RGC Exploration

ACN 001 426 946

ANNUAL REPORT

TASMANIAN BASE METALS PROJECT

EL47/96

BOCO SIDING / NORTH PINNACLES

Vol 1 of 3
Text and Appendices 1-3

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24 March, 1998

PROSPECTS: Boco Siding - North Pinnacles

MAP SHEETS:	**1:25,000: Block**	**1:100,000: Sophia**
GEOGRAPHIC COORDS	**Min East: 377000mE** **Min North: 5384000mN**	**Max East: 385000mE** **Max North: 5391000mN**

COMMODITY(s): Pb, Zn, Cu, Au, Ag

KEY WORDS: Boco Siding, North Pinnacles, Alteration, Volcanic Massive Sulphides, Tyndall Group Correlates

Distribution:

o RGC Exploration Information Centre Reference:

SUMMARY

Exploration activities carried out on EL 47/96 for the reporting period consisted of an initial literature review and report on previous exploration, geophysical interpretations, mapping, and geochemical surveys involving rock chip and soil sampling.

Focus was targeted on a NE trending magnetic complex in the north west area of the tenement. This magnetic complex thought to be Tyndall Group correlate rocks closely resembling the Lynchford Tuff, an andesitic-dacitic crystal rich sandstone which is type sectioned south of Queenstown. Initial investigation on the ground revealed that the rock found in outcrop along a track that leads to Silver Falls did indeed closely resemble the Lynchford Tuff and that further thin section and lithgeochemical analysis by past explorers supports a correlation (McKibben 1993, Pasminco 1993).

Soil sampling over the residual soils covering the outcropping sandstone unit gave disappointing results with peak responses of 50ppm Cu, 374ppm Zn and 233ppm Pb corresponding to rock chip sample # W263060 taken on a manganiferous altered version of the sandstone which yielded 838ppm Pb and 154ppm Zn.

Lithogeochemical analysis of selected rock types throughout the tenement showed that rhyolitic to andesitic rocks are present within the tenement with Ti/Zr ratios from 5.4 to 45.4 present. Basemetal results of 0.99% Pb in sample # 253059 were encounted at the contact of the Pinnacles rhyolite and Dundas Group sediments as well as elevated Pb and Zn results from sample # W263060 mentioned above.

Mapping of the prospect at 1:5000 scale revealed rhyolitic-dacitic lavas, intrusives and sediments of the Central Volcanic Complex, volcanogenic sediments and quartz - feldspar porphyries of the Dundas Group and andesitic feldspar crystal rich sandstones of what is interpreted to be a Tyndall Group correlate the Lynchford Tuff.

In light of extensive previous exploration work at the Boco alteration zone and at North Pinnacles. It was decided that these areas did not warrant further attention with regards to ongoing exploration.

Exploration for the 1998-99 field season will focus on further exploration east of the Silver Falls area where interpreted Tyndall Group, particularly the Lynchford Tuff correlate is present. Further grid cutting to facilitate access for additional mapping and or geochemical sampling / geophysical surveys is envisaged, and with further encouragement, infill mapping and geochemical surveys will be employed to generate targets for drilling.

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Appendix 5 Volcanic Facies and Hydrothermal Alteration at the Boco Prospect, EL 47/96, Tasmania

1.0 INTRODUCTION

233006

Exploration lieence 47/96 was granted to RGC Exploration on 11th April 1996 for an initial term of five years. The tenement is located approximately 10 kilometres north west of the township of Tullah on the west coast of Tasmania. (Fig 1).

Access is via the Murchison Highway to the Boco Siding turn off and then unsealed tracks and roads maintained by the Forestry and Emu Bay Railway.

Vegetation consists of button grass plains in the eastern portion of the tenement to hilly tea tree scrub and temperate rainforest to the west.

EL 47/96 Boco - North Pinnacles was aquired by RGC Pty Ltd to ascertain if suitable stratigraphy and rocktypes exist for the development of volcanic hosted massive sulphide mineralisation (VHMS). Models driving the exploration effort are Rosebery type VHMS base metal and Henty style gold mineralisation.

2.0 LAND TENURE

Exploration Licence 34/96 comprises :- State Forest - Multiple Use Forest Land
Land vested in HEC

3.0 REGIONAL GEOLOGY

EL 47/96 is covered largely by Cambrian rocks of the Mt Read Volcanics. These consist of rhyolitic to dacitic lavas intrusives and associated volcanoclastics of the Central Volcanics Complex (CVC), cross cut by mafic dykes and sills, and Dundas Group rocks consisting of sedimentary, fine to coarse grained turbidite sequences and intrusive quartz - feldspar phyric porphyries and lavas. Quaternary glacial till represents a large portion of the south eastern part of the exploration licence.

The main areas of focus for previous exploration have been at the contact or near contact of the CVC and Dundas Group. Two areas of more intense focus have been at:-

a) the Boco Alteration zone that consists of a series of ryholitic to dacitic lavas, intrusives and volcanoclastics which have been extensivly quartz-serecite-pyrite altered.

b) The North Pinnacles area and the contact of the Pinnacles Rhyolite and the Dundas Group and geochemically /geophysically anomalous zones within the rhyolite.

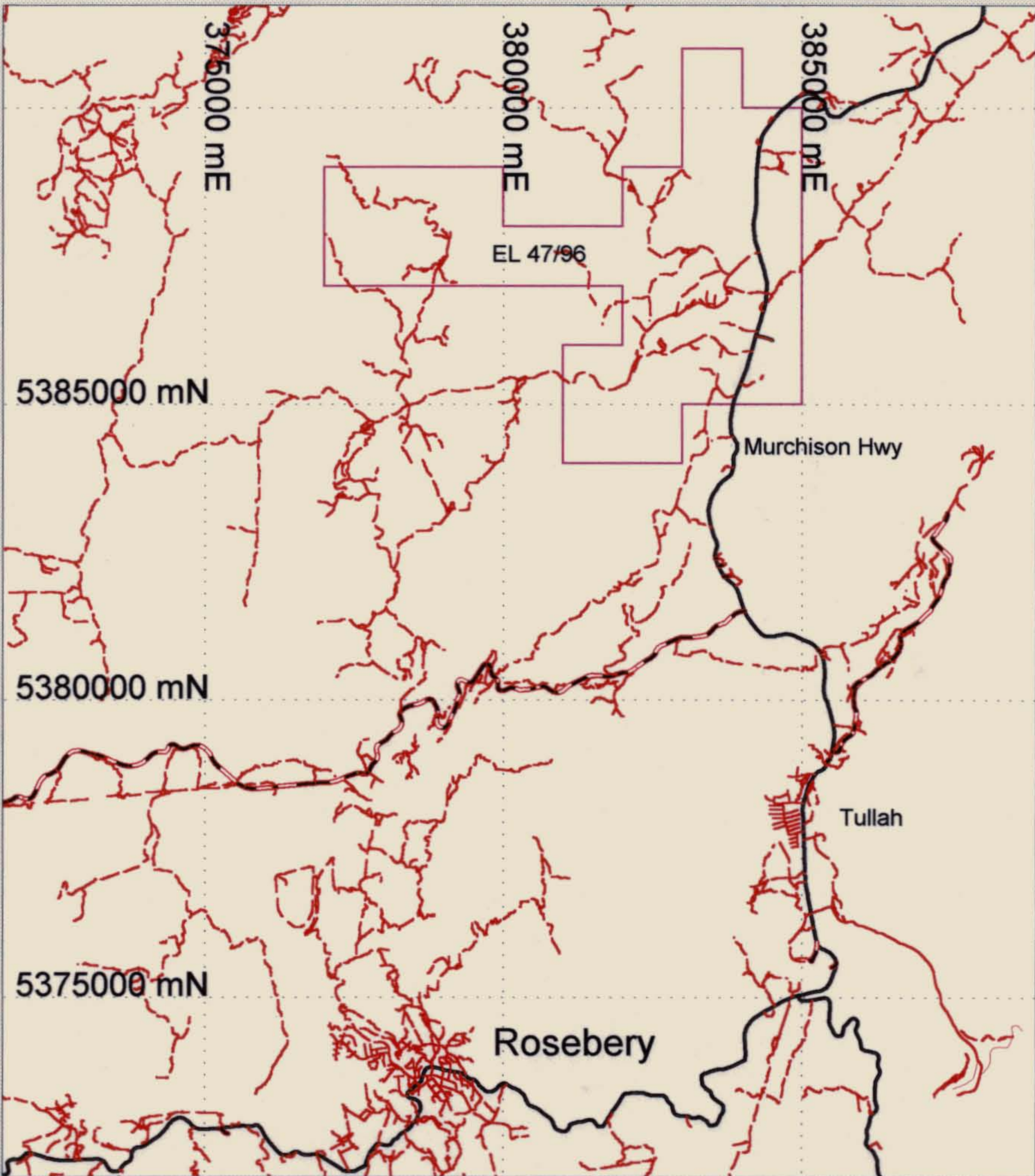
In the Silver Falls area just outside the western most Boundary of EL 47/96 a crystal rich quartz - feldspar phyric sandstone of the Dundas Group has been mapped. This marker unit can also be observed from previous mapping on both the western and eastern edges of the Pinnacles rhyolite south of the EL.

Poltock in 1993 described this unit as the representation of what he called the "Silver Falls Syncline". A repetition of the syncline can also be interpreted to the east of the Pinnacles Rhyolite with the eastern limb trending north of Boco Road into EL 47/96. Structural readings throughout the area both west and east of the Pinnacles rhyolite, also seem to support this.

RGC Exploration

238007

EL 47/96
Boco / North Pinnacles



5 cm

Scale = 1:100,000

Figure 1

Structurally the tenement exhibits a number of linear features that can be seen on the regional magnetics of the area.

A large demagnetised SSE-NNW linear feature, coincident with the Boco alteration has been interpreted to represent a zone of magnetite destruction. Intersecting this dominant structure are several other structures with a dominant NE-SW trend (Dauth 1997).

Another large scale magnetically anomalous linear signature trending NW-SE in the North Pinnacles area is also present on the regional magnetics. RGC geophysicists have interpreted it to be either:-

a) a large late mafic dyke.
b) magnetite/pyrrhotite alteration along a major structure.
c) a pre-existing structure intruded by a mafic dyke.

Due to the lack of displacement of surrounding magnetic stratigraphy, a mafic dyke scenario seems most likely.

For further detailed geophysical interpretation an, RGC internal report by Dauth 1997 is attached as Appendix 2 as both written text and associated figures and plans.

4.0 PREVIOUS EXPLORATION

During the reporting period RGC Exploration contracted W. Herrmann to conduct a comprehensive literature review with regards to exploration history and potential. The report has been attached as Appendix 4.

5.0 WORK COMPLETED 1996-1997

5.1 Literature Review

During the year RGC contracted W. Herrmann from Walter Herrmann Geoscience Pty Ltd to conduct a review on previous exploration and potential prospectivity of the entire EL and volcanic facies and hydrothermal alteration at Boco in March-April 1997. Both these reports are attached as Appendix 3 and 4 respectively.

Initial findings by Herrmann concluded that the alteration zone at Boco had sufficient exploration coverage (both geochemical and geophysical) not to warrant further work on the Boco alteration zone. To add to this, isotopic studies showed that temperature of formation for the hydrothermal fluids parent to the alteration were not hot enough (~200 °C) to transport economic amounts of ore forming sulphides. Further technical disscussion on Hermmann's findings can be seen in Appendix 5.

Findings for the North Pinnacles area were similar with drilling, geochemical and geophysical coverage of the prospective contact between the Pinnacles Rhyolite and the Dundas Group of sediments offering limited scope for further exploration.

5.2 1:5000 Mapping

1:5000 scale mapping was conducted over the tenement in an effort to establish continuity with previous maps and redefine areas of interest and or doubt. To achieve this a collage of past explorers, Mines department and inhouse mapping and interpretation was utilised to gain a regional and local geological picture of the licence and surrounds.

Results of the mapping as a rule confirmed that of previous explorers. The contact of the Lower Dundas Group and the CVC could be seen in a number of locations. Obviously the contact with the Pinnacles Ryholite in the western part of the tenement can be observed but other less obvious sites can be seen at :-

- 5385500mN / 380500mE - outside western part of tenement on Boco Road.
- 5386800mN / 382400mE - central area of EL 47/96 on existing track off Boco Road.
- 5387200mN / 383800mE - near rail line (eastern most exposure).

The trace of the contact therefore trends NE from the Pinnacles area through the central portions of the licence and on into the Animal Creek area.

A large magnetic complex east of Silver Falls has been correlated to Tyndall Group rocks with the magnetic trace and associated outcrop likened to the Lynchford Tuff south of Queenstown. Comparative petrological studies by Pasminco and lithogeochemical analysis by McKibben in 1993 seem to support this. It could therefore be stratigraphically interpreted that this magnetic unit is in fact a Tyndall correlate (Mt Cripps Subgroup ?), with outcrops in the core of the Silver Falls Syncline (Southwell Subgroup) as described previously in Section 3.0 and Poltock 1993. Further detail is portrayed as Plans 1 and 2 within this report.

5.3 Rock chip Geochemistry

In order to classify and distinguish certain rock types on EL 47/96, lithogeochemical sampling was undertaken on those rocks thought to be chemically distinctive. Multielement analysis was achieved using neutron activation, atomic absorbtion and X-ray fluorescence methods. Analytical details as follows:-

Table 1:- Analytical Methods

Method	Elements
AAS (A101)	Cu,Pb,Zn,Ag
XRF (X401)	P,Zr,V,Ti
Neutron Activation (N701)	Au,Ag,As,Ba,Br,Ca,Ce,Co,Cr,Cs,Eu Fe,Hf,Ir,K,La,Lu,Mo,Na,Rb,Sb,Sc,Se Sm,Ta,Te,Th,U,W,Zr,Yb

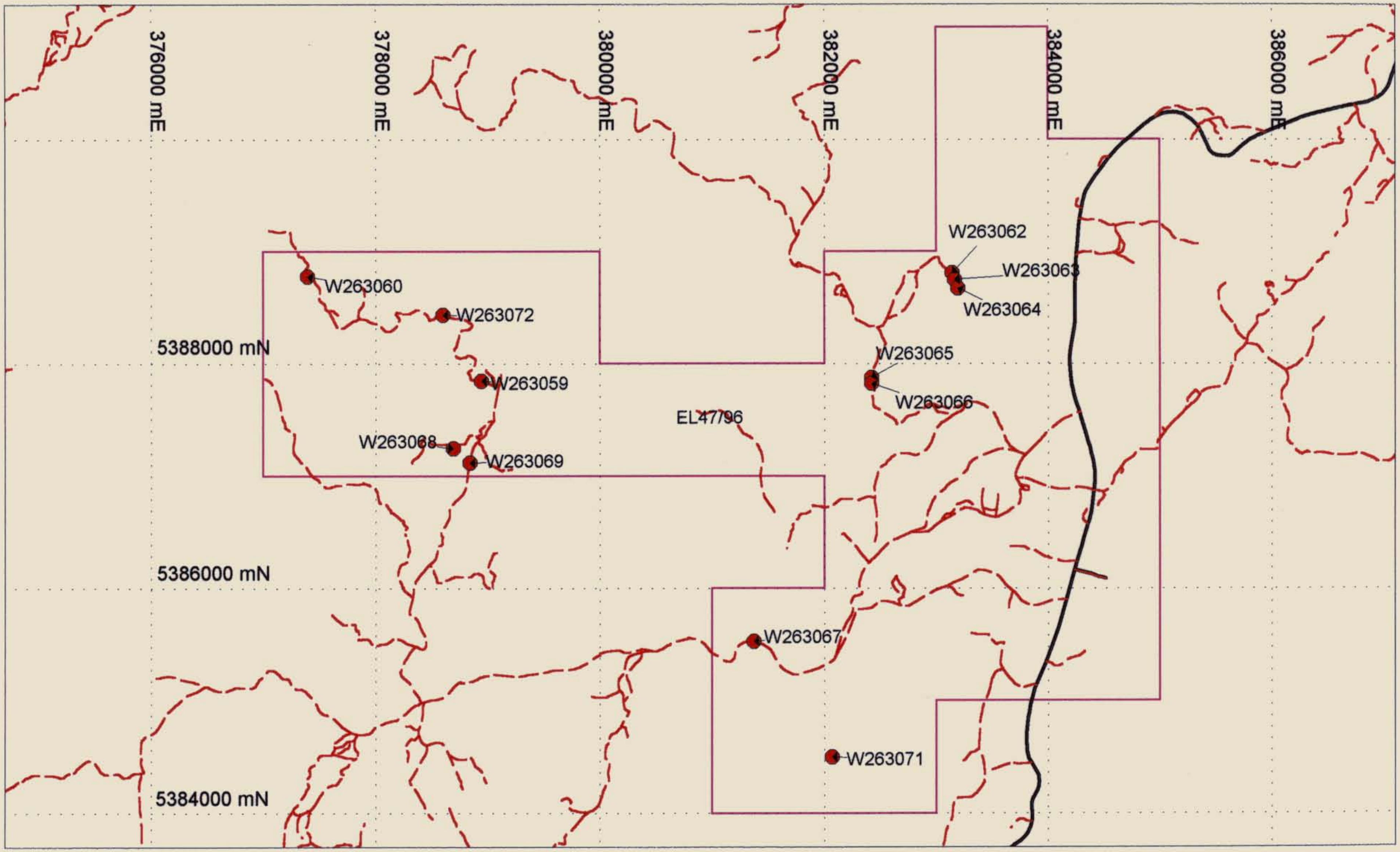
Sample # W253059 returned a result of 0.99 % Pb at the manganiferous contact of the Pinnacles Rhyolite and Lower Dundas Group sediments. Due to the widespread anomalism at this contact and the amount of previous exploration effort directed at it, the result was not considered to be of any real encouragement.

BOCO - NORTH PINNACLES - ROCK CHIP SAMPLE LOCATIONS

5 cm

1:50,000

FIGURE 2

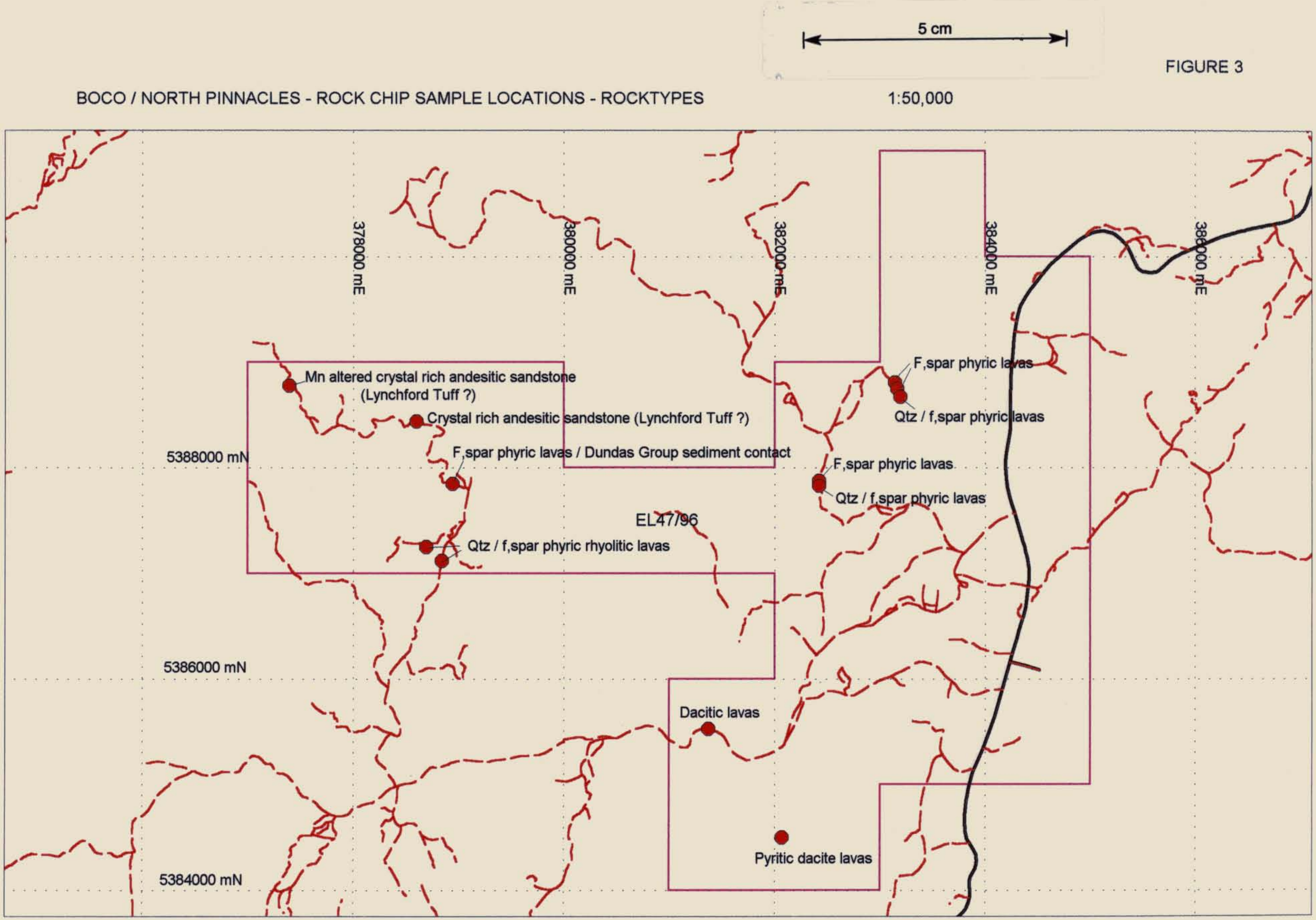


233011

FIGURE 3

BOCO / NORTH PINNACLES - ROCK CHIP SAMPLE LOCATIONS - ROCKTYPES

1:50,000

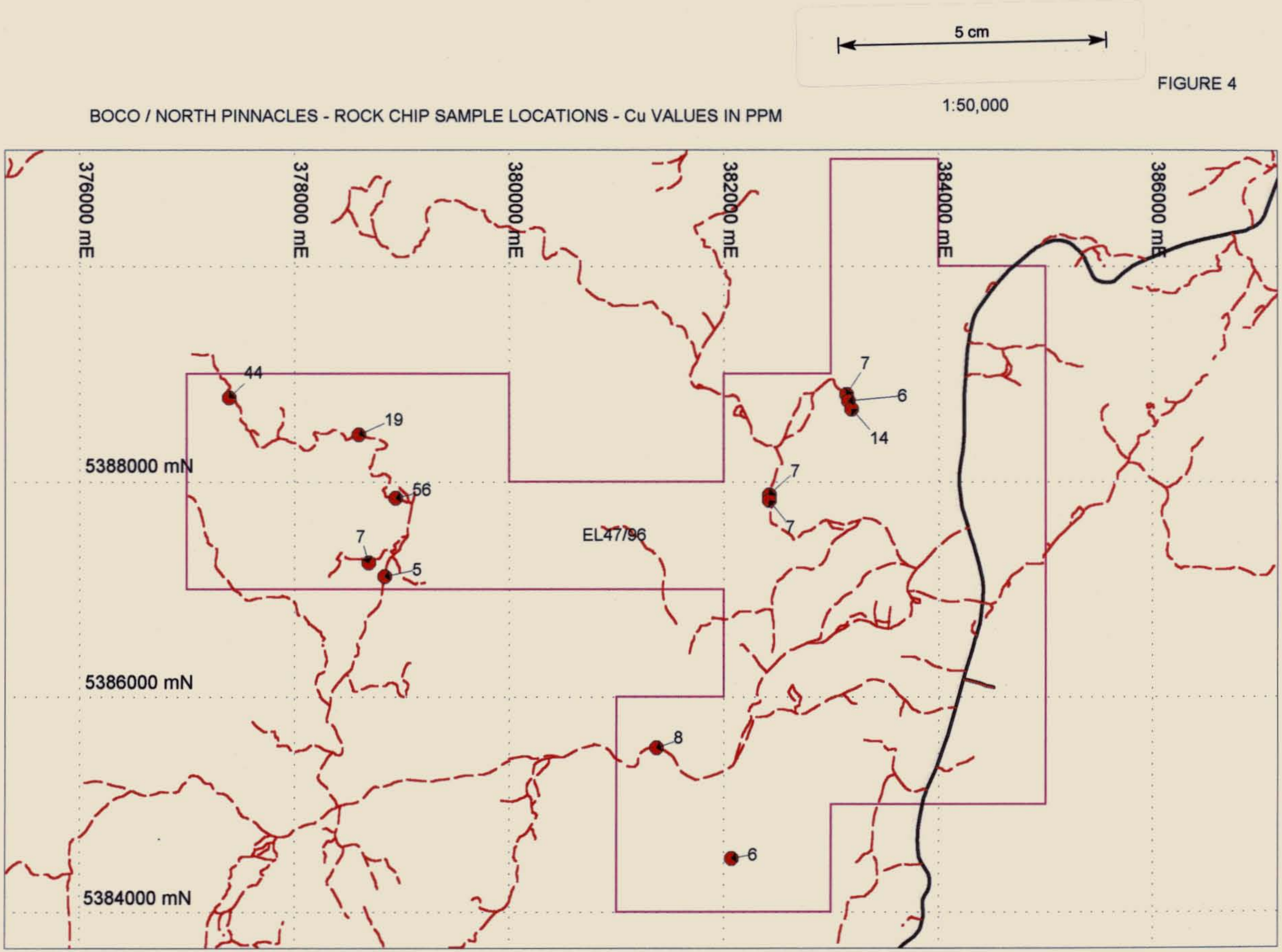


233012

FIGURE 4

1:50,000

BOCO / NORTH PINNACLES - ROCK CHIP SAMPLE LOCATIONS - Cu VALUES IN PPM

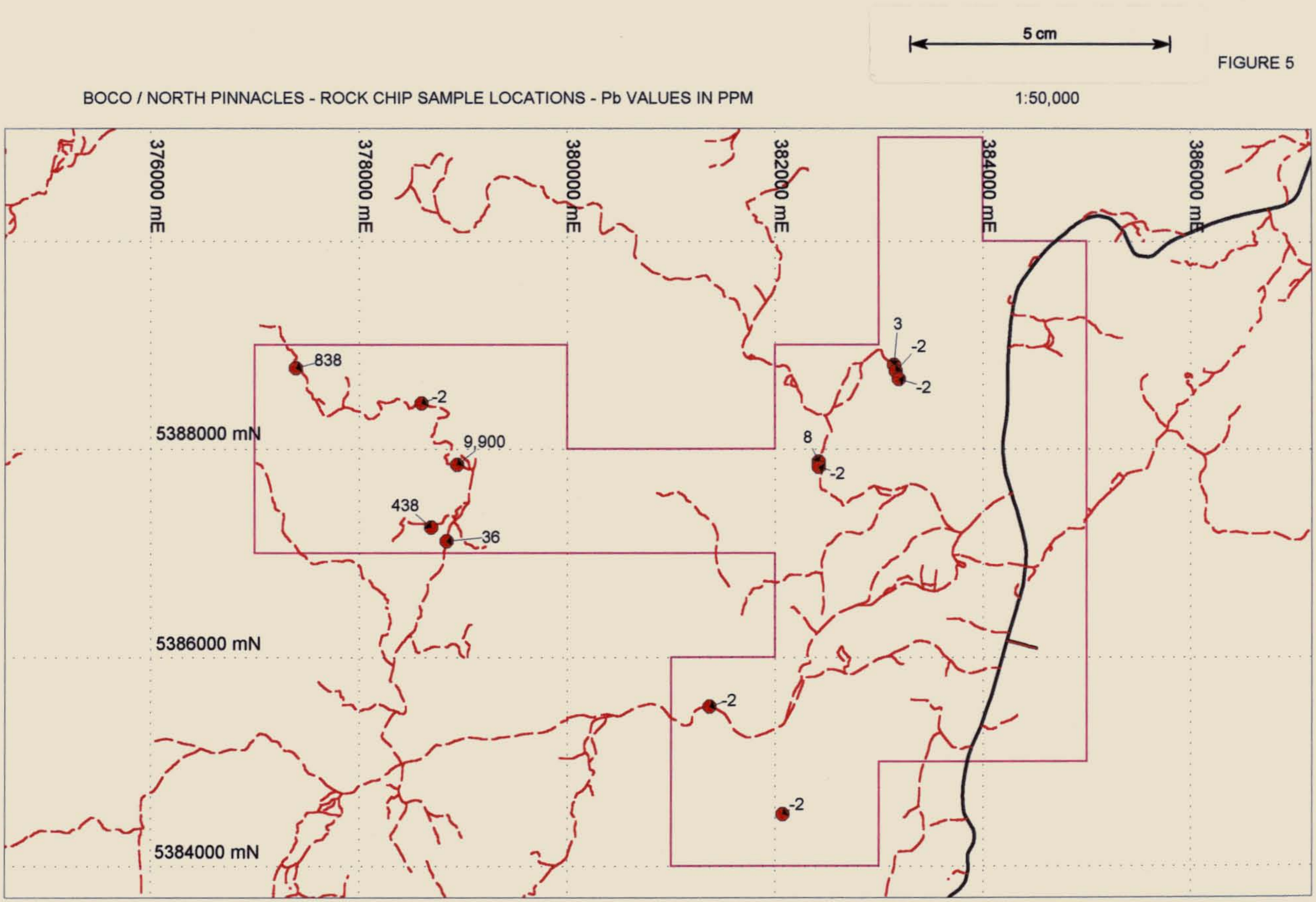


238013

FIGURE 5

BOCO / NORTH PINNACLES - ROCK CHIP SAMPLE LOCATIONS - Pb VALUES IN PPM

1:50,000



238014

FIGURE 6

BOCO / NORTH PINNACLES - ROCK CHIP SAMPLE LOCATIONS - Zn VALUES IN PPM

5 cm

1:50,000

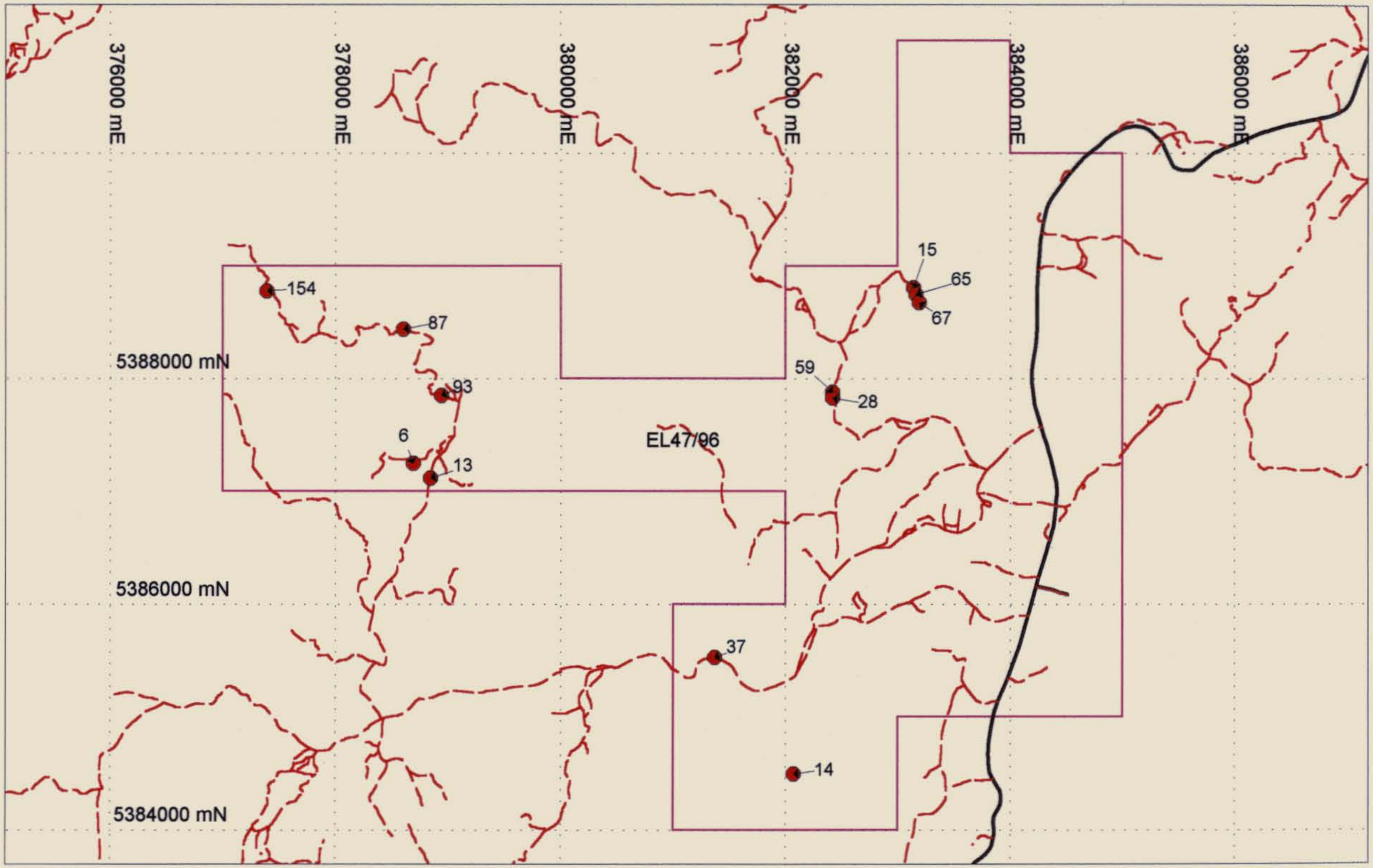
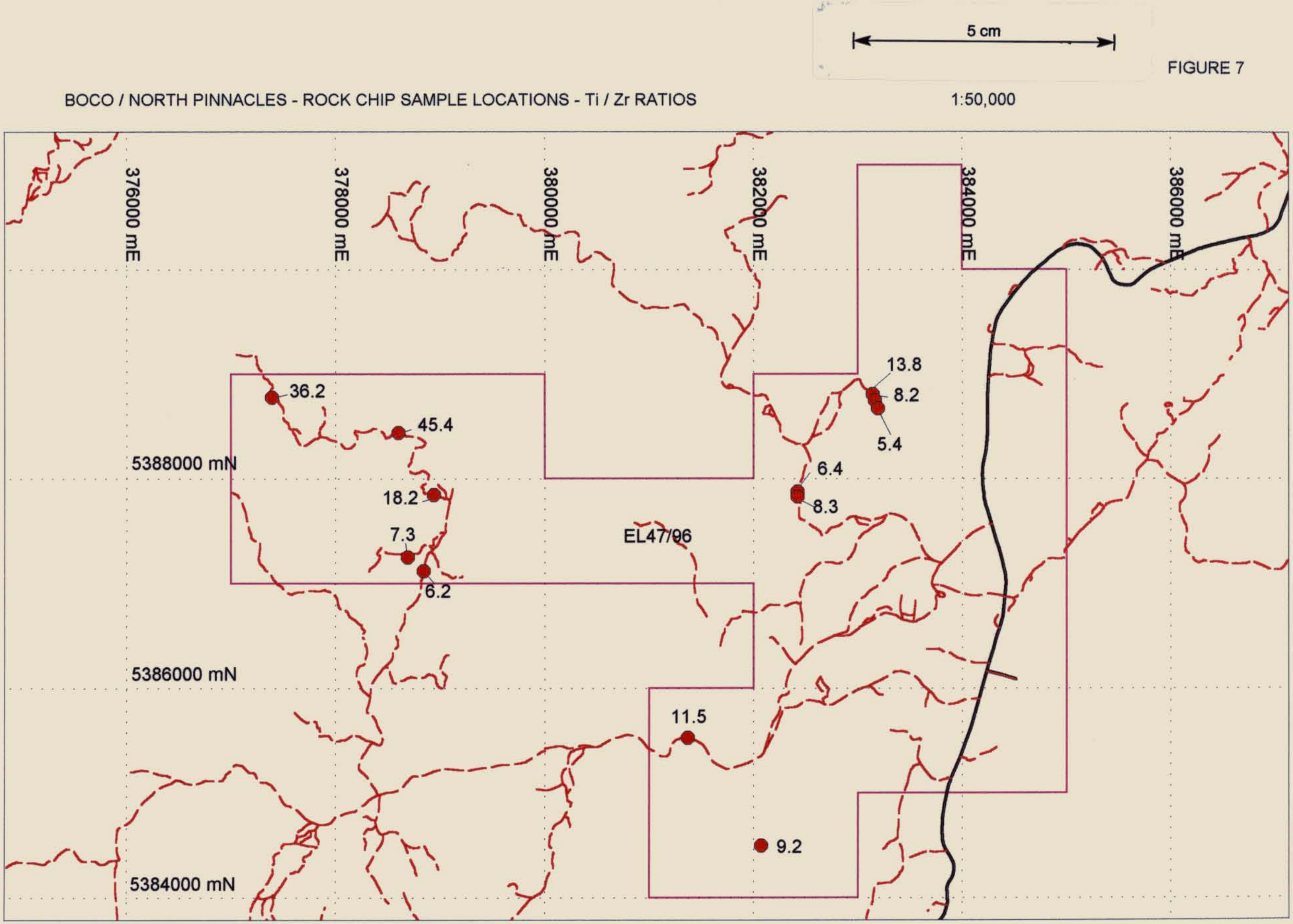


FIGURE 7

BOCO / NORTH PINNACLES - ROCK CHIP SAMPLE LOCATIONS - Ti / Zr RATIOS

1:50,000

238015



Lithogeochemically rocktypes in the Boco - North Pinnacles area showed rocks of andesitic through to rhyolitic composition. Ti / Zr ratios for the fresh unaltered crystal rich sandstone thought to be a correlate of the Lynchford Tuff gave a value of 36.2 hence a distinctly andesitic signature. The Central Volcanic Sequence of rocks and lavas and intrusives from the Dundas Group had a range of Ti/Zr ratios from 5.4 to 11.5. This is indicative of ryholitic to dacitic compositions.

Sample locations, field descriptions, Cu, Pb, Zn values and Ti/Zr ratios are shown as figures 2 - 7 with further analytical data is attached as Appendix 1.

5.4 Soil Sampling

A total of twenty four C horizon soil samples (W263059-60, W263062-69 & 71-72) were taken on 20m centres along those parts of the track leading to Silver Falls where residual soils, subcrop and some outcrop of the look alike Lynchford member is present. The samples were obtained by using a hand auger for approximately 2.5 kg of residual soil.

The aim of this survey was to observe if any obvious geochemical anomalism resulted with regards to basemetals and gold. Again neutron activation and AAS methods (as in Table 1), were used for analysis.

Results gave disappointing results with peak responses of 50ppm Cu, 374ppm Zn and 233ppm Pb corresponding to rock chip sample # W263060 taken on a manganese altered version of the sandstone which yielded 838ppm Pb and 154ppm Zn. Although these Zn and Pb responses could be considered elevated it is probably due to surficial enrichment.

Sample sites and Pb, Zn values can be seen as Figures 8 - 10 and analytical data is attached as Appendix 2.

5.5 Geophysical Interpretation

To aid in geological interpretation RGC geophysicists in Perth conducted an open file magnetic interpretation of EL 47/96. Some mention of the findings are in Section 3 and further details can be seen as Appendix 3 in the format of an internal report.

6.0 FUTURE EXPLORATION

Exploration for the 1998-99 field season will focus on further exploration east of the Silver Falls area where interpreted Tyndall Group, particularly the Lynchford Tuff correlate is present.

Further grid cutting to facilitate access for further mapping and or geochemical sampling / geophysical surveys. With further encouragement it is envisaged that infill mapping and geochemical surveys will be employed to generate targets for drilling.

238017

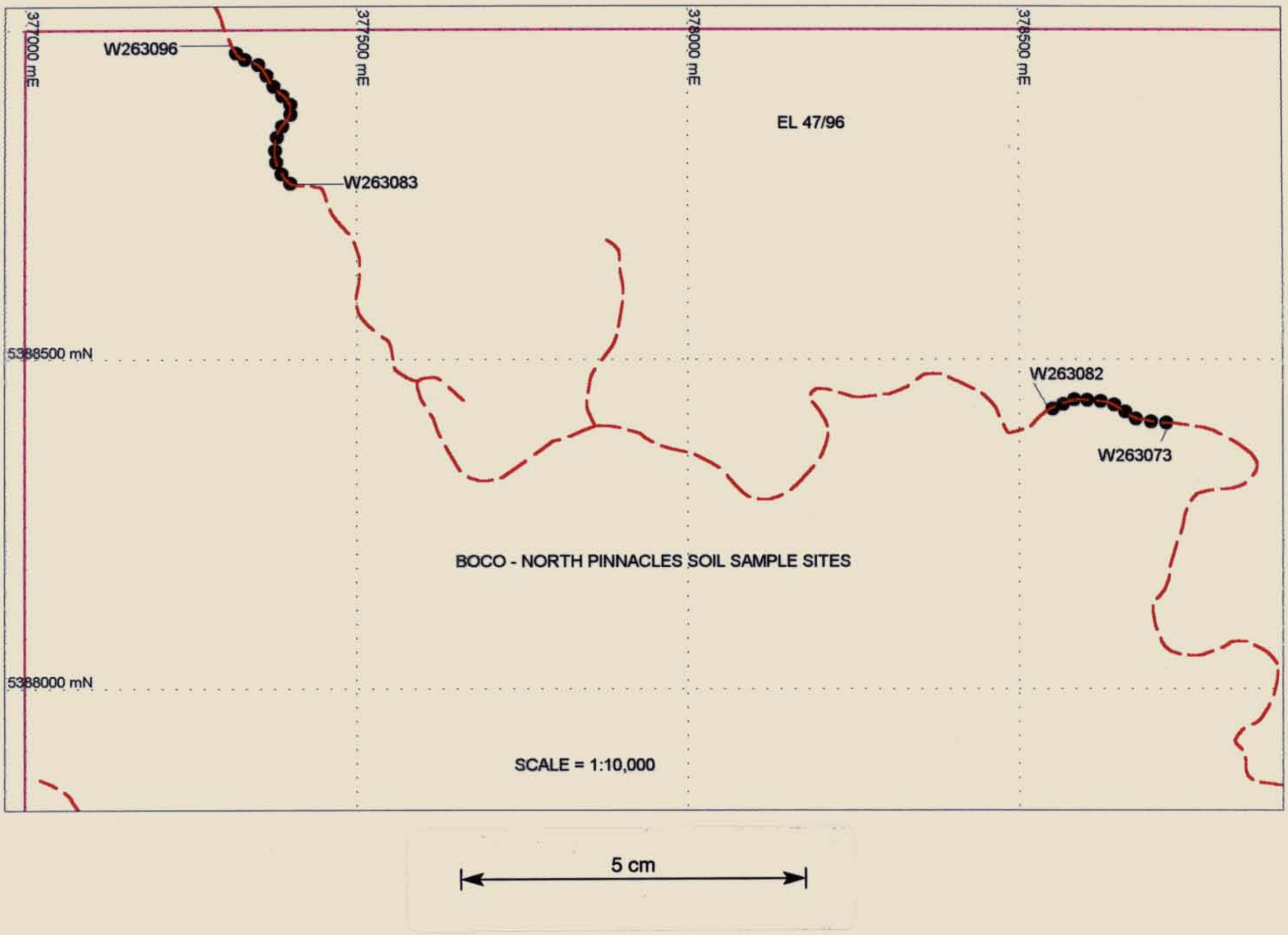


FIGURE 8

238018

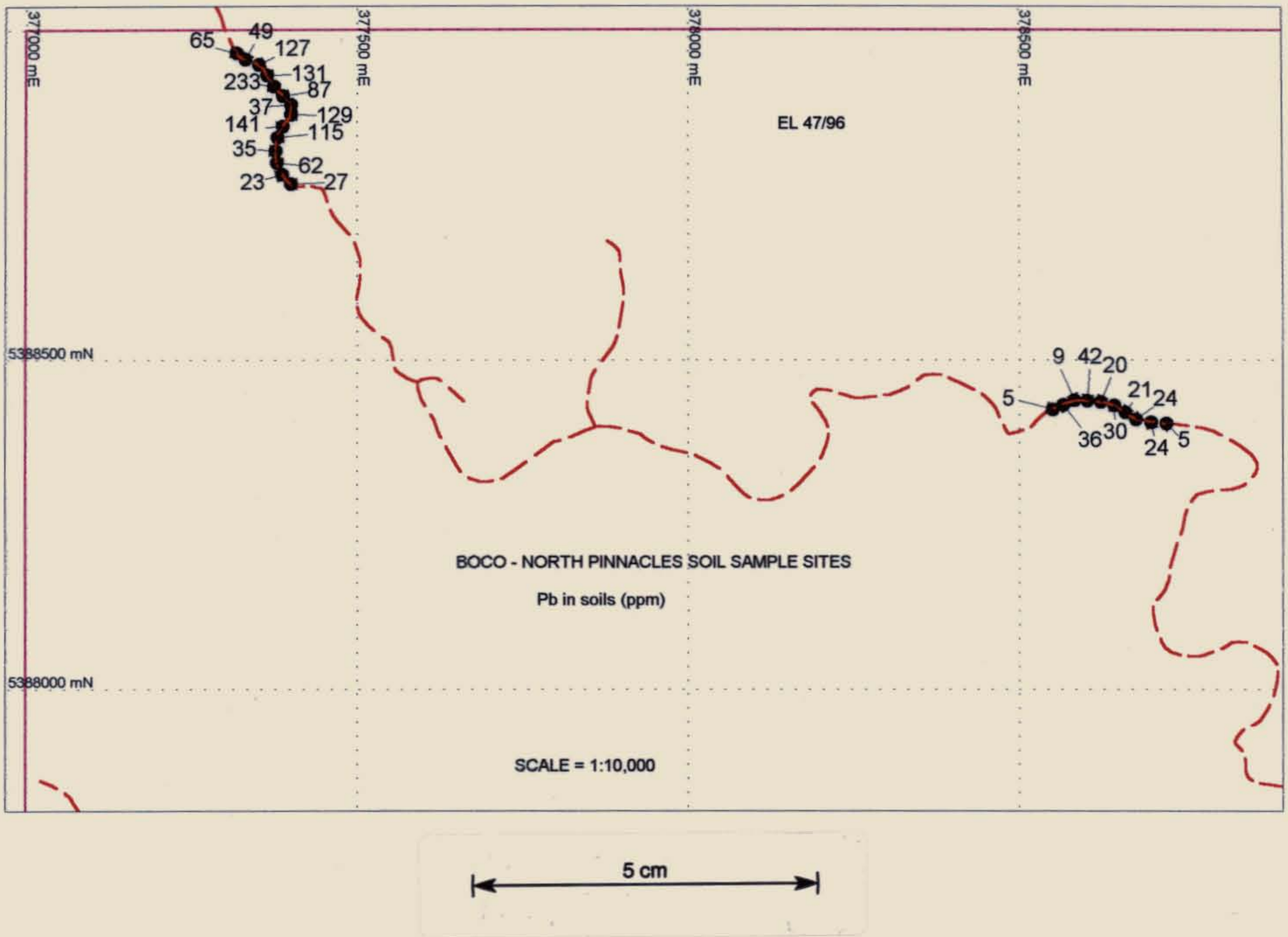


FIGURE 9

238019

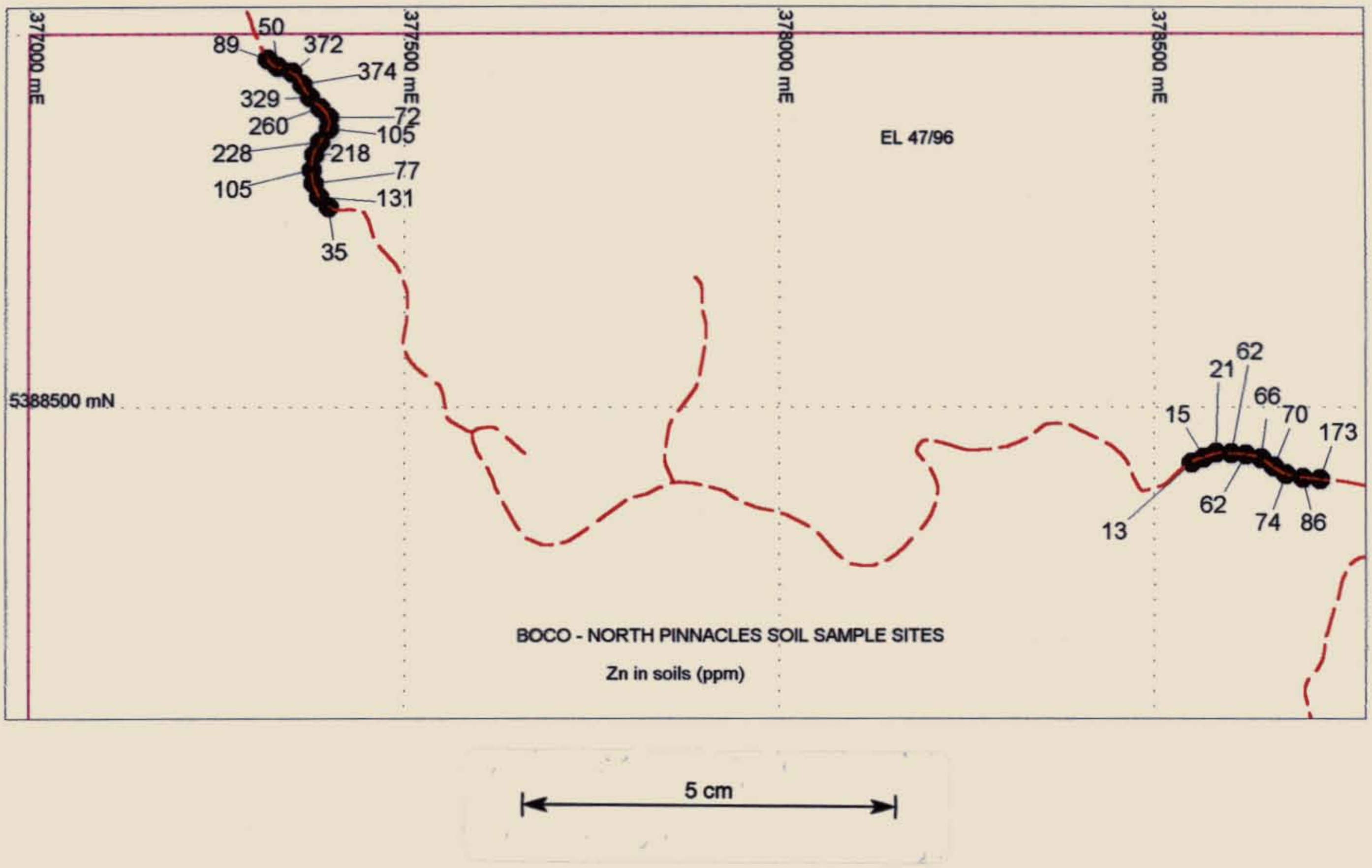


FIGURE 10

7.0 REFERENCES

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RGC EXPLORATION (ZEEHAN) - ROCK CODES

233021

TYPE

U - Volcanic (general)
V - Volcaniclastic
E - Epiclastic
L - Lava
I - Intrusive

COMPOSITION

R - Rhyolite
Y - Rhyodacite
D - Dacite
A - Andesite
B - Basaltic
F - Felsic
M - Mafic
U - Ultramafic

CRYSTAL TYPE

X - Crystal rich
A - Aphyric
F - Feldspar phyric
< - Feldspar - quartz phyric
> - Quartz - feldspar phyric
Q - Quartz phyric
H - Hornblende phyric
P - Pyroxene phyric
B - Biotite phyric
V - Vitric / glassy
L - Lithic rich
R - Reworked, commonly with Carbonate matrix

OTHERS

TILL - Glacial moraine
CLAY - Glacial clays
SILT - Black pyritic siltstone
FALT - Fault
CARB - Massive Carbonate
CBBX - Carbonate breccia
VEIN - Vein
GWAC - Greywacke
CONG - Siliciclastic Conglomerate
SAND - Siliciclastic Sandstone
XXXX/YYYY - Interbedded units

GRAINSIZE

B - Breccia
C - Coarse
M - Medium (Sandy)
F - Fine (Silty)
V - Very fine (Shaley)
A - Ashy
/ - Undifferentiated
X - Crystal Rich
P - Pumiceous

ALTERATION

P - Pyrite
$ - Mineralised
Q - Quartz
O - Chlorite
C - Carbonate
H - Hematite
S - Sericite
K - K feldspar
A - Albite
E - Epidote
F - Fuchsite
M - Magnetite
L - Limonite

N - Scale

1 - Very Weak
3 - Weak
5 - Moderate
7 - Strong
9 - Intense

eg. AOC7
Strong albite-chlorite-carbonate alteration
(albite>chlorite>carbonate, albite = 7)

APPENDIX 1- ROCK CHIP DATA & ASSAYS

METHOD	ELEMENT	DETECTION LIMIT	LAB	RGC Refer. #	Analab Refer. #
AAS	Cu	2ppm	Analabs Burnie	0599	BU013922
	Pb	3ppm	Analabs Burnie	0599	BU013922
	Pb2	0.01%	Analabs Burnie	0599	BU013922
	Zn	2ppm	Analabs Burnie	0599	BU013922
	Ag	1ppm	Analabs Burnie	0599	BU013922
XRF	P	30ppm	Analabs Burnie	0599	BU013922
	Zr	5ppm	Analabs Burnie	0599	BU013922
	V	5ppm	Analabs Burnie	0599	BU013922
	Ti	100ppm	Analabs Burnie	0599	BU013922
NAA	Au	5ppb	Lucas Heights NSW	0599	BU013922
	Ag2	5ppm	Lucas Heights NSW	0599	BU013922
	As	1ppm	Lucas Heights NSW	0599	BU013922
	Ba	100ppm	Lucas Heights NSW	0599	BU013922
	Br	1ppm	Lucas Heights NSW	0599	BU013922
	Ca	1ppm	Lucas Heights NSW	0599	BU013922
	Ce	2ppm	Lucas Heights NSW	0599	BU013922
	Co	1ppm	Lucas Heights NSW	0599	BU013922
	Cr	5ppm	Lucas Heights NSW	0599	BU013922
	Cs	1ppm	Lucas Heights NSW	0599	BU013922
	Eu	0.5ppm	Lucas Heights NSW	0599	BU013922
	Fe	0.02%	Lucas Heights NSW	0599	BU013922
	Hf	0.50ppm	Lucas Heights NSW	0599	BU013922
	Ir	20ppb	Lucas Heights NSW	0599	BU013922
	K	0.20%	Lucas Heights NSW	0599	BU013922
	La	0.50ppm	Lucas Heights NSW	0599	BU013922
	Lu	0.20ppm	Lucas Heights NSW	0599	BU013922
	Mo	5ppm	Lucas Heights NSW	0599	BU013922
	Na	0.01%	Lucas Heights NSW	0599	BU013922
	Rb	20ppm	Lucas Heights NSW	0599	BU013922
	Sb	0.20ppm	Lucas Heights NSW	0599	BU013922
	Sc	0.1ppm	Lucas Heights NSW	0599	BU013922
	Se	5ppm	Lucas Heights NSW	0599	BU013922
	Sm	0.2ppm	Lucas Heights NSW	0599	BU013922
	Ta	1ppm	Lucas Heights NSW	0599	BU013922
	Te	5ppm	Lucas Heights NSW	0599	BU013922
	Th	0.5ppm	Lucas Heights NSW	0599	BU013922
	U	2ppm	Lucas Heights NSW	0599	BU013922
	W	2ppm	Lucas Heights NSW	0599	BU013922
	Zn2	100ppm	Lucas Heights NSW	0599	BU013922
	Zr2	500ppm	Lucas Heights NSW	0599	BU013922
	Yb	0.5ppm	Lucas Heights NSW	0599	BU013922

233024

SAMPLE	NORTH	EAST	ROCK	CU	PB	PB2	ZN	ZN2	AG	AG2	AU	AS	BA	BR	CA	CE	CO	CR
263059	5387850	378940	LR<F	56	>10000	0.99%	93	123	1	-5	70	217	2930	2	-1	414	94	163
263060	5388780	377390	VDFM	44	838	NA	154	207	3	-5	20	39	262	3	-1	2000	439	49
263062	5388810	383140	LDF	7	3	NA	15	-100	-1	-5	-5	3	1650	-1	-1	214	4	-5
263063	5388750	383160	LD<F	6	-2	NA	65	107	-1	-5	-5	22	3250	2	-1	96	-1	213
263064	5388675	383190	LR<F	14	-2	NA	67	114	-1	-5	-5	2	1810	4	-1	164	-1	-5
263065	5387880	382420	LDF	7	8	NA	59	101	-1	-5	-5	1	1270	-1	-1	100	-1	366
263066	5387830	382420	LR>F	7	-2	NA	28	-100	-1	-5	-5	-5	1350	2	-1	116	-1	10
263067	5385530	381370	IDF	8	-2	NA	37	-100	-1	-5	-5	2	935	2	-1	127	3	116
263068	5387250	378690	LR>F	7	438	NA	6	-100	-1	-5	-5	65	1920	2	-1	149	-1	-5
263069	5387120	378840	LR<F	5	36	NA	13	-100	-1	-5	-5	162	2480	2	-1	130	-1	87
263071	5384500	382070	LDF	6	-2	NA	14	-100	-1	-5	-5	2	564	-1	-1	78	12	13
263072	5388440	378600	VDFM	19	-2	NA	87	166	-1	-5	-5	4	1900	-1	3	63	32	79

233025

CS	EU	FE	HF	IR	K	LA	LU	MO	NA	RB	SB	SC	SE	SM	TA	TE	TH	U	W	ZR2	ZR
7	1	2	5	-20	3	52	0	13	0	135	8	16	-5	6	-1	-5	12	4	-2	-500	178
4	1	8	6	-20	1	7	0	-5	0	20	2	53	-5	2	2	-5	10	3	-2	-500	201
-1	3	1	5	-20	3	122	1	-5	2	80	0	6	-5	13	2	-5	17	4	-2	-500	162
1	1	2	11	-20	3	46	1	11	3	90	0	6	-5	8	2	-5	26	6	-2	-500	150
2	2	2	13	-20	4	80	1	-5	3	125	0	10	-5	11	-1	-5	30	8	-2	-500	442
1	2	2	4	-20	1	54	0	-5	1	40	0	5	-5	7	1	-5	15	3	-2	-500	459
-1	1	1	6	-20	1	58	0	-5	5	30	-0	6	-5	8	2	-5	19	4	-2	-500	139
3	2	3	8	-20	3	55	1	-5	1	185	1	11	-5	10	1	-5	25	6	-2	-500	252
2	1	0	5	-20	3	107	1	-5	2	90	1	5	-5	8	1	-5	19	6	-2	-500	166
-1	1	0	8	-20	4	62	1	-5	4	90	2	7	-5	8	3	-5	25	6	-2	-500	214
4	1	3	7	-20	3	35	1	-5	2	135	1	9	-5	6	2	-5	23	7	-2	-500	206
4	2	9	5	-20	3	28	0	-5	3	95	-0	38	-5	7	-1	-5	5	-2	-2	-500	130

233026

YB	TI	V	P
2	3238	74	332
2	7285	302	273
5	2235	36	91
4	1224	5	110
4	2403	12	236
3	2959	22	266
3	1149	-5	89
4	2919	55	478
4	1206	5	155
4	1332	-5	128
4	1904	23	243
3	5909	256	477

238027

APPENDIX 2- SOIL DATA & ASSAYS

METHOD	ELEMENT	DETECTION LIMIT	LAB	RGC Refer. #	Analab Refer. #
AAS	*Cu*	*2ppm*	Analabs Burnie	0600	BU013923
	Pb	3ppm	Analabs Burnie	0600	BU013923
	Zn	2ppm	Analabs Burnie	0600	BU013923
	Ag	1ppm	Analabs Burnie	0600	BU013923
NAA	Au	5ppb	Lucas Heights NSW	0600	BU013923
	As	1ppm	Lucas Heights NSW	0600	BU013923
	Ba	100ppm	Lucas Heights NSW	0600	BU013923
	Br	1ppm	Lucas Heights NSW	0600	BU013923
	Ca	1ppm	Lucas Heights NSW	0600	BU013923
	Ce	2ppm	Lucas Heights NSW	0600	BU013923
	Co	1ppm	Lucas Heights NSW	0600	BU013923
	Cr	5ppm	Lucas Heights NSW	0600	BU013923
	Cs	1ppm	Lucas Heights NSW	0600	BU013923
	Eu	0.5ppm	Lucas Heights NSW	0600	BU013923
	Fe	0.02%	Lucas Heights NSW	0600	BU013923
	Hf	0.50ppm	Lucas Heights NSW	0600	BU013923
	Ir	20ppb	Lucas Heights NSW	0600	BU013923
	K	0.20%	Lucas Heights NSW	0600	BU013923
	La	0.50ppm	Lucas Heights NSW	0600	BU013923
	Lu	0.20ppm	Lucas Heights NSW	0600	BU013923
	Mo	5ppm	Lucas Heights NSW	0600	BU013923
	Na	0.01%	Lucas Heights NSW	0600	BU013923
	Rb	20ppm	Lucas Heights NSW	0600	BU013923
	Sb	0.20ppm	Lucas Heights NSW	0600	BU013923
	Sc	0.1ppm	Lucas Heights NSW	*0600*	BU013923
	Se	5ppm	Lucas Heights NSW	0600	BU013923
	Sm	0.2ppm	Lucas Heights NSW	0600	BU013923
	Ta	1ppm	Lucas Heights NSW	0600	BU013923
	Te	5ppm	Lucas Heights NSW	0600	BU013923
	Th	0.5ppm	Lucas Heights NSW	0600	BU013923
	U	2ppm	Lucas Heights NSW	0600	BU013923
	W	2ppm	Lucas Heights NSW	0600	BU013923
	Zn2	*100ppm*	Lucas Heights NSW	0600	BU013923
	Zr2	500ppm	Lucas Heights NSW	0600	BU013923
	Yb	0.5ppm	Lucas Heights NSW	0600	BU013923

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Project Boco File BOCOSOIL.DAT Wed Mar 04 09:33 1998

SAMPLE	TYPE	NORTH	EAST	CU	PB	ZN	AG	AUPPB	AS	BA	BR
W263073	SOIL	5388403	378722	18	5.000	173.000	2.000	<5.0	<1.0	375.000	10.000
W263074	SOIL	5388405	378699	29	24.000	86.000	2.000	<5.0	5.000	689.000	7.000
W263075	SOIL	5388410	378676	19	24.000	74.000	2.000	<5.0	4.000	794.000	4.000
W263076	SOIL	5388420	378660	19	21.000	70.000	1.000	<5.0	7.000	704.000	4.000
W263077	SOIL	5388431	378643	31	30.000	66.000	2.000	<5.0	12.000	804.000	23.000
W263078	SOIL	5388436	378623	31	20.000	62.000	3.000	<5.0	8.000	599.000	26.000
W263079	SOIL	5388438	378603	23	42.000	62.000	3.000	<5.0	8.000	313.000	10.000
W263080	SOIL	5388439	378583	5	9.000	21.000	1.000	<5.0	<1.0	1260.000	15.000
W263081	SOIL	5388432	378566	4	36.000	15.000	1.000	<5.0	<1.0	1260.000	7.000
W263082	SOIL	5388425	378550	6	5.000	13.000	1.000	<5.0	<1.0	923.000	6.000
W263083	SOIL	5388768	377400	10	27.000	35.000	1.000	<5.0	2.000	946.000	10.000
W263084	SOIL	5388782	377387	17	23.000	131.000	4.000	<5.0	7.000	388.000	27.000
W263085	SOIL	5388800	377379	14	62.000	77.000	2.000	<5.0	32.000	525.000	20.000
W263086	SOIL	5388818	377377	31	35.000	105.000	3.000	<5.0	10.000	613.000	37.000
W263087	SOIL	5388838	377380	23	115.000	218.000	4.000	<5.0	7.000	353.000	127.000
W263088	SOIL	5388855	377388	26	141.000	228.000	3.000	<5.0	6.000	349.000	38.000
W263089	SOIL	5388873	377400	30	129.000	105.000	2.000	<5.0	21.000	343.000	46.000
W263090	SOIL	5388888	377400	17	37.000	72.000	3.000	<5.0	10.000	270.000	45.000
W263091	SOIL	5388901	377388	34	87.000	260.000	4.000	<5.0	8.000	564.000	18.000
W263092	SOIL	5388915	377374	44	233.000	329.000	3.000	<5.0	7.000	414.000	20.000
W263093	SOIL	5388932	377364	45	131.000	374.000	3.000	<5.0	12.000	386.000	48.000
W263094	SOIL	5388948	377351	50	127.000	372.000	3.000	<5.0	12.000	489.000	32.000
W263095	SOIL	5388956	377331	15	49.000	50.000	2.000	<5.0	27.000	522.000	35.000
W263096	SOIL	5388966	377318	12	65.000	89.000	2.000	<5.0	15.000	134.000	159.000

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CA	CE	CO	CR	CS	EU	FE%	HF	IRPPB	K%	LA	LU
<1.0	70.000	20.000	38.000	5.000	1.000	4.170	9.900	<20.00	1.700	27.900	0.600
<1.0	126.000	11.000	139.000	15.000	1.500	4.270	8.400	<20.00	3.400	57.800	0.700
<1.0	113.000	8.000	95.000	13.000	1.500	3.550	8.400	<20.00	3.100	49.300	0.600
<1.0	104.000	8.000	140.000	14.000	1.300	3.260	6.600	<20.00	3.700	46.700	0.500
<1.0	85.000	13.000	96.000	8.000	1.200	7.790	7.900	<20.00	2.400	31.300	0.400
<1.0	105.000	19.000	179.000	3.000	0.800	14.700	6.000	<20.00	0.900	4.000	0.200
<1.0	63.000	8.000	37.000	2.000	<0.5	7.170	7.900	<20.00	0.700	10.100	0.400
<1.0	95.000	2.000	54.000	5.000	1.300	0.810	11.100	<20.00	2.500	39.800	0.800
<1.0	183.000	1.000	92.000	14.000	1.600	1.020	8.900	<20.00	4.400	79.700	0.600
<1.0	35.000	2.000	169.000	10.000	0.600	1.070	8.600	<20.00	3.700	13.800	0.500
<1.0	85.000	2.000	96.000	19.000	0.800	1.880	7.800	<20.00	3.800	32.200	0.500
<1.0	129.000	41.000	109.000	5.000	<0.5	10.900	5.800	<20.00	0.600	4.800	<0.20
<1.0	50.000	3.000	34.000	7.000	0.700	6.970	10.900	<20.00	1.800	21.800	0.600
<1.0	14.000	11.000	162.000	3.000	<0.5	16.800	6.900	<20.00	0.600	3.700	0.200
<1.0	39.000	30.000	84.000	3.000	0.500	13.100	6.400	<20.00	0.400	6.700	0.200
<1.0	78.000	36.000	48.000	2.000	<0.5	10.200	9.500	<20.00	0.200	9.100	0.500
<1.0	30.000	12.000	115.000	8.000	<0.5	10.900	8.300	<20.00	1.400	5.600	0.400
<1.0	50.000	17.000	105.000	2.000	<0.5	9.300	7.900	<20.00	0.400	8.900	0.200
<1.0	220.000	49.000	60.000	3.000	0.900	9.620	8.200	<20.00	1.300	20.300	0.400
<1.0	77.000	39.000	91.000	3.000	0.700	11.200	5.700	<20.00	0.800	13.600	0.300
<1.0	177.000	22.000	55.000	9.000	1.100	5.800	8.600	<20.00	1.800	33.600	0.500
<1.0	89.000	18.000	84.000	6.000	1.700	9.550	7.200	<20.00	1.700	36.400	0.500
<1.0	75.000	3.000	24.000	7.000	1.200	3.630	6.000	<20.00	2.000	40.200	0.200
<1.0	54.000	<1.0	167.000	3.000	1.600	4.450	8.600	<20.00	0.500	25.500	0.400

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MO	NA%	RB	SB	SC	SE	SM	TA	TE	TH	U	W
<5.0	0.440	70.000	0.900	22.600	<5.0	5.700	2.000	<5.0	17.700	2.000	<2.0
<5.0	0.130	185.000	1.100	20.300	<5.0	9.300	1.000	<5.0	19.300	4.000	<2.0
<5.0	0.200	150.000	1.400	21.200	<5.0	7.900	2.000	<5.0	16.800	4.000	<2.0
<5.0	0.140	180.000	1.400	23.700	<5.0	7.200	<1.0	<5.0	15.100	3.000	5.000
<5.0	0.080	130.000	1.200	41.600	<5.0	5.500	2.000	<5.0	15.900	4.000	<2.0
<5.0	0.020	45.000	0.900	79.500	<5.0	2.400	1.000	<5.0	7.900	<2.0	<2.0
<5.0	0.030	40.000	1.400	40.000	<5.0	1.900	2.000	<5.0	17.100	5.000	<2.0
<5.0	0.030	110.000	0.300	15.200	<5.0	7.100	2.000	<5.0	23.100	5.000	<2.0
<5.0	0.100	205.000	0.700	21.900	<5.0	10.200	2.000	<5.0	19.600	3.000	<2.0
<5.0	0.100	175.000	0.700	19.900	<5.0	2.600	<1.0	<5.0	12.200	5.000	<2.0
<5.0	0.070	185.000	1.800	20.500	<5.0	5.600	1.000	<5.0	25.900	4.000	<2.0
<5.0	0.020	25.000	2.300	62.000	<5.0	1.800	1.000	<5.0	7.700	<2.0	<2.0
<5.0	0.040	115.000	2.100	16.000	<5.0	4.300	1.000	<5.0	21.600	5.000	<2.0
<5.0	0.020	30.000	0.700	92.900	<5.0	1.700	1.000	<5.0	8.100	<2.0	<2.0
<5.0	0.040	<20	1.800	50.400	<5.0	2.100	2.000	<5.0	9.700	<2.0	<2.0
<5.0	0.030	25.000	1.200	40.600	<5.0	2.200	2.000	<5.0	19.300	5.000	<2.0
<5.0	0.060	90.000	2.200	42.900	<5.0	1.500	2.000	<5.0	20.400	4.000	<2.0
<5.0	0.040	25.000	1.600	31.000	<5.0	1.500	2.000	<5.0	11.700	3.000	<2.0
<5.0	0.040	65.000	1.500	47.600	<5.0	3.500	1.000	<5.0	13.700	4.000	<2.0
<5.0	0.030	55.000	1.800	50.200	<5.0	2.900	1.000	7.000	7.000	<2.0	<2.0
<5.0	0.070	80.000	5.100	29.700	<5.0	4.900	2.000	<5.0	15.900	3.000	4.000
<5.0	0.390	95.000	3.100	32.400	<5.0	6.600	3.000	<5.0	14.300	4.000	<2.0
<5.0	0.120	80.000	6.000	11.700	<5.0	4.200	<1.0	<5.0	9.800	3.000	<2.0
<5.0	2.960	<20	2.100	13.800	<5.0	4.400	<1.0	<5.0	10.700	4.000	<2.0

ZR	YB
<500	3.7
<500	4.3
<500	4.1
<500	3.8
0.060	2.9
<500	1.6
<500	2.4
<500	4.9
<500	3.8
<500	3.5
<500	3.7
<500	1.2
0.060	4.0
<500	1.9
<500	1.7
<500	3.7
<500	2.7
<500	1.8
<500	2.7
<500	2.0
<500	3.1
<500	3.1
<500	1.4
<500	2.6

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APPENDIX 3 - GEOPHYSICAL INTERPRETATION
(RGC Internal report)

233034

RGC Exploration

ACN 001 426 946

APPENDIX III

BOCO PROJECT
EL 47/96

Interpretation of Openfile Helimagnetic Data

Vol 1 of 1

HELD BY: RGC Limited

MANAGER & OPERATOR: RGC Exploration Pty Ltd

AUTHOR(s): Chris Dauth

4 March, 1998

PROSPECTS:

MAP SHEETS:	**1:250,000: SK/55-NW**	**1:100,000: Sophia 8014**
GEOGRAPHIC COORDS	**Min East: 376,000mE** **Min North: 5,383,000mN**	**Max East: 385,000mE** **Max North: 5,392,000mN**

COMMODITY(s): Zn, Pb, Cu, Ag, Au

KEY WORDS: alteration, gold, helimagnetics, lineament, magnetite, VHMS

Distribution:

- **RGC Exploration Information Centre Reference:**

3A - Appx 308 98-v

SUMMARY

Reported herein are results of an interpretation of helimagnetic data from the Boco Project (EL47/96) located approximately 60km NE of Zeehan, Tasmania. The Boco Project is currently being explored by RGC Exploration for its potential to host Rosebery style VHMS mineralisation, or alternatively a similar mineralisation style to that observed at the Henty Gold Mine. The helimagnetic survey was flown in 1991 for Pasminco Exploration, who then held the ground. This data has subsequently been obtained from the Tasmanian Mines Department by RGC Exploration at minimal cost and re-interpreted.

The survey was flown by GEOINSTRUMENTS Pty Ltd at 100m line spacing on east-west oriented lines at 80m nominal terrain clearance. The survey is of relatively high quality, although certain specifications would not be regarded as suitable by current standards. The survey was visually navigated (which may introduce errors of up to 100m in flight path recovery), and flown with a towed bird magnetometer at 80-100m terrain clearance (current day systems would facilitate use of a stinger mounted magnetometer flown at 20-30m terrain clearance).

The main aim of interpretation and computer modelling of the helimagnetic data was to assist with the geological understanding of the project area, and in addition, identify discrete structural targets for further investigation.

The project area comprises units of the Cambrian Mount Read Volcanics, including volcanic, and volcaniclastic sequences of the Central Volcanic Complex, stratigraphically overlain by the interbedded volcanogenic units of the Dundas Group. Much of the previous exploration has focused on the Boco alteration zone, a NNE-SSW oriented linear zone with pervasive pyrite alteration. This is found to be relatively coincident with a demagnetised zone in the helimagnetic data, conceptually related to magnetite destruction within the alteration zone. The linear demagnetised zone is situated within a relatively high amplitude package of magnetic lineaments, thought to correspond to andesitic lavas intermixed with felsic and intermediate volcanics. These are stratigraphically underlain to the east by a non-magnetic domain considered to represent dominantly felsic volcanic rocks. To date, exploration along this demagnetised zone has failed to identify significant accumulations of economic minerals.

To the north-west of the alteration zone, a broad wavelength (>4km diameter) ovoid magnetic anomaly up to 75nT in amplitude is thought to be due to a large magnetic porphyry intrusive. Computer modelling of the broad wavelength anomaly suggests the source is relatively shallow (<100m in places) with a magnetite content unlikely to exceed 0.05% (derived from the modelled magnetic susceptibility of 0.003 SI units). The anomaly was modelled with 11 polygonal stacked layers of variable shape forming an irregular surface extending to depth. Local short wavelength anomalies are most likely to represent shallower parts of the intrusive and are not considered to represent volcanic stratigraphy. The significance (if any) of the intrusive is not known, and it is not considered to form an exploration target.

In the western part of the tenement, a synclinal structure is identified in the magnetic stratigraphy. Modelled dips on the outer limbs of the folded magnetic stratigraphy suggest the fold forms a northerly plunging syncline. Dips varied from 45°-75° towards the centre of the fold, and magnetic susceptibilities ranged from 0.001-0.006 SI units. The change from relatively non-magnetic stratigraphy to abundant magnetic lineaments within the folded structure is most likely representative of a change from non-magnetic volcanogenic sediments of the Dundas Group, underlying the magnetic sandstone and siltstone horizons of what is

thought to be a Tyndall Group correlate (Mt Cripps Subgroup). Identification of significant structures at this contact, and within the Dundas Group units is considered the primary objective for delineation of targets for the Henty Gold Mine style of mineralisation. Two structures are evident within EL47/96, however these are considered secondary. A major lineament showing a positive magnetic anomaly striking NW-SE extends through the interpreted syncline and into the Dundas Group. The geological nature of the lineament is not known, and it is postulated to be either a late mafic dyke intrusion, or a magnetite enriched structure, the latter may present a viable target for further investigation. There is some evidence, through a truncation of the magnetic signature of the eastern most stratigraphic horizon of the syncline, that a structure strikes NNE-SSW along the contact between the postulated Tyndall Group and Dundas Group magnetic responses. This is highly speculative and solid evidence is not provided in the magnetic data. Further to the north of EL47/96, the folded magnetic structure does appear to be intersected by several significant NE-SW and NW-SE striking fault/shear zones that would conceptually be of interest for exploration.

No targets for immediate follow-up have been derived from the helimagnetic interpretation and modelling, however, the results should be used as a guide for further mapping and target generation using alternative techniques such as electrical geophysics or geochemistry.

CONTENTS

LIST OF FIGURES

LIST OF PLAN

1. INTRODUCTION

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The Boco Project is located approximately 60km NE of Zeehan on the west coast of Tasmania within the SK55-NW 1:250,000 Sheet (location diagram Figure 1). The tenement EL47/96 lies within the Cambrian Mt Read Volcanics, and has potential to host both Rosebery style VHMS mineralisation, and gold mineralisation similar to that observed at the Henty Gold Mine further to the south.

This report presents an interpretation and computer modelling results from a helimagnetic survey flown at Boco Siding for Pasminco Exploration in 1991. The survey was flown by GEOINSTRUMENTS Pty Ltd, using a Squirrel helicopter flying at 80m terrain clearance and 100m line separation. The ground was relinquished by Pasminco some time after the survey was flown, and then picked up by RGC Limited, who have subsequently obtained the helimagnetic data through the Tasmanian Mines Department. The aim of interpretation of the helimagnetic data was to increase the geological understanding of the project area, and to try and focus in on regions or zones considered to have greater potential for mineralisation.

2. GEOLOGICAL SETTING

The project is situated within lithologies of the Mount Read Volcanics including the Lower Dundas Group (and possibly Tyndall Group correlates), and the Central Volcanic Complex (CVC).

The Lower Dundas Group lithologies occur in the western two-thirds of the EL. The Dundas Group rocks consist of a volcanogenic sedimentary fine to coarse grained turbidite sequences and intrusive qtz-feldspar porphyries and lavas. These stratigraphically overly a volcanic and volcaniclastic sequence of felsic to intermediate lavas of the CVC.

A significant NNE-SSE striking zone of alteration has been identified at Boco (the Boco alteration zone), that comprises a pyritic quartz-sericite alteration of a sequence of felsic lavas, pyroclastics, and minor epiclastics. No significant base or precious metals have been identified within this zone. Very minor exhalative pyrite is reported within an epiclastic unit. Oxygen isotope numbers from this alteration zone are reported to be compatible with alteration by a fluid of seawater origin but at a lower temperature (<200°C) than those required to form substantial base metal deposits in a volcanic environment (Green 1986).

It is possible that the postulated Tyndall Group correlates may have the potential to host similar mineralisation to that observed at Henty. Arguably fault related, whether genetic or not, the Henty mineralisation does have a spatial association with the Henty Fault Zone. This is a large fault zone readily identified as a lineament bounding two magnetic textural domains in the helimagnetic data of that region. It is not unreasonable to suggest that a similar structure (if it did exist) might form a viable exploration target in the western portion of the EL.

3. SURVEY SPECIFICATIONS

The helimagnetic survey was conducted by GEOINSTRUMENTS Pty Ltd during February 1991. Survey specifications are detailed below:

Client:	Pasminco EXPLORATION PTY LTD
Survey:	Airborne Geophysical Survey
Area:	Boco, Tasmania
Acquisition:	GEOINSTRUMENTS PTY LTD

Data Format: ASCII Located Magnetics Data
Job No. 9101

?

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AIRBORNE SURVEY SPECIFICATIONS AND EQUIPMENT

Helecopter:	Aerospatiale Ecureuil Squirrel
Magnetometer:	Towed bird Geometrics G833 Helium Vapour
Sensitivity:	Resolution 0.01 nT
Recording Interval:	0.2 sec (appr. 7 metres)
Spectrometer:	Geometrics GR800
Crystal Size:	16.4 l
Flight Line Direction:	090 - 270 degrees
Flight Line Separation:	100 metres
Tie Line Direction:	000 - 180 degrees
Tie line Separation:	2000 metres
Mean Terrain Clearance:	nominally 80m metres
Navigation:	Visual
Flight Path Recovery:	Visually onto aerial photographs
Processed By:	Kevron Geophysics
Survey Flown:	February 1997

Located magnetic data were obtained from the mines department. These were processed, gridded, and imaged by RGC Exploration staff. Radiometric data were not processed by the acquisition contractors, and only raw count rates were supplied on the located data tape. These have also been gridded, and imaged.

4. RESULTS

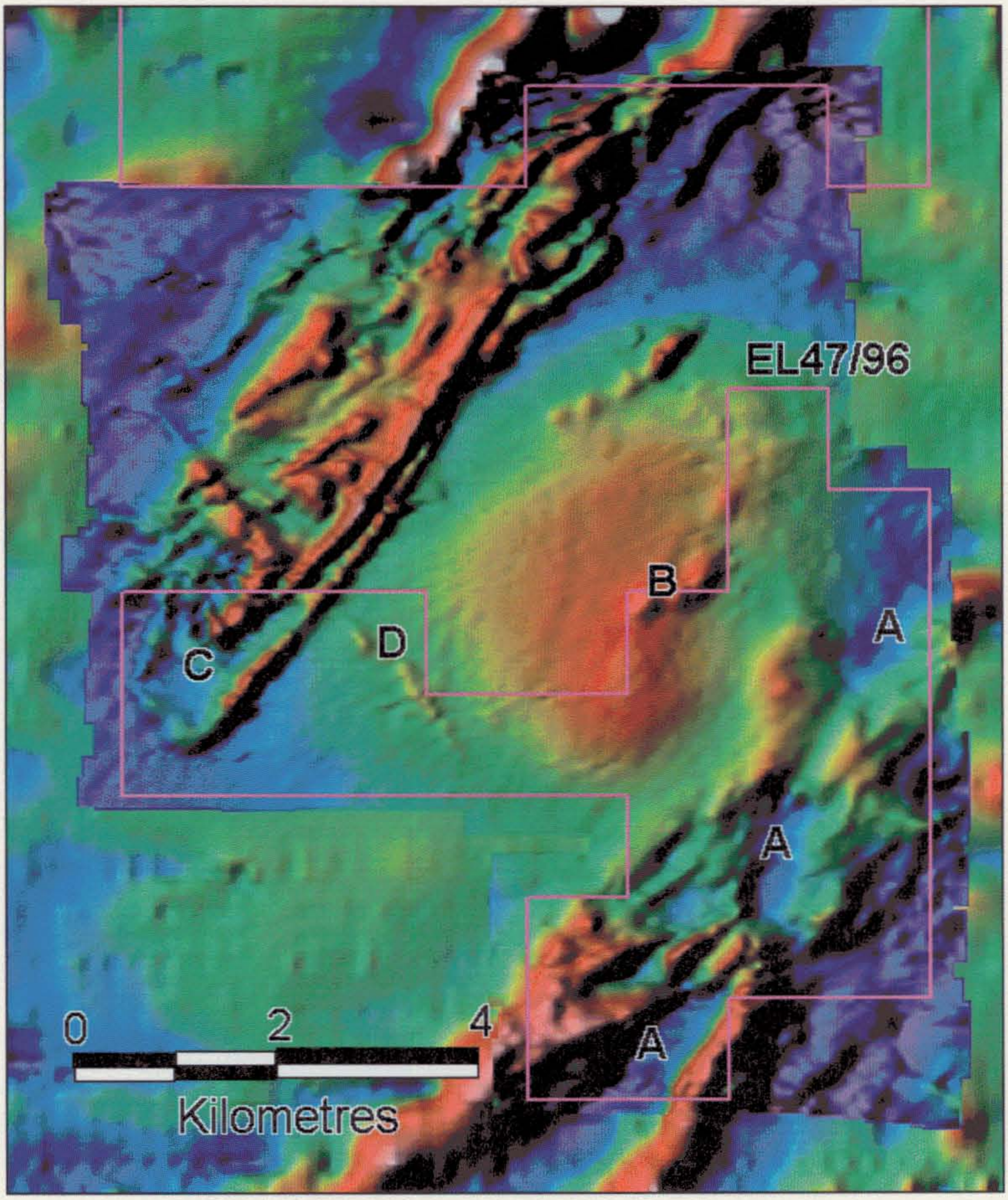
The helimagnetic data are of relatively high quality, considering the time of acquisition (ie prior to GPS positioning and development of a stinger mounted helicopter magnetometer system). The survey was flown at a relatively high terrain clearance of 100m. The towed bird containing the magnetometer was located nominally 20m below the helicopter (ie MTC of 80m). Errors in positioning of the bird are likely to exist in the data due to the fact that it was visually recovered. Discussions with the contractors indicate that the terrain clearance typically exceeded generally regarded safety margins on the side of caution, and currently such a survey would be flown with the sensor at 20-30m above ground level.

A suite of images and contour plans have not been placed in the context of this report. Processing has been completed on the data, and registered images have been placed into the RGC GIS. The Boco helimagnetic survey data have been overlain on the regional government flown 500m line spaced data as a composite image. Initially the two datasets were stitched together using mathematical algorithms, however, this is not thought to be useful (other than aesthetically) for interpretation of the data. In fact, the result of different terrain clearances between the surveys can often lead to erroneous interpretations being made at the boundary of stitched grids where the boundary has been "disguised". It is considered by the author that the most useful form of data display is the image of the 1st vertical derivative computed on the reduced to pole TMI grid. In addition to this image, 2nd horizontal derivative bipole plots computed along the flight lines, and images of the total magnetic intensity (TMI), and reduced to pole TMI were utilised in the process of data interrogation. Computer modelling has been conducted on the raw flight line data to determine likely geometries of magnetic units. For the purpose of computer modelling, the following geomagnetic field parameters were used:
Magnetic Declination 12.79°

233040

Magnetic Inclination -72.17°
Total Field 62200nT
Barometric height is used as the sensor level for computer modelling, and a ground level has been derived by subtracting the radar altimeter. The results were surprisingly of good quality.

An image of the 1st vertical derivative of the reduced to pole total magnetic intensity (1VD) is presented below for reference in this report. The image includes an outline of EL47/96, and has labels representing the major magnetic units. An interpretation plan of the data is presented at 1:25,000 in Plan 1. This is underlain by an intensity image of the sun-shaded 1VD, and includes vectors of mapped geological boundaries.



The major features of the helimagnetic data are described below, (referring to the above labels A-D):

5 cm

A) This NNE-SSW oriented zone of demagnetisation corresponds with the ground position of the Boco Alteration Zone. It most likely represents magnetite destruction of the host lithologies. Several structures with a dominant NE-SW orientation are observed to intersect this demagnetised zone. The location of these structures is shown of Plan 1.

B) This is a broad wavelength (>4km diameter) moderately high amplitude (>75nT) anomaly. It has been interpreted to be an intrusive porphyry body (Dundas Group). Computer modelling of the response has been conducted using MODELVISION software. A stacked section of 11 polygonal bodies were used to model the broad wavelength response. These polygonal bodies were assigned magnetic susceptibilities of 0.003 SI units (this would correspond to a magnetite content of approximately 0.05%), and assumed not to have remanent components. A plan outlining the magnetic response, and the stacked polygonal model is presented in Figure 2. A section through the centre of the anomaly is presented in Figure 3. A perspective view which gives a sense of the 3D nature of the combined model is presented in Figure 4.

C) The region designated **C** on the preceding page corresponds to the closure of several magnetic lineaments about a NNE-SSW oriented axis. This closure represents a northerly plunging syncline within Dundas Group lithologies. The high amplitude (>100nT) magnetic lineaments most likely represent detrital magnetite within sandstone and siltstone beds within the Tyndall Group correlates. These have been offset in places (offsets are overlain on Plan 1), and modelling results generally indicate shallow tabular sources (ie depths to the top of modelled bodies was less than 50m below ground level). Modelled dips indicate the closed structure is a syncline, with dips varying from 45°-75° towards the centre of the fold. Modelled magnetic susceptibilities range from 0.001-0.006 SI units which would correspond to magnetite contents in the order of 0.1%. Only several minor faults intersect the folded structure within EL47/96, and are unlikely to be equivalent in nature to the Henty Fault. The outer most magnetic lineament of the folded structure is truncated on the eastern side of the fold, which may represent faulting out by a structure running parallel to the contact between the non magnetic CVC and the Dundas Group magnetic signatures. The evidence for such a structure is not very conclusive from the magnetic data, and it forms only a speculative model.

D) This anomaly refers to a relatively large NW-SE striking positive magnetic lineament transecting both the interpreted NW syncline, and into the CVC. The lineament does not displace the intersected magnetic stratigraphy. The orientation, and nature of the magnetic anomaly is quite uncharacteristic for the Mount Read Volcanics of Western Tasmania, and therefore, on this basis may be of interest for further investigation. Three possible sources are postulated for the lineament. These are firstly that it represents a late mafic dyke, secondly that it represents magnetite/pyrrhotite alteration along a structure, or thirdly, that it represents a pre-existing structure that has been intruded by a mafic dyke. The latter of the two may present this structure as a viable exploration target.

5. RECOMMENDATIONS

No immediate targets for direct ground testing have been delineated by interpretation of the helimagnetic data. The data have confirmed the presence of a synclinal structure within Dundas Group sediments (possibly Tyndall Group correlates), and show a demagnetised response that may be correlated with the Boco pyrite-sericite-quartz alteration zone. There are several sections of the demagnetised zone that have been poorly tested by existing exploration drilling, however these most likely do not present good targets due to discouraging geochemical results from this alteration system. Modelling results indicate that a significant sized intrusive body underlies a large portion of the EL47/96, however there is no reason that this should present an exploration target.

It is conceivable that the NW-SE striking magnetic lineament (D) could be worthy of followup, however, testing this region with other exploration techniques such as surface geochemistry or electrical geophysics would be warranted before any drill targets could be considered.

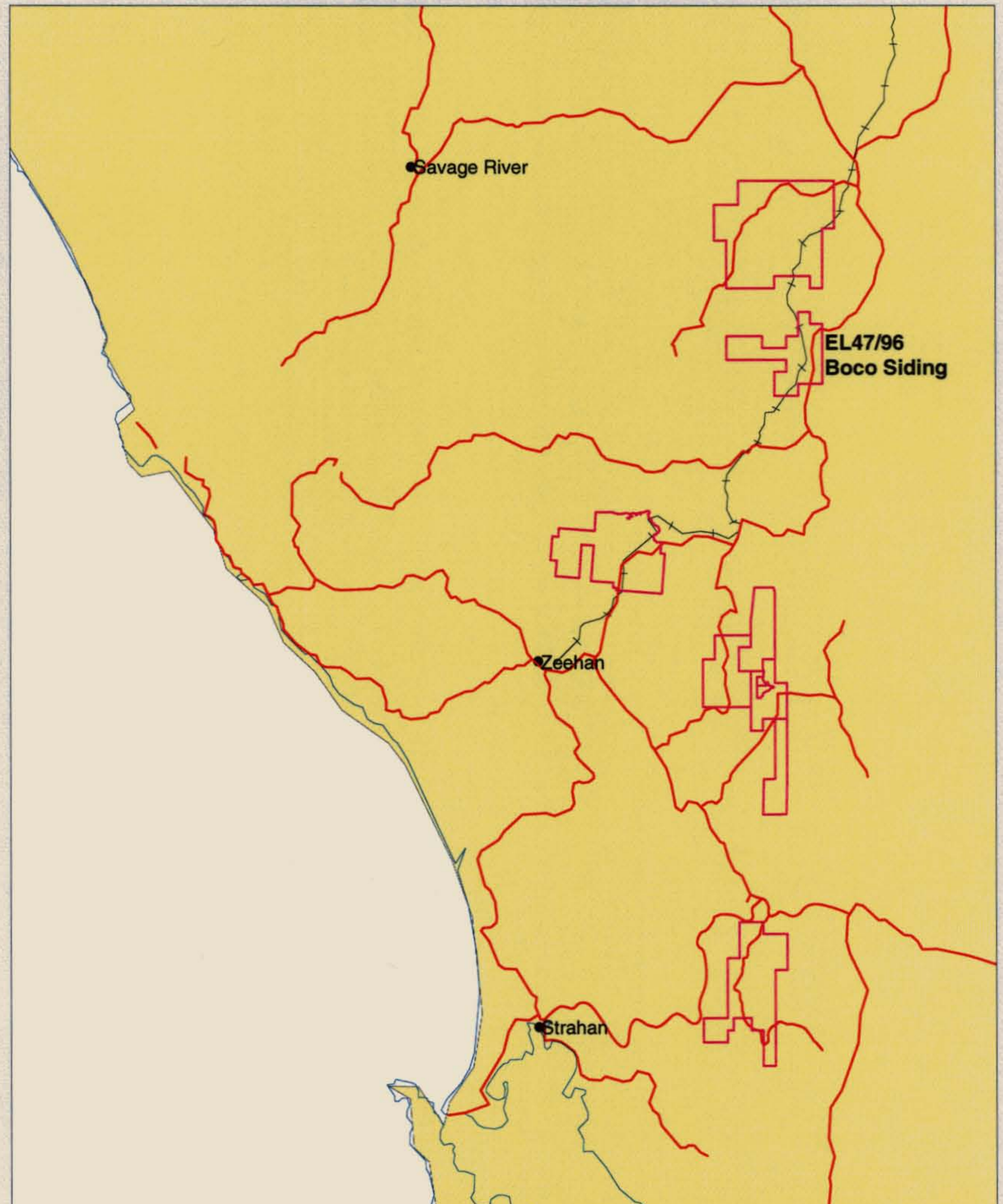
6. REFERENCES

Green, G. R., 1986, Stable isotope and alteration investigations of the Mount Read Volcanics: the Hercules and Boco areas; in The Mount Read Volcanics and Associated Ore Deposits, A Symposium, Burnie, November 1986 Ed R. R. Large, Geol. Soc. Of Aust. & Uni. Of Tas.

RGC Exploration

233043

Figure 1. Boco Project Location Plan



233044

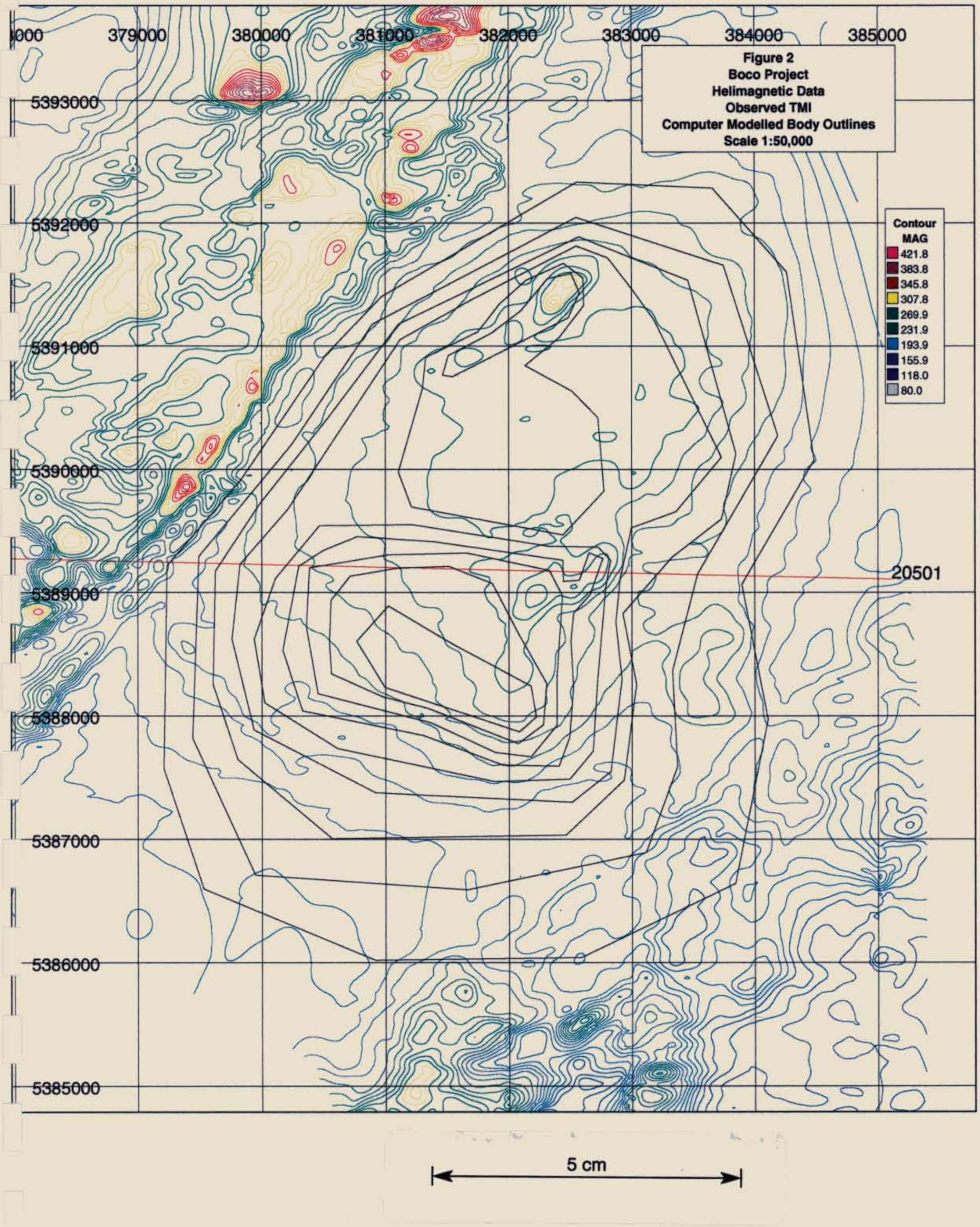


Figure 2
Boco Project
Helimagnetic Data
Observed TMI
Computer Modelled Body Outlines
Scale 1:50,000
Contour
MAG
421.8
383.8
345.8
307.8
269.9
231.9
193.9
155.9
118.0
80.0
379000
380000
381000
382000
383000
384000
385000
5393000
5392000
5391000
5390000
5389000
5388000
5387000
5386000
5385000
20501
5 cm

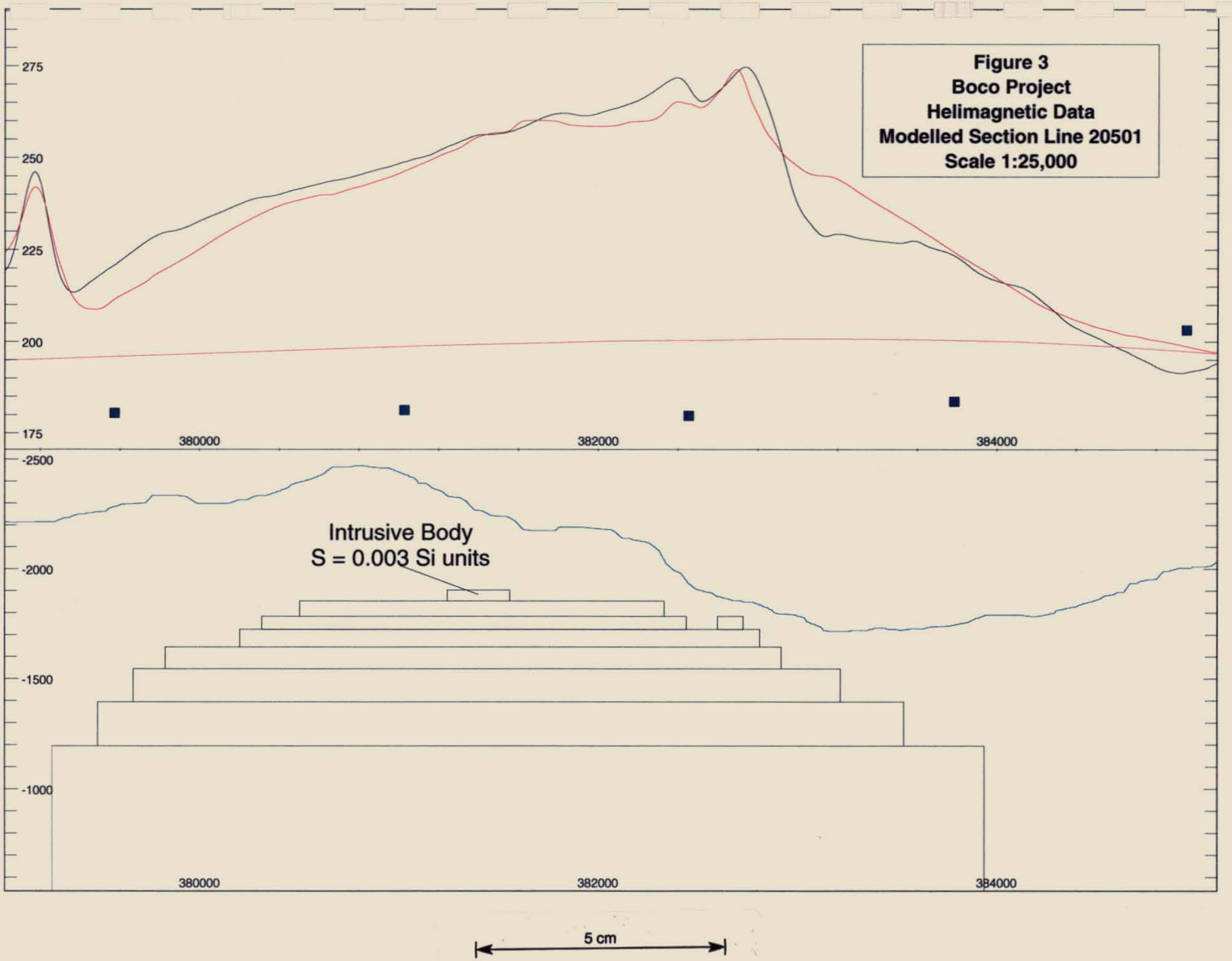
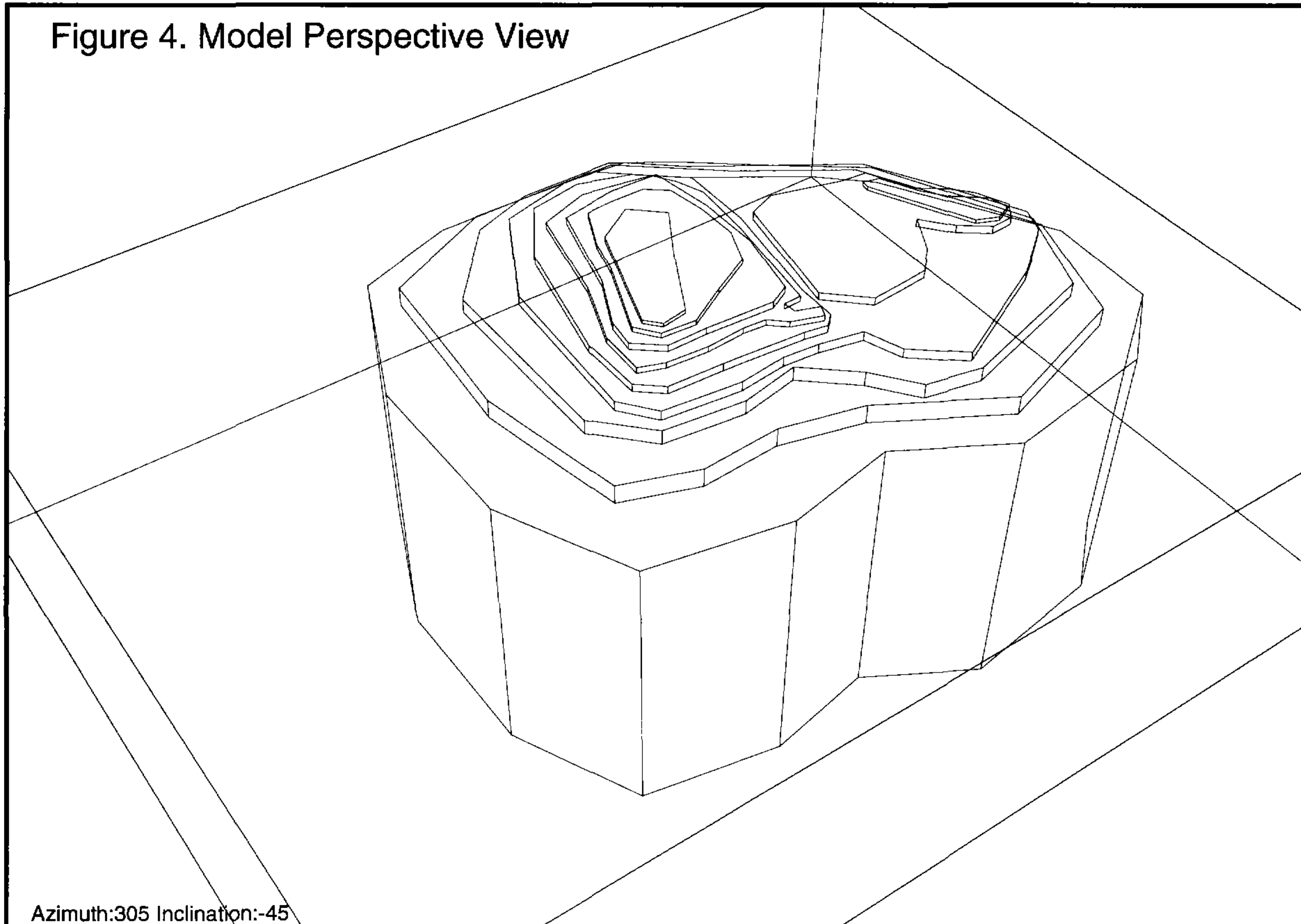


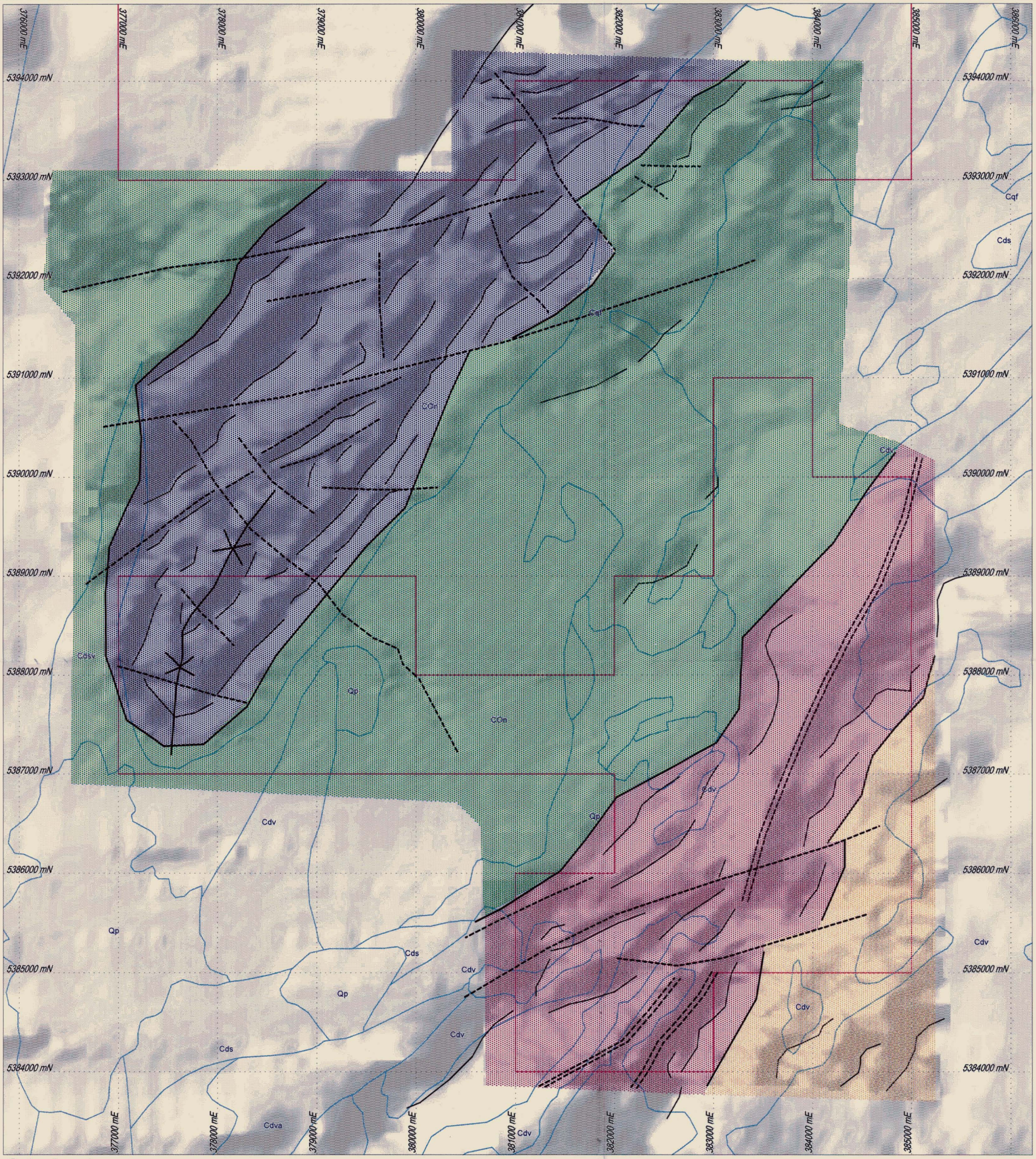
Figure 3
Boco Project
Helimagnetic Data
Modelled Section Line 20501
Scale 1:25,000
275
250
225
200
175
380000
382000
384000
-2500
-2000
-1500
-1000
Intrusive Body
S = 0.003 Si units
380000
382000
384000
5 cm

Figure 4. Model Perspective View



233046

RGC EXPLORATION ModelVision - Wed Mar 04 10:47:40 1998



Geology Legend

(outlines in blue)

Q
'Undifferentiated Quaternary sediments.'

Qp
'Glacialperiglacial and fluvioglacial sediments including till and interglacial deposits.'

Tb
'Basalt.'

COn
'Interbedded micaceous sandstone siltstone and siliciclastic pebble conglomerate mostly grey in colour. Trace fossils widespreadtrilobites and brachiopods !'

Cqf
'Quartz-feldspar porphyry - dominantly intrusive.'

Cdsv
'Dominantly felsic volcanosedimentary sequences of sandstone siltstone conglomerate volcaniclastic breccia and minor lava.'

Cds
'Cambrian marine sedimentary sequences.'

Cdva
'Units of dominantly andesitic volcanic rocks.'

Cdv
'Dominantly felsic to intermediate volcanic rocks - includes Mt Read Volcanics (in part).'

Interpretation Legend

Magnetic lineament (stratigraphic horizon?)

Structural break (fault?)

Demagnetised zone (Shear/alteration?)

Magnetic textural boundary (Lithological divide?)

Fold axis

High amplitude magnetic domain (4)
Sandstone/siltstone + detrital magnetite (Lower Tyndall Group?)

Low amplitude magnetic domain (3)
Felsic volcaniclastics and porphyry intrusive (Dundas Group)

Variable amplitude magnetic domain (2)
Altered felsic volcanics volcaniclastics and minor andesite (CVC)

Low amplitude magnetic domain (1)
Felsic volcanics and non-magnetic sediments (CVC)

Data Parameters

Survey Date: February 1991
Contracter: GeoInstruments Pty Ltd
Job No: 9101
Helicopter: Squirrel
Magnetometer: G833 Helium Vapour
Line Spacing: 100m E-W
Tie Spacing: 2000m N-S
Bird MTC: 80m
Sample Interval: 0.2 sec (3-5m)

Image Parameters

Layer 1: 1st Vertical Derivative
Colour Table: Intensity
Limits: 99.9%
Histogram Transform: Logarithmic
Sun Angle: SE 45 degrees

AMG North

238047

Scale 1:25,000

0 500 1000 1500 2000 2500 m

Distances in Metres

Projection: UTM
Grid: AMG
Zone: 55
Spheroid: ANS66

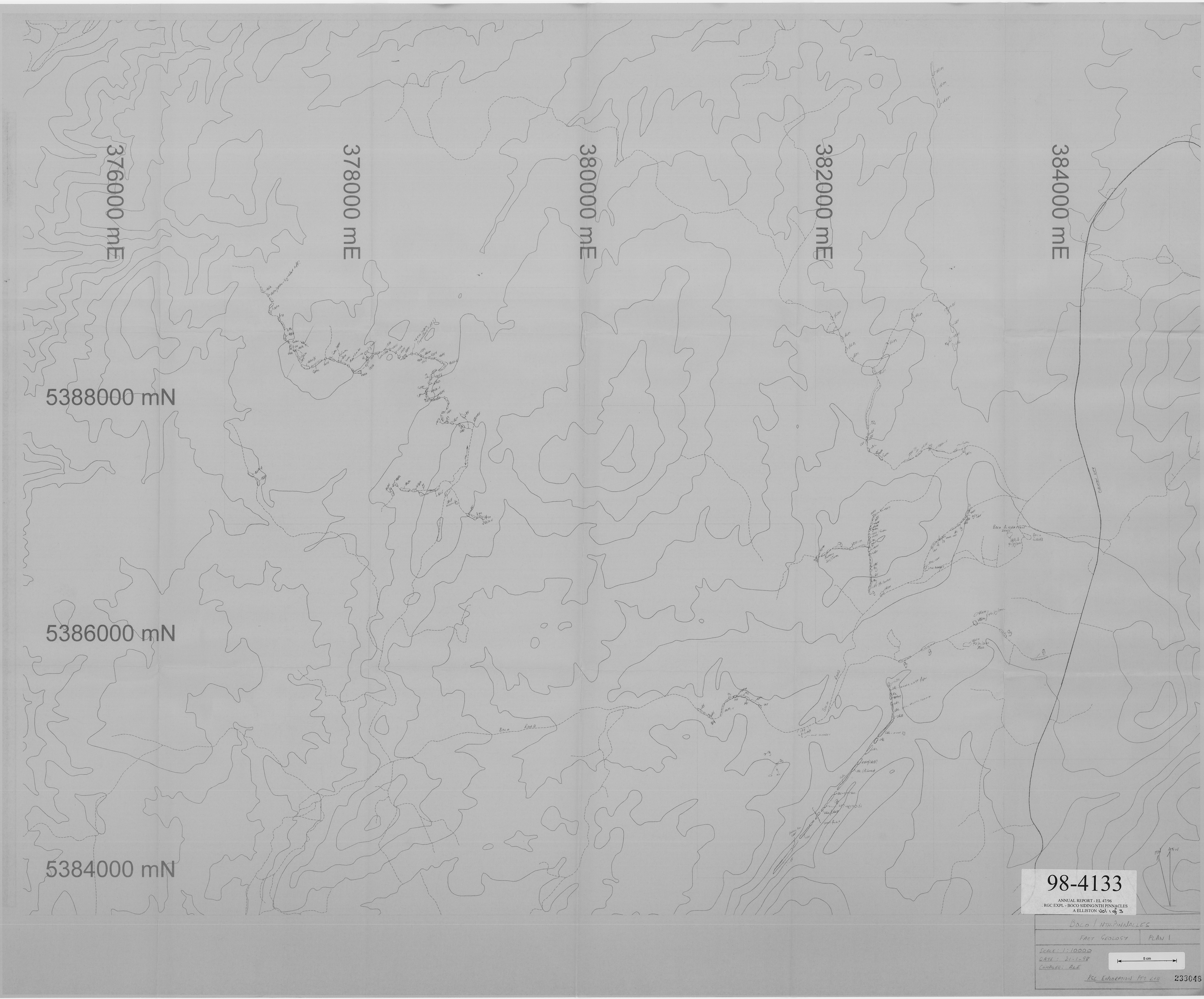
5 cm

RGC Exploration

Tasmania Base-Metals
BOCO SIDING Project

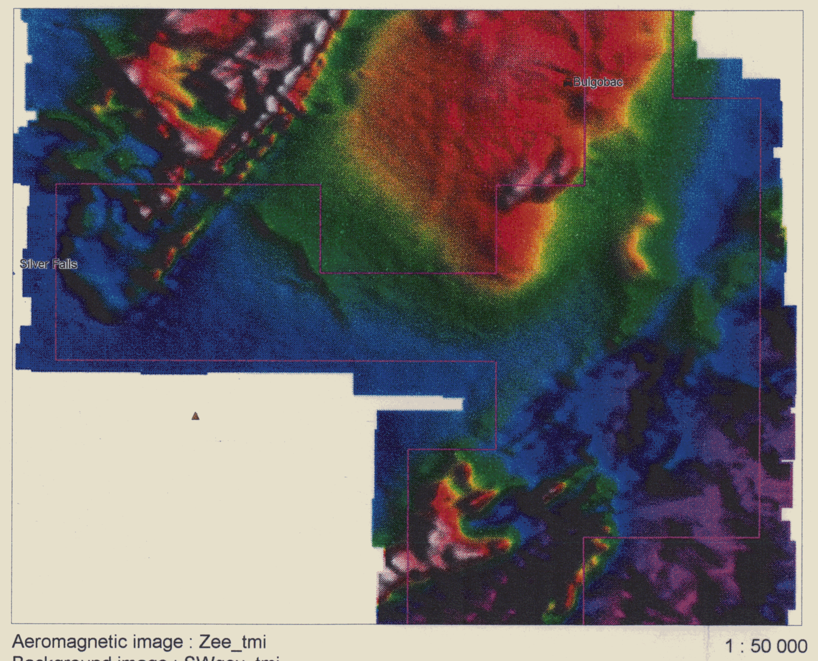
Helimagnetic Interpretation

Date: Nov 1997	**Plan 1**
Compiled by C Dauth	



376000 mE
378000 mE
380000 mE
382000 mE
384000 mE
5388000 mN
5386000 mN
5384000 mN
MN
AMG N
98-4133
ANNUAL REPORT - EL 47/96
. RGC EXPL - BOCO SIDING/NTH PINNACLES
A ELLISTON Vol 1 of 3
BOCO / NTH. PINNACLES
FACT GEOLOGY
PLAN 1
SCALE: 1:10000
DATE: 21-1-98
COMPILED: A.L.E
5 cm
RGC EXPLORATION PTY LTD
233048

Aeromagnetic Image

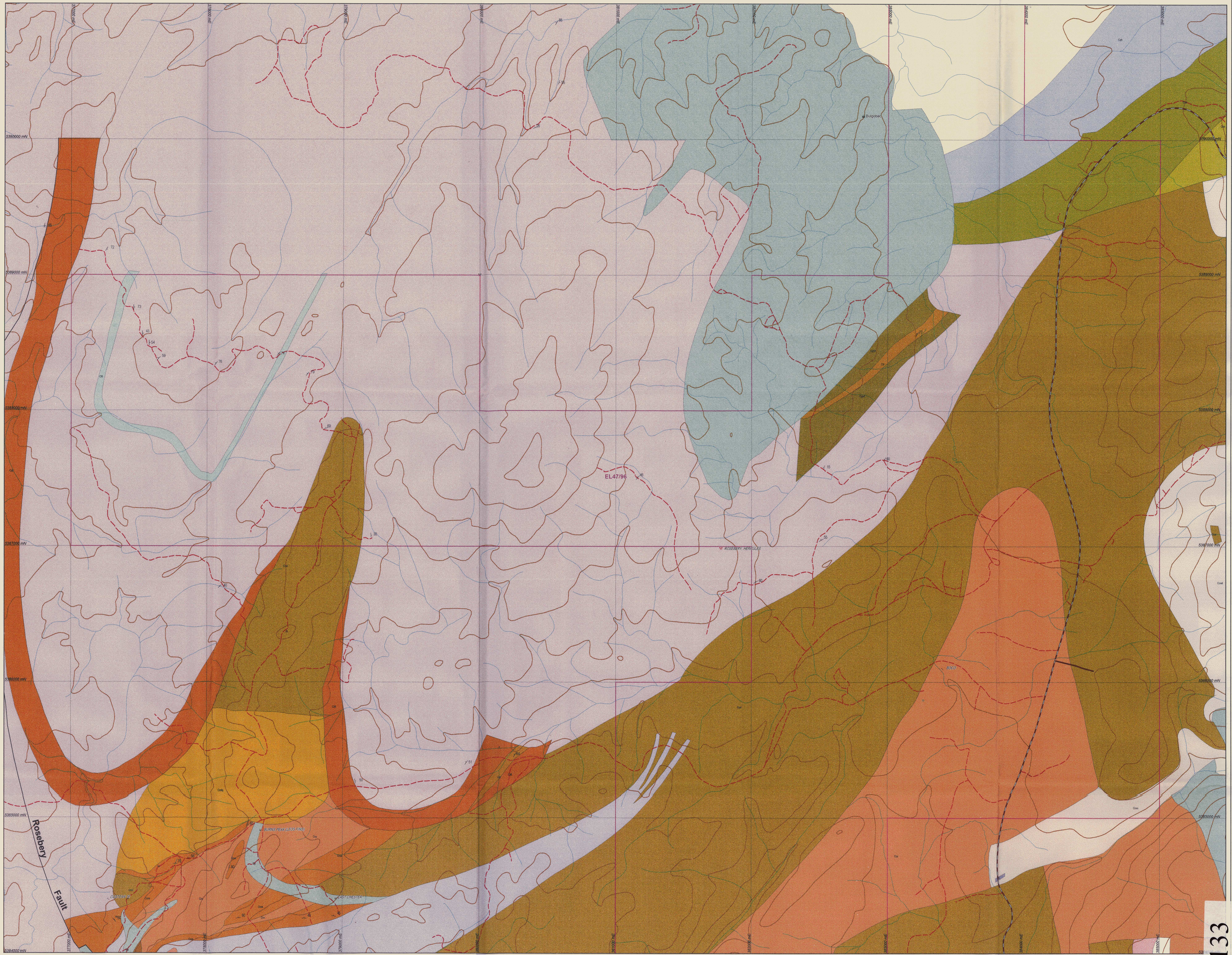


Aeromagnetic image : Zee_tmi
Background image : SWgov_tmi

1 : 50 000

Geology Legend

- Qg — Glacial and fluvioglacial deposits
- Qt — Talus and slope deposits
- Cd — Undifferentiated Dundas Group.
- Cdd — Dominantly siltstone and sandstone with minor conglomerate.
- Cdf — Felsic tuff and agglomerate, generally quartz - feldspar phyric.
- Cdl — Crystal - rich volcanic sandstone (feldspar-pyroxene phyric), lithic-rich bases with minor ash, sandstone & limestone. Lynchford Tuff & correlates.
- Ca — Andesitic to basaltic intrusive bodies with lavas & clastic units. Includes feldspar-hornblende-pyroxene-phyric & feldspar-pyroxene phyric types & small chlorite altered dykes.
- Cb — Basalt. Henty Dyke Swarm
- Ccv — Mainly felsic pyroclastic rocks, dominantly feldspar phyric, including pumice bearing tuff & breccia, crystal vitric tuff, vitric tuff & minor shale & sandstone
- Ccvu — Undifferentiated Central Volcanic Sequence
- Ccvi — Fiamme-bearing eutaxitic tuff of ignimbrite type. Some block-&-ash flow units shown (Ccvib)
- Ccvag — Lithic breccia & agglomerate
- Ccvvt — Fine grained vitric tuff.
- Ccf — Mainly felsic felspar phyric lava and intrusives; massive to flow banded or autobrecciated, with rare colmnar jointing
- Ccvq — Quartz phyric rhyolite. Pinnacles Rhyolite
- Ccs — Units of bedded siltstone, sandstone, tuff & agglomerate
- Quartz phyric volcaniclastic sediments
- Cp — Quartz feldspar porphyry
- Cqh — Que - Hellyer Volcanics undifferentiated
- Cqhf — Feldspar phyric lava
- Cgc — Micaceous Greywacke
- Cbh — Interbedded ashy volcaniclastic sediments, mass flow breccias & siltstone



Geological boundary, accurate
Geological boundary, inferred
Fold feature
Fault, position accurate
Inferred Fault
Concealed Fault

Underground Mine
Open Cut Mine
Mineral Deposit
Mineral occurrence
Prospect, explored
Abandoned Mine

Built up populated area
Homestead (Pastoral)
Building
Railway Station
Beacon, Lighthouse
Airport or Aerodrome
Bridge
Road tunnel
Monument, Statue, Cross
Landmark Object

Named Relief Feature
Mountain or mountain range
Pass
Cliff, Escarpment, Breakaway
Sand Ridge or Sand Dunes
Spur, Spur line
Rock
Plateau
Valley
Gully, Gap

Cave, Cavern
Island
Point
Pool, Pond, Waterhole, Rockhole
Swamp
Waterfall
Dam
Spring
Ford
Marina, Mooring Pen, Port

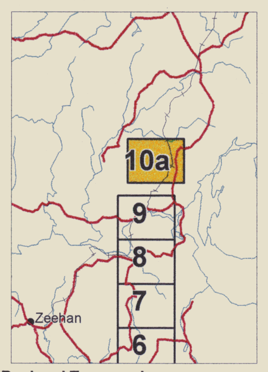
Highway
Secondary Road
Minor Road
Vehicle Track
Runway
Landing Ground
Powerline
Contour line
Watercourse
Perennial Lake

Scale 1 : 10 000
0 500 1000
Distances in Metres
Contour Interval 5m
AMG Zone 55

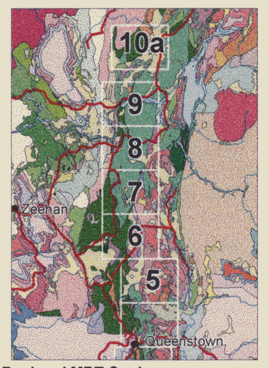
5 cm

Luina 3640	Pearse 3840
Ramsay 3639	Charter 3839
Parsons 3638 10a	Block 3838
Rosebery 3637 9	Tullah 3837
Dundas 3636 8 7	Selina 3836
Oceana 3635 6	Tyndall 3835

Sheet Index



Regional Topography



Regional MRT Geology

RGC Exploration

Mt Read Volcanics Belt Tasmania SHEET 10a (Boco)

GEOLOGICAL INTERPRETATION

Workspace Path: i: \ draft \ mapinfo \ basemet \ bm_tas \ 2301 \ 10K \ SHEET10a \ SH10a_GEOL10K.WOR

Page Setup: A0 and landscape

Date: March 1998

233049

PLAN 2

98-4133

ANNUAL REPORT - EL 47/96
. RGC EXPL - BOCO SIDING/NTH PINNACLES
A ELLISTON Vol. of 3

RGC Exploration

ACN 001 426 946

ANNUAL REPORT

TASMANIAN BASE METALS PROJECT

EL47/96

BOCO SIDING / NORTH PINNACLES

Vol 2 of 3
Text and Appendices 1-3

HELD BY: RGC EXPLORATION PTY LTD

MANAGER & OPERATOR: RGC EXPLORATION PTY LTD

AUTHOR(s): Adam Elliston

24 March, 1998

PROSPECTS: Boco Siding - North Pinnacles

MAP SHEETS:	**1:25,000: Block**	**1:100,000: Sophia**
GEOGRAPHIC COORDS	**Min East: 377000mE** **Min North: 5384000mN**	**Max East: 385000mE** **Max North: 5391000mN**

COMMODITY(s): Pb, Zn, Cu, Au, Ag

KEY WORDS: Boco Siding, North Pinnacles, Alteration, Volcanic Massive Sulphides, Tyndall Group Correlates

Distribution:

- o **RGC Exploration Information Centre Reference:**
- o **RGC Exploration Zeehan**
- **ania**

98-4133B

APPX 4 of 98-4133

238051

Exploration History and Potential of EL 47/96

Boco - North Pinnacles Area, Tasmania

Vol. I
Text, Tables and Figures

For RGC Exploration Pty Ltd
PO Box 62 Zeehan TAS 7469

By W. Herrmann
Walter Herrmann Geoscience Pty Ltd
57 Webberleys Road FORTH TAS 7310

Date 7 April, 1997

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1 SUMMARY

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EL 47/96, covering 26km^2 in the Boco and North Pinnacles area, has a 20 year history of modern base metal and gold exploration that has mostly been conducted by companies closely connected with the Rosebery, Hercules and Pinnacles VHMS deposits which represent the most analogous exploration models for the area.

About two thirds of the area has been covered by detailed grid based surveys including soil geochemistry, IP and TEM and high resolution aeromagnetic and gravity data is available for the entire area. Twenty diamond core holes, totalling 7600m, have been drilled to test a variety of IP/geochemical and conceptual exploration targets. Extensive zones of quartz-(sericite-pyrite) alteration have been delineated in felsic volcanics at the Boco and North Pinnacles prospects but no significant base or precious metals, even remotely approaching economic grades, have been intersected.

At Boco, no favourable horizon has been identified and the facing direction is uncertain. Despite the substantial amount of previous drilling and some lines of interpretation which suggest the hydrothermal alteration system/s may have been barren, truncated by erosion or unrelated to sea floor volcanism, it is considered to have moderate VHMS potential which could be explored by more detailed alteration studies and volcanic facies analysis.

There is moderate potential at North Pinnacles for deeply buried VHMS deposits associated with the interpreted equivalent of the Rosebery favourable horizon but the findability factor appears to be low.

A recent interpretation that a correlate of the Lynchford Member exists within the volcano-sedimentary sequence exposed in the Silver Falls syncline west of North Pinnacles, suggests low to moderate potential and high to low findability for VHMS and possibly Henty type Au deposits at this stratigraphic level.

There is unknown to moderate potential for Henty type Au deposits associated with structurally modified synvolcanic alteration zones situated close to or intersected by major faults in both the Boco and North Pinnacles areas.

2 INTRODUCTION

EL 47/96, held by Renison Ltd., covers 26km^2 in the Boco to North Pinnacles area, midway between the Rosebery and Hellyer mines in western Tasmania.

This report presents a comprehensive review of previous geological information and current exploration potential. It has been prepared by W.Herrmann, under a contract arrangement for RGC Exploration P/L, on the assumption that RGC's main exploration targets are volcanic hosted polymetallic massive sulphide (VHMS) deposits and Henty style gold deposits. No new exploration data have been generated.

3 EXPLORATION HISTORY

Early prospecting efforts in the Boco-North Pinnacles area appear to have been largely unproductive. Although the altered gossanous outcrops at Boco Siding showed signs of prospecting, the only documented mineral occurrence is Samuel Smith's lode which reportedly extends from Boco Creek to the Siding, on a trend of 020° and dip 70°W, (Williams, 1985).

Modern systematic exploration commenced in the 1960s, when the area was covered by Comstaff's large EL 5/63, but was initially restricted to a regional stream geochemical survey and two lines of dipole-dipole IP over the fluvio glacial plain at Boco.

During the period 1972 to 1988 a 94km^2 area was held by Electrolytic Zinc Co. under EL 12/72 (Figure 1) and intensively explored, under a series of joint venture arrangements, involving EZ and Getty Oil Development Co. upto 1984, then CSR-EZ-Getty in 1985 and Pancontinental-Outokumpu-EZ-Little River Goldfields in 1986-87. Exploration work initially included regional Input EM, stream geochemical and mapping surveys and then focussed on grid based soil geochemical and IP surveys culminating in drilling at the Boco prospect (14 holes for 5665m) and North Pinnacles prospect (3 holes = 400m).

EL 12/72 expired in December 1987 but EZ managed to retain a 5km^2 remnant at North Pinnacles, for two additional years, to drill a fourth hole and test potential for disseminated gold mineralisation. The relinquished major part of EL12/72 was taken up as EL 17/88 by Samisen Pty Ltd which carried out RRMIP and gravity surveys at Boco.

Billiton Australia subsequently tendered for ELs 2/90-Boco and 8/90-North Pinnacles, more or less covering the southern half of the former EL 12/72. After reviewing the data and cursory lithogeochemical studies, which indicated empirical prospectivity for VHMS deposits at both Boco and North Pinnacles, Billiton entered a joint venture agreement, in late 1990, with Pasminco Exploration which managed exploration up to Billiton's withdrawal in 1994. Pasminco expended a combined total of $737,099 on the licences between 1990 and their voluntary relinquishment in 1996.

In the interest of maintaining geological and chronological continuity, the previous exploration results from Boco, North Pinnacles and other areas are summarised separately, as follows.

3.1 Boco

1975-77 A regional Barringer INPUT airborne EM survey detected a few fair to poor conductivity anomalies in the Boco area. An initial gradient array IP survey over the best Input anomaly (CS27) failed to get a response and it was consequently decided to apply gradient IP as a reconnaissance exploration method.

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EZ established a large grid covering ~6km of strike centred on Boco Siding and carried out ~55km of gradient array IP which indicated numerous (22) significant "moderate" chargeability anomalies. A C-horizon? (10-20cm depth) geochemical survey over the southern area (not covered by glacial overburden) was intended to assist in evaluation of IP but failed to record any anomalies; samples from glacial covered areas were generally below detection and some false anomalies were found to be due to contamination on the down slope side of the Emu Bay Railway (which hauled mineral concentrates to Burnie).

Three short diamond drill holes were completed to test IP anomalous zones: (Figure 2)

BBP 207 (159.5m) was collared 900m SW of Boco Siding, near the old Burns Peak Road and just north of an outcrop of altered volcanics; it intersected intensely silicified tuffs with disseminated and veiny pyrite contributing upto 3% sulphur and maxima of 200ppm Pb, 1300ppm Zn.

BBP 208, collared near the Murchison Highway, 1km SE of BBP 207, intersected pink porphyry, tuffaceous sediments and ash flow tuffs with patchy vein/disseminated pyrite; maxima 2% sulphur, 1450ppm Pb, 2600ppm Zn. Graded bedding in the volcaniclastics indicated facing and dip to the east.

BBP 209, 700m NW of BBP 207 just north of the new Boco (forestry) Road, intersected auto brecciated felsic porphyritic lavas, ash flow tuffs and sheared siliceous tuffs with rare pyrite (patchy upto 3% sulphur, maxima 150ppm Pb, 4000ppm Zn) and stockworks of Fe-Mn veinlets.

1978 The Boco grid was extended to the west (17.5 line km) and covered by gradient array IP but no anomalies were found.

A dipole-dipole survey over the 1977 gradient IP anomalies produced similar results but with less resolution at depth. It was concluded that the best targets at Boco had already been drilled and found to be lacking significant mineralisation.

1979 Grid extensions from the SE corner were covered by soil geochemical survey which yielded no anomalies and a line of 100m dipole-dipole IP which found three anomalous zones, the western most of which had previously been tested by BBP 208. These IP anomalies were written off as probably representing barren sulphide (pyrite) responses of the type intersected in BBP 207.

1981 Mitre Geophysics reviewed the Boco IP results and found that:

* Poor line cutting had resulted in variable data density so that some anomalies were isolated one liners.
* Gradient IP was susceptible to glacial responses; it was suspected that most anomalies were not bedrock responses.
* Dipole-dipole IP subsequent to drilling of BBP 207, 208 & 209 suggested that the holes may not have adequately tested the anomalies; these holes had been sited on one line anomalies rather than anomalous zones, thereby increasing the likelihood of spuriosity.

1982-84 A review of the Boco prospect concluded that the geological environment (subaqueous sediment lenses in felsic volcanics) was favourable for VHMS deposits and the quartz-sericite-pyrite alteration intersected by BBP 207 (comparable to Rosebery host volcanics?) was inferred to extend beneath the glacial plain. Although the glacial cover had masked IP and geochemical responses there was sufficient space for orebodies between areas of reliable bedrock data.

233057

EZ carried out a 12 hole vertical percussion drilling programme (Figure 2) in an attempt to map out the alteration zone beneath glacial cover. The programme was only partly successful in that 10 holes reached bedrock (at depths ranging from 20 to 104m) but it did partly define the limits of the alteration zone and led to the interpretation that it was stratiform, ~200m wide and with a strike length of 1km open to the north and south. Geochemistry of bedrock samples indicated mostly low values in the leached oxide zone, maximum values were 115ppm Pb and 1600ppm Zn in PDH 3 near BBP 207.

Major and trace element geochemistry of bedrock samples from percussion holes 1 to 10 and BBP 207 showed that the alteration zone was associated with slight SiO_2 enrichment, strong Na_2O and Sr depletion and a general decrease in Na_2O westward from PDH 4, through BBP 207, to PDH 3. This was taken to indicate a westward facing alteration zone with an increase in alteration intensity up through the "footwall".

A further 8 angled diamond core holes were drilled (4 to the east and 4 to the west) to test the alteration zone and obtain geological information on sections spaced 150m to 400m apart over ~1400m of strike (Figure 2).

BBP 242	457.5m	BBP 250	358.0m
BBP 246	525.0m	BBP 251	379.5m
BBP 247	382.5m	BBP 253	
BBP 248	577.5m	BBP 254	439.5m

A limited UTEM survey, which was conducted part way through this drilling programme, detected three weakly conductive anomalies (labelled A,B,C in Figure 2). Anomalies A and B were tested by BBP 253 and BBPs 251 & 254 respectively but no significant conductors were intersected and the UTEM responses were subsequently attributed to conductive layers within the glacial cover.

All drill holes, except BBP 246, were surveyed by downhole SIROTEM which produced noisy data but no anomalies (Taylor, 1987).

The principal host rocks to alteration were interpreted as dacitic fragmental lavas with felsic leucoandesitic (?) lavas to the west and rhyolitic fragmentals to the east. An initial interpretation was that there was zonation of most intense, Na_2O depleted, quartz-sericite-pyrite alteration along the western side and weaker sericite+/-pyrite on the east, suggesting that the host rocks and the alteration zone faced west (slightly overturned with 80°E dip) and that a potential ore horizon could exist at its upper (western) boundary. More extensive sampling showed that Na_2O depletion was non systematic (low Na_2O everywhere) but a slight enrichment of CaO (?), Pb and Zn (increasing from ≤100ppm to 300-400ppm!) from east to west, maintained slender support for the west facing model.

BBP 251 intersected a 10m thick laminated pelitic ash siltstone with thin (syngenetic?) pyritic bands near the western margin of the alteration zone; this was regarded as a potential favourable horizon but could not be traced 200m to the north in BBP 254 which intersected a different sequence of altered lavas.
BBP 253 closed off the alteration zone to the south but the strong alteration and subaqueous volcanic setting, with possible analogies to Kuroko and Que River, were regarded as very favourable and further drilling to the north was recommended.

1985 CSR joint ventured in to further investigate the Boco alteration zone; particularly to drill test the undefined northern extensions, the alternative concept that the favourable horizon could lie along the eastern margin of the alteration zone and a downhole SIROTEM response suggesting a conductor east of BBP 254 (Williams, 1985).

Three diamond core holes were drilled (on westerly azimuths):

233058 BBP 278 (501m) tested the northern area, 500m along strike from previous drill holes, and effectively closed off the alteration zone by intersecting unaltered lavas.

BBP 279 (700m) tested the eastern targets. The hole intersected unaltered rhyolitic volcaniclastics and lavas above ~580m, then passed through a fault zone into pyritic altered lavas and volcaniclastics and finally into relatively unaltered pumiceous volcaniclastics below 645m. This effectively eliminated the eastern favourable horizon concept. The downhole SIROTEM anomaly was attributed to a 10m wide silicified zone with (5-20%) pyritic stringers in otherwise unaltered volcanics at ~450m.

BBP 280 (400m) was drilled to test for southward extensions of the favourable pyritic volcaniclastic lithologies intersected by BBP251. It intersected a complex assemblage of felsic lavas, vitric tuffs and volcaniclastics , partly correlatable with the sequence in BBP 251, and with strong quartz-sericite-pyrite alteration in the interval 75-350m, but no other mineralisation.

Major and immobile trace element analyses of (32) representative rock types indicated that the Boco volcanics are rhyolites and dacites, which contrast with dacitic to andesitic compositions from Que River, and effectively refuted earlier proposed stratigraphic correlations with the latter.

Sulphur isotope analyses on 5 core samples from the pyritic alteration zone (Williams, 1985) showed that the Boco sulphur was isotopically light ($\delta^{34}S$: -1.2 to 4.7‰) suggesting a non seawater origin. Randell (1991a) noted the similarity to δS^{34} ratios from Chester (-3.9 to 0.4‰), and the contrast with data from Hellyer (5 to 11‰) and Rosebery (10 to 15‰), and suggested a magmatic source of sulphur.

Williams (op cit.) recommended further investigations, including additional sulphur, oxygen and lead isotopic studies, DHEM of BBP 279 (to confirm that the 10m pyrite stringer zone was the source of the BBP 254 DHEM anomaly) and conductivity testing of glacial clays (to investigate the possibility of current channelling masking bedrock EM responses). However, CSR had downgraded the potential of the Boco alteration zone and consequently withdrew from the joint venture.

1986-87 Pancontinental-Outokumpu farmed in to the joint venture in late 1986 with the principal objective (inspired by the discovery of the Hellyer deposit by UTEM in 1984) of applying blanket TEM to search for conductive bodies over the Boco alteration zone and along strike.

A grid was established over 5.8km of strike with NW-SE lines at 200m intervals (Figure 1 & Figure 3) and surveyed in December 1986 by a four loop UTEM survey (43 line km) which failed to detect any significant conductors (Wilson, 1987). The survey was carried out "within loops" on the assumption that potential conductive sulphide deposits could have shallow dips. The structural set up was not well known: EZ considered that Boco was in an anticlinal setting whilst the CSR interpretation was that dips were semi-vertical with a northerly strike.

Following the UTEM survey, a re-appraisal of Boco geology, based on fairly cursory examination of the existing drill core [6 days] and minor surface mapping [2 days] by W.Herrmann (1987a) found that the volcano-stratigraphic units probably strike approximately north-south with steep east and west dips. The younging direction could not be reliably determined but the regional setting implied a west facing sequence.

The dominant volcanic lithotypes were interpreted as rhyolitic to dacitic, glassy, variably massive, flow banded and auto-brecciated quartz amygdaloidal and feldspar phyric lavas with substantial felsic pumiceous-lithic volcaniclastics and minor, areally

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restricted?, mass flow polymictic lithic breccias and volcaniclastic sandstone-siltstone units.

The zone of intense, pervasive, plagioclase destructive quartz-sericite-pyrite alteration (averaging 2-5% disseminated pyrite) appeared to have a N-S oriented, elongate dumbbell shape in plan, upto 1300m in strike length and 350m width (Figures 7 to 13). Alteration was observed in all rock types but appeared to be particularly associated with the restricted volcaniclastic breccia and sandstone facies. The presence of variably altered lithics and semi-massive pyrite clasts within the breccias suggested some synvolcanic alteration-mineralisation and volcaniclastic re-sedimentation. In the northern area, the alteration zone appeared to be partly stratabound to the west, against a unit of massive pumiceous-lithic breccia. The alteration zone was interpreted to have been bisected by a north trending, steeply east dipping fault (partly forming its eastern margin in the northern part and its western margin in the southern part) which had produced a dextral offset of ~600m in a formerly more or less cylindrical, steeply east plunging, alteration "pipe".

Despite the uncertainty of facing it was considered that the existing drill holes had adequately tested the possibilities for favourable horizons to east and west (assuming a stratiform alteration system). Alternatively, the apparent steep pipe like form of the alteration was consistent with an interpretation that it represented a sub vertical, cross cutting, footwall zone beneath a favourable horizon now removed by erosion. Given the structural uncertainties, no further firm conceptual drilling targets could be recommended.

A limited wholerock geochemical and petrographic study of (11) relatively unaltered rock specimens from the Boco-Bulgobac area (Airas, 1987) concluded that the absence of intermediate and mafic volcanics did not support a correlation with the Que-Hellyer Volcanics.

EL 12/72 (apart from the "time extension" over the segment at North Pinnacles) was relinquished in December 1987 under the new regulations limiting EL tenure to ten years.

1988-89 Samisen Pty. Ltd. became interested in the Boco prospect and applied for EL 17/88 (which covered virtually the same area as EZ's EL 12/72 excluding North Pinnacles) apparently on the basis of a long association with Boco geophysics by one of its principals (A.W.Howland-Rose), and the conviction that previous geophysical surveys had not effectively explored beneath the glacial cover. Accordingly they re-established the central Boco part of Pancontinental-Outokumpu's grid and extensions to the east, (Figure 4) and conducted an RMIP (reconnaissance magnetic induced polarisation) survey which detected seven polarisation anomalies of insignificant resistive contrast, (Howland-Rose, 1989a). Five of these anomalies were subsequently checked by surveying gravity profiles; only one showed slight a mass surplus (Howland-Rose, 1989b). In view of the poor conductivity response it was concluded that no "obvious" VHMS mineralisation existed in the surveyed area and the licence was voluntarily relinquished.

1990 Billiton acquired EL 2/90 (Figure 5) by tender to explore for VHMS deposits (Randell, 1991a).

Initially interested in the Boco alteration zone, Randell (op cit.) reviewed the previous exploration results including some unacknowledged Oxygen isotope data (the $\delta^{18}O$ numbers are similar to those quoted by Green, 1986). He noted that the heavy $\delta^{18}O$ values of the Boco alteration zone (9.7 to 11.8‰) were not typical of Tasmanian VHMS systems (eg: Hercules: 6.8 to 10‰ and Hellyer: 7 to 9‰) but were consistent with a seawater dominated system at temperatures of <200°C which would be insufficient to inorganically reduce seawater sulphate or transport ore forming quantities of base metals. Green (op cit.) noted that such a low temperature system, leaching sulphur from volcanic country rocks, would also account for the low $\delta^{34}S$ values.

233060 On the basis of S and O isotopic results, low base and precious metal contents and unfavourable Zinc Ratios, it was concluded that the known Boco alteration zone does not represent a footwall hydrothermal system beneath an exhalative VHMS deposit but rather was initiated by intrusion of the Sock Creek Porphyry (?) with mobilisation of "late tectonic fluids" into a structural zone of weakness in an antiformal hinge.

Deterred from the Boco alteration zone by the extent of previous exploration, depth of glacial cover and the interpretation that it was an infertile system, Billiton subsequently applied an "inhouse" lithogeochemical technique to search for (other?) favourable horizons.

This lithogeochemical technique appears to have been empirically based on observations that the Rosebery, Que River and Hellyer massive sulphide deposits exist close to contacts between CL and CH type volcanics, respectively denoting low and high (but unspecified) Ti and Zr contents. The CH type were further subdivided into CHl and CHh types denoting low and high (but unspecified) Sr contents. CL and CHh type volcanics were regarded as prospective whilst CHl types appeared to indicate unfavourable hanging wall sequences.

Although the lithogeochemical sampling density was low (Figures 5 & 6), the complex distribution of CL, CHh and CHl types at Boco suggested it was a favourable area and, furthermore (fancifully), that it was situated in the hinge of a shallow NNE plunging antiform. This, tied in with some doubtful regional stratigraphic correlations, suggested that the most favourable position was at or near the Central Volcanic Complex (CVC)-Dundas Group contact between 1km and 3km northeast of Boco Siding. About half of this zone had been covered by Pancontinental-Outokumpu's UTEM survey but Billiton's interpretation of steeply dipping fold limbs led to the conclusion that the UTEM survey had been ineffective due to poor electromagnetic coupling.

It was proposed that a >800m stratigraphic diamond core hole should be drilled to test the postulated favourable zone near Murchison Highway, 3km NNE of Boco. CSAMT and TEM depth soundings were suggested to provide better target definition.

1991-92 Billiton's exploration managers apparently declined the chance to test Randell's (1991a) conceptual target and instead arranged a joint venture whereby Pasminco took over exploration management of both the Boco and North Pinnacles licences (ELs 2/90 & 8/90, Figure 14) and, by expending $500,000 over 4 years, could earn a 60% equity in the licences.

Pasminco's first exploration step (Kirsner, 1992) was to arrange a new aerial photographic survey and photogrammetric production of 1:10,000, 1:5,000 and 1:2,500 scale topographic base plans.

A 700 line km, high resolution, helicopter borne aeromagnetic-radiometric survey was flown, in February 1991 by Geoinstruments P/L, on 100m spaced E-W lines at ~80m terrain clearance, sampling at <10m intervals with <0.1nT sensitivity, (Leaman, 1991a and Figures 15 & 16). The principal aims were to assist regional mapping, assess structural controls and signatures associated with known mineralisation, and identify alteration zones.

Leaman's (op cit.) preliminary interpretations (typically difficult to comprehend) were that:

* The volcanics are structured, probably folded, but depth limited, indicating the presence of basal detachments or limited volumes.
* The magnetic pattern over Dundas Group sediments in the western part of the area

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is comparable to the volcanics, likewise implies a limited depth, but is magnetically unlike that of Dundas sediments elsewhere.

* NE, E and NW trends and structures are common but rarely continuous across the area.
* A large magnetic high centred near Bulgobac Siding was possibly attributable to a tabular slice of ultramafics at considerable depth ~3-6km.
* The Boco alteration zone is clearly outlined as a magnetic low and similar smaller lows, implying further alteration, exist on a NNE trend 2-3km north of Boco. [An additional, partly defined but distinct, low anomaly centred at 385000E 5387000N ~1.5km NE of Boco, appears to have been overlooked.]

In order to enable refinement of regional structural and magnetic interpretation a gravity survey was carried out over the eastern part of the licence, from Animal Creek to the southern boundary, to provide data at an average spacing of ~225m.

Leaman (1991b) interpreted the combined gravity-magnetic data, after compensating for the glacial cover, and suggested that the Boco alteration zone is in a "critical site". It apparently lies adjacent to a major E-ENE trending, inferred Cambrian "structure" which offset and controlled volcanism, and along an inferred early Devonian NNE trending alteration axis which overlies an older basin margin "structure".
This arrangement implied that the Boco alteration was associated with Devonian fluid activity amongst disrupted volcanics above an east soling detachment overlying an old margin. Recommendations to drill test the structures away from the Boco alteration zone were outlined.

Accordingly diamond core hole AK1 (553.7m) was drilled, 700m south of Animal Creek and 200m east of Murchison Highway on a SE azimuth (Figure 21), to test the extension of alteration zones (inferred from magnetics) NNE of Boco and the CVC-Dundas contact which had been identified as a VHMS favourable horizon by Billiton and "inhouse" Pasminco studies.
However the hole went through 70m of glacial cover straight into a sequence of CVC rhyodacitic to dacitic lavas with minor volcaniclastic breccia and sandstone (Figure 22). Patchy moderate silicification and weak to moderate sericitisation associated with traces to ~3% disseminated pyrite, of similar style to Boco alteration, was reported for the interval 200-400m, decreasing in intensity downhole. No significant base metal mineralisation was intersected.

This unfavourable result, combined with Leaman's implication of Devonian structural control and the unfavourable Boco isotopic data, led to doubts about the VHMS potential for any part of the line of magnetic lows and alteration zones trending NNE from Boco. The failure of AK1 to intersect the CVC-Dundas contact was attributed to a dextral offset on a NW trending fault inferred to run along Animal Creek; potential for mineralisation on this structure was also postulated.

AK1 was subsequently surveyed with a Crone DHEM system but no off hole anomalies were detected (Poltock, 1993).

Geological mapping by A.Lorrigan, as part of a larger regional project, (Kirsner, 1992) had led to interpretation of a generally west younging sequence from dominantly volcanics (Ci) through transitional volcano-sedimentary assemblages (Cii, Ciii) to turbidites (Civ) and shallow water conglomerates (Cv), which was folded and disrupted by thrust faults above a basal detachment fault with presumed PreCambrian basement at <2-4km depth (Figures 17 to 20). For reasons which are obscure (reported only in Pasminco internal reports?) Lorrigan considered the Cii transitional group to be most prospective and apparently concluded that (within ELs 2/90 & 8/90) the Silver Falls area warranted "immediate attention".

No further work was carried out in the Boco-Animal Creek area.

3.2 North Pinnacles

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1979-80 EZ cut seven E-W reconnaissance grid lines,totalling 10.9km, (Figure 1) at North Pinnacles over a "tongue" of massive rhyolite flanked to the west by a possibly onlapping, west facing and dipping, sequence of siltstone, tuffaceous sandstone and minor conglomerate, and to the east by a similar sequence of uncertain facing. This appears to have been inspired by observations of sparse disseminated pyrite in the volcanics and minor veiny Pb-Ba mineralisation near Burn's Peak, 2km to the south (Mill, 1979).

The grid was covered by 100m dipole-dipole time domain IP and 20m spaced C-horizon geochemical (Cu,Pb,Zn,Fe,Ag,Mn) surveys.

IP outlined two encouraging anomalous zones:

* A ~600m long eastern zone straddling the eastern contact of the rhyolite, reportedly co-incident with Pb-Zn soil geochem anomalies in the northern part.
* A 200m western zone in sediments about 200m west of the rhyolite contact.

Soil geochemistry indicated semi-continuous Pb anomalies upto 2500ppm and broadly co-incident weaker Zn anomalies; mainly within the area of rhyolite or along its eastern and western contacts. Ao and Aoo (leaf litter) geochemical samples showed much lower Pb & Zn levels with poor correlations to C-horizon data.

EZ subsequently carried out minor additional gridding and extensions to soil sampling, stream geochemical sampling, geological mapping and IP follow-up surveys (Mollison, 1980).
Mapping indicated that sediments on both sides of the rhyolite dip away from the contact and an overlying/onlapping relationship was inferred. Stream geochemical results were surprisingly low with an isolated maximum of 3000ppm Pb but otherwise ≤110ppm Pb and ≤150ppm Zn
Detailed 40m dipole-dipole IP over the known anomalies failed to locate anomalies "of prime interest" but several were co-incident with soil geochemical anomalies near the rhyolite contact; both within and adjacent to the rhyolite.

Three short diamond core holes were drilled to test IP/geochemical anomalies: (Figure 23)

* NPP 213 (130.1m) was targeted to test co-incident Pb geochemical and weak IP anomalies 250m west of the rhyolite contact. It intersected a west dipping and facing sequence of felsic tuffaceous sandstone, siltstone and grey shale with minor fine pyrite-sphalerite-galena in carbonate veinlets; maximum 565ppm Pb and 1350ppm Zn in interval 85-90m, IP attributed to shales.

* NPP 214 (142m) was designed to test a spot Pb-Zn-Cu geochemical anomaly on the same section as NPP 213 but ~100m west of the rhyolite contact. It intersected a similar sedimentary sequence and ended in rhyolitic volcaniclastics indicating that the west contact dips at ~80° to the west. Minor galena-sphalerite mineralisation in fluorite veinlets, peaking at 1250ppm Pb and 1000ppm Zn in the interval 35-50m, correlated with soil geochemical anomaly.

* NPP 215 (128m) tested co-incident IP and Pb geochemical anomalies within the rhyolite; it intersected sparsely feldspar phyric rhyolite and rhyolite breccia containing minor pyrite-galena-sphalerite in quartz-carbonate veinlets with maxima of 0.38% Pb and 1.1% Zn in the interval 45-50m.

It was concluded that all of the drill holes intersected vein style epigenetic mineralisation within both sedimentary and volcanic facies; the local existence of fluorite possibly indicating a magmatic-intrusive metallogenic association. The absence of a recognisable favourable horizon lowered the VHMS potential.

1984 During the late stage of the EZ-Getty JV, drill holes NPP 213, 214 & 215 were re-sampled to investigate the gold potential (Taylor, 1988). NPP 215 was found to have intersected anomalous gold averaging 0.2g/t over a 20.3m interval of pyritic-silicified-brecciated rhyolite.

1987 Pancontinental-Outokumpu farmed in to the joint venture in late 1986 and carried out a review of the previous exploration at North Pinnacles.

It was noted (Herrmann, 1987b) that in NPP 215 there was an association between weak Au-As-Pb-Zn mineralisation, a zone of unusual brecciation and weak but pervasive grey quartz-sericite-carbonate alteration and that Zinc Ratios in the anomalous zone(s) were similar to those of Tasmanian VHMS deposits. It was postulated that the weak alteration could represent a peripheral part of a VHMS related hydrothermal system but the limited area of volcanics, absence of a recognisable favourable horizon and the possibility that a favourable horizon had been stripped by erosion prior to disconformable deposition of the adjacent sediments, indicated a fairly low prospectivity for VHMS deposits.

Nevertheless, Pancontinental-Outokumpu re-cut and extended the grid and carried out a four loop EM37 survey covering an area of 1.6 x 1.2km centred on the North Pinnacles rhyolite (Figure 24). No anomalous responses were recorded.

Rock chip sampling undertaken during reconnaissance mapping discovered an outcrop of brecciated rhyolite containing upto 2.2g/t Au about 200m north of NPP 215 (Figure 25). This was sufficient encouragement to secure a one year extension of the North Pinnacles part of EL 12/72, beyond the "compulsory" expiry date in December 1987.

A subsequent bedrock Wacker sampling programme (at 10m sample spacings on six lines 100m apart) indicated erratic Au, Ag and Pb bedrock geochemical anomalies, peaking at 3.1g/t Au and 33g/t Ag, in brecciated, quartz veined, quartz-sericite altered rhyolite over a 400m strike length extending north of NPP 215 (Taylor, 1988). The highest bedrock Au anomaly, by co-incidence, was located over the surface projection of the 20.3m @ 0.2g/t Au intersection in NPP 215; ie: the best anomaly had already been tested.

On the basis of these results, Pancontinental-Outukumpu withdrew from the joint venture.

A subsequent review of the earlier IP data by Mitre Geophysics led to a recommendation to drill test the strongest chargeability anomaly in the Au anomalous zone on line 10400N near (AMG) 379050E 5387300N.

EZ managed to arrange an additional one year extension on the EL segment and tested the IP/geochemical target 200m north of NPP 215 with diamond core hole NPD 004 (199m), (Mathison, 1989; Figure 23). The hole intersected rhyolitic lava and breccias with patchy alteration and minor pyrite-sphalerite-galena in quartz-carbonate veinlets and rare galena veins to 5cm. The base metal grades (in 3m splits) were generally low, mostly <0.1% Pb+Zn with a maxima of 3m @ 1.8% Pb. Gold grades were mostly ≤0.01g/t with a maxima of 9m @ 0.05g/t Au at the bottom of the hole. The sulphides intersected were considered insufficient to explain the IP anomaly but a downhole EM37 survey indicated there were no conductors close to the hole.

It was concluded that an east dipping zone of weak mineralisation could exist east of and above NPD004 but that, in any case, the low grade and erratic gold distribution were not favourable indications of an economic deposit, and that the area had been adequately tested.

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1990 Billiton picked up EL 8/90 for its perceived VHMS potential based on several stratigraphic, lithogeochemical and geophysical concepts and considerations (Randell, 1991b) which were:

* The concept that the sequence hosting mineralisation at Pinnacles, ~3km to the south, lies stratigraphically below the North Pinnacles rhyolite. A simplistic model based on shallow northerly plunging folds suggested the favourable sequence would be at ~1000m below surface in EL 8/90 but it was "hoped" that it existed closer to the surface.
* The possibility that the gold anomalous weak alteration intersected in NPP215 and NPD004 represented a hangingwall alteration zone above a VHMS deposit.
* A time-stratigraphic metallogenic concept that Pinnacles and Que-Hellyer deposits exist near the upper CVC-Dundas Group boundary which therefore represented the most empirically favourable VHMS stratigraphic interval in the northern part of the Dundas Trough. In EL 8/90, this favourable interval was interpreted to be represented by the sequence underlying the rhyolite, the rhyolite itself and the lowermost overlying Dundas Group sediments.
* Billiton's in house CL-CH lithogeochemical discriminator which indicated that favourable rocks existed at Pinnacles and along strike to North Pinnacles (see also discussion in section 3.1, 1990, above).
* A positive regional gravity anomaly associated with the North Pinnacles rhyolite ridge.
* Anomalous Au results in BLEG samples (ex BHP on EL 5/63) from streams draining the eastern side of the North Pinnacles rhyolite; (although this zone had already been tested by Wacker geochem and two drill holes!)
* Billiton's interpretation of a subtle late time EM37 anomaly at 10000E 10200N near a favourable CH-CL lithogeochemical contact and the western margin of the rhyolite.

Apart from taking three lithogeochemical samples from EL 8/90, as part of a wider regional study, Billiton did not carry out any on ground exploration.

1992-95 North Pinnacles was not explored in the first year of the Billiton-Pasminco JV (Kirsner, 1992) but the geological setting was gradually elucidated by work carried out in the second year on the Silver Falls extension grid to the north (Figures 14 and 21).

Poltock (1993) interpreted the rocks in the Silver Falls syncline (Figure 21) to represent an upright succession with possible regional stratigraphic correlations, summarised in Figure 26 and as follows:

<u>TOP</u>

Siltstone, micaceous sandstone, polymictic felsic volcaniclastics	>750m	*Southwell SubGroup*
Mafic-felsic derived lithic-crystal rich volcaniclastic sandstone	<50m	*Lynchford Member (Tyndall Gp)*
Thick interlayered felsic volcaniclastics and grey siltstone	~500m	*White Spur Formation*
Distinctive quartz crystal rich coherent rhyolite and volcaniclastics	<50m	*Rosebery-Hercs Hangingwall Seq.*
Sparsely feldspar>quartz phyric (Pinnacles) rhyolite	>200m	

<u>BASE</u>

It was noted that all known mineralisation in the NW sector of EL 2/80 is associated with the upper part of the Pinnacles rhyolite and the base of the overlying White Spur Formation at a stratigraphic level which could be equivalent to the Rosebery-Hercules host horizon. Furthermore, Poltock (op cit.) observed that the Pinnacles rhyolite, on the western limb of the syncline, was pervasively sericite-carbonate-pyrite altered but had relatively low alteration indices (AI = 32-44) and hosted minor disseminated-veinlet Pb>Zn mineralisation at the old Silver Falls prospect.
Despite this and other occurrences of mineralisation being dominantly of veinlet style, the stratabound association and its similarities to the Rosebery-Hercules host sequence suggested VHMS related (rather than Devonian granitoid) metallogenesis.

Improved regional gravity survey coverage and high resolution aeromagnetic data led to an interpretation that a major NNE trending gravity axis along the western margin of the Pinnacles rhyolite ridge (lower density to SE, greater density to NW) and the associated zone of "quiet" magnetic character are associated with a NE trending basement rift margin (Figure 27; Leaman, 1993; Poltock, 1993).

The possible presence of major basement structures which may have focussed mineralising fluids, was regarded as a positive factor for prospectivity. The greatest exploration potential was considered to exist near the intersection of such major structures and the base of the White Spur Formation.

Pasminco subsequently reviewed the previous IP and EM geophysical data for North Pinnacles (Hughes, 1993) and concluded that there were no significant anomalies. An early time response at 10000E 10200N was interpreted to be due to a shallow easterly dipping source, possibly a lithological or overburden contrast; ground checking was recommended. (This response was reported to be a "subtle late channel anomaly" by Randell, 1991b.)

Pasminco's exploration in the Brown's Tunnel area, ~3km south of North Pinnacles, suggested that the Brown's Tunnel Host sequence (BTH) consisting of a mixed package of cherty pyritic mudstones, shales, coarse volcaniclastics, andesite and disseminated to massive sulphide lenses (best intercept: 24m @ 9.3%Zn, 3.8%Pb, 0.5%Cu and 2.5g/tAu) extended northwards below the Pinnacles rhyolite. It was considered to have lithologic similarities to the Rosebery host sequence and occupy a similar position above CVC pumiceous volcaniclastics. Poltock, (1994) developed the concept that the BTH (with possible VHMS deposit/s; Figure 28) occupies an anticlinal position, below a thickness of 300-550m of rhyolite, at North Pinnacles. Billiton's interpretation that the known pervasive alteration and weak mineralisation represented a VHMS hangingwall alteration style, was re-invoked.

This conceptual target was tested by diamond core hole NPD5 (781.6m) which was collared just east of the Pinnacles rhyolite ridge 75m north of the southern boundary of EL 8/90 (Figures 21 & 29). The hole intersected 44m of laminated siltstone, feldspathic sandstone and basal breccia (White Spur Formation correlate) and passed into a thick pile of rhyolitic lava and lava breccias (Pinnacles Rhyolite) extending to the bottom of the hole. Core-bedding angles indicated that the hole was not drilled down dip. The BTH was not intersected but an apparent decrease in intensity of alteration downhole did not suggest that the target was close by; presumably Pasminco could not justify pursuing it any deeper.
The upper 200m of Pinnacles rhyolite in NPD5 is affected by pervasive moderate to intense "silicification" containing minor disseminated and veinlet pyrite, traces of Pb-Zn mineralisation and a best assay of 2m @ 0.02g/t Au. Short intervals of sub percentage level disseminated Pb-Zn exist in the mid to lower parts of the hole (maximum: 2m @ 0.2%Pb and 1.0%Zn) with scattered fluorite-galena veins contributing upto 1m @ 2.1%Pb.
Poltock (op cit.) concluded that the extensive silicification and weak mineralisation "may be associated with a hydrothermal system that may have generated a VHMS deposit" but he did not speculate on possible alteration vectors.

NPD5 was surveyed with the CRONE downhole EM system (Saxon, 1995b).
A "negative bow" response in the mid channels at ~400m depth was interpreted to indicate a conductive body at >300m from, possibly to the east of, the hole. It was attributed to shales within the White Spur Formation correlates.
North Pinnacles was not affected by the 50% area reduction of EL 2/90 in 1995 (Saxon, 1995a, Figure 30) but no further work was reported upto the final relinquishment in 1996.

3.3 Regional Exploration

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Previous exploration of the area presently covered by EL 47/96 has been heavily biased toward fairly detailed surveys and drilling programmes centred on the Boco and North Pinnacles prospects; there has been relatively little investigation of the small areas between them and to the south west of Boco.

The lack of encouragement from Pasminco's 1992 review and drilling programme in the Boco-Animal Creek area, combined with Lorrigan's identification of the prospectivity of Silver Falls, turned the exploration emphasis to the western areas.

Much of the subsequent work there, reported by Poltock (1993 & 1994), was of a semi regional nature on a broad reconnaissance grid (400m to 1000m line spacing) covering the area between Sawmill Creek and the NW corner of EL 2/90 (Figure 21). Most of the grid, particularly NW of Silver Falls was covered by soil geochemical, pole-dipole IP (Figure 31) and geological mapping surveys but the results were unexceptional and most of the area was relinquished in the 50% area reduction of 1995, and is therefore outside RGC's current EL 47/96. Poltock's regional geological interpretation based on mapping of this area, is discussed in Ch. 4, below.

The south eastern ends of some of the southern reconnaissance grid lines extended across the northern part of North Pinnacles and the adjacent area to the east. Weak to moderate IP anomalies were recorded on the North Pinnacles line (Figure 31) but are unremarked in Pasminco's reports.

Several lines of the "EAB" grid extending southeastward into the area of EL 47/96 were covered by ground magnetic, 50m dipole-dipole IP and reconnaissance mapping surveys in 1995-96 (Dibben, 1996a; Figure 21). The results were not significant and apparently did not warrant interpretative comment by Dibben (op cit.). However, for the optimists, the southeastern end of Line 1400E appears to terminate in an incompletely defined zone of increasing chargeability and decreasing resistivity; the highest chargeability reading (14.5, say about twice background) was recorded at n=4 at the southern end of the line.

4 REGIONAL GEOLOGY

The early regional interpretations by EZ that the Boco area was in a similar stratigraphic setting to Que-Hellyer were discounted by the Department of Mines' mid 1980s MRV mapping project which interpreted the Dundas Group sediments to overlie CVC massive felsic volcanics and placed the Que-Hellyer Volcanics at a higher level within the Dundas Group (Corbett, 1986; McNeill & Corbett, 1989). In the Boco-Animal Creek area the contact between CVC and Dundas Group was variously considered to be conformable (Corbett & McNeill, 1986; Herrmann, 1987a), disconformable, or faulted (Corbett& Komyshan, 1989).

Lorrigan's attempt at a regional stratigraphic-structural interpretation (Kirsner, 1992 & Figure 18) showed most of the the major lithological contacts as reverse faults but it is difficult to assess the validity of the interpretation because she established a new set of stratigraphic subdivisions, which are not readily translated into the more widely known MRV groups, and the work was only reported internally to Pasminco.

The most sensible advances on MRV Project 1:25000 mapping were made by Poltock (1993) who interpreted the sequence in the Silver Falls syncline, NW of North Pinnacles, to represent an upright succession with regional stratigraphic correlations reiterated as follows:

TOP		
Siltstone, micaceous sandstone, polymictic felsic volcaniclastics	>750m	*Southwell SubGroup*
Mafic-felsic derived lithic-crystal rich volcaniclastic sandstone	<50m	*Lynchford Member (Tyndall Gp)*
Thick interlayered felsic volcaniclastics and grey siltstone	~500m	*White Spur Formation*
Distinctive quartz crystal rich coherent rhyolite and volcaniclastics	<50m	*Rosebery-Hercs Hangingwall Seq.*
Sparsely feldspar>quartz phyric (Pinnacles) rhyolite	>200m	
BASE		

By implication, the Pinnacles rhyolite underlying the correlate of the Rosebery-Hercules Hangingwall sequence, would be considered to be either part of the Rosebery-Hercules host unit or the CVC rhyolitic volcanics underlying it. Subsequent work to the south at Brown's Tunnel and planning of NPD5 at North Pinnacles, suggesting that the mixed volcanic-sedimentary below the Pinnacles rhyolite was equivalent to the Rosebery-Hercules host unit, appears to favour the former correlation.

Largely on the basis of regional gravity-magnetic interpretation, Poltock (op cit.) considered the Burns Peak-North Pinnacles and Boco areas to comprise very different volcanic sequences, separated by a NE trending "feature" extending from Hollway Rivulet to High Point, 2km west of Mt Charter. This structure was termed (or at least is coincident with the) Burns Peak Shear Zone. Leaman (1993 & Figure 27) identified it as a possible southeastern rift margin fault (partly obscured by overlapping/overthrust CVC) and claimed to recognise its "ghosts" in the Mt Charter Fault and the Jack Fault at Hellyer, with clear implications for VHMS potential.

Leaman postulated that the volcanics NW of the rift margin at Burns Peak and Pinnacles were part of "an older suite and possibly not related to the Mt Read Volcanics". Poltock, meanwhile, considered the northwestern Pinnacles suite to be correlates of the Rosebery-Hercules host and hangingwall sequences and the southeastern Boco suite to be correlates of the Mt Black Volcanics (MBV) assigned to the CVC.

At that time, the MBV were regarded as overlying the Rosebery host sequence (Lees et al., 1990). Recently, however, the lithological similarity of the Rosebery Footwall Pyroclastics (RFP) to the MBV, and the presence of an east dipping reverse fault at the western contact of the MBV near Rosebery, has prompted the interpretation that they are parts of the same volcano-stratigraphic unit repeated by thrust faulting, (Corbett, 1992; Allen, 1994). Allen (op cit., in discussion) was adamant that pumiceous mass flow units of the RFP and MBV are indistinguishable, and considered it unlikely that such similar lithologies and facies would exist in stratigraphic repetition.

I consider that the correlation of the felsic volcanic assemblages remains highly uncertain and, given the likelihood of radical facies variations and difficulty in recognising facing and structure in these dominantly massive rocks, will probably remain controversial unless some unequivocal petro-geochemical evidence is found. Nevertheless, the general arrangement of MBV overthrust onto Rosebery Sequence as recently inferred for the Rosebery area, seems to fit the Leaman-Poltock model and has also been anticipated in Lorrigan's cross section: Figure 18. The latter also accommodates the strong magnetic and topographic NE linear feature running up Boco Creek, through the Boco alteration zone and beyond to AK1, as a steep imbricate splay above the main thrust.

Aside from uncertainties of felsic volcanic correlations, Poltock's (1993) correlations of the volcano-sedimentary units in the Silver Falls syncline seem, however, to be well founded on lithological grounds and the folded trace of the Lynchford Member sandstone is clearly outlined in the magnetic data. The discovery of a limestone and black shale association at about this stratigraphic position west of Bulgobac Falls (Poltock, 1994) supports the correlation, as similar lithologies are prominent at the base of the Lynchford Member in the Anthony Road and Comstock areas north of Queenstown (White and McPhie, 1996).

If the correlation of the Lynchford Member is correct, then the position occupied by Suite II Anthony Road Andesites south east of the Henty Fault is equivalent to the White Spur Formation at North Pinnacles. This could probably be accommodated by lateral facies changes and is consistent with a general westward increase of sedimentary lithotypes in the MRV.

It is however, contrary to Poltock's correlation of the upper units in the Silver Falls syncline with the Southwell SubGroup. McPhie and Allen (1992) suggest a correlation between the White Spur Formation and Southwell SubGroup and more recent work north of Hellyer, by White and McPhie (1996), places the Lynchford Member above the Southwell SubGroup.

The aeromagnetic data indicates that the postulated Lynchford Member and overlying volcano-sedimentary sequence are not repeated on the eastern side of the North Pinnacles rhyolite anticlinal? axis.

5 VOLCANIC and ALTERATION GEOCHEMISTRY

5.1 Boco

A total of about 63 whole rock major and immobile trace element analyses have been reported for surface rock samples (Airas, 1987 and Randell, 1991a) and drill core samples (Williams, 1985) from the Boco-Bulgobac area; they are re-tabulated here as Table 1.

Figure 32 graphically portrays the TiO2 & Zr contents with different plot symbols for the various sources of data and individual drill holes.

Two features are immediately apparent:

* Pancontinental's and Billiton's surface samples include a group of very high Zr rhyolites[1] (>400ppm Zr) from a single unit of feldspar phyric-quartz amygdaloidal rhyodacite, ~200-300m thick, which extends on a NE strike from the railway 1.5km north of Boco Siding to the Mt Charter Fault east of Sock Creek (Figure 1). Corbett & Komyshan (1989) considered this to be stratigraphically equivalent to the Que-Hellyer Volcanics but the high TiO_2 and Zr levels are quite distinct from the compositions reported for Que-Hellyer felsic volcanics (op cit.).

* The majority of CSR's drill core samples from the Boco prospect appear to be rhyolitic (Ti/Zr ratios <10), only two are dacitic (Ti/Zr ~13) and there are several from mafic dykes? (Ti/Zr >25). In contrast, Billiton's samples are mostly dacitic (Ti/Zr 10-20) with only three in the (normal Zr) rhyolitic field. Although Williams (1985) expressed some doubts about the accuracy of some of CSR's analytical data (especially Zr), this dichotomy appears to be real (on the basis of TiO_2 levels). Not all of Billiton's sample locations are shown (Figure 5) but it seems that the three rhyolitic samples are all from the immediate Boco area and the peripheral samples are dacitic. It could be a function of low sampling density but there may be some support in this for Sainty's (1984) interpretation that Boco represents a restricted, submarine, rhyolitic caldera setting.

A closer look at the CSR data, subdivided on the TiO_2-Zr plot (Figure 33) according to volcanic facies as per the textural categories of Herrmann (1987) indicates that:

* The volcaniclastic varieties (Cpa, Ceb & Cpp) occupy a similar range to the coherent lavas? (Cva & Cvb) and could therefore be comagmatic.

* The crudely radial-linear arrangement of coherent Cva & Cvb samples, in this case, appears to be due to a spread of primary immobile element concentrations rather than alteration related mass changes (MacLean & Barrett, 1993) as they mostly have >1.4% Na_2O and low (AI) alteration indices[2] and in fact most of the samples are from outside the alteration zone (Figures

[1] A.J.Crawford (1991) commented on high Zr rhyolites (400-500ppm Zr) from the Deloraine area and suggested that such compositions are extremely unusual in the MRV and may have significance for regional correlation. It would be interesting to know if there have been any advances on such correlations but I have been unable to contact him this week. (W.H. 4/4/97)

[2] Alteration Index of Ishikawa et al., 1976; $AI = 100*(MgO+K_2O)/(MgO+K_2O+CaO+Na_2O)$

8, 11 & 13). The only exception is No. 212903 from just below the base of glacial overburden in BBP 280, (0.06% Na_2O, AI = 98) which is probably affected by surface weathering. The apparent variations in primary TiO_2 and Zr abundances in coherent Cva & Cvb rocks would seriously limit the calculation of alteration mass changes (if analyses of altered Cva & Cvb were obtained) unless some (textural?) method of identifying single precursor units could be devised.

* The only data available, for permitting reasonable comparison of fresh and altered samples from a possible single precursor unit, is from the intervals 261.5-268.6m and 278.5-287.6m in BBP280. These samples are both of Cvf feldspar-(ferromag) phyric dacitic lava? within the zone of strong, but evidently patchy, alteration; the former contains 4.35% Na_2O with AI=42 and the latter 0.10% Na_2O and AI=75.
  Calculation of mass changes associated with this increase in alteration intensity (using Zr as an immobile monitor according to the method of MacLean & Barrett, 1993; tabulated in Table 1) suggests that it involved slight losses of SiO_2 (-4g/100g), Al_2O_3 (-2.2g/100g, suspicious!), essentially total loss of Na_2O (-4.3g/100g) and slight gain of K_2O (1.3g/100g) for a nett loss of -9g/100g.
  Although hardly indicative of the whole system, this pattern of mass change (apart from the strong Na_2O depletion) is not characteristic of other Australian proximal footwall alteration zones, such as Hellyer (Gemmel & Large, 1992) and Thalanga (Herrmann, 1994), which are typically associated with nett mass gains dominated by progressive gains of SiO_2, Fe_2O_3 and S.

5.2 North Pinnacles

Wholerock geochemical data for the North Pinnacles area is restricted to nine core samples from NPD5, three from NPP215 and three surface samples from Billiton's regional lithogeochemical study; this data is presented in Table 2.

A TiO_2-Zr scatterplot (Figure 34) shows that the Billiton surface samples (locations shown on Figure 23) have a diverse range whilst all samples from NPD5 and NPP215 (Figure 28) are rhyolitic (Ti/Zr range: 6-9) and occupy a narrow linear distribution. The drillcore samples form a linear regression, with a correlation factor of r=0.945, which passes exactly through the origin. This suggests that the samples are all from a single unit, or at least are co-magmatic. Therefore, the linear distribution is likely to be due to alteration mass changes (apart from sample 34994 which is from a hyaloclastic or peperitic breccia) and the data could be used to estimate alteration mass changes if an unaltered precursor composition can be chosen.

Choice of an unaltered precursor from the NPD5 data is a little problematic. Poltock (1994) logged moderate to intense silicification in the upper 200m of rhyolite but the alteration indices are highest in the middle parts (34990,92,93 & 94). Handicapped by not seeing the core samples, I have taken the data at face value and estimated a least altered precursor composition as the average of the three samples with lowest AI outside of the logged alteration zone; ie: mean of samples 34991,95 & 96, (Table 2).

Comparison of this least altered composition with the "silicified" sample 34989 from ~100m (using the calculation method of MacLean & Barrett, 1993 and Zr as an immobile monitor) suggests that the alteration involved a loss of ~23g/100g SiO_2, slight gain of MgO offset by slight losses of all alkalis for a nett loss of ~22g/100g. This does not seem like silicification; there is no great change in volatiles to suggest that it is misinterpreted carbonate alteration.

By contrast, mass change estimates comparing the least altered composition with the average of the two samples with highest AI (34992 & 93) indicates gains of ~8g/100g SiO_2 , 6g/100g K_2O and significant loss of -2.2g/100g Na_2O for a nett gain of 10g/100g. This pattern is more typical of proximal VHMS footwall alteration zones. Note that the gain in SiO_2 is barely perceptible in terms of the analysed SiO_2 content.

On the basis of this slender data, it appears that either the alteration in NPD5 has been misinterpreted or there has been a sample mix-up. The low apparent mass changes in Al_2O_3 and the high TiO_2-Zr correlation suggest that the analyses are reliable.

Similar calculation of the alteration mass change in NPP215, comparing the least altered sample from 72.8m to the most intensely altered sample from 50.6m indicates gains of 23 g/100g SiO_2, 9g/100g K_2O and major loss of -5g/100g Na_2O for a nett gain of 31g/100g. Again, the pattern is similar to that expected in VHMS footwall zones. It is again worth noting that the significant SiO_2 gain is not apparent in the SiO_2 wt% contents; in fact the silicified sample has a lower SiO_2 content than the assumed less altered precursor.

The high K_2O gains are rather unusual, since the altered North Pinnacles rhyolite does not seem especially sericitic, and could suggest a weak system with similarity to the gold rich distal part of the Que River footwall stringer zone which reportedly contains potash feldspar (McGoldrick and Large, 1992). Some significant differences between the North Pinnacles alteration and Que River Au rich stringer zone, are the higher sulphide content of the latter (6-10% sulphur and anomalous Pb-Zn upto 2-3% according to data presented by McGoldrick and Large,op cit.) and its existence in coarse permeable volcaniclastics within ~100m of the ore deposit.

6 EXPLORATION POTENTIAL

High quality aeromagnetic and gravity data exists for all of EL 47/96 and a large part of its 26km^2 area has been covered by detailed grid based geochemical, IP and EM surveys (~15km^2 at Boco and 2km^2 at North Pinnacles). Regional mapping and mega-structural interpretation, within the limitations of outcrop etcetera, has been significantly advanced within the past five years. A total of 20 diamond drill holes, amounting to 7600m, have tested a variety of conceptual targets and geophysical-geochemical anomalies, and stepped out along known alteration zones. Access is relatively good by Tasmanian standards and the greater part of the work (and all of the drilling) has been carried out by companies closely connected with the Rosebery, Hercules and Pinnacles deposits, which seem to provide the most analogous exploration models.

It can fairly be stated to have been thoroughly, and probably well, explored.
For an incoming explorer then, much of the hard work has been done but, likewise, much of the easy potential has been exhausted.

The main conceptual lines of exploration to date have been:

* Pursuit of the equivalent of the Rosebery-Hercules favourable horizon which was variously interpreted to be represented by the Brown's Tunnel host (BTH) sequence or the base of the White Spur Formation (WSF) correlate; ie: immediately below or above the Pinnacles rhyolite. The VHMS potential of the former interpretation, within EL 47/96, was effectively downgraded by drilling of NPD5, at the southern boundary where the BTH was expected to be shallowest. It suggests that if the BTH does extend north below Pinnacles rhyolite, it is likely to be well beyond reasonable exploration depths.

  Grid based exploration around the upper contact of the rhyolite at North Pinnacles and two drill holes through the contact (NPP 214 and NPD5, one on each side of the ridge) have not shown significant stratiform mineralisation at this level. The coherent nature of the rhyolite is entirely unlike the thick pumice breccia of the Rosebery footwall suggesting that, even if the stratigraphic correlation is correct, the facies association is not analogous to Rosebery. However, the known pervasive alteration appears to be concentrated in the upper few hundred metres of Pinnacles rhyolite and has some characteristics (SiO_2 gain, Na_2O depletion, anomalous Pb-Zn-Au) of VHMS footwall alteration zones suggesting that this horizon may have been associated with synvolcanic hydrothermal activity. The possibility that there may be a lateral facies variation to a geological setting more analogous to Rosebery, either in subsurface synclinal positions to east or west or down plunge? to the north, cannot be discounted. Further lateral pursuit of this exploration concept would involve moderate depth stratigraphic-alteration drilling and require a thorough knowledge of footwall alteration zonation and a commitment to following up alteration vectors, to maximise the chance of success.

Exploration potential for this concept is regarded as moderate to low and the findability factor is low.

* Drilling of <u>pyritic alteration zones</u>, <u>eg:</u> Boco and Animal Creek. The initial targets at Boco were identified by blanket IP surveys and probably recognition of altered outcrops; subsequent drilling was essentially stepping out to delineate the alteration zone and test conceptual favourable horizons. Surface UTEM and downhole EM was systematically applied. Two UTEM targets were tested by drilling and eventually attributed to overburden conductivity; DHEM produced few responses and only one drill hole was partly targeted on DHEM grounds. Latterly, Pasminco used aeromagnetic interpretation to predict and target an additional alteration zone/s, AK1, along strike NNE of Boco.

  Unfortunately, the many metres of drilling of the Boco and Animal Creek alteration zones have failed to produce:
  * significant intersections of Pb-Zn or Au mineralisation,
  * a recognisable favourable horizon or reliable facing direction,
  * a comprehensive alteration zonation model.

  A number of lines of evidence (including S and O isotopic data, inappropriate Zn Ratios and apparent NNE structural control inferred to be related to Devonian faulting) suggest that the Boco etc. alteration zones are either not related to synvolcanic VHMS forming hydrothermal systems or the systems were too weak/cool to produce significant deposits.

  Nevertheless, I am unconvinced that they can be written off as barren systems. There is a large volume of rock at Boco which has suffered near complete depletion of Na_2O and unknown mass changes of other components; this implies the involvement of large and energetic volumes of fluid[3]. Large volumes of fluid can shift large quantities of base metals and potentially redeposit them in large sulphide orebodies.

  The negative isotopic data has not been reported in great scientific detail (at least not in the company exploration reports) and it is not easy to assess whether the sampling has been adequate and the interpretations valid. The 11 holes drilled at Boco were comprehensively sampled and analysed for Na_2O, SiO_2 and CaO by EZ in early efforts to fathom out alteration vectors and their geologist (R. Sainty) made an excellent attempt (for that era) at volcanic facies analysis but it was hampered by structural uncertainties (and a complete lack of oriented core). My own geological review in 1987 was, as stated, rather cursory and apart from mapping distribution of pyrite did not do much to advance the identification of alteration vectors.
  I believe that significant improvements could be made in this area by systematic sampling of drill core on a prospect wide and possibly sub-regional basis, and analysing for the complete wholerock major element suite and Zr which may permit partial construction of an alteration mass change model (within the constraints of the apparent primary compositional variability mentioned on Page 18). More detailed isotopic studies may also assist in identification of alteration vectors[4] or confirmation of the "infertility" of these systems.

  This kind of work would be best carried out in conjunction with the CODES-AMIRA MRV alteration study to take advantage of the latest alteration interpretations and also requires a fair commitment to following up possible vectors.

  In view of the extent of previous drilling at Boco, and the possibility that the vectors may prove to be up (ie: deposit removed by erosion) a detailed alteration study at this stage may prove to be of greater academic than exploration significance. I estimate the potential to be moderate with a moderate findability factor.

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[3] A rough calculation based on a pipe like form 500m in diameter and ~400m deep indicates a bulk of about 150Mt; assuming a precursor composition with 3% Na_2O, the removal of ~5Mt of Na_2O is implied.

[4] A recent discovery of significant mineralisation at Thalanga Range in the Mt Windsor Volcanics, North Queensland was apparently based on follow up of an O-isotope fluid temperature anomaly; this might be one of the first Australian instances where the method has actually led to a deposit.

Two additional geological concepts which do not appear to have been addressed by previous explorers are:

* Henty style Au deposits related to structural modification? and metal remobilisation? in Cambrian volcanic related alteration zones where they are intersected by younger Devonian? major fault zones. The age and genesis of the Boco and etc. alteration zones is uncertain but they are located on an obvious (magnetic and topographic) structural lineament which is probably a fault. The pervasive alteration in the Pinnacles rhyolite is likewise of uncertain affinity but according to Pasminco's interpretation it is widespread and may be close to some fairly major basement controlling structures. RGC's inside knowledge of the Henty gold deposit presumably presents a major advantage in predicting favourable locations and the ability to recognise favourable alteration vectors.

  In consideration of the empirical nature of this exploration model (Henty metallogenesis is, at least publicly, not well understood) and the extent of previous drilling and sampling (EZ appear to have analysed their Boco drill holes from top to bottom) the potential for Henty Au type deposits in EL 47/96 is estimated as being moderate to unknown.

* VHMS and Henty style Au deposits associated with the Lynchford Member. Recent (public) recognition of the stratigraphic control on the Henty Au deposit within the lower part of the Tyndall Group (=Lynchford Member), existence of rich Pb-Zn massive sulphide mineralisation at the same stratigraphic level at Comstock and the enormous zone of essentially VHMS footwall style alteration immediately below this level at Mt Lyell has focussed considerable exploration interest on the Lynchford Member (LM) as a regionally extensive favourable horizon between Henty and Mt Lyell and elsewhere (eg: Clark Valley and Mt Jacob).

  R. Poltock's interpretation that a correlate of the LM exists above the WSF north and west of North Pinnacles suggests that the ~3km strike length there probably warrants further investigation for VHMS mineralisation. The aeromagnetic data shows it does not re-appear in the syncline east of the North Pinnacles ridge.
  Exploration, probably involving reconnaissance IP, alteration mapping and wholerock geochemistry (if fresh samples are obtainable) should be designed to identify extensive quartz-sericite-pyrite alteration zones in the WSF footwall below the LM. Henty MQ-Comstock Chert type silicification and anomalous gold, especially close to major fault structures (such as Leaman's northern rift margin, Figure 27) could indicate potential for Henty style deposits. The possible subsurface intersection of the LM and the Rosebery Fault could represent a deeper conceptual target to be considered if surface work confirms the correlation with the sequence in the Henty area.

  The uncertainty of this correlation of the Lynchford Member across the Henty Fault, and in an apparently more distal volcano-sedimentary setting, suggests a low-moderate VHMS-Henty potential at this stratigraphic level in the North Pinnacles area.

The areas which have not previously been the subject of detailed grid surveys are:

* The 5km^2 area north and northwest of Boco. It is mostly covered by thick glacial overburden over which (bedrock) geochemical sampling and IP would be largely ineffective, the aeromagnetic data does not suggest major alteration zones and it could be largely underlain by relatively unprospective intrusive felsic porphyry and Dundas Group sediments. Further work is not justified in the absence of some favourable stratigraphic indications; this would require shallow stratigraphic drilling (the technique most dreaded by exploration managers) Exploration potential is regarded as low.

* The 2km^2 area linking Boco and North Pinnacles. It lies entirely over Dundas Group sediments and porphyry, and was crossed by Pasminco's reconnaissance line from Silver Falls grid (11600N) but no favourable results were reported. Exploration potential is low.

* The 3km^2 area west of 378500E, west of North Pinnacles ridge. Poltock's (1993) interpretation (Figure 21) shows this to cover White Spur Formation and Lynchford Member correlates and overlying Tyndall Group? volcano-sediments in the hinge of the Silver Falls syncline. VHMS exploration potential, as discussed above, is considered to be low to moderate with high findability factor for near surface deposits but low findability for down dip deposits.

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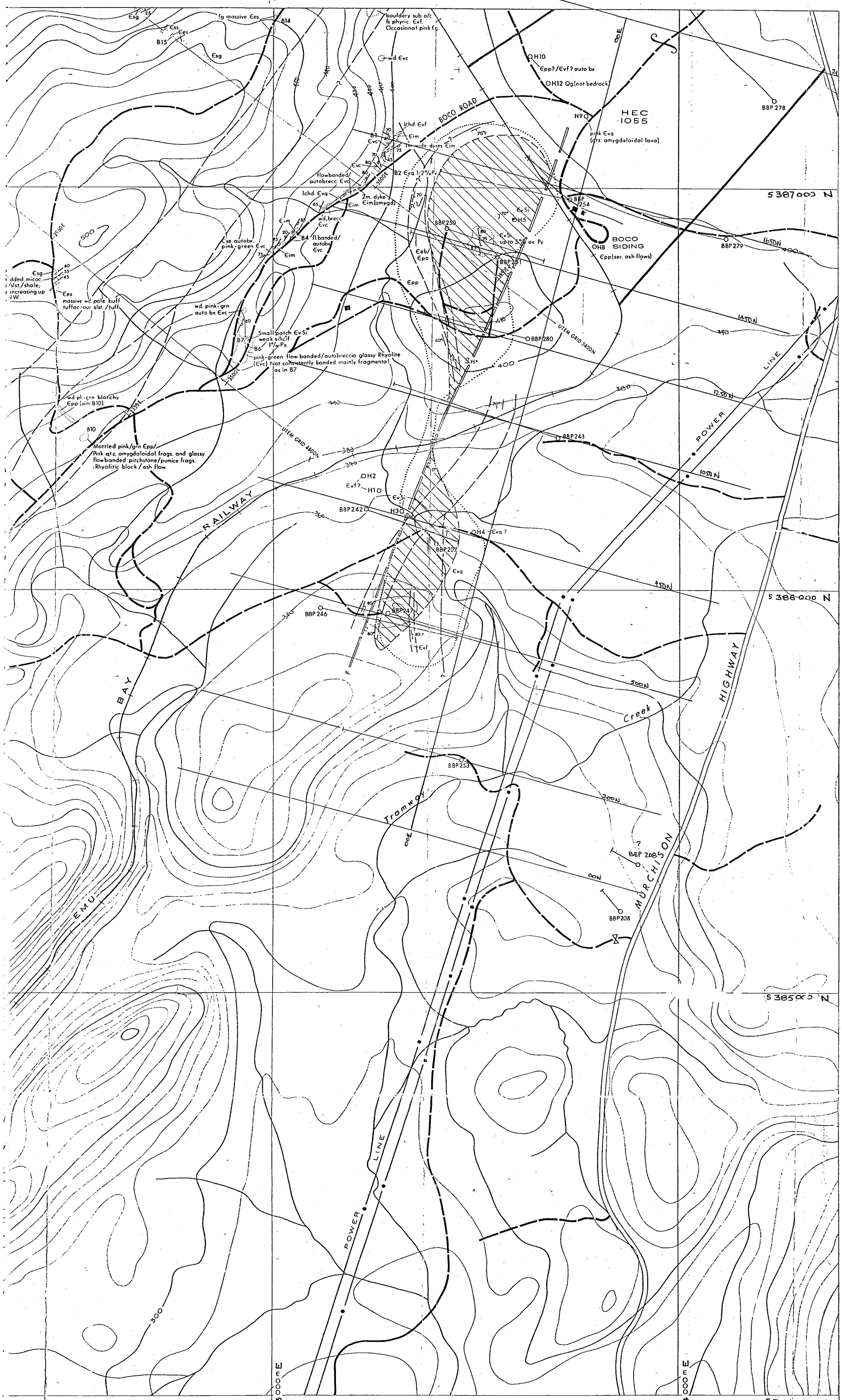


LEGEND

5 387 000 m N	A.M.G co-ordinates
	Creek
	Track
	Highway
	Power Transmission Line and Pylon Positions
— 500 —	Topographic contours in metres

REFERENCE

QUATERNARY	Qg	Fluvioglacial gravels, clays. (Unlithified)
CAMBRIAN		
Post "Dundas" Intrusives ?	Єim	Mafic Intrusive Dykes. Sometimes fs phyric, amygdaloidal.
	Єip	Feldspar Quartz porphyry : Intrusive ? / extrusive ?
"Dundas Group" sediments.	Єss	Thin bedded gray shale, siltstone.
	Єsg	Massive or thin bedded micaceous / tuffaceous greywacke and siltstone
	Єes	Massive creamy coloured tuffaceous siltstone.
"Mt. Read Volcanics" "Central Volc. Seq." of: Rhyolitic to Dacitic Composition	Єeb	Epiclastic volcanolithic breccias (rounded, reworked)
	Єpp	Pumiceous - lithic Ashflow tuffs (Ignimbrites)
	Єpa	Fine grained Crystal - vitric - ash tuffs (massive or stratified)
	Єvq	Pink-grey quartz amygdaloidal lava
	Єvf	Pink - grey feldspar (ferromagnesian) phyric lava.
	Єva	Pink (sparsely feldspar phyric) lavas. (Sometimes flow banded.)
	Єvb	Massive fine grained / glassy lavas (aphyric, not banded)
	Єvc	Flow banded / flow brecciated glassy lavas
Synvolcanic Alteration	ЄvSi	Silica - Sericite - Pyrite rocks. Commonly 2-5% diss. Py.

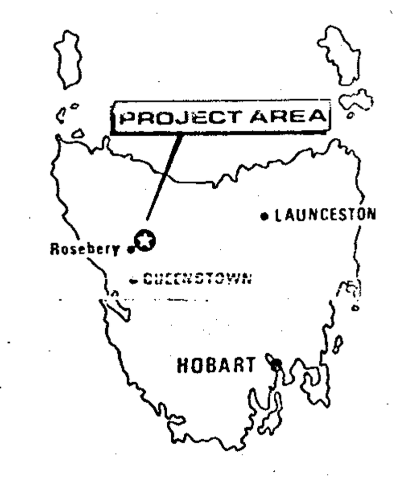
	Fault (projected to surface from drill hole data)
— ? — ? —	Geological boundary, position approx., ? inferred
	Outcrop boundary
	Limit of ЄvSi alteration (surface projection)

SHEET 1

SHEET 2

EL 12/72

T.N



LOCATION PLAN

PANCONTINENTAL MINING LIMITED
EXPLORATION DIVISION
PANCON

BULGOBAC PROJECT
EL 12/72 - TASMANIA
87-2740 Vol 1/2
INTERPRETATIVE GEOLOGICAL PLAN

SCALE 1:5000
0 100 200 300 400 500
METRES

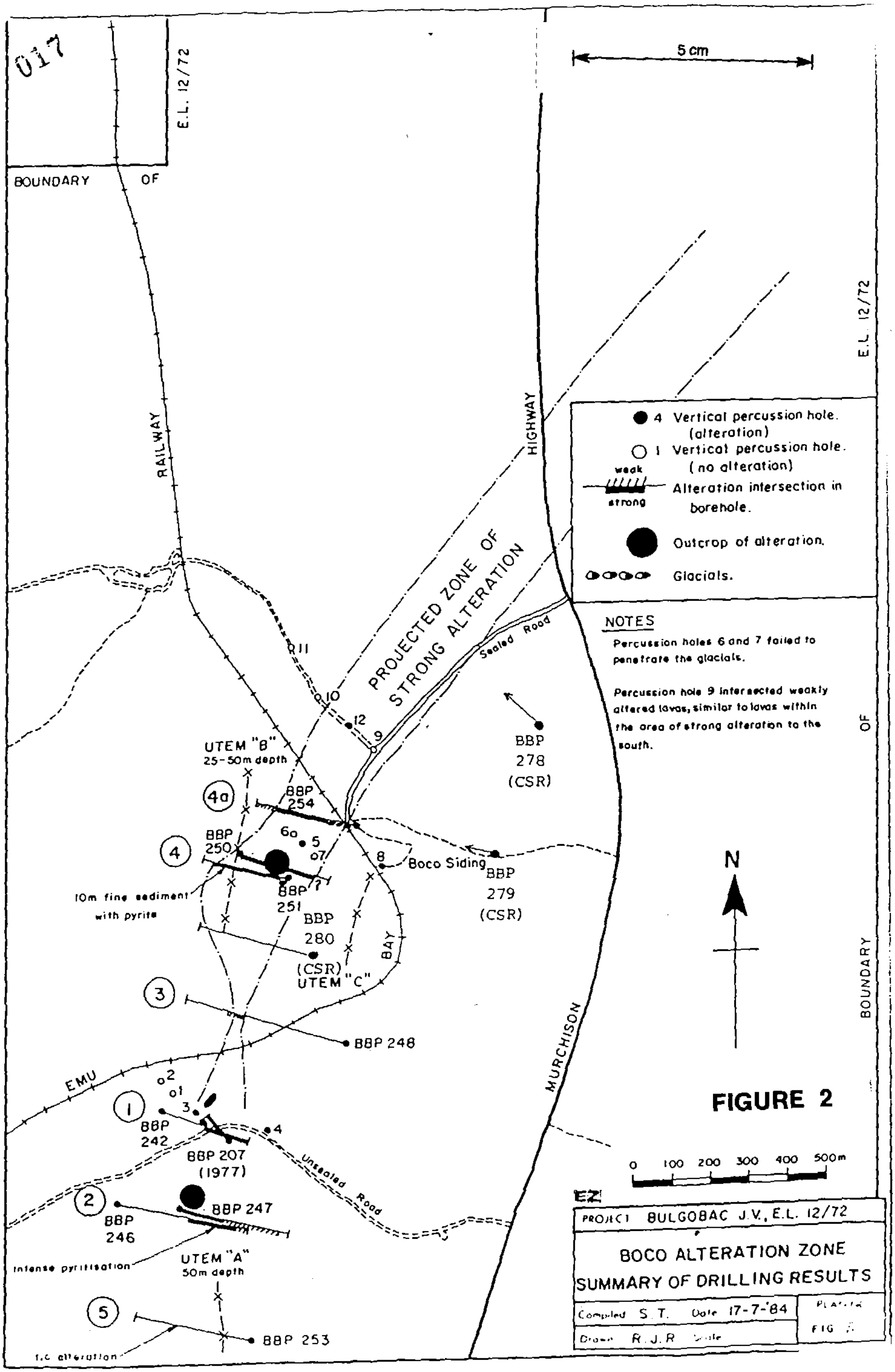
Compiled W. HERRMANN	Date JANUARY, 1987	Dwg. Nº 108/0/1
Report Nº 87/25	Map Ref. SK 55-3	PLATE 1

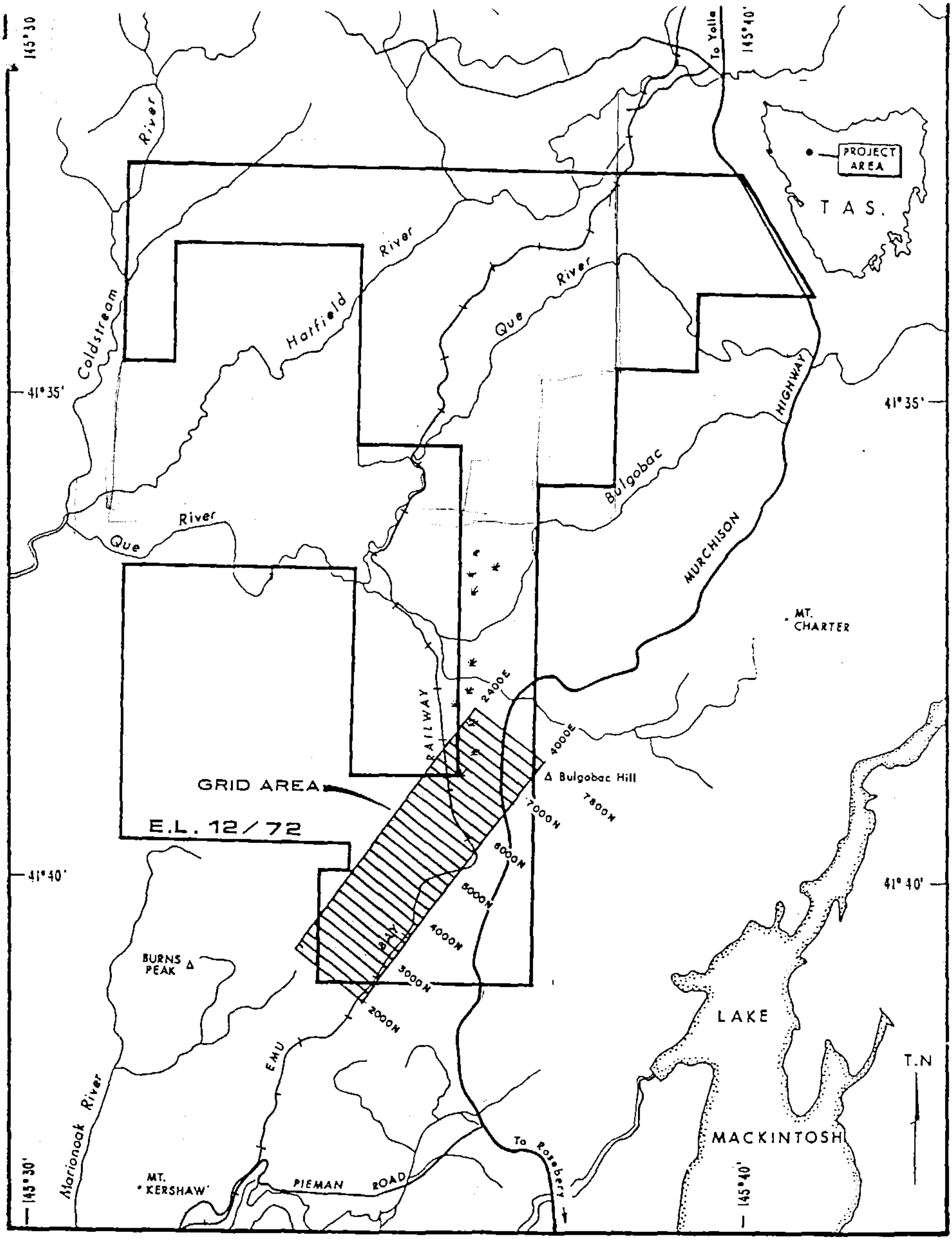
98-4133
ANNUAL REPORT - EL 47/96
RGC EXPL - BOCO SIDING/NTH PINNACLES
A ELLISTON Vol 2 of 3

233096

Figure 1 1:5,000
Interpretative Geological Plan
Boco Prospect, EL 47/96, Tasmania
Walter Herrmann Geoscience Pty.Ltd. Aug. 1997

5 cm


5 cm
E.L. 12/72
BOUNDARY OF E.L. 12/72
RAILWAY
HIGHWAY
MURCHISON
EMU BAY
PROJECTED ZONE OF STRONG ALTERATION
Sealed Road
Unsealed Road
Boco Siding
Vertical percussion hole. (alteration)
Vertical percussion hole. (no alteration)
weak
strong
Alteration intersection in borehole.
Outcrop of alteration.
Glacials.
NOTES
Percussion holes 6 and 7 failed to penetrate the glacials.
Percussion hole 9 intersected weakly altered lavas, similar to lavas within the area of strong alteration to the south.
BBP 278 (CSR)
BBP 279 (CSR)
BBP 280 (CSR)
UTEM "B" 25-50m depth
UTEM "C"
UTEM "A" 50m depth
BBP 254
BBP 250
BBP 251
BBP 248
BBP 242
BBP 207 (1977)
BBP 246
BBP 247
BBP 253
10m fine sediment with pyrite
Intense pyritisation
t.c alteration
N
0 100 200 300 400 500m
FIGURE 2
EZ
PROJECT BULGOBAC J.V., E.L. 12/72
BOCO ALTERATION ZONE
SUMMARY OF DRILLING RESULTS
Compiled S.T.
Date 17-7-'84
Drawn R.J.R
Scale
FIG 2



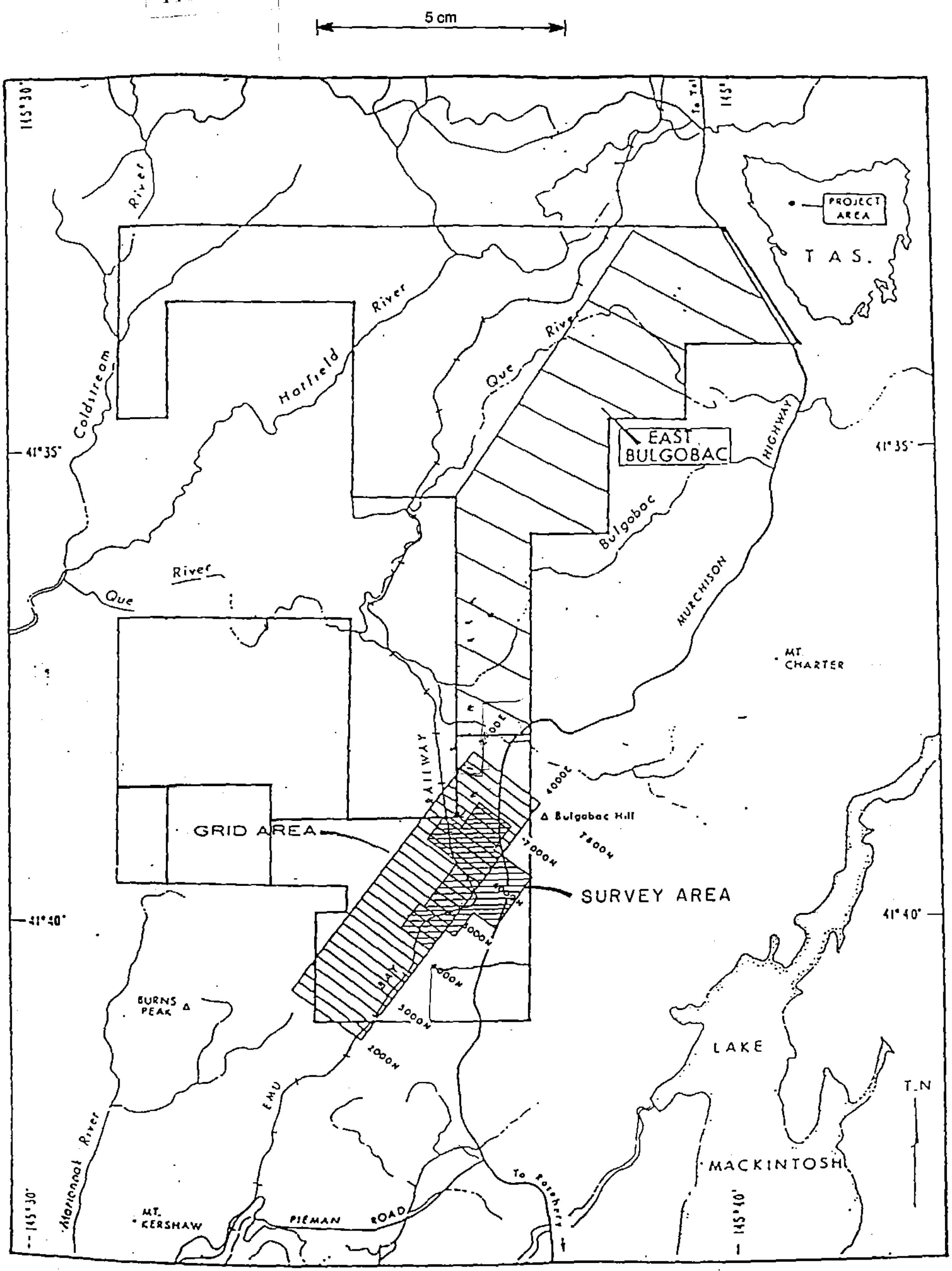
BULGOBAC PROJECT
E.L. 12/72 - TASMANIA
(UTEM 1986) GEOPHYSICAL GRID

SCALE 1:100000

0 1 2 3 4 5 Km

5 cm

FIGURE 3



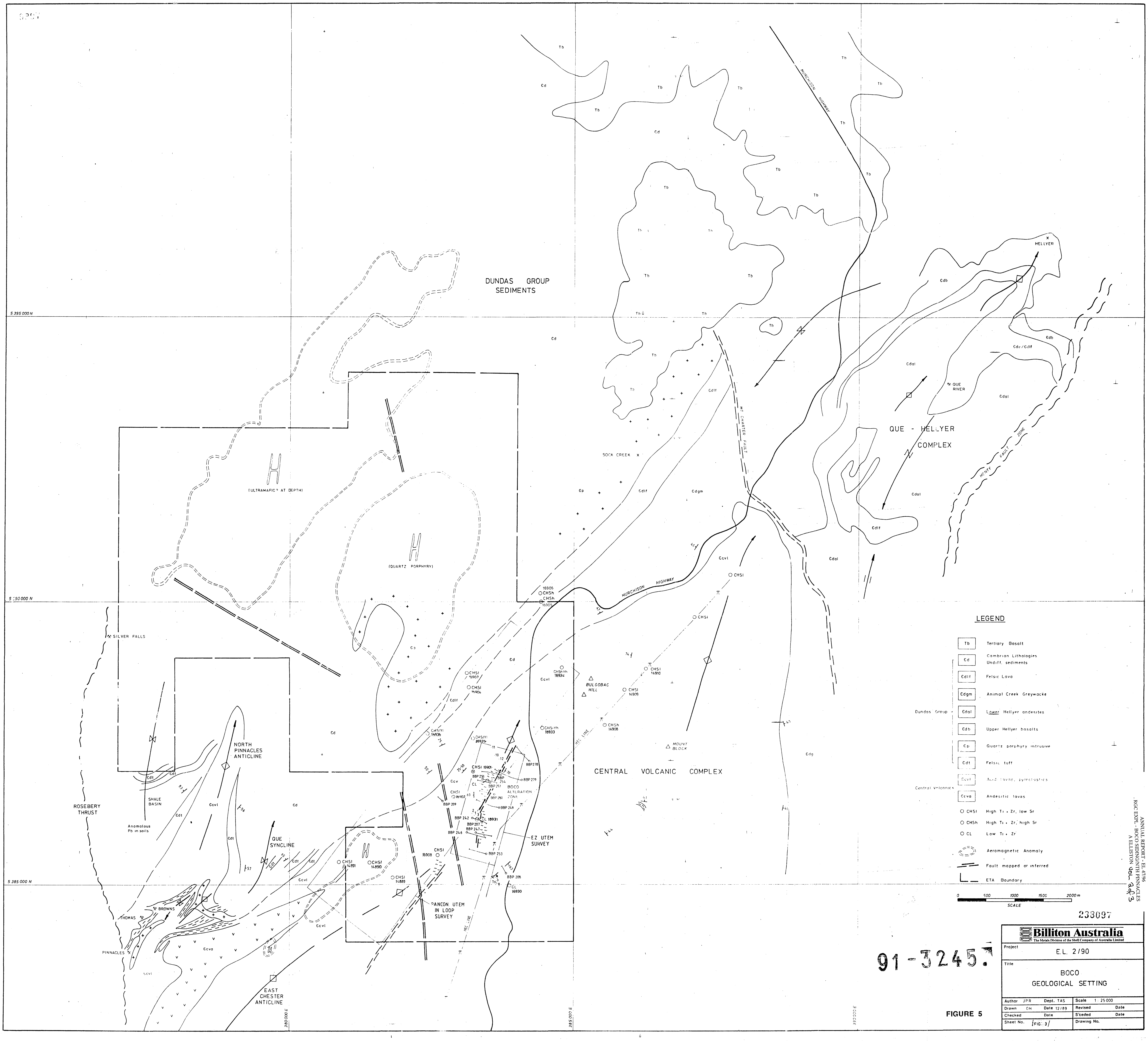
BOCO SIDING PROJECT

E.L. 17/88 - TASMANIA

GEOPHYSICAL GRID

233078

FIGURE 4


DUNDAS GROUP
SEDIMENTS
(ULTRAMAFICS AT DEPTH)
(QUARTZ PORPHYRY)
MURCHISON HIGHWAY
MT CHARTER FAULT
SOCK CREEK
HELLYER
QUE RIVER
QUE - HELLYER
COMPLEX
HENTY FAULT ZONE
CENTRAL VOLCANIC COMPLEX
BULGOBAC HILL
MOUNT BLOCK
SILVER FALLS
ROSEBERY THRUST
NORTH PINNACLES ANTICLINE
SHALE BASIN
Anomalous Pb in soils
QUE SYNCLINE
THOMAS
BROWNS
PINNACLES
EAST CHESTER ANTICLINE
BOCO ALTERATION ZONE
EZ UTEM SURVEY
PANCON UTEM IN LOOP SURVEY
5 395 000 N
5 390 000 N
5 385 000 N
380 000 E
385 000 E
LEGEND
Tb Tertiary Basalt
Cd Cambrian Lithologies Undiff. sediments
Cdlf Felsic Lava
Cdgm Animal Creek Greywacke
Dundas Group
Cdal Lower Hellyer andesites
Cdb Upper Hellyer basalts
Cp Quartz porphyry intrusive
Cdt Felsic tuff
Central Volcanics
Ccvl Acid lavas, pyroclastics
Ccva Andesitic lavas
O CHSl High Ti + Zr, low Sr
O CHSh High Ti + Zr, high Sr
O CL Low Ti + Zr
Aeromagnetic Anomaly
Fault mapped or inferred
ETA Boundary
0 500 1000 1500 2000 m
SCALE
238097
Billiton Australia
The Metals Division of the Shell Company of Australia Limited
Project E.L. 2/90
Title BOCO GEOLOGICAL SETTING
Author JPR Dept. TAS Scale 1:25 000
Drawn DH Date 12/89
Checked
Sheet No.
FIGURE 5
91-3245
98-4133

395000 N
390000 N
385000 N
380000 E
385000 E
390000 E
HELLYER
QUE RIVER
QUE - HELLYER
VOLCANIC COMPLEX
MT. CHARTER
MT CHARTER
FAULT
MURCHISON HIGHWAY
SOCK CREEK
Felsic Lava (Que Hellyer equivalent ?)
SOCK CREEK
PORPHYRY
SCHEMATIC
POSITION OF
STRATIGRAPHIC
HOLE
FAVOURABLE STRATIGRAPHIC POSITION FOR VMS DEVELOPMENT
Possible
shallow
plunge
CENTRAL VOLCANIC
COMPLEX
SILVER FALLS
NORTH
PINNACLES
PROSPECTIVE
VOLCANIC
STRATIGRAPHY
DUNDAS GROUP
SEDIMENTS
MIXED
CHh
CL
CHh
BOCO ALTERATION
ZONE
QUE
SYNCLINE
PINNACLES
CHI
CHh
CL
AMG N
MAG N
LEGEND
CHI High Ti + Zr, low Sr Volcanics
CHh High Ti + Zr, high Sr Volcanics
CL Low Ti + Zr Volcanics
PROSPECTIVE VOLCANICS
ETA Boundary
5 cm
0 500 1000 1500 2000 m
SCALE
98-4133
ANNUAL REPORT - EL 47/96
RGC EXPL - BOCO SIDING/NTH PINNACLES
A ELLISTON
91-3245.
233098
Billiton Australia
The Metals Division of the Shell Company of Australia Limited
Project
E.L. 2/90
Title
BOCO
LITHOGEOCHEMICAL MAP
Author J.P.R. Dept. TAS Scale 1:25 000
Drawn D.H. Date 12/89 Revised Date
Checked Date S'ceded Date
Sheet No. Drawing No.
FIGURE 6

FIGURE 7

233099

98-4133

ANNUAL REPORT - EL 47/96
RGC EXPL - BOCO SIDING/NTH PINNACLES
A ELLISTON Vol 2 of 3

125

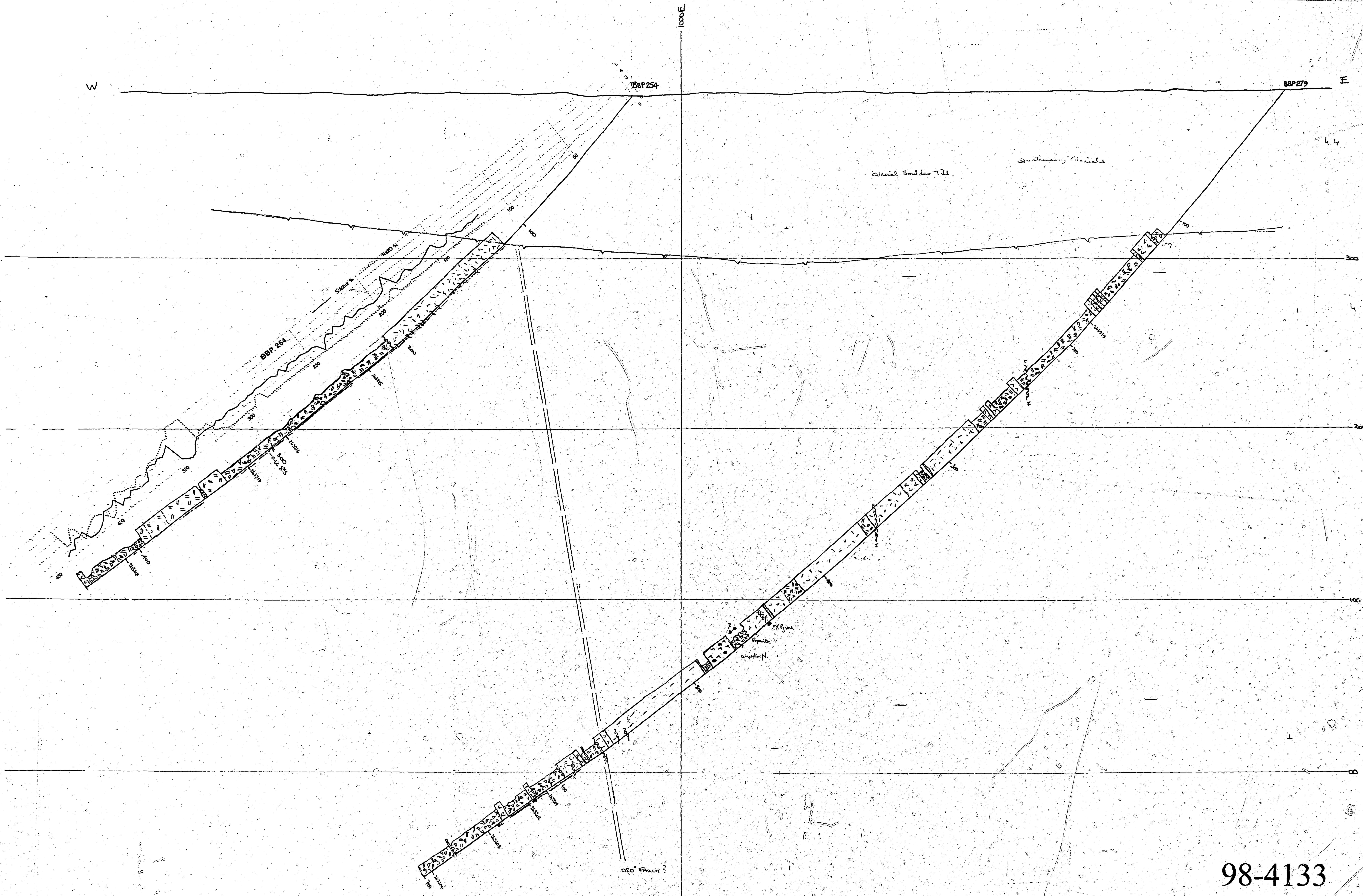
98-4133

ANNUAL REPORT - EL 47/96
RGC EXPL - BOCO SIDING/NTH PINNACLES
A ELLISTON Vol 2 of 3

87-2740 Vol 1/2

233100

FIGURE 8



98-4133

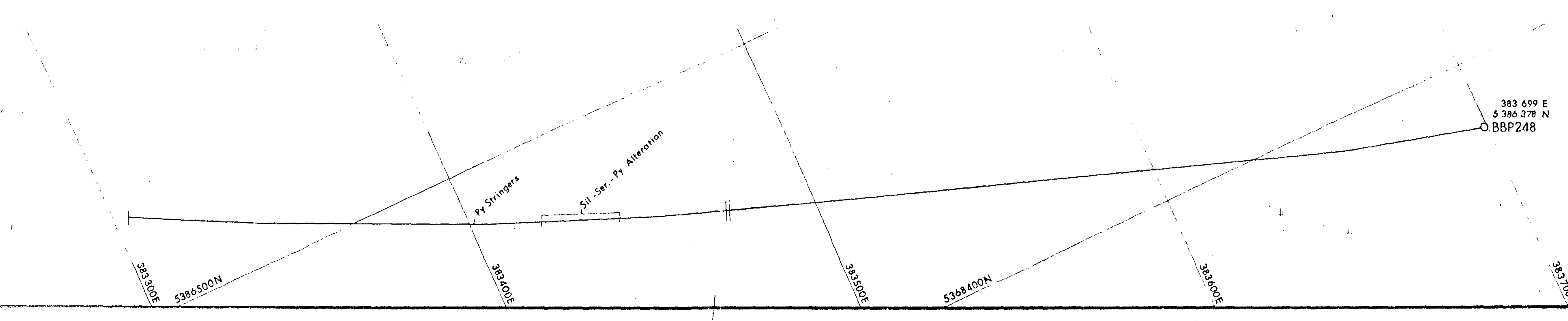
ANNUAL REPORT - EL 47/96
. RGC EXPL - BOCO SIDING/NTH PINNACLES
A ELLISTON VOL. 3 of 3

Figure 9 1:1,000

Cross Section BBP 254 & 279

Boco Prospect, EL 47/96, Tasmania

Walter Herrmann Geoscience Pty.Ltd. Aug. 1997



98-4133

ANNUAL REPORT - EL 47/96
. RGC EXPL - BOCO SIDING/NTH PINNACLES
A ELLISTON Vol 2 of 3

REFERENCE

QUATERNARY	Qg	Fluvioglacial gravels, clays. (Unlithified)
CAMBRIAN Post "Dundas" Intrusives ?	Єim	Mafic Intrusive Dykes. Sometimes fs phyric, amygdaloidal.
	Єip	Feldspar Quartz porphyry: Intrusive ?/ extrusive?
"Dundas Group" sediments	Єss	Thin bedded gray shale, siltstone.
	Єsg	Massive or thin bedded micaceous / tuffaceous greywacke and siltstone.
	Єes	Massive creamy coloured tuffaceous siltstone.
"Mt. Read Volcanics" "Central Volc. Seq." of Rhyolitic to Dacitic Composition	Єeb	Epiclastic volcanolithic breccias (rounded, reworked)
	Єpp	Pumiceous - lithic Ashflow tuffs (Ignimbrites)
	Єpa	Fine grained Crystal-vitric-ash tuffs (massive or stratified)
	Єvq	Pink-grey quartz amygdaloidal lava
	Єvf	Pink-grey feldspar (ferromagnesian) phyric lava.
	Єva	Pink (sparsely feldspar phyric) lavas. (Sometimes flow banded)
	Єvb	Mass. fine grained / glassy lavas (aphyric, not banded)
	Єvc	Flow banded / flow brecciated glassy lavas.
Syn-volcanic Alteration	ЄvSi	Silica - Sericite - Pyrite rocks. Commonly 2-5% diss. Py.

Disseminated Pyrite

xxxxx Tectonic brecciation, shearing

5 cm

233101

87-2740 Vol 1/2

PANCON

PANCONTINENTAL MINING LIMITED
EXPLORATION DIVISION

EL 12/72 BOCO PROSPECT TASMANIA

GEOLOGICAL CROSS SECTION DIAMOND DRILL HOLE BBP 248

SCALE 1 : 1000

0 40 80
metres

Compiled W.Herrmann	Date: January, 1987	Dwg No.: 108 / D / 4
Report No. 87 / 25	Map Ref. SK 55 - 3	PLATE 4

FIGURE 10

6139

98-4133

ANNUAL REPORT - EL 47/96
RGC EXPL - BOCO SIDING/NTH PINNACLES
A ELLISTON Vol 2 of 3

REFERENCE

QUATERNARY	Qg	Fluvioglacial gravels, clays. (Unlithified)
CAMBRIAN Post "Dundas" Intrusives ?	Єim	Mafic Intrusive Dykes. Sometimes fs phyric, amygdaloidal.
	Єip	Feldspar Quartz porphyry: Intrusive ?/extrusive?
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	Єvc	Flow banded/flow brecciated glassy lavas.
Synvolcanic Alteration	ЄvSi	Silica-Sericite-Pyrite rocks. Commonly 2-5% diss. Py.

Disseminated Pyrite

xxxxx Tectonic brecciation, shearing

87-2740 Vol 1/2

PANCONTINENTAL MINING LIMITED
EXPLORATION DIVISION
PANCON

EL 12/72 BOCO PROSPECT
TASMANIA

GEOLOGICAL CROSS SECTION
DIAMOND DRILL HOLE
BBP280

233102

SCALE 1:1000
0 40 80
metres

Compiled W.Herrmann	Date January, 1987	Dwg No. 108/D/5
Report No 87/25	Map Ref. SK 55-3	PLATE 5

FIGURE 11

RL 00

5 cm

REFERENCE

QUATERNARY	Qg	Fluvioglacial gravels, clays. (Unlithified)
CAMBRIAN Post "Dundas" Intrusives ?	Єim	Mafic Intrusive Dykes. Sometimes fs phyric, amygdaloidal.
	Єip	Feldspar Quartz porphyry: Intrusive ?/ extrusive?
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	Єsg	Massive or thin bedded micaceous/tuffaceous greywacke and siltstone.
	Єes	Massive creamy coloured tuffaceous siltstone.
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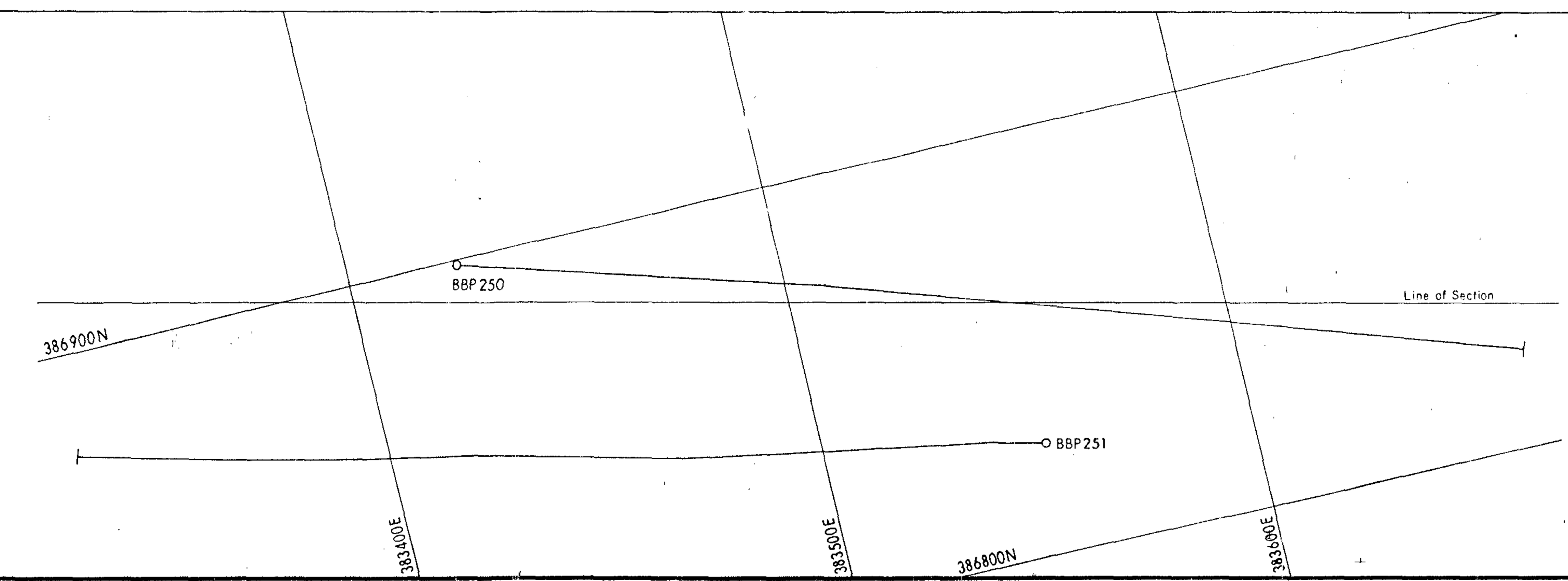
	Єvf	Pink-grey feldspar (ferromagnesian) phyric lava.
	Єva	Pink (sparsely feldspar phyric) lavas. (Sometimes flow banded)
	Єvb	Mass. fine grained/glassy lavas (aphyric, not banded)
	Єvc	Flow banded/flow brecciated glassy lavas.
Synvolcanic Alteration	ЄvSi	Silica - Sericite - Pyrite rocks. Commonly 2-5% diss. Py.

Disseminated Pyrite

xxxxx Tectonic brecciation, shearing



PANCONTINENTAL MINING LIMITED
EXPLORATION DIVISION
PANCON

EL 12/72 BOCO PROSPECT TASMANIA

GEOLOGICAL CROSS SECTION DIAMOND DRILL HOLES BBP250 AND BBP251

SCALE 1:1000
0 40 80
metres

Compiled: W.Herrmann	Date: January, 1987	Dwg.No.: 108/D/6
Report No.: 87/25	Map Ref.: SK 55-3	PLATE 6

FIGURE 12

383400E
383500E
383600E
383700E
383800E
383900E
384000E
384100E
metres
RL 400
RL 300
RL 200
RL 100
RL 00
BBP254
BBP279
Qg
Qg : Quaternary glacial deposits.
100
200
300
400
500
600
700 m
Altered massive glassy lava Єvb
2-3% Py
Altered faintly flow banded glassy lava. Incipient clvg/ sericitigation ?
Єvc
Єva
2-4% Py
FAULT PUG/BROKEN ZONES
Sparsely fs porphyritic, altered massive glassy lava. Incipient sericitic clvg. development. Short intervals multilithic breccia (Δ)
Єva
0.5% Py
Altered pumiceous-lithic ash flow tuff (si-py alt. somewhat selective in matrix)
Єpp
Altered massive glassy lava Єvb
δS34 -0.1‰
Altered pumiceous-lithic ash flow tuff Єpp
Broken core zone
Sparsely fs phyric pink-grey massive (locally flow banded) lava
Єvf
Pink-grey fs phyric massive lava accretionary lapilli/spherulitic in structure above 355m Єvf
2-4% Py only patchy weak Si alt.
Pumiceous lithic ash flow tuff Єpp
Єim
v. minor Py
439.5m
Zone of stong Silica - Sericite alteration characterized by: Sr, Na2O, CaO depletion, : Si enrichment, : 2-4% disseminated Pyrite minz.
FAULT ZONE
Pumiceous "Ash flow" Єpp
Єim
Єpp
Pale grey pink massive glassy lava, faint flow banding.
Єvc
Sparsely fs phyric lava Єva
Єim
Єva
25.6
Pink sparsely <5% fs phyric lava flow banding with consistent orientation.
Єva
Lithic tuff/ash flow, variable minor pumiceous, rigid & juvenile lava clasts ashy matrix
Compaction / foliation variable 25-65° LAOC. Lithic tuff, rare pumice fragments.
20% Py
Silicified zone c̄ pyrite stringers overall 2-5% Py.
←(SOURCE OF SIROTEM ANOMALY)
Єva-Єvb
Massive pink rhyolitic lava, very sparsely fs phyric to aphyric locally auto brecciated
FAULT BRECCIA
FAULT PUG
Altered f.g. rhyolitic lava? Єvb
Altered lithic/crystal/vitric tuff Єpp
Altered strongly pyritic rhyolite Єvb
Altered unsorted pumiceous lithic ash flow tuff Єpp
2-3% Py
2-4% Py
10-20% Py
Alteration patchy below 643m diminishing rapidly down hole. Pyrite virtually absent below 645m.
Unsorted pumiceous, lithic ash flow tuff Єpp
98-4133
ANNUAL REPORT - EL 47/96
RGC EXPL - BOCO SIDING/NTH PINNACLES
A ELLISTON VOL 2 of 3
5 cm
REFERENCE
QUATERNARY
Qg Fluvioglacial gravels, clays. (Unlithified)
CAMBRIAN
Post "Dundas" Intrusives ?
Єim Mafic Intrusive Dykes. Sometimes fs phyric, amygdaloidal.
Єip Feldspar Quartz porphyry: Intrusive ?/ extrusive?
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Єeb Epiclastic volcanolithic breccias (rounded, reworked)
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Єva Pink (sparsely feldspar phyric) lavas. (Sometimes flow banded)
Єvb Mass. fine grained/glassy lavas (aphyric, not banded)
Єvc Flow banded/flow brecciated glassy lavas.
Synvolcanic Alteration ЄvSi Silica - Sericite - Pyrite rocks. Commonly 2-5% diss. Py.
Disseminated Pyrite
xxxxx Tectonic brecciation, shearing
87-2740 Vol 1/2
PANCONTINENTAL MINING LIMITED
EXPLORATION DIVISION
PANCON
EL 12/72 BOCO PROSPECT
TASMANIA
233104
GEOLOGICAL CROSS SECTION
DIAMOND DRILL HOLES
BBP254 AND BBP279
SCALE 1:1000
0 40 80
metres
Compiled: W.Herrmann
Date: January, 1987
Dwg.No.: 108/D/7
Report No.: 87/25
Map Ref.: SK 55-3
PLATE 7

FIGURE 13

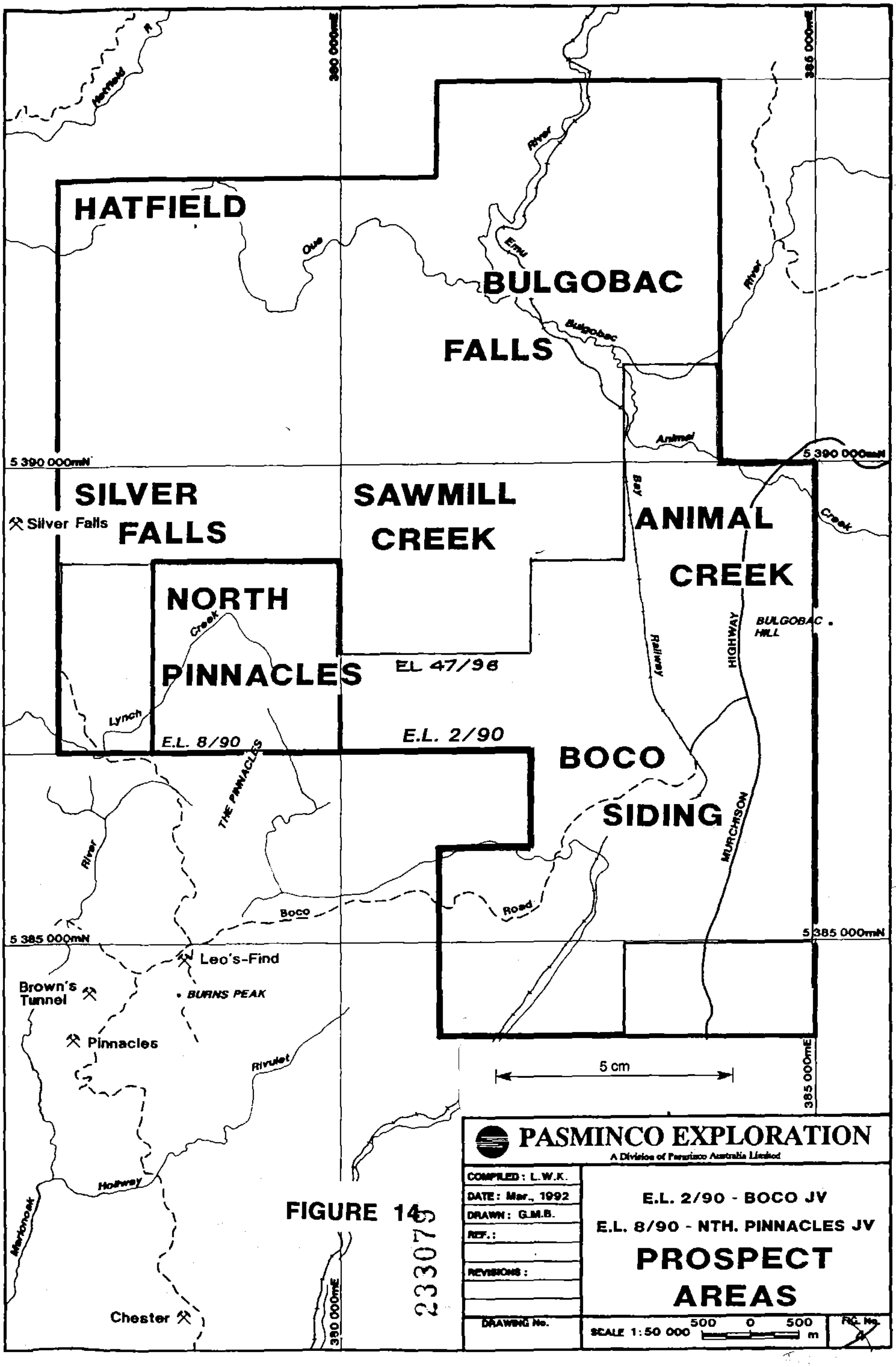
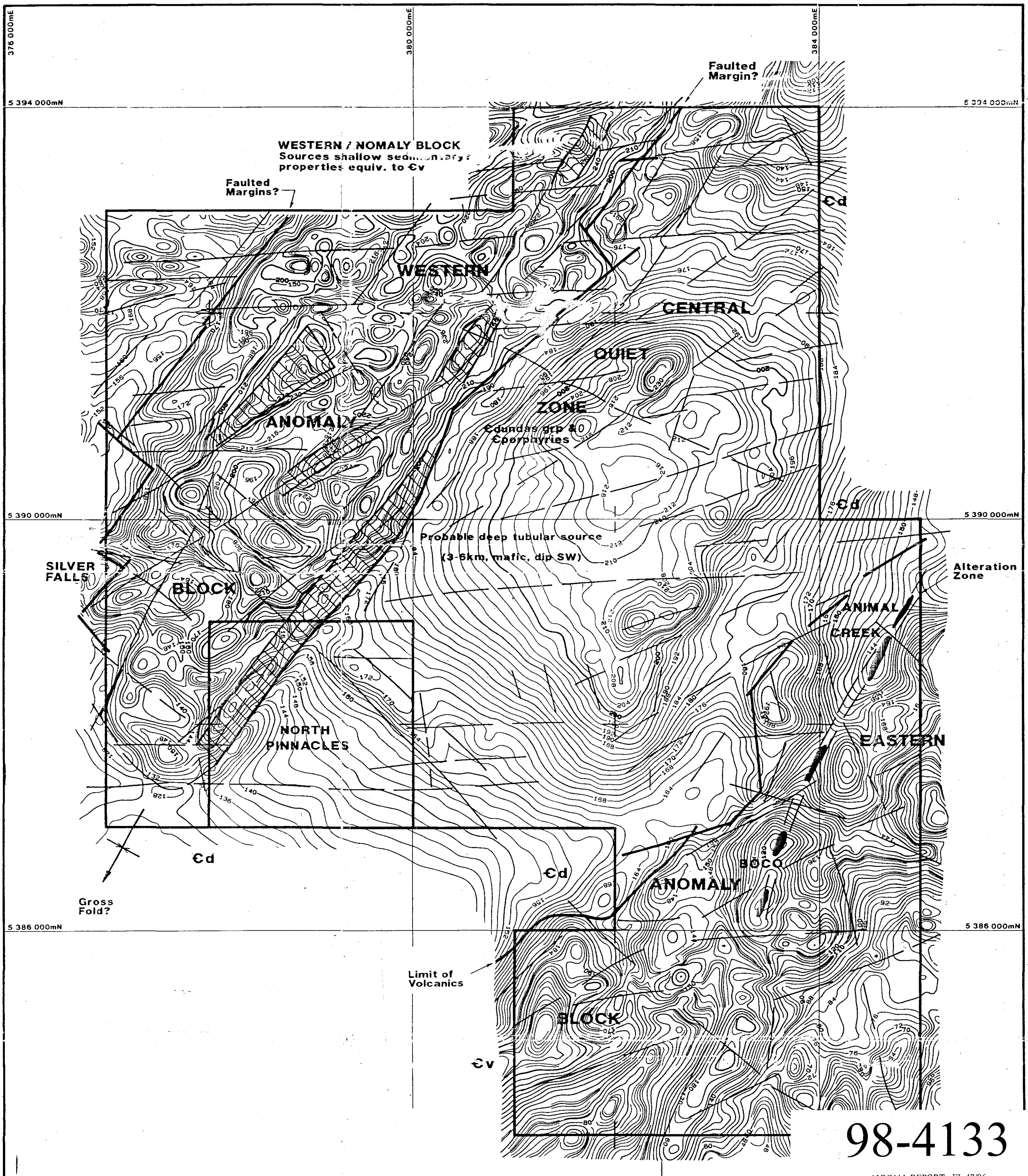

HATFIELD
BULGOBAC
FALLS
SILVER
FALLS
SAWMILL
CREEK
ANIMAL
CREEK
NORTH
PINNACLES
BOCO
SIDING
EL 47/96
E.L. 8/90
E.L. 2/90
5 390 000mN
5 385 000mN
380 000mE
385 000mE
Hatfield
River
Oue
Emu
Bulgobac
Animal
Creek
Bay
Railway
HIGHWAY
MURCHISON
BULGOBAC HILL
Silver Falls
Lynch
THE PINNACLES
Boco
Road
Leo's-Find
Brown's Tunnel
BURNS PEAK
Pinnacles
Rivulet
Hollway
Marionoak
Chester
5 cm
PASMINCO EXPLORATION
A Division of Pasminco Australia Limited
COMPILED : L.W.K.
DATE : Mar., 1992
DRAWN : G.M.B.
REF. :
REVISIONS :
DRAWING No.
E.L. 2/90 - BOCO JV
E.L. 8/90 - NTH. PINNACLES JV
PROSPECT AREAS
SCALE 1:50 000
500 0 500 m
FIG. No.

FIGURE 14



98-4133

ANNUAL REPORT - EL 47/96
RGC EXPL - BOCO SIDING/NTH PINNACLES
A ELLISTON Vol 2 of 3

KEY

Inferred Alteration

High Contrast Units

Interpreted Fault

Magnetic Trends

BASE CONTOUR PLAN - PART OF SHEET N

"Residual Magnetics"
Contour Interval 2nT
Terrain Clearance 120m
Processed by Tas. Division of Mines & Mineral Resources, Aug., 1991

NOTE

Subtle anomalies require further review after upgrade of surface mapping

233105

92-3343.

PASMINCO EXPLORATION
A Division of Pasminco Australia Limited

COMPILED: D.L.	E.L. 2/90 -BOCO JV
DATE: Mar., 1991	E.L. 8/90 - NTH. PINNACLES
DRAWN: L.K./G.B.	INTERPRETATION AND TREND SUMMARY OF PRELIMINARY INTERPRETATION (Leaman 1991a)
REF:	
REVISIONS:	
DRAWING No.	SCALE 1:25,000 (500 0 500 metres) — FIG. No. 22

5 cm

FIGURE 15

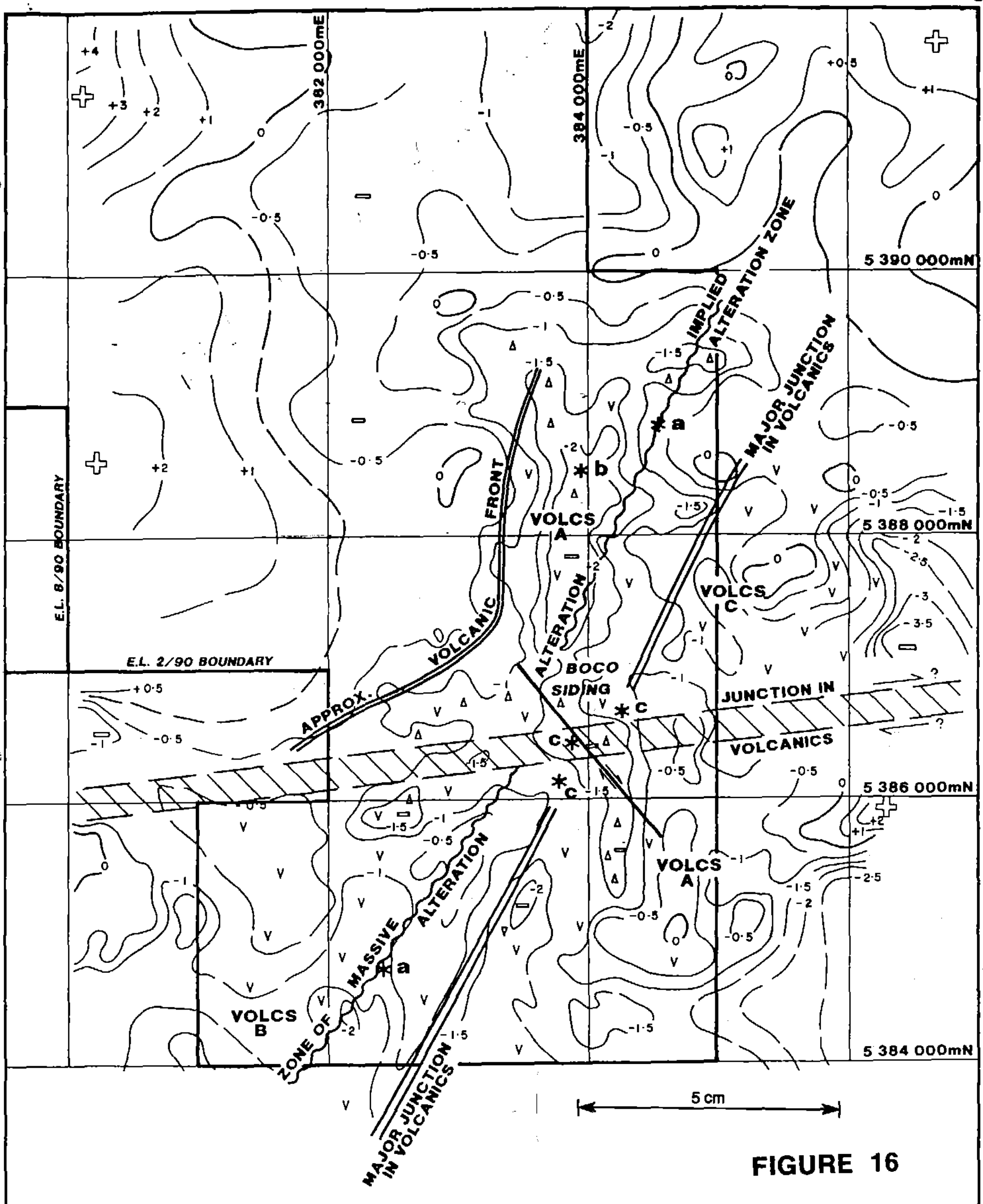


FIGURE 16

LEGEND

Δ Δ Glacials

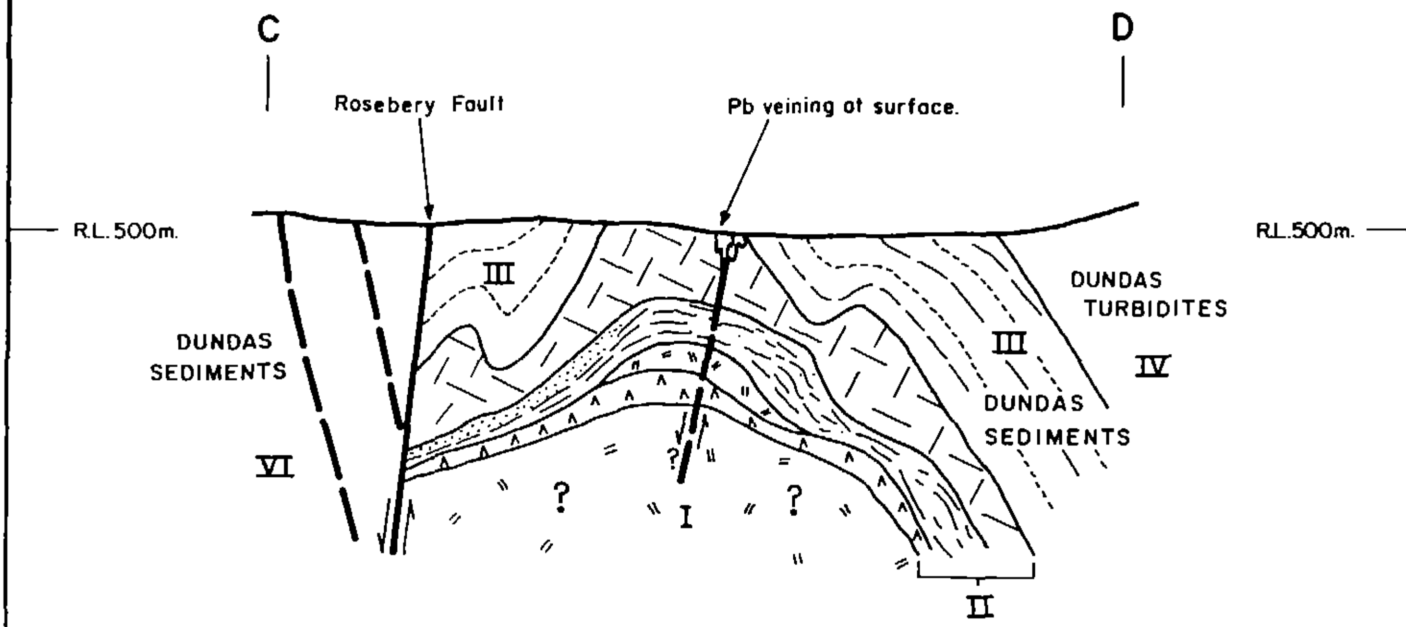
V V Volcanic rocks

* Suggested drill test positions (various reasons - see text, APPENDIX 5)

233080

PASMINCO EXPLORATION
A Division of Pasminco Australia Limited

COMPILED: D.L.	E.L. 2/90 - BOCO JV
DATE: Dec., 1991	RESIDUAL BOUGER ANOMALY AND SYNTHESIS OF INTERPRETATION
DRAWN: G.M.B.	
REF.:	
REVISIONS:	
DRAWING No.	SCALE 1:40,000 0 80 m
FIG. No. 23	



LEGEND

Non-stratigraphic

- Detrital quartz and feldspar sandstone.
- Conglomerate volcanic quartz and mudstone matrix. Volcanic and rare sedimentary clasts.
- Volcanic quartz sandstone. Often black mud matrix.
- Quartz-feldspar rhyolite lava.
- Feldspar dacite.
- Siltstone, grey mudstone.
- Micaceous sandstone.
- Dark grey andesite. Feldspar and pyroxene.

Major Rock Groupings-Stratigraphic

VI – Dundas sediments-shallow water conglomerate-dolomite siltstone. (West of Rosebery Fault).

V – Dundas sediments-shallowing water, conglomerate beds.

IV – Dundas turbidites. No porphyry or lava association. Minimal volcanic quartz.

III – Dundas sediments. Black shale-porphyry association. Volcanic quartz.

II – Transition Rocks. Lava, sediments etc. "HOST PACKAGE"

I – Massive, feldspar-phyric volcanics.

5 cm

233081

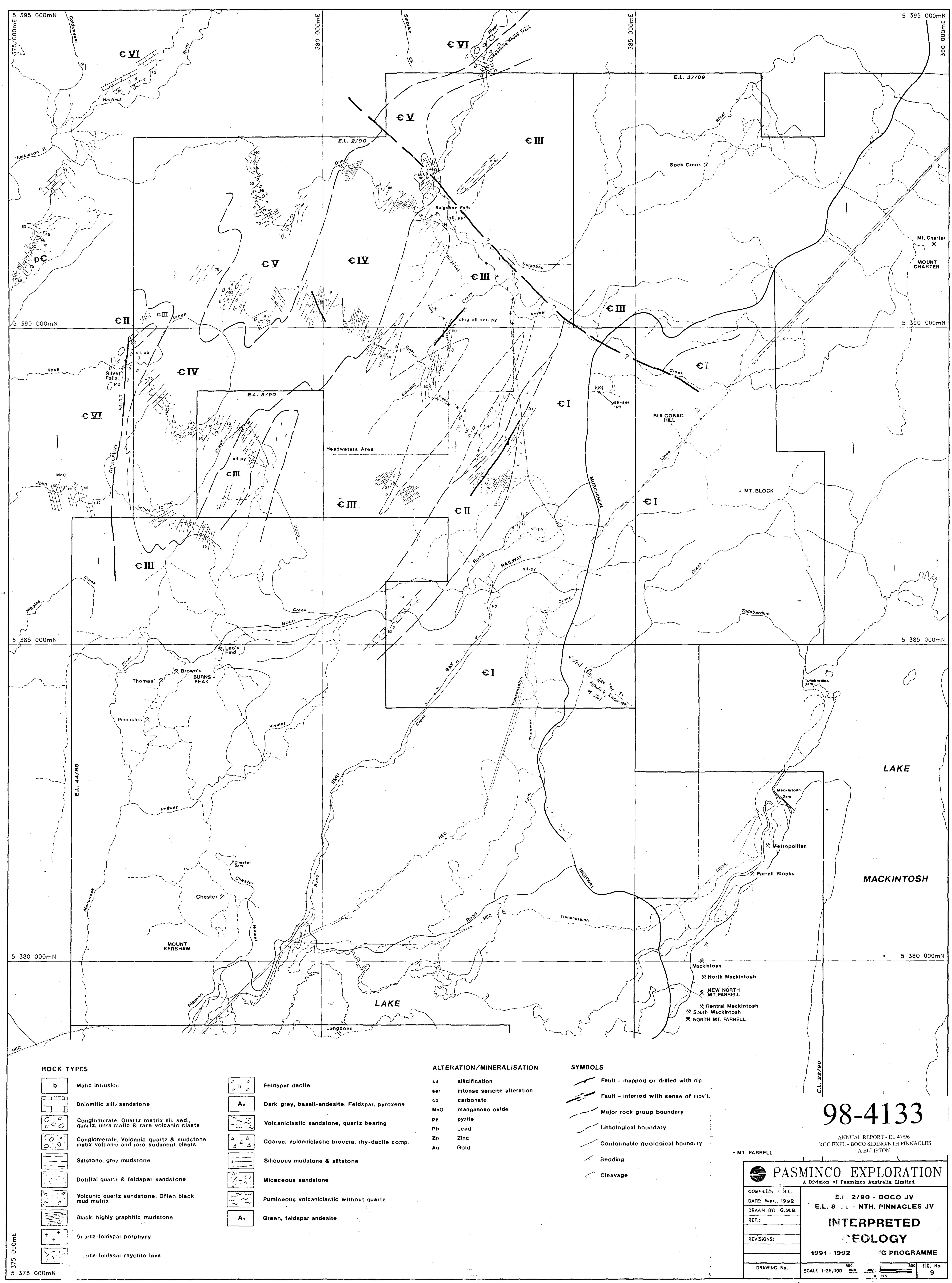
FIGURE 17

PASMINCO EXPLORATION
A Division of Pasminco Australia Limited

COMPILED: A.N.L.
DATE: JAN. '92.
DRAWN: L.W.K.
REF.:
REVISIONS:
DRAWING No.

E.L. 2/90 - BOCO JV
SILVER FALLS PROSPECT
INTERPRETED GEOLOGICAL CROSS SECTION

SCALE 1:10,000 0 200m.
FIG. No. 21



98-4133

ANNUAL REPORT - EL 47/96
. RGC EXPL - BOCO SIDING/NTH PINNACLES
A ELLISTON

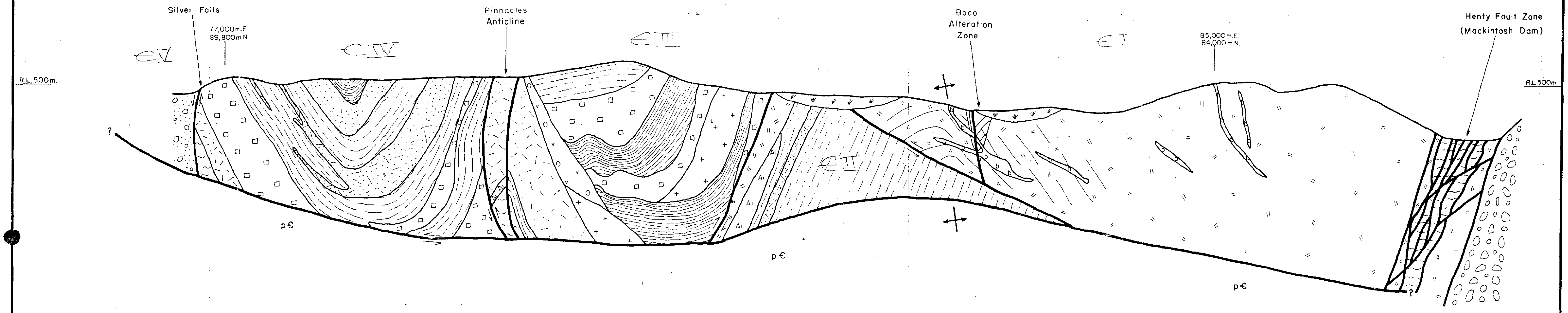
PASMINCO EXPLORATION
A Division of Pasminco Australia Limited

COMPILED: N.L.	E.L 2/90 - BOCO JV
DATE: Mar., 1992	E.L. 8 - NTH. PINNACLES JV
DRAWN BY: G.M.B.	INTERPRETED GEOLOGY
REF.:	
REVISIONS:	1991 - 1992 G PROGRAMME
DRAWING No.	SCALE 1:25,000 — FIG. No. 9

URE 18

5 cm

233106



LEGEND

- Fluvio glacials.
- Conglomerate (Owen).
- Andesite (green, feldspathic).
- Basaltic dykes.
- Bedded sediments. Shale, siltstone, sandstone.
- Quartz-feldspar porphyry.
- Rhyolite lava.
- Massive, pumiceous rocks.
- Black shale.
- Quartz-mica sandstone.
- Quartz-mica sandstone, with large fragments of Rhyolite.
- Quartz crystal sandstone.
- Feldspar-phyric lavas (Rhyodacitic).
- Conglomerate (Upper Dundas).
- p€ Pre-Cambrian basement.
- Fault with direction of relative movement.

5 cm

98-4133

ANNUAL REPORT - EL 47/96
RGC EXPL - BOCO SIDING/NTH PINNACLES
A ELLISTON

233107

FIGURE 19

PASMINCO EXPLORATION
A Division of Pasminco Australia Limited

COMPILED: A.N.L.
DATE: JULY '91
DRAWN: N.W.D.S.
REF.:
REVISIONS: L.W.K.
NOV. '91
DRAWING No.

NORTHERN LEASES

INTERPRETED GEOLOGY REGIONAL CROSS SECTION

SCALE 1:25,000 0 500m.
FIG. No.

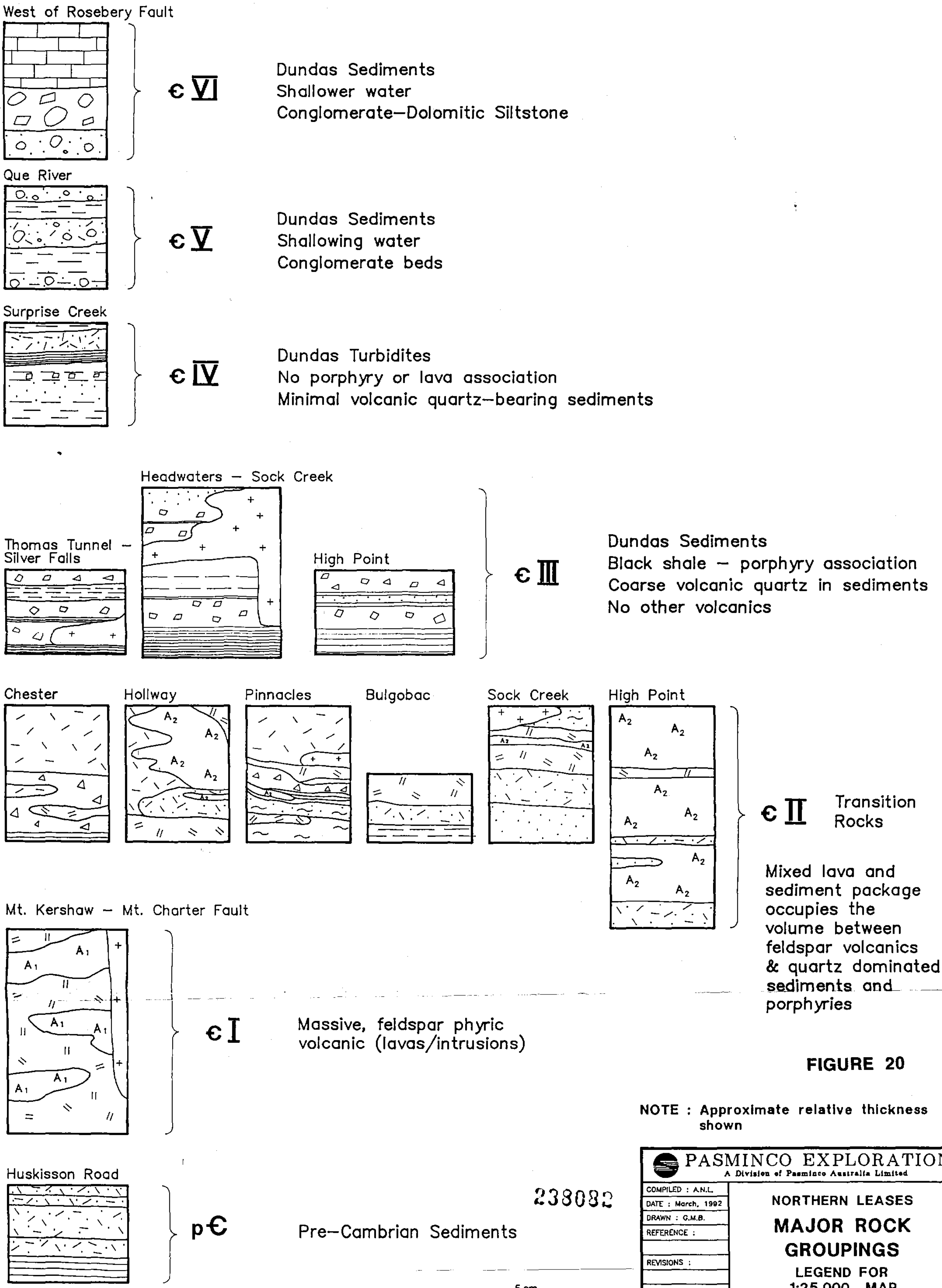


FIGURE 20

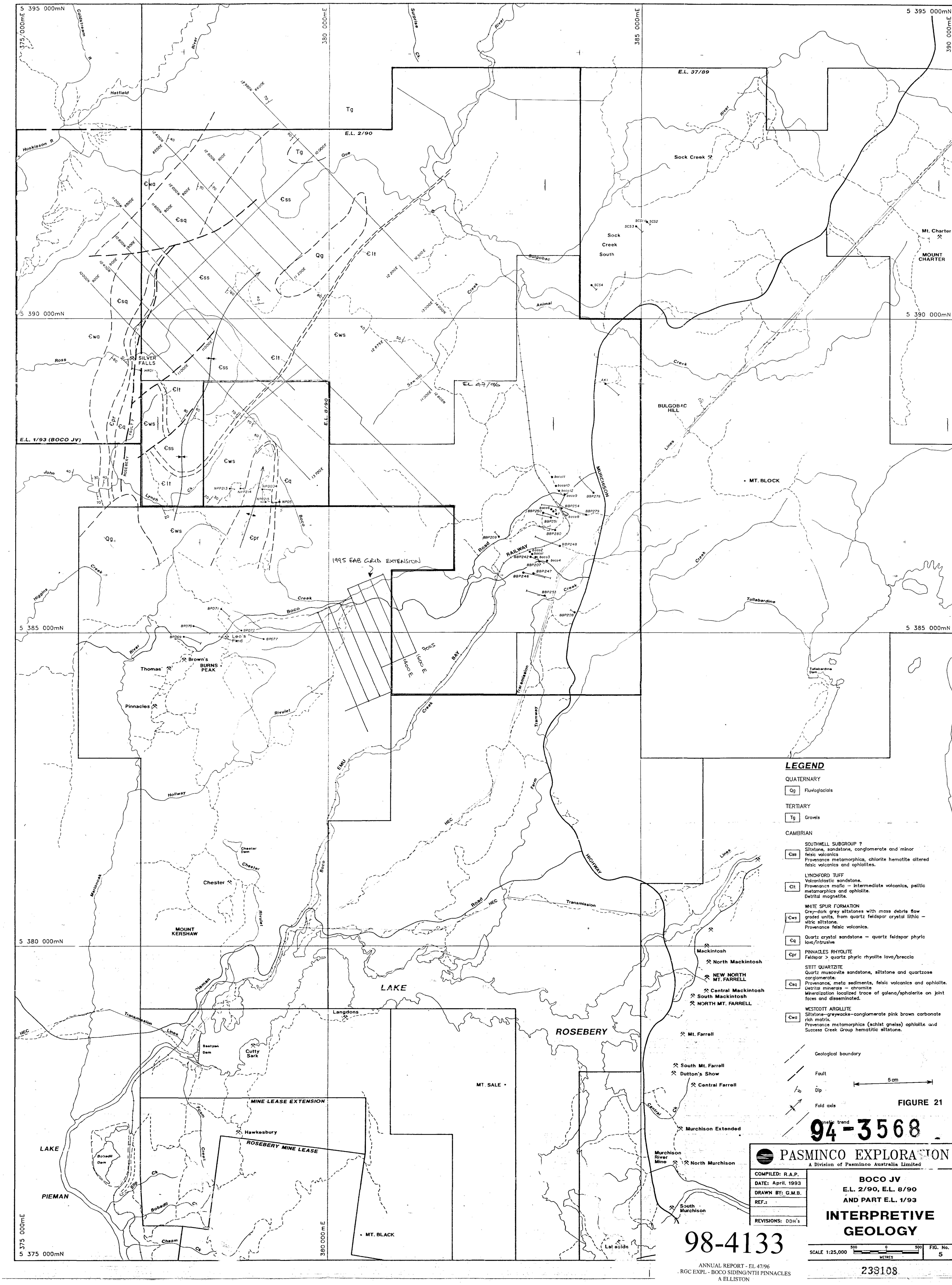
NOTE : Approximate relative thickness shown

238082

PASMINCO EXPLORATION
A Division of Pasminco Australia Limited

COMPILED : A.N.L.	NORTHERN LEASES
DATE : March, 1992	**MAJOR ROCK GROUPINGS**
DRAWN : G.M.B.	LEGEND FOR 1:25,000 MAP
REFERENCE :	
REVISIONS :	
DRAWING No.	SCALE As shown — FIG. No. 8

20



98-4133

ANNUAL REPORT - EL 47/96
RGC EXPL - BOCO SIDING/NTH PINNACLES
A ELLISTON

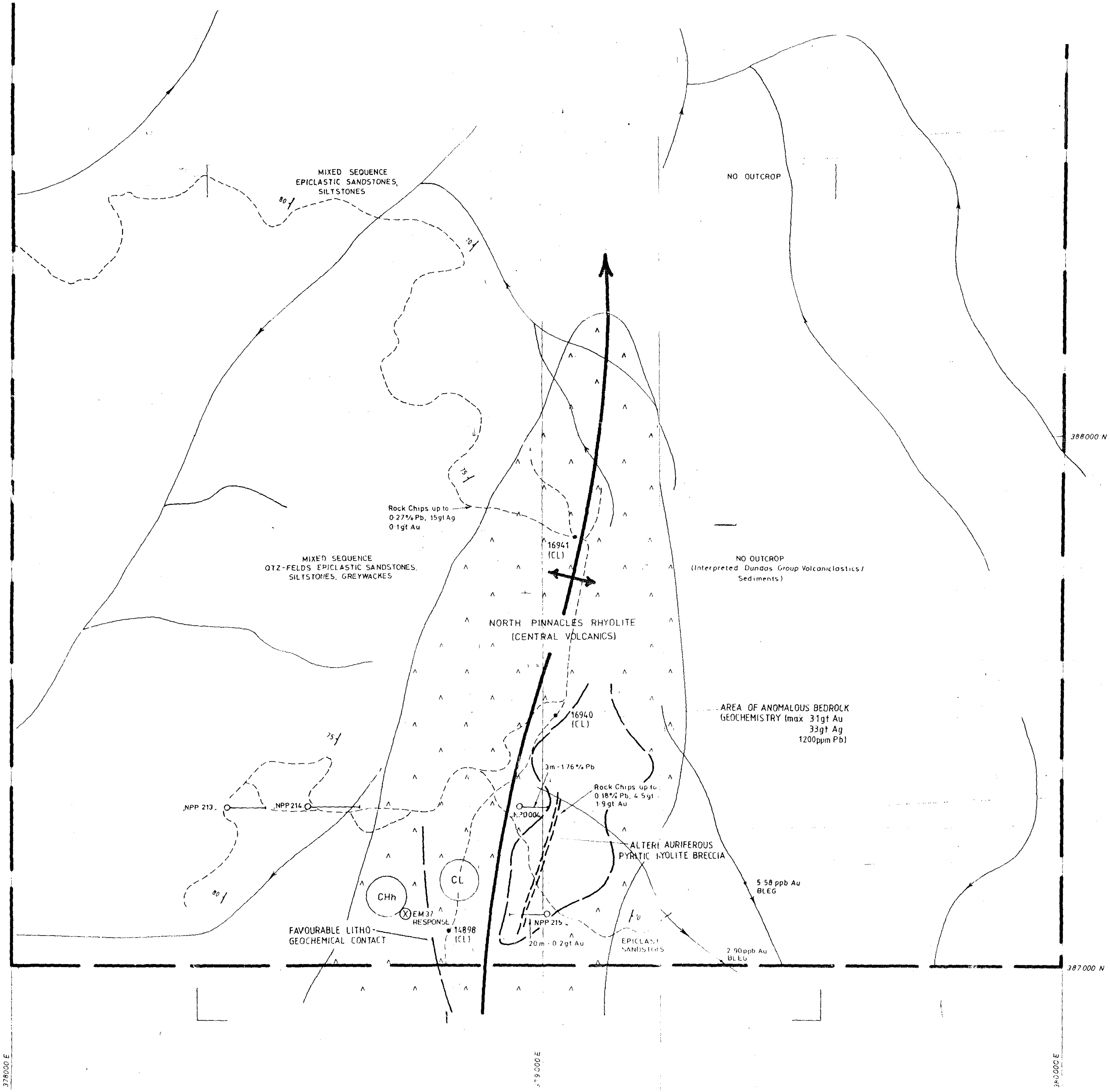
238108

98-4133

ANNUAL REPORT - EL 47/96
RGC EXPL - BOCO SIDING/NTH PINNACLES
A ELLISTON

92-3343.

FIGURE 22



LEGEND

- TRACK
- CREEK
- ANTICLINAL AXIS WITH PLUNGE
- RHYOLITE LAVA AND LAVA BRECCIA
- (CHh) HIGH Sr, Ti, Zr VOLCANICS
- (CL) LOW Ti, Zr VOLCANICS
- DDH
- GRIDDED AREA + EM 37 COVERAGE
- LITHOGEOCHEMICAL SAMPLE

98-4133

ANNUAL REPORT - EL 47/96
RGC EXPL - BOCO SIDING/NTH PINNACLES
A ELLISTON Vol 2 of 3

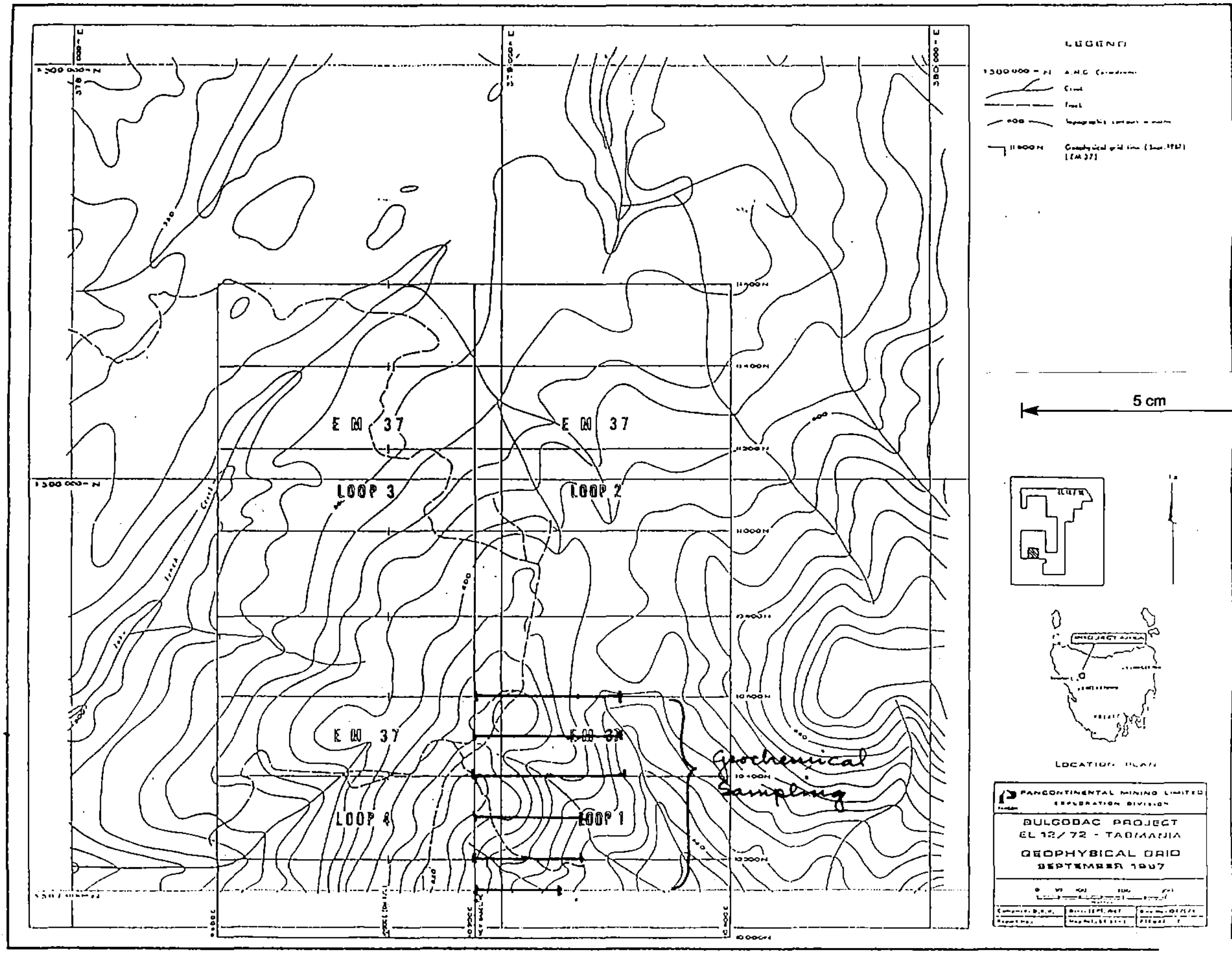
5 cm

FIGURE 23

Billiton Australia
The Metals Division of the Shell Company of Australia Limited

Project	E.L. 8/90		
Title	NORTH PINNACLES GEOLOGICAL COMPILATION		
Author J.P.R.	Dept. TAS	Scale 1:5000	
Drawn O.H.	Date 2/90	Revised	Date
Checked	Date	S'ceded	Date
Sheet No.		Drawing No.	

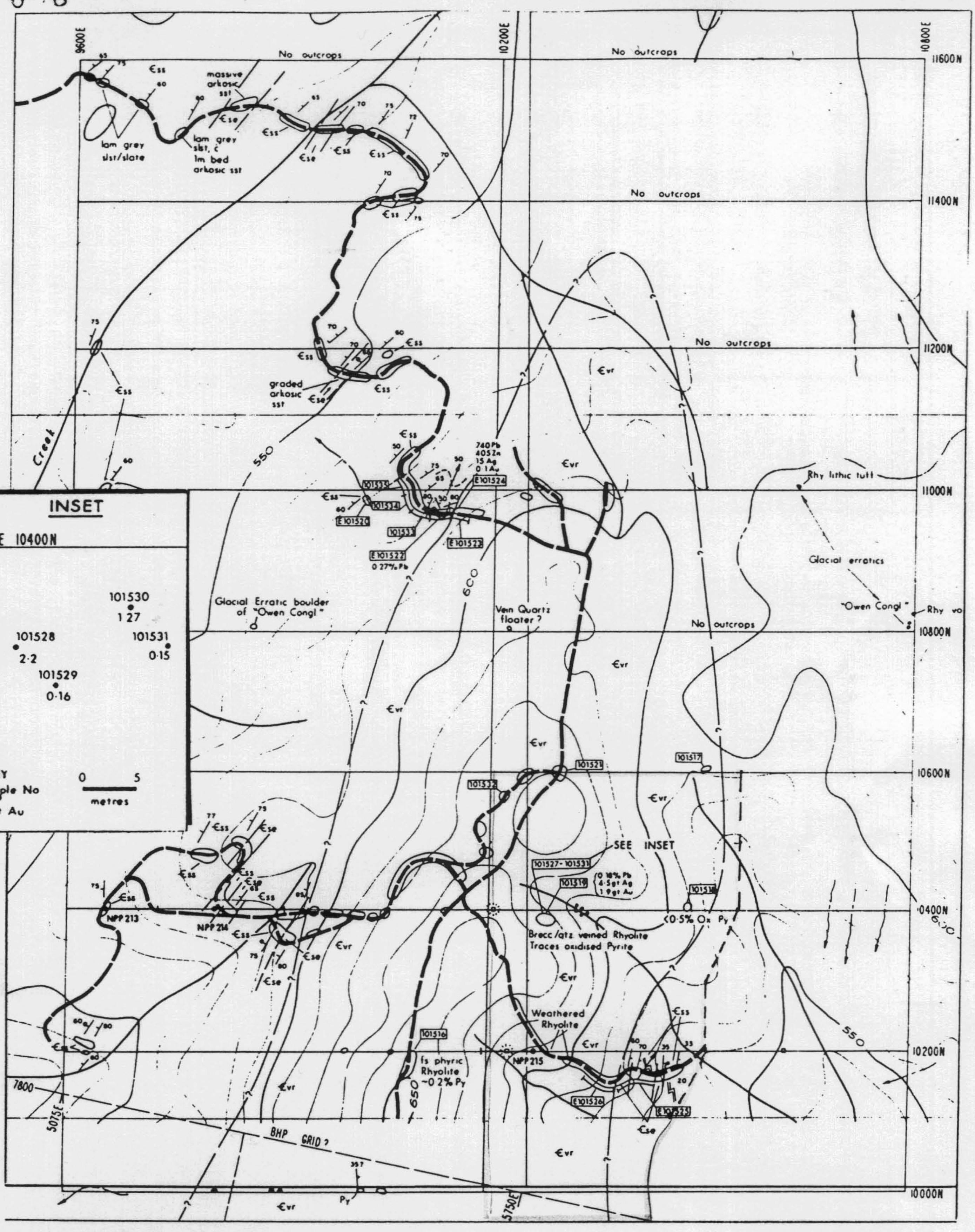
233110



LEGEND
5 cm
EM 37
EM 37
LOOP 3
LOOP 2
EM 37
LOOP 4
LOOP 1
Geochemical Sampling
LOCATION PLAN
PANCONTINENTAL MINING LIMITED
EXPLORATION DIVISION
DULGODAC PROJECT
EL 12/72 - TADIAANIA
GEOPHYSICAL GRID
SEPTEMBER 1907

FIGURE 24

006



DUNDAS GROUP : Mid Middle - Mid Late Cambrian?

€se	*Thick bedded quartzo-feldspathic tuffaceous - epiclastic sandstone*
€ss	*Thinly bedded greywacke, siltstone, grey to black shale*

CENTRAL VOLCANIC SEQUENCE ? : Late Early - Mid Middle Cambrian?

€vr	*Massive feldspar (quartz) phyric rhyolite, probably extrusive.*

238084

E.L. 12/72

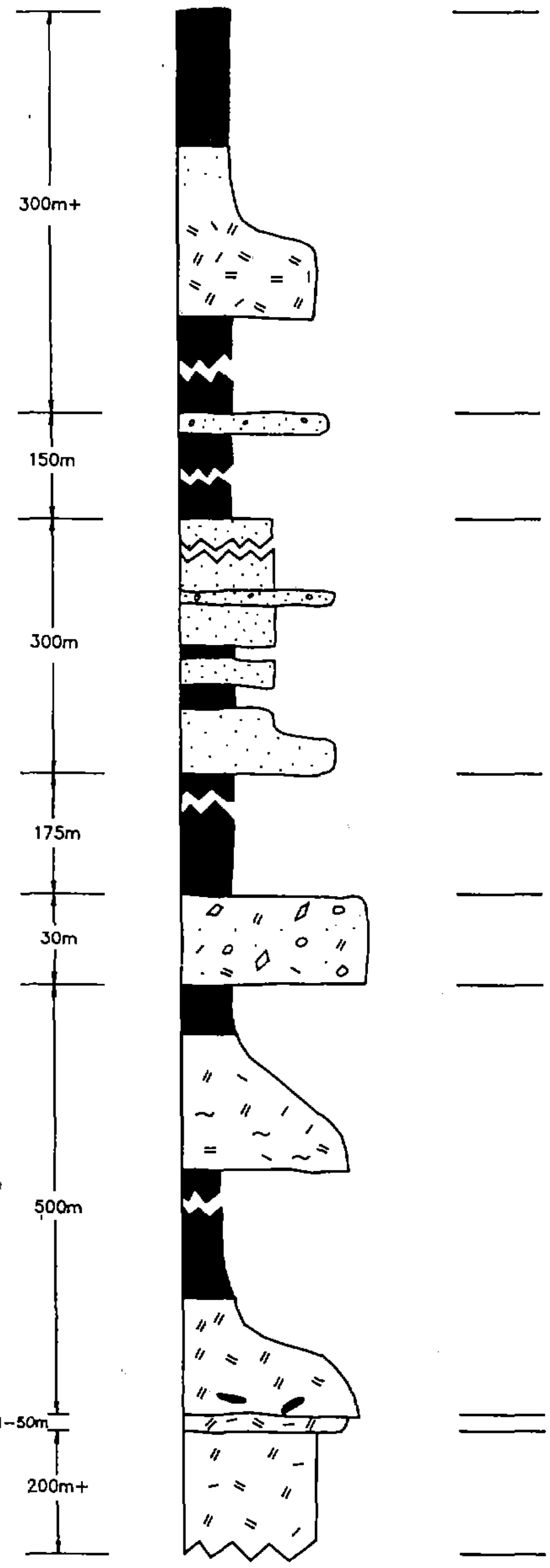
BULGOBAC

PANCONTINENTAL ROCK CHIP AND WACKER SAMPLING TO INVESTIGATE GOLD POTENTIAL
(NORTH PINNACLES)

AREA COVERED BY WACKER SAMPLING

FIGURE 25

(SOUTHWELL SUB GROUP)



Siltstone with minor felsic mass debris flows and pebble conglomerate.
Provenance metamorphics, chlorite–hematite altered felsic volcanics and ophiolite.
* Magnetite grains in felsic mass debris flows.

Siltstone and pebble conglomerate (as for unit below).

Quartz muscovite sandstone, pebble conglomerate and siltstone.
Provenance metamorphics, chlorite hematite altered felsic volcanics and ophiolites.
Detrital minerals tourmaline, chromite and magnetite.

Siltstone

LYNCHFORD TUFF – TYNDALL GROUP

Volcaniclastic sandstone.
Provenance mafic – intermediate volcanics, pelitic metamorphics and ophiolite
Detrital magnetite.

WHITE SPUR FORMATION

Grey–dark grey siltstones with mass debris flow, graded units, from quartz feldspar crystal lithic – vitric siltstone.
Provenance felsic volcanics.

Quartz crystal sandstone? – quartz grains < 8mm rounded and embayed.

Rhyolite lava, feldspar > quartz phyric.
Host North Pinnacles Pb Ag Au mineralization

BROWN'S ~~TUNNEL~~ PACKAGE ?

5 cm

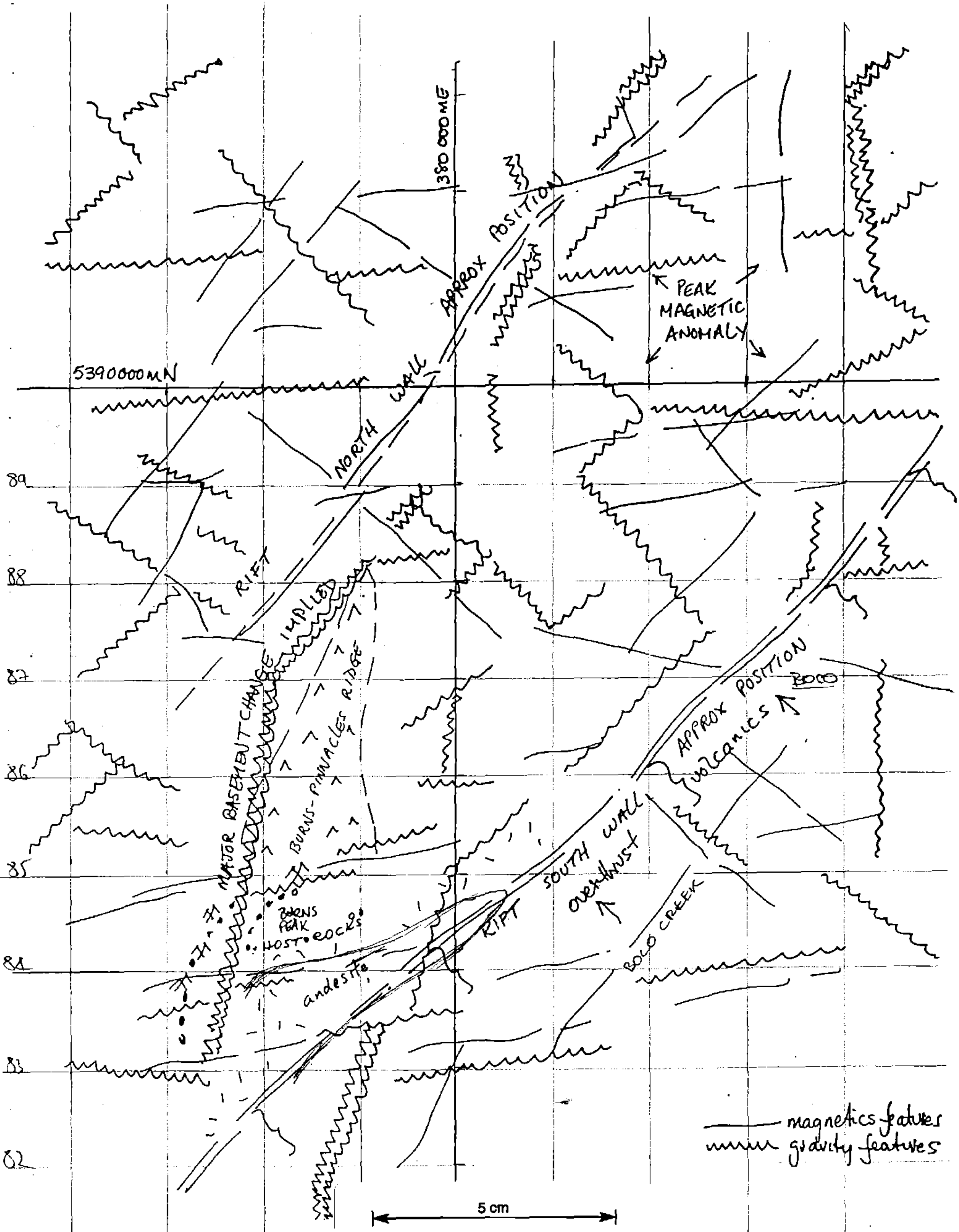
FIGURE 26

238085

PASMINCO EXPLORATION
A Division of Pasminco Australia Limited

COMPILED : R.A.P.	E.L. 2/90 – BOCO JV
DATE : April, 1993	E.L. 8/90 – NORTH PINNALCES JV
DRAWN : G.M.B.	SCHEMATIC STRATIGRAPHIC COLUMN
REFERENCE :	EASTERN LIMB OF SILVER FALLS SYNCLINE
REVISIONS :	
DRAWING No. SC_ELSFS	SCALE 1:2000 — FIG. No. 12

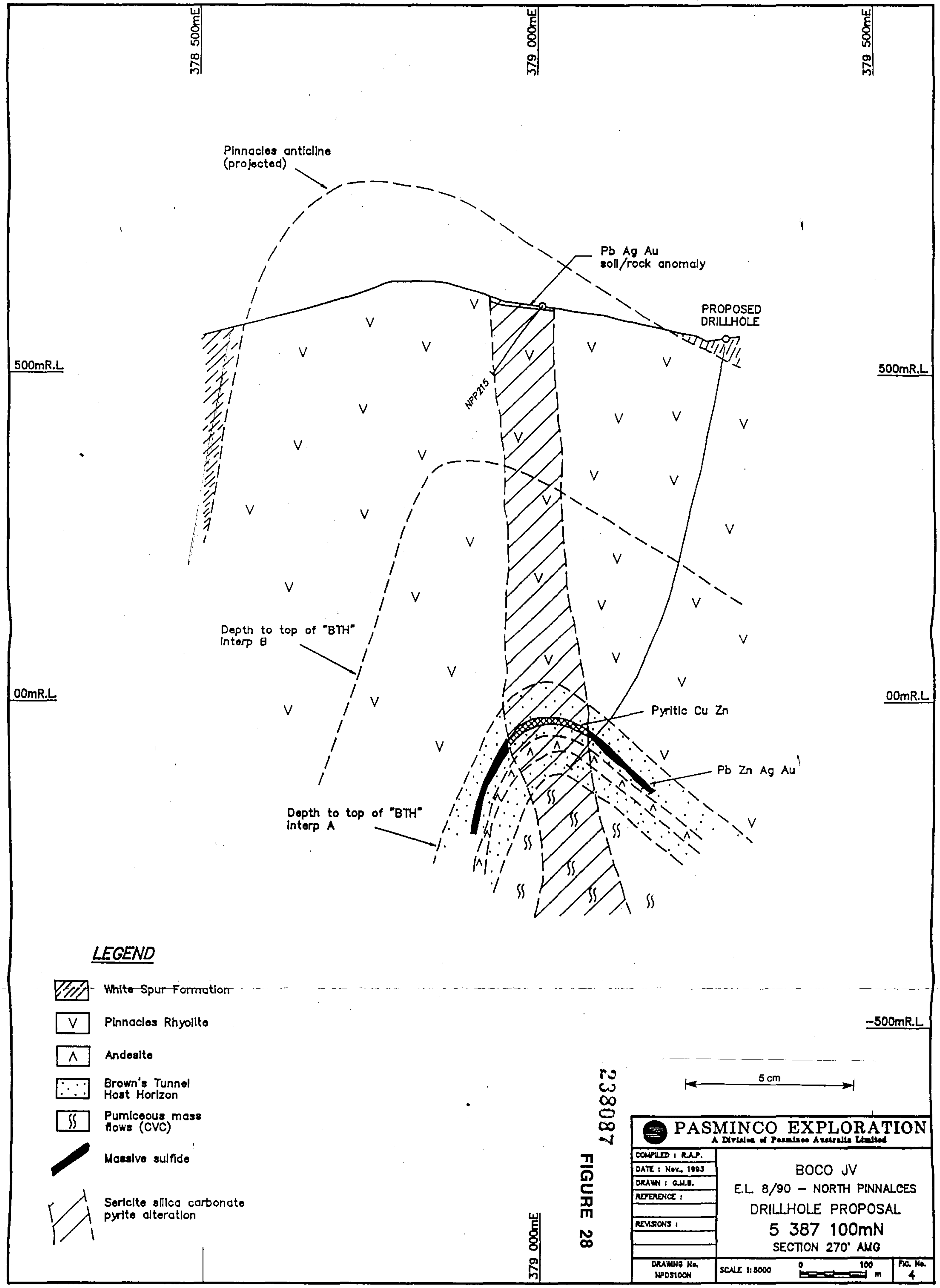
Fig 26



SUMMARY OF MAJOR STRUCTURAL ELEMENTS 1:50,000?

FIGURE 27

233086



378 500mE
379 000mE
379 500mE
Pinnacles anticline (projected)
Pb Ag Au soil/rock anomaly
PROPOSED DRILLHOLE
NPP215
500mR.L.
00mR.L.
-500mR.L.
Depth to top of "BTH" Interp B
Depth to top of "BTH" Interp A
Pyritic Cu Zn
Pb Zn Ag Au
LEGEND
White Spur Formation
Pinnacles Rhyolite
Andesite
Brown's Tunnel Host Horizon
Pumiceous mass flows (CVC)
Massive sulfide
Sericite silica carbonate pyrite alteration
5 cm
238087
PASMINCO EXPLORATION
A Division of Pasminco Australia Limited
COMPILED : R.A.P.
DATE : Nov., 1993
DRAWN : G.M.B.
REFERENCE :
REVISIONS :
DRAWING No. NPD5100N
BOCO JV
E.L. 8/90 – NORTH PINNALCES
DRILLHOLE PROPOSAL
5 387 100mN
SECTION 270° AMG
SCALE 1:5000
0 100 m
FIG. No. 4

FIGURE 28


SECTION LINE 5 387 075mN
NPP215
NPD5
Track
Creek
5 387 100mN
5 387 000mN
378 600mE
378 700mE
378 800mE
378 900mE
379 000mE
379 100mE
379 200mE
379 300mE
700mR.L.
600mR.L.
400mR.L.
300mR.L.
200mR.L.
100mR.L.
00mR.L.
-100mR.L.
-200mR.L.
Soil, rock chip Pb, Ag, Au geochemical anomaly
Base of oxidation
WHITE SPUR FORMATION
PINNACLES ANTICLINE
20.3m @ 0.2% Pb, 0.49% Zn 0.23g/t Au Disseminated and veinlet pyrite galena and sphalerite
75m – 77m 2m @ 0.02 g/t Au
Pinnacles Rhyolite quartz and feldspar phyric.
Moderate – intense silicification, occasionally associated with hydro thermal brecciation
Moderate – intense silicification
279.5m – 280.5m 1m @ 2.11% Pb Galena fluorite veins
339.0m – 340.0m 1m @ 0.25% Pb Galena fluorite veins
346.0m – 348.0m 2m @ 0.31% Pb Pyrite galena veinlets
360.0m – 362.0m 2m @ 0.38% Pb, 0.14% Zn 0.03g/t Au Disseminated, veinlet and semi massive pyrite
364.0m – 366.0m 2m @ 0.55% Pb Galena veinlets
388.0m – 390.0m 2m @ 0.29% Pb Galena fluorite veinlets
Feldspar phenocrysts sericitized and occasionally replaced by galena/sphalerite
Quartz veins associated with silicified haloes.
PINNACLES RHYOLITE
Pinnacles Rhyolite feldspar phyric
436.8m – 571.0m Feldspar phenocrysts sericitized and carbonitized. Abundant thread like veinlets of carbonate/chlorite/pyrite.
sericitized lithic sandstone
677.1m – 679.2m 2.2m @ 0.23% Pb, 0.95% Zn Sphalerite disseminated and fine grained aggregates
Pinnacles Rhyolite feldspar phyric.
34978
34980
34990
34991
34992
34993
34994
34995
34996
300
436.8m
LEGEND
Shear
Brittle Fault
Geological contacts
Cleavage
Facing
Bedding to LCA
Bedding to LCA strike and dip (oriented)
Flow banding
Lithogeochem sample
Zones of disseminated and veinlet sulphides
Significant assay intervals
Black Shale
Siltstone
Sandstone
Volcaniclastic Sandstone
Conglomerate
Siliceous (Rhyolite) Lavas/Sills
Spherulites
Pumice Breccia
Flow Banding
Cloudy silica or Nodular Carbonate alteration
Skarns
Feldspar
Quartz Crystals
Sulphides
Lithic Clasts
Schistose
Black Mudstone Clasts
Massive Sulphides
Vesicles/Amygdales
Brecciation (crackle/in-situ)
Vein
ALTERATION
Moderate – intense silicification, occasionally associated with hydro thermal brecciation
94-3568
PASMINCO EXPLORATION
A Division of Pasminco Australia Limited
COMPILED : R.A.P.
DATE : March 1994
DRAWN : G.M.B.
REFERENCE :
REVISIONS :
E.L. 8/90 – NORTH PINNACLES JV
DRILL SECTION
5 387 075mN AMG
NPD5
DRAWING No. NPD5_A0
SCALE 1:000
FIG. No. 12
FIGURE 29
98-4133
ANNUAL REPORT - EL 47/96
RGC EXPL - BOCO SIDING/NTH PINNACLES
A ELLISTON
5 cm
238111

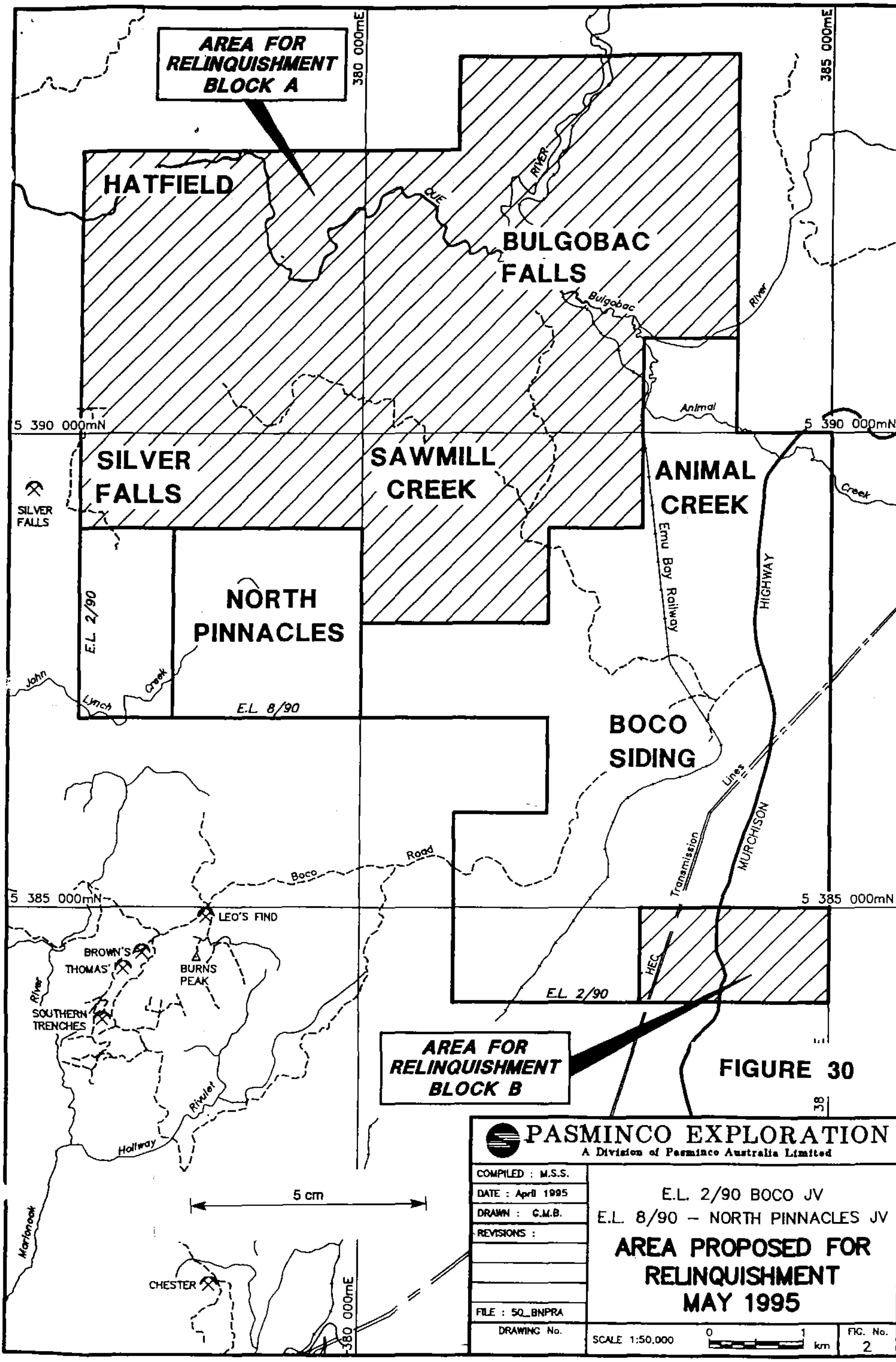


FIGURE 30

PASMINCO EXPLORATION
A Division of Pasminco Australia Limited

COMPILED : M.S.S.	E.L. 2/90 BOCO JV
DATE : April 1995	E.L. 8/90 – NORTH PINNACLES JV
DRAWN : C.M.B.	AREA PROPOSED FOR RELINQUISHMENT MAY 1995
REVISIONS :	
FILE : 50_BNPRA	
DRAWING No.	SCALE 1:50,000 0 1 km — FIG. No. 2

233035

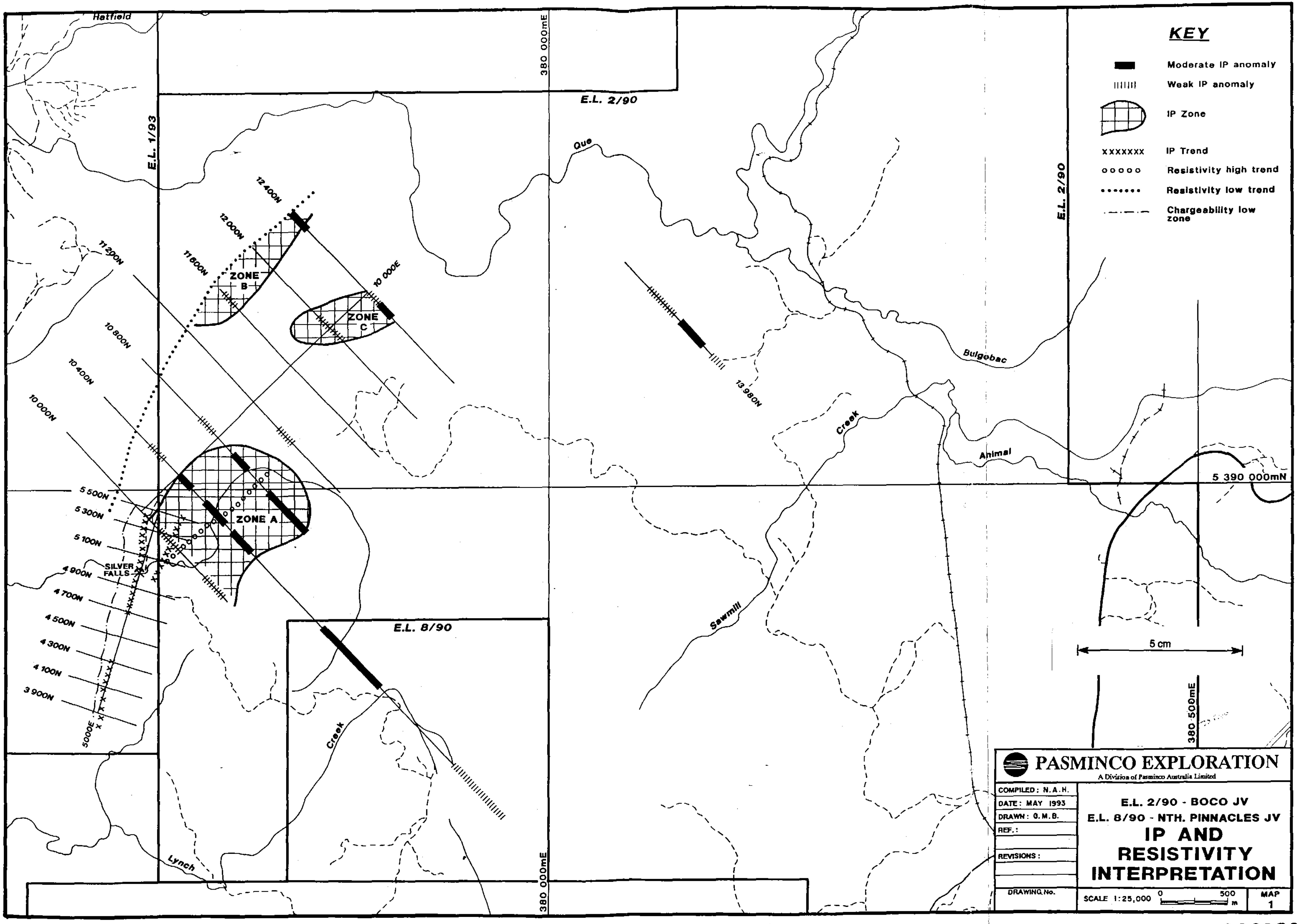


FIGURE 31 233089

TABLE 1 **Boco Wholerock Geochemical Data. Pancon, Billiton and CSR samples** BocoWRss 3 April, 1997 P1

SAMPLE	Hole	E/Fr	N/To	Descrip	Fmn	Gp	SiO2	TiO2	Al2O3	Fe2O3	MnO	MgO	CaO	Na2O	K2O	P2O5	LOI	Total	Al	Ba	Cr	Sr	Nb	Y	Zr	P/Ti	Ti/Zr
19837	PANCONTINENTAL (Alras, 1987)						71.80	0.37	12.80	2.94	0.05	0.83	0.23	3.84	3.42	0.09	1.64	98.01	51	1240	20	205	12	54	180	0.24	12.3
19838							65.90	0.64	14.60	4.56	0.14	1.33	2.40	4.38	1.84	0.14	2.06	97.99	32	1280	14	660	14	48	760	0.22	5.0
19839							68.70	0.50	15.90	2.06	0.05	0.26	0.34	4.22	5.05	0.09	2.48	99.65	54	1360	**40**	**275**	**12**	38	465	0.18	6.4
19840							72.90	0.38	14.30	2.26	0.08	0.44	0.52	6.60	1.61	0.13	0.84	100.06	22	1160	**16**	**280**	16	38	435	0.34	5.2
19841							73.50	0.25	12.60	1.84	0.06	0.36	0.06	0.45	10.20	0.08	1.14	100.54	95	3360	16	47	6	24	160	0.32	9.4
19842							73.90	0.25	12.30	1.65	0.08	0.14	0.68	3.64	5.45	0.06	1.02	99.17	56	1900	8	135	8	36	150	0.24	10.0
19843							76.30	0.10	10.60	0.88	0.04	0.10	0.06	1.15	6.15	0.01	2.56	97.95	84	2040	24	78	10	22	110	0.10	5.4
19844							71.60	0.13	13.70	3.14	0.19	0.56	0.60	3.94	2.10	0.04	2.52	98.52	37	300	14	390	14	48	140	0.31	5.6
19845							72.30	0.27	12.30	3.32	0.12	0.40	0.20	4.42	3.34	0.05	1.41	98.13	45	940	5	135	12	28	160	0.19	10.1
19846							68.20	0.46	14.40	3.62	0.12	0.37	1.26	4.06	4.40	0.10	1.42	98.41	47	1240	24	365	14	40	445	0.22	6.2
19847							67.50	0.52	15.70	1.82	0.03	0.17	0.82	3.24	5.35	0.08	2.78	98.01	58	1160	5	345	14	34	475	0.15	6.6
16901	BILLITON (Randell, 1991a)						71.80	0.31	15.90	1.89	0.06	1.43	0.11	0.17	4.14	0.03	4.42	100.26	95			16	18	30	240	0.10	7.7
16902							72.10	0.35	14.20	2.76	0.03	0.67	0.07	0.74	5.30	0.03	3.50	99.75	88			105	16	32	230	0.09	9.1
16903							80.40	0.26	13.70	0.63	0.00	0.08	0.03	0.29	1.12	0.02	2.32	98.85	79			78	17	14	210	0.08	7.4
16904							64.70	0.61	18.40	2.84	0.06	0.40	0.13	2.24	4.44	0.06	5.25	99.13	67			140	16	28	530	0.10	6.9
16905							69.70	0.54	15.10	3.08	0.06	0.52	0.47	3.70	4.48	0.09	2.26	100.00	55			220	15	24	480	0.17	6.7
16906							67.50	0.63	16.00	3.10	0.04	0.42	0.66	2.98	5.00	0.10	3.12	99.55	60			240	17	34	570	0.16	6.6
16907							65.30	0.31	19.70	2.96	0.03	0.39	0.06	0.35	1.95	0.04	8.60	99.69	85			20	14	20	240	0.13	7.7
16908							72.00	0.39	14.20	3.62	0.07	0.80	0.51	3.84	3.78	0.10	1.72	101.03	51			140	14	34	200	0.26	11.7
16930							69.60	0.40	14.50	2.92	0.05	1.11	1.05	3.28	3.66	0.24	2.58	99.39	52			300	10	18	175	0.60	13.7
16931							72.60	0.36	12.50	2.44	0.02	0.94	0.69	1.91	4.98	0.24	2.10	98.78	69			70	16	24	180	0.67	12.0
16933							72.80	0.48	12.90	1.60	0.02	0.93	1.16	1.03	5.15	0.40	1.58	98.05	74			78	13	36	230	0.83	12.5
16934							69.30	0.73	14.60	3.60	0.09	1.45	1.59	4.56	1.46	0.36	2.64	100.38	32			220	16	35	300	0.49	14.6
16935							62.30	0.67	19.00	4.68	0.09	1.27	0.95	0.07	2.12	0.37	8.20	99.72	77			18	15	16	260	0.55	15.4
16936							67.10	0.41	16.50	2.68	0.08	1.18	0.84	1.00	2.26	0.28	6.50	98.83	65			78	14	22	200	0.68	12.3
16937							77.90	0.23	11.20	1.78	0.08	0.89	0.70	2.56	2.52	0.22	2.32	100.40	51			130	14	24	140	0.96	9.8
16938							75.30	0.26	12.70	1.37	0.02	0.72	0.81	1.66	5.50	0.25	1.76	100.35	72			115	15	25	145	0.96	10.7
16939							70.20	0.55	14.60	3.00	0.06	1.31	1.00	4.58	1.40	0.29	3.38	100.37	33			200	11	16	190	0.53	17.4
16940							75.10	0.32	12.20	0.80	0.01	0.55	0.88	2.42	4.56	0.29	1.88	99.01	61			96	11	16	125	0.91	15.3
16941							75.30	0.35	12.50	1.91	0.03	0.92	0.82	0.24	4.18	0.26	3.08	99.59	83			30	10	22	155	0.74	13.5
16942							67.70	0.50	15.20	3.56	0.03	0.82	1.51	2.36	1.59	0.27	4.84	98.38	38			320	10	22	170	0.54	17.6

23090

TABLE 1 Boco Wholerock Geochemical Data. Pancon, Billiton and CSR samples

SAMPLE	Hole	E/Fr	N/To	Descrip	Fmn	Gp	SiO2	TiO2	Al2O3	Fe2O3	MnO	MgO	CaO	Na2O	K2O	P2O5	LOI	Total	AI	Ba	Cr	Sr	Nb	Y	Zr	P/Ti	Ti/Zr
CSR (Williams, 1985)																											
184709	248	567.0	577.0		Cpp		75.60	0.22	11.70	1.65	0.04	0.10	1.10	2.65	4.55	0.02	1.51	99.14	55	940	80	75	8	35	170	0.10	7.8
184710	248	319.0	331.0		Cvf?		73.00	0.24	13.70	2.15	0.04	0.45	1.00	3.05	3.30	0.02	2.07	99.02	48	500	55	95	15	35	210	0.09	6.9
184711	246	272.0	287.0		Cva		73.50	0.23	12.00	4.15	0.07	0.45	0.55	2.15	4.60	0.02	1.36	99.08	65	1350	30	95	10	35	180	0.09	7.7
184712	250	337.0	355.0		Cvb		70.90	0.33	12.40	3.35	0.08	0.80	2.90	1.75	2.95	0.05	3.50	99.02	45	450	30	100	10	35	230	0.17	8.6
184713	242	195.0	213.0		Cvf		72.60	0.30	13.80	2.45	0.05	0.65	1.50	2.35	3.10	0.07	2.86	99.73	49	600	70	110	15	25	190	0.23	9.5
184706	253	114.7	128.0				73.00	0.30	12.60	2.95	0.05	0.20	1.35	2.75	5.25	0.04	1.53	100.02	57	920	10	110	8	40	260	0.14	6.9
184707	253	319.0	336.0				68.80	0.30	12.40	2.80	0.09	0.15	3.05	2.05	5.05	0.03	3.21	97.93	50	610	35	95	10	40	260	0.11	6.9
184708	253	436.5	448.5				73.40	0.34	13.70	2.10	0.04	0.70	1.40	2.80	3.20	0.04	2.62	100.34	48	560	25	120	10	35	250	0.13	8.2
184701	278	183.3	196.0				70.8	0.30	13.40	3.85	0.07	0.50	1.20	3.85	3.35	0.08	1.75	99.15	43	1150	35	210	15	40	200	0.25	9.0
184702	278	217.2	223.1				49.50	0.68	11.50	11.60	0.37	5.50	8.45	1.95	1.05	0.61	8.75	99.96	39	680	125	160	7	35	150	0.89	27.2
184703	278	438.2	442.5				56.90	1.15	14.60	9.75	0.18	2.35	4.35	4.30	1.50	0.43	4.33	99.84	31	480	15	230	7	40	140	0.37	49.2
184704	278	447.5	457.0				72.00	0.29	11.60	3.00	0.10	0.70	2.70	0.29	3.75	0.06	4.78	99.27	60	320	45	50	10	40	170	0.21	10.2
184705	278	324.9	339.0				72.80	0.31	12.70	2.70	0.05	0.70	1.70	3.95	2.15	0.04	2.21	99.31	34	30	454	90	10	25	230	0.13	8.1
184680	279	217.0	227.0		Cpp		75.90	0.21	11.20	2.25	0.05	0.40	2.05	2.25	2.30	0.02	2.70	99.33	39	450	35	85	10	35	170	0.10	7.4
184681	279	237.0	242.0		Clm		55.90	0.90	15.30	9.55	0.19	3.05		2.00	1.90	0.34	6.20	95.33	71	460	5	130	10	30	150	0.38	36.0
184682	279	319.0	330.0		Clm		49.90	0.64	10.40	12.00	0.30	7.40	7.50	1.80	0.68	0.57	8.70	99.89	46	370	95	180	10	30	150	0.89	25.6
184683	279	374.0	381.0		Cva		72.20	0.30	12.50	2.90	0.05	0.30	1.35	2.65	5.25	0.04	1.45	98.99	58	1000	35	110	15	40	270	0.13	6.7
184684	279	418.0	426.0		Cva		70.30	0.29	12.70	3.60	0.08	0.30	2.55	3.55	2.90	0.07	2.90	99.24	34	800	35	200	10	35	200	0.23	8.7
184685	279	441.0	450.0		Cva		70.80	0.29	11.80	5.40	0.03	0.25	1.35	1.40	4.40	0.34	3.25	99.31	63	650	115	75	10	35	250	1.17	7.0
184686	279	516.0	530.0		Cva		73.90	0.24	11.70	2.10	0.05	0.20	1.85	2.30	5.00	0.02	2.20	99.56	56	960	55	85	10	40	190	0.10	7.6
212901	279	697.6	698.2		Cpp		71.40	0.28	13.15	2.45	0.07	0.35	1.19	2.49	4.11	0.30	2.36	98.15	55						260	1.07	6.5
212903	280	74.9	85.0		Cva		80.60	0.22	10.15	2.15	0.01	0.10		0.06	3.19	0.01	1.92	98.42	98						180	0.05	7.3
212909	280	104.9	108.0		Clm		66.00	0.85	17.35	2.45	0.02	1.15	0.06	0.05	3.92	0.05	5.44	97.34	98						170	0.06	30.0
212932	280	190.0	202.0		Cpa		77.00	0.24	12.30	2.20	0.01	0.45		0.05	4.03	0.01	2.66	98.96	99						200	0.06	7.2
212938	280	211.0	221.0		Cpa		74.10	0.35	13.60	2.75	0.01	0.35	0.05	0.05	4.20	0.05	3.11	98.62	98						250	0.14	8.4
212802	280	261.5	268.6		Cvf		66.20	0.49	14.35	5.10	0.11	1.55	0.98	4.35	2.31	0.11	2.62	98.17	42						220	0.23	13.4
212806	280	278.5	287.6		Cvf		67.80	0.52	13.30	4.65	0.08	0.80	1.51	0.10	3.94	0.12	4.62	97.44	75						240	0.23	13.0
Mass Changes 212802->212806					(g/100g)		-4.05	-0.01	-2.16	-0.84	-0.04	-0.82	0.40	-4.26	1.30	-0.00	1.62	Nett:	-9								
212809	280	289.6	295.6		Ceb		73.40	0.31	12.75	3.05	0.01	0.60	0.90	0.09	4.17	0.05	3.51	98.84	83						240	0.15	7.7
212819	280	307.6	317.6		Cpa		75.60	0.24	12.05	2.15	0.60	0.55	0.46	0.09	4.25	0.02	3.03	99.04	90						210	0.10	6.9
212832	280	332.7	342.0		Cpa		73.30	0.27	12.45	2.65	0.02	0.50	0.22	0.08	4.18	0.03	3.29	96.99	94						230	0.09	7.0
212836	280	344.6	347.4		Clm		58.20	1.00	14.35	9.05	0.18	1.85	1.54	0.41	1.89	0.36	5.08	93.92	66						170	0.36	35.3
212839	280	395.0	400.0		Cpp		73.20	0.26	11.70	2.50	0.04	0.45	0.56	2.70	3.06	0.03	2.70	97.20	52						220	0.13	7.1

23301

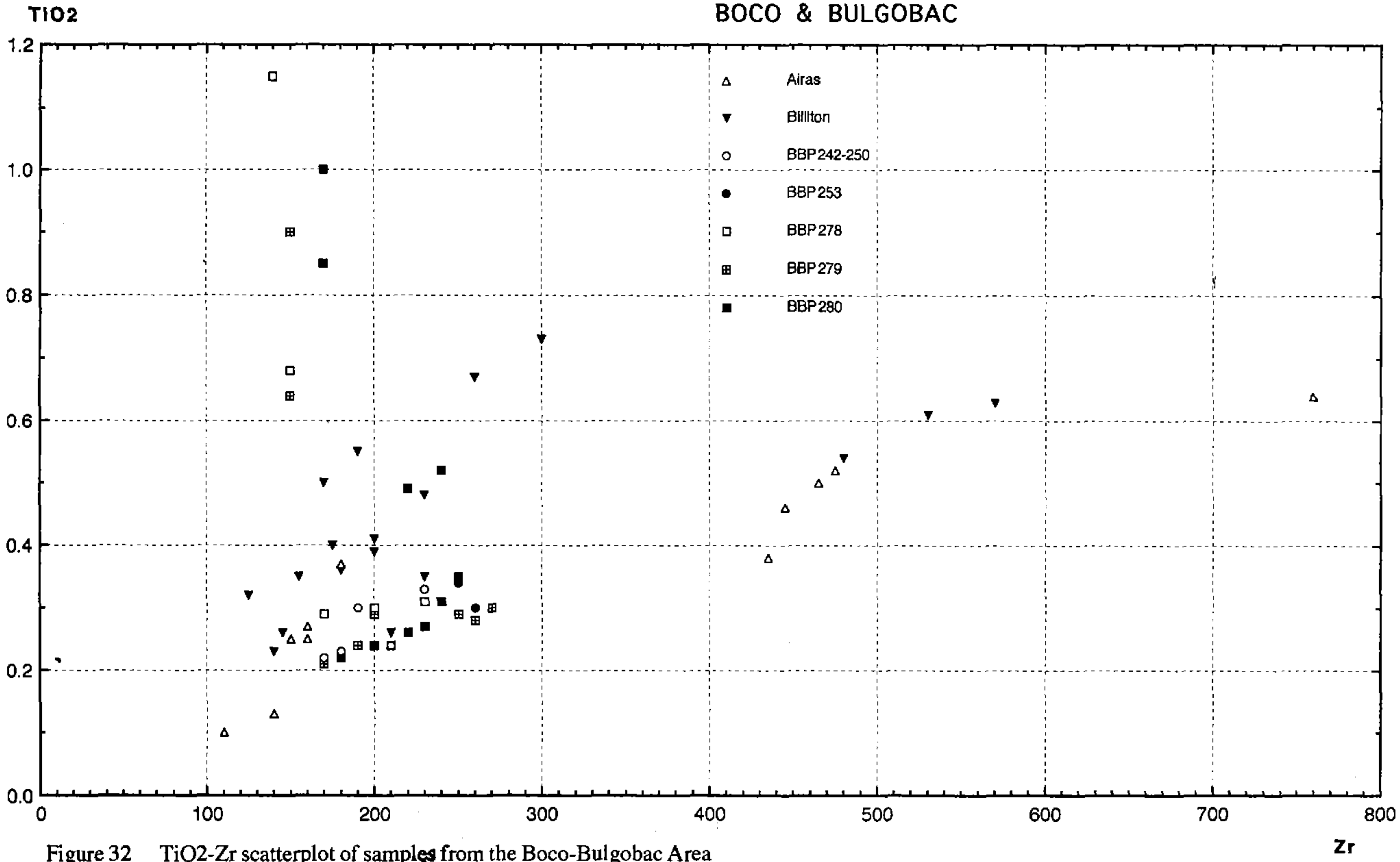


Figure 32 TiO2-Zr scatterplot of samples from the Boco-Bulgobac Area

233092

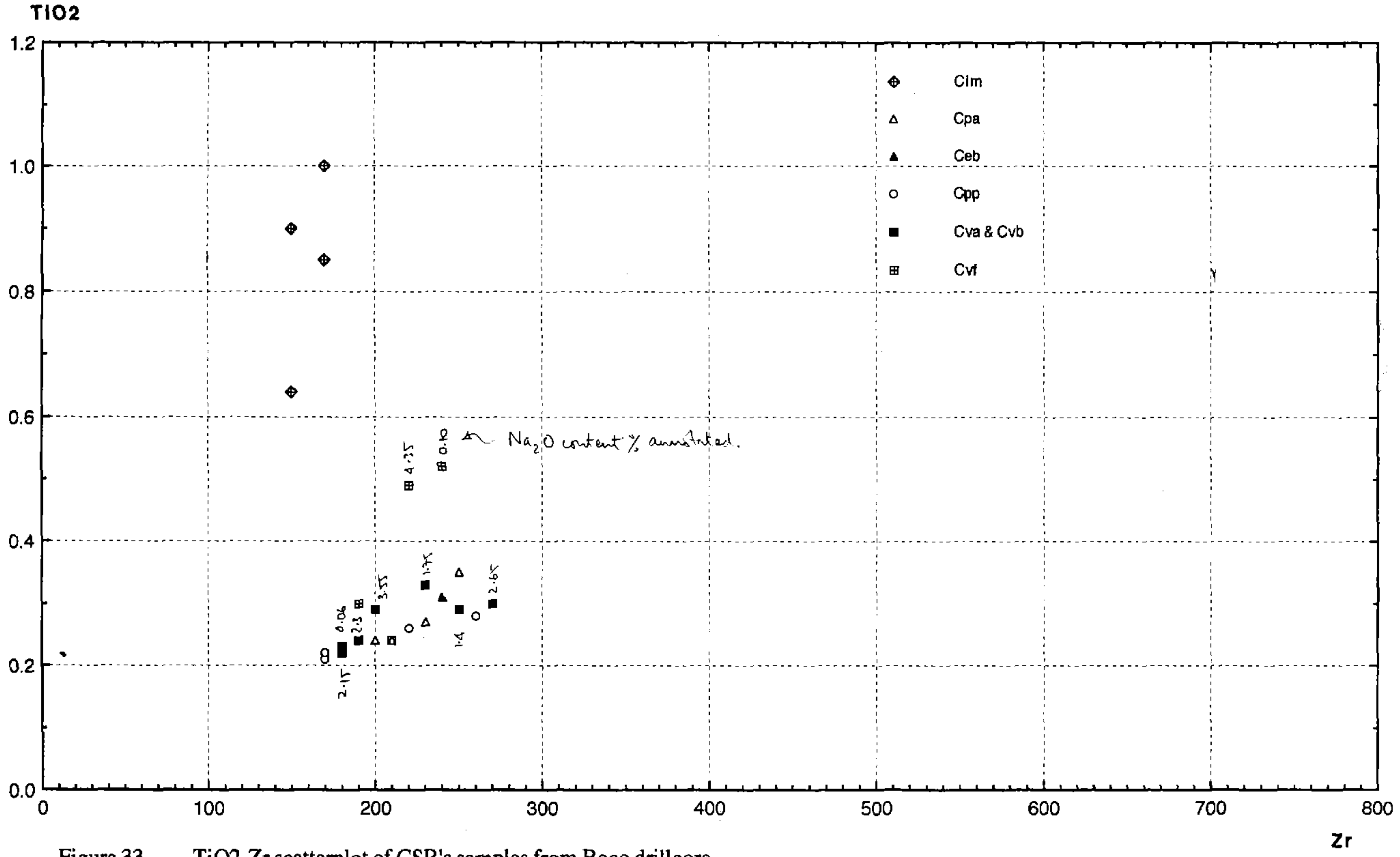


Figure 33 TiO2-Zr scatterplot of CSR's samples from Boco drillcore

233093

TABLE 2 **North Pinnacles Wholerock Geochemical Data.** **Pancon, Pasminco & Billiton samples** NPWRss 6 April, 1997 P1

SAMPLE	Hole	E/Fr	N/To	Descrip	Fmn	Gp	SiO2	TiO2	Al2O3	Fe2O3	MnO	MgO	CaO	Na2O	K2O	P2O5	SO3	LOI	Total	AI	Cr	Sr	Nb	Y	Zr	P/Ti	Ti/Zr
PASMINCO (Poltock, 1994)																											
34989	NPD5	100.0		silicif qfpRhyolite			64.00	0.30	17.65	4.37	0.09	2.30	0.59	3.18	3.17	0.05	0.93	3.80	100.43	59	<7	265	8	38	227	0.17	7.9
34990	NPD5	311.0		flbd fpRhyolite			75.50	0.21	10.89	3.05	0.14	1.08	0.35	2.02	4.81	0.04	0.67	1.15	99.91	71	<7	112	4	19	138	0.20	9.1
34991	NPD5	392.0		cb-chl vnd fpRhyolite			73.20	0.24	12.52	3.24	0.08	0.54	0.81	3.60	4.09	0.04	0.38	1.26	100.00	51	<7	158	9	24	167	0.16	8.6
34992	NPD5	452.0		cb-chl vnd fpRhyolite			72.60	0.23	12.64	1.60	0.04	0.09	0.95	1.01	9.10	0.04	0.81	1.19	100.29	82	7	95	6	22	162	0.15	8.5
34993	NPD5	551.0		cb-chl vnd fpRhyolite			73.10	0.23	12.61	1.95	0.07	0.21	0.60	0.73	9.05	0.04	0.24	1.06	99.89	87	<7	65	4	20	158	0.15	8.7
34994	NPD5	625.0		qfp?Rhyolite breccia			77.50	0.11	11.15	2.32	0.09	0.68	0.21	1.87	4.57	0.01	0.34	1.29	100.14	72	<7	58	6	23	109	0.10	6.0
34995	NPD5	716.0		qfp?Rhyolite			71.50	0.27	13.43	2.98	0.10	0.48	1.32	3.03	4.52	0.04	0.01	1.97	99.65	53	<7	130	7	29	183	0.15	8.8
34996	NPD5	781.0		qfp?Rhyolite			72.10	0.27	13.57	2.85	0.13	0.68	0.88	2.93	4.58	0.05	0.20	1.72	99.96	58	<7	98	11	24	177	0.17	9.1
34997	NPD5	58.0		silicif qfpRhyolite			70.70	0.24	14.89	3.10	0.08	1.53	0.68	5.19	1.35	0.04	0.02	1.87	99.69	33	<7	379	7	29	179	0.17	8.0
Mean of 34991,95 & 96				Least altered Rhyolite?			72.27	0.26	13.17	3.02	0.10	0.57	1.00	3.19	4.40	0.04	0.20	1.65	99.87	54		129	9	26	176	0.16	8.9
Mean of 34992 & 93				Most altered Rhyolite?			72.85	0.23	12.62	1.78	0.05	0.15	0.77	0.87	9.08	0.04	0.52	1.12	100.09	85		80	5	21	160	0.15	8.6
Mass Changes: Least altd -> 34989					(g/100g)		-22.7	-0.0	0.5	0.4	-0.0	1.2	-0.5	-0.7	-1.9	-0.0	0.5	1.3	-22	Nett							
Mass Changes: Least altd -> 34990					(g/100g)		23.8	0.0	0.7	0.9	0.1	0.8	-0.6	-0.6	1.7	0.0	0.7	-0.2	27	Nett							
Mass Changes: Least altd -> Most altered					(g/100g)		7.7	-0.0	0.7	-1.1	-0.0	-0.4	-0.2	-2.2	5.6	-0.0	0.4	-0.4	10	Nett							
PANCON (Alras, 1987)																											
19848	NPP215	50.6					74.20	0.19	10.50	0.88	0.03	0.05	1.37	0.37	9.10	0.10		1.81	98.60	84	5	70	8	26	135	0.53	8.4
19849	NPP215	72.8					75.90	0.23	12.70	0.52	0.04	0.11	0.78	5.50	3.08	0.10		1.07	100.03	34	14	145	10	32	180	0.43	7.7
19850	NPP215	125.4					60.40	0.34	20.10	1.10	0.05	0.66	1.69	6.40	4.14	0.08		3.12	98.08	37	22	150	12	44	250	0.24	8.2
Mass Changes: 19849 -> 19848					(g/100g)		23.0	0.0	1.3	0.7	0.0	-0.0	1.0	-5.0	9.1	0.0		1.3	31	Nett							
Mass Changes: 19849 -> 19850							-32.4	0.0	1.8	0.3	-0.0	0.4	0.4	-0.9	-0.1	-0.0	0.0	1.2	-29	Nett							
BILLITON (Randell, 1991b)																											
16940							75.10	0.32	12.20	0.80	0.01	0.55	0.88	2.42	4.56	0.29		1.88	99.01	61		96	11	16	125	0.91	15.3
16941							75.30	0.35	12.50	1.91	0.03	0.92	0.82	0.24	4.18	0.26		3.08	99.59	83		30	10	22	155	0.74	13.5
14898		3768400	3970400				81.80	0.11	8.93	1.62	0.24	0.62	0.05	1.42	2.19	0.00			96.99	66		84	12	21	174	0.00	3.8

23804

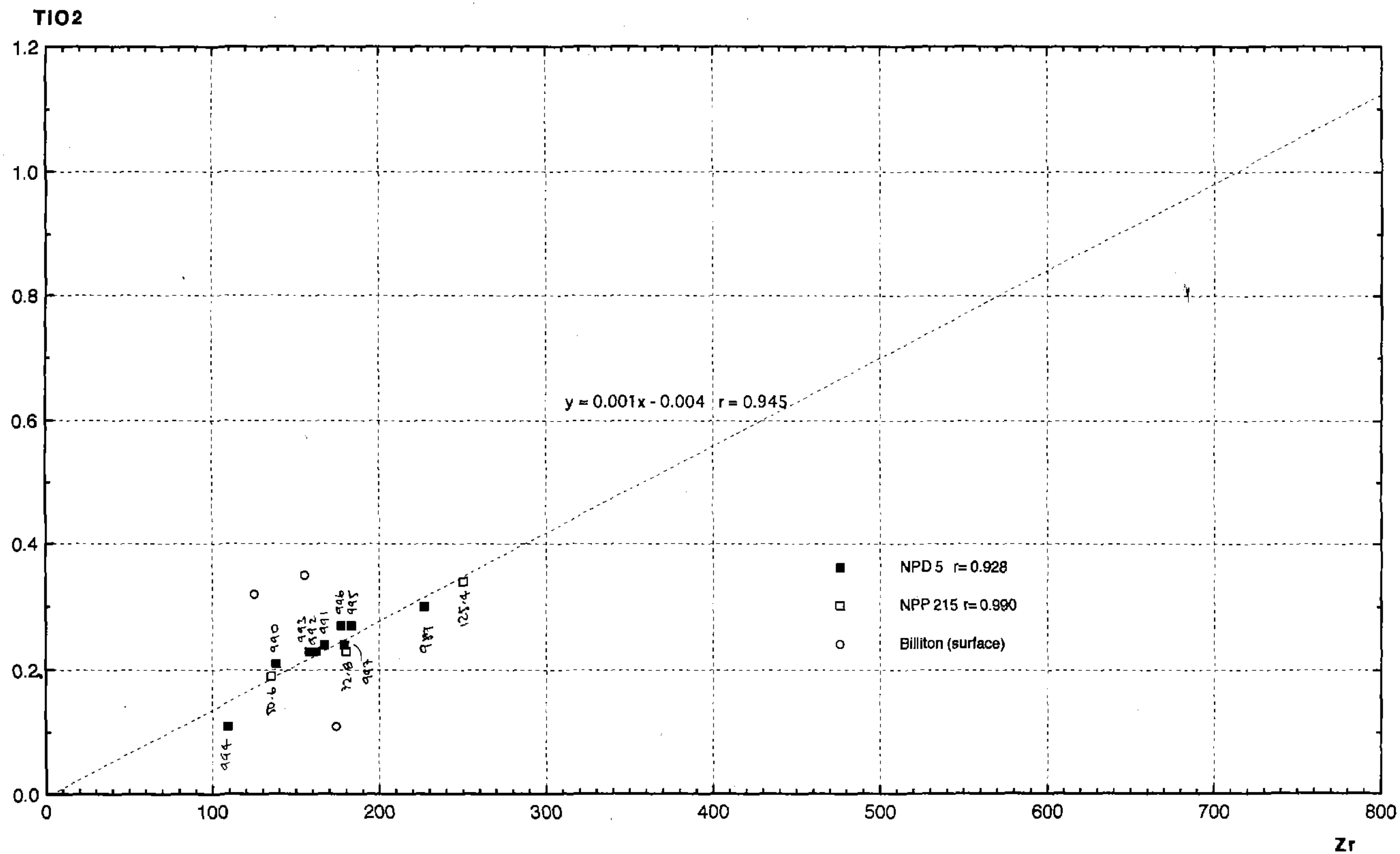


Figure 34 TiO2-Zr scatterplot of North Pinnacles rhyolite samples

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98-4133
VOL 3 of 3

RGC Exploration

ACN 001 426 946

ANNUAL REPORT

TASMANIAN BASE METALS PROJECT

EL47/96

BOCO SIDING / NORTH PINNACLES

Vol 3 of 3
Text and Appendices 1-3

HELD BY: RGC EXPLORATION PTY LTD

MANAGER & OPERATOR: RGC EXPLORATION PTY LTD

AUTHOR(s):Adam Elliston

24 March, 1998

PROSPECTS: Boco Siding - North Pinnacles

MAP SHEETS:	**1:25,000: Block**	**1:100,000: Sophia**
GEOGRAPHIC COORDS	**Min East: 377000mE** **Min North: 5384000mN**	**Max East: 385000mE** **Max North: 5391000mN**

COMMODITY(s): Pb, Zn, Cu, Au, Ag

KEY WORDS: Boco Siding, North Pinnacles, Alteration, Volcanic Massive Sulphides, Tyndall Group Correlates

Distribution:

- **RGC Exploration Information Centre Reference:**
- **RGC Exploration Zeehan**

APPX 5 of 98-4133 233113

Volcanic Facies and Hydrothermal Alteration at the Boco Prospect

EL 47/96

Tasmania

For RGC Exploration Pty Ltd
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By W. Herrmann
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57 Webberleys Road FORTH TAS 7310

Date 20 August, 1997

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1 SUMMARY

A thorough re-examination of diamond drill core from the Boco prospect has indicated that the volcanic facies are dominantly resedimented rhyolitic pumice breccia/s intruded by and interlayered with voluminous sills, domes and flows of coherent rhyolite, probably emplaced in a subaqueous rhyolitic caldera setting, typical of the Central Volcanic Complex. The most likely interpretation is that the facies assemblage is upright and dipping at a low angle to the northwest. The structural set up is uncertain because of conflicting sedimentary facing indicators and general difficulty in correlation of the massive and compositionally non-distinctive volcanic units.

The rhyolitic facies assemblage is host to a cross cutting, sub vertical, pipe like synvolcanic quartz-sericite-pyrite alteration zone which, prior to deformation and ~600m dextral fault offset, had a roughly cylindrical form about 500m in diameter. The alteration zone is known to extend sub vertically at least 400m below the present erosion surface, which truncates it at a stratigraphic level about 150m (or possibly upto 450m) below the probably conformable contact between CVC volcanics and the overlying volcano-sedimentary part of the Dundas Group. There is slender, indirect evidence that this contact is stratigraphically equivalent to the Rosebery-Hercules favourable horizon.

The alteration system appears to have been relatively focussed but there are no obvious volcanic facies or structurally induced permeability controls on hydrothermal flow. It has not been possible to deduce prospect-wide alteration intensity vectors within the alteration zone, due to a broad range of immobile element concentrations, in both least altered and strongly altered rocks, inferring a phase of non-feldspar destructive, diagenetic? alteration in which some major component mass changes outweighed those due to quartz-sericite-pyrite alteration.

However, on a local scale, it is evident that strong quartz-sericite-pyrite alteration was associated with modest gains of SiO_2, Fe_2O_3 and S and total depletion of Na_2O, comparable to the mass changes estimated for the medial to peripheral zones of the Hellyer and Thalanga footwall alteration systems.

The small mass gains, lack of a well defined pyritic stringer zone and absence of base metals supports an earlier interpretation, based on $\partial^{18}O$ and $\partial^{34}S$ data, that Boco is a weak synvolcanic hydrothermal system that did not achieve temperatures sufficient to transport base metals and produce a VHMS deposit.

Accordingly, there is low exploration potential, for further infill or deep drilling of the Boco system. VHMS potential of the possibly favourable CVC-Dundas Group contact, within EL 47/96, is considered to be moderate to low with a low findability factor.

2 INTRODUCTION

The Boco prospect is centred on an extensive quartz-sericite-pyrite alteration zone located beneath the fluvio-glacial plain at Boco railway siding, in rhyolitic volcanics assigned to the Central Volcanic Complex (CVC) of the Mt Read Volcanics, approximately midway between the Rosebery and Hellyer mines in western Tasmania.

It was subjected to a fairly intensive programme based on gradient array IP and soil geochemical exploration for VHMS deposits, by EZ Co. and CSR, during the late 1970s and mid 1980s. That culminated in drilling of 12 short percussion drill holes and 14 diamond drill holes totalling ~5650m which more or less defined a 1400m x 350m zone of strong pervasive quartz-sericite alteration, characterised by near total Na_2O depletion and a few percent disseminated pyrite, but did not intersect significant base metal mineralisation. Subsequent systematic down hole and surface TEM, RMIP and gravity surveys failed to produce further drilling targets. In 1991, Pasminco drilled an aeromagnetic low anomaly about 2km NNE of Boco (AK1) but intersected only weak alteration and no base metals.

RGC Exploration P/L acquired tenure of $26km^2$ in the Boco-North Pinnacles area under EL 47/96 to explore for VHMS deposits and carried out a detailed literature review of previous exploration results, (Herrmann, 1997a). That review concluded that, despite the substantial amount of previous drilling and some lines of interpretation suggesting the hydrothermal alteration system may have been barren, truncated by erosion or unrelated to sea floor volcanism, the Boco prospect could still have VHMS potential which could be explored by more detailed alteration studies and volcanic facies analysis in an attempt to establish the facing direction and identify favourable horizon/s and alteration vectors.

This report presents the interpretations from a consequent more detailed re-examination of Boco drill core and geochemical data, carried out for RGC under a contract agreement by W.Herrmann.

The re-examination has focussed on detailed re-logging and preparation of graphic core logs, of the extant Boco drill core[1] and interpretation of 33 new whole rock analyses as well as previous whole rock, Na_2O, S and $\partial^{18}O$ geochemical data.

3 VOLCANIC FACIES and STRUCTURE

3.1 Volcanic facies association

The rocks which host the Boco alteration zone are vastly dominated by massive rhyolitic volcanics. Their massive character, lack of compositional contrast and the significant blurring effects of extensive hydrothermal alteration, have considerably frustrated my efforts to interpret a volcanic facies and structural model.

The most volumetrically abundant rocks are sparsely feldspar phyric to aphyric coherent rhyolites (<3%, 1-3mm tabular plagioclase phenocrysts in fine grained aphanitic siliceous pink to red- grey matrix) which exist in individual units from a few metres upto at least 200m in (downhole) thickness (eg: BBP278). They are dominantly massive; in places they have faint planar flow banding or well developed perlitic and spherulitic devitrification fabrics and local pseudoclastic fabrics developed from domainal silicification of perlitic groundmass. Occasional peperitic contacts against volcaniclastic units suggest a partly intrusive mode of emplacement although I have not found any instances where both (upper and lower) contacts are peperitic. On the other hand, locally developed monomict hyaloclastite breccias and the fairly common presence of similar looking sparsely feldspar phyric rhyolite clasts in polymict and/or pumiceous breccias, indicate that the coherent rhyolites were at least partly eruptive. These coherent rhyolites were probably

[1] Most of the Boco drill core is in surprisingly good condition and is currently stored at Pasminco's Tullah Core Compound. All holes except BBP209 were relogged; all but the top two trays of BBP209 (in glacial cover) appear to have been lost during transfer from the Rosebery Mine core shed.

emplaced as a complex assemblage of overlapping flows, small domes and sub volcanic intrusives.

Feldspar porphyritic rhyolites (≥5% plagioclase phenocrysts, often glomeroporphyritic) appear to be volumetrically minor, usually exist as thin units upto a few tens of metres thick and are inferred to have been emplaced mainly as synvolcanic sills or dykes.

Monomict rhyolitic "hyaloclastite" breccias are relatively restricted (in BBPs 207, 246, 247 and some thin zones in BBP 278). Resedimented volcaniclastic breccias composed of polymictic mixtures of rhyolitic lithics, pumice clasts and locally, volcaniclastic siltstone intraclasts, are more widespread. These polymict breccias are volumetrically very subordinate to coherent rhyolite and typically exist in massive to crudely stratified units upto a few tens of metres thick, (eg: upper part of BBP253) or as thin screens between sill like intrusives? of coherent rhyolite (eg: upper part of BBP 250). They are typically quite rich in juvenile, angular to irregular shaped clasts, mostly in the 5-50mm size range, which are unsorted or crudely graded in clast size or abundance, and invariably matrix supported in a murky "ashy" siliceous, pumiceous or (least commonly) sandy groundmass. The dominantly massive bedforms, matrix support and angularity of clasts, and apparent compositional relationship to the coherent rhyolites, indicates more or less syneruptive deposition of largely quench fragmented rhyolite and some pyroclastic detritus by subaqueous mass flows in a fairly proximal volcanic setting.

In a few places, polymictic breccias are associated with diffusely bedded, graded or thin bedded lithic volcaniclastic sandstone and minor siltstone. They are best represented in BBPs 208, 251 and 280 where individual graded units range from a couple of metres to about 15m in thickness but are still relatively subordinate in volume and are interpreted to represent the sandy tops or slightly more distal parts of subaqueous volcaniclastic mass flows.

The most abundant volcaniclastic deposits are tube pumice rich breccias of rhyolitic composition which exist in massive units usually at least 20m and upto ~100m in downhole thickness (eg: BBP 279). Their fabrics are commonly well preserved, even in moderately altered zones, with closely packed, disoriented clasts of tube pumice from a few mm to ~50mm in size, some greenish sericitic compacted pumiceous "fiamme" and variable amounts of (not ubiquitous) juvenile rhyolitic clasts in a typically grey murky matrix. Some units are crudely graded in terms of lithic clast content and some pumiceous sequences have thin graded pumiceous sandstone interbeds probably representing the winnowed tops of individual depositional units. They are interpreted to be more or less syneruptive deposits, mainly of resedimented pumiceous pyroclastics, deposited by subaqueous mass flow processes. In only one case (BBP 253, 202-212m) there are possible relict spherulites in pumice breccia, suggesting high temperature devitrification, possibly in a partly welded pumice deposit.

The apparent close compositional relationship between coherent rhyolites and pumice breccias (see also Ch. 4) suggests a comagmatic relationship. The coherent sills and lava domes may represent the devolatilised magmas intruded into and erupted onto a sequence of pumiceous mass flow deposits originating from the preceding phase of explosive eruption. A proximal subaqueous rhyolitic caldera setting, similar to that interpreted for much of the CVC and particularly the Rosebery-Hercules footwall sequence (Allen, 1994), is probably applicable for the Boco area. Very limited geochemical data (analysis 100610, Table 1) suggests that the fine grained sandy-silty volcaniclastics in BBP 280 have a similar rhyolitic source and represent locally resedimented materials.

Persistent units of medial-distal volcano sedimentary facies association or ambient suspension sediments appear to be absent in the Boco prospect area. Likewise, there is no recognisable major compositional break in the volcanics at Boco; apart from minor mafic and dacitic intrusives virtually all of the rocks are rhyolitic (with a narrow range of Ti/Zr ratios between 5 and 8).

The only exception appears to be the east facing sequence of volcaniclastics in BBP208 (the southeastern most hole, about 700m outside the Boco alteration zone) which includes pumiceous lithic sandstone and breccias containing feldspar phyric dacite clasts and a ~20m thick coherent dacite. The extent of this dacitic part of the sequence and its stratigraphic relationship with the Boco rhyolites is uncertain.

Virtually all the Boco drill holes intersected several to numerous short intervals of coherent mafic and intermediate rocks ranging from medium grained holocrystalline dolerite, through fine grained amygdaloidal basalt to feldspar porphyritic-glomeroporphyritic andesite. These have invariably been interpreted as thin intrusive sills and/or dykes. They commonly have finer grained quenched or more amygdaloidal margins and sharp intrusive contacts, and sometimes include spalled fragments of the wall rock. The thickest of them are holocrystalline dolerites in (downhole) intercepts of upto 45m in the southern holes BBPs 246, 247, 248 and 253.

Similar intercepts of dolerite at about the 200m level in BBPs 246 and 247 suggest a sub horizontal sill like form but, in general, the orientation of these mafic intrusives is unconstrained. They do not appear to be very regular or persistent. Rare examples of possible peperitic mafic intrusive breccias (eg: BBP279, 259m; BBP253, 180m) suggest that they were partly emplaced into unlithified volcaniclastics, ie: they were probably more or less syn-volcanic.

Limited whole rock geochemical data (of questionable accuracy) from six mafic intrusives in BBPs 278, 279 & 280 (Figure 11) indicates that the fresh basalts and andesites have high P_2O_5/TiO_2 ratios ~0.9 and 0.4, respectively. The two most mafic samples fall in the compositional range occupied by shoshonitic Suite III mafics of the Que-Hellyer Volcanics, (Crawford et al., 1992).

Feldspar phyric dacite sills of similar form exist in BBPs 208, 253, 279 & 280.

3.2 Volcano-stratigraphic facing and Structure

A few reliable, and some doubtful, facings have been interpreted from bedded and graded volcaniclastic units intersected in several drill holes. These are shown on the graphic logs and cross sections[2] in Figures 2 to 10.

Unfortunately the facings are too few and far between, none of the core was oriented and the general difficulty of correlating units from hole to hole and section to section, has made it impossible to arrive at a convincing and geologically realistic structural model.

The most reliable facing indicators (in order of increasing northing) are located at:

Hole	Depth	Type	Bedding/LAC ø°	Facing Direction
BBP208	20, 70, 150m	Graded breccia & Sst	~45° (30-60°)	?
BBP253	60-120m	Lithic content of breccias	Compaction fol.~45°	?
BBP246	130m	Graded PumBx->Sst	?	West
BBP242	320m	" "	60-70°	West
BBP280	320m	Graded Sst->Slst	30-40°	?
BBP251	275, 342 & 375m	Graded Breccia & Sst	45°	West or down?
BBP279	460-490m	Graded lithics in PumBx	Compaction fol.~40°	" "

Figure 2, shows alternative interpretations for geological sections based on the observed bedding to core angles which, in general, indicate either fairly steep or fairly shallow westerly dips; assuming that the sections are roughly perpendicular to strike, as indicated by the NNE trend of the CVC-Dundas Group contact west of Boco Siding. If the strike is otherwise, then moderate NE or SE dips are possible.

[2] The 1:1000 and 1:5000 scale cross sections in Figures 2 to 10 are drawn on section lines bearing approximately 285° AMG, sub-parallel to the majority of the drill hole traces. For the purposes of this report and to provide a relational framework for the cross sections I have used an arbitrary grid with a 1000E baseline running at 015° AMG roughly through the middle of the prospect as defined by the existing drill holes. This is a reasonable approximation to the general strike trend as indicated by the contact between the CVC and Dundas Group immediately northwest of Boco Siding. The "virtual grid" has no particular relationship to the various exploration grids pegged and surveyed by previous exploration groups although the bearings are roughly similar to that used for EZ Co's.1983 UTEM survey.

The sections on the left side of Figure 2 show interpretations based on flattish westerly dips, which satisfactorily accommodate all the uphole facings in the southern holes from 200N to 1250N but run into a major problem on 1450N and 1650N where facings in BBPs 251 and 279 are down hole. This kind of local overturning is not credible for a flat lying sequence.

The down hole facings in BBP251 favour a steeply west dipping sequence (as represented in the sections on the right side of Figure 2) but this interpretation is difficult to reconcile with the uphole (steeply overturned easterly?) facings in BBP280, on the next section 200m to the south. The same difficulty arises between sections 500N and 200N where the steep westerly dipping model is confounded by westerly facing in BBP246 and easterly facings in BBPs 208 & 253. The facings in BBP253 are doubtful and there may be room for an antiform between BBP 253 and BBP 208, but there is no other evidence for it.

Whatever model is considered, the contrary facings in similar volcaniclastic sequences intersected 200m apart in BBPs 251 and 280, are irreconcilable. Facings in one or the other of these holes, have to be invalid.

If the facings in BBPs 280 and 253 are ignored then the remaining facings are consistent with the steeply west dipping model with a tight antiform invoked for the southeastern corner between BBPs 253 and 208. However, the Boco volcanics, including the strongly altered and pumiceous lithofacies, generally do not have well developed cleavage and there is little evidence of ductile strain which might be expected in tightly folded rocks.

Alternatively, if the interpreted downhole facings in BBPs 251 & 279 are discounted, all the other observed facings are consistent with the shallow westerly dipping model. The cross sections interpreted for the shallow dipping model in Figure 2 are geologically reasonable but there is a possible problem on section 1650N where limited geochemical data suggests that the pumice breccias in BBP279 are compositionally different from those in BBP254 and 251 (see: Ch. 4.2).

The shallow west dipping model is probably more consistent with the moderate (25°-58°) northwesterly dips recorded in Dundas Group sediments nearby to the NW of Boco (Corbett & McNeill, 1986; Herrmann, 1987) and Selley's (1992) interpretation of high structural competence of the CVC relative to the enclosing sedimentary sequences.

There is no persistent, compositionally or texturally distinctive, marker unit or facies association to enable a more rigorous structural-stratigraphic interpretation[3]. I currently favour the shallow west dipping structural model (a revision of my 1987 preference) but the evidence is far from overwhelming.

The most readily correlated structural feature is the brittle fault zone associated with a broad zone of silicified cataclasite and quartz-carbonate-(chlorite) veining in holes BBP207, 242 and 246. This fault appears to trend ~20°AMG and dip at ~80° to the east and is probably traceable through broad fracture zones (without major silicification) to the north. In both BBP242 and 246, there is no lithological change across the fault which suggests it has no great dip slip displacement.

Its apparent control on the western boundary of the pervasive quartz-sericite-pyrite alteration zone on section 750N (BBP242), the eastern boundary of alteration on 1450N and 1650N (BBPs 250 & 279) and the pinching out of the alteration zone in the middle parts (1050N, BBP248), is consistent with a dextral strike slip displacement of ~500m (Herrmann, 1987).

The inferred dextral movement is compatible to that of a major "brittle-ductile" shear zone interpreted by Selley (1992) to trend NE from the Pinnacles-Burns Peak area. The latter has no aeromagnetic expression but is sub parallel to a distinct magnetic and topographic linear along Boco Creek south west of the Boco Prospect (the Boco Shear Zone of Leaman, 1991b). The orientation of the fault intersected in the drill holes corresponds to the secondary synthetic shear

[3] A few sticks of oriented core from the bedded volcaniclastic sequences in BBPs 208, 251 & 280 would have substantially reduced the uncertainties. Given the depth of unconsolidated glacial overburden and the mainly BQ hole sizes, it would not be straightforward to now run back into these holes and obtain oriented cores by wedging off.

("P") direction in a dextral strike slip system. It possibly extends along a weaker NNE magnetic linear to the magnetic low anomaly tested by drill hole AK1.

The Pinnacles-Burns Peak NE shear zone (Selley, op. cit.) apparently has no significant displacement but it formed a locus for hydrothermal fluids and developed [alteration] "pods of quartz and sericite ... connected by a series of oblique synthetic fractures". Selley's (op. cit.) interpretation links the formation of NE trending folds (in Dundas Group sediments) in the hanging wall (east) of the Rosebery fault with dextral simple shear along NE trending zones by the mechanism of wrench folding.

These structures are unequivocally Devonian; Selley's interpretation for Pinnacles-Burns Peak implies a Devonian hydrothermal and alteration event. However, as discussed in Ch. 4.2, it is likely that the Boco pervasive alteration zone was formed by a syn-volcanic (Cambrian) hydrothermal system and has been dextrally offset during Devonian deformation.

4 ALTERATION

4.1 Alteration Zone Morphology

The Boco Alteration Zone is characterised by an assemblage of microcrystalline quartz, sericite and disseminated pyrite which has pervasively replaced felsic volcanics of both coherent and volcaniclastic facies. Pyrite content is generally around 1-3%, very locally upto about 10%, (by volume) existing mainly as very fine disseminated specks, in places as disseminated blebs occupying former feldspar crystal sites or as fine veinlets replacing flow laminae or perlitic devitrification cracks in coherent rhyolites. Well developed pyritic stringer vein networks are negligible.

The alteration generally is quite pervasive and continuous, with total plagioclase destruction across broad zones, and no megascopically recognisable internal zonation except that it tends to be patchy around the fringes. Primary volcanic fabrics such as perlitic devitrification fractures and delicate tube pumice clasts are, in parts, extremely well preserved despite strong alteration. Elsewhere (eg: in BBPs 250 and 280) pervasive quartz-sericite-pyrite alteration has "detextured" the rocks to a massive, fine granular siliceous mosaic which effectively defies facies definition; I have generally interpreted these "detextured" sections as being altered coherent sparsely feldspar phyric rhyolite on account of their massive, unvarying fabric.

The boundaries of the alteration zone are not fully constrained by the existing drill holes. In BBP242 (and probably also in BBP207 which ended in the fault zone) the alteration zone abruptly terminates westwards against the 020° trending fault (discussed in Ch. 3.2) but the eastern limit is undefined. In BBP246, 250m further south, the western boundary of alteration is about 30m east of the fault and the eastern limit of strong alteration in BBP247 indicates that it is ~120m wide at ~200m below surface[4]. The southern extent and the dip of the boundaries is not well constrained but, if the geometry is simple, the alteration zone here probably pitches steeply to the east.

North of BBP280, the eastern boundary of alteration is determined by the northward projection of the 020° fault[5] in BBP 250 (very abruptly) and in BBP279 (less obviously). The only constraint on the western boundary is its projection from BBP254 to BBP279 which suggests it pitches at ~50° east.

The known extent of the alteration zone is thus generally consistent with a moderately to steeply east pitching elliptical pipe, originally of ~600m x 400m in plan dimensions, which has been

[4] In BBP247, there is a patch of 1-3% disseminated pyrite at 285-325m but the eastern limit of the main alteration zone is interpreted to be where major Na_2O depletion cuts out at about 155m.

[5] The massive quartz-(carbonate-chlorite) alteration and veining characteristic of the 020° fault zone in BBPs 207, 242 & 246 was not observed in the northern holes but in every case there is a significant fault or fault zone in about the right location to suggest that it persists northward.

bisected and dextrally offset about 600m by the 020° fault (Figure 1). It extends to at least 400m vertically below surface.

Unaltered rocks in BBP253 infer that the alteration zone does not extend very far south of BBP246 & 247 but the northern end is not tightly constrained. There is a possibility that it extends some distance to the north in the untested zone between unaltered rhyolites in (percussion holes) BS 10 & 11 and outcrops on Boco Road near 383300E 5387100N.

Depending on which structural model is preferred, the steeply east pitching alteration pipe either squarely cuts across the volcano-stratigraphy or transects it at a low angle. However, there is no clear facies-permeability control on the location or intensity of alteration. Some of the most pyritic zones are in volcaniclastics (eg: BBP 251, 270m; BBP242, 300m) but there are also extensive zones of total Na_2O depletion in coherent rhyolites.

On a local scale (for instance: on the western fringe of alteration in the lower part of BBP254) there may have been some coherent=low permeability controls on hydrothermal flow and alteration intensity but, in general, the hydrothermal system seems to have been fairly resolute in reacting pervasively with whatever facies lay in its path[6].

Given the great contrasts in permeability which would be expected in a sequence dominated by pumice breccias and glassy coherent rhyolite, this rather surprising observation suggests that substantial diagenetic compaction and siliceous? pore space filling reduced the permeability of volcaniclastic breccias prior to peak hydrothermal activity. Fracture permeability or major structural brecciation does not seem to have provided an overall control on pervasive quartz-sericite-pyrite alteration.

I remain puzzled by the relatively focussed nature of the Boco alteration system. There are no clear exploration implications, in regard to predicting which volcanic facies and structural settings may host other, related alteration systems.

Regardless of which structural model (shallow or steeply dipping) is applied, it is apparent that the system is upright. In the immediate Boco area, it has been "unroofed" by erosion; ie: there is no indication, in the drill holes, of a palaeo sea floor horizon marking a contrasting footwall-hangingwall style of alteration, or at which hydrothermal exhalative deposition may have occurred.

4.2 Mobile component mass changes

4.2.1 Boco quartz-sericite-pyrite alteration

The most obvious geochemical changes associated with the Boco alteration system are broad zones of major Na_2O, CaO and Sr depletion (attributable to plagioclase feldspar destruction) and sulphur addition[7]. This is evident in the extensive analytical data assembled by Sainty (1984) from EZ Co's. drill holes BBPs: 207, 242, 246, 247, 248, 250, 251 & 254; from which the Na_2O and S analyses are reproduced as line graphs on the 1:1000 drill hole sections in Figures 3 to 10. There are broad zones of <0.2% Na_2O with surprisingly abrupt boundaries at the fringe of the alteration zone, against background levels of ~2-3%. Na_2O depletion does not seem to be gradational.

In general, there is a negative correlation between Na_2O and S indicating that pyritisation accompanied feldspar destruction but there are some surprising exceptions (eg: BBP 247, 300-325m; BBP251, 185-215m) where moderate levels of Na_2O and S co-exist.

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[6] Frequent exceptions exist within the zone of pervasive alteration in the mafic intrusives which are mostly unaltered and indicate intrusion after the hydrothermal alteration event; mafic intrusives between 160-180m in BBP251 contain xenoliths of quartz-sericite-pyrite altered rhyolite. This is not, however, always the case and there are several similar textured fine grained basaltic dykes, within pervasively altered zones in BBPs 247, which are also pervasively sericitised and enclose pyrite veinlets. The implications are that intrusion of mafic dykes/sills partly preceded, but largely post dated, pervasive alteration.

[7] CaO depletion is not as clear cut, probably due to overprinting by carbonate vein networks.

Additional[8] wholerock major and immobile element analyses were acquired as part of this study, in an attempt to determine the major component mass changes due to alteration, and to check for regular zonation which could infer "alteration vectors" for exploration.
The data are listed in Table 1, sorted data in Table 2, and a background explanation is given in Appendix III, on the method of calculating mass changes using Zr as an immobile monitor.

The objective is to compare altered and least altered compositions of uniform or equivalent volcanic units. This has not been straightforward at Boco due to the complexity of the volcanic facies assemblage and difficulty of correlation.

The TiO_2-Zr data, plotted in Figure 12, indicates that all samples of aphyric rhyolites, sparsely feldspar phyric rhyolites and pumice breccias which dominate the Boco volcanics (Groups A,B,D), occupy a narrow range of Ti/Zr (6-8) and could be regarded as more or less co-magmatic, or at least, derived from similar melting sources. The single sample of ashy siltstone has a similar ratio, consistent with the interpretation that the subordinate fine grained volcaniclastics are locally derived. The feldspar porphyritic coherent rhyolites have a slightly greater Ti/Zr range (5-8) and the single sample of pumiceous sandstone with dacitic lithic clasts, from BBP208 in the south eastern part of the prospect, is distinctly different at Ti/Zr=10.3.

The calculated linear regression for all the rhyolitic samples (coherent and volcaniclastic, Groups A to E) intersects the TiO_2 axis at 0.02% and has a correlation factor $r = 0.90$. The Pumice breccias (Group D) fit a linear regression which passes exactly through the origin of the plot and has a correlation of $r = 0.97$. These highly correlated linear trends, of least altered and altered samples, are consistent with the rocks being co-magmatic and satisfy the (MacLean and Barrett,1993) test that <u>TiO_2 and Zr were essentially immobile during alteration.</u> The broader scatter in the Al_2O_3-TiO_2 plot suggests greater primary variation in Al_2O_3 (possibly due to variable feldspar content) or slight mobility, even though Al_2O_3 is typically fairly immobile in VHMS footwall alteration systems.

However, on the TiO_2-Zr plot, there is a disconcertingly wide spread <u>along</u> the "alteration line" and a complete overlap of data points for the least altered and altered samples, of coherent and pumice breccia groups alike. This makes it impossible to determine prospect wide "least altered precursor" compositions, needed to calculate major mobile component mass changes due to hydrothermal alteration.

Given the confidence in the precision of these analyses[9], it must be concluded that either:

a) there were primary differences in TiO_2 and Zr (but similar Ti/Zr ratios!) between separate eruptive units - I cannot think of a magmatic process to account for this;

or:

b) there was a phase of non plagioclase destructive (diagenetic??) alteration which involved large nett mass changes.

Closer consideration of the available TiO_2-Zr data (facilitated by the expanded Zr axis in Figure 14) reveals that there is a compositional dichotomy amongst the pumice breccias: all samples with >270ppm Zr are from holes BBP 251 & 254 and all samples with ≤240ppm Zr are from BBPs 253, 279 & 280; both groups include least altered and altered samples. A comparison between the <u>mean</u> compositions of all least altered pumice breccias from both high and low Zr groups (disregarding the altered samples with AI>75) with the <u>mean</u> composition of the least altered pumice breccias from the high Zr group, indicates it would require a nett mass change of -18g/100g, mainly from SiO_2 loss, to achieve such a shift in Zr content (Table 3). Obviously, the changes could be even greater than that, if the precursor Zr content was (fairly likely) different from the mean applied.

[8] Thirty two previous wholerock analyses from BBPs 278, 279 & 280 (reported by Williams, 1985) were deemed to be not useful for this purpose due to suspected inaccuracies in the critical Zr data and because most of them were of relatively unaltered rocks from outside the quartz-sericite-pyrite alteration zone.

[9] Analysis No. 263234 of (Thalanga) standard rhyolite RH1, within this batch, produced results within the range of five previous Analabs assays of this standard, using the same methods. TiO_2 and Zr values for 263234 are very close to the means of previous analyses: TiO_2: 0.08 cf. mean 0.079, σ 0.002 (%); Zr: 140 cf. mean 137, σ 2 (ppm).

Non feldspar destructive alteration involving mass changes of this order would be a fairly interesting field for investigation -- it could reveal something about the low temperature "recharge" zones of synvolcanic hydrothermal systems or diagenetic processes -- but the complexity and low correlatability of the Boco volcanic facies assemblage is not favourable for this type of study.

There seems to be a loose spatial control, insofar as the >270 Zr group are from the northwestern most parts of the alteration zone.
If the Zr dichotomy is primary, it could indicate that the pumice breccias in BBP279 are from a different eruptive unit/s than those in BBP 251 & 254 (even though they look quite similar). This could be accommodated by either the steeply west dipping structural model or, less readily, the shallow dipping model -- the latter case implying a correlation between the pumice breccia units in the upper and lower parts of BBP279, possibly offset by the 020° Fault.

Alternatively, it could be speculated that this north western part is a remnant of an early or peripheral zone of SiO_2 depletion which was subsequently partly overprinted by feldspar destructive quartz-sericite-pyrite alteration, of insufficient intensity to replenish the original mass loss. A possible (but more complex) analogy for this exists in the Hellyer footwall alteration system (Gemmell & Large, 1992) where the "chlorite zone", partly enclosing the "siliceous core", is apparently depleted in SiO_2 (-13g/100g) although, paradoxically, the outer "sericite" and "stringer envelope" zones were also enriched in SiO_2 (~8-13g/100g).

Whatever the cause, the implication for Boco is that estimation of zonal mass changes is severely impeded by the difficulty of determining least altered precursor compositions, and it can only be attempted on a small scale.

Comparison of pumice breccias, intra BBP254, indicates that progressive? alteration from the least altered sample near the end of the hole (263218) to moderately altered samples (263216 &263217) involves mass changes of about -9g/100gSiO_2, -2g/100gCaO, -1g/100gNa_2O, 1g/100gS and -1g/100gCO_2 for a nett change of -12g/100g (Table 3). More intense alteration, from moderately altered to strongly altered (263215), involves changes of about 9g/100gSiO_2, -1g/100gNa_2O and 0.3g/100gS for a nett gain of 8g/100g. That is: (if this progression is real) CaO is completely removed and Na_2O partly removed with accompanying silica loss and sulphur gain, in the incipient stage of alteration and, in the progression to more intense alteration, the remaining Na_2O is lost and the SiO_2 substantially replenished.

The overall change, from least altered to most altered, thus involves a fairly minor nett mass change of -5g/100g, mainly due to loss of CaO and Na_2O. A similar pattern of mass changes, although of smaller magnitude, is apparent in the compositional progression from least altered to most altered pumice breccias in the lower part of BBP279 and also in weakly altered to strongly altered samples from BBP251, (Table 3).
There is notably little change in Fe_2O_3; it suggests that the hydrothermal system did not introduce much iron and that pyrite may have been formed by sulphidation of existing iron. This is unlike some VHMS systems , such as Hellyer and Thalanga, where there is a strong positive correlation between sulphur and iron mass gains.

However, on a very local scale and outside the pyritic alteration zone, comparison of adjoining pink and grey patches in BBP253 (263231 & 263232) indicates significant differences in SiO_2, Al_2O_3, Fe_2O_3, Na_2O and K_2O contents suggesting mass transfers (from pink to grey patches) of about 25g/100g, -2g/100g, 1g/100g, -5g/100g and 4g/100g, respectively, for a nett gain of ~23g/100g! There is negligible sulphur or pyrite in these rocks; there appears to have been a local swap of Na_2O and K_2O, major SiO_2 transfer and worrisome mobility of Al_2O_3.

The only comforts to be drawn from this data subset are:
* The consistent Ti/Zr ratios (6.4 & 6.5; within analytical precision) supporting the notion that TiO_2 and Zr were immobile and that pumice breccias had reasonable primary compositional homogeneity.
* The close correspondence of the mean composition of samples 263231 & 263232 and the mean composition of least altered samples in BBP279 (263203 & 263204) which are comparable "low Zr" pumice breccias, but not necessarily from the same emplacement unit. This suggests that the patchy pink and grey alteration in BBP253 pumice breccias (and quite typical elsewhere)

occurred on a local, sub-metre, scale.
A "hypothetical" calculation of mass changes involved, in transforming the mean of 263231 & 263232 (BBP253) to the mean of 263203 & 263204 (BBP279), implies losses of about 5g/100gSiO_2 and 1g/100gNa_2O which is consistent with the pattern of changes due to incipient? alteration already noted, (Table 3).

However, the small scale mass changes vastly outweigh those due to feldspar destructive quartz-sericite-pyrite alteration and cast grave doubt on the validity of interpreting broad scale alteration zonation from calculated mass changes, at least in pumice breccias, in this environment.

Nevertheless, an examination of analyses of aphyric rhyolites[10] (Group A, Table 2) suggests a similar pattern of mass changes. A progression from least altered-least pyritic, through weakly altered but somewhat pyritic, to totally sericitised plagioclase and most pyritic samples, involves incipient losses of SiO_2 and CaO followed by replenishment of SiO_2 and complete loss of CaO and Na_2O, (Table 3). In this case the outcome is a nett gain of 5g/100g including a gain of 2.4g/100gFe_2O_3 almost matching the 2.9g/100g sulphur gain[11] .

The sparsely feldspar phyric coherent rhyolites (Group B) also appear to show a dichotomy of least altered samples into low Zr and high Zr groups[12]. However, on a local scale in BBP 242, the compositions of least altered, moderately altered but pyritic, and strongly altered samples, shows a similar pattern of SiO_2, CaO and Na_2O losses in incipient alteration and substantial replenishment of the SiO_2 in the more intense zones of feldspar destruction and pyritisation, (Table 3).

The mass changes associated with the more intense (second?) phase of alteration thus observed in Boco pumice breccias and aphyric to sparsely feldspar phyric coherent rhyolites, namely gains of SiO_2, Fe_2O_3, S and complete loss of Na_2O, are similar to those of "medial" zones of footwall alteration beneath the Hellyer and Thalanga massive sulphide deposits.

At Hellyer (Gemmel and Large, 1992) the "sericite zone", peripheral to the "siliceous core", gained about 13g/100gSiO_2 and 5g/100g each of Fe_2O_3 and S and lost ~5g/100gNa_2O (in andesites); this indicates a rather higher pyrite content than Boco.

At Thalanga (Herrmann, 1994), the zone of "moderate" quartz-sericite-chlorite alteration (Group 2) gained about 10g/100gSiO_2 and ~2g/100g each of Fe_2O_3, S and MgO and lost most of its Na_2O ~3g/100g. The Thalanga "moderate" quartz-sericite-chlorite alteration zone encloses restricted, semi stratiform, proximal zones of more intense silicification associated with pyritic stringer veins, and extends at least 200m into the footwall for virtually the entire strike length of the deposit, ~2km.

This general similarity, of the more intense parts of the Boco system with the medial to peripheral parts of the Hellyer and Thalanga footwall alteration zones, is in accord with G.Green's (pers. comm.) interpretation, based on isotopic data, that Boco represents a relatively weak synvolcanic hydrothermal system which never attained fluid temperatures high enough to transport significant amounts of base metals and inorganically reduce sea water sulphate.

The low concentration of base metals in the Boco alteration zone certainly supports this.

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[10] The samples are from diverse locations and drill holes, and the likely intrusive mode of emplacement defies their correlation. However, the very consistent Ti/Zr ratios support the possibility that they were co-magmatic. The Ti/Zr range is 6.8 to 6.9 except for G.Green's sample 100614 at 6.1. The latter is from a different analytical batch but was duplicated by 263230 which has very similar Zr but a difference of 0.02% TiO_2.

[11] If all the sulphur is in pyrite it would require 2.5g/100gFe, equivalent to 3.6g/100gFe_2O_3. As for the pumice breccias discussed above, it is consistent with nearly all of the pre-existing iron in the precursor being converted to pyrite, and then some added: precursor (263230) Fe_2O_3 = 1.57%; 1.57+2.4 ≈ 4, cf. 3.6g/100gFe_2O_3 in Py.

[12] Samples from BBPs 253 & 278 (southern and northernmost holes) are >230ppmZr, all others <220ppm.

The extensive EZ Co. analytical data[13] shows that the zone of strong Na_2O depletion typically carries <20ppmCu, <60ppmPb, <200ppmZn and 0.025ppmAu with anomalous values tending to be sporadic and non systematic.

Metal	Background ppm	Maxima ppm	Comment
Copper	5-20	600 & 890	Associated with patch of semi massive pyrite stringers in BBP251, 82.5-85.7m, no Pb, Zn correlation. Otherwise rarely over 100ppm.
Lead	10-60	710	BBP247, 43-46m, pervasive Q-ser-py alteration (5%Py) in polymictic breccia, assoc 2350 Zn. Sporadic values in 100-200ppm range.
Zinc	25-200	4300	BBP247, 124-127m, Q-ser-py altered mafic dyke adjacent to fault, within pervasive alteration zone. Sporadic values 300-2000ppm fairly frequent; levels of ~600-1600ppmZn in places associated with chloritic mafic intrusives. Ends of BBPs 251 and 254 seem anomalous in range 400-1500ppm - spatial association with fringes of alteration zone?
Silver	x-2	11.5	BBP207, 80-92m, in Q-ser-py altered rhyolitic breccia, 3-5% Py but no Pb, Zn correlation.
Gold	x-0.025	0.08	BBP254, 295.5-298.5m, a "oncer" in altered pumice breccia. Rare sporadic values 0.03 to 0.05ppm, generally not correlated with base metals except for 0.05ppm Au at BBP251, 85.2-85.7m which coincides with peak Cu value and distinctly anomalous 5.6ppmHg. Hg background <0.1ppm.

4.2.2 AK1 quartz-carbonate-pyrite alteration

The indications from very limited wholerock analyses (Table 1 & 2) from the Animal Creek drill hole AK1, (Kirsner, 1992; summarised in: Herrmann, 1997) are that the zone of weak, patchy, semi pervasive quartz-carbonate-pyrite alteration in coherent rhyolite (AK1, ~100-160m) is associated with modest gains of 6g/100gSiO_2 and 3g/100gNa_2O (Table 3). This apparent albitisation? is not characteristic of VHMS footwall alteration zones and contrasts with the Na_2O depletion of the Boco system.

The extent of the AK1 zone is not known but the style and intensity of alteration is not impressive and I think it does not warrant further follow up.

[13] EZ Co. analysed ~645 split core samples, mostly in contiguous 3m lengths, from the altered zones in BBPs: 207, 242, 246, 247, 248, 250, 251 & 254. Analyses, by ANALABS, included Cu, Pb, Zn, Ag, Fe, Mn, Co, Ni, Ba, Sr, Hg, Na_2O, SiO_2, CaO and S. All samples except those from BBPs 247 & 248 were analysed for Au by fire assay Method 309.

4.2.3 Boco 020° Fault associated alteration

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Comparison of compositions of unaltered sparsely feldspar phyric rhyolite from BBP242, (263228) and the massively silicified, re-brecciated and quartz carbonate veined material in the adjacent 020° fault zone, suggests huge mass changes of about 1300g/100gSiO_2, 70g/100gCaO and 50g/100gCO_2. Na_2O is the only component which appears to have been depleted. Obviously, nett mass gains of ~1400g/100g imply a major volume increase, probably in dilational parts of the fault zone.

This style of silicification and veining is structurally controlled, with sharp contacts, and contains negligible sulphide and much carbonate. It starkly contrasts with the pervasive Boco quartz-sericite-pyrite style of alteration which it appears to transect. The observations are consistent with it being localised along the fault(s?) and unrelated to the synvolcanic hydrothermal system.

The silicified and quartz carbonate veined section in BBP242 (~240-256m) is not anomalous in Au, Hg or base metals and does not have any obvious potential for Henty type or other style of structurally controlled gold deposit.

4.3 Isotope Geochemistry

A cursory $\partial^{34}S$ and $\partial^{18}O$ investigation of the Boco alteration zone was undertaken by Geoff Green in the mid 1980s and briefly reported by Williams, 1985; Green, 1986, and Green & Taheri, 1992.
The five $\partial^{34}S$ analyses are tabled below and fifteen $\partial^{18}O$ analyses are listed in Appendix III. Sample locations are shown on 1:1000 scale cross sections (Figures 3-11).

Sulphur isotope analyses: (from: Williams, 1985)

Hole No	Depth (m)	$\partial^{34}S$ (‰)
BBP246	304.5	+0.2
BBP247	140.2	+4.7
BBP251	93.5	-1.2
"	265.2	-0.7
BBP254	300.4	-0.1

The $\partial^{34}S$ samples were of pyrite from within the Boco quartz-sericite-pyrite alteration zone.
The wholerock $\partial^{18}O$ samples were mostly from outside the alteration zone, from BBPs 253, 278 and 280, representing the southernmost, northernmost and roughly central parts of the prospect, respectively. Accordingly, only two samples, from BBP280 (276.6m & 316.5m), can be considered to represent the alteration zone. The remaining samples do not show strong feldspar destructive quartz-sericite-pyrite alteration.

The range of $\partial^{18}O$ values is: 9.7 to 11.8‰ for least altered samples (mainly comprising samples of coherent rhyolite, a couple of pumice breccia and one mafic intrusive) and 11.5 to 11.7‰ for the altered samples (which are both ashy volcaniclastic sandstone-siltstones).

Green and Taheri (1992) noted the lack of $\partial^{18}O$ contrast between unaltered and altered samples and the lack of lighter values (down to ~6‰) which exist in proximal parts of the Hellyer and Hercules footwall systems, and the notably light $\partial^{34}S$ values which are similar to those of "some other apparently barren pyritic deposits in the Mount Read Volcanics such as Basin Lake, Chester and the Cattley Range prospect.
They concluded that: "The data are compatible with alteration by a fluid of seawater origin but at lower temperatures (<200°C) than those required to inorganically reduce seawater sulphate or to transport sufficient base metals together with H_2S to form an orebody. This would account for the low $\partial^{34}S$ values in the deposit, in that the sulphur was probably leached from the surrounding volcanic rocks."

Although the primary $\partial^{18}O$ values in unaltered felsic volcanics is likely to be in the range 5-10‰ (say ~7.5‰, cf.: Green et al, 1983; Large, 1993) and the seawater would be ~0‰, the relatively high fractionation factors between water and silicate minerals, at low temperatures, can significantly enrich the ^{18}O levels in altered rocks, even at low water to rock ratios.

The graph in Figure 16 (reproduced from Green, 1993) illustrates the relationships between final $\partial^{18}O_{rock}$, water/rock (atomic)[14] ratio and various temperatures calculated for a system where seawater has initial $\partial^{18}O$= 0‰, felsic volcanics have initial wholerock $\partial^{18}O$= 7.5‰ and the wholerock fractionation factor approximates to that of alkali feldspar:
$\Delta^{r}_{w} \approx (2.91*10^{6} / {}^{\circ}K^{2}) - 2.63$

This model was used by Green (1990) to illustrate the Rosebery-Hercules alteration systems; the volcanic facies, rock composition and isotopic parameters are quite appropriate for Boco; none of the rocks contain significant primary phenocrysts of quartz and the known resistance of quartz to ^{18}O re-equilibration can be ignored.

It shows that Boco type $\partial^{18}O_r$ values of ~10 to 12‰ could be produced by:

A: reaction with quite small volumes of seawater (water/rock ratios of ~0.2 to 0.8) at low temperatures ~25-100°C,

or:

B: reaction with quite large volumes of seawater (water/rock ratios of ~10 to >100) at moderate temperatures ~180-200°C. Temperatures higher than ~220°C would result in final $\partial^{18}O_r$ values of <9‰, whatever the water/rock ratio.

Either possibility (or some condition between those extremes) is in accord with the conclusion of Green and Taheri (1992).

However, the lack of $\partial^{18}O$ contrast in unaltered and altered Boco rocks, suggests that both possibilities were operative - it seems unlikely that uniform temperatures and water/rock ratios across the prospect would produce the distinct zone of Na_2O depletion and sulphur enrichment. System A is likely for the cooler peripheral parts of the Boco area, especially where the dominance of coherent rocks (eg: BBP278) would impede hydrothermal flow and keep water/rock ratios low. System B is more applicable for the zones of strong quartz-sericite-pyrite alteration where total plagioclase destruction and moderate SiO_2, CaO and Na_2O mass transfers imply larger volumes of warmer, more reactive, fluids[15].

It is unfortunate then, that we do not have a more comprehensive set of $\partial^{18}O$ data for the altered zone. The existing $\partial^{18}O$ data does not sufficiently represent the alteration zone and is not directly comparable from $\partial^{34}S$ data from different locations. The Green & Taheri (op. cit.) interpretation of the available data is probably correct but may be telling only the peripheral part of the alteration story[16].

If there were steep temperature and fluid/rock ratio gradients in and around the relatively focussed Boco alteration system, it may be possible to map high flow-high temperature zones (of higher prospectivity) by $\partial^{18}O_r$ levels. This could be wishful thinking, given the lack of a recognised discrete pyritic stringer zone, and of limited exploration significance in the likelihood that the Boco system has been unroofed by erosion. Nevertheless, if Boco is to be characterised as a barren system, it would be useful to have $\partial^{18}O$ data from the central parts of the system to compare with

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[14] For Boco rhyolites, the atomic water/rock ratio is about 1.8 times that of the mass water/rock ratio.

[15] Geoff Green (pers. comm., 1997) guessed that pervasive total plagioclase sericitisation and Na_2O removal would require water/rock ratios in the order of 10 or greater.

[16] Geoff Green (pers. comm., 1997) considered the light $\partial^{34}S$ values of Boco, Chester etc. to be the most compelling evidence that they were low temperature systems "that never really got going well enough to transport base metals".

other systems[17].

5 DISCUSSION and EXPLORATION POTENTIAL

A likely, but not unequivocal, interpretation for the Boco geological setting is that it represents part of a subaqueous, rhyolitic caldera? with massive units of proximal resedimented rhyolitic pumice breccia intruded by, and possibly interlayered with, voluminous sills, domes and flows of sparsely feldspar phyric coherent rhyolite. It appears to be upright and dipping at <20° to west-northwest. The composition and facies association is not particularly distinctive and it could probably be comfortably placed anywhere in the Central Volcanic Complex (Corbett, 1992; Allen 1994).

No regionally accepted VHMS favourable horizon has been recognised in the Boco drill core. However, the CVC-Dundas Group contact, a few hundred metres NW of Boco, can be tentatively correlated with the North Pinnacles area. Work by Pasminco Exploration (Poltock, 1994) indicated equivalents of the White Spur Formation, possibly including the distinctive quartz phyric Rosebery-Hercules Hangingwall Sequence as the basal unit, overlies massive coherent rhyolites on either side of the Burns Peak-Pinnacles ridge.

In other words, the CVC-Dundas Group contact near Boco could be volcano-stratigraphically equivalent to the Rosebery-Hercules favourable horizon. This is not a new concept; it was proposed by Randell (1991) and an unsuccessful attempt to drill it was made by Pasminco, further north in AK1, (Kirsner, 1992).

The Boco quartz-sericite-pyrite alteration zone has a roughly cylindrical, subvertical form, ~500m in diameter (prior to deformation), which appears to cut through the volcanic facies sequence and to have been fairly tightly focussed, although fracture or volcanic facies permeability controls are not obvious. Assuming a shallow NW dipping structural model, the alteration zone surfaces about 150m stratigraphically below the CVC-Dundas Group contact[18]. It has a known subvertical (≈stratigraphic?) extent of about 400m and would likely have persisted up sequence to the possible favourable horizon.

$\partial^{18}O$ data from peripheral areas and limited $\partial^{18}O$ and $\partial^{34}S$ data from within the alteration zone are consistent with reaction of felsic volcanics and quite small volumes of seawater at low temperatures; that is: in conditions approximating diagenetic alteration of sub-marine volcanics. However, the near total removal of Na_2O and CaO, addition of upto 2g/100g of sulphur and probable significant mobility of SiO_2, suggests water/rock ratios approaching 10, or greater, for the quartz-sericite-pyrite alteration zone. This could still accommodate the $\partial^{18}O$ and $\partial^{34}S$ data at temperatures below about 200°C.

Silica solubility in hydrothermal fluids below about 300°C is mainly proportional to temperature, (Fournier, 1985). In a subaqueous volcanic setting in which hydrothermal fluid is dominantly of seawater origin: cold seawater encountering hot rock would become under saturated and leach SiO_2 from the rock; conversely a hot fluid which has equilibrated with hot rocks and then passed into a cooler zone would become over saturated and precipitate silica.

A hydrothermal model which could account for the apparent loss of SiO_2 in zones of "moderate" feldspar destructive alteration at Boco, and the apparent SiO_2 gain (or neutralisation) in zones of most intense alteration and pyritisation is proposed as follows:

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[17] ^{18}O isotope analyses are obtainable at Dept. of Earth Sciences, University of Queensland, for $250 per sample. Contact person is Dr. Sue Golding (Tel: 07 33651159). They are running sulphurs at present, then hydrogens, and will be switching to oxygens in late September; analyses of a small batch of samples could be expected by early October, 1997.

[18] If the Boco sequence dips steeply NW then the known alteration system surfaces about 450m stratigraphically below the CVC-Dundas Group contact.

An initial plume of ascending warm evolved seawater hydrothermal fluid induced or entrained circulation of cold seawater in the subsurface which leached SiO_2 from the peripheral parts of the system. As the system increased in intensity and scale, the high temperature zone expanded laterally into the previously SiO_2 depleted periphery, continuing the process of feldspar destruction and depositing SiO_2 and S. This could be have been partly self propagated by silica sealing of permeability in the central zone. SiO_2 depletion of the peripheral zone could also have occured during the waning stage, or "thermal collapse" of the system as shallow circulating cold water invaded incipiently altered fringes.

Apart from Na_2O and CaO depletion, the other major component mass changes in the most intensely altered Boco rocks: gains of SiO_2, Fe_2O_3 and S, are relatively modest in comparison with the proximal parts of other VHMS footwall zones and are more comparable to medial to peripheral zones. The broad and overlapping ranges of TiO_2 and Zr concentrations in both least altered and strongly altered rocks, implying major mass changes during non feldspar destructive diagenetic? alteration, has obscured the major component mass change pattern and I have not been able to infer any prospect scale alteration vectors by this means.

However, what can be interpreted from local alteration mass changes, is consistent with the isotopic interpretation, the lack of well defined pyritic stringer zone/s and the apparent absence of base metals: that the Boco hydrothermal system did not evolve to temperatures high enough to produce an orebody.

It resembles a weak VHMS type footwall alteration system.
Although the drilling to date has been on widely spaced sections (150-300m) the indications do not encourage closer spaced or deeper drilling. The uncertain structural and volcanic facies interpretation is that the system has been unroofed by the present erosion surface and there is no potential for following the system "downstream" (up sequence) to a potential palaeo sea floor horizon. Even though it appears to be a barren system, it would certainly have been of interest to examine the site of exhalation, if any, at the intersection of the alteration pipe and the palaeo sea floor

Perhaps the most positive exploration implication that can be drawn from Boco is that it affirms that synvolcanic hydrothermal system/s were active in the stratigraphic footwall sequence below a possible correlate of the Rosebery-Hercules favourable horizon. There could have been other systems of greater intensity.

The lack of distinction in the Boco facies assemblage and no apparent synvolcanic controls on its location do not help to predict favourable sites for other systems. Most of the eastern part of EL 47/96 is overlain by by thick fluvio-glacial deposits and the bedrock geology is not well known. The greater part of the favourable contact, within EL 47/96, has been covered by Pancontinental's UTEM survey which did not detect significant conductors (Herrmann, 1997) and there are no obvious, untested low magnetic anomalies to indicate additional alteration zones.

Further exploration of this potentially favourable contact would probably come down to regularly spaced stratigraphic drilling and downhole EM, in the hope of recognising footwall alteration zones or geochemical indicators near the favourable horizon. Regional $\partial^{18}O_r$ patterns might provide broad vectors and would be useful to discriminate low temperature alteration zones if any turn up. Given the prominence of massive coherent rhyolites in the Boco-Bulgobac Hill area, the potential for identifying favourable structural settings (eg: growth faults) by stratigraphic thickness variations is remote. This might be more applicable in the layered volcano-sedimentary Dundas Group but, again, would be seriously limited by the lack of exposure.

On the strength of the limited insights gained by the present detailed re-examination of the Boco prospect, I am inclined to downgrade the VHMS prospectivity rating, of the Boco-Bulgobac Hill area in EL47/96, to moderate to low, with a low findability factor.

The northeast strike extension of the CVC-Dundas Group contact, along the Murchison Highway north of Animal Creek, is currently straddled by Pasminco's EL 37/89 and "open ground" to the south, but has been previously covered by BHP-Comstaff's 1987 UTEM survey.

This survey identified a couple of small zones of deep responses with low conductance (among numerous others) which remain untested, near Animal Creek about 1km east of AK1. This area, being free of glacial cover, is more amenable to surface mapping and use of IP to detect shallow pyritic alteration zones and would, I estimate, have moderate to low prospectivity similar to the Boco area.

The prospectivity rating would be enhanced if it could be definitely established, by surface mapping or shallow stratigraphic drilling, that the CVC-Dundas Group contact is stratigraphically equivalent to the Rosebery-Hercules horizon.

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Geoff Green also provided the whole rock $\partial^{18}O$ data in Appendix II and six of the major element analyses in Table 1.

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TABLE 1 Boco Wholerock Geochemical Data.

RGC samples 263201-263234: ANALABS Report No:00009915. Analyses 100602-100614 courtesy of G.Green; written comm., June 1997.

Al = 100(MgO+K2O)÷(MgO+CaO+Na2O+K2O)

*Hole prefix: BBP, unless otherwise indicated

SAMPLE	Hole*	From	To	Description	Gp	SiO2	TiO2	Al2O3	Fe2O3	MnO	MgO	CaO	Na2O	K2O	P2O5	S	CO2	LOI	Total	Ba	Zr	P/Ti	Ti/Zr	Al
					Units	%	%	%	%	%	%	%	%	%	%	%	%	%	%	ppm	ppm	Calc	Calc	Calc
					Method	OX408	OX408	OX408	OX408	OX408	OX408	OX408	OX408	OX408	OX408	OM813	OM812	OX408	OX408	GX401	GX401			
					Detection Limit	0.05	0.01	0.05	0.01	0.01	0.01	0.01	0.05	0.01	0.005	0.00	0.02	0.01		10	5			
263201	279	609.0	610.0	QSPy alt PumBx	D	76.00	0.25	11.90	2.42	0.02	0.53	1.01	0.02	3.85	0.015	1.55	0.70	2.90	99.0	1443	204	0.06	7.3	81
263202	279	622.0	623.0	Pyl wk alt PumBx	D	75.50	0.24	12.40	2.61	0.03	0.56	0.75	1.97	3.11	0.023	1.60	0.48	2.87	100.1	867	214	0.10	6.7	57
263203	279	652.0	652.5	wk alt PumBx	D	75.40	0.24	12.60	2.30	0.04	0.50	0.84	2.51	3.20	0.015	0.31	0.51	1.81	99.5	863	210	0.06	6.9	52
263204	279	693.8	694.0	wk alt PumBx	D	75.40	0.22	12.60	2.54	0.03	0.56	0.64	1.40	4.72	0.016	0.05	2.49	1.92	100.0	1039	201	0.07	6.6	72
263205	AK1	186.9	187.1	flbd spFsp Rhy	B	74.30	0.23	11.80	2.12	0.07	0.87	1.55	2.15	2.73	0.025	0.20	1.83	3.60	99.5	589	193	0.11	7.1	49
263206	AK1	131.2	132.0	wk QPy alt Rhy	B	73.50	0.20	12.40	2.24	0.09	0.53	1.21	5.00	1.92	0.021	0.80	1.50	2.33	99.5	431	175	0.10	6.9	28
263207	AK1	180.3	180.5	wk QPy alt Rhy	B	75.10	0.24	12.00	1.68	0.03	0.16	0.81	2.95	5.19	0.024	0.93	0.73	1.73	100.0	1591	194	0.10	7.4	59
263208	242	356.0	356.3	ser-chl alt Fsp Rhy	B	72.40	0.29	14.60	2.62	0.04	1.14	0.97	0.17	4.45	0.051	0.06	0.73	3.58	100.3	341	243	0.18	7.2	83
263209	242	390.7	391.0	QSPy alt Rhy	B	75.00	0.23	11.60	4.11	0.00	0.44	0.38	0.02	3.78	0.035	2.69	0.27	3.92	99.5	369	189	0.15	7.3	91
263210	242	403.7	404.0	pink Py alt? Rhy	B	76.40	0.25	13.00	2.36	0.00	0.60	0.10	0.83	3.99	0.025	0.86	0.07	2.80	100.4	469	214	0.10	7.0	83
263211	242	407.4	407.7	QSPy alt Rhy	B	76.40	0.24	12.60	3.05	0.00	0.49	0.21	0.07	4.02	0.018	1.81	0.13	3.50	100.6	405	199	0.08	7.2	94
263212	242	453.0	453.4	QSPy alt Rhy	B	77.70	0.26	13.00	2.23	0.00	0.31	0.12	0.11	3.87	0.013	1.30	0.07	2.98	100.6	374	216	0.05	7.2	95
263213	207	103.5	104.1	QSPy alt perlitic ap Rhy	A	78.00	0.21	10.90	3.83	0.00	0.20	0.04	0.07	3.25	0.035	2.77	0.03	3.51	100.1	473	184	0.17	6.8	97
263214	207	120.0	120.7	FspRhy patchy QSPy & vns	C	69.90	0.34	14.30	4.94	0.02	0.69	0.42	0.89	4.36	0.047	2.99	0.37	4.52	100.4	524	255	0.14	8.0	79
263215	254	226.5	227.5	QSPy alt fine PumBx	D	75.80	0.33	13.00	2.88	0.00	0.58	0.14	0.09	3.98	0.028	1.96	0.09	3.49	100.4	693	291	0.08	6.8	95
263216	254	289.5	290.5	(QSPy alt) PumBx? relict Fs	D	70.60	0.35	15.40	3.18	0.02	0.70	0.29	1.82	3.98	0.032	2.10	0.20	3.70	100.0	1105	322	0.09	6.5	69
263217	254	318.5	319.5	(QSPy alt) PumBx? relict Fs	D	75.10	0.34	13.70	2.38	0.02	0.56	0.17	0.53	4.04	0.035	1.56	0.13	3.13	100.0	869	306	0.10	6.7	87
263218	254	409.5	410.5	wk alt PumBx	D	72.50	0.29	12.50	2.50	0.07	0.71	2.22	1.89	3.61	0.029	0.57	1.61	3.09	99.4	850	274	0.10	6.3	51
263219	279	182.0	182.3	wk alt PumBx	D	73.30	0.21	12.50	1.94	0.04	0.52	2.54	0.87	3.80	0.013	0.02	1.83	3.52	99.2	675	192	0.06	6.6	56
263220	250	286.0	287.3	QSPy alt spFsp Rhy	B	77.50	0.24	12.50	2.04	0.00	0.51	0.07	0.02	3.59	0.018	1.14	0.06	3.26	99.8	594	201	0.08	7.2	98
263221	250	341.6	342.0	pink wk alt spFsp Rhy	B	73.40	0.25	11.60	2.04	0.06	0.42	2.89	0.67	3.33	0.030	0.84	2.13	4.40	99.1	299	198	0.12	7.6	51
263222	251	195.2	195.9	QSPy alt perlitic ap Rhy	A	76.60	0.24	12.50	2.37	0.03	0.43	0.08	1.86	3.38	0.023	1.40	0.04	2.63	100.1	1198	209	0.10	6.9	66
263223	251	196.0	196.5	QSPy alt perlitic ap Rhy	A	75.40	0.23	12.30	2.15	0.02	0.41	0.43	3.09	2.76	0.013	1.50	0.22	2.53	99.3	1823	202	0.06	6.8	47
263224	251	293.2	293.9	QSPy alt PumBx	D	72.40	0.33	14.70	2.95	0.06	0.69	0.15	0.02	4.76	0.039	1.99	0.36	3.92	100.1	856	280	0.12	7.1	97
263225	251	331.5	332.2	wk alt PumBx	D	71.30	0.32	13.30	2.09	0.34	0.71	1.67	0.74	5.28	0.032	0.84	1.39	3.65	99.5	960	284	0.10	6.8	71
263226	208	125.5	125.8	PumSst with dacitic lithics	F	71.40	0.35	14.20	3.18	0.05	1.02	2.66	2.23	3.34	0.067	0.08	0.36	2.03	100.5	814	204	0.19	10.3	47
263227	242	179.5	180.0	pink Fsporphyritic Rhy	C	74.40	0.18	13.10	1.50	0.04	0.32	1.58	5.28	1.36	0.034	0.11	1.06	1.93	99.7	276	215	0.19	5.0	20
263228	242	223.4	223.9	pink spFsphyric Rhy	B	75.70	0.22	11.30	1.41	0.05	0.36	2.17	4.35	1.36	0.020	0.07	1.54	2.34	99.3	198	185	0.09	7.1	21
263229	242	253.5	254.0	silicfd & Qvnd Fault Bx	G	89.10	0.00	0.72	0.85	0.08	0.16	4.89	0.02	0.13	0.003	0.02	3.59	3.79	99.7	20	12	0.60	2.5	6
263230	253	328.5	329.0	aphyric (perlitic) Rhyolite	A	74.20	0.22	12.20	1.57	0.05	0.26	1.79	2.72	4.53	0.016	0.01	1.32	2.06	99.6	948	193	0.07	6.8	52
263231	253	421.5	421.8	pink albitic? PumBx	D	72.70	0.23	14.30	1.04	0.03	0.20	1.21	5.44	2.51	0.017	0.02	0.84	1.69	99.4	765	214	0.07	6.4	29
263232	253	421.8	422.2	grey silicifd pumBx	D	79.00	0.19	10.00	1.76	0.03	0.35	0.86	0.38	5.23	0.012	0.03	0.62	1.73	99.6	1531	174	0.06	6.5	82
263233	253	460.6	461.0	fl.bdd spFsp Rhyolite	B	74.20	0.25	13.90	2.22	0.03	0.57	0.80	3.32	3.07	0.020	0.04	0.51	2.17	100.5	562	231	0.08	6.5	47
263234	RH1	Standard			S	75.70	0.08	11.50	1.91	0.03	0.98	0.79	0.81	5.88	0.003	0.04	0.30	1.39	99.2	1239	140	0.04	3.4	81
100602	278	173.9		p/gry spFsp Rhy	B	72.32	0.26	12.74	2.59	0.05	0.11	0.95	2.42	5.85	0.05			2.58	99.92	1250	260	0.19	6.0	64
100605	278	264.5		monomict Rhy Bx	B	72.69	0.26	12.14	2.36	0.07	0.19	1.82	2.07	5.74	0.04			2.74	100.12	965	240	0.15	6.5	60
100608	278	489.5		red spFsp Rhy	B	74.01	0.26	12.63	2.68	0.04	0.17	0.98	3.03	5.12	0.04			1.54	100.50	950	260	0.15	6.0	57
100610	280	276.6		QSPy alt ashy SLST	E	77.57	0.20	13.17	1.63	0.01	0.56	0.05	0.10	4.13	0.02			2.68	100.12	840	180	0.10	6.7	97
100612	280	395.0		wk alt PumBx	D	73.26	0.24	13.98	2.20	0.03	0.42	0.43	3.06	3.55	0.03			2.6	99.83	740	240	0.12	6.0	53
100614	253	329.5		ap Rhy (=263230)	A	74.49	0.20	13.03	1.68	0.04	0.23	0.70	2.31	4.40	0.02			1.73	98.83	980	195	0.10	6.1	61

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TABLE 2 Boco Wholerock Geochemical Data: Sorted according to lithofacies group and Hole No.

RGC samples 263201-263234: ANALABS Report No:00009915. Analyses 100602-100614 courtesy of G.Green; written comm., June 1997.

Al = 100(MgO+K2O)+(MgO+CaO+Na2O+K2O)

*Hole prefix: BBP, unless otherwise indicated

SAMPLE	Hole*	From	To	Description	Gp	SiO2	TiO2	Al2O3	Fe2O3	MnO	MgO	CaO	Na2O	K2O	P2O5	S	CO2	LOI	Total	Ba	Zr	P/Ti	Ti/Zr	Al
				Units		%	%	%	%	%	%	%	%	%	%	%	%	%	%	ppm	ppm	Calc	Calc	Calc
				Method		OX408	OX408	OX408	OX408	OX408	OX408	OX408	OX408	OX408	OX408	OM813	OM812	OX408	OX408	GX401	GX401			
				Detection Limit		0.05	0.01	0.05	0.01	0.01	0.01	0.01	0.05	0.01	0.005	0.00	0.02	0.01		10	5			
263213	207	103.5	104.1	QSPy alt perlitic ap Rhy	A	78.00	0.21	10.90	3.83	0.00	0.20	0.04	0.07	3.25	0.035	2.77	0.03	3.51	100.1	473	184	0.17	6.8	97
263223	251	196.0	196.5	QSPy alt perlitic ap Rhy	A	75.40	0.23	12.30	2.15	0.02	0.41	0.43	3.09	2.76	0.013	1.50	0.22	2.53	99.3	1823	202	0.06	6.8	47
263222	251	195.2	195.9	QSPy alt perlitic ap Rhy	A	76.60	0.24	12.50	2.37	0.03	0.43	0.08	1.86	3.38	0.023	1.40	0.04	2.63	100.1	1198	209	0.10	6.9	66
263230	253	328.5	329.0	aphyric (perlitic) Rhyolite	A	74.20	0.22	12.20	1.57	0.05	0.26	1.79	2.72	4.53	0.016	0.01	1.32	2.06	99.6	948	193	0.07	6.8	52
100614	253	329.5		ap Rhy (=263230)	A	74.49	0.20	13.03	1.68	0.04	0.23	0.70	2.31	4.40	0.02			1.73	98.83	980	195	0.10	6.1	61
263206	AK1	131.2	132.0	wk QPy alt Rhy	B	73.50	0.20	12.40	2.24	0.09	0.53	1.21	5.00	1.92	0.021	0.80	1.50	2.33	99.5	431	175	0.10	6.9	28
263205	AK1	186.9	187.1	flbd spFsp Rhy	B	74.30	0.23	11.80	2.12	0.07	0.87	1.55	2.15	2.73	0.025	0.20	1.83	3.60	99.5	589	193	0.11	7.1	49
263207	AK1	180.3	180.5	wk QPy alt Rhy	B	75.10	0.24	12.00	1.68	0.03	0.16	0.81	2.95	5.19	0.024	0.93	0.73	1.73	100.0	1591	194	0.10	7.4	59
263228	242	223.4	223.9	pink spFsphyric Rhy	B	75.70	0.22	11.30	1.41	0.05	0.36	2.17	4.35	1.36	0.020	0.07	1.54	2.34	99.3	198	185	0.09	7.1	21
263208	242	356.0	356.3	ser-chl alt Fsp Rhy	B	72.40	0.29	14.60	2.62	0.04	1.14	0.97	0.17	4.45	0.051	0.06	0.73	3.58	100.3	341	243	0.18	7.2	83
263210	242	403.7	404.0	pink Py alt? Rhy	B	76.40	0.25	13.00	2.36	0.00	0.60	0.10	0.83	3.99	0.025	0.86	0.07	2.80	100.4	469	214	0.10	7.0	83
263209	242	390.7	391.0	QSPy alt Rhy	B	75.00	0.23	11.60	4.11	0.00	0.44	0.38	0.02	3.78	0.035	2.69	0.27	3.92	99.5	369	189	0.15	7.3	91
263211	242	407.4	407.7	QSPy alt Rhy	B	76.40	0.24	12.60	3.05	0.00	0.49	0.21	0.07	4.02	0.018	1.81	0.13	3.50	100.6	405	199	0.08	7.2	94
263212	242	453.0	453.4	QSPy alt Rhy	B	77.70	0.26	13.00	2.23	0.00	0.31	0.12	0.11	3.87	0.013	1.30	0.07	2.98	100.6	374	216	0.05	7.2	95
263221	250	341.6	342.0	pink wk alt spFsp Rhy	B	73.40	0.25	11.60	2.04	0.06	0.42	2.89	0.67	3.33	0.030	0.84	2.13	4.40	99.1	299	198	0.12	7.6	51
263220	250	286.0	287.3	QSPy alt spFsp Rhy	B	77.50	0.24	12.50	2.04	0.00	0.51	0.07	0.02	3.59	0.018	1.14	0.06	3.26	99.8	594	201	0.08	7.2	98
263233	253	460.6	461.0	fl.bdd spFsp Rhyolite	B	74.20	0.25	13.90	2.22	0.03	0.57	0.80	3.32	3.07	0.020	0.04	0.51	2.17	100.5	562	231	0.08	6.5	47
100608	278	489.5		red spFsp Rhy	B	74.01	0.26	12.63	2.68	0.04	0.17	0.98	3.03	5.12	0.04			1.54	100.50	950	260	0.15	6.0	57
100605	278	264.5		monomict Rhy Bx	B	72.69	0.26	12.14	2.36	0.07	0.19	1.82	2.07	5.74	0.04			2.74	100.12	965	240	0.15	6.5	60
100602	278	173.9		p/gry spFsp Rhy	B	72.32	0.26	12.74	2.59	0.05	0.11	0.95	2.42	5.85	0.05			2.58	99.92	1250	260	0.19	6.0	64
263214	207	120.0	120.7	FspRhy patchy QSPy & vns	C	69.90	0.34	14.30	4.94	0.02	0.69	0.42	0.89	4.36	0.047	2.99	0.37	4.52	100.4	524	255	0.14	8.0	79
263227	242	179.5	180.0	pink Fsporphyritic Rhy	C	74.40	0.18	13.10	1.50	0.04	0.32	1.58	5.28	1.36	0.034	0.11	1.06	1.93	99.7	276	215	0.19	5.0	20
263225	251	331.5	332.2	wk alt PumBx	D	71.30	0.32	13.30	2.09	0.34	0.71	1.67	0.74	5.28	0.032	0.84	1.39	3.65	99.5	960	284	0.10	6.8	71
263224	251	293.2	293.9	QSPy alt PumBx	D	72.40	0.33	14.70	2.95	0.06	0.69	0.15	0.02	4.76	0.039	1.99	0.36	3.92	100.1	856	280	0.12	7.1	97
263231	253	421.5	421.8	pink albitic? PumBx	D	72.70	0.23	14.30	1.04	0.03	0.20	1.21	5.44	2.51	0.017	0.02	0.84	1.69	99.4	765	214	0.07	6.4	29
263232	253	421.8	422.2	grey silicifd pumBx	D	79.00	0.19	10.00	1.76	0.03	0.35	0.86	0.38	5.23	0.012	0.03	0.62	1.73	99.6	1531	174	0.06	6.5	82
263218	254	409.5	410.5	wk alt PumBx	D	72.50	0.29	12.50	2.50	0.07	0.71	2.22	1.89	3.61	0.029	0.57	1.61	3.09	99.4	850	274	0.10	6.3	51
263216	254	289.5	290.5	(QSPy alt) PumBx? relict Fs	D	70.60	0.35	15.40	3.18	0.02	0.70	0.29	1.82	3.98	0.032	2.10	0.20	3.70	100.0	1105	322	0.09	6.5	69
263217	254	318.5	319.5	(QSPy alt) PumBx? relict Fs	D	75.10	0.34	13.70	2.38	0.02	0.56	0.17	0.53	4.04	0.035	1.56	0.13	3.13	100.0	869	306	0.10	6.7	87
263215	254	226.5	227.5	QSPy alt fine PumBx	D	75.80	0.33	13.00	2.88	0.00	0.58	0.14	0.09	3.98	0.028	1.96	0.09	3.49	100.4	693	291	0.08	6.8	95
263203	279	652.0	652.5	wk alt PumBx	D	75.40	0.24	12.60	2.30	0.04	0.50	0.84	2.51	3.20	0.015	0.31	0.51	1.81	99.5	863	210	0.06	6.9	52
263219	279	182.0	182.3	wk alt PumBx	D	73.30	0.21	12.50	1.94	0.04	0.52	2.54	0.87	3.80	0.013	0.02	1.83	3.52	99.2	675	192	0.06	6.6	56
263202	279	622.0	623.0	Py! wk alt PumBx	D	75.50	0.24	12.40	2.61	0.03	0.56	0.75	1.97	3.11	0.023	1.60	0.48	2.87	100.1	867	214	0.10	6.7	57
263204	279	693.8	694.0	wk alt PumBx	D	75.40	0.22	12.60	2.54	0.03	0.56	0.64	1.40	4.72	0.016	0.05	2.49	1.92	100.0	1039	201	0.07	6.6	72
263201	279	609.0	610.0	QSPy alt PumBx	D	76.00	0.25	11.90	2.42	0.02	0.53	1.01	0.02	3.85	0.015	1.55	0.70	2.90	99.0	1443	204	0.06	7.3	81
100612	280	395.0		wk alt PumBx	D	73.26	0.24	13.98	2.20	0.03	0.42	0.43	3.06	3.55	0.03			2.6	99.83	740	240	0.12	6.0	53
100610	280	276.6		QSPy alt ashy SLST	E	77.57	0.20	13.17	1.63	0.01	0.56	0.05	0.10	4.13	0.02			2.68	100.12	840	180	0.10	6.7	97
263226	208	125.5	125.8	PumSst with dacitic lithics	F	71.40	0.35	14.20	3.18	0.05	1.02	2.66	2.23	3.34	0.067	0.08	0.36	2.03	100.5	814	204	0.19	10.3	47
263229	242	253.5	254.0	silicfd & Qvnd Fault Bx	G	89.10	0.00	0.72	0.85	0.08	0.16	4.89	0.02	0.13	0.003	0.02	3.59	3.79	99.7	20	12	0.60	2.5	6
263234	RH1	Standard			S	75.70	0.08	11.50	1.91	0.03	0.98	0.79	0.81	5.88	0.003	0.04	0.30	1.39	99.2	1239	140	0.04	3.4	81

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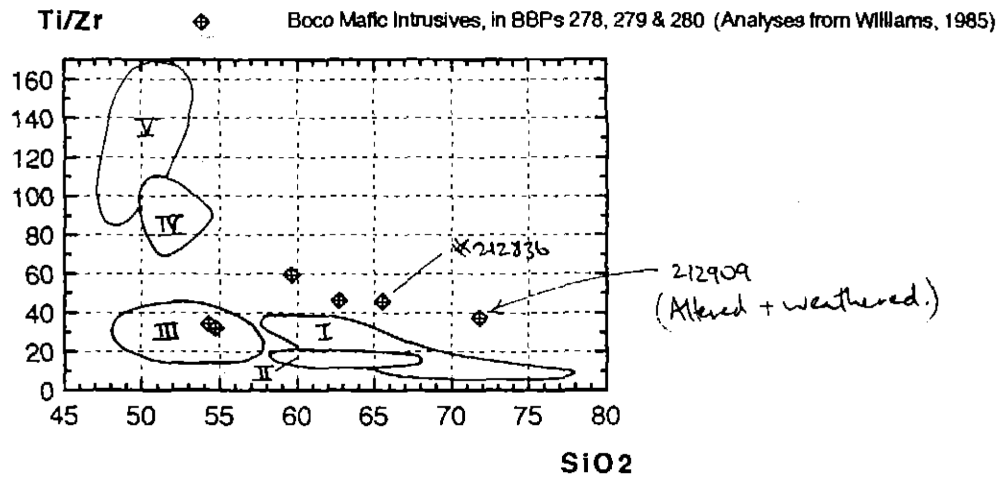
TABLE 3 **Boco: Calculated mass Changes** (Based on wholerock geochemical data in Table 1)

Mass Change: $C_{g/100g} = (Zr_p/Zr_a * C_a\%) - C_p\%$ (where: C is major component, p is precursor sample, a is altered sample)

Precursor	n =	Altered	n =	SiO2	TiO2	Al2O3	Fe2O3	MnO	MgO	CaO	Na2O	K2O	P2O5	S	CO2	LOI	Nett
				g/100g	g/100g	g/100g	g/100g	g/100g	g/100g	g/100g	g/100g	g/100g	g/100g	g/100g	g/100g	g/100g	g/100g
Low Zr and high Zr Pumice Breccias																	
Mean: least altd. Pumice Bx	9	Mean: lst altd Pumice Bx >270ppm Zr	3	-15.1	0.0	-2.1	-0.2	0.0	0.0	-0.0	-1.0	-0.3	0.0	0.3	-0.3	0.1	-18.5
Pumice Breccias in BBP254																	
Lst altd PumBx 263218 (BBP254)	1	Mean: wkly altd PumBx 263216,217	2	-8.9	0.0	0.2	-0.1	-0.1	-0.2	-2.0	-0.9	-0.1	0.0	1.0	-1.5	-0.1	-12.4
Mean: wkly altd PumBx 263216,217	2	QSPy altd PumBx 263215 (BBP254)	1	8.9	0.0	-0.5	0.3	-0.0	-0.0	-0.1	-1.1	0.3	-0.0	0.3	-0.1	0.4	8.1
Lst altd PumBx 263218 (BBP254)	1	QSPy altd PumBx 263215 (BBP254)	1	-1.1	0.0	-0.3	0.2	-0.1	-0.2	-2.1	-1.8	0.1	-0.0	1.3	-1.5	0.2	-5.4
Pumice Breccias in BBP279																	
Least altd, Mean: 263203 & 204	2	Wkly altd: 263202	1	-2.9	0.0	-0.7	0.1	-0.0	0.0	-0.0	-0.1	-1.0	0.0	1.4	-1.0	0.9	-4.2
Wkly altd: 263202	1	QSPy altd 263201	1	4.2	0.0	0.1	-0.1	-0.0	-0.0	0.3	-1.9	0.9	-0.0	0.0	0.3	0.2	3.8
Least altd, Mean: 263203 & 204	2	QSPy altd 263201	1	1.2	0.0	-0.6	0.0	-0.0	0.0	0.3	-1.9	-0.1	-0.0	1.4	-0.8	1.1	-0.6
Pumice Breccias in BBP251																	
Weakly altered: 263225	1	QSPy altered 263224	1	2.1	0.0	1.6	0.9	-0.3	-0.0	-1.5	-0.7	-0.5	0.0	1.2	-1.0	0.3	1.8
Pumice Breccias in BBP253																	
Pinkpatch: 263231	1	Greypatch: 263232	1	24.5	0.0	-2.0	1.1	0.0	0.2	-0.2	-5.0	3.9	-0.0	0.0	-0.1	0.4	22.6
Comparison of mean compositions of weakly altered pumice breccias from BBP253 & 279																	
Mean of 263231 & 263232 pink & grey	2	Mean of 263203 & 263204	2	-4.7	0.0	-0.3	0.9	0.0	0.2	-0.3	-1.1	-0.1	0.0	0.1	0.7	0.1	-4.5
Aphyric Rhyolites (Group A)																	
Least altered 263230	1	Wkly alt, pyritic; Mean 263222 & 223	2	-2.8	0.0	-0.6	0.6	-0.0	0.1	-1.6	-0.4	-1.6	0.0	1.3	-1.2	0.4	-6.2
Wkly alt, pyritic; Mean 263222 & 223	2	Q-Ser-Py altered: 263213	1	11.1	-0.0	-0.2	2.0	-0.0	-0.2	-0.2	-2.4	0.6	0.0	1.6	-0.1	1.3	12.2
Least altered 263230	1	Q-Ser-Py altered: 263213	1	7.6	0.0	-0.8	2.4	-0.0	-0.1	-1.7	-2.6	-1.1	0.0	2.9	-1.3	1.6	5.3
Sparsely Fs phyric rhyolites (Group B)																	
Least altd. 263228 (W of Fault)	1	Moderate altd. (Mean: 263208,263210)	2	-15.5	-0.0	-0.1	0.6	-0.0	0.3	-1.7	-3.9	2.1	0.0	0.3	-1.2	0.2	-19.2
Moderate altd. (Mean: 263208,263210)	2	Q-Ser-Py altd: (Mean: 263209,211,212)	3	12.3	0.0	0.3	1.1	-0.0	-0.4	-0.3	-0.4	0.2	-0.0	1.7	-0.2	0.7	14.2
Least altd. 263228 (W of Fault)	1	Q-Ser-Py altd: (Mean: 263209,211,212)	3	-5.5	0.0	0.1	1.5	-0.0	0.0	-2.0	-4.3	2.2	0.0	1.7	-1.4	0.8	-7.7
Moderate altered: 263221, BBP250	1	Q-Ser-Py altd: 263220, BBP250	1	2.9	-0.0	0.7	-0.0	-0.1	0.1	-2.8	-0.7	0.2	-0.0	0.3	-2.1	-1.2	-1.4
Rhyolites in AK1 (Animal Creek)																	
"unaltd" Rhyolite, Mean: 263205, 207	2	Pyritic altd Rhyolite: 263206	1	6.6	-0.0	1.8	0.6	0.0	0.1	0.2	3.0	-1.8	-0.0	0.3	0.4	-0.1	11.1
Silicified Fault Breccia																	
Least altd Rhy. adjacent fault: 263228	1	Silicified breccia in Fault zone: 263229	1	1298	-0	-0	12	1	2	73	-4	1	0	0	54	56	1437



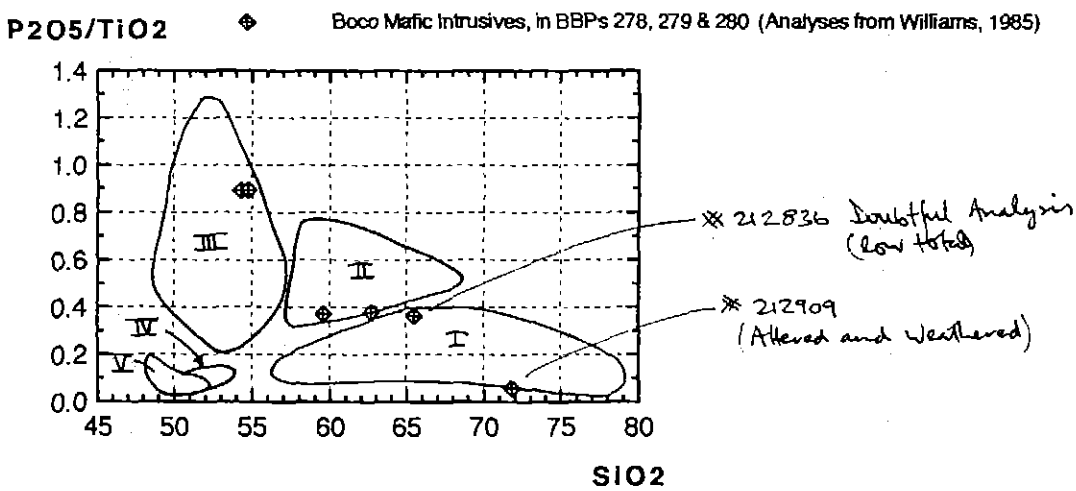


Figure 11 Ti/Zr and P_2O_5/TiO_2 vs SiO_2 plots for Boco mafic intrusives

Wholerock analyses from Williams, 1985; recalculated volatile free.
Fields for MRV Suites I to V from Crawford et al., 1992.
Williams (op cit.) recognised some analytical inaccuracies in these data on the basis of poor correspondence with CSR standard samples. In particular, Zr was reported at ~15% higher than the expected standard value. The Ti/Zr plot above has been constructed with Zr values adjusted (down) to compensate for the apparent systematic analytical error. This has produced slightly higher Ti/Zr ratios than the raw data. The treatment may not be valid since the CSR analytical standard was a rhyolite with SiO_2 ~73% and Zr ~255ppm; not strictly comparable to basalts and andesites.

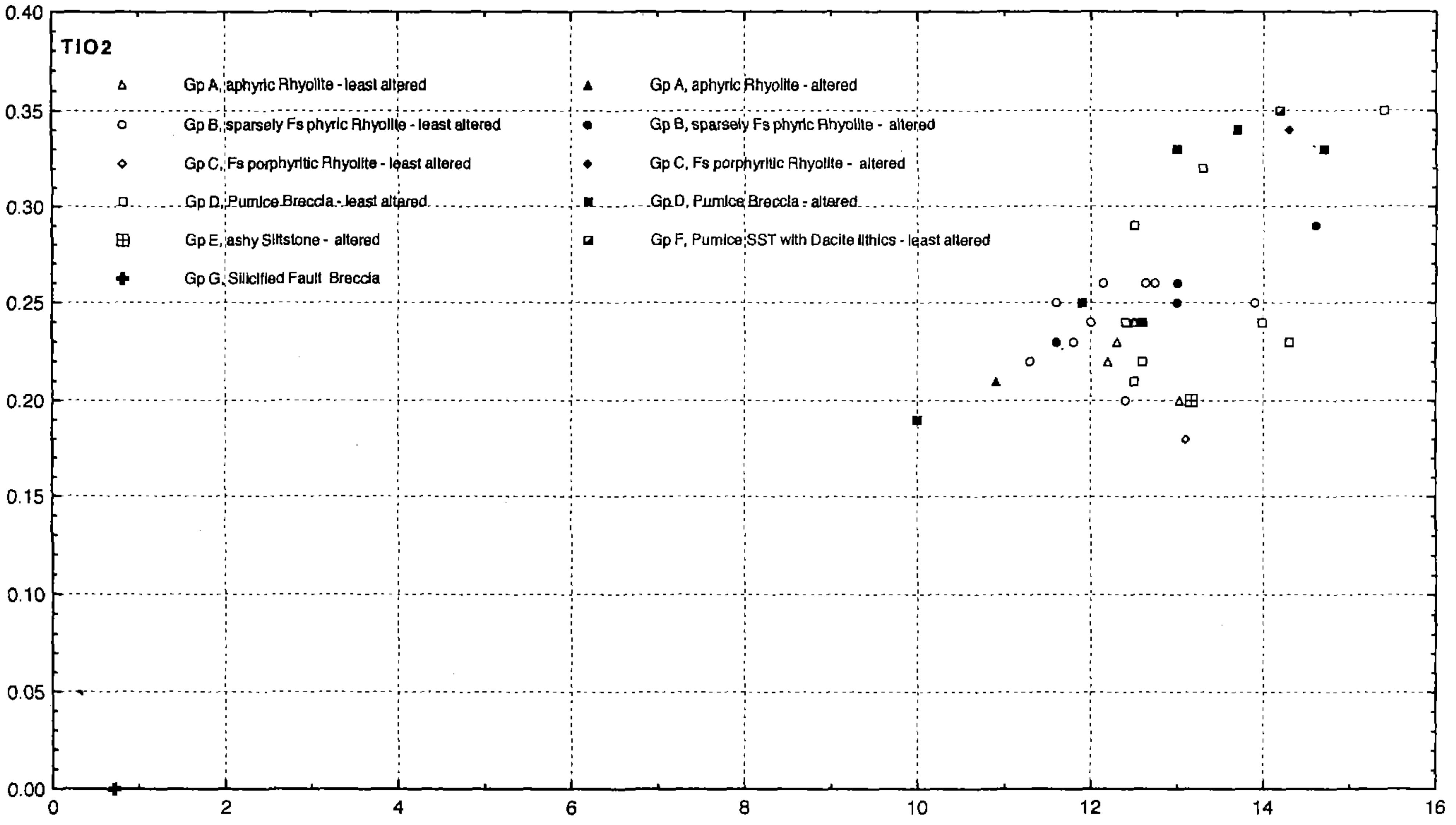


Figure 13 Al2O3-TiO2 scatterplot of Boco samples (listed in Table 1)

233137

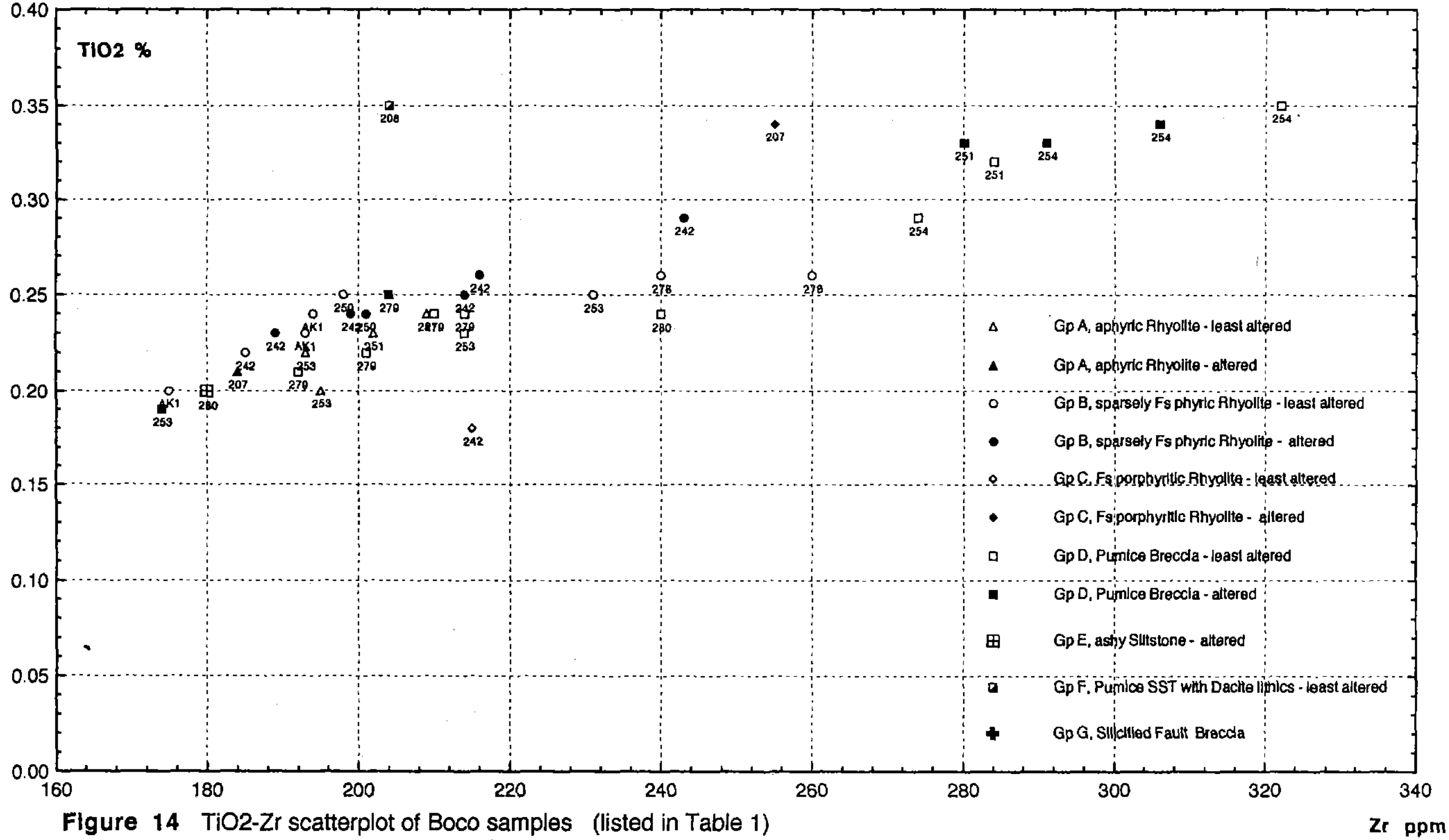


Figure 14 TiO2-Zr scatterplot of Boco samples (listed in Table 1)
Axes expanded and data points labelled by Hole No.

233138

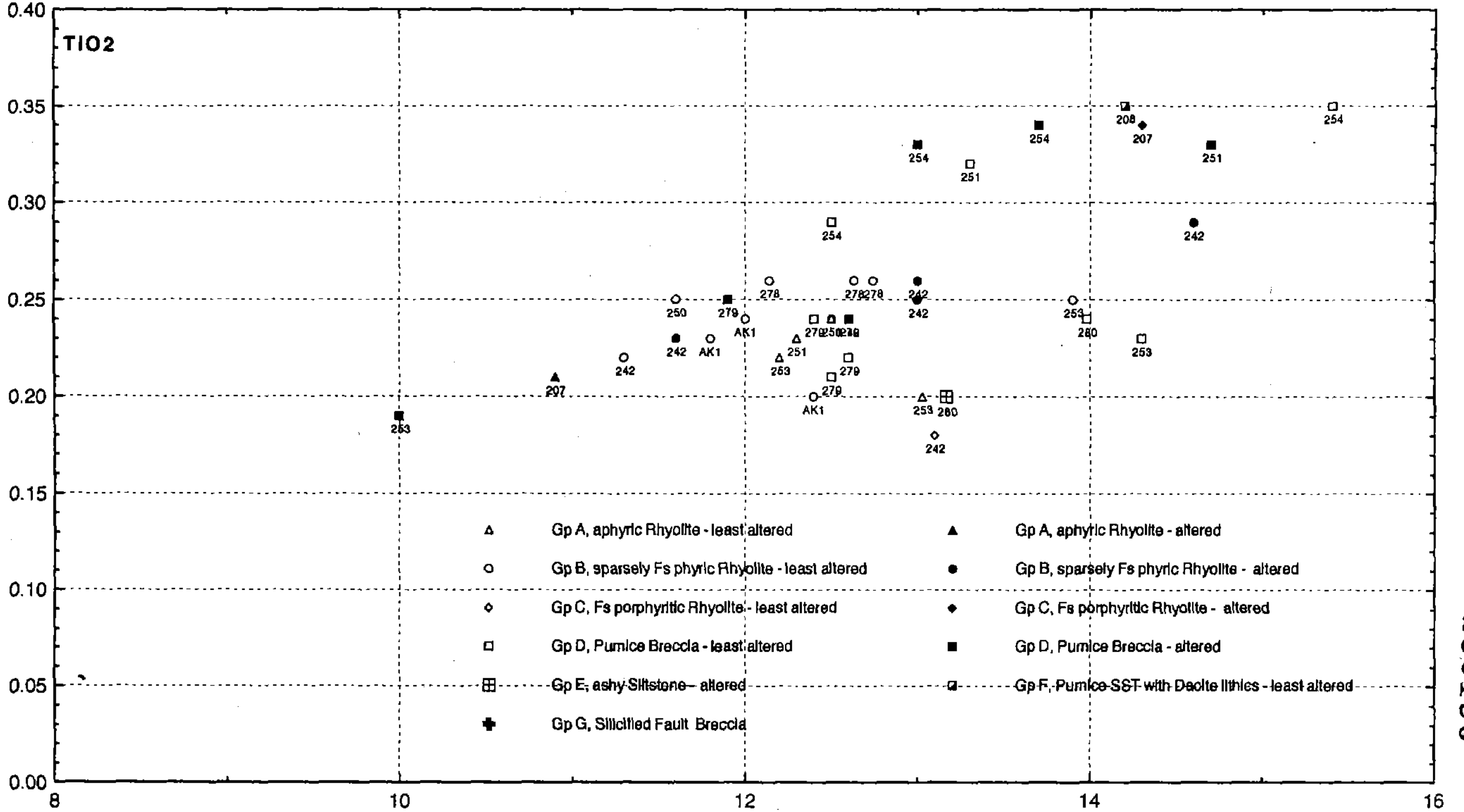


Figure 15 Al2O3-TiO2 scatterplot of Boco samples (listed in Table 1)
Axes expanded and data points labelled by Hole No.

233139

233140

fractionation Factor for Rosebery "whole Rock"

$\Delta^{v}_{w} \approx (2.91 \times 10^6/°K^2) - 2.63$ (deduced from graph)

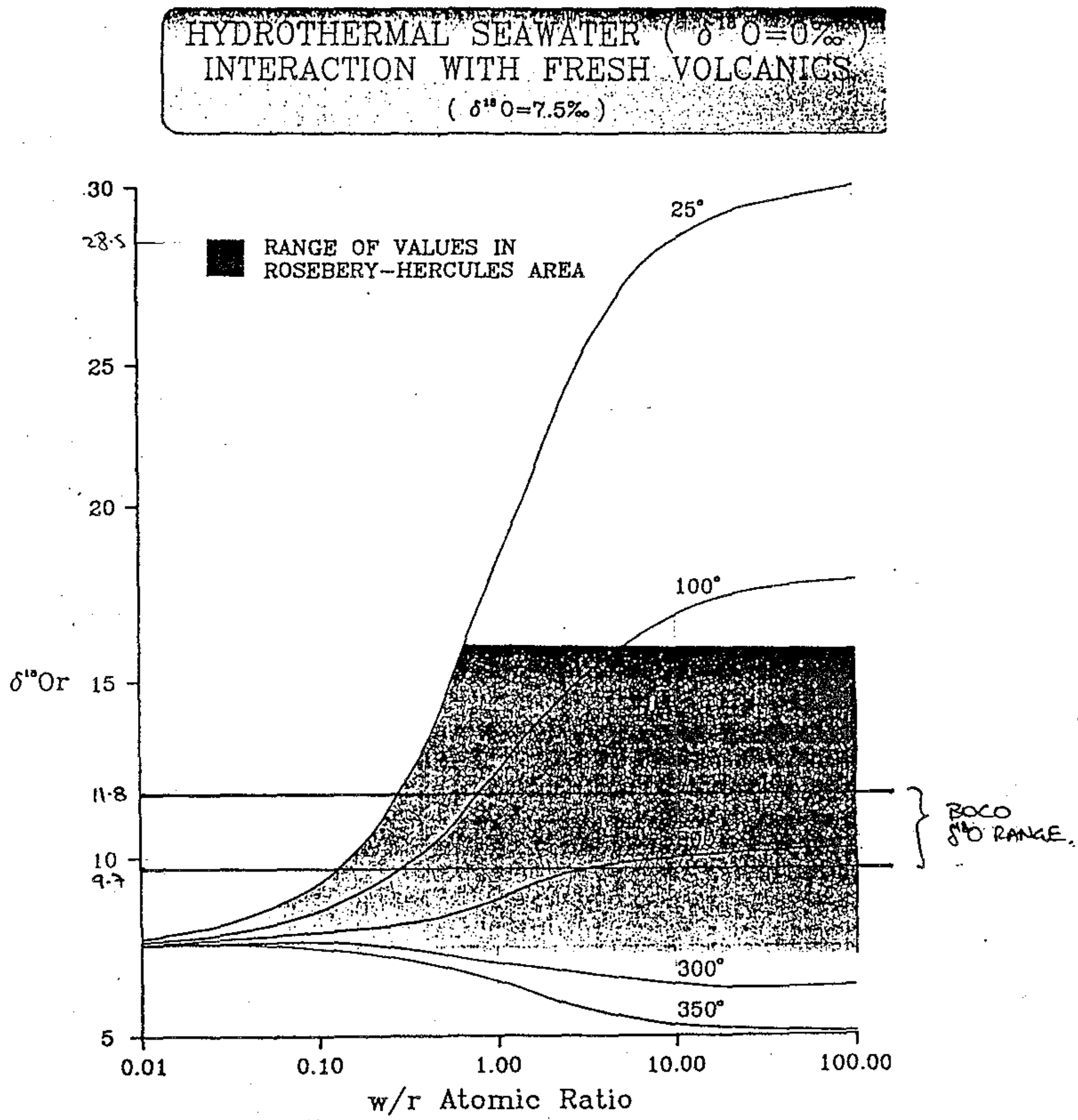


Fig. 24 Changes in the $\delta^{18}O$ value of a volcanic rock interacting with a fluid with the seawater $\delta^{18}O$ value at various temperatures as a function of the water/rock ratio, showing that the range of whole rock values in the Rosebery- Hercules area can be generated at temperatures ranging from ambient surface conditions to hydrothermal conditions, but that at w/r ratios > 1 temperatures greater than 200° C are required. (from Green 1990)

Figure 16 **$\partial^{18}O_r$ - H_2O/rock ratio diagram (from Green, 1993)**

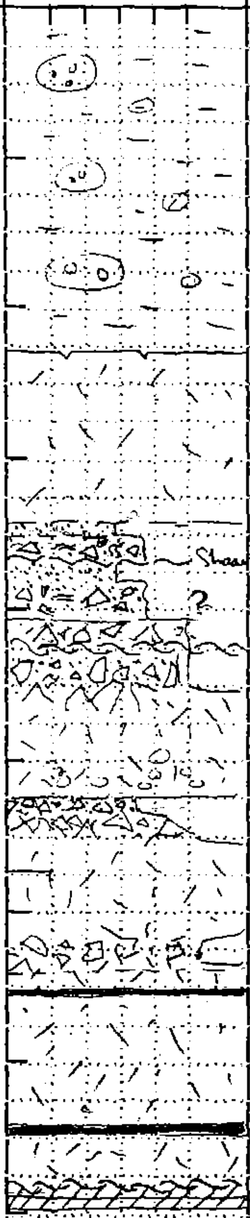
APPENDIX I **Graphic Core Logs**

238141

GRAPHIC CORE LOG

Scale 1:1000	Hole No. BBP 207 Depth 159.5 m
By W. HERRMANN	Project BOCO EL 47/96
Date 19 JUNE 1997	Section
	Collar co-ords E N RL
Page 1 of 1	Az. °G °M Incl. °

Columns: Depth m | Mean Grainsize (Mud, 0.5, 2, 8, 32 mm) | Max. clast ϕ & Structure | Altn. | Na_2O % | Description

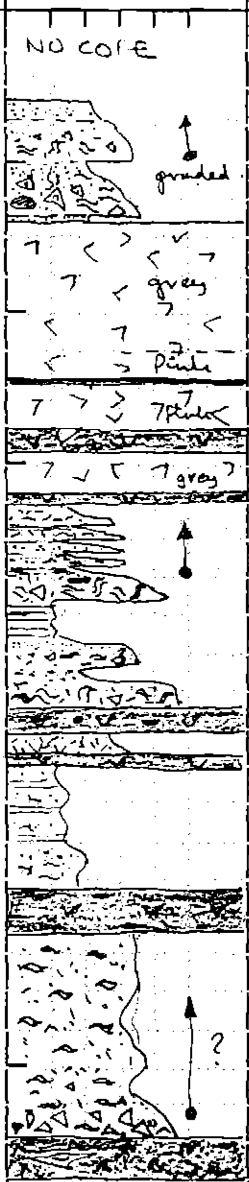


Depth (m)	Max. clast ϕ & Structure	Altn.	Na_2O %	Description
0–45				Qg: glacial boulder-till, (very poor core recovery).
~50–68	5% Py; 3% Py; 1% Py	K	0.05; 0.11; 0.28; 0.98; 0.08; 0.55	Siliceous-Sericitic-Pyritic aphyric RHYOLITE? Pervasive "destructive" alteration, Py stringers above 50. } Trace relict Fs and micropoikilitic fabric?
~68–72	3% Py			Alt. volcaniclastic SANDSTONE?
~72–88	Shear; 3-5% Py, Minor vnlts.; Shear		<0.2	Pervasively Sil-Ser-Py altered POLYMICTIC RHYOLITIC – PUMICEOUS BRECCIA?
~88–103	3-5% Py; Perlitic			Sil-Ser-Py altd. aph. RHYOLITE HYALOCLASTITE? BRECCIA (partly pseudoclastic/sheared) grading into coherent aph. RHYOLITE? well developed relict Banded Perlite ~103 m.
~103–128	2% Py; <1% Py; Minor Py vnlts; 2-3% Py	K; K; K	0.26; 0.13; 0.08; 0.07; 0.32	Siliceous (sericitic-pyritic) sparsely Fs phyric RHYOLITE with local zones of hyaloclastite BRECCIA; some relict perlite.
~128				DISTINCTIVE Grn. Fs glomeroporphyritic ANDESITE (Post dates pervasive alteration)
~128–150	1-3% Py		<0.2	
~150				DISTINCTIVE Fs glomeropor. ph. ANDESITE (sim. 131 m)
~155–159.5	Ripping FAULT			Pale greenish grey pervasively SILICIFIED rebrecciated and white Qtz veined cataclasite ex (indeterminate) felsic volcanic? identical to silicified breccia adjacent to fault at 238-257 m in BBP 242. Very little doubt that the faults in BBP 242 and BBP 207 are correlatable; a pity that BBP did not go a little deeper.

238143

GRAPHIC CORE LOG	Hole No. BEP 208	Depth ~ 154.2 m
Scale 1: 1000	Project	
By W. HERRMANN	Section	
Date 19 JUNE 1997	Collar co-ords E N RL	
Page 1 of 1	Az. °G °M Incl. °	

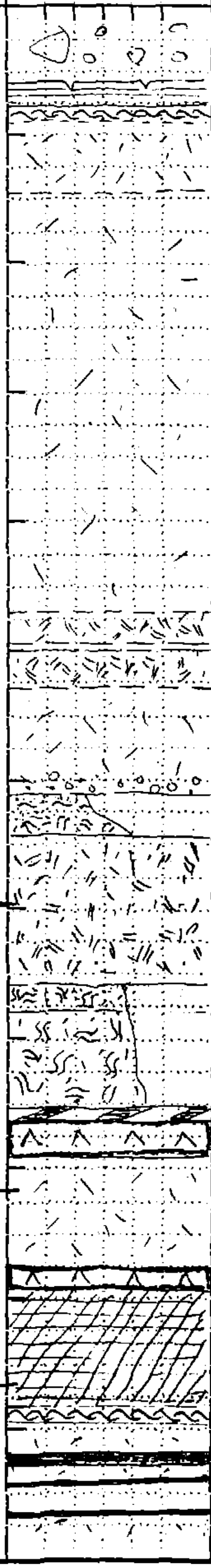
Depth m	Mean Grainsize Mud 0.5 2 8 32 mm	Max. clast φ & Structure	Altn.		Description
0	NO CORE				
20	graded	So: 40-60° So: 30°	Fs xts fresh.		Diffuse bedded, graded fs xtal rich PUMICEOUS SANDSTONE and POLYMICT FELSIC VOLCANIC BRECCIA. Clasts include Fs phyric DACITE (angular) tube pum and intraclasts SANDY-SILTSTONE.
40	grey Pink	Contact Sharp but broken (not peperitic)	Fs fresh.		Fs (Qtz-FeMg) porphyritic massive DACITE(? 2-3%) 1-2mm tabular fuzzy/zoned Fs, <1% 1mm equant clear angular Qtz and shred chloritized ferromagnesian (<1%) in gray-pink micropoikilitic. Abrupt change from mid grey to brick red matrix colour at ~45m. but phenocryst population constant. Not magnetic.
	Pink	Chloritic fg BASALTS Intrusive Bx contact.			
60	grey				
80		So: 30° So: 45° So: 45/Si: 0°		0.5% Py	Interbedded fine cherty siltstone and graded fs xtal rich-pumiceous felsic volcaniclastic SANDSTONE and PUMICEOUS BRECCIA.
					Chloritic vesicular fine grained BASALT.
100		So: 30-40°		Trace Py	Siliceous massive to diffusely bedded f.g. cherty volcaniclastic SILTSTONE and SANDSTONE ± felsic composition
120					Chl-Epidote alt. m.g. DOLERITE c̄ finer grained vesicular margins.
140	?	Contact Sharp planar 30°	Fs fresh		Feldspathic massive PUMICEOUS/LITHIC SANDSTONE grading to lithic clast rich BRECCIA below 145m. Wispy dark chl-ser-fs phyric "fiamme" ~5% to 30mm, matrix supported in pale grey fs xt rich ashy volcaniclastic SANDSTONE (trace detrital qtz xts.) Fiamme and small rigid fs phyric DACITE angular lithics (5mm-30mm) increase abruptly to 10-20% below 145m. Appear to be (part of) a single mass flow unit, probably normally graded (lithic rich base)
160		Fs fresh but blurry. Pyx fresh.			Massive Feldspar-Pyroxene porphyritic "ANDESITE" ~15%, 1-3mm stout tabular white Fs and ~2%, 2-3mm rounded equant prisms of fresh Pyroxene in pale greenish grey f.g. granular felsic matrix.



O Pum SST.

233144

GRAPHIC CORE LOG	Hole No. BBP 242	Depth 457.5 m
Scale 1:1000	Project BOCO EL 47/96	
By W. HERRMANN	Section	
Date 17 JUNE 1997	Collar co-ords E N RL	
Page 1 of 2	Az. °G °M Incl. °	



Depth m	Max. clast φ & Structure	Altn.	Na_2O %	Description
40				No Core, presumed Qg (glacials)
	2m puggy	Qtz.		Massive white vein quartz, Sericitic Shear/FAULT ZONE.
60				Pervasive Cb-Ser altered massive sparse Fs phyric RHYOLITE? ≡ abund. Qtz veinlets.
80	Flow Fol ~30° CAC			Siliceous (K-Spar?) pale grey to pink massive, sparsely Fs phyric, RHYOLITE looks aphyric in parts with fine granular felsic (suspected due to devitrification/alteration – not SST? Irregular stockwork qtz +/- chl veinlets mostly <1mm, up to 10-50/m. No Py.
100		K		
		K		
120		K	analysed	
		K		
	Contacts Obscure		?	(Silicic) Fs porphyritic massive RHYOLITE 3-5%, 1-2mm tabular whit. Fs in med. grey 'flinty' matrix
140	Contacts Sharp 30°			
		K		
		K		Silic(ks) massive, pink aphyric RHYOLITE
160		K		Spherulitic/perlitic near downhole contact.
	? xtal rich base		?	Sericitic MASSIVE PUMICEOUS SST – BRECCIA Tube pumice clasts <4mm, more xtal rich downhole – possible grading?
180				Siliceous massive pink Fs porphyritic RHYOLITE. Fresh Fs 5%, 2mm tabular (accessory <0.5% blebby Pyrite)
				Sericitic/siliceous massive Fs phyric fine PUMICE
200	(Fs frag.)	9.5	Ti/Zr	Siliceous massive Fs phyric PUMICE BRECCIA
		2.4	Na_2O	Very blurry silicified matrix, clasts
		47	AI	indistinct but abund. relict tube pumice
	Q-chl-Py veins to 5cm			
				Chloritic m.g. amygdaloidal ANDESITE
220	No Py			Silicic (chloritic-carbonated) pink massive
	Fs fresh in pink zones			sparsely Fs phyric RHYOLITE. Local "granular" felsic (sim: 69-134m) and pseudo bx formed by stkwork Q-Chl-Cb veins + local semi p. Chl-Cb
240			– –	CATACLASITE BRECCIA mainly of felsic volc (minor mafic dyke) pervasive quartz-carbonate alteration and spongy cb-qtz matrix.
	Puggy Shear		<0.2	
260	Qtz-Cb veins to 10mm 2-10/m	2% Py	–	Distinctive pale grn Feldspar? glomeroporphyritic chloritic ANDESITE DYKES. Not magnetic.
				Siliceous (Sericitic-Pyritic) massive sparsely Fs phyric RHYOLITE?? facies largely indeterminate
280				Strong pervasive silica-sericite ≡ 2% blebby diss. py – Could be altered fine pumice Breccia??

263227

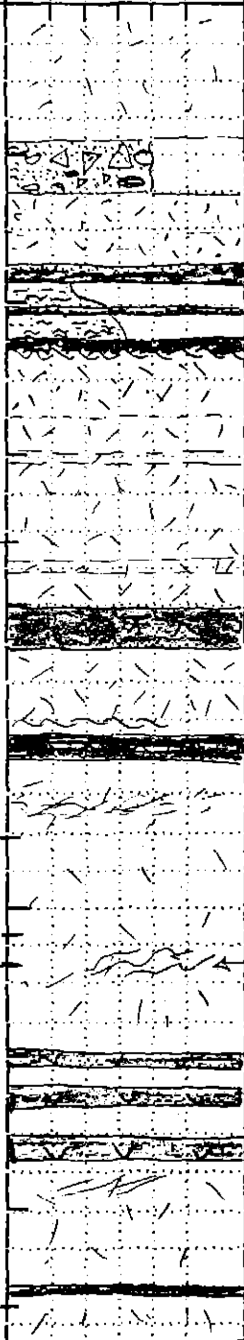
263228

263229

233145

GRAPHIC CORE LOG

Scale 1:1000	Hole No. BCP 242 Depth m
By W. HERRMANN	Project 3000
Date 17/6/97	Section
Page 2 of 2	Collar co-ords E N RL
	Az. °G °M Incl. °

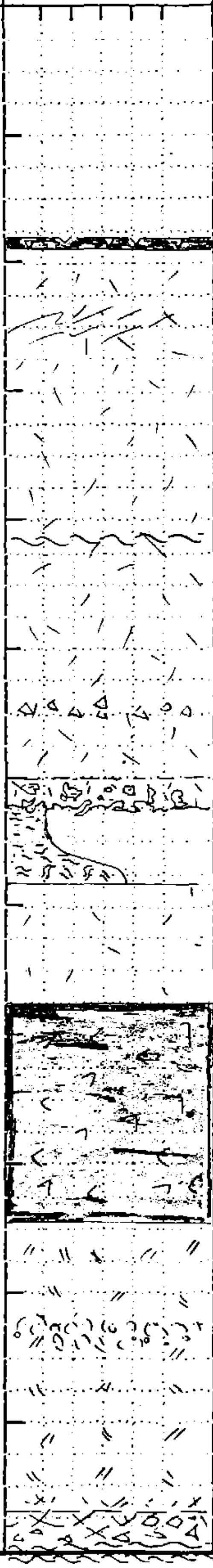


Depth m	Sample	Max. clast ϕ & Structure	Altn.	Na_2O %	Description
280			1-2% Py	0.27	Siliceous (Sericitic Pyritic) massive grey Fs phyric altered RHYOLITE. Evenly distrib. Fs pets altd to dark Ser-chl (2% 1-2mm) visible from ~280m on.
300		10.45% Py; 2-5% Py		<0.2	Silic-Sericitic-Pyritic POLYMICT VOLCANICLASTIC BRECCIA and gritty SANDSTONE. Rhyolitic + ... some qtz xtals. Strong pervasive Sil-Ser. alt. c 5-15% dissem Py and local anastomosing pyritic stringer veinlets to 2mm.
320		Fg chl BASALT; 1-5% Py; 1.5m pugg? Fault 30°	So (Beds) ~ 60-70		Silic-Sericitic massive SILTSTONE grading (down) to f-m.g. ashy pumiceous SANDSTONE - BRECCIA.
		0.5% Py; 2% Py			Silic-Sericitic pervasive altd. massive grey Fs phyric RHYOLITE, Fs altd chl. ser. sim to 280-298.
340	263208	0.5-2% Py		0.35; 1.21; 2.02	Silicic-Sericitic sparsely Fs phyric to aphyric massive RHYOLITE. Detextured in most intensely pervasive Qtz-ser alt. zones c 1-2% Py; <1% Py in pinkish least alt. zone
360					Distinctive (pelegrian?) Fs glomero porph ANDESITE DYKE (c 265m)
		0.5-1% Py		<0.12	Silica-Sericite altd. massive DETEXTURED RHYOLITE - either aphyric coherent or SST?
380–400	263209; 263210; 263211	5% Py; 0.5-2% Py; Relict Flow Foln ~30°		0.33; 0.28; 0.19	Silicic-sericitic (pyritic) massive aphyric to sparsely Fs phyric RHYOLITE. Mostly "detextured" in zones of strong Q-Ser alt; relict pink (KS?) in less alt. zones and rare flow banding suggests coherent. Irregular stockwork of qtz+chl veins post date pervasive alteration.
420				<0.13	Chloritic fine grained massive / sparsely amygdaloidal BASALT.
440	263212	flow fol? 2% Py; ~1% Py patchy		1.64; 0.39; 0.13	Siliceous (sericitic) "textureless" RHYOLITE presumed aphyric/sparsely fs. phyric as above. Pervasive strong-moderate qtz-sericite alteration with typical 0.5-1% dissem Pyrite and prominent stockwork of fine qtz-chlorite and reddish Siderite? carbonate veinlets generally >20 metre — appear to postdate pervasive alteration and do not contain significant pyrite
460					

238146

GRAPHIC CORE LOG	Hole No. BBP 24-6 Depth m
Scale 1:1000	Project Boco EL 47/96
By W.HERRMANN	Section
Date 22 JULY 1997	Collar co-ords E N RL
Page 1 of 3	Az. °G °M Incl. °

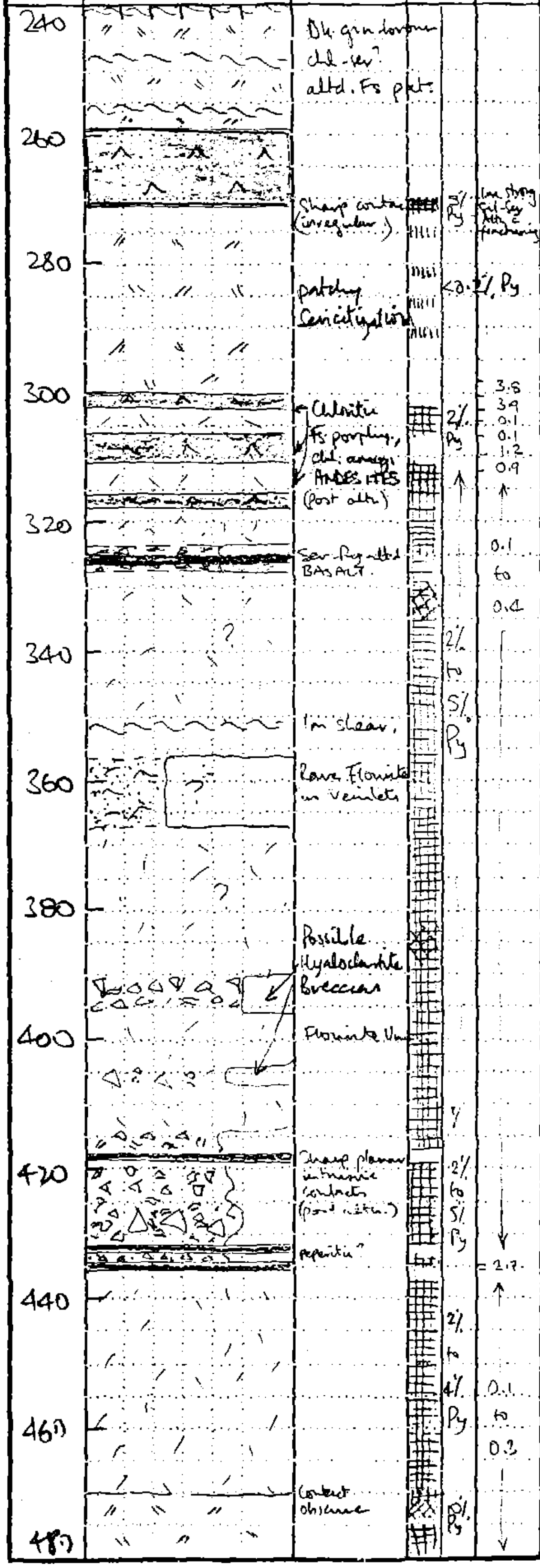
Depth m	Mean Grainsize (Mud 0.5 2 8 32 mm)	Max. clast ϕ & Structure	Altn.	Description
0				NO core (presumed glacial boulder till?)
20				
(36)				Massive chloritic f.g. BASALT Dykes
40		Flow Bands ~40-60° LAC		Massive siliceous Feldspar Porphyritic RHYOLITE. ~3% 1-2mm short tabular whitish feldspar phenocrysts evenly distributed in variably pale pink to grey siliceous aphanitic matrix, locally with velvet planar flow banding, pseudofragmental near 110m. Fs generally fresh or weakly sericitized. Typical low frequency Qtz-CO3 veinlets.
60				
80		Bleached near minor fault zone		
100				Peperitic lower contact zone 120-125m.
120		Peperite	5% Py	20cm zone dissem Py and SM Py vein
		Contact Shd.	<0.2% Py	Massive/graded siliceous-sericitic f.g. ashy SILTSTONE grading downhole through ashy SANDSTONE to fine tube PUMICE BRECCIA.
140				Massive siliceous coherent aphyric RHYOLITE. Pale rosy pink colour, flinty siliceous matrix c ultrafine spotty spherulites? Stockwork fine Qtz vns.
160				Massive dark greenish grey holocrystalline DOLERITE
180				
200		Relict Spherulites		Massive siliceous, Feldspar porphyritic RHYOLITE, coherent, 5-8%, 2-4 mm pink or grey short tabular Fs phenocrysts in variably pink or grey siliceous matrix. Fs phenocrysts locally altered to dark brown chl-ser. but generally fresh, Py generally <0.2% disseminated.
220		Patchy/pervasive silicification		Grey Qtz-chl veins increasing in intensity below 220m.
240		Silicified CATACLASITE		Flinty grey pervasively silicified multiply brecciated FAULT cataclasite. Patchy chlorite +/- Carbonate, <0.2% dissem Pyrite



233147

GRAPHIC CORE LOG	Hole No. BBP 246	Depth m
Scale 1:	Project	
By	Section	
Date	Collar co-ords E N RL	
Page 2 of 3	Az. °G °M Incl. °	

Depth m	Mean Grainsize Mud 0.5 2 8 32 mm	Max. clast φ & Structure	Altn.	Na_2O %	Description



239.5 - 241m: Puggy Sheared Zone; chloritic
Massive, siliceous, Fs porphyritic RHYOLITE: dk brown chl-ser altd. Fs, texturally similar RHYOLITE above fault zone.

Massive, chloritic, Fs glomeroporphyritic ANDESITE, fine grained less porphyritic margin

Massive siliceous/sericitic Feldspar phyric RHYOLITE. ~3%, 1-3mm pink tabular Fs phenocrysts evenly distrib. in rosy pink siliceous matrix (often indistinct) Fs highlighted by brownish colour imparted in patchy zones of pervasive sericitization not assoc. c sig. Py.

Massive sparsely Fs phyric? RHYOLITE with pervasive strong qtz-sericite-pyrite alteration, mainly coherent?

Very abrupt boundary to alteration zone at 302m; more or less pervasive and "detexturing" consisting of fine "granular" mosaic of quartz +/- shreds of sericite dusted with 2-5% fine granular dissem. Py. Locally well developed stringer veinlets of Pyrite. Upper part looks coherent except for fragmental appearance between 324-328m. Otherwise difficult to interpret emplacement mode - There are pseudo fragmental fabrics developed by Qz-Py veining and brecciation; zone from ~357-367m could be f.g. massive SST; possible relict pumice in breccia at ~416.5m. However, evenly dispersed relict euhedral Fs pxts in slightly less alt. Rhyolite at 410m. suggests most was coherent.

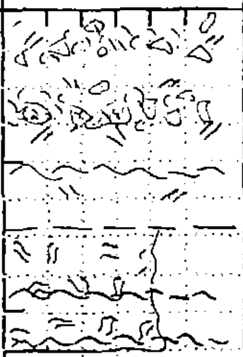
Chloritic f.g. amygdaloidal BASALT

Massive unsorted silica-sericite pyrite altered silicic breccia of resedimented sp. Fs. phyric Rhyolite hyaloclasts and subordinate pumice (eg. 428m) (Alteration + pyrite somewhat concentrated in matrix.)

Massive siliceous-sericitic-pyritic aphyric to sparsely Fs phyric RHYOLITE?
Very pervasive detexturing sil-ser-py alt. of very bland appearance + local regular qz-py veinlets suggests former coherent lava.

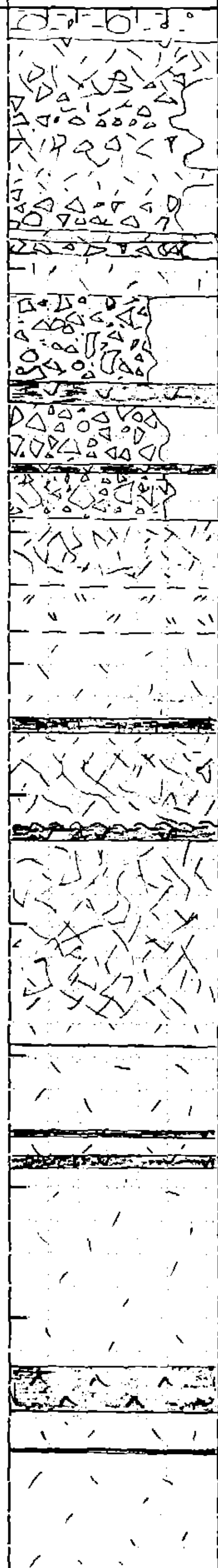
See Page 3.

GRAPHIC CORE LOG	Hole No. BCP 246 Depth 525.0 m
Scale 1:	Project
By	Section
Date	Collar co-ords E N RL
Page 3 of 3	Az. °G °M Incl. °

Depth m	Mean Grainsize Mud 0.5 2 8 32 mm	Max. clast φ & Structure	Altn.	Na_2O %	Description
480		locally Perlitic! Pseudoclastic "BRECCIA" (broken)	2% to 3% Py	0.8 <0.2	Massive silica-sericite altered and pseudoclastic/siliceous Feldspar phyric RHYOLITE. Pervasive alteration is patchy with least altd. zones showing classic pseudofragmental silicification "pseudoclasts" of pink FS phyric RHYOLITE (5%, 1-3mm FS) in siliceous grey pyritic more or less destructed matrix.
500				0.2 to 0.8	
		Contact Indistinct	1%		
520		(Broken Zones)	to 3% Py	~0.1	Massive siliceous-sericitic-pyritic PUMICE BRECCIA. Fairly pervasive sil-ser-Py alteration but patchy below 515m; generally destructured (also rather broken) but distinct well preserved relict fine tube pumice clasts at ~510m. Pumice clasts are mostly <10mm, disoriented, closely packed finely fibrous and apparently aphyric — could well be altered equivalent of Pumice Bx at end of BBP 247.

233149

GRAPHIC CORE LOG		Hole No. BBP 247.	Depth 382.2 m
Scale 1:1000		Project BOCO EL47/96	
By W.HERRMANN		Section	
Date 1 JULY 1999		Collar co-ords E N RL	
Page 1 of 2		Az. °G °M Incl. °	

Depth m	Mean Grainsize Mud 0.5 2 8 32 mm	Max. clast φ & Structure	Altn.	Na_2O	Description
0					GLACIAL BOULDERS
20			3° to 5% Py	<0.2	Massive aphyric RHYOLITIC HYALOCLASTITE BRECCIA and semi coherent RHYOLITE with pervasive silica-sericite-pyrite alteration and disseminated + veinlet pyrite. Some appears to be in situ hyaloclastite but finer breccias with clasts mostly <20 mm are clast rich resedimented breccias. Not stratified.
40			"		
60		Altd. BASALT c Py stringers	"		Massive (polymictic) RHYOLITIC clast rich BRECCIA – probably resedimented HYALOCLASTITE?. Clasts 5-50 mm close packed, dominantly of aphyric – sparsely Fs phyric RHYOLITE. Pervasive grey silica-sericite-pyrite alteration of both clasts and matrix. Matrix composed of fine fragments (no significant pumiceous/ash)
		Altd. BASALT unsorted clasts 5-150 mm	3% Py	0.57	
80			3% Py	<0.2	Massive Buff-grey sp. Fs phyric RHYOLITE pervasive silica-sericite alteration and stockwork irregular diffuse silica-pyrite veinlets similar to 110-155 m
			2%	0.56 0.37 0.10	Massive mod. sil-ser altd. Fs porphyritic RHYOLITE 5%, 1-2 mm tabular Fs xts sericitised but well preserved relicts, minor relict perlite.
100			0.5-1% Py	0.75 1.29 2.22 2.31	Pink-Buff weakly sil-ser altd. sparsely Fs phyric RHYOLITE with minor diffuse silica-pyrite veinlets
		Fs fresh		1.45	Fs porphyritic DACITE (not magnetic, grey)
120					Sericitic (Buff), pervasively altered amygdaloidal BASALT Dyke, adjacent to 1 m. fault chlorite
140			1-4% Py	<0.1	Massive sparsely Fs phyric to aphyric, pervasively silica-sericite altered RHYOLITE with irregular stockwork of diffuse silica-pyrite veinlets producing "hydrothermal breccia", in places (eg: 135 m) it looks like hyaloclastite breccia with alteration concentrated in matrix + fractures?
		Pink			
160				0.4 to 2.6	Patchy semi pervasive silicification c 0.5-2% dism Py Some kernels relatively unalt. pink rhyolite
					Chloritic, massive (vesicular) BASALT Dykes
180		Patchy pervasive silicification and irregular veinlets Py	1% Py	<0.3	
200			<0.5% Py	0.9 to 3.7	Massive chloritic f.g. Fs porphyritic ANDESITE (locally magnetic)
220		Patchy 0.5% Py			Massive pink/grey sparsely Fs phyric RHYOLITE Patchy silicification with ~0.5% dissem to fine veinlets of Pyrite
240				NA.	

GRAPHIC CORE LOG

Scale 1:1000	Hole No. BBP 247 — Depth 382.2 m
By W. HERRMANN	Project 3000
Date	Section
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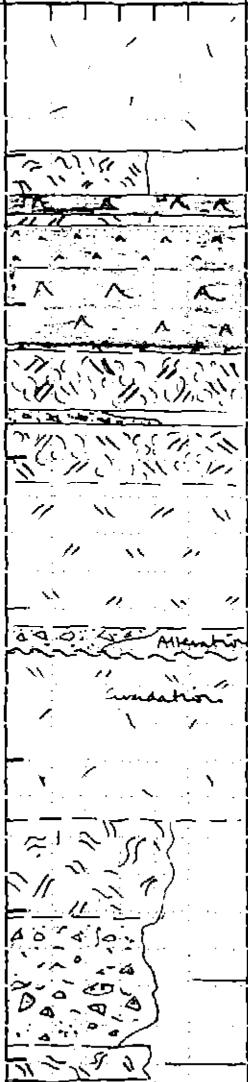
	Az. °G °M Incl. °



Depth m	Max. clast φ & Structure	Altn.	% Na_2O	Description
240	Fl. Bd ~60°			Massive pink sparsely fs phyric coherent RHYOLITE. Traces crude flow banding
260	Compaction fol. 80° LAC	Fs fresh		Massive silic/sericitic welded? Fs phyric PUMICE BRECCIA. 5%, 1-2 mm euhedral tabular Fs xts.
				Chloritic Fs porphyritic (magnetic) ANDESITE?
280	Contacts Sharp and intrusive? Distinctly	Magnetic		Massive holocrystalline (Fs-Hbl?-Mt) "DOLERITE" c finer grained chloritic marginal phases; similar to sill? in BB253, 134-180m
?	Patchy 1% diss Pyrite		0.05, 0.32	Siliceous (grading to sericitic) massive Feldspar porphyritic PERLITIC RHYOLITE. (classical)
Contacts obscure	So(Bd) 50-60		0.66, 1.10	Diffuse stratified, Sil-Ser POLYMICT BRECCIA-SST. Clasts Perlitic Rhyolite, Pumice and cherty SLST
300	Fs sericitic in Perlite Zone. Fs fresh in coherent Zone.	1% Py	1.16, 2.34, 3.33, 2.45, 3.24, 3.73, 3.41	Massive siliceous Fs porphyritic RHYOLITE well developed (classic) relict Perlite - banded Perlite above 303m. 5-10% 2-4mm stout tabular white Fs in pale pink/grey siliceous/spherulitic matrix c distinctive leucozone? granules?
320	Contact Obscure. Alteration focussed on Shear?	3% Py	3.04, 2.23, 1.86, 1.51	MASSIVE sil-ser-py altered polymict RHYOLITIC BRECCIA-SST. Angular clasts pink Rhy; matrix supported in massive altd sandy material larger more abundant clasts upsection
?? / 340				Massive siliceous Fs phyric RHYOLITE grading down to sparsely Fs phyric RHYOLITE below 350m.
360				MASSIVE siliceous aphyric rhyolitic PUMICE BRECCIA. Abundant disoriented tube pumice clasts 5-50mm
				Massive siliceous (sericitic) rhyolitic Monomictic BRECCIA dominated by perlitic rhyolite hyaloclasts? in ashy matrix with local patches pumiceous breccia. Feldspar generally fairly fresh, locally weakly carbonate-sericite altered.
380				Massive mainly siliceous PUMICE BRECCIA?

GRAPHIC CORE LOG

Scale 1:1000	Hole No. BBP 248 Depth 577.5 m
By W HERRMANN	Project BOCO EL 47/98
Date 1 JULY 1997	Section
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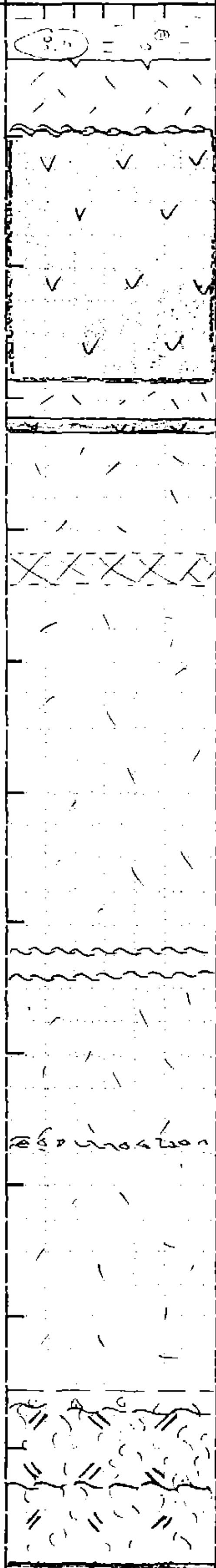
	Az. °G °M Incl. °

Mean Grainsize: Mud 0.5 2 8 32 mm



Depth m	Max. clast φ & Structure	Altn.	Description
80			Qg; glacial Boulder till.
			Argillic (weathered) massive sparsely Fs phyric-aphyric RHYOLITE? light tan colour.
100			(Weathered) massive f.g. holocrystalline (Fs-Hb!?-) DOLERITE. Very poor core recovery and badly broken throughout.
120	BOCO.		
140	contact obscure. Sharp.		
160	Pervasive Ser-Cb alth.	Few Py veinlets.	Pink siliceous massive aphyric RHYOLITE. Fs phenocrysts absent or inconspicuous against pale pink-grey flinty matrix.
180			Essentially fresh, no Pyrite, trace blebby Carbonate and ubiquitous fine stockwork of Qtz-carbonate hairline veinlets.
200			
220	0.5m 0.4m		Narrow discrete puggy Fault/cataclasite (brittle deformation) zones. Narrow selvedge bleaching + Silica-CO_3 alteration (weak).
240			
260	CO_3 cemented cataclasite		Patchy weak silicification and trace Py
280	Contact obscure.		
300			Siliceous, massive, perlitic Feldspar porphyritic RHYOLITE. 3-5% 1-3mm stout tabular feldspar phenocrysts (pink where fresh but variably sericite - CO_3 altered) in pink-grey siliceous matrix with extensive perlitic zones overprinted by weak sericite-carbonate alteration. Minor disseminated Py ~1% across ≈ narrow (0.2-0.5m) fracture zones at 293, 306, 319 m.
320			

233152

GRAPHIC CORE LOG

Scale 1:1000	Hole No. BBP 248 Depth: m
By	Project BOCO
Date	Section
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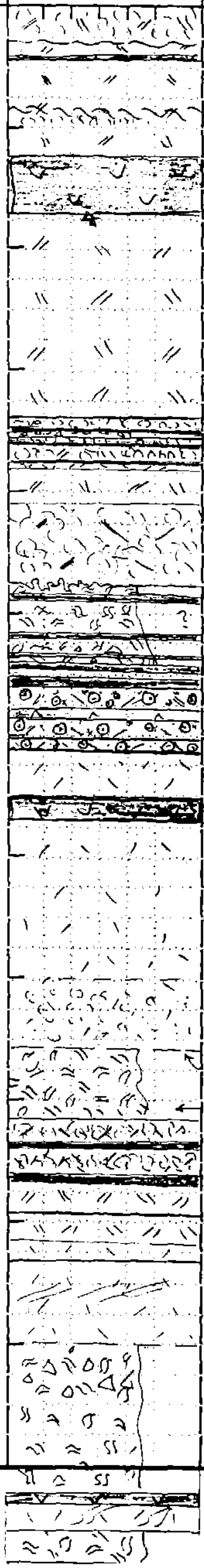
	Az. °G °M Incl. °

Some core looks out of place but I could not satisfactorily verify it.



Depth m	Max. clast φ & Structure	Altn.	% Na_2O	Description
320				
	Contact indistinct			Siliceous-sericitic (chloritic) Fs porphyritic RHYOLITE, related to above but with
	diffuse brittle fault zone 2m			
	Trace Py	chloritic		perlitic textures absent (except narrow zone at 338m). Stockwork fine Cb Chl veinlets, Fs locally chlorite sericite altered near 337m
340	Sharp, intrusive contacts Bas -> Rhy			Chloritic massive fine grained BASALT dyke?
360	Fs fresh			Siliceous massive Fs porphyritic RHYOLITE. 5%, 1-3mm tabular somewhat glomeroporphyritic feldspar (and shreds of chl. ferromag, minor) evenly distrib. in pale grey-pink felsic matrix
380			0.66	Not magnetic
*	1-2% Py		0.48	Zone of Silica-Sericite-Py altd. perlitic RHYOLITE
			1.72	and thin 20cm unit of polymict felsic BRECCIA
	Bridging clast ?		0.21	interrupted by 3 Fs phyric ANDESITE dykes
			0.05	
400			0.05	Sericitic-Siliceous massive-perlitic
	<0.5% Py		0.30	Fs phyric RHYOLITE. Fs partly ser-chl-Cb
			0.19	altered, fairly pervasive sericite matrix altn.
	Peperitic	Fs	xtals	Sericitic massive Fs phyric fine PUMICE BRECCIA
420	↑?	alt	Ser/Cb	Close packed pum. clasts mostly <10mm. peperitic above 419; sparse rhyolite lithics below 430m
	Fs fresh, matrix		Sericitic	
				Siliceous/sericitic sparsely Fs phyric SPHERULITIC
440				RHYOLITE (massive)
			0.67	
				Chloritic massive f.g. BASALT? Dyke
460	Fs fresh			Siliceous massive sparsely Fs phyric coherent flinty RHYOLITE. <1% 1-2mm narrow tabular Fs phts in f.g. devitrified felsic siliceous matrix, variably pale grey and pink
480	Pseudo frag. Chl-Ser-Cb			Weak blotchy chlorite-carbonate-sericite alteration below 480m imparts pseudo fragmental fabric.
	<0.2% Py			
	Fs part Ser.			
	contact indistinct			Sericitic-siliceous massive Tube PUMICE
500	← CLASSIC PMBX		0.20	BRECCIA. Monomict, close packed clasts, relict perlite + spherulites ~501m suggests welding?
			0.21	sericitic/siliceous perlitic massive - pseudo fragmental Fs phyric RHYOLITE (coherent)
	Fs fresh		3.67	Siliceous massive Fs porphyritic RHYOLITE
520			2.16	
			1.99	
	contact broken		3.33	
	Planar Flow Banding 45°			Massive, siliceous sparsely Fs phyric RHYOLITE. Variable pink + grey; faintly perlitic in places
540	contact obscure			Massive siliceous (Fs phyric) PUMICE BRECCIA. Tube pumice generally difficult to discern in much silicification and blotchy pink + dk grey alteration but obvious at ~ 546m, 554m etc.
560				10% angular clasts of sp. Fs phyric pink Rhyolite above 5... may be present below but obscured?
	f.g. amygd. BASALT			
	Fl. bd. RHYOLITE			

577.5 m

233153

GRAPHIC CORE LOG	Hole No. BBP 250	Depth 358.0 m
Scale 1:1000	Project BOCO EL 47/96	
By W HERRMANN	Section	
Date 12 JUNE 1997	Collar co-ords E N RL	
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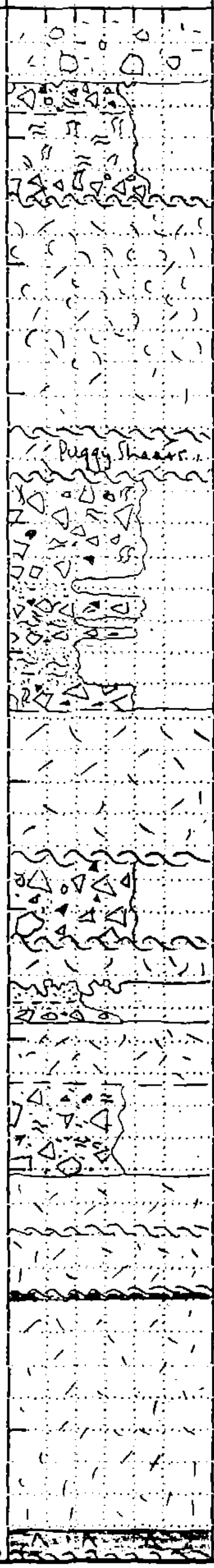

Depth m	Max. clast ϕ & Structure	Altn. (Na_2O %)	Description
40	Qg		Qg miscellaneous boulders. No continuous
	— Boco		Polymict Rhyolitic Breccia
60	1-2% dissem Pyrite	<0.1	Sil (Ser-Py) alt. PUMICE BRECCIA? with Lithic (RHY) clast rich base?
80	1% dissem Pyrite		Silicic (sericitic - pyritic) massive coherent fs phyric RHYOLITE with well preserved perlitic/spherulitic fabrics above 95m.
100		0.5 to 1.4	
	Puggy Shears. 2-3% Py		
120	1-2% Py. Clasts: 50mm	<0.2	Sil (Ser-Py) Polymict - RHYOLITIC BRECCIA. Clast rich dominantly "cherty" aphyric Rhy minor pumice, massive
140	"		Interbeds? upto 5m thick of massive f-m grained "ashy" SANDSTONE (essentially destructed - could be ap. Rhy?)
160	1% Py. Ser-Cb	0.6 to 1.2	Silic (Ser-Py) massive RHYOLITE sparsely feldspar phyric 2% ~2mm tabular in pale pink felsic f.g. matrix, patches Sil-Ser-Cb alt preserved 150-160m.
180	Puggy SL. clasts: 100 mm. Puggy	<0.1	Massive polymict RHYOLITIC BRECCIA. unsorted clasts mainly 5-100mm.
	Peperitic?		Silicic (Ser-Py) alt. sparse Fs ph. RHYOLITE sills?? in SST-BRECCIA sequence?
200	Avg: 1-2% Py. C: obscure	0.2 to 0.3	Sil-Ser-Py altd. M-C.g. POLYMICT RHYOLITE / LITHIC BRECCIA, (minor pumice)
220	0.5-1% Py. 20cm Puggy Shs		Sil (Ser) pervasively Alt. sparsely fs phyric RHYOLITE uniform buff colour. Generally <1% dissem Py except for local (spaced ~ 3m apart) SM bands
240	Chl. AND.	<0.2	and stringers of Pyrite 5-50mm between 247 and 276m. Unit largely "destructed" and indeterminate, local possible pseudoclastic/alteration
260	?		
280	Sharp Contact. 50mm Shear.		chloritic m.g. holocrystalline? ANDESITE

238154

GRAPHIC CORE LOG	Hole No. BBP 250 Depth m
Scale 1:	Project Boco EL 47/96
By	Section
Date	Collar co-ords E N RL
Page 2 of 2	Az. °G °M Incl. °

Depth m	Mean Grainsize Mud 0.5 2 8 32 mm	Max. clast ϕ & Structure	Altn.		Na_2O	Description
280		0.5-1% diss Py			<0.1	Sil (Ser-Py) alt. Sparse Fs phyric RHYOLITE Fine veliet spherulitic fabrics eg 285-290 m give apparent granular SANDY texture but otherwise convincingly coherent. Pervasive Sil (Ser) alt but <1% Py.
		20cm SZ				
300		1m Shear Pug				
		Patchy Sil-Cb Stock vlts	K		Not anal.	Very abrupt ALTERATION BOUNDARY at FAULT at 299-300 m.
320			K			
		0.5% diss Py generally	K		10cm SM Py	
			K			Pink-Buff/grey Siliceous (Kspar) f.g. massive sparsely fs phyric to aphyric RHYOLITE
340				8.6	Ti/Zr	
			K	1.8	Na_2O	
			K			Generally exceedingly bland/textureless felsic volcanic; locally c 1-2% 1-2mm fs phenocrysts apparently highlighted by patchy Cb alth. (eg 334-335 m) but elsewhere looks aphyric as if fs pcts are subsumed by pervasive Sil (Ks) alth. Commonly ~0.5% diss Pyrite but Sil ser Py alth is VERY RESTRICTED TO small shear/fracture zones at 328 m and 338 m
360						

238155

GRAPHIC CORE LOG		Hole No. BBP 251	Depth 379.5 m
Scale 1:1000		Project BOCO EL 47/95	
By W. HERRMANN		Section	
Date 11 JUNE 1997		Collar co-ords E N RL	
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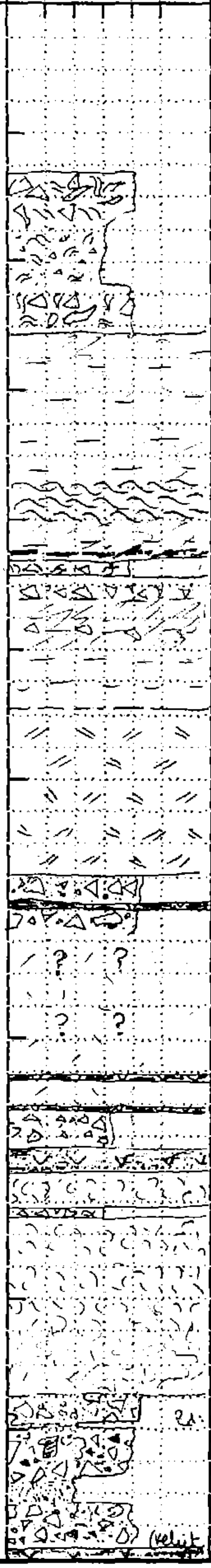

Depth m	Max. clast φ & Structure	Altn.	Na_2O %	Description
0				No Core
20				
(27) – (56.5) 40	Pervasive Silica (+ creamy sericite) pyrit <0.5% Py.		<0.2	Siliceous (Sericitic) Polymict RHYOLITE – PUMICE BRECCIA and fine PUMICE BRECCIA. Clasts mainly wispy pumice and angular jagged juvenile flow bd. Rhyolite.
60 – 80	1-2%, Py; Broken/Rugged Cataclasite			Silicic-Sericitic Massive APHYRIC flow banded RHYOLITE. Bizarre convoluted flow banding / devitrification / perlite pervasive silica-creamy sericite altn. c 1-2% dissem. blebby Pyrite mainly in siliceous irregular veinlets along devitr. flow foliations etc.
	MPy Vns to 10cm; 1-5% Py.			Polymict – PUMICE BRECCIA. — Local (monomict) pseudo breccia >2% Py restricted to patches of irregular stringer veinlets, c anomalous Cu to 800ppm but low Pb, Zn.
100 – (109) – 120	1-2% dissem Py		0.71, 1.05, 1.11, 0.66, 1.60, 0.11, 1.42, 2.31, 0.08, 1.50	Siliceous - Sericitic massive (coherent) fs phyric RHYOLITE c upto 3% 2mm plag, and 2% 2mm teardrop qtz amygdales or silicified lithophysae in matrix/flow aligned. Traces relict fs and pink matrix locally
140 – 160	Clasts to 100mm; 2% dis Py.		<0.2	RHYOLITE clast rich BRECCIA, not Pumiceous. Below 145m indeterminate facies, pervasive Sil-Ser-Py altd. Rhyolitic, essentially destructured but fine polymict Breccia at 173m, 176m
180	Clasts <20mm		0.3 to 2.7	4 chloritic vesicular BASALT DYKES c sharp contacts are essentially unaltered but contain enclaves of Py/Sil altd. Rhy? — evidence for pre basalt pervasive altn!
200	2% dis Py lacework along perlitic fractures; 1-2% Py. alteration patchy			Silicic massive aphyric PERLITIC RHYOLITE. Well preserved relict perlite, banded perlite and local pseudo fiamme fabric. Transition to flowbanded aphyric (perlitic) RHYOLITE below 200m.
220 – 240	So: 60°; 1-2% Py; 2% Py. fs below 225m		<0.2	Polymict Cathic (Pumiceous) RHYOLITIC BRECCIA Angular clasts chiefly aph. Rhy. + lesser pumice mass flow, clast rich; with interbeds of Massive M-f grained SST. Not graded.

GRAPHIC CORE LOG	Hole No. BBP 251	Depth m
Scale 1:1000	Project BOCO EL 47/96	
By	Section	
Date	Collar co-ords E N	RL
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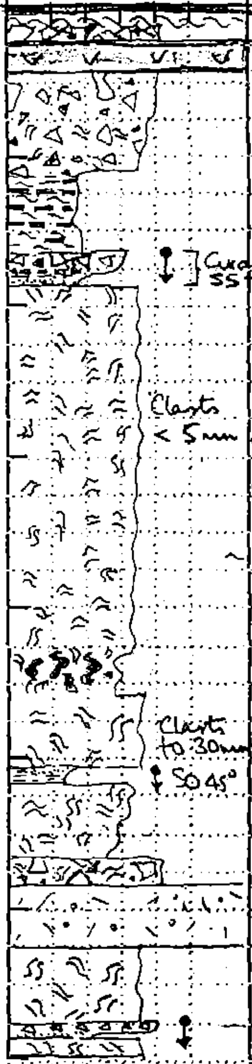


Depth m	Mean Grainsize (Mud 0.5 2 8 32 mm)	Max. clast φ & Structure	Altn.	Description
240		2% Py		Chl (Ep-Cb) f.g. vesicular BASALT (not pyritic or silic-ser altd)
		2% Py		Sil-(Ser-Py) altered Polymict/Pumice mass. RHYOLITE BRECCIA. More pumiceous below
260		SM Py 1-5cm bands ~10% Py overall		Sil-Ser-Py alt. f-m.g. pumiceous SANDSTONE with contorted bands of pyrite + grey chert averaging about 10% Py. Some [illegible] deformed beds upto 5cm, some more like veins
		Graded Bx → SST. So=45°		
280		Patchy alternating Sil-Ser-Py and Sil-Cb (Py) altn		Silicic fs phyric massive FINE PUMICE BRECCIA (RHYOLITIC). Very massive and even grained with blurry close packed clasts of tube pumice mostly < 5mm size. 2% tabular 2mm fs xts partly Cb altd. Pervasive silicification with patchy blebby Siderite alteration generally ~1% dissem Py, locally ~2% Py.
300	Clasts < 5mm			
320		1-2% Py; 1% Py		Irregular grey cherty band/lenses of ashy SILT intermixed c̄ PUMICE Bx → PEPERITE?
340	Clasts to 30mm; So 45°	Sil-Ser-Cb 1% Py dissem.		Sil-Ser-Cb alt. fs phyric massive PUMICE BRECCIA. Thin Bedded Vclastic SST + SLST (Graded)
		"		
360		Pinky/grey c̄ relict spher. contacts obscure		Sil-Ser-Cb altd. massive Polymict RHY-PUMICE; Silic-(Fs-Cb) sparsely Fs porphyritic - Qtz amygdaloidal/spherulitic Massive RHYOLITE
		0.5% Py		Sil (Ser-Cb) massive fs ph. PUMICE BRECCIA
380				Polymict RHY-PUMICE BRECCIA grading downhole to m.g. SST. PUMICE BRECCIA.

233157

GRAPHIC CORE LOG	Hole No. BBP 253	Depth 469.8 m
Scale 1:1000	Project BOCO EL 47/96	
By W. HERRMANN	Section	
Date 20 JUNE 1997	Collar co-ords E N RL	
Page 1 of 2	Az. °G °M Incl. °	

Depth m	Max. clast φ & Structure	Altn.		Description
40				NO CORE – premined dig (glacials)
	(Weakly Magnetic)			(Weathered) Fs porph DACITE ē accessory Mt.
60	BOCO; Clasts to 30 cm.	Weak to Moderate Carb Ser Altn. <0.5% Pyrite		(Sericitic–Carbonated) massive PUMICEOUS – RHYOLITIC BRECCIA. Central zone 65–75m very clast rich, Fs porph Rhyolite and sparsely Fs phyric–aphyric pink Rhyolite juvenile/angular clasts almost framework supported with sparse pumiceous matrix
80	(Weakly Magnetic) →			chloritic vesicular f.g. BASALT(S)
	Compaction Foliation 45°	0.5% Py.		Sericitic–Carbonated compacted PUMICE BRECCIA
100	Minor puggy Shear			Siliceous–(Sericitic) massive PUMICEOUS – RHYOLITIC LITHIC BRECCIA. Similar pink and green blotchy/wispy appearance to unit between 53–80m with similar clasts (Fs phyric fiamme, sparse Fs pl. Rhyolite and lesser fs porph Rhyolite) increasing lithics below 110m.
120	Clast to 150 mm.	6.9 / 2.8 / 57	Ti/Zr / Na_2O / A.I.	
140	Contact Sharp. (Intrusive)			Massive holocrystalline DOLERITE. Uphole margin finer grained, chloritic and vesicular similar to basalts above, lower contact looks peperitic/intrusive.
160				Weakly magnetic
180	Peperitic? Clasts to 50 mm.			Monomict (Fs p Rhy) Resedimented Hx Bx ē Pumice matrix
				Sericitic, massive, Fs phyric (RHY) PUMICE BRECCIA. Abundant tube Pumice, no rigid lithics.
	Sharp.	<0.2% Pyrite (accessory)		
200	Fs very fresh. Obscure			Pink, massive Fs porphyritic coherent RHYOLITE 5%, 2–3mm white tabular Fs pxts in f.g. pink matrix.
	Pumice clasts to >50mm.	*	11.7 / 130	Coarse PUMICE BRECCIA ē blotchy pink colour and local spherulites = hot welded Pumice??
220				Sericitic–Siliceous massive Fs phyric PUMICE BRECCIA and PUMICEOUS SANDSTONE? No lithics. * Apparent sandy top and base may be due to destructive alteration? Not stratified.
	Sharp Contact			Chloritic massive Fs phyric DACITE weakly Magnetic
240				(Blotchy pink + greenish grey pseudo fragmental alteration overprint of PUMICE BRECCIA)
	Magnetic Sharp chilled contacts			Chloritic f.g. BASALT, chilled amygdaloidal margins
260		Trace Py <0.2%. Fs fairly fresh		Siliceous (sericitic) massive Fs phyric PUMICE BRECCIA? Pervasive grey silicification below 268m with wispy sericitic velvet pseudofiamme – could be pseudoclastic alteration of coherent Rhyolite but seems to have faint pumiceous velvet fabric. Tube pumice not preserved
280				

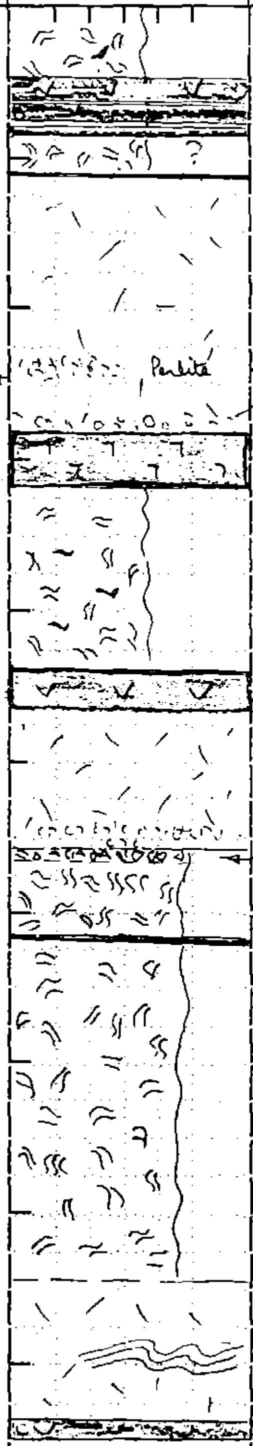
* Uncertain Facing based on proportion and size of juvenile rigid lithics but critical contacts obscured by intrusive dykes/sills

233158

GRAPHIC CORE LOG

Scale 1: 1000	Hole No. BBP 253 Depth m
By	Project
Date	Section
	Collar co-ords E N RL
Page 2 of 2	Az. °G °M Incl. °

Depth m	Mean Grainsize (Mud 0.5 2 8 32 mm)	Max. clast φ & Structure	Altn.		Description
280–300					Chloritic massive fine grained BASALT DYKES? with sharp chilled contacts. Not magnetic
300–337	Perlite	* 11.6 $\delta^{18}O$; Banded Perlite + Spherulites	6.4 / 2.1 / 50	Ti/Zr / Na_2O / AI	Siliceous massive v sparsely Fs phyric to aphyric coherent RHYOLITE. <1% tabular 1-2mm pinkish feldspar sparsely distributed in pale pinkish grey flinty siliceous (devitrified glassy) matrix. Relict perlite at 327.5m, spherulites near lower contact
337–345		(Fs fresh)			Dark green chloritic massive Fs phyric DACITE Moderately magnetic, sharp bleached contacts.
345–370		(Fs fresh)			Siliceous massive sparsely Fs phyric PUMICE BRECCIA; pervasive pink/grey silica-Fs alteration with blotchy pink pseudoclastic fabric overprinting rare relict tube pumice (eg: 358.5m) Sim to above 290m
370–375		Chl-Ep BASALT f.g., magnetic			
375–393	Perlite	0.5% diss blebby Py; Perlitic.	10.2	$\delta^{18}O$	Siliceous massive, sparsely Fs phyric coherent RHYOLITE similar 303-337m; Fs phenos rather sericitized well preserved relict Perlite at 389m.
393–403		← Peperitic or RHYOLITE hyaloclastite & pumice matrix?			Siliceous massive tube PUMICE BRECCIA. Abundant tube pumice; uphole contact Hx or peperite Bx
403–405					Chloritic f.g. vesicular BASALT, faintly magnetic.
405–450		? Indistinct	8.2 / 2.8 / 48	Ti/Zr / Na_2O / AI	Siliceous massive blotchy pink and grey PUMICE BRECCIA. V. sparsely Fs phyric, abundant classic relict tube pumice clasts but mostly blurry with clast margins obscured by pervasive devitr./alteration. Pumice clasts typically 5-10mm. disoriented and non compacted.
450–475		Fl. Bd: 0°; Fs fresh; 0.2% Py.			Siliceous massive (locally Flow Bdd) v. sparsely Fs phyric coherent RHYOLITE. Contact with above is indistinct – compositionally similar – distinction based on lack of pumice, traces of relict perlite and rare flow banding.
475					Chloritic massive fine grained BASALT (not magnetic)



Left margin notes:

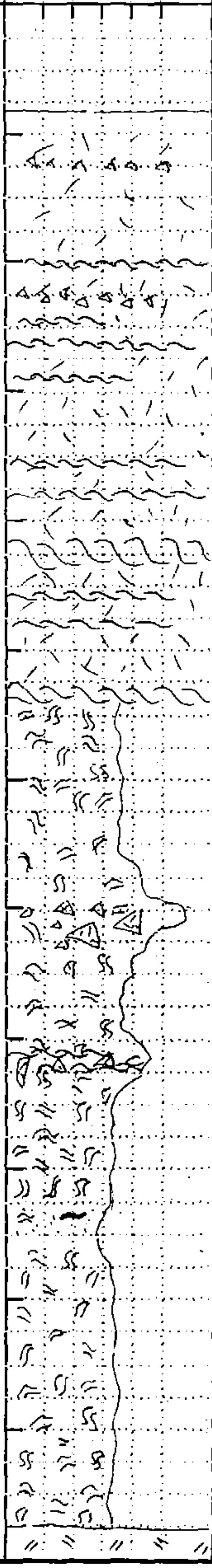
c. Green Sample 100614! ○ (324.5)
Ti/Zr = 6.1, Na_2O = 2.3, AI = 61
But Zr at 195ppm is much lower than CSF ≈ 250ppm!

? Ampules ? contrast colour changes?

○

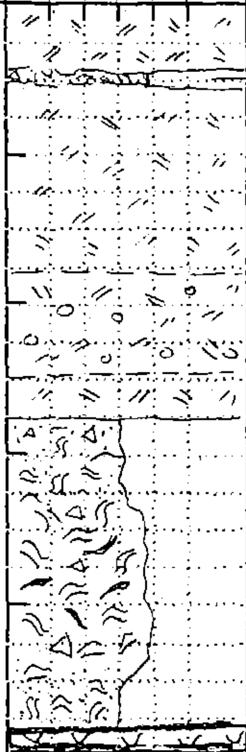
GRAPHIC CORE LOG	Hole No. BBP 254	Depth 439.5 m
Scale 1:1000	Project 3000 EL 47/96	
By W. HERRMANN	Section	
Date 11 JUNE 1997	Collar co-ords E N RL	
Page 1 of 2	Az. °G °M Incl. °	

Depth m	Mean Grainsize (Mud 0.5 2 8 32 mm)	Max. clast ϕ & Structure	Altn.	Na_2O %	Description
100					NO CORE
(117) 120		1-2% fine dissem Pyrite		<0.3	Pervasively silica (sericite-pyrite) altered massive RHYOLITE. Largely detextured to fine granular (perlitic) fabric apart from some zones (eg 125m, 145m etc) where m.g. fragmental fabric is clearly cataclastic – lack of grainsize variations and "bland" appearance of least altered sections (eg: 188-190m) suggests f.g. aphyric to sparsely fs phyric RHYOLITE. Weak pervasive shear/strain/cleavage and numerous puggy shear/fault zones which are locally oxidized, otherwise pyrite fresh.
140–200		Numerous puggy faults			
180–190				0.9	
200		Contact obscure			
220		1-3% dissem Py		<0.2	Pervasively Silica-(sericite-pyrite) altered fine PUMICE BRECCIA and polymict RHYOLITE – PUMICE BRECCIA. Mostly detextured with ~5mm granular fabric with anastomosing wispy (sericitic) matrix but least altered segments (eg: 227m) show clear close packed relict pumice clasts mostly <5mm. Local polymict angular RHYOLITIC lithics eg 233-240m
240		78% SiO_2			
260		1-2% Py			
280–290		1-2% Py		1.1	Traces relict fs xts and Cb. alt. fiamme
300				<0.3	Siliceous/feldspathic massive fine PUMICE BRECCIA, evenly distributed 3%, 1-3mm pink relict fs xts in totally silicified grey cherty matrix c̄ relict tube pumice fabric. Pumice clasts indistinct generally <5mm. Patchy weak Cb altn.
320		1% Py dissem blebby		0.7 / 0.9	
340				3-5%	



233160

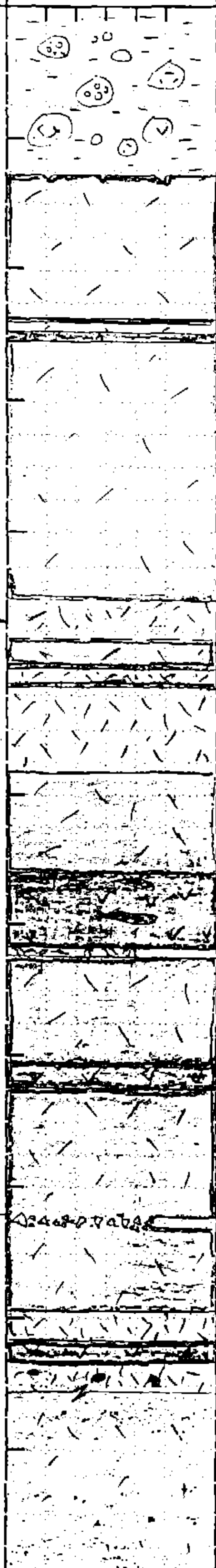
GRAPHIC CORE LOG	Hole No. BBP 254 Depth m
Scale 1:1000	Project BOCO EL 47/96
By	Section
Date	Collar co-ords E N RL
Page 2 of 2	Az. °G °M Incl. °

Depth m	Mean Grainsize Mud 0.5 2 8 32 mm	Max. clast φ & Structure	Altn.		Description
340		0.2% Py → Polymict Breccia clasts to 40mm	(Not Fldsp /	Mag. wht) Pumice	Massive Feldspar porphyritic/micropoikilitic RHYOLITE. Variably dk grey/green or pink ~5%, 1-2 mm tabular plag. fresh.
360					locally spherulitic (Contacts obscure possibly peperitic?)
380					Up to 2% → 5mm ellipsoidal calcite filled amygdales.
400		Patchy 0.5% Py fracts fresh			Siliceous f.g. plagioc massive coarse RHY-ite pumice PUMICE BRECCIA and PUMICEOUS SANDSTONE, blurry sil matrix Central portion (405 ~ 430 m) resembles PuBx at end of BBP 279.
420					Upper and lower parts include some "jumbled" f-m.g. grey pumiceous SST, no overall grading observed.
440		chilled contact			F.g. Chloritic (amygdaloidal) BASALT.

233161

GRAPHIC CORE LOG	Hole No. BBP 278	Depth 501.0 m
Scale 1:1000	Project Boco EL 27/96	
By W. HERRMANN	Section	
Date 27/ JUNE 1997.	Collar co-ords E N RL	
Page 1 of 2	Az. °G °M Incl. °	

Depth m	Mean Grainsize Mud 0.5 2 8 32 mm	Max. clast φ & Structure	Altn. Na2O Ti/Zr	Si⁰⁾ %	Description
80					Qg: Quaternary Glacial boulder Till from ~20m; poor recoveries.
100		Boco			
		Fs fresh. Some core is faintly Magnetic			Massive sparsely Fs porphyritic coherent RHYOLITE. 1-2%, 1-3mm tabular plag. and lesser shreds/prisms chloritized ferromagnesian evenly distributed in brick red-brown coloured; f.g. devit. flinty matrix
120		Distinctly Magnetic			
					Chloritic Fs porphyritic massive ANDESITE. 2% 1-3mm pink tabular Fs and 0.5% grains Mt. in dk. green chloritic f.g. matrix.
140				10.4	"
160					
100602		Fl. Bd. 0-10° contacts indistinct	2.4 / 6.0	10.5	Massive Fs porphyritic RHYODACITE? 3-4%, 1-3mm slightly glomeroporph. Fs in gray brown matrix, Fs may be highlighted by darker matrix but appear more abundant than above. Weakly Magnetic
180		Hyaloclastite?		10.1	
			3.9 / 9.0		
200					"
			2.0 / 27.2		Chloritic massive f.g. BASALT, Sharp intrusive contacts and several short included segments of fractured in situ brecciated coherent Rhyolite
220		Compaction Foliation ~50°		11.1	Sericitic massive compacted PUMICE BRECCIA. Fs xls partly sericitized, greenish sericitic matrix
240		Sharp Contacts 50° 60°			"
260					
100605			2.1 / 6.5	11.8	Monomict Hyaloclastite BRECCIA
280		Sharp intrusive contacts (Basalt into R.Dac)			Massive Fs porphyritic RHYODACITE similar to units 171-196m, weakly magnetic with few rounded mafic xenoliths similar to BBP 279, 470-485 m
		Intrusion Breccia RHY-DAC into RHYOLITE			Chloritic massive fine grained BASALT
300					Massive sparsely Fs phyric coherent RHYOLITE uniform brick red colour.
320					



GRAPHIC CORE LOG

Scale 1:1000	Hole No. BBP 278 Depth m
By	Project BOCO.
Date 27 JUNE 1997.	Section
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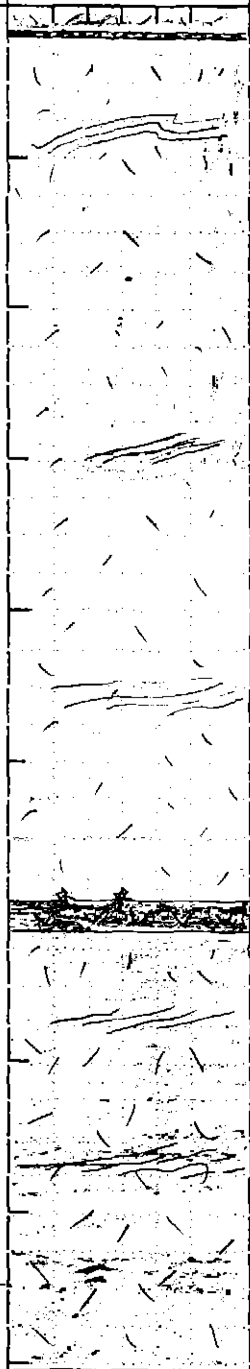
	Az. °G °M Incl. °



Depth m	Max. clast φ & Structure	Altn. Na_2O	Ti/Zr	δ18O	Description
320–440	Flow Bd. 30° LAC (c. 335); Flow Bd. 20° LAC (c. 378); Flow Bd. 0-10° LAC (c. 410)	4	8.1		Massive sparsely Fs phyric coherent RHYOLITE. Uniform brick red colour, v. faint flow banding. As above but with paler buff pink to brownish grey colour, "bleaching?" Phenocryst population and faint relict flow banding similar to above – considered part of same unit. Fs still very fresh.
440	Sharp intr. contact. (Basalt into Rhy)	4.2	44	11.2	Chloritic massive, fine grained, calcite amygdaloidal BASALT.
440–500	Fl. Bd: 25°; Fl. Bd ~ 15°	0.3	10.2	11.1	Massive sparsely Fs phyric brick red coherent RHYOLITE, similar to above. * CSR sample 184704 with low Na_2O and high Ti/Zr (due to low Zr?) is not sensible – rock looks identical to G. Lowe's sample at 489.5m, no sign of Feldspar destructive alteration – (must have muddled samples or analyses unreliable?)
100608 (c. 490)		3.0	6.0	10.7	

233163

GRAPHIC CORE LOG

Scale 1: 1000	Hole No. BBP 279 Depth 700.0 m
By W. HERRMANN	Project BOCO
Date 6 JUNE 1997	Section
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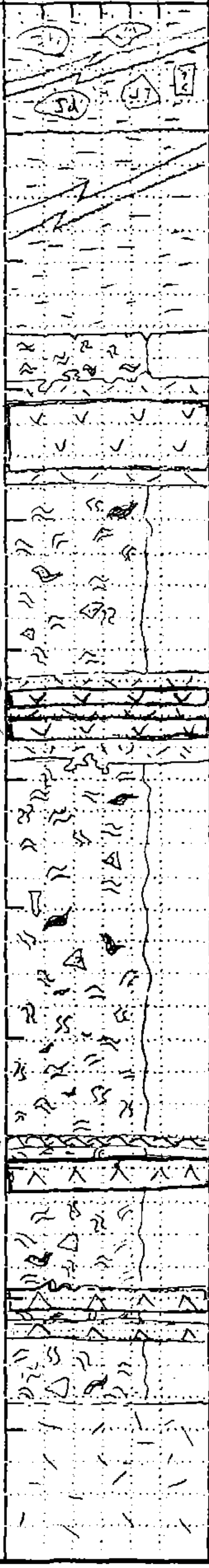
	Az. °G °M Incl. °



Depth m	Max. clast ϕ & Structure	Altn.	Description
0			Qg: Glacial Boulder Tills, poor recovery ~1.5 trays of various felsic volc. boulders
(79.0) 80			Qg or clays? No core, casing Advancer.
100	Sc (compaction foliation)		
(111.5)	S(l) ~ 45° Peperitic		Sil - (ka-Ser) pink RHYOLITIC PUMICE BRECCIA
(118) 120 (121.8)			Silic. pink + grey massive f.p spherulitic RHYOLITE
(132.0)			Chloritic f.g. amygdaloidal BASALT (DYKE)
(134.0) 140		Minor Chl veins	Silic - fs (ser-chl) massive RHYOLITIC PUMICE BRECCIA. (Sim 111.5-118m). Distinct disoriented tube pumice clasts, mostly pink silica - felsic with patchy chl-ser altn highlighting chloritic fiamme. Sparse pink aphyric rhyolite clasts.
160 (162.5) (166.3)	Contact Obscure.	Chl veins ... 10-20/m	Grey - Pink silic. spherulitic - f.p. RHYOLITE with 2 intervals f.g. chl. BASALT.
(173.5) 180	Peperitic		
200			Silicic - fs (chl-ser) massive RHYOLITIC PUMICE BRECCIA. Sparse fs cts, fiam. (Similar to above) Mostly pink + pale grey with patchy greenish/grey ser-chl altn, producing pseudo fiamme? flecks, possible lithic pink aph. rhyolite clasts but not clear or abundant. (No Py.)
220		7.4 Ti/Zr; 2.3 Na₂O; 39 AI	
(238.4) 240 (243)	Cataclastic Bx (235-237)	Ti/Zr 36	(Chl) fs phyric ANDESITE. (3%, 2mm Fs phts) Dark greenish grey matrix, distinctly MAGNETIC
			Silicic RHYOLITIC PUMICE BRECCIA. (unrecognisable near contacts.)
(259) 260	Peperitic?		Fs phyric ANDESITE
(276) 280	Contact Obscure		Silicic v. sparsely fs phyric MASSIVE RHYOLITE. Pink and grey; macro-perlitic pseudo bx ē grey altn. of fractures. <1% 1-2mm pink fs phts, some locally chloritized
300	Faint Flow Fol.		

233164

GRAPHIC CORE LOG	Hole No. BBP 279	Depth m
Scale 1:1000	Project Boco	
By	Section	
Date	Collar co-ords E N RL	
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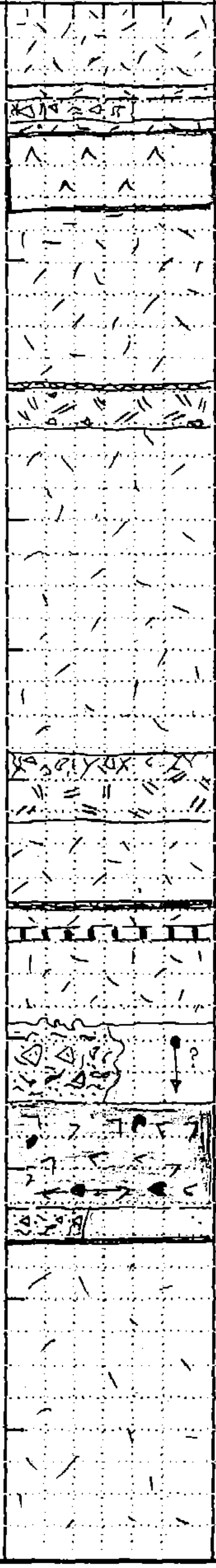

Depth m	Max. clast φ & Structure	Altn.		Description
300				Coherent RHYOLITE as above
				Pumice breccia c 40% pink RHYOLITE clasts.
320	Na2O 1.8%		Ti/Zr 25.6	F-M grained massive, weakly amygdaloidal BASALT-AND; holocrystalline phase below 325 m.
331.8		Cb Vns		
340		(Unaltered)		Silicic - (Ks) sparsely fs phyric to aphyric (1-2%, 1-2mm plag) massive coherent RHYOLITE. Very bland pink and pale grey colour. Trace acc. Py <0.1%
360	Brittle Fault			
(366)				Coherent? fs phyric RHY-DACITE? xenoliths near contact
	Fl. Bd: 0° LAOC.		Ti/Zr 6.7 Na2O 2.65%	
380				Silicic (Ks) sparsely fs phyric to aphyric massive coherent RHYOLITE. Similar to 331.8 - 359 m. Minor pseudo breccia resembling in situ hyaloclastite at upper contact and 373m. Essentially unaltered AI = 58.
400				
(416)	Pseudo Bx?			Contacts obscure - alteration pseudobreccia?
420		8.7 3.6	Ti/Zr Na2O	Fs phyric massive coherent RHYOLITE, 5% tabular - glomeroporphyritic pink fs and qz filled lithophysae? in f.g. pink (grey) matrix.
440	v.f.g. Basalt; 70% Py vns	9.0 1.4	Ti/Zr Na2O	Silicic pink-grey sparsely fs phyric - aphyric massive RHYOLITE; 2m zone grey silicified (but c relict fs) with band SM Pyrite ~10%
460	slight Peperitic contact. Compact. Fol. 40° LAOC			Polymict lithic PUMICE BRECCIA - SST. Angular juvenile pink (fsp) RHY clasts (to 50mm 20%) and fs fiamme in f.g. pumice/SST matrix. Matrix supported.
480		Tr.	Mt access.	Pink-grey massive sparsely fs phyric DACITE with characteristic rounded/embayed dk green mafic? vs SST xenoliths? Dacite weakly magnetic
	Fol: 30-60°; f.g. BASALT			Rhyolitic lithic PUMICEOUS SST. Clasts mostly <10 mm
500				Siliceous massive aphyric pink-buff-grey pale RHYOLITE, virtually textureless.
520		7.6 2.3	Ti/Zr Na2O	
				Stockwork of fine <2mm Siderite - (Qtz) veinlets >50/m ~2-3% volume.
540				

233165

GRAPHIC CORE LOG	Hole No. BBP 279 Depth m
Scale 1:1000	Project Boco
By	Section
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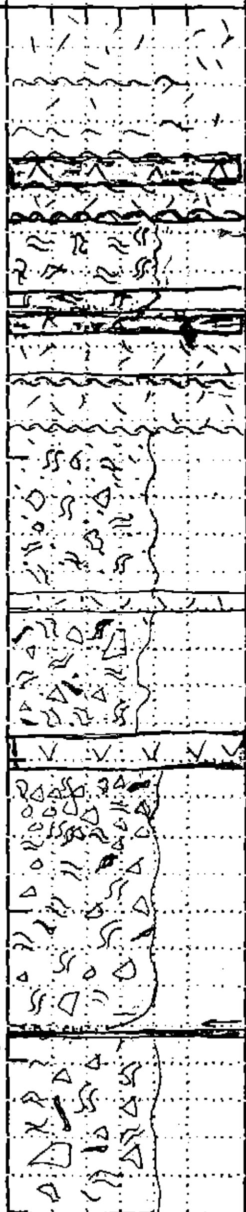
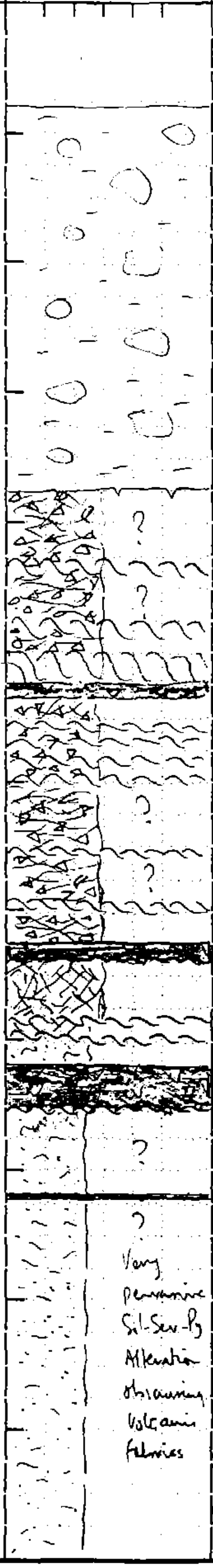


Depth m	Max. clast ϕ & Structure	Altn.		Description
540			Siderite	Aphyric RHYOLITE
	Zone of broken core.			
560			calcite vns.	Chloritic massive f.p. porphyritic ANDESITE
F	Pugging Fault Zone (1m wide)			
				Massive Silic - KSP (blotchy pink + grey) classive tube PUMICE BRECCIA.
580				
	Minor brittle faults.	2% Py		Massive Pink sparsely f.p. phyric RHYOLITE dissem Py in grey pervasively silicified matrix
		1% Py		Patchy Cc veins overprinting perv. altn.
600		1-2% Py		Silicified pyritic RHY-LITHIC PUMICE BRECCIA/SST. Pervasive grey silica altn c 1-2% fine dis Pyrite, partly detectable ~~lent tube pumice~~ locally.
620	Traces of relict FS xls.	10% Py		Q-Cb alt ~~microporkilitic~~ RHYOLITE 10% diss. Pyrite
	Clasts to 40mm.	1-2% Py		RHY-LITHIC PUMICE BRECCIA/SST. pervasive silica altn c dissem fine Py, relict fs below 615m.
640				Chloritic f.g. Massive BASALT, no Py, sharp contact
	Transition Alt. Boundary	1-2% Py		
				Silicic (ksp-ser-chl) Massive unsorted
660	fresh fs			RHYOLITIC LITHIC - PUMICE BRECCIA: Mainly clasts pink aphyric and grey fs phyric Rhyolite and abundant fs phyric tube pumice closely packed in muddy siliceous matrix.
	fg SST ?			
680				Dominance of smallish <15mm Rhy clasts above 650m and possible f.g. SST. 674-675m but otherwise massive and unsorted.
	Pumice clasts to 80mm			Blotchy pink, grey and green grey colours.
700		6.5	Ti/Zr	R
		2.5	Na2O	

GRAPHIC CORE LOG

Scale 1: 1000	Hole No. BBP 280 Depth 400.0 m
By W. HERRMANN	Project BOCO EL 47/96
Date 25 JUNE 1997	Section
	Collar co-ords E N RL
Page 1 of 2	Az. °G °M Incl. °

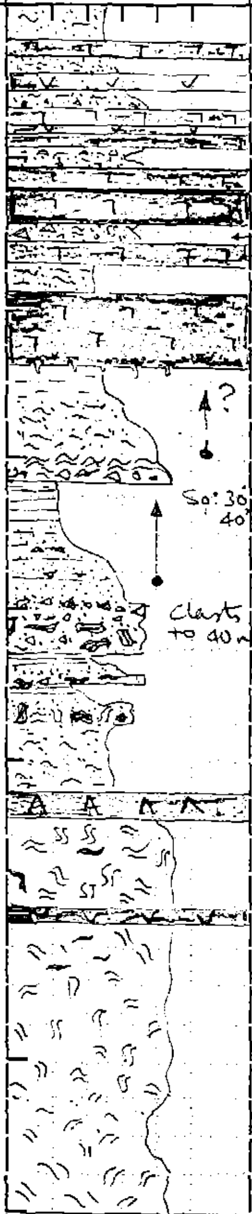
Depth m | Mean Grainsize Mud 0.5 2 8 32 mm | Max. clast ф & Structure | Altn. | Description



Depth (m)	Max. clast ф & Structure	Altn.	Description
0			NO CORE.
20–(74.9)			Qg. Quaternary Glacial Boulder Till
(74.9)–100	1-3% Py (where unoxidized below 85m)	7.3 Ti/Zr; 0.06 Na2O; 98 AI	Weathered, partly argillic and ironstained, cataclasite (fault breccia) of pervasively (strongly) Silica-Sericite-Pyrite altered volcanic as below. Facies indeterminate. Very extensive brittle cataclasite.
~104	BOCO.	30 Ti/Zr; 0.05 Na2O; 98 AI	DOLERITE Red, weathered, argillic.
~105–145	1-4% Py; Cataclasite; Puggy Shear		Cataclasite of pervasively Sil-Ser-Py altered and detextured felsic volcanic (c̄ ubiquitous 1-4% dissem. Pyrite) seriously tectonically brecciated with coarse to fine cataclasts/fragments in finer milled sericitic/granular matrix. Precursor indeterminate; rare relicts near ~120m look like massive SANDSTONE?
~145–163	~0.5% Py; ~1% Py		Silicified - Rebrecciated + Qtz veined felsic volcanic some traces of relict Pumice?? but facies indeterminate - essentially cataclastic
~163–183	~1% Py		Chloritic Massive Mg. DOLERITE; very broken core with puggy sheared margins; esp @ 179m. (Notably not pyritic and not Sil-Ser altered)
~183–240	1-3% Py (Dissem); Locally 10% Py; 1-3% Py	7.2 Ti/Zr; 0.09 Na2O; 99 AI / 8.4 Ti/Zr; 0.05 Na2O; 98 AI	Siliceous - sericitic - pyritic massive f.g. ashy SANDSTONE - SILTSTONE. Very pervasive Sil-Ser-Py alteration has "detextured" the rock to a fine granular fabric; the very massive nature (no stratification anywhere) and pinkish grey vaguely felsic appearance of least altered zones at ~176m and 236m suggests aphyric coherent Rhyolite but relict tube pumice (in frags in Dolerite!) at 165m and faint sandy - xtal fabric at 161m suggests a massive volcaniclastic unit. Certainly VERY massive but intensity of alteration makes facies interp. uncertain.

233167

GRAPHIC CORE LOG	Hole No. BBP 280	Depth 400.00 m
Scale 1:1000	Project Boco	
By	Section	
Date	Collar co-ords E N	RL
Page 2 of 3	Az. °G °M Incl.	°



Depth m	Max. clast φ & Structure	Altn.	* δ¹⁸O ‰	Description
240	2% Py		* 9.2	(Continued) Also clear relict fine breccia below 251.5m suggests volcaniclastic units
	2% Py	2% Py		Sericitic PUMICEOUS-LITHIC FINE BRECCIA + SST
260				Chloritic massive f.g. amygdaloidal BASALT (DYKES)
	1% Py, 0.5% Py, 2% Py, 2% Py, 1-3% Py	13.4, 4.4, 32	Ti/Zr, Na₂O, AI; * 11.7	Massive Fs porphyritic DACITE SILLS? ~5% glomeroporphyritic 2-3mm white/pink Fs in mottled green-grey matrix ≥ thread Chl. Not magnetic, typically ~1% dissem Py but Fs fresh.
280				Sil-Ser-Pyritic f.g. massive ashy SILTSTONE?
	Peperitic?	13.0, 0.1, 75	Ti/Zr, Na₂O, AI	Massive Fs porphyritic DACITE Fs pcts partly sericitized or weakly CO₃ altered.
300	1-2% Py, 3-5% Py	7.7, 0.1, 82		Graded PUMICEOUS mass flow? grading from thin (20cm) lithic rich Bx at base through compacted PUMICE BRECCIA to massive Fs phyric PUMICE SST and fine grained massive ashy SILTSTONE. Pervasive Sil-Ser-Py.
	S₀: 30° 40°; 0.5% Py	6.9, 0.1, 90	Ti/Zr, Na₂O, AI	Siliceous f.g. laminated-massive "cherty" grey ashy SILTSTONE, grading down to ashy SST with thin (<10cm) beds of SST intraclast rich BRECCIA. Pervasively silicified but <0.5% Py
320	Clasts to 40mm. 1-2% Py			Siliceous BRECCIA dominated by angular/wispy intraclasts of grey-cherty SILTSTONE, Pumiceous sand matrix
			* 11.5	Interbedded massive-stratified ashy SANDSTONE,
	1-2% Py; few stringer Py's	7.0, 0.06, 94	* Ti/Zr, Na₂O, AI	SILTSTONE and PUMICE-SILTSTONE INTRACLAST RICH BRECCIAS. Pervasive Sil-Ser-Py altn ~1-3% dissem Py esp. in coarser units; some fine stringer Py veinlets in f.g. SLST.
340	0.5% Py near margins	35.0	4.66	Murky grey Fs phyric ANDESITE pink altn and minor veinlets of Pyrite near margins.
	Pumice clasts to 30mm			Siliceous (sericitic-Pyritic) massive Fs phyric coarse PUMICE BRECCIA. Patchy pervasive Ser-Py 1-2% Py.
360	Sharp chilled contacts. 60°; 1-3% Py	LAC		Chloritic massive CO₃-Chl amygdaloidal f.g. BASALT
380	<0.5% Py	K		Siliceous (felsic) massive Fs phyric PUMICE BRECCIA. Abundant close packed clasts disoriented tube pumice 5-50mm, and ~3% 2mm pink Fs xts; blotchy pink (Qtz-Fs) and greenish grey (ser-chl) alteration;
400	Zr 240	7.1, 2.7, 52	11.7 Ti/Zr *, Na₂O, AI	Fs generally fresh and overall <0.5% Py but there are minor patches of moderate Sil-Ser-Py alteration with 1-2% dissem Pyrite.

Whole rock assays by CSR + G. Green show discrepancies in TiO₂, Al₂O₃, K₂O and Zr. Uncertain if Green used same sample as CSR. There are no core blocks in trays to indicate G. Green sample. 10cm segments of ½ core (split) every ~0.5m through the zone 395-400m of fresh material (avoiding patchy Qtz-Ser-Py alteration)

233168

GRAPHIC CORE LOG

Scale 1: 1000	Hole No. AK1 Depth 553.7 m
By W. HERRMANN	Project BOCO EL 47/96
Date 13 JUNE 1997	Section
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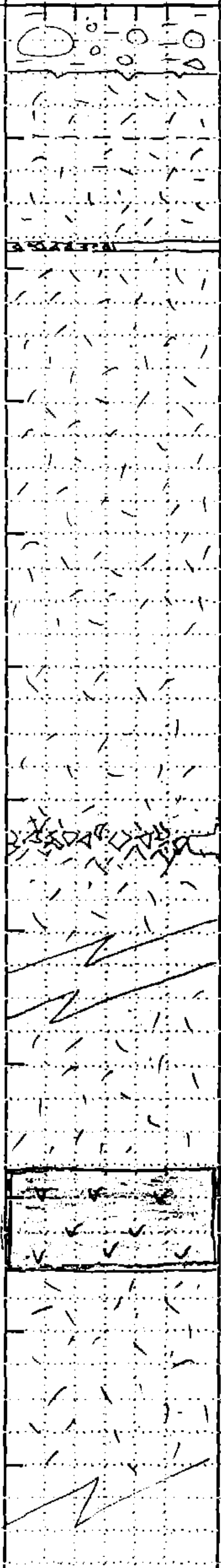

Depth m	Max. clast ϕ & Structure	Altn.		Description
60				Qg. Glacial varved clays + boulder till.
80	BOCO; Fs fresh	K K	<0.5% Py.	(Silicic) Fs phyric massive RHYOLITE 2% 1-2mm tabular white Plag pts in f.g. cherty siliceous matrix, variably pale buff grey to pink. Network irregular fractures with fine pyrite along but fs very fresh
	Contact obscure			Chloritic Hyaloclastite Bx or Fault Breccia?
100	(Pink zone marked "K")	K K		Silicic sparsely fs phyric massive RHYOLITE probably similar to above but fs pts less apparent (or less abundant?).
120	Albitized!		0.5% -1% Py	Patches of semi pervasive to pervasive silica-carbonate ?? - pyrite altn. (shown:) appear to be related to zones of fracturing and contain ~0.5% v. fine diss. Pyrite
140				(Overprinted by Cb-Qtz stockwork veinlets ~1-2mm 10-20/m, ubiquitous)
160		K K	<0.5% Py	
180	Flow Band ~70-80°		No Py	Monomict hyaloclastite Breccia.
	Flow Band 70°			Uniform pink-buff-grey sparsely fs phyric massive RHYOLITE. Fs fresh ~1%, 1-2mm narrow tabular white plag; rarely flow banded and very rarely flow bx.
200				
280	Fl. Bd: 20°			
	Fl. Bd: 60°			
300	Contact 15° Sharp int.			Chl (Ep) f.g. (amygdaloidal) BASALT DYKE.
	Contact 30°			
320				Monotonous buff, pink or grey fs phyric RHYOLITE variably massive or flow banded (grey least altd: zones highlight fs pts ~2% 1-2mm tabular).
				Fg BASALT Dykes at 389.7 - 392.7 m, 413.0 - 416.5 m, 428.3 - 431.5 m

233169

GRAPHIC CORE LOG	Hole No. AK1	Depth m
Scale 1: 1000	Project Boco EL 47/96	
By	Section	
Date	Collar co-ords E N RL	
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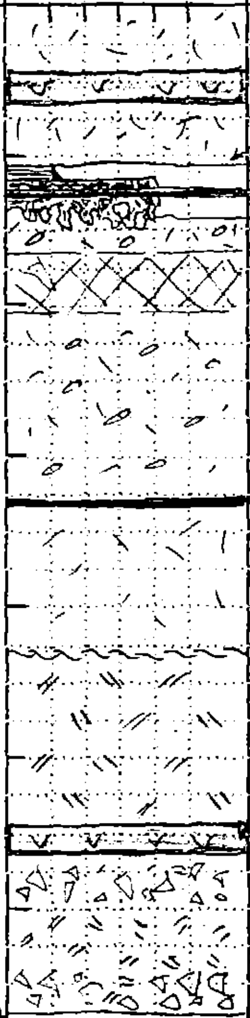


Depth m	Max. clast ϕ & Structure	Altn.			Description
420					→ FACING based on Ashy SLST top ?? to Pumiceous mass flow. –(dodgy)
440	Sharp Passive conformable	? ↑	So:	40-50°	Laminated grey Sil/Ser ashy SILTSTONE Sericitic fs phyric fine PUMICE BRECCIA.
	Basalt Dyke Peperitic	3m			
460	FAULT BX. c̄ Cb matrix				Silicic pale grey massive, sparsely Fs phyric RHYOLITE. 1% 1-2 mm narrow tabular white Fs and 1% narrow elongate aligned amygdales (to 5-10 mm) filled with chl-qtz-cb. Apart from amygdales composition (odes similar to massive RHYOLITES up hole. Amygdales not present below 485 m
480	Vesicular Top? of Sill?				
	DOLERITE				
500	Contact obscure 20 cm Cataclasite/FAULT				(Silicic) Fs porphyritic massive RHYOLITE 5%, 1-4 mm white fat tabular/glomero porphyritic Fs in grey f.g. glassy/devitr. matrix. Distinctly more porphyritic than above
520					Chl (Ep) massive f.g. BASALT Dyke
540					(Silicic) Fs porphyritic RHYOLITE as above; with extensive blotchy pink and green/grey pseudoclastic? alteration – could be Hyaloclastite breccia with trace pumice? in matrix but suspect much is pseudoclastic alt. of coherent RHYOLITE, in any case nearly monomict and very proximal
553.7					

APPENDIX II Boco whole rock Oxygen Isotope Data (G.Green)

Boco oxygen isotopes

Sample#	Hole/m	$\delta^{18}O$ (‰)	Sample description
	BPP 278		
100601	151	10.4	pink fs-phy lv, minor q-chl vnlts.
100602	173.9	10.5	pink lv, white fss, min ser in frac
100603	183.9	10.1	pnk-grn lv, pnk fss, q vnlts
100604	228.2	11.1	lv, patchy chl, few 1mm q vns
100605	264.5	11.8	pnk-grn lv, white fs, few q vns
100606	441.5	11.2	vescicular mafic dyke
100607	452	11.1	pnk-grn aphyric, flow bdd lv
100608	489.5	10.7	pink ms lv. fs alt. s,cb; fm alt. chl
	BPP 280		
100609	245.7	9.7	grey-grn lv, pink fs, ~2% vfg py
100610	276.6	11.7	grey-grn sericitised aphy lv, 3mm q vn w. py
100611	316.5	11.5	crm-grey serd. fbdd lv, q-py vns
100612	395	11.7	ms pink fs-phy lv, grn ser mesh altn., 1mm q vnlets
	BPP 253		
100613	204.5	11.7	fbdd lv, minor fs alt. cb, tr q vnlts
100614	329.5	11.6	ms pnk lv, serd. zones, minor q-py vnlts.
100615	391	10.2	pnk-grn tuff, fs alt. cb (weak), serd. g'mass, precl chl-cb vnlts, X cutting q-chl vnlts.

py $\delta^{34}S$ BPP 280 260.6m 2.8 ‰

- Have more analyses, but can't track down details of sample location at moment - total range -1.2 to +4.7 ‰
- similar to other barren pyritic system. J. Chester

Fax 0364 283255

APPENDIX III

Explanation of the use of immobile trace elements in interpretation of altered rocks.

It has been shown that some components of hydrothermally altered volcanic rocks, notably Al_2O_3, TiO_2 and the high field strength elements (HFSE) Zr, Nb & Y, may be chemically immobile during hydrothermal, metamorphic and weathering alteration processes, (Winchester and Floyd, 1977, and Finlow-Bates and Stumpfl, 1981).

Immobile components have applications in identifying the magmatic affinities of otherwise unrecognisable altered rocks in which concentrations of mobile components may have been substantially modified, and in quantitative estimation of such chemical mass changes due to alteration (eg: MacLean and Kranidiotis, 1987; Barrett et al., 1993; MacLean and Barrett, 1993).

MacLean and Barrett (1993) recommended that element mobility in a system should be tested (rather than assumed) on variably altered and fresh samples, preferably from an identifiable volcanic unit that was traceable through an alteration zone. X-Y scatter plots of analyses of immobile element pairs, from such "single precursor" systems, should show highly correlated (r=0.90 to 0.99) linear trends - "alteration lines" - due to mass gains and losses of the mobile components in the altered zones of the rock unit. Effectively, the immobile components could be either concentrated by bulk mass loss of mobile components, or diluted by bulk mass gain, during alteration. Calculated linear regressions of such alteration lines ideally pass through the origin of the scatterplot (representing infinite mass gain) with positions between the origin and the (unaltered) precursor composition representing net mass gain and those at values higher than the precursor composition representing net mass loss (Figure 1, from MacLean and Barrett, 1993)..

Scatter plots of immobile incompatible-incompatible element pairs such as Zr-Y and Zr-Nb can be used to identify rocks of different magmatic fractionation series within a volcanic sample set; they produce separate linear trends of magmatic enrichment which pass through the origin and are coincident with their respective alteration lines, (Figure 3, from MacLean and Barrett, 1993).

On the other hand, plots of immobile compatible-incompatible pairs (eg. TiO_2-Zr) and compatible-compatible pairs (eg. Al_2O_3-TiO_2) produce separate alteration lines for each chemically distinct rock unit and are useful for discrimination and correlation of individual homogenous volcanic units within and through alteration zones (Figure 5, from MacLean and Barrett, 1993).

Studies of altered volcanics at the Thalanga massive sulphide deposit in the Mt Windsor Volcanics, North Queensland (Herrmann, 1994) and the Mt Read Volcanics, Tasmania (Crawford et al., 1992) have shown that Zr, TiO_2, P_2O_5 and Al_2O_3 are the most reliably "immobile" components. Nb and Y have relatively low abundance levels and low primary ranges in typical calcalkaline lavas and have not proven useful for diagnostic geochemistry.

In practice, it has been found that TiO_2-Zr and P_2O_5/TiO_2-SiO_2 scatterplots and the ratios Ti/Zr and P_2O_5/TiO_2 are most useful for discriminating various volcanic rock units and compositional groupings.

In cases where the pre alteration (precursor) composition of an altered rock can be inferred (from mapping or the recognition on TiO_2-Zr scatterplots of highly correlated linear trends including samples of altered and least altered rocks) it is possible to estimate the mass changes which occurred during alteration, for each mobile component, using calculations based on the dilution or concentration of an immobile component, such as Zr.

Mass changes for each mobile component (using Zr as the immobile monitor) are calculated as:

$$\text{Mass Change (g/100g)} = [Zr_{precursor} / Zr_{altered} \times \%\ component_{altered}] - \%\ component_{precursor}$$

(after: MacLean and Barrett, 1993)

Mass change calculations can be made either for individual precursor & altered sample pairs or by comparisons of "average" compositions from a set of least altered precursors with "average" compositions of particular types of altered rocks from the same or magmatically related volcanic units.

The calculated mass changes are expressed in the unit: g/100g (interchangeable with weight% but not to be confused with the chemical "concentration") for each of the twelve major components of wholerock analyses (SiO_2 to P_2O_5, S and LOI).

Components which are expected to be immobile (eg: TiO_2 and Al_2O_3) should have very low calculated mass changes. Small Al_2O_3 changes may be due to variations in feldspar phenocryst abundance (the plagioclase end member compositions albite and anorthite contain ~19%Al_2O_3 and ~36%Al_2O_3 respectively) but significant mass changes in Al_2O_3 (say >1%) should trigger suspicions that the precursor composition is inappropriate.

The sum of individual component mass changes represents the net mass change due to alteration. Large mass changes have implications for gross volume change (MacLean and Barrett, 1993) although considerable mass gains can be accommodated as void fillings in volcaniclastic, pumiceous or amygdaloidal volcanics.

Calculated mass changes offer a means of discriminating alteration styles and delineating zones of different intensity of alteration which could provide vectors to ore and set exploration priorities (Barrett and MacLean, 1994).

The identification of of Na_2O depletion in footwall alteration zones is a well known VHMS exploration technique (eg: Date et al., 1983; Hashiguchi et al. 1983). Near total Na_2O depletion, however, tends to exist in rather broad pervasive zones in VHMS footwall alteration systems and may not provide useful gradients or vectors to centres of hydrothermal flow and possible mineralisation. In contrast, studies of the Hellyer and Thalanga alteration systems (Gemmel & Large, 1992 and Herrmann, 1994) indicate that major progressive mass gains of silica, iron and sulphur (upto about 30-90g/100g, 20g/100g and 15g/100g respectively) occurred in the proximal stringer zones beneath massive sulphides.
These silica, iron and sulphur mass gains considerably outweigh the Na_20 mass loss (usually limited to ~3-4g/100g in felsic volcanics) and could provide more reliable vectors to ore on a prospect scale.

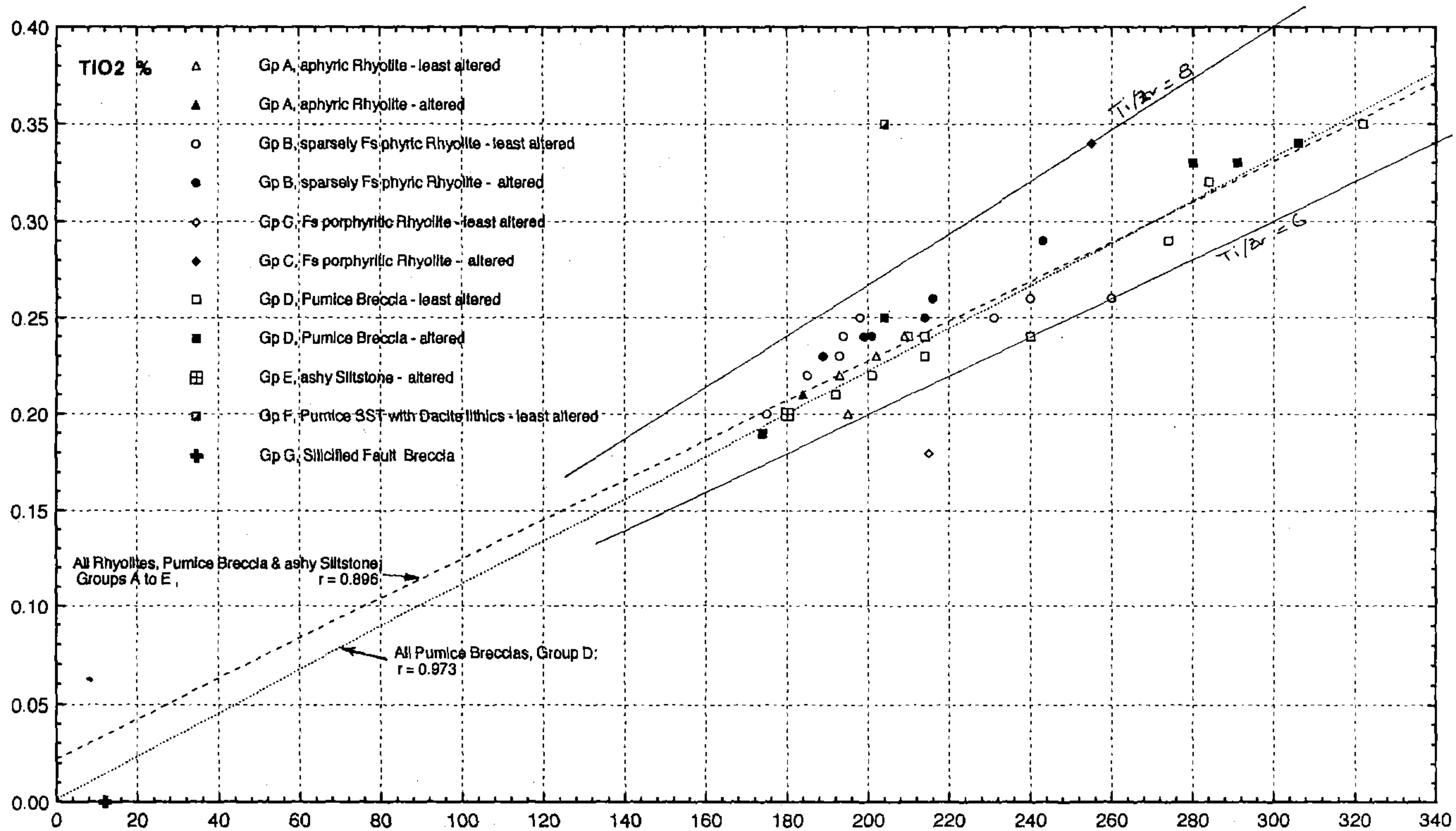
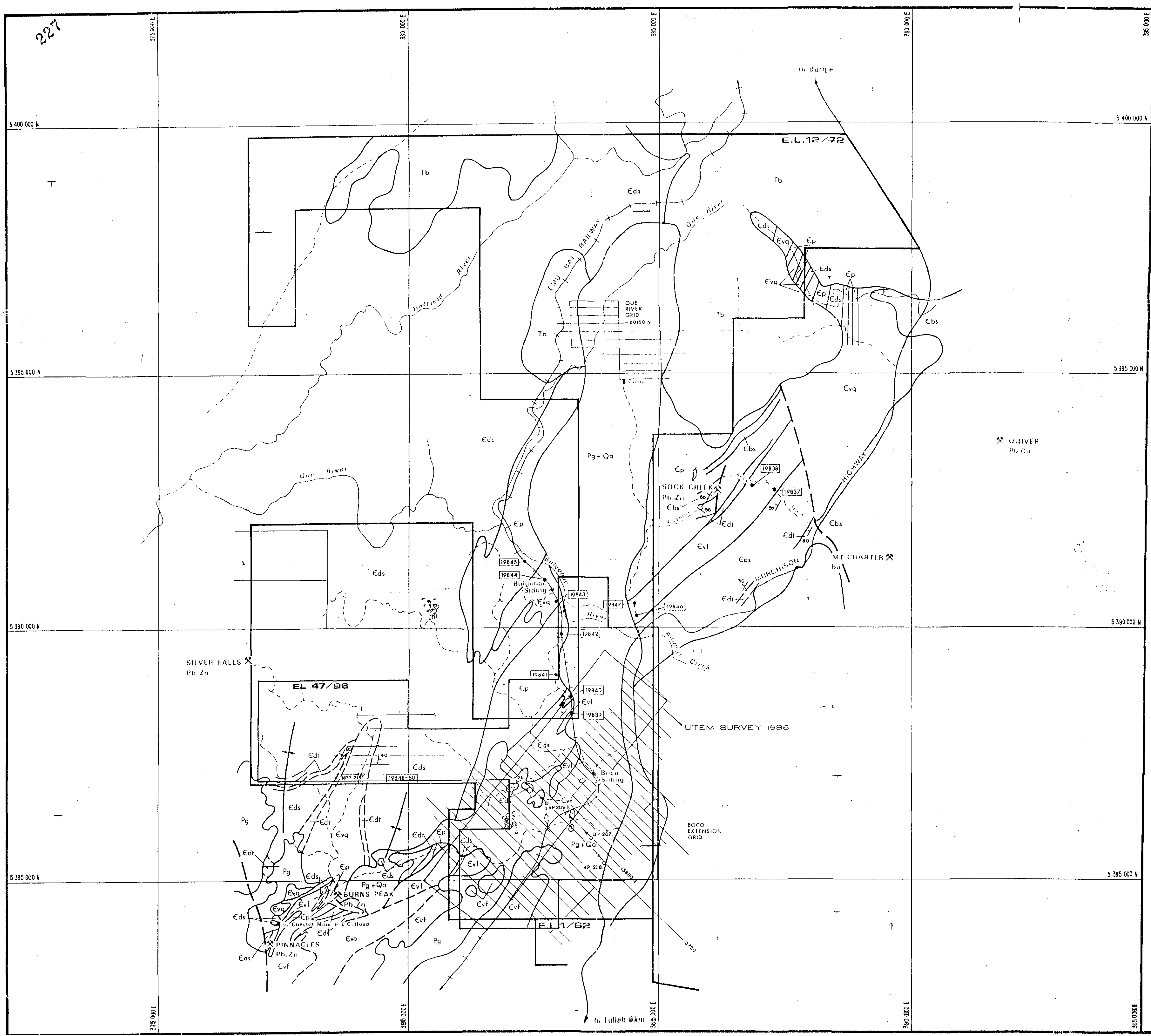


Figure 12 TiO2-Zr scatterplot of Boco samples (listed in Table 1)

233173



PROJECT AREA

Queenstown

HOBART

L E G E N D

PLEISTOCENE - RECENT

Pg + Qa	Flouvioglacials and Alluvium

TERTIARY

Tb	Basalt and sub-basaltic gravels

CAMBRIAN

Ɛds	Micaceous - tuffaceous greywacke, siltstone, shale
Ɛdt	Felsic tuffs and epiclastic sediments (quartz feldspar phyric)
Ɛbs	Dark grey to black shales, siltstones
Ɛvq	Quartz - feldspar phyric (rhyolitic) pyroclastics and lavas
Ɛp	Coarse quartz - feldspar porphyry (rhyolitic, intrusive)
Ɛvf	Feldspar phyric (dacitic - rhyolitic) lavas and pyroclastics
Ɛva	Andesite (?)

⚒ Mine, Prospect

19837 • Sample locality

o BP 207 Drill hole

5 cm

98-4133

ANNUAL REPORT - EL 47/96
RGC EXPL - BOCO SIDING/NTH PINNACLES
A ELLISTON Vol 3 of 3

GN MN/TN 11°15'

233174

NOTE: ADAPTED FROM MAPPING BY - MILL 1979, KOMYSHAN 1986, CORBETT + GREGORY 1986.

87-2740 Vol 2/2

PANCONTINENTAL MINING LIMITED
EXPLORATION DIVISION

E.L.12/72-TASMANIA
BULGOBAC PROJECT
GEOLOGICAL INTERPRETATION

SCALE 1:50 000
0 0·5 1 1·5 2 2·5 3
kilometres

Compiled W.H.	Date May 1987	Dwg.No. 108/D/9
Report No. 87/33	Map Ref.	PLATE 1

FIGURE 1

98-4133

ANNUAL REPORT - EL 47/96
. RGC EXPL - BOCO SIDING/NTH PINNACLES
A ELLISTON Vol 3of3

238175

Figure 2 1:5,000

Interpreted Geological cross Sections
Boco Prospect, EL 47/96, Tasmania

Walter Herrmann Geoscience Pty.Ltd. Aug. 1997

Figure 3 1:1,000

Cross Section BBP 208 & 253

Boco Prospect, EL 47/96, Tasmania

5 cm

Walter Herrmann Geoscience Pty.Ltd. Aug. 1997

Figure 4 1:1,000
Cross Section BBP 246 & 247
Boco Prospect, EL 47/96, Tasmania
Walter Herrmann Geoscience Pty.Ltd. Aug. 1997

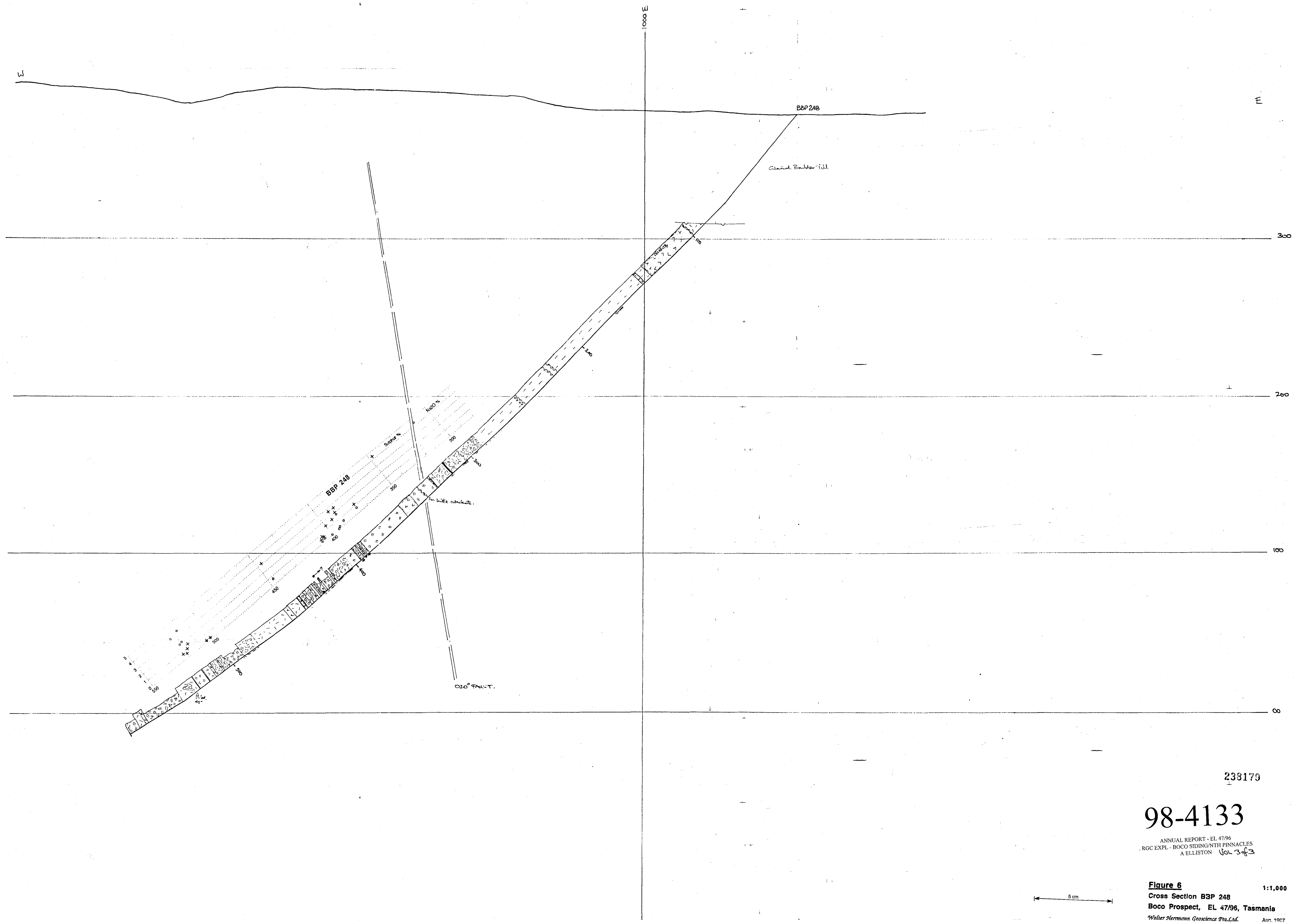
233178

98-4133

ANNUAL REPORT - EL 47/96
RGC EXPL - BOCO SIDING/NTH PINNACLES
A ELLISTON Vol 3 of 3

5 cm

Figure 5 1:1,000
Cross Section BBP 207 & 242
Boco Prospect, EL 47/96, Tasmania



98-4133
ANNUAL REPORT - EL 47/96
RGC EXPL - BOCO SIDING/NTH PINNACLES
A ELLISTON Vol 3 of 3

Figure 6 1:1,000

Cross Section BBP 248

Boco Prospect, EL 47/96, Tasmania

Walter Herrmann Geoscience Pty.Ltd. Aug. 1997

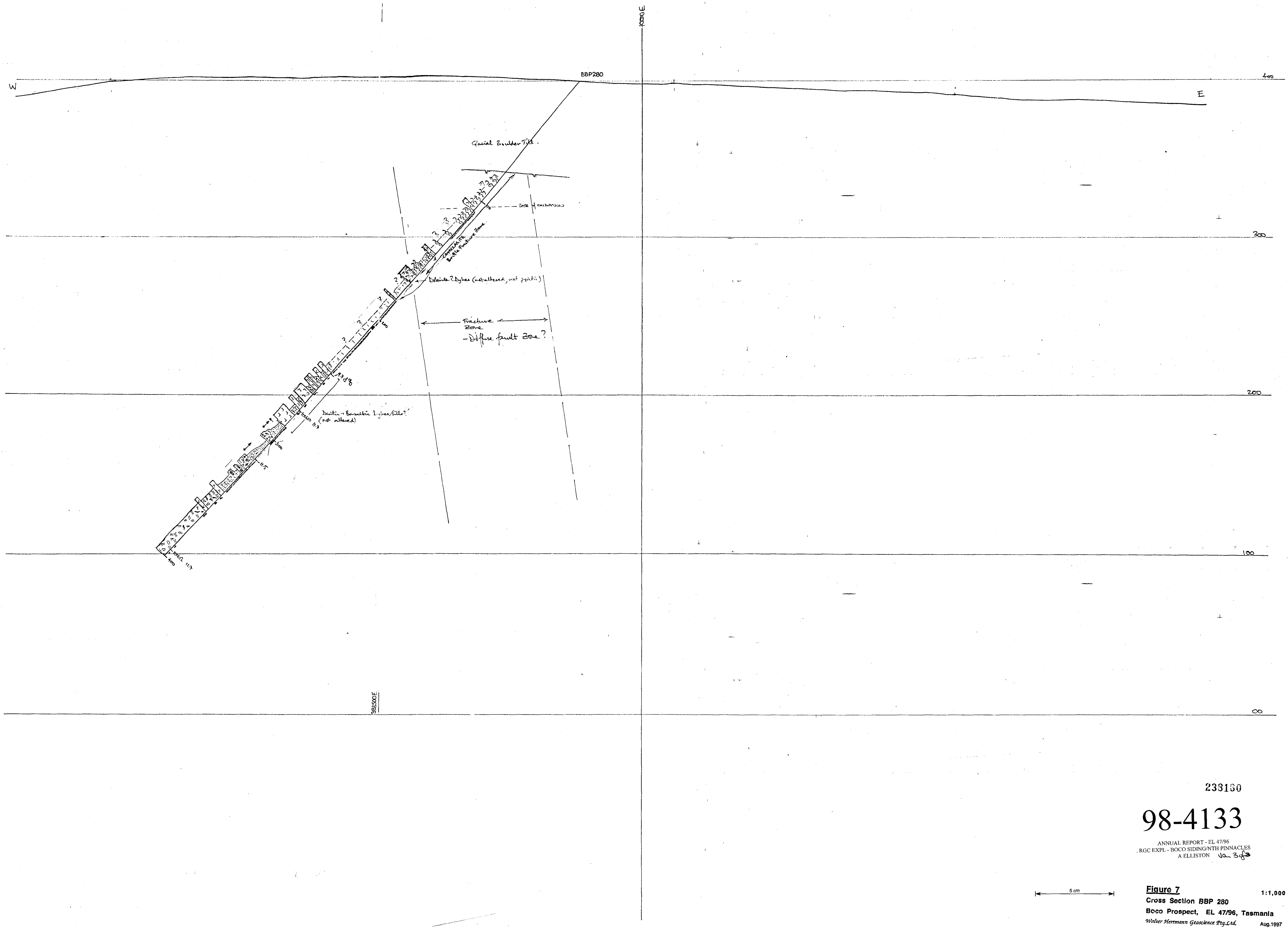
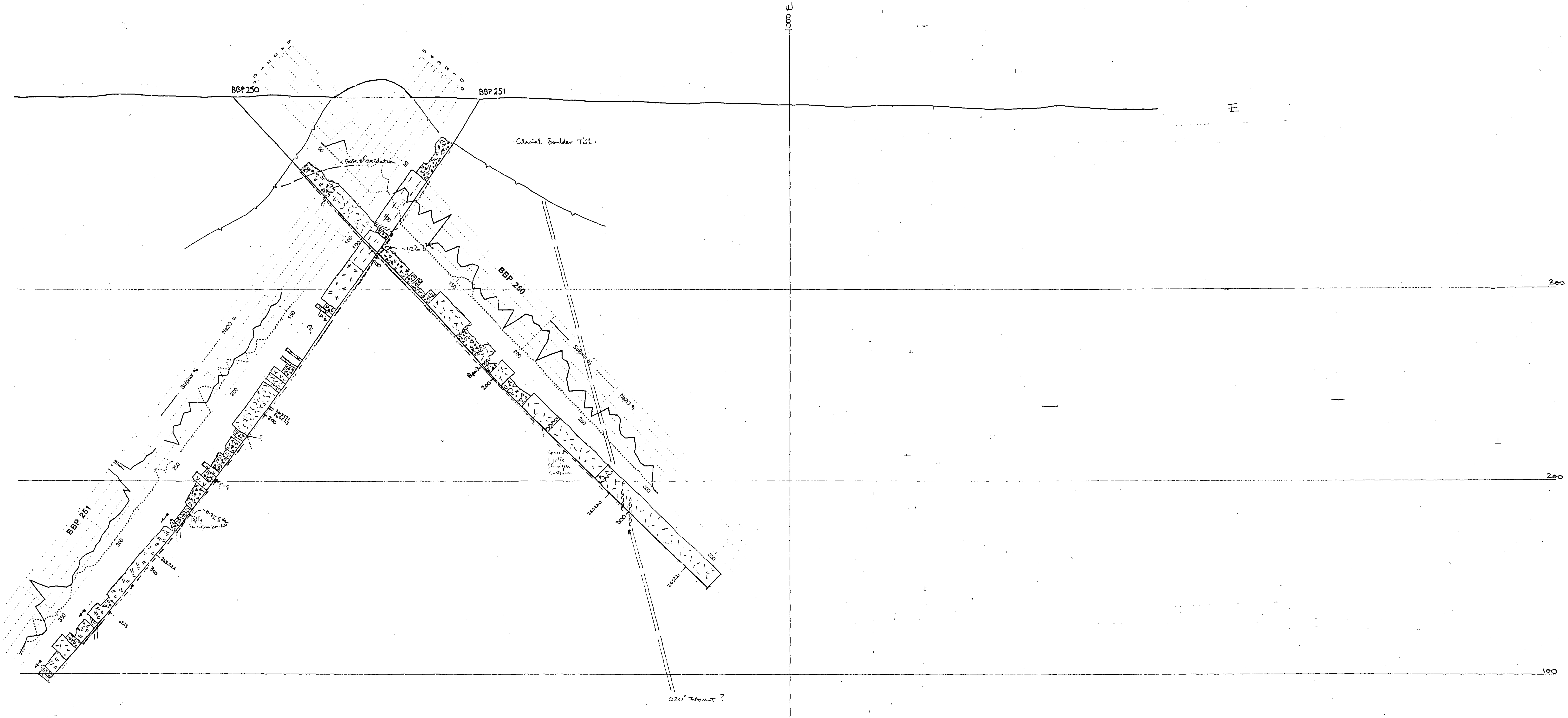


Figure 7 1:1,000

Cross Section BBP 280

Boco Prospect, EL 47/96, Tasmania

Walter Herrmann Geoscience Pty.Ltd. Aug.1997



233181

98-4133

ANNUAL REPORT - EL 47/96
RGC EXPL - BOCO SIDING/NTH PINNACLES
A ELLISTON VOL 3 of 3

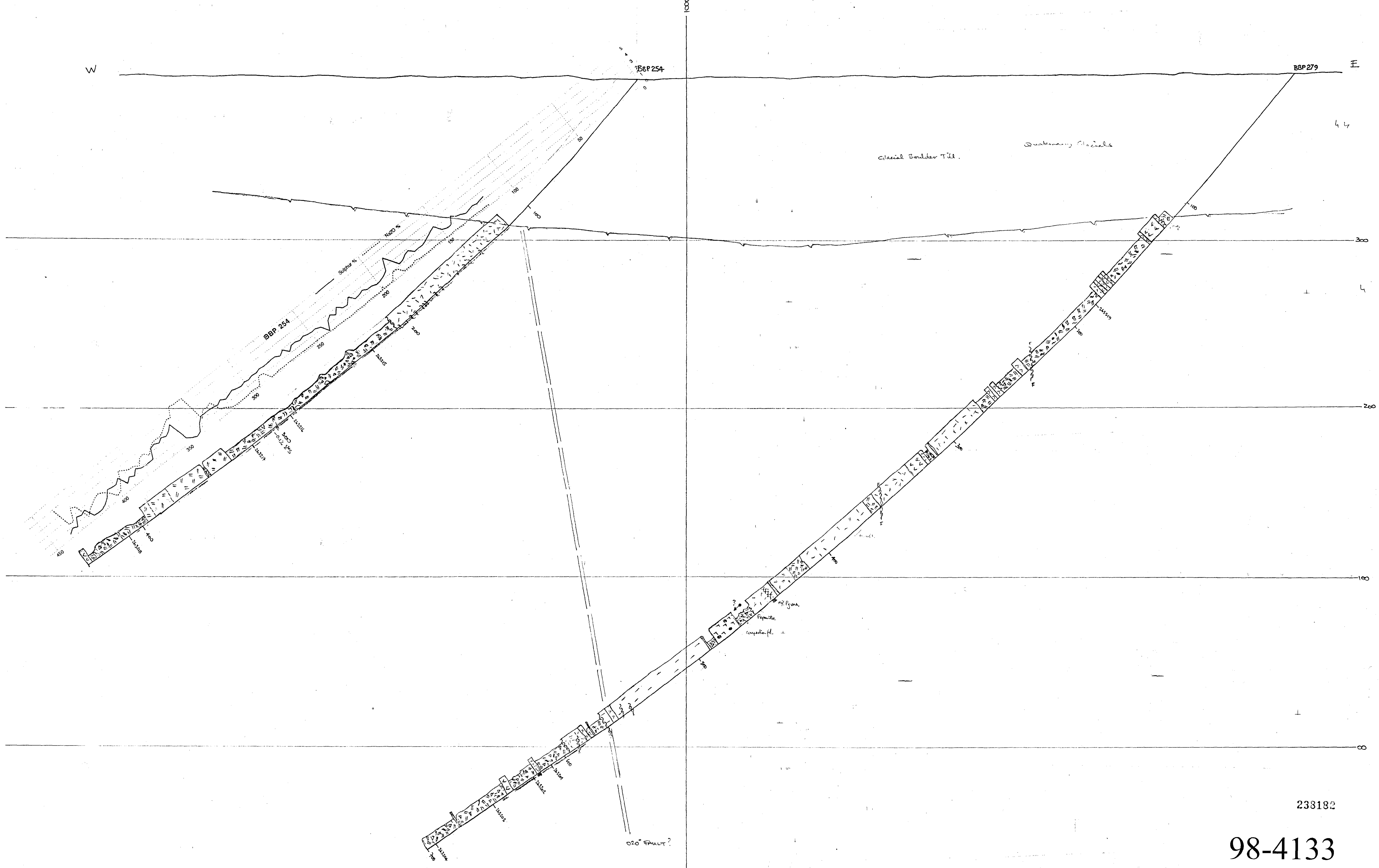
5 cm

Figure 8 1:1,000

Cross Section BBP 250 & 251

Boco Prospect, EL 47/96, Tasmania

Walter Herrmann Geoscience Pty.Ltd. Aug. 1997



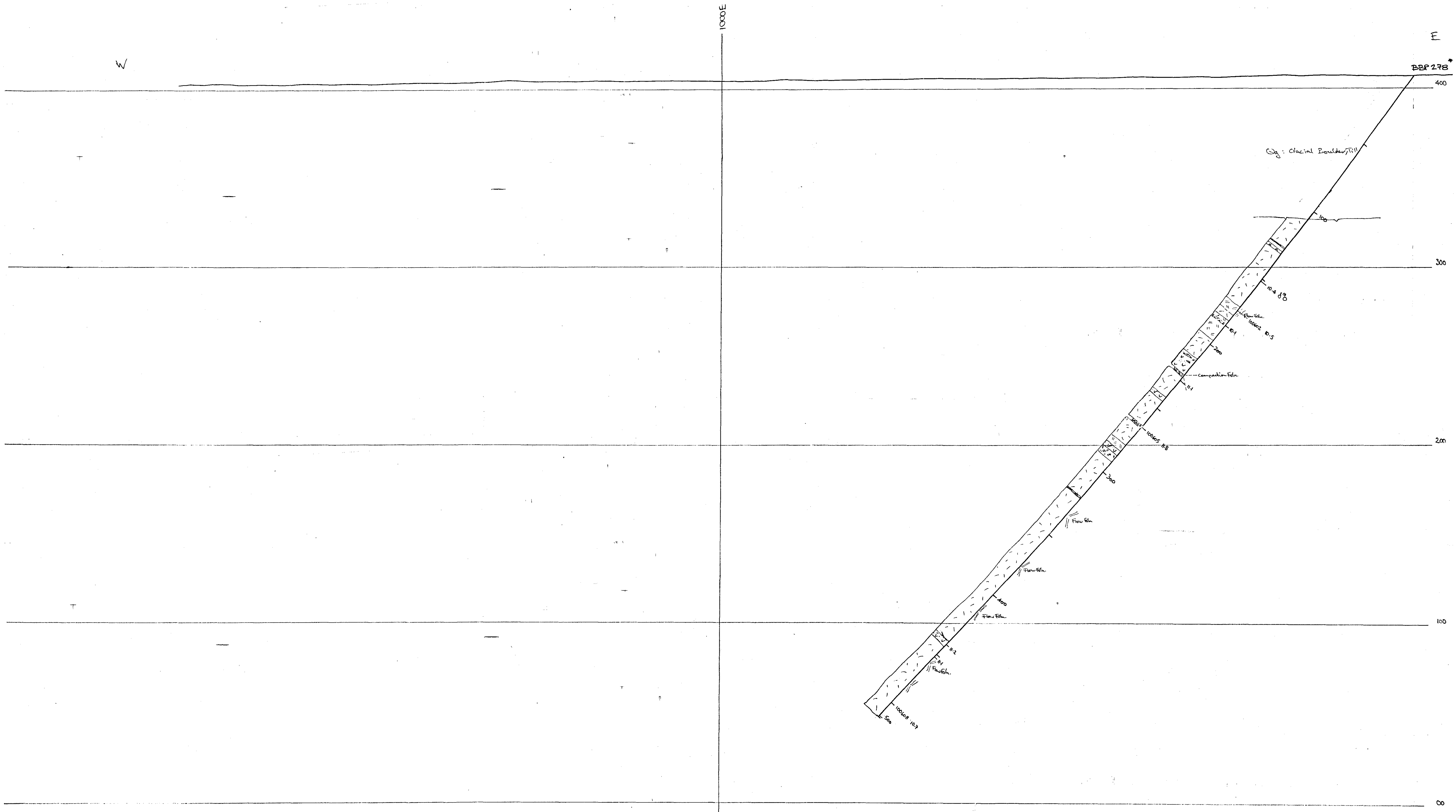
238182

98-4133

ANNUAL REPORT - EL 47/96
RGC EXPL - BOCO SIDING/NTH PINNACLES
A ELLISTON VOL 3 of 3

5 cm

Figure 9 1:1,000
Cross Section BBP 254 & 279
Boco Prospect, EL 47/96, Tasmania
Walter Herrmann Geoscience Pty.Ltd. Aug. 1997



* AZIMUTH of BBP 278 ≈ 315° AMG.
THIS SECTION IS PROJECTED ONTO ~285° AMG
PARALLEL TO OTHER BOCO SECTIONS.

233183

98-4133
VOL 3 of 3

5 cm

Figu… 10 1:1,000
Cr… …ection BBP 278
Boco Prospect, EL 47/96, Tasmania
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