. PURVIS
LOGGED BY	J.G. PURVIS
RELOGGED	
COMMENCED	26.8.94
COMPLETED	21.11.94
DRILLED BY	F. ORTNER
DRILL RIG	MINDRILL 66

OBJECTIVE

TO COMPLETE TEST OF QUE-HELLYER MIXED SEQUENCE, ORIGINALLY DESIGNED TO BE CARRIED OUT BY ABORTED HOLE BHD5.

RESULT

MIXED SEQUENCE BRECCIO-CONGLOMERATES INTERSECTED 677 – 815m (55m TRUE THICKNESS), CONTAINING DISSEMINATED SPHALERITE AND PYRITE. BEST INTERSECTIONS: 7.7m @ 0.33% Zn IN MIXED SEQUENCE AND 2m @ 1.2% Zn IN FOOTWALL BASALTS.

LOCATION/SURVEY DATA (AMG)

Grid	AMG	RL Collar m	682.9
Northing m	5 392 522.9	Bearing Collar	131° 50'
Easting m	387998.8	Dip Collar	−80°
DH Survey Type	EASTMAN DOWNHOLE CAMERA	Length Hole m	1060.9m

Depth m	Bearing	Dip	Depth m	Bearing	Dip
0	132°	−80°	781	146.8°	−75.4°
30	126°	−80.7°	811	146°	−75.2°
61	130°	−80.9°	841	147°	−75.75°
91	132°	−80.5°	871	149°	−75.8°
127	137°	−80.7°	904	149.25°	−76°
157	133°	−80.1°	934	151°	−76.5°
187	137°	−80.5°	964	151.75°	−76.5°
217	135°	−80.2°	997	155°	−77°
247	143°	−80.1°	1030	153°	−77.5°
280	145°	−80.2°	1060.9	154°	−78°
310	147°	−80.5°	(EOH)		
340	150	−80.1°			
364	151.5°	−80.9°			
403	153°	−79.7°			
433	154.5°	−79.7°			
493	153°	−78.5°			
526	151.5°	−78.2°			
559	149.5°	−77.3°			
592	151°	−76.1°			
622	146.7°	−75.3°			
655	144.5°	−75°			
688	145°	−75°			
748	146.5°	−75.3°			

SIGNIFICANT INTERSECTIONS

From m	To m	Interval m	Zn	Pb	Ag	Au		Comments
708	741	33	0.17%	<0.05%	<1	<0.008		DISSEMINATED SULPHIDES IN MAFIC
INCL: 718.6	720.8	2.2	0.38%	<0.02%	<1	<0.008		BRECCIO-CONGLOMERATES
754.8	762.5	7.7	0.33%	<0.05%	<1	<0.008		AS ABOVE
853.5	862.5	9	0.41%	0.08%	<1	<0.008		DISSEMINATED + STRINGER SULPHIDES
INCL: 854.5	856.5	2	1.2%	0.08%	<1	<0.008		IN ALTERED BRECCIATED BASALT

SIGNIFICANT CORE LOSS

From m	To m	% Lost
379.9	381.3	21
624.3	625.5	20

POOR GROUND CONDITION ZONES

From m	To m	Condition
314.5	327.7	BROKEN BY BRITTLE FAULTS + FRACTURES ALMOST // LCA
574	615	BROKEN BY NUMEROUS FAULTS AT LOW ANGLE TO LCA (POSSIBLY A SINGLE STRONG STRUCTURE)
889	970	EXTENSIVELY DEFORMED + BROKEN BY STRONG DUCTILE/BRITTLE FAULTING AT LOW ANGLE TO LCA.

HOLE SIZE

Size	Depth m
HW	8
HQ	366
NQ	1060.9

HOLE CONDITIONS AFTER COMPLETION

Collar	HW CASING WITH STEEL SCREW-ON TOP
Steel Casing	8m HW CASING LEFT IN TOP OF HOLE
PVC Casing	40mm ID CLASS 9 PVC PLACED TO BASE
Ground Water	–
Wedge	–
Drill Pad	–

LOG OF HOLE BHD6

0 - 211.0m: SOUTHWELL SUBGROUP

0 - 8.4m: NO CORE

8.4 - 70.6m: CRYSTAL-LITHIC SANDSTONE/BRECCIA

Lithology: Creamy-grey to black & white.

Up-hole fining mass-flow pulses of coarse qtz-feld xyl sst to fine breccia, with thin tops of fine bedded sst.

Zones of black shale/siltstone as matrix, lumps & bands, increasing below 54m & predominant below 66.5m.

Volc qtz xyls to 8mm, av <4mm, sl rounded & fractured. Feld xyls 1-3mm.

Subangular lithics (av <15mm, rarely to 150mm) of qtz-feld porph, flow-banded qtz-phyric rhyolite & fi gr volcs. Two 15mm pyritic mafic frags @ 67-69m.

Some fine deformed pumice in matrix.

Alteration: Weak oxidation on fracts to 15m, carb leaching to 60m.

Weak sericite-chlorite. Some silica-albite above 26m, carbonatisation below 54m.

Structure: Bedding: 65°/LCA @ 12m & 39m; 50°/LCA @ 27.8m (dips 33° to 122° AMG); 43°/LCA @ 56m (dips 41° to 070°AMG); 62°/LCA @ 67m.

Gradational contact at base.

Mineralization: Minor to 1% dissem & fract-filling py. Trace dissem sp below 36m.

70.6 - 104.8m: BLACK SHALE

Lithology: Dark grey, weakly calcareous siltstone/shale. Sl carbonaceous & vitric.

Intervals of up-hole fining volcaniclastic sst above 85m.

Structure: Fine regular bedding (except for small-scale folding in upper 3m): 72°/LCA @ 83m (dips 9° to 112° AMG); 63°/LCA @ 97m.

Fault 15°/LCA @ 72.7m;

Broken by fracts @ 78.2-79.3m (10-20°/LCA) & 103.8-104.8m.

Basal contact abrupt, broken.

Mineralization: Minor to 1% dissem & fract-filling py. 2% py just below top contact.

Rare cp-sp on fracts & in carb veinlets.

104.8 - 125.2m: FINE VOLCANICLASTIC SANDSTONE

Lithology: Pale grey. Massive. Uniform. Even-grained.

Largely finely comminuted qtz and sericitic volc glass. Minor feld & lithic grains.

Grainsize av <0.5mm, but coarsens gradually to 1mm at base.

Blotchy appearance due to diagenetic de-watering.

Minor sericitic bands & wisps after pumice (abund 115-116m). Frags of fuchsitic pumice to 8mm below 124m.

Alteration: Weak sericitisation of glass & along faults.

Veining: Leached qtz(-carb) veins below 121m.

Structure: Massive. Poorly-defined bedding: 35°/LCA @ 109m (dips 45° to 110° AMG); 60°/LCA @ 124.5m.

Broken in places by fracts & brittle faults almost //LCA.

Faulted at intervals 104.8-110.3m by prob single structure <15°/LCA.

Abrupt basal contact 55°/LCA (bedding).

Mineralization: Minor dissem py.

125.2 - 211.0m: PUMICEOUS BRECCIO-CONGLOMERATE

Lithology: Grey. Massive. Hard. Largely unbroken.

Mass-flow deposit coarsening downhole overall.

Angular to subrounded volc clasts (incl pumice) in sandy matrix of volc qtz, felds & glass.

Clasts incl: abund deformed pumice; variable dacites (incl fi gr, feld-porph, flow-banded, perlitic, & amygdaloidal); mafics (gen amygdaloidal); qtz-feld porph; lithified black shale & greywacke.

Above ≈ 133m: fine pumice-rich bx (frags/clasts av <8mm, to 25mm), fining downhole.

133-150m: diffuse bands of sandy open-framework fine bx-cong, grit & coarse sst.

Below ≈150m: bx-cong gradually coarsens, with increasing clast abundance.

185-198.5m: Clasts av 10-25mm, max 300mm (black shale).

Below 198.5m: v coarse & packed, with rounded boulders to 1.8m of dacite & mafics.

Alteration: Weak-mod sil (dacitic clasts strongly sil±alb). Pumice sericitised.

Local v strong carbonatisation below 195m (clasts & matrix).

Some mafic clasts (& some pumice) strongly fuchsitic, eg: 198-199m.

Structure: Bedding expressed as weak 1° orientation of clasts, av 50–60°/LCA: @ 145m: 54°/LCA (dips 28° to 105° AMG); @ 175.5m: 53°/LCA (dips 26° to 088° AMG).

Basal contact abrupt, irreg: black shale squeezed up 200mm amongst basal clasts.

Mineralization: To 198m: Minor to 1% py – dissem & on fracts.

25x10mm massive py nodule @ 163.7m.

198–211m: 1–2% py, trace sp. Dissem, patches & stringers, both in clasts & matrix. Several massive py clasts to 20x10mm @ 198–199m.

211.0 – 336.55m: QUE RIVER SHALE

211.0 – 336.6m: BLACK SHALE

Lithology: Dk grey to black, carbonaceous shale.

Silty in places in upper half. More carbonaceous at depth. Graphite on some partings.

To 287.5m, occasional up–hole fining turbiditic beds to 600mm of qtzo–feldspathic micaceous sst & sed bx (clasts to 10mm of shale, sst, mafics).

Alteration: Silty & sandy sections (& parts of shale 245–287.5m), are calcareous.

Veining: Calcite veins/veinlets, esp in faulted zones in lower half.

Structure: Fine regular bedding. Weak cleavage sub//LCA (gen same sense as bedding).

(to LCA): B63° @ 219m; B55° & C20° @ 227m; B43° @ 241.6m (dips 54° to 050° AMG); B55° & C 20° @ 258m; B28° @ 271.8m (dips 56° to 094° AMG); B35° & C//LCA @ 289m; B15° @ 301.5m (dips 75° to 070° AMG); B23° & C10° (opp sense) @ 308m; B26° @ 324m.

Largely unbroken in upper half. Increasingly broken below 279m (esp 314.5–327.7m) by brittle faults & fracts almost //LCA.

Fault 264.6–264.9m, 35°/LCA (sub// bedding). Fault 292.65–295.4m, <5°/LCA.

Strong fault 310.8–313.5m, 25°/LCA //bedding, crush zone & carb–annealed cataclasite.

Major fault at base: 5–25°/LCA (sub// bedding). Extends 327.7m – 338.5m (centred 329–331.5m in graphitic, carb–veined, annealed cataclasite).

Actual contact a fault plane 25°/LCA (dips 67° to 030° AMG) at base of 400mm qtz–

carb vein.

Mineralization: 211-218.5m: 2-3% dissem py, some bedded.

218.5-270m: av 1-2% dissem py. Some bedded.

270-289m: av 2-3% dissem py (5% locally as bedded dissem in shale).

281.5m: "worm burrow-like" slugs of massive py to 60x10mm.

289-336.6m: 1% py, mainly dissem (some on fracts & in calcite veinlets).

(NB: Total lack of sp & low pyrite content of shale, are unusual).

336.6 - 676.8m: QUE-HELLYER HANGINGWALL VOLCANICS

336.6 - 367.3m: MAFIC BRECCIAS

Lithology: Grey-green. Massive.

Largely-monomict breccias, mainly hyaloclastite.

Highly angular to subangular frags (gen <100mm) of fi gr mafic with calcite amygdales & sparse feld phenos (1mm). In fi gr volc matrix occasionally replaced by calcite or silica.

Upper half sl variable: several blocks of med gr feld-porph andesite, frags of mafic with broken qtz xenocrysts, & 30% of matrix silif (baked?) shale or qtzose sst.

Unit becomes more massive & closed-framework with depth.

Sl transport of bx debris evident, with bleached silif (±pyritic) frags amongst unsilif frags.

Alteration: Mod-strong patchy sil (±.bleach & py). To 360m silif confined to discrete frags. Below 360m conc in matrix, smaller frags & marginal parts of larger frags. Strong carbonatisation in upper 10m. Weak chlorite>sericite, increasing with depth.

Veining: Abund calcite veinlets & comb-structured qtz(±calcite) veins.

Structure: Upper 2m broken by faulting on shale/volcanics contact.

Basal contact marks abrupt appearance of qtz-phyric mafic frags in bx - matrix here contains minor black shale.

Mineralization: To 340m: 3% dissem py.

340-357.5m: 1-2% patchy dissem py (clasts & matrix).

357.5-364m: 2-3% dissem py, conc in silif frags.

364-367.3m: 3-5% dissem & stringer py, assoc with silif of frags & matrix. Trace sp, cp & fuchsite in qtz-carb veins.

367.3 - 388m: MIXED MAFIC BRECCIAS

Lithology: Greenish-grey. Massive. Hard.

Mafic hyaloclastite breccias.

Angular frags of all sizes in fi gr volc matrix (rarely black shale).

Mafics are of at least two types:

1. Fi-med gr, finely feld-phyric, as in unit above. Forms bulk of bx & also occurs as massive partly-brecciated zones to 4m wide.
2. Med gr, qtz & feld-phyric, amygdaloidal. Qtz sparse, corroded or fragmented xyls, 1-2mm. This type most common where matrix contains traces of black shale.

Alteration: Patchy mod-strong sil (+py & bleach), in places only affects matrix & margins of some frags.

Weak-mod chlorite-sericite, best where less silif. Trace fuchsite.

Veining: Abund carb-qtz veins & veinlets to 100mm.

Structure: V strong fault 370.9-372m,15°/LCA, crushed & sericitised.

Basal contact gradational & sl arbitrary - some black shale in matrix here.

Mineralization: 367.3-375m: 3-5% py (locally 5-10% @ 370m). Mostly dissem, minor stringers. Rare cp in carb veinlets.

375-381.75m: 2% py, dissem.

381.75-388m: 3-5% py, dissem.

388 - 482m: QUARTZ-PHYRIC ANDESITE HYALOCLASTITE BRECCIAS

Lithology: Grey-green. Massive. Hard.

Gen open-framework, monomict, with highly angular frags of all sizes (90% <50mm), in fi gr silif volc matrix.

Several zones of partly -brecciated andesite (eg: 396.5-419m & 466.5-469m).

Andesite is finely feld-phyric, amygdaloidal (calcite/qtz), with qtz xyls 1-3mm (gen corroded or fragmented). Qtz most common 425-456m & markedly sparser below 456m.

Rarely, matrix contains silif (baked?) black shale (eg: above 396.5m, & 460-463m).

Alteration: Patchy mod-strong sil to 420m (chlorite mod-strong above 396.5m).

Below 420m, patchy mod-strong chlorite-carbonate predominates, with weak sil (conc in matrix) & sericite (in vein-like zones).

Veining: Abund carb-qtz veins & veinlets to 420m.

Some chalcedonic qtz veining 415-420m.

Structure: Faults 10°/LCA @ 425.8-426.8m, & 476.4m.

Chloritic fract set, 5-20°/LCA, 435-441.5m.

Basal "contact" put at last visible qtz (no other change in andesite evident).

Mineralization: 388-400m: 2-3% py, dissem>stringer, very patchy.

400-406m: 2-3% py>po. Dissem. Patchy -best sulphs assoc with silif.

406-427m: 1% po>py. Trace cp. Rare sp in carb-qtz veins.

427-450m: V minor py. Trace sp & cp.

450-454m: Minor to 1% sp, minor gn, py & cp. Dissem & tiny stringers.

454-466.5m: Minor py-sp>cp.

466.5-468m: 2% py, 1-2% sp>gn-cp. Dissem & stringers in massive silif andesite.

468-482m: Minor py-sp>cp.

482 - 532m: ANDESITE HYALOCLASTITE BRECCIAS

Lithology: Grey-green.

Similar to above, but lacks qtz xyls.

Monomict quench breccias, with highly angular frags (90% <50mm) of sparsely feldphyric amygdaloidal (calcite>qtz) andesite, in silif or carb-cemented fine volc matrix.

Intervals of net-vein brecciated andesite below 518.5m.

Alteration: Mod-strong carbonate-chlorite (former absent & latter strong, below 518m).

Weak-mod sil, conc in bx matrix & smaller frags. Patches of sericitisation.

Veining: Abund carb (±qtz) veinlets & veins.

Structure: Sericitic fault 0-10°/LCA at intervals 505.3-513.6m, centred 509.5m (cataclasite with frags of qtz-carb vein material).

Basal "contact" marks appearance of black shale in bx matrix.

Mineralization: 482-506m: 1% sp-py, trace cp-gn, dissem (sp also in carb veinlets & amygdales).

506-509m: 3% py, dissem & stringers.

509-532m: Minor to 1% py, most dissem. Persistent minor cp, trace sp-gn.

532 - 534.85m: ANDESITE PEPERITE BRECCIA

Lithology: Dark greenish-grey.

Brecciated andesite (as above except rare qtz xyl frags), in black shale matrix (90% andesite, 10% shale).

Alteration: Mod chloritised. Silif-bleaching of andesite marginal to matrix.

Veining: Calcite patches & veinlets.

Structure: Fault 20°/LCA @ 532.1m.

Basal contact fault 5–10°/LCA, commencing 533m.

Mineralization: V minor dissem py, cp, sp.

534.85 – 546.9m: ANDESITE

Lithology: Greenish-grey. Massive.

Andesite as above 532m, with feld laths av 1mm & sparse small qtz/calcite amygdales.

No qtz xyls.

Alteration: Zones of mod chlorite interspersed with mod–strong sil zones.

Talc on fracts & small faults.

Veining: Qtz–carb veins & veinlets, former comb-structured.

Structure: Basal contact abrupt, 30°/LCA, // orient of frags in black shale immed below: a 1° depositional surface with some later shearing.

Mineralization: V minor dissem py, rare cp & sp.

546.9 – 574.3m: VARIABLY-BRECCIATED ANDESITE

Lithology: Dark grey-green.

Feld-phyric amygdaloidal andesite as before (amygs increase with depth).

Ranges from lightly-brecciated andesite (most common, with massive andesite intervals to 2m), hyaloclastites (fi gr volc matrix), to minor peperites (black shale matrix).

Alteration: Mod–strong chlorite.

Sil–bleach in diffuse bands assoc with qtz–carb veining in bx matrix (affects frags within & andesite adjacent to such zones).

Talc on fracts & faults.

Veining: Abund irreg qtz–carb veinlets.

Structure: Broken in places, esp at base, by faults at low angle to LCA.

571.25–572m: faulted zone 25°/LCA (dips 78° to 282° AMG).

Strong brittle fault at base, 5–20°/LCA, extends 573.7–576.5m.

Mineralization: Minor dissem py. Rare cp & sp.

574.3 - 614.8m: MIXED ANDESITIC BRECCIAS

Lithology: Dark grey-green.

Mixed breccias of finely feld-phyric amygdaloidal andesite similar to above except contains fragmented qtz xyls to 2mm.

Mostly peperite (black shale matrix) & hyaloclastite (volc matrix), but ranges from epiclastic breccias (small subangular frags, incl black shale, in sandy/shaley matrix), to partly-brecciated lava.

Alteration: Mod-strong chlorite-carbonate.

Minor sil in vein-like zones in bx matrix.

Weak sericite>fuchsite below 600m. Talc on fracts.

Veining: Common tiny irreg carb(±qtz) veinlets & cement in bx matrix.

Zones of brecciated carb>qtz veins, largest 609.6-610.25m.

Structure: Broken by numerous faults at low angle to LCA, poss a single strong brittle structure cutting hole at intervals, as follows:

Strong faults 10° LCA, @ 582-583.3m & 594.5-596.6m.

Small fault @ 610.4m, 20°/LCA (dips 64° to 150° AMG).

Weak ≈25°/LCA orientation of bx frags & matrix in places (@ 608m: frags 35°/LCA, dip 51° to 213° AMG).

Basal contact irreg & gradational.

Mineralization: Minor to 1% py, dissem/stringer. Rare sp, cp, gn.

614.8 - 622.4m: SANDSTONE

Lithology: Grey-black. Downhole-coarsening unit.

Massive fi gr quartzo-feldspathic carbonaceous sst, with 1m black shale top & 1m fine sedimentary breccia base (latter has 5-10mm subangular frags of bleached perlitic basalt & black mafic glass).

Basal 0.65m: black shale with lumps of perlitic basalt from unit below.

Alteration: Patchy carbonatisation, locally strong.

Structure: Fine bedding @ 620.5m: 48°/LCA. Bedding disturbed in places.

Strong puggy fault on top contact (614.9-615.6m), 15°/LCA, badly broken.

Basal contact intruded by highly feld-porph amygdaloidal mafic dyke, 622.4 - 623.1m, with chilled contacts (upper 50°/LCA, lower 15°/LCA, both approx same sense).

Mineralization: 614.8-620m: 2% py, dissem & veinlets. Trace sp.

620–621.75m: 3–5% py>sp, dissem (sp conc in bleached perlitic mafic frags).
621.75–622.4m: 2% py>sp.

622.4 – 676.8m: BASALT HYALOCLASTITE BRECCIAS

Lithology: Pale greenish-grey. Hard.
Open-framework breccias, with angular & sub-angular frags (av 5–20mm) of glassy basalt, in altered fi gr volc matrix.
Basalt fi gr, commonly perlitic (esp above 635m & towards base where also variolitic), with v rare small feldspar laths & amygdales.
Minor peperite intervals with black shale matrix.
Variablity of adjacent frags (eg: perlitic / non-perlitic), sub-angularity & weak frag alignment (esp above 635m), suggests minor transport.
Alteration: Conc in matrix, smaller frags & margins of larger frags.
Mod-strong sil &/or sericite-bleaching (ser best above 644m, sil best below).
Larger frags mod chlorite-carbonate alt.
Veining: Qtz-carb veins to 150mm, common above 654m.
Structure: Weak 1° alignment of frags: 30°/LCA @ 624, 630 & 648m.
650.3–651.8m: fault <5°/LCA.
Basal contact abrupt, sl irreg, 20°/LCA (dips 85° to 340° AMG).
Mineralization: Sulphs assoc with silif & conc in matrix. Dissem, clots & irreg stringers. Sp pale brown, replaces or rims small intensely silif-bleach frags.
622.4–635m: 2% py, minor sp-gn (5% py 628–629.5m).
635–647.4m: 1% py>sp, sp increasing with depth.
647.4–651.5m: 3% sp>py.
651.5–654m: 5% py, stringery dissem. Minor cp.
654–676.8m: 1–2% sp>py, dissem & clots. Sp increasing with depth, with zones of 5% sp>py @ 661–662m & 672.2–673.5m.

676.8 - 815.1m: QUE-HELLYER MIXED SEQUENCE

676.8 - 682.15m: MIXED VOLCANIC CLASTS IN BLACK SHALE

Lithology: Grey-black & khaki.

A slumped deposit. Irreg clasts (to 500mm) of fi-med gr basalt (highly amygdaloidal at base), & minor silif-bleached clasts to 150mm of flow-banded feld-porph dacite. All in disturbed matrix of black shale > carbonaceous qtzose sst.

Alteration: Patchy strong carbonatisation.

Structure: 1° soft-sed flow angle 20°/LCA @ 680m.

Basal contact a small fault, 20°/LCA (// 1° flow angle).

Mineralization: Pale brown sp>py, dissem & veinlets. Sp in matrix & mafic/dacite clasts, esp in small frags & marginal areas of larger frags.

676.8-682.3m: 2-5% sp>py. Trace cp & gn. Sp best towards top & bottom contacts.

Several massive py clasts to 15x5mm @ 677.65m. 15x8mm massive py clast @ 680m.

682.15 - 732.0m: VOLCANIC BRECCIO-CONGLOMERATE

Lithology: Greenish-grey. Hard. Massive.

Open-framework polymict unit of mafic to dacitic provenance.

Mixed epiclastic & quench breccias, with highly angular frags amongst transported subangular to subrounded clasts, in grey, finely sandy, silif volcaniclastic matrix.

Most clasts/frags <150mm, to 500mm max.

Clasts/frags incl: fine feld-phyric andesite (predom below 697m, gen subangular); amygdaloidal basalt; non-amygdaloidal basalt (gen highly angular), & silif-bleached feld & hornblende-phyric flow-banded dacite (gen sub-rounded).

Alteration: Strong sil of matrix & some clasts (esp dacite).

Minor sericitisation around faults.

Most mafic frags mod-strongly chloritised.

Structure: Weak 1° orientation of small clasts in upper 7m (20°/LCA @ 684m) & below 730m (25°/LCA @ 731m).

Fault 30°/LCA @ 727.5m.

Basal contact gradational.

Mineralization: Sulphs mainly dissem (some veinlets), conc in matrix & rimming or in marginal parts of clasts. Best where silif strongest.

682.3-684.4m: 2-3% patchy sp>>py>po.

684.4-701m: 3% py>po-sp, patchy -locally +5%. Sp decreases with depth.

701–718.6m: 2–3% py>sp, minor cp.

718.6–732m: 2–5% sp>py, minor cp.

732.0 – 738.0m: MINERALIZED DACITIC/ANDESITIC BRECCIA

Lithology: Grey. V hard.

Small frags & large lumps (to 500mm) of partly–brecciated dacite/andesite with white porphyritic feld laths av 2mm, in fi gr matrix containing similar felds.

Small intervals of mafic breccio–conglomerate.

Alteration: V strong sil (±bleaching) of matrix & frags.

Veining: Comb–structured qtz–carb veins at high angle to LCA.

Structure: Basal contact abrupt, irreg.

Mineralization: 5–10% py>sp, dissem & veinlets, conc in matrix. Much of sp in & marginal to tiny fracts.

738.0 – 747.85m: VOLCANIC EPICLASTIC BRECCIA

Lithology: Greenish–grey. Massive. Hard.

Similar to above 732m. Predom v angular quench–brecciated frags mixed with lesser subangular (rarely subround) transported clasts.

Clasts/frags to 200mm (most <70mm), in fine sandy volcaniclastic matrix.

Clasts/frags mainly basalt (some sub–ophitic), lesser andesite (some amygdaloidal), minor finely feld–phyric silif andesite/dacite, & rare feld & hornblende–phyric dacite.

Alteration: Mod sil, mainly matrix & discrete clasts.

Mod chlorite–carbonate of mafic frags/clasts, others strongly sericitised with trace fuchsite.

Structure: Weak 1° orientation of smaller clast/frags: 10°/LCA @ 740.5m, 25°/LCA @ 747m.

Fault (with strong sericite & weak fuchsite alt) @ 743.9m: 20°/LCA.

Basal contact abrupt, approx 35–50°/LCA (cuts across frag attitude).

Mineralization: 738–741m: 3% sp>py, dissem. Sp pale reddish–brown.

741–747.85m: 2% py, minor sp. Dissem.

747.85 – 750.85m: FINE QUARTZO-FELDSPATHIC SANDSTONE

Lithology: Grey. Massive. Uniform.

Grains, av 1mm, of qtz, feldspar & lithics (some black shale).

Alteration: Felds carbonatised.

Structure: Not bedded.

Basal contact abrupt, approx 55–70°/LCA, cuts across frag attitude below.

Mineralization: 2% fine dissem py.

750.85 – 815.1m: VOLCANIC BRECCIO-CONGLOMERATE

Lithology: Grey with creamy-green patches.

Similar to above 732m. A variable unit of polymict, reworked, open-framework debris flow pulses, mixed with mafic quench breccias.

Frags/clasts to 500mm, most <100mm. Incl: finely feld-phyric andesite, amygdaloidal & non-amygdaloidal basalt, flow-banded silif-bleached feld-phyric dacite (±hornblende). Rare small lumps of shale & sst.

Matrix: silif, fine sand & grey/black shale.

At 763–770m & 777–781m, monomict lumps (some with jig-saw fit) of sparsely feld-phyric basalt in silif (baked?) shale: poss sills/dykes intruded into the unlith wet sediments.

Alteration: Strong carbonate-chlorite>sil (sil strongest 755–762m & assoc with best sulphides).

Strong sericite-fuchsite (± pink calcite) assoc with faults as follows:

765–781m, (centred on faults @ 768m & 778m); & below 795m, increasing towards basal fault.

Structure: Crudely layered, with weak 1° orientation of clasts.

Unit finest above 764m, coarsest below 793m.

Bedding: 35°/LCA @ 754.3m; 25°/LCA @ 762.4m (dips 53° to 145° AMG), 775m & 788.2m (dips 57° to 122° AMG); 15°/LCA @ 797.5m.

Strong carb-cemented fault 15°/LCA @ 767.5–768.25m.

Faults 8°/LCA @ 778–778.5m & 20°/LCA @ 795.1m.

Strong fault at base: 15–30°/LCA, calcite-cemented cataclasite with sericite-fuchsite alt basalt frags.

Mineralization: Best sp (pale brown) replaces small altered clasts in more-reworked debris flow pulses. Py conc in matrix, with minor assoc cp.

750.85–754.8m: 1% dissem py. Trace sp.

754.8–762.5m: 5% sp>>py, rare cp, dissem. 3mm massive py clast @ 761m. Rare highly pyritic amyg basalt clasts (pyritised prior to incorp in unit). 756.2m: 60mm ripped-up lump of bedded pyritic sst.

762.5–771m: Minor to 1% dissem py.

771–790m: 2% dissem py. V patchy- locally 3–5%.

790–793.2m: 5% sp>py, trace cp.

793.2–815.1m: 1–3% py, v minor sp–cp. Sulphs decrease to minor at base.

815.1 - 899.6m: QUE-HELLYER FOOTWALL VOLCANICS

815.1 - 881m: PARTLY-BRECCIATED AMYGDALOIDAL BASALTS

Lithology: Dark green. Fi–med gr.

Highly amygdaloidal (calcite) olivine basalt with characteristic variolitic texture.

Rarely perlitic. Sparse small feld phenos below 869m.

Partly quench-brecciated (esp below 855m), with net-vein-like matrix of baked grey shale or fi gr volc material (often replaced by calcite & silica).

Alteration: V strong carbonate>chlorite. Mod sil below 867m.

856–869m: zone of strong bleaching-sericite (epidote?) >sil–fuchsite, assoc with strongest sulphide mineralization.

Strong sericite–fuchsite–carbonate(±pink calcite) assoc with faults (to 817m & around 823m).

Veining: Abund irreg calcite veins & veinlets, also regular thin comb-structured qtz-calcite veinlets. Vein of asbestos @ 864.4m.

Structure: Highly fuchsitic faults 10°/LCA @ 816m & 823m.

Fault 852.7m, 20–40°/LCA. Strong brittle fault with pug, 870.4–870.9m, 30°/LCA.

Gradational change at base.

Mineralization: 815.1–834.6m: Trace dissem py.

834.6–853.5m: Minor sp, dissem, best in brecciated intervals.

853.5–856.5m: 5% sp>py, trace gn–cp. Dissem, stringers & calcite veins.

856.5–860.2m: 3–4% py>>sp. Dissem & stringers, predom in bx matrix.

860.2–863m: 1–2% sp>>py. Dissem, some sp filling amygdales.

863–868.8m: V minor py,sp,cp, mainly in amygdales.

868.8–881m: 1–3% py>sp, dec with depth, dissem, esp in shale matrix.

881 – 899.6m: BASALT HYALOCLASTITE BRECCIA

Lithology: Dark green.

V angular frags (to 150mm) of quench-brecciated fi gr amygdaloidal basalt in fi gr volc matrix (baked in places).

Basalt non feld-phyric, finer gr & less amygdaloidal than unit above.

Breccia varies from open-framework to frags with jig-saw fit.

Alteration: Strong carbonate-chlorite of basalt frags, matrix carbonatised only (silif in upper 2m).

Mild sericitisation assoc with faulting.

Veining: Abund calcite±qtz veinlets.

Structure: Strongly brittle faulted & broken below 889.4m (<20°/LCA), centred in strong ductile deformed zone 15–35°/LCA @ 896.5–898.5m.

Basal contact brittle fault 25°/LCA.

Mineralization: 881–883m: 2% dissem py>sp.

883–899.6m: Trace py>sp.

899.6 – 1013.0m: "ANIMAL CREEK GREYWACKE"

899.6 – 902.15m: MAJOR FAULT IN SANDSTONE & BLACK SHALE

Grey fine calcareous qtzose sst & lesser black shale, badly deformed & broken by major fault. Strong ductile deformation 40°/LCA overprinted by brittle zones of cataclasite & pug 20°/LCA (same sense).

Abund calcite veinlets filling microfracts.

Rare py.

Sharp contact at base – fault plane 50°/LCA.

902.15 – 906.4m: AMYGDALOIDAL MAFIC VOLCANIC

Lithology: Green massive mafic volc with abund calcite flecks 1–5mm, (mostly amygdales, but some lath-shaped & poss feldspar phenos).

Variolitic texture @ 905.4m.

Alteration: Strong carbonate>chlorite.

Veining: Common calcite veinlets.

Structure: Mod broken, esp at top & bottom of unit.

Basal contact sharp, 15°/LCA.

Mineralization: Rare py.

906.4 – 912.25m: FAULTED CARBONACEOUS SANDSTONE

Lithology: Grey & black. Fine carbonaceous calcareous qtzose sst. Irreg laminae, lenses & frags of black shale.

Alteration: Patchy silif.

Veining: Abund irreg calcite(±qtz) veinlets & veins.

Structure: Bedding 65°/LCA @ 907.2m. Sst fines uphole 908.5 to 907m.

Bedding gen disrupted (soft sed?). Abund microfracturing of sst.

Badly broken & zones of pug, due to strong fault 5–10°/LCA, centred 907.7–910m & 911.3–912.25m.

Mineralization: Rare py.

912.25 – 969.60m: INTERCALATED BASALT & SANDSTONE/SHALE

Lithology: Green & grey/black.

Basalt bands, fine carbonaceous qtzose sst, minor black shale.

Volc bands av >3m, seds av <3m (2:1). Chilled margin on mafic @ 936.3m & highly amygdaloidal mafic margin @ 943m, suggest volc bands could be dykes.

Basalt sparsely amygdaloidal. Sub-ophitic in places. Variolitic 945–950m.

Minor zones with poss feld phenos (eg: 943m), as in mafic @ 902–906m.

Alteration: Basalt: mod–strong chlorite > sericite, weak fuchsite. Sericite (& assoc fuchsite) strong around faults, eg: 931.5m.

Strong carbonatisation of all rock types below 940m.

Veining: Abund irreg calcite±qtz veins/veinlets, also as fault cement.

Structure: Extensively deformed & broken by strong ductile/brittle faulting.

Volc/sed contacts all abrupt, gen brittle faulted. Preserved 1° contacts //cleav.

Strongest brittle faults (all with pug & cataclasite):

914–915m: 20°/LCA; 920–920.4m: 40°/LCA; 932.3–934.4m: (v strong) 25°/LCA; 937.2–938.3m: 15°/LCA.

Cleav (bedding-//): 25°/LCA @ 941m; 35°/LCA @ 951m; 20°/LCA @ 968m.

Basal contact a v strong ductile shear, 5°/LCA.

Mineralization: V minor dissem py.

969.6 – 982.2m: MAJOR FAULT IN SANDSTONE & BLACK SHALE

Lithology: Grey–black. Sl broken.

Fine calcareous carbonaceous qtzose sst & black shale, strongly tectonically deformed to augen schist cataclasite with dismembered frags & augen of sst in foliated shale. Minor small deformed frags of sericitised basalt (same as above unit).

Veining: Common irreg veinlets & augen of calcite–qtz.

Structure: A major zone of ductile & brittle faulting, with bedding deformed into fault–induced cleavage.

Cleav: 55°/LCA @ 979.6m (dips 27° to 081° AMG).

Basal contact abrupt, 40°/LCA (//cleav).

Mineralization: V minor dissem py. Rare cp.

982.2 – 991.2m: DEFORMED MAFIC VOLCANIC

Lithology: Green with white flecks. Fi gr. Massive.

Same mafic as above 970m. 1° texture largely obliterated.

Small qtz & calcite amygdales visible below 986m.

Minor tectonically–incorp silif black shale & sst.

Alteration: Mod–strong sericite–chlorite–carbonate (sericite strongest in upper part of unit where deformation worst).

Veining: Abund veinlets of calcite(±qtz), commonly dismembered.

Structure: Strongly foliated, brecciated & micro–fractured. Cleav 45°/LCA.

Strong fault, 15°/LCA (sub//cleav), centred 983m.

Basal contact step–faulted along cleav, 40°/LCA.

Mineralization: 1% dissem py, trace cp.

991.2 – 1013.0m PARTLY DEFORMED SANDSTONE & BLACK SHALE

Lithology: Fine qtzose & micaceous (musc) sst with minor carbonaceous material. Lesser black shale. Sst strongly calcareous in places.

Veining: Calcite(±qtz & chlor) veinlets & veins.

Below 1009m, veinlets of chlorite–fuchsite.

Structure: To 1007m sst gen undeformed but shale intervals strongly foliated.

Below 1007m highly deformed (but unbroken) major ductile fault zone assoc with basal contact, with frags/augen of silif sst & sericitised pyritic mafics, in foliated black shale (as at 969–982m). Cleav @ 1006.7m gives angle of this fault zone: 20°/LCA (dips 70° to 060° AMG).

Bedding: 40°/LCA @ 1002m. Sst bed fines uphole @ 1003m.

Cleav: 53°/LCA @ 991.9m (dips 55° to 017° AMG); Brittle fault centred 992m, 40–60°/LCA (// cleav).

Basal contact abrupt, qtz-annealed fault, 15°/LCA.

Mineralization: V minor dissem py, trace cp (1–2% py to 992m).

1013.0 – 1060.9m: CENTRAL VOLCANIC COMPLEX

1013.0 – 1060.9m: STRONGLY DEFORMED FELSIC VOLCANICS

Lithology: Yellowish-khaki. Med gr. Largely unbroken.

Highly foliated, heterogeneous feldspar-phyric volcs. Feld phenos to 3mm.

Prob a coarse volc breccia sequence.

Bands & threads of foliated sericitic material with visible fine pumice in places, interpersed with zones & frags of more-massive silic volcs that are either non-porph or have abund unoriented feld phenos.

Rare small qtz xyls. Leucoxenised mica flakes.

Common augen, lumps & bands (to 200mm) of deformed amygdaloidal mafic volcs (all in the foliated sericitic zones). No chilled margins noted.

Alteration: Strong sericite, lesser sil-chlor-carb (silif locally strong).

Mafics bleach-sil-fuchsitic or chlor-carb.

Veining: Abund fine chlor veinlets, increasing with depth.

Minor calcite veinlets (often dismembered, rarely pink), & comb-structured qtz-calcite veins to 200mm.

Structure: V strong to intensely foliated. Extensive tectonic brecciation.

Cleav: 20°/LCA @ 1019m (dips 70° to 080° AMG); 25°/LCA @ 1027m; 20°/LCA @ 1037m (dips 72° to 087° AMG); 15°/LCA @ 1052m.

Brittle fault 20–30°/LCA @ 1023m.

Mineralization: 1013–1015m: 1% py, dissem & in thin bands in cleav.

1015–1045.9m & 1047–1060.9m: Minor dissem py.

1045.9–1047m: 2–3% py, dissem in stringer-like zones of grey silica in bx matrix.

END OF HOLE

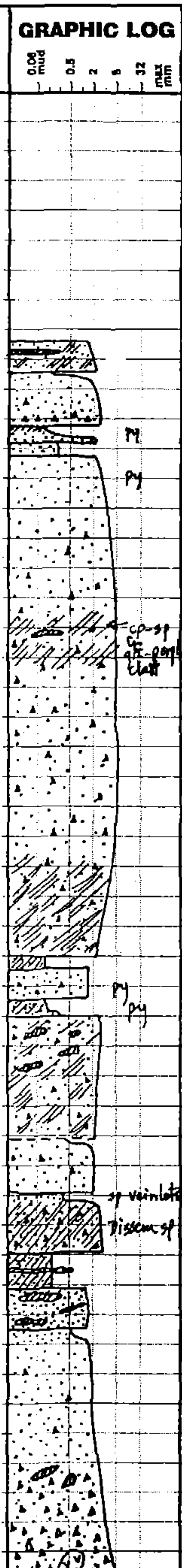
770060

Project : HIGH POINT
Logged by: J.G. PURVIS
Date : NOVEMBER 1994

PASMINCO EXPLORATION
DIAMOND DRILL LOG

HOLE No. BHD6

m	VEINING and ALTERATION (1 = weak, 4 = intense)	STRUCTURE b = bedding c = cleavage f = fault Angles to LCA	GRAPHIC LOG	LITHOLOGY	MINERALISATION
0					
2					
4				NO CORE	
6					
8				sst with black shale matrix	
9		Broken			
10				8.4 – 70.6m.	
11				sst with sericitic matrix after glass; CRYSTAL-LITHIC SANDSTONE/BRECCIA WITH BANDS AND INTERMIXED BLACK SHALE	
12		B: 65°	py	fine sst	
13			py	coarse sst	
17				fine bx	
18			cp-sp; cp-py clast	Black shale matrix	
27				shale matrix	
28		B: 50° (dips 33° to 122° AMG)			
29		Broken		siltstone	
30		B: 60°	py; py	sst with shale matrix; Bedded siltst/fine sst	
32				shale lumps; sst with shale matrix	
36				Sst	
37			sp veinlets		
38			Dissem sp	sst with occasional frags in black shale matrix	
39		B: 65°		Siltstone	
41				sst with shale lumps	
44				sst	
47				fine bx	
50				100mm rhyodacite clast	



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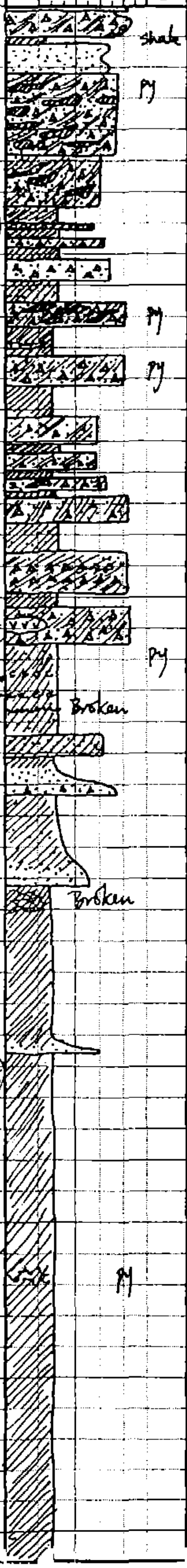
Date : NOVEMBER 1994

PASMINCO EXPLORATION DIAMOND DRILL LOG

HOLE No. BHD 6

m	VEINING and ALTERATION (1 = weak, 4 = intense)	STRUCTURE (b = bedding, c = cleavage, f = fault, Angles to LCA)	GRAPHIC LOG	LITHOLOGY	MINERALISATION
50			shale	Fine Bx	
				sst	
52–54			Py	Fine Bx with shale lumps + matrix	
55				sst with weak shale matrix	
56		B: 43° (Dips 41° to 070° AMG)		Shale/siltstone	
57				sst (in shale)	
58				Fine Bx shale	
				Bx	
59				Siltstone/shale	
60			Py	Bx c̄ shale lumps + matrix	
61				Shale	
62			Py	fine bx c̄ shale matrix	
63				Shale	
64				sst c̄ shale matrix	
65				sst c̄ shale matrix	
				Fine bx c̄ shale	
66				Fine bx c̄ shale matrix	
67		B: 62°		shale/siltstone	
68				Bands of fine bx in shale	
70		150mm Flow-banded rhyodacite clast		Fine bx c̄ shale matrix	70.6M
71			Py		
72		Fault 15° Fold s	Broken	siltstone/shale	
74				Xyl sst in shale	
75		⇑		sst	
78		⇑ Fracts 10-20°	Broken	Fine sst	
80				Shale	
83		B: 72° ⇑ (Dips 9° to 112° AMG)		sst	
85					BLACK SHALE
88		B: 68°			
90				shale/siltstone	
91		Calcite veins	Py		
97		B: 63°			
100					



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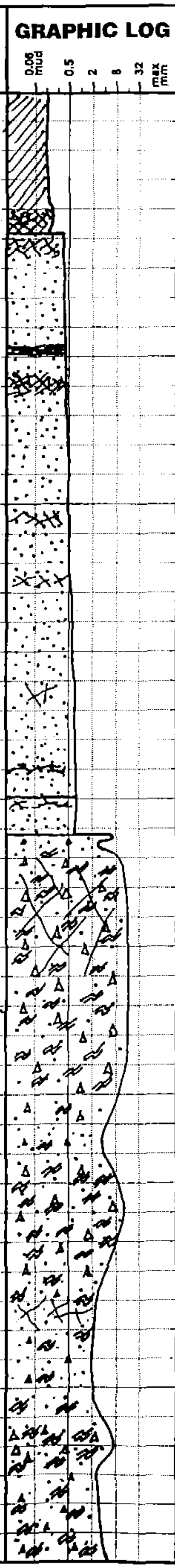
Date : NOVEMBER 1994

PASMINCO EXPLORATION
DIAMOND DRILL LOG

HOLE No. BHD 6

m	VEINING and ALTERATION (1 = weak, 4 = intense)	STRUCTURE b = bedding c = cleavage f = fault Angles to LCA	GRAPHIC LOG	LITHOLOGY	MINERALISATION
100					
102		B: 63°		BLACK SHALE; shale/siltstone	
104		Fractured + broken; F: //LCA		siltstone	104.8m
106					
108		F: 15°			
110		Fractured + broken; F: 10°			
112					
114		Fractured		FINE SILICEOUS & VITRIC VOLCANICLASTIC SANDSTONE	
116		Fractured			
118					
120					
122		qtz veins			
124		Small Fault			125.2m
126					
128		Fractured		Pumice-rich Bx	
130					
132				PUMICEOUS EPICLASTIC BRECCIA	
134					
136				sst	
138				fine pumiceous Bx	
140					
142		Fractured		sst	
144					
146				Bx	
148				Grit	
150					



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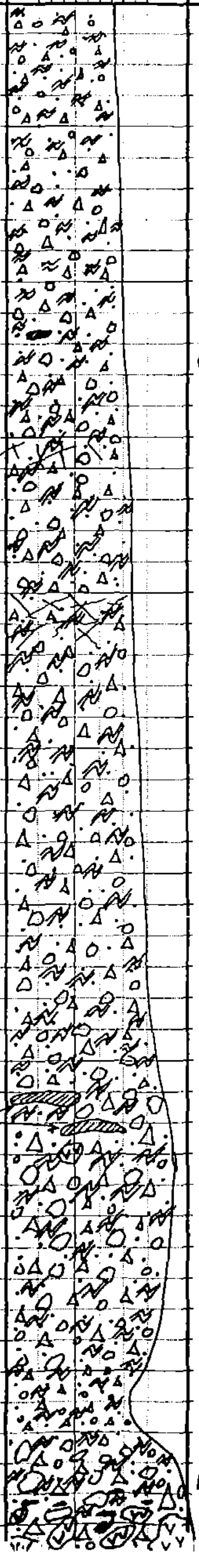
PASMINCO EXPLORATION DIAMOND DRILL LOG

HOLE No. BHD6

GRAPHIC LOG (0.06 mud, 0.5, 2, 8, 32, max mm)



m	VEINING and ALTERATION (1 = weak, 4 = intense)	STRUCTURE (b = bedding, c = cleavage, f = fault, Angles to LCA)	LITHOLOGY	MINERALISATION
150			↑	
152				
154				
156				
158			PUMICEOUS	
160			fine bx-cong; BRECCIO -	
162			CONGLOMERATE	
164		Fracture // LCA		
166				
168				
170		Fractures		
172			Medium bx-cong	
174				
176				
178				
180				
182				
184				
186		300mm black shale clasts		
188			clasts to 100mm	
190				
192				
194				
196			fine bx-cong	
198			Fuchsitic mafic clasts; Coarse bx-cong.	several massive py clasts to 20×10mm
200			clasts to 400mm ↓	

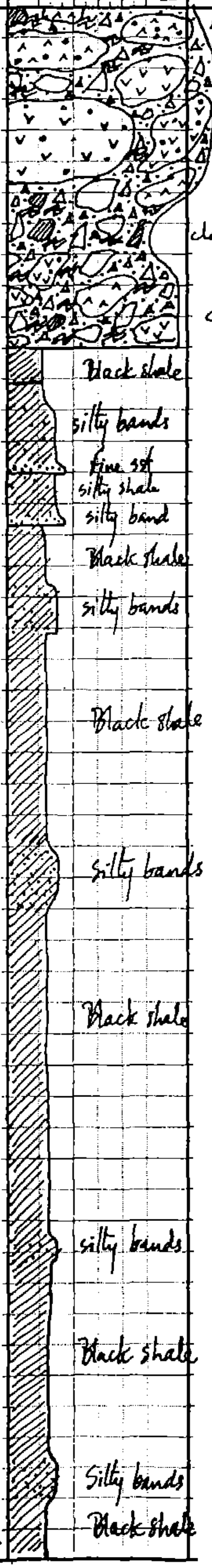
770064

Project : HIGH POINT
Logged by: J. G. PURVIS
Date : NOVEMBER 1994

PASMINCO EXPLORATION
DIAMOND DRILL LOG

HOLE No. BHD6

m	VEINING and ALTERATION (1 = weak, 4 = intense)	STRUCTURE (b = bedding, c = cleavage, f = fault, Angles to LCA)	GRAPHIC LOG	LITHOLOGY	MINERALISATION
200				Amygdaloidal basalt clasts to 500mm.	
202				Boulders to 1.8m. (flow-banded dacite/andesite) PUMICEOUS	
204				BRECCIO -	
206				CONGLOMERATE	
208				clasts to 30mm	
210		py; Irregular abrupt contact		clasts to 250mm	
				211m	
212		shear 60°	Black shale		
214		py; ⇑	silty bands; fine sst		
216		py; ⇑	silty shale; silty band		
218		py	Black shale		
220			silty bands		
222				QUE	
224		py	Black shale	RIVER	
226		50mm sst ⇑		SHALE	
228			silty bands		
230					
232					
234		py	Black shale		
236					
238		40mm sst ⇑			
240			silty bands		
242		carb veinlets			
244			Black shale		
246					
248		py	Silty bands		
250		py ⇑; 40mm sst	Black shale		



770065

Project : HIGH POINT
Logged by: J.G. PURVIS
Date : NOVEMBER 1994

PASMINCO EXPLORATION
DIAMOND DRILL LOG

HOLE No. BHD6

Graphic log scale: 0.06 mud, 0.5, 2, 8, 32, max mm

m	VEINING and ALTERATION (1 = weak, 4 = intense)	STRUCTURE (b = bedding, c = cleavage, f = fault, Angles to LCA)	GRAPHIC LOG	LITHOLOGY	MINERALISATION
250–300				QUE RIVER SHALE	
252.5		py	Black shale		
254.5		py			
258		40mm sst bed ⇑			
260.5		py	silty		
262		py			
263		Fault 35-50°			
264.5		Fault 35° py Broken			
265.5			Black shale		
267		calcite veins	← 10mm py vein 40° (opp sense to bedding)		
270		⇑			
270.5	Calcareous (270–287)	py	silty		
271.5		py ⇑	Fine sedimentary bx.		
273			silty		
274		py			
275			Black shale		
278			silty		
279		fracts			
281		py ⇑	fine bx/grit.		
282			silty		
284		py ⇑	fine bx		
285		fracts	silty		
286		py			
287		py ⇑	Bx		
288–290	more carbonaceous		Black shale		
293–295.5		Fault zone 45° Broken.			
296		Shear			
298		Fault 35°			
299.5	Increasing calcite veining				

Project : HIGH POINT
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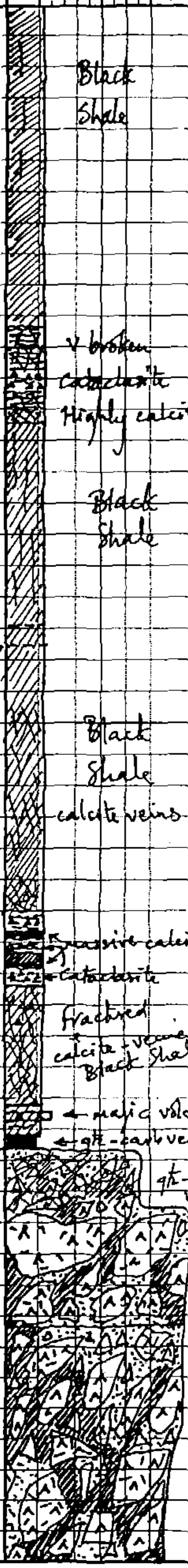
Date : NOVEMBER 1994

PASMINCO EXPLORATION
DIAMOND DRILL LOG

HOLE No. BHD6

m	VEINING and ALTERATION (1 = weak, 4 = intense)	STRUCTURE b = bedding c = cleavage f = fault Angles to LCA	GRAPHIC LOG (0.06 mud, 0.5, 2, 8, 32, max mm)	LITHOLOGY	MINERALISATION
300		Calcite veining	Black Shale	QUE RIVER SHALE (300–336.6 m)	
304		Fracts // LCA			
310		Strong fault zone	v broken; cataclasite; Highly calcite veined		
316		Broken by fracts // LCA	Black Shale		
320		Deformed calcite-veined zones			
322		Fracts; Py	Black Shale		
326		Fracts	calcite veins		
328		MAJOR FAULT ZONE 5-20°; MAIN FAULT	massive calcite vein; cataclasite		
332			Fractured calcite-veined Black Shale		
335		shear	← mafic volc sliver		
336		Fault 30°	← qtz-carb vein	336.6m	
337		Mod broken; Py	qtz-carb veins	shale + sst matrix in mafic bx.	
339		Py	Andesite frags to 600mm.	QUE-HELLYER HANGINGWALL VOLCANICS (336.6–350 m)	
341			MAFIC BRECCIAS (Mixed basalt/andesite provenance, in 30% sst-shale matrix)		
342		small fault 30°			
350		Py			



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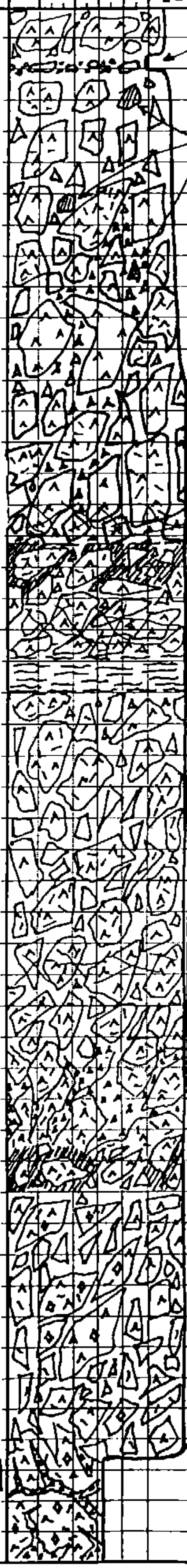
Logged by: J.G. PURVIS
Date : NOVEMBER 1994

PASMINCO EXPLORATION
DIAMOND DRILL LOG

HOLE No. BHD 6

m	VEINING and ALTERATION (1 = weak, 4 = intense)	STRUCTURE b = bedding c = cleavage f = fault Angles to LCA	GRAPHIC LOG 0.06 mud / 0.5 / 2 / 8 / 32 / max mm	LITHOLOGY	MINERALISATION
350				possible epiclastic horizon	
352	Ble, sil clasts to 30mm	py Small fault //LCA		QUE-HELLYER HANGINGWALL VOLCANICS	
354				ble/sil sub-angular mafic clasts	
356					
358		sil		MAFIC LAVA BRECCIAS	
360					
362		py			
364		sil py py		coarser + more closed-framework.	
366		Broken by facts almost //LCA.			
368		some blackshale matrix py		367.3m	
370		Fracts py		MIXED MAFIC LAVA	
372		STRONG FAULT 15° py		crushed BRECCIAS	
374		py			
376					
378					
380		ser			
382		py			
384		py		Partly-brecciated feldspar-phyric lava. (same composition as clasts in breccia)	
386		py			
388		some black shale matrix		388m Gradational arbitrary contact.	
390		py		QUARTZ-PHYRIC MAFIC LAVA	
392		Minor black shale		BRECCIAS	
394		in matrix py		+	
396				BRECCIATED	
398		Partly-brecciated lava		LAVAS	
400					



270067

Project: HIGH TOWN
Logged by: J.G. PURVIS
Date: NOVEMBER 1994

PASMINCO EXPLORATION
DIAMOND DRILL LOG

HOLE No. BHD 6

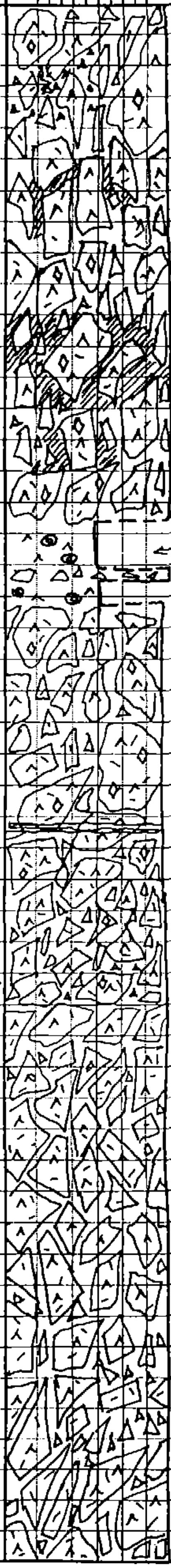
m	VEINING and ALTERATION (1 = weak, 4 = intense)	STRUCTURE b = bedding, c = cleavage, f = fault, Angles to LCA	GRAPHIC LOG (0.06 mud, 0.5, 2, 8, 32, max mm)	LITHOLOGY	MINERALISATION
400				↑	
401		Py		PARTLY - BRECCIATED QUARTZ - PHYRIC AMYGDALOIDAL MAFIC LAVA	
403		Py			
408		sl in 10mm qtz-carb vein →		↓	
416		chalcedonic silica		Bx	
419				↑	
421		Trace black shale in matrix		QUARTZ - PHYRIC MAFIC LAVA BRECCIAS	
425		fault 10°			
437		Fracture set 5-20°		sl broken	
443		95% of frags < 50mm			
449		Trace black shale in matrix →		↓	
450					

Project: HIGH POINT
Logged by: J.G. PURVIS
Date: NOVEMBER 1994

PASMINCO EXPLORATION
DIAMOND DRILL LOG

HOLE No. BHD6

770069

m	VEINING and ALTERATION (1 = weak, 4 = intense)	STRUCTURE b = bedding c = cleavage f = fault Angles to LCA	GRAPHIC LOG 0.06 mud, 0.5, 2, 8, 32, max mm	LITHOLOGY	MINERALISATION
450				QUARTZ - PHYRIC MAFIC LAVA BRECCIAS	
452		bleached & silicified matrix zones c̄ sp		Traces of sp	
456		Trace black shale in matrix		less qtz-phyric	
460–462		Black shale in matrix			
466–480	"veins" sericite				
468		py, sp, cp		silicified lava intervals	
476		Puggy fault 10°			
478–480		Massive lava zones to 0.5m			
482		bleached & silicified zones in & around matrix		↑ Qtz / ↓ No qtz	
482–500				FELDSPAR-PHYRIC MAFIC LAVA HYALOCLASTITE BRECCIAS	
500					

Project : HIGH POINT
Logged by: J.G. PURVIS
Date : NOVEMBER 1995

PASMINCO EXPLORATION
DIAMOND DRILL LOG

HOLE No. BHD6

m	VEINING and ALTERATION (1 = weak, 4 = intense)	STRUCTURE (b = bedding, c = cleavage, f = fault, Angles to LCA)	GRAPHIC LOG (0.06 mud, 0.5, 2, 8, 32, max mm)	LITHOLOGY	MINERALISATION
500				↑ FELDSPAR-PHYRIC ANDESITE HYALOCLASTITE BRECCIAS ↓	
506		Cataclasite fault 0–10° py			
508		py			
510		Cataclasite fault 0–10°		ser	
513		Fault 0–10°		ser-chl	
519–521				Net-vein brecciated lava; chl	
522		small fault 20°			
526				Brecciated lava; ser	
528–530				Breccia + brecciated lava	
532		Fault 20°		532m ANDESITE PEPERITE BRECCIA; Minor black shale matrix	
534	Rare qtz xyls	Fault 5–10°		Broken; 534.85m	
536		small fault 15°		↑ MASSIVE ANDESITE ↓	
537		small fault 20°	bx		
542				ser	
543		small fault 30°	fracts		
547		strongly lineated with black shale matrix		546.9m ↑ PARTLY-BRECCIATED ANDESITE	
550					

770070

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Date : NOVEMBER 1994

PASMINCO EXPLORATION
DIAMOND DRILL LOG

HOLE No. BHD6

770071

m	VEINING and ALTERATION (1 = weak, 4 = intense)	STRUCTURE (b = bedding, c = cleavage, f = fault, Angles to LCA)	GRAPHIC LOG (0.06 mud, 0.5, 2, 8, 32, max mm)	LITHOLOGY	MINERALISATION
550		Black shale matrix		↑ PARTLY - BRECCIATED	
552				Hyaloclastite ANDESITE	
554					
556		Black shale matrix		Partly-bx lava	
558		Fault 5°			
560				Peperite with black shale matrix	
562		Fault 15°		Partly-bx lava	
564				Hyaloclastite; Peperite	
566					
568		Fault 30°		Partly-bx andesite (most bx matrix is black shale)	
570					
572		Fault 25°			
574		STRONG FAULT 5-20°		Partly-epiclastic bx with black shale matrix; 574.3m	
576					
578				MIXED	
580				Hyaloclastite ANDESITE; bx lava	
582		strong Fault 10°		Peperite; BRECCIAS (QUARTZ - PHYRIC)	
584				Epiclastic bx with black shale matrix	
586		series of small faults 15-30°		Peperite	
588					
590					
592				Brecciated lava	
594		Fault 5-15°		Fine peperite; Large cataclasite	
596		STRONG FAULT 10°		Peperite	
598				Mainly Hyaloclastite	
600				Black shale ↓	

Project : HIGH POINT
Logged by: J. G. PURVIS
Date : NOVEMBER 1994

PASMINCO EXPLORATION
DIAMOND DRILL LOG

HOLE No. BHD 6

m	VEINING and ALTERATION (1 = weak, 4 = intense)	STRUCTURE (b = bedding, c = cleavage, f = fault; Angles to LCA)	LITHOLOGY	MINERALISATION
600		Black shale c̄ lumps of fuchsitic volcs.		
602			Hyaloclastite MIXED ANDESITIC BRECCIAS	
606			Mainly Hyaloclastite	
608		lineated shale lumps		
610		Small Fault 20° (sl fuchsitic)	Tectonic bx	
611			Peperite/epiclastic bx c̄ black shale matrix	
613		Fault, minor fuc	Tectonic bx? Minor black shale matrix	
614.8			614·8m	
615		STRONG FAULT 15° (in black shale)	shale	
617		⇑	sst SANDSTONE	
620		Fractures		
621			Epiclastic bx	
622		Black shale c̄ perlitic mafics	Mafic Dyke	
622.4			622·4m	
626			Perlitic ANDESITIC HYALOCLASTITE BRECCIAS	
629		py		
630			ser	
632		↓ more matrix		
634		Black shale matrix		
641			ser	
643		Some black shale matrix		
644			Black shale band	
645		sp	Minor black shale matrix	
648		sp	Minor baked shale matrix	
650		sp		

Project : HIGH POINT
Logged by: J.G. PURVIS
Date : NOVEMBER 1994

PASMINCO EXPLORATION
DIAMOND DRILL LOG

HOLE No. BHD6

m	VEINING and ALTERATION (1 = weak, 4 = intense)	STRUCTURE b = bedding c = cleavage f = fault Angles to LCA	GRAPHIC LOG (0.06 mud, 0.5, 2, 8, 32, max mm)	LITHOLOGY	MINERALISATION
650–652		Fault // LCA			
654				Minor black shale matrix	
656–660				Ser ↓ Very open framework — ANDESITIC HYALOCLASTITE BRECCIAS	
661		sp			
664				bleached + altered smaller frags c̄ sp, + minor silif grey shale matrix	
671		sp			
673		sp			
674		sp		Finer frags (some silif + bleached c̄ sp) + minor black shale matrix	
676		sp		Perlitic	
676.8		25°		676.8m	
678		sp		small massive py clasts	
679		sp; amygdaloidal basalt clasts		VOLCANIC BRECCIO-CONGLOMERATE IN BLACK SHALE	MIXED
681		sp		Dacite clasts	
682		sp		682.15m	
683		Small fault 35°		Ser Bedding 20°	
684	sp	Minor black shale matrix			
686		Mainly hyaloclastite c̄ some pebbles		Large lumps of amygdaloidal basalt to 500mm.	SEQUENCE
688–700				VOLCANIC BRECCIO-CONGLOMERATE	

Project : HIGH POINT
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Date : NOVEMBER 1995

PASMINCO EXPLORATION
DIAMOND DRILL LOG

HOLE No. BHD6

770074

m	VEINING and ALTERATION (1 = weak, 4 = intense)	STRUCTURE b = bedding c = cleavage f = fault Angles to LCA	GRAPHIC LOG 0.06 mud 0.5 2 8 32 max mm	LITHOLOGY	MINERALISATION
700				↑	
702					
704					
706					
708				VOLCANIC BRECCIO-CONGLOMERATE	
710					
712				Flow-banded dacite clasts	
714					
716					
718		sp			
720		sp			
722					
724		sp			
726		sp			
728		fault 30°			
		sp			
730		sp		↓	
732		sp		732m — — — Gradational contact	
734		py-sp		↑ MINERALIZED DACITIC/ANDESITIC BRECCIA	
736	qtz-carb veins	py-sp			
738		py-sp		↓ 738m	
		sp		↑	
740				VOLCANIC EPICLASTIC BRECCIA	
742		py			
744		fault 20°		ser, fuc	
746				↓	
748		35-50°		747.85m FINE QUARTZO SANDSTONE	
750					

Project : HIGH POINT
Logged by: J. G. PURVIS
Date : NOVEMBER

PASMINCO EXPLORATION
DIAMOND DRILL LOG

HOLE No. BHD 6

m	VEINING and ALTERATION (1 = weak, 4 = intense)	STRUCTURE b = bedding c = cleavage f = fault Angles to LCA	GRAPHIC LOG 0.06 mud 0.5 2 8 32 max mm	LITHOLOGY	MINERALISATION
750		55-70°		750.85m SANDSTONE	
752				Bx with minor baked or silif shale matrix	
756–762	sp replaces smaller frags	Main Zn Zone: sp, sp, sp, sp, sp		finer reworked bx-cong. Minor fine sst/siltst matrix	
				VOLCANIC BRECCIO-CONGLOMERATE	
764				Largely monomict basalt lumps (ser-ble-fuc altered), some with jig-saw fit, in grey shale matrix.	
768		carb-cemented Fault 15°			
772				Bx-cong c̄ fine sandy matrix	
774–778		Altered zone pink calcite, fuchsite, sericite, bleaching		sst matrix	
778		andesite clasts		Fault 8°, c̄ fuchsite	
780				shale matrix	
784–788		py, py		Reworked breccio-cong with fine sandy matrix + v minor shale.	
790–794		py; LOWER Zn ZONE: sp, sp, sp			
795		Fault 20° c̄ talc			
796				Large amygdaloidal basalt clasts (some fuchsite)	
800					

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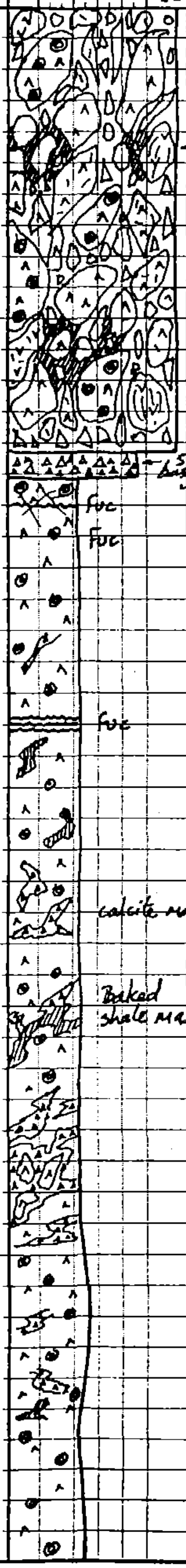
PASMINCO EXPLORATION DIAMOND DRILL LOG

HOLE No. BHD6

m	VEINING and ALTERATION (1 = weak, 4 = intense)	STRUCTURE b = bedding c = cleavage f = fault Angles to LCA	GRAPHIC LOG (0.06 mud, 0.5, 2, 8, 32, max mm)	LITHOLOGY	MINERALISATION
800		py			
802		py			
804		py	some black shale matrix	VOLCANIC BRECCIO-CONGLOMERATE	
806					
808				Fine sandy to shaley matrix	
810					
812		ser-fuc alteration	Minor black shale matrix		
814		20° 30° Fault	ser-fuc basalt frags in cataclasite	STRONG FAULT 814.3m 15-30°	
816			fuc		
818			fuc	PARTLY	
820				BRECCIATED	
822		fault 10°	fuc	AMYGDALOIDAL	
824				BASALTS	
826				Variolitic	
828			calcite matrix		
830					
832			Baked shale matrix		
834					
836					
838					
840					
842					
844					
846					
848					
850					



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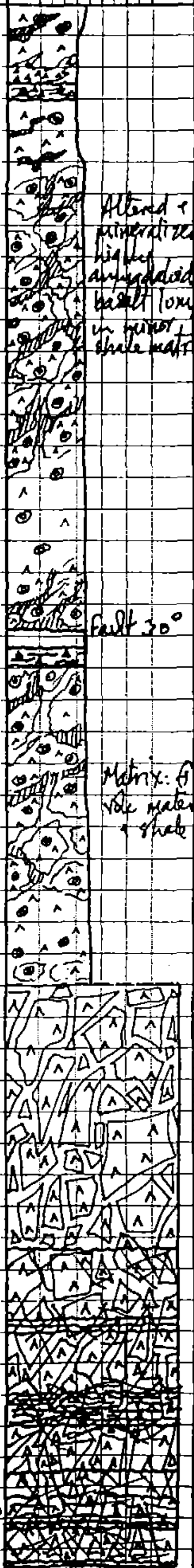
PASMINCO EXPLORATION
DIAMOND DRILL LOG

HOLE No. BHD 6

m	VEINING and ALTERATION (1 = weak, 4 = intense)	STRUCTURE (b = bedding, c = cleavage, f = fault, Angles to LCA)	GRAPHIC LOG (0.06 mud, 0.5, 2, 8, 32, max mm)	LITHOLOGY	MINERALISATION
850					
852		Faulted Zone 20-40°			
854				limit of variolitic texture	
856		sp	Altered + mineralized highly amygdaloidal basalt lumps in minor shale matrix		
858		sp		ALTERED + MINERALIZED ZONE	
		py		PARTLY BRECCIATED AMYGDALOIDAL BASALTS	
860		py			
862					
864					
866					
868		sp			
870		py	Fault 30°		
		STRONG FAULT 30°		Very sparsely feldspar-phyric	
872		py			
		sp			
874		py	Matrix: Grey vole material + shale		
876					
878					
880				gradational — 881m	
882					
884				BASALT HYALOCLASTITE BRECCIA	
886					
888					
890		Fault		Faulted + broken	
892		Fault			
894		Fault (almost // LCA)			
896		Fault			
898		STRONG DUCTILE ZONE 15-35°			
900		Fault 25°		899.6m – sst/shale — Base of	FOOTWALL VOLCANICS



770077

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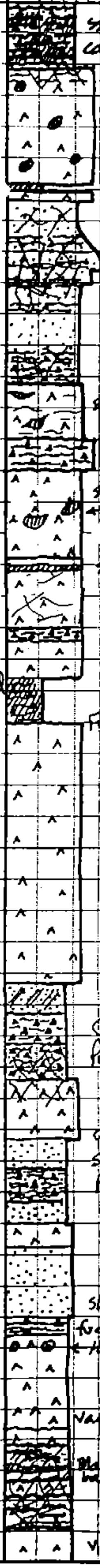
PASMINCO EXPLORATION DIAMOND DRILL LOG

HOLE No. BHD6

m	VEINING and ALTERATION (1 = weak, 4 = intense)	STRUCTURE (b = bedding, c = cleavage, f = fault, Angles to LCA)	GRAPHIC LOG (0.06 mud, 0.5, 2, 8, 32, max mm)	LITHOLOGY	MINERALISATION
900		20°/40°	sst/sh cataclasite, pug, schist	FAULT ZONE IN SANDSTONE & BLACK SHALE	↑
902		50°		902.15m	
904				AMYGDALOIDAL MAFIC VOLCANIC	
906		15°	Black shale	906.4m	ANIMAL
908		B: 65°; STRONG FAULT 5-10°		FAULTED CARBONACEOUS QUARTZOSE SANDSTONE	CREEK
910					
912		Fault 5°		912.25m	GREYWACKE
914		Deformed	shale frags; Fault Zone 10-30°	INTERCALATED BASALT DYKES AND SANDSTONE/SHALE	
916			shale frags		
918		Fault 20°	shale band		
920		Fracts; Fault 40°			
922		Ductile deformed zone // LCA	fuc; Black shale; fuc		
924					
926					
928		ser/fuc			
930					
932		ser/fuc	sst/sh.		
934		VERY STRONG FAULT 20-25°; Fracts	Calcite-cemented cataclasite; Pug & cataclasite in fine sst/sh		
936			chilled margin		
938		STRONG FAULT 10-20°	sst; Pug & cataclasite in sst; sst		
940		Tectonic zone 30° →	Mafic		
942		Fault 20° 25°	sst; shale laminae; fuc		
944			← Highly amygdaloidal	Mafic Volc	
946		Fault 50°	Variolitic		
948		Faulted Zone 20-25° (broken)	Black shale band		
950			Variolitic	↓	↓



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PASMINCO EXPLORATION
DIAMOND DRILL LOG

HOLE No. BHD6

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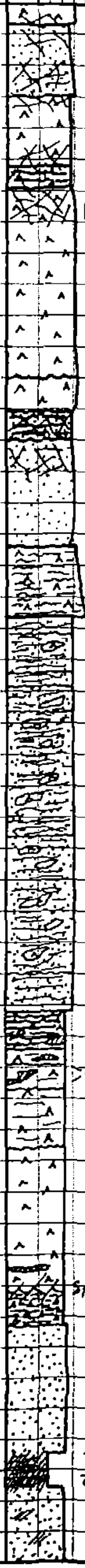

m	VEINING and ALTERATION (1 = weak, 4 = intense)	STRUCTURE (b = bedding, c = cleavage, f = fault, Angles to LCA)	GRAPHIC LOG notes	LITHOLOGY	MINERALISATION
950		30°	Mafic	INTERCALATED BASALT DYKES AND SANDSTONE/SHALE	ANIMAL CREEK GREYWACKE
952		Fracts 50°	sst		
954			Mafics, Fracts		
956		Fault 15-20°	Fracts		
958					
960					
962		Fault 40°			
964		Fault 45°, Fracts	Broken/some pug, sst		
966					
968		Fault 50°, STRONG DUCTILE SHEAR 50	Mafic – strongly cleaved		
970		Fault 35°		969.6m	
972		Fault 25°, Fault 55°, Fault 40°		DEFORMED SANDSTONE + BLACK SHALE	
974			Minor mafic frags + thin bands		
976					
978					
980		Fault 45°			
982		STRONG FAULT 15° 40°	mafic + sst/shale	982.2m	
984			shears 10-20°	CLEAVED MAFIC VOLCANIC (Amygdaloidal)	
986		Decreasing cleavage	amygdales		
988					
990		sst/sh			
992		Brittle Fault Zone 40-60°	step-faulted contact 40°, Py	991.2m	
994			Undeformed sst	PARTLY DEFORMED SANDSTONE + BLACK SHALE	
996					
998			Deformed black shale c̄ sst laminae + lumps; Undeformed sst, minor shale		
1000					

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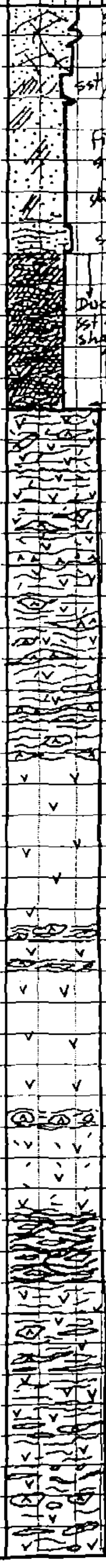
PASMINCO EXPLORATION
DIAMOND DRILL LOG

HOLE No. BHD6

m	VEINING and ALTERATION (1 = weak, 4 = intense)	STRUCTURE (b = bedding, c = cleavage, f = fault; Angles to LCA)	GRAPHIC LOG (0.06 mud, 0.5, 2, 8, 32, max mm)	LITHOLOGY	MINERALISATION
1000			sst c minor shale; Double graded sst band		
1002		B: 40°	sst; sst/sh		
1004			fine sst + shale	PARTLY-DEFORMED SANDSTONE + SHALE	ANIMAL CREEK GREYWACKE
1006		Increasing deformation ↓	sst		
1008					
1010	chl-fuc veinlets	py in mafic frags	DUCTILE FAULT ZONE (unbroken) sst c vlc augen + lumps in shale matrix		
1012		Fault 15°	ser-fuc		
1014			mafic bands	HIGHLY DEFORMED FELSIC VOLCANICS With Minor Mafic Volcanics	CENTRAL VOLCANIC COMPLEX
1016		Shear 20°; v strong foliation			
1018			Brecciated mafic band		
1020					
1022		Fault 20-30°			
1024		Cleavage decreases, sil increases	Volcanics more massive, almost no mafics		
1026					
1028					
1030		Mafic lumps in highly cleaved zones			
1032					
1034					
1036		sil decreases ↓ cleaved	Bx - some mafics		
1038			abund porphyritic felds		
1040		Intensely deformed zone (augen schist) 25°			
1042			Banded, cleaved, felsic vlc + dismembered mafic bands		
1044	ser				
1046	grey sil, py				
1048					
1050					



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PASMINCO EXPLORATION
DIAMOND DRILL LOG

HOLE No. BHD6

m	VEINING and ALTERATION (1 = weak, 4 = intense)	STRUCTURE b = bedding c = cleavage f = fault Angles to LCA	GRAPHIC LOG 0.06 mud 0.5 2 8 32 max mm	LITHOLOGY	MINERALISATION
1050				↑	↑
1052		Highly cleaved + sericitised with abund. dismembered mafics ↓		DEFORMED	CENTRAL
1054		weaker cleav. Chl	Abund. porphyritic feldspars	FELSIC	VOLCANIC
1056				VOLCANICS	COMPLEX
1058		↓ cleaved + brecciated	dismembered mafic bodies	↓	↓
1060					
			EOH 1060.9m		

770081

BHD6 ORE SUITE

FROM	TO	SAMPLE	Cu	Pb	Zn	Ag	Au	Ba	As
336.0	338.0	38842	12	12	50	<1	<0.008	330	-
338.0	340.0	38843	35	18	51	<1	<0.008	630	-
357.0	359.0	38844	18	6	51	<1	<0.008	99	-
359.0	361.0	38845	26	10	60	<1	<0.008	131	-
359.7	359.9	38146	26	7	105	<1		116	16
361.0	363.0	38846	37	4	60	<1	<0.008	179	-
363.0	365.0	38847	135	13	74	<1	<0.008	193	-
365.0	367.0	38848	27	21	57	<1	<0.008	230	-
367.0	369.0	38849	17	6	58	<1	<0.008	170	-
369.0	371.0	38850	18	8	55	<1	<0.008	152	-
371.0	373.0	38851	19	4	57	<1	<0.008	310	-
373.0	375.0	38852	23	9	52	<1	<0.008	300	-
375.0	377.0	38853	33	7	46	<1	<0.008	169	-
377.0	379.0	38854	40	8	66	<1	<0.008	179	-
379.0	381.0	38855	20	7	50	<1	<0.008	350	-
381.0	383.0	38856	46	13	45	<1	<0.008	455	-
383.0	385.0	38857	24	15	38	<1	<0.008	290	-
384.5	384.8	38147	41	29	73	<1		210	18
385.0	387.0	38858	43	21	152	<1	<0.008	191	-
387.0	389.0	38859	18	17	80	<1	<0.008	191	-
389.0	391.0	38860	12	17	89	<1	<0.008	171	-
391.0	393.0	38861	23	31	195	<1	<0.008	137	-
393.0	395.0	38862	25	118	218	<1	<0.008	190	-
395.0	397.0	38863	5	6	60	<1	<0.008	172	-
397.0	399.0	38864	25	11	60	<1	<0.008	107	-
398.6	398.9	38148	22	24	118	<1		133	15
399.0	401.0	38865	35	9	65	<1	<0.008	162	-
401.0	403.0	38866	15	9	40	<1	<0.008	104	-
403.0	405.0	38867	19	18	60	<1	<0.008	198	-
405.0	407.0	38868	35	24	75	<1	<0.008	1000	-
412.6	412.9	38149	36	57	115	<1		1480	9
435.9	436.2	38150	25	18	116	<1		148	6
459.6	459.9	38151	14	34	192	<1		148	4
466.5	468.0	38869	49	277	1637	<1	<0.008	550	-
466.6	466.7	38155	23	47	374	<1		675	11
477.6	477.9	38152	17	1066	1787	<1		265	7
482.0	484.0	38870	15	2021	1499	<1	<0.008	280	-
484.0	486.0	38871	26	700	1092	<1	<0.008	860	-
486.0	488.0	38872	14	407	1044	<1	<0.008	370	-
488.0	490.0	38873	59	448	1355	<1	<0.008	235	-
488.5	488.6	38161	38	202	1139	<1		196	5
490.0	492.0	38874	28	502	1138	<1	<0.008	320	-
492.0	494.0	38875	69	450	1162	<1	<0.008	410	-
494.0	496.0	38876	32	335	1512	<1	<0.008	310	-
496.0	498.0	38877	73	1115	2610	<1	<0.008	395	-
498.0	500.0	38878	27	346	774	<1	<0.008	220	-
499.6	499.9	38162	11	46	309	<1		415	7
500.0	502.0	38879	32	24	307	<1	<0.008	345	-
502.0	504.0	38880	55	54	1336	<1	<0.008	415	-
504.0	506.0	38881	45	34	296	<1	<0.008	395	-
506.0	507.5	38882	38	27	184	<1	<0.008	365	-

FROM	TO	SAMPLE	Cu	Pb	Zn	Ag	Au	Ba	As
507.5	509.0	38883	19	29	179	<1	<0.008	370	-
509.0	511.0	38884	15	23	247	<1	<0.008	370	-
511.0	513.0	38885	26	80	294	<1	<0.008	220	-
513.0	515.0	38886	89	73	287	<1	<0.008	156	-
515.0	517.0	38887	197	104	339	<1	<0.008	191	-
517.0	519.0	38888	83	48	437	<1	<0.008	116	-
519.0	521.0	38889	127	59	303	<1	<0.008	110	-
521.0	523.0	38890	107	18	183	<1	<0.008	133	-
521.1	521.4	38163	19	62	348	<1	-	106	2
540.8	541.0	38164	5	16	132	<1	-	129	1
562.3	562.7	38165	4	<3	146	<1	-	73	2
593.1	593.5	38166	7	9	183	<1	-	285	2
604.3	604.5	38167	13	23	131	<1	-	122	6
620.0	621.8	38891	58	13	1849	<1	<0.008	495	-
621.8	622.4	38892	35	72	750	<1	<0.008	240	-
622.4	624.0	38893	32	164	246	<1	<0.008	365	-
622.6	622.7	38169	102	28	115	<1	-	245	16
624.0	626.0	38894	29	363	842	<1	<0.008	415	-
626.0	628.0	38895	17	137	490	<1	<0.008	375	-
628.0	629.5	38896	45	19	879	<1	<0.008	550	-
629.5	631.0	38897	18	9	42	<1	<0.008	595	-
631.0	633.0	38898	14	11	365	<1	<0.008	535	-
633.0	635.0	38899	37	12	286	<1	<0.008	560	-
633.6	633.8	38175	13	<3	739	<1	-	595	7
635.0	637.0	38900	31	4	665	<1	<0.008	500	-
637.0	639.0	39101	17	<3	348	<1	<0.008	630	-
639.0	641.0	39102	9	6	34	<1	<0.008	650	-
641.0	643.0	39103	7	6	29	<1	<0.008	700	-
643.0	645.0	39104	25	9	600	<1	<0.008	735	-
645.0	647.0	39105	11	<3	1226	<1	<0.008	1340	-
647.0	648.5	39106	22	9	1849	<1	<0.008	2085	-
648.5	650.0	39107	131	19	3750	<1	<0.008	1115	-
650.0	651.5	39108	281	9	1963	<1	<0.008	1205	-
651.5	653.0	39109	919	42	1145	2	<0.008	1180	-
653.0	654.0	39110	81	13	427	<1	<0.008	1670	-
654.0	656.0	39111	13	3	414	<1	<0.008	2470	-
656.0	658.0	39112	17	4	958	<1	<0.008	1995	-
658.0	659.5	39113	10	5	834	<1	<0.008	2365	-
658.9	659.1	38170	33	12	1445	<1	-	2915	17
659.5	661.0	39114	19	13	619	<1	<0.008	2675	-
661.0	662.0	39115	77	29	2710	<1	<0.008	2750	-
662.0	664.0	39116	21	12	1310	<1	<0.008	2005	-
664.0	666.0	39117	12	25	1174	<1	<0.008	2675	-
666.0	668.0	39118	5	24	704	<1	<0.008	2815	-
668.0	670.0	39119	12	18	622	<1	<0.008	3260	-
670.0	672.0	39120	7	18	918	<1	<0.008	2650	-
672.0	673.5	39121	29	31	3291	<1	<0.008	2265	-
673.5	675.0	39122	6	10	865	<1	<0.008	2145	-
675.0	676.8	39123	6	7	912	<1	<0.008	1445	-
676.8	678.3	39124	22	89	2019	<1	<0.008	2135	-
678.3	680.0	39125	32	86	1741	<1	<0.008	965	-
680.0	681.6	39126	42	613	1972	<1	<0.008	790	-
681.6	682.3	39127	12	250	4900	<1	<0.008	905	-
682.3	684.4	39128	40	1730	4961	<1	<0.008	1705	-

FROM	TO	SAMPLE	Cu	Pb	Zn	Ag	Au	Ba	As
684.4	686.0	39129	89	402	1471	<1	<0.008	2640	-
685.0	685.2	38171	73	11	118	<1	-	850	40
686.0	688.0	39130	87	628	1555	<1	<0.008	1725	-
688.0	690.0	39131	88	255	373	<1	0.01	2170	-
690.0	692.0	39132	68	333	922	<1	0.04	3080	-
692.0	694.0	39133	74	65	122	<1	<0.008	1940	-
694.0	696.0	39134	71	124	300	<1	<0.008	1360	-
696.0	698.0	39135	48	314	893	<1	<0.008	1420	-
698.0	700.0	39136	41	96	223	<1	<0.008	1395	-
700.0	702.0	39137	45	214	430	<1	<0.008	2085	-
702.0	704.0	39138	48	192	361	<1	<0.008	1130	-
703.4	703.6	38172	8	<3	87	<1	-	4355	3
704.0	706.0	39139	52	219	614	<1	<0.008	1520	-
706.0	708.0	39140	40	534	856	<1	<0.008	1745	-
708.0	710.0	39141	49	1047	1759	<1	<0.008	1950	-
710.0	712.0	39142	48	65	3130	<1	<0.008	1410	-
712.0	714.0	39143	31	51	1064	<1	<0.008	1740	-
714.0	716.0	39144	61	29	1116	<1	<0.008	1790	-
716.0	718.0	39145	40	140	1861	<1	0.01	2555	-
716.8	717.0	38173	127	84	424	<1	-	3710	3
718.0	718.6	39146	24	44	663	<1	<0.008	2865	-
718.6	720.8	39147	24	100	3775	<1	<0.008	1875	-
720.8	723.0	39148	11	107	2065	<1	<0.008	2075	-
723.0	725.0	39149	108	658	1783	<1	<0.008	1175	-
725.0	727.0	39150	30	450	1738	<1	<0.008	2205	-
727.0	729.0	39151	22	55	840	<1	<0.008	1335	-
729.0	731.0	39152	85	44	733	<1	<0.008	2870	-
731.0	732.0	39153	39	11	2643	<1	<0.008	3060	-
732.0	734.0	39154	16	12	2108	<1	<0.008	1925	-
733.7	733.9	38176	9	7	1939	<1	-	1225	3
734.0	736.0	39155	24	33	989	<1	<0.008	1365	-
736.0	738.0	39156	15	13	919	<1	<0.008	1745	-
738.0	739.5	39157	140	7	2363	<1	<0.008	2210	-
739.5	741.0	39158	80	158	2124	<1	<0.008	1205	-
741.0	743.0	39159	42	45	135	<1	<0.008	505	-
743.0	745.0	39160	76	29	98	<1	<0.008	615	-
745.0	747.0	39161	38	<3	97	<1	<0.008	485	-
747.0	749.0	39162	63	5	70	<1	0.01	460	-
749.0	751.0	39163	52	4	92	<1	0.01	430	-
751.0	753.0	39164	26	<3	66	<1	<0.008	305	-
753.0	754.8	39165	34	<3	83	<1	<0.008	370	-
754.8	756.0	39166	39	5	3069	<1	<0.008	450	-
756.0	757.0	39167	51	11	4036	<1	0.01	510	-
757.0	758.0	39168	52	17	3264	<1	<0.008	430	-
758.0	759.0	39169	56	35	3381	<1	<0.008	445	-
759.0	760.0	39170	139	63	2646	<1	<0.008	430	-
760.0	761.0	39171	60	410	3521	<1	<0.008	490	-
761.0	762.5	39172	36	48	3068	<1	0.01	445	-
762.5	764.0	39173	58	4	126	<1	<0.008	590	-
764.0	766.0	39174	9	3	43	<1	<0.008	570	-
766.0	768.0	39175	9	7	33	<1	<0.008	605	-
768.0	770.0	39176	4	<3	32	<1	<0.008	525	-
770.0	772.0	39177	48	7	86	<1	<0.008	330	-
772.0	774.0	39178	35	5	64	<1	<0.008	405	-

FROM	TO	SAMPLE	Cu	Pb	Zn	Ag	Au	Ba	As
774.0	776.0	39179	54	6	62	<1	0.01	425	-
776.0	778.0	39180	10	4	34	<1	<0.008	605	-
778.0	780.0	39181	7	4	15	<1	<0.008	730	-
780.0	782.0	39182	5	<3	32	<1	<0.008	490	-
780.7	780.8	38178	7	<3	39	<1	-	770	3
782.0	784.0	39183	10	<3	58	<1	<0.008	350	-
784.0	786.0	39184	22	<3	78	<1	<0.008	325	-
786.0	788.0	39185	13	<3	90	<1	<0.008	325	-
788.0	790.0	39186	40	3	86	<1	<0.008	385	-
790.0	791.5	39187	14	5	2737	<1	<0.008	510	-
791.5	793.2	39188	257	11	2713	<1	<0.008	415	-
792.3	792.5	38179	47	<3	42	<1	-	585	3
793.2	795.0	39189	33	7	671	<1	<0.008	300	-
795.0	797.0	39190	43	10	650	<1	<0.008	240	-
797.0	799.0	39191	50	42	2984	<1	<0.008	325	-
799.0	801.0	39192	27	16	281	<1	<0.008	255	-
801.0	803.0	39193	44	7	110	<1	<0.008	285	-
803.0	805.0	39194	42	8	148	<1	<0.008	310	-
805.0	807.0	39195	9	<3	44	<1	<0.008	540	-
807.0	809.0	39196	33	8	140	<1	<0.008	430	-
809.0	811.0	39197	21	8	87	<1	<0.008	440	-
811.0	813.0	39198	8	3	38	<1	<0.008	555	-
829.5	829.8	38180	80	5	260	<1	-	675	5
853.5	854.5	39301	9	6	2184	<1	<0.008	1165	-
854.5	855.5	39302	34	132	15100	<1	<0.008	775	-
855.5	856.5	39303	96	1506	8800	1	<0.008	765	-
856.5	858.5	39304	81	631	1096	<1	<0.008	480	-
858.5	860.5	39305	81	852	1970	<1	<0.008	225	-
860.5	862.5	39306	136	1311	2371	<1	<0.008	575	-
868.8	871.0	39307	88	996	1429	<1	<0.008	520	-
871.0	873.0	39308	86	890	1828	<1	<0.008	730	-
873.0	875.0	39309	86	664	962	<1	<0.008	830	-
875.0	877.0	39310	88	903	2120	<1	<0.008	390	-
877.0	879.0	39311	68	120	2990	<1	<0.008	530	-
879.0	881.0	39312	70	121	1086	<1	<0.008	525	-
879.7	880.0	38181	73	79	307	<1	-	350	19
881.0	883.0	39313	45	103	360	<1	<0.008	480	-
903.7	904.0	38182	7	3	93	<1	-	205	4
920.8	921.0	38183	8	3	66	<1	-	189	16
957.8	958.0	38184	4	<3	60	<1	-	128	8
988.0	988.2	38185	26	3	70	<1	-	79	14
1022.3	1022.5	38186	63	6	59	<1	-	225	37
1027.7	1027.9	38187	66	96	337	<1	-	250	6
1037.1	1037.3	38189	4	8	40	<1	-	525	3
1055.2	1055.5	38188	6	11	44	<1	-	625	14

BHD6 LITHOGEOCHEMICAL SUITE

FROM	TO	SAMPLE	Rb	Sr	V	Nb	Y	Zr
359.7	359.9	38146	6	290	188	6	26	153
384.5	384.8	38147	17	168	139	9	13	133
398.6	398.9	38148	7	195	177	12	28	212
412.6	412.9	38149	39	344	125	9	22	176
435.9	436.2	38150	10	188	161	12	26	188
459.6	459.9	38151	6	191	176	9	17	148
466.6	466.7	38155	88	110	134	7	17	115
477.6	477.9	38152	29	230	178	7	22	138
488.5	488.6	38161	17	222	181	9	16	150
499.6	499.9	38162	58	158	126	8	21	128
521.1	521.4	38163	6	180	180	6	16	147
540.8	541	38164	9	171	164	7	17	139
562.3	562.7	38165	<5	135	161	7	19	141
593.1	593.5	38166	68	74	180	6	22	147
604.3	604.5	38167	21	113	163	11	27	186
622.6	622.7	38169	41	155	282	7	20	106
633.6	633.8	38175	112	119	42	11	35	784
658.9	659.1	38170	110	288	34	10	35	721
685	685.2	38171	72	124	226	6	25	209
703.4	703.6	38172	118	312	272	7	21	148
716.8	717	38173	112	363	57	8	20	194
733.7	733.9	38176	52	320	21	14	32	214
780.7	780.8	38178	154	62	45	10	29	196
792.3	792.5	38179	61	201	64	8	24	162
829.5	829.8	38180	10	233	146	6	18	131
879.7	880	38181	9	457	247	4	21	85
903.7	904	38182	71	31	82	8	14	103
920.8	921	38183	60	73	178	8	19	143
957.8	958	38184	53	59	115	7	16	98
988	988.2	38185	37	97	311	6	32	108
1022.3	1022.5	38186	102	77	217	<3	32	51
1027.7	1027.9	38187	110	54	18	12	35	209
1037.1	1037.3	38189	249	35	19	20	39	388
1055.2	1055.5	38188	269	35	20	19	44	428

BHD6 ALTERATION SUITE

FROM	TO	SAMPLE	Al2O3	SiO2	TiO2	Fe2O3	MnO	CaO	K2O	MgO	P2O5	Na2O	SO3	LOI
359.7	359.9	38146	17.68	57.2	0.57	6.6	0.08	2.37	0.16	4.01	0.24	7.02	1.21	4.18
384.5	384.8	38147	16.48	61.4	0.49	6.11	0.05	0.86	0.51	2.92	0.17	6.66	0.97	3.33
398.6	398.9	38148	14.24	60.2	0.6	7.47	0.09	1.47	0.21	6.34	0.4	3.81	0.22	4.49
412.6	412.9	38149	11.77	65.8	0.5	3.75	0.09	4.75	2.22	2.15	0.34	3.7	1.01	3.97
435.9	436.2	38150	12.61	56.8	0.55	7.43	0.25	5.3	0.31	5.78	0.36	3.18	0.03	6.91
459.6	459.9	38151	16.35	56.5	0.52	8.07	0.4	1.21	0.15	6.66	0.21	5.02	0.17	4.26
466.6	466.7	38155	13.4	62.3	0.43	3.68	0.26	5.67	2.5	2.04	0.24	2.42	1.15	6.22
477.6	477.9	38152	16.39	51.2	0.51	7.19	0.51	5.52	0.82	5.05	0.2	4.57	0.42	7.02
488.5	488.6	38161	16.9	54.1	0.53	8.44	0.54	1.36	0.42	7	0.2	4.74	0.49	4.8
499.6	499.9	38162	13.61	61.8	0.44	2.94	0.19	6.53	1.65	1.53	0.3	4.13	0.77	5.92
521.1	521.4	38163	17.27	53.6	0.53	8.97	0.62	0.89	0.16	7.54	0.21	4.93	0.35	4.57
540.8	541.0	38164	15.62	59.6	0.48	7.71	0.32	0.71	0.28	6.76	0.22	4.29	0.23	4.01
562.3	562.7	38165	15.99	55.5	0.5	8.47	0.39	1.43	0.13	7.45	0.21	4.36	0.26	4.91
593.1	593.5	38166	17.11	56.7	0.52	7.36	0.19	1.29	1.9	6.95	0.22	2.44	0.11	5.09
604.3	604.5	38167	12.8	57.9	0.57	7.68	0.24	4.06	0.63	6.69	0.38	2.26	0.36	6.11
622.6	622.7	38169	14.02	45.5	0.6	8.79	0.32	9.14	1	6.99	0.39	2.18	0.44	10.52
633.6	633.8	38175	14.91	64.5	0.66	5.39	0.13	2.57	2.99	1.81	0.14	1.86	0.2	4.44
658.9	659.1	38170	14.35	65.4	0.64	5.77	0.15	1.69	3.99	1.52	0.13	2.9	0.39	2.48
685.0	685.2	38171	11.54	40.8	0.68	8.18	0.38	12.64	1.6	11.64	0.52	0.22	0.58	10.91
703.4	703.6	38172	19.78	48.2	0.7	9.41	0.42	1.49	5.39	6.87	0.35	2.33	<0.01	4.45
716.8	717.0	38173	11.93	73.6	0.32	2.14	0.09	1.79	4.45	0.62	0.12	2.81	0.06	1.43
733.7	733.9	38176	14.13	72.7	0.34	1.73	0.07	1.01	2.07	0.37	0.09	5.91	0.28	0.87
780.7	780.8	38178	14.38	66.8	0.31	2.87	0.15	3.83	4.11	1.78	0.09	0.39	0.11	5.12
792.3	792.5	38179	11.76	72.3	0.3	2.16	0.17	3.48	1.62	0.81	0.11	3.64	0.19	3.51
829.5	829.8	38180	8.71	49.7	0.5	6.99	0.36	11.84	0.27	7.92	0.33	0.94	0.06	12.32
879.7	880.0	38181	15.13	47.7	0.47	8.95	0.42	8.57	0.3	6.81	0.32	4.57	1.18	5.49
903.7	904.0	38182	11.78	61.1	0.28	6.14	0.3	4.2	1.86	4.94	0.09	1.31	0.12	7.97
920.8	921.0	38183	12.94	54.2	0.54	7.72	0.36	5.05	1.56	5.56	0.22	1.79	0.3	9.45
957.8	958.0	38184	12.5	60.7	0.29	6.96	0.18	3.71	1.23	5.76	0.09	1.59	0.28	6.33
988.0	988.2	38185	16.26	44	1.04	11.18	0.28	7.48	0.79	5.35	0.36	3.39	0.62	8.93
1022.3	1022.5	38186	13.57	46.7	0.4	7.98	0.25	11.38	2.39	3.4	0.13	1.13	0.29	11.91
1027.7	1027.9	38187	9.48	71.5	0.23	1.6	0.1	6.28	2.65	0.64	0.03	0.83	0.16	6.28
1037.1	1037.3	38189	17.65	67.5	0.42	2.25	0.02	0.61	5.5	1.62	0.05	0.82	0.09	3.29
1055.2	1055.5	38188	19.65	61.7	0.47	4.06	0.03	0.69	5.78	2.33	0.06	0.88	0.19	3.97

BHD6

PETROLOGY

SAMPLE NUMBER: 038161 BHD06 High Point 488.5m
SUMMARY:

This is a moderately plagioclase-phyric mafic andesite lava that also contains a few almost terminally reacted quartz xenocrysts. Albitized plagioclase phenocrysts are either rounded, rather larger crystals with clear rims, and more abundant well-formed albitized plagioclase phenocrysts with light sericite flecking and submicroscopic hematite giving them a reddish tinge. Two probably former olivine phenocrysts are replaced by fine-grained silica. The groundmass is riddled by albitized plagioclase laths and former glass is totally replaced by chlorite and spotty secondary silica, and calcite overprints all the groundmass. Vesicles are filled by chalcedony and sericitized feldspar, with occasional spots of deep yellow sphalerite and small pyrite cubes.

SAMPLE NUMBER: 038162 BHD06 High Point 499.75m
SUMMARY:

This is a very sparsely plagioclase-phyric dacitic lava in which the vitrophyric groundmass, originally composed of plagioclase laths and microlites set in glass, has crystallized to blebby, often rather coarse-grained secondary quartz and albite. The few albitized plagioclase phenocrysts are lightly sericite-speckled and mainly occur in clots of three or four crystals. Common, mainly fine-grained calcite and trains of very fine-grained pyrite are common in this sample.

SAMPLE NUMBER: 038163 BHD06 High Point 521.4m HW Volcanics
SUMMARY:

This is a sparsely plagioclase-phyric moderately vesicular andesitic lava. Plagioclase phenocrysts mainly less than about 1.5mm long make up around 1-2 modal% of the rock, and are slightly sericite speckled and reddish from hematite dust inclusions. There appear to have been no former mafic phenocrysts in this rock. The groundmass is a fairly even-textured intergrowth of lath-like to acicular plagioclase set in secondary albite, quartz, tiny Fe(Ti?) oxides and chlorite after glass. Vesicles are filled by calcite and secondary quartz and albite, and contain spots and patches of yellow sphalerite in the biggest vesicles. About 10-15 small disseminated pyrite crystals are also present.

SAMPLE NUMBER: 038165 BHD06 High Point 562.6m HW Volcanics
SUMMARY:

This sample was originally very similar to the preceding rock, except that it has a notably finer-grained and probably originally more glassy groundmass than 38163. Small sparse palbitized plagioclase phenocrysts are slightly reddish due to hematite dust. Two strongly resorbed quartz xenocrysts are present, and no mafic phenocrysts were present in this rock. The groundmass consists of acicular to lathlike albite crystals set in a chlorite-silica-tiny Fe oxide-feldspar intergrowth. A number of fractures through the rock are filled by coarsely crystalline quartz and albite, with a small amount of yellowish-green sphalerite and a few biggish pyrite cubes. Calcite occurs as crosscutting veinlets, but is not abundant. The fwe vesicles are filled by silica and chlorite.

SAMPLE NUMBER: 038166 BHD06 High Point 593.1m HW Volcanics
SUMMARY:

This is another weakly plagioclase-phyric, sparsely vesicular andesitic lava, quite similar to the previous two samples. Notably, albitized plagioclase phenocrysts include smaller euhedral crystals with sharp outlines, and not uncommon larger crystals with quite rounded shapes, typical of those High Point lavas that also contain quartz xenocrysts (although there are no quartz phenocrysts in this sample). The groundmass consists of albitized plagioclase microlites set in a amtrix of dusty calcite, secondary quartz and chlorite. Vesicles and tension gashes are filled by rather coarse-grained secondary quartz and albite, and probably sericitized KSpar, and occasionally contain small pyrite cubes and a few small spots of yellowish green sphalerite.

SAMPLE NUMBER: 038167 BHD06 High Point 604.1m HW Volcanics
SUMMARY:

This is a strikingly unusual contaminated basaltic lava that contains abundant resorbed quartz and albitized plagioclase xenocrysts, as well as abundant cognate but completely altered augite and olivine phenocrysts. Quartz xenocrysts average around 1mm across and most contain devitrified or chloritized melt inclusions. Albitized plagioclase xenocrysts are rather rounded. Smaller, tabular albitized plagioclase phenocrysts may have crystallized after the contamination (mixing) event. Abundant augite phenocrysts are replaced by pale brownish secondary silica and very fine-grained carbonate and epidote(?), and olivine is replaced by fine-grained polycrystalline silica and chlorite. The groundmass of this lava was composed of plagioclase microlites in glass, but glass has been extensively replaced by chlorite. A weak stockwork of quartz- and chlorite-filled fractures cuts the sample.

SAMPLE NUMBER: 038169 BHD06 High Point 622.5m HW Volcanics
SUMMARY:

This is a sparsely vesicular notably primitive basaltic lava or dyke composed of around 3-5 modal% of well-formed olivine phenocrysts now altered to either fine-grained polycrystalline quartz, or calcite, and much more abundant former augite phenocrysts that are altered to a messy yellowbrown material that is probably a microcrystalline intergrowth of epidote, calcite and quartz. Small chromite inclusions are common in the olivine phenocrysts. The groundmass is texturally oblterated by strong sericite-carbonate alteration, but relics of small plagioclase laths are common. This sample is very reminiscent of the two basaltic dykes in the Que River Shale in this hole at 213.0m (38156) and 386.5m (38157), and is likely to have had a similar origin.

SAMPLE NUMBER: 038175 BHD06 High Point 633.6m HW Volcanics
SUMMARY: This is a felsic, probably dacitic lava breccia composed of fragments to at least l cm across composed of devitrified, often perlitically cracked lava. All fragments were either aphyric, or very sparsely plagioclase-phyric, the latter carrying only a few small sericite-altered narrow microphenocrysts of albitized plagioclase. There were certainly no mafic phenocrysts in this sample. Recrystallized devitrified glass varies texturally from exceptionally fine-grained quartzo-feldspathic(?) intergrowths, to coarser-grained mosaic intergrowths of quartz and albite with overprinting calcite. Inter-fragment areas are also composed of a quartz-dominated very fine-grained intergrowth in which trains of tiny pyrite grains are common.

SAMPLE NUMBER: 038170 BHD06 High Point 658.9m HW Volcanics
SUMMARY:

This is an andesitic hyaloclastite composed of mainly angular fragments of sparsely plagioclase-phyric perlitically-cracked andesite lava. Glass has altered to patchy quartz and subordinate albite riddled with abundant chlorite. Chlorite is also concentrated on the perlite cracks, but is much less abundant in the clearer inter-fragmental matrix. Plagioclase phenocrysts are rare, and are mostly elongate small albitized crystals partially to completely replaced by sericite. This sample contains minor disseminated pyrite, a few spots of deep red sphlerite.

SAMPLE NUMBER: 038171 BHD06 High Point 685.2m Mixed Seq.
SUMMARY:

This is a moderately vesicular, quite primitive basaltic lava that was originally quite glassy. Augite phenocrysts are always fractured but are mainly fresh, and make up around 10 modal% of this rock; most are less than 1mm, though some are around 2mm long and clots of several crystals are even larger. Former olivine crystals, most hosting tiny chromite inclusions, are not uncommon (~4 modal%), and are mainly replaced by calcite. The groundmass now consists of abundant chlorite and subordinate blebby secondary quartz in which are set fresh to totally altered microlites of augite and probably plagioclase. Interestingly, acicular crystals of actinolite are common in this sample's groundmass, indicating that it was metamorphosed in low greenschist facies conditions (compared to the samples higher in the hole which show no actinolite, and thus are probably prehnite-pumpelyyite facies). Vesicles and fractures are mainly filled by calcite. A single partially resorbed xenocryst of quartz occurs in this sample.

770089

SAMPLE NUMBER: 038172 BHD06 High Point 703.55m Mixed Seq.
SUMMARY:

This sample is a fragment in a lava breccia, and was originally an abundantly porphyritic plagioclase+hornblende-phyric andesitic lava. Albitized plagioclase phenocrysts mainy less than 1mm long make up at least 15 modal% of this sample, and most are partially replaced by quite coarse-grained sericite. Former hornblende phenocrysts have distinctive amphibole crystal shapes, and are now composed of chlorite, quartz, leucoxene blebs, and fine-grained epidote(?); several contain inclusions of albite laths and small apatite prisms. These make up ~ 5 modal% of the sample. Much less abundant are small chlorite-altered former augite phenocrysts. The groundmass of this lava was glass containing tiny plagioclase microlites. Glass is chloritized, and small blebs of leucoxene and secondary silica are common. Smaller fragments at one end of this thin section were glassy plagioclase-phyric andesitic lavas.

SAMPLE NUMBER: 038174 BHD06 High Point 713.1m Mixed Seq
SUMMARY:

This is a polymict lava breccia of andesitic composition. It contains a remarkable variety of lava fragments varying from plagioclase+augite (altered)-phyric andesite, plagioclase+hornblende (altered)-phyric andesite, aphyric andesitic to dacitic lavas, to perlitically cracked formerly glassy aphyric dacite lava, and one large clast of strongly hydrothermally altered (silica-pyrite) plagioclase-phyric dacitic to andesitic lava. Interfragment matrix consists of extremely fine-grained silica and chlorite spotted with tiny blebs of leucoxene.

SAMPLE NUMBER: 038173 BHD06 High Point 716.8m Mixed Seq
SUMMARY:

This is another polymict andesitic lava breccia. The main fragment in this section is a plagioclase+sparse augite-phyric andesitic to dacitic lava which had an originally vitrophyric groundmass composed of plagioclase microlites set in glass. The latter has altered to a rather coarse-grained inhomogeneous quartzo-feldspathic intergrowth with subordinate chlorite and leucoxene blebs. A spot of reddishbrown sphalerite almost 1mm across occurs in this fragment. Other fragments in this section are considerably smaller than the main fragment, and include a diversity of aphyric to plagioclase-phyric mainly formerly glassy andesitic to dacitic lavas. A perlitically-cracked fragment identical to that noted in 38174 is also present.

SAMPLE NUMBER: 038176 BHD06 High Point 733.9m
SUMMARY:

This sample was a moderately plagioclase-phyric dacitic lava with a distinctive spherulitic glassy groundmass. Plagioclase phenocrysts to about 1.5mm long are mainly subhedral, and often occur in clusters of 2-6 crystals. There were no former mafic phenocrysts in this rock. The groundmass is now composed of a heterogeneously textured mainly fine-grained quartzo-feldspathic intergrowth from which are growing ragged larger grains of secondary quartz. In plane polarized light, quite distinct circular 'shadows' of former spherulites growing from the glassy groundmass are preserved. This sample contains minor disseminated pyrite, and is cut by numerous quartz veinlets that carry occasional crystals of pale yellow epidote and patches of deep red sphalerite. Minor spotty calcite alteration overprints small areas of groundmass.

SAMPLE NUMBER: 038177 BHD06 High Point 749.7m Mixed Seq
SUMMARY:

This is a greywacke, though notably different from the 'standard' Animal Creek Greywacke in that metamorphic quartz and pelitic schist detritus is notably absent. Rather, this sample is a matrix-supported lithic wacke, dominated by subrounded clasts if felsic volcanics, and common detrital plagioclase phenocrysts. Most of the lithic clasts were clearly originally glassy felsic volcanics, as perlitic cracks are preserved in many, and typical coarse micropoikilitic (mosaic) textures are evident in others. Only two or three detrital quartz grains of undoubted volcanic phenocryst origin are present, and there is no clear metamorphic quartz. At least three distinct deep red detrital chromite grains are present, and these and several chlorite-serpentinite clasts are probably derived from the W Tasmanian ophiolites. The matrix of this sample is messy and highly sericite altered, and overprinted by calcite. Disseminated small clusters of pyrite grains are common.

SAMPLE NUMBER: 038178 BHD06 High Point 780.85m Dyke in MS?
SUMMARY:

This is an intensely carbonate+sericite-altered sparsely plagioclase+augite phyric andesitic rock that probably had a glassy to spherulitic groundmass. Former plagioclase phenocrysts are totally replaced by fine-grained sericite and carbonate, and rare small augite phenocrysts by chlorite. The unusual groundmass of this sample consists of small, almost rounded albite grains that may be replacing former spheruilites, set in a much finer-grained and altered quartzo-feldspathic intergrowth after glass. The groundmass is pervaded by fine-grained sericite and chlorite. Former FeTi oxides are replaced by granular sphene and chlorite, and rather fine-grained disseminated pyrite is quite common. From the thin section, it is not possible to judge whether this rock was intrusive or extrusive.

SAMPLE NUMBER: 038180 BHD06 High Point 829.85m FW Volcs
SUMMARY:

This is a vesicular, intensely altered primitive basaltic lava approaching a scoria. Abundant altered euhedral olivine and augite phenocrysts, mainly less than 1mm long, are replaced by fine-grained carbonate, microcrystalline quartz, and chlorite. Many olivine phenocrysts contain small chromite euhedra. The groundmass of this sample was microvesicular to vesicular glass, and it is now entirely and intensely altered to brownish carbonate and colourless to pale green chlorite, with brownish very fine-grained epidote(?). Abundant tiny leucoxene blebs occur throughout the altered groundmass.

SAMPLE NUMBER: 038181 BHD06 High Point 879.7m F'wall Volcs.
SUMMARY:

This is a weakly vesicular augite+plagioclase-phyric basaltic lava that is slightly autobrecciated. Fresh augite phenocrysts make up around 5 modal% of the rock, and are mainly <1mm-sized euhedral crystals. Less abundant are tabular albitized plagioclase phenocrysts, some of which are partly replaced by calcite and clinozoisite. A few small former olivine phenocrysts are altered to fine-grained polycrystalline quartz and magnetite. The groundmass of this sample is a trachytic-textured intergrowth of small albitized plagioclase laths with interstitial chloritized augite blades and tiny leucoxene-altered FeTi oxides. The glassy mesostasis is altered to very fine-grained quartzo-feldspathic material and chlorite. Vesicles are filled by albite, quartz and pyrite. Sudden changes in orientation of the plagioclase groundmass laths at fractures suggest that this sample was slightly autobrecciated. Disseminated pyrite occurs in quartz-chlorite veinlets, and becomes almost massive pyrite in one particular 1mm-thick vein. Rather coarse-grained prehnite occurs in one vein.

SAMPLE NUMBER: 038183 BHD06 High Point 920.8m Dyke in ACG
SUMMARY:

This is a virtually aphric, fine-grained but holocrystalline andesitic dyke rock. One or two small former plagioclase phenocrysts are replaced by calcite, and a few small former augite phenocrysts are replaced by chlorite and calcite. The remainder of the sample consists of an intersertal intergrowth of plagioclase laths and more equant small augite (entirely replaced by calcite and chlorite) grains, small altered FeTi oxides, and occasional spherulites composed of tiny radiating plagioclase microlites set in quartz after glass. Narrow calcite veinlets are common, and a small amount of disseminated pyrite is present. The texture of this sample is clearly indicative of an intrusive rock.

SAMPLE NUMBER: 038184 BHD06 High Point 958.0m Dyke in ACG
SUMMARY: This is another shallow intrusive andesitic rock, although more rapidly cooled than the previous sample. A few former plagioclase and augite phenocrysts are replaced by calcite and sericite, but a distinctive feature of this sample is the presence of five or six quite rounded and reacted quartz xenocrysts. The groundmass of this sample is a micro- poikilitic intergrowth of tiny albitized plagioclase microlites in quartz-chlorite after glass. Calcite veinlets are not uncommon, and a few clusters of small pyrite veins are present.

770090

SAMPLE NUMBER: 038186 BHD06 High Point 1022.3m CVC
SUMMARY:

This is a vesicular, altered sparsely porphyritic basaltic lava or shallow intrusive rock, with occasional altered olivine and augite phenocrysts, and several microphenocrysts of chromite. Phenocrysts are replaced by calcite and chlorite, and calcite fills the vesicles, which are up to almost 2mm across. The groundmass consists of tiny sericite-altered plagioclase laths set in a blebby quartz-chlorite-calcite intergrowth probably replacing glass. At one end of the slide, some lithic fragments of totally chloritized basalt (possibly disaggregated and altered chilled glassy margin of this dyke) and several of altered glassy felsic lava (host rock?) are present. Minor disseminated pyrite occurs in this strongly carbonate-altered sample.

SAMPLE NUMBER: 038188 BHD06 High Point 1055.5m CVC
SUMMARY:

This is an intensely altered felsic lava or shallow intrusive rock in which all trace of the groundmass texture has been obliterated by very strong sericite alteration. The sample consists of about 15 modal% of large (to ~2mm long) blocky albitized plagioclase phenocrysts, and <1 modal% of leucoxene-altered FeTi oxide microphenocrysts, now set in dense sericite that overprints the groundmass. A few rounded quartz phenocrysts or xenocrysts are present. Occasional less sericitized patches of groundmass are composed of very fine-grained sugary quartz and albite; if these are primary, then I would suggest that the rock is an intrusive.

SAMPLE NUMBER: 038189 BHD06 High Point 1037.1m CVC
SUMMARY:

This sample was originally identical to the previous sample (038188), being a plagioclase+quartz-phyric shallow intrusive rhyolite. This rock is much more fractured (though not foliated) than 188, and contains more abundant chlorite along fractures, but the dominant alteration is sericite-carbonate.

BHD6 MAGNETIC SUSCEPTIBILITY

770091

DEPTH	MS	DEPTH	MS	DEPTH	MS
9.4	0.05	184.4	0.07	346.4	0.15
12.3	0.03	187.4	0.09	349.4	0.19
15.2	0.06	190.4	0.07	352.4	0.21
18.4	0.05	193.4	0.09	355.4	0.21
21.5	0.09	196.4	0.09	358.4	0.2
24.6	0.06	197.2	0.1	361.4	0.18
27.7	0.18	199.4	0.18	364.4	0.21
31.4	0.07	202.4	0.07	366.0	0.18
34.4	0.06	205.4	0.05	366.9	0.04
37.4	0.08	208.4	0.06	368.4	0.12
40.4	0.07	211.4	0.11	370.9	0.17
43.4	0.18	214.4	0.14	374.5	0.18
46.4	0.08	217.4	0.14	376.9	0.11
49.4	0.07	220.4	0.13	379.9	0.23
52.4	0.08	221.3	0.15	381.3	0.2
55.4	0.18	223.4	0.16	382.9	0.08
58.4	0.22	226.4	0.32	385.9	0.14
61.4	0.21	229.4	0.1	388.9	0.21
64.4	0.22	232.4	0.11	391.9	0.19
67.4	0.21	235.4	0.13	394.9	0.2
70.4	0.12	238.4	0.1	397.9	0.25
72.9	0.17	241.4	0.14	399.3	0.22
76.0	0.22	244.4	0.11	402.3	0.14
78.8	0.23	247.4	0.26	403.9	0.1
80.0	0.23	250.4	0.18	406.9	0.49
82.4	0.22	253.4	0.11	409.9	0.25
85.4	0.19	256.4	0.23	412.9	0.05
88.4	0.25	259.4	0.18	415.9	0.14
91.4	0.22	262.3	0.19	418.9	0.17
94.4	0.27	263.1	0.14	421.9	0.2
97.4	0.22	266.1	0.11	423.9	0.18
100.4	0.25	268.4	0.19	426.9	0.23
104.8	0.09	271.4	0.13	430.0	0.2
105.4	0.07	274.4	0.27	433.9	0.23
106.1	0.06	277.4	0.13	435.3	0.21
106.8	0.05	280.1	0.23	438.3	0.32
110.3	0.07	283.2	0.33	441.2	0.2
112.4	0.16	285.6	0.46	442.9	0.12
115.4	0.11	287.0	0.05	445.9	0.23
118.4	0.07	289.4	0.14	448.9	0.26
121.4	0.04	292.4	0.08	451.9	0.22
124.4	0.01	295.4	0.09	454.9	0.27
127.4	0.04	296.9	0.11	457.9	0.26
129.8	0.07	299.7	0.16	460.9	0.22
132.9	0.08	301.4	0.09	463.9	0.15
135.5	0.07	304.4	0.14	466.9	0.18
138.5	0.07	306.0	0.22	469.9	0.1
141.6	0.06	308.8	0.11	472.9	0.09
142.8	0.06	312.4	0.03	475.9	0.25
145.4	0.05	313.4	0.14	478.9	0.14
148.4	0.07	316.4	0.07	481.9	0.15
151.4	0.05	318.5	0.06	484.9	0.24
154.4	0.01	319.8	0.05	486.6	0.23
157.4	0.05	322.4	0.04	489.6	0.16
160.1	0.07	324.3	0.02	493.1	0.3
163.2	0.05	326.2	0.05	496.1	0.16
166.3	0.04	330.2	0.22	497.6	0.26
169.4	0.05	331.4	0.04	500.6	0.36
170.7	0.05	333.8	0.14	502.9	0.15
172.4	0.06	336.4	0.03	505.9	0.36
175.4	0.05	337.4	0.05	507.3	0.23
178.4	0.11	340.4	0.23	510.3	0.25
181.4	0.04	343.4	0.06	511.8	0.35

770092

DEPTH	MS
514.8	0.17
517.9	0.34
520.9	0.32
523.9	0.24
526.9	0.09
529.9	0.29
532.9	0.23
535.9	0.37
538.9	0.32
540.4	0.58
543.4	0.13
546.1	0.22
549.1	0.18
552.3	0.33
555.5	0.34
558.9	0.28
561.9	0.2
565.5	0.18
568.5	0.3
571.9	0.19
574.9	0.28
577.9	0.22
580.9	0.24
583.6	0.25
586.9	0.21
589.9	0.15
592.9	0.2
596.2	0.28
598.9	0.19
601.9	0.24
604.9	0.23
607.9	0.17
609.6	0.18
612.6	0.16
615.5	0.06
616.9	0.04
619.9	0.07
621.3	0.07
624.3	0.12
625.5	0.12
628.3	0.11
631.9	0.15
632.0	0.09
633.2	0.17
636.2	0.12
639.7	0.12
642.7	0.1
646.7	0.2
649.2	0.07
650.2	0.11
652.9	0.14
655.9	0.18
658.9	0.13
661.9	0.09
664.9	0.13
667.9	0.13
671.0	0.08
673.9	0.02
675.4	0.06
677.0	0.04
680.0	0.18
681.9	0.12
684.9	0.27
688.4	0.13
691.4	0.08
694.9	0.13
697.9	0.07
699.7	0.09
702.7	0.13
706.3	0.18
709.3	0.16
712.8	0.15
715.8	0.1
718.9	0.15
721.9	0.24
724.9	0.14
727.9	0.06
730.9	0.12
733.9	0.01
739.9	0.19
742.1	0.19
745.1	0.15
748.5	0.1
751.5	0.21
754.9	0.2
757.9	0.26
761.3	0.06
763.9	0.18
766.9	0.06
769.4	0.11
772.9	0.16
775.9	0.13
778.9	0.06
781.9	0.12
784.9	0.21
787.9	0.15
790.9	0.24
793.9	0.37
796.9	0.18
799.9	0.17
802.9	0.31
805.9	0.1
808.9	0.25
811.9	0.07
814.9	0.17
817.9	0.4
820.9	0.35
823.9	0.15
826.9	0.22
829.9	0.32
832.9	0.31
835.9	0.22
838.9	0.16
841.9	0.22
844.9	0.46
847.9	0.24
850.9	0.16
853.9	0.4
856.9	0.17
859.9	0.33
862.9	0.43
865.9	0.51
868.9	0.23
871.9	0.34
877.9	0.57
880.6	0.28
883.9	0.5
889.4	0.6
892.4	0.19
893.7	0.52
896.7	0.72
900.3	0.06
901.8	0.05
904.8	0.2
906.3	0.38
909.3	0.06
912.1	0.09
915.5	0.46
916.9	0.32
919.9	0.28
922.9	0.68
925.9	0.47
928.9	0.18
931.9	0.04
933.9	0.17
936.9	0.1
940.4	0.23
943.4	0.08
946.9	0.26
949.9	0.14
952.9	0.14
955.9	0.48
958.9	0.1
961.9	0.05
963.6	0.12
966.6	0.11
970.1	0.07
973.1	0.07
976.6	0.11
979.6	0.1
982.9	0.03
985.9	0.07
988.9	0.2
991.9	0.05
994.9	0.1
997.9	0.1
1001.8	0.21
1003.9	0.12
1006.9	0.09
1009.9	0.08
1012.9	0.14
1015.9	0.08
1018.9	0.13
1021.9	0.08
1024.9	0.08
1027.9	0.08
1030.9	0.09
1033.9	0.12
1036.9	0.2
1039.9	0.34
1042.9	0.4
1045.9	0.12
1048.9	0.12
1051.9	0.3
1054.9	0.06
1057.9	0.07
1060.9	0.07

BHD6 SPECIFIC GRAVITY

DEPTH	SG
19.7	2.52
40.4	2.43
60.5	2.6
83.4	2.65
102.0	2.68
120.6	2.49
141.1	2.56
160.1	2.58
184.4	2.55
202.4	2.64
224.7	2.68
244.4	2.66
260.3	2.66
282.5	2.68
301.8	2.74
320.0	2.58
340.4	2.61
360.8	2.65
379.7	2.56
401.3	2.52
421.9	2.61
441.2	2.57
460.9	2.62
484.9	2.59
500.6	2.63
520.9	2.57
544.7	2.53
565.5	2.57
583.8	2.57
601.9	2.61
621.1	2.56
646.2	2.66
664.5	2.42
684.9	2.51
712.0	2.48
726.2	2.51
741.0	2.32
762.5	2.52
787.0	2.51
799.9	2.46
824.0	2.62
844.5	2.83
862.5	2.39
883.9	2.63
900.2	2.57
925.9	2.62
940.6	2.6
957.8	2.61
980.9	2.58
1001.0	2.61
1020.2	2.58
1042.9	2.58
1055.1	2.63

APPENDIX 2

DHEM Survey of BHD6, Memo by PW Basford

PASMINCO
EXPLORATION

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

Old Burnie Railway Station
Burnie, Tasmania 7320
G.P.O. Box 886
Burnie, Tasmania 7320

MEMORANDUM

TO: JG Purvis

FROM: PW Basford

DATE: 21 July, 1995

SUBJECT: **DHEM BHD6, BULGOBAC HILL EL 37/89**

FILE: EP/02/3007/8.4 pwb:95019

From April 17 to 24, 1995, Outer Rim Exploration surveyed hole BHD6 with the CRONE PEM system. Two loops were used for the survey, one positioned over the collar of the hole, the other located over but dominantly west of the collar (PAS1184 for loop design and vector plots). Two turns of wire was used to make the loop, increasing the current output. One turn of the loop utilised Outer-Rim's wire, whilst the other turn used Pasminco's wire (which is more resistive). A 20 msec time base and 0.5 msec ramp was used for the survey, with twenty channels of data recorded from 0.07 to 14.5 msecs. Peak currents were 12 Amps for the central loop and 8 Amps for the west loop. Both loops were read with all three components, starting from 200m down the hole.

Collar Loop

Axial data for the collar loop (PAS1185) contains an anomalous zone at the top of the hole. The response appears to be related to the Que River Shales intersected at the top of the hole, with a small in-hole response migrating to an off-hole (negative to positive cross-over) at mid times. The anomaly centre migrates down the hole as the current filament spreads along the conductive horizon. It is assumed that the cause of the anomaly is a more conductive layer within the shales. Modelling of the data

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using FILAMENT has confirmed the presence of a conductor north of the hole. Cross component data is anomalous in the Y direction more than the X (PAS1185). FILAMENT modelling of the X and Y component data (in conjunction with axial data) also infers the shale to be north of the hole. There appear to be no other conductors off the hole.

West Loop

The axial data (PAS1186) indicates the same anomalous shale response as observed in the collar loop data, however, the anomalous response migrates from a positive anomaly to a negative anomaly. Modelling of the axial and cross-component data using FILAMENT produces consistent results to that found from the Collar Loop data.

The west loop data also contains rotation problems with the cross-component data at 320 and 350m, however this does not affect interpreted results.

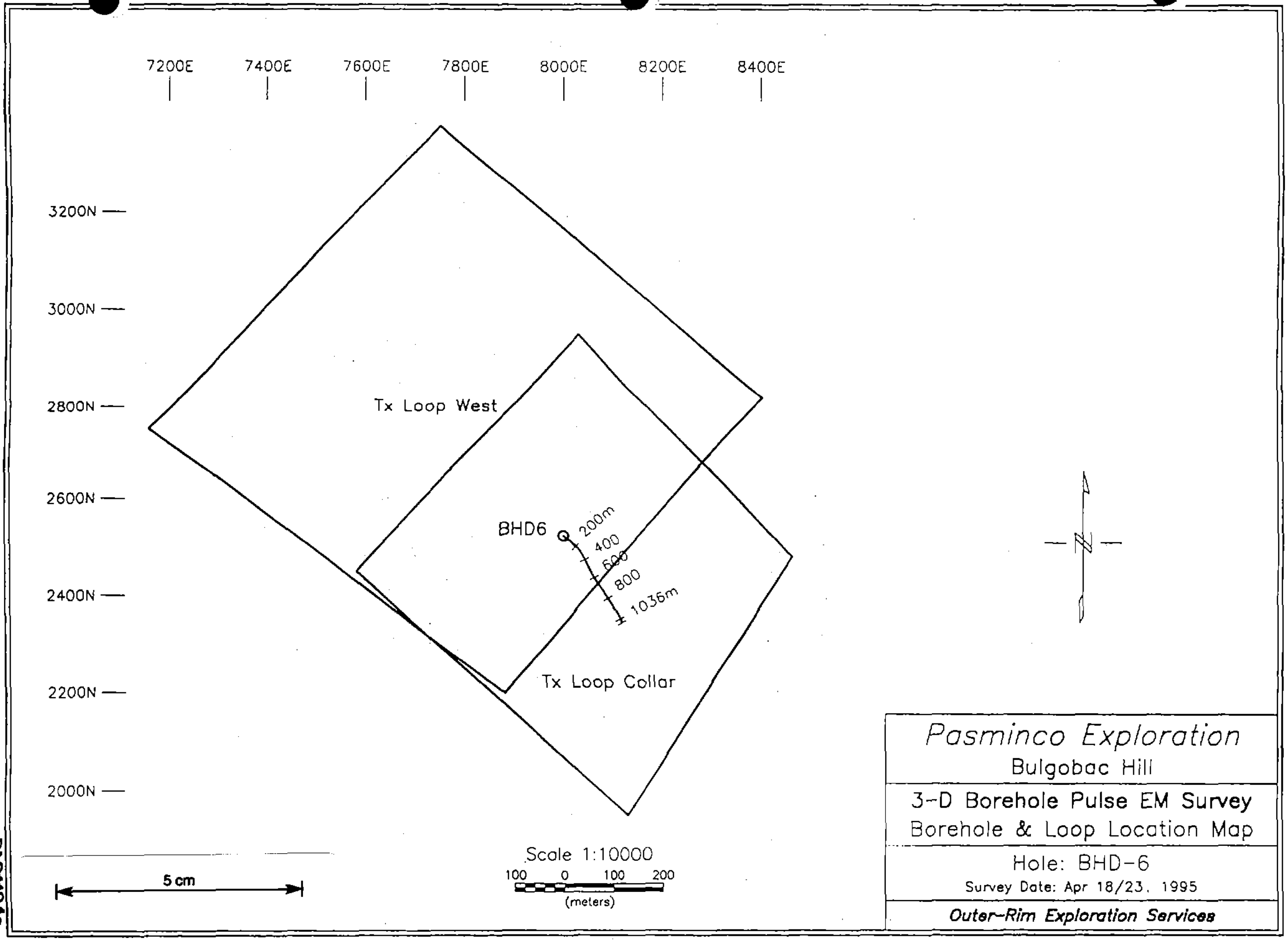
Both the axial and X component data also indicates a minor deflection in the primary field between 600 and 620m (PAS1186). The location of the feature does not correlate with any known mineralisation in the geological log. The in-hole response only persists for early times and is small.

No significant conductors were observed from either loop. Conductivity of the Que River Shale appear to be various. It is apparent from modelling that there exist layers of high conductivity within the shale, as discovered from modelling in FILAMENT and by Durrand (1993).

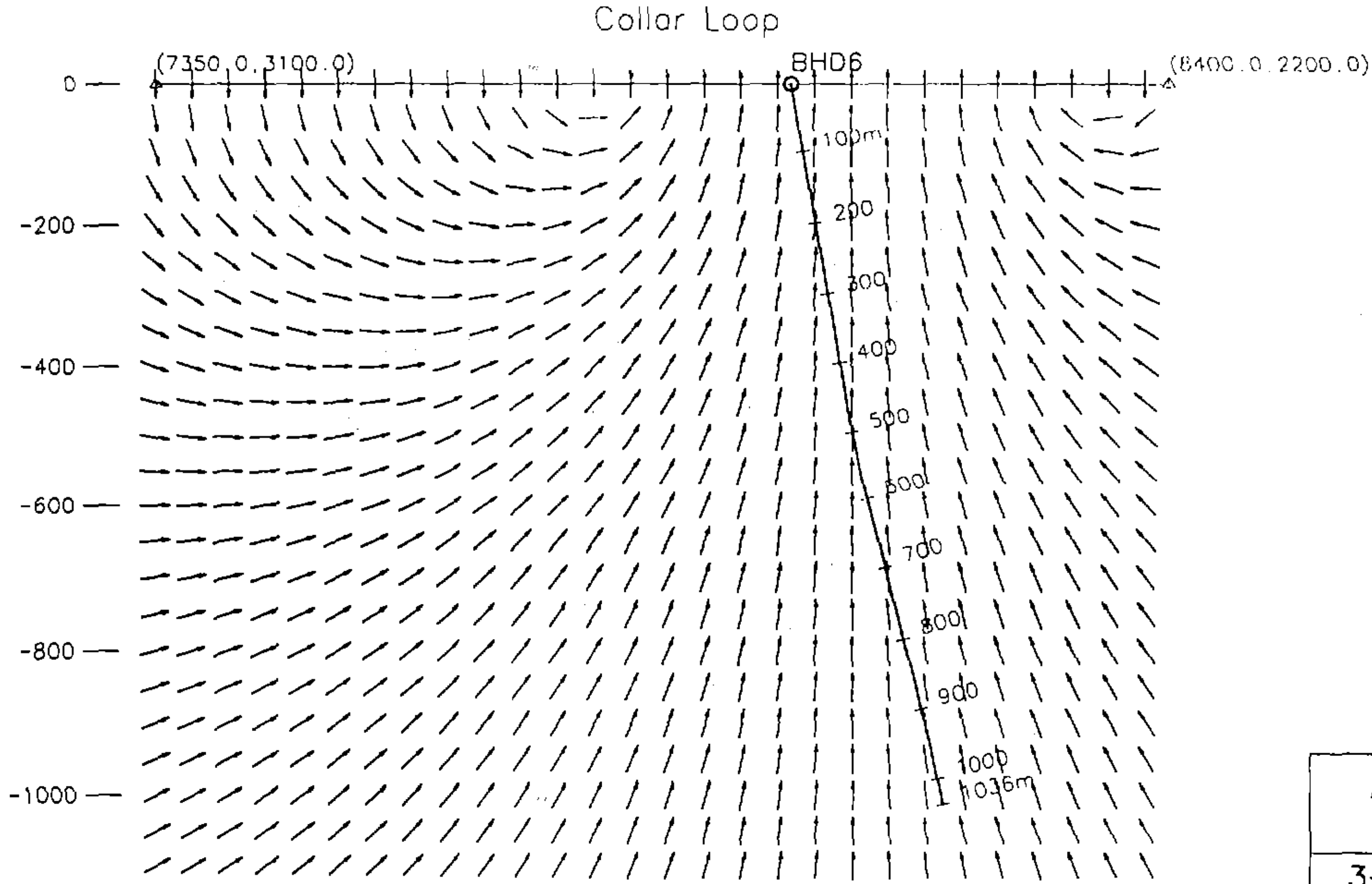
Paul Basford

References

Durrand C.J., 1993. Interpretation and modelling of DHEM anomalies in EL 37/89 Bulgobac, Tasmania. Pasminco Exploration Report - BH45 (HW109).


7200E
7400E
7600E
7800E
8000E
8200E
8400E
3200N
3000N
2800N
2600N
2400N
2200N
2000N
Tx Loop West
Tx Loop Collar
BHD6
200m
400
600
800
1036m
5 cm
Scale 1:10000
100 0 100 200
(meters)
Pasminco Exploration
Bulgobac Hill
3-D Borehole Pulse EM Survey
Borehole & Loop Location Map
Hole: BHD-6
Survey Date: Apr 18/23, 1995
Outer-Rim Exploration Services

PAS1184a



5 cm

Scale 1:10000

250 0 (meters)

Pasminco Exploration

Bulgobac Hill

3-D Borehole Pulse EM Survey

Hole Section with Primary Field

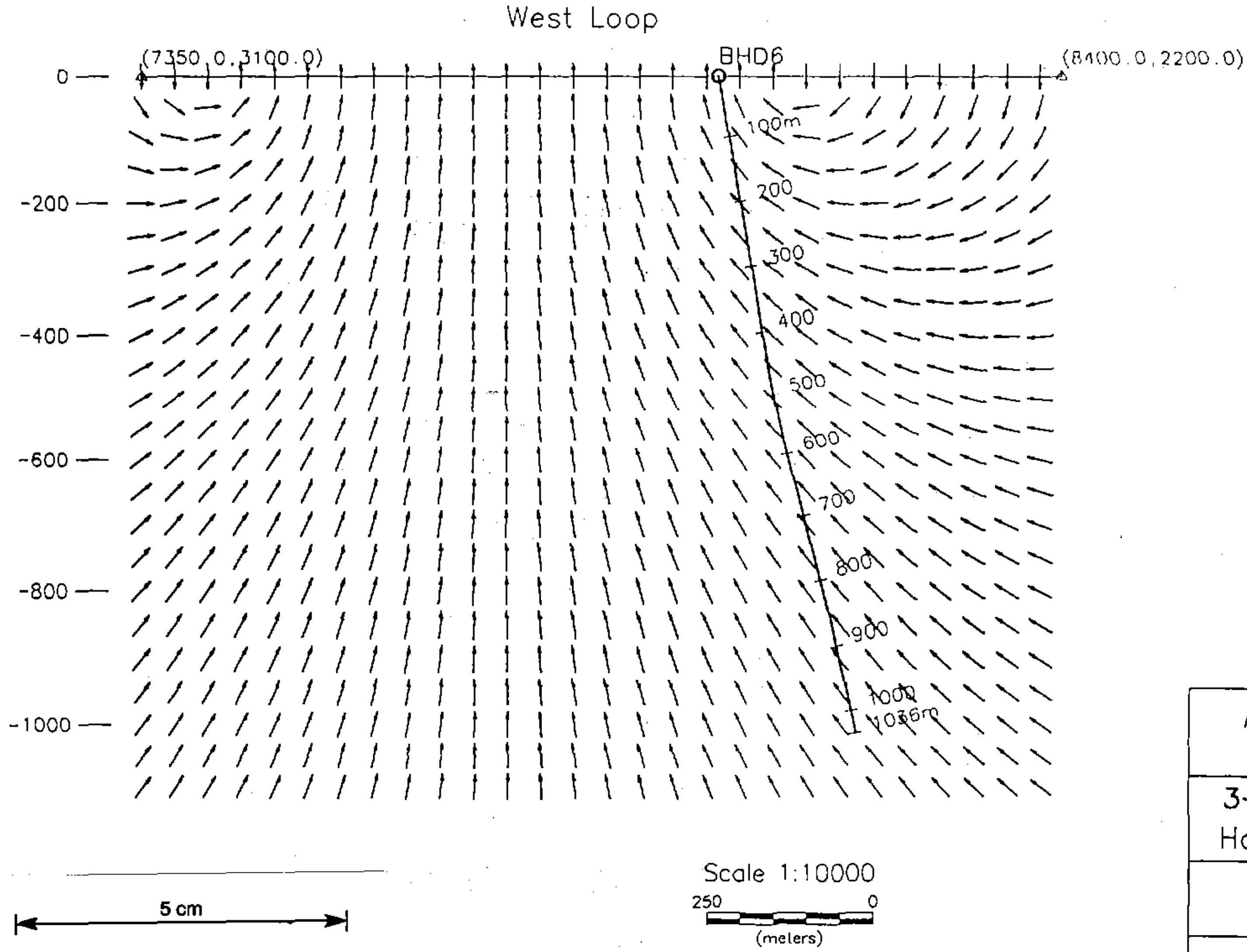
Hole: BHD-6

Survey Date: Apr 23, 1995

Outer-Rim Exploration Services

PAS1184b

77008



Pasminco Exploration

Bulgobac Hill

3-D Borehole Pulse EM Survey

Hole Section with Primary Field

Hole: BHD-6

Survey Date: Apr 18, 1995

Outer-Rim Exploration Services

PAS1184c

0 30074

OUTER-RIM EXPLORATION SERVICES
Operating Crone PEM System
BOREHOLE PEM

770100

Client	: Pasminco Exploration	Hole	: BHD6
Grid	: Bulgobac Hill	Tx Loop	: Collar
Date	: Apr 23, 1995	File name	: BHD6CZ.PEM
Time Base	: 20.00 ms	# Readings	: 115
Ramp Time	: 0.50 ms	Stn Units	: Metric
# Channels	: 20	Coil Area	: 6500 sq m
Sync Type	: Cable	Polarity	: +
Loop Size	: 800m X 800m	Receiver	: Digital #108
Current	: 12 Amps	Operator	: Kent Honner

Loop Coordinates (X,Y,Z)

1. 7580m, 2450m, 0m
2. 8130m, 1950m, 0m
3. 8460m, 2480m, 0m
4. 8030m, 2950m, 0m

Hole Coordinates (X,Y,Z) or (Azimuth,Dip,Length)

1. 7999m, 2523m, 0m
2. 132deg, 80deg, 15m
3. 126deg, 80.7deg, 31m
4. 130deg, 81deg, 30m
5. 132deg, 80.5deg, 33m
6. 137deg, 80.7deg, 33m
7. 133deg, 80deg, 30m
8. 137deg, 80.5deg, 30m
9. 135deg, 80.2deg, 30m
10. 143deg, 80deg, 32m
11. 145deg, 80.2deg, 31m
12. 147deg, 80.5deg, 30m
13. 150deg, 80deg, 27m
14. 151.5deg, 81deg, 31m
15. 153deg, 79.7deg, 35m
16. 154.5deg, 79.7deg, 45m
17. 153deg, 78.5deg, 47m
18. 151.5deg, 78.2deg, 32m
19. 149.5deg, 77.3deg, 34m
20. 151deg, 76deg, 31m
21. 146.7deg, 75.3deg, 32m
22. 144.5deg, 75deg, 32m
23. 145deg, 75deg, 47m
24. 146.5deg, 75.3deg, 46m
25. 146.8deg, 75.4deg, 32m
26. 146deg, 75.2deg, 30m
27. 147deg, 75.8deg, 30m
28. 149deg, 75.8deg, 32m
29. 149.3deg, 76deg, 31m
30. 151deg, 76.5deg, 30m
31. 151.8deg, 76.5deg, 31m
32. 155deg, 77deg, 34m
33. 153deg, 77.5deg, 22m

Channel Times (usec)

Ch	Start	End	Center	Ch	Start	End	Center	Ch	Start	End	Center
PP	-198	-99	-149	1	76	104	90	2	104	131	117
3	131	171	151	4	171	225	198	5	225	292	259
6	292	378	335	7	378	490	434	8	490	639	565
9	639	828	733	10	828	1075	952	11	1075	1395	1235
12	1395	1809	1602	13	1809	2348	2078	14	2348	3046	2697
15	3046	3951	3498	16	3951	5121	4536	17	5121	6646	5884
18	6646	8617	7632	19	8617	11170	9894	20	11170	14490	12830

General Comments

Doubled-up loop to bring overall resistance to approx. 15.0 Ohm.

OUTER-RIM EXPLORATION SERVICES
Operating Crone PEM System
BOREHOLE PEM

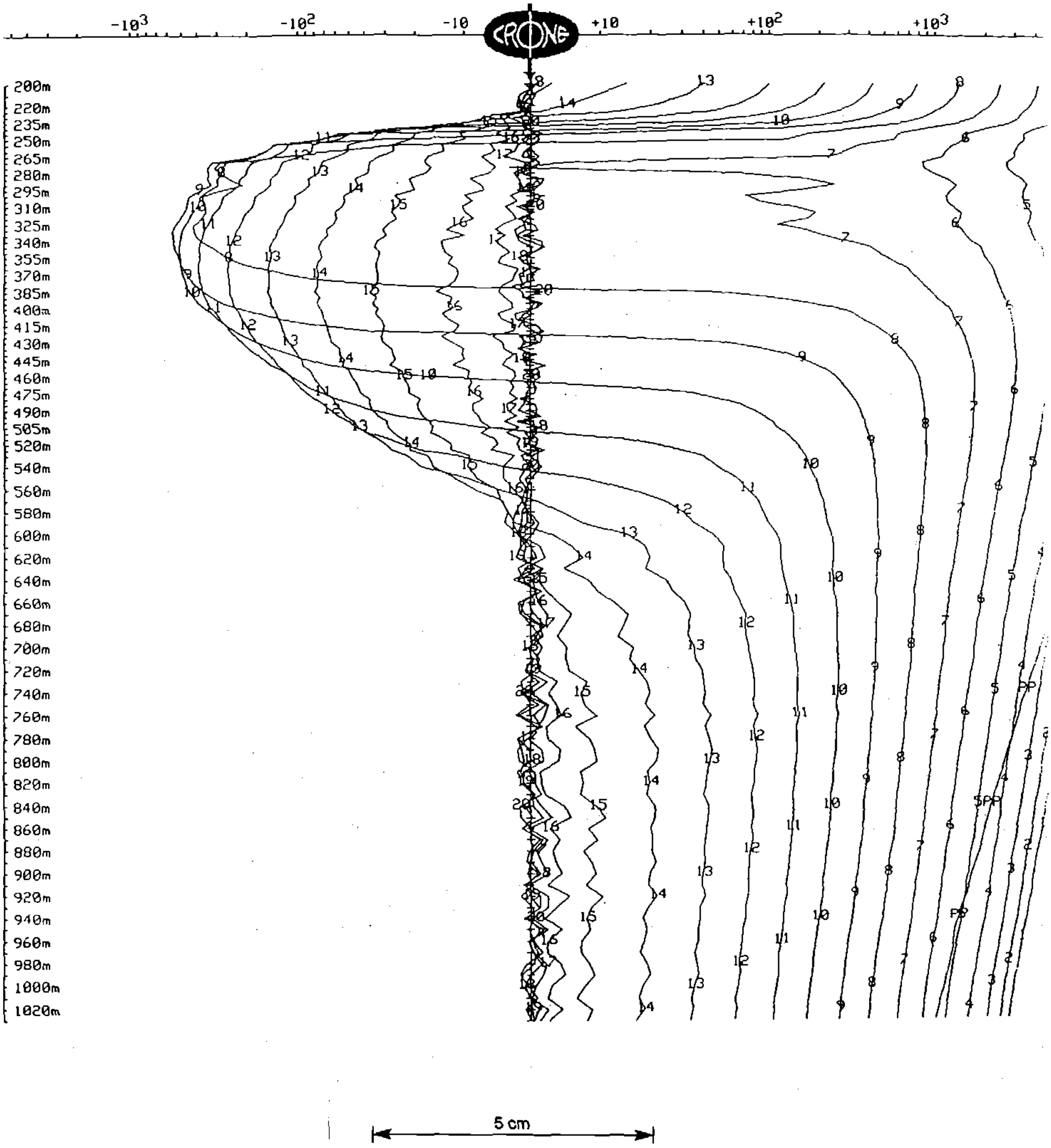
770101

Client : Pasminco Exploration
Grid : Bulgobac Hill
Date : Apr 23, 1995

Hole : BHD6
Tx Loop : Collar
File name : BHD6CZ.PEM

Z COMPONENT dBz/dt nanoTesla/sec - 20 channels and PP

Scale: 1:5000



PAS1185a

OUTER-RIM EXPLORATION SERVICES
Operating Crone PEM System
BOREHOLE PEM

770102

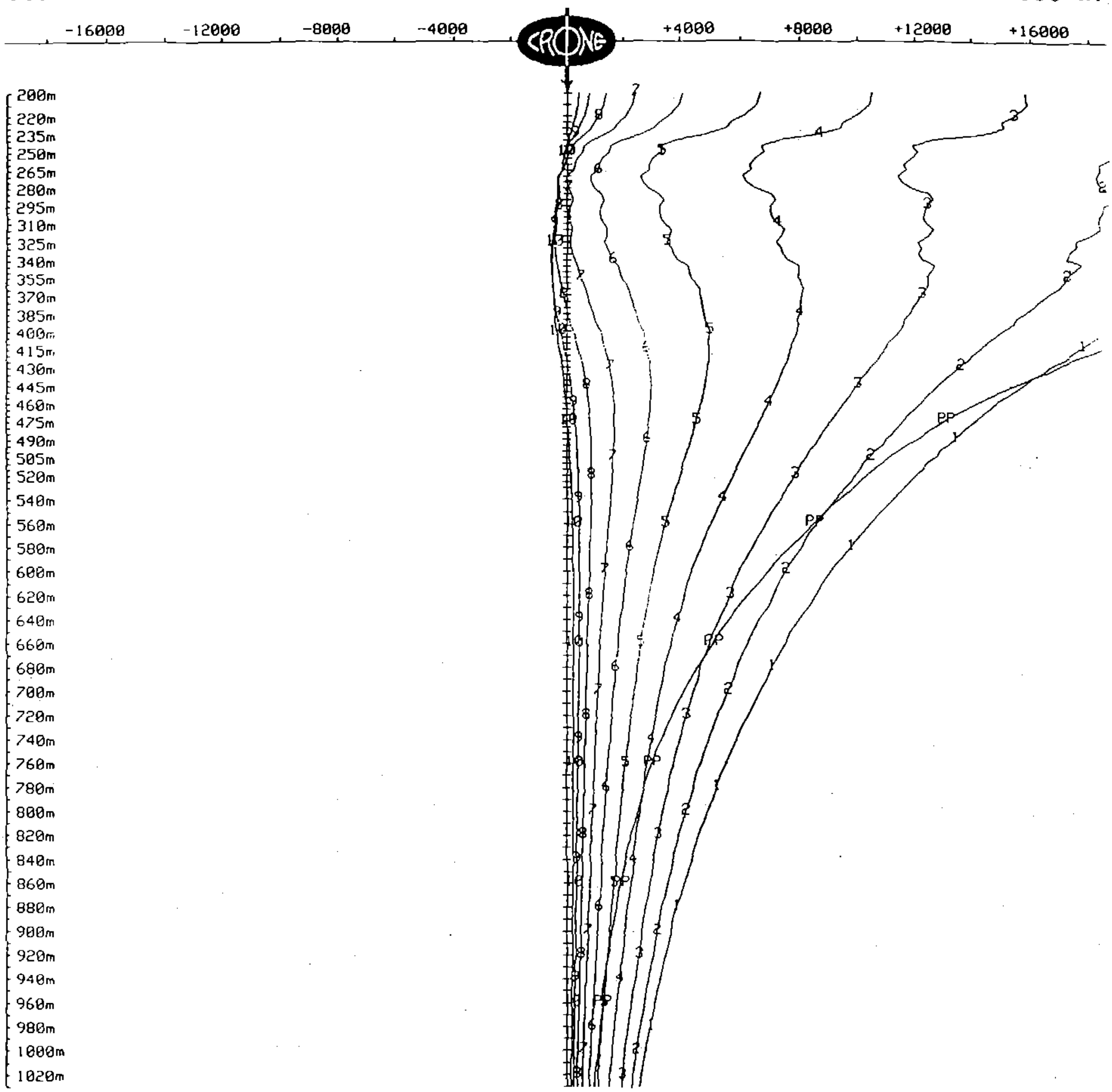
Client : Pasminco Exploration
Grid : Bulgobac Hill
Date : Apr 23, 1995

Hole : BHD6
Tx Loop : Collar
File name : BHD6CZ.PEM

Z COMPONENT dBz/dt nanoTesla/sec - 20 channels and PP

Scale: 1:5000

Unit Scale: 1cm = 2000 nT



5 cm

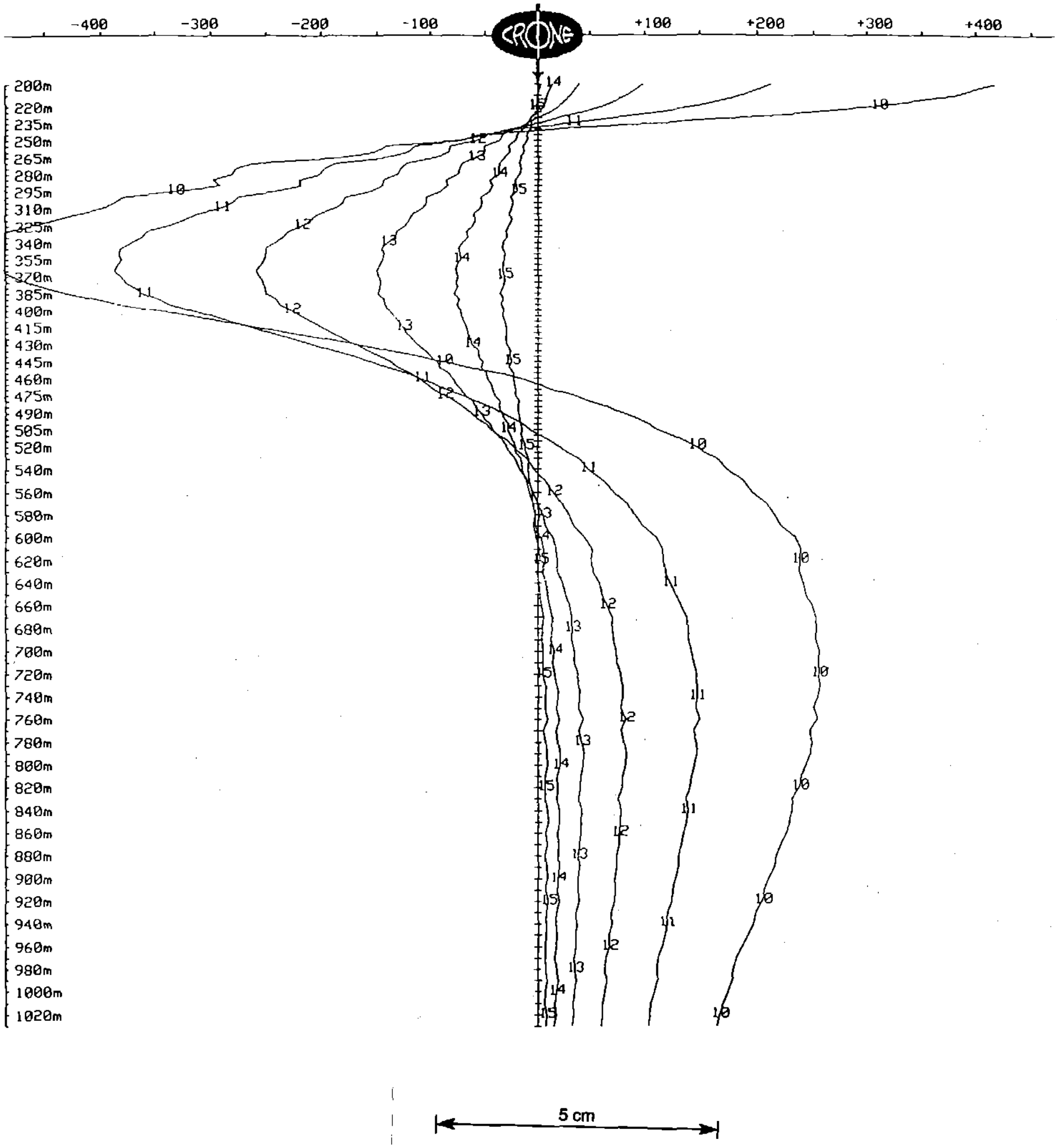
OUTER-RIM EXPLORATION SERVICES
Operating Crone PEM System
BOREHOLE PEM

770103

Client	: Pasminco Exploration	Hole	: BHD6
Grid	: Bulgobac Hill	Tx Loop	: Collar
Date	: Apr 23, 1995	File name	: BHD6CZ.PEM

Z COMPONENT dBz/dt nanoTesla/sec - 20 channels

Scale: 1:5000 Unit Scale: 1cm = 50 nT/



OUTER-RIM EXPLORATION SERVICES
Operating Crone PEM System
BOREHOLE PEM

770104

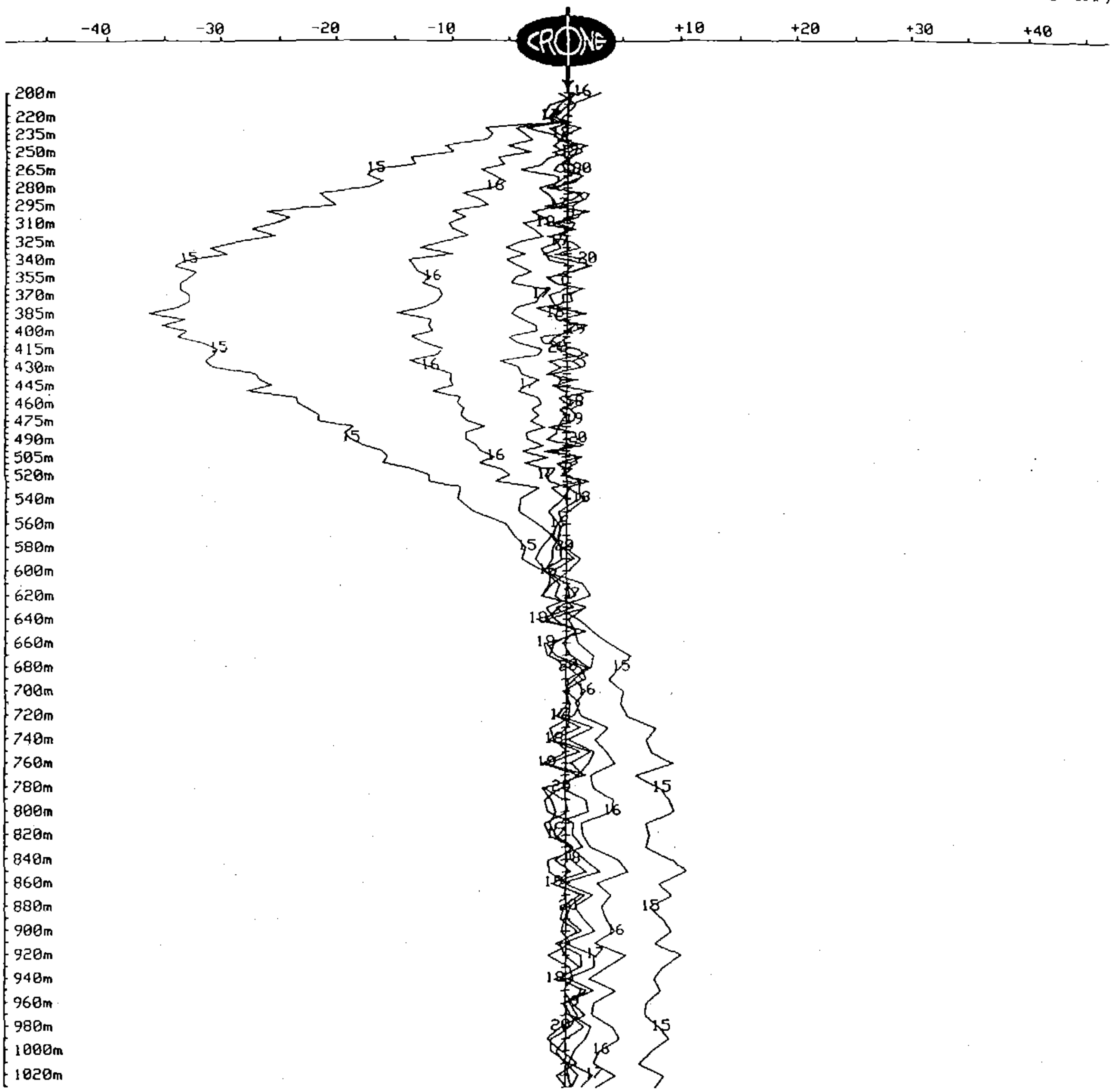
Client : Pasminco Exploration
Grid : Bulgobac Hill
Date : Apr 23, 1995

Hole : BHD6
Tx Loop : Collar
File name : BHD6CZ.PEM

Z COMPONENT dBz/dt nanoTesla/sec - 20 channels

Scale: 1:5000

Unit Scale: 1cm = 5 nT/



5 cm

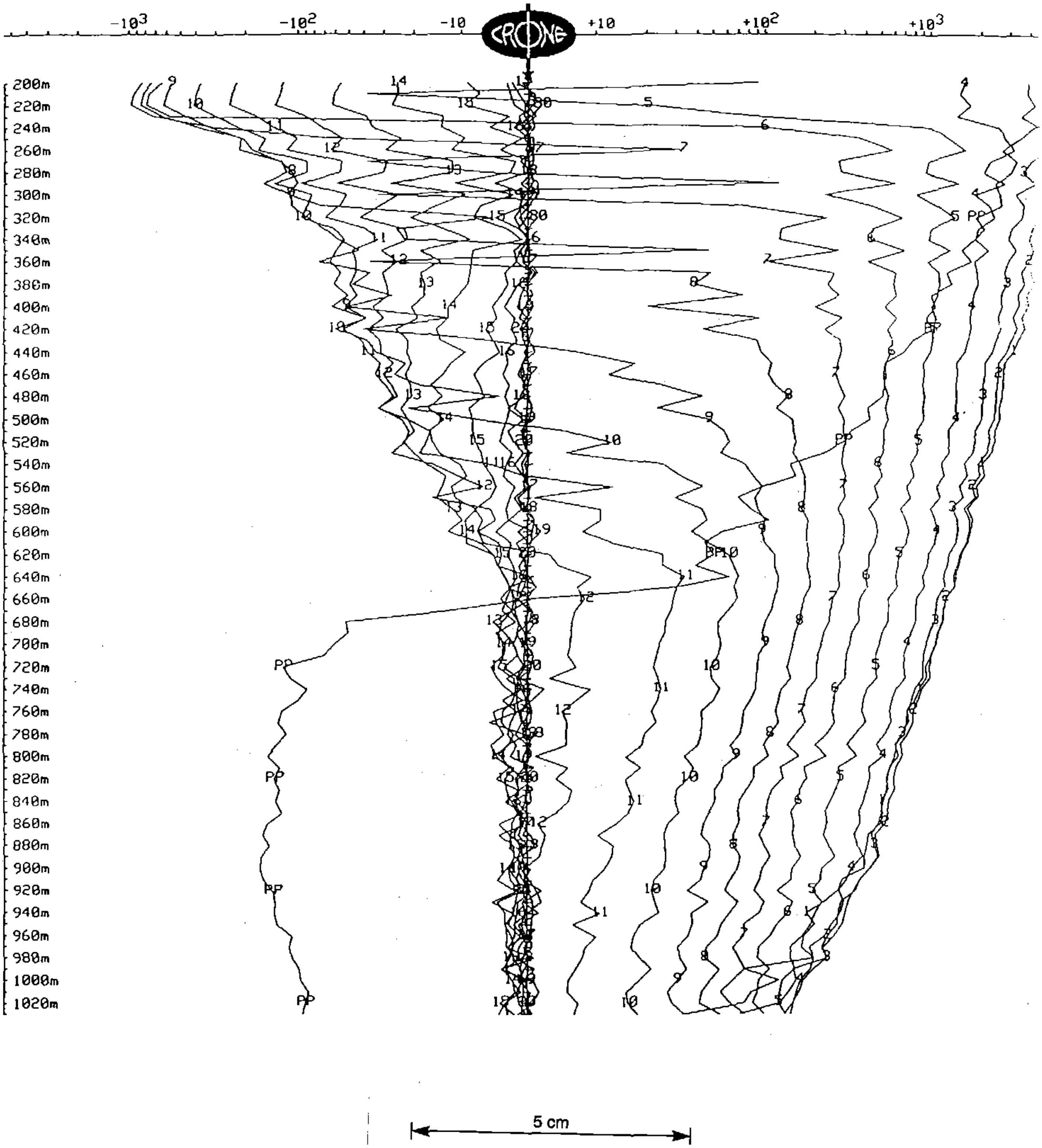
OUTER-RIM EXPLORATION SERVICES
Operating Crone PEM System
BOREHOLE PEM

770105

Client	: Pasminco Exploration	Hole	: BHD6
Grid	: Bulgobac Hill	Tx Loop	: Collar
Date	: Apr 23, 1995	File name	: BHD6CXY.PEM

Data Corrected for Probe Rotation using Orientation Tool #2
X COMPONENT dBx/dt nanoTesla/sec - 20 channels and PP

Scale: 1:5000



PAS1185b

OUTER-RIM EXPLORATION SERVICES
Operating Crone PEM System
BOREHOLE PEM

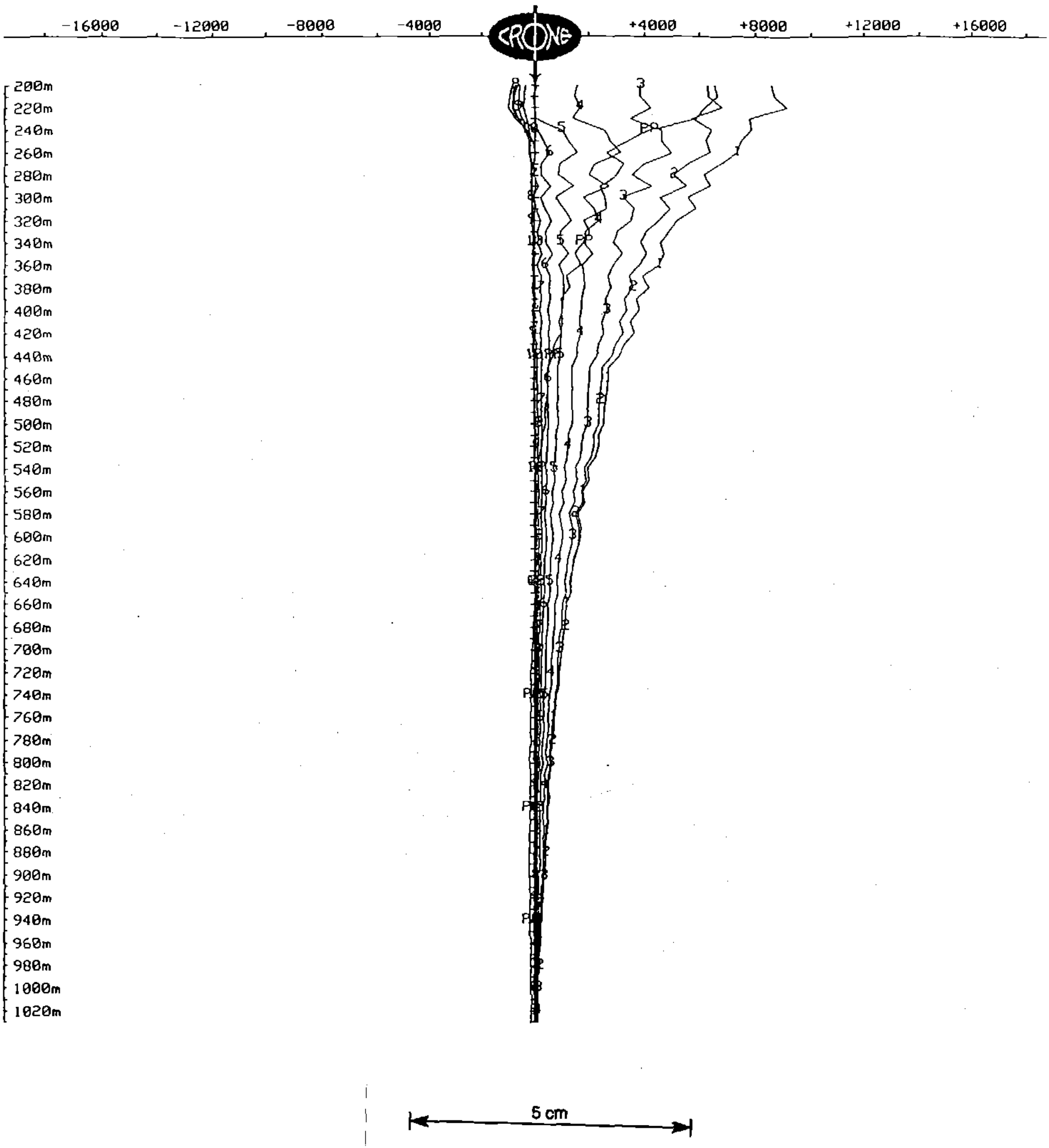
770106

Client : Pasminco Exploration
Grid : Bulgobac Hill
Date : Apr 23, 1995

Hole : BHD6
Tx Loop : Collar
File name : BHD6CXY.PEM

Data Corrected for Probe Rotation using Orientation Tool #2
X COMPONENT dBx/dt nanoTesla/sec - 20 channels and PP

Scale: 1:5000 Unit Scale: 1cm = 2000 nT



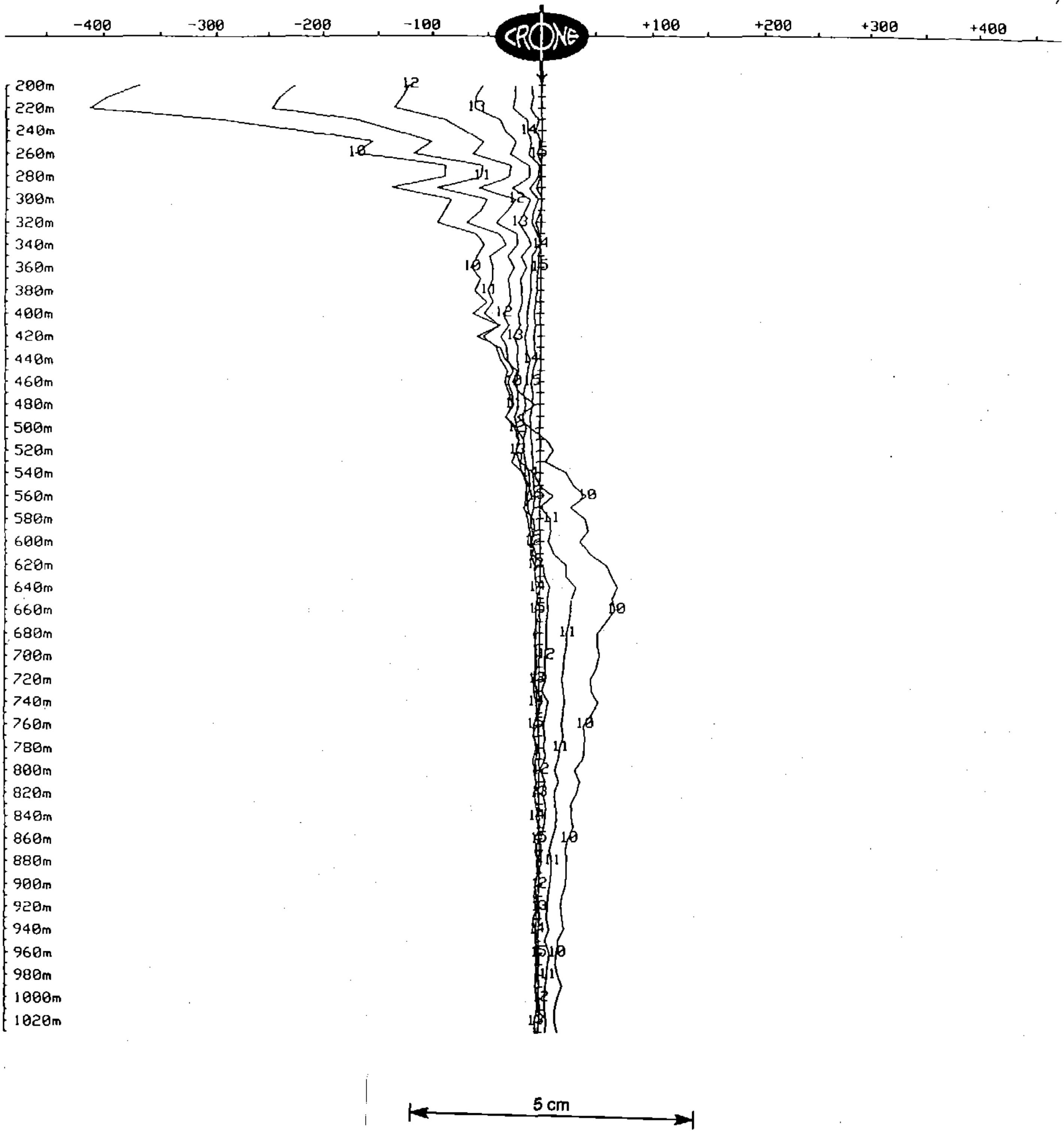
OUTER-RIM EXPLORATION SERVICES
Operating Crone PEM System
BOREHOLE PEM

770107

Client	: Pasminco Exploration	Hole	: BHD6
Grid	: Bulgobac Hill	Tx Loop	: Collar
Date	: Apr 23, 1995	File name	: BHD6CXY.PEM

Data Corrected for Probe Rotation using Orientation Tool #2
X COMPONENT dBx/dt nanoTesla/sec - 20 channels

Scale: 1:5000 Unit Scale: 1cm = 50 nT/



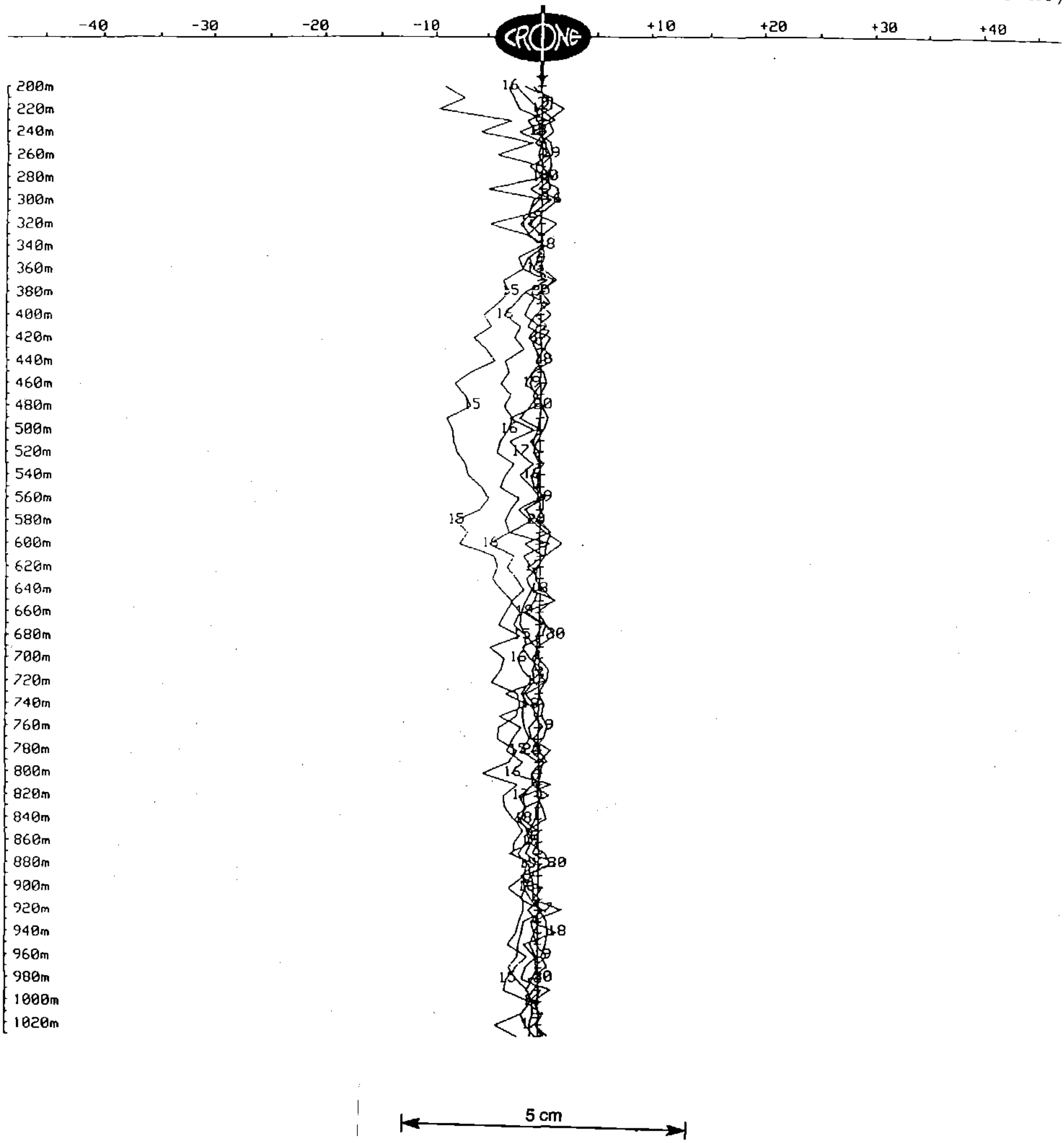
OUTER-RIM EXPLORATION SERVICES
Operating Crone PEM System
BOREHOLE PEM

770108

Client	: Pasminco Exploration	Hole	: BHD6
Grid	: Bulgobac Hill	Tx Loop	: Collar
Date	: Apr 23, 1995	File name	: BHD6CXY.PEM

Data Corrected for Probe Rotation using Orientation Tool #2
X COMPONENT dBx/dt nanoTesla/sec - 20 channels

Scale: 1:5000 Unit Scale: 1cm = 5 nT



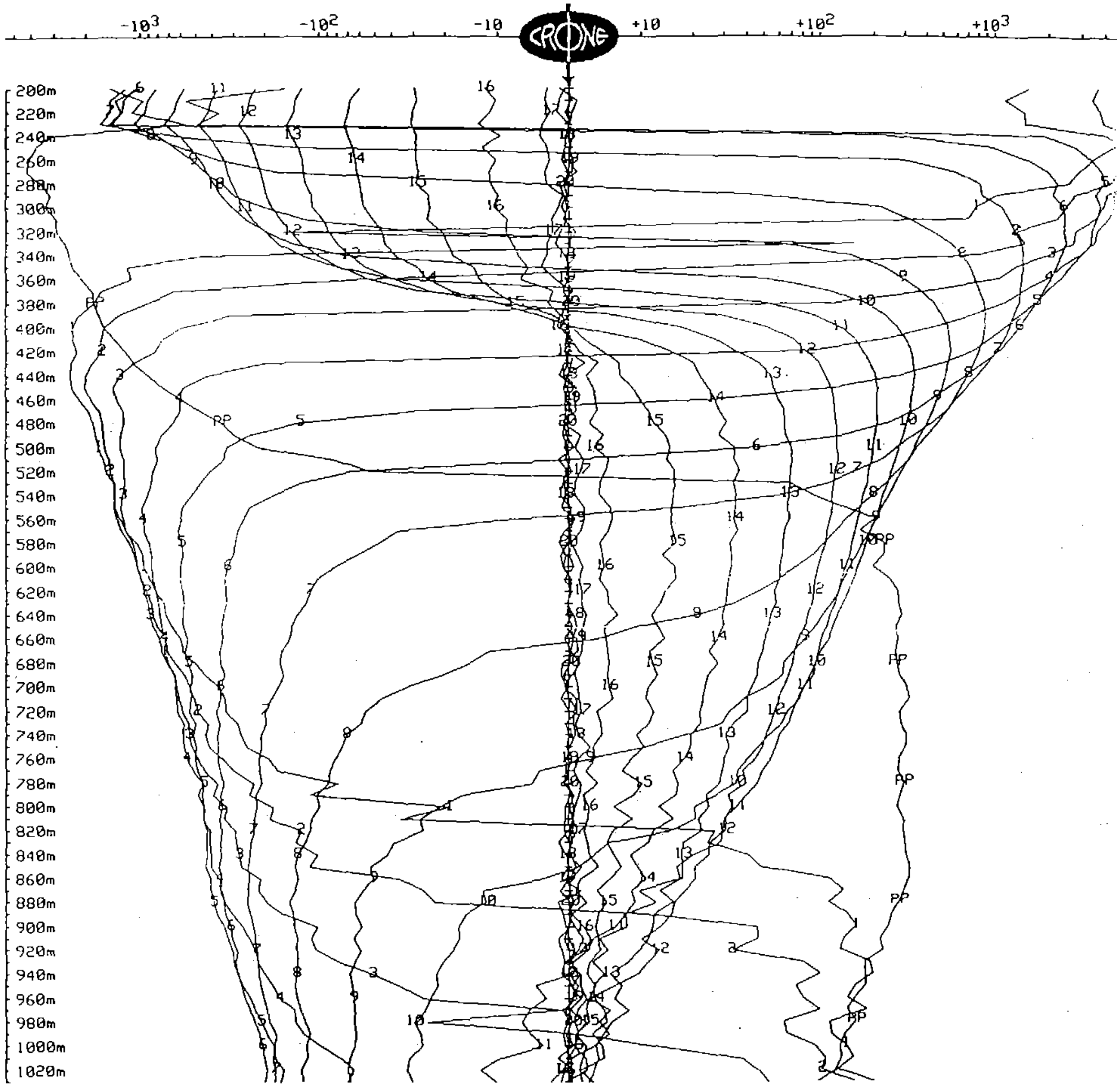
OUTER-RIM EXPLORATION SERVICES
Operating Crone PEM System
BOREHOLE PEM

770109

Client	: Pasminco Exploration	Hole	: BHD6
Grid	: Bulgobac Hill	Tx Loop	: Collar
Date	: Apr 23, 1995	File name	: BHD6CXY.PEM

Data Corrected for Probe Rotation using Orientation Tool #2
Y COMPONENT dBy/dt nanoTesla/sec - 20 channels and PP

Scale: 1:5000



5 cm

PAS1185c

OUTER-RIM EXPLORATION SERVICES
Operating Crone PEM System
BOREHOLE PEM

770110

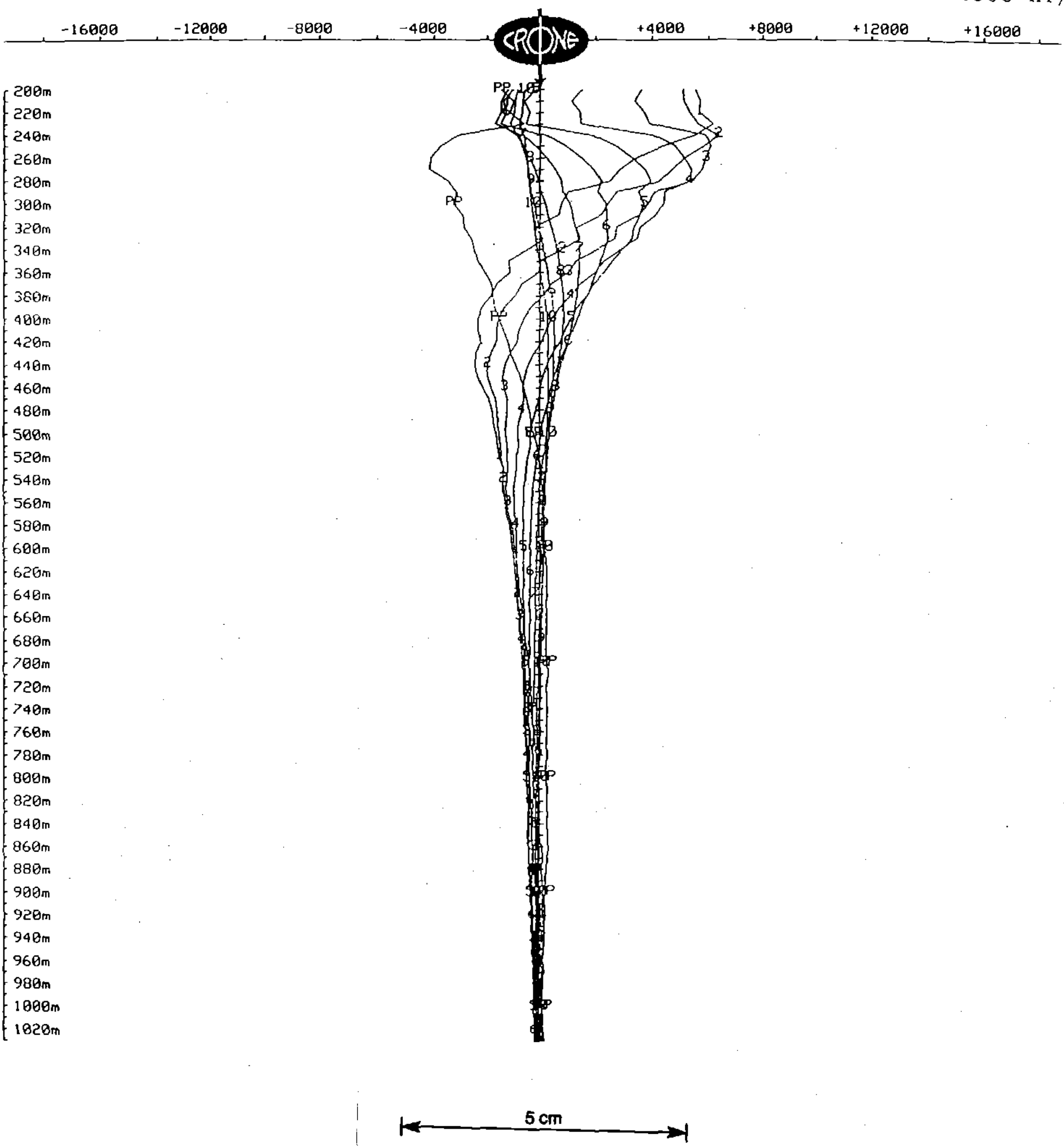
Client : Pasminco Exploration
Grid : Bulgobac Hill
Date : Apr 23, 1995

Hole : BHD6
Tx Loop : Collar
File name : BHD6CXY.PEM

Data Corrected for Probe Rotation using Orientation Tool #2
Y COMPONENT dBy/dt nanoTesla/sec - 20 channels and PP

Scale: 1:5000

Unit Scale: 1cm = 2000 nT,



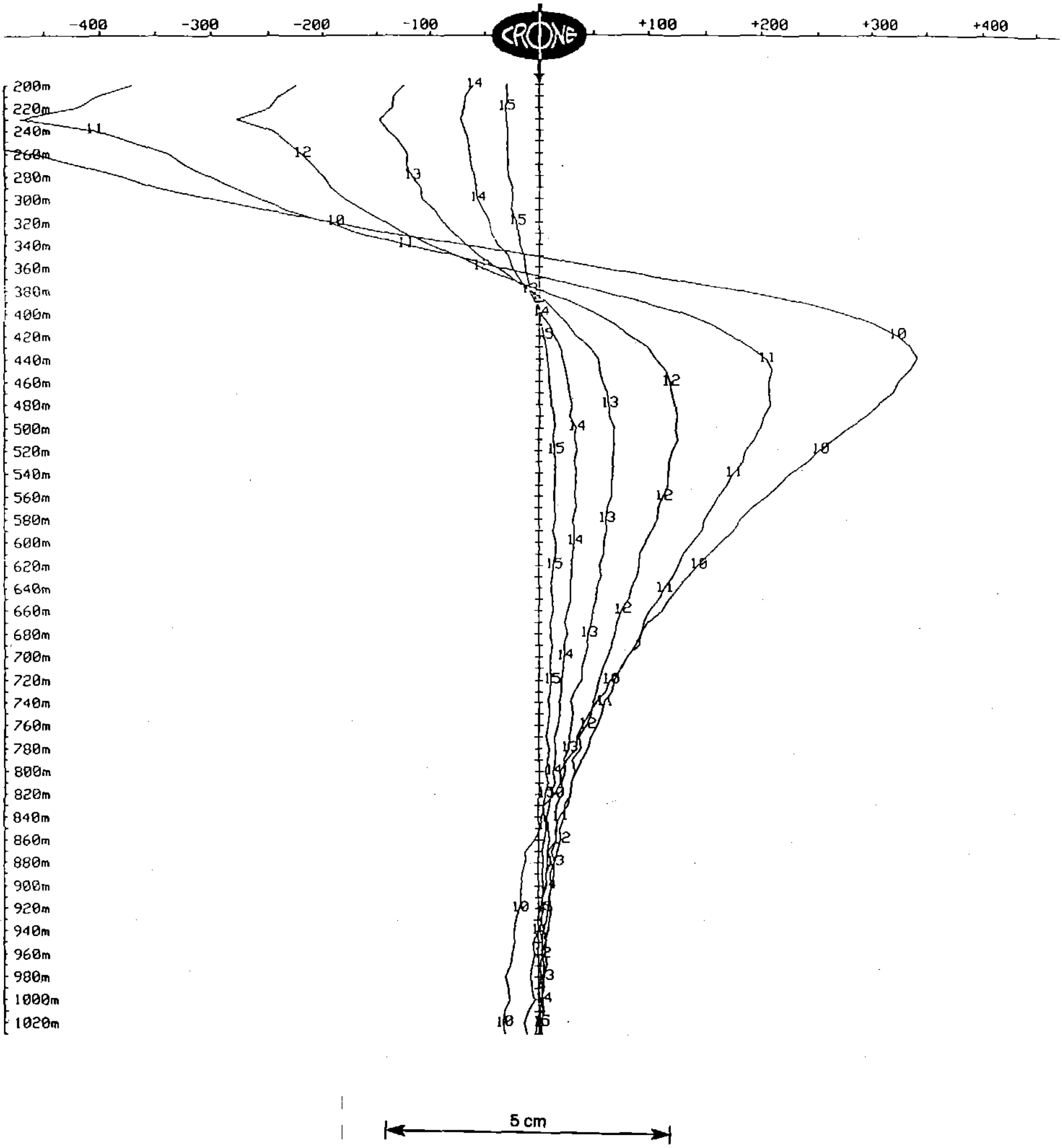
OUTER-RIM EXPLORATION SERVICES
Operating Crone PEM System
BOREHOLE PEM

770111

Client	: Pasminco Exploration	Hole	: BHD6
Grid	: Bulgobac Hill	Tx Loop	: Collar
Date	: Apr 23, 1995	File name	: BHD6CXY.PEM

Data Corrected for Probe Rotation using Orientation Tool #2
Y COMPONENT dBy/dt nanoTesla/sec - 20 channels

Scale: 1:5000 Unit Scale: 1cm = 50 nT/



OUTER-RIM EXPLORATION SERVICES
Operating Crone PEM System
BOREHOLE PEM

770112

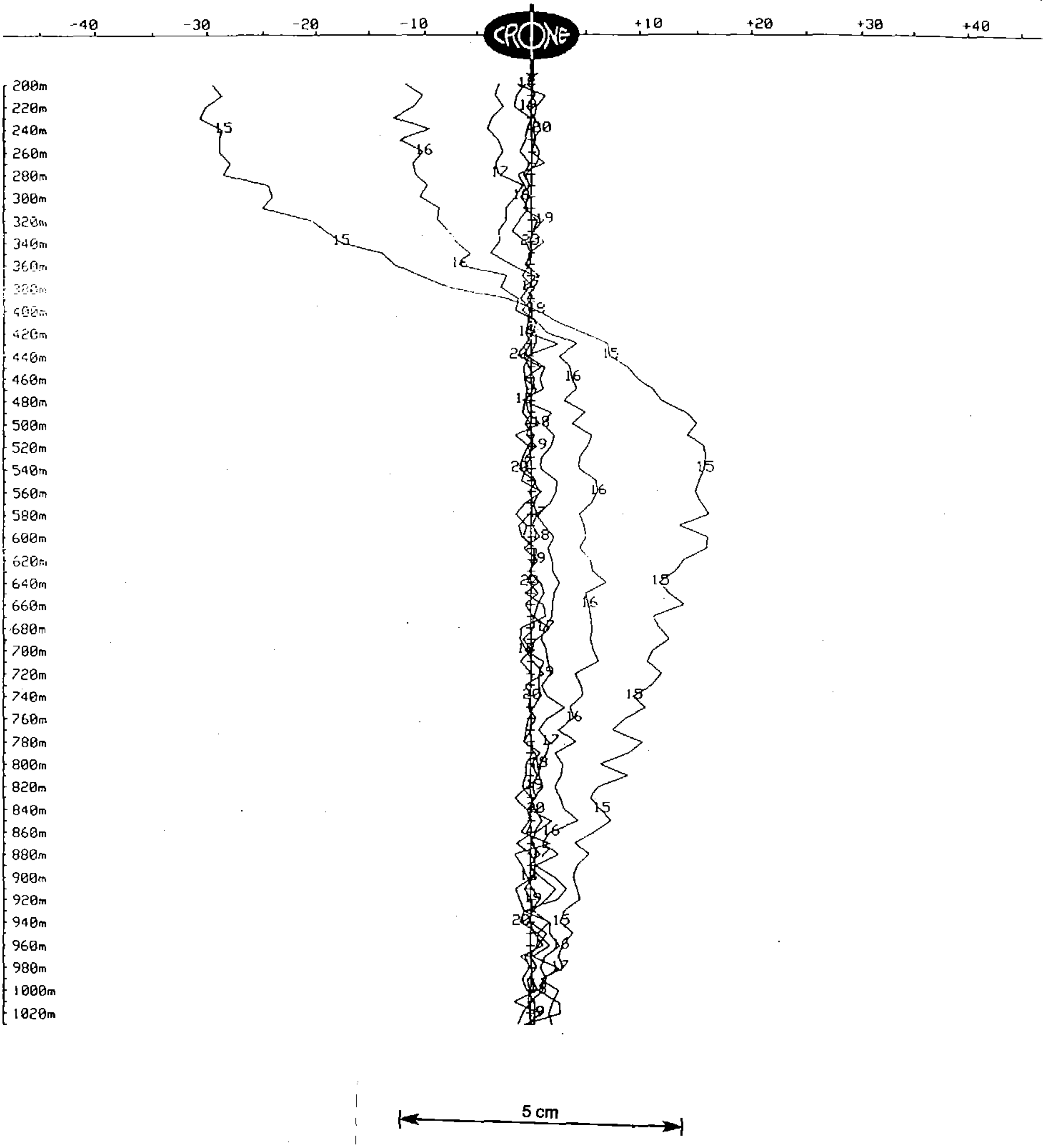
Client : Pasminco Exploration
Grid : Bulgobac Hill
Date : Apr 23, 1995

Hole : BHD6
Tx Loop : Collar
File name : BHD6CXY.PEM

Data Corrected for Probe Rotation using Orientation Tool #2
Y COMPONENT dBy/dt nanoTesla/sec - 20 channels

Scale: 1:5000

Unit Scale: 1cm = 5 nT/



OUTER-RIM EXPLORATION SERVICES
Operating Crone PEM System
BOREHOLE PEM

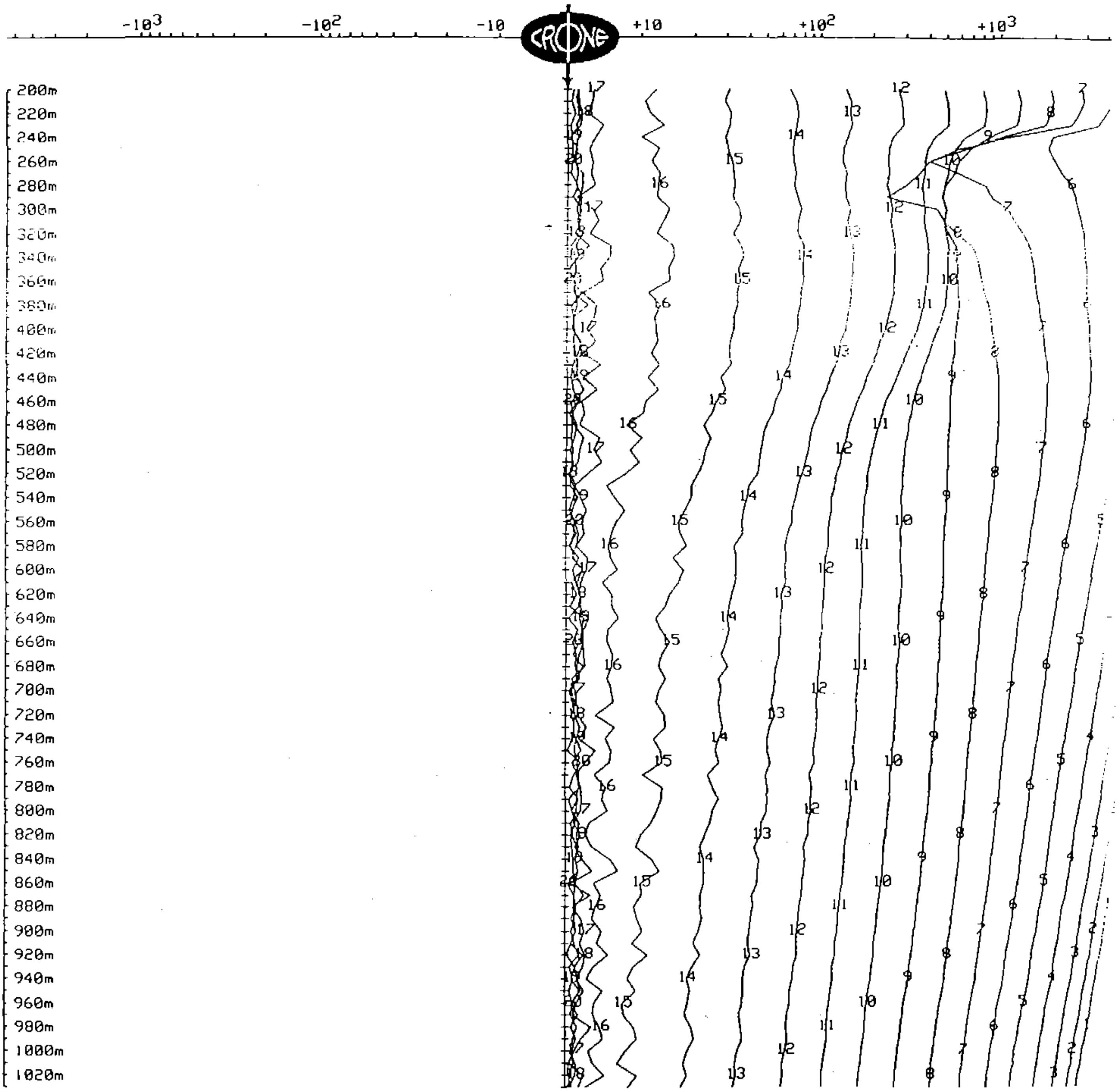
770113

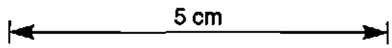
Client : Pasminco Exploration
Grid : Bulgobac Hill
Date : Apr 23, 1995

Hole : BHD6
Tx Loop : Collar
File name : BHD6CXYZ.PEM

Data Corrected for Probe Rotation using Orientation Tool #2
TOTAL FIELD dBxyz/dt nanoTesla/sec - 20 channels

Scale: 1:5000





PAS1185d

OUTER-RIM EXPLORATION SERVICES
Operating Crone PEM System
BOREHOLE PEM

770114

Client	: Pasminco Exploration	Hole	: BHD6
Grid	: Bulgobac Hill	Tx Loop	: West
Date	: Apr 18, 1995	File name	: BHD6WZ.PEM
Time Base	: 20.00 ms	# Readings	: 112
Ramp Time	: 0.50 ms	Stn Units	: Metric
# Channels	: 20	Coil Area	: 6500 sq m
Sync Type	: Cable	Polarity	: +
Loop Size	: 900m X 1000m	Receiver	: Digital #108
Current	: 8 Amps	Operator	: Kent Honner

Loop Coordinates (X,Y,Z)

1. 7880m, 2200m, 0m
2. 8400m, 2820m, 0m
3. 7750m, 3380m, 0m
4. 7160m, 2750m, 0m

Hole Coordinates (X,Y,Z) or (Azimuth,Dip,Length)

1. 7999m, 2523m, 0m
2. 132deg, 80deg, 15m
3. 126deg, 80.7deg, 31m
4. 130deg, 81deg, 30m
5. 132deg, 80.5deg, 33m
6. 137deg, 80.7deg, 33m
7. 133deg, 80deg, 30m
8. 137deg, 80.5deg, 30m
9. 135deg, 80.2deg, 30m
10. 143deg, 80deg, 32m
11. 145deg, 80.2deg, 31m
12. 147deg, 80.5deg, 30m
13. 150deg, 80deg, 27m
14. 151.5deg, 81deg, 31m
15. 153deg, 79.7deg, 35m
16. 154.5deg, 79.7deg, 45m
17. 153deg, 78.5deg, 47m
18. 151.5deg, 78.2deg, 32m
19. 149.5deg, 77.3deg, 34m
20. 151deg, 76deg, 31m
21. 146.7deg, 75.3deg, 32m
22. 144.5deg, 75deg, 32m
23. 145deg, 75deg, 47m
24. 146.5deg, 75.3deg, 46m
25. 146.8deg, 75.4deg, 32m
26. 146deg, 75.2deg, 30m
27. 147deg, 75.8deg, 30m
28. 149deg, 75.8deg, 32m
29. 149.3deg, 76deg, 31m
30. 151deg, 76.5deg, 30m
31. 151.8deg, 76.5deg, 31m
32. 155deg, 77deg, 34m
33. 153deg, 77.5deg, 22m

Channel Times (usec)

Ch	Start	End	Center	Ch	Start	End	Center	Ch	Start	End	Center
PP	-198	-99	-149	1	76	104	90	2	104	131	117
3	131	171	151	4	171	225	198	5	225	292	259
6	292	378	335	7	378	490	434	8	490	639	565
9	639	828	733	10	828	1075	952	11	1075	1395	1235
12	1395	1809	1602	13	1809	2348	2078	14	2348	3046	2697
15	3046	3951	3498	16	3951	5121	4536	17	5121	6646	5884
18	6646	8617	7632	19	8617	11170	9894	20	11170	14490	12830

General Comments

Doubled-up loop to bring overall resistance to approx. 15.0 Ohm.

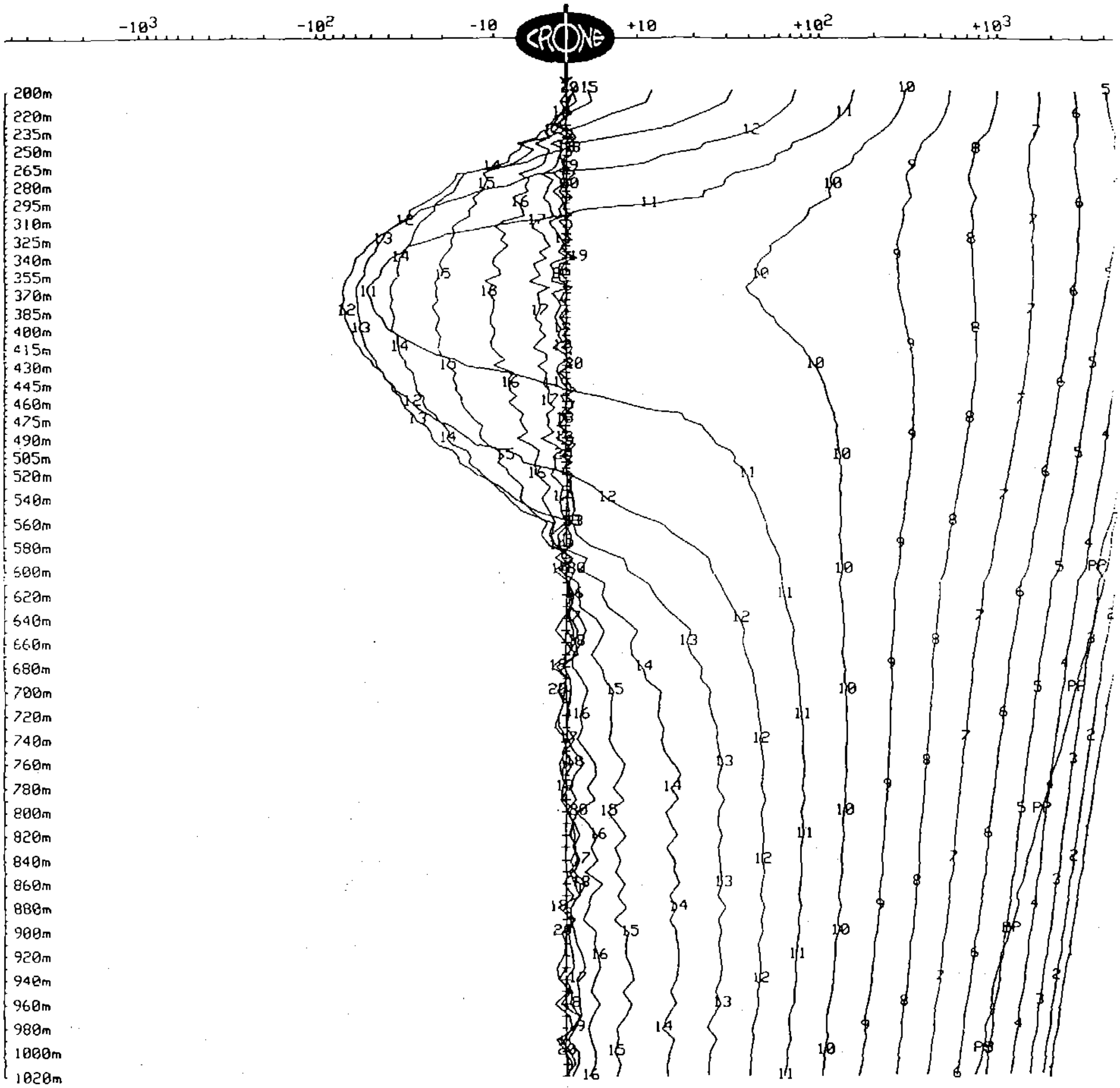
OUTER-RIM EXPLORATION SERVICES
Operating Crone PEM System
BOREHOLE PEM

770115

Client	:	Pasminco Exploration	Hole	:	BHD6
Grid	:	Bulgobac Hill	Tx Loop	:	West
Date	:	Apr 18, 1995	File name	:	BHD6WZ.PEM

Z COMPONENT dBz/dt nanoTesla/sec - 20 channels and PP

Scale: 1:5000



5 cm

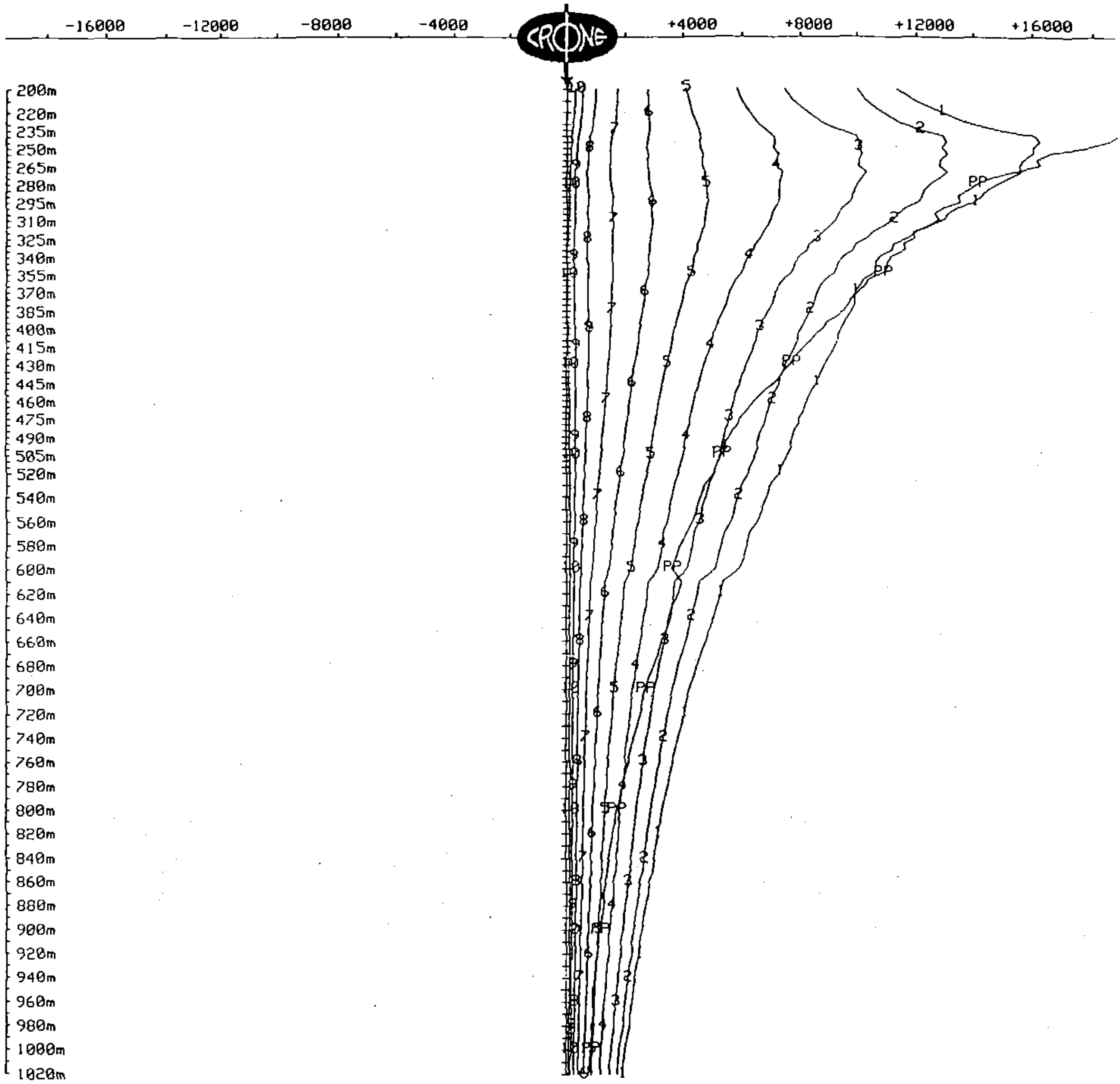
OUTER-RIM EXPLORATION SERVICES
Operating Crone PEM System
BOREHOLE PEM

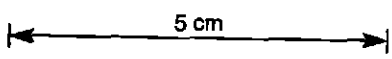
770116

Client	: Pasminco Exploration	Hole	: BHD6
Grid	: Bulgobac Hill	Tx Loop	: West
Date	: Apr 18, 1995	File name	: BHD6WZ.PEM

Z COMPONENT dBz/dt nanoTesla/sec - 20 channels and PP

Scale: 1:5000 Unit Scale: 1cm = 2000 nT/





OUTER-RIM EXPLORATION SERVICES
Operating Crone PEM System
BOREHOLE PEM

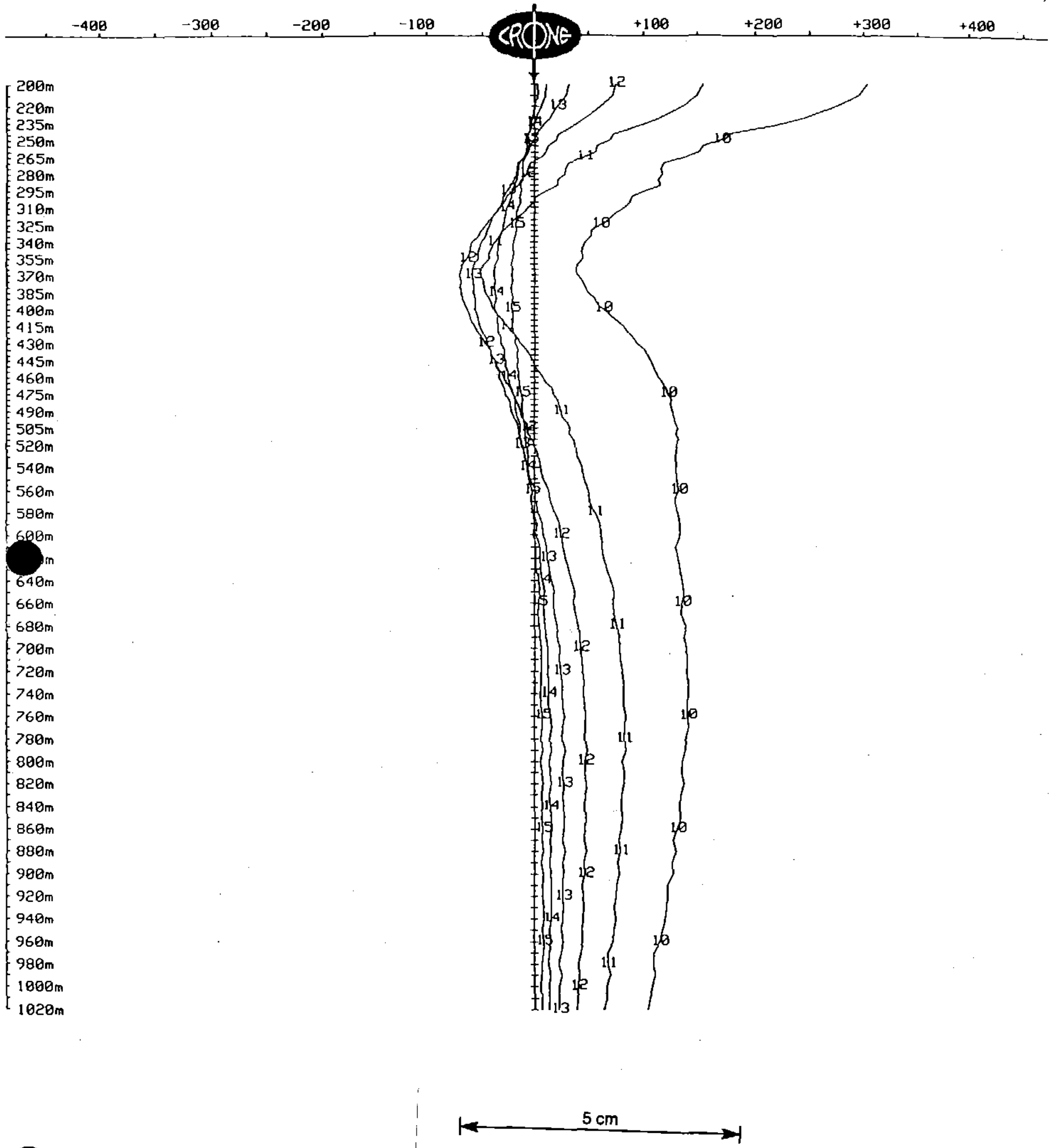
770117

Client	: Pasminco Exploration	Hole	: BHD6
Grid	: Bulgobac Hill	Tx Loop	: West
Date	: Apr 18, 1995	File name	: BHD6WZ.PEM

Z COMPONENT dBz/dt nanoTesla/sec - 20 channels

Scale: 1:5000

Unit Scale: 1cm = 50 nT/



OUTER-RIM EXPLORATION SERVICES
Operating Crone PEM System
BOREHOLE PEM

770118

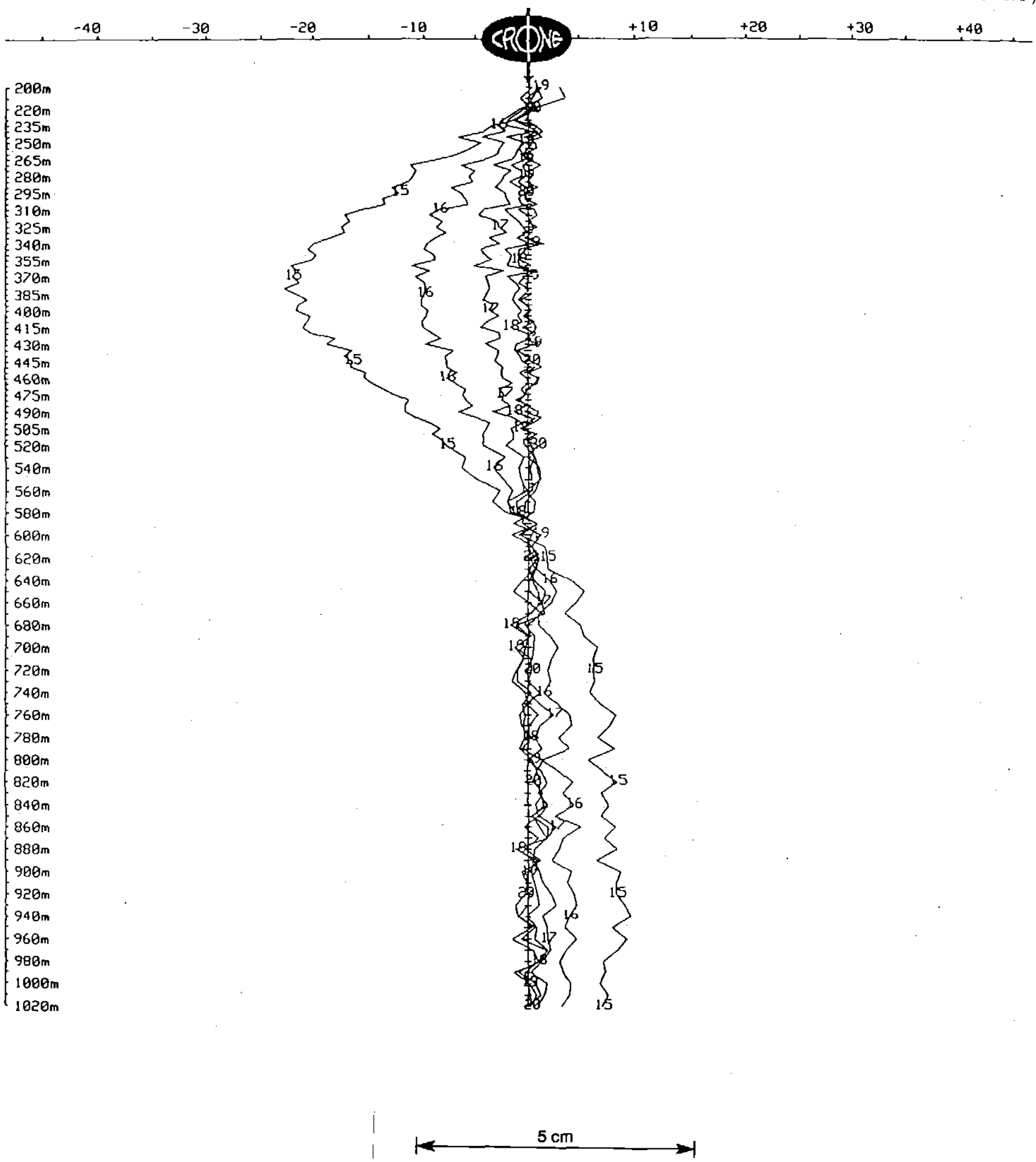
Client : Pasminco Exploration
Grid : Bulgobac Hill
Date : Apr 18, 1995

Hole : BHD6
Tx Loop : West
File name : BHD6WZ.PEM

Z COMPONENT dBz/dt nanoTesla/sec - 20 channels

Scale: 1:5000

Unit Scale: 1cm = 5 nT/



OUTER-RIM EXPLORATION SERVICES
Operating Crone PEM System
BOREHOLE PEM

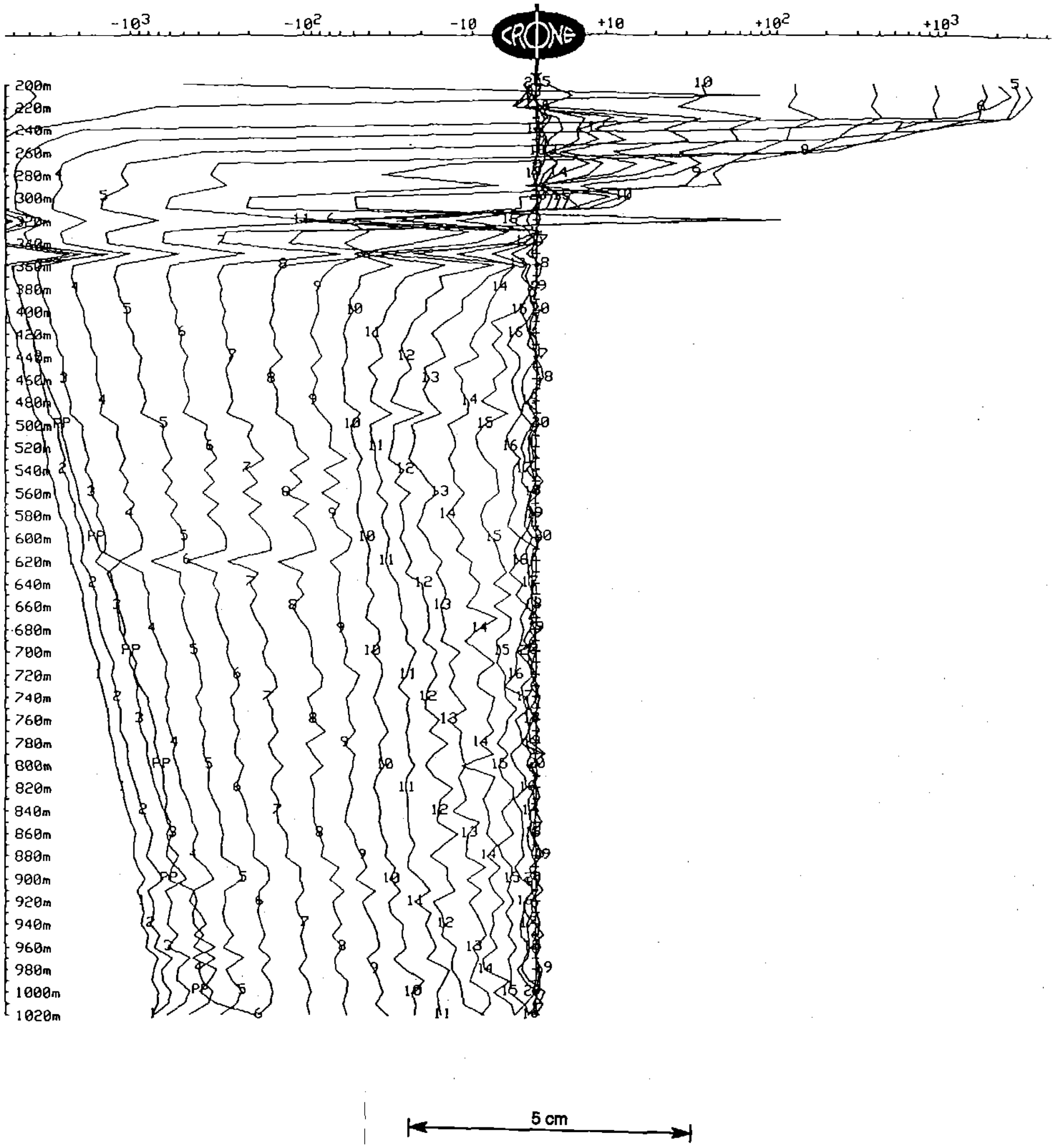
770119

Client : Pasminco Exploration
Grid : Bulgobac Hill
Date : Apr 19, 1995

Hole : BHD6
Tx Loop : West
File name : BHD6WXY.PEM

Data Corrected for Probe Rotation using Orientation Tool #2
X COMPONENT dBx/dt nanoTesla/sec - 20 channels and PP

Scale: 1:5000



PAS1186b

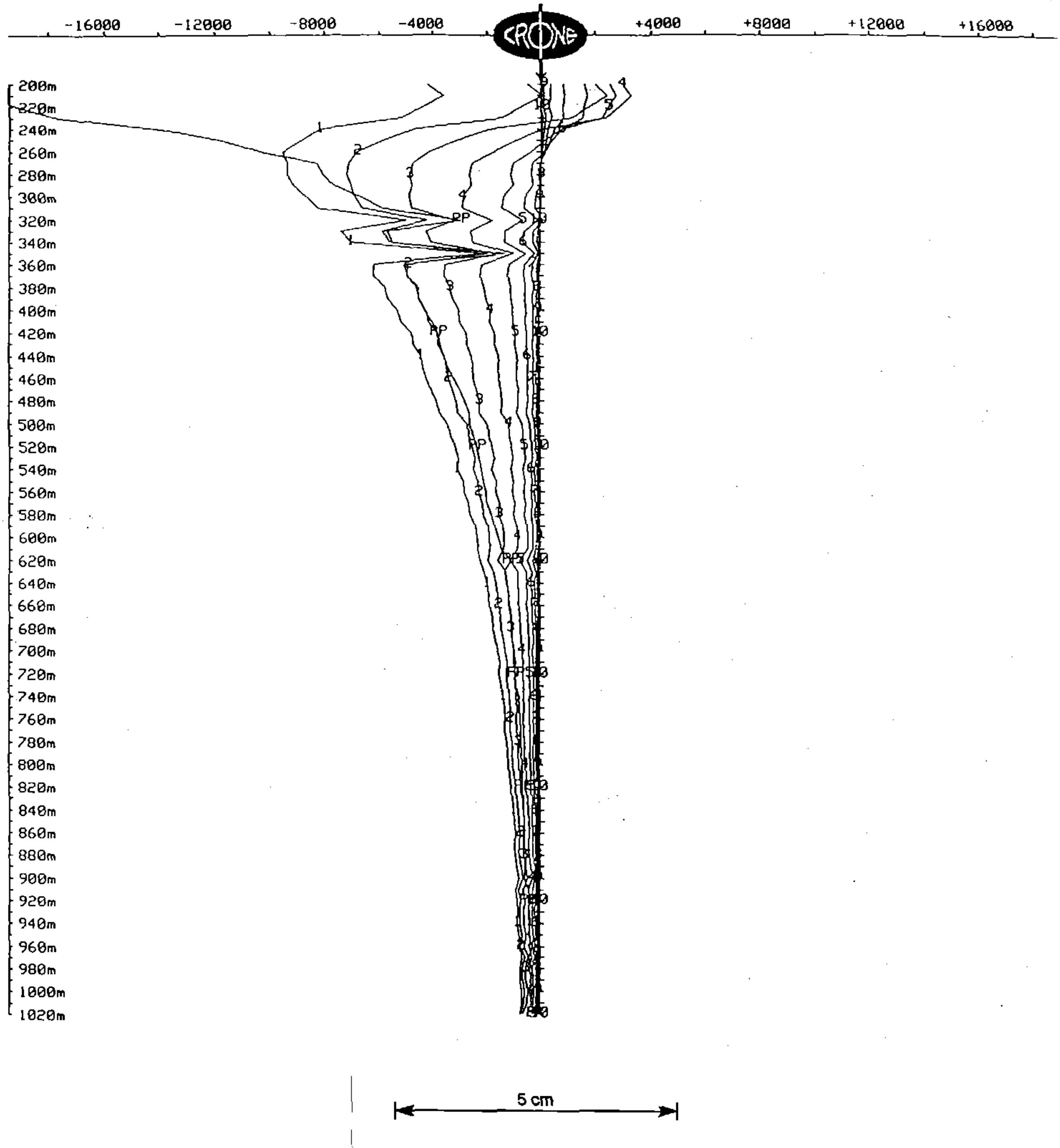
OUTER-RIM EXPLORATION SERVICES
Operating Crone PEM System
BOREHOLE PEM

770120

Client	: Pasminco Exploration	Hole	: BHD6
Grid	: Bulgobac Hill	Tx Loop	: West
Date	: Apr 19, 1995	File name	: BHD6WXY.PEM

Data Corrected for Probe Rotation using Orientation Tool #2
X COMPONENT dBx/dt nanoTesla/sec - 20 channels and PP

Scale: 1:5000 Unit Scale: 1cm = 2000 nT/



OUTER-RIM EXPLORATION SERVICES
Operating Crone PEM System
BOREHOLE PEM

770121

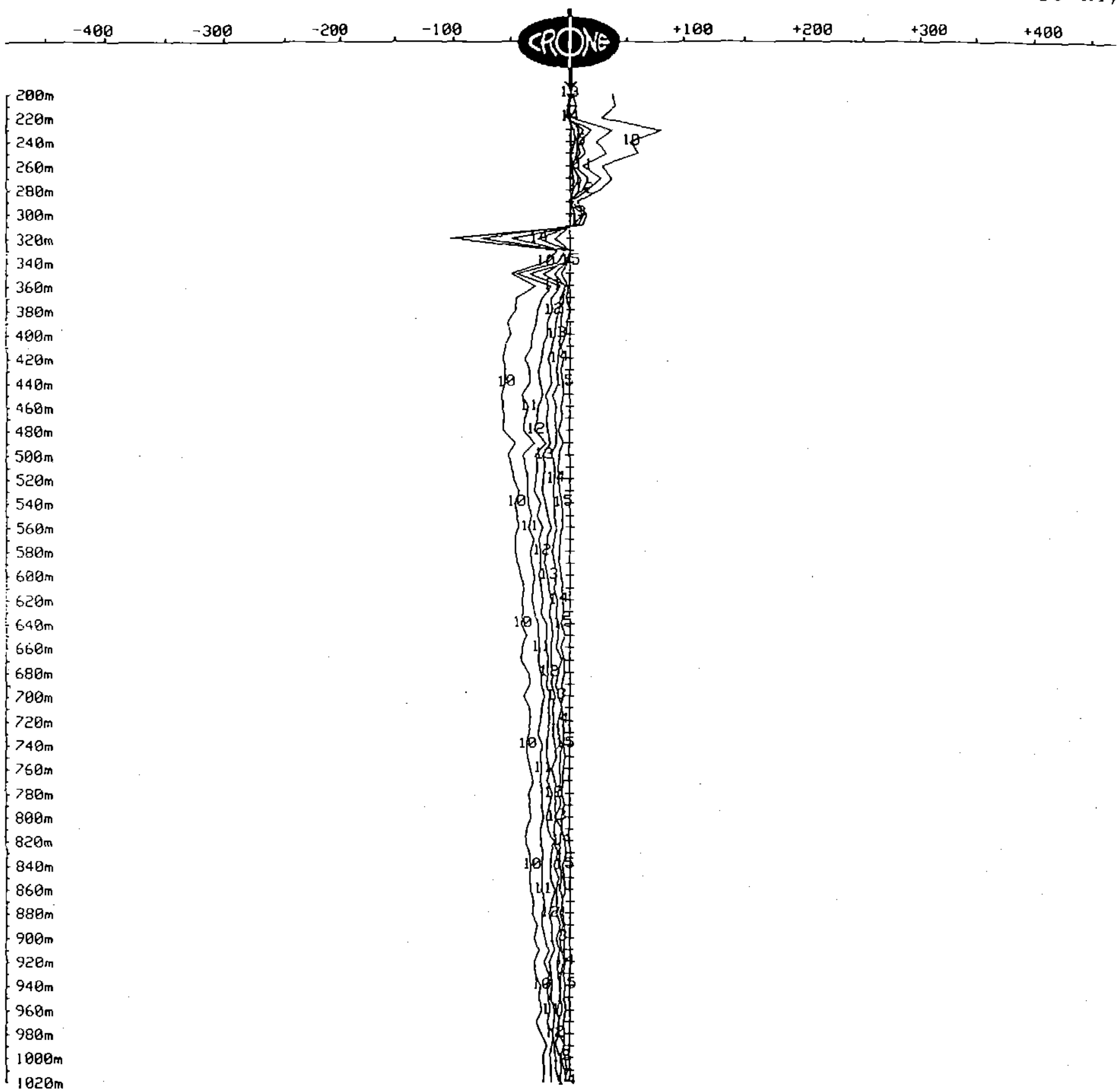
Client : Pasminco Exploration
Grid : Bulgobac Hill
Date : Apr 19, 1995

Hole : BHD6
Tx Loop : West
File name : BHD6WXY.PEM

Data Corrected for Probe Rotation using Orientation Tool #2
X COMPONENT dBx/dt nanoTesla/sec - 20 channels

Scale: 1:5000

Unit Scale: 1cm = 50 nT/



5 cm

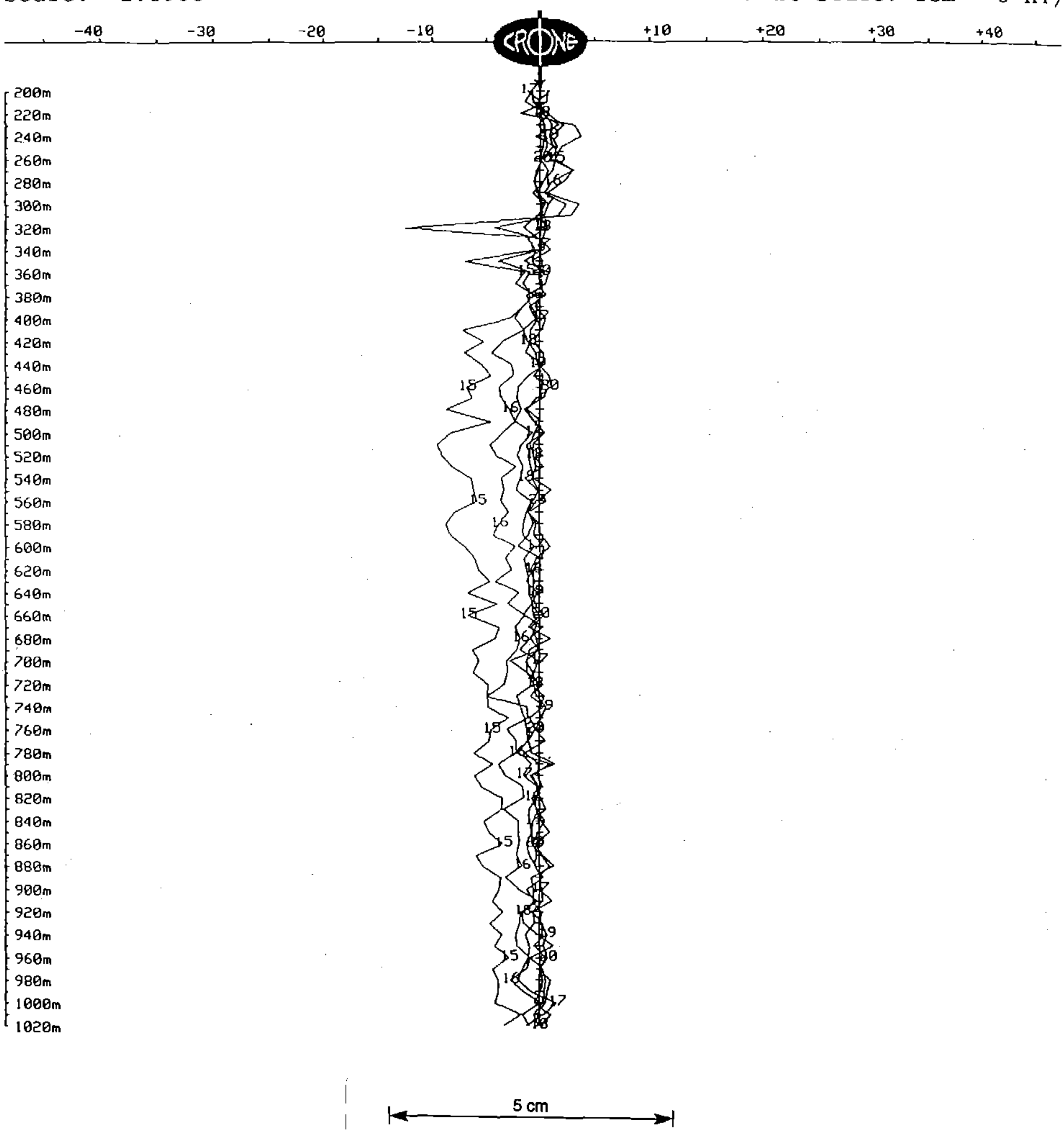
OUTER-RIM EXPLORATION SERVICES
Operating Crone PEM System
BOREHOLE PEM

770122

Client	: Pasminco Exploration	Hole	: BHD6
Grid	: Bulgobac Hill	Tx Loop	: West
Date	: Apr 19, 1995	File name	: BHD6WXY.PEM

Data Corrected for Probe Rotation using Orientation Tool #2
X COMPONENT dBx/dt nanoTesla/sec - 20 channels

Scale: 1:5000 Unit Scale: 1cm = 5 nT/



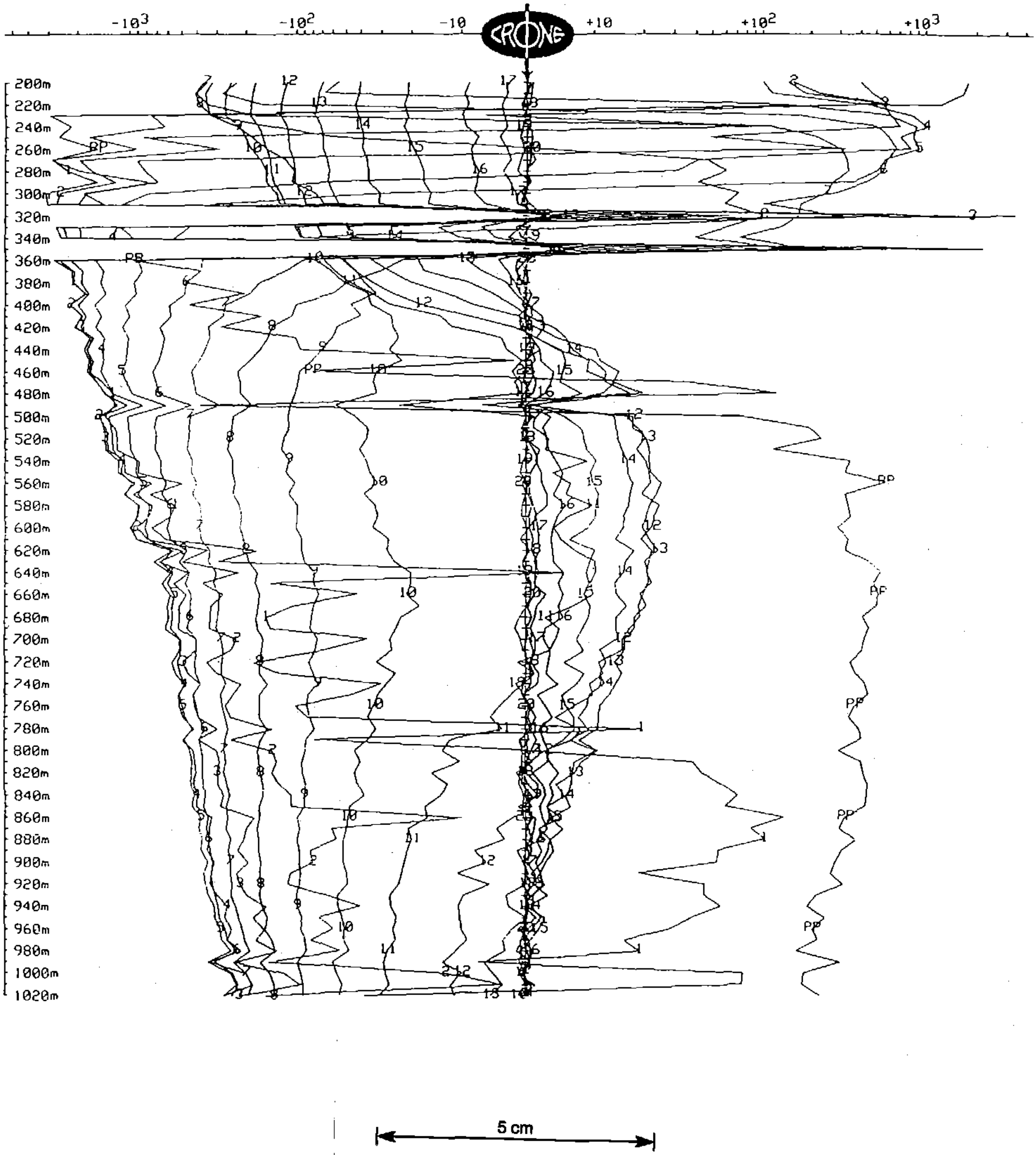
OUTER-RIM EXPLORATION SERVICES
Operating Crone PEM System
BOREHOLE PEM

770123

Client	: Pasminco Exploration	Hole	: BHD6
Grid	: Bulgobac Hill	Tx Loop	: West
Date	: Apr 19, 1995	File name	: BHD6WXY.PEM

Data Corrected for Probe Rotation using Orientation Tool #2
Y COMPONENT dBy/dt nanoTesla/sec - 20 channels and PP

Scale: 1:5000



PAS1186c

OUTER-RIM EXPLORATION SERVICES
Operating Crone PEM System
BOREHOLE PEM

770124

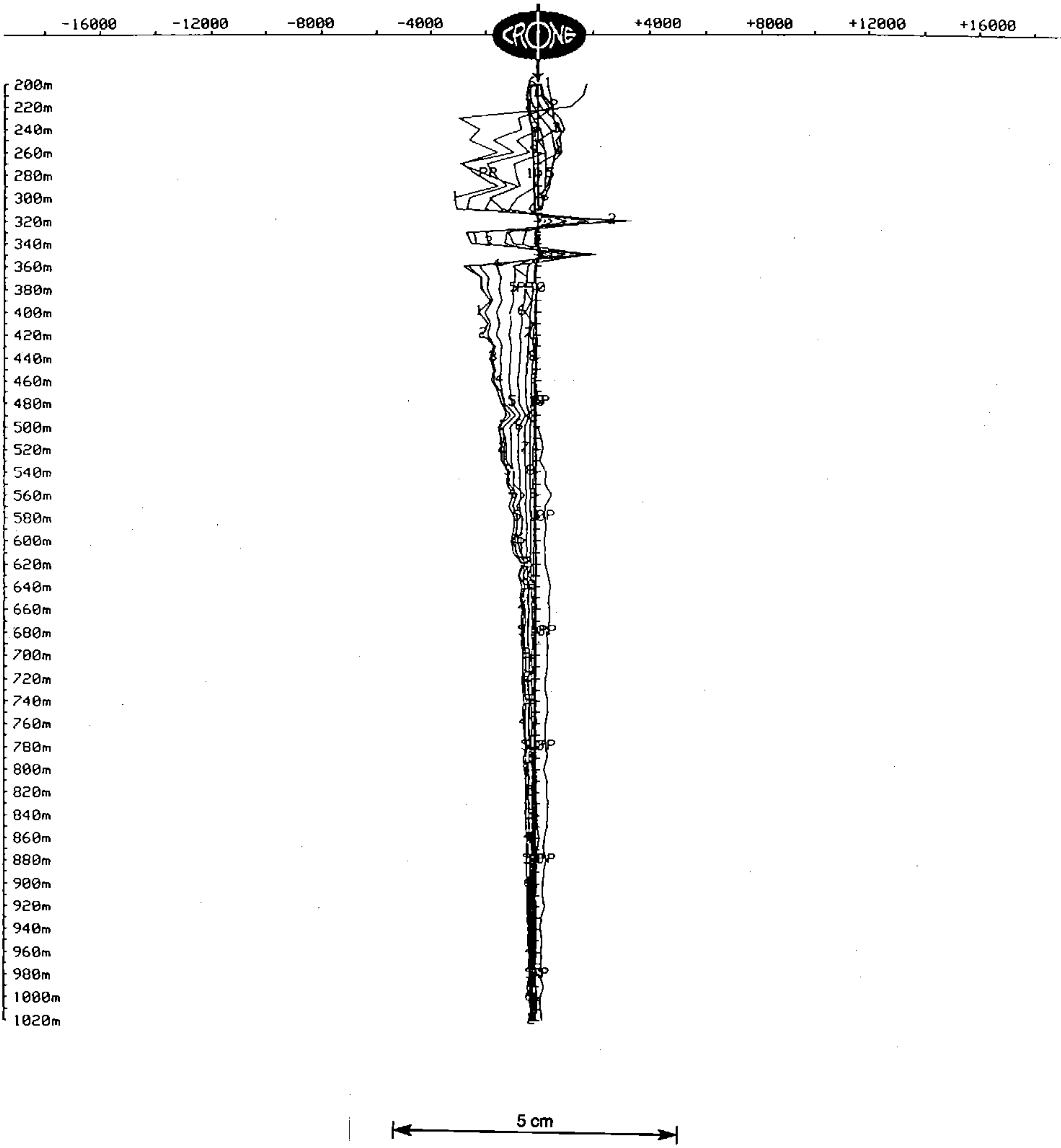
Client : Pasminco Exploration
Grid : Bulgobac Hill
Date : Apr 19, 1995

Hole : BHD6
Tx Loop : West
File name : BHD6WXY.PEM

Data Corrected for Probe Rotation using Orientation Tool #2
Y COMPONENT dBy/dt nanoTesla/sec - 20 channels and PP

Scale: 1:5000

Unit Scale: 1cm = 2000 nT/



OUTER-RIM EXPLORATION SERVICES
Operating Crone PEM System
BOREHOLE PEM

770125

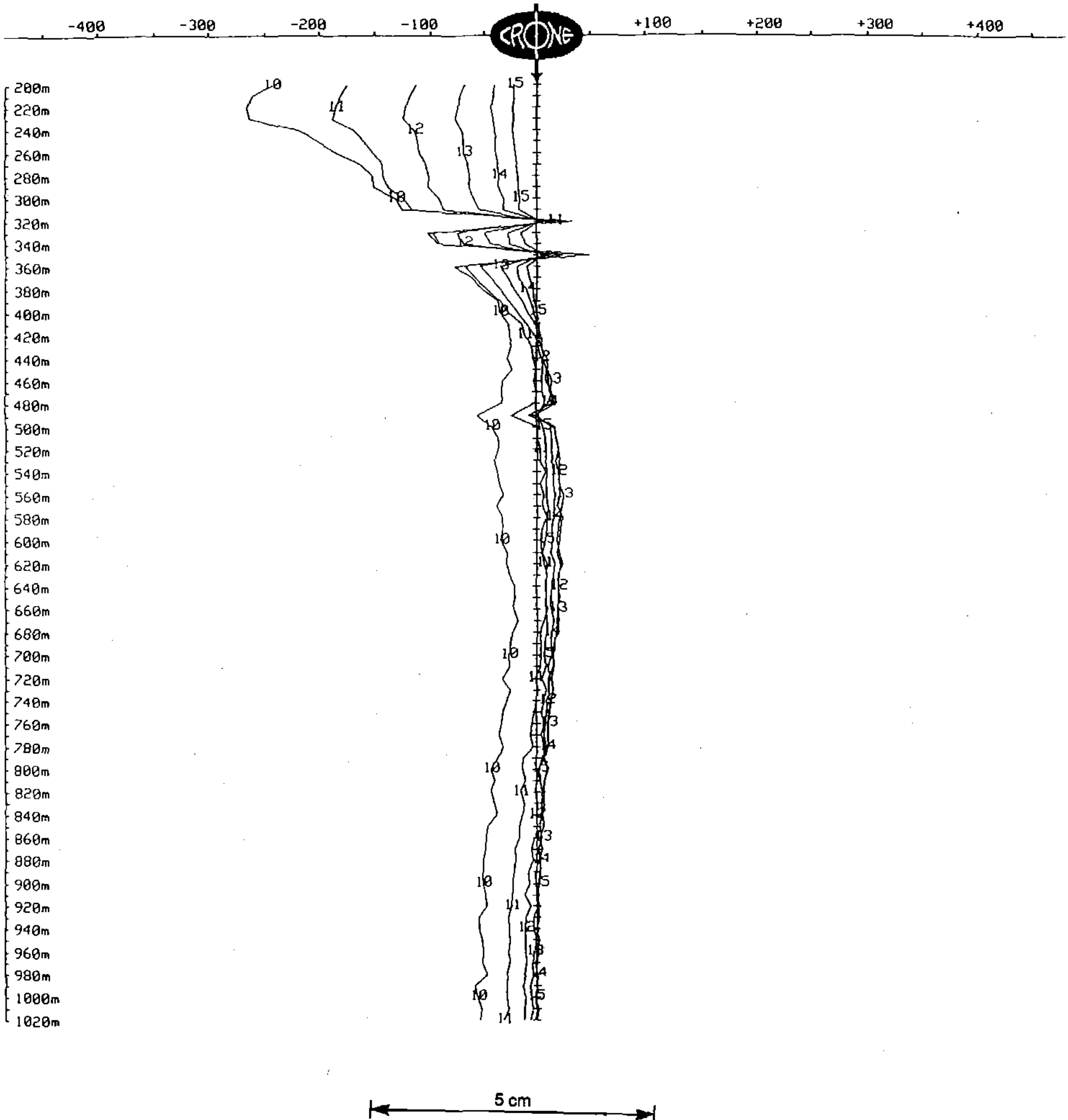
Client : Pasminco Exploration
Grid : Bulgobac Hill
Date : Apr 19, 1995

Hole : BHD6
Tx Loop : West
File name : BHD6WXY.PEM

Data Corrected for Probe Rotation using Orientation Tool #2
Y COMPONENT dBy/dt nanoTesla/sec - 20 channels

Scale: 1:5000

Unit Scale: 1cm = 50 nT/s



OUTER-RIM EXPLORATION SERVICES
Operating Crone PEM System
BOREHOLE PEM

770126

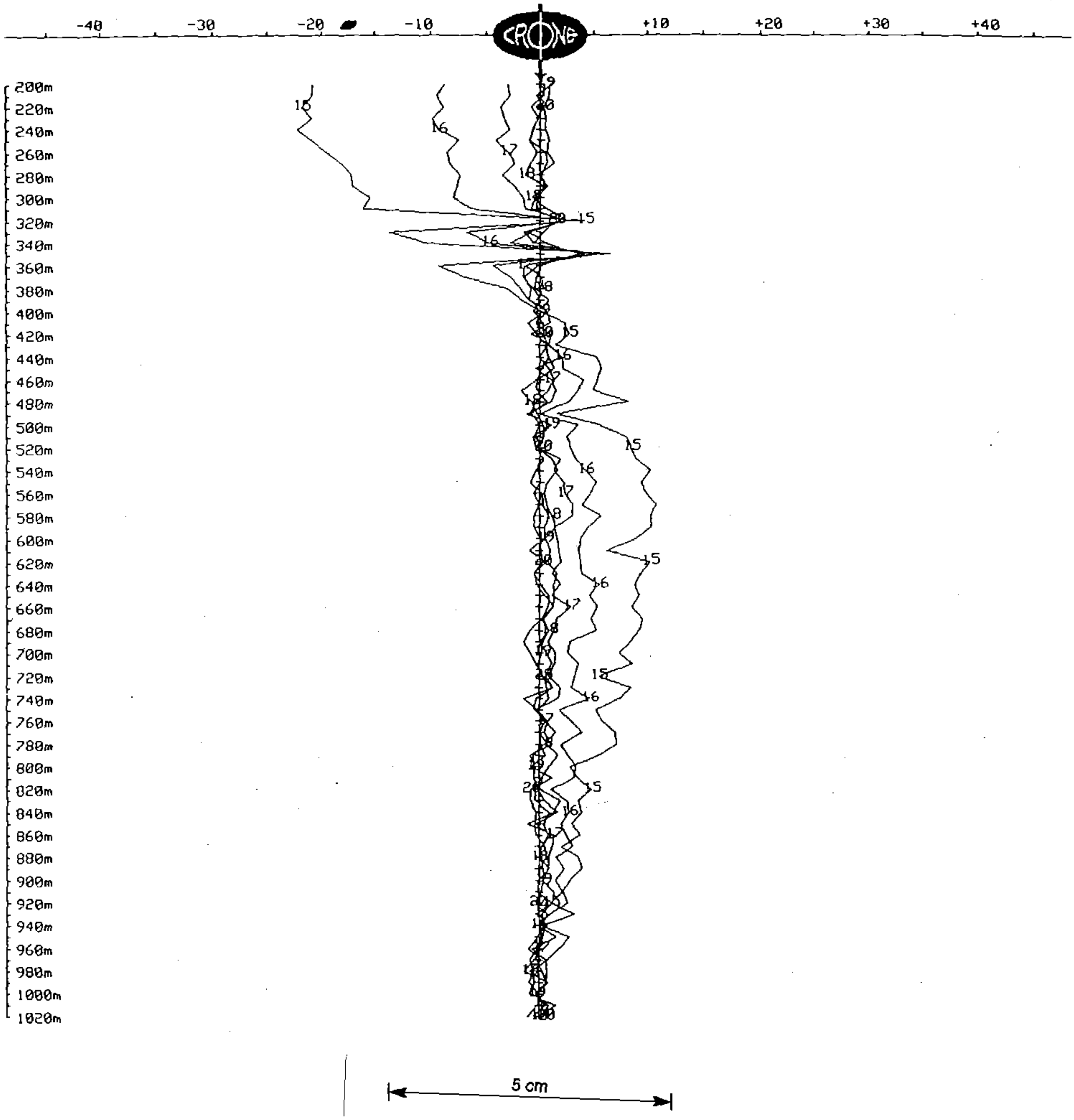
Client : Pasminco Exploration
Grid : Bulgobac Hill
Date : Apr 19, 1995

Hole : BHD6
Tx Loop : West
File name : BHD6WXY.PEM

Data Corrected for Probe Rotation using Orientation Tool #2
Y COMPONENT dBy/dt nanoTesla/sec - 20 channels

Scale: 1:5000

Unit Scale: 1cm = 5 nT/s



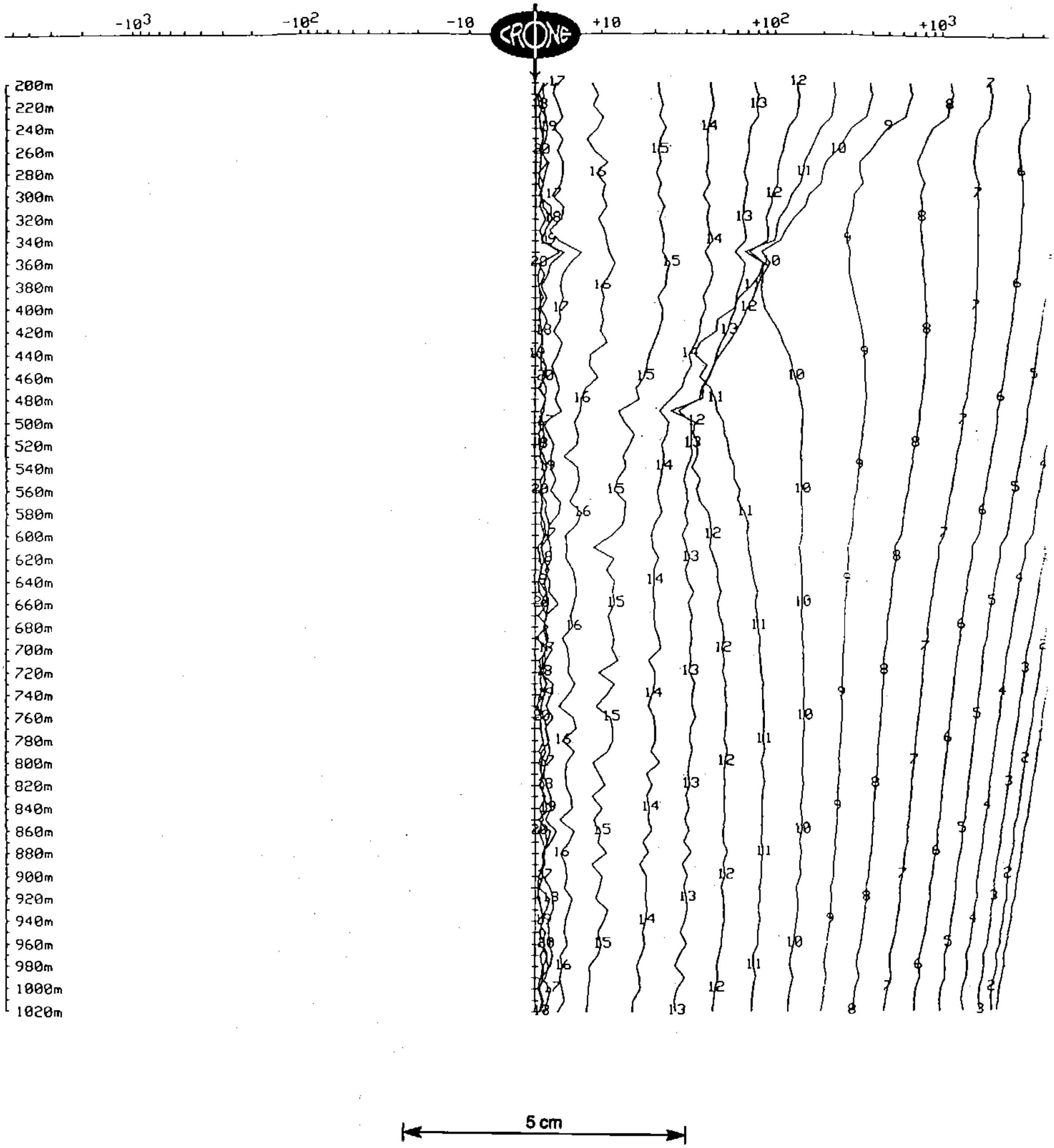
OUTER-RIM EXPLORATION SERVICES
Operating Crone PEM System
BOREHOLE PEM

770127

Client	: Pasminco Exploration	Hole	: BHD6
Grid	: Bulgobac Hill	Tx Loop	: West
Date	: Apr 19, 1995	File name	: BHD6WXYZ.PEM

Data Corrected for Probe Rotation using Orientation Tool #2
TOTAL FIELD dBxyz/dt nanoTesla/sec - 20 channels

Scale: 1:5000



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APPENDIX 3

Excerpts from Crawford (1995):
"Lithogeochemical Stratigraphy of Mt Read Volcanics in the High Point - Mt Charter Area, NW Tasmania."

Lithochemical stratigraphy of the Mount Read Volcanics in the High Point - Mount Charter area, NW Tasmania

A Report for Pasminco Exploration (Tasmania)
(attn Gerald Purvis)

Tony Crawford
Dept of Geology
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24/4/95

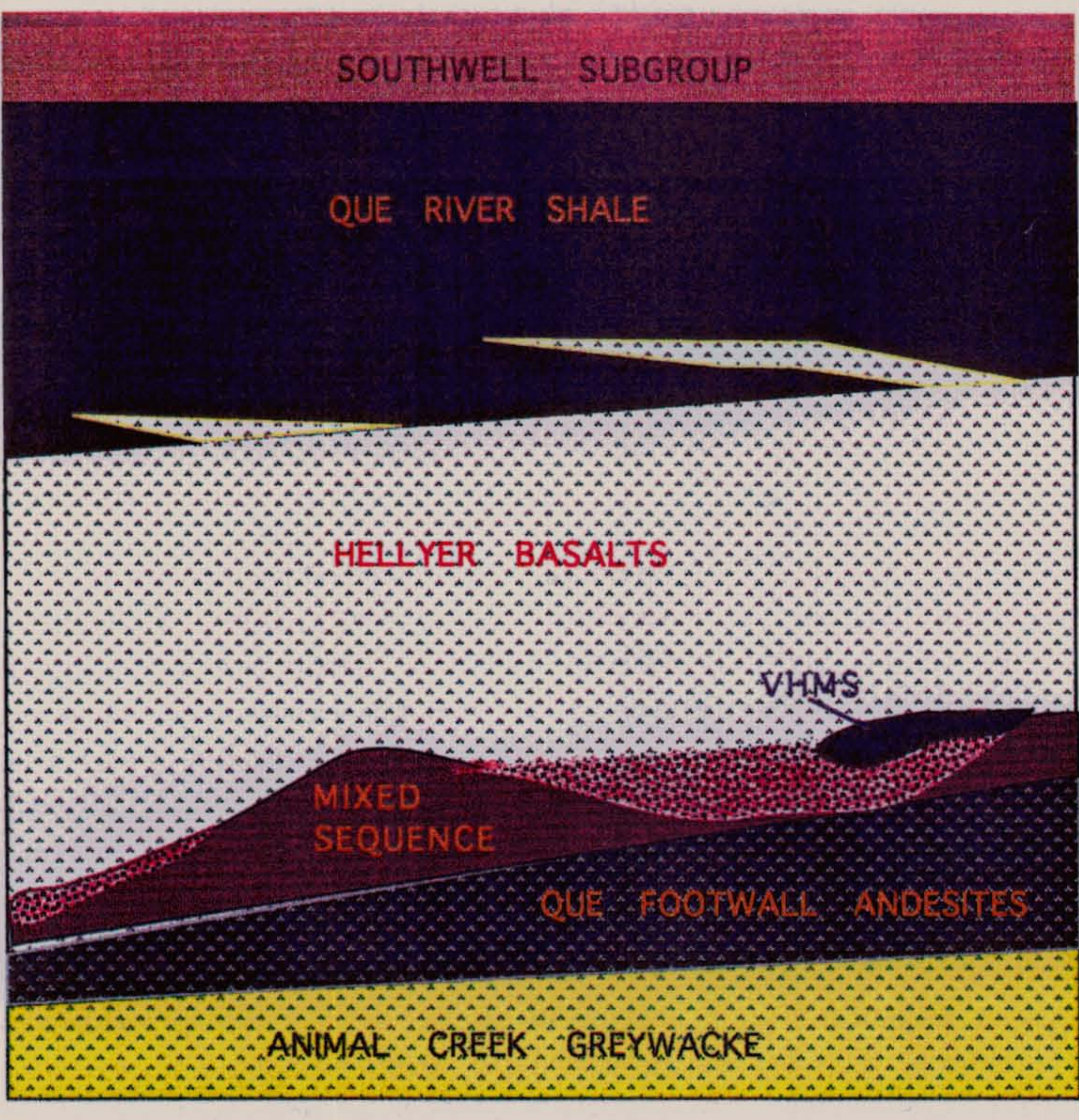

Figure 2a: Suggested revision of the stratigraphy of the Qu-Hellyer region, in which Que Footwall Andesites are separated out as a discrete lithostratigraphic unit.

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GEOLOGICAL CROSS SECTIONS, HIGH POINT-BULGOBAC AREA

Four representative cross sections showing the stratigraphic variation of the lithochemical units in this area have been prepared (Appendix 2). These are based on the generalized logs from Appendix 1; locations of the cross sections are marked on Figure 1. Sections A-B and C-D were prepared by Gerald Purvis for Pasminco, and I have simply added my lithochemical units to his sections, *with a key change in the postulated location of the Mixed Sequence*, as discussed below. Sections E-F and G-H were prepared by me, from generalized logs; several of the dipping drillholes are marked on these sections as vertical (due to constraints of the computer program used in the drafting), but this does not obscure or complicate correlations, since the inclined holes all dip fairly steeply eastward.

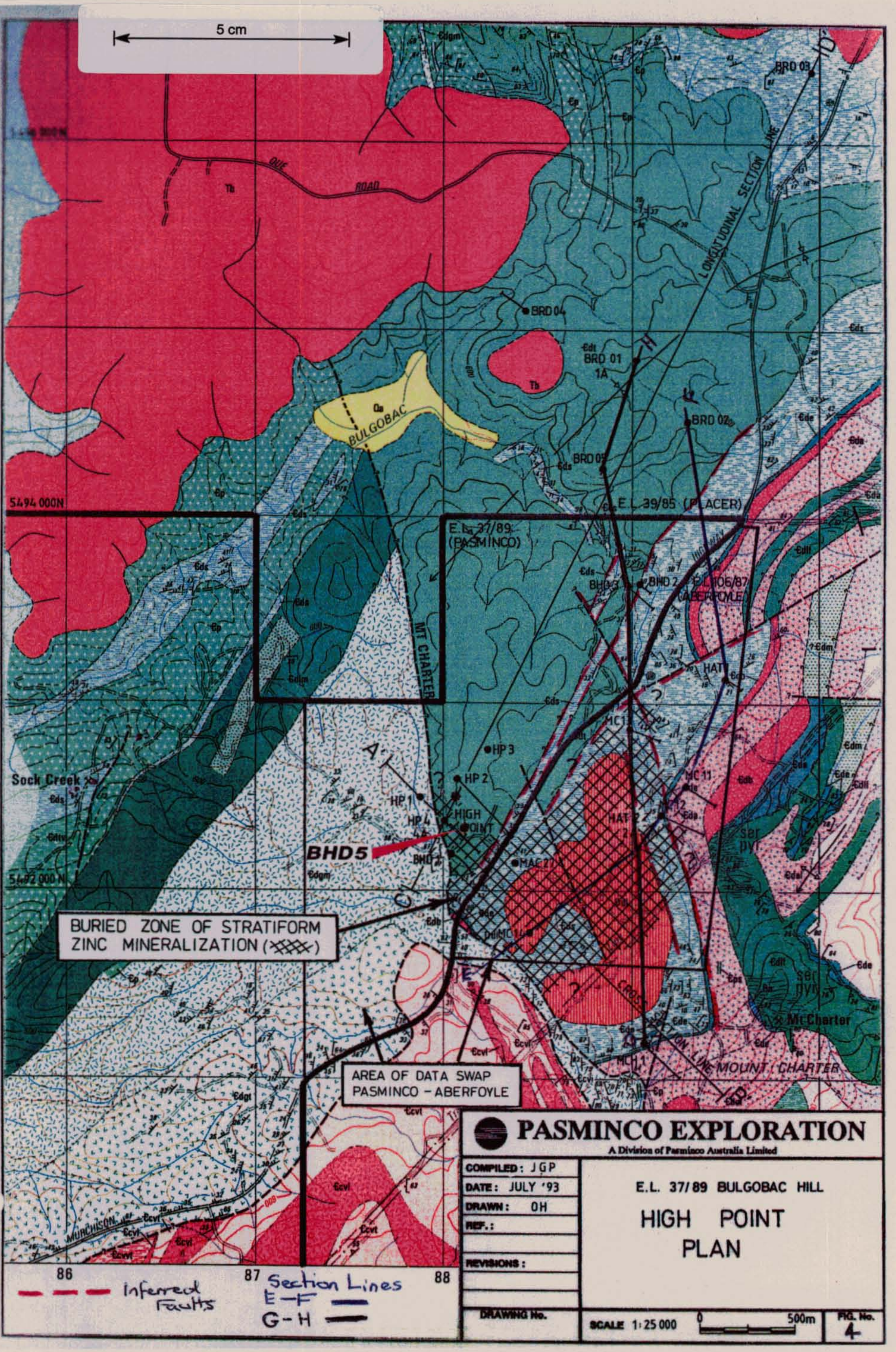
It is important to make it clear that the structural 'detail' shown on the sections that I have prepared (E-F and G-H) is little more than indicative at best. In drawing sections linking drillholes, such as these, when faults are required between almost every adjacent drillhole, this suggests (demands!) that there are far more faults in reality than have been mapped from surficial geology (undoubtedly the case for the poorly-exposed and stratigraphically complex Que-Hellyer area). However, the drill logs do provide evidence for several major, important faults, and these postulated faults are marked on Figure 4 in heavy red ink.

SECTION E-F

This section extends from MC14 in the SW, through HAT-2, MC12, MC11, HAT-1 to BRD02 in the NE. The Mount Charter Dolerite is clearly defined as a sheet <60m thick, although the top is not intersected by this section. East and northeast of MC14 immediately south of the section line, an inlier of Que River Shale within the dolerite is almost certainly fault-bounded. Whether the dolerite has been faulted up (and eroded away), or down, is difficult to determine.

Between MC14 and MC12, the section line almost parallels strike and the base of the Que River Shale is fairly constant around 150m below collar level. However, it was not intersected in nearby hole MC11, requiring a stratigraphic displacement of >120m over a horizontal distance of ~200m, and thus suggesting the presence of a significant fault between MC12 and MC11. This fault may be a southern continuation of the NNW-trending fault that crosses the Murchison Hwy at Bulgobac River crossing, and is marked as such on Figure 4.

An andesite unit with Ti/Zr = 15 occurs immediately beneath the Que River Shale over most of the section, although in HAT-1 this unit is separated from the Que River Shale by about 30m of transitional shoshonitic basalts that carry quartz xenocrysts. The same transitional shoshonites, though lacking quartz phenocrysts in the few


5 cm
QUE ROAD
BULGOBAC
E.L. 39/85 (PLACER)
E.L. 37/89 (PASMINCO)
E.L. 106/87 ABERFOYLE
LONGITUDINAL SECTION LINE
MT CHARTER
BRD 01 1A
BRD 02
BRD 03
BRD 04
BRD 05
BHD 2
BHD 3
HAT 1
HAT 2
HP 1
HP 2
HP 3
HP 4
HIGH POINT
BHD5
MAC 2
MC 1
MC 11
Sock Creek
5494 000N
5492 000N
BURIED ZONE OF STRATIFORM ZINC MINERALIZATION (XXXX)
AREA OF DATA SWAP PASMINCO - ABERFOYLE
MOUNT CHARTER
Mt Charter
MURCHISON
86
87
88
Inferred Faults
Section Lines
E-F
G-H
PASMINCO EXPLORATION
A Division of Pasminco Australia Limited
COMPILED: JGP
DATE: JULY '93
DRAWN: OH
REF.:
REVISIONS:
DRAWING No.
E.L. 37/89 BULGOBAC HILL
HIGH POINT
PLAN
SCALE 1:25 000
0
500m
FIG. No. 4

petrographic thin sections available, occur in the same position near the base of the Que River Shale in BRD05 and BHD3 further to the north, as well as in BRD02, and should be found in outcrop immediately north of the Jack Fault between HAT-1 and the highway (see Figs. 1 and 4). The absence of quartz xenocrysts in the few samples thin sectioned from HAT-2, MC12, and MC11 almost certainly reflects poor sampling or poor petrographic descriptions, or both. (I'll bet megabucks that quartz xenocrysts occur in the andesites in these drillholes!).

The upper andesite in MC14 is followed below by 30-40m of plagioclase+augite-phyric, quartz xenocryst-bearing basalts with Ti/Zr ~24, abnormally low TiO_2 contents (0.32%), and 80ppm Zr. This is one of the few occurrences of this unusual low-TiO_2 basaltic magma in the Que-Hellyer region. HAT-2 is not deep enough to intersect this unit, if it in fact persists this far northeast. At about the same level in MC12 and MC11 is a flow or sill of Charter Dolerite-type basalt, with Ti/Zr = 34, 95ppm Zr and 1000ppm Cr. I suggest that the low-TiO_2 basalts in MC14 are actually higher-Ti/Zr basalts of Charter Dolerite-type, similar to the flow or sill at this level in MC12, that were significantly contaminated by a rhyolitic quartz-bearing melt with typical low TiO_2 (usually <0.4%) Ti/Zr (<10), 150-200ppm Zr, and <10ppm Cr. Note that in MC14, this low-Ti basalt unit *does* contain quartz xenocrysts that were abundant enough to be commented upon by the petrographer who noticed them in this unit, but neglected to mention them in thin sections from other units.

The basal 200m section of MC14 is dominated by quartz xenocryst-bearing basaltic andesites and andesites with Ti/Zr =14-16 and from 35-130ppm Cr. These lavas were not intersected in shallow hole HAT-2, and do not extend across to MC 12 and MC11. At this same level in both MC12 and MC11, dacitic lavas and lava breccias are present instead of andesites. The dacites appear in MC11 at considerably shallower levels than in MC12, suggesting (as does differences in the level of the base of the Que River Shale between these holes) that a major fault with at least 200m vertical displacement occurs between these holes. As noted above, this may be a southern continuation of the fault that crosses the Hwy at the Bulgobac River crossing (Fig. 4).

The lithochemical section in HAT-1 differs significantly from the foregoing part of the Section E-F in that a basaltic unit appears within the basal section of the Que River Shale. This basalt also contains quartz xenocrysts and is presumed to be compositionally modified by contamination by a quartz-bearing felsic magma (see earlier discussion). However, its relatively high Zr and low Ti/Zr suggest that it was more likely a shoshonitic magma that was contaminated by a quartz-phyric felsic magma in this instance. This contrasts with the situation further southwest on Section E - F, where rather than a shoshonitic magma being contaminated, it was a high Ti/Zr, low-Zr

Charter Dolerite-type magma encountering the quartz-phyric felsic magma. Downhole from the Que River Shale follow >60m of evolved andesites with Ti/Zr = 15, essentially identical to those in the holes further southwest in this section.

DISCUSSION OF SECTION E - F

An important point to keep in mind is that in modern settings in which broadly rift-related submarine volcanism is occurring, the felsic lavas always occur at topographic highs relative to the more mafic lavas. They may occur as domes, or as general topographic highs on long ridge segments along which the basalts erupt at greater depths (eg. Manus spreading centre). *The dominance of felsic lavas in the section in MC11 and at the base of adjacent MC12 may therefore reflect an intra-basinal felsic high in this area*. The common occurrence of VHMS deposits lapping off, or ponded adjacent to felsic highs in modern and ancient settings, suggests to me that the extent of this felsic high should be determined. Unfortunately, much of the potential ground for follow-up work addressing this possibility is on Aberfoyle leases! However, further thoughts on this 'model' are offered later in this report.

I have demonstrated that contamination-assimilation of a quartz-phyric felsic magma into at least two different basaltic magmas, one shoshonitic, the other a high-Ti/Zr Charter Dolerite-type magma, has occurred in the High Point - HAT-1 region. This suggests to me that a major, sheetlike body (magma chamber) of felsic magma extended beneath this area late in the history of the Hellyer Basalt. Frozen analogues (but not correlates!) of this sheetlike magma chamber are present (at a higher stratigraphic level) just west of High Point as the NNE-striking massive quartz plagioclase porphyrite bodies in the Sock Creek area. The actual frozen contaminant itself may be represented by the quartz-phyric intrusive rhyolites atbthe base of BHD6. As quartz-phyric felsic lavas are almost unknown in the true Central Volcanic Complex north of the Henty Fault, this may be a correlate or fore-runner of the Sock Creek porphyrite sheets. Certainly the high Zr contents (>400ppm) of this unit are well above measured values for Central Volcanic Complex rhyolites, but match those of some of the porphyrites at Sock Creek.

I postulate that distinct pulses or batches of much less voluminous but hotter basalt, ranging from shoshonitic to more typical medium-K calc-alkaline (Mount Charter Dolerite type), injected from deeper storage zones into the felsic magma, mixed to a limited extent, and passed up to eruption. The extent of the porphyrite sheet in the subsurface is probably well-mapped by the distribution of quartz xenocrysts, which extend from High Point, northeastward towards HAT-1, but they are almost unknown north of the Highway (in BRD05 there is a single xenocryst among >50 thin sections examined, and there are no xenocrysts in BHD3, BRD02 and BRD01).

SECTION H - G

This section extends south from Placer deep hole BRD01 through BRD05, BHD3, MC13, HAT-2 to MCH-1 just north of the Charter Fault. The Que River Shale is remarkably thick in BRD01 and BRD05, 450m and well over 500m respectively. In BRD05, Southwell Subgroup-type rhyolites and epiclastics occur within the top of the Que River Shale, and a transitional shoshonitic basalt unit almost 40m thick occurs within the basal third of the shale.

The upper part of the main basaltic pile in BRD05 is peperitic sequence of transitional shoshonitic basalts, more primitive (i.e. less fractionated) than the unit within the Que River Shale, and hosting a sill or flow of Charter Dolerite-type basalt (Ti/Zr = 44) around 738m depth. These transitional shoshonitic basalts are followed downhole by ~110m of quite primitive shoshonitic basalts which have an excellent, though much thinned, correlate at the top of the basalt pile (below 534m) in BRD01. The transitional shoshonite units in BRD05 within the Que River Shale and immediately above the true shoshonites have no correlates in BRD01, presumably wedging out northward. Below the true, low Ti/Zr shoshonitic basalts in BRD05 (i.e. below 870m depth) follow about 180m of high Ti/Zr (>28) Charter Dolerite-type basalts, but with rather higher P_2O_5 contents than typical Charter Dolerites/basalts, some approaching true shoshonitic compositions. These are discussed further in the next paragraph. A single sample at the top of this unit (886.8m) has quartz xenocrysts, providing a possible temporal link of this level with quartz xenocryst-bearing units in holes further south, around High Point.

The lower series of high Ti/Zr transitional shoshonites in BRD05 correlates well with the large thickness (220m) of similar composition basalts occurring immediately beneath the shoshonites at the top of the basalt pile in BRD01. In the latter hole, many of the transitional shoshonites have Ti/Zr values between 25 and 35, yet P_2O_5 contents of 0.17-0.33%, suggesting that these basalts may be mixtures of broad endmember shoshonites with a Charter Dolerite-type high Ti/Zr basalt. Our detailed studies (in progress) of melt inclusions in fresh clinopyroxene phenocrysts from these particular basalts supports this conclusion, some crystals containing high P_2O_5 melt inclusions in some growth zones, and low P_2O_5 inclusions in others. This further demonstrates the difficulty inherent in trying to erect and define artificial bounds on magmatic units in the Hellyer Basalt. These problems are exacerbated into the andesite range, as fractionation further smears out any differences that may have been diagnostic of the primitive basalts taking part in magma chamber mixing and mingling processes. However, as the man jumping from the skyscraper said as he shot passed the 47th floor, 'No problem so far'.

Within the high Ti/Zr transitional shoshonites in BRD01 just above 800m depth is a 30m thickness of primitive basalts with unusually low TiO_2 contents (0.27-0.35%); these have no obvious counterparts in BRD05. A single thin section showed no quartz xenocrysts, perhaps ruling out a mixing origin as was claimed for the low-TiO_2 basalt in MC14. Further petrographic study of this low-TiO_2 unit, however, is required to rule out a mixing origin.

In both BRD01 and BRD05, a sequence of formerly glassy, often banded, dacite lavas with subordinate breccias and epiclastic units occurs beneath the high Ti/Zr transitional shoshonites. These are probably correlated with the Mixed Sequence. In BRD01, a 30m-thick sequence of andesites and basalts occurs within the dacite sequence, but this interval is missing (probably not drilled deep enough) in BRD05. Interestingly, andesites in this packet (called Unit 6 in Figure 3) within the Mixed Sequence dacites have compositions remarkably similar to the Central Volcanic Complex Suite 2 hornblende andesites (see Figure 3). Their stratigraphic level matches well with the assumed age of the CVC Suite 2 hornblende andesites at the top of, or intruding CVC Suite 1, and suggests that the Suite 2 hornblende andesites might be an interesting exploration target.

Beneath the Mixed Sequence lower dacites in BRD01, from ~1030m to 1075m depth, occurs a sequence of plagioclase-phyric andesites with compositional features that match very closely in every way (Figure 3) with the Que Footwall Andesites. This strong correlation is supported by the occurrence of Animal Creek Greywackes beneath these andesites at the base of BRD01. This strongly supports the correlation of the dacites in BRD01 and BRD05 with the Mixed Sequence.

Reasonably confident correlations can be made between BRD01 and BRD05, in both of which basalts are dominant and andesites are a minor component of their respective lava sequences. However, there are few similarities or correlations between the lithostratigraphic units defined in these two holes, and those in BHD3, the next hole further south in this section. The stratigraphy in BHD3 is complicated by the presence of several major fault zones, particularly around 450-460m and 300-310m. The latter fault separates two 25-35m-thick units of transitional shoshonitic basalts to basaltic andesites, both of which occur within Que River Shale. These units may be broadly equivalent, and repeated by faulting; they correlate well with the transitional shoshonitic basalts within the basal Que River Shale in BRD05 and BRD02. Below the lower of these two units occurs more Que River Shale, and this hosts several basaltic sills or flows, the largest of which (20m-thick) is a distinctive low-Ti basalt. The second major fault terminates the Que River Shale around 450-460m.

Below this major fault in BHD3 follows a sequence of transitional shoshonitic basalts and basaltic andesites, followed downward by ~60m thickness of shoshonitic basalts. At the base of the latter is a thin flow of Charter Dolerite-type high-Ti/Zr (48) basaltic andesite, much thinner than, but correlated with the Charter Dolerite-type basalts below the shoshonites in BRD05, BRD01 and BRD02. Below this are almost 200m of evolved plagioclase-phyric andesites and common polymict epiclastic units. The lowermost lavas in this hole are dacitic in terms of SiO_2 and MgO contents, but have Ti/Zr values from 14-16; these values are somewhat higher than those for the basal dacites in adjacent hole BHD05, but are reasonably correlated with this level, and the Mixed Sequence. *It is important to note that, if this correlation is correct, this is one of the shallowest occurrences of the Mixed Sequence in the Pasminco lease areas, and epiclastics are quite common compared with Mixed Sequence correlates in BRD05, which are almost exclusively coherent lavas.*

As shown on Section G - H, the increasing thickness of the Que River Shale southward from BRD01 to BRD05 changes abruptly between BRD05 and BHD3, with the base of the shale shallowing by almost 300m in BHD3 (although it is terminated by a basal fault). From BHD3 to MCH-1 at the southern end of this section, the base of the Que River Shale continues to rise, despite the presence of faults through the sequence. This sudden elevation of the base of the shale, and the poor correlations of the lithochemical units between BRD05 and BHD3 suggests to me that one or more major faults separates these holes. As marked on the geological map in Figures 1 and 4, a fault-bounded wedge of Que River Shale occurs at the surface between BRD05 and BHD3, and the hypothetical fault may well parallel (or be) one of these northeast-striking faults. The fault present in BHD3 around 450m may also be part of this fault system, as drawn on the Section G-H, although this is hypothetical at best. The southern blocks are generally progressively upthrown along these fault zones, indicating that the deepest part of the Hellyer 'basin' may be that section that encompasses BRD01, BRD02 and BRD05, northwest of the hypothetical fault marked cutting BHD3. The significant change in level of the base of the Que River Shale (it cannot presently be demonstrated whether the shale changes thickness significantly over this fault), and the dominance of andesites in the upper lava sections of holes southeast of this hypothetical fault, suggest that it may be a significant fault that existed during, and perhaps controlled the locus of, Hellyer basalt volcanism and subsequent Que River Shale deposition.

In Section H - G, the hole further south than BHD3 is MC13. This contains a fairly low-Ti basalt flow close to the base of the Que River Shale. Below the shale follows ~25m of andesites that contain quartz xenocrysts, and then about 80m (to EOH) of vesicular transitional shoshonitic basalts with Ti/Zr values around 20. These andesites and transitional shoshonitic basalts broadly correlate with similar basalts and andesites beneath the fault zone at ~450m in BHD3, although they are certainly not directly equivalent (for instance, Ti varies by more than 1500ppm (0.25%) between the two lava sequences in these holes). The next hole south in this Section, HAT-2, was collared in Mount Charter Dolerite and drilled through ~30m of this and 110m of Que River Shale (including a few dykes of Charter Dolerite-type basalt/dolerite) before encountering 80m (to EOH) of evolved andesitic to dacitic lavas with Ti/Zr = 15-16. Three petrographic thin sections from this unit showed no quartz xenocrysts. These are probably slightly more evolved correlates of the andesites immediately below the Que River Shale in MC13, the next hole north in this Section.

The final hole on Section G - H is MCH-1, located some 1100m south of HAT-2. Between the base of the Que River Shale at ~10m depth in the hole, and 200m depth, is a sequence of evolved andesitic to dacitic lavas. Within this sequence betwen 55m and 116m depth is a pile of transitional shoshonitic basalts with Ti/Zr ~21; these correlate well with similar lavas at the base of MC13. From around 180m to 200m depth in MCH-1, an epiclastic andesitic unit contains clasts that carry quartz xenocrysts. Aside from other considerations, this simple observation would seem to rule out correlation of this unit with the Mixed Sequence (as suggested by Corbett and Komyshan), since the quartz xenocryst-bearing lavas occur towards the top of the Hellyer Basalt, whereas the Mixed Sequence clearly precedes the Hellyer Basalt.

A thick and distinctive evolved basaltic unit follows the andesitic epiclastics downhole. This basalt, with strong compositional affinities with evolved Mount Charter Dolerite (Ti/Zr = 38, Zr = 130-145 at Cr levels of only 60-65ppm), probably occurs beneath the EOH depths of HAT-2 and MC13. Below this thick basaltic unit comes a few metres of greywackes that are petrographically identical to typical Animal Creek Greywacke. From the base of the greywacke around360m depth, down to a significant fault at ~425m, follows a sequence of basaltic and andesitic lavas with Ti/Zr around 12-17. Based solely on Zr values and Ti/Zr, since P_2O_5 values are unavailable for MCH-1 lavas, I assume that these have transitional shoshonitic affinities.

Below the fault at 425m depth, a further 65m of andesitic lavas with Ti/Zr = 16-17, but very low Cr contents (<10ppm) occur. A thin siltstone unit separates these from ~20m more of andesites, these having Ti/Zr = 22 and slightly higher Cr contents (30ppm). The latter andesites are correlated with the Que Footwall Andesites; these should have <0.2% P_2O_5%, but no data for P_2O_5 are available. Some 35m of volcaniclastic sandstones separate the andesites from underlying Animal Creek Greywackes. Several sills or dykes of high Ti/Zr basalt unambiguously related to the thick basalt unit between 200m and 350m depth in this hole occur in the Animal Creek Greywacke and overlying siltstone.

4: in BHD6, this lower Charter Dolerite-type basalt unit abuts Animal Creek Greywacke, though the sequence is strongly faulted. In BHD5, it passes into a fault zone in which blocks of lava have broadly transitional shoshonite affinities, and in MAC27, it is followed downhole, apparently conformably, by some 30-40m of dacites that I correlate with the Mixed Sequence.

5: in BHD6, the Mixed Sequence is apparently represented by a basal transitional shoshonitic basalt ~52m thick, followed by typical Mixed Sequence dacitic lavas, abundant epiclastics and polymict breccias, and an upper sequence at least 30m thick of strikingly Zr- and Ti-rich dacites. The latter lavas correlate compositionally REMARKABLY WELL with those high-Zr dacites between 250m and 370m in BHD4 at Sock Creek. These, in turn, sit above a 100m-thick pile of more typical Mixed Sequence dacites, which themselves lie apparently conformably on Animal Creek Greywackes.

DISCUSSION

THE ELUSIVE "MIXED SEQUENCE"

Available data suggest that in the type area around the Que and Hellyer mines, the Mixed Sequence is a sequence of andesitic and more felsic epiclastics, with occasional lavas and pyroclastics. They differ from the andesites and dacites in the underlying Que Footwall Andesites by showing the first signs of a temporal trend towards higher-P_2O_5 compositions. Thus whereas Que Footwall Andesites have P_2O_5 contents <0.20%, Mixed Sequence andesites may have significantly higher P_2O_5 contents, towards 0.5% (Corbett and Komyshan, 1989). The changing magma type and dominance of epiclastic rocks in the Mixed Sequence (as defined in the mines area), and the fact that this sequence heralds the eruption of several hundred metres thickness of mainly quite primitive basaltic lavas, suggest that it records a rather sudden stage of basin subsidence as the rate of crustal extension increased to allow eruption of such volumes of primitive lavas. As the basin collapsed, andesitic detritus from the basin margins and within the basin accumulated in the deepest part of the basin, which at that stage was in the Que River mine region. The basin, and presumably the Mixed Sequence, shallowed (thinned) to the west and south. We know already that it pinches out from about 250m thick at Que Rv mine, to an interpreted 70m thick further south at MCH-1, and only around 10m thick in the Hellyer mine area (Corbett and Komyshan 1989), where it is placed beneath the entire 220m of pillow basalts.

If a search is made for the Mixed Sequence in the drillholes of interest to this study we can draw the following conclusions.

In Placer hole BRD01, Animal Creek Greywackes are followed up-sequence by a suite of aphyric to plagioclase-phyric andesites confidently correlated with the Que Footwall Andesites. The Mixed Sequence, if indeed it exists in this part of the EL, must overlie these andesites, and underlie the Hellyer Basalt correlates in this hole. Thus it is represented by all or some of the 185m-thickness of dacites and associated andesites and rare basalt flows that occur between the two distinctive marker units of lavas in BRD01 (namely, the Que Footwall Andesites and the Hellyer Basalts). So in this hole, the Mixed Sequence could be taken to include an 85m-thick pile of flow-banded dacites and dacite breccias, followed up by ~30m of basalts and andesites in which the P_2O_5 contents (>0.26%) are always higher than the Que Footwall Andesites, followed up-sequence again by a further 60+m-thickness of dacitic and some rhyolitic lavas.

The correlation made previously of both the BRD-01 and -05 dacites and their immediately overlying basalts, suggests that in BRD05, the Mixed Sequence is presumably represented by the 130+m thickness of dacites and dacitic breccias at the base of this hole, below the thick pile of Hellyer Basalt correlates. It is a pity that BRD05 was not drilled another 100-200m-deep, which may have clarified many of the problems associated with identification and significance of the Mixed Sequence.

A key point to note is that in both BRD01 and BRD05, the Mixed Sequence horizon *is not* dominated by epiclastic and pyroclastic rocks, but rather, is characterized by a significant thickness of flow-banded dacitic lavas. Could these dacites, recalling that dacitic rocks in submarine andesite-dacite sequences normally occur as topographic highs, be the source of the epiclastics that dominate the Mixed Sequence where it was defined further east?

The story for drillhole MCH-1 is perhaps more complicated. Indisputable Animal Creek Greywackes and overlying plagioclase-phyric andesite lavas and breccias occur over 175m of section, from the fault at 425m depth, to EOH. A more than 65m-thickness of andesite lavas occurs in this section, with siltstone interbeds and a few basaltic dykes with Mount Charter Dolerite-type compositions. Without P_2O_5 analyses for these lavas, it is difficult to know whether the entire thickness represents Que Footwall Andesite correlates, or whether higher-P_2O_5 andesites of the Mixed Sequence first make an appearance in the upper part of the sequence. Whatever the case, available evidence now suggests that the identification of Mixed Sequence in MCH-1 by Corbett and Komyshan (1989) is wrong. Specifically, these authors suggested that the Mixed Sequence is represented by the unit of banded dacites and occasional epiclastics occurring immediately above the thick low-Cr basalt that appears at 200m depth in this hole. Whereas the range of lithologies in this section identified by Corbett and Komyshan (1989) as Mixed Sequence certainly fits the regional picture of Mixed Sequence rocks, stratigraphic details argue against the correlation, as detailed below.

First and foremost, at least one clast that I examined from the level of Corbett and Komyshan's Mixed Sequence (just below 180m depth), from an epiclastic unit, is a basalt containing quartz xenocrysts. As noted above, the quartz-xenocryst-bearing basalts are restricted to the upper section of the Hellyer Basalt correlates, and could hardly have been available for incorporation in true Mixed Sequence units, which were by definition deposited BEFORE ANY HELLYER BASALT WAS ERUPTED.

Second, nowhere else does the Mixed Sequence have more than one or two thin flows of basalt within it (e.g. BRD01), and basalts only known from below the Mixed Sequence in the fault-disrupted base of BHD6 at High Point. In contrast, Corbett and Komyshan (1989) include a more than 200m-thickness of basalts, and some 70m of andesites in the sequence immediately below their Mixed Sequence. I would argue (see Section A-B) that the thick basalt section from 200-350m depth in MCH-1 is part of the Hellyer Basalt proper sequence, occurring ABOVE the level of the Mixed Sequence, which then is limited to the andesites and associated rocks between depths 425m (Fault) and ~500m.

A GENERALIZED STRATIGRAPHY FOR THE WESTERN QUE - HELLYER BASIN

From the sections presented and discussed above, several important conclusions can be drawn about the lithochemical stratigraphy of the Hellyer Basalts in this region.

1: In the northern part of the area, as exemplified by the Placer deep holes, basalts dominate the Hellyer Basalt stratigraphy, quartz xenocrysts are very rare or absent, and the basalts themselves are basically transitional shoshonitic basalts and (usually overlying) true shoshonitic basalts, which themselves follow a thick pile of basalts with higher Ti/Zr (usually >28) and lower P_2O_5 (usually <0.4%) contents. This basalt pile is constructed on a sequence of andesites and dominant dacite, with occasional thin basalt flows, which is correlated with the Mixed Sequence; epiclastics are notably rare or absent. The latter overlies aphyric and plagioclase-phyric andesites the Animal Creek Greywacke.

2: In the High Point area, lava units are less continuous between holes, and correlations are more difficult to make with confidence. This is partly due to disruptions along the Charter Fault zone, but also is probably partly due to rapid thickness changes of units near the Charter Fault. The lithochemical stratigraphy of the Hellyer Basalts in this area is an upper and lower unit of Charter Dolerite-type high Ti/Zr basalts sandwiching a thick sequence of quartz xenocryst-bearing basalts and andesites. Extensive faulting at the base of the deep High Point holes precludes confident recognition of the lithochemical unit(s) originally lying beneath the lower Charter Dolerite-type unit. However, some clues are offered by MAC27, where there appears to be a conformable passage from this unit down into dacites of the Mixed Sequence. I presume that had MAC27 been drilled another 50-100m deeper, Animal Creek Greywacke would have been encountered. It is important to note that the Mixed Sequence correlates in BHD6 contain common epiclastic units.

3: To the east and southeast of High Point, extending from MAC27 to MCH-1, a compositionally distinctive low-Ti basalt unit occurs near the top of the Hellyer Basalts (in MC14 and MCH1). Excluding this unit, the same chemical stratigraphy as noted in (2) above applies to this area. As shown by MCH-1, quartz xenocryst-bearing basalts and andesites overlie a thick high-Ti/Zr Charter Dolerite-type basalt, which itself overlies a sequence of andesites, epiclastics and minor basalts that I correlate with the Mixed Sequence. The latter sits on typical Que Footwall Andesites, which in turn, lie above Animal Creek Greywackes.

IMPLICATIONS FOR BASIN ARCHITECTURE AND MINERALIZATION

In MCH-1, the entire lava sequence between the Que River Shale and the Animal Creek Greywacke is 550m thick, and includes probably 15-50m of Que Footwall Andesites. In BRD01, the lava thickness over the same stratigraphic interval to the top of the Que Footwall Andesites is ~530m. Hole BRD05 contains a 480m thickness of lavas below the shale, but did not reach the Que Footwall Andesites level. In BHD6, the total thickness of lavas between the base of the Que River Shale and the Animal Creek Greywacke (Que Footwall Andesites are apparently absent in this hole) is ~570m. *It is important to note, therefore, that the Hellyer Basalt sequence maintains a fairly constant thickness, around 550m, over the entire region under consideration.* It only thins dramatically to the north of BRD01, as shown by the ~120m total thickness of Hellyer basalts in BRD03, and to the west of High Point, where the Hellyer Basalt sequence is thin or absent at Sock Creek. There is thus no real evidence suggesting that the Charter Fault system operated as a growth fault during Hellyer Basalt magmatism in a manner such that basalts thinned away from the marginal fault into the basin. Certainly the Hellyer Basalt decreases rapidly in thickness west of the Charter Fault, and may have been absent from much of this area. Also, the Que River Shale thins basinward (towards section line G - H), so that by Que River Shale time, the Charter Fault may have been an active bounding fault in the Que-Hellyer 'basin'.

The Que Footwall Andesites appear to show thickness variations inverse to those of the Que River Shale. They are thickest in the Que Mine area and thin westward, being apparently absent in BHD6 and Sock Creek.

I note with interest the apparent shallowing of the depth to Mixed Sequence in the area of BHD3. This shallowing brings the prospective Mixed Sequence to somewhat more accessible drilling levels than in the immediate High Point area (at least 100m deeper), or in the northern part of the basin (>200m deeper) drilled unsuccessfully by Placer some years ago. In my opinion, the poorly-drilled region around BHD3 deserves further investigation, although not immediately around BHD3, as there lavas dominate the Mixed Sequence. Considering the significant epiclastic component of the Mixed Sequence in BHD6 compared with its counterparts in BRD01, BRD05 and BHD3, where lavas predominate and epiclastics are rare, I suggest drilling between High Point and BHD3, guided by geophysical data. The dominance of lavas over epiclastics in the central part of the Que-Hellyer 'basin', going right the way through from Mixed Sequence times, to the felsic lava-dominated upper parts of the Hellyer Basalt as shown by MC11 and MC12, suggests that a bathymetric high (ridge) may have extended up the centre of the basin (broadly along the N-S line joining MC14 and BRD01), with epiclastics washing off to both the east and west (see very diagrammatic representation in Figure 2a). A gravity structure has been recorded by Placer some 500m SW of BHD3; I have no information about this feature, but note that it lies in the area that I believe to be most prospective for future drilling.

The occurrence of thin, broadly Hellyer-type basalts in some Sock Creek South drillholes to the west of High Point is interesting and worth some attention. These basalts are notably higher Ti/Zr, and more tholeiitic than any Hellyer Basalts in the main 'basin' east of the Mount Charter Fault. The Sock Creek basalts are unique in the Mount Read Volcanics have compositional affinities midway between the Charter Dolerite-type magmas and the tholeiitic Henty Dyke Swarm. This gradual trend towards tholeiitic compositions through the history of the Mount Read Volcanics reflects a progressive increase in the rate of extension of the crust in this region, and progressive ascent and tapping of convective asthenospheric mantle. It is surprising perhaps, that the lavas reflecting maximum extension of the crust occur out to the western edge of the main Hellyer 'basin', rather than in the region where the Hellyer basalts are most thickly developed. Evidence suggests that the axis of maximum lava thickness (and maximum extension?) shifted westward from the Que mine area during Que Footwall Andesite magmatism, towards the location of Section H - G during main Hellyer Basalt magmatism, possibly to the Sock Creek region in the waning phase of Hellyer magmatism. This offers some general encouragement that the region west of High Point and west of BRD03 may still be worth examining carefully for VHMS deposits.

DISPERSED ZINC MINERALIZATION

A final but important point involves the origin of the dispersed zinc mineralization demarcated on Figure 1 and Gerald Purvis' two sections A-B and C-D. Two key points are worth noting. First, the extent of this dispersed Zn mineralization closely parallels the distribution of the Charter Dolerite sheet. This may suggest that the Charter Dolerite acted as a heat engine, driving hydrothermal fluids through the basalt pile in this region. If some source of massive VHMS mineralization occurred in the pile reached by these fluids, that is, broadly beneath the High Point region, then Zn (more soluble at relatively lower temperatures than Cu) and S might have been scavenged by these fluids to be deposited at higher crustal levels in porous units and fractures as the fluids cooled. In this scenario, it might be hypothesized that the scavenged base metals are ultimately derived from a VHMS 'deposit' located somewhere broadly below the CHarter Dolerite in the High Point region.

However, note that the extent of the disseminated Zn mineralization also corresponds fairly well with the distribution of the quartz xenocryst-bearing basalts and andesites within the Hellyer Basalt pile. Major controls on S solubility in magmas include temperature and SiO_2 content (essentially, these parameters are inter-related). Contamination of S-undersaturated Hellyer Basalt-type basaltic magmas by a cooler, much higher SiO_2 rhyolitic melt, evidenced by the quartz xenocrysts, would have forced a massive drop in S solubilty, and probably precipitation of disseminated sulphides in the basalts being contaminated. It is worth considering that the diseminated Zn mineralization results from dissolution and remobilization of these sulphides by hydrothermal fluids, possibly associated with the Charter Dolerite. In this instance, there is little likelihood of the disseminated Zn mineralization being traced back to an underlying VHMS ore deposit.

One final consideration is that the very strong faulting and disruption of the Hellyer Basalts in the High Point region, especially adjecent to the Mount Charter Fault zone, as evidenced by the lateral impersistence of lithochemical units in closely spaced drillholes in this region, might mean that any VHMS deposit in this area would be similarly faulted, discontinuous along strike, and difficult to mine.

SUMMARY

Animal Creek Greywacke correlates have been drilled in MCH-1 (southeast region), BRD01 and BRD03 (northern region), and BHD6 (western region). This sequence of pelitic metamorphic-derived micaceous sandstones forms the basement to the thick Que-Hellyer lava sequence, and has been interpreted to conformably overlie the Central Volcanic Complex. The Que Footwall Andesites, thought to be hundreds of meters thick in the vicinity of Que mine, pinch out westward, since they are only around 35m thick in BRD01, probably <50m thick in MCH-1, and are absent from (although possibly faulted out of) BHD6 and Sock Creek. This suggests that at the time that the Que Footwall Andesites were being produced, the main source of volcanism in the basin/rift was centred in Que-Hellyer area, with lavas pinching out gradually westward.

Accelerated crustal extension and magma supply at the end of Que Footwall Andesite eruptions led to:
(i) deepening of the Que - Hellyer basin and accumulation of epiclastics washing off basin margin uplifts and dacitic domes within the basin, and
(ii) a change in the nature of magmatism, with the first appearance of higher-P_2O_5 andesites transitional to shoshonitic compositions, and a gradual trend to more basaltic compositions; many Hellyer Basalts are remarkably primitive, and attest to rapid crustal extension during their emplacement.
At this time, between the low-P_2O_5 Que Footwall Andesites, and the basalt-dominated Hellyer Basalt magmatism, the Que and Hellyer VHMS ore deposits accumulated on the seafloor.

RECOMMENDATIONS

1: All future drilling in the Que-Hellyer region should be followed up by continuous core grind assaying of all lava sections for Ti, Zr, Cr and P2O5. These elements successfully discriminate various lava units within the Hellyer Basalt, Que Footwall Andesites and Mixed Sequence, and facilitate interpretation of stratigraphic position and 'depth to Mixed Sequence'.

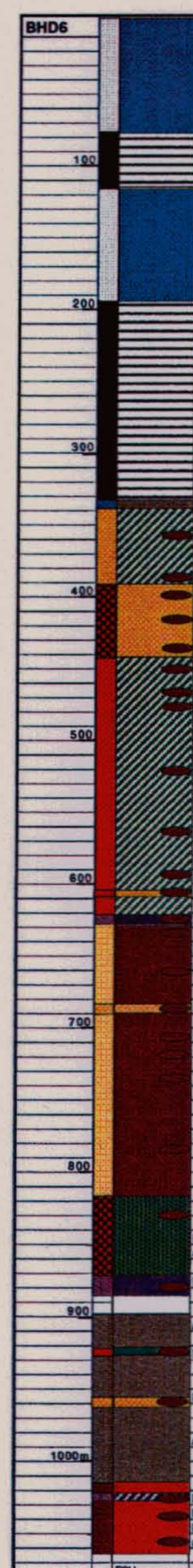
2: Shallowing of the Mixed Sequence around BHD3, plus the occurrence of common epiclastics in the only hole at High Point that reached the Mixed Sequence (BHD6), suggest that the poorly known region between BHD3 and HP3, and the area immediately west of BHD3, might be prospective drilling sites for Mixed Sequence-hosted Hellyer-Que type VHMS deposits. A significant gravity structure recorded 500m SW of BHD3 by Placer deserves further investigation.

3: Lateral impersistence of lava units in the immediate area of High Point (between BHD1 and HP3), due largely to intense faulting probably mainly related to the Mount Charter Fault zone, suggests that any VHMS deposit in this area might be heavily faulted and discontinuous along strike.

4: The dispersed zinc mineralization between Mount Charter and High Point may originate by hydrothermal activity associated with emplacement and cooling of the

Mount Charter Dolerite body. Fluids scavenged sulphides precipitated from Hellyer Basalt magmas following sudden sulphur saturation due to contamination of the basalts by a quartz-phyric intrusive sheet that extends NE from High Point. This explains the general distribution of the dispersed zinc, which follows the Mount Charter Dolerite distribution quite closely. The dispersed zinc mineralization is not thought to be related to remobilized VHMS lenses at depth beneath High Point.

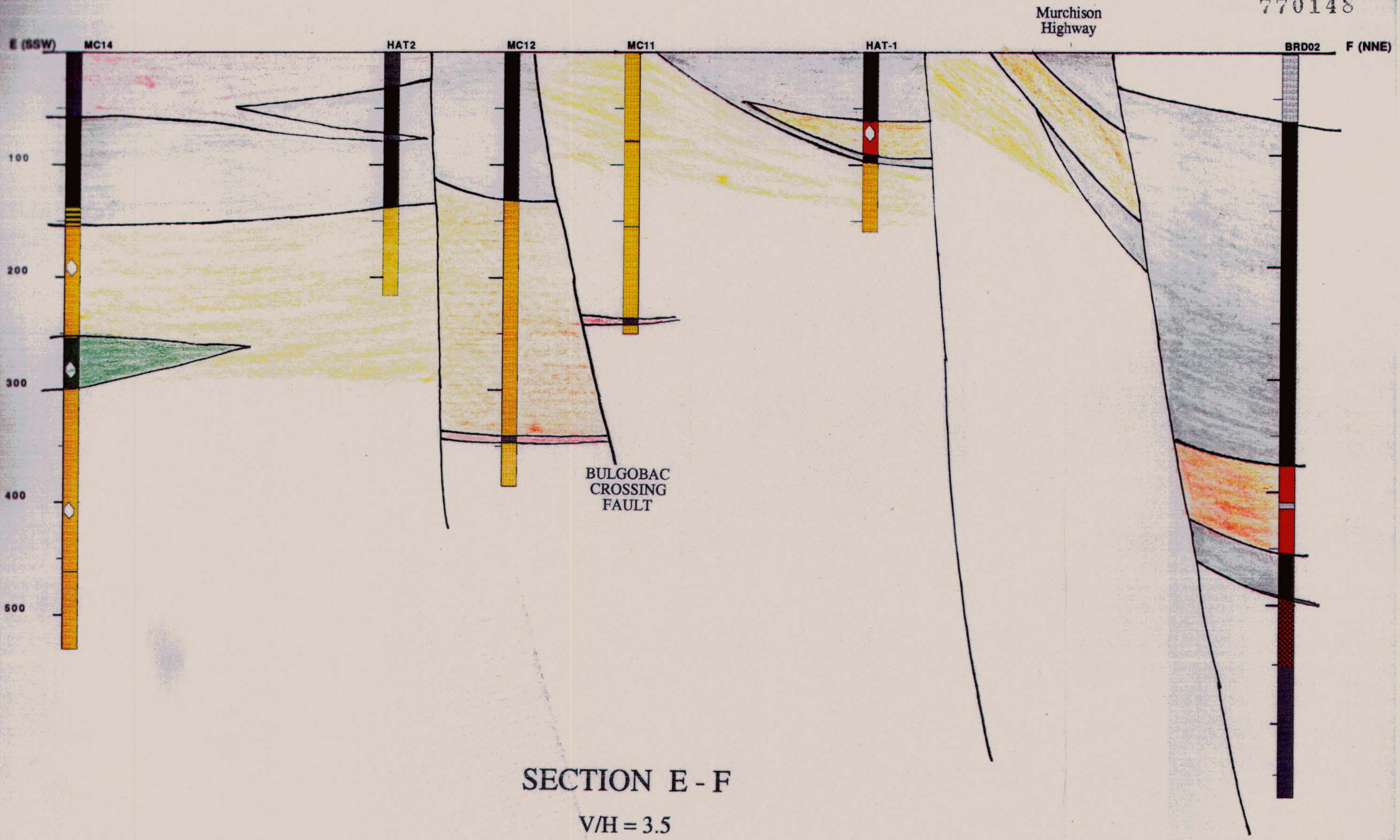
BHD6



Ti/Zr	Ti	Zr	Cr	P2O5%	TS sample No	Thin Section Depth	
22	3580	162	69	0.25	38146	359.7-359.9m	
22.1	3070	139	74	0.18	38147	384.5-384.6m	
17	3790	223	595	0.42	38148	398.6-398.9m	
17.2	3150	183	339	0.36	38149	412.6-412.9m	
16.7	3560	214	370	0.39	38150	435.9-436.2m	
21.6	3290	151	145	0.22	38151	459.6-459.9m	
22.9	2770	122	135	0.26	38155	466.6-466.9m	
22.2	3320	150	161	0.22	38152	477.6-477.9m	
					38161	488.5m	
					38162	499.7m	
21.6	3354	155	175	0.23	38163	521.4m	Sp. plag-phyric andesitic lava
21.3	3170	149	229	0.22	38165	562.6m	Sp. plag-phyric andesitic lava
21.2	3285	155	199	0.23	38166	593.1m	Sp. plag-phyric andesitic lava
18.4	3670	200	326	0.41	38167	604.1m	Aug+sp.ol-phyric basalt
33.9	4045	119	394	0.44	38169	622.5m	Ol+aug-phyric basaltic dyke?
5	4170	826	13	0.15	38175	633.6m	Dacitic lava breccia
5.3	3975	747	10	0.14	38170	658.9m	Sp. plag-phyric andesitic hyaloclastite
19.5	4620	237	913	0.59	38171	682.5m	Ol+aug-phyric basaltic lava
28.4	4420	156	249	0.37	38172	703.55m	Pl+hbd and clast in polymict lava bx
9.9	1980	198	12	0.12	38174, 38173	713.1m,716.8m	Polymict dacite lava breccias
9.5	2070	217	9	0.09	38176	733.9m	Spher. pl-phyric felsic lava
					38177	749.7m	Volcaniclastic lithic gwacke
9.5	1960	207		0.1	38179	780.85m	Spherulitic plag-phyric felsic lava
22.8	3420	150	922	0.37	38180	829.85m	Ol+aug-phyric vesicular basalt
33.1	3025	91	517	0.35	38181	879.7m	Aug+plag-phyric basaltic lava
					38182	904.0m	
22.8	3600	159	277	0.25	38183	920.8m	Holocrystalline aphyric basaltic andesitic dyke
17.7	1870	105	332	0.1	38184	958.0m	Pl+aug-phyric basaltic andesitic dyke
					38185	988.25m	
47	6920	120	57	0.4	38186	1022.3m	Sparsely pyx+ol-phyric basalt dyke
6.5	2745	402	4	0.05	38189	1037.1m	Pl+qtz-phyric rhyolitic intrusive
6.6	1475	224	19	0.04	38188	1055.5m	Pl+qtz-phyric rhyolitic intrusive

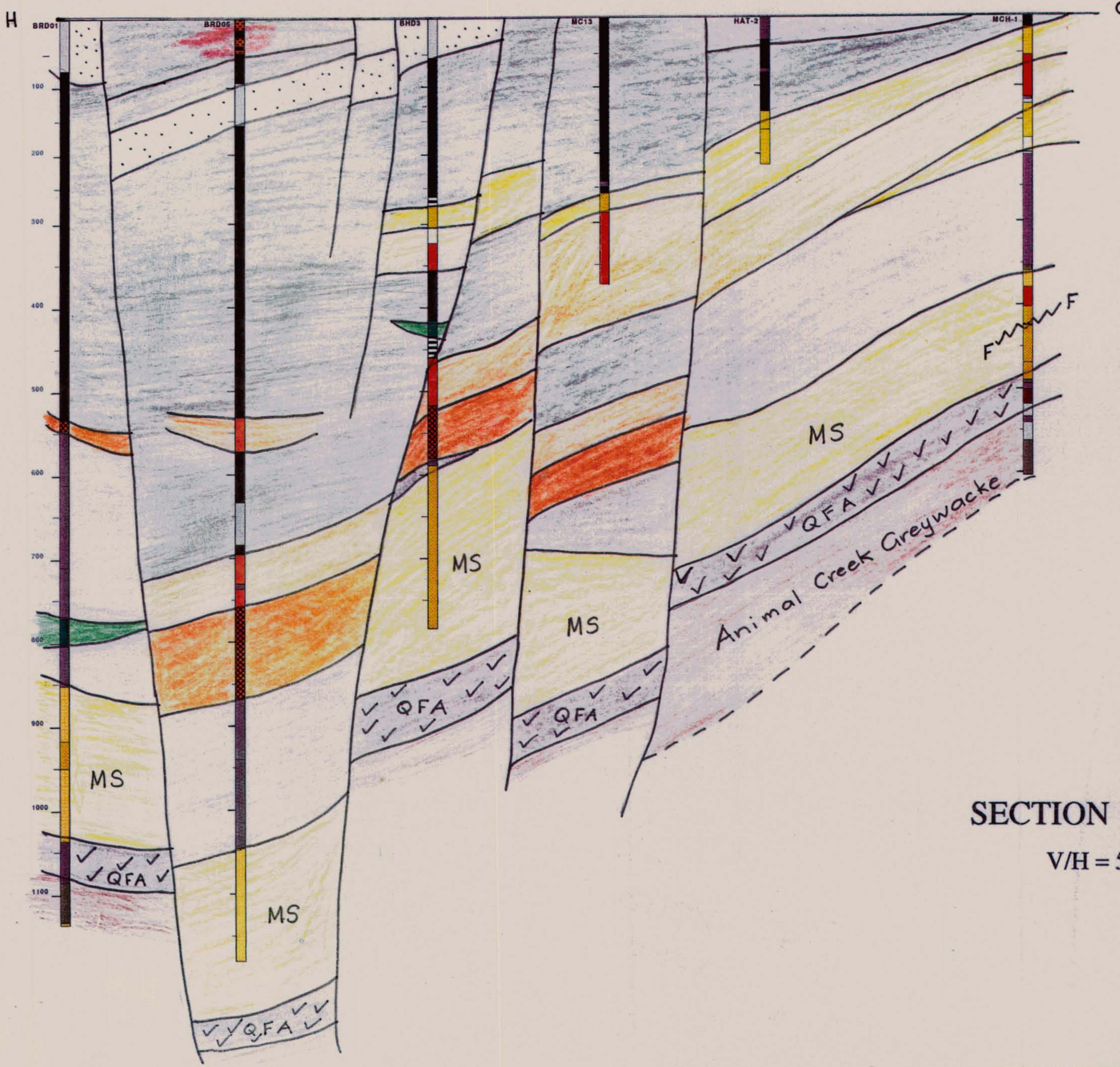
SAMPLE	38146	38147	38148	38149	38150	38151	38152	38155	38161	38162	38163	38164	38165	38166	38167	38169
Depth Information	359.7-35	384.5-38	398.6-39	412.6-41	435.9-43	459.6-45	477.6-47	466.6-46	488.5m	499.75m	521.4		582.65	593.1	604.1	622.55
SiO2	59.63	64.19	63.45	69.21	61.35	59.42	55.86	67.03	57.41	66.37	56.59	62.09	58.77	59.73	62.11	51.17
TiO2	0.59	0.51	0.63	0.53	0.59	0.55	0.55	0.46	0.56	0.47	0.56	0.50	0.53	0.55	0.61	0.67
Al2O3	18.43	17.23	15.06	12.38	13.62	17.19	17.62	14.42	17.93	14.62	18.23	16.27	16.93	18.03	13.73	15.77
Fe2O3	6.89	6.39	7.87	3.94	8.03	8.49	7.82	3.96	8.96	3.16	9.47	8.03	8.97	8.01	8.24	9.69
MnO	0.08	0.05	0.09	0.09	0.28	0.42	0.55	0.28	0.57	0.20	0.65	0.33	0.41	0.20	0.26	0.36
MgO	4.18	3.05	6.68	2.26	6.24	7.00	5.49	2.19	7.43	1.64	7.96	7.04	7.89	7.32	7.18	7.86
CaO	2.47	0.90	1.55	5.00	5.72	1.27	6.00	6.10	1.44	7.01	0.94	0.74	1.51	1.36	4.36	10.28
Na2O	7.32	6.96	4.02	3.89	3.43	5.28	4.97	2.80	5.03	4.44	5.20	4.47	4.62	2.57	2.42	2.45
K2O	0.17	0.53	0.22	2.34	0.33	0.16	0.89	2.69	0.45	1.77	0.17	0.29	0.14	2.00	0.68	1.12
P2O5	0.25	0.18	0.42	0.36	0.39	0.22	0.22	0.26	0.22	0.32	0.23	0.23	0.22	0.23	0.41	0.44
LOI	4.36	3.48	4.73	4.18	7.46	4.48	7.63	6.89	5.09	6.36	4.82	4.18	5.20	5.36	6.55	11.83
Cr	69	74	595	339	370	145	161	133	173	137	175	199	229	199	328	394
V	196	145	210	131	174	185	194	144	192	135	190	171	170	190	175	317
Zr	162	139	223	183	214	151	150	122	164	137	155	145	149	155	200	119
Nb	6	9	13	9	13	9	8	8	10	9	6	7	7	6	12	8
Y	27	14	27	23	28	18	24	18	17	23	17	18	20	23	29	22
Sr	302	176	206	362	203	201	250	116	236	170	190	178	143	78	121	174
Rb	6	18	7	41	11	6	32	95	18	62	6	9	4	72	23	46
Ba	121	220	140	1557	160	156	288	728	208	446	112	134	77	300	131	276
Cu	27	43	23	38	27	15	18	25	40	12	20	5	4	7	14	115
Pb	7	30	25	60	19	38	1159	51	214	49	65	17	3	9	25	31
Zn	109	78	124	121	125	202	1943	402	1209	332	387	138	155	193	141	129
Ti/Zr	22.05	22.09	16.97	17.23	16.65	21.65	22.16	22.81	20.50	20.61	21.61	20.70	21.26	21.21	18.37	33.93
Zr/Nb	25.83	14.78	17.67	19.33	16.50	16.00	19.71	16.14	17.22	16.00	24.50	19.86	20.14	24.50	16.91	15.14
Zr/Y	5.96	10.23	8.15	7.91	7.62	8.47	6.27	6.65	9.69	6.10	9.19	8.19	7.42	6.68	6.89	5.30
V/Zr	1.21	1.05	0.94	0.72	0.81	1.22	1.29	1.19	1.17	0.98	1.22	1.18	1.14	1.22	0.88	2.66
Ti/V	18.19	21.13	18.08	23.98	20.48	17.71	17.18	19.24	17.55	20.93	17.65	17.55	18.62	17.32	20.96	12.76

SAMPLE	38175	38170	38171	38172	38173	38176	38179	38180	38181	38182	38183	38184	38185	38186	38187	38189
Depth	633.6	658.9	682.5	703.55	716.8	733.9	780.85	829.85	879.7	904.0m	920.8	958	988.25m	1022.1	1055.5	1037.1
Information											Dyke in AC	Dyke in ACG				
SiO2	67.92	67.75	46.26	50.77	75.20	73.87	70.54	56.76	51.19	66.41	60.26	65.26	48.82	53.48	76.60	69.99
TiO2	0.70	0.66	0.77	0.74	0.33	0.35	0.33	0.57	0.50	0.30	0.60	0.31	1.15	0.46	0.25	0.44
Al2O3	15.70	14.87	13.06	20.83	12.19	14.36	15.19	9.95	16.24	12.80	14.39	13.44	18.04	15.54	10.16	18.30
Fe2O3	5.68	5.98	9.27	9.91	2.19	1.76	3.03	7.98	9.61	6.67	8.58	7.48	12.40	9.14	1.71	2.33
MnO	0.14	0.16	0.43	0.44	0.09	0.07	0.16	0.41	0.45	0.33	0.40	0.19	0.31	0.29	0.11	0.02
MgO	1.91	1.57	13.20	7.24	0.63	0.38	1.86	9.05	7.31	5.37	6.18	6.19	5.94	3.89	0.69	1.68
CaO	2.71	1.74	14.33	1.57	1.83	1.02	4.03	13.52	9.12	4.57	5.61	3.99	8.30	13.03	6.73	0.63
Na2O	1.96	3.00	0.25	2.45	2.87	6.01	0.41	1.07	4.90	1.42	1.99	1.71	3.76	1.29	0.89	0.85
K2O	3.15	4.13	1.81	5.68	4.55	2.10	4.34	0.31	0.32	2.02	1.73	1.32	0.88	2.74	2.84	5.70
P2O5	0.15	0.14	0.59	0.37	0.12	0.09	0.10	0.37	0.35	0.10	0.25	0.10	0.40	0.15	0.04	0.05
LOI	4.68	2.57	12.37	4.69	1.46	0.86	5.41	14.07	5.89	8.66	10.51	6.81	9.91	13.64	6.73	3.41
Cr	13	10	913	249	12	8	0	922	517	248	277	332	57	790	19	4
V	44	35	256	286	58	21	48		265	89	198	124	345	248	19	20
Zr	826	747	237	156	198	217	207	150	91	112	159	105	120	58	224	402
Nb	12	10	7	7	8	14	11	7	4	9	9	8	7	2	13	21
Y	37	36	28	22	20	33	31	21	23	15	21	17	36	37	37	40
Sr	125	298	141	329	371	325	65	266	490	34	81	63	108	88	58	36
Rb	118	114	82	124	114	54	163	11	10	77	67	57	41	117	118	258
Ba	627	3020	964	4587	3791	498	813	771	376	223	210	138	89	258	268	544
Cu	14	34	83	8	130	9	7	91	76	8	9	4	29	72	71	4
Pb	2	12	12	2	86	7	2	6	65	3	3	2	3	7	103	8
Zn	779	1497	134	102	433	1970	41	297	329	101	73	65	78	68	361	41
Ti/Zr	5.05	5.32	19.51	28.35	9.89	9.52	9.48	22.88	33.15	16.30	22.64	17.74	57.73	47.02	6.60	6.49
Zr/Nb	71.27	72.10	34.83	21.14	24.25	15.29	19.60	21.83	21.25	12.88	17.88	14.00	18.00	25.50	17.42	19.40
Zr/Y	22.40	20.60	8.36	7.05	9.70	6.69	6.76	7.28	4.05	7.36	7.53	6.13	3.38	1.59	5.97	9.95
V/Zr	0.05	0.05	1.08	1.84	0.29	0.10	0.23	0.00	2.91	0.80	1.24	1.17	2.88	4.25	0.09	0.05
Ti/V	94.21	112.85	18.04	15.43	33.66	97.06	41.30		11.41	20.47	18.19	15.12	20.05	11.05	76.80	132.52



SECTION E - F

V/H = 3.5



SECTION G - H

V/H = 5

APPENDIX 4

Additional Geochemical & Petrological Samples, Hole HP4/4A, High Point

PASMINCO EXPLORATION
DIAMOND DRILL CORE ASSAY DATA

HOLE No. HP4/4A

PROJECT: HIGH POINT, BULGOBAC HILL EL.

ASSAYS (ppm unless specified; Y/H → %)

Number	Type	From m	To m	Interval m	Recovered m	Cu / Pb	Zn / Ag	Au / As	Ba / Rb	Sr / V	Zr / Nb	Y / Cr	Al_2O_3 / SiO_2	TiO_2 / Fe_2O_3	MnO / CaO	K_2O / H_2O	P_2O_5 / SO_3	Na_2O / L.O.I.	COMMENTS
HOLE HP4:																			
038131	SPLIT HQ	195.7	197.5	1.8		892 / 10	51 / <1	<.008 / 124	641 / 134	107 / 250	99 / 5	34 / 261	12.48 / 40.9	0.56 / 4.42	0.71 / 15.12	4.05 / 3.35	0.394 / 1.77	0.26 / 16.35	Deformed, altered, brecciated mafic volc
HOLE HP4A:																			
038133	SPLIT NQ	200.1	200.65	0.55		52 / <3	29 / <1	<.008 / 49.5	725 / 130	80 / 287	105 / 5	22 / 265	13.02 / 41.1	0.57 / 4.75	1.00 / 12.73	4.07 / 4.53	0.362 / 0.25	0.30 / 17.55	Amygdaloidal mafic lava.
038134	" "	250	250.25	0.25		62 / 6	195 / <1	<.008 / 39.5	294 / 44	107 / 370	87 / 4	16 / 579	11.6 / 41.2	0.57 / 9.44	0.46 / 11.87	1.30 / 7.27	0.364 / 0.13	0.61 / 14.86	Block in breccia: amygdaloidal mafic lava
038135	" "	253	253.8	0.8		48 / 9	240 / <1	<.008 / 58.5	398										Mafic lava bx c̄ 50mm semi-massive py.
038136	¼ NQ	336	336.8	0.8		24 / 7	664 / <1	<.008 / 3.5	121 / <5	184 / 237	116 / 7	20 / 867	9.06 / 45.9	0.48 / 8.70	0.65 / 10.11	0.06 / 10.75	0.286 / 0.17	0.49 / 12.81	Chloritised basalt c̄ minor py.
038137	" "	363.4	364.1	0.7		96 / 5	198 / <1	<.008 / 4	169 / <5	<5 / 243	<5 / <3	<5 / 861	9.34 / 46.3	0.50 / 8.27	0.56 / 10.55	0.17 / 10.51	0.300 / 0.14	1.07 / 11.83	Chloritised basalt.
038139	SPLIT NQ	452	452.7	0.7		13 / <3	73 / <1	<.008 / 4	156 / <5	<5 / 140	<5 / <3	<5 / 280	12.66 / 64.0	0.29 / 5.16	0.20 / 3.93	0.37 / 2.88	0.181 / 0.25	5.51 / 4.48	Amygdaloidal feldspar-phyric mafic lava
038140	SPLIT BQ	504.4	505.5	1.1		216 / <3	80 / <1	<.008 / 2.5	296 / <5	<5 / 134	<5 / <3	<5 / 280	12.61 / 62.5	0.30 / 6.00	0.24 / 4.62	0.41 / 3.58	0.094 / 0.12	4.35 / 5.49	" " " "
038141	" "	557.7	558.35	0.65		71 / <3	108 / <1	<.008 / 4	485 / <5	<5 / 320	<5 / <3	<5 / 44	15.14 / 54.8	0.54 / 10.30	0.24 / 2.28	1.12 / 6.90	0.537 / 0.16	2.70 / 5.48	Hyaloclastite: amygdaloidal basalt
038143	SPLIT NQ	594.5	596.5	2.0		152 / 14	65 / <1	.013 / 74	733										Pyritic mafic peperite.
038144	" "	596.5	598.5	2.0		104 / 11	71 / <1	.009 / 50.5	487										" " "
038145	" "	598.5	600.0	1.5		108 / 15	73 / <1	.009 / 50.5	557										" " "
Laboratory	ANALABS, COOEE & PERTH			Analytical Method		AAS	AAS	FA / HA140	XRF	XRF	XRF	XRF	XRF	XRF	XRF	XRF	XRF	XRF	
Job No. PAS EX: 1455 / 111310.60.10364		Date 15.8.94		Detection Limit		2 / 3	2 / 1	0.008 / 0.5	10 / 5	5 / 5	5 / 3	5 / 5	0.05 / 0.1	0.01 / 0.01	0.01 / 0.01	0.01 / 0.01	0.005 / 0.01	0.05 / 0.01	

SAMPLE NUMBER: 038131 HP4A 196.5m
SUMMARY:

This sample is an intensely altered and recrystallized former mafic or intermediate volcanic that is so thoroughly altered and mineralogically reconstituted that very little trace of the primary mineralogy and texture is preserved. Occasional ghost patches of significant textural and grainsize change suggest that the sample was originally a lava breccia (rather than a lava brecciated during the intense alteration), and the absence of chromite and occasional suggestions of the former presence of plagioclase phenocrysts suggest that this rock may have been andesitic rather than basaltic. The alteration is a pervasive calcite-sericte±pyrite assemblage.

SAMPLE NUMBER: 038132 HP4A 198.25m
SUMMARY:

This sample is a strongly carbonate-altered quartz-mica greywacke dominated by angular detrital quartz, detrital muscovite flakes, occasional lithic clasts, and not uncommon small red chromite grains. The quartz is strained, often polycrystalline, and is almost certainly derived from pelitic metamorphics, as the same type of quartz occurs in quartz-muscovite schist lithic clasts. The matrix of this greywacke has been totally overprinted by carbonate alteration, and common stylolitic pressure solution bands defined by very fine-grained insoluble opaques are present, defining a very weak fracture cleavage. This is a typical Animal Creek-type greywacke that has suffered hydrothermal carbonate alteration.

SAMPLE NUMBER: 038133 HP4A 200.3m
SUMMARY:

This sample is extremely altered and rather difficult to diagnose with confidence. It was certainly basaltic in composition, as judged by the common small chromites. However, the texture was almost certainly holocrystalline, and now consists of a rather coarse-grained intergrowth of anhedral plagioclase (albite), chlorite, sericite and talc(?), all overprinted by abundant coarse carbonate. This sample is either a near-totally recrystallized basaltic lava, or more likely, a holocrystalline doleritic dyke.

SAMPLE NUMBER: 038134 HP4A 250.0m
SUMMARY:

This sample is a strongly altered quite prophyritic lava that may have been evolved basalt to basaltic andesite in composition. Former blocky to tabular plagioclase phenocrysts are common (>15-20 modal%) but have totally recrystallized to a rather patchy unusual albite charged with tiny chlorite (and carbonate?) spots. Former augite phenocrysts were much less abundant and are replaced by chlorite and calcite. Unlike the following samples, this sample contains common rather coarse-grained sericite in the recrystallized, strongly altered groundmass. The latter is composed mainly of albite microlites and laths in a chlorite-dominated matrix dotted with tiny equigranular leucoxene spots after FeTi oxides. At least one carbonate veinlet contains a few patches of yellow Fe-poor sphalerite. As for the next sample (038136), the alteration in this sample is hydrothermal in origin rather than being regional burial 'metamorphic' degradation.

SAMPLE NUMBER: 038136 HP4A 336.0m
SUMMARY:

This sample is an intensely hydrothermally-altered pillow basalt margin now composed essentially of chlorite, carbonate and minor silica. Textures are relatively well-preserved, and are typically quench textures with swallowtail plagioclases and altered acicular augites in chloritized glass. Rapid changes in grainsize and crystallinity suggest this is a pillow margin sample. Former phenocryst sites are obvious, but it is not clear, due to the strong alteration, whw=ether these were olivine or augite. Veinlets and spots of calcite occasionally have yellow sphalerite cores, sometimes with associated quartz. This was a fairly mafic basaltic lava that has suffered intense chlorite-carbonate alteration in a proximal hydrothermal system.

SAMPLE NUMBER: 038137 HP4A 363.4m
SUMMARY:

This sample is an intensely altered formerly strongly porphyritic primitive basaltic lava. It now has a weak foliation not evident in hand specimen, but defined in thin section by a flattening of phenocrysts and subparallel alignment of calcite and chlorite veinlets. Original phenocrysts included both olivine and augite, although alteration precludes determination of their original relative proportions. Small chromite microphenocrysts occur as discrete crystals and inclusions in chlorite-altered olivine. The groundmass was probably vitrophyric with small augite and plagioclase laths and microlites set in the glass. Intense carbonate-chlorite alteration pervades this distinctive sample, and is definitely hydrothermal in origin.

SAMPLE NUMBER: 038138 HP4A 398.3m
SUMMARY:

This sample is a massive plagioclase-phyric basaltic andesite with more abundant (~15 modal%) albitized plagioclase phenocrysts than in sample 038139. Clots of small intergrown albitized plagioclase phenocrysts occasionally contain chlorite-calcite-altered former small augite crystals. At least four quartz xenocrysts are present, all rounded resorbed grains with small chloritized melt inclusions. Surprisingly, three or four red chromite microphenocrysts are present in this section. The groundmass is relatively coarse-grained and conatins abundant tabular plagioclase laths and finer-grained microlites with interstitial anhedral quartz, albite and chlorite after glassy mesostasis. Narrow veinlets of quartz and calcite cut the sample, and stylolitic concentrations of insoluble oxides and leucoxenitic material are common.

SAMPLE NUMBER: 038139 HP4A 452.7m
SUMMARY:

This sample is a rather coarse-grained, sparsely plagioclase-phyric, evolved basaltic lava with not uncommon quartz-chlorite-calcite-filled vesicles up to 4mm across. Plagioclase phenocrysts are mainly 0.5-1mm long, albitized and some are slightly rounded and resorbed. A few chloritized former mafic phenocrysts are present, and a single rounded quartz xenocryst containing a crystallized former melt inclusion is clearly of felsic volcanic origin. The groundmass is rather heterogeneous in grainsize and texture, with abundant albite microlites and lathes set in a fine-grained quartzo-feldspathic intergrowth after glass. Minor carbonate alteration is present in the groundmass.

SAMPLE NUMBER: 038140 HP4A 505.5m
SUMMARY:

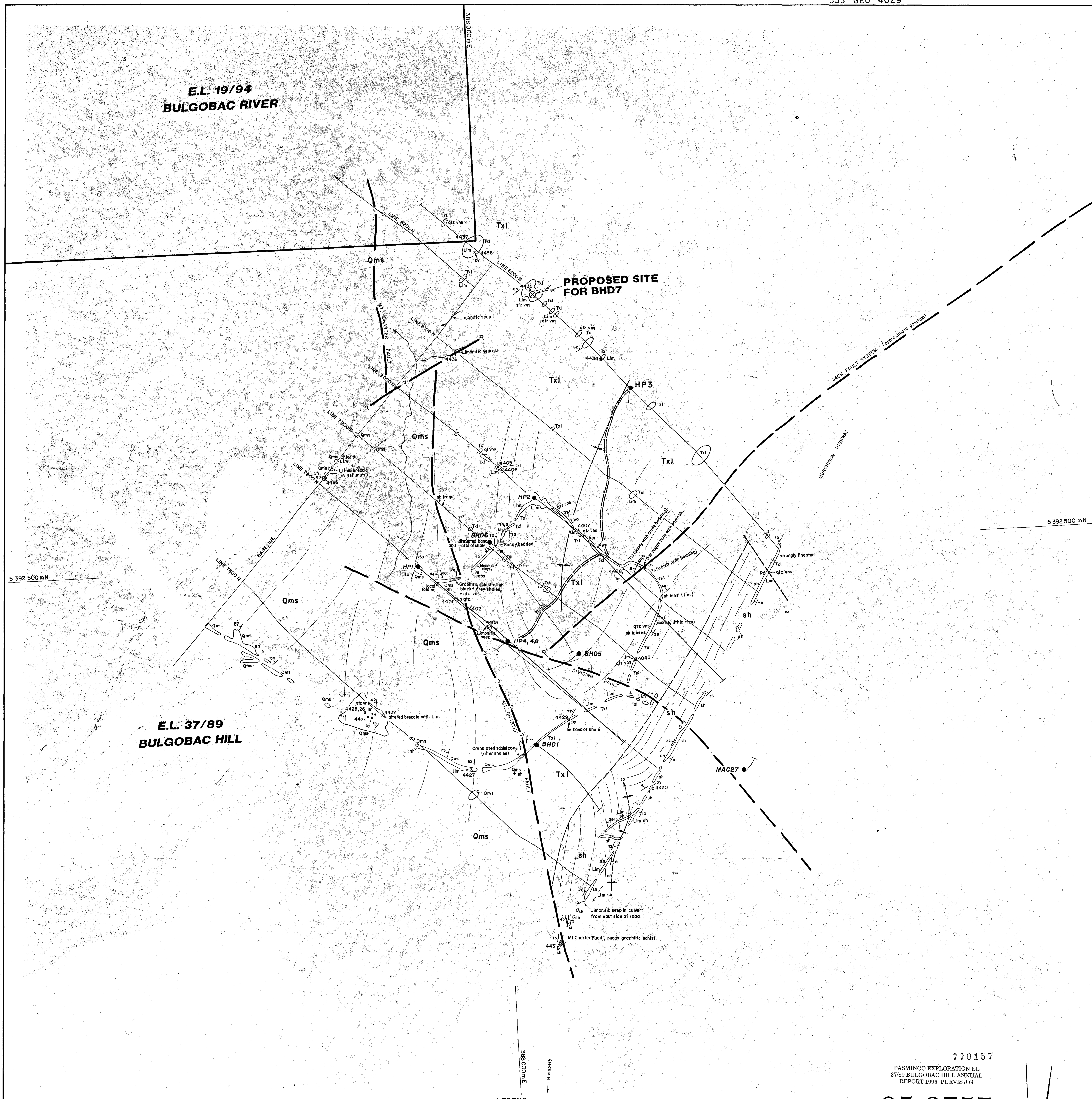
This sample is a rather evolved plagioclase-phyric basaltic lava with around 5-8 modal% of albitized plagioclase phenocrysts that mainly occur in clots of three or four crystals each less than 0.5mm long. Occasional small former mafic phenocrysts are replaced by calcite and chlorite, and were probably augite. Two definite quartz xenocrysts are present, although they are smaller and more rounded than in 038041. The groundmass of this sample is less altered than in 041, and is heterogeneous in texture and grainsize. It was probably weakly vesicular, spherulitic to vitrophyric, with plagioclase crystals ranging from microlitic to 0.1mm-long lathes. Vesicles are filled with chlorite and calcite, and occasional spots and patches of calcite in the groundmass clearly overprint former crystalline epidote aggregates. A single strained calcite veinlet transects the sample, but the metamorphic overprint on this lava is regional burial degradation rather than local hydrothermal in origin.

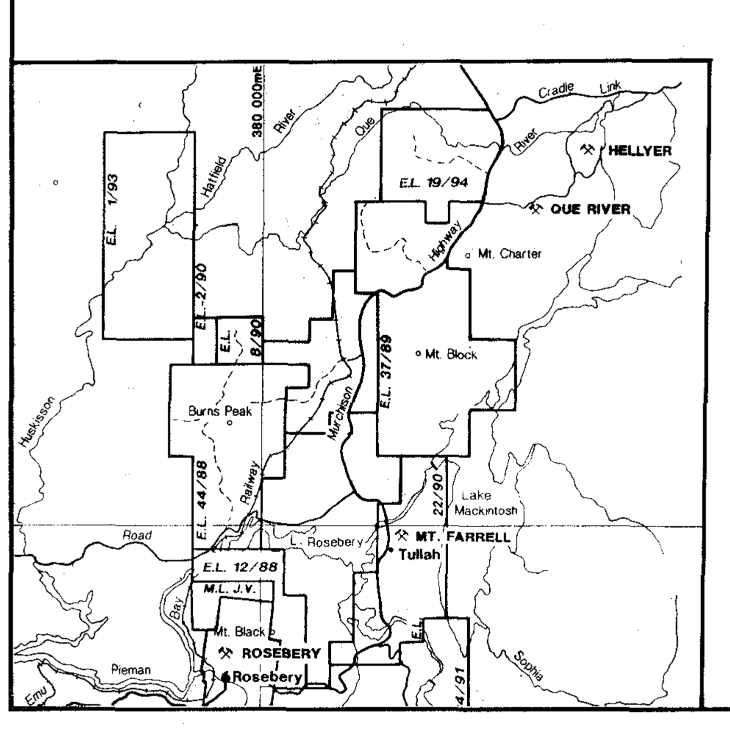
SAMPLE NUMBER: 038141 HP4A 557.9m Block in breccia
SUMMARY:

This sample is a weakly vesicular basaltic lava that is quite strongly pervasively carbonate altered, and veined by quartz-albite stockworks. Slightly reacted albitized plagioclase phenocrysts make up about 2-3 modal% of the rock and are moderately sericitized. Several 0.5-1mm-sized rather rounded quartz xenocrysts are present, and have shapes and altered melt inclusions indicating that were were phenocrysts in a felsic magma or lava before becoming incorporated into this rock. A few chlorite-silica-altered former mafic phenocrysts are present, and are thought to have been former olivine phenocrysts. Small vesicles are filled by radiating fibrous quartz and chlorite. The groundmass of this sample was quite glassy, with a coarse, almost spherulitic texture charged with tiny plagioclase and augite microlites. The strong carbonate alteration is more intense than regional metamorphic alteration, and presumably is of localized hydrothermal origin.

SAMPLE NUMBER: 038142 HP4A 586.1m
SUMMARY:

535-GEO-4029





LEGEND

WEST OF MT. CHARTER FAULT ZONE

CAMBRIAN

ANIMAL CREEK GREYWACKE

Qms — QUARTZ-MICA-LITHIC SANDSTONE
Often feldspathic. Intercalations of shale and siltstone. Unaltered. Occasionally weakly pyritic. Occasional qtz ± chlor veins.

EAST OF MT. CHARTER FAULT ZONE

SOUTHWELL SUBGROUP

Txl — CRYSTAL LITHIC SANDSTONE & BRECCIA
Epiclastic unit of rhyolitic and dacitic provenance. Varies from coarse lithic-rich breccias to sandy quartz-feldspar crystal rich sections, latter sometimes displaying bedding. Occas. lenses of dk grey silic shale and sltst. Weakly altered (sericitisation-bleaching-chloritisation-silicification) Weakly pyritic in places.

QUE RIVER SHALE

sh — *Finely bedded black and grey shale. Partly carbonaceous. Lesser siltstone and sandstone. Locally strongly pyritic*

MT CHARTER FAULT ZONE
Puggy, grey and black, partly graphitic SCHIST after black carbonaceous SHALES. Minor sandstone/siltstone intercalations.

- BHD5 — *Pasminco diamond drill hole*
- HP2 — *BHP diamond drill hole*
- 30 30 — *Bedding ; Schistosity*
- *Outcrop ; Suboutcrop*
- *Interpreted geological contact*
- *Trend lines ; Fault*
- *Synclinal axis with plunge*
- x4430 — *Grab rock sample (outcrop or float)*
- 4431 — *Chip sample.*

SCALE 1:2500 (Approx)
0 100 200 300 m

5 cm

770157

PASMINCO EXPLORATION EL 37/89 BULGOBAC HILL ANNUAL REPORT 1995 PURVIS J G

95-3757

Grid North (A.M.G.) 12° Mag. North

ABBREVIATIONS

sh	shale
s	sandstone
Lim	limonite, limonitic
py	pyrite
qtz vn	quartz vein

NOTE: After Purvis, BHP - 1988

PASMINCO EXPLORATION
A Division of Pasminco Australia Limited

COMPILED : J.G.P.	E.L. 37/89 - BULGOBAC HILL
DATE : Aug. 1988	HIGH POINT
DRAWN : M. Rosker	**GEOLOGY**
REF. :	
REVISIONS : J.G.P. 1994, 1995	
DRAWING No	SCALE 1:2500 approx. — FIG. No. 11

SOUTHWELL SUB-GROUP
QUE RIVER SHALE
QUE – HELLYER HANGINGWALL VOLCANICS
MIXED SEQUENCE
"FOOTWALL VOLCANICS"
ANIMAL CREEK GREYWACKE
CENTRAL VOLCANICS COMPLEX
700mR.L.
600mR.L.
500mR.L.
400mR.L.
300mR.L.
200mR.L.
100mR.L.
00mR.L.
-100mR.L.
-200mR.L.
-300mR.L.
BHD6
HP2
HP1
HP4,4A
BHD5
BHD1
SANDSTONE/BRECCIA
BLACK SHALE
FINE VOLCANICLASTIC SANDSTONE
PUMICEOUS BRECCIO-CONGLOMERATE
MAFIC BRECCIAS
MIXED MAFIC HYALOCLASTITE BRECCIAS
QUARTZ-PHYRIC ANDESITE HYALOCLASTITE BRECCIAS
ANDESITE HYALOCLASTITE BRECCIAS
ANDESITE PEPERITE BRECCIA
ANDESITE
VARIABLY-BRECCIATED ANDESITE
MIXED ANDESITE BRECCIAS
SANDSTONE
DACITE BRECCIAS
VOLCANIC BRECCIO-CONGLOMERATE
MINERALIZED DACITE BRECCIA
VOLCANIC EPICLASTIC BRECCIA
PARTLY-BRECCIATED AMYGDALOIDAL BASALTS
BASALT HYALOCLASTITE BRECCIA
SANDSTONE & BLACK SHALE
INTERCALATED ANDESITE & SANDSTONE/BLACK SHALE
MAJOR DUCTILE/BRITTLE FAULT ZONE IN SANDSTONE & BLACK SHALE
DEFORMED MAFIC VOLCANIC
STRONGLY DEFORMED & ALTERED RHYOLITE
PLAN - 1:2000
LEGEND
Strong ductile fault or shear
Strong brittle fault
Inferred or angle unknown
Measured
Cleavage
Bedding
Facing
Zones of disseminated sulphides
Significant assay intervals
Alteration
co carbonatised
chl chloritised
ser sericitised
si silicified
fuc fuchsitic
ble bleached
PASMINCO EXPLORATION EL 37/89 BULGOBAC HILL ANNUAL REPORT 1995 PURVIS J G
95-3757
770158
PASMINCO EXPLORATION
A Division of Pasminco Australia Limited
COMPILED : J.G.P.
DATE : Dec., 1994
DRAWN : G.M.B.
REVISIONS : J.G.P.
DATE : August 1995
E.L. 37/89 – BULGOBAC HILL
HIGH POINT PROSPECT
SECTION THROUGH
BHD6
BEARING 132° AMG
FILE : BHD6_A0
DRAWING No.
SCALE 1:1000
FIG. No. 12