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Mt Read Volcanics Project
Geophysical Report 1

Interpretation and Evaluation Report

1981 West Tasmania aeromagnetic survey

by D. E. LEAMAN

TASMANIA DEPARTMENT OF RESOURCES & ENERGY

DIVISION OF MINES & MINERAL RESOURCES

025002

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MOUNT READ VOLCANICS PROJECT:

INTERPRETATION AND EVALUATION REPORT 1981 WEST TASMANIA AEROMAGNETIC SURVEY

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1: SUMMARY

The 1981 aeromagnetic survey by the Department of Mines in western Tasmania has been reviewed. The survey represents a regional coverage flown with set specifications and provides a uniform reference framework for other surveys and interpretation. Although flown as a nominal drape at 150 m clearance many deviations and limitations were introduced by terrain and instrumental factors. The actual clearance was sometimes not recorded due to range limitations of the radar altimeter and the terrain clearance ranged from about 100 m to more than 600 m leading to complex distortions in the field intensities recorded and plotted.

Due to rough terrain, the wide range in rock properties, anomaly scale and the varied observational range, various types of data treatment and presentation have been compared to evaluate suitability for exploration purposes. Where data is acquired for mapping, unit tracing or reconnaissance purposes retention of the highest resolution is desirable and a drape presentation is preferable. Large parts of this survey require no correction for terrain or clearance for this application. Such areas lie west of the Mt Read Volcanics and the West Coast Range. Where quantitative analysis, anomaly relativity, structure modelling or assessment of lineaments is required then the data must be corrected and reconstituted at some fixed level clear of the topography. This approach does not preclude some reconnaissance-mapping value but detail is lost where the land surface is much lower than the height chosen. The problem, due to relief of up to 1275 m, is which height to choose. No single level is recommended for the entire survey area but various parts of the West Coast Range incorporating the Mt Read Volcanics are adequately defined at 800, 1000 or 1275 m.

Qualitative interpretive comments are provided for the entire survey area but quantitative assessment has been restricted to three representative regions of about 200 square kilometres each and some isolated profiles. The regions - around Mt Lyell, near Renison and Rosebery, and east of Waratah - were selected to assess optimum processing procedures and resolve lineaments, anomalous property variations and structural implications. Some common denominators were resolved at the regional level permitted by the coverage. East-west structures, though not always apparent at the surface, are dominant at every site of economic mineralisation and bulk contrasts of potential host units are modified by the mineralising process.

The basalt-covered region east of Waratah contains a concealed block of probable Cambrian volcanics beneath an average 200 m of basalt. The plateau is composed of many flows filling a drainage system with an original relief of 300 m. No special data corrections are essential for this region but are advised for simpler interpretation. An unexplained magnetic source is indicated beneath the basalt at the junction of Precambrian and probable Cambrian suites. The Bischoff mineralisation is strongly magnetic and lies at the intersection of major E-W and NE-SW and minor NW-SE and N-S

lineaments.

The mineralisation within the Rosebery-Renison Region offers a family of responses. There are clear magnetic responses for Rosebery, Renison and Red Hills mineralisation but the response at Hercules is subtler. Although character is evident in observed data it is enhanced by derivative processing. The primary structural relationships are evident only when the data is processed from its near drape format to a fixed level. True drape corrections are not generally justified. When the data is corrected the mineralisation within the Mt. Read Volcanics can be associated with major E-W corridors and NW-SE lineaments. The Renison mineralisation is granite-related and the granite mass has an E-W elongation across strike. The extent of the granite can only be identified in corrected data which allows some separation of sources within the thermally affected halo. Groups of small prospects west of Williamsford are associated with the same lineament corridors.

The Lyell mineralisation can also be related to E-W corridors and NW-SE lineaments. The mineralised belt contains a large volume of altered volcanics which is magnetically identifiable. There is almost total loss of contrast in the host materials which is commonly only established using 3D methods. Terrain correction or effects are significant and while there is little benefit in drape processing, correction to a fixed level is productive. Modelling must allow for terrain and complex structure. The magnetic Tyndall Group permits considerable structural mapping of the east side of the range. Ore mineralisation generates small anomalies in the altered zone. Second derivative presentations appear most effective. It is likely that surface surveys, unless extensive, would not yield comparable results or definition of the altered zone.

Mineralisation in the Zeehan or Cleveland regions may be related to shelving granite masses (or cupolas) and consequent thermal alteration and dyke activity. The magnetic field reflects the distribution and extent of such halo effects. This character is also evident in the Renison - Colebrook Hill area.

While most lineaments are evident in raw data presentations many are not precisely located or are obscured by near surface detail. Fixed level processing permits identification of primary features. E-W features in the Rosebery and Lyell regions were defined in this way. While E-W trends are not geologically emphatic they do appear crucial to the evolution of the province and its mineralisation. Other features should be clarified and explored wherever potential host rocks are known or likely.

Magnetic mineralisation signatures are generally subtle, especially for Cu-Au or Pb-Zn-Ag deposits. Sn deposits are usually associated with noisy field due to both mineral association and major unit alteration. These effects, in either case, may not be appreciated in raw data presentations. In the Sn case source separation is advised and in other cases derivative treatments and 3D modelling may be necessary to define the altered rock masses and anomalous characteristics within it.

Limited regional modelling suggests an easterly dip for parts (at least) of the western side of the Tyennan Geanticline but this result may reflect unknown remanence properties or a more complex margin to the Geanticline. The Precambrian rocks of the Tyennan Block are less magnetic than those of the western or Oonah sequence and the junction between the two may lie near the present position of the Henty Fault. The structural treatment, though regional and coarse, illustrates some of the benefits and limits of magnetic analysis. Variations in magnetic properties within units to depths of 1.5 km at least are deducible but primary structural forms beyond this depth are inevitably diffuse. There is evidence that remanence effects are significant for some mafic and ultramafic suites and contribute to the bulk contrast of many other units. Mafic units generate most of the large anomalies. Regional analyis suggests that a thick volcanic suite occupies an anticlinorium west of the range which extends south from Strahan. The regional synclinoria are mappable due to either presence of Crimson Creek or Tyndall Group materials. The Dundas Group is magnetic overall but offers less contrast than other Cambrian units. Many structural conclusions are uncertain at this level of treatment and comparative gravity analysis is required. The latter may be less direct in terms of location of mineralisation or alteration but more definitive structurally. Regional thrusting appears to be significant. It is possible that the Precambrian rocks south of Macquarie Harbour have been displaced and key elements of the western volcanic sequence between Que River and Mt. Dundas, including the Rosebery section, have been multiply overthrust.

This report presents a survey assessment and an indicative interpretation. It acts as a sign post. It is not a complete interpretation of the entire survey but sufficient detailed analysis has been undertaken to demonstrate the potential applications for this data and the techniques required to extract information about alteration characteristics, contrasts and true structural geometry. This work shows that magnetic surveys in Western Tasmania have been underinterpreted and much useful information has not been recovered. It still can be. Advanced methods are required and specialist analysis is advised. These comments apply to both primary and secondary exploration; definition of the corridors in the crust which have transferred the mineralising fluids and been concomitantly altered, and detailed unit assessment in exposed geology above them. Collation of property determinations undertaken as part of the Mt Read Project should assist this process. Other methods, including geochemistry, mapping, host evaluation, EM etc may be relevant in more detailed studies although magnetic analysis of subtle features coupled with any other indicator may be viable technology. This report suggests that careful magnetic analysis can be coupled with geochemical/alteration predictions, can evaluate them on a gross scale and can provide insights into unit continuity and structural form at depth - aspects not always deducible from surface mapping. This last aspect is relevant wherever Devonian movements may have shifted Cambrian host and source relationships.

2: INTRODUCTION

The coverage of the 1981 Department of Mines aeromagnetic survey is shown in Figure 3-3 (folder). It extends from a little north of Waratah to a few km south of Macquarie Harbour and from the coast to 395 000 mE. The region had been surveyed previously by various exploration companies (refer Leaman, 1973b, 1980b). Only the Lyell-EZ and Rio Tinto surveys of the late fifties approached the scale and consistent coverage offered by the 1981 survey. Unfortunately detailed specifications and results are no longer available but a nominal drape at 150 m was attempted. All other lesser, and more recent, surveys, are fragmental in terms of coverage and specification. The 1981 survey sought to redress this situation by providing a modern, regional skeleton with capacity to allow detailed infill or extension where explorers felt desirable.

This report, commissioned as part of the Mt Read Volcanics Project, examines the adequacy of the specifications, any limitations within the data set and its regional usefulness. It was recognised that a total, quantitative evaluation was not possible within the time frame of the project and more limited objectives were set. These were :-

i) to examine the specifications and results and review the advisability of reprocessing or terrain correction for various purposes.
ii) to compare different processing procedures.
iii) to provide a general qualitative interpretation for the survey
iv) to examine a few key areas in detail to test if regional signatures or property variations are recognisable and to provide some stand-alone examples of more complete interpretation. The latter were to provide tests of the feasibility and value of more comprehensive interpretation.
v) to concentrate on issues associated with the structure and composition of the Mt Read Volcanics along the West Coast Range.

This report is not an exhaustive treatment, but an indicative analysis designed to form the basis for future work by suggesting how the data may be handled and which interpretive procedures are likely to prove most cost effective in various geological regimes. Comment is therefore provided on data acquisition and processing limitations or problems and experimental quantitative reviews of structure, lineament extraction and basalt cover problems. This material has two uses; direct and continuing where an interpretation is provided and directional where method assessment is provided. Efforts have also been made to extract bulk estimates of rock properties from the anomalies and this data can be contrasted with the measurements summarised by Hudspeth (1986).

The report augments the qualitative outline of the survey provided by Corbett et al (1982) but emphasises the structural features and deposit relationships within the general context of the

Cambrian volcanic arc.

This report forms only one unit in the Mt Read Volcanics Project regional appraisal. Others include interpretation of survey extensions to the south (Leaman, 1986a), to the north and north east (Bishop, 1986) and collation of rock properties (Hudspeth, 1986). All reports may be reviewed in conjunction with the ore deposit signature study (Bishop et al, 1986) and gravity interpretation (Leaman, 1986b). The early release of this report reflects data availability and the need to provide some interpretive conclusions at an early phase of the project. Revisions indicated by gravity data (in acquisition at time of writing) will be described in the gravity study report. No results from the property determination programme were available by March 1986.

3: SURVEY DETAILS

The survey was flown by Geoex Pty Ltd of Adelaide during 1981 and was funded by a Commonwealth grant for additional mineral exploration in Tasmania. The survey area was nominated as that offering greatest benefit given the need to provide a uniform, high quality aeromagnetic coverage of western Tasmania. The specifications were designed to provide good results for regional analysis, to be reproducible for survey extensions or infill and which could be processed into other formats with minimal loss in resolution or detail.

Since the survey was to form the basis of a more extensive survey (funds permitting) and complement rather than replace detailed surveys by explorers a line spacing of 500 m (+/- 100m) was selected as the minimum separation able to resolve most first and second order structures. This may be contrasted with detailed surveys where 100 to 150 m is desirable.

The survey was flown with fixed wing aircraft (Cessna A185E) to minimise costs and increase coverage. The aircraft was loaded only with magnetometer and recording equipment (Sonotek 1GSS1 and King KRA10 altimeter) to lessen weight and allow more controlled flying in the difficult terrain. Flight lines were east west or approximately normal to principal geological structures. North south tie lines 10 km apart were observed.

The most critical specifications were related to terrain clearance and other elevation data. A nominal clearance of 150 m (or an envelope of 50 to 250 m) was specified for several reasons. If the drape could be flown then a high resolution result of direct benefit for mapping purposes would be obtained directly. Secondly, by flying close to the ground no detail would be lost as in fixed height presentations and fixed height survey would either have to be flown at different elevations in various parts of the area or at a height often too high to retain details on units elsewhere. Unfortunately the specifications were not consistently met due to severe flying conditions in the terrain. The average clearance was about 180 m, and although not a serious deviation in itself, is coupled with an absence of barometer trace and several instances of off scale radar altimeter (difference > 600 m). Not all flight paths are absolutely recoverable. This limits some processing options. Clearance was to have been measured within +/- 10 m.

The specified sample interval was estimated at 40 to 42 m. Review of various lines shows that wherever variable terrain was encountered sample intervals have varied from 25 to 85 m with an average within a few metres of specification. The maps presented by the contractor quote an average sample interval of 36 m and clearance of 135 m. This is incorrect. The specifications and the deviations from them illustrate the difficulty of providing a general, workable specification which retains maximum processing flexibility in a region with nearly 1300 m relief.

The observed data were corrected for misties and diurnal variation with flight path recovery to industry standard. Flying was not attempted on days when the field was disturbed (4-5 nT/5 mins). Observation precision 1 nT. The International Geomagnetic Reference Field was subtracted (base value 62664 nT) and the results plotted after applying a three point filter. No other corrections were performed and the data was gridded on a 125 m cell before contouring. No attempt was made to compensate for varying terrain clearance or terrain anomalies and spurious or modified anomalies may be included in the original presentation.

The data was supplied by the contractor in four forms:-

i) flight path plots, (Figure 3-1, in folder)
ii) stacked profile plots (Figure 3-2, in folder)
iii) contour maps (e.g. Figure 3-3, in folder)
iv) digital magnetic tape.

The contour interval is variable but 5 nT was used in areas of low magnetic relief which tends to enhance minor anomalies at the expense of larger features (compare with profiles).

Various processing options are available. These include regional-residual separations, recontouring, correction to uniform terrain clearance by line or area and transformation to fixed level. In the last case some minor problems may be induced due to altimeter range excesses (see discussion Rosebery-Renison Region, section 4-D). Interpretive options include trend, susceptibility or first and second derivative analysis. These treatments should be restricted to fixed level transformations due to high gradients and terrain effects at drape altitudes (see sections 4-C, 4-D).

Coverage of the 1981 survey was incomplete over the central part of Macquarie Harbour (see Figure 3-3). This deficiency has now been overcome as part of the 1985-6 programme. The relevant survey fragment is presented as Figure 3-4. Specifications of this data are described by Leaman (1986a).

4: INTERPRETATION

4-A: GENERAL

i) Introduction

Interpretation has been restricted to a general commentary and to a few specific issues due to time constraints on this phase of the Mount Read Volcanics Project. The commentary and chosen issues were selected to augment other literature in the public domain (e.g., Corbett et al, 1982) and to provide guidance and leads for extensions of this project. I have chosen to develop discrete quantitatively intrepreted units within the survey area so that at least some parts of it will have received a reasonable treatment. The units selected (Rosebery-Renison, Lyell, Waratah-Guildford) were thought representative of exposed and concealed Mt Read Volcanics and contain varied styles of mineralisation. It was hoped that work in these regions might reveal some common denominators - structural or property variants - which may have general application as well as defining the regional signature of five major economic deposits (Mt. Bischoff, Rosebery, Renison, Hercules, Mt. Lyell). Several isolated profiles have been examined in addition in order to relate other deposits to the above units and to the gross structure of the volcanic arc. These profiles were selected to enable comparison with the Farrell and Que River deposits. It must be appreciated that this report uses data from the 1981 survey only and that this is suitable only for regional evaluations. It is to be expected that subtleties and details related to the definition of a deposit signature might not have been recorded. Nevertheless, by restricting this work to the regional data, future explorers can evaluate the gross capability of the magnetic method, and the relative resolution of coverage and processing of this survey.

ii) Geology

Geological base mapping is available at varying standards and scales across the entire survey area. The body of this interpretation depends on the compilation map of the Mount Read Volcanics from Que River to Mt Darwin by Corbett (1984) augmented by the mapping of Brown (1983), Baillie et al (1977) and Blissett (1962). The detailed geology of the region has been described by Blissett (1962), and Corbett (1979).

Metamorphosed Precambrian rocks of the Tyennan Region are exposed east of the Cambrian Mt Read Volcanics axis while correlates of the Oonah Formation are exposed to the west. There are two distinctive ?Eocambrian - Cambrian sequences. South and east of the Henty Fault Zone a volcano-sedimentary sequence including greywacke, siltstone, tuffs and some basalts is overlain by an acid-intermediate volcanic pile (Central Volcanic Sequence). This is overlain by the Sticht Range Beds (quartz wacke, siltstone) and the

Tyndall Group acidic volcanics and volcaniclastic conglomerates. North and west of the Henty Fault the sequence consists of Success Creek Group (mudstone, quartzite, dolomite), Crimson Creek Formation (mafic lithic wacke, mudstone), the Central Volcanic Sequence and the Dundas Group including the Rosebery Beds (greywacke, siltstone, mudstone, conglomerate, felsic tuffs and intermediate-basic volcanics). There is an array of Cambrian intrusives including ultramafics, gabbros, felsic porphyry and granite.

The Owen Conglomerate of late Cambrian-Early Ordovician age unconformably or disconformably overlies the Cambrian or Precambrian sequences. The Ordovician Gordon Limestone Subgroup overlies the conglomerate (where present) with varying degrees of conformity. The Siluro-Devonian Eldon Group consisting of mudstones, quartzites overlies the Ordovician conformably (?).

All units have been folded several times in their history, the latest orogeny being in the late Middle Devonian. Massive intrusion of granites accompanied this event. Permo-Triassic rocks of the Parmeener Super Group were deposited on the irregular topography of the early Permian and were later intruded by Jurassic dolerites. Only remnants of these post Carboniferous rocks persist. The northern part of the area is blanketed by Tertiary basalts while Macquarie Harbour to the south occupies a Tertiary fault depression with substantial sediment thicknesses.

iii) Materials and properties

The rock materials of the region were outlined briefly in the previous section. Very few units possess significant magnetic properties. The first attempt to collate these properties was made by Leaman (1973b). These early results suggested that the ultramafics, some of the volcanic units and magnetite-bearing tuffs generated most anomalies and that these could be mapped magnetically. Susceptibility data was collected but no attempt was made to measure remanent magnetisations. These deficiencies are being overcome (Hudspeth, 1986) but no results were available for this interpretation. Inferences from anomaly studies and available results have been summarised in Table 1. Where sufficient data are available it will be noted that the inferences lie within measured ranges with few exceptions. This indicates that the bulk values should be employed for modelling and anomaly assessment. In several notable cases, for example the Tertiary basalts, the inferred value of effective contrast exceeds the measured susceptibility but not the observed susceptibility plus a reasonable allowance for the remanence using an average value for the Koenigsberger ratio. Sample measurements and bulk field inferences have been compared in the table.

Some inferences can be derived directly from inspection of both contours and profiles (Figures 3-2, 3). Although the profiles appear to present an attenuated view of many important but subtle features they do offer the true perspective of anomaly forms free of the contour crowding effects or contour interval variations.

The comparatively "unmetamorphosed" Precambrian sequences are essentially non magnetic and associated with stable fields and gentle, smooth gradients. South of Balfour and west of Savage River many anomalies can be related to "sandstone - mudstone" boundaries or "mudstone" units. These units tend to be less than 500 m thick. More highly metamorphosed units are more magnetic and locally may have contrasts of 0.0025 to 0.004 cgs. Garnet-bearing units are readily identified, as are the amphibolites and iron-bearing units of the Savage River - Rocky River Region.

Most sedimentary (turbidite) Cambrian units have little obvious magnetic signature although no area of such materials is free of anomalies. These tend to be small and isolated suggesting local intrusives, minor extrusive content or mineralisation. Acid - intermediate rocks yield a slightly noisier field but only rarely is the effect in excess of 200 nT. Basic - intermediate volcanics are more distinctive with an anomaly relief sometimes in excess of 500 nT.

Other Palaeozoic materials are non magnetic. As described in other parts of this report thermally metamorphosed haloes around Devonian granites may generate complex and intense anomalies implying high localised contrasts. Observations by Collins et al (1981) from the Meredith, Heemskirk, and Pine Hill granites have been included in the table.

Jurassic dolerite and Tertiary basalts generate a distinctive anomaly style but contrasts are clearly variable and patchy and anomalies rarely exceed 50 - 200 nT. Inspection of the Figures (3-2, 3) indicates that there are at least two basalt "signatures"; one noisy and general and the other localised and somewhat smoothed. These characteristics probably reflect basalt thickness and variability and the composition of the underlying materials.

The values ultimately used in modelling must be treated as very approximate bulk estimates. Contrasts are relative.

SI and cgs unit relationships are not provided in the table but an example of their equivalence and use of either system is provided in Section 4-F-i, page 78.

TABLE 1

Unit age/group	Magnetic properties Measured: Susceptibility $\times 10^{-3}$ cgs	Magnetisation Gauss	K	Inferred Effective Contrast $\times 10^{-3}$ cgs: lab	field
TERTIARY					
sediments	-	-	-	0	0
basalts	0-1.7	0-10000	20	5-6	3-6
JURASSIC					
dolerite	0-5	100-7000	1-5	4-7	2-7
PERMO-TRIASSIC	-	-	-	0	0
DEVONIAN					
Meredith/Heemskirk/Pine Hill/Qz porph			-	0	0
Contact alteration zones					0-3
Housetop	0-0.3			0-.3	0-.3
granodiorite	0-0.5			0-.5	0-.5
skarn	0-80			0-80	
ORDOVICIAN TO DEVONIAN					
Gordon/Eldon Gps	-	-	-	0	0
CAMBRIAN					
Tyndall Gp					2-3
Dundas Gp	0-0.2				0-1
Crimson Ck Fm	0-8				0-3
Success Ck Fm	0-0.2				0-1
Gabbros	0-1				3-5
Volcanic seq					.6-1.5
Porphyry	0-0.8				.5-1
Murchison gr	2-3				2-3
Serp Hill complex	0.3-6+				0-20
PRECAMBRIAN					
Deep Ck volcs	0-7				0-10
Qzite/phyllite	0.06/0.02				0-.5
Oonah Fm					0-1
altered					1-2

4-B: REGIONAL COMMENTARY

The following notes provide a generalised, regional interpretation of the magnetic field. Some specific interpretation follows in other sections of this report. Correlations or contrasts with available geological mapping have been emphasised but the comments do not constitute a final interpretive statement. Terrain-sourced features and deficiencies in overall mapping limit the reliability of many correlations at this stage.

Although Cambrian-related features have been treated expansively the entire coverage is described. The discussion refers to Figures 4-B-1, 2, 3 for geological-geographical base material (from 250 000 geological map series) and a magnetic field overlay which can be related to the anomaly map (Figure 3-3). The anomaly numbers used are essentially those of Corbett et al (1982) augmented where necessary. Many correlations can only be appreciated in profile form (Figure 3-2).

As implied in the discussion of rock properties (Section 4-A) there are several distinct geological-magnetic field regimes within the surveyed area. In perspective (Figure 3-2) the magnetic field is generally quiet and relatively few units generate a significant response.

Regime 1: The high frequency noisy field of basalt and dolerite-covered areas. This is evident north of Que River and east of Waratah. The result is unique. Dolerite produces a similar effect where surface exposure is sizeable - SE of Trial Harbour and along the Pieman River.

Regime 2: High amplitude anomalies reflect ultramafics or magnetite rich materials. The first class is evident south of Asbestos Point (8), in the Dundas - Colebrook Hill region, in the limbs of the Huskisson synclinorium and at Bald Hill. The second class is represented by the metamorphosed rocks of the Arthur Lineament and its iron rich members.

Regime 3: Compositional variations within the Precambrian rocks produce minor but mappable anomalies which are evident in the Tyennan region and west of Savage River. The field is generally flat and normal in these blocks.

Regime 4: Most other anomalies are related to Cambrian rocks. The response is governed by sensor clearance, exposure or lithology. Some magnetite rich tuffs or the igneous content generates the observed responses. The anomalies are generally comparable with the basalt category (regime 1) but are more restricted reflecting stratigraphic controls.

Regime 5: The thermally metamorphosed haloes about certain granitic plutons has overprinted most other signatures. The effect is most evident where the country rock is normally magnetically bland - as east of Mt. Heemskirk. The halo effect surrounds most of the Meredith Granite. The reach of the halo is variable but rarely exceeds 6 to 8 km. A comparable effect may be implied in the Renison-Dundas Region. Some of these effects are locally substantial, exceeding all but regime 2 effects locally.

The contour presentations stress the subtle gradients which pervade the large tracts of non magnetic rocks. Typical gross, systematic variations are often of the order of 125 nT across 10 or more kilometres. These effects imply that those units which are magnetic, and often subtly so in total, are usually present in substantial volumes with a considerable depth range. The belt of Lower Palaeozoic rocks in the West Coast Range must represent the tip of a very large volume of material in order to generate a regional tail effect at Ocean Beach.

a) Strahan-Macquarie Harbour Region (Figure 4-B-1, 3-3)

The major anomaly south of Macquarie Harbour (8) is compound and related to Cambrian basic-ultramafic rock suites. There are three main elements. The peak values may be correlated with ultramafics while the accessory features reflect suites with a basic rock component. The entire host suite is also slightly magnetic. The correlation with extant mapping is good here. The anomaly appears to extend to Ocean Beach via (12, 13, 14) but the segment between Goat Head and the King River (13) is very subdued. While this may indicate absence of ultramafics the change is most likely due to source depth changes. The apparent sharpness of 12-14, which are all relatively small, low gradient anomalies, is due to sources lying at the edge of the Tertiary basin. Anomaly 13 lies at a corner and bifurcation within the basin with a sub basin lying between 13 and 14; the coalescence and increased depth seaward leads to the reduction in amplitude of 13. The trend change between 8 and 12 is not simply explained and there are suggestions of two magnetic sources. The higher amplitude NW-SE effect overprints a NNE-SSW extension of the Asbestos Point feature. Only near Mt Strahan does the basin edge affect these trends. The offset reflects the thickness of sediment and changes in relative source geometries. The anomaly near Trig 575, SE of Rum Point on Birch Inlet (9), is comparable to 13.

Many of these features have been examined quantitatively to assess the source of the symmetric anomalies and the implied thickness of Tertiary and Ordovician materials. See section 4-F-i.

It is probable that the principal Tertiary faulting extends from Cape Sorell-Goat Head-Pine Point and from north Swan Basin-east Howard-Mt Strahan-Pillinger on the south and north sides respectively.

Anomalies comparable with parts of 8 have also been observed over basic volcanics further west (4) but mapping is suspect in this area since the sharpest and largest anomalies occur in rocks south of the "volcanics". Several other smaller features occur in this same Cambrian block (6, 7) or in the adjacent "unmetamorphosed" Precambrian rocks (7, 5). Some Cambrian granite is present and it is possible that some of the rocks have been altered over a wide area. Alternatively some localised fault zone alteration and dykes may be inferred. Anomaly 6 and part of 7 may be related to tuffs or volcanics within the normal Cambrian rocks but this seems unlikely in view of the patchiness and isolation of each component of these anomalies. A variety of sources, some near surface, is suggested. Other parts of these blocks are magnetically quiet.

Small, localised anomalies occur in the Precambrian block south and west of Table Head (1, 2, 3). Structural control is apparently absent and 1, 2 have deeper sources than part of 3. Localised pelitic variations could generate these anomalies. It is possible that the anomalies relate to concealed materials carrying a trend pattern consistent with the exposed Cambrian rocks. In Section 4-F-ii it is suggested that the Precambrian rocks in this region have been overthrust.

The low amplitude anomaly on the east side of Kelly Basin (11A) can be used to estimate basin thickness (4-F-i). The anomaly has a NNE-SSW trend consistent with predominant trends south of Macquarie Harbour and with terminations of the range at Nord River and Baxter Rivulet. A significant NW-SE lineament is indicated from Swan Basin to Pillinger to Western Plains.

b) Strahan-Gormanston-Mt. McCall Region (Figure 4-B-1)

The principal anomalies are related to the Cambrian volcanics exposed in the West Coast Range. The largest anomalies lie along the range axis or its eastern margin (22-24-27-28) while smaller anomalies are associated with the western margin (22A, 23, 25). Maximum anomalies correlate with exposures of the volcanics but the relationship between such exposures, source content, Ordovician cover or sensor clearance is not clear and must be corrected. Two anomaly sources are generally evident, one bulk and low contrast and the other superimposed, obvious stratigraphically controlled features. South east of Mt Owen Upper Cambrian rocks pass beneath exposed Ordovician rocks (27 extended). Similar anomaly extensions occur south of South Darwin Peak (22 south, 11). Localised anomalies in the Lynchford area (e.g., 23) reflect minor intrusives, gabbros.

Few distortions have been observed in the magnetic field where Ordovician to Permian rocks are exposed massively or where these overlie Precambrian units. There are exceptions. Anomaly 15 is associated with Permian rocks and the source is at moderate depth - Jurassic dolerite or Cambrian basement. The pair of small anomalies near Rinadeena (21) and the small wrinkle (18A) on a possible herring bone effect are not obviously explained but local fault zone oxidation effects seem most likely. Similar explanations may apply to 12A/B south of Teepookana although extrusive pods may also be the source.

The character of the garnet-bearing metamorphosed Precambrian rocks is exemplified by 10. The anomalies may be correlated with mapped lithologic variations and the magnetic units can be traced beneath the Ordovician cover in several places (Western Plains, Mt Maud west, Mt Madge north west) but the pattern is inconsistent with extant mapping along the Engineer Range.

c) Queenstown-Zeehan-Rosebery-Eldon Range Region (Figure 4-B-1, 2)

This region encompasses the heartland of the Mt. Read

Volcanics. Anomalies 29-35-36 continue the trend established by 22-28. All are associated with various parts of the Mt. Read Volcanic suite. Anomalies 26 and 33 appear to be the normal response for acid volcanics or tuffaceous units. 20 is an abnormal feature within a turbidite sequence and may be contrasted with 19. There is no direct explanation for 30 or 32 although the peak anomaly is related to coarse-grained basic rocks. It is likely that all three anomalies have the same origin and the relative sharpness of the features is consistent with sources for 30 and 32 at quite shallow depth. The extension of 30 follows the western side of the fault across Mt Dundas. The field is more complex near Mt Murchison; anomalies can be correlated with mineralisation at Red Hills and the Cambrian granite on the east side of the range. These features have been examined and resolved quantitatively after correction for extreme sensor clearance variations (section 4-D).

Some other minor features may be noted. Small anomalies are related to the dolerite caps on Eldon Peak and Mt Dundas (31) and subtler versions of anomaly type 10 (see 4-B-b) can be recognised over the Precambrian units east of the range.

d) Zeehan-Mt Heemskirk Region (Figure 4-B-2)

The magnetic field across the Zeehan area is relatively undisturbed wherever Junee and Eldon Group rocks are exposed and gradients reflect gross geometry of underlying Cambrian materials. Similar quiet responses are associated with the Heemskirk Granite west of Gap Peak. The remainder of the granite and the materials marginal to it exhibit erratic behaviour and many high amplitude anomalies. While several sources lie close to the surface some lie at depths in excess of a kilometre. Most anomalies are multicomponent. The disturbed zone is most pronounced near Trial and Granville Harbours (51, 52). 51A is due to ultramafics, 51B is at least partly associated with Cambrian gabbros and 53 is apparently related to Tertiary basalts although the anomaly character is atypical. Similarly the bulk of 51 is not normal for Ordovician or Precambrian rocks and trend 52 is quite uncharacteristic of unmetamorphosed Precambrian rocks. It is possible that Cambrian basic rocks are present at depths of a few hundred metres (compare 51B) and a small exposure has been mapped beneath Tertiary cover (53A) but, with the exception of a small part of trend 52 (at #52) all other anomalies have deeper sources. The disturbed field effect extends 3 to 7 km from the granite. This range is of the same order as that predicted for the width of a shelf (less than 2 km deep) around the granite (Leaman, 1974). The magnetic field probably mirrors a zone of shallow-seated thermal alteration with a variety of basic and ultrabasic sources superimposed. This interpretation also implies that a granite spine extends as far as Zeehan (see also Section 4-F-iii). Indeed, with only one exception, all principal Pb/Ag workings lie around the edge of this spine. 54 lies at the north eastern limit of the spine. The anomalies suggest that the granite surface, although irregular, is shallowest near Granville Harbour, near the headwaters of the St. Dizier and Tasman Rivers, and south and east of Mt. Agnew. Tin has been recovered from the latter areas.

Most of the disturbance within the granite area is related to contact effects (incl. parts of 52). Several small anomalies not associated with tin mineralisation or contact interference may also be observed. These may reflect the junction between "red" and "white" granite (e.g., 52A, B).

All other significant anomalies in the region are related to Jurassic dolerite (54, Eureka cone sheet; Badger River). A larger, isolated feature (52C) may be related to granite contact alteration. It is not consistent with normal dolerite character. The slightly disturbed field within the dolerite structure can be interpreted in terms of dolerite at depth but is more probably due to the thermal halo of the Heemskirk Granite. This would be quite consistent with the occurrence of tin "within" the cone sheet.

e) Renison-Pieman River Region (Figure 4-B-2)

This almost magnetically featureless region corresponds with exposures of unmetamorphosed Precambrian rocks. The gradients reflect the deeply rooted pile of Cambrian magnetic sources between Renison Bell and Parsons Hood (Section 4-F-iv). The magnetic data suggest that the base mapping is incorrect northwest of Stringer Rivulet and that the boundary between Precambrian rock types lies at least 2 km further west (55s). Very small features nearby may be of interest but only 55A implies significant departure form normality in this coverage.

f) Mt. Meredith-Rosebery-Dundas Region (Figure 4-B-2)

The maps indicate the uniqueness of this region with its distorted "Y" of large anomalies. The eastern arm is continuous from the Ring River to a little south of Waratah (43-44) and the southern large anomalies are related to ultramafics. Shoulder anomalies on the eastern side of this axis indicate more normal Cambrian variants (tuffs, basic volcanics).

The western arm of the "Y" anomaly is broader and less intense reflecting a greater width of exposure and less ultramafics. There are several shoulder anomalies due to other materials but these are clearly seen only in profiles (43A, 45A). A moderate anomaly can be detected in the region of the Renison mineralisation but many subtler features have been swamped. Analysis of the anomaly pattern around Renison and correction for terrain effects greatly clarifies the magnetic field (see section 4-D).

Anomalies 45, 45A appear to be marginal effects from units near the base of the Cambrian succession but the increased complexity and scale of some features (45B) imply either further ultramafics (some exposed) or thermal alteration of Cambrian sediments by granite. Gradients southwest of Mt. Livingstone are displaced from the mapped granite boundary suggesting either mapping error or probably presence of a granite shelf at shallow depth.

The magnetic field within the Huskisson Syncline cannot be assessed without detailed study due to the major surrounding anomalies. Some anomalies, such as 46, may be artifacts of source variations to east or west. However, the gradient across the Ordovician rocks between Mt. Ramsay and the junction of the Wilson and Alfred Rivers is abnormal. Anomalies (47) follow the trend of

Cambrian sedimentary rocks westward toward the granite. Between 47 and the north end of 45, and south east to 44/48, the gradients are gentle and unlike those near Parsons Hood or the termination of the western arm of the "Y" which implies that the margin of the pluton changes character. Either the granite dips shallowly westward and the syncline rocks are underlain by a mix of Cambrian rocks, or the granite shelves eastward to the Alfred River, at least, and the anomalies are alteration effects. There are distinct, small anomalies within this zone (47A) but mapping and gravity data might be needed to resolve this issue.

The magnetic field across the Meredith Granite is normal and generally reflects gross geometric effects of the boundaries. Abnormalities are associated with outliers of Tertiary basalt (47B). The grain of the magnetic field and its structural relationships north and south of the pluton reflect once continuous structures disrupted by intrusion (see also Groves et al, 1972, p 191). The arc of ultramafics was once a substantial structure in its own right; over 70 km long and not simply restricted to a "complex" at Bald Hill.

Anomaly 50 is related to a poorly defined block of Cambrian rocks northwest of Melba Flat.

g) Mt. Bischoff-Cleveland Region (Figure 4-B-2)

The east limb of 62 is the continuation of the eastern arm of the "Y" anomaly described above. It is sourced by Crimson Creek Beds and basic intrusives. The anomaly trends westward south of Magnet Mine and is then terminated. It is linked with anomalies 62(west) which flank the northern extension of the Meredith Granite. The character of gradients for westside of 48-62, eastside of 62 west, southside of 59 and northside of 45A, B - all instances of Cambrian sediments (?) in contact with granite - suggests that part of the enhancement of these features is due to thermal alteration. In all cases the source is located outside the mapped granite boundary and is consistent with shelving contacts at depth.

Several subtle anomalies are evident which display N-S and NE-SW trends (61, 63). Localised and patchy anomalies may be correlated with the gabbroic rocks in the Mt. Cleveland, Luina, Magnet areas. Most are unrelated but may reflect lithological variations within the same formation. Elsewhere, west of North Valley, these same rocks are virtually non magnetic which supports the thermal alteration hypothesis.

Anomalies east of Waratah posses NE trending character with most intense effects correlated with Cambrian sediment exposures. These features may be consistent with basic volcanics (unmapped), magnetite-bearing sediments or thermal alteration phenomena. The source is general and extends beneath the basalt. The long wavelength effect can be traced some distance until the multiple basalt effects disguise it (see section 4-E).

Anomaly 63 is unique, isolated and related to the south face of Mt. Bischoff. It is a couplet feature with a low about 1 km to the south. Comparable anomalies occur north of Bald Hill within undifferentiated Precambrian rocks (68, 69). Anomalies near 61 are associated with basic volcanics; the relative enhancement around 61 compared perhaps to more normal response near Cleveland may reflect contact alteration. The group of anomalies related to the Bald Hill complex (58) is distinctive. Some N-S lineaments can be observed. A number of small anomalies flank the main anomaly group and the causes are unknown in most cases. 58A is at Bronze Hill.

One of the more unusual anomaly couplings in the entire survey is at 60 where granite and ultramafics are juxtaposed.

h) Bulgobac-Mt. Bischoff-Guildford Region (Figure 4-B-2)

This portion of the survey area is almost completely covered by Tertiary basalt. The ubiquitous high frequency response of the basalt is superimposed on several other features. At 67, and in an arc to the north and north west toward Waratah the basalt cover appears relatively thin or absent. Elsewhere no simple implications are deducible. See especially section 4-E. Inspection of some profiles reveals some field inversions and it may be inferred that some flows carry reversed magnetisations or small feeder pipes.

i) Rosebery-High Tor-Bulgobac Region (Figure 4-B-2)

The predominant rock types in this region are Cambrian "turbidites" and acid-intermediate volcanics. Anomalies 42, 49 represent the only definite non basalt features. Only 42 has any strike length and parallels the regional grain, developing greatest relief between the Que and Hatfield Rivers. A N-S trend from 49 persists for 20 km.

Anomalies within the acid volcanics (e.g., 39-40) are subtle and suggest small changes in composition. There is no obvious pattern to these features. 37 marks the boundary between Palaeozoic and Precambrian rocks. The magnetic character of the Precambrian rocks around High Tor is consistent with metamorphosed garnet-bearing units.

The magnetic field associated with non Cambrian Palaeozoic rocks is unexceptional apart from 41. This near surface feature may lie within Cambrian materials but is restricted and out of character for the region.

j) Savage River-Sandy Cape Region (Figure 4-B-3)

Available mapping is sketchy in this region but there is good correlation between certain members of the mudstone sequence and magnetic response (57A, B). The source unit is little more than 500 m thick in many cases. Most pronounced anomalies occur at the junction of mudstone-sandstone associations. One unit, 57-57C, has considerable strike extent. Many lesser anomalies may have the same origin.

Although a dyke swarm of Precambrian dolerites has been mapped there is no special correlation between anomalies and dykes. Only in the region of Mt. Bolton and Mt. Hadmar is there probable interference but no obvious anomaly strike relationship. The anomalies suggest some alteration effects but the E-W feature 57D suggests some other structural influence.

The region is dotted with small subcircular anomalies. Few, if any, appear due to basic intrusives but in the absence of better maps the role of facies variation and mineralisation cannot be assessed.

The contact zone of the coastal granite produces anomalies at Pieman Heads (56) only although some effect persists along the coast at the edge of the survey. The inland contact, with some localised exceptions north of Interview River, has no such effect. This boundary may be contrasted with other granite boundaries and is clearly not normal.

Anomalies 55B can be associated with basalts within the unmetamorphosed Precambrian sequence. Trend 55A is enhanced by contact effects with metamophosed rocks to the southeast. The two part nature of this anomaly confirms the existence of multiple sources close to the limit of resolution. The termination of the larger eastern component at the anomaly constriction near Savage River and possible continuation fo the western component (55B) to Badger Plains suggests that mapping of the western edge of the lineament is inaccurate.

k) Savage River-Corinna-Granville Harbour Region (Figure 4-B-3)

The anomalies of the Arthur Lineament zone of metamorphic rocks including amphibolites show that the lineament is not a simple continuous structure. The anomalies within the southern part of the lineament (55) appear to be related to pelitic sequences and amphibolites. These have only been mapped around Savage River but appear to extend to the coast. Local anomaly peaks can be correlated with known occurrences of amphibolite and/or iron ore. 55C corresponds to the Rocky River deposit.

The northern part of the lineament is distinct (56). Alignments are not as well developed and are comparable to 55. The huge central anomaly is related to the Savage River deposit.

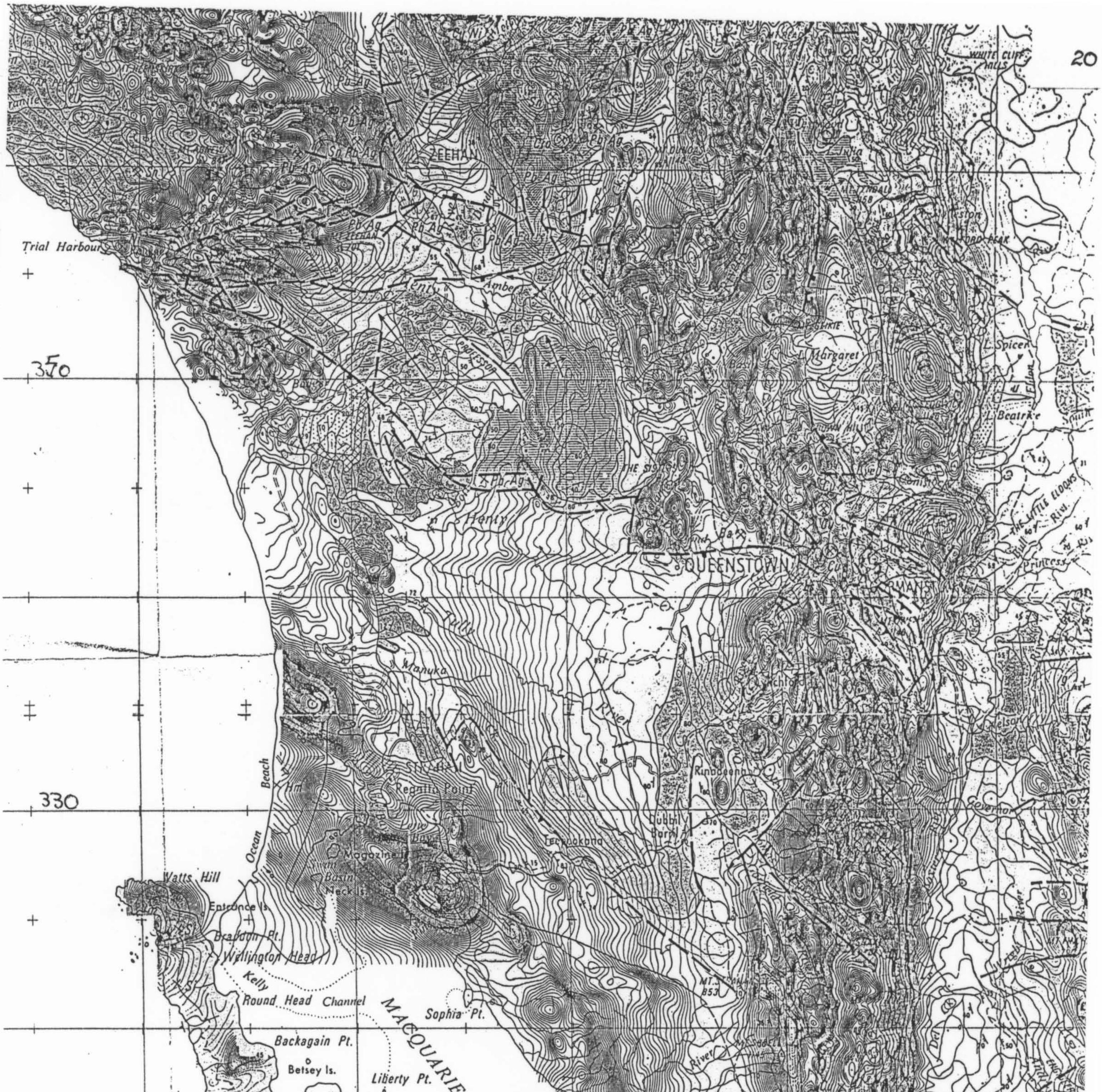


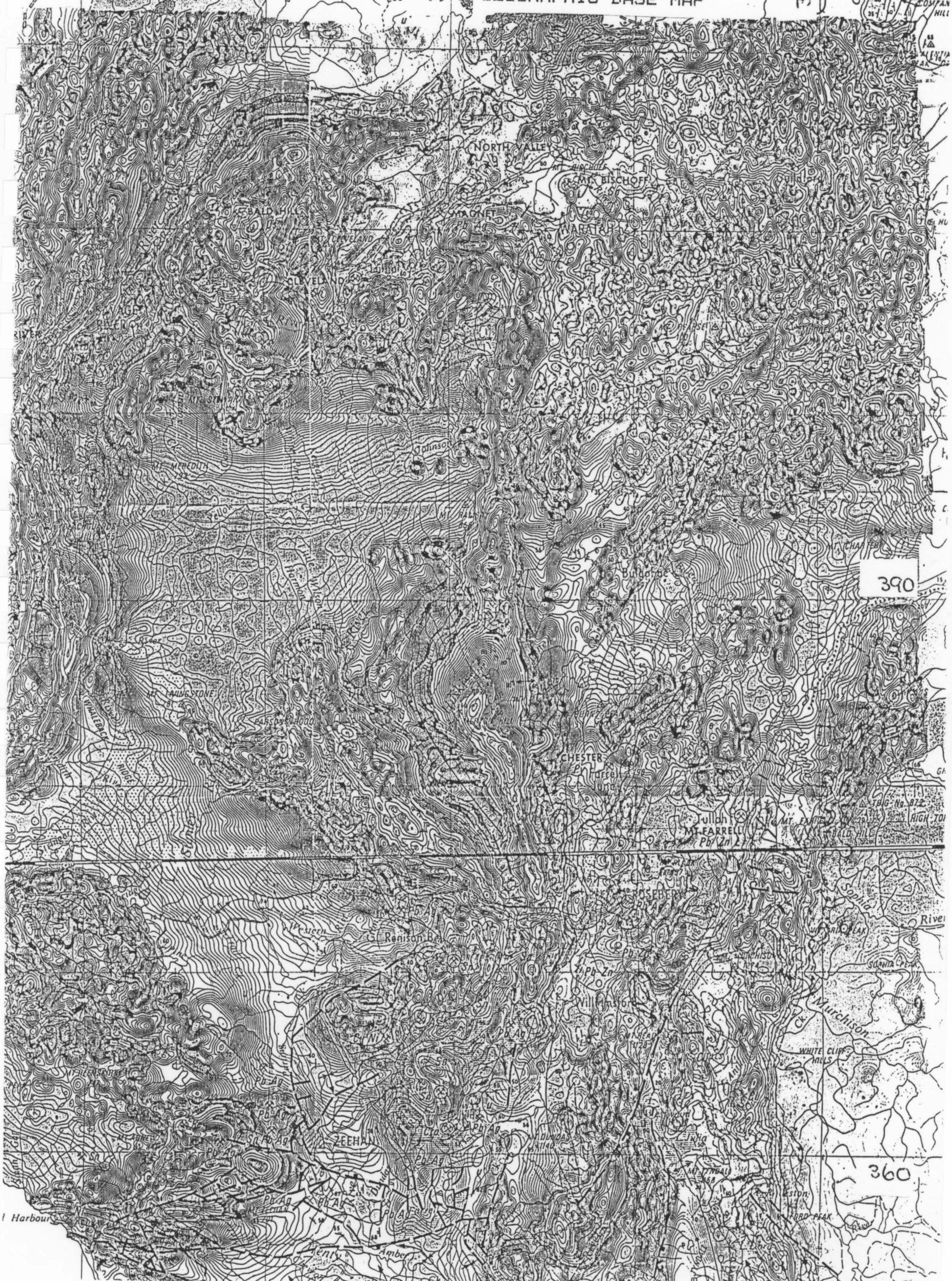
FIGURE 4-B-1
MAGNETIC FIELD WITH
GEOGRAPHIC BASE MAP

025025

025026

21

FIGURE 4-B-2
MAGNETIC FIELD WITH
GEOGRAPHIC BASE MAP



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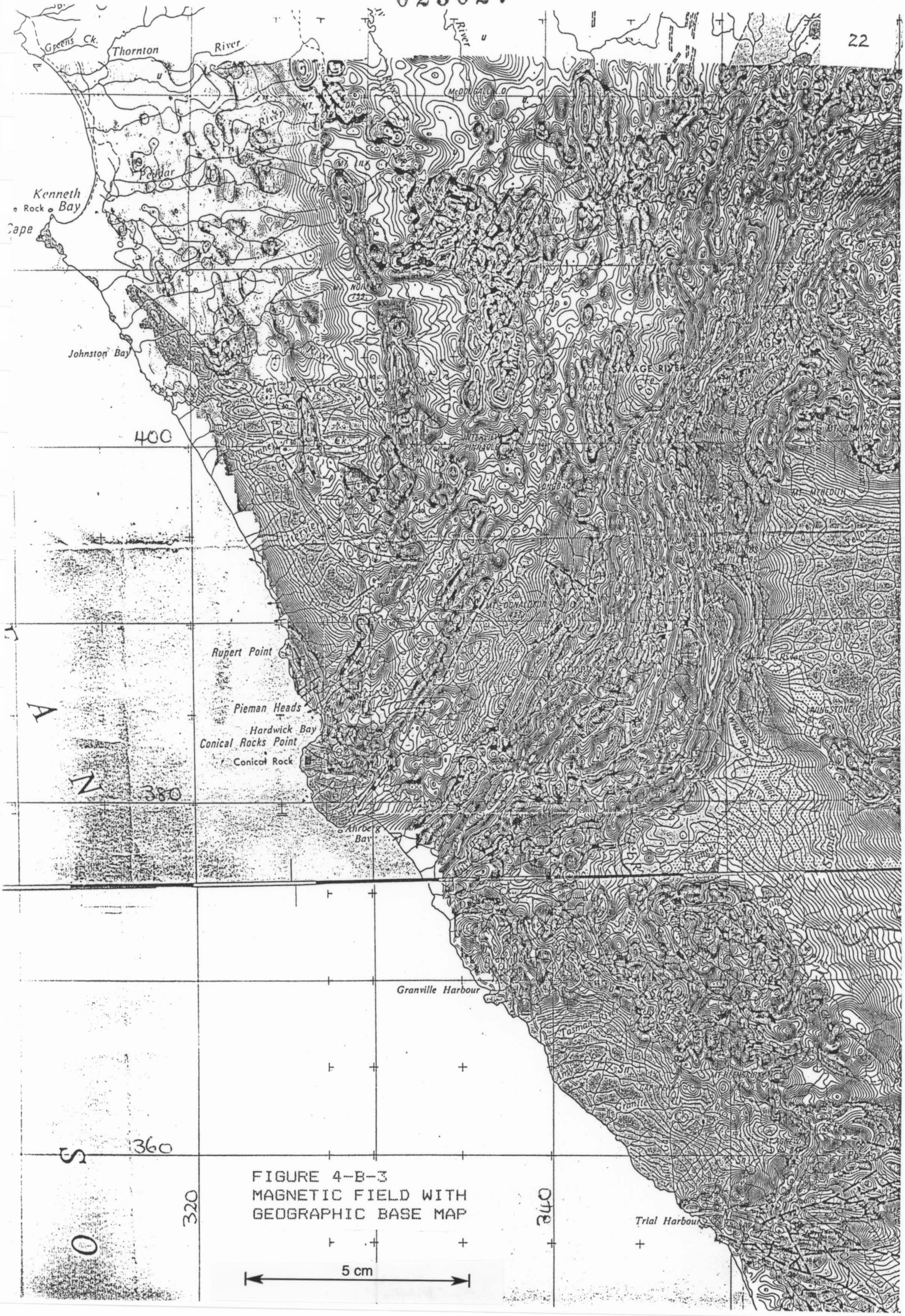


FIGURE 4-B-3
MAGNETIC FIELD WITH
GEOGRAPHIC BASE MAP

4-C: LYELL REGION

The Lyell Region was selected for specific review because of the presence of apparently simple magnetic anomalies, complex structures and mineralisation. Topographic relief is also significant.

Several goals were thus set for this review.

i) To assess the contribution of terrain effects.
ii) To test whether useful structural interpretation is feasible and what minimum procedures are required.
iii) To review whether any variations in bulk contrast can be deduced and related either to structure or mineralisation.
iv) To determine whether the mineralisation possesses any recognisable regional signature.

The area examined extends from 375 to 395 000 mE and 5340 to 5346 000 mN. The axis of major mineralisation at Mt. Lyell extends from the "Blow" to "Comstock" along an easting of about 383 000 mE. The following lines were used for this review. Nominal northings are bracketed.
821 (5340), 830 (53405), 845 (5341), 851 (53415), 861 (5342), 871 (53425), 880 + 886 (5343), 890 (53435), 907 (5344), 910 (53445), 925 + 927 (5345), 930 + 935 (53455), 940 (5346) and 950 (53465).

The observed magnetic field is dominated by large, virtually isolated anomalies along the eastern side of the range (see Figure 3-3). There is little anomaly continuity between Mts. Owen and Sedgwick. The Linda and Comstock valleys disrupt these anomalies. The region is structurally complex with an array of post Cambrian structures.

Several procedures have been used for rapid preliminary evaluation of this segment of the survey. No attempt has been made to provide a final, or detailed, interpretation. Techniques have been applied, in so far as allocated time has permitted, in order to adequately satisfy the goals described. The results are somewhat generalised, do reveal the potential of this data to aid exploration efforts or assist structural interpretation, and define the procedures required.

Three lines were analysed completely (851, 861, 871). These cover the Linda structural zone, moderate terrain and the Lyell mineralisation. All lines, however, were converted to a set height presentation for general processing and modelling and lines 851, 890 and 925 have formed the basis for a limited structural and rock property assessment. This assessment was supported by more limited work on lines 821, 845 and 907. Figure 4-C-5 represents a fragment of the accessory treatment. The work completed is sufficient to meet the goals and generate a moderately advanced but indicative interpretation.

LINE 851 passes along the LINDA valley, over the "Blow" and across Queenstown. Figure 4-C-1 presents the basic data. Flight elevation is fairly consistent but terrain clearance is naturally erratic (note : clearance scale in feet). The Figure presents observed data, 250 m compensated drape, and results calculated at an elevation of 1000 m. This is about 100 m clear of Mt. Lyell. The drape calculation represents a continuation adjustment, both up and down from the actual clearance, to the desired clearance. The 1000 m calculation is derived from the observed clearances and ground levels under the line. The latter have been inferred from the line coordinates and standard contour base maps. Some smoothing of the deduced flight path is required to compensate for small errors in position and ground elevation. The results show, with few exceptions, that a drape of 150 to 250 m approximates closely the actual survey observations. There is little difference between the original data or either drape other than a 25% change in the anomaly peak. Processing of lines 851, 861 and 871 suggests that there is little point in drape processing of the data in this region. Reductions to levels lower than 150 m lead to instability in some data segments. An anomaly was observed in the region of the "Blow" at about 8300 m. The main anomaly is related to the exposed Tyndall Group tuffs immediately north and south of the line.

Figure 4-C-2 presents the results of analytic processing along line 851. The green line represents the observed data. The significant results are to be seen in the black and pink profiles (second derivative and analytic signal). The analytic signal picks out significant or concentrated or shallow discrete sources; the "Blow" is at the small peak. The second derivative emphasizes the effect. Analysis of the data corrected to 1000 m shows that the effect is not completely lost at this level (compare Figure 4-C-3). Line 851 has been used throughout this discussion since it also forms a control line for modelling (Figure 4-C-6). The effects described are clearer on some other lines.

The presentations in Figures 4-C-2, 3 are normalised. Each function is plotted so as to use the entire plot frame. Thus the scale for each curve is different. The maximum is given on the axis but the actual range in negative and positive numbers is shown in the header table. The analytic signal values have been divided by 1000. Comparison of the header tables for the two figures reveals the reduction in amplitude with elevation change from about 200 m clearance to an average of 600 m clearance.

The mineralised zone was found to be anomalous on all lines examined using this style of treatment. The character at Cape Horn (907) is more erratic but still distinctive. Ore-bearing zones appear slightly magnetic within a virtually non magnetic host.

The issues of terrain effects, structure and property variations were treated concomitantly. To avoid any contamination from surface effects or terrain shape the data corrected to 1000 m were used throughout. Two and three dimensional procedures have been used. The topography was digitised between Mt. Sedgwick, Little Eldons, Mt. Owen and west of Queenstown. All units within the area of general Cambrian outcrop were presumed initially to be magnetic. The effect of the material in the terrain can be assessed in Figure 4-C-4 for line 890. The results are typical. The precise contributions from topographic effects depends on presumptions about mitigating structures - principally the form and distribution of the Ordovician cover (4). The assumptions used are indicated in other Figures but the interaction of profiles 1 and 4 largely define the intra terrain effects which are clearly sizeable even at 1000 m and a large proportion of the resultant anomaly. All contrast units shown are cgs. The profiles shown in Figure 4-C-4 are segments of a 3D interpretation for an intermediate model which yields a fair result as discussed below. Comparison of the resultant effect with the 1000 m profile (lower diagram) shows that the magnitude of the interpreted components is about right but that the geometric relationship is not quite correct. The terrain effects approach 50% of the total effect for key parts of the profile. Any interpretation using datum methods (simple horizontal reference axis for the observations) ignoring terrain shape must be faulty. The nature of the topography also requires that this part of the interpretation be three dimensional for reliable, final or detailed interpretation. Indeed, the geology also requires this for other parts of any serious interpretation in this area due to the scale and shape of the various structural blocks and lithological units. These 3D conditions have only been partly fulfilled in this review due to time considerations, but an indicative 2D interpretation was generated for lines 851, 890 and 925 and crudely tested for 3D factors on 890. These interpretations provide some idea of the structural resolution possible although the treatment is basic and not exhaustive. The validity of the interpretations across several lines and structures can be judged from the observed/calculated shift ratio. This should be nearly constant if the contrast-volume products are truly relative to one another on all sections.

An interpretation of line 851 along the Linda valley is shown in Figure 4-C-6. There are several important features. The contact between the Cambrian and Precambrian rocks is inferred to dip east. This conclusion is in opposition to mapping evidence and, as yet incomplete, gravity interpretation. The result has been inferred in other areas and discussed in Sections 4-D (conclusion) and 4-F-iii. The Ordovician rocks exposed in the Linda valley are folded in a manner consistent with those on the axis of Mt. Lyell although the fold axes are offset by the Linda disturbance. The folds may be inferred from the effect of the underlying Cambrian rocks (esp. Tyndall Gp) exposed on the eastern face of the range. There is a distinct break within the Cambrian sequence immediately east of the Lyell mineralisation at the extensions of the main Lyell faulting. The central volcanics are less magnetic. Cambrian rocks persist at relatively shallow depth beneath the mapped Ordovician to Devonian rocks west of Queenstown. All units west of Queenstown dip westward toward a synclinal core. The apparent thickness of the entire magnetic sequence (mainly Cambrian) is at least 4 to 6 km. The magnetic members of the Upper Cambrian Tyndall Gp are at least 500 to 1000 m thick. The inferred bulk contrast for the Cambrian sequence lies in the range 0.0006 to 0.001 cgs. Only the Tyndall Group is distinctly contrasted (0.0022).

Figure 4-C-5 presents the energy spectrum for line 845 across the north face of Mt. Owen and Gormanston. It presents two straight line segments which may be converted to depth estimates using the method of Spector and Grant (1970). These yield values of about 200 and 1000 m which can be related to the land surface (clearance below aircraft) and (?) base of the strongly magnetic parts of the Tyndall Group. These estimates are consistent with model 851 (Fig 4-C-6). Survey and processing noise is also evident.

An interpretation of LINE 890 along the axis of MT LYELL is shown in Figure 4-C-7. The Lyell faulting is evident but the primary anomaly can again be attributed to the Tyndall Group. The form of the Tyndall Group is based on the relationship of the mapped fold limbs to the line. All units possess contrasts higher than indicated for line 851. There is a suggestion of reduced contrast near the mineralisation or fault zone at Cape Horn-North Lyell.

A more comprehensive view of line 890 is given in Figure 4-C-4. Significant elements of the magnetic field and the structure can be assessed in component analysis (labelled in figure). As noted above profile 1 and part of 4 amount to a terrain correction. The precise form of 4 is governed by the modelled or real nature of the Cambrian - Ordovician surface (e.g. Fig. 4-C-7). The sequence west of Mt. Lyell has not been assessed in detail by 3D methods but the profile divergence in the 3D summation contrasts with the 2D study and indicates a contrast overestimate for that end of the 3D model (0.0013 cgs presumed) by a factor of about 2. The dominance of the Tyndall Group is evident. Although the profiles are from an interim model they clearly show the resolving power of whole geology 3D methods when applied to geometric and contrast relationships.

Firstly there is no distortion due to topographic forms since all can be compensated. Secondly any unusual geometric or contrast interactions are immediately recoverable. The fit between the resultant (sum of component profiles) and the observed profiles is fair (Figure 4-C-4). The differences can be related to bulk contrast overestimates west of Queenstown (above), the geometric relationship of the Tyndall Group and Ordovician cover where some relatively minor adjustments are required and to the mineralised volcanics near 7500 m. The latter discrepancy is critical. The 3D model was derived from the 2D model solutions and available regional geologic data which is very limited when used to compile a whole volume model with a depth scale of several kilometres and not very helpful even within Mt. Lyell itself. (Consequently this style of interpretation can do much to resolve important geological issues) Thus the difference noted in the region of the Cape Horn and North Lyell mineralisation implies that the material in this zone has a much lower contrast than presumed or indicated by the 2D model. This zone is clearly anomalous under 3D conditions but not under 2D conditions due to a combination of terrain and structural geometry effects. Near total loss of contrast may be inferred (see also line 925, Fig 4-C-8) and the volume affected must be quite large. The contrasts inferred from Figure 4-C-4 as used or as would be used in the next modelling stage are 0.001 to 0.0013 cgs for the main volcanic sequence, 0.0 for Ordovician, 0.0025 for Tyndall Group, 0.0006 for units west of Queenstown and about 0.0001 for the mineralised volcanics.

The 3D methods employed enable interactive and flexible variation of contrasts within the model independent of geometric considerations. Each segment of the structure, or magnetically distinct lithology, is modelled individually and the results combined to produce a resultant profile for comparison with the observed profile. This approach is geologically demanding but does allow complete evaluation of contributing contrasts and identifies any invalid geometries - flaws in Figure 4-C-4 (discussion above). When these techniques are combined with the following criteria the solution is usually unambiguous in style and at the threshold of resolution of the magnetic method.

The reference criteria are geological believability, realistic properties within observed ranges, test sections calculated at ANY orientation must yield a solution which is consistent in style overall with no conflicting elements between sections, and a base level pattern which is also line consistent across the survey/model area. These conditions appear self evident but are extremely demanding when applied in tandem. They lead to recovery of geological information and not mere geophysical elegance. Although the base level criterion can be applied to 2D models (see Figures 4-C-6, 7, 8) application of the other criteria is limited in the case of 2 or 2.5D models. The power of this application depends on use of 3D methods. The contrast weighting function procedures used for 3D analysis are proprietary to Leaman Geophysics and are not described in this report.

An interpretation of LINE 925 along the COMSTOCK VALLEY is given in Figure 4-C-8. The Great Lyell Fault and its extensions are again evident. Greatly reduced contrasts for all parts of the section, except perhaps the Tyndall Group, distinguish this line. While the base of the model shapes is not critical or even well defined, and should not be accepted in any but the most general way, the inferred depth is also less. This confirms the implied bulk contrast reductions since all blocks east of the Great Lyell Fault should be downthrown when compared with lines 890 or 851. Thus the contrast estimates implied are maxima since block volumes should be greater. West of the central sequence the model reflects porphyry and structure distribution in an anticline.

The mineralised zone is shown to be highly anomalous on line 925 and to be consistently anomalous between the "Blow" and just north of "Comstock" when the 2D and limited 3D results are combined. The localised contrast loss is consistent with alteration and mineralisation of the volcanics. The present treatment suggests that the material between lines 890 and 925 is highly altered and that material between lines 845/851 and 890 is less altered. Precise evaluation requires complete 3D assessment and the southern inference may have been limited by the procedures and extent of their use in this review. Insufficient work has been reported here to identify or describe the alteration pattern. It should also be stressed that the affected volume is several cubic kilometres with a substantial depth extent; skin effects are not involved.

The magnetic field calculated at 1000 m has been superimposed

on the geological map of Corbett (1984) (Figure 4-C-9). It may be compared with the original presentation of the magnetic field (Figure 3-3). The field pattern is simpler but the large anomalies related to parts of the Tyndall Group are evident. The Comstock Valley is abnormal. The "Tyndall Group effect" is much reduced and topographic variation is not, as shown above, the cause. The Tyndall Group is present beneath the valley (line 925, Fig. 4-C-8) but is either much thinner or altered.
The underlying volcanic sequence is certainly altered. The "Comstock effect" is emphasized by the derivatives (Figure 4-C-10, 11). Note that this trend is not at all obvious in the low level observations. Several other lesser east-west trends are apparent, especially in the Linda region. The complex Linda zone structures partly disguise the effect by overprinting a NW-SE trend set. The Figures suggest that the greatest alteration is along the Comstock axis but the minimum derivative values (esp. second derivative) lie across the Linda - Prince/North Lyell axis. The scale of the alteration across the Comstock corridor can be assessed in Figure 4-C-10 (second derivative). The amplitude of the response diminishes rapidly along the exposures of the Tyndall Group south east toward Comstock. It is very low near the mapped fossil locality.

Trends inferred from this study are summarized in Figure 4-C-12. Two distinct E-W corridors can be recognised - through Comstock and Linda. These are presumably long lived influences since the offsets of the Firewood Siding Fault west of Queenstown also coincide with them. The source of these magnetic corridors has not only affected the properties of the Cambrian sequences but also controlled structures developed during Late Cambrian and Devonian times. The location of the Cambrian - Precambrian contact is also indicated. This junction is offset by nearly 2 km near the confluence of Comstock Creek and the King River. The problem of the dip of this boundary is discussed in Sections 4-D and 4-F-iii.

This preliminary work suggests that drape processing of the data is unwarranted since the differences recovered are minimal. Detailed line treatments are viable and the mineralised area has distinctive properties. Localised magnetic sources are most clearly recovered from the observed data but may still be resolved in data at 1000 m level. Detailed examination of structure and large scale rock property variations requires elimination of terrain effects. These studies may be guided by simple 2D methods but require 3D methods for complete appraisal and detailed resolution of anomalous rock volumes.

The Lyell mineralisation is associated with a large volume of altered rock which is magnetically identifiable. Within this volume there are some smaller magnetic anomalies which probably reflect local increases in pyrrhotite or magnetite (- ore?). There is evidence of significant E-W and NW-SE alignments. The NW trends surely include some Devonian influence but the E-W trends cannot be explained in this way. The second derivative presentation is perhaps the most useful overall. While the Blow/Prince Lyell and Comstock/Cape Horn mineralisation lie in or marginal to E-W corridors the North Lyell mineralisation seems exceptional. The lateral trend is present and while a minor E-W feature may be present the extent of spatial shifting by Devonian movements is unclear. The N-S altered zone within the volcanics is evident in all cases.

A combination of low and high level profiles is required to identify both mineralisation and altered rock masses respectively. A reasonable structural view is deducible from application of 2D methods to fixed level corrected lines. Detailed or more complete regional studies must use 3D methods.

1	B:M851	W TAS 1981 MAGNETICS LINE 851
2	B:D250851	DRAPE 250 M W TAS MAGNETICS LINE 851
3	B:FHT851	CONTINUATION TO 1000 M W TAS MAGNETICS LINE 851
4	B:ELEV851	FLIGHT ELEVATION PATH W TAS MAGNETICS LINE 851
5	B:DIFF851	CLEARANCE (FT) W TAS MAGNETICS LINE 851

ZERO SHIFT : 51

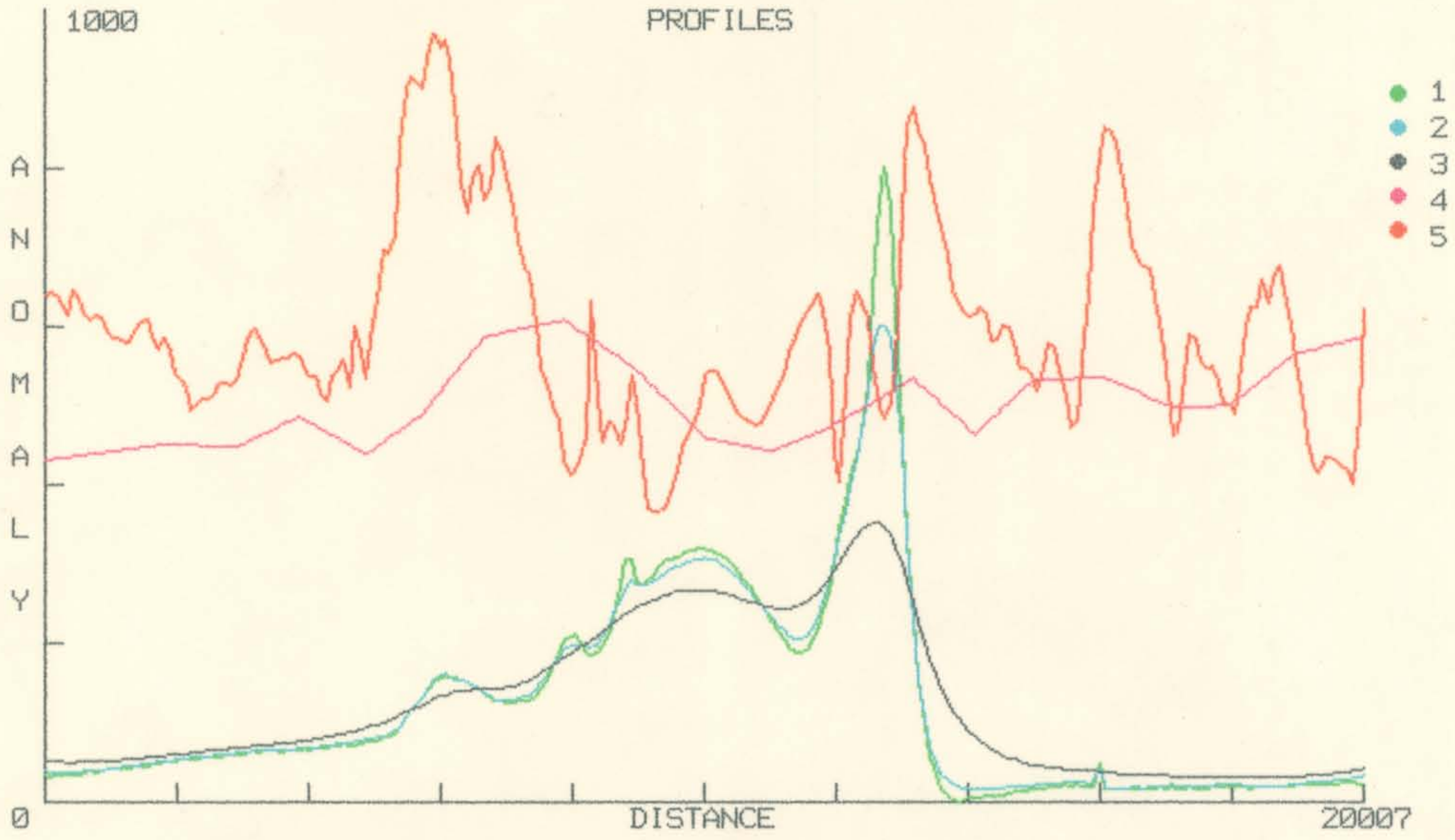
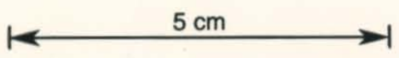


FIGURE :4-C - 1

LINE 851 - from 375000 mE - THROUGH LINDA AND QUEENSTOWN
SURVEY DETAILS AND MAGNETIC DATA CONVERSIONS



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 1            B:M851          51             799
W TAS 1981 MAGNETICS LINE 851
 2            B:D1M851        811.1645       1067.207
VERTICAL DERIVATIVE 1 W TAS MAGNETICS LINE 851
 3            B:D2M851        1128.063       4314.2
VERTICAL DERIVATIVE 2  W TAS MAGNETICS LINE 851
 4            B:ASM851        5.210152       5321.71
ANALYTIC SIGNAL W TAS MAGNETICS LINE 851
```

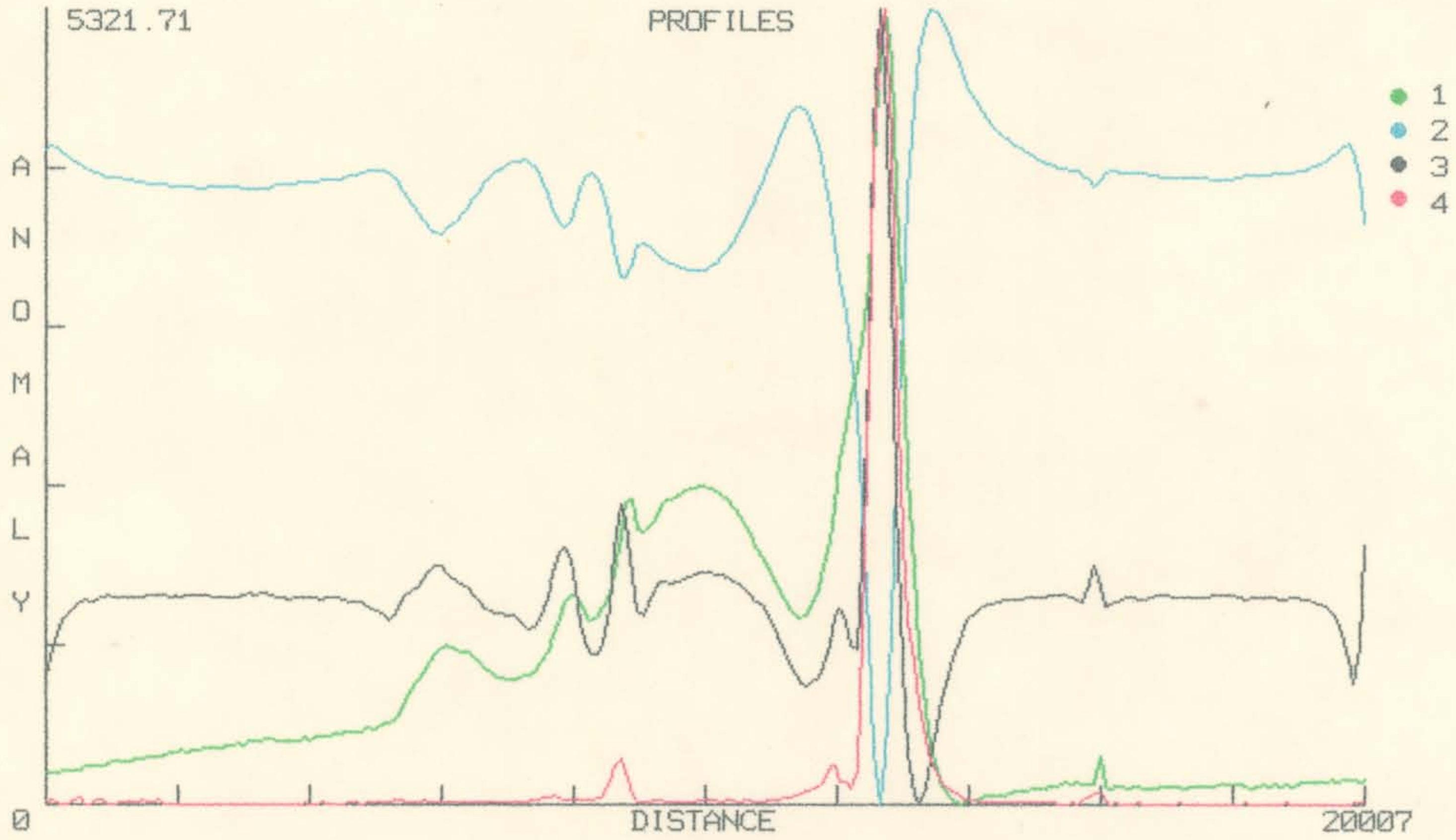
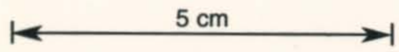


FIGURE :4-C - 2

LINE 851 - DERIVATIVE TRANSFORMATIONS
OBSERVED DATA



025037

```
 1              B:FHT851        20.75655       322.1415
CONTINUATION TO 1000 M W TAS MAGNETICS LINE 851
 2              B:D1FH851       189.0449       256.6919
VERTICAL DERIVATIVE 1  1000M CONTINUATION LINE 851
 3              B:D2FH851       368.7332       737.0653
VERTICAL DERIVATIVE 2  1000M CONTINUATION  LINE 851
 4              B:ASFH851       3.962854       118.3346
ANALYTIC SIGNAL  1000M CONTINUATION LINE 851
```

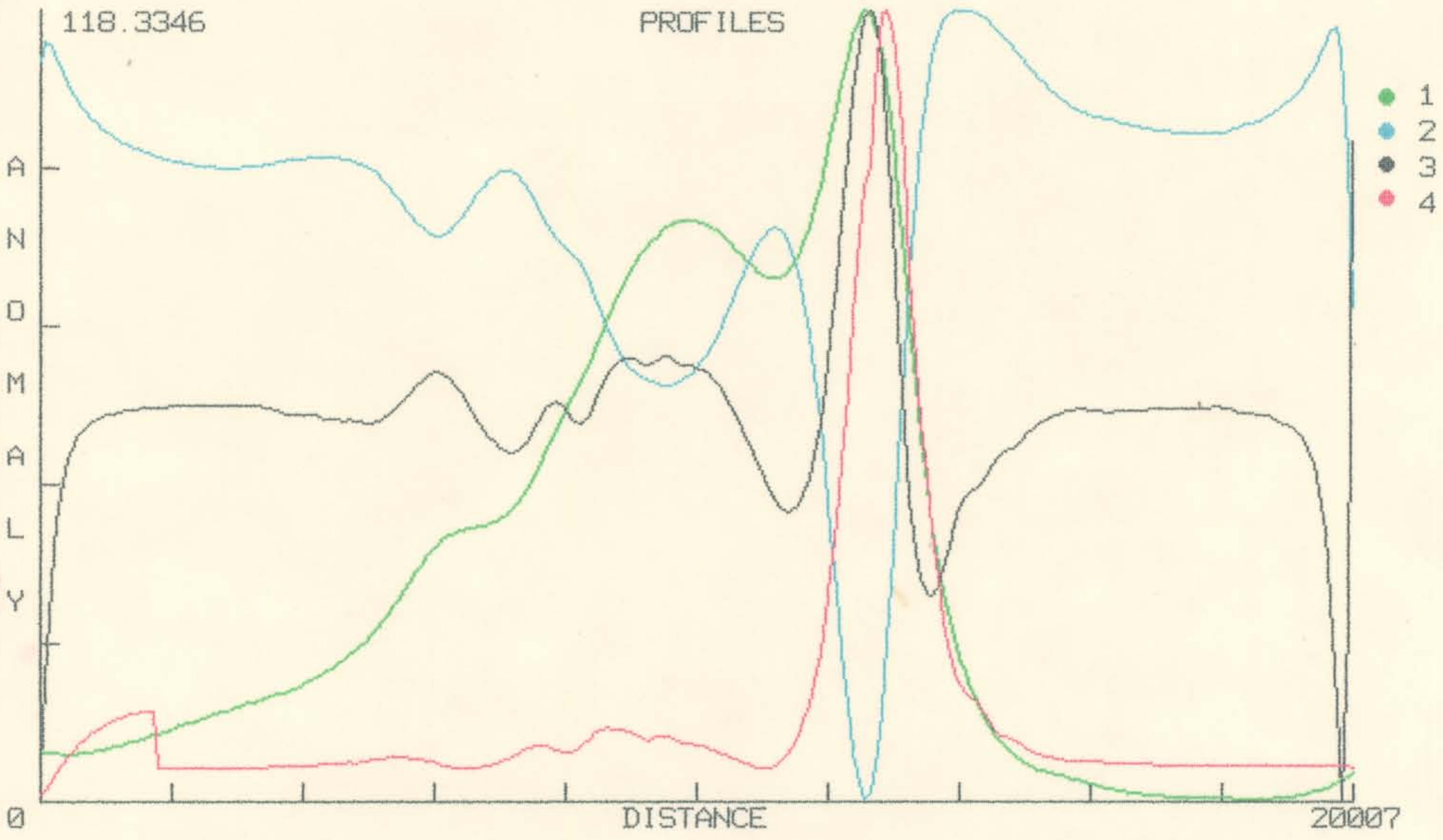
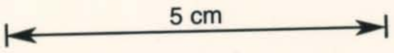


FIGURE :4-C - 3

LINE 851 - DERIVATIVE TRANSFORMATIONS
CONTINUED DATA - 1000 m level



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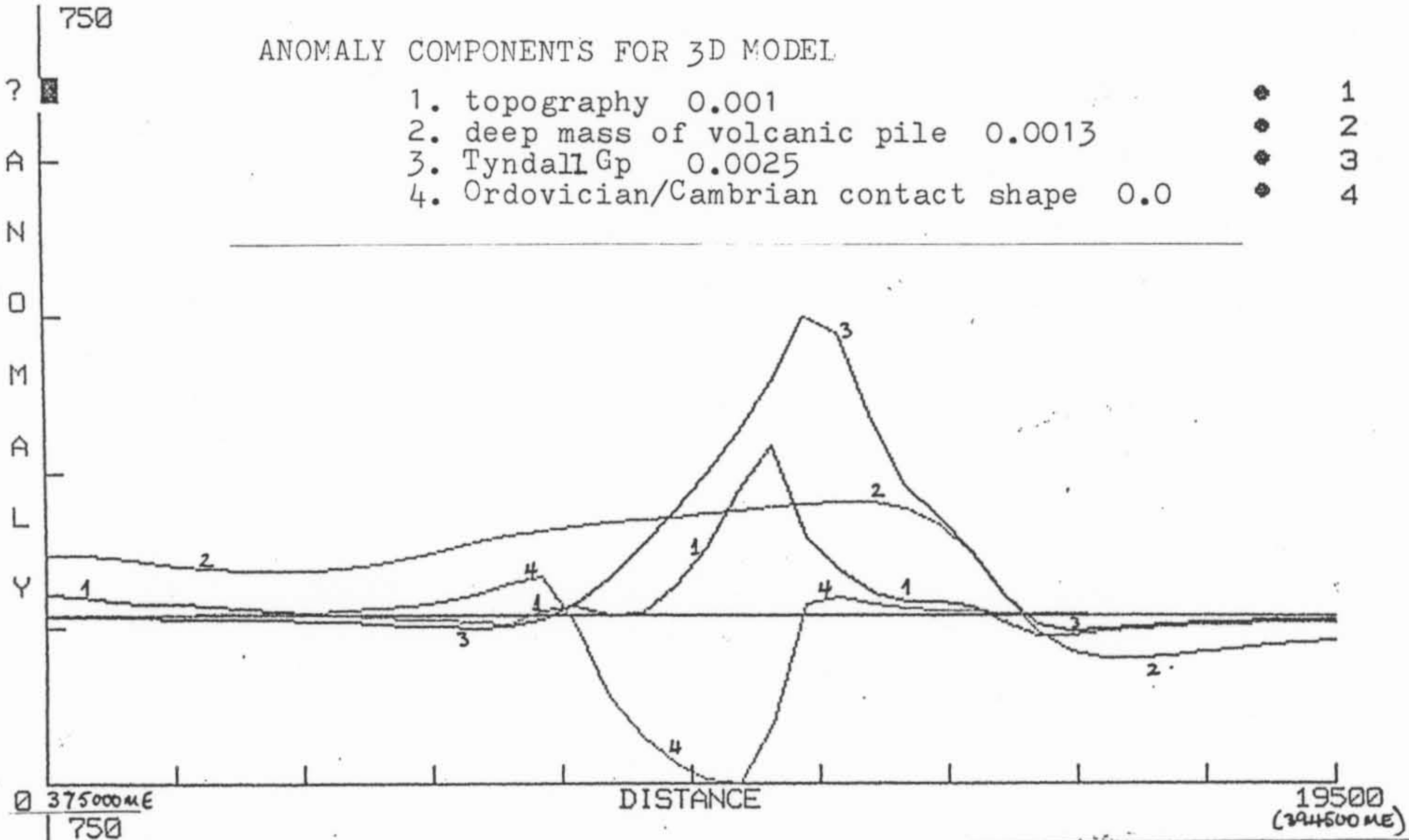
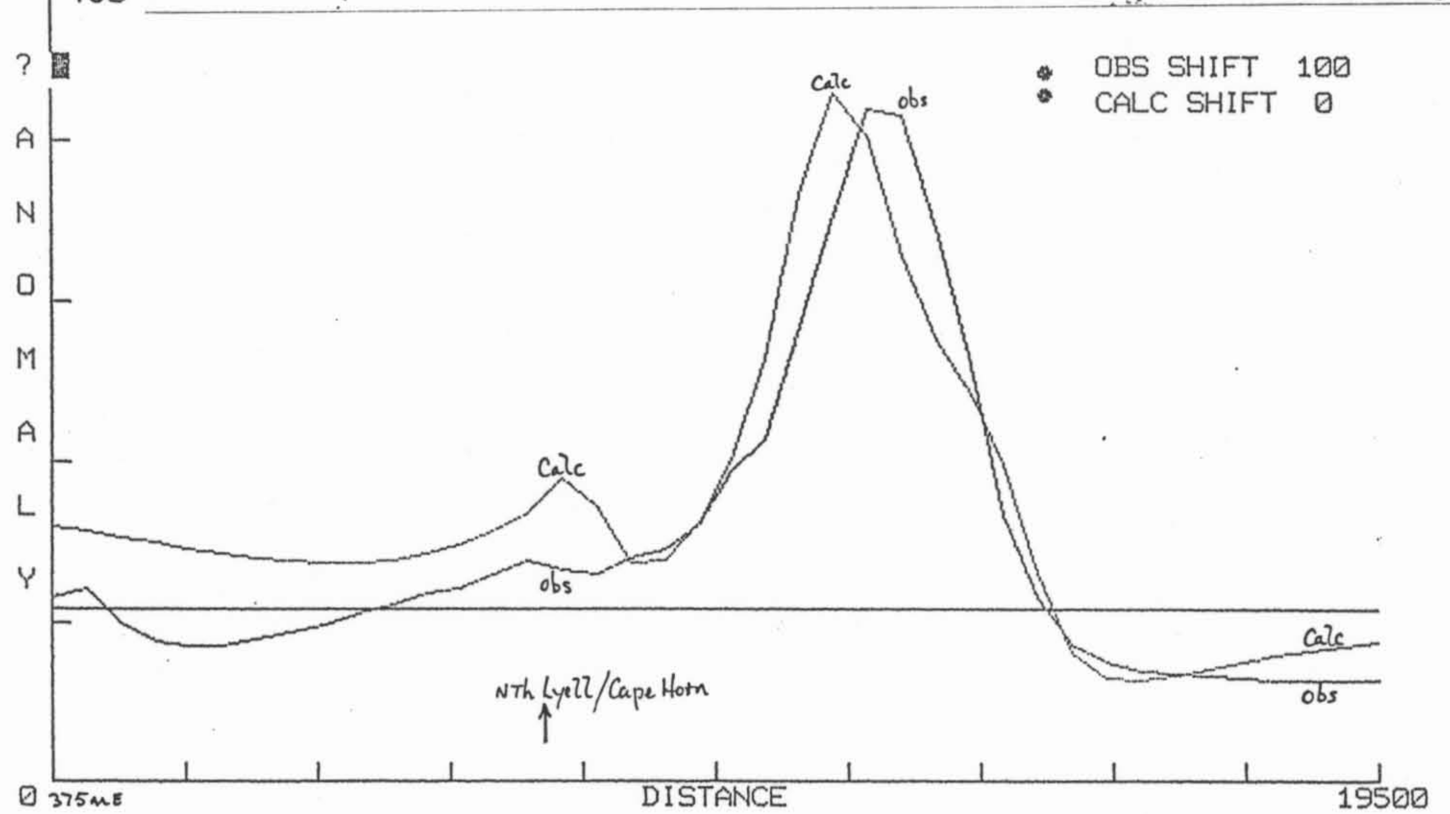
5 cm

025038





MODEL RESULTANT VS OBSERVED PROFILE

ZERO SHIFT 162.514

FIGURE 4-C-4

LINE 890 - ALONG AXIS OF MT LYELL

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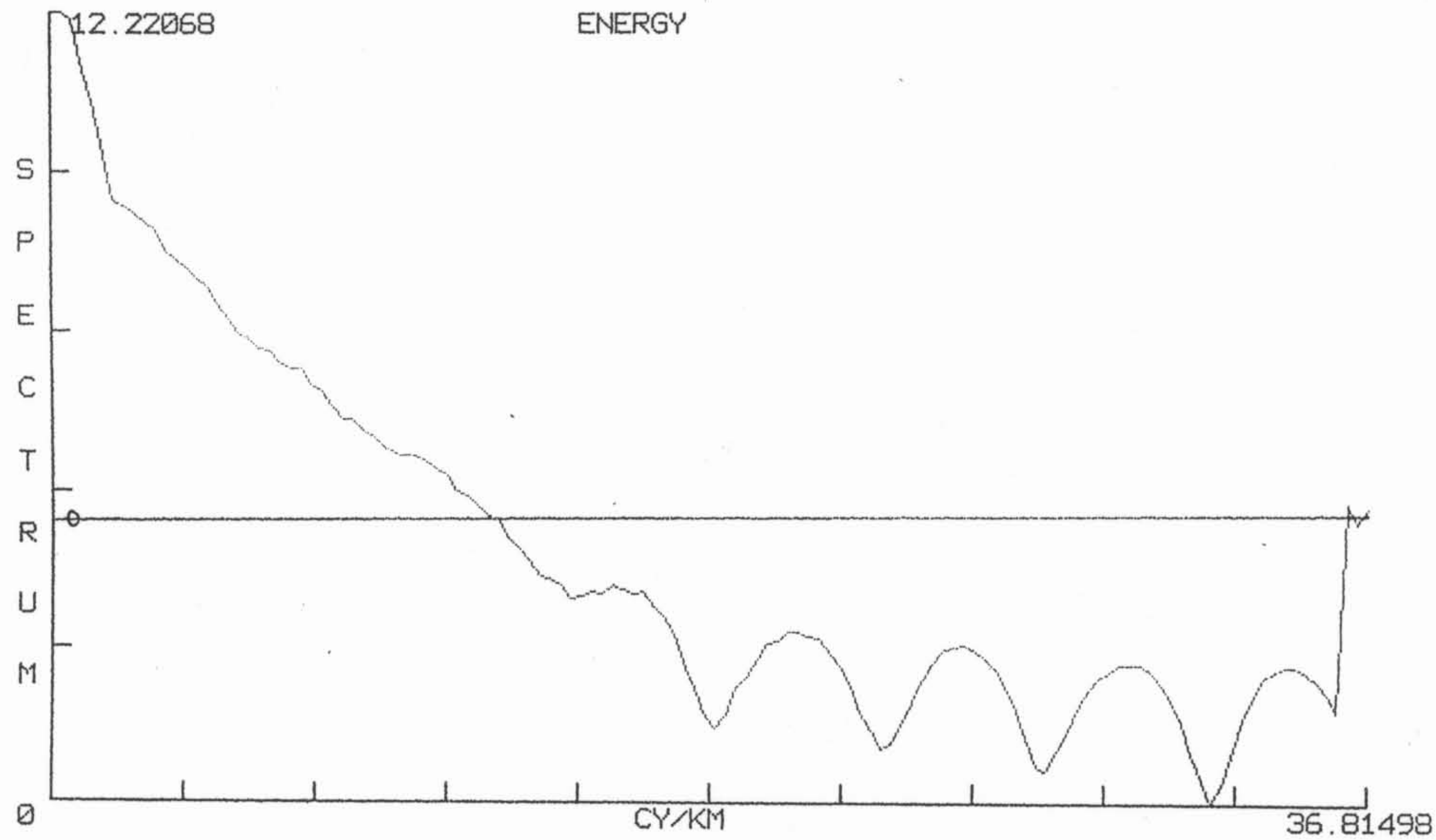

FIGURE 4-C-5

LINE 845 - LOG ENERGY PLOT

Gradients imply average source depths of 185-200 m (flight clearance) and 1000-1100 m.

5 cm

LINE PARAMETERS - ORIGIN,LIMIT,INCR : 0 20000 500

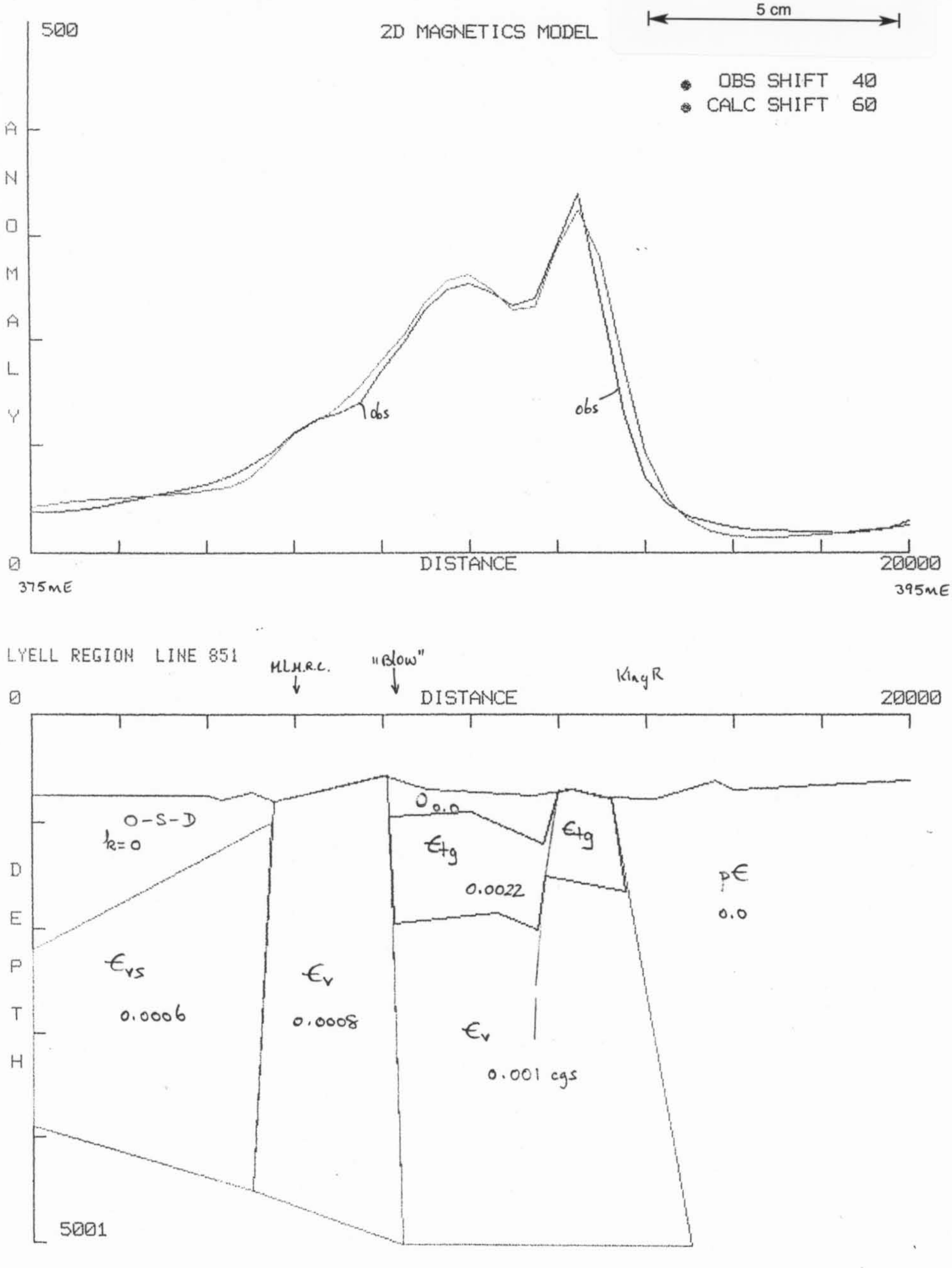

FIGURE 4-C-6

LINE 851 - through LINDA

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

LINE PARAMETERS - ORIGIN,LIMIT,INCR : 0 20000 500

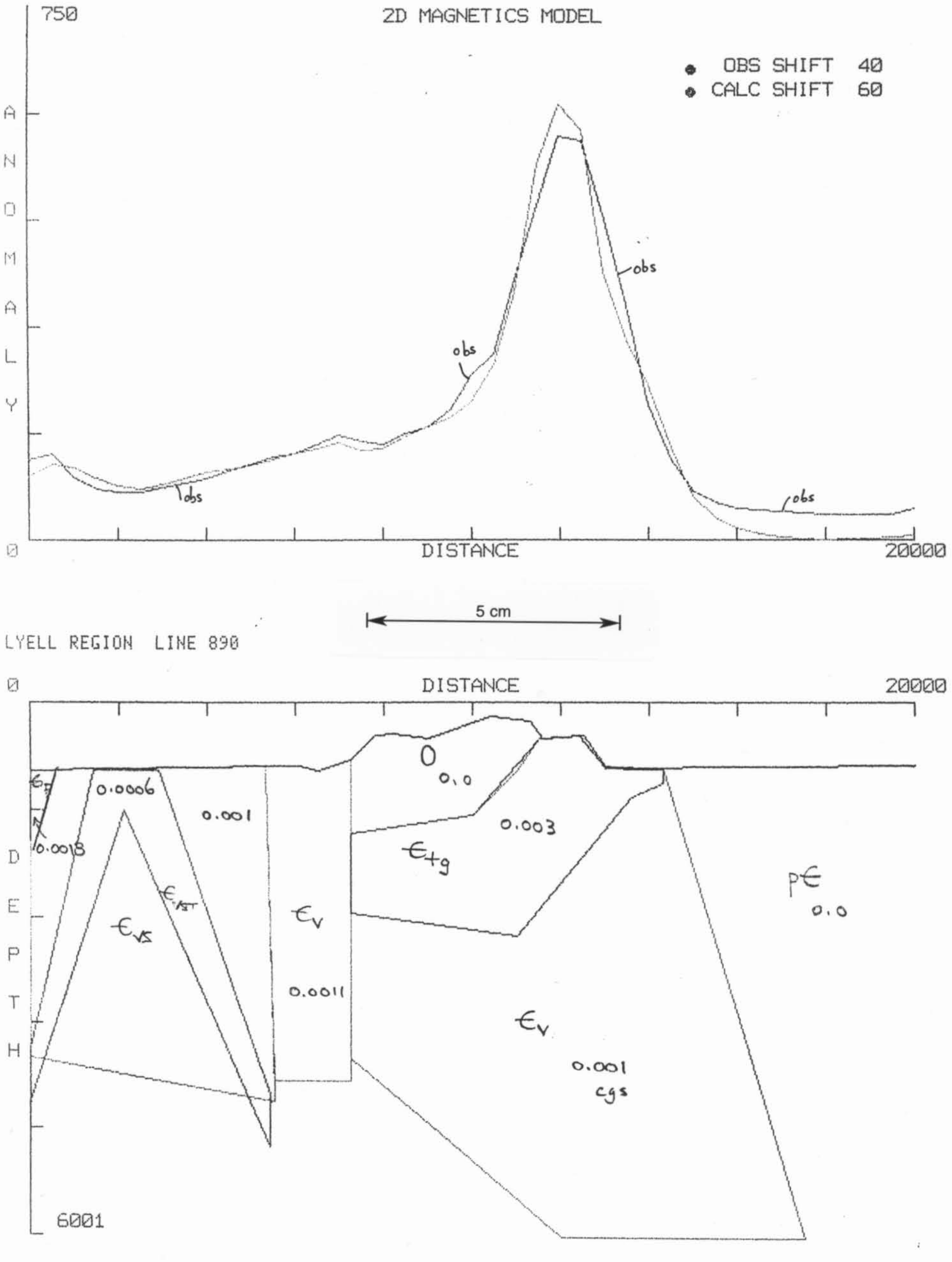

FIGURE 4-C*7

LINE 890 - THROUGH MT LYELL

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

025042

LINE PARAMETERS - ORIGIN,LIMIT,INCR : 0 20000 500

LYELL LINE 925

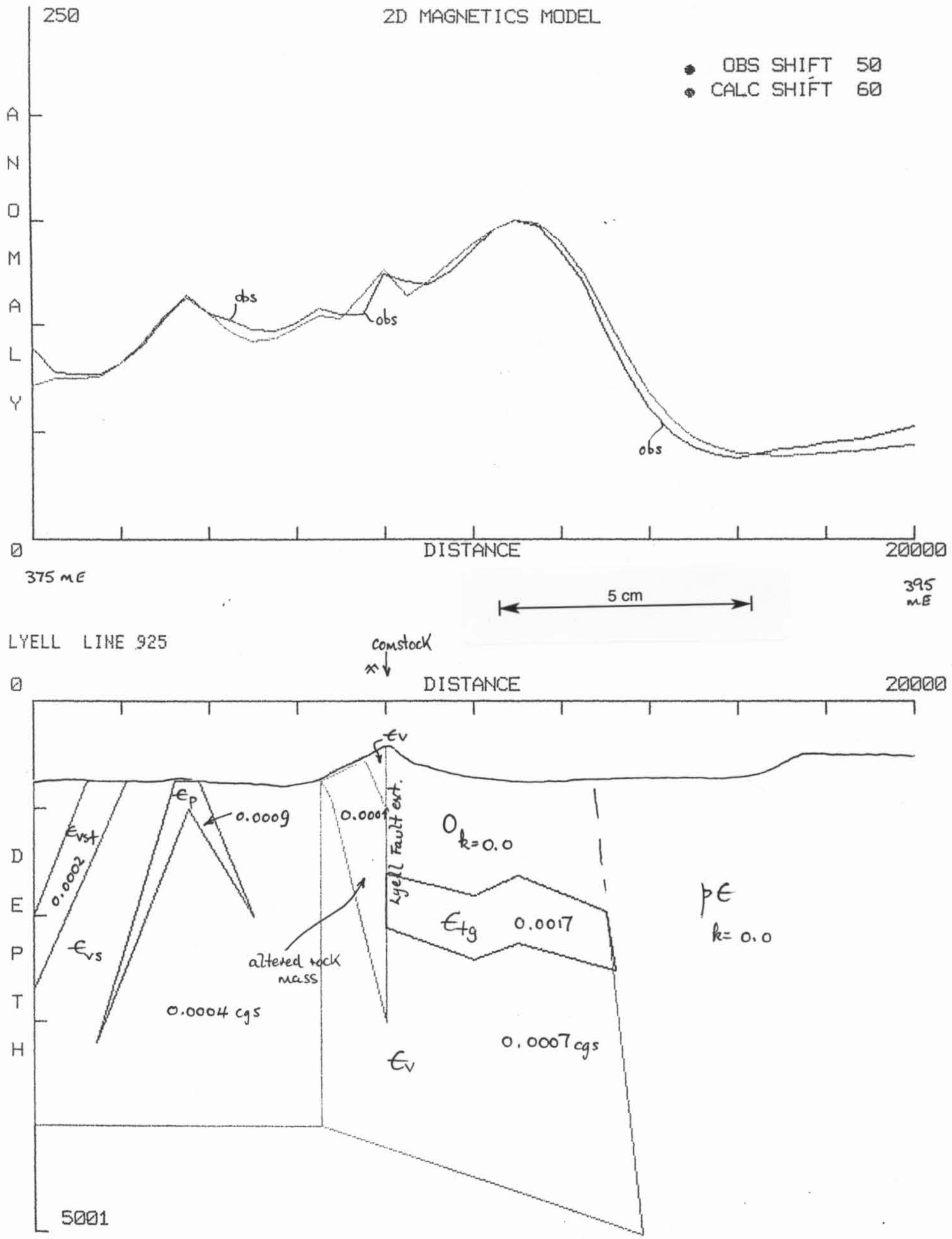

FIGURE 4-C-8

LINE 925 - ALONG COMSTOCK VALLEY

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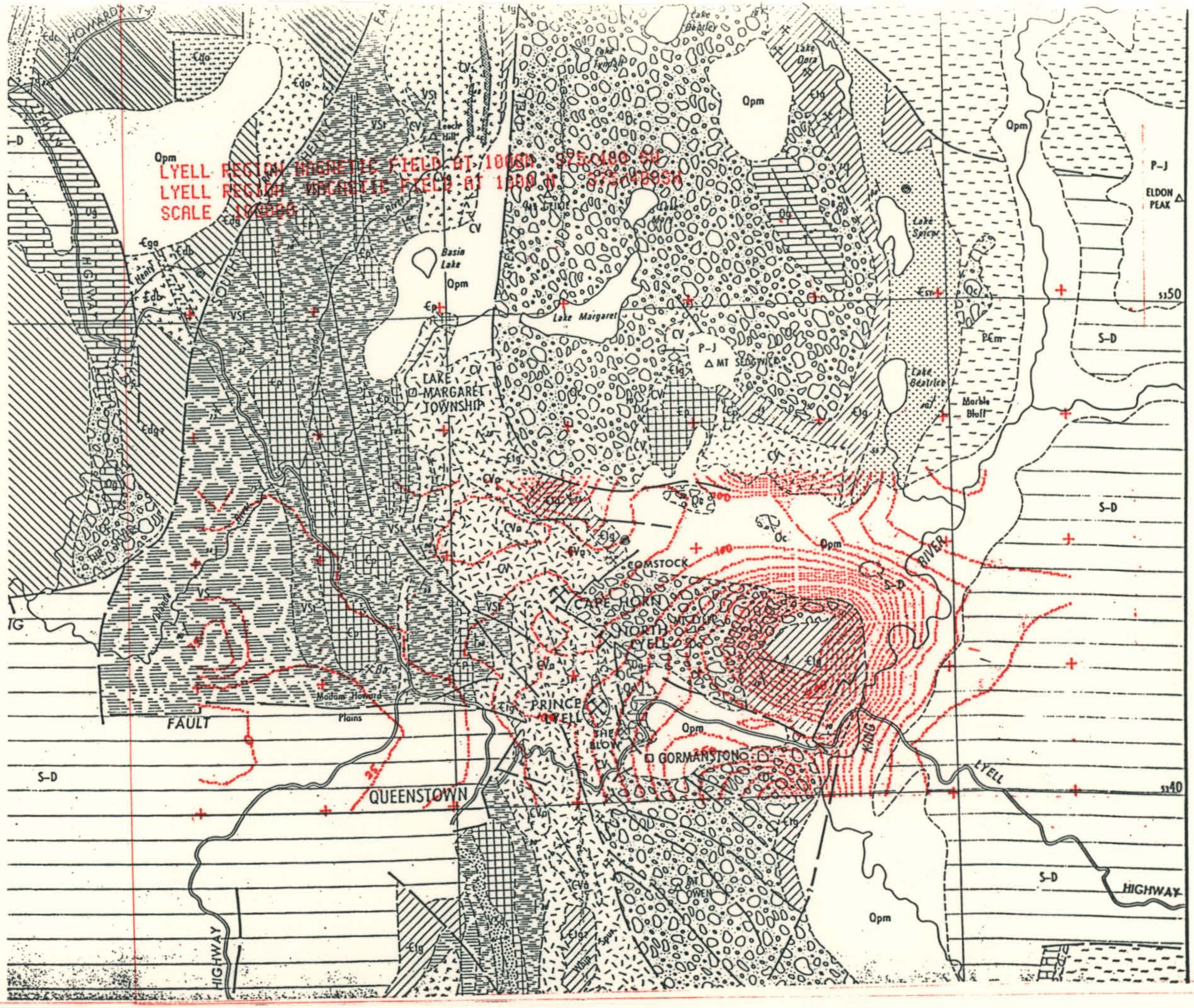
GEOLOGY AND MAGNETIC FIELD AT 1000 m
Geology after Corbett (1984)

FIGURE 4-C-9

5 cm



025043

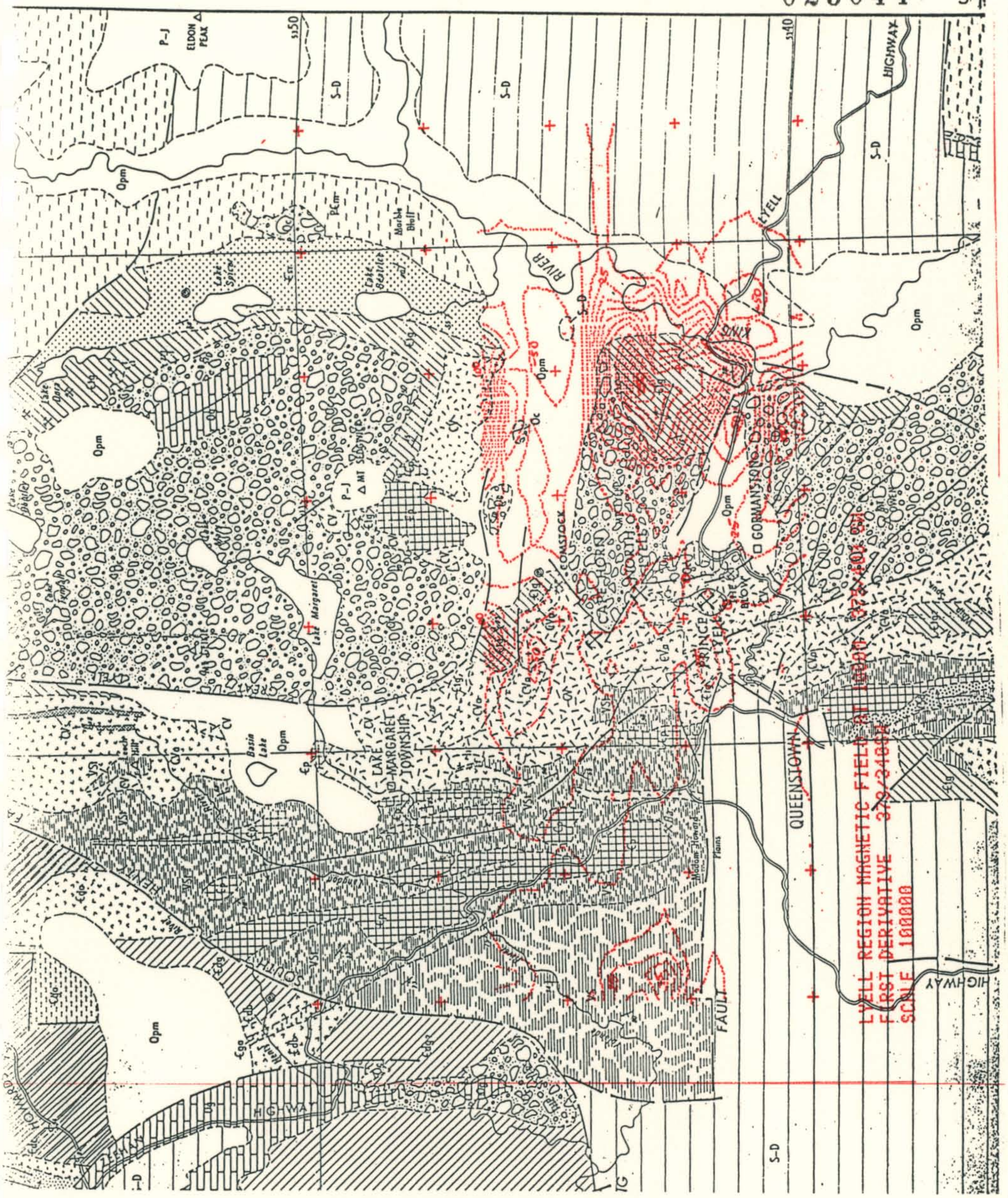


FIGURE 4-C-10

GEOLOGY AND FIRST VERTICAL DERIVATIVE OF MAGNETIC FIELD AT 1000 m
Geology after Corbett (1984)

5 cm

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

025045

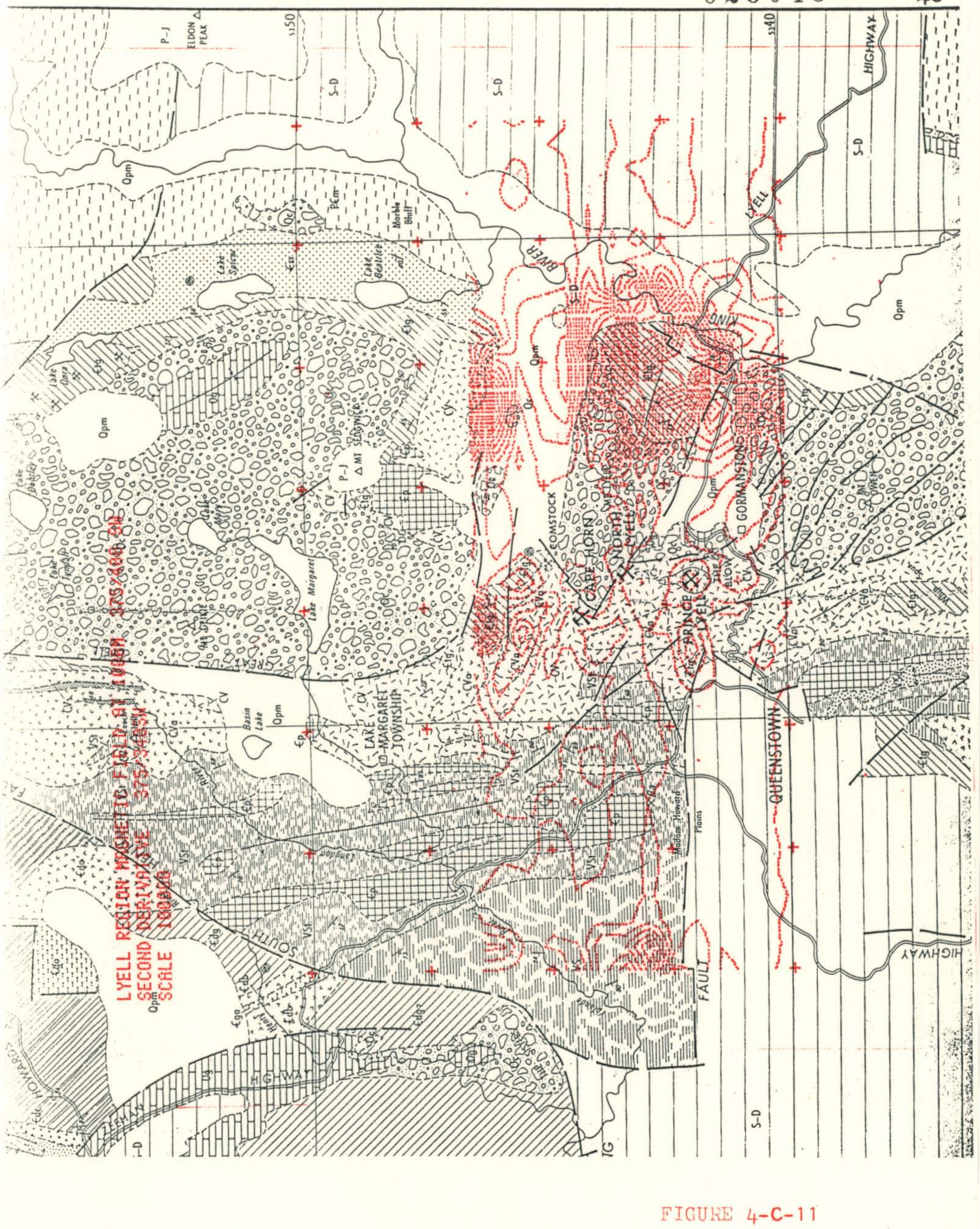


FIGURE 4-C-11

GEOLOGY AND SECOND VERTICAL DERIVATIVE OF MAGNETIC FIELD AT 1000 m
Geology after Corbett (1984)

5 cm

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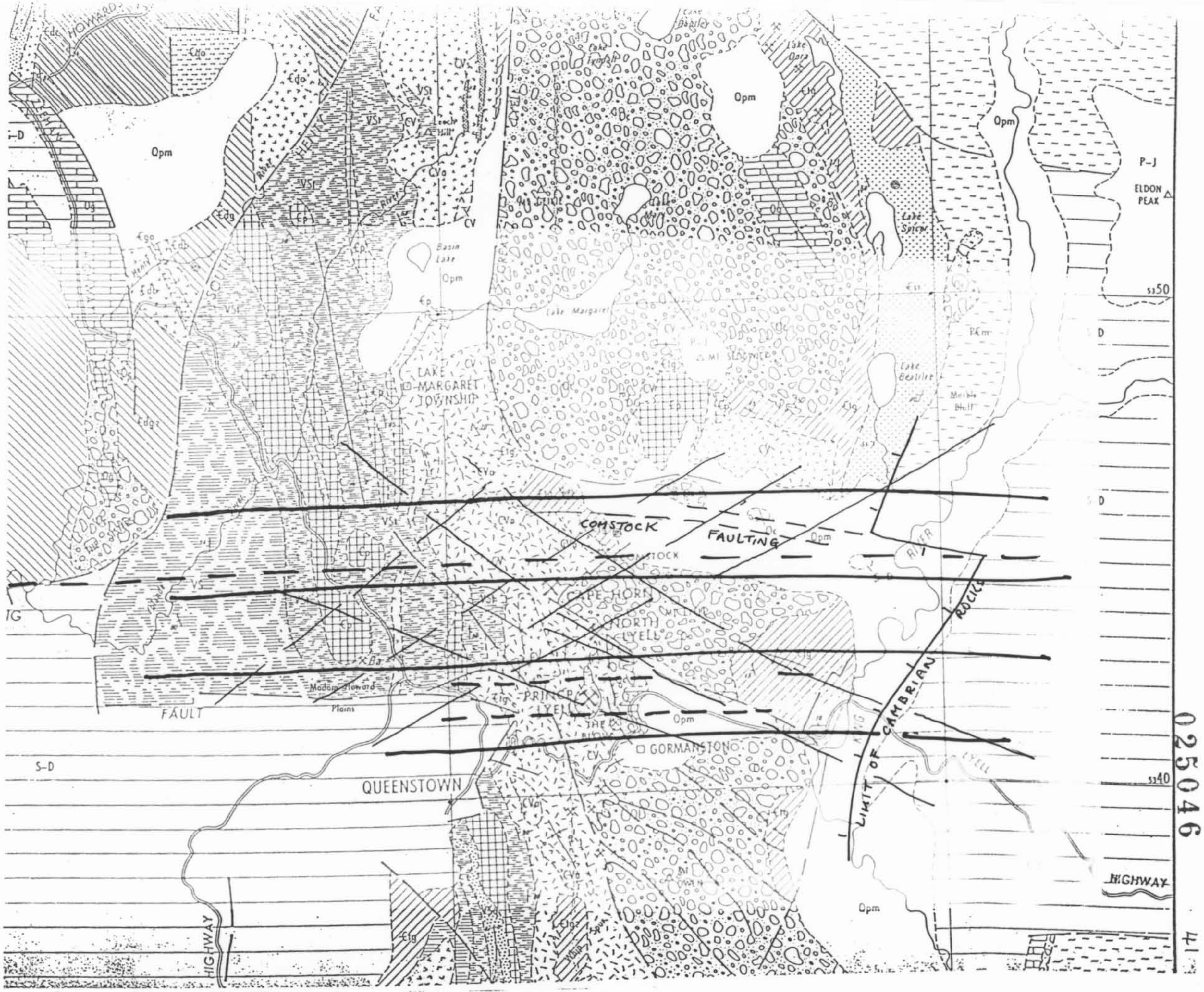
Hobart, Tasmania 7001

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

5 cm



LYELL REGION
INTERPRETED TRENDS AND LINEAMENTS

FIGURE 4-C-12

025046

4-D: ROSEBERY - RENISON REGION

The Rosebery - Renison Region was selected for more detailed examination because it contains several major, but different, mineralised zones (Renison, Rosebery, Hercules, Red Hills) and a variety of minor workings. It also contains, in terms of the original presentation of the magnetic survey (Figure 3-3, 4-D-9) some of the most complicated anomaly textures. These reflect the presence of magnetic ores (Renison), strongly magnetic units (ultramafics east of Renison) and other magnetic units (e.g. tuffs in Crimson Creek Formation, pyrrhotite at Colebrook Hill) and suspected hornfels. The region also possesses the highest relief in the surveyed area and the specifications were not approximated over substantial parts of the Mt. Read Volcanics.

Several goals were therefore set for this review.

i) To evaluate whether erratic, and often extreme terrain clearances may have affected presentation of the data in a region with exposed, highly magnetic units.

ii) To assess whether drape presentations offer an improved presentation in detail.

iii) To determine if structural elements are enhanced by conversion of the data to some fixed level clear of intense surface sources.

iv) To establish whether any common factors, lineaments or signature elements are recognisable for the mineralisation covered. None are evident in the raw presentation.

v) To assess any regional mineralisation signatures.

The area examined extends from 360 to 390 000 mE and 5365 to 5375 000 mN (see Figure 4-D-9) and the following lines were used for the assessment. Nominal northings are bracketed.
1321 (5365), 1335 (53655), 1341 + 1345 (5366), 1350 + 1355 (53665), 1360 (5367), 1370 (53675), 1385 (5368), 1391 + 1395 (53685), 1401 (5369), 1411 (53695), 1423 + 1425 (5370), 1430 + 1435 (53705), 1441 (5371), 1450 + 1455 (53715), 1460 + 1465 (5372), 1470 (53725), 1480 (5373), 1490 (53735), 1500 (5374), 1505 (53745), 1510 (5375).

Two styles of presentation have been adopted. In Figure 4-D-1 the profiles for drapes at 150 and 250 m have been contrasted with the observed data and data inferred at a height of 1275 m. The profiles are maximised; the value range for profile 1 (green) is -141 to 617 nT. Plotted in this form it is seen that anomalies are strong and that their shapes are retained through the drapes. But there are significant changes in amplitude. Expressed as maxima the ranges are 758, 595, 715 and 370 nT respectively. The smaller anomalies are most affected.

The alternate presentation (e.g. Figure 4-D-3) compares observed, continued and drape data. The scale is large in order to allow simple comparisons between lines (several are displayed). This format tends to obscure the differences between drape and observed data.

Review of Figures 4-D-1, 3, 4, 5, 6, 13 shows that the effective clearance for the survey was about 250 m since the difference between the observed data and a 250 m drape is minimal. The difference is generally less than 15% but may exceed 30% which may lead to gross errors should the anomaly be modelled (e.g. Red Hills, Fig 4-D-6). The 1981 presentation is thus satisfactory for anomaly recognition and resolution but well beyond specification and not suitable for reliable quantitative interpretation. Exact drape presentations do not offer any significant improvement in detail in this region due to source intensities.

The Figures also show the flight trajectory and the erratic terrain clearance. This reflects the relief of the region. There are several instances in the lines presented where the clearance specification was exceeded. This may have considerable ramifications, depending on the combination of the form of the terrain and the nature and disposition of the magnetic units. The flight elevation path has been recovered by digitising the topography along the recovered path and adding the clearance. The result is noisy reflecting errors in recovery, digitisation and scanning. Since the flight path must be smooth the deduced elevations have been filtered using a running average. The errors induced in the fixed level continuation by deficiencies in this process are insignificant at the height chosen. Note also that the clearance data are expressed in feet. Line 1500 (Fig 4-D-3) represents the nearest approach to the 500 feet specified clearance and that few other lines fall within the 300 to 750 feet envelope desired. There are several examples where the line was begun with a clearance in excess of 550 m. Drape correction of such data, or even appraisal of anomalies in such segments, is not always possible due to instability in the continuation process (e.g. Fig 4-D-4). This results in loss of data coverage. Similar problems are introduced by the variable sample spacing recorded (37 to 85 m). High "flat" segments in the clearance curve indicate that the radar altimeter was off scale and the flight path cannot be recovered reliably. Reliable drape correction to levels of 250 m or less is not possible without filtering where the clearance exceeds 500 m.

However, drape calculation for levels much less than 200 m is not warranted here. Amplification of some terrain noise effects is undesirable and where these are absent continuation cannot equalise or generate real responses where none have been resolved. Any effects created will most likely be artifacts of the calculation process. In this region conversion to a precise drape adds little; there is no improvement in detail and the resulting presentation is virtually identical to the existing map (Fig 4-D-9). This is due to the strong responses observed and a very different conclusion might be made in similar terrain with less magnetic units. Drape calculation at levels of 250 m or less does not clarify the anomaly pattern nor lead to improved resolution of structures.

Drape corrections may be compared with the lowest feasible level for fixed level observation - the height of Mt. Murchison

(1275m). The maximum flight height was 1439 m. The data have been adjusted to 1275 m for comparison and the process has a considerable effect on anomaly form (Figures 4-D-2, 8). There are three results - two positive and one negative. The effect of deficiencies in acquisition is minimised and the perspective on the anomalies is a true sensor-distance relationship. Secondly, the calculation process is stable and the result is readily modelled. The ultimate result is a filtered map. Negatively, detail and unit mappability is lost (Figure 4-D-3 to 6, 8) since the result is not dominated by near surface effects or localised high contrast sources. Consequently this procedure cannot yield high resolution source location detail as can the observed data or drape. Similarly data acquisition at fixed high level can never provide this information. Low level acquisition as a "fair drape" is the best observational compromise for all subsequent usages provided varied presentations are derived from it.

Figure 4-D-8 demonstrates the benefit of the fixed level conversion. The field is simplified and several features not evident in the original plots are revealed or enhanced. These mirror the primary source distributions and major structures. Figures 4-D-2, 10 and 11 also present the first and second vertical derivatives.

The magnetic field at 1275m greatly clarifies the principal lithologic and structural elements. The largest single anomaly is at Red Hills in association with exposures of magnetite-bearing rhyolite (Fig 4-D-6). Although apparently an isolated feature it is actually part of a NNW-SSE anomaly. The Ordovician cover on the western slopes of Mt. Murchison does not shape the effect and it may be concluded that much of the general source lies within the volcanics beneath the cover. There is no indication of another source of the Red Hills type within the area processed.

A larger anomalous area occurs across the east face of Mt. Murchison and reflects the distribution of the Murchison Granite. The anomaly shows that the exposed granite represents about half the cross section of the body. Some magnetic properties were noted by Collins et al (1981). The anomaly is dislocated near 53665, 5368, 53695 and 5374 mN.

Other parts of the volcanic sequence east of the Henty Fault are not strongly magnetic/magnetised. Nor, indeed, are the Rosebery Beds and the volcanics west of the Henty Fault.

Anomalies west of Williamsford are generally sourced by either ultramafics (near the Murchison Highway, north of the Pieman River or at Colebrook Hill) or mineralised units. The general orientation of the largest anomalies is consistent with the mapped distribution of these materials. There is, however, a large E-W feature which extends from Renison Bell to Colebrook Hill and cuts all mapped litho-structural trends. It is distinctive. The peak anomaly occurs south of Colebrook Hill where the effects of the E-W source and ultramafics superimpose. The E-W anomaly is due to either the metamorphic halo of a post Cambrian granite or the mineralisation introduced in the country rocks above it. There is much pyrrhotite in this area. The anomaly at Renison is seen as a reduced, but distinct, extension of this feature. There are no comparable anomalies at Rosebery or Hercules.

Figures 4-D-3, 4, 5, 6 indicate the quality and character of observations in the region of the Rosebery, Renison, Hercules and

Red Hills mineralisation respectively. The Rosebery mineralisation is associated with a small response while the Renison and Red Hills responses are sizeable. The Hercules region also generates a small anomaly at this flight clearance but it is best seen in derivative treatments (Figure 4-D-7, 10) or other processed forms. The analytic signal indicates that the relative source strength is very weak when compared with other units in the area. It must also be noted that the lines discussed are the nearest traverses and need not show the optimum response for the deposit. On first inspection it might appear that the character at Hercules is no different from that west of 7000 m. Close examination of the derivatives, however, shows that the Hercules response is more localised and less likely to be due to gross geological or lithological factors.

Three pronounced E-W lineaments emerge with processing; at 5374 mN (+Rosebery), 53695 mN (+Renison granite) and 53665 mN (Hercules/Red Hills). Further processing to derivative forms emphasizes these lineaments. The first derivative relates source intensities and depth and reinforces the above comments. The second derivative generates "residuals" and picks out the anomalous zones; Red Hills, ultramafics. The E-W trends displayed in Figure 4-D-12 are not artifacts of either processing, sampling or contouring, or the original line direction since any bias would be clear before processing and the process of upward continuation would disperse it in any event.

Some other lineaments are also evident in the processed maps (Figure 4-D-12). These are either NW-SE or NNW-SE with the former dominant. There are some notable intersections with the E-W features (Rosebery, Renison, Hercules) and the pattern is most reliably seen when the field and its derivatives are overlaid as done in Figure 4-D-12. Decreasing line weight indicates derivation from the field, first or second derivatives respectively.

The relationship between mineralisation and lineaments or trend corridors exposed by this limited treatment is sufficiently consistent to warrant expansion(see also Section 4-F-v, Figure 4-F-12). In my view, the E-W features provide the controlling agencies with NW-SE subsidiary structures contributing to formation of the vent system. Thus Rosebery and Hercules are found in, or very close to, the primary E-W corridors in the studied area where these transect the volcanic pile or associated and suitable host rocks under or in the pile. The Renison mineralisation is somewhat different, being granite related. The intrusion, however, has an E-W extension and the mineralised site lies near the intersection of its axis and a major NW-SE intersection. Red Hills is marginal to one corridor but seems to lack other structuring. A southward extension of this analysis would clarify this judgment.

There is independent geological evidence for some of these features. This discussion has stressed those features not immediately evident in either raw magnetic or geological maps. Contrast the interpretation with the base map. Close review of geological mapping does show that fragmental E-W structures are present. Some occur near Williamsford (Corbett, 1984) and Renison (Blissett, 1962).

It is also relevant to consider whether the other, lesser mineralised prospects bear any relationship to the structures inferred. These form three general groups. The Success, Ben Accord group north west of Renison lie on what may be called the Rosebery corridor. A second group south east of Renison lie about what may be called the Renison transect (NW-SE) while the third group including Rich, Frazer, Hecla lie within the Hercules corridor and especially near the intersection with the Renison transect. I consider the general spread consistent with the main thesis offered here but that either suitable host materials were unavailable, vents were smaller off the volcanic axis or that a large deposit remains to be discovered. These options should be assessed in the region of the main lineament intersection 2 to 3 km west of Hercules.

Preliminary inspection of gravity data supports identification of major structures in the region of the lineaments inferred magnetically. See also Leaman (1986b).

Line 1411 has been examined semi-quantitatively. The corrected profile (at 1275m) and a possible solution is shown in Figure 4-D-14. This treatment was not intended to resolve all issues but does assess property relationships and evaluate anomaly sources while recognising that all anomalies require three dimensional whole geology analysis for complete structural interpretation. Time has not permitted such a treatment. The model reflects the array of sources west of Williamsford. Some comparative dip analysis was attempted but two dimensional resolution was ambiguous. It is certain that the volume of Murchison Granite is large and that local topographic effects within the Mt. Read Volcanics west of the Henty Fault generate minor anomalies. Other large anomalies are due to ultramafics or pyrrhotite. However, much of the western anomaly match depends on a magnetic skin to a granite, the granite itself or to mineralisation in the rocks above. Curve departures reflect three dimensional effects.

Some bulk properties may be inferred.
Any body of Devonian granite must have an equivalent susceptibility of less than 0.0006 (no skin) or 0.0002 (with skin). The contact zone if present must exceed 0.01 to 0.013.
Mt. Read Volcanics west of the Henty Fault have a contrast of about 0.0015 while those east of it, 0.0012.
The Murchison Granite is strongly magnetic (0.0017), a value which compares favourably with the limited observations of Collins et al (1981).
The Crimson Creek Formation also possesses significant properties, 0.001 general and 0.004 (possibly) when mineralised.
The ultramafics have an effective contrast of 0.004 to 0.009 but there are suggestions that associated materials possess reversed remanent magnetisations.
The Precambrian rocks east of Mt. Murchison are non magnetic.
(All units are cgs.)

The contact between Cambrian and Precambrian rocks is near vertical but may dip steeply west. This result may be contrasted with those of Section 4-C and 4-F-iii. Current mapping and gravity data appear to support a westerly attitude. The magnetic field, while not unambiguous, indicates the opposite at this level of treatment. Possible explanations include - some artifact of the modelling procedure and block geometries (unlikely), unknown properties or remanence effects (possible), or a complex structural arrangement in which the normal stratigraphic onlap is preserved near the present surface but the entire western section of the Tyennan Block is overthrust across the eastern part of the West Coast Range (possible but requiring much more consideration). In the last option the surface need not have the simple attitude shown in the models but magnetic materials would be present several kilometres east of current exposures at depths of 3 to 5 km.

Preliminary assessment of the gravity data shows that the volume of the Murchison Granite is substantial (see residual Figure 4-D-14). The granite mass south east of Renison is very large and may extend east of Williamsford at depths not greatly in excess of 1500m.

It may be concluded from the above that the observed data is a reasonable approximation to a mid level drape (200 to 250 m) and to require no adjustment for purposes of unit mapping at the scale permitted by the survey due to the presence of high contrast materials. This need not be so elsewhere and there might be advantage in flying at lower elevations in some areas. There are terrain induced anomalies but these are swamped by the scale of the anomalies. Structural considerations benefit from processing of the data, either in derivative formats or to fixed reference altitudes. Correction of the data is advised before any subtle mineralisation signatures can be appraised since these are often obscured by large scale lithologic effects. Key structural alignments may not be reflected in, or deducible from, drape or observed data. These are more reliably extracted from fixed level data. There are distinct magnetic signatures for each main deposit in the region and all have consistent relationships to gross structural lineaments.

The extension of the procedures applied to this data set is recommended, especially to those areas in which the magnetic field is compound and complex. Full definition of structures depends on a combined gravity-magnetic, whole geology, three dimensional treatment which is beyond the scope of this report.

1	B:DD151470	141.0012	617.4071
DRAPE 150M W TAS MAGNETICS LINE 1470			
2	B:D2501470	101.8945	494.4589
DRAPE 250M W TAS MAGNETICS LINE 1470			
3	B:M1470	121	594
MAGNETIC DATA W TAS MAGNETICS LINE 1470			
4	B:FHT1470	70.08494	306.1178
CONTINUATION TO 1275M W TAS MAGNETICS LINE 1470			

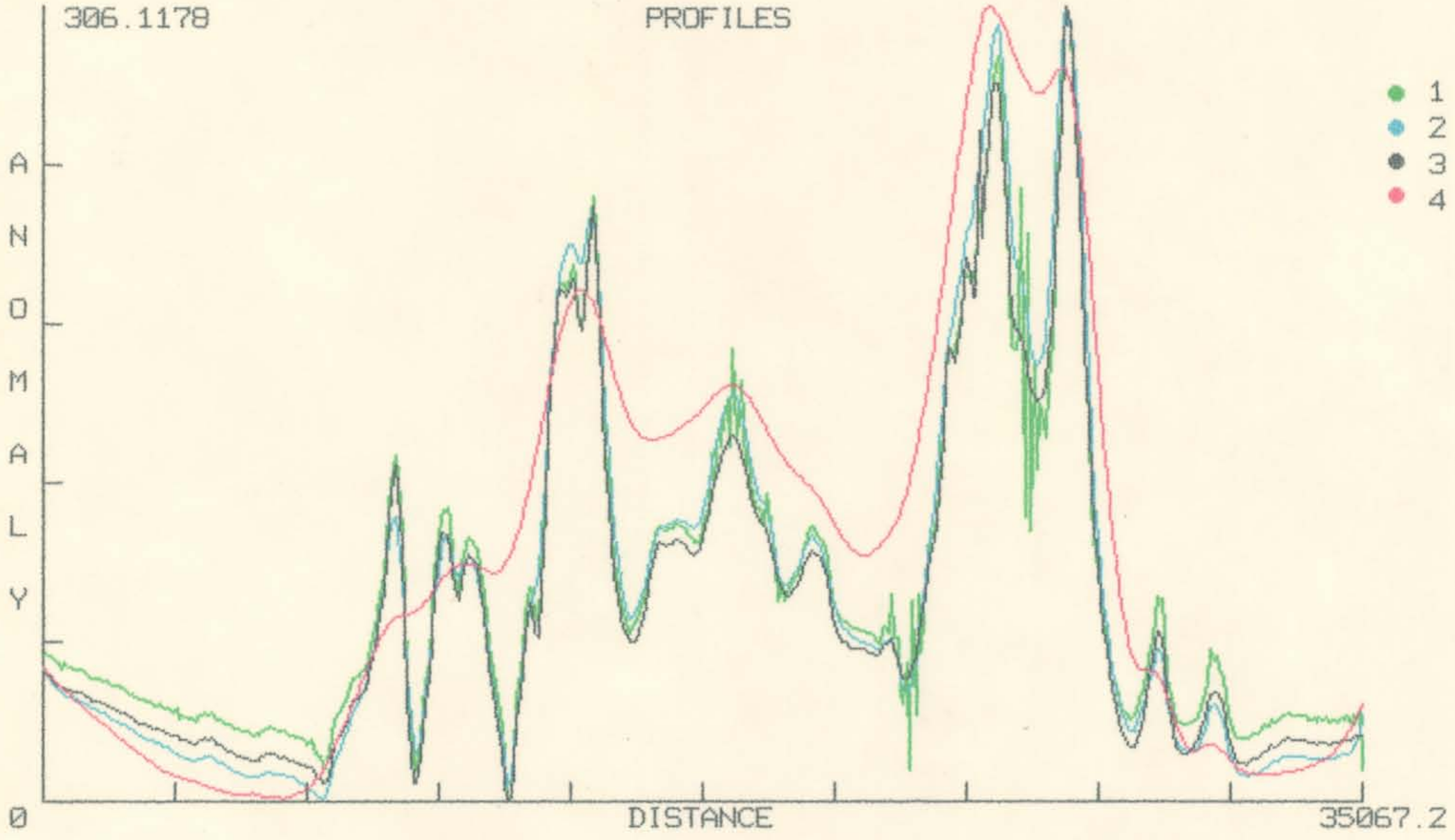
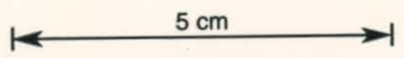


FIGURE :4-D - 1

NORMALISED COMPARISON OF OBSERVED AND CORRECTED DATA
Individual scalings provided in header descriptions



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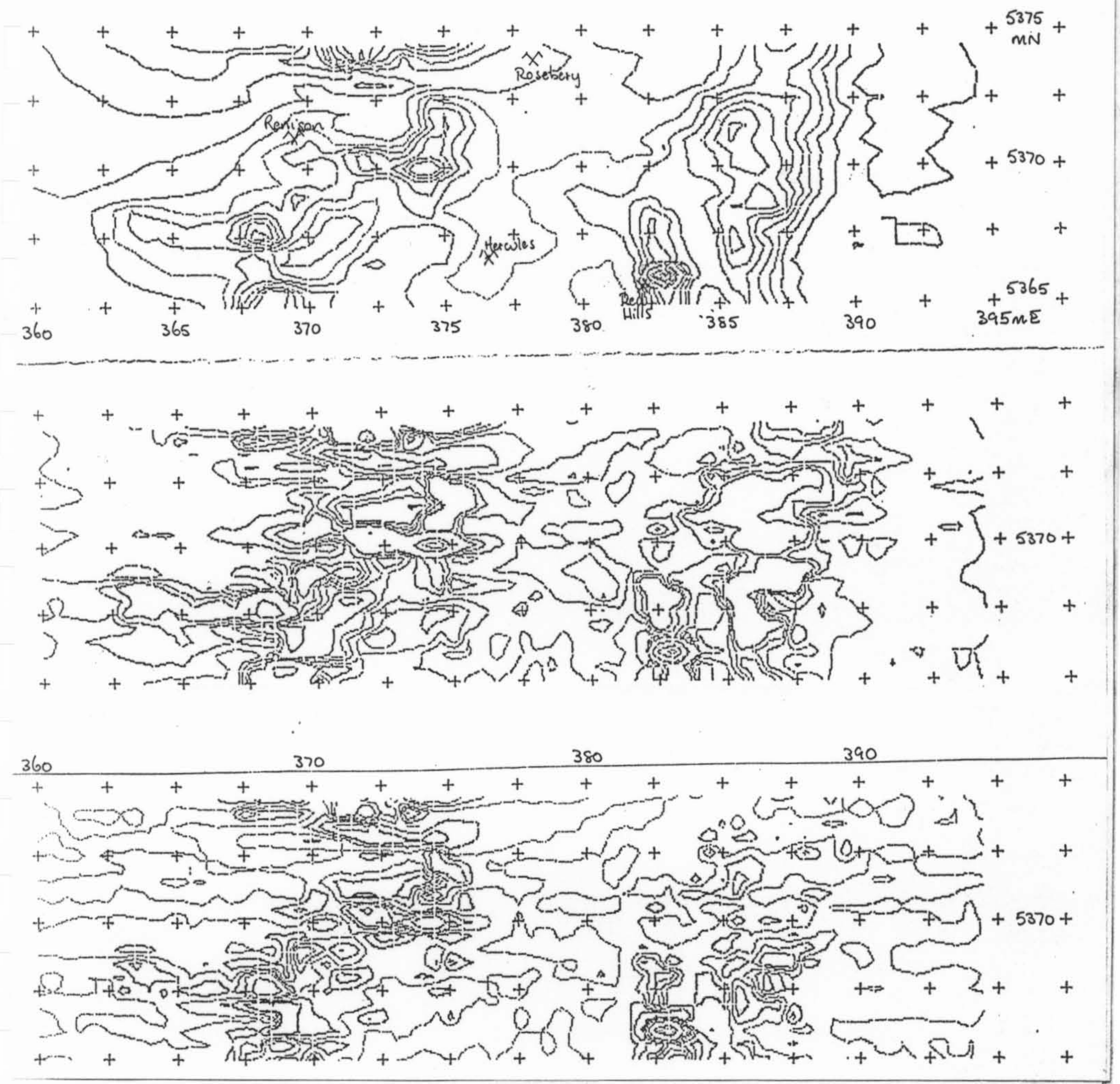
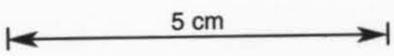


FIGURE 4-D-2

Comparative summary presentation of processed data at 1275 m
(For detail refer to Figures 4-D-8, 10, 11)
1:200 000



1	B:M1500	MAGNETIC DATA W TAS MAGNETICS LINE 1500
2	B:DD251500	DRAPE 250M W TAS MAGNETICS LINE 1500
3	B:FHT1500	CONTINUATION TO 1275M W TAS MAGNETICS LINE 1500
4	B:ELEV1500	FLIGHT ELEVATION PATH LINE 1500
5	B:DIFF1500	CLEARANCE FT DATA LINE 1500

ZERO SHIFT : 105

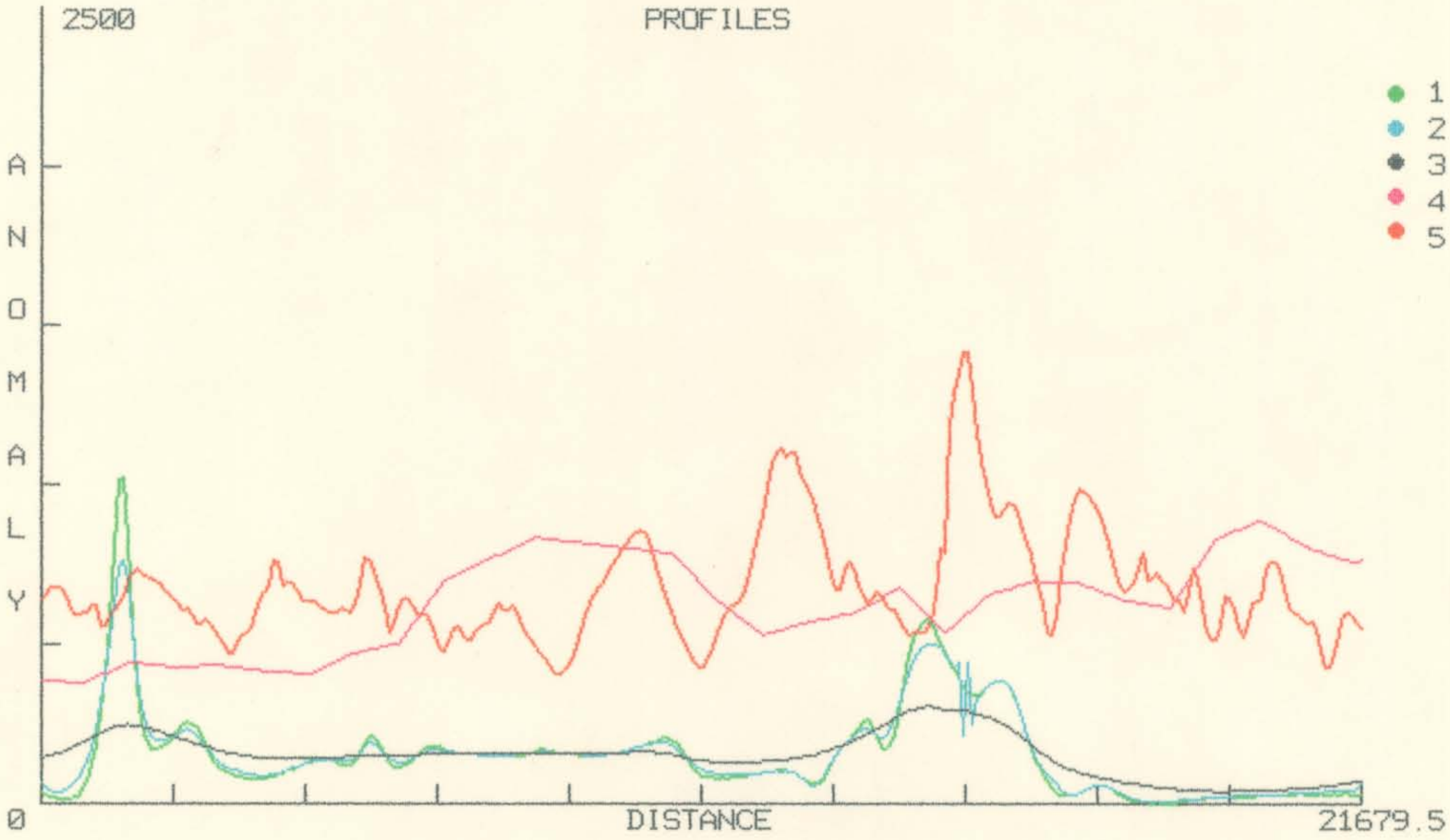
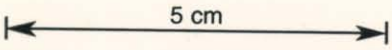


FIGURE :4-D - 3

LINE 1500 - THROUGH ROSEBERY
ROSEBERY : small couplet anomaly at approx 5000 m



1	B:M1441	MAGNETIC DATA W TAS MAGNETICS LINE 1441
2	B:DD251441	DRAPE 250M W TAS MAGNETICS LINE 1441
3	B:FHT1441	CONTINUATION TO 1275M W TAS MAGNETICS LINE 1441
4	B:ELEV1441	FLIGHT ELEVATION PATH LINE 1441
5	B:DIFF1441	CLEARANCE FT DATA LINE 1441

ZERO SHIFT : 139.7955

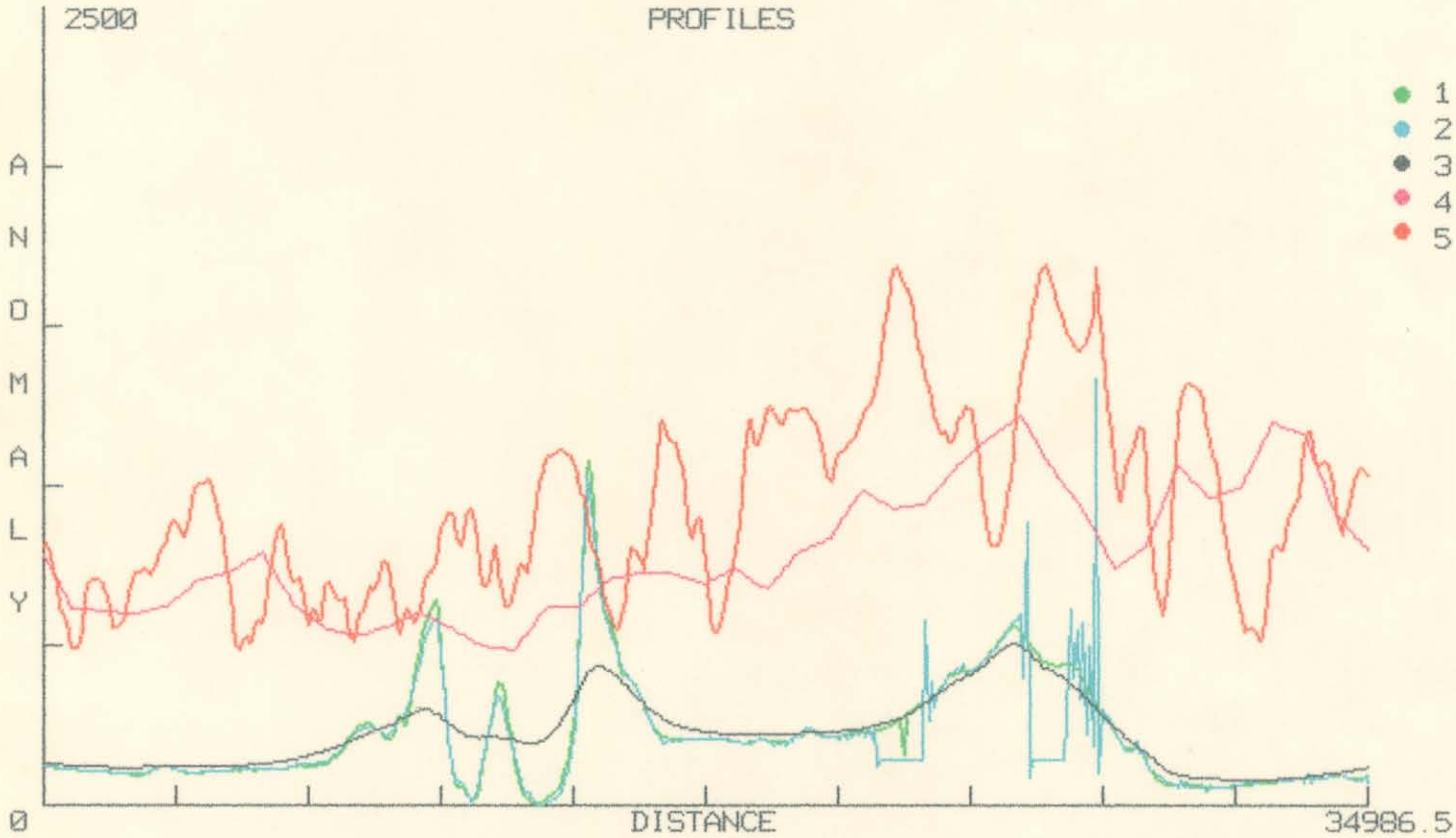
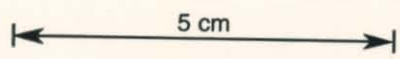


FIGURE :4-D - 4

LINE 1441 - THROUGH RENISON
RENISON: large feature at approx 10000 m



1	B:M1360	MAGNETICS DATA W TAS 1981 LINE 1360
2	B:DD251360	DRAPE 250M W TAS MAGNETICS LINE 1360
3	B:FHT1360	CONTINUATION AT 1275M W TAS MAGNETICS LINE 1360
4	B:ELEV1360	FLIGHT ELEVATION PATH LINE 1360
5	B:DIFF1360	CLEARANCE FT LINE 1360

ZERO SHIFT : 93

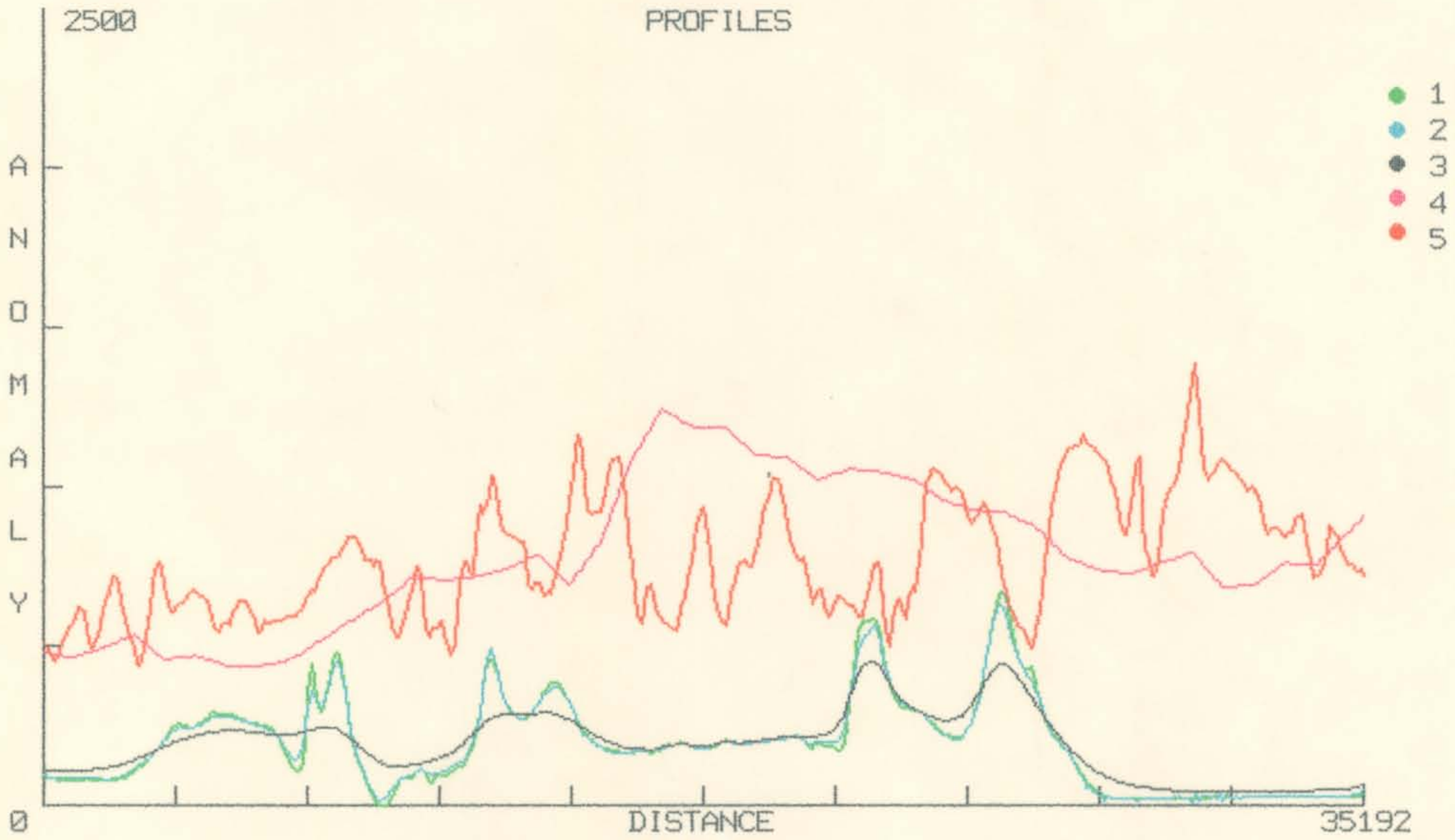


FIGURE :4-D - 5

LINE 1360 - THROUGH HERCULES
HERCULES: anomaly located at "S" in "DISTANCE"

5 cm

1	B:M1345	MAGNETIC DATA W TAS MAGNETICS LINE 1345
2	B:DD251345	DRAPE 250M W TAS MAGNETICS LINE 1345
3	B:FHT1345	CONTINUATION TO 1275M W TAS MAGNETICS LINE 1345
4	B:ELEV1345	FLIGHT ELEVATION PATH LINE 1345
5	B:DIFF1345	CLEARANCE FT LINE 1345

ZERO SHIFT : 100.0217

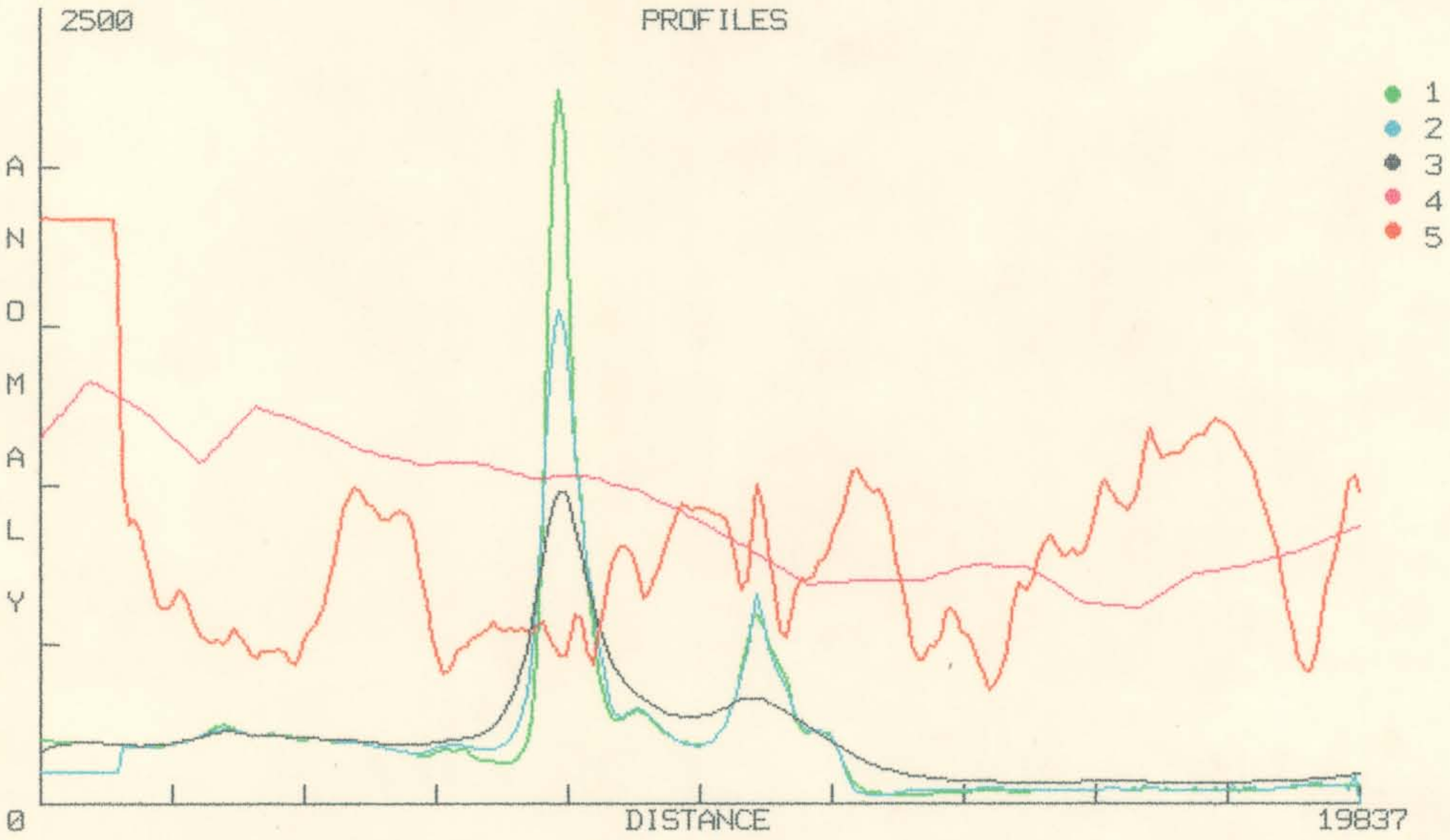
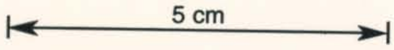


FIGURE :4-D - 6

LINE 1345 - THROUGH RED HILLS
RED HILLS: principal anomaly-due to mineralised rhyolite



1	B:D2M1360	1336.827	3069.559
VERTICAL DERIVATIVE 2 OBS DATA LINE 1360			
2	B:D2FH1360	596.0606	1061.633
VERTICAL DERIVATIVE 2 1275M LINE 1360			
3	B:ASM1360	874.3696	2499.987
ANALYTIC SIGNAL OBS DATA LINE 1360			
4	B:M1360	93	673
MAGNETICS DATA W TAS 1981 LINE 1360			
5	B:FHT1360	50.87346	411.1429
CONTINUATION AT 1275M W TAS MAGNETICS LINE 1360			

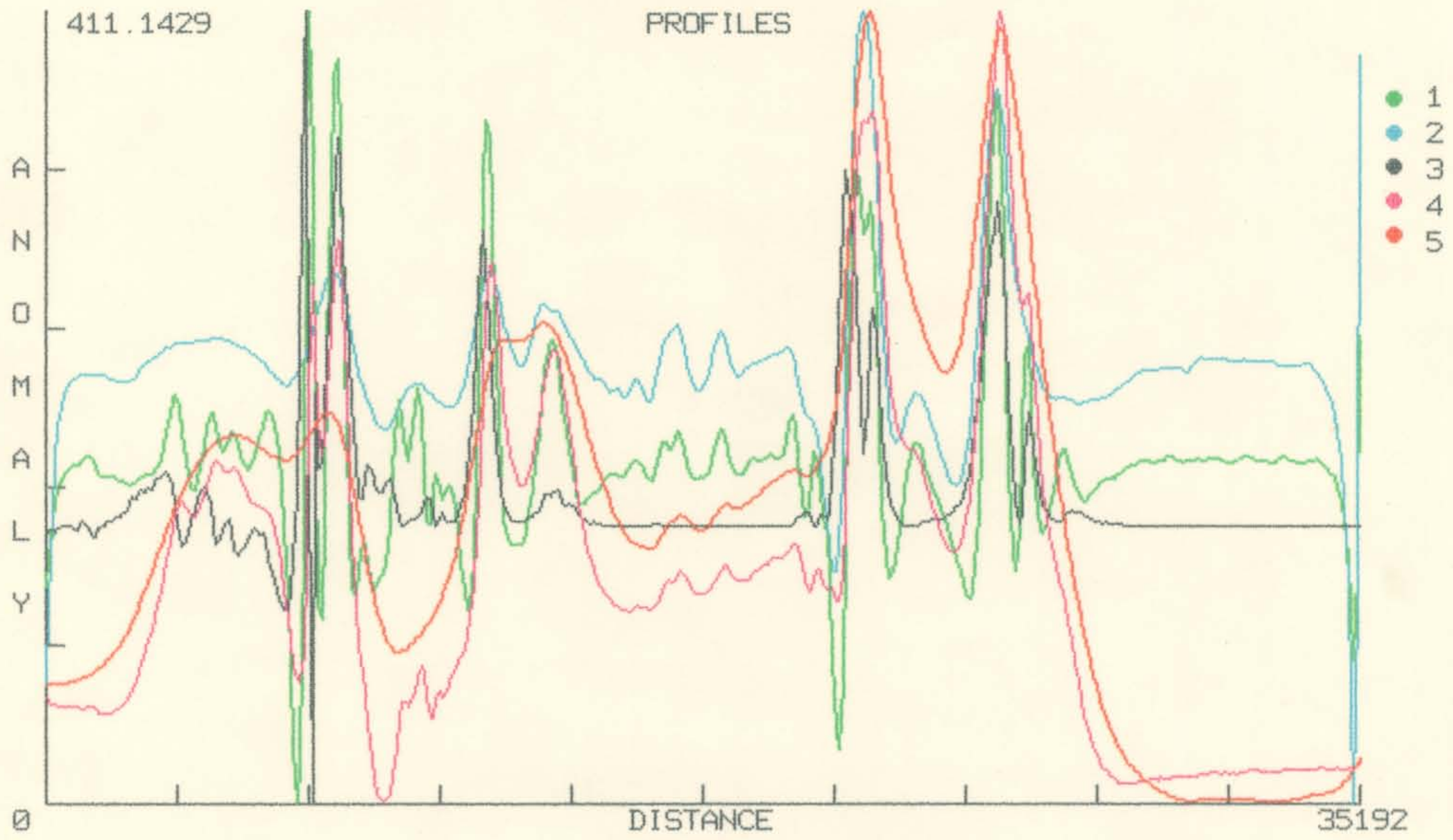
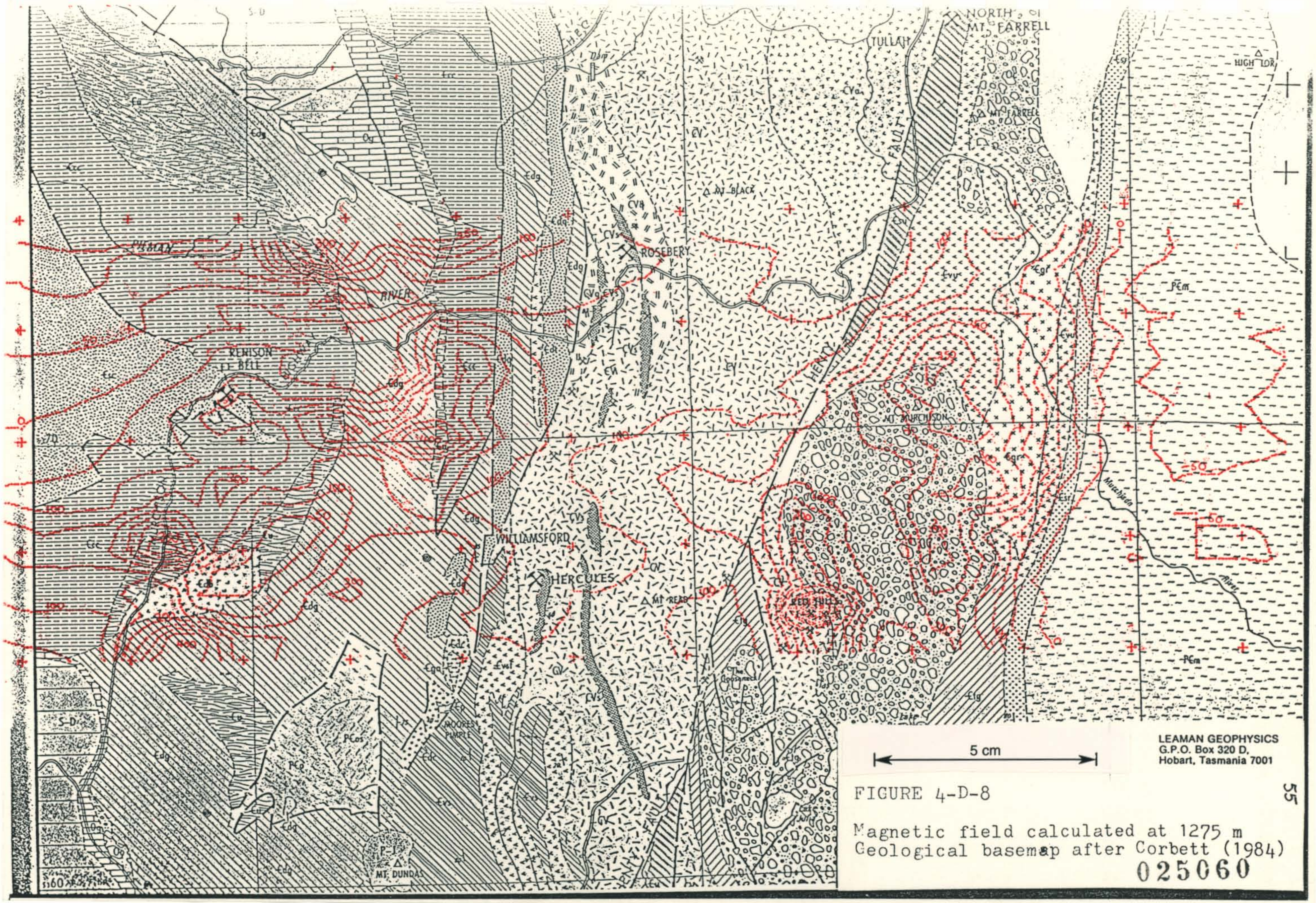


FIGURE :4-D - 7

LINE 1360 - THROUGH HERCULES - ANALYTIC PROCESSING
Compare Fig 4-D - 7 to assess anomaly enhancement

5 cm



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55

FIGURE 4-D-8

Magnetic field calculated at 1275 m
Geological basemap after Corbett (1984)

025060

5 cm

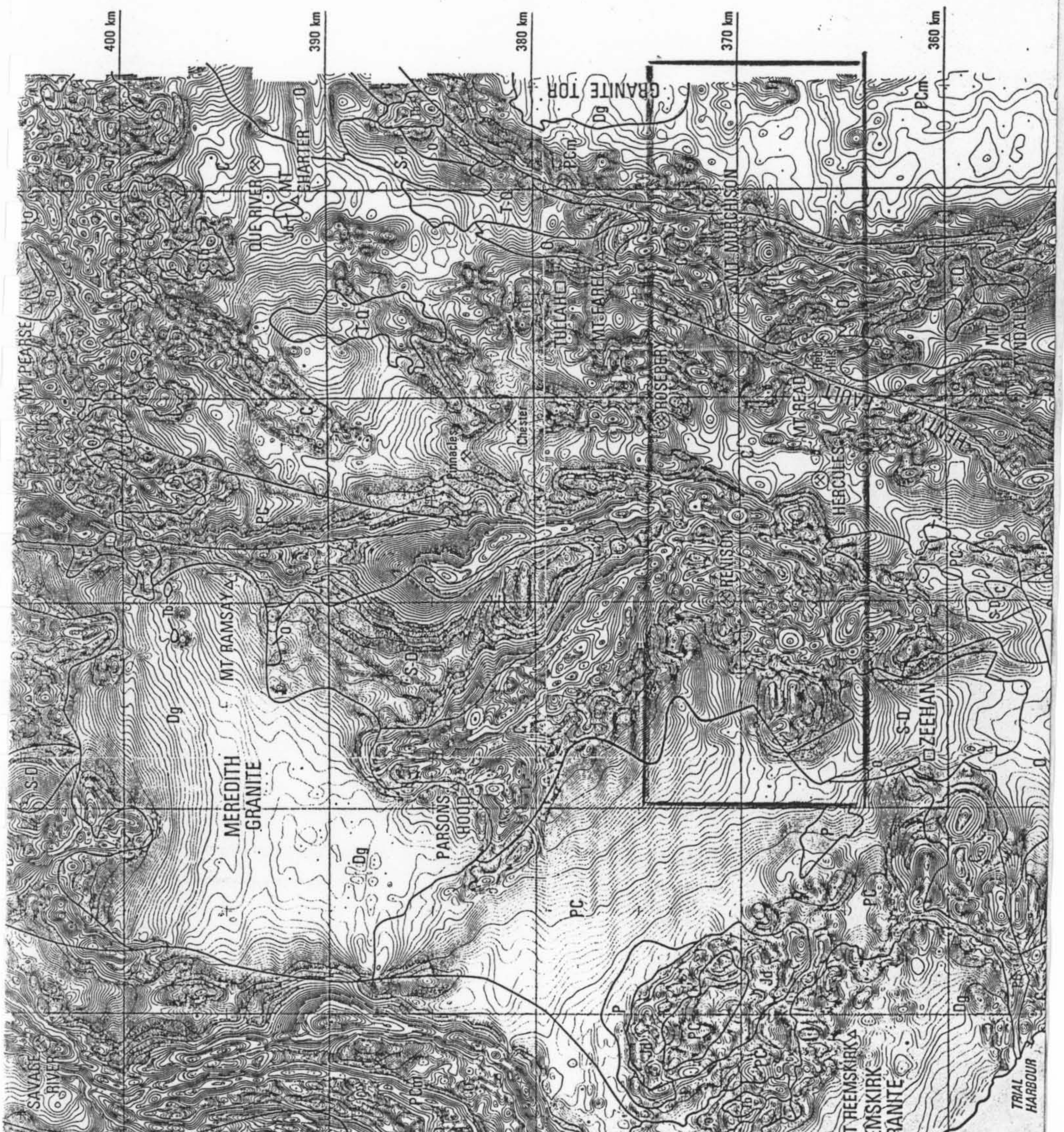

FIGURE 4-D-9

Magnetic field as observed and originally presented by contractor. Scale 1: 250 000

Special study area outlined

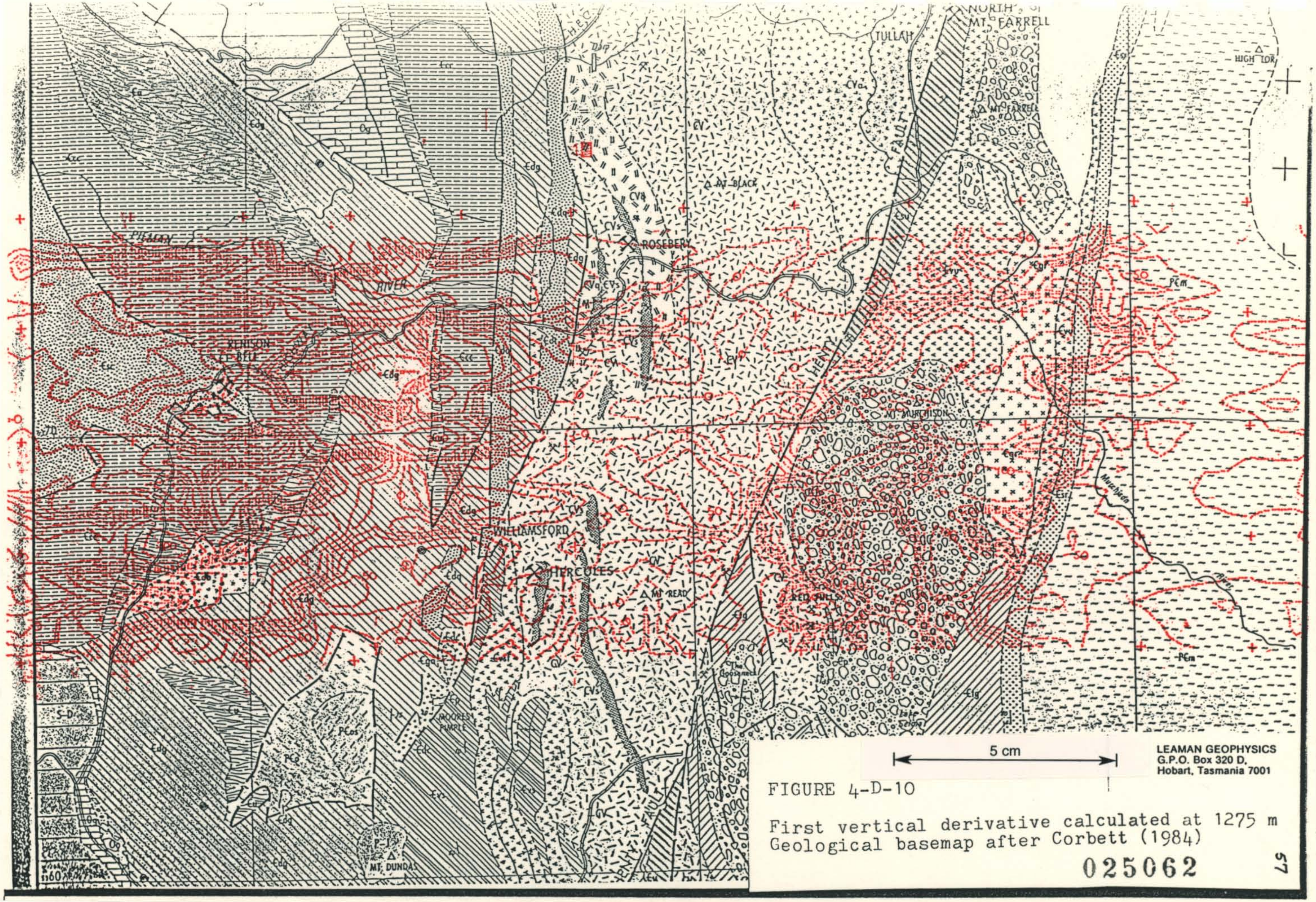

FIGURE 4-D-10

First vertical derivative calculated at 1275 m
Geological basemap after Corbett (1984)

025062

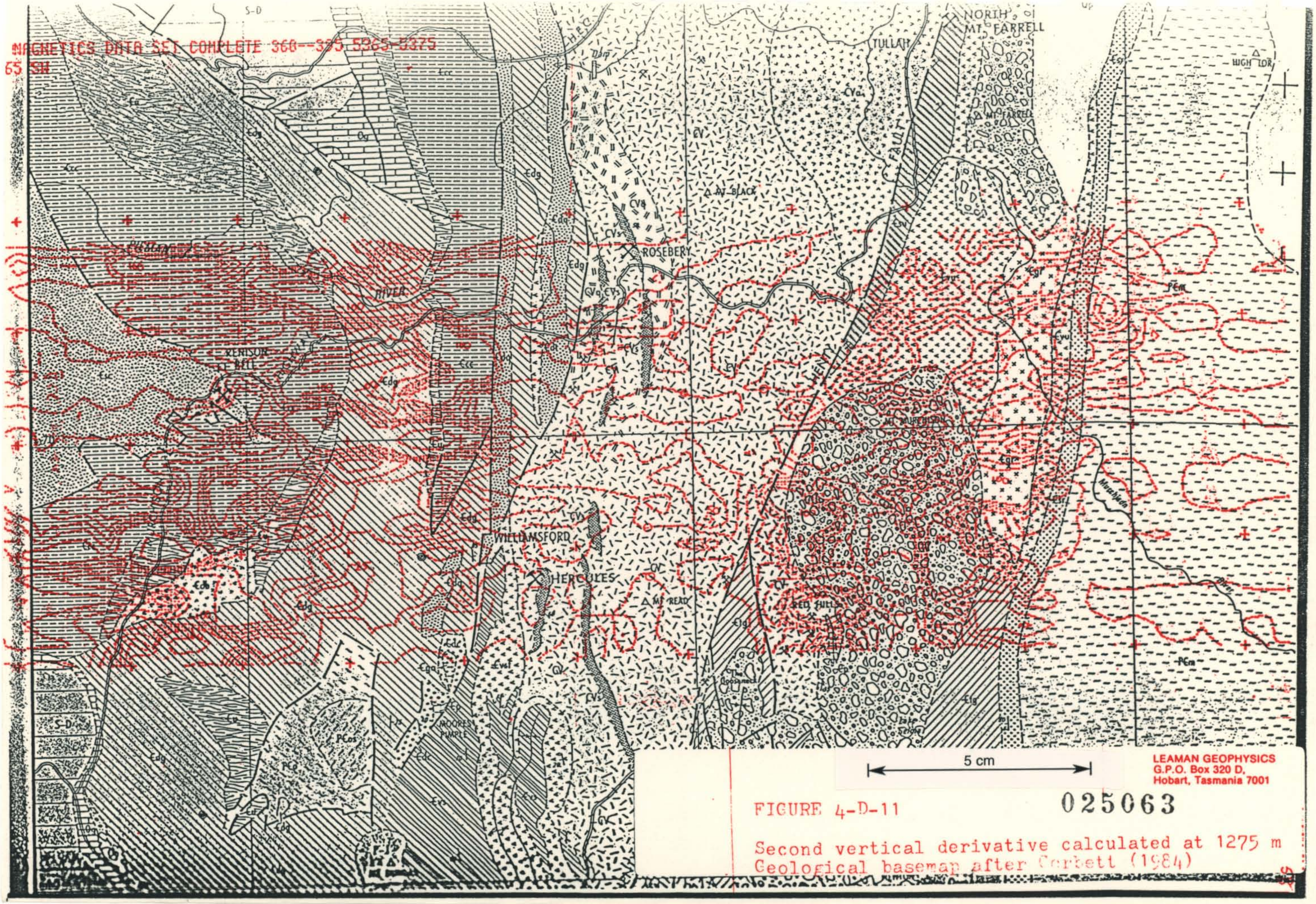

FIGURE 4-D-11

Second vertical derivative calculated at 1275 m
Geological basemap after Corbett (1984)

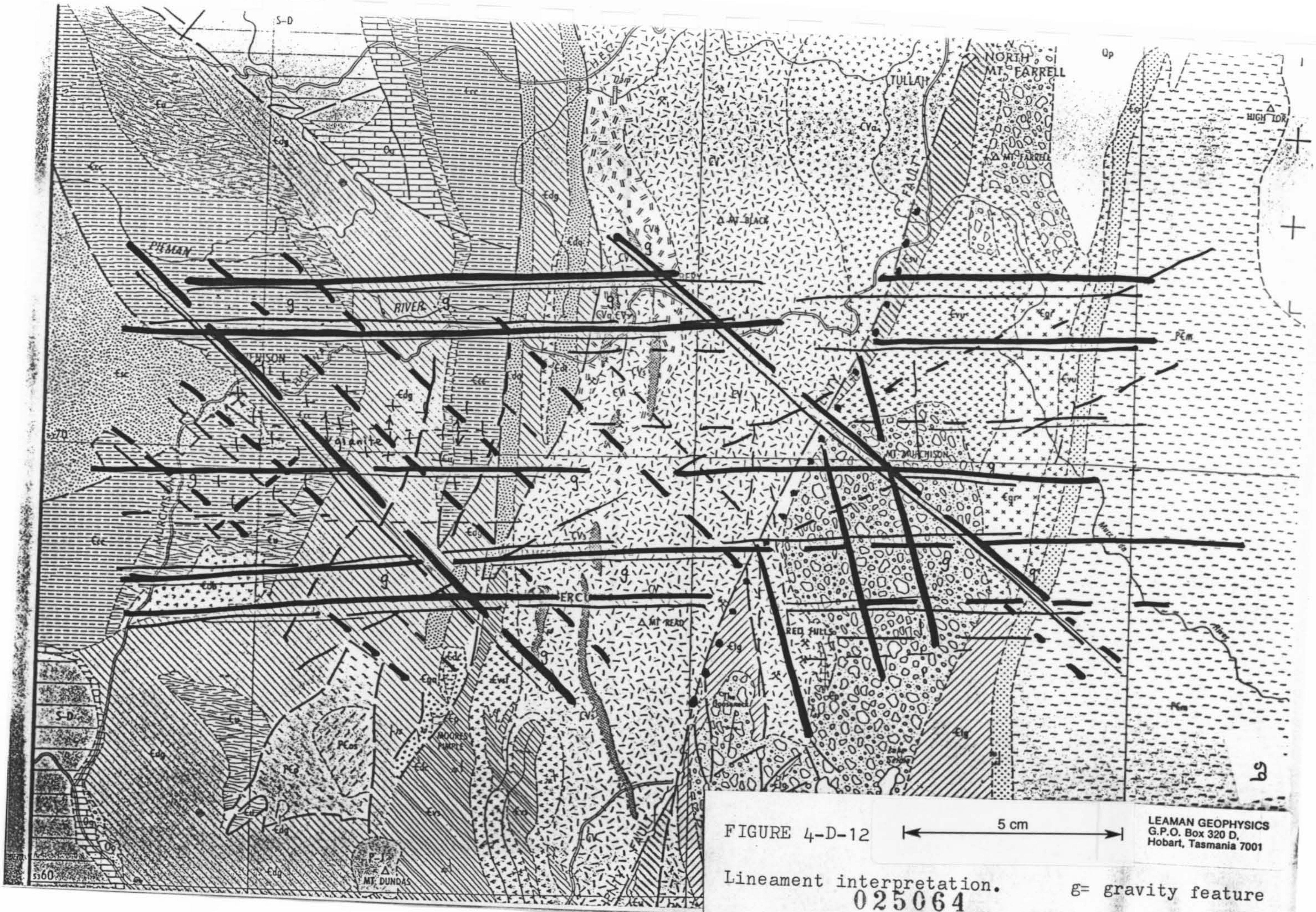

FIGURE 4-D-12

Lineament interpretation. g= gravity feature

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025064

025065

1	B:M1411	MAGNETIC DATA W TAS MAGNETICS LINE 1411
2	B:DD251411	DRAPE 250M W TAS MAGNETICS LINE 1411
3	B:FHT1411	CONTINUATION TO 1275M W TAS MAGNETICS LINE 1411
4	B:ELEV1411	FLIGHT ELEVATION PATH 1411
5	B:DIFF1411	CLEARANCE DATA LINE 1411

ZERO SHIFT : 245.2903

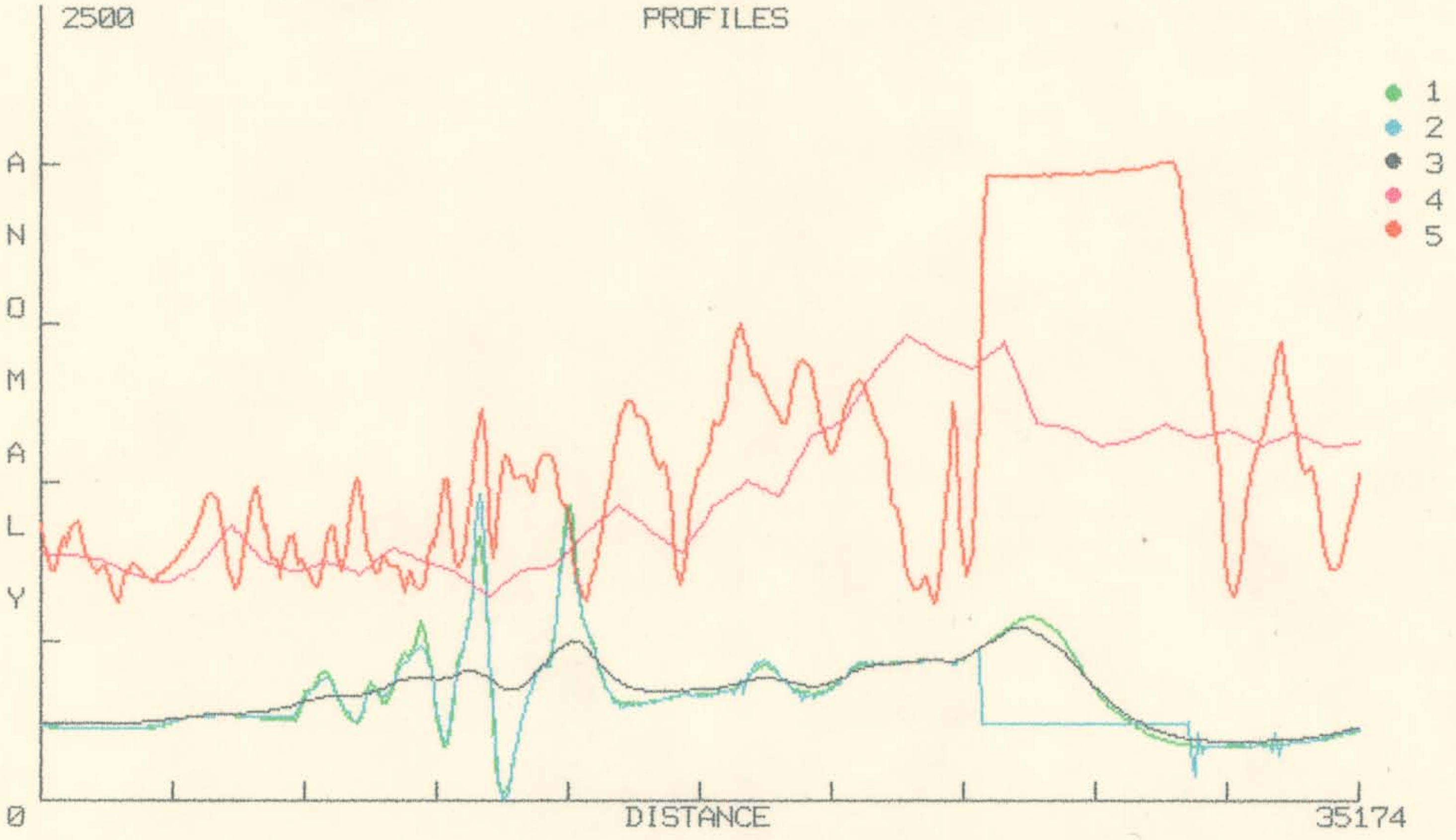
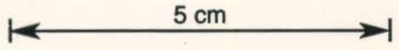


FIGURE :4-D - 13

LINE 1411
Note excessive clearance near Mt Murchison and consequent continuation failure



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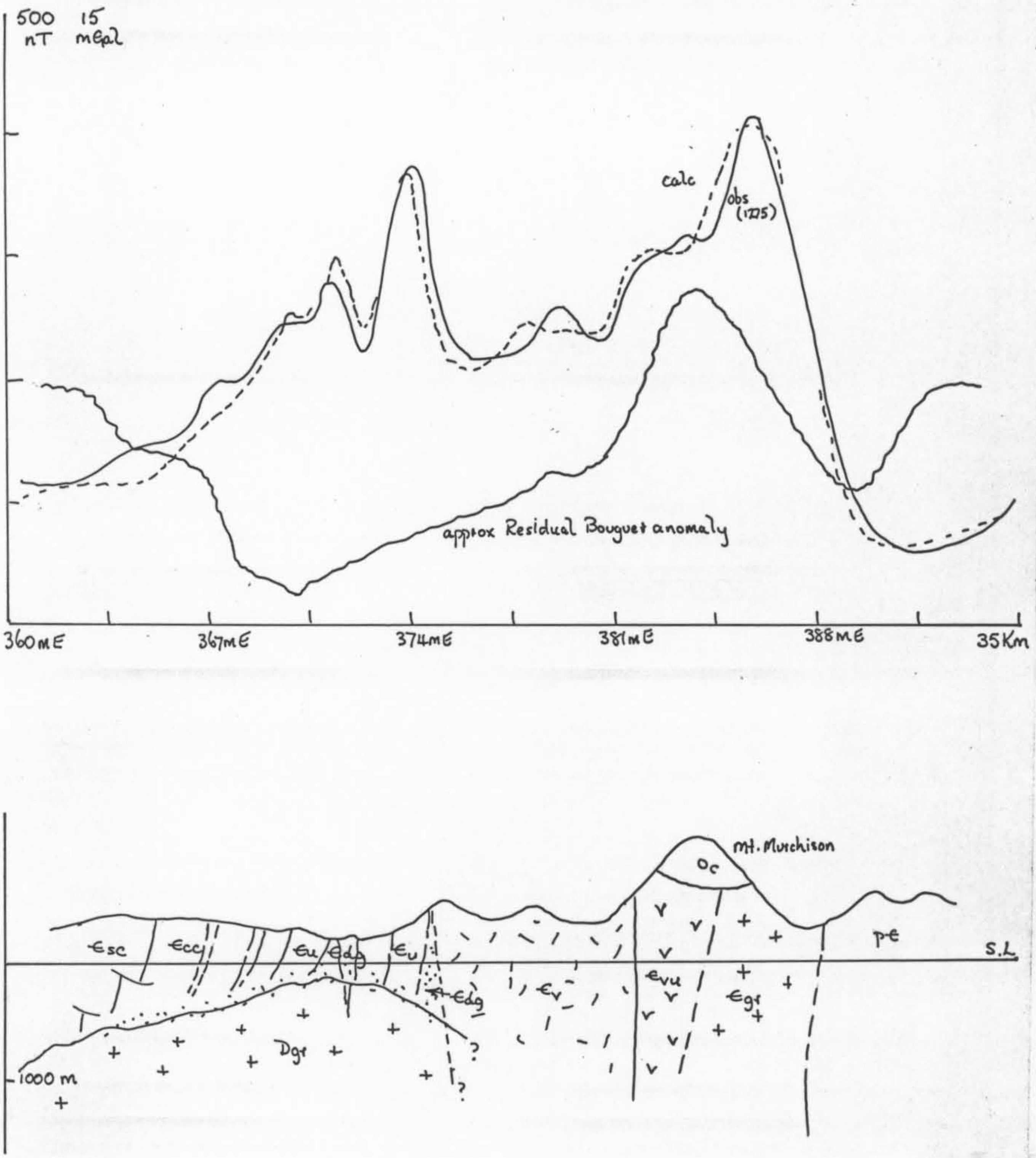

FIGURE 4-D-14

Introductory interpretation - line 1411

5 cm

4-E: WARATAH-GUILDFORD REGION

The basalt-covered region north of Que River and east of Waratah has long frustrated exploration. It has seemed an attractive search area with economic deposits of various types located around the periphery of the basalt cover. The absence of outcrop, however, and the risks associated with blind drilling has intimidated most explorers. Recent work by a few companies has appeared to confirm some of the worst fears. The basalt has been shown to exceed 200 m thick in many places although few holes have provided information on sub-basalt materials. AMT and TEM research programmes have indicated that such thicknesses may be general although sounding sites are relatively few and dispersed and confirmation by drilling even rarer (refer Smyth and Hungerford, 1983 for details of trials).

Because of the recognised, potential importance of basalt-covered areas I have reviewed and tested over many years many geophysical methods which might yield information on basalt thickness and so provide general guidance on the location of soil-covered windows, Palaeozoic rocks at shallow depth and control for other methods. Integrated method usage reduces ambiguity since no single method should be expected to solve all problems unambiguously, including identification of sub-basalt targets. The materials present difficulties for all methods; electrical - false sounding inferences due to low resistivity layers(Leaman, 1980a), reflection - blind zones and intra pile reflectors due to lateral and vertical variability (e.g. Leaman, 1978), gravity - ambiguity due to interference of volcanic-sediment-basement effects. Magnetics is no exception since sources at moderate depth (basalt base) are not immediately distinguishable from shallower, interfering near surface effects. Magnetic methods offer considerable benefits if the problems can be solved or minimised since entire areas can be extensively covered and interpreted at relatively low cost. The feasibility of the use of magnetic methods in this region was considered by Weste (1979), but not especially optimistically and not on the scale demonstrated in this report. Surface profiles and low level aeromagnetics was recommended.

I have chosen the Waratah-Guildford region for analysis since it is an important, representative region with fair drilling control and demonstrates the possibilities and limitations of magnetic interpretation in basaltic terrain. Time for the present study has restricted treatment to about 150 km^2 immediately east of Waratah. The particular objectives were:

- to provide a coherent piece of interpretation,
- to locate any occurrences of shallow Palaeozoic materials,
- to infer the bedrock composition,
- to identify any anomalous features, and
- to suggest what further work is feasible and how it should be

specified.

The first Figure (4-E-1) presents the observed magnetic field. The nominal clearance was about 175 m in this area. The field appears irregular with many small anomalies but in fact the high frequency effects disguise some large regional anomalies (see Figures 4-E-3, 7). The basalt cover limits source inferences but some are possible (below and Fig 4-E-6). Centred about 385 mE, 5415 mN the field is elevated (approx 200 nT) with strong peripheral gradients (e.g. 382, 5414). North and north west of this area the field is more extreme (approx 300+ nT). To the east the field is near zero (-50 to 100 nT) to 391 mE before rising to values comparable to the core area. To the west and south west the field is much reduced (<-100 nT) with local aberrations (incl. Mt. Bischoff; 3765, 54125). These features are best seen if the contour map is coloured (e.g. <-200, -100 to -200, 0 to -100, 0 to 100, 100 to 200, 200 to 300, >300 nT). Most of the characteristics are summarised in Figure 4-E-6. Basalt blankets the region but there is no obvious correlation between basalt and gross features in the field suggesting that the primary features reflect Palaeozoic structures and units. The suite of drill holes along, and mapping west of, the Murchison Highway confirms the junction between materials (Cambrian/Precambrian). There are no other pre-basalt exposures or basalt penetrations in the area examined.

Figure 4-E-2 presents a preliminary version of the residual Bouguer gravity field. It is based on data on the TASGRAV data base as at September 1985 and was derived by linear trend filtering. The relatively smooth anomalies probably reflect the wide traverse spacing although, as shown below, the quite regular thickness of basalt may minimise any correlation between anomalies and basalt variations. In any event the gross anomalies are long wavelength and clearly sourced sub-basalt (compare magnetic anomalies). The implications are discussed below and summarised in Figure 4-E-6. A more comprehensive regional gravity interpretation is to be provided separately (Leaman, 1986b).

Magnetic interpretation has been based on lines 2220 (nominal northing 5410), 2240 (5411), 2260 (5412), 2280 (5413), 2300 (5414), 2341 (5416), 2360 (5417), 2380 (5418), 2400 (5419), 2420 (5420), 2451 (54215) east of 371500 mE. The procedure used is proprietary to Leaman Geophysics and not wholly defined here. It is computationally intensive and multiphase but does require considerable interpreter involvement. Two phases of the process are derivations and improvements on the method of Spector and Grant (1970) and Green (1972). The preparatory phase involves test sampling, appraisal and spatial conditioning to ensure enhancement of sources within the depth range anticipated. In this area drilling indicates a range of 140 to 500 m below the aircraft is the minimum required. After processing the results must be converted to depth estimates and evaluated before presentation in acceptance plots of the type shown in Figure 4-E-3. On average, up to 5 or 6 estimates are provided for each position. The procedure is not unlike that used for multifold assessment of seismic data. The technique is neither absolute nor guaranteed without some parameter control and this is limited in the area described. The interpretation is offered as a crude predictive contribution to appreciation of the region.

The interpretation shown in Figure 4-E-3 is discussed below but several comments are necessary. Most estimates are derived from contacts and variations close to the surface. Response from the base of the basalt pile is always patchy. No deep basement sources are recorded unless the contrast is high, e.g. line 2280: 383 mE; line 2400 : west of 382 mE. The shallow sources create a diffuse blank zone not unlike the reflection response but boundaries within the pile are always evident. Some diffusion also occurs where the land surface is irregular. Identification of the base of the pile is critical and some control is essential in order to separate high level intra flow contacts and the stack base. Control should, ideally, be located away from steeply dissected terrain to minimise dispersion and ambiguity. In this case the holes along the Murchison Highway (refer St. Valentine Peak geological map sheet) were used for control. The interpretation was later compared with drilling results on EL 1/76 (Smyth and Hungerford, 1983). Unfortunately much of this drilling ended within the basalt pile but the predicted values were at least consistent with the implied minimum thicknesses. Only one drill hole appears in the sections presented (GF1, 2280) and it terminated in basalt. Review of the section shows the significance of this information since the stronger shallower contacts could have been mistaken for the basalt base. This hole was not used for control but later plotted in verification. The results of the drilling along the Murchison Highway defined these problems and controlled the depth scale and response style sought.

Any agreement within 25 m is an excellent result due to the effect of sample spacing and terrain clearance effects. The latter are minimal (Fig 4-E-7) for most of this area but have been compensated by continuation to a level of 800 m above sea level. All interpretation has been related to this level. Variations in observed sample spacing is more serious and less readily compensated. On line 2260, for example, the recorded spacing varies - on a kilometre basis - from 31.2 to 43.5 m with an overall average of 39.5 m. This variation could generate an error of +/- 30 m along the line segments. Overlapped sampling procedures smooth and minimise such errors but the overall precision is unlikely to better 25 m or 10%.

Line 2260 (east west through Mt Bischoff) was used for assessment of data and processing requirements. The line was used in observed, compensated drape and fixed height forms. All but the drape are shown in Figure 4-E-7. The compensated drape used was 150 m - the specified clearance for the survey although the actual clearance range was in fact 130 to 350 m overall and 170 to 200 m over the plateau. The differences between profiles are sizeable west of 378 mE but not elsewhere due to the nature of the terrain. Future surveys should be specified and flown at a set height for three reasons. No errors are introduced by terrain effects or any processing required although spectral review showed that the procedures affect noise levels only. Processing is minimised and interpretation is eased. The interpretation is free of difficult to assess terrain-related anomalies. Most importantly, airspeed variations are minimised and the sample spacing problem is avoided. A higher sampling rate is not necessary in areas comparable to this but flight lines should allow at least 2 km beyond the area of immediate interest to provide for inevitable data loss at line ends during treatment.

The body of the interpretation is presented in Figures 4-E-4, 5. The basalt pile is rarely less than 200 m thick. This is hardly encouraging for further exploration or drilling in this area unless some indication of a deep, worthwhile target is forthcoming (below). The inferred valley fill, flow drainage pattern (Figure 4-E-5) could imply drainage to either north or south since there is no indication of dip within the main channel within the precision of the interpretation. This discussion ignores the possibility that sediment-filled channels underlie the basalt and that the true flow regime in the leads is not indicated. There is evidence in some drill holes and in all profile interpretations of complex valley fill, erosion, shifting valley axes and lava flow systems (e.g. Fig 4-E-3). Similar features were established on a smaller scale in Pipers River (Leaman, 1973). Overall topographic relief prior to volcanism was at least 300 m.

Figure 4-E-6 summarises deductions on trends, lineaments and source composition. As noted above most large gravity and magnetic effects are sourced beneath the basalt cap; the latter introducing negligible gravity anomalies but substantial (and useful) magnetic noise. Basalt-sourced magnetic anomalies are generally of variable frequency and amplitude and disguise the major gradients. Both data sets reveal several major E-W, N-S, NW-SE and NE-SW lineaments. Only the largest are visible in the residual Bouguer anomalies. The magnetic data have been reviewed as presented by the contractor (Fig 4-E-1) since tests on line 2260 showed that data acquired above the basalt plateau requires negligible correction for consistent evaluation. This is not the case off the plateau or where the cap is more highly dissected. The review indicates that the trends indicated regionally may be recognised in the dyke system at Mt. Bischoff. Indeed, Mt. Bischoff lies near the intersection of the most emphatic E-W and NE-SW lineaments in the region. Significant? The continuity of line in Figure 4-E-6 reflects my appraisal of the relevance and recognisability of the feature. The lighter line weight represents deductions from magnetic data; the heavier lines gravity data.

Several basement categories are indicated. Core block (A) has both gravity and magnetic expression. A magnetic contrast of about 0.001 cgs can be inferred. Block (B) is less magnetic (0.0007 cgs est.) and less dense. Blocks (C) and (C?) are believed comparable to (A), being dense and quite strongly magnetic. Blocks (D) are moderately dense but variably and generally weakly magnetic. Block (E) is composed of light generally non magnetic materials. These identifications are generalised and relative and not the result of exhaustive gravimetric analysis which might suggest bulk density values and improved source deductions. I believe, however, that some gross deductions are possible at this stage.

Corbett et al (1982) have labelled four anomalies in the survey area; (63) - the Bischoff mineralisation anomaly, (64) - low order noisy magnetics due to basalt, (65) - the Waratah River wedge anomaly due to Cambrian basalts and (66) - the Wardle River anomaly due to Cambrian basalts beneath Tertiary basalts. This anomaly selection is limited in its sampling of the basement categories identified above.

My preliminary identifications are as follows:

(A) Cambrian suite with significant basic volcanics.

(B) Cambrian suite with less volcanics of all types.

(C) Similar to (A) but with more extensive basic igneous content.

(D) Sundry Lower Palaeozoic rocks dominated by post Cambrian rocks. Cambrian sedimentary or siliceous sequences possible also.

(E) Precambrian.

(A) and (C) are not exposed and may represent a fold core or elevated blocks of Cambrian volcanics. (C?) probably is exposed. The limited peripheral exposures and drill control support support these broad deductions. The Mt. Pearse block can be traced as an extension of (D). Thus anomaly (64) of Corbett et al (1982) represents basalt noise on a quiet Palaeozoic background (D) while (65) and (66) represent the noisiest background (C, C? resp). The dominant bulk differences between (A) and (B) were not noted. The notation used for the pre-Tertiary sources is also shown in the sections (Fig 4-E-3). The major basement structures implied on line 2400 are identified first order lineaments in Figure 4-E-6.

A more comprehensive derivative analysis of the terrain corrected magnetic field supplemented by an infilled and fully interpreted gravity coverage would allow refinement of this interpretation. Unfortunately the inferred composition and distribution of sub-basalt materials limits target prospectivity in the region. The type of mineralisation normally expected in Cambrian - Mt Read arc materials may be too deeply buried to be economic while further Mt. Bischoff style mineralisation will be limited to the south west corner of the area studied.

The profiles used for interpretation support the above suggestions. Line 2400 (Fig 4-E-3) shows that magnetic sources occur for some distance beneath the basalt and are then terminated by a dipping contact with less magnetic homogeneous material (C? to B). The isolated deep source on lines 2260 to 2290 (2280 Fig 4-E-3) is more interesting. It is one of the few unaccounted features noted in the interpretation. It is isolated and well defined on several lines. Perhaps more significantly it lies near the intersection of major lineaments at the probable contact between volcanic Cambrian and the Precambrian. The site is marked with large "?" marks in Figure 4-E-6. Trends at the intersection are similar to those evident around Mt. Bischoff in terms of this study and the mapped dyke swarm (Groves et al, 1972). The anomalous site has an area in excess of 1.5 km . Possible explanations include local thickening of the basalt, intrusive plugs or pipes of any age or a Bischoff-style source. While large basaltic vents are possible no other occurrences on this scale have been located and the scale seems extreme. Similarly, isolated and greatly thickened pods of basaltic cap are not really consistent with the body of the interpretation. A Palaeozoic feature is most likely. There seems little doubt that a localised magnetic source is present at the marked location (3826,54133). Modelling along line 2300 showed that the gross geometric effects of other sources including the edge and wedging of the basalt cap and the change between blocks (A) and (E) generate a large negative response in this area. Profiles for lines 2280 and 2300 (Fig 4-E-7) show that while such a negative tail is developed it is disrupted (2280) and almost cancelled (2300) by another source. Both lines reflect the substantial effect of block (A) - especially 2300.

Modelling has also shown that the basalt generates anomalies within an envelope of about 200 nT. These are evident in all profiles (e.g. Fig 4-E-7) and can be produced by patchy property variations up to 60 m thick. Basalt alone cannot generate the large anomaly bulge evident on line 2280 and 2300 east of 383 mE. The isolated anomaly 6 km from the start of line 2300 is related to the isolated residual basaltic exposure west of the main plateau. The effective contrast of the basalt is about 0.005 to 0.006 cgs given the anomalies observed. Smyth and Hungerford (1983) have recorded susceptibility values up to 0.0017 cgs and high remanence values with Koenigsberger ratios of up to 70 (av 10-20). A bulk value of around 0.005 cgs could be anticipated for rock in average to fresh condition.

THE BISCHOFF ANOMALY is self evident and distinctive. It is contrasted against a relatively quiet negative background. It has been examined in order to evaluate its character, source implications and the potential for recognition of similar features at greater depth or beneath a basalt cap.

The anomaly is located near the intersection of several strong magnetic lineaments. Gravity data are not available but at least two of those lineaments are recognised to the east (Fig 4-E-6). The dyke system, and to some extent the magnetic anomaly, reflects the trends of these features. Groves et al (1972) note that E-W and N-S trends are dominant in the dyke swarm.

The Bischoff anomaly is essentially in two parts (Fig 4-E-7); a high amplitude spike and a raised base. The base anomaly must be due to gross lithological changes and dispersed replacement mineralisation plus any dyke swarm effects. These alterations may not be immediately obvious in essentially non magnetic lithologies. The spike reflects virtual exposure of massively mineralised material but which requires a bulk contrast of no more than 0.01 to 0.015 cgs. This is easily attained with a few percent dispersed pyrrhotite. The base anomaly can be generated with a bulk volume contrast of no more than 0.002 cgs. Some units clearly carry much higher contrasts but at effective clearances of 120 to 200 m such units are integrated, smoothed and not resolved. The dispersed, gross response becomes significant instead.

The upper profile set (line 2260, Fig 4-E-7) illustrates the possible resolution of the components of the Bischoff anomaly. The observed data (1) and the fixed level (800m) corrected data (2) differ little east of the Bischoff spike. This illustrates the minimal differences between 800 m and the actual elevation of the aircraft. The correction is significant near Mt. Bischoff and the anomaly peak is reduced by 30%. Similar differences can be observed for continuations 200 m higher. The continuations, taken as either relevant pair (obs data -1 vs UC 2260 -4 or fixed level corrected FHT2260 -2 vs UC2260H -3) allow assessment of what has been observed and what might be observed if the source were 200 m deeper. Either pair shows that the base anomaly and the spike would be clearly recognisable if set against a relatively quiet background field.

The remainder of the profile shows how the effect of 200 to 250 m of basalt cap is modified by continuation. However, the continued Bischoff anomaly must be contrasted with the observed data to assess identification beneath a comparable cap. It is obvious that the spike component could not be uniquely identified but the basal anomaly would be noted if not necessarily appreciated. It would be recognised as a sub-basalt effect but would require a compound analysis including another method (e.g. gravity) to appraise the surrounding material and indicate if the feature was anomalous. Of course if such broad anomalies were inferred over, say, Precambrian materials (E) rather than (D) as on this line then the appraisal might be positive. The anomaly near the contact between blocks (A) and (E) appears to lie within (E) making it of more interest from a Sn viewpoint. The entire approach implied by these responses in this terrain must be careful and quantitative in order to separate feasible sources.

Analysis of all lines available within this region and complete treatment of the implications of the anomaly noted on line 2280 is beyond the scope to this study. It is recommended that all data, whether from the 1981 survey or surveys by others, be reviewed prior to drilling of this feature.

Additional gravity coverage both as infill of the extant survey and around Mt. Bischoff would confirm the lineament implications and refine the location of these features near the anomalous areas. Full benefit of the power and coverage of the gravity method does require more complete interpretation.

This study indicates that magnetic data may do much to help unravel problems faced by exploration in basaltic terrains and that considerable information can be extracted from average quality surveys. The level of preparatory treatment and processing required depends largely on the terrain.

Only a relatively small proportion of the basalt-covered regions of NW Tasmania was covered by this survey and the sample interpreted here represents only about a third of the area surveyed. The prospect of a thinner cap or more prospective basement elsewhere cannot be excluded by the disappointing indications of this sample which treats an area lacking in any "Palaeozoic islands". It may be atypical. The data are, however, adequate and a potentially viable analytic treatment has been offered.

It may be remarked that use of any method in isolation is risky practice - especially where the sources are concealed and the anomalies complicated by overburden issues. The discussion should be tempered with this understanding since further drilling or other method control is advised before this prototypical treatment can be properly appraised and used to link control points. It is clear, however, that general guidance can be offered in the absence of such control.

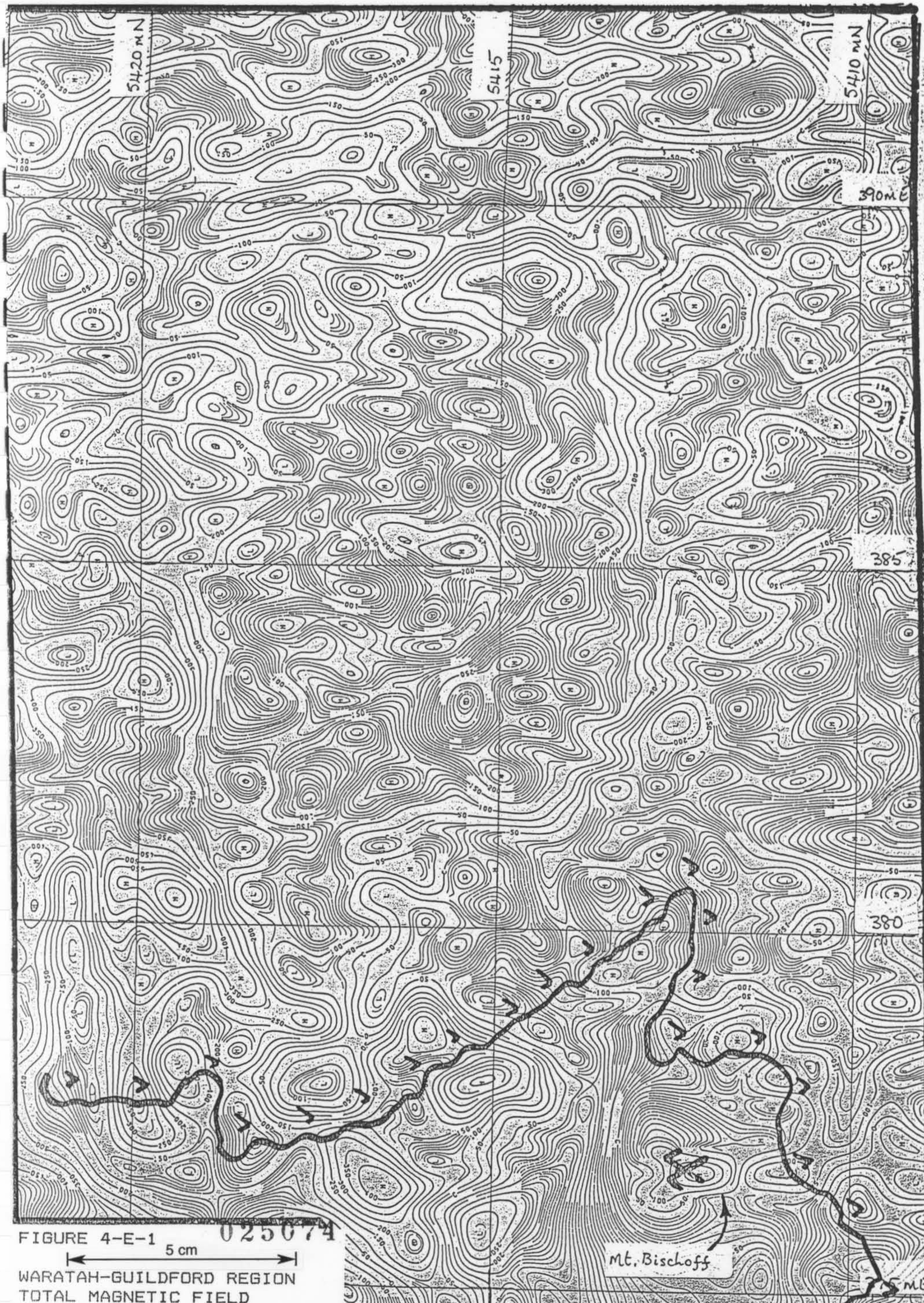

FIGURE 4-E-1 025074

WARATAH-GUILDFORD REGION
TOTAL MAGNETIC FIELD
Mines Department Survey 1981

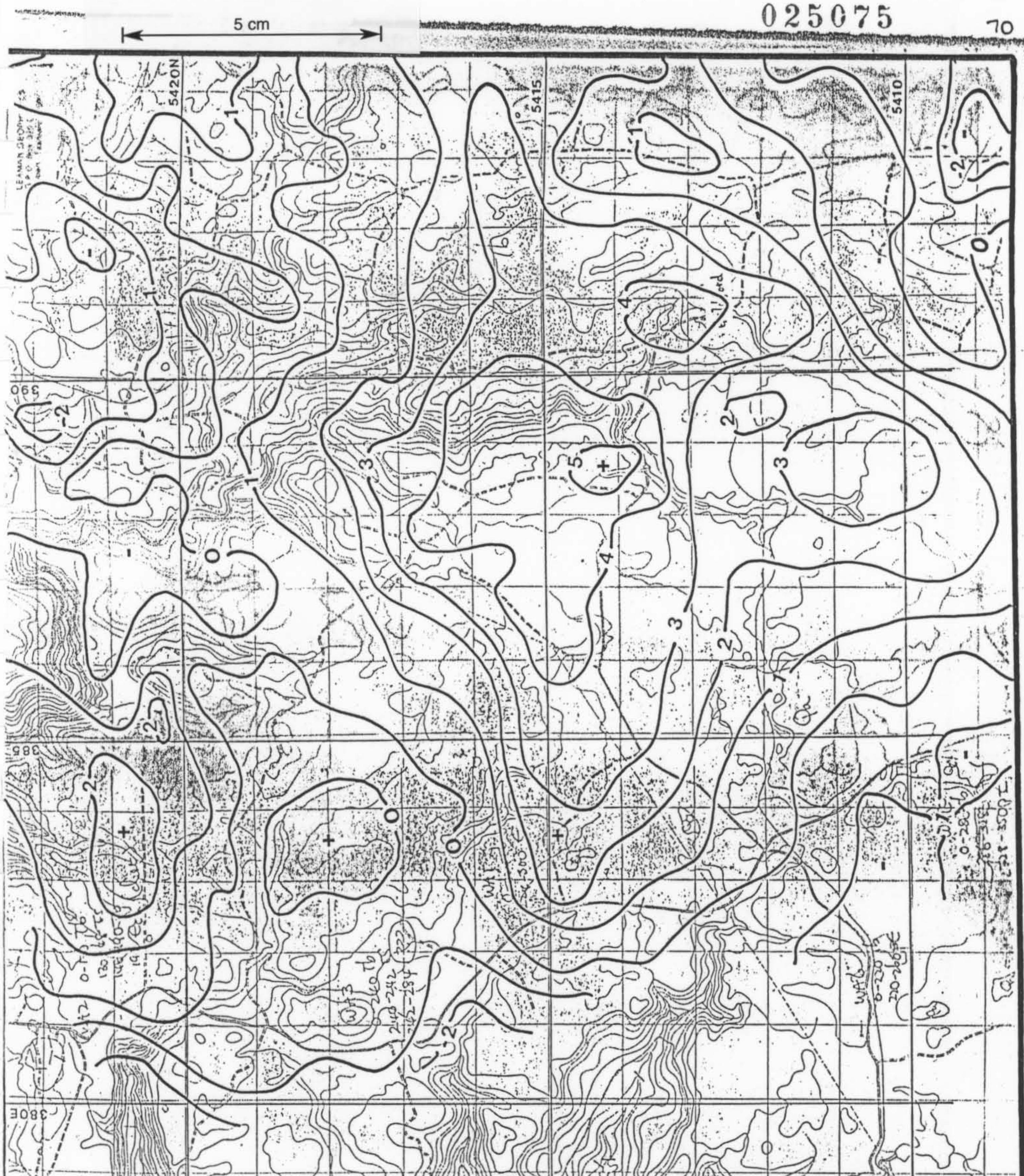

FIGURE 4-E-2

data:TASGRAV

WARATAH-GUILDFORD REGION

RESIDUAL BOUGUER ANOMALY

density 2.67 t/m^3

Residual separation by Leaman Geophysics

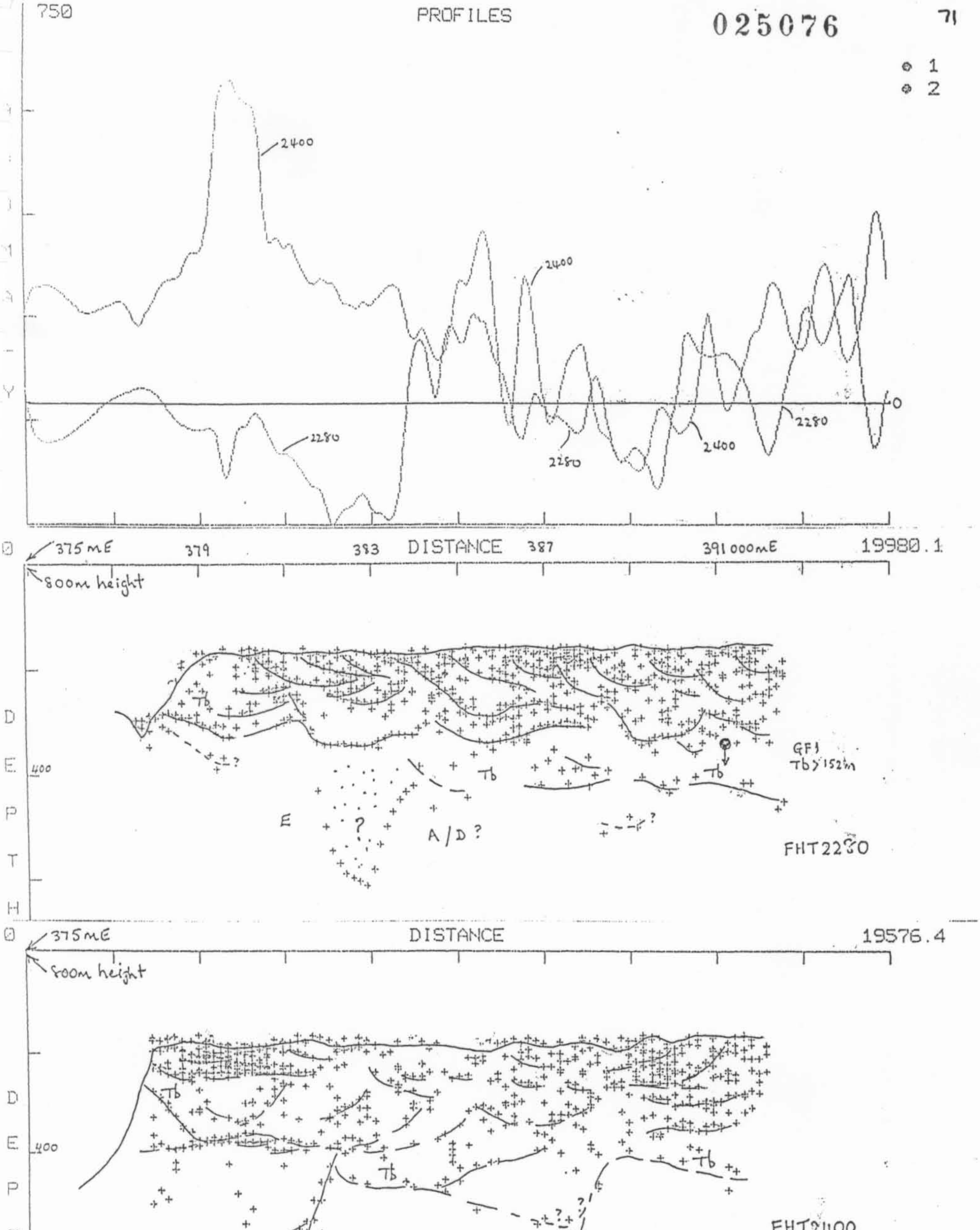

FIGURE 4-E-3

WARATAH-GUILDFORD REGION
MAGNETIC PROFILES AND INTERPRETATION

LINES 2280, 2400

5 cm

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5 cm

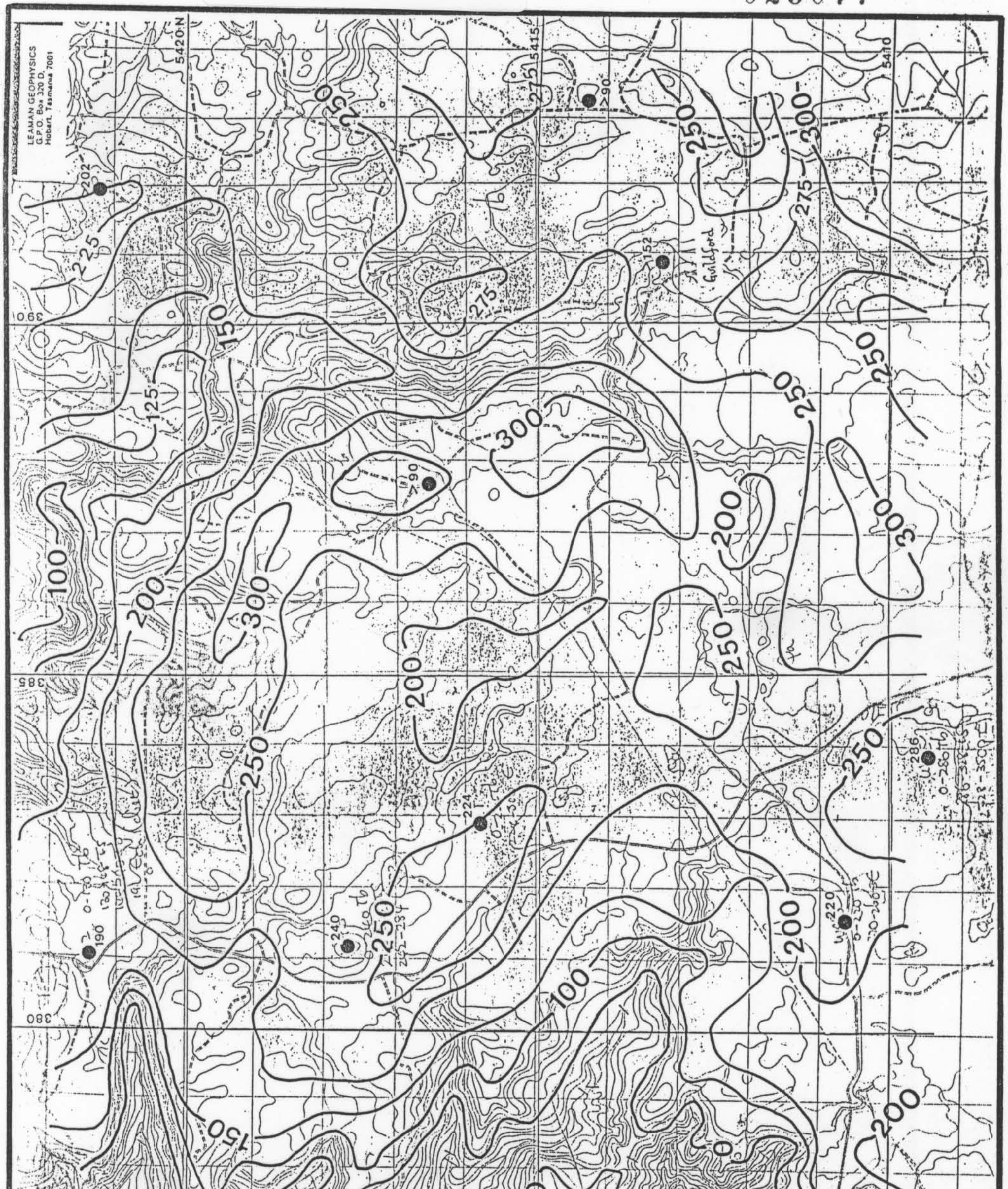

FIGURE 4-E-4 WARATAH-GUILDFORD REGION
INTERPRETATION: CONTOURS OF BASALT THICKNESS

025078

5 cm

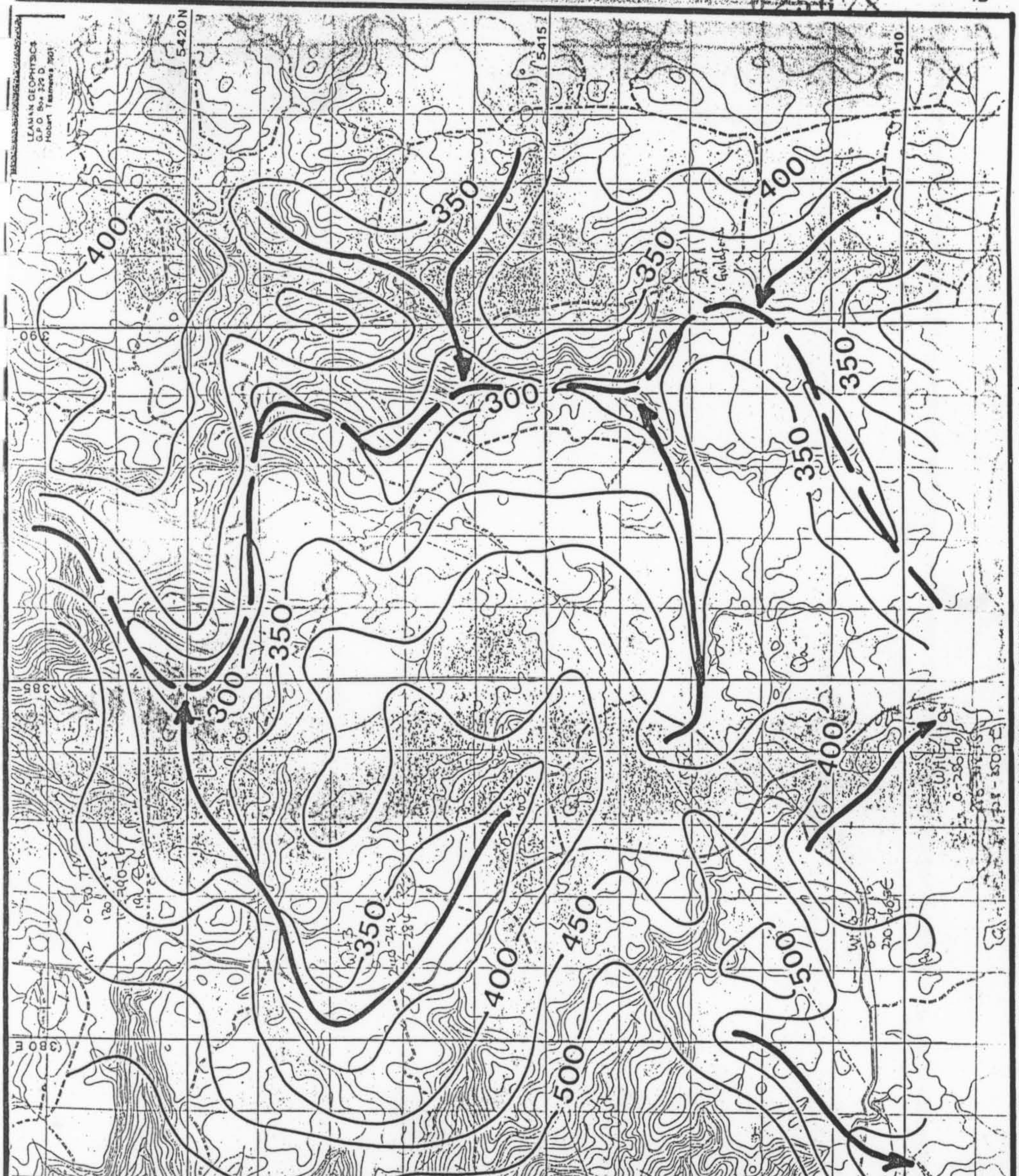

FIGURE 4-E-5 WARATAH-GUILDFORD REGION
INTERPRETATION: SUB-BASALT TOPOGRAPHY contours ASL

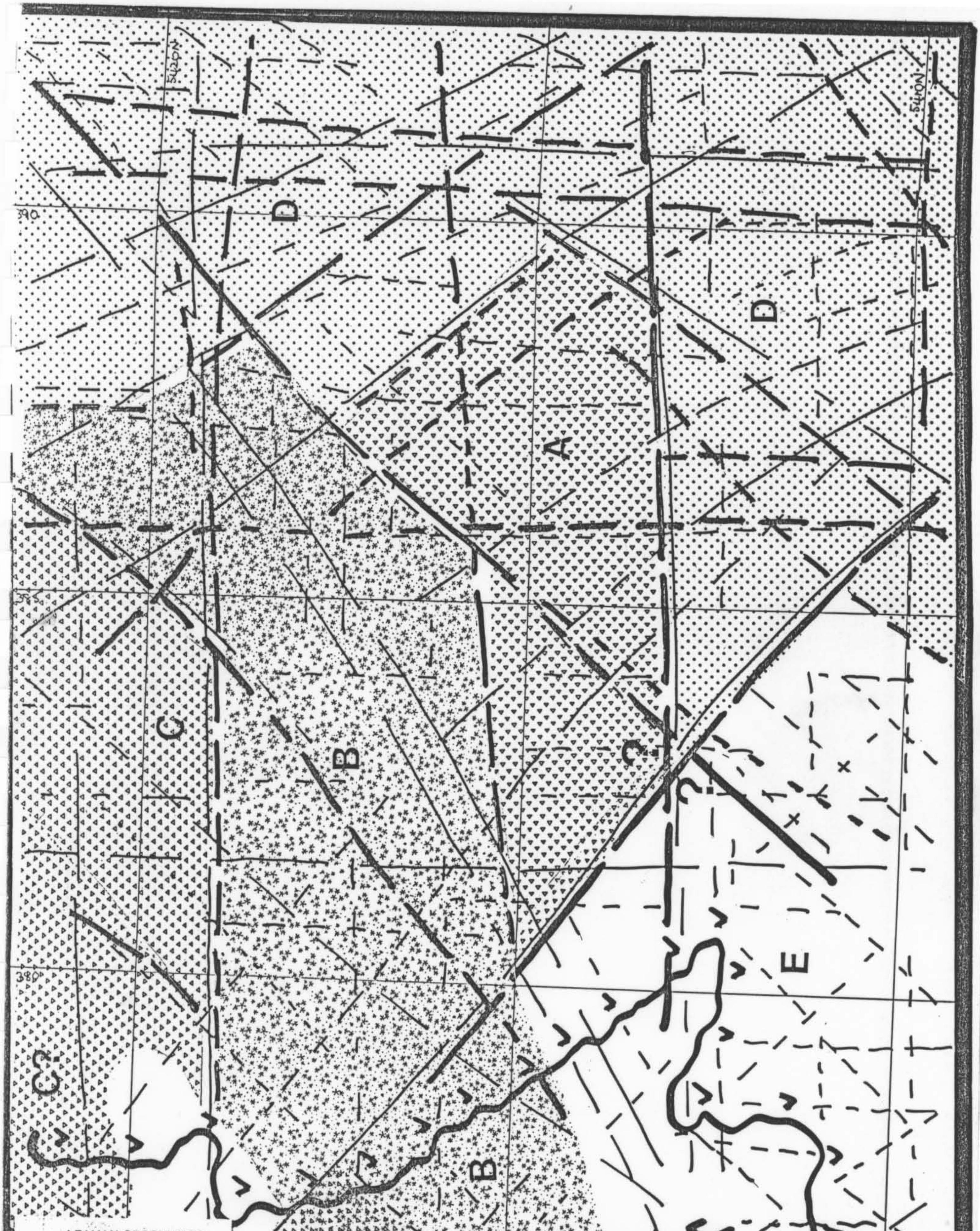

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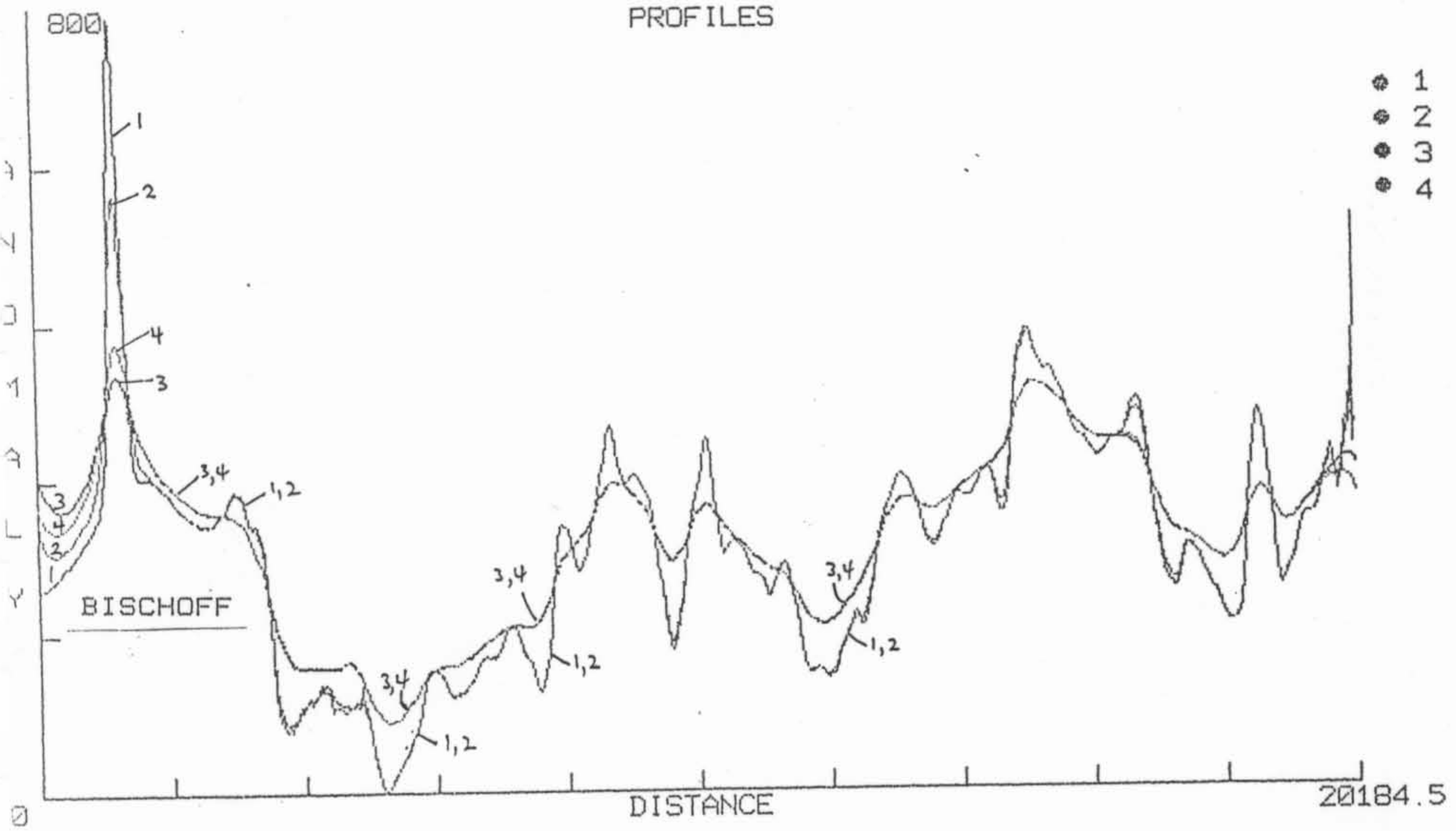
FIGURE 4-E-6
WARATAH-GUILDFORD REGION
INTERPRETATION:
LINEAMENTS AND INFERRED
GEOLOGY

025079

1 B:M2260WAR W TAS 1981 MAGNETICS LINE 2260 OBSERVED DATA
2 B:FHT2260 CONTINUATION TO 800M W TAS 1981 MAGNETICS LINE 2260
3 B:UC2260H
PWARD CONTINUATION 200M OF 800M LEVEL DATA W TAS MAGNETICS LINE 2260
4 B:UC2260
PWARD CONTINUATION BY 200M W TAS MAGNETICS LINE 2260 OBS
ERO SHIFT : 257

5 cm



1 B:FHT2280 CONTINUATION AT 800M W TAS MAGNETICS LINE 2280
2 B:FHT2300 CONTINUATION TO 800M W TAS MAGNETICS LINE 2300
3 B:FHT2400 CONTINUATION AT 800M W TAS MAGNETICS LINE 2400
ZERO SHIFT : 177.4965

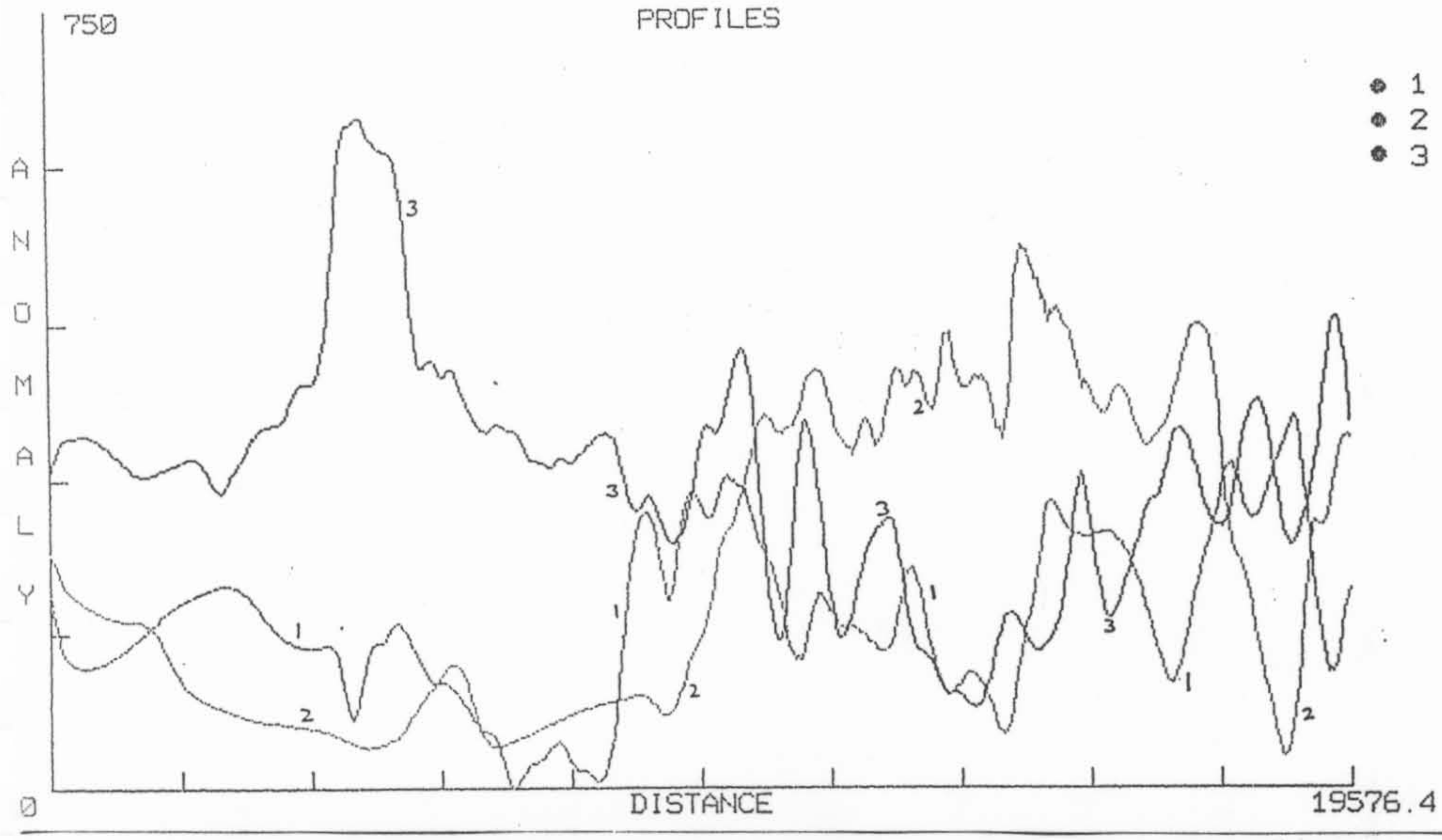


FIGURE 4-E-7 WARATAH-GUILDFORD REGION MAGNETIC PROFILES

025081

4-F: STRUCTURE

Introduction

The time allocated for this report, and the objectives of the project have limited structural analysis to the principal Cambrian volcanic sequences. Simple quantitative methods have been used and only general conclusions are offered since off-profile sources have not been adequately compensated. There remains considerable scope for productive whole geology structural analysis using three dimensional methods. These are beyond the scope of any part of this study but were briefly described in Section 4-C.

Structures or unit associations have been reviewed on a representative basis. Several lines have been examined across segments of the Mt. Read Volcanics. I have sought to assess relationships between parts of the sequence, the effective contrasts and any issues which may have modified the form of the anomaly. Since the aim was to review gross concepts unit effects, and doubtless properties, have been integrated and the results are somewhat stylised but geologically recognisable. More geological detail could be resolved but such analysis was beyond the scope of this review.

The modelling approach used throughout considers both isolated sources and whole unit sources. This recognises the reality of the Cambrian succession where magnetic members are often dispersed leading to a situation where large blocks of material possess a slight but apparently uniform contrast above background. Only where strong sources have significant volumes or occur at shallow depths are isolated anomalies clearly identified.

Many modern procedures aim to resolve top depth, perhaps width and contrast, and occasionally dip and thickness. These treat obvious anomalies but ignore the regional significance of background forms and anomaly tails. The latter may extend many kilometres from the "anomaly" and interact to produce the observed result. Their importance is evident in Figure 4-C-4 and when such low amplitude effects are coupled (as is usual) the result may exceed 100 nT. The relativities associated with such background effects has little effect on "spike" treatments of isolated anomalies but are important to regional block combinations. They also indicate viable or faulty solutions overall according to some of the interpretation criteria listed in Section 4-C.

All solutions offered in this report, even the crudest models, were derived within these limitations. Thus the difference between observed and calculated data shifts is rarely more than 30 nT which ensures that an adequate level of depth range and consistency have been employed for the Mt. Read Volcanics and other suites. Many of the profiles modelled are a subset of the observed (or processed) data. This was done to accelerate interpretation and remove fine detail inappropriate in regional analysis.

The lineament study, although largely qualitative, was developed after processing data from the Lyell, Rosebery-Renison and Waratah-Guildford regions. Correction of magnetic data for sundry observational and terrain effects has emphasized some suspected features and exposed others. This work has unified signature studies (section 4-G).

i) South of Macquarie Harbour

Lines 40, 120 and 270 at nominal northings of 5300200, 5304400 and 5312000 mN were selected for a reasonable two dimensional treatment of anomalies 4, 8, 8A, 9, 11, 11A and part of 22 (refer Figure 3-3) and assessment of the effect of Tertiary and Ordovician cover on Cambrian sources. The observed profiles are plotted in Figure 4-F-1 with an origin at 360 mE. There are several common features. Anomalies 6, 7 and 11 are trivial, 4 is minor and only 8 and 9 are significant. The compound nature of 8 is evident. All lines reveal a pervasive but gentle gradient to the east but it is not of sufficient magnitude to require compensation at this level of analysis.

Figure 4-F-2 illustrates most of the issues for line 270. The divergence of the observed and calculated profiles to the east represents the regional gradient. The form of the anomaly is not greatly affected by it. The table below indicates probable source conditions and the basic specifications for the model for the calculated profile in Figure 4-F-2.

TABLE 1:

Anomaly	Line	Width(m)	Top depth(m)	Contrast(cgs)	Remanence?
4	270	700	50-100	0.0005	no
8	40	300	20	to 0.013	no
	40	600	10-20	0.008	no
	120	400	130	0.017	no?
	270	850	150	0.004+	no
8A	40	1000	60-75	0.002+	yes
	120	3000	110	0.0015	no
	120	2300	60-150	0.004	yes
	270	5200	400-500	0.003	no
	270	5400	ca 750	0.001	yes
9	40	1250	200	0.004	no
11	270	1000	1500	0.001	no
11A	120	1600	1000	0.001	no

General contrasts are low indicating that the source minerals are dispersed or that only a few percent by volume of the unit is magnetic. A value of 0.001 to 0.0015 cgs probably represents the normal bulk equivalent susceptibility for the Cambrian units in this region. Higher values (0.004) represent a substantial content of basic volcanics. Values in excess of 0.005 indicate ultramafics.

Deductions for anomaly 8 show an increased source depth with northing. This reflects burial by water and sediment in the southern part of Macquarie Harbour but the depths do not indicate that the Tertiary basin extends as far south as line 270. Source depths for 11 and 11A, however, reflect Tertiary and Ordovician plus Tertiary cover respectively. Note that all estimates are uncontrolled thickness, contrast or depth products and all three cannot be unambiguously resolved. The likely ranges are indicated.

Anomalies 8 and 9 are not simply modelled. Any use of standard rules of thumb would be misleading and are not advised. Several sources are involved and the table does not convey these easily. The anomaly peak is related to a relatively thin ultramafic core but the anomalous zone is more than 5 km thick. The effect of the ultramafics appears almost entirely inductive but this is unlikely to be true in detail. Some other materials, however, possess significant remanent properties. The resultant contrast has an orientation close to the existing field; comparable dip and declination between 345 and 30 degrees. It varies across the unit. The secondary sources generate the shoulder anomaly on the east side of the peak and the remanent contribution leads to the symmetrical form of the anomaly with the absence of a western low trough. This is important. The apparent observed anomaly is free of this effect in all cases; purely inductive effects from a N-S source and E-W observations at this latitude should generate a depression of more than 200 nT. This shows that the sign of the remanence opposes the present field and is slightly offset from it. The intensity of magnetisation is about 0.0015 Gauss. The implied Koenigsberger ratio is 1 to 2.5. An example of the calculation is given below.

In a field of 60000 nT(gammas) a susceptibility of 0.001 (cgs) and magnetisation (J) of 0.0015 Gauss leads to a K. ratio (Q) of
Q=J/kF where F is the field in Oersted.
= 0.0015 / 0.001 x 60000/100000 = 2.5
If k=0.003 then Q=0.83

Although I prefer to use the older cgs units because of their simplicity and relevance to magnetism I have provided the equivalent SI calculation.
k=0.001 cgs = 4 pi x 0.001 = 0.0126 SI
J=0.0015 G = 1000 x 0.0015 = 1.5 A/m
F=60000 x 10^{-9} / 4 pi x 10^{-7} = 47.7 A/m
Q= 1.5 /0.0126 x 47.7 = 2.5

Note, that if the remanent field is oriented close to the inducing field, then the resultant local field will be
60000/100000 Oe x 0.001 + 0.0015 = 0.0021 Gauss
and the equivalent bulk susceptibility is
0.0021 / 60000/100000 = 0.0035 cgs
Where orientations oppose the result may be reduced to -0.0009 cgs. In such cases the field response is usually patchy and the contrast variable above this minimum value. A highly disturbed field is observed.

Dips are not reliably recovered from these profiles. However, all units are subvertical. The combination of sources for anomaly 8 are disposed to suggest a steep (70 - 85 deg) dip to the west. This is consistent with the mapped dips in the vicinity of the contacts. The folding is virtually isoclinal. Other anomalies imply structural complications including gross thrusting (see 4-F-ii below).

ii) Mt. Lyell to Mt. Darwin

Only two lines have been examined (435 and 550 at approximate northings of 5320250 and 5326500 mN).

Line 435 samples the low amplitude extension of anomaly 8 (Figure 3-3), the faulted western side of the West Coast Range and the main anomaly (22). Analysis suggests that the ultramafic content of 8 is minimal north of Macquarie Harbour. The general contrasts are of the order of 0.001 to 0.002 cgs which are typical of the volcanic sequences as a whole. Modelling indicates a Tertiary cover of some 350 to 600 m, deepening southwestward from the mapped Tertiary/Cambrian boundary. Anomalies and source distribution in the range are more complex. Two units are strongly magnetised (0.0025, up to 0.005 cgs) to generate 22A and 22 respectively but are relatively thin and no more than 800 m thick. The main body of the volcanics is less magnetic (approx 0.002 cgs) but is more magnetic overall than any parts of the section to the west or southwest. This may reflect the granitic content of this part of the range since the equivalent granites elsewhere may contribute 0.0017 to 0.002 to the total contrast. A small anomaly of type 10 (within the Precambrian Tyennan Block) has also been sampled. Such anomalies can be explained by low contrast (0.0005 cgs) near surface variations less than a kilometre wide or thick. Simple, lithologic changes are implied.

Line 550 samples anomalies 1, 12, 12A, 13, 22 and 22A and an array of gross structures. Several structural elements can be recognised in the rather crude 2D interpretation provided (Figure 4-F-3). The solution shown is reasonable given the non fulfillment of 2D assumptions west of Teepookana (22000 m). Due to the angular relationship between structural strike and line orientation no review of the Tertiary basin is given. Similarly the precise relationship between the Precambrian rocks south of the Harbour and the Cambrian north of it is not resolved. The grossly dipping surface on the Cambrian blocks south west of Pine Cove approximates the Tertiary basin and an average 600 to 800 m of Tertiary cover is implied. This crude modelling indicates that the Cambrian (predominantly sedimentary?) block extends toward Cape Sorell and may indicate that the Precambrian blocks have been thrusted. Other features are less affected by line orientation.

Anomaly 1 may be due to localised lithological variation with a contrast of 0.0005 cgs but a substantial depth extent is also implied. It is possible that the small anomalies observed in the Cape Sorell - Table Head Precambrian block reflect underlying Cambrian materials and are consistent with a thrust hypothesis.

Anomaly 13 is more complex. Anomalies in this region reflect diminished Tertiary cover at the edge of the basin and the materials in an anticlinal core. Some ultramafics may be present but the core properties are consistent with normal volcanic sequences (basalts are exposed). The model offers crude shapes for this material and any mafic heart since the line direction does not yield true anomaly forms. Note that a thin folded unit with limbs extending to depth might yield the same effect as the core mafic slab shown. Most importantly, the model suggests some age relationships for the sequence here by placing the bulk of the relatively non magnetic sedimentary (?) sequence above a major volcanic or magnetic unit.

Eastward from Teepookana the model reflects the major Lower Palaeozoic syncline with its faulted western edge. The eastern edge is very complex and no real attempt has been made at this scale to define the lesser structures. Some raised blocks are indicated on the eastern limb of the fold.

The pattern across the range (22) is consistent with other lines and regional studies. The model offers little structural reality and the core block may represent granite or Tyndall Group - probably the latter. The main range block carries normal volcanic contrasts and appears to dip east, as in the Lyell region (see discussion page 46, and next section).

The interpretation shown in Figure 4-F-3 is based directly on the observed data and has not been corrected for terrain effects. These are considered minor west of anomaly 22-22A.

Structures in the Lyell Region (at least east of 375 mE) were described in Section 4-C (Figures 4-C-6, 7, 8). The more detailed analysis provides a clearer, but still coarse, division of the main volcanic axis east of 381 mE as shown in the simpler treatment of Figure 4-F-3 (line 550). The higher contrast fragment (0.0035 cgs) then correlates directly with the folded Tyndall Group and/or units within or immediately beneath it although limitations in detail may have led to an unrealistically high contrast. The eastern limb of the syncline containing Lower Palaeozoic rocks is also reproduced in Figures 4-C-6, 7, 8.

I believe the key aspect of the model, though crude, lies in the implication of a second volcanic pile axis west of Teepookana. The Cambrian section, though unassigned, as shown by Corbett (1984) is wholly consistent with the model. A large volume of volcano-sedimentary sequence is implied. This sequence, as shown above (incl Section 4-F-i), continues south of Macquarie Harbour.

iii) Mt Lyell to Mt Murchison

Only three lines have been examined between the Lyell study area (Section 4-C) and the Rosebery-Renison study area (Section 4-D). These are 1030, 1260 and 1280 at nominal northings of 5350250, 5362000 and 5363000 mN.

The interpretation for line 1030 is shown in Figure 4-F-4. As in other sections the base of the model is not well resolved nor critical. West of the South Henty Fault the Cambrian section is presumed to consist of Dundas Group but the relatively high bulk contrast for these units indicates a significant igneous content within a thick sequence. This sequence is disrupted by the extension of the Firewood Siding Fault and Tabberabberan folding. A comparable solution could be generated with a lower contrast for much of the section. The broad swell in the observed field west of the Henty Fault does, however, suggest a non zero contrast. Most importantly, as in other sections, the nature and relief of the easternmost Cambrian block incorporating the eastern volcanic sequence sets a minimum bulk response. This has then been used throughout the section and is presumed satisfactory without independent control.

The Jurassic dolerite exposed near the coast north of the Henty River is a thin sheet with a feeder dyke near the western side of the exposure (anomaly 16). The basic rocks immediately west of the South Henty Fault near the Zeehan Highway produce the sizeable anomaly 30. The Great Lyell Fault with its offset of the Ordovician rocks is evident. The nature of this step provides some semi-independent support for the bulk contrast assumed.

The main anomaly correlates with the partial exposure of the Tyndall Group. The western limit of the group is covered by Ordovician rocks and the anomaly suggests a fold limb thickness of 1500 m. The model simplifies the undoubdtedly complex structures east of Lake Margaret but the thickness-product is indicative only. There is no shallow synclinal fold returning the material toward the surface at depths less than 4 km.

An interpretation for lines 1260, 1280 is given in Figures 4-F-5, 6, 7. The two lines are not continuous but overlap near Moores Pimple (371 mE) with an offset of 1 km to the north. The model uses a subset of the observed data corrected to an elevation of 1000 m. The solution offered is not unique although there are substantial limitations on any variants, and is simplified and regional. Many relevant details have not been explained or included but analysis of most of these is beyond the simple 2D treatment employed. 2.5D methods are also not generally appropriate since many influences of limited strike length are off section. 3D methods must be used by most detailed treatments. Property estimates made here probably understate the contrasts.

East of the Henty Fault the interpretation is consistent with previous sections and easily supported by available mapping although most magnetic units are shielded by Ordovician rocks. Figures 4-F-6, 7 contrast the attitude of the Tyennan Block boundary. This exposes the clear conflict between magnetic implication and mapping discussed above and in Sections 4-C, D. Magnetic data, simply treated on face value, imply an overall easterly dip however it is arranged across the upper 5 or 6 km of the crust. The result may yet prove to be illusory if other evidence, including remanence properties or gravity data, are definitive. Between the Despatch Fault (and associates) at Zeehan and the Henty Fault the section, although containing several minor folds, generally dips west. Minimum dips are shown for all but the near section ultramafics near 378 mE and the Precambrian block north of Mt. Dundas. Some structural rearrangements are feasible given the inferred contrasts but there are limits. The major division occurs across the fault between Dundas Group and the volcano-sedimentary sequence. Sheet-like ultramafic bodies are included in the former. The model attempts to show the faulted Precambrian inlier at Dundas. A small volume is shown but the bulk of the block beneath (marked volcanics in Figure 4-F-7) could be partly or wholly composed of equivalent material including a faulted, thrusted slab (e.g. Fig 4-F-6). If this is so then Oonah correlates could extend as far east as the Henty Fault. Note that Oonah correlates are magnetic; the Tyennan Precambrian is not. The sequences west or east of the Henty Fault may reflect the form and style of basement development. Evaluation of the content of the section at moderate depths is not certain with the simple methods used due to limited contrasts and no allowance for 3D effects. The thrust proposal suggested is consistently feasible to as far north as line 1890 (Que River, see below).

West of Zeehan the section proved difficult to interpret in 2D terms since the source distribution is clearly three dimensional and not well sampled by line 1260. At least four sources can be recognised, however. These can be associated with the Oonah Formation, volcanics within the Oonah, Cambrian gabbros near the Heemskirk Granite and Crimson Creek Formation. There are also suggestions that the margin of, or discrete parts within, the Heemskirk Granite, are also slightly magnetic but evaluation of these is beyond the scope of this study.

Three Figures (4-F-5, 6, 7) have been included for interpretation along lines 1260/80 since they illustrate many of the issues commented elsewhere in the report. Consider Figure 4-F-5. This diagram shows a 2D solution for the anomalies west of Zeehan. The match is not perfect but all characteristics required are evident at the amplitude required and the fit lies within the 30 nT obs/calc window. However, when this solution is assembled with a reasonable interpretation east of Zeehan (Figure 4-F-6) the curve match is destroyed. This illustrates the effect of lateral spread of effect; an effect which also occurs for off-section bodies and which can only be evaluated three dimensionally. Figure 4-F-7 offers an alternative solution. It demonstrates the relative insensitivity of the interpretation to changes in the shape of the main volcanic pile bodies and the enforced contrast estimate changes required west of Zeehan. The fit west of Zeehan remains inadequate but the implied contrast for a 2D fit with an attempt to incorporate ALL THE GEOLOGY in the section requires changes of 100%, 30% and >70% for Oonah, Crimson Creek and gabbros respectively. The factor is not a constant. The issues raised in this demonstration are as fundamental as those described in Section 4-C. Unless the anomaly and the causative geology is physically isolated or elongate then some aspect of the interpretation must be deficient when using simple methods. In this case it is a combination of source shape AND contrast.

Within the limitations of the interpretation the concepts presented are consistent with extant mapping with no special pleading for any structure or lithology. The shape of the Heemskirk Granite is perhaps the most significant feature of the section. Proper evaluation of this part of the section west of Zeehan requires some check property studies and 3D treatment but there is no doubt that the contact dips eastward with an angular shelf extending virtually to Zeehan. Cupolas are probable on this surface. Mineralisation is clearly related to the shape of this margin and its juxtaposition with various lithologies.

iv) Mt. Murchison to Mt. Pearse

Two lines have been reviewed; 1621 (5380000 mN) across the Huskisson Syncline, and 1890 (5393500 mN) across the Meredith Granite and Arthur Lineament. Line 1621 ends near Mt. Farrell and passes close to Chester while line 1890 passes over the Que River deposit.

Line 1621 was not corrected for terrain influences. Relief is generally low and clearances were fairly consistent. This interpretation is more restricted but may be compared with other models. The line did not extend to the Tyennan Block in the east and base reference values cannot be obtained from the model. The profile is dominated by the Crimson Creek Formation and ultramafic units within the Huskisson Syncline (Figure 4-F-8). The model offers few surprises. The smoothly varying field west of 358 mE is largely due to the ultramafics within the syncline with a local aberration (45A/B) generated by Crimson Creek members. The form of the field, however, indicates that the Precambrian units are all slightly magnetic. It is possible, with a crude regional model of this type. that the contrasts have all been elevated by about 0.0005 cgs although similar rock types to the south do induce magnetisations of this order (refer Section 4-F-iii).

Modelling of the syncline is non unique but the contrasts suggested are probably maxima. The relief of the syncline is not magnetically critical. There is no suggestion of abnormal structuring and the ultramafics are essentially concordant. The anomaly at 345 mE (55S) is related to amphibolites as mapped. A steep easterly dip is implied but terrain effects may have biassed this conclusion. The dips ascribed to the Precambrian rocks and the Arthur Lineament have not been critically evaluated.

Cambrian rocks east of the syncline provide a contrast with all units to the west. The anomaly is stepped bout 100 nT above background levels and reflects the large volume of unaltered volcanics. The structure cannot be simple, nor as implied by surface mapping. Anomaly characteristics, consistent with line 1890 (below) indicate that the western sequence is multiply overthrust.

Modelling of line 1890 provided some of the most challenging structural suggestions; many not in keeping with available mapping. The regional interpretation is shown in Figure 4-F-9. The solution is based on a data subset corrected to an elevation of 800 m. Modelling shows that terrain effects are important and parts of several anomalies are terrain induced. The form of the eastern side of 55C north, 48, 42 and 41 are all influenced by ravine or pinnacle shapes. An acceptable 30 nT obs/calc shift has been obtained and it is clearly satisfactory in the region of the Arthur Lineament and the Meredith Granite. Units west of the Lineament appear to be negatively magnetised but this is probably an illusion induced by granite forms to east and west. Rocks within the western Precambrian block present tabular source shapes and two of the most intense have been shown in the model. Some lesser anomalies are visible west of 55B/C.

The more important and difficult anomalies lie east of the Meredith Granite. The field is considerably elevated when compared with the Precambrian region. The rising gradient toward the peak at 48 reflects the three dimensional form of the granite contacts and the truncation of the Huskisson Syncline with its embedded Cambrian elements. The significant structural issues are raised by the anomalies to the east of 48 which are directly related to the Crimson Creek Formation. The profile does not extend to the Tyennan Block and check controls on the structure are not available.

The mapping of Corbett (1984) suggests that all units west of the Murchison Highway near Que River dip west with the exception of a narrow zone near the exposure of a fault block of Oonah Formation near the confluence of the Que and Hatfield Rivers. East of the Que River Mine the rocks appear to dip east. Thus the bulk of the section east of the Oonah fault block dips steeply west. The critical anomaly is (42). Correlation of Figure 3-3 and the mapping of Corbett (1984) suggests that it is caused by the exposed porphyries. This is an illusion soon dispelled by modelling. The high frequency character so evident in contour maps is related to crestal spikes on a much broader feature. These reflect porphyry and topography. The bulk of the anomaly, however, cannot be accounted for by any contrast combination of any exposed or nearly exposed units. The suite of rocks in the fold axis has a moderate contrast as shown by the lesser anomalies and terrain responses.

An array of source distributions were evaluated which might generate the body of anomaly 42. There are real limitations. The source must lie no shallower than 3 km at 381 mE and extend no further east than 385 mE at 5 km. It must be of moderately high contrast and by correlation of contrasts either Crimson Creek Formation or ultramafics or both; i.e., materials of the deep Huskisson Syncline. Figure 4-F-9 suggests the location of the source. The Figure indicates a possible structural relationship. Several key issues must be reviewed. The high contrast Cambrian units do not extend to the east and there is a fault-bounded Precambrian block exposed east of the Meredith Granite. The properties defined allow various interpretations. A simple faulted syncline(367) - anticline(374) - syncline(382) - anticline(393 mE) is possible but this generates problems for deep sources. Insertion of the Precambrian is also a problem irrespective of the volume actually present. This is not magnetically definitive. I prefer a thrust solution as implied in the Figure. If correct there are ramifications as far south as Dundas since it is then possible that fragments of similar structures are represented on Mt. Dundas. The Rosebery sequence would also be affected.

A detailed analysis of line 1890 in the immediate vicinity of the QUE RIVER deposit is shown in Figure 4-F-10. While the work is limited by the rather coarse sampling of this survey several features are visible and enhanced by processing. The main anomaly at the eastern end of the line is visible in the regional model as the small spike near 395 mE. This is due to lithological changes near the crest of the local anticline. The profile presented in the Figure is corrected to a drape at 200 m. It shows some small anomalies about an order of magnitude above the resolution of the survey above the deposit. Derivative processing enhances these subtle features and provides clear crossover effects. Some of the character is evident in the raw observations but irregular terrain clearances make judgments difficult. The anomalies are very subtle but the minima correspond generally with the locations of the two main ore lenses.

These effects are so small that they could be assigned to the interference of site developments. However, review of the only detailed data available to me acquired prior to development of the site shows the same fine character and irregular terrain clearance. This data was published by Webster and Skey (1979). Because of the larger electromagnetic responses from the site they discarded their magnetic data and state on page 712 of their paper that "magnetic data, however, proved to be of no value in this environment, due to the lack of magnetic minerals in the ore and related rock units, and the results are not included in this paper". I believe this to be based on a response presumption and no correction. There is no doubt that the EM effect is larger, but the regional significance of the delicate magnetic response should not pass unrecorded. For example, I would predict that even if the ore or its hosts were not especially magnetic at least the host rock suite is slightly magnetic in bulk and that alteration would act to modify these properties. The effect might be slight and, in this case, measurable. Two other comments may be made. The effects are not consistent with interference from surface objects and they are comparable with those noted for Hercules (Section 4-D). Subtle anomalies of this type may be valuable indicators within the main volcanic sequences but future surveys will need higher resolution and sampling rates. Recognition, or deductive use, of such features could only be appraised by careful study and correlation with some other indicator.

v) Lineament study

Some magnetic lineaments have been described in preceding sections where these have been revealed by observation or processing. Several were not particularly obvious in raw data presentations due to various distracting elements.

A generally qualitative assessment has been extended to the survey area and presented in Figure 4-G-1 (folder). I have tried to emphasize those features which are not evident or well defined in current geological mapping. This is not always presented successfully; e.g., the NE-SW feature through Rosebery has some obvious geological control locally as have many other features with this orientation - compare Figures 4-F-12, 13. The presentation is inevitably subjective and, given the comments of Sections 4-C, D, probably inaccurate. Exact location of trend corridors, or even identification of many features, depends on analytic processing. Many of the features indicated were suggested by the transformations noted in the Lyell and Rosebery Regions.

A relationship between mineralised sites and inferred lineaments is suggested in Figures 4-F-11, 12 and 13. The sites were collated from maps of Blissett (1962) and Corbett (1984). Not all sites may be marked on these sources but the sampling is adequate for this assessment of the Mt. Read Volcanics. Variation in symbols reflect major producers, minor producers or prospects.

Sites in the Rosebery-Dundas Region are shown in Figure 4-F-11. The distribution appears random until overlain on Figure 4-D-12 - see Figure 4-F-12. This overlay was suggested by Dr. J. Hudspeth after reviewing a preliminary version of Section 4-D. The trends were interpreted quite independently of any prospect map. Although there is some slight scatter the correlation with interpreted features is excellent. The NW-SE features account for many sites and others lie adjacent to the E-W corridors or structures within the reliability of the regional data and this study. Very few are related to obvious geological influences and on this hypothesis would be predicted to be minor sites. This is a complex area affected by Devonian structures, at least, and many granite-related deposits. I believe that most sites displaced from the corridors reflect this influence although the fundamental texture ultimately controls deposition. This thesis would suggest that any large deposits of volcanogenic origin would be located in/near the E-W corridors east of Rosebery, east of Hercules (incl beneath the Ordovician cover) or, given the apparent absence of acceptable hosts in these areas, in the zone up to 4 km west of Hercules. Devonian mineralisation would be associated with irregularities and cross texture in the area of concealed granite east of Renison (see also Section 4-D).

A more regional view of mineralised sites has been overlaid on a portion of Figure 4-G-1 and shown in Figure 4-F-13. Allowing for limitations in trend picks and presentation correlations are impressive - especially for sites not related to granite. Line weighting reflects apparent continuity and the limited quantitative studies undertaken. On the trend relations evident some other sites may be considered prospective, particularly where minor mineralisation is already established nearby. Some examples are:

1. Dundas ca. 370, 5360 for Pb-Zn. Needs review of E-W system.
2. Selina ca. 385, 5361 - possibly beneath Ordovian or moraine.
3. Sth L. Dora ca. 387, 5353.
4. Sth Ring River ca. 373, 5366.
5. Mt. Jukes ca. 383, 5350.
6. Pinnacles also has potential.

These inferences are based on lineament density, orientation patterns and possible overriding E-W control. More work is needed in each zone to confirm the siting and relative power of the inferred lineaments.

The lineament-site map for the Rosebery-Renison Region was presented in this section (rather than 4-D) since it allows ready comparison with the more regional and more qualitative Figure 4-F-13. Somewhat different lateral trend emphases have been drawn for the Rosebery area on this basis and the E-W corridors are less apparent. This style of structural assessment must be treated with caution, even when the whole survey is treated consistently and quantitatively. This has not been done as part of this study and is certainly advised on the scale of E.L. area exploration.

NW trends seem more continuous and I presume that these, and to a lesser extent the NE set, are largely Devonian creations. Offsets of an older, deeper (?), and less readily identified E-W set may prove crucial in defining tectonic displacements. There is also a suggestion that the E-W trend pattern may be broken in the general region west of Rosebery. Some features are clearly seen on either side of the survey area but rarely do these persist across it; a predictable result if the gross thrusting suggested elsewhere in this report has occurred. The location of any dislocation or its confirmation may be suggested in gravity or processed magnetic data but no firm conclusion is possible here. The present trend pattern would suggest that E-W and NE-SW are older than NW-SE structures.

The E-W trend pattern described is quite unexpected and not easily explained. Since such features are not geologically obvious it could be argued that they are imaginary or an artifact of processing. Neither argument can be valid. While not obvious in surface mapping this trend reccurs fragmentally in rocks of all ages in Tasmania and structures at various scales are evident within the surveyed area. Additionally, there are indisputable examples of E-W corridors within the magnetic data. Such a zone crosses Heemskirk Granite and Oonah Formation rocks at about 5364000 mN. In gross cases the zone is about 3 km wide. The apparently limited or disguised character of these features elsewhere probably reflects complex source interactions and Devonian or Cambrian dislocations. Only a complete structural interpretation with complete data processing could establish continuity and the present position of any Cambrian unit shifted from such corridors. It may also be instructive to relate ore composition to location of trends.

If mineralisation is Cambrian in age and the source or circulatory structures were active then the magnetic responses of the channel or alteration systems would be retained in even quite thin slabs of material. Thus the features would remain magnetically identifiable in blocks later intruded by granites and in which, today, the roof cover is quite thin. In the corresponding gravity case trends could only be recognisable if the vertical section is relatively undisturbed to great depth. It could be anticipated that the chemical indicators might well be confusing where overprinting has occurred and a syngenetic ore might well possess some epigenetic characters. Understanding of these situations may well depend on mangetic appraisal of structure and properties.

1	B:M40	W TAS 1981 MAGNETICS LINE 40
2	B:M120	W TAS 1981 MAGNETICS LINE 120 ORIGIN FID 7670
3	B:M270	W TAS 1981 MAGNETICS LINE 270 ORIGIN FID 12170

ZERO SHIFT : 43

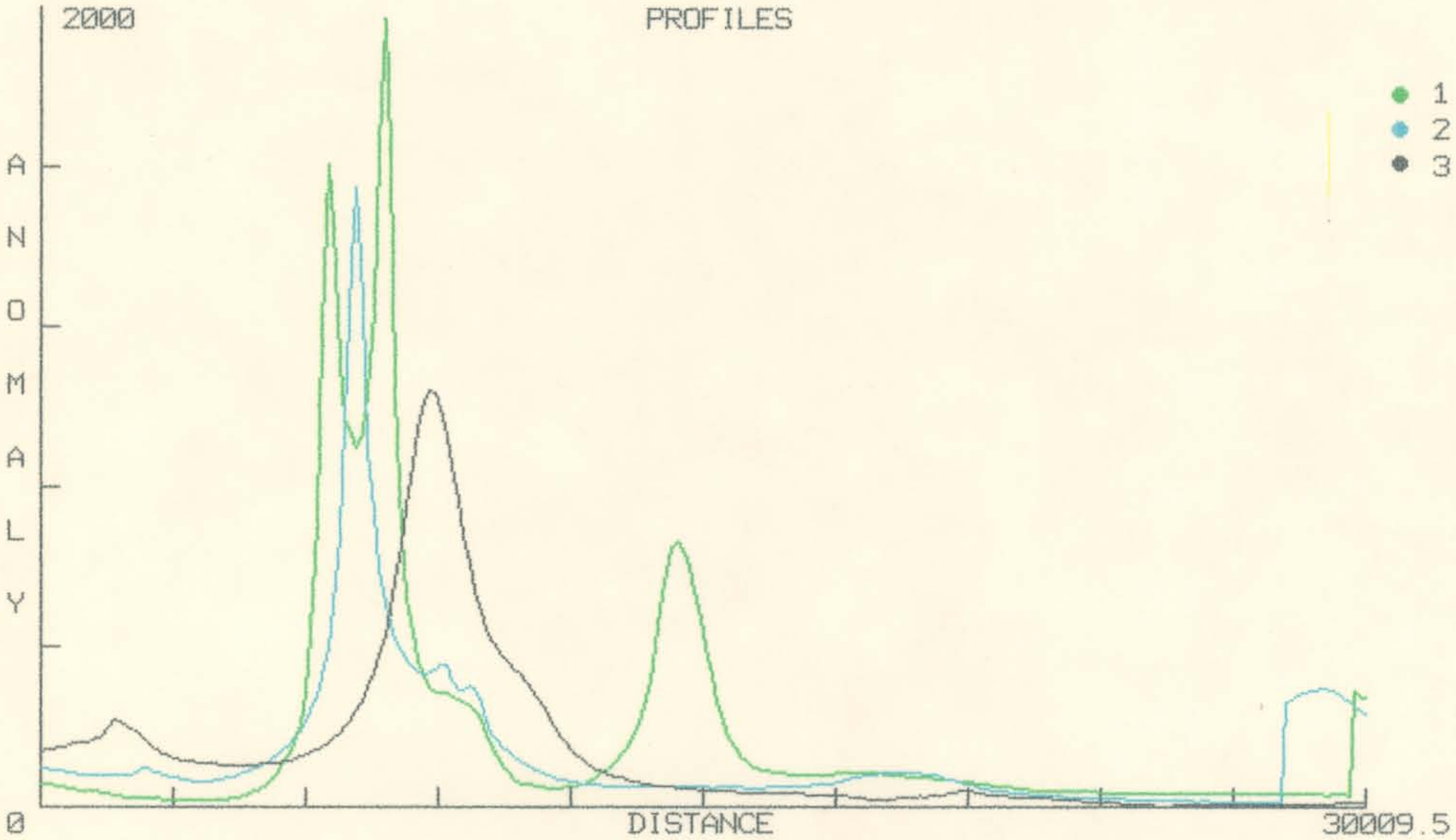
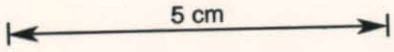


FIGURE :4-F - 1

OBSERVED PROFILES - MACQUARIE HARBOUR SOUTH



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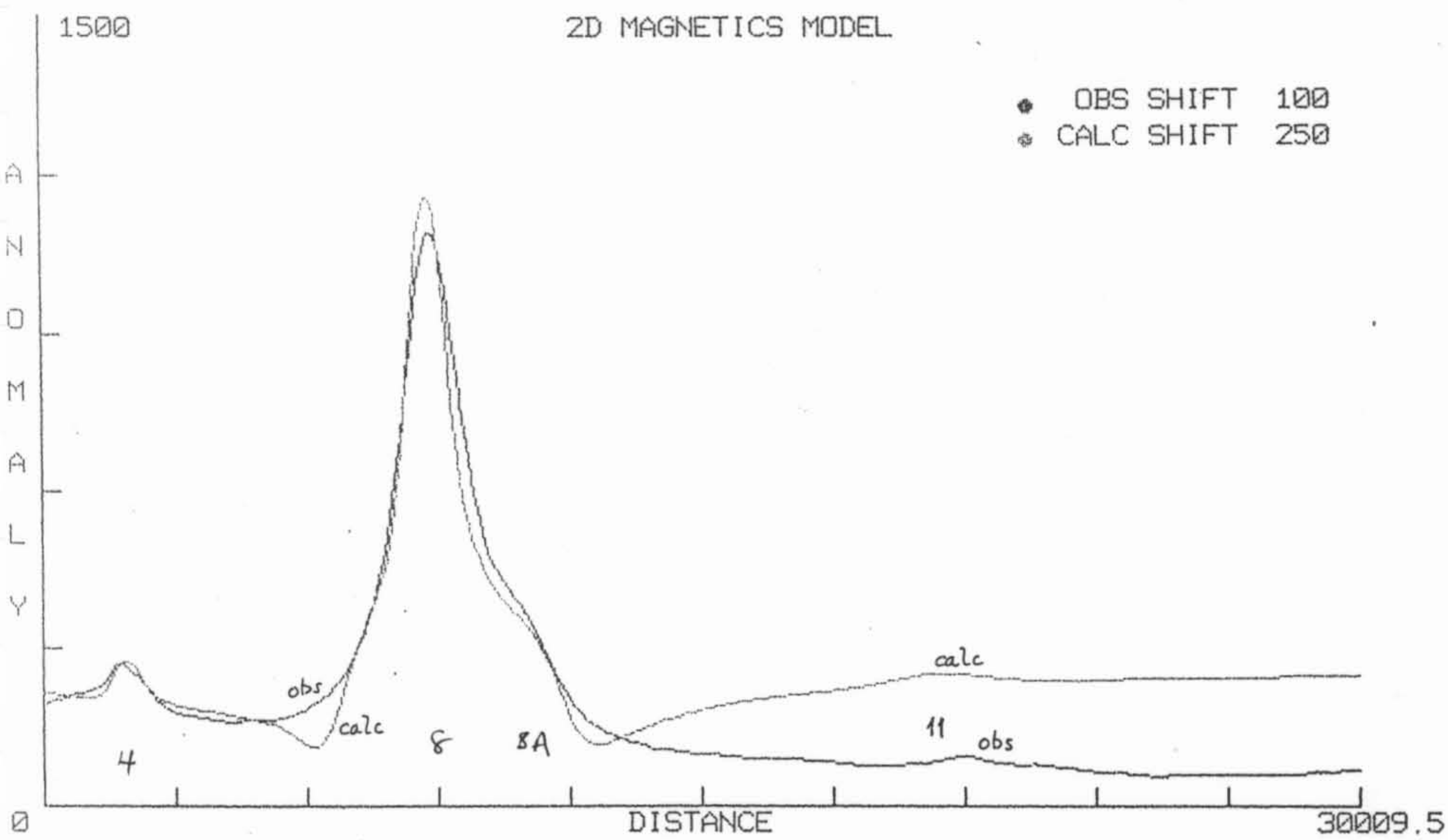


LINE 270 W TAS 1981 MAGNETICS MACQUARIE HARBOUR
MAG2D
LEAMAN GEOPHYSICS

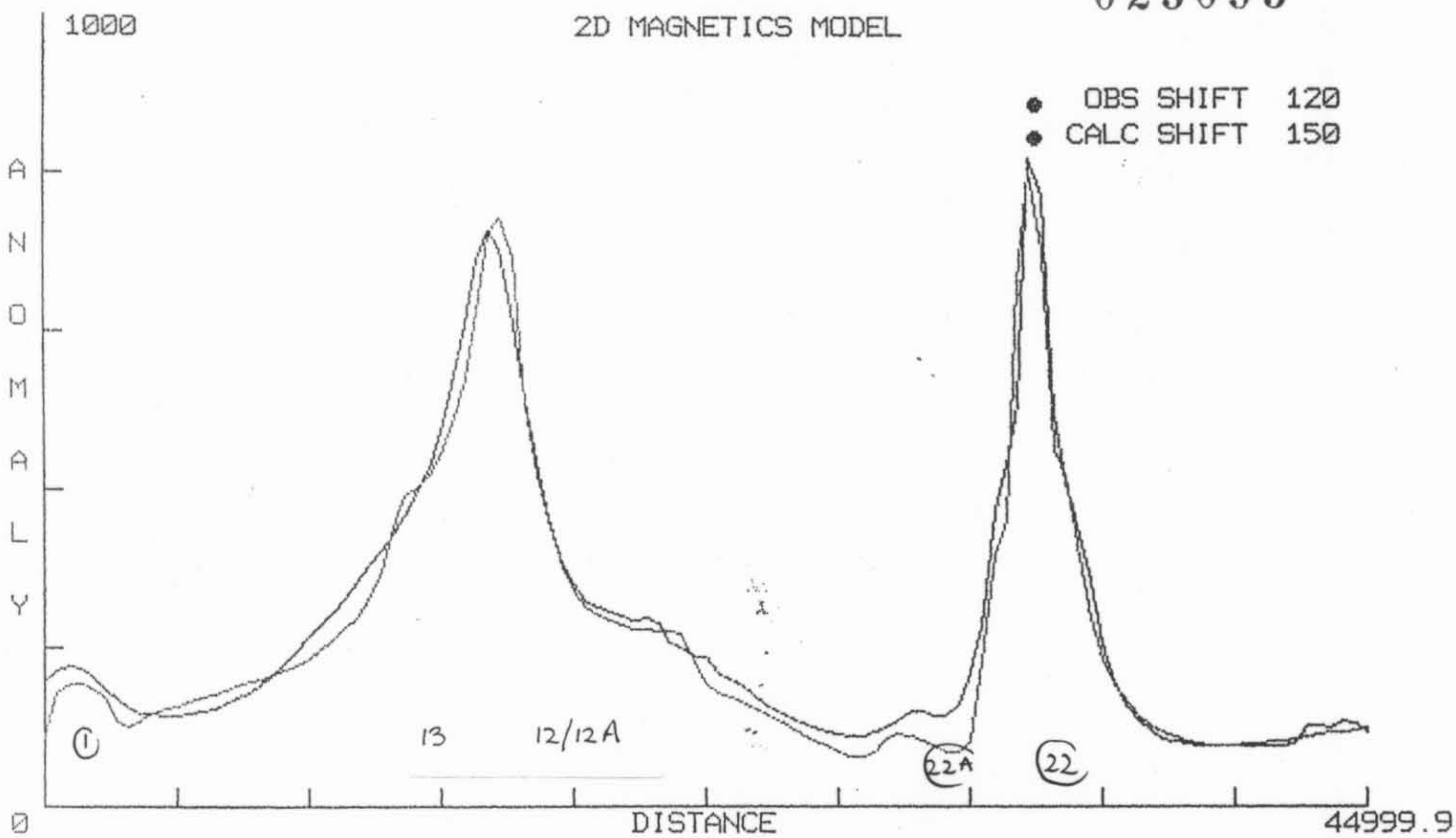
FIGURE 4-F-2

OBSERVED AND CALCULATED PROFILE FOR LINE 270
SOUTH MACQUARIE HARBOUR

5 cm

LINE PARAMETERS - ORIGIN,LIMIT,INCR : 0 44999.9 409.09

025095



5 cm

W TAS MAGNETICS LINE 550

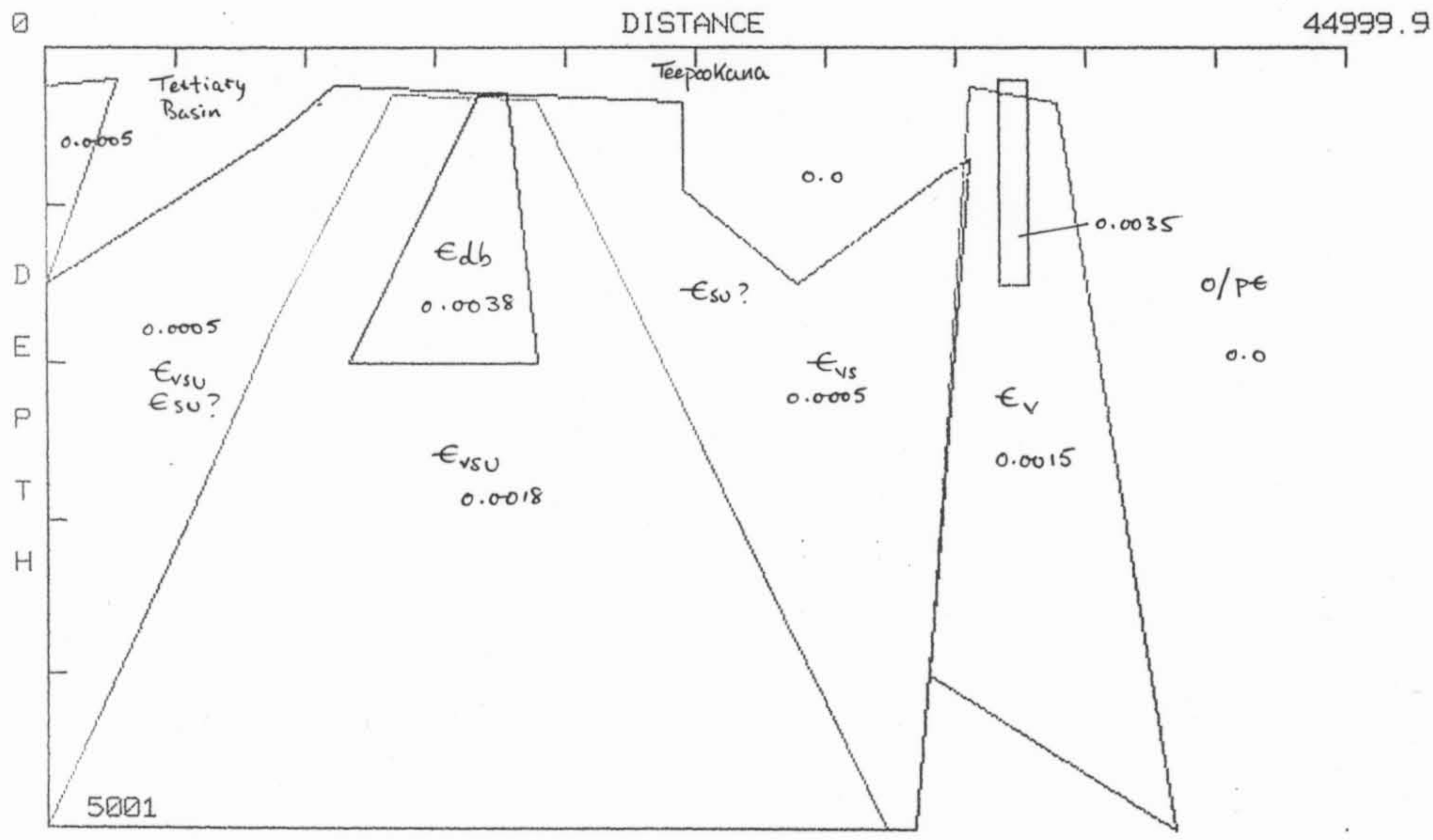


FIGURE 4-F-3

LINE 550 - 2D REGIONAL INTERPRETATION

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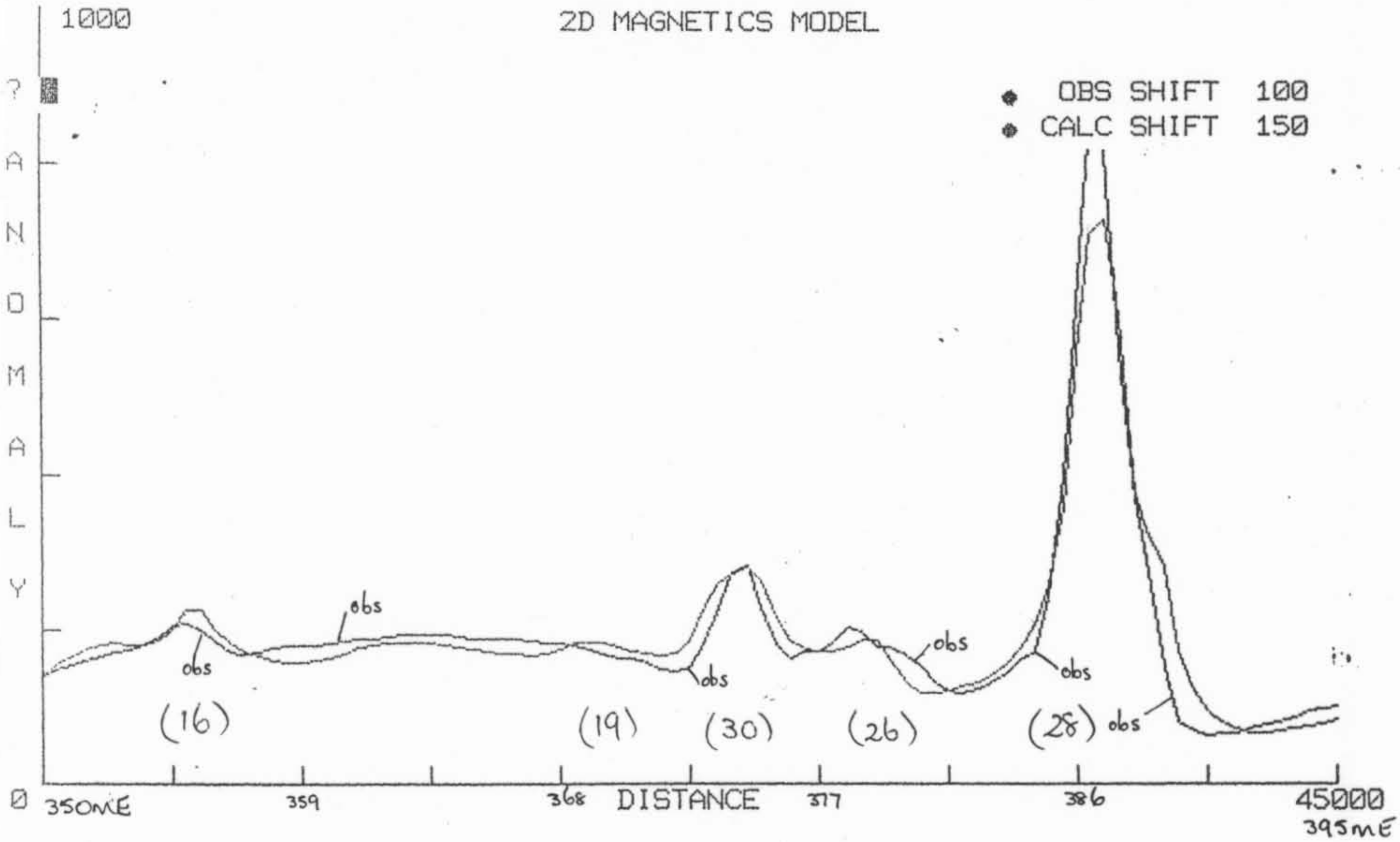
LINE PARAMETERS - ORIGIN,LIMIT,INCR : 0 45000 500

025096



LINE 1030 REFERENCE LEVEL 1000 M

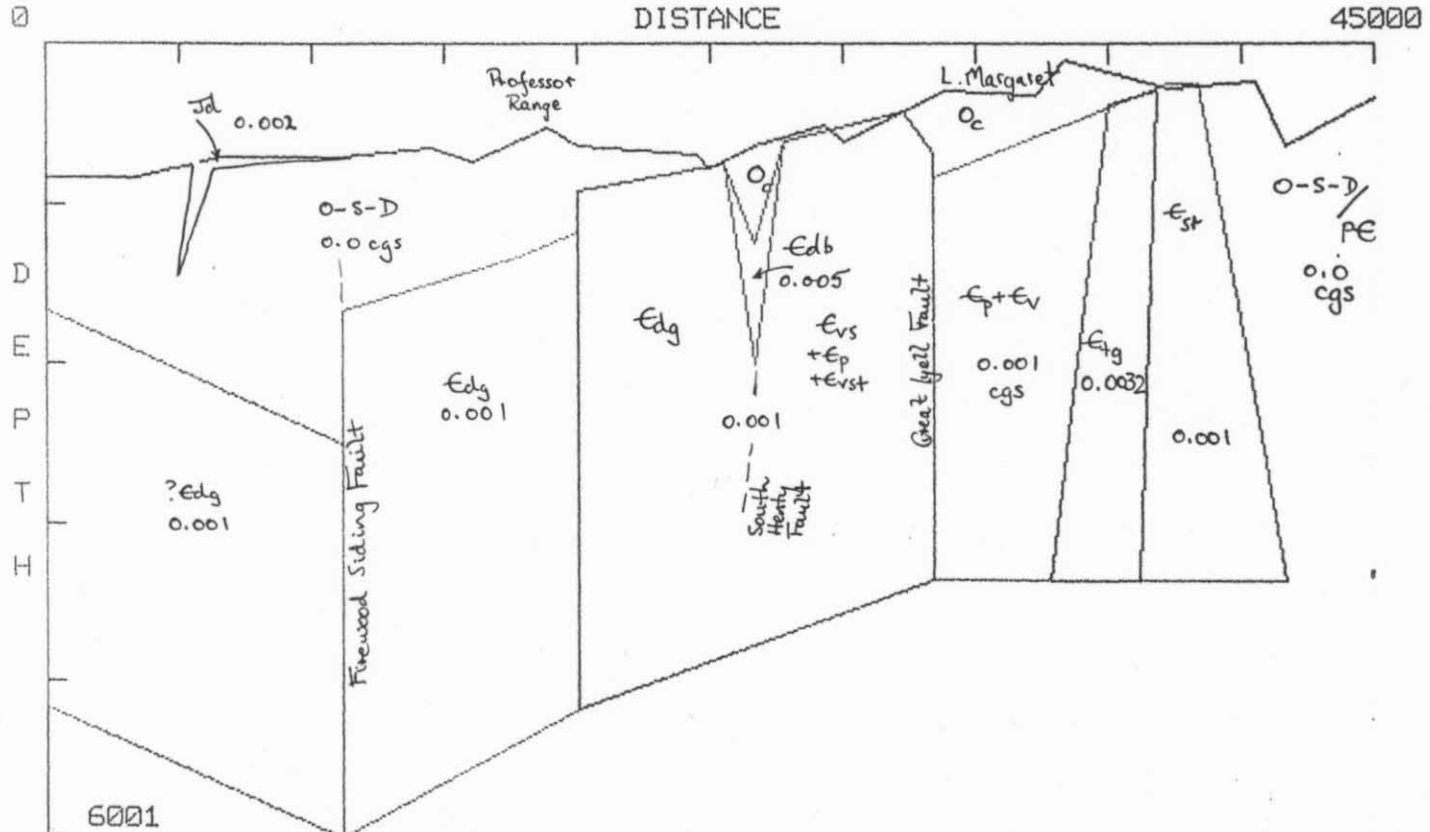


FIGURE 4-F-4

LINE 1030 - 2D REGIONAL INTERPRETATION

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Hobart, Tasmania 7001

5 cm

LINE PARAMETERS - ORIGIN,LIMIT,INCR : 0 50000 500 025097 92

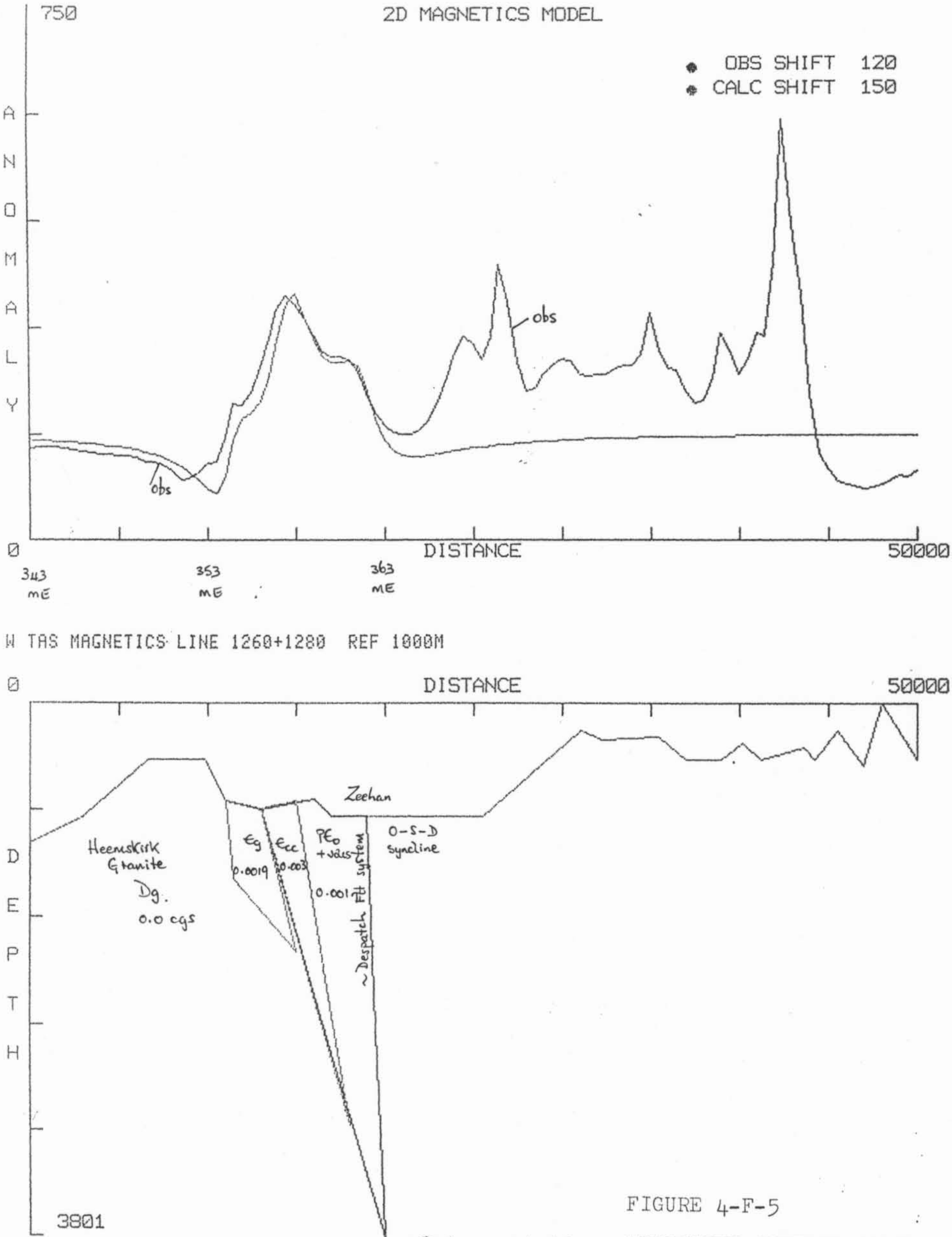

FIGURE 4-F-5

Interpretation: HEEMSKIRK CONTACT ZONE

LINE 1260

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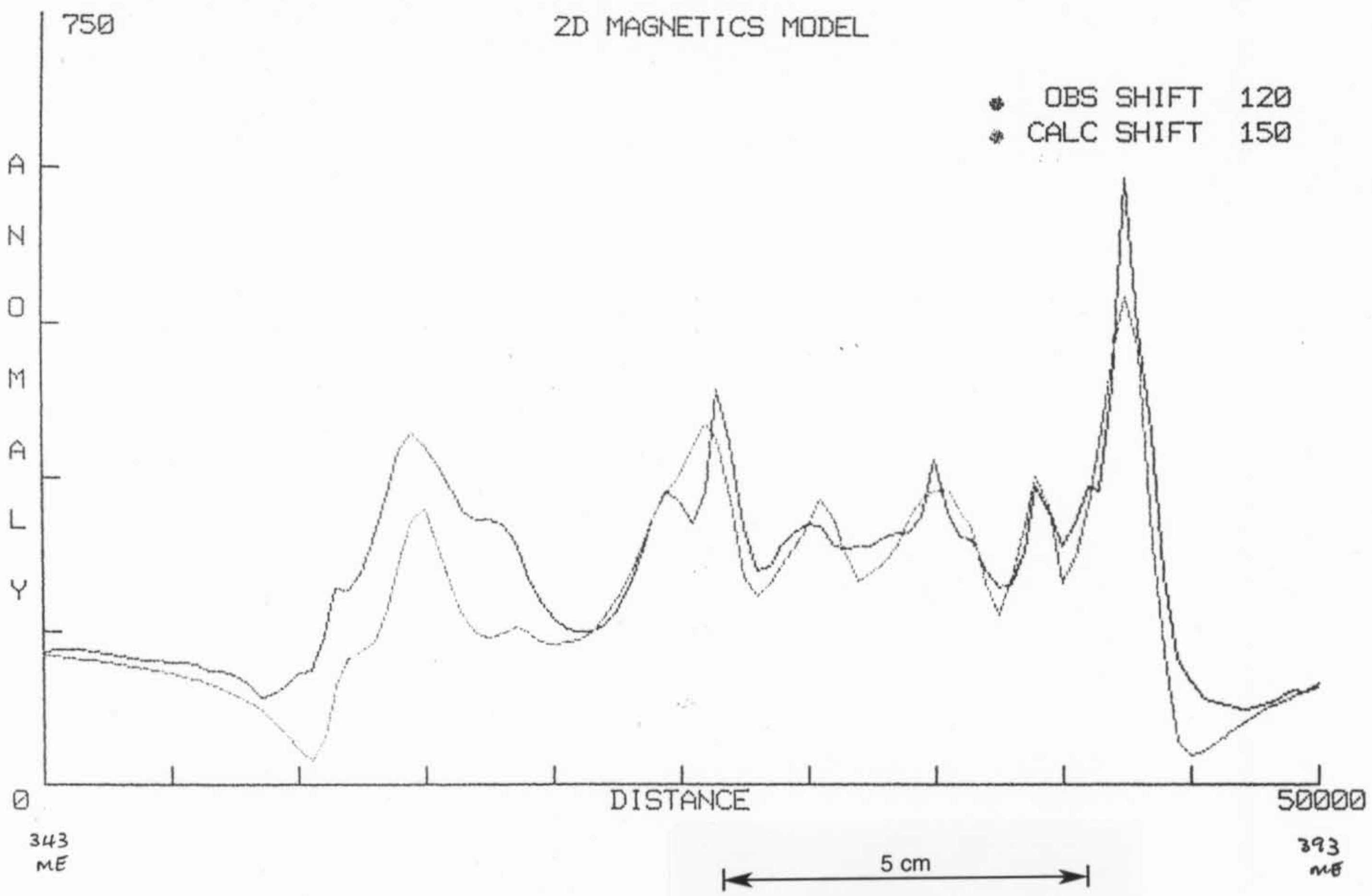
5 cm

LINE PARAMETERS - ORIGIN,LIMIT,INCR : 0 50000 500

025098



W TAS MAGNETICS LINE 1260+1280 REF 1000M

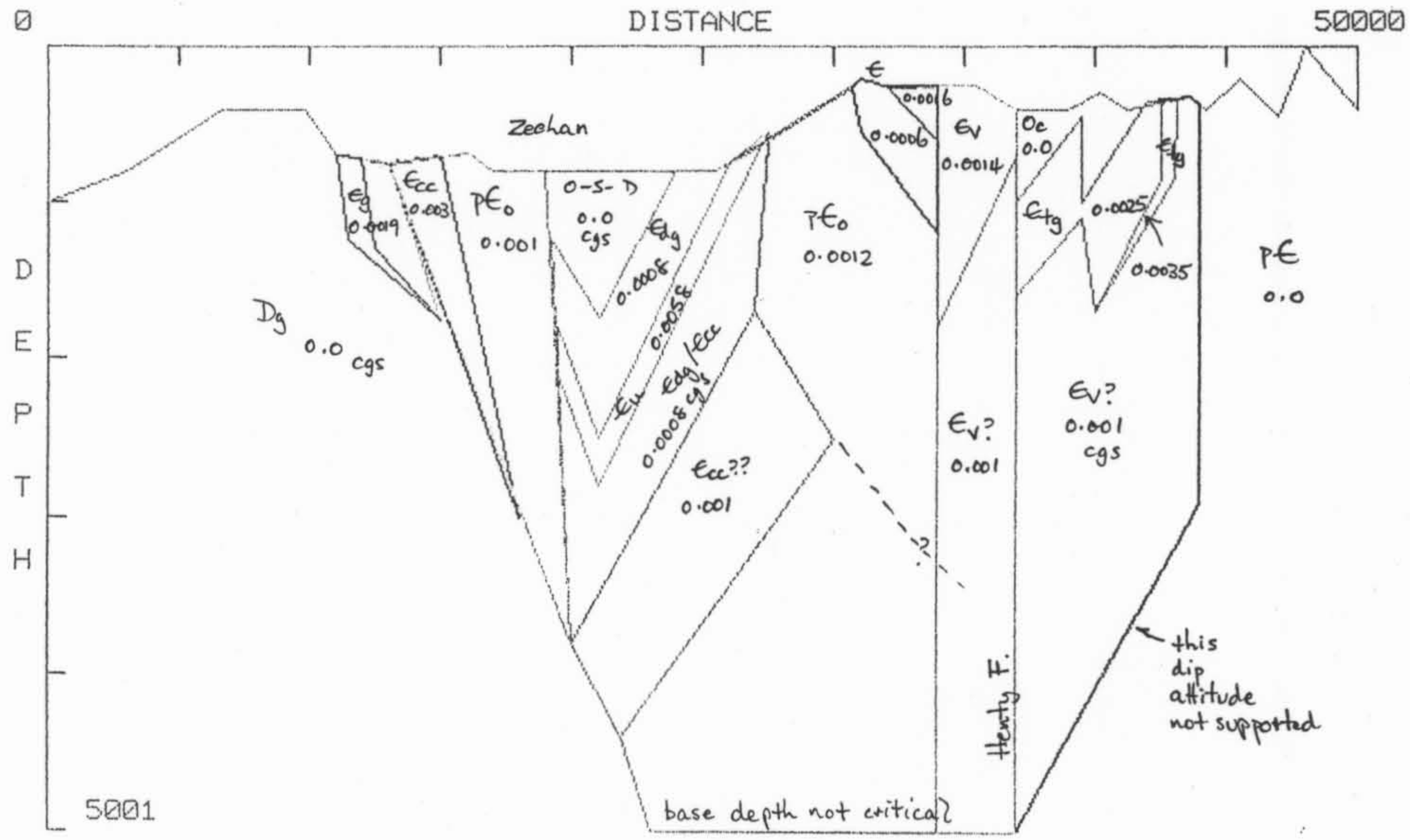


FIGURE 4-F-6

LINE 1260/80 - 2D REGIONAL INTERPRETATION version 1

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Hobart, Tasmania 7001

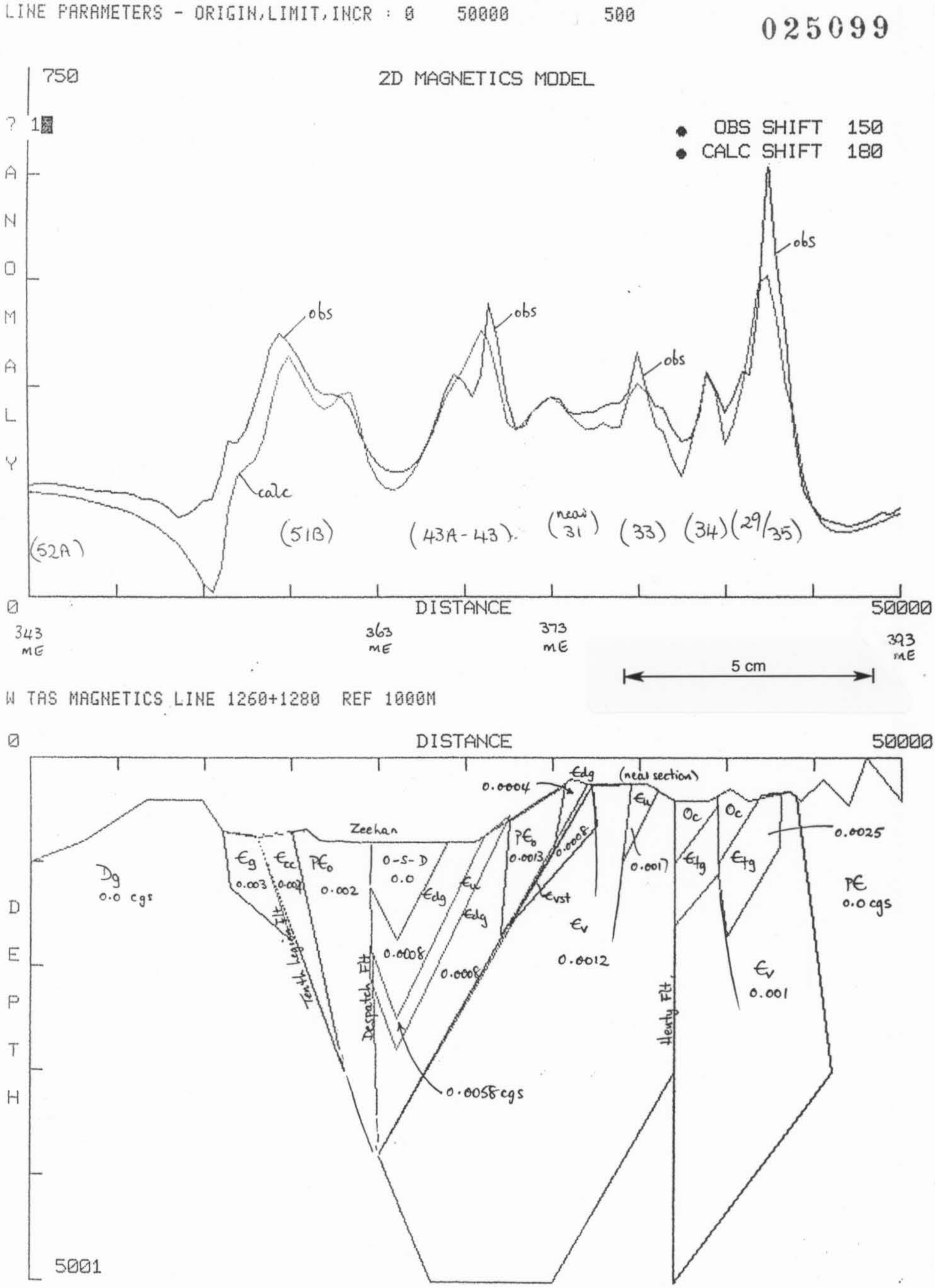

FIGURE 4-F-7

LINE 1260/80 - 2D REGIONAL INTERPRETATION version 2

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Hobart, Tasmania 7001

LINE PARAMETERS - ORIGIN,LIMIT,INCR : 0 45000 500

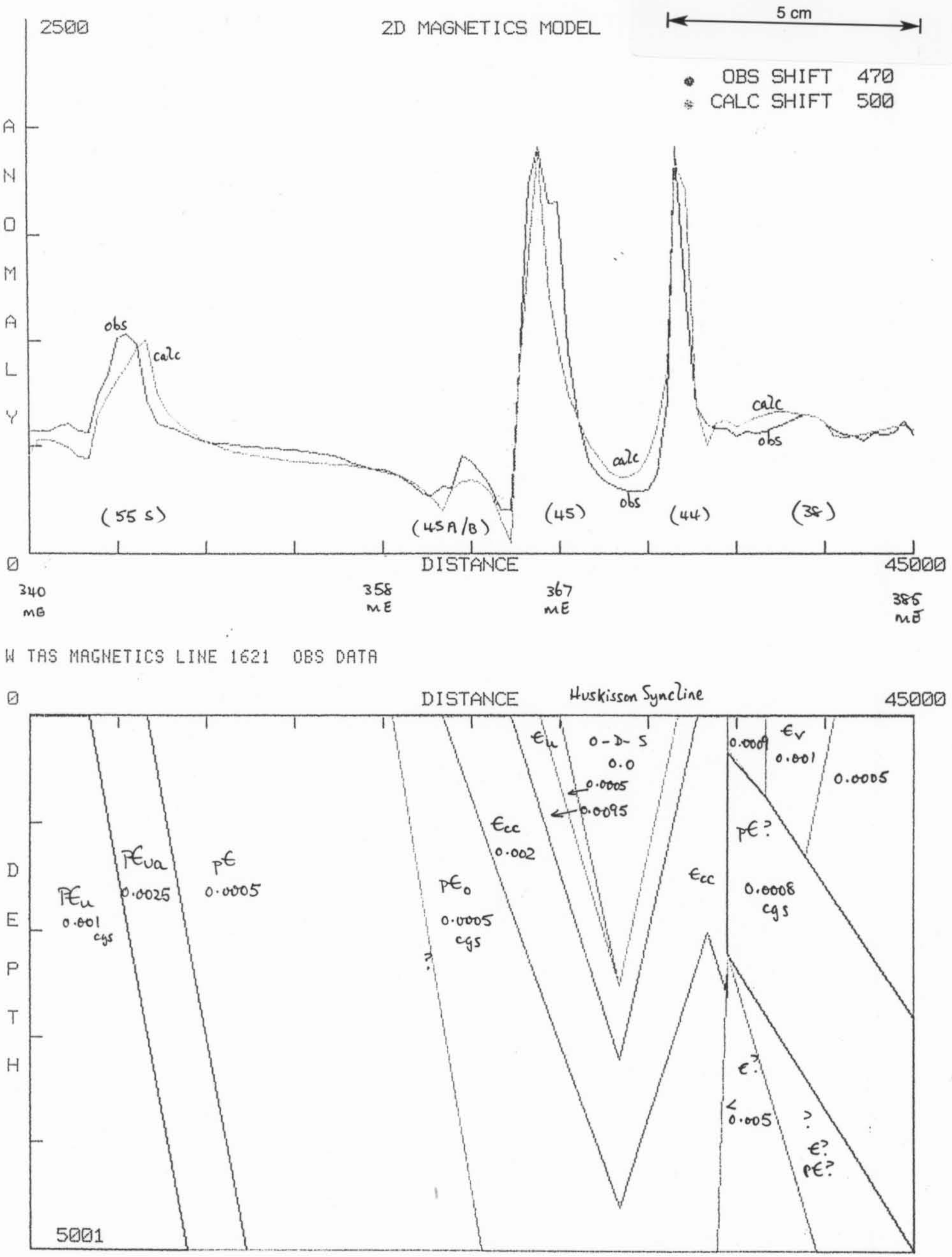

FIGURE 4-F-8

LINE 1621 - 2D REGIONAL INTERPRETATION

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Hobart, Tasmania 7001

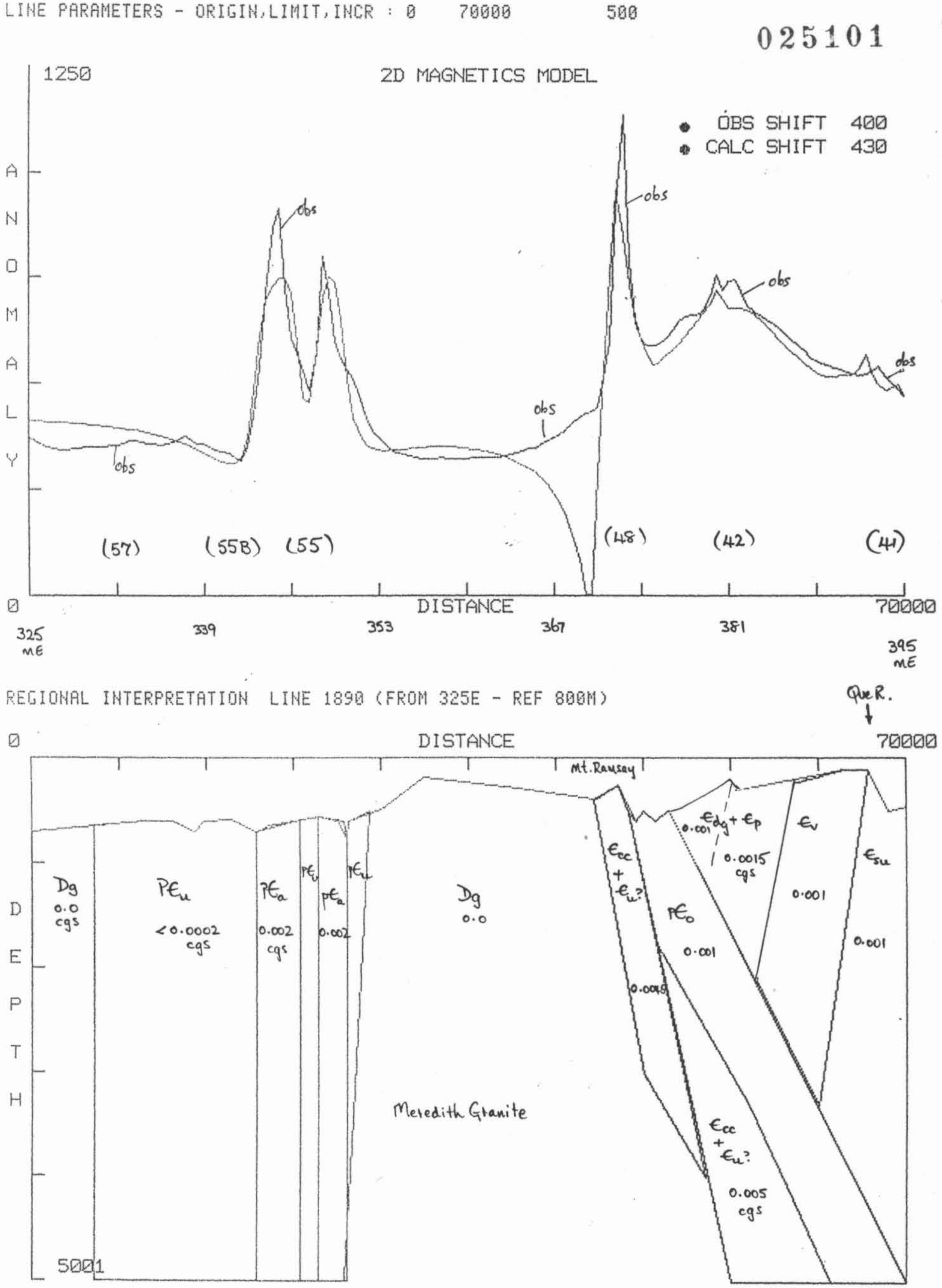

FIGURE 4-F-9

LINE 1890 - 2D REGIONAL INTERPRETATION

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5 cm

```
 1             B:D200QUE     -58.91291      189.9865
DRAPE 200 M W TAS MAGNETICS LINE 1890 QUE RIVER
 2             B:D1200QUE     86.96032      190.6447
VERTICAL DERIVATIVE 1  LINE 1890 QUE RIVER
 3             B:D2200QUE     1494.767      2956.06
VERTICAL DERIVATIVE 2  LINE 1890 AT 200 M QUE RIVER
```

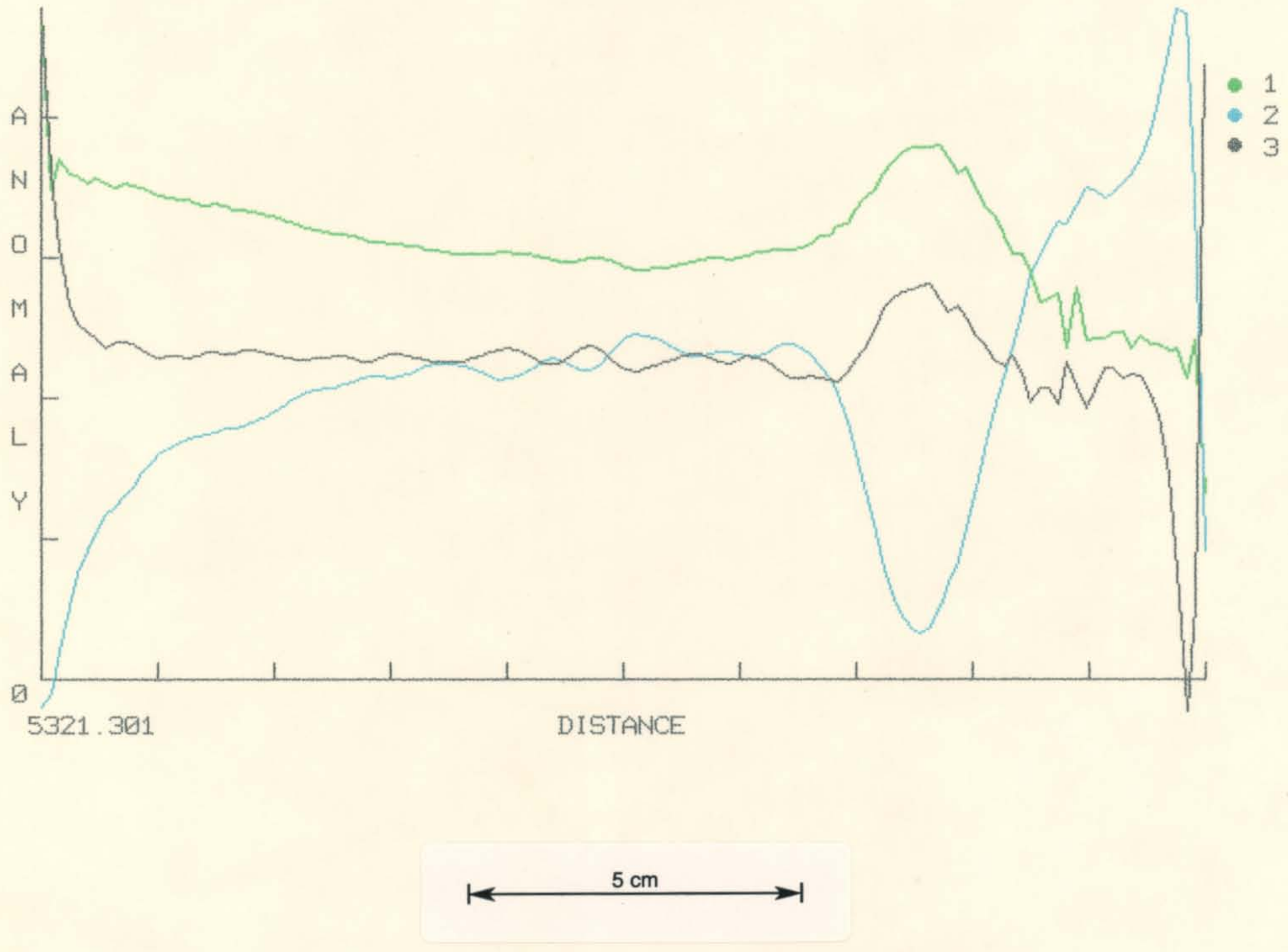

FIGURE :4-F - 10

LINE 1890 - QUE RIVER DETAIL - DERIVATIVE PRESENTATION OF DRAPE DATA
The ore lenses are located above the left side of S and A in DISTANCE

025103

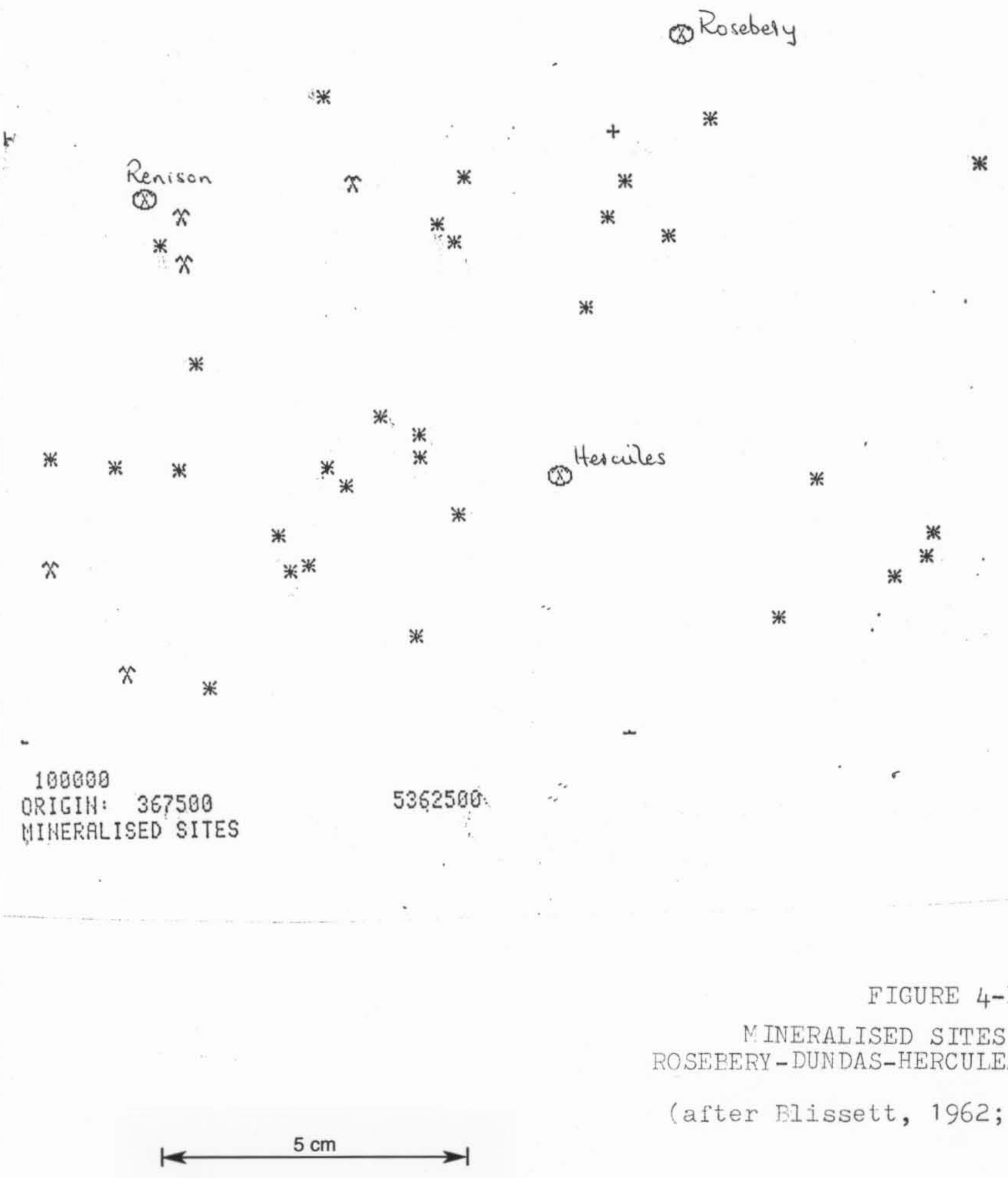

FIGURE 4-F-11

MINERALISED SITES IN THE
ROSEBERY-DUNDAS-HERCULES REGION

(after Blissett, 1962; Corbett, 1984)

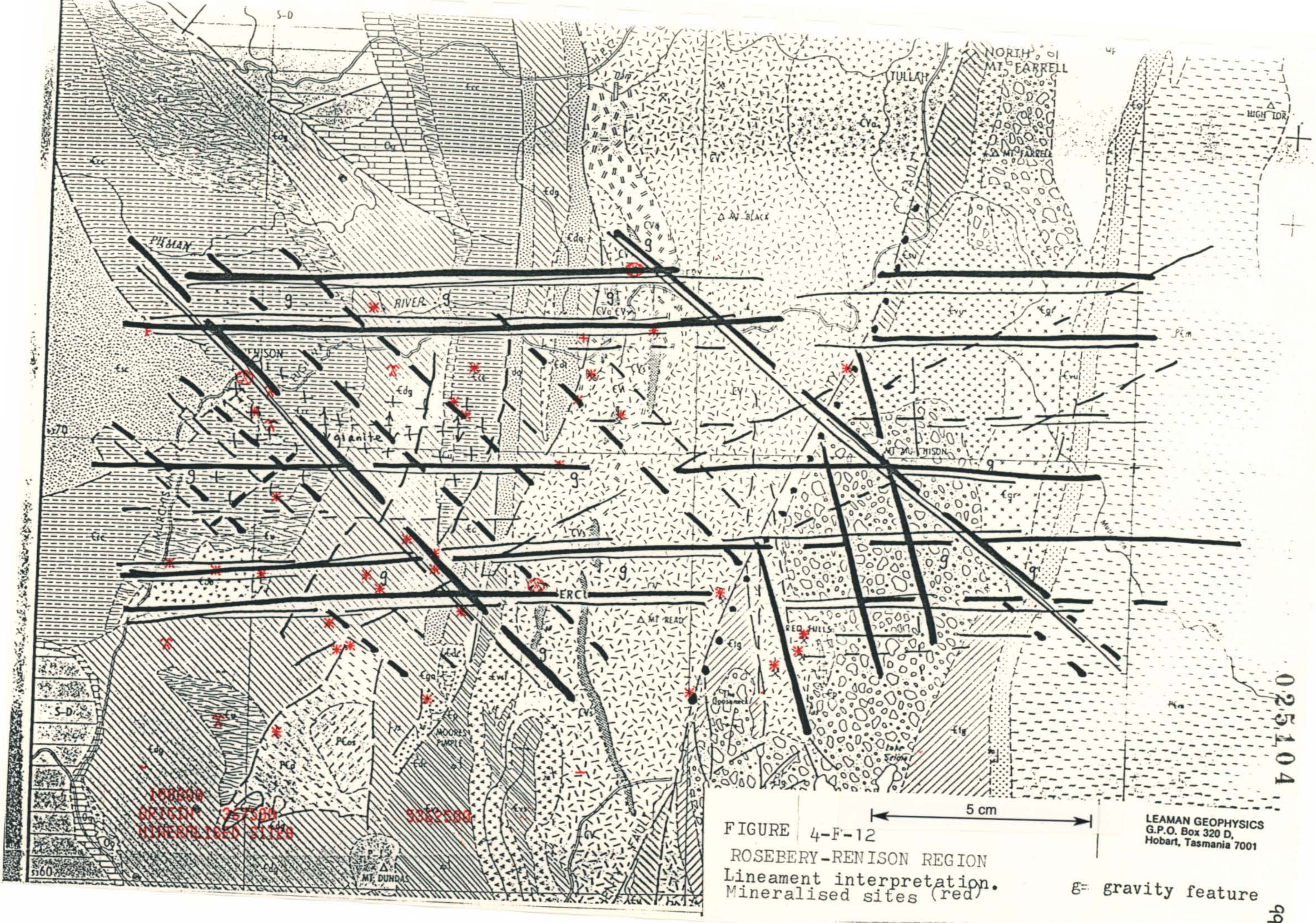

FIGURE 4-F-12
ROSEBERY-RENISON REGION
Lineament interpretation.
Mineralised sites (red)

g= gravity feature

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025104

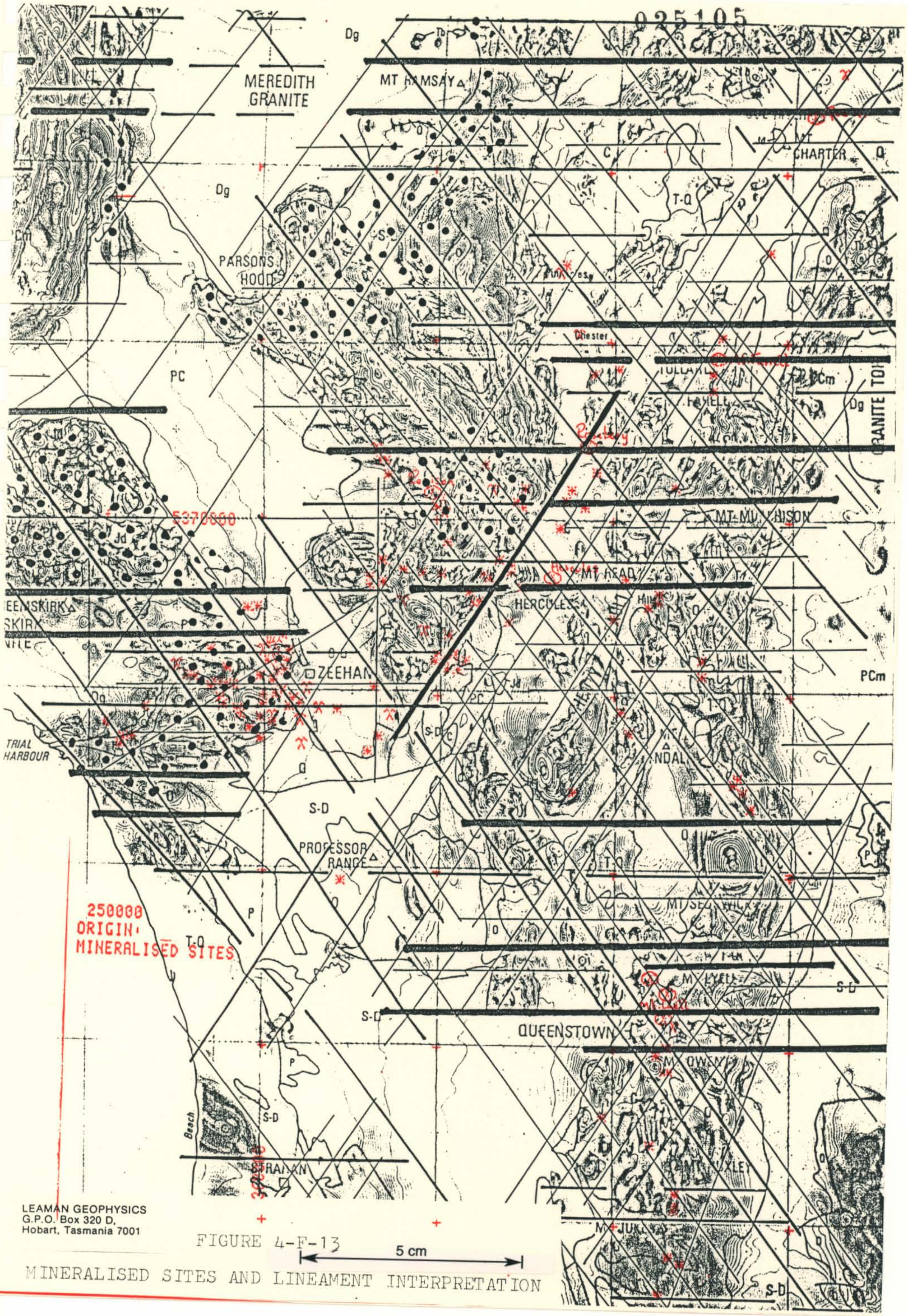

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FIGURE 4-F-13

MINERALISED SITES AND LINEAMENT INTERPRETATION

025106

4-G: REGIONAL SUMMARY OF MINERALISATION SIGNATURES

General

The principal mineralised areas within the surveyed area have been examined in order to evaluate any common characteristics or particular responses. The comments below are based on available geological information in the public domain.

It must also be recognised that while a few deposits have a defined signature as a result of the mineral association present others may possess an obscure or generalised character due to the properties of the host rock(s). In most cases only the host lithology (or variants of it) and gross structural considerations are likely to produce circumstantial correlations at this level of analysis.

Aeromagnetic data will, in addition, integrate many important subtleties and present to the viewer a filtered summation of magnetic properties. High resolution observation may be advisable but this survey does not offer it. Some of the issues have already been described in sections 4-C, D where it was shown that proper correction of the observed data and unbiassed or smoothed presentations of it are far more definitive than the original presentation (Figure 3-3) which was filtered and uncorrected. Some ambiguity and complication due to flight and terrain issues is universal in high relief areas within the present processing and the differences may be contrasted in the sample areas studied.

The inferences are regional since the data is widely spaced (approx 500 x 40 m) at 120 to 600 m terrain clearance and many prospects may not have been flown closely enough to offer measurable response. "No anomaly" may reflect either no response, no coverage or an insignificant prospect.

Site associations:

Some prospect or mine correlations may be slightly suspect due to geographic conversion limitations, offsets in the magnetic field and the reasons mentioned above. Field offsets depend on the sensor - source separation and may be affected by terrain.

ARGENT- : no direct response, regional high.
ATHENIC- : negative shoulder on ultramafic? anomaly.
AUSTRAL-Pb/Ag: no anomaly.
BALD HILL-Os: unable to separate response without analysis.
BALFOUR FIELD-Cu: all prospects related to anomaly crests and N-S axes.
BANNOCKBURN-Ag/Pb: no anomaly.
BEN ACCORD-Ag/Pb: small negative spine relationship possible.
BIG BEN- : no anomaly.
BLACK JACK-Ag/Pb: no anomaly.
BONNIE DUNDEE-Cu/Au: regional negative axis, no direct correlation.

BOSS- : no direct response, regional high.
BOULDER- : no direct response, regional high.
BRITANNIA- : no direct response, regional high.
CENTRAL BALSTRUP- : no direct response, regional high.
CHESTER-pyr: gradient closures against E-W trend.
CLEVELAND-Sn: possible subtle response in disturbed field plus NE-SW trend.
CLIFF-Sn: no anomaly.
COLEBROOK- :negative shoulder on ultramafic? anomaly..
COMET-Ag/Pb: no direct response, regional low anomalies.
COMSTOCK- : no direct response, regional high (Zeehan Comstock).
CORONET NORTH- : possible minor anomaly.
CORNWALL-Sn: possible minor anomaly.
CROWN- : no anomaly.
DREADNOUGHT- : no direct response, regional high.
EMPRESS-Sn: possible anomaly, disturbed field area.
EUREKA-Sn: no direct correlation, in disturbed field area.
EVENDEN-Cu/Au: regional positive axis, no direct correlation.
FAHL-CU/Au: regional negative axis, no direct correlation.
FEDERATION-Sn: no anomaly.
FENTON- : negative shoulders on ultramafic? anomalies.
FLORENCE-Pb/Ag: no direct response, regional high.
FRAZER-Cu/Au: regional positive axis, no direct correlation.
GLOBE-Sn: no particular anomaly, disturbed field area.
GRAND PRIZE-Sn: possible minor anomaly.
GRIEVE SIDING-Pb/Zn: no anomaly.
GRUBBS-Pb/Ag: no direct response, regional high.
HECLA-Cu/Au: regional positive axis, no direct correlation.
HELLYER-Pb/Zn: regional E-W gradient.
HERCULES-Pb/Zn: small local feature, regional E-W trend.
INTERVIEW RIVER-W: no anomaly.
JUNCTION-Pb/Ag: no anomaly.
KAPI-Ag/Pb: no deducible relationship due to ultramafics.
KELVIN-Sn: no direct correlation, disturbed field area.
KOSMINSKI-Ag/Pb: regional negative axis, no direct correlation.
MC KIMMIE-Pb/Ag: no direct response, regional low.
MAESTRIES- : no direct response, regional low.
MARIPOSA-Ag/Pb: no anomaly.
MAGNET-Pb/Ag: no clear cut signature, on NE-SW trend related to particular lithology?
MAXIM-AG/Pb: Ag/Pb: possible relationship.
MAYNE-Sn: no particular anomaly, disturbed field area.
MELBA-Ag/Pb: no deducible relationship due to ultramfics.
MELBA FLAT-Misc, Cu: association with N-S trend.
MEREDITH-Sn: prospects lie near gradient change across granite.
MONTAGU-Sn: possible anomaly.
MONTANA S L- : no anomaly.
MONTE CHRISTO-Pb/Ag: possible minor anomaly.
MOORES PIMPLE- : no anomaly.
MT. BISCHOFF-Sn: strong couplet on raised field levels.
MT. FARRELL-Ag/Pb: small residual anomalies near N-S trend.
MT. LINDSAY-Sn,Pb/Zn/Ag: area of general field disturbance.
MT. LYELL REGION-Cu/Au: possible correlation of prospects with second order small anomalies.
MT. STEWART-Ag/Pb/Os: disturbed field area, unusual contact to Meredith Granite?
NEW MT ZEEHAN- : no direct response, regional high.

NIKE-Pb/Ag: no anomaly.
NTH AUSTRAL- : no direct response, regional high.
NTH COMET- : no direct response, regional low.
NTH TASMANIAN- : no anomaly.
NUBEENA-Pb/Ag: no direct response, regional high.
OLYMPIC- : negative shoulder on ultramafic? effect.
OCEANA-Pb/Ag: no anomaly.
OONAH-Pb/Ag: no anomaly.
OONAH HILL-Ag/Pb: no firm association but all prospects flank a
WNW-ESE trend.
ORIENT-Sn: no particular anomaly, disturbed field area.
OWEN MEREDITH- : possible minor anomaly.
PENZANCE-Sn: uncertain, indirect regional low.
PERIPATETIC-Sn: no anomaly.
PINNACLES-Cu/Au/pyr: possible relation, SW gradient.
POSEIDON-Ag/Pb: small spine related?
PRINCE GEORGE-Sn: no anomaly.
PROPRIETARY- : negative shoulder on ultramfic? anomaly.
QUE RIVER-Pb/Zn: regional E-W anomaly.
RAZORBACK-Sn: no direct response, regional high.
RENISON BELL-Sn: moderate anomaly superimposed on generally
disturbed field area.
RICH-Cu/Au: negative regional axis, no direct correlation.
ROCKY RIVER-Fe: high amplitude anomaly.
ROSEBERY-Pb/Zn: small couplet anomalies, unusual, E-W trend.
SAVAGE RIVER-Fe: high amplitude anomalies.
SERPENTINE HILL-Ag/Pb: no resolution due to ultramafics.
SILVER BELL-Pb/Ag: possible minor anomaly.
SILVER HILL-Pb/Ag: no anomaly.
SILVER DUKE- : no direct response, regional high.
SILVER KING-Pb/Ag: possible minor anomaly.
SILVER STREAM- : no direct response, regional high.
SOUTH COMSTOCK-Pb/Ag/Zn: no direct response, regional high.
SOUTH NUBEENA-Pb/Ag: no direct response, regional high.
SPRAY- : no direct response, regional high.
ST. DIZIER- Sn: no particular anomaly, disturbed field area.
STONEHENGE- : no direct response, regional high.
STORMSDOWN-Sn: possible minor anomaly.
SUCCESS-Ag/Pb: small negative spine related?
SUSANITE-Pb/Zn: no direct response, regional high.
SWANSEA-Pb/Zn/Ag: no direct response, regional high.
SWEENEYS-Sn: possible association.
TASMAN RIVER-Sn: no particular anomaly, disturbed field area.
TASMANIAN-Pb/Zn/Ag: no direct response, regional high.
WAKEFIELD-Sn: possible minor anomaly.
WOMBAT-Sn: no anomaly.
ZEEHAN WESTERN- : possible minor anomaly.

Summary:

The above review, with all its limitations, indicates that certain types of mineralisation may have usable magnetic signatures when seen in regional perspective. These are

i) tin of the Bischoff type. There are other possible targets (68, 69 see Section 4-E) with strong pyrrhotite related anomalies.

ii) copper-gold of the Lyell type. This is a much more subtle effect and requires appropriate correction of data (Section 4-C).

iii) tin of the Renison type. Strongly anomalous and coupled with an area of disturbed field which implies thermal alteration and haloes about granite contacts (Section 4-D). Cleveland probably of this type.

iv) iron of the Savage River type. No comment necessary.

v) lead-zinc of the Que-Hercules-Rosebery type. Subtle anomaly couplets best seen in derivative treatments. Strongest at Rosebery.

There are several other instances where the correlation between magnetics and mineralisation is more uncertain and in which the host rock may be the material identified. Alteration, and recognition of it, may be as important to exploration as any direct signature since it is likely to identify massively anomalous areas which may contain larger or deeper targets. Other associations may be established with further work. Examples include

i) Interview River-Balfour: mineralisation appears related to anomaly peaks and probable host alteration.

ii) Melba Flat: quite anomalous area. Little geological control at present. Extent of mineralisation not known.

iii) Zeehan: anomalies and mineralisation reflect(?) stratigraphic or structure continuity especially within the halo of the Heemskirk Granite.

Some other relatively unknown, mineralised regions can be related to abnormal field patterns. Examples include Mt. Lindsay, Success-Poseidon, Fenton-Olympic. Such abnormalities may be induced by thermal metamorphic contact effects or subtle alteration of magnetic minerals.

The magnitude of the anomalies recorded cannot be considered particularly significant at this stage; too little is known of mineral or host properties. In any event, the anomalies must be evaluated for width-depth and terrain clearance factors before the full implications of any potential correlation can be appreciated.

There is, however, a key element which links all the major and economic deposits. I now believe there are no exceptions. Prior to this study some lineaments could be seen in the presented magnetic field plots but no single feature could be said to be common or perhaps fundamental. Correction of the Rosebery-Renison and Lyell blocks has shown that there is a possible link. Prior analysis indicated that while Renison could be related to its local cupola the deposits at Rosebery, Que River, Lyell, Hercules and Mt Farrell were isolated and anomalous. Why should it be there? Where were the structures controlling the source vents?

All sites of worth lie on, or very close to, extensive and nearly east - west lineaments (also gravity data, Leaman (1986b). These features trend a little north of east (ca 85 deg true) and are not always obvious in the original map presentation but are always enhanced by correction of the data. Structures with comparable orientation are rarely marked in surface exposures or regional mapping but are universal upon close examination. This suggests that primary crustal structures initiating bulk property alteration are involved. That alteration may be due to passage, perhaps repeated, of mineralising fluids. Consider some of the relationships between the E-W system and other trends, not always apparent in regional mapping, at several important sites.

BISCHOFF: some surface evidence E-W, + minor N-S, NE-SW, NW-SE
CHESTER-PINNACLES: weak E-W Pinnacles, both + lesser NW-SE
CLEVELAND: + NW-SE, NE-SW
FARRELL: + possible NW-SE
HELLYER: + possible major NW-SE
HERCULES: + minor NW-SE trends.
LYELL: some surface evidence for E-W, + poss NW-SE, N-S minor trend
QUE RIVER: + possibly major NW-SE
RENISON: some surface E-W + lesser NW-SE trend, granite in E-W axis
ROSEBERY: +lesser NW-SE trends (NE-SW host control)
ZEEHAN FIELD: other lineaments require detailed review but NW-SE and NE-SW features are present. Two E-W corridors may have fundamental control.

I believe this table indicates a pattern that is too consistent to be accident. An intersection near, or in, reasonable host rocks is associated with a worthwhile accumulation. Other prospects represent secondary mobilisation and deposition along structures cutting such hosts, migration within a host unit or general sweating of sulphides at susceptible sites. Without a primary feeding system such sites could never accumulate sufficient sulphides to be economic. Encouragingly this thesis has exploration potential since there are several other E-W features intersecting the Mt Read Volcanics which are either apparently unmineralised or inadequately explored (Figure 4-G-1). Additionally, detailed work could be concentrated on the corridors with established mineralisation. A global approach using magnetic methods might assist but follow up work of any sort should use methods whose coverage is adequate to define abnormalities. This, in my opinion, has been a common weakness with detailed surveys - especially when the primary and more regional analysis of the type reported here has not been done. The processing-interpretation sequence ghosted in this report must be applied to the entire volcanic arc in order to confirm positions and sites for ground surveys of appropriate type.

Some of the sites listed contain accumulations of tin mineralisation of non volcanogenic origin. I propose that similar controls apply to granite or dyke emplacement and ultimately to disposition of the sources for fluids leading to the replacement ores (Renison, Cleveland etc). I identified these alteration haloes in a confidential exploration report in July 1982. Webster (1984) has subsequently expanded on this theme but the work described in this report largely supersedes the published account by defining a wider, yet more specific halo (compare Renison and Pine Hill Granite distribution). Probable chemical overprint problems may confuse genetic evaluations.

Philosophy of further exploration:

This limited study indicates that all major mineralised sites possess a magnetic signature, albeit a very subtle one in some cases, or reflect host alteration. There are situations where this might be appreciated only by a highly detailed survey and other methods may prove more effective (e.g. EM). But the signature does exist and magnetic data acquired in the past or at an early stage of exploration should not be neglected.

The study also suggests that detailed exploration be restricted to certain E-W corridors barely wider than 2 km and often narrower. These can be recognised in aeromagnetic data although some clarifying processing is advised. It was already clear at the time of preparation of this report that regional gravity data support the corridors near Que River, Rosebery and Lyell at least (see Leaman, 1986b). I have suggested that these features are the fundamental elements controlling mineralisation while recognising that the existence and retention of suitable hosts and intersecting structures near the present land surface set the scene for any economic deposit.

Given the generally difficult surface conditions I believe that magnetic data should be used to define alteration along the inferred corridors and subtly anomalous features within it and that where these cannot be explained by exposed materials other methods then be considered. I also suspect that the key to successful use of any method (incl electrical) is an assurance that coverage and penetration is adequate. This has been a common fault and is often crucial for gravity and magnetic surveys. It follows that a more balanced proportion of E-W and N-S flight paths may be beneficial. This work suggests that the common practice of drilling obvious positive anomalies is unlikely to assess subtle, mineralised or altered formations. Straightforward lithological explanations are to be expected in most cases. Experience supports such a conclusion. The approach suggested in this report is more complex and difficult, and untried.

Two other issues may be raised at this point.

1. How relevant and useful is the magnetic signature for Pb-Zn deposits generally?
2. What about problems in detailed or surface surveys?

These issues are related and may impose restrictions on magnetic analysis. The subtle Hercules and Que River signatures, for example, are visible only because there is a locally quiet background. Assessment might be impossible if the background were noisier. A contrast is seen in line 1360 through Hercules where unit effects are evident at the western end of the line and while they are so identifiable from all characters, any superimposed mineralisation effect might not be. Methods of the type used around Lyell (3D unit assessments etc) are then required for evaluation. Surface surveys with adequate coverage or station density are likely to prove noisy in some areas. Similar problems and reduction techniques apply. Note that ground magnetic surveys are feassible within mine areas or towns given appropriate specification, instrumentation and observational procedures. Processing requirements have been found to be a function of actual responses, nature of interfering infrastructure, data coverage, and data redundancy.

Consequently, I suggest that exploration funding for follow up or site work would be better divided between potential (gravity and magnetic) and electrical methods than simply spent on only one method class (usually electrical since 1970). This would yield a sounder geological appraisal of the region covered and targets within it and would be more cost effective. It is a strongly quantitative approach and one untried in Tasmania.

Some appraisals may depend on structural evaluations economically possible only with gravity and magnetic methods. These applications are necessary wherever displacements are suspected from/within the corridors.

Overall this is a more conceptual, reasoned approach based on regional indications of crustal control and sourcing of mineralisation followed by more restrictive areal review. The second order concentration of effort can take the usual forms (mapping, geochemistry, electrical surveys etc) but refined usage of the regional methods is likely to prove more cost effective at all stages. Such methods demand geological input commensurate with the concepts and prospects under test. In this respect the approach is both more difficult and productive since it suffers from less risk of black box detachment from the geology under review.

5: CONCLUSIONS

This review demonstrates the considerable contribution which magnetic data can yet offer mineral exploration in Western Tasmania. The survey reviewed is regional and, in some minor respects, flawed. This serves to stress the potential value of more detailed, high resolution surveys. The principles relating to the treatment of ANY magnetic data in the region have been defined. The review was designed to assess the survey, its treatment and its potential applications and provides a basic interpretation only.

CONCERNING THE SURVEY:-

1. The data as presented by the contractor (Figures 3-3, 4-B-1, 2, 3) is often misleading due to the contour intervals used. A truer perspective on the magnetic field is offered in profile form (Figure 3-2).
2. Except for relatively small areas along the West Coast Range the survey is an approximate drape at 150 to 200 m. For all practical purposes it may be considered a drape at, say, 180 m.
3. Actual flight path recovery in space is not always possible due to some off scale radar altimeter records.
4. The data is fully tied and IGRF corrected. There is very little evidence of inadequate correction or herring bone textures.
5. Observation sampling was extremely variable. While the mean was 38 to 42 m the range recorded was 25 to 85 m. This affects many analytic procedures.

PROCESSING CONSIDERATIONS:-

6. The survey is more than adequate for regional mapping of magnetic units although replotting is recommended at appropriate scales and contour intervals. Contouring, or use of profiles, free of the moving average filter used by the contractor is advised.
7. Although the data is generally a virtual drape at 150 to 200 m there are considerable excursions from this mean even in those areas where it is generally approximated. These can be compensated by correction to drapes at either 150, 200 or 250 m. This practice ensures that subtleties are properly related. However, in high relief areas, parts of the continuations may be unstable and drapes lower than 250 m may not be properly defined where the clearance exceeds 400 to 450 m.
8. Drape correction and retention of true anomaly relativities is most critical where unit contrasts are low. Hercules and Que River may be cited as examples.
9. Drape correction is not necessary for qualitative review or unit tracing applications but any profile analyses should follow correction.

10. Some source separation and improvement in gross trend clarity is effected by continuation to fixed levels clear of the terrain. Unfortunately the range in relief and geological regime-relief combinations preclude any simple recommendation for the level chosen. 800 m is adequate north of Mt. Meredith, 1000 m near Queenstown but 1275 m is required near Rosebery. The actual levels may be governed by the areal extent and location of any subsample and the survey as observed allows all these options.
11. It is appropriate to attempt a drape in these conditions since such observations retain a fairly even high resolution in all topographic situations and can always be adjusted to a true drape or to some fixed level. Some loss in resolution occurs with fixed level transformations which are most suited to regional structure, bulk property analysis or complete interpretation at the scale of this survey.

INTERPRETATION PROCEDURES:-

12. Terrain effects are generally substantial and can only be evaluated simply from the fixed level viewpoint. This is true even at the level of simple 2D treatments but many situations arise where anomaly assessment must use 3D methods. These must be capable of defining the topography and real or proposed geological configurations to depths in excess of 2 km. Modelling for this review suggests that the base level for modelling should be at least 5 to 6 km deep. The methods must also be able to resolve contrast differentials within a unit or structural element. 2.5D methods are not generally advised since too many sources are off section and the direct 2D approach is adequate to define the initial 3D model and may be satisfactory in itself depending upon the objectives.
13. Detailed quantitative interpretation must be 3D. Only these methods can reliably describe the form and situation of truly anomalous conditions (e.g., Lyell region).
14. Analytic profile methods, such as derivatives or analytic signal, can offer clearer presentation of subtle variations (e.g., Que, Hercules, Rosebery).
15. Areal derivative treatments may enhance definition of anomalous events. They are most effective when applied to fixed level data sets converted from the observations and may clearly define major lineaments and structures.

GENERAL COMMENTS:-

16. As the magnetic field is influenced by relatively few geological units structural inferences may be limited or ambiguous. This is especially so at depths in excess of 1.5 to 2 km. Contrast deductions are less seriously affected. Comparable, correlated gravimetric analysis is necessary to resolve many possible ambiguities.
17. Many of the implications listed below have not been suggested by previous interpretations. There are several possible explanations. Other surveys have possessed inherently lower resolution, more restrictive coverage, poorer flight control and have not been treated with more than rule-of-thumb procedures. Lack of a digital topographic base makes fixed level conversion

time consuming. Many examples have been cited in the text where anomaly interference may be an important issue (e.g., Zeehan west, 4-F-iii).

18. The limited treatment represents underutilisation of the data of this survey. The lid to the treasure trove of exploration and geological information it offers has barely been lifted. Only the possibilities have been presented. Comprehensive analysis with the intensity usually associated with surface follow-up and detailed surveys is necessary and worthwhile if low cost magnetic surveys are to yield full value.
19. It follows from much of items 1 to 18 that proper or extended analysis of magnetic data, i.e., for purposes other than simple unit tracing, that the methods required are advanced and not in the tool kit of geophysicists who do not specialise in gravity or magnetic methods. Two procedures used in this review (incl 3D weighted whole geology modelling and basalt cover analysis) are unpublished.

INTERPRETATION CONCLUSIONS:-

STRUCTURES

20. Many lineaments are evident in the raw data presentation (Fig. 3-3). These mostly take the form of unit truncations or trends with obvious geologic (esp. unit) control. Many others may be suggested. Analytical treatments - especially at reasonable elevations - clarify many of these. E-W trends lacking surface geological sources are possibly dominant indicating gross crustal alteration zones. A sample of inferred trends is shown in Figure 4-G-1 (folder).
21. Available rock property data, as inferred during this review from anomaly analysis or as measured, do not suggest any major departures from reasonable geological sections based on available regional mapping in the first 1.5 to 2 km. Thus the various synclinoria and anticlinoria can be mapped magnetically and units traced around them. Much of the definition depends on the presence of Crimson Creek Formation, Dundas Gp, or Tyndall Gp.
    Detailed structural treatments depend on combined gravity-magnetic interpretations. The present control and property data do impose some limits on the depth of Cambrian rocks within the synclinoria however. West of Queenstown, for example, the Lower Ordovician must be thin since the Cambrian offset from the exposures west of Lynchford is quite small.
22. Structures within and west of the Arthur Lineament reflect contrasting units and tabular sources. Source arrangements within the Mt. Read Volcanics are much more irregular and structurally complex.
    Ultramafics in the Huskisson Syncline and its extremities are at least quasi-concordant. Precambrian blocks east of the syncline , north of Dundas and south of Macquarie Harbour are probably disrupted parts of large thrust blocks. A large part of the western Mt. Read Volcanics Sequence is also thrusted.
23. Disturbed field areas surround all or part of most granites. These zones mirror thermally metamorphosed lithologies and the effects are superimposed on local effects. Such areas are defined by processing - especially to higher levels. The Pine

Hill Granite was delineated in this way and shown to have an E-W elongation.

PROPERTIES

24. Most Cambrian units are magnetic and contrast with most other lithologies. The most strongly magnetised units are, in normal order of intensity, ultramafics, Crimson Creek Formation, Tyndall Group, Murchison Granite, volcanic sequences, altered sequences. Measured properties may account for the implied values only if the range-proportions are accumulated and a remanence factor is allowed. Few observations were available at the time of writing. The properties inferred in analysis are believed to represent the bulk unit value.
25. Local lithologic variations within the Precambrian blocks account for most anomalies. With the exception of the amphibolites or magnetite-rich units of the Arthur Lineament most variations are subtle. Parts of the Oonah correlates may be contrasted with the Tyennan materials but the properties may be thermally induced.

MINERALISATION

26. All major mineralised sites lie on or near E-W lineament corridors where NW-SE linears intersect these and suitable host materials. Examples include Bischoff, Cleveland, Hercules, Que River, Lyell, Renison and Rosebery.
The separation of E-W lineaments accounts for the separation of deposits. Major lineaments may reflect grossly altered structures in the crust.
27. Tin deposits at Renison, Cleveland and parts of the Zeehan Field appear related to the alteration halo of local granites. Well developed anomalies are associated with mineralisation.
28. Bischoff mineralisation may be more marginal to the Meredith Granite but is distinctively magnetic suggesting the nature of responses where alteration effects are less. There are limitations on the resolution of such features beneath the basalt cover.
29. Magnetic anomalies associated with Pb/Zn mineralisation are generally subtle and not necessarily reflective of ore. Localised alteration may be more significant magnetically. Anomalies at Hercules and Que River are slight and appreciated with any certainty only in derivative presentations of corrected data. The character at Rosebery is a less subtle couplet.
30. The Lyell copper-gold mineralisation also possesses very slight contrast against background. The background of altered rock is also definable within the context of comparable lithologies provided allowance is made for terrain induced effects and appropriate techniques are employed. Most previous surveys, especially at ground level, have probably been inconclusive due to inadequate coverage to establish the contrast differentials.
31. The combination of structural control and magnetic signature analysis has exploration significance but nearly all aspects of lineament and signature definition requires correction and analysis of the data.

RECOMMENDATIONS:-

32. The results indicate that the specifications for this survey are the minimum necessary to retain adequate detail and permit all styles of processing options. Higher resolution observations and more regular and closer sampling would be an advantage in future surveys. Targets of the Que-Hercules-Lyell-Rosebery type would be best approached at sample spacings of 25 m or less using an instrument sensitivity of 0.1 nT at elevations of 100 to 150 m. More tie lines are advised.
33. Larger portions of the survey should be processed to fixed levels. This should confirm suggested lineament locations and assist definition of granite contacts.
34. Prospective localities, as defined by lineament intersections, within the volcanic arc should be reviewed using analytic methods on drape corrected data. Ground follow-up should seek to verify subtle indications. It is possible that ground magnetics may prove noisy in some situations. The only solution to this problem is to use a high sampling rate and process accordingly. Other methods might also be appropriate.

    Recommendations 32 to 34 apply to any aeromagnetic survey past, present or future. This survey was relatively coarse and is still potentially very productive.
35. In some lithologies it will be necessary to analyse variations in properties in order to identify the most prospective sites. Most mineralisation is not strongly magnetic but host alteration is a definitive indicator. This review shows that it is feasible to infer property variations and relate them to alteration. It is essential that such studies be intensively undertaken on a prospect area in order to locate the axis of greatest alteration.

    This style of interpretation is essential if deep targets are to be detected. Possible sites must be defined by the plumbing and alteration indicators first. Many minor prospects have been worked or identified within the area surveyed. How these relate to the trend and alteration indicators would suggest whether they are significant, mere sweating points, deposition points for remobilised material or conceal deeper mineralisation nearby.
36. This study suggests that more extensive use of magnetic (and gravity) data is justified - as both complement to, and replacement of, some other surveys - and may prove most cost effective. This comment applies to structural appreciation, concept development/test and alteration/mineralisation appraisal of a site.

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025120

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March 17, 1986.

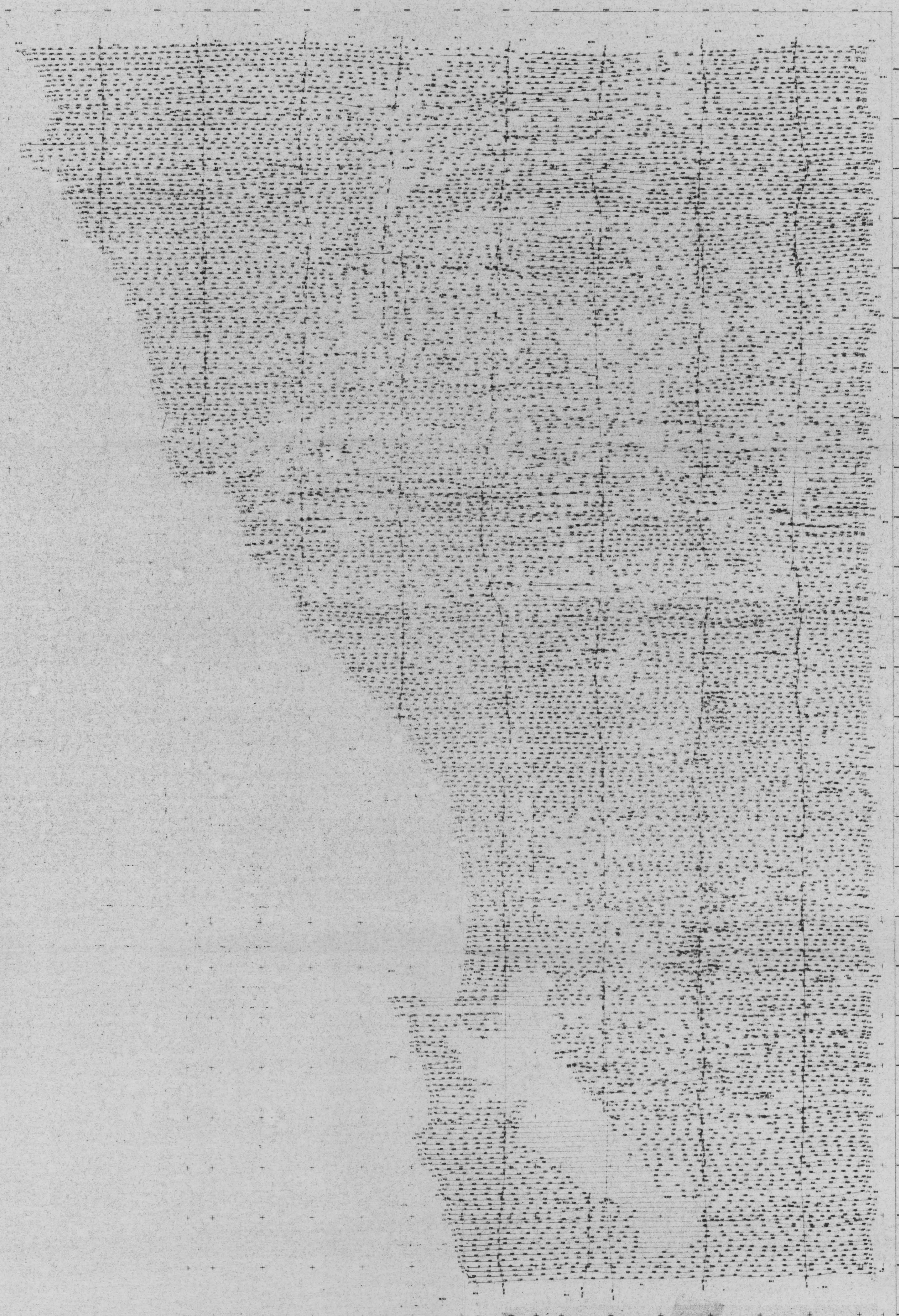


FIGURE 3-1

FLIGHT PATHS
WEST TASMANIA (1981) AEROMAGNETIC SURVEY

025121

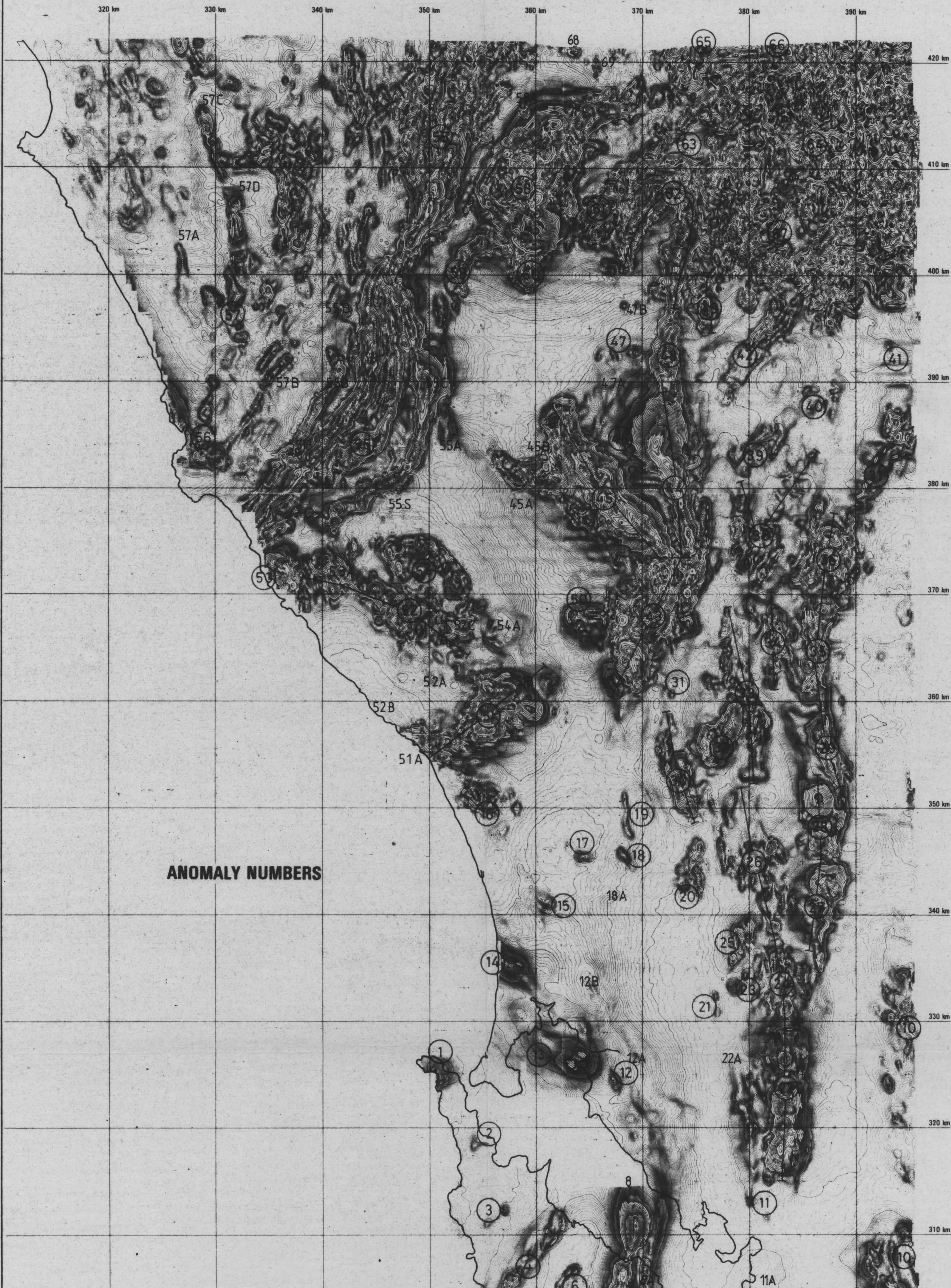
FIGURE 3-2

STACKED PROFILES
WEST TASMANIA (1981) AEROMAGNETIC SURVEY

025122

DEPARTMENT OF MINES TASMANIA

5 cm



SCALE 1:250 000

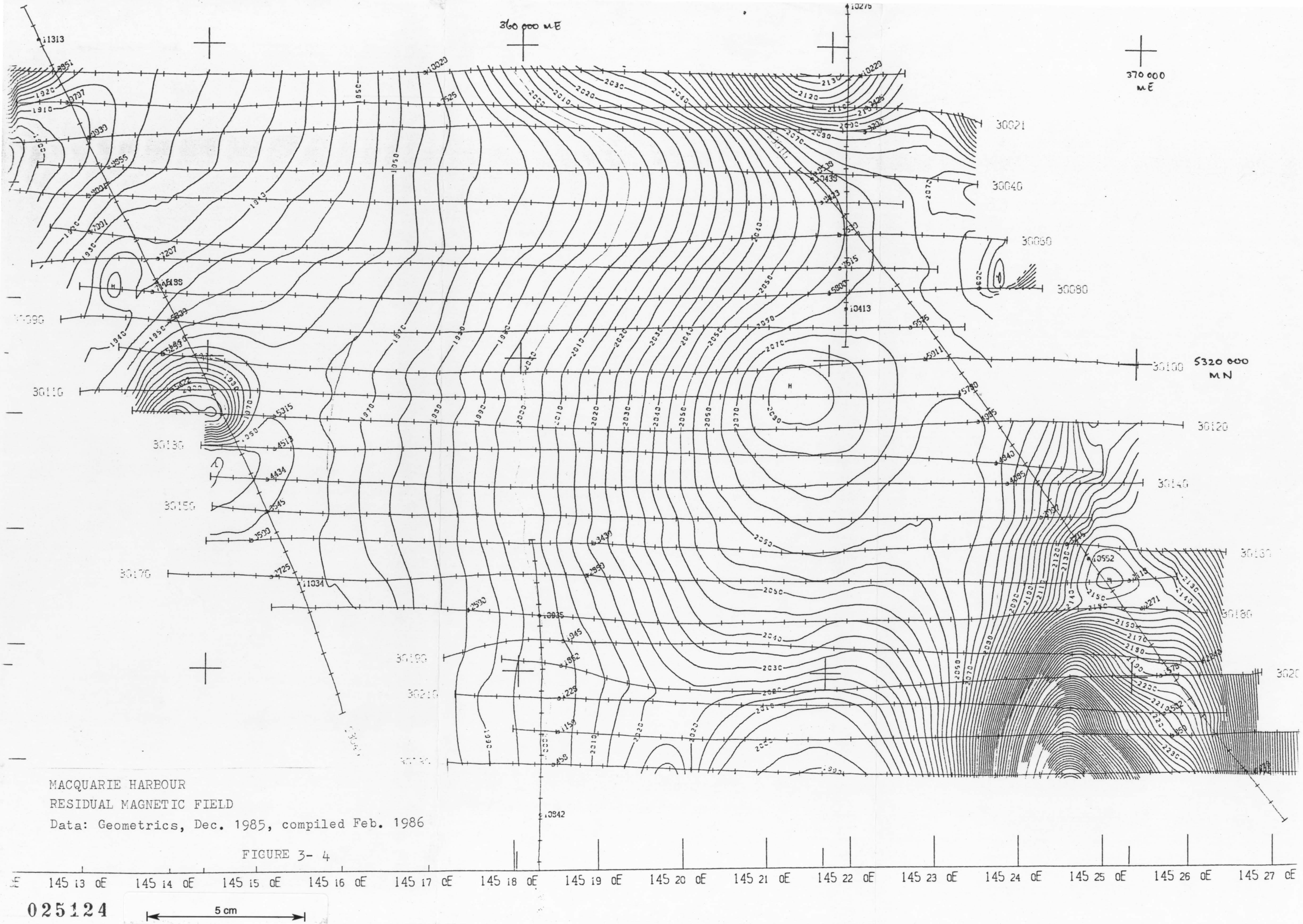
FIGURE 3-3

MAGNETIC FIELD & ANOMALY NUMBERS

025123

5 cm

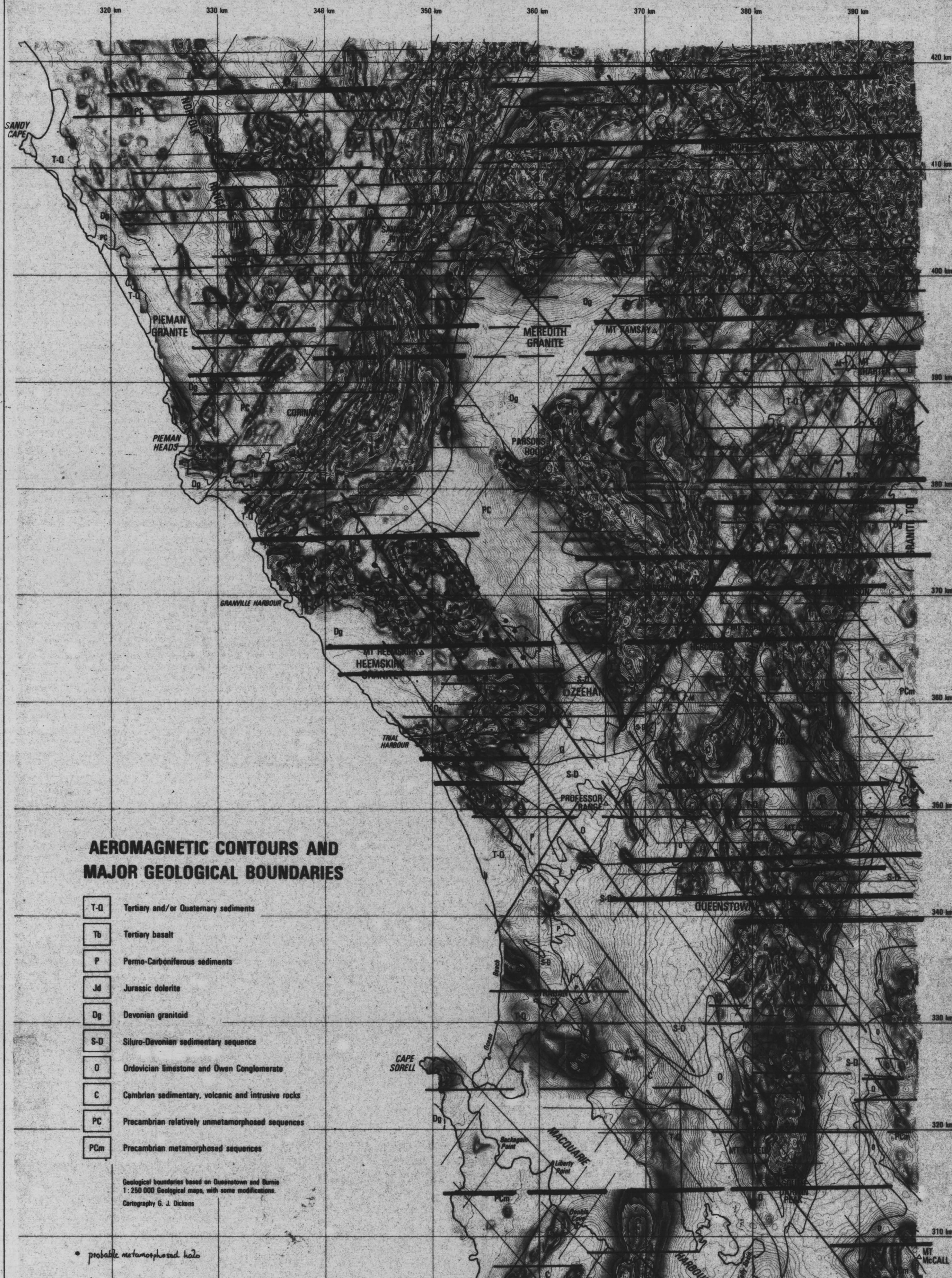
Figure 2



MACQUARIE HARBOUR
RESIDUAL MAGNETIC FIELD
Data: Geometrics, Dec. 1985, compiled Feb. 1986

FIGURE 3- 4

025124



Lineament line weighting reflects judgments on significance and continuity which are only partly the result of detailed analysis (see text)

SCALE 1:250 000

FIGURE 4-G-1
INTERPRETATION SUMMARY

D Leaman
Leaman Geophysics
Dec 85

025125

Figure 1