PLUTONIC OPERATIONS LIMITED

EXPLORATION LICENCE 10/88

GOWRIE PARK

Partial Relinquishment Report - July 1993

Plutonic
A.C.N. 004 680 997

Grant MacDonald
July 1993

TABLE OF CONTENTS

Page No.

FIGURES

APPENDICES

A. Detailed Mapping, Lake Barrington Rowing Course Road - Wally Herrmann

B. Petrographic Studies, Lake Barrington Rowing Course Road and Gog Range - Dr A Crawford

C. Geophysical Summary of CRAE Data - P Zarzavatjian

D. Regional Interpretation - Gravity and Magnetic Data - Dr D Leaman

E. Review of Gravity Data EL 10/88 - Dr D Leaman

F. Aeromagnetic Survey EL 10/88 - Acquisition Report and Preliminary Interpretation - Dr D Leaman

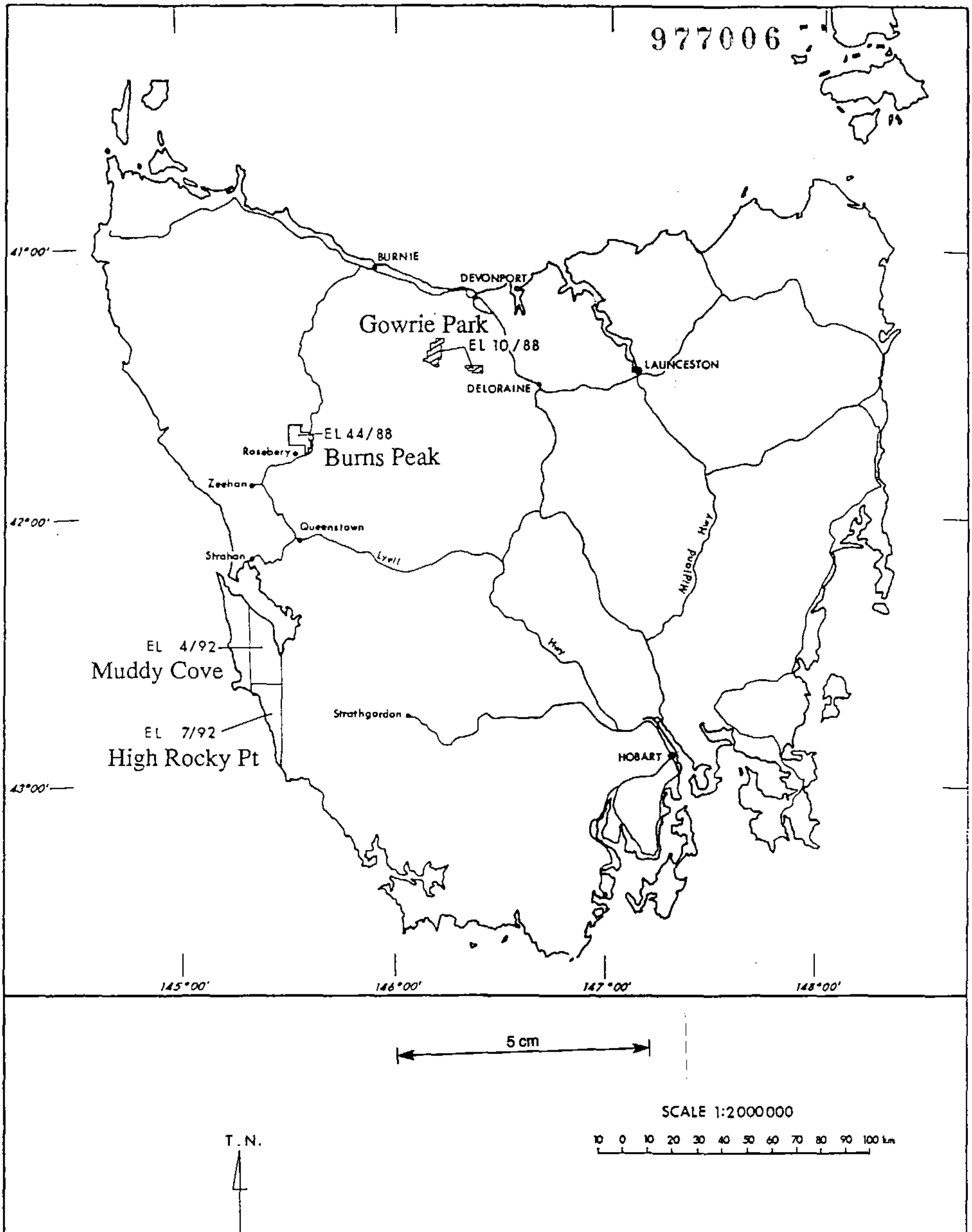
G. Drill Log/Assays DD80LB1, Lake Barrington Prospect

1.0 INTRODUCTION

The prospective rocks in EL 10/88 are considered to be the Cambrian volcanics and associated sediments, correlates of the rocks which host the orebodies of Hellyer, Que River, Rosebery, Hercules and Mt Lyell. A VHMS base metal orebody, of which the above are examples, has been the principal target of exploration.

A secondary target has been a volcanic hosted gold deposit of which Henty and South Hercules may be considered as examples.

The EL lies in the central northern part of Tasmania (see Figure 1).



REVISION	PLUTONIC OPERATIONS LIMITED A.C.N. 004 680 997
Technical Report No.	PROJECT: TASMANIA GENERAL
DRG. OFFICE CHECKED BY.	PROJECT LOCATIONS
DATE: APR. 1992 SCALE: 1:2000000	DRAWN BY: K.G.F. / L.H.B. GEOLOGIST: K.M.T.
DWG. No. PROJECT No 701	

FIGURE 1

2.0 TENURE AND ACCESS

The relinquished area of 34km² is part of a total area of 58 km² granted to Noranda Pty Ltd, with 49.1 km² granted originally in August 1988 and 8.9 km² granted subsequently.

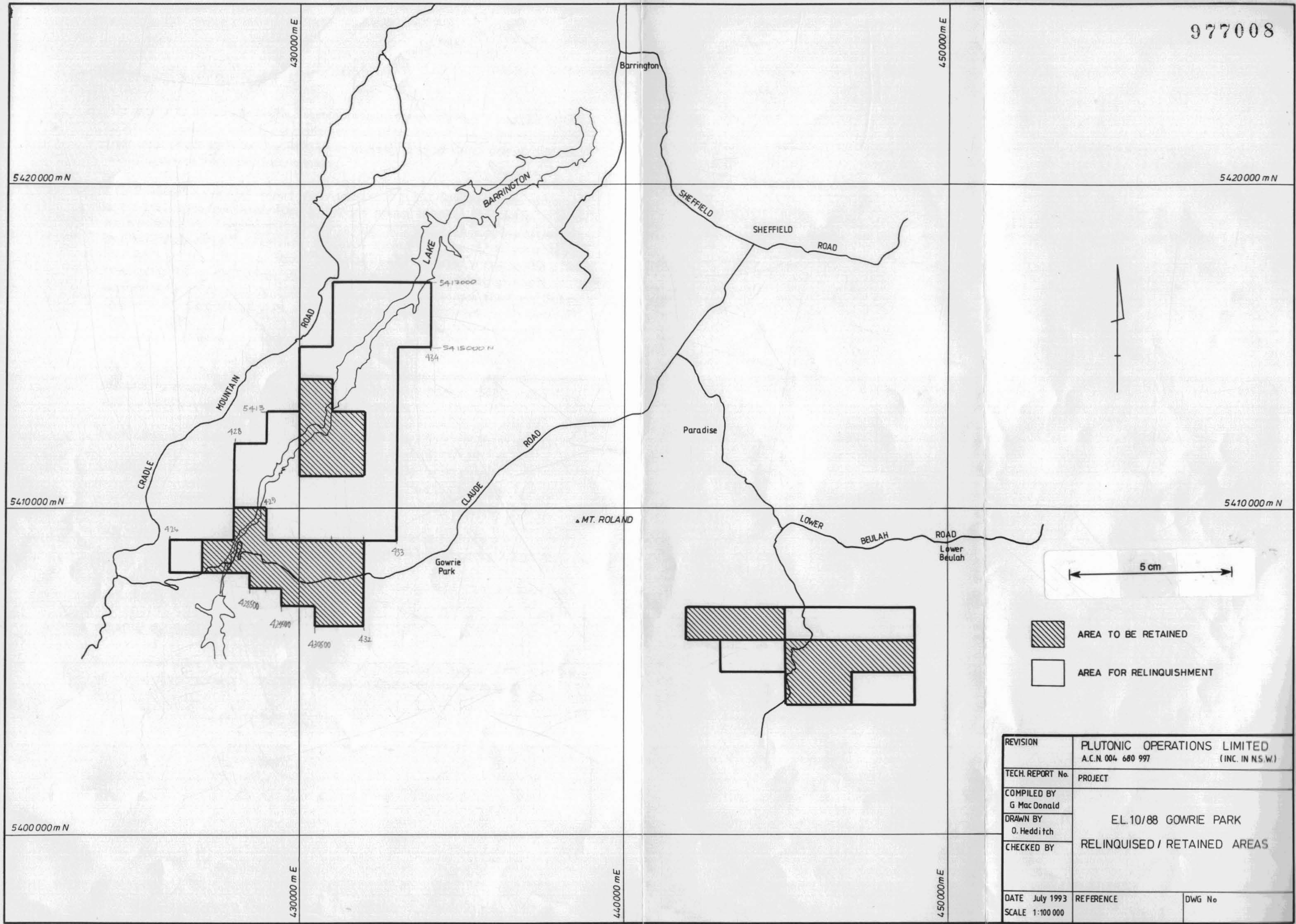
Plutonic Operations Limited became the operator in March 1992 with Noranda Pty Ltd retaining 10% NPI. This relinquishment is the compulsory relinquishment of half of the original area.

The EL has been in two parts, however, the relinquished area is in five discrete parts (see Figure 2).

Access to the relinquished areas is generally good with roads, of varying standard accessing most parts, the exception being the south-eastern corner of the Gog Range. However, access to drill sites has been problematic with most of the relinquished ground in areas of steep topography.

Most of the ground to be relinquished is in State Forest, with the fringes often in private land. Much of the Lake Barrington Prospect is in private land.

977008


430000 m E
450000 m E
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5420 000 m N
5410 000 m N
5400 000 m N
Barrington
LAKE BARRINGTON
SHEFFIELD
SHEFFIELD ROAD
CRADLE MOUNTAIN ROAD
CLAUDE ROAD
MT. ROLAND
Paradise
LOWER BEULAH ROAD
Lower Beulah
Gowrie Park
5 cm
AREA TO BE RETAINED
AREA FOR RELINQUISHMENT
REVISION
PLUTONIC OPERATIONS LIMITED
A.C.N. 004 680 997 (INC. IN N.S.W.)
TECH. REPORT No.
PROJECT
COMPILED BY G Mac Donald
DRAWN BY O. Hedditch
CHECKED BY
E.L. 10/88 GOWRIE PARK
RELINQUISED / RETAINED AREAS
DATE July 1993
SCALE 1:100 000
REFERENCE
DWG No

3.0 EXPLORATION HISTORY

The ground to be relinquished had seen little exploration prior to the granting of 7/73 to Asarco. Asarco's initial programme was one of regional stream sediment sampling (two samples per km²) and reconnaissance mapping. Essentially all current prospects were discovered from this stream sampling.

CRAE entered into a joint venture with Asarco in 1976 and initiated ground surveys to assess the targets generated through Asarco's stream sampling programme. These surveys included gridding, geological mapping, soil and rock chip sampling and geophysical surveying (gradient array IP, dipole-dipole IP, magnetics, self potential and VLF-EM) on the Lake Barrington, Promised Land, Staverton, Cethana (East and West), Gog Range and Cethana Picnic Ground Prospects. Encouraging results led to detailed work to be conducted on the Lake Barrington, Cethana (East and West), Staverton and Gog Range grids. These surveys included detailed dipole-dipole IP, Genie EM, PEM, UTEM and helicopter borne EM (Dighem), results of which led to the drilling of 17 holes; 14 diamond and three percussion.

Four diamond holes were drilled on the Lake Barrington Prospect and encountered encouraging pyritic copper mineralisation with some gold and silver credits within felsic volcanics and volcaniclastics. Best results are as follows:

431780 E
5415680 N

DD80LB1	179.4-179.5	=	0.10m @ 14% Cu, 0.75% Pb, 0.59% Zn 84 g/t Ag, 1.35 g/t Au.
DD82LB3	140.8-149.98	=	0.18m @ 9.1% Cu, 52 g/t Ag
	156.5-172.45	=	15.85m @ 1.2% Cu, 12 g/t Ag
	207.85-209.00	=	1.15m @ 1.6% Cu, 18 g/t Ag
DD83LB4	48.0-49.0	=	1.00m @ 1.9% Cu, 5 g/t Ag
	225.8-226.3	=	0.50m @ 4.8% Cu, 36 g/t Ag, 3.2 g/t Au

A mise-a-la-masse anomaly and nearly coincident IP and strong Cu soil anomaly were not tested by any of these holes.

CRAE relinquished their EL in early 1988.

In the period since the granting of EL 10/88 to Noranda, in August 1988, and the transferral of operatorship to Plutonic, Noranda completed the following work:

i) Mapped the Lake Barrington rowing course road. This mapping is shown along with interpreted geology for the rest of the Lake Barrington part of EL 10/88 in Figure 3 with the part of the report relevant to the relinquished area in Appendix A.

Petrological descriptions of three samples from this mapping are included in Appendix B with locations shown on Figure 3.

ii) Mapped the Gog Range grid (see Figures 5, 6 and 4). Petrological descriptions of samples from the relinquished area are in Appendix B with locations in Figure 13. A soil and rock chip sampling survey was also carried out over the Gog Range grid with some lines extending into the relinquished area (see Figures 7 to 14).

Stream sediment sampling results from the relinquished parts of the Gog Range are also shown in Figure 4.

iii) Compiled a summary of CRAE geophysical data. Parts of the report relevant to the relinquished area are in Appendix C.

iv) Contracted an airborne magnetics and radiometrics survey (nominal flight line spacing 150m). The data tape was lodged with the Tasmanian Mines Department, for interpretation (see (v) below).

v) Contracted Dr D Leaman to interpret the regional gravity and above magnetics with three reports prepared. These are enclosed as Appendices D, E and F.

4.0 EXPLORATION FOR THE 12 MONTHS ENDING 22 AUGUST 1993

Since Plutonic became operators of EL 10/88 in March 1992 the Lake Barrington part of the EL at has been mapped at 1:10000 scale with some rock chip samples assayed. This map with rock chip assay results is in Figure 15. The old CRAE grid at the Lake Barrington Prospect has been re-established and the prospect mapped at 1:1000 scale (see Figure 16).

It was decided to test the coincident mise-a-la-masse and IP anomaly at the Lake Barrington Prospect, by extending the old CRAE hole DD80LB1 by 75m. Due to the presence of sulphides at this depth the hole was extended 100.30m to a final depth of 287.80m. The log for all of DD80LB1 is included as Appendix G and a drill section as Figure 17.

Best intersections are as follows:

222.0m to 223.30m	1.3m @	1.32% Cu, 0.21% Pb, 1.02% Zn in a pyrite-chalcopyrite-galena-sphalerite vein at 15 degrees to the core axis.
239.0m to 240.0m	1.0m @	0.36% Cu, 0.57% Pb, 0.85% Zn in a pyrite-chalcopyrite-galena-sphalerite vein.
242.9m to 246.1m	3.2m @	1.17 % Cu, 1.04% Pb, 0.70% Zn in a carbonate vein with pyrite-chalcopyrite-galena-sphalerite veins.
246.1m to 247.9m	2.8m @	1.41% Cu, 0.12% Pb, 0.61% Zn as sulphide infilling of brittly brecciated black siltstone.

It is considered that the sulphide veins are the reason for the IP and mise-a-la-masse anomalies. The sulphide mineralisation is in veins and is not associated with any significant alteration other than carbonate. The sulphides in the black siltstone are in post lithification brittle fractures. Similar sulphide veins occur to the north of the EL where they have proven to be uneconomic.

A Crone pulse DHEM Survey was carried out on the extended DDH (see Figures 18 to 26).

The survey gave no EM responses due to conductive sulphides other than repeating the response at 100m which was revealed in a previous UTEM survey. This response, by a steeply west dipping body below the hole is only seen on channel one and is not considered to be worthy of follow-up.

APPENDIX A

Detailed Mapping Lake Barrington Rowing Course Road

Wally Herrmann

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Notes on the Geology of the Cethana and Staverton Areas

E.L. 10/88 N.W. Tasmania

for: NORANDA

by: W. Herrmann, R.S.D. 1066, Devonport...7310

date: January 1989

TABLE OF CONTENTS

1. INTRODUCTION

This report is intended as explanatory notes to cover a short roadside outcrop mapping and preliminary drill core re interpretation program on E.L. 10/88 carried out under contract arrangements to NORANDA during November 1988.

The aims of the program were to produce a preliminary geological map and to assess the style and significance of previously known minor base metal sulphide occurrences and extensive zones sericitic alteration in felsic volcanics.

Approximately 8 days mapping in the Cethana and Staverton areas and 2 days core logging of diamond drill holes CC1, CC2, CC3 at Cambridge (Tasmania) was carried out.

2. SUMMARY AND CONCLUSIONS

A preliminary geological mapping program in Noranda's E.L. 10/88, N.W. Tasmania has indicated that basement rocks in the Cethana area comprise an assemblage of proximal felsic extrusives, intrusives and pyroclastics with subordinate volcanolithic epiclastics and fine grained tuffaceous siltstones. These appear to be in thrust faulted contact with a folded sequence of siliciclastic conglomerate and quartz arenites correlated with the Late Cambrian - Ordovician Denison Group.

Strong sericitic alteration associated with intense cleavage development and minor disseminated pyrite mineralization is of district scale extent and appears to be partly structurally controlled occurring in broad belts and narrow shears essentially parallel to the faulted Denison Group /volcanic contact and partly lithologically controlled tending to be associated with felsic pumiceous tuffs.

A brief examination of core from three CRAE drill holes (CC1, CC2, CC3) suggested that low grade base metal sulphide mineralization is associated with quartz + carbonate ± chlorite veins/veinlets which generally appear to postdate the formation of tectonic cleavage.

Mapping of the Lake Barrington Rowing Course Road indicates that the basement rocks there are of a rather different suite comprising andesitic extrusives and pyroclastics, felsic pumiceous tuffs and coarse to fine grained epiclastic wackes of mixed andesitic + felsic volcanic provenance.

Although generally rather weathered this group does not appear to be associated with significant sericitic alteration but the presence of andesitic volcanics may suggest an analogy with the VMS bearing environment of the Que River-Hellyer Volcanics.

Similarly sericitic and pyritic schists occur in narrow bands or shear zones of a few metres width within the otherwise massive feldspar porphyry (Єqfbp) opposite Bellana Picnic Area (400m SW of Forth River Bridge below Cethana Dam). The impression here is that cleavage development, sericitization and pyrite mineralization are shear related (Compare Specimens C1, C2). Elsewhere in the Cethana and Olivers Road areas cleavage development etc appears to be more or less stratabound but due to the masking effect of sericitization and foliation on rocks of essentially similar chemical composition the mapped boundaries of extrusive (Єqr) and pyroclastic (Єxt) units are rather conjectural.

The section exposed along the Rowing Course Road north of Staverton is of rather different character. The rocks exposed here comprise a mixed volcanic-epiclastic assemblage including porphyritic andesites and associated pyroclastics, a thick unit of pumiceous quartz phyric felsic tuff/ignimbrite with associated mass flow type medium grained lithic wackes of mixed felsic-intermediate volcanic parentage and minor intercalations of mixed micaceous/volcaniclastic greywacke and siltstone. The sequence appears to be tightly and complexly folded. Several *sedimentary facing determinations* indicate a younging generally northwards. I have a not very well founded impression that the andesites are basal and are overlain by the mixed epiclastic/sedimentary/felsic pyroclastic sequence.

Cleavage trends here are also semi vertical and have North to North Westerly trends. Some of the rocks, notably the andesites and mass flow lithic wackes, are essentially massive and unaffected by cleavage development whilst in the finer sediments cleavage is weakly to moderately developed.
Although extensively and deeply weathered, none of the exposures in this section seem to be notably (hydrothermally) altered.

APPENDIX 6.1

Description of Lithotypes

Ꞓqfbp Feldspar Porphyry

In the freshest exposures (eg: C1,C8) this rock type consists of coarse tabular phenocrysts of whitish grey plagioclase (1-4mm, 25%), randomly oriented prisms of (chloritized) ferromagnesian (1-3mm, 10%), occaisional small rounded phenocrysts of grey quartz and accessory specks of magnetite contained in a pale rosy pink matrix of granular k-feldspar and quartz in the proportion about 2:1.
The rock is moderately magnetic.
The composition and fabric is uniform and massive without notable grain size variation or layering.
Compositionally and texturally this rock tends toward a porphyritic microgranodiorite and is interpreted to be of felsic intrusive origin.

The feldspars generally appear to be quite fresh except in localized zones of strong cleavage development (west of the Forth Bridge below Cethana Dam) in which the phenocryst and matrix feldspars are altered to pale greenish grey sericite.

Ꞓqr Quartz Porphyritic Rhyolite

In the freshest exposures (eg: C7, C11, C34) this rock type is composed of large equant subangular to subrounded phenocrysts of translucent pale grey quartz (2-5mm, 10%), smaller tabular phenocrysts of pinkish to greenish white plagioclase (1-2mm, 5-10%) and small prisms of chloritized ferromagnesians (hornblende?) ($<$ 2mm, $<$ 2%) evenly distributed in a uniform, pale pinkish grey, very finely granular to aphanitic glassy-feldspathic? matrix.

Rarely (eg: C15) the matrix displays a fine-glassy planar fabric resembling flow banding.
On this basis, this lithotype is interpreted to be of rhyolitic extrusive origin although the more massive types could be high level subvolcanic intrusives.

Єxt Quartz Phyric Rhyolitic Tuffs/Ignimbrite

In fresh exposures (eg: C48) this lithotype consists of small crystals of quartz and plagioclase (generally $<$3mm size and 5-10% volume) contained in a pale greenish grey fine grained-glassy siliceous matrix usually displaying a wavy eutaxitic planar fabric. In places small wispy volcanic glassy and collapsed pumiceous fragments are a minor component.

This lithotype, however, seems very susceptible (in the areas mapped) to deformation related (?) sericitic alteration.

Consequently, in most exposures, the only primary features still recognizable are the quartz grains scattered about in a white to buff coloured finely schistose matrix of sericite, sometimes dusted with pyrite. (eg: C13, C18 etc.)

Because of the general compositional similarity to the quartz porphyritic rhyolitic extrusives (Єqr) it is difficult, in the field, to confidently identify the precursor lithotype for these quartz phyric quartz-sericite "schists".

Єvt Felsic Vitric Tufs

Rocks of this category occur in several thin units amidst the (schistose) quartz phyric tuffs in the Cethana area. These are essentially aphyric fine grained quartz + sericite schists generally without recognizable clastic stratification. They are interpreted to represent fine grained felsic vitric tuffs.

Ɇts Fine Grained Tuffaceous Siltstones

These are fine grained well stratified clastic rocks of essentially felsic volcanic provenance probably largely composed of fine siliceous vitric ash. They vary from pale to dark grey in colour (eg: C22) to banded grey-buff colour (eg: C49) and commonly have a rather cherty appearance although a fine silty clastic texture can usually be distinguished.

They generally occur as thin units of a few to a few tens of metres thickness interbedded with felsic pyroclastics in the Cethana area and with intermediate volcaniclastic wackes in the cuttings of the Lake Barrington Rowing Course Road.

Ɇsg Turbiditic Micaceous-Feldspathic Wackes/Silstones

Rocks of this category occur along the Rowing Course Road in association with coarser mass flow type lithic wackes and finer vitric? tuffaceous siltstones. They are generally well stratified or laminated or turbiditic varying from fine grained siltstone (~ 0.02mm) to fine sandstone (0.1mm) grain size and commonly exhibit grain size grading.
The composition appears to consist largely of volcaniclastic feldspar and quartz but the common (although minor) occurrence of detrital? mica as small pearly flakes lying flat on the bedding plane suggests some clastic input from a PreCambrian metasedimentary provenance.

€es Volcaniclastic Lithic Wackes

These are prominent along the Lake Barrington Rowing Course Road. They mostly massive and unstratified, poorly to moderately sorted in the medium to coarse arenite grain size range (0.5-2.0mm). The composition is dominated by immature subangular grains of feldspar, chloritized ferromagnesians, small volcanic lithics and minor quartz.
The lithic fragments are mostly of similar arenaceous grain size but occaisional well rounded clasts to about 40mm occur. These are mostly of pale grey to pinkish grey fine grained felsic volcanic or tuff.
The abundance of feldspar and (lesser) ferromagnesians combined with paucity of quartz grains suggests an at least partly "andesitic" intermediate volcanic origin. These rocks are interpreted to represent thick epiclastic mass flow units.

€pa Porphyritic Andesite

These are prominent along the Rowing Course Road and although most exposures are extremely weathered the distinctive feldspar phyric relict fabric is usually distinguishable.

The fresh rocks consists of tabular prismatic phenocrysts of pale greensih grey plagioclase (2-4mm, ~20% volume) and elongate prisms of ferromagnesian (hornblende?) 1-4mm, 10% volume) evenly scattered about in a very fine grained medium greenish grey matrix consisting partly of a fine meshwork of plagioclase laths ($<$0.05mm). Small grains of magnetite are present as a minor accessory and the fresh rocks are weakly magnetic.
These rocks are massive in outcrops; in some specimens (eg: C54) the elongate ferromagnesians display a weak preferred orientation suggesting an igneous flow fabric.

I consider them to represent thick andesitic extrusive flows although intrusive members may also be present.

Єat Andesitic Lithic Tuff and Breccia

These are of variable grain size with fragments from a few millimetres to a few centimetres in size.
They consist essentially of angular clasts of fine grained sometimes rather glassy, porphyritic andesite as well as small crystal fragments of feldspar and ferromagnesians constituting about 50% of the rock volume supported in a fine granular or glassy pale grey (silicified?) to purplish grey matrix. They are generally weakly magnetic.
These are interpreted to be fine pyroclastics and volcanic breccias clearly compositionally related to the porphyritic andesites.

APPENDIX B

Petrographic Studies -

Lake Barrington Rowing Course Road and Gog Range

Dr A Crawford

SAMPLE No. E225090

SUMMARY:

This rock is a somewhat silicified vitric crystal tuff composed of angular fragments of quartz and devitrified vitric tuff or rhyolite in a fine-grained devitrified matrix. The absence of feldspar phenocrysts is notable.

HAND SPECIMEN:

This is an altered (silicified?) and fractured pinkish quartz-phyric felsic lava or tuff.

THIN SECTION:

This sample is a silicified and veined vitric crystal tuff. Framework grains include angular crystal fragments of quartz phenocrysts and more abundant subrounded to angular grains of devitrified glassy rhyolite or rhyolitic vitric tuff. The latter are up to 5mm long and are composed of a chequered mosaic of granular quartz and albite with minor sericite, in which occasional small albitized plagioclase phenocrysts are set. The matrix between the quartz and vitric tuff fragments is extremely fine-grained and has probably formed from devitrified glass. The rock is extensively transected by veinlets of secondary quartz, often ribbon quartz, and even narrower veinlets of sericite. This sample is unusual in the absence of blocky feldspar phenocrysts which are so common in most of the rocks described above.

SAMPLE No. E225091

SUMMARY:

This sample is a crystal lithic tuff dominated by angular quartz crystal fragments and subordinate lithic fragments of vitric crystal tuff or devitrified glassy rhyolite.

HAND SPECIMEN:

This is a medium grey chlorite-rich felsic crystal lithic tuff or lava breccia with a suggestion of quite large angular fragments up to 1cm across, but better defined smaller (<2mm) lithic clasts of chert or formerly glassy felsic lava/tuff.

THIN SECTION:

The coarser fragments hinted at in hand specimen are certainly not discernible in thin section in this rock; in fact, very few smaller lithic clasts easily seen in hand specimen are obvious in thin section. The rock is composed of about 30 modal% of angular fragments of volcanic quartz set in a matrix composed of a heterogeneous intergrowth of quartz, albite chlorite and sericite. Occasional large feldspar crystal fragments are totally sericitized. The presence of lithic fragments is only defined by slight variation in the amount of chlorite, and subtle textural differences from the matrix of the rock. All lithic fragments were felsic tuff or rhyolite.

A remarkable feature of this rock is the large number of large euhedral zircons, which almost qualify as microphenocrysts.

SAMPLE No. E225157

SUMMARY:

This sample is a very distinctive epiclastic sandstone, almost matrix-free, composed of detrital lithic fragments of devitrified vitric tuffs, quartz crystal fragments and abundant FeTi oxide grains which occur as layers probably representing heavy mineral swash bands.

HAND SPECIMEN:

This is a coarse gritty sandstone with detrital grains of quartz and red ferric stained detrital grains of ?.

THIN SECTION:

This sample in thin section is an epiclastic sandstone characterized by a remarkable abundance of detrital FeTi oxide grains. Most FeTi oxide grains are subrounded and around 0.2-0.8mm across, and when cut thinly enough, they show well-developed skeletal alteration involving exsolution of ilmenite and replacement of remaining magnetite by chlorite. These Fe Ti oxide grains constitute at least 20 modal% of the rock and occur in discrete layers. Other detrital grains, usually less than 1mm long, include angular volcanic quartz crystal fragments and polycrystalline lithic fragments mainly represented by devitrified vitric felsic tuffs showing variable degrees of recrystallization (ie. variable grainsize) and and sericitization. Plagioclase phenocrysts or crystal fragments are notably rare. A single 8mm long lithic fragment is a strongly sericitized epiclastic siltstone or fine-grained tuff. The matrix component of this rock is almost non-existent, as detrital grains and lithic fragments have been intimately intergrown during pressure solution accompanying burial and diagenesis.

SAMPLE No. E225162

SUMMARY:

This sample is a quartz crystal fragment-rich vitric crystal lithic tuff with abundant sericitized pumice fragments.

HAND SPECIMEN:

This is a grey-green crystal lithic tuff with occasional lithic fragments to 1cm long.

THIN SECTION:

This sample is a crystal vitric tuff containing a large proportion (around 40 modal%) of fragments of volcanic quartz and pumice in subequal proportions. The quartz crystal fragments are up to 0.5mm long and angular to subrounded, and they frequently show internal strain features and limited subgrain recrystallization along across-grain fractures. Former pumice fragments are ragged-edged sericite-rich areas to about 1mm across which show occasional well-preserved typical flattened pumice shapes defining a broad bedding, but are often relatively massive and un-flattened. They are not vesiculated (at least not now, as this structure may have been obliterated during alteration). Some of the more blocky sericite fragments may be totally sericitized plagioclase phenocrysts, although if this is the case, it is unusual that the phenocrysts have not maintained their former outlines. The several large dark green lithic fragments in the handspecimen are not obvious in the thin section, and have not been sampled in the section.

The matrix of this sample is a very fine-grained intergrowth of quartz, albite and sericite after a former dominant vitric ash component.

SAMPLE No. E225163

SUMMARY:

This is a well-preserved quartz+plagioclase+FeTi oxide +biotite-phyric rhyolitic lava with a devitrified vitrophyric groundmass.

HAND SPECIMEN:

This is a brown, slightly weathered but well-preserved quartz+feldspar-phyric rhyolitic lava

THIN SECTION:

This sample is a quartz+feldspar-phyric rhyolitic lava dominated by 5-10 modal% of large phenocrysts of quartz to 5mm long. These are slightly rounded euhedra often with chloritized melt inclusions. Plagioclase phenocrysts are slightly less abundant than the quartz phenocrysts and are blocky, slightly rounded euhedra to 2mm across which are always partially altered to very fine-grained sericite. They sometimes occur in multi-crystal clusters. A few totally altered microphenocrysts now composed of chlorite and concentrations of sphene crystals were almost certainly large FeTi oxide phenocrysts. A few small microphenocrysts composed of green chlorite may have been former biotite flakes.

The groundmass of this lava is vitrophyric and very uniform. It is composed of tiny albitized plagioclase microlites in a fine-grained quartz-albite-chlorite and minor sericite matrix which has formed from devitrification of rhyolitic glass. Occasional slightly coarser-grained pools of secondary quartz are also growing from the devitrified glass.

SAMPLE No. E225167

SUMMARY:

This sample is a well-preserved quartz+plagioclase +FeTi oxide +biotite-phyric rhyolite lava which has suffered strong hematite/limonite alteration of the groundmass, but is otherwise very similar to sample 225166.

HAND SPECIMEN:

This is a weathered, pale pink-orange, porous quartz+ feldspar-phyric rhyolitic lava with a highly altered sericitic(?) groundmass.

THIN SECTION:

This sample is a quartz+plagioclase+FeTi oxide + biotite-phyric rhyolite in which the quartz phenocrysts are notably rounded and reacted compared with many of the other sample of rhyolite examined for this study. In this respect, and also with respect to the relatively sparse large plagioclase phenocrysts, this sample is reminiscent of 225166. .Plagioclase phenocrysts are slightly rounded blocky euhedra which are totally altered. Biotite phenocrysts are rare and chloritized, and FeTi oxide phenocrysts, also rare, are replaced by sphene and chlorite.

The devitrified glassy to vitrophyric groundmass of this sample is most distinctive in that it has been stained bright brick red. The main locus of the pervasive Fe-staining is relatively fine-grained sericite scattered evenly throughout the groundmass. This is probably a weathering feature.

phenocrysts, whereas those with essentially pristine quartz phenocrysts have well-preserved vitrophyric or mildly devitrified-recrystallized groundmasses (eg. 225163).

SAMPLE No. E225168

SUMMARY:

This sample is a quartz-phyric rhyolitic lava with a thoroughly recrystallized, very slightly foliated formerly glassy groundmass. It lacks the plagioclase phenocrysts present in the previous 4 rhyolitic lavas, and almost certainly is from a different unit.

HAND SPECIMEN:

This is a light green-brown sparsely quartz+feldspar-phyric rhyolitic lava.

THIN SECTION:

This is a quartz-phyric rhyolitic lava with quartz phenocrysts to 3mm across which show fairly extensive rounding and reaction with the groundmass, and the development of narrow rims of incipient breakdown and resorption into the groundmass. Only two very small, totally sericitized plagioclase phenocrysts were noted, and in this respect, this sample contrasts strongly with the four preceding rhyolites. Many of the quartz phenocrysts show granulation and subgrain recrystallization along fracture planes.

The groundmass of this sample is relatively coarse-grained (compared to the preceding 4 rhyolites) and extensively sericitized, with sericite defining a weak foliation as it wraps around quartz and albite grains which have grown from the formerly vitric groundmass.

The degree of recrystallization (coarseness) of the groundmass in these 5 rhyolite samples seems to reflect the extent to which the formerly vitrophyric to glassy groundmasses were strained during devitrification and recrystallization. Those lavas with the coarsest groundmass now (this sample) have the most deformed quartz

SAMPLE: 225221

SUMMARY:

This is a former feldspar-phyric dacitic lava or shallow intrusive that has been thoroughly carbonated. The alteration assemblage, dominated by calcite and chlorite, is unlike the sericite-dominated assemblages seen in the majority of samples described above.

HAND SPECIMEN:

On a freshly-cut surface, this sample is a dark grey fairly fine-grained felsic or intermediate volcanic with apparently no phenocrysts; it is massive and not foliated.

THIN SECTION DESCRIPTION:

This sample is seen in thin section to have been a sparsely feldspar-phyric probably dacitic lava, with a few modal percent of totally pseudomorphed plagioclase phenocrysts in a fine grained groundmass that has been almost totally carbonated. The feldspar crystals are small, mainly less than 1mm long, and they have been albitized, and then largely replaced by fine sericite and abundant calcite. The original groundmass texture of this sample has been obliterated by pervasive calcite-chlorite alteration, but small furry-edged opaque grains are abundant in the groundmass and probably represent altered primary FeTi oxides. Calcite and pale green chlorite are intimately intergrown, and pervade more than 95 modal% of the groundmass.

This sample was almost certainly a daitic lava or shallow intrusive. The style of alteration in this sample, dominated by calcite and chlorite, contrasts strongly with the style noted in most of the other samples described above (sericite-quartz), despite the fact that primary compositions of the dacites and rhyolites described herein probably showed little significant variation. This means that the alteration system responsible for the alteration of this sample was quite unlike that which produced most of the other sericitic (and commonly foliated) samples described above.

SAMPLE: 225222

SUMMARY:

This is a formerly quartz+feldspar-phyric glassy rhyolitic lava or crystal tuff that has suffered fairly extensive calcite alteration, although it lacks the chlorite that occurs intergrown with calcite in the previously described sample (225113).

HAND SPECIMEN:

On a freshly-cut surface, this sample is a dark grey-green mottled felsic lava or tuff with sparse small quartz phenocrysts and some angular patches of calcite filling fractures in the rock.

THIN SECTION DESCRIPTION:

This sample is made up of around 3-5 modal% of generally quite rounded and resorbed small quartz crystal fragments, mostly less than 0.5mm across. Similar sized feldspar phenocrysts are albite replaced by caclite and minor sericite in most cases. A small percentage of altered former FeTi oxide phenocrysts, now composed of leucoxene and chlorite, are scattered through the rock.

The groundmass of this sample, as for many of those described above, is a fine-grained quartz-albite-sericite intergrowth almost certainly replacing an originally glassy matrix. Unlike many of the samples described above, however, calcite is a fairly abundant phase replacing groundmass and parts of feldspar phenocrysts.

This sample was either a crystal tuff or a rhyolitic lava with a glassy groundmass; on the basis of the textural evidence left after alteration of this sample I can't make any more definitive assignment of this rock.

SAMPLE: 225223

SUMMARY:

This is an epiclastic sandstone derived from a mixed andesitic-felsic lava pile; it contains detrital igneous hornblende and augite, and may be a useful marker horizon.

HAND SPECIMEN:

On a freshly-cut surface, this sample is a dark grey green epiclastic sediment or lithic crystal tuff with a maximum grainsize of around 2mm.

THIN SECTION DESCRIPTION:

This sample shows a clear clastic sedimentary texture, being composed of about 75 modal% framework grains, and the remainder a strongly chloritized matrix. Framework grains include about 25 modal% fractured volcanic quartz crystals, about 40-45 modal% totally sericitized slightly rounded former feldspar euhedra (to about 1.5mm across), and the remainder being partially altered primary igneous hornblende and leucoxenized FeTi oxide phenocrysts. The hornblende grains are small irregular crystal fragments, and show characteristic pale green to deeper olive green pleochroism. Several small crystal fragments of fresh augite were also noted, but the rock appears to contain no lithic fragments..

The matrix of this sample is very fine-grained and largely overprinted by pale green chlorite. The source area of this epiclastic sandstone was probably a mixed andesite-dacite-rhyolite lava pile. The presence of hornblende in the sample is interesting, as the only rocks from this northern section of the Mount Read Volcanics known to carry fresh hornblende is the Bond Range Porphyry. This epiclastic sandstone should be a good marker horizon in the sequence from which it was taken, as it is the first detrital hornblende-bearing sample I have seen from this part of the Mount Read Volcanics, after examining several hundred thin sections.

APPENDIX C

Geophysical Summary of CRAE Data

P Zarzavatjian

CONTENTS

INTRODUCTION

This report is an appraisal of past geophysical surveys conducted over certain areas within two exploration licences relinquished recently by CRA Exploration Proprietary Limited. The areas discussed in this report are included at present within EL 10/88 owned by Noranda Proprietary Limited.

My appraisal is based on CRAE reports and plans forwarded to me by Phil Jones & Associates, Saddle Road, Kettering, Tasmania.

In my appraisal I have followed chronologically the various stages of exploration activity in each area. This approach involved the review of several reports in cases where work in an area continued for periods longer than that covered by a single report. In such instances, the need frequently arose in the text of my report to refer to various CRAE reports for one reason or another. In order to facilitate reference to these reports in my text, I have assigned reference numbers to CRAE's reports. These numbers appear in red at the top right hand corner of the cover page. Instead of referring to the lengthy title of CRAE's report which might become cumbersome through repetition, I have instead quoted the reference number. For the sake of the record, I have listed below CRAE's reports and their corresponding reference numbers.

Report	Reference No:
EL's 7/73 and 10/76 Exploration at Western Cethana - August 1976-1977	5
Exploration at East Cethana EL 10/76 Sept.1977 - Sept.1979	1

Report	Reference No:
Exploration at Western Cethana Report No.2 Aug.1977 - Nov.1979 - EL's 7/73 and 10/76	6
Exploration of Cethana EL 10/76 - 1981-1982	2
EL 10/76 Cethana Area - Report on Exploration for 12 months to 28 Feb.1985	3
EL 10/76 Cethana - Report on Exploration for 12 months to Feb.1987	7
EL 10/76 Cethana - Relinquishment Report Incorporating Exploration for period Feb.1987 to Feb.1988	4
Exploration at Lake Barrington Copper Prospect Sheffield EL 7/73:- July 1979 - March 1981	8
Exploration at Lake Barrington Copper Prospect Sheffield EL 7/73:- May 1981 - Dec.1982	9
Exploration at Lake Barrington Copper Prospect Sheffield EL 7/73 for period ending Dec.1983	10
Initial Exploration on Staverton Prospect EL 7/73 - 18 Feb.1978	11

Report	Reference No.
EL 7/73, Sheffield - Report on Exploration during 1982	12
Memorandum: Electromagnetic Surveys on Beulah Baryte and Staverton Prospects, Sheffield EL 7/73	18
Exploration Results, Beulah, Staverton, Gog Range and Ireland Prospects - Sheffield 7/73, Tasmania, Report for the 12 months ending 15 Feb. 1984	13
Sheffield EL 7/73 - Electromagnetic Surveys in Sheffield area EL (7/73) in Tasmania during 1985	17
EL 7/73 Sheffield area - Report on Exploration for 12 months to 15 Feb. 1985	14
EL 7/73 Sheffield Area - Report on Exploration for 12 months to Feb. 1986	15
EL 7/73 Sheffield Area - Report on Exploration for 12 months to Feb. 1987.	16
Dighem II Surveys in Sheffield Area, Tasmania for CRA Exploration Pty Ltd. by Dighem Ltd - 16 July 1981	19
Phase 1 Induced Polarization Surveys - Cethana EL 10/76 1976-1977.	20

205 3. The following areas should be checked to ensure that the recorded chargeability responses can be satisfactorily explained, by cultural features noted in their proximities:-

1. Line 20800E, close to 3200S
2. Line 19800E, near 2970S and 3300S.

4. In the following areas chargeability highs coincide directly with resistivity lows and require detailing because they present good targets to explore for sulphide mineralization.

1. Line 20200E, 3400S-3500S
2. Line 20400E, 3500S
3. Line 21000E, 3700S-3800S

LAKE BARRINGTON COPPER PROSPECT

1. Induced polarization, mise-a-la-masse and self-potential surveys combine to produce a viable target that has not been satisfactorily tested.

2. It would be very useful if the missing 50 metres spread IP pseudo-section for line 4600E can be located. It would then be possible to correlate chargeability values with sulphides intersected at depth in hole DD80LB2.

STAVERTON PROSPECT

1. In the case of drill hole PD83SP1, the influence of steep topography on the choice of the most promising drill intersection within an IP target

208 *PROMISED LAND PROSPECT*

The following areas require further field appraisal:

1. Southern ends of lines 4400E, 4500E and 4600E where a weak VLF-EM trend occurs in the vicinity of high geochemical soil values.

2. Line 4300E at 5025N where a partly recorded VLF-EM anomaly coincides with the peak of a ?200nT magnetic anomaly.

GROUND FOLLOW-UP OF DIGHEM ANOMALIES

It would be prudent to conduct a limited amount of work to confirm the status of several anomalies classified at present under low to very low order of priorities.

GENERAL

a) If future exploration programmes are to include induced polarization surveys, I recommend that the dipole-dipole geometry be employed so that there will be depth information regarding anomaly sources.

b) If future drill targets are to include results of induced polarization surveys, care should be exercised so as not to overlook the effect of steep topography on the zone where the hole is likely to intersect the target at depth.

229

LAKE BARRINGTON COPPER PROSPECT

REPORT 8 (July 1979-March 1981)

During the period covered by this report CRAE completed an induced polarization survey over the established grid and conducted a limited amount of magnetic survey. Both surveys are discussed in Appendix 5 of the report. My comments regarding above work are given below:-

1. *Induced Polarization Survey*

   The interpretation presented in Appendix 5 is satisfactory. The results are shown both as pseudo-sections and as plan contours. The only missing piece of data is the pseudo-section for the 50m spread for line 4600E.

   Apart from the two anomalous zones labelled A and B in the report, I would like to draw attention to another such feature. It is a weak shallow zone recorded over lines 4900E (4850-4900N) and 4800E (4900N) and appears as a lobe-like northerly extension of the definite anomaly A.

   Zone A is the most prominent feature in the survey area. It is clearly defined on most lines and gives the impression of becoming progressively shallower as it extends westward. There is an abrupt major change in the chargeability pattern between lines 4600E and 4500E leading one to suspect the presence of a possible structural discontinuity or lithological change between these two lines.

2. *Magnetic Survey*

   A small magnetic survey was conducted over IP Zone A to determine whether the anomalous IP responses were caused by pyrrhotite or pyrite.

230

Results are included as profiles in the report. As the magnetic picture appears to lack coherent anomalous pattern, it was concluded that the IP responses could not have been caused by pyrrhotite.

I do not believe the magnetic survey provides conclusive evidence because pyrrhotite's magnetic property is variable and ranges from non-magnetic to weakly and sometimes to moderately magnetic.

3. *Drilling*

Two diamond drill holes were completed to investigate the source of IP anomaly A.

i) Hole DD80LB1 (Plan No. TV377) was drilled on line 4700E to a depth of 187.5m. Pyrite appears to be common over large sections of the drill hole. Three anomalous copper intersections are shown in the top 46.7m of the hole in the zone where no IP values are also recorded. High copper, zinc, lead, silver and gold values are also encountered from 179.4m to 181.8m. This interval, which includes a 0.1m section of massive sulphides, occurs approximately 6m from the end of the hole.

I have traced hole LB1 on the IP pseudo-section and marked the high assay intervals in red. It is evident that the hole was stopped just short of the high chargeability zone as defined by the 45msec. chargeability contour. To have tested the IP anomaly properly the hole should have been extended to a depth of about 250m. CRAE notes towards the bottom of Page 5 of the report that hole LB1 "...was stopped prematurely...."

231

Furthermore, my tracing on the pseudo-section does not take into account the topography gradient which averages about 24 degrees on the north side of the valley. Probably its symmetrical outline (see plan TV 377) does not affect the pattern of the chargeability anomaly, but would most likely diminish its magnitude.

ii) Pyrite is pervasive in hole DD80 LB2 on line 4600E (Plan No.TV 377), ranging from 1% to 10% throughout its entire length. In addition, LB2 intersects anomalous copper values at various depths. I have traced LB 2 on the pseudo-section of the 25m dipole spread. It encounters the broad zone of high chargeabilities at some distance away and below the maximum recorded values and appears to extend parallel to them.

It is unfortunate that the pseudo-section for the 50m dipole for line 4600C is not available to correlate the chargeabilities with the sulphides intersected at depth. It would be very useful if this pseudo-section can be located as I believe correlation of the chargeability results with the copper values intersected at the deeper levels of the hole might play a vital role in any future decisions taken about this prospect.

REPORT 9 (May 1981-December 1982) DD82LB3.

Several geophysical surveys and one diamond drill hole were completed during this period. Although positive responses were obtained from some of the surveys, drilling results were rather disappointing. All the geophysical surveys are discussed in Appendix 3 of the Report.

232

1. *Electromagnetic Survey*

The EM survey was conducted by Crone Geophysics (Aust) Pty Ltd using the DEEPEM mode. The survey was of a local nature; only the most promising lines were covered in the near vicinity of IP anomaly A. No anomalies of any consequence were recorded.

On Page 2 of the interpretation memorandum dated 5/8/1981, several reasons are given for the lack of EM anomalies. One of these is the possibility of lack of coupling between the sulphides, if any are present at all, and the magnetic field. If we take into consideration the positions of the loop and the IP anomaly A*, this reason would be valid if the sulphides occur at depths in excess of 350m and have moderate grid-southerly dips.

2. *Mise-a-la-Masse Survey*

Results show a well defined broad anomaly with an oblong central high situated between lines 4700E and 4800E. The coincidence of the mise-a-la-masse anomaly axis with the chargeability values at n5 and n6 is quite evident from the plans and sections included with the report. However, I concur with the note of caution expressed in the interpretation memorandum dated 3/6/1981 that the pattern may simply reflect a lithological effect.

* The assumption made here is that, if there is any electromagnetic anomaly at all, it might possibly coincide with the position of the induced polarization anomaly A.

3. *Self-Potential Survey*

This survey is discussed in a memorandum dated 18/5/1981 and the results are shown as profiles that accompany the memorandum. The small survey covered critical sections of lines 4600E, 4700E and 4800E where positive IP (Anomaly A) and mise-a-la-masse responses were observed.

The results for each line are plotted once separately and again as stacked profiles. The patterns for the latter plot are shown reversed upside-down compared with the individual plots. I have assumed the stacked profiles are the correct presentation because SP anomalies are characterized by negative values.

The profiles show negative values of about 120 mV located over the central high of the mise-a-la-masse anomaly. Although no negative values are recorded on line 4600E the SP profile shows a definite low centred at 4850N which coincides both with the northwest extension of the mise-a-la-masse central high axis and also with the shallowest (n1) chargeability high recorded by the 25m spread.

It is difficult to comment reliably on the merits of the self potential survey because it can be affected by quite a few factors as noted in CRAE's interpretation memorandum. The maximum recorded amplitude of about 120 millivolts is actually classified as a weak anomaly. It has been noted in the literature that 50 millivolts usually indicates about 5% conductive sulphides or possibly less. If this is true, the SP feature discussed here might reflect the presence of 12% conductive sulphides at the most. Furthermore, presence of SP anomalies generally imply

234 sulphides present at depths as shallow as depths to the water table. However, situations contrary to this have been noted in the literature.

The plan on which the stacked SP profiles are shown also displays the positions of the IP anomalies and the mise-a-la masse anomaly. IP anomaly A is shown to occur at the outer edge of the mise-a-la-masse central high axis. This position refers to that part of anomaly A which occurs at shallow depth (n1). However, its position at greater depths (n5 and n6) coincides squarely with the central high axis of the mise-a-la-masse anomaly and with the SP lows.

4. *Drilling Results*

DD82 LB3 was drilled to intersect the centre of the mise-a-la-masse anomaly at a depth of 100m. Apart from several small anomalous copper and silver intersections, no economic massive sulphides were encountered. Mineralization is described as fracture filling within a stringer zone.

The rocks in the area of hole LB3 display more intense alteration associated with mineralization than in holes LB1 and LB2. Alteration in hole LB3 is described as strong to very strong chloritic alteration with considerably more carbonate (calcite-siderite) veining.

I have traced hole LB3 and the high assay values on the IP pseudo-sections for lines 4700E and 4800E (See Report 8). It must be kept in mind that the bottom part of the hole is actually situated between these two lines. It is evident that this hole does not reliably tap the central chargeability high recorded on both lines.

REPORT 10 (December 1982 - December 1983)

235 No geophysics was done during this period. One hole, DD83 LB4 was drilled between lines 4800E and 4900E to a depth of 281m. I have traced this hole onto the IP pseudo-sections of these lines filed with Report 8. The position shown on the pseudo-section is doubtful as I do not have enough information about the topography to place the hole collar at the correct height when I project it onto the adjoining grid lines. It is difficult to comment reliably on the position of hole LB4 at depth in relation to the source of IP anomaly A.

REPORT 17 (Electromagnetic surveys in the Sheffield Area During 1985)

A general description is given on Page 10 in the report of UTEM survey results over the old and the extended grid. Plots of the results are also available. As stated in the report, the only definite responses occur over the extended portions of the grid lines. All the lines from 4500E to 4800E record very weak channel 8 and in one or two cases channel 7 or 6 anomalies in the section from 5600N to 5900N. Their sources appear to be at a shallow depth, ranging between 20 to 30 metres. These anomalies are interpreted in the report to be expressions of the edge of basalt that forms the northern boundary of the grid lines.

There is no other information at hand in the area of the UTEM anomalies that we can use to correlate the UTEM results with.

Reference is also made to downhole EM on one of the holes. No data have been supplied.

REPORT 14 (12 months to 15 February 1985)

Lake Barrington Prospect is discussed on Page 14 of the report. Appendix 4 contains a short discussion on EM downhole logging results for hole DD82 LB3. No data are included.

REPORT 15 (12 months to February 1986)

Lake Barrington Prospect is discussed briefly on Pages 9 & 10. The geophysics part is a repeat of work mentioned earlier in Reports 17 & 14 above.

The discussion concludes by stating that no further work is recommended on this prospect.

PROMISED LAND PROSPECT

REPORT 12 (1982)

This prospect is discussed on Page 7 of the report. Several plans are also included at a scale of 1:5000. They show results of geophysical (VLF-EM, magnetics) and geochemical (copper, lead, zinc, manganese) surveys completed over a small grid. Sample locations and geology is also shown on a separate plan.

The main feature of interest occurs towards the southern end of grid lines 4400E, 4500E and 4600E where a weak VLF zone occurs in the vicinity of high copper, zinc and lead values. It is not clear from the geology plan the type of rocks present in the area of these anomalies. They could be greywackes, conglomerates and grits or siltstones and shales.

A second feature of interest occurs on line 4300E about 5025N where a partly recorded VLF-EM anomaly coincides with the peak of a 200-300 nT magnetic response.

GROUND FOLLOW UP OF DIGHEM II ANOMALIES

In Report 19 the contractors, Dighem Limited, discuss the results of the airborne survey and recommend anomalies favourable for ground follow-up.

Parts of Reports 12 & 2 discuss the outcome of CRAE's ground follow-up surveys of the recommended Dighem anomalies in Cethana EL and Sheffield EL respectively. Other electromagnetic and aeromagnetic anomalies, not recommended by Dighem were also investigated in the ground follow-up. In several instances this work was based on knowledge of the local geology where the anomalies occur.

SHEFFIELD EL 7/73 (Report 12)

I have examined all the Dighem follow-up anomalies discussed on Page 5 to 19 except for the following because plots of the results are either not available or no geophysics was performed.

Section 6.13	EM anomalies 98xG, 100xE, 1000E, 1010M; apparently no geophysics were performed.
Section 6.19	EM anomalies 143xA, 146xB (Garden of Eden). Detailed work conducted over a proper grid discussed elsewhere.
Section 6.22	EM 126xB falls within the Gog Range Grid

Section 6.25 Aeromagnetic anomaly 2600-3695 (Cethana Picnic Area Grid)

No ground geophysics were performed.

Section 6.27 Aeromagnetic anomalies 15-2781, 2100-3643, 29, 1614 (Dalcoath Margin anomalies).

Positions of all the Dighem follow-up anomalies are shown on plans TASh 1119 and TASh 1120.

On the basis of the geophysical results presented, none of the anomalies can be justifiably recommended as a good or even a fair target for future exploration. However, I have noted below several anomalies which might be classified as third or fourth category responses and therefore require a limited amount of field investigation.

In nearly all cases the method employed in the investigation consisted of reconnaissance geophysical (VLF-EM, magnetics) surveys, geochemical soil surveys and brief geological checks. I would like here to point out that the VLM-EM surveys are affected by topography, but to have the results corrected we need to know the variations in the topography. However, in many instances, topographic effects are manifested by slow variations in the VLF-EM profile whereas anomalies caused by mineralization are usually local and steep.

As I noted above, the following low priority anomalies might warrant further field checks:-

Section 6.5 EM anomaly 27xJ

- two lines of magnetics, VLF-EM and geochemistry in an area of fresh quartz porphyries of Bull Creek Volcanics.
- Line A records two weak VLF-EM responses about 100 to 150 metres inside the edge of 400 metres wide anomaly that averages 400nT. Geochemical assays gave negative results.

Section 6.7 EM anomalies 56xF, 59xG, 60xD

- four lines of VLF-EM and magnetics; no geochemistry.
- several weak VLF-EM cross-overs are present as well as magnetic anomalies in the range of 100 to 250nT. Anomalies 56xF and 59xG are located within the Gowrie Park Grid already investigated by CRAE (Pervis, 1978, Report 9160). CRAE concludes that the geophysical responses are caused by conductive lithology.

Section 6.8 EM anomaly 63C

- two lines of VLF-EM and magnetics; no geochemistry.
- area is situated over a river alluvium. The feature of interest is a weak but definite VLF-EM anomaly that coincides with the edge of a 40-60nT local magnetic anomaly.

Section 6.10 EM anomaly 66xC

- three lines of VLF-EM and magnetics.
- weak VLF-EM anomalies coincide with pronounced magnetic responses and correlate with low, boulder covered ridge, presumably reflecting a resistive lithology, e.g. basic dyke.

Section 6.11 EM anomaly 73xA

- three lines of VLF-EM, magnetics and geochemistry.
- magnetic anomalies of 500-600nT give impression of a dyke-like source with weak but definite VLF-EM anomalies at their western edges. Magnetic anomaly source is possibly ?dolerite dyke. Geochemistry results are negative. The geology consists of an inlier of fresh Cambrian shales and tuffs surrounded by Roland Conglomerate.

Section 6.12 EM anomaly 75A

- three lines of VLM-EM, magnetics and geochemistry.
- one line (100W) records a weak VLF-EM anomaly and coincides with the edge of a 200nT magnetic anomaly.

Section 6.17 EM anomalies 119xB, 121xA

- four lines of VLF-EM, magnetics and geochemistry.
- one line was established over anomaly 119xB. A ?partly recorded moderate cross-over coincides with the edge of a magnetic anomaly of about 150nT. This information cannot be taken as significant because

there is only one line to consider. Maximum soil assay results were 110 ppm copper, 32 ppm lead and 147 ppm zinc.

- three lines were surveyed to investigate anomaly 121xA. All lines show moderate to strong VLF-EM cross-overs at the northern edges of pronounced, partly recorded magnetic anomalies of the order of several hundred nanoteslas. Soil samples assayed up to 70 ppm copper, 58 ppm lead and 130 ppm zinc.

Section 6.23 Aeromagnetic anomalies 19-2686, 24-1816, 29-1607.

- profiles for anomaly 29-1607 are not available.
- each of the remaining two anomalies were surveyed with one ground traverse. It was concluded they were caused by Bull Creek porphyries.
- above anomalies were investigated because of their alignment with Bismuth Creek Fault zone which is located outside the EL and has known mineralization. The position of the Fault and/or its projection is neither stated in the discussion in CRAE's report, nor is it shown on the profiles. In general, this type of approach to exploration, whereby single, widely spaced traverses are established to investigate mineralization or structures projected from a distance is neither logical nor practical so far as serious exploration is concerned.

CETHANA EL 10/76 (Report 2)

Four Dighem anomalies were followed up on the ground. They are discussed on Pages 2 to 5 of the report. Plots of all the results are also included with the report. Two of these follow-up anomalies are interesting enough to warrant brief comments.

Anomaly 3900xH

A three line grid was established to investigate a weak Dighem anomaly situated half-way between Round Hill and Round Hill Extended silver-lead workings. Grab samples in and around adits from Moina Sandstone gave high lead, zinc, copper, silver and gold assays.

Weak to moderate VLF-EM anomalies are recorded on all lines. On line 5500E, the VLF-EM response coincides with a 10nT change in the level of magnetic background values, the latter being the only meaningful magnetic response in otherwise featureless survey results.

CRAE's report notes that the possibility of a "blind" orebody within the Moina Sandstone is high and that a structural interpretation followed by ground EM survey is the best way to approach the problem. To the best of my knowledge no such programme was undertaken.

Anomaly 36xH

This weak anomaly is located on the western end of Cethana East Grid. This area has been the subject of IP and UTEM survey coverages as I discussed earlier under the section on Cethana East Grid.

APPENDIX D

Regional Interpretation - Gravity and Magnetic Data

Dr D Leaman

977061

LEAMAN GEOPHYSICS
Survey Review, Specification, Reduction, Interpretation
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Registered Office:
21. Zomay Avenue, DYNNYRNE, TAS. 7005
All Correspondence to:
G.P.O. BOX 320 D, HOBART, TAS. 7001
TELEPHONE: (002) 240319

TCR 91-3231A

REGIONAL INTERPRETATION
GRAVITY AND MAGNETIC DATA

EL 10/88 GOWRIE PARK

for
NORANDA PTY LTD

by
Dr. D.E. Leaman

September 1989

GOWRIEPK

SUMMARY

Although the quality and coverage of available gravity and magnetic data in the vicinity of EL 10/88 (Lake Barrington and Gog Range) is variable this review leaves little doubt that the data sets and methods can resolve many issues related to the prospectivity or structure of the area.

Both data sets imply, but cannot fully resolve, high contrast mafic units north of the Staverton Prospect. Thusts involving ultramafics are indicated and some complex repetition of the sequence should be anticipated.
It can be shown that the large Devonian Dolcoath Granite is terminated near Cethana and that the effects of its emplacement control or fracture system barely extend into the EL but would account for at least some of the schistose alteration extending NW from Cethana. The granite is enclosed by a thermal alteration halo about 800 m wide and it is likely that most Devonian mineralisation or overprinting occurs in or near this range from the granite contact.
It is suggested, therefore, that mineralisation north of the Cethana shear zone, including Staverton, is Cambrian in origin.
Extant data do not permit evaluation of rock formation/property alteration, possible mineralisation responses or detailed structure and boundary mapping.

Both data sets suggest the presence of at least two small granitoids of variable composition in the Beulah, Gog Range region. Implied properties and scale are consistent with Cambrian intrusives. Both methods can be used to map them although it is possible that part of the magnetic responses are compound and may involve some alteration effects. The intrusives appear to be aligned N-S. Known gold mineralisation in the area, at Star of the West and near the Gog Range Fire towrer, correlates closely with the crudely interpreted granitoid forms. The large faults on the south side of the range have a displacement of at least 1000-1700 m.

It is recommended that the data coverage be improved and that refined analysis be attempted in light of encouraging results with current information.
The Lake Barrington area should be reflown magnetically with new specifications and the gravity coverage should be infilled. Such surveys would allow full analysis of signatures, rock properties and structure including rock volumes capped by Tertiary rocks. Detailed survey of prospects such as Staverton may also yield useful results within the regional framework and may directly assess the extent of any mineralisation present.
Magnetic data in the Gog Range area is satisfactory but further work must use it in fully corrected form. Some assessment of rock property characteristics is advised prior to further interpretation. The gravity data base should be infilled. This data acquisition and processing should allow a fuller appraisal of structure or anomalous rock volumes.

INTRODUCTION

EL 10/88, Gowrie Park, consists of two parts - Lake Barrington north of Cethana, and part of the Gog Range near Beulah in North west Tasmania (see Figure 1).

Both areas include Cambrian volcanic and sedimentary rock suites and Lower Ordovician conglomerates and sandstones. Some Tertiary basalts and sediments obscure parts of these sequences which generally are very poorly exposed. Mapping is old and lacking in detail (e.g., Jennings & Burns, 1958; Jennings et al, 1959 and Bamford & Green, 1988 based on the above). Available geological mapping does indicate that both areas are structurally complex and mineralised although the nature of most known mineralisation or its controls remains hypothetical.

Mineralisation near Cethana (area 1) indicates a Cambrian lead isotope signature with a superimposed Devonian alteration assemblage. This is consistent with primary base metal mineralisation associated with the various volcanics intruded by the Devonian Dolcoath Granite. The Dolcoath Granite is exposed on the shores of Lake Cethana but the work of Leaman & Richardson (1989) has shown that the granite exposed represents only a small fraction of the total cross section of this body. A large intrusive may well have played a major role in remobilisation or emplacement of mineralisation.
South of Beulah (area 2), where a further granitoid is exposed, some gold and barytes mineralisation has long been known. This intrusion has also been presumed to be Devonian in age. There has been long debate about the source and age of much mineralisation in north west Tasmania - issues critical to exploration and further discovery.

Knowlege of the form and distribution of Devonian, or Cambrian, granitoids in the area is an important factor in appraisal of mineralisation and assessment of these materials forms the basis of this report. Similarly, any regional overview of gross structures, including thrusting, which might have repeated segments of target volcanics and, indeed, the nature and distribution of the volcanics forms a secondary element in the assessment reported.
Available magnetic data has also been reviewed for indications of alteration or mineralisation signatures.

DATA USED FOR ANALYSIS

Magnetic data was extracted from the 1986 Mines Department aeromagnetic survey of north Tasmania (Bishop, 1987). This is the most recent public domain data available and provides coverage of both parts of EL 10/88. Contour presentation of this data is shown in Figures 2 and 11.
The survey was flown with north-south flight lines 500 m apart. The sampling was about 40 m. The specified terrain clearance was 150 m but this was rarely achieved in EL 10/88.
In the Lake Barrington portion clearances were extreme (> 400 m) due to drainage patterns, the Round Mountain ridge and HEC transmission lines. This results in an uncertain presentation in Figure 2. Basalt caps on interfluves and extreme clearances over valleys have distorted the data base and much detail and resolution related to pre Tertiary materials has been irrecoverably lost.
Similar problems apply across the Gog Range but the nominal specifications were more closely approximated except south of the Gog Range ridge top.
These issues have prohibited useful correction and compensation of the data for flight path variation. Sample profiles, based on the contour compilation, have been generated but these can only indicate gross structural features.

Other magnetic surveys have been examined with a view to recovering lost detail. A survey by Shell during the last decade terminated at 528 000 mE and 5408 000 mN in the region of Lake Barrington and excluded the Cethana region. Older surveys have more uncertain specification and acquisition parameters and provide no improvement.

Gravity data, from the TASGRAV and MTREAD data bases of the Mines Department, is limited in coverage in this region. Stations are indicated in Figures 3 and 12. The Bouguer anomaly values have been converted into residual values using the geological crustal concept known as MANTLE-88 (Leaman, 1988). This process removes the deep crustal contribution to the Bouguer anomalies and simplifies analysis in terms of shallow sources (up to 5 km deep). This improvement in resolution and application is largely neutralised by the gappiness in extant data.

BACKGROUND INFORMATION

Geological information has been drawn from Jennings & Burns (1958), Jennings et al (1959) and Bamford & Green (1988). This mapping is old and limited by relatively poor exposure of many units. Large areas are also covered by Tertiary materials. Cambrian and Ordovician rocks dominate the licence and the Cambrian suites include an array of volcanic units (lava and pyroclastics) with a range of compositions.

Previous geophysical work has either been superficial, using magnetics, prospect oriented using electrical methods, or regional. Examples of regional analysis applicable to EL exploration include the review of granite forms by Leaman & Richardson (1989). Prospect surveys have been described by Jones (1989).

The regional granite study has indicated that the Dolcoath Granite is a more significant body than mapping or exposure would suggest and that it is distinct from the three Dove Granite bodies exposed further south. This study also showed that the granite exposures centred on Beulah are unusual and idiosyncratic and part of a compound intrusion. The Beulah intrusions have been presumed to be Devonian in age by previous workers. Various granite and granodiorite or monzonite compositions have been recorded in the Dove Granite bodies and at Beulah while the Dolcoath Granite is an adamellite. Each granite type possesses distinctive magnetic and density contrasts. The igneous plutons, of different volumes and crustal penetration, contrast with the intruded sedimentary and volcanic sequences.

Known properties may be summarised as follows but there is a need for more extensive sampling in order to confirm appropriate value ranges.

Unit		Density (t/cu m)	Susceptibility (cgs)
Tertiary	sediment	2.0	0.0
	basalt	2.7- 3.0 fresh	0.0-0.006
Jurassic	dolerite	2.75-3.0 fresh	0.0-0.005
Permian	units	2.35-2.65	0.0
Devonian	granite	2.62-2.64	0.0
Silurian	units	2.55-2.65	0.0
Ordovician	units	2.55-2.65	0.0-0.0005
Cambrian	sedimentary	2.65-2.77	0.0-0.0002
	volcanics	2.65-2.85	0.0005-0.005
	ultramafics	2.55-3.1	0.0-0.02
	granitoids	2.59-2.72	0.0-0.003
Precambrian		2.65-2.67	0.0-0.0005

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INTERPRETATION

LAKE BARRINGTON PART OF LICENCE

Introduction

Interpretation of data in the Lake Barrington area has involved consideration of qualitative and quantitative implications of each data set and their integration into a structural synthesis. The available data and basemap control limit this integration. A profile-based assessment of anomaly or alteration characteristics is precluded by lack of resolution and detail along the magnetic profiles due to excessive ground clearance.

Gravity interpretation

A refined version of the granite forms inferred by Leaman & Richardson (1989) has been produced after three dimensional modelling. A coarse 3D model was tested by Leaman (1988) after extensive 2D modelling in NW Tasmania (e.g. Leaman & Richardson, 1989). This 3D model was used to test and confirm the crustal concept and has been used as basic stock for the refined version presented here as Figure 4. The detailed refinement of the 3D model has been based on 18 profiles at various orientations and, in particular, one profile along the Forth River at Staverton. The model of the entire pluton is close to the limit of resolution with the available data. The 3D profile calculation fit is shown in Figure 5. Note that 3D models generate a 9 mgal profile shift differential between observed and calculated profiles. The consistency of this fit differential is a test of the reliability of the model and the coherence of the geological and rock property assumptions used to generate it. The profiles also show how dominant the effect of this pluton is. All other sources are minor by comparison.

The 3D model shows that the granite has a relatively flat but undulating crest and roof whose pinnacles are associated with mineralisation between Cethana and Moina. The margins of the pluton are very steep. The intrusion is generally extended east-west but is terminated a little east of Lake Cethana.

Note that these comments apply to the entire granite even though only a small part of the model are shown in Figure 4. The information is deduced because no 3D model can be restricted to only part of an anomalous source; the entire body must be assessed, even if the detail extracted may vary around it. The Cethana termination of the pluton is super detailed but the shape varies smoothly, unlike its form near Moina. The observed profile, acquired at ground level, has been differentially continued to an absolute level of 800 m above sea level so that the model may include the irregular interactions between its upper surface and the irregular topography. The only limitations on this process, the method or the solution relate to the quality and coverage of the basic survey.

Two dimensional appraisal of the Lake Barrington profile, undertaken to provide some evaluation of other minor sources, yields similar and consistent results. There is insufficient geological or gravimetric information to enable realistic 3D modelling of any other unit or structure. The shift differential is again about 9 mgal and any variation from this value would indicate a serious deficiency in the interpretation.
Other sources are suggested in Figure 6 which were initially inferred by magnetic interpretation. It is clear that density variations within the Cambrian sequence are either minor or that units are relatively thin with respect to the coarse station spacing. NW of Lake Barrington there is evidence of a major variation and the abnormally positive residual values (Figure 3) suggest a mafic complex or pile. There is little surface evidence of this although some minor mafic exposures were flooded by Lake Barrington (see Jennings et al, 1959). The profile avoids any complications which might be introduced by the Tertiary rocks which cap the interfluves.

Magnetic interpretation

Inspection of the magnetic contour map reveals a number of sizeable anomalies, most of which are associated with basalt-capped areas. Subtle character or smooth gradients are evident elsewhere. Numerous high frequency, but moderate amplitude effects may be observed where basalt is exposed. Many of these responses occur as couplets and most are limit-of-source effects. Their resolution has been enhanced by the reduced terrain clearances in these elevated areas. Responses related to Cambrian rocks are broad scale and relatively gentle and direct inspection does not enable certain resolution of geometric effects induced by the basalt.

Few direct response correlations may be made between "mapped" Cambrian units and the magnetic field due to lack of detail and Tertiary or Ordovician cover.

Felsic lavas west of Cethana provide a clear correlation but few other systematic correlations can be made. Near Gowrie Park only parts of the undifferentiated sequence are magnetic and there is no clear match with outcrop or mapping indications.
South of Roland the Beulah Formation (Ebf) is strongly magnetised but the anomaly extends far beyond mapped limits. Nearer Lake Barrington the same unit is not magnetic. There may be several explanations but the response pattern is not induced by deficiencies in the magnetic survey. Either the available mapping is faulty (possible), inconsistent (probable), important changes occur within the unit (also possible), or deeper structurally controlled sources are also present (also possible). Some of these factors could be assessed within the EL with a better survey. Note that this formation contains mafic

materials and should be moderately magnetic. Therefore any correct mapping of it coupled with a loss of contrast implies bulk alteration. This may have occurred near Lake Barrington. If this inference can be proven then the prospectivity of the region between the Staverton and Lake Barrington prospects will be considerably increased.
Other Cambrian units appear to be non magnetic.

The largest magnetic anomaly in the region occurs south of Wilmot to the northwest of Lake Barrington and may be correlated with the large positive residual Bouguer anomalies in the same area.
The Dolcoath Granite yields a neutral response. Modelling has shown (below) that the neutral field value is about 1850 nT. Many of the associated anomalies nearby are contact effects; that near the Cethana Dam is typical. The anomaly pattern around Cethana is modified and displays a NW-SE trend. This effect is not due to flight patterns, although it has probably been modified in amplitude by clearance variations, and appears to correlate with a schistose alteration zone and the limit of the shelving roof of the granite beneath (see Figures 4 and 6).

In order to test some of the possible explanations for character in the magnetic field a profile along the Forth valley was modelled. This is in the same location as the gravity profile and is free of direct Tertiary effects. Some secondary geometric character may be present, however.

Various approximate solutions are shown in Figures 7, 8, 9 and 10. These were selected to demonstrate issues involved in both geology and modelling procedure. Figures 7 and 8 contrast dipping sources at the north ende of Lake Barrington. Note that these are not exposed. Whatever solution is preferred high contrasts are implied - consistent only with massive basalts/ mafics, or in the case of the larger anomaly, ultramafics. In Figures 7 and 8 the observed to calculated shift differential is about 230 nT implying a neutral field at about 2000 nT. Note that the contractors have added such a value to the mean of their observations but this does not mean that the appropriate normal field values were either observed, used as a base reference or recovered. In my opinion the addition of such a scalar to residual values derived from the IGRF function is misleading when the assigned base reference value is not quoted. With this fit shift, however, it is quite impossible to match the zone between 5 and 9 km; especially if the sources dip south. Modelling of the simpler field patterns near Beulah (below) indicate a differential of about 100 nT and a neutral field value of 1850 nT. When the profile is recalculated with this shift scale and the sources adjusted appropriately much better correlations are achieved (Figures 9, 10). These observations show how it is possible to obtain different solutions and how they can be separated. Note that there is only one geology and any solution must be geologically believable. Reliability and resolution is enhanced if some part of the model can be tied to exposed fact but this is not easy to do in this area due to data and mapping problems and lack of information on source properties.

The Figures suggest the nature of sources near Lake Cethana. The three dimensional shape of the granite and the contact zone makes appraisal difficult unless analysis is detailed but the style is clearly established. The granite shape, from gravity analysis, has been used and a thermal contact skin about 800 m thick applied. This may be demonstrated around the intrusion and above the roof but it is certainly more irregular than modelled here. The anomaly at 1.5 km near the Cethana Dam must be due to anomalous alteration about the contact and the source is not incompatible with Moina style mineralisation. Unfortunately it is just outside the EL. A suggestion of the shape of felsic volcanics is also included at this end of the profile.

The issues posed by the northern end of the profile can not yet be fully resolved. Various options have been displayed in Figures 7 to 10 but it is not easy to demonstrate a southerly dip for the high contrast sources which have to be material of Beulah Formation composition at least. If the lower shift differential is accepted it is almost impossible to justify this for the body at 9.5 km. It is possible that the sources represent limbs of a syncline since the larger anomaly is best fitted with a southerly dip although this may be an illusion due to geometric factors. All gross dip indicators suggest two sources dipping north. The mapping of Jennings et al (1959) showing slices of dolerite or gabbro at the projected position of the northern body is wholly consistent. The volumes implied for these sources are relatively small and each must posses a moderate to high contrast. It seems likely that the best solution is north dipping, high contrast slices. This would imply thrust sheets involving ultramafics and considerable repetition of sequence along Lake Barrington. The termination of sources at shallow depth is consistent with such structures.

GOG RANGE PART OF LICENCE

Introduction

The Gog Range portion of the EL is very small but critically located. It lies south of exposed granitic rocks and gold mineralisation near Beulah. Geological control is suspect here, as elsewhere in this region, but a major NW-SE - trending fault zone cuts off the south west part of the area.

Magnetic data for the region are shown in Figure 11 and residual gravity data in Figure 12.
Analysis for this report has been restricted to structural concept appraisal and the regional setting of the EL. No previous work of this type has been reported although an attempt was made by Leaman & Richardson (1989) to unravel the form of the Beulah granitoids. That work exposed a number of curious features and although it was suggested that these intrusions were part of a large body this could not be conclusively established.

Magnetic interpretation

Consideration of magnetic responses in this region also demonstrates some inconsistencies. The strong anomaly between Beulah and Lower Beulah can be correlated with the Beulah Formation in large part but equivalent anomalies are directly associated with granite exposures at Beulah.
Tertiary materials near Paradise yield comparable responses although the extent of those responses extends beyond the mapped basalt distribution - unless talus/scree from Mt Roland has buried it. What may be termed the Paradise anomaly extends onto the eastern flank of Mt Roland, however, near Minnow Falls. This is anomalous behaviour, unless the Ordovician conglomerate overlies Beulah Formation (if magnetic) or some other strongly magnetised unit. The Minnow Falls anomaly lies at the intersection of two anomaly trends; N-S through Paradise and NW-SE along the Gog Range.

These observations enable some perspective to be given to features within the EL. There is a group of isolated anomalies on the north face of the range which require either select parts of the Gog Greywacke to be magnetised or there are unmapped volcanic members high on the range. The bulk of the Minnow Keratophyre is non magnetic as shown by the non anomalous gradient between the ridge axis and Lower Beulah. Near Lower Beulah none of the greywacke is magnetic and thus the responses south east of Mt Roland, and on the Gog Range, must be due to some other source. That source may be local alteration or blocks of an unmapped unit. Note that the rocks forming Mackenzies Hill, and containing the Star of the West gold prospect, are similarly slightly magnetised. This effect is not immediately obvious due to the interference of the Paradise anomaly.

South of the range the magnetic field is stabler and displays reduced gradients. All sources are much deeper and the responses along the south face of the range appear consistent with topographic scarp and downthrown source effects coupled with some, probably, locally extreme terrain clearances.

Several of these factors have been tested by modelling a regional line which extends from the Beulah granite outcrops, across Mackenzies Hill (Star of the West) and the range col used by Union Bridge Road.
Two solutions are provided in Figures 13 and 14. Each provides for the large, deep anomaly south of the Mersey River west of Mole Creek. Only folded Silurian and Ordovician rocks are exposed and thus the source, certainly Cambrian, lies at some depth. Its shape must mimic the broad fold trends and forms unless detached. This aspect of the modelling is important since it provides an estimate of the scale of displacement at the south face of the Gog Range and magnetic field base level information for the entire profile. The fold pattern also provides some non Cambrian geological control.
Each solution also shows that the Beulah granite exposures are irregularly and often reversely magnetised. The bulk effect is reverse. This property alone demonstrates that these rocks of variable composition are not Devonian. See Leaman & Richardson (1989) for discussion of the distinctive magnetic properties of the Cambrian granitoids.

The Gog Range anomaly, one of several compound effects, consists of a superimposed axis and local effects. The compound character is clearly shown by the north facing shoulder on the anomaly at 10.5 km in Figure 13. It may be explained in two ways.
It could be due to either a wedge of volcanics exposed or conealed near ridge top (Figure 13) or a variably magnetised Beulah style granite at shallow depth (Figure 14). The first option does include the case of local alteration, perhaps due to a source of the second option type. This would yield a compound source and response pattern although it should be noted that the compound response may be purely geometric from a single source.
A shallow granite solution for these minor anomalies could account for the mineralisation at Mackenzies Hill and in the stockwork discovered by Noranda on the south face of the range below the fire tower. Each mineralised site would then lie adjacent to the south dipping face of the roof of a granite pod. This is a concept which must be investigated further.

Gravity interpretation

The gravity coverage is poor but the residual anomalies are consistent and suggestive (Figure 12). These indicate that the gravity field is generally negative south of the large structures along the south face of the Gog Range but positive north of them. Such a first order pattern is consistent with the presence of exposed Cambrian rocks to the north and more deeply buried Cambrian rocks overlain by siliceous rocks and weathered

limestones to the south.
Transverse to this grain, however, is a N-S trending depression in the field. This swells and then closes north of Beulah but the negative swell encloses all known granitic exposures in the area. The correlation is unambiguous. The scale of the response is compatible with small granite bodies or low contrasts; neither condition is noted in the case of Devonian granitoids.

Modelling of the N-S regional line chosen for magnetic interpretation verifies these conclusions. The more negative effects to the south are related to the folded siliceous Ordovician units. The underlying Cambrian units are not modelled, nor are they elsewhere in Figures 15 and 6, since their bulk Cambrian density of 2.74 t/cu m has been set as the reference density in each model. Only significant excursion from this value, as in mafic piles or formations, is modelled.
Although the total solution offered provides a good curve fit the data do not allow refinements of the type suggested from magnetics. Even so the general form of two granitic plugs can be extracted. It seems likely that a denser composition or variant outcrops north of Beulah.

The magnetic and gravity interpretations, are for all practical purposes, concordant with extant data (See Figures 14 and 15). The more localised solution implied in Figure 13 cannot be easily sustained gravimetrically.

The granite pod concept was further tested by an E-W line through the Star of the West mine where data coverage is the best available (though still poor). The result is shown in Figure 16. A small granitoid pod, or at least material of equivalent composition, lies at shallow depth (about 100 m). This is consistent with local exposure nearby. The anomaly form establishes the limited volume and low contrast of the source. The down-faulted Beulah Formation east of Lower Beulah could account for the asymmetry of the background levels (west to east).

The various models suggest the scale of the displacement for faulting south of the Gog Range. Although estimates vary depending on the method, the quality of the data, allowances for terrain form and clearance, the minimum throw is about 1000 m and the maximum is about 1700 m.

CONCLUSIONS

Basic review of gravity and magnetic data in the Lake Barrington and Gog Range areas has clarified a number of structural issues and shown that more information could be extracted using these methods provided some additional data was provided.

In the Lake Barrington area:
The Devonian Dolcoath Granite has been defined in some detail. It is a very large, high contrast intrusion with a thermal halo about 1 km wide. Beyond this distance changes in rock properties are minimal. It seems probable that most mineralisation of Devonian origin, or superimposition of Devonian signatures, will be restricted to this halo. A schistose alteration zone near Cethana occurs above the steeply plunging north wall of the pluton.
Data available preclude any assessment of mineralisation or alteration signatures within exposed Cambrian units.
Magnetic data do, however, reveal at least two concealed mafic-ultramafic units which have shallow dips and little thickness. Thust slices are implied and the corollary of repeated sections along the Forth River follows.

In the Gog Range area:
Local gold mineralisation appears to be related to the upper surfaces of small granitoids. Their unusual properties and varied composition is consistent with small Cambrian plugs. These intrusive pods are generally oriented N-S although some subtle magnetic anomalies occur on the periphery of the apparent axis of intrusion. It is not yet clear whether the magnetic anomalies represent alteration, mineralisation effects or an unmapped volcanic member high on the range.

Further data acquisition is recommended in each sub area; magnetics and gravity at Lake Barrington, and gravity at Gog Range. Some rock property determinations are also desirable. Detailed analysis of such data could be expected to resolve many persistent structural questions and assist geological mapping.

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RECOMMENDATIONS

Given that gravity and magnetic techniques can provide useful information in this complex area and that the present interpretation is based on far from ideal data some acquisition is recommended. The potential uses for improved surveys are indicated.

Lake Barrington area:

1: Acquire new aeromagnetic data with high quality specifications. Terrain clearance approx 100 m; 250 m line spacing N-S and 500 m line spacing E-W. The E-W coverage to extend 1 km beyond the EL on all sides. Field sample spacing of 10 m with precision of 0.1 nT or better. In this area these specifications will require a helicopter. Cost estimated at $8000 for 300 line km for acquisition and basic presentation.
Vet drape data acquired for mapping purposes, formation characteristics and alteration and possible mineralisation signatures.
Differentially continue data to fixed level of 700 and 1000 m. This will allow appraisal of Tertiary-covered areas, terrain effects and structural relationships. If required this version of the data could also be used for detailed 3D modelling.

2: Infill gravity data base using available roads, tracks, access and lake shore. Some improvement in the area around the EL is also advised. The upgraded gravity coverage can be used to support structural assessments and cross-control magnetic interpretation.TASGRAV specification.

3: Undertake a trial gravity detailed survey of the Staverton Prospect or some other mineralised site for which geology, geochemistry or any other indicator indicates prospectivity. If undertaken at Staverton lines should be along contours and tied at 100 m intervals. Stations at 15 m interval in order to ensure redundancy and expose problems. A line separation of 50 m across an area of 500 by 500 m centred on the target site. Full terrain correction required.
Such a survey may well define targets or further exploration.

Gog Range area:

1: Infill gravity survey regionally to about 1 km spacing and about 500 m within the EL. Review structural implications.

2: Check magnetic properties of Cambrian suites and materials near gold prospects.

3: Differentially continue extant magnetic data to a true drape at the nominal specification of the survey for detailed profile examination and to a fixed level of about 1100 m for more accurate structural appraisal.

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Report submitted on behalf of
Leaman Geophysics
by

D. Leaman

Dr. D.E. Leaman, B.Sc., Ph.D
M.Aus.I.M.M., M.M.I.C.A

22/9/89

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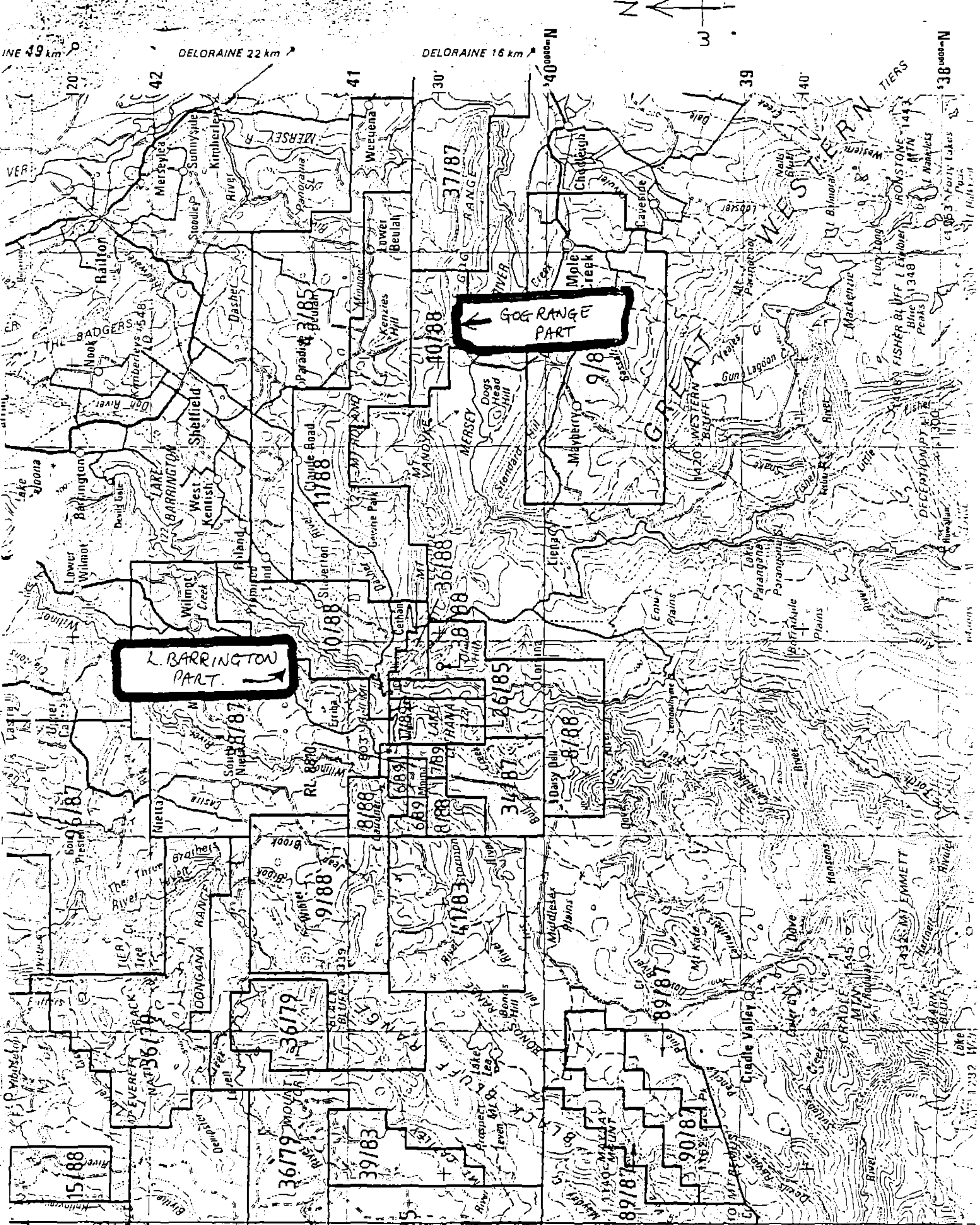
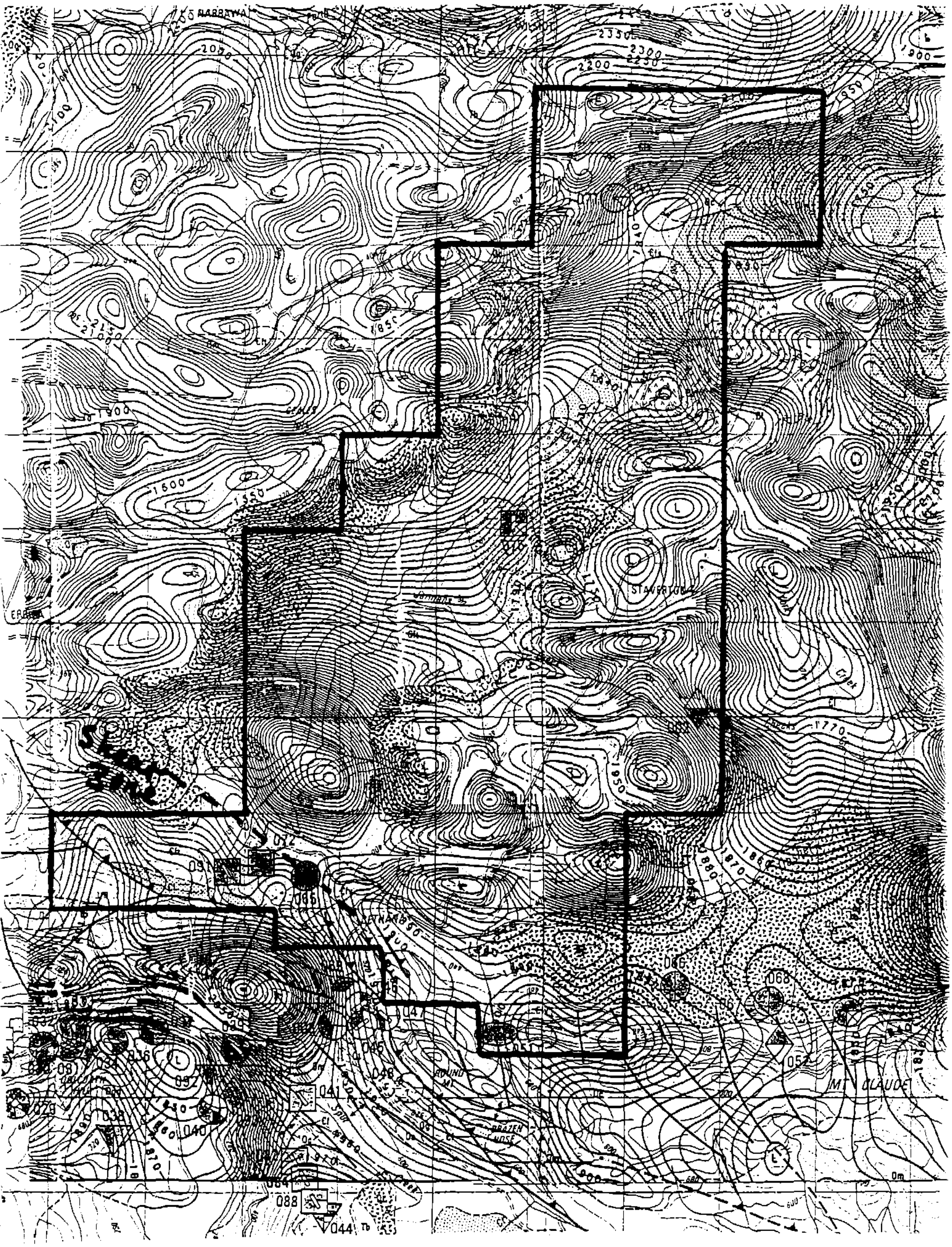


EL 10/88 GOWRIE PARK LOCATION FIGURE 1



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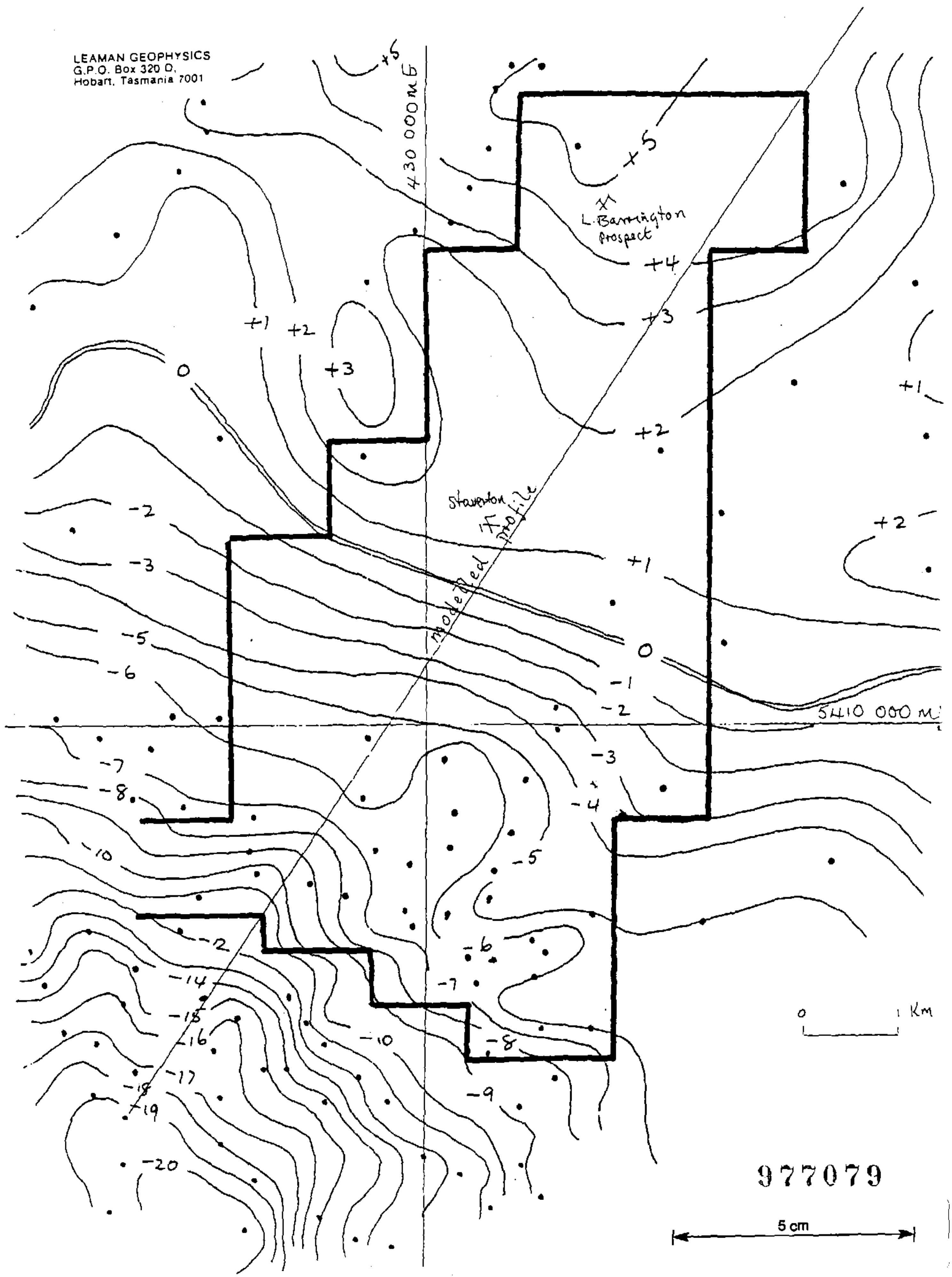
EL 10/88 GOWRIE PARK TOTAL MAGNETIC FIELD INTENSITY
LAKE BARRINGTON AREA
Geology base from Bamford & Green (1988)
Magnetic data by Department of Mines

FIGURE 2



EL 10/88 GOWRIE PARK RESIDUAL BOUGUER ANOMALY
LAKE BARRINGTON AREA
Regional separation using MANTLE-88 (Leaman, 1988) FIGURE 3

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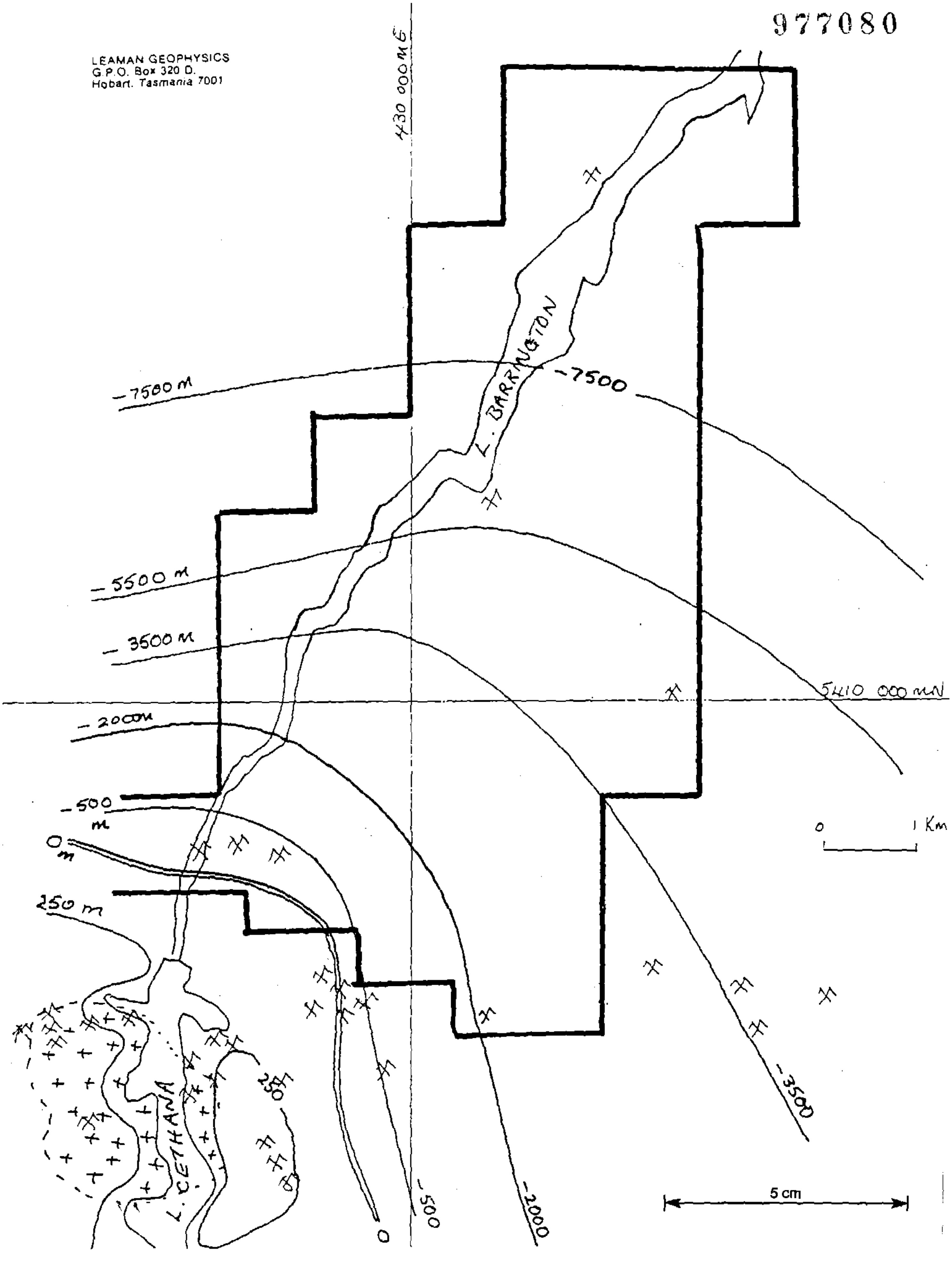
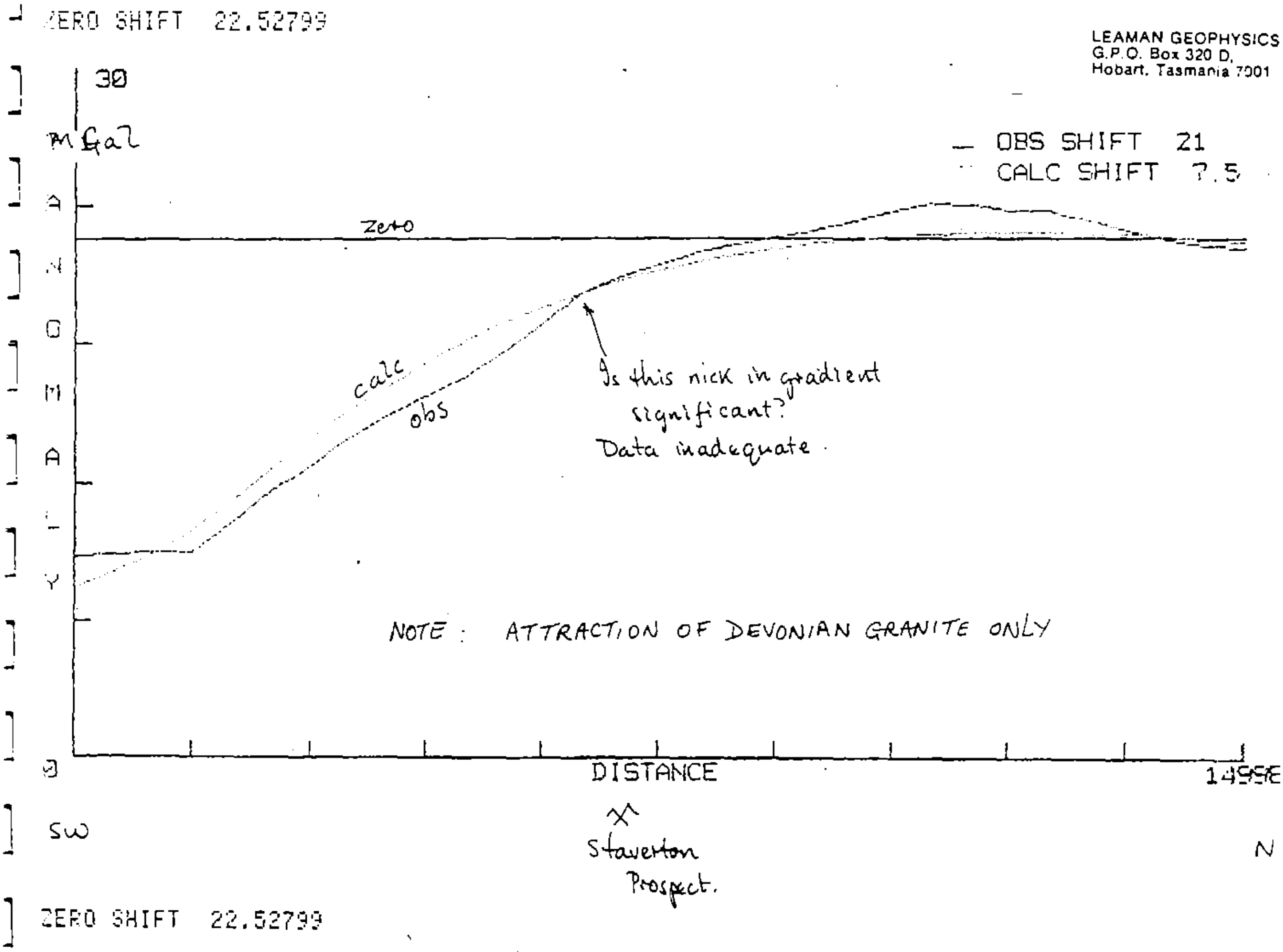


EL 10/88 GOWRIE PARK 3D MODEL OF DOLCOATH GRANITE
LAKE BARRINGTON AREA

Note that only a portion of a model of the entire granite is displayed. Contours relative to sea level of upper or outer granite surface.

FIGURE 4



Differential: 22.53 - (21-7.5) = 9.03 mGal.

For granite profile: see Figures 4 and 6.

EL 10/88 (GRAVITY) GOWRIE PARK 3D PROFILE COMPARISON FORTH RIVER
LAKE BARRINGTON AREA

FIGURE 5

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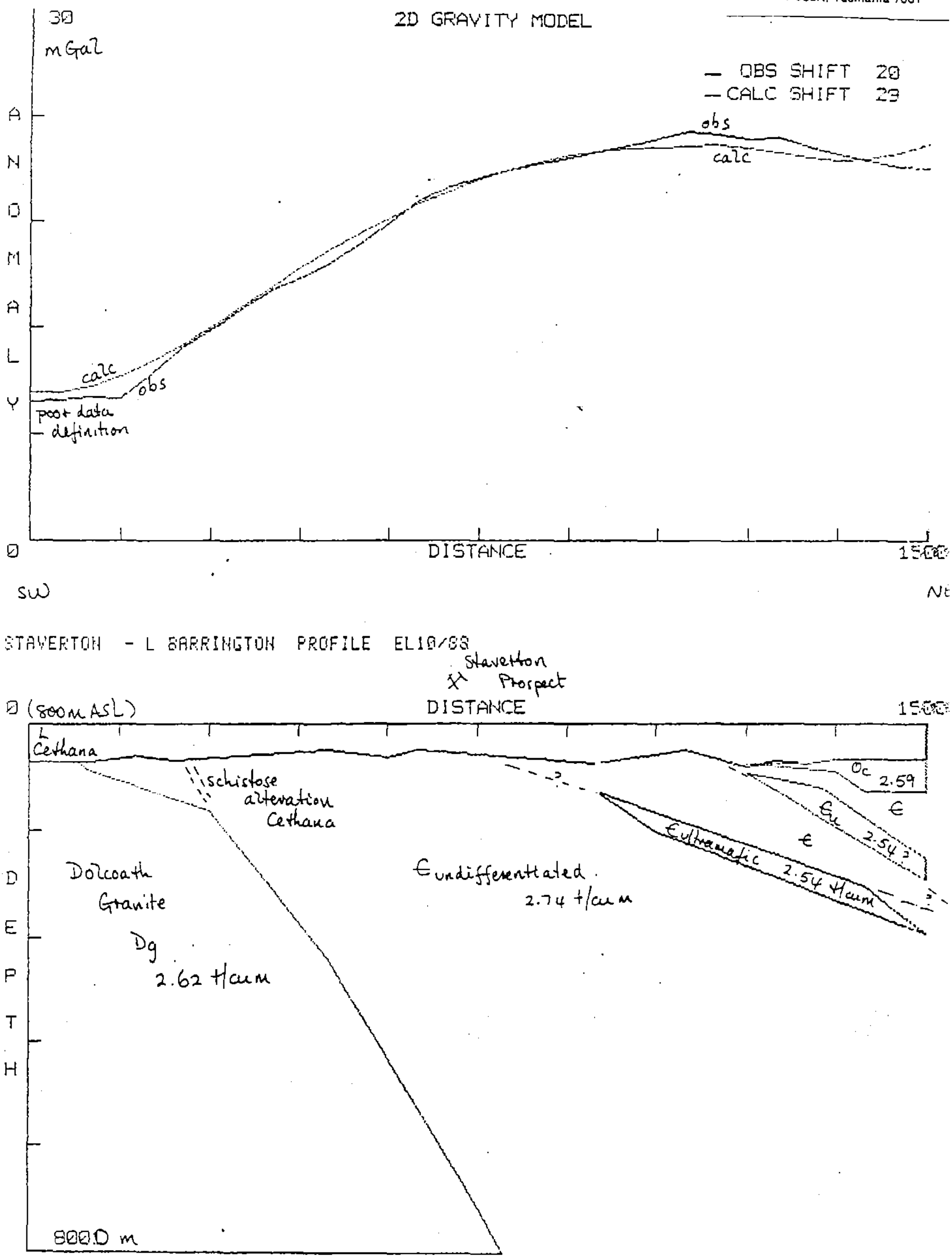
LINE PARAMETERS - ORIGIN,LIMIT,INCR : 0 15000 500



EL 10/88 GOWRIE PARK 2D GRAVITY MODEL - FORTH RIVER LAKE BARRINGTON AREA

FIGURE 6

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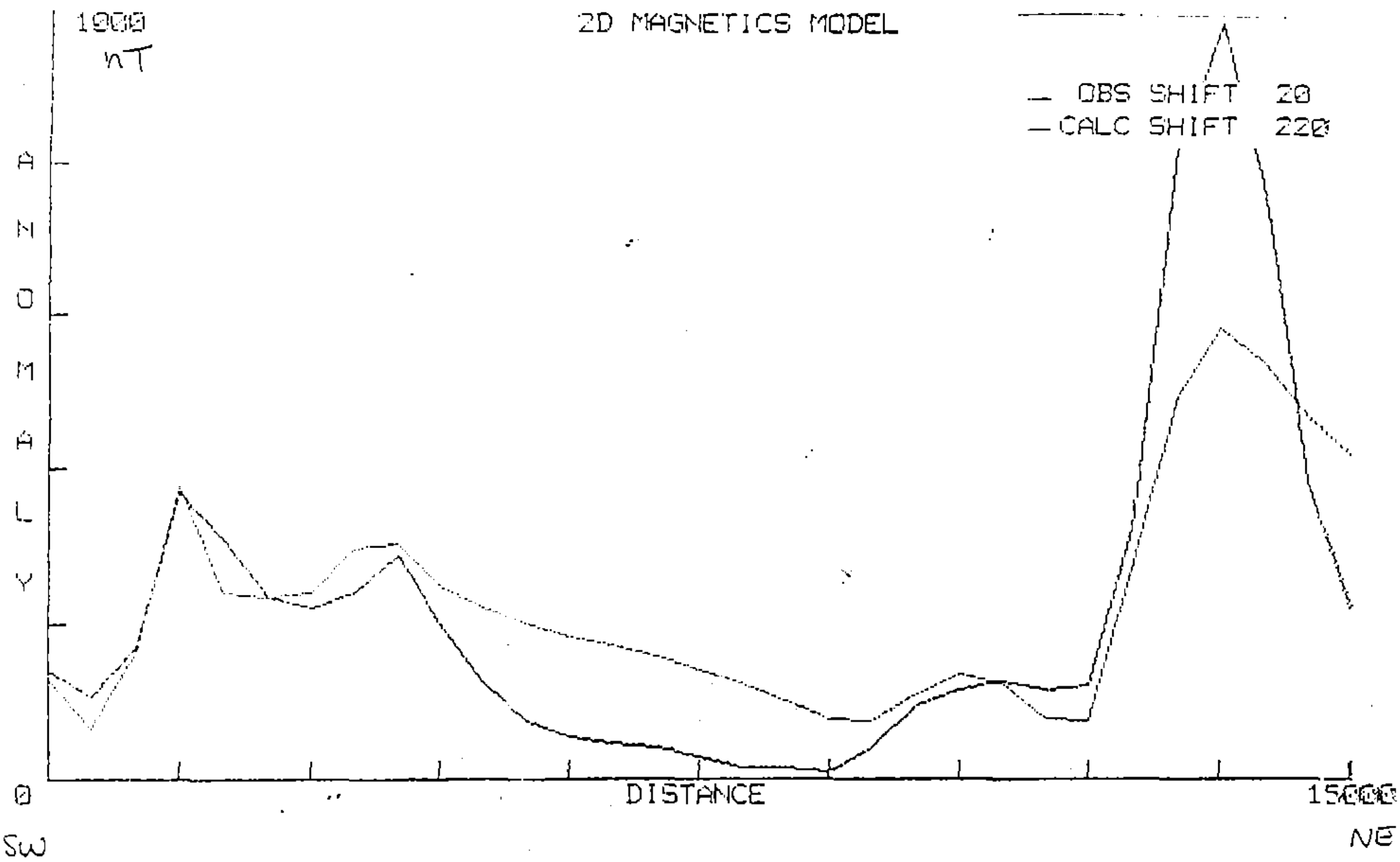
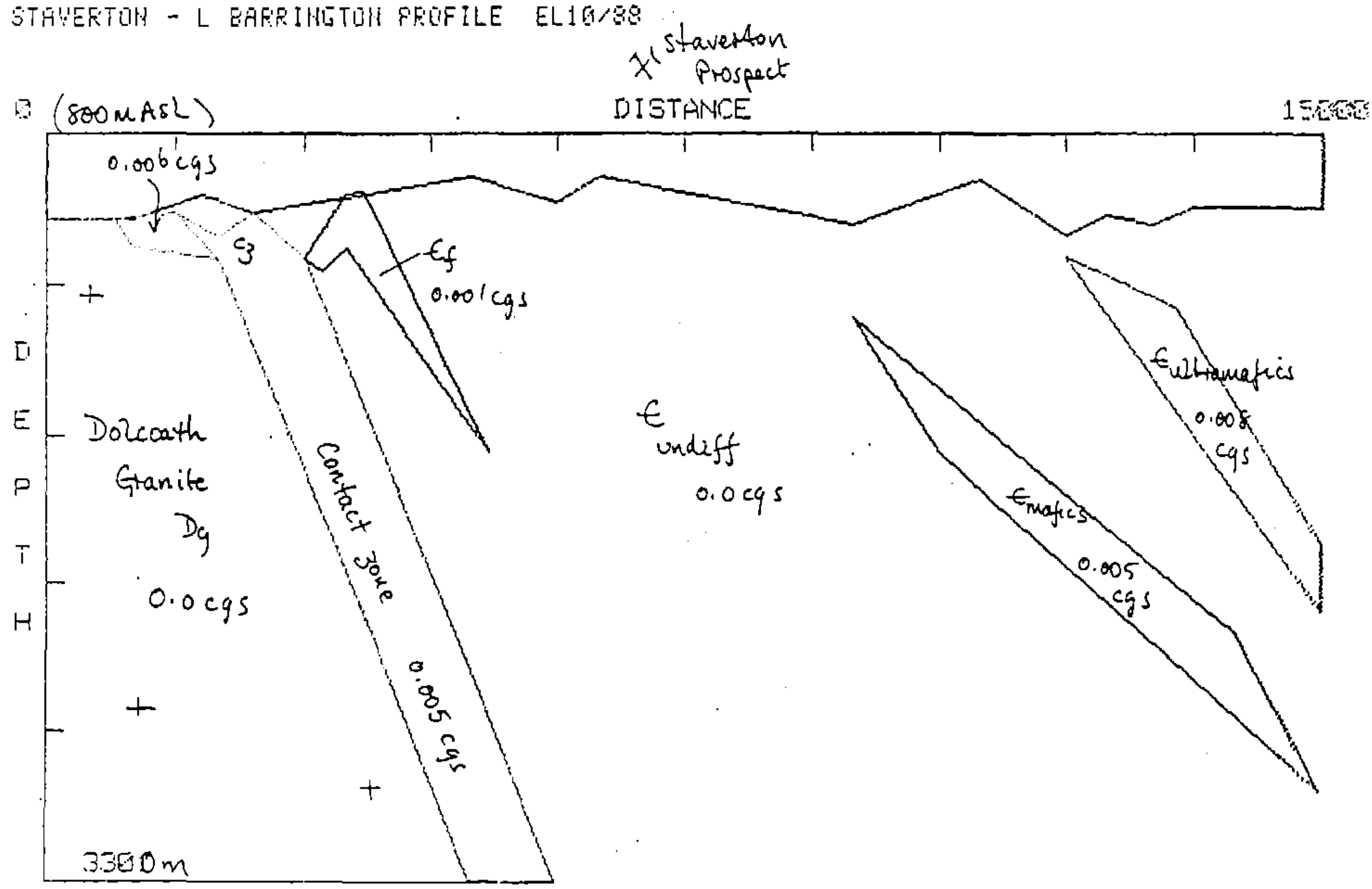
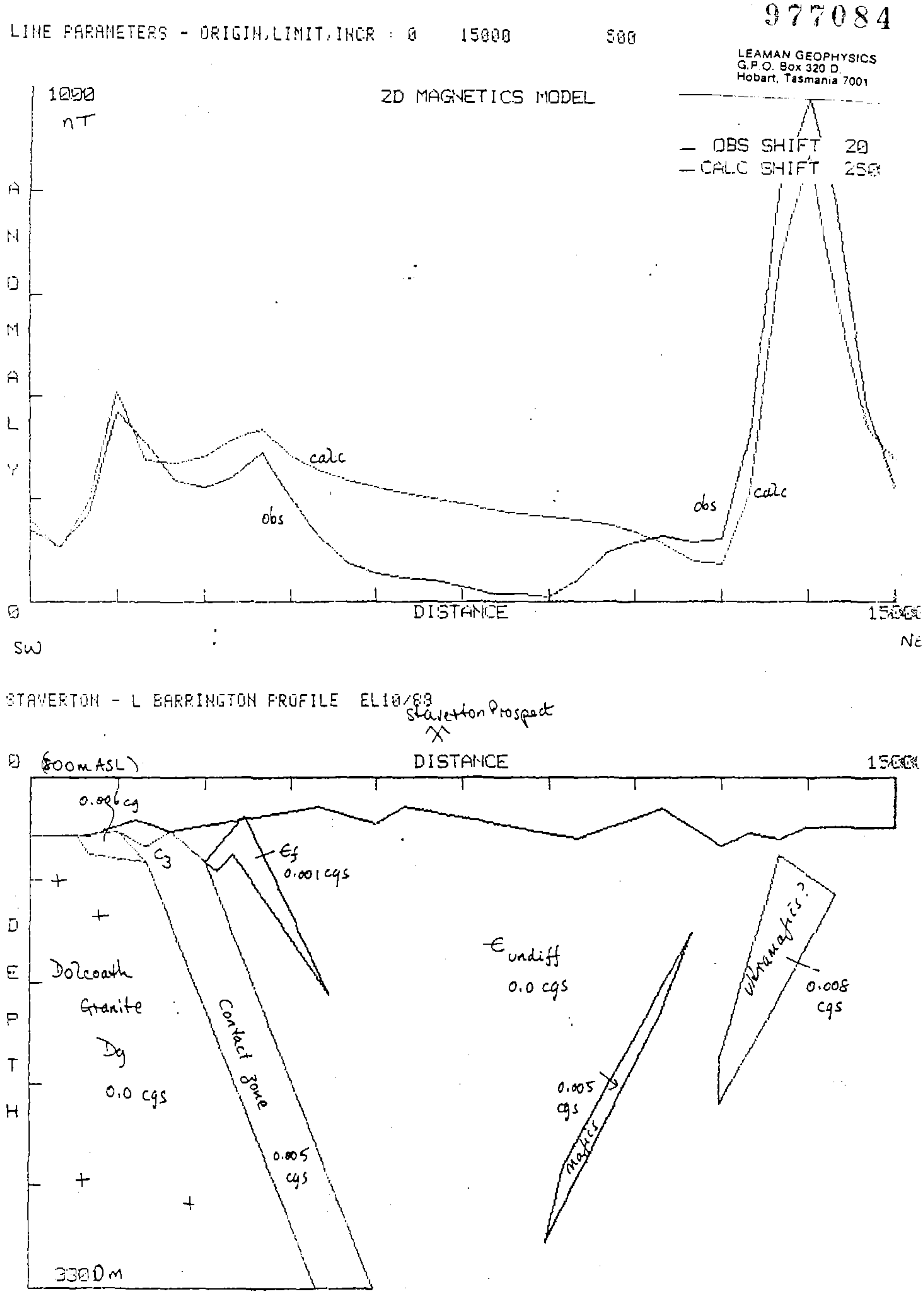




EL 10/88 GOWRIE PARK 2D MAGNETICS MODEL - FORTH RIVER
LAKE BARRINGTON AREA
SHIFT MATCH OPTION 1, NORTH DIPS FIGURE 7



EL 10/88 GOWRIE PARK 2D MAGNETICS MODEL - FORTH RIVER
LAKE BARRINGTON AREA
SHIFT MATCH OPTION 1, SOUTH DIPS

FIGURE 8

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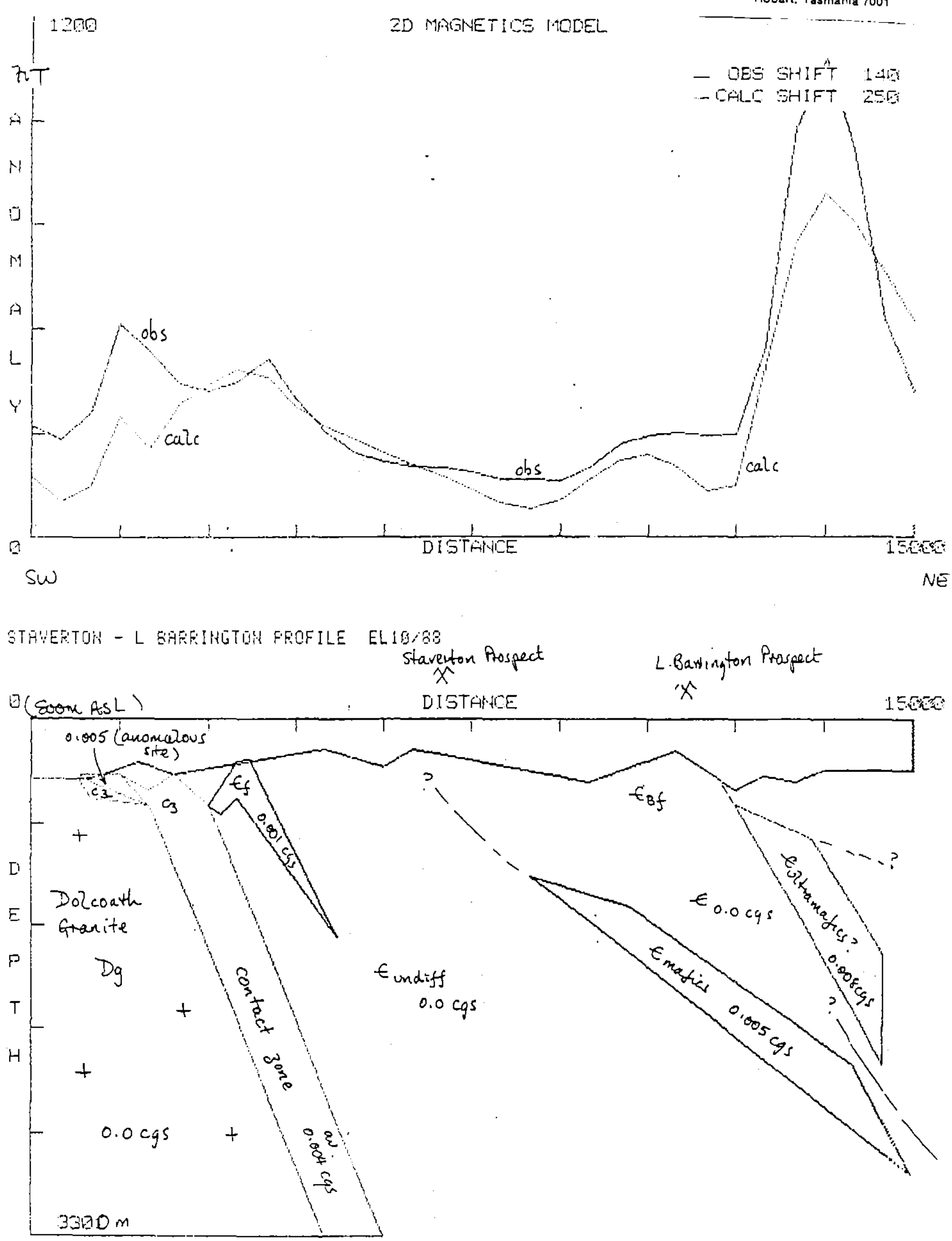
LINE PARAMETERS - ORIGIN,LIMIT,INCR : 0 15000 500



EL 10/88 GOWRIE PARK 2D MAGNETICS MODEL - FORTH RIVER
LAKE BARRINGTON AREA
SHIFT MATCH OPTION 2, NORTH DIPS SOLUTION A FIGURE 9

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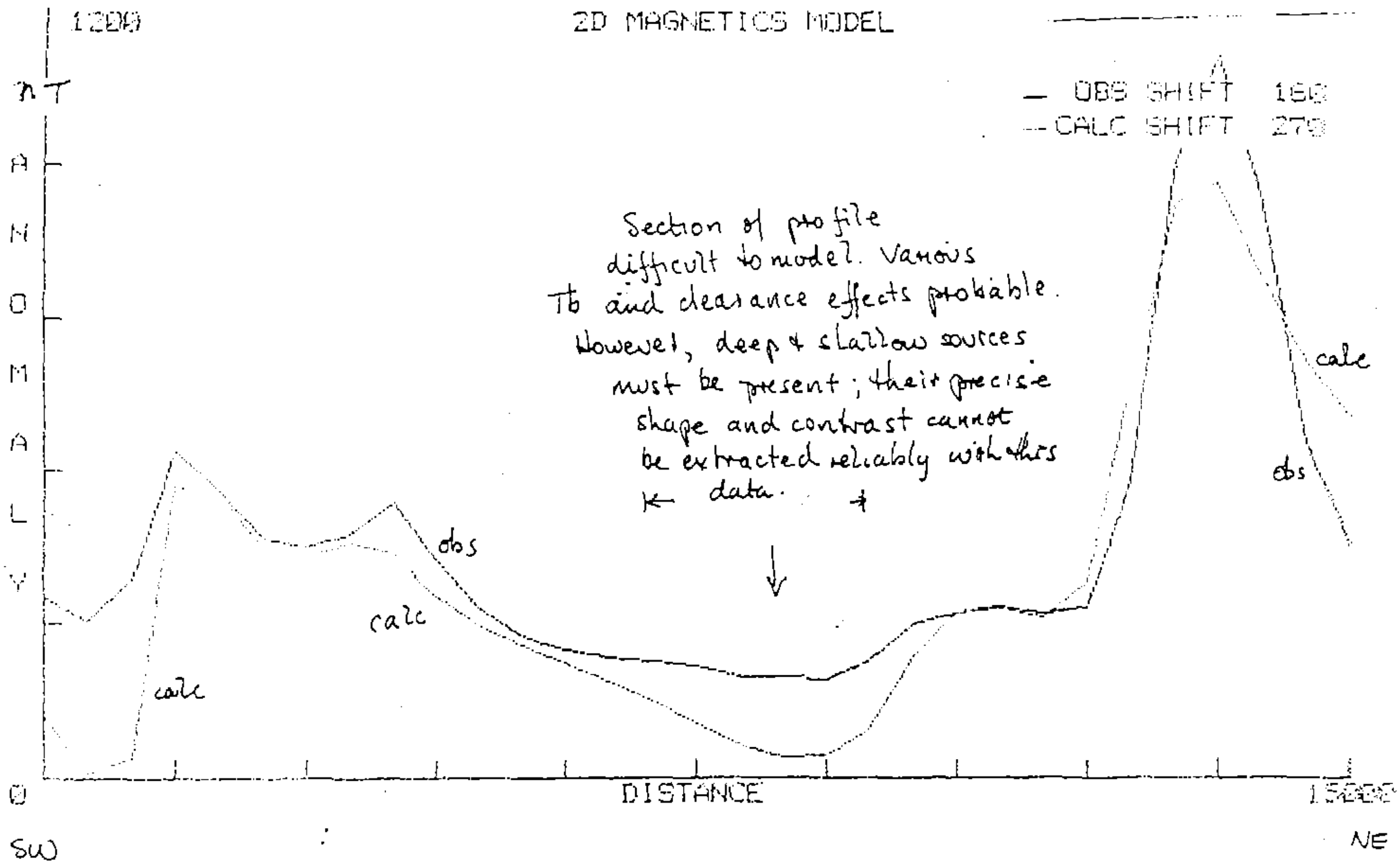
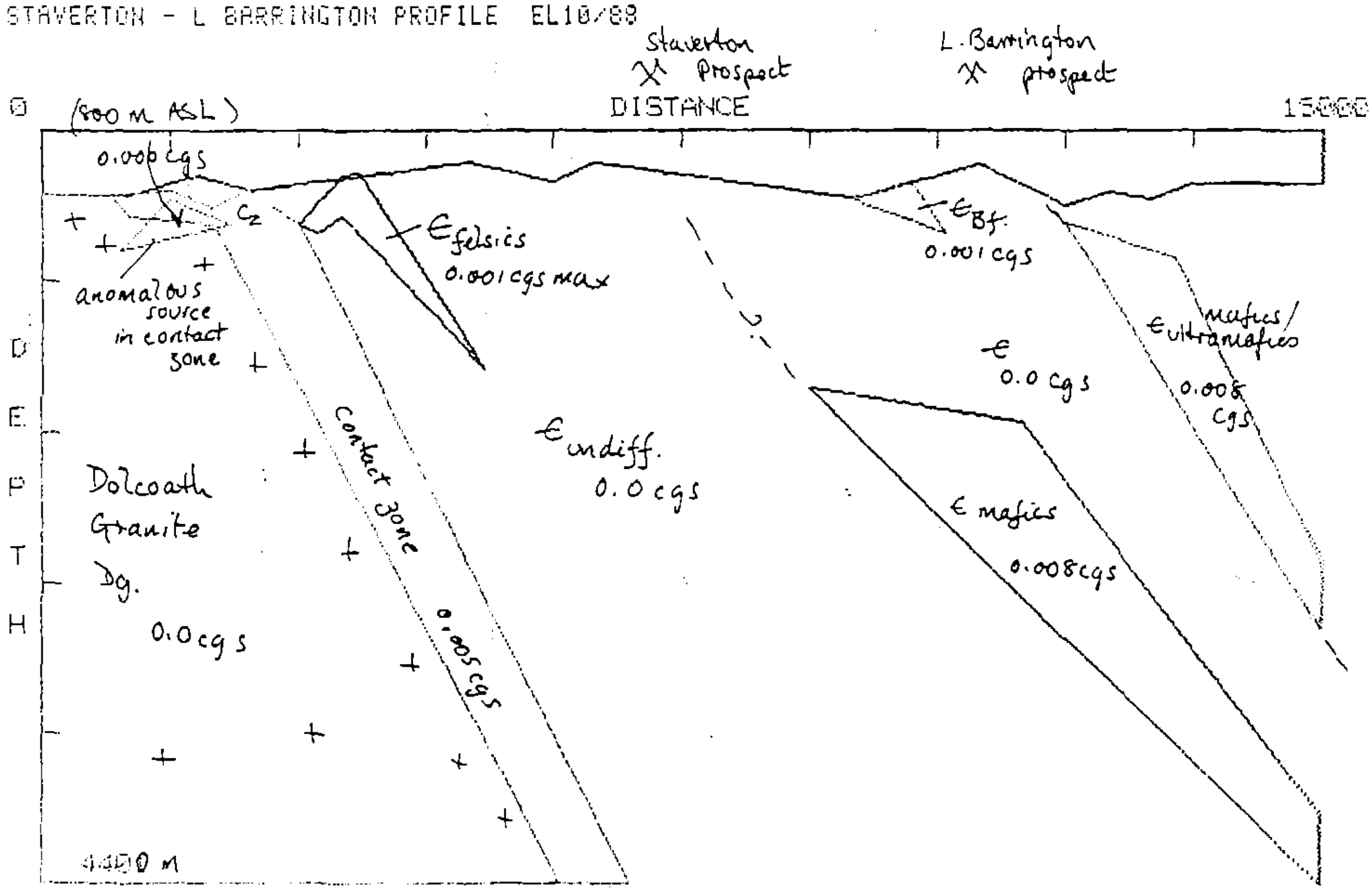
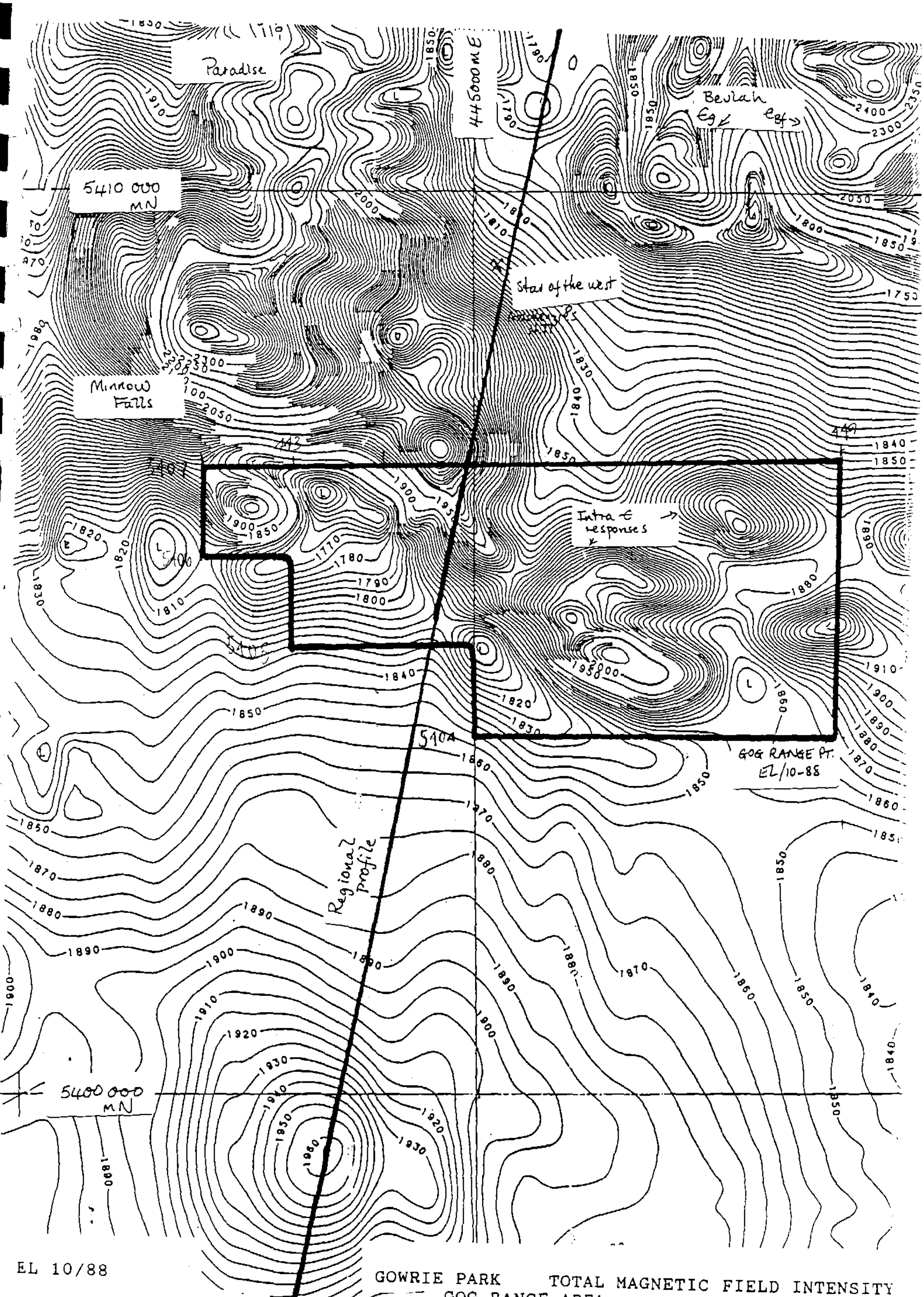
LINE PARAMETERS - ORIGIN/LIMIT/INCR : 0 15000 500



STAVERTON - L BARRINGTON PROFILE EL10/88



EL 10/88 GOWRIE PARK 2D MAGNETICS MODEL - FORTH RIVER
LAKE BARRINGTON AREA
SHIFT MATCH OPTION 2, NORTH DIPS SOLUTION B FIGURE 10



EL 10/88

Mines Department Survey

GOWRIE PARK TOTAL MAGNETIC FIELD INTENSITY
GOG RANGE AREA

FIGURE

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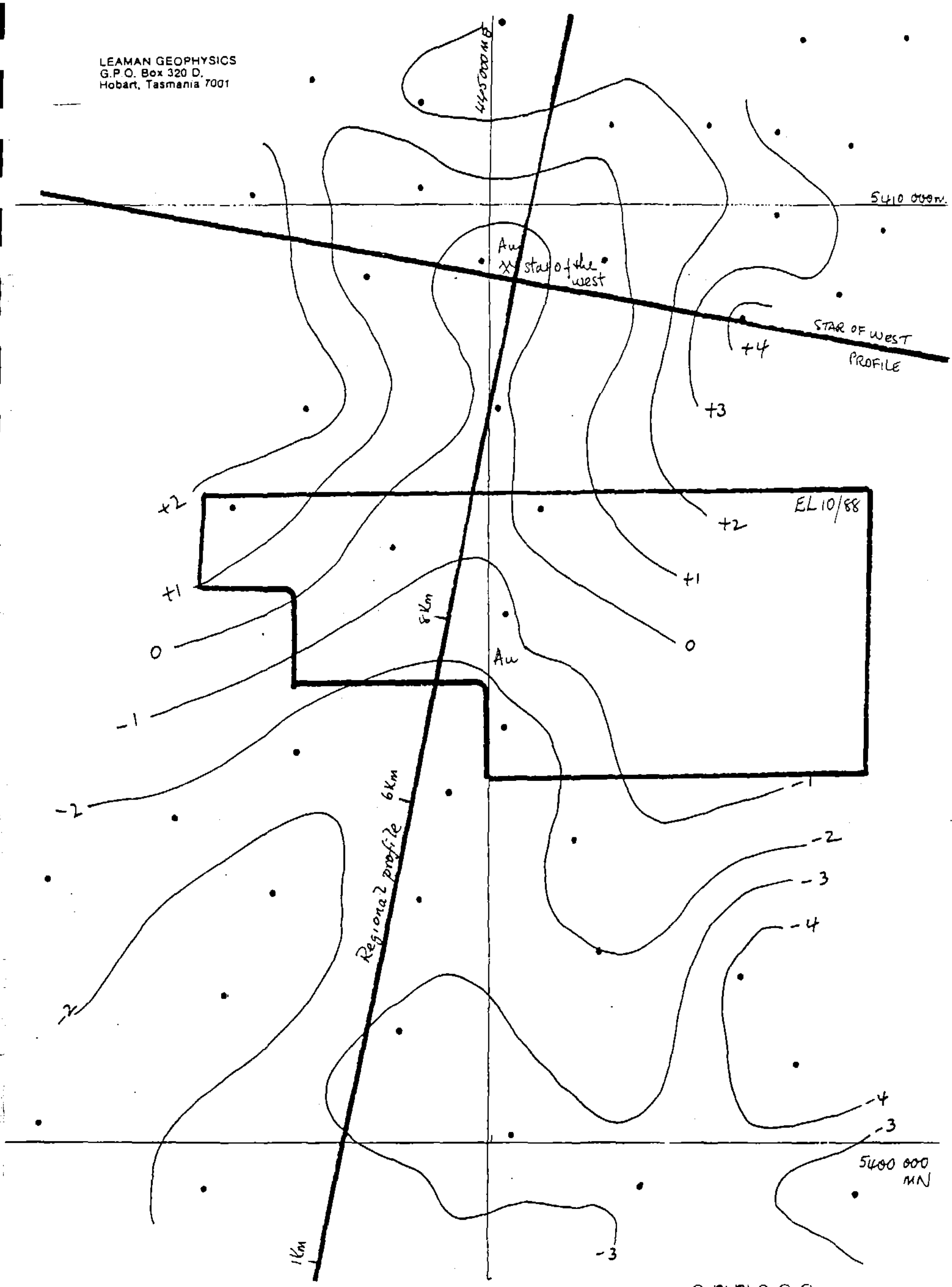

977088

EL 10/88 GOWRIE PARK RESIDUAL BOUGUER ANOMALY
GOG RANGE AREA
Regional separation using *MANTLE-88* (*Leaman, 1988*) FIGURE 12

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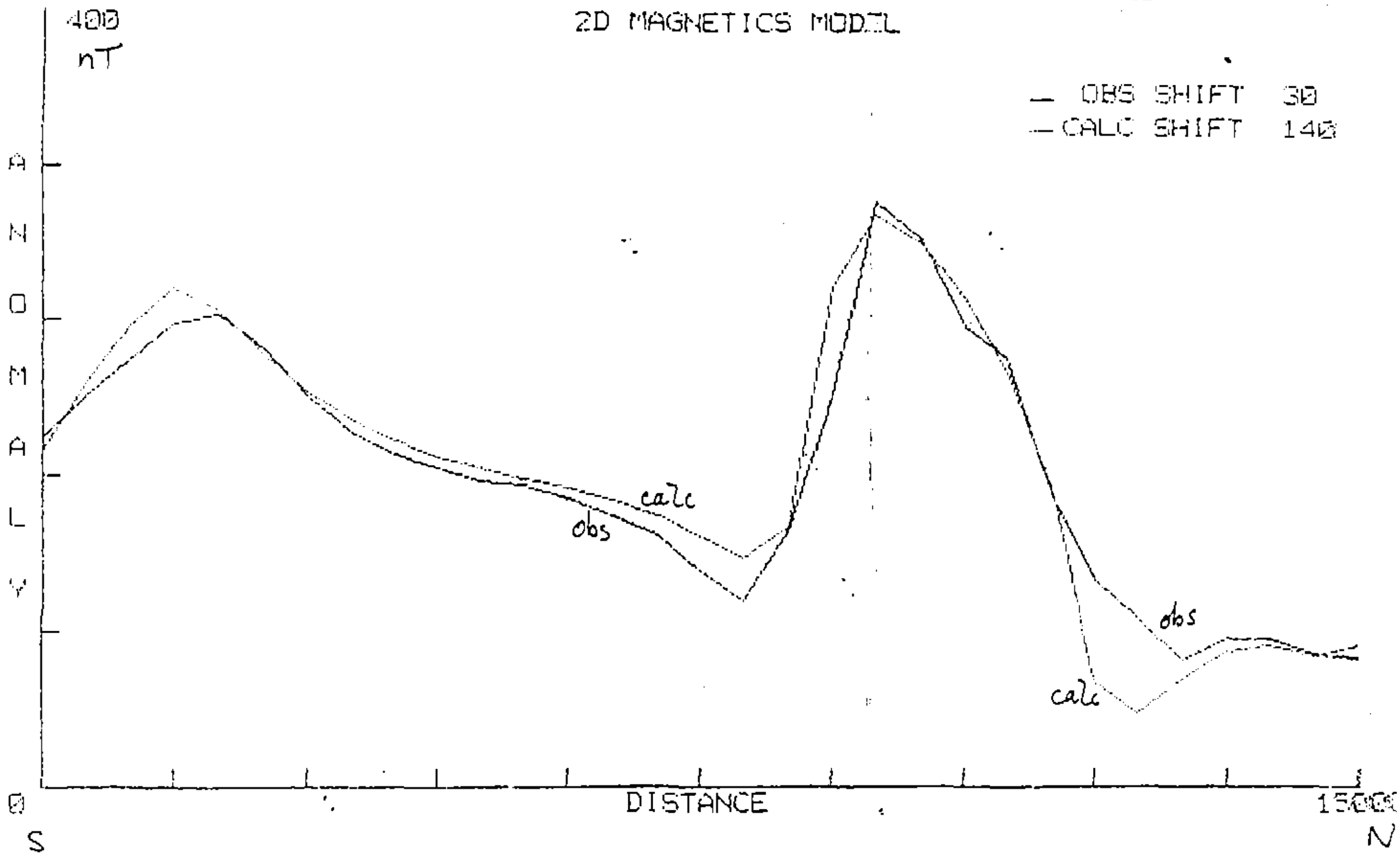
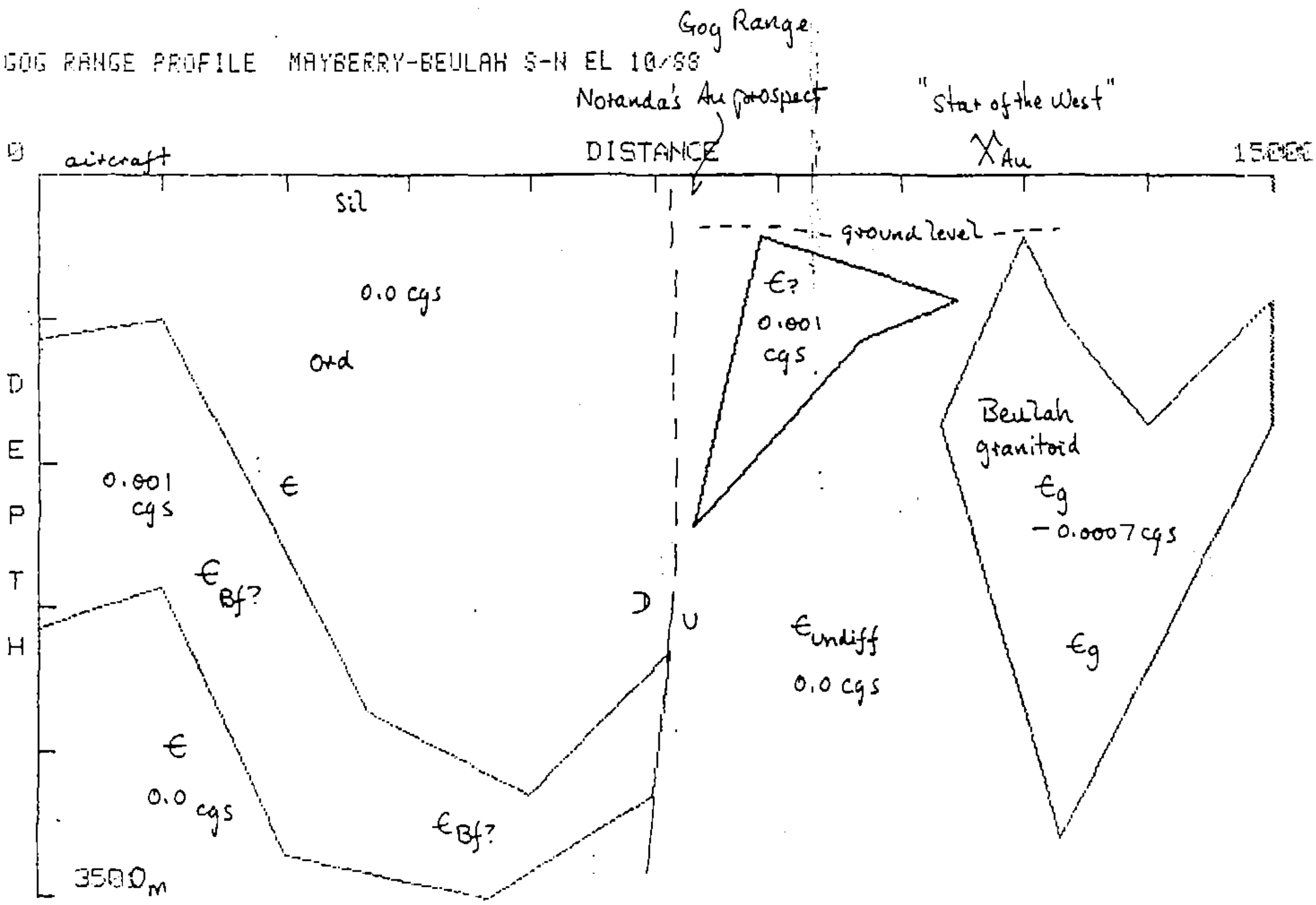
LINE PARAMETERS - ORIGIN/LIMIT/INCR : 0 15000 500



GOG RANGE PROFILE MAYBERRY-BEULAH S-N EL 10/88



EL 10/88 GOWRIE PARK 2D REGIONAL MAGNETICS MODEL
GOG RANGE AREA
RANGE TOP WEDGE SOLUTION

FIGURE 13

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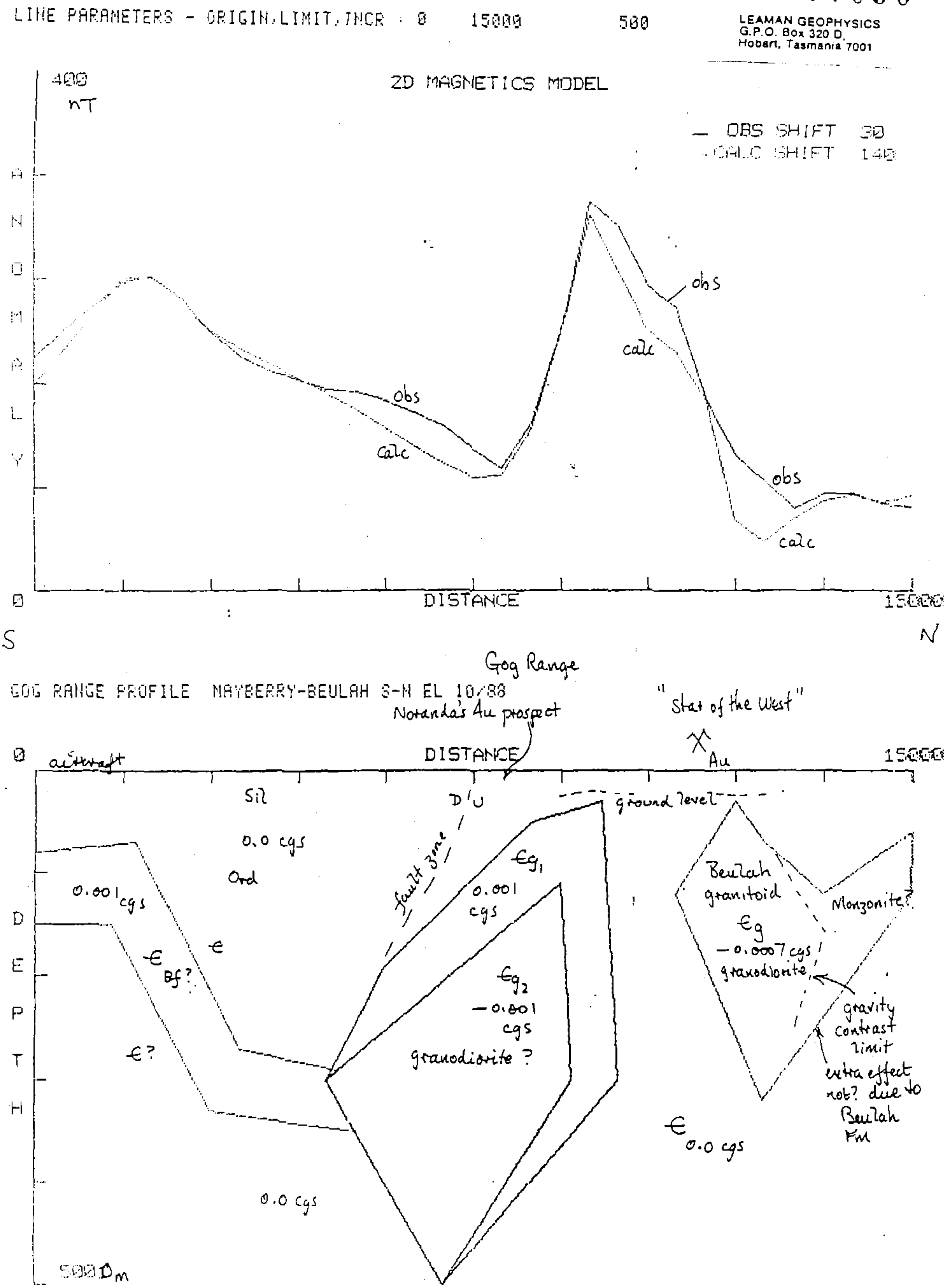
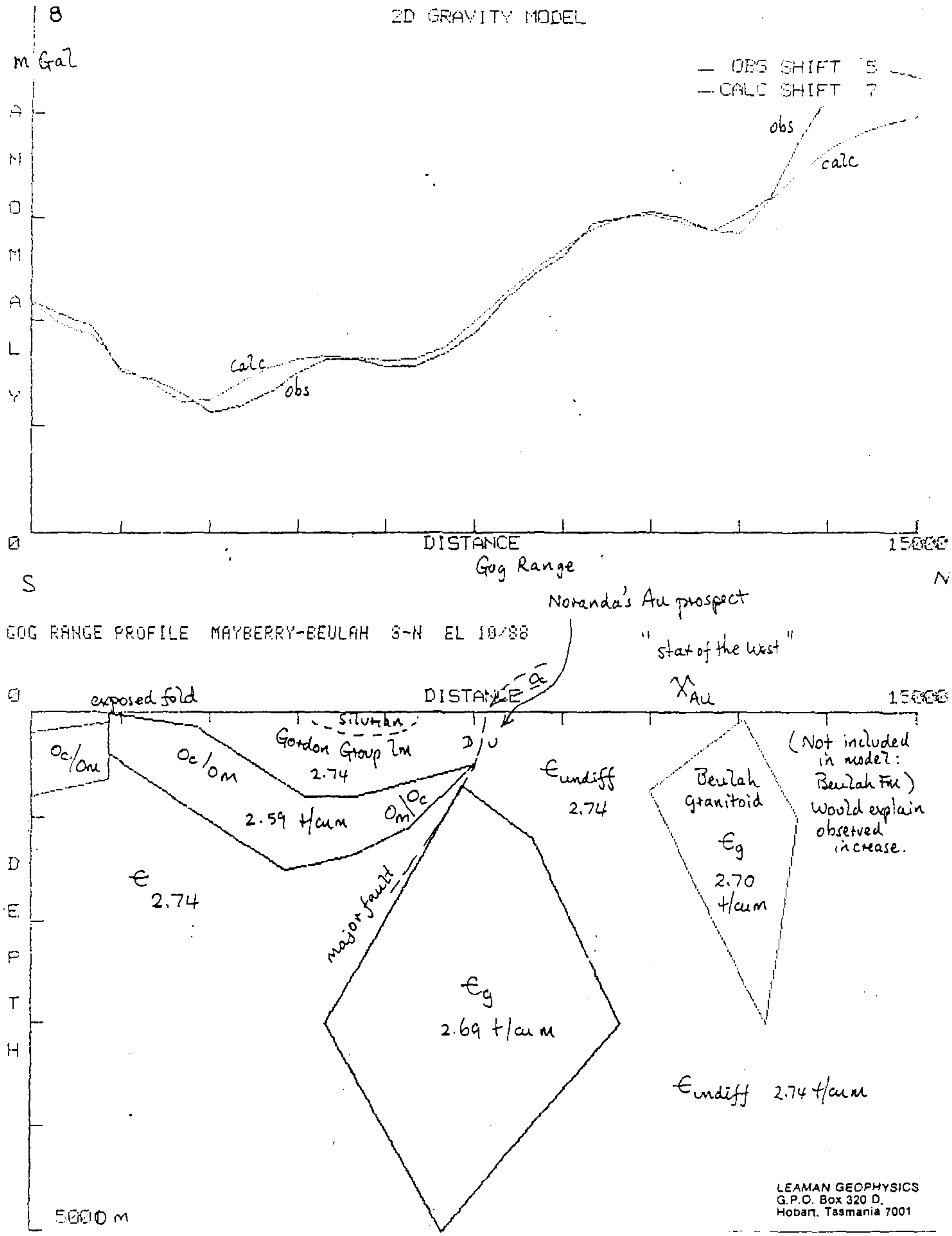


EL 10/88 GOWRIE PARK 2D REGIONAL MAGNETICS MODEL
GOG RANGE AREA
CONCEALED SMALL GRANITE IN RANGE SOLUTION

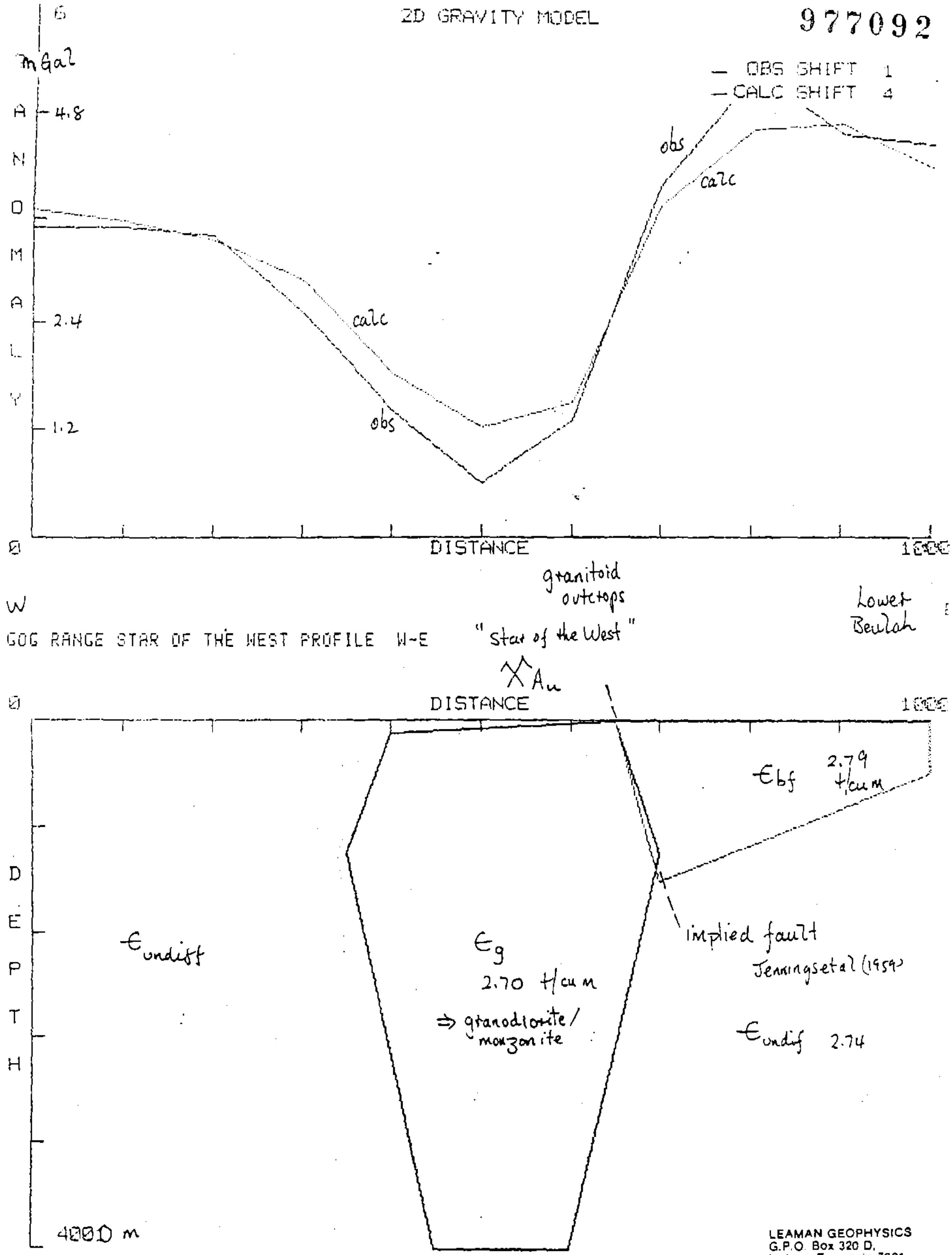
FIGURE 14

LINE PARAMETERS - ORIGIN,LIMIT,INCR : 0   15000   500   977091



EL 10/88   GOWRIE PARK 2D REGIONAL GRAVITY MODEL
GOG RANGE AREA
MULTIPLE SMALL GRANITES SOLUTION   FIGURE 15

977092



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EL 10/88

GOWRIE PARK 2D BEULAH GRAVITY MODEL
NORTH GOG RANGE AREA
TEST OF GRANITE SOLUTION AT STAR OF WEST MINE

FIGURE 16

APPENDIX E

Review of Gravity Data

Dr D Leaman

977094

LEAMAN GEOPHYSICS
Survey Review, Specification, Reduction, Interpretation
Gravity, Magnetic and Seismic Methods
Structure and Prospect Evaluation

Registered Office:
21 ZOMAY. AVENUE, DYNNYRNE, TAS. 7005
All Correspondence to:
G.P.O. BOX 320 D, HOBART, TAS. 7001.
TELEPHONE: (002) 24 0319
FACSIMILE: (002) 23 3194

TCR 91-3231B

REVIEW OF GRAVITY DATA

EL 10/88 LAKE BARRINGTON

for
NORANDA PTY LTD

by
Dr. D.E. Leaman

April 1990

BARRINTN

SUMMARY

Improved gravity coverage of the Lake Barrington area (EL 10?88) of northwestern Tasmania has revealed several large structures which are not clearly reflected in exposed geology or current mapping. Many of these features represent primary basement discontinuities or their impression or rejuvenation within subsequent structures.

The valley of the Forth River is controlled by these structures. The Cambrian sequence, and structure, is different on either bank, especially in the region of the Staverton Prospect. The largest features trend NE-SW and can be traced into regional features first exposed near the Vale of Belvoir many kilometres to the south west. Lesser NW-SE trends may be associated with known fold axes and trends in this area. Some E-W character is also evident.

Two zones with persistent and continuous gradients cross the EL. One outlines the roof phase and shallow projection of the Devonian Dolcoath Granite; the other lies along an axis extending from Mt Roland - Staverton - S Nietta.. This latter gradient lies north of the mapped fault/thrust zone exposed west of Erriba and cannot be correlated directly with any known structure. Its trend is often mirrored in Devonian displacement structures.

Most known mineralisation within the Cethana region is associated with the roof of the Dolcoath Granite. All other sites can, however, be associated with the defined gravity features within the precision allowed by the data density.
Several isolated sites, including Staverton, can be associated with the Erriba gradient, while the Lake Barrington prospect lies on another feature (N-S).

Three minor, probable, granite protrusions have been identified in the southern part of the EL. While it is possible that these are apophyses of the Dolcoath Granite their location, indicated density, size and magnetic response suggest Cambrian granitoids. Each is asymmetric and the intrusion has been structurally controlled.

Precambrian basement lies at shallow depth in the central east of the EL and Beulah Formation correlates appear to overlie it. These units vary in thickness and composition and must locally form significantly more mafic pods. Their presence enables some mapping of structure and the alignments along the Forth River appear to disguise major fold closures and possible early Cambrian growth faulting.

The region immediately west and south west of the Staverton Prospect is anomalous and possibly prospective. The strong NE-SW lineaments intersect the Erriba gradient zone in this area and the latter is both displaced and distorted. Both features carry mineralisation elsewhere.

977096

INTRODUCTION

EL 10/88, Lake Barrington, is located north of Cethana in NW Tasmania (Figure 1).

A review of gravity and magnetic data in the region was prepared in 1989 (Leaman, 1989). This suggested that both data sets might assist understanding of the setting of known mineralisation and definition of controlling structures. Geological mapping in the area is dated and the surface geology, where not obscured by Tertiary materials, is not well understood or described. Interpretation undertaken as part of the review suggested that several major, basement-involved structures - possibly thrusts, might intrude into the Lake Barrington area.

Data available for review in 1989 was either patchy (gravity) or lacking in resolution and detail (gravity and magnetics). Infill (gravity) or resurvey (magnetics) was recommended.

This report describes the revised gravity data base and some possible implications. A fuller analysis will be possible after acquisition and preliminary assessment of the new magnetic survey.

GRAVITY DATA

The pre 1989 content of the Tasmanian gravity data base for the Lake Barrington area was presented in Figure 3 of Leaman (1989). This data was in the public domain and available from the Tasmanian Department of Resources and Energy (Mines Division).

The coverage was infilled as a joint venture between Noranda Pty Ltd and the Department at comparable specifications. Suspect stations were duplicated or replaced.

All stations are linked to the state tie network and have been terrain corrected to a radius of 22 km. Elevations were barometrically determined and elevation errors limit the RMS accuracy of the survey to about 0.5 mGal. This is more than adequate for regional and structural applications.

A compilation of the revised data base is presented in Figure 2. An enlargement is provided as Map 1 (folder). The additional detail provided by the survey augment confirms many elements of the gravity field which were only inferred previously and also suggests many unsuspected features. It may be noted that there remains scope for further detailing and infill.

DATA TREATMENT

The original presentation of gravity data by Leaman (1989) was in the form of a residual Bouguer anomaly generated using the crustal model for Tasmania known as MANTLE-88 (Leaman, 1988; Leaman & Richardson, 1989b).
This presentation retained the effect of the Dolcoath Granite, the next largest contributor to the total field in this area (see Leaman & Richardson, 1989a). Leaman (1989 - Figure 4) presented part of a refined 3D model of the granite derived from the basic work reported by Leaman & Richardson (1989a) and specific 3D analysis commensurate with the data base available in December 1988. All long wavelength characteristics are satisfied by this model.

In order to enhance the new compilation (Figure 2) and more clearly define structural trends unrelated to the Devonian granite the effect of the granite, as determined by this 3D model, has been removed. The effect of ocean water has also been removed in order to fully comply with MANTLE-88 (see Leaman, 1988).

The resulting compilation after correction of the observed Bouguer anomalies for crust, ocean and Dolcoath Granite is shown in Figure 3. The residuals presented are true values and contain no disguised or undefined filter effects. All values apply at the station locations on the land surface and interpretation must allow for this.
Profiles used for modelling have been sampled from this data set and differentially continued to a reference level of 700 m ASL in order to allow inclusion of topographic shapes and interaction with near surface sources in the models.

COMMENTS ON THE RESIDUAL FIELD

The residual field clarifies the features of the observed field but emphasizes the anomalous character and location of the features observed.

A negative response has been retained above the roof of the Dolcoath Granite. This shows that the density of this body, at least in its upper part, is less than the bulk assumed value of 2.62 t/cu m. A lighter roof phase of 2.58-2.60 t/cu m is implied.

Most mineralisation within the Moina - Lake Cethana area lies close to the -5 mGal contour and almost certainly reflects roof irregularities and the siliceous phases of the granite.
Other, more distant mineralisation, near Cethana - Round Mt, is related to the ultimate margin of the granite; the zone in which low angle roof forms are converted to high angle walls. I

believe these prospects lie in, or near, the projection of the wall fracture system (see Leaman, 1989 Figure 4; also Figures 5 and 6 of this report for relationships).

The more scattered remaining prospects cannot be related to the Devonian granite in any way. Many of the sites which can be related to the granite forms may also represent some remobilised material (below).

The residual field (Figure 3) reveals a 3 mGal step anomaly across the area at a nominal northing of 5411 000 mN (actual trend ESE). This trend is extensive (Map 2). The feature was suggested in the earlier compilation of Leaman (1989, Figs 3 and 5) and noted to occur near the Staverton prospect. Small prospects near Gowrie Park, Mt Roland and south east of Staverton are all within this gradient band (see Figure 4, Map 2). This band is subsequently referred to as the Erriba gradient.

The two zones of anomalous gradient, one clearly related to the granite roof, the other to some large concealed structure, account for most mineralised sites in the area.

The gravity field north of the Erriba gradient is strongly positive for many kilometres in all directions. This indicates a thick, Cambrian sequence. Map 2, however, shows this effect to be part of a belt which is enclosed to the north and east by a moderate, smooth and areally large negative anomaly whose form is not consistent with known elements of surface geology.

Negative anomalies are not consistent with Cambrian rocks since no substantial Cambrian unit has been found whose bulk density is less than 2.67 t/cu m (typical siliceous Precambrian basement or the reduction density), or even less than 2.73 t/cu m. Review of the anomaly patterns of Figure 3 will show that the Tertiary cover does not significantly influence the gravity field. This is consistent with the station spacing and the relative thinness of the Tertiary cover.
Ordovician rocks, which may generate negative anomalies, are too thin and too localised to produce the effects observed.
The gross negative effects observed north and east of EL 10/88 can only be explained by another large Devonian granitoid - the Beulah Granite of Leaman & Richardson (1989a). Its composition must be dioritic or granodioritic, however, since regional contrasts of only -0.03 t/cu m seem likely (below). This composition could also account for the moderate anomalies observed.

Many gross trends are defined by the Cambrian-related anomalies (see Figure 4) and the largest of these, north west of the EL can be traced far to the south west to the Vale of Belvoir and beyond. Others indicate that different sequences and exposures across the Forth valley are no accident; major structures transect or underlie the regional grain of the surface geology. The Lake Barrington prospect can be associated with a second order N-S structure or trend.

Mineralisation near Mt Claude can be correlated with a trend parallel to the Erriba gradient.

Inferred trends and relationships are suggested in Figure 4. Not all are well defined. Some are major and emphasized. Further, more regular, infill might well lead to some revision - especially in the region of Round Mt, Mt Claude and Mt Roland. The contrasts and correlations with the geological base map are evident.

Three other features should be noted in Figures 3 and 4. Two lie within the EL. These relatively negative features may be observed at 428 500 mE, 5409 000 mN; 430 500, 5408 500 and 431 500, 5406 500 (see Figure 3). These are shown with symbols in Figure 4.
These anomalies could be due to local spines or apophyses of Dolcoath Granite, minor Cambrian granitoids or data errors.
Inspection of the character of the features and the required general disposition of the Devonian granite for the 3D model suggests that any spines or apophyses present would be of very high relief (over 2000 m) and unlikely to generate the local responses observed.
Data errors have also been considered; the most likely sources being in elevation or terrain correction. Review does not indicate any such problem and certainly not one which could result in 1 to 2 mGal in the Bouguer anomaly. Each site lies in different terrain and geology but within a consistent zonal style of the gravity field. The features must be accepted pending additional survey.
The anomalies can, however, be explained by small Cambrian granitoids with a density of 2.68-2.71 t/cu m whose roofs are quite shallow, perhaps directly beneath the local thrusts and unconformities.

Several of the issues raised by inspection of the data have been tested by analysis.

ANALYSIS

Three representative profiles have been interpreted. These are shown in Figure 3 and are labelled in kilometres from their origin in order to permit correlations between modelled section and the basemap shown in Figures 2 to 4.

Each profile extends beyond the confines of EL 10/88 in order to provide a regional setting for the features described.
Profiles 1 and 2 may be contrasted with Figures 5 and 6 of Leaman (1989).

Profiles 1 and 2 (Figures 5 and 6) contain a representation of the Dolcoath Granite even though its effects have been removed from the data set. This has been done to scale other elements of the structure and also allow assessment of the volume of the ligher roof phases. The residual negative anomalies associated with the granite can be explained by reducing the bulk density for the entire granite to about 2.60 t/cu m or a substantial roof phase of about 2.58 t/cu m.

The profile match parameters for these profiles are neutral (observed data shift = calculated data shift) reflecting the true residual status fo the compiled data set.

Profile 1 (Figure 5) shows that the Cambrian sequence is up to 4 km thick at normal bulk densities. In the particular model shown (many variants have been assessed for each profile) an asymmetric wedge of Ordovician is coupled with a denser basal Cambrian unit. The curve fit suggests that the wedge of Ordovican should be thinned to the SW. The dense unit, on the basis of this section, could be placed almost anywhere within the Cambrian succession. Other sections are more definitive.

The negative feature at the NE end of the profile can only be explained by a large volume of moderate contrast and considerable depth range. A large granitoid with properties comparable with the Housetop Granite, or a granodiorite, is implied. Its scale would suggest that it is Devonian in style and age. The precise mass balance and shape cannot be determined reliably with current data but the denser Cambrian unit is involved and perhaps thickened. Were this increased thickness to be carried across the section the entire sequence could be thinned by several hundred metres.

Profile 2 (Figure 6) is apparently similar in style but review of Figure 3 shows that it is very different. So is any model solution. The Cambrian section is thinner and patchier and the denser unit cannot be associated with exposed Beulah (?) Formation near Lake Barrington. The implication is clear. If any intermediate-mafic sequence is present and within the exposed materials then it is very thin near the lake but rapidly thickens and dips west (see Figure 7, compare Figures 5 and 6) and north. The model suggests thrusting and the style of solution is comparable with that deduced from regional magnetic data (see Figures 6, 7, 9 and 10 of Leaman, 1989).
Space requirements near the lake indicate that the denser unit is either exposed or virtually exposed and that it is basal to the Cambrian succession envelope. It is probably also variable in thickness, composition and bulk density but significantly denser than the felsic or sedimentary rocks.

Profiles 1 and 2 show that there is room for small Cambrian granitoids with root depths of up to 4 km within the zone marginal to the walls of the Dolcoath Granite. The form of profile 2 suggests the location of such a body - near 5 km - gi en the shape of the profile and the absence of other possible sources. Model tests confirm that a small body of granodioritic composition could explain the data.

Profile 3 (Figure 7) provides one solution for the E-W differences across the Forth River near the crest of the structures implied in other profiles. It shows that it is possible to account for the differences by folding. The structure cannot be as simple as this, as shown by Figure 6. It is also possible to explain the profile by faulting and direct changes in thickness of the basal, dense member. All options stress, however, the fundamental nature of the location and its structural development and the options could be considered to include growth faulting and similar basic controls.

The model shown is consistent with Figures 5 and 6 and accounts for the differences in thickness of the Cambrian succession.

It may be observed that the curve fit parameters have been offset by 2 mGal. This is necessary for any 2D model with the orientation of this profile and reflects the lateral 3D influence of the Dolcoath Granite (-1.7 to -2.2 mGal along the profile) which cannot be properly represented in this simpler format. Thus the calculated effect is about 2 mGal too high and must be matched by shifting the observed profile.

Extant magnetic data (e.g., Figure 2 of Leaman, 1989) confirms the presence of more mafic materials in zones where the residual Bouguer anomaly exceeds +5 mGal. This data also shows that a magnetic anomaly can be associated with each of the three small negative features offset from the Dolcoath Granite. While such anomalies can be produced by thermal alteration about small extensions from the large intrusion they are also consistent with small Cambrian granitoids of the composition implied. Pending acquisition of more detailed gravity data and review of new aeromagnetic data it must be concluded that these anomalies are related to small granitoids and that any mineralisation nearby is probably remobilised Cambrian material. This explanation cannot be used to account for the Staverton and Lower Barrington prospects which could be early Cambrian in age and not remobilised.

CONCLUSIONS

New gravity data enables new explanations to be offered for all the known mineralised sites in the Lake Barrington region. Within EL 10/88 these are associated either with small Cambrian granitoids included in or near the thermal halo of the Devonian Dolcoath Granite, or with major basement fracture zones. It might be expected that the former would indicate a hybrid Cambro - Devonian age while the latter should be early Cambrian and be associated with basal sequences and variable volcanic products.

The largest basement-involved structure lies beneath Lake Barrington and has probably dominated both fold patterns and deposition and may hav controlled local growth faulting and volcanism. The critical interaction of many of these structures lies immediately NE of the Staverton prospect but there is no proof that this dislocated zone is mineralised or has not been shifted from the original site of control. It can be argued that this complex structure has been described and is not anomalous.
This cannot be said for the features to the SW of the Staverton Prospect where NE-SW basement fractures intersect the WNW-ESE Erriba gradient zone. The largest spine of Cambrian (?) granitoid lies immediately south of this intersection, the gradient zone itself is mineralised and it is distorted NE toward Staverton at the intersection. These observations indicate a major confluence with anomalous distortion of all characters.

The zone W and SW of Staverton prospect should be closely examined. Is, for example, the thickening westward sequence massively altered? Any target will lie beneath the thrusts implied. While these are thought to lie north of the prospect any structure south of it could well conceal the altered volume if it exists. Magnetic data might assist this assessment which also requires careful geological groundwork.

The present data set has not been exhausted but further analysis should await receipt of magnetic data.

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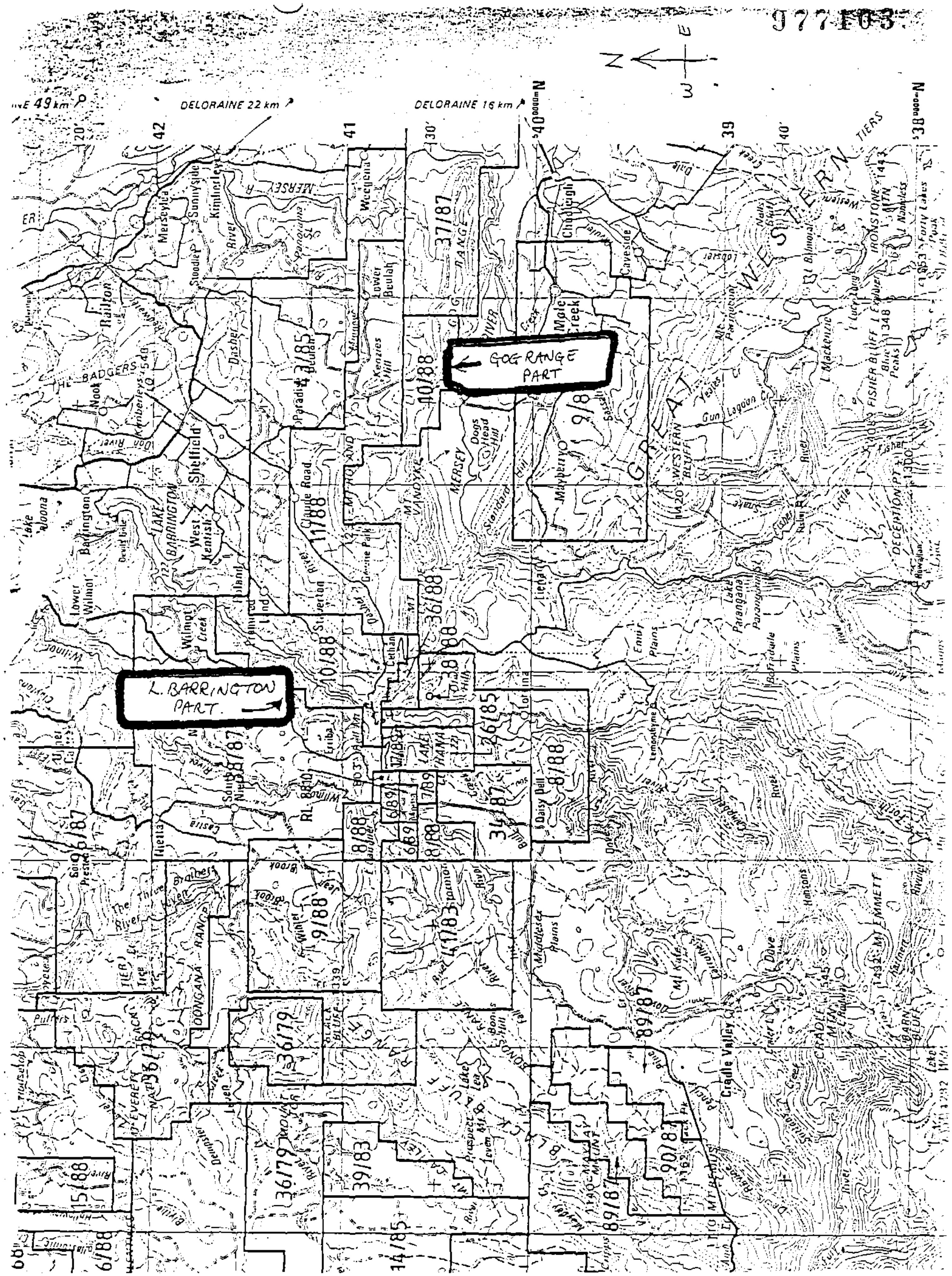
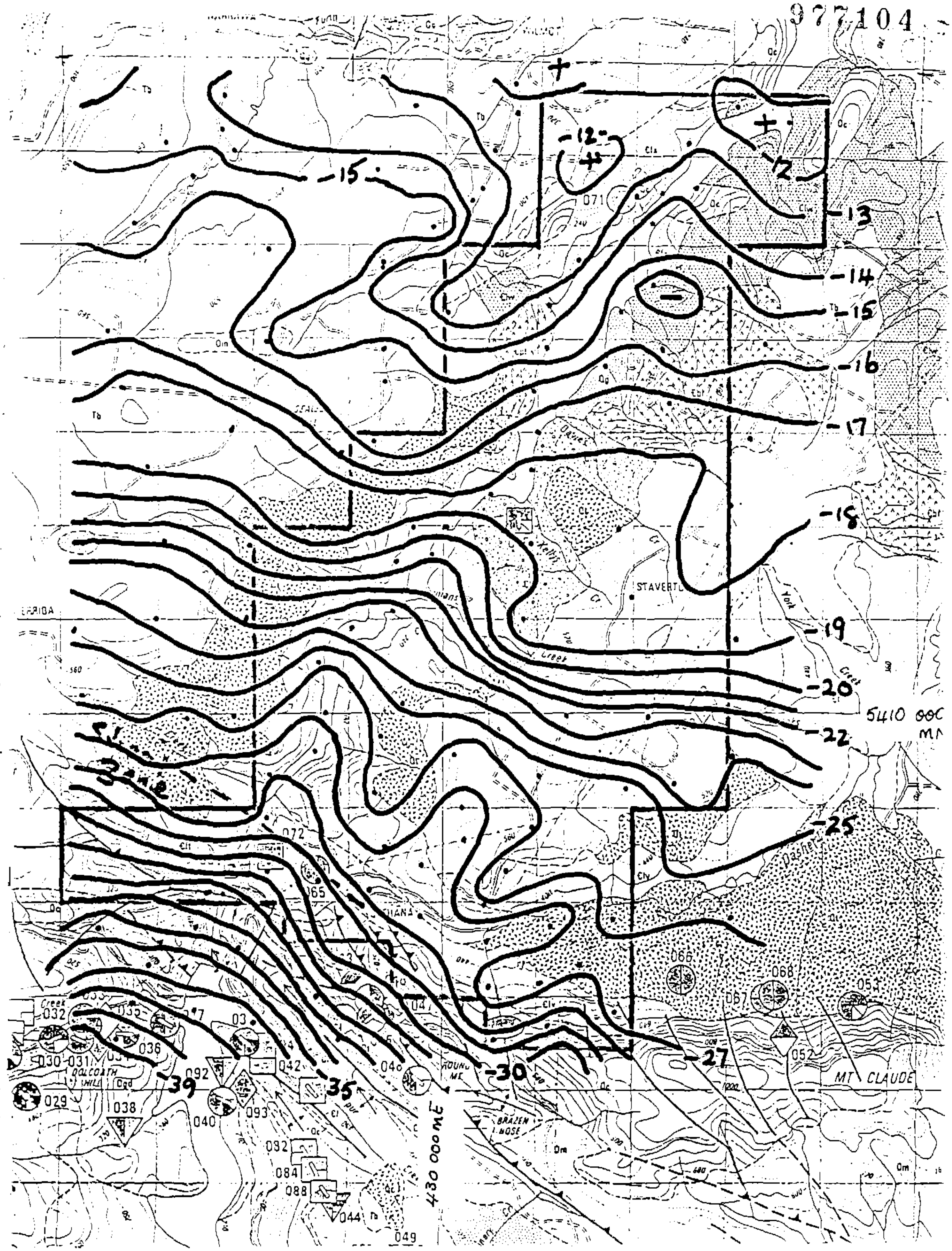
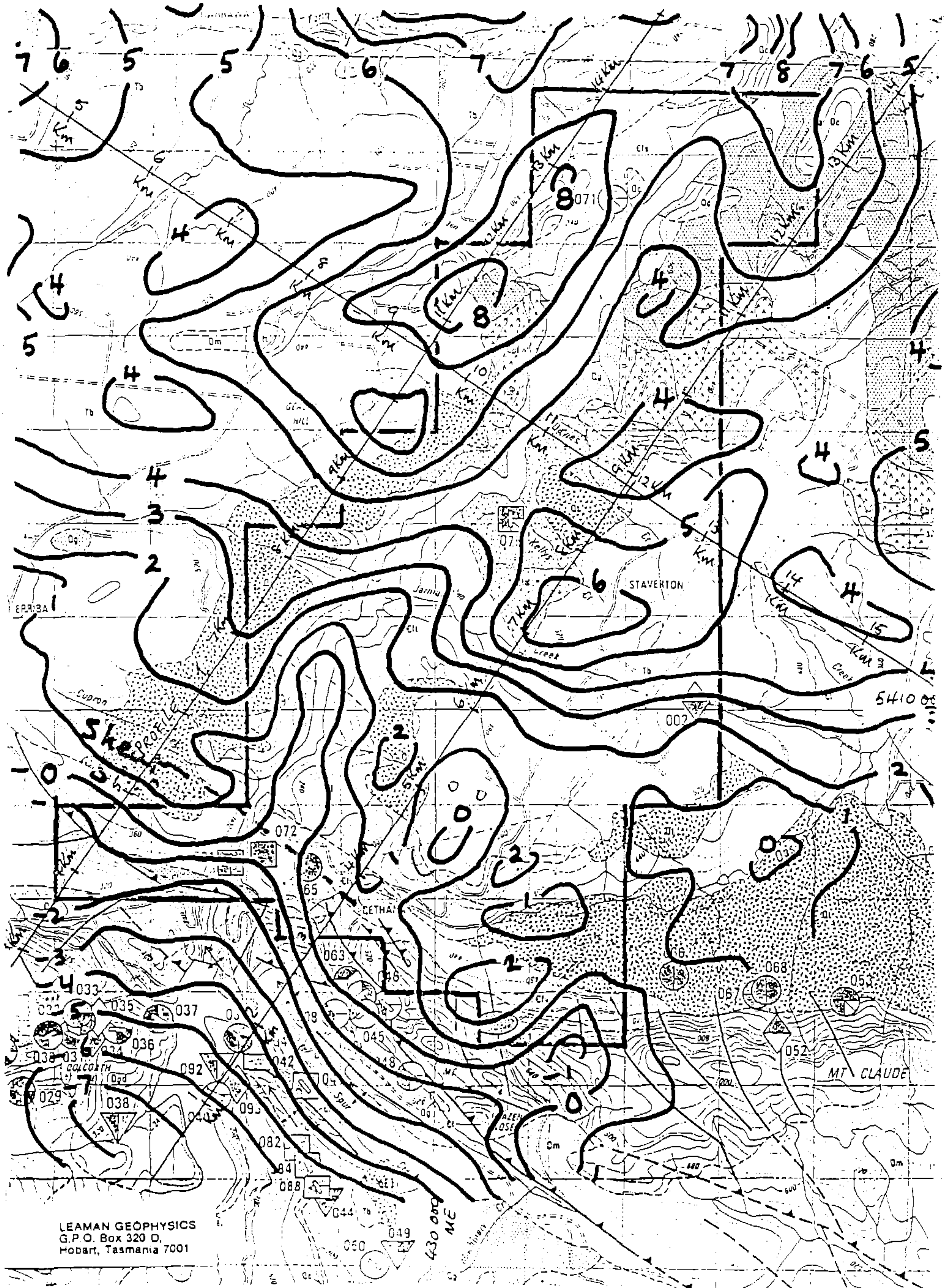


EL 10/88 GOWRIE PARK LOCATION FIGURE 1



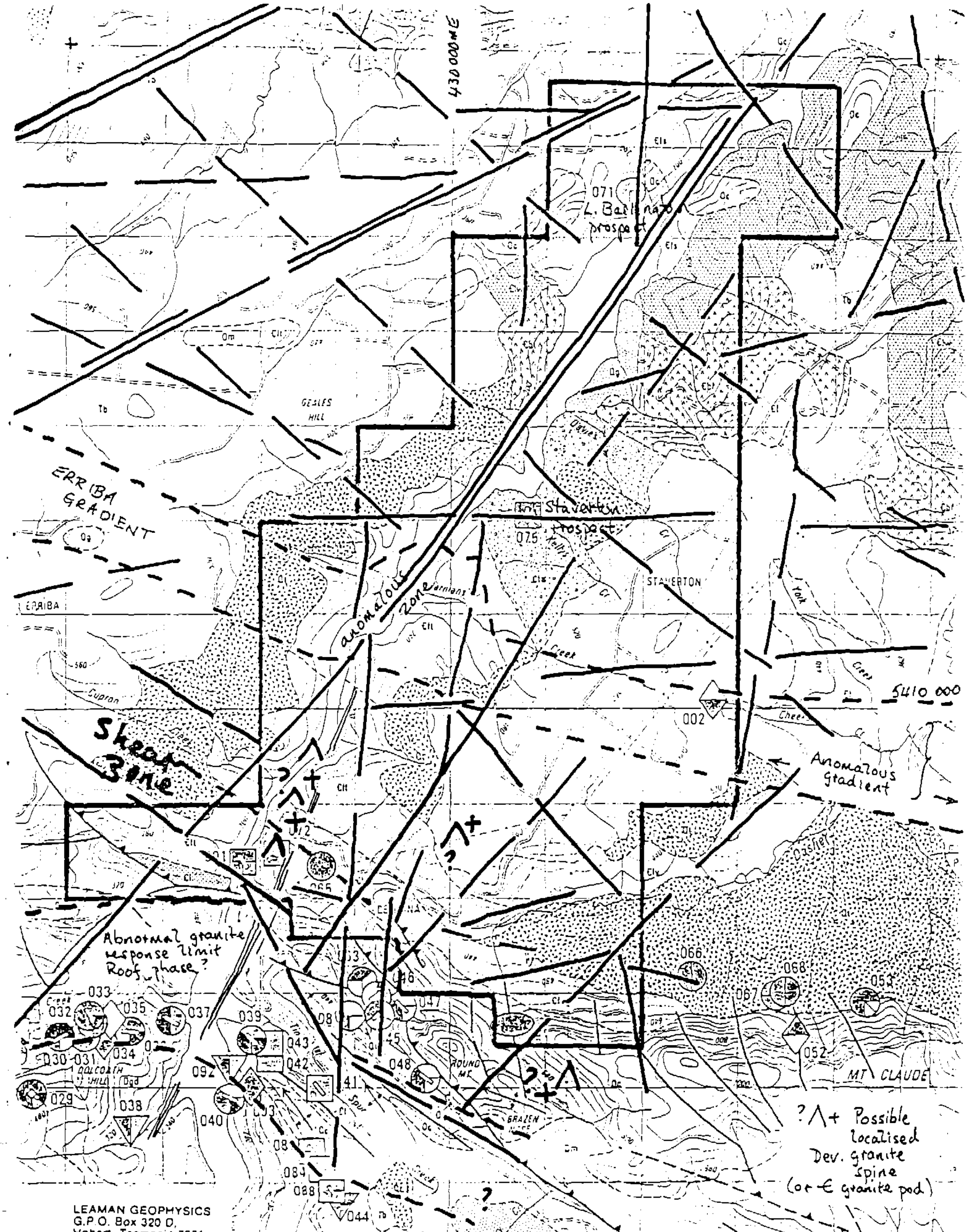
BOUGUER ANOMALY EL 10/88 LAKE BARRINGTON
Sources: TASGRAV and Noranda. Basemap: Bamford & Green (1988)
Reduction density: 2.67 t/cu m

FIGURE 2



RESIDUAL BOUGUER ANOMALY   EL 10/88 LAKE BARRINGTON .
Derived by subtraction of crust, ocean and Dolcoath Granite (see text). Modelled profiles are shown.

977105 FIGURE 3



PRIMARY TRENDS AND STRUCTURES INFERRED FROM RESIDUAL ANOMALIES
EL 10/88 LAKE BARRINGTON

FIGURE 4

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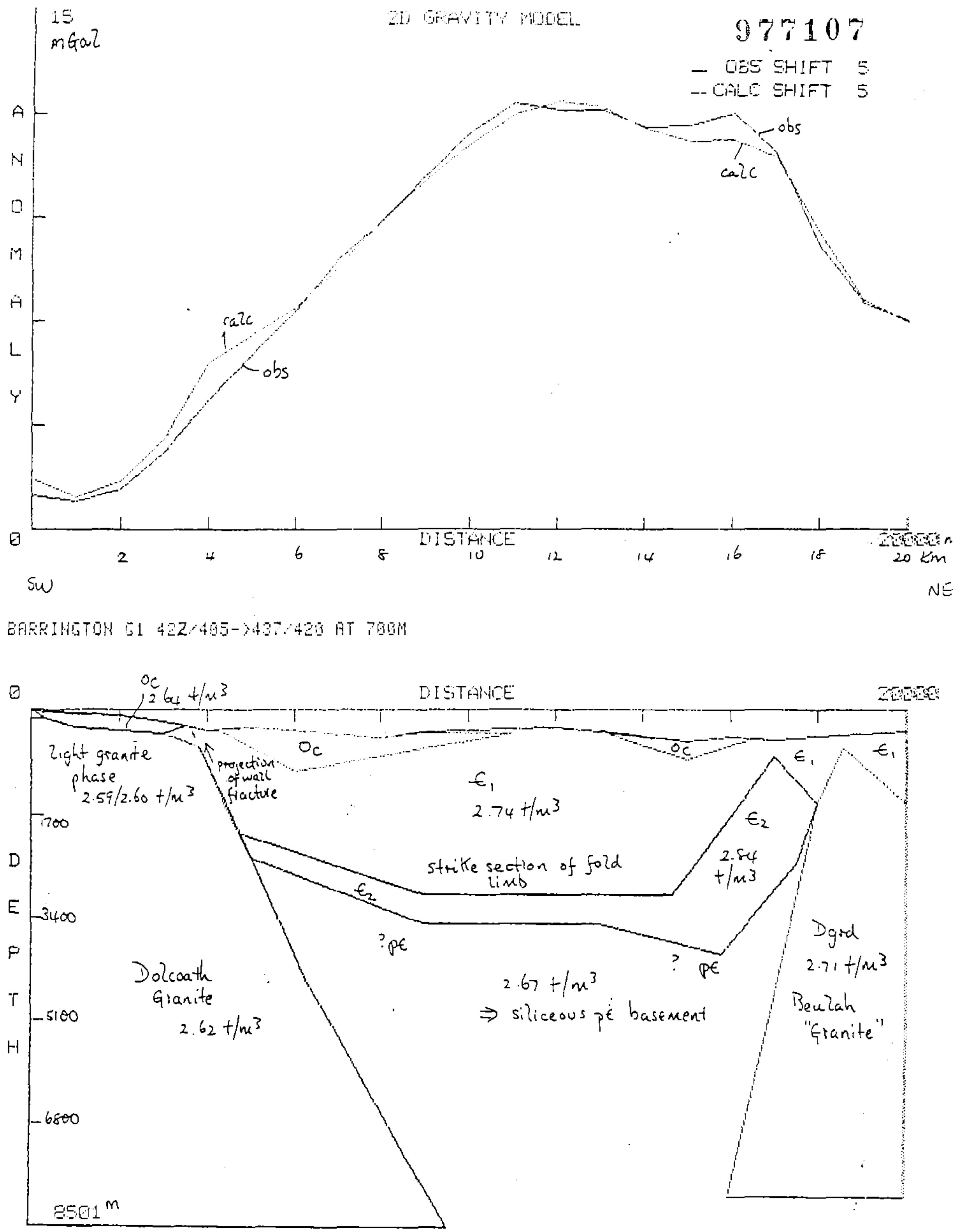

LEAMAN GEOPHYSICS
G.P.O. Box 320 D.
Hobart, Tasmania 7001

2D GRAVITY MODEL PROFILE 1 EL 10/88 LAKE BARRINGTON
FIGURE 5

LINE PARAMETERS - ORIGIN,LIMIT,INCR : 0 20000 1000

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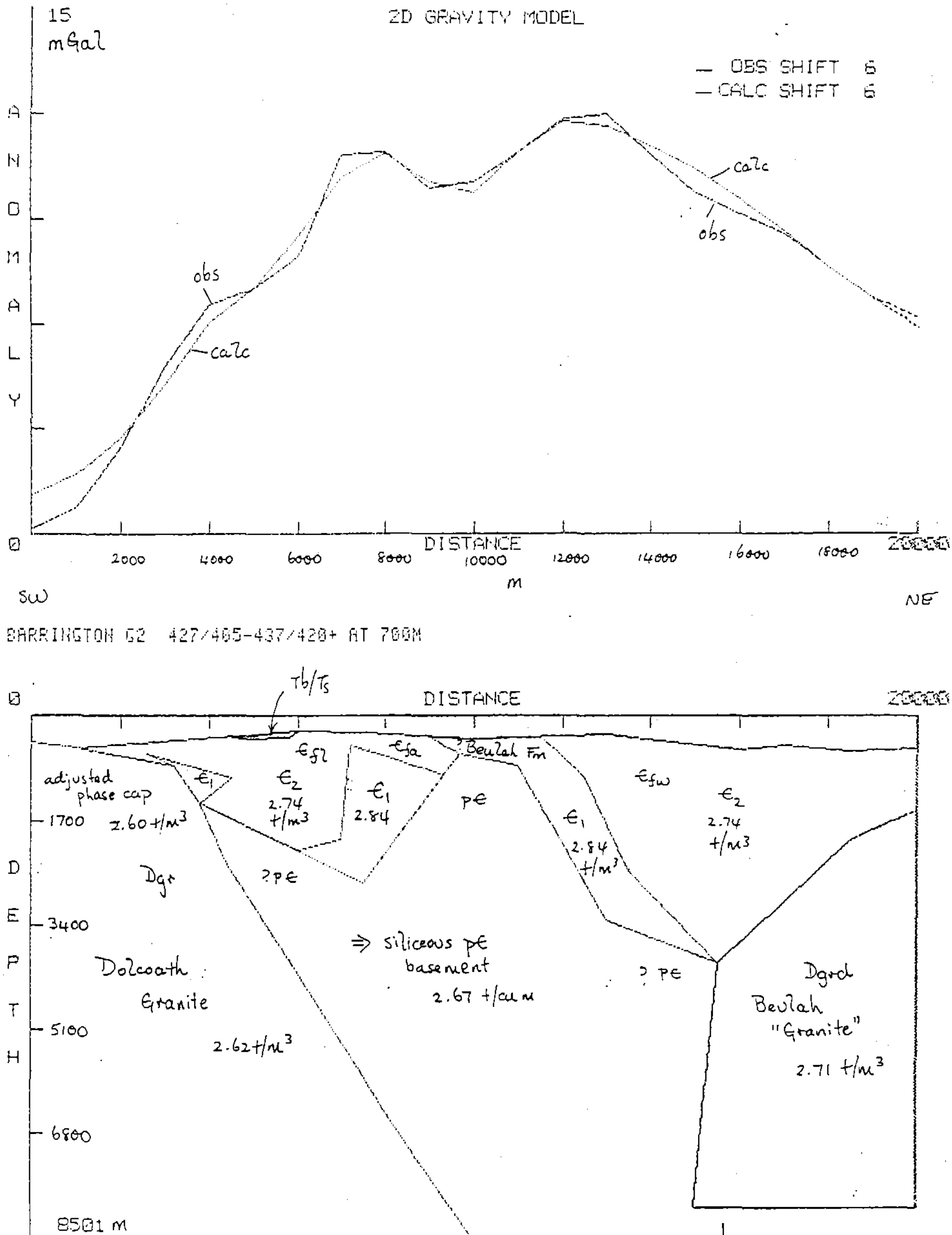

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G.P.O. Box 320 D,
Hobart, Tasmania 7001

2D GRAVITY MODEL PROFILE 2 EL 10/88 LAKE BARRINGTON

FIGURE 6

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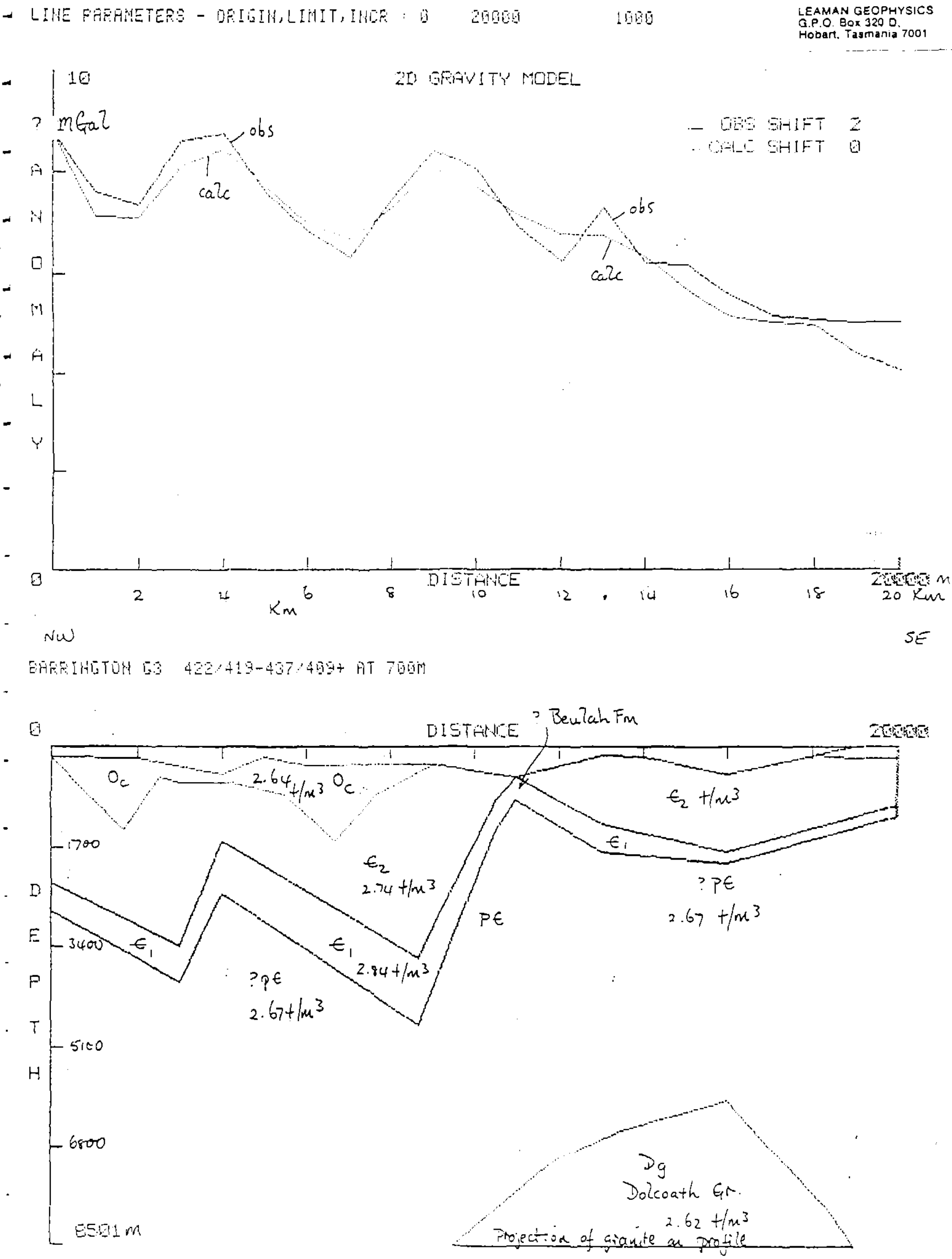
G.P.O. Box 320 D,
Hobart, Tasmania 7001



2D GRAVITY MODEL PROFILE 3 EL 10/88 LAKE BARRINGTON
FIGURE 7

977110

Report submitted on behalf of
Leaman Geophysics
by

D. Leaman

Dr. D.E. Leaman, B.Sc., Ph.D
M.Aus.I.M.M., M.M.I.C.A

2-4-90

APPENDIX F

Aeromagnetic Survey

Acquisition Report and Preliminary Interpretation

Dr D Leaman

LEAMAN GEOPHYSICS
Survey Review, Specification, Reduction, Interpretation
Gravity, Magnetic and Seismic Methods
Structure and Prospect Evaluation

Registered Office:
21 ZOMAY, AVENUE, DYNNYRNE, TAS. 7005
All Correspondence to:
G.P.O. BOX 320 D, HOBART, TAS. 7001.
TELEPHONE: (002) 24 0319
FACSIMILE: (002) 23 3194

AEROMAGNETIC SURVEY
EL 10/88 LAKE BARRINGTON

ACQUISITION REPORT
(INCLUDING PRELIMINARY INTERPRETATION)

for

NORANDA PTY LTD

by

Dr. D.E. Leaman

April 1990

BARRMAG1

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CONTENTS

FIGURES

MAPS

SUMMARY

A new high resolution helicopter aeromagnetic survey of the Lake Barrington region has shown that systematic variations in the magnetic field occur and may be associated with primary structure and fracture systems.

This report describes specification and acquisition of the survey. It also includes a discussion of possible implications but further interpetation requires some re-examination of specific features observed at, or near, known mineralised sites and use of observed rather than processed data.

The most persistent and largest features trend WNW-ESE. These clearly reflect gross structure or basement involvements.
Some other lesser trends and lineaments can be recognised. These display NE-SW and NW-SE orientations approximately. It is not possible to define the relative significance of these features due to their variable presentation in different image or contour displays. Such features probably represent transverse or conjugate fracture sets.

The largest responses observed in the survey area can be associated with mafic members of the Cambrian sequence or local aureole effects around irregularities in granites, most of which appear to be relatively small, and probably, Cambrian bodies.

Mineralised sites can be consistently explained by the defined elements of the magnetic field. Those sites far removed from the influence of granites appear to lie near intersection of NW-SE and E-W lineaments although the ultimate control may be NE-SW. Few sites are present and this restricts confidence in the association suggested. The relative simplicity of the alignment patterns does mean, however, that the propositions may be readily tested and reviewed.

The locations of known mineralised sites and implied lineaments should be determined as accurately as possible and literature reviewed to assess suggestions of apparently more subtle fracture orientations or stress controls at the site. Both gravity and magnetic data sets imply similar patterns and a complementary interpretation although the magnetic data offer a capacity for more precise location of character. The region immediately west and south west of the Staverton prospect remains the most obviously anomalous and initial detailed work should be undertaken there.

The survey has shown that detailed airborne magnetic surveys can add to the structural appraisal and possible understanding of the setting of known mineralisation. No analysis of local rock alteration is included but this should be undertaken as soon as tapes of corrected data from the survey are supplied by the contractor.

INTRODUCTION

EL 10/88, Lake Barrington, extends north from Cethana along the valley of the Forth River in north west Tasmania (Figure 1).

The area has been subject to previous exploration and has been covered by regional gravity and magnetic surveys (e.g., Bishop, 1987). This data was reviewed by Leaman (1989) who recommended much improved magnetic coverage and some infill of the gravity data base. Existing data were suggestive but lacking in resolution.

The gravity infill survey was recently completed and reported (Leaman, 1990). The clarification provided by the improved coverage coupled with a reliable regional separation revealed primary structural alignments which, though often suspected but not demonstrable from current exposure or surface mapping, have influenced evolution and mineralisation of the area. Gravity data also imply presence of several small Cambrian granitoids fringing the NE face of the Devonian Dolcoath Granite and a distinctly anomalous region SW of the Staverton Prospect (430 800 mE, 5412 000 mN). The distribution of Cambrian granitoids implied suggests that a small cluster of these bodies have been dilated or separated by the emplacement of the larger Devonian mass.

Previous aeromagnetic surveys have been undertaken with quite coarse line spacings and often erratic flight clearances. The latter are inevitably imposed in this area by use of fixed wing aircraft. These deficiencies have not greatly affected regional evaluations but have prohibited any prospect evaluation or predictive application. Tertiary materials, which cap the divides, have also tended, or have appeared, to dominate the presentation due to lack of resolution.

The new aeromagnetic survey was specified with the lowest feasible terrain clearance, close line spacings (as survey and tie lines), and a sensitive magnetometer. Helicopter acquisition was essential.

This report details the new survey and preliminary implications. It is intended as an outline of specifications and to foster discussion and close inspection of the observations and their correlation with the complex geology of the area.

MAGNETIC SURVEY

SPECIFICATION

Specifications for the survey were determined by the previous experience provided by the Mines Department survey (Bishop, 1987) and the need to resolve possible alteration features, subtle trends, and the contribution due to Tertiary materials. Leaman (1986, 1987) has established the general viability of magnetic methods for assessment of alteration and mineralised sites in areas free of strong interference effects such as introduced by Tertiary basalt. The responses sought are known to be subtle and all previous data has lacked the necessary data resolution - in terms of low clearance, close sampling and line density. Detail, once lost due to variable or excessive clearances, is not recoverable.
Since it is not yet known whether the magnetic method is of direct exploration value in the Barrington environment it was important to ensure that a fair and substantial trial of the application was permitted. The best practicable specification was defined.

Line spacing: 150 metres E-W
Tie line spacing: 500 metres N-S
Nominal terrain clearance: 80m.
Sample interval: < 10 m.
Magnetometer sensitivity: < 0.01 nT.

The line balance and orientation reflects the general form of the terrain and the need to define sub E-W or NW-SE and SW-NE trends as suggested by gravity surveys and the Mines Department survey. Rigorous draping necessitated use of a helicopter. Use of fixed wing aircraft, a higher nominal clearance and general wide variation in that clearance effectively destroyed the resolving power of the Mines Department survey across the important, relatively low relief magnetic field environment associated with the window of Cambrian rocks along the valley. The tie line density reflects the need to properly define, or separate, any effects induced due to the capping of Tertiary materials on the divides.

Multichannel radiometric data were also specified but no commitment was made toward processing of that data pending inspection of the raw data.
(This data has not yet been fully processed and it is possible that no further analysis will be undertaken).

SURVEY

The survey was flown in February 1990 by Geo Instruments Pty Ltd under the supervision of Zoltan Beldi using a G-813 proton precession magnetometer in a towed bird and a GR 3001 spectrometer with 16.8 l capacity.

An equivalent magnetometer was used as base station and the survey was completed in one day.

Survey tracking was visual supported by colour video using topographic basemaps and aerial photographs with a recovery scale of 1: 10000. The only problem experienced in this area related to avoidance of high clearance power lines.

Total line coverage was about 380 km. Line recovery and line location details are presented in Map 1 (folder).

PROCESSING

Flight path digitising, processing, gridding and mapping were performed by Pitt Research Pty Ltd of Sydney.
IGRF 1985 was removed from the data and a scalar of 5000 nT added to residual data.
The stability of gridding and acquisition was tested by preparation of pixel image maps which expose line misties. The many cross ties generated by this survey were adjusted by spline interpolations in both directions.

A contour interval of 5 nT was selected for the primary presentation (Map 3 - folder) as a compromise separation able to provide a reasonable amount of detail in areas with subtle variations in magnetic field. Stacked profiles are presented in Map 2.

Radiometric data has not been corrected, levelled or compiled beyond the raw presentation shown in Figure 5.

DATA PRESENTATION

Maps 1, 2 and 3 (folders) provide detailed presentation of the survey coverage, observed profiles and contours of the magnetic field at 1: 25000 scale.

Figures 2 to 5 provide pixel image versions of the magnetic data using various colour and lighting combinations. Figure 4 presents the horizontal gradient. Figures 6A and 6B provide reduced versions of Map 3.

All images were prepared by Pitt Research Pty Ltd.

Figure 7 supplies a plot of past workings or known mineralisation based on the compilation of Bamford and Green (1988) and is not necessarily complete. This plot is at the same scale (1: 100000) as the images and a transparency is included in the pocket with Map 1.

INTERPRETIVE COMMENTS

The following comments outline possible correlations and implications within and of the data set with respect to exposed geology and mineralised sites.

The principal object of this discussion has been to assess observed features and possible identification of patterns and relationships which may lead to explanation of known sites and prediction of possible targets for follow-up study.

All styles of presentation have been reviewed.

FIGURE 2 suggests the first order character of the magnetic field. The features illustrated in this coarse colour image are comparable with those observed in the Mines Department survey (Bishop, 1987).

Several magnetic regimes are suggested by this figure which reduces the survey to regional character due to broad banding of amplitudes. High frequency character has been subdued. Figure 8 provides clarification of terminology and location.

The first regime lies south of 5410 000 mN and is a broad belt of raised intensity. It is disturbed east of 430 000 mE and may be composed of two ESE-trending zones; one near the Dolcoath Granite, and another near 5410 000 mN. The disturbed area centred on 431 500, 5409 000 lies within a basalt-covered region but the scale of the features observed is not consistent with sources within the Tertiary cover. The extension of this effect along the basalt-capped ridge through Staverton village shows that the basalt contributes little of the response.

Leaman (1989) suggested that the Dolcoath Granite elevated rock magnetisation contrasts in the thermal aureole of the granite and this effect could account for some of the changes S and SW of Cethana. It cannot explain the continuity of the response toward Mt Claude (see Figure 6B for locations).

Leaman (1990) further suggested that some minor Cambrian granitoids may occur N and NE of the Dolcoath Granite. These could account for the more northerly features in this regime, including the disturbed area NE of Cethana. The gravity and magnetic responses can be correlated within the resolution permitted by the gravity station spacing.

The near N-S effect observed near 430 000 mE is also reflected by gravity data.

The centre of the "disturbed" magnetic field at 431 500, 5409 000 lies near a local positive gravity effect which is ringed by gravity residuals up to 2 mGal lower. The correlation between these effects is too close to be accident and suggests the presence of a relatively low density magnetic lithology within a core of denser non magnetic material. This might be explained by a domal fold with variable Cambrian volcanics or a composite, but small, granitoid body. Other responses fringing the outer zone of the Dolcoath Granite are also consistent with this view. The lithologies implied must include intermediate compositions.

A belt of low intensity covers the centre of the surveyed area and this defines the second regime. The reduced field intensity extends far more broadly than might have been suggested by casual inspection of contour maps such as Figure 6 or Map 3.

The southern boundary, trending ESE near 5410 000 mN, is marked and the strong gradient across this zone can be correlated closely with the southern edge of the Erriba Gradient of Leaman (1990) as defined by the gravity survey. The slight trend changes indicated by gravity data near Lake Barrington have also been reproduced.

Figure 9 presents the gravity field in a form which can be compared with the images. A transparency is included in the pocket for Map 2.

The northern limit of this regime is also clearly defined - by a NW-SE gradient and step anomaly. This feature was also suggested by the gravity survey but not precisely located or oriented (see Figure 4, Leaman, 1990).

Figure 2 shows that the source of the regime 2 feature is relatively non magnetic. Comparison with the gravity data set shows that it is also denser than normal Cambrian suites. There is also no direct correlation between the presumed Beulah Formation as exposed and the magnetic field implying either that this unit does not account for the gravity-magnetic responses or that its mafic content is low.

This pattern and association could indicate the presence of shallow basement with non Tyennan compositions.

There are several suggestions of NW-SE trends within the bland presentation of this regime in this figure.

The third regime lies NE of the strong NW-SE gradient through 432 000 mE, 5415 000 mN.

The regime is in two parts; one extending E and NE which is only marginally more magnetic than regime 2 and another centred near 432 000, 5417 500 which is strongly magnetic. The most strongly magnetised rocks in the area lie in this northern segment. The anomaly pattern, for either type, can not be correlated with Tertiary basalt; it is too regional and extends beyond outcrop or talus. The most positive gravity anomalies can, however, be correlated (compare Figure 3, Leaman, 1990). These observations imply a predominantly mafic sequence NW of Lake Barrington.

Two zones of distinctive response, each trending approximately NE-SW, has been observed within the second regime. Each is linked to another regime. Each could be associated with the Tertiary cover but close inspection shows that this cannot be the entire solution. In each instance the anomalies extend beyond basalt cover, or talus cover, and part of the response lies within the Cambrian rocks exposed or concealed.

The extension of the northwestern feature (marked 4A in Figure 8), which joins the magnetic part of regime 3 (3B), corresponds with the steepest gravity gradient and both gravity and magnetic features are terminated at the northern side of the Erriba Gradient (Leaman, 1990). Correlations with the gravity compilation may be made using Figure 9 and the transparency provided.

Similar properties, correlations and disruptions can be associated with the more patchy south eastern feature (labelled 4B in Figure 8) which joins the disturbed part of regime 1.

All patterns are consistent with the primary structural view presented by Leaman (1990, esp. Figure 4) where the disposition of key units has flagged and generated responses and exposed the controlling trends.

Both data sets confirm the existence of primary ESE, NW-SE and NE-SW structures; features which are poorly reflected in extant mapping and whose continuity and scale have not been suspected previously.

If the prospect map (Figure 7) is overlain on Figure 2 some gross structural correlations may be implied.
Mineralisation W and ESE of Cethana lies along, or close to, a major gradient - the northern edge of the southern anomaly belt defined for regime 1 (1A).

The remaining prospects are best associated with NW-SE structures. This crude image implies regional fracture control and the sites are non random. (Gravity data - Leaman, 1990 - could have been interpreted in this way in light of this data set but were not due to the poorer positional resolution afforded by a 1 km station spacing)

FIGURE 3 presents more highly resolved illuminated colour images. All the primary elements seen in Figure 2 can be recognised but some lateral trends are more obvious. The colour separation stresses internal character.

The two perspectives provided, coupled with grey tone relief, have enhanced the character of the field. The continuity of ESE trends is now evident between regimes 1A, 1B and 1 and 2. Several NW-SE systems may also be traced across regimes 2 and 3A. These disrupt elements of 3B and 4A, 4B. See Figure 8 for terminology.

Comparison with Figure 7 now stressess the correlations implied above. For the Lake Barrington and Staverton sites, however, an additional factor can be recognised - a sub E-W trend. This is most pronounced at Lake Barrington but it is evident from inspection of offsets at Staverton.
The more uncertainly located prospect (labelled 002 by Bamford and Green, 1988) can be similarly assigned within location precision.

FIGURE 4 provides additional detail on the character of the field, especially in the form of the horizontal gradient.

Comparison of Figures 4 (monochrome field) and Figure 7 is not helpful due to lack of resolution. The gradient presentation is complicated by the high frequency surface detail associated wtih Tertiary rocks but the ESE and NW gradients are reflected - if subtly in zones 1A and the centre of zone 2.

FIGURE 5 presents a high resolution colour image of the magnetic field and an uncorrected image of total count radiometrics.

While the colour magnetic image improves the resolution of some aspects of Figure 2 it does not add anything new.

The radiometric data, however, are more distinctive and tend to reflect the extent of Tertiary cover.
Comparison with Figure 7 would suggest a correlation between low and high count sites but the relationships are not systematic and appear to be artifacts of the relative exposure of Cambrian and Tertiary materials.

FIGURE 6 presents contours of the magnetic field intensity (Map 3) in reduced form. Figure 6B includes a base map. Tertiary sources appear to dominate the field when viewed in this format; a view which is quite misleading - see Figures 2 to 5.

FIGURE 7 provides a prospect location map. A transparent overlay is included in the pocket for Map I. This diagram stresses the apparently random distribution of known mineralisation in the Lake Barrington area. The considerable spread of Tertiary or Tertiary-derived materials clearly contributes to the paucity of known sites or patterns. The present magnetic survey, coupled with the gravity survey, suggests the nature and origin of controls on known sites and indicates the particular zones which might repay further exploration.

Detailed work is required at one or two of the known sites in order to assess which of the structural features now defined provides the necessary rather than sufficient condition for mineralisation and indeed whether any of the known sites carries economic quantities and grades.

CONCLUSIONS AND RECOMMENDATIONS

While it must be stressed that this report provides only a preliminary descriptive evaluation, and there is much scope for expansion and review, any further work must follow careful appraisal of the mineralised sites and assessment of the implications of the structural trends deduced.

The gravity and magnetic data sets are clearly coherent and complementary and are able to suggest concealed structural and lithological patterns.

This preliminary review of magnetic data has confirmed that the 2 to 3 km wide zone beyond the margin of the Dolcoath Granite contains some complex structures and , possibly, Cambrian granitoids. It has also confirmed all the primary trends inferred from gravity data and specifically located several of them. This improvement reflects data density.

There is also considerable evidence to suggest that the mineralisation for removed from granitoids of any type (e.g. Lake Barrington, Staverton) is associated with NW-SE fracture systems and their intersection with sub E-W features. This is clearly established by the horizontal gradients. Gravity data imply dthe insertion of a NE system as well.

The most complex and anomalous zone lies WSW of Staverton where many structures are terminated, stepped and offset. Both data sets suggest close examination of the zone near 429 300 - 430 000, 5411 500 - 5412 000 is justified. The target area covers both sides of the lake north of Jarmans Creek and WSW of Staverton.
Some other possible target areas could be suggested on the basis that the NW-SE and E-W fracture systems are critical. Such sites would lie near 433 500, 5413 500 and 429 000, 5409 300. Other sites lie beneath Tertiary cover.

Current data presentations do not allow assessment of alteration characteristics within each unit. These properties should be reviewed after receipt of the corrected, located raw data tape from the contractor.

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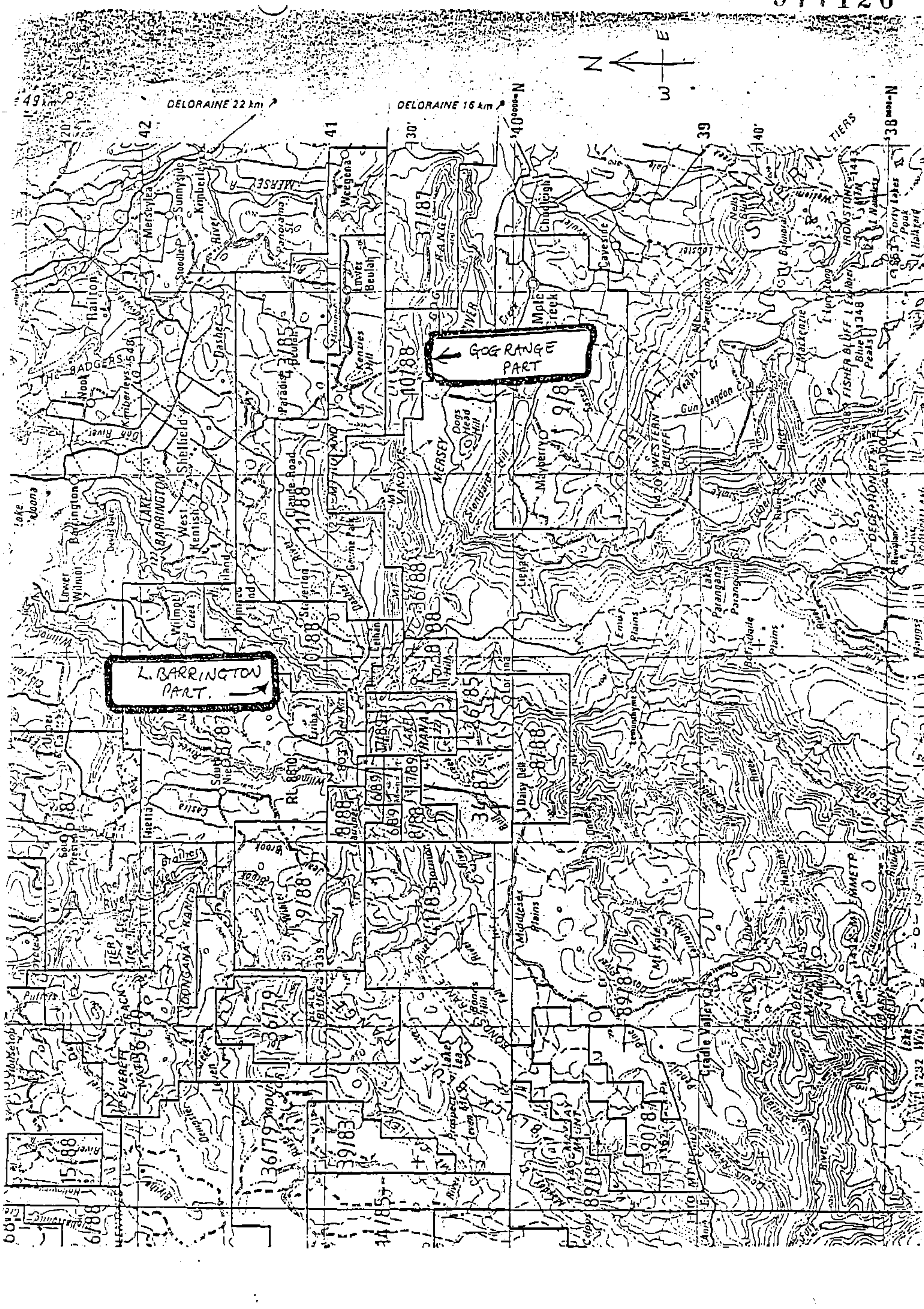
Report submitted on behalf of
Leaman Geophysics
by

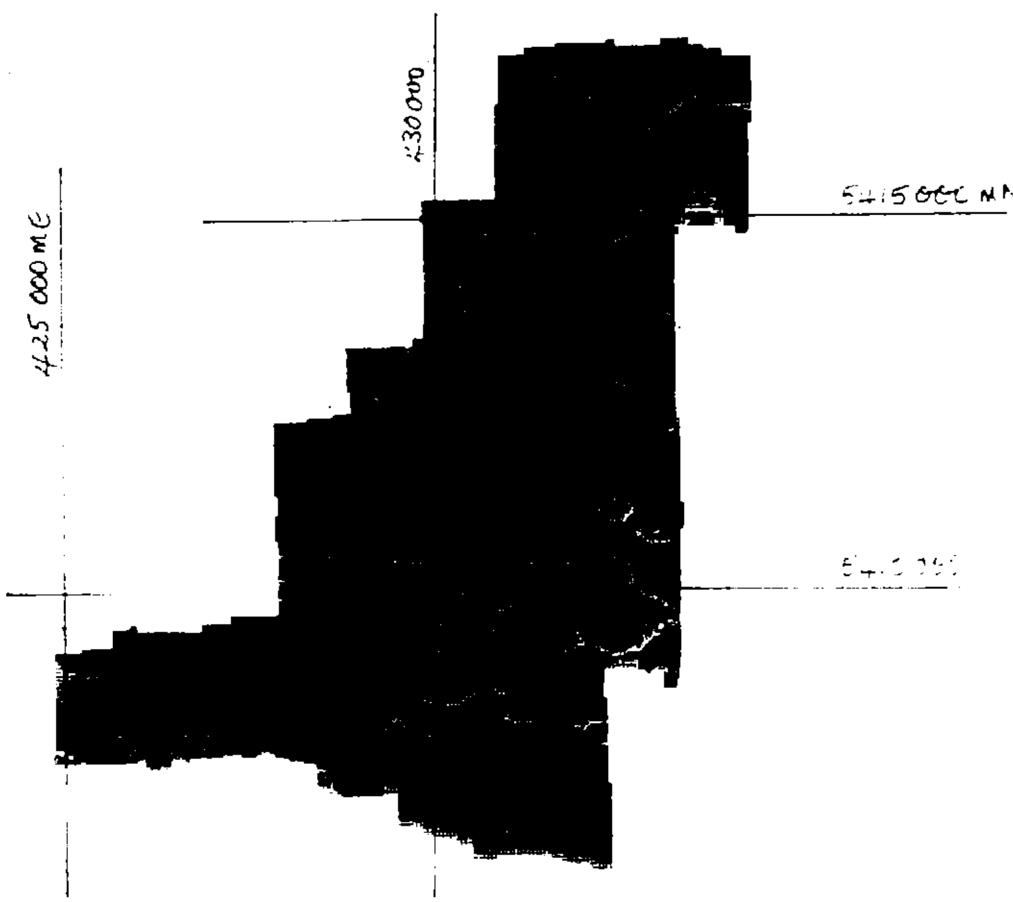
D. Leaman

Dr. D.E. Leaman, B.Sc., Ph.D
M.Aus.I.M.M., M.M.I.C.A

17-4-90



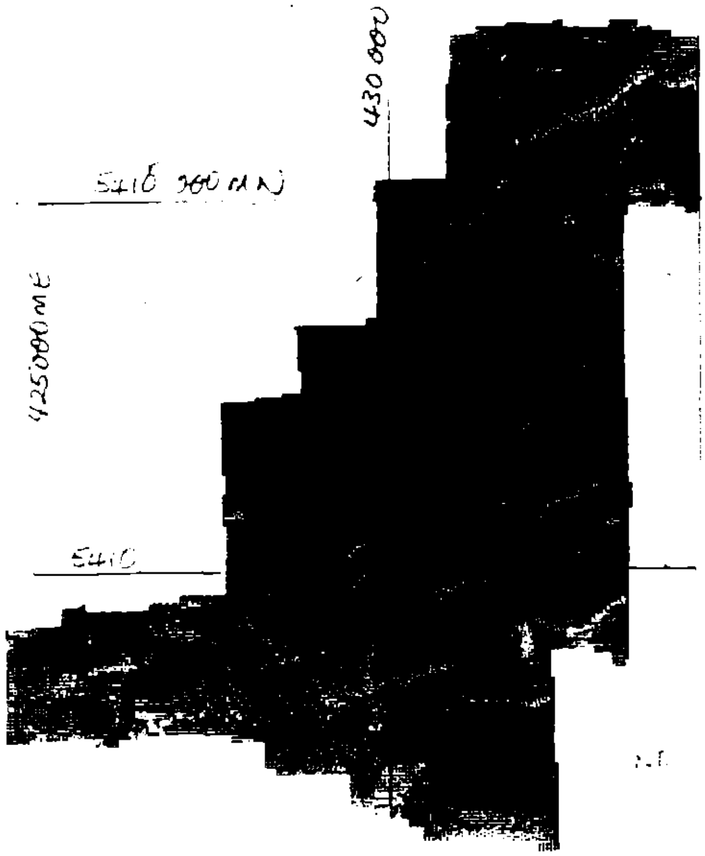
EL 10/88 GOWRIE PARK LOCATION FIGURE 1



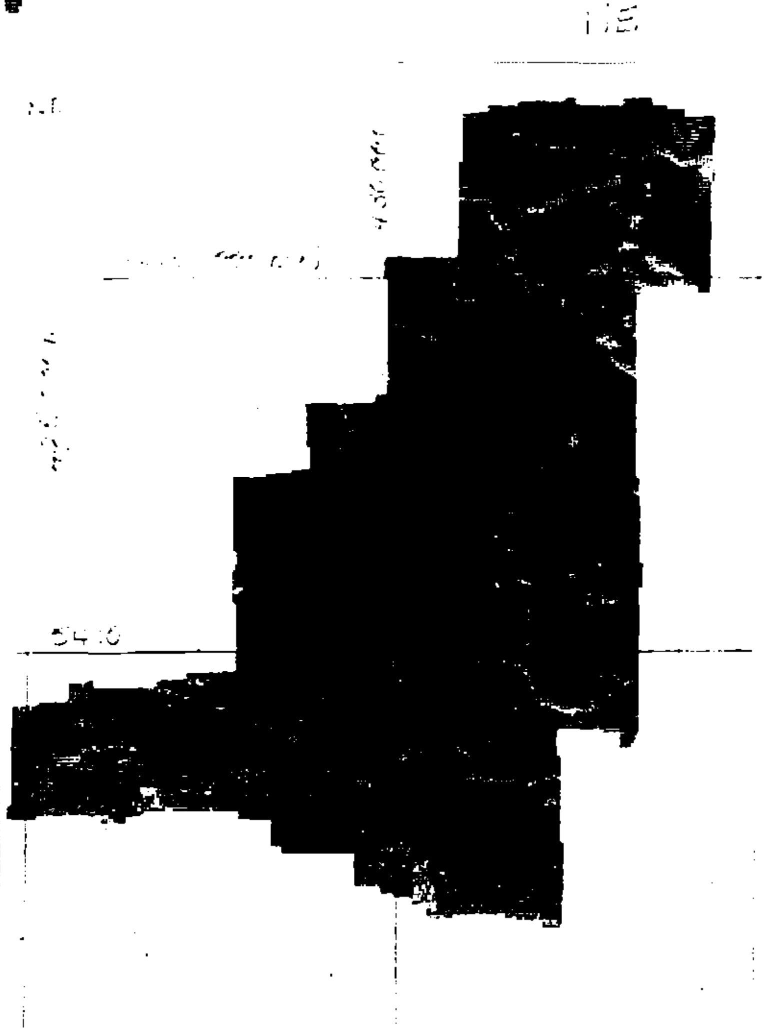
MAGNETIC FIELD
(colour reverse image)

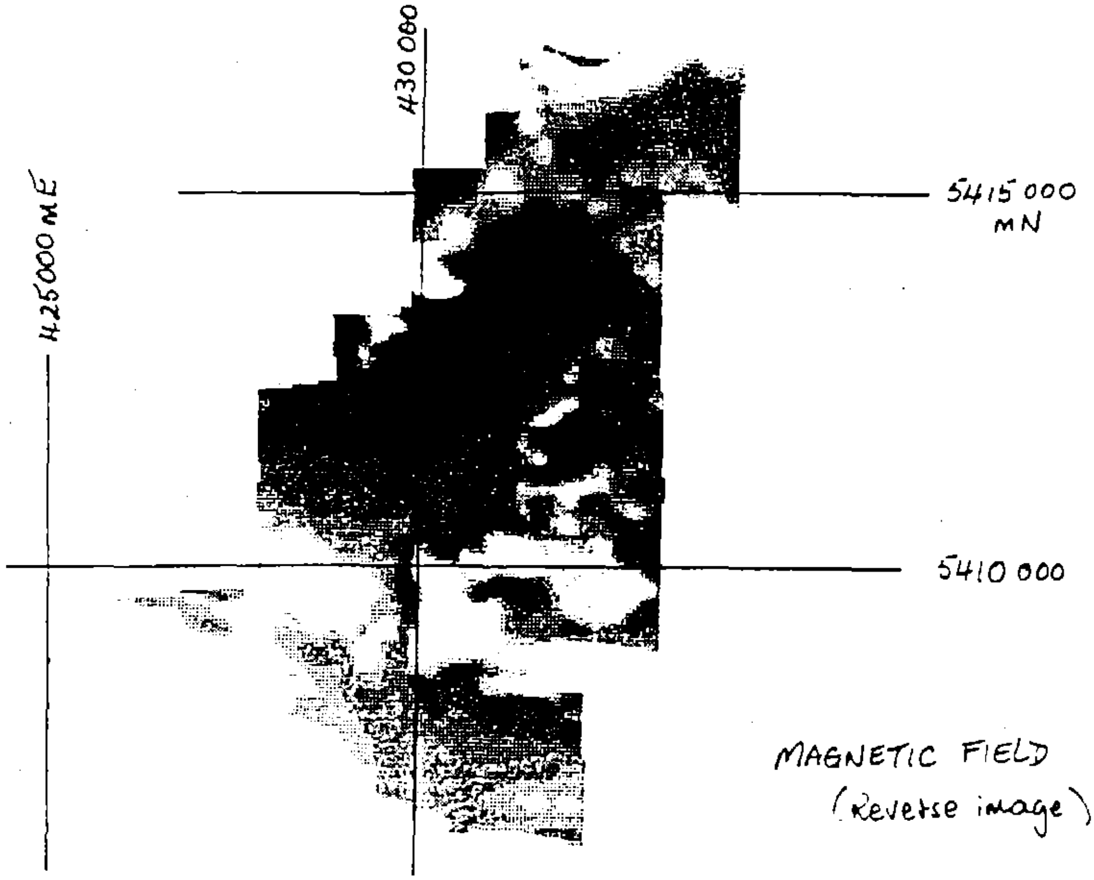
MAGNETIC FIELD

"LIT" IMAGES

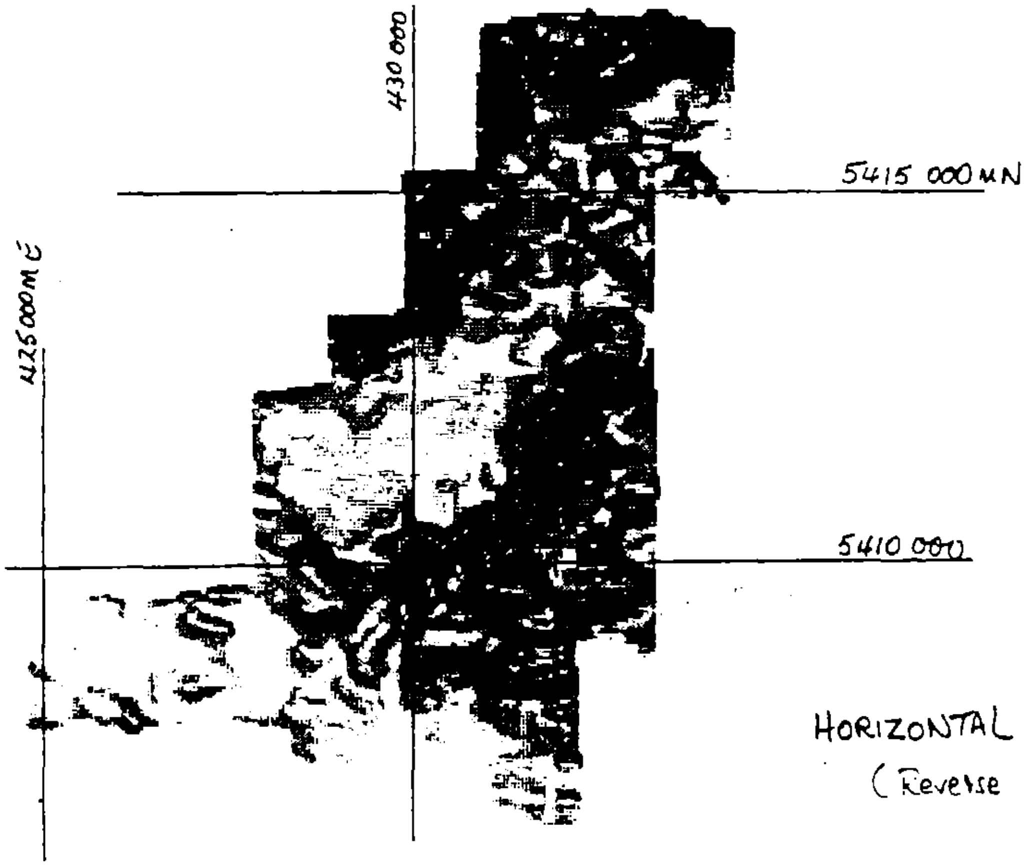


NW lighting



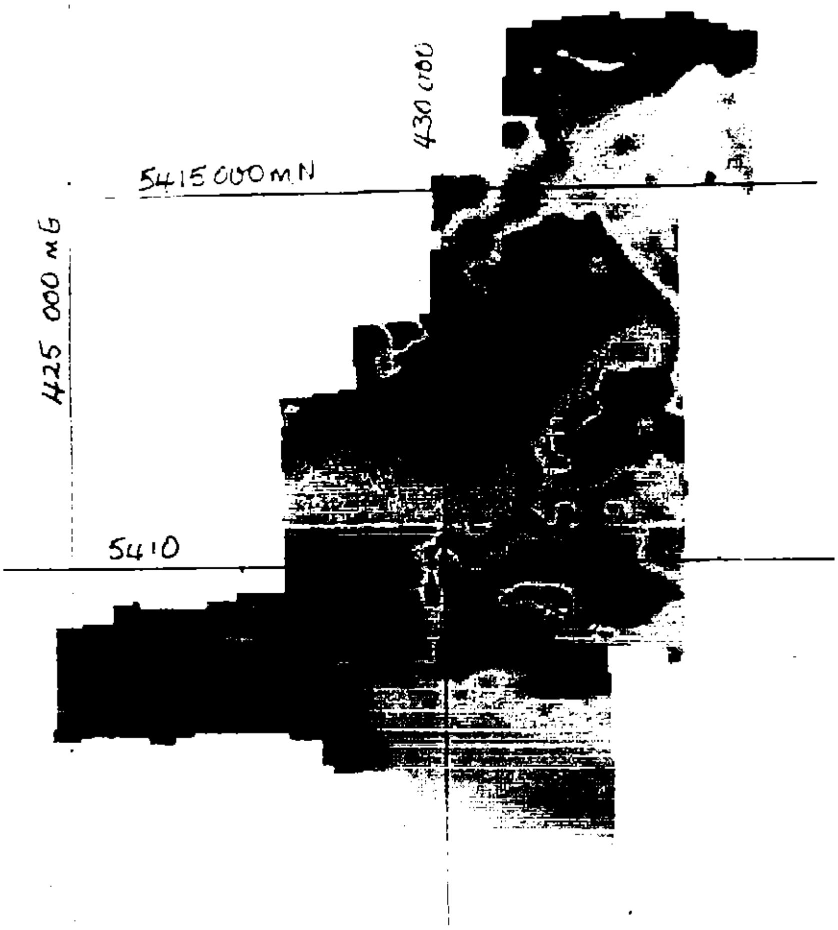


MAGNETIC FIELD
(Reverse image).

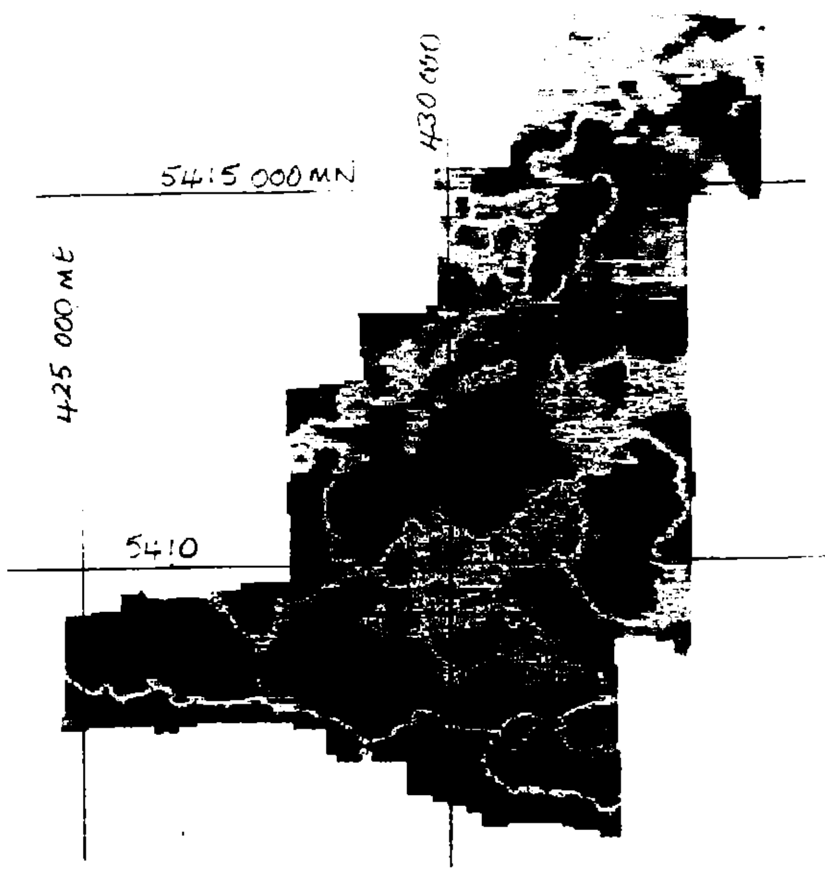


HORIZONTAL GRADIENT
(Reverse image)

FIG. 4

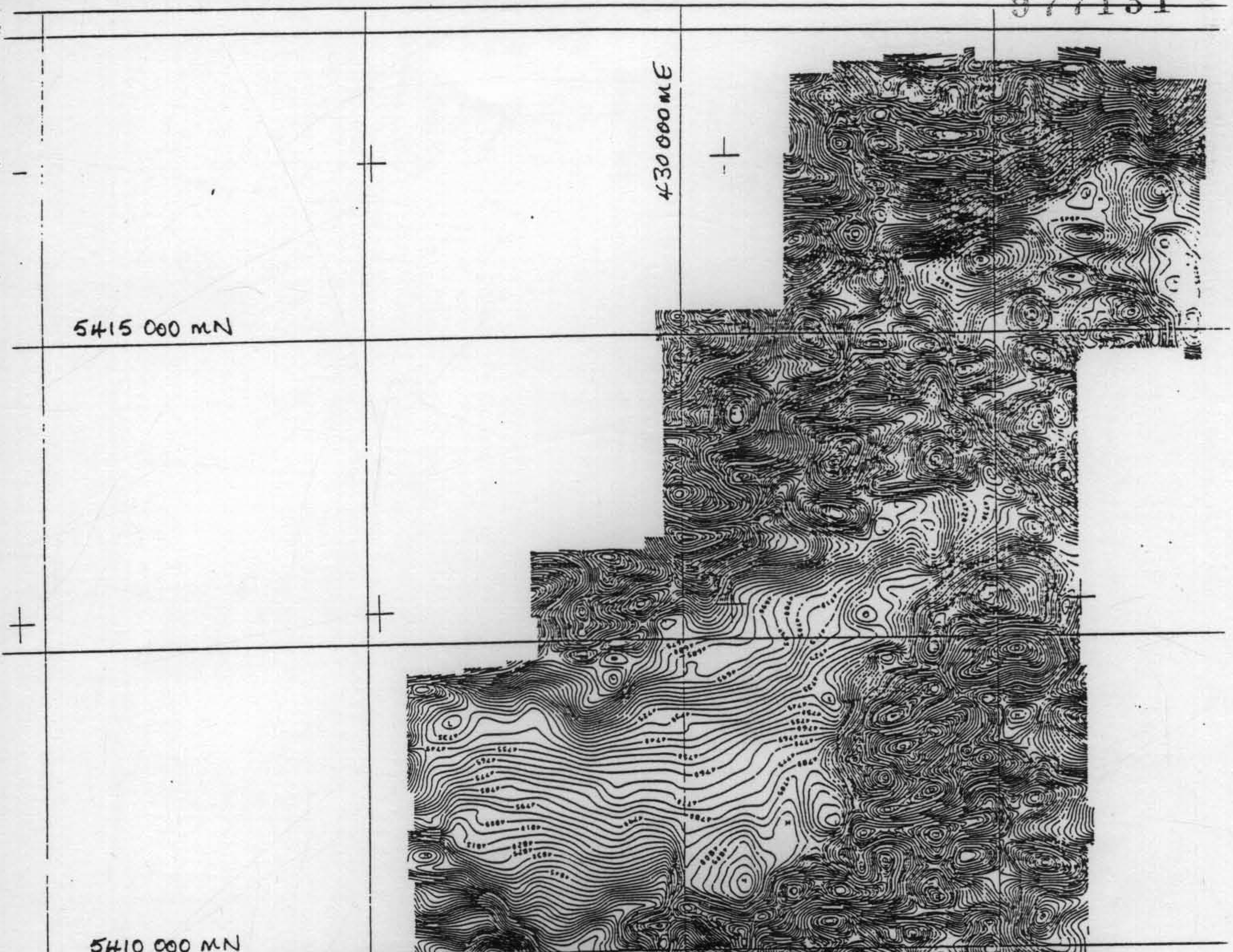


MAGNETIC FIELD
(Hires colour image)



Radiometrics
Total Counts
(INVERSE colour image)

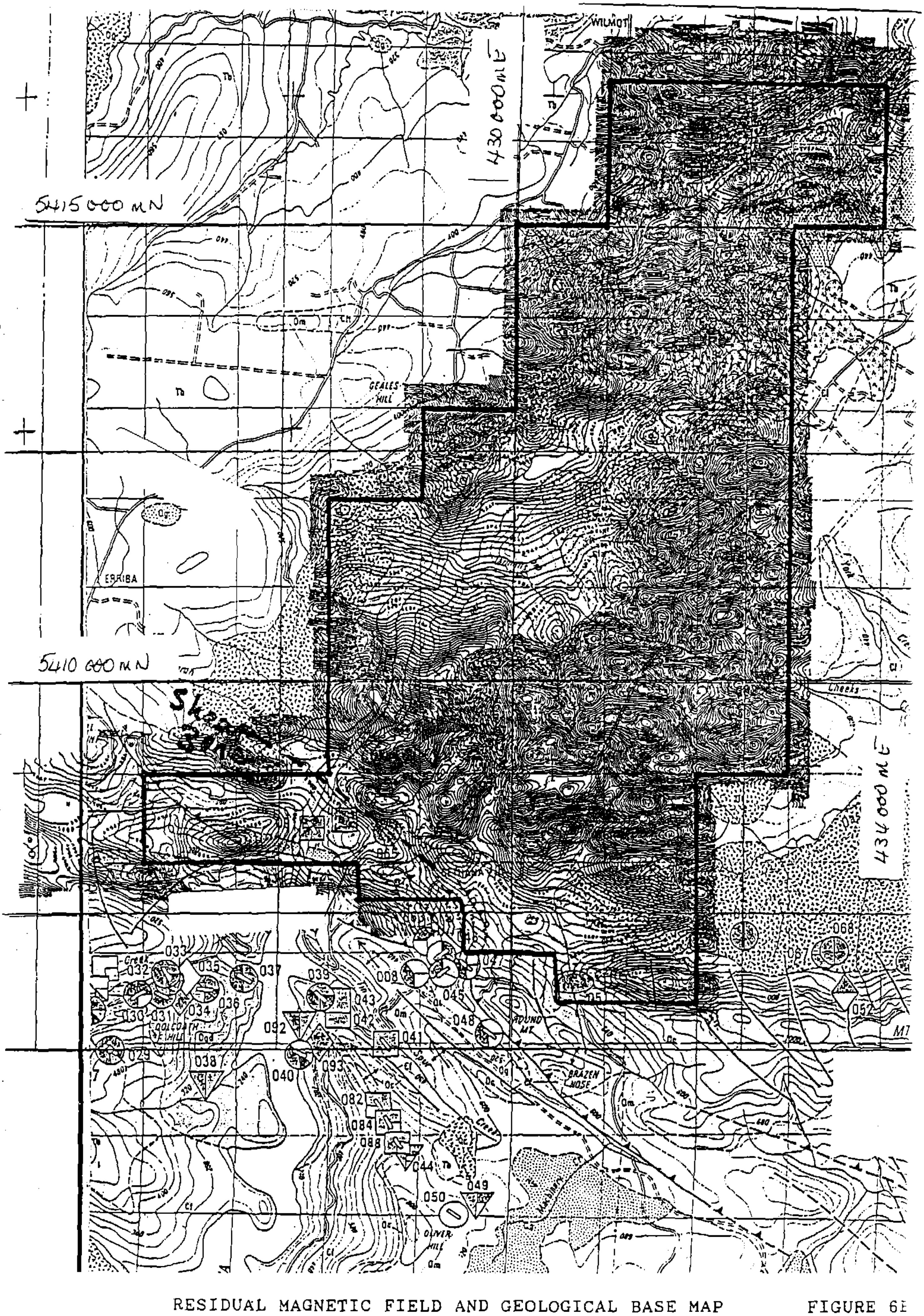
977131



High centred at 29400E 8700N

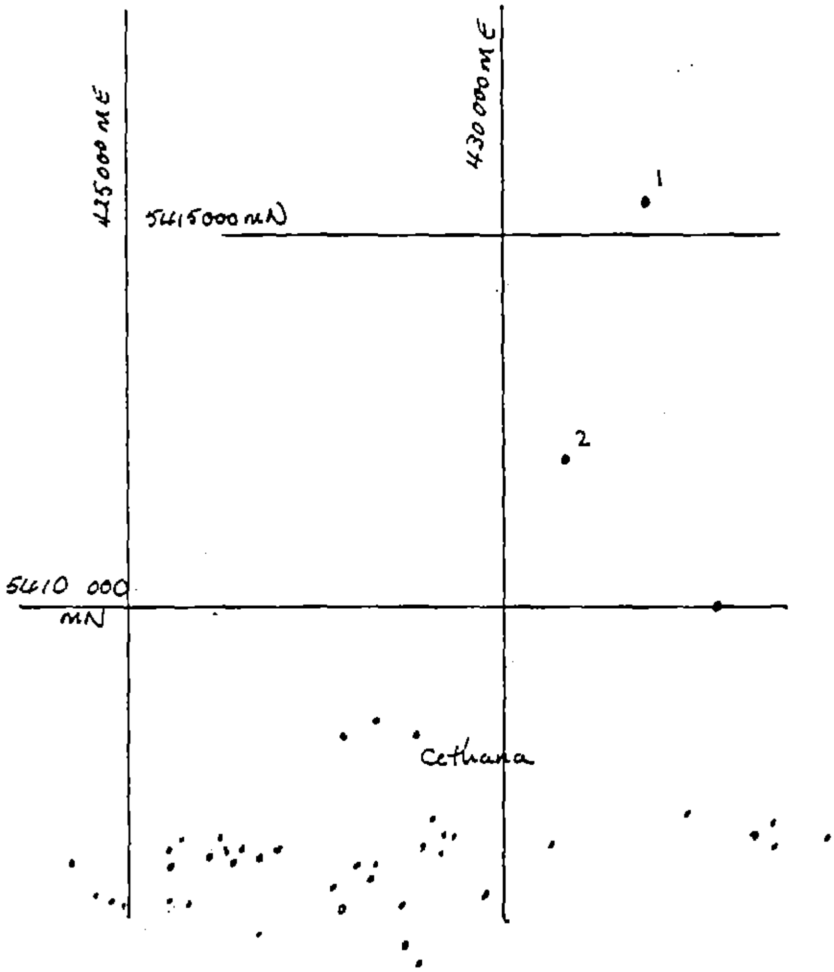
CONTOURS OF RESIDUAL MAGNETIC FIELD
(contour interval 5 nT) See also map 3

FIGURE 6A



RESIDUAL MAGNETIC FIELD AND GEOLOGICAL BASE MAP FIGURE 6E
Basemap by Bamford & Green (1988).

977132

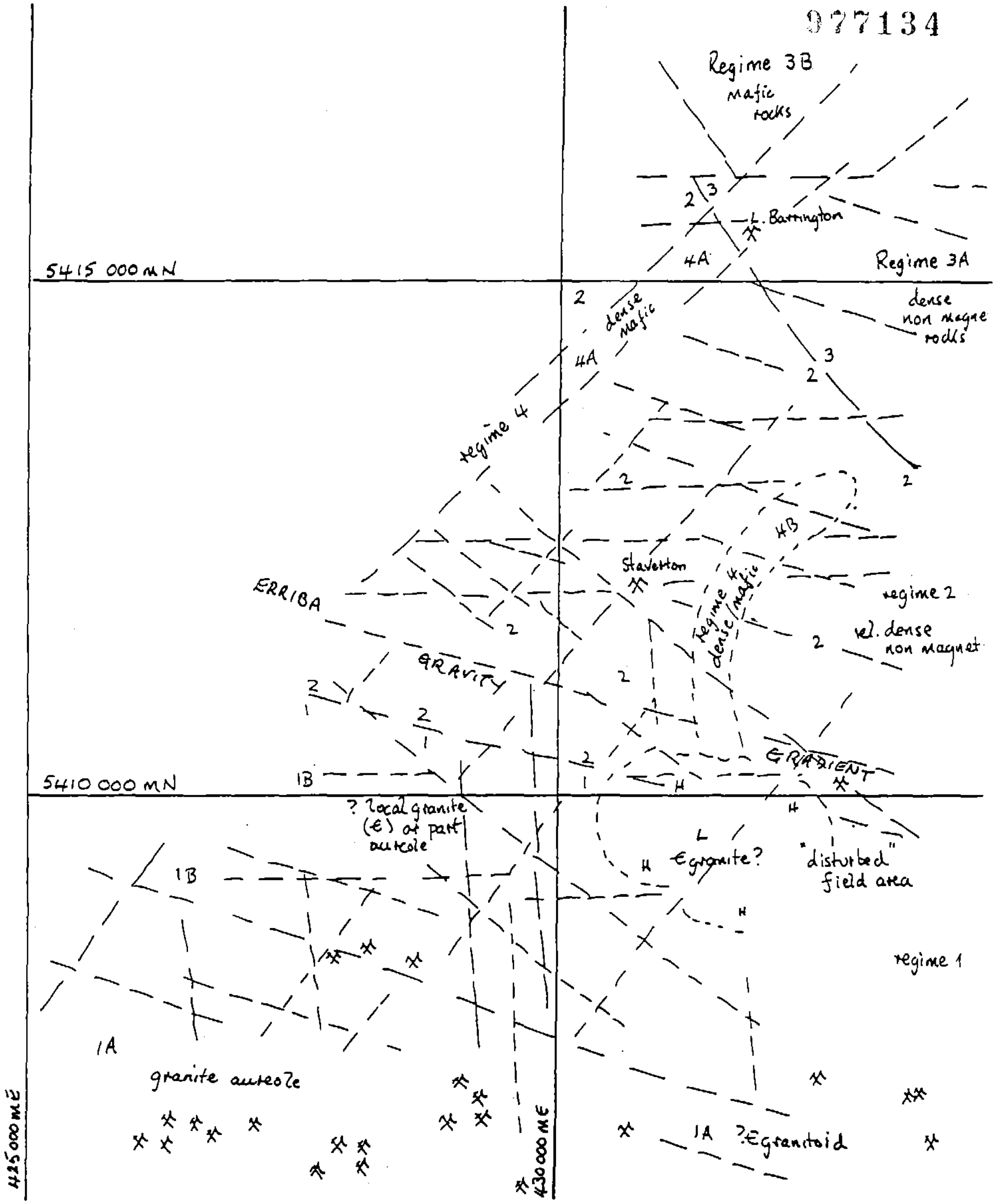


1. Lake Barrington
2. Staverton

Locations after
Bamford & Green (1988)

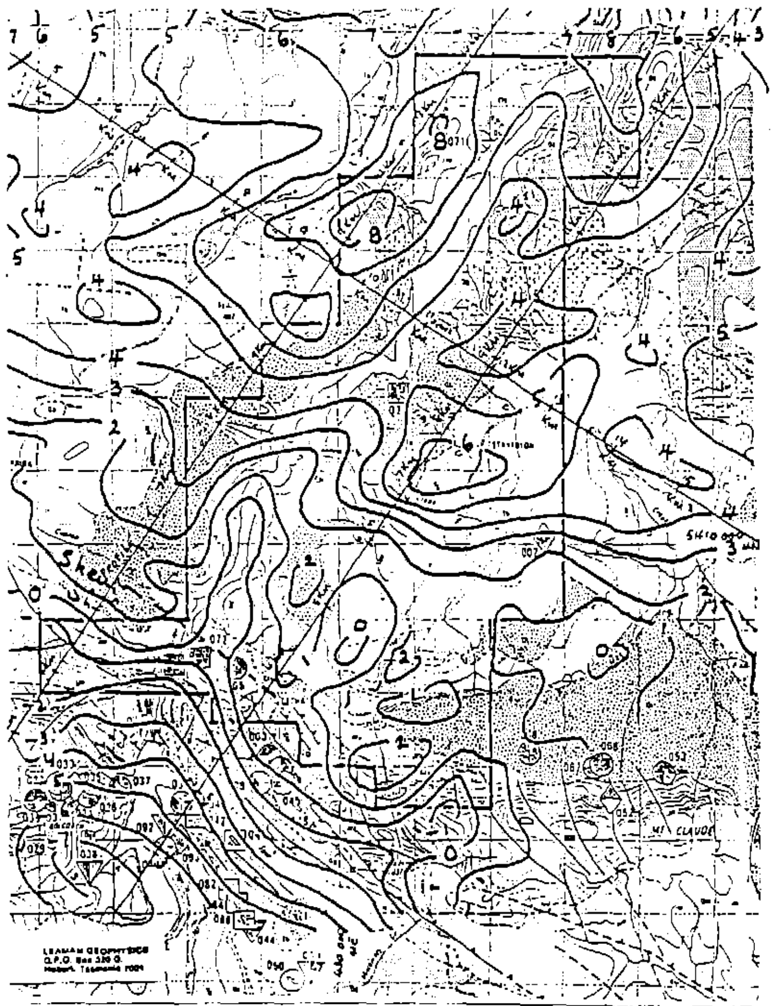
SITES OF KNOWN MINERALISATION LAKE BARRINGTON AREA EL 10/88
(available as an overlay) FIGURE 7

977134



INTERPRETATION SUMMARY   LAKE BARRINGTON   EL 10/88

FIGURE 8



RESIDUAL GRAVITY FIELD LAKE BARRINGTON
(from Leaman, 1990) Available as overlay

FIGURE 9

APPENDIX G

Drill Logs for DD80LB1 Extended

Lake Barrington Prospect

HOLE NO. : DD80LB1 — PLUTONIC OPERATIONS LIMITED — GOWRIE PARK — Page: 1

SECTION : 4700.00 EAST

DIAMOND DRILL RECORD

Northing	: 4920.00			Property	: LAKE BARRINGT
Easting	: 4700.00			State	: Tasmania
Grid	: LAKE BARRINGTON			GMR	: WILMOT
Direction	: GRID S			E.L. No.	: GOWRIE PARK
Inclination	: -60.0	Drill Type	:LY38	Project No.	: 706
Elevation	: 296.00	Core Size	:HQ 2.30 NQ 27.0 BQ	Date Started	: 22/12/92
Azimuth	: 180.0	Contractor	:Longyear	Date Completed	: 11/1/93
Mag Azimuth	: 210,209,208,208,208,208,208,208; OM=12.5T OR 330G			Logged by	: G. MacDONALD
Length (m)	: 287.80	Dip Tests	Method:	Relogged by	:
Precol. (m)	: 2.30M			Date Logged	: 28/1/93
BOCO	:			Interpreted	: G. MacDONALD
TFR	:				
Water Table	: na			Initialled	:

Depth	Az	Dip
30.0	180.0	-60.0
60.0	179.0	-59.3
90.0	178.0	-59.3
120.0	178.0	-58.5
150.0	178.0	-56.7
180.0	178.0	-56.3
230.0	178.0	-56.0
285.0	178.0	-55.7

From (m)	To (m)	Description	Sample No.	From (m)	To (m)	Width (m)	Cu (ppm)	Pb (ppm)	Zn (ppm)
.00	2.30	PRECOLLAR							
2.30	17.40	FELSIC MASS FLOW Very coarse grained conglomerate consisting of sub - rounded clasts to 80 mm of predominantly pale pink orange quartz feldspar phyric lava and fragments of quartz and feldspar phenocrysts in a matrix of the same composition. In patches the rock is matrix supported, other places it is more clast supported. The rock is very poorly sorted. The rock also contains clasts of fine grained siliceous felsic rock which are probably quenched lava fragments, occasional dark grey quartz feldspar phyric unaltered porphyritic rock and moderately sericitized quartz feldspar porphyritic rock with strongly sericitized feldspars in a moderately sericitized matrix. The rock is unaltered in the upper part becoming weakly silicified downhole. The rock has no obvious bedding. The rock contains limonitic quartz veins with approximately 2 veins per metre predominantly at 50 to 60 degrees to the core axis and 70 to 80 degrees to the core axis. The rock contains no obvious sulphides. The rock grades up somewhat downhole.	816101	8.40	8.70	.30	1770	18	28
			795551	8.70	11.00	2.30	790	15	56
			795552	11.00	13.60	2.60	440	13	50
			816102	13.60	14.20	.60	320	6	13
			795553	14.20	16.00	1.80	270	13	120
			795554	16.00	18.00	2.00	350	14	56
17.40	17.90	PSAMMITE / VOLCANICLASTIC QUARTZ FELDSPAR LITHIC SANDSTONE / VOLCANICLASTIC. The rock has the same composition as the overlying and underlying rocks. The rock contains limonitic quartz veins at approximately 10 per metre at 40 to 90 degrees to the core axis, variably oriented. The rock is massive with no bedding. The rock is gradational with both the underlying and overlying mass flows suggesting that the underlying and overlying rocks are from the same unit. Occasional lithics are up to 10 mm and are sub - rounded. The rock is still poorly sorted.							
17.90	47.60	FELSIC MASS FLOW Same rock as logged for 2.30 to 17.40. From the upper	816103	18.00	18.30	.30	18800	120	690

From (m)	To (m)	Description
		contact with the overlying sandstone the rock coarsens up somewhat downhole. Veins cross-cutting the rock are relatively fresh and pyritic with variable chalcopyrite and bornite as noted below. Clast composition is the same as for 2.30 to 17.40 though there also some more intermediate clasts and the clasts are generally only up to 40 mm. The rock is weakly silicified in patches with some weakly haematite altered parts. The rock contains a fine grained beige brown clast / raft of siliceous tuffaceous siltstone or quenched lava from 38.40 to 38.60. Contacts with thic clast are indistinct though the upper contact may be at 70 degrees to the core axis. At 18.40 a clast / bed of siltstone at 55 degrees to the core axis. The contact with the underlying siltstone is probably at 40 degrees to the core axis with the mas flow adjacent to the contact still containing clasts to 15 mm. The rock is generally massive with some weak possible bedding at 60 degrees to the core axis at 41.30. Rocks towards the base of this unit are still of mixed provenance as above.
		18.50 18.55 20% pyrite in veins at 35 degrees to the core axis and as matrix to autobrecciated fragments.
		21.70 22.00 5% limonitic pyrite and minor bornite.
		22.30 22.31 25% pyrite and 5% bornite and minor chalcopyrite in a cross-cutting, moderately limonitic vein at 70 degrees to the core axis.
		28.02 28.12 Three limonitic quartz veins at 80 degrees to the core axis, 2, 5 and 10 mm thick.
		28.80 29.00 Two limonitic pyrite quartz veins, 10 to 20 mm thick, at 35 degrees to the core axis.
		32.00 32.50 Two limonitic pyrite quartz and minor chalcopyrite veins, 10 mm thick, at 70 degrees to the core axis.
		32.50 32.51 Limonitic pyrite and minor chalcopyrite vein at 20 degrees to the core axis.
		35.30 35.65 Three limonitic pyrite bornite and quartz veins ; 30 mm thick at 45 degrees to the core axis with 10% bornite, 20 mm thick at 40 degrees to the core axis with 20% bornite and 5 mm thick at 30 degrees to the core axis with 5% bornite.
		37.90 37.93 Two limonitic pyrite veins, 5 mm thick at 30 degrees to the core axis.
		38.55 38.56 Cuprite crystals in fine limonitic veins at 30 degrees to the core axis.
		39.50 39.60 Limonitic pyrite vein, 30% pyrite, 20 mm thick at 20 degrees to the core axis.
		41.20 41.40 Manganese staining in bands at 60 degrees to the core axis.
		42.30 42.40 Spotty manganese staining and minor malachite.
		44.00 46.00 As above but weakly limonitic throughout and weakly brecciated in patches.
		46.00 46.03 Limonitic pyrite vein at 30 degrees to the core axis.
		46.03 46.75 Disseminated clots of bornite, 1%, and manganese staining and trace malachite.
47.60	48.80	PELITE

Sample No.	From (m)	To (m)	Width (m)	Cu (ppm)	Pb (ppm)	Zn (ppm)
795555	18.30	21.70	3.40	490	18	46
816104	21.70	22.30	.60	7700	21	17
795556	22.30	25.00	2.70	730	11	64
795557	25.00	27.90	2.90	870	9	91
816105	27.90	28.20	.30	1160	10	17
795558	28.20	28.40	.20	1670	6	14
816106	28.40	28.60	.20	600	10	19
816107	28.60	28.80	.20	380	4	9
816108	28.80	29.10	.30	1930	12	24
795559	29.10	31.50	2.40	320	10	110
795560	31.50	33.80	2.30	2500	16	67
816109	33.80	34.00	.20	15200	52	22
795561	34.00	35.20	1.20	517	8	7
816110	35.20	35.60	.40	27000	48	42
795562	35.60	36.80	1.20	1904	8	15
816111	36.80	37.10	.30	7200	16	30
795563	37.10	39.50	2.40	2900	15	56
816112	39.50	39.80	.30	2500	22	13
795564	39.80	42.00	2.20	1560	12	73
816113	42.00	42.40	.40	3800	12	10
795565	42.40	45.40	3.00	2800	11	59
816114	45.40	46.00	.60	4300	74	42
816115	46.00	46.30	.30	13900	18	13
816116	46.30	46.70	.40	11900	14	13
816117	46.70	47.50	.80	540	8	15
816118	47.50	48.40	.90	1000	21	13

From (m)	To (m)	Description	Sample No.	From (m)	To (m)	Width (m)	Cu (ppm)	Pb (ppm)	Zn (ppm)
		BEIGE TUFFACEOUS SILTSTONES. Beige brown / green siliceous fine grained tuffaceous siltstone. The upper contact is at 40 degrees to the core axis. The rock is moderately limonitic and brecciated from 47.60 to 48.20. Bedding is at 35 to 40 degrees to the core axis. The rock has relatively sharp upper and lower contacts and is not a graded top to the underlying and overlying mass flows.	816119	48.40	49.00	.60	1600	10	30
48.80	56.00	FELSIC MASS FLOW The rock is essentially the same as for the previous intersections except that the rock is generally fine grained. The contact with the underlying felsic lava is indistinct with the last metre from 55.00 to 56.00 very similar to the lava in gross appearance though fragments in the rock overlying the last metre are still of mixed provenance. The rock from 55.00 to 56.00 is probably a hyaloclastite with quenching and brecciation of the lava. The rock is pinky orange brown throughout. 49.50 49.60 Pyrite > chalcopyrite and minor bornite vein, 20 mm thick and at 20 degrees to the core axis. 53.00 53.10 Diffuse vein consisting of 10% pyrite and 10% chalcopyrite associated with sericite alteration.	816126	49.00	51.00	2.00	870	20	57
			816127	51.00	52.50	1.50	280	17	28
			816128	52.50	53.80	1.30	2800	9	19
			816129	53.80	55.00	1.20	580	11	25
			816130	55.00	56.90	1.90	270	14	32
56.00	84.60	FELSIC LAVA Pinky orange brown, quartz feldspar phyric, massive fine grained lava. The rock contains clastic textures to 62.00 m, probably hyaloclastites due to quenching of the lava or as a result of a shallow intrusion into the mass flows. The rock is grey in patches due to weak silicification but is not strongly altered with no obvious sericitisation but moderate carbonate (siderite) veinlets. The rock contains patchy pyrite and lesser chalcopyrite in attenuated veins generally at 40 to 60 degrees to the core axis. The rock contains occasional quartz carbonate veins at 70 to 80 degrees to the core axis. The rock contains fine irregularly oriented clay (after carbonate?) veinlets. The rock is variably fine grained and medium grained throughout below 74.50 with a sharp contact with a coarse grained clastic rock at 75.40 to 75.50 followed by more fine grained and medium grained rock to about 76.50 where the rock becomes more clastic until 77.40 where it becomes porphyritic again. It is probable that the hole has re-entered the hyaloclastic top of the flow from 74.50 to 77.40 with the juxtaposed fine grained and medium grained patches representing fragments of a coarse grained hyaloclastic breccia. The rock becomes moderately pyritic from 84.40 to 84.60 adjacent to the contact with the underlying porphyritic intermediate dyke with approximately 10% pyrite in spaces between brecciated fragments of quenched dyke rock and the lava.	816131	56.90	58.50	1.60	2400	14	41
			816132	58.50	59.60	1.10	1040	12	30
			816133	59.60	61.90	2.30	210	16	39
			816134	61.90	63.00	1.10	800	18	34
			816135	63.00	64.50	1.50	1170	16	27
			816136	64.50	66.50	2.00	940	18	40
			816137	66.50	67.50	1.00	1290	13	25
			816138	67.50	68.50	1.00	160	12	21
			816139	68.50	70.00	1.50	800	10	22
			816140	70.00	72.60	2.60	380	9	20
			816141	72.60	73.90	1.30	850	8	21
			816142	73.90	75.60	1.70	240	13	27
			816143	75.60	77.40	1.80	330	37	31
			816144	77.40	79.50	2.10	26	16	20
			816145	79.50	80.70	1.20	41	13	21
			816146	80.70	82.50	1.80	350	15	22
			816147	82.50	83.70	1.20	55	15	24
			816148	83.70	85.50	1.80	98	33	45
84.60	87.50	INTERMEDIATE INTRUSIVE INTERMEDIATE INTRUSIVE. Tan brown, clayey, sericitized feldspar phyric rock with rounded quartz carbonate filled amygdules up to 3 mm and	816149	85.50	87.50	2.00	45	13	58

From (m)	To (m)	Description	Sample No.	From (m)	To (m)	Width (m)	Cu (ppm)	Pb (ppm)	Zn (ppm)

chilled margins. The rock has a sharp lower contact at 20 degrees to the core axis and a moderately brecciated upper contact, probably at 30 degrees to the core axis. Feldspars, up to 1 mm long are foliated at 30 degrees to the core axis. The rock is an intermediate intrusive. The rock contains very minor pyrite with some limonitic amygdules probably after pyrite.

87.50 103.00 FELSIC LAVA

Same unit as logged for 56.00 to 84.60 but without clastic textures. The rock is massive, porphyritic, quartz and feldspar phyric throughout with occasional pyrite, minor chalcopyrite veins, occasionally parallel to the core axis with very minor associated chlorite below 95.50. The rock is still only weakly altered with weak carbonate alteration and weak silicification. The lower contact with the intrusive is sharp with no associated alteration. The lower contact is in broken core but is probably parallel to the foliation in the intrusive at 30 degrees to the core axis.

Sample No.	From (m)	To (m)	Width (m)	Cu (ppm)	Pb (ppm)	Zn (ppm)
816150	87.50	89.00	1.50	31	12	38
816151	89.00	91.30	2.30	27	7	19
816152	91.30	93.00	1.70	120	10	22
816153	93.00	95.00	2.00	63	12	15
816154	95.00	97.00	2.00	85	16	18
816155	97.00	99.00	2.00	28	27	17
816156	99.00	101.30	2.30	42	15	23
816157	101.30	103.00	1.70	10	5	17

103.00 104.60 INTERMEDIATE INTRUSIVE

INTERMEDIATE INTRUSIVE.

Similar rock to that logged for 84.60 to 87.50 except all amygdules are limonitic and feldspars are sericitized and more tabular and up to 3 mm. The rock is soft and clayey but is brittly fractured below 103.30. The rock is foliated at 30 degrees to the core axis. The rock contains very minor disseminated pyrite near the upper contact.

Sample No.	From (m)	To (m)	Width (m)	Cu (ppm)	Pb (ppm)	Zn (ppm)
816158	103.00	104.70	1.70	21	8	57

104.60 108.40 FELSIC LAVA

As logged for 56.00 to 84.60 and 87.50 to 103.00. The rock contains fine limonitic fractures adjacent to the upper contact and contains occasional irregular pyrite veins generally at low angles to the core axis. The rock is more coherent, occasionally weakly fractured, weakly silicified and carbonate altered. The lower contact is sharp with the underlying fine grained siliceous siltstone with the contact marked by a 1 cm wide pyrite vein at 65 degrees to the core axis.

Sample No.	From (m)	To (m)	Width (m)	Cu (ppm)	Pb (ppm)	Zn (ppm)
816159	104.70	106.00	1.30	130	16	44
816160	106.00	108.30	2.30	190	20	32
816161	108.30	109.70	1.40	126	15	113

108.40 109.45 PELITE

TUFFACEOUS SILTSTONE.

Fine grained, beige green, siliceous siltstone with distinct dark banding / bedding at 30 degrees to the core axis at 108.80, 60 degrees to the core axis at 109.20 and 35 degrees to the core axis at 109.45. The beds / bands are micro-fractured and micro-faulted sub-perpendicular to the banding. The rock has a sharp upper contact and a sharp but moderately brecciated lower contact at 35 degrees to the core axis. The rock is weak to moderately brecciated throughout with the fine fractures filled with later quartz carbonate or pyrite and trace chalcopyrite. The rock is weakly sericitized. The pyrite veins don't appear to be disrupted by the microfaulting.

109.45 176.25 FELSIC LAVA

From (m) | To (m) | ----------------------Description----------------------

Very similar to that logged for 56.00 to 84.60, 87.50 to 103.00 and 104.60 to 108.40 except that the rock has a weak green tinge to its pinky orange brown colour. From 109.45 to 122.00 the rock is variably clastic with textures suggesting that the rock is hyaloclastic. Below 122.00 the rock is much more coherent and massive. The rock adjacent to the lower contact is relatively coherent also. Occasional cross-cutting quartz carbonate (haematite) veins are at 60 to 80 degrees to the core axis. Feldspars are generally sericitized and the matrix is weakly sericitized, silicified and siderite altered in patches but is relatively fresh and unaltered throughout. The rock contains only minor sulphides except for approximately 1 to 2% pyrite in attenuated veins with associated minor chalcopyrite and bornite from 109.50 to 113.00 and 1 to 2% pyrite from 163.00 to 166.00. Below 166.00 the rock contains variable but generally minor to very minor disseminated pyrite, chalcopyrite, sphalerite (?) and galena. The rock is brecciated in patches with haematite infilled autobrecciation from 118.00 to 118.50 and variable but generally minor carbonate brecciation from 127.00 to 133.00 and 162.50 to 164.00. Fine chlorite stringers noted in previous logging of this core are negligible where present. The lower contact is in broken core but may be at 70 degrees to the core axis. The rock adjacent to the lower contact is somewhat finer grained but is coherent.

Sample No.	From (m)	To (m)	Width (m)	Cu (ppm)	Pb (ppm)	Zn (ppm)
816162	109.70	112.60	2.90	539	22	128
816163	112.60	113.80	1.20	535	20	132
816164	113.80	114.80	1.00	110	10	35
816165	114.80	117.50	2.70	178	10	53
816166	117.50	120.00	2.50	302	12	87
816167	120.00	122.50	2.50	1141	15	111
816168	122.50	124.90	2.40	257	8	81
816179	124.90	128.50	3.60	153	12	81
816180	128.50	136.20	7.70	257	13	152
816181	136.20	138.60	2.40	154	12	115
816182	138.60	141.40	2.80	161	15	78
816169	173.75	175.30	1.55	70	100	210
816170	175.30	177.60	2.30	390	100	200

176.25 187.50 PELITE

INTERMIXED SEQUENCE OF TUFFACEOUS SILTSTONES.

Mixed sequence of sandy and silty tuffaceous siltstones with no obvious bedding and more gradational contacts except for 60 degrees to the core axis at 177.00. The sandy and silty tuffs contain sericitized feldspars and are weakly sericitized and carbonate altered and beige green in colour. Finer grained tuffaceous siltstones are beige green and siliceous and occasionally contain angular fragments of black tuffaceous siltstones, quartz and sericitized feldspars and are weak to moderately siderite altered and variably weakly to moderately silicified and weakly sericitized throughout. The rock contains minor disseminations and fine attenuated veinlets of pyrite, chalcopyrite, sphalerite and galena and / or bornite throughout with the major veins being the chalcopyrite pyrite sphalerite veins / banded massive sulphides with quartz gangue from 179.40 to 179.50 and a 10 mm thick chalcopyrite bornite sphalerite vein with quartz carbonate gangue at 181.50. Other than these the rock contains numerous carbonate veins cross-cutting at 40 to 80 degrees to the core axis but generally at 60 to 70 degrees to the core axis, approximately 10 to 20 per metre in patches. There has been considerable core loss and there is much broken core but roughly speaking the rock consists of predominantly very fine grained siltstones from 176.50 to 177.00, sandy and silty siltstones to 184.50 and very fine grained siltstones to 187.50. Of note is a coarse grained rock from 182.30 to 182.50 which consists of sub - rounded

Sample No.	From (m)	To (m)	Width (m)	Cu (ppm)	Pb (ppm)	Zn (ppm)
816171	177.60	179.40	1.80	1200	100	310
816172	179.40	179.50	.10	14000	7500	5900
816173	179.50	180.40	.90	4700	600	1100
816174	180.40	181.80	1.40	2100	200	2800
816175	181.80	184.00	2.20	350	100	1300
816176	184.00	185.05	1.05	260	100	230
816177	185.05	186.20	1.15	300	100	230
816178	186.20	187.50	1.30	450	100	310

From (m)	To (m)	Description	Sample No.	From (m)	To (m)	Width (m)	Cu (ppm)	Pb (ppm)	Zn (ppm)
		to sub - angular grey cherty clasts and altered feldspars in a chloritic matrix.							
187.50	192.20	PELITE / VOLCANICLASTIC BEIGE GREEN SILTSTONES AND VOLCANICLASTICS. Interbedded fine grained beige green siltstones and medium grained quartz and feldspar rich volcaniclastics. Bedding is parallel to the core axis in places, at low angles to the core axis in others. The rock is weak to moderately carbonate altered throughout with 0.5% disseminated pyrite. Feldspars and quartz in the volcaniclastics are tabular but in confused bedding.							
192.20	205.00	PELITE / PSAMMITE CHLORITIC SILTSTONES AND SANDSTONES. Very broadly interbedded fine grained chloritic siltstones and chloritic volcaniclastics with feldspars and lesser quartz as above. The rock does not show bedding but contacts between sandstones and siltstones are at low angles to the core axis. The rock contains up to 0.5% disseminated pyrite and very occasional cross-cutting pyrite carbonate galena veins below 204.50.							
205.00	212.80	PELITE							
		BEIGE GREEN / GREY SILTSTONES, BRECCIATED.	S00871	206.40	207.40	1.00	825	510	470
		Pale beige green brecciated siltstone and medium grained volcaniclastic as above with strong carbonate alteration in fracture fillings and snowflake textures. The rock contains 0.2% chalcopyrite as fracture fillings. Occasional bedding is at 20 degrees to the core axis. The rock becomes more chloritic downhole below 211.5.							
212.80	214.30	SHEAR ZONE / BRECCIA							
		Moderately sheared, strongly brecciated, chloritic zone.	S00872	214.00	215.00	1.00	2200	245	690
		The rock was previously a siltstone, chlorite altered. The rock contains minor pyrite and very minor chalcopyrite. The shearing is at 20 degrees to the core axis and the zone is clearly a significant structure.							
214.30	218.70	PELITE							
		PINKY ORANGE SILTSTONES, SIDERITIC.	S00873	215.00	216.00	1.00	705	105	195
		Pinky orange siltstones and volcaniclastics with	S00874	216.00	216.40	.40	4300	70	145
		feldspars. The rock is moderately to strongly carbonate	S00875	216.40	217.00	.60	3250	34	105
		altered as above. The rock is strongly sulphidic with 5%	S00876	217.00	218.15	1.15	2100	22	80
		to 10% pyrite in irregularly cross-cutting blebs	S00877	218.15	219.00	.85	1650	25	100
		associated with carbonate and silicification. The rock is a reworked tuff. The rock contains minor chalcopyrite and occasional minor galena.							
218.70	222.50	VOLCANICLASTIC / FELSIC MASS FLOW							
		Lithic rich volcaniclastic / mass flow, very sulphidic.	S00878	219.00	220.00	1.00	1400	25	110
		From 218.70 to 219.30 the rock contains coarse grained	S00879	220.00	222.00	2.00	4150	1600	9050
		feldspar phyric volcanics. From 219.30 to 222.70 the rock	S00880	222.00	223.30	1.30	13200	2100	10200
		is a medium grained volcaniclastic with 3% pyrite associated with carbonate alteration and minor chalcopyrite and galena. The rock is moderately sericite and strongly carbonate altered throughout with 2% pyrite							

From (m)	To (m)	Description	Sample No.	From (m)	To (m)	Width (m)	Cu (ppm)	Pb (ppm)	Zn (ppm)

overall. Lithics are up to 20mm in diameter.

222.50 223.30 SEMI-MASSIVE SULPHIDES

Approximately 40% massive pyrite, 2% chalcopyrite, 1% galena and 1% sphalerite associated with carbonate and silica alteration. The upper contact is gradational whilst the lower contact is sharp. Mineralization is in discrete bands at 15 degrees to the core axis but is quite clearly a vein. The matrix consists of quartz carbonate and sericite. The lower contact is at 30 degrees to the core axis.

223.30 232.20 VOLCANICLASTIC / FELSIC MASS FLOW

Strongly carbonate, moderately sericite altered, mass flow / volcaniclastic with minor pyrite disseminated and in fracture fill veins. From 233.30 to 233.33 and 233.50 to 233.53 the rock contains two 30mm thick massive chalcopyrite veins at 45 degrees to the core axis. Lithics include beige to grey siltstones and porphyritic volcanics. Lithics are up to 20mm in diameter.

232.20 234.60 SEMI-MASSIVE SULPHIDES

SELVEDGE TO VEIN.

Irregular veining of very fine grained pyrite and minor chalcopyrite associated with strong carbonate alteration / matrix running sub - parallel to the core axis. The veins are hairlike with a carbonate matrix. The rock contains 0.5% chalcopyrite throughout associated with the pyrite. The rock appears as a number of veins running through carbonate with disseminated pyrite clots. It is very similar to the selvedges to the more massive vein from 239.00 to 240.00 and may indeed be one of the selvedges to this vein.

Sample No.	From (m)	To (m)	Width (m)	Cu (ppm)	Pb (ppm)	Zn (ppm)
S00881	233.30	234.00	.70	17900	445	1400
S00882	234.00	235.00	1.00	3100	1200	8750

234.60 239.00 PELITE

Moderately carbonate altered, pinky orange massive siltstone with snowflake carbonate alteration. The rock contains 0.5% pyrite and 0.5% chalcopyrite in fine fractures at irregular angles to the core axis. The rock becomes strongly carbonate altered / brecciated below 238.00 as it approaches the underlying massive vein.

Sample No.	From (m)	To (m)	Width (m)	Cu (ppm)	Pb (ppm)	Zn (ppm)
S00883	235.00	236.00	1.00	795	1200	665
S00884	236.00	237.00	1.00	3650	2950	2850
S00885	237.00	238.00	1.00	5900	1900	9600
S00886	238.00	239.00	1.00	2500	2100	7750

239.00 240.00 SEMI-MASSIVE SULPHIDES

Semi-massive pyrite > chalcopyrite vein with a carbonate matrix with approximately 50% pyrite, 1% chalcopyrite, 1% galena and 1% sphalerite. The vein is at 5 degrees to the core axis and appears to be 50mm thick. The upper contact and lower contact are very similar with both strongly carbonate altered. The vein is sub - parallel to the core axis and hence any assays overstate its true sulphide content.

Sample No.	From (m)	To (m)	Width (m)	Cu (ppm)	Pb (ppm)	Zn (ppm)
S00887	239.00	240.00	1.00	3620	5700	8500

240.00 242.90 VOLCANICLASTIC / FELSIC MASS FLOW

Lithic rich volcaniclastic / massflow in a strongly carbonate altered matrix. The contact with the overlying massive sulphide vein is gradational with the very strong carbonate alteration decreasing downhole. From 240.00 to

Sample No.	From (m)	To (m)	Width (m)	Cu (ppm)	Pb (ppm)	Zn (ppm)
S00888	240.00	241.00	1.00	6500	1200	2300

From (m)	To (m)	Description	Sample No.	From (m)	To (m)	Width (m)	Cu (ppm)	Pb (ppm)	Zn (ppm)	(
		241.00 the rock contains 2% pyrite with minor chalcopyrite whilst from 241.00 to 242.90 the rock contains 1% pyrite and minor chalcopyrite in a lithic rich rock as logged previously.								
242.90	245.70	SEMI-MASSIVE SULPHIDES SELVEDGE TO VEIN. Carbonate selvedge very sulphidic with 4% galena, 2% chalcopyrite and sphalerite and 5% pyrite in a very strongly carbonate altered / breccia matrix. Discrete veins are at 5 to 10 degrees to the core axis. The lower contact is brecciated with the underlying black siltstone. The rock is very probably a selvedge to the vein from 239.00 to 240.00.	S00889	242.90	244.00	1.10	15700	11800	7050	
			S00890	244.00	245.00	1.00	9500	14900	10400	
			S00891	245.00	246.10	1.10	10000	4350	3600	
245.70	247.93	PELITE BRECCIATED SULPHIDIC BLACK SILTSTONE. Fine grained black siltstone, strongly brecciated post lithification with fractures filled with carbonate and 2% chalcopyrite and 2% pyrite. Bedding is unreliable. The lower contact with the underlying pinky orange siltstone is marked by a 30mm thick pyrite vein cross-cutting at 80 degrees to the core axis with a carbonate sericite and silica matrix. Fractures are irregularly oriented.	S00892	246.10	247.00	.90	17400	2400	5650	
			S00893	247.00	247.90	.90	10700	78	440	
247.93	254.50	PELITE Pinky orange siltstone with snowflake textured carbonate alteration throughout. The rock is massive throughout with irregularly cross-cutting pyrite and minor chalcopyrite fracture fill veins increasing below 252.50. The rock contains minor chalcopyrite.	S00894	249.00	250.00	1.00	9000	39	90	
			S00895	250.00	251.00	1.00	14700	195	500	
			S00896	252.50	253.50	1.00	3500	68	48	
			S00897	253.50	254.50	1.00	5450	163	125	
254.50	263.80	VOLCANICLASTIC / FELSIC MASS FLOW Lithic rich volcaniclastic / mass flow as logged further uphole. Lithics consist of fine grained cherty sediment and porphyritic volcanics in a moderately carbonate altered, moderately sericite, occasionally moderately chlorite altered matrix with 0.5% to 1% pyrite in disseminated clots.								
263.80	272.50	PELITE Pinky orange siltstone as logged for 247.93 to 254.50 with ghosted siliceous clasts in patches. The rock becomes chloritic below 267.90. The rock is massive throughout.								
272.50	272.60	SHEAR ZONE Chloritic shear zone at 25 degrees to the core axis.								
272.60	287.80	VOLCANICLASTIC Lithic rich volcaniclastic with clasts up to 15mm in a moderately carbonate, weak to moderately sericite altered matrix. Fragments include porphyritic volcanics, feldspars, quartz and cherty siltstones. The rock contains 0.5% pyrite and occasional minor chalcopyrite in cross-cutting veins. From 283.20 to 283.60 the rock contains 4% chalcopyrite in cross-cutting chalcopyrite pyrite veins associated with carbonate alteration and	S00898	283.20	283.60	.40	18300	5900	4200	

From (m)	To (m)	Description	Sample No.	From (m)	To (m)	Width (m)	Cu (ppm)	Pb (ppm)	Zn (ppm)	(
		minor galena. Below 286.30 the rock is less altered.								
		287.80 E.O.H.								

93-3497.

977146

93-3497.

LEGEND

QUATERNARY

Q	– Alluvial, gravel, talus

LATE CAMBRIAN – EARLY ORDOVICIAN

Om	– Moina Sandstone
Or	– Roland Conglomerate

CAMBRIAN

(Minnow Keratophyre – Gog) Range Greywacke

Ɛcvt	– Rhyolitic crystal vitric tuff
Ɛrq	– Quartz phyric rhyolitic lava
Ɛrf	– Feldspar phyric rhyolitic lava

Ɛxt	– Rhyolitic Crystal tuff [Fragmental in West Fluer to East
Ɛi	– Intrusive Rhyolite
Ɛs	– Tuffaceous Siltstone

- Scree Covered Contact
- 48 390 36 — Stream Sediment Sample point
- Fault – Interpreted
- Mineralized Shear / Fault Zone

GN
TN
MN
GRID CONVERGENCE 0.5°
GRID/MAGNETIC ANGLE 12.2°

noranda

E.L. 10/88 PART 2

GOG RANGE

INTERPRATIVE GEOLOGY

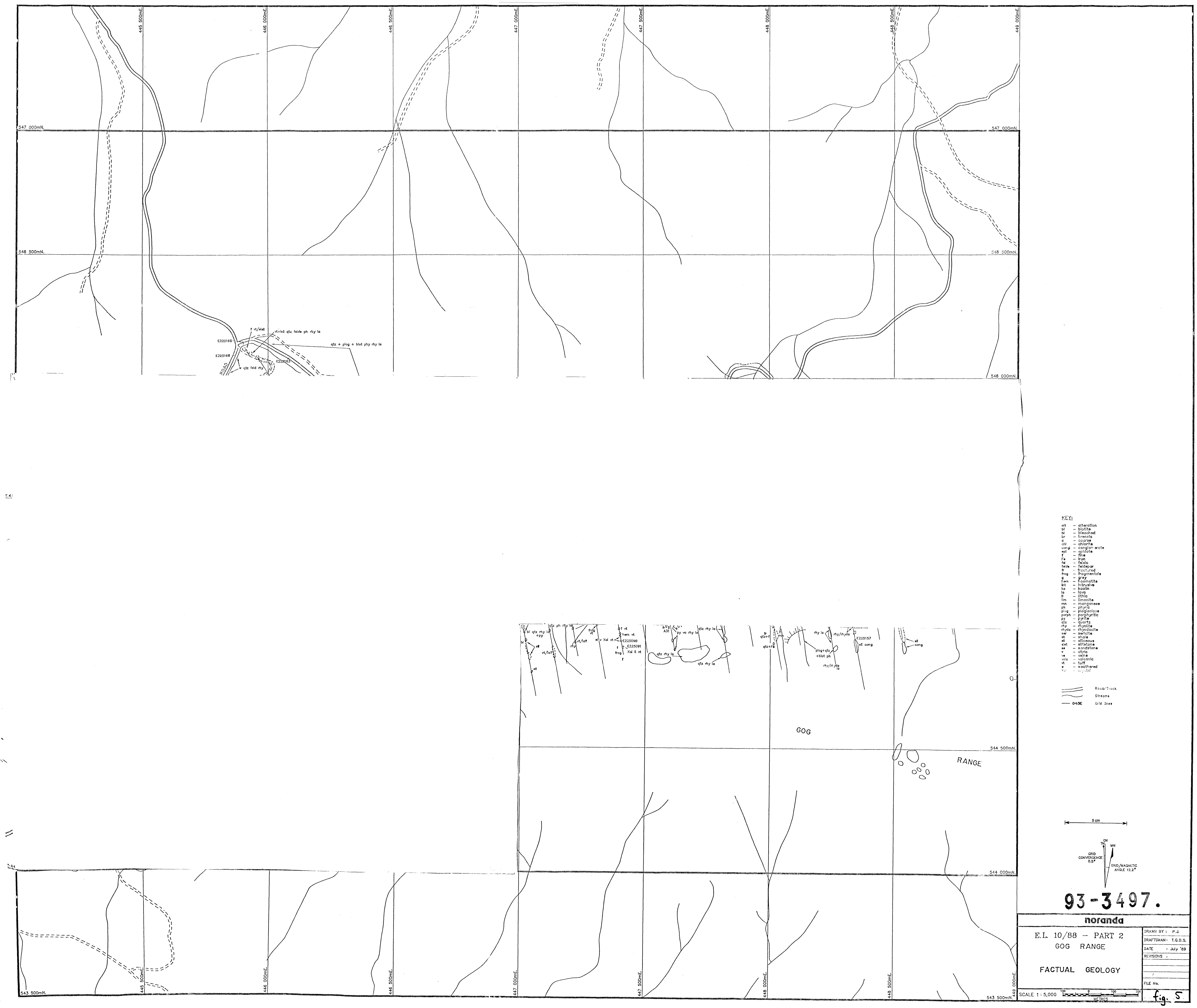
DRAWN BY :	P.J.
DRAFTSMAN :	T.G.D.S.
DATE :	July '89
REVISIONS :	
FILE No.	
	fig. 4

SCALE 1 : 10000 — 200 0 200 400 METRES

N.W. Coast Computer Aided Drafting Centre. Phone (004 354315)
Fax. (004 354495)

5 cm

977147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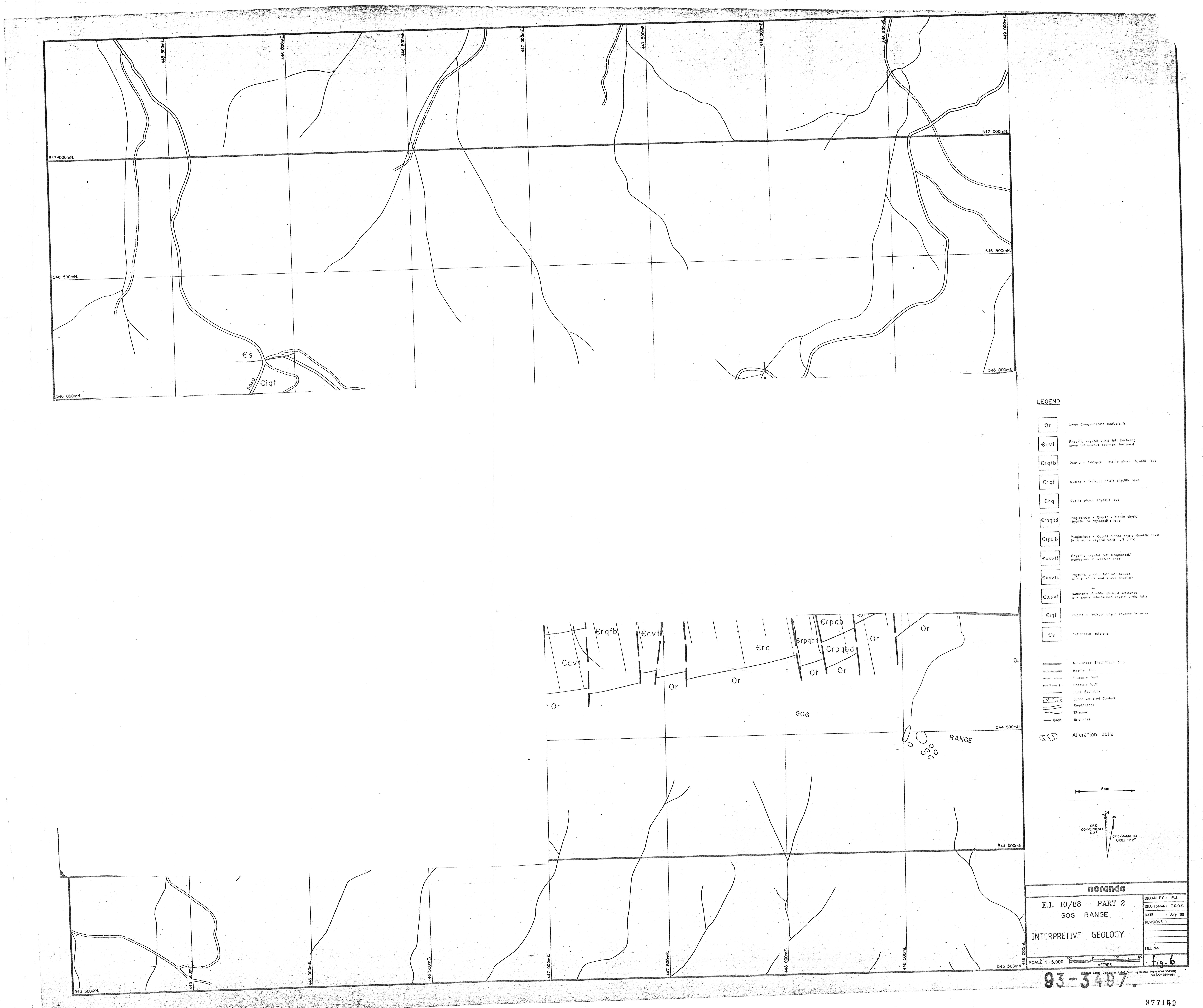
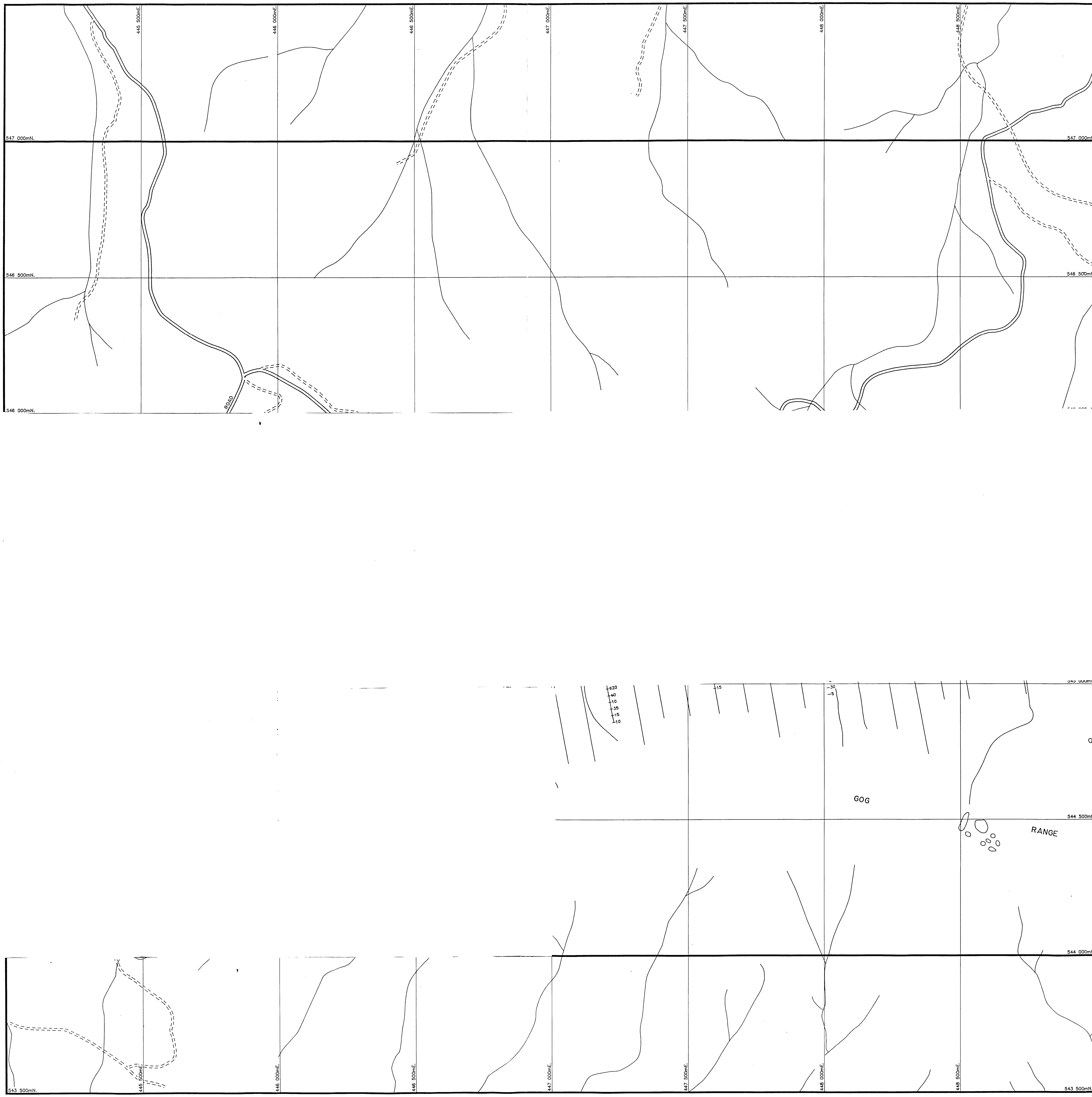
448 000mE.
448 500mE.
449 000mE.
ROAD
qtz + plag + biot phy rhy la
qtz feld rhy
GOG
RANGE
KEY:
alt – alteration
bi – biotite
bl – bleached
br – breccia
c – coarse
chl – chlorite
congl – conglomerate
epi – epidote
f – fine
Fe – iron
fel – felsic
felds – feldspar
fr – fractured
frag – fragmentals
g – grey
hem – haematite
int – intrusive
ka – kaolin
la – lava
li – lithic
lim – limonite
mn – manganese
ph – phyric
plag – plagioclase
porph – porphyritic
py – pyrite
qtz – quartz
rhy – rhyolite
rhyda – rhyodacite
ser – sericite
sh – shale
sil – siliceous
slst – siltstone
ss – sandstone
v – vitric
ve – veins
volc – volcanic
vt – tuff
w – weathered
Road/Track
Streams
Grid lines
GN
TN
MN
GRID CONVERGENCE 0.5°
GRID/MAGNETIC ANGLE 12.2°
93-3497.
noranda
E.L. 10/88 – PART 2
GOG RANGE
FACTUAL GEOLOGY
DRAWN BY : P.J.
DRAFTSMAN : T.G.D.S.
DATE : July '89
REVISIONS :
FILE No.
SCALE 1 : 5,000
METRES
fig. 5

977148



93-3497.

977149



CONTOUR INTERVAL

☐	> 400 ppm
☐	200 – 400
☐	100 – 200
☐	< 100 ppm

5 cm

GN TN MN
GRID CONVERGENCE 0.5°
GRID/MAGNETIC ANGLE 12.2°

93-3497.

noranda

E.L. 10/88 – PART 2
GOG RANGE

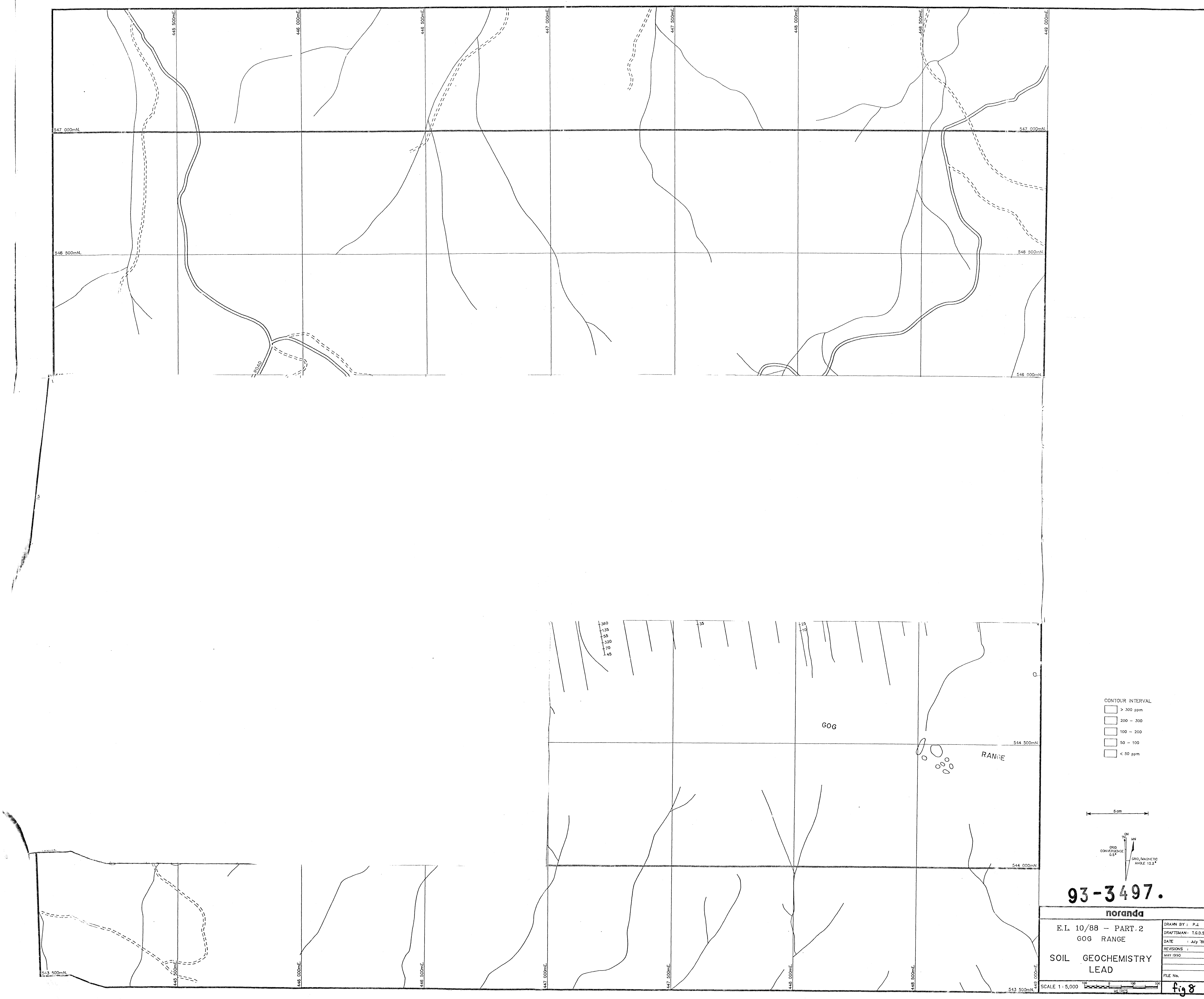
SOIL GEOCHEMISTRY
COPPER

DRAWN BY :	P.J.
DRAFTSMAN :	T.G.D.S.
DATE :	July '89
REVISIONS :	MAY 1990
FILE No.	

SCALE 1 : 5,000 100 0 100 200 METRES

fig 7.

977151


445 500mE.
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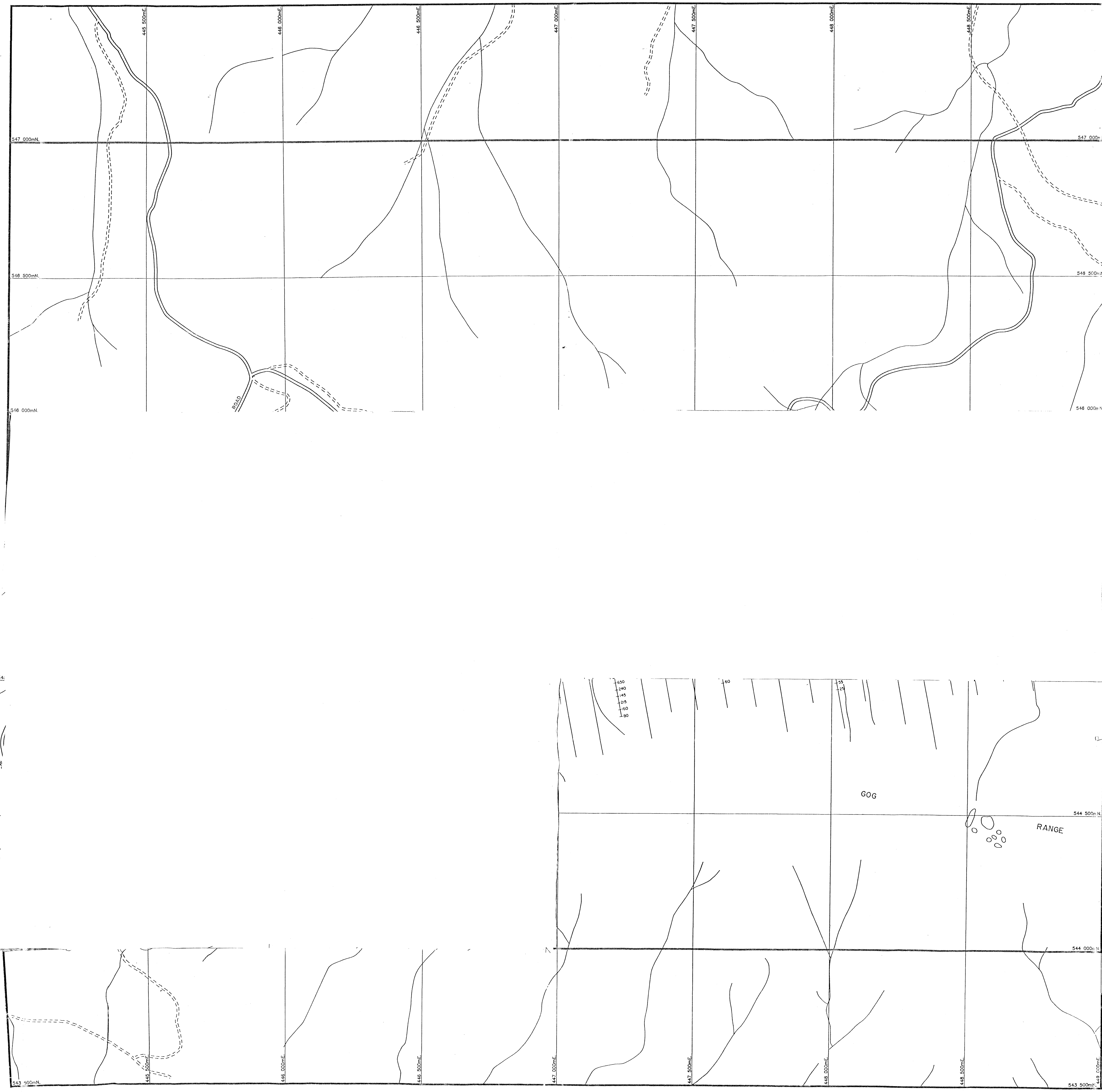
546 500mN.
546 000mN.
544 500mN.
544 000mN.
543 500mN.
ROAD
GOG
RANGE
CONTOUR INTERVAL
> 300 ppm
200 – 300
100 – 200
50 – 100
< 50 ppm
5 cm
GN
TN
MN
GRID CONVERGENCE 0.5°
GRID/MAGNETIC ANGLE 12.2°
93-3497.
noranda
E.L. 10/88 – PART 2
GOG RANGE
SOIL GEOCHEMISTRY
LEAD
DRAWN BY : P.J.
DRAFTSMAN : T.G.D.S.
DATE : July '89
REVISIONS :
MAY 1990
FILE No.
SCALE 1 : 5,000
100 0 100 200
METRES
fig 8

977152



CONTOUR INTERVAL

- > 400 ppm
- 200-400
- 100-200
- < 100ppm

5 cm

GN
TN
MN
GRID CONVERGENCE 0.5°
GRID/MAGNETIC ANGLE 12.2°

93-3497.

noranda

E.L. 10/88 – PART 2
GOG RANGE

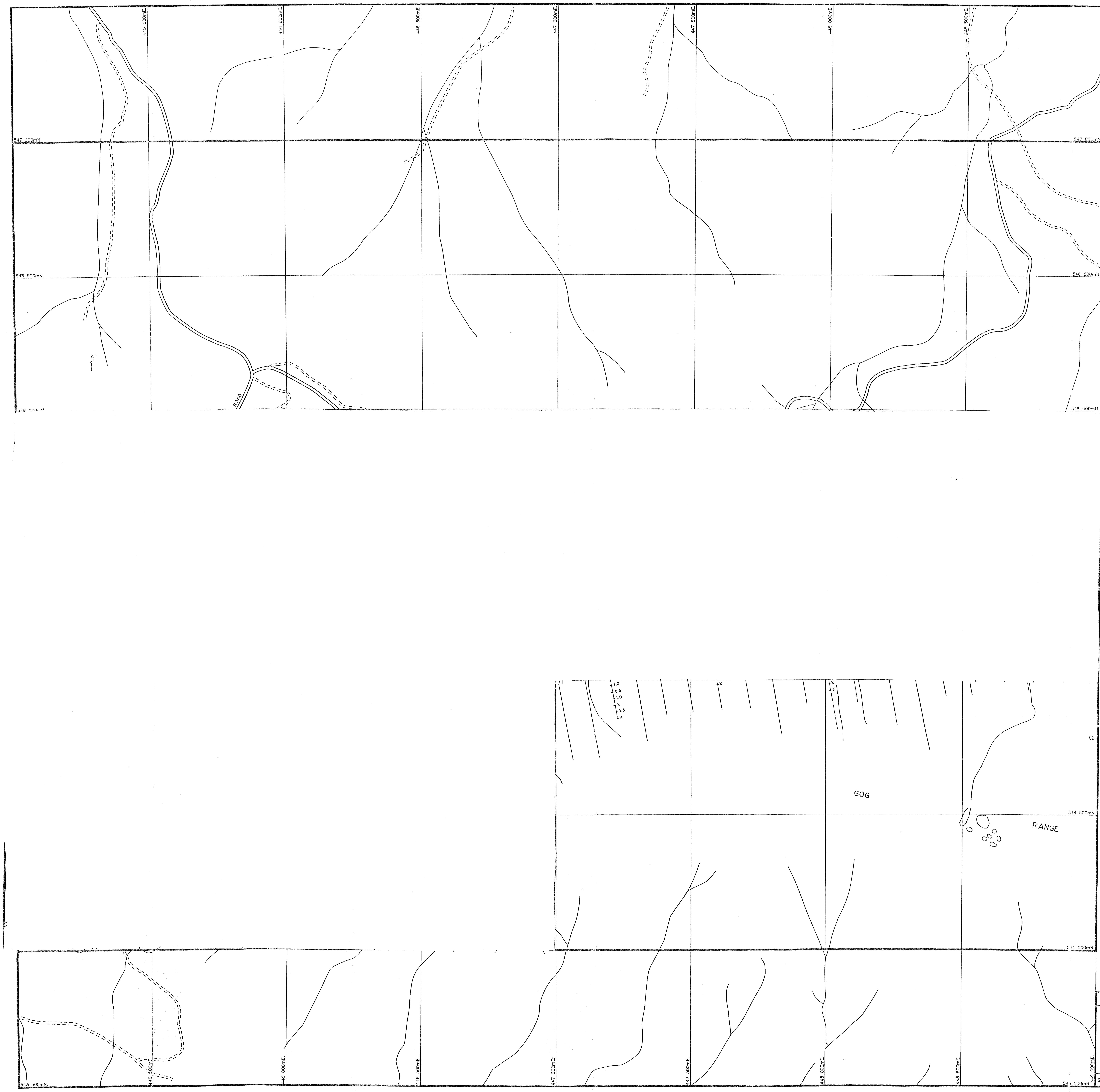
SOIL GEOCHEMISTRY
ZINC

SCALE 1 : 5,000 — METRES

DRAWN BY :	P.J.
DRAFTSMAN :	T.G.D.S.
DATE :	July '89
REVISIONS :	MAY 1990
FILE No.	

fig 9

977153



93-3497.

noranda 977154

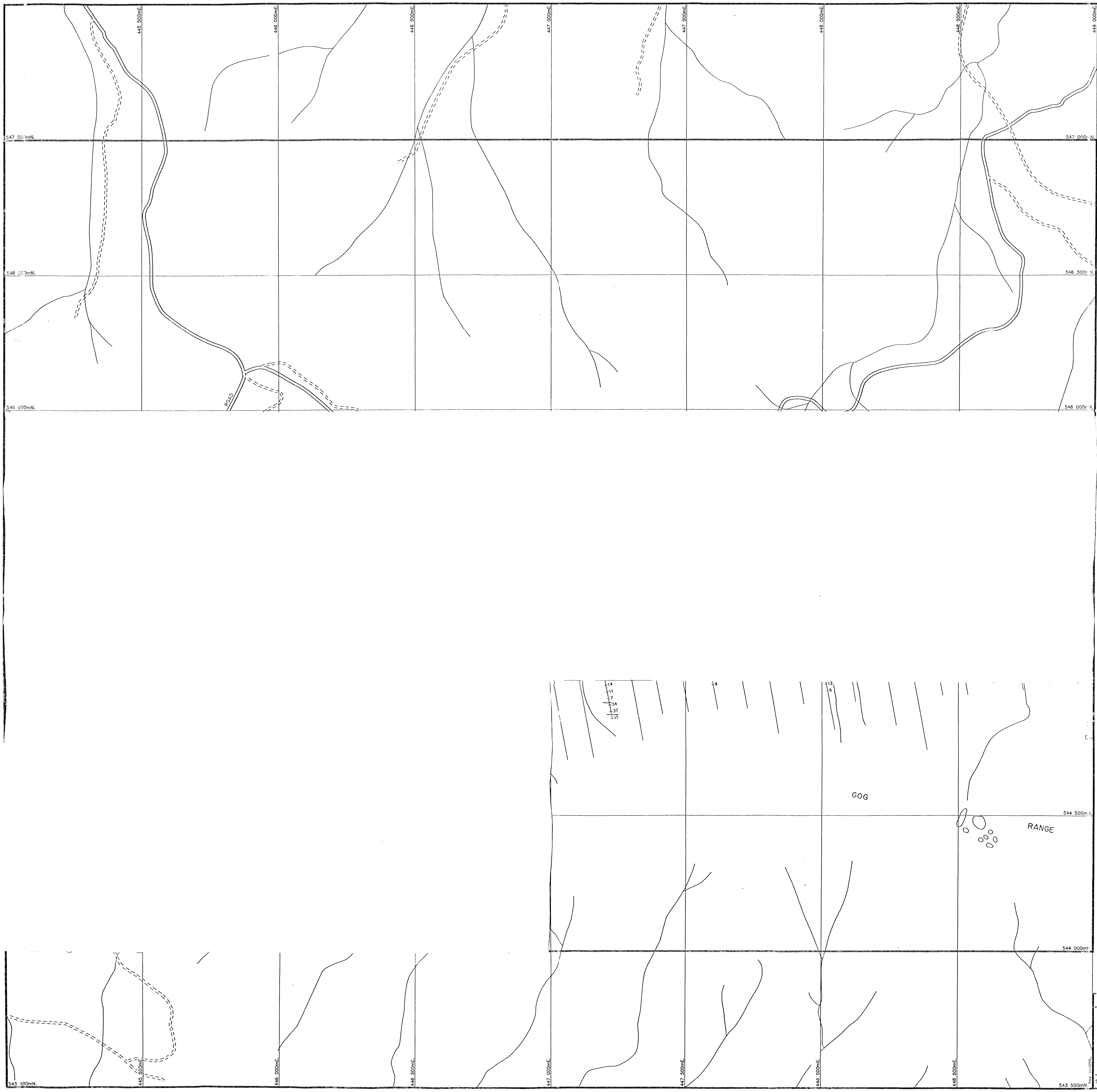
E.L. 10/88 – PART 2
GOG RANGE

SOIL GEOCHEMISTRY
SILVER

DRAWN BY :	P.J.
DRAFTSMAN :	T.G.D.S.
DATE :	July '89
REVISIONS :	
MAY 1990	
FILE No.	

SCALE 1 : 5,000 — 100 0 100 200 METRES

fig 10



CONTOUR INTERVAL

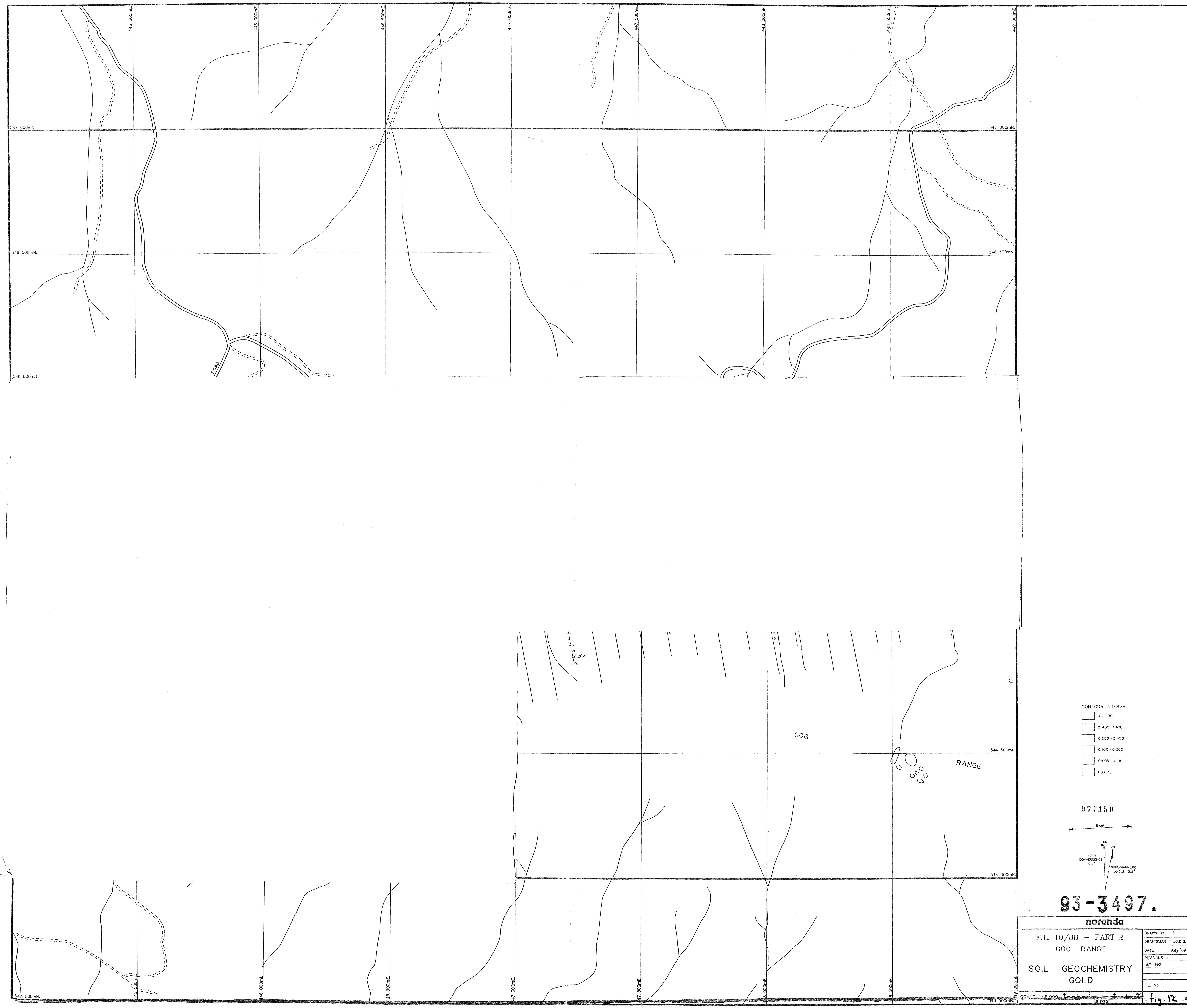
- >250 ppm
- 150 - 250
- 50 - 150
- 25 - 50
- <25 ppm

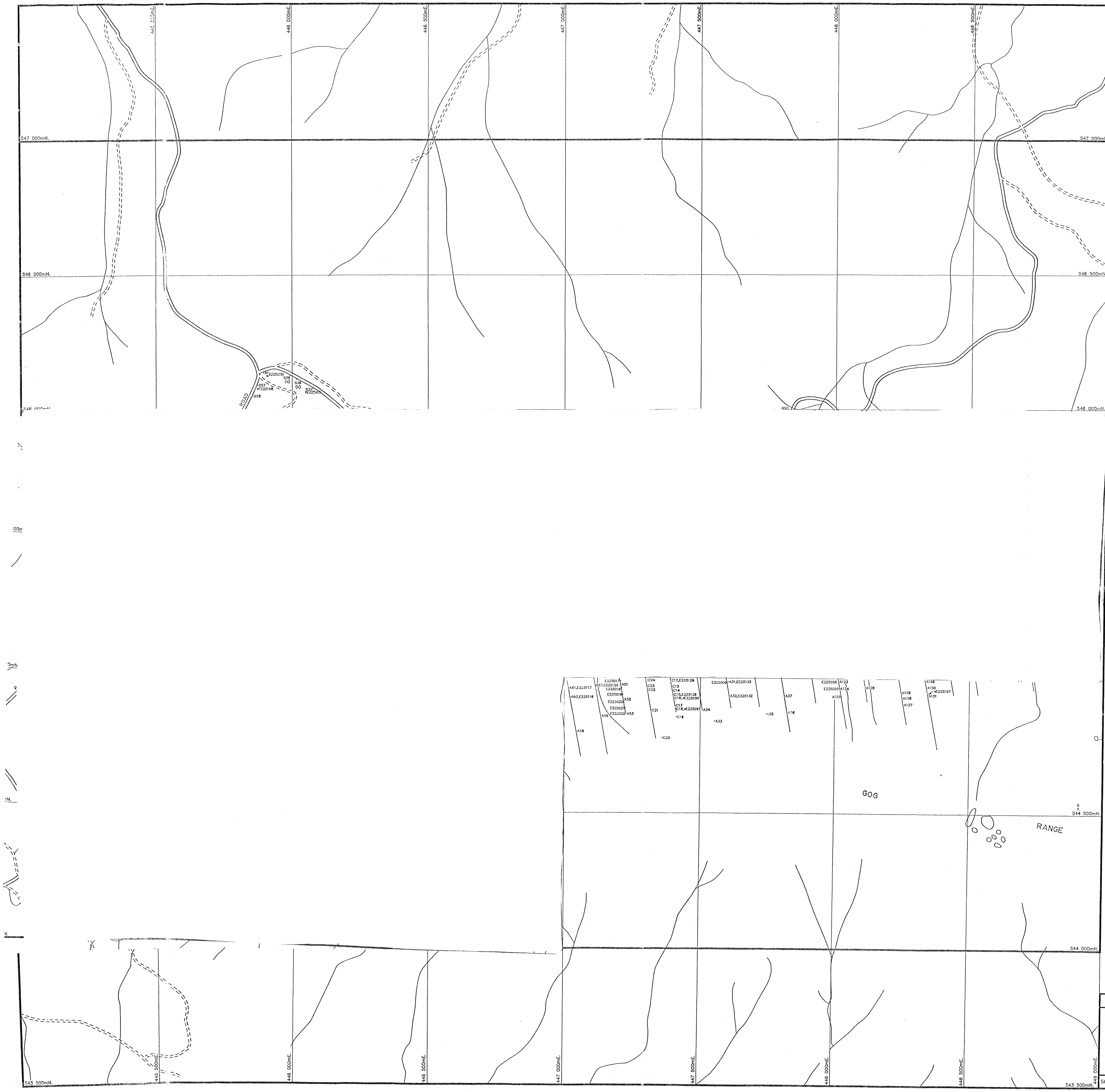
5 cm

GN
TN
MN
GRID CONVERGENCE 0.5°
GRID/MAGNETIC ANGLE 12.2°

93-3497.

noranda	977155
E.L. 10/88 - PART 2 GOG RANGE SOIL GEOCHEMISTRY ARSENIC	DRAWN BY : P.J. DRAFTSMAN : T.G.D.S. DATE : July '89 REVISIONS : MAY 1990 FILE No.
SCALE 1 : 5,000 (100 0 100 200 METRES)	fig 11


445 500mE
446 000mE
446 500mE
447 000mE
447 500mE
448 000mE
448 500mE
449 000mE
547 000mN.
546 500mN.
546 000mN.
544 500mN.
544 000mN.
543 500mN.
ROAD
0.005
GOG
RANGE
CONTOUR INTERVAL
>1·400
0·400 - 1·400
0·200 - 0·400
0·100 - 0·200
0·005 - 0·100
<0·005
977150
5 cm
GN
TN
MN
GRID CONVERGENCE 0.5°
GRID/MAGNETIC ANGLE 12.2°
93-3497.
noranda
E.L. 10/88 - PART 2
GOG RANGE
SOIL GEOCHEMISTRY
GOLD
DRAWN BY : P.J.
DRAFTSMAN : T.G.D.S.
DATE : July '89
REVISIONS :
MAY 1990
FILE No.
SCALE 1 : 5 000
METRES
fig 12



KEY:
Sample Nos. commencing with A,B,C or SS – Field Sample Nos.
Sample Nos. commencing with E – Laboratory Sample Nos.
* Denotes Thin Section and Geochemistry
All other samples — Geochemistry only
Samples E225001 to E225086 – Soil Samples
Samples E225087 to E225097 Stream Sediment Samples
All other samples – Rock Samples

NOTE: Lines not slope corrected

5 cm

GN
TN
MN
GRID CONVERGENCE 0·5°
GRID/MAGNETIC ANGLE 12.2°

93-3497.

noranda 977156

E.L. 10/88 – PART 2
GOG RANGE

SAMPLE LOCATIONS

DRAWN BY :	P.J.
DRAFTSMAN :	T.G.D.S.
DATE	: July '89
REVISIONS :	
FILE No.	

SCALE 1 : 5,000 (100 0 100 200 METRES)

fig 13.

93-3497.

noranda

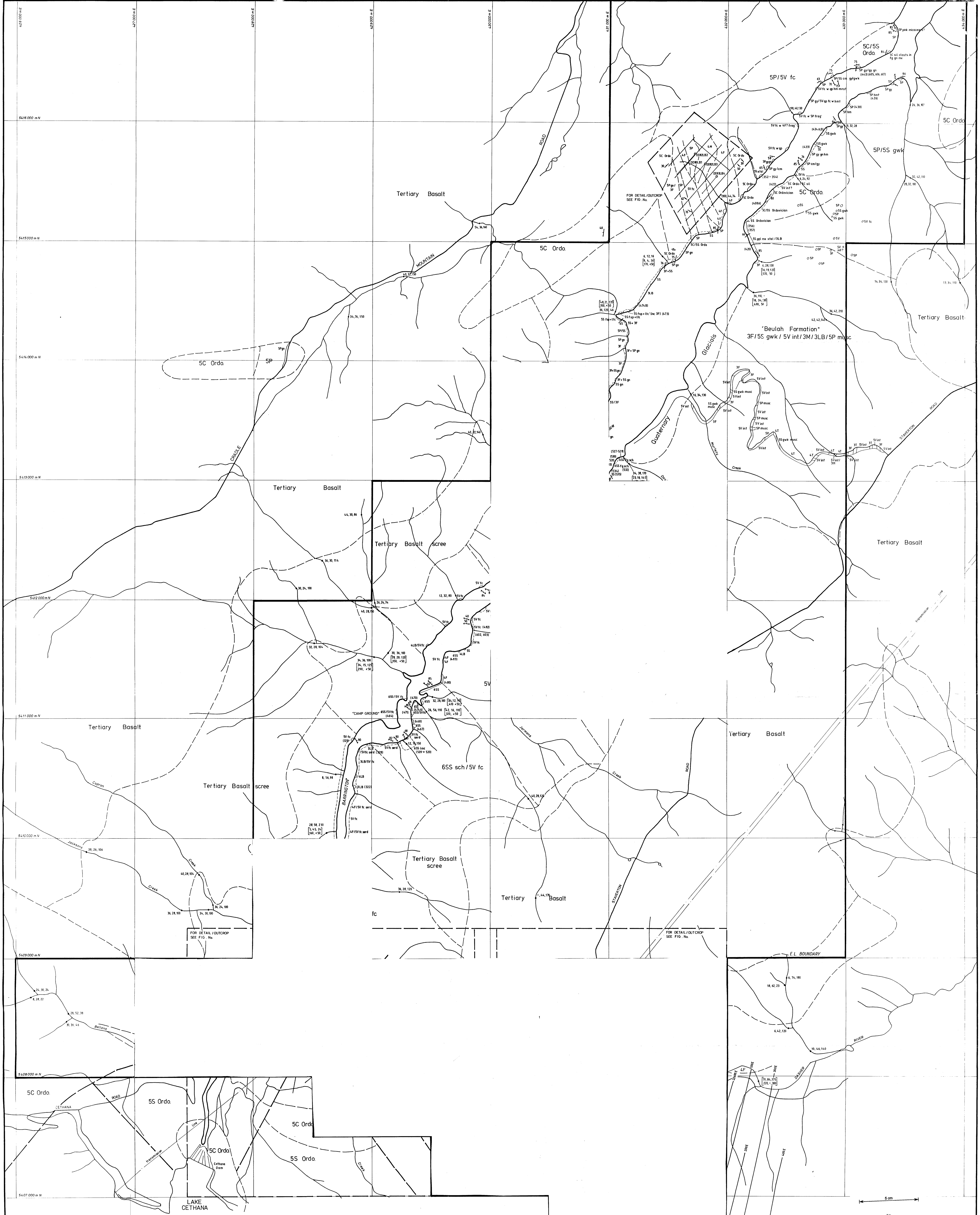
E.L. 10/88 – PART 2
GOG RANGE

ROCK GEOCHEMITRY
Cu,Pb,Zn,Ag and Au

DRAWN BY :	P.J.
DRAFTSMAN :	T.G.D.S.
DATE	: July '89
REVISIONS :	
FILE No.	
fig 14.	

SCALE 1 : 5,000 — 100 0 100 200 METRES

977157



QUATERNARY		Glacials; both true glacials and Roland Conglomerate scree, tens of metres thick in places
TERTIARY		Basalt and basalt scree
LATE CAMBRIAN - ORDOVICIAN	5C Ordo.	Siliciclastic pre-cambrian derived conglomerate (Roland Conglomerate) and sandstone (Moina Sandstone)
	Beulah Formation	"Beulah Formation" interbedded andesitic to dacitic lavas, mass flows, lava breccias, intermediate volcaniclastics and tuffs, greywacke sandstones and siltstones
	6SS	Silica sericite altered felsic tuffs / volcaniclastics, invariably schistore
	4F	Felsic lavas, quartz or quartz feldspar phyric as noted
	3F	Dacitic lavas (southern part)
	3T	Dacitic tuffs (southern part)

5V	Felsic volcaniclastics with quartz eyes and variable feldspars, fine to medium grained, generally altered
5P / 5P bk	Siltstones, green to purple or black (bk) where noted
4M	Felsic mass flows dominated by felsic lava clasts
5C chy clasts	Rounded siliceous clasts in a finer grained matrix
	Fault
	Geological contact
	Outcrop
	Float
	Diamond drill hole unless prefixed PD
	Cleavage
	Bedding
	Younging direction

chy	cherty
clc	chloritic
cm	cream
fc	felsic
fg	fine grained
frag	fragments
fsp	feldspar
gly	generally
gn	green
gwk	greywacke
gy	grey
hmt	haematite
ibdd	interbedded
int	intermediate
lmc	limonitic
lss	lesser
ltc	lithic
mg	medium grained
musc	muscovite
mx	matrix
ocy	occasionally
Ordo.	Ordovician
pphc	porphyritic
py	pyrite
q	quartz
sch	schist
serd	sericitised
sil	siliceous
sts	schistose
vn	vein
w	with

Stream sediment survey results.
Cu ppm, Pb ppm, Zn ppm.
and
[Cu ppm, Pb ppm, Zn ppm, Ba ppm, Au (-8 # CN leach) ppt]
See also Geology Cethana West

(Cu ppm, Pb ppm, Zn ppm)

Rock sample locations shown as (408) etc. - add prefix SO1 to all sample numbers.

977158

93-3497.

REVISION	PLUTONIC OPERATIONS LIMITED A.C.N. 004 680 997 (INC IN N.S.W.)
TECHNICAL REPORT NO:	PROJECT: 706 - GOWRIE PARK
COMPILED BY: G. MacDonald DRAWN BY: O. Hedditch CHECKED BY:	LAKE BARRINGTON PART E.L. 10/88 GEOLOGY & STREAM SEDIMENT GEOCHEMISTRY (SOME ROCK CHIP SAMPLE LOCATIONS)
DATE: JULY, 1993 SCALE: 1:10,000	REFERENCE / DWG. NO Fig 15.

LEGEND

bg	bedding
bge	beige
bn	brown
bxd	brecciated
clc	chlorihc
cm	cream
d	dark
fg	fine grained
ft	float
gly	generally
gn	green
gy	grey
hm	haematite
hmt	haematitic
mnst	marganese staining
Owen	Roland Conglomerate/Owen Conglomerate
p	pale
py	pyrite
rd	rhyodacitic
sid	silicified
st	siltstone
ts	tuffaceous
w	with
wy	weakly

4900E 4700N — Grid line – Grid peg

Outcrop in–situ

Sub–crop

Float

70 — Bedding, strike and dip

80 — Cleavage, strike and dip

DD80LB1 (-60° to 222°) 4M 3I 4F E.O.H. 187·50m — DDH No. (inclination, azimuth) Final depth, lithologies shown

Creek

4WD Tracks

Geological contact known

Geological contact interpreted

Geological contact interpreted–uncertain

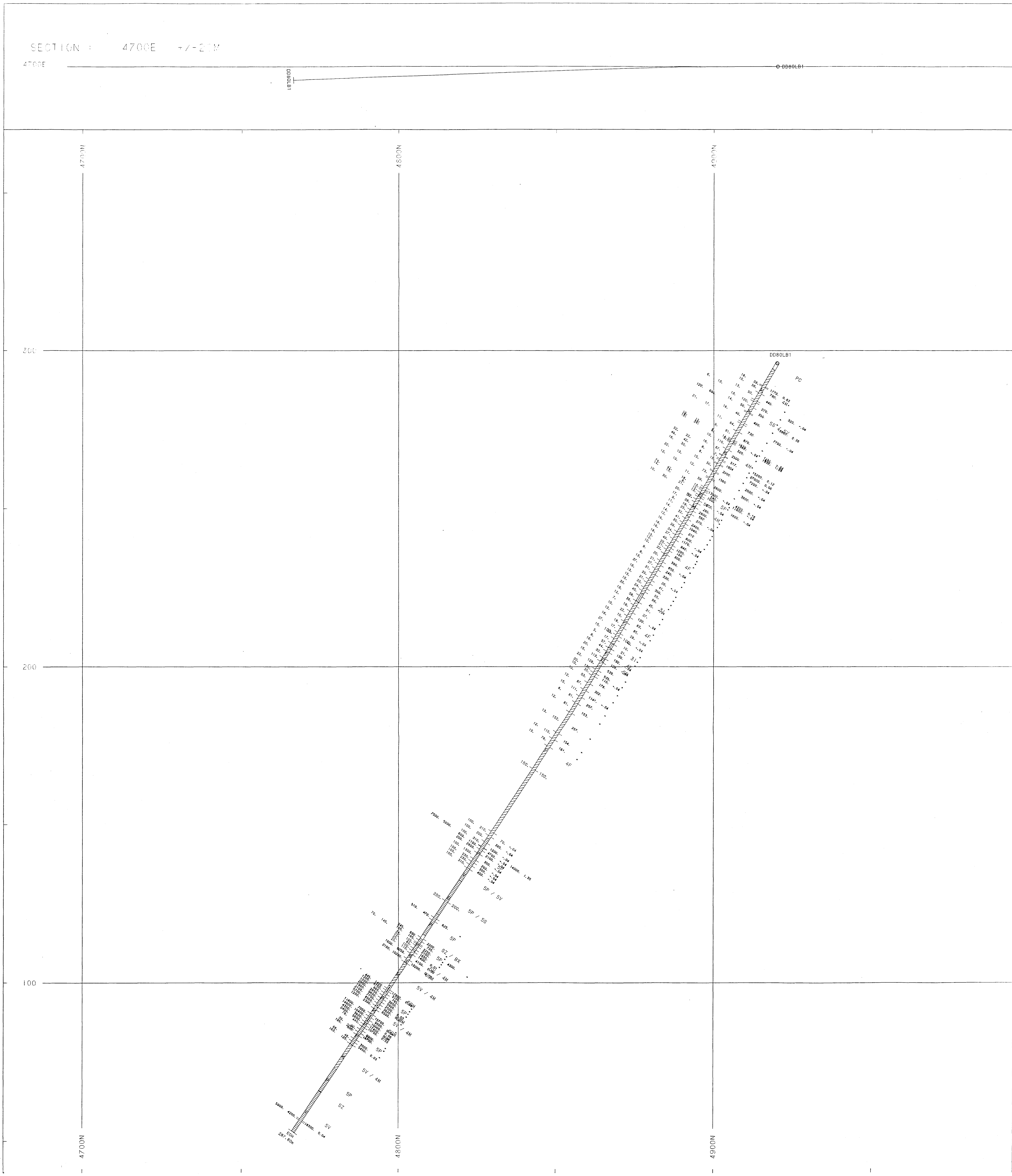
– 5C	Siliciclastic conglomerate – Ordovician Roland Conglomerate, generally with a haematitic matrix
– 5S	Siliciclastic sandstone – Ordovician Moina Sandstone (?), generally with a haematitic matrix
– 3F	Intermediate lavas feldspar >quartz phyric to the east
– 3T	Intermediate tuffs, green, feldspar rich sandy to silty
– 5V	Volcaniclastics - generally medium grained quartz and occasional lithics in a fine grained matrix. Of felsic derivation
– 3I	Feldspar phyric clayey intrusive intersected in drilling with limonitic amygdules
– 4T	Felsic tuff, beige green, sandy to silty, quartz feldspar rich
– 4CLT	Quartz feldspar phyric tuff with lithics < 2mm
– 4C	Quartz feldspar phyric crystal tuff
– 4L	Lapilli tuff with lithics generally subangular and consisting of subangular felsic lava fragments and fine grained volcanics in quartz feldspar rich matrix
– 4M	Similar to 4L but with prominent subrounded siliceous clasts of fine grained volcanics and cherty fragments and exhibiting signs of reworking
– 5P	Finegrained siltstones, variably beige green grey, black in colour. almost certainly reworked tuffs ie tuffaceous siltstone
– 4F	Felcic lavas feldspar > quartz + hornblende phyric (4F, rd) to the east, quartz feldspar phyric (4F) to the west, generally pink/orange or grey green when chloritic
– 4FB	Volcaniclastics consisting of subangular 4F and 4F rd fragment, possibly hyaloclastic
– 4I	Finegrained felsic intrusive in DD80 LB2, pinky orange siliceous rock

5 cm

93-3497.

PLUTONIC OPERATIONS LTD.
A.C.N. 004 680 997 (INC. IN N.S.W.)

COMPILED : G.MacDonald	PROJECT : 706 – GOWRIE PARK
SURVEYED : I. LEIGHTON	
DATE : JULY 1993	977159
DRAWN : O.H.	GEOLOGY
TECHNICAL REPORT No. : 706–R2	LAKE BARRINGTON PROSPECT
REVISIONS :	
DRAWING No. 706 - LB - 1	SCALE 1:1000 0 20 40 METRES — FIG. No. 16



<u>LEGEND</u>

8A	:	ALLUVIUM
8BX	:	COLLAPSE BRECCIA
8CB	:	CLAY WITH BEDROCK AFFINITIES
8CS	:	CLAY - SOIL PROFILE
8E	:	ELUVIUM
8L	:	LATERITE
8G	:	GOSSAN
8J	:	JASPER
7D	:	DIORITE
7DL	:	DOLERITE
7G	:	GRANITE
7GD	:	GRANODIORITE
6S	:	SILICA ALTERATION
6SS	:	SILICA SERICITE ALTERATION
6SP	:	SILICA PYRITE ALTERATION
6SSP	:	SILICA SERICITE PYRITE ALTERATION
6PSS	:	PYRITE SILICA SERICITE ALTERATION
6SSC	:	SILICA SERICITE CARBONATE ALTERATION
6CS	:	CHLORITE SILICA ALTERATION
6CSP	:	CHLORITE SILICA PYRITE ALTERATION
6SZ	:	STRINGER ZONE
6SM	:	SEMI-MASSIVE SULPHIDES
6MS	:	MASSIVE SULPHIDES
5C	:	CONGLOMERATE
5S	:	PSAMMITE
5P	:	PELITE
5PB	:	BLACK SHALE
5V	:	VOLCANICLASTIC
4A	:	FELSIC AGGGLOMERATE
4L	:	FELSIC LAPILLI TUFF
4V	:	FELSIC VITRIC TUFF
4T	:	FELSIC TUFF
4F	:	FELSIC LAVA
4I	:	FELSIC INTRUSIVE
4M	:	FELSIC MASS FLOW
4QP	:	QUARTZ PORPHYRY
4QFP	:	QUARTZ FELDSPAR PORPHYRY
4QFBP	:	QUARTZ FELDSPAR BIOTITE PORPHYRY
3A	:	INTERMEDIATE AGGLOMERATE
3L	:	INTERMEDIATE LAPILLI TUFF
3V	:	INTERMEDIATE VITRIC TUFF
3T	:	INTERMEDIATE TUFF
3F	:	INTERMEDIATE LAVA
3I	:	INTERMEDIATE INTRUSIVE
3M	:	INTERMEDIATE MASS FLOW
2M	:	MAFICS
1U	:	ULTRAMAFICS

FZ : FAULT

QV : QUARTZ VEIN

ASSAYS : Pb Zn ll Cu Au all in ppm

EOH : END OF HOLE

GRID N. = 042 DEGREES TRUE N.

977160

93-3497.

PLUTONIC RESOURCES LIMITED

LAKE BARRINGTON PROSPECT
SECTION 4700E
LOOKING GRID WEST
GMR 4241 WILMOT TASMANIA

EL	10/88	DATE	11/92
LOGGED BY		DRAWN BY	
CHECKED BY		DRAWING #	Fig. 17

TASMANIAN DIVISION

977161

ANALABS

A Division of Inchcape Testing Services (Australia) Pty. Ltd.
A.C.N. 004 591 664

ANALYTICAL DATA

SAMPLE PREFIX	REPORT No.	REPORT DATE	CLIENT ORDER No.	PAGE
	111715.60.09510	28/05/93	2005688	4 OF 4

TUBE No.	SAMPLE No.	Cu	Pb	Zn	
1	S01603	13	21	51	q r fc volc sy serd w hmt vn's
2	S01604	7	17	50	q r fc serd volc sts.
3	S01605	342	<5	100	very ~~brown~~ hmt cherty conglomerate?
4	S01606	339	<5	118	"
5	S01607	314	<5	123	"
6					
7	altd	altered			
8	fc	felsic			
9	fg	fine grained			
10	fsp	feldspar			
11	hb	hornblende			
12	hmt int	haematite/haematitic intermediate			
13	lmc	limonitic			
14	~~pa~~ mx	matrix			
15	ph	phyric			
16	q	quartz			
17	r	rich			
18	ser	sericite			
19	sts	schistose			
20	sy	strongly			
21	vn	vein			
22	volc w	volcaniclastic with			
23	DETECTION	4	5	4	
24	UNITS	ppm	ppm	ppm	
25	METHOD	GA101	GA101	GA101	

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

AUTHORISED OFFICER Keith Hand

Re Fig 15

93-3497

ANALABS 977162

A Division of Inchcape Testing Services (Australia) Pty. Ltd.
A.C.N. 004 591 664

ANALYTICAL DATA

SAMPLE PREFIX	REPORT No.	REPORT DATE	CLIENT ORDER No.	PAGE
	111715.60.09510	28/05/93	2005688	3 OF 4

TUBE No.	SAMPLE No.	Cu	Pb	Zn	
1	S01474A	6	<5	227	q fsp sed fe volc
2	S01474B	5	<5	15	andesitic lava
3	S01480	4	<5	30	q fsp ph rhyolitic lava?
4	S01483	4	<5	19	q fsp fe volc sed
5	[redacted]				
6	S01492	5	146	121	q r sts sed fe volc
7	[redacted]				
8					
9					
10					
11					
12					
13	S01509	7	5	23	↑
14	S01510	6	<5	23	
15	S01511	137	26	30	
16	S01512	7	<5	20	
17	S01513	5	8	24	all leached but haematitic
18	S01514	10	361	242	fine to medium grained
19	S01515	9	<5	21	schistose felsic volcaniclastics
20	S01516	5	<5	23	from 'campground'
21	S01517	8	11	74	
22	S01518	15	<5	39	
23	S01520	16	240	123	↓
24	S01601	7	5	28	q r fe volc lme.
25	S01602	19	130	50	q r fe volc sy sed w hmt vn's

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

AUTHORISED OFFICER Keith Hand

Reg Fig 15

93-3497

977163

ANALABS

A Division of Inchcape Testing Services (Australia) Pty. Ltd.
A.C.N. 004 591 664

ANALYTICAL DATA

SAMPLE PREFIX	REPORT No.	REPORT DATE	CLIENT ORDER No.	PAGE
	111715.60.09605	09/07/93	TBA	1 OF 8

TUBE No.	SAMPLE No.	Cu	Pb	Zn	Au	Au(R)	Au(S)			
1	S01527	<4	35	20	-	-	-			
2	S01528	6	42	138	-	-	-			
3	S01529	5	35	35	-	-	-			
4	S01530	9	42	24	-	-	-			
5	S01531	<4	33	15	-	-	-			
6	S01532	5	39	36	-	-	-			
7	S01533	15	44	39	-	-	-			
8	S01534	7	38	64	-	-	-			
9	S01535	39	70	51	-	-	-			
10	[redacted]				-	-	-			
11	[redacted]				-	-	-			
12	[redacted]				-	-	-			
13	[redacted]				-	-	-			
14	[redacted]				-	-	-			
15	[redacted]				-	-	-			
16	[redacted]				-	-	-			
17	[redacted]				-	-	-			
18	[redacted]				-	-	-			
19	[redacted]				-	-	-			
20	[redacted]				-	-	-			
21	[redacted]				-	-	-			
22	[redacted]				-	-	-			
23	[redacted]				-	-	-			
24	[redacted]				-	-	-			
25	[redacted]				-	-	-		[redacted]	

rock chip samples from shore line Lake Barrington from Davies Creek to Kellys Creek. ie. 1:10000 geological map.

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

AUTHORISED OFFICER Gary Lindberg

Re Fig 15

93-3497

977164

ANALABS

A Division of Inchcape Testing Services (Australia) Pty Ltd
A.C.N. 004 591 664

ANALYTICAL DATA

DEVELOPMENT ... 24 SEP ... ROA

SAMPLE PREFIX	REPORT No.	REPORT DATE	CLIENT ORDER No.	PAGE
	111715.60.09510	28/05/93	2005688	2 OF 4

TUBE No.	SAMPLE No.	Cu	Pb	Zn	
1	S01322	8	102	26	fsp > q crystal tuff w hmt vn's
2	S01328	6	<5	13	red weathering lmc sts fe volc
3	S01329	6	20	37	q fsp volc w hmt pods.
4	S01352	50	<5	28	q fsp sed fe volc
5	S01353	34	<5	46	"
6	S01354	85	14	56	"
7	S01356	13	<5	48	dacitic lava breccia
8	S01357	18	13	52	hmt vein
9	[redacted]				[redacted]
10	[redacted]		[redacted]		
11	[redacted]		[redacted]		[redacted]
12	S01422	12	<5	8	cherty hmt siliceous sediment (Ordovician?)
13	S01433	33	43	12	
14	S01434A	9	<5	98	
15	S01434B	11	<5	117	
16	S01438	210	<5	60	hmt sed's.
17	S01439	263	14	57	silicified fractured hmt volc
18	S01443	15	<5	7	Roland conglomerate ?
19	[redacted]				
20	S01464	8	6	28	q fsp sed fe volc
21	S01467	20	14	97	lmc q vn
22	S01468	6	103	42	q fsp sed fe volc
23	S01470	10	9	17	q vn w lmc clots blk st trace
24	[redacted]				
25	S01473	5	<5	32	purple hmt q and lithic rich sediment

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

AUTHORISED OFFICER Keith Hand

see Fig 15

93-3497

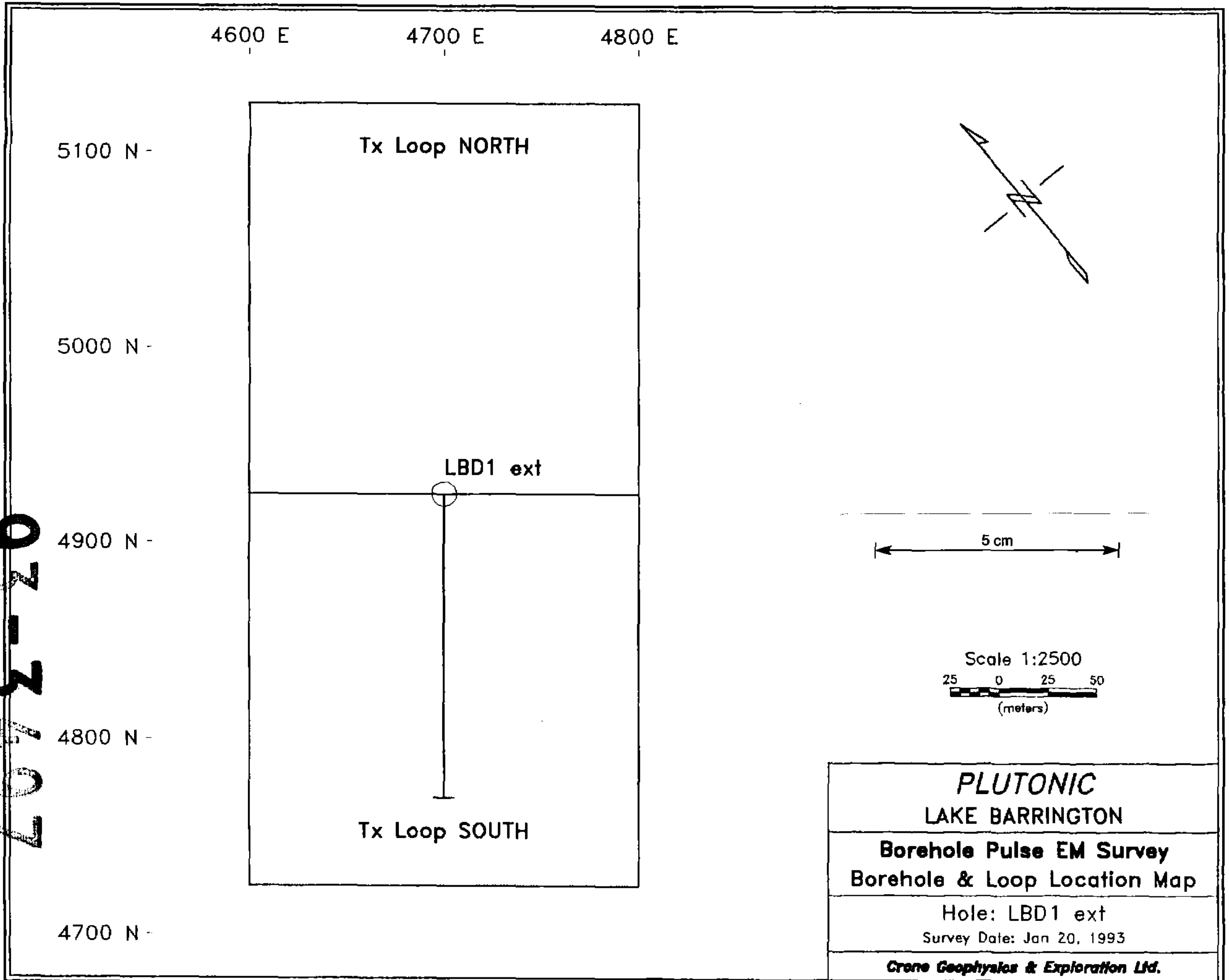


fig. 18

A07 3-96

9771 65

93-3-97.

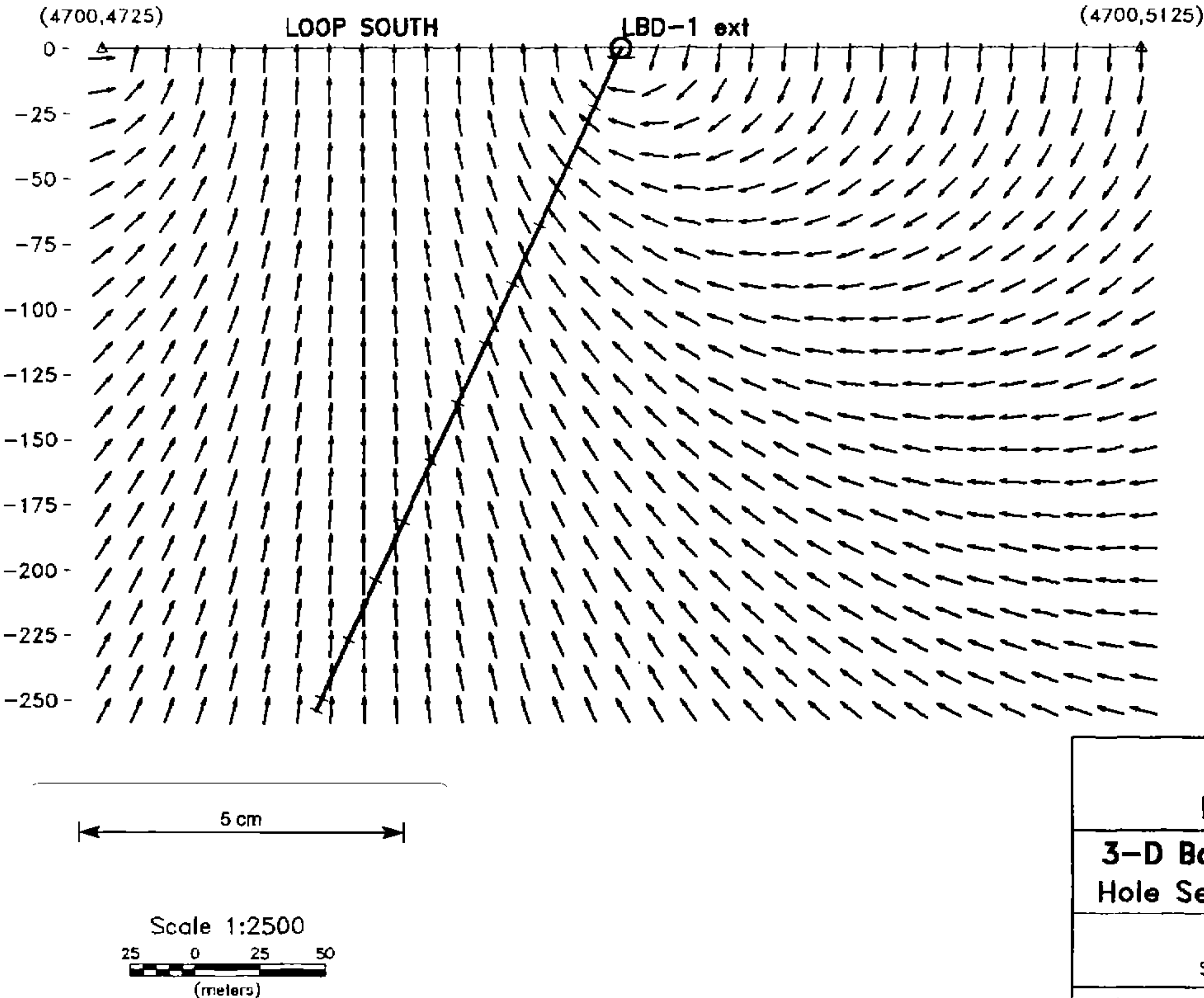


Fig. 19

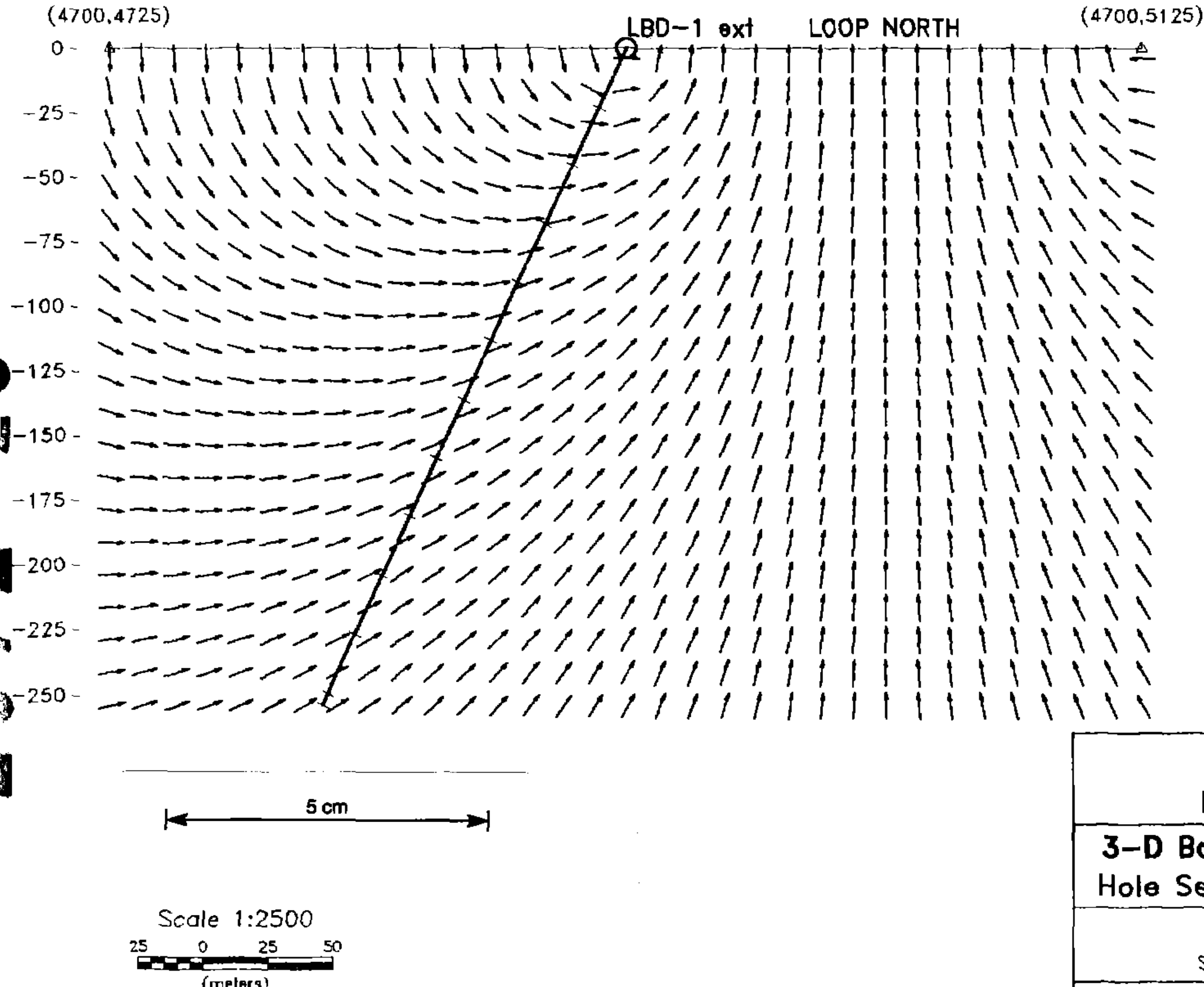
991776

PLUTONIC
LAKE BARRINGTON

3-D Borehole Pulse EM Survey
Hole Section with Primary Field

Hole: LBD-1 ext
Survey Date: Jan 20, 1993

Crone Geophysics & Exploration Ltd.



PLUTONIC

LAKE BARRINGTON

3-D Borehole Pulse EM Survey

Hole Section with Primary Field

Hole: LBD-1 ext

Survey Date: Jan 20, 1993

Crone Geophysics & Exploration Ltd.

fig.21

CRONE GEOPHYSICS & EXPLORATION LTD
BOREHOLE PEM

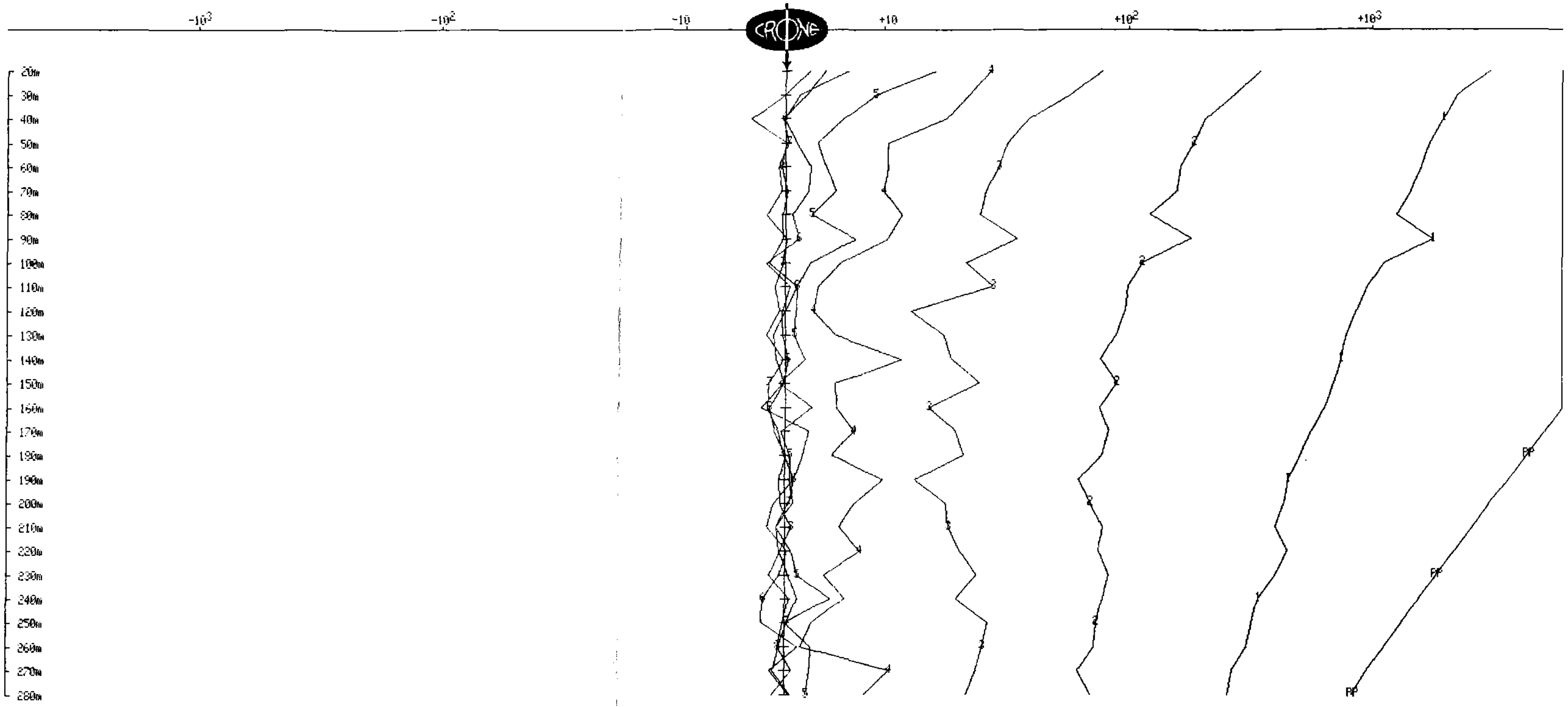
Client	: PLUTONIC	Hole	: LBD-1 ext
Grid	: LAKE BARRINGTON	Tx Loop	: SOUTH
Date	: Jan 20, 1993	File name	: LBD1XYS.PEM

5 cm

Data Corrected for Probe Rotation using Cleaned PP
X COMPONENT dBx/dt nanoTesla/sec - 8 channels and PP

977168

Scale: 1:2000



93-3497.

fig. 22

CRONE GEOPHYSICS & EXPLORATION LTD
BOREHOLE PEM

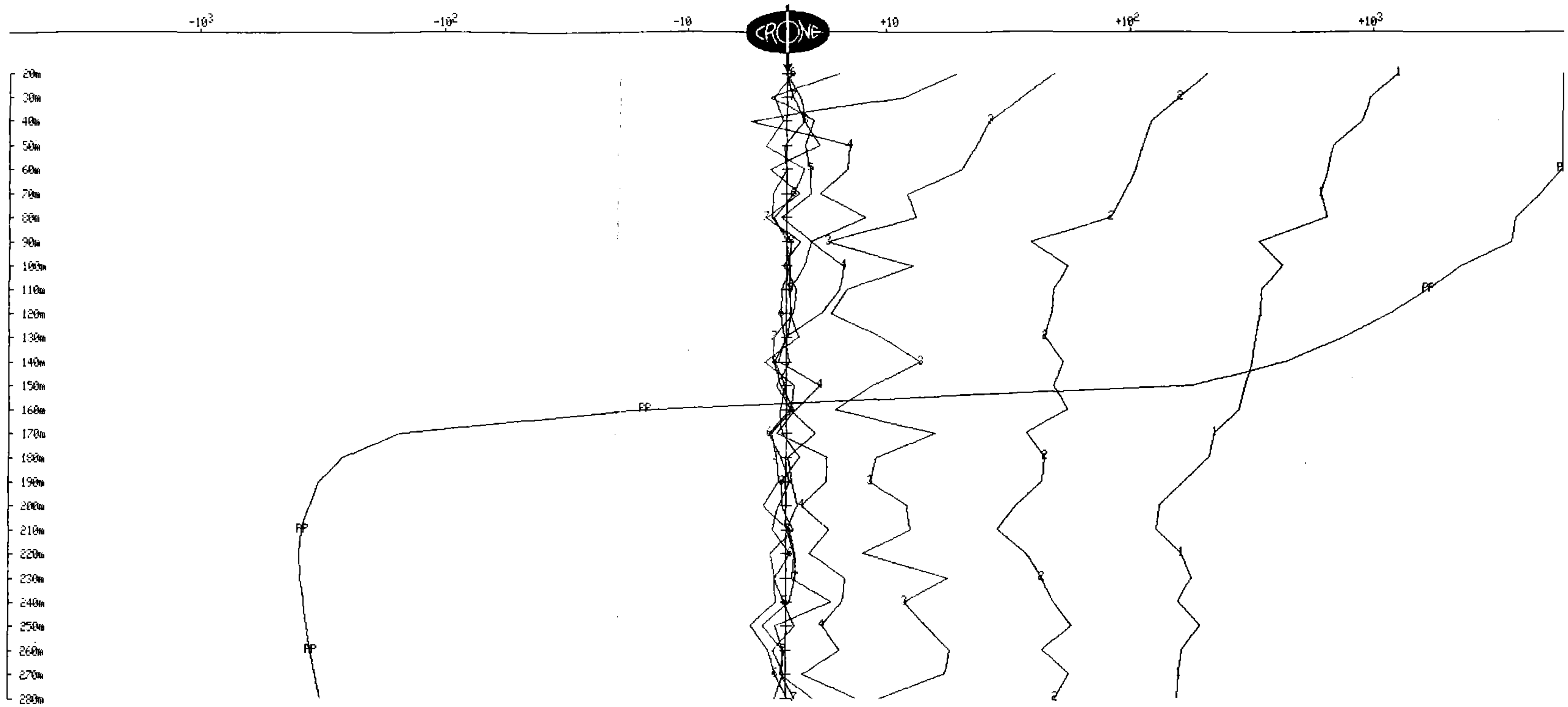
977169

5 cm

Client	: PLUTONIC	Hole	: LBD-1 ext
Grid	: LAKE BARRINGTON	Tx Loop	: SOUTH
Date	: Jan 20, 1993	File name	: LBD1XYS.PEM

Data Corrected for Probe Rotation using Cleaned PP
Y COMPONENT dBy/dt nanoTesla/sec - 8 channels and PP

Scale: 1:2000



93-3497.

fig.23

977170

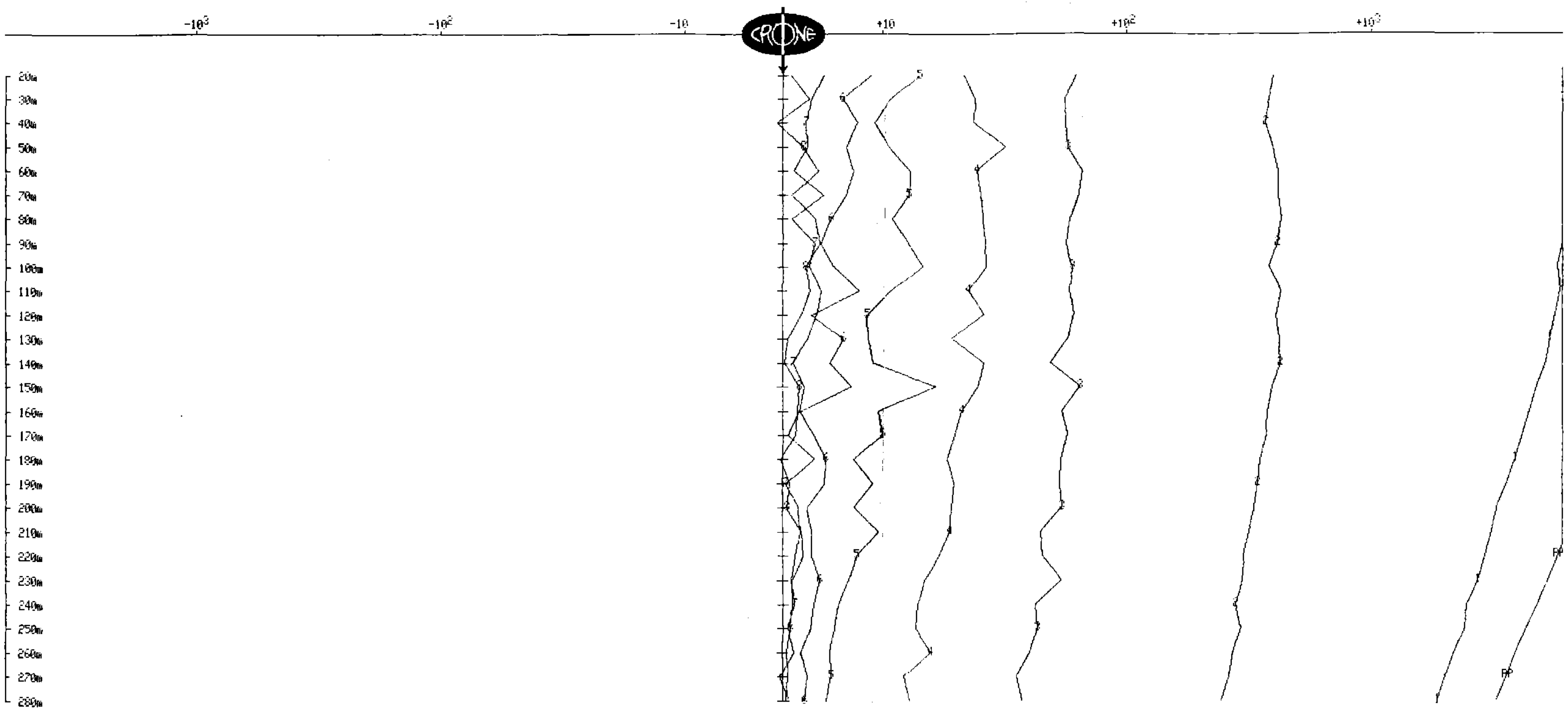
CRONE GEOPHYSICS & EXPLORATION LTD
BOREHOLE PEM

5 cm

Client	: PLUTONIC	Hole	: LBD-1 ext
Grid	: LAKE BARRINGTON	Tx Loop	: SOUTH
Date	: Jan 20, 1993	File name	: LBD1ZS.PEM

Z COMPONENT dBz/dt nanoTesla/sec - 8 channels and PP

Scale: 1:2000



93-3497.

CRONE GEOPHYSICS & EXPLORATION LTD

BOREHOLE PEM

fig. 24

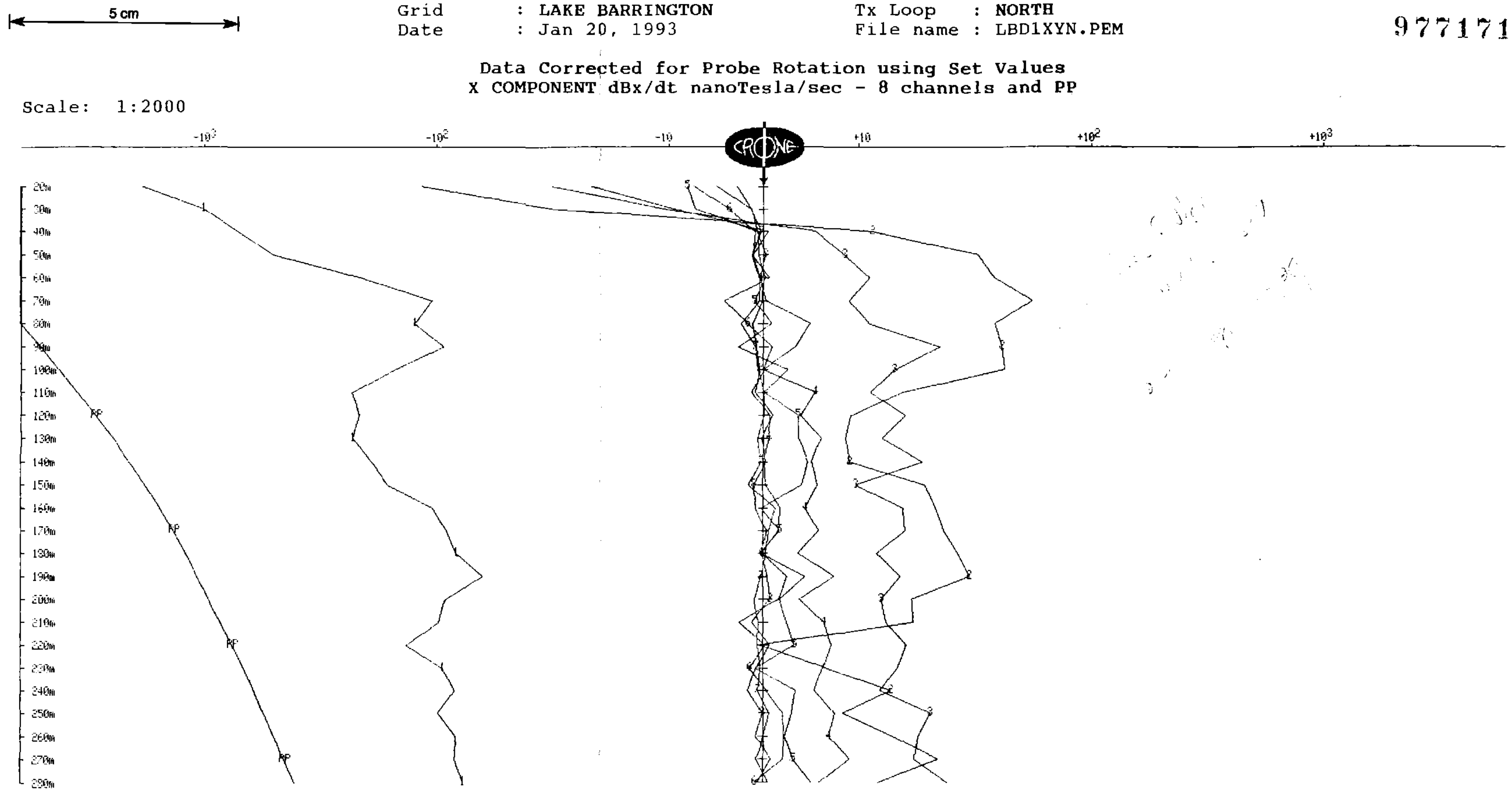
977171

Client : PLUTONIC
Grid : LAKE BARRINGTON
Date : Jan 20, 1993

Hole : LBD-1 ext
Tx Loop : NORTH
File name : LBD1XYN.PEM

Data Corrected for Probe Rotation using Set Values
X COMPONENT dBx/dt nanoTesla/sec - 8 channels and PP

Scale: 1:2000



93-3497.

CRONE GEOPHYSICS & EXPLORATION LTD
BOREHOLE PEM

fig. 25

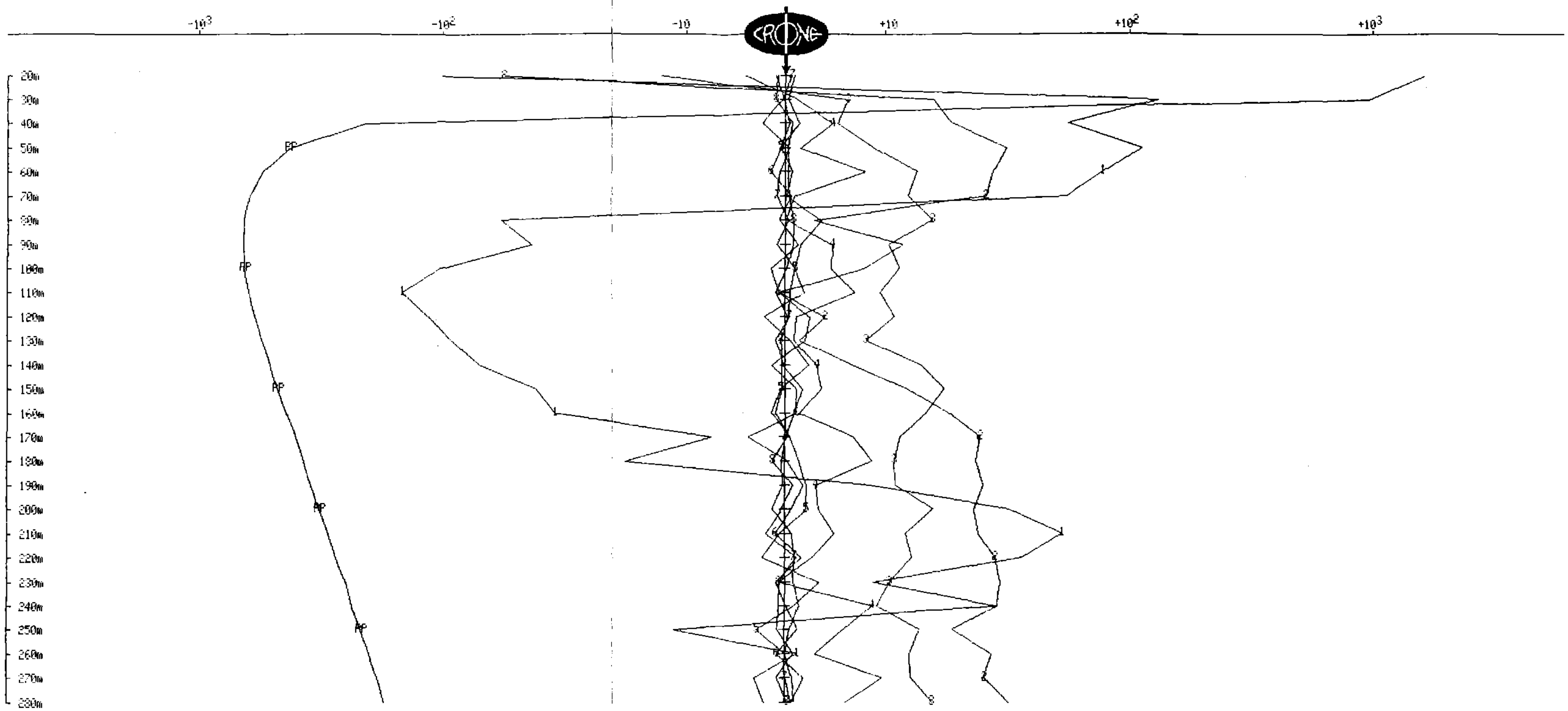
Client	: PLUTONIC	Hole	: LBD-1 ext
Grid	: LAKE BARRINGTON	Tx Loop	: NORTH
Date	: Jan 20, 1993	File name	: LBD1XYN.PEM

977172

Data Corrected for Probe Rotation using Set Values
Y COMPONENT dBy/dt nanoTesla/sec - 8 channels and PP

5 cm

Scale: 1:2000



93-3497.

CRONE GEOPHYSICS & EXPLORATION LTD
BOREHOLE PEM

fig. 26

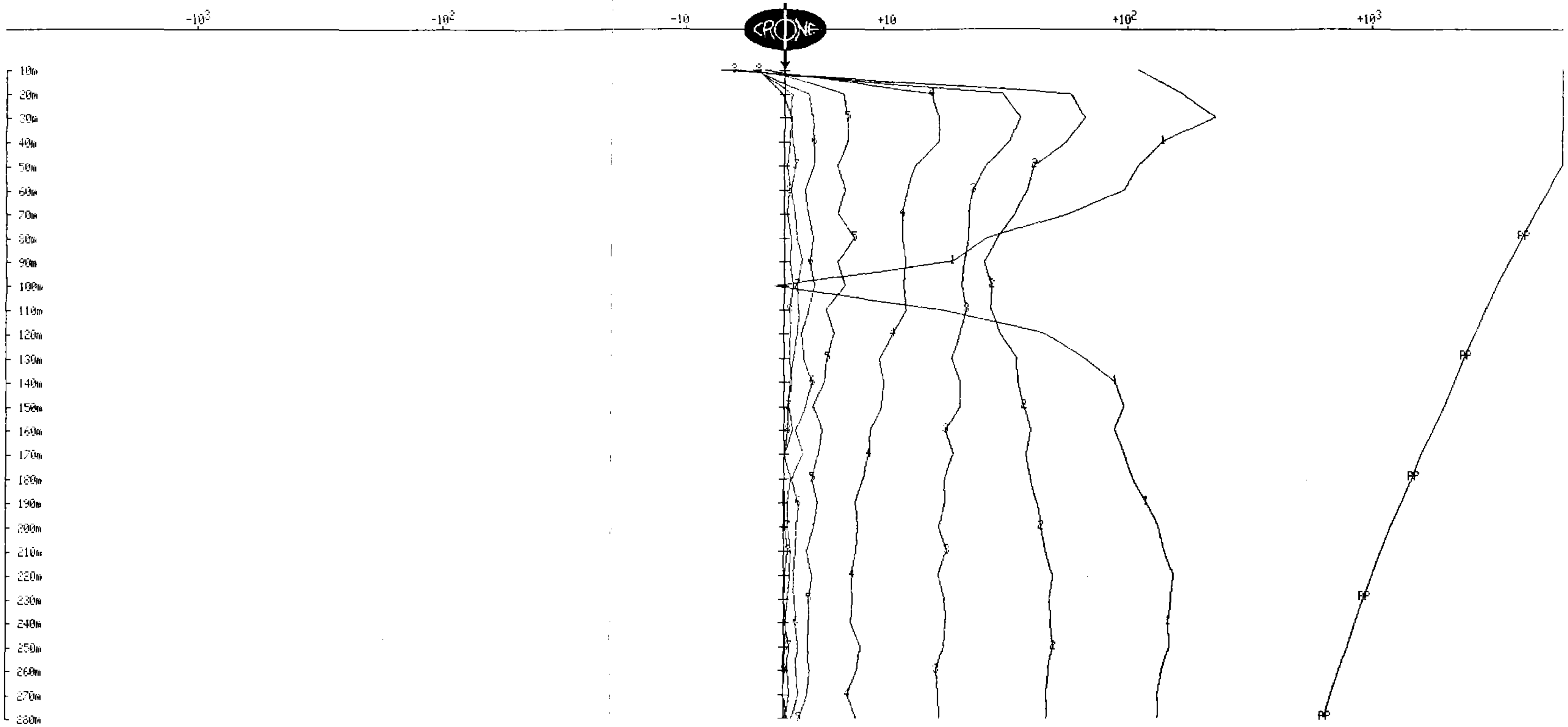
5 cm

Client	: PLUTONIC	Hole	: LBD-1 ext
Grid	: LAKE BARRINGTON	Tx Loop	: NORTH
Date	: Jan 20, 1993	File name	: LBD1ZN.PEM

977173

Z COMPONENT dBz/dt nanoTesla/sec - 8 channels and PP

Scale: 1:2000



93-3497.