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EXPLORATION LICENCE NO. 39/85

BULGOBAC RIVER, TASMANIA
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KEYWORDS

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DRILLING

GEOCHEMISTRY

DOWNHOLE EM

MT READ VOLCANICS

ALTERATION

SOPHIA

GEOLOGY

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GEOPHYSICS

PETROLOGY

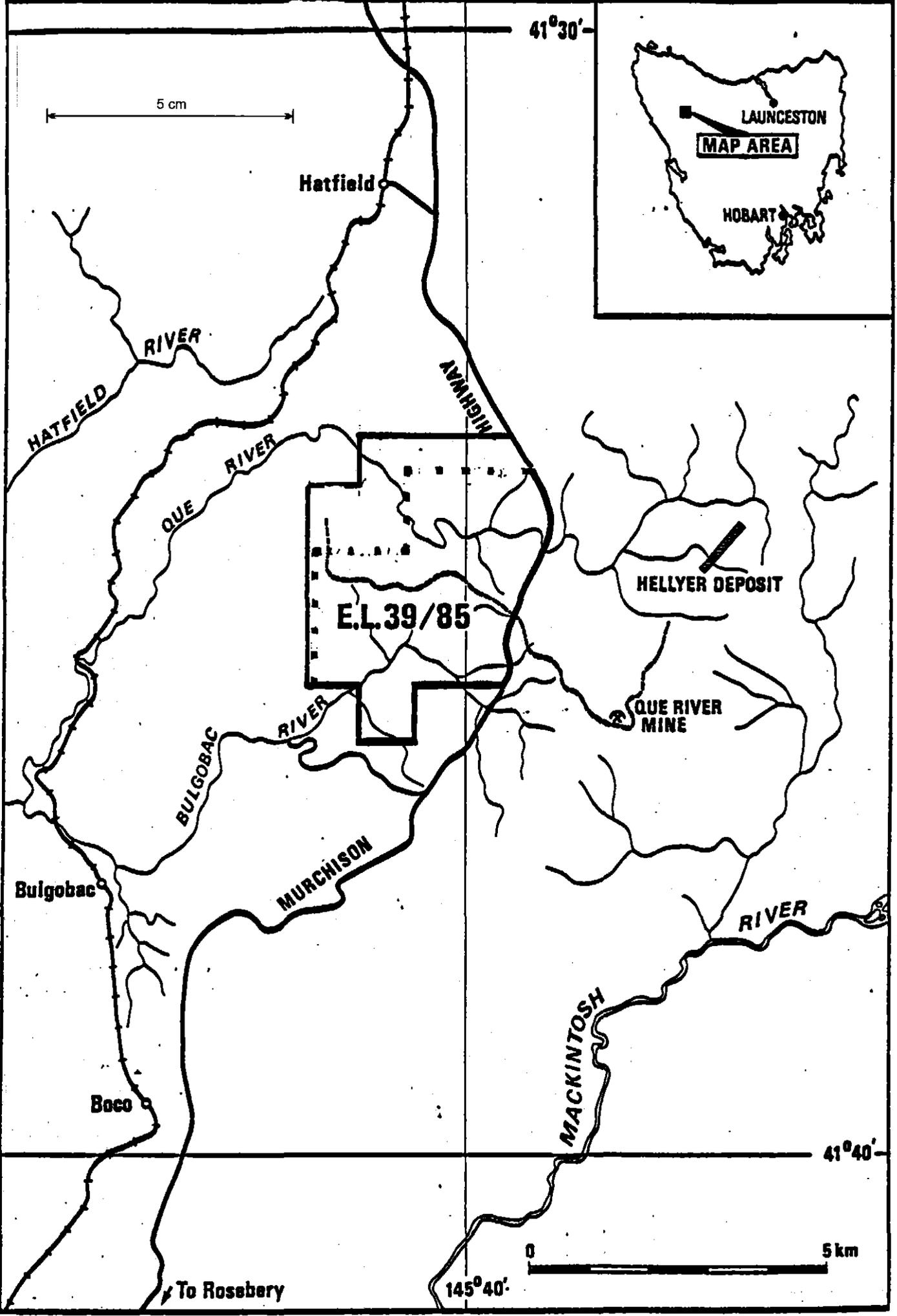


FIG. 1 LOCATION MAP E.L.39/85 BULGOBAC RIVER TAS.

1. INTRODUCTION

EL 39/85, "Bulgobac River", is located 60km SSW of Burnie, a major industrial town and port on the NW coast of Tasmania. The Murchison Highway forms the eastern boundary of the 11km² title which was granted on 14 February, 1986. Aberfoyle's Que River and Hellyer Mines are located immediately east of the adjacent Murchison Highway (Figure 1).

The EL was granted after an application under the recently introduced tender system. The area, which had been held by Comstaff Pty Ltd as part of EL5/63, became available when EL 5/63 was reduced to the maximum allowable area of 125km².

In June 1988, the area of EL 39/85 was increased to 16km² (Figure 1). This was caused by the Department of Mines adjusting the Licence boundaries to the AMG kilometre graticules on the relinquishment of the adjacent Exploration Licence (EL12/72 formerly held by EZ).

Infrastructure in the area is excellent with major electricity transmission lines passing through Aberfoyle's nearby mining leases; the Murchison Highway being the eastern boundary of the title area; the close proximity of EZ's Burnie to Rosebery railway line; abundant water and new link roads bringing population centres within commuting distances of any possible mining operation.

The exploration target in EL 39/85 is a volcanogenic polymetallic base and precious metal deposit similar to the nearby Hellyer deposit. The Hellyer deposit has a published

- 2 -

resource of 15m tonnes indicated at 13.0% Zn, 6.9% Pb, 0.4% Cu, 156 g/t Ag and 2.3 g/t Au with a further 4.0m tonnes inferred (Aberfoyle, 1987).

This report summarizes the investigations completed by Placer Exploration Ltd (the purchaser of CSR's Mineral Group) in the fourth twelve month term of the Licence ending on February 14, 1990.

2. SUMMARY

Exploration continued during 1989. The most encouraging work was the drilling of BRD 01 TO 1133m. Large sections of the core below the Hellyer Basalt were significantly altered by calcite/sericite and in places epidote and fuchsite. Minor base metals were observed in vesicules and veins. The hole was logged with a down hole EM 37 survey with disappointing results.

Core from BRD 01 has been analysed for Pb isotopes whole rock and trace elements with this being matched to thin section descriptions. This confirmed that the rocks in BRD 01 were similar to those around Hellyer Mine.

Currently a second hole to 1100m is being drilled. This is still in the Que River Shale after passing through quartz-feldspar porphyry, shale/tuff and pyroclastics. This will be evaluated by downhole geophysics, geology and geochemistry.

Other work completed during 1989 was the calculation of magnetic remanance for basaltic rocks from BRD 01, 02 and 03 (by D Leaman) which showed the core basalt was atypical of fresh surface basalt but more like glassy weathered/altered basalts.

A review of CSR's CSAMT survey showed this to be of limited use "seeing" only to a depth of about 50m due to near field effects.

3. LOCATION AND GENERAL

EL 39/85 is centred 5km west of the Hellyer base metal deposit and 25km North of Rosebery on the West Coast of Tasmania. The 6km (N-S) by 4km (E-W) area is adjacent to and West of Aberfoyle's EL 106/87 containing both the Hellyer and Que River base metal deposits (Figure 1).

Excellent access to the Licence area is provided by the sealed Murchison Highway, which forms the eastern boundary. The forestry constructed gravel Que Road bisects the Licence from east to west providing good driving access to within 2km of most parts. Access is further improved by a forestry track to the Bulgobac River (in the south of the Licence) and CSR constructed drill tracks in the central area to the south of Que Road. A CSR drill track to the north of Que Road has been rehabilitated, although this requires fertilizing in Autumn. Regrowth on this track was impeded by a dry period shortly after rehabilitation.

Most of the northwestern half of the Licence is a plateau underlain by a cover of Tertiary Basalt flows. These flows weather to form a rich soil supporting a thick rainforest vegetation. Most of this rainforest was selectively logged earlier this century (evidenced by large old butts and numerous overgrown skidways) while the area around the western end of Que Road was clear felled in recent times.

The southwestern portion of the Licence is underlain by relatively flat lying late Middle Cambrian volcanoclastics and sediments overlying the Que/Hellyer volcanic sequence. Much of

the volcanoclastics support only button grass type vegetation which is now periodically burnt by the forestry industry. To the south, the volcanoclastics and intrusives are covered by rainforest, horizontal and regrowth.

The Licence is drained by two main drainages. The area to the north of Que Road is drained by the Que River while the south is drained by the Bulgobac River. These rivers join to the west of the Licence and drain via the Huskisson River to the Pieman River. The Que and Bulgobac Rivers and their tributaries are deeply incised in steep gorges resulting in a plateau area at an elevation of 630-680m and drainages at heights to 480m above sea level.

4. PREVIOUS EXPLORATION

The Gold Hill prospect, located immediately north of the Que River Mine, was located by prospecting activity in the 1920's. Prospectors followed pannable gold upstream from the Que River to locate Gold Hill. Consequently, it is probable that prospecting activity extended into EL 39/85. However, no mineral occurrences are recorded within EL 39/85 and exploration to date has not located any evidence of early prospecting.

Forestry operations were undertaken in the late 1960's - early 1970's in the plateau area on the western section of EL 39/85. The area logged was the myrtle rainforest growing on red soils developed over Tertiary basalt. Access to this area was by a graveled road, the "Que Road", from the Murchison Highway.

Geological mapping of the area was undertaken on a limited basis by geologists employed by Rio Tinto as part of a joint venture with EZ in the 1950's. Department of Mines' geologists mapped part of the area as shown on the published Mackintosh 1" = 1 mile geological map.

In 1969-1971, Comstaff Pty Ltd completed stream sediment and geological mapping of the area as part of a reconnaissance programme on EL 5/63. Results for this stream sediment sampling are available on open-file reports at the Department of Mines. Evidence of this sampling programme was observed during geological mapping of EL 39/85.

The programme undertaken by Comstaff consisted of detailed -80 mesh stream sediment sampling and limited heavy mineral concentrate stream sediment sampling. This sampling produced two areas in or adjacent to EL 39/85 which were followed up:

- (i) Debussey Creek resulted from an anomalous gold assay in a heavy mineral concentrate stream sediment sample, and
- (ii) Sock Creek area resulted from anomalous -80 mesh stream sediment samples.

The Debussey Creek anomaly was followed up with additional stream sediment geochemistry and A° horizon soil sampling with negative results. Additional follow-up in 1984 located only one sample with detectable gold in a heavy mineral concentrate, Comstaff Pty Ltd (1985).

The Sock Creek anomalies were followed up and the Sock Creek vein type Ag-Pb-Zn mineralization discovered. The Sock Creek prospect is located 1km southwest of the south-west corner of EL 39/85. The follow-up sampling programme in the Sock Creek area extended into EL 39/85 with grid lines being cut into the Hash and Joint Creek areas. It is believed that geological mapping, soil geochemistry and a moving loop EM system was undertaken on these grid lines, but no data for this work are available on open-file reports at the Department of Mines.

In 1975, as part of a larger programme on EL 5/63, an INPUT EM and magnetics survey was flown over the area. Within EL 39/85, no follow-up to this survey was undertaken as the major conductive zones located were interpreted to be due to surficial or stratigraphic conductors, Butt et al. (1975).

After EL 39/85 was granted to CSR in February 1986, as a result of a successful tender application for the Bulgobac Exempt Area (ETA 8464), work was commenced in the search for a polymetallic volcanogenic deposit. An initial programme of geological mapping and geophysical surveys involving aeromagnetics, grid based VLF-EM, induced polarization, CSAMT and gravity, resulted in the drilling of two diamond drill holes. These two vertical holes BRD01 to 860.5m and BRD02 to 676m tested CSAMT anomalies with some supporting gravity anomalies. Weak mineralization in the hanging wall Hellyer Basalt was intersected in BRD01. However, the greatly increased thicknesses of the Que River Shales and the Hellyer Basalt intersected in these holes suggests the mineralization host horizons are deeper than the effective depth penetration of electrical geophysics. O and C isotope data on calcite veining and vesicle infilling from within the Hellyer Basalt in BRD 01 and 02 indicated formation temperatures of 150°C and 110-120°C, respectively. Downhole EM was successfully completed to the full depth of BRD02, but reached only 700m in BRD01 with no anomalies being detected (Williams 1987a, 1987b).

Two further stratigraphic holes were drilled in 1988. BRD03 near Que River showed the Que/Hellyer volcanic sequence thinned dramatically to the north (north of Que Road) while BRD04 near Mutter Creek showed the Tertiary Basalt to the west was underlain by Animal Creek Greywacke. Mutter Creek was thought to be on or near the Mt Charter Fault.

The programme of gridding, geological mapping and 50m spaced gravity surveys were extended to cover most of the Licence area. This work suggested the most prospective area of the Licence was a 1.5km square block between BRD02 and BRD04 and extending from between Que Road and BRD01 to the Licence

boundary in the south. This area contains an abnormal thickness of Que River Shale and Hellyer Basalt and is bounded by growth faults active during the deposition of these rocks.

A UTEM III survey was completed over the area north of Que Road. Elsewhere the shale and basalt units extend to depths in excess of 600m below surface.

5. REGIONAL GEOLOGY AND MINERALIZATION

The lithologies of exploration interest are the Cambrian calc-alkaline Mt Read Volcanics which host important base metal deposits at Mt Lyell, Hercules, Rosebery, Que River and Hellyer. The regional geology is described in numerous publications, e.g. Corbett and Lees (1987).

Prior to the discovery of the Que River Deposit in 1974, the geology of the area of EL 39/85 was poorly investigated. Knowledge of the geology and structure of the area progressed with exploration undertaken by Aberfoyle, Comstaff and Ez on various ELs within the general area. Mapping was undertaken by the Department of Mines prior to preparation of the explanatory notes on the Mackintosh 1 mile map (Collins et al., 1981).

Collins (op cit) postulated the following sub-division of the Mt Read Volcanics in the Que River area:

- (i) a western volcano-sedimentary sequence of which the Que River Beds (Que River Shales), of late Middle Cambrian age, were interpreted as the basal sediments in the Que River area, and
- (ii) an eastern (central) volcanic sequence which in the Que River area was dominantly andesitic.

The boundary between the two sequences was interpreted to be discordant and in places in faulted contact.

With the discovery of the Hellyer deposit in the early 1980's, and the consequent generation of more detailed knowledge of the stratigraphy and structure, the Que River Shale was interpreted to be in conformable contact with the

underlying volcanics. Thus, the stratigraphy hosting the Hellyer deposit could be projected down dip into the eastern area of EL 39/85.

Previous conceptual thinking regarded the volcanics at Que River-Hellyer as forming part of Corbett's "Central Volcanic Sequence". However, recent geological mapping (Komysan, 1986) and trace and whole rock analyses (Crawford, 1987) have resulted in a revised interpretation of the Que River-Hellyer volcanics as forming the basal part of the Dundas Group. This can be equated with Corbett's "Western Sequence" to the northwest of the Henty Fault Zone.

Exploration undertaken since granting of EL 39/85 has extended the area of potential host stratigraphically for Hellyer-Que River type mineralization. However, drilled thicknesses of the Que River Shale have exceeded those indicated by previous mapping and drilling on adjacent titles.

6. CURRENT EXPLORATION

6.1 Access

Pre-existing vehicular access within EL 39/85 was previously described (Williams, 1987a). This covered walking access cut for creek mapping and initial gridding for geophysics.

In late 1987 (Williams, 1987b) the geophysical grid was extended to cover most of the Licence. This was surveyed and levelled (Ellis, 1988).

During 1989 a drill access track to BRD05 was formed. This track is subparallel to the 2400E baseline and extends from near BRD01 southwards to end at 7000N 2400E (Drg No. 7612-14).

Prior to extending this drill access track the proposed route was examined by T. Duckett (Forestry rehabilitation) and F. Podger (CSIRO) to discuss problems and methods.

Grid lines were cut for the placement of loops for the downhole EM37 survey. Five 600 x 600m loops were cut using existing grid lines wherever possible. One loop was centred on the drill hole BRD01 while the other four had a common corner at the drill hole.

Loops grids and tracks are shown on Drg No. 7612-14.

6.2 Diamond Drilling

The following 2 hole programme was proposed for the current period to February 1990. (Drill locations are shown on Drg No. 7612-13).

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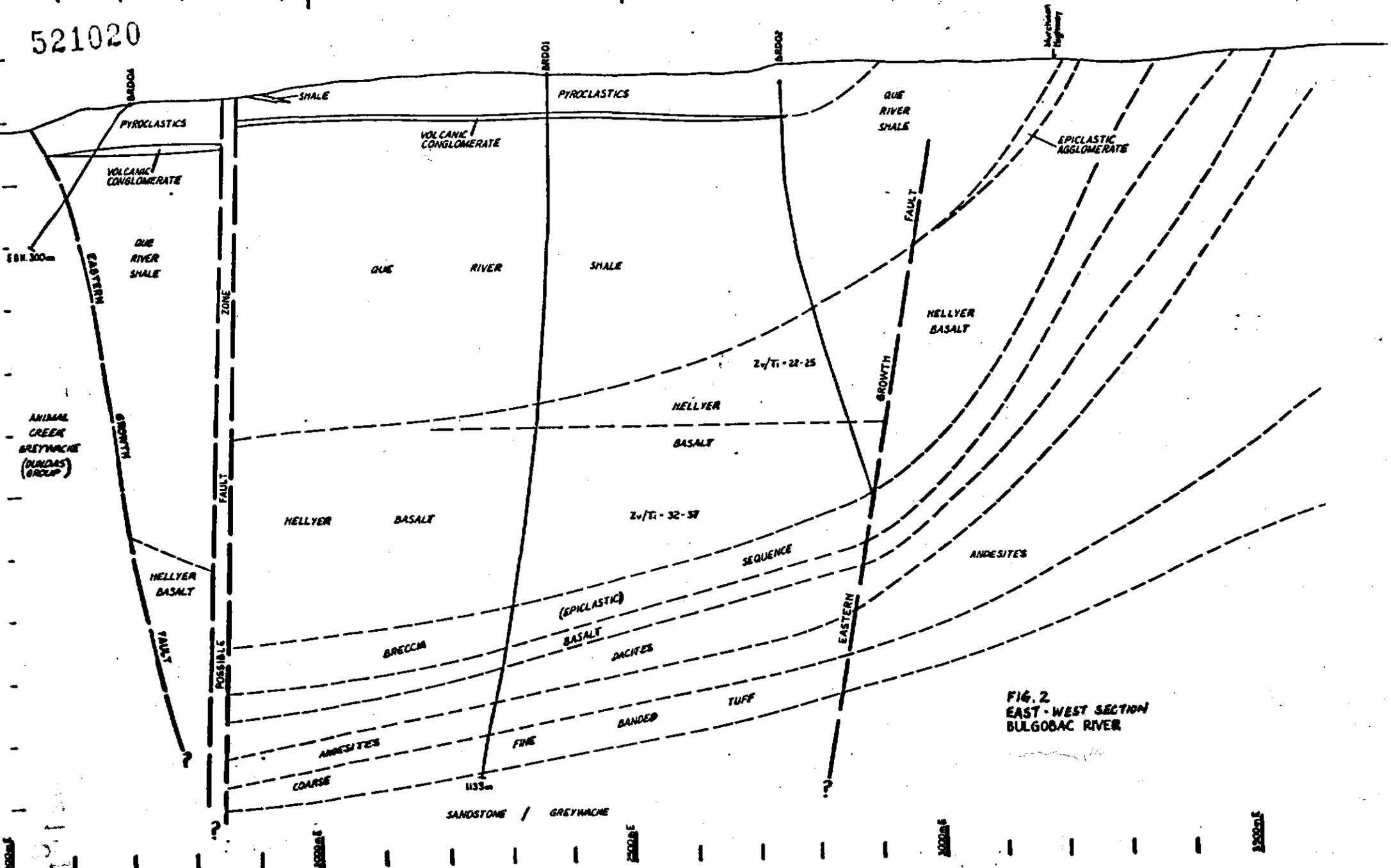


FIG. 2
EAST-WEST SECTION
BULGOBAC RIVER

011

2500m

DDH BRD 01: re-open and extend the old hole to 1100m after penetrating the Que/Hellyer Volcanics - this would enable a "wide-seeing" down hole EM survey to be completed (former BRD01 was blocked with no EM coverage below 680m).

DDH BRD 05: a vertical hole 600m grid south of BRD01 with a final depth of 1100m - to test the Que/Hellyer Volcanics outside the downhole EM37 surveys zone of exclusion of 450m from BRD 01.

Core logging was undertaken using the same computerised format as that used by CSR for the previous holes. Appendix I includes a description of this system and the detailed drill logs for BRD 01A. BRD 05 is still in progress at the time of writing. Figures 2 and 3 show interpreted geological sections through the extended BRD 01 area.

DDH BRD 01A

The extension of BRD 01 was primarily to test the Que/Hellyer Volcanics beneath the Hellyer Basalt by both drill core analyses and a downhole EM survey. Petrology of the core from the bottom of the original hole suggested the hole terminated in the "Mixed Sequence", the host horizons for the Que River and Hellyer basemetal deposits. Downhole EM could not be completed on the original hole, even though it was cased with PVC, due to a cave-in at about 680m.

An NQ drill string was lowered down the original hole over the PVC casing. With some difficulties the drill string was lowered to 600m, the base of the NQ in the original hole. The

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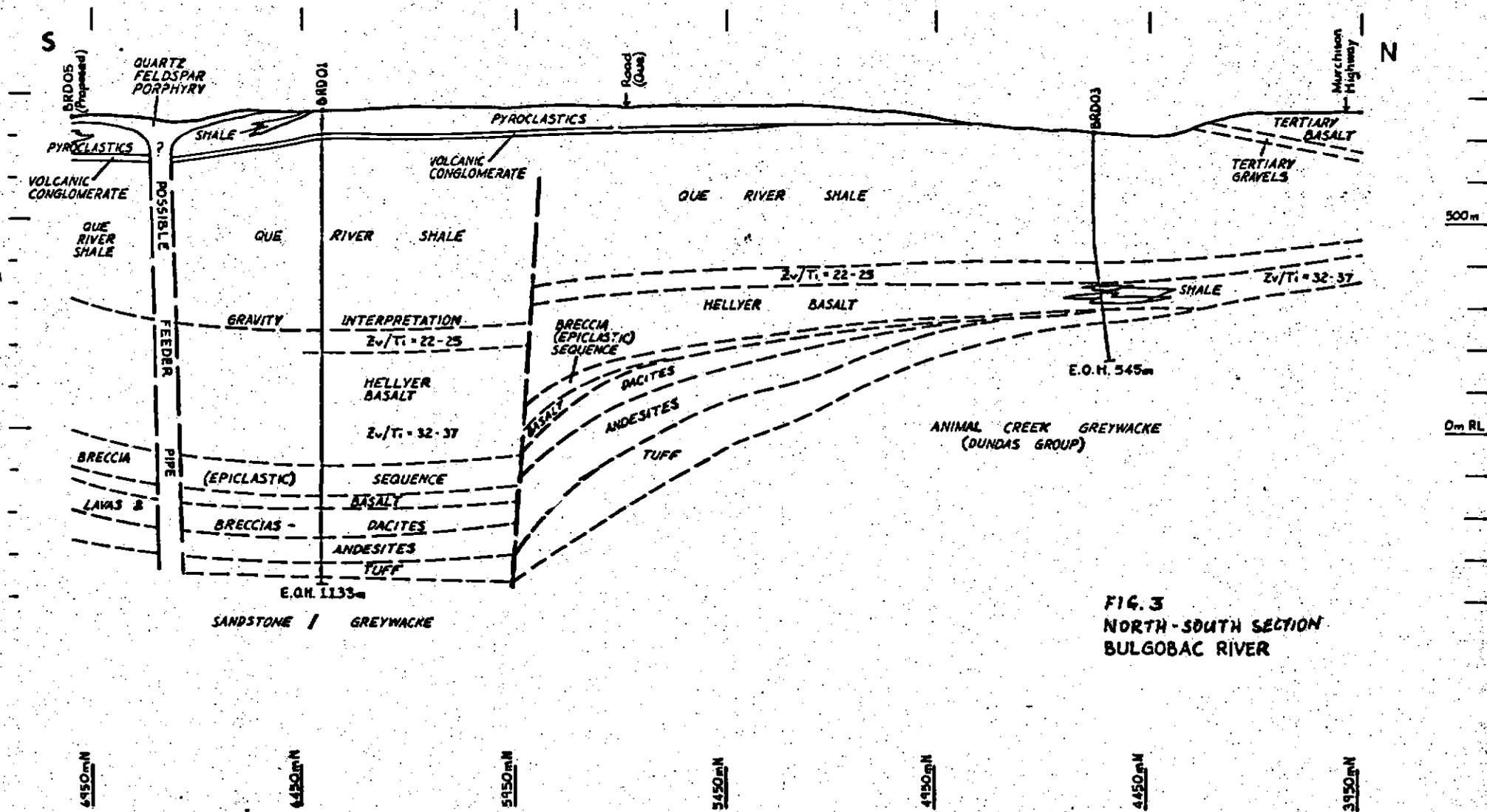


FIG. 3
NORTH-SOUTH SECTION
BULGOZAC RIVER

casing was removed and a Hallrowe Wedge set at 586m down hole (to the top). Due to hole conditions this could not be set at the most appropriate direction. A new NQ hole was drilled off this wedge to a depth of 1133m.

The lithologies intersected in this hole were:

0 - 75m	Pyroclastics
75 - 531m	Que River Shale
531 - 850.5m	Hellyer Basalt
850.5m - 917m	Mixed Epiclastic
917 - 953m	Lower Basalt
953 - 1052m	Dacites - Lavas and Breccias
1052 - 1086m	Andesites
1086 - 1120m	Tuffs and Sediments
1120 - 1133m	Animal Creek Greywacke
1133m	EOH

In hand specimen large parts of the core between 850.5 and 1086m were significantly altered. Much of the alteration was calcite-sericite but some zones were silica⁺ chlorite⁺ pyrite⁺ epidote altered. Fuchsite was visible in parts of the Lower Basalt unit particularly at 917-922m.

Core samples were selected for thin section petrography by A. Crawford (Appendix II). This work confirmed the above rock types and showed the alteration to be extremely patchy. Some samples showed little more than normal regional burial metamorphism (prehnite-pumpellyite facies as in 701305 at 856m) through local hydrothermal alteration (calcite-sericite as in 701306 at 862.8m) to intense hydrothermal alteration (epidote-sericite-fuchsite alteration overprinted by calcite-sericite alteration as in 701315 at 917.9m).

BULGOBAC PROSPECT

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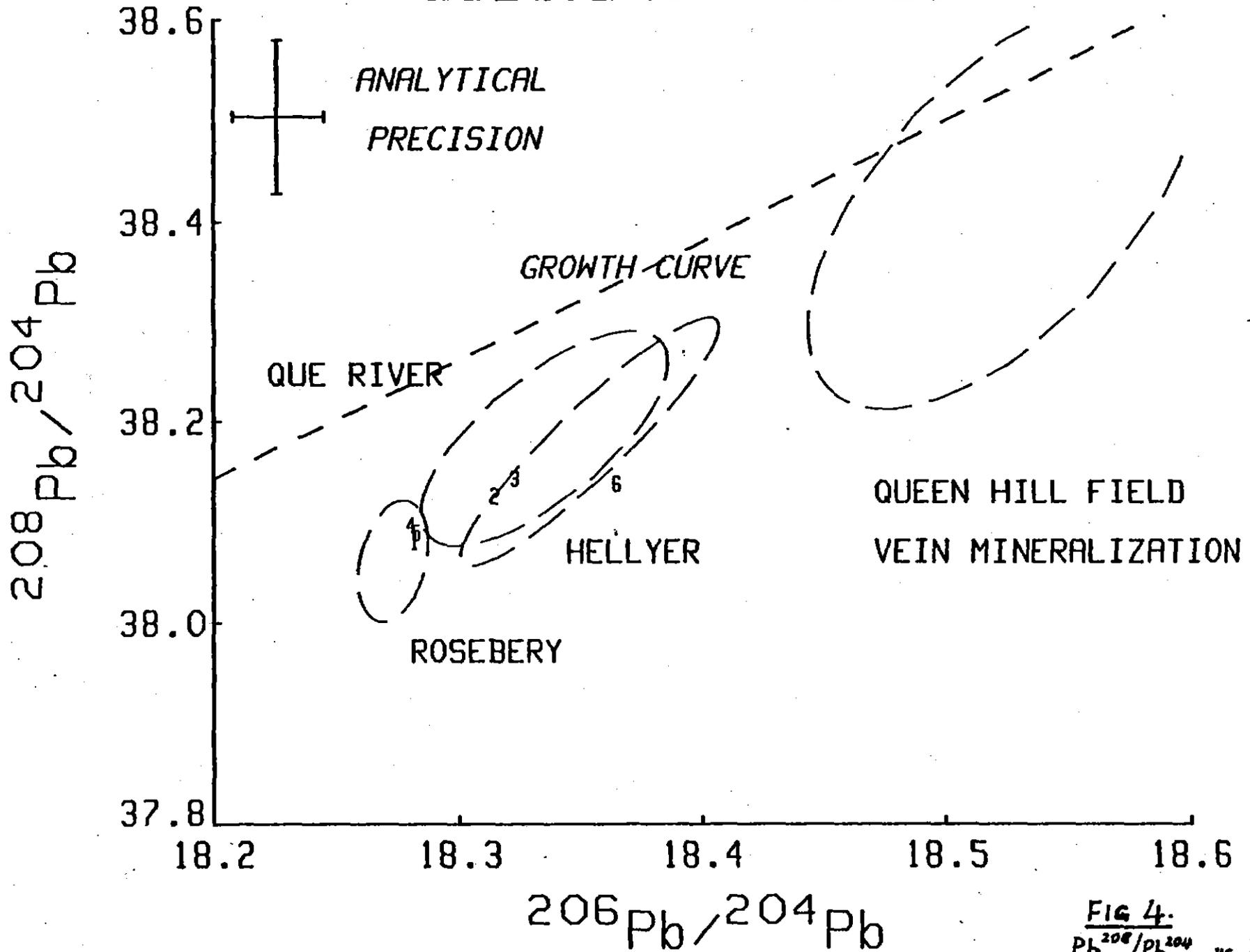
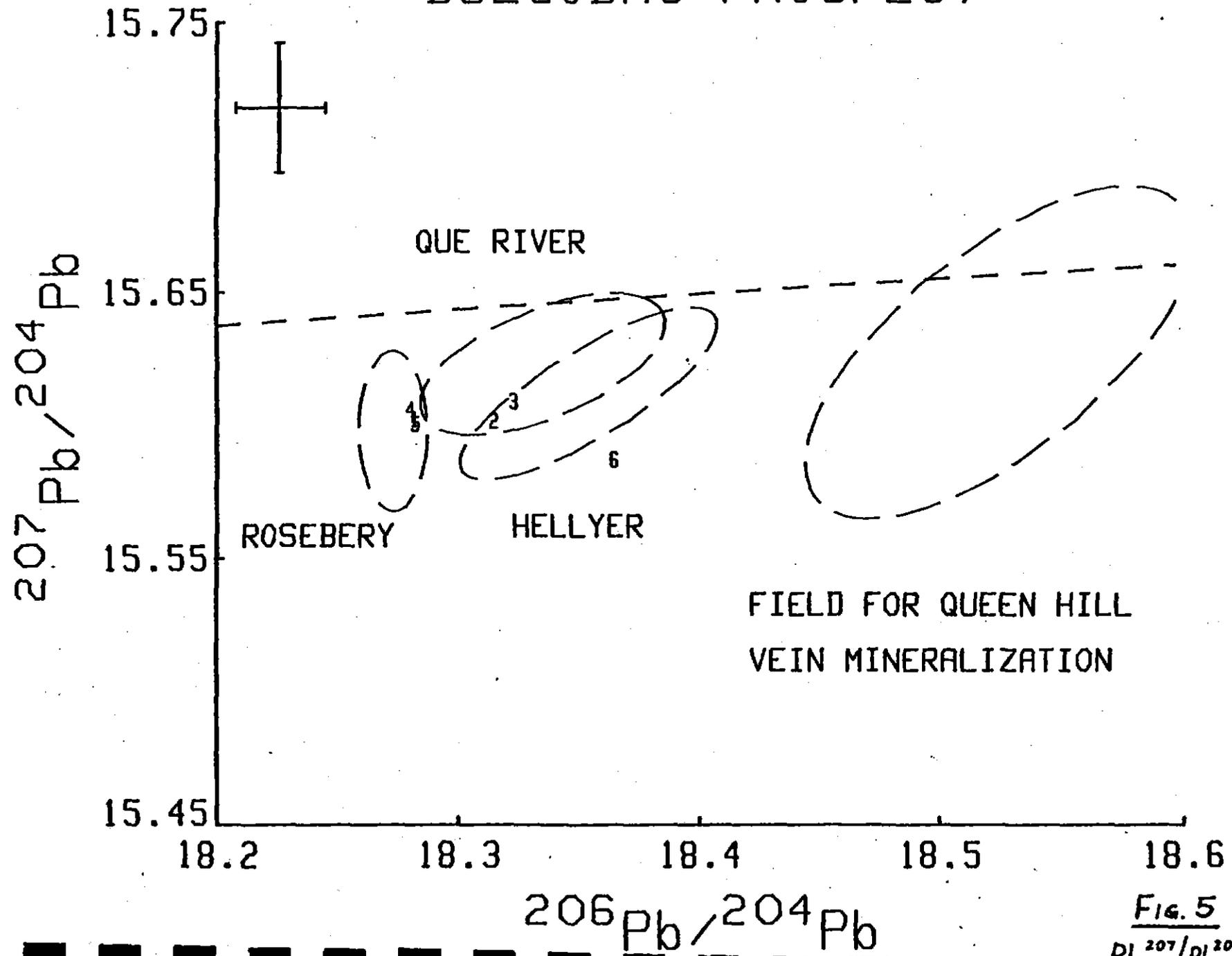


FIG 4.
 $\text{Pb}^{208}/\text{Pb}^{204}$ vs. $\text{Pb}^{206}/\text{Pb}^{204}$

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BULGOBAC PROSPECT



023

Fig. 5

$\text{Pb}^{207}/\text{Pb}^{204}$ vs. $\text{Pb}^{206}/\text{Pb}^{204}$

Intervals sampled for thin section evaluation were generally sampled for comparative whole rock and trace element analyses. Most of the core from below the Hellyer Basalt to the end of the hole have been rock chip sampled (half core in strongly altered zones). Results of analyses (Appendix III) confirmed:

- the extensive alteration of the volcanics
- the thin section rock descriptions.

Several thin sections of core are being studied by Dr. G. Green (Mines Department) for deposition/extrusion temperature as determined by probe analysis of the primary chlorites occurring in the volcanics. Results are not yet available.

Four pieces of basalt were analysed for Pb isotope composition. Three samples contained sphalerite and galena in vesicles in the basalt while the fourth sample was adjacent to and included blobs of galena/sphalerite. Samples came from both the Hellyer Basalt and Lower Basalt horizons. Results of the analyses (Appendix IV) showed the Pb mineralization within the basalt horizons of the Que/Hellyer Volcanics to have a similar isotopic age to the Que River-Hellyer-Rosebery massive sulphide mineralization (Figures 4 and 5).

DDH BRD 05

This hole was commenced in late November/early December and is currently still in the Que River Shale at 685m. Rocks intersected in the hole to date are:

0 - 11.5m	Quartz-feldspar porphyry
11.5 - 24.4m	Shale
24.4 - 36.5m	Quartz-feldspar porphyry
36.5 - 48.4m	Interlayered shale and quartz-feldspar porphyry

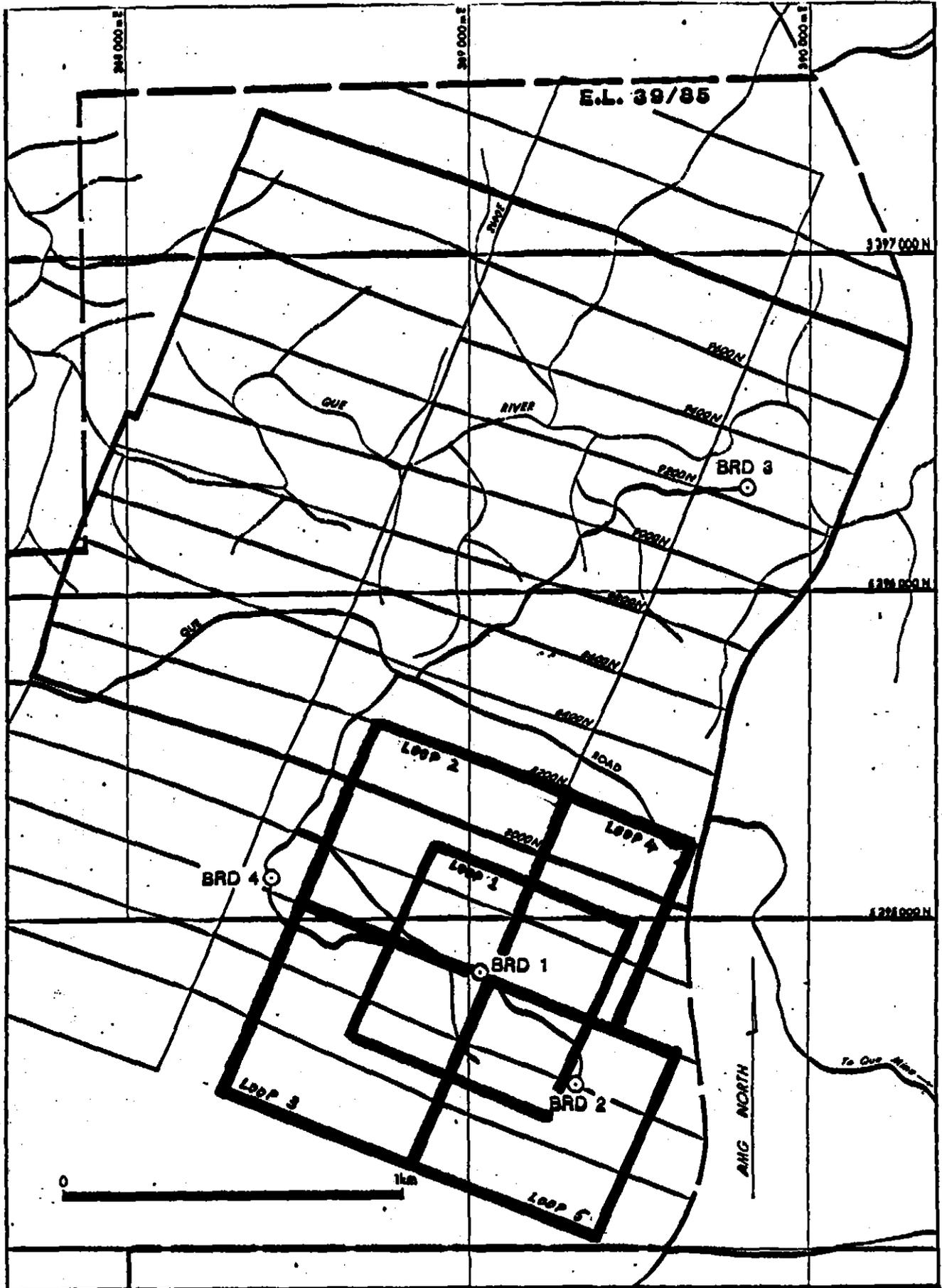


FIG.6 BRD D1 EM37 LOOPS BULGOBAC RIVER TAS.

48.4 - 92.5m	Shale
92.5 - 157.6m	Pyroclastics
157.6 - 530.6m	Que River Shale
530.6 - 530.7m	Basalt
530.7 - 531.8m	Que River Shale
531.8 - 570.7m	Hellyer Basalt (with py + qtz veins)
570.7 - 570.9m	Pyrite and Quartz
570.9 - 634.0m	Quartz River Shale
634.0 - 684.2m	Conglomerate
684.2 - 685m+	Que River Shale

Drilling will continue to at least 1100m or to the Animal Creek Greywacke basement. The core will be evaluated similar to that from BRD 01 (geologically logged, thin section petrology, whole rock and trace element geochemistry, chlorite probe and C and O isotope determination of temperature of formation) and downhole EM will be run.

6.3 Downhole EM 37

On completion of DDH BRD 01 the hole was logged using five separate 600 x 600m (nominally) square loops and the EM 37 downhole logger and probe. The loops (Figure 6) were set out such that Loop 1 was centred over the drill hole and the remaining four loops were on the previously cut geophysical grid with one common corner at the collar of BRD 01. Readings were taken at 10m intervals from 600m to 1133m down the hole. 0 - 600m was not read as the downhole SIROTEM EM survey of the original BRD 01 was completed to a blockage at 700m in 1987 (Williams 1987a, 1987b). The 600m to 700m zone gave a sufficient overlap to enable a comparison of the two EM systems to be made.

The downhole EM 37 survey results (Appendix V) were very disappointing. Essentially they show a simple slow decay curve for the electromagnetic field generated at the surface by the loop (Figure 7). They are fairly "clean" curves with very little "noise", probably due to the large thickness of shale. Only minor odd points do not fall on the decay curve. These probably represent weak, off-hole but close, thin, concentrations of sulphides (pyrite?) with no economic significance.

6.4 Magnetic Remanance

Basalt from the CSR drilled holes of BRD 01, 02 and 03 had magnetic remanance calculations made using field measurements taken with a proton precision magnetometer. Measurements were made of the magnetic field changes caused by a section of the core of basalt being inverted close to the magnetometer head. These measurements were made for the basalt core at 3m intervals down each of the holes.

Dr. D. Leaman used the measurement of field changes to calculate rough relative magnetic remanance (Appendix VI). These showed the Hellyer Basalt intersected in the CSR diamond drilling at Bulgobac River was atypical of fresh surface basalt but more like glassy weathered or altered basalt. This would confirm the geological/geochemical evaluation of the core.

6.5 CSAMT Re-Evaluation

The initial siting of BRD 01 and 02 was based on the 1986/87 CSAMT survey and the anomalies it generated. Neither BRD 01 or 02 intersected an explanation for these CSAMT anomalies. CSR did not record a re-evaluation of the CSAMT in response to the results of the diamond drilling.

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However, during the drilling of the extension of BRD 01 a re-evaluation of the "extensional basin" interpretation of previous gravity surveys showed a lack of detail in the area of the northern bounding fault. The CSAMT data was thus re-examined by Placer geophysicists. This showed (Appendix VII) the CSAMT survey was inadequate due to transmitter positioning leading to near surface near field effects in some areas.

A further test line has been proposed along the North-South 2400 E baseline in an attempt to position the proposed northern bounding fault of the downfaulted highly prospective graben structure.

7. PROPOSED EXPLORATION

Exploration to be completed within the next renewal period (to February 1991) should include further evaluation of the defined graben structure (the area of highest potential for locating mineralization) and completion of the mapping in the northwestern corner of the Licence (in preparation for half relinquishment of EL 39/85 in February 1991).

A. Graben Evaluation

Evaluation of the DDH BRD 01 drill core will continue with the calculation of temperatures of formation using electron probe analyse of primary chlorite crystals.

STAGE 1

BRD 05 will be completed to about 1100m. It will then be logged using the EM 37 downhole system. The UTEM downhole system may be used if it can be obtained.

After geological logging, the core will be evaluated by thin section petrology, whole rock and trace element geochemistry, chlorite probing and isotopic studies.

The drilling information from the graben structure (DDH BRD 01, 02 and 05) will be re-evaluated and compared and then with the information for the outlying holes BRD 03 and 04 be used to re-examine the regional gravity interpretation. This may lead to closer definition of the gravity interpreted structures.

STAGE 2

Further drilling will be required to follow up anomalies located in Stage 1.

STAGE 3

If no downhole EM anomaly is located then a widely spaced drilling programme (of up to a further 3 holes to depths of about 1100m each) will be considered over the area of the downfaulted, highly prospective, graben structure to test beyond the range of the BRD 01 and 05 downhole EM surveys. Any new holes will be geologically logged, logged by downhole EM surveys, evaluated by thin section petrology, whole rock and trace element geochemistry, isotopic studies and chlorite probing.

It is anticipated that Stage 1 and a portion of the Stage 2 and/or Stage 3 will be completed during 1990.

B. Northwest EL 39/85 Evaluation

Geological mapping of the Que River to the northeast of the AMG 5397000m N should be completed. This should include mapping of all small tributaries as well as the main river.

8. CONCLUSIONS AND RECOMMENDATIONS

Exploration has vindicated the original geological concept of the subsurface extension of the Hellyer-Que River host rocks into EL 39/85. However, no significant mineralization was intersected in the four diamond drill holes completed to date.

Although the drilling has shown the target stratigraphy to be at a greater depth than originally interpreted, the greater thickness of Que River Shale and the Hellyer Basalt are considered to be favourable factors in the application of the Kuroko-type model to the search for Hellyer-type deposits.

The use of O and C isotopes to determine temperatures of calcite formation in the Hellyer Basalt shows considerable promise as a technique to select favourable areas. Also the recently developed analysis of chlorite crystals shows some promise as a quick method of determining temperatures of formation.

It is recommended that exploration be continued with an emphasis on completing the subsurface evaluation of the area around BRD 01 and BRD 05.

Further drilling is required within the downfaulted graben structure either at downhole EM defined targets or on a wide spaced grid. Downhole EM should be completed as the drilling of each hole is finished.

Geological mapping of the drainages in the north-western area of the Licence should be completed to ensure that no prospective ground is relinquished in 1991 if the Licence area has to be reduced by half.

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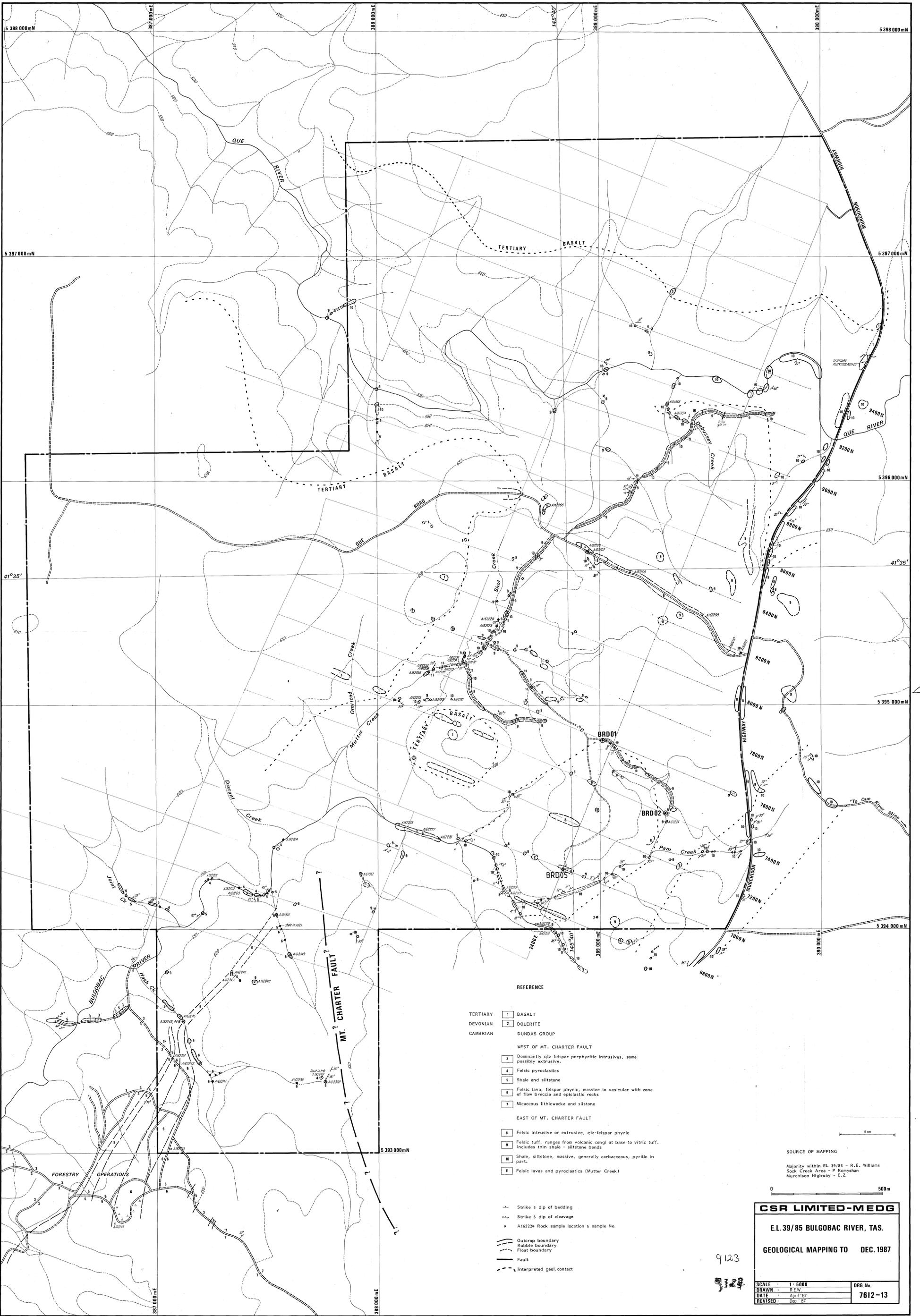
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Unpubl. Rept., MEDG, CSR Limited, Rept. No. EMR 75/85

WILLIAMS, R.E. (1987b)

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Unpubl. Rept. MEDG, CSR Limited. Rept. No. EMR 145/87



REFERENCE

TERTIARY 1 BASALT
DEVONIAN 2 DOLERITE
CAMBRIAN DUNDAS GROUP

WEST OF MT. CHARTER FAULT

3 Dominantly qtz felspar porphyritic intrusives, some possibly extrusive.
4 Felsic pyroclastics
5 Shale and siltstone
6 Felsic lava, felspar phyrlic, massive to vesicular with zone of flow breccia and epiclastic rocks
7 Micaceous lithicwacke and siltstone

EAST OF MT. CHARTER FAULT

8 Felsic intrusive or extrusive, qtz-felspar phyrlic
9 Felsic tuff, ranges from volcanic congl at base to vitric tuff. Includes thin shale - siltstone bands
10 Shale, siltstone, massive, generally carbaceous, pyritic in part.
11 Felsic lavas and pyroclastics (Mutter Creek)

--- Strike & dip of bedding
--- Strike & dip of cleavage
x A162224 Rock sample location & sample No.

--- Outcrop boundary
--- Rubble boundary
--- Float boundary
--- Fault
--- Interpreted geol. contact

SOURCE OF MAPPING

Majority within EL 39/85 - R.E. Williams
Sock Creek Area - P. Kanyshan
Marchion Highway - E.Z.

CSR LIMITED-MEDG

EL. 39/85 BULGOBAC RIVER, TAS.

GEOLOGICAL MAPPING TO DEC. 1987

SCALE 1:5000
DRAWN R.E.W.
DATE April '87
REVISED Dec '87

DRG No. 7612-13



50m

REFERENCE

- BRIDGING & ACCESS TO 1ST APRIL '87
- BRIDGING & ACCESS FROM 1ST APRIL '87

0 500m

CSR LIMITED-MEDG

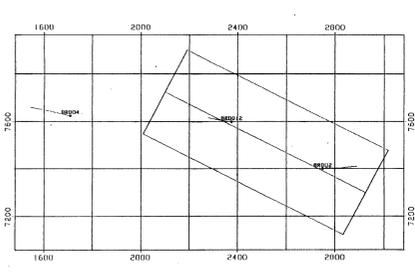
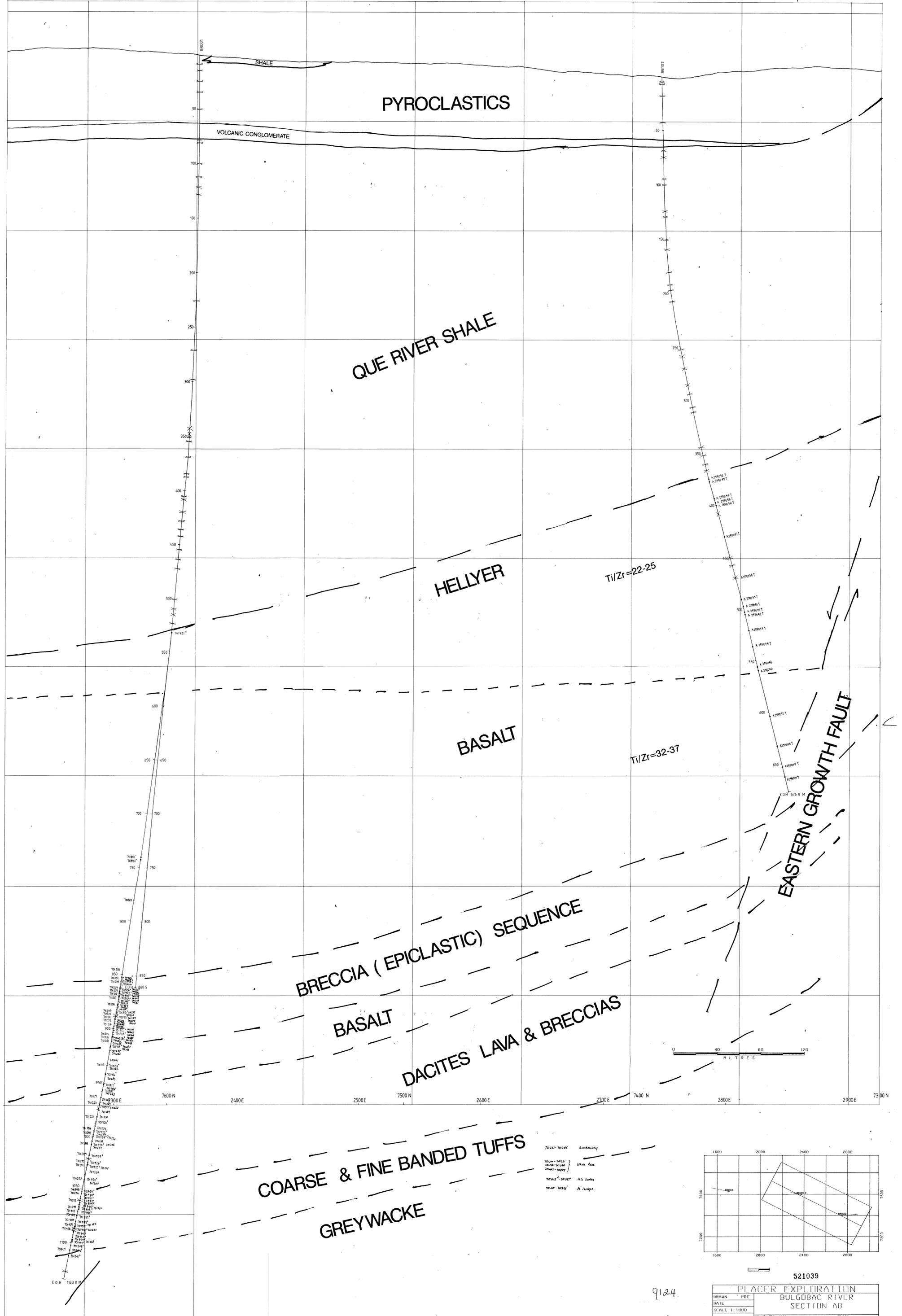
E.L. 39/85 BULGOBAC RIVER, TAS.

ACCESS AND GRIDDING

521038

922.

SCALE	DRG. No.
DRAWN	7612-14
DATE	
REVISED	



521039
 PLACER EXPLORATION
 BULGOBAC RIVER
 SECTION AB
 SCALE 1:1000
 NILLIKAM 3300 PLATE

9124



005

521040

OPEN FILE

PROJECT 258
K-55-3

MINES	
File Ref.	EL 39/85
	1990
Doc. Ref.	
Action/Status	Folio 10B
	ON FILE
	REFERS
Resubmit to	Date

PLACER EXPLORATION LIMITED

RENEWAL REPORT, 1990

EXPLORATION LICENCE NO. 39/85

BULGOBAC RIVER, TASMANIA
VOLUME 2

PLACER EXPLORATION REPORT TAS 1/90

MICROFILMED

HOBART

JANUARY 1990

P.D. ELLIS

521041

030

APPENDIX I

DRILL LOGS DDH BRD 01A

DETAILED DRILL LOG SHEET - CODING PROCEDURES1. Header

This is self evident. The hole number identifies the prospect for the system, eg. DDH BRD 01 = Bulgobac hole 1, and the type of drilling (eg. DDH = diamond drilling, PDH = percussion, RCH = reverse circulation. The computer system will work provided that all lithology codes and mineral species fields are the same and clearly defined for each prospect.

2. Depth to - Columns 1-7

Record the depth to the base of the logged interval in metres, to 2 decimal places.

3. Core Recovery - Columns 8-13

Record the measured core recovery for the interval, in metres to 2 decimal places.

4. Lithology - Columns 14-21

Space is provided to record up to two lithologies for the logged interval, using a three letter code for each. It is acceptable to use either a standardized general coding system, or to develop a set of prospect or project specific rock type codes, provided that these are consistent and defined for (at least) each prospect. It is helpful if these codes match those used in surface mapping of the prospect.

5. Oxidation - Column 22-23

Record the extent of oxidation of iron minerals, particularly sulphides, by the extent of limonite development, using single letter codes as follows:

- 0 (or blank) Unoxidised-sulphides quite fresh -
no limonites present.
1. Trace oxidation - sulphides fresh but minor
limonite coating joints or fractures.
2. Weakly oxidized - most sulphates preserved but
significant limonite developed on joints and in
joint selvages.
3. Moderately oxidized - sulphides replaced by
limonites in about 50% of the rock.
4. Strongly oxidized - limonite throughout with
minor remaining sulphides.
5. Completely oxidized, limonite throughout,
no remaining sulphides.

Fields 5-11. Record the sulphide content of the logged interval, as follows:

Field 5 (Total %) (Columns 24-25) Record the total of sulphides present, on a volume percent basis, using a two letter code as follows:

TR	present but less than 0.5% by volume.
01	0.5-1.5% by volume
99	98.5-99.5% by volume
then AL	99.5-100%

039

Field 6 Grainsize (Column 26) Record the average grainsize of sulphide minerals present, using single letter codes eg. c = coarse > 2mm, m = medium (0.5-2mm), F = fine < 0.5mm.

Fields 7-11 (Columns 27-38) These two character fields record the mode of occurrence and relative proportions of the most common sulphides. Fields are allowed for pyrite (py), chalcopyrite (cpy), pyrrhotite (po), galena (ga) and sphalerite (sp).

Codes used are a single letter code for the dominant mode of occurrence of the mineral in the logged interval, eg.

D = disseminated

A = vesicular

V = within veins

B = banded; bedded

F = coating fractures

C = disseminated in clasts

and a single letter/number code to record the relative proportion of each sulphide species of the total sulphide using the codes.

Blank - mineral not present.

T = trace, mineral present but less than 5% of the total sulphide

1 = 5-15% of the total sulphide

to 9 = 85-95% of the total sulphide

and A = >95% of the total sulphide.

The proportion codes should sum to 10, unless significant proportions of a different sulphide to those listed occurs. The estimated volume percentage of any mineral can be obtained by multiplying the total sulphide percent (field 5) by the proportion code for that mineral and dividing by 10.

Sulphide minerals not included in the above list should be noted in the comments column.

Fields 12 to 24 (Columns 39-63) record alteration mineralogy.

Field 12 - Alternative Intensity - col. 39 - Record alteration intensity as a single number code as follows:

- 0 - Fresh unaltered rock with original texture and >95% of original rock forming minerals intact.
- 1 - Partly altered, original textures preserved and 5-35% of original minerals replaced by alteration products.
- 2 - Moderately altered, overall original textures preserved but 35-65% of original minerals replaced by alteration products.
- 3 - Strongly altered, original textures visible but 65-95% of original minerals replaced by alteration products.
- 4 - Completely altered, original textures still preserved but original minerals replaced by alteration products.
- 5 - Intensely altered - as above but original rock texture only poorly preserved.
- 6 - Fubarite - original rock mineralogy and textures completely obliterated.

Fields 13 - 24 Alteration Mineralogy Cols. 40-63. Twelve two column fields are allowed, to record the presence of specific alteration minerals. For each mineral two columns are provided. The first column for each mineral is for a single letter code for the estimated volume percentage of the mineral;

blank = not present,

T = present but less than 5%,

1 = 5-15%, 2 = 15-25%,, 9 = 85-95%,

A = +95%.

In the second column, use a single letter code to record the dominant mode of occurrence of the mineral;

P = pervasively disseminated,

W = wallrock selvages adjacent to veins or fractures,

F = coatings on fracture surfaces,

V = as vein fill material,

S = some particles partially silicified.

The minerals to record are:

LIMONITE, ALBITE, CHLORITE,

EPIDOTE, K-FELDSPAR, SERICITE,

CLAY MINERALS, SILIFICATION (not veining)

CALCITE, JAROSITE/ALUNITE,

BARITE, AND FUCHSITE.

Quartz Veining. Space is provided to routinely record only one vein set per logged interval. To make this workable, only quartz and quartz composite (eg quartz-calcite, quartz-barite, quartz-sulphide) veins should be recorded here (N.B. for NTT assume all barite veins have some quartz). Calcite,

jarosite-alunite or straight pyrite veining can be accommodated the alteration mineralogy or sulphide columns, with appropriate comments in the comment field.

Field 25 Vein type - Columns 66-67. Record here a two letter code to specify the vein type. Include barite veins with quartz veins. Letter codes QU = quartz + carbonate, QB = quartz-barite, QC = quartz-calcite, TC = tremolite, QE = quartz-chlorite-carbonate-epidote, EC = carbonate-epidote, QS = quartz-carbonate-sericite-epidote, QF = quartz-carbonate-sericite-chlorite-fuchsite etc.

In the case of breccia fill use codes QX or BX. Attempts to record too many very different vein types in different logged intervals will render the system unworkable from a plotting or statistical point of view.

Field 26 Veining % - columns 68-69. Record the estimated volume percent of veining using 2 digit codes as for total sulphide percentage.

Field 27 Veins/metre (columns 70-71). Record the average number of veins per metre on a 0-99 scale.

Field 28 Angle to core axis (aca) column 72. Record the dominant angle between veins and the core axis using a single number code:

0 = parallel to, through to
9 = 90° to core axis

or letter codes such as

R = random, or
S = stockwork

Fields 29 - 32 deal with structure.

Field 29 - Bedding angle (column 77). Record the angle between the bedding trace and core axis using a single digit code.

0 = parallel to 9 = perpendicular.

Field 30 - Fractures/metre (columns 78,79). Record the average number of fractures (not healed) per metre in the logged interval on a 0-99 numeric scale.

Field 31, Joint angle (column 80). Record the dominant joint direction with a single digit angle code (0-99) if appropriate, or R for random.

Field 32, Hardness (column 81). This is a potentially very useful measure to assess aspects like ripability or grindability of the rock. Record using a single digit code as follows:

1. very soft easily crumbled by hand
2. soft - broken by hand with difficulty
3. moderate - broken with hammer, but does not ring when hit by a hammer
4. hard - broken by hammer, and rings when struck by hammer
5. very hard - broken with difficulty with hammer.

Fields 33, 34, Faulting. Record the percentage of the logging interval occupied by fault gouge, using a 2 letter percentage code in columns 86-87, and the angle of the zone to the core axis with a two letter code (00-90) in column 88 -89.

Field 35, Unit Code (columns 90-93). This is for a 2 letter or digit code to identify major rock units, to correlate with field mapping units, and/or to control compositing of assay values. In many cases this information will be added or changed by later interpretations, but the ability to lump data together in a controlled way is very important for computer processing of data.

Field 36-37 (Columns 96-110)

Field 36 Sample Number (Column 96 - 102)

Space is provided for a sample number (normally a six digit number with or without a prefix letter.

Field 37 Sample Type (Column 103 - 110)

Two letter sample type code.

TS = Thin Section

WR = Whole Rock

GC = Geochemical sample of set interval

Pb = Lead Isotope sample

R.J. Fountain

(Modification by R.E.Williams
and P.D. Ellis)

LITHOLOGICAL CODINGDDH'S BRD 01 to 05

(Columns 14-21)

<u>ROCK TYPE:</u>	AN	ANDESITE
	ANL	" LAVA
	ANLG	" " GLASSY
	ANLD	" " DACITIC BLEBS
	AN1D	" DYKE
	BS	BASALT
	BSP	" PILLOW
	BSV	" VESICULAR
	BSM	" MASSIVE
	BSPV	" PILLOW WITH VESICULAR PARTS
	BSVP	" VESICULAR WITH SOME PILLOW MARGINS
	BSVB	" " " " BRECCIAS
	BSMP	" MASSIVE WITH SOME PILLOW MARGINS
	BSMV	" " " " VESICULAR AREAS
	DC	DACITE
	DCL	" LAVA
	DCLB	" " BRECCIA
	DCLF	" " - FLOW BANDED
	DCLG	" " - GLASSY
	MBC	MONOMICT BRECCIA
	MBCD	" " DACITE
	PBC	POLYMICT BRECCIA
	QCV	QUARTZ CARBONATE VEIN
	SL	SILTSTONE
	SLGT	" /GREYWACKE/TUFF
	SLGW	" / "
	SLTF	" / TUFF
	TF	TUFF
	TFBC	" BRECCIA (DACITE?)
	TFSH	" /SHALE INTERBEDS
	TFX	" - CRYSTAL
	TFXL	" - " LITHIC (DACITE)
	TFXD	" - " DACITIC

HOLE : DDH BRD 01A Coords : 389013.9E 5394846.1N Collar RL : 661.3
Logged by: PDE Driller: ORTNER Rig id: J49 (mod)
Commenced: 20th August 1989 Completed: 15th Nov 1989
Start Log: 592.8m Total Depth: 1133m
Total Oxid Depth: - Part Oxid Depth: -

010

Target Description

Extension of BRD 01 to test the Que/Hellyer sequence below the Hellyer Basalt and allow downhole geophysics to be run to test the surrounding area.

Mineralisation

None of significance - trace Sp-Gn associated with Qtz-carb veining and vesicule infilling in the basalt horizons.

Significant Results

0-75.0m	Pyroclastics
75.0-527.5m	Que River Shale
527.5-850.5m	Hellyer Basalt
850.5-922.0m	Dalcitic Lavas and Breccias
922.0-953m	Lower Basalt
953 -1052.2m	Feldspar phyric sequence
1052.2-1085.1m	Lower Andesites
1085.1-1109.8m	Lower Dacitic Tuffs and Lavas
1109.8-1133	Animal Creek Greywacke
1133	EOH

Alteration Details

Sericite-calcite common below 850.5m - stronger towards base.
Fuchsite-epidote-silica occurs particularly around 917-922m near the Lower basalt.

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017

General Comments

3 weeks to remove PVC, set wedge and commence drilling.

Geological Notes

Pb isotopes indicate Que River-Hellyer-Rosebery mineralisation signature.
Geochemistry confirms alteration.

DOWNHOLE SURVEY DATA

Depth	Dip	Azimuth	Core Size
0	-90	0	HQ
30	-90	0	HQ
60	-90	321.0	NQ
90	-89	321.0	NQ
120	-89	261	NQ
150	-89	256	NQ
183	-89	259	NQ
213	-88	262	NQ
243	-87	276	NQ
273	-87	281	NQ
303	-87	287	NQ
333	-86	289	NQ
363	-86	288	NQ
393	-84	287	NQ
423	-85	288	NQ
451	-85	295	NQ
483	-85	288	NQ
514	-84	298	NQ
585	-84	304	NQ

521052

040

WEDGE AT 586m

604	-81	290
634	-81	290
664	-81	290
724	-81	291
769	-81	293
883	-79	294
970	-78	292

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019

DEPTH To	Core Recov	LITH'GY MaMi	0.	Sulphides										Alteration										Veining			Structure		Fault	SU	Sample								
				Vo	G	Py	Cp	Po	Ga	Sp	I	Li	Bi	Cy	Ep	Kf	Se	Cl	Si	Ca	Ja	Ba	Mn	Ty	Vo	No	A	B	F		n	J	H	%	I	An	Number	Ty	
598.8	6.0	BSPB	0																																				
604.8	6.0	BSPB	0																																				
610.8	6.0	BSPB	0																																				
616.8	6.0	BSM	0																																				
622.8	6.0	BSMV	0																																				
628.8	6.0	BSMV	0																																				
634.8	6.0	BSMP	0																																				
640.8	6.0	BSMV	0																																				
646.8	6.0	BSMV	0																																				
652.8	6.0	BSMV	0																																				
658.8	5.9	BSBM	0																																				
664.8	6.0	BSBV	0																																				
670.8	6.0	BSBV	0																																				
676.8	6.0	BSB	0																																				
682.8	6.0	BSBV	0																																				
688.8	6.0	BSBM	0																																				
694.8	6.0	BSMB	0																																				
700.8	6.0	BSBM	0																																				
BRECCIA TO 699.2																																							
706.8	6.0	BSMB	0																																				
709.8	3.0	BSMB	0																																				
711.9	2.1	BSMV	0																																				
718.3	6.4	BSMB	0																																				
MASSIVE TO 714.5																																							
724.8	6.5	BSMV	0																																				
730.8	6.0	BSVM	0																																				
736.8	6.0	BSMV	0																																				
742.8	6.0	BSBV	0																																				
741.7	0.1	BSBV	0																																				
742.6	0.1	BSBV	0																																				
748.8	6.0	BSMB	0																																				
754.8	6.0	BSMV	0																																				
760.8	6.0	BSVB	0																																				
763.8	3.0	BSMB	0																																				
769.8	6.0	BSMB	0																																				

701301 Pb
701302 Pb

521054

030

DEPTH To	Core Recov	LITH'GY MaMi	Sulphides					Alteration							Veining			Structure		Fault		SU	Sample														
			Vo	GPy	Cp	Po	Ga	Sp	ILi	Bi	Cy	Ep	Kf	Se	Cl	Si	Ca	Ja	Ba	Mn	Ty		Vo	No	A	BF	nJH	%I	A	n	Number	Ty					
775.8	6.0	BSMB	0																																		
779.1	3.3	BSMB	0																																		
784.8	5.7	BSMB	0																																		
781.1	0.1	BSMB	0																																	701303 Pb	
790.8	6.0	BSBM	0																																		
796.8	6.0	BSBM	0																																		
802.8	6.0	BSVB	0																																		
808.8	6.0	BSVB	0																																		
814.8	6.0	BSVB	0																																		
820.8	6.0	BSMV	0																																		
826.8	6.0	BSMV	0																																		
832.8	6.0	BSMV	0																																		
838.8	6.0	BSMV	0																																		
844.8	6.0	BSVM	0																																		
849.3	4.5	BSBV	0																																		
849.4	0.1	BSB	0	TRFDA																																701201 WR	
849.4	0.1	BSB	0																																		
851.2	1.8	BSBV	0	OIFDA																																	
851.4	0.2	PBC	0	02FDA										1P																						701202 WR	
851.4	0.1	PBC	0																																		
851.5	0.1	PBC	0	02FDA										1PTP																							
854.0	2.5	MBCD	0	03FCA										1P2S																						701222 GC	
853.1	0.1	MBCD	0																																	701203 WR	
856.2	2.2	MBCD	0	01FDA										1P2STP																						701223 GC	
858.4	2.2	DCLB	0	TRFDA										1P1PTS1P																						701224 GC	
856.7	0.1	DCLB	0																																	701305 TS	
856.7	0.1	DCLB	0																																	701204 WR	
860.0	1.6	MBCD	0	TRFDA										2P1P1P2P																						701225 GC	
862.0	2.0	PBC	0	01FVA										2P1PTS2P																						701226 GC	
864.0	2.0	MBCD	0											2P1PTS1P																							701227 GC
862.9	0.1	MBCD	0																																		701306 TS
862.9	0.1	MBCD	0																																		701205 WR
865.5	1.5	MBCD	0											TP1PTSTP																						701228 GC	
867.3	1.8	DCL	0	TRFDA										2PTP4P2P																						701229 GC	
865.8	0.1	DCL	0																																		701307 TS

521055

0 052

DEPTH To	Core Recov	LITH'GY MaMi	Sulphides										Alteration										Veining			Structure		Fault %IAn	SU	Sample						
			Vo	GPy	Cp	Po	Ga	Sp	ILi	Bi	Cy	Ep	Kf	Se	Cl	Si	Ca	Ja	Ba	Mn	Ty	Vo	No	A	B	F	n			J	H	Number	Ty			
906.1	0.1	MBCD	0																															701214	WR	
908.0	2.0	MBCD	0	TRFDA																														701252	GC	
909.1	1.1	PBC	0	02FDA			DT																											701253	GC	
908.6	0.1	PBC	0																															701314	TS	
908.6	0.1	PBC	0																															701215	WR	
911.0	1.9	MBCD	0	01FDA																														701254	GC	
913.0	2.0	MBCD	0	01FDA			DT																											701255	GC	
912.1	0.1	MBCD	0																															701216	WR	
915.0	2.0	MBCD	0	TRFDA			DT																											701256	GC	
917.9	2.9	MBCD	0	TRFDA																														701257	GC	
918.8	0.9	BSM	0	D1FDA																														701258	GC	
918.0	0.1	BSM	0																															701315	TS	
920.3	1.5	BSMB	0	01MVA			AT																													
921.1	0.8	MBCD	0	01FDA			AT																												701259	GC
922.0	0.9	BSMB	0	TRFDA																															701260	GC
932.0	10.0	BSMV	0	TRFDA																															701261	GC
941.0	9.0	BSMP	0	TRFDA			AT																												701262	GC
934.5	0.1	BSMP	0																																701218	WR
950.5	9.5	BSPV	0	TRFDA																															701263	GC
943.2	0.1	BSPV	0																																701316	TS
953.5	3.0	BSB	0	TRFDA																															701264	GC
953.0	1.0	BSB	0																																701317	TS
958.3	4.8	MBCD	0	TRFDA																															701265	GC
958.1	0.1	MBCD	0																																701318	TS
967.5	9.2	DCL	0	01FVA																															701266	GC
964.1	0.1	DCL	0																																701219	WR
971.4	3.9	MBCD	0	04FVA																															701267	GC
971.4	0.1	MBCD	0																																701319	TS
971.4	0.1	MBCD	0																																701220	WR
972.8	1.4	DCL	0	02FDA																															701268	GC
974.9	2.1	MBCD	0	TRFDA																															701269	GC
988.8	13.9	MBCD	0	01FV9DT			A1																												701270	GC
982.1	0.1	MBCD	0																																701221	WR
987.7	0.1	MBCD	0																																701320	TS

521057

053

DEPTH To	Core Recov	LITH'GY MaMi	0.	Sulphides		Alteration											Veining			Structure		Fault %IA	SU	Sample				
				VoGPyCpPoGaSp	VT	ILiBiCyEpKfSeClSiCaJaBaMn	TyVoNoA	BfnJH	Number	Ty																		
994.8	6.0	MBCD	0	01FV9V1	VT	1		1P1P	1P								QC02045		4						701272	GC		
998.2	3.4	MBCD	0	01MDA		1		1P1P3P1P									QC02107	502	4						701273	GC		
996.9	0.1	MBCD	0																						701322	TS		
996.9	0.1	MBCD	0																							701286	WR	
1001.2	3.0	DCLF	0	01FVA		2		1P	1PTP2P1V								QS01067		6	4					701274	GC		
999.7	0.1	DCLF	0																							701323	TS	
999.7	0.1	DCLF	0																								701287	WR
1004.0	2.8	DCL	0	01FVADT		1			TP1P	TP							QC04067			4						701275	GC	
1006.6	2.6	DCL	0	01FVA		2		1P	TPTP3PTP								QC0108R		5	4						701276	GC	
1008.2	1.6	DCLF	0	TRFDA		1			TP1P2P								QC0108R		6	4						701277	GC	
1011.3	3.1	DCL	0	TRFDA		1			1P2P								QC0108R				4							
1008.7	0.1	DCL	0																							701324	TS	
1008.7	0.1	DCL	0																							701288	WR	
1013.0	1.7	DCL	0	TRFDA		2		1P	1PTP3PIV								QC0308R			4								
1014.6	1.6	MBCD	0	TRFVA		1			1P2P								QC0108R				4							
1016.2	1.6	DCLG	0	TRFVA		2		1P	1P	2P1P							QC0108R				4							
1020.8	4.6	DCLF	0	TRFDA		1			1P1P1P								QC0208R		7	4								
1017.9	0.1	DCLF	0																							701325	TS	
1017.9	0.1	DCLF	0																							701289	WR	
1024.1	3.3	DCLB	0	01FDA		1			1P								QC0208R			4								
1026.4	2.3	MBCD	0						TP1P2P								QX1215R				4							
1025.2	0.1	MBCD	0																							701326	TS	
1025.2	0.1	MBCD	0																							701290	WR	
1028.8	2.4	MBCD	0	TRFDA		1			1PTP1P1P								QC0105R			4						701278	GC	
1027.3	0.1	MBCD	0																							701327	TS	
1027.3	0.1	MBCD	0																							701291	WR	
1029.5	0.7	MBCD	0	TRFDA		1											QC0105R			4								
1029.6	0.1	QCV	0														QS90017				4							
1035.0	5.4	PBC	0	01FCA		1											QC0102R				4					701279	GC	
1041.9	6.9	PBC	0	02FDA		3			TP2P2P1P								QC0102R				4							
1041.0	0.1	PBC	0																							701328	TS	
1041.0	0.1	PBC	0																							701292	WR	
1046.0	4.1	MBCD	0	TRFDA		1			1P	1V							QC0102R			4						701280	GC	
1048.0	2.0	MBCD	0	02FVA		1			1PTP								QC0502R		20	4								
1052.2	4.2	MBCD	0	TRFDA		1			1P								QC0215R				4			1012				

521058

054

DEPTH To	Core Recov	LITH'GY MaMi	0.	Sulphides										Alteration										Veining			Structure		Fault %IAN	SU	Sample								
				Vo	GPy	Cp	Po	Ga	Sp	ILi	Bi	Cy	Ep	Kf	Se	Cl	Si	Ca	Ja	Ba	Mn	Ty	Vo	No	A	B	F	n			J	H	Number	Ty					
1052.2	0.1	MBCD	0																																701329	TS			
1052.2	0.1	MBCD	0																																701293	WR			
1060.0	7.8	ANLG	0	TRFDA																																701330	TS		
1053.7	0.1	ANLG	0																																	701294	WR		
1053.7	0.1	ANLG	0																																	701331	TS		
1058.2	0.1	ANLG	0																																	701332	TS		
1059.8	0.1	ANLG	0																																		701281	GC	
1067.9	7.9	ANL	0	TRFDA																																	701333	TS	
1060.4	0.1	ANL	0																																		701297	WR	
1060.4	0.1	ANL	0																																		701334	TS	
1065.7	0.1	ANL	0																																		701335	TS	
1066.7	0.1	ANL	0																																		701299	WR	
1066.7	0.1	ANL	0																																				
1072.0	4.1	ANLD	0	TRFDA																																			
1070.8	0.1	ANLD	0																																			701336	TS
1070.8	0.1	ANLD	0																																			701402	WR
1074.3	2.3	MBCD	0	TRFDA																																			
1075.8	1.5	ANL	0	TRFDA																																			
1074.9	0.1	ANL	0																																			701337	TS
1074.9	0.1	ANL	0																																			701403	WR
1077.8	2.0	ANL	0	TRFVA																																			
1081.0	3.2	ANLD	0	TRFVA																																			
1080.1	0.1	ANLD	0																																			701338	TS
1080.1	0.1	ANLD	0																																			701404	WR
1085.1	4.1	ANL	0																																				
1086.0	0.9	DCL	0	02FDA																																			
1085.2	0.1	DCL	0																																				
1085.2	0.1	DCL	0																																				
1087.6	1.6	TFXD	0	02FBA																																			
1086.7	0.1	TFXD	0																																				
1086.7	0.1	TFXD	0																																				
1089.0	1.4	TFBC	0	01FBA																																			
1089.8	0.8	TFSH	0	01FBA																																			
1090.1	0.3	TFBC	0	01FBA																																			
1092.2	2.1	TFBC	0	01FBA																																			

521059

521061

058

APPENDIX II

PETROLOGY OF THE DRILL CORE SAMPLES

DDH BRD 01A

521062

059

PETROGRAPHIC REPORT

FOR PLACER EXPLORATION (Aust.)

Rocks from BULGOBAC DDH 1 (attn. Peter Ellis)

**by
Anthony J. Crawford
Geology Dept
University of Tasmania
26/10/89**

SAMPLE NUMBER: BRD-01, 534.6m

701321

SUMMARY:

This is one of the best preserved 'Hellyer-type' basalts that I have seen. It is a primitive augite+olivine-phyric basalt, with a microporphyritic groundmass dominated by augite microlites in former glass.

HAND SPECIMEN:

This is a very fresh black, speckled mafic lava with abundant augite(?) phenocrysts, and a few large calcite-filled vesicles.

THIN SECTION:

This sample is an extremely well-preserved basaltic lava with more than 25 modal% of well-formed augite phenocrysts and around 2-3 modal% of pseudomorphed olivine phenocrysts, set in a microporphyritic groundmass. The augite phenocrysts average around 1mm long, but some crystals are at least 3mm long; they are generally colourless euhedral crystals that frequently occur in multi-crystal clots. They are perfectly fresh. Former olivine crystals are now represented by pale green chlorite pseudomorphs that sometimes enclose small chromite euhedra. They are mainly 0.5-1.5mm long euhedral crystals, and are also partly replaced by minor calcite in places.

The groundmass of this sample is quite distinctive. It consists of abundant tiny stubby fresh augite crystals set in a chlorite-albite matrix, the latter possibly after former glass. Several vesicles are filled by massive calcite, and occasional discontinuous meandering calcite veinlets cut the slide. Also, en echelon tiny fractures filled with secondary quartz, albite and chlorite are quite common. Possible prehnite patches in some chlorite pseudomorphs after olivine, and the absence of actinolite, indicate that this sample contains a prehnite-pumpellyite grade metamorphic assemblage.

SAMPLE NUMBER: 856m

701305

SUMMARY: This is a dacitic lava breccia composed of sparsely plagioclase-phyric largely (formerly) glassy dacitic fragments; hydrothermal alteration is insignificant.

HAND SPECIMEN:

Altered dark grey-green andesitic lava breccia with abundant white feldspar phenocrysts.

THIN SECTION:

The fragmental texture of this sample is obvious in thin section, with individual lava fragments recognizable due largely to local variations in groundmass texture. The dominant lava fragment type was a plagioclase-phyric formerly glassy dacite, in which the perlitically-cracked glass has devitrified to a very fine-grained quartz-albite mixture, with narrow seams of pale green chlorite picking out the perlitic cracks. Feldspar phenocrysts are blocky albitized plagioclase with slight sericite flecking, and are mainly less than 1mm long. They make up about 5 modal% of these perlitically-cracked lava fragments. Another fragment variety is essentially identical to that just described, except these lack the perlitic cracking. A third and quite abundant lava fragment type has a similar amount of blocky albite phenocrysts set in a formerly less glassy, vitrophyric groundmass riddled with tiny albite microlites. There is no sign of the former presence of mafic phenocrysts, but occasional leucoxenized microphenocrysts of FeTi oxide occur in most fragments. An irregular meshwork of sericite pervades this sample, but sericitization is not strongly developed. Minor late-stage calcite fills fractures and veins. The metamorphic assemblage is prehnite-pumpellyite facies, and the amount of hydrothermal alteration is insignificant.

There is nothing to say that the various lava fragments in this sample could not have come from the same flow unit, albeit from different parts of a flow. Textural variations simply reflect cooling rates; all fragments have similar amounts of similar looking plagioclase phenocrysts. The blocky shapes and relatively small modal amount of the plagioclase phenocrysts, the absence of mafic phenocrysts, plus the abundant glass that was present in most fragments, all suggest to me that this was a dacitic rather than andesitic flow. The relatively abundant chlorite in the sample suggests that either the sample is at the andesitic (ie low-Si, high-Mg) end of the dacite spectrum, or that it has been selectively chloritized. I favour the latter possibility, which would predict Ti/Zr ratios of around 15-20.

SAMPLE NUMBER: 862.8m

701306

SUMMARY:

This is a dacitic lava breccia very similar originally to sample 856m above. However, it has suffered much stronger hydrothermal calcite-sericite alteration, with a significant reduction in the amount of chlorite compared to 856m.

HAND SPECIMEN:

This is a grey, strongly altered dacitic to andesitic lava breccia with poorly-defined formerly glassy lava fragments up to at least several cm long.

THIN SECTION:

The lava fragments present in this sample show the same range of of textures and phenocryst mineralogy as that sample described above. Most were glassy, sparsely plagioclase-phyric dacites, many with perlitic cracking of the formerly glassy groundmass. In fact, the only major difference from the sample described above is that this sample (862.8m) shows considerably more sericite-calcite alteration, and correspondingly less chlorite. The sericite occurs both replacing most or all of the albitized plagioclase phenocrysts, and as a fairly dense but irregularly distributed mesh through the rock, and the abundant calcite occurs as dispersed patches and blebs throughout the section, overprinting all lava fragments.

The intensity of the calcite-sericite alteration in this sample is notably greater than shown by sample 856m, and also much more intense than ambient low-grade burial metamorphic alteration. It is therefore pre-seumed to be of local hydrothermal origin.

001
SAMPLE NUMBER: 865.6m

701307

SUMMARY:

This is a formerly highly glassy, sparsely plagioclase-phyric massive dacitic lava that has developed a weak banded appearance due to sericitization; hydrothermal alteration (sericite-calcite) is very weak.

HAND SPECIMEN:

This is a pale grey-green massive weakly flow-banded felsic lava with sparse altered feldspar phenocrysts.

THIN SECTION:

This is a massive very poorly plagioclase-phyric dacitic lava that was originally essentially entirely glassy. The plagioclase phenocrysts (<2 modal%) are totally sericitized blocky euhedra to about 1mm long, that blend at their margins into the highly sericitized groundmass. Sparse leucoxenized microphenocrysts of FeTi oxide are also present.

The groundmass of this sample was almost certainly wholly glassy at eruption. It has devitrified to the present extremely fine-grained quartz-albite-sericite mixture, and subsequent sericite alteration in discontinuous bands and streaks has imparted a flow-banded appearance to the sample. The sericite-rich bands are irregular and of variable thickness, and are 'dirty' relative to the 'cleaner' sericite-poor quartz-albite bands and streaks. Calcite is a minor alteration phase occurring together with sericite both replacing former albite phenocrysts and as small blebs and stringers in the groundmass. Chlorite is rare in this sample, occurring only as occasional small fracture fillings.

The amount of sericite in this sample is only a little more than might be expected from the regional low-grade degradation of a glassy dacitic lava; therefore, hydrothermal alteration of this sample is weak, if any.

SAMPLE NUMBER: 867.8m... 701306

SUMMARY:

This is a plagioclase-phyric formerly glassy dacitic lava with very weak sericite-calcite alteration.

HAND SPECIMEN:

This is a mottled pale brown and dark grey-green formerly glassy felsic lava with and chlorite-poor areas dominant, and patchy, more chlorite-rich areas scattered irregularly through the sample.

THIN SECTION:

This is a fairly uniform-textured, plagioclase-phyric formerly glassy dacitic lava with a few slightly flattened vesicles filled with sericite, quartz and calcite. Plagioclase phenocrysts are more abundant, and rather more elongate-prismatic than the typically blocky phenocrysts in the previous two samples. The albite phenocrysts are sericite-free through most of the section, but contain sericite-calcite alteration in more altered areas of the sample. Small leucoxenized FeTi oxide microphenocrysts are not uncommon, but former mafic silicate phenocrysts were not present in this sample.

The groundmass has a classic quartz-albite patchy mosaic texture developed from the devitrification of glass. Chlorite is not abundant, but is common enough as small tufts and spots patchily developed in the groundmass. Dominant alteration minerals are sericite and calcite; although these are not strongly developed, they occur in broad bands and patches of more altered groundmass. In the few vesicles, sericite and calcite are both quite coarsely crystalline, and sometimes contain euhedral crystals of secondary quartz.

This is a reasonably well-preserved dacitic lava, with very mild, if any hydrothermal overprint, dominated by sericite-calcite.

003

521068

²⁷¹⁰
SAMPLE NUMBER: 870.3m

701 309

SUMMARY:

This is a well-preserved formerly fairly glassy plagioclase-phyric low-Si dacite or acid andesite lava, with minimal hydrothermal alteration.

HAND SPECIMEN:

This is a dark grey-green massive, even-textured plagioclase-phyric andesitic to dacitic lava.

THIN SECTION:

This is a texturally and mineralogically well-preserved plagioclase-phyric andesitic to dacitic lava. It contains about 10 modal% of tabular albitized plagioclase phenocrysts to almost 2mm long that show very slight sericite alteration, and often contain rows of chloritized melt inclusions. Five or six small (<0.5mm long) euhedral shapes now composed of chlorite were almost certainly augite microphenocrysts. Small leucoxenized FeTi oxide microphenocrysts are not uncommon. Several multi-crystal clots of tiny intergrown plagioclase phenocrysts are also present.

The groundmass of this sample was glassy to vitrophyric; it contains tiny albite microlites set in a coarse patchy quartz-albite mosaic after devitrified glass. Very fine-grained chlorite is quite common dispersed in the groundmass, and sericite is more localized in broad bands of more intense alteration. Calcite and sericite also occur as sparse, narrow meandering veinlets.

The abundance of chlorite in the groundmass of this sample, and the more elongate (rather than blocky equidimensional) plagioclase phenocrysts suggest that this is a low-Si dacite or acid andesite. It is well preserved and should be analyzed to compare with the Que-Hellyer 'Mixed' sequence lavas.

SAMPLE NUMBER: 885.1m

761 310

SUMMARY:

This is a polymict lava breccia dominated by formerly glassy dacitic lava and vitric tuff fragments that vary from chlorite-rich to sericite-rich; this alteration is hydrothermal rather than due to burial metamorphism.

HAND SPECIMEN:

This is a polymict lava breccia containing light coloured formerly glassy, sparsely plagioclase-phyric dacitic lava fragments, and darker, more plagioclase phenocryst-rich and more chloritic andesitic or dacitic lava fragments.

THIN SECTION:

The largest fragment in this section is typical of the light coloured formerly highly glassy fragments obvious in the hand specimen. It consists of sparse (<1 modal%) blocky albite phenocrysts that have been totally sericitized, set in a patchy quartz-albite mosaic-textured intergrowth after glass. Virtually all of the albite in the groundmass has been replaced by exceptionally fine-grained sericite that renders the groundmass 'cloudy'. This fragment has been strongly sericitized relative to most of the samples described above.

The other fragments making up this section are more chloritic, and vary from perlitically-cracked sparsely plagioclase-phyric dacites identical to sample 856m, to samples of vitric tuff with clearly preserved outlines of glassy shards that have recrystallized to fine-grained quartz-albite. Some fragments show pervasive and intense chloritization of the groundmass, whereas others are intensely sericitized. Calcite overprints sericite in many fragments.

It is important to note that the sericite and chlorite alteration is clearly localized in separate otherwise identical fragments, and must therefore have formed pre-burial metamorphism of the sample. I suggest that the fragments making up this rock were variably hydrothermally altered when the rock was formed by explosive submarine volcanic activity.

SAMPLE NUMBER: 888.3m

701 311

SUMMARY:

This is a dacitic crystal lithic vitric tuff, with a high proportion of comminuted glassy material in the matrix, and variable chloritic-, or sericite-calcite alteration, of local hydrothermal origin.

HAND SPECIMEN:

This is a strongly altered massive plagioclase-phyric dacitic lava(?) with streaks of dark chlorite-rich material through more massive diffuse pale-grey-green strongly calcite-sericite altered lava.

THIN SECTION:

The first thing that strikes me about this sample is that it is quite obviously fragmental, a fact not obvious to me from the hand specimen. The sample is composed of small lava fragments and abundant broken albite phenocrysts set in a heterogeneous matrix that was originally highly glassy. Albite phenocrysts are generally less than 1mm long, and are nearly all crystal fragments, except for a few well-formed phenocrysts in clear dacitic lava fragments.

The groundmass of this sample is unusual in texture, changing rapidly over very small distances, with a very uneven distribution of chlorite and sericite. In many places, relic glass shard textures are poorly preserved in ghost outlines. I think this sample is a crystal lithic vitric tuff of dacitic composition, although small formerly glassy lava fragments are more abundant than the glassy shard material. The abundant broken albite crystals support this tentative interpretation. The matrix may have been largely composed of comminuted dacitic glass.

Alteration is variable in intensity and composition, being either chloritic, or sericite-calcite dominated. The sample is not strongly altered, but the alteration present is hydrothermal rather than pervasive regional burial metamorphic alteration.

SAMPLE NUMBER: 902m

701312

SUMMARY:

This is a polymict lava breccia dominated by formerly glassy dacitic lava fragments identical to sample 856m, but it also contains not uncommon chlorite-rich andesitic lava fragments. Hydrothermal sericite-calcite alteration is fairly weak.

HAND SPECIMEN:

This is a dark green lava breccia dominated by chloritic, sparsely feldspar-phyric dacitic to andesitic lava fragments to around 1cm long.

THIN SECTION:

The fragmental nature of this sample is obvious in thin section. The dominant lava fragment variety is beautifully perlitically-cracked sparsely plagioclase-phyric dacite identical in every way to sample 856m. Chlorite picks out the perlitic cracks and is quite abundant in most fragments. A somewhat less abundant fragment type is very distinctive in having a rare albite phenocrysts set in a pilotaxitic textured groundmass composed of elongate plagioclase microlites embedded in bright green chlorite; the latter probably forms more than 50 modal% of these fragments. These chloritic fragments also contain common small FeTi oxide granules in the groundmass, and were probably andesitic in composition. Calcite and sericite are common overprinting both chloritic and chlorite-poor lava fragments, but the intensity of alteration is not strong. This is a polymict lava breccia dominated by formerly glassy dacitic lava fragments, but containing also an andesitic lava fragment component.

007

521072

SAMPLE NUMBER: 903m

701313

SUMMARY:

This is a highly altered dacitic glassy lava breccia showing development of a zoned epidosite alteration assemblage probably developed around a conduit through which oxidizing hydrothermal fluids were moving.

HAND SPECIMEN:

This is a highly altered dark green lava breccia with a patch of intense alteration at least 10cm across, showing intense zoned alteration from a black chloritic rim to a pale grey-green sericite- and epidote-rich core.

THIN SECTION:

The least-altered part of this sample is dominated by poorly defined lava fragments that are sparsely plagioclase-phyric formerly highly glassy dacites. Some of the fragments have preserved excellent perlitic cracking in the glassy groundmass, and are essentially identical to sample 856m. Alteration within this 'least-altered' part of this rock is nevertheless quite strong, with sericite, chlorite and calcite all common through the matrix of the lava fragments. This 'least-altered' zone passes into a zone about 1cm wide composed almost entirely of sericite that lacks any relict texture whatsoever. This sericite zone contains sparse small pyrite cubes, and tiny chlorite spots. This sericitic zone passes abruptly into a zone in which a few relic albite phenocrysts replaced almost completely by coarse-grained sericite are set in a structureless matrix composed almost entirely of exceptionally fine-grained, dirty, almost isotropic epidote.

This excellent example of epidosite alteration is characteristic of quite oxidizing hydrothermal fluids. The same zonation on a scale of tens of meters rather than centimeters, commonly occurs in footwall sequences in andesites below hematite-rich VMS orebodies, such as at the Cadia deposit in central W NSW. It is not, however, restricted to occurrences associated with (footwalls of) VMS mineralization.

SAMPLE NUMBER: 908.6m

701314

SUMMARY:

This is a strongly sericite-calcite altered polymict dacitic lava breccia containing abundant formerly glassy sparsely plagioclase-phyric dacitic lava fragments, and subordinate fragments of crystal vitric tuff.

HAND SPECIMEN:

This is a pale grey lava breccia containing sparsely plagioclase-phyric lava fragments to at least 6cm across, and smaller, more angular strongly sericitized yellowish lava fragments.

THIN SECTION:

In thin section, this sample is seen to be a very strongly altered fragmental volcanic, dominated by strongly sericitized formerly glassy sparsely plagioclase-phyric dacite lava fragments, most of which show preserved perlitic cracking. Other fragments are less easy to identify; they have occasional albite phenocrysts, but very heterogeneous groundmasses, with rapid local variations in texture and amount of chlorite and sericite. They were certainly glass-rich, and there are several areas in which there are strong suggestions of the former presence of glassy shards. These clasts may have been crystal vitric tuffs. Irregular slightly rounded areas of intergrown pale pink albite crystals have probably developed in situ, rather than being crystalline clasts. Calcite is common overprinting the groundmass and phenocrysts alike. The strong calcite-sericite alteration of this sample is definitely of hydrothermal origin.

683

521074

SAMPLE NUMBER: 917.9m

701315

SUMMARY:

This is an olivine+augite+chromite-phyric basaltic lava similar to the more primitive Hellyer basalts; it has been overprinted by epidote-sericite alteration, that in turn was overprinted by a calcite-sericite-fuchsite alteration assemblage.

HAND SPECIMEN:

This is a massive grey mafic (?) lava transected by a 5mm-wide calcite vein that has a well-developed pink halo of intense sericite-epidote(?) alteration containing abundant small green fuchsite patches to about 2mm across.

THIN SECTION:

The least altered part of this section is petrographically strikingly different from all the foregoing samples, in that it is a metabasic lava, with altered phenocrysts of olivine and augite, and minor plagioclase. It contains at least 25 modal% of phenocrysts set in a murky vitrophyric groundmass. The dominant phenocryst phase is now replaced by a pale brown almost isotropic very fine-grained epidote mixture. These have shapes that suggest that they were augite originally. A second set of former mafic phenocrysts with very different outlines and replacement assemblages are clearly former olivine phenocrysts; several contain small euhedral red chromite inclusions, and all are altered to calcite and quartz. A few former plagioclase phenocrysts are altered totally to sericite.

The groundmass of this lava was vitrophyric, with epidotized augite and plagioclase microlites set in a sericite-epidote-altered formerly glassy matrix.

The pinkish bleached halo surrounding the coarsely-crystalline calcite vein is texturally identical to the unbleached area further out, but contains very little fine-grained dirty epidote, and much more abundant sericite-calcite alteration. Only a single small patch of fuchsite was intersected in this thin section; it looks like rather coarsely-crystalline and high-birefringent muscovite, but shows no green colour in plane polarized light.

This sample was definitely a fairly primitive basaltic lava, with the olivine-augite-chromite phenocryst assemblage typical of many of the more primitive Hellyer basalts. Intense alteration with epidote-sericite dominant has been overprinted by a calcite-sericite alteration assemblage associated with calcite veins.

070

SAMPLE NUMBER: 943.1m

701316

521075

SUMMARY:

This is a sparsely olivine-phyric metabasaltic lava with strong calcite alteration overprinting groundmass and phenocrysts.

HAND SPECIMEN:

This is a grey, uniform-textured intermediate aphyric lava with a few rounded patches of calcite (vesicles?).

THIN SECTION:

This is a poorly porphyritic lava with scattered former mafic phenocrysts set in a highly altered vitrophyric groundmass. The phenocrysts make up around 2-3 modal% of the sample, and have shapes typical of an olivine precursor, and are replaced by a very fine-grained quartz aggregate that is overprinted by calcite. Many of the former olivine phenocrysts contain tiny euhedral red chromite crystals. Rare small albite phenocrysts are partially replaced by granular yellow epidote.

The groundmass of this sample is strongly calcite-altered, but clearly was composed of abundant tiny plagioclase and augite microlites set in a glassy mesostasis replaced by pale green chlorite and dirty, very fine-grained epidote; tiny former FeTi oxide granules are altered to leucoxene.

This sample is a metabasaltic lava, rather unusual (for Hellyer-type basalts) in being relatively phenocryst-poor. It has suffered strong calcite alteration, but a sample from this unit should be altered for the Mount Read Volcanics data base if possible.

072

521076

SAMPLE NUMBER: 952.9m 701376

SUMMARY:

This sample was a sparsely olivine-phyric metabasaltic lava that has been strongly calcite-altered; it is essentially identical to the previous sample.

HAND SPECIMEN:

This is a massive, dark grey uniform-textured almost aphyric metabasic lava cut by common calcite veins up to 1cm wide.

THIN SECTION:

This sample is almost the same as the previous sample in most respects. The only major points of difference are that the groundmass of this sample was more glassy than that of 943.1m; this glassy was riddled by larger plagioclase microlites than in the groundmass of the previous sample, and has altered to abundant green chlorite. Olivine phenocrysts are totally replaced by calcite, and calcite as abundant small patches and blebs overprints at least 60 modal% of the groundmass. The extent of the calcite alteration demands local hydrothermal alteration.

072

521077

SAMPLE NUMBER: 958m

701318

SUMMARY:

This is a dacitic lava breccia basically identical to most of those described from above the lower basalt unit. Alteration of this sample is hardly more than regional burial alteration.

HAND SPECIMEN:

This is a dark grey lava breccia dominated by plagioclase-phyric dacitic(?) lava fragments mainly less than 1cm across.

THIN SECTION:

This sample is a dacitic lava breccia very similar in every respect to most of those lava breccias described above. It is composed of abundant plagioclase-phyric formerly glassy dacitic lava fragments, many of which show well-developed perlitic cracking. Occasional euhedral microphenocrysts replaced by chlorite have shapes suggestive of augite precursors. One significant difference between this sample, and the other dacitic lava breccias described above is that this sample has well-defined fragment margins, due to their being highlighted by narrow rims composed of tiny crystals of FeTi oxides that have probably recrystallized from leucoxenized FeTi oxides in the groundmass during stylolitic pressure solution of adjacent fragments. Calcite alteration is not well-developed in these fragments.

Occasional chlorite-rich andesitic(?) lava fragments are also present, with less glassy groundmasses and larger plagioclase microlites. This sample clearly indicates a return to the dominant explosive dacitic volcanism in that part of the sequence under the lower basalt unit. There are no basaltic fragments in any of the dacitic breccias above or below the lower basalt.

073

SAMPLE NUMBER: 971.3m

701319

521078

SUMMARY:

This is a plagioclase+(sparsely) augite-phyric dacitic lava with poorly defined autobrecciation, and very weak alteration, dominated by mild silicification; it contains very little calcite.

HAND SPECIMEN:

This is an unusual textured dacitic lava autobreccia with fragments of dark grey sparsely plagioclase-phyric formerly glassy dacite in a heterogeneous matrix that shows pronounced bleaching and concentrated calcite alteration.

THIN SECTION:

This is a plagioclase+augite-phyric dacitic or andesitic lava that shows little evidence in thin section of a fragmental texture. It is composed of about 10 modal% of albitized plagioclase phenocrysts to about 2mm long, and slightly sericitized. Much less abundant are small (<0.5mm long) chloritized augite phenocrysts, and leucoxene-altered FeTi oxide microphenocrysts.

The dark groundmass in the hand specimen is composed of almost isotropic devitrified glass in which are set abundant tiny plagioclase microlites (albitized) and less common small spots and streaks of chlorite.

The dark area contains a fine network of subparallel sericite veinlets. In the more pale-coloured bleached areas of the hand specimen, the groundmass is composed of a quartz-albite-sericite assemblage after glass, that is basically chlorite-free. In the most intensely altered light coloured areas, angular quartz veinlets and segregations indicate that silica-soaking is responsible for the bleaching.

This sample is probably a slightly autobrecciated dacitic lava. It differs from most of the dacites described above in that it contains rather more abundant former augite phenocrysts, and more plagioclase phenocrysts.

The alteration of this sample is no different from the less megascopically altered (or more homogeneously-textured and coloured in hand specimen) dacites described above. It is dominated by weak silicification that is scarcely more intense than regional burial metamorphic alteration, and calcite is scarce in this sample.

521079

SAMPLE NUMBER: 987.6m

701320

SUMMARY:

This is a dacitic lava breccia made up of sparsely plagioclase-phyric fragments of formerly glassy dacite; the alteration assemblage is calcite-chlorite-sericite, but is not strongly developed.

HAND SPECIMEN:

This is a mottled grey-green highly altered lava breccia with dark dacitic lava fragments to at least 2cm long, and common calcite patches and veinlets.

THIN SECTION:

The brecciated fragmental texture obvious in the hand specimen is far less obvious in the thin section of this sample, although abrupt changes in the groundmass texture probably mark fragment boundaries. All fragments are of very similar formerly glassy dacitic lavas that carry sparse small (<1mm) albitized plagioclase phenocrysts that are slightly speckled with sericite. The groundmass of these fragments has devitrified and crystallized as patchy mosaics of quartz- albite-sericite-chlorite. The abundance of chlorite varies across the sample from fragment to fragment, although it is never a common phase. Angular patches of quartz, calcite and coarse-grained sericite are present, and appear to be fracture fillings. Calcite is quite common as small blebs and patches overprinting the groundmass.

This sample is a dacitic lava breccia little different from those described above occurring above the lower basalt. The alteration of this sample is fairly mild, although more intense than regional alteration.

075

521030

SAMPLE NUMBER: BRD01A 996.8m

701322

SUMMARY:

This is a well-preserved plagioclase-phyric dacitic lava.

HAND SPECIMEN:

This is a massive dark green plagioclase-phyric dacitic lava.

THIN SECTION:

This is a texturally well-preserved plagioclase-phyric dacitic lava. It contains around 5 modal% albitized plagioclase phenocrysts set in a formerly largely glassy groundmass. The plagioclase phenocrysts are mainly euhedral blocky laths with common multi-crystal clots. The crystals average around 1mm long, and show minor speckling by sericite and less abundant pale green chlorite. Several pseudomorphs after former mafic crystals are present, now composed mainly of chlorite; these were probably originally small augite phenocrysts. Former FeTi microphenocrysts are present but not common, and are always replaced by messy leucoxene.

The groundmass of this sample consists of tiny acicular albite microlites showing a broad general alignment of long axes, and far less abundant but not uncommon chlorite pseudomorphs after rather elongate slender augite microlites, all set in a mosaic-textured quartz-albite patchy matrix, originally clearly glassy. Tiny patches of rather coarse-grained sericite are common. Calcite occurs as small irregular patches overprinting the groundmass, as narrow, discontinuous streaks and veinlets that cut the rock.

This sample was a dacitic lava; the relatively common (former) augite pseudomorphs in the groundmass suggest that it was a relatively low-Si dacite. It is well-preserved, and should be included in the wholerock analysis group.

SAMPLE NUMBER: BRD01A, 999.6m

701 373

SUMMARY:

This is a plagioclase-phyric originally largely glassy dacitic lava very similar to the preceding sample, except for more intense (but still not strong) sericitization.

HAND SPECIMEN:

This is a massive, weakly flow-banded pale grey plagioclase -phyric dacitic lava, probably originally highly glassy.

THIN SECTION:

The general diagnosis of this sample is essentially the same as the preceding sample. This was a formerly plagioclase-phyric dacitic lava with a largely glassy groundmass; it contains a few phenocrysts of chloritized augite, and somewhat more common former FeTi oxide phenocrysts that are altered to leucoxene. Major differences from the preceding sample are:

1. this sample is notably more sericitized, with sericite occurring both in the albite phenocrysts and scattered throughout the groundmass.
2. this sample contains more chlorite in the groundmass, where it occurs as an irregular mottling throughout the groundmass, as as speckles in the albite phenocrysts.
3. an unusual feature of this sample is the presence of common tiny very elongate former FeTi oxide crystals in the groundmass.
4. this sample contains some small patches of relatively coarse-grained intergrown green chlorite and secondary quartz.

The very weakly-defined banding in the hand specimen is not observed texturally or mineralogically in the hand specimen.

This is clearly a dacitic lava, and as for the preceding sample, the relative abundance of chlorite in the groundmass suggests that it is a low-Si dacite (possibly around 64-66% SiO₂). I will analyze this dacite also.

677

521032

SAMPLE NUMBER: BRD01A, 1008.6m 701324

SUMMARY:-

This is a well-preserved plagioclase-phyric massive dacitic lava.

HAND SPECIMEN:

This is a massive dark grey plagioclase-phyric felsic to intermediate lava.

THIN SECTION:

This is a well-preserved dacitic lava with around 5 modal% of albitized plagioclase phenocrysts in a vitrophyric groundmass. It is very close texturally to the two preceding samples, but probably contains rather more chlorite in the groundmass, and certainly contains more chloritized small former augite phenocrysts (albeit much less than 1 modal%). The groundmass was originally a glass, charged through with tiny plagioclase microlites that show a broad flow alignment. Sericite and calcite occur together as fairly uncommon extremely narrow meandering veinlets. Calcite occurs as small blebs and patches overprinting the groundmass. It is notable that the degree of alteration in these dacitic lavas is much less than those described from higher in the hole (from between the basalt units). It is considered that this is not simply due to the fact that the upper dacites were mainly lava breccias, and therefore more permeable to alteration fluids. This sample could also be analyzed.

Q70

521033

SAMPLE NUMBER: BRD01A, 1017.8m

701325

SUMMARY:

This is a massive sparsely plagioclase-phyric dacitic lava with slightly more calcite alteration than the preceding samples, but otherwise essentially the same.

HAND SPECIMEN:

This is a dark grey, very sparsely plagioclase-phyric extremely fine-grained felsic lava.

THIN SECTION:

This sample is also a massive, plagioclase-phyric dacitic lava. It contains more albitized plagioclase phenocrysts than expected from the hand specimen, probably because many albite phenocrysts are partially altered to chlorite and sericite. A few small former augite phenocrysts are replaced by chlorite, while former FeTi oxide microphenocrysts altered to leucoxene are not uncommon.

The groundmass of this sample is extremely fine-grained, and consists of flow-aligned and sericitized tiny plagioclase microlites in a formerly glassy matrix. It shows rather more calcite in the groundmass than the preceding samples, mainly as small irregular patches and spots, and also commonly as rims on albite phenocrysts.

SAMPLE NUMBER: BRD01A, 1025.1m 701326

SUMMARY:

This is a more Si-rich plagioclase-phyric dacite than the preceding samples, containing notably less chlorite, and rather more calcite than the four previously-described massive dacitic lavas.

HAND SPECIMEN:

This is a massive plagioclase-phyric dacitic lava with diffuse patches and narrow veinlets of calcite.

THIN SECTION:

This is a plagioclase-phyric dacitic lava with around 5-8 modal% of albitized plagioclase-phenocrysts set in a devitrified glassy groundmass with a fine-grained snow-flake (mosaic) texture defined by patchy albite and quartz. Most of the plagioclase phenocrysts are actually multi-crystal clots of smaller phenocrysts. Mafic phenocrysts are rare, and are small chloritized augite crystals.

The groundmass of this sample contains irregular patches that are composed of quite coarsely-crystalline quartz enclosing rosettes of pale yellow sericite. This sample contains less former mafic phenocrysts and less chlorite in the groundmass, and is probably a more Si-rich dacite (68-70%SiO₂) than the preceding samples. It contains quite common calcite veins and small spots and patches throughout the groundmass.

630
SAMPLE NUMBER: BRD01A, 1027.2m

701327

521035

SUMMARY:

This sample is a formerly largely glassy lava breccia or hyaloclastite derived from a plagioclase-phyric dacitic lava similar to the first four dacitic samples described above.

HAND SPECIMEN:

This is a pale grey highly altered fragmental dacitic lava breccia, with most fragments being less than 0.5cm across.

THIN SECTION:

The fragmental nature of this sample is well-displayed in thin section, mainly defined by notable differences in the groundmass textures of adjacent lava fragments. All the textural varieties of plagioclase-phyric dacites as described for the preceding five massive dacitic lavas are present, including formerly highly glassy snowflake-textured fragments, through to microporphyrific-textured varieties with flow-aligned albite microlites. A large majority of the samples were highly glassy, and are now composed of devitrified glass crystallizing to patchy albite-quartz intergrowths.

Angular interstices between lava fragments contain calcite, streaks and trains of very fine-grained sericite, and minor chlorite. I suggest that this sample is probably a flow-top breccia or hyaloclastite composed mainly of small glassy lava fragments spalling of a quenching flow of plagioclase-phyric dacitic lava identical to the first four described above.

081

521086

SAMPLE NUMBER: BRD01A, 1040.9m 701318

SUMMARY:

This is a strongly altered plagioclase-phyric dacitic lava breccia with common silicification of the matrix, and relatively abundant chlorite and calcite alteration. It contains altered disseminated pyrite.

HAND SPECIMEN:

This is a dark grey felsic lava breccia with angular fragments of plagioclase-phyric lava up to 1cm across in a lighter coloured, highly altered matrix.

THIN SECTION:

This sample shows a fragmental texture in thin section, but rather extensive alteration between fragments has rendered the texture more difficult to determine than in the previous samples. The clearly defined lava fragments are definitely formerly highly glassy plagioclase-phyric dacites, little different to those dacites described above. In these, the glass has devitrified to a dark coloured, almost isotropic material from which small spots of secondary quartz are crystallizing. Many of these fragments show perlitic cracks preserved by highlighting with fine-grained chlorite and sericite.

Most of the matrix between lava fragments is strongly recrystallized, although flattened shapes composed of a rim of quartz and cores of chlorite are common, and could have been either vesicles or less likely perhaps, flattened pumice fragments. Silica alteration is abundant in the inter-fragment areas, and calcite overprinting is also common. Small trains of tiny altered pyrite (?) grains are not uncommon in this sample, and altered disseminated pyrite occurs in both fragments and matrix, but is a very subordinate component of this sample.

682

521087

SAMPLE NUMBER: BRD01A, 1052.2m 701379

SUMMARY:

This sample is a massive formerly largely glassy plagioclase-phyric dacitic lava (probably 66-68% SiO₂) with a distinctive groundmass texture.

HAND SPECIMEN:

This is a dark grey massive sparsely plagioclase-phyric dacitic lava.

THIN SECTION:

This sample is a dacitic lava that contains around 5 modal% of albitized plagioclase phenocrysts in an unusual textured formerly glassy matrix. Plagioclase (albite) phenocrysts are generally clustered in multi-crystal clots and show very slight sericite flecking. Occasional FeTi oxide microphenocrysts are altered to leucoxene, and a few former mafic phenocrysts in this rock.

The groundmass shows a most unusual texture. It is basically divided into subrounded to flattened, pillow-like domains by stylolite-like concentrations of tiny Fe oxide or leucoxene grains. Within each domain, which are much less than 1 mm long, are either patches of devitrified glassy lava containing small patches of secondary quartz, or more coarse-grained areas of secondary quartz and chlorite. This sample was a dacitic lava similar to the more chlorite-rich samples described above. It is a good sample to analyze for major and trace elements.

SAMPLE NUMBER: BRD01A,1053.6m 701330

SUMMARY:

This is an almost aphyric formerly highly glassy low-Si dacitic to andesitic lava.

HAND SPECIMEN:

This is a massive dark grey-green almost aphyric felsic to intermediate lava with small subrounded spots of black chlorite to about 2mm abundant common in the groundmass, and at least one distinct lava fragment about 1cm across.

THIN SECTION:

This is an almost aphyric formerly glassy lava. It contains less than 2 modal% of albitized plagioclase phenocrysts. These are small (<1mm) and partially to completely sericitized. A few small blocky chlorite pseudomorphs after augite are also present, and leucoxenized FeTi oxide microphenocrysts are not uncommon.

The groundmass of this sample was clearly originally vitrophyric, with tiny albite microlites showing broad flow alignment set in a devitrified glassy matrix from which are crystallizing quite coarse-grained (0.2-0.5mm across) patches composed of polycrystalline quartz growing into green chlorite. Tiny leucoxene spots are common in the altered groundmass. Calcite occurs as small spots and patches overprinting the groundmass. The lava fragment in one corner of the section is a very sparsely plagioclase-phyric lava with an almost isotropic devitrified glassy groundmass. It is essentially a quenched version of the rock making up the remainder of this sample, and probably represent a fragment of glassy crust of this flow incorporated into the lava during convective or flow overturn.

This lava is rather different from those massive dacites described above. The fewer plagioclase phenocrysts and the relatively abundant chlorite and tiny groundmass FeTi oxides suggests that it may be transitional to an andesitic lava.

SAMPLE NUMBER: BRD01A, 1058.1m 701331

SUMMARY:

This is a sparsely plagioclase-aphyric andesitic lava with a distinctive patchy light and dark groundmass representing more glassy, and more crystallized areas respectively.

HAND SPECIMEN:

This is a massive dark grey aphyric lava with an unusual texture defined by diffuse but abundant spots of lighter colored grey-green material mainly less than 1mm across in a darker grey groundmass.

THIN SECTION:

This is a rather distinctive sample due to its unusual alteration texture. It is composed of less than 1 modal% of totally sericitized plagioclase phenocrysts to about 1mm long set in a most unusual groundmass. FeTi oxide phenocrysts altered to leucoxene are relatively common, and occasional chloritized augite(?) microphenocrysts are also present.

The groundmass of this sample has a most unusual texture. Basically, it is composed of light coloured and dark coloured domains, each up to a few millimeters across. These are clearly formed during devitrification or alteration of the groundmass, since single plagioclase phenocrysts may be seen extending from one domain into another. The lighter coloured domains are sericite-rich quartz-albite intergrowths after glass, with no plagioclase microlites, and the dark areas are more chloritic, but distinctive in having abundant plagioclase microlites embedded in the devitrified glass. Yellow epidote occurs as small grains in the darker domains, and as small amorphous patches.

The texture of the groundmass (ie 98+%) of this sample is due to patchy quench crystallization of the rock, with more crystallized (dark areas with microlites) areas embedded in more glassy areas. It is not obvious to me why the latter areas should be more sericitized. The presence of quite common epidote in this sample indicates a relatively high CaO content (probably >3-4%), and strongly suggests an andesitic precursor for this rock. I will analyze this sample.

SAMPLE NUMBER: BRD01A, 1059.7m 701331

SUMMARY

This is an almost aphyric andesitic lava that had a glassy to vitrophyric groundmass that shows the light and dark variably crystalline domains described in detail for the preceding sample.

HAND SPECIMEN:

This is a massive aphyric grey intermediate to felsic lava with patches of light and dark devitrification texture as described in the preceding sample. It is cut by relatively abundant very thin calcite veinlets at a high angle to the core.

THIN SECTION:

This is a virtually aphyric lava containing about 1 modal % or less of small albitized plagioclase microphenocrysts that have been almost totally altered to sericite, set in a devitrified vitrophyric groundmass. It contains a few chloritized mafic microphenocrysts and not uncommon FeTi oxide microphenocrysts. It is texturally midway between those textures described for the preceding two samples, and contains diffuse sericite-rich domains lacking microlites of plagioclase and darker domains charged with microlitic plagioclase, although this texture is not as well-developed as in the previous sample. Amorphous yellowish epidote occurs intergrown with green chlorite in both the matrix and in veinlets and fracture fillings.

Most veinlets are quartz fibre veins overprinted by coarsely-crystalline calcite. This sample is clearly related to the two previous samples, and is probably andesitic, for the reasons given for the preceding sample.

030

521091

SAMPLE NUMBER: BRD01A, 1060.3m 701333

SUMMARY:

This is a massive aphyric andesitic lava related to the two previous samples, but slightly more slowly cooled.

HAND SPECIMEN:

This is a mid-grey almost aphyric intermediate lava with sparse feldspar phenocrysts set in a fine-grained formerly glassy matrix.

THIN SECTION:

In thin section, this sample is essentially identical to the preceding sample in most ways, except for the very minor differences noted below:

1. this sample shows less well-developed light and dark domains that typify the previous two samples. The groundmass was glassy, but charged with tiny plagioclase acicular microlites.

2. there is more very fine-grained, dirty brown microcrystalline epidote in this sample than in the previous two samples, and less granular yellow epidote.

There is little doubt that this sample was a massive aphyric andesitic lava related to the previous two samples. The less abundant glassy areas in the groundmass of this sample might suggest that it comes from deeper within a single andesitic cooling unit (flow) than the more typical flow-margin samples 1059.7m and 1058.1.

607

521092

SAMPLE NUMBER: BRD01A, 1065.6m 701 334

SUMMARY:

This is a very sparsely plagioclase-phyric andesite lava identical to the preceding sample in every way. It contains a few very fine-grained lava fragments probably derived from the glassy crust of the same flow, and has a distinctive 'false-cleavage' texture.

HAND SPECIMEN:

This is a massive almost aphyric grey intermediate to felsic lava. The rock contains a few lava fragments that are rather rounded, very fine-grained lavas darker than the matrix, and rarely more than 7mm across. They constitute only about 10 modal% of the sample. The remainder of the sample shows a cleavage-like devitrification texture that isn't penetrative.

THIN SECTION:

In thin section, this sample is seen to be an andesitic lava identical in every way to the previous sample. Unfortunately, the thin section prepared did not intersect one of the lava fragments noted in the hand specimen. I have no doubt, however, that they are simply spalled-off fragments of glassy flowtop incorporated into the lava during flow. The slight rounding of the lava fragments indicates that they suffered marginal melting during incorporation into the andesite flow.

688

521093

SAMPLE NUMBER: BRD01A, 1066.6m 701235

SUMMARY:

This is an unusual lava formed by felsic blebs of devitrified glassy dacite hosted within an almost aphyric more andesitic lava. It is suggested that this unit may be a useful marker horizon in the region.

HAND SPECIMEN:

This is a dark grey intermediate aphyric lava with two textural domains, one uniform fine-grained, and the other composed of subcircular light-coloured blebs to about 5mm across, set in a darker matrix.

THIN SECTION:

The texturally uniform part of this sample is a sparsely-phyric andesite essentially identical to the preceding few andesites. However, the texture of the heterogeneous areas is most intriguing, and strongly suggestive of magma mixing. The almost rounded light coloured blebs obvious in the hand specimen of the drill core show a quenched texture defined by a mosaic textured quartz-albite intergrowth after glass, in which are embedded tiny albite microlites. Sparse totally sericitized plagioclase phenocrysts occur in these felsic blebs. The host material in which the felsic blebs are set contains about 5 modal% of small albitized plagioclase phenocrysts, and several modal% of chlorite-quartz pseudomorphs after augite set in a quite chloritic fine-grained matrix containing albite microlites. A notable feature of the darker areas is the presence of relatively common crystals of sphene, probably produced during breakdown of leucoxene (itself after FeTi oxide microphenocrysts). Sphene also occurs as discontinuous crystals aligned along veinlets and microshears, clearly supporting the secondary origin for sphene in this rock.

Perhaps the most simple explanation for the unusual texture shown by this sample is that it formed by commingling of dacitic magma into andesitic (or less siliceous than the dacitic blebs) magma, probably during evacuation of a magma chamber. The texture is unusual and distinctive, suggesting that this unit may be a useful marker horizon in the "Hellyer area" stratigraphy.

521094

089

SAMPLE NUMBER: BRD01A, 1070.7m 701336

SUMMARY:

This is a lava composed of darker andesitic areas in which are set more than 50 modal% of subrounded felsic blebs of formerly glassy sparsely plagioclase-phyric dacitic lava. It presumably formed by mixing of a dacitic and an andesitic magma, and is part of the same distinctive unit as the preceding rock.

HAND SPECIMEN:

This is a mottled grey-green intermediate lava with the same felsic blebs set in a darker matrix as described for the preceding sample.

THIN SECTION:

The division into two textural-compositional domains is even more pronounced in this rock than in the previous sample. The darker areas are very fine-grained and composed of about 5 modal% of small (<0.5mm) albite microphenocrysts, and less than 1 modal% of chloritized augite microphenocrysts set in an almost isotropic groundmass dominated by microcrystalline epidote. The felsic blebs are up to 5mm across and composed of a mosaic-textured intergrowth of quartz and albite after glass, containing a few modal % of blocky albitized plagioclase phenocrysts, most of which are totally sericitized. The felsic blebs also contain uncommon leucoxenized FeTi oxide microphenocrysts.

This sample is essentially similar to the preceding sample, although the differentiation into felsic and more mafic blebs is even more pronounced in the present sample.

521095

SAMPLE NUMBER: BRD01A, 1074.8m 701337

SUMMARY:

This is a formerly sparsely plagioclase-phyric, vitrophyric andesitic lava closely similar to 1065.6m; both have a distinctive streaky devitrification texture that should enable easy identification of this type of rock in other drillcore.

HAND SPECIMEN:

This is a massive dark grey andesitic to dacitic lava with a few altered plagioclase phenocrysts; it has a distinctive streaky devitrification texture resembling a foliation, but lacking the penetrative nature typical of true cleavage. It is identical texturally to sample 1065.6m.

THIN SECTION:

This is a formerly glassy andesitic lava containing about 5 modal% of altered plagioclase phenocrysts and around 1 modal% of chloritized former mafic phenocrysts in a devitrified vitrophyric groundmass. The plagioclase phenocrysts, mainly less than 1mm long, are albitized but contain abundant dirty brown micro- crystalline epidote. Much less abundant are former mafic (augite) phenocrysts replaced by pale green chlorite, and leucoxenized FeTi oxide phenocrysts.

The groundmass of this sample consists of tiny acicular albite microlites set in former glass that has devitrified to a quartz-albite-chlorite-microcrystalline epidote intergrowth. The streaky 'cleavage-like' texture notable in hand specimen is due to weakly developed devitrification banding, with adjacent bands characterized by slightly different textures and abundances of mainly chlorite and epidote. A calcite veinlet about 2mm thick cuts the sample, and is bordered by a zone of fairly intense calcite-sericite alteration that extends out at least 5mm either side of the vein. Except for the minor difference that this sample does not contain quenched glassy crust fragments that are present in 1065.6m, it is otherwise identical to that sample.

SAMPLE NUMBER: BRD01A, 1080.0m 701338

SUMMARY:

This is an mixed andesitic-dacitic lava identical originally to 1066.6m and 1070.7m (with felsic blebs in a more andesitic host magma), but showing much stronger calcite-sericite alteration.

HAND SPECIMEN:

This sample is a dark grey andesitic lava showing the distinctive mottled texture seen in some of the preceding samples (1066.6m,1070.7m) in which light coloured blebs of a felsic magma are incorporated in a darker, more andesitic lava.

THIN SECTION:

This sample is texturally and mineralogically identical to 1066.6m and 1070.7m, in being dominated by subrounded blebs to about 5mm across composed of plagioclase-phyric devitrified dacitic lava, set in a darker more andesitic lava containing more elongate, smaller plagioclase phenocrysts in a microcrystalline epidote-rich dark, almost isotropic matrix. The sample is slightly more altered than either of the aforementioned samples, with fairly intense sericite-calcite alteration occurring both as veinlets and as pervasive alteration overprinting the rock.

521097

004
SAMPLE NUMBER: BRD01A, 1085.1m 701339

SUMMARY:

This is a plagioclase-phyric dacitic lava that shows variable intensities of calcite(\pm sericite) alteration on either side of a quartz veinlet. The amount of calcite alteration is much greater than seen in most samples from deeper in the core than 996m, except for the preceding lava.

HAND SPECIMEN:

This sample appears to be a contact between a dark grey plagioclase-phyric dacitic lava and a less porphyritic lighter grey dacitic or andesitic lava. A quartz veinlet occurs along the contact.

THIN SECTION:

In thin section it is apparent that the two lavas noted in the hand specimen are in fact, probably the same lava showing different intensities of alteration. The lava was a plagioclase-phyric dacitic lava containing around 10 modal % of plagioclase phenocrysts that have been albitized; many occur as multi-crystal clots, and most are partially to completely replaced by pale brown calcite and subordinate epidote. No mafic phenocrysts were present in this sample, but microphenocrysts of leucoxenized former FeTi oxide are not uncommon.

The groundmass of this sample is extremely fine-grained and probably composed of quartz and feldspar, although it is irresolvable. Small subcircular patches of quartz are crystallizing from the groundmass, which was probably largely glassy. Chorite is not common., and epidote occurs only as rare granular inclusions in altered plagioclase. The quartz vein separates domains that show very different amounts of calcite overprinting, producing the apparent different 'lavas' noted in the hand specimen description. Of course, these may represent two flows, but they would have been essentially identical originally, with the present difference in appearance being due to variable alteration.

The paucity of chlorite and altered mafic phenocrysts, the scarce epidote, and the generally blocky plagioclase phenocrysts suggest that this lava was dacitic.

SAMPLE NUMBER: BRD01A, 1086.6m 701340

SUMMARY:

This is a banded, strongly calcite-sericite-altered dacitic crystal tuff containing several narrow bands of sulphide (pyrite) concentrated in the more cleaved, finer grained shaley bands in the sample.

HAND SPECIMEN:

This is a uniform-textured fine-grained aphyric lava or tuff containing at least one very 'syngenetic-looking' band of fine-grained sulphide to about 4mm wide that cuts the core almost perpendicular to its length.

THIN SECTION:

This sample shows a strong fine-grained fragmental texture, and is quite clearly a crystal tuff, with several bands of variable grainsize being obvious. The dominant crystalline component in the sample is made up of broken and euhedral blocky crystals of albitized plagioclase, many of which have been totally replaced by sericite or calcite or both. Formerly glassy dacitic lava fragments are less abundant, and harder to distinguish due to the similar strong sericite-calcite alteration affecting the glassy groundmass of the tuff itself and its contained glassy lithic fragments. Although the coarser-grained (medium sandstone-textured) bands of tuff are uncleaved, finer-grained bands show a well-developed cleavage defined by calcite streaks and sericite along cleavage planes. In the finest-grained band of the rock, tiny disseminated sulphides and possibly some carbonaceous material show a strong development along the cleavage. About 5mm from this sulphide-rich band, a second band of larger (to 0.4mm across) and much more dispersed sulphide grains occurs. Without a polished section, it could not be determined which sulphide(s) is represented in this sample, although grain shapes strongly suggest pyrite.

This incoming of fragmental (tuffaceous) rocks, although still dacitic in nature, marks a notable change in the nature of the volcanism occurring in this basin, which has been dominated by dacitic and andesitic lava flows.

SAMPLE NUMBER: BRD01A, 1090.5m 701341

SUMMARY:

This is a dacitic tuff breccia, dominated by angular fragments of dacitic tuff and glassy dacitic lava, but also containing tuffaceous shale fragments; it shows quite strong sericite-calcite alteration.

HAND SPECIMEN:

This sample is a distinctive polymict lava breccia dominated by plagioclase-phyric dacite, but also containing long, flat black shale fragments and fine-grained formerly glassy aphyric lava, with strong calcite alteration in the areas between lava fragments. Some clasts immersed in quartz-calcite veins are bright yellow-green and may contain fine-grained epidote. Fragments are up to 3cm long.

THIN SECTION:

This sample in thin section is seen to be composed dominantly of angular fragments of crystal tuff and tuffaceous shale, although several dacitic lava fragments are also present. The tuff fragments are dominated by albitized plagioclase phenocryst debris, mainly broken crystals, in a formerly glassy matrix that has devitrified and been strongly altered to fine-grained calcite=sericite assemblages. A few fragments contain detrital quartz grains, although it is not possible to tell from the small grains whether they are derived from pelitic metamorphics or were phenocrysts from rhyolitic volcanics. One fragment contains several bands of sulphide only a fraction of a mm wide. Dacitic lava fragments are similar in mineralogy to the tuffs, but are easily distinguished from them by their notably less abundant feldspar phenocrysts and their more uniform textures, especially of the groundmass. The fine-grained very dark grey to black elongate fragments obvious in the hand specimen appear to be tuffaceous shale. They probably contained a fairly high component of vitric ash, and occasional small albite crystal fragments are visible, plus disseminated very fine-grained sulphides.

The areas between angular fragments have been replaced by coarse-grained calcite, and as for the two preceding samples, the intensity of calcite-sericite alteration in this sample is much greater than in the dacites and andesites described from 996m to 1085m.

SAMPLE NUMBER: BRD01A, 1093.8m 701302

SUMMARY:

This sample was a dacitic crystal lithic tuff; it shows strong calcite alteration and veining, but less intense sericite alteration than the preceding two samples.

HAND SPECIMEN:

This is a uniform, unbedded fine-medium-grained tuff containing abundant altered plagioclase crystals and small formerly glassy lava fragments.

THIN SECTION:

In thin section, this sample is clearly a dacitic crystal lithic tuff. Almost all lithic fragments, which dominate this rock, are sparsely plagioclase-phyric dacitic lavas that were highly glassy, and that suffered devitrification followed by crystallization of the altered glass to albite-quartz mosaics. Blocky albite phenocrysts and crystal fragments are probably also a major detrital component. A few very fine-grained tuffaceous shale-siltstone fragments are present. The matrix of the sample was probably originally silty vitric ash, but it too has recrystallized as quartz-albite (\pm sericite \pm minor chlorite). Bands and veins of coarsely-crystalline calcite are common in this sample, and sericite development is not as strongly developed as in the previous few samples. This sample was clearly a dacitic crystal lithic tuff.

008

521101

SAMPLE NUMBER: BRD01A, 1095.2m 701363

SUMMARY:

This is a relatively fine-grained dacitic lithic tuff, showing fairly strong calcite-minor sericite overprinting.

HAND SPECIMEN:

This is a mid-grey altered fine-grained lava breccia or lithic tuff, with distinct but not abundant small (<6mm across) lava fragments set in a very similar-looking matrix. A few small dark lava fragments are probably tuffaceous shale, as noted in the previous two samples described above.

THIN SECTION:

Although close examination shows this sample to be a lithic tuff, the fragmental nature of this rock is less distinct than the previous two samples due to a much more limited range in the nature of the lithic clasts in this sample. Most lava fragments are less than 1mm across, and were sparsely plagioclase-phyric glassy dacitic lava. Glass has invariably devitrified and crystallized as ragged mosaics of quartz, albite and sericite, speckled by tiny dots of dirty, isotropic microcrystalline epidote(?) in places. The textural range in the dacitic lava fragments observed is a reflection of their original 'glassiness', and their varying response to devitrification-crystallization of the former glass. Generally blocky albite phenocrysts are partly altered to calcite and sericite, and altered (leucoxenized) FeTi oxide microphenocrysts are not uncommon. Calcite-sericite alteration is fairly strong in this sample, and veinlets of both calcite and sericite occur.

007

SAMPLE NUMBER: BRD01A, 1097.6m 7013114

521102

SUMMARY:

This is a massive holocrystalline andesitic dyke rock that shows minimal calcite-sericite alteration relative to the preceding rocks.

HAND SPECIMEN:

This is a grey, massive, uniform intermediate aphyric lava

THIN SECTION:

This sample in thin section is very clearly a completely aphyric, almost holocrystalline andesitic rock, composed almost entirely of interlocking slightly elongate plagioclase (albite) laths with interstitial chlorite after augite, and small leucoxenized FeTi oxide grains abundantly dispersed throughout the sample. Occasional small blebs of clear secondary quartz are present in the rock. Plagioclase is only very rarely altered to sericite, and small calcite pools and patches are uncommon in this sample.

This sample lacks a former glassy component, and is most unlikely to be a lava. It is almost certainly an andesitic dyke rock. The fact that the calcite-sericite alteration that is strongly developed in the preceding three or four samples (at least) is absent in this sample could be interpreted in two ways. Either the dyke was massive and impervious to the alteration fluids, or the alteration occurred before the dyke was emplaced in this sequence. I have no doubt that the dyke is Cambrian, and tend to favour the first option. A careful examination of the core over this interval might help understand this problem. This sample should be analyzed.

098 SAMPLE NUMBER: BRD01A, 1102.8m

701346

521103

SUMMARY:

This rock is a lithic tuff-breccia of dacitic composition, basically identical to sample 1090.5m.

HAND SPECIMEN:

This sample is a green-grey felsic to intermediate tuff breccia composed of polymict lithic fragments mainly less than 1cm long.

THIN SECTION:

In thin section, this sample is seen to be a dacitic lithic tuff-breccia, *essentially identical to the sample from 1090.5m in this core.* Almost all lithic fragments, mainly 1-2mm across, are of sparsely plagioclase-phyric formerly glassy dacite. The calcite-sericite alteration overprinting the devitrified glassy groundmasses of these lava fragments is quite intense, and albitized plagioclase phenocrysts are almost totally altered to sericite.

SAMPLE NUMBER: BRD01A, 1107.0m 70146

521104

SUMMARY:

This sample is of the contact between a strongly carbonate-sericite altered dacitic lava and a formerly ash-rich epiclastic siltstone or fine-grained tuff that contains a small component derived from the Precambrian metamorphics. Pyritic bands and veinlets are common in the tuff.

HAND SPECIMEN:

This sample appears to be the contact between a highly altered dacitic lava and a fine sandstone or tuff. The latter contains discontinuous narrow (to 3mm thick) pyrite bands and also veinlets of exceptionally fine-grained pyrite along fractures. A dark chlorite-rich band up to 4mm wide marks the contact between these two lithologies.

THIN SECTION:

The lava section of this sample is very strongly calcite-sericite altered, making identification of the original rock rather difficult. However, dispersed blocky phenocrysts of totally calcite-sericite± chlorite-altered albitized plagioclase, to about 2mm long, and the devitrified glassy nature of the groundmass suggest that this was broadly dacitic in composition. Calcite and dirty brown sericite strongly overprint much of the groundmass.

The other part of this section is composed of a structureless fine-grained tuff or epiclastic silt in which detrital muscovite flakes are not uncommon, and a large altered vitric ash component was probably present. Small cubes of pyrite are abundant disseminated through this rock, and form thin layers (<<1mm) parallel to the contact (bedding?) and also veinlets that are almost perpendicular to the contact. This rock was probably a glass-rich water-worked tuff that received a small input (the muscovite flakes) derived from Precambrian pelitic metamorphics.

The chloritic region developed between the tuff/epiclastic and the dacitic lava is charged with leucoxene and corroded relics of feldspar crystals; it probably represents a fluid passageway along which intense dissolution occurred of the Si-rich parts of the rock, concentrating less soluble leucoxene and low-Si chlorite.

SAMPLE NUMBER: BRD01A, 1112.6m 701347

SUMMARY:

This is a quartz- and detrital muscovite-rich greywacke derived entirely from a pelitic metamorphic source. I suggest it is a correlate of the Animal Creek Greywacke. It contains large red chromite grains showing that the ophiolites were emplaced and being eroded before eruption of the Que-Hellyer Volcanics.

HAND SPECIMEN:

This sample is a massive, medium-grained greywacke containing a black shale interbed at least 1cm thick.

THIN SECTION:

Most of this thin section consists of a quartz-rich greywacke, dominated by angular grains of mono- and polycrystalline quartz to at least 1mm across. Most of the quartz shows irregular extinction, and is clearly not phenocrysts from rhyolitic lavas. An abundant detrital component is well-formed muscovite flakes, clearly derived from a pelitic metamorphic source. A few lithic fragments vary from very fine-grained polycrystalline quartz, possibly chert fragments, to coarser-grained quartz-muscovite schists. Small grains of accessory green, zoned tourmaline are present. A most important component of this sample is the not uncommon quite large grains of red chromite, which indicate that the ophiolitic rocks were being eroded and transported **before** eruption of the Que-Hellyer Volcanics. The matrix of this greywacke has been entirely replaced by coarsely crystalline secondary calcite.

The shale in contact with the greywacke is composed of very fine-grained quartz and muscovite flakes, and probably carbonaceous material.

I have no hesitation in correlating this greywacke with the Animal Creek Greywacke. It is derived entirely from a Precambrian pelitic source, and lacks any volcanic component, a feature typical of the Animal Creek Greywacke.

APPENDIX III

GEOCHEMISTRY OF DRILL CORE SAMPLES

DDH BRD 01A

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521107

Mr Peter Ellis
Placer Exploration Limited
P.O. BOX 384
ROSNY PARK
TAS 7018

Job Number: 9AD2870

Your Reference: 1465
Number of Samples: 21
Extra Samples : 0

Date Received: 02-NOV-1989
Date Reported: 10-NOV-1989

This report comprises a cover sheet and pages 1 to 3, I1 to I5

This report relates specifically to the samples tested in so far as that the samples as supplied are truly representative of the sample source. Please address any enquiries to Mr. Trevor Francis.

Approved Signature:

for

Dr. John Kikkert
General Manager - Adelaide.

CC Placer Exploration NSW

Report Analyte Codes:
N.A. - Not Analysed.
L.N.R. - Listed But Not Received.
I.S. - Insufficient Sample for
Analysis.

Distribution Codes:
CC - Carbon Copy
EM - Electronic Media
MM - Magnetic Media

100

521108



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Job: 9AD2870

O/N: 1465

ANALYTICAL REPORT

Sample	As	Rb	Sr	Zr ^{24/10}	Nb ^{14/11}	Y	Cr
849.3 701201	<2	<2	135	1050.012	8 0.5	16	910
851.3 701202	6	42	115	1500.001	13 0.46	28	52
853.0 701203	25	195	115	2900.010	22 0.39	38	<2
856.6 701204	2	35	190	2100.044	16 0.64	25	18
862.8 701205	<2	130	90	2100.050	16 0.53	30	<2
865.7 701206	<2	185	44	2000.000	15 0.5	30	<2
867.8 701207	<2	40	180	2200.056	15 0.57	32	19
871.0 701208	<2	76	130	1950.001	15 0.54	28	12
877.9 701209	2	84	98	2000.050	15 0.5	30	9
885.1 701210	<2	98	95	2300.074	15 0.54	28	40
885.2 701211	<2	125	40	2000.005	14 0.64	22	7
888.2 701212	<2	30	100	2000.065	15 0.58	26	52
898.0 701213	<2	46	175	2000.056	13 0.43	30	36
906.0 701214	2	72	200	2200.055	15 0.5	30	40
908.5 701215	5	105	100	1900.056	15 0.54	28	26
912.0 701216	<2	78	145	1900.056	13 0.5	26	40
9X1 - 701217	4	17	1080	2800.012	60 3.75	16	105*
934.4 701218	4	10	330	1450.032	12 0.55	22	360
964.0 701219	3	36	85	2000.054	14 0.7	20	58
971.3 701220	3	96	115	1850.053	15 0.625	24	42
992.0 701221	<2	64	105	1800.055	14 0.5	28	58

Units	ppm						
Detn Limit	2	2	2	4	2	4	2
Scheme	XRF1	XRF1	XRF1	XRF1	XRF1	XRF1	XRF3

Thin Sections Done :

3 13

1. = 11/15/77
11/10/77



Job: 9AD2870

O/N: 1465

ANALYTICAL REPORT

Sample	Cu	Pb	Zn	Ag
701201	56	26	80	<1
701202	15	20	44	<1
701203	17	24	50	<1
701204	10	12	48	<1
701205	9	14	17	<1
701206	7	10	7	<1
701207	12	15	35	<1
701208	13	12	38	<1
701209	12	12	35	<1
701210	11	8	24	<1
701211	11	8	10	<1
701212	11	8	20	<1
701213	18	16	72	<1
701214	14	20	120	<1
701215	42	38	11	<1
701216	10	26	105	<1
701217	64	26	115	1
701218	105	48	170	<1
701219	11	16	66	<1
701220	44	12	19	<1
701221	18	26	65	<1
Units	ppm	ppm	ppm	ppm
Detn Limit	2	4	2	1
Scheme	AAS1	AAS1	AAS1	AAS2



ANALYTICAL REPORT

Sample	Au Avg	Au Dp1	Au Dp2	Au Dp3
701201	0.02	0.02	<0.01	--
701202	<0.01	<0.01	--	--
701203	0.01	0.01	--	--
701204	<0.01	<0.01	--	--
701205	<0.01	<0.01	--	--
701206	<0.01	<0.01	--	--
701207	<0.01	<0.01	--	--
701208	<0.01	<0.01	--	--
701209	<0.01	<0.01	--	--
701210	<0.01	<0.01	--	--
701211	<0.01	<0.01	--	--
701212	<0.01	<0.01	--	--
701213	<0.01	<0.01	--	--
701214	0.01	0.01	--	--
701215	0.07	0.02	--	--
701216	<0.01	<0.01	--	--
701217	<0.01	<0.01	--	--
701218	<0.01	<0.01	--	--
701219	<0.01	<0.01	--	--
701220	<0.01	<0.01	--	--
701221	<0.01	<0.01	--	--
Units	ppm	ppm	ppm	ppm
Detn Limit	0.01	0.01	0.01	0.01
Scheme	FA1	FA1	FA1	FA1



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Analysis code ICP 5

Report AC 9AD2870

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NATA Certificate

Results in percentages

	701201	701202	701203	701204	701205
SiO ₂	42.1	66.1	61.7	68.9	66.9
TiO ₂	0.58	0.37	0.49	0.48	0.42
Al ₂ O ₃	9.25	12.7	17.7	15.1	14.7
Fe ₂ O ₃	9.75	4.32	6.10	4.84	2.36
MnO	0.18	0.08	0.06	0.06	0.08
MgO	12.8	1.81	2.56	1.71	1.25
CaO	11.0	3.04	0.96	1.00	3.78
Na ₂ O	0.42	4.70	2.22	5.45	2.40
K ₂ O	^{1.45} 0.29	^{1.53} 1.33	^{0.52} 4.26	^{0.93} 1.12	^{0.77} 3.40
P ₂ O ₅	0.39	0.09	0.14	0.15	0.13
LOI	12.3	3.70	3.80	2.08	5.00
Totals	99.1	98.2	100.0	100.9	100.4

Total FE as Fe₂O₃

Somenkat added - LOI 2 - 12.3%
variable added



Analysis code ICP 5

Report AC 9AD2870

Page 12

NATA Certificate

Results in percentages

	701206	701207	701208	701209	701210
SiO ₂	69.5	69.2	67.7	65.5	70.7
TiO ₂	0.45	0.39	0.48	0.40	0.31
Al ₂ O ₃	14.5	14.4	13.9	13.7	14.7
Fe ₂ O ₃	1.67	3.68	5.85	5.40	3.42
MnO	0.05	0.06	0.09	0.10	0.04
MgO	0.75	1.09	1.22	1.25	0.99
CaO	3.14	1.90	2.72	3.70	1.06
Na ₂ O	0.16	5.15	3.16	3.14	3.50
K ₂ O	4.72	1.32	1.99	2.24	2.38
P ₂ O ₅	0.16	0.12	0.19	0.12	0.10
LOI	4.66	2.60	3.64	4.82	2.46
Totals	99.8	99.9	100.9	100.4	99.7

Total FE as Fe₂O₃

521113

Analysis code ICP 5

Report AC 9AD2870

Page I3

NATA Certificate

Results in percentages

	701211	701212	701213	701214	701215
SiO2	76.5	71.5	67.2	66.4	69.3
TiO2	0.19	0.31	0.36	0.40	0.34
Al2O3	11.7	13.1	12.9	14.4	12.2
Fe2O3	2.06	2.70	4.20	5.25	1.32
MnO	0.04	0.06	0.10	0.11	0.12
MgO	0.62	0.84	1.48	1.81	0.52
CaO	1.78	2.52	3.66	2.70	5.75
Na2O	0.86	5.45	4.20	3.86	2.16
K2O	3.26	0.93	1.35	1.96	2.80
P2O5	0.04	0.08	0.14	0.16	0.11
LOI	3.22	2.68	4.34	3.90	6.00
Totals	100.3	100.2	99.9	100.9	100.6

Total FE as Fe2O3



Analysis code ICP 5

Report AC 9AD2870

Page I4

NATA Certificate

Results in percentages

	701216	701217	701218	701219	701220
SiO ₂	69.1	45.1	54.5	65.9	74.9
TiO ₂	0.34	2.34	0.45	0.37	0.35
Al ₂ O ₃	12.2	14.3	12.2	14.2	11.9
Fe ₂ O ₃	4.62	12.8	7.05	6.25	2.14
MnO	0.12	0.17	0.39	0.12	0.04
MgO	1.69	8.35	7.15	2.26	0.40
CaO	3.48	7.80	8.05	1.97	1.22
Na ₂ O	2.62	5.50	3.70	4.88	2.74
K ₂ O	1.79 2.02	2.77 2.02	0.81	0.98	4.64
P ₂ O ₅	0.12	0.97	0.25	0.07	0.09
LOI	4.46	1.61	6.00	3.30	1.75
Totals	100.8	101.0	100.5	100.3	100.2

Total FE as Fe₂O₃



Analysis code ICP 5

Report AC 9AD2870

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NATA Certificate

Results in percentages

701221

SiO ₂	67.8
TiO ₂	0.33
Al ₂ O ₃	13.4
Fe ₂ O ₃	4.26
MnO	0.11
MgO	1.42
CaO	3.34
Na ₂ O	3.92
K ₂ O	1.61
P ₂ O ₅	0.07
LOI	4.00

Totals 100.3

Total FE as Fe₂O₃



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Mr Peter Ellis
Placer Exploration Limited
P.O. BOX 384
ROSNY PARK
TAS 7018

Job Number: 9AD3379

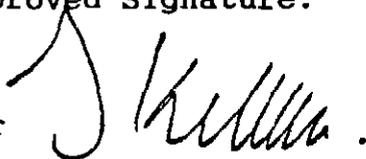
Your Reference: 1471
Number of Samples: 20
Extra Samples : 0

Date Received: 27-NOV-1989
Date Reported: 08-JAN-1990

This report comprises a cover sheet and pages 1 to 2, I1 to I4

This report relates specifically to the samples tested in so far as that the samples as supplied are truly representative of the sample source. Please address any enquiries to Mr. Trevor Francis.

Approved Signature:

for 

Dr. John Kikkert
General Manager - Adelaide.

Report Analyte Codes:
N.A. - Not Analysed.
L.N.R. - Listed But Not Received.
I.S. - Insufficient Sample for Analysis.

Distribution Codes:
CC - Carbon Copy
EM - Electronic Media
MM - Magnetic Media



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Job: 9AD3379

O/N: 1471

ANALYTICAL REPORT

Sample	As	Rb	Sr	Zr	Nb	Y	Cr	Depths
701286	<2	135	160	220	17	35	38	996.8
701287	2	64	165	180	14	24	68	999.6
701288	2	64	230	190	15	26	95	1008.6
701289	<2	120	220	195	17	28	5	1017.8
701290	3	28	155	160	12	44	98	1025.1
701291	2	62	145	200	15	28	30	1027.2
701292	14	72	170	130	11	20	64	1040.9
701293	3	50	210	155	12	25	34	1052.1
701294	5	105	230	140	13	24	4	1053.6
701295	L.N.R.							
701296	L.N.R.							
701297	3	48	380	130	10	25	25	1060.3
701298	L.N.R.							
701299	2	94	120	140	13	20	34	1066.6
701402	7	76	330	130	11	22	22	1070.8
701403	3	72	280	140	11	25	50	1074.8
701404	3	82	290	140	12	26	22	1080.0
701405	2	74	230	135	12	24	35	1085.1
701406	16	82	200	120	9	20	85	1086.6
701407	20	10	185	88	8	16	105	1107.0
Units	ppm							
Detn Limit	2	2	2	4	2	4	2	
'Scheme	XRF1	XRF1	XRF1	XRF1	XRF1	XRF1	XRF3	



Job: 9AD3379
O/N: 1471

ANALYTICAL REPORT

Sample	Cu	Pb	Zn	Ag	Au
701286	66	20	58	<1	<0.01
701287	68	14	32	<1	0.01
701288	11	24	48	1	<0.01
701289	17	12	25	1	<0.01
701290	5	20	20	<1	<0.01
701291	10	15	22	1	<0.01
701292	56	42	280	1	0.01
701293	8	24	98	1	<0.01
701294	18	20	42	1	<0.01
701295	L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.
701296	L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.
701297	54	32	86	1	<0.01
701298	L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.
701299	6	18	96	1	<0.01
701402	34	34	52	1	0.02
701403	8	26	36	1	<0.01
701404	5	20	50	1	<0.01
701405	17	20	44	<1	<0.01
701406	38	68	330	2	<0.01
701407	66	50	52	1	0.01
Units	ppm	ppm	ppm	ppm	ppm
Detn Limit	2	4	2	1	0.01
Scheme	AAS1	AAS1	AAS1	AAS2	FA1



111
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Analysis code ICP5

Report AC 9AD3379

Page 11

NATA Certificate

Results in percentages

	701286	701287	701288	701289	701290
SiO ₂	63.2	72.0	66.9	64.3	65.0
TiO ₂	0.40	0.32	0.35	0.37	0.29
Al ₂ O ₃	16.5	13.3	14.0	14.4	12.6
Fe ₂ O ₃	5.35	1.92	5.25	4.88	2.98
MnO	0.09	0.04	0.09	0.07	0.10
MgO	1.93	0.37	1.19	0.80	0.48
CaO	1.55	1.24	2.02	2.96	6.00
Na ₂ O	3.52	4.68	4.26	3.16	5.45
K ₂ O	2.96	3.06	2.64	3.94	1.02
P ₂ O ₅	0.09	0.08	0.08	0.07	0.05
LOI	3.00	1.14	2.26	3.42	5.30
Totals	98.6	98.1	99.0	98.4	99.3

Total FE as Fe₂O₃



Analysis code ICP5

Report AC 9AD3379

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NATA Certificate

Results in percentages

	701291	701292	701293	701294	701297
SiO2	69.4	64.4	53.0	60.6	59.3
TiO2	0.34	0.51	0.61	0.55	0.53
Al2O3	14.2	12.8	16.7	14.6	14.2
Fe2O3	4.08	7.85	11.4	6.70	7.05
MnO	0.05	0.14	0.19	0.11	0.14
MgO	0.70	2.70	3.82	1.89	2.30
CaO	0.76	1.50	2.52	4.04	5.10
Na2O	4.92	2.74	4.10	3.00	3.36
K2O	1.97	3.04	1.99	3.16	2.12
P2O5	0.07	0.16	0.19	0.17	0.17
LOI	1.59	3.08	4.10	4.08	3.94
Totals	98.1	98.9	98.6	98.9	98.2

Total FE as Fe2O3



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Analysis code ICP5

Report AC 9AD3379

Page I3

NATA Certificate

Results in percentages

	701299	701402	701403	701404	701405
SiO2	60.3	60.5	61.2	57.1	59.8
TiO2	0.54	0.50	0.54	0.58	0.55
Al2O3	14.8	13.4	14.8	15.5	13.8
Fe2O3	9.30	5.35	5.70	7.80	7.05
MnO	0.15	0.12	0.11	0.14	0.15
MgO	3.60	1.67	1.52	2.56	2.58
CaO	1.61	6.30	4.22	4.74	4.62
Na2O	1.84	2.82	3.92	3.08	2.84
K2O	2.72	2.84	2.30	2.46	2.32
P2O5	0.16	0.16	0.15	0.17	0.15
LOI	3.88	5.25	3.96	4.86	4.92
Totals	98.9	98.9	98.4	99.0	98.8

Total FE as Fe2O3



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Analysis code ICP5

Report AC 9AD3379

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NATA Certificate

Results in percentages

701406 701407

SiO ₂	49.4	64.0
TiO ₂	0.68	0.56
Al ₂ O ₃	16.0	11.7
Fe ₂ O ₃	9.55	7.80
MnO	0.21	0.10
MgO	5.20	2.90
CaO	5.55	3.04
Na ₂ O	2.52	4.36
K ₂ O	2.56	0.57
P ₂ O ₅	0.14	0.13
LOI	6.70	3.96

Totals 98.5 99.1

Total FE as Fe₂O₃

ANALABS

521123

Phone (09) 458 7999

A division of MacDonald Hamilton & Co. Pty. Ltd.
52 Murray Road, Welshpool, W.A. 6106

Telex AA92560

FAX: 004 31 8890

ANALYTICAL REPORT No. 799.52.08.06637

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

P.D. Ellis
Placer Exploration Ltd.
479 Oceana Drive
Howrah
Tasmania 7018

ORDER No. 1466	PROJECT Sulgobac
DATE RECEIVED 03/11/89	RESULTS REQUIRED ASAP

No. OF PAGES OF RESULTS 3	DATE REPORTED 17/11/89	No. OF COPIES 1	TOTAL No. OF SAMPLES 51
------------------------------	---------------------------	--------------------	----------------------------

STATE OF SAMPLES	REFER BELOW	SAMPLE NUMBERS	PRE-TREATMENT							OTHER SEE REMARKS	NONE	ANALYSIS		
			DRY	CRUSH	SPLIT	PUL-VERISE	SIEVE	REFER TO ANALYSIS SECTION	PREPARATION			METHOD		
		7012,17,22/71	DC	Prep: 006	010,011	012,013	016					Cu,Pb,Zn,Ag/101		
		7012,17,22/71	DC	Prep: 006	010,011	012,013	016					As/114		
		7012,17,22/71	DC	Prep: 006	010,011	012,013	016					Au,AuChk/309		
		7012,17,22/71	DC	Prep: 006	010,011	012,013	016					As/101		

RESULTS TO

P.D. Ellis
Placer Exploration Ltd.
479 Oceana Drive
Howrah
Tasmania 7018

RESULTS TO

REMARKS

STATE OF SAMPLES	ANALYSIS — PREPARATION	ANALYSIS — METHOD
whole core WC	perchloric acid A1	atomic absorption AAS
split core SC	hydrochloric acid A2	x-ray fluorescence XRF
cutting CU	nitric acid A3	spectrophotometry SPEC
rock Ro	aqua regia A4	colorimetry COL
soil SO	nitric-perchloric A5	chromatography CHR
pulp PU	HF mixture A6	titration ITN
water WA	HF under pressure A7	other chemical means CHEM
tissue TI	fusion A8	miscellaneous MISC
stream sediment SS		fluorescence FLUOR
heavy mineral HM		Inductively coupled plasma ICP

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ANALYTICAL DATA

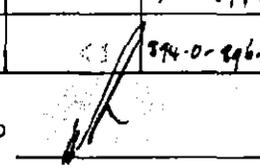
SAMPLE PREFIX REPORT NUMBER REPORT DATE CLIENT ORDER No. PAGE

999.52.08.06637 17/11/89 1466 1 OF 3

TUBE No.	SAMPLE No.	Cu	Pb	Zn	Ag	Au	AuChk	As	As	
1	701217	350	175	4550	7.0	0.467	-	600	>100	Px 1
2	701222	15	15	80	<0.5	0.018	0.008	-	11	851.5-854.0
3	701223	5	15	85	<0.5	<0.008	-	-	2	854.0-856.2
4	701224	<5	20	110	<0.5	<0.008	-	-	1	856.2-858.4
5	701225	<5	10	90	<0.5	<0.008	-	-	<1	858.4-860.0
6	701226	<5	10	55	<0.5	0.007	-	-	<1	860.0-862.0
7	701227	5	20	45	<0.5	0.039	0.038	-	<1	862.0-864.0
8	701228	<5	5	60	<0.5	<0.008	-	-	<1	864.0-865.5
9	701229	<5	10	30	<0.5	<0.008	0.029	-	1	865.5-867.3
10	701230	<5	10	40	<0.5	<0.008	-	-	<1	867.3-870.0
11	701231	<5	10	55	<0.5	0.009	-	-	3	870.0-872.0
12	701232	<5	10	60	<0.5	0.014	-	-	1	872.0-874.0
13	701233	<5	10	45	<0.5	<0.008	-	-	<1	874.0-875.6
14	701234	<5	10	65	<0.5	<0.008	-	-	2	875.6-878.0
15	701235	<5	15	60	<0.5	<0.008	-	-	2	878.0-880.0
16	701236	<5	<5	60	<0.5	0.009	<0.008	-	<1	880.0-882.0
17	701237	<5	15	55	<0.5	0.010	-	-	<1	882.0-884.0
18	701238	<5	20	45	<0.5	0.008	-	-	<1	884.0-886.1
19	701239	<5	15	40	<0.5	0.020	-	-	1	886.1-887.9
20	701240	<5	10	45	<0.5	<0.008	-	-	3	887.9-889.2
21	701241	<5	10	60	<0.5	<0.008	-	-	<1	889.2-890.1
22	701242	5	5	65	<0.5	<0.008	-	-	<1	890.1-890.3
23	701243	<5	5	70	<0.5	<0.008	-	-	<1	890.2-892.0
24	701244	<5	5	75	<0.5	<0.008	-	-	2	892.0-894.0
25	701245	5	<5	85	<0.5	<0.008	-	-	<1	894.0-896.0

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

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521125

ANALYTICAL DATA

SAMPLE PREFIX

REPORT NUMBER

REPORT DATE

CLIENT ORDER No.

PAGE

		999.52.08.06677				17/11/89		1466		2 OF 3	
TUBE No.	SAMPLE No.	Cu	Pb	Zn	Ag	Au	AuChk	As	As		
1	701246	20	20	115	<0.5	<0.008	-	-	<1	896.0-898.0	
2	701247	10	10	120	<0.5	<0.008	-	-	<1	899.0-900.0	
3	701248	8	25	160	<0.5	<0.008	-	-	<1	900.0-902.0	
4	701249	5	35	175	<0.5	<0.008	-	-	1	902.0-904.0	
5	701250	40	40	180	<0.5	<0.008	-	-	<1	904.0-906.0	
6	701251	85	20	60	<0.5	0.455	-	-	9		
7	701252	10	30	140	<0.5	<0.008	-	-	<1	906.0-908.0	
8	701253	5	40	80	<0.5	0.025	<0.008	-	<1	908.0-909.1	
9	701254	5	15	140	<0.5	0.043	-	-	<1	909.1-911.0	
10	701255	10	20	140	<0.5	0.020	-	-	<1	911.0-913.0	
11	701256	<5	10	125	<0.5	0.014	0.015	-	<1	913.0-915.0	
12	701257	5	15	110	<0.5	0.016	-	-	<1	915.0-917.9	
13	701258	5	60	340	<0.5	0.011	-	-	1	917.9-918.8	
14	701259	5	20	155	<0.5	0.025	-	-	<1	918.8-921.1	
15	701260	5	25	150	<0.5	0.049	-	-	<1	921.1-922.0	
16	701261	40	80	370	<0.5	0.016	-	-	1	922.0-932.0	
17	701262	60	160	850	<0.5	0.014	-	-	1	932.0-941.0	
18	701263	65	70	365	<0.5	0.011	-	-	2	941.0-950.5	
19	701264	5	35	225	<0.5	0.015	-	-	<1	950.5-953.5	
20	701265	10	25	135	<0.5	0.050	-	-	10	953.5-958.3	
21	701266	5	10	125	<0.5	0.020	-	-	7	958.3-967.8	
22	701267	5	20	105	0.5	0.019	<0.008	-	<1	967.8-971.4	
23	701268	170	15	145	0.5	0.013	-	-	5	971.4-972.8	
24	701269	30	20	75	0.5	0.016	-	-	<1	972.8-974.9	
25	701270	20	15	140	<0.5	0.013	-	-	<1	974.9-988.9	

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

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521126

ANALYTICAL DATA

SAMPLE PREFIX

REPORT NUMBER

REPORT DATE

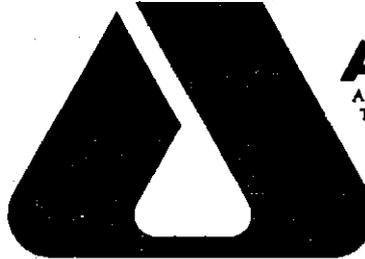
CLIENT ORDER No.

PAGE

SAMPLE PREFIX		REPORT NUMBER				REPORT DATE		CLIENT ORDER No.		PAGE	
		999.52.08.06637				17/11/89		1466		3 OF 3	
TUBE No.	SAMPLE No.	Cu	Pb	Zn	Ag	Au	AuChk	As	As		
1	701271	340	210	4350	5.0	0.829	0.508	600	>100		
2											
3											
4											
5											
6											
7											
8											
9											
10											
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12											
13											
14											
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16											
17											
18											
19											
20											
21											
22											
23	DETECTION	5	5	5	0.5	0.008	0.008	100	1		
24	UNITS	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm		
25	METHOD	101	101	101	101	309	309	101	114		

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

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A division of Inchcape Inspection and
Testing Services, Australia, Pty. Ltd.

Perth Head Office:

52 Murray Road, Welshpool, Western Australia 6106.
Tel: (09) 458 7999. Telex: AA92560. Fax: (09) 458 2922.
P.O. Box 210 Bentley, W.A. 6102.

P O Box 929
Burnie Tas 7320

P D Ellis
Placer Exploration Ltd
479 Oceana Drive
Howrah
Tasmania 7016

Results for Ti, Y, Nb, Ba on your order No 1466 are as follows:-

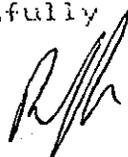
Sample	Ti	Y	Nb	Ba
701222	1650	32	14	470
701223	1850	33	11	230
701224	2150	36	10	290
701225	1850	43	12	500
701226	1800	33	12	2200
701227	1950	35	12	820
701228	2050	33	13	380
701229	2000	35	10	390
701230	2000	35	17	210
701231	2300	33	12	330
701232	2300	36	13	280
701233	2500	34	11	160
701234	2150	36	12	290
701235	2100	35	10	300
701236	2250	35	12	180
701237	2050	37	14	370
701238	1350	35	13	300
701239	1400	36	11	380
701240	1550	33	13	170
701241	1900	32	13	300
701242	210	21	<3	<10
701243	2150	41	11	110
701244	2050	43	13	210
701245	2100	36	11	280
701246	2050	34	10	250
701247	2000	37	11	320
701248	2000	37	13	250



- 2 -

Sample	Ti	Y	Nb	Ba
701249	2000	34	14	510
701250	1950	35	10	530
701252	1950	37	9	420
701253	1900	33	12	450
701254	1950	37	12	340
701255	2050	34	9	440
701256	1850	31	13	230
701257	1700	34	14	390
701258	3200	35	10	120
701259	2250	32	11	290
701260	1950	32	12	290
701261	2600	26	8	430
701262	2200	27	10	530
701263	2450	26	12	360
701264	2800	40	10	410
701265	2100	40	12	65
701266	1950	29	15	95
701267	1900	31	14	230
701268	1750	31	15	1250
701269	1800	34	13	210
701270	1800	34	13	230
Detection	50	5	3	10
Units	ppm	ppm	ppm	ppm
Method	401	401	401	401

Yours faithfully



Peter Dzwonczyk
 Manager - ANALABS TASMANIA



CLASSIC LABORATORIES LTD

Osman Place, Thebarton, South Australia 5031
Telephone: (08) 43 5722 Facsimile: (08) 234 03251



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521129

Mr Peter Ellis
Placer Exploration Limited
P.O. BOX 384
ROSNY PARK
TAS 7018

Job Number: 9AD3259

Your Reference: 1468
Number of Samples: 51
Extra Samples : 0

Date Received: 23-NOV-1989
Date Reported: 15-DEC-1989

This report comprises a cover sheet and pages I1 to I11, 1 to 2

This report relates specifically to the samples tested in so far as that the samples as supplied are truly representative of the sample source. Please address any enquiries to Mr. Trevor Francis.

Approved Signature:

for

Dr. John Kikkert
General Manager - Adelaide.

Report Analyte Codes:
N.A. - Not Analysed.
L.N.R. - Listed But Not Received.
I.S. - Insufficient Sample for
Analysis.

Distribution Codes:
CC - Carbon Copy
EM - Electronic Media
MM - Magnetic Media



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Analysis code ICP 5

Report AC 9AD3259

Page 11

NATA Certificate

Results in percentages

	701222	701223	701224	701225	701226
SiO ₂	67.4	68.9	64.2	64.7	65.9
TiO ₂	0.38	0.39	0.43	0.39	0.40
Al ₂ O ₃	14.6	13.9	15.3	14.9	14.7
Fe ₂ O ₃	4.68	4.58	5.10	3.74	3.36
MnO	0.06	0.06	0.09	0.09	0.09
MgO	2.44	2.14	2.10	2.18	2.22
CaO	1.50	1.64	2.50	3.42	3.62
Na ₂ O	2.60	4.52	4.64	2.40	2.32
K ₂ O	2.82	1.37	1.70	3.06	3.16
P ₂ O ₅	0.10	0.12	0.15	0.12	0.11
LOI	3.50	2.72	3.64	5.05	5.15
Totals	100.1	100.3	99.8	100.0	101.0

Total FE as Fe₂O₃



Analysis code ICP 5

Report AC 9AD3259

Page 12

NATA Certificate

Results in percentages

	701227	701228	701229	701230	701231
SiO ₂	66.1	66.1	66.0	67.8	65.3
TiO ₂	0.40	0.44	0.44	0.42	0.48
Al ₂ O ₃	14.3	15.1	14.9	14.7	14.4
Fe ₂ O ₃	2.60	4.14	1.95	3.48	5.40
MnO	0.09	0.09	0.08	0.08	0.11
MgO	1.41	1.49	0.92	0.93	1.16
CaO	3.98	3.00	4.72	3.08	3.38
Na ₂ O	2.10	2.38	1.08	4.26	3.36
K ₂ O	3.46	3.36	4.36	2.06	2.36
P ₂ O ₅	0.13	0.16	0.16	0.17	0.20
LOI	5.30	4.52	6.00	3.72	4.40
Totals	99.9	100.8	100.6	100.7	100.5

Total FE as Fe₂O₃



Analysis code ICP 5

Report AC 9AD3259

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NATA Certificate

Results in percentages

	701232	701233	701234	701235	701236
SiO2	66.3	64.4	60.5	63.5	65.2
TiO2	0.48	0.53	0.55	0.41	0.45
Al2O3	14.3	14.9	14.7	13.9	15.1
Fe2O3	5.20	3.68	5.80	5.65	5.30
MnO	0.09	0.09	0.13	0.11	0.09
MgO	1.23	1.06	1.92	1.09	0.97
CaO	2.98	3.80	4.32	3.28	2.44
Na2O	3.44	5.75	2.74	3.20	6.20
K2O	2.30	2.52	4.92	2.16	0.97
P2O5	0.20	0.39	0.58	0.04	0.03
LOI	3.84	3.82	4.80	4.80	3.34
Totals	100.4	100.9	101.0	98.1	100.1

Total FE as Fe2O3



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Analysis code ICP 5

Report AC 9AD3259

Page 14

NATA Certificate

Results in percentages

	701237	701238	701239	701240	701241
SiO2	64.8	70.3	68.4	69.5	66.9
TiO2	0.41	0.28	0.30	0.31	0.40
Al2O3	15.1	14.0	14.4	14.1	15.4
Fe2O3	4.94	3.28	3.02	3.26	4.54
MnO	0.09	0.08	0.08	0.07	0.08
MgO	1.11	0.69	0.88	0.82	1.48
CaO	2.80	2.72	3.38	2.58	2.24
Na2O	3.36	3.78	2.72	5.45	3.50
K2O	2.58	2.04	2.84	1.10	2.44
P2O5	0.02	<0.01	<0.01	<0.01	0.03
LOI	4.40	3.76	4.54	3.42	3.78
Totals	99.6	100.9	100.5	100.6	100.8

Total FE as Fe2O3



Analysis code ICP 5

Report AC 9AD3259

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NATA Certificate

Results in percentages

	701242	701243	701244	701245	701246
SiO ₂	77.0	66.0	64.6	66.5	64.8
TiO ₂	0.04	0.43	0.42	0.40	0.41
Al ₂ O ₃	3.24	14.2	14.0	13.7	13.8
Fe ₂ O ₃	5.05	4.62	4.56	5.10	5.10
MnO	0.16	0.10	0.11	0.10	0.11
MgO	1.78	1.97	2.02	1.88	1.77
CaO	6.50	3.26	4.06	3.22	3.54
Na ₂ O	0.08	5.20	3.56	3.18	3.80
K ₂ O	0.08	0.82	1.76	1.89	1.61
P ₂ O ₅	0.05	0.14	0.13	0.13	0.16
LOI	6.30	4.08	5.30	4.56	4.68
Totals	100.3	100.8	100.5	100.7	99.8

Total FE as Fe₂O₃



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Report AC 9AD3259

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Results in percentages

	701247	701248	701249	701250	701251
SiO ₂	65.8	65.3	64.0	65.5	73.9
TiO ₂	0.40	0.43	0.41	0.43	0.50
Al ₂ O ₃	13.6	14.4	14.5	13.4	12.2
Fe ₂ O ₃	5.15	5.25	5.25	5.05	4.20
MnO	0.11	0.11	0.12	0.12	0.02
MgO	1.97	1.92	1.93	1.95	0.69
CaO	3.56	3.00	3.16	3.14	0.39
Na ₂ O	3.64	5.05	4.00	3.38	0.94
K ₂ O	1.74	1.16	1.99	2.08	4.98
P ₂ O ₅	0.19	0.21	0.20	0.23	0.21
LOI	4.68	3.86	4.38	4.22	2.82
Totals	100.8	100.7	99.9	99.5	100.8

Total FE as Fe₂O₃



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Results in percentages

	701252	701253	701254	701255	701256
SiO ₂	64.9	63.5	65.0	63.5	66.6
TiO ₂	0.41	0.42	0.41	0.42	0.39
Al ₂ O ₃	14.3	13.4	14.0	14.9	13.8
Fe ₂ O ₃	4.18	1.92	4.48	5.15	4.72
MnO	0.12	0.16	0.13	0.13	0.10
MgO	1.70	1.01	1.86	2.08	1.89
CaO	3.74	6.55	3.54	3.28	2.64
Na ₂ O	3.60	2.32	3.44	3.26	3.84
K ₂ O	2.36	3.28	2.22	2.56	1.82
P ₂ O ₅	0.23	0.27	0.22	0.25	0.23
LOI	4.86	7.10	4.84	4.70	3.86
Totals	100.4	99.9	100.1	100.2	99.9

Total FE as Fe₂O₃



Analysis code ICP 5

Report AC 9AD3259

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NATA Certificate

Results in percentages

	701257	701258	701259	701260	701261
SiO ₂	66.2	47.4	58.9	63.4	48.5
TiO ₂	0.39	0.38	0.47	0.42	0.52
Al ₂ O ₃	13.8	11.6	13.4	14.4	12.7
Fe ₂ O ₃	4.74	8.05	5.70	5.15	9.55
MnO	0.10	0.11	0.15	0.10	0.34
MgO	1.91	5.35	3.24	2.78	8.60
CaO	2.64	10.8	5.50	3.04	7.00
Na ₂ O	3.80	1.68	1.76	2.64	2.46
K ₂ O	1.82	0.78	2.70	2.72	0.84
P ₂ O ₅	0.22	0.24	0.31	0.26	0.37
LOI	4.58	11.6	7.20	4.90	9.05
Totals	100.2	98.0	99.3	99.8	99.9

Total FE as Fe₂O₃



Analysis code ICP 5

Report AC 9AD3259

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NATA Certificate

Results in percentages

	701262	701263	701264	701265	701266
SiO2	53.9	49.0	28.4	48.4	59.3
TiO2	0.47	0.48	0.56	0.48	0.44
Al2O3	12.6	12.4	14.6	18.2	16.4
Fe2O3	8.25	9.80	14.6	9.05	8.20
MnO	0.36	0.32	0.43	0.22	0.16
MgO	8.35	8.90	10.1	4.24	3.16
CaO	6.30	7.40	13.4	5.90	2.42
Na2O	2.96	2.20	1.74	6.30	5.75
K2O	1.43	0.85	0.48	0.86	0.93
P2O5	0.33	0.32	0.40	0.19	0.18
LOI	6.00	9.25	16.0	7.15	3.84
Totals	100.9	100.9	100.7	101.0	100.8

Total FE as Fe2O3



Analysis code ICP 5

Report AC 9AD3259

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NATA Certificate

Results in percentages

	701267	701268	701269	701270	701271
SiO ₂	64.5	68.3	62.7	64.8	68.4
TiO ₂	0.41	0.38	0.38	0.41	0.40
Al ₂ O ₃	15.2	14.4	14.0	15.1	14.6
Fe ₂ O ₃	7.75	4.54	5.60	5.45	4.42
MnO	0.13	0.08	0.13	0.12	0.29
MgO	2.78	1.38	1.65	1.99	1.15
CaO	0.90	1.26	3.20	2.70	2.02
Na ₂ O	4.60	3.50	4.40	3.46	0.74
K ₂ O	1.39	3.94	1.78	2.58	4.52
P ₂ O ₅	0.17	0.18	0.08	0.22	0.27
LOI	2.78	2.22	4.28	4.04	4.08
Totals	100.6	100.2	98.2	100.9	100.9

Total FE as Fe₂O₃

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Analysis code ICP 5

Report AC 9AD3259

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Results in percentages

701217

SiO2	68.7
TiO2	0.39
Al2O3	14.7
Fe2O3	4.46
MnO	0.29
MgO	1.09
CaO	1.99
Na2O	0.78
K2O	4.42
P2O5	0.22
LOI	3.64

Totals 100.7

Total FE as Fe2O3



Job: 9AD3259

O/N: 1468

ANALYTICAL REPORT

Sample	Zr	Ba	Y	Nb	Cr
701217	135	380	12	9	98
701222	200	430	28	16	94
701223	190	200	28	14	130
701224	200	250	32	15	90
701225	210	420	38	15	115
701226	200	2050	35	16	88
701227	200	680	30	15	64
701228	210	360	28	15	75
701229	200	340	32	14	40
701230	200	190	32	15	115
701231	185	290	30	14	55
701232	185	260	30	14	80
701233	185	160	28	16	52
701234	190	260	30	15	72
701235	190	270	32	14	105
701236	195	170	30	14	125
701237	210	330	30	17	86
701238	220	250	28	15	84
701239	230	340	34	17	150
701240	210	160	30	17	78
701241	220	270	26	16	180
701242	12	10	16	5	470
701243	210	110	34	15	155
701244	210	195	34	15	145
701245	210	240	32	16	135
701246	210	240	30	15	175
701247	210	270	32	15	125
701248	210	220	30	16	170
701249	210	440	30	14	130
701250	200	460	28	15	105
701251	I.S.	I.S.	I.S.	I.S.	I.S.
701252	210	350	30	17	86
701253	200	400	30	14	140
701254	210	300	32	16	76
701255	210	390	32	16	96
701256	200	190	28	15	90
701257	210	350	28	16	86
701258	130	140	26	12	350
701259	190	280	30	14	160
701260	210	280	30	15	105
701261	155	490	22	12	470
701262	145	870	20	14	440
701263	145	410	20	13	440
701264	165	35	32	14	480
701265	230	90	32	16	52
701266	210	110	25	17	80
701267	200	230	22	17	64
701268	185	1200	26	15	185
701269	190	180	30	15	70
701270	195	200	30	16	86
Units	ppm	ppm	ppm	ppm	ppm
Detn Limit	4	10	4	2	2
Scheme	XRF1	XRF1	XRF1	XRF1	XRF3



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Job: 9AD3259

O/N: 1468

ANALYTICAL REPORT

Sample	Zr	Ba	Y	Nb	Cr
701271	I.S.	I.S.	I.S.	I.S.	I.S.
Units	ppm	ppm	ppm	ppm	ppm
Detn Limit	4	10	4	2	2
Scheme	XRF1	XRF1	XRF1	XRF1	XRF3



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Mr Peter Ellis
Placer Exploration Limited
P.O. BOX 384
ROSNY PARK
TAS 7018

Job Number: 9AD3395

Your Reference: 1472
Number of Samples: 14
Extra Samples : 0

Date Received: 24-NOV-1989
Date Reported: 14-DEC-1989

This report comprises a cover sheet and pages 1 to 1, I1 to I3

This report relates specifically to the samples tested in so far as that the samples as supplied are truly representative of the sample source. Please address any enquiries to Mr. Trevor Francis.

Approved Signature:

for

Dr. John Kikkert
General Manager - Adelaide.

Report Analyte Codes:
N.A. - Not Analysed.
L.N.R. - Listed But Not Received.
I.S. - Insufficient Sample for
Analysis.

Distribution Codes:
CC - Carbon Copy
EM - Electronic Media
MM - Magnetic Media



Analysis code ICP 5

Report AC 9AD3395

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NATA Certificate

Results in percentages

	701272	701273	701274	701275	701276
SiO2	63.8	62.1	67.0	62.4	64.1
TiO2	0.36	0.41	0.35	0.39	0.37
Al2O3	14.6	16.3	14.6	15.8	14.6
Fe2O3	5.60	7.10	4.16	6.30	4.70
MnO	0.12	0.12	0.08	0.12	0.11
MgO	1.82	2.02	1.21	2.18	1.18
CaO	2.72	2.34	2.46	2.36	3.70
Na2O	4.12	3.76	3.86	3.12	4.22
K2O	1.66	2.44	2.52	2.62	2.30
P2O5	0.11	0.11	0.09	0.10	0.09
LOI	3.96	4.10	3.60	4.46	4.40
Totals	98.9	100.8	99.9	99.8	99.8

Total FE as Fe2O3



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Analysis code ICP 5

Report AC 9AD3395

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NATA Certificate

Results in percentages

	701277	701278	701279	701280	701281
SiO ₂	64.1	64.4	65.0	60.4	59.3
TiO ₂	0.35	0.34	0.37	0.59	0.58
Al ₂ O ₃	14.2	14.7	13.8	15.9	14.8
Fe ₂ O ₃	5.25	4.74	5.45	9.70	7.30
MnO	0.12	0.09	0.11	0.18	0.14
MgO	1.06	1.03	2.12	4.36	2.54
CaO	3.54	3.36	3.42	0.79	5.05
Na ₂ O	3.98	4.14	2.54	3.66	2.90
K ₂ O	3.14	2.28	2.38	1.40	2.52
P ₂ O ₅	0.09	0.10	0.14	0.21	0.20
LOI	3.94	4.50	5.00	3.64	4.80
Totals	99.8	99.7	100.3	100.8	100.1

Total FE as Fe₂O₃



Analysis code ICP 5

Report AC 9AD3395

Page 13

NATA Certificate

Results in percentages

	701282	701284	701285
SiO2	58.8	57.1	62.8
TiO2	0.54	0.60	0.47
Al2O3	14.5	16.0	13.7
Fe2O3	6.70	8.25	6.35
MnO	0.14	0.16	0.15
MgO	2.12	3.46	2.54
CaO	5.65	3.58	3.94
Na2O	3.04	4.16	4.48
K2O	2.46	1.69	1.75
P2O5	0.18	0.18	0.13
LOI	6.35	4.96	4.64
Totals	100.5	100.1	100.9

Total FE as Fe2O3

[Handwritten scribbles and marks]



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Job: 9AD3395

O/N: 1472

ANALYTICAL REPORT

Sample	Zr	Ba	Y	Nb	Cr	
701272	200	360	30	16	58	998.8 - 994.9
701273	220	500	32	15	34	994.8 - 999.2
701274	195	640	30	15	40	998.2 - 1001.2
701275	210	490	35	16	35	1001.2 - 1004.0
701276	195	640	32	14	38	1004.0 - 1006.6
701277	190	990	30	15	35	1006.6 - 1008.2
701278	190	440	30	15	48	1026.4 - 1028.8
701279	185	290	26	13	68	1028.6 - 1035.0
701280	150	270	16	12	30	1041.9 - 1046.0
701281	140	900	28	10	38	1060.0 - 1067.9
701282	135	530	28	11	30	1081.0 - 1085.1
701283	L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.	
701284	145	450	24	13	32	1085.1 - 1086.0
701285	150	780	25	13	42	1096.8 - 1098.0
Units	ppm	ppm	ppm	ppm	ppm	
Detn Limit	4	10	4	2	2	
Scheme	XRF1	XRF1	XRF1	XRF1	XRF3	

521148

APPENDIX IV

Pb ISOTOPE ANALYSIS

DDH BRD 01A

Sirotope



CSIRO
AUSTRALIA

521149

Division of Exploration Geoscience
Delhi Road, North Ryde, NSW. Postal Address: PO Box 136, North Ryde NSW 2113
Telephone (02) 887 8666. Telex AA25817. Fax (02) 887 8909

Chief: Dr B.J.J. Embleton

REPORT TO PLACER EXPLORATION LIMITED

ON THE METALLOGENIC ASSOCIATION

OF EXPLORATION SAMPLES FROM THE

BULGOBAC PROSPECT, WESTERN TASMANIA

REPORT SR 103

JUDITH A. DEAN
4/12/89

R e s e a r c h A d v a n c i n g A u s t r a l i a

Floreat Park
Location: Underwood Avenue, Floreat Park
Postal Address: CSIRO Private Bag, PO Wembley WA 6014
Telephone: (09) 387 4233
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Fax: (09) 387 6046

Lindfield
Location: Bradfield Road, Lindfield
Postal Address: PO Box 218, Lindfield NSW 2070
Telephone: (02) 467 6733
Telex: AA26296
Fax: (02) 467 1902

1. AIMS OF STUDY

The aim of this study has been to compare the ratios of exploration samples from the Bulgobac prospect 3kms west of the Que River Mine in northwest Tasmania with the known signatures for Cambrian VMS mineralization within the Mt Read Volcanic Belt.

2. SAMPLES

Four drill core samples were provided by Peter Ellis of Placer Exploration. Three of these contained visible galena (samples 701301-701303) which was hand picked for analysis and a portion of the fourth sample (701304) was crushed.

3. TARGET Pb ISOTOPIC SIGNATURES

The Pb isotopic characteristics of Cambrian VMS mineralization in western Tasmania are well established (Gulson and Porritt, 1987; SIROTOPE Database). All of the major deposits of Cambrian age have similar Pb isotopic compositions confirming that they formed as part of a major metallogenic event. A relatively homogeneous isotopic composition over such a large region suggests the hydrothermal systems were large, leaching Pb and other elements from a significant volume of crust and tending to average out local variations in the isotopic compositions of the source rocks. The Cambrian massive sulfide signature (Target Signature) is represented in this study by the overlapping fields for Hellyer, Que River and Rosebery in Figures 1 and 2. The fields are 95% confidence ellipses which define the mean $\pm 2\sigma$ the standard deviation of the data for each deposit. Also shown is the Pb evolution or Growth Curve of Cumming and Richards, 1975 (heavy dashed line in the Figures) which depicts the average composition of crustal Pb through geological time.

Minor mineralization in western Tasmania commonly consists

of discontinuous pods or veins. The isotopic composition of such mineralization varies between occurrences indicating that the hydrothermal systems were probably much smaller. Most examples of this mineralization have isotopic compositions that are more radiogenic than the Cambrian target (i.e. higher $^{206}\text{Pb}/^{204}\text{Pb}$ ratios) and some can be associated with Devonian plutonism (e.g. Queen Hill, Figs 1 and 2).

4. METHODS

About 0.15g of sample 701304 was digested in a 1:1 mixture of 7N HNO_3 and 7N HCl acids in teflon beakers. Lead was extracted by anion exchange methods in HBr solutions prior to purification by micro-electrodeposition techniques. The lead concentration was determined simultaneously with the isotope ratios by the addition of a ^{202}Pb spike. Galenas were dissolved in concentrated HNO_3 and purified as above.

Lead isotope ratios were determined on a VG Isomass 54E thermal ionization mass spectrometer run in fully automated mode. Precision estimates of the ratios are shown as error bars in the upper left hand corner of the accompanying diagrams. They represent 2 standard deviations about the mean of over 1000 analyses of international standards and natural samples.

5. RESULTS

Lead isotope results are given in Table 1 and plotted in Figures 1 and 2. Samples 701302 and 701303 were run in duplicate.

The isotopic compositions of the drill-core samples from which galena was extracted are very similar and plot either within the target reference field for Rosebery (samples 701301 and 701303) or Que River/Hellyer (701302).

Sample 701304 contains only 165ppm Pb and plots just outside the 95% confidence ellipses for Que River and Hellyer.

6. DISCUSSION AND CONCLUSIONS

The Pb isotopic compositions of the three galenas from the Bulgobac prospect indicate that there is a very high probability that the mineralization associated with these drill-core samples is representative of the major Cambrian VMS systems of the region. The 0.2% variation in the $^{206}\text{Pb}/^{204}\text{Pb}$ ratio between samples 701301/701303 and 701302 is equivalent to the 2σ error on this ratio and is smaller than the total variation of the high Pb data from Que River and Hellyer.

The more radiogenic nature of the relatively low Pb sample 701304 (165ppm Pb) can almost certainly be explained by the in situ addition of radiogenic Pb due to the radioactive decay of U and Th (^{238}U decays to ^{206}Pb , ^{235}U decays to ^{207}Pb , ^{232}Th decays to ^{208}Pb , ^{204}Pb has essentially remained constant through geological time). Thus, over the period between the time of formation of the mineralization in the Cambrian and the present, the isotopic composition of this sample has shifted from values more typical of Cambrian VMS deposits in western Tasmania to the higher $^{206}\text{Pb}/^{204}\text{Pb}$ values now measured.

7. REFERENCES

- Cumming, G.L. and Richards, J.R. (1975). Ore Pb isotope ratios in a continuously changing Earth. *Earth Planet. Sci. Letts*, 28, pp. 155-171.
- Gulson, B.L and Porritt, P.M. (1987). Base metal exploration of the Mt Read Volcanics, western Tasmania: Part II. Lead isotope signatures and genetic implications. *Econ. Geol.* 82, pp. 291-307.

TABLE 1. Lead Isotope Data for Samples From the Bulgobac Prospect

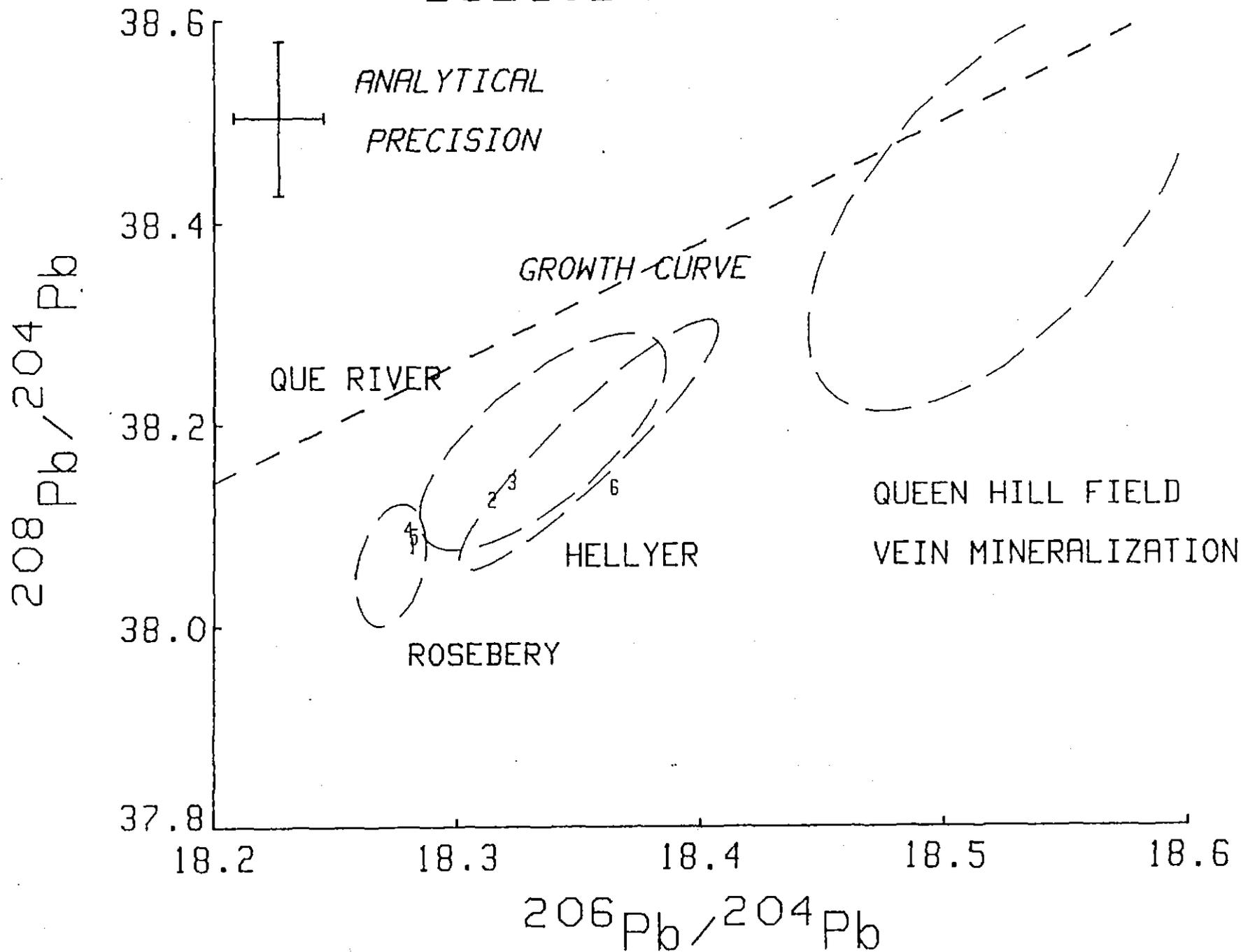
Sample	$\frac{208 \text{ Pb}}{206 \text{ Pb}}$	$\frac{207 \text{ Pb}}{206 \text{ Pb}}$	$\frac{206 \text{ Pb}}{204 \text{ Pb}}$	$\frac{207 \text{ Pb}}{204 \text{ Pb}}$	$\frac{208 \text{ Pb}}{204 \text{ Pb}}$	Pb(ppm)
1 701301gn	2.0830	0.8534	18.282	15.602	38.080	870,000
2 701302gn	2.0816	0.8519	18.315	15.602	38.124	870,000
3 701302gn rel	2.0817	0.8519	18.323	15.609	38.142	870,000
4 701303gn	2.0840	0.8537	18.280	15.606	38.095	870,000
5 701303gn rel	2.0833	0.8533	18.282	15.600	38.088	870,000
6 701304	2.0766	0.8487	18.365	15.587	38.137	165

gn denotes galena

rel denotes reload from the same sample dissolution

BULGOBAC PROSPECT

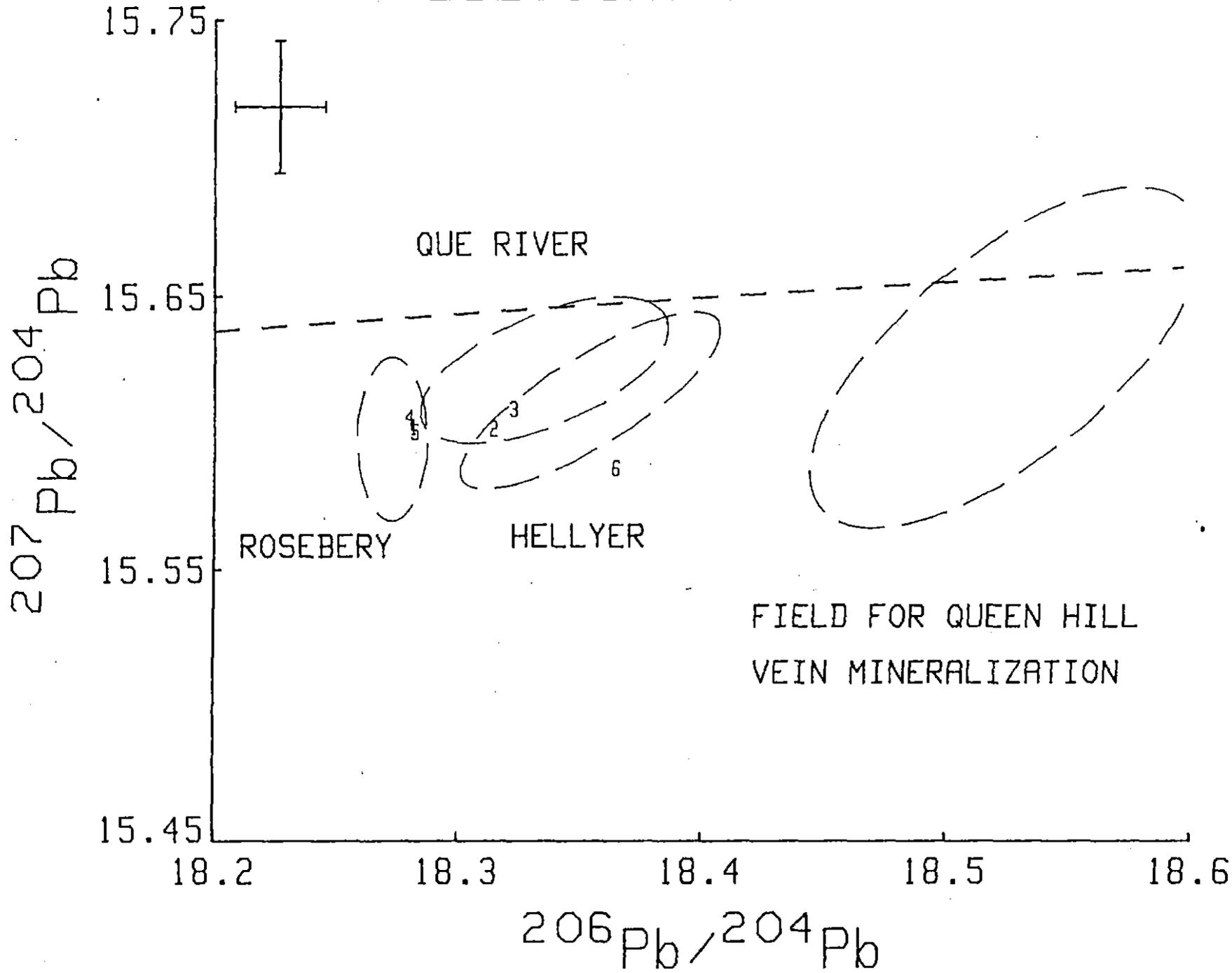
100



521154

BULGOBAC PROSPECT

150



521155

521150

APPENDIX V

EM 37 DOWNHOLE SURVEY

DDH BRD 01A



PLACER PACIFIC LIMITED

521157

Gold Fields House,
1 Alfred Street,
GPO Box 4315,
SYDNEY, N.S.W. 2001
AUSTRALIA

INTEROFFICE MEMORANDUM

DATE: 21 November 1989
TO: P. Ellis cc. John Coggan
Peter Kowalczyk
FROM: K. Logan
SUBJECT: BULGOBAC RIVER BRD01 DOWNHOLE EM37 SURVEY

A downhole EM survey of Bulgobac River drillhole BRD 1 was acquired from 15-17/11. Five loops were used to survey BRD1 from 600m to 1120m. Figures 1 and 2 show plan and sectional views of the survey area. Loop locations are also written on the accompanying survey data profiles (Figures 3-11). Most loops were 600m x 600m and had an average current of 15A. Station spacing along the drillhole was 10m. Polarity of survey was positive within the loop.

Initial interpretation of the data suggests that no significant anomalous responses occur within the survey area. The "layered" response observed is attributed to an attenuating signal with increasing depth from the "conductive" Que River Shale. Previous downhole SIROTEM data (Figure 12) from 20-700m suggested that an in hole response due to the Que River Shale was centred on 200m. This response attenuated down the hole. The EM37 survey results are supported by those earlier results.

Very small responses occur at 940m and 960m on loop 3; 940m and 1010m on loop 5. These responses may be due to lithological/alteration conductivity contrasts.

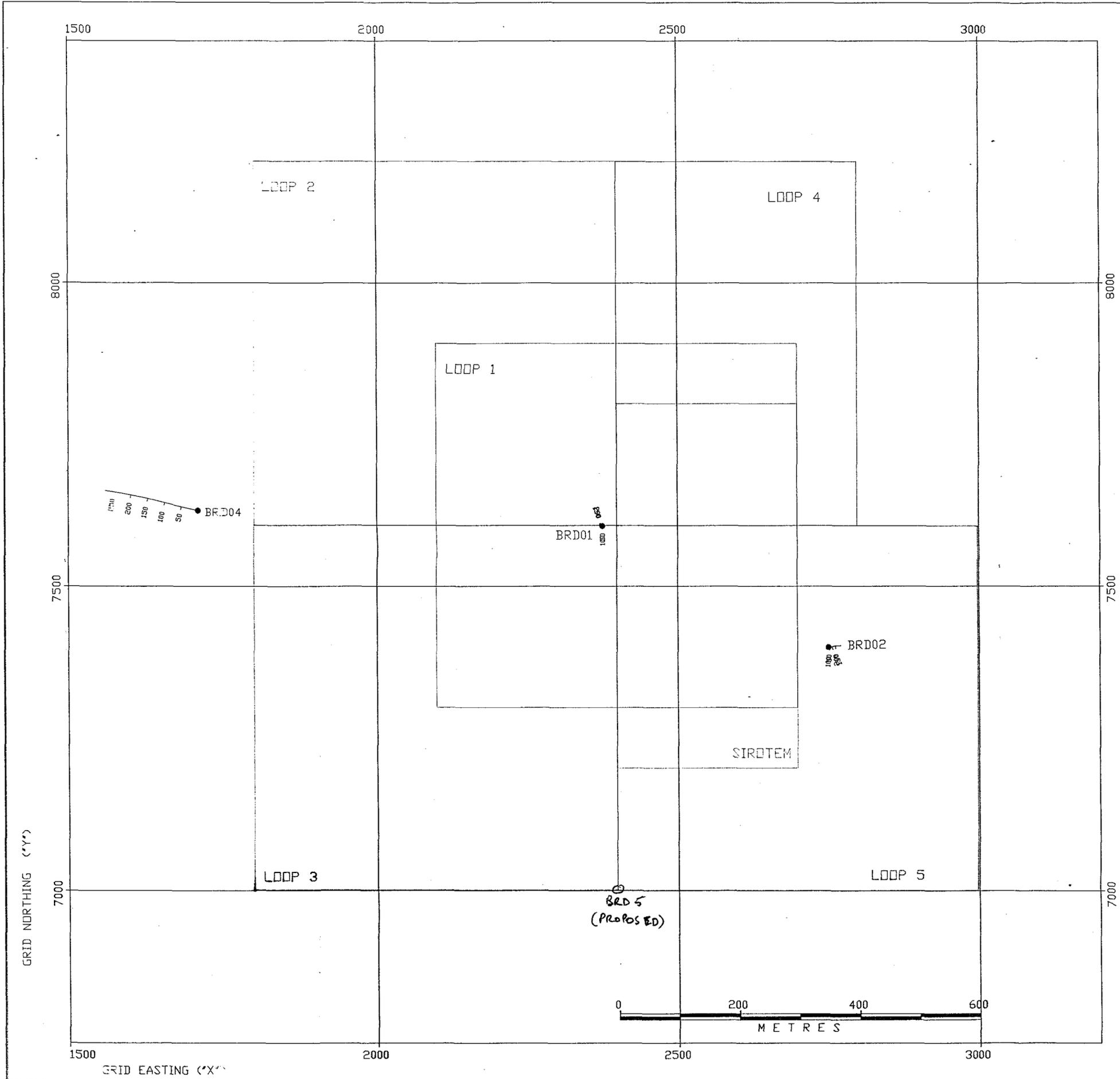
This data will be sent to J. Coggon for further interpretation/processing. Further information may be "gleaned" from the data by removing the "layered" lithology response and observing the residual.

At this stage of interpretation, modelling of a Hellyer type response indicates that this survey has inferred that a target does not exist within 200-250m radius of the drill hole. The proposed hole BRD5 at 2400E, 7000N (600m to the south) will allow the adequate coverage of the area to the south of BRD1 for such a target.

att. (Figures 1 - 12)

KL935

PLOT RUN BY: KJL 891120 PLOT:RUN



DOWNHOLE EM SURVEY SPECIFICATIONS

1985 SIRTEM SURVEY

Loops: 1
 Current: 9.6 - 10.7 A
 Receiver: BRD01 20 - 700m
 Receiver Station spacing: 10m

1989 EM37 SURVEY

Loops: 5
 Current: 13.5 - 15.8 A
 Receiver: BRD01
 Depth: 600 - 1120m
 Receiver Station spacing: 10m

5 cm

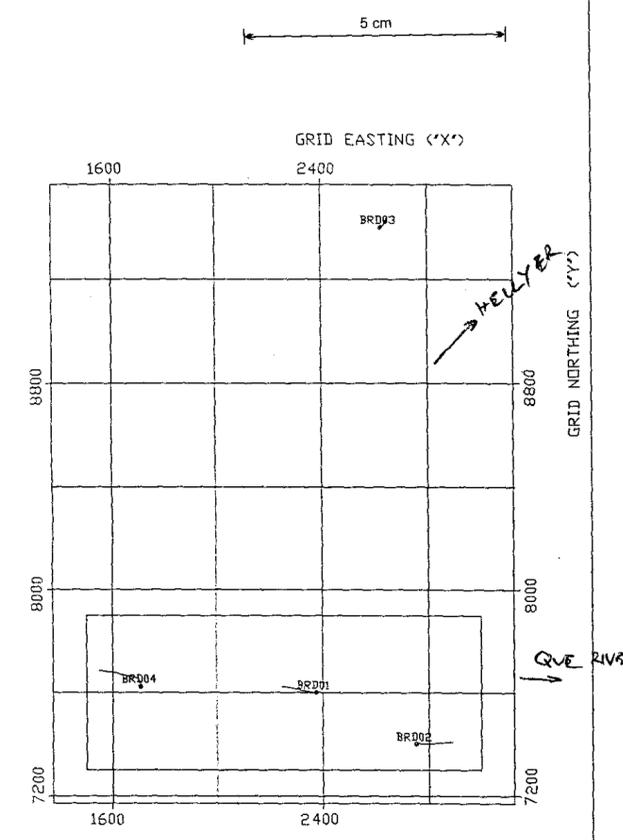
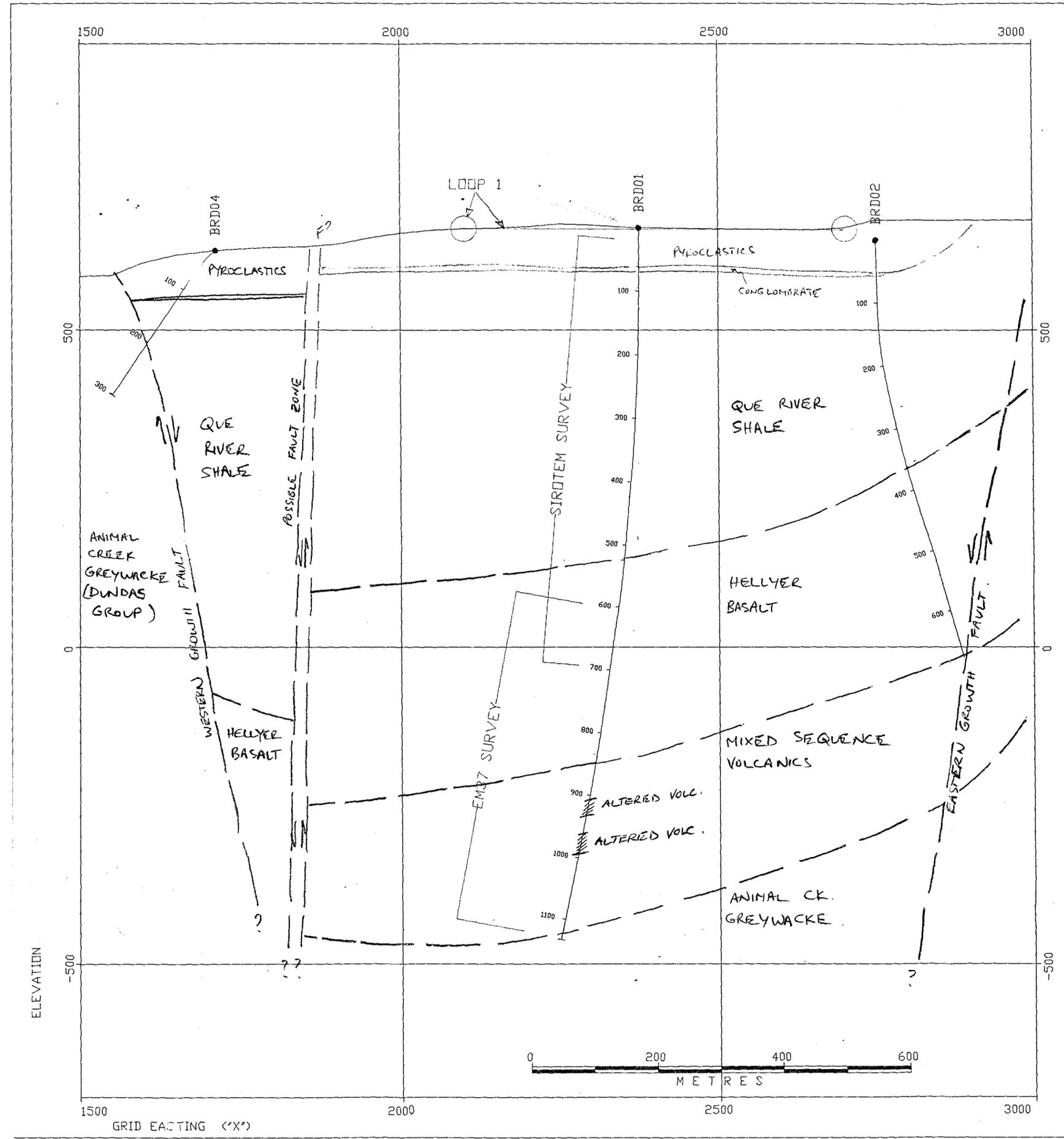
DIRECTORY: #EXPL/BULGOBAC/DHOLE
 DATA FILE: BRD.GLG

DRAWN DRA		PLACER EXPLORATION LIMITED BULGOBAC RIVER EM37 LOOP LOCATIONS
DATE 891120		
SCALE 1:5000		
		IND. PLATE

521158

Figure 1

PLDT RUN BY: K.J.L 891121 7600N.RUN



LOCATION OF THIS CROSS-SECTION

XL	YL	XR	YR
1500.	7600.	3000.	7600.
WIDTH	ZT	ZB	
600.	700.	-461.	

LOOKING N

DIRECTORY: SEXPL/BULGOBAC/DH-DLE
 DATA FILE: BRD.GLG
 TOPO FILE: 7600N.HT

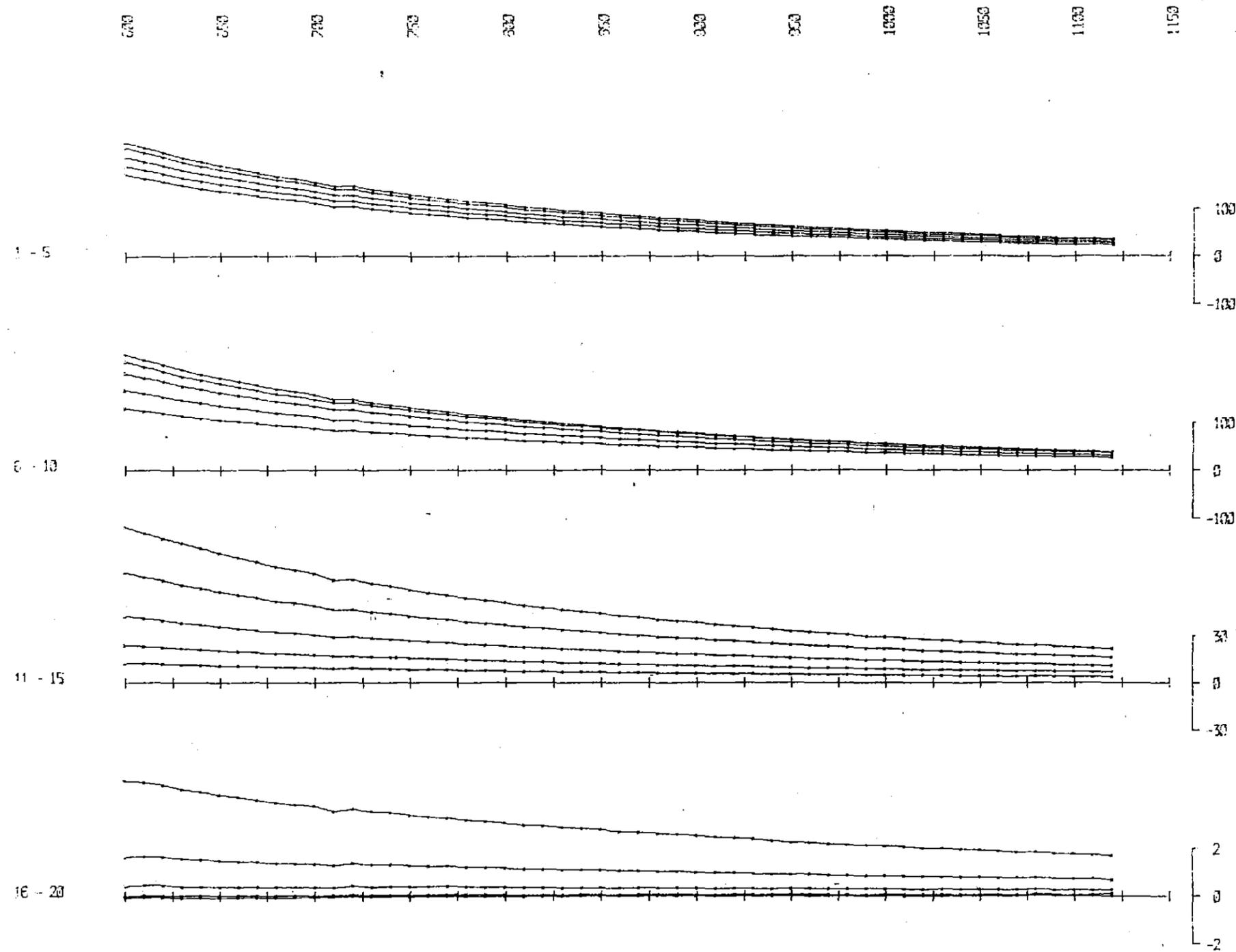
PLACER EXPLORATION LIMITED	
DRAWN KJL	BULGOBAC RIVER DOWN-HOLE EM37
DATE 891121	SECTION 7600N - BRD 1
SCALE 1:5000	+ INTERPRETED GEOLOGY (P.R.U.S).
NO.	PLATE

521159

Figure 2

0127

AXIAL COMPONENT B (Z)



EM-37

BOREHOLE SURVEY

ELECTROMOTIVE FORCE INDUCED BY SECONDARY FIELD

TIME DERIVATIVE OF FLUX DENSITY (B)

nanovolts per amp metre squared

5 cm

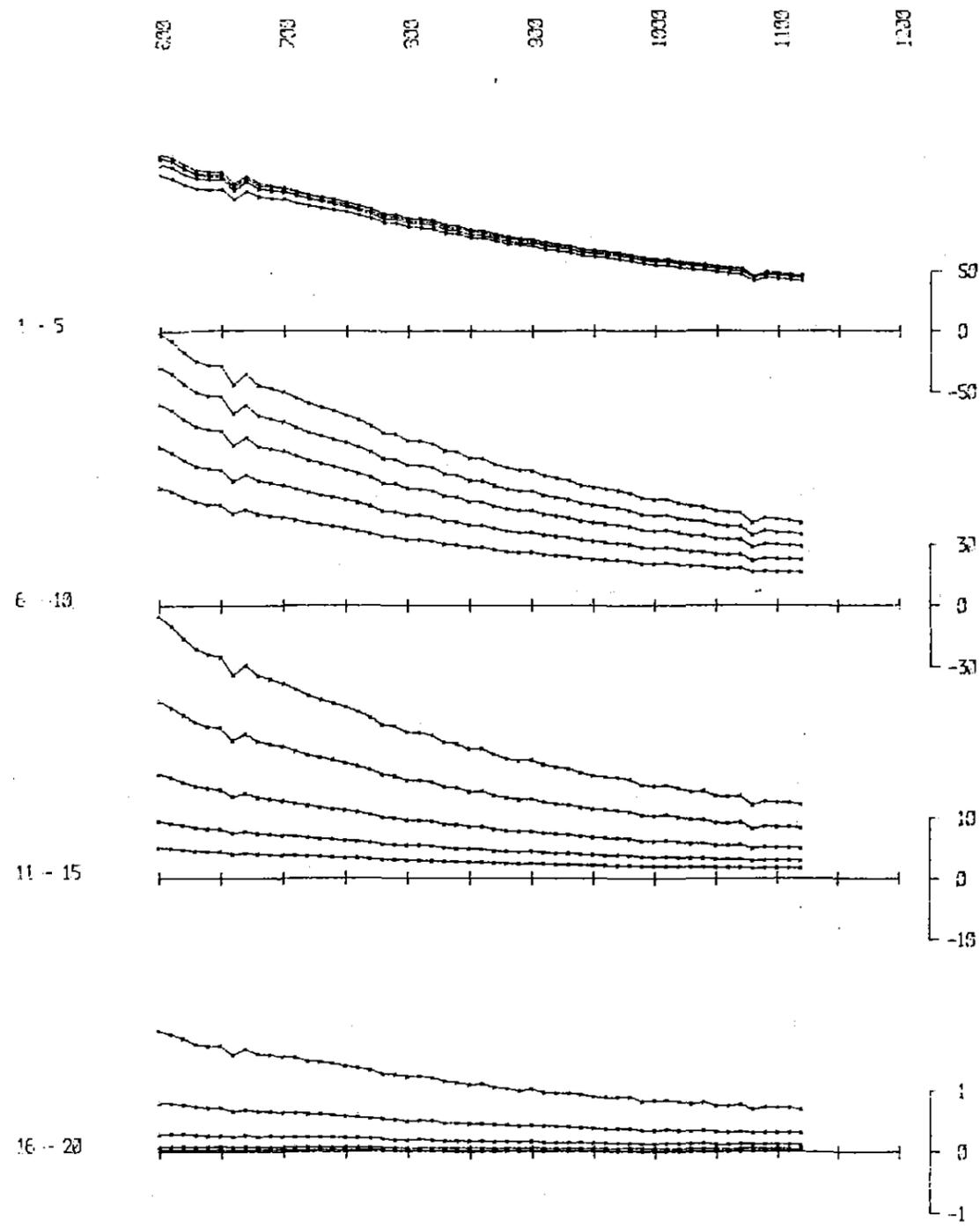
TX LOOP SIDES : 07300N 02100E
 : 07900N 02700E
 TX LOOP SIZE : 600 m X 600 m
 TX TURN OFF TIME : 290 microseconds
 FIRST GATE TIME : 98.5 microseconds
 CURRENT : 13.7 amps
 FREQUENCY : 25 Hz
 INTEGRATION TIME : 1024 cycles
 SYNC MODE :
 HORIZONTAL SCALE : 1:2500
 SURVEYED BY : PG
 DATE : 15/11/1999

	SURVEYED AND COMPILED BY	PROJECT NO.
	GEOTREX PTY. LTD.	4-14

CLIENT : PLACER
 PROJECT : EL 39/85
 AREA : BULLDOBAC RIVER
 BOREHOLE : BRD 1 A
 TX LOOP : 1

Fig. 3

AXIAL COMPONENT B (Z)

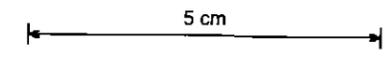


EM-37

BOREHOLE SURVEY

ELECTROMOTIVE FORCE INDUCED BY SECONDARY FIELD

TIME DERIVATIVE OF FLUX DENSITY (B)



nanovolts per amp metre squared

TX LOOP SIDES : 07800N 01600E
 : 00200N 02400E
 TX LOOP SIZE : 600 m X 600 m
 TX TURN OFF TIME : 295 microseconds.
 FIRST GATE TIME : 98.5 microseconds.
 CURRENT : 13.5 amps.
 FREQUENCY : 25 Hz.
 INTEGRATION TIME : 1024 cycles
 SYNC MODE :
 HORIZONTAL SCALE : 1:5000
 SURVEYED BY : EG
 DATE : 16/11/1999

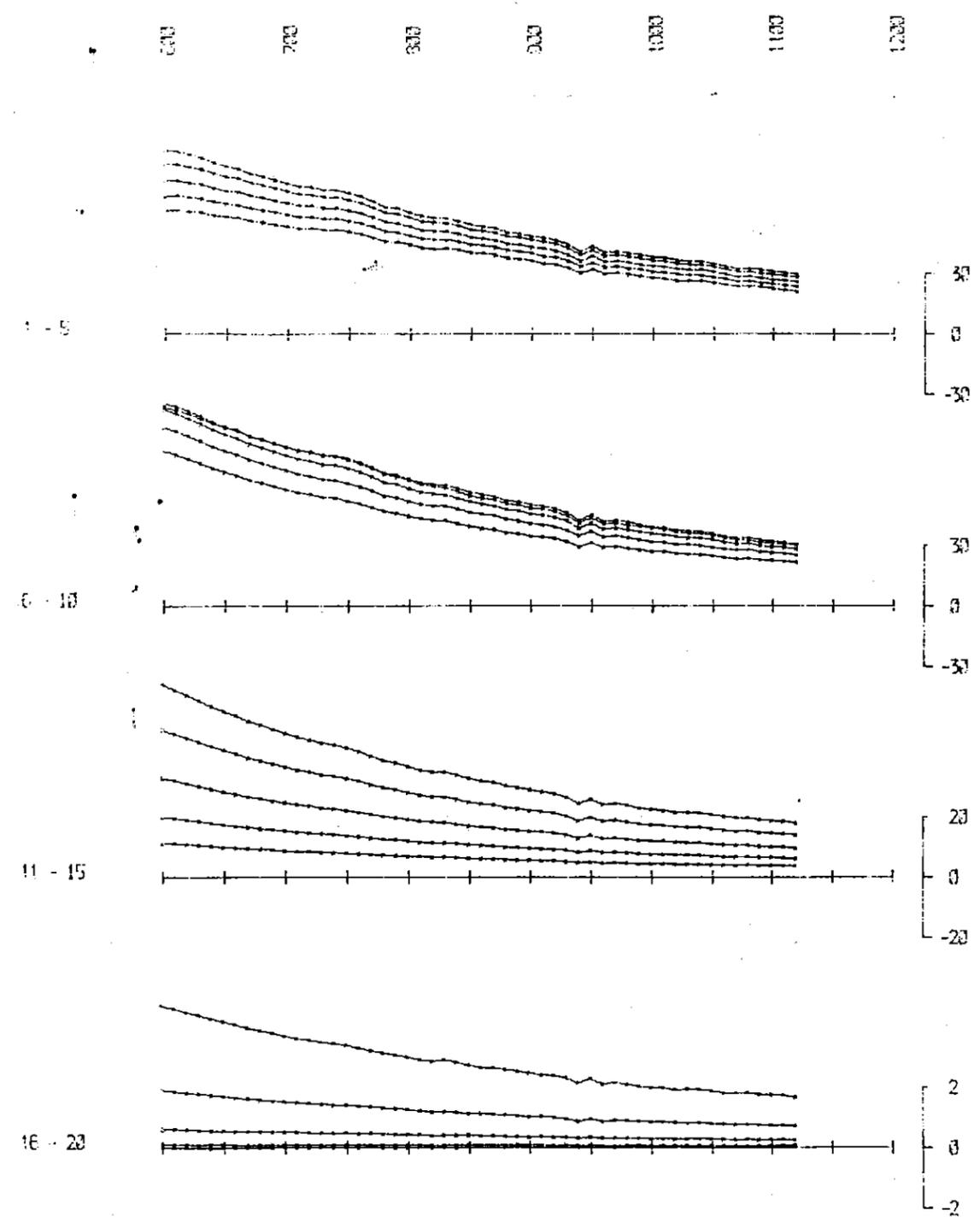
	SURVEYED AND COMPILED BY	PROJECT NO.
	GEOTREX PTY. LTD.	4-14

CLIENT : PLACER
 PROJECT : EL 39/35
 AREA : BULOBBAC RIVER
 BOREHOLE : BRD 1 A
 TX LOOP : 2

Fig. 4

9129

AXIAL COMPONENT B (Z)

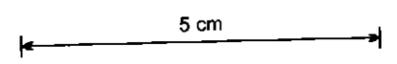


EM-37

BOREHOLE SURVEY

ELECTROMOTIVE FORCE INDUCED BY SECONDARY FIELD

TIME DERIVATIVE OF FLUX DENSITY (B)



DATA NOT TO BE USED FOR ANALYSIS

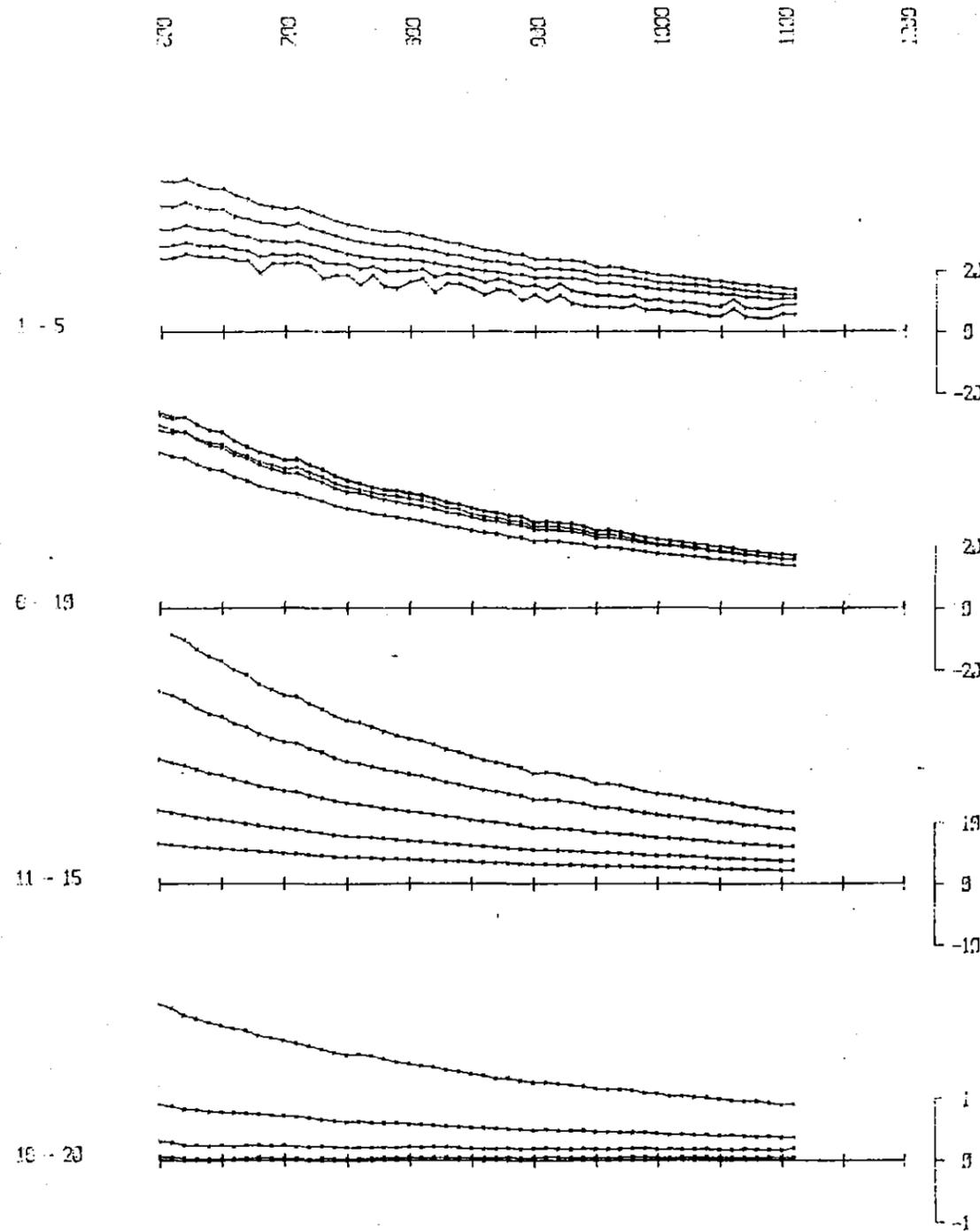
TX LOOP SIDES : 02000N 01600E
 : 02600N 02400E
 TX LOOP SIZE : 600 m X 600 m
 TX TURN OFF TIME : 290 microseconds
 FIRST GATE TIME : 98.5 microseconds
 CURRENT : 14.0 amps
 FREQUENCY : 25 Hz.
 INTEGRATION TIME : 1024 cycles
 SYNC MODE :
 HORIZONTAL SCALE : 1:5000
 SURVEYED BY : EG
 DATE : 16/11/1999

	SURVEYED AND COMPILED BY	PROJECT NO.
	GEOTREX PTY. LTD.	4-14

CLIENT : PLACER
 PROJECT : EL 39/35
 AREA : BULOBOBO RIVER
 BOREHOLE : BRD 1 A
 TX LOOP : 5

Fig. 5

AXIAL COMPONENT B (Z)



nanoampere per amp metre squared

EM-37

BOREHOLE SURVEY

ELECTROMOTIVE FORCE INDUCED BY SECONDARY FIELD
TIME DERIVATIVE OF FLUX DENSITY (B)

5 cm

TX LOOP SIDES : 92000N 92400E
: 92000S 92900E
TX LOOP SIZE : 600 m X 400 m
TX TURN OFF TIME : 200 microseconds
FIRST GATE TIME : 00.5 microseconds
CURRENT : 15.0 amps
FREQUENCY : 25 Hz.
INTEGRATION TIME : 1024 cycles
SYNC MODE :
HORIZONTAL SCALE : 1:5000
SURVEYED BY : BC
DATE : 12/11/1999

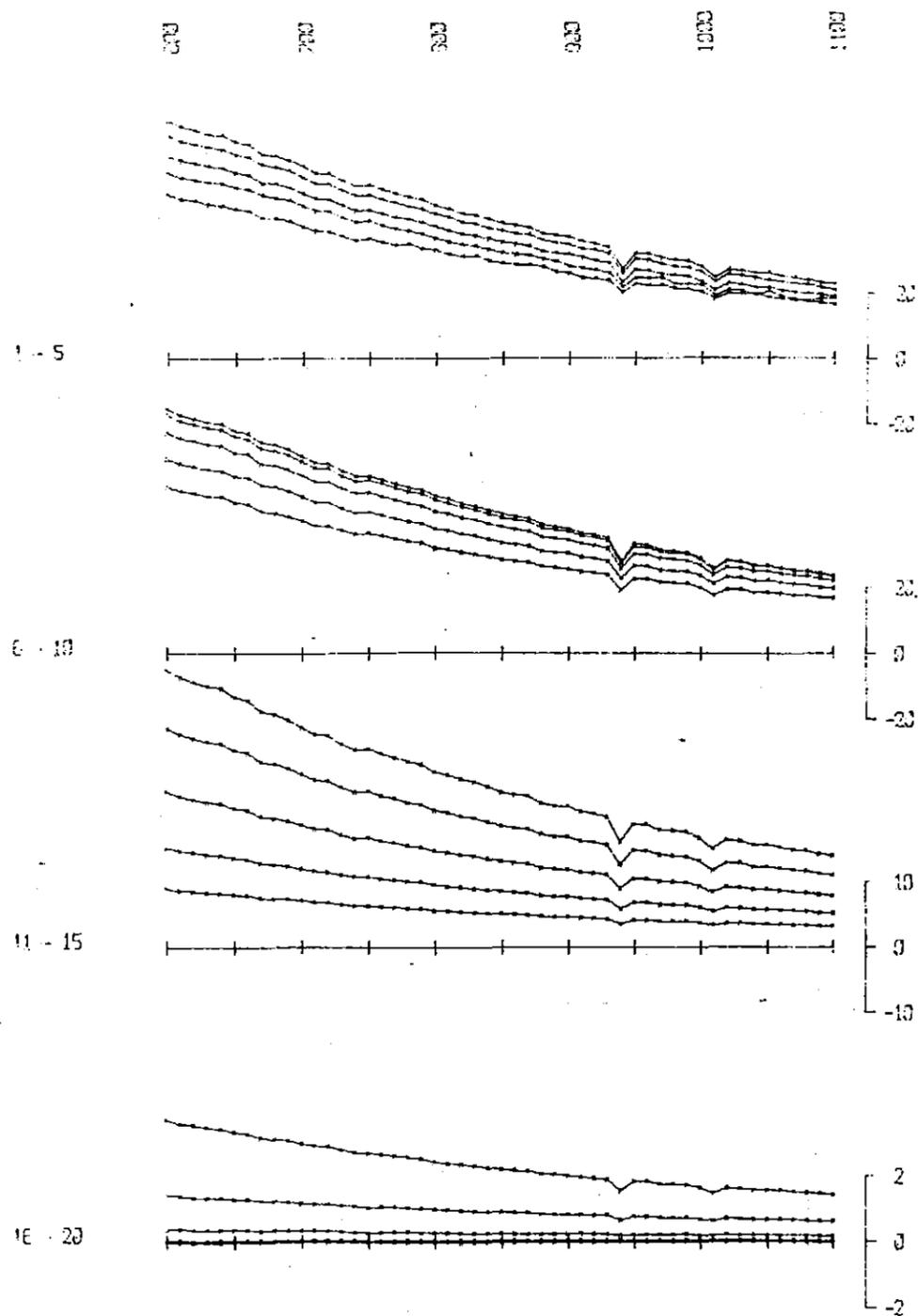
SURVEYED AND COMPILED BY GESTERREX P.Y. LTD.	PROJECT NO. 1-14
---	---------------------

CLIENT : PLADER
PROJECT : EL 33/95
AREA : BOLOGNEAC RIVER
BOREHOLE : BRD 1 A
TX LOOP : 4

Fig. 6

9181

AXIAL COMPONENT B (Z)



EM-37

BOREHOLE SURVEY

ELECTROMOTIVE FORCE INDUCED BY SECONDARY FIELD

TIME DERIVATIVE OF FLUX DENSITY (B)

5 cm

nanovolts per amp metre squared

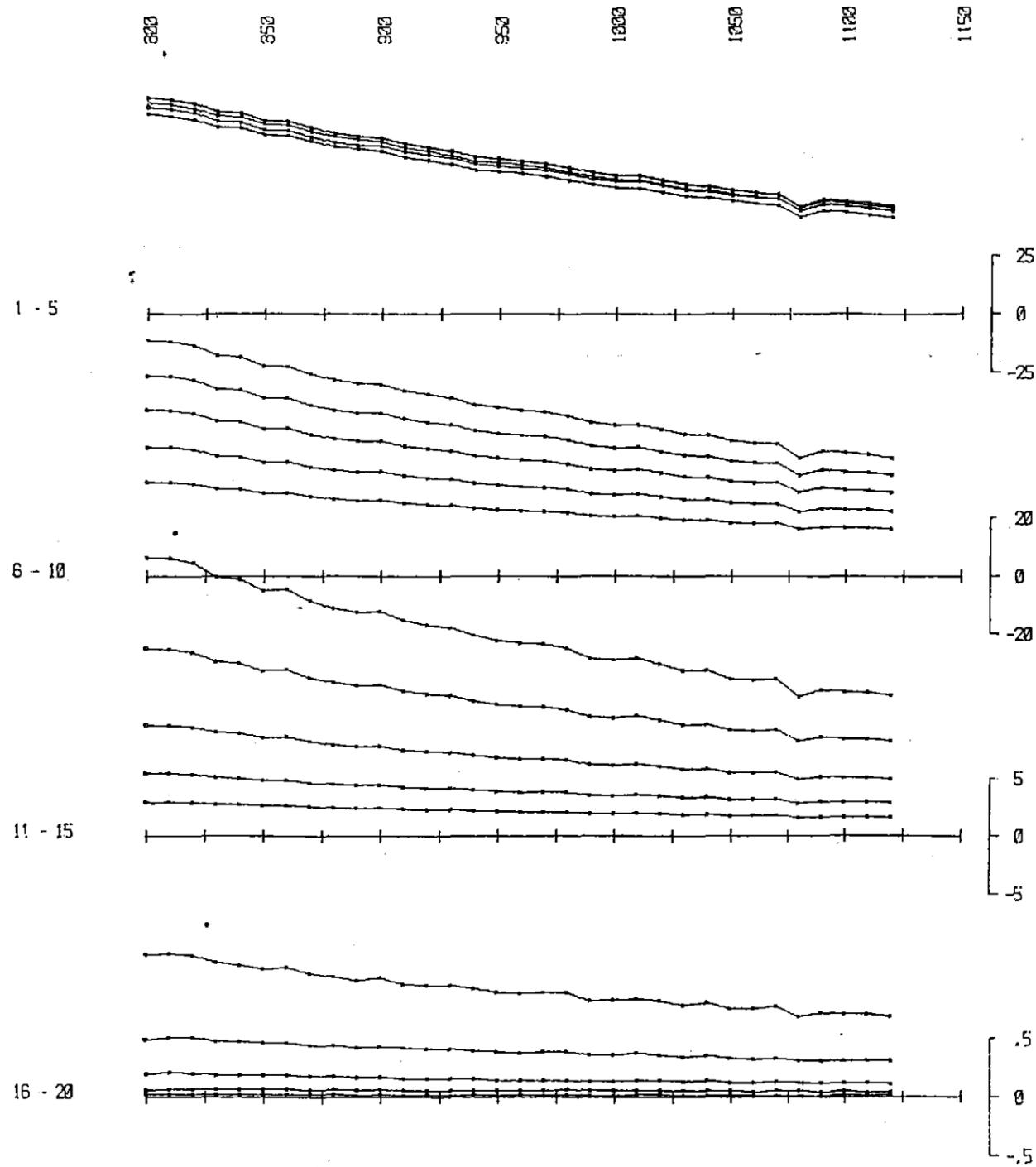
TX LOOP SIDES : 02600N 02400E
 : 02000N 03000E
 TX LOOP SIZE : 600 m X 600 m
 TX TURN OFF TIME : 310 microseconds
 FIRST GATE TIME : 69.5 microseconds
 CURRENT : 14.0 amps
 FREQUENCY : 25 Hz
 INTEGRATION TIME : 1024 cycles
 SYNC MODE :
 HORIZONTAL SCALE : 1:5000
 SURVEYED BY : EG
 DATE : 17/11/1999

SURVEYED AND COMPILED BY : GEOTERRAX PTY. LTD. PROJECT NO. : A-13

CLIENT : PLACER
 PROJECT : EL 39/95
 AREA : BULLOCKE RIVER
 BOREHOLE : BRD 1 A
 TX LOOP : 5

Fig. 7

AXIAL COMPONENT \dot{B} (Z)



EM-37

BOREHOLE SURVEY

ELECTROMOTIVE FORCE INDUCED BY SECONDARY FIELD

TIME DERIVATIVE OF FLUX DENSITY (\dot{B})

5 cm

nanovolts per amp metre squared

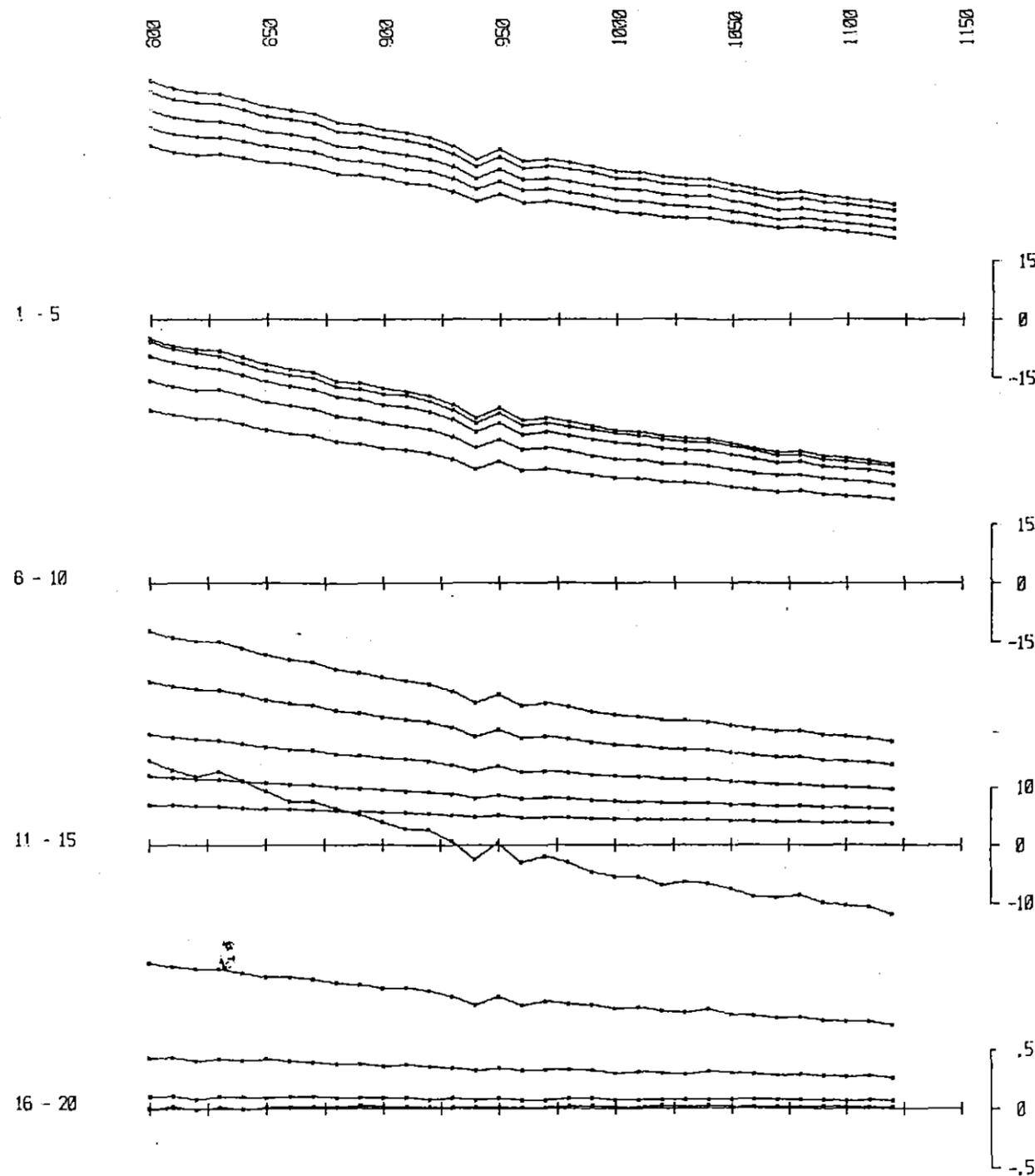
TX LOOP SIDES : 07600N 01800E
 : 08200N 02400E
 TX LOOP SIZE : 600 m X 600 m
 TX TURN OFF TIME : 295 microseconds.
 FIRST GATE TIME : 88.5 microseconds.
 CURRENT : 13.5 amps
 FREQUENCY : 25 Hz.
 INTEGRATION TIME : 1024 cycles
 SYNC MODE :
 HORIZONTAL SCALE : 1:2500
 SURVEYED BY : BG
 DATE : 16/11/1989

	SURVEYED AND COMPILED BY	PROJECT NO.
	GEOTERREX PTY. LTD.	4-14

CLIENT : PLACER
 PROJECT : EL 39/85
 AREA : BULGOBAC RIVER
 BOREHOLE : BRD 1 A
 TX LOOP : 2

Fig. 8

AXIAL COMPONENT B (Z)



EM-37

BOREHOLE SURVEY

ELECTROMOTIVE FORCE INDUCED BY SECONDARY FIELD

TIME DERIVATIVE OF FLUX DENSITY (B)

5 cm

nanovolts per amp metre squared

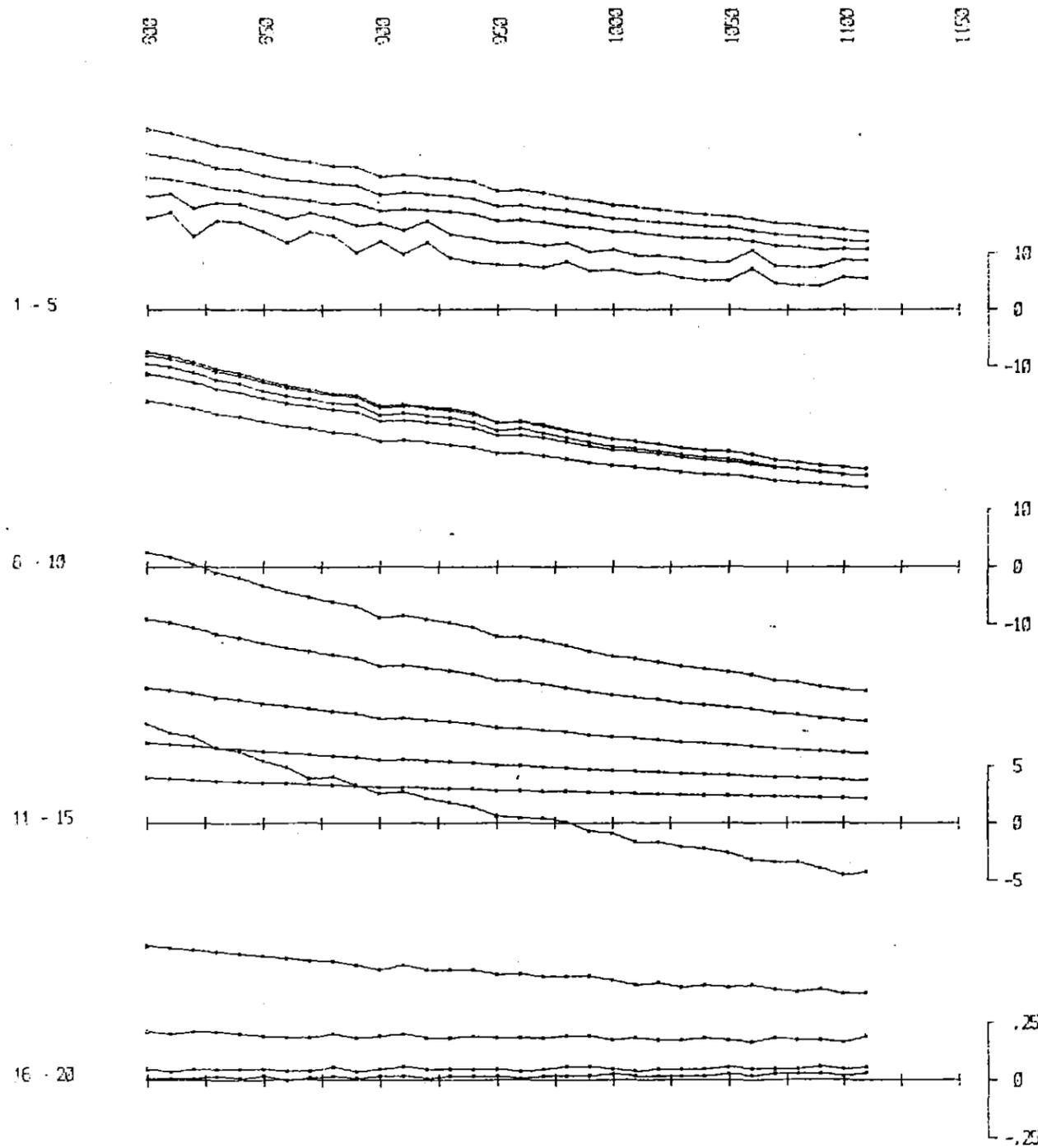
TX LOOP SIDES : 07000N 01600E
 : 07600N 02400E
 TX LOOP SIZE : 600 m X 600 m
 TX TURN OFF TIME : 290 microseconds.
 FIRST GATE TIME : 88.5 microseconds.
 CURRENT : 14.0 amps
 FREQUENCY : 25 Hz.
 INTEGRATION TIME : 1024 cycles
 SYNC MODE :
 HORIZONTAL SCALE : 1:2500
 SURVEYED BY : BG
 DATE : 16/11/1989

	SURVEYED AND COMPILED BY		PROJECT NO.
	GEOTREX PTY. LTD.		4-14

CLIENT : PLACER
 PROJECT : EL 39/85
 AREA : BULGOBAC RIVER
 BOREHOLE : BRD 1 A
 TX LOOP : 3

Fig. 9

AXIAL COMPONENT B (Z)



EM-37

BOREHOLE SURVEY

ELECTROMOTIVE FORCE INDUCED BY SECONDARY FIELD

TIME DERIVATIVE OF FLUX DENSITY (B)

5 cm

nanovolts per amp metre squared

TX LOOP SIDES : 02600N 02400E
 : 08200N 02800E
 TX LOOP SIZE : 600 m X 400 m
 TX TURN OFF TIME : 250 microseconds
 FIRST GATE TIME : 98.5 microseconds
 CURRENT : 15.6 amps
 FREQUENCY : 25 Hz
 INTEGRATION TIME : 1024 cycles
 SYNC MODE :
 HORIZONTAL SCALE : 1:2500
 SURVEYED BY : EC
 DATE : 17/11/1989

SURVEYED AND COMPILED BY GEOTERREX PTY. LTD. PROJECT NO. 4-14

CLIENT : PLACER
 PROJECT : EJ 39/85
 AREA : BULOGEAC RIVER
 BOREHOLE : BRD 1 A
 TX LOOP : 1

Fig. 10

9135

AXIAL COMPONENT B (Z)

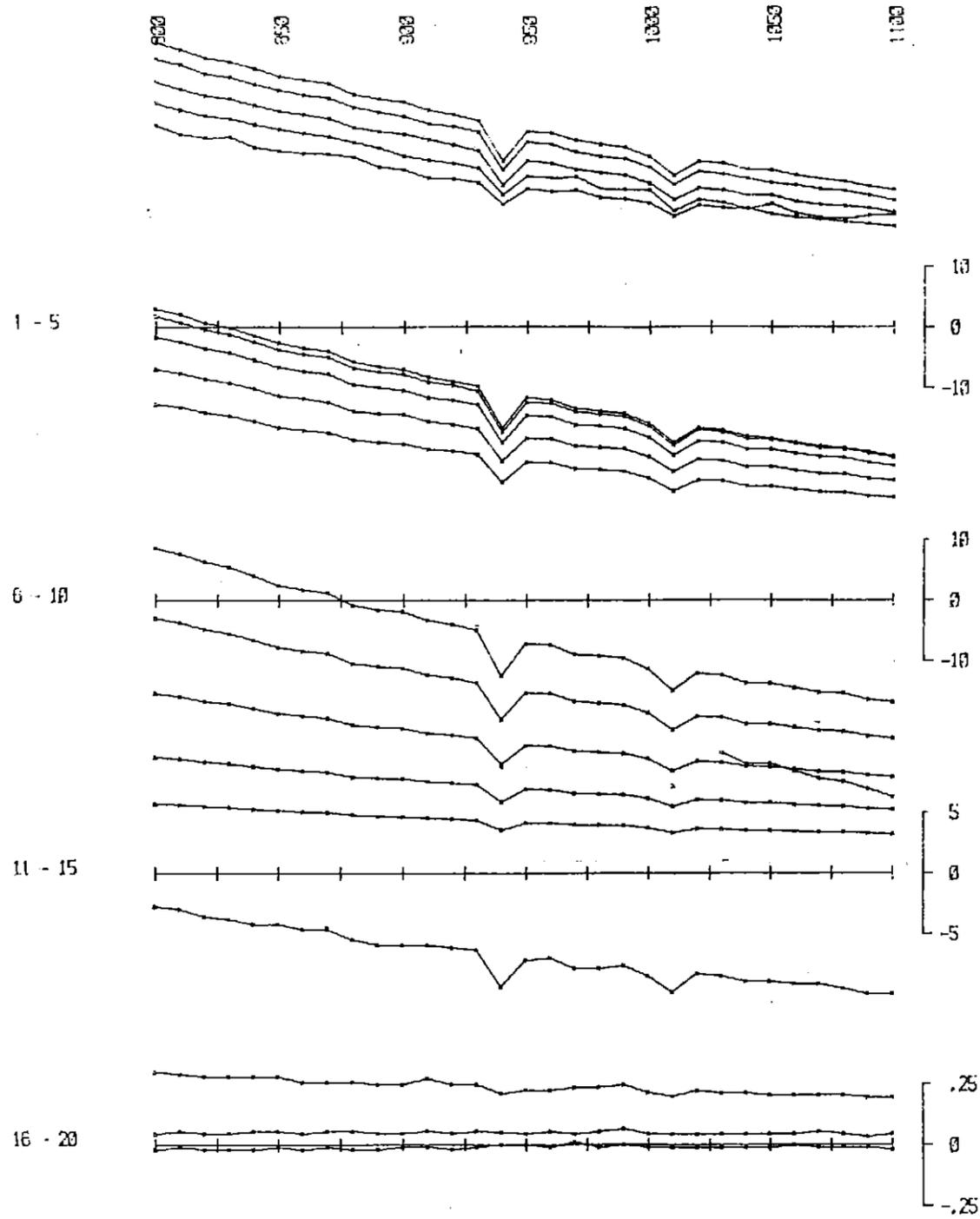
521168

EM-37

BOREHOLE SURVEY

ELECTROMOTIVE FORCE INDUCED BY SECONDARY FIELD

TIME DERIVATIVE OF FLUX DENSITY (B)



microvolts per ampere metre squared

5 cm

TX LOOP SIDES : 07600N 02400E
 : 07000N 03000E
 TX LOOP SIZE : 600 m X 600 m
 TX TURN OFF TIME : 310 microseconds.
 FIRST GATE TIME : 69.5 microseconds.
 CURRENT : 14.0 amps
 FREQUENCY : 25 Hz.
 INTEGRATION TIME : 1024 cycles
 SYNC MODE :
 HORIZONTAL SCALE : 1:2500
 SURVEYED BY : BC
 DATE : 17/11/1989

	SURVEYED AND COMPILED BY	PROJECT NO.
	GEOTREX PTY. LTD.	d-14

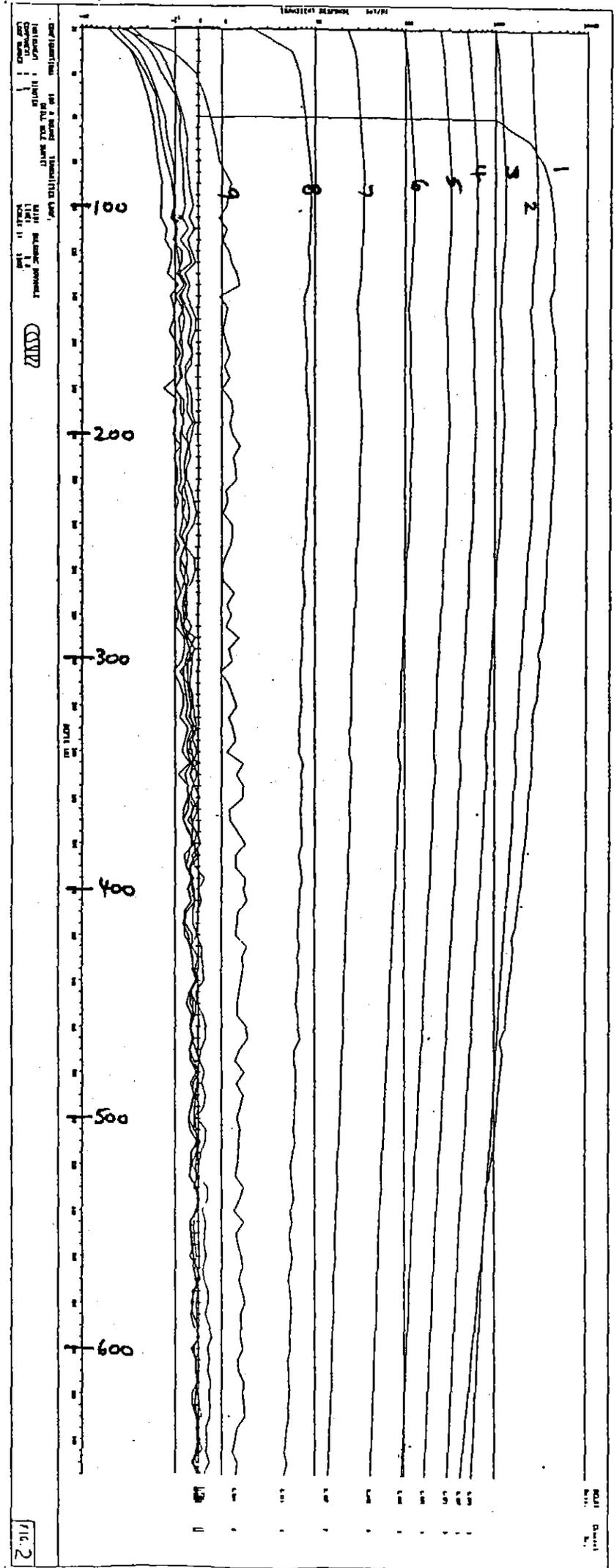
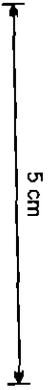
CLIENT : PLACER
 PROJECT : EL 39/85
 AREA : BULGOBAC RIVER
 BOREHOLE : BRD 1 A
 TX LOOP : 5

Fig. 11.

1985 SIROTEM SURVEY

521169

SCALE 1:2500



CHAMBERS

FIGURE 12.

521170

APPENDIX VI

MAGNETIC REMANANCE

DDH BRD 01, 02, 03

LEAMAN GEOPHYSICS

Survey Review, Specification, Reduction, Interpretation
Wide Experience Most Methods
Specialties:- Gravity, Magnetics, Seismic Methods

521171

Registered Office:
21 Zomay Avenue, DYNMYRNE, TAS. 7005
All Correspondence to:
G.P.O. BOX 320 D, HOBART, TAS. 7001.
TELEPHONE: (002) 240319

April 18, 1989

Re: Magnetic property observations on core

Bulgobac River: EL 39/85

Attention: P. Ellis

I have calculated the magnetisation properties implied by your magnetometer measurements of core samples. These have been tabulated for each hole.

You should ignore any sense of sign in the results unless you are certain that all core samples were oriented in the same way, whether in the core box or under the magnetometer, and the measurement sequence was systematic. Some sign changes reflect steps in the background field during the measurement sequence. It is possible that some of the "reversals" are real and may reflect either field change during extrusion of the lavas or rolling of pillows.

All calculations allow for demagnetisation of the specimen. A cylindrical geometric factor has been used.

The general magnetic contrast of the basalts in the Bulgobac River drilling is atypical of fresh, surface basalts but is consistent with glassy, weathered or altered basalts. The effective bulk contrast, allowing for the remanence factor as well as susceptibility, is no more than 0.0005 cgs. The Koenigsburger ratio (Q) which indicates the relative magnitude of remanent magnetisation rarely exceeds unity but is occasionally as high as 5. There does not seem to be any clear pattern between high values and total contrast and high Q values should not be presumed to reflect unaltered rock. Elevated susceptibility values are a better guide to rock quality.

Susceptibility values rarely exceed 0.0015 cgs and the relevance of higher values may need to be assessed in terms of rock texture; e.g., whether the sample was from the core of a pillow or centre of a flow, as compared to the skin of the rock mass.

The maximum effective contrast in hole BRD-1 is of the order of 0.0005 cgs but may locally be as high as 0.0015 cgs. These values are associated with densities of 2.73 to 2.80 t/cu m. It should be noted that estimates of bulk contrast based on the present determinations have assumed that the remanent and induced fields are not opposed. The variability of sign in the determinations and the type of material would suggest that this assumption might not be valid. Hence, contrasts are quoted as maxima.

In hole BRD-2 the effective contrast is less than 0.0005 cgs above 445 m but about that value at greater depth. Locally it

may be as high as 0.001 cgs. Higher densities (> 2.82 t/cu m) correlate with higher contrast zones although density sampling is less detailed.

A higher contrast is general in BRD-3.

This property pattern is consistent with the general thrust of my gravity interpretation which implied that most alteration in the volcanics occurs somewhere in the general region of holes 1 and 2.

I have also examined the response associated with the exposed basaltic materials near the Murchison Highway as observed in your detailed low level aeromagnetic survey. I have estimated the residual effect, although the anomaly is at the edge of the survey, and used the structural style of the gravity models to scale the possible source. The amplitude of the anomaly is no more than 7 to 10 nT. This approach suggests that the rocks exposed may have a bulk contrast in the range 0.0001 to 0.0005 cgs but that this contrast decreases down dip to the west.

It may be useful to sample the exposures since the contrast may be restricted to a few, or thin, members of the sequence.

The properties should be graphed against lithological descriptions since some cyclicity is suggested. This may reflect alteration, weathering or flow patterns.

The field technique depends on consistent measurement habits in a quiet field. Some steps were observed in the background field and background should also be observed between specimen determinations as well as at the end of each sequence whenever the field is erratic. That is read the field with the specimen distant; with the specimen up; with the specimen distant; with the specimen down; with the specimen distant.



D. E. Leaman

MACPROP

QUE ROAD

BRD-1 DEPTHS IN METRES

SAMPLE	FIELD	VALUE1	VALUE2	RADIUS	LENGTH	DISTANCE	NRM	SUSC	Q
748.0	61361	61363	61364	1.85	23.50	20.00	-0.00000	0.00064	-0.20
751.0	61364	61366	61364	1.85	10.50	20.00	0.00035	0.00057	1.00
754.0	61370	61369	61367	1.85	26.00	20.00	0.00014	-0.00047	-0.50
756.0	61369	61368	61370	1.85	11.00	20.00	-0.00034	0.00000	0.00
757.0	61364	61365	61365	1.85	12.00	20.00	0.00000	0.00051	0.00
760.0	61366	61368	61368	1.85	11.00	20.00	0.00000	0.00110	0.00
763.0	61366	61367	61366	1.85	9.00	20.00	0.00021	0.00034	1.00
765.0	61367	61366	61365	1.85	9.00	20.00	0.00021	-0.00101	-0.33
767.0	61367	61364	61365	1.85	16.00	20.00	-0.00012	-0.00095	0.20
772.0	61365	61371	61368	1.85	18.00	20.00	0.00031	0.00152	0.33
775.0	61370	61369	61370	1.85	18.00	20.00	-0.00010	-0.00017	1.00
778.0	61368	61367	61368	1.85	17.50	20.00	-0.00011	-0.00017	1.00
781.0	61369	61369	61370	1.85	28.00	20.00	-0.00007	0.00011	-0.99
785.0	61370	61370	61371	1.85	14.00	20.00	-0.00013	0.00022	-1.00
786.0	61370	61366	61367	1.85	13.50	20.00	-0.00014	-0.00157	0.14
790.0	61367	61368	61369	1.85	15.50	20.00	-0.00012	0.00059	-0.33
793.0	61366	61367	61369	1.85	18.00	20.00	-0.00021	0.00067	-0.50
797.0	61364	61366	61366	1.85	15.00	20.00	0.00000	0.00081	0.00
799.0	61363	61366	61363	1.85	18.00	20.00	0.00031	0.00050	1.00
802.0	61365	61368	61365	1.85	25.00	20.00	0.00022	0.00036	1.00
805.0	61367	61366	61366	1.85	11.50	20.00	0.00000	-0.00053	0.00
806.0	61368	61367	61369	1.85	25.00	20.00	-0.00015	0.00000	0.00
809.0	61368	61368	61368	1.85	18.00	20.00	0.00000	0.00000	0.00
812.0	61371	61368	61369	1.85	16.00	20.00	-0.00012	-0.00095	0.20
814.0	61367	61367	61366	1.85	14.00	20.00	0.00013	-0.00022	-1.00
817.0	61369	61369	61369	1.85	17.00	20.00	0.00000	0.00000	0.00
822.0	61370	61370	61369	1.85	30.00	20.00	0.00006	-0.00010	-1.00
825.0	61370	61368	61368	1.85	19.50	20.00	0.00000	-0.00052	0.00
827.0	61369	61370	61369	1.85	11.00	20.00	0.00017	0.00028	0.99
830.0	61370	61369	61366	1.85	19.00	20.00	0.00029	-0.00000	-0.60
834.0	61365	61365	61366	1.85	14.00	20.00	-0.00013	0.00021	-1.00
836.0	61365	61367	61370	1.85	19.00	20.00	-0.00029	0.00112	-0.43
839.0	61368	61368	61371	1.85	13.00	20.00	-0.00043	0.00070	-1.00
842.0	61371	61372	61370	1.85	21.00	20.00	0.00018	0.00000	0.00
844.0	61372	61377	61378	1.85	24.50	20.00	-0.00008	0.00136	-0.09
846.0	61382	61379	61383	1.85	16.50	20.00	-0.00045	-0.00037	1.98
850.0	61381	61386	61387	1.85	26.00	20.00	-0.00007	0.00128	-0.09
852.0	61389	61386	61391	1.85	16.00	20.00	-0.00058	-0.00019	5.05
854.0	61389	61392	61395	1.85	14.00	20.00	-0.00040	0.00195	-0.33
854.0	61408	61392	61395	1.85	14.00	20.00	-0.00040	-0.00627	0.10
855.0	61408	61413	61413	1.85	20.00	20.00	0.00000	0.00151	0.00
856.0	61415	61418	61417	1.85	16.00	20.00	0.00012	0.00095	0.20
856.0	61418	61418	61417	1.85	16.00	20.00	0.00012	0.00000	0.00
856.0	61420	61418	61417	1.85	16.00	20.00	0.00012	-0.00095	-0.20
857.0	61420	61419	61419	1.85	15.50	20.00	0.00000	-0.00039	0.00
860.0	61425	61423	61426	1.85	11.00	20.00	-0.00051	-0.00028	3.00

MAGPROP

QUE ROAD

BRD-1 DEPTHS IN METRES

SAMPLE	FIELD	VALUE1	VALUE2	RADIUS	LENGTH	DISTANCE	NRN	SUSC	Q
594.0	61323	61322	61321	2.40	9.50	20.00	0.00012	-0.00057	-0.33
596.6	61320	61322	61321	1.85	17.50	20.00	0.00011	0.00052	0.33
598.6	61318	61319	61320	1.85	15.00	20.00	-0.00012	0.00061	-0.33
601.7	61317	61320	61319	1.85	8.50	20.00	0.00022	0.00178	0.20
604.0	61315	61317	61314	1.85	12.50	20.00	0.00045	0.00024	2.99
605.0	61313	61311	61310	1.85	18.50	20.00	0.00011	-0.00092	-0.20
607.7	61311	61312	61311	1.85	23.50	20.00	0.00008	0.00013	1.00
611.0	61310	61310	61311	1.85	11.50	20.00	-0.00016	0.00026	-1.00
613.0	61312	61310	61314	1.85	13.00	20.00	-0.00057	-0.00000	2334.
55									
617.0	61320	61323	61324	1.85	29.00	20.00	-0.00006	0.00073	-0.14
619.0	61324	61323	61322	1.85	27.00	20.00	0.00007	-0.00034	-0.33
622.0	61325	61324	61325	1.85	24.00	20.00	-0.00008	-0.00013	1.00
625.0	61324	61324	61327	1.85	14.50	20.00	-0.00038	0.00063	-1.00
628.0	61322	61323	61321	1.85	12.00	20.00	0.00031	0.00000	2 1.7
01412E+30									
631.0	61319	61319	61319	1.85	15.00	20.00	0.00000	0.00000	2 1.7
01412E+30									
634.0	61322	61326	61324	1.85	19.00	20.00	0.00020	0.00096	0.33
637.0	61320	61321	61323	1.85	15.00	20.00	-0.00025	0.00081	-0.50
640.0	61319	61322	61323	1.85	13.00	20.00	-0.00014	0.00163	-0.14
643.0	61319	61321	61321	1.85	16.00	20.00	0.00000	0.00076	0.00
645.0	61320	61321	61321	1.85	17.00	20.00	0.00000	0.00036	0.00
647.0	61321	61322	61323	1.85	18.50	20.00	-0.00010	0.00049	-0.33
649.0	61323	61326	61326	1.85	18.00	20.00	0.00000	0.00101	0.00
652.0	61324	61325	61326	1.85	14.00	20.00	-0.00013	0.00065	-0.33
655.0	61325	61327	61328	1.85	20.00	20.00	-0.00009	0.00076	-0.20
658.0	61329	61334	61332	1.85	27.00	20.00	0.00014	0.00090	0.25
660.0	61329	61330	61329	1.85	16.00	20.00	0.00012	0.00019	1.00
663.0	61330	61330	61331	1.85	15.50	20.00	-0.00012	0.00039	-0.50
667.0	61329	61330	61332	1.85	14.50	20.00	-0.00026	0.00084	-0.50
670.0	61344	61345	61346	1.85	16.50	20.00	-0.00011	0.00055	-0.33
674.0	61345	61344	61343	1.85	22.00	20.00	0.00008	-0.00041	-0.33
676.0	61343	61343	61343	1.85	17.00	20.00	0.00000	0.00000	2 1.7
01412E+30									
679.0	61342	61345	61346	1.85	12.00	20.00	-0.00016	0.00177	-0.14
682.0	61343	61343	61345	1.85	10.00	20.00	-0.00037	0.00061	-0.99
685.0	61342	61346	61345	1.85	12.50	20.00	0.00015	0.00170	0.14
689.0	61416	61419	61419	1.85	12.00	20.00	0.00000	0.00151	0.00
691.0	61417	61421	61421	1.85	13.00	20.00	0.00000	0.00186	0.00
694.0	61414	61421	61421	1.85	16.00	20.00	0.00000	0.00265	0.00
698.0	61414	61423	61420	1.85	19.00	20.00	0.00029	0.00239	0.20
700.0	61364	61367	61364	1.85	11.00	20.00	0.00051	0.00082	1.00
703.0	61363	61367	61366	1.85	10.50	20.00	0.00018	0.00202	0.14
706.0	61363	61364	61365	1.85	8.50	20.00	-0.00022	0.00107	-0.33
710.0	61358	61360	61363	1.85	18.50	20.00	-0.00030	0.00115	-0.43
714.0	61362	61361	61360	1.85	9.00	20.00	0.00021	-0.00101	-0.33
716.0	61361	61362	61362	1.85	12.00	20.00	0.00000	0.00050	0.00
719.0	61360	61365	61364	1.85	22.50	20.00	0.00000	0.00121	0.11
722.0	61362	61366	61364	1.85	18.50	20.00	0.00020	0.00098	0.33
726.0	61360	61361	61365	1.85	14.00	20.00	-0.00053	0.00130	-0.66
728.0	61365	61368	61368	1.85	20.00	20.00	0.00000	0.00091	0.00
731.0	61367	61370	61368	1.85	21.00	20.00	0.00018	0.00058	0.50
734.0	61368	61367	61364	1.85	29.50	20.00	0.00019	-0.00051	-0.60
737.0	61363	61365	61365	1.85	12.00	20.00	0.00000	0.00101	0.00
740.0	61364	61365	61364	1.85	18.50	20.00	0.00010	0.00016	1.00
742.0	61363	61364	61361	1.85	14.00	20.00	0.00040	-0.00021	-3.02
745.0	61360	61362	61362	1.85	20.50	20.00	0.00009	0.00074	0.20

QUE ROAD
BRD-2 DEPTHS IN METRES

SAMPLE	FIELD	VALUE1	VALUE2	RADIUS	LENGTH	DISTANCE	NRM	SUSC	Q
298.6	61322	61320	61322	2.40	23.50	30.00	-0.00032	-0.00052	0.99
301.2	61323	61324	61322	2.40	13.00	20.00	0.00017	0.00000	0.00
304.2	61322	61322	61322	2.40	20.50	20.00	0.00000	0.00000	0.00
307.5	61319	61320	61319	2.40	17.00	20.00	0.00007	0.00011	1.00
310.0	61319	61321	61316	2.40	25.00	20.00	0.00022	-0.00007	-5.04
313.3	61318	61316	61317	2.40	17.00	20.00	-0.00007	-0.00032	0.33
316.4	61320	61319	61320	2.40	22.50	20.00	-0.00005	-0.00000	1.00
319.4	61321	61320	61319	2.40	17.50	20.00	0.00006	-0.00031	-0.33
322.6	61321	61324	61319	2.40	14.00	20.00	0.00039	0.00013	5.04
325.8	61321	61322	61322	2.40	18.00	20.00	0.00000	0.00020	0.00
329.8	61318	61318	61319	2.40	13.50	20.00	-0.00000	0.00013	-1.00
333.3	61318	61318	61319	2.40	17.50	20.00	-0.00006	0.00010	-1.00
336.8	61382	61381	61383	2.40	13.00	20.00	-0.00017	-0.00000	2167.
19									
339.9	61382	61381	61380	2.40	9.00	20.00	0.00012	-0.00060	-0.33
343.0	61378	61381	61380	2.40	21.00	20.00	0.00005	0.00043	0.20
346.1	61380	61377	61382	2.40	16.00	20.00	-0.00035	-0.00011	5.05
349.2	61330	61332	61333	2.40	22.00	20.00	-0.00005	0.00041	-0.20
352.3	61331	61330	61331	2.40	13.00	20.00	-0.00000	-0.00014	0.99
356.4	61330	61330	61326	2.40	11.50	20.00	0.00038	-0.00063	-1.00
360.0	61325	61325	61324	2.40	12.00	20.00	0.00009	-0.00015	-1.00
363.0	61322	61320	61323	2.40	30.00	20.00	-0.00011	-0.00006	2.99
367.0	61324	61327	61325	2.40	20.00	20.00	0.00011	0.00036	0.50
370.6	61328	61325	61325	2.40	23.00	20.00	0.00000	-0.00047	0.00
373.6	61325	61325	61327	2.40	17.00	20.00	-0.00013	0.00021	-0.99
376.6	61323	61322	61323	2.40	15.00	20.00	-0.00007	-0.00012	1.00
378.6	61323	61324	61323	2.40	8.00	20.00	0.00014	0.00023	1.00
382.6	61322	61326	61323	2.40	22.50	25.00	0.00029	0.00078	0.60
385.6	61320	61323	61323	2.40	23.00	25.00	0.00000	0.00092	0.00
388.6	61324	61323	61327	2.40	12.50	20.00	-0.00035	0.00029	-1.99
391.6	61322	61323	61324	2.40	14.00	20.00	-0.00008	0.00039	-0.33
395.0	61327	61326	61328	2.40	15.50	20.00	-0.00014	0.00000	0.00
399.0	61329	61325	61328	2.40	17.50	20.00	-0.00019	-0.00051	0.60
403.6	61322	61324	61322	2.40	23.00	25.00	0.00019	0.00031	1.00
407.0	61320	61321	61324	2.40	21.00	20.00	-0.00016	0.00043	-0.60
410.0	61319	61321	61320	2.40	8.50	20.00	0.00013	0.00064	0.33
413.0	61320	61320	61319	2.40	13.00	20.00	0.00009	-0.00014	-1.00
416.0	61321	61317	61319	2.40	20.00	20.00	-0.00011	-0.00054	0.33
418.6	61318	61320	61318	2.40	17.50	20.00	0.00013	0.00021	1.00
421.3	61318	61317	61318	2.40	14.50	20.00	-0.00008	-0.00012	1.00
424.1	61317	61317	61317	2.40	11.50	20.00	0.00000	0.00000	0.00
427.5	61321	61320	61321	2.40	31.00	25.00	-0.00007	-0.00011	1.00
430.6	61319	61321	61322	2.40	14.00	20.00	-0.00008	0.00064	-0.20
433.0	61321	61323	61319	2.40	19.00	20.00	0.00023	-0.00000	2-334
.49									
436.6	61323	61320	61322	2.40	14.00	20.00	-0.00016	-0.00052	0.50
439.6	61321	61322	61324	2.40	23.00	25.00	-0.00019	0.00061	-0.50
442.6	61321	61320	61321	2.40	20.00	20.00	-0.00006	-0.00009	1.00
445.6	61322	61322	61322	2.40	19.50	20.00	0.00000	0.00000	0.00
447.0	61322	61318	61319	2.40	13.50	20.00	-0.00000	-0.00093	0.14
451.6	61323	61320	61324	2.40	20.00	20.00	-0.00022	-0.00018	1.99
454.6	61319	61322	61323	2.40	11.00	20.00	-0.00010	0.00115	-0.14
457.6	61323	61323	61318	2.40	22.00	20.00	0.00025	-0.00041	-1.00
460.1	61323	61321	61324	2.40	18.50	20.00	-0.00018	-0.00010	2.99
463.6	61327	61322	61321	2.40	16.00	20.00	0.00007	-0.00124	-0.09
466.6	61322	61325	61324	2.40	8.50	20.00	0.00013	0.00106	0.20
469.6	61322	61324	61326	2.40	21.00	25.00	-0.00021	0.00101	-0.33
472.6	61324	61326	61322	2.40	23.50	25.00	0.00037	0.00000	0.00
475.6	61322	61324	61321	2.40	12.50	20.00	0.00027	0.00014	2.99
478.6	61326	61325	61326	2.40	21.50	20.00	-0.00005	-0.00000	1.00

QUE ROAD
BRD-2

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DEPTHS IN METRES

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SAMPLE	FIELD	VALUE1	VALUE2	RADIUS	LENGTH	DISTANCE	NRM	SUSC	Q
481.6	61326	61325	61324	2.40	17.50	20.00	0.00006	-0.00031	-0.33
484.6	61325	61329	61323	2.40	16.00	20.00	0.00041	0.00023	2.99
487.6	61327	61325	61328	2.40	17.50	20.00	-0.00019	-0.00010	3.02
490.6	61326	61322	61328	2.40	12.50	20.00	-0.00053	-0.00029	3.01
493.6	61324	61324	61327	2.40	10.00	20.00	-0.00033	0.00054	-1.00
496.6	61329	61329	61329	2.40	18.00	20.00	0.00000	0.00000	0.00
499.0	61333	61331	61332	2.40	18.00	20.00	-0.00006	-0.00030	0.33
502.6	61330	61327	61329	2.40	22.50	25.00	-0.00019	-0.00063	0.50
505.6	61302	61301	61302	2.40	12.50	20.00	-0.00009	-0.00014	1.00
508.6	61302	61306	61303	2.40	9.00	20.00	0.00037	0.00100	0.60
511.6	61335	61333	61333	2.40	24.50	25.00	0.00000	-0.00057	0.00
514.6	61334	61331	61332	2.40	22.50	25.00	-0.00010	-0.00078	0.20
517.6	61335	61335	61333	2.40	22.00	25.00	0.00020	-0.00032	-1.00
520.6	61337	61336	61337	2.40	23.50	25.00	-0.00009	-0.00015	1.00
523.6	61335	61336	61337	2.40	25.00	20.00	-0.00004	0.00022	-0.33
526.6	61335	61338	61336	2.40	15.00	20.00	0.00015	0.00048	0.50
529.6	61338	61337	61338	2.40	15.00	20.00	-0.00007	-0.00012	1.00
532.6	61338	61336	61339	2.40	11.00	20.00	-0.00030	-0.00016	2.99
535.6	61337	61337	61338	2.40	15.00	20.00	-0.00007	0.00012	-1.00
538.6	61338	61339	61336	2.40	14.50	20.00	0.00023	-0.00012	-2.99
541.6	61340	61338	61338	2.40	8.50	20.00	0.00000	-0.00005	0.00
544.6	61339	61337	61338	2.40	15.00	20.00	-0.00007	-0.00036	0.33
547.6	61337	61340	61341	2.40	21.00	20.00	-0.00005	0.00060	-0.14
550.6	61341	61340	61340	2.40	25.00	25.00	0.00000	-0.00028	0.00
553.6	61339	61337	61339	2.40	21.00	20.00	-0.00011	-0.00017	1.00
556.6	61339	61339	61340	2.40	17.00	20.00	-0.00006	0.00010	-1.00
559.6	61339	61341	61342	2.40	11.00	20.00	-0.00010	0.00002	-0.20
563.0	61338	61334	61335	2.40	11.00	20.00	-0.00010	-0.00115	0.14
567.0	61329	61329	61331	2.40	12.00	20.00	-0.00010	0.00030	-1.00
571.6	61329	61328	61328	2.40	21.00	20.00	0.00000	-0.00017	0.00
574.6	61301	61301	61302	2.40	15.50	20.00	-0.00007	0.00012	-1.00
577.6	61301	61301	61303	2.40	14.00	20.00	-0.00016	0.00026	-1.00
580.6	61300	61301	61301	2.40	12.00	20.00	0.00000	0.00030	0.00
583.6	61317	61315	61314	2.40	16.50	20.00	0.00007	-0.00055	-0.20
586.6	61316	61313	61317	2.40	20.50	20.00	-0.00022	-0.00018	1.99
590.0	61316	61317	61316	2.40	19.00	20.00	0.00006	0.00010	1.00
593.0	61315	61315	61315	2.40	15.00	20.00	0.00000	0.00000	0.00
596.2	61316	61313	61313	2.40	26.00	25.00	0.00000	-0.00001	0.00
590.0	61306	61306	61308	2.40	23.00	20.00	-0.00010	0.00016	-1.00
603.0	61308	61309	61309	2.40	13.00	20.00	0.00000	0.00028	0.00
606.0	61310	61309	61308	2.40	11.50	20.00	0.00010	-0.00047	-0.33
610.0	61308	61308	61310	2.40	13.50	20.00	-0.00016	0.00027	-0.99
613.0	61309	61307	61310	2.40	17.00	20.00	-0.00019	-0.00010	3.02
616.6	61305	61307	61305	2.40	16.50	20.00	0.00013	0.00022	1.00
619.6	61309	61309	61308	2.40	20.00	20.00	0.00006	-0.00009	-1.00
621.0	61308	61307	61306	2.40	12.00	20.00	0.00009	-0.00045	-0.33
625.6	61306	61306	61304	2.40	15.00	20.00	0.00015	-0.00024	-1.00
627.0	61305	61306	61304	2.40	8.00	20.00	0.00023	0.00000	0.00
629.0	61373	61373	61372	2.40	23.00	20.00	0.00005	-0.00000	-1.00
634.6	61372	61371	61372	2.40	19.00	20.00	-0.00006	-0.00009	1.00
636.0	61370	61368	61369	2.40	14.50	20.00	-0.00000	-0.00037	0.33
640.6	61371	61370	61369	2.40	16.00	20.00	0.00007	-0.00034	-0.33
642.0	61372	61373	61371	2.40	12.50	20.00	0.00018	0.00000	0.00
645.0	61307	61308	61311	2.40	18.00	20.00	-0.00018	0.00050	-0.60
649.6	61309	61310	61311	2.40	16.00	20.00	-0.00007	0.00034	-0.33
652.6	61309	61311	61309	2.40	18.50	20.00	0.00012	0.00020	1.00
655.6	61309	61313	61309	2.40	15.00	20.00	0.00029	0.00048	1.00
658.6	61312	61310	61311	2.40	12.50	20.00	-0.00009	-0.00043	0.33
661.0	61311	61311	61312	2.40	17.50	20.00	-0.00006	0.00010	-1.00
664.0	61312	61310	61312	2.40	21.50	20.00	-0.00010	-0.00017	1.00
667.6	61312	61311	61311	2.40	12.50	20.00	0.00000	-0.00029	0.00
671.0	61308	61310	61312	2.40	9.00	20.00	-0.00025	0.00120	-0.33
675.0	61300	61312	61312	2.40	27.00	25.00	0.00000	0.00104	0.00

SAMPLE	FIELD	VALUE1	VALUE2	RADIUS	LENGTH	DISTANCE	NRM	SUSC	Q
298.9	61393	61395	61394	2.40	10.50	15.00	0.00004	0.00022	0.33
300.0	61395	61398	61397	2.40	26.50	25.00	0.00002	0.00066	0.20
302.0	61397	61397	61395	2.40	30.00	30.00	0.00025	-0.00040	-1.00
304.4	61395	61395	61396	2.40	16.50	20.00	-0.00007	0.00011	-1.00
307.4	61402	61400	61397	2.40	18.00	20.00	0.00018	-0.00070	-0.43
308.0	61396	61392	61393	2.40	19.50	20.00	-0.00006	-0.00065	0.14
310.4	61300	61382	61389	2.40	23.00	20.00	-0.00034	0.00086	-0.63
311.2	61377	61381	61380	2.40	27.00	25.00	0.00008	0.00091	0.14
313.4	61392	61391	61389	2.40	19.00	20.00	0.00012	-0.00038	-0.50
316.4	61392	61392	61393	2.40	15.00	20.00	-0.00007	0.00012	-1.00
319.4	61393	61392	61389	2.40	13.50	20.00	0.00025	-0.00057	-0.60
322.4	61389	61385	61387	2.40	13.00	20.00	-0.00017	-0.00083	0.33
323.0	61390	61391	61392	2.40	14.00	20.00	-0.00008	0.00038	-0.33
325.4	61393	61391	61384	2.40	13.50	20.00	0.00057	-0.00147	-0.64
328.4	61388	61386	61394	2.40	23.50	20.00	-0.00028	0.00046	-1.00
330.0	61387	61385	61386	2.40	10.00	20.00	-0.00011	-0.00054	0.33
332.0	61385	61387	61388	2.40	21.00	20.00	-0.00005	0.00043	-0.20
334.4	61391	61390	61397	2.40	22.00	20.00	0.00005	0.00106	0.08
337.4	61388	61385	61386	2.40	22.50	20.00	-0.00005	-0.00040	0.20
339.6	61383	61382	61383	2.40	11.50	20.00	-0.00010	-0.00016	0.99
340.0	61384	61384	61383	2.40	16.00	20.00	0.00007	-0.00011	-1.00
342.7	61383	61383	61384	2.40	19.00	20.00	-0.00006	0.00009	-1.00
345.8	61387	61389	61387	2.40	13.50	20.00	0.00016	0.00027	1.00
347.0	61385	61385	61383	2.40	10.00	20.00	0.00022	-0.00036	-1.00
348.9	61382	61384	61383	2.40	25.00	25.00	0.00009	0.00042	0.33
350.0	61382	61382	61386	2.40	24.00	25.00	0.00018	-0.00029	-1.00
352.0	61380	61382	61380	2.40	19.00	20.00	0.00012	0.00019	1.00
355.0	61376	61377	61376	2.40	12.00	20.00	0.00009	0.00015	1.00
356.8	61378	61382	61379	2.40	11.00	20.00	0.00030	0.00082	0.60
359.9	61381	61379	61381	2.40	13.00	20.00	-0.00017	-0.00020	1.00
363.0	61378	61381	61380	2.40	15.00	20.00	0.00007	0.00060	0.20
366.0	61382	61380	61382	2.40	26.00	25.00	-0.00017	-0.00027	1.00
369.0	61382	61381	61381	2.40	18.00	25.00	0.00000	-0.00039	0.00
373.1	61382	61382	61381	2.40	14.00	20.00	0.00008	-0.00013	-1.00
376.4	61382	61382	61383	2.40	13.00	20.00	-0.00008	0.00014	-1.00
379.5	61384	61380	61383	2.40	27.00	30.00	-0.00041	-0.00113	0.60
382.4	61383	61385	61386	2.40	21.00	25.00	-0.00010	0.00084	-0.20
385.0	61386	61388	61389	2.40	18.00	20.00	-0.00006	0.00050	-0.20
388.0	61390	61389	61389	2.40	17.00	20.00	0.00000	-0.00021	0.00
391.1	61393	61393	61394	2.40	17.00	20.00	-0.00007	0.00011	-1.00
394.2	61400	61401	61401	2.40	20.00	20.00	0.00000	0.00018	0.00
397.3	61402	61403	61402	2.40	16.50	20.00	0.00007	0.00011	1.00
400.4	61401	61403	61404	2.40	22.00	20.00	-0.00005	0.00041	-0.20
403.4	61404	61404	61405	2.40	18.00	20.00	-0.00006	0.00010	-0.99
404.0	61409	61406	61407	2.40	15.00	20.00	-0.00007	-0.00060	0.20
406.4	61406	61407	61408	2.40	15.00	20.00	-0.00007	0.00036	-0.33
409.4	61407	61408	61407	2.40	26.50	25.00	0.00008	0.00013	1.00
412.4	61405	61406	61409	2.40	15.50	20.00	-0.00021	0.00058	-0.60
415.4	61408	61409	61405	2.40	23.00	20.00	0.00019	-0.00016	-2.00
418.4	61413	61410	61410	2.40	10.00	20.00	0.00000	-0.00100	0.00
421.4	61412	61409	61410	2.40	20.00	20.00	-0.00006	-0.00045	0.20
424.4	61414	61414	61415	2.40	15.50	20.00	-0.00007	0.00012	-1.00
427.4	61413	61413	61412	2.40	16.50	20.00	0.00007	-0.00011	-1.00
430.0	61415	61412	61412	2.40	17.00	20.00	0.00000	-0.00063	0.00
433.4	61414	61416	61410	2.40	12.50	20.00	0.00053	-0.00029	-3.01
436.4	61414	61416	61416	2.40	14.50	20.00	0.00000	0.00050	0.00
439.0	61413	61414	61412	2.40	16.00	20.00	0.00014	0.00000	0.00
442.0	61419	61418	61418	2.40	13.00	20.00	0.00000	-0.00028	0.00
445.4	61419	61421	61419	2.40	13.00	20.00	0.00017	0.00028	1.00
448.0	61420	61419	61419	2.40	10.00	20.00	0.00000	-0.00036	0.00
451.0	61415	61419	61420	2.40	24.00	20.00	-0.00005	0.00067	-0.11
454.0	61425	61426	61425	2.40	12.50	20.00	0.00009	0.00014	1.00
457.4	61425	61427	61424	2.40	18.50	20.00	0.00018	0.00010	3.03
460.0	61424	61422	61427	2.40	23.00	20.00	-0.00024	0.00008	-4.98
463.4	61394	61390	61395	2.40	21.00	20.00	-0.00026	-0.00026	1.66

APPENDIX VII

CSAMT RE-EVALUATION

DATE: 21 February 1990
TO: Peter Ellis
FROM: Keiran Logan
SUBJECT: RE-INTERPRETATION OF 1986 CSAMT SURVEY

The initial interpretation of CSAMT incorrectly inferred that the survey had detected the Mixed Layer Sequence Volcanics and that the low resistivities between 128 - 256 Hz corresponded with the depth limits of the Que River Shale. The drill-hole BRD01 quickly dissolved this interpretation prompting the need for a re-interpretation of the data in the light of new geological information.

Figure 1 shows an annotated plan of the stacked CSAMT traverses. On this plan the inferred boundaries of the Far, Transitional and Near field effects are also plotted. These boundaries were inferred from selected station plots on a resistivity v's frequency plot (Figure 2). The relevance of these boundaries is as follows:

1. Near field

Data within this field is useless because of the complex nature of the electromagnetic field which makes the resistivity independent of frequency and hence not representing the apparent resistivities.

2. Transitional field

Transitional field zone between the Near and Far fields which is displayed as a low resistivity "notch" on Figure 2 at frequencies 128 - 256 Hz.

3. Far field

This is responsible for the data above 256 Hz. It displays the useful resistivity information at shallow depths.

The result of these boundary definitions is that most of the data below 256 Hz is un-interpretable. However, exceptions to this were discovered, for example station 2400E/7600N (Figure 3) which coincides with BRD01. Figure 3 shows the modelling results for this station which correspond with the geology in BRD01. Note that

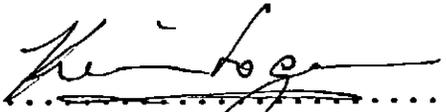
...2/

Memo to P. Ellis 21.2.90
RE-INTERPRETATION OF 1986 CSAMT SURVEY

.2

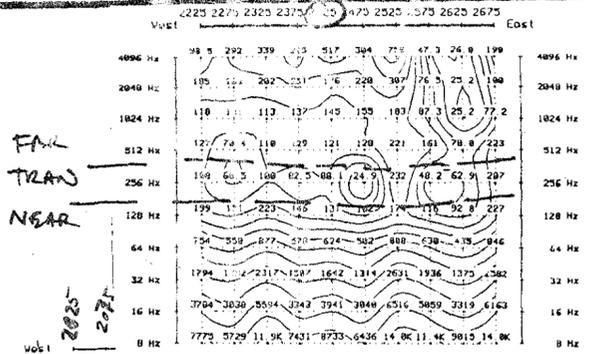
the bottom of the Que River Shale could not be seen in the data but the model suggests that it could be seen at lower frequencies (ie in the range of a Magnetotelluric survey). The model also suggests that the top of the Que River shale is very conductive (15ohm.m).

The transmitter location for the survey was 12km to the SE and this was considered (at the time) adequate to remove most of the Near field from the survey's lower frequencies. This did not work and suggests that the transmitter was in highly resistive geology permitting a "good" propagation of the field. The modelling of station 2400E/7600N infers that at places the Transitional zone overlaps with the conductive top of the Que River Shale, but it also infers that this conductive layer inhibits the depth penetration of CSAMT regardless of the absence of a Near field effect. Magnetotellurics in the frequency range of 0.025 - 16 Hz would have to be used to penetrate to depths of 1.6 - 2km but this would also have a decrease in resolvability of geologically units.

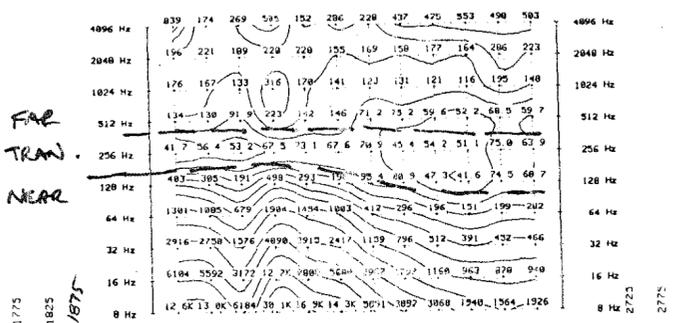

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Keiran Logan
Geophysicist

encl. Figures 1 to 3

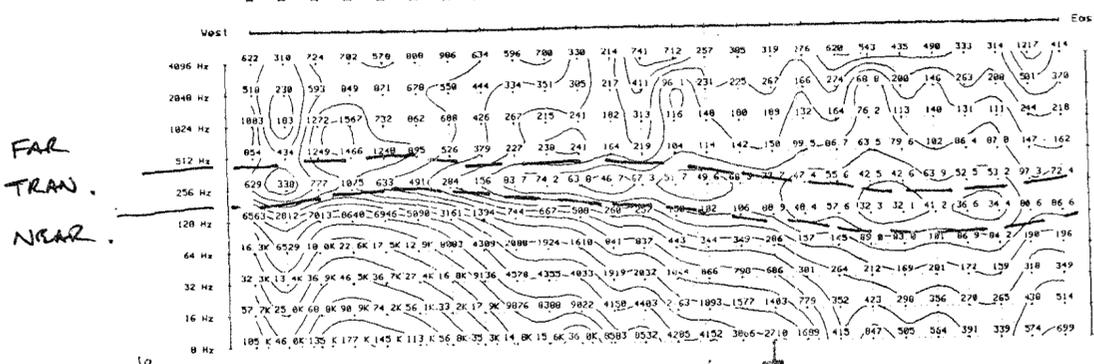
KL122



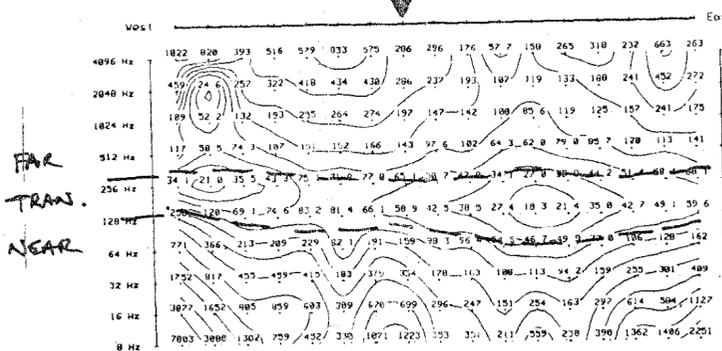
LN 9000N



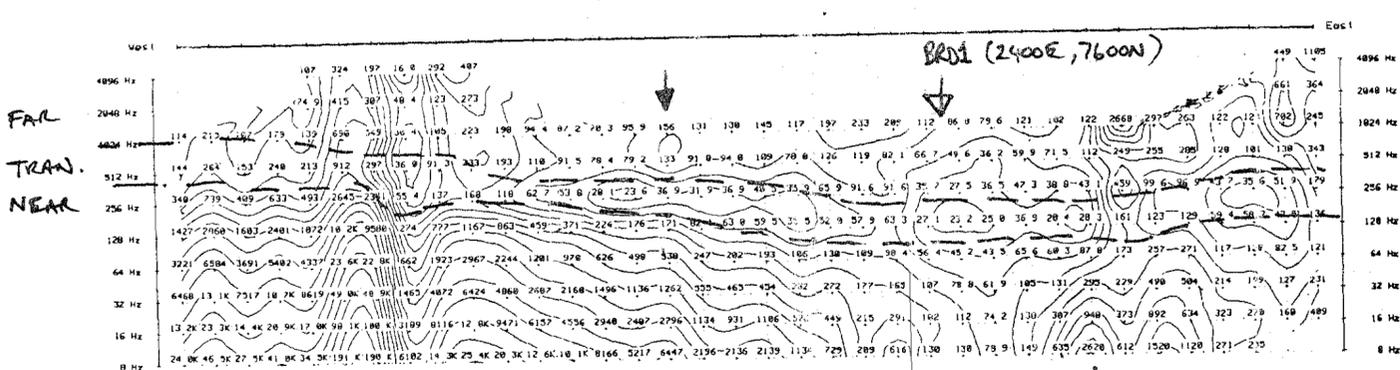
LN 8600N



LN 8200N



LN 7800N



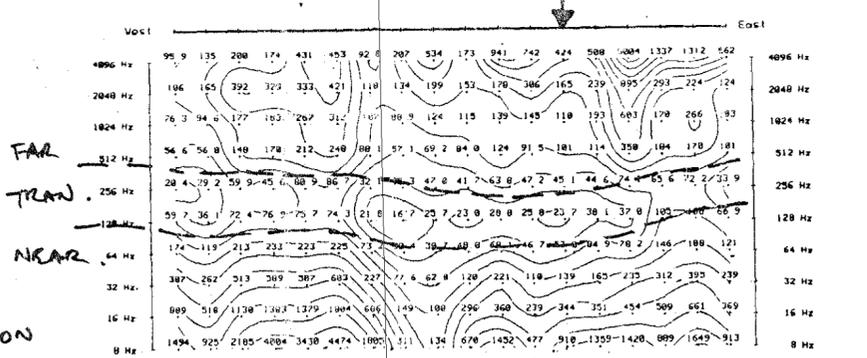
LN 7600N

KEY

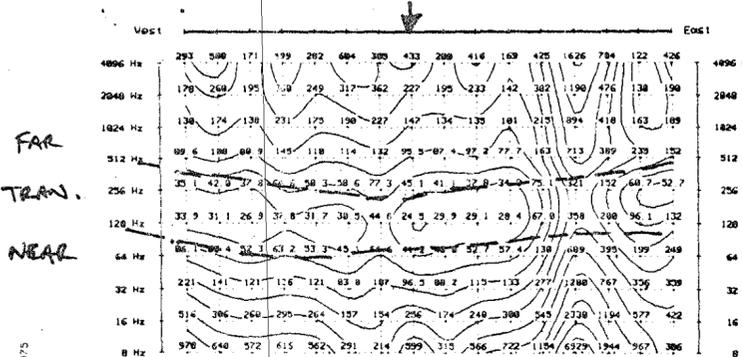
↓ STATIONS PLOTTED FROM VSP CURVE (Figure 1).

FAR BOUNDARIES BETWEEN DATA
TRANSITION AFFECTED BY FAR, TRANSITION
NEAR AND NEAR FIELDS.

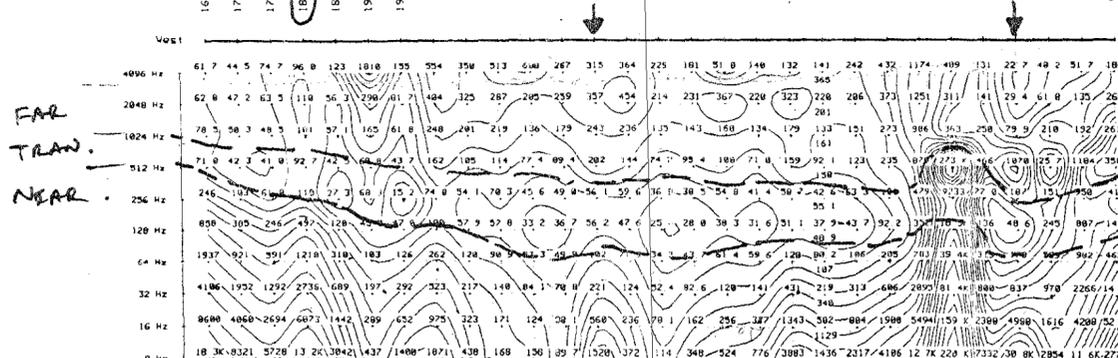
NB USEFUL CSAMT DATA IS
CONTAINED IN THE TOP
FAR FIELD DATA.
TRANSITIONAL AND NEAR
FIELD DATA IS NOT USEFUL.



LN 7400N



LN 7200N



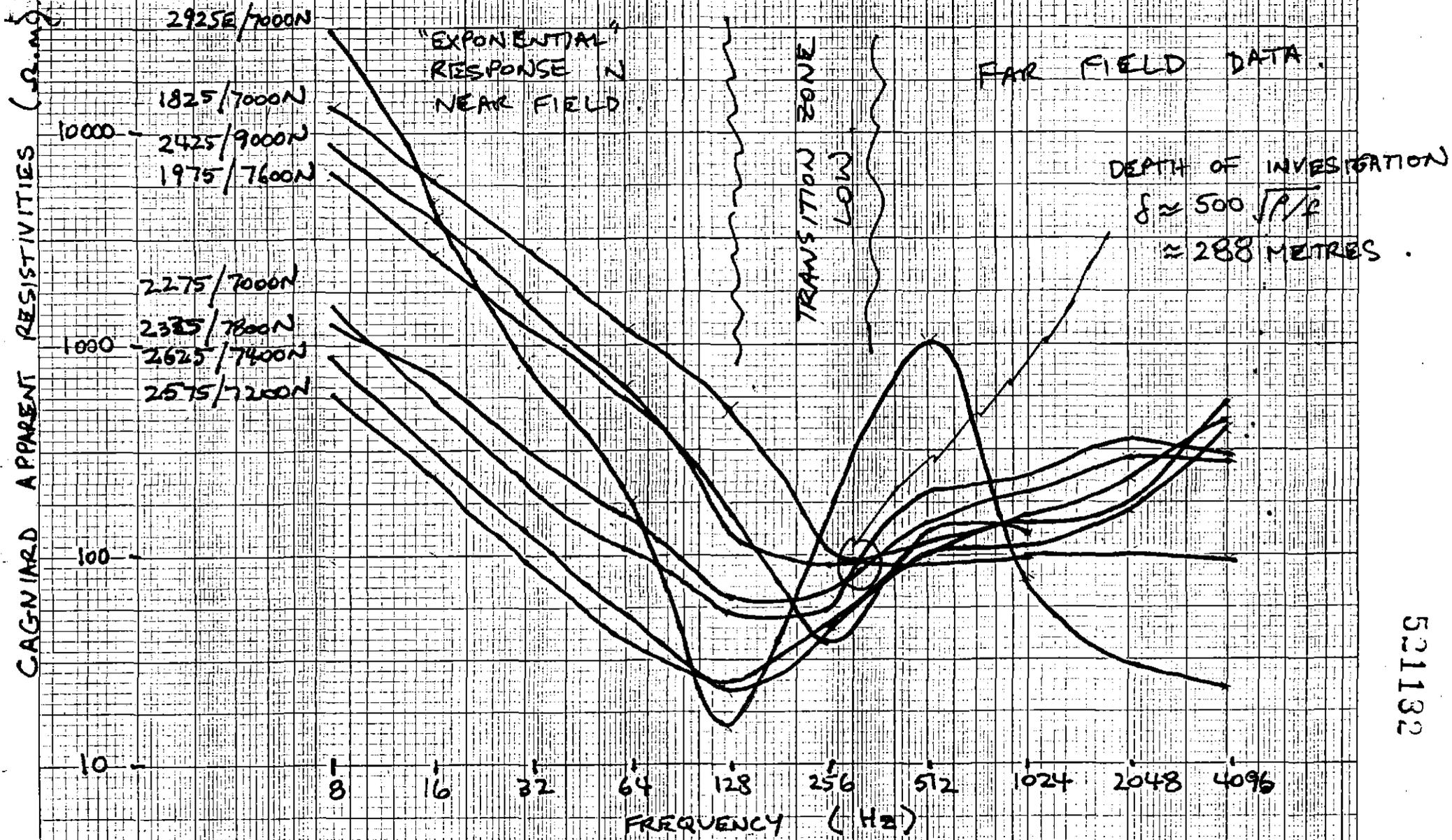
LN 7000N

Figure 1

CSR Limited - MEDG

BULGOBAC CREEK
CSAMT CAGNIARD
RESISTIVITIES (ANNOTATED)

SCALE:	DATE: 10/10
DRAWN: KSL	REV: PLAN NO
CHECKED: KSL	7612-9
APPROVED: KSL	



FREQUENCY - RESISTIVITY CURVES FOR SELECTED CSAM STATIONS THROUGH SECTIONS 7000N TO 9000N. ILLUSTRATING THE EARLY INFLUENCE OF THE NEAR FIELD EFFECT.

521132

BULGOBAC RIVER.

CSAMT MODELLING.

STATION 2400E / 7600N

(BRD 1).

KJL 10/1/90.

PYROCLASTICS

QUE RIVER
SHALES.

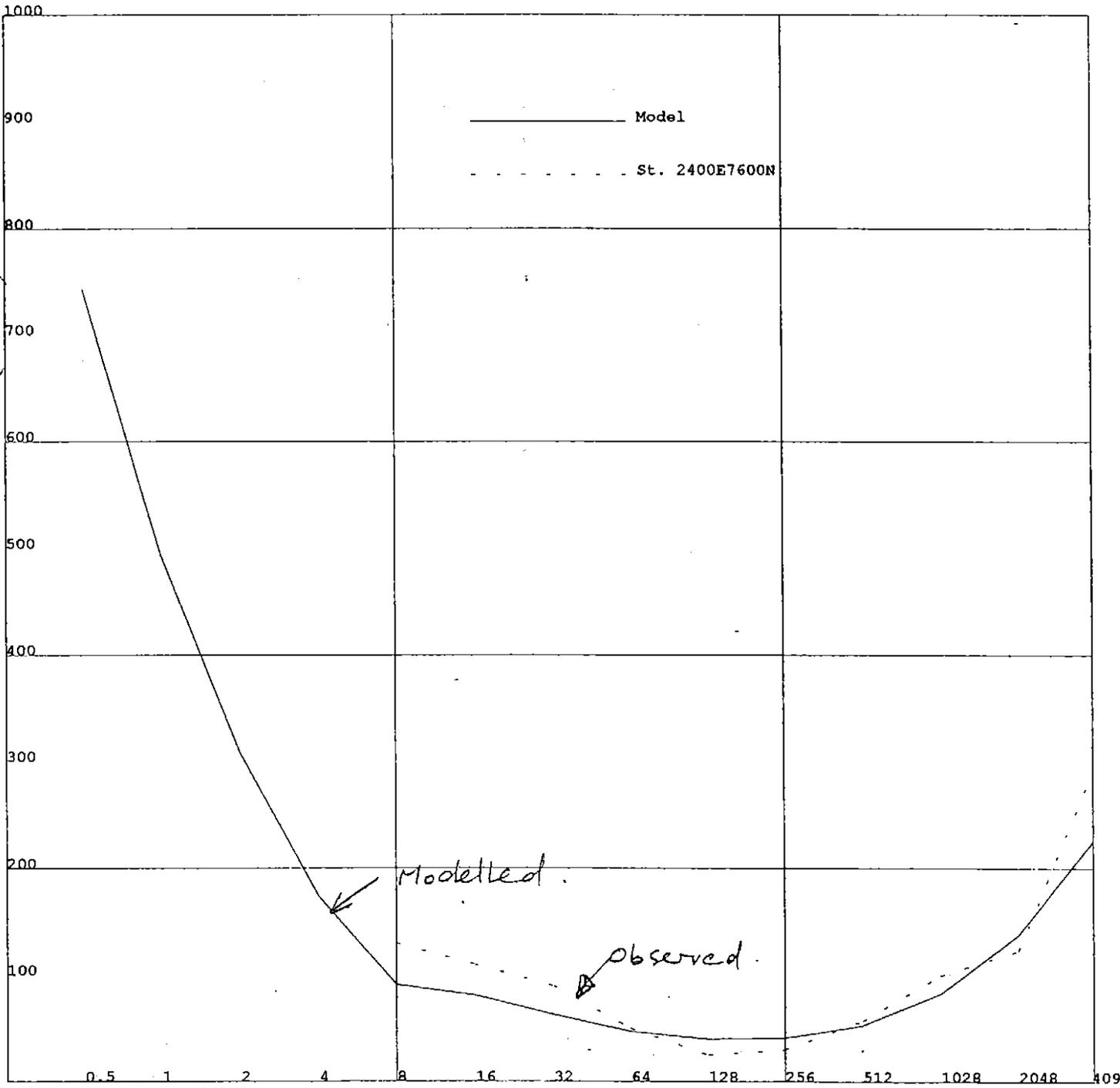
HELLYER
BASALT.

Depth.

MODEL.

75	400 Ω.m
145	15 Ω.m
535	150 Ω.m
∞	300 Ω

CARNIGARD RESISTIVITY (Ω.m) - LINEAR SCALE



Bulgozac Synthetic CSAMT

FREQUENCY (Hz)

FIGURE 3